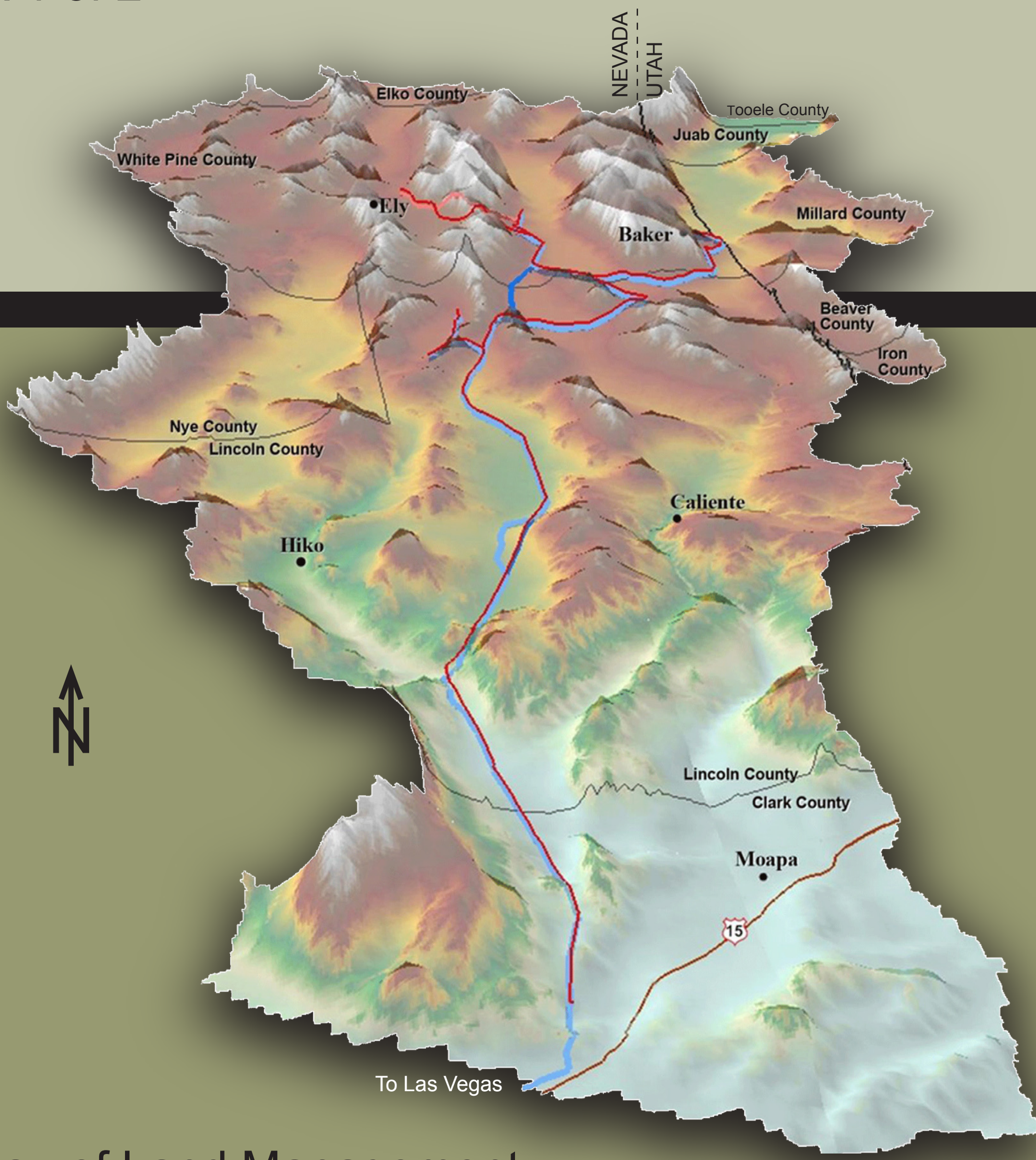
Clark, Lincoln, and White Pine Counties Groundwater Development Project Final Environmental Impact Statement

Book 1 of 2



Bureau of Land Management

August 2012
FES 12-33

Cooperating Agencies

Army Corps of Engineers
Bureau of Indian Affairs
Bureau of Reclamation
Central Nevada Regional Water Authority
Clark County, NV
Juab County, UT
Lincoln County, NV
Millard County, UT
National Park Service
Nellis Air Force Base
Nevada Department of Wildlife
State of Utah
Tooele County, UT
U.S. Fish and Wildlife Service
U.S. Forest Service
White Pine County

BLM
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4.4 How were the effects of long-term pumping on water resources determined?

A groundwater flow model was developed for this Final EIS to evaluate the probable long-term effects of groundwater withdrawal on a regional scale. The study area for water resources encompasses all or part of 35 hydrographic basins shown in **Figure ES-15** and covers over 20,000 square miles. **Figure ES-15** also indicates the locations of inventoried springs and identified perennial stream reaches located within the region. Generally speaking, the analysis of pumping effects on environmental resources followed a series of steps that links the results of groundwater flow modeling to those resources with dependence on surface water and/or groundwater as a source of water or habitat.

The computerized model was calibrated to water levels and flow measurements in the field. The groundwater model represents a generalized understanding of the surface and underground water and hydrogeologic conditions over this large region. The model was used to simulate groundwater withdrawal for the eight alternatives for analysis (i.e., the Proposed Action, six action alternatives, and the No Action Alternative). The assumed time frame for full build out under the Proposed Action is 38 years from BLM issuance of a Notice to Proceed. The modeling results were evaluated at three future time frames: full build out, full build out plus 75 years, and full build out plus 200 years.

The BLM established a technical review team to assist it by reviewing the model documentation reports and provide recommendations for improving the model. The team included hydrology specialists from the BLM Nevada and Utah State Offices, and National Operations Center in Denver; the U.S. Geological Survey: and AECOM (BLM EIS Contractor).

An electronic copy of the modeling report is included with this EIS.

Despite inherent uncertainty associated with hydrogeologic conditions over this broad region, the calibrated model is a reasonable tool for estimating probable regional-scale drawdown patterns and trends over time resulting from the various pumping alternatives. Impacts were evaluated in terms of the potential impacts to flows of seeps, springs and streams, potential impacts on water rights, and drawdown effects on subsurface water.

Results of the regional groundwater flow model were used to evaluate the effects on water resources at three time frames that correspond to full build out of the system (approximately 38 years after Notice to Proceed), and at full build out plus 75 and full build out plus 200 years after full build out.

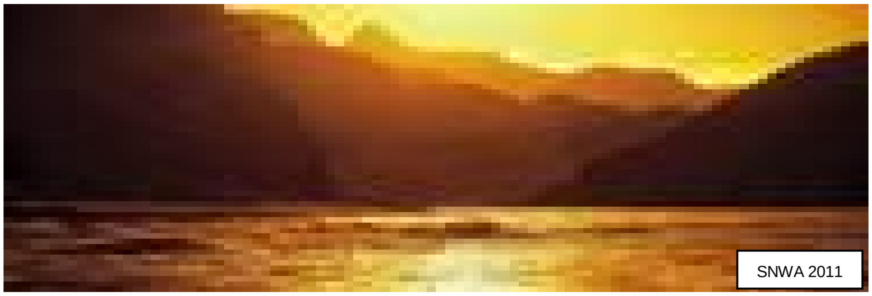
The potential for impacts to individual seeps, springs, or stream reaches depends on:

1) the source of groundwater that sustains the perennial flow;
2) the interconnection (or lack of interconnection) between the perennial surface waters and the groundwater aquifers; and
3) the drawdown that results from the groundwater development.

This evaluation identifies areas where there is likely to be a high or moderate risk of impacts to perennial surface water sources from groundwater development.

The impact evaluation identifies perennial water resources located in areas where there is a high or moderate risk of impacts.

The water rights impact evaluation discloses potential effects to existing surface and groundwater rights resulting from the various proposed pumping alternatives. The assessment was conducted by overlaying maps of the predicted drawdown on the maps of existing water rights. For surface water rights, it was assumed that water rights located within the projected 10-foot drawdown area and located within the identified high and moderate risk areas previously described for perennial water could be affected. It was also assumed that groundwater rights located within the same defined drawdown area could be affected.



3.3 Water Resources

3.3.1 Affected Environment

Figure 3.3.1-1 shows the region of study for water resources. This study area (or hydrologic study area) includes the ROWs and groundwater development areas and encompasses 35 hydrographic basins, as defined by the NDWR (2009). Most (but not all) boundaries between the hydrographic basins correspond to topographic divides.

QUICK REFERENCE

BARCAS – Basin and Range Carbonate-Rock Aquifer System study

ET – Evapotranspiration

GPM – Gallons per minute

NDWR – Nevada Division of Water Resources

NRA – National Recreation Area

NRCS – Natural Resources Conservation Service

3.3.1.1 Overview

The general topographic and physiographic features of the region are discussed in Section 3.2, Geologic Resources. In summary, the region of study is situated within the Basin and Range physiographic region, characterized by a series of generally north- to northeast-trending mountain ranges separated by broad valleys. The mountain ranges typically are 20 to 100 miles long and are spaced approximately 5 to 15 miles apart. Within this hydrologic study area, the land-surface elevations range from 13,063 feet amsl (at Wheeler Peak in the Snake Range) to approximately 1,111 feet amsl at Lake Mead in November 2007.

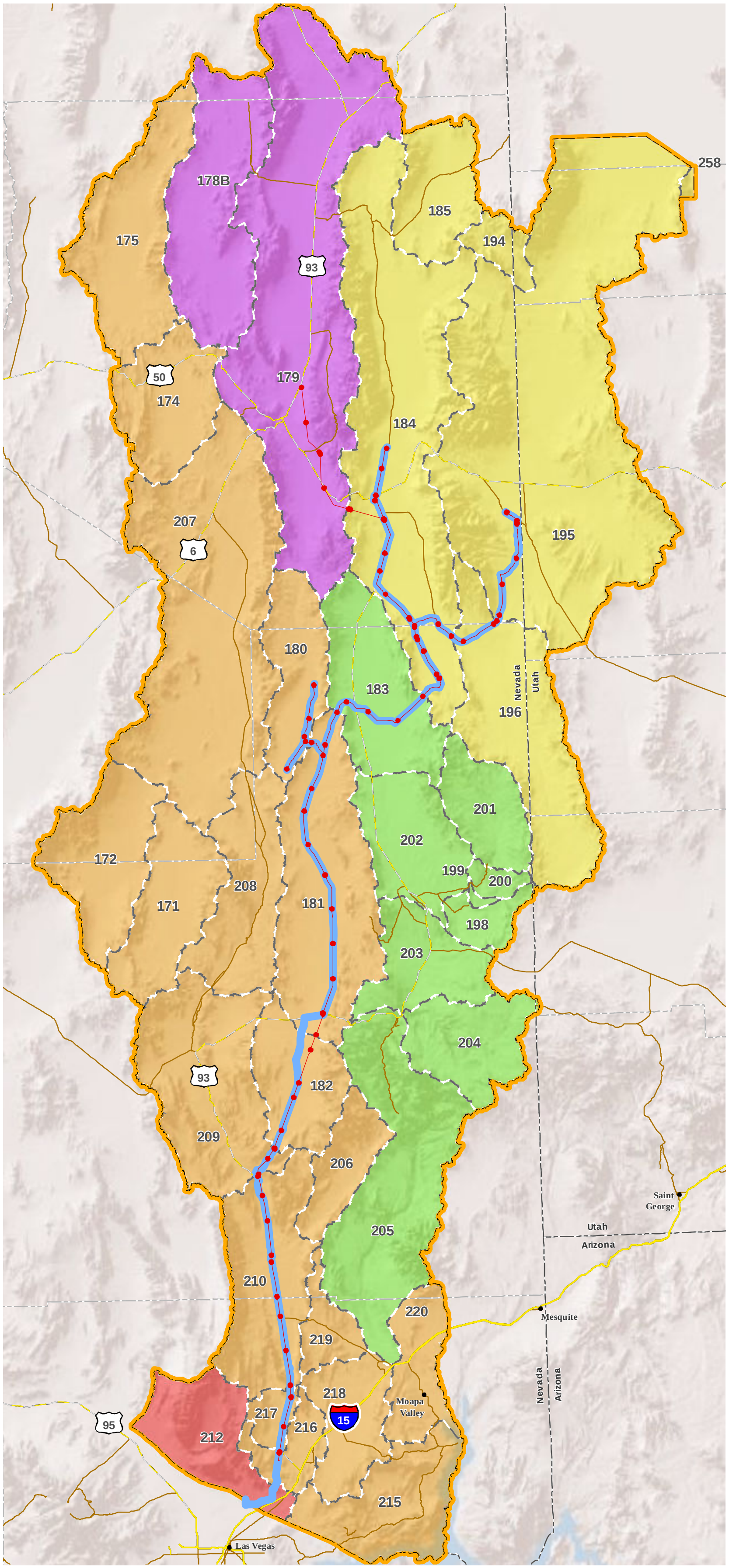
The climatic conditions across the hydrologic study area are highly variable and reflect wide elevation changes, the presence of numerous mountain ranges, and a wide range in latitude. Precipitation generally increases with elevation (see Figure 20 in Welch et al. 2007). In the Great Basin, the mean annual precipitation ranges from less than 5 to 16 inches in the valleys and approximately 16 to 60 inches in the mountains (Harrill and Prudic 1998). Elevation and precipitation generally decrease from north to south across the region. Specific information about climate (including precipitation, temperature variations and trends, and discussions of climate change) are provided in Section 3.1, Air and Atmospheric Values.

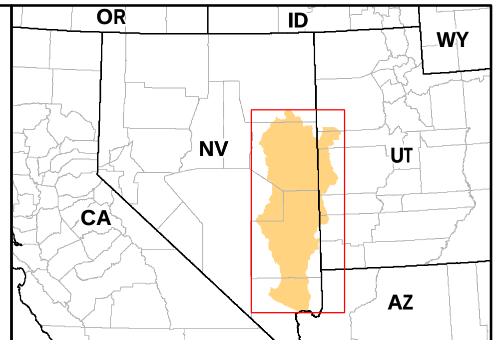
Hydrographic basins are local drainage basins within large multi-basin flow systems. Hydrographic basins (or areas) are defined by the State Engineer’s Office, Department of Conservation and Natural Resources (DCNR), Division of Water Resources. The terms *hydrographic areas*, *hydrographic basins*, and *groundwater basins* often are used interchangeably to describe the same area in published literature and reports.

This section describes water resources within the hydrologic study area. In addition, the section provides a summary of more-detailed, site-specific information for the five hydrographic basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys) where pumping is proposed as part of future activities associated with the Proposed Action and alternatives. The initial Affected Environment subsections provide an overview of the regional flow systems within the region of study. The remaining sections provide a baseline summary of the surface water, groundwater, water quality, and water rights relevant to the project.

3.3.1.2 Regional Flow Systems

The 35 hydrographic basins within the hydrologic study area can be grouped into regional flow systems, and each can be defined as a set of hydraulically connected basins. As **Figure 3.3.1-1** shows, the hydrologic study area encompasses all or portions of five flow systems and includes, from north to south: 1) Goshute Valley flow system; 2) Great Salt Lake Desert flow system; 3) White River flow system; 4) Meadow Valley flow system; and 5) Las Vegas flow system.





Legend

- Proposed Power Line Centerline
- Proposed Pipeline Centerline
- Interstate Highway
- US Highway
- Major Road

Groundwater Flow Systems

- Goshute Valley
- Las Vegas
- Meadow Valley
- Great Salt Lake Desert
- White River
- Water Resources Region of Study
- Hydrographic Basin

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-1

Water Resources Region of Study and Groundwater Flow Systems

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
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The north-central section of the hydrologic study area includes a portion of the Goshute Valley flow system. The Goshute Valley flow system includes Steptoe and Southern Butte valleys (in the north-central portion of the study area), and Goshute Valley (immediately north of the hydrologic study area). Groundwater flow in this system generally is north, toward Goshute Valley.

The northeastern section of the hydrologic study area includes a portion of the Great Salt Lake Desert flow system. Hydrographic basins in the Great Salt Desert flow system in the study area include Tippet, Pleasant, Spring, Hamlin, Snake, and a small portion of Fish Springs Flat that encompasses Fish Springs. The overall direction of flow in this region is toward the northeast. This flow system terminates at the Great Salt Lake (northeast of the study area), with intermediate discharge at Fish Springs in Juab County, Utah.

The western and southern portions of the hydrologic study area encompass the White River and Meadow Valley Wash flow systems. These systems are tributary to the Colorado River regional flow system. Both the entire White River and Meadow Valley flow systems are included within the hydrologic study area. The White River flow system consists of 19 hydraulically-interconnected basins, which flow from north to south over a distance of approximately 250 miles. The Meadow Valley flow system essentially is parallel to the White River flow system and includes nine basins. The flow direction in the Meadow Valley flow system also is north to south, and the system merges into the White River flow system in the southern portion of the hydrologic study area. Major surface discharge features in the lower end of the White River flow system include Muddy River Springs, which forms the headwaters of the Muddy River, and Rogers and Blue Point springs. The Muddy River is a tributary to the Colorado River and its current stream course terminates at Lake Mead. Rogers and Blue Point springs are located within the Lake Mead National Recreation Area.

The southwest corner of the study area includes a segment of the Las Vegas Valley hydrographic area (HA) that is part of the Las Vegas flow system.

3.3.1.3 Hydrologic Cycle and Conceptual Groundwater Flow

Surface water and groundwater discharged in the region originate from precipitation. Precipitation that falls to the land surface might infiltrate the soil or bedrock and recharge the groundwater system, evaporate, be transpired by plants, or flow as runoff through drainages. Surface water runoff that originates at higher mountain elevations generally flows in well-defined channels cut into bedrock in the mountain blocks; the runoff then discharges onto alluvial fans at the valley margin. Several potential outcomes exist for runoff that flows from the mountain blocks and into the valley bottom. As surface water moves from the mountains into the valley setting, it is continually removed from the surface-water system by a variety of processes including: 1) infiltration as recharge to groundwater (as seepage into fractures in bedrock or permeable sediments in the drainage channel, into alluvial fans at the margins of the mountain fronts, or into basin-fill sediments in the central portions of the valley); 2) removed from the system by evaporation or transpired by plants (both in the channel, in ponds or lakes, and at playas in the valley bottom); and 3) diversion for irrigation or other beneficial uses.

Perennial surface water is supported by groundwater discharge in this region. Springs that discharge groundwater at the land surface can collect into channels to form perennial streams. Periodic rain storms and snow melt generate runoff that contributes to temporary stream-flow increases. However, a consistent base flow for streams and springs in the region observed even after prolonged dry periods is maintained by the discharge from the groundwater system.

The downward movement of water, through the soil to groundwater, is known as *infiltration*. Water infiltration that reaches a groundwater source is called *recharge*.

The movement of water from soil or groundwater into plants and then released into the atmosphere is known as *transpiration*.

An *alluvial fan* is a fan-shaped deposit of generally coarse material (sand, gravel, rocks) that is created where a stream flows out of the mountains and onto the valley floor.

A *perennial* stream (or stream reach) flows throughout the year.

A conceptual diagram of the groundwater flow system for the region is illustrated in **Figure 3.3.1-2**. This conceptual groundwater flow system is described in the BARCAS report (Welch et al. 2007), as follows:

> "Ground water in the study area is influenced by a combination of topography, climate, and geology. Ground water moves through permeable zones under the influence of hydraulic gradients from areas of recharge to areas of discharge, and this movement can be discussed in terms of local, intermediate, and regional flow systems.
>
> Local flow systems are characterized by relatively shallow and localized flow paths that terminate at upland springs. Local springs are low volume, tend to have temperatures similar to annual average ambient atmospheric conditions and have discharge that fluctuates according to the local precipitation. Intermediate flow systems include flow from upland recharge areas to discharge areas along the floor of the intermontane valley. Within intermediate flow systems, springs typically discharge near the intersection of the alluvial fan and the valley floor near the range front. Intermediate flow system springs often are of moderate volume and tend to have less variable flow relative to local springs.
>
> Regional ground-water flow follows large-scale (tens to hundreds of miles) topographic gradients as water moves toward low altitudes in the region. Discharge from these regional flow systems manifests as large springs and, in some areas, extensive wetlands."

Hydraulic gradient is the gradient or slope of a water table or potentiometric surface measured in the direction of the steepest change.

Intermontane refers to a feature that lies between mountains.

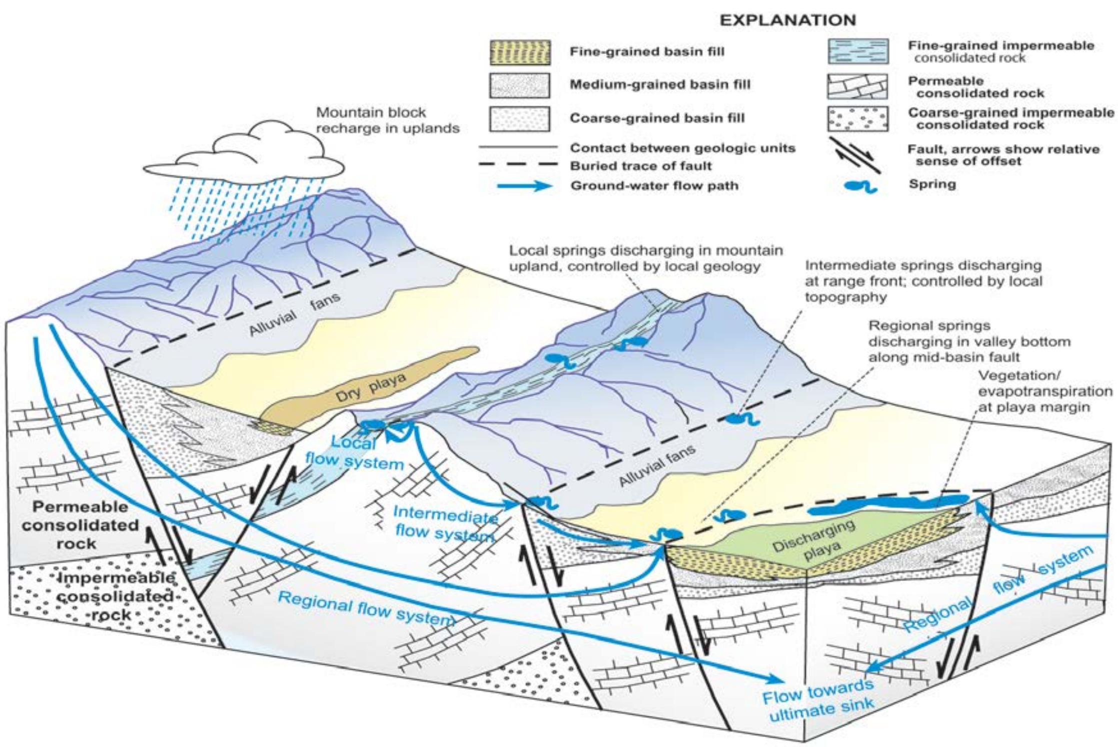


Figure 3.3.1-2 Conceptual Groundwater Flow System (From Welch et al. 2007)

Numerous springs occur in high-elevation areas in the mountains throughout much of the region. These springs generally are controlled by discharge from localized or perched groundwater systems that are not hydraulically connected to the regional groundwater system (Prudic et al. 1995). Many small springs also occur in the valleys or along the margins of the valleys. The occurrence and discharge of these springs generally is controlled by flow along intermediate flow paths (as described previously) that originate in the adjacent mountain ranges or alluvial fans.

Perched (localized) groundwater systems are not hydraulically connected to the regional groundwater system.

Large springs (greater than 100 gpm) with relatively constant discharge rates are present in several valleys within the hydrologic study area. These springs typically discharge from carbonate rock or from basin-fill that overlies or that is adjacent to carbonate rocks (Prudic et al. 1995). Discharge at these large springs is presumed to be controlled by groundwater that moves through a deep, regional groundwater flow system; this system is made up of interconnected basin-fill and carbonate-rock aquifers and is unconstrained by local topographic or drainage features (Plume 1996; Welch et al. 2007). As illustrated in the conceptual flow diagram (**Figure 3.3.1-2**), water enters the regional groundwater flow system primarily as recharge in the mountains and can flow through several basins and beneath mountain ranges before finally discharging at a regional spring.

Basin-fill and *carbonate-rock* aquifers are described in Section 3.3.3.1.

3.3.1.4 Surface Water Resources

Rights-of-way/Groundwater Exploratory Areas

Figure 3.3.1-3 shows perennial stream reaches and springs that have been identified near the ROWs and groundwater development areas for the Proposed Action and alternatives.

The ROW for the Proposed Action (and Alternatives A through C) for the Snake Valley lateral would cross one perennial stream, Snake Creek, in the southern portion of the Snake Valley hydrographic basin. The ROWs for the main pipeline and laterals into Spring Valley and Cave Valley would not cross perennial streams. The ROW for the power line for the Proposed Action would cross Steptoe Creek (a perennial stream in Steptoe Valley).

The ROWs for the Proposed Action and alternatives would cross numerous ephemeral stream channels. Most of these channels are local drainage features on alluvial fans. Rainfall from severe storms poses a risk of flash flooding in these ephemeral channels. Two of the larger ephemeral or intermittent stream crossings include Lexington Creek in Snake Valley and Pahranagat Wash in Coyote Spring Valley. Lexington Creek is an incised, intermittent stream that is approximately 2 miles south of Big Wash in southern Snake Valley. Pahranagat Wash drains the northern half of Coyote Spring Valley. The wash is an ephemeral drainage up to approximately 0.5-mile wide, where flash flooding is possible. The proposed ROWs would cross and parallel Pahranagat Wash for approximately 13 miles.

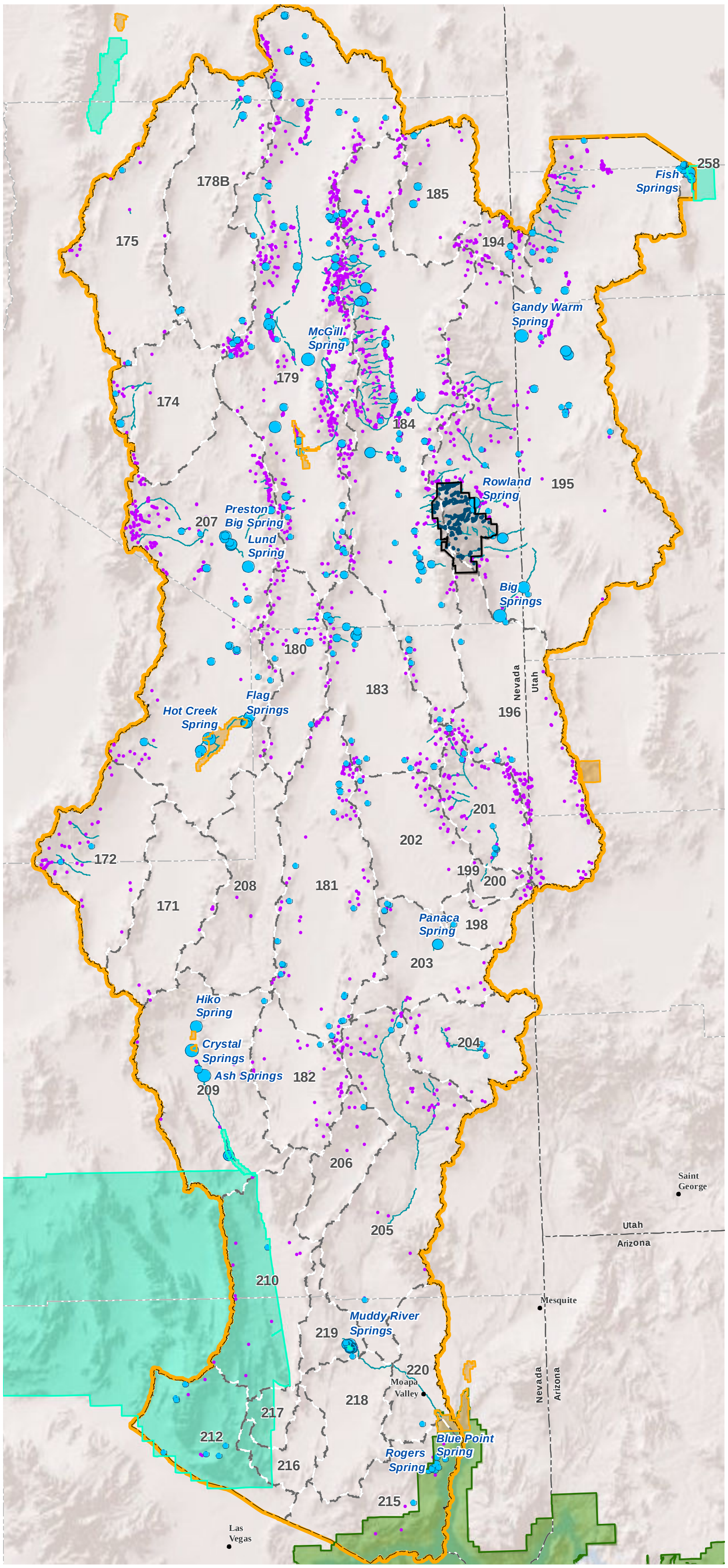
An *ephemeral* stream is a stream or portion of a stream that flows briefly in direct response to precipitation.

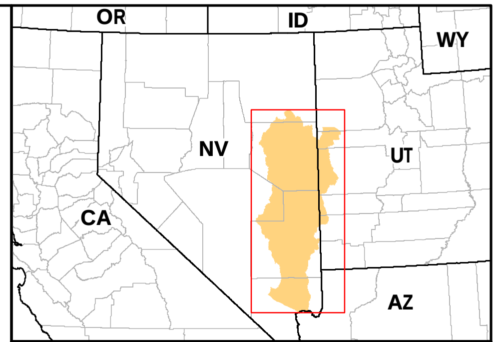
The proposed ROW would cross numerous small ephemeral washes through Las Vegas Valley. These washes typically drain runoff across alluvial fans that slope gently from the Las Vegas Range. Alluvial fan flooding is likely to occur in these areas.

Information that relates to perennial streams and springs within or near the groundwater exploratory areas is provided in subsequent sections that describe water resources within the region of study and in the proposed groundwater development basins.

Floodplains

Floodplains are areas where water overflows onto an area of typically dry land. Floodplains often occur adjacent to existing waterways and help to moderate flood flow, recharge groundwater, spread silt to replenish soils, and provide habitat for numerous plant and animal species. Executive Order (EO) 11988, Floodplain Management, requires federal





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Additional Spring Location[1]
- Great Basin National Park Spring
- Perennial Stream Reach
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

[1]These springs have not been field-verified (i.e. actual existence and flow characteristics are uncertain.)

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-3

Perennial Streams and Springs

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
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No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

agencies to ensure that their actions minimize the impacts of floods on human health and safety and to restore the natural and beneficial values of floodplains. USDOE regulation 10 CFR Part 1022 requires public notification of floodplain involvement.

Federal Emergency Management Agency (FEMA) delineates 100-year floodplains. FEMA maps are available for Clark County; however, maps are only available for the local unincorporated areas of White Pine and Lincoln counties. In two areas within Clark County, the proposed pipeline and power lines cross FEMA-designated 100-year floodplain boundaries. A playa in Hidden Valley (within the Hidden Valley North hydrographic basin southwest of Moapa, Nevada) is designated as a 100-year floodplain. The pipeline and transmission lines parallel U.S. 93, which also crosses the Hidden Valley floodplain. The total pipeline and power line distance that crosses the floodplain is 4.6 miles. Immediately north of the Hidden Valley playa is an unnamed stream with a designated floodplain area. The span across this floodplain is approximately 0.2 miles.

Region of Study

Figure 3.3.1-1 shows the region of study for water resources. This section provides an overview of the perennial water sources (streams, springs, and seeps) within the region of study. Groundwater pumping under the Proposed Action and alternatives would occur in five hydrographic basins within the Great Salt Lake Desert flow system (Spring Valley and Snake Valley) and the White River flow system (Delamar, Dry Lake, and Cave valleys). Major surface-water discharge features within these two flow systems are described, followed by a description of surface-water resources in each of the five proposed groundwater pumping basins.

Surface-water resources within the region of study include intermittent washes, perennial streams, ponds or reservoirs, playas, and springs. In terms of streams, ephemeral drainages represent the predominant feature type. Perennial stream locations are shown in **Figure 3.3.1-3**; estimated miles of perennial stream, by basin, are provided in **Table 3.3.1-1**. Perennial stream reaches were defined by compiling available published and unpublished information that identified perennial streams (BLM 2007; NPS 2007; Elliott et al. 2006; SNWA 2006; Crookshanks 2011; USGS 2011; Eakin 1966, 1963). The length of the individual stream reaches were further evaluated using available aerial photo imagery.

Hydrographic basins with more than 100 miles of estimated perennial stream length include Steptoe Valley (162 miles), Spring Valley (207 miles), and Snake Valley (218 miles). All of the other basins have total estimated perennial stream lengths of less than 100 miles. Major perennial streams of interest controlled by discharge from the groundwater flow system include Big Spring Creek, in Snake Valley; White River, in White River Valley; Pahranagat Creek, in Pahranagat Valley; Meadow Valley Wash, in Lower Meadow Valley Wash; and Muddy River, which originates in the Muddy River Springs area.

Other perennial streams, ponds, and reservoirs are discussed in Section 3.7, Aquatic Biological Resources.

There are a total of 316 inventoried springs that have been identified in the region of study. For the purposes of this analysis, inventoried springs are springs that have been field-verified and typically include flow measurements. A list of the inventoried springs, including the spring names, location, average flow rate, and data source is provided in **Appendix F3.3.1**, **Table F3.3.1-1A**. Other data, such as temperature and water-quality, also are available for many of these springs. The inventoried springs compilation includes information from the following sources: 1) USGS spring data provided in the BARCAS study (Welch et al. 2007), and National Water Information System (USGS 2009a); 2) SNWA's spring inventory for the project (SNWA 2007); 3) spring data collected by BIO-WEST (BIO-WEST 2008, 2007); and 4) spring data included in the Desert Research Institute (DRI) spring database.

The SNWA inventory documents baseline hydrologic conditions for selected springs in 13 hydrographic basins in the study area. The SNWA spring inventory includes existing data, photographic documentation, discharge measurements, water-chemistry sampling, and physical and geologic descriptions of the spring source area. BIO-WEST (2007) collected flow and temperature data of selected springs at 105 locations in 13 hydrographic basins (located inside and outside the study area boundary) as part of a baseline inventory of aquatic resources in the region.

Table 3.3.1-1 Perennial Stream Reaches Within the Region of Study

Groundwater Flow System	Basin Number (Upgradient to Downgradient)	Basin Name	Total Estimate Miles
White River	175	Long Valley	0.8
	174	Jakes Valley	21.8
	207	White River Valley	76.8
	180	Cave Valley	2.1
	172	Garden Valley	27.7
	171	Coal Valley	0.0
	208	Pahroc Valley	0.0
	181	Dry Lake Valley	0.9
	209	Pahranagat Valley	22.0
	182	Delamar Valley	0.0
	206	Kane Springs Valley	0.0
	210	Coyote Spring Valley	0.0
	219	Muddy River Springs Area	6.2
	218	California Wash	8.0
	220	Lower Moapa Valley	15.8
	217	Hidden Valley	0.0
	216	Garnet Valley	0.0
	215	Black Mountains Area	0.0
Goshute Valley	179	Steptoe Valley	161.8
	178B	Butte Valley (Southern Part)	19.1
Great Salt Lake Desert	196	Hamlin Valley	5.1
	185	Tippett Valley	2.2
	184	Spring Valley (184)	207.4
	194	Pleasant Valley	0.0
	195	Snake Valley	217.8
Meadow Valley	183	Lake Valley	8.3
	201	Spring Valley (201)	43.1
	202	Patterson Valley	1.6
	200	Eagle Valley	3.2
	199	Rose Valley	0.0
	198	Dry Valley	3.1
	203	Panaca Valley	7.4
	204	Clover Valley	17.9
	205	Lower Meadow Valley Wash	67.7
Las Vegas	212	Las Vegas Valley	0.0
Total			**947.8**

An additional 427 springs have been identified by the NPS in the GBNP (NPS 2007). Information on these springs includes location, an estimate of discharge (predominantly using a visual estimate rather than a measured value), and results for several field water quality parameters. Additional information on these springs is presented in the surface water discussions for Spring Valley and Snake Valley later in this section.

Numerous other spring locations have been mapped in the area but do not have documented flow, temperature, or water-quality data. These additional (or "other") spring locations also are shown on **Figure 3.3.1-3**. These spring locations were compiled from the National Hydrography Dataset (USGS 2009b), digitized from 7.5 minute topographic maps for selected basins (i.e., Spring, Snake, Dry Lake, Delamar, and Coyote Spring valleys) (SNWA 2008), or identified from other sources. These springs have not been field-verified, so their actual existence and status as a perennial or ephemeral surface water feature has not been determined.

The locations of springs with flow data and their relative flow magnitudes are shown on **Figure 3.3.1-3**. Springs with reported average discharges of 200 gpm or greater are listed in **Table 3.3.1-2**. The largest spring discharge areas in the Great Salt Lake Desert and the White River regional flow systems area are briefly summarized in the following subsections.

Table 3.3.1-2 Springs with Average Discharges of 200 gpm or Greater in the Region of Study

Groundwater Flow System	Basin Number	Basin Name	Spring Name	Average Flow (gpm)
White River	174	Jakes Valley	Illipah Spring	900
	207	White River Valley	Hot Creek Spring	5,032
			Arnoldson Spring	1,608
			Cold Spring	582
			Preston Big Spring	3,572
			Lund Spring	3,594
			Moorman Spring	405
			Flag Springs 3	969
			Flag Springs 2	1,287
			Flag Springs 1	1,019
			Butterfield Spring	1,225
			Hardy Springs	200
			Nicholas Spring	1,185
			Moon River Spring	1,707
			Emigrant Springs	797
			Forest Home Spring	221
			Water Canyon Spring	320
			Indian Ranch Spring	236
			Sunnyside Creek Spring (Upper)	2,553
			Sunnyside Creek Spring (Lower)	5,284
	180	Cave Valley	Cave Spring	211
	209	Pahranagat Valley	Hiko Spring	2,735
			Crystal Springs	4,235
			Ash Springs	6,909
			Brownie Spring	224
			Cottonwood Spring	1,760

Table 3.3.1-2 Springs with Average Discharges of 200 gpm or Greater in the Region of Study (Continued)

Groundwater Flow System	Basin Number	Basin Name	Spring Name	Average Flow (gpm)
White River (Continued)	219	Muddy River Springs Area	Jones Spring	455
			Baldwin Spring	1,065
			Muddy Spring	3,148
			Iverson Flume	3,912
			M-11	515
			M-13	287
			M-15	702
			M-19	414
			M-20	363
			Warm Springs East	1,000
			Warm Springs West	2,431
			M-10	278
			Apcar Springs (Moapa)	264
	215	Black Mountains Area	Rogers Spring	771
			Blue Point Spring	223
Goshute Valley	179	Steptoe Valley	Murry Springs	3,179
			McGill Spring	4,782
			Monte Neva Hot Springs	649
			Indian Ranch Spring	215
			Big Spring	300
			Willow Creek Springs	624
			Big Indian Creek Spring	426
			Wilson Creek Springs	265
			Comins Lake Spring	334
			Nelson Spring	973
			Schoolhouse Spring	450
			Currie Springs	2,181
			Twin Springs	661
			Campbells Embayment Spring	2,746
			Egan Creek Springs	803
			Currie Gardens	225
			Borchert Spring	610
			Cave Springs	300
			McGill Spring	450
			Lower Schellbourne Warm Spring	450
			Lower Schellbourne Pass Spring	314
			Willow Creek Springs	685
			Shallenberger Spring	450
			Bird Creek Spring	720
			McDermitt Ranch Springs	2,697
	178B	Butte Valley (Southern Part)	Stratton Springs	350

Table 3.3.1-2 Springs with Average Discharges of 200 gpm or Greater in the Region of Study (Continued)

Groundwater Flow System	Basin Number	Basin Name	Spring Name	Average Flow (gpm)
Great Salt Lake Desert	184	Spring Valley (184)	Kalamazoo Spring	869
			North Millick Spring	284
			South Millick Spring	506
			Swallow Springs	391
			Keegan Spring	234
			Minerva Spring	258
			Bastian Spring	1,150
			North Creek Spring	1,000
			Muncy Creek Spring	1,005
			West Spring Valley Complex # 1	438
			Keegan Spring Complex (North)	221
			West Spring Valley Complex # 5	756
			Swallow Spring	318
			Schellbourne Springs	242
			Kalamazoo Creek Spring	1,112
	195	Snake Valley	Rowland Spring	1,088
			Big Springs	4,289
			Gandy Warm Springs	7,426
			Foote Reservoir Spring	1,300
			Twin Springs	1,423
			Spring Creek Spring	1,205
			Miller Spring	206
			Outhouse Springs	500
			Stateline Spring/Lake Creek	3,663
	258	Fish Springs Flat	North Springs	3,140
Meadow Valley	183	Lake Valley	Geyser Springs	471
			North Creek Springs	397
			Unnamed spring flowing north	431
			Unnamed spring flowing south	974
			Dupont Spring	970
			Burnt Knoll Spring	972
			North Big Spring	1,400
	203	Panaca Valley	Panaca Spring	1,256

Great Salt Lake Desert Regional Flow System

The largest spring discharge area for the Great Salt Lake Desert flow system is at Fish Springs, along the extreme northeast edge of the region of study (**Figure 3.3.1-3**). The Fish Creek Range forms a surface-water divide between the Snake Valley and Fish Springs Flat hydrographic basins. Springs in the Fish Springs discharge area occur along a north-northwest trending zone that extends for approximately 10 miles and is coincident with the eastern margin of the Fish Springs Range in the Fish Springs Flat hydrographic basin. The discharge locations for most of these springs are assumed to be controlled by an inferred north-northwest trending fault (Bolke and Sumison 1978). Numerous springs discharge in the Fish Springs area. Specific springs that have been identified as the Fish Springs Group include North Spring, Deadman Spring, Walter Spring, and Fish Spring complex (including House, Mirror, Thomas, Middle, Lost, Crater, South, and Percy springs). The USFWS estimated that the total discharge at Fish Spring Group was approximately 21,000 afy, or 28.69 cubic feet per second (cfs) (USFWS 2004). An earlier water resources reconnaissance report for the Fish Flats hydrographic basin estimated that the Fish Springs had a combined discharge of approximately 24,000 afy, or 33.5 cfs (Bolke and Sumison 1978).

Several major springs are identified in Spring Valley and Snake Valley. The largest discharges occur at Gandy Warm Springs (approximately 15 cfs) and Big Springs (approximately 10 cfs) in Snake Valley. Discharge at Big Springs sustains perennial flows in Big Spring Creek. The springs in Spring Valley and Snake Valley are discussed in more detail under separate hydrographic basin headings.

White River Regional Flow System

Major perennial surface-water discharge occurs within the White River flow system in White River Valley, Pahranagat Valley, and the Muddy River Springs area. The White River Valley is located in the upper portion of the flow system and is characterized by numerous perennial surface-water features, which include approximately 13 major spring discharge areas. Major springs identified in White River Valley include (from north to south) Preston Big Springs, Moorman Spring, Hot Creek Spring, and Moon River Spring. The average annual discharge from these springs is approximately 17,000 afy (24 cfs). Lund Spring is another major spring that occurs in the northern portion of White River Valley and has an average discharge of approximately 5,700 afy (8 cfs). Other major springs in the valley include Cold Spring, Nicholas Spring, Arnoldson Spring, Hardy Springs, Emigrant Spring, Butterfield Spring, and Flag Springs. Spring discharge contributes flow to localized perennial reaches of the White River and to several surface-water features (e.g., ponds, reservoirs, marshes, wetlands) in the basin, including extensive surface-water features in the Kirch Wildlife Management Area in the southern portion of the basin.

Pahranagat Valley is located near the middle of the White River flow system. Major surface-water resources in Pahranagat Valley include groundwater discharge at Hiko, Crystal, and Ash springs, along with Brownie Spring, and other smaller springs and seeps in the southern portion of the discharge area. Eakin (1963) indicated that Hiko, Crystal, and Ash springs have the largest discharge, with an estimated combined total discharge of approximately 25,000 afy (35 cfs). Discharge from the springs supports perennial flows and riparian vegetation along Pahranagat Wash in the Pahranagat hydrographic basin. Spring discharge likely also contributes to flow in lakes and wetlands, including flow to the Upper Lake, Middle Pond, and Lower Lake in the Pahranagat National Wildlife Refuge.

Muddy River Springs consists of numerous springs that discharge over approximately 3 square miles in the eastern portion of the Muddy River Springs hydrographic basin. These springs represent the largest groundwater discharge at the lower end of the White River flow system. Discharge from the springs forms the headwaters of the Muddy River and sustains perennial flow along portions of the Muddy River. The Moapa flow gauge on the Muddy River measures the total discharge from the Muddy River Springs area, minus diversions for municipal and industrial uses (SNWA 2009a). Eakin (1966) indicates that from 1914 to 1962, the average mean annual flow at the Moapa gauge was 33,700 afy (approximately 47 cfs). Between 1963 and 2004, the mean annual flow at the Moapa gauge exhibited a long-term trend of reduced flows. From 2004 to 2010, flows at the gauge generally increased (ranging from approximately 24,000 to 25,900 afy) but were still reduced compared to the 1914 to 1962 conditions. As of 2010, the mean annual flow at the Moapa gauge was approximately 25,900 afy (approximately 36 cfs) or approximately 23 percent less than the average mean annual flow for the 1914 to 1962 period. Flow rates in the river are affected by diversions for agriculture and power generation. Spring discharge rates into Muddy River are controlled by water levels in the carbonate aquifer system that vary in response to climate conditions and groundwater pumping (Mayer and Congdon 2007).

Rogers and Blue Point springs are located in the extreme southeastern margin of the study area, within the White River flow system. These springs occur in the Black Mountain hydrographic basin and are within the Lake Mead National Recreation Area. The spring discharge represents a mixture of local and regional water sources (Pohlmann et al. 1988). The combined discharge of these springs is approximately 1,600 afy (2.2 cfs).

Springs that support special status aquatic species are discussed in Section 3.7, Aquatic Biological Resources.

Surface Water Resources within the Proposed Pumping Basins

The following subsections provide an overview of the surface-water resources for the five basins proposed for groundwater development under the Proposed Action and alternatives.

Spring Valley

The Spring Valley hydrographic basin is a topographically closed basin that is bounded by the Schell Creek and Fortification ranges on the west and the Snake Range on the east. Both Schell Creek and Snake ranges have extensive high-elevation areas (greater than 10,000 feet amsl). The lowest elevation of the valley floor is approximately 5,545 feet amsl and occurs in a playa area (Yelland Dry Lake) in the north-central segment of the valley north of Highway 50. The elevation of the valley floor increases to approximately 6,500 feet amsl along both the north and south margins of the valley floor. A substantial band of irrigated fields, marshes, and open-water ponds occurs along the valley floor, south from Piermont Creek approximately 20 miles to Cleve Creek. In addition to stream flows, these features are maintained by irrigation ditches and numerous springs that discharge along the lower margin of the alluvial fans between elevations of approximately 5,570 to 5,600 feet, just above the valley floor.

Streams

Spring Valley Creek is an ephemeral stream with a north-to-south gradient and is the main channel along the valley axis. Spring Creek also is an ephemeral stream that occupies a similar position, with a south-to-north gradient from the southern end of the valley. Dry lakes and other smaller playa features occur in the valley bottom. Along the west side of the basin, stream flows originate in the Schell Creek Range. Runoff from the Fortification Range enters the basin from the southwest and flows originating in the Snake Range enter from the east.

Rush and Kazmi (1965) described the general-surface water resources in Spring Valley. In addition, SNWA identified 22 streams with perennial stream reaches (SNWA 2006, Table 4-1). **Figure 3.3.1-4** shows the locations of perennial stream reaches in the Spring Valley hydrographic basin. SNWA collected instantaneous discharge measurements between 1990 and 2006 at selected stream sites and compiled and evaluated miscellaneous discharge measurements from other sources for perennial streams in Spring Valley (SNWA 2006). Elliott et al. (2006) also conducted field investigations and flow monitoring to define surface water within and near the GBNP. The Elliott et al. (2006) study includes continuous stream-discharge data for Shingle Creek (also known as Willard Creek) and Williams Canyon, which drain the southern Snake Range.

Table 3.3.1-3 lists selected streams that drain from the Schell Creek and Snake ranges onto the alluvial fans of the basin. Perennial streams generally originate in channels in higher-elevation mountain settings and these flows tend to rapidly dissipate into the valley fill sediments after leaving the mountain front. A large number of other smaller canyons and channels also exit the surrounding ranges onto the valley floor. Physical descriptions of the streams in **Table 3.3.1-3** are provided in SNWA (2008) and Elliott et al. (2006).

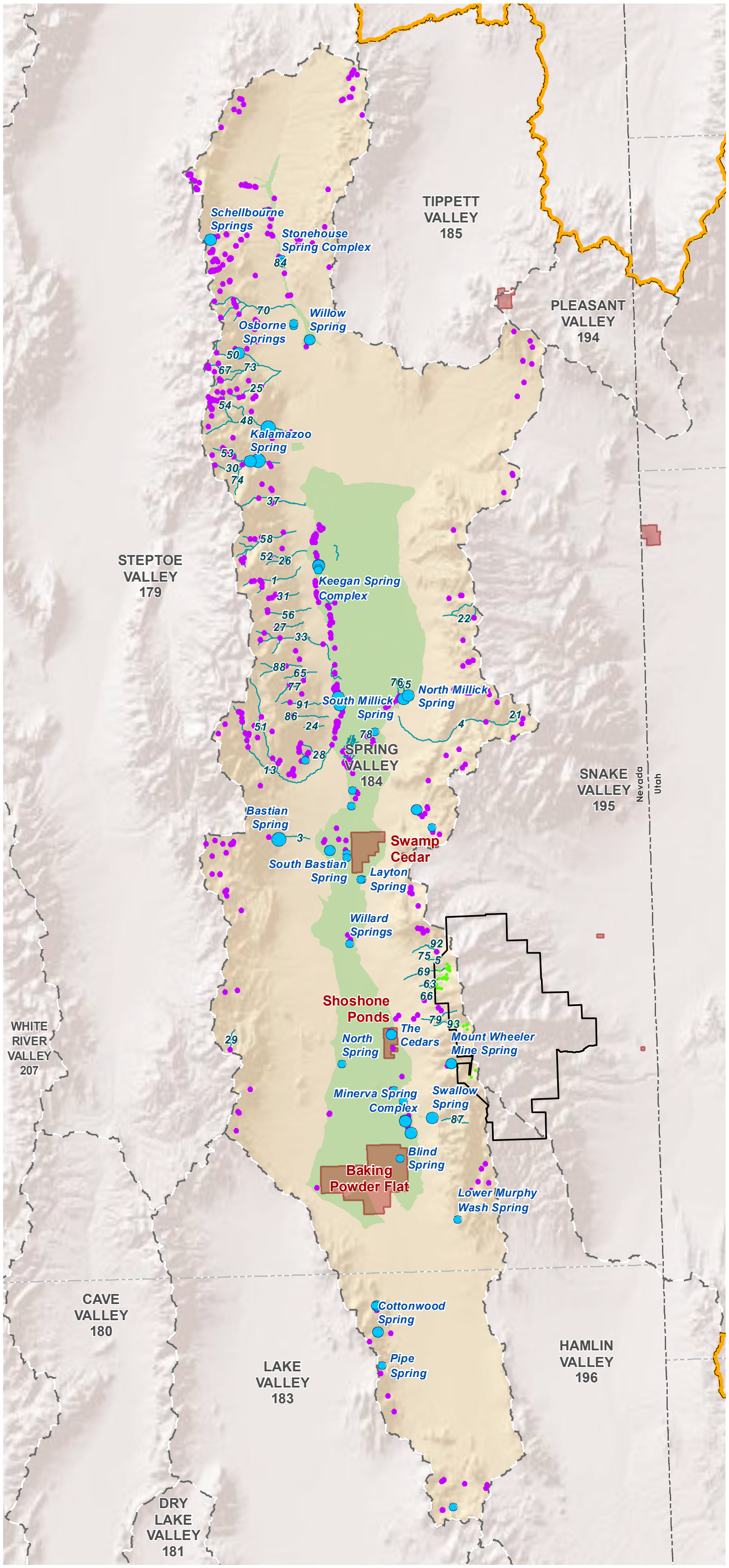
Cleve Creek is a prominent surface-water feature and has the largest drainage area in Spring Valley. The USGS has intermittently operated several gauging stations on Cleve Creek since 1914. Cleve Creek has the longest period of record for streams in Spring Valley. The long-term mean annual discharge is 10.5 cfs, and the second highest mean annual discharge was reported as 21.6 cfs in 2005 (USGS 2007). Stream flow in this region fluctuates, depending on annual and seasonal precipitation variations.

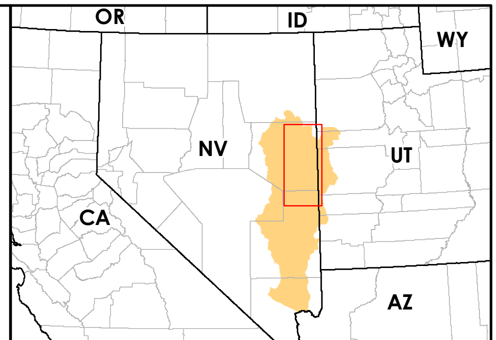
Springs

Springs identified within the Spring Valley hydrographic basin are shown in **Figure 3.3.1-4**. This includes 52 inventoried springs (i.e., springs that have been field-verified and that have flow measurements) and 621 other springs (i.e., springs with map locations that have not been field verified) have been identified in the basin. The location, name, average flow, and data source for the inventoried springs are listed in **Table F3.3.1-1A** in **Appendix F3.3.1**.

A large number of springs occur in the Schell Creek, Snake, and Fortification ranges. Approximately 50 unnamed springs are shown on USGS maps for this area, paralleling the western margin of the valley at elevations of approximately 5,550 to 5,800 feet amsl. These lower-elevation springs contribute to surface-water uses and features on the valley floor.

Thirty-seven springs have been identified in GBNP within Spring Valley by the NPS (2007). These springs occur in the Lincoln Canyon (2 springs), Pine Creek and Ridge Creek (15 springs), Shingle Creek (9 springs) and Williams Canyon Creek (11 springs) watershed areas. Available field information for all the springs identified in GBNP is summarized under the Snake Valley subheading below.





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Inventoried Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location[1]
- Perennial Stream Reach
- Evapotranspiration Area
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- BLM Areas of Critical Environmental Concern

[1]These springs have not been field-verified (i.e. actual existence and flow characteristics are uncertain.)

#	Stream Name	#	Stream Name
1	Bassett Creek	55	North Millick Spring Creek
3	Bastian Creek	56	Odgers Creek
4	Big Negro Creek	58	Piermont Creek
5	Board Creek	63	Pine Creek
13	Cleve Creek	65	Ranger Creek
21	Deer Head Canyon Creek	66	Ridge Creek
22	Eightmile Creek	67	Ruby Creek
24	Freehill Creek	69	Shingle Creek
25	Frenchman Creek	70	Siegel Creek
26	Garden Creek	73	Snow Bank Creek
27	Gordon Creek	74	South Fork Kalamazoo Creek
28	Indian Creek	75	South Fork Willard Creek
29	John Henry Wash	76	South Millick Spring Creek
30	Kalamazoo Creek	77	South Taft Creek
31	Little Negro Creek	78	Spring Creek
33	McCoy Creek	79	Spring Creek (GBNP)
37	Meadow Creek	84	Spring Valley Creek
48	Muncy Creek	86	Stephens Creek
50	North Creek	87	Swallow Canyon Creek
51	North Fork Cleve Creek	88	Taft Creek
52	North Fork Garden Creek	91	Vipont Creek
53	North Fork Kalamazoo Creek	92	Willard Creek
54	North Fork Muncy Creek	93	Williams Canyon Creek

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-4

Spring Valley Perennial Streams and Springs

0 5 10 15 20 25 Miles
0 5 10 15 20 25 Kilometers
1:800,000
N

Table 3.3.1-3 General Characteristics of Perennial Streams In Spring Valley

Stream	Location	Estimated Mean Annual Stream Flow (gpm)[1]	Stream with Perennial Reaches
Muncy Creek	Schell Creek Range	853	Yes[3]
Kalamazoo Creek	Schell Creek Range	2,693	Yes[3]
Meadow Creek	Schell Creek Range	350	No
Siegel Creek	Schell Creek Range	462	Yes[3]
North Creek (station 1840401)	Schell Creek Range	557	Yes[6]
North Creek (station 1843401)	Schell Creek Range	4	Yes[1,5]
Frenchman Creek	Schell Creek Range	242	Yes[3]
Piermont Creek	Schell Creek Range	754	Yes[3]
Garden Creek	Schell Creek Range	175	Yes[3]
Bassett Creek	Schell Creek Range	2,240	Yes[3]
Little Negro Creek	Schell Creek Range	386	Yes[3]
Negro Creek	Snake Range	1,176	Yes[3]
Odgers Creek	Schell Creek Range	1,064	Yes[3]
McCoy Creek	Schell Creek Range	3,025	Yes[3]
Taft Creek	Schell Creek Range	1,176	Yes[3]
Stephens Creek	Schell Creek Range	467	Yes[3]
Cleve Creek	Schell Creek Range	4,713 [2]	Yes[3]
Bastian Creek	Schell Creek Range	1,234	Yes[3]
Board Creek	Snake Range	13	Yes[1,5]
Eight Mile Creek	Snake Range	440	Yes[3]
Swallow Creek	Snake Range	3,434	Yes[3]
Dry Canyon and Williams Canyon	Snake Range	458	Yes[3,4]
Pine and Ridge Creeks	Snake Range	530	Yes[3,4]
Willard Creek	Snake Range	413	Yes[3]
Shingle Creek	Snake Range	431	Yes[4]
Ranger Creek	Schell Creek Range	27	Yes
South Taft Creek	Schell Creek Range	310	Yes[6]

[1]SNWA (2008), estimated mean annual stream flow for ungauged perennial streams and the gauge at Cleve Creek.
[2]USGS (2007).
[3]SNWA (2006).
[4]Elliott et al. (2006).
[5]Perennial stream reach not mapped.
[6]Crookshanks (2011).

SNWA has conducted detailed field investigations at 10 representative springs in Spring Valley (SNWA 2008). SNWA selected these springs based on aerial distribution, discharge, and lithologic setting. The general characteristics of these springs are summarized in **Table 3.3.1-4** and discussed in the following paragraphs.

Willow Spring. Willow Spring is in northern Spring Valley. The spring has two distinct orifices that discharge into a small, man-made impoundment that forms a small pond used by livestock and wildlife.

The spring discharges from Quaternary alluvium and is one of several springs that surface along a northeast trending lineation, suggesting the presence of a concealed fault (SNWA 2008).

Table 3.3.1-4 General Characteristics of Selected Springs in Spring Valley[1]

Spring Name	Location	Landscape Position	Elevation (feet)	Source Geology	Measured Discharge Range in gpm (Number of Measurements)	Water Temperature (Number of Measurements) °C[2]
Willow Spring	Schell Creek Range	Mountain upland	5,982	Carbonate bedrock	1.8–35.9 (5)	10.4–14.9 (3)
North Millick Spring	Snake Range	Valley margin	5,590	Unconsolidated sediment	196–328 (10)	10.9–15.5 (7)
South Millick Spring	Snake Range	Valley margin	5,592	Unconsolidated sediment	200–727 (13)	10.2–15.8.(10)
South Bastian Spring	Snake Range	Valley floor	5,660	Unconsolidated sediment	0.5–4.76 (3)	12–12.9 (2)
Willard Spring	Snake Range	Valley floor	5,755	Unconsolidated sediment	NMD–3 (2)	7.9 (1)
Layton Spring	Snake Range	Valley floor	5,698	Unconsolidated sediment	NMD–1.0 (7)	8.6–22 (5)
North Spring	Schell Creek Range	Valley floor	5,763	Unconsolidated sediment	10.0 (1)	22.7
The Cedars[3]	Snake Range	Valley floor	5,783	Alluvium	20.6–74.5 (6)	23.7–24.5 (6)
Swallow Springs	Snake Range	Valley floor	6,080	Alluvium	275–511 (13)	9.4–13.8 (10)
Blind Spring	Snake Range	Valley floor	5,773	Unconsolidated sediment	NMD (5)	2.2–25.3

NMD = No measurable discharge (dry or stagnant pond).

[1] Source: SNWA (2008) unless otherwise noted.

[2] Range of available temperature measurements; SNWA (2008), USGS (2007), BIO-WEST (2007).

[3] The area referred to as "The Cedars" contains surface discharges from two artesian wells that provide water to a wetland area (see text for additional description).

North and South Millick Springs. North and South Millick springs are approximately 3.5 miles southeast of the center of Yelland Dry Lake and approximately 6 miles east of the West Spring Valley Highway (State Route [SR] 893). They are in north-central Spring Valley on the west flank of the Snake Range, about 6 miles north of U.S. Highway 50. South Millick Spring is approximately 0.5 mile to the southwest of North Millick Spring. Several small orifices contribute flow to form large spring pools at each spring (SNWA 2008).

Both North and South Millick springs discharge from alluvium and are located on a northeast-southwest trending normal fault. Mean discharge was recorded at the South Millick Spring as approximately 506 gpm. The mean discharge of North Millick Spring was recorded as approximately 284 gpm. Water from the North and South Millick springs is used to water livestock (SNWA 2008).

Layton Spring. Layton Spring is approximately 2.5 miles north of U.S. Highway 50, along the eastern flank of Spring Valley. During a field visit on July 15, 2004, the spring was observed to be dry (SNWA 2008). When flowing, the spring discharges from a 2-inch-diameter pipe into a watering trough and then overflows into a shallow reservoir (SNWA 2008).

South Bastian Spring. South Bastian Spring is located approximately 2.8 miles southeast of Bastian Creek Ranch and approximately 2.3 miles northwest of Layton Spring. The spring discharges along the western edge of an extensive marshy area with large cedar trees. Two other springs with similar conditions, including discharge from the Quaternary alluvium and diversion structures, also were observed in the area (SNWA 2008). Discharge at South Bastian Spring was measured at approximately 4 gpm during a July 15, 2004, field visit. Livestock and wildlife use the water (SNWA 2008).

Willard Spring. Willard Spring is located in the valley bottom near the central axis of the valley, approximately 1.5 miles south of U. S. Highway 50. The spring discharges from unconsolidated sediments. The spring was described as stagnant with no measured discharge on July 15, 2004; and had a measurable flow of 3 gpm on March 27, 2007 (SNWA 2008).

North Spring. North Spring is 10 miles north of Lake Valley Summit and 2 miles east of U.S. Highway 93. North Spring discharges along a north-south-trending fault and is flanked on the east and west by additional north-south-trending faults. Another small spring approximately 900 to 1,200 feet north of North Spring appears to discharge from the same fault (SNWA 2008).

Discharge was estimated to be 10 gpm during a June 22, 2004, field visit (SNWA 2008). The spring flow travels only 150 yards before it is lost to infiltration and ET. The water is used for livestock watering and supports a small grassy area downstream of the spring (SNWA 2008).

Swallow Springs. Swallow Springs is in a grove of large cottonwood trees, 1.5 miles north of Shoshone, Nevada, and 1.5 miles east of SR 894. Swallow Springs is in the middle of a large alluvial fan, approximately 0.25 mile from an outcrop of middle Cambrian limestone (Hose et al. 1976). The combined discharge of the two orifices on November 29, 2007, was approximately 337 gpm. There are several historic water diversions in the area, and water currently discharges in the natural channel (SNWA 2008).

Blind Spring. Blind Spring is in southern Spring Valley, approximately 7 miles east of U.S. Highway 93 and 2 miles southwest of Minerva, Nevada. A raised rim surrounds Blind Spring and it appears to be manmade. The SNWA (2008) reports that the pool level might represent the potentiometric surface or groundwater table. At the time of the field visit, Blind Spring was discharging into a stagnant pool, so no discharge measurements were possible. Water from Blind Spring is used for wildlife and livestock (SNWA 2008).

A *potentiometric surface* is one that represents the static head of groundwater in tightly cased wells that tap a water-bearing unit (i.e., aquifer).

Other Major Ponds and Wetland Areas Fed by Groundwater Discharge

Shoshone Ponds Area. The Shoshone Ponds area is located in the southern portion of the Spring Valley approximately 10 miles south of U.S. Highway 6/50. The area consists of wet meadow/wetlands complex situated along the eastern margin of the valley floor that also is named “The Cedars” on topographic maps of the area. The source of water for the wet meadow/wetland complex is discharge from six artesian wells located along the eastern margin of the area. Five of the wells were constructed in the 1930s to supply water to a Civilian Conservation Corps Camp located in the area; the sixth well was constructed in the early 1970s for the NDOW to provide a water source for three ponds (known as the Shoshone Ponds) used as refugia for Nevada native fish (BLM 2010). (The management of the ponds as refugia for federally endangered fish is discussed in Section 3.7, Aquatic Biological Resources.) The SNWA conducted field investigations of the discharge characteristics at two of the artesian wells (SNWA 2008). The two wells are described as being situated at the toe of an alluvial fan that consists mainly of carbonate clasts. Discharge volume was measured for both wells on July 28, 2004. Total discharge from the two wells was estimated at 75 gpm.

Artesian well: A well in which the water pressure is so great that the water level in the well stands above the ground surface and may discharge at the surface without pumping (i.e., "flowing artesian well").

Snake Valley

Snake Valley is a western tributary to the Great Salt Lake drainage basin. The western margin of the valley is bounded by the Deep Creek and Snake ranges, which have extensive high-elevation areas (greater than 10,000 feet amsl). The eastern margin of the valley is bounded by the Fish Springs and Confusion ranges; neither exceeds 9,000 feet amsl. The elevation of the valley surface gently slopes toward the north, although it does not contain a well-defined continuous stream channel that extends the length of the valley (Hood and Rush 1965).

A gentle land surface separates the Snake Valley hydrographic basin from the Hamlin Valley hydrographic basin. Hamlin Valley Wash dissipates northward on the valley floor toward Snake Valley and Big Springs Creek and Lake Creek closely parallel the wash, also flowing north. Because of the subdued topography and surface drainage, some investigators include Hamlin Valley as the southernmost part of Snake Valley (Hood and Rush 1965; Welch et al. 2007).

Streams

Perennial stream reaches identified in the Snake Valley hydrographic basin are shown on **Figure 3.3.1-5**. These stream reaches were defined based on available information in the BLM Ely Proposed RMP/Final EIS (BLM 2007), in the GBNP Bio-Physical Report (NPS 2007), and in Elliott et al. (2006). From north to south, the perennial stream reaches include Trout Creek and several other perennial reaches that drain the Deep Creek Range; Deadman Creek, Deep Canyon Creek, Hampton Creek, Hendry's Creek, and Silver Creek in the Snake Range north of Highway 50; and Weaver Creek, Strawberry Creek, Mill Creek, Lehman Creek, Baker Creek, Snake Creek, Spring Creek, and Big Wash within or near the GBNP, as described by Elliott et al. (2006). Big Springs Creek/Lake Creek is a perennial stream in the southwest portion of Snake Valley that originates at Big Springs and terminates at Pruess Lake, with an estimated surface area of about 200 acres.

Hood and Rush (1965) identified 14 perennial streams in Snake Valley, including streams that discharge from Gandy Warm Springs and Big Spring and 12 others that originate in the high mountains of the Deep Creek and Snake ranges. Discharge measurement and observations included in Hood and Rush (1965) are summarized in **Table 3.3.1-5**.

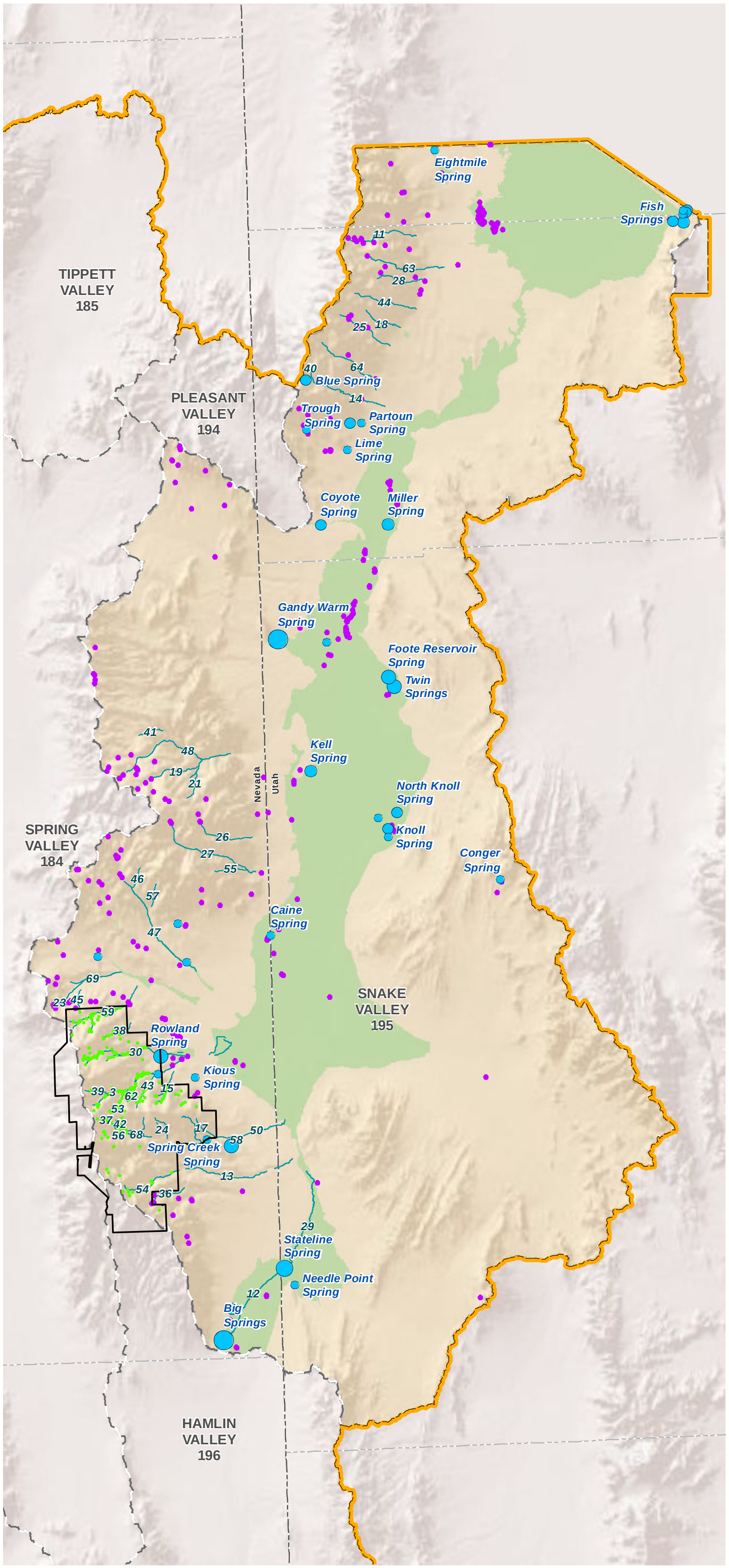
Mean annual discharge was estimated by the SNWA for 11 inventoried streams, and these results are presented in **Table 3.3.1-5** (SNWA 2008). Variation in mean annual discharge estimates on the same stream for different studies might be caused in part by differences in measurement location.

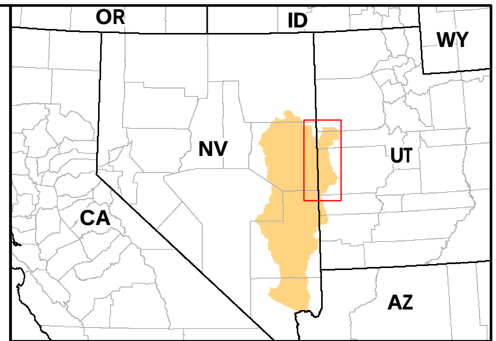
Great Basin National Park. Perennial streams identified within the GBNP are shown on **Figure 3.3.1-6**. The USGS and the NPS investigated streams originating in the GBNP and flowing into Snake Valley (Elliott et al. 2006; NPS 2007). The study characterized surface-water resources in the GBNP and included measuring the discharge of streams and springs and assessing the natural variability of their flow. Mean annual discharge was estimated for six stream gauges and Rowland Spring in Snake Valley. Snake Creek has four gauge sites and two of these sites had sufficient data to estimate a mean annual discharge.

Stream discharge characteristics reported in Elliott et al. (2006) are summarized in **Table 3.3.1-6**. This investigation included miscellaneous discharge measurements at different locations along the streams to further characterize variations and potential water sources along the channels. The results of the study indicated that substantial differences in discharge occur along the stream lengths and at different times of year. Multiple discharge measurements over short periods of time along Baker, Lehman, and Snake creeks indicate that these streams gain and lose water over relatively short stream reaches. These discharge fluctuations are attributed to the distribution of permeable and impermeable consolidated rocks that form the stream channels. Typically, higher values of discharge occur in the spring and summer months (June or July), and lower values occur in the fall (October). Lower flows in the fall typically are associated with higher specific conductance and lower temperatures (Elliott et al. 2006).

Water Resources in Caves. Elliott et al. (2006) identified an area within the GBNP where surface water resources likely are susceptible to groundwater withdrawal. Baker (2009) has identified 6 caves in these susceptibility areas that are in direct contact with the water table or surface water. These include Model Cave, Ice Cave, Wheeler's Deep Cave, and Systems Key Cave in the Baker Creek watershed. There is limited information to define the hydrology of these caves or determine the source of water that occurs within these caves.

Trip reports from spelunkers published during the 1950s and 1960s reported explorations of the Baker Creek Cave System. Bridgemon (1967) describes the Baker Creek Cave System as 15 caves that occur within the Pole Canyon Limestone. Wheeler's Deep Cave also is reported to have a perennial stream (Baker 2009). Model Cave is reported to be the most important cave within the Baker Creek Cave System and is reported to have one or more perennial streams (McLean 1965; Bridgemon 1967; Baker 2009). Lange (1954) describes slots in the floor of Model Cave that he states were formed by upward (or artesian) flow. However, he does not provide data to determine if these features were formed in the geologic past (i.e., under different hydrologic conditions) or were formed recently under present hydrologic conditions. If the latter were true, these features would suggest that artesian flow in the limestone is the





Legend

Inventoried Springs Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location[1]
- Perennial Stream Reach
- Evapotranspiration Area
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park

[1]These springs have not been field-verified (i.e. actual existence and flow characteristics are uncertain.)

#	Stream Name	#	Stream Name
3	Baker Creek	41	North Fork Smith Creek
11	Basin Creek	42	North Fork Snake Creek
12	Big Springs Creek	43	Pole Creek
13	Big Wash	44	Red Cedar Creek
14	Birch Creek	45	Sage Creek
15	Can Young Canyon	46	Second Fork Silver Creek
17	Cave Canyon Creek	47	Silver Creek
18	Cottonwood Creek	48	Smith Creek
19	Deadman Creek	50	Snake Creek
21	Deep Canyon Creek	53	South Fork Baker Creek
23	Grace Creek	54	South Fork Big Wash
24	Granite Baisn Creek	55	South Fork Hendry's Creek
25	Granite Creek	56	South Fork Snake Creek
26	Hampton Creek	57	Spring Creek (Trib. to Silver Creek)
27	Hendry's Creek		
28	Indian Farm Creek	58	Spring Creek (Trib. to Snake Creek)
29	Lake Creek		
30	Lehman Creek	59	Strawberry Creek
36	Lexington Creek	62	Timber Creek
37	Middle Fork Snake Creek	63	Tom's Creek
38	Mill Creek	64	Trout Creek
39	North Fork Baker Creek	68	Upper Snake Creek
40	North Fork Birch Creek	69	Weaver Creek

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Figure 3.3.1-5

Snake Valley Perennial Streams and Springs

0 5 10 15 20 25 Miles
0 5 10 15 20 25 Kilometers
1:800,000
N

Table 3.3.1-5 Mean Annual Stream Discharge Estimates for Selected Perennial Streams In Snake Valley

Stream	Location	Hood and Rush (1965)[1] cfs	Elliott et al. (2006) cfs	USGS (2007) cfs	SNWA (2008) cfs
Baker Creek	Southern Snake Range	8.53	9.08	NS	NS
Lehman Creek	Southern Snake Range	7.49	5.13	5.67	NS
Trout Creek	Deep Creek Range	4.34	NS	5.51	NS
Warm Creek	West Central Snake Valley	Inventory	NS	NS	NS
Big Springs Creek	Southern Snake Range	Inventory	NS	NS	NS
Big Wash	Southern Snake Range	Inventory	NS	NS	1.44
Snake Creek	Southern Snake Range	Inventory	2.70	NS	9.50
Silver Creek	Northern Snake Range	Inventory	NS	NS	5.10
Hendry's Creek	Northern Snake Range	Inventory	NS	NS	2.62
Birch Creek	Deep Creek Range	Inventory	NS	NS	4.39
Granite Creek	Deep Creek Range	Inventory	NS	5.12	NS
Cedar Creek	Deep Creek Range	Inventory	NS	NS	NS
Thomas Creek	Deep Creek Range	Inventory	NS	NS	NS
Basin Creek	Deep Creek Range	Inventory	NS	NS	NS
Indian Farm Creek	Deep Creek Range	NS	NS	NS	4.24
Smith Creek	Northern Snake Range	NS	NS	NS	4.66
Hampton Creek	Northern Snake Range	NS	NS	NS	0.728
Weaver Creek	Southern Snake Range	NS	NS	NS	0.383
Strawberry Creek	Southern Snake Range	NS	0.58	NS	1.46
Lexington Creek	Southern Snake Range	NS	NS	NS	0.226

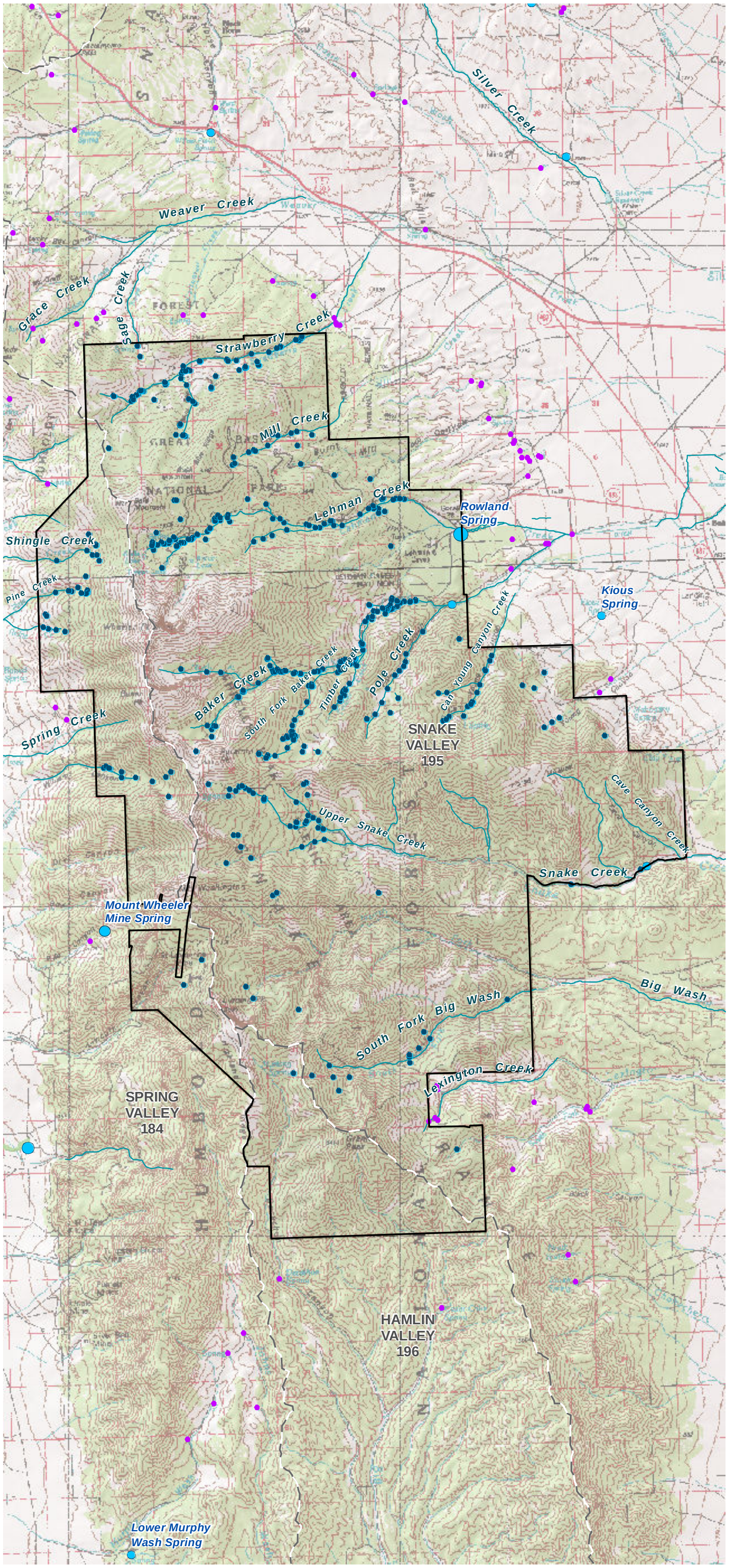
[1]Inventory = Discharge measurement used for basin estimate provided in Hood and Rush (1965), but no mean annual discharge estimate was reported.
NS = Mean annual stream discharge estimates not surveyed by this study.

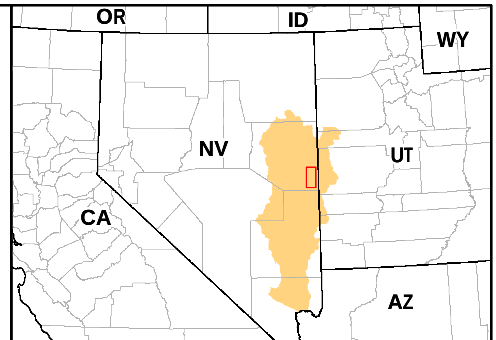
source of water in this cave. Preliminary results from ongoing hydrogeologic and water resource investigations at GBNP suggest that water resources in Model Cave may be interconnected with the alluvial basin-fill in Snake Valley (Prudic and Sweetkind 2012).

Ice Cave is reported to have a stream that is controlled by flow through a surface culvert directing water into the cave entrance (Baker 2009). Systems Key Cave is partially located beneath Baker Creek and has a small stream that originates in the ceiling, flows along the floor, and then disappears down a tight passage (Baker 2009). These descriptions suggest that water within Ice Cave and Systems Key Cave likely is due to the infiltration of surface runoff and not upward flow from the regional groundwater flow system. Uncertainty exists regarding the degree of hydraulic connection, if any, among water in these caves, the local aquifer, and aquifer(s) beneath Snake Valley, including how their degree of connection might vary seasonally and through wet and dry years.

Squirrel Springs Cave extends below the water table. The water table is reported to fluctuate and the cave experiences seasonal flooding (Baker 2009). These descriptions suggest that the water table observed in the cave likely is controlled in part by groundwater fluxuation and in part by seasonal precipitation patterns. Water Trough Cave is described as containing ponded water. Information regarding the likely source of water in Water Trough Cave is not available.

Overall, much uncertainty exists regarding hydraulic interconnection between these caves in the Pole Canyon limestone and the regional aquifer system that would be targeted for groundwater development in Snake Valley. As described in Section 3.0.3, Incomplete and Unavailable Information, USGS in conjunction with the NPS are conducting additional studies to address cave hydrology within GBNP.





Legend

Inventoried Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location[1]
- Perennial Stream Reach
- Evapotranspiration Area
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park

[1]These springs have not been field-verified (i.e. actual existence and flow characteristics are uncertain.)

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-6

Great Basin National Park Streams and Springs

0 1 2 3 4 5 Miles
0 1 2 3 4 5 10 Kilometers
1:200,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Table 3.3.1-6 Summary of Stream Characteristics in and near GBNP

Basin	Stream Name	Discharge Range (cfs)	Water Temperature Range (°F)	Specific Conductance Range (µS/cm)
Snake Valley	Strawberry Creek	0.12 to 3.18	45 to 63	52 to 153
Spring Valley	Shingle Creek	0.59 to 2.02	45 to 55	60 to 80
Snake Valley	Lehman Creek	0.49 to 11.7	45 to 68	30 to 152
Snake Valley	Baker Creek	0 to 8.07	43 to 65	28 to 107
Snake Valley	Snake Creek	0 to 15.5	45 to 59	76 to 375
Snake Valley	Big Wash	0 to 5.05	45 to 57	341 to 475

µS/cm = microSiemens per centimeter.
Source: Elliott et al. 2006.

Springs

Springs that were identified in Snake Valley are shown on **Figure 3.3.1-5**.

Available spring data include: 1) inventoried springs with flow measurements; 2) additional springs identified in GBNP; and 3) other unverified spring locations identified on topographic maps or included in the National Hydrographic Dataset.

Thirty-eight inventoried springs that have flow measurement data have been identified. The location, name, average flow, and data source for the inventoried springs are listed in **Table F3.3.1-1A** in **Appendix F3.3.1**.

GBNP Springs. The NPS has identified an additional 427 springs located in the GBNP (NPS 2007). Of these, 390 springs occur in Snake Valley in 13 watershed areas. The identified spring locations within the GBNP are shown in **Figure 3.3.1-6**. Information on these springs is summarized in **Table 3.3.1-7**, including the ranges of estimated discharge and the minimum and maximum reported field water quality results by watershed area. The location, watershed area, discharge method used, and estimated discharge range for the springs are listed in **Table F3.3.1-1B** in **Appendix F3.3.1**. The estimated spring discharge for springs is reported as a range in flow. The flow estimates were based on visual observations (305 springs), volumetric measurements (109 springs), and flow meter measurements (1 spring). No flow measurements were reported for 15 of these springs. The discharge and field water quality parameters were collected over a period from April through October 2003, April through October 2004, and July 2005.

Available information for Big Springs, Caine Springs, Gandy Warm Springs, Cave Springs, Rowland Springs, Spring Creek Spring, and Needle Point Springs is presented in **Table 3.3.1-8** and summarized in the following paragraphs.

Big Springs. Big Springs provides water for irrigation at Big Springs Ranch and then flows northeast into Big Springs Creek, which becomes Lake Creek east of the Utah-Nevada border, and finally flows into Pruess Lake 3 miles southeast of Garrison, Utah (SNWA 2008).

There are several springs emanating from the alluvium in the area and Big Springs has the largest discharge. Two unnamed spring complexes are located northeast of Big Springs, possibly along the same north-northeast trending fault that controls Big Springs. North and South Little Springs complexes are to the southeast of Big Springs. These springs are located along separate, but sub-parallel, north-northeast trending faults with varying vertical and horizontal surface displacement.

Discharge measurement location in the Big Springs area is important because of a number of diversions and because Big Spring Creek gains water before flowing into Lake Creek. The diversions at Big Springs include several portable pumps that divert water and a splitter box consisting of two weirs. The discharge for Big Springs (approximately 9 cfs [4,086 gpm]) is defined as the total measured below each of the two weirs (SNWA 2008). Additional springs that contribute flow downstream of the weirs increased the discharge to between 15 and 19 cfs (6,730 and 8,530 gpm) from June through November 1972 (Walker 1972).

Table 3.3.1-7 Summary of Springs Identified in GBNP

Hydrographic Basin	Watershed	Springs Inventoried	Number of Springs by Range of Estimated discharge (gpm)[1]			Water Temp °F		Specific Conductance (µS/cm)		pH (units)	
			0-10	10-100	100-1000	min	max	min	max	min	max
Snake Valley	Baker Creek	148	103	31	10	34	65	12.7	303	3	8.4
	Burnt Mill Creek	4	4			45	50	89.9	161.2	6.4	7.3
	Can Young Canyon	19	12	5		37	55	40.1	426.4	6.1	7.62
	Decathon Creek	1				63	63	399	399	7.1	7.1
	Lehman Creek	79	46	26	3	36	61	15.4	241.6	4.97	7.59
	Lexington Creek	1				56	56	630	630	7.67	7.67
	Mill Creek	13	9	3		40	52	19.1	290.8	6.2	7.5
	North Fork Big Wash	6	2	2	2	37	50	193	420.7	7.5	8
	Snake Creek	38	24	11	3	33	59	30.9	280.6	5.7	7.8
	South Fork Big Wash	12	6	3	3	43	47	169	414.4	7.47	8.5
	Strawberry Creek	59	39	11	9	39	54	38.4	324.5	6	7.8
	Weaver Creek	2	2			45	54	180	185.6	6.96	7.06
	Young Canyon	8	6	2		45	55	31.3	457.2	6.41	7.3
Spring Valley	Lincoln Canyon	2				37	37	281	362.5	7.7	8
	Pine Creek/Ridge Creek	15	13	2		39	52	25.7	101.5	6.4	10.2
	Shingle Creek	9	5	3	1	39	48	25.7	94.8	6.5	9.43
	Williams Canyon Creek	11	3	3	2	35	45	17	38.3	6.28	7.3
Total springs		427	274	102	33						

[1] Flow estimates based on visual observations (305 springs), volumetric measurements (109 springs), and flow meter measurements (1 spring).

[2] Temperature converted from °C and rounded to whole number.

Table 3.3.1-8 Selected Spring Discharge Measurements in Snake Valley

Spring Name	UTM[1] Easting (m)	UTM[1] Northing (m)	Elevation (feet amsl)	Mean Discharge (gpm) (Number of measurements)	Mean Discharge (cfs) (Number of measurements)	Temperature Range (°F) (Number of measurements)
Big Springs	749,476	4,287,141	5,572	4,267 (23)	9.5 (23)	61–64 (2)
Caine Spring	755,138	4,336,186	5,032	5.0 (1)	0.010 (1)	58 (1)
Gandy Warm Springs	756,007	4,371,984	5,156	7,252 (28)	16.2 (28)	76–82 (10)
Rowland Spring	741,778	4,321,448	6,580	1,032 (continuous)	2.2 (continuous)	48–50 (3)
Cave Springs	739,312	4,322,110	7,270	45 (daily 2004-2006)	0.1 (daily 2004-2006)	56 (356)
Spring Creek Spring	750,345	4,310,673	6,123	1,205 (2)	2.7 (2)	55 (1)
Needle Point Springs	758,117	4,293,839	5,460	see text	see text	Not available

[1]Coordinates are in UTM Zone 11 and North American Datum of 1983.

[2] Temperature converted from °C and rounded to whole number.

UTM = Universal Transverse Mercator; m = meter.

Sources: SNWA 2008; Elliott et al. 2006; Summers 2012; NPS 2007.

Caine Spring. Caine Spring is approximately 10 miles north of Baker, Nevada. The spring discharges from two seeps. One of the seeps is enhanced by artesian flow from a 3-inch-diameter well. The total discharge was estimated at 0.011 cfs, or 5 gpm (SNWA 2008).

Gandy Warm Springs. Gandy Warm Springs is a major surface-water feature and a popular recreation area with local Snake Valley residents. Swimmers are able to swim in the main discharge channel and into the large solution cavern where the spring discharges from Paleozoic carbonate rocks (SNWA 2008). The spring is located approximately 0.5 mile east of the Nevada state line and 3 miles west of Gandy, Utah. Spring flow is diverted to the south and the east towards Gandy, where it supports agriculture.

Water discharges from several orifices, which coincide with the intersection of fault and fracture zones perpendicular to a major northeast-southwest trending, normal fault. Discharge measurements of 8.0 cfs in November 1964 (Hood and Rush 1965) and 8.42 cfs (3,780 gpm) in June 2004 are anomalously low (SNWA 2008). These measurements appear to have missed a large volume of flow and are not included in the mean discharge estimates (16.8 cfs [7,562 gpm]) in **Table 3.3.1-8**.

Rowland Spring. Rowland Spring is located at the eastern boundary of the park. The spring discharges from alluvium and glacial sediments (Elliott et al. 2006). Discharge was monitored at Rowland Spring, a tributary to Lehman Creek, as part of the USGS study at GBNP. Rowland Spring is one of the major springs of the South Snake Range. Average annual discharge of Rowland Spring is 2.3 cfs based on 2 years of measurements (Elliott et al. 2006). The source of water for Rowland Springs is uncertain. Elliott et al. (2006) suggest that two possible sources for the discharge are eastward groundwater flow through the Pole Canyon Limestone in the Lehman Creek Drainage or northeastward groundwater flow through carbonate rocks in the Baker Creek Drainage.

Cave Springs. Cave Springs is the water supply for the GBNP operational facilities. Mean annual discharge for 2004 through 2006 was 0.1 cfs (NPS 2007). Cave Springs consists of several small springs that discharge from alluvial and glacial deposits near the contact between quartzite and granite. A recent USGS investigation of Cave Springs (Prudic and Glancy 2009) investigated the source of water to the spring to evaluate the potential for depletion from groundwater development in Snake Valley. The results of the study indicate that the source of the water in the spring is primarily from winter precipitation that discharges from quartzite on the upstream contact between quartzite and granite. The study also indicated the potential for spring depletion from groundwater pumping in Snake Valley is less than if carbonate rocks were present beneath the springs, as carbonate rocks would provide a better connection with alluvial aquifers in the valley.

Spring Creek Spring. Spring Creek Spring is located near the eastern boundary of the GBNP and is a tributary to Snake Creek. Spring Creek Spring discharges from the Fishtown and Lakehaven Dolomites at a fault contact with alluvial and glacial tertiary age sediments (Elliott et al. 2006). The spring discharge sustains perennial flows in Spring Creek, a tributary to Snake Creek. Most of the flow in Spring Creek is diverted into the NDOW's Spring Creek Rearing Station, a fish culture facility, with return flows entering Snake Creek downstream of the rearing station. Discharge of Spring Creek just upstream of the fish-rearing ponds was 2.02 cfs (906.6 gpm) in June 2003 and 1.78 cfs (798.9 gpm) in October 2003 (Elliott et al. 2006), indicating a small (approximately 12 percent) reduction in flow between June and October.

Needle Point Springs. Needle Point Springs is located near the southeast margin of Snake Valley Utah near the Utah-Nevada state line, approximately 5 miles northeast of Big Springs in Nevada. The spring occurs in an area of basin alluvium, which is inferred to be underlain by fractured dolomite that outcrops at the surface in the Needle Point Mountain south of the spring (Summers 2012). The following summary is based on information compiled in an unpublished BLM report on Needle Point Springs, prepared by BLM Senior Hydrogeologist Paul Summers (Summers 2012).

Spring discharge has been documented as early as 1939 by the Civilian Conservation Corps work crew who performed improvements at the spring. The Civilian Conservation Corps camp engineers documented flow from the spring at 6 gpm on September 22, 1939. The spring was developed by digging approximately 10 feet into the alluvium and installing a 6-foot-diameter circular steel tank, which was perforated to allow water to flow into the tank. An outlet pipe feeds water to a nearby trough and a surface pond, for easy access by stock and wild horses. Water at the spring has been used continuously since 1939 for watering stock and wild horses. Prior to 1939, anecdotal reports of spring use suggest that water at this spring was used for several years by sheep and cattle operations in the area.

The following flow measurements were recorded by BLM staff between 1992 and 2001:

- Sept. 24, 1992, 6 gpm;
- Feb. 16, 1994, 7 gpm;
- July 11, 1997, 7 gpm;
- June 6, 2001, 2.4 gpm;
- Late June, 2001: water level dropped below outlet pipe of the spring box and the flow to the watering trough and surface pond ceased; and
- July 2001 to March 2012: the water level has remained below the spring outlet; no flow to watering troughs.

After flow ceased in June 2001, the BLM installed a 2-inch-diameter monitoring well (piezometers) to measure the elevation of the water table next to the spring. The water level in the spring head-box and the monitoring well coincide with each other so that the monitoring well accurately represents the water level at the spring. The depth to water has been monitored by the BLM staff on a regular basis since August 28, 2001. The results of the monitoring indicate that there has been no observable flow at the spring between the periods of record (available at the time of this evaluation) that extends from June 6, 2001, to December 1, 2010. The water table has declined by as much as 7.74 feet, which occurred on September 30, 2010. The water table exhibits rapid and steep seasonal declines, corresponding to irrigation season cycles, when center pivot irrigation pumps located approximately 1.25 to 1.5 miles away are turned on. Water levels decline for 5 to 6 months each year during the irrigation season (typically starting in late March to early May and ending in late October), and partially recover over the remainder of the annual cycle, when irrigation pumps are shut off. The water level recovery after each cycle of pumping does not return to the pre-pumping water level prior to the start of the previous year's pumping cycle. Thus, the water levels at the end of each irrigation season have continuously trended downward, resulting in a continuously lowered water level year over year (Summers 2012).

Cave Valley

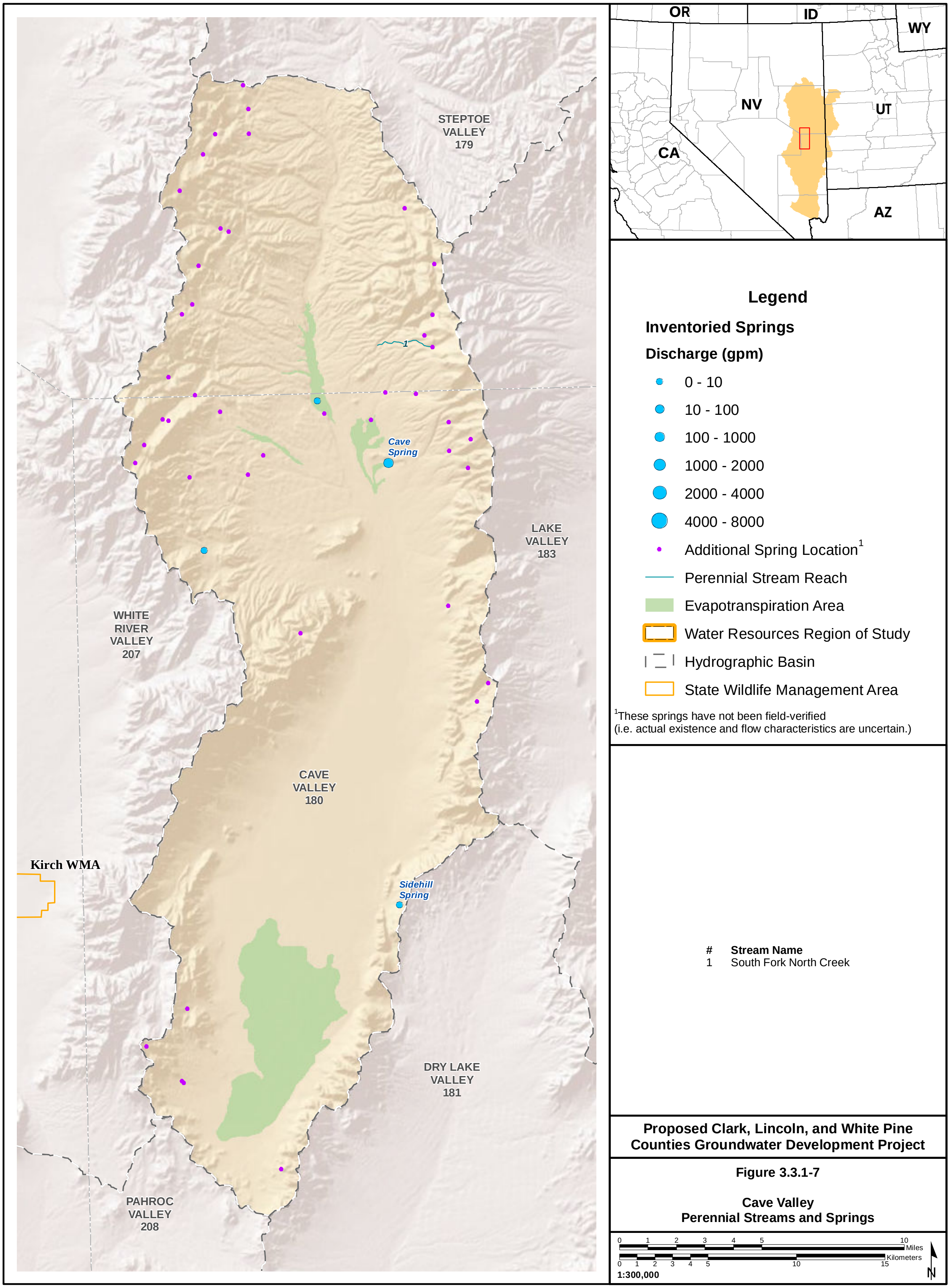
Figure 3.3.1-7 shows the perennial water resources in Cave Valley. This valley is a comparatively small basin, with a topographically closed, surface-drainage system. This system is defined by the southern Egan Range on the west and the southern Schell Creek Range on the east and is bounded in the south where these two ranges merge. The wash varies down-valley from ephemeral to intermittent because of runoff from tributaries such as Haggerty Wash and Big Springs Wash. Ditches, small embankments, and several small stock ponds are located along Cave Valley Wash. Cave Valley Wash dissipates southward into the valley floor sediments. No discharge measurements are known to exist for these streams.

<u>Springs</u>

Springs that were identified within the Cave Valley hydrographic basin are shown in **Figure 3.3.1-7**. Four inventoried springs (**Table F3.3.1-1A** located in **Appendix F3.3.1**) and 44 other springs were identified in the basin.

The two inventoried springs (Cave and Sidehill springs) investigated by SNWA personnel (SNWA 2008) are described below. Most of the other mapped springs occur in higher elevation areas in the northern part of the valley.

Discharge and temperature data for Cave and Sidehill springs are presented in **Table 3.3.1-9**. Cave Spring is located on the eastern side of the valley and discharges from Cambrian Pole Canyon limestone. The spring discharge flows into a small creek incised 3 to 4 feet into the alluvium. Discharge at Cave Spring was measured three times during separate field sessions in June, July, and September of 2004 (SNWA 2008). Spring discharge was observed to decrease during the summer months and the spring was observed to be dry in September. This variable discharge and the cold temperature of the water suggest that this spring is fed solely by local precipitation (SNWA 2008).



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-7

Cave Valley Perennial Streams and Springs

Table 3.3.1-9 Springs with Discharge Measurements in Cave Valley

Spring Name	UTM Easting[1] (m)	UTM Northing[1] (m)	Elevation[2] (feet amsl)	Mean Discharge, (gpm) (Number of Measurements)	Mean Discharge (cfs) (Number of Measurements)	Temperature Range (°C) (Number of Measurements)
Cave Spring	691,760	4,279,249	6,488	211 (11)	0.47 (11)	11.6 - 13 (5)
Sidehill Spring	692,407	4,254,280	6,527	1.84 (2)	0.003 (2)	15 - 17 (2)

[1] Coordinates are in UTM Zone 11 and North American Datum of 1983.
[2] Elevations are in North American Vertical Datum of 1988.
Source: SNWA 2008.

Sidehill Spring is located on the east side of Cave Valley and discharges from volcanic tuffs. Two reliable discharge measurements are available; they indicate an average flow of 0.006 cfs, or 1.8 gpm (SNWA 2008). The area around the spring has reportedly been disturbed by heavy equipment and other surface disturbances are present (SNWA 2008). The spring discharge is conveyed to a large livestock tank on the valley floor.

Dry Lake Valley

Figure 3.3.1-8 shows perennial water resources in Dry Lake Valley. Dry Lake Valley is bounded on the west by the North Pahroc Range and on the east by several smaller or more-localized low-elevation ranges, including the Fly Springs and Burnt Springs ranges. Dry Lake merges to the south with Delamar Valley and forms a single structural trough (Eakin 1963). Coyote Wash is the main south-trending channel in the basin. It is ephemeral and forms the axis of the valley floor. Coyote Wash has a large number of smaller, ephemeral tributaries that drain dissected fan piedmonts on either side of the valley. There are no perennial streams in Dry Lake Valley and no discharge measurements are known to exist.

Springs

Springs identified within the Dry Lake Valley hydrographic basin are shown in **Figure 3.3.1-8**. Seventeen inventoried springs and 95 other springs were identified in the basin. The location, name, average flow, and data source for the inventoried springs are listed in **Table F3.3.1-1A** in **Appendix F3.3.1**. A majority of these springs are at higher elevations.

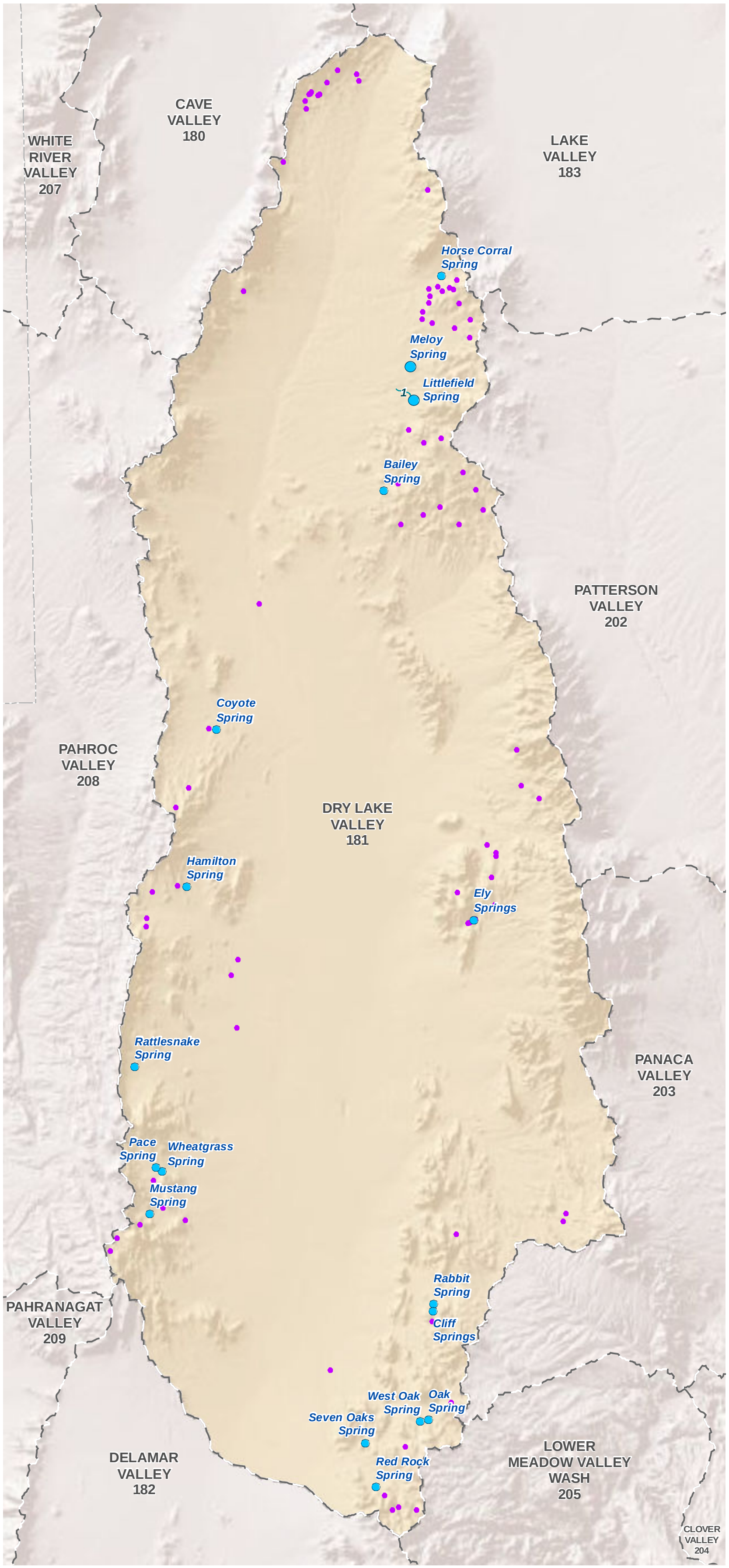
Meloy, Bailey, Littlefield, and Coyote springs were investigated by the SNWA as summarized in **Table 3.3.1-10** and described in the following paragraphs.

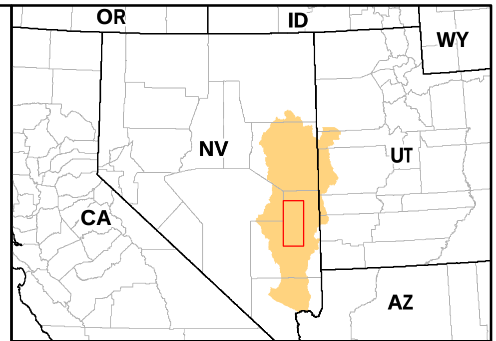
Table 3.3.1-10 Springs with Discharge Measurements in Dry Lake Valley

Spring Name	UTM Easting[1] (m)	UTM Northing[1] (m)	Elevation[2] (feet amsl)	Mean Discharge (gpm) (Number of Measurements)	Mean Discharge (cfs) (Number of Measurements)	Temperature Range (°C) (Number of Measurements)
Meloy Spring	700,888	4,236,201	6,174	49.0 (3)	0.11 (3)	19.3 (1)
Bailey Spring	699,080	4,227,795	6,086	1.80 (3)	0.004 (3)	13.0 (1)
Littlefield Spring	701,112	4,233,949	6,146	27.1 (3)	0.06 (3)	15 - 17.9 (2)
Coyote Spring	687,693	4,211,513	5,220	1.32 (5)	0.003 (5)	18.0 (2)

[1] Coordinates are in UTM Zone 11 and North American Datum of 1983.
[2] Elevations are in North American Vertical Datum of 1988.
Source: SNWA 2008.

Meloy Spring discharges from the base of small scarp in Tertiary volcanic rocks. During a 2004 field visit, the spring was inaccessible because of wild rose bushes, so no measurement was taken. In May 1980, the spring's discharge was measured at 82 gpm. In 1997, the discharge was estimated at 0.1 cfs (45 gpm) (SNWA 2008). Livestock and wildlife currently use the spring.





Legend

Inventoried Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Additional Spring Location[1]
- Perennial Stream Reach
- Water Resources Region of Study
- Hydrographic Basin

[1]These springs have not been field-verified (i.e. actual existence and flow characteristics are uncertain.)

#	Stream Name
1	Littlefield Spring (Unnamed Creek)

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-8

Dry Lake Valley Perennial Streams and Springs

0 1 2 3 4 5 10 Miles
0 1 2 3 4 5 10 15 Kilometers
1:450,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Bailey Spring is located near a small abandoned homestead and the spring area has been excavated. The spring discharges from Tertiary volcanic rocks along a small fault. At the time of a field visit in June 2004, wildlife was the only observable water user (SNWA 2008). The three available discharge measurements were obtained in 1912, 1980, and 2004.

Littlefield Spring discharges from the alluvium near an outcrop of volcanic rock. The mean of three discharge measurements is 27.1 gpm; this value is skewed by an anomalously high discharge of 59.7 gpm measured on July 25, 2005 (SNWA 2008).

Coyote Spring discharges from the base of a scarp in volcanic rocks. Discharge measurements date to 1912 and the average measured flow is 1.33 gpm. Modifications, including a large concrete livestock tank, have been made to the spring, but the spring currently is not in use (SNWA 2008).

Delamar Valley

Figure 3.3.1-9 presents perennial water resources in Delamar Valley. This valley is a topographically-closed basin, bounded on the east by the Delamar Mountains and on the west by the Pahroc Range. The unnamed ephemeral wash that forms the valley axis generally ranges in width from 600 to 1,200 feet. The wash might be inundated during and shortly after severe storms. Knoll Pond Reservoir is a small ephemeral water body within the northern part of the exploratory area in the center of the valley. At the southern end of the valley, Delamar Lake and the associated wash along the valley floor form a much-larger playa area subject to shallow flooding during and shortly after severe storms. The playa elevation is about 4,538 feet. Several ephemeral washes, including Cottonwood Wash, Monkey Wrench Wash, Delamar Wash, Jumbo Wash, and Big Lime Wash, drain westward from the mountains into the basin. All of these distribute runoff across alluvial fans. There are no perennial streams in Delamar Valley and no discharge measurements are known to exist.

Springs

Springs that were identified within the Delamar Valley hydrographic basin are shown in **Figure 3.3.1-9**. One spring (Grassy Spring) was investigated and documented by SNWA (**Table 3.3.1-11**); 2 springs were identified in the USGS National Water Information System and DRI databases, and the remaining 28 springs were identified from additional location only datasets and topographic maps. The majority of the springs occur at higher elevations on the eastern side of the valley.

Table 3.3.1-11 Springs with Discharge Measurements in Delamar Valley

Spring Name	UTM Easting[1] (m)	UTM Northing[1] (m)	Elevation[2] (feet amsl)	Mean Discharge (gpm) (Number of Measurements)	Mean Discharge (cfs) (Number of Measurements)	Temperature Range (°C) (Number of Measurements)
Grassy Spring	695,124	4,157,193	5,786	4.62 (4)	0.26 (4)	11–21.2 (3)

[1] Coordinates are in UTM Zone 11 and North American Datum of 1983.

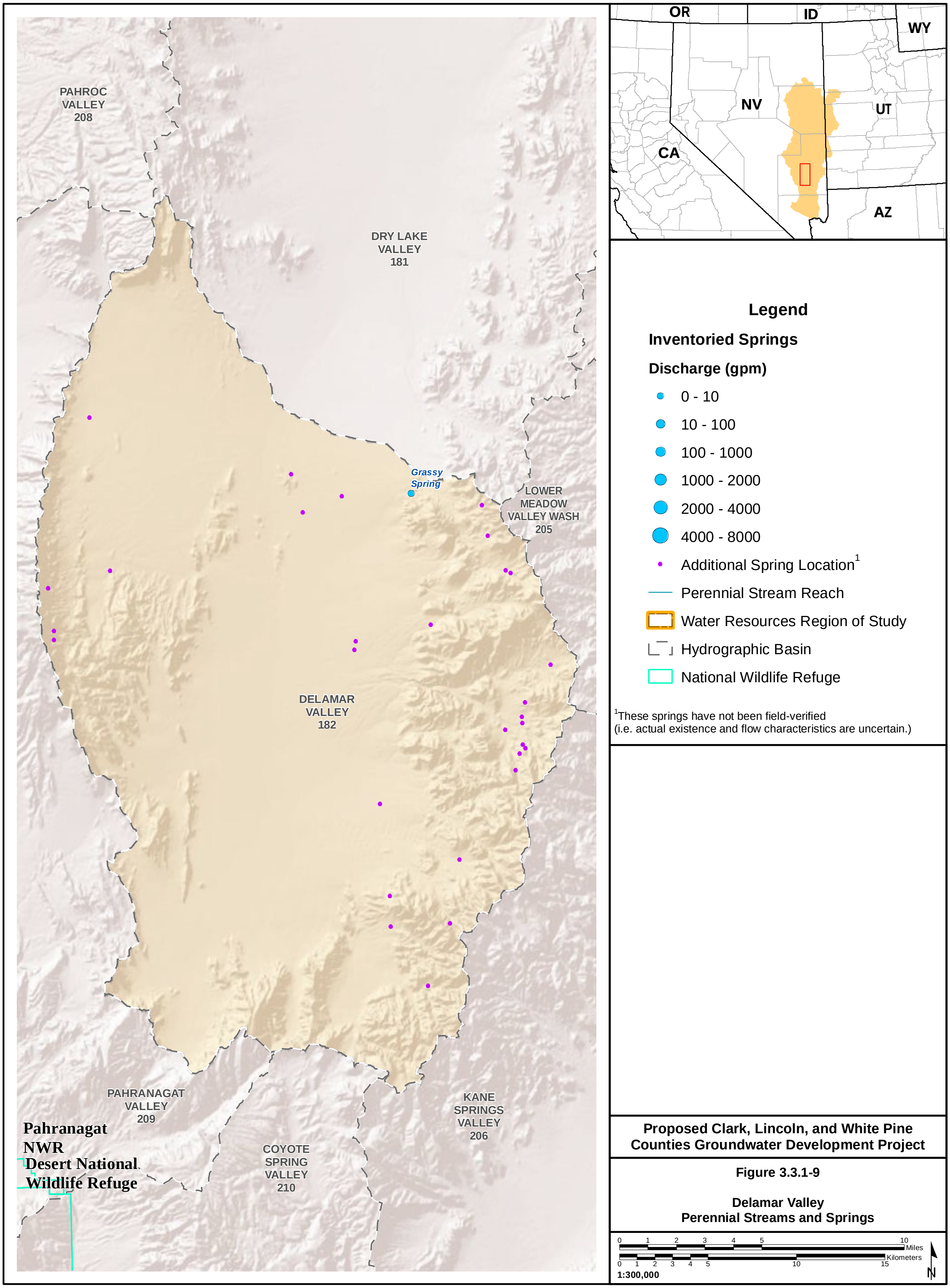
[2] Elevations are in North American Vertical Datum of 1988.

Source: SNWA 2008.

Information on Grassy Spring documented by the SNWA (2008) is summarized in **Table 3.3.1-11**. Grassy Spring is located along the western flank of the Delamar Mountains and supplies water to livestock. The spring discharges from alluvial sediments, near contact between the sediments and volcanic rocks (SNWA 2008). The mean discharge of four measurements is 4.62 gpm and the lowest flow recorded was 0.5 gpm on June 2, 2004.

3.3.1.5 Groundwater Resources

This section includes a description of the hydrogeologic conditions, groundwater elevations, and water balance components for the region of study. Baseline information for the groundwater resources and hydrogeologic conditions in the region of study is derived in part from the project baseline characterization report (SNWA 2008). Other



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

important information that was used to define these baseline conditions includes the recently completed the USGS BARCAS report (Welch et al. 2007) and various other USGS reports completed as part of the Regional Aquifer System Analysis Program for the Great Basin Region (including Harrill et al. 1988; Harrill and Prudic 1998; Plume and Carlton 1988; Prudic et al. 1995; Thomas and Dettinger 1996; Plume 1996).

Hydrogeologic Conditions

Lithologic refers to the composition of rock formations.

Recharge, storage, movement, and discharge of groundwater are dependent in part on the regional geologic conditions and the topography. The general stratigraphic and structural framework of the region of study is described in Section 3.2, Geologic Resources. As described in that section, the geology across the region of study is both stratigraphically and structurally complex. To characterize the groundwater conditions in the area, the geologic formations are grouped into 12 hydrogeologic units (HGUs) (SNWA 2008). The HGUs were developed by grouping geologic map units with similar lithologic properties and inferred ability to transmit water. The HGUs range from Precambrian to Holocene in age. The general distribution of these units is presented in the generalized hydrogeologic map (**Figure 3.3.1-10**), and their physical characteristics are summarized in **Table 3.3.1-12**. Major structural features in the region are illustrated on **Figure 3.3.1-11**; generalized cross-sections at representative locations are presented in **Appendix F3.3.3**.

The 12 HGUs include two distinct types of materials: fractured rock (carbonate, siliceous, intrusive, volcanic, and metamorphic), and unconsolidated to poorly-consolidated sediments (alluvial and basin-fill deposits). In the bedrock units, recharge, storage, flow, and discharge of groundwater primarily are controlled by the secondary features (fractures, faults, and solution cavities) that have enhanced the porosity and permeability of the rock. In the unconsolidated to poorly-consolidated sediments, the groundwater is stored and transmitted through interconnected pores within the sediments.

Regional Aquifer Systems

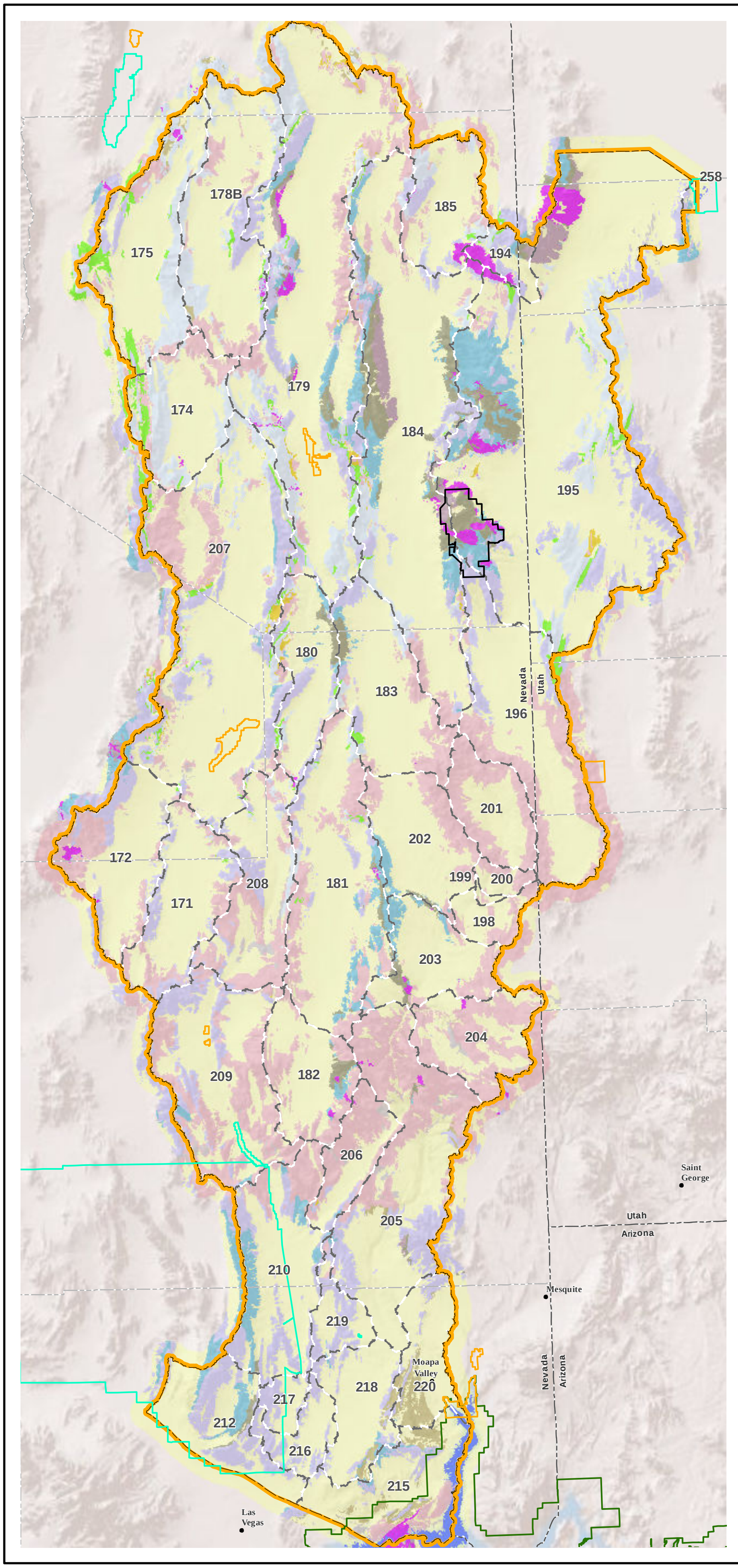
Aquitards are geologic strata (i.e., beds) that act as impediments to flow between aquifers.

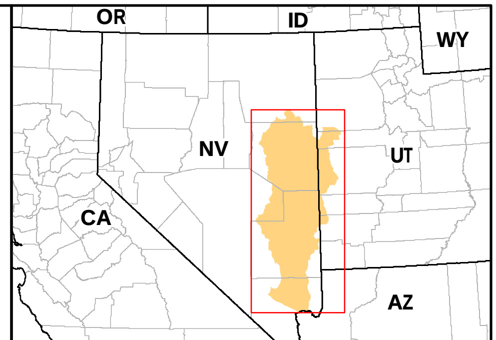
Two principal aquifer systems—the carbonate-rock aquifer system and basin-fill aquifer system—occur in the region of study. The volcanic rock unit might be an important aquifer in particular areas, depending on actual rock types and fracture characteristics. The volcanic rocks also might be regional conduits for flow, where they have sufficient permeability and are in contact with the carbonate or basin-fill aquifer systems. The other rocks are believed to act as impediments (i.e., aquitards) to flow. These aquitards divide the carbonate rocks into an upper and lower flow system and serve as boundaries to flow.

Carbonate-Rock Aquifer System

Clastic pertains to rock or sediment that is composed primarily of broken fragments that have been transported some distance from their origin.

The carbonate-rock aquifer system is regionally extensive and underlies the eastern two-thirds of the Great Basin (Plume 1996). This system is an important conduit for recharge and interbasin groundwater flow (Welch et al. 2007). The carbonate-rock aquifer system consists of lower and upper carbonate-rock aquifers that are stratigraphically separated by low-permeability, fine-grained clastic rocks that restrict vertical flow between the two aquifers (Plume and Carlton 1988; Winograd and Thordarson 1975; Welch et al. 2007). The lower carbonate-rock aquifer consists of the Cambrian carbonate rocks and Mississippian to Ordovician carbonate rock HGUs (SNWA 2008). The lower carbonate-rock aquifer generally is present over most of the region of study, except within caldera complexes or areas underlain by igneous plutons. The Mississippian Siliciclastic Unit includes abundant, shaley, predominantly fine-grained rocks (including the Chainman Shale) with low permeability; these rocks act as a confining bed for vertical flow between the lower and upper carbonate-rock aquifer. The upper carbonate-rock aquifer is composed of a sequence of Pennsylvanian to Permian age carbonate rocks with minor clastic rocks. Both the Mississippian Siliciclastic Unit and upper carbonate-rock aquifer occur over broad areas in the northern and central regions of the region of study. However, these units have been removed by erosion and generally are not present in the southern portion of the region of study (i.e., south of Pahroc Valley).





Legend

Hydro-Geologic Formations

- QTs, Quaternary-Tertiary sediments
- QTb, Quaternary and Tertiary basalts
- Tv, Tertiary volcanic rocks
- Tos, Tertiary older sediments
- TJi, Tertiary-Jurassic intrusive rocks
- KTRs, Cretaceous-Triassic clastic rocks
- PPPc, Permian-Pennsylvanian carbonate rocks
- Ms, Mississippian clastic rocks
- MOc, Mississippian-Ordovician carbonate rocks
- Cc, Cambrian carbonate rocks
- CpCs, Cambrian-Precambrian clastic rocks
- pCm, Precambrian metamorphic rocks
- Open Water
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-10

Hydro-Geologic Formations

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N

Table 3.3.1-12 HGUs in the Study Area

HGU	Map Symbol	Geologic Map Units[1] (Geologic Age)	Equivalent HGU in BARCAS (Welch et al. 2007)	General Occurrence and Range of Thickness	Major Lithologic Characteristics	Generalized Aquifer Characteristics
Quaternary and Tertiary Sediments	QTs	Ts2, Ts3, Ts4, QTa	Fine-grained Younger Sedimentary HGU; Coarse-grained Younger Sedimentary HGU; Older Sedimentary HGU	Occurs below the valley bottoms in the hydrographic basins. Average thickness in basins ranges from 1,000 to 13,000 feet.	Predominantly basin-fill deposits (QTa) consisting gravel, sand, silt, and clay; unconsolidated near surface and becomes moderately consolidated at depth. Locally tuffaceous and contains minor limestone. Unit also includes Tertiary sedimentary rocks (Ts2, Ts3, and Ts4) that underlie basin-fill sediments that consist of sandstone, conglomerate, and minor limestone and tuff beds.	Basin-fill sediments are considered significant aquifers in hydrographic basins; unit includes beds of less permeable finer-grained sediment and volcanic ash that act as local confining beds within the sequence. Older consolidated rocks (Ts2, Ts3, and Ts4) have significantly lower permeabilities than the overlying basin-fill sediments.
Quaternary and Tertiary Basalt	QTb	QTb	Volcanic Flow Unit	Localized, typically less than 200 feet thick.	Basalt flows; generally thin and localized.	Basalt flows typically contain closely spaced joints and breccia zones that are highly permeable; however, because of limited thickness and distribution in the region of study, this unit is not a significant regional aquifer.
Tertiary Volcanic Rocks	Tv	Tmb, Ta1, Ta2, Ta3, Ta4, Tr1, Tr2, Tr3, Tr4, Tt1, Tt2, Tt3 and Tt4	Volcanic Flow Unit; Volcanic Tuff Unit	Outside caldera complexes the unit typically ranges from 1,000 to 4,000; within the calderas the unit generally is greater than 10,000 thick.	Volcanic rock units that include poorly to densely welded ash flow tuffs with interbedded air fall tuffs; rhyolite, andesite, and dacitic lava flows, with flow breccias and mudflow breccias, and megabreccia associated with caldera development.	Volcanic rocks generally are moderately permeable; depending upon jointing and fracture characteristics, the rocks may be significant aquifers.
Older Tertiary Sediments	Tos	Ts1	Older Sedimentary HGU	Localized occurrence; thickness ranges from 600 to 3,000 feet.	Mostly nonresistant sandstone, mudstone, conglomerate and minor lacustrine limestone that locally underlies Tv.	Overall permeability probably similar to the consolidated rocks included in the QTs unit. Not a significant regional aquifer due to limited lateral extent and porosity and permeability.

Table 3.3.1-12 HGUs in the Study Area (Continued)

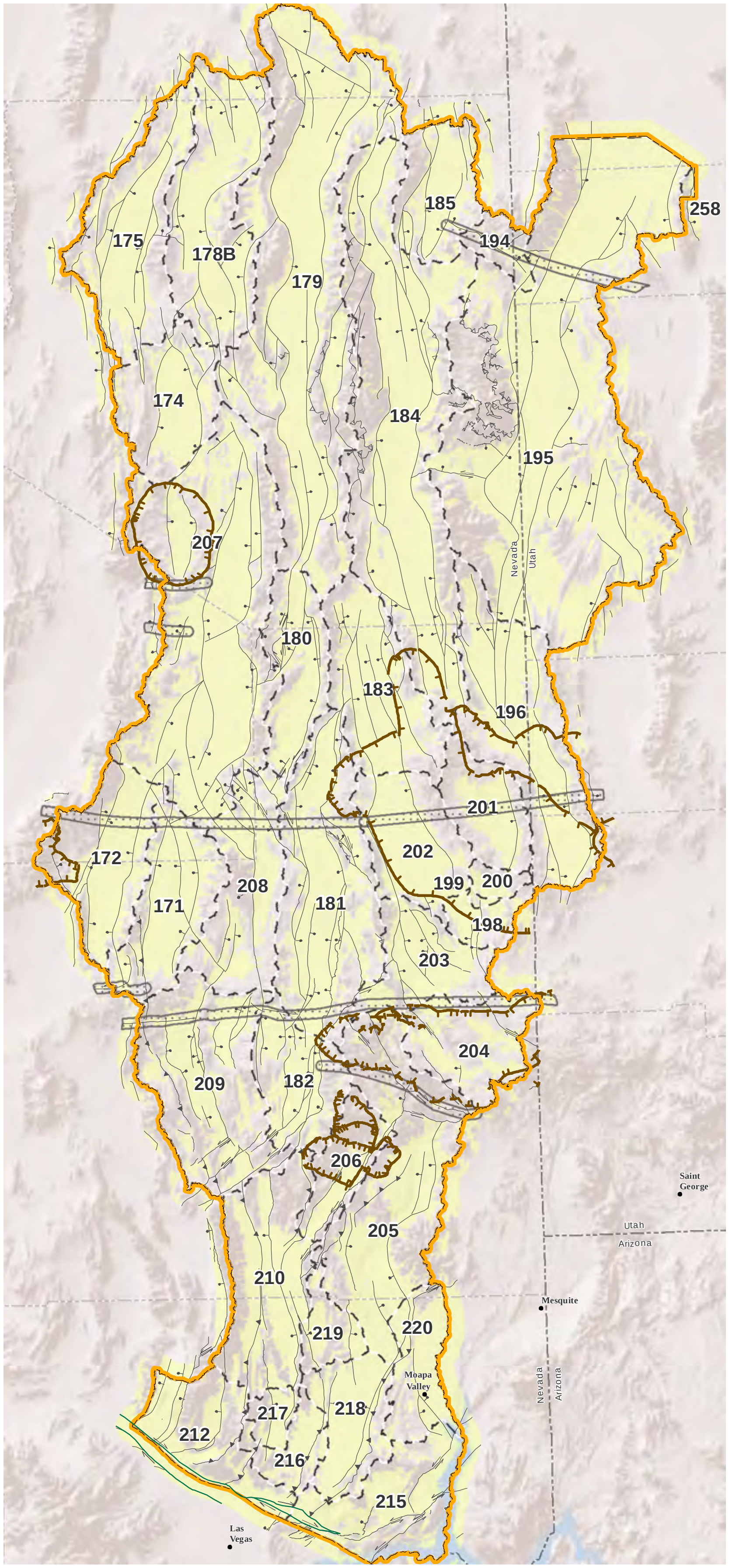
HGU	Map Symbol	Geologic Map Units[1] (Geologic Age)	Equivalent HGU in BARCAS (Welch et al. 2007)	General Occurrence and Range of Thickness	Major Lithologic Characteristics	Generalized Aquifer Characteristics
Tertiary to Jurassic Intrusive Rocks	TJi	Ji, Ki, TKi, Ti	Intrusive Unit	Occurs as large plutons that form a significant portion of the Snake, Schell Creek, Egan and Kern ranges, and beneath caldera complexes.	Predominantly quartz monzonite, granodiorite, and diabase composition.	Plutonic rocks typically act as impediments to groundwater flow. Relatively small quantities of water move through these rocks where sufficiently fractured or weathered.
Cretaceous to Triassic Siliciclastic Rocks	KTrs	Trs, Js, Ks	Mesozoic Sedimentary HGU	Occurs in the southeast portion of the region of study and in a few isolated areas in other portions of the region of study. Average thickness ranges from less than 1,000 to ~10,000 feet.	Includes a broad range of rock types from massive to soft variegated mudstones and siltstone and gypsiferous beds ("red beds"). Also includes siltstone, limestone, claystone, shale, and conglomerate.	The aquifer characteristics depend on the actual rock types present in specific areas. For example, thick sandstone beds likely have moderate permeability, particularly where fractured and are potential aquifers. Fine-grained rocks such as the shales, soft mudstones, and siltstones are potential aquitards. However, the unit has restricted occurrence and only locally affects groundwater flow patterns.
Permian and Pennsylvanian Carbonate Rocks	PPc	P, PP, Pr, Pa, Par, Pp, Pz	Upper Carbonate HGU	Occurs over broad regions in the central and northern portion of the region of study. Ranges from less than 1,000 to 9,000 feet thick.	Mostly carbonate rocks with minor clastic rocks.	Major regional aquifer. Movement and storage of groundwater primarily controlled by networks of fractures or solution openings (or vuggy zones along fractures). Unit contains zones of high transmissivity that can be controlled by structural deformation, solution openings, or karstic features. Unit potentially important as a conduit for interbasin groundwater flow.
Mississippian Siliciclastic Rocks	Ms	Mc, Md, MDd	Upper Siliciclastic HGU	Occurs over broad regions in the central and northern portion of the region of study. Ranges from 1,000 to 3,000 feet thick.	Predominantly fine-grained clastic rocks (i.e., shale).	Regional aquitard that impedes flow between the lower and upper Paleozoic carbonate rock units.

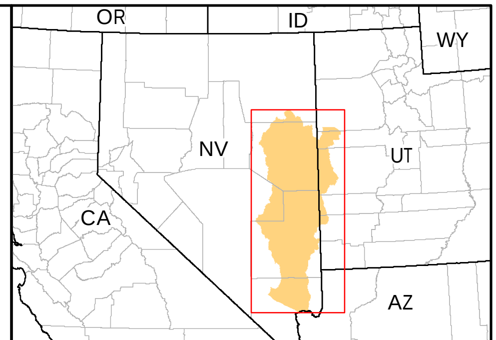
Table 3.3.1-12 HGUs in the Study Area (Continued)

HGU	Map Symbol	Geologic Map Units[1] (Geologic Age)	Equivalent HGU in BARCAS (Welch et al. 2007)	General Occurrence and Range of Thickness	Major Lithologic Characteristics	Generalized Aquifer Characteristics
Mississippian to Ordovician Carbonate Rocks	MOc	Ol, SOu, So, Ds, Dg, Dn, Dd, Du, DO, DS, MD	Lower Carbonate HGU	Occurs over broad regions throughout most of the region of study. Ranges from 1,000 to 12,000 feet thick.	Predominantly carbonate rock with interbedded clastic rocks (i.e., shale, quartzite).	Major regional aquifer. Similar characteristics to PPc; movement and storage of groundwater primarily controlled by networks of fractures, solution openings (particularly vuggy zones or solution cavities formed along fracture zones). Unit contains zones of high transmissivity typically controlled by structural deformation, solution openings, or karstic features. Unit potentially important as a conduit for interbasin groundwater flow.
Cambrian Carbonate Rocks	Cc	Cm, Cc	Lower Carbonate HGU	Occurs over broad regions throughout most of the region of study. Ranges from 2,000 to 6,000 feet thick.	Predominantly carbonate with limited clastic rocks.	Major regional aquifer with similar properties to the MOc unit.
Cambrian to Precambrian Siliciclastic Rocks	CpCs	CpCs	Lower Siliciclastic HGU	Occurs over broad regions throughout most of the region of study. Ranges from 4,000 to 9,000 feet thick.	Nonmetamorphosed to moderately metamorphosed siliciclastic rocks (predominantly shale and quartzite).	Regional aquitard with low permeability. Where it occurs at shallow depths, rocks are commonly highly fractured and can transmit relatively small flows.
Precambrian Metamorphic Rocks	PCm	PC	Lower Siliciclastic HGU	Basement rocks throughout region; exposed in the core of several mountain ranges.	Crystalline metamorphic rocks including metamorphosed quartzite, slate, and argillite.	Regional aquitard with very low permeability.

[1]See Section 3.2, Geologic Resources, and SNWA (2008) for description of geologic map units.

Source: SNWA (2008); Welch et al. (2007); additional references for aquifer properties provided in text.





Legend

- Caldera Boundary
- Fault
- Las Vegas Shear Zone
- Transverse Zone
- Quaternary-Tertiary Sediments
- Water Resources Region of Study
- Hydrographic Basin

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
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181	Dry Lake Valley	209	Pahranagat Valley
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183	Lake Valley	212	Las Vegas Valley
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195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-11

Structural Features

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
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N

Where both the upper and lower carbonate units are present, extensive normal faulting throughout the region has juxtaposed these units such that they are commonly in fault contact and probably are hydraulically connected in most areas (Plume and Carlton 1988). In addition, the carbonate-rock aquifer system is locally bounded by relatively impermeable, intrusive rocks, truncated by major faults zones that juxtapose the carbonate sequence against low-permeability rocks that potentially compartmentalize the aquifer into different flow systems (Winograd and Thordarson 1975).

Groundwater in the carbonate rocks primarily is stored and transmitted within a network of fractures that may have been solution-widened to varying degrees. Solution channels typically develop by the dissolution of carbonate minerals along secondary openings (such as fractures and faults) in the rock mass. As a result, solution channels are appreciably wider than the original secondary opening. Solution channel widths can range from inches to tens of feet (Plume 1996).

Analyses of 10 aquifer-pumping tests in the Cambrian to Devonian age carbonate sequence at the Nevada Test Site, northwest of Las Vegas and outside of the region of study, indicate a hydraulic conductivity that ranges from 0.7 to 700 feet per day (Winograd and Thordarson 1975), with a mean value of 80 feet per day and median values of 6 feet per day. Estimates from four wells in Pennsylvanian and Permian limestone, drilled and tested as part of the MX missile-siting program, indicate hydraulic conductivity ranging from 0.1 feet per day to 900 feet per day, with a mean of 200 feet per day and a median of 9 feet per day (Bunch and Harrill 1984). Higher values are assumed to reflect fault or fracture zones with solution widening; lower values are assumed to reflect relatively unfractured rock.

The combined thickness of the carbonate-rock aquifer system typically is greater than 20,000 feet. There is uncertainty regarding the depth of the groundwater flow within the carbonate-rock aquifer system. Significant secondary permeability does not extend over the entire stratigraphic thickness (Plume 1996). The base of the groundwater system is either the underlying siliclastic rocks or impermeable carbonate rocks presumed to occur at great depth (Plume 1996).

Basin-Fill Aquifer System

The basin-fill aquifer system is the most important and most developed aquifer in the region (Welch et al. 2007). Each HA within the region of study is characterized by a structural basin, filled by thousands of feet of clastic sediments eroded from adjacent mountain ranges. These clastic sediments include older and younger basin-fill deposits. The older deposits consist of Tertiary age, consolidated deposits of conglomerate, sandstone, siltstone, claystone, freshwater limestone, and evaporite, with local interbeds of volcaniclastic rocks. The older basin-fill deposits are overlain by younger Pliocene to Holocene aged alluvium, colluvial, and lacustrine sediments that are predominantly uncemented and unconsolidated near the surface and are more indurated with increasing depth. These deposits include coarser-grained material (predominantly sandy gravel with interbedded gravelly sand and sand) and fine grained playa and lake deposits (Welch et al. 2007). In general, the younger basin-fill deposits are coarser near the valley margins and become progressively finer towards the central axis of the valley. However, valleys drained by perennial streams typically have associated channel and floodplain deposits that include coarse-grained materials. In summary, younger basin-fill deposits are inherently heterogeneous, characterized by complexly interfingered coarse- and fine-grained materials.

Lacustrine pertains to or is produced by a lake.

Colluvial material consists of alluvium and angular fragments of rocks that typically are found at the bottom or on lower slopes of hills.

The thickness of the basin-fill deposits ranges from zero at the valley margin to several thousands of feet along the axis of the valley. In some valleys in the region of study, the thickness of the basin-fill locally exceeds 10,000 feet (SNWA 2008). In some valleys, the basin-fill sediments are entirely enclosed by low-permeable bedrock. In other valleys, the basin fill extends laterally into one or more adjacent basins and is part of a multibasin flow system. Even where the basin-fill sediments are not laterally continuous between basins, they may be connected hydraulically by flow through permeable rocks.

The permeability and hydraulic conductivities of the basin-fill deposits are highly variable and reflect the heterogeneous characteristics of the unit. The hydraulic properties of the material in a specific area depend on the lithology of the material, degree of sorting, and amount of interfingering and interbedding of coarse- and fine-grained sediments (Plume 1996). Aquifer tests in basin-fill sediments were conducted for the MX missile-siting investigation in valleys in central and eastern Nevada and western Utah. Those tests indicate that the hydraulic conductivity (for 18 tests) from 14 basins ranges from 0.02 to 140 feet per day and averaged 78 feet per day (Bunch and Harrill 1984).

Permeability is the ability of a material, such as rocks, to allow the passage of a liquid, such as water.

Volcanic Rock Aquifer

Volcanic rocks have a wide range of physical and hydraulic properties and can behave as either aquifers or flow barriers (Plume 1996). Despite the fact that volcanic rocks are widely distributed throughout the Great Basin, volcanic rocks have been identified as aquifers in relatively few areas (Plume 1996). Prudic et al. (1995) noted that fractured, basalt, and welded tuffs can yield significant quantities of water to wells, over large areas. At the Nevada Test Site, measured hydraulic-conductivity values for volcanic rocks (lava flows and ash flow tuffs) range from approximately 1.5 to 17 feet per day (Winograd and Thordarson 1975). Plume (1996) reported that 54 drill-stem tests in volcanic rocks in the Railroad and White River valleys in eastern Nevada produced hydraulic-conductivity values that range from less than 0.001 to 0.3 feet per day, with a mean value of 0.02 feet per day.

Conductivity is the capacity of a rock or sedimentary deposit to transmit water (see the Glossary for additional description).

Potential Lithologic Barriers to Regional Groundwater Flow

Rocks with low permeability characteristics tend to confine, restrict, or impede groundwater flow in the regional aquifer systems. Although many of these rocks can yield or transmit small volumes of water if sufficiently fractured, in a regional framework, these rocks are not considered regional aquifers. Depending on their stratigraphic position and structural juxtaposition, these rocks have the potential to restrict both vertical and horizontal flow paths. Identifying the spatial distribution of these low-permeability rocks is important to understanding potential barriers to flow between basins or boundaries that segregate flow systems within the carbonate-rock aquifer system (Prudic et al. 1995).

From oldest to youngest, the following HGUs are considered as potential barriers to regional flow: 1) Precambrian metamorphic rocks and Cambrian to Precambrian siliciclastic rocks (also collectively referred to as the Lower Siliciclastic Unit); 2) Mississippian siliciclastic rocks (also referred to as the Upper Siliciclastic Unit); 3) Cretaceous to Triassic siliciclastic rocks (also referred to as the Mesozoic Sedimentary Unit); and 4) Tertiary to Jurassic intrusive rocks (also referred to as the Intrusive Unit) (Welch et al. 2007).

The two lowermost units—the Precambrian Metamorphic HGU and Cambrian to Precambrian Siliciclastic HGU—are believed to have very low permeability characteristics throughout the eastern Great Basin (Winograd and Thordarson 1975; Plume 1996). Regionally, the top of this unit represents the base of the groundwater flow system (Welch et al. 2007).

The Mississippian Siliciclastic HGU consists predominantly of shaley, fine-grained, low-permeability rocks. The water-bearing properties of this unit are not well known, but it is assumed to behave as a local barrier to flow between the upper and lower carbonate-rock aquifers. A steeply dipping north-south oriented section of this unit acts as a barrier to eastward flow between southern Snake Valley and Pine, Wah Wah, and Tule valleys (Gardner et al. 2011).

The Cretaceous to Triassic Siliciclastic HGU occurs in local, isolated areas in the north and central portions of the region of study and along the margin of the Colorado Plateau in the southeastern portion of the region of study. This unit includes diverse lithologies, and its water-bearing properties are unknown (Plume and Carlton 1988). Because these rocks have only localized occurrences and are relatively thin, they are not considered to behave as important conduits for groundwater flow (Welch et al. 2007). However, in the southeastern portion of the region of study, these units are relatively thick and are likely to include lithologic zones with moderate permeability.

The Tertiary to Jurassic Intrusive HGU occurs as large plutons that form a large portion of the Snake, Schell Creek, Egan, and Kern ranges (SNWA 2008). Large intrusive bodies also are inferred to exist beneath ash flow tuff sequences within the White River, Indian Peaks, Central Nevada, and Caliente Caldera complexes. These intrusives primarily are composed of granodiorite and quartz monzonite. No aquifer tests have been performed on the intrusive rocks within the region of study. However, intrusive rocks generally have very low permeability and impede the movement of groundwater (Plume 1996). Belcher et al. (2001) report horizontal hydraulic conductivities from 0.002 feet per day to 3.3 feet per day for Jurassic- to Oligocene-age granodiorite, quartz monzonite, granite, and tonalite in Southern Nevada and parts of California. In some areas, plutons intrude the carbonate-rock aquifers and act as potential vertical barriers to groundwater flow.

Hydrostructural Conditions

In summary, the region of study is located within a region that has experienced various episodes of structural deformation, including compressional, extensional, and translational tectonics. As a result, the structural geology of the region of study is complex. Major fault or structural zones identified or mapped within the region of study include detachment faults, thrust faults, strike-slip faults, normal faults, and east-west lineaments, and caldera margins (SNWA 2008). The distribution of major fault zones and other structural discontinuities (i.e., lineaments) in the region of study are shown in **Figure 3.3.1-11**.

Slip refers to a planar feature where movement along a fault has occurred and resulted in the displacement of formerly adjacent points on either side of the fault.

Groundwater flow pathways may be influenced by major faults that offset and displace rock units and older alluvial deposits. A recent study completed by the USGS "Conceptual Model of the Great Basin Carbonate and Alluvial Aquifer System" (Heilweil and Brooks 2011; Sweetkind et al. 2011) describes how fault displacement disrupts HGUs and can affect groundwater flow in the Great Basin carbonate and alluvial aquifer system (GBCAAS):

Gouge is pulverized, clay-like material found along some faults; formed by the grinding of rock material during fault movement.

> "Given the complex geologic history of the GBCAAS study area, HGUs often are disrupted by large-magnitude offset thrust, strike-slip, and normal faults. These geologic structures disrupt bedrock continuity (figs. C–2 and C–3) and result in a complex distribution of rocks that affect the direction and rate of interbasin groundwater flow by altering flow paths. The juxtaposition of thick, low-permeability siliciclastic-rock strata against higher permeability carbonate-rock aquifers, caused by faulting, commonly forms barriers to groundwater flow and greatly influences the shape of the potentiometric surface (Winograd and Thordarson, 1975; McKee and others, 1998; Thomas and others, 1986)."

Breccia is rock made up of angular fragments of other rocks, held together by mineral cement or a fine-grained matrix. Fault breccia is made by breaking and grinding rocks along a fault.

Conversely, where fault movement results in the juxtaposition of HGUs with similar permeabilities, the juxtaposition of these materials would not behave as an impediment to cross-fault groundwater flow unless the fault zone had a lower permeability than the unfaulted material on either side of the fault zone.

Fault zones typically are lithologically heterogeneous (i.e., nonuniform) and structurally anisotropic (i.e., variable in different directions) (Caine et al. 1996). Depending on the physical properties of the rocks involved, the amount and type of structural deformation, and the alteration and mineralization history, fault zones may behave as barriers, conduits, or combined conduit/barrier systems that enhance or restrict groundwater flow (Caine et al. 1996). In addition, the hydraulic properties of the materials within individual fault zones can vary spatially along the fault zone.

For the purposes of discussion, fault zones can be subdivided into two zones: the principal fault zone and the damaged zone. Both zones can have distinct physical properties that control the storage and movement of groundwater. The principal fault zone is defined as the zone in which most of the displacement has occurred and can consist of a wide range of materials, including a single slip or multiple slip surfaces, unconsolidated clay-rich gouge, breccia zones, chemically altered zones, or mylonite zones. The generation of fine-grained materials and alteration and mineral precipitation tends to reduce the porosity and permeability of the primary fault zone, compared to the adjacent unfaulted bedrock materials (Caine et al. 1996). The principal fault zone can be bounded on one or both sides by a damaged zone, defined as a zone of fractured or highly fractured rock that is associated with the fault zone and that has not experienced large displacement. By definition, rocks within the damaged zone are more highly fractured than the bedrock outside of the fault zone. The fracture network within the damaged zone tends to have a higher or enhanced permeability, compared to both the principal fault zone and the less-fractured regional bedrock material outside of the fault zone (Caine et al. 1996). In this way, major regional fault zones have the potential to behave as both conduits and barriers to groundwater flow (Sweetkind et al. 2011).

Mylonite is a brecciated, metamorphic rock frequently found in a fault zone; formed by the crushing actions of fault movement.

Monitoring associated with dewatering activities related to open pit and underground mining activities in the Carlin Trend in north central Nevada have demonstrated that major basin- and range-type faults zones can restrict the propagation or spread of drawdown resulting from the groundwater pumping. One example is the effects of dewatering at the Barrick Goldstrike Mine located in the Carlin Trend. Dewatering required for mining at the Goldstrike Mine was initiated in 1990 and continued through 2011. Dewatering occurs in permeable carbonate rock that host the ore deposit. Dewatering rates peaked at approximately 70, 000 gpm in 1998 and gradually declined to approximately 15,000 gpm at the end of 2011. Dewatering activities at the mine have resulted in lowering the groundwater levels approximately 1,700 feet within the carbonate aquifer. Monitoring results indicate that the drawdown area resulting from groundwater pumping is an elongate northwest-trending zone that is approximately 2.5 miles wide and 8 miles long and is bounded by major fault zones. Long-term monitoring results indicate that major fault zones bounding the northeast and southwest boundaries of the carbonate block behave as barriers to groundwater flow between aquifers that have restricted the spread of aquifer drawdown (Zhan et al. 2011). The influence of these structures on the groundwater flow system generally is characterized by a noticeable change in gradient and water levels on either side of the faults. These hydrostructural features are described in BLM (2000) and in Zhan et al. (2011).

The major hydrostructural features that occur in the region, and their potential influence on groundwater flow patterns, are briefly summarized in the following paragraphs. In the region of study, the basin and range topography is defined by an extensive system of normal faults, which separate the basin and mountains ranges. The systems of north- to northwest-trending fault zones bound the mountain blocks and typically display vertical displacements of several thousand feet (or greater). These faults commonly juxtapose permeable basin-fill sediments against older consolidated rock as well as permeable rocks against low-permeability rocks. Fault displacement of aquifer units against materials with low permeabilities can result in fault compartmentalization of aquifers (Winograd and Thordarson 1975). However, as stated previously, where fault movement results in the juxtaposition of HGUs with similar permeabilities the juxtaposition of these materials would not behave as an impediment to cross-fault groundwater flow unless the fault zone had a lower permeability than the unfaulted material on either side of the fault zone. Where they are not cemented, the highly fractured rocks (or damaged zone) associated with these faults can behave as conduits for groundwater flow (Prudic et al. 1995; Sweetkind et al. 2011). Flow also can be restricted across these fault zones where they contain fault gouge or other fine-grained materials, alteration products, or mineral precipitation products. Overall, hydrologic significance of major normal fault structures in the region is presumed to be variable and dependant on both the relative permeability of the materials juxtaposed by the fault movement, and the hydraulic properties of the fault zone. It is likely that in some locations, major regional normal faults may impede groundwater flow across the fault, whereas in other locations, the fault may not restrict groundwater flow across the fault (Sweetkind et al. 2011).

Large-offset extensional detachment faults occur locally in some mountain ranges within the region of study. These fault zones are gently to moderately dipping and typically separate lower metamorphic rocks from overlying unmetamorphosed rocks. Seismic reflection data and interpretive cross-section suggest detachment fault dip beneath Snake Valley and the Confusion Range in the Snake Valley hydrographic basin (Welch et al. 2007). The hydrologic significance of these detachment faults on groundwater flow is generally unknown. Four east-west oriented transverse lineaments have been identified in the region of study (SNWA 2008). These lineaments generally are several tens of miles to hundreds of miles long and up to several miles wide and are oriented at nearly right angles to the basin and range normal faults. These lineaments are marked by alignment of such features as topographic breaks or terminations of mountain ranges, stratigraphic discontinuities, positioning of large volcanic fields and caldera boundaries, and in some instances, emplacement of large igneous intrusions. The influence of these large structural features on regional groundwater flow patterns is not well understood. Prudic et al. (1995) infer that these lineaments may behave as leaky barriers to groundwater flow or could act as barriers where they disrupt or truncate carbonate-rock aquifers.

Several shear zones, defined by either left-lateral or right-lateral movement, occur in the region of study (SNWA 2008). The identified shear zones primarily are restricted to the southern half of the region of study. The most notable shear zones are the Pahranagat shear zone and the Las Vegas shear zone. The Pahranagat shear zone consists of a series of roughly parallel left lateral faults that trend east-northeast in the southern portion of Pahranagat Valley, Delamar Valley, East Pahranagat Range, Hiko Range, and the southern Delamar Mountains and adjacent areas, as mapped by Ekren et al. (1976). Eakin (1966) inferred that the relatively large hydraulic gradient between Pahranagat Valley and Coyote Valley was likely the result of the Pahranagat shear zone acting as an impediment to flow. The Las Vegas shear zone is a west-northwest trending right-lateral shear zone that defines the southern boundary of the region of study in the Las Vegas Valley. Winograd and Thordarson (1975) inferred that a steep gradient between adjacent wells in Las Vegas Valley is evidence that the shear zone is a barrier to groundwater flow.

Several major thrust faults have been mapped in the southern part of the region of study but occur in only few isolated areas in the northern and central parts of the region of study (SNWA 2008). The SNWA (2008) suggest that gouge and mylonite zones associated with these thrust faults act as impediments to flow, most notably in the Sheep and Pahranagat ranges, Delamar Mountains, and several other ranges in the southern portion of the region of study. Prudic et al. (1995) suggest that because they could not correlate the locations of major thrust faults with changes to simulated water levels and transmissivities during regional modeling, these structures may only minimally influence regional groundwater flow patterns.

More detailed descriptions of these and other structural features in the region and their potential influence on groundwater flow paths are provided in Heilweil and Brooks 2011.

Potential for Interbasin Groundwater Flow

Interbasin flow of groundwater depends both on the geologic conditions between basins and groundwater gradients. SNWA (2008) and Welch et al. (2007) identified locations in which the known or inferred geologic conditions between the hydrographic basins could allow for significant movement of groundwater, without respect to groundwater gradient. Groundwater flow could occur wherever the consolidated rocks under the valleys and in the mountains that separate the valleys are permeable and interconnected and wherever the basins are connected by unconsolidated sediments (basin-fill). Groundwater flow between hydrographic basins is considered to be unlikely in areas where the hydrographic basins are separated by relatively impermeable bedrock. For additional information and discussion of potential locations for interbasin flow, see SNWA 2008, Welch et al. 2007, and Heilweil and Brooks 2011.

Groundwater Elevations, Gradients, and Potential Flow Directions

The following summary of groundwater elevations is based on the information in the report "Water Level Data Compilation and Evaluation for the Clark, Lincoln, and White Pine Counties Groundwater Development Project" (SNWA 2008). This report presents the results of a comprehensive compilation and evaluation of water-level data for the project basins and other hydrographic basins included within the region of study.

As described in this baseline report, water-level measurements were compiled from 1,976 wells and springs in the region of study, derived from published and unpublished reports and agency databases. The data evaluation included determining the effective open interval and the HGU for each well completion, calculating water-level elevations from depth-to-water data, and identifying outlier and non-steady state water-level measurements. The resulting data set was used to construct water-level contour maps for the basin-fill aquifer for each hydrographic basin. Additional maps that show areas of shallow groundwater also were developed for basins where there is significant groundwater discharge from ET. A water-level contour map also was constructed for the carbonate-rock aquifer system for the entire region of study (**Figure 3.3.1-12**).

Details regarding the data reduction and analysis methodologies and a complete set of water-level contour maps for all basins were provided in the report. The following section provides an overview of the water-level data for the five basins proposed for groundwater development under the Proposed Action and alternatives.

Additional information for the portion of the Great Salt Lake Desert Groundwater Flow System included within the study area is based on the recently completed regional potentiometric map prepared by Gardner et al. (2011).

Spring Valley

Basin-fill Aquifer

A water-level elevation map for the basin-fill aquifer in Spring Valley is presented in **Figure 3.3.1-13**. Water-level elevations for wells completed in the basin-fill aquifer range from 6,862 feet amsl (in the northern portion of the valley) to 5,537 feet amsl (in the central portion of valley). The water levels are higher in the north and south ends of the valley and lower in the center of the valley, indicating that the general direction of groundwater flow within the basin-fill material is toward the central portion of the valley. The hydraulic gradient is approximately 25 to 30 feet per mile in the northern part of the valley and approximately 5 feet per mile in the southern part of the valley (SNWA 2008).

In addition, the water-level data suggest that a groundwater divide in southern Spring Valley separates groundwater that flows toward the central portion of Spring Valley from groundwater that flows towards Hamlin Valley (SNWA 2008; Gardner et al. 2011).

As shown on the depth-to-water map (**Figure 3.3.1-14**), shallow groundwater conditions exist over large portions of the valley floor in Spring Valley. Depths to groundwater ranges from above ground surface (i.e., flowing wells and spring discharge areas) to greater than 400 feet below ground surface near the southern end of the valley. The central portion of the valley contains a number of springs, ponds, and small playa lakes; most of these features are presumably controlled by groundwater discharge.

Carbonate-Rock Aquifer

Water-level elevation data for the carbonate-rock aquifer system in Spring Valley are provided in the SNWA's baseline water resource report (SNWA 2008). The water-level data were derived from water-level measurements at six sites, which include three wells drilled prior to 2006 and three new locations drilled by SNWA in 2006 and 2007 (SNWA 2008). Each of the three SNWA locations includes a test well and a monitoring well.

The average water-level elevations for the carbonate-rock wells range from a high of 6,645 feet amsl located along the east central edge of the valley near Sacramento Pass to 5,706 feet amsl for the southernmost SNWA test well situated at the Hamlin Valley hydrographic basin boundary. The SNWA (2008) noted that the high water elevations in the well near Sacramento Pass might be influenced by the presence of clastic rocks that confine the carbonate-rock aquifer in this area. The water-level data for the wells completed in the carbonate-rock aquifer system suggest there is a potential for groundwater to flow from north to south in the southern half of Spring Valley. The water-level data for the region suggest that there is a potential for groundwater in the carbonate-rock aquifer to flow from the southern half of Spring Valley into Hamlin Valley and then into Snake Valley.

A water-level elevation map of the carbonate-rock aquifer recently was completed as part of the BARCAS study (Wilson 2007). That study suggested that some of the groundwater in the carbonate-rock aquifer in the northern half of the Spring Valley HA flows northward into the Tippett Valley HA; and some water flows east into Snake Valley along the northeast boundary of the HA.

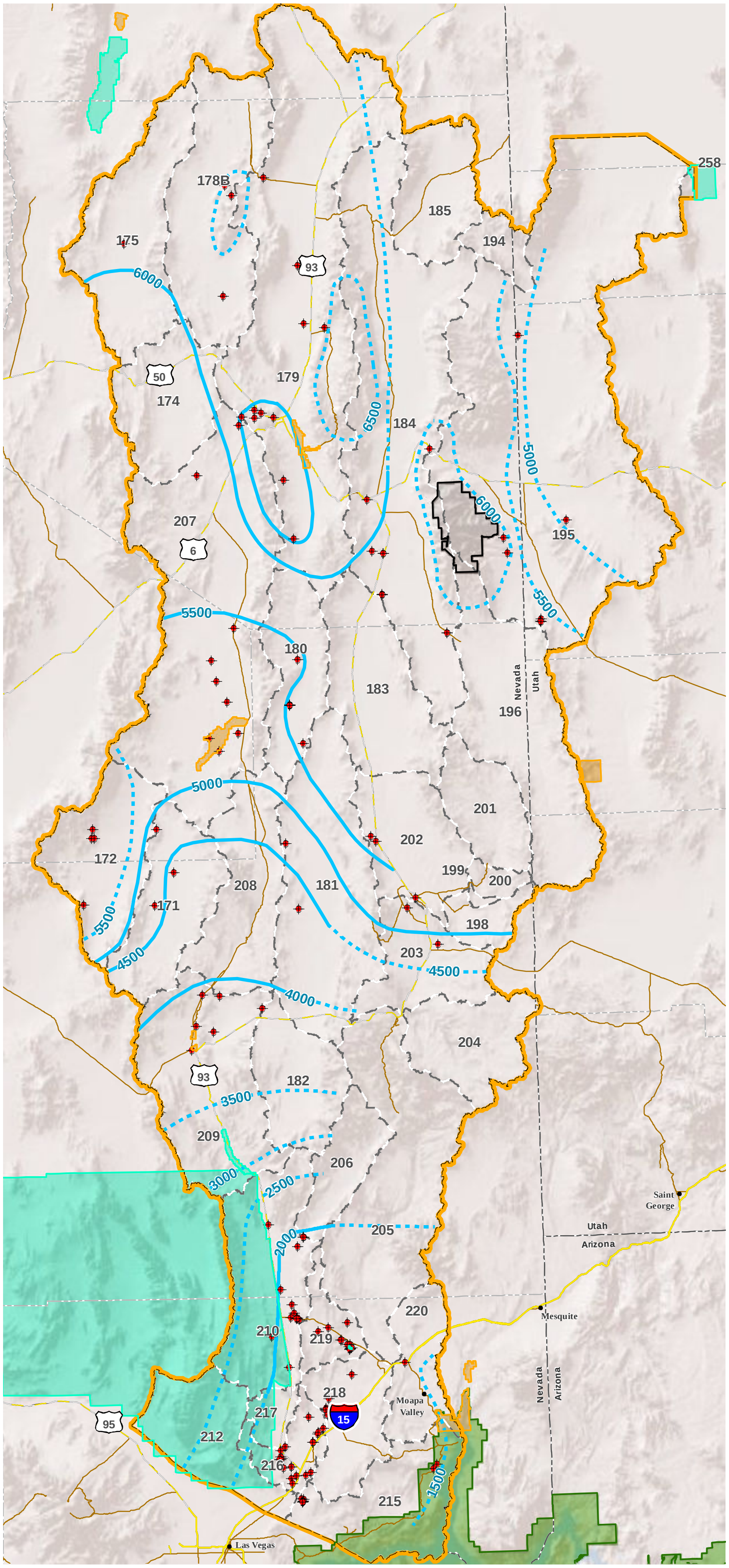
Trends

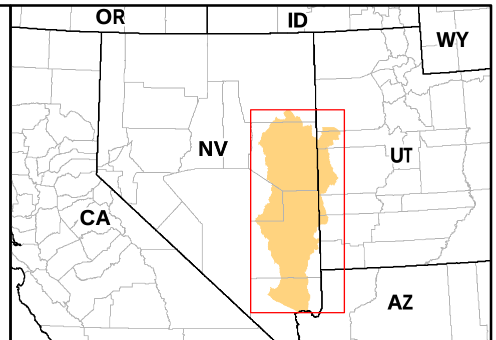
Hydrographs were constructed for wells that had 10 or more depth-to-water measurements (SNWA 2008). All of the wells that met the 10-or-more-measurement criterion are completed in the basin-fill aquifer. Review of the hydrographs indicates that most wells exhibit water-level variations of 1 to 10 feet in the basin-fill aquifer. Several wells display trends lasting several years of decreasing or increasing water levels. A USGS MX well near the center of the valley (N15 E67 26CA1) exhibits the maximum variation and indicates a long-term reduction of water levels of approximately 14.5 feet over the period of record (1981 and 2006). The SNWA (2008) suggests that some wells that show a reduction in water-level elevation occur in or near agricultural areas.

Snake Valley

Basin-fill Aquifer

Data has been compiled for more than 250 wells and springs in Snake Valley (SNWA 2008). **Figure 3.3.1-15** presents the average water levels for specific wells and springs and interpreted water-level elevation contours for the basin-fill aquifer system in Snake Valley. Water-level elevations for wells on the valley floor range from approximately 5,522 feet amsl (along the southern margin of the valley) to 4,324 amsl (in the northernmost portion of the valley). The





Legend

Monitoring Well

Carbonate-Rock Aquifer Water Level

Water-level Contour (ft-amsl)

Inferred Water-level Contour (ft-amsl)

Interstate Highway

US Highway

Major Road

Water Resources Region of Study

Hydrographic Basin

Great Basin National Park

Lake Mead National Recreation Area

National Wildlife Refuge

State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

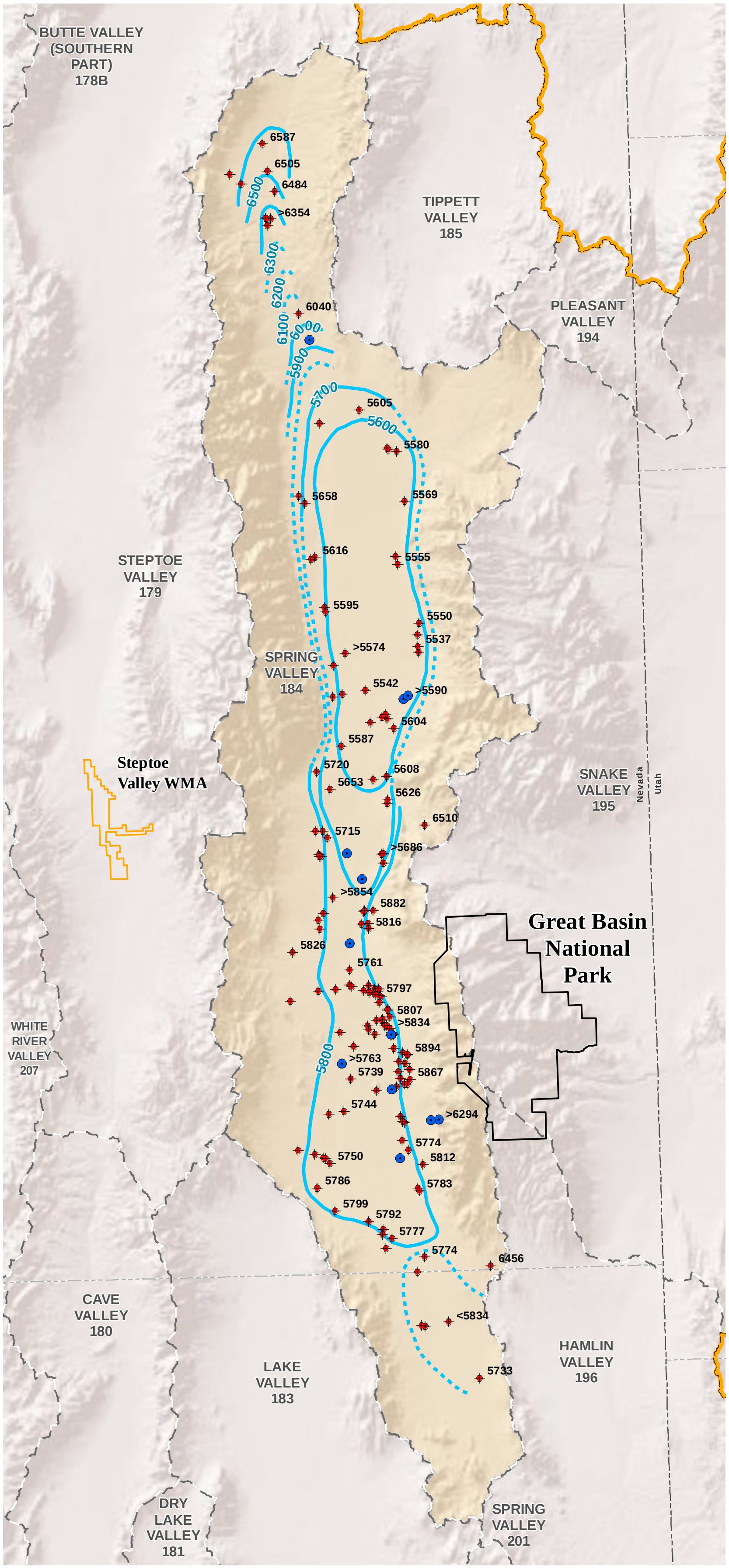
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

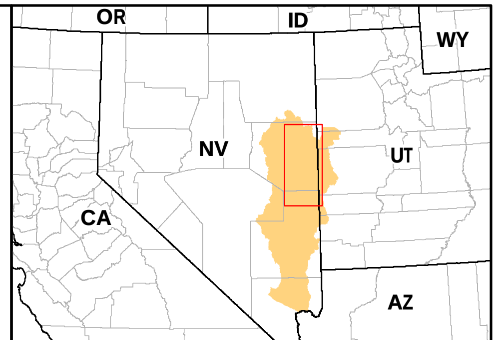
Figure 3.3.1-12

Carbonate-Rock Aquifer System Water-level Map

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N





Legend

Monitoring Points

- Basin Fill Well (Groundwater elevation, ft-amsl)
- Spring (Surface elevation, ft-amsl)
- Water-level Contour (ft-amsl)
- Inferred Water-level Contour (ft-amsl)
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- State Wildlife Management Area

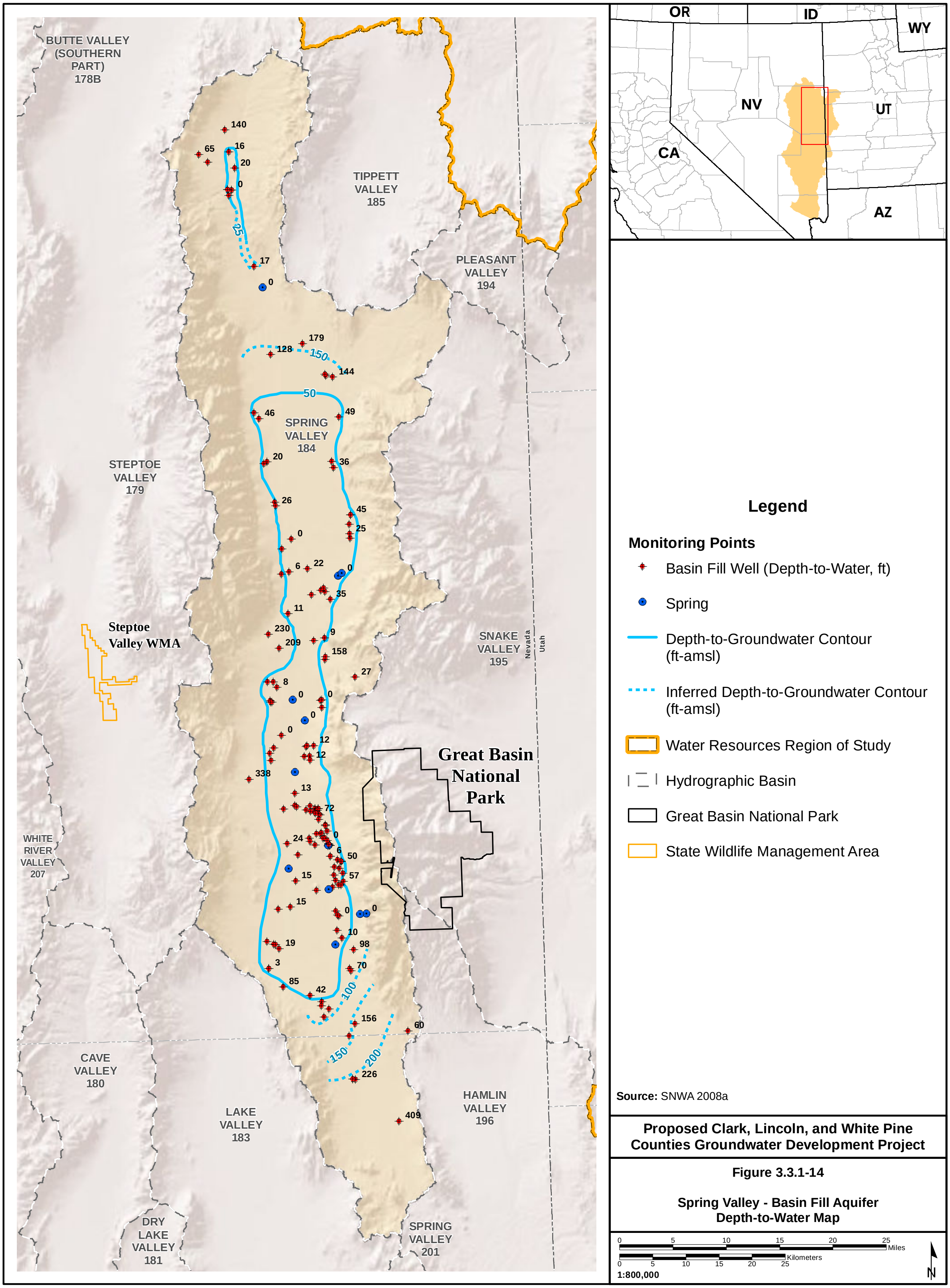
Source: SNWA 2008a

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-13

Spring Valley - Basin Fill Aquifer Water-Level Elevation Map

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

water-level contours indicate that groundwater in the basin-fill sediments generally flows toward the north (towards the Great Salt Lake Desert HA) with a north-to-south hydraulic gradient of approximately 11 feet per mile (SNWA 2008).

The depth to groundwater in Snake Valley ranges from above ground surface to greater than 500 feet below ground surface. As shown in **Figure 3.3.1-16**, the depth to groundwater is less than 50 feet over large areas in the central portion of the valley. The depth to groundwater generally increases toward the margins of the valley and is greatest in the southeast and south margins of the valley.

Carbonate-Rock Aquifer

Water-level elevation data for the carbonate-rock aquifer system in Snake Valley is presented in the SNWA's baseline water resources report (SNWA 2008). This data set identified five wells completed in the carbonate-rock aquifer system; three of these are oil wells along the southern boundary of the HA. The water levels for these monitoring wells range from 6,194 feet amsl to approximately 4,988 feet amsl. The regional water-level data indicate that the gradient for groundwater flow in the carbonate rocks in Snake Valley is generally from southwest to northeast, across the basin.

Water-level elevation contour maps prepared as part of the USGS BARCAS study (Wilson 2007) indicate that in the central portion of the Snake Valley HA, groundwater in the carbonate-rock aquifer system flows from west to east, with a potential for flow beneath the Confusion Range and toward the Tule Valley HA. The BARCAS study also indicates that groundwater in the carbonate rock system in the northern portion of the Snake Valley HA flows toward the northeast (toward the Great Salt Lake Desert HA).

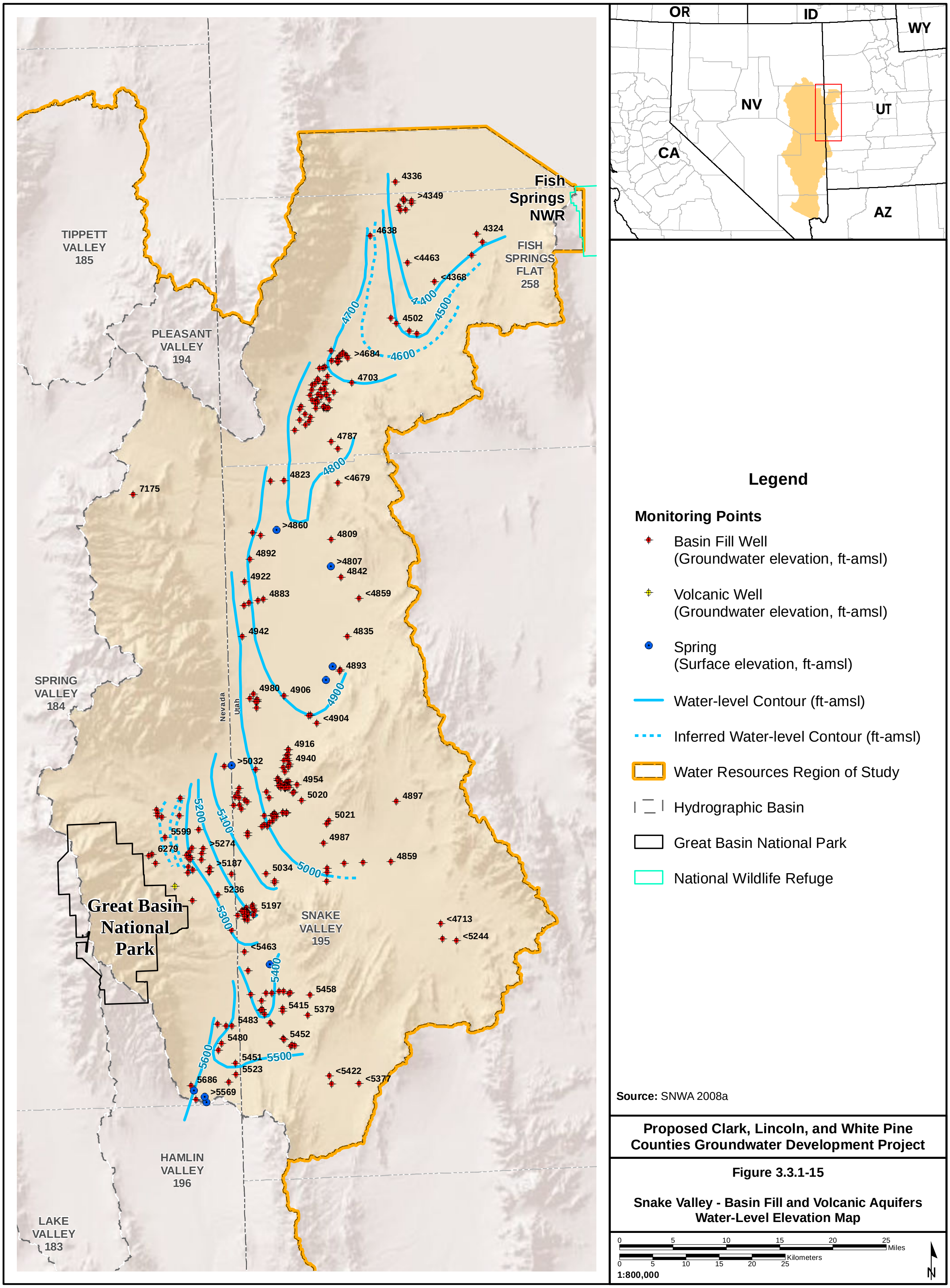
A recent (2011) potentiometric map prepared by the USGS for the Snake Valley and adjacent areas indicates that groundwater gradients and flow paths are controlled by a north-south oriented band of steeply dipping Chainman Shale that occurs along the east margin of Snake Valley (Gardner et al. 2011). The band of low permeability rocks extends for nearly 60 miles from Hamlin Valley on the south to near Highway 50 in Snake Valley on the north. This band of low permeability rocks act as a barrier to groundwater flow in this area between Snake Valley and Pine, Wah Wah, and the southern portion of Tule Valley. This report also indicates that north of this barrier, there is uncertainty regarding the existence of substantial interbasin flow between Snake Valley and Tule Valley (and subsequently, Fish Springs).

Trends

Hydrographs were constructed for wells with 10 or more depth-to-water measurements (SNWA 2008). All of the wells that met this criterion are completed in the basin-fill aquifer. Review of the hydrographs indicates that most wells exhibit variations of 10 feet or less; however, some wells show water-level fluctuations of as much as 50 feet. There is no consistent trend for water levels across the valley. Some wells exhibit relatively consistent water levels over their respective period of record, whereas many wells show increasing or decreasing water-level trends that continue over several years or several decades. Additional description of water-level trends and hydrographs for wells in Snake Valley are provided in the project baseline characterization report (SNWA 2008); and in the appendices to the transient groundwater model report (SNWA 2009b).

The USGS maintains a "groundwater watch" web site (USGS 2010) that provides up-to-date statistics on water-level measurements and trends for active wells monitored in Snake Valley and throughout the nation. Review of the data sets for the central and southern portions of Snake Valley indicate that there is a cluster of wells located in the area around Eskdale, Utah (extending south to Highway 50/6 and west to Gandy Road), where most wells in the network within this area exhibit a trend of declining water levels starting in the late 1980s or early 1990s and continuing to the present (March 2011). The non-artesian wells located in this area have experienced a reduction of water levels over this period ranging from approximately 3 to 10 feet. Two other wells in this area, including the BLM's Shell-Baker Creek Well located just south of Highway 50/6; and the USGS-MX (Snake Valley North) well located west of the Gandy Road in Nevada near the state line also show recent declining water-level trends.

Two artesian wells in this area are included in the groundwater watch monitoring well network—the West Buckskin Well (USGS location number C-20-19 1bcc-1) located about 2 miles south of Eskdale; and Flowing Well #2 (USGS location number C-20-19 8bcb-1) located about 5 miles southwest of Eskdale. Both artesian wells are reported to be completed in the basin-fill aquifer and have only limited head measurement data.

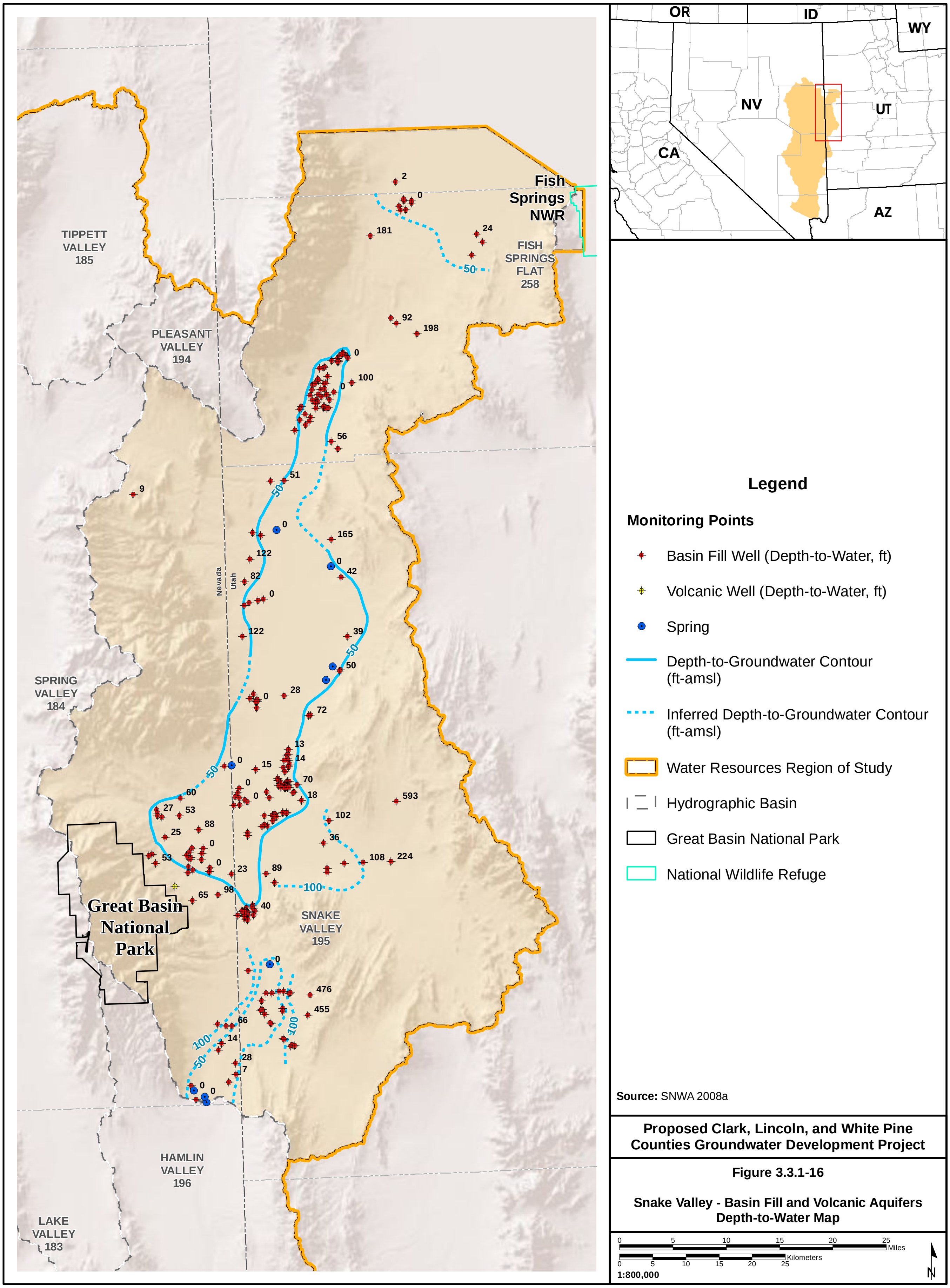


Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-15

Snake Valley - Basin Fill and Volcanic Aquifers Water-Level Elevation Map

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

The head measured at the West Buckskin Well was reported as 12.2 feet above ground surface in 1951. Quarterly monitoring initiated in September 2009 indicated a head of 4.41 feet above ground surface that has continued to decline to 2.44 feet above ground surface as of March 2011. This limited dataset indicates that the head in the West Buckskin Well has declined a total of 9.13 feet since the 1951 measurement.

For Flowing Well #2, 4 measurements have been taken between 1936 and 1948 and 8 measurements taken quarterly between June 2009 and March 2011. The older water-level data suggest that the head was relatively stable over the 1936 to 1948 period with measurements ranging from 7.4 to 8.6 feet above ground surface. All of the recent quarterly measurements indicate that the head in the well has dropped below surface with depth to water measurements fluctuating seasonally between 20.73 to 5.12 feet below ground surface. This limited dataset indicates that the head in Flowing Well #2 has declined a total of 13.12 to 28.73 feet depending on the season compared to the 1948 measurement. The limited water levels recorded during the recent quarterly monitoring are not sufficient to definitely identify any current trends in the well.

The Utah Geological Survey (UGS) has recently established a groundwater monitoring network in Utah's west desert that includes a series of wells installed at 27 sites in Snake Valley HA. The wells were installed between 2007 and 2009 and include: 1) paired wells competed in the carbonate rock and basin-fill aquifers; 2) wells located near agricultural areas; 3) water quality monitoring wells; 4) wells located near springs; and 5) shallow piezometers (less than 10 feet deep) in sensitive wetlands associated with spring discharge areas. Information on these monitoring locations, including water level hydrographs for the wells, is provided at the UGS web site (UGS 2010). Water levels have declined (as much as 7.74 feet since 2001) in the vicinity of Needle Point Springs as previously discussed in the surface water resources section for Snake Valley. The UGS groundwater monitoring network includes continuous water-level monitoring at Needle Point Springs and at a new well located approximately 1 mile south of Needle Point Springs.

Cave Valley

Basin-Fill Aquifer

A water-level elevation map for the basin-fill aquifer in Cave Valley is presented on **Figure 3.3.1-17**. Water-level elevations that were completed in the basin-fill aquifer range from 6,896 feet amsl (near the north end of the valley) to 5,790 feet amsl (in the southern portion of Cave Valley). The water-level data indicate that the general direction of groundwater flow within the basin-fill material is from north to south, with a gradient of approximately 48 feet per mile. The depth to groundwater ranges from near surface in the northern portion of the valley (**Figure 3.3.1-18**) to greater than 200 feet below ground surface in the southern portion of the valley.

Carbonate-Rock Aquifer

Water-level elevations for five wells completed in the carbonate-rock aquifer system in Cave Valley are presented in SNWA's water resource baseline report (SNWA 2008). These limited data suggest that in Cave Valley, a potential exists for groundwater flow from south to north within the carbonate-rock aquifer. However, Cave Valley can be subdivided into a north and south subbasin with distinct structural characteristics that are separated by an oblique-slip fault (SNWA 2008) or normal fault (Welch et al. 2007). This fault and structural discontinuity between the two subbasins could disrupt or partition the groundwater flow system in the carbonate-rock aquifer in Cave Valley (SNWA 2008).

On a regional scale, the water levels in the carbonate wells in the central and southern portion of Cave Valley typically are several hundred feet higher than those in carbonate wells in White River Valley. The difference in water-level elevations between these two adjacent basins suggests the potential for groundwater in the carbonate-rock aquifer system in Cave Valley to flow towards the west or southwest into White River Valley (Harrill et al. 1988; Wilson 2007).

Trends

A well drilled during the MX missile program and completed in the carbonate-rock aquifer system in the south central portion of the region of study has shown a gradual increase in water levels of approximately 10 feet since 1980. There are no other wells with long-term (greater than 10 years) water-level recordings in Cave Valley (SNWA 2008).

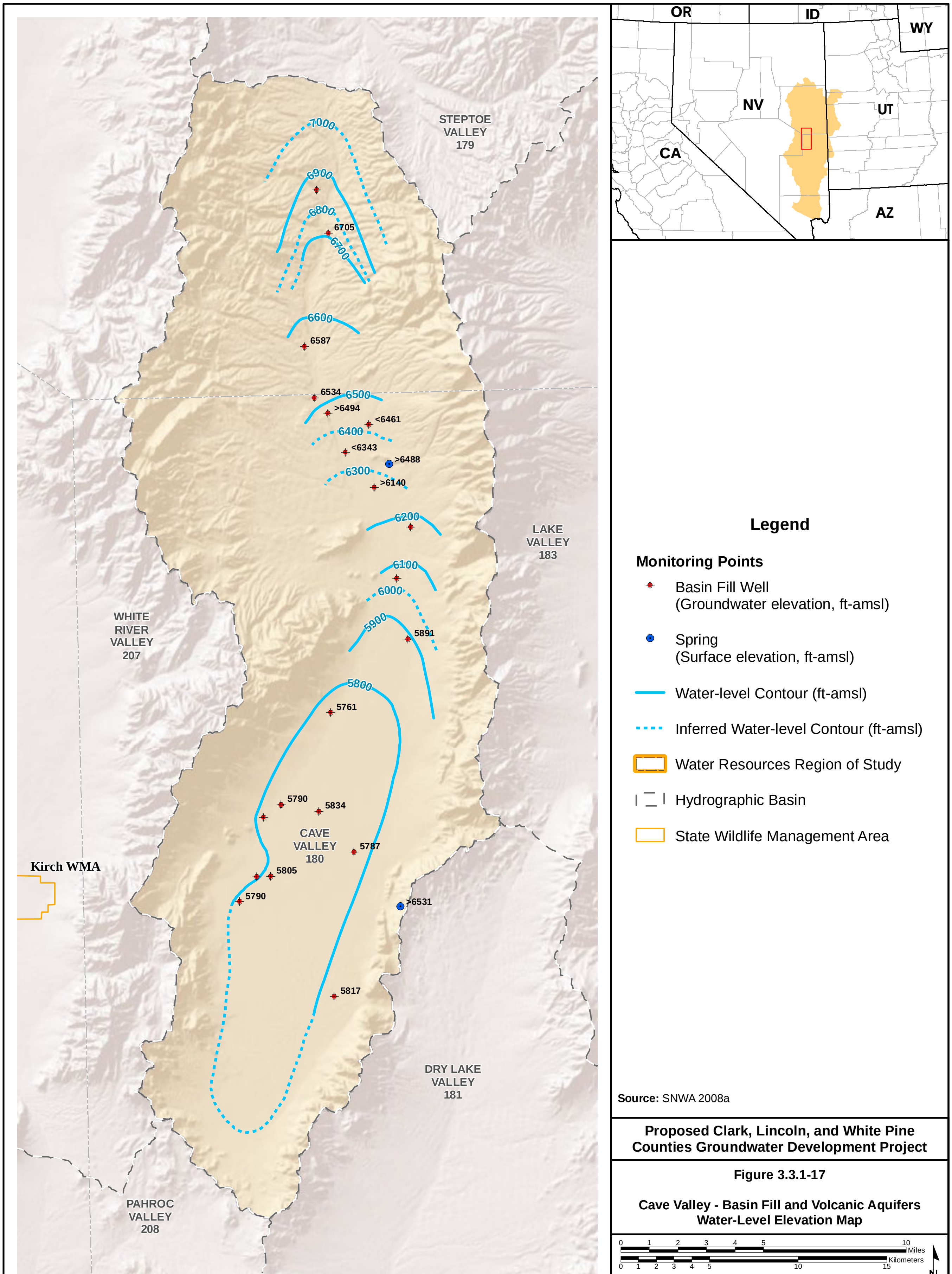


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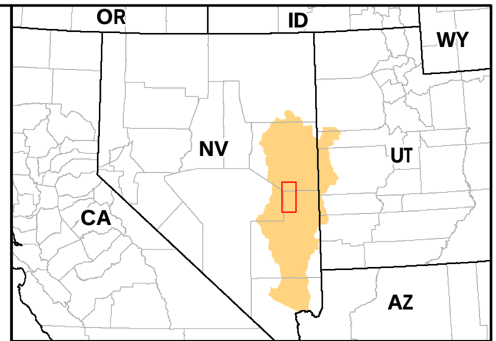
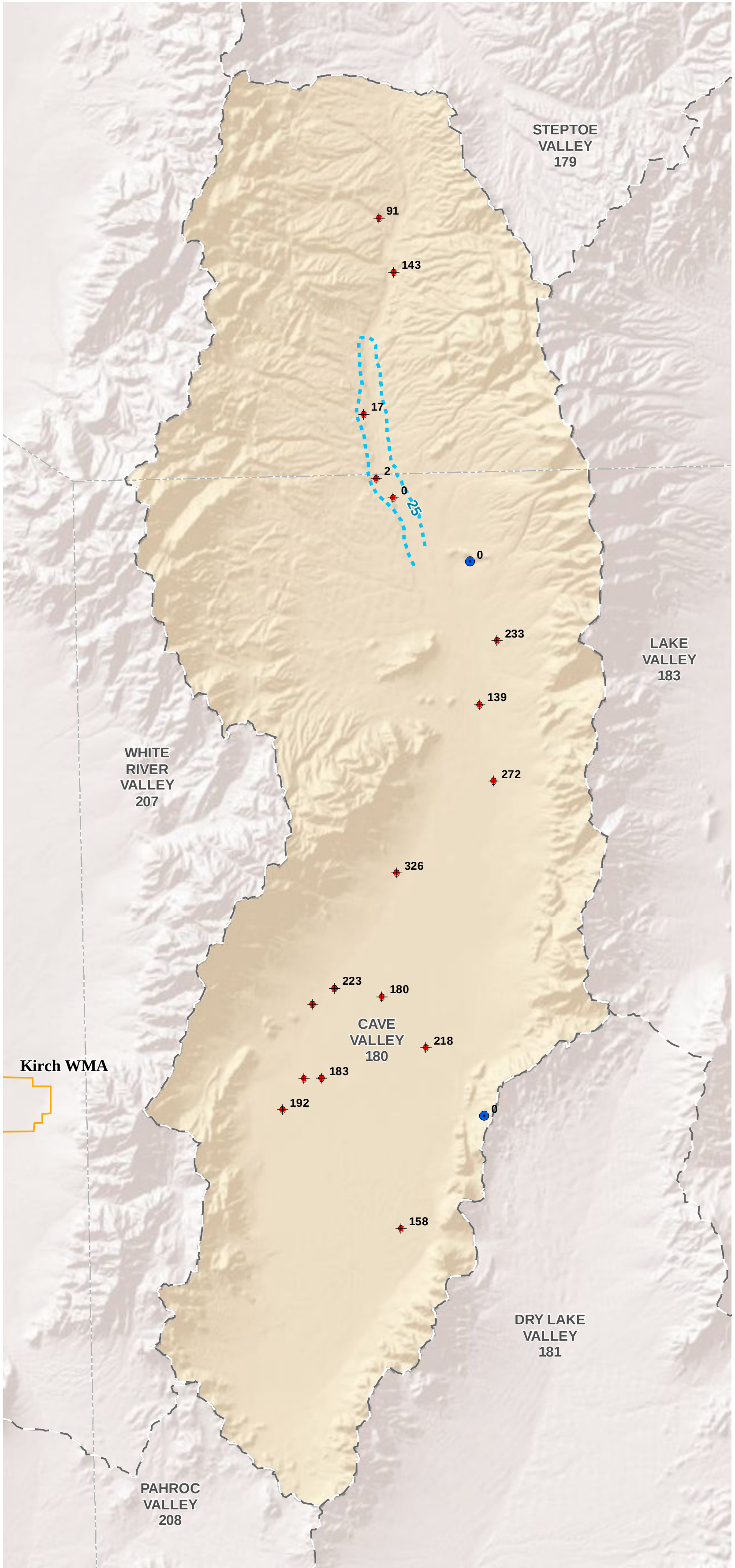
Figure 3.3.1-17

Cave Valley - Basin Fill and Volcanic Aquifers Water-Level Elevation Map

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.





Legend

Monitoring Points

- Basin Fill Well (Depth-to-Water, ft)
- Spring
- Depth-to-Groundwater Contour (ft-amsl)
- Inferred Depth-to-Groundwater Contour (ft-amsl)
- Water Resources Region of Study
- Hydrographic Basin
- State Wildlife Management Area

Source: SNWA 2008a

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-18

Cave Valley - Basin Fill and Volcanic Aquifers Depth-to-Water Map

0 1 2 3 4 5 10 Miles
0 1 2 3 4 5 10 15 Kilometers
1:300,000
N

Dry Lake and Delamar Valleys

Basin-Fill Aquifer

Water-level data for the basin-fill aquifer system in Dry Lake and Delamar valleys is presented on **Figures 3.3.1-19** and **3.3.1-20**, respectively. Water-level data for these two basins is limited. Water-level elevations for wells completed in the upper valley basin-fill sediments range from greater than 5,431 feet amsl (near the north end of Dry Lake Valley) to 3,845 feet amsl (near the center of Delamar Valley). The water-level data indicate that the general direction of groundwater flow within the basin-fill material is from north to south, with a gradient between the central portions of one valley to another of approximately 13 feet per mile. The depth to groundwater ranges from 200 to 500 feet below ground surface in Dry Lake Valley and exceeds 800 feet in Delamar Valley.

Carbonate-Rock Aquifer

Only two wells completed in the carbonate-rock aquifer have been identified in these hydrographic basins (SNWA 2008). Both wells are near the west margin of Dry Lake Valley. The average water levels for the two wells are 4,541 to 4,288 feet and suggest a general north-to-south flow direction in the carbonate-rock aquifer system in this region. These carbonate-rock water levels are more than 1,000 feet lower in elevation than water levels in Cave Valley that adjoin to the north and more than 2,000 feet higher than water levels in wells in Coyote Spring Valley that adjoin to the south. These numbers suggest a potential for groundwater in the carbonate-rock aquifer in southern Delamar Valley to flow toward the south into Coyote Spring Valley.

Trends

Only a few monitoring wells in these basins have been used for long-term water-level recordings. Five wells completed for the MX missile-siting program have reliable water-level data that extend back to the early 1980s. Water-level data for a well completed in the carbonate-rock aquifer system in Dry Lake Valley indicate that there has been a gradual increase in water levels of approximately 5 feet over the past 25 years. Hydrographs for wells completed in the basin-fill sediments also tend to show a gradual water-level increase of as much as several feet over the past 1 to 2 decades (SNWA 2008).

Additional Water Level Data for the Great Salt Lake Desert Regional Groundwater Flow System

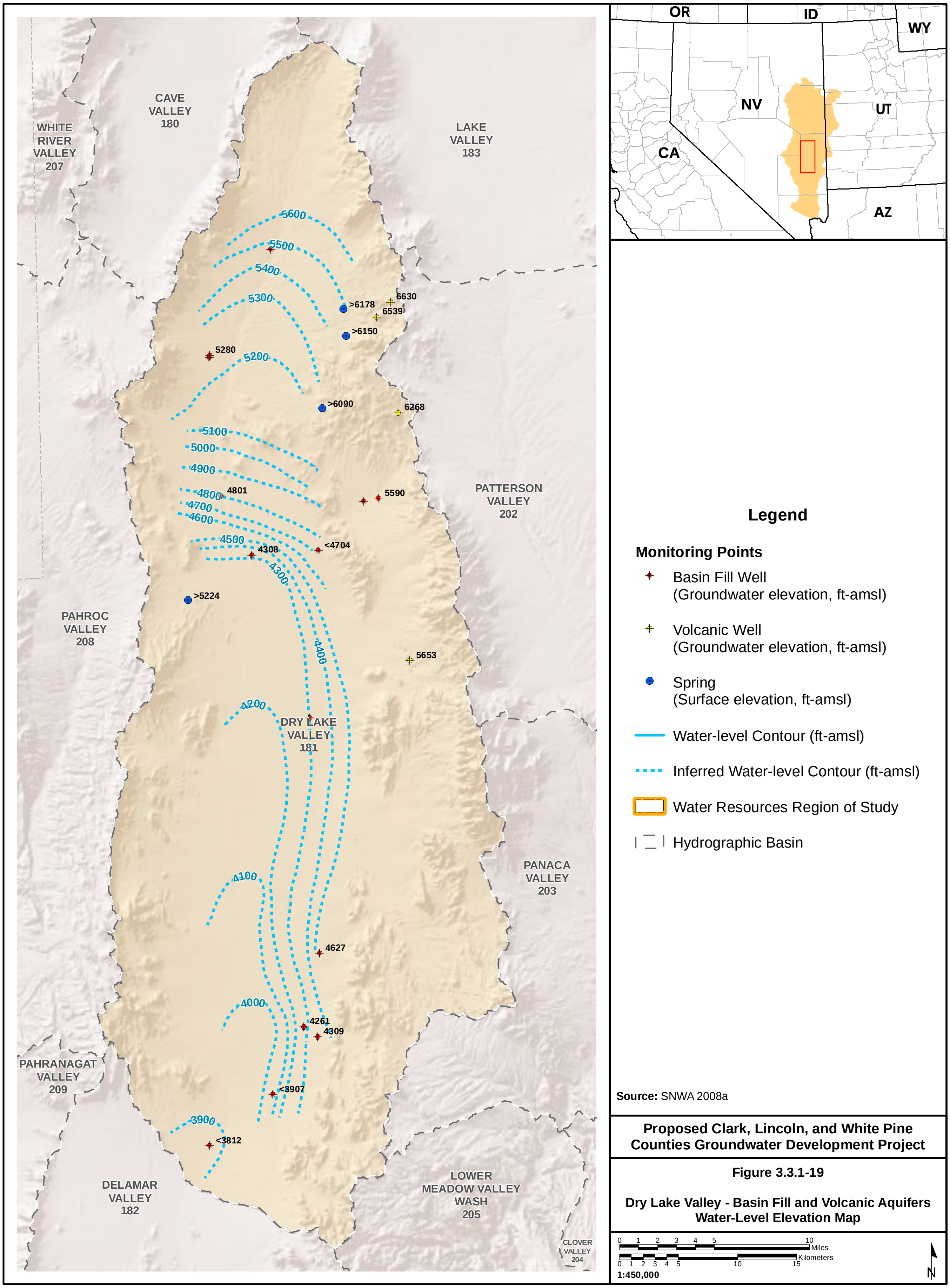
The USGS recently published an updated regional potentiometric map of the Great Basin carbonate and alluvial aquifer system that includes Spring Valley, Snake Valley, and adjacent areas in eastern Nevada and western Utah (Gardner et al. 2011). This study included the results of recent (2007 to 2010) drilling by the UGS and USGS. At 20 sites, water levels were measured in "nested wells." Sites with nested wells include two or more monitoring wells designed and constructed to monitor water levels at different depths to evaluate vertical gradients. Several of the nested well sites include one or more wells with screened (or open zones) in the basin fill; and another well screened in the deeper carbonate bedrock. Water-level data from these particular nested well sites were used to evaluate the hydraulic connection between basin fill and consolidated bedrock. With respect to vertical gradients and hydraulic interconnection between the basin-fill and carbonate rock aquifers Gardner et al. (2011) state:

> *"Throughout the study area, water levels in neighboring consolidated-rock and basin-fill wells, and in nested observation wells, were found to be similar, indicating that consolidated-rock and basin-fill aquifers are hydraulically connected. The current map, therefore, is assumed to represent a single aquifer system. This assumption is consistent with the conceptualization of Sweetkind and others (2011b) in which water levels in shallow alluvium were considered to be in hydraulic connection with the underlying permeable bedrock."*

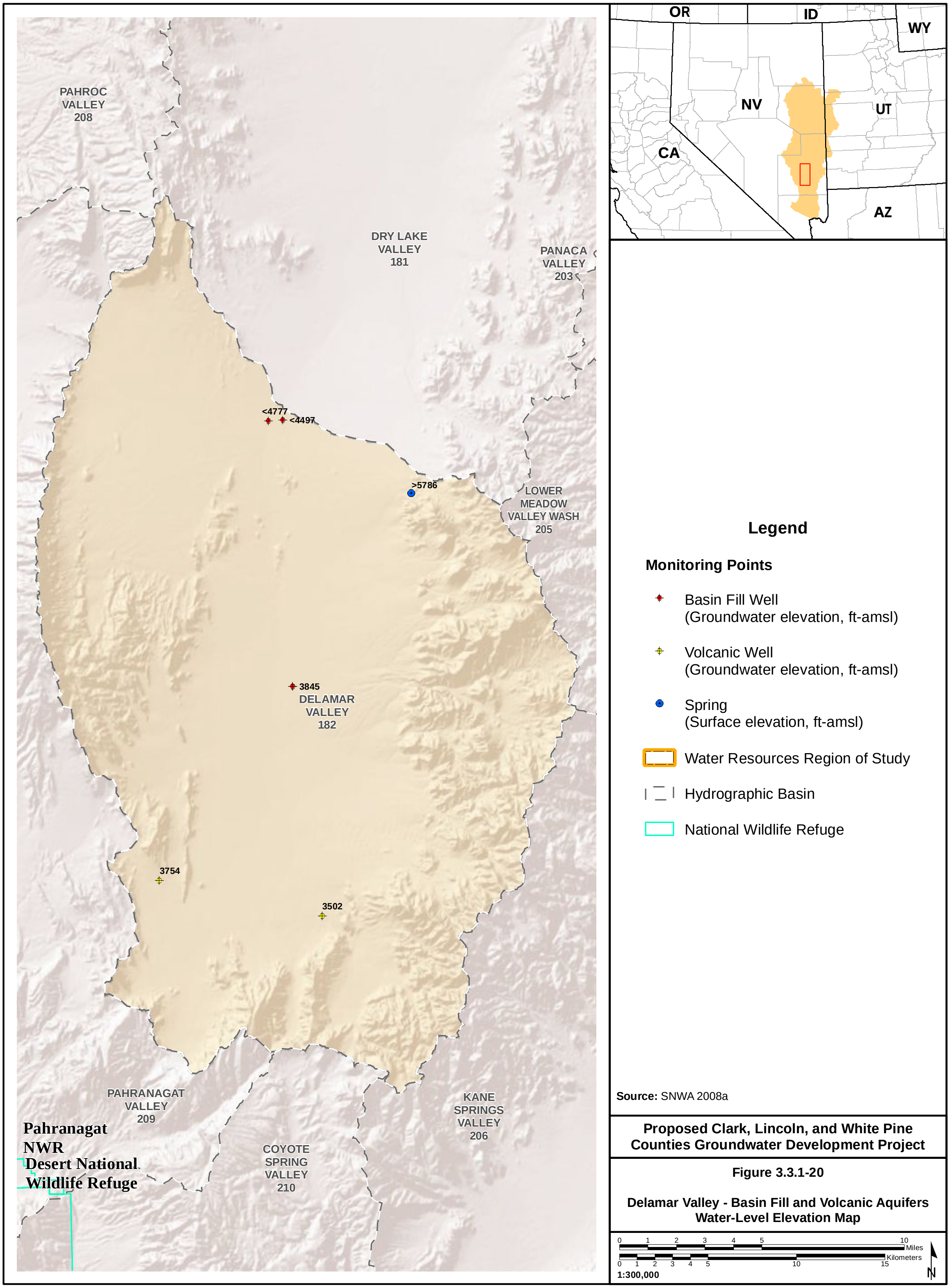
Groundwater Budget Estimates

A groundwater budget is a basic accounting of the inflows and outflows from an aquifer system in a specific area. Water budgets provide a means to quantitatively evaluate the availability and sustainability of a water resource (Healy et al. 2007). Under predevelopment conditions, the major components of inflow in a groundwater system include recharge from precipitation and groundwater inflow from adjacent basins. The principal groundwater outflow components include discharge of groundwater by ET and groundwater that leaves the area as subsurface flow in the aquifer system.

A *groundwater budget* is a basic accounting of the inflows and outflows from an aquifer system in a specific area.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.



Source: SNWA 2008a

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-20

Delamar Valley - Basin Fill and Volcanic Aquifers Water-Level Elevation Map

The *Basin Characterization Model* (BCM) incorporates data sets for geology, soils, vegetation, air temperature, slope aspect, potential ET, and precipitation to create a mathematical estimate of the precipitation recharge to groundwater in a given basin.

This section provides an overview of past and relatively recent water-balance estimates developed for the five basins identified for the Proposed Action and alternatives. In the 1960s and 1970s, the USGS, in cooperation with the State of Nevada, conducted water-resource reconnaissance studies throughout Nevada. These studies were intended to evaluate the availability of groundwater resources within specific hydrographic basins. These reports typically provide an estimate of recharge and ET and discuss groundwater subsurface flow into or out of the hydrographic basins. Recharge to the groundwater system from direct precipitation was estimated using an empirically derived relationship between precipitation and recharge developed by Maxey and Eakin (1949). Water resource reconnaissance reports are available for all of the basins within the region of study. The recently completed USGS BARCAS study (Welch et al. 2007) provides a re-evaluation of the recharge and groundwater discharge components for basins in the northern portion of the region of study, including three (i.e., Spring Valley, Snake Valley, and Cave Valley) of the five basins that would be developed under the Proposed Action. Precipitation recharge to groundwater was estimated using a mathematical model known as the Basin Characterization Model, which incorporates data sets for geology, soils, vegetation, air temperature, slope, aspect, potential ET, and precipitation (Flint and Flint 2007). Groundwater ET discharge was re-evaluated by using the Landsat Thematic Mapper (TM) to map ET units. The ET units were selected to correspond to different vegetation and soil conditions common to ET areas. The ET losses were estimated by determining the acreages of land cover types within each basin for each ET unit, multiplying the acreages by a coefficient to estimate ET losses, and summing the losses for each unit to estimate the total ET losses within each area.

The BARCAS study used a groundwater-accounting computer model to evaluate potential groundwater flow between the hydrographic basins. The computer model is described as a simplified, mass-balance mixing model that uses deuterium as a trace. The model was based on deuterium concentrations from sites distributed throughout the BARCAS region of study (Welch et al. 2007).

The SNWA has completed several studies in the past several years; these studies were submitted as exhibits to provide estimates of water availability for water rights hearings for Coyote Spring Valley (LVVWD 2001), Spring Valley (SNWA 2006), and Delamar, Dry Lake, and Cave valleys (SNWA 2008). Recharge to the groundwater system from precipitation was estimated by using an empirically derived relationship between precipitation, recharge, and altitude, similar to that developed by Maxey and Eakin (1949). The revised Maxey-Eakin relationship is based on a distribution of average annual precipitation, derived from the PRISM (Parameter-elevation Regressions on Independent Slopes Model) into zones where each zone is related to groundwater recharge via empirically derived recharge coefficients. Recent studies by the SNWA (SNWA 2008, 2006) also have used remote sensing imagery to map the ET units and have estimated ET by using methods similar to those used by the USGS for the BARCAS (Welch et al. 2007).

Recent compilations of published and unpublished water-balance estimates for the hydrographic basins within the region of study are discussed in the BARCAS study (Welch et al. 2007), SNWA documents (LVVWD 2001; SNWA 2009a, 2008, 2006), and Burbey (1997).

Spring Valley

Selected water-balance estimates for the Spring Valley HA are presented on **Table 3.3.1-13**. Rush and Kazmi (1965) conducted the first comprehensive evaluation of the water resources in Spring Valley. They estimated that the average annual groundwater recharge for the Spring Valley HA was 75,000 afy. Of this 75,000 afy of recharge, Rush and Kazmi (1965) estimated that an average of approximately 70,000 afy was consumed by ET on the valley floor; 4,000 afy was discharged from the southeastern boundary into Hamlin Valley; and (in 1964) less than 1,000 acre feet of groundwater was pumped for stock, domestic, and irrigation use.

The SNWA presented estimates of the water balance for Spring Valley at the hearings for their water rights applications in Spring Valley (SNWA 2006). At that time, SNWA estimated that the average annual groundwater inflow to Spring Valley consisted of 98,800 afy of precipitation recharge and 2,000 afy of groundwater subflow from

Table 3.3.1-13 Estimated Groundwater Inflow and Outflow for the Spring Valley Hydrologic Area (afy)[1]

Water Balance Component	Rush and Kazmi (1965)	SNWA (2006)	Welch et al. (2007)	SNWA (2009a)[2]
Groundwater Inflow				
Precipitation Recharge (Direct and Mountain Front Recharge)	75,000	98,800	93,100	81,300
Groundwater Inflow from Tippet Valley HA		2,000	0	
Groundwater Inflow from Steptoe Valley HA			4,000	
Groundwater Inflow from Lake Valley HA			29,000	
Total Inflow	**75,000**	**100,800**	**126,100**	**81,300**
Groundwater Outflow				
ET	70,000			75,600
Natural Vegetation and Dry Playa		90,000	72,000	
Irrigated Crops		5,800	4,000	
Other Groundwater Uses (mining and milling, stock water, quasi-municipal, wildlife)	<1,000	300	100	
Groundwater Outflow to Tippets Valley HA			2,000	
Groundwater Outflow to Snake Valley HA			16,000	
Groundwater Outflow to Hamlin/Snake HA	4,000	4,000	33,000	5,700
Total Outflow	**75,000**	**100,100**	**127,100**	**81,300**
Storage Estimates				
Estimated Groundwater Storage (upper 100 feet saturated basin fill)	4,200,000		3,788,000	

[1] Estimates rounded to the nearest hundred afy.

[2] Estimated predevelopment steady-state groundwater budget.

Tippets Valley HA (SNWA 2006). Groundwater outflow from Spring Valley included losses through ET from native vegetation and playas (90,000 afy), crop irrigation (5,800 afy), other uses (300 afy), and discharge to Hamlin Valley (4,000 afy).

The groundwater balance derived from estimates provided in the BARCAS study (Welch et al. 2007) suggests that there is substantially more groundwater moving through the Spring Valley HA than previously recognized. The BARCAS water budget estimates indicate that in addition to recharge (93,100 afy), groundwater flows from the west into the basin from Steptoe Valley (4,000 afy) and Lake Valley (29,000 afy). Although the ET estimates for natural vegetation and playa areas are similar to the estimates in the water resources reconnaissance report (Rush and Kazmi 1965), the BARCAS study indicates that a large percentage of the groundwater moving through the basin discharges as subsurface flow into the adjacent Snake and Hamlin valleys HAs (49,000 afy) to the west and the Tippet Valley HA (2,000 afy) to the north.

The SNWA provided new estimates of the steady-state predevelopment (i.e., prior to any groundwater development) groundwater budget for each basin within the hydrologic study area in the Conceptual Model Report (SNWA 2009a). These estimates indicate that groundwater inflow to the Spring Valley consists of 81,000 afy of precipitation recharge with no groundwater inflow from adjacent basins. Groundwater discharged from the basin was estimated at 76,000 afy to ET and 6,000 afy as groundwater outflow to the Hamlin Valley HA.

Snake Valley

Both the water resources reconnaissance report (Hood and Rush 1965) and the BARCAS study (Welch et al. 2007) define Snake Valley as the combination of the Snake Valley HA (Hydrographic Basin 195) and the Hamlin Valley HA (Hydrographic Basin 196), as designated by the NDWR (2009). Note that the NSE administers water rights individually for each of these basins. The baseline data reports for this project also address resources individually for each of these basins (SNWA 2008).

Selected water-balance estimates for groundwater inflow and outflow to the combined Snake Valley/Hamlin Valley HA are listed in **Table 3.3.1-14**. The water resources reconnaissance report estimates that the average groundwater inflow into this area (104,000 afy) is comprised of 100,000 afy of precipitation recharge and 4,000 afy of groundwater inflow from southern Spring Valley to Hamlin Valley (Hood and Rush 1965). The average annual groundwater outflow from this area is estimated to consist of 80,000 afy of ET from phreatophytes in the valley bottom; 7,000 afy pumped from wells used for irrigation and other uses; and 10,000 afy of groundwater that discharges through the alluvium across the north boundary of the Snake Valley HA into the Great Salt Lake Desert hydrographic basin (Hood and Rush 1965). Hood and Rush (1965) assumed that the difference between the estimated inflow and outflow components is groundwater that is discharged out of the area through the carbonate rock system. Using estimates provided in Hood and Rush (and accounting for losses from groundwater use for irrigation and other uses), the net difference is 7,000 afy.

Table 3.3.1-14 Estimated Groundwater Inflow and Outflow for the Combined Snake and Hamlin Valleys Hydrographic Basins (afy)[1]

Water Balance Component	Hood and Rush (1965)	Welch et al. (2007)	SNWA (2009a)[3]
Groundwater Inflow			
Precipitation Recharge (Direct and Mountain Front Recharge)	100,000	111,000	151,000
Groundwater Inflow from Spring Valley HA	4,000	49,000	5,700
Total Inflow	**104,000**	**160,000**	**156,700**
Groundwater Outflow			
ET (Natural Vegetation and Playa)	80,000	124,000	132,300
Irrigated Crops	7,000	8,000	
Other Groundwater Uses (mining and milling, stock water, quasi-municipal, wildlife)			
Groundwater Outflow to Great Salt Lake Desert HA to north	10,000	29,000	
Groundwater Outflow to Carbonate Rock System to east[2]	7,000	0	
Groundwater Outflow to Great Salt Lake Desert Flow System (to north and east)			24,400
Total Outflow	**104,000**	**161,000**	**156,700**
Storage Estimates			
Estimated Groundwater Storage (upper 100 feet saturated basin fill)	12,000,000	8,944,900	

[1]Estimates rounded to the nearest hundred afy.

[2]Estimated using the difference between inflow and outflow components provided in Hood and Rush (1965).

[3]Estimated predevelopment steady-state groundwater budget provided in Appendix I, SNWA 2009a.

The groundwater budget derived from recent estimates developed for the BARCAS study (Welch et al. 2007) is provided in **Table 3.3.1-14**. The results of the BARCAS study suggest that substantially more groundwater is moving through the Hamlin and Snake valleys hydrographic basins than was estimated in the water resources reconnaissance report (Hood and Rush 1965). The BARCAS water budget estimates that the total groundwater inflow to the area is 160,000 afy, comprising 111,100 afy of precipitation recharge and 49,000 afy of groundwater inflow from the Spring Valley HA. The BARCAS study results infer that groundwater inflow from the Spring Valley HA occurs in two general areas. The first area is between the Kern Mountains and Snake Range, along the northeast boundary of the Spring Valley HA, where estimated groundwater inflows of 16,000 afy flow into the northern portion of Snake Valley. The second area is along the southeast boundary of the Spring Valley HA, where an estimated 33,000 acre foot per year of water is inferred to flow into Hamlin Valley south of the Snake Range.

The BARCAS study estimates that groundwater outflow from the area occurs through ET (124,000 afy), pumping for crop irrigation (8,000 afy), and groundwater outflow (29,000 afy) (Welch et al. 2007). Most of the groundwater outflow is inferred to discharge across the northern boundary of Snake Valley into the Great Salt Lake Desert HA.

The SNWA estimates of the steady-state predevelopment quantities provided in the Conceptual Model Report (SNWA 2009a) indicates groundwater inflow to the combined Snake and Hamlin Valley HAs consists of 151,000 afy of precipitation recharge and 5,700 afy of groundwater inflow from the Spring Valley HA. Groundwater discharged from the basin was estimated at 132,300 afy to ET and 24,400 afy outflow to the Great Salt Lake Desert Flow System along the boundary of the study area. Compared to the BARCAS water balance estimates, the SNWA estimate assumes greater inflow from recharge, and substantially less groundwater inflow from Spring Valley. However, the total inflow estimates for the BARCAS study (160,000 afy) and SNWA conceptual model (156,700 afy) are similar.

Cave Valley

The water resource reconnaissance study (Eakin 1962) for the Cave Valley HA estimated the average annual recharge at 14,000 afy (**Table 3.3.1-15**). The reconnaissance study also indicates that ET is no more than a few hundred acre feet per year and estimates that most of the recharge leaves Cave Valley by subsurface flow toward the west and southwest. Harrill et al. (1988) interpret that the approximately 14,000 afy estimated by Eakin (1962) flows west into the White River HA.

Table 3.3.1-15 Estimates of Groundwater Inflow and Outflow for the Cave Valley Hydrologic Area (afy)[1]

Water Budget Component	Eakin (1962)	Welch et al. (2007)	SNWA (2007)	SNWA (2009a)
Groundwater Inflow				
Precipitation Recharge	14,000	11,000	14,700	15,000
Groundwater Inflow from adjacent basins	0	0	0	0
Total Inflow	**14,000**	**11,000**	**14,700**	**15,000**
Groundwater Outflow				
ET	few 100	1,600	1,300	1,500
Groundwater Outflow:	about 14,000			
Outflow to White River Valley HA		9,000	4,000	13,500
Outflow to Pahroc Valley HA			9,400	
Total Outflow	**about 14,000**	**10,600**	**14,700**	**15,000**
Storage Estimates				
Estimated Groundwater Storage (upper 100 feet saturated basin fill)	1,000,000		805,200	

[1]Estimation rounded to the nearest hundred afy.

The BARCAS study estimates the average groundwater recharge for the Cave Valley at 11,000 afy. Under predevelopment conditions, the BARCAS study estimates that of the 11,000 afy recharge, 1,600 afy is discharged by ET and that the remaining balance (9,000 afy) leaves the hydrographic basin by subsurface flow out to the White River Valley (Welch et al. 2007).

The SNWA's water budget prepared for the 2008 water rights hearings for the Delamar, Dry Lake, and Cave HAs estimate that approximately 14,700 afy of recharge in the Cave Valley HA (SNWA 2007). Groundwater outflow from the Cave Valley HA was estimated to consists of 1,300 afy from ET, and groundwater outflow to the White River Valley HA (4,000 afy) and Pahroc Valley HA (9,400 afy). The SNWA's revised estimates provided in the Conceptual Model Report (SNWA 2009a) are similar to the 2007 estimates. The SNWA estimate for total inflow and outflow (15,000 afy) are similar to Eakin's (Eakin 1962) estimate (14,000 afy) and approximately 33 percent greater than those estimated in the BARCAS study (Welch et at. 2007) (11,000 afy).

Dry Lake Valley

Selected estimates of groundwater inflow and outflow to the Dry Lake Valley HA are listed in **Table 3.3.1-16**. The water resources reconnaissance report for Dry Lake Valley (Eakin 1963) estimates that the average recharge for Dry Lake Valley is 5,000 afy and that all or nearly all of the recharge discharges by subsurface flow into Delamar Valley.

Table 3.3.1-16 Estimates of Groundwater Inflow and Outflow for the Dry Lake Valley Hydrographic Basin (afy)[1]

Water Budget Component	Eakin (1963)	SNWA (2007)	SNWA (2009a)
Groundwater Inflow			
Precipitation Recharge	5,000	15,700	16,200
Groundwater Inflow from Pahroc Valley HA		2,000	2,000
Total Inflow	**5,000**	**17,700**	**18,200**
Groundwater Outflow			
ET	Minor	0	0
Groundwater Outflow to Delamar Valley HA	5,000	17,700	18,200
Total Outflow	**5,000**	**17,700**	**18,200**
Storage Estimates			
Estimated Groundwater Storage (upper 100 feet saturated basin fill)			

[1]Estimation rounded to the nearest hundred afy.

The SNWA's (2007) estimates (prepared for the 2008 water rights hearings for the Delamar, Dry Lake, and Cave HAs) indicate that the Dry Lake Valley hydrographic basin receives approximately 15,700 afy of recharge and 2,000 afy of subflow from the Pahroc Valley hydrographic basin. The total inflow of 17,700 afy discharges as subflow into Delamar Valley. The SNWA's revised estimates provided in the Conceptual Model Report (SNWA 2009a) are similar to their 2007 estimates. These estimates suggest there is approximately 3 times more recharge in this HA than originally estimated by Eakin (Eakin 1963).

Delamar Valley

The water resources reconnaissance report (Eakin 1963) estimates that the average recharge for Delamar Valley HA is 1,000 afy, and subsurface flow from the Delamar Valley HA is approximately 5,000 afy (**Table 3.3.1-17**). There is essentially no ET in the valley, and all of the inflow discharges as groundwater outflow. SNWA (2007) estimates a much higher recharge and subsurface flow from Delamar Valley HA and assumes the entire inflow (24,100 afy) discharges into Coyote Spring Valley HA. The recently revised groundwater budget provided in the Conceptual Model Report (SNWA 2009a) is very similar to the earlier 2007 estimate.

Table 3.3.1-17 Estimates of Groundwater Inflow and Outflow for the Delamar Valley Hydrographic Basin (afy)[1]

Water Balance Component	Eakin (1963)	SNWA (2007)	SNWA (2009a)
Groundwater Inflow			
Precipitation Recharge	1,000	6,400	6,600
Groundwater Inflow from Dry Lake Valley HA	5,000	17,700	18,200
Total Inflow	**6,000**	**24,100**	**24,800**
Groundwater Outflow			
ET	0	0	0
Groundwater Outflow (Coyote Spring Valley HA)	6,000	24,100	**24,800**
Total Outflow	**6,000**	**24,100**	**24,800**
Storage Estimates			
Estimated Groundwater Storage (upper 100 feet saturated basin fill)			

[1] Estimation rounded to the nearest hundred afy.

[2] Assumed to be equal to recharge.

3.3.1.6 Water Quality

Groundwater quality generally is controlled by the composition of the water that reaches an aquifer and its subsequent interactions with aquifer materials. Groundwater quality also is affected by the length of time that the groundwater is in contact with aquifer materials and can change with distance along a flow path. Some of the processes that influence groundwater quality that have been identified in the regional aquifer systems of the Great Basin include dedolomitization (gypsum and dolomite dissolution and calcite precipitation, which releases sulfate and magnesium ions), exchange of calcium and magnesium in the groundwater for sodium in clays, and dissolution of volcanic rock (which releases sodium to the groundwater). In some localized areas, calcium, sodium, sulfate, and chloride are released to groundwater by gypsum and halite dissolution.

Three aquifer types have been identified in the region of study: carbonate, volcanic, and basin-fill. The general baseline characteristics of groundwater associated with these three aquifer types have been described by SNWA (2008). Groundwater from carbonate-rock aquifers tends to have a calcium-bicarbonate composition with varying amounts of magnesium and sulfate; this water corresponds to the calcium-magnesium-bicarbonate groundwater facies described by Winograd and Thordarson (1975). Groundwater associated with volcanic rocks in the Great Basin generally has a sodium-potassium-bicarbonate composition with a lower pH than groundwater associated with carbonates. The composition of groundwater associated with valley fill generally is a function of the source of the valley fill. Calcium-magnesium-bicarbonate water occurs in basin-fill aquifers composed chiefly of carbonate-rock material (Winograd and Thordarson 1975; SNWA 2008). The SNWA (2008) identified sodium, chloride, and sulfate as the dominant constituents in basin-fill aquifers composed mainly of volcanic rocks. Valley-fill aquifer materials composed of a mixture of volcanic and carbonate rocks produce mixed-cation groundwater compositions (Winograd and Thordarson 1975; SNWA 2008).

The water quality in the region of study generally is good. The composition of the groundwater generally is controlled by its interaction with the deeper carbonate-rock aquifer material. Interaction between the groundwater and volcanic material and evaporites commonly results in increased sodium, sulfate, and chloride concentrations with groundwater transport distance in the White River Flow System. Concentrations of minor elements usually are low; all water samples from the Great Salt Lake Regional Flow System had minor element concentrations below the USEPA maximum contaminant levels (MCLs). However, the majority of the arsenic values from Coyote Spring Valley in the White River Flow System exceeded the USEPA MCL of 10 micrograms per liter. Some samples from both flow systems exceeded MCLs, including pH, chloride, and sulfate in the Great Salt Lake Desert Regional Flow System and aluminum, iron, manganese, and total dissolved solids (TDS) in the White River Flow System.

Characterization of the water quality and stable isotope concentrations in the Great Salt Lake Desert, and White River Flow Regional Flow Systems, including water-quality summary tables for each flow system, is provided in **Appendix F3.3.4**.

3.3.1.7 Water Rights and Water Use

Water law in both Nevada and Utah are based on the doctrine of prior appropriation, or first in time – first in right, and is administered by the respective State Engineer. Nevada's water law is contained in Nevada Revised Statutes, Chapters 532 through 538; Utah's water law is contained in Utah Code, Title 73. Both states' laws provide that water is the property of the state's public, and a water right is the right to put that water to beneficial use. The basis of a water right is the beneficial use. The process of obtaining a water right in both states begins with applying for an appropriation and ends with the right being "perfected" through filing proof of beneficial use or through final adjudication.

Adjudication is a state initiated finalization process for beneficial uses that existed prior to the law establishing a permit system of the respective states, and uses established through federal reserved water rights (discussed later in this section). Adjudication may be requested by the entity that manages the lands containing the right (e.g., private landowner, Tribe, or federal agency), or initiated by the state.

Active water rights within the hydrologic study area were inventoried to identify the location and status of water rights. The inventory was based on water rights records on file with the NDWR. Water rights on file with the Utah Division of Water Rights (UDWRi) also were inventoried for the Utah portion of the study area. The water rights are summarized in **Appendix F3.3.2**. The summary tables list the point of diversion, type of water rights permit, owner, water source (such as stream, spring, or underground), beneficial use, and annual duty (i.e., quantity of water use per year allocated by the water rights permit) for the each water right. The water source identified for water rights associated with water-well development in the water-rights databases for both states is referred to as "underground." For descriptive purposes in this EIS, water rights that are listed with an "underground" source designation are informally referred to as "groundwater rights."

The points of diversion for active surface water rights and groundwater rights within the region of study are shown on **Figures 3.3.1-21** and **3.3.1-22**, respectively. The surface water and groundwater rights for each of the basins within the study area are summarized in **Tables 3.3.1-18** and **3.3.1-19**, respectively.

State Water Rights held by Federal Bureaus

Federal bureaus have established state water rights in both states through the processes administered by the respective State Engineer. **Figure 3.3.1-23** depicts those water rights held by federal bureaus as returned by searches of NDWR and UDWRi water rights databases.

Nevada records both state-perfected water rights and state-adjudicated federal reserved water rights for federal bureaus.

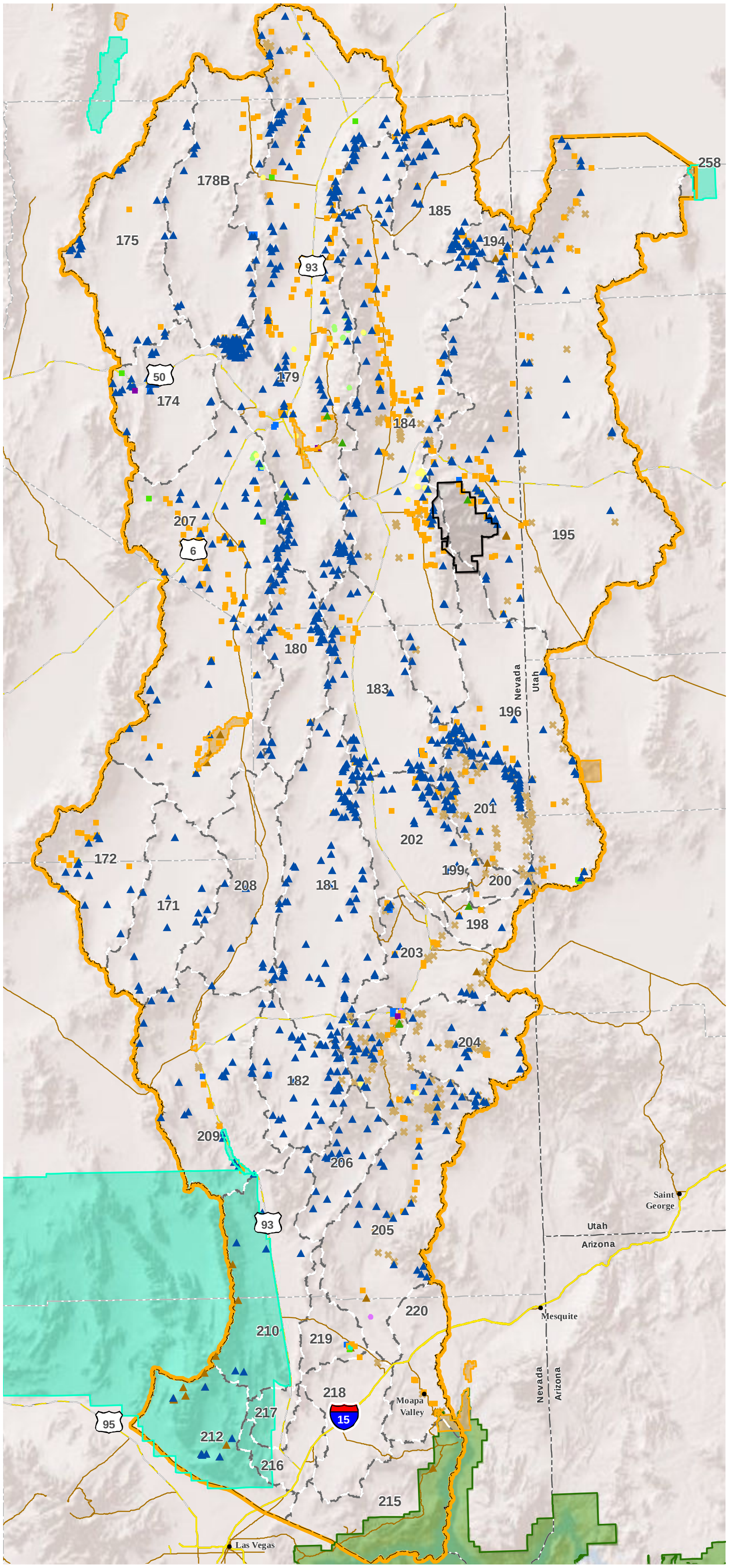
In Utah, "diligence claims" have been filed in the project area by the BLM for the establishment of multiple water rights. Diligence claims are Utah's vehicle for establishing and recording beneficial uses of surface water prior to 1903 or groundwater prior to 1935.

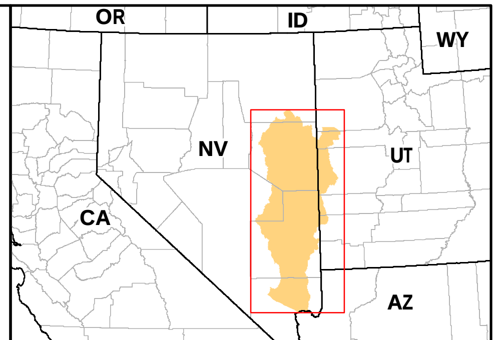
Federally Reserved Water Rights

The federally reserved water rights doctrine was originally established in 1908 by the U.S. Supreme Court in *Winters v. United States*, and is commonly known as the "Winters Doctrine." In a conflict over competing use of surface water between non-Indian settlers and Indians on the Fort Belknap Reservation in Montana, the U.S. Supreme Court held that when the Reservation lands were reserved by a 1888 agreement, water rights for the Indians also were reserved by necessary implication for farming and pastoral purposes. The Winters Doctrine was upheld and further defined by the U.S. Supreme Court in *Arizona v. California* (1964). The U.S. Supreme Court held that the doctrine applied to the establishment of a Reservation by treaty, statute or EO; that the water rights are reserved as of the date of creation of the Reservation; that the quantity of water reserved for Indian use is that amount sufficient to irrigate all the practicably irrigable acreage of the Reservation; and that the rights are not lost by non-use. The doctrine has been defined further in the state general stream adjudication process authorized by the McCarren Amendment (43 U.S.C. 666). In: *In Re the General Adjudication of All Rights To Use Water In The Gila River System and Source, W-1 (Salt), W-2 (Verde), W-3 (Upper Gila), W-4 (San Pedro) (Consolidated)*, the Arizona Supreme Court ruled that the homeland purpose is a valid Reservation purpose and that there is a reserved right to groundwater. The Homeland purpose has been interpreted to include a variety of water uses, including recreation, agriculture, domestic use, stock watering, commercial, and industrial uses.

The federally reserved water rights doctrine also applies to Reservations for non-Indian purposes, such as for National Parks (NPs), National Wildlife Refuges, certain BLM lands, and National Forests, although the U.S. Supreme Court has interpreted the uses of reserved water rights for non-Indian purposes more narrowly than the Indian reserved water rights. See *United States v. New Mexico* (1978) and *Cappaert v. United States* (1976). These rights, similar to the Indian reserved rights discussed previously, include the amount of water necessary to fulfill the primary purposes of the federal Reservation, with a priority date of the establishment of the Reservation. Water is taken from the unappropriated water at the time of creation of the Reservation. The right does not arise by use nor can it be lost by nonuse. Water is reserved for both present and future needs. The most common type of federal reserved water rights on BLM lands in the project area are Public Water Reserves (PWR), which set aside certain quantities of water from public water holes and springs for human and animal consumption. PWR were originally established on an individual basis; the earliest being PWR No. 1 established in 1912, which included wetland areas in Snake Valley. President Coolidge issued the EO of April 17, 1926, that created PWR No. 107 that reserved water yields from springs and natural water holes for human and animal consumption over vast tracks of public lands. Because of this, the vast majority of state-recognized PWRs hold the priority date of the EO.

The locations of federal reserved water rights included in the NDWR water rights database within the region of study, along with state-adjudicated water rights held by federal bureaus in both Nevada and Utah are shown on **Figure 3.3.1-23**. No federal reserved water rights were returned through searches of the UDWRi database, potentially because such rights in Utah have been established through "diligence claims" as discussed above. The federal reserved





Legend

Water Rights (Manner of Use)

- Commercial
- Industrial
- Mining and Milling
- Municipal
- Storage
- Domestic
- Irrigation
- Stockwatering
- Recreational
- Wildlife
- Other
- Interstate Highway
- US Highway
- Major Road
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Source: Nevada Division of Water Resources and Utah Division of Water Rights

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-21

Surface Water Rights

0 5 10 15 20 25 50 Miles
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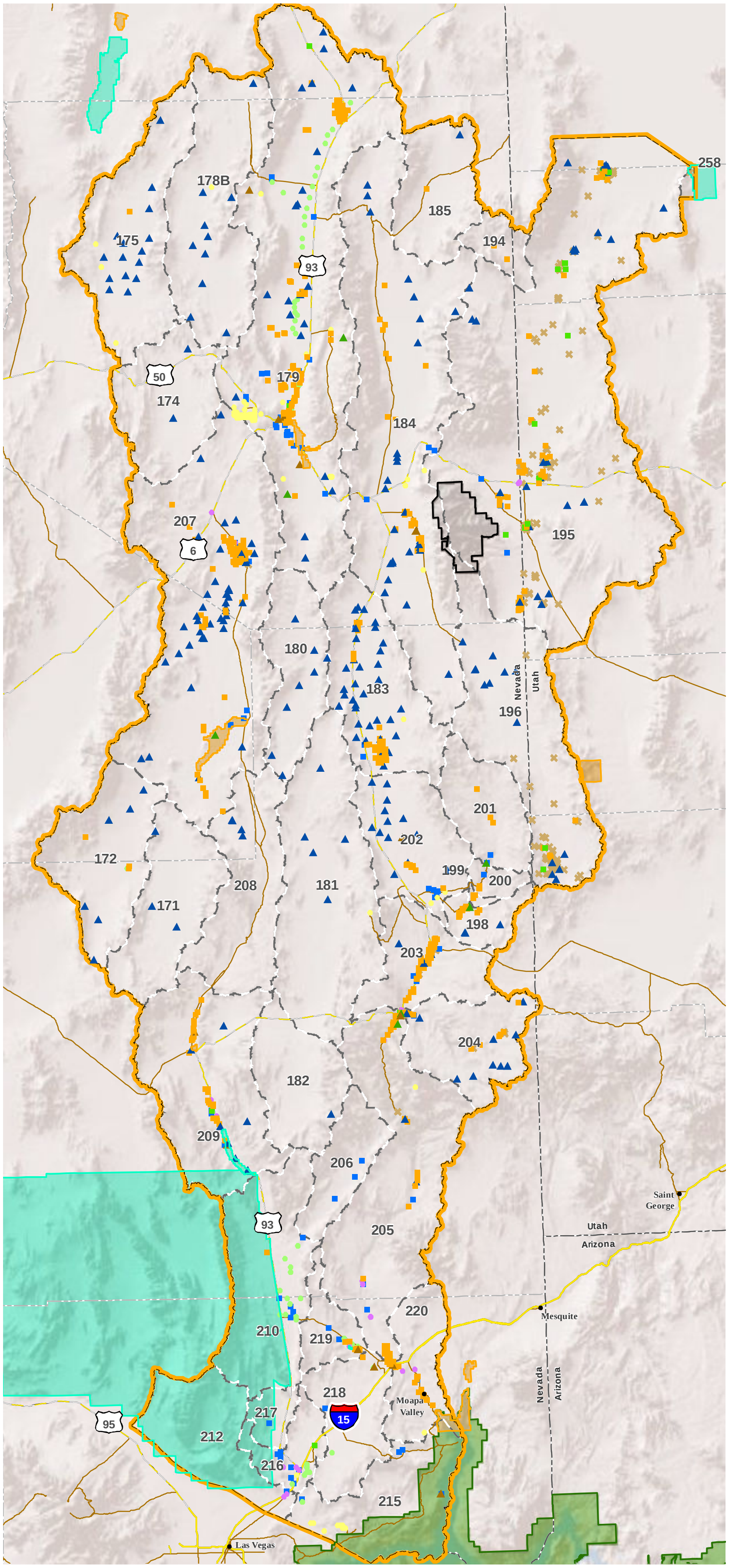
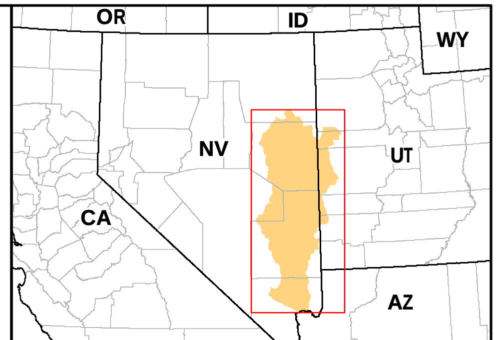




Legend

Water Rights (Manner of Use)

- Commercial
- Industrial
- Mining and Milling
- Municipal
- Domestic
- Irrigation
- Stockwatering
- Recreational
- Wildlife
- Other
- Interstate Highway
- US Highway
- Major Road
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Source: Nevada Division of Water Resources and Utah Division of Water Rights

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-22

Groundwater Rights

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Table 3.3.1-18 Surface Water Rights Summary Table (Number of Surface Water Rights)

GW Flow System	Basin Number	Basin Name (Upgradient to Downgradient)	Commercial	Industrial	Mining and Milling	Municipal	Domestic	Irrigation	Stockwatering	Storage	Recreational	Wildlife	Other	Total
White River	175	Long Valley						2	20					22
	174	Jakes Valley				2	1	3	27	4				37
	207	White River Valley		7	1	3	2	74	59			4	2	152
	180	Cave Valley					1	11	47				2	61
	172	Garden Valley					1	16	14					31
	171	Coal Valley							13					13
	208	Pahroc Valley							10				1	11
	181	Dry Lake Valley						3	88				1	92
	209	Pahranagat Valley				1		11	20				3	35
	182	Delamar Valley			1	2		1	46				2	52
	206	Kane Springs Valley							18					18
	210	Coyote Spring Valley							8			3		11
	219	Muddy River Springs Area		4		2	1	8				1		16
	218	California Wash											1	1
	220	Lower Moapa Valley						11				2	2	15
	215	Black Mountains Area										1		1
Goshute Valley	179	Steptoe Valley		10	8	7	2	100	179	1	3	9	10	329
	178B	Butte Valley (Southern Part)						11	38					49
Salt Lake Desert	196	Hamlin Valley					2	20	57				20	99
	185	Tippett Valley						5	34					39
	184	Spring Valley (184)		1	16		1	115	90				30	253
	194	Pleasant Valley						7	19			1		27
	195	Snake Valley		2		1	1	58	61		1	2	24	150
	258	Fish Springs Flat											2	2
Meadow Valley	183	Lake Valley			1	3		22	49				1	76
	201	Spring Valley (201)						7	62			1	47	117
	202	Patterson Valley			1			5	37				2	45
	200	Eagle Valley						1	2				6	9
	198	Dry Valley						4	3		1		3	11
	203	Panaca Valley	1			3		8	8			1	17	38
	204	Clover Valley						2	20				29	51
	205	Lower Meadow Valley Wash	1		2	3		21	48	1	3	2	60	141
Las Vegas	212	Las Vegas Valley							7			13		20
Total			**2**	**24**	**30**	**27**	**12**	**526**	**1084**	**6**	**8**	**40**	**265**	**2024**

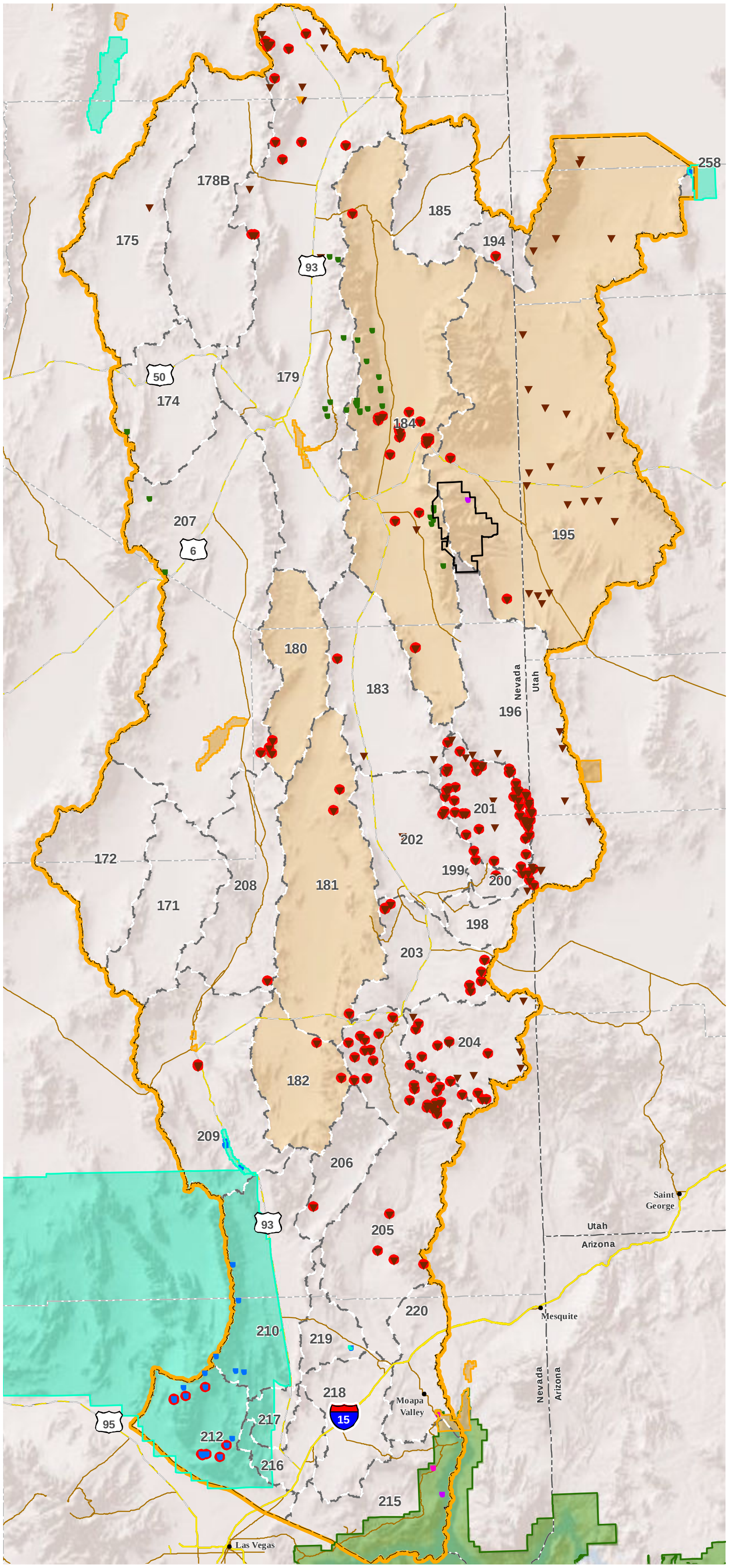
[1]The "other" category applies to water rights in Nevada or Utah where the use is not specified (see Water Rights Inventory, Appendix F3.3.2).
[2]Does not include water rights in the Fish Springs Flat HA since most of this HA is located outside of the study area boundary.

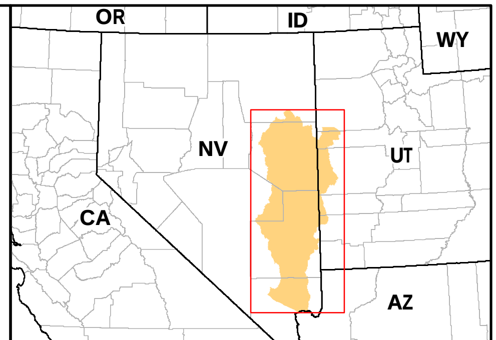
Table 3.3.1-19 Groundwater Rights Summary Table (Number of Groundwater Rights)

GW Flow System	Basin Number	Basin Name (Upgradient to Downgradient)	Commercial	Industrial	Mining and Milling	Municipal	Domestic	Irrigation	Stockwatering	Recreational	Wildlife	Other	Total
White River	175	Long Valley			5			1	15				21
	174	Jakes Valley							2				2
	207	White River Valley	2		6	8		83	44	1		1	145
	180	Cave Valley							8				8
	172	Garden Valley		1				3	6				10
	171	Coal Valley							3				3
	208	Pahroc Valley							4				4
	181	Dry Lake Valley			1				5				6
	209	Pahranagat Valley	4			7	1	34	8		2		56
	182	Delamar Valley							1				1
	206	Kane Springs Valley				4							4
	210	Coyote Spring Valley		16		4		1					21
	219	Muddy River Springs Area	3	30		5		17			1		56
	218	California Wash		2		4		5			3		14
	220	Lower Moapa Valley	2		2	2		17					23
	217	Hidden Valley (North)				1							1
	216	Garnet Valley	3	11	1	10	1						26
	215	Black Mountains Area		3	9	7					2		21
Goshute Valley	179	Steptoe Valley	3	31	35	54	2	148	23	3	4		303
	178B	Butte Valley (Southern Part)			1				10				11
Salt Lake Desert	196	Hamlin Valley					2	4	14			44	64
	185	Tippett Valley						1	1				2
	184	Spring Valley (184)			5	3		36	28		2		74
	194	Pleasant Valley						2					2
	195	Snake Valley	3			3	21	73	37			119	256
	258	Fish Springs Flat										1	1
Meadow Valley	183	Lake Valley			1	3		69	39				112
	201	Spring Valley (201)				3		3		1			7
	202	Patterson Valley			3	8		11	14		1		37
	200	Eagle Valley				2		3					5
	199	Rose Valley						4					4
	198	Dry Valley						21	3	2			26
	203	Panaca Valley	4			8	1	73	3			7	96
	204	Clover Valley		1		4		14	12			6	37
	205	Lower Meadow Valley Wash	8	8	1	7	1	56	2	2	1	5	91
Las Vegas	212	Las Vegas Valley	2			2							4
Total			**34**	**103**	**70**	**149**	**29**	**679**	**282**	**9**	**16**	**183**	**1554**

[1] The "other" category applies to water rights in Nevada or Utah where the use is not specified (see Water Rights Inventory, Appendix F3.3.2).

[2] Does not include water rights in the Fish Springs Flat HA since most of this HA is located outside of the study area boundary.





Legend

Federal Agency Water Rights

- BLM
- BLM & Lear Ranches
- USDA
- USFS
- USFWS
- USNPS
- Federal Reserved Water Right as returned by NDWR Database
- Interstate Highway
- US Highway
- Major Road
- Water Resources Region of Study
- Hydrographic Basin
- Pumping Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Source: Nevada Division of Water Resources and Utah Division of Water Rights

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-23

Federal Agency Water Rights within the Region of Study

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N

water rights returned by the NDWR water rights database include 161 water rights owned by the BLM and 9 water rights owned by the USFWS. All of these water rights are surface water rights at springs. The manner of use listed for the BLM's water rights includes "other" (143), stockwatering (15), wildlife (2), and irrigation (1). The BLM federal reserved water rights are distributed within 20 hydrographic basins, with the largest number occurring in Spring Valley (HA 184).

The USFWS federal reserved water rights returned though searches of the NDWR water rights database are all used for wildlife at locations within the Las Vegas Valley hydrographic basin. Unless the state has initiated a McCarran Amendment adjudication, federal reserved water rights would not necessarily be included in that state's database.

The unknown nature of unadjudicated federal reserved water rights, regarding both locations and quantities of water, limit the ability to further describe water use of this type in the hydrologic study area. Although the rights exist, without further judicial action there have been no details provided beyond what has been recorded by the state water administrations and what has been generally described here. The water resources in a particular flow system within the hydrologic study area would provide the source for federal reserved water rights located within that specific flow system. Even though the exact nature of these federal reserved water rights is unknown, the potential effects to water resource that supports these rights, whether surface or ground water, is described in Sections 3.3.2 and 3.3.3 in this chapter.

Proposed Pumping Basins Water Rights

The groundwater rights for each of the proposed groundwater development basins are summarized in **Table 3.3.1-20**. For Nevada, this summary is based on the data in the NDWR "Hydrographic Basin Summary by Manner of Use," downloaded from the NDWR on April 21, 2011 (NDWR 2011), and data provided by UDWRi (as summarized in SNWA 2008). **Table 3.3.1-20** includes "perennial yield" estimates for each of the hydrographic basins provided in recent NSE's water rights rulings for Spring, Delamar, Dry Lake, and Cave valleys (NDWR 2012a,b,c,d). The perennial yield is the estimated amount of groundwater available for appropriation in each basin. NDWR defines perennial yield as follows:

> "The perennial yield of a ground-water reservoir may be defined as the maximum amount of ground water that can be salvaged each year over the long term without depleting the ground-water reservoir. Perennial yield is ultimately limited to the maximum amount of natural discharge that can be salvaged for beneficial use. The perennial yield cannot be more than the natural recharge to a ground-water basin and in some cases is less. If the perennial yield is exceeded, ground-water levels will decline and steady-state conditions will not be achieved, a situation commonly referred to as ground-water mining" (NDWR 2012a).

Table 3.3.1-20 Summary of Active Groundwater Rights by Beneficial Use (afy) for the Proposed Pumping Basins

	Hydrographic Basin					
	Spring	Snake Valley		Cave	Dry Lake	Delamar
Manner of Use	**Valley[6]**	**Nevada**	**Utah**	**Valley[6]**	**Valley[6]**	**Valley[6]**
Commercial	35	12	0	0	0	0
Domestic	0	2	111	0	0	0
Industrial	0	0	0	0	0	0
Irrigation	19,805	10,611	37,942	0	1,009	0
Mining and Milling	1,356	0	0	0	18	0
Municipal[6]	0	0	0	0	0	0
Quasi-municipal	79	56	0	0	0	0
Stockwatering	404	35	824	47	38	7
Wildlife	58	0	0	0	0	0

Table 3.3.1-20 Summary of Active Groundwater Rights by Beneficial Use (afy) for the Proposed Pumping Basins (Continued)

Manner of Use	Hydrographic Basin					
	Spring Valley[6]	Snake Valley		Cave Valley[6]	Dry Lake Valley[6]	Delamar Valley[6]
		Nevada	Utah			
Other [1]	NA	NA	1,563	NA	NA	NA
Total[2]	**21,736**	**10,715**	**40,440**	**47**	**1,066**	**7**
Perennial Yield Estimate[3]	**84,000**	**25,000[4]**		**5,600**	**15,000**	**6,100**
		80,000[5]				
Perennial Yield Reference Source:	State Engineers Ruling 6164 (NDWR 2012a)	USGS Open File Report 78-768 (Nolin 1986)	USGS Recon. 34 (Hood and Rush 1965)	State Engineer Ruling 6165 (NDWR 2012b)	State Engineer Ruling 6166 (NDWR 2012c)	State Engineer Ruling 6167 (NDWR 2012d)

[1]The "other" category applies to water rights in Utah where the use is not specified.

[2] Totals may differ from the sum of the individual numbers due to rounding.

[3] Perennial yield estimates contained in the State Engineer Rulings 6164, 6165, 6166, and 6167 dated March 22, 2012.

[4,5] For Snake Valley, the 25,000 afy (Nolin 1986) represents the Nevada fraction of total basin yield of 80,000 AFY (Hood and Rush 1965) and is the estimate provided by the NDWR for Hydrographic Basin 195.

[6] Summary of active water rights by manner of use was based on the NDWR hydrographic basin summaries by manner of use dated April 21, 2011; and, do not include the March 22, 2012, water rights appropriated for municipal and domestic use to the Las Vegas Valley Water District in Spring, Delamar, Dry Lake, and Cave valleys (NDWR 2012a,b,c,d).

Sources: NDWR (2011) for Nevada; SNWA (2008) for Utah.

The sources of information used to estimate perennial yields referenced by NDWR are included in **Table 3.3.1-20**. Note that the State Engineer can modify estimates of perennial yield as new data and analyses becomes available or as necessary when considering all available hydrologic studies as part of a water rights hearings process.

The following subsection briefly summarizes the active water rights and their designated beneficial uses in Nevada and Utah within the five groundwater development basins included under the Proposed Action and alternatives prior to the March 22, 2012, water rights appropriation for municipal and domestic use to the Las Vegas Valley Water District in Spring, Delamar, Dry Lake, and Cave valleys (NDWR 2012a,b,c,d). The locations of the points of diversion for active water rights in these basins are shown in **Figures 3.3.1-21** and **3.3.1-22**. Additional information on water rights in these basins and other basins in the region is available at the NDWR and UDWRi web sites and in the project baseline characterization report (SNWA 2008).

Spring Valley

Based on the NDWR database, there are a total of 327 active water rights in the inventoried area, which includes 253 surface water rights and 74 groundwater rights. The surface water rights include 24 reserved rights filed by the BLM and 16 claims of vested rights by the USFS (SNWA 2008). The primary uses for surface water are irrigation, stock watering, mining and milling, and domestic use.

The designated use for active groundwater rights is presented in **Table 3.3.1-20**. According to the NDWR records (2011), as of April 21, 2011, the total groundwater appropriated in Spring Valley was 21,736 afy. The current estimate for perennial yield for the basin is 84,000 afy (NDWR 2012a).

Snake Valley

Snake Valley includes land in both Nevada and Utah. Water development in Snake Valley supports crop irrigation on the valley floor and the communities of Garrison, Callao, Eskdale, Gandy, and Trout Creek. Water rights are associated with most of the perennial streams and major springs in the basin. The majority of the perennial streams originate on the east slope of the Snake Range. The estimated total of 406 active water rights includes 150 surface water rights and 256 groundwater rights.

NDWR indicates that there are 10,715 afy of active underground (groundwater) rights in Snake Valley within Nevada (**Table 3.3.1-20**). Irrigation accounts for 99 percent of the total groundwater use; the remainder of the water is designated for quasi-municipal use and stock watering. The total groundwater use permitted on the Utah side of the basin is 40,440 afy with 98 percent of this water being used for irrigation (SNWA 2008). Other uses of groundwater include stock watering and domestic supply.

Cave Valley

Based on the NDWR database, there are a total of 69 active water rights in Cave Valley, which includes 61 surface water rights and 8 groundwater rights. Most of the water rights are associated with springs used for stock watering. As of April 21, 2011, the total groundwater appropriated was 47 afy (**Table 3.3.1-20**,) and all of this water is designated for stock watering. The current estimate for perennial yield for the basin is 5,600 afy (NDWR 2012b).

Dry Lake Valley

The majority of the water rights in Dry Lake Valley are springs, although there are surface water rights on ephemeral drainages on the eastern side of the basin (SNWA 2008). According to the NDWR database, there are a total of 98 active water rights in the inventoried area, which includes 92 surface water rights and 6 groundwater rights. As of April 21, 2011, the total groundwater appropriated in the basin was 1,066 afy and this water was designated for irrigation, stock watering, and mining and milling (**Table 3.3.1-20**). The current estimate for perennial yield for the basin is 15,000 afy (NDWR 2012c).

Delamar Valley

Most of the active water rights in Delamar Valley are associated with springs used for stock watering in the mountains above the valley floor. According to the NDWR database, there are a total of 53 active water rights in the inventoried area, which includes 52 surface water rights and 1 groundwater right. As of April 21, 2011, the total groundwater appropriated (**Table 3.3.1-20)** was 7 afy and all of this water was designated for stock watering. The current estimate for perennial yield for the basin is 6,100 afy (NDWR 2012d).

Irrigated Acres

The USGS has recently completed studies as part of BARCAS that included an estimate of irrigated acreages in Spring Valley, Snake Valley, and Cave Valley hydrographic basins (Welch et al. 2007). The USGS mapped irrigated acreages using imagery processed from the TM sensor onboard the Landsat 4 and 5 satellites. These satellites have acquired images of the Earth nearly continuously since 1982, with a 16-day repeat cycle. Irrigated fields were mapped for 2000, 2002, and 2005. The analysis indicates that the estimated irrigated acres increased in both Spring and Snake valleys over these time intervals; however, there was no active irrigation in Cave Valley during the period. In 2005, the USGS conducted field work during the growing season to evaluate the TM data for accuracy. The field verification studies indicated that less than 5 percent of the fields identified on the TM images as active were determined to be inactive, and the estimates for 2005 were adjusted accordingly. The USGS estimated irrigated acreages for Spring and Snake valleys for 2005 are listed in **Table 3.3.1-21**.

Table 3.3.1-21 Estimated Irrigated Acreages for the Proposed Groundwater Development Basins

Hydrographic Basin	Irrigated Acreage (acres)	
	BARCAS[1] (2005 Imagery)	SNWA[2] (2002 Imagery)
Spring Valley	4,888	4,101
Snake Valley	9,200	12,594
Cave Valley	0	0
Dry Lake Valley	NA	0
Delamar Valley	NA	0

[1] Welch et al. (2007).
[2] SNWA (2008).

The SNWA estimated irrigated acres by using satellite imagery from June 2002 for all of the basins within the region of study (SNWA 2008). The SNWA irrigated acreage estimates for the five proposed groundwater development basins is summarized in **Table 3.3.1-21**. The SNWA estimates indicate that at the time of the imagery, there was essentially no active irrigation occurring in Delamar, Dry Lake, and Cave valleys. Both the USGS and SNWA estimates indicate that the largest areas of irrigated land occur in Snake Valley, and considerably fewer acres occur in Spring Valley. As shown on **Table 3.3.1-21**, the SNWA estimate for irrigated acreages for Spring Valley and Snake Valley are approximately 16 percent less and 37 percent greater, respectively, than the USGS estimate.

3.3.2 Environmental Consequences

3.3.2.1 Rights-of-way

Issues

Project development would require surface disturbance for construction of the pipelines, power lines, and ancillary facilities. The following water resource issues were evaluated as part of the impact analysis for construction and operation of the groundwater development project within the primary pipeline and power line ROWs.

- Surface disturbance to springs, seeps, and streams.
- Erosion and release of sediment from disturbed areas.
- Impacts to surface water quality from project construction-related activities.
- Damage to pipeline and ancillary facilities from flooding or scour.

Other potential impacts to wetlands and riparian areas are discussed in the Section 3.5, Vegetation Resources; and Section 3.7, Aquatic Biological Resources. Potential impacts to water resources resulting from the transportation, storage, and use of hazardous substances are addressed in Section 3.19, Public Safety and Health.

Methodology

Surface disturbance-related impacts to water resources were evaluated according to the following steps:

- Identify water resources (springs and seeps) located within the construction ROWs;
- Identify perennial, intermittent, and ephemeral streams that would be crossed or disturbed by the proposed facilities;
- Evaluate erosion and sedimentation impacts associated with construction and operation-related activities;
- Identify known flood zones and flood hazards that would be crossed or disturbed by the proposed facilities;
- Evaluate the existing BLM RMP management actions and BMPs, and ACMs to limit the extent and duration of predicted impacts;
- Recommend additional mitigation measures if warranted, to avoid, reduce, or offset impacts;
- Evaluate the effectiveness of the proposed mitigation measures; and
- Estimate residual impacts after the BLM management actions and BMPs, ACMs, and recommended mitigation measures are applied.

The applicant has committed to measures to minimize potential impacts. These ACMs are presented in **Appendix E**. The assessment of potential impacts to water resources assumes that these ACMs would be implemented as part of construction and operation of the project. SNWA also would be required to fund a comprehensive Construction, Operation, Monitoring, Maintenance, Management, and Mitigation Plan (COM Plan) that would include all facilities and hydrographic basins associated with the SNWA GWD Project. The plan would be approved and managed by the BLM in accordance with the FLPMA. A framework for development of the COM Plan is provided in Section 3.20, Monitoring and Mitigation Summary, and includes a description of the development process; plan components; roles and responsibilities for BLM, SNWA, and other federal and state agencies; enforcement; and description of the effectiveness of the plan to mitigate potential adverse impacts associated with the project.

3.3.2.2 Proposed Action, Alternatives A through C

The development associated with the primary pipeline and power line ROWs would be the same for the Proposed Action and Alternatives A through C. The proposed development within the ROW areas is described in detail in Chapter 2. Chapter 2 also provides estimates of surface disturbance from construction-related activities. In summary, the development would include construction of 306 miles of pipeline, 323 miles of overhead power lines, and two primary and five secondary electrical substations. Ancillary facilities that would be developed include five pumping stations, six regulating tanks, three pressure reducing stations, a water treatment facility, buried storage reservoir, access roads, and communication facilities.

Surface Disturbance of Water Sources

No known springs are located within the boundaries of the disturbance area for the ROWs and ancillary facilities. There are 4 known or suspected springs located downgradient near (i.e., within 1,000 feet) the proposed ROW. These include one inventoried spring (Big Springs located in Snake Valley) and 3 other non-inventoried springs (located in Snake Valley and Dry Lake Valley) identified from the National Hydrography Database or topographic maps. The actual existence and flow characteristics of these non-inventoried springs have not been confirmed by field investigation. Springs located downgradient and in the near vicinity of the ROW could be impacted by erosion and sedimentation from construction disturbance. However, implementation of the Storm Water Pollution Prevention Plan (SWPP Plan) and erosion control ACMs discussed below should protect these resources from construction-related impacts.

The proposed pipeline ROW would cross one perennial stream reach (Snake Creek) and two intermittent stream reaches (Big Wash and Lexington Creek), all located in Snake Valley. The intermittent stream reaches may be flowing during the period when the pipeline is constructed across the creeks. Construction across live (flowing) stream crossings would be accomplished using one of two methods: an open cut method with temporary diversions of stream flow, or a jack and bore method to tunnel under the stream. All construction across live streams would be accomplished in accordance with USACE and State of Nevada permit requirements.

The open cut method for live streams would consists of constructing a temporary diversion to divert flows around the stream crossing, excavating a trench across the stream bed from one or both banks, installing the pipe and cover, reconstructing the stream channel, and finally, diverting flows back into the reclaimed stream channel. Applying open cut methods to construct the pipeline across live streams would result in short-term (up to 2 years) impacts to the stream reach; and depending on the stream bed and stream bank characteristics and site-specific construction methods, could result in longer-term (greater than 2-year) impacts to the stream channel and downstream stream reach.

The jack and bore method requires the construction of a pit on either side of the stream. From these pits, the tunnel is created under the stream using a bore machine. The main advantage of the jack and bore method is that it generally does not result in alteration of the stream bed or flow conditions in the stream reach. Therefore, impacts to the stream channel using the jack and bore method should be minimal; however, there is a potential for erosion and sedimentation at the entrance and exit points for the bore.

Ground disturbance associated with the construction of the 306 miles of pipeline (including main and lateral pipelines) and ancillary facilities would result in direct impacts to an estimated 720 ephemeral stream reaches intersected along the ROWs. These ephemeral stream reaches predominantly are dry washes that only flow for short periods in response to infrequent runoff events. Construction across dry washes would use standard cut and cover methods with implementation of erosion control measures in accordance with an approved SWPP Plan required by the NDEP as part of the General Permit for Stormwater Discharges that will be required prior to any surface disturbance.

ACM A.1.52 also requires that construction across perennial, intermittent, and ephemeral drainages follow industry standards, permit requirements, and the BLM's guidance practices (DOI 2007). The BLM RMP guidance recommends an analysis of channel degradation and scour be completed to determine the depth of burial at all stream crossings that would prevent exposure or damage of the pipeline during extreme runoff events. Therefore, with implementation of ACM A.1.52, impacts associated with channel degradation and scour are not anticipated.

Other ACMs (including A.1.53 through A.1.68) include measures to control stormwater and minimize erosion and channel degradation. ACM A.4.1 requires that BMPs be used for the pipeline crossing of Snake Creek and Big Wash (if flowing).

The proposed overhead power line would span two perennial stream reaches (Snake Creek in Snake Valley and Steptoe Creek in Steptoe Valley) and two intermittent streams (Big Wash and Lexington Creek in Snake Valley). The 323-mile length of proposed power line also would span an estimated 642 ephemeral drainages. Transmission towers would not be located within active channels of these streams. The location of roads required for access and maintenance of the power system and tower locations would be determined in the final POD. Depending on location, construction of access roads associated with the power line and transmission tower could result in localized disturbance of the identified perennial and intermittent streams located within the corridor.

Other ancillary facilities associated with construction of the pipeline are located to avoid perennial water sources, intermittent and ephemeral drainages, and springs and seeps. Therefore, impacts to water resources associated with construction of these facilities are not anticipated.

Pipeline construction dewatering trenches are not anticipated to be necessary. However, if detailed geotechnical investigations indicate that dewatering is needed, a dewatering plan would be developed. That plan would specify that discharge waters be directed to prevent flow from entering streams, wetlands, or sensitive environmental areas (ACM A.1.51).

Hazardous and toxic materials (e.g., fuels, solvents, lubricants, acids) used during construction would be controlled to prevent accidental spills. Refueling of vehicles or equipment would be prohibited within 100 feet of any wash or stream (ACM A.1.43). Spill cleanup kits would be available on equipment so that accidental spills can be cleaned up quickly (ACM A.1.44). Therefore, the risk of spills into live streams or springs would be low, and impacts are not anticipated.

Conclusions. There are no springs that would be crossed by the pipeline ROW; and impacts to springs located downgradient and in the near vicinity of the ROW are unlikely due to implementation of required stormwater and erosion controls and ACMs.

The proposed pipeline ROW would cross one perennial stream reach (Snake Creek) and two intermittent stream reaches (Big Wash and Lexington Creek) all located in Snake Valley. Construction across live (flowing) stream crossings would include either an open cut method or a jack or bore method. Typically, open cut methods would result in short-term (up to 2 years) impacts to the stream reach; however, longer-term (greater than 2-year) impacts to these stream reaches could occur.

Ground disturbance associated with the pipeline ROW also would impact an estimated 720 ephemeral streams (i.e., dry washes). Implementation of required erosion control measures and ACMs are expected to generally limit these to short-term (up to 2 years) effects.

Overhead power lines would span two perennial streams, two intermittent streams, and 642 ephemeral drainages. Depending on location, construction of access roads associated with the power line and transmission tower could result in localized disturbance of the two perennial streams located within the corridor. Additional mitigation measures could be required in some situations, depending on the proximity of the streams and drainages and site-specific conditions at the time of construction.

Proposed mitigation measures:

ROW-WR-1: Stream Crossing Construction Plan. A site-specific plan would be developed to detail the construction procedures, erosion control measures, and reclamation that would occur for pipeline construction across live (flowing) stream reaches. The plan would include site-specific designs using either open cut or jack and bore techniques and site-specific measures to minimize disturbance of the stream bed, and release of sediment from the construction area into the downstream stream reach. The plan would be reviewed and approved by the BLM and NDOW prior to initiation of any construction activities within the stream corridor. Effectiveness: This mitigation measure would be moderately effective at reducing construction-related impacts to the streambed. Implementation of this additional mitigation measure, combined with other federal and state requirements, likely would result in a reduction of short-term impacts and minimize or eliminate long-term impacts at live stream crossings. Effects on other resources: This measure would not adversely affect other environmental resources.

ROW-WR-2: Avoid Power Line Structures in Streams. Power line structures would be designed to span all perennial streams and other ephemeral/intermittent streams or washes. No power line structures or ancillary facilities would be located within the active channels of these streams. Access roads constructed for the power line would be located to avoid or minimize disturbance to perennial and intermittent streams. Effectiveness: This measure would be highly effective in mitigating potential erosion and ground disturbance-related impacts to perennial streams associated with the power line construction. This avoidance measure is not currently included in the SNWA ACMs. Effects on other resources: This measure would not adversely affect other environmental resources.

Residual impacts include:

- Implementation of the federal and state requirements, ACMs, and additional mitigation measures should effectively mitigate construction-related impacts to water sources including perennial springs and streams and intermittent and ephemeral stream channels. Therefore, long-term adverse residual impacts to these water resources are not anticipated.

Erosion and Sedimentation

Erosion would occur in the disturbance areas for pipelines, power lines, and ancillary facility construction. Stormwater and erosion control measures include the preparation of site-specific SWPP Plans (ACM A.1.54) to identify and develop methods to control all potential sources of pollution affecting the quality of stormwater discharges from the construction site. Other ACMs to control erosion include developing construction plans to minimize the construction time frame, and implementing erosion and sediment control measures using both non-structural and structural construction BMPs (ACMs A.1.53-A.1.68). Examples of these measures include siltation or filter berms, filter or silt fencing, sediment barriers, rock or gravel mulches, and jute and synthetic netting. After construction, all temporary erosion and sediment controls not required for the protection of facilities would be removed and the drainages restored to their original form. Soils used for erosion control and soils captured by sedimentation control structures during construction would either be used in the ROW for construction or disposed of in approved borrow pits (ACM A.1.66).

Ground surface would be graded to match the surrounding topography and slopes as closely as possible. Perennial streams, washes, or ephemeral/intermittent drainages would be restored to pre-existing conditions as closely as possible. Permanent erosion control measures would be installed where necessary and could include vegetation restoration, placing matting on steep slopes to maintain stability, berming, and placement of rip-rap (ACMS A.1.67 and A.1.68).

Construction of the pipeline would require permanent disposal of excess soil generated during pipeline excavation. This includes soil volume displaced by the volume of the pipe and bedding material not generated from the excavation, and anticipated expansion of the soil material after excavation. Excess soil material generated from the trench operation would be spread evenly over the ROW disturbance corridor. The estimated volume of excess soil to be disposed of during construction and potential erosion impacts are discussed in Section 3.4, Soils.

Hydrostatic Testing. Hydrostatic testing would be required during construction to test the integrity of the pipeline. Discharge of these waters would be subject to conditions defined in a Hydrostatic Discharge Plan submitted to the BLM for approval (ACM A.1.64). The discharge plan would include energy dissipaters to minimize impacts from sedimentation and erosion. It currently is anticipated that discharge flow rates and volumes would not be allowed to exceed the 2- to 5-year storm event for the individual drainages (ACM A.1.62). If flows exceed these rates, the potential for erosion and scour would increase, resulting in deposition of sediment downstream. Water used for hydrostatic testing and for other construction activities would be tested and treated if necessary prior to discharge or disposal in accordance with the National Pollutant Discharge Elimination System (NPDES) permit requirements. Water not discharged locally would be hauled offsite for disposal (ACM A.1.65).

Emergency Drains. Construction of the water pipeline system would include drain valves located at low points along the pipeline. The location of the drains and design of the discharge points and erosion control measures would be determined prior to final BLM approval. Conceptually, the drains would discharge through energy dissipating devices and then would flow to dry washes lined with rip rap to control erosion. A detailed hydrologic analysis would be conducted during facility design for each discharge point to provide sufficient erosion control and prevent scouring. It currently is anticipated that discharge flow rates and volumes would not be allowed to exceed the 2- to 5-year storm event for the individual drainages (ACM A.1.62).

Conclusions. Surface disturbance from construction activities could affect water quality from sediment input on a short- and long-term basis. The development of construction plans, implementation of ACMs referenced above, and development of SWPP Plan and a Hydrostatic Discharge Plan would define methods to control runoff from construction activities.

Application of the ACMs to control erosion and sedimentation outside of the disturbed areas should minimize the potential impacts to perennial water sources and ephemeral and intermittent drainages. Although the ACMs would minimize erosion and sedimentation from construction activities, there is potential for erosion and sedimentation to occur locally until reclamation is completed, particularly after large storm events. These storm events could release sediment into drainages downgradient of the disturbance area.

Proposed mitigation measures:

None.

Residual impacts include:

- Disturbance areas in the ROW, particularly soils disturbed for pipeline excavation, likely would experience localized erosion in both the short- and long-term periods. Erosion likely would increase sedimentation to some water resources located downgradient from the disturbance areas. Resulting sedimentation would predominantly affect ephemeral drainages that terminate on the valley floors within closed basins.
- The amount of long-term erosion and sedimentation would depend on reclamation success and would be expected to diminish over time.

Flooding

The ROW project components would be subject to periodic localized flooding during the life of the project. Flooding risks include areas where facilities are located in a designated floodplain. The water pipelines and associated power line transmission structures cross two FEMA-designated 100-year floodplain areas in Clark County, Nevada. For discussion purposes, the northernmost floodplain is referred to as the "Unnamed Stream Floodplain Crossing," and the southernmost floodplain is referred to as the "Hidden Valley Floodplain."

The unnamed stream drainage floodplain crossing would require a span of approximately 894 feet. The proposed power line crossing the floodplain has above-ground structures with a maximum span between structures of approximately 800 feet. Therefore, at least one power line structure would need to be placed in that floodplain. The power line alignment also would cross approximately 4.6 miles of the Hidden Valley floodplain, requiring approximately 31 structures to be located within the floodplain. Long-term disturbance would be limited to the footprint of the structures and access roads for maintenance activities. The structures located within the floodplains would not impede the natural action or function of the floodplains. Considering the slope gradient within the floodplain areas, the potential for the structures to be damaged by flooding would be low.

The water pipeline located along the same alignment would be buried underground with a minimum of 6 feet of cover. Because the pipeline is underground, it would not impede the natural action or function of the floodplains. Both floodplains occur in areas with relatively gentle slopes (less than 5 percent), and it is unlikely that flooding in these areas would result in erosion that could expose the pipeline. Therefore, potential damage to the buried pipeline from flooding in these areas is low.

The water treatment facility, buried storage reservoir, and a secondary electrical substation are located within the boundaries of FEMA mapping in Clark County (FEMA 2009); however, none of these facilities are located within the 100-year floodplain. Therefore, potential impacts associated with flooding are not anticipated for these facilities.

A substantial portion of the project area is not covered by the FEMA 100-year floodplain delineation. Without specific delineation, it is assumed that construction of the pipeline and power lines, as well as pumping stations, electrical substations, staging areas, and borrow pits and access roads located near stream and playa crossings could be subject to localized flooding.

The ROW construction also would cross drainages that are subject to flash flooding. As discussed above, perennial, intermittent, and ephemeral stream crossings by the pipelines would be constructed according to the BLM design guidelines incorporated into ACM A.1.52 such that the final pipeline is constructed at sufficient depth to minimize the risk associated with scour and channel degradation. Even with appropriate design and construction practices, there is a risk of impact to project facilities from localized flooding. These types of impacts likely would be short-term and would be addressed as part of maintenance of the project components.

Conclusions. Construction and maintenance of project components within the ROW areas would be subject to periodic localized flooding during the life of the project. Even with appropriate design and construction practices, there is a risk of impact to project facilities from localized flooding.

Proposed mitigation measures:

None.

Residual impacts include:

- Portions of the ROW would be subject to flooding and flash-flood risks. Any resulting impacts would be managed as part of ongoing maintenance activities.

Construction Water Supply

Construction of the pipeline and ancillary facilities would require a water supply for dust suppression, hydrostatic testing, pipe bedding, and trench backfill compaction. It is estimated that between 5.5 and 8.7 million gallons of construction water would be needed for every mile of pipeline, with less water needed for dust control in wet winter conditions. Approximately one water supply well would be needed every 10 miles along the pipeline alignment, and would need to be capable of delivering up to 800 gallons per minute. The construction water supply would be obtained from existing wells or constructing new wells at the time of construction. Additional temporary construction water wells would be drilled within the construction staging areas; therefore, no additional surface disturbance is anticipated for the construction water supply. The temporary water supply would likely be derived by pumping from wells completed in the basin-fill aquifer located near the ROW. Temporary pumping for the construction water supply is anticipated to result in temporary (minor) drawdown effects that likely would be localized in the vicinity of the ROW well sites. Once the project has been completed these wells would be plugged and abandoned and the site would be reclaimed. This would restrict the possibility of these wells being used for multiple use management (i.e., wildlife, wild horses or grazing management).

Conclusions. Impacts associated with the construction of water supply wells could result in localized drawdown effects. Identification of volumes and source of water required during construction needs to be completed prior to construction for the ROW areas and additional mitigation may be needed on a case-by-case basis.

Proposed mitigation measures:

The following proposed mitigation measure is intended to minimize and control potential impacts associated with the development of water required during construction. A specific construction water supply plan and agency coordination to approve such a plan are not included in the SNWA ACMs.

ROW-WR-3: Construction Water Supply Plan. A Construction Water Supply Plan would be provided to the BLM for approval prior to construction. The plan would identify the specific locations of water supply wells that would be used to supply water for construction of the water pipeline and ancillary facilities; identify specific groundwater aquifers that would be used; estimate effects to surface water and groundwater resources resulting from the groundwater withdrawal; define the methods of transport and delivery of the water to the construction areas; and identify reasonable measures to reuse or conserve water. The BLM would review and approve the plan and, if necessary, include any monitoring or mitigation requirements required to minimize impacts prior to construction approval. SNWA would provide the drilling logs and water chemistry reports on water wells drilled for pipeline construction. BLM in consultation with State agencies and grazing permittee will review the location of construction water wells and determine if any would be needed for multiple use management goals. If specific wells slated to be plugged and abandoned are determined to be a benefit to the BLM for multiple use management, the BLM would work with the SNWA to procure the rights to the wells and obtain appropriate water rights for the beneficial use(s).

Effectiveness: This measure would be highly effective in identifying specific local impacts to water resources and provide for mitigation measures if necessary to avoid, reduce, or offset the identified localized effects. Effects on other resources: The BLM procurement of selected construction water supply wells (that would have been plugged and abandoned) would allow BLM to provide water for wildlife, wild horses, or grazing management as appropriate.

Residual impacts include:

- Residual impacts from development of construction water supply could include localized drawdown related impacts associated with groundwater pumping. The residual impacts would be quantified during subsequent BLM review following plan submittal.

3.3.2.3 Alternative D

Development in Snake Valley and the White County portion of Spring Valley would be eliminated under Alternative D. The same ROW construction and operational maintenance issues discussed for the Proposed Action and Alternatives A through C would apply to Alternative D, which would require 225 miles of pipeline, and 208 miles of power lines in Clark and Lincoln counties, Nevada. In addition, the BMPs and ACMs described for the Proposed Action, and Alternatives A through C would be applied to construction and operation to minimize impacts to water resources.

Surface Disturbance of Water Sources

Conclusions. No known springs are located within the boundaries of the disturbance area for the ROWs and ancillary facilities. There is one spring located downgradient near (i.e., within 1,000 feet) the proposed ROW. This is an unnamed spring located in Dry Lake Valley that has not been field verified. There are no springs that are crossed by the pipeline ROW; and impacts to springs located downgradient and in the near vicinity of the ROW are unlikely due to required stormwater and erosion controls and ACMs.

The proposed pipeline and power line ROWs would not cross any perennial stream reach and or intermittent stream reaches. Ground disturbance associated with the pipeline ROW would impact an estimated 504 ephemeral streams (i.e., dry washes); overhead power lines also would span 380 ephemeral drainages. Implementation of required erosion control measures and ACMs are expected to generally limit these to short-term (up to 2 years) effects.

Proposed mitigation measures:

None.

Residual impacts include:

- Implementation of the federal and state requirements, and ACMs should effectively mitigate construction-related impacts to water sources. Therefore, long-term, adverse residual impacts to these water resources are not anticipated.

Erosion and Sedimentation

Conclusions. Surface disturbance from construction activities could affect water quality from sediment input on a short- and long-term basis. The development of construction plans, implantation of ACMs referenced above, and development of SWPP Plan and a Hydrostatic Discharge Plan would define methods to control runoff from construction activities.

Application of the ACMs to control erosion and sedimentation outside of the disturbed areas should minimize the potential impacts to water resources located downslope from the ROWs. Although the ACMs would minimize erosion and sedimentation from construction activities, there is potential for erosion and sedimentation to occur locally until reclamation is completed, particularly after large storm events. These storm events could release sediment into drainages downgradient of the disturbance area.

Proposed mitigation measures:

None.

Residual impacts include:

- Disturbance areas in the ROW, particularly soils disturbed for pipeline excavation, likely would experience localized erosion in both the short- and long-term periods. Erosion from disturbed areas likely would increase sedimentation to some water resources located downgradient from the disturbance areas. The resulting sedimentation would predominantly affect ephemeral drainages that terminate on the valley floors within closed basins. The amount of long-term erosion and sedimentation would depend on reclamation success and would be expected to diminish over time.

Flooding

Conclusions. Construction and maintenance of project components within the ROW areas would cross delineated flood zones as discussed previously for the Proposed Action, and Alternative A through C. The ROW construction also would cross drainages that are subject to flash flooding. As a result, project components within the ROW areas would be subject to periodic localized flooding during the life of the project. Even with appropriate design and construction practices, there is a risk of impact to project facilities from localized flooding.

Proposed mitigation measures:

Mitigation measure ROW-WR-2 previously described under the Proposed Action also would apply to Alternative D. This would avoid placement of power lines or ancillary facilities in active stream channels. This measure would be highly effective in mitigating potential erosion and ground disturbance-related impacts to streams associated with the power line construction.

Residual impacts include:

- Portions of the ROW would be subject to flooding and flash flood risks. Any resulting impacts would be managed as part of ongoing maintenance activities.

Construction Water Supply

Construction of the pipeline and ancillary facilities would require a water supply for dust suppression, hydrostatic testing, pipe bedding, and trench backfill compaction. The construction water supply would be obtained from existing wells or constructing new wells at the time of construction. Additional temporary construction water wells would be drilled within the construction staging areas; therefore, no additional surface disturbance is anticipated for the construction water supply. Groundwater withdrawal for the construction water supply could result in localized drawdown effects.

Conclusions. Impacts associated with the construction of water supply wells could result in localized drawdown effects.

Proposed mitigation measures:

Mitigation measure ROW-WR-3 previously described under the Proposed Action also would apply to Alternative D. This would require that a Construction Water Supply Plan be approved by the BLM prior to construction. This measure would be effective in identifying specific local impacts to water resources and provided for mitigation measures if necessary to avoid, reduce, or offset the identified effects.

Residual impacts include:

- Residual impacts from development of construction water supply could include localized drawdown related impacts associated with groundwater pumping. The residual impacts would be quantified during subsequent BLM review following plan submittal.

3.3.2.4 Alternatives E and F

Development in Snake Valley would be eliminated under Alternatives E and F. The same ROW construction and operational maintenance issues discussed for the Proposed Action, and Alternatives A through C would apply to Alternatives E and F, which would require 263 miles of pipeline, and 280 miles of power lines in Clark and Lincoln counties, Nevada. In addition, the BMPs and ACMs described for the Proposed Action, and Alternatives A through C would be applied to construction and operation to minimize impacts to water resources.

Surface Disturbance of Water Sources

Conclusions. No known springs are located within the boundaries of the disturbance area for the ROWs and ancillary facilities. There is one spring located downgradient near (i.e., within 1,000 feet) the proposed ROW. This is an unnamed spring located in Dry Lake Valley that has not been field verified. There are no springs that are crossed by the pipeline ROW; and impacts to springs located downgradient and in the near vicinity of the ROW are unlikely due to required stormwater and erosion controls and ACMs.

The proposed pipeline and power line ROWs would not cross any perennial stream reach and or intermittent stream reaches. Ground disturbance associated with the pipeline ROW would impact an estimated 581 ephemeral streams (i.e., dry washes); overhead power lines also would span 514 ephemeral drainages. Implementation of required erosion control measures and ACMs are expected to generally limit these to short-term (up to 2 years) effects.

Proposed mitigation measures:

Mitigation measure ROW-WR-2 previously described under the Proposed Action also would apply to Alternatives E and F. This would avoid placement of power lines or ancillary facilities in active stream channels. This measure would be highly effective in mitigating potential erosion and ground disturbance-related impacts to streams associated with the power line construction.

Residual impacts include:

- Implementation of the federal and state requirements, and ACMs should effectively mitigate construction-related impacts to water sources. Therefore, residual impacts to these water resources are not anticipated.

Erosion and Sedimentation

Conclusions. Surface disturbance from construction activities could affect water quality from sediment input on a short- and long-term basis. The development of construction plans, implementation of the ACMs referenced above, and development of SWPP Plan and a Hydrostatic Discharge Plan would define methods to control runoff from construction activities.

Application of the ACMs to control erosion and sedimentation outside of the disturbed areas should minimize the potential impacts to water resources located downslope from the ROWs. Although the ACMs would minimize erosion and sedimentation from construction activities, there is potential for erosion and sedimentation to occur locally until reclamation is completed, particularly after large storm events. These storm events could release sediment into drainages downgradient of the disturbance area.

Proposed mitigation measures:

None.

Residual impacts include:

- Disturbance areas in the ROW, particularly soils disturbed for pipeline excavation, likely would experience localized erosion in both the short- and long-term periods. Erosion from disturbed areas likely would increase sedimentation to some water resources located downgradient from the disturbance areas. The resulting sedimentation would predominantly affect ephemeral drainages that terminate on the valley floors within closed basins. The amount of long-term erosion and sedimentation would depend on reclamation success and would be expected to diminish over time.

Flooding

Conclusions. Construction and maintenance of project components within the ROW areas would cross delineated flood zones as discussed previously for the Proposed Action, and Alternatives A through C. The ROW construction also would cross drainages that are subject to flash flooding. As a result, project components within the ROW areas would be subject to periodic localized flooding during the life of the project. Even with appropriate design and construction practices, there is a risk of impact to project facilities from localized flooding.

Proposed mitigation measures:

None.

Residual impacts include:

- Portions of the ROW would be subject to flooding and flash flood risks. Any resulting impacts would be managed as part of ongoing maintenance activities.

Construction Water Supply

Construction of the pipeline and ancillary facilities would require a water supply for dust suppression, hydrostatic testing, pipe bedding, and trench backfill compaction. The construction water supply would be obtained from existing wells or constructing new wells at the time of construction. Additional temporary construction water wells would be drilled within the construction staging areas; therefore, no additional surface disturbance is anticipated for the construction water supply. Groundwater withdrawal for the construction water supply could result in localized drawdown effects.

Conclusions. Impacts associated with the construction of water supply wells could result in localized drawdown effects.

Proposed mitigation measures:

Mitigation measure ROW-WR-3 described under the Proposed Action previously also would apply to Alternatives E and F. This would require that a Construction Water Supply Plan be approved by the BLM prior to construction. This measure would be effective in identifying specific local impacts to water resources and provided for mitigation measures if necessary to avoid, reduce, or offset the identified effects.

Residual impacts include:

- Residual impacts from development of construction water supply could include localized drawdown related impacts associated with groundwater pumping. The residual impacts would be quantified during subsequent BLM review following plan submittal.

3.3.2.5 Alignment Options 1 through 4

Alignment Options 1 through 4 would adjust the location of specific segments of the Proposed Action ROWs, as described in Chapter 2. Potential effects to water resources associated with these alignment modifications are summarized in **Table 3.3.2-1**.

Table 3.3.2-1 Water Resources Impact Summary for Alignment Options 1 through 4

Alignment Option	Analysis
Alignment Option 1 – Humboldt-Toiyabe Power Line Alignment (Modifies a portion of the 230-kV power line from the Gonder Substation near Ely to Spring Valley)	Impacts associated with the Humboldt-Toiyabe Power Line Alignment would be similar to the comparable section of the Proposed Action alignment (similar number of ephemeral stream crossings but no perennial stream or spring crossings).
Alignment Option 2 – North Lake Valley Pipeline Alignment (Modifies the location of the mainline pipeline and electrical transmission line in North Lake Valley)	Potential impacts associated with the North Lake Valley Pipeline Alignment would be similar to the Proposed Action and Alternatives A through C segment except for the following: 1) Three springs (North Big Springs, Wambolt Springs, and an un-named spring) are located downslope and within 1,000 feet of the construction ROW. The reported flow at North Big Springs is 1,400 gpm. Flow rates have not been reported for Wambolt Springs; and the unnamed spring was located based on National Hydrography Database data and has not been field verified. In contrast, no springs are located downslope and within 1,000-feet of construction disturbance for the comparable section of the Proposed Action ROWs. 2) Geyser Creek, a perennial stream located in Lake Valley, would be crossed by the pipeline and spanned by the power line but would not be crossed by the comparable sections of the Proposed Action ROWs. Potential surface disturbance related impacts would be essentially the same as discussed for the Snake Creek crossing in Snake Valley under the Proposed Action. Therefore, mitigation measure ROW-WR-1 described under the Proposed Action also would apply to the Geyser Creek crossing.
Alignment Option 3 – Muleshoe Substation and Power Line Alternative (Eliminates the Gonder to Spring Valley transmission line, and constructs the Muleshoe Substation that would interconnect with an interstate power line in Muleshoe Valley)	Potential impacts for this option would be less than the comparable Proposed Action and Alternatives A through C segment because of the elimination of the Steptoe Creek crossing associated with the Humboldt-Toiyabe Power Line ROW.
Alignment Option 4 – North Delamar Valley Pipeline and Power Line Alignment (Modifies the location of a short section of mainline pipeline in Delamar Valley to follow an existing transmission line.)	Impacts associated with the North Delamar Valley Pipeline and Power Line Alignment would be similar to the comparable section of the Proposed Action alignment (same number of ephemeral stream crossings but no perennial stream or spring crossings).

3.3.2.6 No Action Alternative

As described in Chapter 2, the No Action Alternative assumes that the BLM would not grant ROWs for the proposed project. Under this scenario, the proposed pipelines, power lines, ancillary facilities, and well fields would not be developed. Therefore, construction or operational impacts to water resources associated with the proposed GWD Project would not occur.

3.3.2.7 Comparison of Alternatives

Impacts resulting from construction and operation and maintenance activities on water resources from the Proposed Action and Alternatives A through F are listed in **Table 3.3.2-2.**

Table 3.3.2-2 Comparison of Potential Effects to Water Resources Associated with Construction, Operation and Maintenance of the Primary Rights-of-way

Parameter	Proposed Action, Alternatives A through C	Alternative D	Alternatives E and F
Springs (Number of Springs)			
Within ROW	0	0	0
Downslope[1] of ROW	4	1	1

Table 3.3.2-2 Comparison of Potential Effects to Water Resources Associated with Construction, Operation and Maintenance of the Primary Rights-of-way

Parameter	Proposed Action, Alternatives A through C	Alternative D	Alternatives E and F
Perennial Stream Crossings			
Pipelines			
-Snake Creek	Yes	No	No
Power Lines			
-Snake Creek	Yes	No	No
-Steptoe Creek	Yes	No	No
Intermittent Stream Crossings			
Pipeline			
-Big Wash	Yes	No	No
-Lexington Creek	Yes	No	No
Power Lines			
-Big Wash	Yes	No	No
-Lexington Creek	Yes	No	No
Ephemeral Stream Crossings (number of crossings)			
Pipelines	720	504	581
Power Lines	642	380	514
Ground Disturbance (Acres)	12,288	8,828	10,681

[1] Within 1,000 feet of ROW disturbance.

3.3.2.8 Groundwater Development and Groundwater Pumping

Issues

The following water resource issues were evaluated as part of the programmatic impact analysis for construction and operation of the well fields within the groundwater development areas.

Groundwater Well Field Construction and Facility Maintenance

- Surface disturbance to springs, seeps, and streams.
- Erosion and release of sediment from disturbed areas.
- Impacts to surface water quality from project construction-related activities.
- Damage to pipeline and ancillary facilities from flooding or scour.

Groundwater Pumping

- Reduction of groundwater levels from pumping activities resulting in adverse effects on water supply.
- Potential drawdown impacts to perennial springs, seeps, and streams.
- Potential drawdown impacts to surface and groundwater rights.
- Potential water balance changes (including reduction in ET discharge) from the pumping basins and regional flow system from groundwater withdrawal.
- Potential degradation of surface water or groundwater quality attributed to groundwater pumping.
- Potential effects to caves resulting from groundwater drawdown.

Potential impacts to wetlands and riparian areas are discussed in Section 3.5, Vegetation Resources, and aquatic resources are discussed in Section 3.7, Aquatic Biological Resources. Potential effects to caves are discussed in Section 3.2, Geologic Resources, and Section 3.6, Terrestrial Wildlife. Potential impacts to water resources resulting from the transportation, storage, and use of hazardous substances are addressed in Section 3.19, Public Safety and Health.

Mitigation measures discussed in this resource section focus on new measures for impacts associated with groundwater development. Where applicable, ROW mitigation measures ROW-WR-1 and ROW-WR-2 may apply to surface disturbance activities associated with groundwater development. These ROW mitigation measures would be considered in subsequent NEPA tiers after plans for the groundwater development are provided to the BLM.

Methodology, Assumptions, and Limitations

This section describes the general methodology, assumptions, and limitations used to quantify potential effects to perennial water sources associated with groundwater withdrawal, including:

- A summary of the numerical groundwater flow modeling used to predict changes in groundwater levels and flow rates;
- A definition of the drawdown area used in the analysis;
- A description of the method used to identify springs and streams that could be affected within the drawdown area;
- A description of the method used to evaluate potential changes in flow in selected springs and spring-fed streams; and
- Methods used to evaluate impacts to water rights.

Groundwater Flow Modeling

A numerical groundwater flow model was developed for this EIS to evaluate the probable long-term effects of groundwater withdrawal on a regional scale. The model, known as the Central Carbonate-Rock Province (CCRP) Model was developed specifically for this EIS by the SNWA under the BLM's guidance (SNWA 2010a,b; 2009a,b).

The model was constructed by: 1) developing a conceptual model of the groundwater flow system including the definition of major HGUs across the region, and estimating groundwater budget components (i.e., recharge, groundwater discharge by ET, and interbasin inflow and outflow); 2) constructing a numerical model to represent the conceptual model; and 3) calibrating the model to transient conditions.

The final calibrated model was used to simulate groundwater withdrawal under the seven different pumping scenarios (i.e., six project pumping alternatives and the No Action pumping scenario) for a period extending to full build out plus 200 years. The model also was used to evaluate the combined effects associated with continuation of existing and historic pumping, project pumping, and reasonably foreseeable future pumping in the region over the same time period.

The following section provides a brief description of other important groundwater flow models for the region and a description of the construction, calibration, and uncertainty and limitations associated with the CCRP model.

Other Important Groundwater Flow Models for the Region

There currently are three other regional groundwater flow models that encompass two or more of the proposed groundwater development basins:

1. Great Basin Regional Aquifer Systems Analysis (RASA) Model previously developed by the USGS to evaluate the conceptual flow system in the carbonate-rock province (Prudic et al. 1995);
2. GBNP Model recently developed by the USGS for the NPS to evaluate the potential effects of pumping in Snake Valley on springs, streams, and water levels in and adjacent to GBNP (Halford and Plume 2011);
3. Eastern Nevada-Western Utah (ENWU) Regional Model in development (Durbin and Loy 2010; Loy and Durbin 2010) for the BLM (Utah State Office), NPS, USFWS, and BIA to evaluate potential impacts of groundwater pumping resulting from several water rights applications filed in Iron and Beaver counties, Utah. This model evaluated impacts to groundwater resources in White Pine and Lincoln counties, Nevada, and Iron and Beaver counties, Utah.
4. Groundwater models developed by Myers (2011a,b) as evidence for consideration by the NSE prior to ruling on SNWA's water right applications in Spring, Delamar, Dry Lake, and Cave valleys.

<u>RASA Model</u>. The RASA model was constructed as a steady-state, three-dimensional, finite-difference groundwater flow model using MODFLOW (McDonald and Harbaugh 1988). The model encompassed a very large region (approximately 92,000 square miles) with coarse discretization (individual cells of 5 miles by 7.5 miles in dimension). The model was constructed with two layers and was intended to be conceptual in nature for the purpose of evaluating the possible interconnection between the deep flow through the carbonate rocks and the shallow flow system (Prudic et al. 1995). The model was later modified to develop "first approximations" of the possible effects of groundwater withdrawal of 180,800 afy by the Las Vegas Valley Water District in 17 basins in Nevada (Schaefer and Harrill 1995). The RASA model was not used to predict effects associated with the proposed groundwater withdrawal for this EIS because of:

- The broad regional nature of the model and its coarse discretization;
- The highly generalized assumptions and simplifications used to construct the model;
- The fact that the model was not calibrated to transient conditions; and
- The lack of model set up to simulate the effects associated with existing pumping in the region.

In summary, the CCRP model used for this EIS was constructed to provide a more detailed representation of a portion of the regional carbonate-rock groundwater flow system that was conceptually evaluated by the earlier RASA model.

<u>GBNP RASA Model</u>. The GBNP RASA model was constructed by refinement of the RASA model (described above) in Spring and Snake valleys, which encompass the GBNP study area. Groundwater flow in the GBNP RASA study area was simulated with a 4-layer, finite-difference MODFLOW model that extends from the water table to 2,000 feet below the water table. The model incorporates a refined grid cell network that encompasses the park with cells

measuring 1,620 feet by 1,620 feet. The refined model simulated local flow in mountain blocks that was not simulated in the original RASA model. The GBNP RASA model does not explicitly represent the hydraulic properties of major fault zones; but rather represents the contrasting hydraulic properties of geologic units that may result from fault displacement.

The model was calibrated to existing water-level data, simulated water levels from the original RASA model, depth-to water beneath ET areas, spring discharges, and changes in discharge on selected stream reaches in the vicinity of the GBNP. The final calibrated model was used to simulate the potential effects of groundwater withdrawals associated with pumping in Snake Valley at nine points of diversion identified on the SNWA's water rights applications. Model simulations were conducted for groundwater withdrawal rates of 10,000 afy; 25,000 afy; and 50,000 afy over a 200-year period. Separate simulations were conducted with and without the addition of existing irrigation pumping. The irrigation pumping was based on the estimated distribution and rate of pumping that occurred in 2002, and assumed that this rate of pumping would continue in the future over the 200-year simulation period. Results from the GBNP model scenarios are presented as maps of groundwater capture and drawdown, time series of drawdowns and discharges from selected wells, and time series of discharge reductions from selected springs and streams.

Since the model design currently is focused on the Spring Valley and Snake Valley area, and pumping only in Snake Valley, the model results cannot be used to evaluate the potential effects to water resources associated with pumping in Spring, Delamar, Dry Lake, and Cave valleys. Additionally, the GBNP model results for Snake Valley assume pumping occurs at SNWA's original points of diversion and therefore, it cannot be used to evaluate potential effects associated with the distributed pumping in Snake Valley included in the Proposed Action and Alternatives A and C. However, given the points of diversion used in the GBNP model were the same ones used to simulate Alternative B, a preliminary comparison of simulated reductions of spring and stream flow results in Snake Valley will be discussed for the 50,000-afy GBNP model simulation and the CCRP model simulation for Alternative B (50,000 afy). While the amounts of water pumped at each point of diversion differ between the two model simulations, the comparison is still informative in bracketing the potential range of impacts.

ENWU Model. The ENWU model was developed using FEMFLOW3D version 3.01. This is a modified version of an earlier USGS code originally developed in 1998 that employs a different computational method than MODFLOW. The ENWU model domain extends further east into Utah, but not as far west and southwest in Nevada as the CCRP model used for this EIS; it only includes two of the five pumping basins included in the SNWA's proposed groundwater development project. Specifically, the ENWU model was not designed to evaluate the SNWA's proposed pumping in Delamar, Dry Lake, and Cave valleys. As a result, many of the areas where drawdown related impacts are indicated by the SNWA simulations are not included in the ENWU model.

A preliminary review of the documentation for the ENWU model indicated that the model has not been peer reviewed and the documentation currently does not provide sufficient information to make a rigorous evaluation (Poeter 2010; Halford 2010). Halford (2010) also raised concerns regarding the assumed hydraulic properties used to represent non-carbonate rocks within mountain blocks and the distribution of recharge.

The ENWU model assumes that the average annual rate of discharge from the combined Snake and Hamlin valleys is 78,000 afy instead of the 132,000 afy estimated from the recent BARCAS study (Welch et al. 2007) used in the CCRP model. Compared to the CCRP model, the pumping scenarios used for the ENWU model simulations included additional future pumping in Snake Valley and pumping in Pine and Wah Wah valleys by the Central Iron County Water District, but does not include the proposed pumping in Delamar, Dry Lake, and Cave valleys. Since the two models used different assumptions for ET discharge in Snake Valley and different pumping scenarios, it is not possible to make a direct comparison of their respective simulation results. In consideration of the preliminary review of the model and simulation results, the BLM has determined that the CCRP model designed and developed specifically for this EIS analysis currently is the best available tool for evaluating the probable long-term effects of groundwater withdrawal from the project on a regional scale.

Myers' Models (Myers 2011a,b). Myers conducted two separate groundwater modeling efforts that were submitted to the NSE as evidence provided by protestants for consideration prior to ruling on SNWA's groundwater appropriation applications for Spring, Delamar, Dry Lake, and Cave valleys.

- The first was a groundwater flow model for Spring Valley and surrounding areas developed by Myers (2011a) using MODFLOW-2000 (Harbaugh et al. 2000). The Spring Valley model domain included five hydrographic basins: Spring, Snake, Tippett, Pleasant, and Hamlin valleys. The model grid size ranges from 4 square miles in outlying areas to 0.25 square mile near the simulated pumping well location. The model was constructed with seven layers and designed to simulate vertical flow in the basin-fill aquifer. Layer 1 was set up as an unconfined layer. Faults were simulated in the model using horizontal flow barriers (HFBs). The HFB parameters were adjusted during calibration to simulate known or suspected gradients across the fault zones. D'Agnese (2011) conducted a technical review of the Myers model for SNWA and concluded that the model included a series of features that are not adequately associated with known hydrogeologic units or structures; and the model documentation was insufficient.

The NSE reviewed the Myers' Spring Valley model and compared it to the CCRP model (referred to in the following quote as the "Applicant's model") and provided the following conclusion in the water rights ruling for Spring Valley (NDWR 2012a):

> *"There was considerable discussion and evidence presented by all parties regarding the construction, errors, capabilities and accuracy of both the Applicant's and Dr. Myers' models. After considering the models, the evidence and the testimony, the State Engineer finds that the Applicant's model generally provides a more reliable basis to predict regional-scale impacts resulting from the Applicant's proposed pumping. The Applicant's model relies on better data and techniques, was developed through a more rigorous collaborative process with the BLM and recognized modeling experts, and is accompanied by more thorough documentation. Dr. Myers' Spring and Snake Valley model did not have the same benefit of a time-intensive collaborative process and a diversity of expert input."*

- The second modeling exercise conducted by Myers consisted of using the RASA model (Prudic et al. 1995; Schaefer and Harrill 1995) to analyze the effects of SNWAs proposed pumping in Delamar, Dry Lake, and Cave valleys. The RASA model was not used to predict effects associated with the proposed groundwater withdrawal for this EIS because the CCRP model used for this EIS was constructed to provide a more detailed representation of a portion of the regional carbonate-rock groundwater flow system that was conceptually evaluated by the earlier RASA model.

CCRP Model Construction, Calibration, Uncertainty, and Limitations

<u>Technical Review Team</u>

The BLM established a technical review team of hydrology specialists from the BLM Nevada and Utah State Offices and National Operations Center in Denver, the USGS, and AECOM (BLM EIS Contractor) to review the CCRP model. The review team included two groundwater flow modeling experts: Dr. Keith Halford (USGS) and Dr. Eileen Poeter (Poeter Engineering). A technical specialist from the NSE's Office observed the review process. The technical review team was formed to assist the BLM by reviewing the model documentation reports and providing recommendations to the BLM for improvements to the model. The review team held periodic conference calls and meetings with the SNWA modeling team and the BLM EIS project management team at various stages of the model development. The review team reviewed early work products, modeling files, data compilations and draft reports, and the most recent updated reports used for this impact analysis. The technical team requested specific improvements to the model. Key issues identified by the review team and their resolution, or improvements made to the model to address these issues, are discussed in Section 3.0 of SNWA (2009a), and in SNWA (2010a).

<u>Model Development</u>

The following discussion provides an overview of the CCRP model that was developed for use in the water resource impact analysis. Detailed documentation of the model is provided in the following technical documents:

1. Conceptual Model of Groundwater Flow for the Central Carbonate-Rock Province: Clark, Lincoln, and White Pine Counties GWD Project, SNWA, November 2009 (SNWA 2009a);
2. Transient Numerical Model of Groundwater Flow for the Central Carbonate-Rock Province: Clark, Lincoln, and White Pine Counties GWD Project, SNWA, November 2009 (SNWA 2009b);

3. Addendum to the Groundwater Flow Model for the Central Carbonate-Rock Province: Clark, Lincoln, and White Pine Counties Groundwater Development Project, Draft, August 2010 (SNWA 2010a); and

4. Simulation of Groundwater Development Scenarios Using the Transient Numerical Model of Groundwater Flow for the Central Carbonate-Rock Province: Clark, Lincoln, and White Pine Counties GWD Project, SNWA, Draft September 2010 (SNWA 2010b).

Model Construction. The transient, three-dimensional, finite-difference numerical groundwater flow model was developed by the SNWA's modeling team using the USGS groundwater flow program, MODFLOW-2000 (Harbaugh et al. 2000). The parameter-estimation code UCODE_2005 (Poeter et al. 2006) was used to assist in the calibration process.

The model domain is the same area as the hydrologic study area depicted on **Figure 3.3.1-1**, encompassing approximately 35 hydrographic basins and 20,688 square miles. The model grid is oriented north and the cells are uniform in size with a side dimension of 3,281 feet (1 kilometer). The model includes 11 layers that vary in thickness from 328 to 6,252 feet. The model extends vertically from -10,000 feet amsl to the water table, which varies from approximately 1,148 feet to more than 9,022 feet amsl.

Hydrogeologic Framework. Available geologic information was compiled and simplified to develop a geologic map and representative cross-sections for the region. This geologic representation was further simplified by combining geologic units with similar hydraulic properties to delineate regional HGUs and major structural features that may control groundwater flow. Two of the regional HGUs are important regional aquifers: the basin-fill aquifer and the carbonate-rock aquifer. Other units include basement rock that comprises the base of the flow system, plutons, plateau sedimentary rocks, and an upper aquitard that separates the upper and lower carbonate aquifers throughout much of the northern study area. Available hydraulic parameter data was compiled and evaluated to establish a range of properties for each of the regional HGUs. The spatial distribution of the regional HGUs is represented in the numerical model as zones of variable hydraulic properties. A function was added to the model to account for the reduction of hydraulic conductivity with increasing depth resulting from increased compression under load.

Representation of Structural Features. Major structural features are believed to influence or control groundwater flow in the region (SNWA 2009a,b). Faults can behave as barriers or conduits to flow as described in Section 3.3.1.5. Major structural features in the region include: a) basin-bounding faults; b) faults that cause large juxtaposition of geologic units; c) faults that exhibit large disturbances to HGUs; and d) faults that are known to restrict or partition groundwater flow. Major structural features include normal basin and range faults, strike-slip (lateral) fault zones, caldera bounding structures, low angle detachment faults, and regional thrust faults (Welch et al. 2007; Heilweil and Brooks 2011). Fifty faults (or fault zones) have been represented in the numerical model (Figure 4-11, p. 4-20, SNWA 2009b). The hydraulic conductivities for these faults were treated as parameters and were estimated during the model calibration process.

Recharge. Recharge refers to infiltration of precipitation or stream flow into the groundwater system. Recharge is the primary mechanism for replenishment of groundwater supplies within the region. Groundwater recharge cannot be measured directly in the field for areas as large as the model area. Groundwater recharge is spatially and temporally variable and its distribution is affected by many factors, including the amount and type of precipitation, topography and the hydrogeology of the unsaturated zone as well as the saturated zone.

The spatial distribution of precipitation across the region was estimated based on an averaged 30-year historical record (PRISM normal precipitation grid). This precipitation grid was used because it is recognized as the best available spatial climate data for the region. Recharge from precipitation was estimated using the groundwater balance method whereby recharge was calculated as the difference between total volume of groundwater discharge (i.e., groundwater ET plus subsurface outflow) and the volume of subsurface inflow as described in SNWA 2009a. This methodology was used to estimate an annual potential recharge by basin. The potential recharge from precipitation for a given area was then proportioned using hydrogeologic factors into in-place recharge and runoff recharge (i.e., infiltration down gradient and along streams).

Groundwater recharge is input into the numerical model as an average annual rate that is held constant during the entire modeling period. The model is not set up to simulate wet and dry cycles, or seasonal fluctuations. The actual rates, distribution, and timing of recharge remain very uncertain and therefore, the current model cannot provide a realistic simulation of wet and dry cycles over the region of study.

Evapotranspiration and Spring Flow. Groundwater discharges to the surface in ET areas or as spring or stream flow. Groundwater ET estimates were derived by delineating different types of ET areas and applying appropriate ET rates to estimate ET flow (SNWA 2009a). The groundwater discharge to ET areas and selected springs was simulated as drains in the numerical model. Large springs and streams controlled by groundwater discharge in Pahranagat Valley, Muddy River Springs Area, and Big Springs were simulated as streams in the model where the springs may flow upward through a number of layers, gaining or losing water along the route, and the spring discharge to streams at the surface can infiltrate into the flow system downstream from the spring orifice.

Boundary Conditions. Potential locations where flow could occur initially were identified based on the three-dimensional hydrogeologic framework (SNWA 2008). Boundary segments where the geologic conditions were favorable for flow were further evaluated using available water-level data, interpretive hydrogeologic framework information, and estimates from previous studies. Estimates of flow across external model boundaries are presented in SNWA 2009a. These flow estimates were used as flow observation targets during steady-state calibration of the model. The length of the flow segments were modified in some locations based on testing during the model calibration process and additional evaluation of geologic data as described in the numerical modeling report (SNWA 2009b). Flow into and out of the perimeter of the model was simulated by constant head cells. The locations of the constant head boundaries used in the model are described by basin (SNWA 2009b). The initial constant-head values assigned in the model were derived from published information (SNWA 2009b). However, the constant-head values were treated as model parameters that were adjusted during the model calibration process.

Calibration Process. Calibration entails adjustment of input parameter values to identify a set of parameter values that agrees with field observations and causes hydraulic heads and flows calculated by the model to generally match hydraulic heads and flows measured in the field. Model calibration can provide estimates of parameters that cannot be measured directly.

The model was calibrated to both steady-state and transient stress periods. The initial steady-state period represents predevelopment conditions prior to 1945. The transient calibration period extends from 1945 to 2004.

During the model calibration, the conceptual model represented in the numerical model was modified (or refined) to yield a better fit to field observations. The calibration was accomplished primarily through a trial and error, iterative process. During the model calibration process, variations in the: 1) hydrogeologic framework; 2) external flow boundaries; 3) recharge processes; and 4) discharge areas were tested and major improvements in model fit were retained in the final calibrated model. Major model refinements that were developed during the calibration process are briefly described below and discussed in detail in SNWA 2009a and 2010a.

Two conceptual models were considered during early stages of model development. The first model consisted of assigning rocks in mountain blocks with very low hydraulic conductivities; the second model assigned rocks in mountain blocks with moderately low hydraulic conductivities, combined with faults with low cross-fault transmissivity (i.e., flow barriers). The second conceptual model was adopted for the final model because this model configuration generally improved the calibration by: 1) improving the simulation of hydraulic head elevations in the mountain blocks; 2) eliminating or substantially diminishing the overall size of areas where the earlier model-simulated water levels above the ground surface; and 3) allowing for the simulation of large spring discharges (that in many cases, could not be simulated without the fault barrier) (SNWA 2009b). Subsurface data, aquifer test data, and water-level monitoring data are not available in most areas to evaluate if the major regional faults act as barriers to flow. One example of where there is water-level data across a major normal fault zone is in Dry Lake Valley and Patterson Valley where substantial drops in groundwater elevations across two normal faults appear to be controlled by faulting rather than mountain block bedrock characteristics (SNWA 2009b). In addition, major fault zones typically consist of a wide range of characteristics, including a single slip or multiple slip surfaces, unconsolidated clay-rich gouge, breccia zones, chemically altered zones, or mylonite zones. The generation of fine-grained materials and alteration and mineral precipitation tends to reduce the porosity and permeability of the primary fault zone, compared to the adjacent unfaulted bedrock materials (Caine et al. 1996). Therefore, it is plausible that major regional fault structures could behave as impediments to groundwater flow. The hydraulic properties of the materials along the external flow boundaries are largely unknown. The external flow boundaries were adjusted during the model calibration process (SNWA 2009b) to improve the model representation of hydraulic heads (i.e., groundwater elevations) and ET and spring discharge to more closely match field observations. The modifications of the external flow boundaries were consistent with the current understanding of the hydrogeologic conditions in these areas (SNWA 2009b).

The amount of recharge was not modified during final calibration. However, the runoff distribution paths were adjusted manually to reduce unrealistic simulated mounds in the water table. Modifications during calibration typically consisted of extending the distribution path to resolve the mounding problem. Other refinements were made to better constrain the distribution of ET across valley bottom areas and improve spring discharge rates (SNWA 2009a).

Detailed comparisons between measured or estimated values and model-simulated values are provided in the numerical model report (SNWA 2009b). Overall, the model results indicate that the calibrated model is a reasonable representation of the regional groundwater flow system. The aquifer parameters incorporated into the model generally lie within the range of estimated values for the HGUs. The distributions of hydraulic conductivity values generally are consistent with the conceptual model. Transmissivities, while high in some areas, are reasonable overall.

Model Uncertainty

Major sources of uncertainty inherent in the regional model results are associated with incomplete or limited information for the region, or generalizations required for model construction including:

- Limitations regarding the current understanding of the hydrogeologic framework that controls groundwater flow throughout the region;
- Limitations resulting from the gross simplification of hydrogeologic conditions required for construction of a regional scale model;
- Limitations and generalizations imposed by the use of a 1-kilometer (3,281 feet) grid cell width;
- Assumption of homogeneity within a given regional model unit or parameter zone as a result of data limitations and generalizations;
- Uncertainty regarding the mean recharge and spatial distribution of recharge across the region; and
- Uncertainties regarding the hydraulic interconnection between the groundwater flow system throughout the region.

There is uncertainty regarding the final set of aquifer parameters used to represent the HGUs across the region. A sensitivity analysis was performed by adjusting the hydraulic conductivity and storage properties simultaneously and within a reasonable and plausible range, to evaluate how this adjustment in parameters could change the drawdown results. The results of this sensitivity analysis (using the Alternative A pumping scenario) are provided in Figure 5-2 in SNWA 2010b. The results indicate that shifting these aquifer parameters within a plausible range would expand the areal extent of the area encompassed within the 10-foot drawdown contour. The changes in parameter values used in this sensitivity analysis, however, reduced the model fit compared with the calibrated model (SNWA 2010b).

Groundwater model solutions are not unique. In other words, the choice of parameter values and boundary conditions is not unique and other combinations of parameter values and boundary conditions may provide an equally justified calibrated model that also approximates the groundwater flow system. However, predictions from that model may differ from the current predictions. In addition, it is well established that groundwater models cannot be validated (Konikow and Bredehoeft 1992). Konikow and Bredehoeft explain that calibration is "only a limited demonstration of the reliability of the model." The term "validation" has been used to describe the successful simulation of a post-calibration stress to the groundwater system. However, one such success does not assure that the model will reliably predict a different future stress. Konikow and Bredehoeft note that realistic expectations of models "will help to shift emphasis towards understanding complex hydrogeological systems and away from building false confidence into model predictions." Although false confidence cannot be placed in numerical models, it is more realistic that hydrologists build a reasonable model that uses field information to estimate future conditions than to ignore such capability in lieu of less rigorous estimates. The goal is for the numerical model to reasonably represent the system.

Additional uncertainties are associated with the observation data sets (such as hydraulic head measurements, ET discharge estimates, and historic groundwater pumping estimates) used for calibration. These and other model uncertainties are discussed in detail in the transient model report and model simulation reports (SNWA 2010a,b; 2009b,c).

Climate Change. Section 3.1.3.2, Climate Change Effects to All Other Resources, discusses the current research into climate change and predicted future trends for the Great Basin and provides a discussion of the range of potential effects on water resources. Current climate change models suggest that within the study area, mean temperatures are expected to rise and annual precipitation is likely to remain similar to present conditions as the century progresses (Redmond 2009). However, there is insufficient information available to predict how changes in climate would affect the rate of groundwater recharge in the region. Because of the uncertainties regarding potential effects of climate change on the groundwater flow system, it was not possible to provide a reasonable or meaningful simulation of the combined effects of pumping and climate change on water resources.

Model Limitations

All models have limitations and the CCRP model is no exception. A detailed discussion of the model limitations and accuracy of the model to reproduce measured groundwater levels and estimated groundwater budget components is provided in the numerical model report (SNWA 2009b). Although the model results provide valuable insight as to the general, long-term drawdown patterns and relative trends likely to occur from the various pumping scenarios, the model does not have the level of accuracy required to predict absolute values at specific points in time (especially decades or centuries into the future). Two major limitations of the model for predictive studies include: 1) a lack of reliable information regarding the hydraulic properties of faults included in the model; and 2) representation of future climate as discussed below.

Regional information suggests that the presence of faults throughout the region strongly influences the movement of groundwater. However, reliable estimates of hydraulic properties of faults included in the model are not available. Considering the size of the study area, number of faults, and the fact that these properties likely would vary both horizontally and vertically along these structures, it is not practical (and likely would be impossible) to collect reliable estimates of hydraulic parameters for all of the major faults in the region of study. It also is probable that other faults exist in the model area that have not been identified or incorporated into the model. This pervasive lack of information regarding fault hydraulic parameters is considered a major limitation of the model. As described previously, 50 faults (or fault zones) have been represented in the numerical model (Figure 4-11, p. 4-20, SNWA 2009b). The hydraulic conductivities for these faults were treated as model parameters and were estimated during the model calibration process. Most of the major regional faults included in the calibrated model are represented as low permeability structures that inhibit flow across the fault zones. The presence of these structures in the model tends to influence the pattern and magnitude of drawdown simulated by the model.

Another limitation is that the recharge estimates used as model input assumes that the same average precipitation rate and pattern observed over approximately the past 30-year period is representative of the average conditions that will occur over the 245-year future simulation period (i.e., assumption that the annual recharge rates do not vary over the 245-year future simulation period [2005 – 2250]). For this reason, the calibrated model should not be considered an accurate or precise predictor of future conditions because it does not account for variations in future climate conditions that cannot be accurately forecasted at this time.

Conclusion. Although there are inherent uncertainties and limitations associated with results of a regional groundwater flow model over a broad region with complex hydrogeologic conditions, the calibrated CCRP model is a reasonable tool for estimating probable regional-scale drawdown patterns and trends over time, resulting from the various pumping alternatives that were evaluated. When combined with the baseline information on water resources in the study area, the simulated drawdowns, flow estimates, and water budget estimates provide reasonable and relevant results for analyzing the probable regional-scale effects and comparing alternatives for this programmatic level analysis.

Defining the Drawdown Area

For this impact analysis, the model-simulated area where the water table would experience a change (decrease) in groundwater elevation of 10 feet or more is defined as the "drawdown area." The 10-foot drawdown contour is used as a frame of reference to identify water-dependent water resources within the drawdown area that may be at risk, and for comparison of the potential effects between the various pumping scenario alternatives. Drawdowns of less than 10 feet could reduce flows in perennial springs or streams that are controlled by discharge from the regional groundwater flow system, which in turn potentially could cause declines in the diversity and abundance of associated riparian flora and fauna that may only be able to tolerate water declines on the order of a few feet. However, considering the regional scale of the model and unavoidable uncertainty associated with the model predictions (summarized below), the BLM does not believe that it is reasonable or appropriate to use the regional model to quantify changes in groundwater elevation of less than 10 feet. In addition, in many areas within the study area, changes in groundwater levels of less than 10 feet can be difficult to distinguish from natural seasonal and annual fluctuations in groundwater levels. The BLM has used the 10-foot drawdown contour to define the drawdown area for quantification of impacts associated with groundwater pumping in many other EISs in Nevada over the past 10 to 15 years[1]. The BLM recognizes that refinements, such as the collection of additional site-specific hydrologic information and model refinement (such as the development of embedded models in specific areas of interest) would be necessary to improve the ability to predict drawdown impacts at a more localized scale.

The drawdowns used in the impact evaluation were calculated as follows:

- For the No Action pumping scenario, the drawdowns results are calculated as the difference between the initial hydraulic heads (those simulated at the end of 2004 by the calibrated numerical model) and the simulated hydraulic head for the specific time frame.
- The drawdowns presented for the Proposed Action and Alternatives A through F pumping scenarios represent the estimated incremental drawdown attributable to each specific pumping scenario without the effects of the No Action pumping. These were calculated as the difference between the total drawdown simulated by the combined No Action pumping scenario plus the specific groundwater development pumping scenario (included in the Proposed Action or Alternatives A through F) subtracted from the No Action drawdown results for the specific time frame.
- The results for the cumulative pumping scenarios represent the combined effects of: 1) continuation of the No Action pumping scenario in the future; 2) addition of identified reasonably foreseeable future pumping actions; and 3) pumping associated with groundwater development project (Proposed Action or Alternatives A through F pumping scenarios). All of the drawdown results for the cumulative analysis were calculated as the difference between the initial hydraulic heads (those simulated at the end of 2004 by the calibrated numerical model) and the simulated hydraulic head for the specific time frame.

Spring and Stream Impacts Evaluation

Potential impacts to springs and streams were evaluated by identifying and evaluating the potential risk to all known or suspected perennial water sources in the defined drawdown area using the methodology described below. Because of the regional nature of the groundwater flow model and model limitations discussed previously, it is not possible to accurately predict site-specific changes in flow for springs or streams. However, the model is viewed as a useful and relevant tool for predicting flow trends resulting from the various pumping scenarios at selected springs and streams, primarily those with large flows that likely represent discharge from the regional groundwater flow system. These flow predictions were used to evaluate: 1) if and when impacts to flow were likely to occur; and 2) the relative magnitude of change that could occur. The methodology used for each of these evaluations is summarized below.

<u>Identification of Springs and Streams Susceptible to Drawdown Impacts</u>

The springs and streams in the region can be characterized as either ephemeral, intermittent, or perennial. Ephemeral and intermittent springs and stream reaches flow only during or after wet periods in response to seasonal runoff. By definition, these surface waters are not controlled by discharge from the regional groundwater flow systems. During the low-flow period of the year, ephemeral and intermittent springs and stream reaches typically are dry. In contrast, perennial springs and stream reaches generally flow throughout the year. Flows observed during the high-flow periods

[1] A few Nevada BLM EIS examples include: Final EIS Cortez Hills Expansion Project, September 2008; Final EIS Phoenix Project, January 2002; Draft SEIS Barrick Goldstrike Mines Inc. Betze Project, September 2000; Draft EIS Leeville Project, March 2002; Final EIS Newmont Mining Corporation South Operation Area Project Amendment, April 2002.

in perennial springs and streams include a combination of surface runoff and groundwater baseflow discharge, whereas during the low-flow period, flows are sustained entirely by baseflow discharge from the groundwater system. If the flow from the perennial spring or stream is controlled by discharge from the aquifer used for the GWD Project, a reduction of groundwater levels from well field production could reduce the groundwater discharge to perennial springs or streams with a corresponding reduction in spring flows, lengths of perennial stream reaches, and their associated riparian/wetland areas.

The actual impacts to individual seeps, springs, or stream reaches would depend on the extent of drawdown that occurs in the area, and the interconnection between the surface water feature and the aquifers affected by drawdown. The interconnection (or lack of interconnection) between the perennial surface waters and deeper groundwater sources is controlled by the specific hydrogeologic conditions that occur at each site. Considering the complexity of the hydrogeologic conditions over this broad region, inherent uncertainty in numerical modeling predictions (discussed above) related to the exact areal extent and magnitude of drawdown, and uncertainty in the site-specific hydrogeologic conditions controlling flow at most of the springs within the model domain, it is not possible to conclusively identify specific springs and seeps that would show effects from future drawdown from the various pumping scenarios considered in this analysis. However, the regional model results, coupled with a generalized understanding of the groundwater flow system, provide the most reasonable means available at this time to identify areas where impacts associated with the proposed action (or alternative) pumping are likely to occur. This drawdown impact evaluation for springs and streams is limited to a prediction of areas of risk with the recognition that actual impacts to individual springs and streams distributed over this broad region cannot be determined precisely prior to pumping.

Potential impacts to all perennial streams and springs located within the defined drawdown area were evaluated by:

1. Identifying perennial streams and springs within the model-simulated drawdown area (defined by the 10-foot drawdown contour at various future points in time); and
2. Evaluating the likely source of the water to identify water resources that potentially are susceptible to groundwater development drawdown impacts.

Baseline information for perennial springs and streams in the study area is summarized in Section 3.3.2. The spring databases compiled for this project include two types of data: 1) inventoried springs, and 2) other springs. For the purposes of this study, “inventoried springs” are springs that have been field verified and include one or more flow measurements. “Other springs” are mapped spring locations that have not been field verified and therefore do not include flow measurements. The other springs were identified based on locations shown on topographic maps or included in the National Hydrography Database.

As described in Section 3.3.1.3, Hydrologic Cycle and Conceptual Groundwater Flow, the conceptual model indicates that springs are controlled by local, intermediate, or regional flow systems. For this impact analysis, it is assumed that the intermediate and regional groundwater flow systems are hydraulically connected within the drawdown areas. For the purposes of discussion, unless otherwise specified, the use of the term “regional groundwater flow system” in the remainder of this document refers to the combined intermediate and regional groundwater flow systems described in Section 3.3.1.3.

The water resource impact analysis uses the geomorphic setting (i.e., valley floor, valley margin, and upland areas) defined in **Table 3.3.2-3**, combined with water level data, to identify the general risk level for each perennial water source within the simulated drawdown areas. For this analysis, springs in upland areas (i.e., high elevation regions or mountain block settings) are assumed to be controlled by discharge from local or perched groundwater systems that are unlikely to be hydraulically connected to the regional groundwater flow system that would be affected by groundwater withdrawal. Therefore, the analysis assumes that the risk of impacts to springs and perennial stream reaches located in upland settings is considered low regardless of the drawdown in the regional groundwater flow system that may occur beneath these areas.

Springs located in valley floor settings are assumed to be controlled predominantly by discharge from the regional groundwater flow system. The impact analysis further assumes a high risk of impacts to most springs (and associated stream reaches fed by springs) that discharge on the valley floors within the drawdown area. It is important to recognize that perched aquifers may occur in localized valley floor settings; however, localized perched aquifers in valley floor settings are not identified or evaluated as part of this regional impact assessment.

Table 3.3.2-3 Assumptions Used to Evaluate Potential Impacts to Perennial Water Resources Located Within the Drawdown Area

Generalized Geomorphic Setting	Predominant Groundwater Flow System Assumed to Control Discharge to Perennial Springs and Streams	Relative Risk of Impacts to Perennial Water Resources within the Drawdown Area	Explanation
Upland Areas	Local or Perched	Low	Impacts are unlikely to occur regardless of predicted model drawdown.
Valley Margin Areas	Local and Intermediate[1]	Moderate[2]	Impacts to some perennial waters may occur in springs discharging from aquifers hydraulically connected to the regional flow system. Impacts are unlikely to occur to perennial waters discharging from local or perched groundwater flow systems that are not hydraulically connected to the regional flow system.
Valley Floor Areas	Regional	High[2]	Impacts are likely to occur to perennial water resources that depend on discharge from the regional groundwater flow system. Impacts are unlikely to occur in localized perched aquifers that occur in some areas.

[1] Intermediate flow system is assumed to be interconnected with the regional flow system.
[2] Except where available, water-level data indicates that surface water resources are likely perched or hydraulically isolated from the regional groundwater flow system (see text for further explanation).

Springs (and stream reaches fed by springs) located in valley margin settings may be controlled by discharge from local, intermediate, or in some instances, regional groundwater flow systems. The actual discharge source for each spring or stream reach in these areas is controlled by site-specific hydrogeologic conditions that typically are not well understood. Considering the uncertainty associated with the source of groundwater discharge for individual springs and hydraulic interconnection between the spring source and the aquifer systems that would be affected by groundwater pumping, the impact analysis assumes that there is a moderate risk of impacts to springs (and stream reaches fed by springs discharging in these areas) located within the valley margin setting in the drawdown area.

The geomorphic settings (i.e., valley floor, valley margin, and upland areas) were determined for each basin within the study area using slope, elevation, and geology (based on the simplified hydrogeologic framework used to construct the numerical flow model provided in SNWA 2009b). The valley floor area was defined as the flat valley bottoms with the lowest elevations within each basin. The valley floor areas are underlain by unconsolidated basin-fill deposits. The valley margin areas generally are characterized by the intermediate slope and intermediate elevation zones between the flat valley floor and steeper bedrock areas in the mountain block. The valley margin areas generally are underlain by alluvial fans but may locally include bedrock, including carbonate bedrock units, which extend beneath the valley floor areas and their associated basin-fill deposits. The upland areas are characterized as higher elevation areas with typically steeper terrain that is predominantly underlain by bedrock.

Site-specific water-level data is not available in all locations to evaluate if perennial water resources are likely or unlikely to be connected to the regional groundwater system. Available depth-to-water data for the region is provided in the baseline characterization report (SNWA 2008 Volume 4), supplemented in Snake Valley with new information collected by UGS (2010). The data points (i.e., wells) with water-level data are spatially variable between the different geomorphic settings. Depth-to-water information is scarce to nonexistent in most upland areas, available locally in some areas within the valley margin zone, and typically available in the valley floor areas in most basins. However, the number of data points within the valley floor areas varies greatly between basin and by area within each basin. In most areas, the depth-to water data correlates with the geomorphic setting in that shallow water levels (less than 100 feet) generally occur in valley floor settings, and deeper water levels (greater than 100 feet) generally occur in the valley margin and upland areas. The areas of potential high risk initially identified using the geomorphic setting (summarized in **Table 3.3.2-3**) were adjusted in some areas if there was sufficient water-level data to demonstrate that the depth to the regional water table was relatively deep for a particular region or hydrographic basin. Specifically, if there were sufficient data to demonstrate that the depth-to-water in the valley floor setting was greater than 100 feet, the level of risk was adjusted to “moderate risk”; if the water level data indicated that the depth-to-water was greater than 150 feet, the risk level for that area was adjusted to “low risk”. For example, in Delamar Valley, the depth-to-water is greater than 800 feet below ground surface indicating that surface water resources in this basin are not controlled by discharge from (or are hydraulically connected to) the regional groundwater system in this basin that would be affected by the proposed groundwater withdrawal. Therefore, the potential risk to surface water resources in the Delamar Valley hydrographic basin are assumed to be low (i.e., impacts are unlikely to occur regardless of drawdown) even if these resources occur in a valley floor or valley margin setting.

Identification of Springs and Streams Susceptible to Drawdown Impacts within and Adjacent to Great Basin National Park

As described previously, this analysis uses the geomorphic setting (i.e., valley floor, valley margin, and upland areas) combined with site-specific water-level data to identify the general risk level for each perennial water source within the predicted drawdown areas. This analysis has identified springs and perennial stream reaches located in lower elevation areas along the valley margin area of the park where surface waters could be impacted. The USGS has conducted a more detailed, site-specific study within GBNP and adjacent areas in Spring Valley and Snake Valley to evaluate the susceptibility of surface water resources to groundwater pumping. This study is described below.

The NPS requested a study by the USGS to identify areas within the GBNP where surface water resources are susceptible to groundwater pumping in the valleys adjacent to the park. The results of this study were published in the USGS report "Characterization of Surface-Water Resources in the GBNP Area and Their Susceptibility to Ground-Water Withdrawals in Adjacent Valleys, White Pine County, Nevada” (Elliott et al. 2006). The study assessed surface water resources to identify areas vulnerable to groundwater pumping effects. The results of the study delineated specific areas within and near the park; these areas were defined as follows:

(1) “Areas where surface-water resources likely are susceptible to ground-water withdrawals;” and

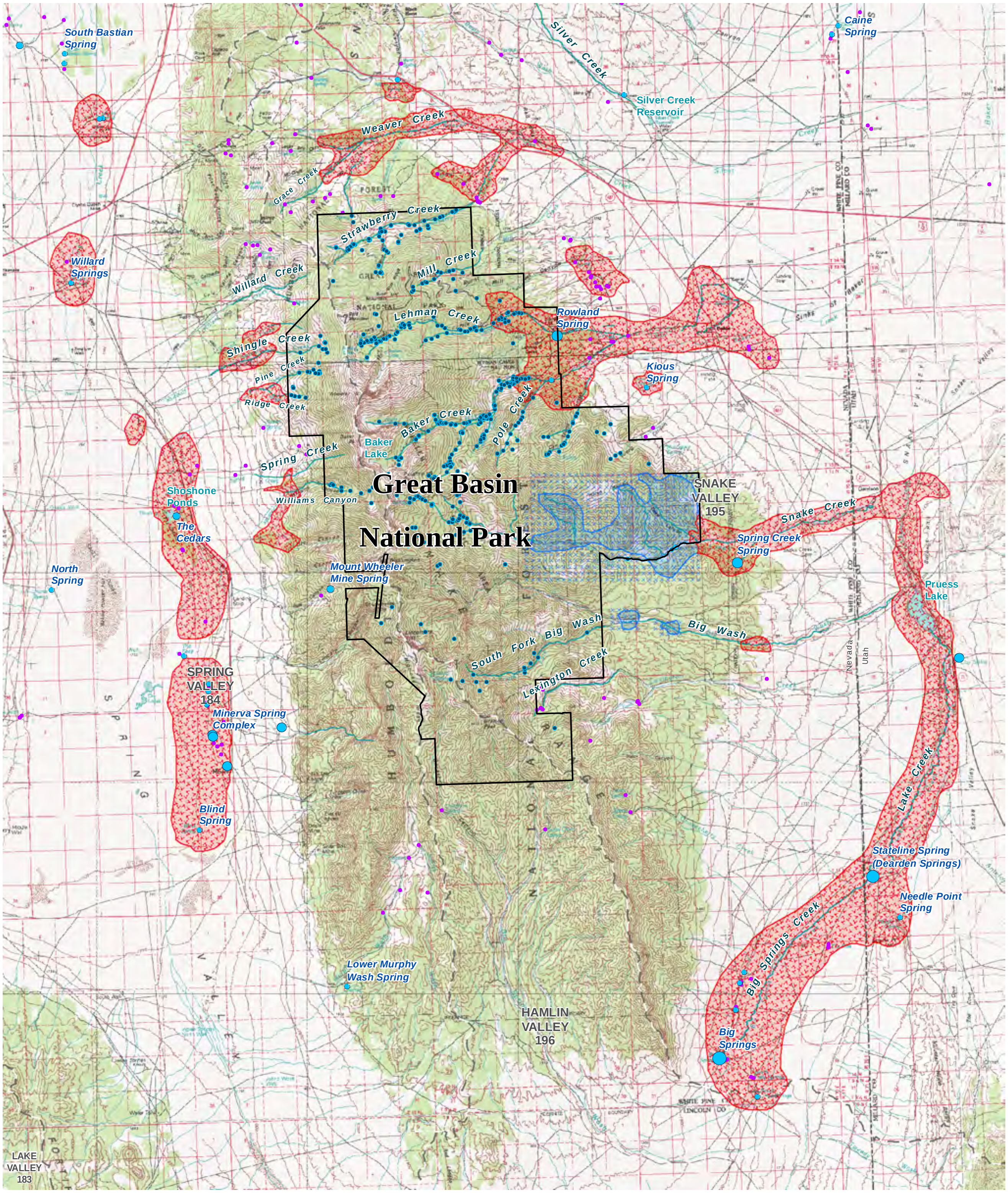
(2) “Areas where surface-water resources potentially are susceptible to ground-water withdrawal.”

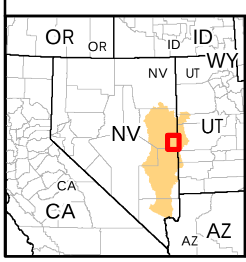
Prudic (2006), a coauthor of the susceptibility study, provided responses to comments on the susceptibility study that included an explanation of the difference between the two types of susceptibility areas identified on Plate 1. Prudic explained that the ‘likely susceptible” areas are more vulnerable to groundwater pumping effects than the “potentially susceptible areas.” He also states in the concluding summary of this document that “Results from the study indicate that surface-water resources in most of the Park are not susceptible to ground-water pumping in the adjacent valleys. However, we identify a few areas area within and near the Park’s boundaries that are susceptible (potentially or likely); these warrant additional monitoring and study.” As described in Section 3.0.3, Incomplete and Unavailable Information, the USGS and the University of Nevada, Reno (UNR) are in the process of completing a study entitled *A Study of the Connection Among Basin-Fill Aquifers, Carbonate-Rock Aquifers, and Surface-Water Resources in Southern Snake Valley, Nevada.* Additional studies also are ongoing to investigate the source of water in caves and interconnection between the caves and the groundwater flow system (Van Liew 2012; USGS 2008).

The areas identified in and adjacent to the park as “likely susceptible to groundwater withdrawal” (Elliott et al. 2006) are shown on **Figure 3.3.2-1** and include:

Spring Valley Hydrographic Basin:

- Shingle Creek (middle and lower reaches along the west boundary of the park)
- Pine and Ridge creeks (middle and lower reaches along the west boundary of the park)
- Williams Canyon (middle and lower reaches along the west boundary of the park) and adjacent Shoshone Ponds and Minerva spring complexes





Inventoried Springs Discharge (gpm)
- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach

- Lake or Pond
- Great Basin National Park
- Hydrographic Basin

Surface Water Susceptibility to Ground-Water Withdrawals[1]
- Area where surface-water resources likely are susceptible to groundwater withdrawals
- Area where surface-water resources potentially are susceptible to ground-water withdrawals

[1]USGS SIR 2006-5099 Elliot, P.E., Beck, D.A., and Prudic, D.E., 2006

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-1

Surface Water Susceptibility Zones Great Basin National Park

0 1 2 3 4 5 Miles
0 2 4 8 Kilometers
1:275,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Snake Valley Hydrographic Basin:

- Weaver Creek (full reach along the north boundary of the park)
- Strawberry Creek (lower reaches) and adjacent springs (along the north boundary of the park)
- Lehman and Baker creeks (middle to lower reaches), and Rowland and Cave springs (along the northeast boundary of the park)
- Snake Creek and its tributary Spring Creek Tributary (lower reach along the eastern boundary of the park)
- Big Wash (lower reach east of the park boundary)
- Big Springs Creek/Lake Creek and associated springs (full reach from Nevada into Utah, southeast of the park boundary)

The areas identified in and adjacent to the park as "potentially susceptible" to groundwater withdrawal (Elliott et al. 2006) also are shown on **Figure 3.3.2-1** and include:

- Snake Creek and its tributaries (middle reach located upgradient of the likely susceptible lower reach)
- Big Wash (middle reach below confluence of North and South Forks of Big Wash, east of the park boundary)

The risk analysis used for this regional water resource impact evaluation has incorporated the results of the Elliot et al. (2006) study by assuming that there is a moderate risk of impacts to perennial water resources located within the susceptibility zones as defined on **Figure 3.3.2-1** within the boundaries of GBNP. For this analysis, the susceptibility zones delineated in **Figure 3.3.2-1** that occur outside park boundaries are defined as moderate or high risk depending on whether the perennial resources in these areas occur in the valley margin or valley floor setting, respectively.

Evaluation of Model-simulated Stream Flow Results

The numerical groundwater flow model was used to simulate changes in baseflow in a few selected springs and streams resulting from the Proposed Action and alternatives. The specific methods used to simulate spring and stream flow in the numerical model is provided in the model documentation (SNWA 2009b). Baseflow is the groundwater component of surface water flow and is distinct from the contributions to streamflow associated with runoff from precipitation or snowmelt. There is a high level of uncertainty associated with long-term simulations of changes in baseflow (or groundwater discharge) in streams and springs distributed over large regions. The numerical model encompasses over 20,000 square miles. As discussed previously, the groundwater flow model is based on a conceptual model that represents a simplified and generalized understanding of the hydrogeologic and hydrologic conditions over a very large region. A major source of uncertainty is the hydraulic interconnection between the regional groundwater flow system and the springs and streams represented in the model. Due to the simplified assumptions in the model and unknown or poorly-understood conditions that control flow in most of the springs and streams, the baseflow may not change as predicted by the model.

Considering the limitations of the regional model and inherent uncertainty associated with the flow predictions, the model-simulated spring flows are used in this analysis to identify major spring discharge areas outside of the identified drawdown area (including White River Valley, Pahranagat Valley, Muddy River, Big Springs, and Gandy Warm Springs in Snake Valley) where potential flow reductions could occur; they also are used to provide an indication of potential trends in flow that are likely to occur to springs located both within and outside the defined drawdown area. However, as explained previously, considerable uncertainty exists regarding the accuracy of these predictions. Therefore, it is not reasonable to use the results to predict the absolute change in flow over the long-term simulation period.

For the springs or streams with flow predictions, a simulated incremental change in flow of less than 5 percent was inferred to indicate that measureable impacts were unlikely to occur. A less than 5 percent reduction of flow would be difficult to accurately measure or distinguish from natural fluctuations and is presumed to be within the model uncertainty. The impact analysis further assumes that springs with model-simulated flow reductions of 5 percent or greater could be affected.

Big Springs Flow Predictions. An earlier version of the numerical model was set up such that a low permeability HFB was used to control the discharge at Big Springs (SNWA 2009b). The HFB was situated immediately east of Big Springs at the location of a local Quaternary fault. This model construction was able to closely approximate the discharge at Big Springs. However, the placement of the north-south fault barrier immediately east of the spring, and the assumed distribution of pumping wells on the east side of the fault restrict the drawdown impacts to Big Springs. The geologic map and cross-section provided in the baseline report indicate that the simulated fault is subparallel to a major range-bounding fault located approximately 0.75 mile to the west of Big Springs (SNWA 2008) that was not simulated in this version of the model. After review of the model construction, the BLM technical review team requested that the model be modified in southern Snake Valley that consisted of shifting the position of the HFB to essentially match the major range-bounding fault. In the final calibrated model used for the EIS, the HFB in the area of Big Springs was moved to the west to closely match the location of the range-bounding fault, as requested by the BLM (SNWA 2010a). As a result of this move, the local fault situated east of Big Springs on the valley floor was no longer represented in the regional model.

With this revised configuration, the model was only able to simulate discharge of about one-half of the observed discharge at Big Springs. It was not possible to simulate a larger spring discharge without drastic changes to the numerical model (SNWA 2010a). However, this fit to the observed discharge is similar to the quality of fit at other locations in the model. Because of this different representation of the spring in the earlier and final version of the models, the decrease in springflow caused by pumping is different. The spring discharge simulated by the original model decreases following a gentle slope. By the end of the simulation period, spring discharge has been reduced by less than a third of the rate in 2005. The spring discharge simulated by the modified numerical model decreases following approximately the same rate of decrease as the one simulated by the original model until about the year 2050 (when pumping is initiated in Snake Valley). After that time, the rate of decrease increases drastically causing the discharge at the spring to cease (SNWA 2010b). These alternative model configurations illustrate that there is considerable uncertainty regarding the hydrogeologic conditions that control the groundwater discharge at Big Springs. Therefore, the simulated reduction in flows should not be viewed as reliable predictions of future flows at specific points in time in the future. Rather, these flow predictions from the regional model should be viewed as indicators of the potential risk to the spring associated with pumping in southern Snake Valley and Spring Valley.

Water Rights Impact Evaluation

This impact evaluation is not intended to determine reasonable (or unreasonable) effects to water rights allowable under state law such as the Nevada Statue (NRS 534.110{4}) that allows for a reasonable lowering of the static water level at the points of diversion for existing water rights provided that the existing water rights can be satisfied. The water rights impacts evaluation is intended to provide a disclosure of potential effects to existing surface and groundwater rights resulting from the various proposed pumping alternatives.

Active water rights including their points of diversion and manner of use were identified within the hydrologic study area as described in Section 3.3.1.5, Groundwater Resources. The impact assessment was conducted by overlaying the predicted drawdown on the water right points of diversions to identify water rights that may be affected. For surface water rights, it was assumed that water rights located within the model-simulated drawdown area (defined by the 10-foot drawdown contour) and located within the identified high and moderate risk areas previously described for perennial water could be affected. It also was assumed that groundwater rights located within the same defined drawdown area could be affected. Groundwater rights were further evaluated by determining the magnitude and timing of the drawdown at the points of diversions. Potential impacts to surface water rights and groundwater rights were summarized by determining the number of water rights potentially affected in each hydrographic basin for each alternative. Additional information regarding uncertainty associated with the water rights impact assessment is presented under the Proposed Action drawdown effects analysis.

Presentation of Results

The results of the groundwater pumping analysis are summarized by alternative in the following section. Additional details and the supporting information used to develop the summaries and quantification of potential impacts to water resources are provided in the substantial material in **Appendices F3.3.7** through **F3.3.16**. This includes the following information provided for each pumping scenario and comparison time frame (i.e., full build out, full build out plus 75 years, and full build out plus 200 years).

- Drawdown maps for each pumping scenario at each time frame (**Appendix F3.3.7**);
- Maps delineating the risk to perennial surface water resources within the predicted drawdown areas (**Appendix F3.3.8**);
- Tables listing the number of springs by basin that occur within the high, moderate, and low risk areas for each pumping scenario and time frame (**Appendix F3.3.9**);
- Tables identifying the inventoried springs that occur within the moderate and high risk areas for each pumping scenario and time frame (**Appendix F3.3.10**);
- Tables listing the miles of perennial stream within areas where effects to surface waters could occur for each pumping scenario and time frame (**Appendix F3.3.11**);
- Maps illustrating the risks to surface water rights by manner of use within the drawdown areas for each pumping scenario and time frame (**Appendix F3.3.12**);
- Tables defining the risk to surface water rights by basin within the drawdown areas for each pumping scenario and time frame (**Appendix F3.3.13**);
- Maps illustrating the drawdown effects to groundwater rights by manner of use for each pumping scenario and time frame (**Appendix F3.3.14**);
- Tables defining the risk to groundwater rights by basin within the drawdown areas for each pumping scenario and time frame (**Appendix F3.3.15**); and
- Tables presenting the simulated groundwater budgets by basin and flow system for each pumping scenario and time frame (**Appendix F3.3.16**).

3.3.2.9 Proposed Action

Groundwater Development Areas

Groundwater development areas have been identified in the five groundwater development basins (i.e., Spring, Snake, Delamar, Dry Lake, and Cave valleys). Groundwater development areas are located in portions of the valley floor and valley margins within each basin. Development within the groundwater development areas would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been identified at this stage of the project and will be subject to future site-specific NEPA analysis.

Construction and Operation

Springs identified within the groundwater development areas are summarized in **Table 3.3.2-4**. Under the Proposed Action, there are 60 springs located within the boundaries of the development areas. Of these 60 springs, 13 have been verified in the field and include flow data. The remaining 47 springs were identified based on locations shown on topographic maps or included in the National Hydrography Database. These springs occur within the groundwater development areas within Spring Valley (37 springs), Snake Valley (11 springs), Delamar Valley (7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring).

There also are 28 separate perennial stream reaches with a total length of 29 miles that occur within the groundwater development areas (**Table 3.3.2-5**). This includes 23 perennial stream reaches (total length of 20.2 miles) located in Spring Valley and 5 (total length of 8.8 miles) located in Snake Valley.

The potential for impacts to springs and streams located within these groundwater development areas would depend on the location of facilities. For this programmatic analysis, it is assumed that the ACMs discussed for construction of the primary ROWs that address surface water resources, stream crossings, and erosion control measures would apply to these future ROWs. In addition, SNWA Programmatic Measures indicate that: 1) well pads would avoid riparian and wetland areas (ACM B.1.1); and 2) as feasible, collector pipeline, electrical service lines, and substations would avoid wetlands and stream crossings (ACM B.1.3). Implementation of these combined measures would minimize impacts to perennial water sources associated with the well field development.

Table 3.3.2-4 Number of Springs Located within the Groundwater Development Areas

Alternative				Proposed Action, A and C		B		D		E and F	
GW Flow System	Basin #	Basin Name	Name	Inv. Spg.[1]	Other Spgs.[2]	Inv. Spg.[1]	Other Spgs.[2]	Inv. Spg.[1]	Other Spgs.[2]	Inv. Spg.[1]	Other Spgs.[2]
White River	180	Cave Valley	381658114523300	–	1	–	–	–	1	–	1
	181	Dry Lake Valley	181 S01 E64 06DB 1	–	1	–	–	–	1	–	1
			Unnamed Springs		3	–	–	–	3	–	3
	182	Delamar Valley	Grassy Spring	1	–	–	–	1	–	1	
			Unnamed Springs	–	6	–	–	–	6	–	6
Salt Lake Desert	184	Spring Valley (184)	Blind Spring	1	–	–	–	–	–	1	–
			Four Wheel Drive Spring	1	–	–	–	–	–	1	–
			Indian Springs	1	4	–	–	–	–	1	4
			Kalcheck Springs	–	1	–	–	–	–		1
			Layton Spring	2	–	–	–	–	–	2	–
			N. Millick Spring	1	–	–	–	–	–	1	–
			S. Bastian Spring	1	–	–	–	–	–	1	–
			S. Bastian Spring 2	1	–	–	–	–	–	1	–
			S. Millick Spring	1	–	–	–	–	–	1	–
			The Seep	1	–	–	–	–	–	1	–
			Unnamed Springs	–	21	–	–	–	1	–	21
			Unnamed Springs east of Cleve Creek	1	–	–	–	–	–	1	–
	195	Snake Valley	363854114072701	–	1	–	–	–	–	–	–
			Kious Spring	–	–	1	–	–	–	–	–
			Unnamed Caine Spring	–	1	–	–	–	–	–	–
			Unnamed Caine Spring - South	–	1	–	–	–	–	–	–
			Unnamed Spring SW of Caine Spring	–	1	–	–	–	–	–	–
			Unnamed Springs	1	6	–	5	–	–	–	–
			Youn-Aquainv-003	–	–	1	–	–	–	–	–
Total				**13**	**47**	**2**	**5**	**1**	**12**	**12**	**37**
Total All Springs				**60**		**7**		**13**		**49**	

[1] Inventoried spring (field verified).

[2] Other springs (not field verified).

Table 3.3.2-5 Perennial Streams within the Proposed Groundwater Development Areas

GW Flow System	Basin #	Basin Name	Stream Name	Proposed Action, and A and C	B	D	E and F
Salt Lake Desert	184	Spring Valley (184)	Bassett Creek	0.8			0.8
			Bastian Creek	2.0			2.0
			Big Negro Creek	2.7			2.7
			Cleve Creek	2.3			2.3
			Freehill Creek	0.4			0.4
			Garden Creek	1.1			1.1
			Gordon Creek	0.1			0.1
			Indian Creek	1.7			1.7
			Kalamazoo Creek	0.1			0.1
			McCoy Creek	2.4			2.4
			McCoy Creek (Unnamed Wash)	0.5			0.5
			Meadow Creek	1.3			1.3
			Muncy Creek	0.2			0.2
			North Millick Spring Creek	0.6			0.6
			Odgers Creek	0.7			0.7
			Piermont Creek	0.7			0.7
			Ranger Creek	0.4			0.4
			Shingle Creek	0.5			0.5
			South Millick Spring Creek	0.1			0.1
			Spring Creek (GBNP)	0.1			0.1
			Spring Valley (Unnamed Creek 1)	0.4			0.4
			Stephens Creek	0.8			0.8
			Vipont Creek	0.4			0.4
	195	Snake Valley	Big Springs Creek	5.3	2.7		
			Big Wash	2.0			
			Lake Creek	0.1			
			Lehman Creek	0.2	1.0		
			Lehman Creek Diversion	1.2	2.1		
Total Miles				**29.0**	**5.8**		**20.3**

Although the SNWA Programmatic Measures commit to avoiding wetlands and stream crossing where feasible, the final facility likely would include some (unavoidable) perennial stream crossings. Potential construction related impacts to perennial streams generally would be minimized by the implementation of the BLM's BMPs and ACMs discussed previously for the primary pipeline and power line ROWs. These measures would minimize erosion and potential channel degradation and scour impacts. However, construction across perennial streams likely would result in short-term (2-year) impacts; depending on site-specific conditions and construction methods, construction also could result in long-term (greater than 2 years) impacts. Construction also would result in short-term disturbance of the stream beds in the other intermittent and ephemeral streams crossed by a pipeline or access road.

Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 8,400 acres within 5 hydrographic basins. This surface disturbance would result in an increase in erosion and sedimentation from construction of facilities in the groundwater development areas. Stormwater and erosion control measures including the preparation of site-specific SWPP Plans, implementation of the BLM Management Decisions and BMPs, and temporary and permanent erosion control measures included in the ACMs (previously discussed for the Primary ROWs) should minimize potential impacts to perennial water sources and ephemeral and intermittent drainages.

The development areas are not located within any mapped or delineated flood zone. However, the development areas incorporate drainage areas that are subject to periodic flooding, flash flooding, and associated erosion and sedimentation during extreme or prolonged runoff events. Potential periodic impacts from flooding likely would be localized and short-term and would be addressed as part of ongoing maintenance activities.

Monitoring and Mitigation Recommendation

SNWA would be required to develop and implement (and fund) a comprehensive COM Plan that would include all facilities and hydrographic basins associated with the SNWA GWD Project. The plan would be approved and managed by the BLM in accordance with the FLPMA. A framework for development of the COM Plan is provided in Section 3.20, Monitoring and Mitigation Summary, and includes a description of the development process; plan components; roles and responsibilities for BLM, SNWA, and other federal and state agencies; enforcement; and a description of the effectiveness of the plan to mitigate potential adverse impacts associated with the project.

In addition to all mitigation measures identified for ROW activities, the following monitoring and mitigation measures are recommended to supplement the ACMs and state and federal regulations to protect or reduce potential impacts to perennial water sources within the groundwater development areas.

Monitoring

GW-WR-1: Spring Inventories. A spring inventory would be conducted in all groundwater development areas to verify and map the location of all springs prior to construction. Construction and development of the groundwater development areas would avoid ground disturbance in the vicinity (i.e., 0.5 mile) of all verified spring locations. Effectiveness: This measure should effectively mitigate impacts to springs from ground disturbance and construction related activities.

Mitigation

GW-WR-2: Stream Crossing Plans. A site-specific plan would be developed to detail the construction procedures, erosion control measures, and reclamation that would occur for pipeline construction across live (flowing) stream reaches. The plan also would incorporate information from BLM Technical Reference 423, for hydraulic considerations in designing pipeline stream crossings (DOI 2007). The plan would include site-specific designs using either open cut or jack and bore techniques and site-specific measures to minimize disturbance of the stream bed, and release of sediment from the construction area into the downstream stream reach. The plan would be reviewed and approved by the BLM and NDOW prior to initiation of any construction activities within the stream corridor. Effectiveness. This measure would be effective in ensuring the use of best construction methods at all stream crossings.

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 8,400 acres within five hydrographic basins. There are 60 known or suspected springs identified within the groundwater development areas. These springs occur within the groundwater development areas within Spring Valley (37 springs), Snake Valley (11 springs), Delamar Valley

(7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring). There also are 37 separate perennial stream reaches located in Spring Valley (32), Snake Valley (4), and Cave Valley (1) with a total length of 54.7 miles within the groundwater development areas. The potential for impacts to springs and streams located within these groundwater development areas would depend on the location of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional mitigation recommendations include all previous, applicable ROW mitigation measures.

Groundwater Pumping

Groundwater Pumping Scenario

The groundwater pumping scenario for the Proposed Action assumes pumping at the full quantities (i.e., approximately 177,000 afy) listed on the pending water rights application for the 5 proposed project pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys). The well distribution developed by SNWA for this model scenario (**Figure 3.3.2-2)** distributes the simulated production wells spatially within the groundwater development areas in an effort to minimize pumping effects. For all pumping scenarios, pumping simulations were set up such that production wells associated with the SNWA groundwater development project were completed (depending on location) in either the Upper Valley Fill, Lower Valley Fill, or Lower Carbonate unit. Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report (SNWA 2010a). The pumping schedule reflects the proposed staged general south-to-north sequence of basin development for the project.

Impacts to Water Levels

The predicted change in groundwater levels attributable to groundwater development under the Proposed Action at full build out, full build out plus 75 years, and full build out plus 200 years are provided in **Figures 3.3.2-3**, **3.3.2-4**, and **3.3.2-5** , respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels.

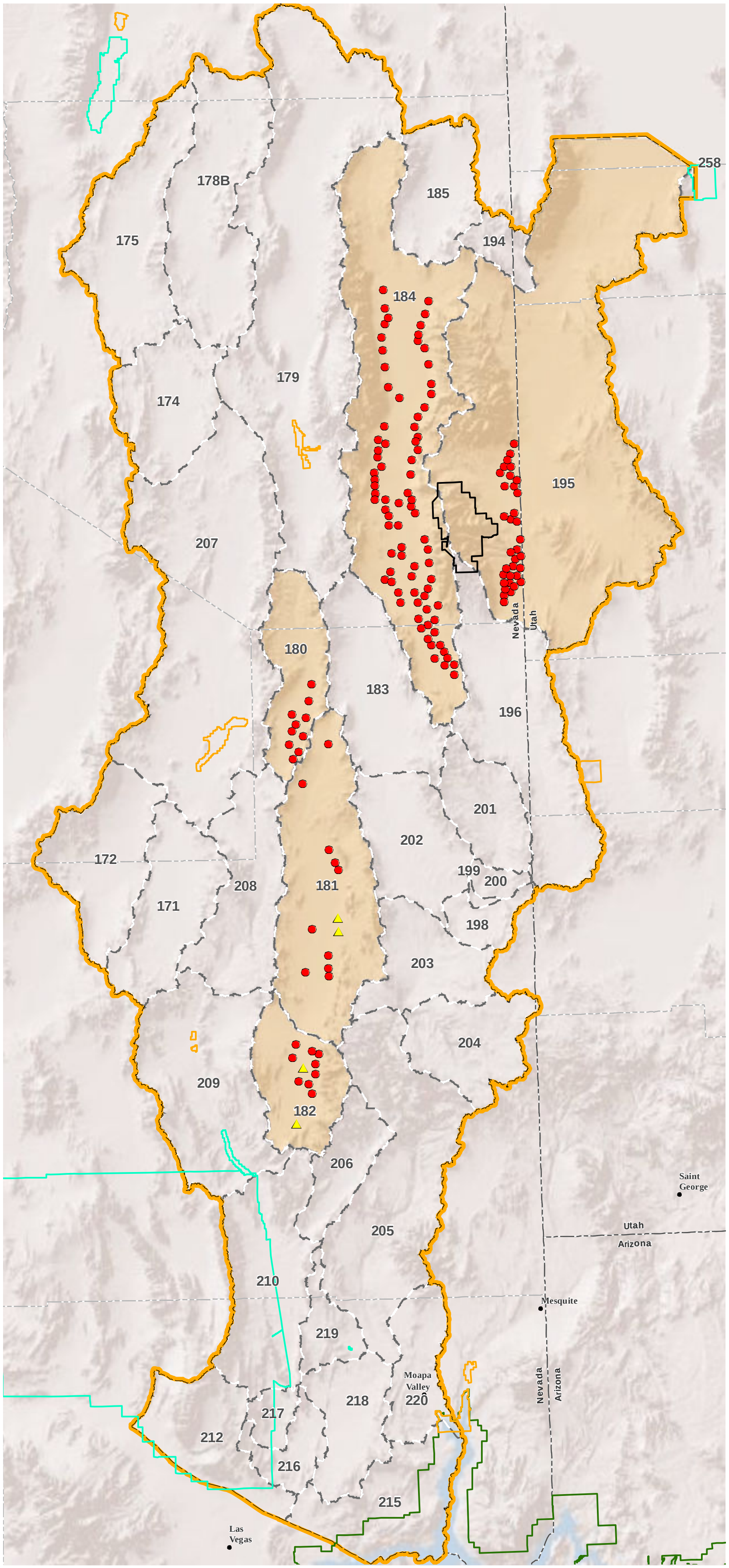
At full build out, the drawdown areas are localized in the vicinity of the pumping wells in Spring, Delamar, Dry Lake, and Cave valleys. Drawdown does not occur at this time period in Snake Valley. Comparison of the simulation results for the three representative points in time indicates that the drawdown area continues to progressively expand as pumping continues into the future.

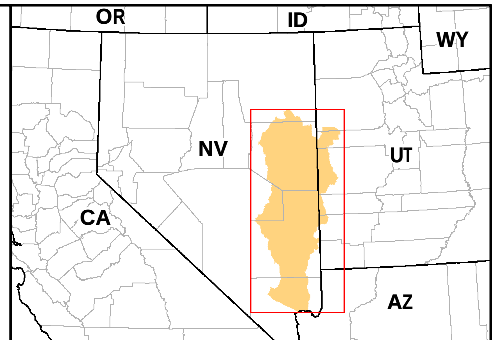
At the full build out plus 75 years time frame, there are two distinct drawdown areas. The northern drawdown area encompasses most of valley floor in Spring Valley, southern Snake Valley, and northern Hamlin Valley. The southern drawdown area extends across the Delamar, Dry Lake, and Cave valleys in an elongate north-south direction and extends into the eastern margin of Pahranagat Valley and northwestern margin of Lower Meadow Valley Wash.

By the full build out plus 200 years time frame, the 2 drawdown areas merge into one that extends approximately 190 miles in a north-south direction and up to 55 miles in a east-west direction. At this time frame, the simulated drawdown area extends into Tippetts Valley, southeastern Steptoe Valley, the eastern margins of Pahroc and Pahranagat valleys, and the western margins of Panaca Valley and Lower Meadow Valley Wash.

The locations of six selected observation wells located within the proposed pumping basins are presented in **Figure 3.3.2-6**. Water level hydrographs for each of these observation wells within the pumping basins are provided in **Figures 3.3.2-7** and **3.3.2-8**. The hydrographs illustrate the predicted rate and magnitude of water-level decline at these representative locations over the simulation period. The hydrographs for the observation wells indicate that water levels are predicted to continue to decrease over the model simulation and are not predicted to reach a renewed equilibrium (or steady state condition) before the end of the simulation period. These results further suggest that with continued pumping beyond 200 years, additional drawdown is likely to occur after the model simulation period (i.e., after the full build out plus 200-year period).

The predicted drawdown associated with the Proposed Action pumping would lower water levels in basin-fill sediments particularly within the valley floor areas in the proposed pumping basins. Reduction of the water level in the unconsolidated sediments essentially would dewater the portion of the basin-fill aquifer situated within the drawdown cone. The portion of the unconsolidated basin-fill sediments that would be dewatered would undergo compaction as the water is removed from the material. The mechanics of compaction and the resultant changes in storage properties in





Legend

Pumping Scenario Well Locations[1]

- SNWA Project Well
- Lincoln County Water District Approved Water Right
- Hydrographic Basin
- Pumping Basin
- Water Resources Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

[1]The SNWA well locations represent the production well locations simulated in the numerical groundwater flow model for evaluating potential impacts. The actual number and location of the wells will be determined after additional field investigations.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Springs Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

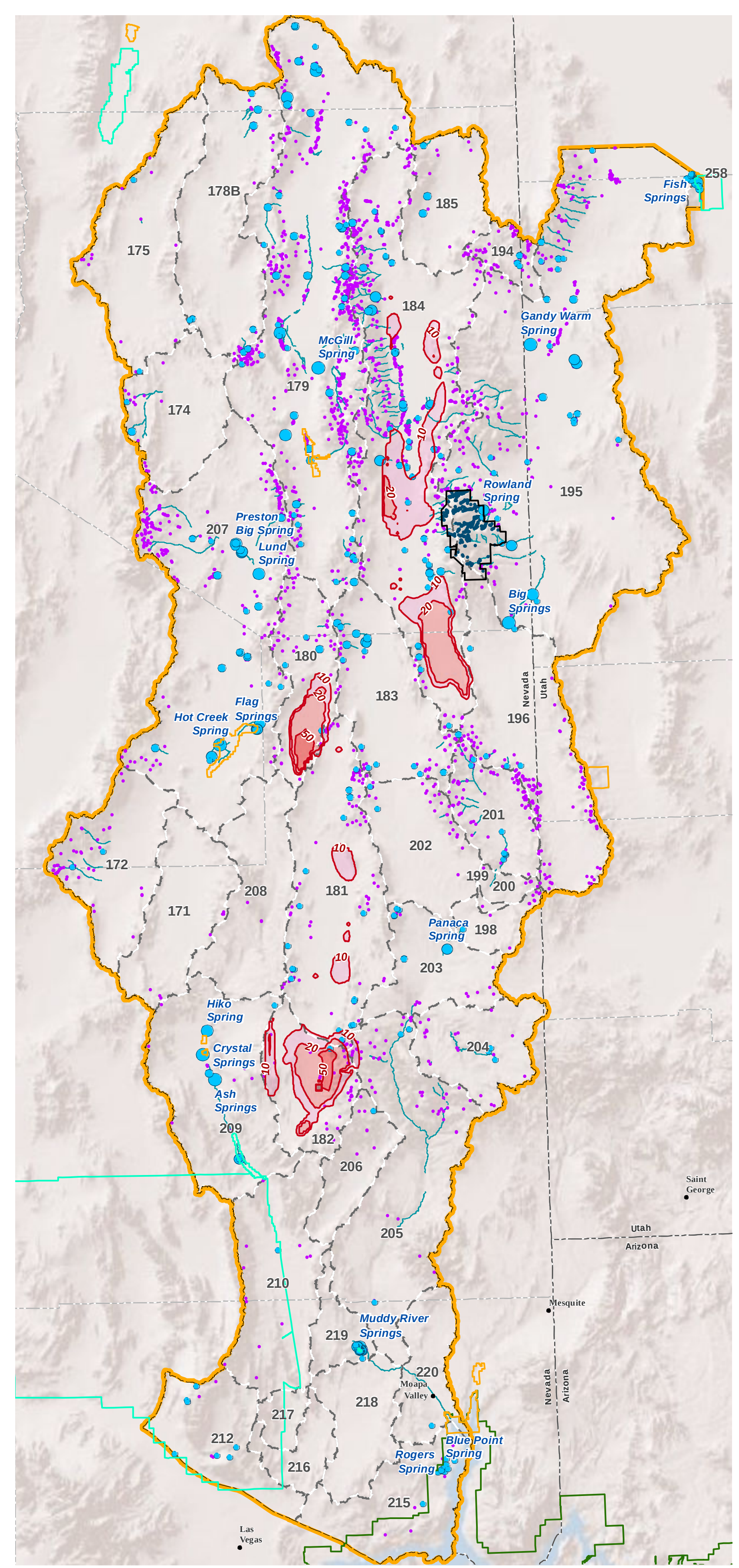
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

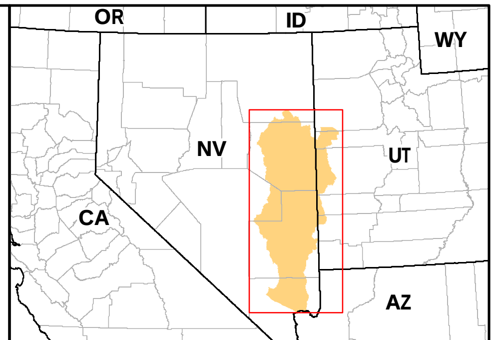
Figure 3.3.2-2

Pumping Distribution Proposed Action

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.





Legend

Major Springs Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
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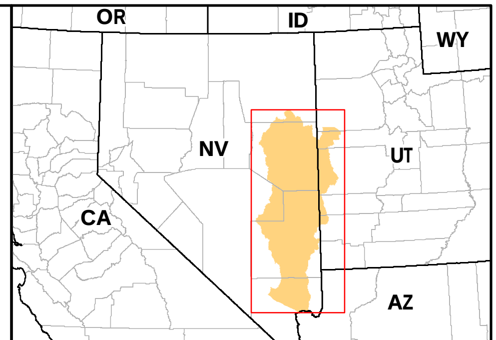
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Springs Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

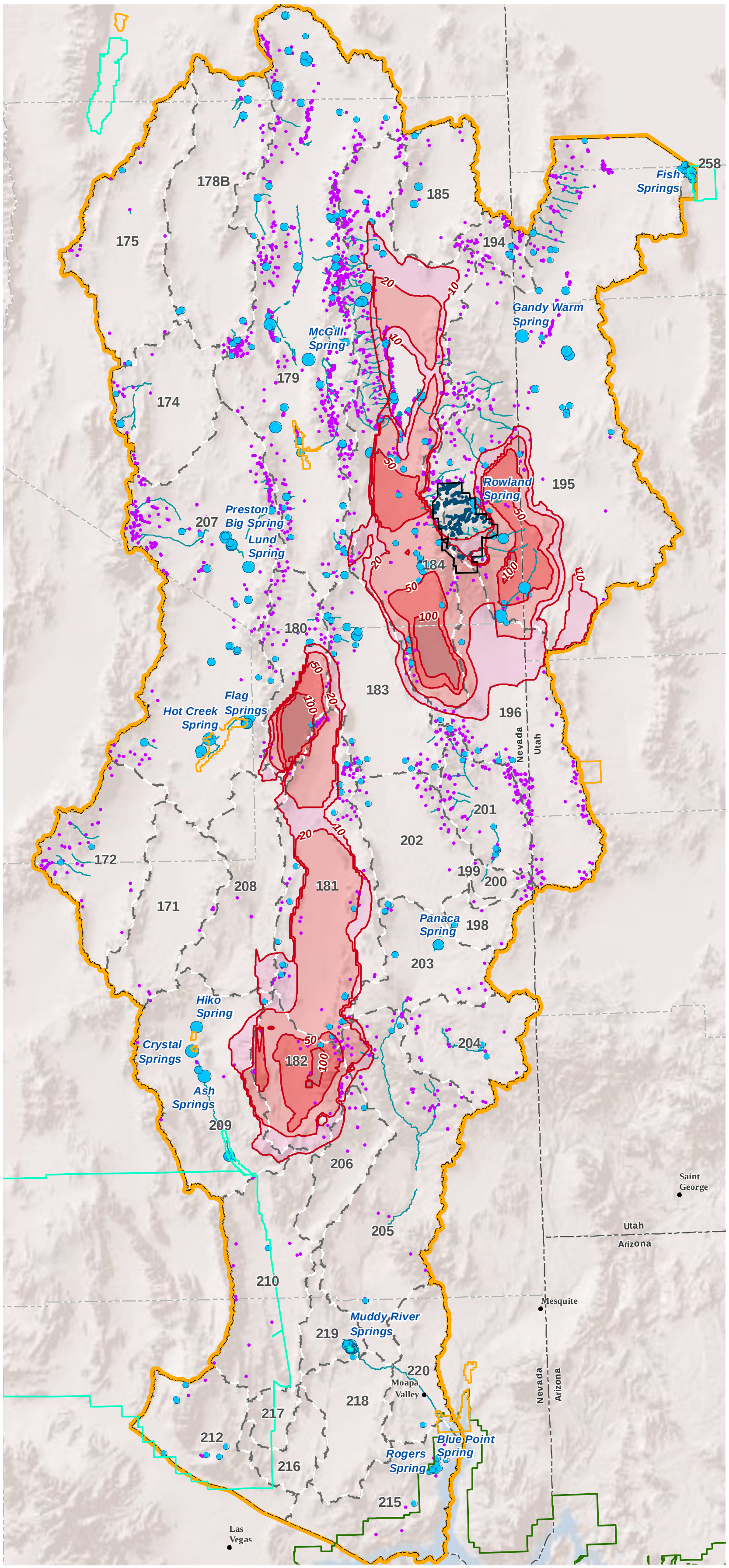
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-3
Predicted Change in Groundwater Levels
Proposed Action
Full Build Out

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.





Legend

Major Springs
Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
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181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Springs Valley
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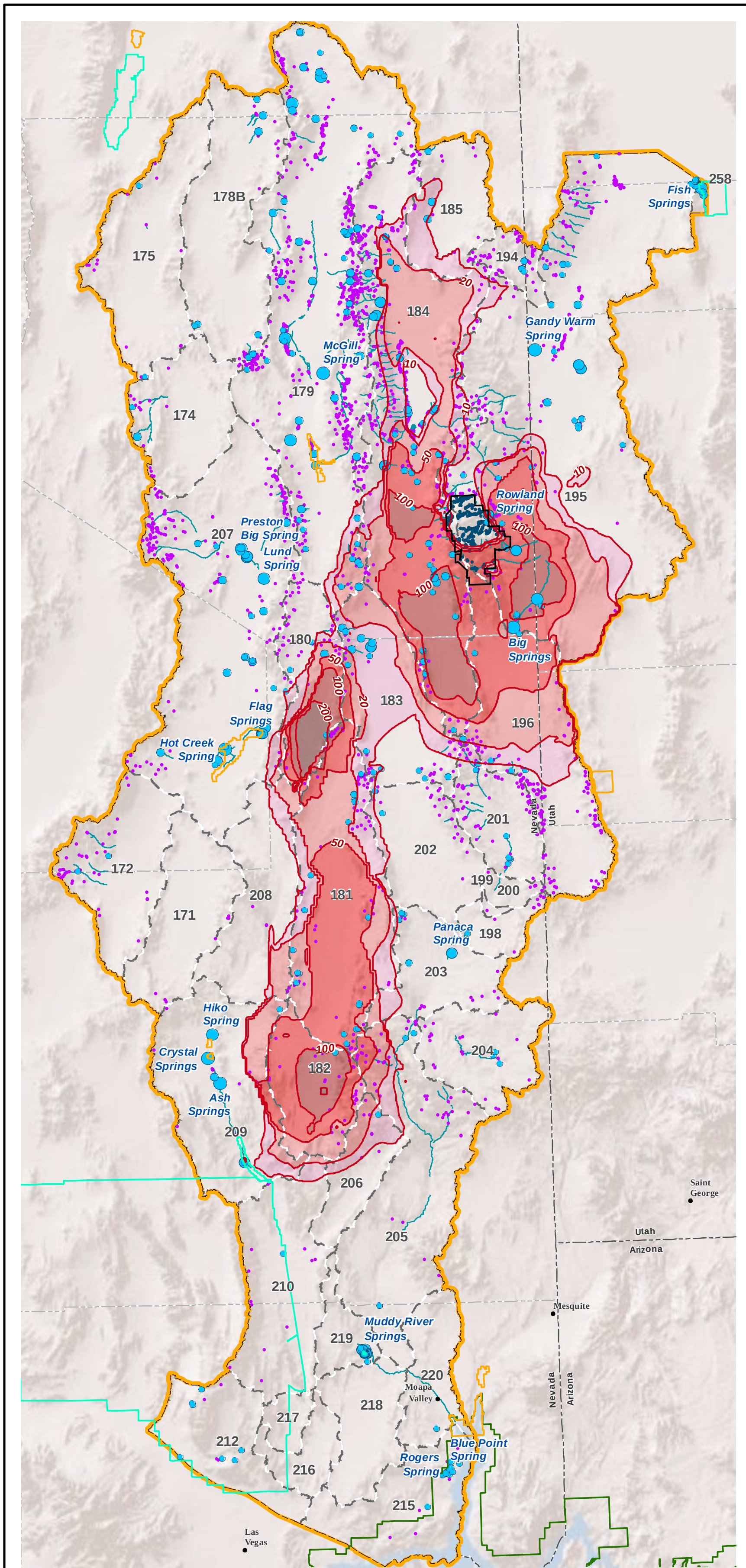
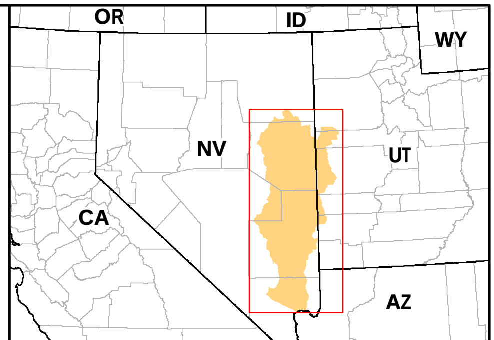
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-4
Predicted Change in Groundwater Levels
Proposed Action
+ 75 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N





Legend

Major Springs Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
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182	Delamar Valley	210	Coyote Springs Valley
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184	Spring Valley	215	Black Mountain Area
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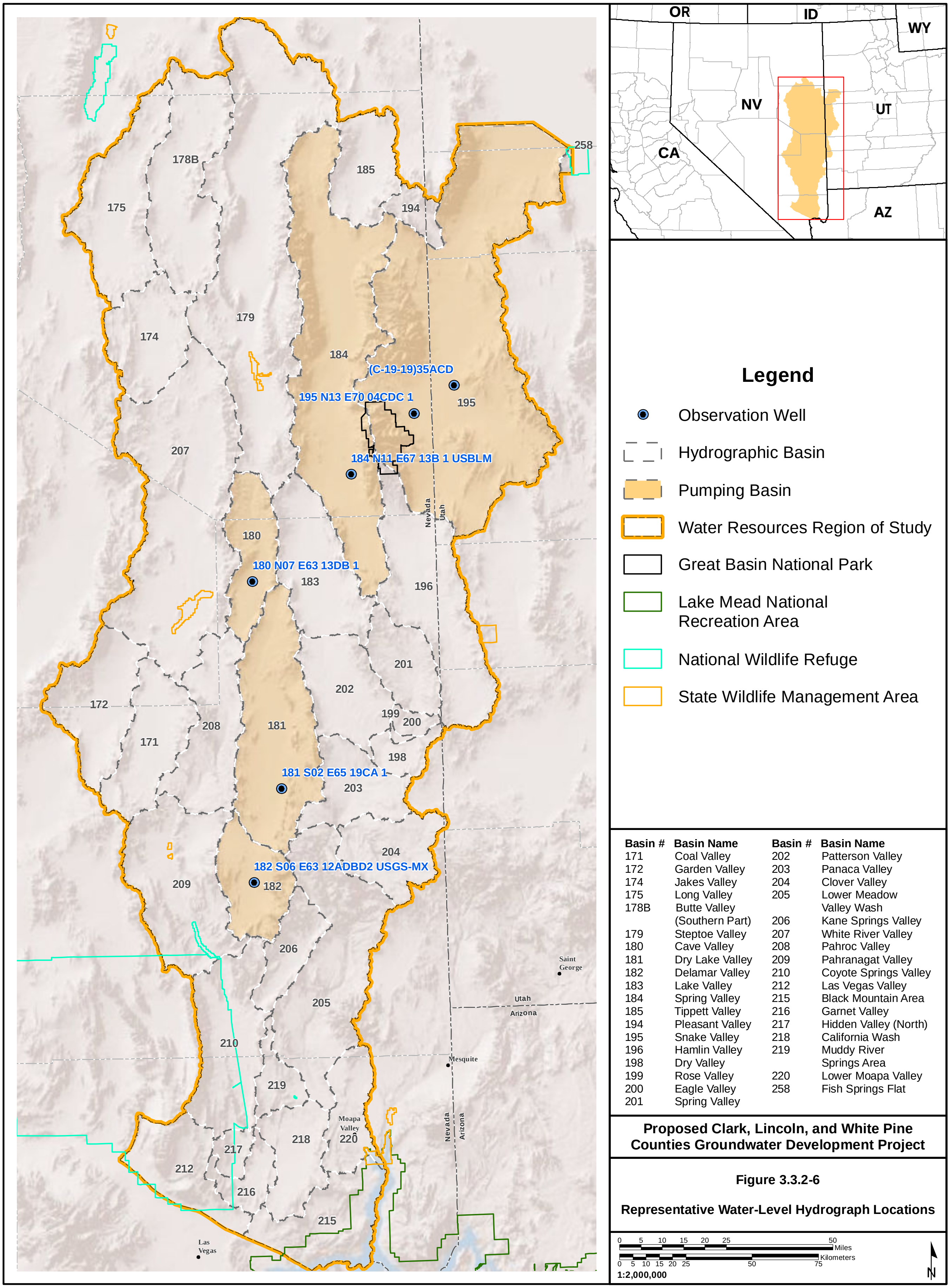
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-5
Predicted Change in Groundwater Levels
Proposed Action
+ 200 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
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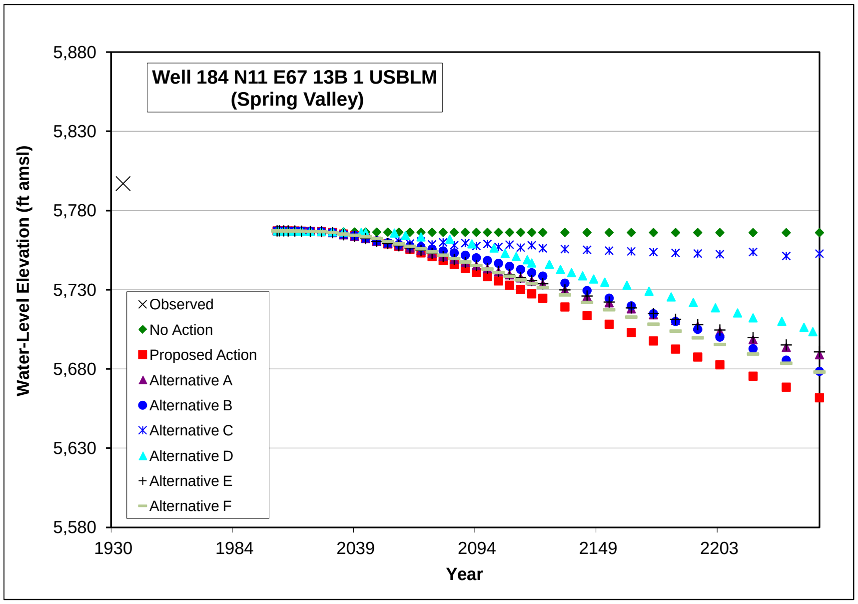
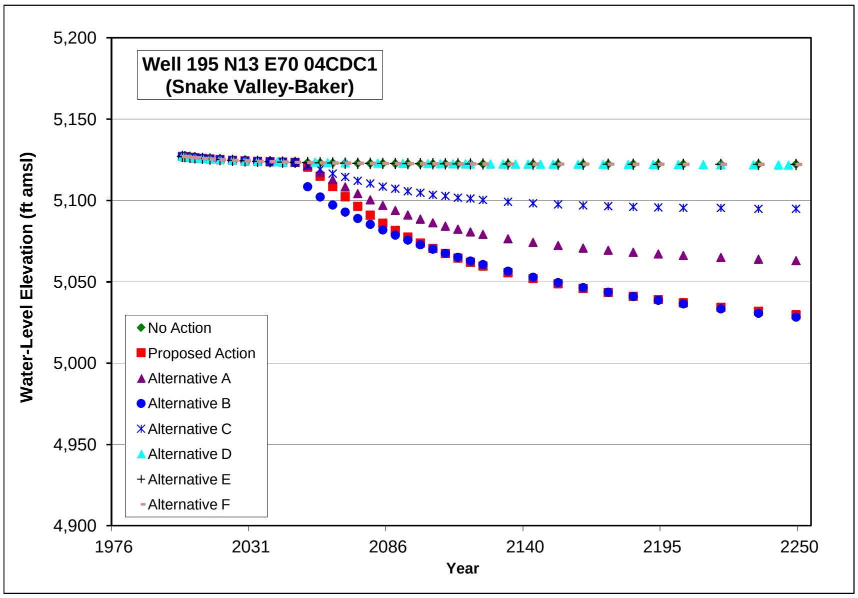
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-6

Representative Water-Level Hydrograph Locations





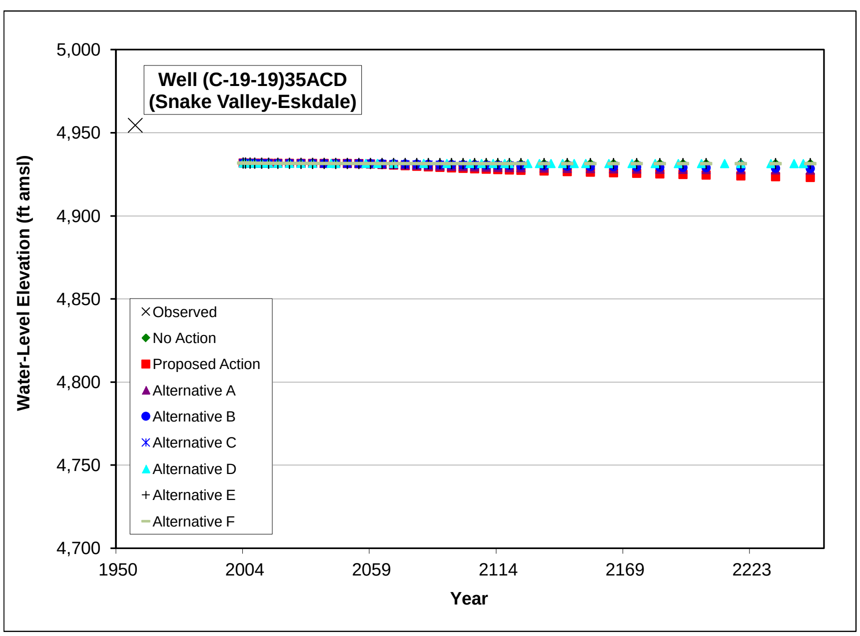
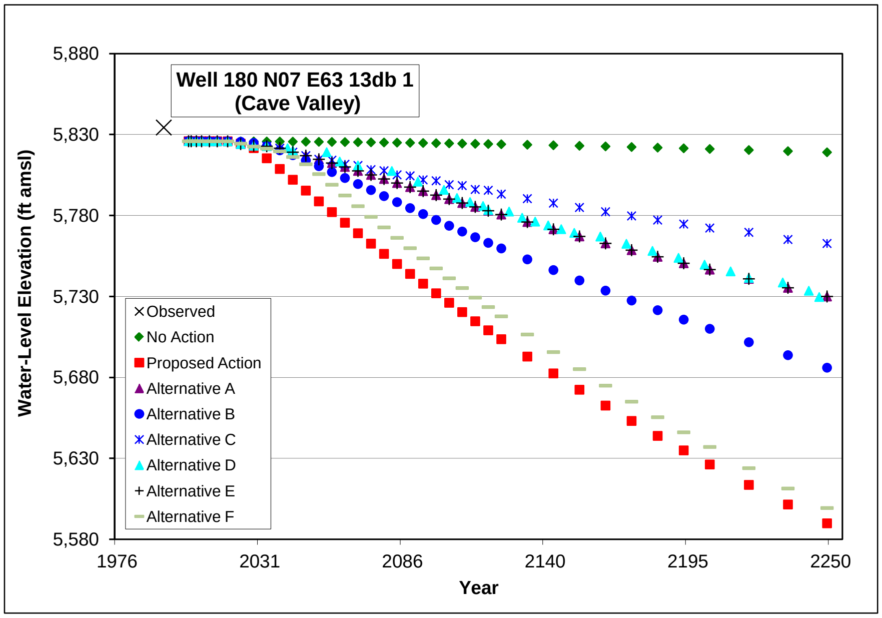
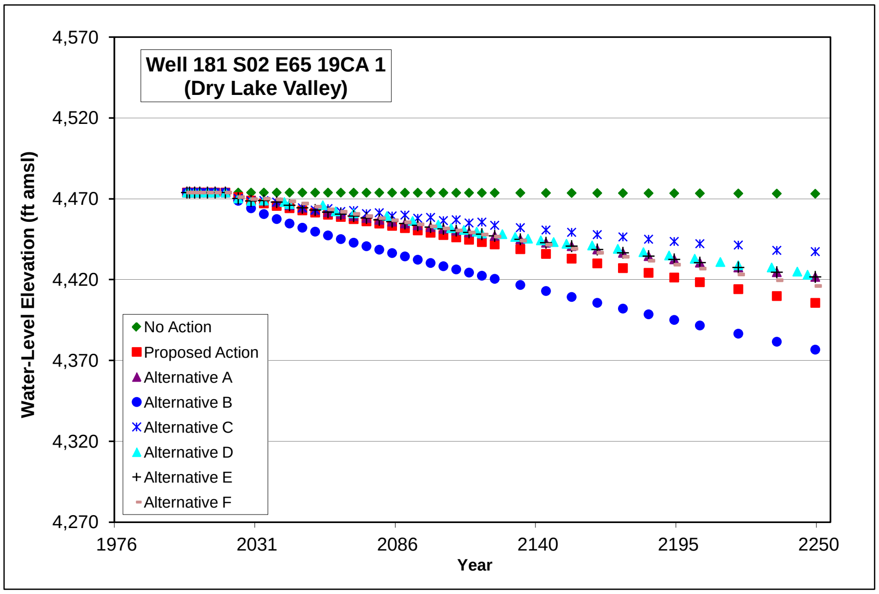


Figure 3.3.2-7 Representative Water-Level Hydrograph Locations for Spring and Snake Valleys





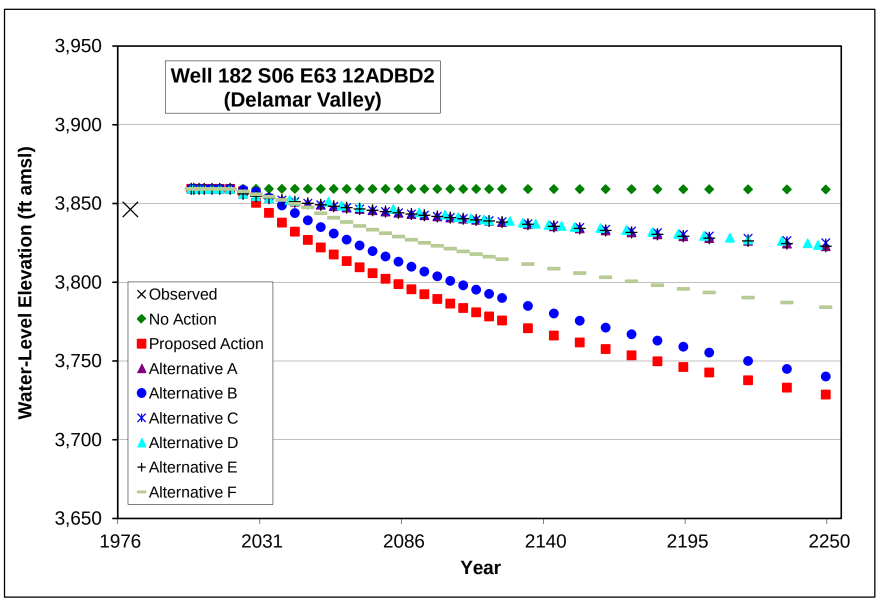


Figure 3.3.2-8 Representative Water-Level Hydrograph for Cave, Dry Lake, and Delamar Valleys

aquifer and aquitard materials and subsidence resulting from groundwater withdrawal are described in Poland (1984). Compaction of these sediments would result in a permanent reduction of the water storage properties of the aquifer. However, the amount of compaction and reduction in storage properties would depend on the grain-size and texture of the layers within the basin-fill sedimentary sequence. For example, the reduction in storage properties for the fine-grained materials (i.e., clays beds or aquitards) would be much greater than the reduction in storage for the coarse-grained materials (sands and gravel or high transmissive aquifers) in the sequence. The potential impacts associated with groundwater pumping-induced ground subsidence are described in Section 3.2, Geologic Resources.

Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at full build out, at full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.8A-1**, **F3.3.8A-2**, and **F3.3.8A-3**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-1A** in **Appendix F3.3.9**. Specific inventoried springs located within the drawdown area at the representative points in time are listed in **Appendix F3.3.10**.

Potential effects to perennial springs and streams are summarized in **Table 3.3.2-6**. Comparison of the results of the model simulations and the resource impact evaluation for the three representative time periods indicated that the number of springs and miles of perennial streams that potentially could be affected increases at each successive time period.

For the predicted drawdown area at full build out plus 75 years, there are 44 inventoried springs and 168 “other” springs located within the high and moderate risk areas. At full build out plus 200 years, there are 57 inventoried springs and 248 “other” springs located within the high and moderate risk areas. These springs occur in Cave, Hamlin, Spring (HA 184), Snake, and Lake valleys.

The estimated total number of miles of perennial streams located in drawdown areas where surface waters could be affected is summarized in **Table 3.3.2-6**. The results indicate that the total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts increases from approximately 80 miles at 75 years to 112 miles at full build out plus 200 years. This includes stream reaches located in Pahranagat, Steptoe, Spring (HA 184), Snake, and Lake valleys, and Lower Meadow Valley Wash.

Impacts to individual springs and streams would depend on the actual drawdown that occurs in these areas and the site-specific hydraulic connection between the groundwater systems impacted by pumping and the perennial water source. Perennial water sources that are hydraulically connected to the groundwater system impacted by pumping and within the drawdown area likely would experience a reduction in baseflow. Depending on the severity of these reductions in flow, this could result in drying up of springs or reducing the length of the perennial stream reaches and their associated riparian areas. Potential impacts to vegetation, wildlife, and aquatic resources resulting from these potential drawdown effects are addressed in Sections 3.5, Vegetation Resources; 3.6, Terrestrial Wildlife; and 3.7, Aquatic Biological Resources.

Model-simulated Spring and Stream Discharge Estimates. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-7**. Spring discharge was simulated at 11 springs within White River Valley. The model results indicate that two of these springs, Butterfield Spring and Flag Springs 3, are predicted to experience 7 percent flow reduction at the full build out plus 75 years time frame, and 18 percent and 17 percent flow reductions, respectively, at the full build out plus 200 years time frame. These results suggest that the groundwater development eventually could affect flows in springs located along the southeastern margin of the valley floor in White River Valley. This area is located near the drawdown boundary for these two time frames (see **Figures 3.3.2-4** and **3.3.2-5**). The model results indicate that other springs located in the northern portion of the valley floor in White River Valley are unlikely to experience impacts (greater than 5 percent reductions) attributable to the Proposed Action pumping.

The model results also indicate that the groundwater development is not predicted to reduce flows in the other major regional spring discharge areas within the White River Flow System, including Pahranagat Valley and the Muddy River Springs Area near Moapa. Impacts to flows in the major regional springs discharging in Steptoe Valley in the Goshute Valley Flow System and at Panaca Spring in Panaca Valley in the Meadow Valley Flow System are not anticipated.

Table 3.3.2-6 Summary of Potential Effects to Water Resources Resulting from the Proposed Action Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	7	16	18
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	3	44	59
• Number of other springs located in areas where impacts to flow could occur[4]	5	168	248
• Model-simulated flow reduction at Big Springs (as percent flow reduction)	2%	100%	100%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	1	2	6
• Miles of perennial stream located in areas where impacts to flow could occur	6	80	112
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	25	145	212
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	28	129	96
• Number of groundwater rights located within the 50-100 foot drawdown area	0	68	134
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	2	34
• (Total groundwater rights in drawdown area)	(28)	(199)	(264)
Percent reduction in ET and spring discharge: [5]			
• Spring Valley	45%	77%	84%
• Snake Valley	0%	28%	33%
• Great Salt Lake Desert Flow System[1]	18%	48%	54%
• White River Flow System	0%	1%	3%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule valleys Hydrographic Basins:[5]			
• AFY	0	660	1,800
• Percent Reduction	0%	4%	10%

[1] Located within the groundwater flow model domain.
[2] Unless otherwise noted, supporting information for these estimates are provided in **Appendices F3.3.5** through **F3.3.16**.
[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10A** in **Appendix F3.3.10**.
[4] Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.
[5] Estimate derived from the model-simulated values provided in SNWA 2010b with comparison to No Action pumping results.

Table 3.3.2-7 Model-simulated Flow Changes (Proposed Action)

(Project Specific)					Proposed Action		
					Incremental Change in Flow % (from No-Action)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model-simulated Average Flow (2005) in gpm	Full Build Out	75 years after Full Build Out	200 years after Full Build Out
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	0	-1
		Butterfield Spring	1,225	471	-1	-7	-18
		Cold Spring	582	503	0	0	-1
		Flag Springs 3	969	560	-1	-7	-17
		Hardy Springs	200	73	0	0	-1
		Hot Creek Spring	5,032	6,899	0	-1	-3
		Lund Spring	3,594	3,314	0	0	-1
		Moon River Spring	1,707	1,457	0	0	-1
		Moorman Spring	405	353	0	-1	-3
		Nicolas Spring	1,185	872	0	0	-1
		Preston Big Spring	3,572	3,794	0	0	-1
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	-1	-2
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	-1
		Hiko Spring	2,735	1,985	0	0	-2
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	-1
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	-1
	Black Mountains Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	0	-1
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	-58	-100	-100
		North Millick Spring	284	98	-31	-62	-75
		South Millick Spring	506	278	-55	-94	-99
	Snake Valley (195)	Big Springs	4,289	1,977	-2	-100	-100
		Foote Res. Spring	1,300	211	0	-1	-2
		Kell Spring	120	59	0	-1	-2
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	-1
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010.

In the Great Salt Lake Desert Flow System, spring discharge was simulated at 3 springs in Spring Valley and 4 springs in Snake Valley. In Spring Valley, the model simulations indicate that by full build out plus 75 years, Keegan, North Millick, and South Millick springs all show reductions of flow. At full build out plus 200 years, these springs are predicted to experience flow reductions ranging from 75 to 100 percent. These three springs are all located near the margin of the valley floor in the north central portion of the valley. These results suggest that springs located in the southern portion of the valley that are hydraulically connected to the regional flow system are likely to experience some reduction in flow over the long term.

In Snake Valley, the model simulation results were used to evaluate potential changes in flow at Big Springs, Foote Reservoir Springs, Kell Spring, and Gandy Warm Springs. The model indicated that measurable flow reductions (greater than 5 percent) are not anticipated at Foote Reservoir Springs, Kell Springs, and Gandy Warm Springs located in the central portion of the basin. The results suggest that the springs located on the valley floor in the central and northern portion of the basin are unlikely to experience impacts (greater than 5 percent flow reduction). Big Springs, located in the southern portion of the basin, is predicted to experience a substantial reduction in flow by the full build out plus 75 years time frame. Reductions of flow at Big Springs would reduce flows in Big Springs Creek and reduce flows to Lake Creek and into Pruess Lake. The results suggest that the springs located on the valley floor in the southern portion of the valley likely would experience reductions in flow.

Water Resources Within or Adjacent to the GBNP. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and within the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). At full build out plus 75 years, Outhouse Springs and Spring Creek Spring, both located outside the GBNP boundary, and 6.4 miles of Snake Creek are within the area of moderate risk. By full build out plus 200 years, three springs, Outhouse, Rowland (located along the park boundary), and Spring Creek Springs, along with 9.1 miles of Snake Creek and its tributaries, and 0.5 miles of Lehman Creek and its tributaries are within the area of moderate risk.

Table 3.3.2-8 GBNP Water Resources Risk Evaluation Summary by Alternative

	Proposed Action		Alt. A		Alt. B		Alt. C		Alt. D		Alt. E		Alt. F		No Action	
Years	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**
Springs[1]																
Cave Spring					X	X										
Outhouse Springs	X	X	X	X	X	X		X		X						
Rowland Springs		X		X	X	X										
Spring Creek Spring	X	X	X	X	X	X		X		X						
Other springs[2]	0	0	0	0	15	25	0	0	0	0	0	0	0	0	0	0
Streams (Miles[3])																
Baker Creek and tributaries	0.0	0.0	0.0	0.0	1.7	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lehman Creek and tributaries	0.0	0.5	0.0	0.5	2.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Snake Creek and tributaries	6.4	9.1	5.6	8.3	9.1	10.2	0.0	8.0	0.0	8.0	0.0	2.1	0.0	4.2	0.0	0.0

[1] "X" indicates spring is located both within the simulated drawdown area and susceptibility zones as defined by Elliot et al. (2006).

[2] Other springs identified in GBNP are listed in **Appendix F3.3.1**, **Table F3.3.1-1B**.

[3] Miles of perennial stream identified in the GBNP located both within the simulated drawdown area and susceptibility zones as defined by Elliot et al. (2006).

Available information on water resources identified in caves within the GBNP is summarized in Section 3.3.1.4, Surface Water Resources. Baker (2009) has identified 6 caves in the susceptibility areas defined by Elliott et al. (2006) that are in direct contact with the water table or surface water. (Note that details regarding the locations and known subsurface extent of these cave systems were not available for BLM review at the time the EIS was written.) These include Model Cave, Ice Cave, Wheeler's Deep Cave, and Systems Key Cave in the Baker Creek watershed. Available information (summarized in Section 3.3.1.4) suggests that stream flow within Ice Cave and Systems Key Cave likely are controlled by the infiltration of surface runoff and not by upward flow from the regional groundwater flow system. Wheeler's Deep Cave also is reported to have a perennial stream (Baker 2009). Model Cave is reported to be the most important cave within the Baker Creek Cave System and is reported to have one or more perennial streams (McLean 1965; Bridgemon 1967; Baker 2009). Lange (1954) describes slots in the floor of Model Cave that he believes were formed by upward (or artesian) flow. However, he does not provide data to evaluate if these features likely were formed in the geologic past (i.e., under different hydrologic conditions) or were formed recently under present hydrologic conditions. If the latter were true, these features would suggest that artesian flow in the limestone is the source of water for the streams within this cave.

In summary, there is insufficient information to define the likely water source (i.e., local flow system or artesian flow through the carbonate aquifer system) that sustains the cave streams and uncertainty regarding hydraulic interconnection between the limestone and the regional aquifer system that would be the target for groundwater development in Snake Valley. Preliminary results from ongoing hydrogeologic and water resource investigations in and adjacent to GBNP provide some evidence that water resources in Model Cave may be interconnected with the alluvial basin fill in Snake Valley (Prudic and Sweetkind 2012). However, the model-simulated drawdown area under the Proposed Action pumping scenario is not projected to affect Baker Creek. Therefore, impacts to water resources in the Model Cave System in the Baker Creek drainage area are not anticipated under this alternative.

Utah Surface Water Resources

For the predicted drawdown area, there are three inventoried springs (Stateline, Caine, and Needle Point springs) and three perennial reaches (Big Wash, Lake Creek, and Snake Creek) in Snake Valley located within the high risk areas at the full build out plus 75 years and full build out plus 200 years time frames.

The Pine Valley hydrographic basin is located east of Snake Valley and east of the water resource region of study defined by the numerical groundwater flow model domain boundaries used in the EIS analysis. The model simulations indicate that drawdown could propagate into Pine Valley. At the full build out plus 75 years and full build out plus 200 years time frames, the maximum drawdown simulated at the boundary of the model between Snake and Pine valleys is approximately 17 feet and 51 feet, respectively. Therefore, the model simulations suggest that drawdown eventually could propagate into the Pine Valley hydrographic basin.

The potential for drawdown originating in Snake Valley to affect surface water resources in Pine Valley was evaluated by compiling available information to characterize the surface water and groundwater conditions in the basin to identify the likely source of water that controls perennial water sources and discharges in ET areas (see **Appendix F3.3.17** for baseline data) and potential interconnection to the regional groundwater system that would be affected by the groundwater development.

Stephens (1976) investigated the water resources in Pine Valley as part of a series of USGS investigations of water resources within western Utah. With respect to spring occurrence, Stephens reported that: 1) approximately 80 springs were identified from topographic maps; 2) that all springs in the basin discharge at elevations of 6,200 feet (amsl) along the base of the Needle Range and southern part of the Wah Wah Range; 3) many appear to only flow in response to runoff and are dry part of the year; 4) many of the springs that discharge from the volcanic rocks on the eastern flank of the Needle Range probably are perched; and 5) shallow water table conditions occur locally along Pine Grove Creek upstream of Pine Grove Spring.

Groundwater elevation data for eight wells located in the south, central, and northern portion of the valley can be found in **Appendix F3.3.17**. Seven of the 8 wells are generally located in the valley floor or near the toe of the alluvial fans in lower elevation areas within the basin; the eighth well appears to be situated in an alluvial fan. The average depth to water for the eight wells ranges from a low of 302 feet in the northern portion of the basin to 717 feet for a well located near the southern margin of the basin. These deep depths to groundwater suggest that the springs and other surface water features that occur in Pine Valley likely are controlled by local groundwater occurrences that are perched above the regional groundwater flow system. This depth-to-water data also suggest that drawdown of the regional aquifer system resulting from pumping in Snake Valley is unlikely to impact surface water resources in Pine Valley.

Drawdown could, however, eventually result in a reduction in water levels in water supply wells that exist now or may exist in the future. It also is important to note that the drawdown at the boundary is larger than it would be if the model was extended further east because the model boundary is set up as a no-flow boundary. In other words, if the model were extended to encompass Pine Valley, the drawdown at full build out plus 75 years would be less than the 17 feet currently simulated by the model. The actual maximum drawdown at the individual well locations would depend in part on the distance between the well and the northwest boundary between Pine and Snake valleys where the model simulates drawdown could occur. With these considerations, it seems reasonable to assume that the magnitude of the drawdowns at individual wells located in the Pine Valley would be less than the drawdowns simulated by the current model at the boundary between the Snake Valley and Pine Valley hydrographic basins. Therefore, potential reduction in water levels at production wells located within Pine Valley would be less than 17 feet at full build out plus 75 years and less than 51 feet at full build out plus 200 years.

Impacts to Surface Water Rights

For surface water rights, the actual impacts to individual water rights would depend on the site-specific hydrologic conditions that control surface water discharge. Only those waters sustained by discharge from the regional groundwater system targeted or intercepted by the groundwater pumping would be susceptible to impacts.

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.12A-1**, **F3.3.12A-2**, and **F3.3.12A-3**, respectively, in **Appendix F3.3.12**. These maps also illustrate the relative risk to perennial surface water resources within the projected drawdown area. **Table F3.3.13-1A** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames.

These results indicate that the number of surface water rights that potentially could be affected increases over the model simulation period.

At full build out plus 75 years, there are a total of 145 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 212 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows.

The predominant beneficial use for the surface-water rights within the high- and moderate-risk areas are irrigation, stockwatering, and municipal uses. Other beneficial uses associated with the water rights identified in these risk areas include commercial, industrial, mining and milling, domestic, recreational, wildlife, and other (not specified). It is important to note that some surface water rights only divert surface water runoff or groundwater discharge from local or perched groundwater systems that are not dependent on discharge from the regional or intermediate groundwater flow system. In these cases, impacts to surface water flows are not anticipated regardless of the predicted drawdown. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

For the purposes of this evaluation, it is assumed that wells located within the areas affected by drawdown of 10 feet or greater could experience impacts. Specific impacts to individual wells would depend on the: 1) well completion, including pump setting, depth, yield, predevelopment static and pumping groundwater levels; 2) interconnection between the aquifer in which the well is completed in and the aquifer targeted by the GWD Project; and 3) the magnitude and timing of the drawdown that occurs at the specific location.

Figures F3.3.14A-1, **F3.3.14A-2**, and **F3.3.14A-3** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-1A** lists the groundwater rights by hydrographic basin within the drawdown areas that are predicted to occur.

As summarized in the **Table 3.3.2-6**, the number of groundwater rights potentially impacted from drawdown is projected to increase over the model simulation period. At full build out plus 75 years, there are 199 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. One hundred and twenty-nine of these occur in areas with predicted drawdowns of 10 to 50 feet, 68 occur in areas with predicted drawdowns of 51 to 100 feet, and 2 occur in areas with predicted drawdowns of greater than 100 feet.

At full build out plus 200 years, there are 264 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. Ninety-six of these occur in areas with predicted drawdowns of 10 to 50 feet, 134 occur in areas with predicted drawdowns of 51 to 100 feet, and 34 occur in areas with predicted drawdowns of greater than 100 feet. However, considering the model uncertainty, the actual drawdown could be larger or smaller than predicted.

The predominant beneficial uses for the active groundwater rights within the drawdown area at full build out plus 200 years are irrigation and stockwatering. Additional beneficial uses associated with water rights that could be affected include commercial, mining and milling, municipal, domestic, and wildlife. Impacts to wells could include a reduction in yield, increased pumping cost, or if the water level were lowered below the pump setting or the bottom of the well, the well could be rendered unusable.

The Shoshone Ponds area is located in the drawdown area in the southern portion of the Spring Valley (described in Section 3.3.1.4). The source of water for three ponds (known as the Shoshone Ponds) used as refugia for Nevada native fish (BLM 2010) is artesian flow from a well. Actual impacts to the artesian flow would depend on the interconnection between the aquifer that sustains flow in the artesian well and the aquifers developed for production from proposed well field development. Considering the simulated drawdown and the hydrogeologic setting, there is a high risk that well field pumping eventually could result in reducing or drying up flows that sustain Shoshone Ponds. Potential impacts aquatic resources in Shoshone Ponds are discussed in Section 3.7, Aquatic Biological Resources.

Impacts to Water Balance

The model-simulated groundwater budget for current conditions is presented in **Appendix F3.3.16**, **Table F3.3.16-1A**. Under the current conditions, the principal groundwater outflow component for the groundwater flow systems is discharge of groundwater by ET. The ET estimate accounts for spring discharge that supports riparian and phreatophyte vegetation within delineated ET areas. Basins with large ET discharge rates (i.e., greater than 20,000 afy) that occur in the Great Salt Lake Desert and White River Groundwater Flow Systems include: Spring Valley (73,700 afy) and Snake Valley (105,800 afy) (the Great Salt Lake Desert Groundwater Flow System); and White River (65,600 afy), Pahranagat Valleys (21,800 afy), and Lower Moapa Valley (20,900 afy) (the White River Groundwater Flow System).

Potential changes in the water balance for the groundwater system within the region of study were estimated using the groundwater flow model (SNWA 2009c) results provided in **Appendix F3.3.16**, **Table F3.3.16-1B** with comparison to the simulated water balance under the No Action. The estimated reductions in ET and spring discharge for selected basins and flow systems are summarized in **Table 3.3.2-6**.

For Spring Valley, the pumping is estimated to result in reductions of groundwater discharge for ET that increase from a 77 percent reduction at full build out plus 75 years to 84 percent reduction at full build out plus 200 years. In Snake Valley, the pumping is estimated to result in reductions of groundwater discharge for ET of 28 percent at full build out plus 75 years and 33 percent at full build out plus 200 years, with most of this reduction occurring in the southern portion of the valley.

The proposed pumping is estimated to result in a total reduction of ET discharge from the portion of the Great Salt Lake Desert Flow System included within the study area of 48 percent at full build out plus 75 years and 54 percent at full build out plus 200 years. These predicted reductions in ET discharge rates indicate that spring discharge within and associated with these ET areas would be reduced. Estimates of the potential impacts to vegetation within ET areas are evaluated in Section 3.5, Vegetation Resources.

The pumping is estimated to have minimal impact on ET discharge within the other pumping basins and the White River Flow System.

Pine Valley, Wah Wah Valley, Tule Valley, and Fish Springs Flat hydrographic basins (identified in **Figure 3.0-2**) are located to the east of the northeast boundary of the region of study for the groundwater flow model. The model simulation results indicate that the drawdown area is projected to eventually intercept the model boundary that extends along the southeast margin of Snake Valley and eastern margin of Hamlin Valley. These model boundary areas are adjacent to the Pine Valley hydrographic basin located immediately east of the model domain. The results suggest that drawdown attributable to the Proposed Action pumping scenario eventually could extend into Pine Valley. The potential impacts to surface water resources in Pine Valley resulting from drawdown attributable to the proposed pumping in Snake Valley was discussed previously under the heading "*Utah Surface Water Resources.*"

The total predicted reduction of flow to Pine, Wah Wah, and Tule valleys is summarized in **Table 3.3.2-6**. This reduction corresponds to an approximate 4 percent and 10 percent reduction in flow to these basins at the full build out plus 75 years and full build out plus 200 years time frames. Pine, Wah Wah, and Tule valleys are part of the Great Salt Lake Desert groundwater flow system. A major discharge area located downgradient from Pine Valley is Fish Springs. As discussed in Section 3.3.1.4, estimates for the total discharge at Fish Springs range from 21,000 afy to 24,000 afy (USFWS 2004; Bolke and Sumison 1978; respectively). The actual groundwater flow paths and interconnection between Snake and Hamlin valleys and the valleys east of the model boundary (Pine Valley, Tule Valley, Fish Springs Flat, and Fish Springs) are not well understood. If the groundwater flow system is interconnected and regional flow from Snake Valley contributes to flow at Fish Springs, then a reduction of flow from Snake Valley to Pine, Wah Wah, and Tule valleys eventually could result in a reduction of discharge at Fish Springs. The model-estimated reduction of groundwater outflow from Snake Valley to these basins along the eastern boundary of Snake Valley is 1,800 afy at full build out plus 200 years, which represents approximately 7 to 9 percent of the surface discharge at Fish Springs. It important to understand that there is considerable uncertainty regarding the amount of subsurface flow that occurs between Hamlin and Snake valleys (within the model area) and Pine Valley, Wah Wah Valley, Tule Valley, and Fish Springs Flat (located east of the model boundary). For example, the estimates of interbasin flow from Snake Valley to Tule Valley range from 15,000 to 42,000 afy; for Snake Valley to Pine Valley, estimates range from -5,500 to 16,500 afy (SNWA 2009a). There also is uncertainty regarding the interconnection between underflow leaving from Snake Valley and the flow at Fish Springs. For these reasons, it is not possible to determine (using available data and the results from the CCRP) if the groundwater development is likely to produce a measurable reduction in discharge at Fish Springs.

The GBNP Model (Halford and Plume 2011) was set up to simulate flows at Fish Springs. The simulation results from the GBNP Model indicate that pumping in Snake Valley (at the points of diversion listed in the SNWA water rights applications), at the full application rate (50,000 afy) combined with continuation of existing agricultural pumping would not reduce flows in Fish Springs over the 200-year simulation period. These model results suggest that pumping associated with the groundwater development in Snake Valley is unlikely to result in a measureable reduction in flows at Fish Springs.

Impacts to Water Quality

As described above, the results of the numerical modeling and water resource impact assessment indicate that the GWD Project likely would result in flow reductions and drying up of some perennial water sources. Flow changes potentially could be accompanied by changes in water quality. Considering the complex hydrogeologic conditions over the hydrologic study area, it is not possible to predict the actual change in water quality that would occur from flow reductions at specific springs or streams. The actual changes in water quality would depend on the magnitude of the flow change and the source of the surface discharge. Depending on the origin of the groundwater that discharges at the surface as a seep, spring, or stream, a reduction of flow potentially could be accompanied by a change in water quality. For example, where the source of the surface discharge is a single hydrostratigraphic unit (or aquifer) with relatively constant water quality, lowering the water level within the unit, and thereby reducing the surface discharge rate, should not result in a substantial change in water quality. However, reductions in flow could affect temperatures and temperature-dependent water quality constituents. Conversely, where the source of surface groundwater discharge is a mixture of waters from two different sources, such as a deeper, older regional groundwater flow and a younger intermediate flow, a reduction in discharge from one of the sources potentially could skew the discharge water quality toward the less affected source. Additional discussion of potential localized changes to surface water quality related to aquatic habitat is provided in Section 3.7, Aquatic Biological Resources.

The baseline water quality in the region is summarized in Section 3.3.1.6, with additional details provided in **Appendix F3.3.4** and in the baseline characterization report (SNWA 2008). As described in Section 3.3.1.6, the water quality in the region is generally good. One exception is a zone of groundwater with elevated TDS and chloride concentrations situated in the Great Salt Lake Desert in the northernmost portion of Snake Valley (Hood and Rush 1965). The Great Salt Lake Desert area in Snake Valley is located approximately 50 miles north of the proposed groundwater development area in Snake Valley, and greater than 30 miles north of the projected drawdown area.

Therefore, drawdown associated with the groundwater pumping is not expected to capture or change the gradient or flow directions in the zone of high TDS and chloride concentrations associated with the Great Salt Lake Desert.

Stipulated Agreements, Applicant-committed Measures, and Monitoring and Mitigation Measures

Stipulated Agreements

Stipulation agreements between the DOI and SNWA exist for groundwater development in four (Spring, Delamar, Dry Lake, and Cave valleys) of the five proposed pumping basins. No stipulation agreement between the DOI and SNWA regarding SNWA's groundwater withdrawal permit applications currently exists for Snake Valley; however, approved monitoring plans (hydrologic and biologic) that are part of the Spring Valley stipulation agreement include certain portions of Snake Valley. The agreements are provided in **Appendix C**. The stipulations require that SNWA implement hydrologic monitoring, management, and mitigation plans. The current monitoring and mitigation plans for groundwater development in these four basins are as follows:

1. Spring Valley Hydrologic Monitoring and Mitigation Plan (Hydrographic Area 184) (SNWA 2009c); and
2. Hydrologic Monitoring and Mitigation Plan for Delamar, Dry Lake, and Cave Valleys (SNWA 2009d).

The current plans for locations of spring, stream, and groundwater monitoring sites included under these agreements in relation to the model-simulated drawdown areas are presented in **Figures 3.3.2-9** and **3.3.2-10**. Details regarding monitoring well completion, monitoring well data collection, baseline data collection, and modeling and reporting requirements are defined in the above referenced documents. A few of the key surface water and groundwater monitoring components included in the monitoring plans are the following:

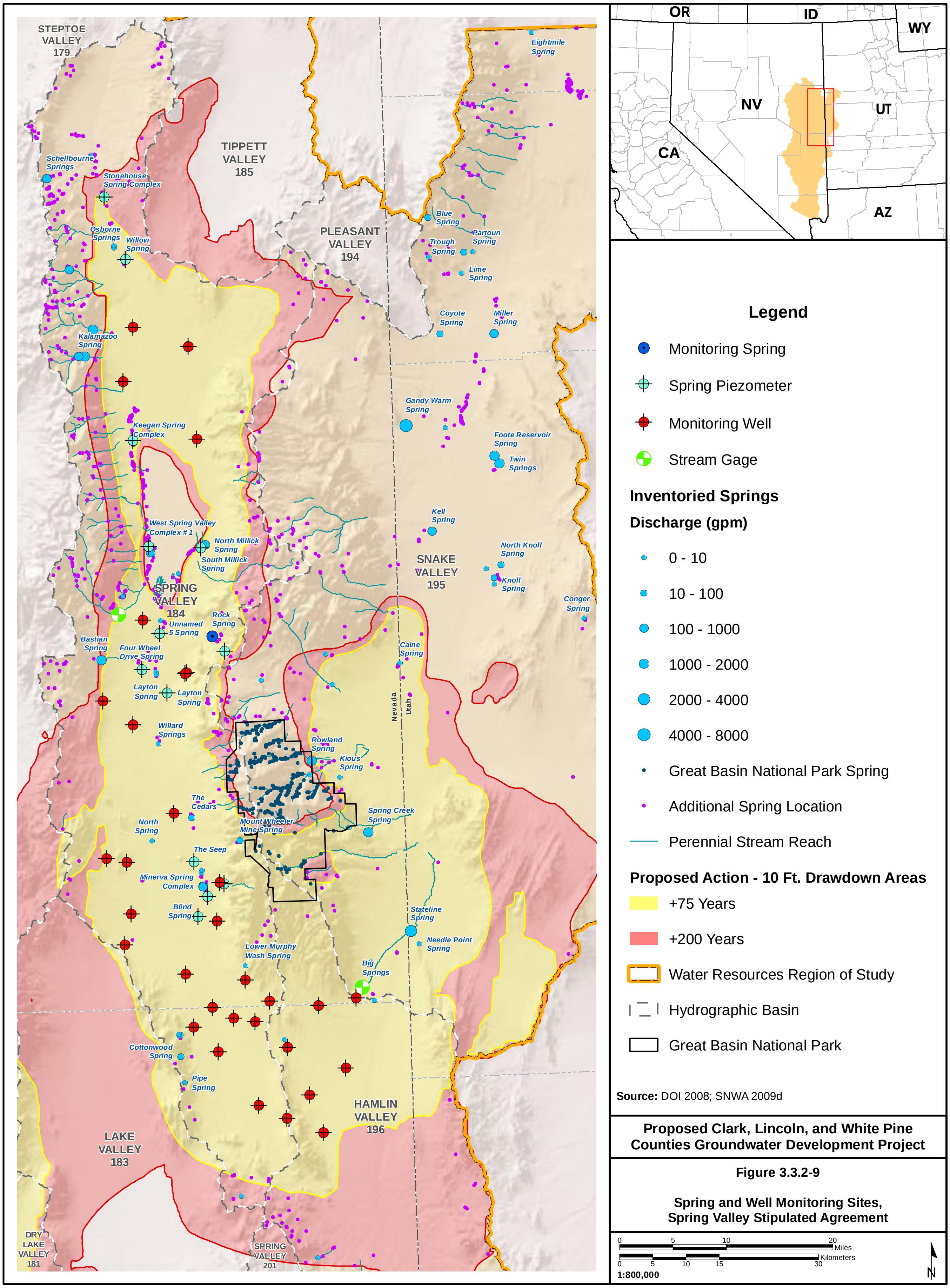
- Monitoring groundwater levels in a network of monitoring wells distributed over the region. Individual wells will be monitored on either a quarterly, semiannual, or continuous basis;
- Monitoring groundwater levels in two new monitoring wells located in the vicinity of Shoshone Ponds in Spring Valley on a continuous basis;
- Monitoring groundwater levels in six new monitoring wells (i.e., four in the carbonate-rock aquifer and two in the basin-fill aquifer) in the "Interbasin Groundwater Monitoring Zone" in Spring and Hamlin valleys on a continuous basis.
- Monitoring wells in White River Valley and Pahranagat Valley;
- Monitoring groundwater levels continuously in shallow piezometers located adjacent to selected springs;
- Monitoring flow at Cleve Creek (Spring Valley) and Big Springs Creek (Snake Valley) using surface water gauges;
- Monitoring spring flow at other selected springs on a biannual basis; and
- Monitoring flow at Hot Creek Spring, Ash Springs, and Crystal Spring on a continuous basis.

The monitoring plans also include monitoring precipitation at various stations distributed across the area, water quality sampling, and baseline monitoring requirements.

Reporting and analysis requirements of the stipulated agreements would include the following:

- Annual reporting to the NSE presenting the results of the required monitoring and sampling and updated water-level drawdown maps for both the basin-fill and carbonate aquifer; and
- Updating an NSE approved groundwater flow model every 5 years after pumping begins and providing predictive results at 10-, 25-, and 100-year periods.

These stipulated agreements also would require the SNWA to modify or curtail pumping to mitigate impacts if required by the NSE.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-9

Spring and Well Monitoring Sites, Spring Valley Stipulated Agreement

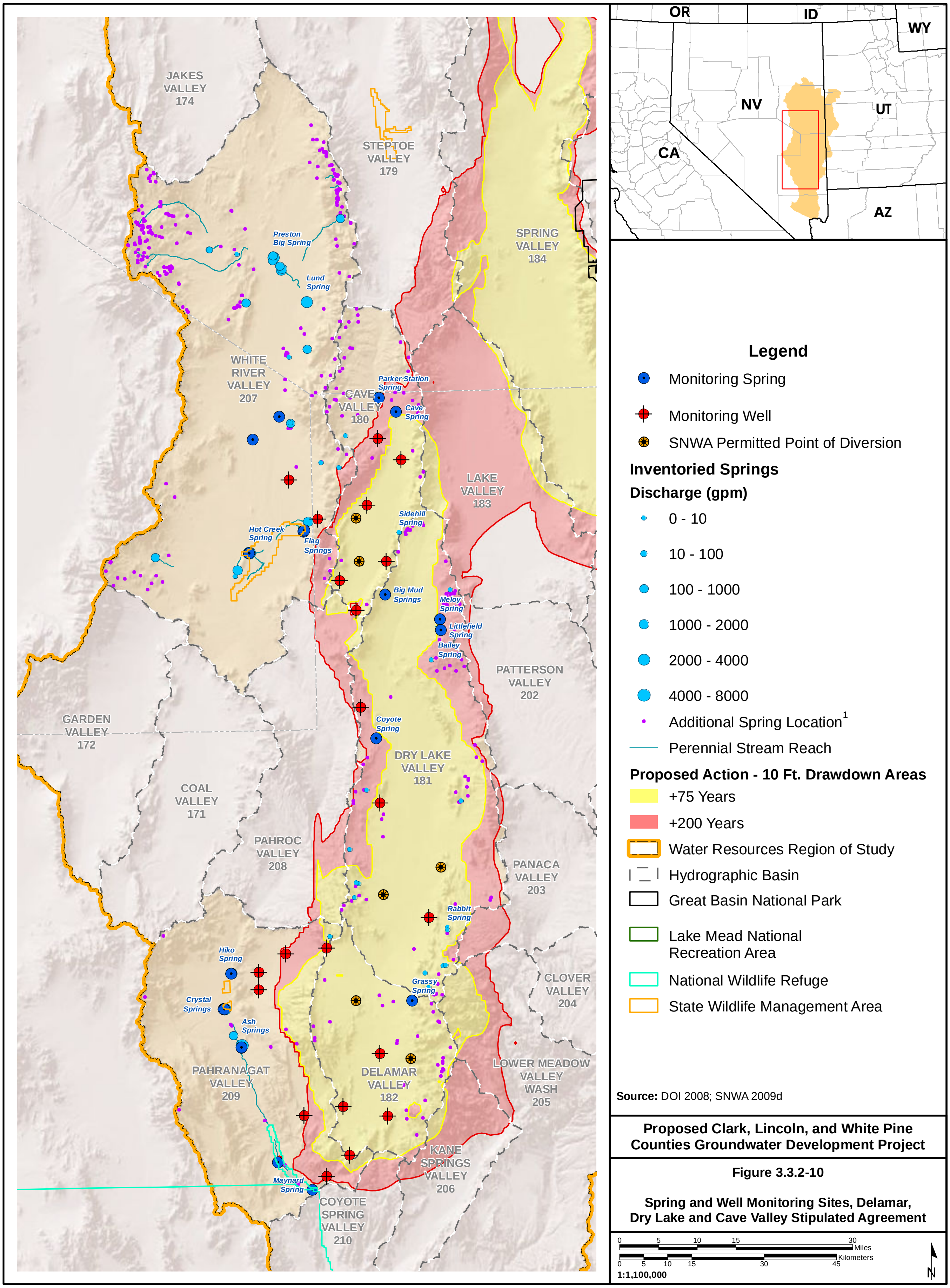


Figure 3.3.2-10

Spring and Well Monitoring Sites, Delamar, Dry Lake and Cave Valley Stipulated Agreement

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Applicant-committed Adaptive Management Plan and Measures

In addition to the stipulated agreements, the SNWA has developed an adaptive management plan that was submitted as part of the Plan of Operations for the proposed project to address uncertainties in predicting potential effects of SNWA's groundwater production on water dependent resources and water rights holders. The adaptive management plan is intended to allow for the SNWA and the BLM to identify, avoid, minimize, and mitigate adverse effects associated with the proposed pumping in all five hydrographic basins and includes a framework for:

1. Monitoring baseline conditions;
2. Monitoring groundwater pumping effects;
3. Establishing groundwater-dependent, early warning thresholds to comply with the stipulated agreements, NSE Rulings, and the draft Snake Valley Agreement;
4. Implementation of adaptive mitigation measures designed to minimize or mitigate impacts to water dependent resources;
5. Monitoring the effects of implementation of adaptive management measures to meet environmental goals;
6. Implementing alternative adaptive mitigation measures if environmental goals are not met; and
7. Annual reporting requirements.

If the BLM determines those early warning thresholds have been reached as a result of the SNWA's groundwater withdrawal; one or more adaptive management measures may be implemented. These measures could include the following actions:

- Geographic redistribution of groundwater withdrawals (ACM C.2.1);
- Reduction or cessation in groundwater withdrawals (ACM C.2.1);
- Augmentation of water supply for federal and existing water rights and federal resources using surface and groundwater sources (ACM C.2.1);
- Conduct recharge projects to offset local groundwater drawdown (ACM C.2.21); and
- Implementation of cloud seeding programs to enhance groundwater recharge (ACM C.2.22).

Utah Geological Survey Monitoring

In addition to monitoring included in the stipulated agreements, the UGS recently established a groundwater monitoring network in Utah's west desert. The UGS groundwater monitoring network includes a series of wells installed in the Snake Valley HA and additional wells in adjacent basins in Utah to monitor: 1) groundwater elevations and water quality, and 2) shallow water levels at wetlands near selected springs. The UGS also established surface- and spring-flow gauges at selected springs. The UGS intends to use the monitoring network to establish baseline groundwater elevations, surface flow, and geochemical conditions, and to monitor for changes in these conditions after pumping begins. The UGS also intends to maintain and operate this monitoring network for at least the next 50 years (UGS 2010).

Monitoring and Mitigation Recommendations

SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins facilities associated with the SNWA GWD Project. The plan would be approved and managed by the BLM in accordance with the FLPMA. The COM Plan would integrate protective measure from the following: BLM RMP management actions and BMPs, BO, ACMs, stipulated agreements, and additional mitigation recommended in this EIS. A framework for development of the COM Plan is provided in Section 3.20, Monitoring and Mitigation Summary, and includes a description of the development process; plan components; roles and responsibilities for BLM, SNWA, and other federal and state agencies; enforcement; and description of the effectiveness of the plan to mitigate potential adverse impacts associated with the project.

The following proposed monitoring and mitigation measures are intended to supplement the existing monitoring and mitigation commitments included in the stipulation agreements and the ACMs described in **Appendix E**.

GW-WR-3a: Comprehensive Water Resources Monitoring Plan. Prior to any project pumping in Spring, Delamar, Dry Lake, or Cave valleys, the SNWA would develop a comprehensive water resources monitoring plan (WRMP). This plan would specify hydrologic monitoring requirements (i.e., meteorological and surface water and groundwater) to provide adequate baseline data to facilitate the creation of an early warning system designed to distinguish between the effects of project pumping, natural variations, and other non-project related groundwater pumping activities. The WRMP also would identify monitoring requirements to be used to improve the calibration and predictive abilities of the numerical groundwater flow models (GW-WR-3b) used to estimate future effects associated with the groundwater development project. The WRMP would specify the siting, installation, monitoring frequency, and monitoring and testing methodology (including quality control and quality assurance procedures). The WRMP would be implemented such that critical baseline data necessary to determine pumping effects would be collected for a period of at least 5 years prior to the initiation of pumping. The WRMP would be developed, implemented, and maintained by the SNWA with approval by the BLM in coordination with other federal and state agencies (as deemed appropriate by the BLM). The WRMP design would allow for reasonable modifications and adjustments to monitoring locations over the project life to account for the results of the monitoring, updated groundwater flow model predictions, and updated biological surveys and habitat/species monitoring.

The WRMP would include surface water and groundwater monitoring sites that have been identified as critical to providing an early warning system for potential effects to federal resources and federal water rights identified by the BLM. The monitoring would include water sources essential for threatened or endangered species, and other BLM-identified sensitive species and related habitat determined to be at risk from the project pumping or ground disturbance related activities. A list of springs and streams with sensitive species or game fish on public lands determined to be at risk from the project (where monitoring is likely to be required) under the various alternatives is provided in **Table 3.3.2-9**. Monitoring at specific surface water sites could include surface water flow monitoring and/or monitoring wells located near the surface water source designed to monitor changes in groundwater elevation.

Groundwater Elevation Monitoring Sites

The WRMP also would include a monitoring well network designed to track the magnitude and aerial extent of drawdown overtime resulting from the project pumping activities. It is anticipated that this monitoring well network would include monitoring wells located in the following areas.

- Wells sited in each pumping basin designed to monitor the magnitude and extent of the drawdown over time from project pumping. This would include wells designed to monitor the basin fill aquifer and carbonate aquifer systems; and in some areas, volcanic aquifers.
- Wells sited to monitor groundwater elevations (including wells both in the carbonate aquifer and basin fill aquifers) in the area between southern Spring Valley and southern Snake Valley and northern Hamlin Valleys.
- Wells sited in southern Snake Valley to monitor drawdown effects in southern Snake Valley due to pumping in Spring or Snake valleys.
- Wells sited to monitor for propagation of drawdown from project pumping in Spring or Snake valleys to major spring discharge areas in northern Snake Valley (e.g., Gandy Salt Marsh Complex, Bishop Spring Complex, Leland-Harris Spring Complex, and Twin Springs).
- Well(s) sited along the eastern margin of Steptoe Valley to monitor for the westward propagation of drawdown from project pumping in Spring Valley into Steptoe Valley beneath the Schell Creek Range.
- Well(s) sited in northeastern Lake Valley to monitor for the propagation of drawdown from project pumping in Spring Valley to the area of Geyser and Wambolt springs in Lake Valley.
- Well(s) sited on the west side of Lake Valley to monitor for the propagation of drawdown from project pumping in Cave Valley to the area of Geyser and Wambolt springs.

Table 3.3.2-9 Comparison of Springs and Streams on Public Lands with Sensitive Aquatic Species or Game Fish at Risk[1] by Alternative

Springs and Streams with Sensitive Species or Game Fish Project Specific[2]				Proposed Action			Alt. A - Distributed Pumping			Alt. B - PODs			Alt. C - Intermittent			Alt. D - LCCRDA			Alt. E - Spring/DDC Only			Alt. F - Spring DDC Only			
GW Flow			Land	Years After Full Build Out			Years After Full Build Out			Years After Full Build Out			Years After Full Build Out			Years After Full Build Out			Years After Full Build Out			Years After Full Build Out			
System	Basin Name	Name	Owner	0	75	200	0	75	200	0	75	200	0	75	200	0	75	200	0	75	200	0	75	200	Sensitive Species or Game Fish[2]
White River	White River (207)	Flag Springs Complex[3]	State		X	X			X	X	X	X			X			X			X		X	X	White River spinedace, White River desert sucker, White River speckled dace, Flag pyrg
		Hot Creek Spring[3]	State								X	X													Moorman White River springfish, Pahranagat pebblesnail, grated tryonia
	Pahranagat Valley (209)	Pahranagat Creek	USFWS			X						X												X	Pahranagat speckled dace
Salt Lake Desert	Spring Valley (184)	Blind Spring	BLM		X	X		X	X		X	X			X		X	X		X	X		X	X	Northern leopard frog
		North Millick Spring[3]	BLM	X	X	X		X	X		X	X		X	X					X	X	X	X	X	Northern leopard frog
		South Millick Spring[3]	BLM	X	X	X	X	X	X	X	X	X	X	X	X				X	X	X	X	X	X	Northern leopard frog
		Pine Creek	NPS, BLM		X	X		X	X		X	X		X	X			X		X	X		X	X	Bonneville cutthroat trout
		Ridge Creek	NPS, BLM		X	X		X	X		X	X		X	X			X		X	X		X	X	Bonneville cutthroat trout
		Spring Valley Creek	BLM		X	X															X			X	Relict dace
	Snake Valley (195)	Rowland Spring	NPS			X			X		X	X													Brook Trout
		Big Springs Creek	BLM		X	X		X	X		X	X		X	X		X	X		X	X		X	X	NDOW unique fish community
		Big Wash	BLM		X	X		X	X		X	X		X	X			X			X			X	Bonneville cutthroat trout
		Hendry's Creek	USFS, BLM		X	X																			Bonneville cutthroat trout
		Snake Creek	NPS, BLM		X	X		X	X		X	X		X	X			X			X			X	Bonneville cutthroat trout
		Strawberry Creek	NPS, BLM			X					X	X													Bonneville cutthroat trout
Meadow Valley	Spring Valley (201)	Camp Valley Creek	BLM														X	X							Meadow Valley Wash desert sucker, Meadow Valley Wash speckled dace
	Lower Meadow Valley Wash (205)	Meadow Valley Wash	BLM			X						X													Meadow Valley Wash desert sucker, Meadow Valley Wash speckled dace

[1] Includes springs and streams located within areas determined to have a moderate or high risk of effects, or springs with a model simulated flow reduction of 5 percent or greater.
[2] See description of risk to sensitive species and game species provided in Section 3.7, Aquatic Biological Resources.
[3] Risk based on model-simulated flow change of 5 percent or greater.

- Wells sited in Cave Valley and at the base of Shingle Pass in southern White River to monitor and track the westward propagation of drawdown from project pumping in Cave Valley towards the springs that discharge along the southeastern margin of White River Valley (i.e., Flag and Butterfield springs).
- Wells sited on the northern boundary between Delamar and Pahranagat valleys, and in northern Pahranagat Valley to monitor groundwater elevations between the project pumping in Dry Lake and Delamar valleys and the regional spring discharge in northern Pahranagat Valley (i.e., Hiko, Crystal and Ash springs).
- Well(s) sited in the Pahranagat Shear Zone at the boundary between southern Delamar and southern Pahranagat valleys to monitor groundwater elevations between the groundwater production well field in Delamar Valley and the perennial water resources in southern Pahranagat Valley (i.e., Pahranagat National Wildlife Refuge).

The WRMP would include other springs and streams sites, and groundwater monitoring areas as deemed appropriate by the BLM. In additional to the sites listed previously, monitoring sites would be included as necessary to: a) track the extent and magnitude of the drawdown; b) monitor flows in perennial springs and streams determined to be at risk of effects from the groundwater development; and c) provide early warning monitoring of groundwater levels between the production well fields and federal water rights and other water dependant resources identified as critical for management and protection of the BLM's water dependant resources.

Monitoring Results Reporting Requirements

The BLM-approved WRMP would specify the reporting requirements for the monitoring plan. At a minimum, the WRMP would require that SNWA provide the BLM with the following information upon implementation of the WRMP and over the life of the groundwater development project:

1. Quarterly reporting of the results of any meteorological, surface water, and groundwater monitoring required for the project (including all field and laboratory data and analysis).
2. An Annual Report that summarizes and evaluates all monitoring results. The report would minimally include:
   a. Drawdown maps identifying the change in groundwater levels from the previous year, and total drawdown since groundwater pumping was initiated;
   b. Hydrographs for groundwater monitoring wells indicating the change in groundwater levels since monitoring was initiated at each site;
   c. Hydrographys for surface water flow monitoring sites indicating changes in flow since monitoring was initiated at each site;
   d. Water quality sampling and testing results for each monitoring site (where water quality monitoring is required);
   e. Description of identified reductions in flow in any monitored surface water resources in the region;
   f. Evaluation of the likely causes for reductions in surface water flow identified in (e);
   g. Description of any significant changes in water quality identified in surface water or groundwater monitoring locations;
   h. Description of any deviations of the monitoring results from the current groundwater flow model predictions or anticipated from prior monitoring; and
   i. Proposed modifications to the monitoring plans based on the results of the monitoring or updated groundwater flow model predictions (i.e., changes to the monitoring well network, or network of springs and stream sites).
3. All data collected as part of the WRMP and quarterly and annual reports, would be accessible to the public and other federal and state agencies via an internet site. The design and maintenance of the internet site would be the responsibility of SNWA and would be approved by the BLM.

GW-WR-3b: Numerical Groundwater Flow Modeling Requirements. The regional model would be updated and recalibrated at least every 5 years (after pumping is initiated) or sooner if BLM identifies major differences between the model simulations and monitoring results (GW-WR-3a) and determines that model recalibration is necessary.

In addition to the regional groundwater flow model, the SNWA would develop more detailed (local scale) groundwater flow models designed to simulate the effects of pumping within each specific basin. These basin-specific models would be developed and approved by the BLM prior to BLM's NEPA review of specific groundwater development activities proposed by the SNWA. The basin-specific models would be coupled with the regional model by constructing separate models, whose boundary conditions are linked to the regional model; constructing an "embedded" model where the local model is coupled to the regional model; or using another method approved by the BLM. The BLM would utilize the basin-specific models and the regional groundwater model to conduct a more detailed NEPA evaluation of potential project-related pumping impacts once the location and pumping schedules for the production wells have been defined by SNWA. Additionally, the BLM would use the basin-specific models to critically evaluate the effectiveness of the proposed mitigation measures, ACMs, and other proposed adaptive management processes. The basin-specific models also would be recalibrated at least every 5 years (after pumping is initiated) or sooner if the BLM identifies major differences between the model simulations and monitoring results and determines that model recalibration is necessary.

The regional groundwater flow model and basin-specific models would be maintained through the life of the project. The BLM would establish a Technical Review Team to review the model on a periodic basis to provide recommendations to improve the calibration and predictive ability of the numerical groundwater flow model(s). The BLM, with input from their Technical Review Team, would determine if periodic updates of the groundwater flow model are no longer necessary or if other groundwater flow models or predictive tools should be used.

<u>Effectiveness</u>: It is anticipated that BLM's review of monitoring results combined with appropriate updated groundwater modeling predictions would provide early warning of potentially undesirable impacts to water-dependent resources. This early warning potentially would allow for implementation of appropriate management measures (identified in GW-WR-7) to mitigate effects on these resources. Implementation of these monitoring and mitigation measures likely would reduce potential impacts to critical areas but would not entirely eliminate impacts to water dependant resources; see the related discussion in *Potential Residual Impacts* (below).

GW-WR-4: Monitoring, Mitigation, and Management Plan for Snake Valley. Mitigation measure GW-WR-4 described below includes the water resource components of the draft documents prepared by BLM during preparation of the Draft EIS:

1) Monitoring, Mitigation, and Management Plan for Snake Valley, Utah-Nevada; and
2) Guidance to Technical Working Group for Development of Snake Valley Monitoring, Mitigation and Management Plan.

The complete Monitoring, Mitigation, and Management (3M Plan) documents are provided in **Appendix B**.

The SNWA, working in conjunction with the BLM and other DOI agencies, and with input from the States of Nevada and Utah, will develop and implement a long-term monitoring, management, and mitigation plan for Snake Valley (3M Plan) as outlined below. When the 3M Plan is fully developed, it will be comparable to the monitoring plans developed (or to be developed) under the existing stipulation agreements for other basins addressed in this EIS. The 3M Plan will reflect a staged approach to implementing monitoring, management, and mitigation activities because of the time period that may elapse between this EIS and construction and operation of groundwater infrastructure in Snake Valley. Building and implementing the various stages of the 3M Plan will be dependent upon triggers as the SNWA moves closer to implementing groundwater development in Snake Valley.

The purpose of the 3M Plan is to insure that: 1) implementation of the ROD protects water dependent resources and water-related resources on public lands, 2) protects federal water rights managed by federal agencies, and 3) provides a process for mitigating impacts. To accomplish this purpose, the 3M Plan will establish a network of groundwater and surface water monitoring sites to collect baseline data and monitor the effects of groundwater development on water resources. The intent of the 3M Plan is to provide early warning of potential adverse impacts to water rights and water-dependent sensitive resources, and provide time and flexibility to implement management measures and gauge their effectiveness. Following this intent, the highest priority actions in the Snake Valley 3M Plan will be tied to predicted impacts from groundwater development, as identified in this EIS.

The 3M Plan would be required to be implemented and updated as long as the SNWA maintains long-term plans to develop groundwater and remove it from Snake Valley. If the SNWA terminates plans to develop groundwater from Snake Valley and the 3M Plan adopted for Spring Valley shows no interbasin effects from pumping in Spring Valley, then the BLM may terminate the requirement for a Snake Valley 3M Plan.

Key Concepts of Proposed Snake Valley 3M Plan

Hydrologic Provisions – The Snake Valley 3M Plan will include sections to address hydrologic issues and would be similar to the plans developed with the BLM and other DOI agencies for the other groundwater development basins analyzed in this EIS. The 3M Plan will include:

- Development and implementation of baseline monitoring plans;
- Establishment of new monitoring sites and use of existing monitoring sites, including monitoring wells, piezometers, stream flow gages, and precipitation or meteorological stations;
- Collection of data on groundwater elevations, spring and stream flow rates, water quality, aquifer testing, vegetation communities, special status and water-dependent species and their habitats; and
- Updates or revisions to groundwater flow numerical modeling.

Management and Mitigation Actions – The initial 3M Plan generally will identify available management options and mitigation actions to address any adverse effects of SNWA pumping. These actions may include:

- Geographic redistribution of groundwater withdrawals;
- Reduction or cessation of groundwater withdrawals;
- If water supplies used for consumptive purposes, such as irrigation, domestic and livestock watering use were limited by the project, then the SNWA will provide alternate supplies of water;
- Acquisition of real property and/or water rights dedicated to management of special status species; and
- Augmentation of water supply and/or acquisition of existing water rights.

The initial 3M Plan will include triggers that will prompt the SNWA and the Technical Working Group (described below) to develop more detailed management response actions and specify conditions when those management actions will be implemented.

Staged Approach with Triggers for 3M Plan Activities – The SNWA and the Technical Working Group will develop an initial 3M Plan within 1 year of the ROD for this EIS. The initial 3M Plan will focus on:

- Identification of existing monitoring sites that would be useful in establishing baseline conditions;
- Identification of additional monitoring sites that will be needed to build full sets of baseline data;
- Processes for sharing monitoring data with interested parties;
- Description of other monitoring, management, and mitigation activities that will begin at later stages of project development; and
- Triggers, such as decisions by the NSE regarding water rights for Snake Valley or completion of the interstate agreement between Nevada and Utah regarding Snake Valley, which will initiate additional activities under the 3M Plan.

When these triggers occur, sections of the initial 3M Plan that were only generally described will be more fully developed to meet the objective of early detection of potential project impacts. Resources that must be committed by

SNWA to build and implement the 3M Plan are expected to gradually increase over time, commensurate with SNWA implementation of groundwater development in Snake Valley.

Management Committee and Technical Working Group – As part of the 3M Plan, a management committee and a Technical Working Group will be formed to implement the various aspects of the 3M Plan to achieve its purpose. SNWA, in conjunction with BLM, will develop appropriate guidelines for the management committee and Technical Working Group. The BLM Nevada State Director, or his designee, will chair the management committee. Members of the management committee and Technical Working Group may include representatives from the SNWA, federal agencies, and the States of Nevada and Utah. Final approval of the Snake Valley 3M Plan (or any interim plans) rests with the BLM.

SNWA Management and Reporting Responsibilities – The SNWA would be responsible for the development and implementation of management actions associated with the 3M Plan including all monitoring activities during the life of the project. In the initial phase of the 3M Plan, the SNWA will provide results of monitoring on a quarterly basis and provide a detailed analysis of monitoring in an annual report provided to the BLM. The report would include maps indicating drawdown extent and magnitude and hydrographs indicating water levels and spring discharge measurements over time. When subsequent phases of the 3M Plan implement additional activities, such as research, groundwater modeling, and groundwater testing, reporting requirements would be similar as specified in the Spring Valley Monitoring and Mitigation Plan (SNWA 2009c). These reports would be made available to the public on BLM's website.

Monitoring Area – The monitoring areas associated with the 3M Plan are to be located within the Great Salt Lake Desert Flow System. Subject to input from the management committee and the Technical Working Group, it is anticipated that the highest intensity area for monitoring efforts will occur between Miller Springs at the northern end of Snake Valley and the southern boundary of the Snake Valley hydrographic area. Lower intensity monitoring efforts will occur in adjacent hydrographic basins, including Fish Springs Flat, Tule Valley, Pine Valley, and Wah Wah Valley. The Technical Working Group will be tasked with coordinating operation of the Snake Valley and Spring Valley Plans.

Management of Monitoring Data – The Technical Working Group will be responsible for establishing data collection methodology and quality control procedures. The Technical Working Group also will be responsible for integrating and interpreting monitoring results from a variety of sources, including the USGS, UGS, and SNWA-operated monitoring well locations. SNWA will be responsible for constructing and maintaining a database to house the collected data and make it publicly available.

Hydrologic Monitoring Provisions – The 3M Plan will include the following provisions for hydrologic monitoring**.** The Technical Working Group will be tasked with prioritization and sequencing of monitoring tasks, so that increased monitoring obligations will be linked to accomplishment of significant milestones toward groundwater development. Accordingly, all of the monitoring tasks listed below may not be implemented immediately, and the recommended timing of each task below will be addressed in the initial 3M Plan.

- **Monitoring Wells –** The 3M Plan will rely upon existing groundwater monitoring networks established by the USGS and the UGS. The SNWA will construct and operate additional monitoring well sites at locations where the greatest impacts of groundwater diversions are expected to occur and in sites where geologic and aquifer properties are not well known. The monitoring plan and operation will be approved by the management committee and the Technical Working Group. The well monitoring network will collect both groundwater level data and water quality data, with the objective of establishing baseline conditions.
- **Spring Monitoring** –The 3M Plan also will include a program for monitoring spring discharge and groundwater levels associated with springs. Monitoring efforts will be focused on identification of early warning of groundwater declines that could impact springs. The SNWA, working with the Technical Working Group, will initially identify the springs to be monitored and this will be updated as the information indicates the need for additional or changed monitoring locations. The initial list of springs to be considered for monitoring will be derived from springs that may experience flow rate reductions, according to the groundwater modeling analysis for this EIS. Initially, the spring monitoring would be accomplished using continuous water-level monitoring in piezometers located near each spring and biannual monitoring of flow at the spring.

- **Stream Monitoring –** The SNWA may be required to construct and operate stream gauges on creeks within Snake Valley or adjacent valleys that currently are not monitored by the USGS gauges or by the State of Utah or State of Nevada. Emphasis will be placed on monitoring stream reaches that could be directly affected by the SNWA groundwater diversions and streams that make significant contributions to the Snake Valley groundwater budget.
- **Meteorological (Climate) Stations –** The SNWA will be required to construct and operate meteorological monitoring stations to provide information for geographic areas not covered by current stations operated by USGS, BLM, NOAA, State of Utah, or State of Nevada. Emphasis will be placed on locations that require better groundwater recharge estimates for use in groundwater modeling procedures. Data collected would include, at a minimum, precipitation, temperature, wind, soil moisture and temperature, and relative humidity (although not all stations may require all parameters).

Hydrologic Analysis Provisions – Hydrologic analysis activities that will be included in the 3M Plan are set forth below. These activities are not expected to be fully implemented until later stages of the 3M Plan, with timing based upon triggers established by the Technical Working Group.

- **Aquifer Characterization –** The regional groundwater model used to support the NEPA process identified areas of uncertainty with regard to geologic and hydraulic characteristics of Snake Valley and adjacent valleys. The Technical Working Group will determine whether the SNWA should conduct additional studies to determine lithology and structure (such as faulting) of geologic units and aquifers in Snake Valley. One area of research focus will be to better characterize inter-basin flow zones in valleys adjacent to Snake Valley. Results from these additional studies will be used to enhance groundwater modeling efforts.
- **Numerical Modeling of Snake Valley Groundwater Flow –** The SNWA will develop a groundwater flow system numerical model that is specific to Snake Valley, in cooperation with the Technical Working Group. The Technical Working Group will determine the characteristics of the Snake Valley flow model, such as grid size and representation of existing groundwater depletions. The SNWA will develop the flow model well in advance of any proposals for specific production well locations, so that model results can be used to identify areas of uncertainty that could be reduced by investigations that could be implemented by the Technical Working Group.

Effectiveness. It is anticipated that the 3M Plan would provide early warning of potentially undesirable impacts to water-dependent resources and provide time and flexibility to implement management measures to mitigate their effects. However, since groundwater development presumes some level of vegetation change and significant reduction in groundwater levels in some parts of Snake Valley, not all impacts would be avoided by this mitigation measure. The Snake Valley 3M Plan may include mitigation measures offered by the SNWA, in coordination with the State of Utah, to mitigate impacts that occur to lands, water rights, and water-dependent resources owned by private parties, local governments, and state governments. However, the BLM cannot enforce mitigation measures on lands owned by other parties and cannot insure that the funding and land access necessary to implement these measures will be made available.

GW-WR-5: Shoshone Ponds. Drawdown is likely to impact the source of water that supports important aquatic resources for Shoshone Ponds (as discussed in Section 3.7, Aquatic Biological Resources). The SNWA would develop a surface water and groundwater monitoring plan specific to providing an early warning system for effects to flow at Shoshone Ponds. The site specific monitoring plan would likely include monitoring discharge at the Shoshone ponds; and monitoring artesian pressures in the aquifer that controls discharge to the ponds. The general requirements for development, approval, implementation, and reporting for the Shoshone ponds monitoring plan would be the same as outlined in GW-WR-3a.

Impacts to Shoshone Ponds that are attributable to the SNWA's groundwater pumping would be mitigated by improving the existing well or drilling a new well, and installing a pump such that the well, pump, and water conveyance system are designed to maintain the flow to the ponds for the foreseeable future regardless of the groundwater drawdown. Any new well should be designed to pump groundwater from the same aquifer system to maintain the same general water quality and temperature characteristics currently used as the source of water for the ponds and sufficient to support the federally listed and special status species that inhabit the ponds, as described in Section 3.7, Aquatic Biological Resources. The SNWA would be responsible for all cost associated with the implementation, operation, and maintenance of the source of water required to offset the effects of SNWA's groundwater pumping activities.

Effectiveness: Pumping groundwater from the existing well or new well located within the same aquifer is a feasible mitigation measure that is expected to effectively mitigate the anticipated reductions of flow resulting from the groundwater development project. Pumping water to replace the existing water supply would result in an incremental increase in drawdown. Impacts to water quality are unlikely to occur if the water supply used for mitigation pumps water from the same aquifer that currently is used to supply water to the ponds.

GW-WR-6: Existing Water Rights, Domestic Water Supply Wells and Other Water-Dependent Resources. Impacts to existing water rights and domestic water supply wells would be mitigated, as required by the State of Nevada or Utah (presumably acting under authority of an interstate agreement between Utah and Nevada that would be developed prior to future development). The NSE would oversee the groundwater development and is required by law to take action to resolve groundwater withdrawal conflicts with existing water rights; to protect the water supply used by domestic water supply wells, or to determine the resolution of conflicts with other provisions of Nevada water law. The NSE also "*recognizes that existing rights must be protected, as well as concerns for the wildlife and maintenance of wetlands and fisheries*" (NDWR 2012a,b,c,d). Mitigation for impacts to existing water rights and domestic water supply wells, as well as water dependent resources, would depend on the site-specific conditions and impacts and could include a variety of measures. Methods to avoid or minimize impacts to existing water rights, water dependent resources and domestic water supply wells, may include such measures as alterations to the groundwater pumping activities (e.g., modifying the pumping regime, changing the location of pumping). The NSE could require the implementation of other proven and cost-effective mitigation measures at the water source locations. These measures may include but would not be limited to the following: 1) for wells, mitigation could include lowering the pump, deepening an existing well, drilling a new well, or providing a replacement water supply of equivalent yield and water quality; and 2) for surface water rights and water dependent resources, mitigation could require providing a replacement water supply of equivalent yield and water quality.

Effectiveness: Mitigation for impacts to existing water rights or domestic water supply wells would be mitigated on a case-by-case basis as determined by the NDWR or UDWRi using proven cost-effective strategies (NDWR 2012a,b,c,d). The NSE rulings regarding water rights permitting for the groundwater development project states that "*The State Engineer's water rights permitting requirements will ensure the Project's environmental soundness*" and that "*The State Engineer finds that the springs and streams upon which water rights exist and wildlife depends must be protected*" (NDWR 2012a,b,c,d). Inventoried springs and perennial streams within the areas at risk from the proposed development typically have existing water rights. The NSE rulings indicate that the NSE has committed to protect water dependant resources such as wildlife, wetlands, and fisheries that may be adversely affected by impacts to springs and streams. The NSE permitting requirements include provisions for comprehensive water resources monitoring, reporting, management, and mitigation for the project. Implementation of appropriate monitoring, management, and mitigation measures required by the NSE is anticipated to effectively protect existing water rights, and minimize the impacts to wildlife, fisheries, and other sensitive biological resources associated with springs and streams, and domestic water supply wells in accordance with applicable state laws.

GW-WR-7: Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights. If the results of the monitoring or modeling information provided in accordance with GW-WR-3a indicate that impacts to federal resources or federal water rights from groundwater withdrawal are occurring or are likely to occur, and the groundwater development project is the likely cause of or contributor to the impacts, the following measures would be initiated:

1. The BLM would evaluate the available information and determine if emergency action and/or a mitigation plan is required.
2. If the BLM determines that emergency action is required to avoid, minimize, or offset the impact, the BLM would serve an immediate "Cease and Desist" order identifying the actions to be taken, including whether SNWA would be required to concurrently develop a mitigation plan as required in bullet 3 below.
3. If the BLM determines that a mitigation plan is required, the SNWA would prepare a detailed, site- specific plan that (a) identifies the magnitude and timing of the drawdown or associated impacts to federal resources or federal water rights; and (b) provides detailed site-specific measures that would be used to avoid, minimize the magnitude

of, or offset the identified impacts. The mitigation plan would be submitted to BLM for approval within 30 days of BLM's determination that a site-specific mitigation plan is required unless a longer time frame is approved by the BLM.

4. The BLM-approved, site-specific mitigation plan would be implemented by the SNWA. The BLM could require that specific measures be implemented per the schedule specified in the mitigation plan to avoid, minimize, or offset the impacts to federal resources or federal water rights. The specific mitigation measures may include but are not limited to the following:
   - Reduction or cessation in groundwater withdrawals;
   - Geographic redistribution of groundwater withdrawals;
   - Recharge projects to offset local groundwater drawdown;
   - Flow augmentation to maintain flow in specific water sources; or
   - Other on-site or off-site improvements.
5. Monitoring of the surface water resources and groundwater elevations required under Mitigation Measure GW-WR3a would be used in addition to other specified monitoring in the approved mitigation plan to document the effectiveness of the implemented measures. If the initial implementation of the mitigation plan does not provide the desired results within the time frame specified by the BLM, the BLM may require implementation of additional measures.

Effectiveness: The effectiveness would depend in part, on the capacity of the comprehensive WRMP (described in GW-WR-3a) and associated groundwater modeling to closely track the groundwater drawdown area resulting from the groundwater withdrawal and provide for an early warning system to identify potential effects to federal resources and federal water rights. The early warning monitoring system coupled with BLM authority to require that specific measures be implemented in a timely manner to avoid, minimize, or offset the impacts is expected to be effective at minimizing residual adverse effects to federal resources and federal water rights. However, reasonable or adequate mitigation measures for long-term reductions of groundwater discharge, or baseflow, may not be available for all locations as discussed in the *Potential Residual Impacts* section provided below. In addition, this mitigation measure also may be limited if actions required to offset, minimize or avoid the identified impact is not within BLM's authority or jurisdiction. See GW-WR-6.

Potential Residual Impacts

Potential residual impacts resulting from groundwater pumping for the Proposed Acton are discussed below.

Groundwater drawdown associated with groundwater development is predicted to expand for at least full build out plus 200 years and persist for the foreseeable future. Successful implementation of the stipulations and adaptive management plan likely would minimize residual adverse effects to water resources at selected locations. The feasibility and success of the mitigation would depend on the site-specific conditions and details of the mitigation plan. However, considering the regional scale of the predicted drawdown and number of perennial water sources identified that could be affected, it may not be feasible to effectively mitigate impacts to all of the potentially affected water sources. In addition, adequate mitigation measures for long-term reductions of groundwater discharge, or baseflow, may not be available for all locations.

The SNWA has identified several adaptive management measures that could be implemented to address adverse impacts. Two of these adaptive management measures would adjust groundwater withdrawal to minimize impacts, specifically: 1) geographic redistribution of groundwater withdrawal; or 2) reduction or cessation in groundwater withdrawal. Implementation of these adaptive management measures would reduce the magnitude of drawdown in specific areas. However, as described in **Appendix F3.3.5** (Pumping Cessation – Recovery Analysis), recovery of water levels in specific areas of interest to pre-project conditions could take several years or decades. Recovery would be dependent on location and implementation of specific adaptive management measures and may not successfully mitigate long-term impacts to surface water resources in some areas. Therefore, a long-term reduction in surface discharge at perennial surface water source areas is likely to occur in some areas even after implementation of the SNWA proposed adaptive management measures and proposed mitigation measures. This potential reduction in surface discharge at perennial surface water source areas is considered an unavoidable adverse impact associated with the proposed groundwater development.

The groundwater development is predicted to result in a long-term reduction in groundwater discharge to ET areas in Spring and Snake valleys. Some of these ET areas are sustained by spring discharge. It is not feasible to mitigate all impacts to ET areas resulting from the reduction in groundwater discharge. Long-term reductions in groundwater discharge to ET are considered unavoidable residual impacts associated with the proposed groundwater development.

3.3.2.10 Alternative A

Groundwater Development Areas

Groundwater development associated with the well fields would occur within the general areas identified within the five groundwater development basins (i.e., Spring, Snake, Cave, Delamar, and Dry Lake valleys). The groundwater development areas defined for Alternative A are the same as previously described for the Proposed Action. As with the Proposed Action, development within the groundwater development areas would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been at this stage of the project and will be subject to future site-specific NEPA analysis.

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 4,800 acres within 5 hydrographic basins. As described under the Proposed Action, there are 60 known or suspected springs identified within the groundwater development areas (**Table 3.3.2-4**). These springs occur within the groundwater development areas within Spring Valley (37 springs), Snake Valley (11 springs), Delamar Valley (7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring). There also are 28 separate perennial stream reaches located in Spring Valley (23 streams) and Snake Valley (5 streams) with a total length of 29 miles within the groundwater development areas (**Table 3.3.2-5**). The potential for impacts to springs and streams located within these groundwater development areas would depend on the final locations of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional monitoring and mitigation recommendations (GW-WR-1, GW-WR-2) described under the Proposed Action also would apply to Alternative A and include identifying and establishing an avoidance buffer around all springs; and developing site-specific plans to minimize impacts at perennial stream crossings within the groundwater development areas.

Groundwater Pumping

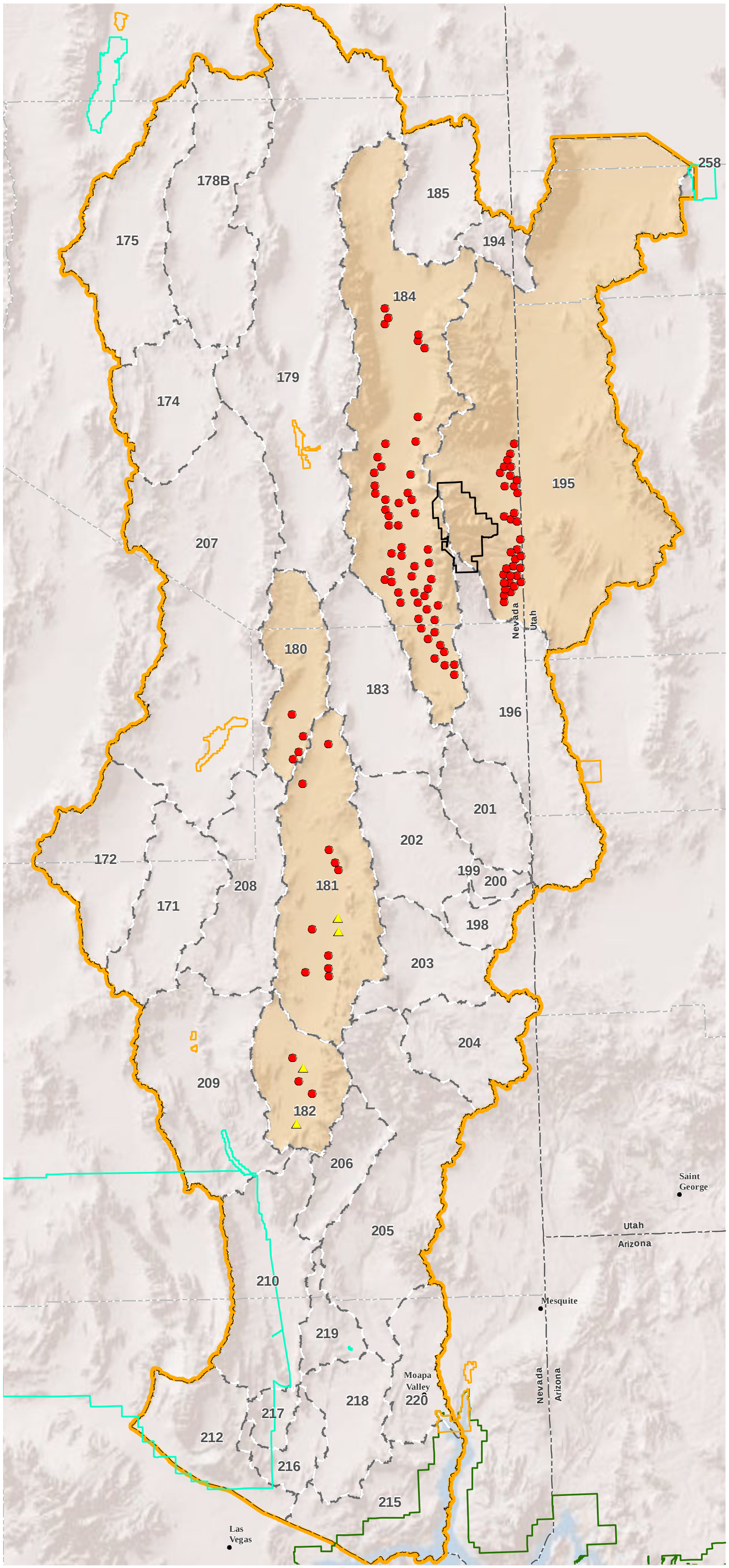
Groundwater Pumping Scenario

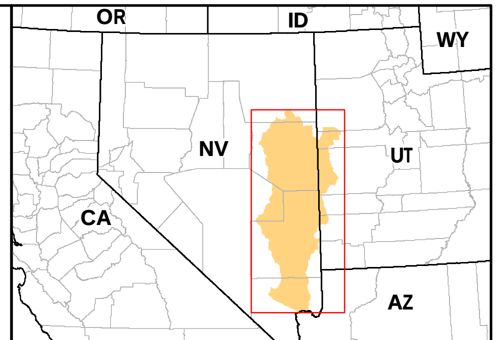
The groundwater pumping scenario for Alternative A assumes pumping at reduced quantities (approximately 115,000 afy) from those listed on the pending water rights application for the 5 proposed project pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys). The well distribution developed by SNWA for this model scenario (**Figure 3.3.2-11)** distributes the simulated production wells spatially within the groundwater development areas in an effort to minimize pumping effects. Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report (SNWA 2010a). The pumping schedule reflects the proposed south to north sequence of basin development for the project.

Impacts to Water Levels

The predicted change in groundwater levels attributable to groundwater development under the Alternative A at full build out, full build out plus 75 years, and full build out plus 200 years are provided in **Figures 3.3.2-12**, **3.3.2-13**, and **3.3.2-14**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels.

At full build out, the drawdown areas are localized in the vicinity of the pumping wells in Spring, Delamar, Dry Lake, and Cave valleys. Drawdown does not occur at this time period in Snake Valley. Comparison of the simulation results for the three representative points in time indicates that the drawdown area continues to progressively expand as pumping continues into the future.





Legend

Pumping Scenario Well Locations[1]

- SNWA Project Well
- Lincoln County Water District Approved Water Right
- Hydrographic Basin
- Pumping Basin
- Water Resources Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

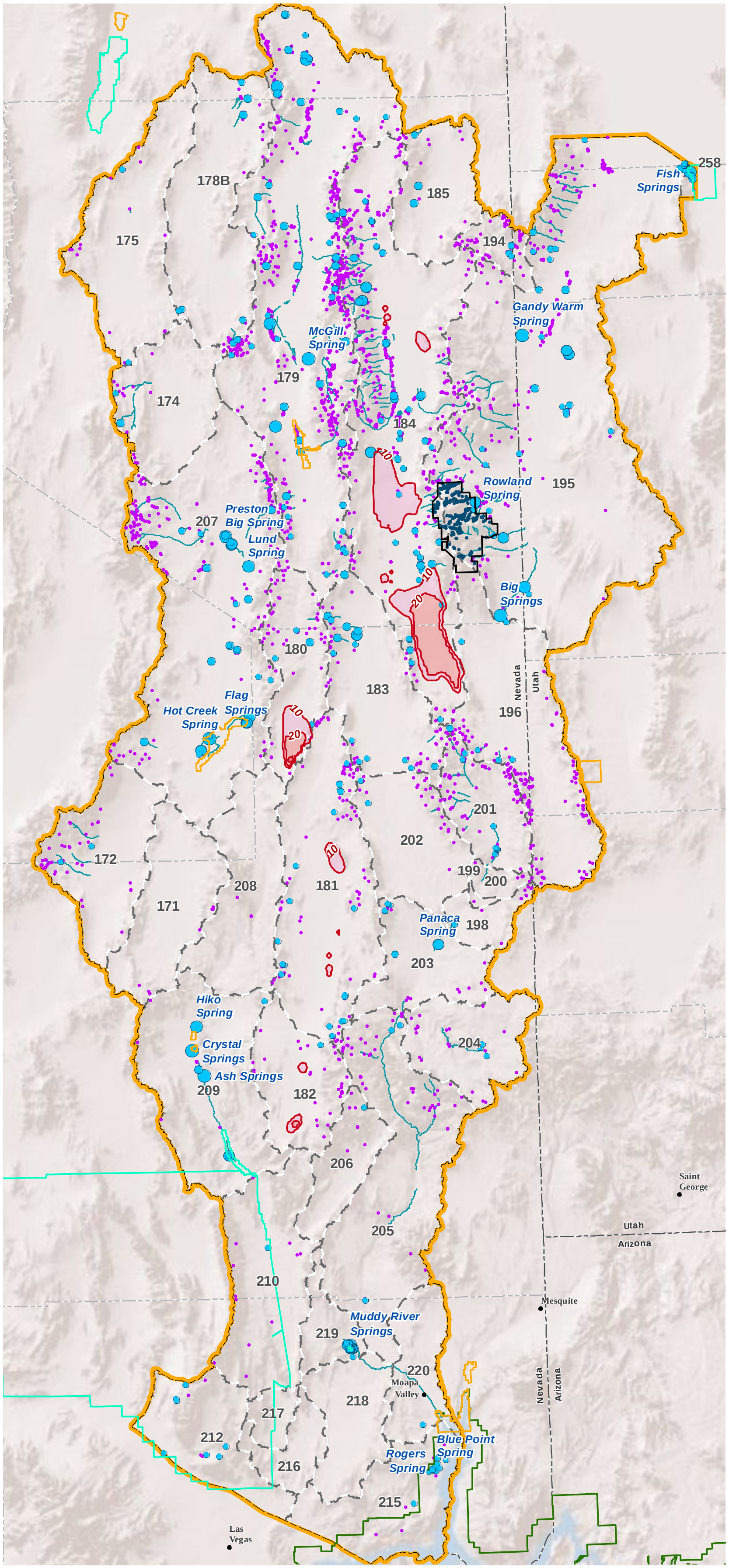
[1]The SNWA well locations represent the production well locations simulated in the numerical groundwater flow model for evaluating potential impacts. The actual number and location of the wells will be determined after additional field investigations.

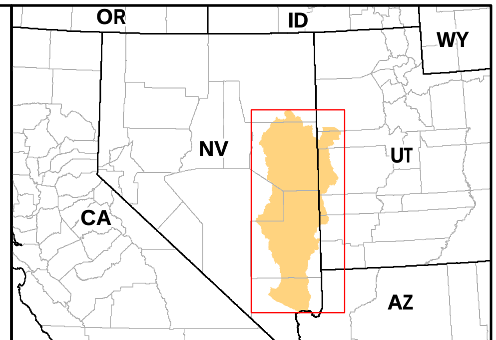
Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-11
Pumping Distribution
Alt. A - (Distributed Pumping/Reduced Quantities) and Alt. C - (Intermittent Pumping)

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

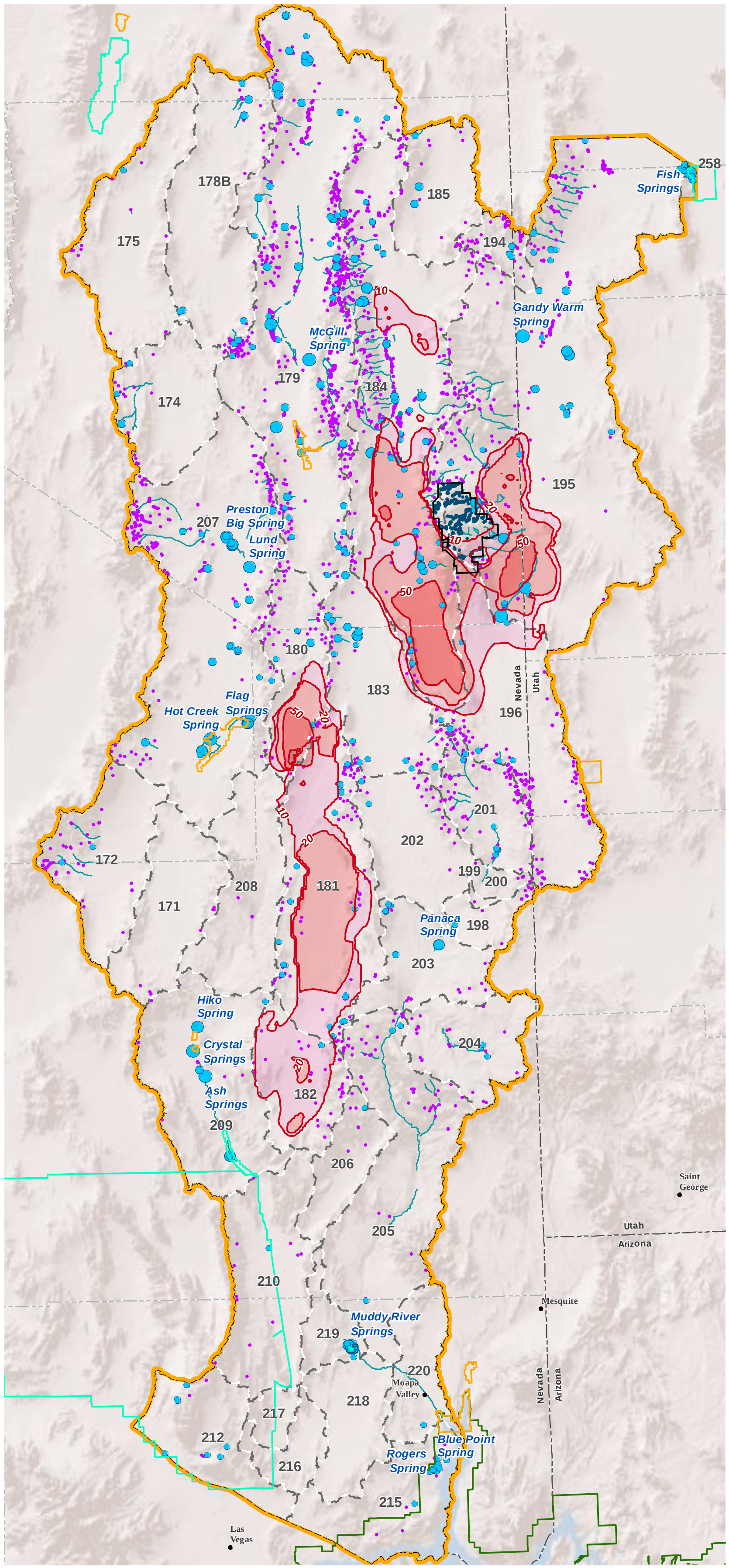
- 10 - 20
- 20 - 50
- 50 - 100
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

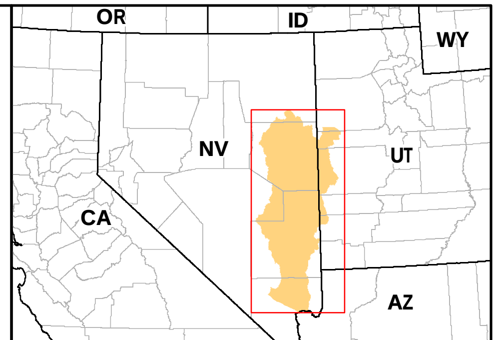
Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-12
Predicted Change in Groundwater Levels
Alt. A - (Distributed Pumping/Reduced Quantities)
Full Build Out

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

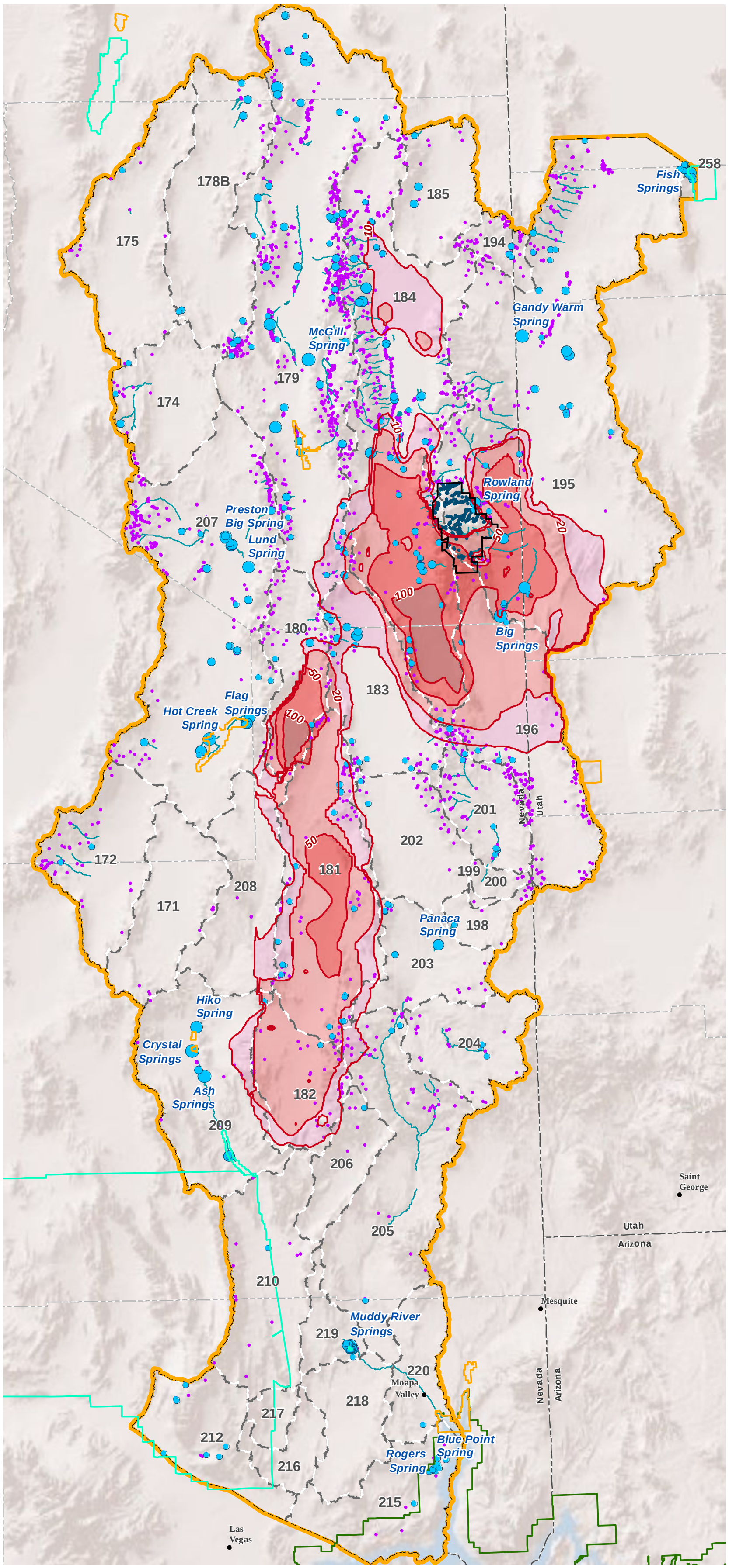
Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

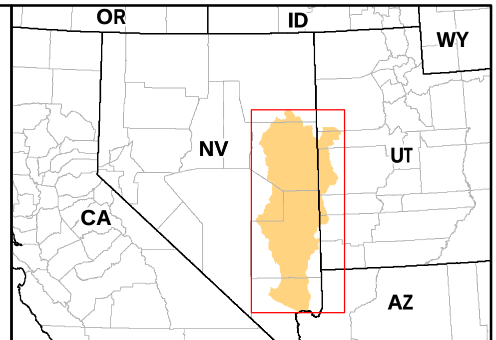
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-13
Predicted Change in Groundwater Levels
Alt. A - (Distributed Pumping/Reduced Quantities)
+ 75 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
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179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-14
Predicted Change in Groundwater Levels
Alt. A - (Distributed Pumping/Reduced Quantities)
+ 200 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N

At full build out plus 75 years time frame, there are three distinct drawdown areas. The northernmost drawdown area is a relatively small localized drawdown area located in the northern portion of Spring Valley. The second drawdown area encompasses the southern Spring Valley, southern Snake Valley, and northern Hamlin Valley. The third drawdown area extends across Cave, Delamar, and Dry Lake valleys in an elongate north-south direction that primarily is confined in these three pumping basins.

By the full build out plus 200 years time frame, the two main drawdown areas are beginning to merge into one that extends approximately 170 miles in a north-south direction and up to 50 miles in a east-west direction. At this time frame, the simulated drawdown area extends into southeastern Steptoe Valley, and into eastern margins of Pahroc and Pahranagat Valleys, and extreme western margins of Panaca Valley and northwest margin of Lower Meadow Valley Wash.

The locations of six selected observation wells located within the proposed pumping basins are presented in **Figure 3.3.2-6**. Water-level hydrographs for each of these observation wells within the pumping basins are provided in **Figures 3.3.2-7** and **3.3.2-8**. The hydrographs illustrate the predicted rate and magnitude of water level decline at these representative locations over the simulation period. As with the Proposed Action, the hydrographs indicate that water levels are predicted to continue to decrease over the model simulation period; and not reach a renewed equilibrium (or steady state condition) before the end of the simulation period. The representative hydrographs illustrate that the reduced groundwater withdrawal under the Alternative A pumping scenario is predicted to result in a reduction in the amount of drawdown within the pumping basins as compared to the Proposed Action.

The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9)

Potential effects to water resources resulting from the Alternative A pumping scenario are summarized in **Table 3.3.2-10**.

Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.8A-4**, **F3.3.8A-5**, and **F3.3.8A-6**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-2A** in **Appendix F3.3.9**. Specific inventoried springs located within the drawdown area at the representative points in time are listed in **Table F3.3.10-1A** in **Appendix F3.3.10**. The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-2A** in **Appendix F3.3.11**.

Potential total effects to perennial springs and streams are summarized in **Table 3.3.2-10**. For the predicted drawdown area at full build out plus 75 years, there are 29 inventoried springs and 86 “other” springs located within the high and moderate risk areas. By full build out plus 200 years, this increased to 46 inventoried springs and 136 “other” springs located within the high and moderate risk areas. These springs occur in Cave, Steptoe, Hamlin, Spring (HA 184), Snake, and Lake valleys.

The total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 58 miles at 75 years to 81 miles at full build out plus 200 years. This includes stream reaches located in Steptoe, Spring (HA 184), Snake and Lake valleys.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action.

<u>Model-simulated Spring and Stream Discharge Estimates</u>. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-11**. The model results indicate that two of the modeled springs in White River Valley, Butterfield Spring and Flag Springs 3, are predicted to experience 8 percent flow reduction at the full build out plus 200 years time frame. These results suggest that the groundwater development eventually could affect flows in springs located along the south eastern margin of the valley floor in White River Valley. The model results also indicate that

Table 3.3.2-10 Summary of Potential Effects to Water Resources Resulting from the Alternative A Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	5	10	16
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	1	29	46
• Number of other springs located in areas where impacts to flow could occur[4]	2	86	136
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	2%	100%	100%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	1	2	4
• Miles of perennial stream located in areas where impacts to flow could occur	1	58	81
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	14	109	151
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	15	171	93
• Number of groundwater rights located within the 50-100 foot drawdown area	0	3	128
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	0	2
• (Total groundwater rights in drawdown area)	(15)	(174)	(223)
Percent reduction in ET and spring discharge[5]:			
• Spring Valley	30%	51%	57%
• Snake Valley	0%	23%	27%
• Great Salt Lake Desert Flow System[1]	12%	34%	39%
• White River Flow System	0%	0%	1%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]:			
• AFY	0	440	1,100
• Percent Reduction	0%	2%	6%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.5** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to No Action pumping results.

Table 3.3.2-11 Model-simulated Flow Changes (Alternative A Pumping)

(Project Specific)					Alternative A (Reduced Pumping)		
					Incremental Change in Flow % (from No-Action)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model-simulated Average Flow (2005) in gpm	Full Build Out	75 years after Full Build Out	200 years after Full Build Out
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	0	0
		Butterfield Spring	1,225	471	0	-3	-8
		Cold Spring	582	503	0	0	-1
		Flag Springs 3	969	560	-1	-3	-8
		Hardy Springs	200	73	0	0	-1
		Hot Creek Spring	5,032	6,899	0	-1	-2
		Lund Spring	3,594	3,314	0	0	-1
		Moon River Spring	1,707	1,457	0	0	-1
		Moorman Spring	405	353	0	0	-1
		Nicolas Spring	1,185	872	0	0	0
		Preston Big Spring	3,572	3,794	0	0	-1
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	0	-1
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	-1
		Hiko Spring	2,735	1,985	0	0	-1
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	0
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	0
	Black Mountains Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	0	0
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	-12	-28	-36
		North Millick Spring	284	98	-4	-9	-11
		South Millick Spring	506	278	-10	-21	-24
	Snake Valley (195)	Big Springs	4,289	1,977	-2	-100	-100
		Foote Res. Spring	1,300	211	0	-1	-1
		Kell Spring	120	59	0	-1	-1
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	0
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010b.

other springs located in the northern portion of the valley floor in White River Valley are unlikely to experience flow reductions (greater than 5 percent) attributable to the Alternative A pumping. The model results indicate that measurable flow reductions attributable to this alternative are not anticipated in major regional spring discharge areas within the White River Flow System including Pahranagat Valley, Muddy River Springs Area near Moapa.

In the Great Salt Lake Desert Flow System, spring discharge was simulated at 3 springs in Spring Valley, and 4 springs in Snake Valley. In Spring Valley, the model simulations indicate that by full build out plus 75 years, the flow at Keegan, North Millick, and South Millick springs all show reductions of flow. At full build out plus 200 years, these springs are predicted to experience flow reductions ranging from 11 to 36 percent. In Snake Valley, the model simulation results are essentially the same as those described for the Proposed Action.

Water Resources Within or Adjacent to GBNP. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). At the full build out plus 75 years time frame, Outhouse Springs and Spring Creek Springs (both located outside the GBNP boundary) and 5.6 miles of Snake Creek (located inside the GBNP boundary) are within the area of moderate risk. By the full build out plus 200 years time frame, three springs, Outhouse, Rowland (located along the park boundary), and Spring Creek Springs along with 8.8 miles of Snake Creek and its tributaries are within the area of moderate risk. Potential risk to streams in cave systems are uncertain as discussed under the Proposed Action. However, it important to note that the magnitude of drawdown simulated by the numerical model beneath the GBNP generally is less under Alternative A compared to the Proposed Action. Therefore, if any perennial waters or waters in cave systems are hydraulically connected to the regional aquifer system affected by groundwater withdrawal, potential impacts to these water sources would be anticipated to be less than those occurring under the Proposed Action.

Utah Surface Water Resources. There are three inventoried springs (Caine Spring, Stateline Springs, and Needle Point Springs in Snake Valley) and three perennial stream reaches (Big Wash, Lake Creek, and Snake Creek) in Snake Valley that could be impacted at either the full build out plus 75 years or full build out plus 200 years time frames. Flow reductions in Lake Creek would result in reduced flow to Pruess Lake.

The model simulations indicate that drawdown could propagate into Pine Valley. At the full build out plus 75 years and full build out plus 200 years time frames, the maximum drawdown simulated at the boundary of the model between Snake and Pine valleys is approximately 0 feet and 31 feet, respectively. Therefore, the model simulations suggest that drawdown eventually could propagate into the Pine Valley hydrographic basin. As described under the Proposed Action, available information suggest that drawdown from pumping in Snake Valley is unlikely to impact surface water resources in Pine Valley (see Proposed Action for further discussion).

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.12A-4**, **F3.3.12A-5**, and **F3.3.12A-6**, respectively, in **Appendix F3.3.12**. **Table F3.3.13-2A** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. At full build out plus 75 years, there are a total of 109 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 151 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-4, **F3.3.14A-5**, and **F3.3.14A-6** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, at full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-2A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 174 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 223 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Impacts to Water Balance

The model-simulated groundwater budget for the Alternative A pumping scenario is presented in **Appendix F3.3.16**, **Table F3.3.16-2B**. Compared to the simulated conditions under No Action, for Spring Valley, the Alternative A pumping is estimated to result in reductions of groundwater discharge for ET of 51 percent at full build out plus 75 years and 57 percent at full build out plus 200 years time frame. In Snake Valley, the pumping is estimated to result in reductions of groundwater discharge to support ET and spring discharge of 23 percent at full build out plus 75 years, and 27 percent at full build out plus 200 years with most of this reduction occurring in the southern portion of the valley. As with the Proposed Action, the Alternative A pumping is estimated to have minimal impact on ET discharge within the other pumping basins and the White River Flow System.

The total predicted reduction of flow to Pine, Wah Wah, and Tule valleys is summarized in **Table 3.3.2-10**. This reduction corresponds to an approximate 2 percent and 6 percent reduction in flow to these basins at the full build out plus 75 years and full build out plus 200 years time frame. If the groundwater flow system is interconnected and regional flow from Snake Valley contributes to flow at Fish Springs, then a reduction of flow from Snake Valley to Pine, Wah Wah, and Tule valleys eventually could result in a reduction of discharge at Fish Springs. The model estimated reduction of groundwater outflow from Snake Valley to downgradient basins in the Great Salt Lake Desert Flow System along the eastern boundary of Snake Valley is 1,100 afy at the full build out plus 200 years. This flow reduction represents approximately 5 percent of the surface discharge at Fish Springs. Flow reduction of this magnitude at Fish Springs likely would be difficult to measure and distinguish from natural flow variations.

The GBNP Model (Halford and Plume 2011) was set up to simulate flows at Fish Springs. The simulation results from the GBNP Model indicate that pumping in Snake Valley (at the points of diversion listed in the SNWA water rights applications), at the full application rate (50,000 afy) combined with continuation of existing agricultural pumping would not reduce flows in Fish Springs over the 200-year simulation period. These model results suggest that pumping associated with the groundwater development in Snake Valley is unlikely to result in a measureable reduction in flows at Fish Springs.

Water Quality

Potential impacts to water quality would be the same as described under the Proposed Action.

Monitoring and Mitigation Recommendations

Additional mitigation recommendations GW-WR-3a (Comprehensive Water Resources Monitoring Plan) and GW-3b (Numerical Groundwater Flow Modeling Requirements); GW-WR-4 (Monitoring, Mitigation and Management Plan for Snake Valley); GW-WR-5 (Shoshone Ponds Mitigation); GW-WR-6 (Water Rights Mitigation); and GW-WR-7 (Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights) described under the Proposed Action, and the COM Plan described in Section 3.20, Monitoring and Mitigation Summary, would apply to Alternative A.

Potential Residual Impacts

Potential unavoidable residual impacts associated with the groundwater development are described under the Proposed Action. Because of the reduced maximum groundwater withdrawal rate (as compared to the Proposed Action), the magnitude of the potential unavoidable residual impacts to water resources associated with the Alternative A pumping scenario would be substantially less than the Proposed Action and Alternative B.

3.3.2.11 Alternative B

Groundwater Development Areas

For the purpose of analysis of surface disturbance related impacts, Alternative B (Points of Diversion) assumes that surface disturbance would be focused primarily near (i.e., within 1 mile radial distance) the points of diversion identified in the water rights applications in five basins (i.e., Spring, Snake, Delamar, Dry Lake, and Cave valleys). The development would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been determined at this stage of the project and will be subject to future site-specific NEPA analysis.

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 4,660 acres within 5 hydrographic basins. As summarized in **Table 3.3.2-4**, there are 7 known or suspected springs identified within the potential disturbance areas, all located in Snake Valley. This includes two inventoried springs (Kious Spring and Youn-Aquainv-003) and five springs identified based on National Hydrography Database or topographic mapping data that have not been field verified. There are three perennial stream reaches (5.8 miles) in Snake Valley within the potential disturbance area (**Table 3.3.2-5**). The potential for impacts to springs and streams located within these groundwater development areas would depend on the actual location of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional monitoring and mitigation recommendations (GW-WR-1, GW-WR-2) described under the Proposed Action also would apply to Alternative B and includes measures to identifying and establishing an avoidance buffer around all springs, and developing site-specific plans to minimize impacts at perennial stream crossings within the groundwater development areas.

Groundwater Pumping

Groundwater Pumping Scenario

The groundwater pumping scenario for Alternative B assumes pumping at the full diversion rates (i.e., approximately 177,000 afy) listed on the pending water rights application for the five proposed project pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys). The well distribution for this model scenario (**Figure 3.3.2-15**) assumes that wells would be developed at the actual points of diversion listed on the water rights applications. The pumping in each valley was distributed equally among the points of diversion based on the demand schedule up to the maximum diversion rate associated with each application. Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report (SNWA 2010a). The pumping schedule reflects the proposed south to north sequence of basin development for the project.

Impacts to Water Levels

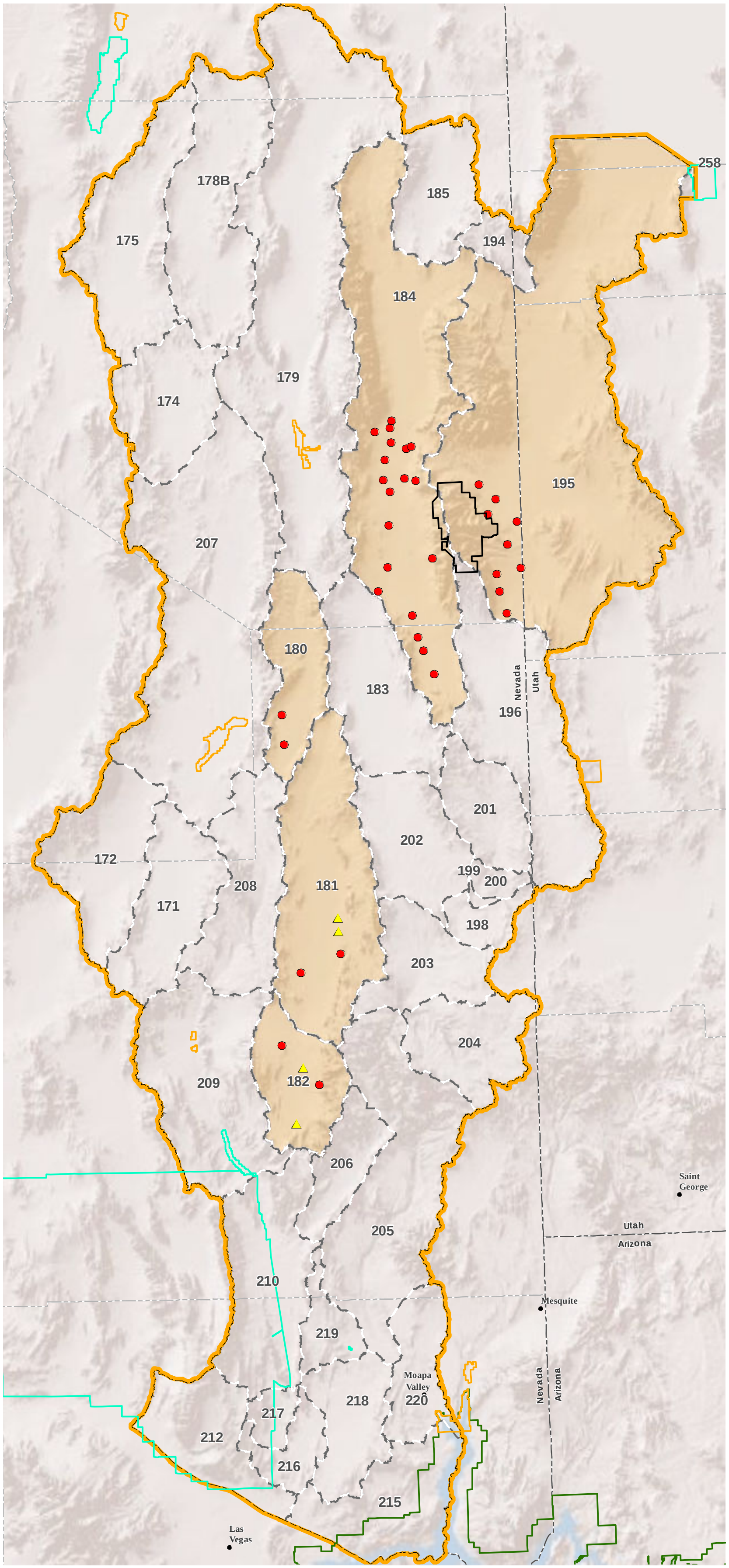
The predicted change in groundwater levels attributable to groundwater development under the Alternative B at full build out, full build out plus 75 years, and full build out plus 200 years is provided in **Figures 3.3.2-16**, **3.3.2-17**, and **3.3.2-18**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels.

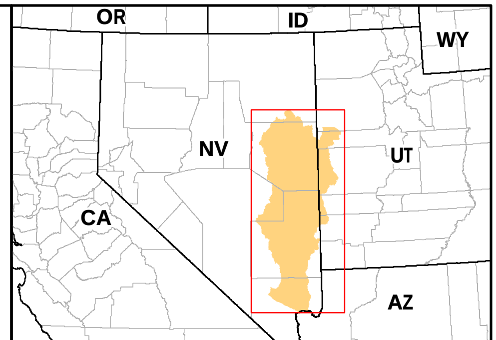
At full build out, the drawdown areas are localized in the vicinity of the pumping wells in Spring, Delamar, Dry Lake, and Cave valleys. Drawdown does not occur at this time period in Snake Valley. Comparison of the simulation results for the three representative points in time indicates that the drawdown area continues to progressively expand as pumping continues into the future.

At full build out plus 75 years time frame, there are three drawdown areas: 1) northernmost drawdown area encompasses the southern Spring Valley, southern Snake Valley, and northern Hamlin Valley; 2) a smaller drawdown area extends across Cave Valley; and 3) southernmost drawdown area that extends across Dry Lake and Delamar valleys.

By the full build out plus 200 years time frame, the drawdown areas merge into one large drawdown area that extends approximately 150 miles in a north-south direction and up to 57 miles in an east-west direction. At this time frame, the simulated drawdown area extends into southeastern Steptoe Valley, the eastern margin of White River Valley, Pahroc and Pahranagat valleys, Lake Valley, and western margins of Panaca Valley, northwest margin of Lower Meadow Valley Wash, and northeast portion of Kane Springs Valley. Compared to the Proposed Action, the drawdown area for Alternative B does not extend into northern Spring Valley (HA 184) or Tippett Valley.

The locations of six selected observation wells located within the proposed pumping basins are presented in **Figure 3.3.2-6**. Water-level hydrographs for each of these observation wells within the pumping basins are provided in **Figures 3.3.2-7** and **3.3.2-8**. The hydrographs illustrate the predicted rate and magnitude of water level decline at these representative locations over the simulation period. As with the Proposed Action, the hydrographs illustrate that the





Legend

Pumping Scenario Well Locations[1]

- SNWA Project Well
- Lincoln County Water District Approved Water Right
- Hydrographic Basin
- Pumping Basin
- Water Resources Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

[1]The SNWA well locations represent the points of diversions associated with individual water right permits (Spring, Cave, Dry Lake, and Delamar Valleys) and applications (Snake Valley)

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
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195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

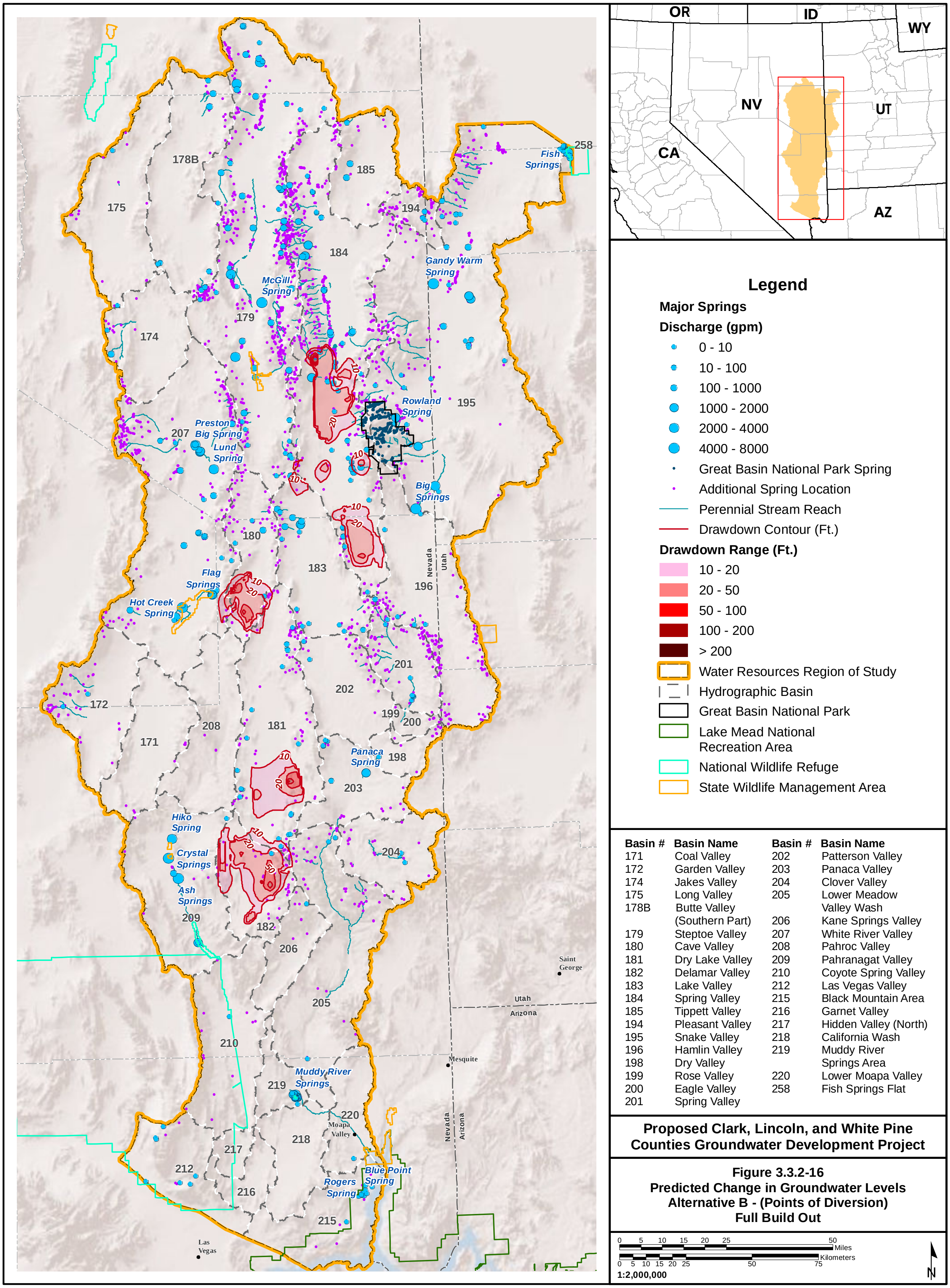
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-15

Pumping Distribution
Alternative B - (Points of Diversion)

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

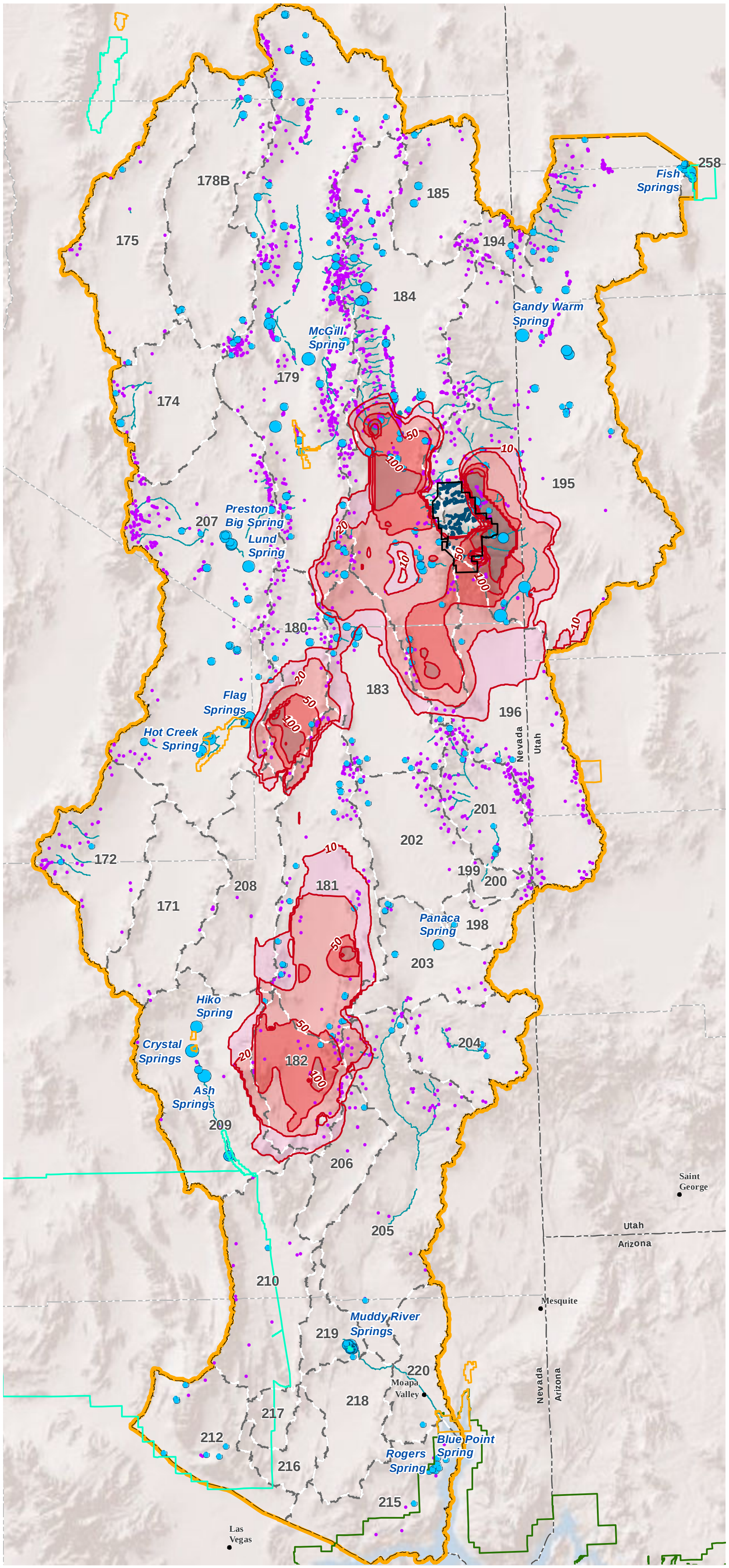
No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

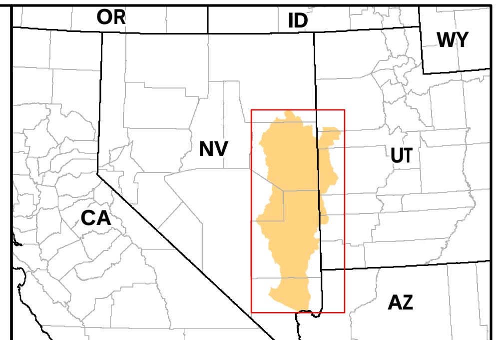


Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-16
Predicted Change in Groundwater Levels
Alternative B - (Points of Diversion)
Full Build Out





Legend

Major Springs Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

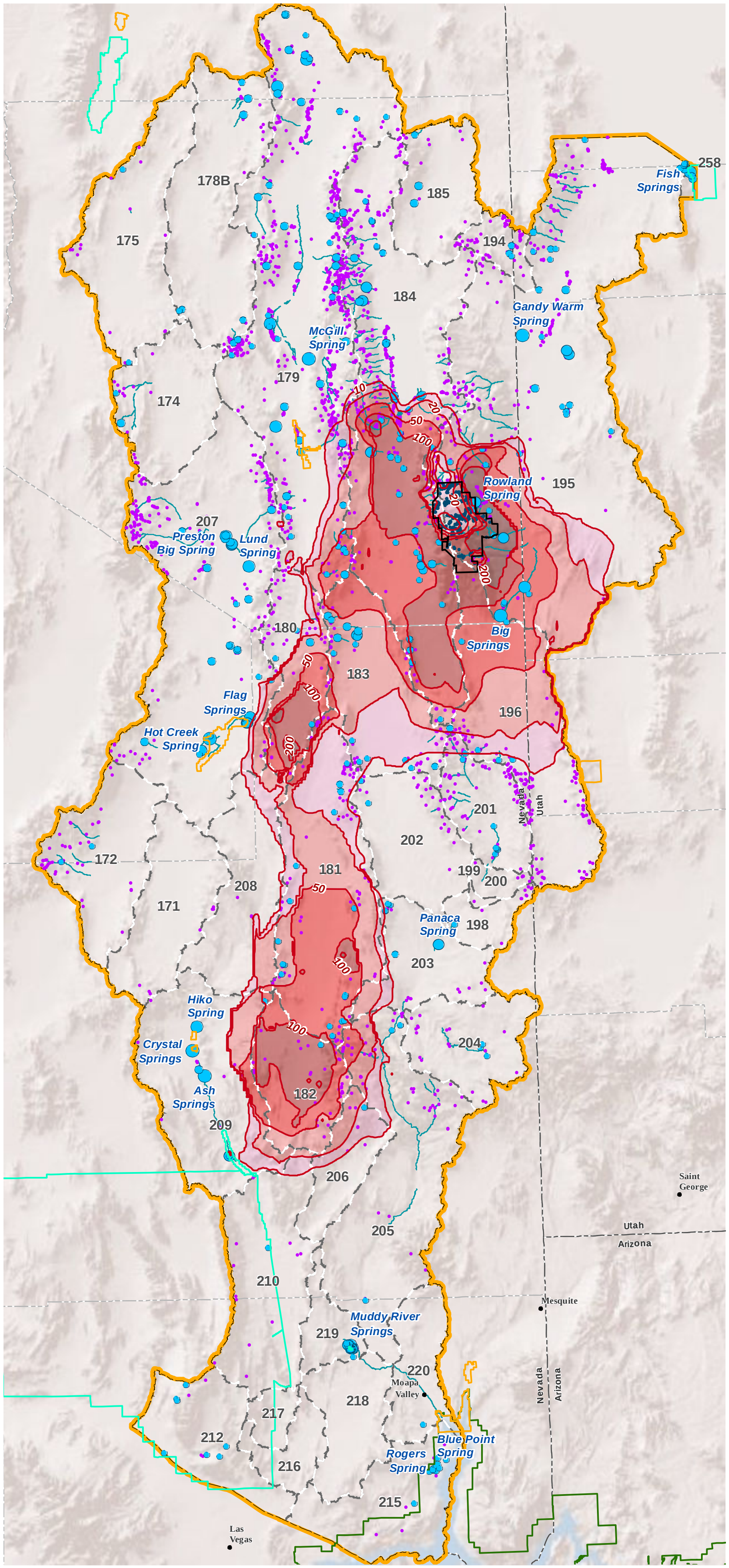
Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

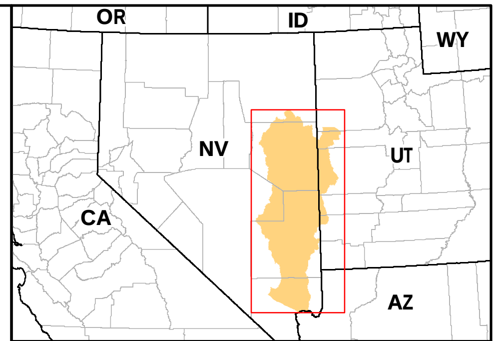
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-17
Predicted Change in Groundwater Levels Alternative B - (Points of Diversion) + 75 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
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179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-18
Predicted Change in Groundwater Levels Alternative B - (Points of Diversion) + 200 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N

water levels are predicted to continue to decrease over the model simulation period; and not reach a renewed equilibrium (or steady state condition) before the end of the simulation period. With the exception of Snake Valley where the drawdown at the observation wells is predicted to be essentially the same as the Proposed Action, the representative hydrographs illustrate that the groundwater withdrawal under the Alternative B pumping scenario is predicted to result in a reduction in the amount of drawdown within the pumping basins as compared to the Proposed Action at the selected observation wells for Spring, Delamar, and Cave valleys; and an increase in drawdown at the observation well in Dry Lake Valley.

In Snake Valley, the model simulation results indicate that under the Alternative B pumping scenario, the magnitude of drawdown would increase (compared to all other alternatives) along the eastern margin of the southern Snake Range. At the full build out plus 200 year time frame, the simulation results indicate that drawdown of greater than 200 feet would encroach along the eastern margin of GBNP.

The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9)

Potential effects to water resources resulting from the Alternative B pumping scenario are summarized in **Table 3.3.2-12**.

Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at full build out, and at full build out plus 75 years and full build out plus 200 years are presented in **Figures F3.3.8A-7**, **F3.3.8A-8**, and **F3.3.8A-9**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-3A** in **Appendix F3.3.9**. Specific inventoried springs located within the drawdown area at the representative points in time are listed in **Table F3.3.10-1A** in **Appendix F3.3.10**. The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-3A** in **Appendix F3.3.11**.

Potential total effects to perennial springs and streams are summarized in **Table 3.3.2-12**. For the predicted drawdown area at full build out plus 75 years, there are 54 inventoried springs and 121 “other” springs located within the high and moderate risk areas. By full build out plus 200 years, this increased to 78 inventoried springs and 210 “other” springs located within the high and moderate risk areas. These springs occur in Cave, Steptoe, Hamlin, Spring (HA 184), Snake, and Lake valleys.

The total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 91 miles at full build out plus 75 years to 120 miles at full build out plus 200 years. This includes stream reaches located in Pahranagat, Steptoe, Spring (HA 184), Snake, Lake valleys, and Lower Meadow Valley Wash.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action.

Model-simulated Spring and Stream Discharge Estimates. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-13**. The model results indicate that two of the modeled springs in White River Valley, Butterfield Spring and Flag Springs 3, are predicted to experience flow reductions of 20 and 19 percent, respectively, by the full build out time frame increasing to flow reductions of 45 percent and 37 percent, respectively, at the full build out plus 200 years time frame. Hot Creek Spring and Moorman Spring also are predicted to experience flow reductions of 7 and 6 percent, respectively, at the full build out plus 200 years time frame. These results suggest that the groundwater development eventually could affect flows in springs located along the south eastern margin of the valley floor in White River Valley. The model results also indicate that other springs located in the northern portion of the valley floor in White River Valley are unlikely to experience measurable reductions (greater than 5 percent) attributable to the Alternative B pumping. Measurable flow reductions attributable to this alternative are not anticipated in major regional spring discharge areas within the White River Flow System including Pahranagat Valley, Muddy River Springs Area near Moapa.

Table 3.3.2-12 Summary of Potential Effects to Water Resources Resulting from the Alternative B Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	10	15	17
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	13	54	78
• Number of other springs located in areas where impacts to flow could occur[4]	28	121	210
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	7%	100%	100%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	1	4	5
• Miles of perennial stream located in areas where impacts to flow could occur	3	91	120
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	34	141	186
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	26	143	148
• Number of groundwater rights located within the 50-100 foot drawdown area	0	33	108
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	8	45
• (Total groundwater rights in drawdown area)	(26)	(184)	(301)
Percent reduction in ET and spring discharge[5]:			
• Spring Valley	36%	66%	73%
• Snake Valley	0%	18%	24%
• Great Salt Lake Desert Flow System[1]	15%	37%	44%
• White River Flow System	0%	3%	5%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]:			
• AFY	0	450	1,400
• Percent Reduction	0%	2%	7%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.5** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to No Action pumping results.

Table 3.3.2-13 Model-simulated Flow Changes (Alternative B Pumping)

(Project Specific)					Alternative B (Points of Diversion)		
					Incremental Change in Flow % (from No-Action)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model-simulated Average Flow (2005) in gpm	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	-1	-2
		Butterfield Spring	1,225	471	-20	-34	-45
		Cold Spring	582	503	0	-1	-2
		Flag Springs 3	969	560	-19	-29	-37
		Hardy Springs	200	73	-1	-2	-4
		Hot Creek Spring	5,032	6,899	-3	-5	-7
		Lund Spring	3,594	3,314	0	-1	-2
		Moon River Spring	1,707	1,457	-1	-2	-2
		Moorman Spring	405	353	-2	-4	-6
		Nicolas Spring	1,185	872	0	-1	-1
		Preston Big Spring	3,572	3,794	0	-1	-2
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	-1	-2
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	-1
		Hiko Spring	2,735	1,985	0	-1	-2
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	-1
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	-1
	Black Mountains Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	0	0
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	0	-3	-5
		North Millick Spring	284	98	-2	-18	-42
		South Millick Spring	506	278	-8	-47	-99
	Snake Valley (195)	Big Springs	4,289	1,977	-7	-100	-100
		Foote Res. Spring	1,300	211	0	0	-1
		Kell Spring	120	59	0	0	-1
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	0
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010b.

In the Great Salt Lake Desert Flow System, spring discharge was simulated at 3 springs in Spring Valley, and 4 springs in Snake Valley. In Spring Valley, the model simulations indicate that by full build out plus 75 years, the flow at Keegan, North Millick, and South Millick springs all show reductions of flow. At full build out plus 200 years these springs are predicted to experience flow reductions ranging from 5 to 99 percent.

In Snake Valley, the model simulation results are essentially the same as those described for the Proposed Action.

Water Resources Within or Adjacent to the GBNP. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and within the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). At the full build out plus 75 years and full build out plus 200 years time frames, Cave, Outhouse, Rowland, and Spring Creek Spring are within the area of moderate risk. There also are 15 other springs (identified in NPS 2007) at the full build out plus 75 years time frame that increases to 25 springs at the full build out plus 200 years time frame located in moderate risk areas. Perennial segments on Baker, Lehman, and Snake creeks and their tributaries occur within the area of moderate risk at both the full build out plus 75 years and full build out plus 200 years time frame (see **Table 3.3.2-8** for stream miles at risk). Potential risk to streams in cave systems are uncertain as discussed under the Proposed Action. However, it is important to note that the magnitude of drawdown simulated by the numerical model beneath GBNP generally is greater under Alternative B compared to the Proposed Action and other alternatives. Preliminary results from ongoing hydrogeologic and water resource investigations in and adjacent to GBNP provide some evidence that water resources in Model Cave in the Baker Creek drainage may be interconnected with the alluvial basin fill in Snake Valley (Prudic and Sweetkind 2012). Because there is a moderate risk of impacts to the lower perennial segment of Baker Creek, there also is a moderate risk to water resource in the Model Cave under this alternative.

Model simulations have been performed using the GBNP RASA model developed by Halford and Plume (2011) to evaluate the potential effects of groundwater pumping in Snake Valley. These models simulate groundwater pumping in Snake Valley and only consider pumping at the points of diversions specified in the water right applications. The model-simulated flow reductions from pumping at the points of diversions are summarized in **Table 3.3.2-14**. These results indicate that after 200 years of pumping in Snake Valley at the points of diversions, this alternative would impact flows in Big Springs, Home Farm Springs, Kious Spring, Rowland Spring, Spring Creek Spring, and would not affect flows in Twin Spring located north of the proposed groundwater development area, and would not affect flows in Fish Springs located in the Fish Springs Flat hydrographic basin.

Cave Springs are used as the water supply for the Lehman Caves Visitor Center at the GBNP. Cave Springs was identified as “likely susceptible” in the Elliott et al. 2006 report. The model simulations summarized in **Table 3.3.2-14** indicate flow reductions of 5 percent or less. Prudic and Glancy (2009) conducted geochemical investigations of the Cave Springs to evaluate the potential for depletion resulting from groundwater pumping in Snake Valley. The results of their study conclude that the source of water to these springs is primarily from winter precipitation and the source area for the springs is the steep east slope of Jeff Davis Peak and not from alluvial and glacial deposits west of the springs. They also indicated that it is unlikely that the Pole Canyon Limestone occurs near the stream. The results of this study suggest that the source of flow to Cave Springs is derived from local precipitation, and limestone that could provide a potential hydraulic connection between the spring and the regional groundwater system is unlikely to occur at the stream. Therefore, the risk of impacts to flow is inferred to be low (i.e., unlikely to occur).

Utah Surface Water Resources. There are three inventoried springs (Caine, Stateline Springs, and Needle Point Springs in Snake Valley) and three perennial stream reaches (Big Wash, Lake Creek, and Snake Creek) in Snake Valley that could be impacted at either the full build out plus 75 years or full build out plus 200 years time frames. Flow reductions in Lake Creek would result in reduced flow to Pruess Lake.

The model simulations indicate that drawdown could propagate into Pine Valley. At the full build out plus 75 years and full build out plus 200 years time frames, the maximum drawdown simulated at the boundary of the model between Snake and Pine valleys is approximately 12 feet and 46 feet, respectively. As described under the Proposed Action, available information suggest that drawdown from pumping in Snake Valley is unlikely to impact surface water resources in Pine Valley (see Proposed Action for further discussion).

Table 3.3.2-14 Model-simulated Flow Reduction from Pumping at Points of Diversion in Snake Valley Only (GBNP-RASA Model)

I. SNWA Pumping (No Irrigation Pumping)											
Spring or Stream	Model-simulated Pre-development Flow (gpm)	25,000 afy Pumping Scenario Years (After Pumping Initiated) (Percent)					50,000 afy Pumping Scenario[1] Years (After Pumping Initiated) (Percent)				
		10	25	50	100	200	10	25	50	100	200
Big Springs	4,340	25	35	35	48	53	28	40	50	60	69
Cave Spring	62	0	0	0	0	0	0	0	1	3	5
Home Farm Spring 6	90	0	0	0	0	0	60	100	100	100	100
Kious Spring	224	0	0	1	2	3	2	12	24	35	43
Lehman Creek	1,364	0	0	0	0	0	0	1	3	6	8
Rowland Spring	434	0	0	0	0	0	0	1	4	10	16
Spring Creek Spring	898	48	87	100	100	100	53	100	100	100	100
Strawberry Creek	124	0	0	0	0	0	0	0	1	3	7
Twin Spring	2,480	0	0	0	0	0	0	0	0	0	0
Warm Spring	2,046	0	0	0	0	0	0	0	0	0	0
Fish Springs (3-8)	15,934	0	0	0	0	0	0	0	0	0	0
II. SNWA Pumping + Irrigation Pumping											
Spring or Stream	Model-simulated Pre-development Flow (gpm)	25,000 afy Pumping Scenario Years (After Pumping Initiated) (Percent)					50,000 afy Pumping Scenario[1] Years (After Pumping Initiated) (Percent)				
		10	25	50	100	200	10	25	50	100	200
Big Springs	4,340	31	42	51	59	67	34	47	59	72	84
Cave Spring	62	0	0	0	0	0	0	0	1	3	5
Home Farm Spring (6)	90	4	4	5	6	6	62	100	100	100	100
Kious Spring	224	1	1	2	4	6	4	15	30	44	55
Lehman Creek	1,364	0	0	0	0	0	0	1	3	5	7
Rowland Spring	434	0	0	0	0	0	0	1	4	10	17
Spring Creek Spring	898	50	90	100	100	100	50	100	100	100	100
Strawberry Creek	124	0	0	0	0	0	0	0	1	3	7
Twin Spring	2,480	0	0	0	0	1	0	0	0	0	1
Warm Spring	2,046	0	0	0	0	0	0	0	0	0	0
Fish Springs (3-8)	15,934	0	0	0	0	0	0	0	0	0	0

[1] Actual pumping was restricted to approx. 40,000 - 43,000 afy because drawdown was not allowed to exceed 1,000 at point of diversion.

Source: Derived from model results provided in Halford and Plume 2011.

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.12A-7**, **F3.3.12A-8**, and **F3.3.12A-9**, respectively, in **Appendix F3.3.12**. **Table F3.3.13-3A** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. These results indicated that the number of surface water rights potentially affected increases over the model simulation period. At full build out plus 75 years, there are a total of 141 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 186 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-7, **F3.3.14A-8**, and **F3.3.14A-9** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-3A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 184 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 301 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Impacts to Water Balance

The model-simulated groundwater budget for the Alternative B pumping scenario is presented in **Appendix F3.3.16**, **Table F3.3.16-3B**. Compared to the simulated conditions under No Action, for Spring Valley, the pumping is estimated to result in reductions of groundwater discharge for ET of 66 percent at full build out plus 75 years and 73 percent at full build out plus 200 years. In Snake Valley, the pumping is estimated to result in reductions of groundwater discharge to support ET and spring discharge of 18 percent at full build out plus 75 years, and 24 percent at full build out plus 200 years with most of this reduction occurring in the southern portion of the valley. Alternative B pumping is estimated to have minimal impact (5 percent or less) on ET discharge within the White River Flow System.

The total predicted reduction of flow to Pine, Wah Wah, and Tule valleys is summarized in **Table 3.3.2-12**. This reduction corresponds to an approximate 2 percent and 7 percent reduction in flow to these basins at the full build out plus 75 years and full build out plus 200 years time frame. If the groundwater flow system is interconnected and regional flow from Snake Valley contributes to flow at Fish Springs, then a reduction of flow from Snake Valley to Pine, Wah Wah, and Tule valleys eventually could result in a reduction of discharge at Fish Springs. The model estimated reduction of groundwater outflow from Snake Valley to downgradient basins in the Great Salt Lake Desert Flow System along the eastern boundary of Snake Valley is 1,100 afy at the full build out plus 200 years. This flow reduction represents approximately 6 percent of the surface discharge at Fish Springs. Flow reduction of this magnitude at Fish Springs likely would be difficult to measure and distinguish from natural flow variations. (See Proposed Action for discussion of uncertainty regarding these flow reduction estimates using the results of the CCRP Model.)

The GBNP Model (Halford and Plume 2011) was set up to simulate flows at Fish Springs. The simulation results from the GBNP Model indicate that pumping in Snake Valley (at the points of diversion listed in the SNWA water rights applications), at the full application rate (50,000 afy) combined with continuation of existing agricultural pumping would not reduce flows in Fish Springs over the 200-year simulation period. These model results suggest that pumping associated with the groundwater development in Snake Valley is unlikely to result in a measureable reduction in flows at Fish Springs.

Water Quality

Potential impacts to water quality would be the same as described under the Proposed Action.

Monitoring and Mitigation Recommendations

Additional mitigation recommendations GW-WR-3a (Comprehensive Water Resources Monitoring Plan) and GW-3b (Numerical Groundwater Flow Modeling Requirements); GW-WR-4 (Monitoring, Mitigation and Management Plan for Snake Valley); GW-WR-5 (Shoshone Ponds Mitigation); GW-WR-6 (Water Rights Mitigation); and GW-WR-7 (Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights) described under the Proposed Action, and the COM Plan described in Section 3.20, Monitoring and Mitigation Summary, would apply to Alternative B.

Potential Residual Impacts

Potential unavoidable residual impacts associated with the groundwater development are described under the Proposed Action. The potential magnitude of residual adverse impacts to water resources associated with the Alternative B pumping scenario would be similar to those described under the Proposed Action. However, the distributed pumping included in the Proposed Action likely would reduce impacts to springs and perennial streams with sensitive resources.

3.3.2.12 Alternative C

Groundwater Development Areas

For Alternative C (Intermittent Pumping), the infrastructure and therefore, ground disturbance effects would be identical to Alternative A. Groundwater development would occur within the areas identified in the five groundwater development basins (i.e., Spring, Snake, Delamar, Dry Lake, and Cave valleys). As with the Alternative A, development within the groundwater development areas would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been determined at this stage of the project and will be subject to future site-specific NEPA analysis.

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 4,800 acres within five hydrographic basins. There are 60 known or suspected springs identified within the groundwater development areas (**Table 3.3.2-4**). These springs occur within the groundwater development areas within Spring Valley (37 springs), Snake Valley (11 springs), Delamar Valley (7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring). There also are 28 separate perennial stream reaches with a total length of 29 miles that occur within the groundwater development areas (**Table 3.3.2-5**). This includes 23 perennial stream reaches (total length of 20.2 miles) located in Spring Valley, and 5reaches (total length of 8.8 miles) located in Snake Valley. The potential for impacts to springs and streams located within these groundwater development areas would depend on the location of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional monitoring and mitigation recommendations (GW-WR-1, GW-WR-2) described under the Proposed Action would apply to Alternative C and include identifying and establishing an avoidance buffer around all springs, and developing site-specific plans for minimize impacts at perennial stream crossings within the groundwater development areas.

Groundwater Pumping

Groundwater Pumping Scenario

The groundwater pumping scenario for Alternative C assumed that the groundwater production wells would be developed and pumped using the distributed well locations shown in **Figure 3.3.2-11** and pumping schedule defined for Alternative A until the project reaches full build out in 2050. The pumping schedule reflects the same south to north sequence of basin development for the project included in the Alternative A pumping scenario. After full development, the pumping rates are assumed to cycle from minimum to maximum pumping rates every 5 years for the remainder of the simulation period. The minimum pumping rate is 9,000 afy and with minimal pumping in all five pumping basins. The maximum pumping rate under this scenario is the same as for Alternative A (approximately 115,000 afy). Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report (SNWA 2010a).

Impacts to Water Levels

The predicted change in groundwater levels attributable to groundwater development under the Alternative C at full build out, full build out plus 75 years, and full build out plus 200 years are provided in **Figures 3.3.2-19**, **3.3.2-20**, and **3.3.2-21**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels.

At full build out, the drawdown areas are localized in the vicinity of the pumping wells in Spring, Delamar, Dry Lake, and Cave valleys. As with the Proposed Action, drawdown does not occur at this time period in Snake Valley. Comparison of the simulation results for the three representative points in time indicates that the drawdown area continues to progressively expand as pumping continues into the future.

At full build out plus 75 years and full build out plus 200 years time frames, there are two distinct drawdown areas. The northern drawdown area encompasses the southern Spring Valley, southern Snake Valley, and northern Hamlin Valley. The southern drawdown area extends across Delamar, Dry Lake, and Cave valleys in an elongate north-south direction

Water-level hydrographs for observation wells located within the pumping basins are provided in **Figures 3.3.2-7** and **3.3.2-8**. As with the Proposed Action, the hydrographs indicate that water levels are predicted to continue to decrease over the model simulation period; and not reach a renewed equilibrium (or steady state condition) before the end of the simulation period. The representative hydrographs illustrate that the reduced groundwater withdrawal under the Alternative C pumping scenario is predicted to result in a substantial reduction in the amount of drawdown within the pumping basins as compared to the Proposed Action.

The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9).

Potential effects to water resources resulting from the Alternative C pumping scenario are summarized in **Table 3.3.2-15**.

Impacts to Springs and Streams

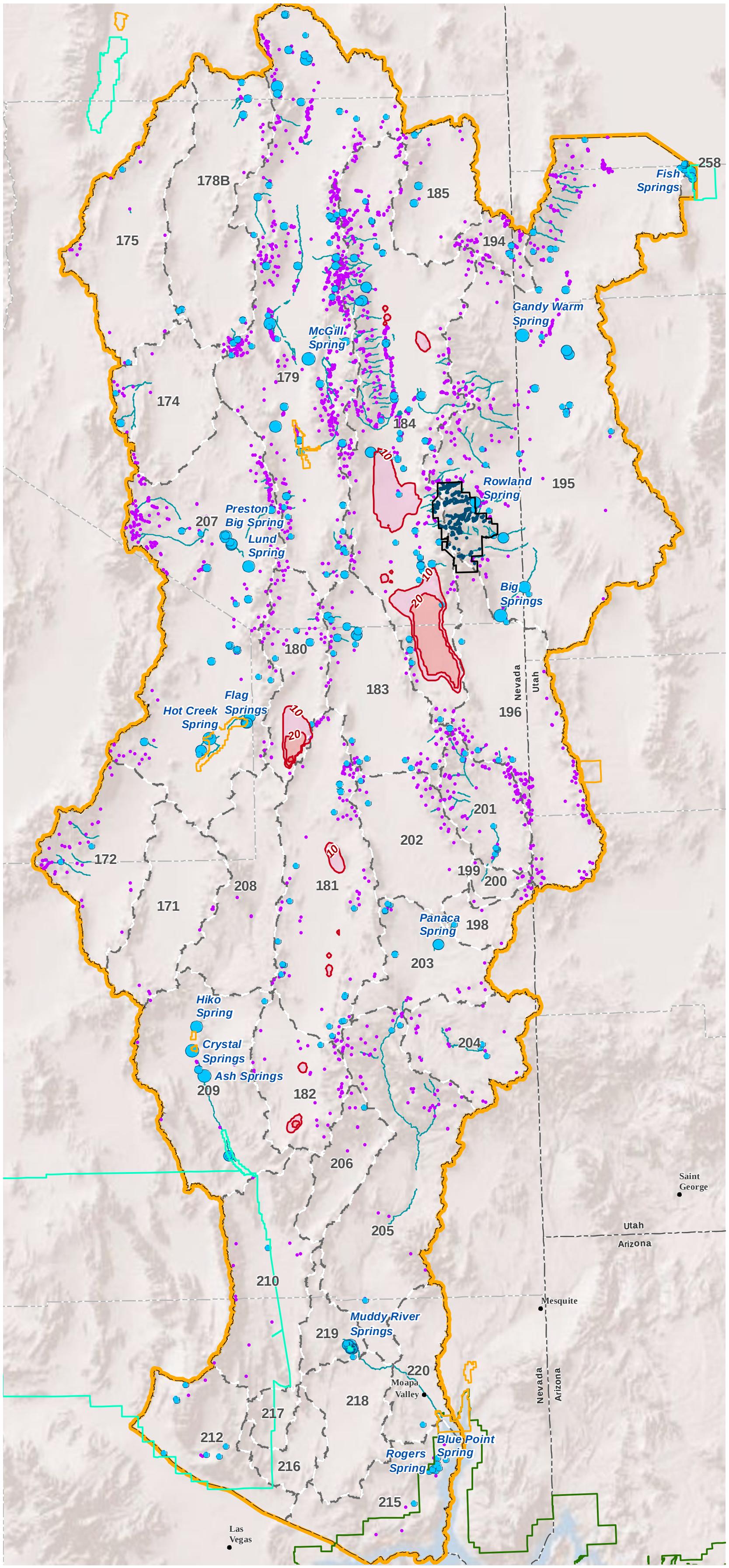
The estimated potential risks to springs located within the projected drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.8A-10**, **F3.3.8A-11**, and **F3.3.8A-12**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-4A** in **Appendix F3.3.9**. Specific inventoried springs located within the cumulative drawdown area at the representative points in time are listed in **Table F3.3.10-1A** in **Appendix F3.3.10**. The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-4A** in **Appendix F3.3.11**.

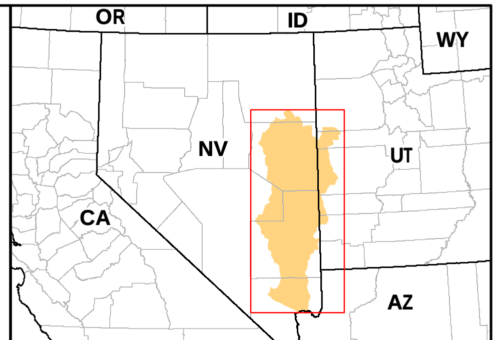
Potential total effects to perennial springs and streams are summarized in **Table 3.3.2-15**. For the predicted drawdown area at full build out plus 75 years, there are 19 inventoried springs and 44 "other" springs located within the high and moderate risk areas. By full build out plus 200 years, this increased to 26 inventoried springs and 70 "other" springs located within the high and moderate risk areas. These springs occur in Hamlin, Spring (HA 184), and Snake valleys.

The total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 37 miles at full build out plus 75 years to 59 miles at full build out plus 200 years. This includes stream reaches located in Spring (HA 184), Snake, and Lake valleys.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action.

<u>Model-simulated Spring and Stream Discharge Estimates</u>. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-16**. The model results indicated that two of the modeled springs in White River Valley, Butterfield Spring and Flag Springs 3, are predicted to experience flow reductions of 5 percent, respectively, by the full build out plus 200 years time frame. These results suggest that the groundwater development eventually could affect





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

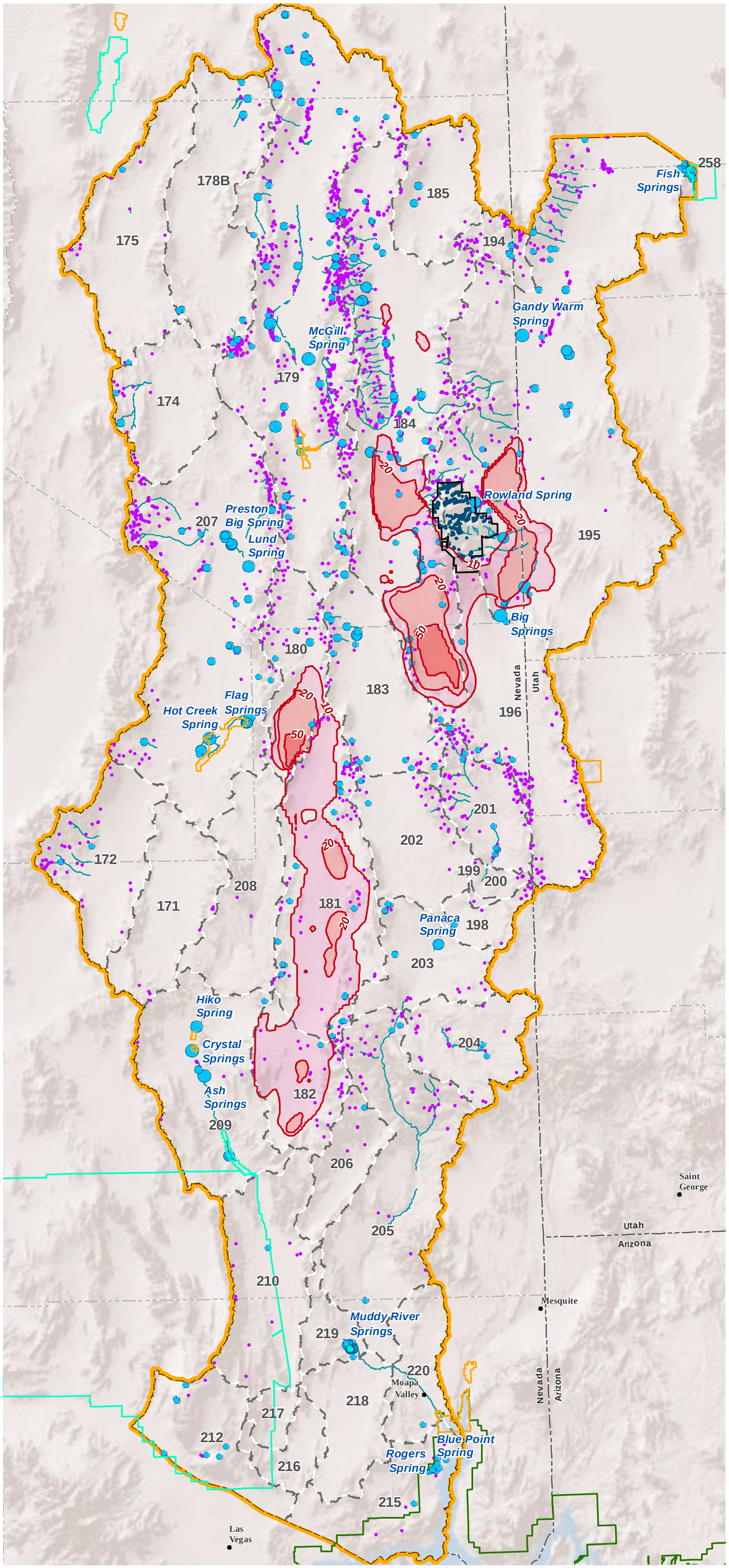
- 10 - 20
- 20 - 50
- 50 - 100
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

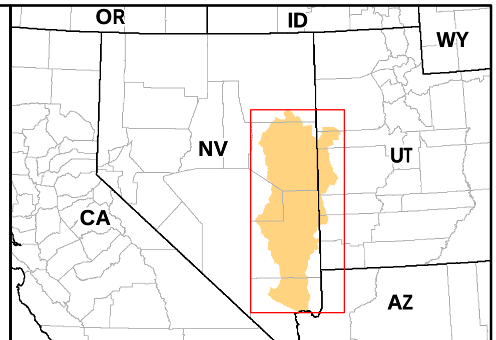
Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-19
Predicted Change in Groundwater Levels
Alternative C - (Intermittent Pumping)
Full Build Out

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

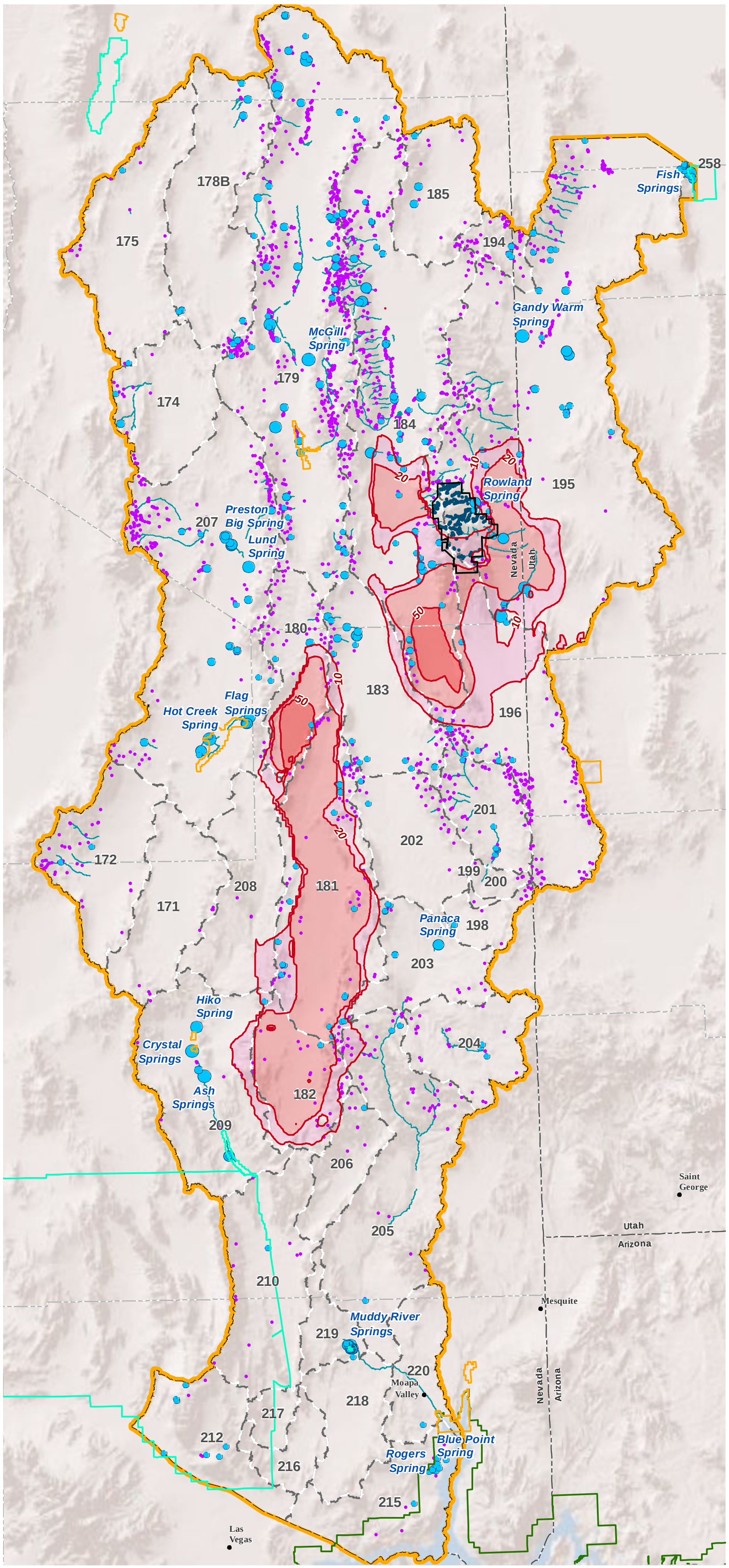
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

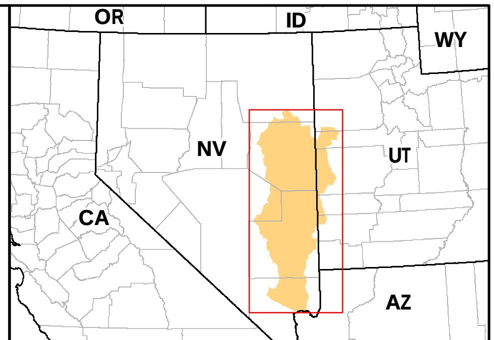
Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-20
Predicted Change in Groundwater Levels Alternative C - (Intermittent Pumping) + 75 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-21
Predicted Change in Groundwater Levels
Alternative C - (Intermittent Pumping)
+ 200 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

Table 3.3.2-15 Summary of Potential Effects to Water Resources Resulting from the Alternative C Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	5	10	14
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	1	19	26
• Number of other springs located in areas where impacts to flow could occur[4]	2	44	70
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	2%	87%	100%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	1	2	2
• Miles of perennial stream located in areas where impacts to flow could occur	1	37	59
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	14	78	98
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	15	132	169
• Number of groundwater rights located within the 50-100 foot drawdown area	0	1	2
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	0	0
• (Total groundwater rights in drawdown area)	(15)	(133)	(171)
Percent reduction in ET and spring discharge[5]:			
• Spring Valley	30%	37%	37%
• Snake Valley	0%	15%	17%
• Great Salt Lake Desert Flow System[1]	12%	24%	25%
• White River Flow System	0%	0%	1%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]:			
• AFY	0	200	400
• Percent Reduction	0%	1%	2%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.5** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to No Action pumping results.

Table 3.3.2-16 Model-simulated Flow Changes (Alternative C Pumping)

(Project Specific)					Alternative C (Intermittent Pumping)		
					Incremental Change in Flow % (from No-Action)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model-simulated Average Flow (2005) in gpm	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	0	0
		Butterfield Spring	1,225	471	0	-2	-5
		Cold Spring	582	503	0	0	0
		Flag Springs 3	969	560	-1	-2	-5
		Hardy Springs	200	73	0	0	0
		Hot Creek Spring	5,032	6,899	0	0	-1
		Lund Spring	3,594	3,314	0	0	0
		Moon River Spring	1,707	1,457	0	0	0
		Moorman Spring	405	353	0	0	-1
		Nicolas Spring	1,185	872	0	0	0
		Preston Big Spring	3,572	3,794	0	0	0
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	0	-1
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	0
		Hiko Spring	2,735	1,985	0	0	-1
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	0
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	0
	Black Mountains Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	0	0
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	-12	-14	-15
		North Millick Spring	284	98	-4	-5	-5
		South Millick Spring	506	278	-10	-12	-11
	Snake Valley (195)	Big Springs	4,289	1,977	-2	-87	-100
		Foote Res. Spring	1,300	211	0	0	-1
		Kell Spring	120	59	0	-1	-1
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	0
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010b.

flows in springs located along the south eastern margin of the valley floor in White River Valley. The model results also indicate that other springs located in the northern portion of the valley floor in White River Valley are unlikely to experience measurable reductions (greater than 5 percent) attributable to the Alternative C pumping. Measurable flow reductions attributable to this alternative are not anticipated in major regional spring discharge areas within the White River Flow System including Pahranagat Valley, Muddy River Springs Area near Moapa.

In the Great Salt Lake Desert Flow System, spring discharge was simulated at 3 springs in Spring Valley and 4 springs in Snake Valley. In Spring Valley, the model simulations indicate that by full build out plus 75 years, the flow at Keegan, North Millick, and South Millick springs all show reductions of flow. At full build out plus 200 years these springs are predicted to experience flow reductions ranging from 5 to 15 percent. In Snake Valley, the model simulation results are very similar to those described for the Proposed Action.

Water Resources Within or Adjacent to the GBNP. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). At the full build out plus 75 years time frame, there are no inventoried springs or perennial streams within the moderate risk zone. By the full build out plus 200 years time frame, Outhouse Spring (located approximately 2 miles outside the park boundary) and 8 miles of Snake Creek and its tributaries are within the area of moderate risk. Potential risk to streams in cave systems are uncertain as discussed under the Proposed Action. However, it is important to note that the magnitude of drawdown simulated by the numerical model beneath GBNP is less under Alternative C compared to the Proposed Action and Alternatives A and B. Therefore, if any perennial waters or waters in cave systems are hydraulically connected to the regional aquifer system affected by groundwater withdrawal, potential impacts to these water sources would be anticipated to be less than those occurring under these alternatives.

Utah Surface Water Resources. There are two inventoried springs (Caine and Stateline springs in Snake Valley) and three perennial stream reaches (Big Wash, Lake Creek, and Snake Creek) in Snake Valley located in an area that could be impacted at the full build out plus 75 years and full build out plus 200 years time frames. Flow reductions in Lake Creek would result in reduced flow to Pruess Lake.

The model simulations indicate that drawdown could propagate into Pine Valley. At the full build out plus 75 years and full build out plus 200 years time frames, the maximum drawdown simulated at the boundary of the model between Snake and Pine valleys is approximately 0 feet and 10 feet, respectively. As described under the Proposed Action, available information suggest that drawdown from pumping in Snake Valley is unlikely to impact surface water resources in Pine Valley (see Proposed Action for further discussion).

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.12A-10**, **F3.3.12A-11**, and **F3.3.12A-12**, respectively, in **Appendix F3.3.12**. **Table F3.3.13-4A** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. At full build out plus 75 years, there are a total of 78 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 98 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-10, **F3.3.14A-11**, and **F3.3.14A-12** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-4A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 133 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 171 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Impacts to Water Balance

The model-simulated groundwater budget for the Alternative C pumping scenario is presented in **Appendix F3.3.16**, **Table F3.3.16-4B**. Compared to the simulated conditions under the No Action for Spring Valley, the pumping is estimated to result in a 37 percent reduction of groundwater discharge for ET at the full build out plus 75 years and full build out plus 200 years time frames. In Snake Valley, the pumping is estimated to result in reductions of groundwater discharge to support ET and spring discharge of 15 percent at full build out plus 75 years, and 17 percent at full build out plus 200 years with most of this reduction occurring in the southern portion of the valley. Alternative C pumping is estimated to have minimal impact (1 percent or less) on ET discharge within the White River Flow System.

The total predicted reduction of flow to Pine, Wah Wah, and Tule valleys is summarized in **Table 3.3.2-15**. This reduction corresponds to an approximate 1 percent and 2 percent reduction in flow to these basins at the 75- and 200-year time frames. If the groundwater flow system is interconnected and regional flow from Snake Valley contributes to flow at Fish Springs, then a reduction of flow from Snake Valley to Pine, Wah Wah, and Tule valleys eventually could result in a reduction of discharge at Fish Springs. The model estimated reduction of groundwater outflow from Snake Valley to downgradient basins in the Great Salt Lake Desert Flow System along the eastern boundary of Snake Valley is 400 afy at the 200 years after full build. This flow reduction represents approximately 2 percent of the surface discharge at Fish Springs. Flow reduction of this magnitude at Fish Springs likely would be difficult to measure and distinguish from natural flow variations.

The GBNP Model (Halford and Plume 2011) was set up to simulate flows at Fish Springs. The simulation results from the GBNP Model indicate that pumping in Snake Valley (at the points of diversion listed in the SNWA water rights applications), at the full application rate (50,000 afy) combined with continuation of existing agricultural pumping would not reduce flows in Fish Springs over the 200-year simulation period. These model results suggest that pumping associated with the groundwater development in Snake Valley is unlikely to result in a measureable reduction in flows at Fish Springs.

Water Quality

Potential impacts to water quality would be the same as described under the Proposed Action.

Monitoring and Mitigation Recommendations

Additional mitigation recommendations GW-WR-3a (Comprehensive Water Resources Monitoring Plan) and GW-3b (Numerical Groundwater Flow Modeling Requirements); GW-WR-4 (Monitoring, Mitigation and Management Plan for Snake Valley); GW-WR-5 (Shoshone Ponds Mitigation); GW-WR-6 (Water Rights Mitigation); and GW-WR-7 (Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights) described under the Proposed Action, and the COM Plan described in Section 3.20, Monitoring and Mitigation Summary, would apply to Alternative C.

Potential Residual Impacts

Potential unavoidable residual impacts associated with the groundwater development are described under the Proposed Action. Because of the reduced maximum groundwater withdrawal rate (as compared to the Proposed Action) and intermittent pumping schedule, the magnitude of the potential unavoidable residual impacts to water resources associated with the Alternative C pumping scenario would be substantially less than the Proposed Action and Alternatives A and B.

3.3.2.13 Alternative D

Groundwater Development Areas

Development in Snake Valley and the White Pine County portion of Spring Valley would be eliminated under Alternative D (LCCRDA). As a result, groundwater development for Alternative D would be restricted to the southernmost portion of Spring, Delamar, Dry Lake, and Cave valleys. Development within the groundwater development areas would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been determined at this stage of the project and will be subject to future site-specific NEPA analysis.

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 4,000 acres within four hydrographic basins. There are 13 known or suspected springs identified within the groundwater development areas (**Table 3.3.2-4**). These springs occur within the groundwater development areas within Spring Valley (1 spring), Delamar Valley (7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring). There are no perennial stream reaches located within the assumed groundwater development areas (**Table 3.3.2-5**). The potential for impacts to springs located within these groundwater development areas would depend on the location of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional monitoring and mitigation recommendations (GW-WR-1) described under the Proposed Action would apply to Alternative D and include identifying and establishing an avoidance buffer around all springs, and developing site-specific plans for minimize impacts at perennial stream crossings within the groundwater development areas.

Groundwater Pumping

Groundwater Pumping Scenario

The groundwater pumping scenario for Alternative D assumes that no pumping will occur in Snake Valley, and pumping in Spring Valley would be restricted to the southern portion of the valley within Lincoln County as shown in **Figure 3.3.2-22**. The maximum groundwater production rate under this scenario is approximately 79,000 afy for the four pumping basins (Spring, Delamar, Dry Lake, and Cave valleys), the same as the maximum pumping rate assumed for these basins under Alternative A, C, and E. The well distribution developed by SNWA for this model scenario includes the same spatial distribution of wells included in Alternative A for Delamar, Dry Lake, and Cave valleys. Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report (SNWA 2010a). The pumping schedule reflects the proposed south to north sequence of basin development for the project.

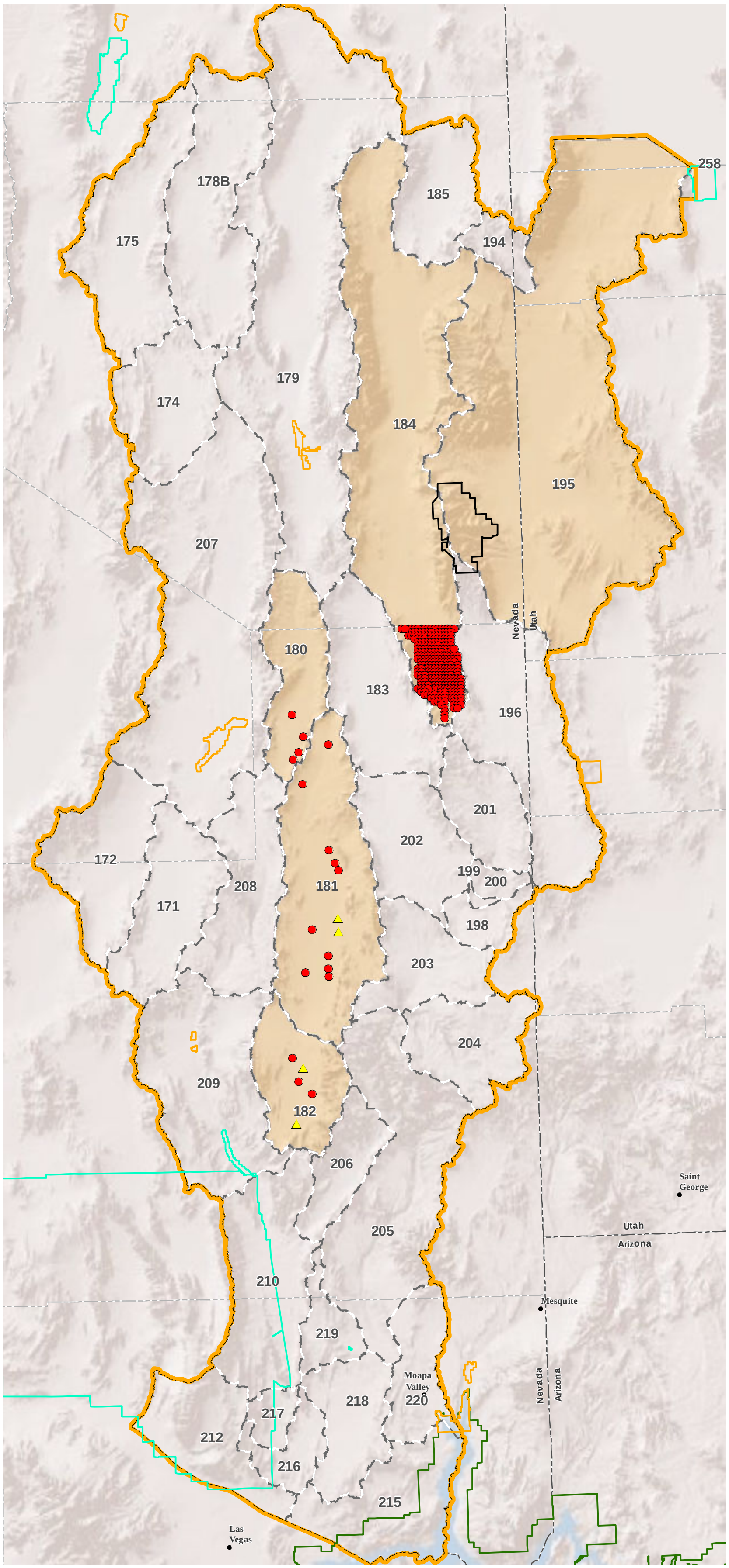
Impacts to Water Levels

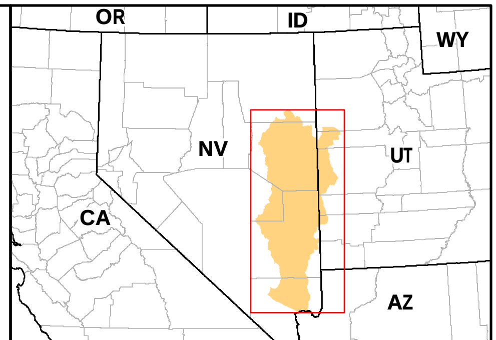
The predicted change in groundwater levels attributable to groundwater development under the Alternative D at full build out, full build out plus 75 years, and full build out plus 200 years are provided in **Figures 3.3.2-23**, **3.3.2-24**, and **3.3.2-25**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels.

At full build out, the drawdown areas are localized in the vicinity of the pumping wells in Spring, Delamar, Dry Lake, and Cave valleys. At this time frame, a drawdown cone is predicted to develop in southern Spring Valley in response to the focused groundwater withdrawal in this area. As with all other pumping alternatives, the simulation results for the three representative points in time indicates that the drawdown area continues to progressively expand over the model simulation period.

At full build out plus 75 years time frame, there are two distinct drawdown areas. The northern drawdown area encompasses the approximate southern Spring Valley, northern Hamlin Valley, and overlaps along the south west margin of Snake Valley and north margin of Lake Valley. The central portion of this drawdown cone is predicted to result in drawdowns greater than 200 feet. The southern drawdown area extends across Delamar, Dry Lake, and Cave valleys in an elongate north-south direction that generally is restricted to these pumping basins.

By the full build out plus 200 years time frame, the two main drawdown areas have merged into one that extends approximately 120 miles in a north-south direction and up to 55 miles in a east-west direction. Compared to the Proposed Action, Alternative D limits drawdown in the central and northern portion of Spring Valley and southern portion of Snake Valley. At the full build out plus 200 years time frame, in addition to the pumping basins, the simulated drawdown area extends across Lake Valley and into the southeastern Steptoe Valley, eastern margins of Pahroc and Pahranagat valleys, and extreme western margins of Panaca Valley and northwest margin of Lower Meadow Valley Wash. The central portion of this drawdown cone predicts drawdowns greater than 200 feet across the entire southern portion of Spring Valley.





Legend

Pumping Scenario Well Locations[1]

- SNWA Project Well
- Lincoln County Water District Approved Water Right
- Hydrographic Basin
- Pumping Basin
- Water Resources Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

[1]The SNWA well locations represent the production well locations simulated in the numerical groundwater flow model for evaluating potential impacts. The actual number and location of the wells will be determined after additional field investigations.

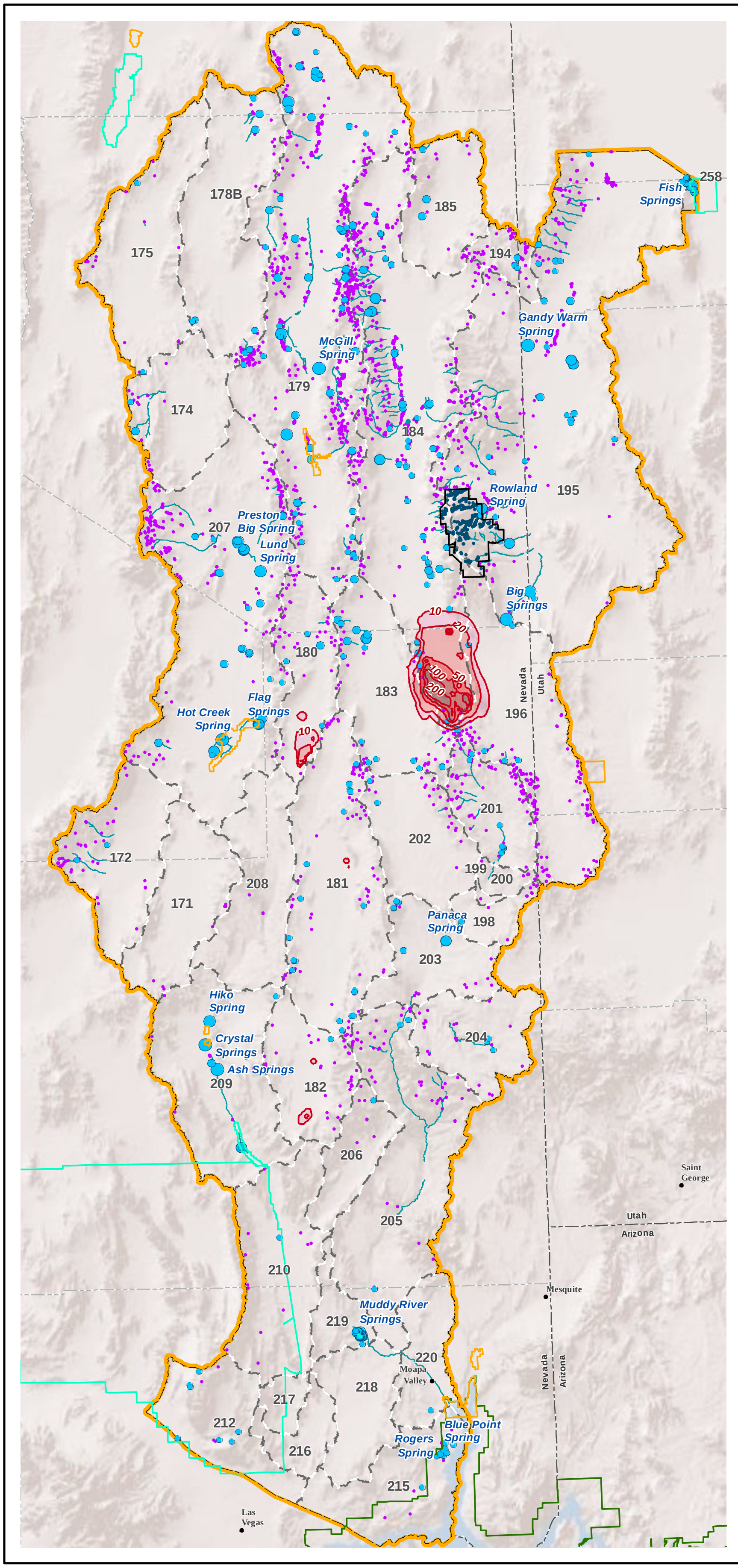
Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

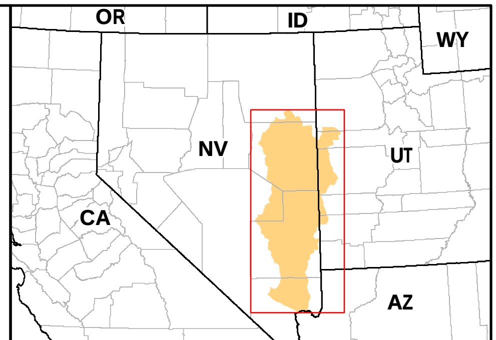
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-22

Pumping Distribution Alternative D - (LCCRDA Distributed Pumping)

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

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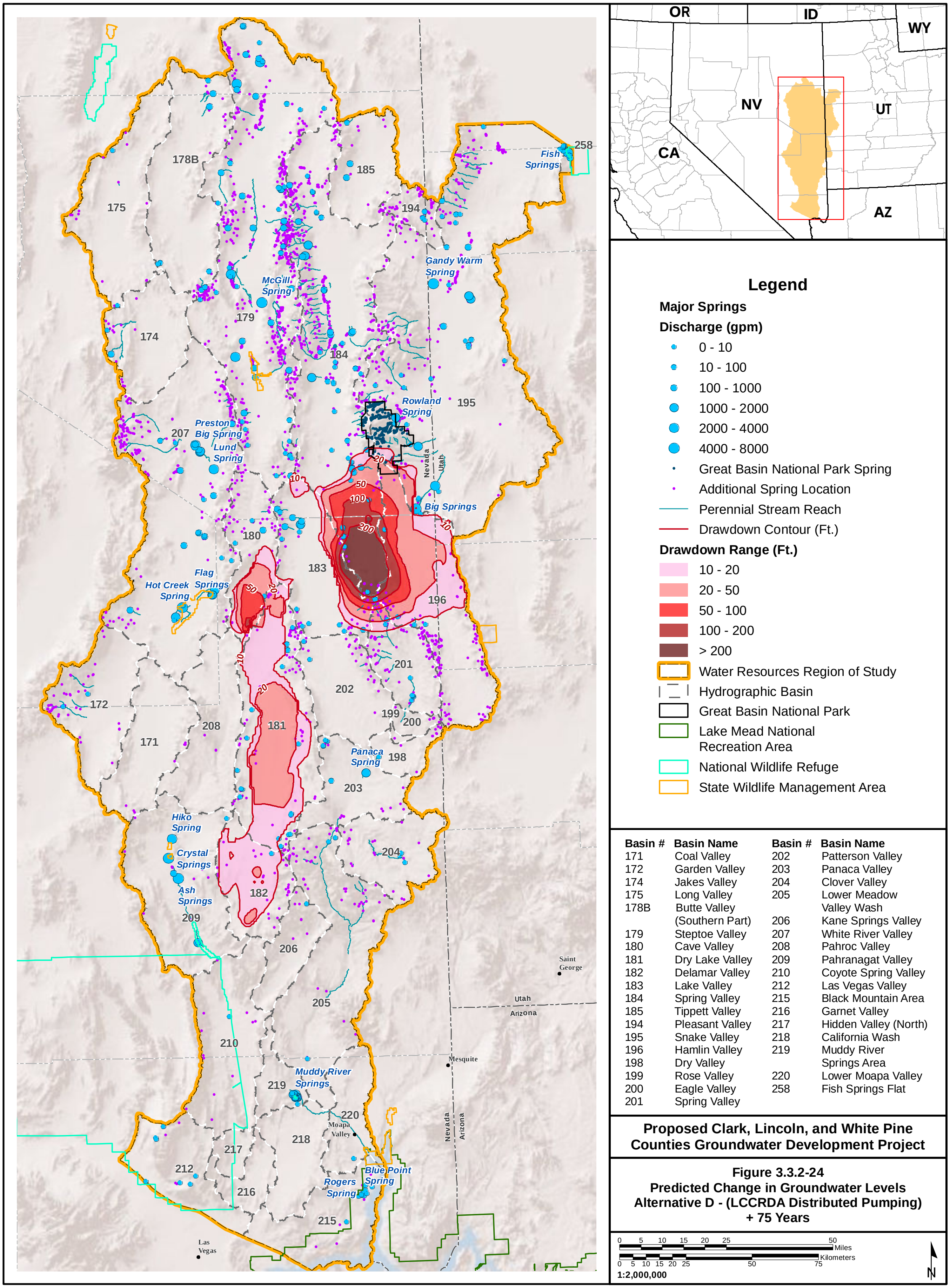
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-23
Predicted Change in Groundwater Levels
Alternative D - (LCCRDA Distributed Pumping)
Full Build Out

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.



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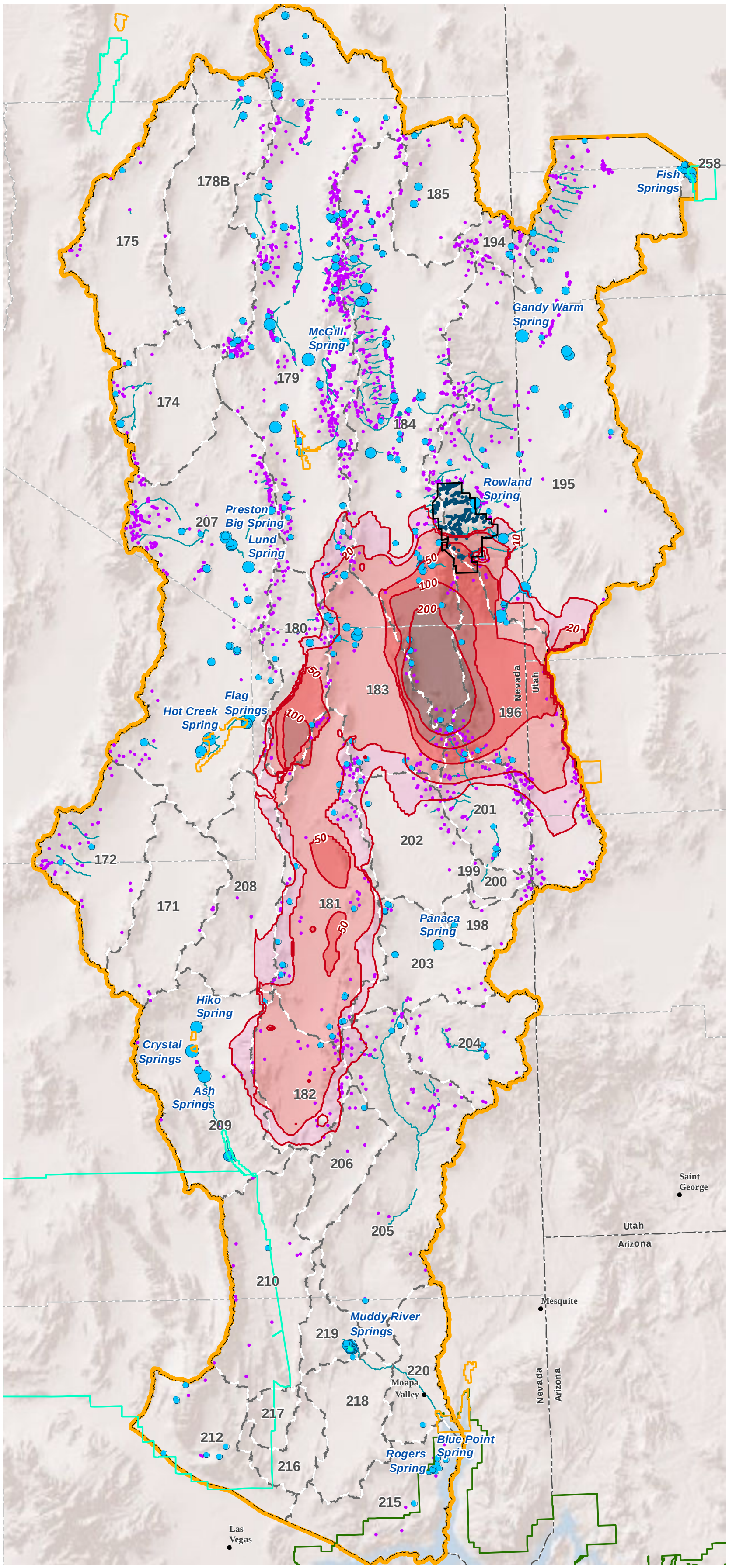
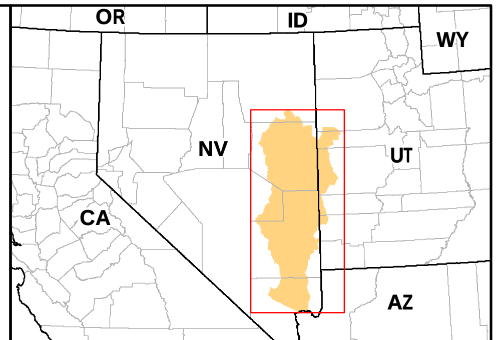
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-24
Predicted Change in Groundwater Levels Alternative D - (LCCRDA Distributed Pumping) + 75 Years

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
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196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-25
Predicted Change in Groundwater Levels
Alternative D - (LCCRDA Distributed Pumping)
+ 200 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N

Water-level hydrographs for each of these observation wells within the pumping basins provided in **Figures 3.3.2-7** and **3.3.2-8** show the predicted rate and magnitude of water level decline at these representative locations over the simulation period. As with the Proposed Action, the hydrographs indicate that water levels are predicted to continue to decrease over the model simulation period, and not reach a renewed equilibrium (or steady state condition) before the end of the simulation period. The hydrographs illustrate that because the same pumping schedule is the same for Alternative A and Alternative D for Delamar, Dry Lake, and Cave valleys, the rate and magnitude of drawdown are the same in those valleys. As shown on **Figure 3.3.2-7**, this alternative would reduce the drawdown area in Snake Valley in the vicinity of Baker compared to the Proposed Action and Alternatives A, B, and C.

The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9).

Potential effects to water resources resulting from the Alternative D pumping scenario are summarized in **Table 3.3.2-17**.

Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.8A-13**, **F3.3.8A-14**, and **F3.3.8A-15**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-5A** in **Appendix F3.3.9**. Specific inventoried springs located within the drawdown area at the representative points in time are listed in **Table F3.3.10-1A** in **Appendix F3.3-10**. The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-5A** in **Appendix F3.3.11**.

Potential total effects to perennial springs and streams are summarized in **Table 3.3.2-17**. For the predicted drawdown area at full build out plus 75 years, there are 13 inventoried springs and 28 “other” springs located within the high and moderate risk areas. By full build out plus 200 years, this increased to 31 inventoried springs and 92 “other” springs located within the high and moderate risk areas. These springs occur in Cave Steptoe, Hamlin, Spring (HA 184), Snake, Lake, Spring (HA 201), and Patterson valleys.

The total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 4 miles at full build out plus 75 years to 48 miles at full build out plus 200 years. This includes stream reaches located in Steptoe, Spring (HA 184), Snake, Lake, and Spring (HA 201) valleys.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action.

<u>Model-simulated Spring and Stream Discharge Estimates</u>. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-18**. The model-simulated results for springs in White River Valley and others within the White River flow system are essentially the same as previously described for Alternative A.

In the Great Salt Lake Desert Flow System, the model simulations results indicate that Alternative D would not impact flows at Keegan, North Millick, and South Millick springs. In Snake Valley, the model simulation results are very similar to those described for the Proposed Action.

<u>Water Resources Within or Adjacent to GBNP</u>. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). Potential effects to water resources within or adjacent to GBNP are essentially the same as described under Alternative C.

Table 3.3.2-17 Summary of Potential Effects to Water Resources Resulting from the Alternative D Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	6	11	16
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	1	13	31
• Number of other springs located in areas where impacts to flow could occur[4]	0	28	92
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	19%	100%	100%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	0	3	5
• Miles of perennial stream located in areas where impacts to flow could occur	0	4	48
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	1	23	56
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	2	21	196
• Number of groundwater rights located within the 50-100 foot drawdown area	0	4	11
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	2	6
• (Total groundwater rights in drawdown area)	(2)	(27)	(213)
Percent reduction in ET and spring discharge[5]:			
• Spring Valley	0%	18%	28%
• Snake Valley	0%	4%	8%
• Great Salt Lake Desert Flow System[1]	0%	10%	16%
• White River Flow System	0%	0%	0%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]:			
• AFY	0	0	200
• Percent Reduction	0%	0%	1%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.5** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to No Action pumping results.

Table 3.3.2-18 Model-simulated Flow Changes (Alternative D Pumping)

(Project Specific)					Alternative D (LCCRDA)		
					Incremental Change in Flow % (from No-Action)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model-simulated Average Flow (2005) in gpm	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	0	0
		Butterfield Spring	1,225	471	0	-3	-9
		Cold Spring	582	503	0	0	0
		Flag Springs 3	969	560	0	-3	-9
		Hardy Springs	200	73	0	0	-1
		Hot Creek Spring	5,032	6,899	0	0	-2
		Lund Spring	3,594	3,314	0	0	-1
		Moon River Spring	1,707	1,457	0	0	-1
		Moorman Spring	405	353	0	0	-1
		Nicolas Spring	1,185	872	0	0	0
		Preston Big Spring	3,572	3,794	0	0	0
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	0	-1
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	0
		Hiko Spring	2,735	1,985	0	0	-1
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	0
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	0
	Black Mountains Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	0	0
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	0	0	0
		North Millick Spring	284	98	0	0	0
		South Millick Spring	506	278	0	0	0
	Snake Valley (195)	Big Springs	4,289	1,977	-19	-100	-100
		Foote Res. Spring	1,300	211	0	0	0
		Kell Spring	120	59	0	0	0
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	0
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010b.

Utah Surface Water Resources. Reduced flows at Big Springs would reduce flows in Big Springs Creek, and likely reduce flows to Lake Creek and into Pruess Lake. The model simulations indicate potential flow reductions at Big Springs (and downstream in Lake Creek).

The model simulations indicate that drawdown could propagate into Pine Valley. At the full build out plus 75 years and full build out plus 200 years time frames, the maximum drawdown simulated at the boundary of the model between Snake and Pine valleys is approximately 18 feet and 53 feet, respectively. As described under the Proposed Action, available information suggest that drawdown from pumping in Snake Valley is unlikely to impact surface water resources in Pine Valley (see Proposed Action for further discussion).

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.12A-13**, **F3.3.12A-14**, and **F3.3.12A-15**, respectively, in **Appendix F3.3.12**. **Table F3.3.13-5A** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. At full build out plus 75 years, there are a total of 23 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 56 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-13, **F3.3.14A-14**, and **F3.3.14A-15** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-5A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 27 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 213 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Impacts to Water Balance

The model-simulated groundwater budget for the Alternative D pumping scenario is presented in **Appendix F3.3.16**, **Table F3.3.16-5B**. Compared to the simulated conditions under the No Action for Spring Valley, the pumping is estimated to result in an 18 percent reduction of groundwater discharge for ET at full build out plus 75 years time frame and 28 percent reduction at full build out plus 200 years time frame. In Snake Valley, the pumping is estimated to result in reductions of groundwater discharge to support ET and spring discharge of 4 percent at full build out plus 75 years, and 8 percent at full build out plus 200 years in the southern portion of the valley. Alternative D pumping is estimated to have minimal impact (1 percent or less) on ET discharge within the White River Flow System and reductions of flow to Pine, Wah Wah, and Tule valleys and Fish Springs.

The GBNP Model (Halford and Plume 2011) was set up to simulate flows at Fish Springs. The simulation results from the GBNP Model indicate that pumping in Snake Valley (at the points of diversion listed in the SNWA water rights applications), at the full application rate (50,000 afy) combined with continuation of existing agricultural pumping would not reduce flows in Fish Springs over the 200-year simulation period. These model results suggest that pumping associated with the groundwater development in Snake Valley is unlikely to result in a measureable reduction in flows at Fish Springs.

Water Quality

Potential impacts to water quality would be the same as described under the Proposed Action.

Monitoring and Mitigation Recommendations

Additional mitigation recommendations GW-WR-3a (Comprehensive Water Resources Monitoring Plan) and GW-3b (Numerical Groundwater Flow Modeling Requirements); GW-WR-4 (Monitoring, Mitigation and Management Plan for Snake Valley); GW-WR-5 (Shoshone Ponds Mitigation); GW-WR-6 (Water Rights Mitigation); and GW-WR-7 (Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights) described under the Proposed Action , and the COM Plan described in Section 3.20, Monitoring and Mitigation Summary, would apply to Alternative D.

Potential Residual Impacts

Potential unavoidable residual impacts associated with the groundwater development are described under the Proposed Action. The magnitude of potential unavoidable adverse impacts to water resources resulting from reduced pumping in Delamar, Dry Lake, and Cave valleys would be less than the Proposed Action. The magnitude of potential unavoidable adverse impacts to Snake Valley also would be considerably less than the Proposed Action since there would be no pumping in Snake Valley. The intensive groundwater withdrawal focused in southern Spring Valley would result in substantially higher magnitude of drawdown in the south Spring Valley and adjacent areas compared to the Proposed Action and all other pumping alternatives. Implementation of adaptive mitigation measures proposed by the applicant and included in the stipulated agreements would be difficult to implement to control the magnitude and aerial extent of drawdown resulting from the pumping in southern Spring Valley. Therefore, the potential for residual adverse impacts in southern Spring Valley and adjacent areas affected by pumping in southern Spring Valley would likely be greater than under the Proposed Action and all other alternatives.

3.3.2.14 Alternative E

Groundwater Development Areas

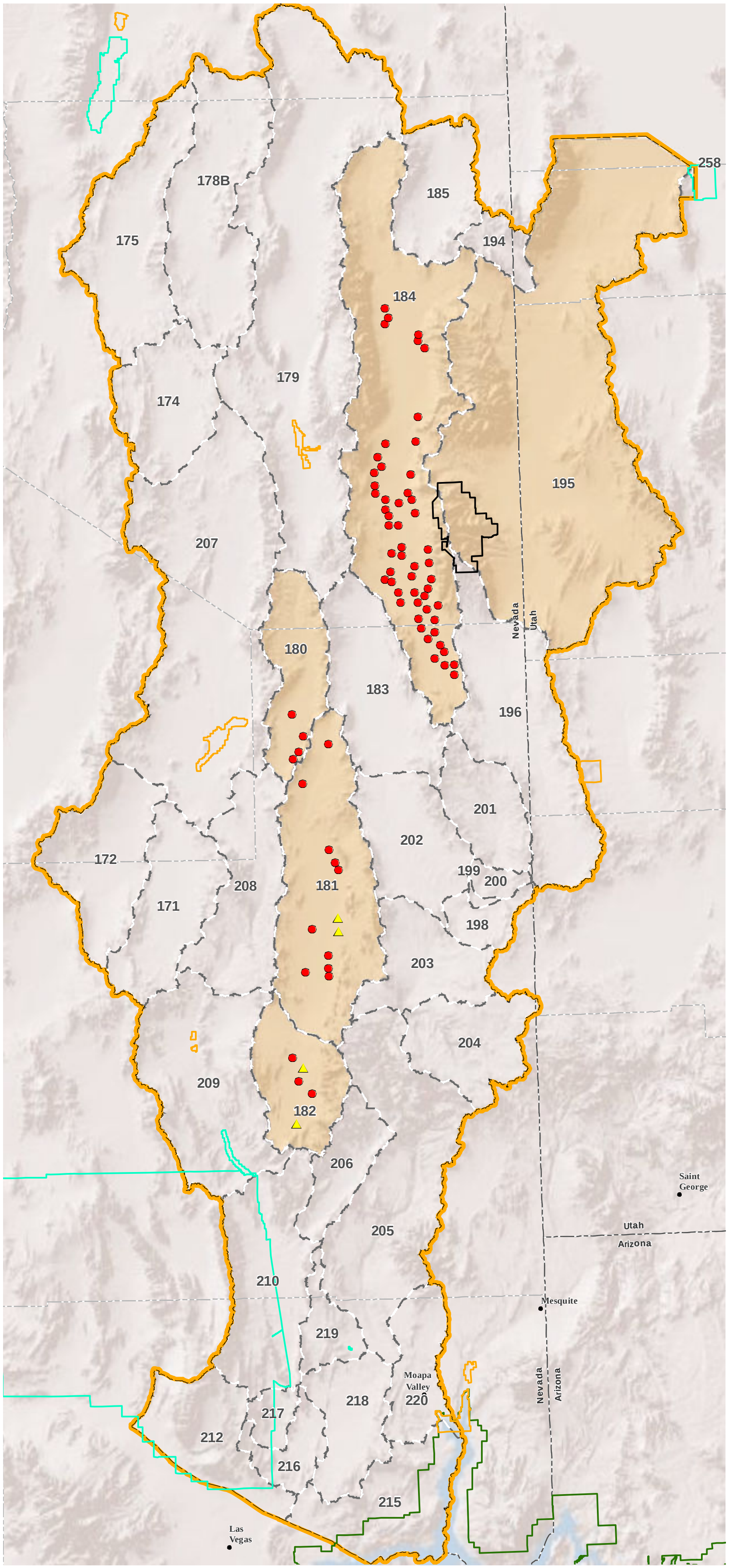
Development in Snake Valley would be eliminated under Alternative E (Spring, Delamar, Dry Lake, and Cave valleys Alternative). The delineated groundwater development areas for Spring, Delamar, Dry Lake, and Cave valleys are assumed to be the same as those defined for the Proposed Action. Development within the groundwater development areas would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been determined at this stage of the project and will be subject to future site-specific NEPA analysis.

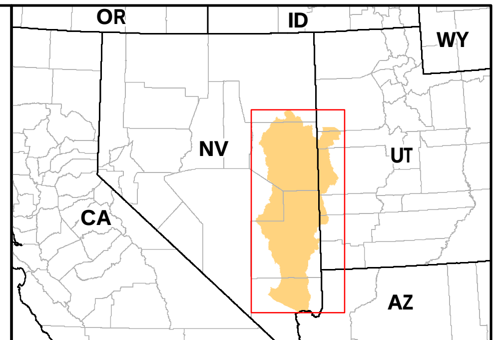
Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 4,080 acres within 4 hydrographic basins. There are 49 known or suspected springs identified within the groundwater development areas (**Table 3.3.2-4**). These springs occur within the groundwater development areas within Spring Valley (37 springs), Delamar Valley (7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring). There also are 23 separate perennial stream reaches with a total length of 20.3 miles that occur within the groundwater development areas (**Table 3.3.2-5**). All of these perennial stream reaches are located in Spring Valley. The potential for impacts to springs and streams located within these groundwater development areas would depend on the location of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional monitoring and mitigation recommendations (GW-WR-1, GW-WR-2) described under the Proposed Action would apply to Alternative E and include identifying and establishing an avoidance buffer around all springs, and developing site-specific plans to minimize impacts at perennial stream crossings within the groundwater development areas.

Groundwater Pumping

Groundwater Pumping Scenario

The groundwater pumping scenario for Alternative E assumes that no pumping will occur in Snake Valley as shown in **Figure 3.3.2-26**. The maximum groundwater production rate under this scenario is approximately 79,000 afy for the four pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys), the same as is assumed for these same basins under Alternatives A, C, and D. The well distribution developed by SNWA for this model scenario includes the same spatial distribution of wells included in Alternative A for Spring, Delamar, Dry Lake, and Cave valleys. Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report (SNWA 2010a). The pumping schedule reflects the proposed staged general south to north sequence of basin development for the project.





Legend

Pumping Scenario Well Locations[1]

- SNWA Project Well
- Lincoln County Water District Approved Water Right
- Hydrographic Basin
- Pumping Basin
- Water Resources Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

[1]The SNWA well locations represent the production well locations simulated in the numerical groundwater flow model for evaluating potential impacts. The actual number and location of the wells will be determined after additional field investigations.

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201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-26

Pumping Distribution
Alt. E - (Spring, Delamar, Dry Lake and Cave Valleys)

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

Impacts to Water Levels

The predicted change in groundwater levels attributable to groundwater development under the Alternative E at full build out, full build out plus 75 years, and full build out plus 200 years are provided in **Figures 3.3.2-27**, **3.3.2-28**, and **3.3.2-29**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels.

Because the pumping schedule for Alternative E is identical to Alternative A for Spring, Delamar, Dry Lake, and Cave valleys, the predicted drawdown for Spring, Delamar, Dry Lake, and Cave valleys (and adjacent areas) are essentially the same as previously described for Alternative A. Pumping in Spring Valley is predicted to eventually result in drawdown along the southwest margin of Snake Valley and northern portion of Hamlin Valley. As shown on **Figure 3.3.2-7**, this alternative would substantially reduce the drawdown area in Snake Valley in the vicinity of Baker compared with the Proposed Action compared to the Proposed Action, and Alternatives A, B, and C.

The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9).

Potential effects to water resources resulting from the Alternative E pumping scenario are summarized in **Table 3.3.2-19**.

Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.8A-16**, **F3.3.8A-17**, and **F3.3.8A-18**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-6A** in **Appendix F3.3.9**. Specific inventoried springs located within the drawdown area at the representative points in time are listed in **Table F3.3.10-1A** in **Appendix F3.3.10**. The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-6A** in **Appendix F3.3.11**.

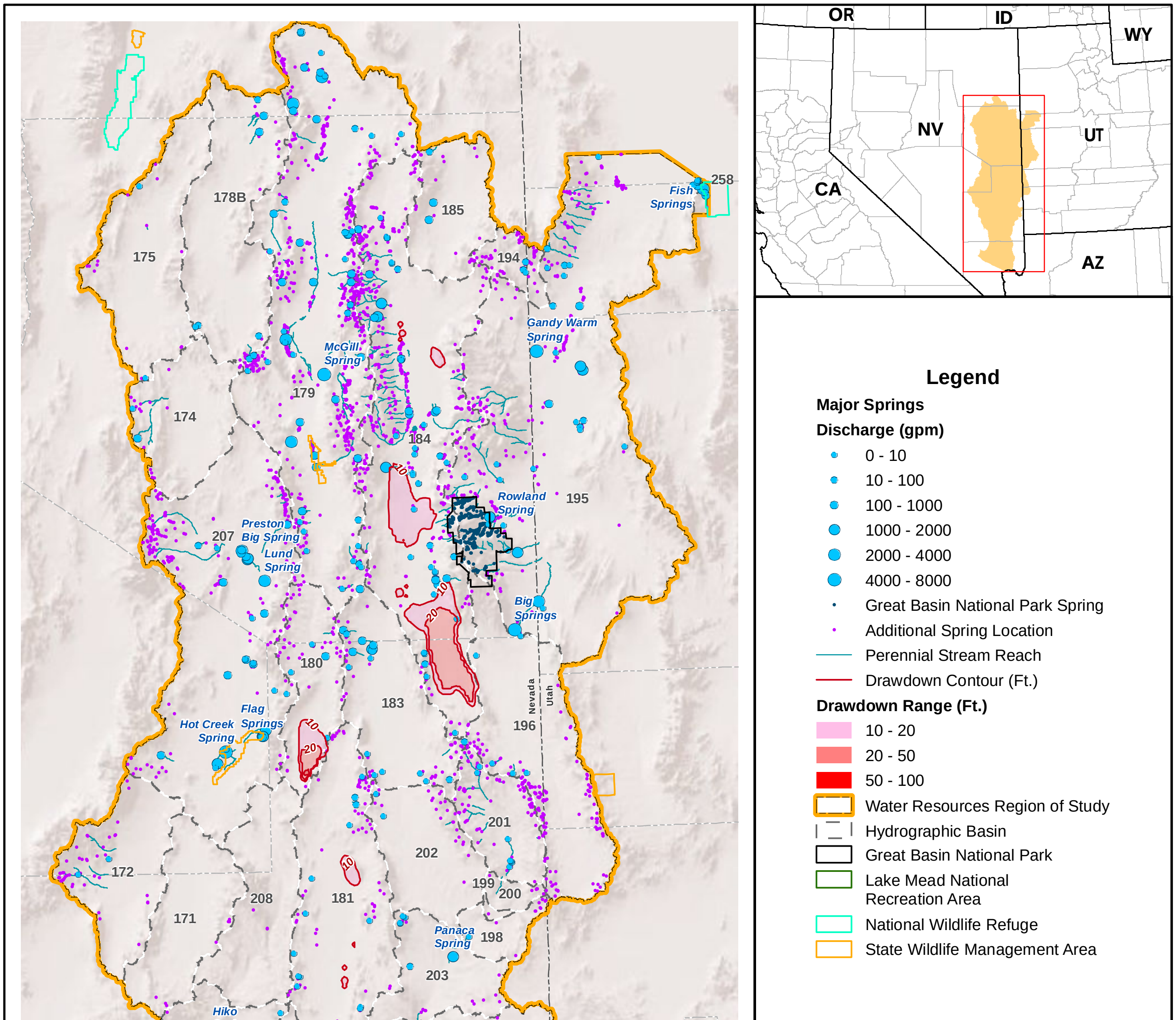
Potential total effects to perennial springs and streams are summarized in **Table 3.3.2-19**. For the predicted drawdown area at full build out plus 75 years, there are 19 inventoried springs and 36 “other” springs located within the high and moderate risk areas. By full build out plus 200 years, this increased to 30 inventoried springs and 174 “other” springs located within the high and moderate risk areas. These springs occur in Cave, Steptoe, Hamlin, Spring (HA 184), Snake, and Lake valleys.

The total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 7 miles at full build out plus 75 years to 23 miles at full build out plus 200 years. This includes stream reaches located in Steptoe, Spring (HA 184), Snake, and Lake valleys.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action.

<u>Model-simulated Spring and Stream Discharge Estimates</u>. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-20**. The model-simulated flows and predicted changes in flows for springs in White River Valley, other springs within the White River flow system, and Spring Valley are the same as previously described for Alternative A. The model-simulated flows for springs in Snake Valley are the same as the Proposed Action and Alternative A except that Big Springs is predicted to experience a 26 percent reduction in flow by the full build out plus 75 years time frame and 78 percent reduction in the full build out plus 200 year time frame. Reductions of flow at Big Springs would reduce flows in Big Springs Creek and likely reduce flows to Lake Creek and into Pruess Lake. The results suggest that the springs located on the valley floor in the in the southern portion of the valley potentially could experience a reduction in flow from pumping in Spring Valley.

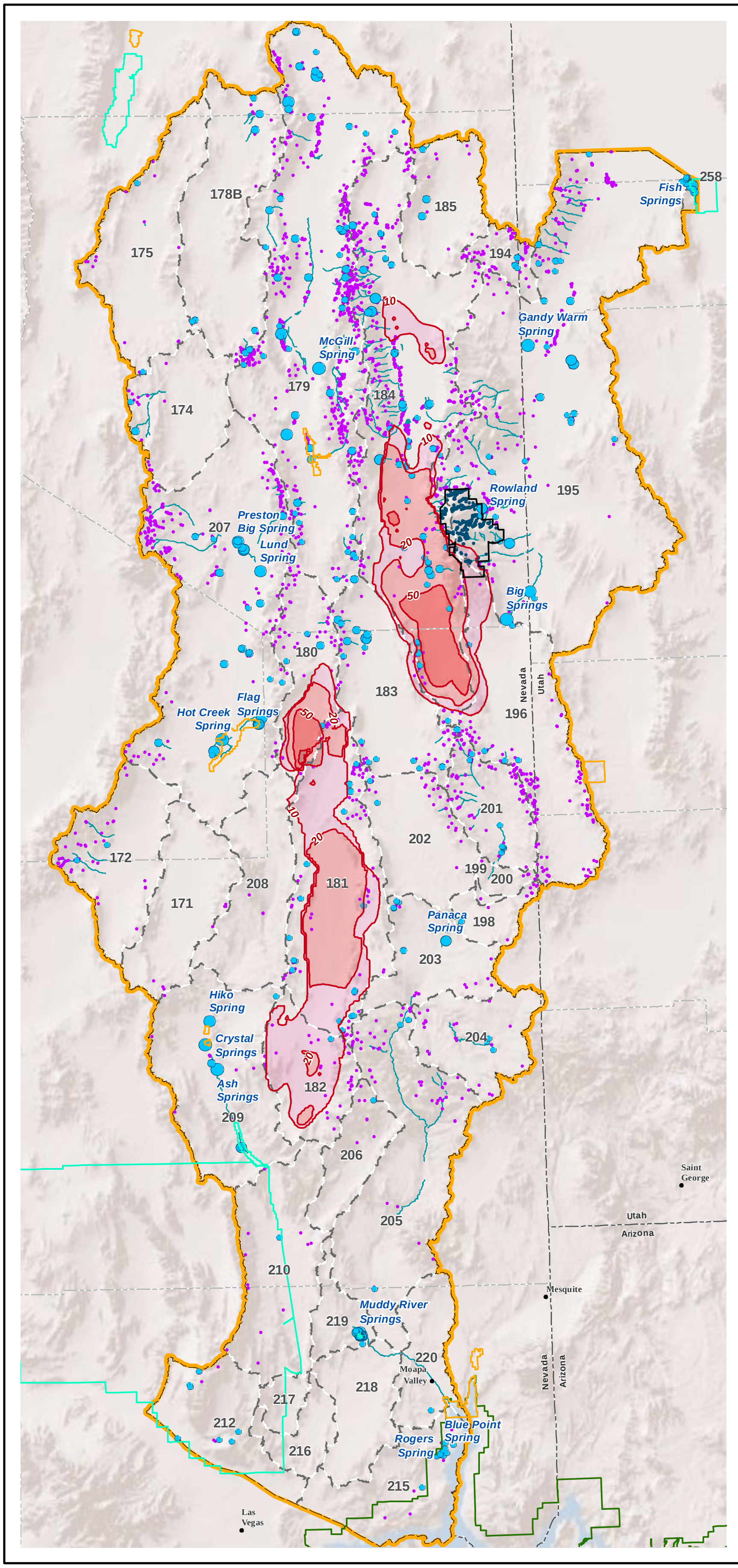
<u>Water Resources Within or Adjacent to the GBNP</u>. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as

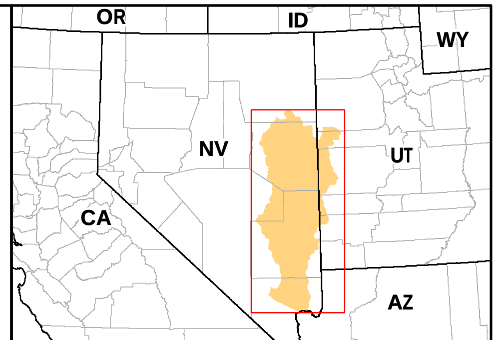


Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-27
Predicted Change in Groundwater Levels
Alt. E - (Spring, Delamar, Dry Lake and Cave Valleys)
Full Build Out





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
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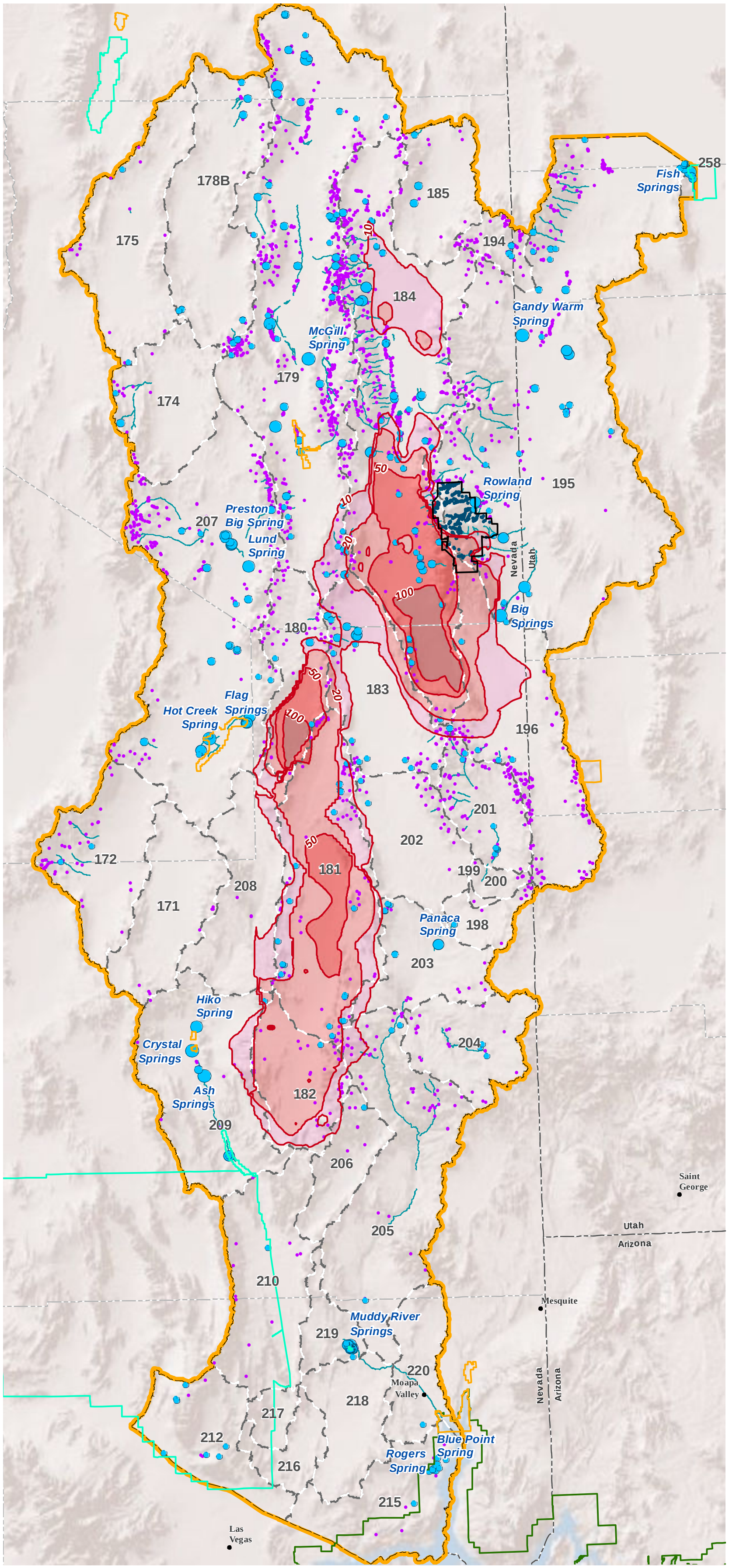
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

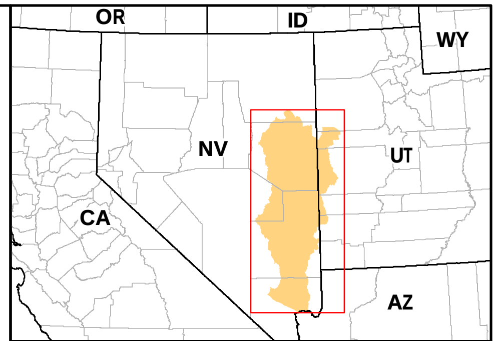
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-28
Predicted Change in Groundwater Levels Alt. E - (Spring, Delamar, Dry Lake and Cave Valleys) + 75 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N





Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
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181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-29
Predicted Change in Groundwater Levels
Alt. E - (Spring, Delamar, Dry Lake and Cave Valleys) + 200 Years

Table 3.3.2-19 Summary of Potential Effects to Water Resources Resulting from the Alternative E Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	5	10	16
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	1	19	30
• Number of other springs located in areas where impacts to flow could occur[4]	2	36	74
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	2%	26%	78%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	1	1	4
• Miles of perennial stream located in areas where impacts to flow could occur	1	7	23
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	14	60	94
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	15	68	58
• Number of groundwater rights located within the 50-100 foot drawdown area	0	2	50
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	0	2
• (Total groundwater rights in drawdown area)	(15)	(70)	(110)
Percent reduction in ET and spring discharge:[5]			
• Spring Valley	30%	52%	56%
• Snake Valley	0%	0%	3%
• Great Salt Lake Desert Flow System[1]	12%	21%	24%
• White River Flow System	0%	0%	1%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]			
• AFY	0	0	0
• Percent Reduction	0%	0%	0%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.5** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to No Action pumping results.

Table 3.3.2-20 Model-simulated Flow Changes (Alternative E Pumping)

(Project Specific)					Alternative E (Spring, Delamar, Dry Lake, and Cave Only)		
					Incremental Change in Flow % (from No-Action)		
Flow System	**Hydrographic Basin**	**Spring**	**Average Flow (Actual) in gpm**	**Model-simulated Average Flow (2005) in gpm**	**Full Build Out**	**Full Build Out Plus 75 Years**	**Full Build Out Plus 200 Years**
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	0	0
		Butterfield Spring	1,225	471	0	-3	-8
		Cold Spring	582	503	0	0	-1
		Flag Springs 3	969	560	-1	-3	-8
		Hardy Springs	200	73	0	0	-1
		Hot Creek Spring	5,032	6,899	0	-1	-2
		Lund Spring	3,594	3,314	0	0	-1
		Moon River Spring	1,707	1,457	0	0	-1
		Moorman Spring	405	353	0	0	-1
		Nicolas Spring	1,185	872	0	0	0
		Preston Big Spring	3,572	3,794	0	0	-1
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	0	-1
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	-1
		Hiko Spring	2,735	1,985	0	0	-1
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	0
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	0
	Black Mountains Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	0	0
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	-12	-28	-36
		North Millick Spring	284	98	-4	-9	-11
		South Millick Spring	506	278	-10	-21	-24
	Snake Valley (195)	Big Springs	4,289	1,977	-2	-26	-78
		Foote Res. Spring	1,300	211	0	0	0
		Kell Spring	120	59	0	0	0
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	0
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010b.

defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). There are no resources identified in the moderate risk zone at the full build out plus 75 years time frame, and 2.1 miles of Snake Creek at the full build out plus 200 years time frame. Potential risk to water resources (associated with the simulated drawdown) within or adjacent to the GBNP would be less under Alternative E than the Proposed Action and all other pumping alternatives.

Utah Surface Water Resources. Reduced flows at Big Springs would reduce flows in Big Springs Creek, and likely reduce flows to Lake Creek and into Pruess Lake. However, the model simulations suggest that potential flow reductions at Big Springs (and downstream in Lake Creek) likely would be less than under the other pumping alternatives. Also, model simulations indicate that drawdown is not expected to extend to the boundary of Snake and Pine valleys.

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75years, and full build out plus 200 years are presented in **Figures F3.3.12A-16**, **F3.3.12A-17**, and **F3.3.12A-18**, respectively, in **Appendix F3.3.12**. **Table F3.3.13-6A** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. At full build out plus 75 years, there are a total of 60 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 94 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-16, **F3.3.14A-17**, and **F3.3.14A-18** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-6A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 70 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 110 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Impacts to Water Balance

The model-simulated groundwater budget for the Alternative E pumping scenario is presented in **Appendix F3.3.16**, **Table F3.3.16-6B**. Compared to the simulated conditions under the No Action for Spring Valley, the pumping is estimated to result in a 52 percent reduction of groundwater discharge for ET at the full build out plus 75 years time frame and 56 percent reduction at full build out plus 200 years time frame. In Snake Valley, the pumping is estimated to result in minimal reductions (less than 4 percent) of groundwater discharge to support ET. Alternative E pumping is estimated to have minimal impact (1 percent or less) on ET discharge within the White River Flow System, and reductions of flow to Pine, Wah Wah, and Tule valleys and Fish Springs.

Water Quality

Potential impacts to water quality would be the same as described under the Proposed Action.

Monitoring and Mitigation Recommendations

Additional mitigation recommendations GW-WR-3a (Comprehensive Water Resources Monitoring Plan) and GW-3b (Numerical Groundwater Flow Modeling Requirements); GW-WR-4 (Monitoring, Mitigation and Management Plan for Snake Valley); GW-WR-5 (Shoshone Ponds Mitigation); GW-WR-6 (Water Rights Mitigation); and GW-WR-7 (Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights) described under the Proposed Action, and the COM Plan described in Section 3.20, Monitoring and Mitigation Summary, would apply to Alternative E.

Potential Residual Impacts

Potential unavoidable residual impacts associated with the groundwater development are described under the Proposed Action. The magnitude of potential unavoidable adverse impacts would be less than the Proposed Action in Spring, Delamar, Dry Lake, and Cave valleys (because of reduced pumping). The magnitude of potential unavoidable adverse impacts to Snake Valley also would be considerably less than the Proposed Action and Alternatives A, B, and C since there would be no pumping in Snake Valley. The potential residual impacts to Snake Valley also likely would be less under Alternative E and Alternative D because of the reduction in the magnitude of drawdown that likely would propagate into this basin.

3.3.2.15 Alternative F

Groundwater Development Areas

Development in Snake Valley would be eliminated under Alternative F. The delineated groundwater development areas for Spring, Delamar, Dry Lake, and Cave valleys are assumed to be the same as those defined for the Proposed Action. Development within the groundwater development areas would include groundwater production wells, collector pipelines, staging areas, power facilities, pumping stations, and access roads. The actual location of specific facilities within the groundwater development areas has not been determined at this stage of the project and will be subject to future site-specific NEPA analysis.

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 4,080 acres within 4 hydrographic basins. There are 49 known or suspected springs identified within the groundwater development areas (**Table 3.3.2-4**). These springs occur within the groundwater development areas within Spring Valley (37 springs), Delamar Valley (7 springs), Dry Lake Valley (4 springs), and Cave Valley (1 spring). There also are 23 separate perennial stream reaches with a total length of 20.3 miles that occur within the groundwater development areas (**Table 3.3.2-5**). All of these perennial stream reaches are located in Spring Valley. The potential for impacts to springs and streams located within these groundwater development areas would depend on the location of facilities. Implementation of the ACMs would minimize impacts to perennial water sources associated with the well field development. Additional monitoring and mitigation recommendations (GW-WR-1, GW-WR-2) described under the Proposed Action would apply to Alternative F and include identifying and establishing an avoidance buffer around all springs, and developing site-specific plans to minimize impacts at perennial stream crossings within the groundwater development areas.

Groundwater Pumping

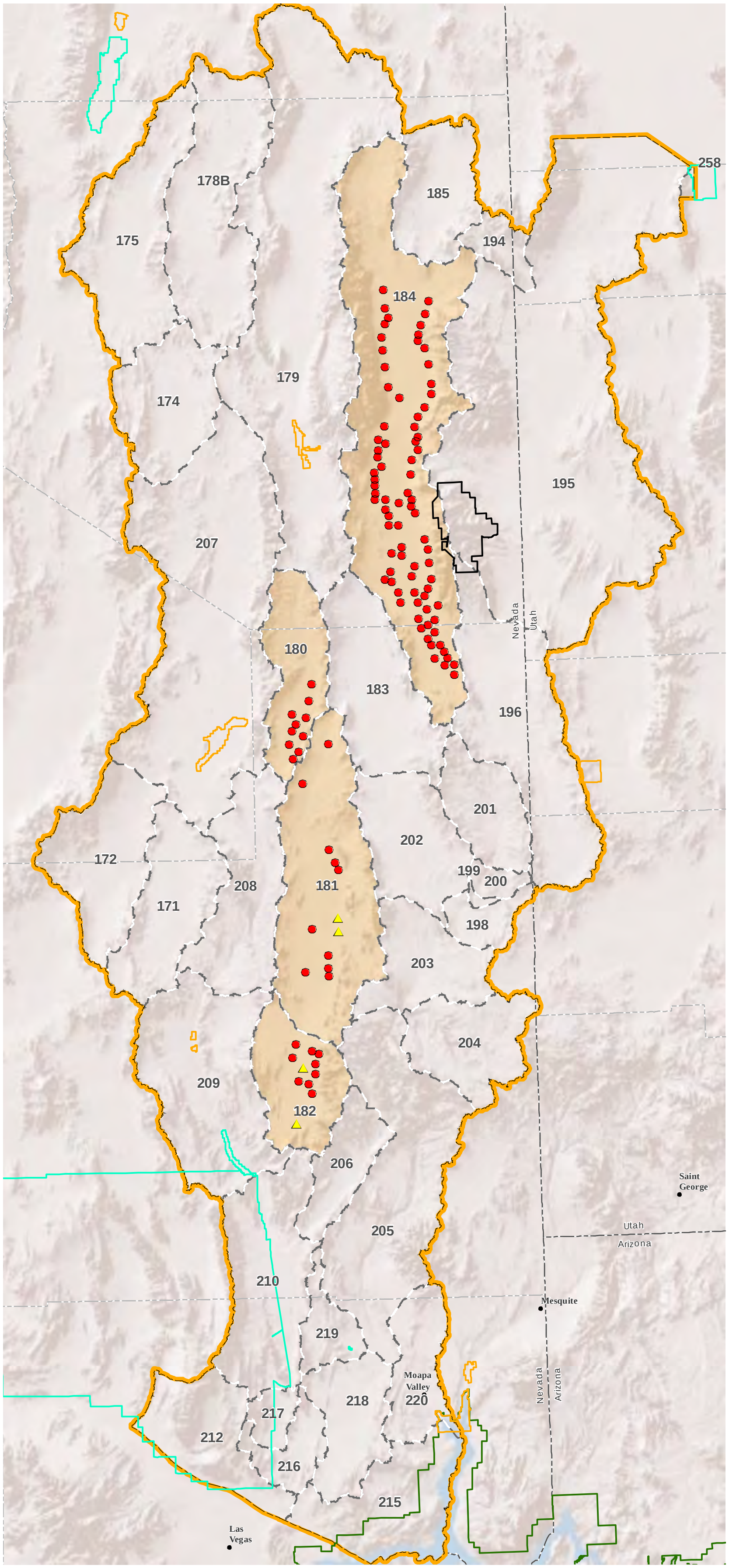
Groundwater Pumping Scenario

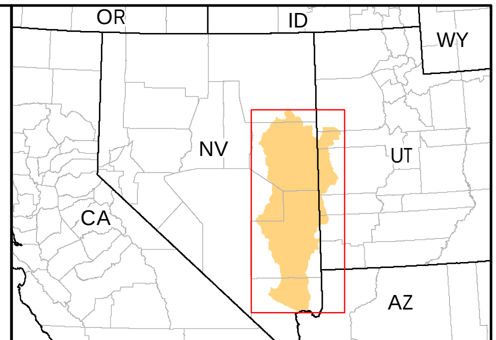
The groundwater pumping scenario for Alternative F assumes that no pumping would occur in Snake Valley as shown in **Figure 3.3.2-30**. The maximum groundwater production rate under this scenario is 114,129 afy for the four pumping basins (Spring, Delamar, Dry Lake, and Cave valleys). The well distribution developed by SNWA for this model scenario includes the same spatial distribution of wells included in Proposed Action for Spring, Delamar, Dry Lake, and Cave valleys. Details regarding the assumed pumping schedule used for the model simulations are provided in the model simulation report addendum (SNWA 2012a). The pumping scenarios for Alternatives E and F have similar distributed pumping in Spring, Delamar, Dry Lake, and Cave valleys and exclude pumping in Snake Valley. However, the assumed pumping rates for Alternative F (114, 129 afy) represent an increase in pumping in Spring, Delamar, and Cave valleys (and the same pumping rate in Dry Lake Valley) compared to Alternative E (78,755 afy).

Impacts to Water Levels

The predicted change in groundwater levels attributable to groundwater development under the Alternative F at full build out, full build out plus 75 years, and full build out plus 200 years are provided in **Figures 3.3.2-31**, **3.3.2-32**, and **3.3.2-33**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the simulated No Action water levels. Comparison of the simulation results for the three representative points in time indicates that the drawdown area continues to progressively expand as pumping continues into the future.

At full build out, the drawdown areas are localized in the vicinity of the pumping wells in central and southern Spring Valley, southern Cave Valley, and Dry Lake Valley. Drawdown does not occur at this time period in Snake Valley.





Legend

Pumping Scenario Well Locations[1]

- SNWA Project Well
- Lincoln County Water District Approved Water Right
- Hydrographic Basin
- Pumping Basin
- Water Resources Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

[1]The SNWA well locations represent the production well locations simulated in the numerical groundwater flow model for evaluating potential impacts. The actual number and location of the wells will be determined after additional field investigations.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

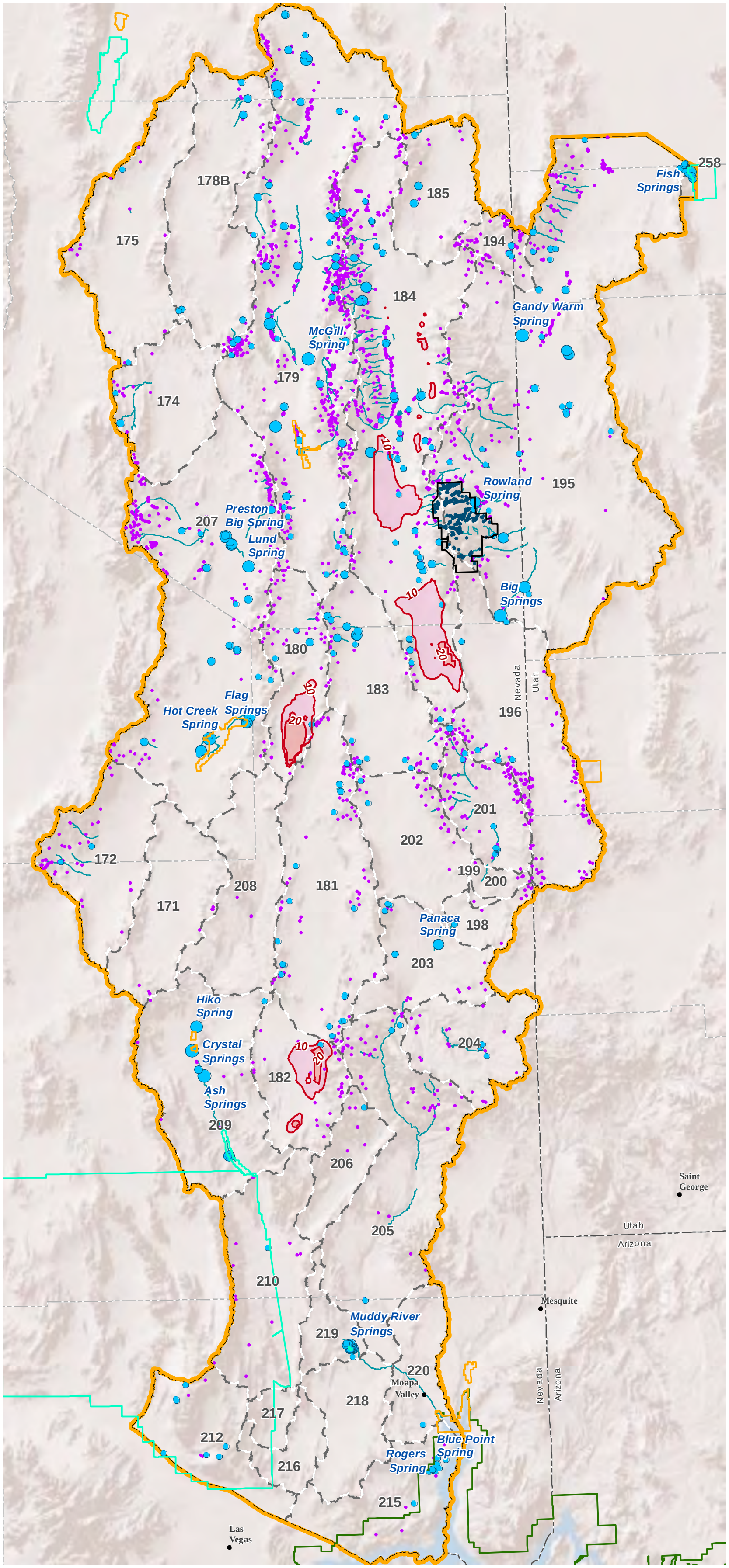
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

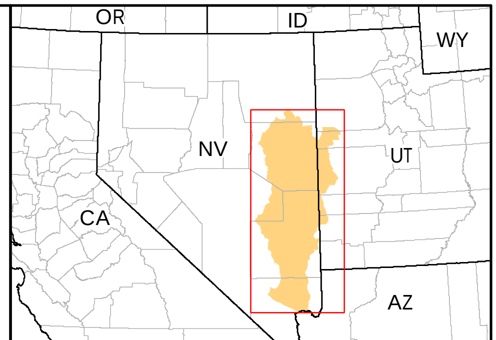
Figure 3.3.2-30

Pumping Distribution
Alt. F - (Spring, Delamar, Dry Lake and Cave Valleys)

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.





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201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-31
Predicted Change in Groundwater Levels
Alt. F - (Spring, Delamar, Dry Lake and Cave Valleys)
Full Build Out

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
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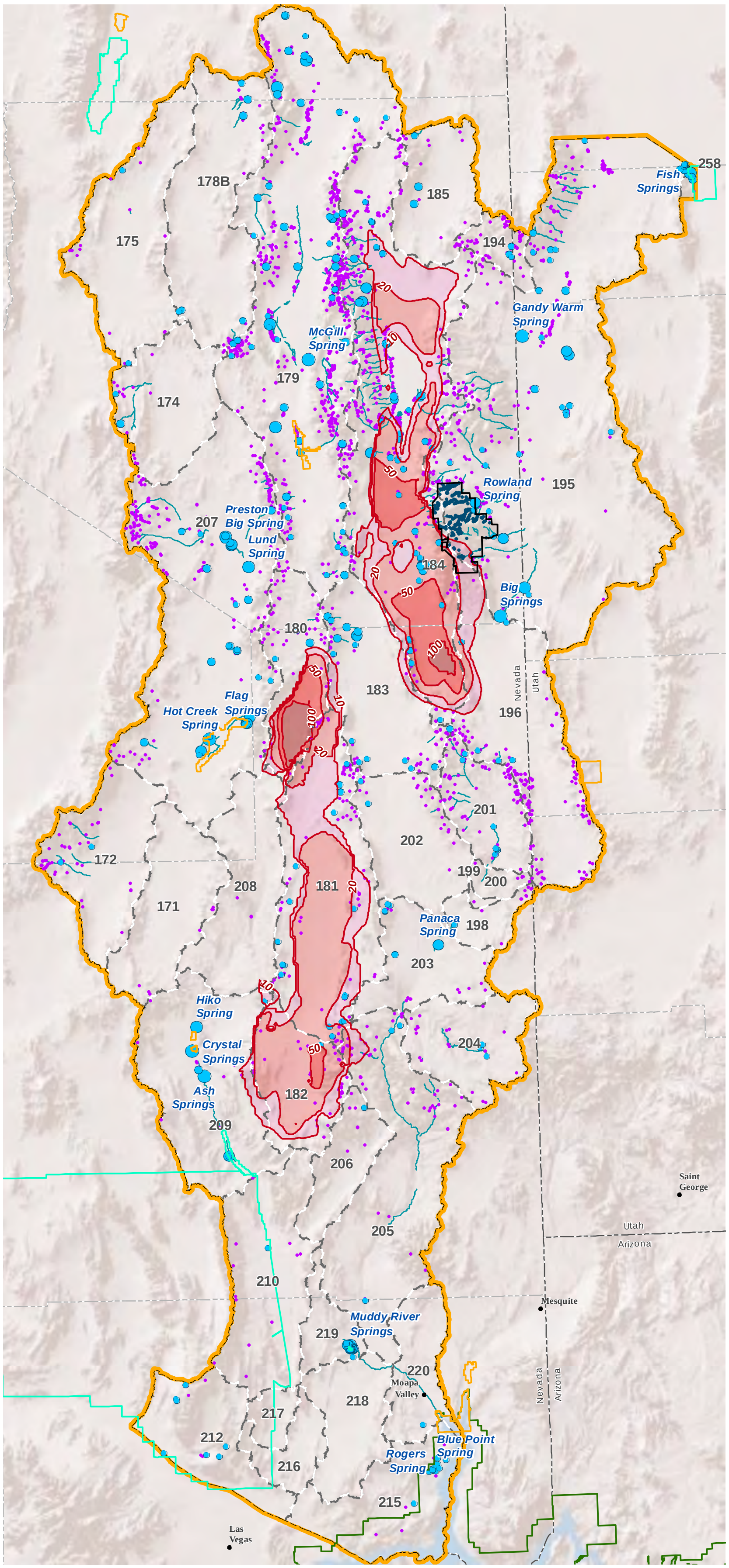

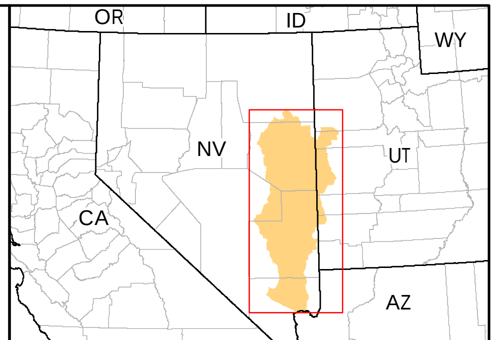

Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
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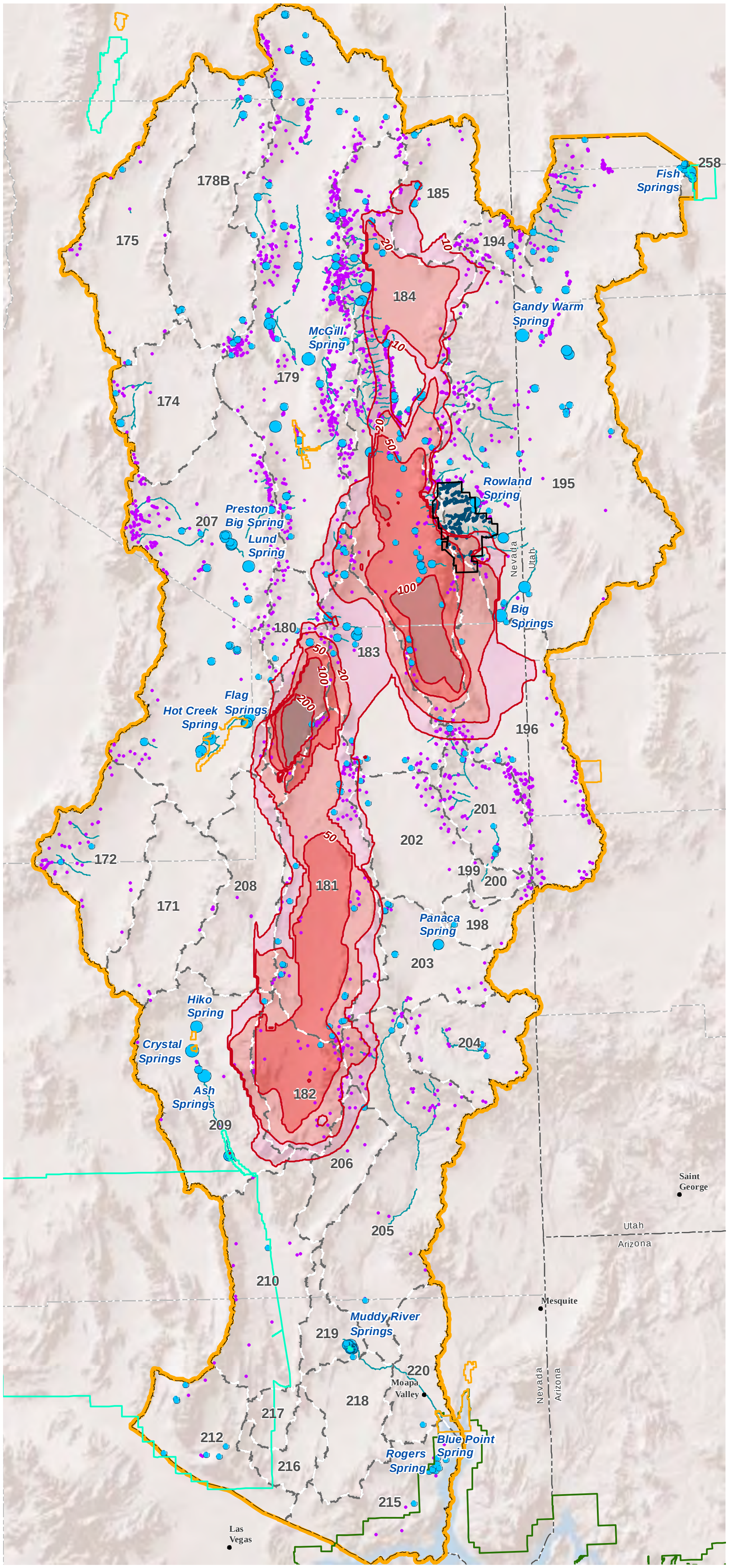
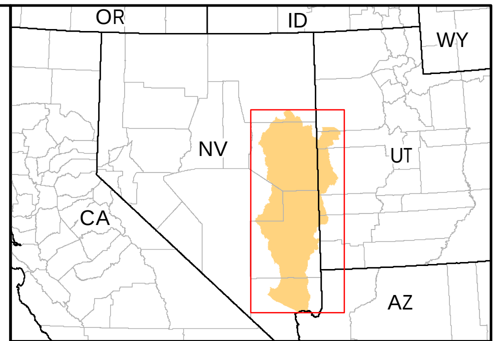
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-32
Predicted Change in Groundwater Levels
Alt. F - (Spring, Delamar, Dry Lake and Cave Valleys) + 75 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-33
Predicted Change in Groundwater Levels
Alt. F - (Spring, Delamar, Dry Lake and Cave Valleys) + 200 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

At the full build out plus 75 years time frame, there are two distinct drawdown areas. The northern drawdown area encompasses most of valley floor in Spring Valley, and extends into northern Hamlin Valley and along the southwest margin of Snake Valley. The southern drawdown area extends across the Delamar, Dry Lake, and Cave valleys in an elongate north-south direction and extends into the eastern margin of Pahranagat Valley and northwestern margin of Lower Meadow Valley Wash.

By the full build out plus 200 years time frame, the 2 drawdown areas merge into one that extends approximately 190 miles in a north-south direction and up to 50 miles in a east-west direction. At this time frame, the simulated drawdown area extends into Tippetts Valley, southeastern Steptoe Valley, the eastern margins of Pahroc and Pahranagat valleys, and the western margins of Panaca Valley and Lower Meadow Valley Wash.

The locations of six selected observation wells located within the proposed pumping basins are presented in **Figure 3.3.2-6**. Water-level hydrographs for each of these observation wells within the pumping basins are provided in **Figures 3.3.2-7** and **3.3.2-8**. The hydrographs illustrate the predicted rate and magnitude of water level decline at these representative locations over the simulation period. The hydrographs for the observation wells indicate that water levels are predicted to continue to decrease over the model simulation and are not predicted to reach a renewed equilibrium (or steady state condition) before the end of the simulation period. These results further suggest that with continued pumping beyond 200 years, additional drawdown is likely to occur after the model simulation period (i.e., after the full build out plus 200-year period).

The hydrographs illustrate that the magnitude of drawdown at the well in Spring Valley would be less than the Proposed Action; similar to Alternatives A, B, and E; and greater than the drawdown simulated under Alternatives D, C, and the No Action. Pumping in Spring Valley is predicted to eventually result in drawdown along the southwest margin of Snake Valley and northern portion of Hamlin Valley. As shown on **Figure 3.3.2-7**, in the vicinity of Baker in Snake Valley, the results for Alternative F (which are essentially the same as for Alternatives D and E) indicate that this alternative would substantially reduce the drawdown area in Snake Valley compared with the Proposed Action (and Alternatives A, B, and C).

The predicted magnitude of drawdown in Cave Valley is essentially the same as the Proposed Action and greater than the drawdown simulated under Alternatives A, B, C, D, E, and the No Action. The simulated drawdown in Dry Lake Valley is less than under Alternatives B; similar to the drawdown simulated for the Proposed Action and Alternatives A, D, and E; and greater than the drawdown simulated for Alternatives C and the No Action. In Delamar Valley, the simulated drawdown is less than under the Proposed Action and Alternative B, and greater than the simulated drawdown for the other alternatives (Alternatives A, C, D, E, and the No Action).

The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9).

Potential effects to water resources resulting from the Alternative F pumping scenario are summarized in **Table 3.3.2-21**.

Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at full build out, full build out plus 75 years, and full build out plus 200 years are presented in **Figures F3.3.8A-19**, **F3.3.8A-20**, and **F3.3.8A-21**, respectively, in **Appendix F3.3.8**. The number of springs within the drawdown area and relative risk of impacts by hydrographic basin are summarized in **Table F3.3.9-7A** in **Appendix F3.3.9**. Specific inventoried springs located within the drawdown area at the representative points in time are listed in **Table F3.3.10-1A** in **Appendix F3.3.10**. The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-7A** in **Appendix F3.3.11**.

Potential total effects to perennial springs and streams are summarized in **Table 3.3.2-21**. For the predicted drawdown area at full build out plus 75 years, there are 30 inventoried springs and 101 "other" springs located within the high and moderate risk areas. By full build out plus 200 years, this would increase to 41 inventoried springs and 162 "other" springs located within the high and moderate risk areas. These springs occur in Cave, Steptoe, Hamlin, Spring (HA 184), Snake, and Lake valleys.

Table 3.3.2-21 Summary of Potential Effects to Water Resources Resulting from the Alternative F Pumping Scenario[1,2]

Water Resource Issue — Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	5	10	18
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	1	30	41
• Number of other springs located in areas where impacts to flow could occur[4]	4	101	162
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	2%	25%	83%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	1	1	5
• Miles of perennial stream located in areas where impacts to flow could occur	1	21	46
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	14	88	132
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	14	70	72
• Number of groundwater rights located within the 50-100 foot drawdown area	0	13	54
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	1	5
• (Total groundwater rights in drawdown area)	(14)	(84)	(131)
Percent reduction in ET and spring discharge:[5]			
• Spring Valley	33%	73%	80%
• Snake Valley	0%	1%	3%
• Great Salt Lake Desert Flow System[1]	13%	30%	34%
• White River Flow System	0%	1%	2%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]			
• AFY	0	10	50
• Percent Reduction	0%	0%	0%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.6** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to No Action pumping results.

The total estimated length of perennial stream located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 21 miles at full build out plus 75 years to 46 miles at full build out plus 200 years. This includes stream reaches located in Pahranagat, Steptoe, Spring (HA 184), Snake, and Lake valleys.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action (Section 3.3.2.9).

Model-simulated Spring and Stream Discharge Estimates. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-22**. The model-simulated flows and predicted changes in flows for springs in White River Valley, other springs within the White River flow system, and Spring Valley are essentially the same as previously described for the Proposed Action. The model-simulated flows for springs in Snake Valley are similar but slightly greater than Alternative E. Big Springs in Snake Valley is predicted to experience a 25 percent reduction in flow by the full build out plus 75 years time frame, and 83 percent reduction in the full build out plus 200 year time frame. Reductions of flow at Big Springs would reduce flows in Big Springs Creek, and likely would reduce flows to Lake Creek and into Pruess Lake. The results suggest that the springs located on the valley floor in the southern portion of the valley potentially could experience a reduction in flow from pumping in Spring Valley.

Water Resources Within or Adjacent to the GBNP. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). There are no resources identified in the moderate risk zone at the full build out plus 75 years time frame, and 4.2 miles of Snake Creek at the full build out plus 200 years time frame. Potential risk to water resources (associated with the simulated drawdown) within or adjacent to the GBNP would be less under Alternative F than the Proposed Action and the alternatives that include pumping in Snake Valley (i.e., Alternatives A, B, and C).

Utah Surface Water Resources. Reduced flows at Big Springs would reduce flows in Big Springs Creek, and likely reduce flows to Lake Creek and into Pruess Lake. However, the model simulations suggest that potential flow reductions at Big Springs (and downstream in Lake Creek) likely would be less than under the other pumping alternatives except Alternative E. Also, model simulations indicate that drawdown is not expected to extend to the boundary of Snake and Pine valleys.

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the drawdown area at full build out, full build out plus 75years, and full build out plus 200 years are presented in **Figures F3.3.12A-19**, **F3.3.12A-20**, and **F3.3.12A-21**, respectively, in **Appendix F3.3.12**. **Table F3.3.13-7A** in **Appendix F3.3.13** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. At full build out plus 75 years, there are a total of 88 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 132 surface water rights located in areas with a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-19, **F3.3.14A-20**, and **F3.3.14A-21** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-7A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 84 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 131 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Table 3.3.2-22 Model-simulated Flow Changes (Alternative F Pumping)

(Project Specific)					Alternative F		
					Incremental Change in Flow % (from No-Action)		
Flow System	**Hydrographic Basin**	**Spring**	**Average Flow (Actual) in gpm**	**Model Simulated Average Flow (2005) in gpm**	**Full Build-Out**	**75 years after Full Build-Out**	**200 years after Full Build-Out**
White River	White River Valley (207)	Arnoldson Spring	1,608	946	0	0	-1
		Butterfield Spring	1,225	471	-1	-6	-17
		Cold Spring	582	503	0	0	-1
		Flag Springs 3	969	560	-1	-6	-16
		Hardy Springs	200	73	0	0	-1
		Hot Creek Spring	5,032	6,899	0	-1	-3
		Lund Spring	3,594	3,314	0	0	-1
		Moon River Spring	1,707	1,457	0	0	-1
		Moorman Spring	405	353	0	-1	-2
		Nicolas Spring	1,185	872	0	0	-1
		Preston Big Spring	3,572	3,794	0	0	-1
	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	0	-1
		Brownie Spring	224	277	0	0	0
		Crystal Springs	4,235	4,647	0	0	-1
		Hiko Spring	2,735	1,985	0	0	-1
	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	0	0	-1
	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	0	0	-1
	Black Mountains Area (215)	Blue Point Spring	223	393	0	0	0
		Rogers Spring	771	515	0	0	0
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	0
		Currie Spring	2,181	1,419	0	0	0
		McGill Spring	4,783	2,074	0	0	0
		Monte Neva Hot Springs	649	280	0	0	-1
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	-35	-98	-100
		North Millick Spring	284	98	-20	-52	-60
		South Millick Spring	506	278	-36	-86	-95
	Snake Valley (195)	Big Springs	4,289	1,977	-2	-25	-83
		Foote Res. Spring	1,300	211	0	0	0
		Kell Spring	120	59	0	0	0
		Warm Creek near Gandy, Utah	7,426	2,697	0	0	-1
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	0	0	0

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2012a.

Impacts to Water Balance

The model-simulated groundwater budget for the Alternative F pumping scenario is presented in **Appendix F3.3.16**, **Table F3.3.16-7B**. Compared to the simulated conditions under the No Action for Spring Valley, the pumping is estimated to result in a 73 percent reduction of groundwater discharge for ET at the full build out plus 75 years time frame and 80 percent reduction at full build out plus 200 years time frame. In Snake Valley, the pumping is estimated to result in minimal reductions (less than 4 percent) of groundwater discharge to support ET. Alternative F pumping is estimated to have minimal impact (1 percent or less) on ET discharge within the White River Flow System and reductions of flow to Pine, Wah Wah, and Tule valleys and Fish Springs.

Water Quality

Potential impacts to water quality would be the same as described under the Proposed Action.

Monitoring and Mitigation Recommendations

Additional mitigation recommendations GW-WR-3a (Comprehensive Water Resources Monitoring Plan) and GW-3b (Numerical Groundwater Flow Modeling Requirements); GW-WR-4 (Monitoring, Mitigation and Management Plan for Snake Valley); GW-WR-5 (Shoshone Ponds Mitigation); GW-WR-6 (Water Rights Mitigation); and GW-WR-7 (Groundwater Development & Drawdown Effects to Federal Resources and Federal Water Rights) described under the Proposed Action, and the COM Plan described in Section 3.20, Monitoring and Mitigation Summary, would apply to Alternative F.

Potential Residual Impacts

Potential unavoidable residual impacts associated with the groundwater development are described under the Proposed Action. The magnitude of potential unavoidable adverse impacts would be similar to the Proposed Action in Spring, Delamar, Dry Lake, and Cave valleys. The magnitude of potential unavoidable adverse impacts to Snake Valley also would be considerably less than the Proposed Action and Alternatives A, B, and C since there would be no pumping in Snake Valley.

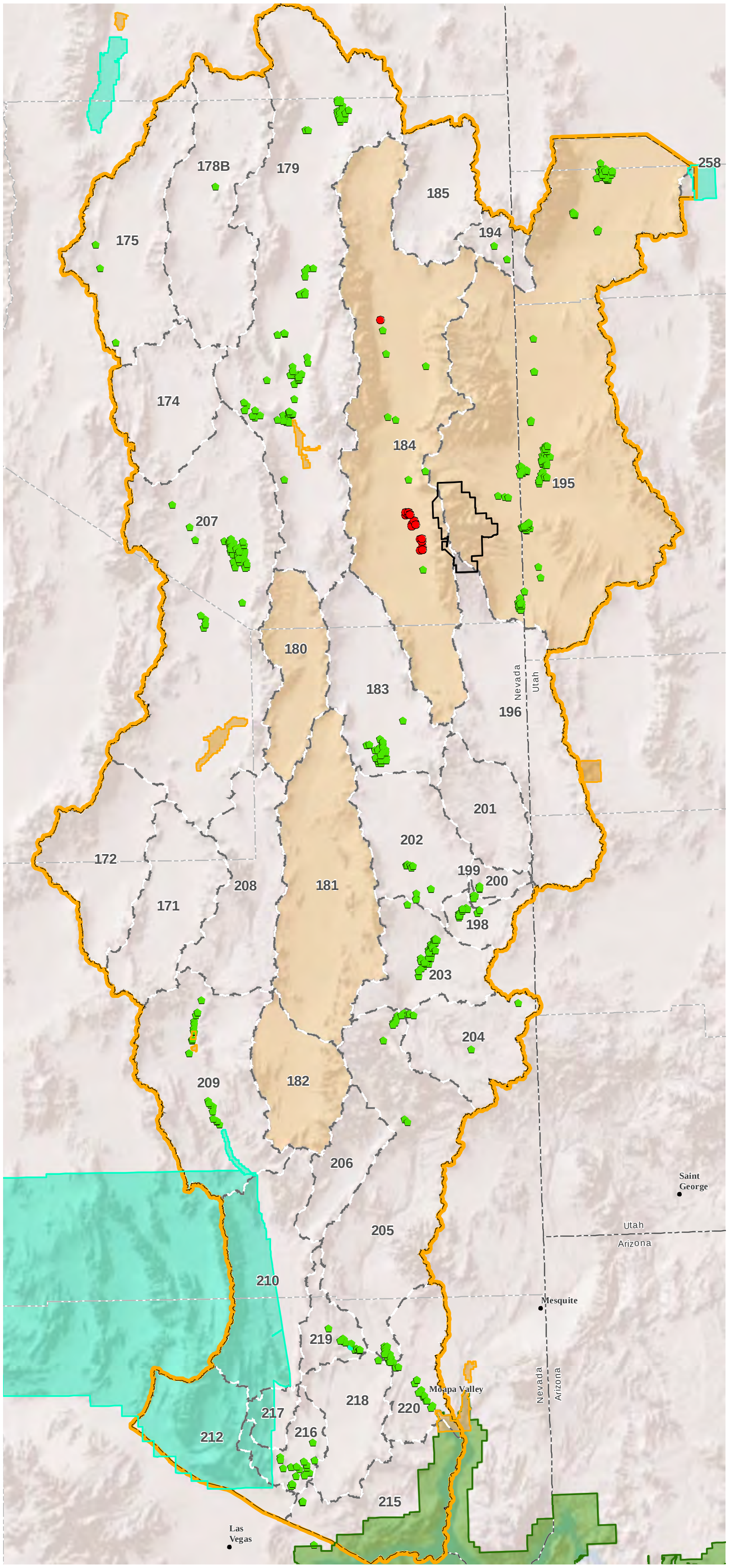
3.3.2.16 No Action

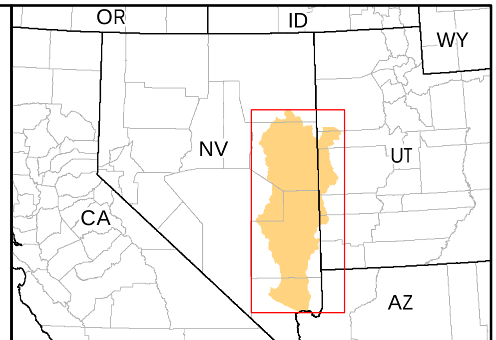
As described in Chapter 2, the No Action assumes that the BLM would not grant ROWs for the proposed project. Under this scenario, the proposed pipelines, power lines, ancillary facilities, and well fields would not be developed. Therefore, no construction or operational impacts to water resources would be associated with the proposed GWD Project.

Groundwater Pumping

Groundwater Pumping Scenario

The locations of the groundwater development wells assumed for modeling of the No Action pumping scenario are shown in **Figure 3.3.2-34**. The pumping scenario used for the No Action represents a continuation of currently existing water uses over the duration of the future model simulation period. The No Action also includes pumping SNWA's existing water rights associated with their ranch properties in Spring Valley (SNWA 2010b). The No Action groundwater pumping scenario is based on the estimates of existing consumptive water use for the model area for agricultural, municipal, mining and milling, industrial, and power plant uses as described in the transient numerical model report (SNWA 2009b). Other uses associated with domestic wells and stock watering wells are not included; however, these are assumed to represent a relatively small percentage of the estimated consumptive uses in the model area (SNWA 2009b). Additional information on the methodology used to derive the consumptive water-use estimates and identified points of diversion are provided in **Appendix C** of the transient numerical model report (SNWA 2009b).





Legend

Pumping Scenario Well Locations

- Existing Pumping Well[1]
- SNWA - Owned Properties[2]
- Hydrographic Basin
- Pumping Basin
- Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

[1]Based on water rights and estimated consumptive uses for agricultural, mining and milling, industrial and power plant, and municipal purposes (SNWA 2009b).

[2]Existing water rights associated with SNWA owned ranch properties in Spring Valley.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-34
Pumping Distribution
No Action

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

Impacts to Water Levels

The predicted changes in groundwater levels attributable to the No Action pumping scenario at the full build out time frame[2], full build out plus 75 years time frame, and full build out plus 200 years time frame are provided in **Figures 3.3.2-35**, **3.3.2-36**, and **3.3.2-37**, respectively. These figures illustrate areas where the water levels are predicted to decrease in comparison to the baseline groundwater elevations at the end of 2004. It is important to understand that these drawdowns are predicted to occur without any groundwater development associated with the proposed project.

Comparison of the simulation results indicate that the drawdown effects under the No Action continue to expand as pumping continues into the future. At the full build out time frame, the largest drawdown area encompasses the southern portion of Lake Valley and northern Patterson Valley. Other smaller drawdown cones are localized in the near vicinity of pumping centers.

At the full build out plus 75 years time frame, there are 3 major drawdown areas. The largest drawdown area extends in a north-south direction from Lake Valley south to the northern margin of Meadow Valley Wash, a distance of approximately 70 miles. The two other major drawdown areas occur in the northern portion of White River Valley, and along the southern margin of the model area in the Black Mountain Area and Las Vegas Valley hydrographic basins.

At the full build out plus 200 years time frame, the drawdown area that extends from the Lake Valley to Lower Meadow Valley Wash hydrographic basins is up to 85 miles long (north-south). The drawdown areas in White River Valley and along the southern margin of the model area also are predicted to continue to expand between the time frames associated with full build out plus 75 years and full build out plus 200 years.

Water-level hydrographs for each of these observation wells within the pumping basins provided in **Figures 3.3.2-7** and **3.3.2-8** show the predicted rate and magnitude of water level decline at these representative locations over the simulation period. The hydrographs indicate that water levels are relatively steady or exhibit minor drawdown (less than 10 feet) in all of the pumping basins over the model simulation period compared to the other groundwater development alternatives.

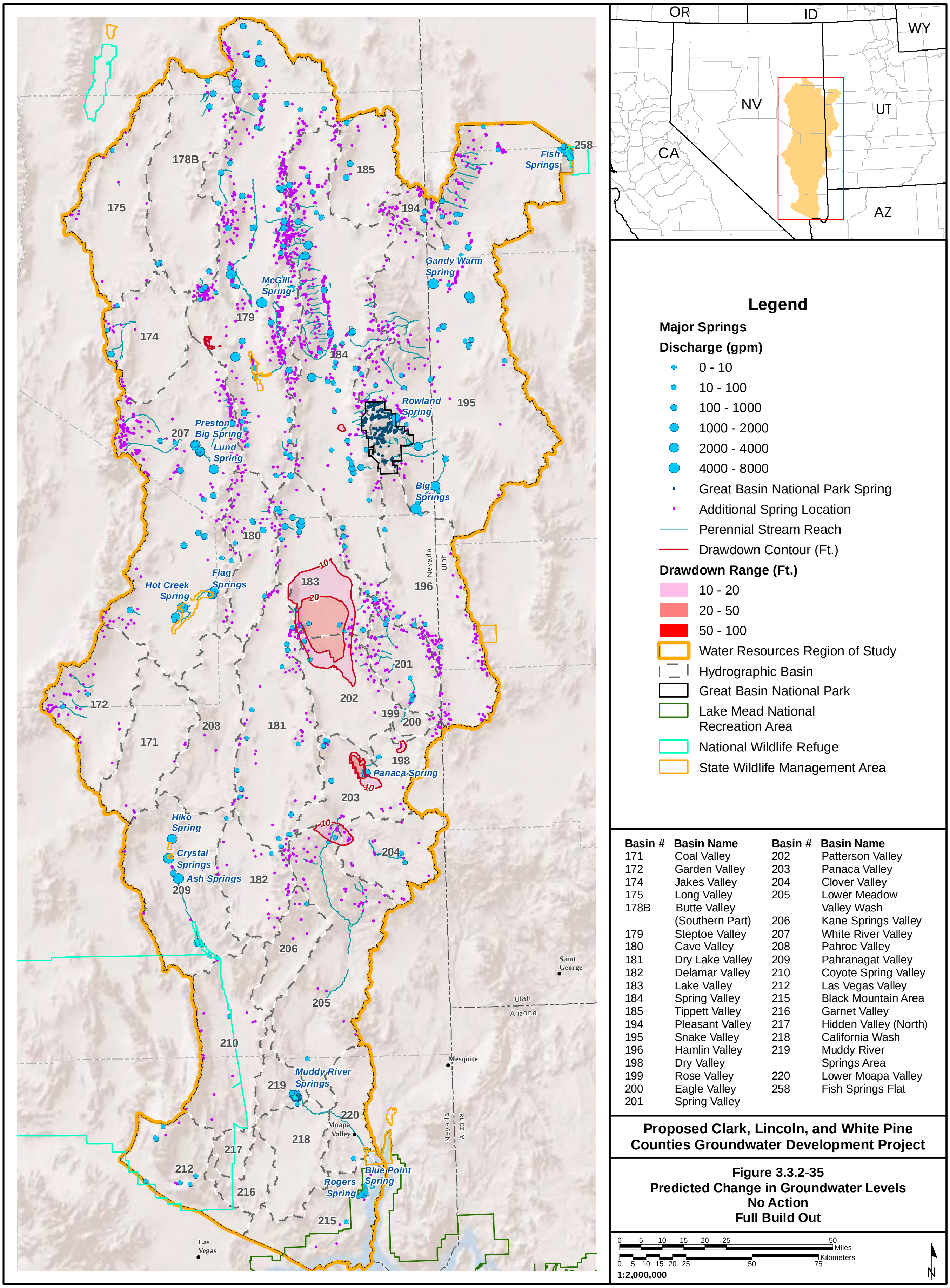
The potential for groundwater withdrawal to reduce the storage properties of the basin-fill sediments within the drawdown cone are the same as previously discussed for the Proposed Action (Section 3.3.2.9).

Potential effects to water resources resulting from the No Action pumping scenario are summarized in **Table 3.3.2-23**.

Impacts to Springs and Streams

The estimated potential risks to springs located within the projected drawdown area at the full build out, full build out plus 75 years, and full build out plus 200 years time frames are presented in **Figures F3.3.8A-22**, **F3.3.8A-23**, and **F3.3.8A-24** (**Appendix F3.3.8**), respectively. The springs within the drawdown area and relative risk of impacts by hydrographic basin is summarized in **Table F3.3.9-8A** (**Appendix F3.3.9**). The estimated miles of perennial streams (by hydrographic basin) located in the predicted drawdown areas where surface waters could be impacted are listed in **Table F3.3.11-8A** in **Appendix F3.3.11**.

[2] The term "full build out time frame" refers to representative points in time in the future that were selected for comparison of potential effects associated with each of the alternatives. The full build out time frame corresponds to full build out of the groundwater development project as defined for Proposed Action.



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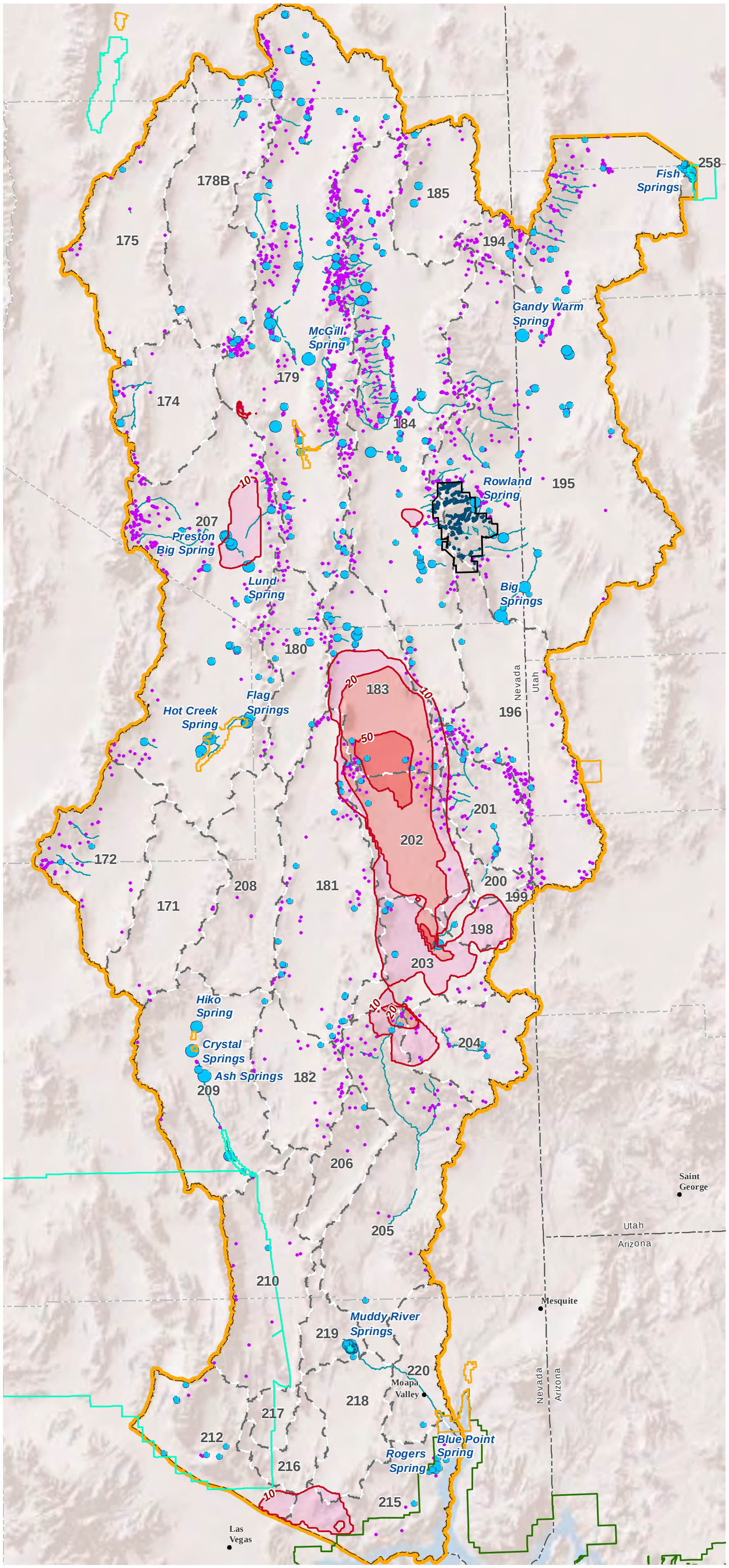
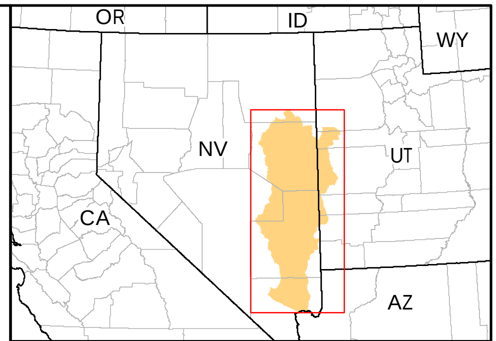
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-35
Predicted Change in Groundwater Levels
No Action
Full Build Out





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
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199	Rose Valley	220	Lower Moapa Valley
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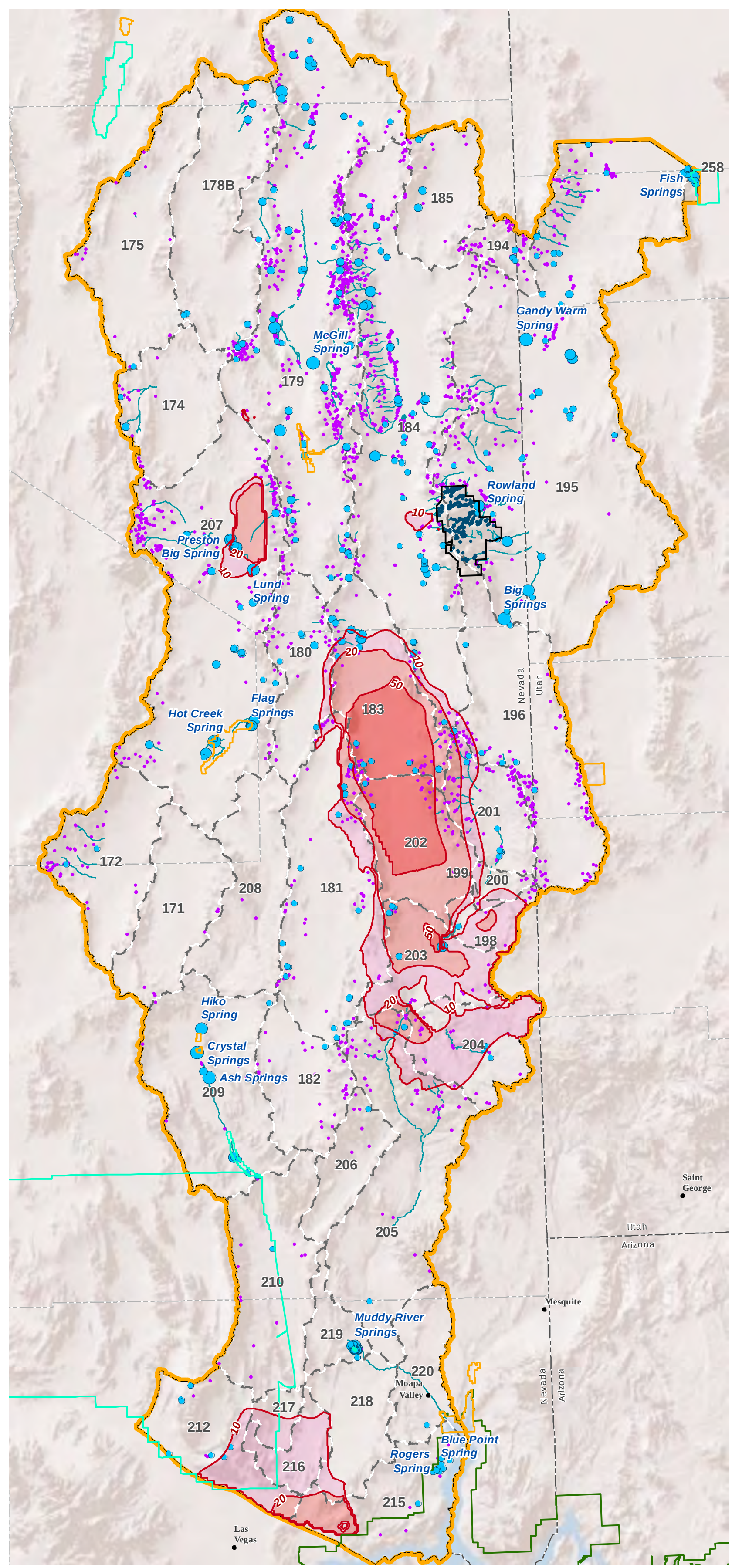
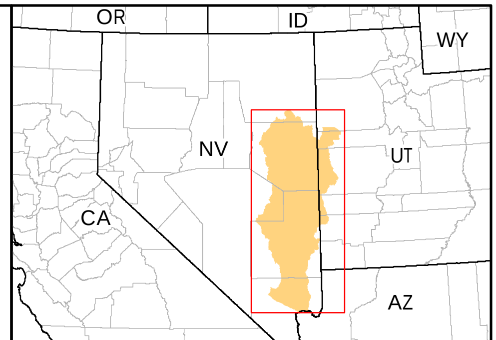
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-36
Predicted Change in Groundwater Levels
No Action
+ 75 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 50 - 100
- 20 - 50
- 10 - 20
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-37
Predicted Change in Groundwater Levels
No Action
+ 200 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

Table 3.3.2-23 Summary of Potential Effects to Water Resources Resulting from the No Action Pumping Scenario[1,2]

Water Resource Issue / Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Drawdown:			
• Number of hydrographic basins affected by drawdown	10	18	20
Drawdown effects on perennial springs:			
• Number of inventoried springs located in areas where impacts to flow could occur[3]	6	12	20
• Number of other springs located in areas where impacts to flow could occur[4]	22	34	66
• Model-simulated flow reduction at Big Spring (as percent flow reduction)	9%	13%	16%
Drawdown effects on perennial streams:			
• Number of basins with perennial stream reaches where impacts to flow could occur	3	6	7
• Miles of perennial stream located in areas where impacts to flow could occur	7	19	52
Drawdown effects on surface water rights:			
• Number of surface water rights located in areas where impacts to flow could occur	58	105	164
Drawdown effects on groundwater rights:			
• Number of groundwater rights located within the 10-50 foot drawdown area	174	281	293
• Number of groundwater rights located within the 50-100 foot drawdown area	1	91	116
• Number of groundwater rights located within the greater than 100-foot drawdown area	0	0	0
• (Total groundwater rights in drawdown area)	(175)	(372)	(409)
Percent reduction in ET and spring discharge[5]:			
• Spring Valley	5%	7%	7%
• Snake Valley	2%	3%	3%
• Great Salt Lake Desert Flow System[1]	3%	5%	5%
• White River Flow System	2%	3%	4%
Reduction in flow from Snake Valley to Pine, Wah Wah, and Tule Valleys Hydrographic Basins[5]:			
• AFY	0	0	0
• Percent Reduction	0%	0%	0%

[1] Located within the groundwater flow model domain.

[2] Unless otherwise noted, supporting information used to develop these estimated effects are provided in **Appendices F3.3.5** through **F3.3.16**.

[3] Specific inventoried springs identified in moderate or high risk areas are identified in **Table F3.3.10-1A** in **Appendix F3.3.10**.

[4] "Other Springs" are springs identified in the National Hydrography Database or topographic maps that have not been field verified.

[5] Estimate derived from the model-simulated values provided in SNWA 2010a with comparison to simulated 2004 conditions.

For the predicted drawdown area at full build out plus 75 years, there are 12 inventoried springs and 34 “other” springs located within the high and moderate risk areas. By full build out plus 200 years, this increased to 20 inventoried springs and 66 “other” springs located within the high and moderate risk areas. These springs occur in White River, Spring (HA 184), Lake, Spring (HA 201), Panaca, and Clover valleys, Lower Meadow Valley Wash, and Las Vegas Valley.

The total estimated length of perennial streams located in areas where there is a high to moderate risk of impacts resulting from the predicted drawdown increases from approximately 19 miles at full build out plus 75 years to 52 miles at full build out plus 200 years time frame. This includes stream reaches located in White River, Spring (HA 184), Lake, Spring (HA 201), Patterson, Eagle, Dry, Panaca, Clover valleys, and Lower Meadow Valley Wash.

Potential site-specific impacts to individual springs and streams affected by drawdown would be the same as discussed for the Proposed Action.

Model-simulated Spring and Stream Discharge Estimates. Model-simulated changes in spring flow for selected springs are presented in **Table 3.3.2-24**. Spring discharges simulated at 11 springs within White River Valley were used for this evaluation. At the full build out plus 75 years and full build out plus 200 year time frame, there are 4 springs (Arnoldson Spring, Cold Spring, Nicholas Spring, and Preston Big Spring in White River Valley) with a predicted reduction of 5 percent or greater. For these springs, the model simulations indicate flow reductions of less than 10 percent for all three time periods.

The model results also indicate that the continuation of existing pumping simulated under the No Action is not predicted to result in a measurable flow reduction (i.e., greater than 5 percent) in discharge at regional springs in Pahranagat Valley within the White River Flow System. However, the existing pumping in the Muddy River Springs Area, Lower Meadow Valley Wash, and Lower Moapa Valley hydrographic basins is predicted to result in a progressive reduction of flow over time in the Muddy River. At the full build out plus 200 years time frame, the flows in the Muddy River are predicted to be reduced by 9 percent at Moapa, 10 percent near Glendale, and 60 percent at Overton. (Note that the numerical model simulations do not account for the existing Muddy River Memorandum of Agreement regarding groundwater withdrawal in Coyote Spring Valley and California Wash basins, among the SNWA, Moapa Valley Water District, Coyote Spring Investment, Moapa Band of Paiutes, and USFWS, which includes minimum in-stream flow levels. The groundwater model could not address these minimum in-stream flow requirements, thus they are not reflected in the simulation results. Based on the agreement, potential flow reductions under the No Action pumping scenario are anticipated to be less than those simulated by the model.)

In the Great Salt Lake Desert Flow System, the model simulations results indicate that the No Action pumping would not impact flows at Keegan, North Millick, and South Millick springs in Spring Valley. In Snake Valley, Big Springs is predicted to experience flow reductions of 13 and 16 percent at the full build out plus 75 years and full build out plus 200 years time frame, respectively. As with the Proposed Action, the No Action is not predicted to reduce flows in the 4 other simulated springs located in the central portion of Snake Valley (Foote Reservoir Spring, Kell Spring, and Warm Creek near Gandy).

Water Resources Within or Adjacent to the GBNP. Surface water resources located within or adjacent to Great Basin National Park that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). The simulation results indicate there are no water resources identified in the moderate risk zone at the full build out plus 75 years time frame or the full build out plus 200 years time frame. These results indicate that a continuation of existing pumping under the No Action alternative presents the least amount of risk to water resources (associated with the simulated drawdown) within or adjacent to GBNP when compared to similar results related to the Proposed Action and all other pumping alternatives evaluated under this EIS.

Utah Surface Water Resources. The predicted small reduction in flow at Big Springs under the No Action would result in small reductions in flow to Big Springs Creek, Lake Creek, and into Pruess Lake. However, the No Action model simulations suggest that potential flow reductions at Big Springs (and downstream in Lake Creek) would be considerably less than under all other pumping alternatives. The model simulations also indicate that, like

Table 3.3.2-24 Model-simulated Flow Changes (No Action Pumping)

(Project Specific)					No Action		
					Incremental Change in Flow % (from Current Conditions)		
Flow System	Hydrographic Basin	Spring	Average Flow (Actual) in gpm	Model-simulated Average Flow (2005) in gpm	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
White River	White River Valley (207)	Arnoldson Spring	1,608	946	-4	-6	-8
White River	White River Valley (207)	Butterfield Spring	1,225	471	0	-1	-3
White River	White River Valley (207)	Cold Spring	582	503	-3	-6	-8
White River	White River Valley (207)	Flag Springs 3	969	560	0	-1	-3
White River	White River Valley (207)	Hardy Springs	200	73	-1	-2	-2
White River	White River Valley (207)	Hot Creek Spring	5,032	6,899	0	-1	-1
White River	White River Valley (207)	Lund Spring	3,594	3,314	0	0	-1
White River	White River Valley (207)	Moon River Spring	1,707	1,457	0	0	0
White River	White River Valley (207)	Moorman Spring	405	353	0	-1	-1
White River	White River Valley (207)	Nicolas Spring	1,185	872	-5	-7	-9
White River	White River Valley (207)	Preston Big Spring	3,572	3,794	-2	-5	-7
White River	Pahranagat Valley (209)	Ash Springs	6,909	7,453	0	-1	-1
White River	Pahranagat Valley (209)	Brownie Spring	224	277	0	0	0
White River	Pahranagat Valley (209)	Crystal Springs	4,235	4,647	-1	-1	-2
White River	Pahranagat Valley (209)	Hiko Spring	2,735	1,985	-1	-2	-3
White River	Muddy River Springs Area (219)	Muddy River near Moapa[1]	20,931	15,383	-4	-6	-9
White River	Lower Moapa Valley (220)	Muddy River near Glendale[1]	19,565	14,895	-5	-7	-10
White River	Black Mountains Area (215)	Blue Point Spring	223	393	0	-1	-2
White River	Black Mountains Area (215)	Rogers Spring	771	515	0	-1	-2
Goshute Valley	Steptoe Valley (179)	Campbel Ranch Springs	2,746	2,088	0	0	-1
Goshute Valley	Steptoe Valley (179)	Currie Spring	2,181	1,419	0	-1	-1
Goshute Valley	Steptoe Valley (179)	McGill Spring	4,783	2,074	0	0	0
Goshute Valley	Steptoe Valley (179)	Monte Neva Hot Springs	649	280	0	-1	-1
Great Salt Lake Desert	Spring Valley (184)	Keegan Spring	234	63	-2	-2	-2
Great Salt Lake Desert	Spring Valley (184)	North Millick Spring	284	98	0	0	0
Great Salt Lake Desert	Spring Valley (184)	South Millick Spring	506	278	-1	-1	-1
Great Salt Lake Desert	Snake Valley (195)	Big Springs	4,289	1,977	-9	-13	-16
Great Salt Lake Desert	Snake Valley (195)	Foote Res. Spring	1,300	211	0	0	0
Great Salt Lake Desert	Snake Valley (195)	Kell Spring	120	59	0	0	0
Great Salt Lake Desert	Snake Valley (195)	Warm Creek near Gandy, Utah	7,426	2,697	0	0	0
Meadow Valley	Panaca Valley (203)	Panaca Spring	1,455	1,208	-2	-5	-7

[1] Simulated using Stream Flow Routing 2 package for MODFLOW.

Source: SNWA 2010b.

Alternative E, drawdown is not expected to extend to the boundary of Snake and Pine valleys. As a result, it is not anticipated that surface water or groundwater resources would be impacted in Pine Valley as a result of a continuation of existing pumping under the No Action.

Impacts to Surface Water Rights

The locations and manner of use of the active surface water rights within the simulated drawdown area for the No Action at the full build out, full build out plus 75 years time frame, and full build out plus 200 years time frame are presented in **Figures F3.3.12A-22**, **F3.3.12A-23**, and **F3.3.12A-24**, respectively, in **Appendix F3.3.12**. **Table F3.3.13-7A** in **Appendix F3.3.7** lists the number of active surface water rights within the drawdown area that occur within the high-, moderate-, and low-risk areas at the three representative time frames. At full build out plus 75 years, there are a total of 105 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. By the full build out plus 200 years time frame, there are 164 surface water rights located in areas where there is a moderate to high risk of impacts to surface flows. For surface water rights that are dependent on groundwater discharge, a potential reduction in the water table at the point of diversion could reduce or eliminate the flow available at the point of diversion for the surface water right.

Impacts to Groundwater Rights

Figures F3.3.14A-22, **F3.3.14A-23**, and **F3.3.14A-24** in **Appendix F3.3.14** illustrate the location and manner of use of existing groundwater rights in relation to the magnitude of the model-simulated drawdown at full build out, full build out plus 75 years, and full build out plus 200 years. **Table F3.3.15-8A** (**Appendix F3.3.15**) lists the groundwater rights by hydrographic basin within the drawdown area. At full build out plus 75 years, there are 372 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. At full build out plus 200 years, the number increases to 409 groundwater rights located within areas that are predicted to experience a reduction in groundwater levels of at least 10 feet. The potential impacts to individual wells are the same as discussed under the Proposed Action.

Impacts to Water Balance

The model-simulated groundwater budget for the No Action pumping scenario is presented in **Appendix F3.3.16**, **Table F3.3.16-8B**. Compared to the simulated conditions in 2005 for Spring Valley, the No Action pumping is estimated to result in a 7 percent reduction of groundwater discharge for ET at the full build out plus 75 years and full build out plus 200 years time frames. In Snake Valley, the pumping is estimated to result in minimal reductions (less than 4 percent) of groundwater discharge to support ET. The pumping is estimated to result in a 3 to 4 percent reduction in groundwater discharge ET and springs within the White River Flow System. Reductions of flow to Pine, Wah Wah, and Tule valleys and Fish Springs are not predicted.

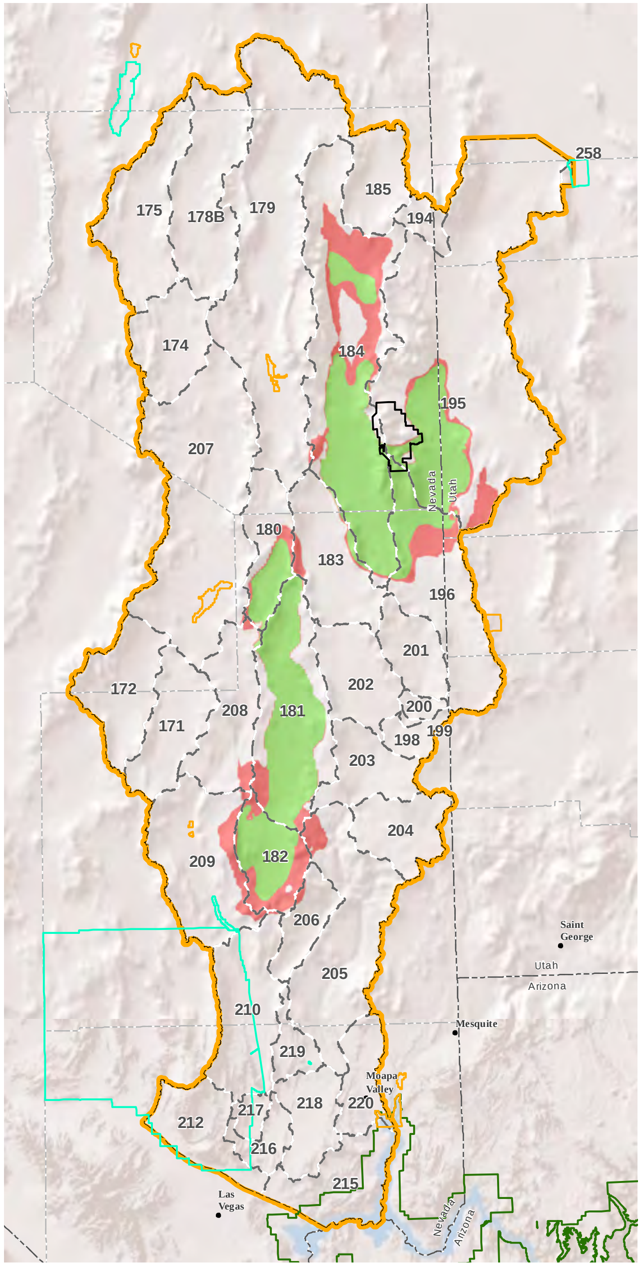
3.3.2.17 Summary and Comparison of Alternative Pumping Scenarios

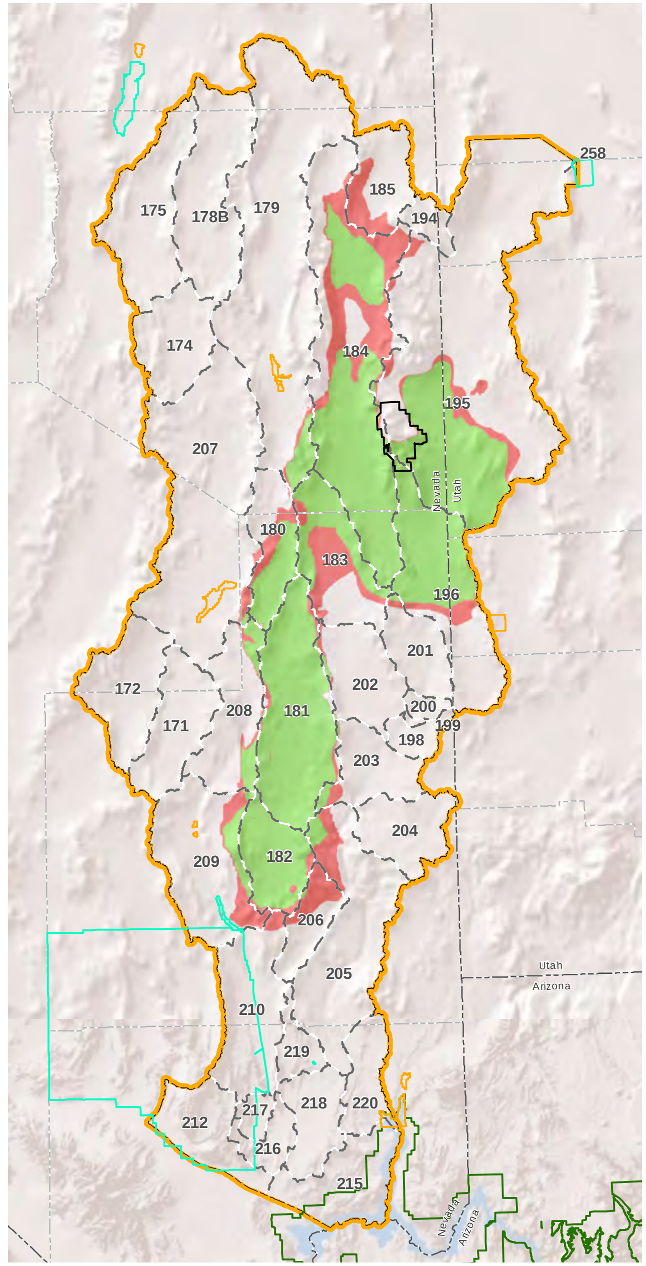
Impacts to Water Levels

The drawdown areas predicted for the Proposed Action at the full build out plus 75 years and full build out plus 200 years time frame are compared to the drawdown areas for the various alternative pumping scenarios in **Figures 3.3.2-38** to **3.3.2-44**. All of the project pumping scenarios (Proposed Action and Alternatives A through F) simulation results indicate that the drawdown area continues to progressively expand as pumping continues into the future. The alternatives with the highest groundwater withdrawal volumes (Proposed Action and Alternative B) show the largest drawdown effects; and the alternatives with the lower groundwater withdrawal volume (Alternatives C, D, and E) show the smallest drawdown effects.

The groundwater pumping scenario for the Proposed Action assumes pumping at the full quantities (i.e., approximately 177,000 afy) listed on the pending water rights application for the five proposed project pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys). The well distribution developed by the SNWA for this model scenario distributes the simulated production wells spatially within the groundwater development areas in an effort to minimize pumping effects to surface water resources. For the Proposed Action pumping scenario, at full build out plus 75 years time frame, there are two distinct drawdown areas (**Figure 3.3.2-38**). The northern drawdown area encompasses most of valley floor in Spring Valley, southern Snake Valley, and northern Hamlin Valley. The southern drawdown area extends across the Delamar, Dry Lake, and Cave valleys in an elongate north-south direction and extends into the

Full Build Out + 75 Years	Full Build Out + 200 Years





Legend

10 Ft. Drawdown Polygon

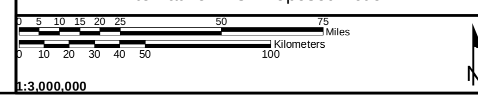
- Proposed Action
- Area Common to Proposed Action and Alternative A
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

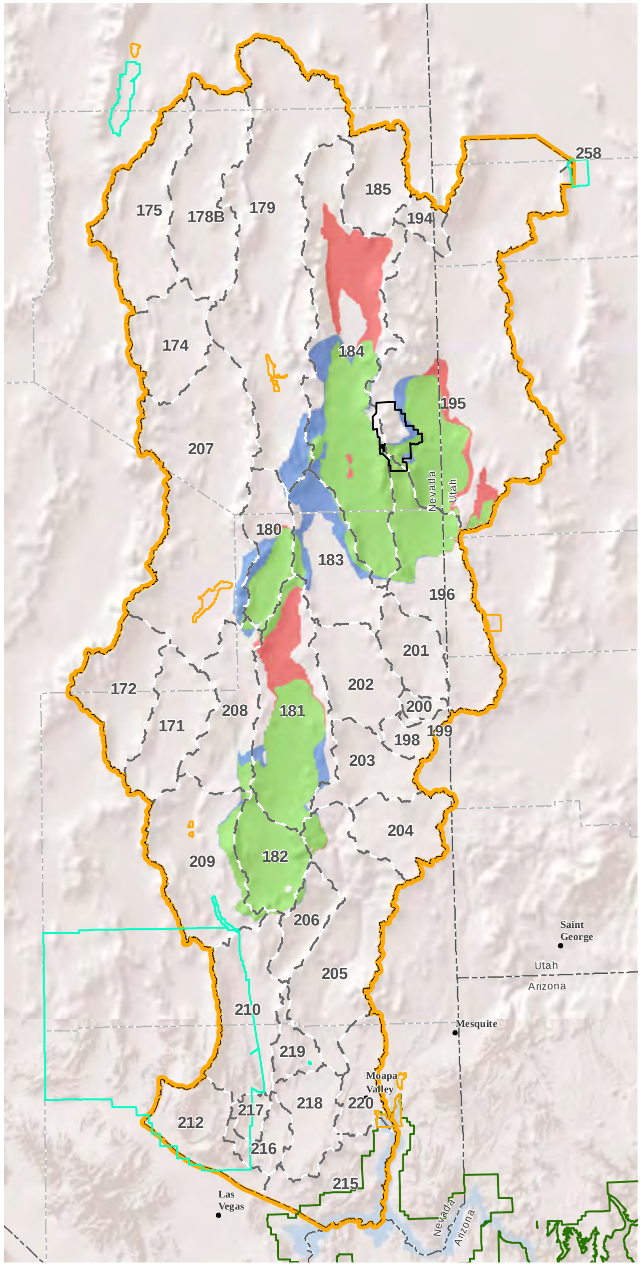
Figure 3.3.2-38

Drawdown Area Comparison
Alternative A vs. Proposed Action

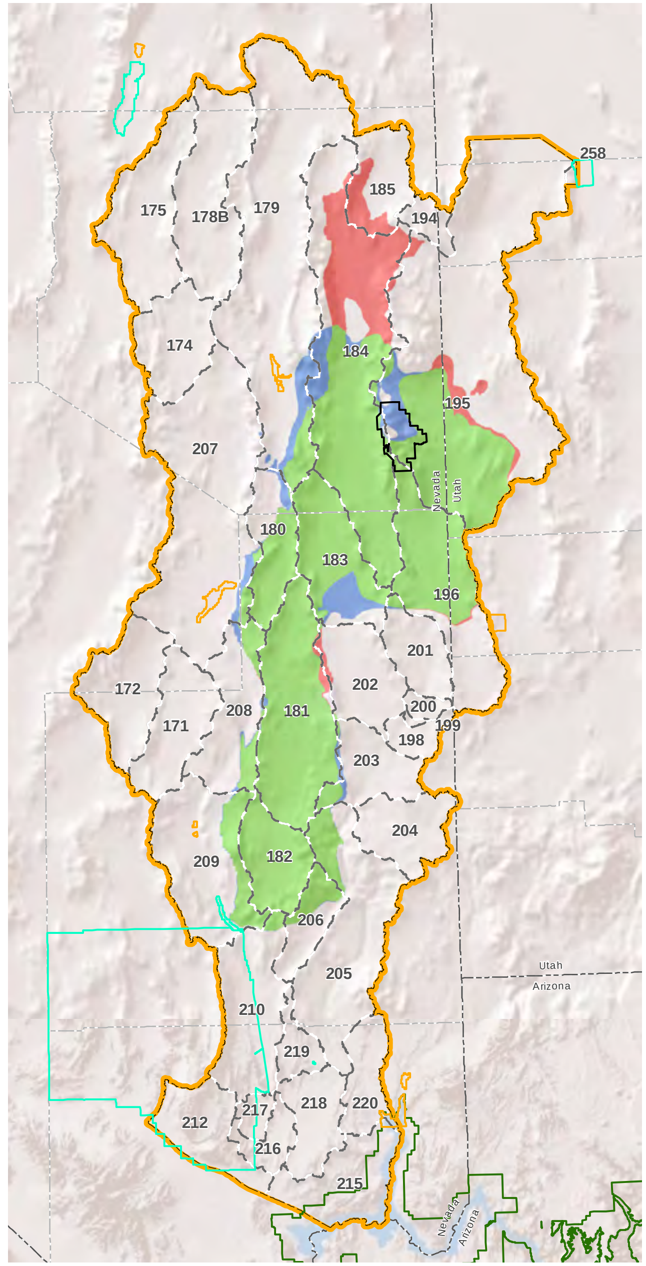


No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Full Build Out + 75 Years



Full Build Out + 200 Years



Legend

10 Ft. Drawdown Polygon

- Proposed Action
- Alternative B Only
- Area Common to Proposed Action and Alternative B
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-39

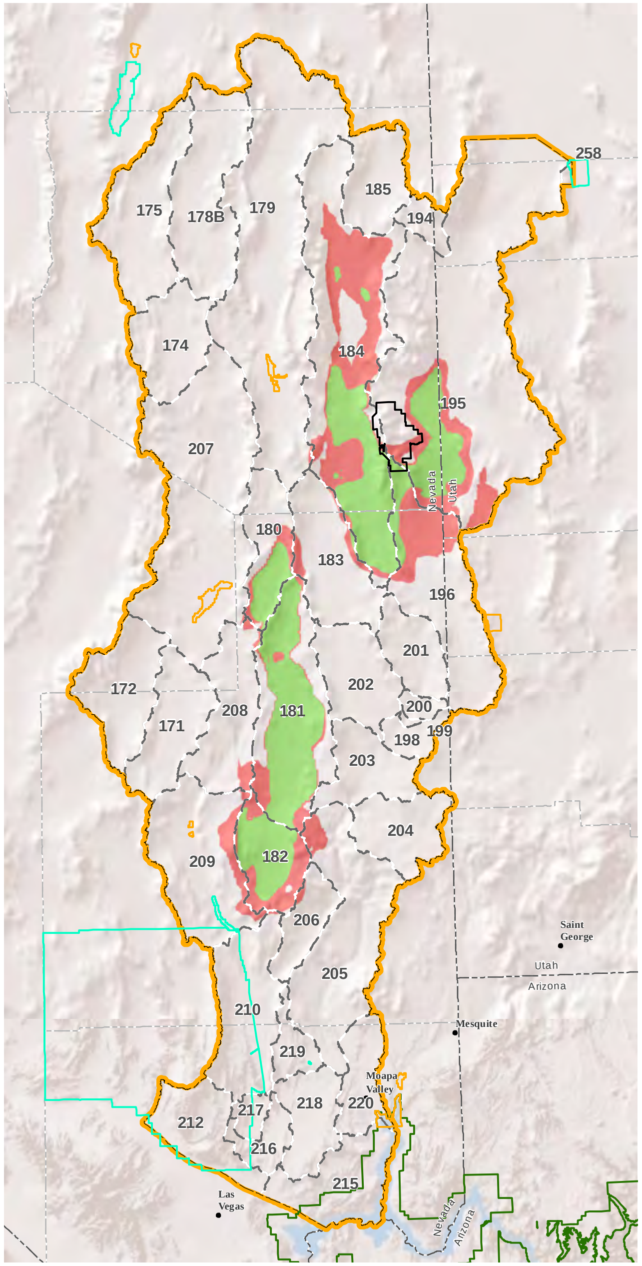
Drawdown Area Comparison
Alternative B vs. Proposed Action

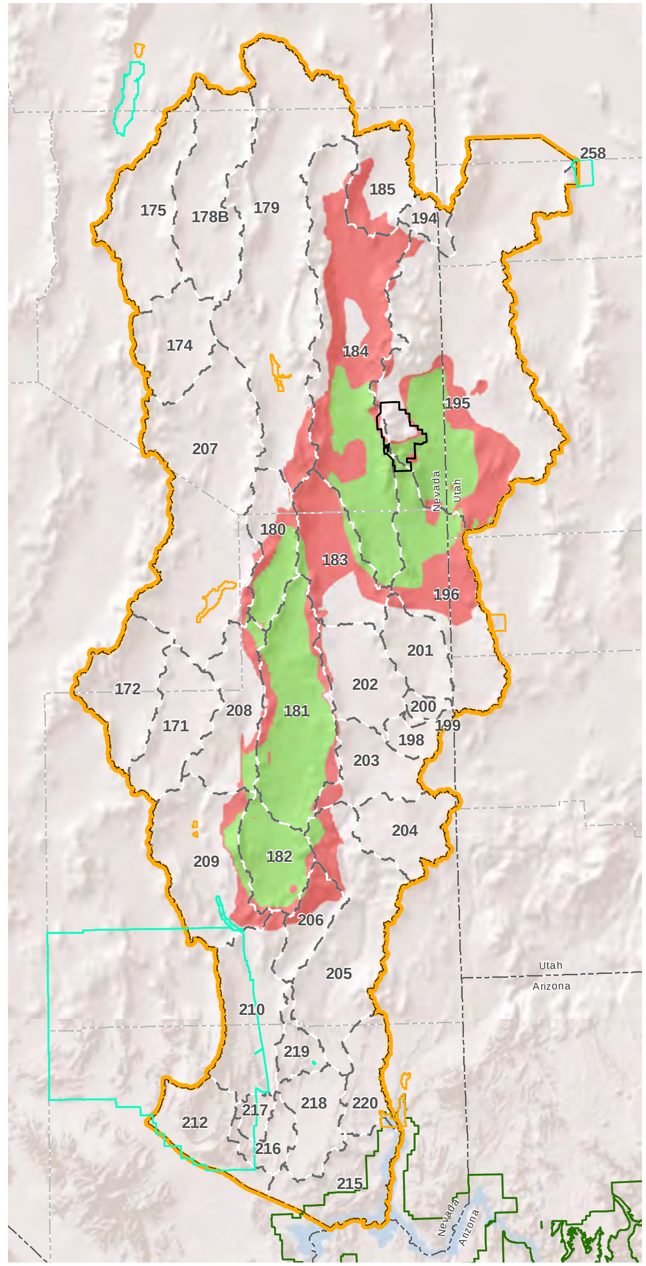
0 5 10 15 20 25 50 75 Miles
0 10 20 30 40 50 100 Kilometers
1:3,000,000

N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Full Build Out + 75 Years	Full Build Out + 200 Years





Legend

10 Ft. Drawdown Polygon

- Proposed Action
- Area Common to Proposed Action and Alternative C
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

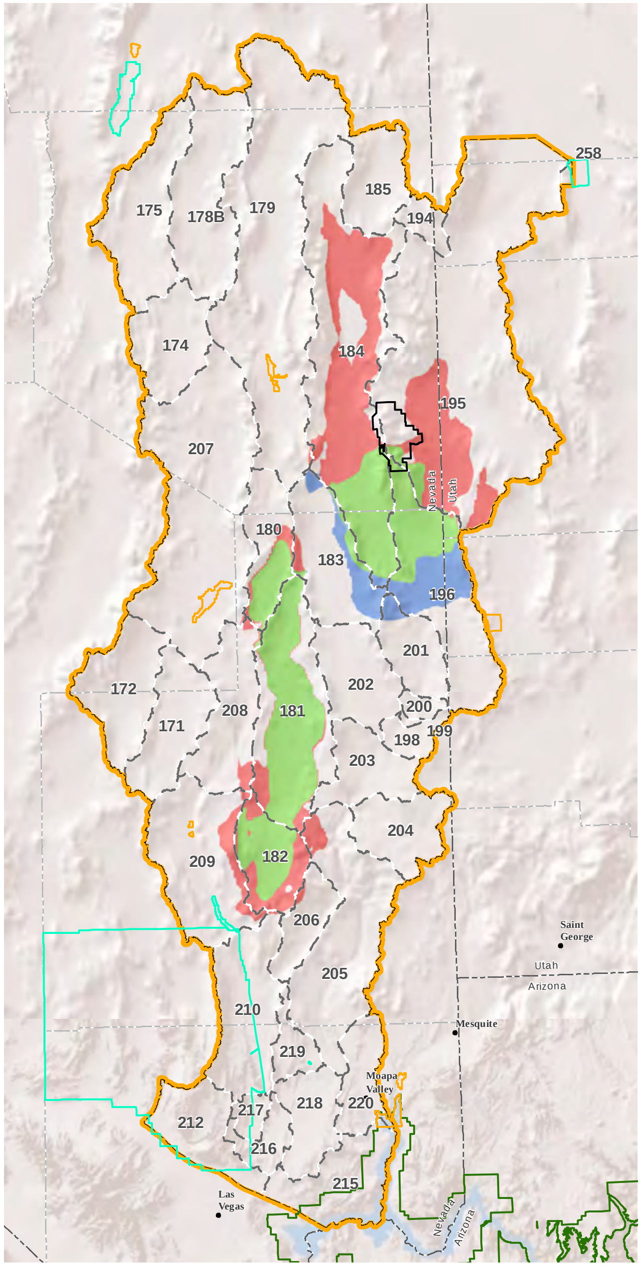
Figure 3.3.2-40

Drawdown Area Comparison
Alternative C vs. Proposed Action

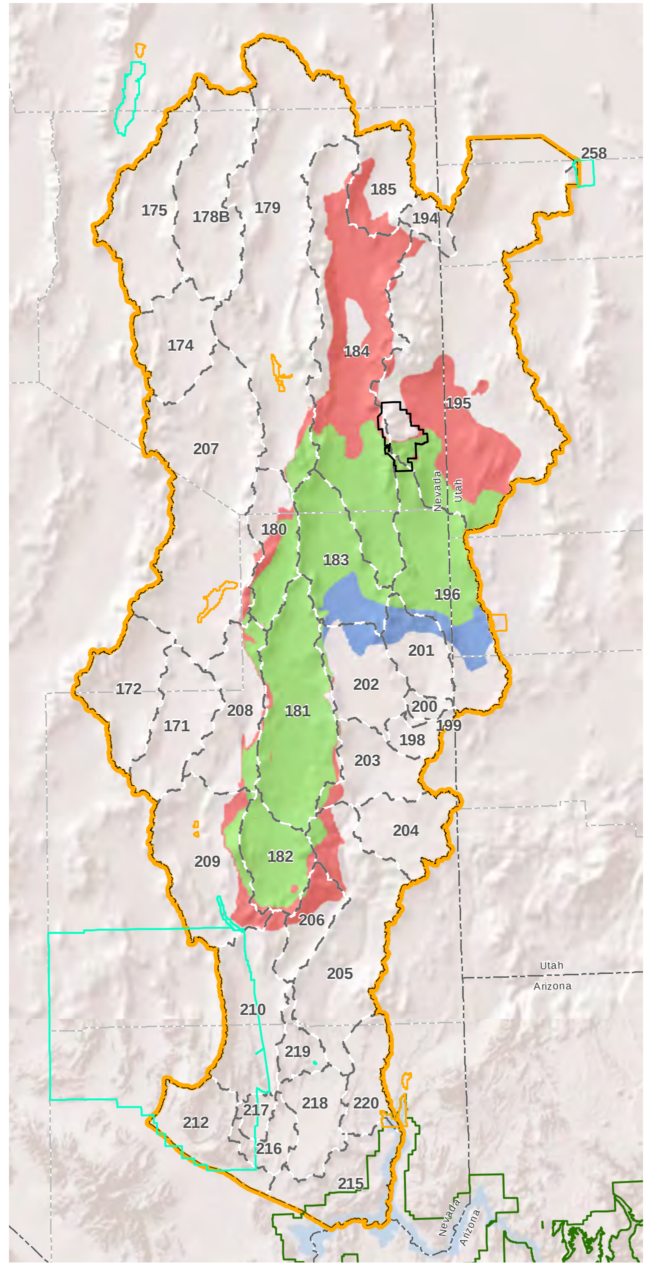
0 5 10 15 20 25 50 75 Miles
0 10 20 30 40 50 100 Kilometers
1:3,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Full Build Out + 75 Years



Full Build Out + 200 Years



Legend

10 Ft. Drawdown Polygon

- Proposed Action
- Alternative D Only
- Area Common to Proposed Action and Alternative D
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-41

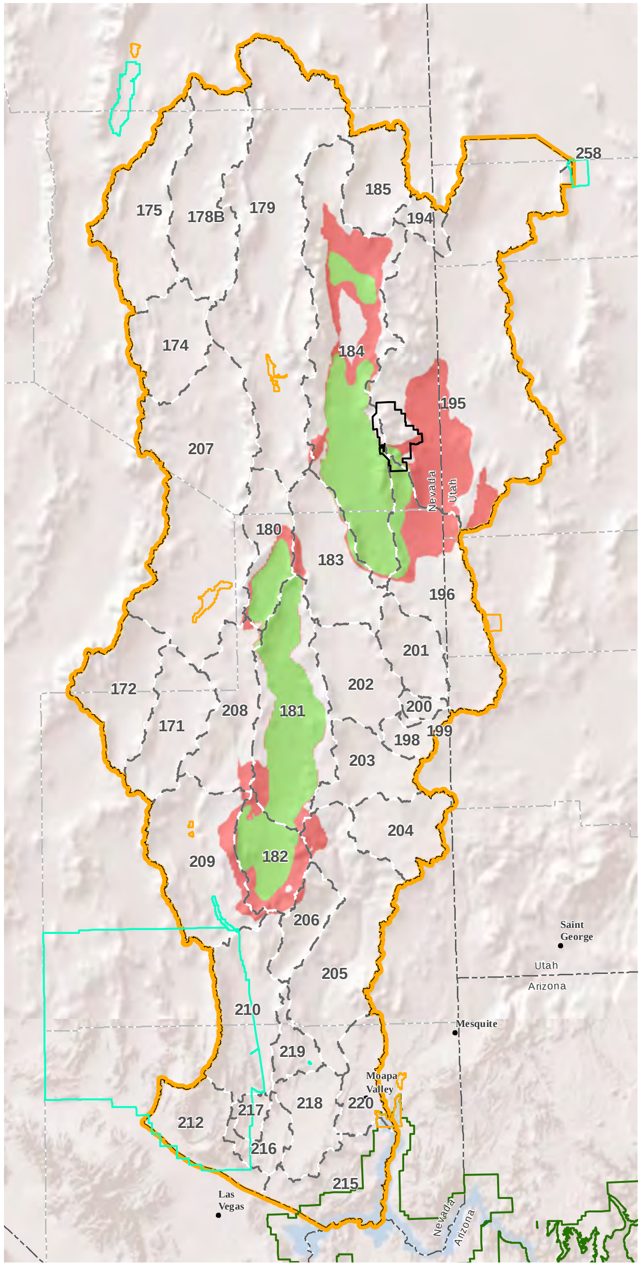
Drawdown Area Comparison
Alternative D vs. Proposed Action

0 5 10 15 20 25 50 75 Miles
0 10 20 30 40 50 100 Kilometers

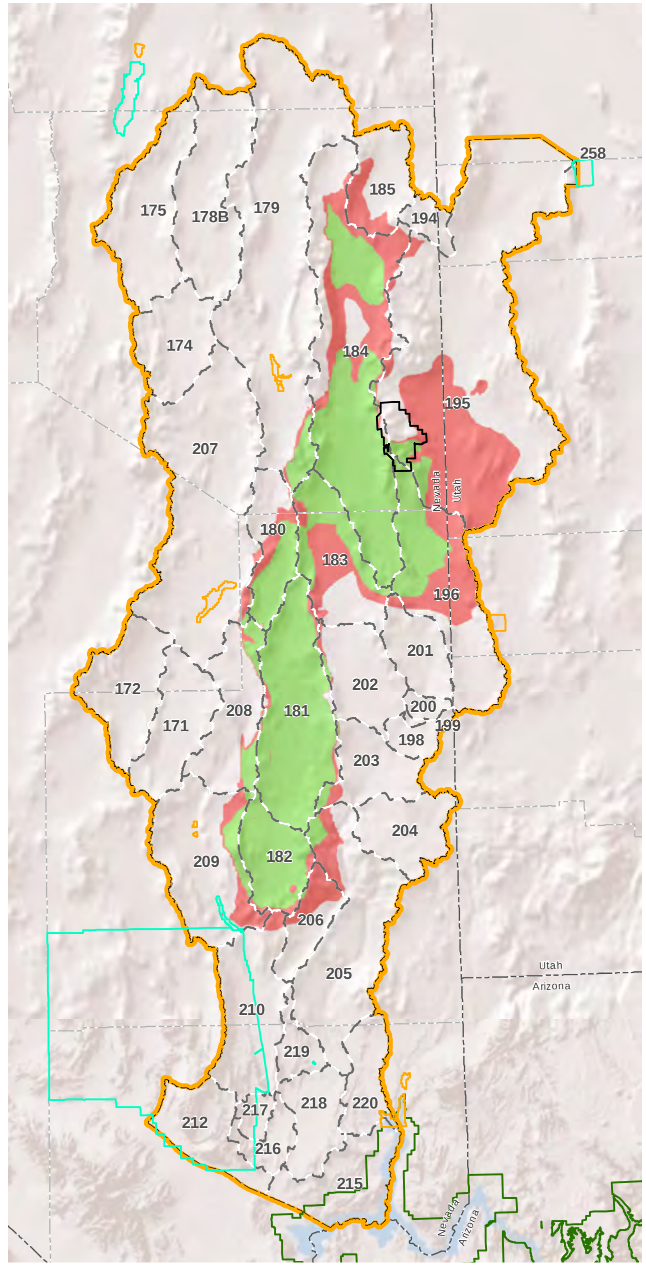
1:3,000,000

N

Full Build Out + 75 Years



Full Build Out + 200 Years



Legend

10 Ft. Drawdown Polygon

- Proposed Action
- Area Common to Proposed Action and Alternative E
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
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184	Spring Valley	215	Black Mountain Area
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194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-42

Drawdown Area Comparison
Alternative E vs. Proposed Action

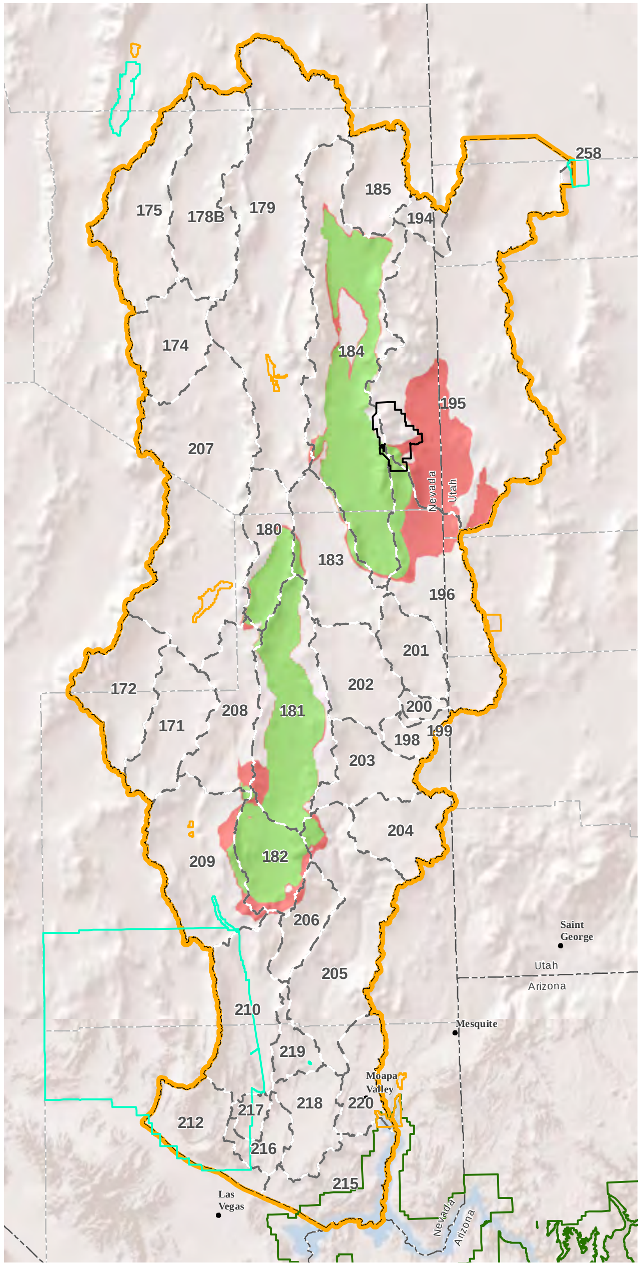
0 5 10 15 20 25 50 75 Miles
0 10 20 30 40 50 100 Kilometers

1:3,000,000

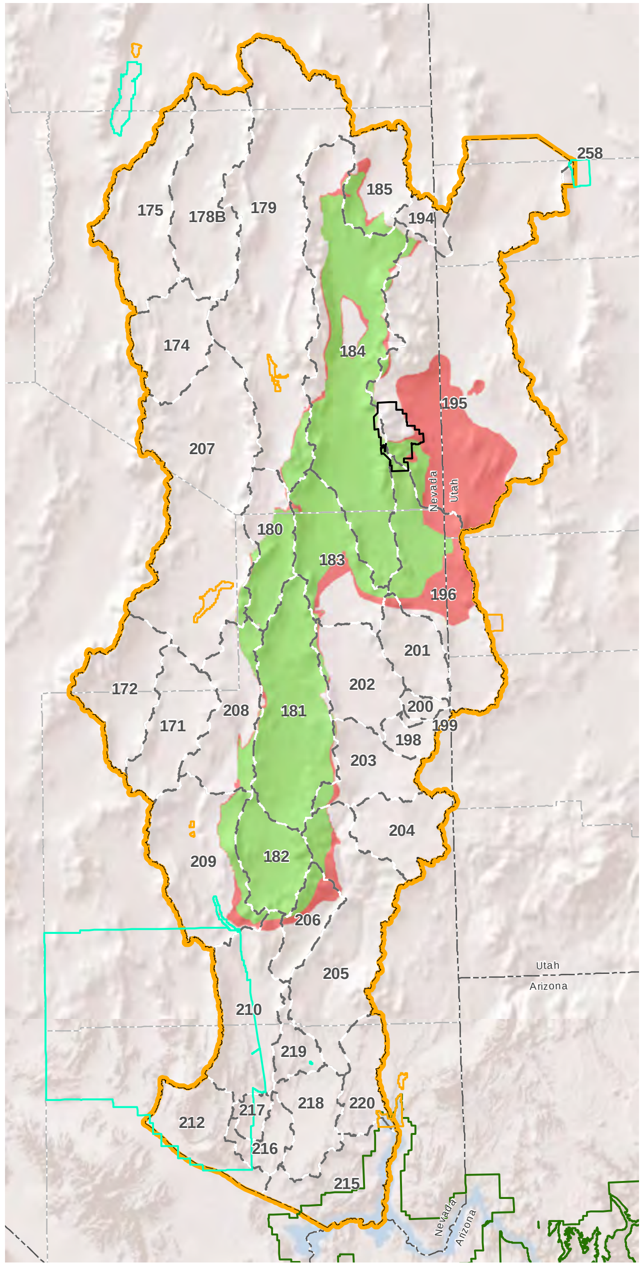
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Full Build Out + 75 Years



Full Build Out + 200 Years



Legend

10 Ft. Drawdown Polygon

- Proposed Action
- Area Common to Proposed Action and Alternative F
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

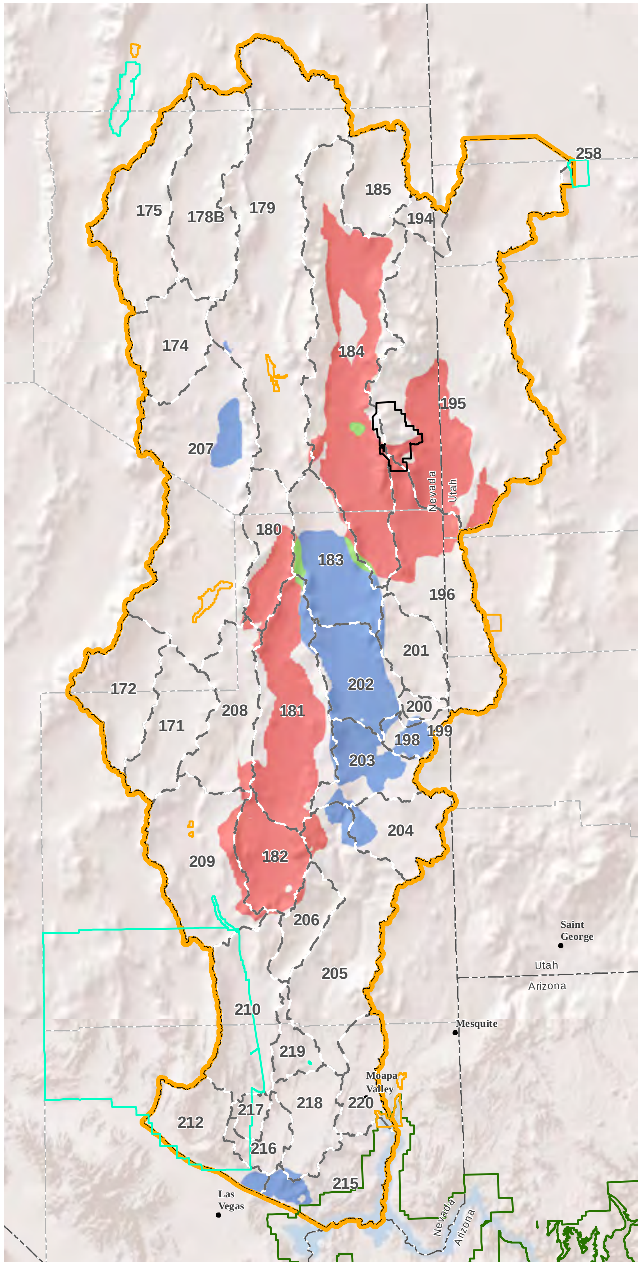
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-43

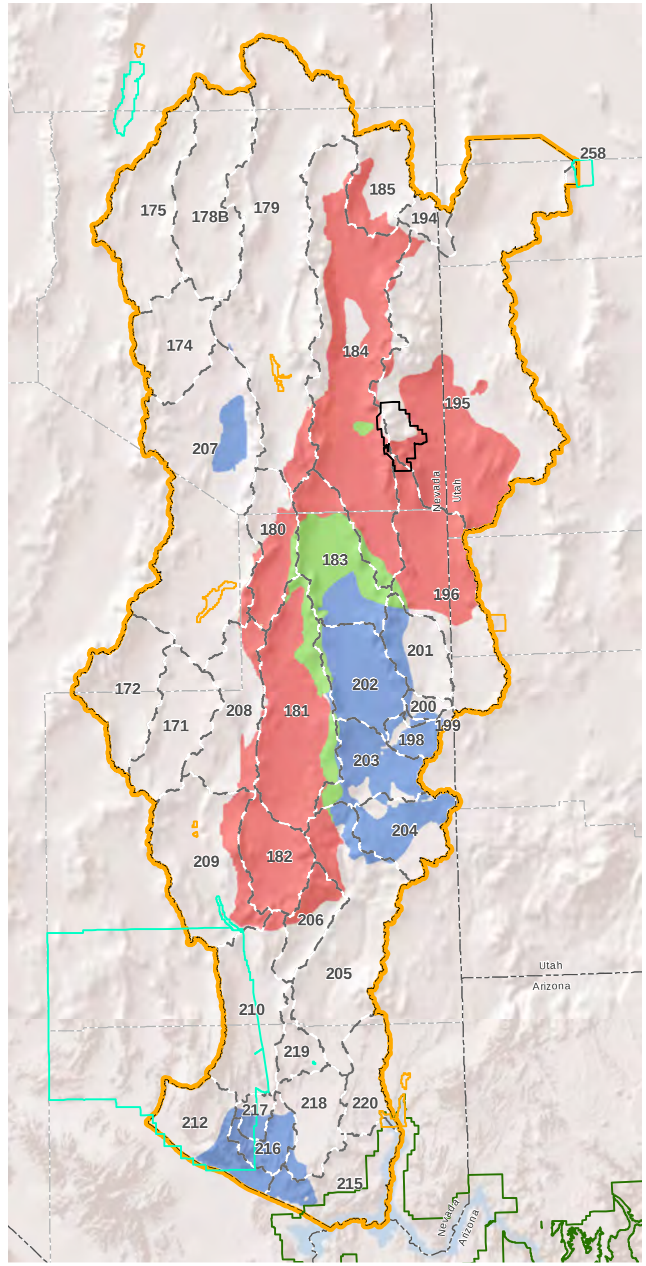
Drawdown Area Comparison
Alternative F vs. Proposed Action

0 5 10 15 20 25 50 75 Miles
0 10 20 30 40 50 100 Kilometers
1:3,000,000
N

Full Build Out + 75 Years



Full Build Out + 200 Years



Legend

10 Ft. Drawdown Polygon

- Proposed Action
- No Action Only
- Area Common to Proposed Action and No Action
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.2-44

Drawdown Area Comparison
No Action vs. Proposed Action

0 5 10 15 20 25 50 75 Miles
0 10 20 30 40 50 100 Kilometers
1:3,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

eastern margin of Pahranagat Valley and northwestern margin of Lower Meadow Valley Wash. By the full build out plus 200 years time frame, the two drawdown areas merge. At this time frame, the simulated drawdown area extends into Tippetts Valley, southeastern Steptoe Valley, and the eastern margins of Pahroc and Pahranagat valleys, and the western margins of Panaca Valley and Lower Meadow Valley Wash.

The groundwater pumping scenario for Alternative A assumes pumping at reduced quantities (approximately 115,000 afy) from those listed on the pending water rights application for the five proposed project pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys). The well distribution developed by the SNWA for this model scenario distributes the simulated production wells spatially within the groundwater development areas in an effort to minimize pumping effects. Compared to the Proposed Action, the reduced pumping under Alternative A would reduce the drawdown area (**Figure 3.3.2-38**) particularly in northern Spring Valley, northern Lake Valley, and along the southern margin of the drawdown area.

The Alternative B pumping scenario assumes pumping at the full diversion rates (i.e., approximately 177,000 afy) listed on the pending water rights application for the five proposed project pumping basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys) and that wells would be developed at the actual points of diversion listed on the water rights applications. Compared to the Proposed Action, the Alternative B pumping scenario would expand the area of drawdown along the southeast margin of Steptoe Valley, and in the Southern Snake Range between Spring and Snake valleys, and in southern Lake Valley (**Figure 3.3.2-39**). The drawdown area for Alternative B also does not extend into northern Spring Valley (HA 184) or Tippett Valley.

The Alternative C pumping scenario assumes the same groundwater production wells defined for Alternative A and that instead of pumping at a sustained rate (as in Alternative A) after full build out, the pumping rates would cycle from minimum (9,000 afy) to maximum (115,000 afy) pumping rates every 5 years after full build out. The maximum pumping rate under this scenario is the same as for Alternative A (approximately 115,000 afy). The model simulations indicate that the reduction in groundwater withdrawal under Alternative C would further reduce the drawdown area as shown on **Figure 3.3.2-40**.

The groundwater pumping scenario for Alternative D assumes that no pumping would occur in Snake Valley, and pumping in Spring Valley would be restricted to the southern portion of the valley within Lincoln County. The maximum groundwater production rate under this scenario is approximately 79,000 afy for the four pumping basins (Spring, Delamar, Dry Lake, and Cave valleys), the same as is assumed for these basins under Alternative A, C, and E. The well distribution developed by the SNWA for this model scenario includes the same spatial distribution of wells included in Alternative A for Delamar, Dry Lake, and Cave valleys. Compared to the Proposed Action, Alternative D limits drawdown in the central and northern portion of Spring Valley and southern portion of Snake Valley; and expands drawdown in Lake Valley, Hamlin Valley, and into northern Spring Valley (HA 201) (**Figure 3.3.2-41**).

The Alternative E pumping scenario includes the same spatial distribution of wells included in Alternative A for Spring, Delamar, Dry Lake, and Cave valleys but assumes no pumping in Snake Valley. The maximum groundwater production rate under this scenario is approximately 79,000 afy for the four pumping basins (Spring, Delamar, Dry Lake, and Cave valleys), the same as the maximum pumping rate assumed for these same basins under Alternative A, C, and D. Because the pumping schedule for Alternative E is identical to Alternative A for Spring, Delamar, Dry Lake, and Cave valleys, the predicted drawdown for Spring, Delamar, Dry Lake, and Cave valleys (and adjacent areas) are essentially the same as for Alternative A (**Figure 3.3.2-42**). This alternative would substantially reduce the drawdown area in Snake Valley compared with the Proposed Action and Alternative A.

The groundwater pumping scenario for Alternative F is similar to Alternative E in that it assumes a spatial distribution of wells for Spring, Delamar, Dry Lake, and Cave valleys and no pumping in Snake Valley. However, the assumed pumping rates for Alternative F (114, 129 afy) represent an increase in pumping in Spring, Delamar, and Cave valleys (and the same pumping rate in Dry Lake Valley) compared to Alternative E (78,755 afy). The spatial distribution of wells is essentially the same as included in Proposed Action for Spring, Delamar, Dry Lake, and Cave valleys. Compared to the Proposed Action, the pumping under Alternative F would reduce the drawdown area (**Figure 3.3.2-43**) along the southern margin of the drawdown area adjacent to Delamar Valley. In Snake Valley, this alternative substantially would reduce the drawdown area compared with the Proposed Action and Alternatives A, B, C, and D; and increase the drawdown area compared to Alternative E.

For the No Action, the groundwater pumping scenario represents an estimate of the potential effects that would occur in the future resulting from a continuation of currently existing water uses. The No Action pumping scenario is based on the estimates of existing and consumptive water use for the model area for agricultural, municipal, mining and milling, industrial, and power plant uses. This includes pumping the SNWA's existing water rights associated with their ranch properties in Spring Valley. However, the No Action pumping scenario does not include any groundwater development associated with the water rights applications in Spring, Snake, Delamar, Dry Lake, or Cave valleys that are included in the proposed project (i.e., Proposed Action pumping scenario). The estimated drawdown attributable to the No Action pumping scenario was estimated by comparison to the baseline groundwater elevations at the end of 2004. The No Action would substantially reduce the drawdown area in Spring, Snake, Delamar, Dry Lake, and Cave valleys compared with the Proposed Action and Alternative A through F (**Figure 3.3.2-44**).

Comparison of the simulation results indicate that the drawdown effects under the No Action continue to expand as pumping continues into the future. At the full build out plus 75 years time frame, there are 3 major drawdown areas. The largest drawdown area extends in a north-south direction from Lake Valley south to the northern margin of Meadow Valley Wash, a distance of approximately 70 miles. The two other major drawdown areas occur in the northern portion of White River Valley, and along the southern margin of the model area in the Black Mountain Area and Las Vegas Valley hydrographic basins. At the full build out plus 200 years time frame, the drawdown area that extends from the Lake Valley to Lower Meadow Valley Wash hydrographic basins is up to 85 miles long (north-south). The drawdown areas in White River Valley and along the southern margin of the model area also are predicted to continue to expand in the future over the model simulation period.

Table 3.3.2-25 provides a comparison of the potential impacts to water resources in the region of study associated with the various alternative pumping scenarios.

Impacts to Springs and Streams

As described previously, springs that are controlled by discharge from (or hydraulically interconnected with) the regional groundwater flow system and located within areas that experience a reduction in groundwater levels likely would experience a reduction in flow. The number of inventoried springs and miles of perennial stream located within the model-simulated drawdown area and located within areas determined to have a high or moderate risk of impacts are graphically illustrated in **Figures 3.3.3-45** and **3.3.3-46**. These charts indicate that the number of springs and miles of stream at risk of impacts increases over time for all of the alternative pumping scenarios. The model-simulated drawdown for the two alternatives with the largest groundwater withdrawal rate (Proposed Action and Alternative B) potentially could impact flows in the largest number of springs and miles of perennial stream reach. However, the distributed pumping assumed for Alternative A would reduce the number of springs and miles of perennial stream potentially at risk from drawdown effects. Compared to the Proposed Action, the reduced drawdown areas resulting from the Alternative A pumping scenario would reduce the number of springs and miles of streams potentially impacted. The Alternative C, D, E, and F pumping scenarios would further reduce the drawdown area compared to Alternative A, and Alternative E potentially would impact the smallest number of inventoried springs and miles of perennial stream reach in the region.

Water Resources within or Adjacent to Great Basin National Park

<u>Water Resources Within or Adjacent to the GBNP</u>. Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and the susceptibility zones identified by Elliot et al. (2006) are listed in **Table 3.3.2-8**. These results indicate that the potential risk to water resources would be greater under the Alternative B pumping scenario. Alternative B is the only pumping scenario where the drawdown area is projected to propagate into the susceptibility zones identified along Baker Creek. Because there is a moderate risk of impacts to the lower perennial segment of Baker Creek, there also is a moderate risk to water resource in the Model Cave under Alternative B.

At the full build out plus 75 years and full build out plus 200 years time frame, Outhouse, Rowland, and Spring Creek Spring and portions of Lehman Creek and Snake Creek are within the area of moderate risk under the Proposed Action, and Alternatives A and B. Compared to the Proposed Action, and Alternatives A and B, the potential risk to water resources in the GBNP would be reduced under Alternatives C and D; further minimized under Alternatives E and F; and not projected to occur under the No Action (**Table 3.3.2-8**).

Table 3.3.2-25 Comparison of Potential Incremental Effects to Water Resources at the Full Build Out Plus 75 Years and Full Build Out Plus 200 Years Time Frame Resulting from the Alternative Pumping Scenarios[1]

Water Resource Issue	Proposed Action	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	No Action
Full Build Out Plus 75 Years								
Drawdown effects on perennial springs:								
• Number of inventoried springs located in areas where impacts to flow could occur[2]	44	29	54	19	13	19	30	12
Drawdown effects on perennial streams:								
• Miles of perennial stream located in areas where impacts to flow could occur[2]	80	58	91	37	4	7	21	19
Drawdown effects on surface water rights:								
• Number of surface water rights located in areas where impacts to flow could occur[2]	145	109	141	78	23	60	88	105
Drawdown effects on groundwater rights:								
• Total groundwater rights in areas with greater than 10 feet of drawdown	199	174	184	133	27	70	84	372
• Number of groundwater rights in areas with greater than 100 feet of drawdown	2	0	8	0	2	0	1	0
Percent reduction in groundwater discharge to ET:								
• Spring Valley	77%	51%	66%	37%	18%	52%	73%	7%
• Snake Valley	28%	23%	18%	15%	4%	0%	1%	3%
• Great Salt Lake Desert Flow System	48%	34%	37%	24%	10%	21%	30%	5%
Full Build Out Plus 200 Years								
Drawdown effects on perennial springs:								
• Number of inventoried springs located in areas where impacts to flow could occur[2]	57	46	78	26	31	30	41	20
Drawdown effects on perennial streams:								
• Miles of perennial stream located in areas where impacts to flow could occur[2]	112	81	120	59	48	23	46	52
Drawdown effects on surface water rights:								
• Number of surface water rights located in areas where impacts to flow could occur[2]	212	151	186	98	56	94	132	164
Drawdown effects on groundwater rights:								
• Total groundwater rights in areas with greater than 10 feet of drawdown	264	223	301	171	213	110	131	409
• Number of groundwater rights in areas with greater than 100 feet of drawdown	34	2	45	0	6	2	5	0
Percent reduction in groundwater discharge to ET:								
• Spring Valley	84%	57%	73%	37%	28%	56%	80%	7%
• Snake Valley	33%	27%	24%	17%	8%	3%	3%	3%
• Great Salt Lake Desert Flow System[1]	54%	39%	44%	25%	16%	24%	34%	5%

[1] Supporting information used to develop these estimated effects are provided in **Appendices F3.3.6** through **F3.3.16**.

[2] Total located in high or moderate risk areas.

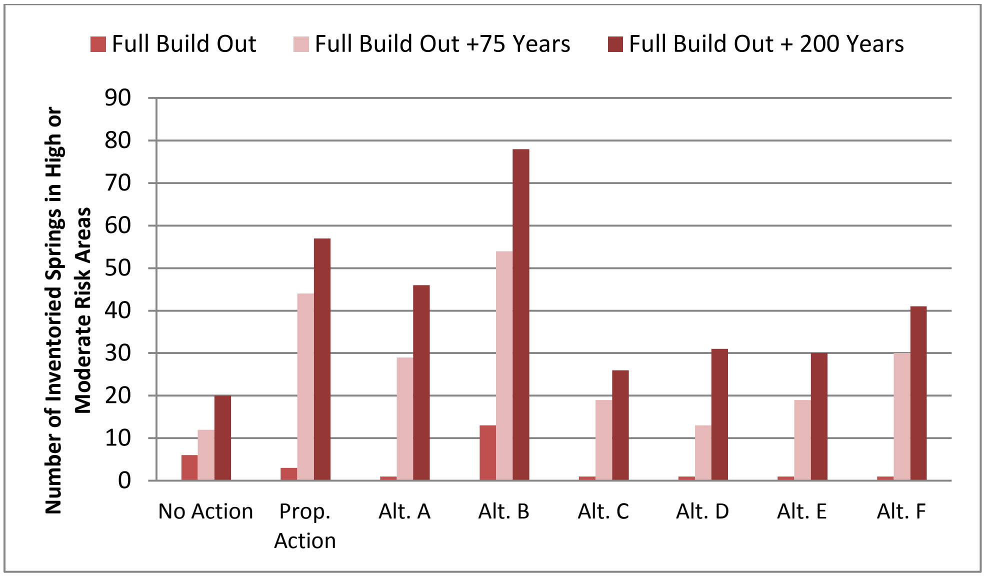


Figure 3.3.2-45 Number of Inventoried Springs Located within the Drawdown Area and Areas Where Impacts to Flow Could Occur (High or Moderate Risk Areas)

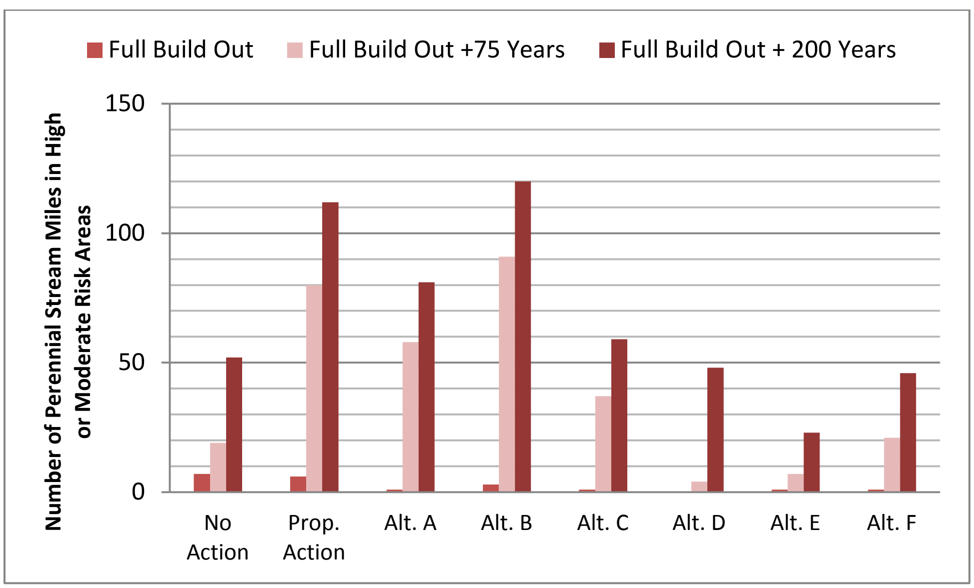


Figure 3.3.2-46 Miles of Perennial Streams Located within the Drawdown Area and Areas Where Impacts to Flow Could Occur (High or Moderate Risk Areas)

Utah Surface Water Resources

The model results indicate that there is a high risk of impacts to flows at Big Spring under all of the groundwater development pumping alternatives. Reduced flows at Big Springs would reduce flows in Big Springs Creek and downstream resources in Utah (i.e., Lake Creek and the flow into Pruess Lake). Comparison of the model simulated flow reductions at the full build out plus 75 year time frame indicates that projected flow reductions are similar (87 percent to 100 percent flow reduction) for the Proposed Action and Alternatives A, B, C, and D; with less flow reductions simulated under Alternatives E and F (26 percent and 25 percent) and the No Action (13 percent). These results suggest that the risk to the flow at Big Springs, Lake Creek, and Pruess Lake (and Stateline Spring that occurs in the same area) would be reduced under either Alternatives E or F and further reduced under the No Action compared to the other alternative pumping scenarios. Caine Spring is located in the moderate risk area, and is within the drawdown area under the Proposed Action and Alternatives A, B, and D; and not within the drawdown area under Alternatives C, E, and F. Measurable effects to Foot Reservoir Spring (i.e., Bishop Springs area) are not anticipated under any of the alternative pumping scenarios.

As described under the Proposed Action, available information suggests that drawdown from pumping in Snake Valley is unlikely to impact surface water resources in Pine Valley.

Impacts to Water Rights

The number of surface water rights located in areas where impacts to surface water resources could occur and number of groundwater rights located within the areas where the model simulations indicate drawdown of 10 feet or more are listed in **Table 3.3.2-25**. There are a large number of existing surface water rights located in areas where impacts from drawdown could occur under both the No Action and groundwater development pumping scenarios. The model results indicate that drawdown for the two alternatives with the largest groundwater withdrawal rate (Proposed Action and Alternative B) potentially could impact the largest number of water rights. The reduced drawdown areas resulting from the other alternatives (Alternatives A through F) would decrease the number of water rights impacted. At the full build out plus 200 year time frame, Alternative D is likely to affect the least number of existing surface water rights, and Alternative E is likely to affect the least number of existing groundwater rights.

Impacts to Water Balance

Potential changes in the water balance for the groundwater system within the region of study were estimated using the groundwater flow model (SNWA 2010b). The estimated reductions in groundwater discharge to the ET areas for selected basins and flow systems are summarized in **Table 3.3.2-25** and illustrated in **Figure 3.3.3-47**.

The Proposed Action would result in the largest reductions in groundwater discharge to the ET areas within Spring and Snake valleys, with estimated reductions of up to 84 percent in Spring Valley and up to 34 percent in Snake Valley. For Snake valley, most of the reductions of discharge to areas would occur in the south portion of the valley. The model results indicate that Alternative D would have the least impact to the ET areas in Spring Valley because the pumping is concentrated in the south end of the valley away from much of the ET areas. The concentrated pumping under Alternative D results in the deepest drawdown cone indicating that a higher percentage of the groundwater withdrawn under this scenario is from groundwater storage compared to the other groundwater development alternatives. Alternatives E and F would result in the smallest impacts (less than 4 percent reduction) to the groundwater discharged to ET area in Snake Valley.

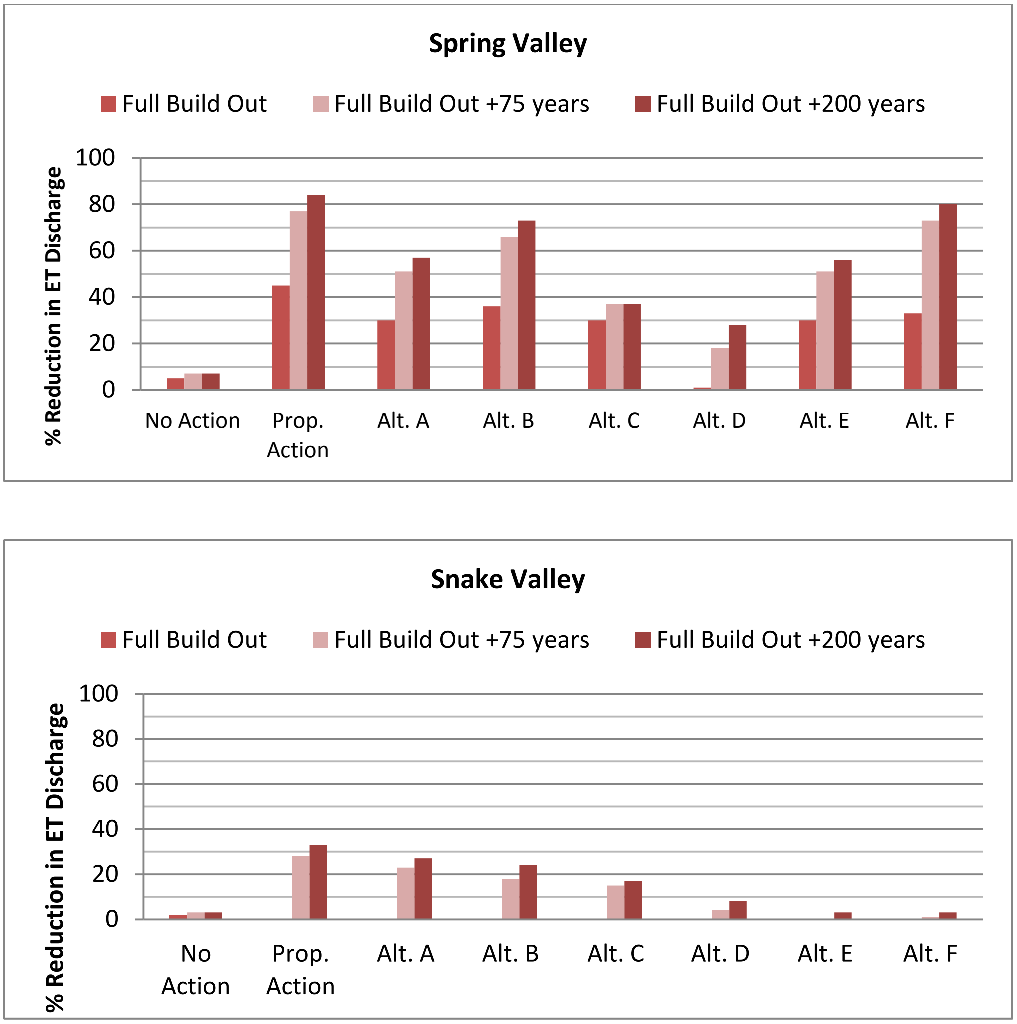


Figure 3.3.2-47 Model-simulated Reductions in Groundwater Discharge to Evapotranspiration Areas in Spring and Snake Valleys

3.3.3 Cumulative Impacts

3.3.3.1 Impacts Common to All Alternatives

Climate Change Effects

Climate change already appears to be influencing both natural and managed ecosystems of the American Southwest (Breshears et al. 2005; Westerling et al. 2006; Seager et al. 2007) and models indicate the likelihood of the Southwest being a climate change "hotspot" in the coming decades (Diffenbaugh et al. 2008). Recent warming in the Southwest is among the most rapid in the nation, significantly more than the global average in some areas (U.S. Global Change Research Program [USGCRP] 2009). Projections suggest continued strong warming in the region, with significant increases in temperature (USGCRP 2009) and decreases in precipitation (Seager et al. 2007). A warmer atmosphere and an intensified water cycle are likely to mean not only a greater likelihood of drought for the Southwest, but also an increased risk of flooding (USGCRP 2009). Greater variability in patterns of precipitation can be anticipated in the future. In the coming century, mean global temperature could increase significantly, with an associated increase in both the frequency of extreme events (heat waves, droughts, storms) and the frequency and extent of wildfire (IPCC 2007; Westerling & Bryant 2008; Krawchuk et al. 2009). Under such conditions, future impacts could be substantial for some resources, impacting biodiversity, protected areas, and agricultural lands.

Climate Change Effects to Water Resources

Global climate change models predict potential alterations in the distribution and seasonality of precipitation (Houghton et al. 1996; Mahlman 1997; Giorgi et al. 1998). The effects of this climate change already are being observed in the western U.S., including the reduction and earlier melting of mountain snowpacks, earlier timing of spring runoff, and associated declines in river flows (Dettinger et al. 2004; Stewart et al. 2004; Barnett et al. 2008). Climate change simulations also clearly indicate a general, large-scale warming over the western U.S. (Barnett et al. 2004), which likely will lead to more widespread drought. Paradoxically, a warmer atmosphere and an intensified water cycle are likely to mean not only a greater likelihood of drought for the Southwest, but also an increased risk of flooding (USGCRP 2009). Patterns of precipitation currently are changing, with more rain falling in heavy downpours that also can lead to such flooding events (IPCC 2007; Allan and Soden 2008). Moreover, increased flood risk in the Southwest is likely to result from a combination of decreased snow cover on the lower slopes of high mountains and an increased fraction of winter precipitation falling as rain and therefore running off more rapidly (Knowles et al. 2006). This increase in rain-on-snow events also could result in rapid runoff and flooding (Bales et al. 2006). Winter precipitation in Arizona is becoming increasingly variable, with a trend toward both extremely dry and extremely wet winters (Goodrich and Ellis 2008). Greater variability in patterns of precipitation can be anticipated in the future. Rapid landscape transformation due to vegetation die-off and wildfire as well as loss of wetlands along rivers also is likely to reduce flood-buffering capacity.

The effect of climate change on streamflow and groundwater recharge will vary regionally and locally, likely following projected changes in precipitation. The impact of climate change on water resources depends not only on changes in the volume, timing, and quality of streamflow and recharge but also on system characteristics, changing pressures on the system, how the management of the system evolves, and what adaptations to climate change are implemented (Arnell et al. 2001). Recent studies from the Sierra Nevada of California indicate that climate change will lead to increasing winter streamflow and decreasing late spring and summer flow (Miller et al. 2003; Maurer 2007). The amount and timing of runoff are dependent on the characteristics of each basin, especially elevation. Increased temperatures lead to a higher freezing line, and therefore, less snow accumulation and increased melting below the freezing height (Miller et al. 2003). These studies suggest that a decrease in late winter snow accumulation is a confident projection, as is the earlier arrival of the annual flow volume.

Climate change could affect water resources in the Project Area by impacting:

- Surface hydrology (volume and timing of surface flows, rainfall-runoff response, flood events, water quality, sediment and contaminant transport);
- Vadose zone hydrology (runoff, ET, infiltration, groundwater recharge); and
- Hydrogeology (groundwater flow).

3.3.3.2 Rights-of-way and Groundwater Development Area Construction and Operation

The water resources cumulative effects study area for evaluating impacts associated with surface-disturbance related effects includes all hydrographic basins experiencing surface disturbance associated with construction of the GWD Project. This includes all hydrographic basins crossed by the primary pipelines, power line ROWs and ancillary facilities; and groundwater production wells, collector pipelines, access roads, and other ancillary facilities constructed within the groundwater development areas identified in Spring, Delamar, Dry Lake, and Cave valleys.

The issues, methodologies, and assumptions used for the evaluation of cumulative effects are the same as previously described for the project specific impacts in Section 3.3.2.

3.3.3.3 No Action

Groundwater Development

As described in Chapter 2, the No Action assumes that the BLM would not grant ROWs for the proposed project. Under this scenario, the proposed pipelines, power lines, ancillary facilities, and well fields would not be developed. Therefore, construction or operational impacts (or cumulative impacts) to water resources associated with the proposed GWD Project would not occur.

3.3.3.4 Proposed Action and Alternatives A through F

Groundwater Development

The potential impacts to surface water resources associated with construction and operation of the Proposed Action and Alternatives A through F are described in Section 3.3.2. The potential construction- and operation-related impacts are similar for all of these alternatives. With respect to water resources, the main difference between these alternatives is that the Proposed Action and Alternatives A through C would construct a pipeline and well field(s) in Snake Valley; whereas, Alternatives D, E, and F would not include surface disturbance in Snake Valley. The Proposed Action and Alternatives A through C would include pipeline construction across one perennial stream (Snake Creek), and two intermittent streams (Big Wash and Lexington Creek) in Snake Valley. Implementation of the BMPs, ACMs, and mitigation recommendations would mitigate long-term residual impacts to perennial stream and springs.

Depending on the alternative, the primary pipeline also would cross 504 to 720 ephemeral streams; typically consisting of dry washes. Implementation of required erosion control measures and ACMs are expected to generally limit these to short-term (up to 2 years) effects.

The cumulative impacts to water resources within the areas to be disturbed for the GWD Project take into account other actions that also could affect water resources. Past and present actions involving grazing, road construction, mining and recent wildfires have affected perennial water sources and contributed to localized erosion and sedimentation to drainages. The primary future actions consist of construction of new utilities (e.g., pipelines, electrical distribution lines), roads and turbine pads for wind energy projects, and collector fields for solar energy projects) in Spring, Dry Lake, Muleshoe, Delamar, and Coyote Spring valleys. These future actions would result in surface disturbance that could (depending the facility locations and access roads) directly disturb or contribute sediment to perennial streams and springs located within the cumulative effects study area.

Surface disturbance would overlap with past and present actions, and potentially would overlap or intersect with RFFAs in the areas shown on **Figures 2.9-1** and **2.9-2**. Overlapping or intersecting areas of ground disturbance would include existing road and highway crossings; utility corridor crossings; and service roads for future wind energy projects in Spring and Dry Lake valleys. The major additive cumulative effects would be the expansion in the width of adjacent utility ROWs, which could cross streams or be located adjacent to streams and springs in Spring Valley. New roads associated with these RFFAs potentially could cross live streams in Spring and Snake valleys. Overall, the ground disturbance associated with the Proposed Action and Alternatives A through F are not anticipated to result in a substantial increase in cumulative impacts to surface water resources in the study area.

3.3.3.5 Groundwater Pumping

The hydrologic study area for cumulative impacts from groundwater withdrawal encompasses the 35 hydrographic basin region defined in **Figure 3.3.1-1**. The boundaries of the hydrologic study area for cumulative effects are the same as those used for the regional numerical groundwater flow model developed to evaluate potential effects of the proposed groundwater development project. The study area for cumulative effects was selected to include the 5 hydrographic basins where the proposed pumping would occur and all or portions of the potentially affected regional groundwater flow systems. Unless otherwise noted in the impact discussion, the issues, methodology, assumptions, and limitations used to quantify potential effects to water resources are the same as those previously described in Section 3.3.2.8. The baseline conditions in this regional study area are summarized in Section 3.3.1. For the purposes of the analysis, the proposed groundwater pumping is assumed to continue in perpetuity. As described in Section 3.3.2, drawdown-related impacts to water resources are predicted to progressively increase over time for the foreseeable future. To evaluate these increasing effects over time, the cumulative impact analysis estimated potential impacts to water resources at three representative time frames (full build out, full build out plus 75 years, and full build out plus 200 years) as discussed previously in Section 3.3.2. Detailed results of the cumulative effects at these three representative time frames are provided in tables and figures in **Appendix F3.3**. The summary of potential cumulative impacts provided in the following paragraphs is restricted to a description of the impacts at the later two time frames (i.e., full build out plus 75 years and full build out plus 200 years).

The estimated historical groundwater consumptive uses for the study area are described in Appendix C of the Transient Numerical Model Report (SNWA 2009b). The baseline conditions are described in Section 3.3.1 and reflect the aggregate effects of past groundwater withdrawals that have historically occurred across the region. The cumulative effects to water resources described in this analysis estimate the total effects that potentially could occur relative to conditions at the end of 2004. The end of 2004 corresponds to the end date used for the final calibration period for the transient numerical flow model (SNWA 2009b).

Groundwater Pumping Scenarios

The cumulative effects to water resources were evaluated using the regional groundwater flow model developed for the GWD Project. The pumping scenarios for the cumulative effects analysis were developed to simulated the combined effects associated with: 1) the continuation of existing pumping in the region included under the No Action pumping scenario described in Section 3.3.2.16; 2) additional pumping associated with the proposed groundwater development project, or alternative groundwater development scenarios (i.e., Alternatives A through F); and 3) additional reasonably foreseeable groundwater developments that have been identified within the cumulative study area.

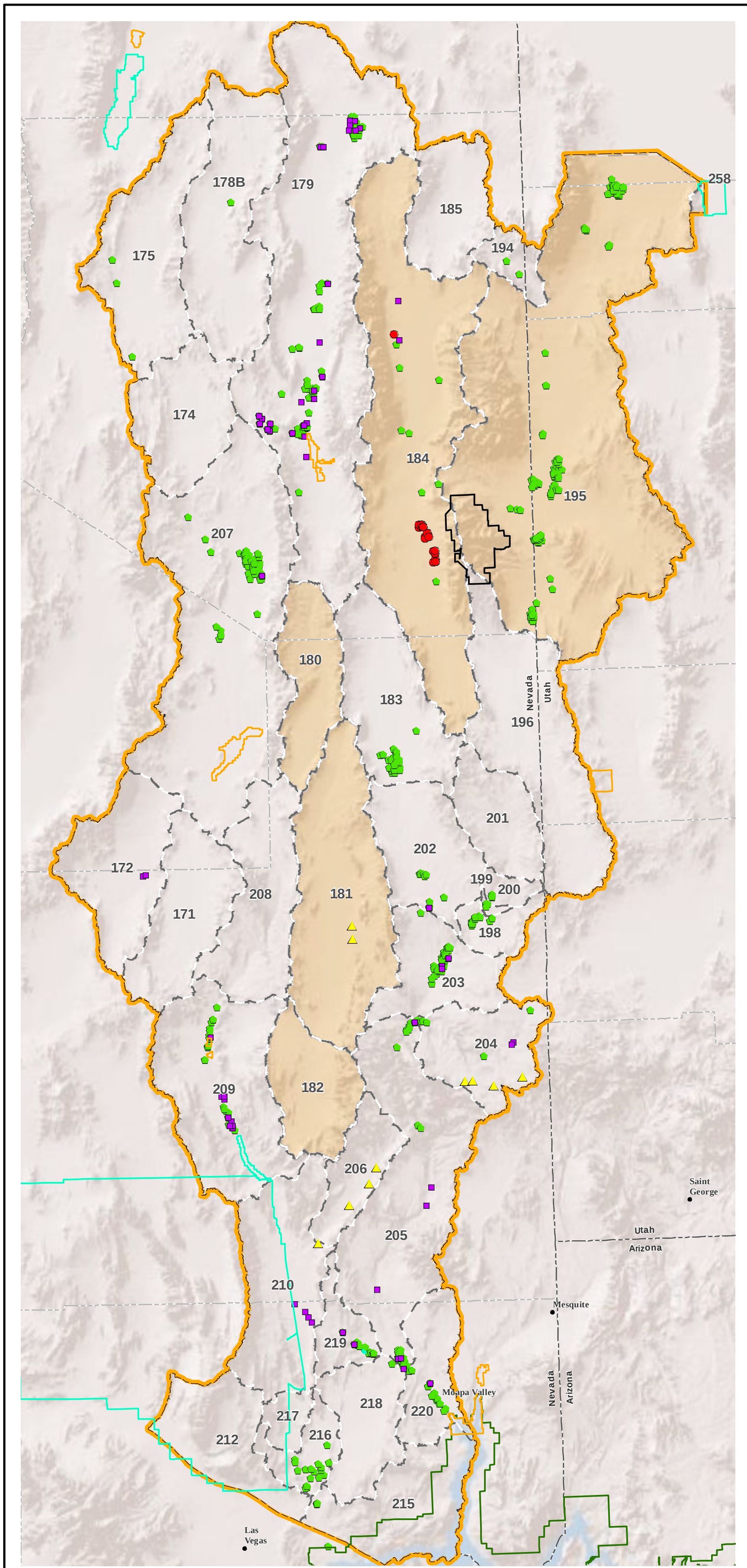
The reasonably foreseeable future groundwater developments included in this cumulative impact evaluation are listed in **Table 2.9-3**. These include future development of existing permitted groundwater rights associated with private lands and previously authorized projects and potential future projects with a groundwater-demand component that have submitted formal development plans to regulatory agencies for permitting purposes.

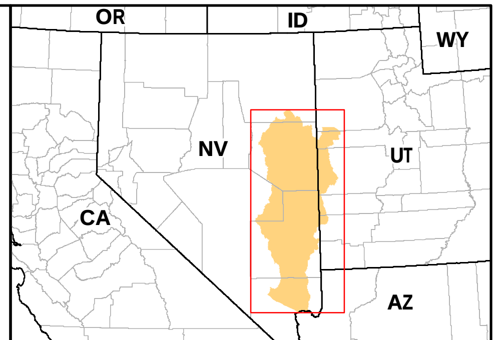
No Action Cumulative Pumping Scenario. The cumulative pumping scenario for the No Action includes the No Action pumping described in Section 3.3.2.15 and reasonable foreseeable future groundwater developments. The location of the existing pumping wells and reasonable foreseeable future groundwater development assumed for the No Action cumulative pumping scenario are shown in **Figure 3.3.3-1**.

Groundwater Development Project Pumping Scenarios (Proposed Action and Alternatives A through F). The cumulative pumping scenarios for each of the groundwater development alternatives provide an estimate of the effects associated with the combined pumping included in: 1) the No Action cumulative pumping scenario (i.e., existing pumping and reasonably foreseeable future pumping); and 2) the well distributions and pumping schedules used for the simulations of the productions wells previously described for the incremental effects analysis (Sections 3.3.2.9 to Section 3.3.2.15).

Impacts to Water Levels

No Action Cumulative Pumping Scenario. The predicted changes in groundwater levels attributable to the No Action cumulative pumping scenario at the full build out plus 75 years and full build out plus 200 years time frames are provided in **Figures 3.3.3-2** and **3.3.3-3**, respectively. Comparisons between these figures with the drawdown at the same time frame for the No Action pumping scenario (**Figures 3.3.2-36** and **3.3.2-37**) illustrate areas where the additional pumping included under reasonably foreseeable future actions would result in additional drawdown. The





Legend

Pumping Scenario Well Locations

No Action

- Existing Pumping Well[1]
- SNWA - Owned Properties[2]

Reasonably Foreseeable Future Uses

- Future Development[3]
- Lincoln County Water District Approved Water Right
- Hydrographic Basin
- Pumping Basin
- Water Resources Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

[1]Based on water rights and estimated consumptive uses for agricultural, mining and milling, industrial and power plant, and municipal purposes (SNWA 2009b).

[2]Existing water rights associated with SNWA owned ranch properties in Spring Valley.

[3]See Table 2.8-3 for a list of included actions.

Source: SNWA 2008a

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

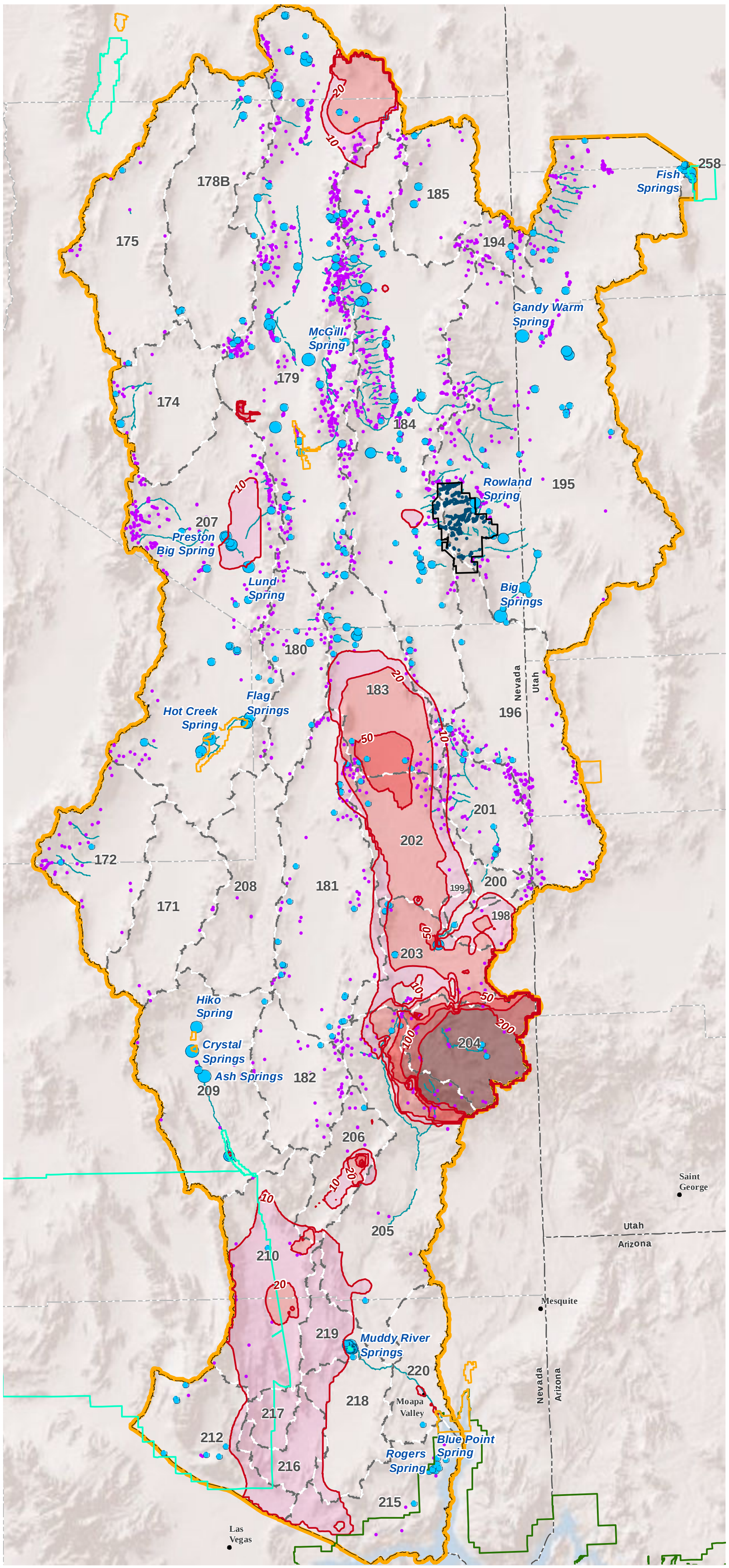
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

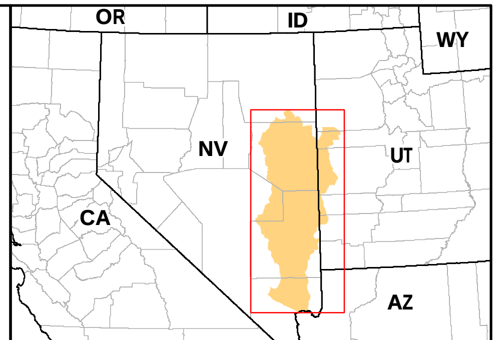
Figure 3.3.3-1

Pumping Distribution
No Action Cumulative Scenario

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
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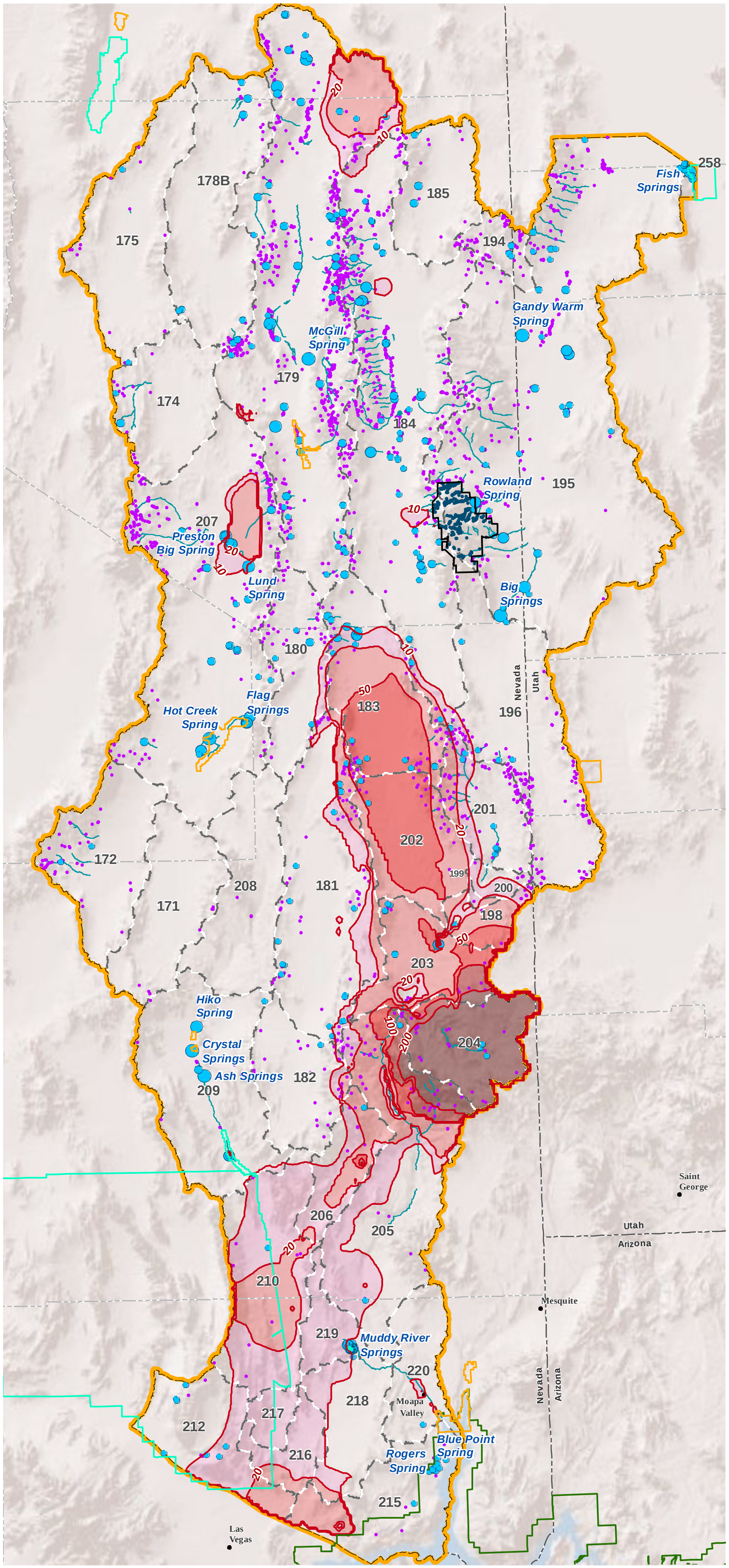
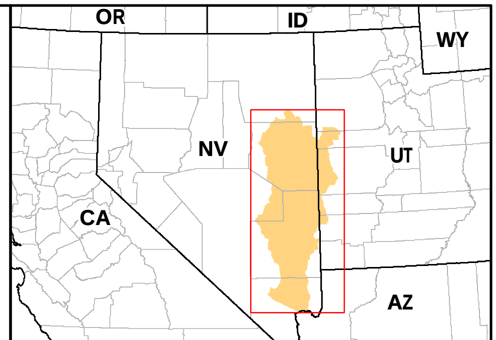
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.3-2
Predicted Change in Groundwater Levels
No Action Cumulative Effects
+ 75 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
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181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.3-3
Predicted Change in Groundwater Levels
No Action Cumulative Effects
+ 200 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

major differences attributable to the assumed reasonably foreseeable future pumping included in the No Action cumulative scenario results in the development of new or expanded drawdowns in the following areas:

Steptoe Valley: Development of a new drawdown area along the northern margin of Steptoe Valley associated with existing permitted water rights for a proposed power plant.

Clover Valley: Substantial expansion of the areal extent and magnitude of drawdown in Clover Valley and adjacent areas resulting from the assumed pumping from the proposed Lincoln County/Vidler groundwater development project.

Kane Springs: Development of a new drawdown area in Kane Springs Valley and adjacent areas resulting from pumping of existing permitted water rights for Lincoln County/Vidler.

Coyote Spring Valley: Development of a new drawdown area in Coyote Spring Valley and adjacent areas resulting from pumping of existing permitted water rights for the SNWA Coyote Spring Pipeline and Coyote Springs Investment.

The model simulations indicate that pumping included in the No Action cumulative scenario does not substantially contribute to drawdowns in Spring and Snake valleys.

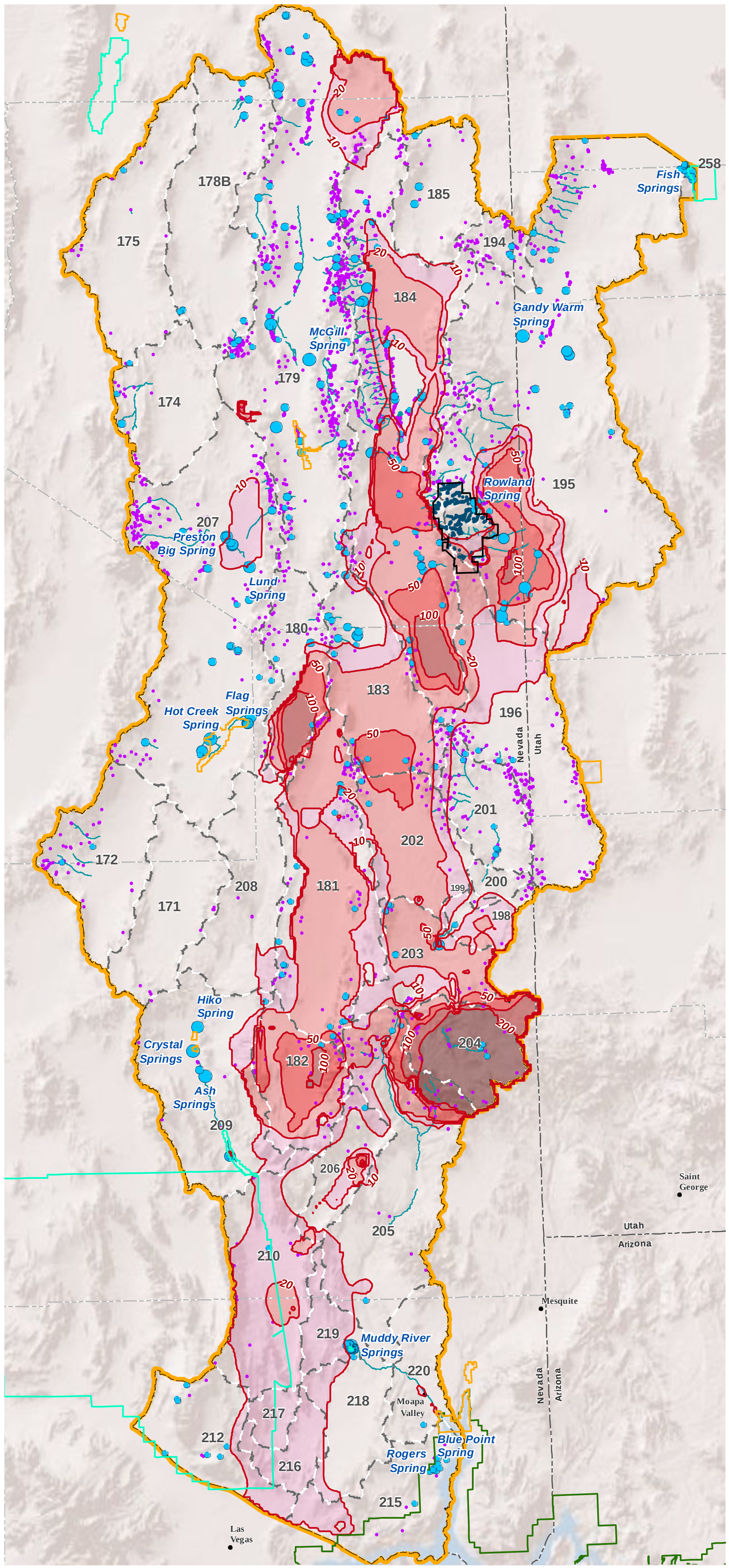
Groundwater Development Pumping Scenarios (Proposed Action and Alternatives A through F). The cumulative drawdown predicted for each of the six groundwater development pumping scenarios (Proposed Action and Alternatives A through F) at the representative time frames are provided in **Appendix F3.3.7**. These drawdown maps reflect the combined effects associated with the No Action cumulative drawdown scenario described above, and the incremental effects attributable to the groundwater pumping under the specific alternate described in Sections 3.3.2.9 to 3.3.2.15.

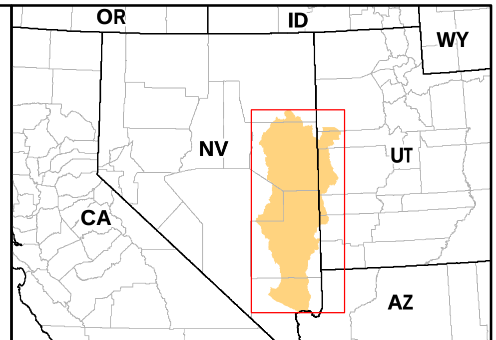
Figures 3.3.3-4 to **3.3.3-5** illustrate the predicted drawdown associated with the Proposed Action cumulative pumping scenario at the full build out plus 75 years and full build out plus 200 years time frame. The Proposed Action provides an example of the maximum extent of the cumulative drawdown predicted to occur for the six groundwater development cumulative pumping scenarios. Comparison of the results for the No Action cumulative pumping scenario with the six project alternative pumping cumulative scenarios results in the following major observations.

(1) Spring and Snake Valleys: The predicted cumulative drawdown is essentially the same as the project only drawdowns described previously. In other words, the continuation of existing pumping and reasonably foreseeable pumping (included in the No Action cumulative pumping scenario) is not expected to substantially increase drawdown effects over those predicted in Section 3.3.2 for the project-specific effects. Exceptions include an increase in drawdown observed in the Shoshone Ponds area that occurs under the Proposed Action, and Alternatives A, B, C, E, and F.

(2) White River, Cave, Dry Lake, and Lake Valleys: Drawdown associated with the project pumping scenarios is predicted to overlap with the drawdowns predicted for the No Action cumulative scenario in Lake Valley and adjacent areas. The overlap of the drawdown effects associated with the project pumping and existing pumping in Lake Valley is predicted to result in increased drawdown in Lake Valley and in Cave and Dry Lake valleys. (Drawdown impacts to springs in White River Valley associated with pumping in Cave Valley are discussed below under model-simulated spring and stream discharge estimates.)

(3) Delamar Valley, Lower Meadow Valley Wash, and Clover Valley: Substantial drawdown is predicted to occur in Clover Valley under the No Action cumulative pumping scenario. The proposed groundwater development is not anticipated to contribute to drawdown in Clover Valley. However, the overlapping drawdown from pumping in Clover Valley and Delamar Valley is predicted to increase drawdown in the northern portion of the Lower Meadow Valley Wash, which is situated between these two pumping centers.





Legend

Major Springs

Discharge (gpm)

- 0 - 10
- 10 - 100
- 100 - 1000
- 1000 - 2000
- 2000 - 4000
- 4000 - 8000
- Great Basin National Park Spring
- Additional Spring Location
- Perennial Stream Reach
- Drawdown Contour (Ft.)

Drawdown Range (Ft.)

- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200
- > 200
- Water Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- National Wildlife Refuge
- State Wildlife Management Area

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
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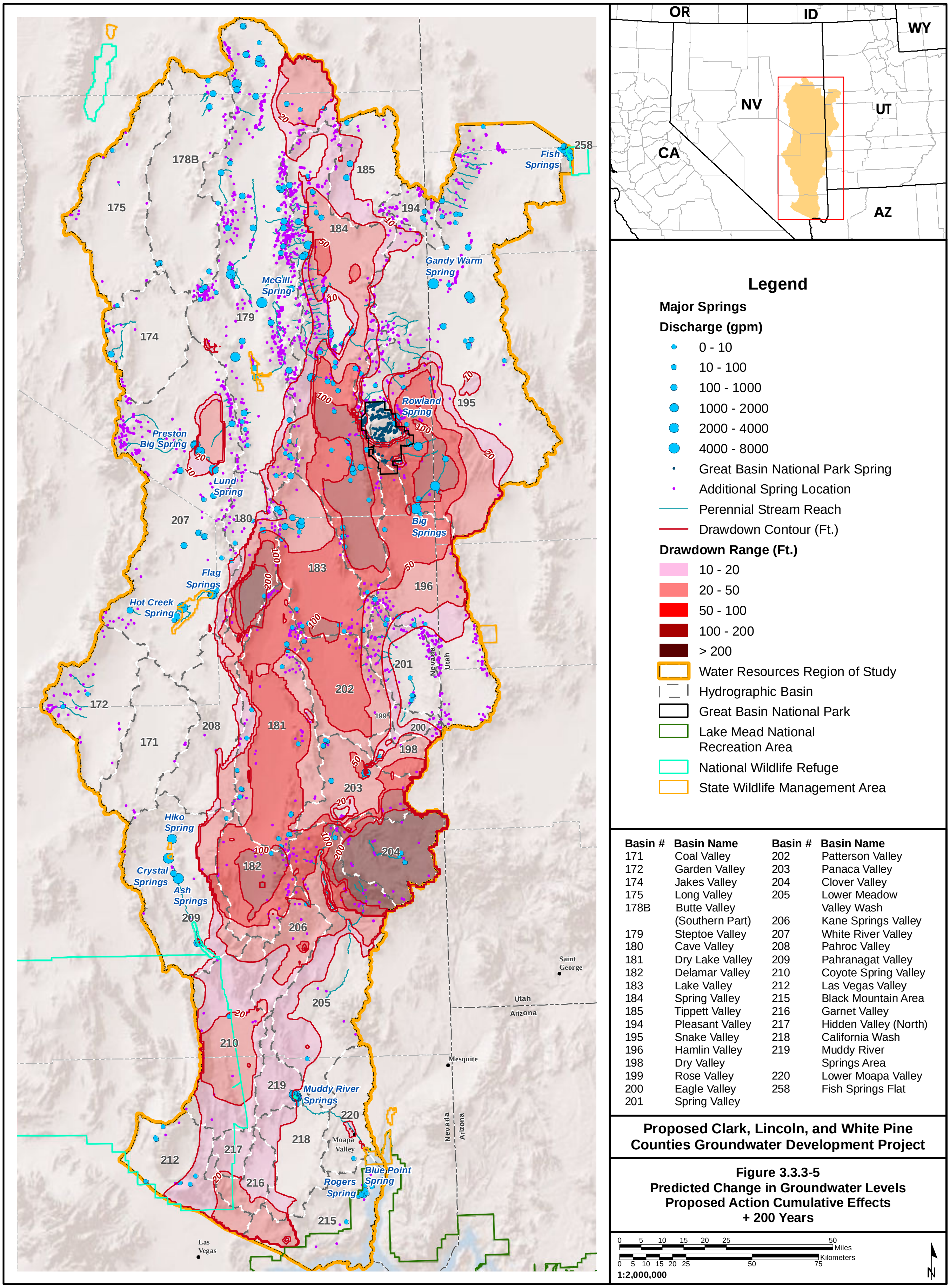
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.3-4
Predicted Change in Groundwater Levels
Proposed Action Cumulative Effects
+ 75 Years

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
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194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.3-5
Predicted Change in Groundwater Levels
Proposed Action Cumulative Effects
+ 200 Years

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

(4) Coyote Spring, Muddy River Springs, Hidden Valley North, Garnet Valley, Black Mountain Area, and Las Vegas Valley: The drawdown effects in these basins is essentially the same under both the No Action cumulative scenarios, and project pumping cumulative scenarios. These results indicate that the incremental drawdown attributable to project pumping is not anticipated to substantially contribute to drawdown effects beyond those simulated for the No Action cumulative scenario in Coyote Spring, Muddy River Springs, Hidden Valley North, Garnet Valley, Black Mountain Area, and Las Vegas Valley.

These observations generally apply to all seven action alternative cumulative pumping scenarios unless otherwise noted. However, the alternatives with the highest groundwater withdrawal volume (Proposed Action and Alternative B) show the largest overlapping drawdown effects; and the alternative with the lowest groundwater withdrawal volume (Alternative C) show the smallest amount of overlapping drawdown effects.

Impacts to Water Resources

The estimated potential risks to perennial springs and streams, water rights, and simulated water balance resulting from the cumulative groundwater pumping projected at full build out, full build out plus 75 years, and full build out plus 200 years for each of the cumulative pumping scenarios are provided in the following locations:

- Tables presenting the model-simulated flow changes for selected springs (**Appendix F3.3.6**);
- Drawdown maps for each pumping scenario at each time frame (**Appendix F3.3.7**);
- Maps delineating the risk to perennial surface water resources within the model-simulated drawdown areas (**Appendix F3.3.8**);
- Tables listing the number of springs by basin that occur within the high, moderate, and low risk areas for each pumping scenario and time frame (**Appendix F3.3.9**);
- Tables identifying the inventoried springs that occur within the moderate and high risk areas for each pumping scenario and time frame (**Appendix F3.3.10**);
- Tables listing the miles of perennial stream present within areas where effects to surface waters could occur for each pumping scenario and time frame (**Appendix F3.3.11**);
- Maps illustrating the risks to surface water rights by manner of use within the drawdown areas for each pumping scenario and time frame (**Appendix F3.3.12**);
- Tables defining the risk to surface water rights by basin within the drawdown areas for each pumping scenario and time frame (**Appendix F3.3.13**);
- Maps illustrating the drawdown effects to groundwater rights by manner of use for each pumping scenario and time frame (**Appendix F3.3.14**);
- Tables defining the risk to groundwater rights by basin within the drawdown areas for each pumping scenario and time frame (**Appendix F3.3.15**);
- Tables presenting the simulated groundwater budgets by basin and flow system for each pumping scenario and time frame (**Appendix F3.3.16**).

Potential effects to water resources resulting from the cumulative pumping scenario at the full build out plus 75 years and full build out plus 200 years time frames are summarized in **Table 3.3.3-1**. The following discussion provides a summary of potential major effects and compares the results for the alternative pumping scenarios.

Impacts to Springs and Streams

As described previously, springs that are controlled by discharge from (or hydraulically interconnected with) the regional groundwater flow system and located within areas that experience a reduction in groundwater levels would likely experience a reduction in flow. The number of inventoried springs and miles of perennial stream located within the model-simulated cumulative drawdown area and located within areas determined to have a high or moderate risk of impacts are presented in **Figure 3.3.3-6** and **Figure 3.3.3-7**. These charts illustrate that the number of springs and miles

Table 3.3.3-1 Comparison of Potential Cumulative Effects to Water Resources at the Time Periods Associated with Full Build Out Plus 75 and Full Build Out Plus 200 Years[1]

Water Resource Issue	Proposed Action	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt F	No Action
Full Build Out Plus 75 Years								
Drawdown effects on perennial springs:								
• Number of inventoried springs located in areas where impacts to flow could occur[2]	65	53	77	42	34	42	51	19
Drawdown effects on perennial streams:								
• Miles of perennial stream located in areas where impacts to flow could occur[2]	131	110	137	98	53	56	69	42
Drawdown effects on surface water rights:								
• Number of surface water rights located in areas where impacts to flow could occur[2]	305	274	299	257	198	224	245	159
Drawdown effects on groundwater rights:								
• Total groundwater rights in areas with greater than 10 feet of drawdown	683	667	679	635	541	558	567	500
• Number of groundwater rights in areas with greater than 100 feet of drawdown	21	19	27	19	21	19	21	19
Percent reduction in ET and spring discharge:								
• Spring Valley	78%	55%	69%	43%	24%	55%	76%	6%
• Snake Valley	30%	25%	21%	17%	7%	4%	4%	2%
• Great Salt Lake Desert Flow System[1]	50%	38%	41%	28%	14%	25%	33%	4%
Full Build Out Plus 200 Years								
Drawdown effects on perennial springs:								
• Number of inventoried springs located in areas where impacts to flow could occur[2]	82	74	102	63	53	62	70	28
Drawdown effects on perennial streams:								
• Miles of perennial stream located in areas where impacts to flow could occur[2]	193	166	201	151	119	120	140	79
Drawdown effects on surface water rights:								
• Number of surface water rights located in areas where impacts to flow could occur[2]	422	372	393	341	302	315	352	228
Drawdown effects on groundwater rights:								
• Total groundwater rights in areas with greater than 10 feet of drawdown	783	752	754	730	672	642	650	555
•								
• Number of groundwater rights in areas with greater than 100 feet of drawdown	181	76	171	66	139	76	97	66
Percent reduction in groundwater discharge to ET:								
• Spring Valley	86%	61%	76%	42%	35%	60%	82%	9%
• Snake Valley	35%	29%	27%	20%	11%	6%	6%	3%
• Great Salt Lake Desert Flow System[1]	56%	42%	47%	29%	21%	28%	37%	5%

[1] Supporting information used to develop these estimated effects are provided in **Appendices F3.3.6** through **F3.3.16**.

[2] Total located in high or moderate risk areas.

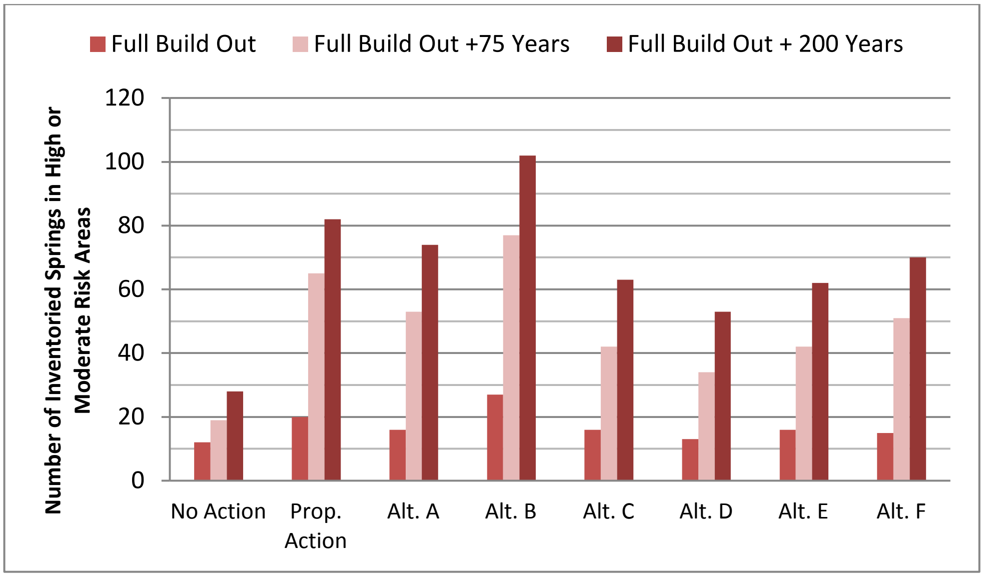


Figure 3.3.3-6 Number of Inventoried Springs Located within the Cumulative Drawdown Area and Areas Where Impacts to Flow Could Occur

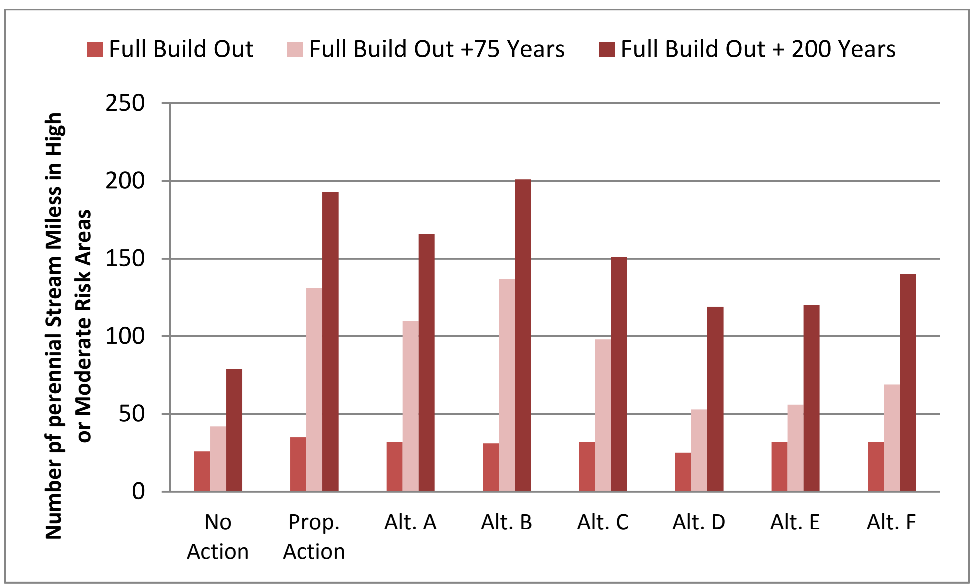


Figure 3.3.3-7 Miles of Perennial Stream Located within the Cumulative Drawdown Area and Areas Where Impacts to Flow Could Occur

of stream at risk of impacts increases over time for all of the cumulative pumping scenarios. For the No Action cumulative pumping scenario, there are 19 and 28 inventoried springs, and 42 miles and 79 miles of perennial streams, at the full build out plus 75 years and full build out plus 200 years time frames, respectively, located in areas where impacts to perennial water could occur. Because the No Action cumulative pumping scenario is a component of the other alternative pumping scenarios, the total number of springs and miles of perennial stream identified for the No Action cumulative scenario is included in the other 7 groundwater development pumping alternatives (i.e., Proposed Action and Alternatives A through F).

The model-simulated drawdown for the two alternatives with the largest groundwater withdrawal rate (Proposed Action and Alternative B) potentially could impact flows in the largest number of springs and miles of perennial stream reach. The reduced drawdown areas resulting from the Alternative A cumulative pumping scenario potentially would reduce the number of springs and miles of streams impacted. The C, D, E, and F cumulative alternatives would further reduce the drawdown area compared to Alternative A, and potentially would impact the smallest number of inventoried springs and miles of perennial stream reach.

Model-simulated Spring and Stream Discharge Estimates

Model-simulated changes in spring flow for selected springs for each of the cumulative pumping scenarios are provided in **Appendix F3.3.6**. The model results for Preston Big Spring, Butterfield Spring, and Flag Springs 3 in White River Valley are presented in **Figure 3.3.3-8**. Preston Big Spring is located in the valley floor in the northern portion of White River Valley. The model results indicate that the flow at Preston Big Springs would be reduced by up to 7 percent from groundwater withdrawals included in the No Action cumulative pumping scenario. Additional reductions in flow resulting from the pumping included in the groundwater development alternatives (i.e., Proposed Action and Alternatives A through F) would be negligible. The model-simulated flow changes at Cold Spring and Nicolas Spring, located in the same general area within White River Valley, show essentially the same results.

Butterfield Springs and Flag Spring are located near the eastern margin of the valley floor in the southern portion of White River Valley. The model results indicate that the No Action cumulative pumping scenario would result in a small reduction in flow (up to 3 percent) over the model-simulation period. The model simulations indicate that all of the groundwater development alternatives would result in reduced flow at these springs. These potential flow reductions result from pumping in Cave Valley. The maximum pumping rate in Cave Valley would occur under the Proposed Action and Alternatives B and F (11,548 afy for all three alternatives) and the greatest flow reduction at these springs would occur under Alternative B. The model results indicate that distributed pumping used in Proposed Action and Alternative F substantially would reduce the potential flow reduction in these springs compared to Alternative B. The reduced pumping in Cave Valley in Alternatives A, C, D, and E pumping scenarios is anticipated to reduce effects to flows at these springs.

The regional springs that discharge in Pahranagat Valley (i.e., Hiko, Crystal, and Ash Springs) are predicted to experience small flow reductions (up to 4 percent) under the No Action cumulative pumping scenario. These model-simulated flow changes are essentially the same for all of the groundwater development cumulative pumping scenarios indicating that additional reductions in flow resulting from the GWD Project would be negligible for all alternatives.

Muddy River Springs near Moapa is the headwaters for Muddy River and represents the largest groundwater discharge at the lower end of the White River flow system. The predicted reductions in flow at Muddy River Springs are presented in **Figure 3.3.3-9**. The model results predict that groundwater withdrawal included in the No Action cumulative pumping scenario eventually would result in up to 61 percent reduction in flow at the Muddy River Springs. Most of the reduction in flow can be attributed to the pumping included under RFFAs in the region including the pumping of SNWA’s existing water rights in nearby Coyote Spring Valley. These model-simulated flow changes are essentially the same for all of the groundwater development cumulative pumping scenarios. (Note that the numerical model simulations do not account for the existing Muddy River Memorandum of Agreement regarding groundwater withdrawal in Coyote Spring Valley and California Wash basins, among the SNWA, Moapa Valley Water District, Coyote Spring Investment, Moapa Band of Paiutes, and USFWS. This agreement requires that minimum in-stream flow levels will be maintained through the implementation of mitigation measures such as redistribution of pumping and/or cessation or reduction in pumping, if necessary. The groundwater model could not address these minimum in-stream flow requirements, thus they are not reflected in the simulation results. Based on the agreement, potential flow reductions under the No Action cumulative pumping scenario are anticipated to be less than those simulated by the model.) The flow at Panaca Spring located in Panaca Valley also is expected to experience flow reductions from pumping included in the No Action cumulative pumping scenario; however, the groundwater development pumping likely would not contribute to these flow reductions.

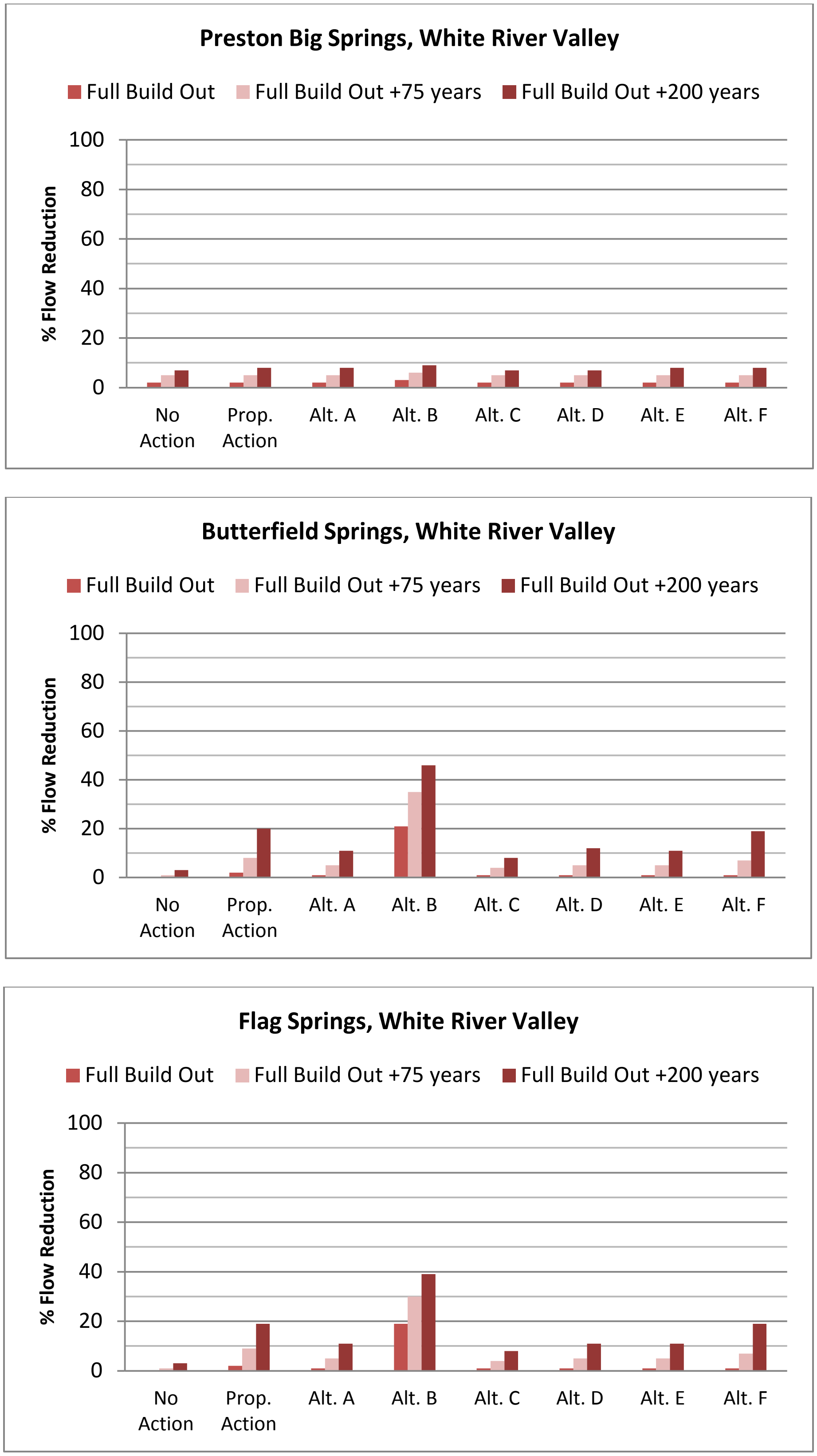


Figure 3.3.3-8 Model-simulated Cumulative Reduction in Flows at Preston Big Springs, Butterfield Springs, and Flag Springs 3, White River Valley

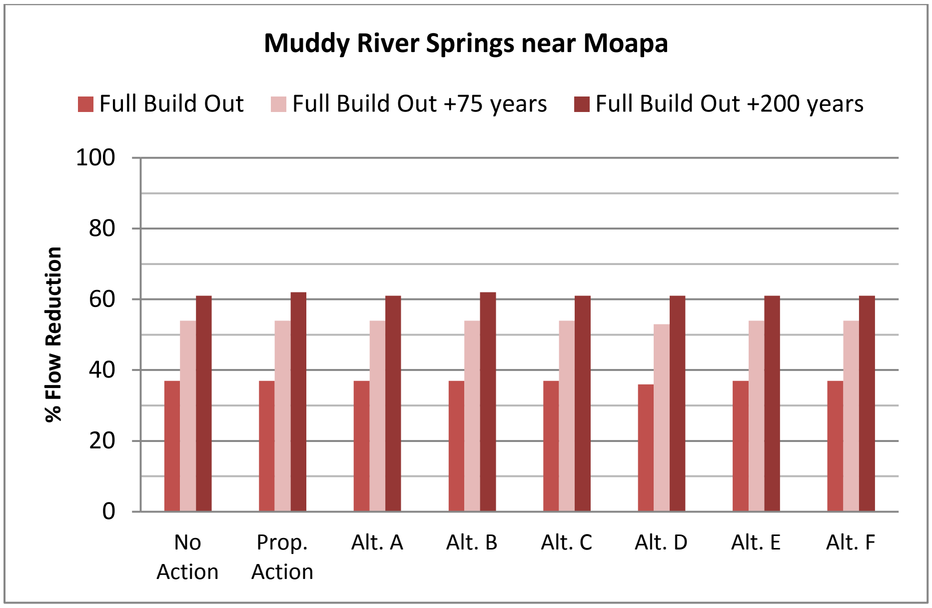


Figure 3.3.3-9 Model-simulated Cumulative Reduction in Flows at Muddy River Springs near Moapa

The magnitude of flow changes predicted at Keegan, North Millick, and South Millick springs in Spring Valley predicted under the cumulative pumping scenarios are similar to those simulated for the project-specific effects summarized in Section 3.3.2. These results indicate that potential cumulative impacts to perennial spring and stream discharge in Spring Valley are attributable to the GWD project pumping, and not existing pumping or reasonably foreseeable future pumping in the immediate area.

For Big Springs in Snake Valley, the model simulations results indicate that flow reductions for the No Action cumulative scenario are the same as previously described under the No Action pumping scenario (Section 3.3.2.16). All of the groundwater development alternatives are expected to result in substantial reduction in flow at Big Springs (**Figure 3.3.3-10**). As described previously, reductions of flow at Big Springs would reduce flows in Big Springs Creek and flows to Lake Creek and Pruess Lake. The model simulations indicate that none of the cumulative pumping scenarios would reduce flows in the three other springs simulated in the groundwater model. These springs are located in the central portion of Snake Valley (Foote Reservoir Spring, Kell Spring, and Warm Creek near Gandy).

Water Resources within or Adjacent to Great Basin National Park

Surface water resources located within or adjacent to the GBNP that occur within both the model-simulated drawdown area and within the susceptibility zones identified by Elliot et al. (2006) for the cumulative pumping scenarios are listed in **Table 3.3.3-2**. For the purpose of the EIS analysis, these areas are considered zones of moderate risk as defined in **Table 3.3.2-3** (i.e., impacts may occur to some perennial waters that are hydraulically connected to the regional flow system). Impacts to GBNP water resources are not anticipated under the No Action cumulative pumping scenario. However, comparison between **Table 3.3.2-8** (incremental effects) with **Table 3.3.3-2** (cumulative effects) indicates that combined effects of the pumping under No Action with pumping included for the project development alternatives (Proposed Action and Alternatives A through F) tends to increase the drawdown in the vicinity of GBNP, resulting in an increase in the length of stream within the drawdown area that is potentially susceptible to project pumping effects. Other effects are the same as previously described for the incremental effects in Section 3.3.2.9 to 3.3.2.16.

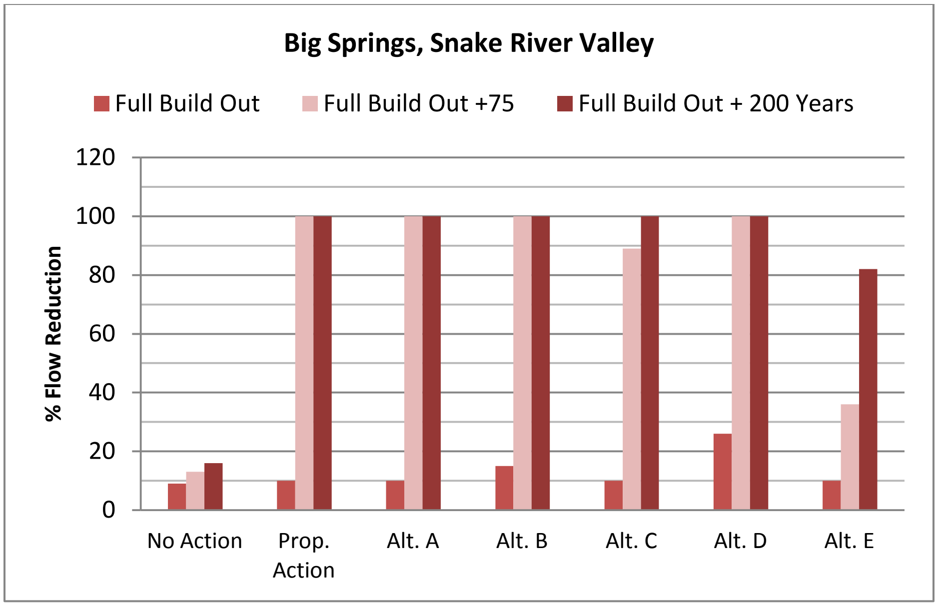


Figure 3.3.3-10 Model-simulated Cumulative Reduction in Flows at Big Springs, Snake Valley

Table 3.3.3-2 GBNP Water Resources Risk Evaluation Summary by Alternative (Cumulative Pumping Scenarios)

	Proposed Action		Alt. A		Alt. B		Alt. C		Alt. D		Alt. E		Alt. F		No Action	
Years	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**
Springs[1]																
Cave Spring					X	X										
Outhouse Springs	X	X	X	X	X	X	X	X		X		X		X		
Rowland Springs		X		X	X	X		X								
Spring Creek Spring	X	X	X	X	X	X	X	X		X		X		X		
Other springs[2]	0	0	0	0	15	25	0	0	0	0	0	0	0	0	0	0
Streams (Miles[3]**)**																
Baker Creek and tributaries	0.0	0.0	0.0	0.0	1.7	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lehman Creek and tributaries	0.0	0.5	0.0	0.5	2.0	2.3	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Snake Creek and tributaries	7.7	9.1	6.4	8.3	9.1	10.2	3.8	8.0	0.0	8.0	0.0	8.0	0.0	8.0	0.0	0.0

[1] "X" indicates spring is located both within the simulated drawdown area and susceptibility zones as defined by Elliot et al. (2006).

[2] Other springs identified in GBNP are listed in **Appendix F3.3.1**, **Table F3.3.1-1B**.

[3] Miles of perennial stream identified in the GBNP located both within the simulated drawdown area and susceptibility zones as defined by Elliot et al. (2006).

Utah Surface Water Resources

The model results indicate that there is a high risk of impacts to flows at Big Spring under all of the Cumulative groundwater development pumping alternatives. The risk of flow reductions generally is similar to but slightly greater than previously described for the project specific incremental effects (Section 3.3.2.9 through Section 3.3.2.16). Reduced flows at Big Springs would reduce flows in Big Springs Creek and downstream resources in Utah (i.e., Lake Creek and flow into Pruess Lake). Comparison of the model-simulated flow reductions at the full build out plus 75 year time frame indicates that projected flow reductions are similar (89 percent to 100 percent flow reduction) for the

Proposed Action and Alternatives A, B, C, and D; with less flow reductions simulated under Alternatives E and F (36 percent and 35 percent) and the No Action (13 percent). These results suggest that the risk to the flow at Big Springs, Lake Creek, and Pruess Lake would be reduced under either Alternative E or F cumulative pumping scenarios and further reduced under the cumulative No Action pumping scenario compared to the other alternative pumping scenarios. Measurable effects to Foot Reservoir Spring (i.e., Bishop Springs area) are not anticipated under the cumulative pumping scenarios for all alternatives.

Available information suggests that drawdown from cumulative pumping under all pumping scenarios is unlikely to impact surface water resources in Pine Valley (see Section 3.3.2.9 for additional discussion) within Utah.

Impacts to Water Rights

The number of surface water rights located in areas where impacts to surface water resources could occur and number of groundwater rights located within the areas where the model simulations indicate drawdown of 10 feet or more are listed in **Table 3.3.3-1**. There are a large number of existing surface water rights located in areas where impacts from drawdown could occur under both the No Action and groundwater development cumulative pumping scenarios. The model results indicate that drawdown for the two alternatives with the largest groundwater withdrawal rate (Proposed Action and Alternative B) potentially could impact the largest number of water rights. The reduced drawdown areas resulting from the other alternatives (Alternatives A through F) would decrease the number of water rights impacted. Potential impacts to individual water rights are the same as discussed under the Proposed Action (Section 3.3.2.9).

Impacts to Water Balance

Potential changes in the water balance for the groundwater system within the region of study were estimated using the groundwater flow model (SNWA 2010b). The estimated reductions in groundwater discharge to the ET areas for selected basins and flow systems are summarized in **Table 3.3.3-1** and illustrated in **Figure 3.3.3-11**. The model simulations indicate that groundwater withdrawal included in the No Action cumulative pumping scenario would have a relatively small effect on the groundwater discharge to ET areas in the Great Salt Lake Desert Flow System. For Spring Valley, the No Action pumping is estimated to result in a 6 and 9 percent reduction of groundwater discharge for ET at the full build out plus 75 years and full build out plus 200 years time frames, respectively. In Snake Valley, the pumping is estimated to result in minimal reductions (less than 4 percent) of groundwater discharge to support ET.

The Proposed Action would result in the largest reductions in groundwater discharge to the ET areas within Spring and Snake valleys; with estimated reductions of up to 86 percent in Spring Valley, and up to 35 percent in Snake Valley. For Snake valley, most of the reductions of discharge to areas would occur in the south portion of the valley. The model results indicate that Alternative D would have the least impact to the ET areas in Spring Valley because the pumping is concentrated in the south end of the valley away from much of the ET areas. The concentrated pumping under Alternative D results in the deepest drawdown cone indicating that a higher percentage of the groundwater withdrawn under this scenario is from storage compared to the other groundwater development alternatives. Alternatives E and F would result in the smallest impacts to the ET area in Snake Valley.

As described in Section 3.3.2, the model simulations indicate that the groundwater withdrawal associated with the groundwater pumping alternatives would have a have a minimal effect on amount of groundwater discharged to the ET areas within the White River Flow System. Pumping under the No Action cumulative scenario would not increase the potential reduction of flow to Pine, Wah Wah, and Tule valleys; and Fish Springs previously described for the specific groundwater pumping alternatives.

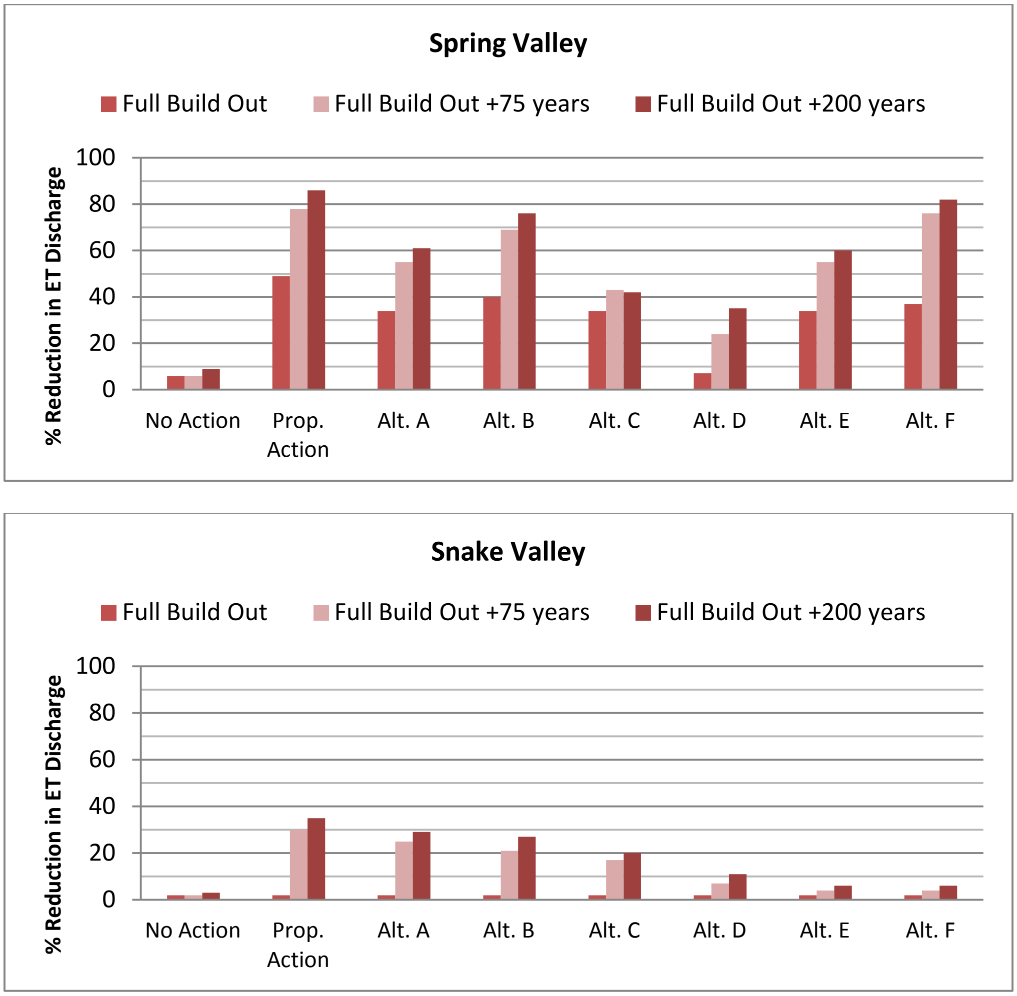


Figure 3.3.3-11 Model-simulated Cumulative Reductions in Groundwater Discharge to Evapotranspiration Areas in Spring and Snake Valleys

3.5 Vegetation Resources

3.5.1 Affected Environment

3.5.1.1 Overview

The GWD Project is located in the Basin and Range Geographic Province. The northern two-thirds of the project lies within Great Basin Desert (also known as the Intermountain Region) and the southern one-third is within the Mojave Desert. The transitional area between these two regions is located in Delamar Valley and southern Dry Lake Valley.

QUICK REFERENCE

ET – evapotranspiration

NRS – Nevada Revised Statutes

TCWCP – Tri-County Weed Control Project

ESA – Endangered Species Act

BARCAS – Basin and Range Carbonate Rock Aquifer System

Hot, dry Mojave Desert lowlands are characterized by low shrub vegetation dominated by a few common perennial species. Characteristic Mojave vegetation includes burrobush (*Ambrosia dumosa*), creosote bush (*Larrea tridentata*), and Fremont's dalea (*Psorothamnus fremontii*) (Bowers 1993). Joshua tree (*Yucca brevifolia*) is an important component of lowland elevations up to approximately 6,500 feet and has been regarded by some plant geographers and ecologists as an indicator of Mojave Desert vegetation (Baldwin et al. 2002). Historically, fire has not been an important ecological component of the Mojave Desert as the native perennial vegetation is relatively resistant to fires. The spread of non-native species, specifically red brome (*Bromus rubens*) and cheatgrass (*Bromus tectorum*), has increased fuels and fire occurrence in this ecological system.

Great Basin Desert lowlands are characterized by low shrub vegetation. Common shrub species of the central Great Basin include big sagebrush (*Artemisia tridentata*), Wyoming big sagebrush (*Artemisia tridentata* ssp. *Wyomingensis*), black sagebrush (*Artemisia nova*), rubber rabbitbrush (*Ericameria nauseous*), fourwing saltbush (*Atriplex canescens*), shadscale (*Atriplex confertifolia*), winterfat (*Kraschennikovia lanata*), and greasewood (*Sarcobatus vermiculatus*). Common understory perennial grasses include Indian ricegrass (*Achnatherum hymenoides*), needle-and-thread grass (*Hesperostipa comata*), western wheatgrass (*Pascopyrum smithii*), basin wildrye (*Leymus cinereus*), Sandberg bluegrass (*Poa secunda*), James'galleta (*Pleuraphis jamesii*), and inland saltgrass (*Distichlis spicata*). The spread of non-native annual grass species has increased fuels and fire occurrence in this ecological system.

Open evergreen woodlands consisting of Utah juniper (*Juniperus osteosperma*), singleleaf pinyon (*Pinus monophylla*), or curlleaf mountain-mahogany (*Cercocarpus ledifolius*) are found on the slopes of most ranges. Cottonwoods (*Populus* ssp.) and willows (*Salix* ssp.) proliferate in low elevation areas with dependable water. Historically, an infrequent mixed fire regime occurred in the Great Basin. Fire is an integral part of the ecological process for many of the vegetation types. Most of the vegetation types are adapted to the effects of fire. Fire most often occurs in this area during drought cycles.

Community characterizations were compiled based on literature research, agency consultation, field survey reports, aerial photograph interpretation, SWReGAP Land Cover descriptions (USGS 2005), and information from the Las Vegas and Ely RMPs. Species nomenclature is consistent with the NRCS Plants Database (NRCS 2009).

A work group process, designated as the Natural Resources Group (NRG), was used to obtain the following types of information for biological resources: 1) compile and evaluate baseline data on biological resources (vegetation, wildlife, and aquatic species); 2) prepare a summary of the data; and 3) assist the BLM and AECOM in developing the impact analysis approach for the EIS and make recommendations for monitoring and mitigation. The NRG included representatives from the BLM in Nevada and Utah, USFWS in Nevada and Utah, NDOW, Utah Division of Wildlife Resources (UDWR), SNWA, AECOM (BLM's EIS Contractor), and Entrix (subcontractor to AECOM). The BLM directed the activities of the NRG. As a result of the NRG work, a report entitled the *Natural Resources Baseline Summary Report – Clark, Lincoln, and White Pine Counties Groundwater Development EIS* (ENSR/AECOM 2008) was prepared in support of the EIS.

The *natural resources region of study* consisted of the 5 hydrologic basins proposed for groundwater development, along with 28 other hydrologic basins which collectively encompass all or a portion of 5 flow systems (Las Vegas Wash Flow System, White River Flow System, Meadow Valley Wash Flow System, Goshute Valley Flow System, and Salt Lake Desert Flow System). The natural resources region of study differed from the water resources model area in that four basins (Long, Jakes, Garden, and Coal) were excluded on the eastern boundary due to a lack of sensitive species habitat. The natural resources region of study also included four basins (Pine, Wah Wah, Tule, and Deep Creek) that were not part of the water resources model area. These four basins contained game or special status species.

3.5.1.2 Right-of-way Areas

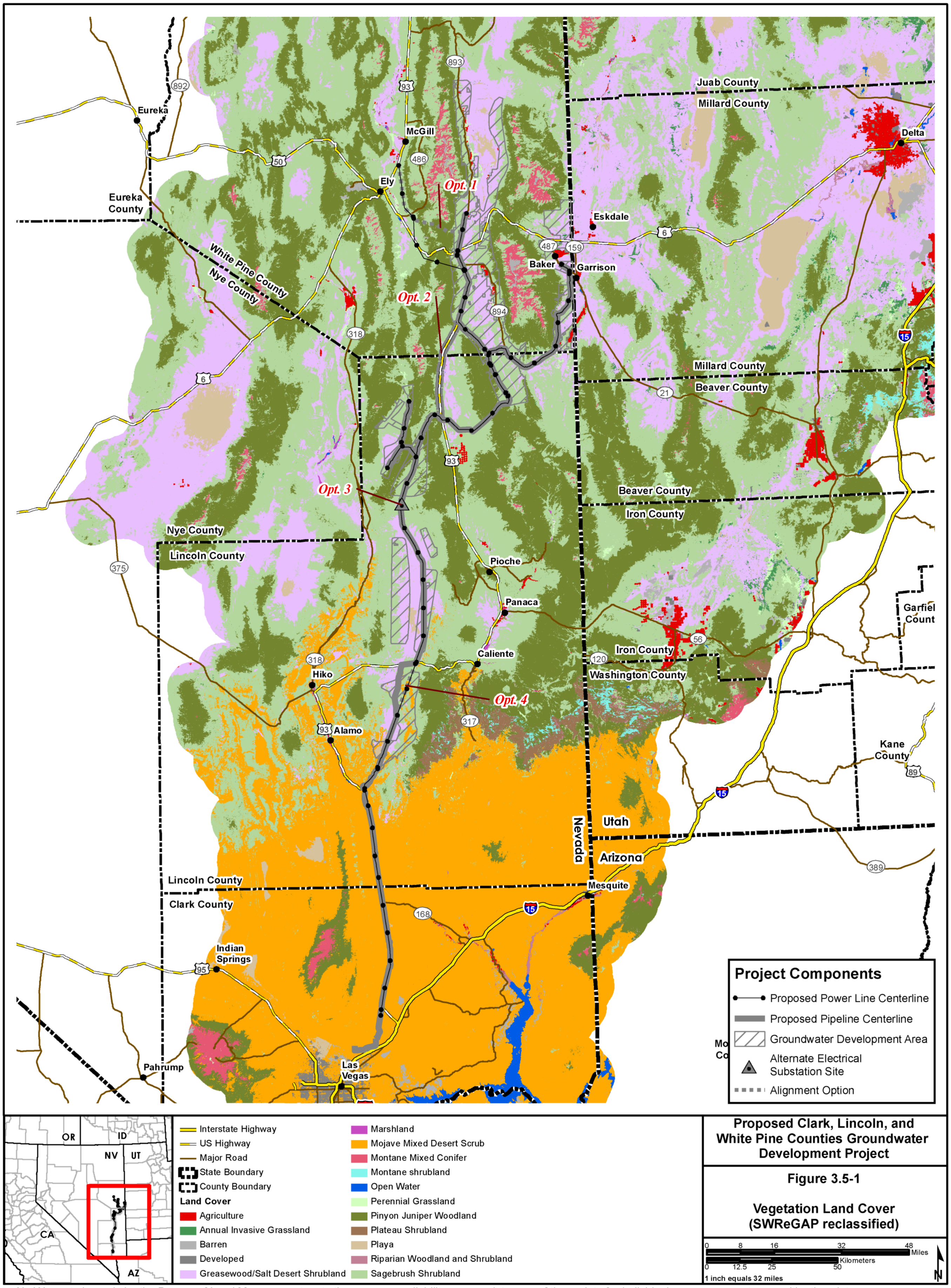
Land Cover Types

The regional SWReGAP Land Cover types were grouped into broader cover classes to provide a description of the major wildlife habitat types (see Section 3.6, Wildlife) (**Figure 3.5-1)**. The ROW study area is defined as the maximum potential project surface disturbance footprint associated with the pipeline and ancillary facilities, including the staging Caliente construction support area (Lower Meadow Valley Wash). **Table 3.5-1** provides the cover types, the hydrologic basins where the ROW study area coincides with these cover types, and the relative percentage of each cover type that would be occupied by ROW facilities. The ROW areas are dominated by three major cover types: sagebrush shrubland (48 percent), Mojave mixed desert shrubland (25 percent), and greasewood/salt desert shrubland (24 percent). All other cover types represent 3 percent or less.

Table 3.5-1 Land Cover Types that Occur within the GWD Project Right-of-way Study Area and Hydrologic Basins

Cover Type	ROW Area by Hydrologic Basin	Percentage of ROW Area Occupied by Cover Type
Agriculture/Developed	LMV	Less than 1
Annual Invasive Grassland	D,H,LMV	Less than 1
Barren	D	Less than 1
Greasewood/Salt Desert Shrubland	C,D,DL,H,L,LMV,P,SN,SP,ST	24
Marshland	LMV	Less than 1
Mojave Mixed Desert Shrubland	CS,D,DL,G,HV,LV,P	25
Perennial Grassland	D,DL,L,SN,SP,	Less than 1
Pinyon-Juniper Woodland	C,DL,H,L,LMV,SN, SP,ST	2
Playa	CS,D,DL,	Less than 1
Riparian Woodland and Shrubland	LMV	Less than 1
Sagebrush Shrubland	C,D,DL,H,L,LMV,P,SN,SP,ST	48

C= Cave Valley, CS = Coyote Springs Valley, D = Delamar Valley; DL = Dry Lake Valley, G = Garnet Valley, H = Hamlin Valley, HV = Hidden Valley, L = Lake Valley, LV = Las Vegas Valley, LMV = Lower Meadow Valley Wash, P = Pahranagat Valley, SN = Snake Valley, SP = Spring Valley, ST = Steptoe Valley.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Wetland and Floodplain Protection

Many wetlands are protected under the CWA as waters of the United States and special aquatic sites. Wetlands are defined by the USACE based on the presence of wetland vegetation, wetland hydrology, and hydric soils. EO 11990, Protection of Wetlands (42 *Federal Register* 26961), directs all federal agencies to minimize the destruction, loss, or degradation of wetlands, and to enhance the natural and beneficial values of wetlands. As a result, federal regulation and management of both USACE jurisdictional and non-jurisdictional wetlands follows a “no net loss” policy. Executive Order 11988, floodplain management requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative.

United States Army Corps of Engineers Jurisdictional Determinations

SNWA conducted preliminary jurisdictional determinations to determine the location and extent of any Waters of the U.S. for which a USACE 404 Permit would be required for constructing the water pipeline and ancillary facilities. A total of 68 ephemeral washes were identified as Waters of the U.S., with channel widths averaging 2 feet. This inventory of crossings is combined with 51 ephemeral washes identified in a prior permit application for a total of 119 ephemeral wash crossings for the GWD Project. Snake Creek (in the Snake Valley) was identified as a perennial stream (SNWA 2008). The stream channel is lined by a narrow band of sandbar willows (*Salix exigua*) classified as an obligate wetland species. The USACE (2009) confirmed the jurisdictional determination findings.

Wildland Fire Risk

Within each vegetation community type, there is a characteristic fire regime. A fire regime is a general description of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995). Historical fire regimes are classified based on average number of years between fires (fire frequency) combined with the severity (amount of replacement) of the fire on the dominant overstory vegetation. Generally the fire frequency is inversely related to fire intensity. For example, due to higher precipitation levels and cooler mean temperatures (which foster plant growth), there are higher fuel loads in pinyon-juniper woodlands and upper montane forest vegetation types as compared to lowland shrublands. In addition, the higher precipitation amounts and cooler temperatures provide higher resistance to fire for longer periods. This leads to fires of high intensity that occur infrequently. The reverse is true in grasslands where fine fuel types lead to fires at a high frequency that burn rapidly with low intensity. Other factors that determine fire behavior include site topography, weather conditions, time of year, type of plant community, health of the ecosystem, fuel moisture levels, depth and duration of heat penetration, fire frequency and site productivity. The highest potential rates of spread occur in areas with flashy fuels such as cured-out annual bromes, and steep brushy mountain slopes.

Wildland fire risk tends to be high in disturbed grasslands and forblands dominated by non-native noxious and invasive species, specifically the annual brome species such as cheatgrass and red brome (BLM 2010). Areas dominated by crested wheatgrass tend to have lower fire risk because this species stays green during the early part of the fire season, and because grass clumps within rows are widely spaced as the result of drill seeding.

The response and revegetation potential of each vegetation type varies depending on actual fire conditions, the seasonal timing, pre- and post-fire vegetation, elevation and post-fire weather patterns. Vegetation in low-intensity fire areas (for example areas, where native perennial bunchgrass cover and site productivity are high) can frequently revegetate naturally without seeding. High intensity fires in areas with dense sagebrush or pinyon-juniper stands can result in scorched, water-resistant soils that become unproductive until the condition changes, which could take several years. Extremely severe fires have been known to sterilize soils and lead to the permanent loss of productivity. **Appendix F3.5** describes general fuel conditions, fire frequency, and succession timelines for vegetation communities present in the ROW.

The Mojave Desert region historically had few, very infrequent fire events due to the limited amount of herbaceous understory vegetation between and around shrub species (Rogstad et al. 2009). The spread of invasive species, specifically annual invasive grass, such as red brome and cheatgrass, into these interspaces has dramatically increased the fuel load in these communities (Brooks and Matchett 2006).

Fire Regime Condition Class (FRCC) is a discrete metric that describes how similar a landscape's fire regime is to its natural or historical state. FRCC quantifies the amount that current vegetation has departed from the simulated historical vegetation reference conditions (Hann and Bunnell 2001; Hardy et al 2001; Barrett et al. 2010; Holsinger et al. 2006). The three condition classes describe low departure (FRCC 1), moderate departure (FRCC 2), and high departure (FRCC 3). Landscapes determined to fall within the category of FRCC 1 contain vegetation, fuels, and disturbances characteristic of the natural regime; FRCC 2 landscapes are those that are moderately departed from the natural regime; and FRCC 3 landscapes reflect vegetation, fuels, and disturbances that are uncharacteristic of the natural regime. A map of Fire Regime Condition Classes along the project ROW can be found in **Appendix F3.5**. The FRCC layer depicted in this figure represents the departure of current vegetation conditions from simulated historical reference conditions according to the methods outlined in the *Interagency Fire Regime Condition Class Guidebook* (Barrett et al. 2010). Full descriptions of the FRCC categories, their associated fire regimes, and management options are found in **Appendix F3.5**.

Noxious and Non-native Invasive Weeds

Under the Federal Plant Protection Act of 2000 (formerly the Noxious Weed Act of 1974 [7 USC SS 2801-2814]), a noxious weed is defined as “any plant or plant product that can directly or indirectly injure or cause damage to crops, livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the U.S., the public health, or the environment” (Animal and Plant Health Inspection Service 2000; Institute of Public Law 1994). Each state is federally mandated to uphold the rules and regulations set forth by this act and manage its lands accordingly. In addition, the federal Noxious Weed Act of 1974, as amended (7 USC Secs.2801 et seq.) requires cooperation with state, local, and other federal agencies in the application and enforcement of all laws and regulations relating to the management and control of noxious weeds.

The State of Nevada also regulates noxious weeds. Under the NRS, a noxious weed is defined as “any species of plant which is, or is likely to be, detrimental or destructive and difficult to control or eradicate” (NRS 555.005 – Control of insects, pests, and noxious weeds). Noxious weeds are classified into three categories based on the statewide importance, distribution, and the ability of eradication or control measures to be successful. Category A weeds are not currently found or are limited in distribution throughout the state (control is required by the state in all infestations); Category B weeds are found in scattered populations in some counties of the state (control is required by the state in areas where populations are not well established or previously unknown to occur); and Category C weeds are currently established and generally widespread in many counties of the state (control is at the discretion of the state quarantine officer) (NRS 555.010).

The spread of noxious weeds has resulted in substantial economic impacts on some sectors in Utah. As a result, Utah has enacted laws requiring the control of noxious weed species (Utah State Legislature 2008). Under the Utah Noxious Weed Act, a “noxious weed” is defined as any plant the commissioner determines to be especially injurious to public health, crops, livestock, land, or other property (Utah State Legislature 2008). In 2008, the Utah Noxious Weed Act was amended to allow for the categorization of weeds into three categories: Class A (Early Detection Rapid Response) Class B (Control) and Class C (Containment). Class A Early Detection Rapid Response weeds are noxious weeds not native to the state of Utah and that pose a serious threat to the state and should be considered as a very high priority for control and prevention. Class B Control weeds are noxious weeds not native to the state that pose a threat to the state and should be considered a high priority for control. Lastly, Class C Containment weeds are noxious weeds that are not native to the state, are widely spread, and pose a threat to the agriculture industry and to agricultural products, and control methods should focus on stopping invasion.

An invasive species is defined as a species that is: 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health (National Invasive Species Council 2001).

Data from the Tri-County Weed Control Project (TCWCP) (2007) and the BLM Ely District Office (BLM 2009) were compiled and integrated into a GIS database. Weed occurrences within the ROW study area and hydrologic basins were then compiled. Based on field surveys conducted within the ROW study area between 2001 and 2008 (BLM 2010), infestations of the following noxious weed species are known to occur within 1,000 feet of the ROWs for all alternatives: Russian knapweed (*Acroptilon repens*), Sahara mustard (*Brassica toumefortii*), Spotted knapweed (*Centaurea stoebe*), Canada thistle (*Cirsium arvense*), poison hemlock (*Conium maculatum*), hoary cress (*Lepidium draba*), tall whitetop (*Lepidium latifolium*), Dalmation toadflax (*Linaria dalmatica*), Scotch thistle (*Onoporodum acanthium*), salt cedar (*Tamarix sp*.), and Malta starthistle (*Centaurea solstitalis*).

The biological characteristics of noxious weeds are provided in **Appendix F3.5** including; 1) status; 2) general distribution in the world, USA or North America; 3) general habitat; 4) life history and flowering period; 5) any details regarding a species' propensity to invade wildlands and any specific mechanisms for doing so (if available); and 6) any preferred control measures (if available). Information on invasive species that are widely distributed within the ROW area, including red brome, cheatgrass, and salt lover (*Halogeton glomeratus*), also is provided.

An Ely District Integrated Weed Management Plan and Preliminary EA (BLM 2009) was prepared by the Ely District for application across all field offices (**Appendix F3.5**). A project-specific weed risk management plan (BLM 2010) was prepared, based on guidance contained in the integrated weed management plan.

Cactus and Yucca

Nevada state law regulates the removal or possession of native cacti and yucca in commercial quantities. A permit must be obtained from the Nevada Department of Forestry to remove and transplant these species. Within the ROW area, 23 protected species of cactus and yucca were identified (**Appendix F3.5**). Surveys for these species were conducted by SNWA (Wildland 2009; Jones & Stokes 2005). Surveys consisted of a complete inventory and total stem count within the proposed ROW and associated ancillary facility sites. These surveys were used to calculate the density of species per acre along the proposed ROW, as well as the number of stems per linear mile. For the ancillary facilities, the stems per acre by species were calculated.

Within the Mojave Desert portion of the project from the south end of Delamar Valley to the pipeline terminus near Las Vegas, approximately 35,000 cacti representing 11 species were inventoried within the ROW. Additionally, approximately 106,000 Mojave yuccas (*Yucca schidigera*); 4,250 Joshua trees (*Yucca brevifolia*); and 2,670 banana yuccas (*Yucca baccata*) were inventoried (Jones & Stokes 2005). Additional yucca and cactus surveys were conducted in Dry Lake and Delamar valleys (Wildland 2009). Joshua trees, banana yuccas, Wiggins' cholla (*Cylindropuntia echinocarpa*), and grizzly bear pricklypear (*Opuntia polyacantha* var. *erinacea*) were the most abundant species. Cactus and yucca density was 1,299 stems per mile in Dry Lake Valley. Cactus and yucca populations were much lower in the remaining valleys crossed by proposed facilities.

Special Status Plant Species

Occurrence data for special status species in the ROW area were obtained from the Nevada Natural Heritage Program (NNHP). Additional occurrence information was obtained through field surveys sponsored by SNWA (Wildland 2009, 2007; Jones & Stokes 2005). The overall list includes 35 BLM sensitive species, 17 USFS sensitive species, 6 Nevada protected critically endangered species, 24 Nevada protected cactus or yucca species, and 1 federally threatened species (**Appendix F3.5**). Additional species of concern that may occur in the ROW were identified by a technical cooperating agency group that was comprised of representatives from the BLM in Nevada and Utah, USFWS in Nevada and Utah, NDOW, and UDWR.

Individuals of five special status species were found to occur within the construction ROW and suitable habitats for four species were identified, based on nearby survey occurrences (**Table 3.5-2**).

Table 3.5-2 Special Status Plant Species Occurrence and Suitable Habitat within the Right-of-way Area

Common Name/Scientific Name	Status	Occurrence
Eastwood milkweed *Asclepias eastwoodiana*	BLM Sensitive, USFS Sensitive Nevada Critically Endangered	ROW
Threecorner milkvetch *Astragalus geyeri* var. *triquetrus*	BLM Sensitive, Nevada Critically Endangered	Habitat in ROW
Long-calyx eggvetch (egg milkvetch) *Astragalus oophorus* var. *lonchocalyx*	BLM Sensitive	ROW
Las Vegas buckwheat *Eriogonum corymbosum* var. *nilesii*	USFWS Candidate, BLM Sensitive	Low potential habitat identified in ROW
Yellow twotone beardtongue *Penstemon bicolor* ssp. *Bicolor*	BLM Sensitive, USFS Sensitive	ROW
Rosy twotone beardtongue *Penstemon bicolor* var. *roseus*	BLM Sensitive, USFS Sensitive	ROW
Blaine's fishhook cactus *Sclerocactus blainei*	BLM Sensitive; Nevada Harvest Regulated	ROW
Nachlinger catchfly (*Silene nachlingerae*)	BLM Sensitive, USFS Sensitive	Habitat in ROW
White bearpoppy (*Arctomecon merriamii*)	BLM Sensitive, USFS Sensitive	Habitat in ROW

3.5.1.3 Groundwater Development Areas

Land Cover

Eleven land cover types are mapped within the groundwater development areas (**Table 3.5-3**). The greasewood/salt desert shrubland and sagebrush shrubland are the dominant cover types in all development areas. The Mojave mixed desert shrubland represented 22 percent of the land cover in Delamar Valley. The remaining cover types provide less than 20 percent cover in the individual hydrologic basins.

Table 3.5-3 Percent Cover of Land Cover Types Within GWD Project Groundwater Development Areas

	Cave Valley	Delamar Valley	Dry Lake Valley	Snake Valley	Spring Valley
Agriculture/Developed	0	0	0	< 1	0
Annual Invasive Grassland	0	< 1	< 1	3	0
Greasewood/Salt Desert Shrubland	23	20	36	43	32
Mojave Mixed Desert Shrubland	0	22	< 1	0	0
Perennial Grassland	0	< 1	< 1	0	< 1
Marshland	0	< 1	0	0	< 1
Barren	0	< 1	< 1	0	< 1
Pinyon-Juniper Woodland	16	< 1	11	6	7
Playa	0	4	1	0	< 1
Riparian Woodland and Shrubland	0	0	0	< 1	0
Sagebrush Shrubland	61	53	51	47	61
Groundwater Development Area Size (acres)	34,787	71,889	168,769	92,703	361,795

Source: SWReGAP (USGS 2005).

United States Army Corps of Engineers Jurisdictional Wetlands

No jurisdictional wetland delineations have been completed for potential future GWD Project in any of the groundwater development areas within the proposed pumping basins. Subsequent NEPA analysis would further identify and quantify wetland impacts associated with the groundwater development project and develop mitigation measures.

Noxious Weed Species

The data sources and field surveys for noxious and non-native invasive weed species in the groundwater development areas are the same as described for the ROW. Noxious weed species found in the groundwater development areas by hydrologic basin are presented in **Appendix F3.5**. Nine noxious weed species have been documented in the groundwater development areas: Russian knapweed, hoary cress, musk thistle, spotted knapweed, water hemlock, Canada thistle, tall whitetop, Scotch thistle, and tamarisk.

Special Status Species

A summary of special status plant species known or potentially present within the groundwater development areas is presented in **Table 3.5-4**. There were four species observed in the groundwater development areas, and three species with potential habitat. Potential habitat was based on the similarity in associated vegetation, soils, and slopes to areas occupied by known populations.

Table 3.5-4 Special Status Species Known or Potentially Present within Groundwater Development Areas

Common/Scientific Name	Status	Occurrence
Eastwood milkweed *Asclepias eastwoodiae*	BLM Sensitive, USFS Sensitive	Dry Lake Valley, Muleshoe Valley – populations found in groundwater development areas
Meadow milkvetch *Astragalus diversifolius*	USFS Sensitive	Spring Valley – Moderate potential habitat
Long-calyx egg milkvetch *Astragalus oophorus* var. *lonchocalyx*	BLM Sensitive	Spring Valley – one population with two individuals
Tunnel Springs beardtongue *Penstemon concinnus*	BLM Sensitive	Spring Valley – Low potential habitat Snake Valley – Moderate potential habitat
Parish's phacelia *Phacelia parishii*	BLM Sensitive	Dry Lake Valley – Large population along playa margin Cave Valley – Very large population (estimated at more than a million plants)
Blaine fishhook cactus *Sclerocactus blainei*	BLM Senstive, Nevada Harvest Regulated	Dry Lake Valley – one individual was observed, and low to high potential habitat identified on 12 transects
Ute ladies'-tresses *Spiranthes diluvialis*	USFWS Threatened, BLM Sensitive, USFS Sensitive	Spring Valley – Based on field surveys, the following springs provide high potential habitat (i.e. ideal conditions) for the orchid : Keegan Ranch (Middle) and Keegan Ranch (South); Stonehouse Spring; Swallow Spring, and West Spring Valley Complex (North). No Ute ladies'-tresses orchids were located during 2007 surveys (BIO-WEST 2007a,b,c)

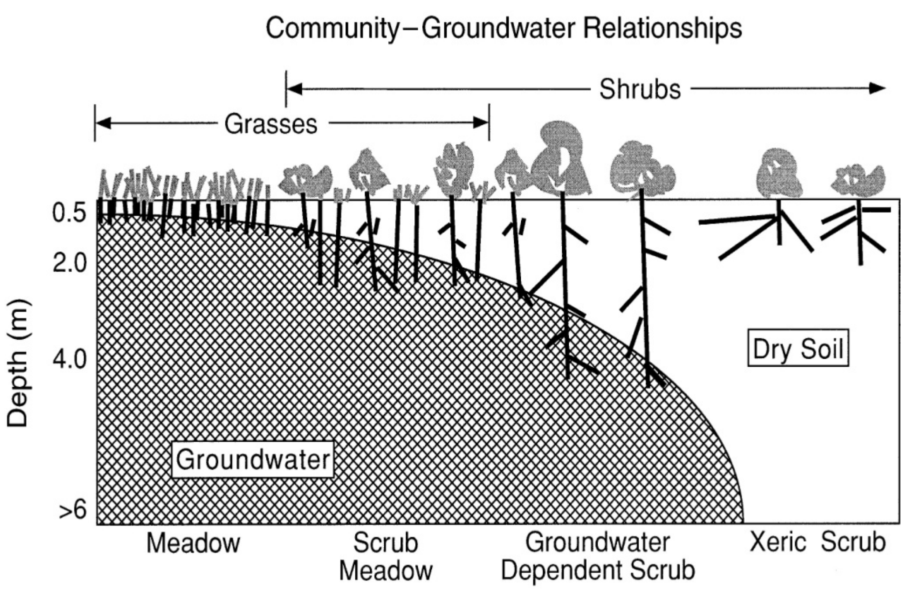
The Ute ladies'-tresses was listed as threatened under the ESA on January 17, 1992 (USFWS 1992). The species is threatened due to scarcity of populations, small population sizes, and loss of habitat due to urbanization and stream channelization for agriculture and development, as well as competition from non-native plant species, and vegetation succession (NatureServe 2009). The species typically inhabits moist, sub-irrigated, or seasonally flooded soils at elevations between 4,200 to 5,300 feet amsl (USFWS 1995). A wide variety of soils are suitable for this species, including sandy or coarse, cobbly alluvium to calcareous, histic (high in organic matter) fine-textured clays, and loams. Primary habitats include valley bottoms, gravel bars, and floodplains along springs, lakes, rivers, or perennial streams that receive periodic disturbance from over-bank flooding and livestock grazing.

3.5.1.4 Region of Study

Overview

The region of study for vegetation resources is the natural resources region of study, discussed in Section 3.0. The focus of this section is on surface and groundwater dependent vegetation resources, riparian areas, located within hydrologic basins potentially affected by future groundwater pumping. Riparian areas are transitional zones between terrestrial and aquatic ecosystems and are distinguished by gradients in biophysical conditions, ecological processes and biota (NRC 2002). These areas are connected to surface and/or sub-surface (groundwater) waterbodies and exhibit unique soil characteristics. Vegetation communities within riparian areas include both woody, such as trees and shrubs, and non-woody species, such as forbs and grasses.

Figure 3.5-2 provides a generalized relationship of groundwater dependent vegetation to groundwater depths. Where groundwater remains at or near the surface for the majority of the growing season, wetland plants such as sedges (*Carex* spp.), rushes (*Juncus* spp.), bulrushes (*Schoenoplectus* spp.) and cattails (*Typha* spp.) are commonly the dominant community components. Root systems of these plants are typically shallow, because the roots are in contact with the groundwater surface over the majority of the year. These wetland plants are characteristic of meadows that form below the spring discharge points. Water dependent shrubs such as willows and cottonwoods often line the channel of streams with perennial to intermittent flow.



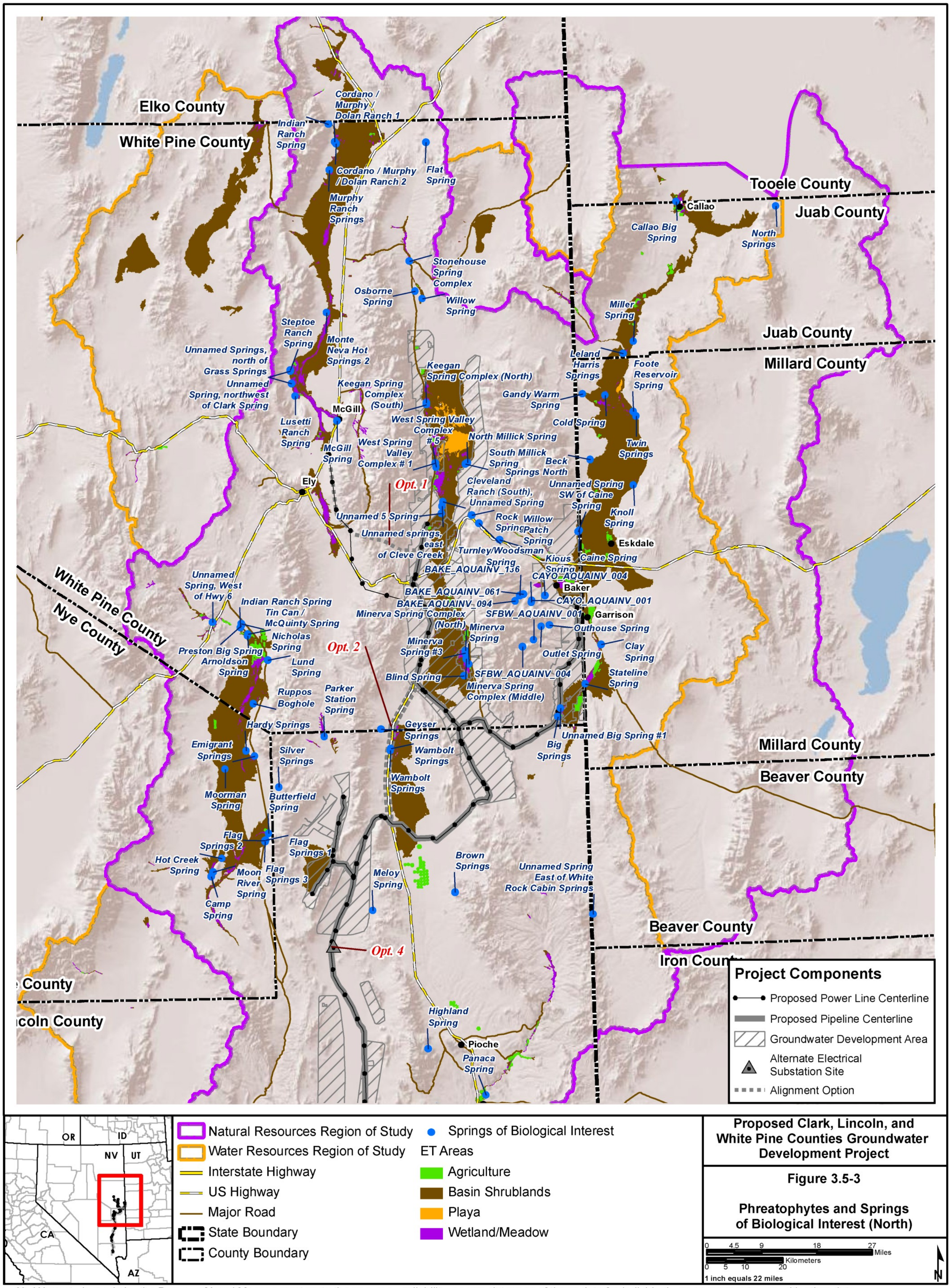
Source: Elmore et al. 2006.

Figure 3.5-2 Relationship of Plant Community Components to Groundwater Depths

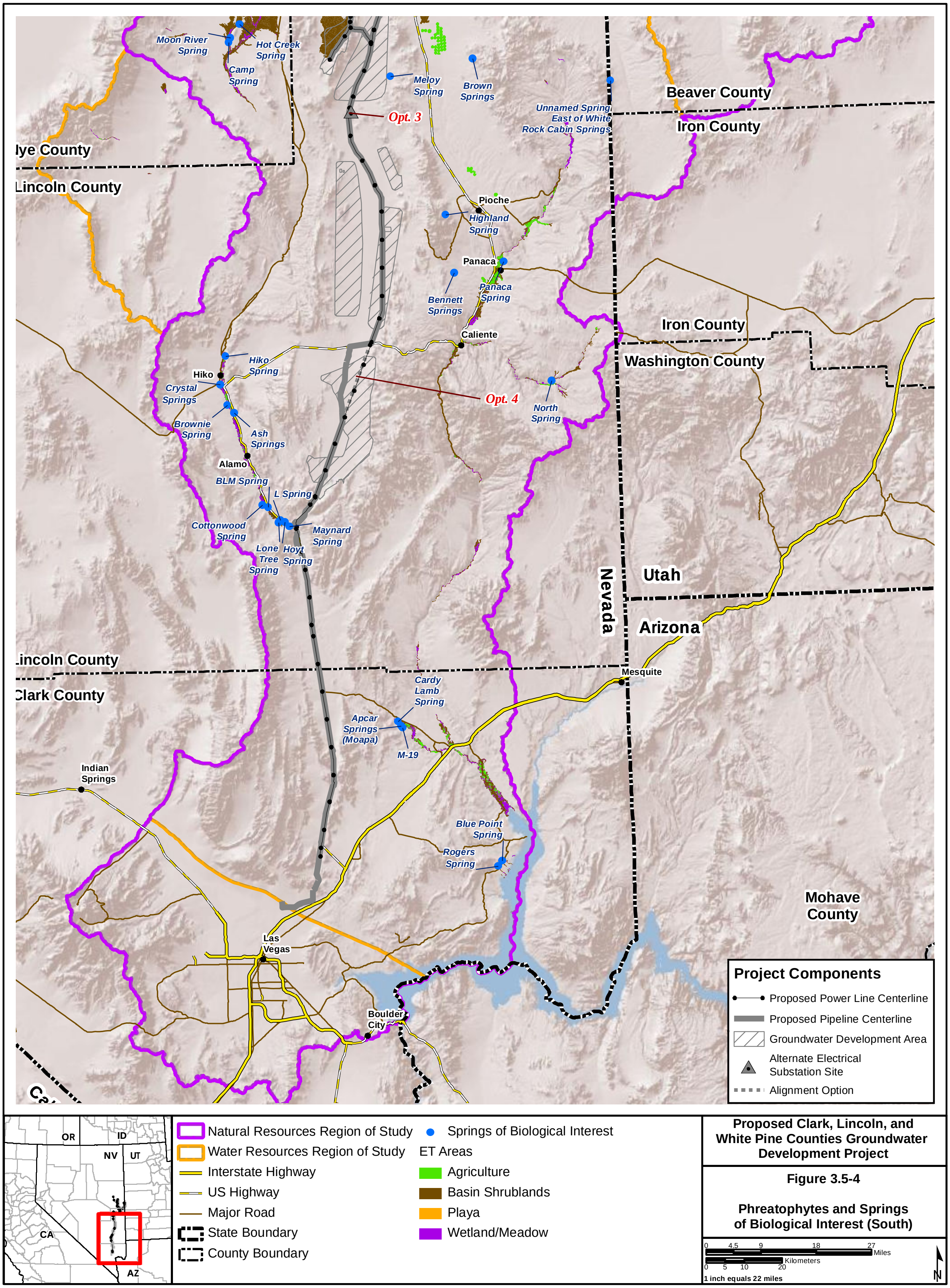
As groundwater depths increase, perennial grasses and shrubs that are capable of extending their root systems to greater soil depths can take advantage of both precipitation and groundwater soil moisture. Several of these species are classified as phreatophytes, which are discussed below. Species that are adapted to grow on soils with no sub-surface moisture provided by groundwater are classified as xerophytes.

Spring Vegetation

Section 3.3, Water Resources, provides detailed information on spring locations and flows within the region of study. **Figures 3.5-3** and **3.5-4** illustrate the major springs of high biological importance within the hydrologic study area. Aquatic and wetland communities that have developed around and downgradient of springs were mapped into dominant species associations (BIO-WEST 2007a). Spring meadow vegetation in these areas ranges from herbaceous wetlands to woody plants along drainages. A summary of the vegetation community types associated with springs sampled within hydrologic basins in eastern Nevada and western Utah is provided in **Table 3.5-5**.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-4

Phreatophytes and Springs of Biological Interest (South)

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Table 3.5-5 Vegetation Community Characteristics for Example Spring Systems Sampled in Hydrologic Basins within the Region of Study

Nevada Hydrologic Basins Proposed for Project Groundwater Pumping	
Spring Valley 19 spring systems mapped	Dominant aquatic vegetation in the Unnamed Springs East of Cleve Creek, South Millick Spring and South Bastion Spring in northern Spring Valley include watercress (*Rorippa nasturtium aquaticum*), fine-leaf pondweed (*Suckenia filiformis*), horsehair algae (*Chlorophyceae* sp.), and stonewort (*Chara vulgaris*). Arctic rush and spike rush (*Eleocharis* sp.) are the dominant wetland species. Dominant aquatic vegetation in southern Spring Valley springs (Willard, Minerva, and Swallow) is similar to that in the northern part of Spring Valley.
Snake Valley 21 spring systems mapped.	Dominant aquatic vegetation in the Big Spring system, South Little Spring, and North Little Spring include watercress, horsehair algae, and muskgrass (*Chara vulgaris*). The dominant wetland species include Arctic rush, Nebraska sedge (*Carex nebrascensis*), redtop (*Agrostis gigantea*), spikerush, and three square bulrush (*Schoenoplectus americanus*).
Cave Valley 2 small springs identified, no access.	Cave Spring, Unnamed Spring at Parker Station.
Dry Lake Valley 3 spring systems mapped	Bailey, Coyote, and Fence Springs. Very small springs (less than 1 acre each). Primarily introduced species in the herbaceous layer: curly dock (*Rumex crispus*), sweet clover (*Melilotus officinalis*). Shrubs: skunkbush (*Rhus trilobata*). Trees: Fremont cottonwood (*Populus fremontii)*.
Delamar Valley 1 spring system mapped	Grassy spring. Highly disturbed small spring, developed for stock watering. Open water with no vegetation, small areas of hardstem bulrush (*Schoenoplectus acutus*).
Other Hydrologic Basins within the Region of Study	
White River Valley, Nevada 9 spring systems mapped	The most abundant aquatic species include horsehair algae and watercress. The most abundant emergent wetland species include Arctic rush, Olney's three-square bulrush (*Schoenoplectus americanus*), broadleaf cattail (*Typha latifolia*), saltgrass, and spike rush. Some trees (cottonwoods, boxelder, black locust, and Russian olive) were established in several wetlands sampled.
Pahranagat Valley (including Pahranagat National Wildlife Refuge [NWR]), Nevada 8 spring systems mapped	Dominant species composition is similar to that of the White River Valley, with the addition of yerba mansa (*Anemopsis californica*). An extensive emergent wetland system is supported by spring flows in the Pahranagat Valley between Hiko and Alamo (Pahranagat NWR).
Lake Valley, Nevada 1 spring system mapped	Wambolt Spring Complex. Mare's tail (*Hippuris vulgaris*) and watercress are the primary aquatic species. Dominant emergent wetland species are Nebraska sedge and spikerush.
Panaca Valley, Nevada 1 spring system mapped	Panaca Big Spring. Algae, the sole aquatic vegetation type, covered about 30 percent of the wet area. Olney's three-square bulrush was the dominant emergent wetland species.
Tule Valley, Utah 4 spring systems mapped	Coyote, South Tule, Tule (4a), and Willow Springs. Horsehair algae and watercress are the dominant aquatic species; Olney's three-square bulrush, Arctic rush, salt grass, and common reed (*Phragmites australis*) are the dominant emergent wetland species.
Fish Springs NWR (Fish Springs Flat), Utah 8 spring systems mapped	Species composition is similar to that described for Tule Valley. Willows, cottonwood trees, and tamarisk also are present.

Woody Riparian

Mountain streams flow for short distances onto the valley floors before being diverted for agriculture or infiltrating into coarse outwash materials on valley side slopes. Surface water from the mountain snowpack and groundwater from springs contribute to the base flows of these perennial streams (see Section 3.3, Water Resources). Examples of mountain streams with well developed bands of riparian vegetation include Cleve Creek on the east side of the Schell Creek Range and Snake Creek, Lehman Creek, Baker Creek, and Big Wash that drain from watersheds in GBNP on the east side of the Snake Range. Woody riparian species occur in narrow bands adjacent to perennial stream reaches.

Example riparian woody species include narrowleaf cottonwood (*Populus angustifolia*), Fremont cottonwood (*Populus fremontii*), willows (*Salix* spp.), chokecherry (*Prunus virginiana*), and water birch (*Betula occidentalis*) (GBNP 2007). A tall riparian shrubland lines the channel of larger regional stream systems (Meadow Valley Wash, Muddy River) in the southern portion of the region of study. These riparian species include cottonwoods, various willow species, and tamarisk (*Tamarix* spp.). These riparian areas have been distinguished as a distinct ET (DeMeo et al. 2008) (see next section).

Evapotranspiration Areas and Phreatophytes

ET areas are ground surface locations where groundwater is discharged (lost to the atmosphere) from plant transpiration, and evaporation from soils and open water bodies. The ET areas within individual hydrologic basins were mapped as an input variable for estimating groundwater discharge (see Section 3.3, Water Resources). ET rates are an essential input to groundwater recharge and discharge budgets, which are in turn used to define sustainable groundwater yields. A variety of reconnaissance studies have been conducted to estimate ET rates from major water supply basins (Harrill et al. 1988; Nichols 2000).

Evapotranspiration (ET): Water lost to the atmosphere from the ground surface, evaporation from the capillary fringe of the groundwater table, and the transpiration of groundwater by plants whose roots tap the capillary fringe of the groundwater table. Source: USGS 2010.

To estimate ET, the amount of water entering the atmosphere from vegetation leaves must be included. Transpiration is the loss of water from the leaves of plants as the result of cellular respiration, and as a response to high atmospheric temperatures and low relative humidity. Water is withdrawn from the soil root system and transported through the stems and branches to the leaves. Water transported upward from the roots replaces water lost from the leaves through pores called stomata.

ET Area: An area of similar vegetation composition and density with similar evapotranspiraton rates.

Certain plants, called phreatophytes, are capable of withdrawing water from the groundwater through a deep and extensive root system. The plants then release a fraction of that water to the atmosphere. There are various definitions for phreatophytes: 1) they are plants dependent on groundwater as a moisture source (Robinson 1958; Busch et al. 1992); 2) they grow where there is insufficient precipitation and thus require groundwater for survival (Naumburg et al. 2005); 3) they habitually obtain their water supply from the saturated zone (Le Maitre et al. 1999); 4) they obtain at least some water from shallow groundwater (Cooper et al. 2006) and through root system adaptations they normally reach and consume groundwater. Plants usually classified as phreatophytes access groundwater by deep roots and can achieve high transpiration rates even during times of low precipitation (Busch et al. 1992; Dileanis and Groeneveld 1989; Le Maitre et al. 1999; Naumburg et al. 2005).

Transpiration: Evaporation of water from plant leaves. The rate of evaporation is affected by temperature, relative humidity, and wind and air movement. Source: USGS 2010.

The phreatophyte shrub greasewood (*Sarcobatus vermiculatus*) is a key indicator of relatively shallow groundwater depths in the Great Basin. Studies of root depths of this shrub species in relation to groundwater depth indicate that rooting depths range from the soil surface to greater than 50 feet (Meinzer 1927; Robinson 1958). Recent studies in the Snake, Spring, and White River valleys (Moreo et al. 2007; Devitt et al. 2011) indicate that depth to groundwater ranged between 10 and 45 feet on sites dominated by greasewood. Greasewood is highly adapted to utilizing water from precipitation as well as groundwater because of the distribution of its root system from near the soil surface down to the groundwater capillary fringe. The sources for plant respiration and growth vary seasonally. Micro-meteorological studies of plant transpiration losses and evaporation from adjacent soils indicated that greasewood shrubs first consumed available shallow soil moisture during the early part of the growing season. As surface soils dried out, the shrubs increasingly transpired water from groundwater source and groundwater depths declined seasonally (Nichols1993; Moreo et al. 2007).

Capillary Fringe: The subsurface layer in which groundwater seeps up from a water table by capillary action to fill pores.

Three stands of an unusual Rocky Mountain juniper "swamp cedar" community type occur in Spring Valley. Two of these three stands are described by Charlet (2006) in a study of interbasin water transport in Spring Valley. The more northern (north of U.S. Highways 6 and 50) stand is approximately 1.5 square miles, and the southern (south of U.S. Highways 6 and 50) stand occupies about 2.5 square miles. These two stands are part of the BLM-NV Swamp Cedar ACEC (see further discussion in Section 3.14, Special Designations). The third stand of "swamp cedar" is located in the vicinity of Shoshone Ponds in southern Spring Valley, and is part of the BLM-NV Shoshone Ponds ACEC. Charlet (2006) reports that common shrub associates include greasewood, yellow rabbitbrush (*Chrysothamnus viscidiflorus*), rubber rabbitbrush, shadscale saltbush, and Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*). Native grasses associated with these woodlands include basin wildrye (*Leymus cinereus*), saltgrass, and alkali cordgrass (*Spartina gracilis*). Permanently wet areas around springs may support arctic rush (*Juncus arcticus*) and bulrush (*Scirpus* sp.). Depending on conditions, the community structures vary from an open park-like savanna to dense woodlands and thickets.

The "swamp cedar" communities in Spring Valley are unique to the low elevation landscape that occurs in seasonally flooded valley bottoms. Rocky Mountain juniper is not assigned a wetland indicator status by the USDA, as it is considered an upland species throughout its range. The distinct low-elevation populations of swamp cedars occurring in the GWD Project area are unique biological systems occurring on the edge of this species' geographic distribution. While no quantitative research has been conducted on these populations to determine the ecological factors that allow them to exist at these low-elevation sites, it is hypothesized that their occurrence is the result of more water being available to the trees than is available solely from precipitation. **Table 3.5-6** lists plant species commonly occurring in ET areas mapped for this project that can function as phreatophtyes, depending upon the availability of shallow groundwater. Big sagebrush, four wing saltbush, shadscale saltbush, rubber rabbitbrush, and greasewood can exploit shallow groundwater systems and therefore function as phreatophytic plants. These species can take advantage of groundwater when present but also can tolerate periods of low water availability (Barbour et al. 1987).

Table 3.5-6 Occurrence of Representative Species within Evapotranspiration Areas Mapped in the GWD Project Region of Study

Species	Life Form	Wetland/Meadow	Basin Shrubland	Riparian Shrubland
Big sagebrush (Artemisia tridentata ssp. tridentata)	Shrub		X	X
Fourwing saltbush (Atriplex canescens)	Shrub		X	X
Shadscale saltbush (Atriplex confertifolia)	Shrub		X	
Saltgrass (Distichlis spicata)	Herb	X	X	X
Rubber rabbitbrush (Ericameria nauseosa)	Shrub		X	X
Basin wildrye (Leymus cinereus)	Herb	X	X	X
Cottonwoods (Populus ssp.)	Tree	X		X
Willows (Salix ssp.)	Shrub	X		X
Greasewood (Sarcobatus vermiculatus)	Shrub		X	X
Alkali sacaton (Sporobolus airoides)	Herb	X	X	X

A first step for estimating water lost to the atmosphere from plant transpiration is to map the distribution and abundance of phreatophyte shrub and herbaceous communities within a hydrologic basin. If the annual transpiration rate can be determined for the dominant phreatophyte species, then the transpiration losses over large areas of similar vegetation composition and density (ET) can be calculated. In groundwater supply reconnaissance studies conducted from the 1940s through 1960s, phreatophyte shrubs that were transpiring groundwater were identified by examining the relative shrub foliage vigor during the summer months (after winter precipitation soil moisture had been evaporated, or taken up by plants). Actively photosynthesizing (green) foliage was considered to be sustained by groundwater. Shrubs with low or no photosynthetic activity (often dormant) were assumed not to be sustained by groundwater. Ground reconnaissance estimates of phreatophyte foliar activity were augmented by the use of multi-spectral satellite imagery to identify and map photosynthetically active vegetation over large areas, based on infrared light reflectance (Nichols 2000). Satellite imagery also allows examination of vegetation in multiple seasons and multiple years. This multiple sampling approach provides a tool for assessing the variability of phreatophyte and other vegetation dependence on underlying groundwater.

The USGS (Smith et al. 2007) used multiple sources of information to map nine ET areas within several of the region of study basins (Snake, Spring, White River, Lake, and Cave) (**Table 3.5-7**). This mapping was a component of the BARCAS studies to estimate the groundwater resources within these basins. The ET boundaries were established from: 1) existing land cover mapping SWReGAP; 2) analysis of certain infrared wavelength bands within LandSat Thematic Mapper Imagery to identify photosynthetically active vegetation; 3) field measurements of ET losses; and 4) inspection of relative vigor of phreatophyte and other vegetation from ground reconnaissance within each basin. The ET areas were aggregated so that relative loss of water from transpiration and evaporation could be estimated for individual hydrologic basins.

Table 3.5-7 Evapotranspiration Areas Established within the GWD Project Hydrologic Region of Study

USGS Vegetation ET (Smith et al. 2007)	Characteristic Species (Smith et al. 2007)	Range of depths to groundwater (feet) (Smith et al. 2007)	SNWA ET[1] (SNWA 2007)	Combination of units for EIS display and analysis
Marshland	Dense wetland vegetation – tall reeds, rushes, some grasses.	Less than 1; soil nearly always saturated	Wetland/Meadow	Wetland/Meadow
Meadowland	Dominated by short, dense perennial grasses; may include shrubs and trees (e.g., Rocky Mountain juniper, cottonwoods).	Less than 5 feet; soil typically moist except late summer	Wetland/Meadow	Wetland/Meadow
Grassland	Dominated by short perennial grasses, including salt grass, sod and pasture grasses. Includes desert shrubs and occasional trees (Rocky Mountain juniper, cottonwoods).	Less than 8 feet; soil damp to dry	Wetland/Meadow	Wetland/Meadow
Dense Desert Shrubland	Mixture of desert shrubs (greasewood, rabbitbrush, shadscale, big sagebrush, and saltbush). Vegetation cover greater than 25 percent.	3 to 50	Phreatophyte/ Medium Vegetation	Basin Shrubland
Moderately Dense Desert Shrubland	Mixture of desert shrubs (greasewood, rabbitbrush, shadscale, big sagebrush, and saltbush). Vegetation cover ranges from 10 to 30 percent.	3 to 50	Phreatophyte/ Medium Vegetation	Basin Shrubland
Sparse Desert Shrubland	Mixture of desert shrubs (greasewood, rabbitbrush, shadscale, big sagebrush, and saltbush). Vegetation cover ranges from 5 to 15 percent.	3 to 50	Bare Soil/Low Vegetation	Basin Shrubland
Recently Irrigated Cropland	Irrigated cropland.	Generally greater than 5	Agriculture	Agriculture
Moist Bare Soil	Moist playa – no vegetation.	At or near the soil 4	Playa	Playa
Dry Playa	Dry playa – no vegetation.	Greater than 10	Playa	Playa
No Category	Not Applicable.	Greater than 10	Wetland/Meadow	Wetland/Meadow (Riparian Shrubland)

[1] Phreatophyte/Medium Vegetation encompasses shrublands with >20% cover within ET areas, and Bare Soil/Low Vegetation encompasses shrublands with <20% cover within ET areas.

The SNWA mapped ET areas in the same hydrologic basins using similar methods to those of the USGS (BIO-WEST 2007a; SNWA 2009). The SNWA ET areas were divided into five categories; the correlation of these units with those identified by the USGS is displayed on **Table 3.5-7**. SNWA also included the riparian shrublands along Meadow Valley Wash and the Muddy River in the wetland/meadow ET area.

For purposes of mapping the vegetation ET areas for impact analysis in this EIS, the three herbaceous meadow types (marshland, meadowland, grassland) defined by the USGS were combined into a single wetland/meadow ET area (consistent with a similar consolidation by SNWA) (**Table 3.5-6**). Depth to water under all three areas is less than 10 feet, with decreasing soil moisture at or near the surface from marshland to grassland.

The three USGS shrub density classes (dense, moderate, sparse) were consolidated into a single ET area called Basin Shrubland. The species composition of these three shrubland ET areas is similar; the primary difference among them is the relative density of shrubs. The Riparian Shrublands mapped along the Meadow Valley and Muddy River drainages (DeMeo et al. 2008) were distinguished from Basin Shrublands because of the differences in species composition and water supply sources (surface and groundwater). Areas currently used for irrigated agriculture are mapped, based on recent satellite imagery.

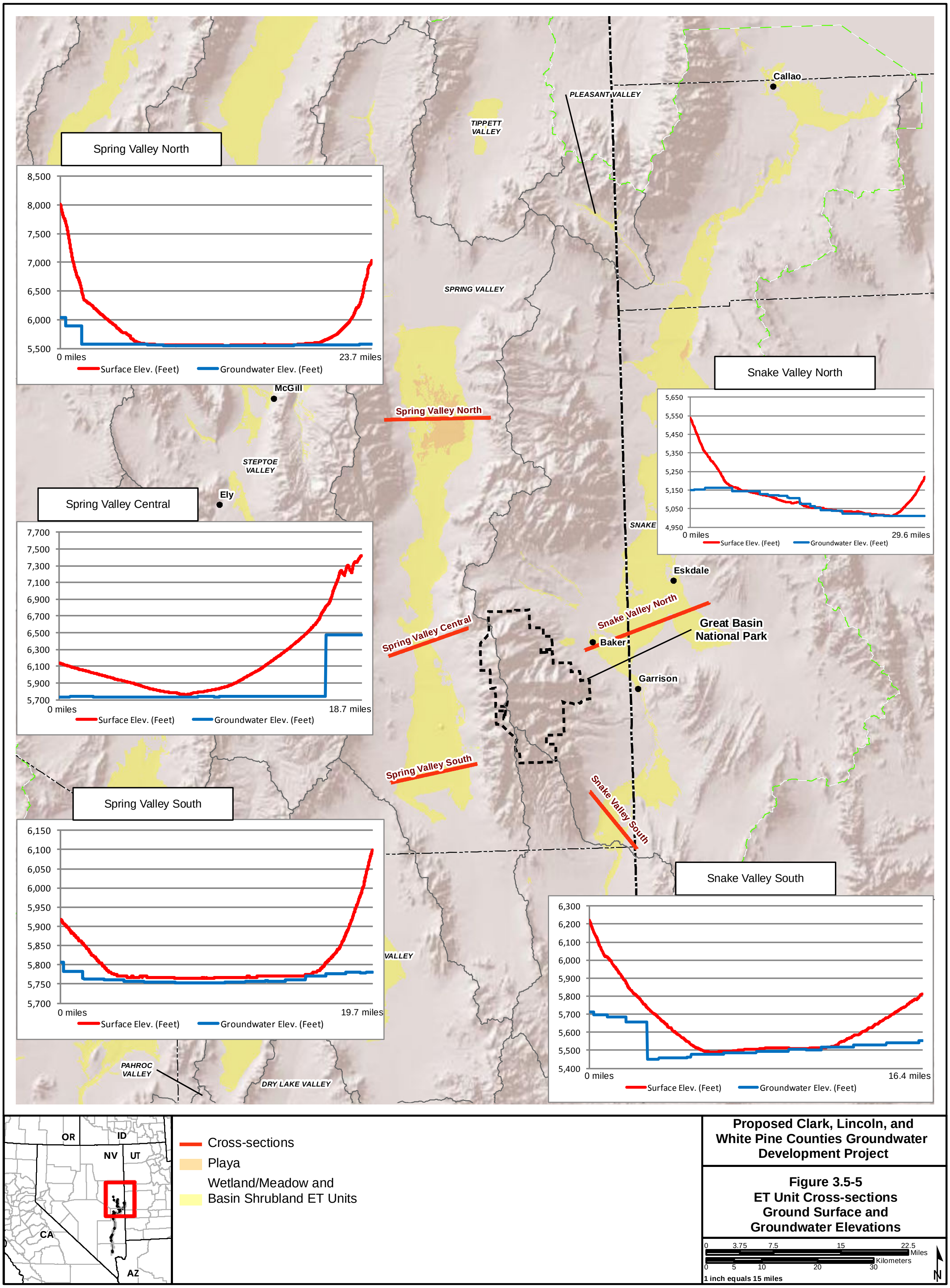
Figures 3.5-3 and **3.5-4** illustrate the location of the ET areas, and the vegetation communities that comprise these areas. The same ET areas are illustrated by individual basin in Section 3.3, Water Resources. **Figure 3.5-5** illustrates the relationship of groundwater depth to the occurrence of ET areas in Spring and Snake valleys.

Special Status Plant Species

There is one known Nevada population of Ute ladies'-tresses in the Panaca Springs near Panaca in Lincoln County (Fertig et al. 2005; BIO-WEST 2007c). There also is a record of Ute ladies'-tresses from the Utah portion of Snake Valley in Juab County. BIO-WEST (2007a,b,c) conducted habitat surveys for this species at 32 springs and spring complexes in lower Snake Valley and Spring Valley in Nevada and Utah. Populations were not found in these surveys, but suitable habitat was identified.

Culturally Significant Plants

The Confederated Tribes of the Goshute Reservation (Steele 2010a), the Paiute Indian Tribe of Utah (Martineau 2010), and the Ely Shoshone (Ely Shoshone 2010) submitted lists of plants to the BLM that are culturally significant to members of these tribes. These plants have traditional values for food, medicine, and tools. The lists were combined to identify important plants to all three Tribes, as well as plants unique to each Tribe (**Table 3.5-8)**. The plant species known to be dependent, or partially dependent, on surface and groundwater sources are noted. In addition, general plant species occurrences by major land cover types within the study area are indicated. The Tribal correspondence concerning culturally significant plants is contained in **Appendix F3.5**.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-5 ET Unit Cross-sections Ground Surface and Groundwater Elevations

Table 3.5-8 Culturally Significant Plants

Scientific Name	Common Name	Tribe			Occurrence by Land Cover Type						
		Paiute Indian Tribe of Utah	Confederated Tribes of the Goshute Reservation	Ely Shoshone	Greasewood/ Salt Desert Shrubland	Mojave Mixed Desert Shrubland	Perennial Grassland	Marshland	Pinyon-Juniper Woodland	Riparian Woodland and Shrubland	Sagebrush Shrubland
FORB/HERB											
Achillea millefolium	Common yarrow	X			X	X	X		X		X
Agastache urticifolia	Nettleleaf giant hyssop		X	X					X	X	
Allium bisceptrum	twincrest onion	X	X	X		X		X		X	
Allium nevadense	Nevada onion			X					X		
*Anemopsis californica**	Yerba mansa	X				X					
Anethum graveolens (Peucedanum graveolens)	Dill		X	X							
Apios sp.	Groundnut	X						X			
Apocynum androsaemifolium	Spreading dogbane		X	X						X	
Apocynum cannabinum	Indianhemp	X		X			X	X			
Argemone munita	Flatbud prickly poppy			X		X					
Artemisia campestris	Field sagewort	X			X				X	X	X
Artemisia dracunculus	Tarragon	X						X		X	
Artemisia ludoviciana	White sagebrush	X			X		X		X		X
Asclepias fascicularis	Mexican whorled milkweed	X						X		X	
*Asclepias speciosa**	Showy milkweed	X						X		X	
Asclepias tuberosa	Butterfly milkweed	X					X		X	X	
Atriplex truncata	Wedgescale saltbush		X	X	X						
Balsamorhiza hookeri	Hooker's balsamroot		X	X					X	X	X
Balsamorhiza sagittata	Arrowleaf balsamroot	X	X	X						X	
Calandrinia ciliata	Fringed redmaids	X					X	X		X	
Calochortus flexuosus	Winding mariposa lily			X	X	X					X

Table 3.5-8 Culturally Significant Plants (Continued)

Scientific Name	Common Name	Tribe			Occurrence by Land Cover Type						
		Paiute Indian Tribe of Utah	Confederated Tribes of the Goshute Reservation	Ely Shoshone	Greasewood/ Salt Desert Shrubland	Mojave Mixed Desert Shrubland	Perennial Grassland	Marshland	Pinyon-Juniper Woodland	Riparian Woodland and Shrubland	Sagebrush Shrubland
Calochortus nuttallii	Sego lily		X	X			X		X		X
Camassia scilloides?	Camas			X				X		X	
*Camassia quamash**	Small camas		X	X				X		X	
Carum gairdneri	Gairdner's yampah [1]		X	X				X	X	X	
Castilleja angustifolia?	Indian paintbrush			X			X	X	X	X	X
Chenopodium atrovirens	Pinyon goosefoot			X		X			X		X
Cirsium eatoni	Eaton's thistle		X	X					X		
Cirsium undulatum	Wavy leaf thistle		X	X			X		X	X	X
Claytonia caroliniana	Carolina springbeauty		X	X			X		X	X	
Cymopterus longipes	Longstalk springparsley		X	X					X		X
Dichelostemma capitatum	Bluedicks	X					X		X		X
Dracocephalum parviflorum	American dragonhead		X	X					X		X
Echinacea angustifolia	Blacksamson echinacea	X					X		X		X
*Erigeron philadelphicus**	Philadelphia fleabane	X							X	X	X
Eriogonum jamesii	James' buckwheat		X	X		X					X
Eriogonum umbellatum	Sulfur-flower buckwheat		X	X		X	X		X		X
Erythronium grandiflorum	Yellow avalanche-lily		X	X					X	X	
Fragaria vesca	Woodland strawberry	X							X	X	
Fragaria virginiana	Virginia strawberry	X							X	X	
Fritillaria affinis	Checker lily	X							X		
Fritillaria pudica	Yellow fritillary		X	X					X	X	
Ipomopsis aggregata	Scarlet gilia		X	X					X	X	X
Heliomeris longifolia	Showy goldeneye		X	X			X				X

Table 3.5-8 Culturally Significant Plants (Continued)

Scientific Name	Common Name	Tribe			Occurrence by Land Cover Type						
		Paiute Indian Tribe of Utah	Confederated Tribes of the Goshute Reservation	Ely Shoshone	Greasewood/ Salt Desert Shrubland	Mojave Mixed Desert Shrubland	Perennial Grassland	Marshland	Pinyon-Juniper Woodland	Riparian Woodland and Shrubland	Sagebrush Shrubland
Helianthus annuus	Common sunflower	X	X	X	X	X	X		X	X	X
Ipomopsis aggregata (same as above)	Scarlet gilia, scarlet trumpet, skyrocket		X	X					X	X	X
*Iris missouriensis**	Rocky Mountain iris	X								X	
Lewisia rediviva	Bitter root	X									
Linum lewisii	Lewis flax			X	X	X	X			X	X
*Lobelia cardinalis**	Cardinal flower	X						X		X	
Lobelia siphilitica	Great blue lobelia	X						X		X	
Lomatium dissectum var. *multifidum*	carrotleaf biscuit root		X	X					X		X
Lomatium multifidum	Biscuit root		X	X					X		X
Agastache urticifolia	Nettleleaf giant hyssop		X	X					X	X	
Sphaeralcea munroana	Munro's globemallow		X	X							X
*Mentha arvensis**	Wild mint		X	X			X			X	
Mentha Canadensis	Mint		X	X			X			X	
Mentzelia dispersa	Bushy blazingstar	X				X			X		X
Monarda fistulosa	Wild bergamot	X							X		X
Nicotiana attenuata	Coyote tobacco		X	X	X	X			X		X
Oenothera sp.	Evening primrose	X					X		X		X
Penstemon eatonii	Firecracker penstemon			X					X		X
Penstemon grandiflorus	Large beardtongue	X					X				X
Phlox longifolia	Longleaf phlox			X			X		X		X
Proboscidea parviflora	Doubleclaw	X				X					
Ratibida columnifera	Upright prairie coneflower	X				X	X				
Rumex salicifolius	Willow dock			X				X		X	

Table 3.5-8 Culturally Significant Plants (Continued)

		Tribe			Occurrence by Land Cover Type						
Scientific Name	**Common Name**	**Paiute Indian Tribe of Utah**	**Confederated Tribes of the Goshute Reservation**	**Ely Shoshone**	**Greasewood/ Salt Desert Shrubland**	**Mojave Mixed Desert Shrubland**	**Perennial Grassland**	**Marshland**	**Pinyon-Juniper Woodland**	**Riparian Woodland and Shrubland**	**Sagebrush Shrubland**
*Sagittaria cuneata**	Arumleaf arrowhead	X						X		X	
*Sagittaria latifolia**	Broadleaf arrowhead	X						X		X	
*Salicornia europaea**	Glasswort		X	X				X		X	
Salicornia herbacea	Brittlewort		X	X	X						
Salvia columbariae	Chia			X	X	X			X		X
Salvia sp.	Chia	X			X	X			X		X
Sisymbrium canescens	Tansy mustard		X	X	X	X	X		X		X
*Trifolium wormskioldii**	Cows clover	X						X			
*Typha domingensis**	Southern cattail	X						X			
*Typha latifolia**	Broadleaf cattail	X	X	X				X			
Urtica dioica	Stinging nettle			X				X		X	
Wyethia amplexicaulis	Mule's ear		X	X					X		X
Zigadenus elegans (Anticlea elegans)	Mountain deathcamas		X	X					X		X
Zigadenus nuttallii	Nuttall's deathcamas		X	X							
CACTUS											
Carnegiea sp.	Saguaro	X									
Hesperoyucca whipplei	Chapparal yucca	X				X					
GRAMINOID											
Achnatherum hymenoides	Indian ricegrass			X			X		X		X
Carex rossii	Ross' sedge	X					X		X	X	X
Elymus elymoides	Bottlebrush squirreltail	X							X		X
Elymus glaucus	Blue wildrye	X			X		X		X		X
Festuca ovina	Sheep fescue	X					X		X		X

Table 3.5-8 Culturally Significant Plants (Continued)

Scientific Name	Common Name	Tribe: Paiute Indian Tribe of Utah	Tribe: Confederated Tribes of the Goshute Reservation	Tribe: Ely Shoshone	Occurrence by Land Cover Type: Greasewood/ Salt Desert Shrubland	Mojave Mixed Desert Shrubland	Perennial Grassland	Marshland	Pinyon-Juniper Woodland	Riparian Woodland and Shrubland	Sagebrush Shrubland
*Hierochloe hirta**	Northern sweetgrass	X						X			
*Juncus arcticus**	Mounatin rush	X		X				X			
*Juncus effusus**	Common rush	X						X			
Leymus cinereus	Basin wildrye			X			X		X		X
Muhlenbergia rigens	Deergrass	X			X	X					
*Phragmites australis**	Common reed			X				X			
Pseudoroegneria spicata	Bluebunch wheatgrass	X									
Schoenoplectus acutus var. *occidentalis*	Tule	X						X			
*Schoenoplectus californicus**	California bulrush	X						X			
*Schoenoplectus pungens**	Common threesquare	X						X			
Schoenoplectus acutus var. *acutus* *	Hardstem bulrush		X	X				X			
Sporobolus airoides	Alkali sacaton	X			X	X					X
*Triglochin maritima**	Seaside arrowgrass		X	X				X			
SHRUB											
Amelanchier alnifolia	Serviceberry (Saskatoon serviceberry)	X	X	X					X		
Arctostaphylos uva-ursi	Kinnikinnick	X									
Artemisia frigida	Prairie sagewort	X			X		X		X		X
Artemisia tridentata	Big sagebrush	X	X	X							X
Atriplex confertifolia	Shadscale saltbush		X	X	X	X					X
Chrysothamnus viscidiflorus	Yellow rabbitbrush				X						X
Ceanothus herbaceus	Jersey tea	X									
Celtis laevigata	Sugarberry	X								X	
Cercis orbiculata	California redbud	X				X				X	

Table 3.5-8 Culturally Significant Plants (Continued)

		Tribe			Occurrence by Land Cover Type						
Scientific Name	**Common Name**	**Paiute Indian Tribe of Utah**	**Confederated Tribes of the Goshute Reservation**	**Ely Shoshone**	**Greasewood/ Salt Desert Shrubland**	**Mojave Mixed Desert Shrubland**	**Perennial Grassland**	**Marshland**	**Pinyon-Juniper Woodland**	**Riparian Woodland and Shrubland**	**Sagebrush Shrubland**
Cercocarpus ledifolius	Curl leaf mountain mahogany	X							X		
Cercocarpus montanus	Mountain mahogany		X	X					X		
Ericameria nauseosa	Rubber rabbitbrush		X	X	X				X		X
Cornus sericea	Redosier dogwood	X								X	
Cornus sericea ssp. *occidentalis*	Western dogwood	X								X	
Cornus stolonifera[2*]	Redosier dogwood		X	X						X	
Cylindropuntia acanthocarpa	Buckhorn cholla	X				X					
Elaeagnus commutata	Silverberry			X							
Ephedra nevadensis	Nevada jointfir	X			X	X			X		X
Ephedra sp.	Jointfir		X	X	X	X			X		X
Ephedra viridis	Mormon tea	X			X	X			X		X
Ericameria teretifolia	Green rabbitbrush	X			X				X		X
Krascheninnikovia lanata	Winterfat		X	X	X	X					X
Gutierrezia sarothrae	Broom snakeweed	X			X	X			X		X
Juniperus pinchotii	Pinchot's juniper	X							X		
Mahonia nervosa	Cascade barberry	X							X		
Nolina microcarpa	Sacahuista	X				X					
Poliomintha incana	Frosted mint	X				X					
Prosopis glandulosa	Honey mesquite	X				X					
Prosopis glandulosa var. *torreyana*	Western honey mesquite	X				X					
Prosopis pubescens	Screwbean mesquite	X				X					
Prunus americana	American plum	X								X	
Prunus demissa[3]	Chokecherry	X	X	X						X	

Table 3.5-8 Culturally Significant Plants (Continued)

		Tribe			Occurrence by Land Cover Type						
Scientific Name	**Common Name**	**Paiute Indian Tribe of Utah**	**Confederated Tribes of the Goshute Reservation**	**Ely Shoshone**	**Greasewood/ Salt Desert Shrubland**	**Mojave Mixed Desert Shrubland**	**Perennial Grassland**	**Marshland**	**Pinyon-Juniper Woodland**	**Riparian Woodland and Shrubland**	**Sagebrush Shrubland**
Purshia tridentata	Antelope bitterbrush	X			X				X		X
Quercus undulata	Scrub oak		X	X		X					
*Ribes aureum**	Golden currant	X						X		X	
Ribes cereum	Wax currant		X	X				X	X	X	
Ribes sp.	Gooseberry or currant			X				X	X	X	
Rosa californica	California wildrose		X	X							
Rosa fendleri[4]	Rose hips		X	X							
Rosa woodsii	Wood's rose	X		X							
Rubus idaeus	American red raspberry	X								X	
Rubus spectabilis	Salmonberry	X								X	
*Salix amygdaloides**	Peachleaf willow	X								X	
*Salix exigua**	Narrowleaf willow	X								X	
Salix lucida	Shining willow	X								X	
Salix scouleriana	Scouler's willow	X								X	
Sambucus nigra ssp. *cerulea*	Blue elderberry			X						X	
Sambucus racemosa	Red elderberry	X								X	
Sambucus sp.	Common elderberry	X								X	
Shepherdia canadensis	Russet buffaloberry	X							X		
Shepherdia sp.	Buffalo berry		X	X					X		
Vaccinium deliciosum	Cascade bilberry	X									
Vaccinium membranaceum	Thinleaf huckleberry	X									

Table 3.5-8 Culturally Significant Plants (Continued)

		Tribe			Occurrence by Land Cover Type						
Scientific Name	**Common Name**	**Paiute Indian Tribe of Utah**	**Confederated Tribes of the Goshute Reservation**	**Ely Shoshone**	**Greasewood/ Salt Desert Shrubland**	**Mojave Mixed Desert Shrubland**	**Perennial Grassland**	**Marshland**	**Pinyon-Juniper Woodland**	**Riparian Woodland and Shrubland**	**Sagebrush Shrubland**
TREE											
Abies concolor	White fir	X									
Abies lasiocarpa	Subalpine fir	X									
Cercis canadensis	Eastern redbud	X								X	
Juniperus communis	Common juniper	X							X		
Juniperus osteosperma	Utah juniper		X	X					X		
Juniperus scopulorum	Rocky Mountain juniper	X							X		
Pinus edulis	Twoneedle pinyon	X					`		X		
Pinus monophylla	Singleleaf pinyon pine	X	X	X					X		
Pinus ponderosa	Ponderosa pine	X									
*Populus fremontii**	Fremont cottonwood	X								X	
Populus sp.	Aspen	X									
Pseudotsuga douglasii[5]	Douglas-fir	X	X	X						X	
Quercus gambelii	Gambel oak	X							X		
Salix sp.	Willow		X	X				X		X	
Washingtonia filifera	California fan palm	X				X					

[1] Scientific name changed to *Perideridia gairdneri* ssp. *gairdneri* within the USDA PLANTS database.

[2] Scientific name changed to *Cornus servicea* within the USDA PLANTS database.

[3] Scientific name changed to *Prunus virginiana* var. *demissa* within the USDA PLANTS database.

[4] Scientific name changed to *Rosa woodsii* and the common name changed to Woods' rose within the USDA PLANTS database.

[5] Scientific name changed to *Pseudotsuga menziesii* within the USDA PLANTS database.

* Facultative wetland species occur in wetlands 67 to 99 percent of the time and obligate wetland species occur in wetlands >99 percent of the time per the Region 8 National Wetlands Inventory Plant List (USFWS 1988).

3.5.2 Environmental Consequences

3.5.2.1 Rights-of-way

Issues

The following issues for vegetation resources are evaluated for ROW construction and facility maintenance:

- Short-term, long-term, and permanent loss of vegetation communities due to surface disturbance and conversion of natural vegetation to industrial uses, as a result of construction-related activities and operational maintenance.
- Potential introduction or population expansion of noxious and non-native invasive weeds due to surface disturbance.
- Loss of individuals or populations of federally listed, candidate, or special status plant species (including cacti and yucca) due to surface disturbance.
- Accidental wildfires caused by construction equipment or smoking during construction and operation.
- Availability of plant species traditionally used for food and fiber by regional tribes.

Assumptions

The following assumptions were used in the impact analysis for vegetation resources:

- Vegetation community disturbance calculations were based on the proposed construction and operational configurations (footprints) presented for each pipeline, power facility, and ancillary facility ROW in Chapter 2, Proposed Action and Alternatives A through F and Alignment Options 1 through 4.
- Construction disturbances, while temporary in nature, have been defined as "long-term" for all vegetation cover types due to existing vegetation structure and composition, long recovery times, and limiting revegetation factors (e.g., low precipitation rates, soil chemistry constraints, and low levels of soil moisture over most the year for most vegetation communities).
- The mainline pipeline ROW would not be realigned or curved to avoid sensitive plant populations because of the large diameter of the pipeline. Temporary work space along the construction ROW may be narrowed to avoid sensitive resources. Access roads and power line pole locations can be adjusted to avoid sensitive plant populations.
- No woody plant maintenance would be required within the permanent pipeline ROW because of the very slow growth and low stature of shrub, pinyon pine, and junipers.

Methodology for Analysis

Construction surface disturbance impacts by alternative were evaluated according to the following steps:

- The area of vegetation communities and the extent of special status species that would be removed temporarily or permanently during project facility resource construction were estimated, based on SWReGAP cover types and field surveys for special status plants.
- Recovery times for disturbed vegetation communities were estimated from a literature review. Recovery times were based on ecological characteristics, fire response, and climatic factors.
- The risk of weed invasion was estimated from field surveys conducted by SNWA and from a weed occurrence database maintained by the BLM Ely District.
- SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins and all facilities associated with the SNWA GWD Project. The COM Plan includes a requirement for comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation

recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect vegetation resources from ROW construction and operation activities.

- The BLM RMP Management Actions and BMPs, as well as ACMs available were evaluated to limit the extent and duration of predicted impacts. Additional mitigation measures were recommended to reduce or offset impacts; mitigation measure effectiveness was estimated and a residual impact summary was developed for each impact issue.

3.5.2.2 Proposed Action, Alternatives A through C

Construction and Facility Maintenance

Vegetation Community Surface Disturbance and Restoration

Pipeline, power facility, and ancillary facility construction activities would clear and blade shrub and herbaceous vegetation from the construction ROW. The root systems and dormant seeds would be piled in excavated topsoil along the ROW margins. Excavated soil would then be replaced over the disturbed construction ROW after construction was completed. Disturbed soils within the ROW would be reseeded with an approved seed mixture. **Table 3.5-9** summarizes construction surface disturbance to each cover type for all project facilities. Estimates of vegetation community recovery are based on post-fire responses (see **Appendix F3.5**). A breakdown of surface disturbance by land cover types within the hydrologic basins is contained in **Appendix F3.5**.

Table 3.5-9 Proposed Action and Alternatives A through C – Construction Disturbance, Operational Conversion of Land Cover Types, and Estimated Vegetation Recovery Periods

Land Cover Type	Construction Disturbance (acres)	Operation (Conversion to aboveground industrial uses) (acres)	Estimated Vegetation Community Recovery Time (years)
Agriculture/Developed	9	9	2
Annual Invasive Grassland	30	7	2
Barren	1	0	0
Greasewood/Salt Desert Shrubland	2,983	252	20-50
Marshland	6	6	2-5
Mojave Mixed Desert Scrub	3,052	260	100-200
Perennial Grassland	28	2	5-15
Pinyon-Juniper Woodland	262	26	100-200
Playa	21	1	0
Riparian Woodland and Shrubland	5	5	20-50
Sagebrush Shrubland	5,891	431	20-50
Total	**12,288**	**999**	

Pipeline, power facility, aboveground facility ROW, construction access roads, and temporary construction areas would remove vegetation for the long-term from approximately 12,288 acres. Of this amount, the land cover types that would be most affected include: sagebrush shrubland (48 percent); Mojave mixed desert shrubland (25 percent); and greasewood/saltbush shrubland (24 percent). Installation of aboveground facility and access road ROWs would result in the commitment of approximately 999 acres to long-term industrial uses. These areas would not be restored until after abandonment, which is considered a permanent land use commitment.

Site stabilization and restoration techniques, as presented in the POD (**Appendix E**), would minimize the duration of vegetation disturbance and provide the framework for a successful vegetation restoration program. The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. ACMs include topsoil segregation and salvage and an integrated Restoration Plan including a restoration monitoring protocol. These measures are described in

Appendix E, as part of general construction practices, general operation practices, and restoration monitoring. Preservation of intact root systems during grading (ACM A1.20), topsoil, and seedbank protection (ACM A.1.23), and topsoil erosion control measures (ACM A.1.25) would be implemented. Commitments to prepare a detailed Restoration Plan are included in ACM A.1.69 and ACM A.1.70. BLM RMP BMPs regarding vegetation would provide additional protective measures (**Appendix D**).

Post-construction revegetation and restoration of each vegetation cover type back to its baseline structure and composition may vary depending on various factors such as soil mixing, timing and duration of disturbance, topography, slope, soil moisture, and precipitation. Reclamation efforts likely would reestablish an early seral vegetation community within two growing seasons following construction for all herbaceous- and woody-dominated communities; however, full recovery of shrub-dominated and pinyon-juniper woodland communities to baseline structure and composition would take longer due to poor soil and low moisture conditions. The shrub component in these cover types would require 50 to 100 years or more to recover to former height and density. Some plant communities (e.g., winterfat) may not return to a pre-construction density because of specialized soil structure requirements that would be permanently altered by soil removal and replacement during pipeline trench excavation.

BLM RMP BMPs for Soil Resources and Vegetation Resources provide guidance and protection measures for construction and restoration practices. **Appendix D** provides a full list of the BMPs, which include:

- Keep removal and disturbance of vegetation to a minimum through construction site management;
- Resoration requirements include reshaping, re-contouring, and/or resurfacing with topsoil, installation of water bars, and seeding on the contour;
- Generally, conduct reclamation with native seeds that are representative of the indigenous species present in the adjacent habitat. Document rationale for potential seeding with selected nonnative species; and
- An area is considered to be satisfactorily reclaimed when all disturbed areas have been recontoured to blend with the natural topography, erosion has been stabilized, and an acceptable vegetative cover has been established. Use the Nevada Guidelines for Successful Revegetation prepared by the NDEP, the BLM, and the U.S. Department of Agriculture Forest Service (or most current revision or replacement of this document) to determine if revegetation is successful.

SNWA ACMs A.1.69 through A.1.81 provide additional protective measures. Restoration efforts would continue as required by the BLM until SNWA received a written release from the BLM. Some areas would recover more quickly than others; therefore, the BLM would issue incremental restoration releases for segments of the ROW over time.

SNWA would be required to develop a Restoration Plan that addresses how restoration will be accomplished in accordance with BLM RMP management decisions and BMPs, as well as SNWA ACMs. The Restoration Plan would be submitted to the BLM for approval, and implemented through the COM Plan.

Conclusion. Approximately 12,288 acres of native shrublands and woodlands removed or disturbed by construction would require 20 to 200 years for recovery to similar species composition and vertical structure as adjacent undisturbed areas. Approximately 64 acres of annual invasive and perennial grassland and marshland cover types would require from 2 to 15 years for recovery. Approximately 999 acres of natural land cover types would be permanently converted to aboveground industrial uses. Operational maintenance activities are expected to disturb small areas, primarily within the permanent ROW. The area of vegetation communities affected by construction surface disturbance would represent less than 1 percent of the surface area of these cover types within the hydrologic basins occupied by the Proposed Action and Alternatives A through C.

BLM RMP BMPs and SNWA ACMs include measures to salvage and preserve soil and during construction, to follow best practices for revegetation seeding and erosion control, to follow a long-term restoration monitoring program, and to obtain a written release of restoration success from the BLM. These measures provide the framework for meeting the desired conditions for vegetation community types specified in the Ely District RMP within the time frames expected for natural recovery of these communities.

Proposed mitigation measures:

ROW-VEG-1: Native Seed Collection. The SNWA, in consultation with the BLM, would develop a seed collection program for native plant species found within the ROW. These native plant seeds would be used along the ROW corridor in revegetation and reclamation activities, to the extent feasible, to enhance the rate and quality of recovery. Seed from locally adapted native sources would likely provide the greatest rates of establishment and subsequent growth, increasing the success of reclamation efforts. Target species and collection methods would be identified in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to native plant species found within the Project ROW by enhancing re-establishment. Effects on other resources: Seed collection activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-2: Temporary Fencing or Closure to Livestock Grazing. The SNWA would conduct pre-construction surveys to determine areas of livestock use within and adjacent to the construction ROW where application of temporary fencing or closure would be needed for revegetation species establishment. The results of these surveys would be provided to the BLM for review and approval. Revegetation areas would be rested from grazing for two full years or until BLM determines that reclamation meets BLM RMP standards. Effectiveness: Temporary fencing or closure would be effective in improving the stabilization and persistence of reseeded areas in the short-term. In the long-term, annual precipitation from year to year, and the seasonal distribution of livestock within the allotment would determine the survival of reseeded plants. Effects on other resources: Temporary fencing would also limit wild horse access to forage inside fenced areas. Big game species would not likely be deterred by temporary livestock fencing. Temporary fencing in riparian areas could improve the recovery rate of shrubs and herbs that assist in stabilizing channel banks.

Residual impacts include:

- Long (20 to 200 years) restoration periods for shrublands and woodlands on 12,288 acres of disturbed ROWs because of sparse and uncertain precipitation, and soil-induced growth constraints (salinity, alkalinity, shallow soil depths).
- Permanent removal of shrubland (primarily sagebrush shrubland, greasewood/salt desert shrubland, Mojave mixed desert scrub) from approximately 999 acres required for permanent aboveground facilities.
- An unknown fraction of some disturbed communities would not recover to previous composition and density because of specialized soil requirements (e.g., winterfat on hardpan/caliche soils within the greasewood/salt desert shrubland type).

ACMs for Noxious Weeds

- **A.1.82** SNWA will prepare and submit an integrated Weed Management Plan to the BLM for approval before construction begins. Noxious weeds will be controlled during and following construction activities.
- **A.1.83** ROW areas with pre-existing noxious weed infestations will be treated with a BLM-approved control method, two to three years prior to the start of construction activities, as feasible.
- **A.1.84** Borrow or fill material be inspected by a qualified biologist or weed scientist to ensure it is free of noxious weeds or others in the approved Integrated Weed Management Plan for the project.
- **A.1.85** Organic products used during construction, restoration, operations, maintenance, or for stabilization will be certified free of plant species listed on the Nevada noxious weed list or specifically identified in the BLM approved Integrated Weed Management Plan for the project.
- **A.1.86** Vehicles and equipment will be cleaned with a high pressure washer to prevent or minimize the introduction or spread of noxious weeds.

  A.1.87 Specific vehicle washing stations will be designated within the ROW for vehicle and equipment washing. Growth of noxious weeds in that area will be treated.
- **A.1.88** SNWA or its certified licensed contractor will submit a Pesticide Use Proposal to the BLM before application of any herbicide. A Pesticide Application Record will be produced following the application.
- **A.1.89** Herbicides will not be sprayed within or around an exclusion area containing sensitive resources. Removal shall be accomplished by alternative method(s) approved by the BLM.

Spread and Introduction of Noxious and Non-native Invasive Weed Species

The prevention of the spread of noxious and non-native invasive weed species and the eradication of known populations are high priorities of Nevada, Utah, and the BLM. Vegetation removal and soil disturbance during construction would create optimal conditions for the establishment of weed species. Construction equipment travelling from weed-infested areas into weed-free areas could disperse weed seeds and propagules, resulting in the establishment of noxious weeds in previously weed-free locations.

BLM (2010) prepared a noxious and invasive weeds risk assessment for the GWD Project (**Appendix F3.5**). The Ely District weed inventory indicated that infestations of 11 listed weeds were located within 1,000 feet of the proposed ROWs; infestations of 14 listed weed species were located within 3 miles of the ROWs along roads or drainages. Several of these species are highly persistent and spread in patches from underground rhizomes. Examples include Russian knapweed (*Acroptilon repens)* and tall whitetop (*Lepidium latifolium).* These species are highly resistant to herbicide treatment. The assessment concluded that the risk of noxious/invasive weeds spreading into the project is "High – Heavy infestations of noxious/invasive weeds are located within or immediately adjacent to the project area. GWD Project activities, even with preventive management actions, are likely to result in the establishment and spread of noxious/invasive weeds on disturbed sites throughout much of the project area." The assessment indicates that facilities would be located in several currently weed-free areas, including the power line routes across the Schell Range between Steptoe and Spring valleys; the pipeline lateral from Lake Valley to Snake Valley; the east side of the Fortification Range; the pipeline spur route to Cave Valley; and the main pipeline route that crosses Muleshoe, Dry Lake, and Delamar valleys. The assessment notes that several recent fires have expanded the dominance of cheatgrass and red brome throughout the burn areas. These fires have occurred in the southern portion of Lincoln County in Pahrangat Valley. Approximately 34 acres of the construction ROW have been directly impacted by these fires and likely have non native invasives present in higher densities than unburned areas. An increase of red brome or cheatgrass could alter the fire regime throughout the project area and increase the fire frequency. This may impact native vegetation. SNWA also sponsored weed surveys along the ROWs.

The BLM noxious and invasive weed risk assessment (**Appendix F3.5**) includes a list of measures to be included in an Integrated Weed Management Plan within the project Construction, Operation, and Maintenance Plan that would be approved by the BLM Weed Coordinator. Example measures include requirements for removal of manually controlled weeds; use of weed-free seed mixtures and mulches; use of weed-free soil from borrow areas; the use of equipment wash stations to prevent weed spread; minimization of overall surface disturbance; stockpiling of weed-infested soils to prevent spread; avoidance of weed contamination from water sources used for fire suppression; herbicide management to prevent contamination of water bodies and unintended effects on special status species, residences, and recreation areas; selection of revegetation species capable of outcompeting weeds; and project proponent responsibilities for monitoring and controlling weeds within the ROW and for infestations that spread outside the ROW.

SNWA applicant-committed weed management measures (ACMs A.1.5, A.1.26, A.1.35, A.1.82 through A.1.89, and A.2.12 [**Appendix E**]) are consistent with the preventive measures and proponent control responsibilities outlined in the BLM noxious and invasive weed risk assessment.

Conclusion. The proposed ROWs for 306 miles of buried water pipelines and 323 miles of overhead power lines are at high risk for invasion by

ACM for Special Status Plants

- **A.5.9** Pre-construction surveys during the blooming or fruiting season will verify plant identification. Locations of sensitive plants will be recorded for salvage or seed collection.
- **A.5.10** Construction activities will avoid any identified sensitive plant populations within the ROW when possible.
- **A.5.11** If sensitive plant species cannot be avoided, SNWA will implement plant or seed salvage before construction.
- **A.5.12** SNWA will consult with the BLM on appropriate plant and/or seed salvage if previously unknown special status plant species are discovered within the ROW.
- **A.5.13** The on-site biological monitor can temporarily halt non-emergency construction activities if protected plant species are discovered within the ROW during construction.
- **A.5.14** SNWA will avoid exclusion areas created for sensitive plants when spraying herbicides.
- **A.5.15** Construction practices will be modified to avoid known Blaine's fishhook cacti identified within the ROW in Dry Lake Valley.

noxious and non-native weed species. Construction and operational maintenance equipment travelling from weed-infested areas into weed-free areas could disperse weed seeds and propagules, resulting in new weed establishment. SNWA would implement a variety of measures to be included in an integrated weed management plan. These measures include management of weed contaminated topsoil, pre-construction weed treatments, and equipment wash stations to prevent the transport of weed plants and seeds along the ROW into new areas. SNWA would continue to monitor and control weeds within the ROW in accordance with overall restoration responsibilities.

Proposed mitigation measures:

The BLM noxious and invasive weed risk assessment states that "green stripping" should be considered as a part of an integrated weed control plan. Green stripping involves planting revegetation species (usually fast growing non-native grasses with low livestock forage values) on disturbed surfaces that are at high risk of weed invasion from adjacent noxious and invasive weed populations. The purpose of this type of revegetation procedure is to prevent the spread of weeds through competition by seeded species and to provide a green firebreak during the early fire season to help limit the spread of wildfires. Green stripping can reduce plant diversity, wildlife habitat suitability, and the recovery of shrublands over the long term. The appearance of a wide ROW dominated by herbaceous species can strongly contrast with adjacent shrublands. To provide flexibility in addressing both the risks of weed invasion and wildfires, while accounting for other resource values, additional mitigation measure ROW-VEG-3 would include the use of green stripping revegetation methods in areas where weed invasion and wildfire risks are high, and the reductions in other resource values (wildlife habitat, grazing, visual resources) can be accommodated under current and future BLM land management actions.

ROW-VEG-3: Green Stripping. SNWA, in consultation with the BLM, would develop a green stripping revegetation prescription where BLM and SNWA preventive and control measures may be inadequate to mitigate risks of weed invasion and wildfire. Green stripping is defined as ROW revegetation with fast-growing herbaceous species that can outcompete annual and perennial weeds and can provide a green firebreak. Locations where this measure may be applied would be identified in the Restoration Plan, Integrated Weed Management Plan, and Fire Prevention Plan, and approved by the BLM Visual Resource Management Coordinator. For example, it would be applied primarily to Great Basin Desert low elevation bottomlands, with limited applications to open evergreen woodlands (due to low risk for weed invasion) and Mojave Desert lowlands (due to low risk as a fire disturbance ecosystem). Effectiveness: This measure may be highly to moderately effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The extent and number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat and grazing. To minimize visual resource impacts, the green stripping prescription shall avoid straight line seeding, and the seed mix shall contain shrubs and grasses with plant and structural diversity to harmonize with the existing colors and textures of surrounding vegetation to the extent feasible. Where VRM is a priority (within 1,000 feet adjacent to scenic byways U.S. 50/6/93, at the junction of U.S. 50/6/93, and in Cave and Delamar Valleys, other BLM BMPs and ACMs shall be utilized first to mitigate fire risk and weed infestations.

Residual impacts include:

- Implementation of these weed control and management methods could prevent expansion of existing weed populations into new areas, but may be insufficient to control highly herbicide-resistant perennial weed species that are already established within, or adjacent to the ROWs.

Cacti and Yucca, Special Status Plants

Approximately 150,000 cacti and yucca plants have been inventoried in the construction ROW in the Las Vegas, Garnet, Hidden, Coyote Springs, Delamar, Pahranagat, and Dry Lake valleys. Cacti and yuccas would be salvaged and replanted (ACMs A.1.71 through A.1.78, A.1.80). Excavated plants would be brought to nursery areas and maintained until the next suitable planting season. Salvaged plants would be replanted back into the ROW and watered. In addition to other exceptions, Joshua trees (*Yucca brevifolia*) and banana yucca (*Yucca baccata*) over 6 feet tall, and all cacti and yucca less than 1 foot tall (with the exception of special status species) would not be salvaged (ACM A.1.71).

Based on recent field inventories, surface disturbance associated with pipeline, power facility, and/or construction access roads would remove individuals of five BLM and/or USFS special status plant species within ROW construction areas and would remove suitable habitat for four BLM and/or USFWS (Candidate) additional species (**Table 3.5-2**). SNWA would salvage topsoil and implement avoidance, transplant, and seed collection measures, depending on the species and location within the ROW. None of these species are federally listed by the USFWS and there are multiple (five or more) known populations of each of these species in Nevada and adjacent Utah (NNHP 2010).

Protection measures for special status plants include pre-construction species-specific surveys, avoidance and minimization practices, and salvage techniques (ACMs A.5.9 through A.5.15). To reduce the long-term loss of individual plants as a result of pipeline construction activities and access road usage, specific locations of sensitive plants, based on the BLM sensitive plant list in effect at the time, will be recorded for subsequent salvage or seed collection. Blaine's fishhook cactus individuals located in the construction ROW would be avoided, or salvaged and transplanted immediately into suitable adjacent habitat on BLM land that will not be disturbed. Impacts to the white bearpoppy, threecorner milkvetch, and Las Vegas buckwheat would be limited to loss of suitable habitat.

Conclusion. Several thousand yucca and cacti would be salvaged from the ROWs over a distance of approximately 100 miles, retained in nurseries along the ROW, and replanted and watered in the next appropriate planting season. Mature Joshua trees and immature cacti would not be salvaged, and therefore would be removed from existing plant populations along the ROW. Criteria that would be used to determine which cacti and yucca would be salvaged is listed in **Appendix E**, ACM A.1.71. Transplanting and seed gathering of special status plant species would assist in restoration of disturbed sites, but would not likely replace existing populations at an equivalent level. The net reduction in individuals and seeds of directly affected special status plant species is not likely to lead to future federal listings because there are five or more populations of these species elsewhere in Nevada and Utah.

Many species of cacti and yucca potentially impacted by the GWD Project - which include sagebrush cholla (*Grusonia pulchella)*, pincushion cactus (*Pediocactus* sp.), Great Basin fishhook cactus (*Sclerocactus pubispinus)*, and Blaine fishhook cactus (*Sclerocactus spinosior* spp. *blainei*) - may be suitable candidates for salvage and relocation as survival rates in the Great Basin are generally good (Abella and Newton 2009). Studies of *Opuntia basilaris* (Newton 2001) and *Ferocactus cylindraceus* indicate high success rates for both species after 2 years with 92 percent survival for *O. basilaris* and 85 percent survival of *F. cylindraceus*. Eighteen years of monitoring data for Knowlton's cactus in New Mexico similarly show good success rates with 41 to 65 percent survival on average (Sivinski and McDonald 2007). Other research indicates that Saguaros, ocotillos, and barrel cacti can be transplanted with success (Archuleta and Dhruv 1995; Harris et al. 2004), except during the winter rainy season when cool temperatures and moisture promotes decay in fresh transplants.

Proposed mitigation measures:

ROW-VEG-4: Special Status Plant Species Establishment. In addition to salvaging and transplanting special status species found in the ROW for tier 1 or subsequent tier construction activities, the SNWA would grow additional plants from seed (collected from individuals prior to salvage) or by grafting (from the salvaged plants) to enhance the new, transplanted populations. Seed collection for this effort would occur over multiple years prior to plant salvage. Specific special status plant species and collection methods would be identified in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to special status plant species found within the Project ROW by enhancing re-establishment. Effects on other resources: Seed/plant collection activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-5: Blaine's Fishhook Cactus Surveys. The SNWA would begin Blaine's fishhook cactus (*Sclerocactus blainei*) surveys as soon as possible after project design and engineering is complete; conducting the surveys within known and potential habitat during the next appropriate season for plant identification. The goal of this mitigation measure is to allow for a minimum of two to three years of surveys, since this species may stay underground for several years. A 3-meter exclusion area would be established around any individuals found during the surveys. Effectiveness: This measure would be effective in avoiding impacts to *Sclerocactus blainei*. Effects on other resources: Conducting surveys would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-6: Blaine's Fishhook Cactus Transplantation. If found during surveys, Blaine's fishhook cactus (*Sclerocactus blainei*) individuals would be transplanted to undisturbed BLM land that is as similar as possible to the habitat from which it was removed. Site selection requirements and details would be provided in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to *Sclerocactus blainei*. Effects on other resources: Transplanting activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-7: Blaine's Fishhook Cactus Compensation. If enhancement measures fail to restore Blaine's fishhook cactus (*Sclerocactus blainei*) where it is found in the ROW prior to construction, SNWA would establish a compensatory mitigation fund for direct, indirect, and cumulative impacts to the species. A single payment of $10,000 would be made by the project applicant (SNWA) to the Center of Plant Conservation. This funding would specifically be used for preserving the genetic material of this species in perpetuity. Details regarding the definition of success with regard to *Sclerocactus blainei* would be determined, in coordination with the USFWS and the BLM, in the COM Plan. Effectiveness: This measure would be effective in offsetting impacts to *Sclerocactus blainei*, should adverse impacts occur. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

Residual impacts include:

- There would be lower populations of yucca, cacti, and five special status species within the construction ROWs after surface disturbance and the initiation of restoration efforts. The recovery times for these species would depend on tolerance to surface disturbance and seed germination and growth rates. Perennial tall desert species such as Joshua trees would require many years (100 to 200) to recover; annual and short-lived perennial herbaceous species could potentially recover in a few (2 to 5) years.

Accidental Wildfires

Accidental wildfires ignited as a result of pipeline, power facility, and ancillary facility construction activities could affect vegetation communities in a variety of ways. Impacts may include, but are not limited to, the following: partial to complete removal of aboveground plant cover and belowground components (e.g., roots, rhizomes, and seed bank); soil moisture loss and possible subsequent hydrophobic soil; loss of cacti, yucca, and special status plant species and/or their associated habitats; propensity to increase the spread or introduction of noxious and non-native invasive weed species; and loss of suitable habitat for wildlife and grazing animals.

The land cover type with the highest overall risk of accidental fires spreading upon ignition is sagebrush shrubland, which occupies 48 percent of the overall length of the ROWs. The risk of fire spread in the sagebrush cover type would largely depend on the shrub interspaces and the cover of the herbaceous understory. Wide interspaces among shrubs and low herbaceous cover would limit fire spread, while dense sagebrush shrub stands, and/or extensive herbaceous plant cover would increase the risk of fire spread. Areas dominated by invasive exotic grasses (red brome, cheatgrass) represent less than 1 percent of the ROW length.

Post-wildfire revegetation to a pre-disturbance baseline structure and composition may vary depending on physical, environmental, and physiological factors such as the severity, intensity, and duration of the wildfire; extent of disturbance; topography; slope; soil moisture; precipitation; and sensitivity of the impacted species. Vegetation cover type recovery time frames would be generally consistent with those described in **Table 3.5-9**.

Conclusion. Accidental wildfires ignited as a result of pipeline, power facility, and ancillary facility construction activities could result in the partial to complete removal of aboveground plant cover. Areas most susceptible to fire are estimated to be sagebrush shrublands and invasive annual grasslands, which occupy about 50 percent of the length of the GWD Project ROWs. SNWA would provide fire suppression equipment and trained personnel to respond to fires that originate on the construction ROW. ACM A.1.47 specifies that fire suppression equipment would be present in construction areas, as well as individuals trained in fire suppression. A comprehensive wildland fire readiness and response plan will be developed as part of the COM Plan to insure adequate training for construction staff; to provide additional fire suppression capability on the construction site (water); and to insure immediate notification of local and federal agencies that would respond to wildfires.

Proposed mitigation measures:

ROW-VEG-3: Green Stripping. SNWA, in consultation with the BLM, would develop a green stripping revegetation prescription where BLM and SNWA preventive and control measures may be inadequate to mitigate risks of weed invasion and wildfire. Green stripping is defined as ROW revegetation with fast-growing herbaceous species that can out compete annual and perennial weeds and can provide a green firebreak. Locations where this measure may be applied would be identified in the Restoration Plan, Integrated Weed Management Plan, and Fire Prevention Plan, and approved by the BLM Visual Resource Management Coordinator. For example, it would be applied primarily to Great Basin Desert low elevation bottomlands, with limited applications to open evergreen woodlands (due to low risk for weed invasion) and Mojave Desert lowlands (due to low risk as a fire disturbance ecosystem). Effectiveness: This measure may be highly to moderately effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

Residual impacts include:

- None, if no accidental construction or operation-related fires occur.

Culturally Significant Plants

Individuals and portions of plant species populations used for Tribal traditional uses (**Table 3.5-8)** may be removed during ROW clearing and grading. The majority of these species grow in uplands, commonly in association with sagebrush, greasewood, and mixed desert shrublands, which occupy the largest surface areas among the regional vegetation cover types. Most of the identified traditional use plants are distributed widely in the Great Basin and Mojave Desert regions.

Conclusion. Abundance of Tribal traditional use plants vary from place to place and none are locally endemic or restricted to a single small area. It is not expected that project clearing and grading operations would affect the overall availability or abundance of these plants, unless project surface disturbance is located in a highly localized, traditional plant gathering area. The ethnographic interviews did not reveal any such highly specific plant gathering areas that would be directly affected by proposed project surface disturbance, but this does not preclude that disturbance to traditional plant gathering sites may potentially occur. Specific traditional plant gathering sites along the pipeline route may be identified through ongoing government to government consultation.

Proposed mitigation measures:

None.

Residual impacts include:

- There would be minor reductions in the availability of plant species used for Tribal traditional uses as the result of 12,288 acres of project surface disturbance, relative to the large areas where these species occur in individual hydrologic basins. Long-term disturbance to specific plant gathering areas may potentially occur.

3.5.2.3 Alternative D

Construction and Facility Maintenance

The same ROW construction and facility maintenance issues discussed for the Proposed Action and Alternatives A through C would apply to Alternative D, which would require 225 miles of pipeline and 208 miles of power lines in Clark and Lincoln counties. **Table 3.5-10** provides a summary of the estimated surface disturbance within vegetation cover types.

Vegetation Community Surface Disturbance and Restoration

Conclusion. Approximately 8,828 acres of native shrublands and woodlands removed or disturbed by construction would require 20 to more than 200 years for recovery to similar species composition and vertical structure as adjacent undisturbed areas. Approximately 48 acres of perennial grassland, annual invasive grassland and marshland cover types would require from 2 to 15 years for recovery. Approximately 808 acres of natural land cover types would be permanently converted to aboveground industrial uses. The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. ACMs include measures to salvage and preserve soil during construction; to follow BMPs for re-vegetation seeding and erosion control; to follow a long term restoration monitoring program; and to obtain a written release of restoration success from the BLM. Implementation of these measures would insure that vegetation species cover and composition would recover within time frames similar to natural recovery rates, or potentially more quickly over the majority of the surface disturbance areas.

Table 3.5-10 Alternative D – Construction Disturbance and Operational Conversion of Land Cover Types

Land Cover Type	Construction Disturbance (acres)	Operation (Conversion to Aboveground Industrial Uses) (acres)
Agriculture/Developed	9	9
Annual Invasive Grassland	29	7
Barren	1	0
Greasewood/Salt Desert Shrubland	1,673	179
Marshland	6	6
Mojave Mixed Desert Scrub	3,052	260
Perennial Grassland	13	1
Pinyon-Juniper Woodland	183	17
Playa	21	1
Riparian Woodland and Shrubland	5	5
Sagebrush Shrubland	3,836	323
Total	**8,828**	**808**

Please see **Table 3.5-9** for Estimated Vegetation Community Recovery Time.

Proposed mitigation measures:

ROW-VEG-1: Native Seed Collection. The SNWA, in consultation with the BLM, would develop a seed collection program for native plant species found within the ROW. These native plant seeds would be used along the ROW corridor in revegetation and reclamation activities, to the extent feasible, to enhance the rate and quality of recovery. Seed from locally adapted native sources would likely provide the greatest rates of establishment and subsequent growth, increasing the success of reclamation efforts. Target species and collection methods would be identified in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to native plant species found within the Project ROW by enhancing re-establishment. Effects on other resources: Seed collection activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-2: Temporary Fencing or Closure to Livestock Grazing. The SNWA would conduct pre-construction surveys to determine areas of livestock use within and adjacent to the construction ROW where application of temporary fencing or closure would be needed for revegetation species establishment. The results of these surveys would be provided to the BLM for review and approval. Revegetation areas would be rested from grazing for two full years or until BLM determines that reclamation meets BLM RMP standards. Effectiveness: Temporary fencing or closure would be effective in improving the stabilization and persistence of reseeded areas in the short-term. In the long-term, annual precipitation from year to year, and the seasonal distribution of livestock within the allotment would determine the survival of reseeded plants. Effects on other resources: Temporary fencing would also limit wild horse access to forage inside fenced areas. Big game species would not likely be deterred by temporary livestock fencing. Temporary fencing in riparian areas could improve the recovery rate of shrubs and herbs that assist in stabilizing channel banks.

Residual impacts include:

- Long (20- to 200-years) restoration periods for shrublands and woodlands on 8,828 acres of disturbed ROWs because of sparse and uncertain precipitation, and soil-induced growth constraints (salinity, alkalinity, shallow soil depths).
- Permanent removal of shrubland (primarily sagebrush shrubland, greasewood/salt desert shrubland, Mojave mixed desert scrub) from 808 acres required for aboveground facilities.
- An unknown fraction of some disturbed communities would not recover to previous composition and density because of specialized soil requirements (e.g., winterfat on hardpan/caliche soils within the greasewood/salt desert shrubland type).

Spread and Introduction of Noxious and Non-native Invasive Weed Species

Conclusion. The proposed ROWs for 225 miles of buried water pipelines and 208 miles of overhead power lines are at high risk for invasion by noxious and non-native weed species. SNWA would implement a variety of measures to be included in an integrated weed management plan. These measures include management of weed contaminated topsoil, pre-construction weed treatments, and equipment wash stations to prevent the transport of weed plants and seeds along the ROW into new areas. SNWA would continue to monitor and control weeds within the ROW until released by the BLM, in accordance with overall restoration responsibilities.

Proposed mitigation measures:

ROW-VEG-3: Green Stripping. SNWA, in consultation with the BLM, would develop a green stripping revegetation prescription where BLM and SNWA preventive and control measures may be inadequate to mitigate risks of weed invasion and wildfire. Green stripping is defined as ROW revegetation with fast-growing herbaceous species that can outcompete annual and perennial weeds and can provide a green firebreak. Locations where this measure may be applied would be identified in the Restoration Plan, Integrated Weed Management Plan, and Fire Prevention Plan, and approved by the BLM Visual Resource Management Coordinator. For example, it would be applied primarily to Great Basin Desert low elevation bottomlands, with limited applications to open evergreen woodlands (due to low risk for weed invasion) and Mojave Desert lowlands (due to low risk as a fire disturbance ecosystem). Effectiveness: This measure may be effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

Residual impacts include:

- Implementation of weed control and monitoring methods could prevent expansion of existing weed populations into new areas, but may be insufficient to control highly herbicide resistant perennial weed species that are already established within or adjacent to the ROWs.

Cacti and Yucca, Special Status Plants

Conclusion. Several thousand yucca and cacti would be salvaged from the ROWs over a distance of approximately 100 miles, retained in nurseries along the ROW, and replanted and watered in the next appropriate planting season. Criteria that would be used to determine which cacti and yucca would be salvaged is listed in **Appendix E**, ACM A.1.71. Mature Joshua trees and immature cacti would not be salvaged, and therefore removed from existing plant populations along the ROW. Five special status plant species populations have been identified within proposed construction ROWs. Transplanting and seed gathering would assist in restoration of disturbed sites, but would not likely replace existing populations at an equivalent level. The net reduction in individuals and seeds of directly affected special status plant species is not likely to lead to future federal listings because there are five or more populations of these species elsewhere in Nevada and Utah.

Proposed mitigation measures:

ROW-VEG-4: Special Status Plant Species Establishment. In addition to salvaging and transplanting special status species found in the ROW for tier 1 or subsequent tier construction activities, the SNWA would grow additional plants from seed (collected from individuals prior to salvage) or by grafting (from the salvaged plants) to enhance the new, transplanted populations. Seed collection for this effort would occur over multiple years prior to plant salvage. Specific special status plant species and collection methods would be identified in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to special status plant species found within the Project ROW by enhancing re-establishment. Effects on other resources: Seed/plant collection activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-5: Blaine's Fishhook Cactus Surveys. The SNWA would begin Blaine's fishhook cactus (*Sclerocactus blainei*) surveys as soon as possible after project design and engineering is complete; conducting the surveys within known and potential habitat during the next appropriate season for plant identification. The goal of this mitigation measure is to allow for a minimum of two to three years of surveys, since this species may stay underground for several years. A 3-meter exclusion area would be established around any individuals found during the surveys. Effectiveness: This measure would be effective in avoiding impacts to *Sclerocactus blainei*. Effects on other resources: Conducting surveys would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-6: Blaine's Fishhook Cactus Transplantation. If found during surveys, Blaine's fishhook cactus (*Sclerocactus blainei*) individuals would be transplanted to undisturbed BLM land that is as similar as possible to the habitat from which it was removed. Site selection requirements and details would be provided in the Restoration Plan. Effectiveness: This measure would be effective in avoiding impacts to *Sclerocactus blainei*. Effects on other resources: Transplanting activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-7: Blaine's Fishhook Cactus Compensation. If enhancement measures fail to restore Blaine's fishhook cactus (*Sclerocactus blainei*) where it is found in the ROW prior to construction, SNWA would establish a compensatory mitigation fund for direct, indirect, and cumulative impacts to the species. A single payment of $10,000 would be made by the project applicant (SNWA) to the Center of Plant Conservation. This funding would specifically be used for preserving the genetic material of this species in perpetuity. Details regarding the definition of success with regard to *Sclerocactus blainei* would be determined, in coordination with the USFWS and the BLM, in the COM Plan. Effectiveness: This measure would be effective in offsetting impacts to *Sclerocactus blainei*, should adverse impacts occur. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

Residual impacts include:

- There would be lower populations of yucca, cacti, and five special status species within the construction ROWs after surface disturbance, and the initiation of restoration efforts. The recovery times for these species would depend on tolerance to surface disturbance, seed germination, and growth rates. Perennial tall desert species such as Joshua trees would require many years (100 to 200) to recover; annual and short-lived perennial herbaceous species could potentially recover in a few (2 to 5) years.

Accidental Wildfires

GWD Project areas most susceptible to fire are estimated to be sagebrush shrublands and invasive annual grasslands, which occupy about 44 percent of the length of the GWD Project ROWs. SNWA would provide fire suppression equipment and trained personnel to respond to fires that originate on the construction ROW.

Proposed mitigation measures:

ROW-VEG-3: Green Stripping. SNWA, in consultation with the BLM, would develop a green stripping revegetation prescription where BLM and SNWA preventive and control measures may be inadequate to mitigate risks of weed invasion and wildfire. Green stripping is defined as ROW revegetation with fast-growing herbaceous species that can outcompete annual and perennial weeds and can provide a green firebreak. Locations where this measure may be applied would be identified in the Restoration Plan, Integrated Weed Management Plan, and Fire Prevention Plan, and approved by the BLM Visual Resource Management Coordinator. For example, it would be applied primarily to Great Basin Desert low elevation bottomlands, with limited applications to open evergreen woodlands (due to low risk for weed invasion) and Mojave Desert lowlands (due to low risk as a fire disturbance ecosystem). Effectiveness: This measure may be effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

Residual impacts include:

- None, if no accidental construction- or operation-related fires occur.

Culturally Significant Plants

Conclusion. Most of the identified traditional-use plants are distributed widely in the Great Basin and Mojave Desert regions. Abundance of these plants varies from place to place and none are locally endemic or restricted to a single small area. It is not expected that project clearing and grading operations would affect the overall availability or abundance of tribal traditional use plants, unless project surface disturbance is located in a highly localized, traditional plant gathering area. The ethnographic interviews did not reveal any such highly specific plant gathering areas that would be directly affected by proposed project surface disturbance , but this does not preclude that disturbance to traditional plant gathering sites may potentially occur. Specific traditional plant gathering sites along the pipeline route may be identified through ongoing government to government consultation.

Proposed mitigation measures:

None.

Residual impacts include:

- There would be minor reductions in the availability of plant species used for Tribal traditional uses as the result of 8,828 acres of project surface disturbance, relative to the large areas where these species occur in individual hydrologic basins. Long-term disturbance to specific plant gathering areas may potentially occur.

3.5.2.4 Alternatives E and F

Construction and Facility Maintenance

The same ROW construction and facility maintenance issues discussed for the Proposed Action and Alternatives A through D would apply to Alternatives E and F, which would require 263 miles of pipeline and 280 miles of power lines in Clark and Lincoln counties. **Table 3.5-11** provides a summary of the estimated surface disturbance within vegetation cover types.

Vegetation Community Surface Disturbance and Restoration

Conclusion. Approximately 10,681 acres of native shrublands and woodlands removed or disturbed by construction would require 20 to more than 200 years for recovery to similar species composition and vertical structure as adjacent undisturbed areas. Approximately 58 acres of annual invasive grassland, perennial grassland, and marshland cover types would require from 2 to 15 years for recovery. Approximately 945 acres of natural land cover types would be permanently converted to aboveground industrial uses. The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. ACMs include measures to salvage and preserve soil and, during construction; to follow BMPs for revegetation seeding and erosion control; to follow a long-term restoration monitoring program; and to obtain a written release of restoration success from the BLM. Implementation of these measures would insure that vegetation species cover and composition would recover within time frames similar to natural recovery rates, or potentially more quickly over the majority of the surface disturbance areas.

Table 3.5-11 Alternatives E and F– Construction Disturbance and Operational Conversion of Land Cover Types

Land Cover Type	Construction Disturbance (acres)	Operation (Conversion to Aboveground Industrial Uses) (acres)
Agriculture/Developed	9	9
Annual Invasive Grassland	29	7
Barren	1	0
Greasewood/Salt Desert Shrubland	2,292	223
Marshland	6	6
Mojave Mixed Desert Scrub	3,052	260
Perennial Grassland	23	2
Pinyon-Juniper Woodland	256	26
Playa	21	1
Riparian Woodland and Shrubland	5	5
Sagebrush Shrubland	4,987	405
Total	**10,681**	**945**

Please see **Table 3.5-9** for Estimated Vegetation Community Recovery Time.

Proposed mitigation measures:

ROW-VEG-1: Native Seed Collection. The SNWA, in consultation with the BLM, would develop a seed collection program for native plant species found within the ROW. These native plant seeds would be used along the ROW corridor in revegetation and reclamation activities, to the extent feasible, to enhance the rate and quality of recovery. Seed from locally adapted native sources would likely provide the greatest rates of establishment and subsequent growth, increasing the success of reclamation efforts. Target species and collection methods would be identified in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to native plant species found within the Project ROW by enhancing re-establishment. Effects on other resources: Seed collection activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-2: Temporary Fencing or Closure to Livestock Grazing. The SNWA would conduct pre-construction surveys to determine areas of livestock use within and adjacent to the construction ROW where application of temporary fencing or closure would be needed for revegetation species establishment. The results of these surveys would be provided to the BLM for review and approval. Revegetation areas would be rested from grazing for two full years or until BLM determines that reclamation meets BLM RMP standards. Effectiveness: Temporary fencing or closure would be effective in improving the stabilization and persistence of reseeded areas in the short-term. In the long-term, annual precipitation from year to year, and the seasonal distribution of livestock within the allotment would determine the survival of reseeded plants. Effects on other resources: Temporary fencing would also limit wild horse access to forage inside fenced areas. Big game species would not likely be deterred by temporary livestock fencing. Temporary fencing in riparian areas could improve the recovery rate of shrubs and herbs that assist in stabilizing channel banks.

Residual impacts include:

- Long (20 to 200 years) restoration periods for shrublands and woodlands on 10,681 acres of disturbed ROWs because of sparse and uncertain precipitation and soil-induced growth constraints (salinity, alkalinity, and shallow soil depths);
- Permanent removal of shrubland (primarily sagebrush shrubland, greasewood/salt desert shrubland, Mojave mixed desert scrub) from 945 acres required for aboveground facilities; and
- An unknown fraction of some disturbed communities would not recover to previous composition and density because of specialized soil requirements (e.g., winterfat on hardpan/caliche soils within the greasewood/salt desert shrubland type).

Spread and Introduction of Noxious and Non-native Invasive Weed Species

Conclusion. The proposed ROWs for 263 miles of buried water pipelines and 280 miles of overhead power lines are at high risk for invasion by noxious and non-native weed species. SNWA would implement a variety of measures to be included in an integrated weed management plan. These measures include management of weed contaminated topsoil, pre-construction weed treatments, and equipment wash stations to prevent the transport of weed plants and seeds along the ROW into new areas. SNWA would continue to monitor and control weeds within the ROW until released by the BLM, in accordance with overall restoration responsibilities.

Proposed mitigation measures:

ROW-VEG-3: Green Stripping. SNWA, in consultation with the BLM, would develop a green stripping revegetation prescription where BLM and SNWA preventive and control measures may be inadequate to mitigate risks of weed invasion and wildfire. Green stripping is defined as ROW revegetation with fast-growing herbaceous species that can outcompete annual and perennial weeds and can provide a green firebreak. Locations where this measure may be applied would be identified in the Restoration Plan, Integrated Weed Management Plan, and Fire Prevention Plan, and approved by the BLM Visual Resource Management Coordinator. For example, it would be applied primarily to Great Basin Desert low elevation bottomlands, with limited applications to open evergreen woodlands (due to low risk for weed invasion) and Mojave Desert lowlands (due to low risk as a fire disturbance ecosystem). Effectiveness: This measure may be effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

Residual impacts include:

- Implementation of weed control and monitoring methods could prevent expansion of existing weed populations into new areas, but may be insufficient to control highly herbicide resistant perennial weed species that are already established within, or adjacent to the ROWs.

Cacti and Yucca, Special Status Plants

Conclusion. Several thousand yucca and cacti would be salvaged from the ROWs over a distance of approximately 100 miles, retained in nurseries along the ROW, and replanted and watered in the next appropriate planting season. Criteria that would be used to determine which cacti and yucca would be salvaged is listed in **Appendix E**, ACM A.1.71. Mature Joshua trees and immature cacti would not be salvaged, and therefore would be removed from existing plant populations along the ROW. Five special status plant species populations have been identified within proposed construction ROWs. Transplanting and seed gathering would assist in restoration of disturbed sites, but would not likely replace existing populations at an equivalent level. The net reduction in individuals and seeds of directly affected special status plant species is not likely to lead to future federal listings because there are additional (five or more) populations of these species elsewhere in Nevada and Utah.

Proposed mitigation measures:

ROW-VEG-4: Special Status Plant Species Establishment. In addition to salvaging and transplanting special status species found in the ROW for tier 1 or subsequent tier construction activities, the SNWA would grow additional plants from seed (collected from individuals prior to salvage) or by grafting (from the salvaged plants) to enhance the new, transplanted populations. Seed collection for this effort would occur over multiple years prior to plant salvage. Specific special status plant species and collection methods would be identified in the Restoration Plan. Effectiveness: This measure would be effective in mitigating impacts to special status plant species found within the Project ROW by enhancing re-establishment. Effects on other resources: Seed/plant collection activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-5: Blaine's Fishhook Cactus Surveys. The SNWA would begin Blaine's fishhook cactus (*Sclerocactus blainei*) surveys as soon as possible after project design and engineering is complete; conducting the surveys within known and potential habitat during the next appropriate season for plant identification. The goal of this mitigation measure is to allow for a minimum of two to three years of surveys, since this species may stay underground for several years. A 3-meter exclusion area would be established around any individuals found during the surveys. Effectiveness: This measure would be effective in avoiding impacts to *Sclerocactus blainei*. Effects on other resources: Conducting surveys would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-6: Blaine's Fishhook Cactus Transplantation. If found during surveys, Blaine's fishhook cactus (*Sclerocactus blainei*) individuals would be transplanted to undisturbed BLM land that is as similar as possible to the habitat from which it was removed. Site selection requirements and details would be provided in the Restoration Plan. Effectiveness: This measure would be effective in avoiding impacts to *Sclerocactus blainei*. Effects on other resources: Transplanting activities would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-VEG-7: Blaine's Fishhook Cactus Compensation. If enhancement measures fail to restore Blaine's fishhook cactus (*Sclerocactus blainei*) where it is found in the ROW prior to construction, SNWA would establish a compensatory mitigation fund for direct, indirect, and cumulative impacts to the species. A single payment of $10,000 would be made by the project applicant (SNWA) to the Center of Plant Conservation. This funding would specifically be used for preserving the genetic material of this species in perpetuity. Details regarding the definition of success with regard to *Sclerocactus blainei* would be determined, in coordination with the USFWS and the BLM, in the COM Plan. Effectiveness: This measure would be effective in offsetting impacts to *Sclerocactus blainei*, should adverse impacts occur. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

Residual impacts include:

- There would be lower populations of yucca, cacti, and five special status species within the construction ROWs after surface disturbance, and the initiation of restoration efforts. The recovery times for these species would depend on tolerance to surface disturbance and seed germination and growth rates. Perennial tall desert species such as Joshua trees would require many years (100 to 200) to recover, while annual and short-lived perennial herbaceous species could potentially recover in a few (2 to 5) years.

Accidental Wildfires

GWD Project areas most susceptible to fire are estimated to be sagebrush shrublands and invasive annual grasslands, which occupy about 47 percent of the length of the GWD Project ROWs. SNWA would provide fire suppression equipment and trained personnel to respond to fires that originate on the construction ROW.

Proposed mitigation measures:

ROW-VEG-3: Green Stripping. SNWA, in consultation with the BLM, would develop a green stripping revegetation prescription where BLM and SNWA preventive and control measures may be inadequate to mitigate risks of weed invasion and wildfire. Green stripping is defined as ROW revegetation with fast-growing herbaceous species that can outcompete annual and perennial weeds and can provide a green firebreak. Locations where this measure may be applied would be identified in the Restoration Plan, Integrated Weed Management Plan, and Fire Prevention Plan, and approved by the BLM Visual Resource Management Coordinator. For example, it would be applied primarily to Great Basin Desert low elevation bottomlands, with limited applications to open evergreen woodlands (due to low risk for weed invasion) and Mojave Desert lowlands (due to low risk as a fire disturbance ecosystem). Effectiveness: This measure may be effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

Residual impacts include:

- None, if no accidental construction or operation-related fires occur.

Culturally Significant Plants

Conclusion. Most of the identified traditional uses plants are distributed widely in the Great Basin and Mojave Desert regions. Abundance of these plants varies from place to place, and none are locally endemic or restricted to a single small area. It is not expected that project clearing and grading operations would affect the overall availability or abundance of Tribal traditional use plants, unless project surface disturbance is located in a highly localized, traditional plant gathering area. The ethnographic interviews did not reveal any such highly specific plant gathering areas that would be directly affected by proposed project surface disturbance, but this does not preclude that disturbance to traditional plant gathering sites may potentially occur. Specific traditional plant gathering sites along the pipeline route may be identified through ongoing government to government consultation.

Proposed mitigation measures:

None.

Residual impacts include:

- There would be minor reductions in the availability of plant species used for Tribal traditional uses as the result of approximately 10,681 acres of project surface disturbance, relative to the large areas where these species occur in individual hydrologic basins. Long-term disturbance to specific plant gathering areas may potentially occur.

3.5.2.5 Alignment Options 1 through 4

Table 3.5-12 presents impacts for the Alignment Options (1 through 4) in relation the relevant underground or aboveground facility segment(s) of the Proposed Action.

Table 3.5-12 Potential Effects on Vegetation Resources from Implementation of GWD Project Alignment Options 1 through 4 as Compared to the Proposed Action

Alignment Options	Analysis
Alignment Option 1 (Humboldt-Toiyabe Power Line Alignment) **Option Description**: Change the locations of a portion of the 230-kV power line from Gonder Substation near Ely to Spring Valley. **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• The option transmission line route would result in 24 fewer acres of surface disturbance and less removal of mature pinyon pine, sagebrush, and juniper trees. • The option transmission line would be located adjacent to an existing transmission line and would represent an expansion of an existing ROW. The corresponding segment of the Proposed Action would require a new 100-foot-wide ROW.
Alignment Option 2 (North Lake Valley Pipeline Alignment) **Option Description**: Change the locations of portions of the mainline pipeline and electrical transmission line in North Lake Valley. **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• This option would require 23 more acres of sagebrush shrubland clearing to construct the mainline pipeline and transmission line. • This option would require additional acreage (approximately 5 acres) to be committed to long-term industrial uses for an additional pump station along U.S. 93.
Alignment Option 3 (Muleshoe Substation and Power Line Alignment) **Option Description**: Eliminate the Gonder to Spring Valley transmission line and construct a substation with a interconnection with an interstate, high voltage power line in Muleshole Valley. **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• This option would eliminate all vegetation clearing associated with construction of a 230-kV line from Gonder Substation near Ely to Spring Valley, for a reduction of 365 acres relative to the Proposed Action. This impact reduction is based on a 33.8-mile length and 100-foot cleared ROW width. • Construction of the Muleshoe Substation would require an additional long-term land commitment of 43 acres of sagebrush shrubland for industrial uses as compared to the Proposed Action.
Alignment Option 4 (North Delamar Valley Pipeline and Power Line Alignment) **Option Description**: Change the location of a short section of mainline pipeline in Delamar Valley to follow an existing transmission line. **Applicable To**: All alternatives.	• The option would be located adjacent to an existing transmission line and would be shorter by 3 miles (representing 53 fewer acres of surface disturbance) as compared to the Proposed Action. However, a 10-acre pump station (5-acre permanent, 5-acre temporary) would be constructed adjacent to U.S. 93. As a consequence, implementation of the option would result in a net of 2 fewer acres of Mojave mixed desert shrubland that would be disturbed and revegetated. • A population of mature and immature Joshua trees and other yucca and cacti occur throughout this portion of Delamar Valley. A comparative estimate of the number of Joshua trees that would be removed under this alternative route or the Proposed Action is not available. However, it is likely that fewer Joshua trees and other species would require salvage if the pipeline overlapped with an existing transmission line ROW.

3.5.2.6 No Action

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Vegetation communities would continue to be influenced by natural events such as drought and fire, and land use activities such as grazing and existing water diversions. Management activities on public lands will continue to be directed by the Ely and Las Vegas RMPs, which involve measures to maintain natural vegetation communities. Management Plan guidance for other public lands in the project study area would be provided by GBNP General Management Plan and the Forest Plan for the Humbolt-Toiyabe National Forest.

3.5.2.7 Comparison of Alternatives

The total vegetation community surface disturbance impacts for each alternative are listed in **Table 3.5-13**.

Table 3.5-13 Summary of Vegetation Community Surface Disturbance Proposed Action and Alternatives A through F

Parameter	Proposed Action, Alternatives A through C	Alternative D	Alternatives E and F
Vegetation Community Surface Disturbance from Construction (acres)	12,288	8,828	10,681

3.5.2.8 Groundwater Development and Groundwater Pumping

This section considers issues, assumptions, and methods related to field development and eventual pumping from up to five hydrologic basins.

Issues

Groundwater Field Development Construction and Facility Maintenance

- Short-term, long-term, and permanent loss of vegetation communities (due to surface disturbance and conversion of natural vegetation to industrial uses) as a result of construction-related activities and operational maintenance.
- Potential introduction or population expansion of noxious and non-native invasive weeds due to surface disturbance.
- Loss of individuals, or populations of federally listed, candidate, or special status plant species (including cacti and yucca) due to surface disturbance.
- Accidental wildfires caused by construction equipment or smoking during construction and operation.
- Availability of plant species traditionally used for food and fiber by regional tribes in relation to project surface disturbance activities.

Groundwater Pumping

- Short-term, long-term, and permanent loss of vegetation communities (including spring-fed wetlands and riparian areas) and special status plant species populations due to groundwater drawdown.
- Changes in the availability of groundwater-dependent plant species traditionally used for food and fiber by regional tribes in relation to groundwater drawdown.

Assumptions

Groundwater Field Development Construction and Facility Maintenance

- The Ely and Las Vegas RMP Management Actions and BMPs would be applied to all proposed construction activities based on the most current Ely and Las Vegas RMPs (BLM 2008, 1998).
- The ACMs included in the SNWA POD to manage surface disturbance effects for future ROWs provide a basis for appropriate measures that may be submitted in future SNWA ROW applications. For purposes of impact analysis, it has been assumed that measures appropriate for ROW construction would be applied to future ROW construction in groundwater development areas.

Groundwater Pumping

- Spring-fed meadows and riparian areas represent small areas within hydrologic basins and are best discussed by individual springs or by perennial stream reaches. The springs and perennial stream reaches of vegetation effects concern are the high and moderate risk water sources as defined in Section 3.3, Water Resources. Both inventoried and other springs are included in the enumeration of potentially affected springs and water bodies. The expected plant successional relationships in response to drawdown are discussed under drawdown effect criteria below.
- It is assumed that a groundwater depth of 50 feet or deeper in relation to the ground surface elevation is not accessible to the roots of most phreatophytic shrubs and this groundwater depth represents a reasonable boundary for: 1) estimating the deepest root zone extent of plant communities that are at least partially dependent on underlying groundwater, and 2) defining a groundwater drawdown boundary that assumes that the roots of overlying plant communities no longer have access to groundwater as a moisture source at depths greater than 50 feet. For example, the phreatophytic shrubland ET that occupies Cave Valley are underlain by existing groundwater depths greater than 50 feet. Therefore, it is assumed that these communities would not be affected by groundwater drawdown in this hydrologic basin.
- The ET areas mapped for each hydrologic basin as part of the water balance estimates (Section 3.3, Water Resources) represent the primary cover types that would be affected by drawdown over large areas. The ET areas were originally mapped primarily on the basis of vegetation density classes and not specifically by species

composition. For purposes of evaluating vegetation community response to groundwater pumping, the primary SNWA ET areas (wetland/meadow, phreatophyte/medium vegetation, and bare soil/low vegetation) were separated into two vegetation cover types (wetland/meadow and basin shrubland) (**Table 3.5-7**). These cover types are encompassed by the ET area boundaries within the primary GWD Project pumping basins and adjacent basins that may experience drawdown effects (**Figures 3.5-3** and **3.5-4**).

- The basin shrubland cover type is comprised of a mosaic of different plant communities, but is dominated by greasewood, low saltbush, big sagebrush, and other shrub species.
- The wetland/meadow cover type is dominated by perennial grasses, sedges, and rushes in spring-fed or sub-irrigated meadows. Also included in this cover type are riparian shrublands adjacent to the channel in Meadow Valley Wash and the Muddy River.
- Playas are classified as ET areas but were distinguished separately because they are barren of vegetation.

- Based on an evaluation of plant rooting depth, physiological responses to drought, available information on groundwater levels, and seasonal soil moisture, an index drawdown contour of 10 feet is assumed to be a reasonable estimate of the point at which long-term changes in plant community vigor and composition would begin to appear. The model drawdown estimates include a wide range of uncertainty (see Section 3.3, Water Resources). Soil texture, soil chemistry, seasonal soil moisture, and rooting depths in these plant communities are highly variable. As a consequence of this variability, the depth index may encompass plant stress levels that would be initiated at shallower drawdown depths or stress that would be initiated at greater depths. Key references that were consulted on wetland and phreatophytic shrub rooting depths, physiological mechanisms to withstand drought, and seasonal water use from underlying soils include: Branson et al. (1976); Busch et al. (1992); Castelli et al. (2000); Hacke et al. (2000); Moreo et al. (2007); Pataki (2008); Sperry and Hacke (2002); Steinwand et al. (2006); Trent et al. (1997); Toft (1995); and Toft and Fraizer (2003).

The vegetation composition and structure response of the Wetland/Meadow and Basin Shrubland ET areas to long-term drawdown stress is expected to vary widely depending on the underlying soil textures, chemistry, and water holding capacity; the relative influence of seasonal and annual precipitation; and the adaptations of individual species to drought stress. Furthermore, multiple sources of water likely support the Wetland/Meadow communities. These communities require high soil moisture during most of the growing season. High soil moisture can result from either 1) a shallow water table (i.e., groundwater within 1 to 3 meters of the soil surface) or 2) substantial amounts of surface flooding, either from outflow from adjacent wetlands or from surface runoff following spring snowmelt or 3) a perched water table, likely resulting from a soil layer with low permeability beneath the Wetland/Meadow communities. The primary source of water maintaining the perched water table is likely a local aquifer that may not be hydraulically connected to the more regional aquifer used for the GWD Project. These meadows also require perturbations sufficiently frequent to exclude dominance by shrubs. Common types of perturbation are high groundwater for at least 6 months of the year or frequent fires.

A limited number of studies have addressed vegetation community responses to groundwater drawdown. These studies were used to develop a general plant successional sequence in response to groundwater drawdown. Relevant studies focused on vegetation community responses to groundwater drawdown in Owens Valley of California (Elmore et al. 2006, 2003; Groeneveld 1992; Manning 1999; Pritchett and Manning 2009; Sorenson et al. 1991). Other studies estimated groundwater drawdown effects on wetland and phreatophytic vegetation in the Great Basin, Arizona, and Colorado (Cooper et al. 2006; 2003; Patten et al. 2008; Naumburg et al. 2005; Stromberg et al. 1996).

The following general changes in these communities may be expected in response to a 10-foot or greater drawdown. As the soil moisture profile dries out and in response to periodic droughts, it is expected that wetland species would become less vigorous and less able to compete against upland species that are either able to spread via rhizomes or by establishment of seedlings that can gain a competitive advantage. In general, it is expected that drawdown-induced root zone stress would result in the following secondary successional sequence:

- Phase 1: A gradual decline in sedges, bulrushes, cattails, and willows that occupy saturated soil sites the majority of the year and an increase in Arctic rush, native grasses such as common reed (*Phragmites australis*), salt grass (*Distichlis spicata*), and alkali sacaton (*Sporobolus airoides*).
- Phase 2: A gradual decrease in grasses and rushes, and an increase in phreatophytic shrubs (rubber rabbitbrush, greasewood) and persistence of drought-tolerant and deep-rooted native grasses (e.g., Basin wildrye, inland saltgrass). Obligate wetland species such as spike rushes and sedges would largely disappear except in areas where year-round soil moisture remains in the root zone.
- Phase 3: A gradual decrease in grass cover and increase in phreatophytic shrub cover and dominance. Bare interspaces among shrubs would increase and some of these interspaces could be invaded by annual native and exotic species. Examples of native species include various species of goosefoot (e.g., *Chenopodium leptophylum*) and exotic species include annual grasses (e.g., cheatgrass, 6-weeks fescue) and salt lover (*Halogeton glomeratus*).
- Phase 4: A gradual reduction in the dominance of deep-rooted phreatophytes (greasewood, rabbitbrush) and an increased dominance of species that rely primarily on shallow soil moisture and are more typical of upland as well as alkaline soil basin sites. Examples of adapted species include mat saltbush (*Atriplex gardneri* and *A. nuttallii*), fourwing saltbush (*A. canescens*) and shadscale on saline/alkaline soils, and sagebrush (*Artemisia tridentata* ssp.), and horsebrush (*Tetradymia canescens*) on non-saline sites. A variety of annual and perennial herbs and grasses would likely occupy the shrub interspaces. While it is expected that greasewood and rabbitbrush would remain in the community, the height and canopy of these species would decline. The endpoint of this successional sequence on non-alkaline or non-saline soils would likely be a sagebrush dominated community – these communities would most likely be found on alluvial fans and the outer margins of valley floors. The successional endpoint of valley floor communities likely would be a mix of the phreatophytic shrubs that already occur there, but at lower densities, more species of low stature saltbush species, and a higher fraction of annual native and exotic species. Invasion by annual grass species would likely increase the wildfire risk in these areas, resulting in fewer shrubs if wildfires occur.

In summary, it is expected that the herbaceous wetland ETs (primarily associated with larger valley floor spring systems) could slowly change toward dominance by phreatophytic shrubs and other species better adapted to lower surface soil moisture levels. Similarly, the areas dominated by greasewood, rabbitbrush, and big sagebrush may be invaded by shrubs, herbs, and grasses that are adapted to seasonal shallow soil moisture, and are capable of withstanding extended droughts, either through complete or partial dormancy, or long-lived seeds.

- Assumptions about the potential changes in vegetation community composition and structure from groundwater pumping do not incorporate additional assumptions about the effects of climate change because the specific long-term effects of climate change are not presently known, and the incremental contribution of climate change effects to project effects cannot be reasonably estimated. A discussion of climate change effects is provided in Section 3.5.3.1, Cumulative Impacts Common to All Alternatives.

Methodology for Analysis

Groundwater Field Development Construction and Facility Maintenance

- The methods outlined under construction ROWs were applied to project surface development activities.
- SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins and all facilities associated with the SNWA GWD Project. The COM Plan includes a requirement for comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect vegetation resources from ROW construction and operation activities.
- Mitigation measures discussed in this resource section focus on new measures. Where applicable, some of the ROW mitigation measures may apply to surface disturbance activities associated with groundwater development. These ROW mitigation measures also would be considered in subsequent NEPA tiers.

Groundwater Pumping

- The COM Plan would integrate protective measures from the following: BLM RMPs, BO, ACMs, Stipulated Agreements, the DOI Handbook for Adaptive Management, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20 along with measures to protect vegetation resources from groundwater pumping activities.
- Wetland/Meadow and Basin Shrubland. Vegetation communities within ET boundaries in each pumping basin were compared with the 50-foot or greater depth-to-water contours to determine if other sources of water may be sustaining these plant communities. For example, the depth to groundwater under ET vegetation areas mapped in southern Cave Valley are greater than 50 feet, indicating that these communities may be sustained by shallow impermeable soil layers that provide sufficient soil moisture to support phreatophytic shrubs. The area enclosed by the maximum extent of the 10-foot drawdown contour was superimposed over the area of the primary ETs (wetland/meadow, basin shrubland cover types) to calculate the area of vegetation that could experience reductions in soil moisture and long-term vegetation community composition changes caused by groundwater drawdown of 10 feet or more at different points in time (full build out, full build out plus 75 years, and full build out plus 200 years). Figures were generated that illustrate the expansion of the 10-foot drawdown contours over time in relation to the vegetation communities within the hydrologic ET boundaries.
- Springs and perennial stream reaches. Wetland and riparian shrubland communities have formed below many springs and along stream channels with perennial flows. These wetland and riparian communities typically occupy small areas of several acres in association with spring brook channels. These areas are important as wildlife and aquatic biota habitat and are expected to experience changes in vegetation composition toward non-wetland species over time. The 10-foot drawdown index was applied to the springs and perennial stream reaches that were classified as “at risk” from being affected by groundwater drawdown (Section 3.3, Water Resources). The springs included for analysis were those rated as presenting a “high” or “moderate” risk of effects. The number of springs and miles of perennial stream reaches potentially affected for each alternative over time are described in Section 3.3, Water Resources. The locations of the major spring complexes are illustrated on **Figures 3.5-3** and **3.5-4**.

3.5.2.9 Proposed Action

Groundwater Development Area

The construction and maintenance methods for well pad, gathering pipelines, access roads, and distribution power lines are anticipated to be the same as those described for the mainline pipeline and ancillary facilities. Effects on natural vegetation communities also would be similar, since future surface disturbance activities would occur in the same hydrologic basins where the mainline pipeline would be located. The major effect of future groundwater field development would be an expansion of surface disturbance activities over a large area within each hydrologic basin. Consequently, the BLM RMP Management Actions, BMPs, SNWA ACMs for ROWs are applicable, and likely to be proposed as part of future ROW applications to the BLM. Because there is flexibility in the layout of well pads and roads, recommendations to reduce impacts are focused on opportunities to avoid sensitive areas.

Vegetation Community Surface Disturbance and Restoration

Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 3,590 to 8,410 acres. It is assumed that approximately 66 percent of the construction surface disturbance, or approximately 2,374 to 5,536 acres, would be committed to long-term industrial uses, and would not be revegetated during the project life. No specific development plans are available, so it is assumed that the vegetation cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/salt desert shrubland, and Mojave mixed desert shrubland types would be most extensively disturbed.

Surface restoration, restoration monitoring measures, and mitigation measures would be those identified in BLM RMP Management Actions, BMPs (**Appendix D**), and SNWA ACMs (**Appendix E**). The vegetation community recovery time frames would be the same as those described under ROW Construction and Facility Maintenance.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

In its Programmatic Environmental Protection Measures, SNWA has stated that it would avoid locating well pads, collector pipelines, distribution power lines, and secondary substations in riparian and wetland areas (ACM B.1.1, B.1.3). SNWA also has committed to colocate pipelines, roads, and electrical service lines within groundwater development areas.

Spread and Introduction of Noxious and Non-native Invasive Weed Species

There would be an expanded risk of noxious and non-native invasive weed species invasion of new, disturbed ROW.

The same target species and control methods as described under ROW Construction and Facility Maintenance would be addressed during the construction of groundwater well field facilities. Implementation of “green stripping” (ROW-VEG-3) to suppress exotic annual grasses and provide a fire resistant strip may be appropriate in many areas.

Cacti and Yucca, Special Status Plants

The same target cacti and yucca species would be salvaged in accordance with the procedures outlined in the ACMs A.1.71 through A.1.78. Yuccas and cacti would be primarily salvaged from the groundwater development areas within Dry Lake and Delamar valleys. Implementation of recommendation GWD-VEG-1 would reduce the loss of mature Joshua trees and other large yucca plants by avoiding these plants wherever possible during the access road and gathering pipeline planning process.

Accidental Wild Fires

The risks of, and control measures for, accidental wild fires would be the same as that discussed under ROWs, Proposed Action and Alternatives A through C. The risk of accidental fires is considered high within all groundwater development areas, with the highest risk in invasive exotic grass-dominated areas and sagebrush communities. Preparation and implementation of a wildfire training and response plan would provide opportunities to control small wildfires before they expand in size and to ensure worker safety.

Culturally Significant Plants

It is expected that project clearing and grading operations within groundwater development areas would slightly reduce the overall availability or abundance of Tribal traditional use plants that occupy upland woodland and shrubland types within project development basins. The ethnographic interviews did not reveal any highly specific plant gathering areas that would be directly affected by proposed project surface disturbance within the overall groundwater development areas, but this does not preclude that disturbance to traditional plant gathering sites may potentially occur. Specific traditional plant gathering sites in the groundwater development areas may be identified through ongoing government to government consultation.

<u>Conclusion</u>. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 8,400 acres within 5 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or 5,540 acres, would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years. It also is assumed that:

1) SNWA would implement its ROW ACMs, including measures for the BLM approval of successfully revegetated areas and long-term weed monitoring and control, as well as its commitment to avoid construction of groundwater development facilities in wetlands and riparian areas;
2) SNWA would identify and avoid special status plant species (including mature Joshua trees) as part of its infrastructure planning for its groundwater development; and

3) SNWA would develop emergency response plans to reduce the risk of starting accidental wildfires, as well as limiting fire spread.

Based on these measures, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities.

Proposed mitigation measures:

GW-VEG-1: Joshua Tree Avoidance. Mature Joshua trees (*Yucca brevifolia*) would be avoided to the extent possible when laying out access roads in Delamar Valley. Effectiveness: This measure would be effective. Road alignments could be designed to minimize the loss of yuccas, but roads also must be designed with a minimal number of curves to ensure traffic safety. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources. No comprehensive ground surveys for special status plants have been completed within the various groundwater development areas. Based on reconnaissance surveys completed to date, five special status plant species have been identified in groundwater development areas adjacent to the proposed pipeline ROW. These five species have already been located within and adjacent to ROW areas. Implementation of GW-VEG-2 would assist in avoiding special status plant species individuals and populations as part of the groundwater development planning process. Additional special status species may be located within exploratory areas that have not yet been surveyed.

Potential residual impacts include:

- The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.

Groundwater Pumping

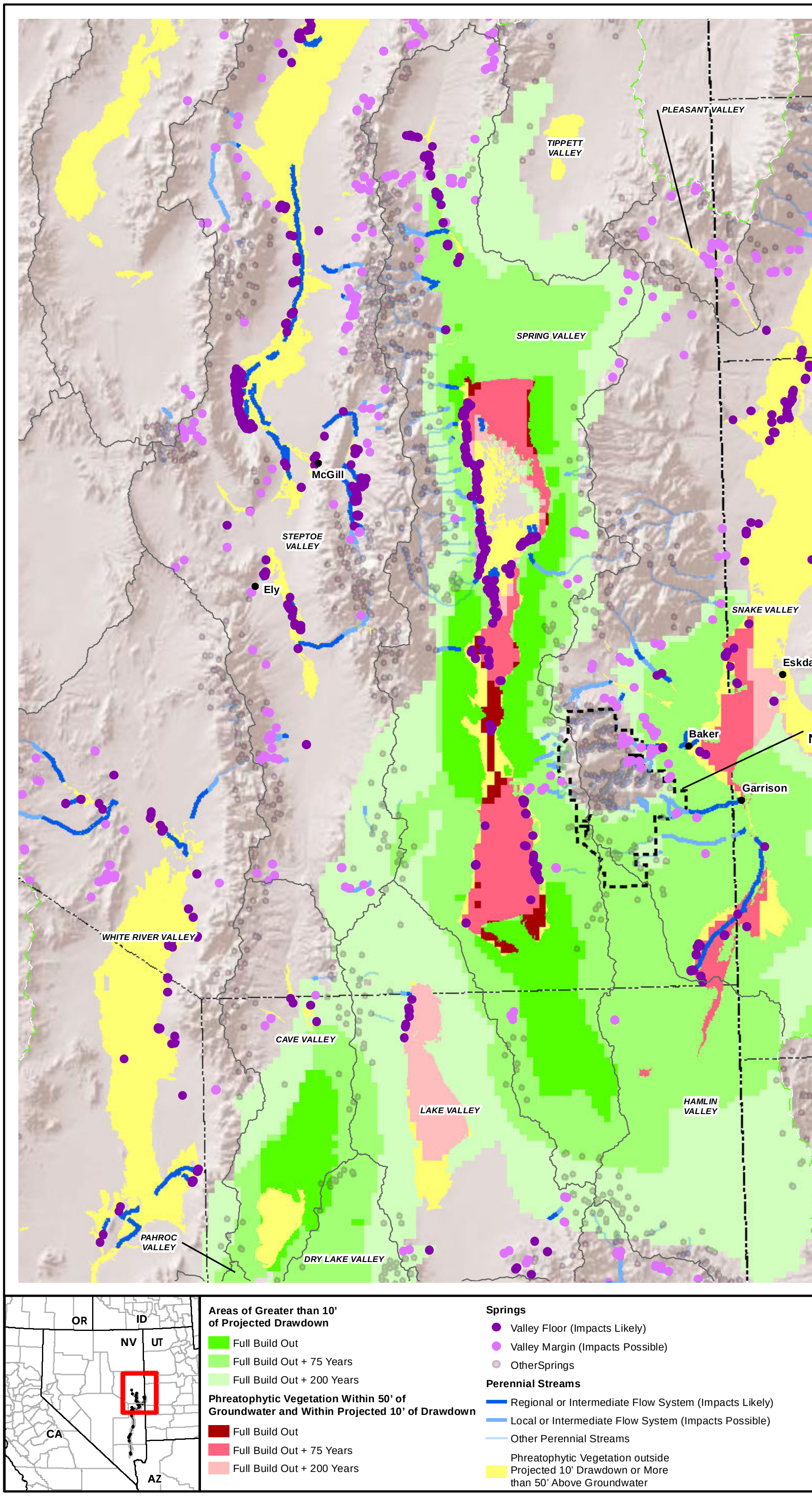
Figure 3.5-6 illustrates the overlap of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins describing areas where surface and groundwater supply may be reduced. This includes the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches.

Full Build Out. Potential drawdown effects are predicted in central, southern, and northeastern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects in ET areas would expand across Spring Valley and would appear in southern Snake Valley near Baker, in the Big Springs Creek drainage, and northeastern Hamlin Valley.

Full Build Out Plus 200 Years. The potential drawdown effects in ET areas would incrementally expand in the Snake Valley in the south of Eskdale and across the majority of the phreatophytic vegetation areas in northern Lake Valley.

The following vegetation community changes could occur in response to groundwater pumping, as outlined under the assumptions. The specific vegetation community responses cannot be predicted on a site-specific basis. The rate of change in plant community composition also would be highly variable, depending on groundwater drawdown rates and local water elevation recovery, as well as the influence of precipitation and overland and runoff in channels.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-6
Proposed Action
Projected Drawdown Greater Than 10' Phreatophytes, Springs, and Streams

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Wetland/Meadow

Plant species in vegetation communities that are directly dependent on perennial spring and stream flows would experience the greatest potential change in plant species composition. Based on the general successional model outlined in the assumptions, it is likely that wetland communities consisting of sedges, rushes, and cattails would progressively change toward a community dominated by deep-rooted grasses. The overall surface area occupied by wetland species would decrease, with persistence only in areas that continue to receive sufficient surface and groundwater for long-term survival. Species composition could change toward dominance by phreatophytes and other species better adapted to low near-surface soil moisture. Over the long term, it is expected that areas occupied by this cover type could be invaded by basin shrubland vegetation units, or other upland vegetation types, depending on sources of surface moisture and soil chemistry (texture, salinity, and alkalinity). This successional progression is unlikely to be reversed, since it is expected that hydric soils would lose many of their wetland characteristic and would likely to become more similar to upland soils with better root zone aeration than hydric soils.

Basin Shrubland

Based on groundwater studies in other hydrologic basins, such as the Owens Valley of California, it is likely that the dominant phreatophytic shrubs (greasewood, rabbitbrush) would persist over the long term, but potentially at lower densities and vigor as the result of reduced availability of soil moisture at greater depths and lower suitability for shrub seedling re-establishment and growth. Swamp cedar communities could also be affected by reduced availability of soil moisture in basin shrubland communities. These areas could be invaded by shrubs, herbs, and grasses that are adapted to seasonal shallow soil moisture and are capable of withstanding extended droughts, either through complete or partial dormancy, or long-lived seeds. It is likely that invasive annual grass species would become increasingly dominant and that the risk of wildfires also would likely increase.

Springs and Perennial Stream Reaches

The effects on vegetation dependent on spring flows would vary by the flow volume and flow persistence. Reductions in spring flow would likely reduce the length of the spring brook and reduce the area of wetland vegetation that is dependent on reliable surface and sub-surface soil moisture. Riparian shrubs (such as willows and birches) likely would decline in vigor and would eventually die in areas where groundwater elevations decline below the root zone. The majority of these spring drying effects are predicted to occur in Spring Valley. Potential pumping effects on waterbodies in the GBNP and adjacent to Utah are discussed in Aquatic Biological Resources, Section 3.7.2.

Special Status Species

To date, no Ute Ladies'-tresses orchid populations have been found in any of the areas potentially at risk, although potential habitat has been identified in Spring and southern Snake valleys. If this species is discovered in potential habitats in the future, there is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long-term population viability.

Culturally Significant Plants

Traditional use plants that are classified as wetland plants by the USACE (**Table 3.5-8**) occur in wetlands and meadows. Examples of common wetland species on the traditional use list that occur in spring meadows within the affected hydrologic basins include Arctic rush, California bulrush (*Schoenoplectus californicus*), cattail (*Typha latifolia*), and common reed (*Phragmites australis*) (**Table 3.5-5**). Groundwater drawdown effects on these species are generally described under the wetland/meadow ET area above and could range from small changes in species composition in areas where groundwater levels are maintained over the long term to a broad scale conversion of wetlands and meadow to dry grasslands and shrublands, with disappearance of wetland species over time. In summary, it is likely that traditional use wetland plant species occupying wetlands and sub-irrigated grasslands in Spring, Snake, and Lake valleys would become less abundant and less available over time.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

ACMs. The stipulated agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of wetland/wet meadow communities, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

Present ACMs could be used to mitigate adverse effects resulting from groundwater pumping. The broad measures that are most applicable to addressing vegetation effects include: 1) geographic redistribution of groundwater withdrawals; 2) reduction or cessation of groundwater withdrawals; 3) acquisition of real property and/or water rights dedicated to the recovery of special status species within their current and historic habitat range; and 4) provision of resources to restore and enhance habitat on the Pahranagat NWR.

SNWA also has identified more specific biological, and land use and range management measures. Specific measures relevant to vegetation resources that are highly or somewhat dependent on groundwater sources include:

- ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community.
- ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts.
- ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles, and then diverting the saved water to the wet meadow areas.

Proposed mitigation measures:

GW-VEG-2: Monitoring within Ute Ladies'-tresses Habitat. In concert with GW-WR-3, and on BLM lands, biological and hydrologic monitoring would be required for Ute Ladies'-tresses (*Spiranthes diluvialis*) groundwater-dependent habitats in areas that may be affected by groundwater pumping. Effectiveness: This measure would provide additional information, not currently available; to assess potential impacts to Ute Ladies'-tresses and its habitat from groundwater pumping. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

GW-VEG-3: Wetlands Monitoring. Prior to any project pumping in Cave, Dry Lake, Delamar or Spring valleys, the SNWA would develop a wetlands monitoring plan. This plan would specify monitoring requirements and metrics for vegetation, soils, and hydrology to provide adequate baseline data to facilitate the creation of an early warning system designed to distinguish between the effects of project pumping, natural variations, and other non-project related groundwater pumping activities. This measure is in concert with GW-WR-3a. Monitoring would be conducted for all wetlands (both USACE jurisdictional and non-jurisdictional) in areas that may be affected by groundwater pumping. Specific monitoring locations would be identified in the COM Plans associated with subsequent NEPA tiers. Effectiveness: This measure would provide additional information, not currently available; to assess potential impacts to wetlands from groundwater pumping. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

GW-VEG-4: Phreatophytic Vegetation Monitoring in GW Development Areas. Prior to any project pumping in Cave, Dry Lake, Delamar or Spring valleys, the SNWA would develop a phreatophytic vegetation monitoring plan. This plan would specify monitoring requirements for quantifying the extent and distribution of phreatophytic vegetation at sufficient resolution to detect changes in density and cover in areas that may be affected by groundwater pumping. Baseline data derived from monitoring would facilitate the creation of an early warning system designed to distinguish between the effects of project pumping, natural variations, and other non-project related groundwater pumping activities. Specific monitoring locations would be identified in the COM Plans associated with subsequent NEPA tiers. This measure is in concert with GW-WR-3a. Effectiveness: This measure would provide additional information, not currently available; to assess potential impacts to phreatophytic vegetation and its habitat from groundwater pumping. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

GW-VEG-5: Swamp Cedar Monitoring. In concert with GW-WR-3, and on BLM lands including ACECs, biological and hydrologic monitoring would be required for swamp cedar (*Juniperus scopulorum*) groundwater-dependent habitats in areas that may be affected by groundwater pumping. Monitoring of these communities would include the determination of groundwater requirements necessary to maintain viable populations, and metrics to assess the health of individual swamp cedars. The goal of monitoring would be to ensure the long-term survival and continued existence of these populations. Effectiveness: This measure would provide additional information, not currently available; to assess potential impacts to swamp cedar populations and their habitat from groundwater pumping. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources.

As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).

Monitoring of surface water resources and groundwater elevations under monitoring measure GW-WR-3a (Comprehensive Water Resources Monitoring Plan) would be used to determine the effectiveness of the implemented measures (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).

As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a “Cease and Desist” order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

Mitigation planning could be developed as part of the Snake Valley 3M Plan (**Appendix B**). Management actions included in the Snake Valley 3M Plan that will be considered will include geographic redistribution of groundwater withdrawals; reduction or cessation of groundwater withdrawals; provision of consumptive water supply requirements using surface and/or groundwater sources; acquisition of property or water rights dedicated to management of special status species; and augmentation of water supply and/or acquisition of existing water rights.

Potential residual impacts include:

- The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.

Conclusions and Summary

Table 3.5-14 provides a summary of potential vegetation community effects for three model time frames.

Table 3.5-14 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Proposed Action

Effects/Conclusions

- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in long-term changes in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs.
- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater.
- Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species.
- Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.

Primary Affected Valleys

- Spring, Snake, and Lake

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 years
Wetland/meadow ET area affected by 10 feet or greater drawdown (acres).	117	5,460	8,048
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	17,702	136,990	191,506
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	8	212	305
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or more of drawdown.	6	80	112

Potential Vegetation Effects in GBNP and adjacent Utah

The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are described in Water Resources, Section 3.3.2.9. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.

Stipulation Agreements

The stipulation agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

ACMs

- ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community.
- ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts.
- ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles and then diverting the saved water to the wet meadow areas.

Table 3.5-14 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Proposed Action (Continued)

Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listed for the Proposed Action. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.

3.5.2.10 Alternative A

Groundwater Development Area

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 2,069 to 4,814 acres within 5 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or approximately 1,370 to 3,171 acres would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP

Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. Based on BLM RMP Management Actions, BMPs, and SNWA ACMs, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that reductions in special status plant populations could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the vegetation cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/salt desert shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Groundwater Pumping

Figure 3.5-7 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

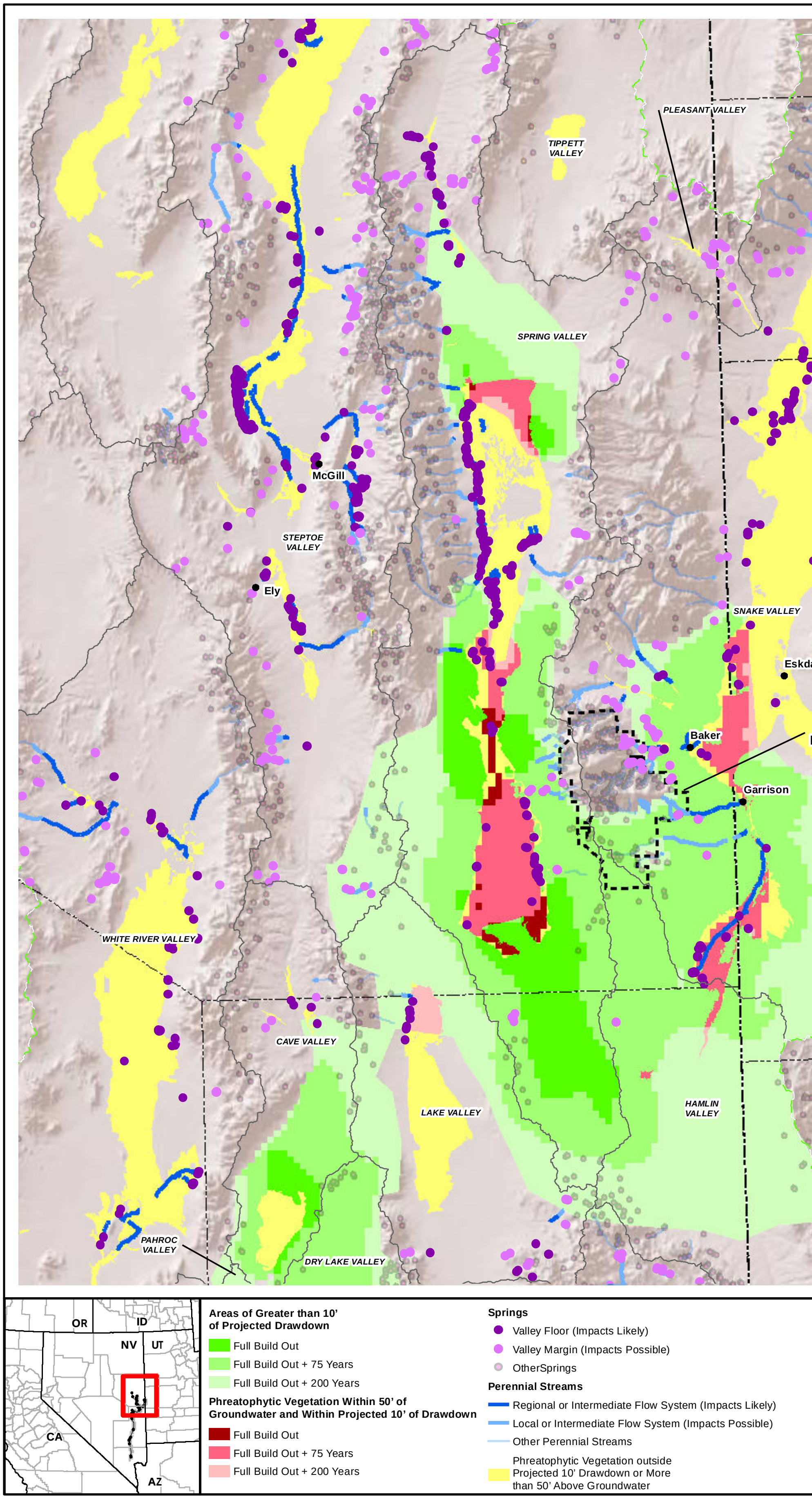
Full Build Out. Potential drawdown effects within ET areas are predicted in central, southern, and northern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects would expand across ET areas in southern Spring Valley and would appear in southern Snake Valley near Baker, in the Big Spring drainage, and northeastern Hamlin Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET boundaries would incrementally expand in central Snake Valley, the Snake Valley east of Baker, and the northern portion of Lake Valley.

Conclusion and Summary

Table 3.5-15 provides a summary of potential vegetation community effects for three model time frames.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-7
Alternative A
Projected Drawdown Greater Than 10' Phreatophytes, Springs, and Streams

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Table 3.5-15 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative A

<table>
<tr><td colspan="4">Effects/Conclusions</td></tr>
<tr><td colspan="4">• Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs.
• Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater.
• Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species.
• Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.</td></tr>
<tr><td colspan="4">Primary Affected Valleys</td></tr>
<tr><td colspan="4">• Spring, Snake, and Lake</td></tr>
<tr><td>Impact Indicators By Model Time Frame</td><td>Full Build Out</td><td>Full Build Out Plus 75 Years</td><td>Full Build Out Plus 200 Years</td></tr>
<tr><td>Wetland/meadow ET area affected by 10 feet or greater drawdown (acres).</td><td>92</td><td>4,624</td><td>6,137</td></tr>
<tr><td>Basin shrubland ET area affected by 10 feet or greater drawdown (acres).</td><td>12,059</td><td>106,414</td><td>123,714</td></tr>
<tr><td>Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).</td><td>3</td><td>115</td><td>182</td></tr>
<tr><td>Total miles of perennial streams with moderate to high risk of being affected by 10 feet or more of drawdown.</td><td>1</td><td>58</td><td>81</td></tr>
<tr><td colspan="4">Potential Vegetation Effects in GBNP and adjacent Utah</td></tr>
<tr><td colspan="4">The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.10, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.</td></tr>
<tr><td colspan="4">COM Plan</td></tr>
<tr><td colspan="4">• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.</td></tr>
<tr><td colspan="4">Stipulated Agreements</td></tr>
<tr><td colspan="4">The stipulation agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (Appendix C). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.</td></tr>
</table>

Table 3.5-15 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative A (Continued)

ACMs
• ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community. • ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts. • ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles, and then diverting the saved water to the wet meadow areas.
Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (PhreatophyticVegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listd for the Proposed Action. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.

3.5.2.11 Alternative B

Groundwater Development Area

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 4,664 acres within 5 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or 3,077 acres would be committed to long term industrial uses, and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. Based on BLM RMP Management Actions, BMPs, and SNWA ACMs, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas, and that reductions in special status plant populations could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the vegetation cover types would be affected in proportion to their relative surface area within 1 mile of the PODs within the five groundwater development basins. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and pinyon juniper woodland vegetation types would be most extensively disturbed.

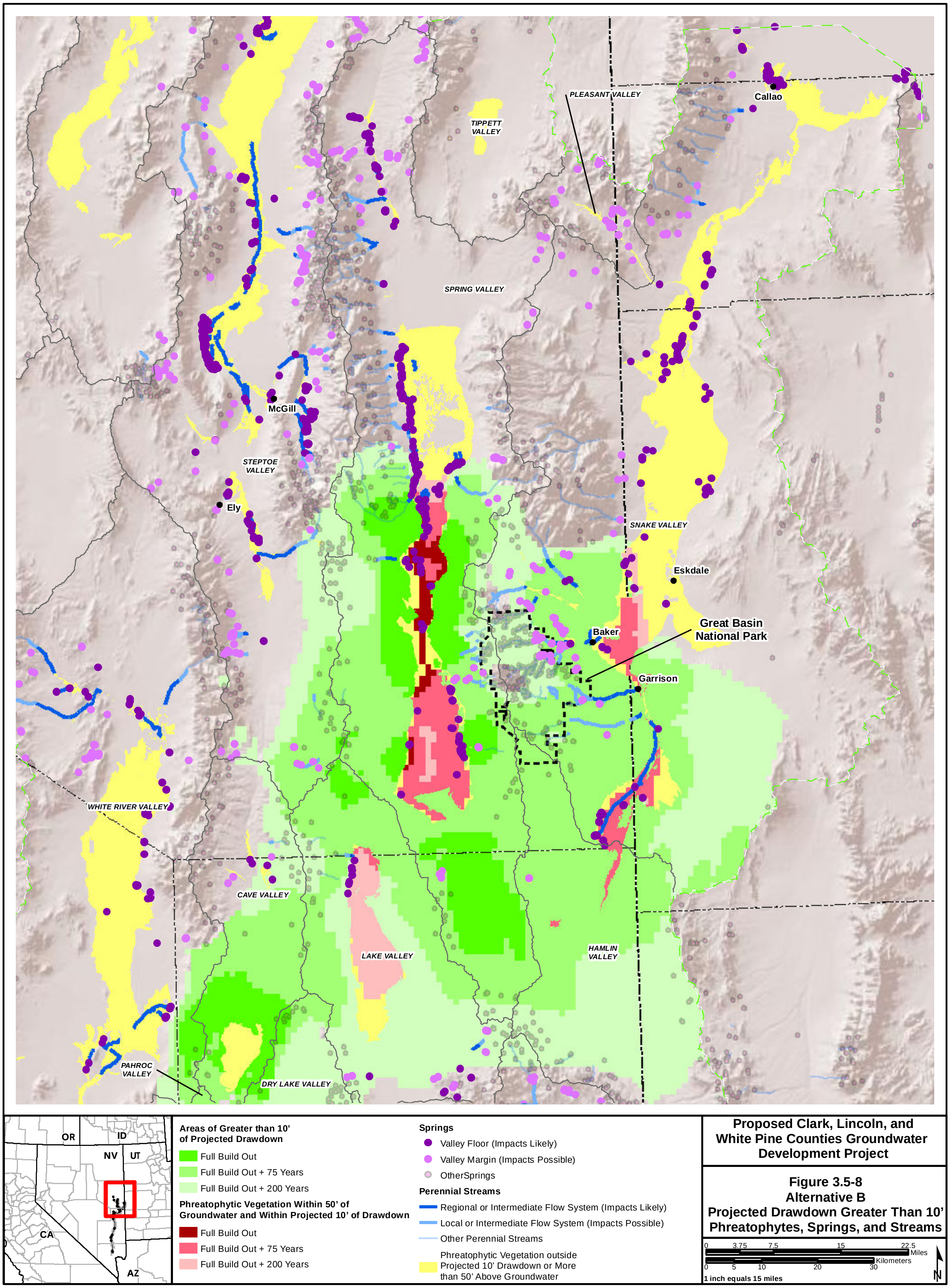
Groundwater Pumping

Figure 3.5-8 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs and perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within the ET area boundaries are predicted in central and southern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand across central and southern Spring Valley, and would appear in southern Snake Valley near Baker, in the Big Spring drainage, northeastern Hamlin Valley, Delamar, Dry Lake, Cave, White River, and Steptoe valleys.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in central and southern Spring Valley, the Snake Valley east of Baker, and the southern portions of Lake and Hamlin valleys.



Areas of Greater than 10' of Projected Drawdown
- Full Build Out
- Full Build Out + 75 Years
- Full Build Out + 200 Years

Phreatophytic Vegetation Within 50' of Groundwater and Within Projected 10' of Drawdown
- Full Build Out
- Full Build Out + 75 Years
- Full Build Out + 200 Years

Springs
- Valley Floor (Impacts Likely)
- Valley Margin (Impacts Possible)
- OtherSprings

Perennial Streams
- Regional or Intermediate Flow System (Impacts Likely)
- Local or Intermediate Flow System (Impacts Possible)
- Other Perennial Streams
- Phreatophytic Vegetation outside Projected 10' Drawdown or More than 50' Above Groundwater

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-8
Alternative B
Projected Drawdown Greater Than 10' Phreatophytes, Springs, and Streams

0 3.75 7.5 15 22.5 Miles
0 5 10 20 30 Kilometers
1 inch equals 15 miles
N

Conclusions and Summary

Table 3.5-16 provides a summary of potential vegetation community effects for the three model time frames.

Table 3.5-16 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative B

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Effects/Conclusions			
• Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs. • Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater. • Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species. • Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.			
Primary Affected Valleys			
• Spring, Snake, and Lake			
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	441	5,794	9,190
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	18,304	97,174	146,998
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	41	175	288
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	3	91	120
Potential Vegetation Effects in GBNP and adjacent Utah			
The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.11, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.			
COM Plan			
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.			
Stipulation Agreements			
The stipulation agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.			

Table 3.5-16 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative B (Continued)

ACMs
• ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community. • ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts. • ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles, and then diverting the saved water to the wet meadow areas.
Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listed for the Proposed Action. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.

3.5.2.12 Alternative C

Groundwater Development Area

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 2,069 to 4,814 acres within 5 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or approximately 1,370 to 3,171 acres, would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodlands would require 20 to 200 years.

The COM Plan would be developed and implemented to protect vegetation resources from groundwater development activities. The COM Plan would integrate protective measures from the following: BLM RMPs, BO, ACMs, Stipulated Agreements, the DOI Handbook for Adaptive Management, and additional mitigation recommended in this EIS. Based on BLM RMP Management Actions, BMPs, and SNWA ACM, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that effects on special status plants could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Proposed mitigation measures:

GW-VEG-1: Joshua Tree Avoidance. Mature Joshua trees (*Yucca brevifolia*) would be avoided to the extent possible when laying out access roads in Delamar Valley. Effectiveness: This measure would be effective. Road alignments could be designed to minimize the loss of yuccas, but roads also must be designed with a minimal number of curves to ensure traffic safety. Effects on other resources: Implementation of this measure would not adversely affect other environmental resources. Groundwater Pumping

Figure 3.5-9 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within the ET area boundaries are predicted in central and southern Spring Valley. Three potentially affected springs are located in Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand around the margin of central and southern Spring Valley and would appear in southern Snake Valley near Baker and in the Big Spring drainage in Snake Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in southern Spring Valley and the Big Spring drainage.

Conclusions and Summary

Table 3.5-17 provides a summary of potential vegetation community effects for three model time frames.

Table 3.5-17 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative C

Effects/Conclusions

- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs.
- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater.
- Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species.
- Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.

Primary Affected Valleys

- Spring, Snake, Delamar, Dry Lake, and Cave

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	92	2,287	3,250
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	12,059	42,703	50,076
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	3	63	96
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown.	1	37	59

Potential Vegetation Effects in GBNP and adjacent Utah

The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.12, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.

Stipulated Agreements

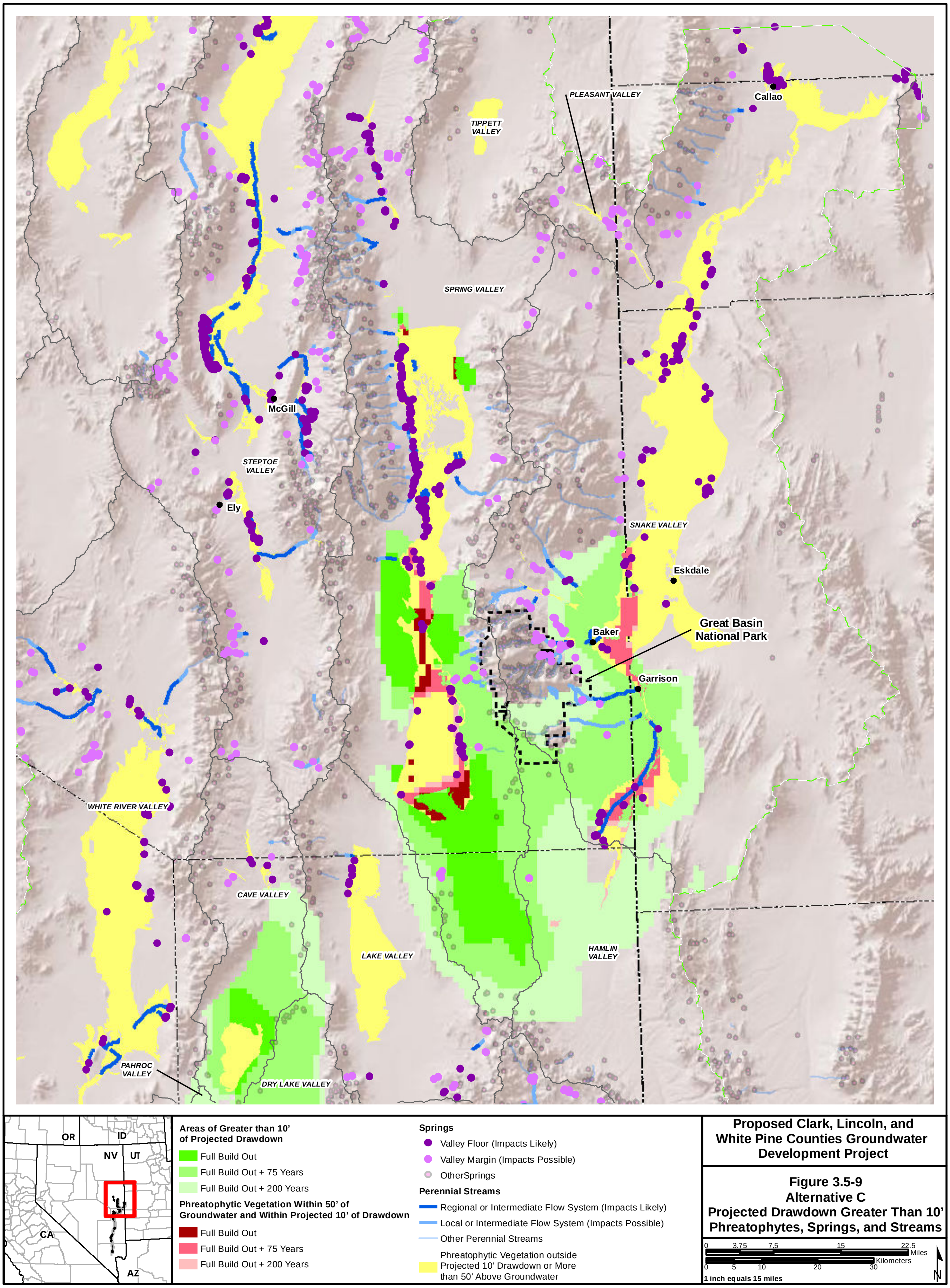
The stipulated agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

ACMs

- ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community.
- ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts.
- ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles and then diverting the saved water to the wet meadow areas.

Table 3.5-17 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative C (Continued)

Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listed for the Proposed Action. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-9
Alternative C
Projected Drawdown Greater Than 10' Phreatophytes, Springs, and Streams

3.5.2.13 Alternative D

Groundwater Development Area

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 2,513 to 4,005 acres within 4 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or approximately 1,655 to 2,635 acres would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. Based on BLM RMP Management Actions, BMPs, and SNWA ACMs, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that effects on special status plants could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Groundwater Pumping

Figure 3.5-10 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Full Build Out. No potential drawdown effects within the ET area boundaries are predicted in this time frame.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would occur in southern Spring Valley and in northeastern Hamlin Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand northward in southern Spring Valley, across northern Lake Valley, and within the Big Spring drainage in Snake Valley.

Conclusions and Summary

Table 3.5-18 provides a summary of potential vegetation community effects for three model time frames.

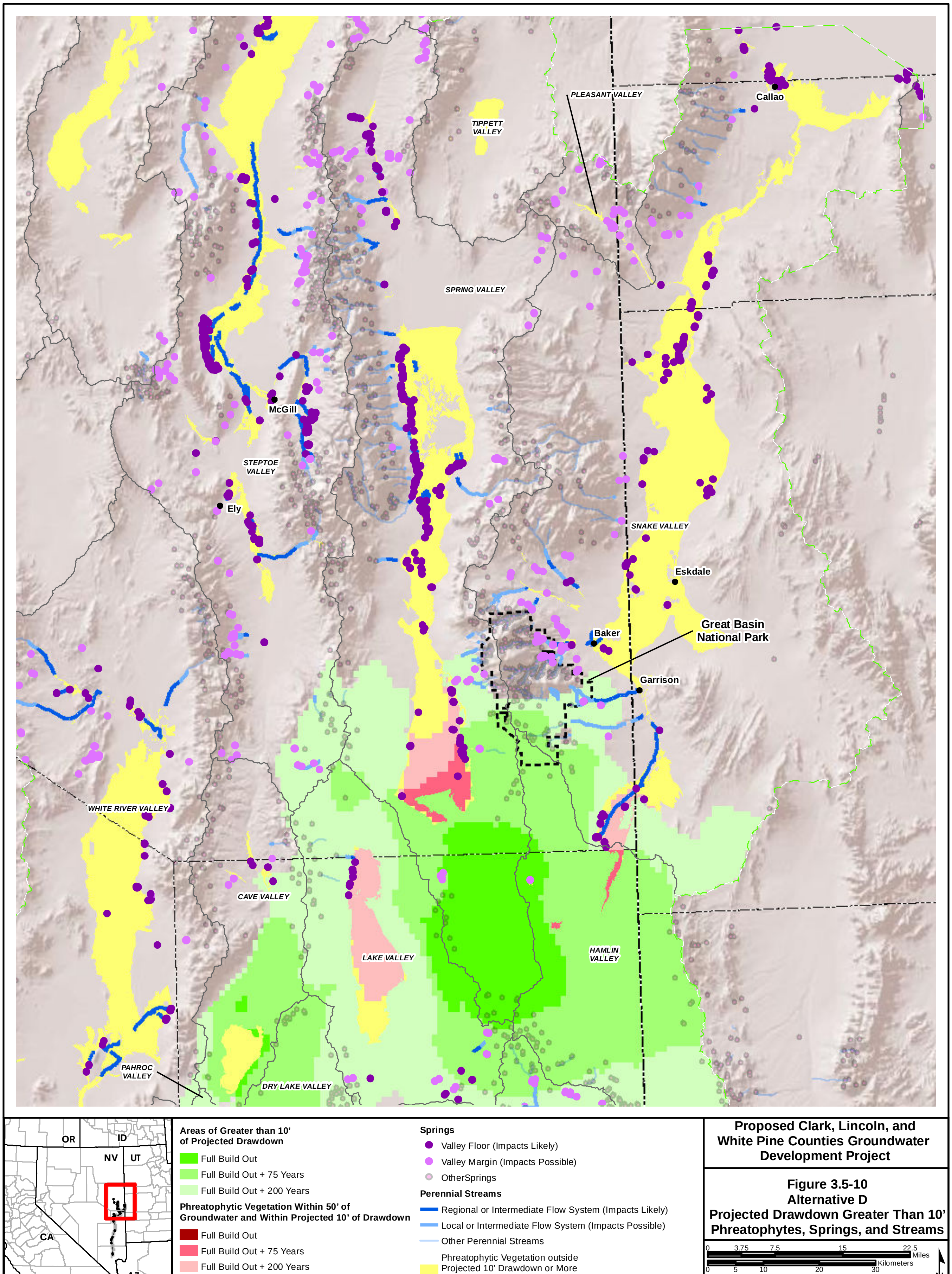


Figure 3.5-10
Alternative D
Projected Drawdown Greater Than 10' Phreatophytes, Springs, and Streams

Table 3.5-18 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative D

Effects/Conclusions			
• Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs. • Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater. • Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species. • Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.			
Primary Affected Valleys			
• Spring, Snake, Hamlin, and Lake			
Impact Indicators By Model Time Frame	**Full Build Out**	**Full Build Out Plus 75 Years**	**Full Build Out Plus 200 Years**
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	0	1,507	4,453
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	0	16,747	81,349
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	1	41	123
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	0	4	48
Potential Vegetation Effects in GBNP and adjacent Utah			
The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.13, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.			
COM Plan			
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.			
Stipulation Agreements			
The stipulation agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.			
ACMs			
• ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community. • ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake Valley to benefit wildlife and reduce potential air resources impacts. • ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles, and then diverting the saved water to the wet meadow areas.			

Table 3.5-18 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative D (Continued)

Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listed for the Proposed Action. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.

3.5.2.14 Alternative E

Groundwater Development Area

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 1,754 to 4,079 acres within 4 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or approximately 1,158 to 2,683 acres, would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. Based on BLM RMP Management Actions, BMPs, and SNWA ACMs, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that effects on special status plants could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Groundwater Pumping

Figure 3.5-11 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within ET area boundaries are predicted in small areas within central and southern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand in southern, central, and northern Spring Valley, and in northern Lake Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in central and southern Spring Valley, and across northern Lake Valley.

Conclusions and Summary

Table 3.5-19 provides a summary of potential vegetation community effects for three model time frames.

Table 3.5-19 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative E

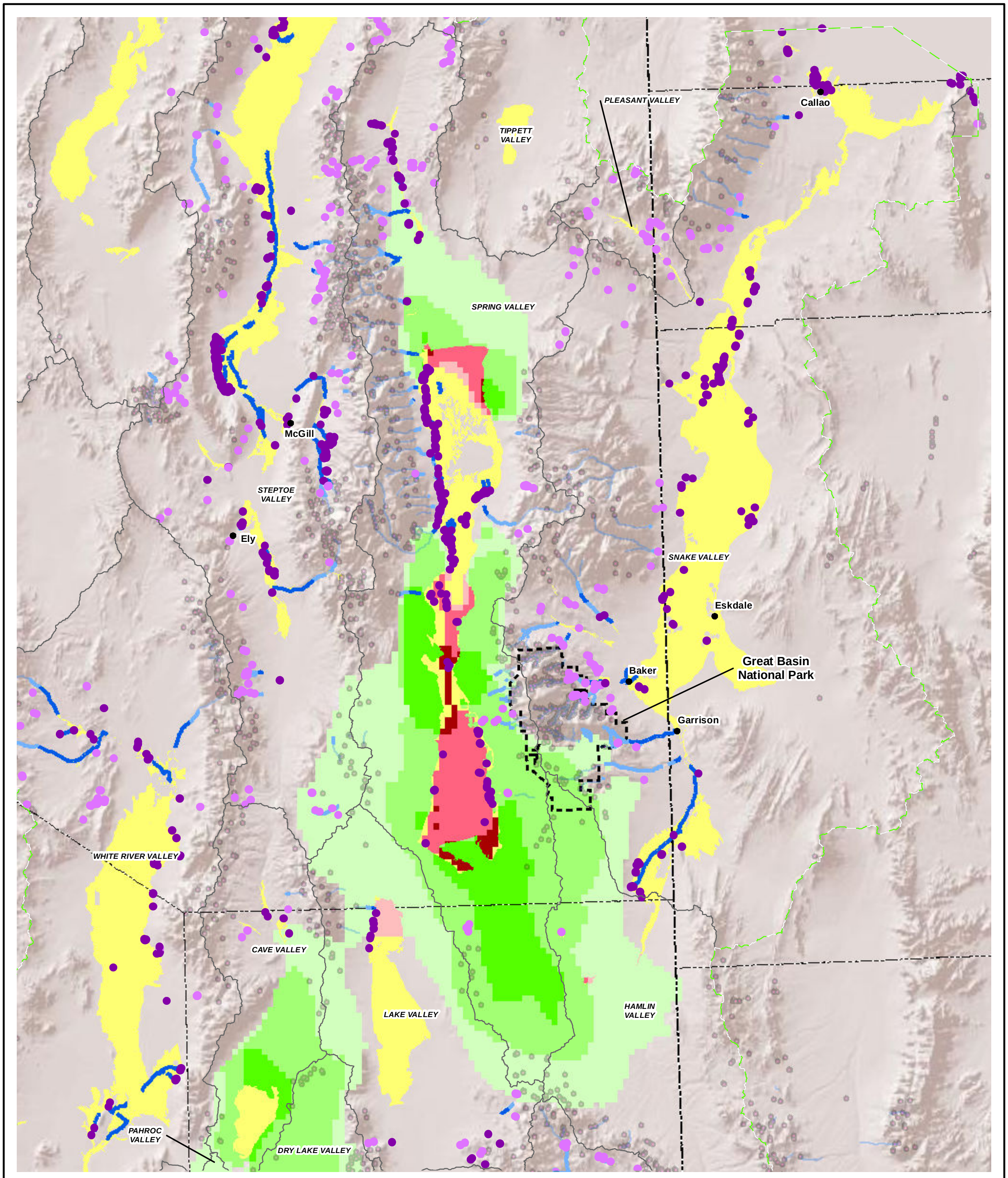
Effects/Conclusions			
• Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs. • Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater. • Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species. • Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.			
Primary Affected Valleys			
• Spring, Lake, Hamlin, and Lake			
Impact Indicators By Model Time Frame	**Full Build Out**	**Full Build Out Plus 75 Years**	**Full Build Out Plus 200 Years**
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	92	2,548	3,835
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	12,059	71,429	81,389

Table 3.5-19 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative E (Continued)

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	3	55	104
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	1	7	23
Potential Vegetation Effects in GBNP and adjacent Utah			
The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.14, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on stream flows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.			
COM Plan			
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.			
Stipulation Agreements			
The stipulation agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.			
ACMs			
• ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community. • ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys to benefit wildlife and reduce potential air resources impacts. • ACM C.2.15 – Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles and then diverting the saved water to the wet meadow areas.			
Monitoring Recommendations			
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).			

Table 3.5-19 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative E (Continued)

Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listed for the Proposed Action. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a “Cease and Desist” order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.



Areas of Greater than 10' of Projected Drawdown
- Full Build Out
- Full Build Out + 75 Years
- Full Build Out + 200 Years

Phreatophytic Vegetation Within 50' of Groundwater and Within Projected 10' of Drawdown
- Full Build Out
- Full Build Out + 75 Years
- Full Build Out + 200 Years

Springs
- Valley Floor (Impacts Likely)
- Valley Margin (Impacts Possible)
- OtherSprings

Perennial Streams
- Regional or Intermediate Flow System (Impacts Likely)
- Local or Intermediate Flow System (Impacts Possible)
- Other Perennial Streams
- Phreatophytic Vegetation outside Projected 10' Drawdown or More than 50' Above Groundwater

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-11
Alternative E
Projected Drawdown Greater Than 10'
Phreatophytes, Springs, and Streams

0 3.75 7.5 15 22.5 Miles
0 5 10 20 30 Kilometers
1 inch equals 15 miles
N

3.5.2.15 Alternative F

Groundwater Development Area

Conclusion. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 2,698 to 6,629 acres within 4 hydrologic basins. It is assumed that approximately 66 percent of the construction surface disturbance, or approximately 1,782 to 4,359 acres, would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on vegetation resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section. Based on BLM RMP Management Actions, BMPs, and SNWA ACMs, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that effects on special status plants could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Groundwater Pumping

Figure 3.5-12 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within ET area boundaries are predicted in small areas within central and southern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand in southern, central, and northern Spring Valley, and in northern Lake Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in central and southern Spring Valley, and across northern Lake Valley.

Conclusions and Summary

Table 3.5-20 provides a summary of potential vegetation community effects for three model time frames.

Table 3.5-20 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative F

Effects/Conclusions

- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs.
- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater.
- Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species.
- Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.

Primary Affected Valleys

- Spring, Lake, Hamlin, and Delamar, Dry Lake, and Cave valleys

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	85	3,096	5,519
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	8,272	89,049	130,591
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	5	131	203
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	1	21	33

Potential Vegetation Effects in GBNP and adjacent Utah

The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.14, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on stream flows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for vegetation resources are summarized below for ACMs and mitigation recommendations.

Stipulation Agreements

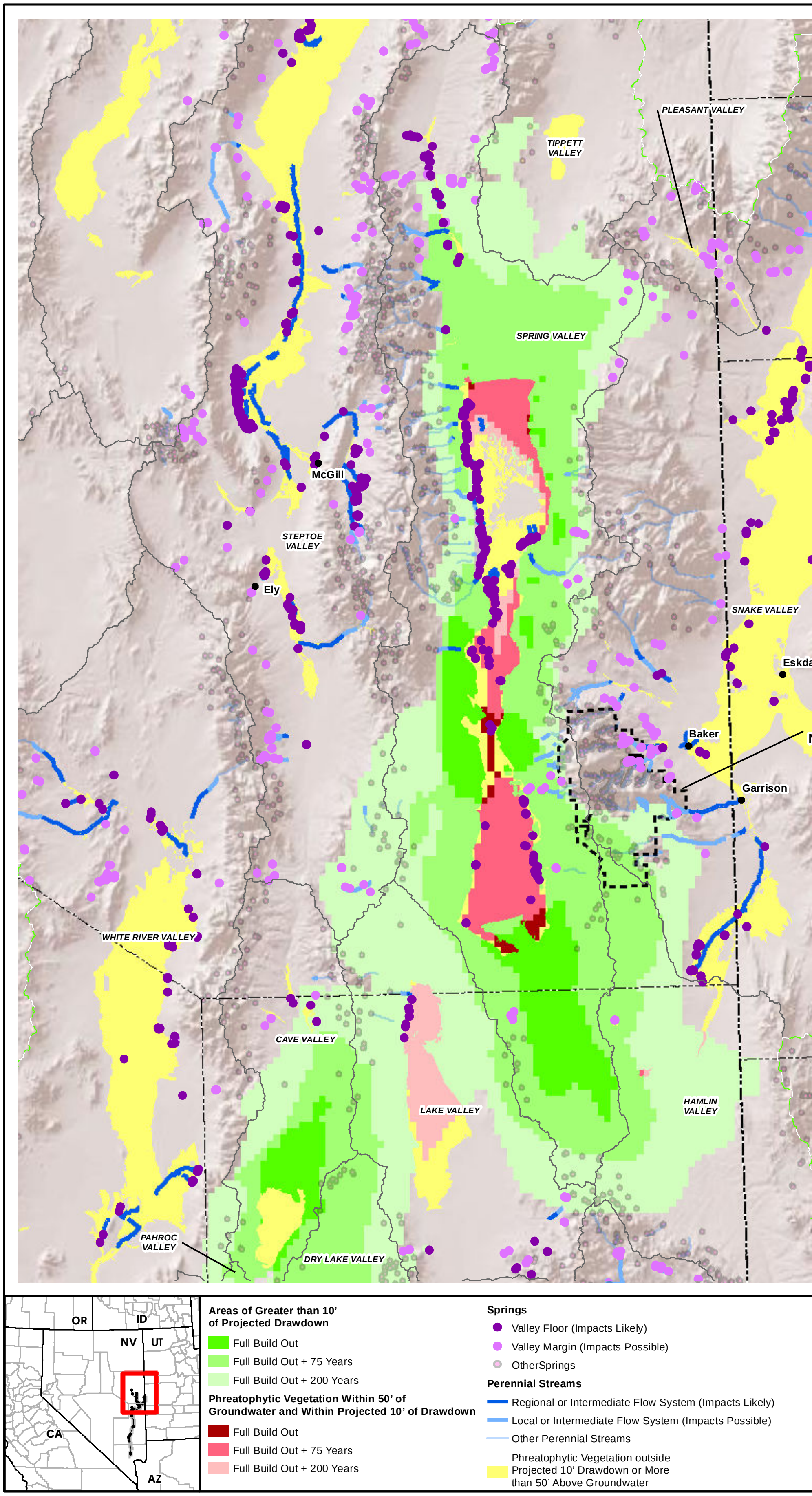
The stipulation agreements for Spring, Delamar, Dry Lake, and Cave valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

ACMs

- ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community.
- ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring Valley to benefit wildlife and reduce potential air resources impacts.
- ACM C.2.15 – Modify use of SNWA’s agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This could be accomplished by changing crop production to a less water-intensive type or changing water cycles and then diverting the saved water to the wet meadow areas.

Table 3.5-20 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative F (Continued)

Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group, Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • **GW-VEG-2 (Monitoring within Ute Ladie's-tresses Habitat)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, **GW-VEG-5 (Swamp Cedar Monitoring)**, and the Sanke Valley 3M Plan, as listed for the Propoed Action. • As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3 for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-VEG-1 (Joshua Tree Avoidance), as listed for the Proposed Action. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to vegetation and special status plant species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to vegetation. However, it is not possible to determine the level of impact reduction at this time. Effects on some vegetation types and plant species could exist considering the potential long recovery period that could occur. Some unavoidable impacts to vegetation types and species could occur at some locations.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-12
Alternative F
Projected Drawdown Greater Than 10' Phreatophytes, Springs, and Streams

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

3.5.2.16 No Action

Groundwater Development Area

Conclusion. Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Vegetation communities would continue to be influenced by natural events such as drought, fire, and land use activities such as grazing and existing water diversions. Management activities on public lands will continue to be directed by the Ely and Las Vegas RMPs, which involve measures to maintain natural vegetation communities. Management guidance for other public lands in the project study area would be provided by Great Basin Park General Management and the Forest Plan for the Humbolt-Toiyabe National Forest.

Groundwater Pumping

Figure 3.5-13 illustrates the expansion of the 10-foot drawdown contour from existing pumping in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface water and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within the ET area boundaries are predicted in Lake Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand northward in Lake Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in northern Lake Valley and a small area in southern Spring Valley.

3.5.2.17 Comparison of Alternatives

Table 3.5-21 provides a summary of impact indicators for the Proposed Action and Alternatives A through F.

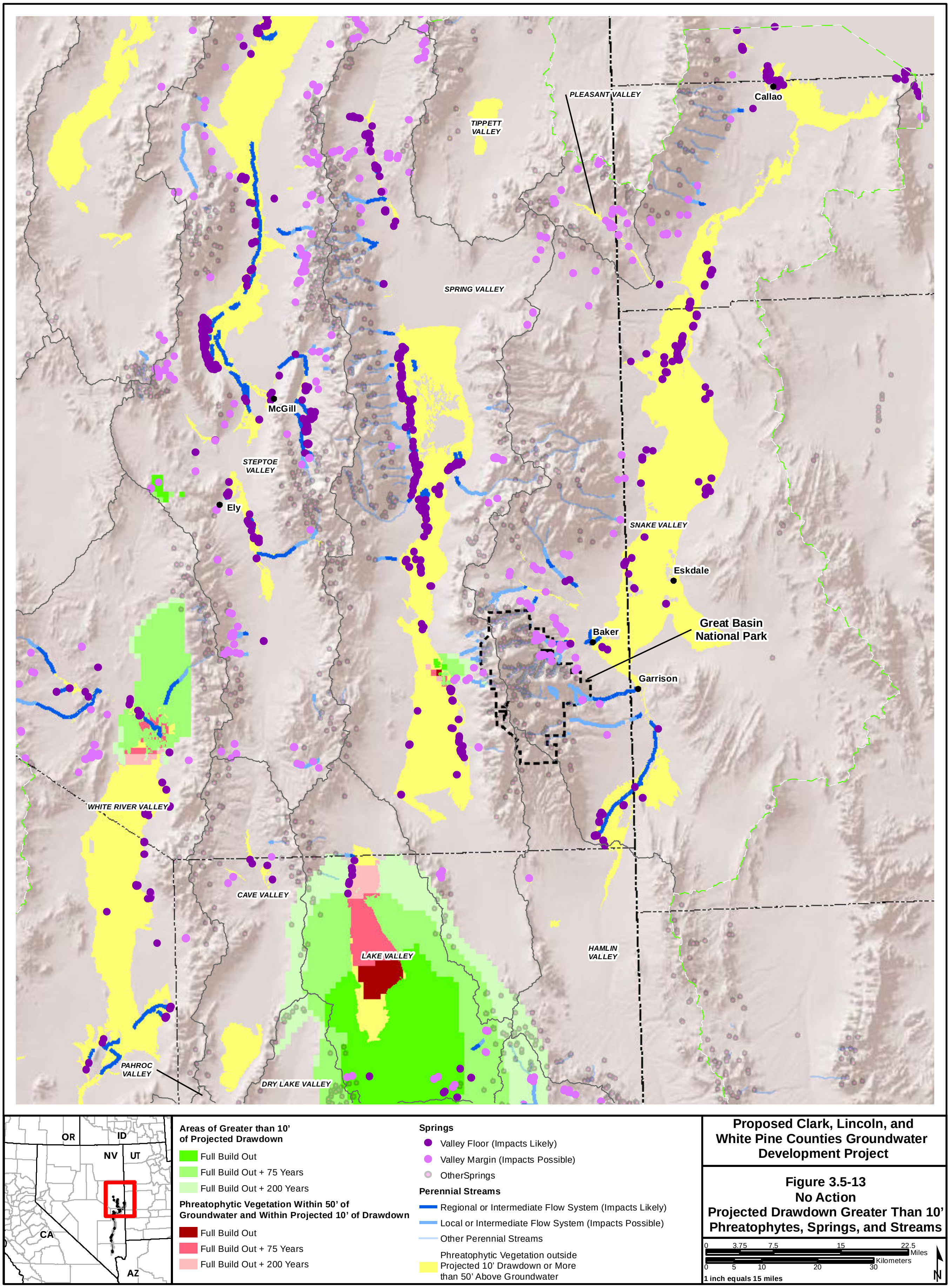
Table 3.5-21 Summary of Vegetation Resource Impacts – Proposed Action, Alternatives A through F Pumping

Impact Information	Impact Indicators (three model periods)	Proposed Action	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Wetland/Meadow ET unit area affected by 10 feet or greater draw down (acres)	FBO[1]	117	92	441	92	0	92	85
	FBO + 75 Years	5,460	4,624	5,794	2,287	1,507	2,548	3,096
	FBO + 200 Years	8,048	6,137	9,190	3,250	4,453	3,835	5,519
Basin shrub ET unit area affected by 10 feet or greater draw down (acres)	FBO	17,702	12,059	18,304	12,059	0	12,059	8,272
	FBO + 75 Years	136,990	106,414	97,174	42,703	16,747	71,429	89,049
	FBO + 200 Years	191,506	123,714	146,998	50,076	81,349	81,389	130,591
Total number of springs with moderate to high risk of being affected by 10 feet or greater drawdown	FBO[1]	8	3	41	3	1	3	5
	FBO + 75 Years	212	115	175	63	41	55	131
	FBO + 200 Years	305	182	288	96	123	104	203

Table 3.5-21 Summary of Vegetation Resource Impacts – Proposed Action, Alternatives A through F Pumping (Continued)

Impact Information	Impact Indicators (three model periods)	Proposed Action	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	FBO	6	1	3	1	0	1	1
	FBO + 75 Years	80	58	91	37	4	7	21
	FBO + 200 Years	112	81	120	59	48	23	33

[1] Full Build Out.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.5-13 No Action Projected Drawdown Greater Than 10' Phreatophytes, Springs, and Streams

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

3.5.3 Cumulative Impacts

3.5.3.1 Impacts Common to All Alternatives

Climate Change Effects

Climate change already appears to be influencing both natural and managed ecosystems of the American Southwest (Breshears et al. 2005, Westerling et al. 2006, Seager et al. 2007) and models indicate the likelihood of the Southwest being a climate change "hotspot" in the coming decades (Diffenbaugh et al. 2008). Recent warming in the Southwest is among the most rapid in the nation, significantly more than the global average in some areas (USGCRP 2009). Projections suggest continued strong warming in the region, with significant increases in temperature (USGCRP 2009) and decreases in precipitation (Seager et al. 2007). A warmer atmosphere and an intensified water cycle are likely to mean not only a greater likelihood of drought for the Southwest, but also an increased risk of flooding (USGCRP 2009). Greater variability in patterns of precipitation can be anticipated in the future. In the coming century, mean global temperature could increase significantly, with an associated increase in both the frequency of extreme events (heat waves, droughts, storms) and the frequency and extent of wildfire (IPCC 2007; Westerling & Bryant 2008; Krawchuk et al. 2009). Under such conditions, future impacts could be substantial for some resources, impacting biodiversity, protected areas, and agricultural lands.

Climate Change Effects to Vegetation Resources

Vegetation

Climate, more than any other factor, controls the broadscale distributions of plant species and vegetation. At finer scales, other factors such as local environmental conditions including soil nutrient status, pH, water-holding capacity and the physical elements of aspect or slope influence the potential presence or absence of a species. However, intra- and inter-specific interactions, such as competition for resources (light, water, nutrients), ultimately determine whether an individual plant is actually found at any particular location (Sykes 2009). Rapid climate change associated with increasing greenhouse gas emissions (IPCC 2007) influences current and future vegetation patterns. Other human-influenced factors are, however, also involved. Sala et al. (2000) identified five different drivers of change that can be expected to affect global biodiversity over the next 100 years. Globally, land use change was considered the most important driver of change, followed by climate change, airborne nitrogen deposition, biotic interactions (invasive species) and direct CO_2 (fertilizing or water use efficiency effects).

Predicted changes in climate that may occur in the southwestern U.S. include increased atmospheric concentrations of CO_2, increased surface temperatures, changes in the amount, seasonality, and distribution of precipitation, more frequent climatic extremes, and a greater variability in climate patterns. Recent temperature increases have made the current drought in the region more severe than the natural droughts of the last several centuries. This drought has caused substantial die-off of piñon trees in approximately 4,600 square miles of piñon-juniper woodland in the Four Corners region (Breshears et al. 2005). The specific physiological effects of increasing greenhouse gas emissions (particularly CO_2) on vegetation include increased net photosynthesis, reduced photorespiration, changes in dark respiration, and reduced stomatal conductance which decreases transpiration and increases water use efficiency (Patterson and Flint 1990). Ambient temperature affects plants directly and indirectly at each stage of their life cycle (Morison and Lawlor 1999). Water (i.e. soil moisture) is usually the abiotic factor most limiting to vegetation, especially in arid and semi-arid regions. CO_2, temperature, and soil moisture effects on plant physiology are exhibited at the whole-plant level in terms of growth and resource acquisition. In addition to the individual effects of increasing temperatures and CO_2, there is the additional interactive effect on photosynthetic productivity and ecosystem-level process (Long 1991).

Plants are finely tuned to the seasonality of their environment and shifts in the timing of plant activity (i.e. phenology) provide some of the most compelling evidence that species and ecosystems are being influenced by global environmental change (Cleland et al. 2007). Changes in the phenology of plants have been noted in recent decades in regions around the world (Bradley et al. 1999; Fitter & Fitter 2002; Walther et al. 2002; Parmesean & Yohe 2003). Phenology of plant species is important both at the individual and population levels. Specific timing is crucial to optimal seed set for individuals and populations; variation among species in their phenology is an important mechanism for maintaining species coexistence in diverse plant communities by reducing competition for pollinators and other resources. Global climate change could significantly alter plant phenology because temperature influences the timing of development, both alone and through interactions with other cues, such as photoperiod.

Shifts in the relative competitive ability of plants that experience changes in CO_2, surface temperatures, or soil moisture may result in changes to their spatial distribution (Bazzaz 1990, Long and Hutchin 1991, Neilson and Marks 1994). In California, two-thirds of the more than 5,500 native plant species are projected to experience range reductions up to 80 percent before the end of this century under projected warming (Loarie et al. 2008). Current research, for example, indicates that temperature increases resulting from climate change in the Southwest will likely eliminate Joshua trees from 90 percent of their current range in 60 to 90 years (Cole et al. 2011). Increases in atmospheric CO_2 and possible increases in winter precipitation would favor woody plant establishment and growth at the expense of grasses and may cause woodland boundaries to shift downslope (Weltzin and McPherson 1994). However, increases in temperature may enhance the competitive ability of C4 plants (such as grasses) relative to C3 plants (shrubs and trees), especially where soil moisture (Neilson 1993) or temperature (Esser 1992) are limiting. In their search for optimal conditions, some species may shift ranges if corridors to do so are present. The potential for successful plant and animal adaptation to coming change is further hampered by existing regional threats such as human-caused fragmentation of the landscape, invasive species, river-flow reductions, and pollution (USGCRP 2009).

Climate change could affect vegetation resources in the GWD Project Area by:

- Altering the distribution of vegetation at local spatial scales; and
- Altering vegetation types and spatial arrangements (i.e., woody vs. herbaceous species).

Wildland Fire

Anthropogenically-induced changes in climate are likely to affect fire frequency and extent. The specific effects of climate change on fire regimes will be spatially variable throughout the Southwest and impacted by a number of factors. In general, total area burned is projected to increase (Lenihan et al. 2008), though regional differences in fuel loading, temperature, and precipitation all influence the likelihood of possible ignition and subsequent fire spread (Westerling and Bryant 2008). Climate change could also cause changes in fire behavior once ignition has occurred (Fried et al. 2008). Alterations in community structure caused by changes in atmospheric composition or climate may have substantial effects on fire regimes. A shift from grassland to woodland could reduce herbaceous biomass and thus reduce fire frequency because of decreased accumulation of fine fuel. Conversely, increased surface temperatures may either increase fire frequency (because hotter, drier conditions cure fuel more quickly) or decrease fire frequency (because of decreased fine fuel production caused by hotter, drier conditions). Increases in summer precipitation may also increase fine fuel loading and thus increase fire frequency.

Climate-fire dynamics will also be affected by changes in the distribution of ecosystems across the Southwest. Increasing temperatures and shifting precipitation patterns will drive declines in high-elevation ecosystems such as alpine forests and tundra (Rehfeldt et al. 2006; Lenihan et al. 2008), while other high-elevation forests are projected to decline by 60 to 90 percent before the end of the century (Hayhoe et al. 2004). At the same time, grasslands are projected to expand, another factor likely to increase fire risk. The effects of changing climate on future fire regimes are difficult to predict, not only due to uncertainties associated with future climate, but because of interactive effects of climate change, biological factors, and activities related to management activities and politics.

Climate change could affect fire ecology and management in the GWD Project Area by impacting:

- The amount, spatial arrangement, connectivity and types of surface fuels; and
- Precipitation patterns, which could lead to prolonged drought, exacerbating the risk of Wildland fire.

3.5.3.2 Issues

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

- Short-term, long-term, and permanent changes in vegetation community structure and composition (due to surface disturbance and conversion of natural vegetation to industrial uses) as a result of construction-related activities and operational maintenance.
- Potential introduction or population expansion of noxious and non-native invasive weeds due to surface disturbance.
- Loss of individuals or populations of federally listed, candidate, or special status plant species (including cacti and yucca) due to surface disturbance.
- Accidental wildfires caused by construction equipment or smoking during construction and operation.
- Availability of plant species traditionally used for food and fiber by regional Tribes.

Groundwater Pumping

- Short-term, long-term, and permanent changes in vegetation community structure and composition (including spring-fed wetlands and riparian areas) and special status plant species populations due to groundwater drawdown.
- Changes in the availability of groundwater dependent plant species traditionally used for food and fiber by regional Tribes in relation to groundwater drawdown.

3.5.3.3 Assumptions

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

- Study Area. The study area is the proposed ROW project surface disturbance area (pipelines, power facilities, and roads) for each project alternative plus the total project surface disturbance estimate (well pads, roads, gathering pipelines, power lines) within groundwater development areas within each hydrologic basin. The overall rationale for this cumulative study area is that the majority of the changes in vegetation communities occur within areas where vegetation has been cleared and reseeded, while recognizing that future plant species composition changes can occur in plant communities adjacent to the ROW from the dispersal of seeds by wind and water, as well as seed consuming animals. For ROWs, a buffer of 500 feet was evaluated to account for the potential influence of adjacent or other nearby surface disturbance activities, and account for possible project effects outside the construction ROWs. For groundwater development areas, the presence of PPAs and RFFAs within the overall groundwater development area boundaries within each hydrologic basin was used as the basis for evaluating potential additive cumulative effects.
- Time frames. Effects time frames range from 2 to 5 years after surface disturbance initially occurs for herbaceous components, to 200 years, which is the estimated time for larger woody species (junipers, pinyon pine, Joshua trees) to recover to their former density and size.
- The PPAs footprints are based on utility ROWs and other surface disturbance activities identified in the BLM database and other databases (Section 2.9.1, Past and Present Actions).
- The reasonably foreseeable actions and activities are discussed Section 2.9, Agency Preferred Alternative. No cumulative effects related to surface development activities are anticipated outside hydrologic basins occupied by project water development and conveyance facilities.

Groundwater Pumping

- Study area. The study area is the boundary for the groundwater model simulations (**Figure 3.0-3**).
- Time frames. Effects time frames range from full build out of the entire project (approximately 2050) to full build out plus 200 years.
- A groundwater depth 50 feet or deeper in relation to the ground surface elevation is not accessible to the roots of nearly all phreatophytic shrubs and this groundwater depth represents a reasonable boundary for: 1) estimating the deepest root zone extent of plant communities that are at least partially dependent on underlying groundwater; and

2) defining a groundwater drawdown boundary that assumes that the roots of overlying plant communities no longer have access to groundwater as a moisture source at depths greater than 50 feet.

- The ET areas mapped for each hydrologic basin as part of the water balance estimates (Section 3.3, Water Resources) represent the primary cover types that would be affected by drawdown over large areas within hydrologic basins. These ET areas are mapped as Wetland/Meadow and Basin Shrubland cover types.
- Based on an evaluation of plant rooting depth, physiological responses to drought, available information on groundwater levels and seasonal soil moisture, an index drawdown contour of 10 feet is assumed to be a reasonable estimate of the point at which long term changes in plant community vigor and composition would begin to appear. The expected responses of the Wetland/Meadow and Basin Shrubland are the same as those described for the project alternatives (Section 3.5.2.8).
- Spring-fed meadows and riparian areas represent small areas within hydrologic basins and are best discussed by individual springs or by perennial stream reaches. The springs and perennial stream reaches of vegetation effects concern are the high and moderate risk water sources as defined in Section 3.3, Water Resources.

3.5.3.4 Methodology for Analysis

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

- The cumulative surface disturbance effects to vegetation communities by hydrologic basin were estimated by overlaying the existing surface disturbances for PPAs and RFFAs and the development areas for the project alternative being evaluated. The estimated cumulative surface disturbance was then compared with the overall area of the hydrologic basin affected. Potential effects on vegetation communities that occupy relatively small areas within individual basins, such as wetlands, were considered.
- The cumulative surface disturbance effects to special status species (including cacti and yucca) were estimated from evaluating the cumulative vegetation community surface disturbance footprint in relation to the habitat requirements of special status plants to provide a risk assessment for future effects on these species.
- The cumulative noxious and invasive species invasion risks were estimated from evaluating the cumulative vegetation community surface disturbance footprint in relation to the currently known distribution of noxious and invasive plant species. The risks of weed invasion were estimated from field surveys conducted by SNWA and from a weed occurrence data based maintained by the BLM Ely Field Office.
- The cumulative accidental wildfire risks were estimated from evaluating the cumulative vegetation community surface disturbance footprint in relation the relative susceptibility of various natural plant communities to wildfires.
- The potential cumulative changes in the availability of plants traditionally used for food and fiber by regional tribes were estimated from evaluating the cumulative vegetation community surface disturbance footprint in relation to the habitat requirements of food and fiber plants.

Groundwater Pumping

- Wetland/Meadow and Basin Shrubland. The area enclosed by the maximum extent of the 10-foot drawdown contour was superimposed over the area of the primary ET areas (wetland/meadow, basin shrubland cover types) to calculate the area of vegetation that could experience reductions in soil moisture and long-term vegetation community composition changes caused by groundwater drawdown of 10 feet or more at different points in time (full build out, full build out plus 75 years, and full build out plus 200 years). The cumulative analysis focuses on those basins with the primary ET areas that were predicted to be affected by each alternative. Figures were generated that illustrate the expansion of the 10-foot and greater drawdown contours over time in relation to the vegetation communities within the hydrologic ET boundaries. The figures depict the incremental effect of each alternative on vegetation resources in combination with other cumulative pumping actions.
- Springs and perennial stream reaches. The 10-foot drawdown index was applied to the springs and perennial stream reaches that were classified as being at risk from being affected by groundwater drawdown (Section 3.3, Water Resources). The springs included for analysis were those rated as presenting a “high” or “moderate” risk of effects. The number of springs and miles of perennial stream reaches potentially affected were enumerated for each alternative over time from the modeling results. The locations of the major spring complexes are illustrated

on the same figures as the ETs (**Figures 3.5-3** and **3.5-4**). The number of springs, and miles of perennial stream reaches potentially affected were graphed for each alternative over time from the modeling results.

3.5.3.5 No Action

Groundwater Development

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Vegetation communities would continue to be influenced by natural events such as drought, fire, and land use activities such as grazing and existing water diversions. Management activities on public lands will continue to be directed by the Ely and Las Vegas RMPs, which involve measures to maintain natural vegetation communities. Management guidance for other public lands in the project study area would be provided by GBNP General Management Plan and the Forest Plan for the Humbolt-Toiyabe National Forest.

Groundwater Pumping

Figure F3.5-12 illustrates the expansion of the 10-foot drawdown contour from existing pumping in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced (**Table 3.5-22**).

Table 3.5-22 No Action – Summary of Potential Cumulative Vegetation Effects Over Three Time Periods

Parameter	Full Build Out	Full Build Out Plus 75 years	Full Build Out Plus 200 years
Wetland/Meadow ET (acres)	1,240	1,840	3,801
Basin shrubland ET (acres)	22,221	47,358	58,492
Springs potentially affected in all hydrologic basins (number)	12	19	28
Springs potentially affected in GBNP (number)	0	0	0
Springs potentially affected in Utah (number)	0	0	0
Streams potentially affected in all hydrologic basins (miles)	26	42	79

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Lake, Patterson, Clover, and Dry Lake valleys and Lower Meadow Valley Wash. Predicted drawdowns in the Panaca Valley affecting up to four springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long-term orchid population viability.

3.5.3.6 Proposed Action

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

Vegetation Community Surface Disturbance and Restoration

PPAs consist primarily of existing roads, energy utility corridors, mining districts, and recent wildfires (**Figure 2.9-1**). Other activities that have influenced vegetation community composition and area include livestock grazing over nearly all public lands and the development of towns and rural communities (Ely, McGill, Baker, Garrison, Pioche, and Panaca). The primary future actions consist of construction of new utilities (pipelines and electrical distribution lines), roads and turbine pads for wind energy projects, which would be located in Spring and Lake valleys. The total estimated surface area disturbance for construction and maintenance of the main pipeline and ancillary facilities, plus the anticipated groundwater development facilities would be up to 20,570 acres. As described previously, the primary vegetation types that would be cleared, and then restored are greasewood/salt desert shrubland, sagebrush shrubland, and Mojave mixed desert scrub.

Cumulative Effects. The maximum GWD Project surface disturbance (20,570 acres) would potentially overlap with PPAs and RFFAs (**Figure 2.9-1**) in all hydrographic basins.

The GWD Project would occupy the LCCRDA utility corridor from Lake Valley on the north to Garnet Valley on the south. The GWD Project would share the LCCRDA corridor with other projects as follows:

Project	Lake Valley	Dry Lake	Delamar	Pahranagat	Coyote Spring	Garnet
Past and Present Actions						
Existing Transmission Line (s)	X	X	X	X	X	X
U.S. Highway 93	X			X	X	
Proposed Project and Reasonably Foreseeable Future Actions						
GWD Project	X	X	X	X	X	X
ON Transmission Line	X	X	X	X	X	X
Wilson Creek Wind Project	X	X				
Eastern Nevada Transmission Line					X	X
Zephyr Transmission Project			X	X	X	X
TransWest Express Transmission Project			X	X	X	X

The major additive cumulative effects within the LCCRDA corridor would be the expansion of ROW surface disturbance that would be reclaimed, the permanent addition of new service access roads within the corridor, the permanent addition of high voltage transmission line structures and conductors, and the fragmentation of native vegetation communities until they recover (2 to 200 years, depending on the vegetation community). It is not expected that cumulative development would substantially expand the surface disturbance of wetlands and riparian areas, based on the very small (11) acres of these cover types by the GWD Project.

The GWD Project groundwater development area in northern Spring Valley would overlap with the Spring Valley Wind Project near the intersection of Highway 93 and Highway 6 and 50 west of Great Basin National Park. The groundwater development would add access roads, water gathering pipelines, and electrical service to well sites with areas currently proposed for electrical generation turbines. Because the specific locations of GWD Project wells have not determined, there are opportunities to share the wind energy project road system to reduce the cumulative surface disturbance footprint of the two projects.

Spread and Introduction of Noxious and Non-native Invasive Weed Species

PPAs include the historical introductions of at least 14 noxious and non-native weed species into nearly all the hydrologic basins that would be occupied by GWD Project components. Sources of weed introduction include seeds spread along railroads and highways and contaminated hay delivered to farms and livestock feed grounds over wide areas. Weed seeds then are spread by wind, water, livestock grazing, and seed eating wild animals over large areas. Some weeds that propagate by rhizomes have spread on the muddy wheels of farm and excavation machinery and from harvest and distribution of food crops harvested from soil such as potatoes. The RFFAs (renewable energy projects, electrical transmission lines, and other utilities) will disturb new areas of native vegetation, creating new opportunities for weed invasion and spread into recently disturbed ROWs and along new roadways that are periodically maintained. The GWD Project also would require surface disturbance for new ROWs in previously undisturbed native communities, particularly in the groundwater development basins (Spring, Snake, Delamar, Dry Lake, and Cave valleys).

Cumulative Effects. The locations where there would be the greatest risk of expanded additive weed invasion would be in areas where new ROWs intersect with or parallel older ROWs where weeds may already be established. These intersections include roads, utility corridors, gravel pits, and mines. There are almost no crossings of agricultural lands, so weeds associated with cultivated fields represent a very low risk. The GWD Project would intersect multiple primary and secondary roads in all hydrologic basins and would parallel an existing utility corridor from southern Lake Valley to the vicinity of Apex in Clark County. The GWD Project would likely intersect service roads for the Spring Valley Wind Project in Spring Valley. It is anticipated that all projects proposed on BLM lands would be required to identify and control noxious and invasive weed species; these requirements on new projects would likely limit the spread of weeds along new ROWs.

Cacti and Yucca, Special Status Plants

PPAs include the construction and maintenance of utility and highway ROWs that cross cacti and yucca habitats in Las Vegas, Garnet, Coyote Springs, Delamar, Hidden, Pahranagat, and southern Dry Lake valleys in Clark and Lincoln counties. The GWD Project facilities would be located in an existing utility corridor (LCCRDA) from the vicinity of Apex in Clark County to the southern portions of Cave, Lake, and Spring valleys in Lincoln County. It is estimated that the GWD Project would remove cacti and yucca from more than 3,000 acres in these valleys. A large fraction of these plants would be replanted in the disturbed ROWs.

Populations of special status plants including Parish's phacelia and Blaine fishhook cactus were identified in Dry Lake Valley; Eastwood milkvetch was identified in Dry Lake Valley; and Long calyx egg milkvetch was identified in Spring Valley. These species were identified during ROW surveys conducted by SNWA and additional populations of these species may be found over a larger area as the result of future surveys. A reasonably foreseeable project that could encompass populations of the Parish's phacelia, Blaine fishhook cactus, and Eastwood milkvetch is the ON Transmission Line project that will use the LCCRDA and other utility corridors from Dry Lake Valley to Delamar Valley. Populations or individuals of these species were found in and adjacent to GWD Project ROWs.

Cumulative Effects. There would be a reduction in cacti and yucca populations within existing utility corridors, combined with surface disturbance from proposed new renewable energy projects and transmission lines and GWD Project facilities in Las Vegas, Garnet, Hidden, Coyote Springs, Pahranagat, Delamar, and Dry Lake valleys. It is anticipated that recovery of yucca and cacti would require many years (up to 200 years for mature Joshua trees). It is likely that there would be an additive reduction in special status plant species in Dry Lake, Muleshoe, and Spring valleys. These reductions are not likely to result in federal listing of these species, since they occur in other regional hydrologic basins.

Accidental Wildfires

There have been several recent large wildfires in southeastern Lincoln County. The source of most of these fires is lightning. The risk of accidental fires from project activities will always be present when heavy machinery is working across natural landscapes. However, this risk is site- or project-specific and not cumulative, since different projects will be constructed at different time frames and different locations. PPAs shown in **Figure 2.9-1** includes areas affected by wildfire.

Culturally Significant Plants

Cumulative Effects. Traditional use plants occur in the vegetation types that extend across all the hydrologic basins that have been affected by PPAs and would be affected by RFFAs and the proposed GWD Project facilities. As described for vegetation community surface disturbance and restoration, there would be a cumulative additive increase in vegetation surface disturbance on a regional basis. This surface disturbance would likely cause a reduction (estimated to be 1 percent or less) in the availability of traditional use plants within native plant communities, and may potentially cause the disturbance or loss of specific traditional plant gathering areas.

Groundwater Pumping

PPAs are represented by the No Action pumping operations described in Section 3.3, Water Resources. The cumulative past and present groundwater uses are presented in **Table 2.9-1**. The RFFAs are described in **Table 2.9-4**. The following discussions are based on an interpretation of the groundwater model simulations that predict groundwater drawdown elevations and changes in flow in springs and perennial stream reaches.

Figure F3.5-3 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-14** and **3.5-15** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be at risk from the Proposed Action pumping operations. These figures include impact parameter information for cumulative with No Action, Proposed Action, and cumulative pumping with the Proposed Action as a way of identifying the incremental effects of the alternative. Representative basins for which the Proposed Action may have a potential impact have been included in the analysis, and include (north to south): White River, Steptoe, Spring, Snake, Lake valleys, and Lower Meadow Valley Wash.

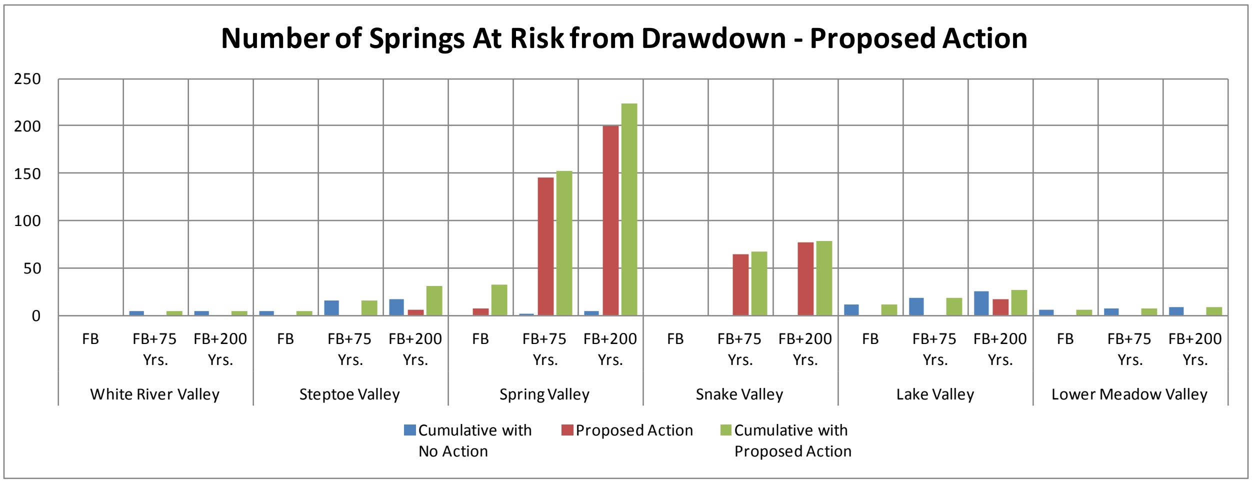


Figure 3.5-14 Number of Springs At Risk from Drawdown, Proposed Action

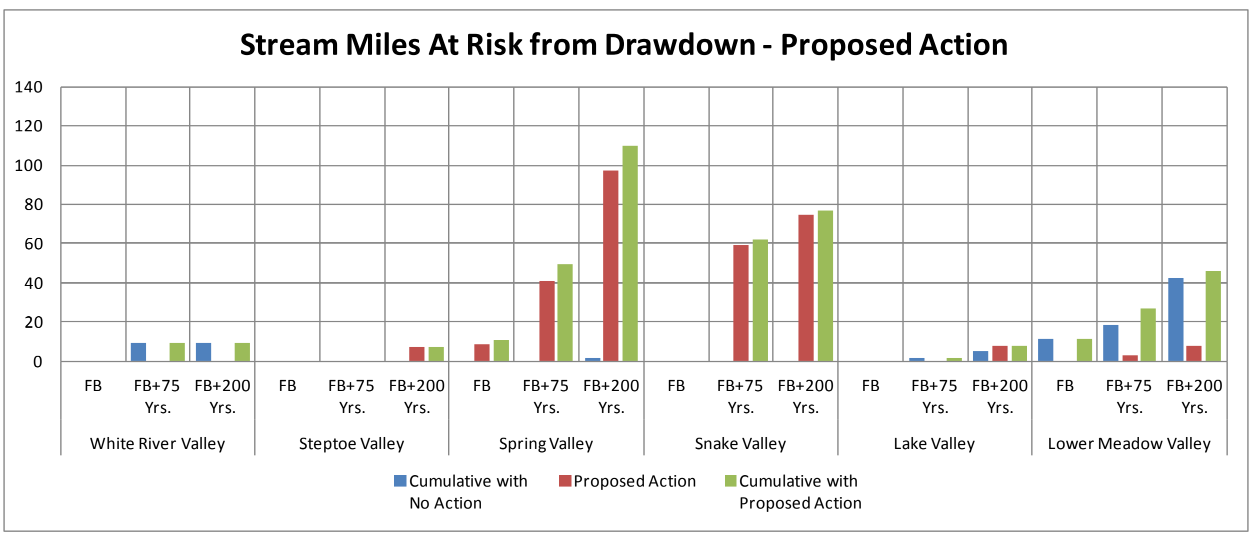


Figure 3.5-15 Stream Miles At Risk from Drawdown, Proposed Action

Cumulative acres of potential root zone soil moisture stress from drawdown for basin shrubland and wetland/meadow ET areas have been graphed by hydrologic basin (**Figures 3.5-16** and **3.5-17**). These figures include impact parameter information for cumulative with No Action, Proposed Action, and cumulative pumping with the Proposed Action as a way of identifying the incremental effects of the alternative. Representative basins for which the proposed action are may have a potential impact have been included in the analysis, and include (north to south): Steptoe, Hamlin, Spring, Snake, Lake, and Lower Meadow Valley Wash. Based on this analysis, the following conclusions were made:

- Steptoe Valley - The Proposed Action would not directly contribute to either basin shrubland or wetland meadow drawdown effects. The cumulative effects on these communities would result from cumulative pumping with No Action.
- Hamlin Valley – The Proposed Action would potentially cause relatively low levels of drawdown effects to both basin shrubland (3,065 acres) and wetland/meadow (154 acres) communities. The adverse effects on these communities would occur during the two later (full build out plus 75 years, full build out plus 200 years) model periods. The impact parameters indicate that the Proposed Action would contribute all of the incremental cumulative effects on basin shrubland and wetland/meadow communities in this basin.

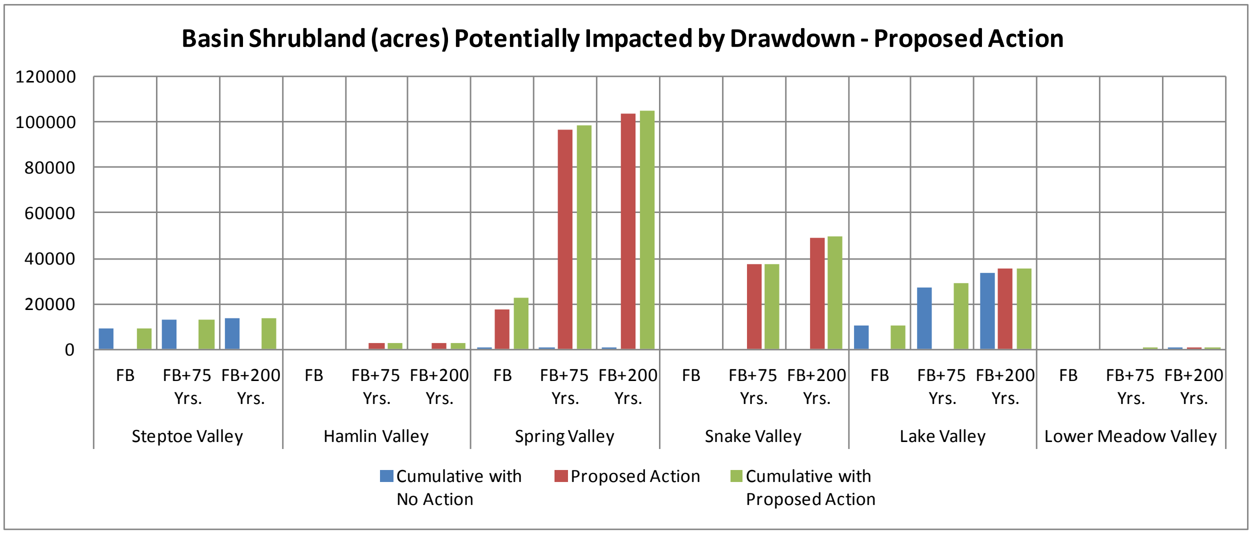


Figure 3.5-16 Basin Shrubland At Risk from Drawdown, Proposed Action

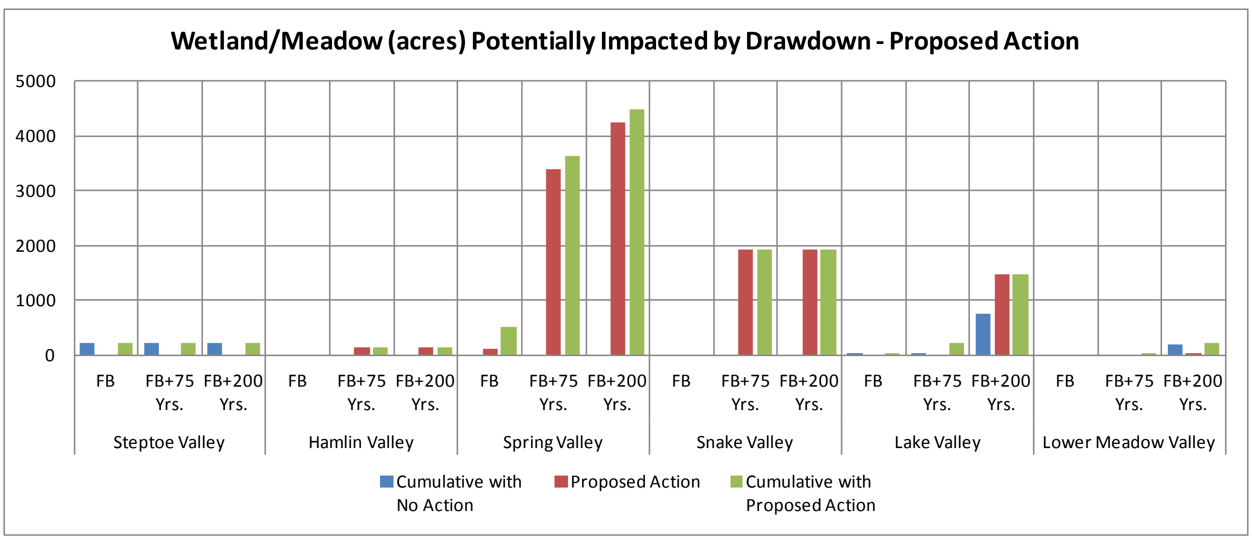


Figure 3.5-17 Wetland/Meadow At Risk from Drawdown, Proposed Action

- Spring Valley – The Proposed Action would potentially cause substantial drawdown effects to both basin shrubland and wetland/meadow communities. The adverse effects on these communities would occur in all 3 model periods. The impact parameters indicate that the Proposed Action would contribute most of the incremental cumulative effects on basin shrubland and wetland/meadow communities in this basin. In total, the Proposed Action would affect a maximum of 103,798 acres of basin shrubland and 4,252 acres of wetland/meadow over the three model periods.
- Snake Valley – The Proposed Action would potentially cause substantial drawdown effects to both basin shrubland and wetland/meadow communities. The adverse effects on these communities would occur in all 3 model periods, though the greatest potential impacts would occur during the full build out plus 75 years and full build out plus 200 years model time frames. The impact parameters indicate that the Proposed Action would contribute to all of the incremental cumulative effects on basin shrubland and wetland/meadow communities in this basin. In total, the Proposed Action would affect 49,068 acres of basin shrubland and 1,927 acres of wetland/meadow for the three model periods.
- Lake Valley – The Proposed Action would potentially cause some drawdown effects to both basin shrubland (35,497 acres) and wetland/meadow (1,486 acres) communities in this basin. The drawdown effects on these communities would occur during the final (full build out plus 200 years) model period. Potential impacts during earlier modeling periods would result from cumulative pumping with No Action, particularly for basin shrubland communities.
- Lower Meadow Valley Wash – The Proposed Action would potentially cause very low levels of potential disturbance to both to basin shrubland (56 acres) and wetland/meadow (26 acres) community types. The drawdown effects on these communities would occur during the final (full build out plus 200 years) model period. The cumulative effects on these communities would result largely from cumulative pumping with No Action.

The following vegetation community changes could occur in response to groundwater pumping, as outlined under the assumptions. The specific vegetation community responses cannot be predicted on a site-specific basis. The rate of change in plant community composition also would be highly variable, depending on groundwater drawdown rates and local water elevation recovery, as well as the influence of precipitation, overland flows, and runoff in channels.

Wetland/Meadow

Plant species in vegetation communities that are directly dependent on perennial spring and stream flows would experience the greatest potential change in plant species composition. Based on the general successional model outlined in the assumptions, it is likely that wetland communities consisting of sedges, rushes, and cattails would progressively change toward a community dominated by deep-rooted grasses. The overall surface area occupied by wetland species would decrease, with persistence only in areas that continue to receive sufficient surface and groundwater for long-term survival. Species composition could change toward dominance by phreatophytes and other species better adapted to low near-surface soil moisture. Over the long-term, it is expected that areas occupied by this cover type could be invaded by basin shrubland vegetation units or other upland vegetation types, depending on sources of surface moisture and soil chemistry (texture, salinity, and alkalinity). This successional progression is unlikely to be reversed, since it is expected that hydric soils will lose many of their wetland characteristics and would likely to become more similar to upland soils with better root zone aeration than hydric soils. Included in this affected area are the swamp cedar areas in central and southern Spring Valley. Also included is the Lower Moapa Area, where riparian vegetation that is at least partially dependent on groundwater sources is present.

Basin Shrubland

Based on groundwater studies in other hydrologic basins, it is likely that the dominant phreatophytic shrubs (greasewood, rabbitbrush) would persist over the long-term, but potentially at lower densities and vigor as the result of reduced availability of soil moisture at greater depths and lower suitability for shrub seedling re-establishment and growth. These areas could be invaded by shrubs, herbs, and grasses that are adapted to seasonal shallow soil moisture and are capable of withstanding extended droughts, either through complete or partial dormancy or long-lived seeds. It is likely that invasive annual grass species would become increasingly dominant and the risk of wildfires also would likely increase. Included in this drawdown area is the habitat for the Baking Powder Flat Blue butterfly, which is protected within a BLM ACEC in central Spring Valley.

Springs and Perennial Stream Reaches

The effects on vegetation dependent on spring flows would vary by the flow volume and persistence. Reductions in spring flow would reduce the length of the spring brook and reduce the area of wetland vegetation that is dependent on reliable surface and sub-surface soil moisture. Riparian shrubs (such as willows and birches) would likely decline in vigor and would eventually die in areas where groundwater elevations decline below the root zone. The majority of these spring drying effects are predicted to occur in Spring Valley.

Special Status Species

To date, no Ute ladies'-tresses orchid populations have been found in inventoried springs in Spring and Snake valleys, where potential habitats exist. Predicted drawdowns in the Panaca Valley affecting up to eight springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability

Culturally Significant Plants

Traditional use plants that are classified as wetland plants by the USACE (**Table 3.5-8**) occur in wetlands and meadows. Examples of common wetland species on the traditional use list that occur in spring meadows within the affected hydrologic basins include Arctic rush (*Juncus balticus*), California bulrush (*Schoenoplectus californicus*), cattail (*Typha latifolia*), and common reed (*Phragmites australis*) (**Table 3.5-5**). Groundwater drawdown effects on these species are generally described under the wetland/meadow ET above, and could range from small changes in species composition in areas where groundwater levels are maintained over the long term to a broad scale conversion of wetlands and meadow to dry grasslands and shrublands, with disappearance of wetland species of time. In summary, it is likely that traditional use wetland plant species occupying wetlands and sub-irrigated grasslands in Spring, Snake, and Lake valleys would become less abundant and less available over time.

3.5.3.7 Alternative A

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

The Alternative A surface disturbance (up to 17,035 acres) would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of designated utility corridor in Clark and Lincoln counties, and would intersect service roads for future wind energy projects in Spring and Lake valleys. Cumulative effects on vegetation include:

- Fragmentation of natural vegetation communities where GWD Project facilities parallel existing utility ROWs or intersect with existing and new roads;
- An additive risk of expanded weed invasion where new ROWs intersect with or parallel older ROWs where weeds may already be established;
- An overall reduction in populations of yucca and cacti as the result of the expansion of existing utility corridors and new renewable energy projects in Coyote Springs and Delamar valleys;
- A potential reduction in special status plant species populations in Dry Lake, and Spring valleys from additional linear projects in utility corridors and construction of a wind energy project; and
- An overall reduction in the availability of Tribal traditional use plants as the result of additive vegetation surface disturbance across all GWD Project hydrologic basins.

Groundwater Pumping

Figure F3.5-4 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-18** and **3.5-19** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be at risk from drawdown from Alternative A operations. These figures include impact parameter information for cumulative with No Action, Proposed Action, and cumulative pumping with the Proposed Action as a way of identifying the incremental effects of the alternative. Representative basins for which the proposed action are may have a potential impact have been included in the analysis, and include (north to south): White River, Steptoe, Spring, Snake, Lake valleys, and Lower Meadow Valley Wash.

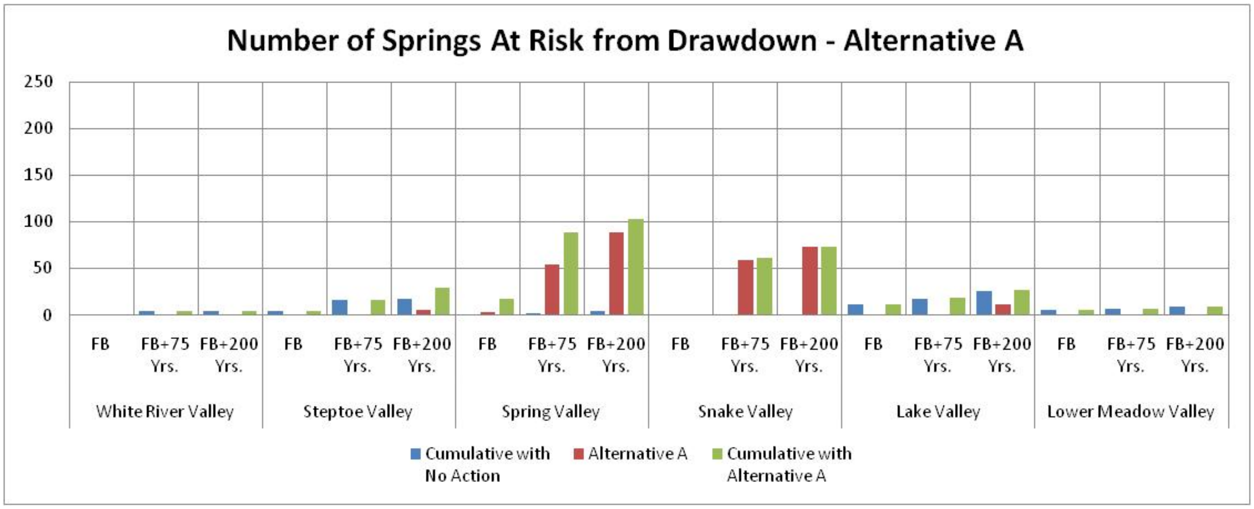


Figure 3.5-18 Number of Springs At Risk from Drawdown, Alternative A

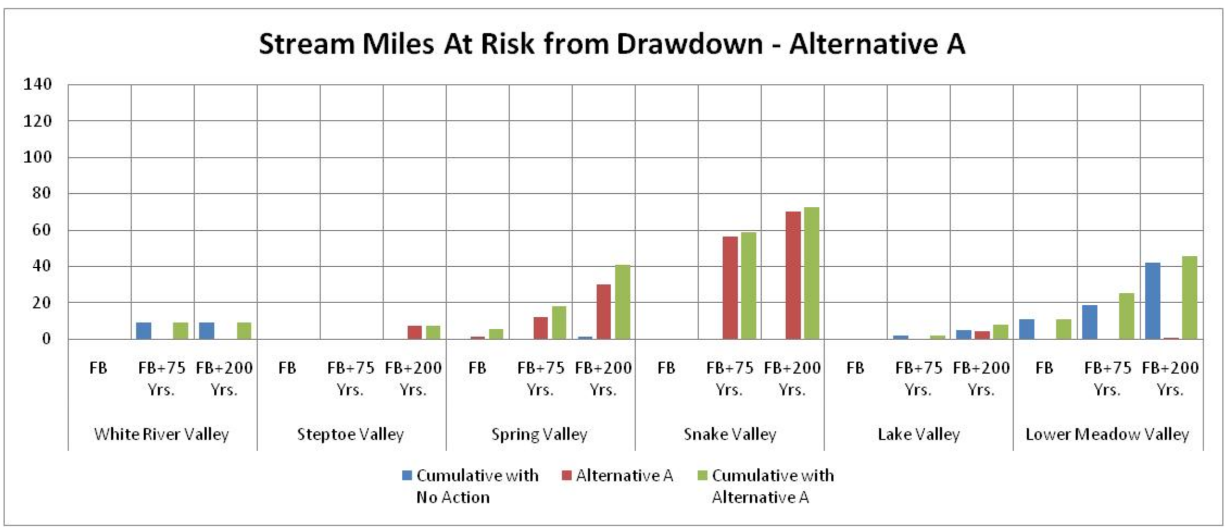


Figure 3.5-19 Stream Miles At Risk from Drawdown, Alternative A

Cumulative acres of potential drawdown effects for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figures 3.5-20** and **3.5-21**). These figures include impact parameter information for cumulative effects with No Action, Alternative A, and cumulative pumping with the Alternative A as a way of identifying the incremental effects of the alternative. Representative basins for which the alternative may have a potential impact have been included in the analysis, and include (north to south): White River, Steptoe, Spring, Snake, Lake valleys, and Lower Meadow Valley Wash. While a similar pattern of potential drawdown effects would occur with Alternative A, one notable difference for this cumulative pumping scenario would be that the magnitude of flow reduction would be smaller compared to cumulative pumping with the Proposed Action. Therefore, the magnitude of effects on vegetation communities would be lower in Spring, Snake, and Lake valleys. Effects on communities in Steptoe, White River, and Lower Meadow Valley Wash would be nearly identical.

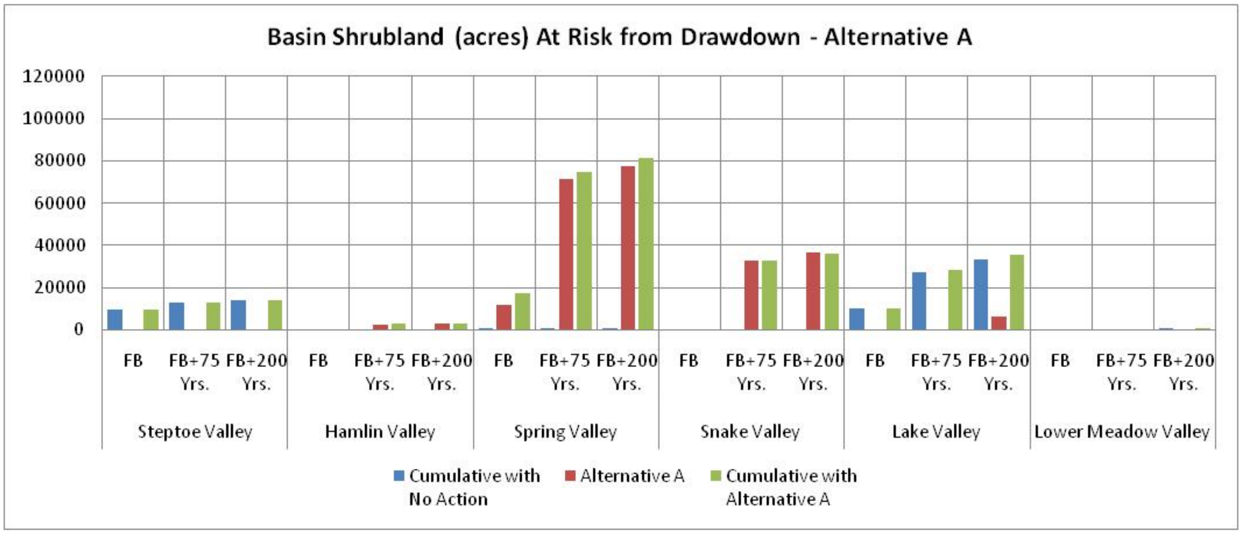


Figure 3.5-20 Basin Shrubland At Risk from Drawdown, Alternative A

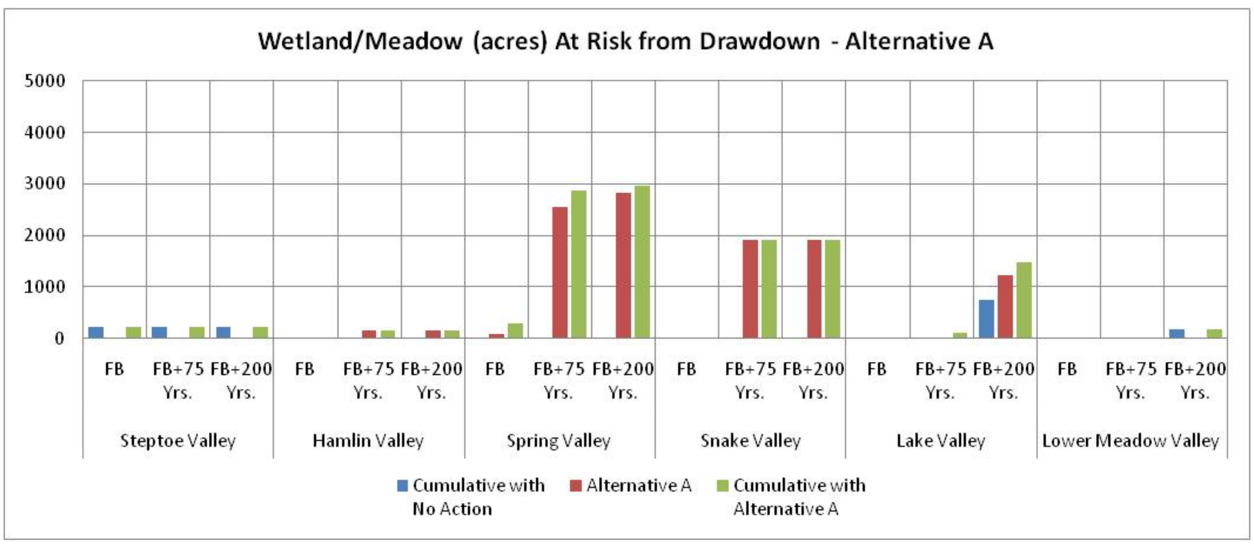


Figure 3.5-21 Wetland/Meadow At Risk from Drawdown, Alternative A

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. Predicted drawdowns in the Panaca Valley affecting up to four springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability.

3.5.3.8 Alternative B

Rights-of-way Groundwater Field Development Construction and Operational Maintenance

The GWD Project surface disturbance (up to 16,888 acres) would intersect with existing road and highway crossings in all hydrologic basins; would parallel approximately 100 miles of designated utility corridor in Clark and Lincoln counties; and would intersect service roads for a wind energy project in Spring Valley. Expected cumulative effects would be the same as those described for Alternative A.

Groundwater Pumping

Figure F3.5-5 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-22** and **3.5-23** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be at risk by Alternative B groundwater drawdown.

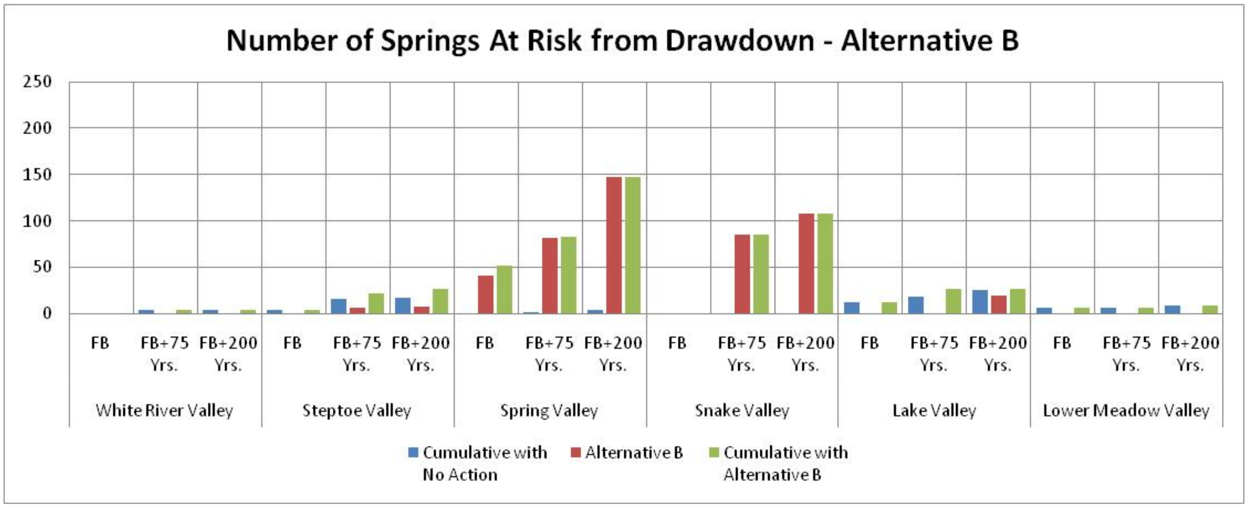


Figure 3.5-22 Number of Springs At Risk from Drawdown, Alternative B

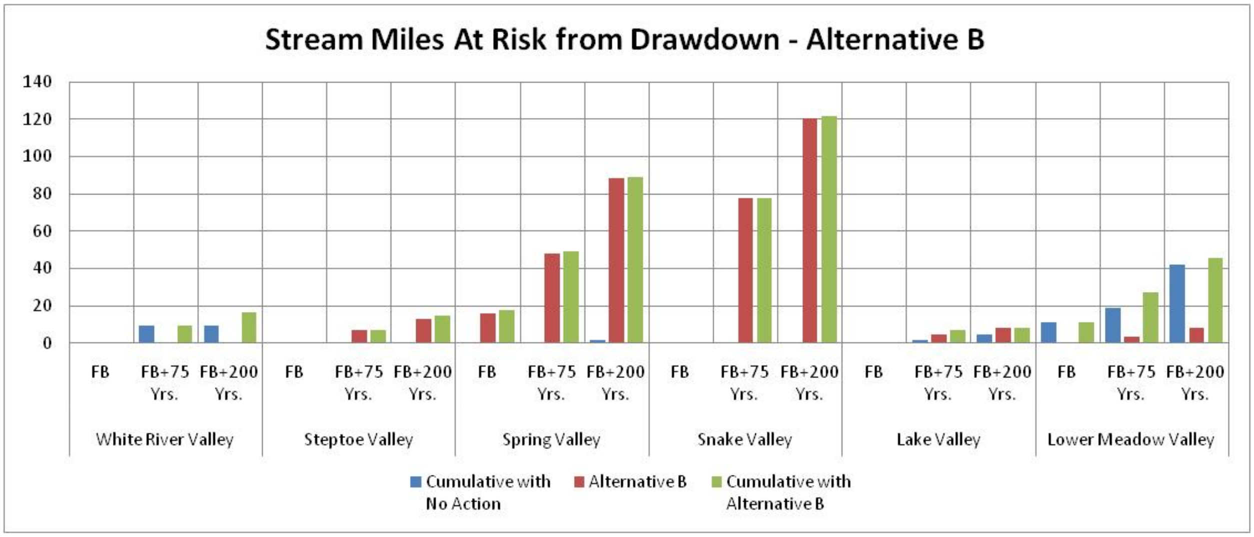


Figure 3.5-23 Stream Miles At Risk from Drawdown, Alternative B

Cumulative acres of potential drawdown effects for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figures 3.5-24** and **3.5-25**). Alternative B would contribute the predominant cumulative drawdown effects to streams and springs in Spring and Snake valleys. Alternative B is predict to cause larger effects on the Wetland/Meadow ET areas as compared to Alternative A. This difference is attributed to the wider distribution of pumping locations under Alternative A.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants. Predicted drawdowns in the Panaca Valley affecting up to four springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability.

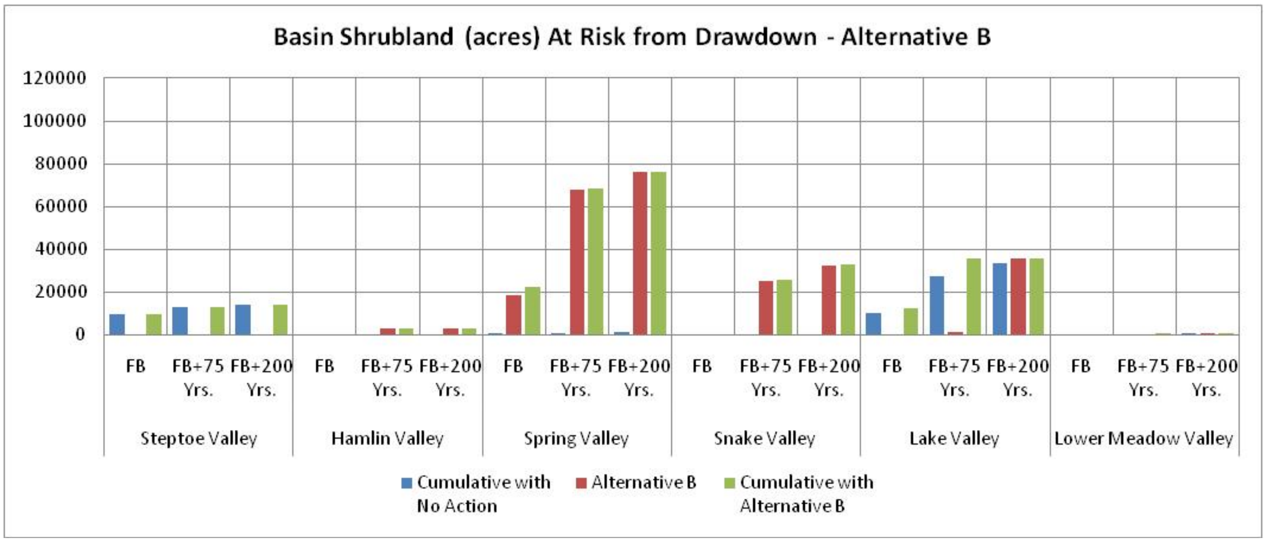


Figure 3.5-24 Basin Shrubland At Risk from Drawdown, Alternative B

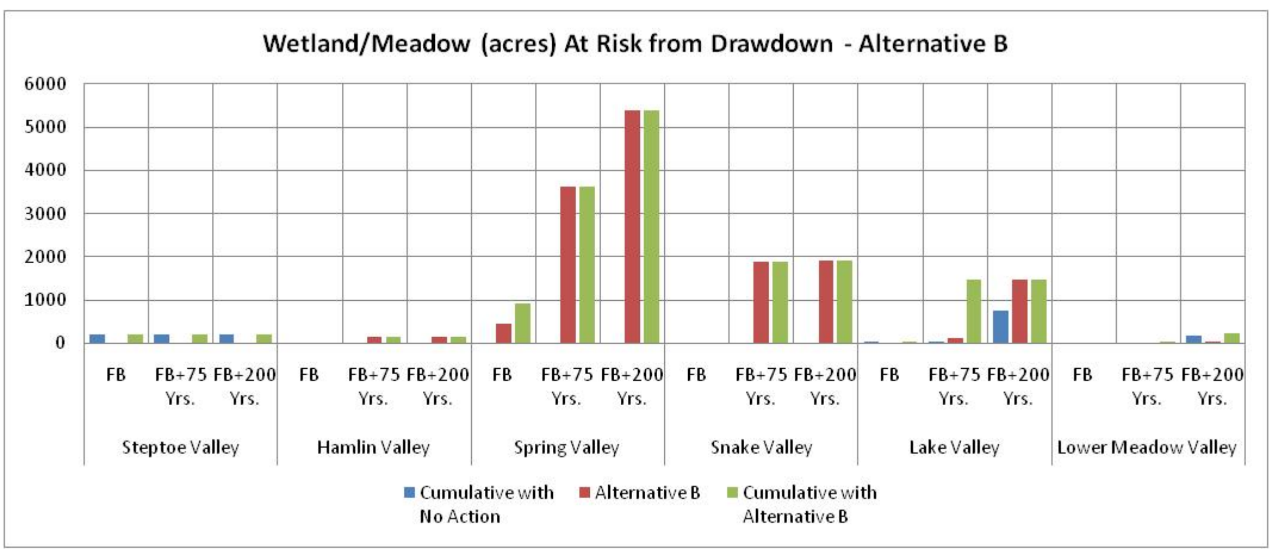


Figure 3.5-25 Wetland/Meadow At Risk from Drawdown, Alternative B

3.5.3.9 Alternative C

Rights-of-way Groundwater Field Development Construction and Operational Maintenance

The GWD Project surface disturbance (up to 17,035 acres) would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of designated utility corridor in Clark and Lincoln counties, and would intersect service roads for future wind energy projects in Spring and Dry Lake valleys and facilities for a solar energy project in Delamar Valley. Expected cumulative effects to resources would be the same as those described for Alternative A.

Groundwater Pumping

Figure F3.5-6 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-26** and **3.5-27** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be affected by the Alternative C drawdown. Alternative C would contribute much lower levels of drawdown effects to springs and streams in Spring and Snake valleys relative to the cumulative effects predicted for the Proposed Action, and Alternatives and B. This difference is attributed to the overall lower groundwater withdrawal assumed for Alternative C.

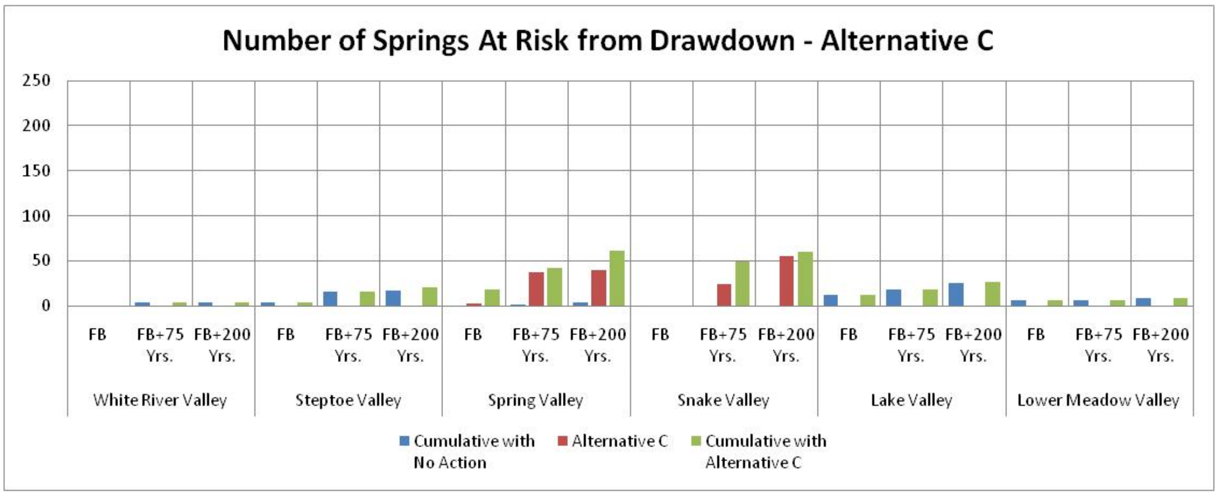


Figure 3.5-26 Number of Springs At Risk from Drawdown, Alternative C

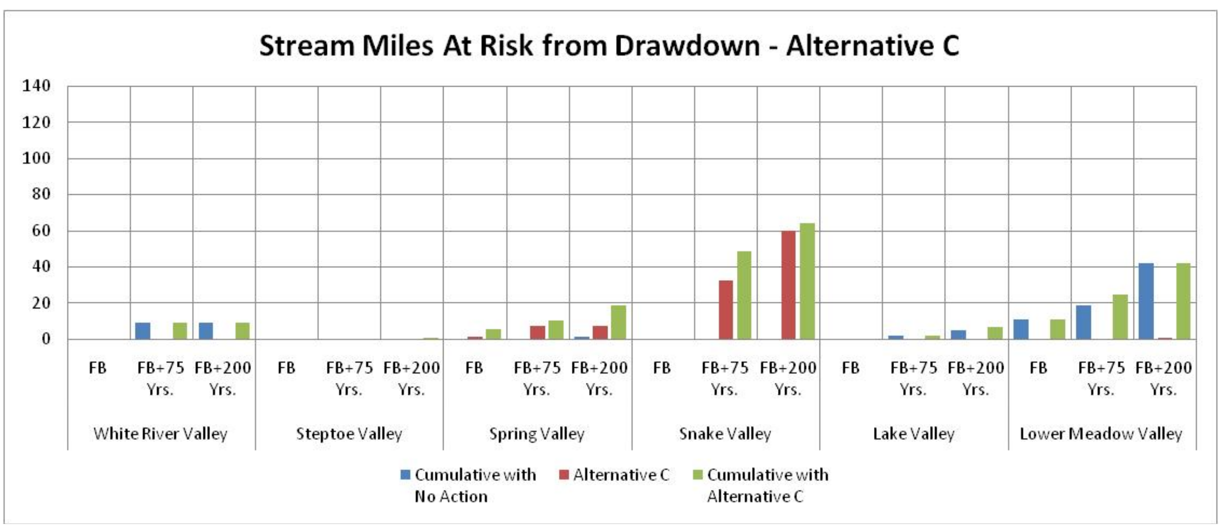


Figure 3.5-27 Stream Miles At Risk from Drawdown, Alternative C

Cumulative acres of potential disturbance due to drawdown for basin shrubland and wetland/meadow ET areas have been graphed by hydrologic basin (**Figures 3.5-28** and **3.5-29**). Similar to springs and streams, there would be lower levels of potential drawdown effects to ET areas from the cumulative contribution of Alternative C as compared to the Proposed Action, and Alternatives A and B.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring and Snake valleys. Predicted drawdowns in the Panaca Valley affecting up to four springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability.

The Ute ladies'-tresses orchid has not been identified in any of the areas potentially at risk. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.

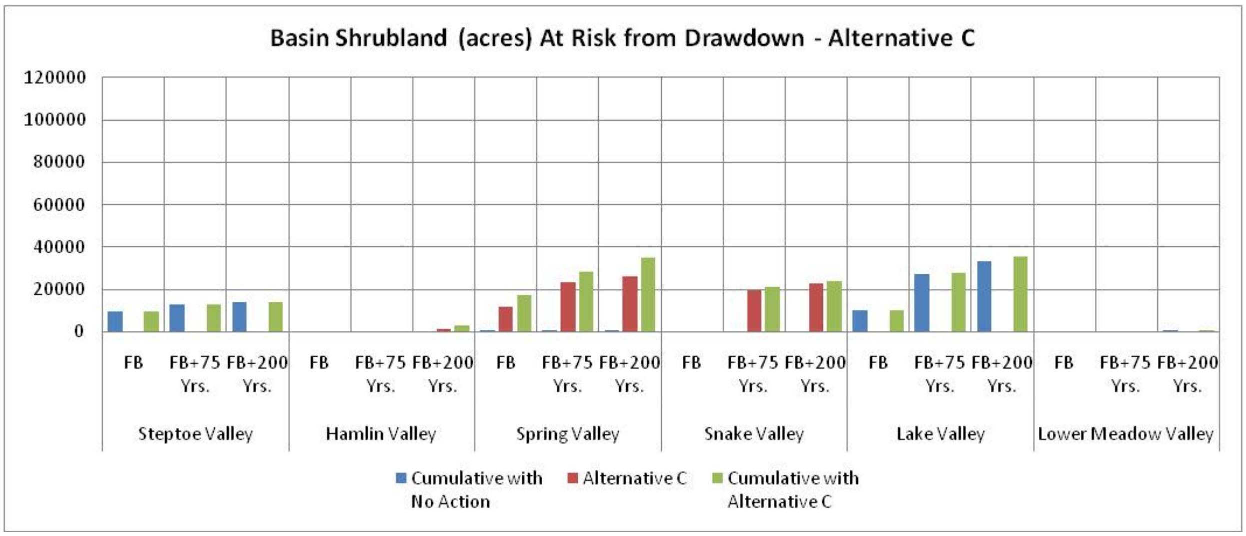


Figure 3.5-28 Basin Shrubland At Risk from Drawdown, Alternative C

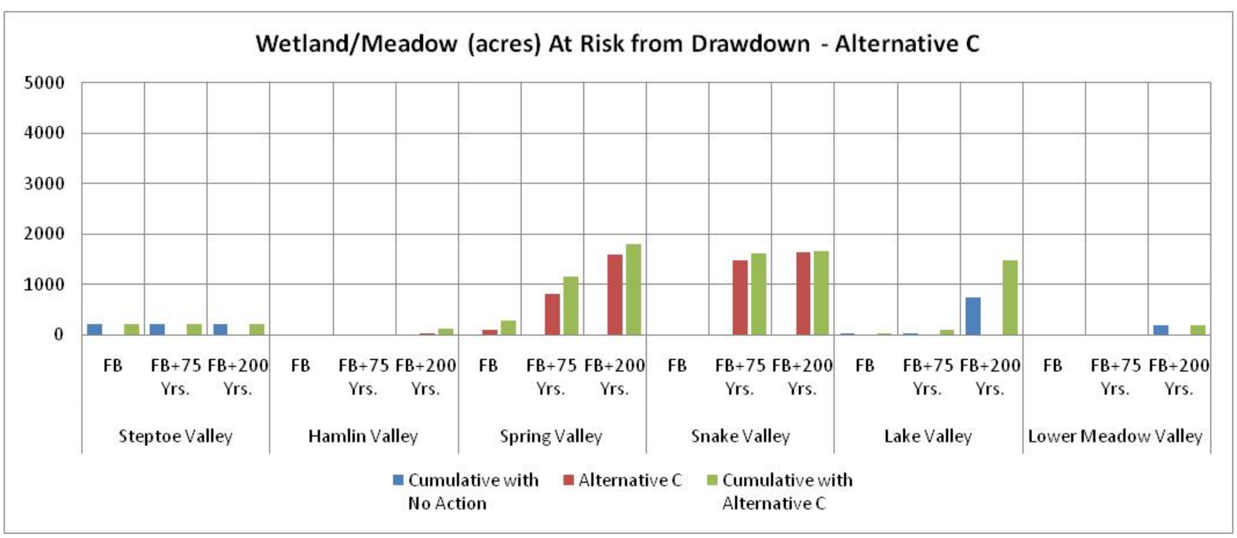


Figure 3.5-29 Wetland/Meadow At Risk from Drawdown, Alternative C

3.5.3.10 Alternative D

Rights-of-way Groundwater Field Development Construction and Operation Maintenance

The GWD Project surface disturbance (up to 12,779 aces) would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of designated utility corridor in Clark and Lincoln counties. Expected cumulative effects to resources would be the same as those described for Alternative A.

Groundwater Pumping

Figure F3.5-7 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-30** and **3.5-31** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be at risk by Alternative D groundwater drawdown. Alternative D would contribute potential drawdown effects to many fewer springs and stream miles as compared to the Proposed Action, and Alternative B. This difference is attributed to the concentration of Alternative D pumping in southern Spring Valley, which would not affect streams and streams in northern Spring and Snake valleys.

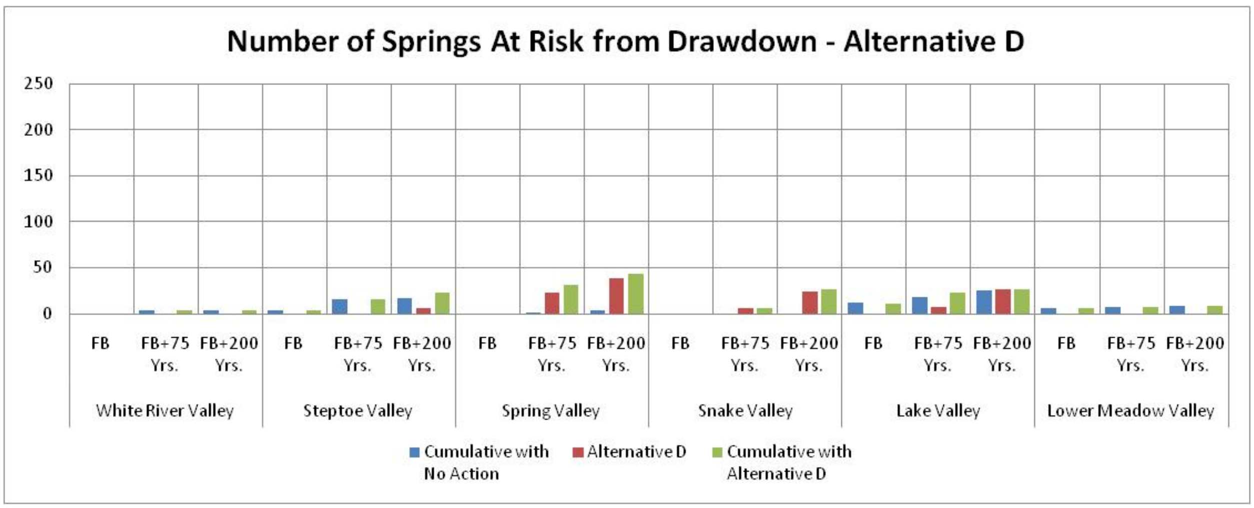


Figure 3.5-30 Number of Springs At Risk from Drawdown, Alternative D

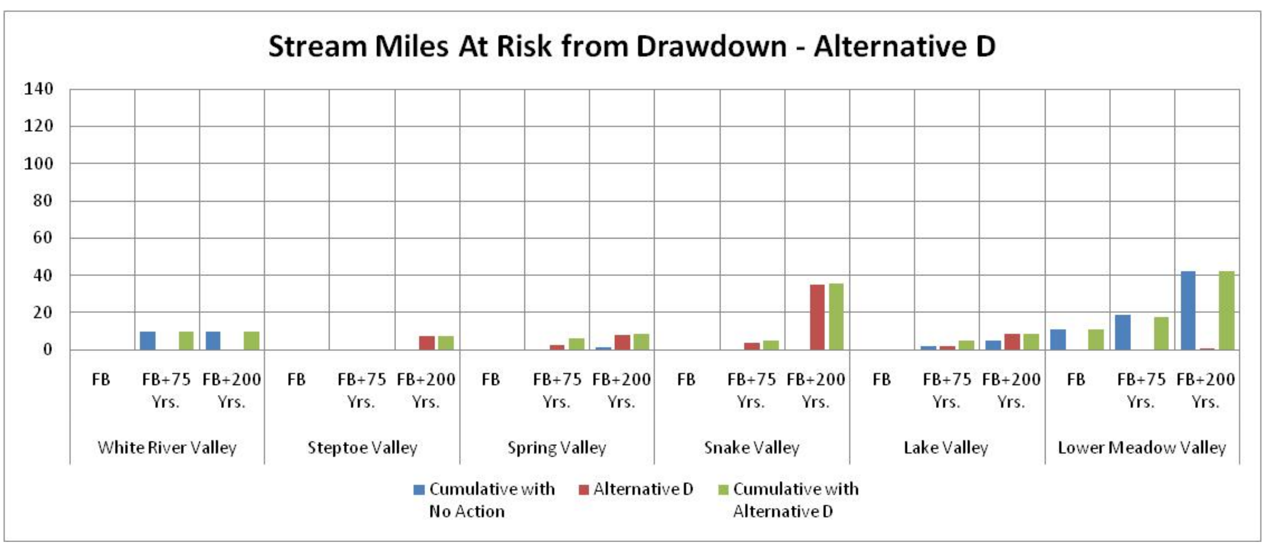


Figure 3.5-31 Stream Miles At Risk from Drawdown, Alternative D

Cumulative acres of potential disturbance due to drawdown for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figures 3.5-32** and **3.5-33**). Alternative D would affect a much smaller ET area acreage as compared to the Proposed Action and Alternative B. This difference is attributed to the concentration of Alternative D pumping in southern Spring Valley, which would reduce the predicted effects in the large ET areas in central and northern Spring Valley.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. Predicted drawdowns in the Panaca Valley affecting up to three springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability.

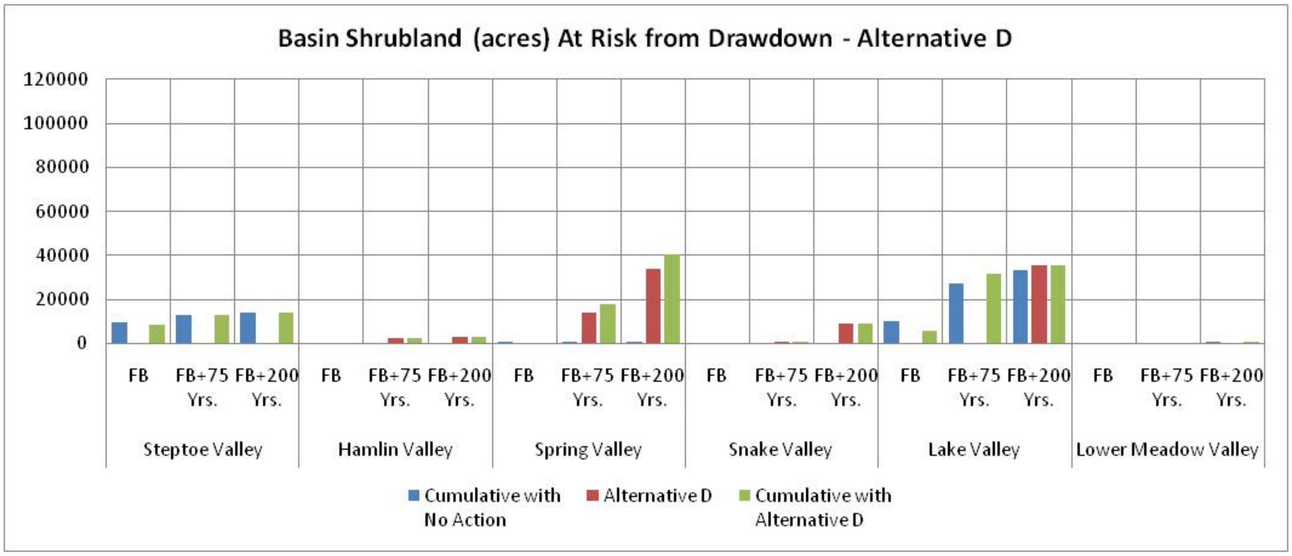


Figure 3.5-32 Basin Shrubland At Risk from Drawdown, Alternative D

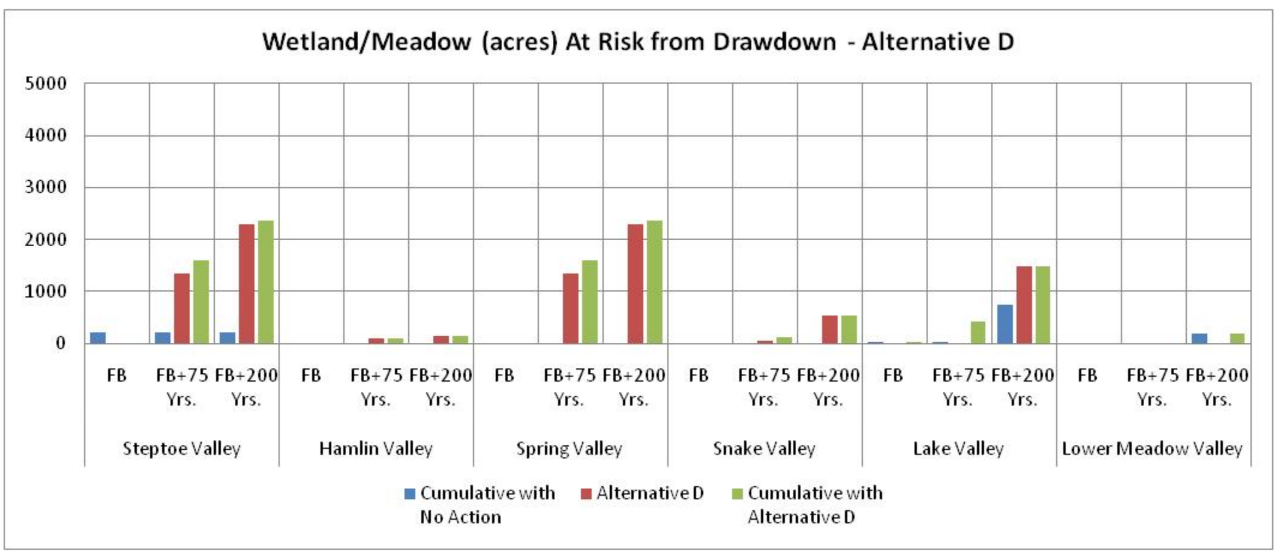


Figure 3.5-33 Wetland/Meadow At Risk from Drawdown, Alternative D

3.5.3.11 Alternative E

Rights-of-way Groundwater Field Development Construction and Operation Maintenance

The GWD Project surface disturbance (up to 14,673 acres) would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of a designated utility corridor in Clark and Lincoln counties. Expected cumulative effects to resources would be the same as those described for Proposed Action.

Groundwater Pumping

Figure F3.5-8 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-34** and **3.5-35** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be impacted by the Alternative E. Alternative E would contribute potential drawdown effects to many fewer springs and stream miles as compared to the Proposed Action, and Alternative B, especially in Snake Valley. This difference is attributed to the lack of Alternative E pumping in Snake Valley. However, Alternative E pumping would potentially affect approximately twice as many springs as Alternative D in Spring Valley. This difference is attributed to groundwater development over the entire area of Spring Valley under Alternative E, as compared to only the southern portion of Spring Valley in Lincoln County under Alternative D.

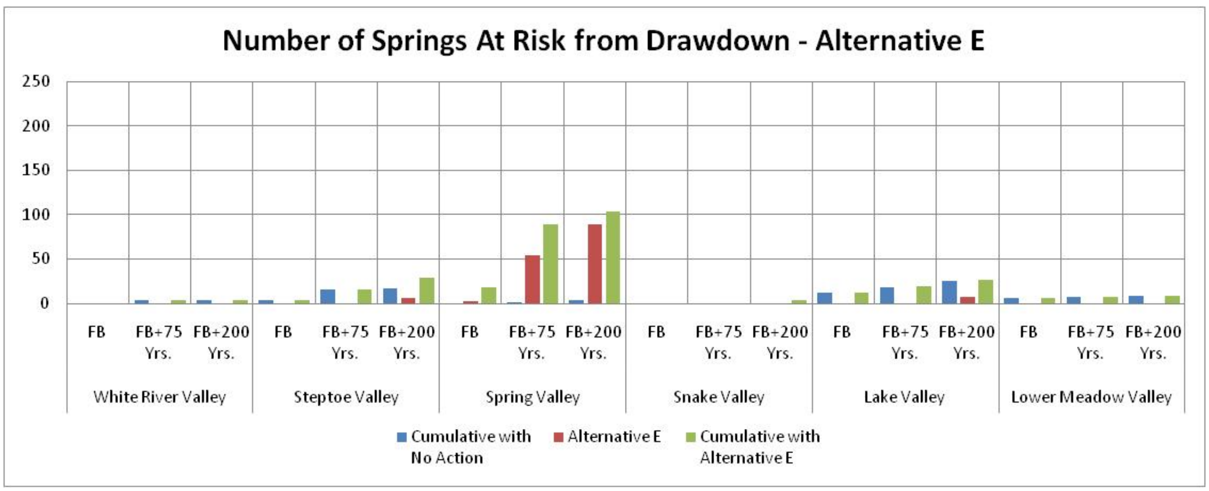


Figure 3.5-34 Number of Springs At Risk from Drawdown, Alternative E

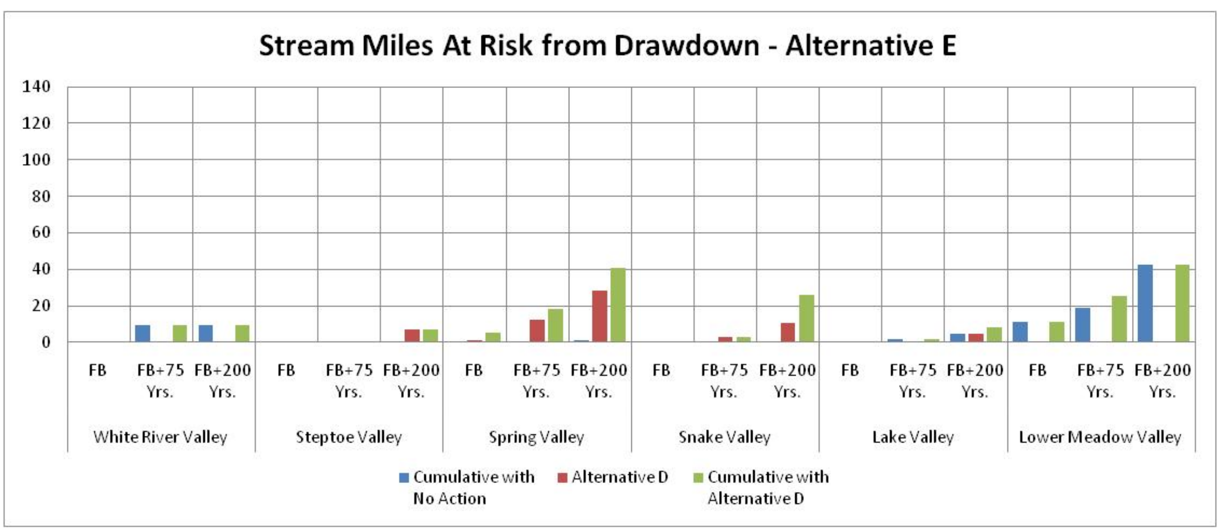


Figure 3.5-35 Stream Miles At Risk from Drawdown, Alternative E

Cumulative acres of potential disturbance due to drawdown for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figures 3.5-36** and **3.5-37**). Alternative E would contribute equivalent effects to ET areas in Spring Valley as Alternative A, because the well development pattern would be the same. No effects on ET areas are predicted in Snake Valley at any time interval.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants. Predicted drawdowns in the Panaca Valley affecting up to three springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long-term population viability.

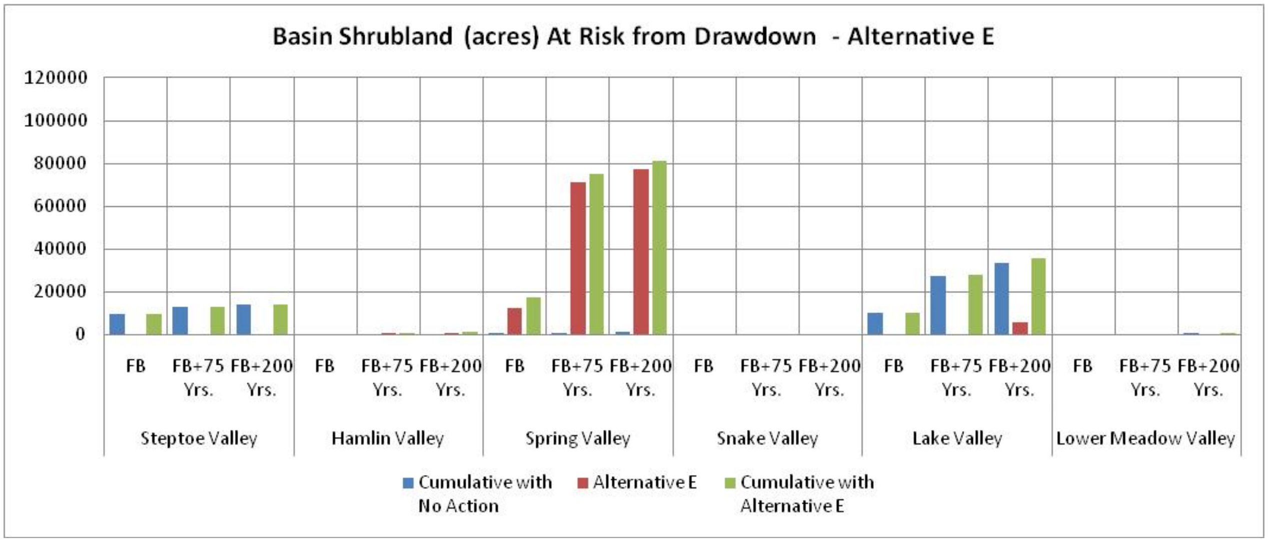


Figure 3.5-36 Basin Shrubland At Risk from Drawdown, Alternative E

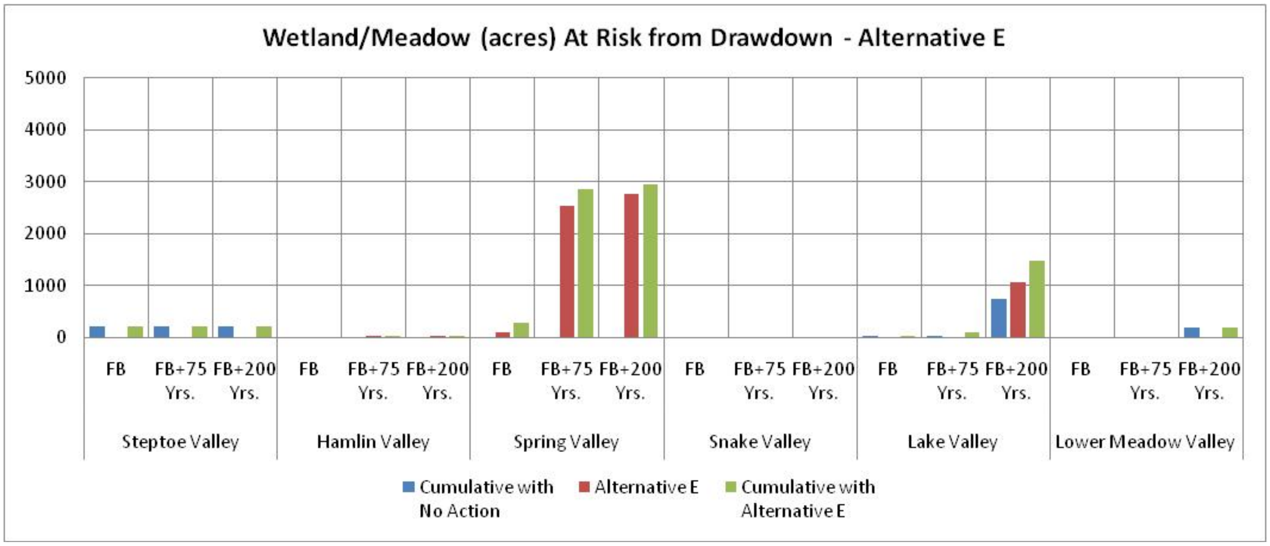


Figure 3.5-37 Wetland/Meadow At Risk from Drawdown, Alternative E

3.5.3.12 Alternative F

Rights-of-way Groundwater Field Development Construction and Operation Maintenance

The GWD Project surface disturbance (up to 17,102 acres) would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of a designated utility corridor in Clark and Lincoln counties. Expected cumulative effects to resources would be the same as those described for Proposed Action.

Groundwater Pumping

Figure F3.5-8 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-38** and **3.5-39** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be impacted by the Alternative E. Alternative E would contribute potential drawdown effects to many fewer springs and stream miles as compared to the Proposed Action, and Alternative B, especially in Snake Valley. This difference is attributed to the lack of Alternative E pumping in Snake Valley. However, Alternative E pumping would potentially affect approximately twice as many springs as Alternative D in Spring Valley. This difference is attributed to groundwater development over the entire area of Spring Valley under Alternative E, as compared to only the southern portion of Spring Valley in Lincoln County under Alternative D.

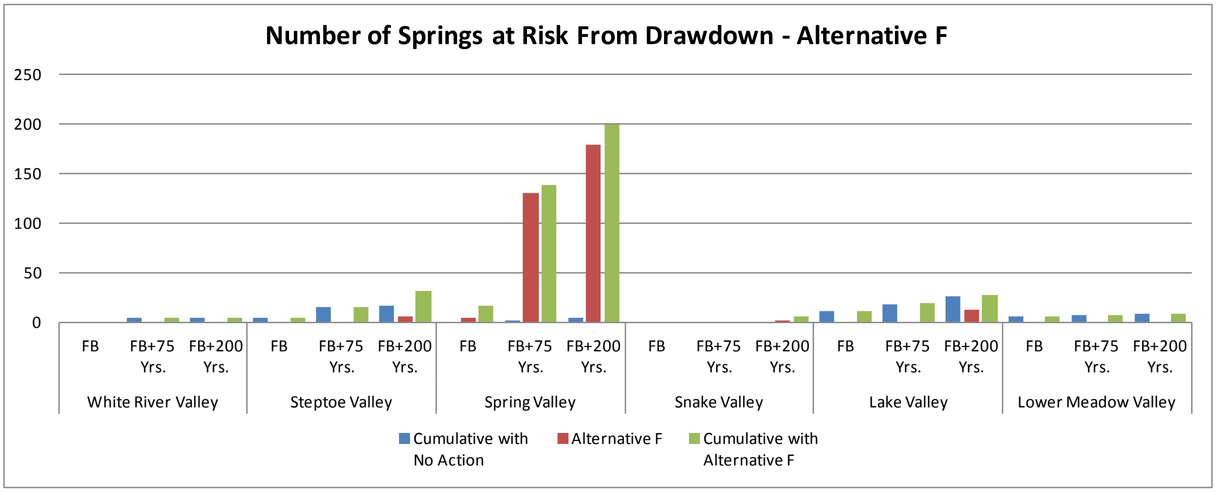


Figure 3.5-38 Number of Springs At Risk from Drawdown, Alternative F

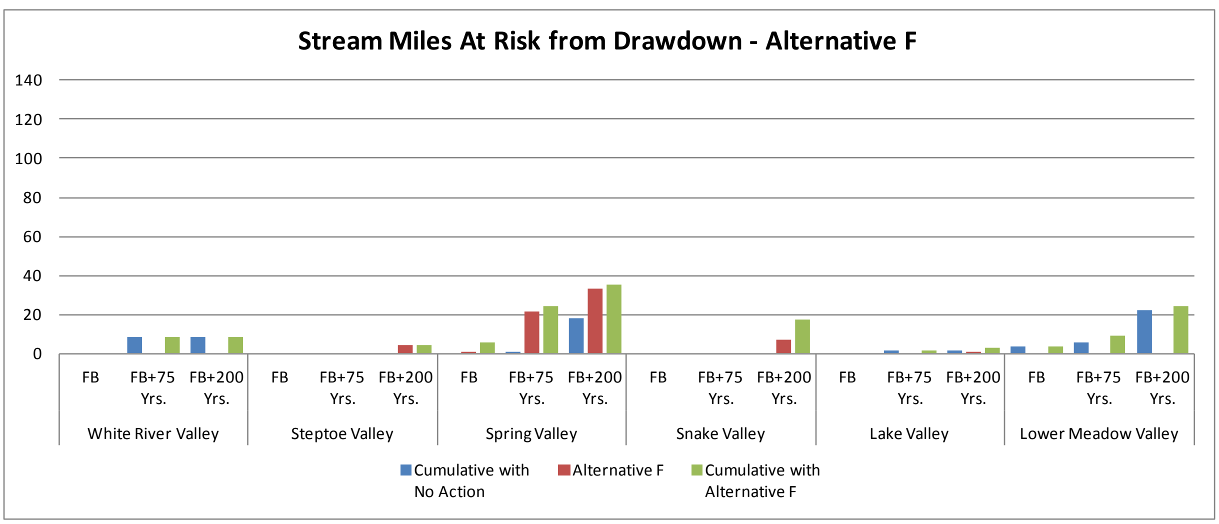


Figure 3.5-39 Stream Miles At Risk from Drawdown, Alternative F

Cumulative acres of potential disturbance due to drawdown for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figures 3.5-40** and **3.5-41**). Alternative F would contribute equivalent effects to ET areas in Spring Valley as Alternative A, because the well development pattern would be the same.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants. Predicted drawdowns in the Panaca Valley affecting up to three springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Lower Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long-term population viability.

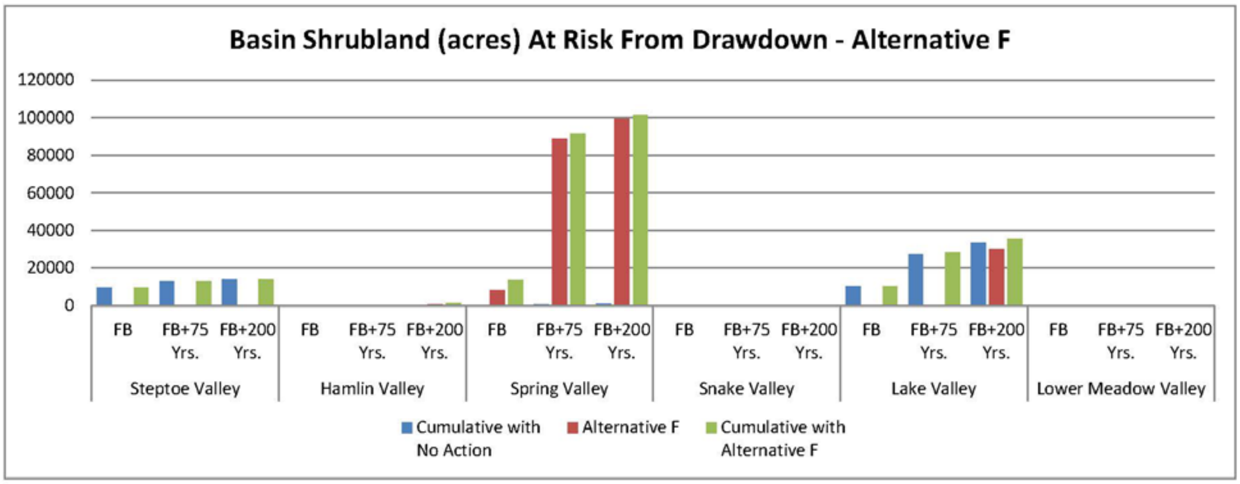


Figure 3.5-40 Basin Shrubland At Risk from Drawdown, Alternative F

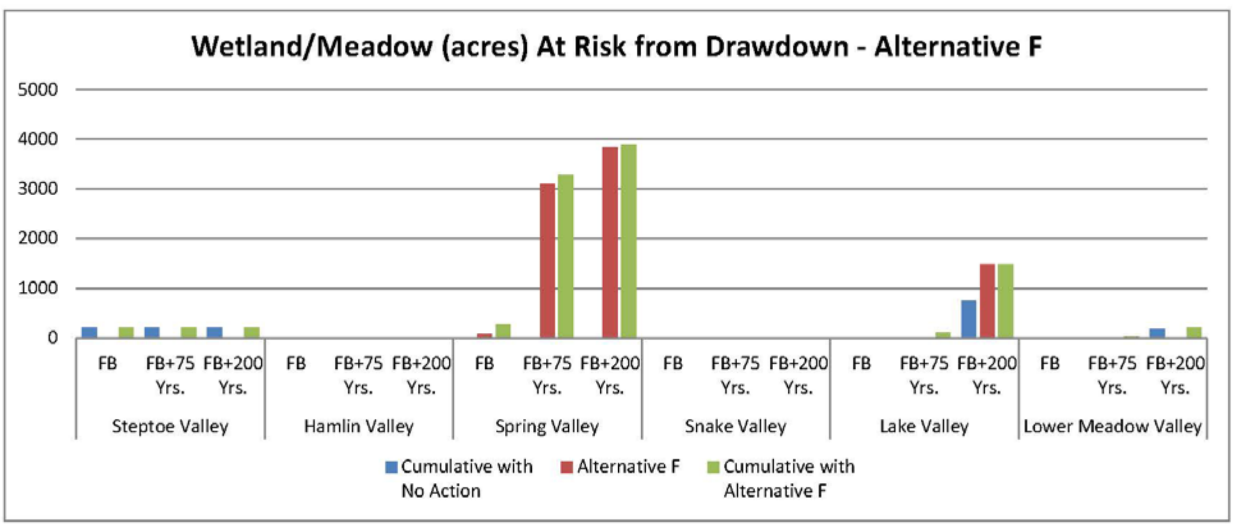


Figure 3.5-41 Wetland/Meadow At Risk from Drawdown, Alternative F

BLM

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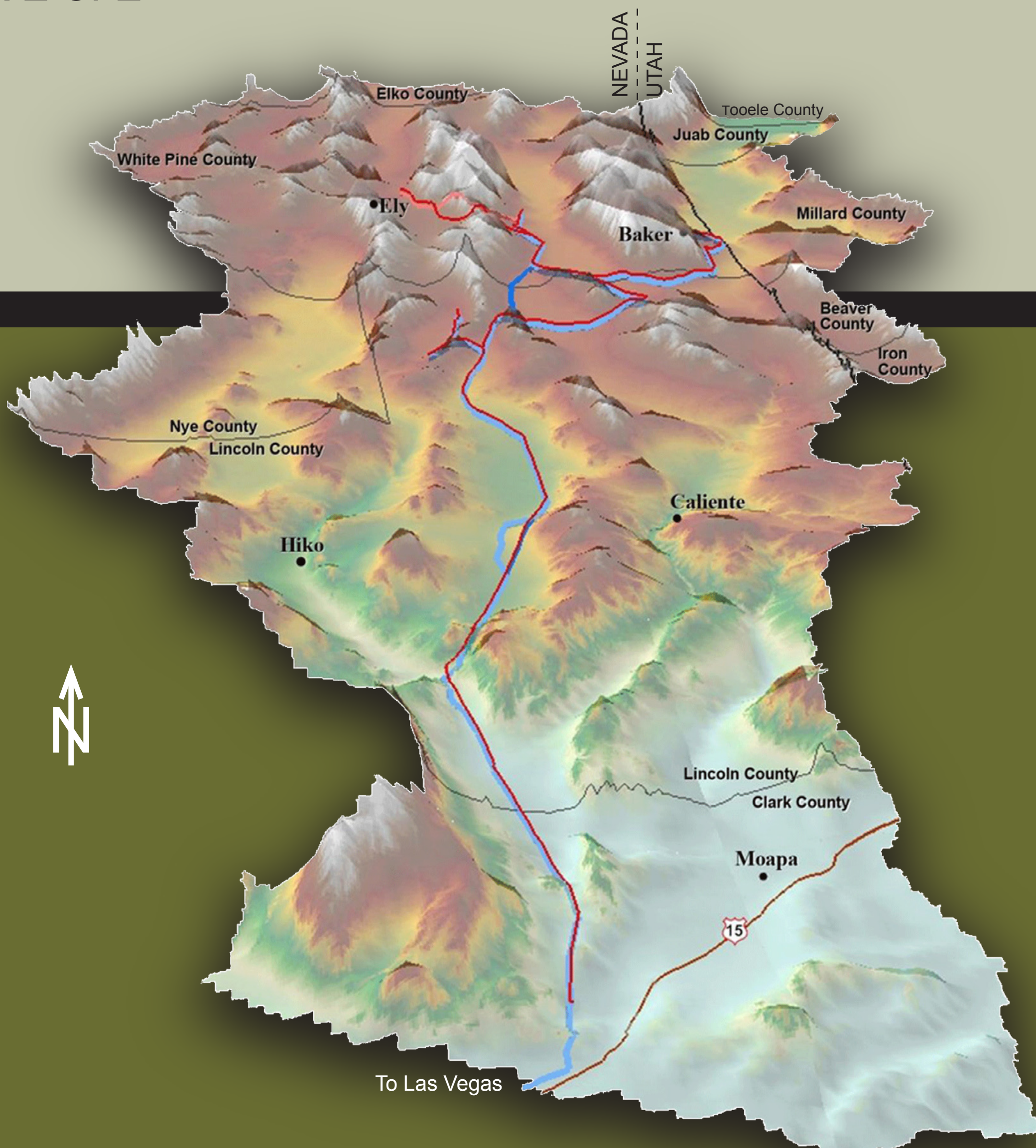

Bureau of Land Management

August 2012
FES 12-33

Nevada State Office

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State of Utah
Tooele County, UT
U.S. Fish and Wildlife Service
U.S. Forest Service
White Pine County

Mission Statement

The BLM's multiple-use mission is to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

BLM/NV/NV/ES/11-17+1793

Clark, Lincoln, and White Pine Counties Groundwater Development Project Final Environmental Impact Statement

Book 2

Bureau of Land Management

August 2012

FES 12-33

Due to the size of this analysis, the EIS was broken into 2 books. This is the second book and contains a portion of Chapter 3 (starting with Section 3.6 -- Terrestrial Wildlife), plus Chapters 4 through 6, references, glossary, and index.

3.6 Terrestrial Wildlife

3.6.1 Affected Environment

3.6.1.1 Overview

This section covers general wildlife, species of management concern, and special status terrestrial wildlife species. General wildlife habitats within the study area are described and quantified in Section 3.5, Vegetation Resources, while general wildlife species are discussed briefly in this overview section.

The region of study for terrestrial wildlife includes 33 hydrologic basins that encompass portions of Nevada and Utah. The natural resources region of study differs slightly from the water resources model area as shown in **Figure 3.6-1**. This is explained in more detail in Section 3.5, Vegetation Resources.

Detailed discussion of management concern and special status species is included for specific portions of the study area, in relation to the ROW and groundwater development areas. The discussion of management concern species focuses on big game, small mammals, game birds, waterfowl, shorebirds, raptors, and migratory birds. These species include wildlife species that occur in the general habitat types found in the project area.

The special status species discussion includes mammals, birds, reptiles, and terrestrial invertebrates that are listed or proposed for listing under the ESA, and considered sensitive by the BLM or the USFS (for that portion of USFS land crossed by a ROW option). The BLM special status species are: 1) species listed or proposed for listing under the ESA, and 2) species requiring special management consideration to promote their conservation and reduce the likelihood and need for future listing under the ESA, which are designated as BLM sensitive by the State Director(s).

All federal candidate species, proposed species and delisted species in the 5 years following delisting will be conserved as BLM-sensitive species (per the BLM Manual 6840 [BLM 2008a]). The Final EIS considers the 2011 updated BLM sensitive species list.

USFS examines the following sources as possible candidates for listing as sensitive species: 1) USFWS candidates for federal listing under the ESA (categories 1 and 2); 2) state lists of endangered, threatened, rare, endemic, unique, or vanishing species, especially those listed as threatened under State law; and 3) other sources as appropriate in order to focus conservation management strategies and to avert the need for federal or state listing as a result of National Forest management activities (USFS 1991).

QUICK REFERENCE

ACEC – Area of Critical Environmental Concern

ACM – Applicant Committed Protection Measure

APLIC – Avian Power Line Interaction Committee

BGEPA – Bald and Golden Eagle Protection Act

DOI – U.S. Department of Interior

ESA – Endangered Species Act

ET – Evapotranspiration

GBBO – Great Basin Bird Observatory

GBNP – Great Basin National Park

MBTA – Migratory Bird Treaty Act

NDOW – Nevada Department of Wildlife

NEPA – National Environmental Policy Act

NNHP – Nevada Natural Heritage Program

NPS – National Park Service

NWR – National Wildlife Refuge

PGH– Preliminary General Habitat

PPH – Preliminary Priority Habitat

RMP – Resource Management Plan

UDWR – Utah Division of Wildlife Resources

USFS – United States Forest Service

USFWS – U.S. Fish and Wildlife Service

Species habitats are managed by the agency who owns or administers the land (i.e., BLM, NPS, USFS, and USFWS refuges). The species are managed by the state agencies (NDOW and the UDWR) with coordination and cooperation with the federal agencies. One exception to species management is the NPS authority in park such as GBNP. NPS direction is to protect and manage resources in the park including terrestrial wildlife resources.

On lands with federally listed species, such species are under the jurisdiction of the USFWS. The USFWS coordinates with the state agencies to develop and implement recovery and other plans for threatened and endangered species.

Collectively, the state and federal agencies develop and implement management plans and strategies for both game and nongame terrestrial wildlife species. Management direction and guidance are provided through the implementation of management plans, agreements, and their wildlife plans (e.g., Wildlife Action Plan [2006] and the Utah Comprehensive Wildlife Conservation Strategy [Sutter et al. 2005].

As previously mentioned in Section 3.5, Vegetation Resources, the Natural Resources Group provided input and evaluation on species occurrences in a baseline summary report (ENSR/AECOM 2008). The Natural Resources Group included representatives from the BLM in Nevada and Utah, USFWS in Nevada and Utah, NDOW, UDWR, SNWA, AECOM (formerly ENSR) (BLM's EIS Contractor), and ENTRIX (subcontractor to AECOM). Tables from that baseline report are the source of **Table F3.6-1** in **Appendix F3.6**. Other data sources used by the Natural Resources Group and for this section include Natural Heritage data, primary research, conservation reports, and input from agency staff. The Natural Heritage dataset was acquired from Nevada and Utah, and occurrence data were used to identify rare and sensitive species presence. Many studies on various animal groups, including mammals (SNWA 2007a, 2008), birds (Great Basin Bird Observatory [GBBO] 2007a,b), herpetofauna (SNWA 2008), and terrestrial invertebrates (Ecological Sciences, Inc. 2007) have been conducted in the region. Amphibians are addressed in Section 3.7, Aquatic Biology Resources. Wildlife Action Plans for Utah (Sutter et al. 2005) and Nevada (Wildlife Action Plan Team 2006) provided additional information on species. The draft Revised Nevada Wildlife Action Plan was referenced for habitat information for new BLM Sensitive Species List additions. The USFWS lists of threatened, endangered, proposed and candidate species, USFS Sensitive Species list, GBNP Listing of Sensitive and Extirpated Species, and BLM's Sensitive Species list were referenced to identify protected and management species.

Wildlife species that have been identified by tribes (Duckwater, Goshute, and Ely Shoshone) as culturally significant include elk, bighorn sheep, antelope, deer, bears, mountain lions, coyotes, wolves, rabbits (pygmy, jack, cottontail), rock chucks, ground squirrels, pack rats, pocket gophers, sage-grouse, mudhen, crickets, and various species of raptors and waterfowl. They have cultural significance in many forms, including food resources, spiritual resources, and resources as traditional values (BLM 2012a; James 1981; Steele 2010). These animals have the potential to occur throughout historical aboriginal territories and throughout the proposed project area in appropriate habitat.

General wildlife communities in the natural resources region of study occur in two main ecological regions: the Great Basin Desert and Mojave Desert. These communities include mammals, birds, herpetofauna, and terrestrial invertebrates. Large mammals occurring in these areas include Rocky Mountain elk, mule deer, pronghorn antelope, desert and Rocky Mountain bighorn sheep, and mountain lions. Medium-sized mammals include coyote, kit fox, and American badger. Small mammals are abundant and include a variety of bat species and rodents. General terrestrial habitat types in these two ecological regions include: shrubland, desert scrub, pinyon-juniper woodland, grassland, playa, and riparian.

Based on surveys conducted by the SNWA (2007a, 2008), 20 small mammal species were collected in seven of the basins that the ROWs and groundwater development areas would cross (Cave, Delamar, Dry Lake, Hamlin, Lake, Snake, and Spring). Fourteen species were associated with riparian and phreatophytic plant communities (i.e., greasewood flats). Species that dominated the collections in one or more valleys included the following: Least chipmunk, Great Basin pocket mouse, Ord's kangaroo rat, Chisel-toothed kangaroo rat, Merriam's kangaroo rat, and Deer mouse.

Some other small mammal species that occur in the study area include: northern grasshopper mouse, pinyon mouse, dark kangaroo mouse (NDOW 2010a), western harvest mouse, montane vole, desert woodrat, and white tailed antelope squirrel.

From April 2005 through June 2006, acoustic surveys were conducted at 32 sites to identify bat species presence within 12 valleys crossed by the GWD Project. Surveys identified a total of 16 special status species (O'Farrell Biological Consulting 2006). From July 9, 2008 through October 9, 2008, mist net surveys were conducted at 11 select spring sites, 7 of which were generally associated with locations sampled in the previous acoustic surveys. Nine bat special status species were captured (SNWA 2009a). Special status bat species are listed in **Appendix F**, **Table F3.6-1**. Of the 22 species listed in the table, only 5 (Allen's big-eared bat, California leaf-nosed, cave myotis, greater western mastiff bat, and spotted bat) were not detected during acoustic or mist net surveys.

Many bird species can be found within the study area throughout the year; some are year-round residents, whereas others are present only during the breeding season or in winter (GBBO 2007a,b). These bird species include neotropical migrants, upland game birds, raptors, waterfowl, and shore birds. Common species include the following: horned lark, house finch, black-throated sparrow, rock wren, northern mockingbird, gambel's quail, greater sage-grouse, red-tailed hawk, northern harrier, american kestrel, and common aquatic bird species, including: Canada goose, cinnamon teal, gadwall, redhead, American coot, pied-billed grebe, double crested cormorant, great blue heron, and killdeer.

There are also a number of important bird areas that have been identified by the Audubon Society in both Nevada and Utah. Important bird areas are sites that provide essential habitat for one or more species of bird. They can include public or private lands, or both, and they may or may not be legally protected. Important bird areas are discussed in more detail later in this section as the locations of individual important bird areas relate to ROWs, groundwater development areas and the region of study.

From July through October 2007, reptile and amphibian surveys were conducted by the SNWA within six valleys crossed by the GWD Project (Cave, Dry Lake, Hamlin, Lake, Snake, and Spring valleys). Fourteen herptile species, out of 26 potentially present species, were identified during these surveys. An additional 2 species were observed during a 2005 survey, for a total of 16 species. The number of species reported per basin ranged from 7 in Hamlin Valley to 12 in Spring Valley. Side-blotched lizard, long-nosed leopard lizard, sagebrush lizard, striped whipsnake, Great Basin gopher snake, and Great Basin spadefoot toad were detected in five or six of the surveyed basins. Other reptiles that occur in the natural resources region of study include species such as the Sonoran Mountain kingsnake, short-horned lizard, desert horned lizard, Great Basin collared lizard (ENSR/AECOM 2008), glossy snake, western red-tailed skink, western blind snake, terrestrial garter snake, coachwhip snake, long-nosed snake, racer snake, and western whiptail lizard (SNWA 2008). Herptile species identified by the Natural Resources Group and newly added species from the Nevada updated BLM sensitive species list are listed in **Appendix F**, **Table F3.6-1**.

A terrestrial invertebrate species desktop review and field survey was completed in 2006 by Ecological Sciences, Inc. (Ecological Sciences, Inc. 2007). Ecological Sciences, Inc. collected invertebrates from 76 sites in the Great Basin and Mojave Desert regions and identified a total of 681 terrestrial invertebrate species, after completing taxonomic analysis of one-third of the specimens. The identified species represented 149 families from 21 invertebrate orders, many of which have aquatic larval stages and terrestrial adults. The orders with the greatest number of species were wasps, beetles, moths, and flies.

The following plans identify wildlife species that the BLM or the states of Nevada or Utah consider a focus of management:

- Ely District Record of Decision and Approved Resource Management Plan (BLM 2008b);
- Record of Decision for the Approved Las Vegas Resource Management Plan and Final Environmental Impact Statement (BLM 1998);
- Nevada Wildlife Action Plan (Wildlife Action Plan Team 2006), and Nevada Wildlife Action Plan (Wildlife Action Plan Team 2012); Utah Comprehensive Wildlife Conservation Strategy (Sutter et al. 2005).

3.6.1.2 Right-of-way Areas

Species of Management Concern

The BLM and other land-management agencies manage wildlife habitat on public lands; the NDOW and the UDWR manage wildlife populations on the public lands. The NPS manages both wildlife and habitat within units it administers. For the purposes of this document, terrestrial wildlife species of management concern are defined as species considered to be a focus of management by the BLM or the states of Nevada and/or Utah and include big game mammals, small mammals, upland game birds, aquatic birds, raptors, passerines, other migratory birds (e.g., hummingbirds, sparrows, and corvids), and reptiles. They are identified in one or a combination of the plans listed above. Non-game species that are included in these plans are a focus of management concern because populations are declining, threats to the species need to be monitored, or the species are protected under regulations such as the MBTA.

Working under BLM direction, the Natural Resources Group developed the list of species presented in **Appendix F**, **Table F3.6-1.** This table provides the representative list of wildlife species of management concern that occur within the natural resources region of study and identifies the hydrologic basins in which the species can be found in ROW areas, according to the Nevada and Utah Natural Heritage datasets, data from the state agencies, and project-specific survey data. The list of bird species in the table – addressed in more detail in this document – follows the policy and management guidance set out in the BLM and USFWS MOU signed in April 2010 as well as the 2001 EO 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds. Both documents direct the agencies to promote the conservation of migratory birds and conduct project evaluations to focus on species of concern, priority habitats, and key risk factors.

Habitat requirements and life-history information for species of management concern are provided in **Appendix F**, **Table F3.6-2**. The following information summarizes the occurrence of representative wildlife species of management concern within the ROW areas. There are no ROW areas in the State of Utah.

Five big-game mammals of management concern are known to occur within the ROW areas (**Appendix F**, **Table F3.6-1**). The occurrence and habitat of these big game species are as follows:

- **Pronghorn antelope (Figure 3.6-1) –** The overall range for this species overlaps with the central and northern portions of the ROWs. No crucial winter range is present in the ROWs. Pronghorn prefer gently rolling or flat topography that provides good visibility. Primary habitat for this species consists of mixed shrubs, grasses, and forbs with modest height and low density of pinyon and juniper trees. Sagebrush is used as cover and food sources.
- **Rocky Mountain elk** (**Figure 3.6-2**) **–** The overall range for elk overlaps with the ROWs in Dry Lake, Cave, Lake, Steptoe, and Spring valleys. The ROWs do not overlap crucial summer habitat. This species occurs in a wide variety of habitats, ranging from low to upper elevations. Summer habitat includes mixed conifer and aspen forests and higher-elevation, pinyon-juniper woodlands and meadows as well as mountain brush and grass communities. Winter use mainly occurs in pinyon-juniper woodlands and sagebrush grasslands between approximately 5,000 and 9,500 feet elevation.
- **Mule deer (Figure 3.6-3) –** Mule deer range occurs along the central and northern portions of the ROWs. Crucial summer and winter ranges overlap the ROWs in Cave, Dry Lake, Hamlin, Lake, Spring, Steptoe, and Snake valleys. This species is widespread, with distribution primarily associated with middle and upper elevations in sagebrush and grassland habitats that occur throughout much of the ROWs as well as all forest types. Forbs and grasses comprise most of the diet in the spring and summer; shrubs are used in the winter and dry summer periods. During the summer, mule deer tend to rely on riparian, mixed mountain brush and forest communities. Movement corridors between Dry Lake Valley up into Lake and Cave valleys are crossed by the ROW.
- **Desert bighorn sheep (Figure 3.6-4) –** Occupied habitat for desert bighorn sheep overlaps with the ROWs in Pahranagat and Delamar valleys and is adjacent to the ROWs in Cave, Dry Lake, Coyote Spring, Garnet, Hidden Valley, and Las Vegas valleys. Potential desert bighorn habitat overlaps with the ROW in Spring and Steptoe valleys and is adjacent to the ROWs in Cave and Dry Lake valleys. All occupied desert bighorn sheep habitat is managed as priority habitat by the BLM on BLM managed lands (BLM 2008b). Migration corridors for desert bighorn sheep cross the ROWs in Las Vegas, Garnet, Hidden, and Coyote Spring valleys. Desert bighorn sheep movements and migration corridors are dynamic and occur in the ROW areas in Delamar and Coyote Spring valleys. Movement between Las Vegas Range and Arrow Canyon Range and Delamar Mountains and Sheep Range (NDOW 1978) are crossed by the ROW. More recent data indicate that the desert bighorn sheep distribution includes the Hiko and South and North Pahroc Ranges to the west of Dry Lake Valley, and Egan Range and Schell Creek Range. Potential habitat is currently being targeted by the NDOW for reintroduction of desert bighorn sheep to expand the occupied areas throughout the state. Desert bighorn sheep habitat typically consists of rough, rocky, and steep terrain, broken by canyons and washes. Bighorn sheep require access to water

during the summer and throughout the year during drought conditions. Their diet mainly consists of grasses, shrubs, and forbs. This species also is a BLM sensitive species, but for the purposes of this document it is addressed with the species of management concern in order to address all big game species together.

- **Rocky Mountain bighorn sheep (Figure 3.6-5) –** The ROWs are located adjacent to occupied habitat in Snake and Hamlin Valleys and adjacent to potential habitat in Spring Valley; however, the ROWs do not cross occupied or potential habitat. Rocky Mountain bighorn sheep prefer high, steep, rocky slopes that are close to suitable feeding sites. However, during the winter months, they will seek open areas in lower elevations where snow depth is lighter and food sources are more plentiful (UDWR 2008). Primary forage consists of grasses, forbs, and shrubs.

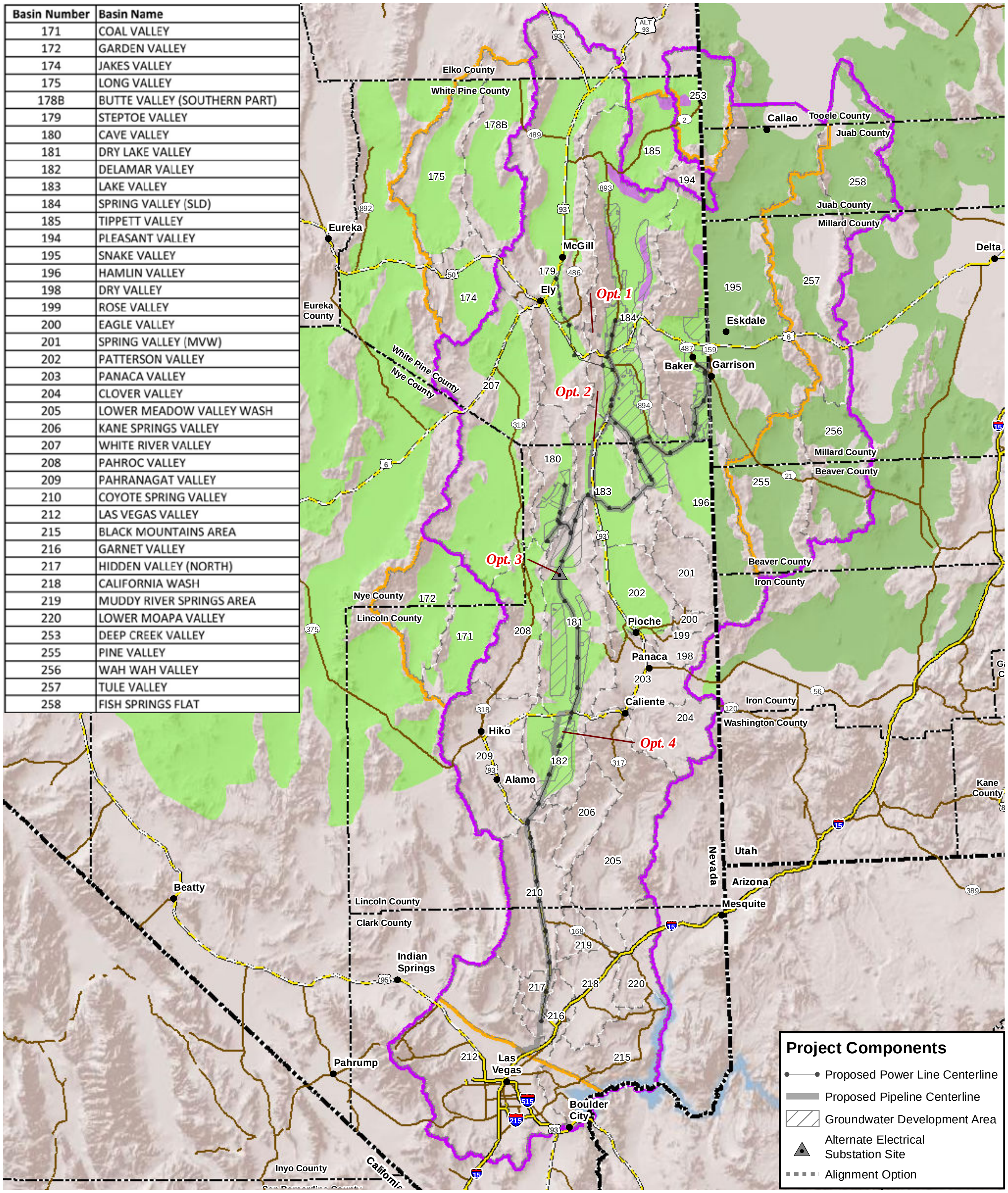
As reference for big game including antelope, elk, and mule deer, crucial winter range is used between November 1 through March 31, and crucial summer range is used between April 15 and late September (BLM 2008b). Within occupied desert bighorn habitat, the rut occurs from approximately August through September (NDOW 1978). Lambing can occur at any time of the year and is associated with favorable environmental conditions. However, lambs are normally dropped during late February or early March in Southern Nevada and during April or early May in Central Nevada (NDOW 1978). The BLM recommends a restriction on activity within bighorn sheep occupied habitat between March 1 to May 31 and July 1 through August 31 (BLM 2008b). Range information shown on **Figures 3.6-1** through **3.6-5** display NDOW (2004) data for antelope, elk and deer and NDOW (2010b) data for bighorn sheep.

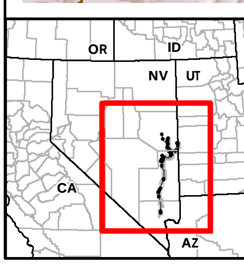
Of the representative species listed in **Appendix F**, **Table F3.6-1**, 35 small mammal species are known to occur or suspected to occur within basins crossed by the ROWs; 9 are species of management concern (brush mouse, desert kangaroo rat, desert pocket mouse, Inyo shrew, kit fox, Merriam's shrew, ringtail, vagrant shrew, and water shrew) and the remaining species are BLM sensitive. The BLM sensitive species are addressed in the Special Status Species section. When considering species range or habitat use, water shrew and Inyo shrew are unlikely to occur in the ROWs. Kit fox habitat occurs in all basins crossed by the ROWs (USGS 2007).

Of the five representative management concern raptor species, two were observed during winter raptor surveys (SNWA 2005-2008). Northern harrier was observed in the ROW in Cave and Delamar valleys and within 0.5 mile of the ROW in two additional valleys (Dry Lake and Spring). Klinger and Williams (2005) also reported an incidental siting of northern harrier within the project area. Prairie falcon was recorded in the ROW in Delamar Valley and also within Dry Lake and Spring valleys within the 0.5 mile buffer (GBBO 2007b, SNWA 2005-2008). The NDOW raptor nest database has no nest records for prairie falcon within the ROW or the 0.5-mile buffer. Within the 10-mile buffer, there are 14 nests in 5 valleys crossed by the ROW (Garnet, Las Vegas, Snake, Spring, and Steptoe); all but two were recorded between 1973 and 1981, with two nests in Las Vegas Valley recorded in 1997 and 2001. Flammulated owl is also suspected to occur in a number of the basins that would be crossed by the ROWs. Many other raptor species are likely to occur in habitats crossed by the ROWs; specific information on special status raptor species is addressed in the next section.

Upland game-bird species (including migratory species) within the ROWs include: greater sage-grouse, mourning dove, chukar, quail, and band-tailed pigeon. Greater sage-grouse, which is considered a BLM sensitive species, was petitioned for listing under the ESA. The species listing was found to be warranted but precluded, and the species has been designated a federal Candidate (Priority 8) species (Federal Register, March 5, 2010).This species is discussed in the Special Status Species section. Mourning dove has been documented in four of the valleys that would be crossed by the ROWs (Coyote Spring, Cave, Snake, and Spring valleys) and is likely to occur in all the valleys crossed by the ROWs. Band-tailed pigeon was recorded in Las Vegas Valley (GBBO 2007a) and could occur within the ROW in this area.

Basin Number	Basin Name
171	COAL VALLEY
172	GARDEN VALLEY
174	JAKES VALLEY
175	LONG VALLEY
178B	BUTTE VALLEY (SOUTHERN PART)
179	STEPTOE VALLEY
180	CAVE VALLEY
181	DRY LAKE VALLEY
182	DELAMAR VALLEY
183	LAKE VALLEY
184	SPRING VALLEY (SLD)
185	TIPPETT VALLEY
194	PLEASANT VALLEY
195	SNAKE VALLEY
196	HAMLIN VALLEY
198	DRY VALLEY
199	ROSE VALLEY
200	EAGLE VALLEY
201	SPRING VALLEY (MVW)
202	PATTERSON VALLEY
203	PANACA VALLEY
204	CLOVER VALLEY
205	LOWER MEADOW VALLEY WASH
206	KANE SPRINGS VALLEY
207	WHITE RIVER VALLEY
208	PAHROC VALLEY
209	PAHRANAGAT VALLEY
210	COYOTE SPRING VALLEY
212	LAS VEGAS VALLEY
215	BLACK MOUNTAINS AREA
216	GARNET VALLEY
217	HIDDEN VALLEY (NORTH)
218	CALIFORNIA WASH
219	MUDDY RIVER SPRINGS AREA
220	LOWER MOAPA VALLEY
253	DEEP CREEK VALLEY
255	PINE VALLEY
256	WAH WAH VALLEY
257	TULE VALLEY
258	FISH SPRINGS FLAT





Natural Resources Region of Study
Water Resources Region of Study
Interstate Highway
US Highway
Major Road
State Boundary
County Boundary
Hydrographic Basins

Pronghorn Habitat
Nevada
Crucial Winter
Year-round
Utah
Year-long Crucial

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.6-1

Pronghorn Habitat

0 10 20 40 60 Miles
0 15 30 60 Kilometers
1 inch equals 40 miles

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Basin Number	Basin Name
171	COAL VALLEY
172	GARDEN VALLEY
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215	BLACK MOUNTAINS AREA
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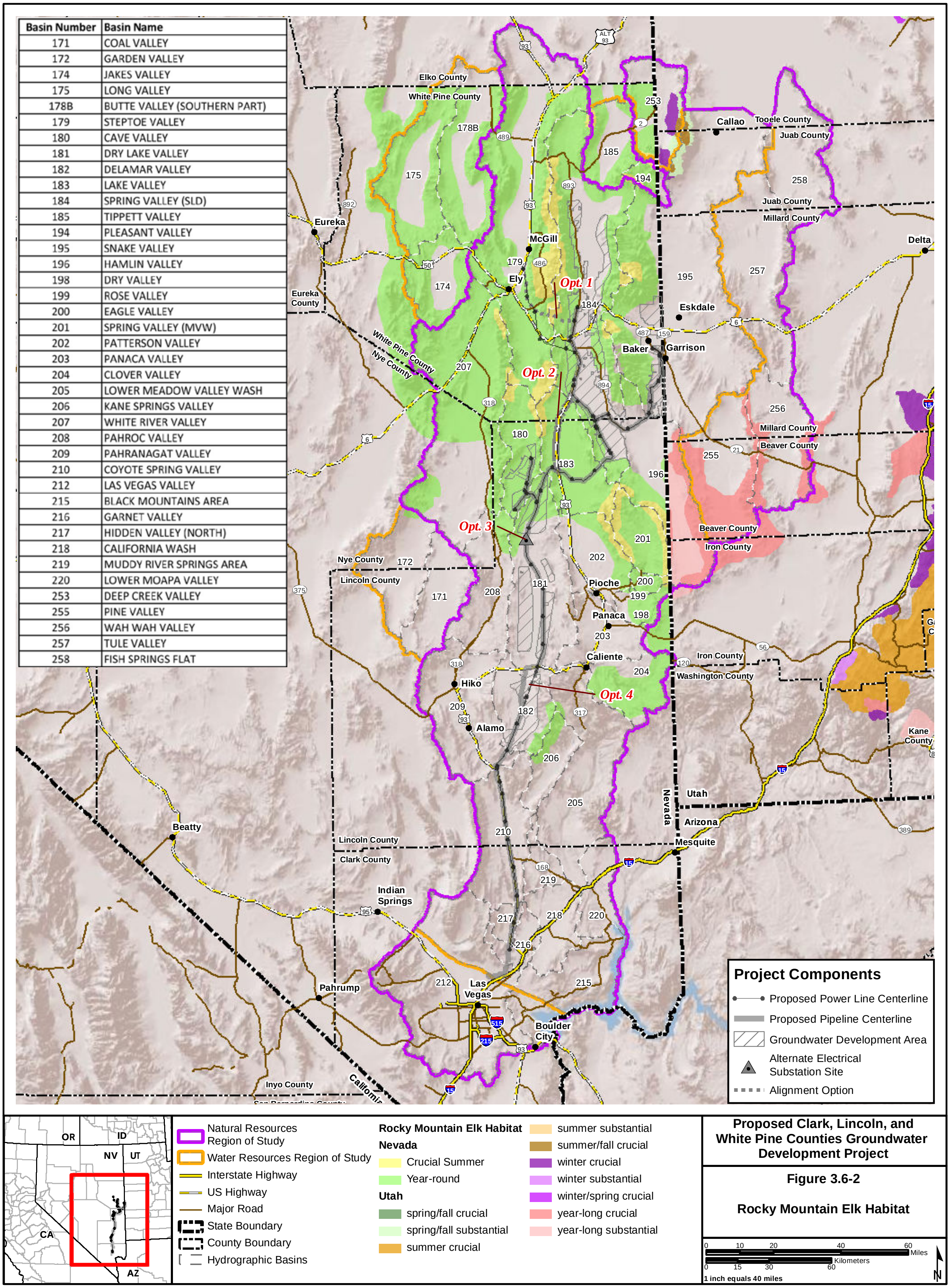
220	LOWER MOAPA VALLEY
253	DEEP CREEK VALLEY
255	PINE VALLEY
256	WAH WAH VALLEY
257	TULE VALLEY
258	FISH SPRINGS FLAT



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.6-2

Rocky Mountain Elk Habitat

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Basin Number	Basin Name
171	COAL VALLEY
172	GARDEN VALLEY
174	JAKES VALLEY
175	LONG VALLEY
178B	BUTTE VALLEY (SOUTHERN PART)
179	STEPTOE VALLEY
180	CAVE VALLEY
181	DRY LAKE VALLEY
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195	SNAKE VALLEY
196	HAMLIN VALLEY
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207	WHITE RIVER VALLEY
208	PAHROC VALLEY
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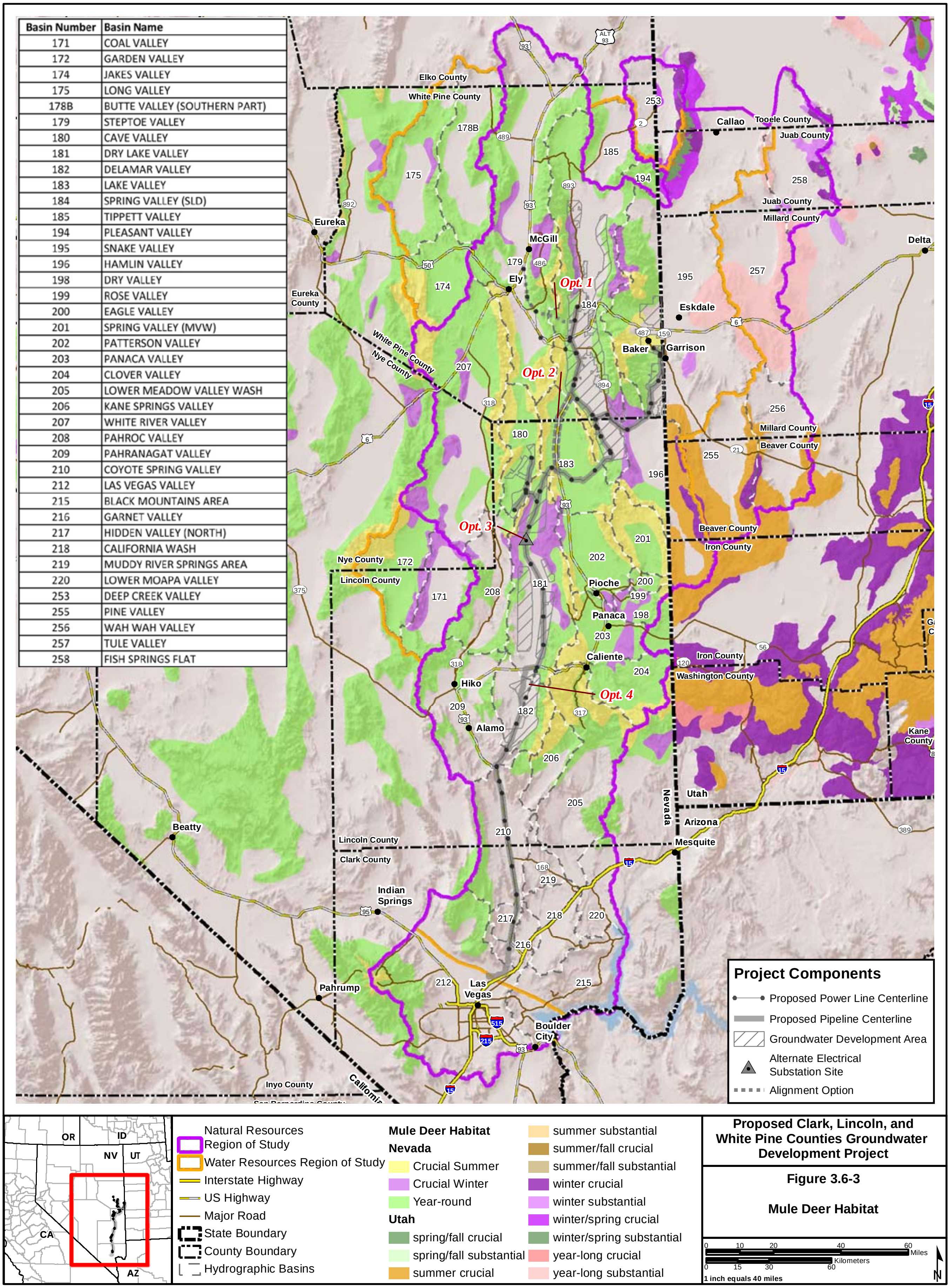
212	LAS VEGAS VALLEY
215	BLACK MOUNTAINS AREA
216	GARNET VALLEY
217	HIDDEN VALLEY (NORTH)
218	CALIFORNIA WASH
219	MUDDY RIVER SPRINGS AREA
220	LOWER MOAPA VALLEY
253	DEEP CREEK VALLEY
255	PINE VALLEY
256	WAH WAH VALLEY
257	TULE VALLEY
258	FISH SPRINGS FLAT



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Basin Number	Basin Name
171	COAL VALLEY
172	GARDEN VALLEY
174	JAKES VALLEY
175	LONG VALLEY
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184	SPRING VALLEY (SLD)
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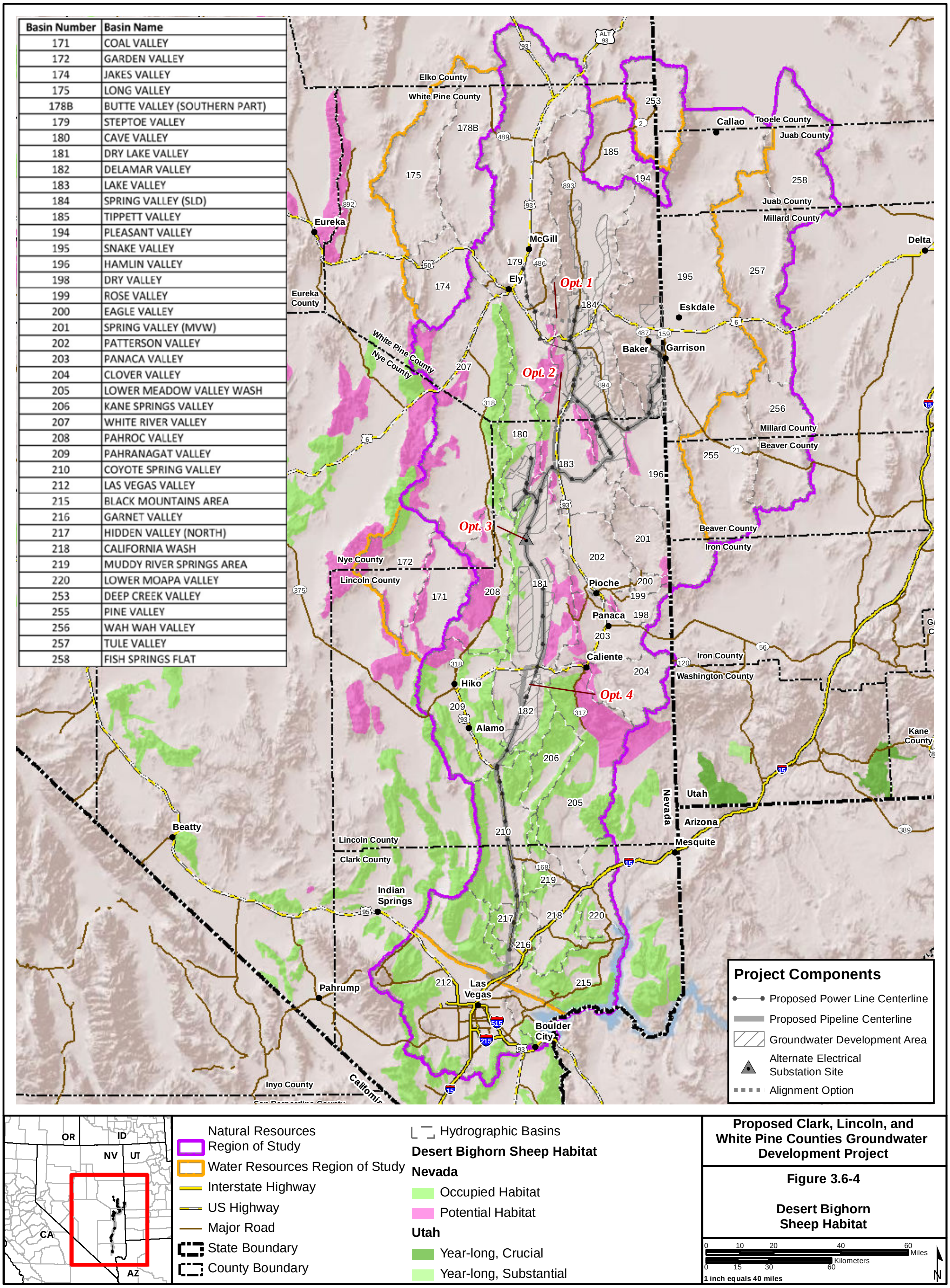
257	TULE VALLEY
258	FISH SPRINGS FLAT

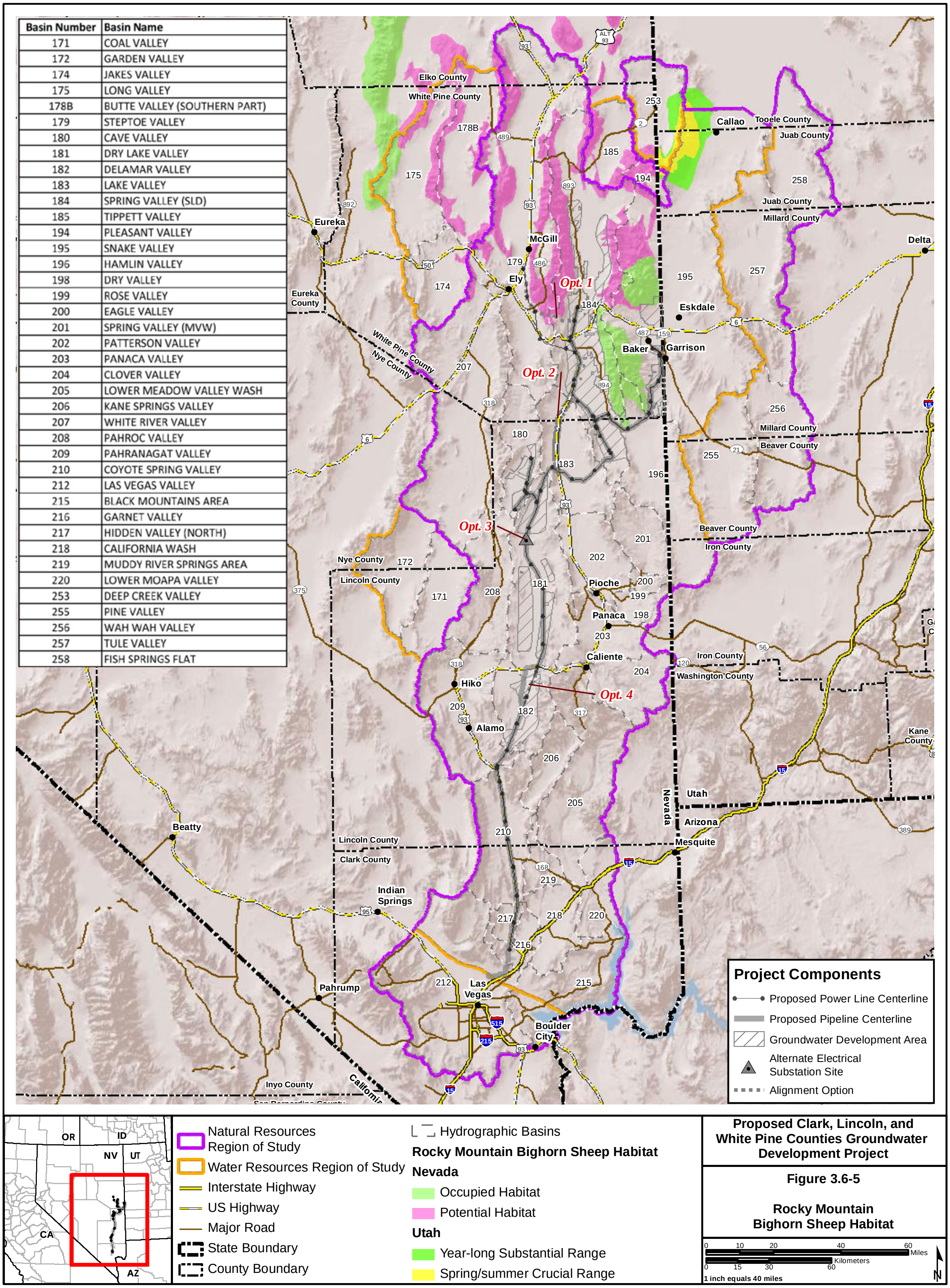


Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.6-4

Desert Bighorn Sheep Habitat

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.



Basin Number	Basin Name
171	COAL VALLEY
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218	CALIFORNIA WASH
219	MUDDY RIVER SPRINGS AREA
220	LOWER MOAPA VALLEY
253	DEEP CREEK VALLEY
255	PINE VALLEY
256	WAH WAH VALLEY
257	TULE VALLEY
258	FISH SPRINGS FLAT

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.6-5

Rocky Mountain Bighorn Sheep Habitat

No waterfowl species of management concern have been documented along the ROWs, although the majority of these species have been documented or are suspected of occurring in at least one of the ROW basins. Marshlands comprise less than 1 percent of the land cover types crossed by the ROW. See Section 3.5, Vegetation Resources, for cover types in the ROW (**Table 3.5-1**).

Some of the more common migratory bird species that occur within the ROW include the neotropical migrants and raptors that are listed in **Appendix F**, **Table F3.6-1**. Additional migratory birds are included in the discussion of special status wildlife species. Based on **Table 3.5-1** in Vegetation Resources, the following list includes cover types and some management concern migratory bird species that are associated with these habitats. The cover types are listed in order of percent occurrence of this vegetative cover in the ROW within this cover type. The last four are habitats of interest that make up less than 1 percent of the ROW collectively:

- **Sagebrush shrubland** (48 percent) – sage sparrow and vesper sparrow;
- **Mojave mixed desert scrub** (25 percent) – cactus wren, crissal thrasher, Bendire's thrasher, and Le Conte's thrasher;
- **Greasewood/Salt Desert Shrubland** (24 percent) – sage sparrow;
- **Pinyon-juniper woodland** (2 percent) – black-throated gray warbler and gray vireo;

Less than 1 percent of the ROW collectively:

- **Marshland** – American avocet, mallard, Canada goose, Wilson's phalarope, willet, northern pintail, and common yellowthroat;
- **Perennial grassland –** grasshopper sparrow, vesper sparrow, horned lark, and boblink;
- **Playa** – American avocet; and
- **Riparian –** Canada goose, Costa's hummingbird, red-naped sapsucker, Williamson's sapsucker, bell's vireo, common yellowthroat, and yellow warbler.

There is one important bird area, Lower Meadow Valley Wash, which overlaps with the construction support site near Caliente (Lower Meadow Valley Wash Valley). The Pahranagat Valley Complex important bird area is approximately 0.2 mile to the west of the ROW in Pahranagat Valley, but it is not crossed by the ROW.

Special Status Wildlife Species

Special status wildlife species' occurrence data were reviewed for the ROWs and are identified in **Appendix F**, **Table F3.6-1**. The terrestrial wildlife species that are identified as special status in this section are federally threatened, endangered, or proposed, under the ESA, or considered sensitive by the BLM or USFS (note that only Alignment Option 1 crosses USFS lands). Information on section 7 consultation with BLM is addressed in Chapter 1. Habitat and life-history information for these species is provided in **Appendix F**, **Table F3.6-3**. Special status wildlife species or groups that are known to occur along the ROWs include desert tortoise, pygmy rabbit, greater sage-grouse, western burrowing owl, other special status raptors (golden eagle, bald eagle, ferruginous hawk,), other special status birds, ten bat species, dark kangaroo mouse, reptiles, and Mojave poppy bee. The following information summarizes the occurrence of these species within the ROWs. (The desert bighorn sheep is discussed under the species of management concern.) See **Appendix F**, **Table F3.6-1** for species status.

- **Desert Tortoise (Federally Threatened) –** The proposed ROWs cross habitat for one federally listed species, Agassiz's desert tortoise (desert tortoise), in five basins (Las Vegas, Garnett, Hidden Valley, Coyote Spring, and Pahranagat valleys). A portion of the tortoise habitat in this area has been designated as critical habitat for the desert tortoise and occurs in the Mormon Mesa Critical Habitat Unit of the Northeastern Mojave Recovery Unit (USFWS 1994a). There are 1,759 acres of critical habitat and 591 acres of non-critical habitat within project ROWs. According to the USFWS, tortoise densities are least abundant in the Northeast Mojave Recovery Unit (0.65–2.32 tortoises per square mile) compared to the other five recovery units, meaning low tortoise densities (USFWS 2006). Of the seven ACECs created by the Ely and Las Vegas BLM RMPs for the protection of desert tortoise, two (Coyote Spring and Kane Spring ACECs) overlap the proposed ROWs. **Figure 3.6-6** displays USFWS critical habitat as well as USGS modeled potential habitat (Nussear et al 2009) for this species.

Many project-specific surveys have been conducted in the ROWs for ESA section 7 compliance with the USFWS. In general, the highest densities of tortoise sign were observed from Hidden Valley south to Las Vegas Valley. Densities of desert tortoise along the ROWs ranged from 0 to 45 along most of the ROWs, with one site recording 46 to 90 tortoises per square mile (Wildland International 2009).

The Fish and Wildlife Service created a team in 1990 to develop a plan that would direct the recovery of the desert tortoise. A team was created of nationally recognized scientists in desert tortoise biology, conservation biology, desert ecology, and disease of reptiles. The main goals of the recovery plan are to eliminate or reduce the threats existing to the desert tortoise and restore a wild population that can be self-sustaining and can be removed from the Endangered Species list. The Desert Tortoise (Mojave Population) Recovery Plan, June 1994 was then completed.

Due to the fact that much new information has become available and will likely result in changes to the recovery strategy for the desert tortoise, it was determined the 1994 plan needed to be revised. In 2003, the Desert Tortoise Recovery Plan Assessment Committee was appointed by the USFWS to conduct a comprehensive assessment of the Recovery Plan. In 2004, the Committee completed its assessment and prepared a report of its findings and recommendations. A draft of the final revised plan was completed and published for the comment period that started in August 2008 and ended in November 2008. The Revised Recovery Plan for the Mojave Population of the Desert Tortoise (*Gopherus agassizii*) was signed on May 6, 2011.

The 2011 Recovery Plan has developed actions that are designed to improve the 1994 Recovery Plan, as listed below:

1. Develop, support, and build partnerships to facilitate recovery.
2. Protect existing populations and habitat, instituting habitat restoration where necessary.
3. Augment depleted populations in a strategic manner.
4. Monitor progress toward recovery.
5. Conduct applied research and modeling in support of recovery efforts within a strategic framework.
6. Implement a formal adaptive management program.

The recovery plan's goals are recovery and delisting of the desert tortoise. Recovery criteria should include the management or elimination of threats, addressing the six statutory (de-)listing factors listed above.

- **Greater Sage-grouse (Federal Candidate) –** Aerial and ground surveys that were conducted along the ROWs by SNWA (2007c) documented active greater sage-grouse leks in two valleys (Cave and Spring valleys). Additional active greater sage-grouse leks in Spring Valley were documented by the SNWA during a greater sage-grouse telemetry study (SNWA 2009a). The 2008 greater sage-grouse NDOW database identified active leks in Cave, Lake, Snake, Spring, Hamlin, and Steptoe valleys. **Figure 3.6-7** displays active, inactive, unknown, and historic leks, while **Figure 3.6-8** displays sage-grouse preliminary priority habitat (PPH) and preliminary general habitat (PGH). Thirty-one leks were identified within 4 miles of the proposed ROW. Of the 31 leks identified, 19 are considered active. Four of the 19 active lek sites were found within the Spring/Snake Valley population management unit (PMU) and within Spring Valley in White Pine County. These leks contained male counts ranging from 3 to 20 males in attendance. One active lek was found within the Spring/Snake Valley PMU unit within Snake Valley, with 5 males in attendance. Five active leks were found within the Cave PMU within Cave Valley, with male counts ranging from 0 to 24 males in attendance. Four active leks were found within the Lincoln PMU; two within Spring Valley with male counts ranging from 0 to 7 males in attendance, and two within Lake Valley with a male counts ranging from 0 to 2 males in attendance. Four active leks were found within the Steptoe/Cave PMU (Steptoe Valley), with male counts ranging from 0 to 3 males in attendance. One active lek was found within the Schell/Antelope PMU (Steptoe Valley), with 4 males in attendance.

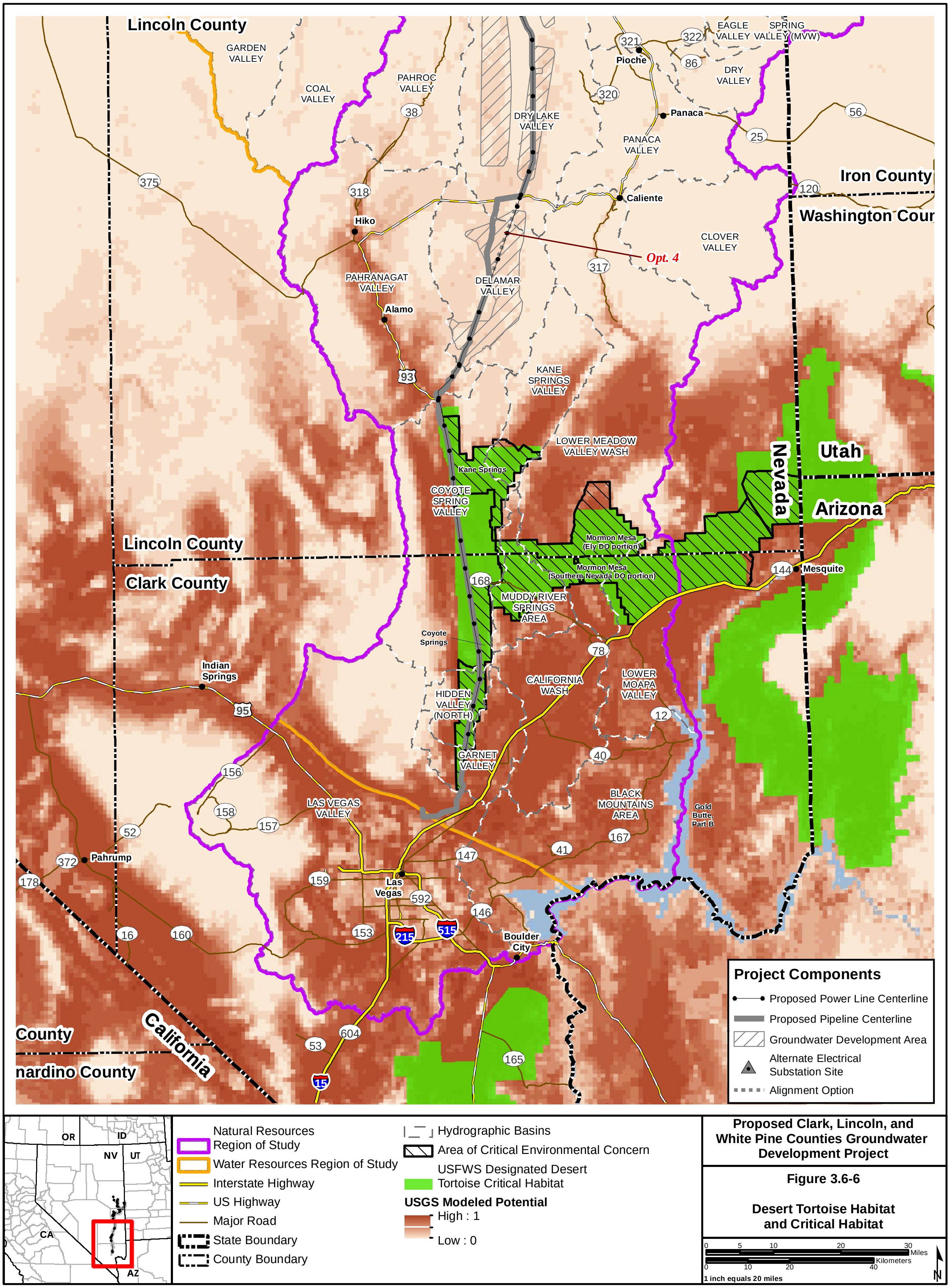
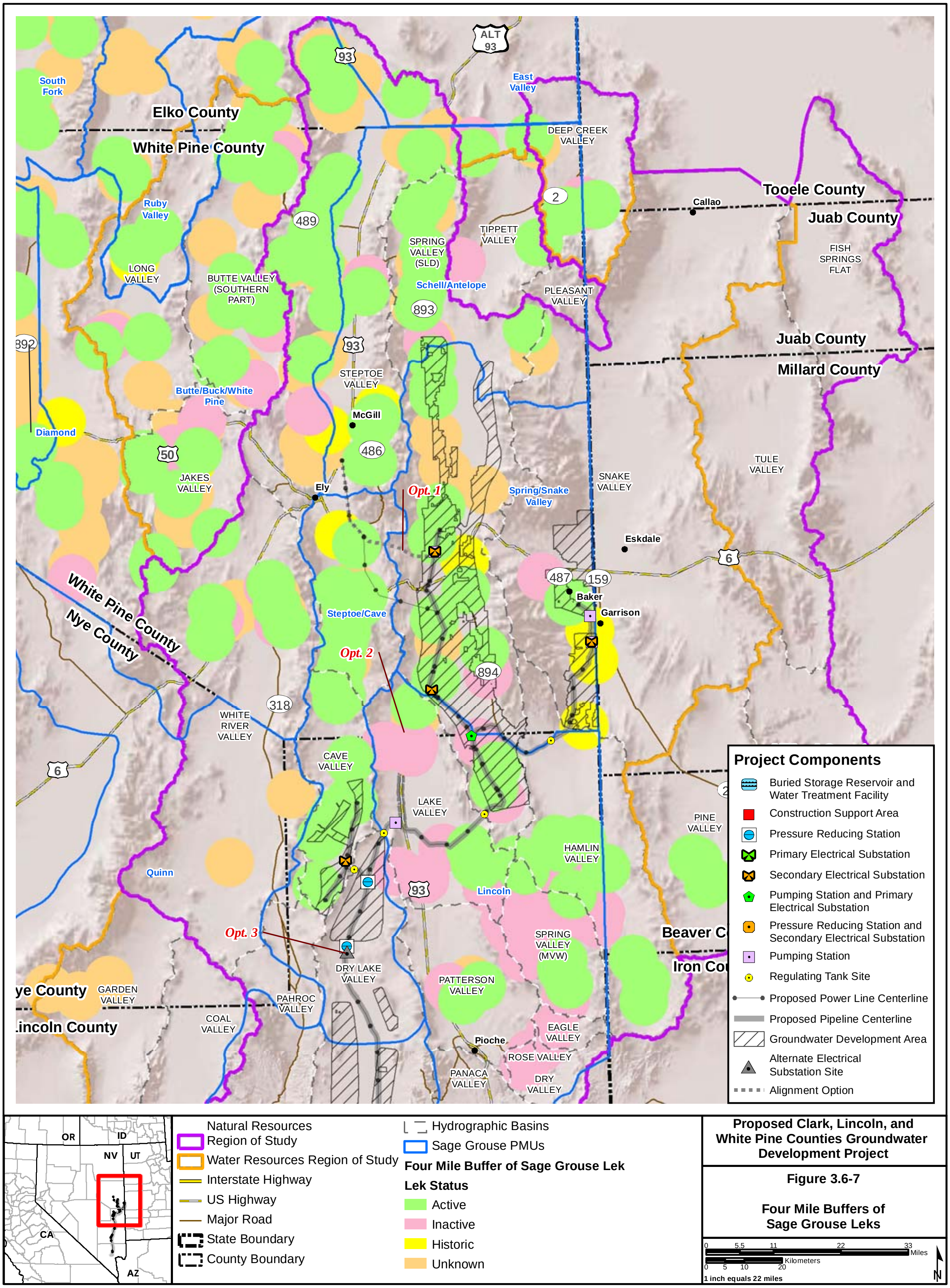


Figure 3.6-6
Desert Tortoise Habitat and Critical Habitat

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.6-7

Four Mile Buffers of Sage Grouse Leks

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

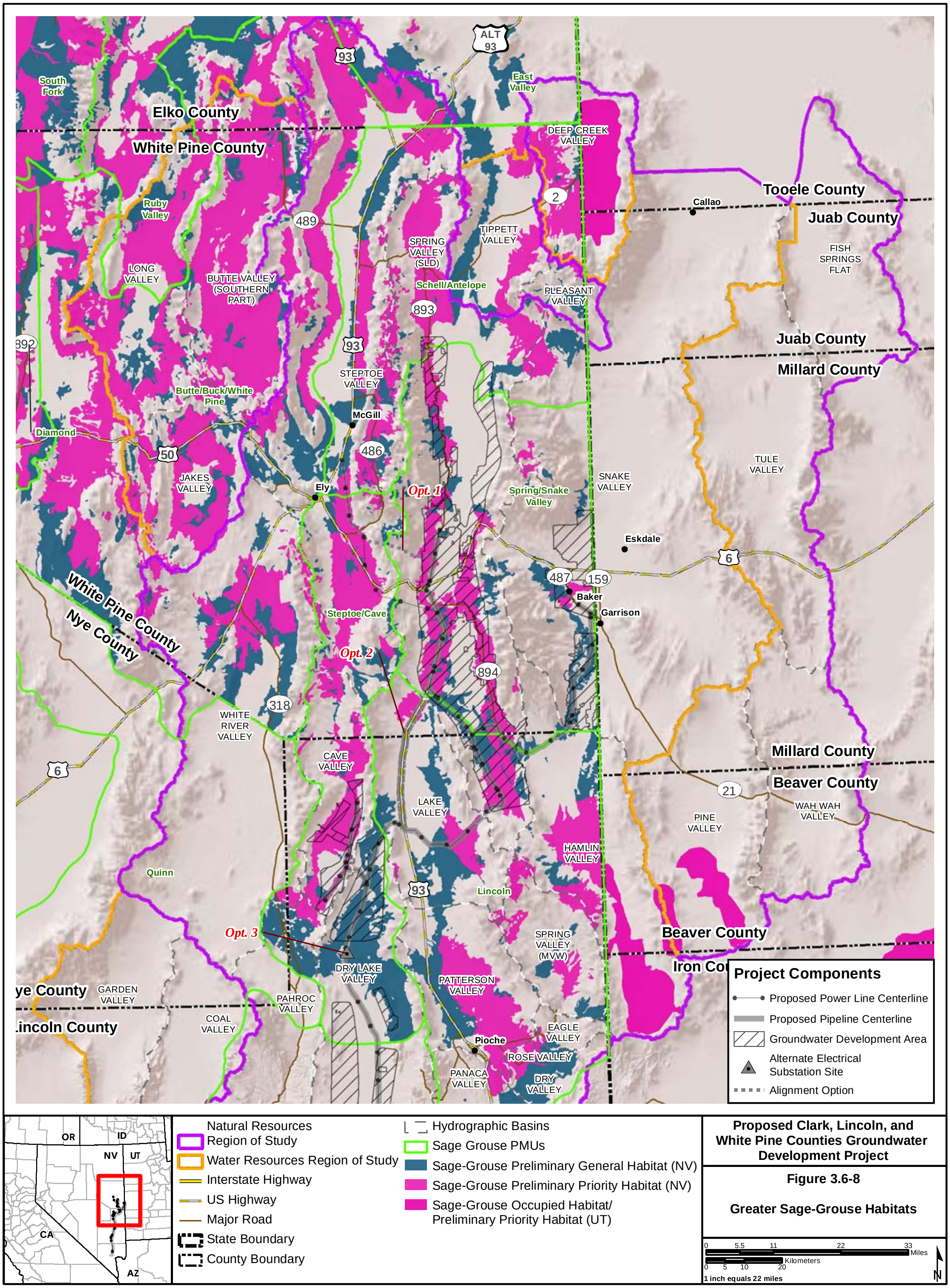


Figure 3.6-8

Greater Sage-Grouse Habitats

Greater sage-grouse typically occupy sagebrush communities, breeding in relatively open lek sites (or strutting grounds). Leks are established in open areas, 0.2 to 12 acres in size. Nesting habitat is characterized primarily by Wyoming big sagebrush communities with a 15- to 38-percent canopy cover and a grass-forb understory (NDOW and California Department of Fish and Game 2004). On average, most nests occur within 4 miles of a lek site; however, nesting habitat may occur at greater distances from a lek site for migratory populations (Connelly et al. 2000). Early brood-rearing generally occurs close to nest sites. Optimum brood-rearing habitat consists of sagebrush stands that are 16 to 32 inches tall, with a canopy cover of 10 to 25 percent and an herbaceous understory consisting of grass and forb species (BLM 2000). Sage-grouse breeding/nesting season occurs from March to May (BLM 2000) and brood rearing season falls between April and August.

Summer habitat consists of sagebrush mixed with areas of wet meadows, riparian habitat, or irrigated agriculture fields. As habitat begins to dry up, greater sage-grouse broods move to more mesic habitat, such as wet meadows, where succulent grasses and insects are still available. In Nevada, greater sage-grouse rely on wet areas for their survival, because Nevada typically receives less precipitation than other states. Fall habitat in northeastern Nevada consists of a mosaic of low-growing sagebrush and Wyoming big sagebrush. In both Nevada and Utah, it is crucial that sagebrush be exposed at least 10 to 12 inches above snow level for wintering greater sage-grouse. Sagebrush is the primary food source of adult greater sage-grouse; however, forb species are an important food source in spring and early summer and improve successful reproduction in females. Numerous forb species also enhance nest concealment and relative nest success (Wambolt et al. 2002). See **Table F3.6-3** in **Appendix F3.6** for additional life history and habitat requirement information.

In March 2012, NDOW prioritized greater sage-grouse habitat based on the best available data (lek observations, telemetry locations, survey and inventory reports, vegetation cover, soils information, and aerial photography). Greater sage-grouse habitat was categorized into the following five NDOW Categories:

1. Essential/Irreplaceable habitat,
2. Important habitat,
3. Habitat of moderate importance,
4. Low value habitat and transitional range, and
5. Unsuitable habitat.

In conformance with BLM Washington Office IM 2012-043 for Greater Sage-grouse Interim Management Policies and Procedures (BLM 2011a), the BLM Nevada identified NDOW Categories 1 and 2 as PPH and NDOW Category 3 as PGH. These designations of PPH and PGH will remain in effect until BLM completes the greater sage-grouse land use planning process in accordance with IM 2012-044 BLM National Greater Sage-grouse Land Use Planning Strategy and Attachment 1 (BLM 2011b) in 2014. At that time, BLM will refine PPH and PGH to:1) identify Priority Habitat to conserve and/or improve greater sage-grouse habitat functionality, and 2) identify General Habitat that provides for major life history functions in order to maintain genetic diversity needed to sustain greater sage-grouse populations. IM 2012-043 also directs the BLM to evaluate ROW applications, and if the BLM decides to authorize a project that will disturb greater than 1 linear mile or 2 acres the following process must be used:

- Require the ROW holder to implement measures to minimize impacts to sage-grouse habitat.
- In addition to onsite mitigation, the BLM will, to the extent possible, cooperate with the project proponents to develop and consider offsite mitigation that the BLM, coordinating with the respective state wildlife agency, determines would avoid or minimize habitat and population-level effects.
- Unless the BLM, in coordination with the respective state wildlife agency, determines the proposed project and mitigation measures would cumulatively maintain or enhance sage-grouse habitat, the proposed ROW decision must be forwarded to the BLM State Director, State Wildlife Agency Director, and USFWS representative for review.

IM 2012-043 further directs the BLM to evaluate the need for proposed fences, particularly those that are within 1.25 miles of leks that have been active in the last 5 years and in movement corridors between leks and roost locations.

- **Raptors** – Additional special status raptor species (golden eagle and ferruginous hawk) have been observed within or near the ROWs. Bald eagle is also addressed here in the raptors discussion.
  - Golden eagle has been recorded in the ROWs during winter surveys in Delamar, Dry Lake, Hamlin, and Spring valleys and also within the 0.5 mile buffer of the ROW in Steptoe Valley (GBBO 2007b; SNWA 2005-2008). NDOW's raptor nest database (2011) was searched for nest sites within the ROWs, as well as a 0.5 mile and 10 mile buffer of the ROWs. There is one golden eagle nest site recorded in 1978 that occurs within the 0.5 mile buffer in Pahranagat Valley. There are 13 nest sites recorded in the 10 mile buffer. Three of the 13 nests are located in Dry Lake Valley and were recorded in 2007; the remaining 10 nests were recorded in Hamlin, Pahranagat, Spring, and Steptoe valleys prior to 1981. NDOW surveys specific to the proposed project ROW found no golden eagle nests in the ROWs or with a 0.5 mile buffer (Klinger and Williams 2005). This species is protected under the Bald and Golden Eagle Protection Act (BGEPA). Habitat and life-history information for this species and subsequent species mentioned in this section is provided in **Appendix F**, **Table F3.6-3**.
  - Ferruginous hawk has been recorded during winter surveys within 0.5 mile of the ROWs in Delamar, Dry Lake, and Spring valleys (GBBO 2007b, SNWA 2005-2008). The NDOW raptor nest database has records of 6 nests in the ROWs in Hamlin and Spring valleys, all recorded before 1984. Within the 0.5-mile buffer, there are 40 nests recorded between 1977 and 1992 in Hamlin, Snake, Spring, and Steptoe valleys. There are 161 nests recorded within the 10-mile buffer recorded between 1976 and 1992. GWD Project-specific nest surveys conducted by the NDOW in 2005 found no active ferruginous hawk nests within the ROWs and 2 active nests within the 0.5-mile buffer, 1 each in Hamlin and Spring valleys (Klinger and Williams 2005).
  - Bald eagle is not known to nest in eastern Nevada (Floyd et al. 2007), but it does winter in basins crossed by the ROW. It has been recorded during winter surveys in Hamlin, Spring, and Snake valleys, but more than 0.5 mile outside the ROWs. This species is protected under the BGEPA.
  - Other special status raptor species that may be in the ROW include Swainson's hawk, peregrine falcon, and northern goshawk. See **Table F3.6-3** in **Appendix F** for life history and habitat requirement information on special status raptors.

- **Western Burrowing Owl** – This species has been recorded in or near the ROWs in seven valleys: Las Vegas, Coyote Spring, Delamar, Dry Lake, Hamlin, Snake, and Spring valleys (Wildland International 2007, 2009; NNHP 2011). There were 8 burrowing owl burrows recorded in 2003 (NNHP 2011) within 0.5 mile of the ROW; all in Las Vegas Valley. NDOW's raptor nest database has 4 burrows recorded within the 10 mile buffer; 2 each in Dry Lake and Spring valleys recorded between 1977 and 2000. Burrowing owls have been sighted throughout the state of Nevada, primarily breeding in salt desert scrub, Mojave shrub, and in some sagebrush habitat. They also are known to breed around the fringes of agricultural lands, using croplands and pasture lands for foraging during the breeding season. Burrowing owl dens can be very diverse with several tunnels and owl entrance and exit burrows. Burrowing owls winter most frequently in the southern half of Nevada but have been recorded throughout the state during all months (Klute et al. 2003). Population status and trends are not well understood for this species (GBBO 2010). See **Table F3.6 3** in **Appendix F** for additional life history and habitat requirement information. This species is discussed separately from other raptors throughout Section 3.6 because it nests in burrows.
- **Additional Special Status Bird Species –** Similar to the species addressed in the management concern section, a list of special status species associated with the various cover types from **Table 3.5-1** is provided below. See the management concern species section for information on important bird areas crossed and near the ROWs and **Table F3.6-3** in **Appendix F** for life history and habitat requirement information on other special status birds.
  - Sagebrush shrubland (48 percent) – loggerhead shrike and Brewer's sparrow;
  - Mojave mixed desert scrub (25 percent) – loggerhead shrike;
  - Greasewood/Salt Desert Shrubland (24 percent) – loggerhead shrike and Brewer's sparrow;
  - Pinyon-juniper woodland (2 percent) – pinyon jay;

Less than 1 percent of the ROW collectively:

- Marshland – western snowy plover;
- Perennial grassland – long-billed curlew;
- Playa – western snowy plover; and
- Riparian – common yellowthroat.

- **Pygmy Rabbit –** The project ROW crosses into the southern extent of the species' range (Himes and Drohan 2007). This species was observed in the ROWs within five basins (Dry Lake, Cave, Lake, Steptoe, and Spring valleys) (SNWA 2009a, 2007b). Pygmy rabbit also has been recorded in Dry Lake and Lake valleys during previous surveys (NNHP 2006). The species also has a reasonable expectation of occurrence in Hamlin Valley based on best available knowledge by wildlife management agencies; however, it has not been recorded in the ROWs. The majority of overlap of this species within the ROWs is in Spring Valley, although signs of pygmy rabbit have been observed throughout the northern portion of the ROWs.

Habitat includes broad valley floors, drainage bottoms, alluvial fans, and other areas with friable soils that are usually associated with rabbitbrush or sagebrush vegetation (SNWA 2007b). Generally, pygmy rabbits burrow in dense sagebrush areas with loamy soils that are deeper than 20 inches (Roberts 2001). Pygmy rabbits typically inhabit dense stands of big sagebrush growing in deep, loose soils. The understory of grasses and forbs in the habitat varies from sparse to dense. This species digs its own burrow, 4 to 10 inches in diameter (Ulmschneider et al. 2004) and deeper than 20 inches, primarily in loamy soils among taller and denser big sagebrush. However, other subspecies of sagebrush may be used as well (SNWA 2007b). Big sagebrush is the primary food source, but grasses and forbs are also consumed in mid- to late summer.

The species can be active during the entire year throughout the day and night, but generally tend to be active during twilight. The breeding period extends from spring to early summer.

- **Bats** – Ten bat species have been recorded in or near the ROWs (big brown, Brazilian free-tailed, California myotis, fringed myotis, hoary bat, long-eared myotis, long-legged myotis, pallid bat, western pipistrelle, and western small-footed myotis). Additional special status bat species have been identified as having reasonable expectation of occurrence based on best available knowledge by wildlife management agencies within basins crossed by the ROWs (ENSR/AECOM 2008) (**Appendix F**, **Table F3.6-1**). See **Table F3.6-3** in **Appendix F** for more information on life history and habitat requirements of these bat species.
- **Dark Kangaroo Mouse –**The NDOW has records of the species dark kangaroo mouse in ROWs in Cave, Dry Lake, Hamlin, and Spring valleys. Generally, the dark kangaroo mouse inhabits areas with loose sands and gravel, and may occur in sand dunes near the margins of its range. It is found in shadscale scrub, sagebrush scrub, and alkali sink plant communities in the Upper Sonoran life zone (Wildlife Action Plan Team 2006). This species primarily feeds on seeds, but it may also consume insects. It does not appear to utilize surface water. Food is likely stored in seed caches within burrow systems. The species is active from March through October. Peak nocturnal activity occurs during the first 2 hours after sunset. Activity level is influenced by ambient temperature and moonlight. Individuals remain underground in burrows when inactive and are believed to hibernate. The majority of young are born in May and June, with litter size ranging from two to seven (O'Farrell 1974). The range of the pale kangaroo mouse, another special status species, falls outside of ROW areas (USGS 2007).
- **Reptiles –** The banded Gila monster has been observed in a number of the basins crossed by the ROWs (Coyote Spring, Garnet, Hidden Valley, Las Vegas, and Pahranagat valleys). Common chuckwalla also is found in these same valleys and was recorded along a power line ROW in Coyote Spring Valley. Mojave Desert sidewinder has been recorded in the ROW in Coyote Springs Valley. These species are known or suspected within or near ROWs. The types of vegetation communities that these species inhabit include desert grassland, Mojave and Sonoran desert scrub, and thorn scrub (NatureServe 2010). See **Table F3.6-3** in **Appendix F** for more information on life history and habitat requirements of these special status reptile species.
- **Terrestrial Invertebrates** – Based on January 2010 Nevada Natural Heritage data and the Ecological Sciences, Inc. (2007) study, there are five BLM sensitive terrestrial invertebrate species that occur in valleys crossed by the

ROWs. These species are the White River wood nymph (Lake Valley), Baking Powder Flat blue butterfly (Spring Valley), Mojave poppy bee (Coyote Spring Valley), Steptoe Valley crescentspot (Steptoe Valley), and Koret's checkerspot (Snake, Spring, and Steptoe valleys). Of these invertebrate species, only the Mojave poppy bee (Coyote Spring Valley) has been recorded within the ROWs. The Mojave poppy bee only utilizes plants in the poppy family for pollen (Tepedino 2000). See **Table F3.6-3** in **Appendix F** for more information on life history and habitat requirements of these special status species.

Alignment Options 1 through 4

Wildlife resources within the four alignment alternatives (Alignment Options 1 through 4) are summarized in the following sections. The dominant types of wildlife habitat are noted, as well as any differences in wildlife use for the alignment alternatives, compared to the Proposed Action segment. Additionally, based on surveys that were conducted by Wildland International (2009, 2007), special status wildlife species that could occur within or near the alignment Alternatives (F through I) include the following:

- **Alignment Option 1 (Humboldt-Toiyabe Power Line) –** This alternative would align a segment of the proposed power line adjacent to other existing power lines across the Humboldt-Toiyabe National Forest rather than create a new corridor for the power line to the south. Habitat consists of higher-elevation montane shrubland, compared to Great Basin pinyon-juniper woodland and xeric sagebrush shrubland along the Proposed Action segment. This alternative contains potential Rocky Mountain bighorn sheep and elk crucial summer range, which are not present along the Proposed Action segment. This alignment would avoid passing within 4 miles of 3 active leks as compared to the the Proposed Action alignment. Special status species include pinyon jay and Brewer's sparrow.
- **Alignment Option 2 (North Lake Valley Pipeline and Power Line) –** Habitat mainly consists of big sagebrush shrubland and grassland (the same as the Proposed Action). Big-game ranges are the same as those that would be crossed by the Proposed Action. This alternative passes within 4 miles of 1 additional active greater sage-grouse lek sites as compared to the Proposed Action. Special status species include long-billed curlew, pygmy rabbit, and White River wood nymph (Lake Valley). Little information on habitat is known about the White River wood nymph subspecies (see **Table F3.6-1** in **Appendix F** for additional information on the White River wood nymph).
- **Alignment Option 3 (Muleshoe Substation and Power Line) –** The predominant habitat is mixed desert shrubland (the same as the Proposed Action). This alternative would avoid passing within 4 miles of 5 active greater sage-grouse lek sites in Steptoe Valley, as compared to the Proposed Action. Special status species include pygmy rabbit, western burrowing owl, pinyon jay, and Brewer's sparrow.
- **Alignment Option 4 (North Delamar Valley Pipeline and Power Line) –** Habitat is dominated by big sagebrush shrubland and desert shrub steppe (the same as the Proposed Action). Special status species include the western burrowing owl. This alternative is the same as the Proposed Action with regard to impacts to active sage-grouse leks.

3.6.1.3 Groundwater Development Areas

Groundwater development areas are proposed in five basins: Snake, Spring, Delamar, Dry Lake, and Cave valleys. There are no groundwater development areas in Utah.

Species of Management Concern

Five big game mammals of management concern are known to occur within the groundwater development areas. Range information shown on **Figures 3.6-1** through **3.6-5** is based on the NDOW (2004, 2010b). Overlap between bighorn sheep habitat and groundwater development areas are shown, but given that habitat for bighorn sheep is generally at higher elevations and groundwater development facilities will most likely be placed in valleys, overlap when actual future groundwater facilities are proposed is not anticipated. The following big game species are found in the groundwater development project areas:

- **Pronghorn Antelope (Figure 3.6-1) –** Year-round range for antelope overlaps all of the groundwater development areas. Crucial winter range is crossed by the groundwater development areas in Spring Valley.

- **Rocky Mountain Elk (Figure 3.6-2) –** Year-round elk range overlaps with the groundwater development areas in Dry Lake, Cave, Snake, and Spring valleys.
- **Mule Deer (Figure 3.6-3) –** Year-round mule deer range overlaps with all five of the groundwater development areas. Crucial summer range occurs in Cave, Dry Lake, Spring, and Snake valleys; crucial winter range overlaps the groundwater development areas in Dry Lake and Spring valleys.
- **Desert Bighorn Sheep (Figure 3.6-4) –** Occupied habitat occurs within the groundwater development areas in Dry Lake, Delamar, and Cave valleys. Potential habitat overlaps the groundwater development areas in Cave, Delamar, and Spring valleys.
- **Rocky Mountain Bighorn Sheep (Figure 3.6-5) –** Occupied and potential habitat for Rocky Mountain bighorn sheep overlaps the groundwater development areas in Spring and Snake valleys.

Of the nine small mammals of management concern, five may occur in groundwater development areas (Merriam's shrew, vagrant shrew, brush mouse, kit fox, and ringtail). Given species range or habitat use, water shrew, Inyo shrew, desert kangaroo rat, and desert pocket mouse are unlikely to occur in groundwater development areas. GWD Project-specific surveys have recorded dark kangaroo mouse in groundwater development areas in Dry Lake, Cave, and Spring valleys. Kit fox habitat occurs in groundwater development areas in all five basins (USGS 2007).

One of the representative raptor species of management concern, the northern harrier, was recorded within groundwater development areas in all five basins (SNWA 2005-2008) and an active nest site (NDOW 2011) was recorded within a groundwater development area in Spring Valley. Flammulated owl has been recorded in groundwater development areas in Spring and Snake valleys and short-eared owl has been recorded in a groundwater development area in Spring Valley. Prairie falcon has been recorded during winter surveys in groundwater development areas in Delamar, Dry Lake, and Spring valleys (GBBO 2007b; SNWA 2005-2008); and also in Snake Valley in the 0.5-mile groundwater development area buffer. The NDOW raptor nest database has 3 prairie falcon nest records from Snake and Spring valleys, all recorded prior to 1980 within the groundwater development areas. There are an additional 4 nests in the 0.5-mile buffer; all 4 recorded before 1982 within the same 2 valleys. The 10-mile groundwater development area buffer has records for 18 nests in five basins (Pahroc, Snake, Spring, Steptoe, and White River valleys), all recorded before 1982.

Mourning dove has been documented in groundwater development areas in three basins (Cave, Snake, and Spring valleys) and is suspected to occur in the other two basins. Band-tailed pigeon has not been recorded in the groundwater development areas, although it could occur there.

Other management concern migratory bird species are found in groundwater development areas. Cover types in the groundwater development areas are similar to those in the ROWs (**Table 3.5-3**, Vegetation Resources). See the ROW management concern species earlier in this section for examples of birds that could occur in these habitats in groundwater development areas as well as **Table F3.6-1** in **Appendix F** for information on basins of suspected occurrence.

No important bird areas are crossed by groundwater development areas, although GBNP and D.E. Moore Bird and Wildlife Sanctuary important bird areas share a boundary with a groundwater development area in Snake Valley. The Northern Snake Range important bird area is located within 2 miles of groundwater development areas in Snake and Spring valleys.

Special Status Wildlife Species

Based on a review of occurrence data for special status wildlife, species occurrences were identified for the groundwater development areas (**Appendix F**, **Table F3.6-1**). The terrestrial wildlife species that are identified as special status in this section are federally threatened, endangered, or proposed under the ESA or are considered sensitive by the BLM or the USFS. There are 36 special status species that have been recorded within groundwater development areas (**Appendix F**, **Table F3.6-1**). Habitat and life history information for these species is provided in **Appendix F**, **Table F3.6-3**.

Special status wildlife species or groups that have habitat in the groundwater development areas include greater sage-grouse, pygmy rabbit, bats, dark kangaroo mouse, golden eagle, bald eagle, western burrowing owl, ferruginous hawk, other special status migratory birds, and Baking Powder Flat blue butterfly. There is no desert tortoise habitat in the groundwater development areas. Based on surveys that were conducted by Wildland International (2007), the banded Gila monster has not been observed in any of the groundwater development areas. Based on the Southwest ReGap animal models and NNHP heritage records, neither Gila monster nor common chuckwalla have habitat in these areas. The following information summarizes the occurrence of pygmy rabbit, greater sage-grouse, raptors, additional special status birds, and terrestrial invertebrates within the groundwater development areas. (The desert bighorn sheep is discussed under the species of management concern.)

- **Greater Sage-grouse –** Habitat for this species is located in three of the groundwater development areas (Cave, Snake, and Spring valleys). Active, inactive, and historic breeding areas within 4 miles of groundwater development areas are shown in **Figure 3.6-7**. Twenty-seven leks were identified within the boundaries of the proposed groundwater development areas. Of the 27 leks identified, 13 are considered active. Nine of the 13 active lek sites are found within the Spring/Snake Valley PMU and within Spring Valley in White Pine and Lincoln counties. Male counts in these leks ranged from 3 to 30. There is one active lek within the Spring/Snake Valley PMU within Snake Valley with five males in attendance. There are two active leks within the Lincoln PMU within Spring Valley. Male counts ranged from two to five males in attendance. One active lek is found within the Cave PMU within Cave Valley. This lek had a count of 10 males in attendance. An additional 7 active leks are found within 4 miles of groundwater development areas. Five are found within the Cave PMU within Cave Valley with male attendance numbers ranging from 0 to 24 and 1 other is found in the Lincoln PMU within Lake Valley with 0 males in attendance. The PPH and PGH habitats that have been mapped by the BLM overlap the groundwater development basins (**Figure 3.6-8**).
- **Raptors –** Additional special status raptor species (golden eagle, bald eagle, ferruginous hawk, and northern goshawk) have been observed within the groundwater development areas.
  - Golden eagle has been recorded in groundwater development areas in Dry Lake, Delamar, Spring, and Snake valleys during winter surveys (GBBO 2007b; SNWA 2005-2008). The NDOW raptor nest database has a 1980 record for a nest in a groundwater development area in Snake Valley. No additional nest sites are recorded in the 0.5 mile groundwater development area buffer. There are 15 nests in the NDOW raptor database within the 10 mile groundwater development area buffer; 3 nests were recorded in 2007 in Dry Lake, Pahranagat, and Pahroc valleys and the other 12 nests were recorded prior to 1981 in Dry Lake, Hamlin, Pahranagat, Snake, Spring, and Steptoe valleys. Habitat and life-history information for this species and subsequent species mentioned in this section is provided in **Appendix F**, **Table F3.6-3**.
  - Bald eagle has been recorded during winter surveys in groundwater development areas in Snake and Spring valleys (GBBO 2007b; SNWA 2005-2008) and in Spring valley in the 0.5 mile groundwater development area buffer. This species is not known to nest in eastern Nevada.
  - Ferruginous hawk has been recorded in Dry Lake, Hamlin, Snake, and Spring valleys (NNHP 2006; Klinger and Williams 2005; GBBO 2007b; SNWA 2005-2008). The NDOW raptor nest database has 70 nests within the groundwater development areas all recorded prior to 1993. There is 1 nest in Snake Valley recorded in 1977 and 69 nests in Spring Valley dating from 1976 to 1992. In the 0.5 mile buffer an additional 6 nests are recorded; 3 in Spring Valley, 2 in Hamlin Valley, and 1 in Dry Lake Valley, all recorded prior to 1993. More recent surveys by NDOW (Klinger and Williams 2005) recorded 5 active ferruginous hawk nests in groundwater development areas in Snake and Spring valleys and three additional ferruginous hawk nests within a 0.5 mile buffer of groundwater development areas in Hamlin and Spring valleys. The 10 mile buffer of groundwater development areas has records for 162 nests recorded between 1972 and 2001 in Dry Lake, Hamlin, Lake, Snake, Spring and Steptoe valleys.
  - Northern goshawk has been recorded in a groundwater development area in Spring Valley (GBBO 2007a). The NDOW raptor nest database does not contain records for this species in groundwater development areas, the 0.5-mile or 10-mile buffers.
  - NDOW's raptor nest site database also contains a short-eared owl nest record from 1978 that falls within a groundwater development area in Spring Valley. Habitat and life-history information for special status raptors is provided in **Appendix F**, **Table F3.6-3**.

- **Western Burrowing Owl –** This species has been recorded during surveys in groundwater development basins in three valleys: Dry Lake, Snake, and Spring (Wildland International 2009, 2007). The NDOW's raptor nest site database has records of four burrows recorded between 1982 and 2000 within groundwater development areas in Dry Lake, Snake, and Spring valleys. See **Table F3.6-3** in **Appendix F** for additional species habitat and life-history information.
- **Additional Special Status Bird Species –** Other special status bird species (e.g. pinyon jay and loggerhead shrike) are found in groundwater development areas. Cover types in the groundwater development areas are similar to those in the ROWs (**Table 3.5-3**, Vegetation Resources). See the ROW special status species earlier in this section for examples of birds that could occur in these habitats in groundwater development areas as well as **Table F3.6-1**, **Appendix F** for information on basins of occurrence.
- **Pygmy Rabbit** – This species was observed in four valleys within the groundwater development areas: Dry Lake, Cave, Spring, and Snake valleys (Wildland International 2007; SNWA 2009a, 2007b). Pygmy rabbit also has been recorded in Dry Lake Valley in previous surveys (NNHP 2006) and by the NDOW in Cave, Spring, and Snake valleys.
- **Bats –** Of the 22 species of bats that occur in the area, 18 have been recorded within groundwater development areas and many have been recorded in at least 1 of the valleys where groundwater development areas are located. See **Tables F3.6-1** and **F3.6-3** in **Appendix F** for basins of occurrence and habitat information.
- **Dark Kangaroo Mouse –** This species is recorded in groundwater development areas in Cave, Dry Lake, and Spring valleys (NDOW 2010a).
- **Terrestrial Invertebrates** – There is one BLM sensitive terrestrial invertebrate species, the Baking Powder Flat blue butterfly, recorded in Spring Valley within a groundwater development area (NNHP 2010). The other five BLM sensitive terrestrial invertebrate species have not been recorded, nor are they suspected to occur in groundwater development areas. This butterfly species is only known from Baking Powder Flat in Spring Valley and its host plant is Shockley's buckwheat (Austin 1998). See **Table F3.6-3** in **Appendix F** for additional species information.

3.6.1.4 Region of Study

The overall natural resources region of study is a large geographical area, within which the focus for terrestrial wildlife is on habitats that are water dependent (i.e., wetland, riparian, and phreatophytic communities). Spring systems and associated species are discussed in Section 3.7, Aquatic Biological Resources. The same habitat types that are discussed for the ROWs and groundwater development areas occur in the natural resources region of study. Therefore, the focus of this section is on Great Basin and Mojave Desert riparian and playa communities and habitats associated with surface water. Cave habitats also are discussed, because of their unique biological characteristics and public interest. Please note the natural resources region of study differs slightly from the water resources region of study discussed in Section 3.3, Water Resources. This is explained in more detail in Section 3.5, Vegetation Resources. These regions of study boundaries are depicted on **Figures 3.5-3** and **3.5-4**.

Wildlife Species of Management Concern

Management guidance for species of management concern is described in state management plans (**Table 3.6-1**). In addition to the species-specific management guidance documents that are listed in **Table 3.6-1**, the Clark County Multiple Species Habitat Conservation Plan (RECON 2000) and the Lower Colorado River Multiple Species Conservation Program (2004) cover some of these species. Many of these species also are covered in the Nevada Wildlife Action Plan (Wildlife Action Team 2012, 2006) and the Utah Comprehensive Wildlife Conservation Strategy (Sutter et al. 2005). Multiple bird species are covered in Landbirds of Nevada and the Habitats They Need (GBBO 2005), Atlas of the Breeding Birds of Nevada (Floyd et al. 2007), Nevada Partners in Flight Bird Conservation Plan (Nevada Partners in Flight 1999), Utah Partners in Flight Avian Conservation Srategy Version 2.0 (Parrish et al. 2002) and the Partners in Flight North American Landbird Conservation Plan (Rich et al. 2004). In addition, the American avocet is discussed in the U.S. Shorebird Conservation Plan (Brown et al. 2001) and the Intermountain West Regional Shorebird Plan (Oring et al. 2000). Most of the mammal, bird, and reptile species have been mapped as part of the Provisional Digital Animal-Habitat Models for the Southwestern U.S. (USGS 2007).

Five big-game mammals of management concern occur within the natural resources region of study in the following areas. Pronghorn antelope and elk occur in approximately half of the hydrologic basins in the study region (18 basins); mule deer are present in 26 of the 33 hydrologic basins in the study region. Desert bighorn sheep occur in all but six of the hydrologic basins, but Rocky Mountain bighorn sheep occur in only five of the basins within the study region. Species distribution for the species of management concern is identified, by hydrologic basin, in **Appendix F**, **Table F3.6-1**. Habitat requirements and life-history information for these species is provided earlier in this section and in **Appendix F**, **Table F3.6-2**.

Table 3.6-1 Management Guidance for Species of Management Concern

Species	Plan/Citation
Pronghorn	Policy for the Management of Pronghorn Antelope (Nevada Board of Wildlife Commissioners 2003); Nevada's Pronghorn Antelope – Ecology, Management and Conservation (Tsukamoto 1983); Utah Pronghorn Statewide Management Plan (UDWR 2009a)
Elk	Nevada Elk Species Management Plan (NDOW 1997); Lincoln County Elk Management Plan (NDOW 2006a); White Pine County Elk Management Plan - Revision (NDOW 2007a); Utah Division of Wildlife Resources Statewide Management Plan for Elk (UDWR 2005)
Mule deer	Management Plan for Mule Deer (NDOW 2006b); Utah Division of Wildlife Resources Statewide Management Plan for Mule Deer (UDWR 2003)
Desert and Rocky Mountain bighorn sheep	Bighorn Sheep Management Plan (NDOW 2001); Utah Division of Wildlife Resources Bighorn Sheep Statewide Management Plan (UDWR 2008)

Small mammals of management concern occur throughout the natural resources region of study. Those species that are dependent on wetland or phreatophytic vegetation are of particular interest (e.g. vagrant shrew and water shrew). The 9 representative management concern species are discussed earlier in this section in the ROW and groundwater development sections. Basins of occurrence and habitat and life history information for the species can be found in **Appendix F**, **Tables F3.6-1** and **F3.6-2**. Similarly, representative upland game birds, waterfowl, and other migratory birds of management concern are addressed earlier in the section and in appendix tables.

There are a number of important bird areas within the natural resources region of study. In Nevada, Lake Mead National Recreation Area, Virgin River, Moapa Valley, Meadow Valley Wash, Sheep Range, Pahranagat Valley complex, GBNP, D.E. Moore Bird and Wildlife Sanctuary, and Northern Snake Range important bird areas are within the region of study (Audubon 2010a). In Utah, the Fish Spring NWR important bird area is within the region of study (Audubon 2010b).

Special Status Wildlife Species

The occurrence of special status wildlife species within the natural resources region of study is listed by basin in **Appendix F**, **Table F3.6-1**. Federally listed species are shown in **Appendix F**, **Figure F3.6-1**. The region of study contains habitat for three federally listed terrestrial wildlife species (e.g., southwestern willow flycatcher, Yuma clapper rail, and desert tortoise).

Management guidance for special status terrestrial species is described in recovery plans, habitat management plans, and conservation agreements (**Table 3.6-2**). In addition, the western snowy plover and long-billed curlew are discussed in the U.S. Shorebird Conservation Plan (Brown et al. 2001) and the Intermountain West Regional Shorebird Plan (Oring et al. 2000), and bats are discussed in NDOW's Bat Conservation Plan (Bradley et al. 2006).

A summary of the occurrence and habitat information for the federally listed species is provided here. This section is followed by a summary of the BLM sensitive species or groups, with more detailed discussions for those species that have conservation agreements or public scoping interest. Many BLM sensitive species occur in the overall region of study; 71 species are addressed in **Appendix F**, **Table F3.6-1** and have potential to be impacted by construction or operation of the proposed project. Detailed occurrence information is provided for the greater sage-grouse and yellow-billed cuckoo, as they are federal candidate species. Raptors, bats, pygmy rabbit, and terrestrial invertebrates also are discussed. Habitat and life history information for the other special status species is provided in **Appendix F**, **Table F3.6-3**.

- **Southwestern Willow Flycatcher (Federally Endangered)** – The range of this subspecies in Nevada is confined to the southern portion of the state (Las Vegas, Pahranagat, Lower Meadow Valley Wash, Muddy River Springs Area, Lower Moapa valleys, and Black Mountains area). Designated critical habitat for this subspecies occurs near the natural resources region of study, approximately 6.5 miles northeast of Lower Moapa Basin along the Virgin River (USFWS 1997). The USFWS is currently reviewing the Revised Proposed Critical Habitat for southwestern willow flycatcher. The final rule is expected to be published on December 14, 2012 (USFWS 2012a). Revised Proposed Critical Habitat occurs within the natural resources region of study, within Pahranagat valley. The final recovery plan for the southwestern willow flycatcher was published in 2002 (USFWS 2002).

Table 3.6-2 Management Guidance for Special Status Terrestrial Wildlife Species

Species	Plan/Citation
Southwestern willow flycatcher (Federally Endangered)	Southwestern Willow Flycatcher Recovery Plan (USFWS 2002); Endangered and Threatened Wildlife and Plants: Designation of Critical Habitat for the Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (USFWS 2005), Review of Revised Proposed Critical Habitat for Southwestern Willow Flycatcher underway, final rule is expected to be published on December 14, 2012.
Yuma clapper rail (Federally Endangered)	Yuma Clapper Rail Recovery Plan (USFWS 1983)
Greater sage-grouse (Federal Candidate)	Greater Sage-grouse Conservation Plan for Nevada and Eastern California (NDOW and California Department of Fish and Game 2004); Utah Greater Sage-grouse Statewide Management Plan (UDWR 2009b); Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats (Connelly et al. 2004); Lincoln County Sage-grouse Conservation Plan (Lincoln County Technical Review Team 2004); White Pine County Portion (Lincoln/White Pine Planning Area) Sage-grouse Conservation Plan (Sage-grouse Technical Review Team 2004); IM 2012-043 BLM Greater Sage-grouse Interim Management Policies and Procedures (BLM 2011a); IM 2012-044 BLM National Greater Sage-grouse Land Use Planning Strategy and Attachment 1(BLM 2011b); Nevada Energy and Infrastructure Development Standards to Conserve Greater Sage-grouse Populations and their Habitats (Nevada Governor's Sage-Grouse Conservation Team [NGSCT] 2010).
Bald eagle (BLM sensitive species)	Pacific States Bald Eagle Recovery Plan (USFWS 1986)
Desert tortoise (Federally Threatened)	Endangered and Threatened Wildlife and Plants: Determination of Critical Habitat for the Mojave Population of the Desert Tortoise (USFWS 1994b); Revised Recovery Plan for the Mojave Population of the Desert Tortoise (*Gopherus agassizii*) 2011.

The southwestern willow flycatcher breeds in dense patches of riparian habitat along streams or other wetland areas, near or adjacent to surface water or saturated soils. Nesting habitat in Nevada includes willow species like coyote willow *(Salix exigua)*, Gooding's willow *(Salix gooddingii)*, and seep willow (*Baccharis salicifolia*). The birds also nest in other tree species including ash *(Fraxinus spp.)* and Russian olive *(Eleagnus angustifolia)*. Relative to the overall region of study, reported suitable breeding habitat for the southwestern willow flycatcher is limited to riparian shrub and wetland habitat within the Pahranagat Valley and Lower Moapa Valley hydrologic basins, as well as along the Lower Meadow Valley Wash. In the study area, southwestern willow flycatchers have been detected in numerous locations in Lincoln County in the Pahranagat Valley on Pahranagat NWR (Koronkiewicz et al. 2006), from 1999–2007 and 2010 on Key Pittman WMA (NDOW 2007b; McLeod and Pellegrini 2011), and on private land in the valley (NDOW 2007b).

The population of southwestern willow flycatchers in the Pahranagat Valley is important to the Lower Colorado Recovery Unit. In 2005, more than 25 percent of breeding territories in this Recovery Unit occurred in the Pahranagat Valley (Durst et al. 2006; Koronkiewicz et al. 2006; NDOW 2007b). In 2005, 19 nests were detected in Pahranagat NWR (Koronkiewicz et al. 2006) and 11 nests at Key Pittman WMA (NDOW 2006c); in 2008, 10 nests were detected in Pahranagat NWR; and in 2010, 20 and 31 nests were found at Pahranagat NWR and Key Pittman WMA, respectively (McLeod and Koronkiewicz 2009; McLeod and Pellegrini 2011). Sporadic breeding occurs along Meadow Valley Wash in Clark and Lincoln counties; breeding was last detected in 1998 (BIO-WEST 2005). In total, approximately 714 acres of woody vegetation types were delineated as potential habitat for this species in Meadow

Valley Wash (BIO-WEST 2005). Consistent surveys have not been conducted in this drainage. Other breeding locations within the study area in Clark County are along the upper and lower Muddy River, particularly in Overton WMA where 4 nests were detected in 2010 and the Warm Springs Natural Area where 3 nests were found in 2010. (Koronkiewicz et al. 2006; NDOW 2007b; McLeod and Pellegrini 2011). Willow flycatcher migrants have been detected along Las Vegas Wash (McLeod et al. 2007), although it is unclear if these birds are southwestern willow flycatchers or a different subspecies.

- **Yuma Clapper Rail (Federally Endangered)** – Yuma clapper rails are primarily known from Arizona and California. Observation records from Braden et al. (2008) report sightings at three sites within Nevada, one of which was along the Virgin River north of Mesquite. No new clapper rail sitings were reported in 2008 within Nevada (Braden et al. 2009). No critical habitat has been designated for this subspecies.

  Habitat for this species includes freshwater marshes with dense stands of cattails and bulrushes, dominated by stands of emergent vegetation interspersed with areas of open water and drier, upland benches. Mature stands of emergent vegetation along the margins of shallow ponds with stable water levels are preferred. Nests are built on dry hummocks or in small shrubs among dense vegetation on the edge of shallow ponds in marshy areas. Relative to the region of study, the species has been reported only from the Las Vegas, Lower Moapa, and Black Mountains hydrologic basins. Along the Muddy River, Yuma clapper rail habitat is starting to recover from the impacts of the 2005 floods and attempts to control them, which removed much of the rail habitat (Braden et al. 2008). Numbers along the Muddy and Virgin rivers have fluctuated from a high of 26 in 2000 to a low of zero in 2005, after the floods (Braden et al. 2008). In 2006, one pair was detected at Overton WMA in the lower Muddy River floodplain (Braden et al. 2007).

- **Desert Tortoise (Federally Threatened)** – One designated critical habitat unit (Mormon Mesa) occurs within the natural resources region of study in eight hydrologic basins (Las Vegas, Garnet, Hidden, Coyote Spring, Kane Springs, Muddy River Springs, Lower Meadow Valley Wash, and Lower Moapa valleys). Within the region of study, approximately 366,676 acres have been designated as critical habitat for the desert tortoise. In 1998, the Las Vegas Field Office BLM RMP established four ACECs for the protection of critical desert tortoise habitat (BLM 1998). Three additional ACECs were established by the Caliente Amendment for the protection of critical desert tortoise habitat (BLM 2000).

  The desert tortoise inhabits upland plateaus and mountain slopes in the Mojave Desert, from 1,000 to 4,200 feet in elevation. The species requires firm ground with adequate ground moisture for constructing burrows in banks of washes or compacted sand and for digging holes for nests. The active period for desert tortoise is from April to October (USFWS 2009). Tortoise activity decreases in summer (June, July, and August), but they emerge after summer rain storms (USFWS 2008). The NDOW, NNHP, BLM, and USFWS have documented numerous desert tortoise sightings within the region of study. There have been several reports of desert tortoise burrows in the lowlands near the mountains from Ash Springs, southward along Pahranagat Wash to the Lincoln County line. Sites that are occupied by desert tortoise are scattered throughout southeastern Lincoln County, with areas of concentration along Kane Springs Wash, Meadow Valley Wash, and the region just south of the Tule Springs Hills. In addition, desert tortoise habitat in Clark County is widespread at elevations below 4,500 feet. The majority of the known occurrences of desert tortoise are found within the southern portion of the county between the Las Vegas Valley and Laughlin, Nevada (RECON 2000). Additional occurrence records are found near Red Rock Canyon and the Moapa Indian Reservation (RECON 2000). See additional discussion under Section 3.6.1.2, ROW Areas, Special Status Species.

- **Yellow-billed Cuckoo (Federal Candidate)** – The yellow-billed cuckoo formerly ranged throughout much of North America, from southern Canada to northern Mexico (USFWS 2001). However, the bird has suffered population decline (primarily because of the loss of streamside habitat) and is declining west of the Continental Divide (Biota Information System of New Mexico 2002).

  The yellow-billed cuckoo inhabits dense riparian woodlands with tall cottonwood and willow trees. It can also occur in deciduous woodlands, moist thickets, orchards, or overgrown pastures. The yellow-billed cuckoo has been reported in six locations in the Lincoln County portions of the study area. Observations of yellow-billed cuckoo were reported at two sites along Meadow Valley Wash: a breeding pair was identified at one site in 2001 and a single bird was identified at another site in 2002. In total, approximately 253 acres of riparian vegetation were delineated as marginal habitat for this species in Meadow Valley Wash (BIO-WEST 2005). At Crystal Springs, two breeding pairs were reported in 2001. South of Crystal Springs, individual birds were observed at a fourth site in 2000 and 2002. At another site on private land near Ash Springs, two breeding pairs and five single birds were reported in 2000. At the same private land site in 2001, four mated birds and one unmated bird were noted based on call response. In Clark County, the yellow-billed cuckoo has been detected at one location in Lower Moapa Valley and two sites in the Muddy River Springs Area hydrologic basins. In addition, this species was detected in Utah in the Fish Springs Flat hydrologic basin. The yellow-billed cuckoo has been detected several times in the Pahranagat Valley, and most recently on the NWR on July 7, 2006, in riparian woodland habitat (Johnson et al. 2007) and at the Pahranagat north survey site in 2008 (Braden et al. 2009). The Warm Spring Ranch in Moapa Valley (north of the town of Glendale) is the most consistent location for yellow-billed cuckoo in southern Nevada (Braden et al. 2007). At one time, 7 to 14 breeding pairs occurred there per season, but numbers since 2002 have been lower (Braden et al. 2007; NDOW 2007b). Potentially suitable habitat for the yellow-billed cuckoo in the region of study is limited to riparian and wetland areas (Las Vegas, Pahranagat, Muddy River Springs Area, Lower Moapa, Lower Meadow Valley Wash, and Fish Springs Flat valleys).

- **Greater Sage-Grouse (Federal Candidate)** – There are more than 300 known greater sage-grouse active, inactive, historic and unknown lek sites within the natural resources region of study (**Figure 3.6-7** and the Glossary for an explanation of these four lek classifications). **Figure 3.6-8** shows PPH and PGH. All greater sage-grouse habitat is in the northern portion of the natural resources region of study, beginning in the northern halves of Lincoln County, Nevada and Iron County, Utah. See the habitat discussion under Section 3.6.1.2, ROW Areas, Special Status Species and in **Appendix F**, **Table F3.6-3**.
- **Raptors** – The GBBO has published data from spring-breeding bird surveys that were conducted from 2004-2006 and winter raptor surveys from 2005-2008. Additional data from GBBO and the state Natural Heritage programs were also reviewed. Of the representative special status species (golden and bald eagle, ferruginous hawk, northern goshawk, peregrine falcon, and western burrowing owl), all but the northern goshawk have been recorded in more than half the basins in the natural resources region of study (Floyd et al. 2007; GBBO 2007a,b; NNHP 2006, 2010, 2011; UNHP 2007; Wildland International 2009, 2007; NDOW 2012) see **Appendix F**, **Table F3.6-1**.

  The study area provides an abundance of habitat for species that depend on sagebrush, salt desert scrub, or pinyon juniper habitats. The highest densities of ferruginous hawks in Nevada occur within the study area. Ferruginous hawks are both a Utah and Nevada Partners in Flight priority species. The NDOW has been monitoring ferruginous hawk nests since the 1970s and has documented a decline in the number of active nesting territories over this period (Klinger and Williams 2005). In Utah, ferruginous hawk is considered rare and productivity may not be sufficient to sustain the state's population (Sutter et al. 2005). Nevada and western Utah represent a large portion of the basin and range province, which support 28 percent of the world population of prairie falcons (Nevada Partners in Flight 1999). Prairie falcons nest in cliffs and rock outcrops; other raptors within the study area may use rock outcrops, trees, or burrows as nesting sites. Habitat and life-history information for special status raptors is provided in **Appendix F**, **Table F3.6-3**.

- **Additional Special Status Birds –** The natural resources region of study includes habitat for a wide variety of bird species. Representative species that occur in habitats potentially impacted by the proposed project construction or operation are included in **Appendix F**, **Table F3.6-1** (e.g. common yellowthroat, long-billed curlew, and western snowy plover). This list follows the MOU between the BLM and the USFWS to Promote the Conservation of Migratory Birds. Section 3.5, Vegetation Resources, explains the key groundwater dependent resources potentially impacted by groundwater pumping, namely phreatophytic vegetation and wetland/wet meadow types. See the bulleted lists earlier in this section on cover types and associated special status species.
- **Pygmy Rabbit**– Pygmy rabbits are found in the Great Basin desert ecological region of the study area. While habitat exists further south, records of the species are found in the northern half of Lincoln County, Nevada, in Beaver County, Utah and areas further north. See habitat discussion under Section 3.6.1.2, ROW Areas, and in **Appendix F**, **Table F3.6-3**.
- **Bats –** The majority of the 23 bat species in Nevada and Utah could occur throughout the natural resources region of study (Bradley et al. 2006). Based on records from NNHP (2006) and O'Farrell Biological Consulting (2006),

bat occurrences are listed for the region of study in **Appendix F**, **Tables F3.6-1** and **F3.6-3** which also include life history and habitat information.

Acoustic sampling for bats was conducted at 32 locations in 12 valleys (O'Farrell Biological Consulting 2006). Nine of these basins (Cave, Delamar, Dry Lake, Lake, Pahranagat, Pahroc, Spring, Snake, and White River) are within the region of study. A total of 16 bat species was recorded in the study, with multiple species occurring in 10 valleys within the study area. Mist net surveys were conducted in 2008 (SNWA 2009a) at 11 sites in four valleys within the region of study. These included two additional sites in Spring Valley and one additional site in Steptoe Valley that had not previously been surveyed in the acoustic sampling study. Special status bat species are listed in **Table F3.6-1**. Of the 22 species listed in the table, only 5 (Allen's big-eared bat, California leaf-nosed, cave myotis, greater western mastiff bat, and spotted bat) were not detected during acoustic or mist net surveys. NDOW reports a large Brazilian free-tailed colony that forages in Spring Valley and adjacent valleys.

Most of the species have a broad distribution in Nevada. However, nine species (big free-tailed, California leaf-nosed bat, cave myotis, fringed myotis, greater western mastiff bat, Yuma myotis, silver-haired, hoary, and western red bat) have a limited distribution in Nevada. The big free-tailed and western red bats have limited distribution in Utah, yet the fringed and Yuma myotis are found in much of the state. Most bat species are insectivores; foraging habitat includes areas with supporting insect populations, usually with some association to surface water (e.g., streams, springs, or ponds). Roost sites vary by season and gender, and commonly are close to foraging habitat. Summer roosts are primarily inhabited by females and their young until the young are independent, approximately 1.5 months after birth. Most bats return to their maternal roost each year. During the period of maternal care, males are thought to have widely-spaced, individual roost sites. After the young are independent, both sexes generally disperse across the habitat, using individual roost sites in tree crevices, cavities and cracks in rocks, and crevices in cliffs. In the fall, both males and females begin to congregate at winter roost sites, which allow more protection during the cold periods. Mating occurs during the fall, just before hibernation, and fertilization occurs in the spring when the female ovulates. One, and occasionally more, young are born per female, 2 to 3 months later in the maternal roost (Bogan 2000).

- **Dark Kangaroo Mouse –** Within the natural resources region of study, NDOW has records of the species in Cave, Dry Lake, Hamlin, Lake, Spring, Steptoe, and White River valleys. See **Appendix F**, **Table F3.6-3** for additional information on habitat and life history.
- **Terrestrial Invertebrates** – Species surveys were conducted by Ecological Sciences, Inc. (2007) at 76 locations within or close to the boundary of the study region in Nevada and Utah. The BLM lists a number of terrestrial invertebrates as sensitive species, which are known to occur in the region of study. Nine of these species occur in habitats or at elevations that may be impacted by construction or operation of the proposed project. These species are the Aegilian scarab beetle, White River Valley skipper, White River wood nymph, Baking Powder Flat blue butterfly, MacNeill sooty wing skipper, Mojave poppy and Gypsum bees, and Steptoe Valley crescentspot. Most species are not well known and potential association with wetland or phreatophytic vegetation also is not well understood. However, given their apparent host plants, the White River Valley and McNeil's sootywing skippers may be tied to surface water dependent resources. See **Appendix F**, **Table F3.6-1** for basins of occurrence and **Table F3.6-3** for information on habitat and life history if information was available.
- Other Wildlife Species or Habitats of Interest

Cave habitats are in karst formations at scattered locations throughout the natural resources region of study (**Figure 3.2-5**) in both Nevada and Utah. In general, cave ecology is unique because nutrients enter the system via water or organisms that in turn deposit debris, guano, or decomposing carcasses. These materials represent the only source of nutrients for organisms that are restricted to life in the cave environment (Baker 2007). Biological surveys that have been conducted in caves within the Baker, Lehman, and Snake creek watersheds in GBNP have shown diverse and unique biological communities (Krejca and Taylor 2003). Model Cave, part of the Baker Creek watershed, has the highest known species diversities of cave invertebrates in Nevada caves (NPS 2005). Based on surveys in eight caves, eight animal phyla were observed, with the most diverse classes being insects, mites, spiders, and scorpions. Some species, such as the Lehman Cave millipede, are restricted to one cave. Caves also contain primitive insect species such as the campodeid dipluran. New or potentially new millipede species also have been described in two of the Baker Creek watershed caves (Shear and Shelley 2007; Shear 2007). Further bioinventory work conducted by Taylor et al. (2008) in 22 caves both in and outside GBNP greatly increased the information available about species using caves. Two new millipede species have been described and identified, *Idagona lehmanensis* and *Nevadesmus ophimontis* (Shear 2007, Shear et al. 2009), and a new springsnail, *Pygmarrhopalites shoshoneiensis*, has also been found and identified (Zeppelini et al. 2009). Based on work by Taylor et al. (2008), the potentially new millipede species described by Shear (2007) has been recorded in more caves, expanding the range of elevations in which the species has been found. A variety of mammals, such as cliff chipmunk, deer mouse, and bats, also inhabit caves (Baker 2007; NPS 2005; Krejca and Taylor 2003). Both the Ely and Las Vegas RMPs as well as the GBNP General Management Plan recognize the importance of caves and have management objectives to protect and manage caves.

Assessment of four watersheds in GBNP (NPS 2007) included surveys for birds, small mammals, and cave resources. Three NPS sensitive bird species were detected during surveys and habitat for 12 additional NPS sensitive bird species was documented. Small mammal surveys detected 11 species, 1 of which is NPS sensitive. The assessment also described 20 caves. These caves serve as habitat for nine different species of bats (NPS 2007), six of which are NPS sensitive (NPS 2006) and macroinvertebrates (see above). For information on other representative species selected by the Natural Resources Group that are NPS sensitive, see **Appendix F**, **Table F3.6-1**.

Culturally Significant Wildlife Species

As explained in the section overview, wildlife species that have been identified by tribes (Duckwater, Goshute, and Ely Shoshone) as culturally significant include elk, bighorn sheep, antelope, deer, bears, mountain lions, coyotes, wolves, rabbits (pygmy, jack, cottontail), rock chucks, ground squirrels, pack rats, pocket gophers, sage-grouse, mudhen, crickets, and various species of raptors and waterfowl. These animals have the potential to occur throughout historical aboriginal territories and throughout the proposed project area in appropriate habitat. Species likely to be impacted by the proposed project are discussed in Section 3.6.2.

3.6.2 Environmental Consequences

3.6.2.1 Rights-of-way

Issues

The following issues are discussed as part of the impact analysis of construction and facility maintenance.

Construction

- Habitat loss and fragmentation from construction clearing of ROWs, transmission lines, and new and improved access roads.
- Direct disturbance and loss of individuals from construction activities along ROWs (including trenching), transmission lines, and access roads.
- Disturbance and loss of individuals from accidental wildfires and loss of habitat.
- Indirect effects, consisting of displacement of individuals and loss of breeding success, from exposure to construction movements, noise and higher levels of human activity (including traffic).
- Compliance with recovery plans, conservation agreements, and state wildlife action plans for special status species.
- Potential disruption of migration patterns because of temporary fencing and potential entanglement and loss of individuals.
- Potential effects on terrestrial wildlife species that are culturally significant and traditionally used as food by regional Tribes.

Facility Maintenance

- Indirect effects, consisting of displacement of individuals and loss of breeding success because of operational noise and higher levels of human activity (including traffic).
- Direct loss of individuals from traffic mortality.
- Potential effects from collisions and electrocutions to raptors and other wildlife from power lines.
- Potential effects of additional infrastructure resulting in increased perches for raptors and corvids that may increase predation on other animals.
- Compliance with recovery plans, conservation agreements, and state wildlife action plans for special status species.

Assumptions

The following assumptions were used in the ROW impact analysis for terrestrial wildlife:

- Identification of terrestrial wildlife that could be affected by project actions focused categorically on species of management concern and special status wildlife species in the ROWs.
- Construction disturbances, while temporary in nature, have been defined as long-term for all habitat types due to existing vegetation structure and composition, recovery time frames, and limiting revegetation factors (e.g., low precipitation rates, soil chemistry constraints, and soil moisture).
- The mainline pipeline ROW would not be realigned or curved to avoid sensitive wildlife species habitat because of the large diameter of the pipeline. Temporary work space along the construction ROW may be narrowed to avoid sensitive habitats. Access roads and power line pole locations can be adjusted to avoid discrete sensitive species habitat features.

Methodology for Analysis

Construction and surface disturbance impacts by alternative were evaluated using the following steps:

- Calculated the area of habitats in general and the extent of special status species habitats where available, that would be removed temporarily or permanently during project construction or facility maintenance based on various habitat layers including NDOW big game layers, sage-grouse habitat, USGS digital animal-habitat models, and vegetation communities based on SWReGAP cover types.
- Provided additional detail on specific impacts (e.g. greater sage-grouse leks), where more specific data were available for some special status species.
- Evaluated the BLM RMP management actions, BMPs and ACMs available to limit the extent and duration of predicted impacts. Recommended additional mitigation measures to reduce or offset impacts. Described mitigation effectiveness.
- Estimated residual impacts after ACM and RMP management actions and BMPs were applied to each alternative.
- SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins and all facilities associated with the SNWA GWD Project. The COM Plan includes a requirement for comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect wildlife resources from ROW construction and operation activities.

3.6.2.2 Proposed Action, Alternatives A through C

Right-of-way Areas

Construction and Facility Maintenance

Habitat Loss, Fragmentation, Accidental Wildfires, and Power Line Effects

Impacts to terrestrial wildlife resources under the Proposed Action and Alternatives A through C would include surface disturbance or alteration of native habitats, increased habitat fragmentation, animal displacement, changes in species composition, and direct loss of wildlife. The severity of both short- and long-term impacts would depend on factors such as the sensitivity of the affected species, seasonal use patterns, the type and timing of project activities, and physical parameters (e.g., topography, cover, forage, and climate).

Habitat impacts would include both short-term and long-term impacts and permanent reduction or loss of habitat as a result of construction and operation of the proposed project. The Proposed Action would result in the (long-term) loss of 12,303 acres of wildlife habitat, primarily consisting of shrub-scrub types including sagebrush shrubland (48 percent), Mojave mixed desert shrubland (25 percent), and greasewood/saltbush shrubland (24 percent), with lesser amounts of woodland, grasslands, and other types comprising the remaining 3 percent. Approximately 1,000 acres would be permanently converted to industrial uses (**Table 3.5-9**, Vegetation Resources). Habitat loss or alteration would result in direct loss of smaller, less mobile species of wildlife, such as small mammals and reptiles, and the displacement of more mobile species into adjacent habitats. Displacement also could result in some local reductions in wildlife populations, if adjacent habitats are at carrying capacity. The most common wildlife responses to habitat fragmentation are avoidance or accommodation. Avoidance would result in displacement of wildlife from an area that is larger than the actual disturbance area. Although the habitats that are adjacent to the proposed disturbance area could support some displaced animals, species that are at or near carrying capacity could experience a reduction in breeding success and some level of unquantifiable wildlife mortalities. Potential indirect impacts also would include an incremental increase in the potential for wildlife/vehicle collisions (short- and long-term), resulting in an unquantifiable reduction in wildlife populations.

Habitat fragmentation would result from the various project facilities including the development of access roads, pipelines, electrical power lines, and various above-ground facilities including pumping stations and electrical substations. Other fragmentation effects such as increased noise, elevated human presence, dispersal of noxious and invasive weed species, and dust deposition from unpaved road traffic would extend beyond the boundaries of the project ROWs. These effects would result in overall changes in habitat quality, habitat loss, increased animal displacement, reductions in local wildlife populations, and changes in species composition. The severity of these effects on terrestrial wildlife species depends on factors as listed above.

Habitat fragmentation caused by the construction of access roads can impact habitat in a variety of ways. Roads alter the temperature, humidity, sunlight intensity, moisture content of surrounding soils, and vegetation composition (Vaillancourt 1995). As a result, vegetation adjacent to the roads is dissimilar to surrounding vegetation, as measured by species composition, abundance, dust, and amount of bare soil and litter. Baker and Dillon (2000) summarized the effects on vegetation at a variety of sites and concluded the average depth-of-edge for vegetation effects was 200 feet. Gelbard and Belnap (2003) showed that desert shrub communities located near maintained gravel and paved roads contained a large amount of exotic species, while plant communities near primitive, two-track roads were less disrupted compared to surrounding native vegetation. Based on the literature (Gelbard and Belnap 2003; Baker and Dillon 2000), vegetation community composition would be expected to be altered for approximately 165 to 200 feet away from the roadsides, despite reclamation with native seed mixtures. Additional fragmentation effects are addressed below within the specific species or species group discussions relative to available literature.

Accidental wildfires could be initiated during construction and facility maintenance activities and could cause minor to major impacts on forage and cover availability to all wildlife, depending on the acreage burned and whether any areas of particular species-specific value were disturbed. Impacts from wildfire would result in mortalities of less mobile species (e.g., small mammals, bird eggs and nestlings, reptiles, amphibians, and invertebrates) and short-term or long-term displacement of wildlife from the impacted area. Although the habitats adjacent to the impacted area may support some displaced animals, species that are at or near carrying capacity could result in some unquantifiable mortalities. It is anticipated that wildlife would slowly return to the impacted areas upon revegetation of herbaceous and woody vegetation. ACMs that would reduce potential impacts to wildlife from wildfire during construction would include a fire prevention plan (ACM A.1.1), the presence of a water truck and other fire suppression equipment, the presence of a designated individual at each construction site responsible for fire watch and suppression, an additional fire watch individual during welding activities, and the placement of all flammable materials within a 15-foot brush/litter-cleared area (ACM A.1.47). Proposed mitigation discussed in Section 3.5, Vegetation Resources (ROW-VEG-3) also would help to minimize the potential for accidental wildfire. Impacts related to vegetation composition changes as a result of accidental wildfires are discussed in Section 3.5, Vegetation Resources.

The operation of proposed electrical power lines would increase the potential for electrocution impacts to some bird species (e.g., eagles and other raptors), incrementally increase the collision potential for migrating and foraging bird species (e.g., raptors and migratory birds [APLIC 1994]) and bats, and could serve as predator perches and nest sites, increasing predation potential on a number of species. Potential electrocution impacts would be minimized through the implementation of ACM A.5.66 (see list below). Collision potential typically depends on variables such as the line location in relation to high-use habitat areas (e.g., nesting, foraging, and roosting), line orientation to flight patterns and movement corridors, species composition, visibility, and line design. Potential impacts to birds and bats from an incremental increase in collision and electrocution may be minimized through implementation of the Ely RMP BMP related to new power lines. To reduce the potential impacts of power lines, the applicant has committed to the following environmental-protection measures (for more detail see **Appendix E**):

- Power poles and lines will be designed and constructed in accordance with recommendations of APLIC to reduce the potential to electrocute or otherwise harm raptors (ACM A.5.66);
- Perch discouraging devices will be installed on power lines in sensitive species habitats (ACM A.5.8); and
- Solar panels will be used on monitoring wells to the extent possible to reduce need for additional power lines (ACM B.1.2).

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on terrestrial wildlife resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Conclusion. A total of 12,303 acres of wildlife habitat, primarily consisting of shrub-scrub types including sagebrush shrubland (48 percent), Mojave mixed desert shrubland (25 percent), and greasewood/saltbush shrubland (24 percent), with lesser amounts of woodland, grasslands, and other types comprising the remaining 3 percent would be disturbed (**Table 3.5-9** in Vegetation Resources for estimated vegetation community recovery times). Approximately 1,000 acres would be permanently converted to industrial uses (**Table 3.5-9**, Vegetation Resources). Impacts to terrestrial wildlife from the project include not only habitat loss, but also fragmentation and increased risk of accidental wildfires and increased risk of electrocution impacts to some bird species. Impacts as a result of ROW construction and facility maintenance would be reduced given the protections provided in the RMPs, BMPs, and the ACMs.

Proposed mitigation measures:

ROW-VEG-3: Green Stripping. This measure would assist in reducing impacts to terrestrial wildlife habitat.

Residual impacts include:

- The long-term (20 to 200 years) restoration periods for shrublands and woodlands disturbed by ROW construction make these habitats less suitable for forage and cover and contribute to habitat fragmentation.
- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.
- Potential terrestrial wildlife mortalities may result from habitat loss, fragmentation, accidental wildfires, or power line electrocutions.

Construction Water Use

SNWA is proposing to use groundwater or temporary construction wells for hydrostatic testing, dust control, pipe bedding, trench backfill compaction, and fire suppression (if needed). Groundwater withdrawal for construction water use could result in localized drawdown effects. There could be potential short-term effects on surface water depending on the hydraulic connection to groundwater and the surface water location. No diversion or modification of surface water flows is anticipated for temporary construction water use. However, any change in water use involving surface water sources would need to meet Nevada permit requirements, as well as a review by the BLM. If surface water use was approved, Ely BMP requirements would apply.

The discharge of hydrostatic test water would follow NPDES requirements, which would eliminate potential effects on water quality. Erosion effects would be minimized by implementing ACMs to reduce discharge velocities (ACM A.1.64 and A.1.65, as described in **Appendix E**). Additional details on hydrostatic test water discharge are provided in Section 3.4, Soil Resources.

Conclusion. Construction water use could adversely affect water sources for wildlife, if surface water is located within the drawdown area and connected to groundwater sources.

Proposed mitigation measures:

As discussed in water resources, mitigation measure ROW-WR-3 (Construction Water Supply Plan) would be required to determine the effects of construction water use on groundwater and surface water. Additional mitigation may be required, if surface water and wildlife habitats are affected.

Residual impacts include:

- Residual effects from construction water use could occur if groundwater withdrawal reduces surface water quantity and water sources for wildlife. Residual effects will be quantified during subsequent BLM review of the Construction Water Supply Plan.

Species of Management Concern

Big Game: Direct impacts to big game species (i.e., pronghorn antelope, Rocky Mountain elk, mule deer, desert bighorn sheep) would include the loss of potential forage within the proposed surface-disturbance areas. Herbaceous forage species might become established within the short-term (Vegetation Resources, **Table 3.5-9**), depending on reclamation success, and future weather conditions in the project region. In most instances, suitable habitat adjacent to the disturbed areas would be available for these species until grasses and woody vegetation were reestablished within the disturbance areas. No impacts to Rocky Mountain bighorn sheep are anticipated from ROW construction or facility maintenance, as this species inhabits higher elevation habitats that would not be impacted by these project activities. Antelope, elk, deer, and bighorn sheep are all considered culturally significant to regional Tribes.

Table 3.6-3 summarizes acreages of pronghorn antelope, Rocky Mountain elk, and mule deer ranges that would be affected by ROW construction (temporary) and facility maintenance (permanent). Impacts include incremental, long-term surface disturbance of approximately 7,952 acres of pronghorn antelope range; 4,019 acres of Rocky Mountain elk range; and 3,917 acres of mule deer range, including 169 acres of mule deer crucial summer range and 133 acres of mule deer crucial winter range. Although surface disturbance activities would represent a long-term habitat loss for big game and the location of the ROW may impact local herds, these disturbance acres would represent a small percentage (less than 1 percent) of the overall available habitat within the basins impacted. Facility maintenance would result in the permanent conversion of mule deer, antelope, and Rocky Mountain elk habitat at the acreages listed in **Table 3.6-3**. During construction, big game species would likely move away from areas being disturbed and may abandon areas of low quality habitat (e.g. areas with low quality forage, invasive weeds, limited water sources, and high human activity). In addition to the habitat impacts, facility maintenance activities could also include long-term, elevated, traffic-caused mortality from the increased vehicle use that would be needed to support maintenance.

Table 3.6-3 Big Game Range Acreage Potentially Impacted by the Proposed Action and Alternatives A through C, Right-of-way Construction (Temporary) and Facility Maintenance (Permanent)

Range	County	Basin	Pronghorn Antelope (Temp.)	Pronghorn Antelope (Perm.)	Rocky Mountain Elk (Temp.)	Rocky Mountain Elk (Perm.)	Mule Deer (Temp.)	Mule Deer (Perm.)
Crucial Summer	Lincoln	Cave	NI	NI	0	0	41	0
		Dry Lake	NI	NI	0	0	4	0
		Lake	NI	NI	0	0	45	5
		LMVW	NI	NI	0	0	11	11
	Lincoln Total		NI	NI	0	0	101	16
	White Pine	Snake	NI	NI	0	0	8	1
		Spring	NI	NI	0	0	42	5
		Steptoe	NI	NI	0	0	18	2
	White Pine Total		NI	NI	0	0	68	8
Crucial Summer Total			**NI**	**NI**	**0**	**0**	**169**	**24**
Crucial Winter	Lincoln	Dry Lake	0	0	NI	NI	3	0
		Hamlin	0	0	NI	NI	130	0
	Lincoln Total		0	0	NI	NI	133	0

Table 3.6-3 Big Game Range Acreage Potentially Impacted by the Proposed Action and Alternatives A through C, Right-of-way Construction (Temporary) and Facility Maintenance (Permanent) (Continued)

Range	County	Basin	Pronghorn Antelope (Temp.)	Pronghorn Antelope (Perm.)	Rocky Mountain Elk (Temp.)	Rocky Mountain Elk (Perm.)	Mule Deer (Temp.)	Mule Deer (Perm.)
Crucial Winter Total			**0**	**0**	**NI**	**NI**	**133**	**0**
Year Round	Lincoln	Cave	668	21	712	21	660	21
		Delamar	757	62	0	0	0	0
		Dry Lake	1,995	184	703	24	1,091	59
		Hamlin	351	2	0	0	0	0
		Lake	566	44	804	57	759	53
		LMVW	0	0	0	0	110	110
		Pahranagat	0	0	0	0	0	0
		Spring	716	80	485	77	328	59
	Lincoln Total		5,053	393	2,704	179	2,948	302
	White Pine	Hamlin	33	0	0	0	0	0
		Snake	879	52	0	0	370	38
		Spring	1,687	113	1,010	83	477	20
		Steptoe	300	16	305	20	122	3
	White Pine Total		2,899	181	1,315	103	969	61
Year Round Total			**7,952**	**574**	**4,019**	**282**	**3,917**	**363**

NI = None Identified. LMVW = Lower Meadow Valley Wash.

Note: Temporary and permanent acreage numbers in the table may include a minimal acreage of facilities that currently exist. Therefore, the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

Direct impacts to desert bighorn sheep would include the incremental, long-term reduction of approximately 259 acres of occupied habitat and 25 acres of potential habitat (**Table 3.6-4**), consisting primarily of grassland and desert shrubland habitats. Although surface-disturbance activities would represent an incremental, long-term habitat loss for desert bighorn sheep, these acreages of disturbance would represent less than 1 percent of the overall available habitat for this species on a regional basis. Facility maintenance activities would permanently convert 11 acres of occupied and potential desert bighorn sheep habitat (**Table 3.6-4**). The ROW areas between one of the pressure reducing stations and 2.5 miles north of the regulating tank site cross habitat for desert bighorn sheep. Given the number of facilities in this area, (regulating tank, pressure reducing station, secondary electrical substation, pipeline, and access road) movement between the Delamar Mountains and South Pahroc and Hiko ranges may be reduced. Additionally, proposed ROW locations between the Las Vegas Range and Arrow Canyon Range, Delamar Mountains and Sheep Range, and Egan Range and Schell Creek Range may reduce desert bighorn movements. Locating ROWs and associated facilities within movement corridors would cause habitat fragmentation and displacement of desert bighorn sheep due to increased noise and human presence. Displacement from current migratory routes would be short term in areas where the ROWs would be reclaimed and long term where permanent facilities and roads are located. The increase in habitat fragmentation and displacement of desert bighorn sheep from current migratory routes could cause stress and increased mortality rates to current populations.

Table 3.6-4 Bighorn Sheep Range Acreage Potentially Impacted by the Proposed Action and Alternatives A through C, Right-of-way Construction (Temporary) and Facility Maintenance (Permanent)

County	Basin	Occupied (Temp.)	Occupied (Perm.)	Potential (Temp.)	Potential (Perm.)
Clark	Coyote Spring	11	1	0	0
	Garnet	14	0	0	0
	Hidden	14	1	0	0
	Las Vegas	14	0	0	0
Clark Total		**53**	**2**	**0**	**0**
Lincoln	Cave	0	0	1	0
	Coyote Spring	1	0	0	0
	Delamar	53	5	0	0
	Dry Lake	0	0	0	0
	LMVW	0	0	0	0
	Pahranagat	152	4	0	0
Lincoln Total		**206**	**9**	**1**	**0**
White Pine	Spring	0	0	11	1
	Steptoe	0	0	13	2
White Pine Total		**0**	**0**	**24**	**3**
Grand Total		**259**	**11**	**25**	**3**

LMVW = Lower Meadow Valley Wash.

Note: Temporary and permanent acreage numbers in the table may include a minimal acreage of facilities that currently exist. Therefore the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

Indirect impacts to all big game species would result from increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from vehicle traffic on unpaved roads during surface-disturbance activities. Given the conservative estimate that adjacent habitats are at or near carrying capacity and due to human development activities in the project region, displacement of big game species would create some unquantifiable reduction in wildlife populations. Displacement of big game, as a result of direct habitat loss and indirect reduction in habitat quality, has been widely documented (Irwin and Peek 1983; Lyon 1983, 1979; Rost and Bailey 1979; Ward 1976). Big game species tend to move away from areas of human activity and roads, reducing habitat utilization near the disturbance areas (Cole et al. 1997; Sawyer et al. 2006). Displacement distances are strongly influenced by the level and timing of human activity, topography, and the presence of vegetation (Cole et al. 1997; Lyon 1979), presumably due to noise attenuation and visual cover. Displacement of big game is greatest for heavily traveled secondary and dirt roads. Most research has focused on displacement distances for elk and deer. Displacement distances indicate the distance from the road's centerline where animal densities are less than in surrounding areas (i.e., under-utilized habitat). In most circumstances, elk were not observed to habituate due to human activities. Deer and pronghorn appear to be more tolerant of human activities than elk. For deer, displacement distances ranged from 330 to 3,168 feet (0.6 mile) depending on the presence of vegetative cover (Ward 1976). Deer and pronghorn have been observed to habituate to vehicles and displacement distances decreased when traffic was predictable, moving at constant speeds, and was not associated with out-of-vehicle activities (Ward 1976). However, traffic within the project area during construction would be characterized by slow-moving traffic, vehicles that stop, and out-of-vehicle activity; thus, acclimation by big game is not anticipated. This displacement would be short term and animals would return to the disturbance area following construction activities (Krausman and Etchberger 1995). In addition, big game may experience increased mortality rates due to increased public access (Cole et al. 1997). Vehicular traffic may injure or kill individuals and local populations may experience higher levels of hunting and poaching pressure due to improved public access (Cole et al. 1997).

The Las Vegas and Ely RMPs include management actions that mitigate loss of priority wildlife habitat, (E:WL-4), seasonally restrict permitted activities (E:WL-6 to 8), protect waters that provide benefit to wildlife (LV:FW-3-e), and ensure authorized activities are consistent with goals and objectives of bighorn sheep management (LV:FW-1-b).

Impacts, as a result of ROW construction and facility maintenance, would be reduced given the protections provided by the RMPs and the ACMs.

In addition to providing a Compliance Inspection Contractor for construction monitoring (ACM A.1.2), the applicant has committed to the following environmental-protection measures to reduce potential impacts to wildlife (for more detail, see **Appendix E**):

- Design to allow seasonal movements across ROWs and access to surface water sources (ACMs A.5.70 and 71);
- Speed-limit restrictions to reduce vehicle/wildlife impacts (ACM A.1.29);
- Escape ramps to be installed at excavation areas that are left open overnight and checked periodically by a biological monitor (ACM A.1.42);
- Assurances that wildlife would not be harassed or intentionally harmed (ACM A.5.5); and
- Where appropriate, restrict permitted activities in big game calving/fawning/lambing grounds and crucial summer range from April 15 through June 30 (ACM A.5.74), in crucial winter range from November 1 through March 31 (ACM A.5.75), and within occupied big horn sheep habitat from March 1 through May 31 and from July 1 through August 31 (ACM A.5.76).

<u>Conclusion</u>. Habitat for big game species would be temporarily disturbed by construction and a portion would be permanently converted to industrial uses as identified in **Tables 3.6-3** and **3.6-4**. There would be a loss of 24 acres of mule deer crucial summer habitat and 11 acres of desert bighorn sheep occupied habitat. Construction and facility maintenance impacts would include displacement of individuals and potential loss of breeding success from habitat alteration, exposure to construction/maintenance movements and noise, and higher levels of human activity (including traffic). The area of habitat affected by construction surface disturbance would represent less than 1 percent of the surface area of these habitat ranges within the hydrologic basins occupied by the GWD Project; however, the location of ROW construction or maintenance activities could impact local herds and migration corridors. Impacts as a result of ROW construction and facility maintenance would be reduced given the protections provided by the RMPs and the ACMs.

Proposed mitigation measures:

In order to address the permanent conversion of 24 acres of mule deer crucial summer habitat and 11 acres of desert bighorn sheep occupied habitat, as well as the long-term surface disturbance to mule deer crucial summer habitat (169 acres), mule deer crucial winter habitat (133 acres), and desert bighorn sheep occupied habitat (259 acres), mitigation measure ROW-WL-1 is proposed.

ROW-WL-1: Big Game Key Habitat Priority Restoration and Habitat Improvement. If surface disturbing activities impact key big game habitats (crucial summer and winter ranges for antelope, Rocky Mountain elk, or mule deer, or occupied desert bighorn sheep habitat), the SNWA would improve 2 acres of comparable habitat for every 1 acre of disturbed habitat. The SNWA would coordinate with the BLM and NDOW to determine the specific areas for big game key habitat improvements. <u>Effectiveness</u>: This measure would be effective in that it would improve habitat thus increasing the carrying capacity of the comparable big game habitat. <u>Effects on other resources</u>: Conducting habitat improvement work for big game may contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

Residual impacts include:

- The long-term (20 to 200 years) restoration periods for shrublands and woodlands in big game ranges disturbed by ROW construction make these habitats less suitable for forage and cover and contribute to habitat fragmentation.
- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.
- Potential big game mortalities may result from vehicle collisions.

Other Terrestrial Wildlife Species of Management Concern: Direct impacts to small mammals, reptiles, game and other bird species of management concern (including raptors) from surface-disturbance activities include the incremental, long-term surface disturbance of 12,208 acres of native shrubland and woodland habitat and would require 20 to more than 200 years for recovery to similar species composition and vertical structure as adjacent undisturbed areas. Sixty-four acres of annual and perennial grassland and marshland habitats would require from 2 to 20 years for recovery. See **Table 3.5-9** in Vegetation Resources for estimated vegetation community recovery times. Natural land habitat types that would be permanently converted to industrial uses would be 1,014 acres. Culturally significant species to regional Tribes in this group of wildlife include rabbits and various species of raptors. Potential impacts also would likely include mortalities of less mobile or burrowing species as a result of crushing from increased vehicle traffic and construction equipment and abandonment or loss of eggs or young. The project will not have any open water storage devices; water troughs proposed in ACMs A.5.72 and A.5.73 for wild horses and big game (**Appendix E**) will include escape ramps approved by the BLM so potential for small wildlife species entrapment and drowning would be minimized.

Indirect impacts include increased habitat fragmentation effects as a result of increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from increased traffic on unpaved roads during surface-disturbance activities. Fragmentation effects would be incremental, but species that require large tracts of unbroken habitat such as sagebrush obligate species may not be able to complete their life functions and this project may contribute to general population declines. General habitat fragmentation, accidental wildfire, and power line impacts are described at the beginning of the ROW areas section; other species-group fragmentation effects are described below.

If construction or facility maintenance were to occur during the breeding season for migratory bird species (approximately March to August, depending on the species, elevation, and location), then direct impacts to MBTA breeding birds could include abandonment of a new site or territory or the loss of eggs or young, resulting in a loss of productivity for the breeding season. Loss of an active nest site, incubating adults, eggs or young would violate the MBTA and potentially could affect populations of migratory bird species that occur within the project area. Management concern raptor species have also been documented in the basins crossed by the ROW (**Appendix F**, **Table F3.6-1**).

Fragmentation effects on upland game birds have been shown to impact populations adversely. Vehicular traffic may injure or kill individuals and local populations may experience higher levels of hunting and poaching pressure due to improved public access (Holbrook and Vaughan 1985).

For raptor species, fragmentation effects can result in the loss or alteration of habitat, reduction in prey base, and increased human disturbance. The loss of native habitat to human development has resulted in declines of hawks and eagles throughout the West (Boeker and Ray 1971; Schmutz 1984). In some cases, habitat changes have not reduced numbers of raptors but have resulted in shifts in species composition (Harlow and Bloom 1987). Impacts to small mammal populations due to habitat loss and fragmentation can result in a reduced prey base for raptors and lower raptor densities. Furthermore, the increased number of access roads associated with the GWD Project would lead to greater public access. As a result, raptors may be disturbed from nests and roosts, thereby leading to displacement and reduced nesting success (Holmes et al. 1993; Postovit and Postovit 1987; Stalmaster and Newman 1978). Noise levels and human activity also can preclude otherwise acceptable raptor habitat from use (Romin and Muck 2002). As with big game, vehicles that stop cause greater levels of disturbance to raptors than continuously moving vehicles (Holmes et al. 1993; White and Thurow 1985).

Elevated noise levels also contribute to fragmentation effects. In studies that examined the effects of high levels of daily traffic on bird densities located near paved roads, reductions in bird population densities from roads in both open grasslands and woodlands were attributed to a reduction in habitat quality produced by elevated noise levels (Reijnen et al. 1997, 1995). Although visual stimuli in open landscapes may add to density effects at relatively short distances, the effects of noise appear to be the most critical factor, since breeding birds of open grasslands (threshold noise range of 43 to 60 decibels on the A-weighted scale) and woodlands (threshold noise range of 36 to 58 decibels on the A-weighted scale) respond very similarly to disturbance by traffic volume (Reijnen et al. 1997). Reijnen et al. (1996) determined a threshold effect for bird species to be 47 decibels on the A-weighted scale, while a New Mexico study in a pinyon-juniper community found that effects of gas well compressor noise on bird populations were strongest in areas where noise levels were greater than 50 decibels on the A-weighted scale. However, moderate noise levels (40 to

50 decibels on the A-weighted scale) also showed some effect on bird densities in this study (LaGory et al. 2001). The applicant has provided information to the BLM that noise levels from stationary sources (pumping stations and pressure reducing stations), would not exceed 52 decibels on the A-weighted scale at 500 feet from these facilities.

The Ely RMP includes a BMP to install wildlife escape ramps in all watering troughs. In addition, a BMP would use current science, guidelines, and methodologies for all new power lines for the purpose of minimizing raptor and other bird electrocution and collision effects. The procedure for MBTA bird species consultation mentioned in ACM A.5.65 should include consultation with USFWS. Further, the Ely RMP management action (SS-4) and ACMs A.5.62 through A.5.69 provide protections for raptors.

In addition to providing a Compliance Inspection Contractor for construction monitoring (ACM A.1.2), the use of predictive models to identify critical nesting locations (ACM A.5.62), pre-construction and other surveys (ACMs A.5.64, 67, 68), compliance reporting (ACMs A.5.4, A.5.7), and raptor nest monitoring by qualified biologists (ACMs A.5.64 and 68), the applicant has committed to the following ACMs to reduce potential impacts to small mammal, game, and MBTA and other birds species of management concern (for more detail, see **Appendix E**):

- Develop a Construction Traffic Management plan, including measures to reduce the number of trips (ACM A.1.28);
- Develop a bird conservation strategy, including measures to reduce impacts to migratory birds, bald and golden eagles, and other sensitive birds (A.1.1);
- Impose speed-limit restrictions to reduce vehicle/wildlife impacts (ACM A.1.29);
- Install escape ramps in excavation areas, where these areas will be left open overnight; biological monitors will also check these areas periodically (ACM A.1.42);
- Provide assurances that wildlife would not be harassed or intentionally harmed (ACM A.5.5);
- Perch discouraging devices will be installed on power lines in sensitive species habitats (ACM A.5.8); and conduct initial ground clearing outside the critical nesting period for migratory birds as feasible (ACM A.5.63);
- Identify and use exclusion areas as feasible until birds have fledged or consultation with the BLM (ACM A.5.65);
- Conduct pre-construction tree removal (if during breeding season, pre-removal surveys will be conducted; if occupied, tree removal will wait until fledging and any necessary permits are obtained) (ACM A.5.68); and
- Include escape ramps for small wildlife in temporary water haul designs (ACM A.5.72).

<u>Conclusion</u>. 12,208 acres of native shrubland and woodland habitat would be removed or disturbed by construction and would require 20 to more than 200 years for recovery to similar species composition and vertical structure as adjacent undisturbed areas. Sixty-four acres of annual and perennial grassland and marshland habitats would require from 2 to 15 years for recovery. See **Table 3.5-9** in Vegetation Resources for estimated vegetation community recovery times. Natural land habitat types would have 1,014 acres permanently converted to industrial uses. Increased mortalities could occur given construction and facility maintenance activities and timing of activities could impact migratory bird and other species breeding. Fragmentation effects would incrementally contribute to species impacts. Impacts as a result of ROW construction and facility maintenance would be reduced given the protections provided in the RMPs and the ACMs.

Proposed mitigation measures:

ROW-WL-2: USFWS Concurrence on Plans. The SNWA would obtain concurrence from USFWS on any plans developed as part of the POD (ACM A.1.1) that address species protected under the MBTA or the BGEPA. <u>Effectiveness</u>: This measure would be effective in reducing impacts to nesting and breeding MBTA birds and eagles. <u>Effects on other resources</u>: Implementation of this measure would not adversely affect other environmental resources.

ROW-WL-3: Raptor Nest Survey and Avoidance. If surface disturbance activities may be initiated during raptor breeding and nesting seasons (as determined by the NDOW and the BLM), surveys for active raptor nests would be conducted by SNWA within suitable habitat, within 2 weeks prior to the anticipated start of surface disturbing construction activities. Raptor nests found during surveys would be addressed under the Ely RMP SS-4 management action, as well as protected under provisions of the MBTA and BGEPA as relevant. (SS-4: Where appropriate, restrict permitted activities from May 1 through July 15 within 0.5 mile of raptor nest sites unless the nest site has been determined to be inactive for at least the previous 5 years.) Effectiveness: This measure would be effective in avoiding impacts to nesting raptors. Effects on other resources: Conducting surveys would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife. This measure also could provide a record of other breeding bird species that could be potentially affected by the project.

Residual impacts include:

- The long-term (20 to 200 years) restoration periods for 12,208 acres of shrubland and woodland habitats disturbed by ROW construction would make these habitats unavailable for nesting, forage, and cover for other management concern species and contribute to habitat fragmentation.
- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.

Special Status Species

The impact analysis for special status terrestrial wildlife species focuses on those species that were identified as occurring or potentially occurring within the ROWs and project facility areas (**Appendix F**, **Table F3.6-1**). Species for which there is a record of occurrence in the proposed project ROWs and that could be affected by the Proposed Action and Alternatives A through C are presented in **Table 3.6-5**. Alternatives D, E, and F are a subset of these alignments and species with these ROWs would be the same or fewer. As a result, 1 federally listed species and 17 BLM Sensitive Species are analyzed in detail for construction and facility maintenance. Direct habitat impacts during construction (temporary) are presented in the first column, while facility maintenance (permanent) is presented in the second column. Impacts to special status species as a result of fragmentation, accidental wildfires and power lines are the same as generally described in the Habitat Loss, Fragmentation, Accidental Wildfires, and Power Line and Direct Disturbance Effects section. Species or groups of species are addressed in more detail in **Table 3.6-5**.

Desert Tortoise (Federally Threatened). Direct impacts to the desert tortoise would include the incremental, long-term reduction of 2,350 acres of desert tortoise habitat from construction of ROWs and project facilities (1,759 acres of designated critical habitat and approximately 591 acres of non-critical habitat) until reclamation activities are completed and native vegetation is reestablished. This temporary habitat loss would occur over an area in five hydrologic basins (Las Vegas, Garnett, Hidden, Coyote Spring, and Pahranagat valleys). The area of habitat affected by construction surface disturbance would represent approximately 1 percent of critical habitat and less than 0.1 percent of non-critical habitat within these basins. Facility maintenance would include permanent conversion of approximately 245 acres of critical habitat and 86 acres of non-critical habitat. Potential impacts also could result in the direct mortalities of individual tortoises, loss of burrows, and loss of eggs, as a result of crushing from increased vehicle traffic and construction equipment and potential proposed blasting. See Chapter 2 regarding SNWA's ACMs, including a blasting plan. Construction and facility maintenance activities could result in an increased risk of accidental wildfire. If fire occurred within tortoise habitat, it could alter habitat structure and vegetation available as food plants and individual tortoises could be lost. Also see the general discussion of accidental wildfire at the beginning of the ROW construction section.

Indirect impacts include increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic during surface-disturbance activities. This habitat change could cause a variety of impacts involving: barriers to movement, degradation of habitat, increased potential for mortality (e.g., stress-related mortalities may result due to disturbance), or illegal collection. Impacts from the operation of new power lines would include increased predation given the creation of additional perching sites for predators within tortoise habitat. Corvids (e.g., ravens and crows) also use power line structures for nest building, thereby increasing the population of these species (BLM 2001) and the potential for increased predation pressure on tortoises.

The Las Vegas and Ely RMPs include a requirement to manage desert tortoise habitat to achieve recovery criteria and ultimately to achieve delisting of the species. Desert tortoise management actions are described in the Las Vegas and Ely RMPs.

Table 3.6-5 Special Status Species Habitat Acreage Potentially Impacted by the Proposed Action and Alternatives A through C, Right-of-way Construction (Temporary) and Facility Maintenance (Permanent)

Common Name	Habitat (acres) (Temporary)	Habitat (acres) (Permanent)	Habitats
Federally listed species			
Desert tortoise	2,350 (1,759 critical/ 591 non-critical)	331 (245 critical/ 86 non-critical)	Shrubland, Mojave scrub
BLM Sensitive Species			
Mammals			
Pygmy rabbit[1]	3,634	235	Sagebrush shrubland
Bat species [2]	1,166 to 12,030	104 to 1,009	Various habitats potential foraging areas depending on species
Dark kangaroo mouse[1]	7,732	557	Shrubland
Birds			
Greater sage-grouse[3]	2,450/2,497	134/153	Preliminary priority habitat and preliminary general habitat
Golden eagles[1]	12,061	888	Most habitats, potential foraging areas
Bald eagle[1]	5,571	442	Most habitats, potential foraging areas
Ferruginous hawk[1]	5,173	331	Grassland, shrubland, woodland
Western burrowing owl[1]	11,621	858	Grassland, shrubland, marshland
Reptiles			
Gila Monster[1]	2,627	248	Mojave scrub, woodland
Invertebrates			
Mojave poppy bee	1,718	120	Mojave scrub in Coyote Spring Valley

[1] Acreages for these species are based on SWReGAP animal habitat models (USGS 2007).
[2] Bat species recorded in the ROW are listed in **Appendix F**, **Table F3.6-1** and include Big brown bat, Brazilian free-tailed bat, California myotis, fringed myotis, hoary bat, long-eared myotis, long-legged myotis, pallid bat, western pipistrelle, and western small-footed myotis. Acreage range in the table is given for the species with the least and most habitat potentially impacted by construction and facility maintenance (based on SWReGAP animal habitat model data), which are the long-eared myotis and western pipistrelle.
[3] Sage-grouse habitat data are from BLM 2012b.
Note: Temporary and permanent acreage numbers in the table may include a minimal acreage of facilities that currently exist. Therefore, the reported acreages conservatively overestimate the amount of disturbance anticipated by the proposed project by approximately 1 percent across all alternatives.

In addition to construction monitoring (ACM A.5.30), adherence to USFWS-approved desert tortoise survey protocols (ACMs A.5.17-20, 30), and acquisition of appropriate state and federal permits or letters of authorization prior to handling desert tortoises and their parts (ACM A.5.16), and development of a blasting plan (ACM A.1.1), the applicant has committed to the following ACMs to reduce potential impacts to desert tortoise (for more detail, see **Appendix E**):

- Excavation, handling and procedures for moving individuals out of harm's way (ACMs A.5.16-17, 21-27, A.5.34);
- Placement of exclusion fencing (ACM A.5.18);
- Speed-limit restrictions to reduce vehicle/wildlife impacts (ACM A.1.29);
- Escape ramps to be installed at excavation areas that are left open overnight and checked periodically by a biological monitor (ACM A.1.42);
- Assurances that wildlife would not be harassed or intentionally harmed (ACM A.5.5);
- Hydrostatic water discharge plans (ACM A.1.64);
- Installation of perch discouraging devices (ACM A.5.8); and

- Reporting of acres disturbed, remuneration fees paid, and number of tortoises taken during the project activities (ACM A.5.36).

Conclusion. Compliance with the ESA would require implementation of measures to reduce the effects of anticipated take of desert tortoise, including through habitat loss or degradation. The USACE has designated the BLM as the lead federal agency to act on their behalf for the purposes of section 7 of the ESA (see Chapter 1). Potential impacts would be reduced based on compliance with recovery plans and RMPs and adherence to ACMs.

Proposed mitigation measures:

The applicant would coordinate with the USFWS on this species. No additional mitigation beyond what would be determined by USFWS would be proposed.

Residual impacts include:

- The long-term (100 to 200 years) restoration period for Mojave mixed desert scrub in areas disturbed by ROW construction makes this habitat unavailable for nesting, forage, and cover for tortoise and contributes to habitat fragmentation.
- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.
- Potential mortalities to tortoises may occur due to construction activities.

Greater Sage-grouse (Federal Candidate). Direct impacts of construction to this species would include the incremental long-term loss of PPH and PGH in the valleys listed in **Table 3.6-6**. Facility maintenance would result in the permanent loss of PPH and PGH shown in **Table 3.6-6**. With over 500,000 acres of PGH and over 900,000 acres of PPH in the seven basins crossed by the ROW, the area of habitat affected by construction surface disturbance would represent less than 1 percent of the surface area of these habitat types in the basins. As explained in the Affected Environment section, 31 leks were identified within 4 miles of the proposed ROWs (**Table 3.6-7**). Of the 31 leks identified, 19 are considered active; however, no known active lek sites occur within 0.25 mile of the proposed disturbance areas for the project. Other direct impacts could include the loss of nests, eggs, or young. These 19 active leks also are within 4 miles of proposed overhead power line ROWs.

Table 3.6-6 Summary of Greater Sage-grouse Preliminary Priority and Preliminary General Habitat Acreages Potentially Impacted by Proposed Action and Alternatives A through C, Construction (Temporary) and Facility Maintenance (Permanent)

Basin	Preliminary Priority Habitat (Temp.)	Preliminary Priority Habitat (Perm.)	Preliminary General Habitat (Temp.)	Preliminary General Habitat (Perm.)
Cave	699	21	0	0
Dry Lake	0	0	694	28
Hamlin	0	0	178	0
Lake	263	22	142	10
Snake	0	0	558	27
Spring	1,236	77	855	83
Steptoe	251	14	51	3
Total	**2,450**	**134**	**2,497**	**153**

Table 3.6-7 Summary of Greater Sage-grouse Active, Inactive, and Historic Lek Locations within 4 Miles of the Proposed Action and Alternatives A through C, Right-of-way (Temporary)

Basin	Population Management Unit	Active	Inactive	Historic	Unknown	Total # of Leks
Cave Valley	Cave	5	0	0	0	5
Lake Valley North	Lincoln	2	2	0	0	4
Hamlin Valley	Spring/Snake Valley	0	0	1	0	1
Snake Valley	Spring/Snake Valley	1	0	3	0	4
Spring Valley - White Pine, Lincoln	Spring/Snake Valley	4	0	0	1	5
Spring Valley - White Pine, Lincoln	Lincoln	2	2	0	0	4
Steptoe Valley	Butte/Buck/White Pine	0	0	0	1	1
Steptoe Valley	Steptoe/Cave	4	0	1	1	6
Steptoe Valley	Schell/Antelope	1	0	0	0	1
Total		**19**	**4**	**5**	**3**	**31**

Indirect impacts include increased habitat fragmentation effects as a result of increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic during surface disturbance activities. Nest or lek abandonment could result from increased human noise and presence close to an active nest or lek site. Additional potential impacts from power lines and roads include disruption of seasonal movements, increased collision potential as well as increased predation or harassment by raptors, corvids, and coyotes. Sage-grouse may also avoid habitat near utility lines as a result of the perceived threat of predation (Atamian et al. 2007).

There are 19 active leks (5 in Cave Valley, 1 in Snake Valley, 5 in Steptoe Valley, 1 in Lake Valley, and 7 in Spring Valley) located within 4 miles of proposed overhead power lines. The alignment of the proposed power line ROW falls within the designated LCCRDA corridor as it passes near the majority of these leks. Seven of the 19 leks are impacted by power line alignments that fall outside designated corridors: 2 in Spring Valley in line-of-sight of the 25 kV power line, 1 in Snake Valley outside of line-of-sight of the 25 kV power line, and 4 in Steptoe Valley in line-of-sight of the 230 kV power line. Impacts to leks near power lines vary given a number of factors related to line-of-sight including: distance between the power line and the lek; cardinal direction (east/west) of the power line from the lek; background of the view; and topography (BLM 2001). Leks most at risk for increased avian predation would be a short distance west of a power line that is on flat ground or on ground with a slope that faces toward the power line, and a mountain range or some other backdrop to obscure the outline of a perched predator (BLM 2001). Other leks near power lines also may experience impacts from predators depending on the combination of these orientation factors.

Additionally, **Table 3.6-8** lists the acreages of PPH and PGH within 4 miles of proposed power line ROWs. While Dry Lake Valley does not have lek sites, there is PPH and PGH within 4 miles of power line ROW. The percent of PPH potentially indirectly impacted by the proposed power line ROWs is shown in **Table 3.6-8**. Sage-grouse may abandon certain areas within and near the proposed project due to loss or alteration of habitat as a result of construction or facility maintenance activities. Sage-grouse are considered culturally significant to regional Tribes.

Table 3.6-8 Summary of Greater Sage-grouse PPH and PGH Acreages Potentially Indirectly Impacted by Proposed Action and Alternatives A through C, within 4 miles of Power Line ROWs

Basin	Greater Sage-grouse PPH within 4 Miles of Power Line ROW (Acres)	Greater Sage-grouse PGH within 4 Miles of Power Line ROW (Acres)	Total Greater Sage-grouse PPH within the Valley	Percent of Total Greater Sage-grouse PPH within the valley that falls within 4 Mile of Power Line ROW (%)
Cave	42,689	3,863	86,900	49
Dry Lake	85	79,108	194	44
Hamlin	0	8,187	69,125	0
Lake	23,258	29,767	34,699	67
Pahroc	4,880	0	7,448	66
Snake	5,382	25,778	24,681	22
Spring (SLD)	104,207	48,915	291,889	36
Steptoe	62,357	28,659	408,851	15
White River	39	0	105,984	Less than 1
Total	**242,897**	**224,277**	**1,029,771**	**24**

SLD: Salt Lake Desert (flow system) as opposed to Spring [201].

In addition to providing a Compliance Inspection Contractor for construction monitoring (ACM A.1.2) and the development of a greater sage-grouse monitoring program in priority habitat that addresses demographics, vital rates, and seasonal movement patterns, as recommended by the NGSCT (2010) (ACM A.5.50), the applicant has committed to the following ACMs to reduce potential impacts to greater sage-grouse (for more detail, see **Appendix E**):

- Site facilities as much as possible to limit disturbance in priority sage grouse habitat, be within designated utility corridors, and be co-located along existing ROWs including power lines and roads, per the National Greater Sage-Grouse Conservation Measures report (BLM 2011b) (ACM A.5.49);
- Design and operation of lighting to reduce visual impacts (ACMs A.11.2 and A.11.3), which also would benefit greater sage-grouse;
- No spraying of herbicides within exclusion areas containing sensitive resources (ACM A.1.89);
- Construction scheduling restrictions (ACMs A.5.51);
- Site and design electrical transmission lines in accordance with the NGSCT (2010), where placement of power lines within 3 miles of an active lek cannot be avoided. (ACM A.5.52);
- Enhanced restoration measures (ACM A.5.53);
- Installation of perch discouraging devices (ACM A.5.8); and
- Habitat enhancement (ACMs A.5.54, A.5.55, A.5.56).

The applicant also is working on development of a Candidate Conservation Agreement with Assurances to provide benefit to specific species (including greater sage-grouse and pygmy rabbit) that occur on SNWA private properties in Spring Valley and associated grazing allotments. ACMs would reduce impacts to sage-grouse from the construction and maintenance of project facilities. ACM A.5.51 limits activities within 4 miles of active leks during breeding, nesting and early brood-rearing periods (generally March through June). This ACM addresses many potential impacts during this critical season and location for sage-grouse, but the timeframe and language of this ACM is not restrictive enough. Further, ACM A.5.8 will reduce potential impacts from predators, but perch deterrents are not completely effective, nor do they address the potential issue of habitat abandonment. Finally, ACM A.5.50 addresses monitoring of sage-grouse in priority habitat in the project area, but the monitoring should be further clarified and the area should be expanded.

IM 2012-043 states that the policies and procedures outlined in the IM are in addition to and do not replace more protective measures in existing land use plans. SNWA, in their original ACMs, included management actions from the Ely RMP that were applicable to greater sage-grouse. Given the evolving nature of the greater sage-grouse policies, SNWA updated their measures to reflect their understanding of what is required under the IM. BLM, in coordination with NDOW, will implement the intent of IM 2012-043 as well as work to amend their RMP in accordance with IM 2012-044. In the intervening time, management actions in the RMP and direction in the IM will be applied to this project; where the two documents conflict, the IM will take precedence.

Ely RMP management actions SS-40 and SS-42 are considered as included for the purposes of this analysis. SS-40 restricts the construction of above-ground facilities within 0.25 mile of a lek outside of designated corridors and underground facilities will not be installed within 0.25 mile of a lek unless the vegetation can be established to pre-disturbance conditions within a reasonable period of time. It also states that no new roads will be constructed within 0.25 mile of leks. Exceptions may be granted by the authorized officer. SS-42 restricts permitted activities from November 1 through March 31within greater sage-grouse winter range, where appropriate.

Conclusion. Habitat for greater sage-grouse would be temporarily disturbed by construction and a portion would be permanently converted to industrial uses as identified in **Tables 3.6-6** through **3.6-8**. Nineteen active leks fall within 4 miles of project ROWs. Construction and facility maintenance impacts could include loss of nests, eggs, or young, nest or lek abandonment, and increased potential for disruption of seasonal movements, collisions with power lines and vehicles, and predation or harassment. RMP management actions and ACMs would reduce potential impacts to greater sage-grouse.

Proposed mitigation measures:

While ACM A.5.8 would reduce potential impacts from predators, perch deterrents are not completely effective, nor would they address the potential issue of habitat abandonment. Given the importance of avoiding impacts to leks where practicable, mitigation measure ROW-WL-4 is proposed. Other ACMs, as listed above, would potentially reduce impacts to greater sage-grouse from the construction and maintenance of project facilities. In addition, mitigation measures ROW-WL-5, ROW-WL-6, ROW-WL-7, ROW-WL-9, and ROW-WL-10 are proposed. ACM A.5.50 would implement a monitoring plan; ROW-WL-8 further clarifies that monitoring plan.

ROW-WL-4: **Specific Lek Avoidance – Burying Power Lines**. For the power line in Cave Valley, the SNWA would bury the portion of the 25-kV line within the 4-mile buffer of the active leks in Cave Valley. For the power line in Snake Valley, the portion of the 25-kV line within the 4-mile buffer of the active lek would be buried. If technology at the time of construction allows, lines greater than 25-kV would also be buried. Effectiveness: This measure would be effective in avoiding power line associated impacts to these specific leks. Effects on other resources: Burying these power line segments would result in additional surface disturbance and could affect various other resources. These proposed segments are adjacent to the proposed pipeline ROW, so impacts are likely to be similar to those along the pipeline. This measure would potentially reduce impacts to visual resources in these portions of Cave and Snake valleys.

ROW-WL-5: **Specific Lek Avoidance –Siting of Power Lines**. Outside the LCCRDA corridor, the SNWA would site 230-kV power lines west of active leks at sufficient distances to avoid line-of-sight with leks. Effectiveness: This measure would be effective in avoiding increased predation of leks due to additional perching sites for raptors and corvids as well as minimizing potential lek abandonment. Effects on other resources: Locations selected to avoid active sage-grouse leks will be evaluated by the BLM for management consistency with other resource values.

ROW-WL-6: **Habitat Restoration to Benefit Greater Sage-grouse for Permanently Converted Habitat**. Restore greater sage-grouse habitat on public lands at a ratio of 2 acres for every acre of PPH or PGH (or designated priority or general habitat) that is permanently converted. The SNWA would coordinate with the BLM and the NDOW to determine the specific areas and timing for restoration activities. Effectiveness: This measure would be effective in mitigating permanent impacts to sagebrush habitat to benefit greater sage-grouse depending on the type, timing, and location of restoration activities. Effects on other resources: Conducting restoration activities would contribute to noise and human presence disturbance to wildlife as well as the potential for vehicle collisions to wildlife. This measure may also benefit other sagebrush obligate species like the pygmy rabbit.

ROW-WL-7: **Habitat Restoration to Benefit Greater Sage-grouse for Other Disturbed Habitat**. Restore greater sage-grouse habitat on public lands for PPH and PGH (or designated priority or general habitat) that is avoided because of temporary habitat loss due to construction and presence of above ground structures. The SNWA would coordinate with the BLM and the NDOW to determine the specific areas, acres, and timing for restoration activities. Effectiveness: This measure would be effective in mitigating impact to sagebrush habitat to benefit greater sage-grouse depending on the type, timing, and location of restoration activities. Effects on other resources: Conducting restoration activities would contribute to noise and human presence disturbance to wildlife as well as the potential for vehicle collisions to wildlife. This measure may also benefit other sagebrush obligate species like the pygmy rabbit.

ROW-WL-8: Greater Sage-grouse Monitoring. In consultation with BLM, NDOW, and USFWS, SNWA would implement a monitoring program before, during, and after the construction phase for greater sage-grouse in the project area that addresses demographics, vital rates, and seasonal movement patterns, as recommended by the Nevada Energy and Infrastructure Standards to Conserve Greater Sage-Grouse (NGSCT 2010) or the most recent standards document approved prior to the start of the monitoring effort. The project area that is relevant to greater sage-grouse would be determined based on best available science at the time of the start of the monitoring effort. Currently, it would include birds using leks within 4 miles of the project area. Effectiveness: This measure would be effective in providing additional baseline information as well as information on birds using the project area. Effects on other resources: Conducting surveys would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

ROW-WL-9: Greater Sage-grouse Timing Restriction Breeding, Nesting, and Early Brood-Rearing. Restrict permitted activities within 4 miles of active greater sage-grouse leks during the breeding, nesting, and early brood-rearing periods (generally March 1 through July 31). Effectiveness: This measure would be effective in avoiding activities during a key time frame for greater-sage grouse. Effects on other resources: Restricting activities during one time period can move work to occur during other seasons, which may impact important activities for other wildlife species or resources.

ROW-WL-10: Greater Sage-grouse Timing Restriction Winter Range. Restrict permitted activities from November 1 through March 31 within greater sage-grouse winter range. Effectiveness: This measure would be effective in avoiding activities during a key time frame for greater-sage grouse. Effects on other resources: Restricting activities during one time period can move work to occur during other seasons, which may impact important activities for other wildlife species or resources.

ROW-WL-11: Fence Marking for Greater Sage-grouse. Fencing used by the project in greater sage-grouse habitat would be adequately marked following accepted methods and approved by BLM prior to installation. Effectiveness: This measure would be effective in minimizing the potential for greater sage-grouse collisions with project fences. Effects on other resources: Marked fences also will be visible to other wildlife and people. Visual resources would be negatively impacted by marked fences.

ROW-WL-12: Co-location of Power Lines. Co-locate proposed utility lines where technically feasible. Effectiveness: This measure would be effective in reducing the amount of infrastructure associated with multiple utility lines, thus reducing potential perching sites and reducing the amount of above ground structures that may cause greater sage-grouse to avoid habitat. Effects on other resources: Minimizing the amount of above-ground infrastructure also may reduce impacts on other resources depending on the selected route for collocation.

Residual impacts include:

- The long-term (20 to 50 years) restoration periods for sagebrush shrubland habitats disturbed by ROW construction make these habitats less suitable for forage and cover for greater sage-grouse.
- An unknown portion of habitats may be degraded because recovery did not fully occur or proximity to permanent facilities makes the habitat less suitable.
- Nine leks within 4 miles of the ROW sited within the LCCRDA corridor may be attended by fewer males or abandoned given the proximity of the overhead power lines.

Raptors: Direct impacts to these species would include the long-term reduction of approximately 12,061 acres of golden eagle habitat in 13 valleys (Cave, Coyote Spring, Delamar, Dry Lake, Garnet, Hamlin, Hidden, Lake, Las Vegas, Pahranagat, Snake, Spring, and Steptoe valleys), and 5,173 acres of ferruginous hawk nesting or foraging habitat in 10 valleys (Cave, Coyote Spring, Delamar, Dry Lake, Hamlin, Lake, Pahranagat, Snake, Spring, and Steptoe valleys). Since bald eagles do not nest in the project area, direct impacts would include the long-term reduction of approximately 5,571 acres of foraging habitat in the same 13 valleys as listed for golden eagles. This would result in a reduction in the amount of available habitat for this species until reclamation activities are completed and native vegetation is reestablished. Note that SWReGAP data may overestimate the amount of habitat used by bald eagles which have only been recorded in the valleys listed in the affected environment ROW section. Habitat loss is expected to have little effect on these raptor populations, based on the amount of suitable breeding and foraging habitat in the surrounding area. Facility maintenance would result in the permanent conversion of 888 acres of golden eagle nesting and foraging habitat in 11 valleys (those listed above, except Hamlin and Pahranagat); 331 acres of ferruginous hawk nesting and foraging habitat in 6 valleys (Cave, Dry Lake, Lake, Snake, Spring, and Steptoe); and 442 acres of bald eagle foraging habitat. If construction or facility maintenance activities were to occur during the breeding season (March through August), then direct impacts to breeding raptors could include the possible direct loss of nests, eggs, or young.

As discussed in the affected environment section, a total of 2 active ferruginous hawk nests were recorded within a 0.5 mile buffer of the ROWs in Snake and Spring valleys (Klinger and Williams 2005). NDOW's raptor database recorded numerous historic ferruginous hawk nests and one historic golden eagle nest within the ROW or a 0.5 mile buffer of the ROW. If construction or facility maintenance activities were to occur within 0.5 mile of an active raptor nest during breeding season, direct impacts could include abandonment of a new site or territory or the loss of eggs or in young, resulting loss of productivity for the breeding season. Loss of an active nest site, incubating adults, eggs or young would violate the MBTA and potentially could affect populations of raptor species that occur within the GWD Project area. In order to avoid impacts to active golden eagle and ferruginous hawk nests as well as nests of other raptor species, mitigation measure ROW-WL-3 is proposed.

Indirect impacts include increased habitat fragmentation effects as a result of increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic during surface disturbance activities. However, the degree of these potential impacts would depend on a number of variables including the location of the nest site, the species' relative sensitivity, breeding phenology, and possible topographic shielding. Nest abandonment could result from increased human noise and presence close to an active nest site.

Fragmentation effects for raptor species can result in the loss or alteration of habitat, reduction in prey base, and increased human disturbance. The loss of native habitat to human development has resulted in declines of hawks and eagles throughout the West (Boeker and Ray 1971; Schmutz 1984). In some cases, habitat changes have not reduced numbers of raptors, but they have resulted in shifts in species composition (Harlow and Bloom 1987). Impacts to small mammal populations due to habitat loss and fragmentation can result in a reduced prey base for raptors, resulting in lower raptor densities. Thompson et al. (1982) and Woffinden and Murphy (1989) found that golden eagles and ferruginous hawks had lowered nesting success where native vegetation had been lost and was unable to support jackrabbit (prey) populations. Furthermore, the increased number of access roads with the project would lead to greater public access. As a result, raptors may be disturbed from nests and roosts, thereby leading to displacement and reduced nesting success (Holmes et al. 1993; Postovit and Postovit 1987; Stalmaster and Newman 1978). Noise levels and human activity also can preclude otherwise acceptable raptor habitat from use (USFWS 2002). As with big game, vehicles that stop cause greater levels of disturbance to raptors than continuously moving vehicles (Holmes et al. 1993; White and Thurow 1985). Certain species of raptors are considered culturally significant to regional Tribes.

In addition to conducting occurrence surveys (ACM A.5.64), monitoring of construction (ACM A.1.2) and of known nests by qualified biologists (ACM A.5.68), use of predictive models to identify critical nesting locations (ACM A.5.62), and compliance reporting (ACM A.5.4 and A.5.7), the applicant has committed to the following ACMs to reduce potential impacts to these species (for more detail, see **Appendix E**):

- Develop a bird conservation strategy (BCS), including measures to reduce impacts to migratory birds, bald and golden eagles, and other sensitive birds (A.1.1);

- Pre-construction tree removal outside of nesting season as feasible and identification of exclusion areas; no eagle nests would be removed without obtaining proper permits (ACM A.5.68);
- Where appropriate, restriction of permitted activities from May 1 through July 15 within 0.5 mile of raptor nest sites unless the nest site has been determined to be inactive for at least the previous 5 years, (ACM A.5.69); and
- Design and construction of power poles and lines in accordance with APLIC (2006) recommendations (ACM A.5.66).

The USFWS issued a letter May 2012 (USFWS 2012) regarding BGEPA compliance for the proposed project that explains SNWA is developing a BCS and that a pre-construction monitoring program has been initiated.

Conclusion. Habitat for raptors would be temporarily disturbed by construction and a portion would be permanently converted to industrial uses as identified above. Habitat loss is expected to have little effect on these raptor populations, based on the amount of suitable breeding and foraging habitat in the surrounding area. ACMs and protections afforded in the RMPs would reduce potential impacts to raptors; however, impacts could result if construction or facility maintenance activities were to occur within 0.5 mile of an active raptor nest.

Proposed mitigation measures:

ROW-WL-3: Raptor survey and avoidance (Bald and Golden eagles are addressed in ROW-WL-13). ROW-WL-3 would be applied to address the potential for impacts from construction or facility maintenance activities within 0.5 mile of an active raptor nest.

ROW-WL-13: Eagle Nest Avoidance. Construction activities would be restricted within a 1-mile buffer zone, if a pair of breeding/nesting eagles is observed during raptor surveys. Construction may resume after eagles have fledged or the nest is abandoned. Effectiveness: This measure would be effective in avoiding impacts to nesting eagles. Effects on other resources: Conducting surveys would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife.

Residual impacts include:

- The long-term (20 to 200 years) restoration periods for shrubland and woodland habitats disturbed by ROW construction make these habitats less suitable for forage and potential nesting sites for golden eagles or ferruginous hawks as well as less suitable for forage for bald eagles; and
- An unknown portion of habitats may be degraded because recovery did not fully occur or proximity to permanent facilities makes the habitat less suitable.

Western Burrowing Owl: Direct impacts to these species would include the incremental, long-term reduction of habitat quality in approximately 11,621 acres of nesting and foraging habitat in 13 valleys (Cave, Coyote Spring, Delamar, Dry Lake, Garnet, Hamlin, Hidden, Lake, Las Vegas, Pahranagat, Snake, Spring, and Steptoe valleys). The area of habitat affected by construction surface disturbance would represent less than 1 percent of modeled burrowing owl habitat within these basins. Facility maintenance would result in the permanent conversion of 858 acres of nesting and foraging habitat in 13 valleys, with habitat in Hamlin and Pahranagat valleys being marginally impacted. Other direct and indirect impacts would be the same as those discussed for golden eagle and ferruginous hawk.

In addition to pre-construction surveys in suitable habitat during nesting season (ACM A.5.41), avoiding active nesting burrows when feasible and identifying these avoidance areas using construction fencing (ACM A.5.42), the applicant has committed to the following ACMs to reduce potential impacts to this species (for more detail, see **Appendix E**):

- Seasonal restrictions during the active nesting season unless a qualified biologist verifies through non-invasive means that either: 1) the birds have not begun egg laying and incubation and 2) juveniles from the occupied burrows are foraging independently and are capable of independent survival, or the birds are no longer displaying evidence of nesting (ACM A.5.47);

- Mitigation for destruction of any active burrows within the ROW with enhanced or new burrows on adjacent BLM lands at a ratio of 2:1, with two enhanced or new burrows to each one active burrow that will be destroyed (ACM A.5.43); and
- Passive relocation of individuals during the fall to winter season prior to the start of construction, in coordination with the BLM, NDOW, and the USFWS (ACM A.5.44).

Conclusion. Habitat for burrowing owl would be temporarily disturbed by construction and a portion would be permanently converted to industrial uses as identified above. Habitat loss is expected to have little effect on burrowing owl populations in these basins, based on the amount of suitable breeding and foraging habitat in the surrounding area and the ACMs for this species. RMP guidance would further reduce potential ROW construction and facility maintenance impacts to the western burrowing owl.

Proposed mitigation measures:

None.

Residual impacts include:

- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.

Additional Special Status Birds: Direct and indirect impacts to additional special status birds would be the same as described for management concern birds earlier in the section. Mitigation measure ROW-WL-2 (USFWS Concurrence on Plans) and ROW-WL-3 (raptor nest survey and avoidance) would also apply to special status MBTA birds and raptor species. ACMs also would be the same.

Pygmy Rabbit: Direct impacts would result in the long-term reduction of approximately 3,634 acres of sagebrush habitat within the ROW and ancillary facility areas in nine basins (Cave, Delamar, Dry Lake, Hamlin, Lake, Pahranagat, Snake, Spring, and Steptoe). This would result in an incremental reduction in the amount of available habitat for this species until reclamation activities are completed and native vegetation is reestablished. The area of habitat affected by construction surface disturbance represents less than 1 percent of modeled pygmy rabbit habitat within these basins. Facility maintenance activities would result in the permanent conversion of 235 acres of habitat in four basins (Cave, Dry Lake, Lake, and Spring). Potential impacts also include the direct mortality of individual rabbits and loss of burrows (as a result of crushing from increased vehicle traffic and construction equipment, if present).

Indirect impacts include increased habitat fragmentation effects as a result of increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic during surface-disturbance activities. General habitat fragmentation, accidental wildfire, and power line impacts are described at the beginning of the ROW areas section, although it is important to note fragmentation of sagebrush habitat is of particular concern for pygmy rabbits because of their limited dispersal potential (Weiss and Verts 1984). Impacts from the operation of new power lines would include increased predation given the creation of additional nesting and perching sites for predators within pygmy rabbit habitat. Rabbits are considered culturally significant to regional Tribes.

The Ely RMP management action (E:SS-10) requires mitigation for the loss of special status species habitat as a result of discretionary permitted activities. Mitigation ratios are 2 acres of comparable habitat for every 1 acre of lost habitat, with the lost acreages determined on a project-by-project basis. ACM A.5.58 will address the loss of occupied pygmy rabbit habitat. ACM A.5.56 would conduct habitat treatments to benefit greater sage-grouse on federal lands outside the ROWs, equal to the acreage of sagebrush habitat disturbed by construction. These may also benefit pygmy rabbit if appropriate soil conditions are present. Acreage of sagebrush disturbed is presented in **Table 3.5-9**, Vegetation Resources. As mentioned under the greater sage-grouse discussion, the applicant also is working on development of a Candidate Conservation Agreement with Assurances for SNWA private properties in Spring Valley which could also benefit this species.

In addition to providing a Compliance Inspection Contractor for construction monitoring (ACM A.1.2) and surveys (ACM A.5.57), the applicant has committed to the following ACMs to reduce potential impacts to pygmy rabbit (for more detail, see **Appendix E**):

- Habitat improvement, habitat mitigation, livestock management, passive relocation, and enhanced restoration measures (ACMs A.5.58, A.5.59, A.5.60);
- Speed-limit restrictions that would reduce vehicle/wildlife impacts (ACM A.1.29);
- Design and operation of lighting to reduce visual impacts (ACMs A.11.2 and A.11.3), which also may benefit pygmy rabbits.
- Escape ramps to be installed at excavation areas that are left open overnight and checked periodically by a biological monitor (ACM A.1.42);
- Assurances that wildlife would not be harassed or intentionally harmed (ACM A.5.5); and
- Installation of perch discouraging devices (ACM A.5.8).

In ACM A.5.57, SNWA commits to conducting surveys for pygmy rabbit in the ROW in areas where pygmy rabbit have been recently documented or their sign observed. Given the potential lag time between the ROW pygmy rabbit survey conducted by SNWA and the construction of the proposed project, as well as other measures that may be implemented as a result of greater sage-grouse and MBTA nesting birds, it is appropriate to develop a survey methodology with the best available science 1-year prior to the time of construction and to use the best available science at the time. Similarly, ACM A.5.58 improves comparable habitat 2:1 for every 1 acre of occupied pygmy rabbit habitat. Given the current difficulty in accurately determining burrow activity (active/inactive) and recent research regarding pygmy rabbit movements from natal territories, areas currently unoccupied may become occupied if appropriate conditions exist. Key habitat features will be critical to the usefulness of the improved habitat conditions (e.g. appropriate soil types). Given the sensitivity of pygmy rabbits to fragmentation, project disturbance that interrupts occupied habitat will likely inhibit movement of rabbits across the ROW.

<u>Conclusion</u>. Habitat for pygmy rabbits would be temporarily disturbed by construction and a portion would be permanently converted to industrial uses as identified above. Protections defined in the RMPs and the ACMs would reduce potential ROW construction and facility maintenance impacts to pygmy rabbit.

Proposed mitigation measures:

While ACM A.5.57 commits to conducting surveys, mitigation measure ROW-WL-14 (Pygmy Rabbit Survey) clarifies when and in what habitat the surveys would be conducted. Similarly, ACM A.5.58 improves comparable habitat at a 2:1 ratio, ROW-WL-15 (Pygmy Rabbit Habitat Improvement) adds additional detail. Pygmy rabbit habitat improvement, as developed by the BLM and the SNWA in coordination with NDOW and USFWS, will need to occur in areas where correct soil conditions exist, so that priorities for improvement projects will likely be in areas of pinyon/juniper encroachment/invasion; areas where invasive species have negatively impacted known or former habitat; and areas where fires have impacted known or former habitat. Mitigation measure ROW-WL-16 (Priority Reclamation in Pygmy Rabbit Habitat) is proposed to more quickly reclaim areas of the ROW where occupied pygmy rabbit habitat has been fragmented. Mitigation measure ROW-WL-17 (Unanticipated Nesting Pygmy Rabbits) is proposed to avoid potential for loss of individual pygmy rabbits that may not have moved during passive relocation efforts.

ROW-WL-14. Pygmy Rabbit Surveys and Passive Relocation. Surveys would be conducted by qualified biologists prior to mowing and initial ground disturbance. Mowing to encourage passive relocation would be conducted between October 1 and February 15. Survey design would use the most recent BLM-approved pygmy rabbit survey and relocation protocol, and in coordination with NDOW and USFWS, include three key components: potential habitat survey; a subsequent pygmy rabbit sign survey conducted during best season for detection in Nevada; and a timeline for completion of these surveys that allows for passive relocation of rabbits ahead of initial ground-disturbing activities between October 1 and February 15. <u>Effectiveness</u>: This measure would be effective in identifying pygmy rabbit habitat and ensuring rabbits are moved out of project disturbance areas using passive relocation techniques. <u>Effects on</u>

other resources: Conducting surveys would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife. Passive relocation efforts would also avoid potential impacts to nesting MBTA birds.

ROW-WL-15. Pygmy Rabbit Habitat Improvement. For the direct loss of occupied pygmy rabbit habitat, 2 acres of comparable habitat for every 1 acre of disturbed habitat would be improved. SNWA would coordinate with the BLM and NDOW to determine the specific areas for pygmy rabbit habitat improvements. Effectiveness: This measure would be effective in improving pygmy rabbit habitat in areas that would benefit the species. Effects on other resources: Improvements to sagebrush habitat will benefit other sagebrush dependent species. Habitat improvement efforts could negatively impact other species if they are conducted during a time frame sensitive to those species.

ROW-WL-16. Priority Reclamation Efforts in Pygmy Rabbit Habitat. Areas of disturbance along the ROW where passive relocation activities are conducted would be evaluated by the BLM in coordination with NDOW. Based on this evaluation, SNWA would prioritize reclamation, including but not limited to the planting of sagebrush seedlings, within the areas of disturbance to facilitate movement of rabbits across the ROW. These areas would be specifically identified in the Restoration Plan (ACM A.1.69) and considered in conjunction with efforts under ACM A.5.53 (Enhance restoration for greater sage-grouse). Effectiveness: This measure would be effective in shortening the time between disturbance and reclamation of pygmy rabbit habitat. Effects on other resources: Reclamation of sagebrush habitats early in the reclamation process will benefit other sagebrush dependent species.

ROW-WL-17. Unanticipated Nesting Pygmy Rabbits. If nesting pygmy rabbits are found during construction despite efforts of passive relocation, construction activities would be restricted within an appropriate buffer zone as approved by BLM in coordination with NDOW and USFWS. Effectiveness: This measure would be effective in avoiding direct loss of individuals that may not have moved out of the construction area during passive relocation efforts. Effects on other resources: No effects on other resources are anticipated.

Residual impacts include:

- The long-term (20 to 50 years) restoration period for sagebrush shrubland habitat disturbed by ROW construction makes this habitat unavailable for forage and cover for pygmy rabbit and contributes to habitat fragmentation.
- An unknown portion of habitat may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.

Bats: Direct impacts to special status bat species (i.e., big brown bat, Brazilian free-tailed bat, California myotis, fringed myotis, hoary bat, long-eared myotis, long-legged myotis, pallid bat, western pipistrelle, and western small-footed myotis; **Appendix F**, **Table F3.6-1**) would include the long-term reduction of foraging habitat within all the basins crossed by the ROW and ancillary facilities. This would result in an incremental reduction in the amount of available habitat for these species until reclamation activities are completed and native vegetation is reestablished. To demonstrate the range of impacts to bat habitat acreages, two species, the western pipistrelle and the long-eared myotis, were selected to provide the range of potential habitat impacts based on the difference in their SWReGAP modeled habitats. Approximately 12,030 acres of foraging habitat for western pipistrelle would be impacted during construction and 1,009 acres would be permanently converted. The area of habitat affected by construction surface disturbance would represent less than 1 percent of modeled western pipistrelle habitat within 13 basins crossed by the ROW. Long-eared myotis, one of the species not recorded in the ROW but that has been identified as having reasonable expectation of occurrence based on best available knowledge by wildlife management agencies, would have approximately 1,166 acres of foraging habitat impacted due to construction activities. The area of habitat affected by construction surface disturbance would represent less than 1 percent of modeled long-eared myotis habitat within 13 basins crossed by the ROW. Facility maintenance would convert 104 acres of foraging habitat for this species. No winter hibernacula, nursery colonies, or maternity roosts have been identified at proposed project facilities for any bat species; however, tree-clearing for ROW construction could result in loss of roosting sites for tree-roosting species. There may also be increased potential for mortality to bats from power line collisions.

Indirect impacts include increased habitat fragmentation effects as a result of increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic during surface-disturbance activities. Many bat species are easily disturbed by noise and human presence (Oliver 2000). These species are especially sensitive to disturbance during roosting, maternity, and parturition. Abandonment of roost sites may occur due to increased human presence and noise disturbance (Oliver 2000).

In addition to providing a Compliance Inspection Contractor for construction monitoring (ACM A.1.2), the applicant has committed to the following ACM to reduce potential impacts to bats (for more detail, see **Appendix E**):

- Improve habitat conditions for bats by reducing or changing grazing in wet meadows on SNWA allotments (ACM C.2.18);
- Design water hauls with escape ramps(ACM A.5.72); and
- Design and operate lighting to reduce visual impacts (ACMs A.11.2 and A.11.3) which would also benefit bat species.

Conclusion. Habitat for bats would be temporarily disturbed by construction and a portion would be permanently converted to industrial uses as identified above. ACMs and the protections afforded in the RMPs would reduce potential ROW construction and facility maintenance impacts to bats.

Proposed mitigation measures:

None.

Residual impacts include:

- The long-term (20 to 200 years) restoration periods for woodland habitats disturbed by ROW construction make this habitat unavailable for forage and roosting for bats.
- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.

Dark Kangaroo Mouse: Direct impacts would result in the long-term reduction of approximately 7,732 acres (**Table 3.6-5**) of dark kangaroo mouse habitat (in Cave, Delamar, Dry Lake, Hamlin, Lake, Pahranagat, Snake, Spring, and Steptoe valleys). This would result in an incremental reduction in the amount of available habitat for this species until reclamation activities are completed and native vegetation is reestablished. The area of habitat impacted by construction surface disturbance is less than 1 percent of modeled dark kangaroo mouse habitat within these basins. Facility maintenance would result in the permanent conversion of 557 acres of habitat. Potential impacts also could result in the direct mortalities of individual mice (as a result of crushing from increased vehicle traffic and construction equipment, if present).

Indirect impacts include increased habitat fragmentation effects as a result of increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic during surface-disturbance activities. Impacts from the operation of new power lines would include increased predation due to the creation of additional nesting and perching sites for predators within mouse habitat.

In addition to providing a Compliance Inspection Contractor for construction monitoring (ACM A.1.2), the applicant has committed to reducing potential impacts to this species by trapping and relocating individual desert valley kangaroo mice (a subspecies of the dark kangaroo mouse) within known habitat if determined appropriate (ACM A.5.61). NDOW has raised questions as to whether translocations would be benign to nearby recipient populations.

Conclusion. Habitat for dark kangaroo mouse would be temporarily disturbed by construction and a portion would be permanently converted to industrial uses as identified above. The ACMs and protections afforded in the RMPs would reduce potential ROW construction and facility maintenance impacts to the dark kangaroo mouse, but some questions remain as to the benefit of proposed translocations.

Proposed mitigation measures:

ROW-WL-18: **Coordination with NDOW on Conservation Measures for Dark Kangaroo Mouse**. The SNWA, prior to being issued the Notice to Proceed, would work with NDOW on developing research objectives, protocols, and implementation plan(s) to identify conservation measures for the SNWA project's potential effects on the dark kangaroo mouse and its habitat. The implementation plan(s) must address mitigation, minimization, or avoidance of impacts from this project on dark kangaroo mouse and its habitat for the duration of construction, maintenance, and operation. A Notice to Proceed would be issued upon receipt of confirmation by NDOW that this process has been completed and that conservation measures for the dark kangaroo mouse and its habitat have been developed. Effectiveness: This measure would be effective in mitigating impacts to dark kangaroo mouse as it would gather key information still needed to effectively manage the species. Effects on other resources: If the measure includes surveys, activities would contribute to noise and human presence disturbance to wildlife as well as the potential for vehicle collisions to wildlife.

Residual impacts include:

- The long-term (20 to 200 years) restoration periods for shrublands and woodlands in habitats disturbed by ROW construction make these habitats unavailable for forage and cover for dark kangaroo mouse.
- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.
- Potential mortalities may occur to dark kangaroo mouse from construction equipment and soil movement.

Banded Gila Monster. Direct impacts to this species would include the long-term reduction of habitat quality in approximately 2,627 acres of suitable habitat (in Coyote Spring, Garnet, Hidden Valley, and Las Vegas valleys) and would result in an incremental reduction in the amount of available habitat until reclamation activities are completed and native vegetation is reestablished. The area of habitat affected by construction surface disturbance is less than 1 percent of modeled gila monster habitat within these basins. Facility maintenance would result in the permanent conversion of 248 acres of habitat in the same valleys listed above. Potential impacts also could result in the direct mortalities of individuals (as a result of crushing from increased vehicle traffic and construction equipment, if present) as well as increased potential for illegal collection.

Indirect impacts include increased habitat fragmentation effects as a result of increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic during surface-disturbance activities as well as potential for increased illegal collection.

In addition to pre-construction surveys by qualified biologists that may follow the NDOW protocol (ACM A.5.37), the applicant has committed to the following ACMs to reduce potential impacts to this species (for more detail, see **Appendix E**):

- Speed-limit restrictions to reduce vehicle/wildlife impacts (ACM A.1.29);
- Individuals that are found during pre-construction surveys will be moved out of harm's way (ACM A.5.38);
- Assurances that wildlife would not be harassed or intentionally harmed (ACM A.5.5); and
- Immediate contact to the NDOW if a gila monster is found, and reporting of all gila monster observations by project workers (ACM A.5.39).

NDOW has raised concerns regarding the potential for landscape and smaller scale impacts to combine negatively within the project area so that standard protection measures may not be sufficient to mitigate for potential impacts. Further, ACM A.5.37 commits SNWA to conduct banded Gila monster surveys, but it is not specific enough with regard to use of the NDOW protocol.

Conclusion. Habitat for Gila monster would be temporarily disturbed by construction and a portion would be permanently converted to industrial uses as identified above. ACMs would reduce potential ROW construction and facility maintenance impacts to Gila monster.

Proposed mitigation measures:

ROW-WL-19: **Coordination with NDOW on Conservation Measures for Banded Gila Monster**. The SNWA, prior to being issued the Notice to Proceed, would work with NDOW on developing research objectives, protocols, and implementation plan(s) to identify conservation measures for the SNWA project's potential effects on the banded Gila monster and its habitat. The implementation plan(s) must address mitigation, minimization, or avoidance of impacts from this project on banded Gila monster and its habitat for the duration of construction, maintenance, and operation. A Notice to Proceed would be issued upon receipt of confirmation by NDOW that this process has been completed and that conservation measures for the gila monster and its habitat have been developed. Effectiveness: This measure would be effective in mitigating impacts to Gila monster as it would gather key information still needed to effectively manage the species. Effects on other resources: If the measure includes surveys, activities would contribute to noise and human presence disturbance to wildlife as well as the potential for vehicle collisions to wildlife.

ROW-WL-20: Banded Gila Monster Surveys. Within potential habitat for banded Gila monster and chuckwalla, pre-construction surveys of the ROW would be conducted by qualified biologists to find and move individuals from project disturbance areas. The surveys would be conducted in accordance with NDOW's most current banded Gila monster survey protocol. All occupied burrows found in the construction zone would be examined and excavated as described for the desert tortoise. If a banded Gila monster is found, NDOW would be immediately contacted. Effectiveness: This measure would be effective in detecting Gila monsters in the ROW prior to disturbance and would move them out of harm's way. Effects on other resources: Conducting surveys would contribute to noise and human presence disturbance to wildlife, as well as the potential for vehicle collisions to wildlife. This measure also could provide a record of other species that could be potentially affected by the project.

Residual impacts include:

- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.
- Potential mortalities to Gila monster from construction equipment and soil movement.

Mojave Poppy Bee: Direct impacts would result in the long-term reduction of approximately 1,718 acres of potentially suitable habitat for this bee species in Coyote Spring Valley and an incremental reduction in the amount of available habitat for this species, until reclamation activities are completed and native vegetation is reestablished. Facility maintenance would result in the permanent conversion of 120 acres of habitat in Coyote Spring Valley. Other impacts could include the direct mortality of individuals (as a result of crushing from increased vehicle traffic and construction equipment, if present). Given the lack of information on this species (e.g. range, distribution, reasons for rarity, degree of threat), the level of impact as a result of this project is not known. There are no proposed species-specific ACMs. It is assumed that potential impacts to this species would be minimized through implementation of mitigation measure ROW-VEG-1 (reducing spread of invasive weeds).

Conclusion. Habitat for Mojave poppy bee would be temporarily disturbed by construction and a portion would be permanently converted to industrial uses as identified above. There are no proposed species-specific ACMs.

Proposed mitigation measures:

ROW-VEG-3: Green Stripping. This measure would assist in reducing impacts to Mojave poppy bee.

Residual impacts include:

- An unknown portion of habitats that may be degraded because recovery did not fully occur.

3.6.2.3 Alternative D

The same ROW construction and facility maintenance issues discussed for the Proposed Action and Alternatives A through C would apply to Alternative D. The following discussion describes acreage and species location-specific differences for this alternative.

The Alternative D ROW ends at the White Pine County line. Surface impacts in White Pine County are removed or reduced as a result.

Summary

General Habitat Loss and Alteration

Construction would disturb approximately 8,843 acres of wildlife habitat, primarily consisting of shrub-scrub types including sagebrush shrubland (44 percent), Mojave mixed desert shrubland (35 percent) and greasewood/saltbush shrubland (19 percent), with lesser amounts of woodland, grasslands and other types comprising the remaining 2 percent. Shrub/scrub and woody vegetations would be impacted long term, while grass and forb vegetation would be impacted over the short term when considering reclamation time frame. Facility maintenance would result in the permanent conversion of approximately 823 acres of terrestrial wildlife habitat in similar proportions to construction (within 4 percent).

Habitat fragmentation would result from the construction of the various project facilities including the development of access roads, pipelines, electrical power lines, and various above-ground facilities including pumping stations and electrical substations. Other fragmentation effects such as increased noise, elevated human presence, dispersal of noxious and invasive weeds species and dust deposition from unpaved road traffic would extend beyond the boundaries of the project ROWs.

Accidental wildfires could be initiated during construction and facility maintenance activities and could cause minor to major impacts on forage and cover availability to all wildlife, depending on the acreage burned and whether any areas of particular species-specific value were disturbed. Impacts from wildfire would result in mortalities of less mobile species (e.g., small mammals, birds, reptiles, amphibians, invertebrates) and short-term displacement of wildlife from the impacted area.

The operation of proposed electrical power lines would incrementally increase the potential for electrocution for birds and collision potential for birds and bats, and could serve as predator perches and nest sites, increasing predation potential on a number of species.

Species of Management Concern

Mitigation measure ROW-WL-1 specifies that SNWA will improve 2 acres of comparable big game key habitat for each 1 acre disturbed.

Big Game: Construction disturbance would result in reduction of forage areas and habitat fragmentation on a long-term basis for big game species, including antelope (4,571 acres), elk (2,704 acres), mule deer range (2,949 acres), mule deer crucial summer range (101 acres), mule deer crucial winter range (3 acres), and desert bighorn sheep occupied habitat (260 acres). Disturbance acres represent less than 1 percent of the available species habitat within the basin impacted. Facility maintenance would result in the permanent conversion of habitat to industrial uses including antelope (391 acres), elk (180 acres), mule deer range (302 acres), mule deer crucial summer range (16 acres), and desert bighorn sheep occupied habitat (11 acres). Impacts also would include displacement of individuals and potential loss of breeding success given habitat alteration, exposure to construction/maintenance movements and noise and higher levels of human activity. The proposed GWD Project also would have potential to cause long-term, elevated, traffic-caused mortality. While the area of habitat affected by construction surface disturbance would represent less than 1 percent of the surface area of these habitat ranges within the hydrologic basins occupied by Alternative D, the location of ROW construction could impact local herds and migration corridors. Protections provided in the RMPs and the ACMs would reduce potential impacts to big game species. However, in order to address the permanent conversion of 16 acres of mule deer crucial summer habitat and 11 acres of desert bighorn sheep occupied habitat, as well as the long-term surface disturbance of mule deer crucial summer range (101 acres) and mule deer crucial winter range (3 acres), mitigation measure ROW-WL-1 is proposed.

Other Terrestrial Species of Management Concern: Direct impacts to small mammals, reptiles, game and other bird species of management concern (including raptors) would include the incremental, long-term surface disturbance of 8,843 acres of habitat and increased fragmentation, until vegetation became reestablished and construction noises ceased. Facility maintenance would result in the permanent conversion of 823 acres of habitat to industrial uses. Fragmentation effects would be incremental, but species that require large tracts of unbroken habitat such as sagebrush obligate species may not be able to complete their life functions and this project may contribute to general population declines. Potential impacts also likely would include:

- Displacement of mobile wildlife species on a short-term basis from noise and human activity from construction and on a long-term basis for facility maintenance;
- Mortalities of less-mobile or burrowing species as a result of crushing from increased vehicle traffic and construction equipment and abandonment or loss of eggs or young;
- Disruption of breeding success (displacement or nest abandonment) of migratory birds from noise or human activity if construction occurred during breeding season; and
- Potential for small wildlife to be trapped in water troughs and be drowned.

ACMs that would reduce potential impacts to wildlife include: speed limit restrictions (ACM A.1.29), traffic management to reduce vehicle trips (ACM A.1.28), escape ramps in water troughs (ACM A.5.72), timing of ground clearing to avoid critical nesting periods for migratory birds as feasible (ACM A.5.63), a bird conservation strategy (ACM A.1.1), and pre-construction bird surveys and avoidance until birds have fledged, or consultation with the BLM (ACM A.5.65). Protections provided in the RMPs and the ACMs would reduce potential impacts to other terrestrial wildlife species of management concern. However, mitigation measure ROW-WL-2 (USFWS concurrence on plans) is added to obtain concurrence from USFWS on plans that address species protected under MBTA or BGEPA and ROW-WL-3 (Raptor nest survey and avoidance) addresses pre-construction surveys and nest avoidance for raptors.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on terrestrial wildlife resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Special Status Species

Desert Tortoise: Direct impacts to the desert tortoise would include the incremental, long-term reduction of approximately 2,350 acres of desert tortoise habitat (1,759 acres of which is designated critical habitat) within 5 basins (Las Vegas, Garnett, Hidden, Coyote Spring, and Pahranagat valleys) from ROW construction until reclamation activities have been completed and native vegetation is reestablished. Facility maintenance would result in the permanent conversion of habitat to industrial uses including approximately 245 acres of critical habitat and 86 acres of non-critical habitat. Potential impacts also could include direct mortality of individual tortoises as a result of crushing from increased vehicle traffic and construction equipment, if present. Indirect impacts would result from increased noise and human presence and increased habitat fragmentation. In addition to construction monitoring by the BLM and USFWS approved qualified biologists (ACM A.5.30), adherence to USFWS-approved desert tortoise survey protocols (ACMs A.5.17-20, 30), and acquisition of appropriate state and federal permits or letters of authorization prior to handling desert tortoises and their parts (ACM A.5.16), development of a blasting plan (ACM A.1.1) the applicant has committed to the following ACMs to reduce potential impacts to desert tortoise (for more detail, see **Appendix E**): procedures for handling and moving individuals out of harm's way (ACM A.5.16-17, 21-27, A.5.34), placement of exclusion fencing (ACM A.5.18), speed limit restrictions that would reduce vehicle/wildlife impacts (ACM A. 1.29), installation of perch discouraging devices (ACM A.5.8), removal of entrapped animals from trenches (ACM A.1.42), and reporting of acres disturbed, remuneration fees paid, and number of tortoises taken during project activities (ACM A.5.36). Compliance with the ESA would require implementation of measures to reduce the effects of anticipated take of desert tortoise, including through habitat loss or degradation. Potential impacts would be reduced based on compliance with recovery plans and RMPs and adherence to ACMs. The applicant would coordinate with USFWS on this species.

Greater Sage-grouse: Incremental, long-term reduction of 1,310 acres of PPH and 1,124 acres of PGH, animal displacement (short and long term), and habitat fragmentation (long term) would result from this alternative. Facility maintenance would result in the permanent conversion of approximately 55 acres of PPH and 98 acres of PGH to industrial uses. Other impacts include potential mortalities from vehicle traffic (short and long-term), potential loss of nests, eggs or young, and potential for increased predation given additional perching sites on power lines. There are 8 active leks within 4 miles of proposed ROWs, 8 of them within 4 miles of proposed overhead power lines. ACMs that would reduce potential impacts to greater sage-grouse include specific facility siting criteria (ACM A.5.49), design and operation of lighting (ACMs A.11.2 and 3), seasonal timing restrictions (ACM A. 5.51), enhanced restoration measures (ACM A.5.53), perch discouraging devices (ACM A.5.8) and habitat enhancement (ACMs A.5.54, 55, and 56). In addition, mitigation measures ROW WL-4 (Specific lek avoidance – Burying power lines), ROW WL-5 (Specific lek avoidance –Siting of power lines), ROW-WL-6 and ROW-WL-7 (Sage-grouse habitat restoration), ROW-WL-8 (Greater sage-grouse monitoring), ROW-WL-9 and ROW-WL-10 (Greater sage-grouse timing restrictions), ROW-WL-11 (Fence marking) and ROW-WL-12 (Co-location of power lines) have been added.

Raptors: Incremental, long-term reduction of approximately 8,615 acres of golden eagle foraging habitat and 3,170 acres of ferruginous hawk nesting and foraging habitat and 4,165 acres of bald eagle foraging habitat would result from this alternative. Facility maintenance would result in the permanent conversion of 700 acres of golden eagle foraging habitat, and 220 acres of ferruginous hawk nesting and foraging habitat and 360 acres of bald eagle foraging habitat to industrial uses. There are no ferruginous hawks or golden eagle nests recorded within 0.5 mile of the ROW. ACMs that would reduce potential impacts to these species include development of a bird conservation strategy including measures to reduce impacts to migratory birds, bald and golden eagles, and other sensitive birds (ACM A.1.1), design of power lines following APLIC recommendations to avoid electrocution potential (ACM A.5.66), construction timing restrictions where appropriate (ACM A.5.69), pre-construction surveys and nest avoidance where feasible (ACM A.5.65), and pre-construction tree removal as feasible (ACM A.5.68). ACMs and the protections afforded in the RMPs would reduce potential ROW construction and facility maintenance impacts to raptors; however, raptors would not be fully protected. As such, mitigation measures ROW-WL-3 for preconstruction surveys and nest avoidance, and ROW-WL-13 for eagle nest avoidance is proposed.

Western Burrowing Owl: Direct impacts would include the incremental, long-term reduction of approximately 8,320 acres of suitable foraging habitat (shrub-scrub) and facility maintenance would result in the permanent conversion of 680 acres of nesting and foraging habitat to industrial uses. Impacts include potential mortalities from vehicle traffic (short term and long term). ACMs that would reduce potential impacts to burrowing owl include mitigation for destruction of any active burrows within the ROW with 2 enhanced or new burrows to each 1 active burrow that will be destroyed (ACM A.5.43), passive relocation of individuals (ACM A.5.44), and seasonal restrictions around occupied burrows (ACM A.5.47). No additional species-specific mitigation is proposed.

Pygmy Rabbit: Direct impacts would include the incremental, long-term reduction of approximately 2,810 acres of suitable habitat (shrub-scrub) would result from this alternative and facility maintenance would result in the permanent conversion of 200 acres of habitat to industrial uses. Impacts would include displacement of animals due to noise and human activity (short and long term), habitat fragmentation (long term), direct mortality that could occur during construction from crushing by vehicles or equipment as well as potential for increased predation given additional perching sites on power lines. ACMs that would reduce potential impacts to pygmy rabbits include, speed limit restrictions (ACM A.1.29), installation of perch discouraging devices (ACM A.5.8), and habitat improvement, mitigation, livestock management, and enhanced restoration measures (ACMs A.5.58, 59, 60). These ACMs and the protections afforded in the RMPs would reduce ROW construction and facility maintenance impacts to pygmy rabbit, however, the surveys and habitat improvement committed to in ACMs are further clarified in mitigation measures ROW-WL-14 (Pygmy rabbit surveys), ROW-WL-15 and ROW-WL-16 (Pygmy rabbit habitat improvement and reclamation). ROW-WL-17 is added to protect nesting pygmy rabbits in the event pygmy rabbits remain after passive relocation is conducted.

Bat Species: Direct impacts would include the incremental, long-term reduction of approximately 690 to 8,610 acres of foraging habitat and facility maintenance would result in the permanent conversion of 93 to 820 acres of habitat to industrial uses (based on Western pipistrelle and long-eared myotis models, **Table 3.6-5** footnote 2). No winter hibernacula, nursery colonies, or maternity roosts have been identified at proposed project facilities; however, tree-clearing for ROW construction could result in loss of roosting sites for tree-roosting species. Impacts also would include displacement of animals due to noise and human activity (short and long term), and habitat fragmentation (long term). There also may be increased mortality to bats from potential power line collisions. ACMs that would reduce potential impacts to bats include improving habitat conditions on SNWA grazing allotments (ACM C.2.18), lighting design (ACMs A.11.2 and 3), and escape ramps in water troughs (ACM A.5.72). No additional species-specific mitigation is proposed.

Dark Kangaroo Mouse: Direct impacts would include the incremental, long-term reduction of approximately 4,997 acres of dark kangaroo mouse habitat would result from this alternative and facility maintenance would result in the permanent conversion of 400 acres of habitat to industrial uses in 6 valleys. Other impacts include potential mortalities from vehicle traffic (short and long-term) and habitat fragmentation (long term). ACMs that would reduce potential impacts to dark kangaroo mouse include speed limit restrictions (ACM A.1.29), installation of perch discouraging devices (ACM A.5.58), and trapping and relocating individual desert valley kangaroo mice (a subspecies of the dark kangaroo mouse) within known habitat if determined appropriate (ACM A.5.61). In addition, mitigation measures ROW-WL-18 (Coordination with NDOW on conservation measures for dark kangaroo mouse), has been added.

Gila Monster: Direct impacts would include the incremental long-term reduction of approximately 2,627 acres of potential habitat and facility maintenance would result in the permanent conversion of 248 acres of habitat to industrial uses. Impacts include potential mortalities from vehicle traffic (short and long term), habitat fragmentation (long term), and increased potential for illegal collection. ACMs that would reduce potential impacts to gila monster include speed limit restrictions (ACM A.1.29), installation of perch discouraging devices (ACM A.5.58), and preconstruction surveys and notifications when individuals are moved from project disturbance areas (ACM A.5.38 and 39). In addition, mitigation measures ROW WL-19 (Coordination with NDOW on conservation measures for Banded Gila monster), and ROW-WL-20 (Banded Gila monster surveys) have been added.

Mojave Poppy Bee: Direct impacts would include the incremental long-term reduction of approximately 1,718 acres of potential habitat would result from this alternative and facility maintenance would result in the permanent conversion of 120 acres of habitat to industrial uses. Impacts include potential mortalities from vehicle traffic (short and long term) and habitat fragmentation (long term). Potential impacts to this species would be minimized through implementation of a mitigation measure in vegetation ROW VEG-3. No additional species-specific mitigation is proposed.

Residual impacts include:

- The same types of residual impacts would occur except that habitat effects would be less than the Proposed Action.

3.6.2.4 Alternatives E and F

The same ROW construction and facility maintenance issues discussed for the Proposed Action and Alternatives A through C would apply to Alternatives E and F. The following discussion describes acreage and species location-specific differences for this alternative.

Summary:

General Habitat Loss and Alteration

Construction would disturb approximately 10,696 acres of wildlife habitat, primarily consisting of shrub-scrub types including sagebrush shrubland (47 percent), Mojave mixed desert shrubland (29 percent), and greasewood/saltbush shrubland (21 percent), with lesser amounts of woodland, grasslands, and other types comprising the remaining 3 percent. Shrub/scrub and woody vegetations would be impacted long term, while grass and forb vegetation would be impacted over the short term when considering the reclamation time frames. Facility maintenance would result in the permanent conversion of approximately 960 acres of terrestrial wildlife habitat in similar proportions to construction (within 4 percent).

Habitat fragmentation would result from the construction of the various project facilities including the development of access roads, pipelines, electrical power lines, and various above-ground facilities including pumping stations and electrical substations. Other fragmentation effects such as increased noise, elevated human presence, dispersal of noxious and invasive weeds species and dust deposition from unpaved road traffic would extend beyond the boundaries of the project ROWs.

Accidental wildfires could be initiated during construction and facility maintenance activities and could cause minor to major impacts on forage and cover availability to all wildlife, depending on the acreage burned and whether any areas of particular species-specific value were disturbed. Impacts from wildfire would result in mortalities of less mobile species (e.g., small mammals, birds, reptiles, amphibians, invertebrates) and short-term displacement of wildlife from the impacted area.

The operation of proposed electrical power lines would incrementally increase the potential for electrocution for birds and collision potential for birds and bats, and could serve as predator perches and nest sites, increasing predation potential on a number of species.

Species of Management Concern

Big Game: Construction disturbance would result in reduction of forage areas and habitat fragmentation on a long-term basis for big game species, including antelope (6,345 acres), elk (4,019 acres), mule deer range (3,547 acres), mule deer crucial summer range (161 acres), mule deer crucial winter range (3 acres), and desert bighorn sheep occupied habitat (260 acres), and potential habitat (25 acres). Disturbance acres represent less than 1 percent of the available species habitat within the basins impacted. Facility maintenance would result in the permanent conversion of habitat to industrial uses including antelope (520 acres), elk (283 acres), mule deer range (326 acres), mule deer crucial summer range (23 acres), and desert bighorn sheep occupied habitat (11 acres). Impacts would also include displacement of individuals and potential loss of breeding success given habitat alteration, exposure to construction/maintenance movements and noise and higher levels of human activity. The proposed project also would have potential to cause long-term, elevated, traffic-caused mortalities. While the area of habitat affected by construction surface disturbance would represent less than 1 percent of the surface area of these habitat ranges within the hydrologic basins occupied by Alternatives E and F, the location of ROW construction could impact local herds and migration corridors. Protections provided in the RMPs and the ACMs would reduce potential impacts to big game species. However, in order to address the permanent conversion of 23 acres of mule deer crucial summer habitat and 11 acres of desert bighorn sheep occupied habitat, as well as the long-term surface disturbance of mule deer crucial summer range (161 acres), mule deer crucial winter range (3 acres), and desert bighorn sheep occupied habitat (260 acres), mitigation measure ROW-WL-1 (Big game habitat restoration and improvement) is proposed.

Other Terrestrial Species of Management Concern: Direct impacts to small mammals, reptiles, game, and other bird species of management concern (including raptors) would include the incremental, long-term surface disturbance of 10,696 acres of habitat and increased fragmentation until vegetation became reestablished and construction noises ceased. Facility maintenance would result in the permanent conversion of approximately 960 acres of habitat to industrial uses. Fragmentation effects would be incremental, but species that require large tracts of unbroken habitat such as sagebrush obligate species may not be able to complete their life functions and this project may contribute to general population declines. Potential impacts also likely would include:

- Displacement of mobile wildlife species on a short-term basis from noise and human activity from construction, and on a long-term basis for facility maintenance;
- Mortalities of less-mobile or burrowing species as a result of crushing from increased vehicle traffic and construction equipment, and abandonment or loss of eggs or young;
- Disruption of breeding success (displacement or nest abandonment) of migratory birds from noise or human activity if construction occurred during breeding season; and
- Potential for small wildlife to be trapped in water storage devices and be drowned.

ACMs that would reduce potential impacts to wildlife include: speed limit restrictions (ACM A.1.29), traffic management to reduce vehicle trips (ACM A.1.28), escape ramps in trenches and water storage devices (ACM A.5.72), timing of ground clearing to avoid critical nesting periods for migratory birds as feasible (ACM A.5.63), and pre-construction bird surveys and avoidance until birds have fledged, or consultation with the BLM (ACM A.5.65). Protections provided in the RMPs and the ACMs would reduce potential impacts to other terrestrial wildlife species of management concern. No additional mitigation is proposed. However, mitigation measure ROW-WL-2 is added to obtain concurrence from USFWS on plans that address species protected under MBTA or BGEPA, and ROW-WL-3 addresses pre-construction surveys and nest avoidance for raptors.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on terrestrial wildlife resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Special Status Species

Desert Tortoise: Direct impacts to the desert tortoise would include the incremental, long-term reduction of approximately 2,350 acres of desert tortoise habitat (1,759 acres of which is designated critical habitat) within 5 basins (Las Vegas, Garnett, Hidden, Coyote Spring and Pahranagat valleys) from ROW construction until reclamation activities have been completed and native vegetation is reestablished. Facility maintenance would result in the permanent conversion of habitat to industrial uses including approximately 245 acres of critical habitat and 86 acres of non-critical habitat. Potential impacts also could include direct mortality of individual tortoises as a result of crushing from increased vehicle traffic and construction equipment, if present. Indirect impacts would result from increased noise and human presence and increased habitat fragmentation. In addition to construction monitoring by BLM and USFWS approved qualified biologists (ACM A.5.30), adherence to USFWS-approved desert tortoise survey protocols (ACMs A.5.17-20, 30), and acquisition of appropriate state and federal permits or letters of authorization prior to handling desert tortoises and their parts (ACM A.5.16), development of a blasting plan (ACM A.1.1) the applicant has committed to the following ACMs to reduce potential impacts to desert tortoise (for more detail, see **Appendix E**): procedures for handling and moving individuals out of harm's way (ACM A.5.16-17, 21-27, A.5.34), placement of exclusion fencing (ACM A.5.18), speed limit restrictions that would reduce vehicle/wildlife impacts (ACM A. 1.29), installation of perch discouraging devices (ACM A.5.8), removal of entrapped animals from trenches (ACM A.1.42), and reporting of acres disturbed, remuneration fees paid, and number of tortoises taken during project activities (ACM A.5.36). Compliance with the ESA would require implementation of measures to reduce the effects of anticipated take of desert tortoise, including through habitat loss or degradation. Potential impacts would be reduced based on compliance with recovery plans and RMPs and adherence to ACMs. The applicant would coordinate with USFWS on this species.

Greater Sage-grouse: Incremental, long-term reduction of 2,232 acres of PPH and 1,636 acres of PGH, animal displacement (short and long term), and habitat fragmentation (long term) would result from this alternative. Facility maintenance would result in the permanent conversion of approximately 134 acres of PPH and 126 acres of PGH to industrial uses. Other impacts include potential mortalities from vehicle traffic (short and long-term), potential loss of nests, eggs or young, and potential for increased predation given additional perching sites on power lines. There are 18 active leks within 4 miles of proposed ROWs, 18 of them within 4 miles of proposed overhead power lines. ACMs that would reduce potential impacts to greater sage-grouse include specific facility siting criteria (ACM A.5.49), design and operation of lighting (ACM A.11.2 and 3), seasonal timing restrictions (ACMs A.5.51), enhanced restoration measures (ACM A.5.53), perch discouraging devices (ACM A.5.8), and habitat enhancement (ACM A.5.54, 55, and 56). In addition, mitigation measures ROW WL-4 (Specific lek avoidance – Burying power lines), ROW WL-5 (Specific lek avoidance – Siting of power lines) ROW-WL-6 and ROW-WL-7 (Sage-grouse habitat restoration), ROW-WL-8 (Greater sage-grouse monitoring), ROW-WL-9 and ROW-WL-10 (Greater sage-grouse timing restrictions), ROW-WL-11 (Fence marking) and ROW-WL-12 (Co-location of power lines).

Raptors: Direct impacts would include the incremental, long-term reduction of approximately 10,460 acres of golden eagle foraging habitat, 4,340 acres of ferruginous hawk nesting and foraging habitat, and 4,900 acres of bald eagle foraging habitat would result from this alternative. Facility maintenance would result in the permanent conversion of 835 acres of golden eagle foraging habitat, 306 acres of ferruginous hawk nesting and foraging habitat, and 410 acres of bald eagle foraging habitat to industrial uses. Two ferruginous hawks nests are recorded within 0.5 mile of the ROW (Spring and Snake valleys). ACMs that would reduce potential impacts to these species include development of a bird conservation strategy including measures to reduce impacts to migratory birds, bald and golden eagles, and other sensitive birds (ACM A.1.1), design of power lines following APLIC recommendations to avoid electrocution potential (ACM A.5.66), construction timing restrictions where appropriate (ACM A.5.69), pre-construction surveys and nest avoidance where feasible (ACM A.5.65), and pre-construction tree removal as feasible (ACM A.5.68). ACMs and the protections afforded in the RMPs would reduce potential impacts to raptors; however, raptors would not be fully protected. As such, mitigation measures ROW-WL-3 for preconstruction surveys and nest avoidance, and ROW-WL-13 for eagle nest avoidance is proposed.

Western Burrowing Owl: Direct impacts would include the incremental, long-term reduction of approximately 10,070 acres of suitable foraging habitat (shrub-scrub) and facility maintenance would result in the permanent conversion of 808 acres of nesting and foraging habitat to industrial uses. Impacts include potential mortalities from vehicle traffic (short term and long term). ACMs that would reduce potential impacts to burrowing owl include mitigation for destruction of any active burrows within the ROW; 2 enhanced or new burrows to each 1 active burrow that will be destroyed (ACM A.5.43), passive relocation of individuals (ACM A.5.44), and seasonal restrictions around occupied burrows (ACM A.5.47). No additional species-specific mitigation is proposed.

Pygmy Rabbit: Direct impacts would include the incremental, long-term reduction of approximately 3,320 acres of suitable habitat (shrub-scrub) and facility maintenance would result in the permanent conversion of 235 acres of habitat to industrial uses. Impacts would include displacement of animals due to noise and human activity (short and long term), habitat fragmentation (long term), direct mortality that could occur during construction from crushing by vehicles or equipment as well as potential for increased predation given additional perching sites on power lines. ACMs that would reduce potential impacts to pygmy rabbits include, speed limit restrictions (ACM A.1.29), installation of perch discouraging devices (ACM A.5.8), and habitat improvement, mitigation, livestock management, and enhanced restoration measures (ACMs A.5.58, 59, 60). ACMs and the protections afforded in the RMPs would reduce potential impacts to pygmy rabbit, however, the surveys and habitat improvement committed to in ACMs are further clarified in mitigation measures ROW-WL-14 (Pygmy rabbit surveys), ROW-WL-15 and ROW-WL-16 (Pygmy rabbit habitat improvement and reclamation). ROW-WL-17 is added to protect nesting pygmy rabbits in the event pygmy rabbits remain after passive relocation is conducted.

Bat Species: Direct impacts would include the incremental, long-term reduction of approximately 1,033 to 10,420 acres of foraging habitat and facility maintenance would result in the permanent conversion of 101 to 955 acres of habitat to industrial uses (based on Western pipistrelle and long-eared myotis models, **Table 3.6-5** footnote 2). No winter hibernacula, nursery colonies, or maternity roosts have been identified at proposed project facilities; however, tree-clearing for ROW construction could result in loss of roosting sites for tree-roosting species. Impacts also would include displacement of animals due to noise and human activity (short and long term) and habitat fragmentation (long term). There also may be increased mortality to bats from potential power line collisions. ACMs that would reduce potential impacts to bats include improving habitat conditions on SNWA grazing allotments (ACM C.2.18), lighting design (ACM A.11.2 and 3), and escape ramps in water troughs (ACM A.5.72). No additional species-specific mitigation is proposed.

Dark Kangaroo Mouse: Direct impacts would include the incremental, long-term reduction of approximately 6,583 acres of dark kangaroo mouse habitat and facility maintenance would result in the permanent conversion of 521 acres of habitat to industrial uses in 7 valleys. Other impacts include potential mortalities from vehicle traffic (short and long-term) and habitat fragmentation (long term). ACMs that would reduce potential impacts to dark kangaroo mouse include speed limit restrictions (ACM A.1.29), installation of perch discouraging devices (ACM A.5.58), and trapping and relocating individual desert valley kangaroo mice (a subspecies of dark kangaroo mouse) within known habitat if determined appropriate (ACM A.5.61). In addition, mitigation measures ROW-WL-18 (coordination with NDOW on conservation measures for dark kangaroo mouse), has been added.

Gila Monster: Direct impacts would include the incremental long-term reduction of approximately 2,627 acres of potential habitat and facility maintenance would result in the permanent conversion of 248 acres of habitat to industrial uses. Impacts include potential mortalities from vehicle traffic (short and long term), habitat fragmentation (long term), and increased potential for illegal collection. ACMs that would reduce potential impacts to gila monster include speed limit restrictions (ACM A.1.29), installation of perch discouraging devices (ACM A.5.58), and preconstruction surveys and notifications when individuals are moved from project disturbance areas (ACM A.5.38 and 39). In addition, mitigation measures ROW WL-19 (coordination with NDOW on conservation measures for Banded Gila monster), and ROW-WL-20 (Banded Gila monster surveys) have been added.

Mojave Poppy Bee*:* Incremental long-term reduction of approximately 1,718 acres of potential habitat would result from this alternative and facility maintenance would result in the permanent conversion of 120 acres of habitat to industrial uses. Impacts include potential mortalities from vehicle traffic (short and long term) and habitat fragmentation (long term). Potential impacts to this species would be minimized through implementation of a mitigation measures in vegetation ROW-VEG-3. No additional species-specific mitigation is proposed.

Residual impacts include:

- The same type of residual effects would occur except that habitat effects would be less than the Proposed Action.

3.6.2.5 Alignment Options 1 through 4

Table 3.6-9 compares the impacts associated with the alignment in the Proposed Action to the impacts associated with the Alignments Options 1 through 4. Mitigation measures and ACMs would apply to these alignment options.

Table 3.6-9 Potential Effects on Terrestrial Wildlife Resources from Implementation of Alignment Options 1 through 4

Alignment Option	Analysis
Alignment Option 1 (Humboldt-Toiybe Power Line Alignment). **Option Description**: Change the locations of a portion of the 230-kV power line from Gonder Substation near Ely to Spring Valley. **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• Big game species ranges with reduced acreage impacts: mule deer crucial summer (-60 acres), antelope year round (-120 acres), elk year round (-96 acres), desert bighorn potential (-23 acres). Facility maintenance conversions reduced: mule deer crucial summer (-8 acres), antelope year round (-14 acres), elk year round (-2 acres), and desert bighorn potential (-3 acres). • Big game species ranges with increased acreage impacts: mule deer year round (75 acres), elk crucial summer (29 acres), rocky mountain bighorn sheep potential (38 acres). Facility maintenance conversions increased: mule deer year round (9 acres), elk crucial summer (4 acres), and rocky mountain bighorn sheep potential (58 acres). • Special status species for which there is no change: desert tortoise, gila monster, Mojave poppy bee. • Special status species with reduced construction/facility maintenance acreage impacts: pygmy rabbit (-16 acres /-1 acre), bats[1] (-2 acres /-105 acres / 0 to -13 acres), dark kangaroo mouse (-121 acres /-14 acres), greater sage-grouse [PPH (-96 acres /-11 acres), PGH (-29 acres /-4 acres), 3 fewer leks within 4 miles], golden eagle (-94 acres / -1 acres), ferruginous hawk (-77 acres /-9 acres), bald eagle (-55 acres /-6 acres), and western burrowing owl (-997 acres /-11 acres).
Alignment Option 2 (North Lake Valley Pipeline Alignment). **Option Description**: Change the locations of portions of the mainline pipeline and electrical transmission line in North Lake Valley. **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• Big game species ranges with increased acreage impacts: mule deer year round (233 acres), antelope year round (294 acres), and elk year round (165 acres). Facility maintenance conversions increased: mule deer year round (42 acres), antelope year round (38 acres), and elk year round (24 acres). • Special status species for which there is no change: desert tortoise, gila monster, and Mojave poppy bee. • Special status species with reduced construction acreage impacts: pygmy rabbit (-189 acres), bats (-57 to -221 acres), dark kangaroo mouse (-168 acres), greater sage-grouse (PPH/PGH, -195/-145 acres), one fewer lek within 4 miles; golden eagle (-69 acres), and western burrowing owl (-81 acres). Facility maintenance conversions reduced: pygmy rabbit (-6 acres), bats[1] (+52 to -57 acres), dark kangaroo mouse (-5 acres), greater sage-grouse PGH (-63 acres), and golden eagle (-4 acres). • Special status species with increased construction acreage impacts: ferruginous hawk (32 acres), bald eagle (61 acres), bats (+52 to -57 acres). Facility maintenance conversions increased: bats[1] (-4 to +15 acres), greater sage-grouse PPH (60 acres), ferruginous hawk (13 acres), bald eagle (6 acres), and western burrowing owl (3 acres).
Alignment Option 3 (Muleshoe Substation and Power Line Alignment). **Option Description**: Eliminate the Gonder to Spring Valley transmission line, and construct a substation with an interconnection with an interstate, high voltage power line in Muleshole Valley.	• Big game species ranges with reduced acreage impacts: mule deer crucial summer (-60 acres), mule deer year round (-111 acres), antelope year round (-294 acres), elk year round (-387 acres), and desert bighorn potential (-3 acres). Facility maintenance conversions reduced: mule deer crucial summer (-8 acres), elk year round (-30 acres), and desert bighorn potential (-3 acres). • Big game species ranges with facility maintenance conversions increased: antelope year round (22 acres) and mule deer year round (35 acres). No construction acreage impact increased for any big game range. • Special status species for which there is no change: desert tortoise, gila monster, and Mojave poppy bee.

Table 3.6-9 Potential Effects on Terrestrial Wildlife Resources from Implementation of Alignment Options 1 through 4 (Continued)

Alignment Option	Analysis
Applicable To: Proposed Action and Alternatives A through C, E, and F.	• Special status species with reduced construction acreage impacts: pygmy rabbit (-15 acres), bats (-73 to -325 acres), greater sage-grouse PPH (-271 acres), PGH (-49 acres), 5 fewer active leks within 4 miles; golden eagle (-362 acres), ferruginous hawk (-290 acres), bald eagle (-332 acres) and western burrowing owl (-272 acres). Facility maintenance conversions reduced: greater sage-grouse PPH (-16 acres), and bald eagle (-22 acres). • Special status species with increased construction acreage impacts: dark kangaroo mouse (39 acres). Facility maintenance conversions increased: pygmy rabbit (25 acres), bats[1] (+18 to -8 acres), dark kangaroo mouse (21 acres), greater sage-grouse PGH (7 acres), golden eagle (13 acres), ferruginous hawk (9 acres), and western burrowing owl (24 acres).
Alignment Option 4 (North Delamar Valley Pipeline and Power Line Alignment). **Option Description**: Change the location of a short section of mainline pipeline in Delamar Valley to follow an existing transmission line. **Applicable To**: All alternatives.	• Big game species range with reduced acreage impacts: antelope year round (-53 acres). Facility maintenance conversion reduced: antelope year round (-45 acres). • Special status species for which there is no change: desert tortoise, greater sage-grouse (no change in PPH/PGH or number of active leks within 4 miles), gila monster, and Mojave poppy bee. • Special status species with reduced construction acreage impacts: bats (-53 to -176 acres), dark kangaroo mouse (-89 acres), golden eagle (-47 acres), bald eagle (-142 acres), and western burrowing owl (-45 acres). Facility maintenance conversions reduced: pygmy rabbit (-2 acres), bats[1] (-46 acres), dark kangaroo mouse (-42 acres), golden eagle (-45 acres), ferruginous hawk (-2 acres), bald eagle (-34 acres) and western burrowing owl (-45 acres). • Special status species with increased construction acreage impacts: pygmy rabbit (130 acres), ferruginous hawk (134 acres). Facility maintenance conversions increased: none.

[1] Two species, the long-eared myotis (with less habitat within the region of study) and the western pipistrelle (with more habitat within the region of study) were selected to provide a range of potential habitat impacts based on the difference in their SWReGAP modeled habitat.

3.6.2.6 No Action

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Impacts to terrestrial wildlife species and their habitat would continue at present levels as a result of natural conditions and existing and other proposed development within the project area. Habitat for terrestrial wildlife species would continue to be influenced by natural events such as drought and fire, land use activities such as grazing, recreational uses such as hunting, as well as reasonably foreseeable development actions. Wildlife species of management concern and special status wildlife species, depending on their status, would continue to be managed by the BLM, USFS, GBNP, or the states of Nevada or Utah, under the relevant plans (e.g., RMPs, recovery plans, and forest, park, or state management plans) that have been developed for their management as described earlier in this section.

3.6.2.7 Comparison of Alternatives

Table 3.6-10 compares Alternatives D, E, and F relative to the Proposed Action and Alternatives A through C.

Table 3.6-10 Comparison of Alternatives

Parameter	Proposed Action and Alternatives A through C		Alternative D Described or provided as a percent decrease from the Proposed Action		Alternatives E and F Described or provided as a percent decrease from the Proposed Action	
	Acres Construction	Acres Permanent	Acres Construction	Acres Permanent	Acres Construction	Acres Permanent
Qualitative Description	Proposed Action footprint		Reduced from the Proposed Action footprint and does not include any ROWs or ancillary facilities north of the White Pine county line, reducing surface impacts to wildlife in Spring Valley and removing surface impacts to wildlife in Snake valley.		Reduced from the Proposed Action footprint and does not include any ROWs or ancillary facilities in Snake Valley, avoiding surface impacts to wildlife from Snake Valley.	
Total habitat disturbance (acres)	12,288 acres	999 acres	8,828 acres	808 acres	10,681 acres	945 acres
Big Game Ranges (habitat):						
Mule Deer crucial summer	169	24	40	33	5	4
Mule Deer crucial winter	133	0	nearly 100	NA	nearly 100	NA
Mule Deer year round	3,917	363	25	17	9	10
Antelope year round	7,952	574	43	32	20	9
Rocky Mtn elk year round	4,019	282	33	36	Same as Proposed Action	Same as Proposed Action
Desert Bighorn (occupied)	259	11	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Desert Bighorn (potential)	25	3	No habitat impacts	No habitat impacts	Same as Proposed Action	Same as Proposed Action
Special Status Spp. (habitat)						
Desert tortoise	2,350	331	Same as Proposed Action for all three species.	Same as Proposed Action for all three species.	Same as Proposed Action for all three species.	Same as Proposed Action for all three species.
Gila monster	2,627	248				
Mojave poppy bee	1,718	120				
Special Status Spp. (habitat)						
Pygmy rabbit	3,634	235	23	15	9	no change
Bat species[1]	1,166 to 12,303	104 to 1,009	18 to 28	11 to 18	11 to 13	1 to 3
Dark kangaroo mouse[2]	7,732	557	35	28	15	6
Golden eagle	12,061	888	29	21	13	8

Table 3.6-10 Comparison of Alternatives (Continued)

Parameter	Proposed Action and Alternatives A through C		Alternative D Described or provided as a percent decrease from the Proposed Action		Alternatives E and F Described or provided as a percent decrease from the Proposed Action	
	Acres Construction	Acres Permanent	Acres Construction	Acres Permanent	Acres Construction	Acres Permanent
Ferruginous hawk (habitat)	5,173	331	39	33	16	16
Ferruginous hawk (nests)	Two known nests within 0.5 mile of ROW		No known nests within 0.5 mile of ROW		Two known nests within 0.5 mile of ROW	
Bald Eagle	5,571	442	25	19	12	7
Western burrowing owl	11,621	858	28	21	13	6
Greater sage-grouse leks	Active leks within 4 miles of ROW and ancillary facilities = 19. Active leks within 4 miles of overhead power lines = 19.		Active leks within 4 miles of ROW and ancillary facilities = 8. Active leks within 4 miles of overhead power lines = 8		Active leks within 4 miles of ROW and ancillary facilities = 18. Active leks within 4 miles of overhead power lines = 18.	
Greater sage-grouse Habitats:						
PPH	2,450	134	47	59	9	No change
PGH	2,497	153	55	36	34	18

[1] Two species, the long-eared myotis (less habitat within the region of study) and the western pipistrelle (more habitat within the region of study) were selected to provide a range of potential habitat impacts based on the difference in their SWReGAP modeled habitat.

[2] Based on SWReGAP modeled habitat.

3.6.2.8 Groundwater Development and Groundwater Pumping

Issues

Groundwater Field Development Construction and Facility Maintenance

- Habitat loss and fragmentation from construction clearing of ROWs, transmission lines, and new and improved access roads.
- Direct disturbance and loss of individuals from construction activities along ROWs (including trenching), transmission lines, and access roads.
- Disturbance and loss of individuals from accidental wildfires and loss of habitat.
- Indirect effects, consisting of displacement of individuals and loss of breeding success, from exposure to construction or operational movements and noise and higher levels of human activity (including traffic).
- Potential disruption of migration patterns because of temporary fencing and potential entanglement and loss of individuals.
- Direct disturbance and loss of individuals from loss of habitat, and traffic mortality.
- Potential effects from collisions and electrocutions to raptors and other wildlife from power lines and power stations.
- Potential effects of additional infrastructure resulting in increased perches for raptors and corvids that may increase predation on other animals.
- Potential effects on terrestrial wildlife species culturally significant and traditionally used as food by regional Tribes.
- Compliance with recovery plans, conservation agreements, and state wildlife action plans for special status species.
- Potential effects of climate change on terrestrial wildlife resources. Refer to Section 3.1, Air and Atmospheric Values and Section 3.6.3.1 for a discussion of how climate change could contribute to groundwater development pumping effects on environmental resources.

Groundwater Pumping

- Short-term, long-term, and permanent loss of wildlife habitats used by wildlife from reductions in phreatophytic, wetland, riparian habitat, and surface water availability.
- Loss of individuals and displacement of wildlife species.
- Potential effects of groundwater drawdown on water resources and habitat that support migratory waterfowl, bats, and important bird areas.
- Potential effects of groundwater drawdown on wildlife that is associated with cave habitats.
- Compliance with recovery plans, conservation agreements, and state wildlife action plans for special status terrestrial wildlife species.
- Potential effects of climate change on terrestrial wildlife resources. Refer to Section 3.1, Air and Atmospheric Resources and Section 3.6.3.1 for a discussion of how climate change could contribute to groundwater development pumping effects on environmental resources.

Assumptions

Groundwater Field Development Construction and Facility Maintenance

- Identification of terrestrial wildlife that could be affected by project actions focused on species of management concern and special status wildlife species in groundwater development areas and drawdown areas.

- Construction disturbances, while temporary in nature, have been defined as long-term for all vegetation cover types due to existing vegetation structure and composition, recovery time frames, and limiting revegetation factors (e.g. low precipitation rates, soil chemistry constraints, and soil moisture).
- Identification of terrestrial wildlife habitat that could be affected by construction activities for groundwater development associated with the Proposed Action, Alternatives A, C, D, E, and F included all habitat within the exploration boundaries (groundwater development areas).
- Identification of terrestrial wildlife habitat that could be affected by construction activities for groundwater development associated with Alternative B included areas within 1 mile of the proposed Points of Diversion within the five groundwater development valleys.
- Application of the Ely and Las Vegas RMP management actions and best management practices to all proposed construction activities, based on the most current RMPs – Ely 2008 and Las Vegas 1998.
- Inclusion of the ACMs included in the SNWA POD to manage surface disturbance effects as a basis for appropriate measures that may be submitted in future SNWA ROW applications.

Groundwater Pumping

- The extent of groundwater drawdown effects on the terrestrial wildlife species is tied directly to drawdown impacts on springs, perennial streams, and vegetation plant communities as outlined in Sections 3.3, Water Resources, and 3.5, Vegetation Resources.
- Assumptions made in the vegetation section also apply to wildlife with regard to vegetation communities, see Section 3.5, Vegetation Resources.
- Assumptions made in the water section also apply to wildlife with regard to spring and perennial stream habitats, see Section 3.3, Water Resources.

Methodology

Groundwater Field Development Construction and Facility Maintenance

- The methods outlined under ROWs were applied to project surface development activities.
- Location of future facilities is unknown. For general discussions of terrestrial wildlife impacts it is assumed that the total estimated acreage for both construction and permanent facilities would impact wildlife habitat. A summary of these general project disturbance numbers is in Chapter 2, **Table 2.10-2**.
- Acreages of overlap between species habitat and groundwater development areas are provided for some species. However, the direct disturbance that is anticipated for construction of future facilities is limited to only a small portion of these acres. Impacts would occur where surface-disturbance activities occur, not within the entire groundwater development areas. Acres of habitat within groundwater development areas are provided in context of the percent of groundwater development area that is a particular type of habitat. It is calculated by using the acres of species habitat within the groundwater development areas divided by the total acreage of the groundwater development areas in each valley or summarized for all valleys. The intent is to provide the reader with a general sense of how feasible it will be to site future facilities outside of a particular species' habitat.
- If the acreage of proposed future facilities is less than the total amount of available habitat within the groundwater development areas, then impacts are conservatively estimated (more impacts to species habitat) to all be sited within that particular habitat and the full acreage of proposed future facilities is listed. If the acreage of proposed future facilities is more than the total amount of available habitat within the groundwater development areas, then impacts are conservatively estimated to be up to the total amount of available habitat.
- Indirect impacts, including construction noise, lighting, spread of noxious weeds, potential for wildfire, could also affect adjacent wildlife habitat. Impact discussions are considered general in terms of applicability to wildlife resources within the five basins and within these groundwater development area.
- Climate Change – Section 3.1, Air and Atmospheric Values and Section 3.6.3.1 discuss the potential effects of climate change on terrestrial wildlife resources. These effects could be in combination with the GWD Project

pumping. As a result of the current knowledge of climate change, it is not possible to relate potential effects with specific pumping alternatives that are analyzed in this EIS.

- SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins and all facilities associated with the SNWA GWD Project. The COM Plan includes a requirement for comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect wildlife resources from ROW construction and operation activities.
- Mitigation measures discussed in this resource section focus on new measures. Where applicable, some of the ROW mitigation measures may apply to surface disturbance activities associated with groundwater development. These ROW mitigation measures also would be considered in subsequent NEPA tiers.

Groundwater Pumping

- To understand how the wildlife habitat impacts related to drawdown are described, the reader should review: 1) the Methodology, Assumptions, and Limitations discussion in Section 3.3, Water Resources; particularly the discussion under the unnumbered heading "Identification of Spring and Streams Susceptible to Drawdown Impacts", and 2) the Assumptions and Methods sections in 3.5, Vegetation Resources.
- The key habitat features (e.g. springs, perennial streams, phreatophytic vegetation communities) within species habitats were calculated (count, miles) and provided in percentage of the total of each features within the species habitat or within the basin to determine relative change in potential availability of those features to wildlife. The phreatophytic vegetation communities, wetland/meadow and basin shrubland, as defined in section 3.5.2.8 (Vegetation – Groundwater Development and Groundwater Pumping, Assumptions) are also used in this section.
- The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on terrestrial wildlife resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.
- As part of the COM Plan, the BLM will coordinate with the MOU partner agencies to define data gaps prior to initiating subsequent NEPA tiers. Several years of data collection may be required for terrestrial wildlife resources.

3.6.2.9 Proposed Action

Groundwater Development Areas

Construction and Facility Maintenance

<u>Habitat Loss, Fragmentation, Accidental Wildfires, and Power Line Effects</u>

The following information summarizes general habitat impacts to terrestrial wildlife resources in groundwater development areas, within the five groundwater development basins (Snake, Spring, Delamar, Dry Lake, and Cave valleys; there are no groundwater development areas in Utah). Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in a total surface disturbance of approximately 3,590 to 8,410 acres. A portion of this construction disturbance – approximately 66 percent (or 2,374 to 5,536 acres) – would be permanently converted to industrial uses for the operational life of the project. No specific development plans are available as they cannot be prepared at this time. As a result, it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland habitat types would be most extensively disturbed (**Table 3.5-9**, Vegetation Resources). The impacts of construction and facility maintenance on terrestrial wildlife in groundwater development areas would be similar to the impacts described in the ROW areas (Section 3.6.2.4.1) including impacts related to habitat fragmentation and potential impacts from accidental wildfires and power lines.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on terrestrial wildlife resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

As part of the COM Plan, ACMs and the BLM RMPs BMPs described for ROWs (**Appendix E**) also would be incorporated for the groundwater development areas, as applicable. Additional project-specific measures would be determined as part of subsequent NEPA analysis for specific project locations. As part of the programmatic level of analysis for this EIS, additional ACMs would be incorporated into future COM Plans and could include the following design features to reduce impacts to terrestrial wildlife resources. Other measures may be added during subsequent NEPA analyses.

In its Programmatic Measures, SNWA stated it will implement ACMs that may reduce potential impacts to terrestrial wildlife species. These may include, but are not limited to:

- Groundwater production well siting and design to reduce impacts (ACM B.1.1, B.1.4);
- Collector pipeline, distribution power line, and secondary substation siting (ACM B.1.3);
- Monitoring well design to use solar panels, to reduce need for additional power lines (ACM B.1.2); and
- Lighting limited and designed to reduce impacts (ACM B.2.4).

Surface restoration, restoration monitoring measures, and ACMs would be those identified in **Appendix E**.

<u>Species of Management Concern</u>

Big Game: Five big game species ranges (pronghorn antelope, Rocky Mountain elk, mule deer, Rocky Mountain bighorn sheep, and desert bighorn sheep) occur in at least one of the groundwater development basins. Species with the most widespread distribution are pronghorn antelope and mule deer. Crucial summer range is present for mule deer in four of the basins; crucial winter range is in Spring Valley for antelope and in Spring and Dry Lake valleys for mule deer (**Figures 3.6-1** to **3.6-5**). Antelope, elk, deer and bighorn sheep are all considered culturally significant to regional Tribes.

Table 3.6-11 summarizes acreage of big game ranges that fall within groundwater development areas for the Proposed Action. Refer to **Table 3.5-3** in Section 3.5, Vegetation Resources, for the acreages of the groundwater development areas in the five valleys.

Direct impacts to big game would include the incremental, long-term surface disturbance of approximately 3,590 to 8,410 acres of primarily shrubland wildlife habitat in groundwater development areas in the five basins. Of this, approximately 66 percent, or 2,374 to 5,536 acres of habitat would be permanently converted to industrial uses. This disturbance would cause the loss of potential forage. Herbaceous forage species might become established within 1 or 2 years, depending on reclamation success; other habitat types including shrubs and woodlands would take much longer (Vegetation Resources, **Table 3.5-9**). Although surface-disturbance activities would represent a long-term habitat loss for big game and the location of facilities within the groundwater development areas may impact local herds, these disturbance acres would represent a small percentage (less than 1 percent) of the overall available habitat within these areas. Other impacts to big game species would be the same as described in ROW impact discussion (Section 3.6.2.2).

The groundwater development areas overlap with approximately 9,269 acres of occupied desert bighorn sheep habitat in Delamar, Dry Lake, and Cave valleys and 7,801 acres of potential habitat in Spring, Dry Lake, and Cave valleys. Rocky Mountain bighorn sheep occupied and potential habitat overlaps groundwater development areas in Snake and Spring valleys including approximately 6,664 acres of occupied habitat and 5,069 acres of potential habitat (**Table 3.6-12**). Potential impacts to desert bighorn and Rocky Mountain bighorn sheep as a result of construction and maintenance of groundwater development facilities would be the same as those described in the ROW impact discussion for desert bighorn sheep (Section 3.6.2.2).

Table 3.6-11 Big Game Range Acreage Overlap with Proposed Action Groundwater Development Areas

Habitat	County	Basin	Pronghorn	Rocky Mountain Elk	Mule Deer
Crucial Summer	Lincoln	Cave Valley	NI	0	2,884
		Dry Lake Valley	NI	0	800
		Spring Valley	NI	0	1,461
	Lincoln Total		NI	0	5,145
	White Pine	Snake Valley	NI	0	11,282
		Spring Valley	NI	0	366
	White Pine Total		NI	0	11,648
Crucial Summer Total			**NI**	**0**	**16,793**
Crucial Winter	Lincoln	Dry Lake Valley	0	NI	27,533
		Spring Valley	0	NI	4,672
	Lincoln Total		0	NI	32,205
	White Pine	Spring Valley	24,813	NI	26,154
	White Pine Total		24,813	NI	26,154
Crucial Winter Total			**24,813**	**NI**	**58,359**
Year Round	Lincoln	Cave Valley	32,319	34,787	31,887
		Delamar Valley	61,896	0	3,196
		Dry Lake Valley	121,659	41,346	50,465
		Spring Valley	54,645	12,843	8,738
	Lincoln Total		270,519	88,976	94,286
	White Pine	Snake Valley	90,163	3,121	22,237
		Spring Valley	288,604	103,030	86,156
	White Pine Total		378,767	106,151	108,393
Year Round Total			**649,286**	**195,127**	**202,679**

NI: None Identified.

NOTE: As described in the methodology section, acreages of overlap between species habitat and groundwater development areas are provided however, the direct disturbance that is anticipated for construction of future facilities is limited to only a small portion of these acres. Impacts would occur where surface-disturbance activities occur, not within the entire groundwater development areas.

Table 3.6-12 Bighorn Sheep Range Acreage Overlap with Proposed Action and Alternatives A and C Groundwater Development Areas

	Desert Bighorn Sheep		Rocky Mountain Bighorn Sheep	
Basin	**Occupied**	**Potential**	**Occupied**	**Potential**
Cave	3,680	500	0	0
Delamar	703	0	0	0
Dry Lake	4,886	2,879	0	0
Snake	0	0	3,079	229
Spring	0	4,422	3,585	4,840
Total	**9,269**	**7,801**	**6,664**	**5,069**

NOTE: As described in the methodology section, acreages of overlap between species habitat and groundwater development areas are provided however, the direct disturbance that is anticipated for construction of future facilities is limited to only a small portion of these acres. Impacts would occur where surface-disturbance activities occur, not within the entire groundwater development areas.

Protections provided by the RMPs and ACMs would reduce impacts to big game.

Habitat Impact by Basin:

Cave Valley: More than 90 percent of the groundwater development area in Cave Valley is antelope, elk, and mule deer year-round habitat ranges. (See **Figure 1.1-1** for groundwater development areas and valleys, **Figures 3.6-1** through **3.6-5** for big game habitats, and **Appendix F**, **Table F3.6-4**). Future facilities built in groundwater development exploratory areas would impact these big game habitats because these habitats could not be completely avoided through siting decisions. Eight percent of the groundwater development area is mule deer crucial summer range and 11 percent is desert bighorn sheep occupied habitat. Given the more limited extent of these big game ranges within the exploratory area in Cave Valley, facility siting decisions could avoid these habitats.

Delamar Valley: Eighty-six percent of the groundwater development area in Delamar Valley is antelope year-round habitat. Four percent is mule deer year round habitat and 1 percent is occupied desert bighorn sheep occupied habitat. In this valley it would be difficult to site future facilities without impacting antelope year round habitat, but other big game ranges could be avoided. There is no crucial seasonal range for mule deer in this valley, no crucial winter for antelope, and no crucial summer for elk.

Dry Lake Valley: Seventy-two percent of the groundwater development area in Dry Lake Valley is antelope year-round range. Thirty percent is mule deer year round range and 24 percent is elk year round. These ranges would likely be impacted by future project facilities. As only 16 percent of the groundwater development area is mule deer crucial winter range and 3 and 2 percent are occupied and potential desert bighorn sheep range, respectively, facility siting decisions could avoid bighorn sheep habitat entirely and should make every effort to avoid mule deer crucial winter range.

Spring Valley: Ninety-five percent of the groundwater development areas in Spring Valley are antelope year-round range. Thirty-two percent is elk year round and 26 percent is mule deer year round range. Nine percent is mule deer crucial winter range and 7 percent is antelope crucial winter range. Since only 1 percent of the development areas in Spring Valley are mule deer crucial summer range, potential desert bighorn sheep, and occupied and potential rocky mountain bighorn sheep ranges, these could likely be avoided through facility siting decisions.

Snake Valley: Ninety-seven percent of the groundwater development areas in Snake Valley is antelope year-round range. Facilities would impact this range type because it would be difficult to site facilities to avoid this range type. Twenty-four percent is mule deer year round habitat and 12 percent is mule deer crucial summer range. Three percent of the areas are elk year-round and Rocky Mountain bighorn sheep occupied habitats, which could be avoided through facility siting decisions.

Big Game Conclusion. Habitat for big game would temporarily be disturbed by construction (approximately 3,590 to 8,410 acres) and a portion would be permanently converted to industrial uses (approximately 2,374 to 5,536 acres) with potential for impact described above by basin. Construction and facility maintenance impacts would also include displacement of individuals, potential loss of breeding success, exposure to construction/maintenance movements and noise, and higher levels of human activities (including potential increased mortality from traffic and illegal poaching). The area of habitat affected by construction surface disturbance would represent less than 1 percent of the surface area of these habitat ranges within these basins; however, the location of facility construction or maintenance could impact local herds and migration corridors. Protections provided by the RMPs and ACMs would reduce impacts to big game.

Mitigation Recommendations:

GW-WL-1: Avoid Siting Facilities in Key Big Game Habitats. Avoid locating wells, new roads, or other linear facilities within key big game habitats including crucial summer and winter ranges, and occupied bighorn sheep habitats. Where avoidance is not practicable, the SNWA would improve 2 acres of comparable habitat for every 1 acre disturbed. Effectiveness: This measure would be effective in that it would first avoid locating facilities in key habitats, and if unavoidable, improve habitat thus increasing the carrying capacity of the comparable big game habitat.

Potential residual impacts include:

- The long-term (20 to 200 years) restoration periods for shrublands and woodlands in big game ranges disturbed by GWD facility construction make these habitats less suitable for forage and cover and contribute to habitat fragmentation.
- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.
- Potential big game mortalities may result from vehicle collisions.

Other Terrestrial Wildlife Species of Management Concern

Direct disturbance to small mammals, reptiles, game, and other bird species of management concern (including raptors) from surface-disturbing activities include the incremental, long-term surface disturbance of approximately 3,590 to 8,410 acres of habitat in Snake, Spring, Delamar, Dry Lake, and Cave valleys (**Table 3.5-9**, Vegetation Resources, for land cover types within the groundwater development areas). Terrestrial wildlife species of management concern habitat requirements are described in **Appendix F**, **Table F3.6-2**. Approximately 66 percent of the construction surface disturbance, or 2,374 to 5,536 acres would be permanently converted to industrial uses, and would not be reclaimed during the project life. Direct and indirect impacts to small mammal, reptiles, game, and other bird species of management concern (including raptors) as a result of construction and facility maintenance in groundwater development areas are anticipated to be similar to those described in ROWs, including general habitat fragmentation and potential for accidental wildfires and power line impacts. Culturally significant species in this group of wildlife include rabbits and various species of raptors.

While no important bird areas overlap with groundwater development areas, GBNP and D.E. Moore Bird and Wildlife Sanctuary important bird areas share a boundary with a groundwater development area in Snake Valley and the Northern Snake Range important bird area is within 2 miles of groundwater development areas in Snake and Spring valleys. Construction of facilities in the groundwater development areas, if near the boundary of the area, could have impacts to wildlife in these important bird areas, from indirect effects of noise and dust.

In its Programmatic Measures, the SNWA has stated it will implement ACMs that may reduce potential impacts to wildlife species. These are mentioned at the beginning of the groundwater development section and available in **Appendix E**.

<u>Conclusion</u>. Construction of well pads, gathering pipelines, and electrical service lines would disturb approximately 3,590 to 8,410 acres of primarily shrubland wildlife habitat in the five groundwater basins. Of this disturbance, approximately 66 percent (2,374 to 5,536 acres) would be permanently converted to industrial uses. Increased mortalities could occur given construction and facilities maintenance activities and timing of activities could impact migratory bird species and other species breeding. Habitat fragmentation effects would incrementally contribute to impacts to species, but for species requiring large tracts of unbroken habitat such as sagebrush obligates, species may not be able to complete their life functions and this project may contribute to general population declines. Protections provided by the RMPs and the ACMs would reduce impacts. See the corresponding section under ROW areas for relevant RMP protections and ACM numbers.

Mitigation Recommendations:

Given the importance of MBTA protections and raptor nest avoidance, additional mitigation recommendations for construction of groundwater development facilities include ROW-WL-2: USFWS Concurrence on Plans and ROW-WL-3: Raptor Nest Survey and Avoidance.

Measures proposed in Section 3.7, Aquatic Biology Resources, section would also benefit other species of management concern. GW-AB-1 (Avoid Disturbance to Springs and Wetlands) and GW-AB-2 (Avoid Disturbance to Streams) would also reduce impacts to terrestrial wildlife species by avoiding or minimizing impacts to aquatic habitat and adjacent wetland and riparian habitats used by many terrestrial wildlife species.

Potential residual impats include:

- The long-term (20 to 200 years) restoration periods for shrubland and woodland habitats disturbed by GWD facility construction would make these habitats unavailable for nesting, forage, and cover for other management concern species and contribute to habitat fragmentation.
- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.

Special Status Species

The focus of the impact analysis was on the following BLM Sensitive Species: pygmy rabbit, bats, dark kangaroo mouse, greater sage-grouse, special status raptors, western burrowing owl, additional special status birds, and Baking Powder Flat blue butterfly. Other special status birds are addressed as a group. Impacts for each species or species group would be qualitatively the same as described for the ROW impacts on special status species (Section 3.6.2.4). Although acreages of overlap between species habitat and groundwater development areas are provided for some species, the direct disturbance that is anticipated for future facilities is limited to approximately 3,590 to 8,410 acres from construction, of which, approximately 66 percent (2,374 to 5,536 acres) would be permanently converted to industrial uses.

Desert Bighorn Sheep: Habitat is discussed under the species of management concern.

Greater Sage-grouse: Construction of facilities in the groundwater development areas could affect greater sage-grouse leks as well as PPH and PGH (BLM 2012b). The number of leks inside groundwater development areas is listed in **Table 3.6-13**, the number of leks within 4 miles of groundwater development areas are shown in **Table 3.6-14** and the estimated number of acres of greater sage-grouse habitat that overlap the groundwater development areas is provided in **Table 3.6-15**. Sage-grouse is considered culturally significant to regional Tribes.

Table 3.6-13 Summary of Greater Sage-grouse Active, Inactive, and Historic Lek Locations within Proposed Groundwater Development Areas

Valley	Population Management Unit	Active	Inactive	Historic	Unknown	Total # of Leks
Cave Valley	Cave	1	0	0	0	1
Snake Valley	Spring/Snake Valley	1	0	2	0	3
Spring Valley - White Pine, Lincoln	Lincoln	2	2	0	0	4
Spring Valley - White Pine, Lincoln	Schell/Antelope	0	1	0	1	2
Spring Valley - White Pine, Lincoln	Spring/Snake Valley	9	1	1	6	17
Total		**13**	**4**	**3**	**7**	**27**

Table 3.6-14 Summary of Greater Sage-grouse Active, Inactive, and Historic Lek Locations within 4 Miles of Proposed Groundwater Development Areas[1]

Valley	Population Management Unit	Active	Inactive	Historic	Unknown	Total # of Leks
Cave Valley	Cave	7	0	0	0	7
Dry Lake Valley	Lincoln	0	2	0	0	2
Lake Valley – White Pine	Lincoln	1	0	0	0	1
Snake Valley	Spring/Snake Valley	1	1	3	0	5
Spring Valley - White Pine, Lincoln	Lincoln	2	2	0	1	5
Spring Valley - White Pine, Lincoln	Schell/Antelope	0	1	0	1	2
Spring Valley - White Pine, Lincoln	Spring/Snake Valley	9	1	1	6	17
Total		**20**	**7**	**4**	**8**	**39**

[1] These include leks inside the groundwater development areas as well as those within 4 miles.

Table 3.6-15 Acres within and Percent of Groundwater Development Areas for Greater Sage-grouse Habitat by Valley

Basin	Acres of PPH within Groundwater Development Areas	Percent of Groundwater Development Areas that is PPH (%)	Acres of PGH within Groundwater Development Areas	Percent of Groundwater Development Areas that is PGH (%)	Total Acres of Groundwater Development Area in Valley
Cave	21,621	62	922	3	34,787
Dry Lake	0	0	42,194	25	168,769
Snake	2,071	2	23,707	26	92,703
Spring	142,406	39	57,056	16	361,795
Total	**166,098**	**25**	**123,879**	**19**	**658,054**

NOTE: As described in the methodology section, acreages of overlap between species habitat and groundwater development areas are provided however, the direct disturbance that is anticipated for construction of future facilities is limited to only a small portion of these acres. Impacts would occur where surface-disturbance activities occur, not within the entire groundwater development areas.

Direct impacts would include the long-term reduction of up to approximately 2,633 to 6,339 acres of habitat within 4 of the groundwater development basins (Cave, Dry Lake, Snake, and Spring valleys). This would result in the incremental reduction in the amount of available habitat for this species until reclamation activities are completed and native vegetation is reestablished. Sixty-six percent of the construction surface disturbance or 1,747 to 4,180 acres of habitat would be permanently converted to industrial uses for the life of the proposed project. **Table 3.6-15** shows the percent of groundwater development areas that is PPH or PGH. Given the amount of the various seasonal habitats within Cave, Snake, and Spring valleys, it would be difficult to site facilities without impacting these habitats (also see **Appendix F**, **Table F3.6-4**). Further, given the number of leks that fall within groundwater development areas as well as within 4 miles of groundwater development areas, facility siting with regard to active sage-grouse leks would be of particular importance. While ACMs may reduce the potential for impacts to sage-grouse leks by siting as much as possible to limit disturbance in priority sage grouse habitat, be within designated utility corridors, and be co-located along existing ROWs including power lines and roads, impacts including potential increased collision and predation (particularly when power lines are located east of leks within line-of-sight) as well as habitat avoidance could occur as a result of overhead power lines. Other impacts to greater sage-grouse would be the same as described in the ROW section.

In its Programmatic Measures, SNWA has stated it will implement ACMs that may reduce potential impacts to wildlife species (for more detail see **Appendix E**). These may include, but are not limited to:

- Groundwater production well siting and design to reduce impacts (ACM B.1.1, B.1.4);
- Collector pipeline, distribution power line, and secondary substation siting (ACM B.1.3);
- Monitoring well design to use solar panels, to reduce need for additional power lines (ACM B.1.2);
- Lighting limited and designed to reduce impacts (ACM B.2.4); and
- Siting groundwater production wells and overhead power lines at least 0.25 mile away from an active greater sage-grouse lek and routing underground pipelines to be at least 0.25 mile away from active leks, unless placed within an existing road and not constructed during the breeding season (ACM B.5.1).

Conclusion. Construction would result in the incremental, long-term reduction of up to approximately 2,633 to 6,339 acres of habitat within 4 of the groundwater development basins (Cave, Dry Lake, Snake, and Spring valleys). Of this disturbance, approximately 1,747 to 4,180 acres of habitat would be permanently converted to industrial uses. Other impacts would include animal displacement (short and long term), habitat fragmentation (long term), increased potential mortalities from vehicle traffic (short and long-term), potential loss of nests, eggs or young, and potential for increased collisions and predation given additional perching sites on power lines. There are 13 active leks within proposed groundwater development areas and 39 active leks within 4 miles. All 7 of the active leks in southern Cave Valley are within 4 miles of groundwater development areas. All 10 of the active leks in Spring/Snake population management unit fall within groundwater development areas in Spring and Snake valleys and an additional 2 active leks in southern Spring Valley are also within proposed Spring Valley groundwater development areas. Protections provided by the RMP and the ACMs would reduce impacts, but potential for long term impacts to local greater sage-grouse populations exists. See ACMs listed above and the corresponding section under ROW areas for relevant RMP protections and ACM numbers.

Mitigation Recommendations:

Given the importance of avoiding line-of-sight views of active leks, additional mitigation recommendations for construction of groundwater development facilities include GW-WL-2. Mitigation measures as outlined in the ROW section including ROW-WL-6: Habitat restoration to benefit greater sage-grouse for permanently converted habitat, ROW-WL-7: Habitat restoration to benefit greater sage-grouse for other disturbed habitat, ROW-WL-8: Greater sage-grouse monitoring, ROW-WL-9: Greater sage-grouse timing restriction breeding, nesting and early brood rearing, ROW-WL-10: Greater sage-grouse timing restriction winter range, ROW-WL-11: Fence marking for greater sage-grouse, and ROW-WL-12: Co-location of power lines are also recommended.

GW-WL-2: Avoid Siting Facilities Within Buffers of Active Sage-grouse Leks. The SNWA would avoid siting facilities within 4 miles of active sage-grouse leks. Where avoidance is not possible, all power lines 33 kV or smaller within 4 miles of active greater sage-grouse leks must be buried. If technology at the time of construction allows, lines greater than 33 kV would also be buried. Effectiveness: This measure would be effective in avoiding power line associated impacts to active sage-grouse leks.

Potential residual impacts include:

- The long-term (20 to 50 years) restoration periods for sagebrush shrubland habitats disturbed by GWD facility construction make these habitats less suitable for forage and cover for greater sage-grouse.
- An unknown portion of habitats may be degraded because recovery did not fully occur or proximity to permanent facilities makes the habitat less suitable.

Raptor Species: Direct impacts to raptor species would include the long-term reduction of an estimated 3,590 to 8,410 acres of foraging and nesting habitat in the 5 basins. This would result in a reduction in the amount of available foraging and nesting habitat for golden eagles, ferruginous hawks, northern goshawks, peregrine falcons, and prairie falcons and foraging habitat for bald eagles within the five groundwater development basins until reclamation activities are completed and native vegetation is reestablished. Sixty-seven percent of the construction surface disturbance, or 2,374 to 5,536 acres would be permanently converted to industrial uses for the life of the proposed project. Other impacts to raptors would be the same as described in the ROW section.

Conclusion. Construction would result in the incremental, long-term reduction of up to an estimated 3,590 to 8,410 acres of raptor foraging and nesting habitat. Of this, approximately 66 percent (2,374 to 5,536 acres) would be permanently converted to industrial uses. Other impacts would include animal displacement (short and long term), habitat fragmentation (long term), increased potential nesting and roosting disruption from vehicle traffic (short and long-term), and potential loss of nests, eggs, or young. Protections provided by the RMP and ACMs would reduce impacts. See the corresponding section under ROW Areas for relevant RMP protections and ACM numbers.

Mitigation Recommendations:

Given the importance of raptor nest avoidance, additional mitigation recommendations for construction of groundwater development facilities include ROW-WL-2: USFWS Concurrence on Plans and ROW-WL-3: Raptor Nest Survey and Avoidance.

Mitigation measure GW-WL-3 protects burrowing owls by requiring pre-construction surveys.

Potential residual impacts include:

- The long-term (20 to 200 years) restoration periods for shrubland and woodland habitats disturbed by GWD facility construction would make these habitats unavailable for nesting, forage, and cover for other management concern species and contribute to habitat fragmentation.
- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.

Western Burrowing Owl: Direct impacts to western burrowing owl would include the long-term reduction of up to approximately 3,590 to 8,410 acres of owl habitat in the 5 groundwater development basins until reclamation activities are completed and native vegetation is reestablished. Approximately 66 percent of the construction surface disturbance, or 2,374 to 5,536 acres, would be permanently converted to industrial uses for the life of the proposed project. Other impacts to western burrowing owl would be the same as described in the ROW section. Based on the SWreGap habitat model for burrowing owl, 99 percent of the groundwater development area in Delamar Valley is burrowing owl habitat. The groundwater development areas in Cave, Dry Lake, Snake, and Spring valleys are 68, 88, 86, and 88 percent burrowing owl habitat, respectively (**Appendix F**, **Table F3.6-4**). As such, siting facilities to avoid burrowing owl habitat may be difficult.

Conclusion. Construction would result in the incremental, long-term reduction of up to approximately 3,590 to 8,410 acres of nesting and foraging habitat for burrowing owl. Of this, approximately 66 percent (2,374 to 5,536 acres) would be permanently converted to industrial uses. Other impacts to burrowing owls would include potential mortalities from vehicle traffic (short term and long term), as well as impacts similar to other raptor species listed above. Protections provided by the RMP and the ACMs would reduce impacts. See the corresponding section under ROW areas for relevant RMP protections and ACM numbers. Additional recommended mitigation measures would include pre-construction surveys, well siting avoidance of western burrowing owl burrows, and other facility siting avoidance of burrows to the extent practicable with applicant-proposed mitigation for burrows that were not avoided.

Mitigation Recommendations:

Given the importance of burrows for western burrowing owl, additional mitigation recommendations for construction of groundwater development facilities include GW-WL-3.

GW-WL-3: Pre-construction Surveys and Avoidance of Active Burrowing Owl Burrows. Prior to siting future facilities, SNWA would conduct pre-construction surveys for burrowing owl based on habitat, known range, and previous occurrences within areas being considered for facilities. Well and other facility siting would avoid active burrows during breeding and nesting season to the extent practicable. Effectiveness: This measure would be effective in avoiding impacts to active burrowing owl burrows.

Potential residual impacts include:

- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.

Additional Special Status Bird Species: Direct impacts to other special status bird species would include the long-term reduction of up to approximately 3,590 to 8,410 acres of nesting and foraging habitat in the 5 groundwater development basins until reclamation activities are completed and native vegetation is reestablished. Approximately 66 percent of the construction surface disturbance (2,374 to 5,536 acres) would be permanently converted to industrial uses for the life of the proposed project. Potential impacts from future groundwater development could impact foraging, courtship, breeding, or nesting success of these species that occur within groundwater development areas. A list of species is provided in **Appendix F**, **Table F3.6-1**. Other impacts to special status birds would be the same as described in the ROW section.

Conclusion. Construction would result in the incremental long-term reduction of up to approximately 3,590 to 8,410 acres of nesting and foraging habitat for additional special status birds. Of this, approximately 2,374 to 5,536 acres would be permanently converted to industrial uses for the life of the proposed project. Native shrubland and woodland habitat would likely be removed or disturbed by construction and would require 20 to more than 200 years for recovery to similar species composition and vertical structure as adjacent undisturbed areas. Annual and perennial grassland, and marshland habitats would require from 2 to 20 years for recovery. Increased mortalities could occur given construction and facilities maintenance activities and timing of activities could impact breeding of migratory bird species. Fragmentation effects would incrementally contribute to impacts to species. Protections provided by the RMP and the ACMs would reduce impacts. See the corresponding section under ROW areas for relevant RMP protections and ACM numbers.

Mitigation Recommendations:

Given the importance of protecting active MBTA bird nests, additional mitigation recommendations for construction of groundwater development facilities include ROW-WL-2: USFWS Concurrence on Plans and ROW-WL-3: Raptor Nest Survey and Avoidance.

Potential residual impacts include:

- The long-term (20 to 200 years) restoration periods for shrubland and woodland habitats disturbed by GWD facility construction would make these habitats unavailable for nesting, forage, and cover for other management concern species and contribute to habitat fragmentation.
- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.

Pygmy Rabbit: Based on the SWReGap habitat model for pygmy rabbits, 52 percent of the groundwater development area in Cave Valley is modeled pygmy rabbit habitat; 35 percent of the groundwater development areas in Dry Lake Valley; 39 percent of the groundwater development areas in Spring Valley and 7 percent of the groundwater development areas in Snake Valley are modeled pygmy rabbit habitat (**Appendix F**, **Table F3.6-4**). Particularly in Dry Lake and Spring valleys it could be difficult to avoid impacting pygmy rabbit habitat. Direct impacts would include the long-term reduction of up to approximately 2,633 to 6,339 acres of habitat within the 4 groundwater development valleys (there is SWReGAP modeled habitat in Delamar Valley; however, there are no records of the species there). Approximately 66 percent of the construction surface disturbance or 1,747 to 4,180 acres of habitat would be permanently converted to industrial uses. This would result in the incremental reduction in the amount of available habitat for this species until reclamation activities are completed and native vegetation is reestablished. Other impacts to pygmy rabbit would be the same as described in the ROW section.

Conclusion. Construction would result in the incremental, long-term reduction of up to approximately 2,633 to 6,339 acres of habitat. Of this, approximately 66 percent (1,747 to 4,180 acres) of habitat (shrub-scrub) would be permanently converted to industrial uses. Impacts would include displacement of animals due to noise and human activity (short and long term), habitat fragmentation (long term), potential for direct mortality from crushing of individuals or burrows by vehicles or equipment (long term), as well as potential for increased predation given additional perching sites on power lines (long term). Protections provided by the RMP and the ACMs would reduce impacts. See the corresponding section under ROW areas for relevant RMP protections and ACM numbers.

Mitigation Recommendations:

Given the importance of active burrows, additional mitigation recommendations for construction of groundwater development facilities include GW-WL-4. Mitigation measures as outlined in the ROW section including ROW-WL-14: Pygmy rabbit surveys and passive relocation, ROW-WL-15: Pygmy rabbit habitat improvement, ROW-WL-16: Priority reclamation efforts in pygmy rabbit habitat, and ROW-WL-17: Unanticipated nesting pygmy rabbits are also are recommended.

GW-WL-4: Pre-construction Survey and Avoidance of Pygmy Rabbit Occupied Habitat. Prior to siting future facilities, the SNWA would conduct pre-construction surveys for pygmy rabbits based on habitat, known range, and previous occurrences within areas being considered for facilities. Well and other facility siting would avoid occupied habitat to the extent practicable. Effectiveness: This measure would be effective in avoiding impacts to pygmy rabbits.

Potential residual impacts include:

- The long-term (20 to 50 years) restoration period for sagebrush shrubland habitat disturbed by GWD facility construction makes this habitat unavailable for forage and cover for pygmy rabbit and contributes to habitat fragmentation.
- An unknown portion of habitat may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.

Bats: Direct impacts to special status bat species would include the long-term reduction of up to approximately 3,590 to 8,410 acres of foraging habitat. For species that use more specialized habitat these acres would likely be lower. This would result in an incremental reduction in the amount of available habitat for these species until reclamation activities are completed and native vegetation is reestablished. Approximately 66 percent of the construction surface disturbance or up to approximately 2,374 to 5,536 acres would be permanently converted to industrial uses within the 5 groundwater development basins. Based on the SWReGap model for western pipistrelle, 100 percent of the groundwater development areas in all 5 basins is potential foraging habitat. For long-eared myotis the percent of the groundwater development areas that is habitat for the species ranges from 7 percent in Spring Valley to 33 percent in Delamar Valley (**Appendix F**, **Table F3.6-4**); thus facility siting will impact habitat for more generalist bat species, but it may be possible to avoid habitat for habitat specialists. Other impacts to bat species would be the same as described in the ROW section.

Conclusion. Construction would result in the incremental, long-term reduction of up to approximately 3,590 to 8,410 acres of bat foraging habitat. Of this, approximately 66 percent (up to 2,374 to 5,536 acres) would be permanently converted to industrial uses. Other impacts could include: loss of roosting sites for tree-roosting species; displacement of animals due to noise and human activity (short and long term); and habitat fragmentation (long term). There also may be increased mortality to bats from potential power line collisions (long term). Protections provided by the RMP and the ACMs would reduce impacts. See the corresponding section under ROW Areas for relevant RMP protections and ACM numbers.

Mitigation Recommendations:

GW-WR-5: Spring Avoidance, **GW-WR-6: Avoid Perennial Streams**, **GW-AB-1: Avoid Direct Impacts to Springs and Wetlands**, and **GW-AB-2: Avoid Locating Facilities Within 0.5 Mile of or Parallel to Perennial**

Streams and Riparian Areas. These mitigations would also reduce impacts to bat species by avoiding or minimizing impacts to these important foraging habitats.

Potential residual impacts include:

- The long-term (20 to 200 years) restoration periods for woodland habitats disturbed by GWD facilities construction make this habitat unavailable for forage and roosting for bats.
- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.

Dark Kangaroo Mouse: Direct impacts to dark kangaroo mouse would include the long-term reduction of habitat due to construction and potential for permanent conversion of habitat within Cave, Dry Lake, and Spring valleys (NDOW 2010a) and possibly in Delamar and Snake (USGS 2007). Using SWReGAP dark kangaroo mouse modeled habitat, up to 575 to 1,652 acres of habitat in Cave Valley, up to 395 to 834 acres of habitat in Dry Lake Valley, up to 1,206 to 2,853 acres in Spring Valley, could be disturbed during construction. Habitat in Snake and Delamar valleys might include an additional 1,407 to 3,056 acres. Of this, approximately 66 percent of the construction surface disturbance would be permanently converted to industrial uses within these basins. Based on the SWreGap model for the species (dark kangaroo mouse) 76 percent of the groundwater development area in Dry Lake Valley is dark kangaroo mouse habitat, for the other valleys see **Appendix F**, **Table F3.6-4**; thus facility siting may impact habitat for this species. Other impacts to dark kangaroo mouse would be the same as described in the ROW section.

<u>Conclusion</u>. Construction would result in the incremental, long-term reduction of habitat. A portion of this surface disturbance acreage (66 percent) would be permanently converted to industrial uses. Other impacts would include potential mortalities from vehicle traffic (short and long-term), and habitat fragmentation (long term). ACMs would reduce impacts to this species. See the corresponding section under ROW Areas for relevant ACM numbers.

Mitigation Recommendations:

Additional mitigation recommendations for construction of groundwater development facilities include ROW-WL-18 (Coordination with NDOW on conservation measures for dark kangaroo mouse) and GW-WL-5 (pre-construction survey and avoidance of dark kangaroo mouse occurrences).

GW-WL-5: Pre-construction Survey and Avoidance of Dark Kangaroo Mouse Occurrences. Prior to siting future facilities, the SNWA would conduct pre-construction surveys for dark kangaroo mouse based on habitat, known range, and previous occurrences within areas being considered for facilities. Well and other facility siting would avoid occurrences to the extent practicable. Where impacts cannot be avoided, measures similar to those proposed by the applicant for ROW construction would be followed. <u>Effectiveness</u>**:** This measure would be effective in avoiding impacts to dark kangaroo mouse.

Potential residual impacts include:

- The long-term (20 to 200 years) restoration periods for shrublands and woodlands in habitats disturbed by GWD facility construction make these habitats unavailable for forage and cover for dark kangaroo mouse.
- An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.
- Potential mortalities may occur to dark kangaroo mouse from construction equipment and soil movement.

Baking Powder Flat Blue Butterfly: Given the presence of Baking Powder Flat Blue Butterfly within a groundwater development area (Spring Valley), potential impact could include the direct mortality to the species (adult) from construction or vehicle traffic, disruption of breeding success (displacement) or direct mortality of adults, larvae, or eggs if host plants are impacted, and temporary or permanent loss of habitat if facilities are sited within occupied habitat.

Conclusion. Construction could result in the incremental long-term reduction of habitat and facility maintenance could result in the permanent conversion of habitat to industrial uses. Impacts include potential mortalities from vehicle traffic (short and long term), habitat fragmentation (long term), or direct mortality of adults, larvae, or eggs if host plants are impacted. Requirements for reclamation, as provided for in the RMP, would reduce impacts.

Mitigation Recommendations:

Given the importance of the currently known location of the butterfly and the host plant in the known occurrence area, additional mitigation recommendations for construction of groundwater development facilities include GW-WL-6 and GW-WL-7.

GW-WL-6: Avoid Siting Facilities within the Baking Powder Flat ACEC. The SNWA would avoid siting groundwater development facilities within the Baking Powder Flat ACEC. Effectiveness: This measure would be effective in avoiding impacts to the baking powder flat blue butterfly and its habitat within the ACEC.

GW-WL-7: Pre-construction Surveys and Avoidance of Baking Powder Flat Blue Butterfly Occurrences and Habitat. Prior to siting future facilities, SNWA would conduct pre-construction surveys for Baking Powder Flat blue butterfly based on habitat, known range, and previous occurrences within areas being considered for facilities. Well and other facility siting would avoid occurrences and habitat. Effectiveness: This measure would be effective in avoiding impacts to occurrences of this species of butterfly.

Potential residual impacts include:

An unknown portion of habitats may be degraded because recovery may not fully occur or proximity to permanent facilities makes the habitat less suitable.

Groundwater Pumping

Pumping Effects General Terrestrial Wildlife Discussion

This section focuses on the potentially long-term, indirect impacts to wildlife species due to a potential reduction in groundwater dependent habitats (i.e. spring, perennial streams, riparian areas below springs and along stream channels with perennial flows, and phreatophytic wetland/meadow and phreatophytic basin shrubland vegetation types).

A change in groundwater level would potentially reduce the water availability in perennial streams and springs as well as to associated vegetation communities (e.g. wetlands, riparian areas, wet meadows) and groundwater dependent phreatophytes vegetation communities. The potential loss or reduction in available water as a result of water level change could result in long-term changes in these wildlife habitats where the water sources are hydraulically connected to pumped areas.

The habitat associated with naturally occurring springs, seeps, and perennial stream reaches and associated perennial pools encompass riparian vegetation (both woody and herbaceous plant species), wetland areas, mesic habitats (wet meadows), and groundwater dependent vegetation communities (phreatophytic vegetation). Reduction or loss of habitats associated with water sources would impact terrestrial wildlife dependent on these sources, resulting in a possible reduction or loss of cover, breeding sites, foraging areas, and changes in both plant and animal community structure. Naturally occurring seeps, springs, and perennial stream reaches provide important wildlife habitat in the region of study. These habitats and their associated plant communities contribute to greater wildlife species diversity, as compared to the adjacent upland areas. Since surface water and associated habitats are limiting factors for wildlife in the study area, loss of these habitat features would alter the available habitat for species that depend on these areas, resulting in: 1) a reduction of available water for consumption; 2) a reduction in amount or quality of groundwater dependent vegetation types for breeding, foraging, and cover; 3) a reduction in the regional carrying capacity; 4) displacement and loss of animals; 5) a reduction in the overall biological diversity; 6) a potential long-term impact to the population numbers of some species; and 7) reduction in prey availability.

The degree of impacts to wildlife resources would depend on a number of variables, such as the existing habitat values and level of use, species' sensitivity (i.e. level of dependency on groundwater dependent habitats), the extent of the anticipated water and habitat reductions/shifts, and capacity for wildlife to accommodate additional effects, such as climate change.

Due to the limited amount of perennial streams and springs and associated wetlands, wet meadow, and riparian habitats within the study area, it is assumed that terrestrial species dependent on these areas are currently at carrying capacity. Consequently, while some species that are displaced due to the reduction in these habitats may be able to move into adjacent areas, it is assumed that these adjacent habitats are already at their full carrying capacity and would not support additional animals. Therefore, some individuals would be lost from the population, concentrating the remaining animals within smaller habitat areas. Species groups likely affected by reduction in groundwater dependent habitats would include: big game, small mammals, carnivores, upland game birds, waterfowl, nongame birds (e.g. raptors and passerines), bats, reptiles, and invertebrates.

Pumping Effects Analysis

Based on evaluations of the model-predicted 10-foot groundwater drawdown contour for the Proposed Action pumping and geology and groundwater characteristics, there is potential risk to terrestrial wildlife species habitat (perennial streams, springs, ET wetland/meadow and basin shrubland) in portions of 8 basins (Spring, Snake, Cave, Pahranagat, Steptoe, Hamlin, Lake, and Lower Meadow Valley Wash) during the three model time frames (full build out, full build out plus 75 years, and after full build out plus 200 years). **Figure 3.5-6**, Vegetation Resources, illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types. **Figures F3.3.8A-1** through **F3.3.8A-3** in **Appendix F3.3** show the potentially impacted perennial waters at the three model time frames for the full water resources region of study. It should be clarified that there are uncertainties associated with the model analysis as described in Section 3.3, Water Resources. This would apply to all impact discussions for individual alternatives, as well as cumulative impacts associated with each alternative.

Pine Valley, Wah Wah Valley, Tule Valley, and Fish Springs Flat basins (**Figure 3.0-3**) are located to the east of the northeast boundary of the water resources region of study, but are part of the natural resources region of study. While the groundwater flow model results suggest that drawdown attributable to the Proposed Action pumping scenario could eventually extend into Pine Valley, depth to the regional groundwater flow system in this valley is so deep that risk to groundwater dependent habitats in this valley are unlikely (see discussion in Section 3.3, Water Resources). There is some predicted reduction in flow from Snake Valley to Pine, Wah Wah, and Tule valleys that could eventually result in a reduction of discharge as Fish Springs, if the groundwater flow system is interconnected and regional flow from Snake Valley contributes to flow at Fish Springs. However, as explained in Section 3.3, Water Resources, flow reductions of this magnitude would likely be difficult to measure and distinguish from natural flow variations. See **Appendix F**, **Table F3.6-1** for species that occur in these valleys.

Full Build Out. Valleys and miles of perennial streams where surface waters could be impacted include approximately 6 miles (3 percent of the perennial stream miles in the valley) in Spring Valley. Eight springs are located in high and moderate risk areas in one valley (Spring). This represents 1 percent of springs in Spring Valley. Small percentages of ET wetland meadow (1 percent) and basin shrubland (12 percent) in Spring Valley may be potentially affected (**Appendix F**, **Table F3.6-9**).

Full Build Out Plus 75 Years. Valleys and miles of perennial streams where surface waters could be impacted include 26 miles (13 percent of the stream miles in the valley) in Spring Valley and 54 miles (25 percent) in Snake Valley (of which 11 miles falls within Utah). The 212 springs are located in high and moderate risk areas in Spring, Snake, and Hamlin valleys, including nine springs in Utah. This represents 20 percent of springs in Spring Valley, 8 percent in Snake Valley, and 1 percent in Hamlin Valley. ET vegetation types are potentially impacted in two additional valleys (Snake and Hamlin) as compared to the full build out time frame; in the case of Hamlin Valley where there is limited ET vegetation, 100 percent of wetland meadow and 94 percent of basin shrubland ET types are in areas that may be potentially impacted. In Spring Valley the percent of ET wetland meadow and basin shrubland increases to 27 and 66 percent, respectively (**Appendix F**, **Table F3.6-9**).

Full Build Out Plus 200 Years. Valleys and miles of perennial streams where surface waters could be impacted include 38 miles (19 percent of the stream miles in the valley) in Spring Valley, 63 miles (29 percent) in Snake Valley (of which 13 miles falls within Utah), less than 1 mile (2 percent) in Pahranagat, 4 miles (3 percent) in Steptoe, 3 miles (35 percent) in Lake, and 3 miles (5 percent) in Lower Meadow Valley Wash. The 305 springs located in high to moderate risk areas in Spring, Snake, Hamlin, Cave, and Lake valleys. The number also includes 10 springs in Utah and 3 springs within the boundary of the GBNP (an important bird area). See **Appendix F**, **Table F3.6-9** for percentage of springs within each valley. ET vegetation types are potentially impacted in three additional valleys (Lake, Lower Meadow Valley Wash, and Pahranagat). The percent of ET wetland meadow and basin shrubland potentially impacted in Spring Valley increases to 34 and 71 percent, respectively (**Appendix F**, **Table F3.6-9**).

The following terrestrial wildlife impacts could occur in response to groundwater pumping as outlined in the general discussion.

Species of Management Concern

Big Game: Big game species require water, as needed, to satisfy physiological requirements. The reduction or loss of existing water sources could impact big game species use and movements. Due to reduced habitat availability resulting from earlier habitat alteration in the area as discussed under surface impacts (ROW and groundwater development areas), populations of big game that currently utilize these disturbed areas may already be under some stress. It is assumed that some individuals could be displaced due to the potential reduction in water availability and associated habitats and may move into adjacent areas that are already at their carrying capacity. These displaced individuals could be lost from the population; however, this loss cannot be quantified.

Other Terrestrial Species of Management Concern: A reduction in groundwater dependent vegetation communities would affect the amount of nesting, brooding, and foraging habitat for upland game birds, and denning and foraging habitat for small mammals. A decline in available surface water would impact the extent of open water and these habitats along portions of perennial streams, springs, and seeps. Since these communities are limited within the study areas, it cannot be assumed that displaced individuals would successfully relocate into adequate breeding or foraging habitat in adjacent areas, as it is assumed that these habitats already would be at carrying capacity. As a result, some animals could be lost from the population.

A variety of bird species may breed, forage, or roost in or near the region of study as described earlier in the section. Potential long-term impacts to bird species could include loss of nesting, roosting, and foraging habitat along perennial stream reaches and at seeps and springs and associated habitats that occur within the drawdown area. These losses would result from an incremental reduction in available habitat for both resident and migratory bird species. In addition, the regional carrying capacity would be reduced by the incremental loss of available nest and roost sites. Some bird species are closely associated with groundwater dependent habitats that support trees and increased shrub density while other species may use these trees for roosting only. Impacts may also include reductions in prey populations.

Potential impacts to reptile species that are associated with groundwater dependent habitats that may be affected by pumping-related drawdown would parallel those discussed for other terrestrial wildlife species. The loss or reduction in water availability and associated vegetation communities could result in an incremental loss of suitable breeding, foraging, cover habitat, and potential reductions in prey base for these species. Impacts on species would depend on the species' ability to move to adjacent habitats, especially smaller less mobile species.

Given the potential for change in abundance and distribution of prey species dependent on groundwater dependent habitats, there also is potential to impact predator species. Birds and bats that feed on insects and raptors and predator mammals that feed on small mammals are examples of predators that also may experience local population reductions and shifts in distribution if their prey base decreases as a result of decreased groundwater dependent habitat. Impacts on predator species would depend on the species' ability to move to adjacent habitats or switch prey type.

Special Status Species

General impacts to special status species would be the same as described above for management concern species and in the general wildlife discussion above. Extent of potential impacts for various special status species or species groups is described below.

- **Desert Tortoise (Federally Threatened)**: Impacts to desert tortoise or desert tortoise-critical habitat would not be anticipated from Proposed Action pumping as the tortoise is not dependent on habitats that may be affected by drawdown.

- **Southwestern Willow Flycatcher, Yellow-billed Cuckoo, and Yuma Clapper Rail (Federally Endangered, Federal Candidate, Federally Endangered)**: These three species use riparian habitats, a habitat type that would potentially be at risk from drawdown. A reduction in groundwater dependent vegetation communities would affect the amount of nesting, brooding, and foraging habitat available for these species. There are two basins (Lower Meadow Valley Wash and Pahranagat) where model-predicted drawdown effects to water resources overlap with southwestern willow flycatcher habitat and where potential effects to water resources overlap with yellow-billed cuckoo migratory range. However, Yuma clapper rail is not currently known to occur in these basins.

  Lower Meadow Valley Wash contains a perennial stream segment that could be impacted at the full build out plus 200 years time frame. Of the approximately 42 miles of Lower Meadow Valley Wash (stream) in Lower Meadow Valley Wash Valley, model results suggest that 8 percent of the stream could be impacted by drawdown. Impacts in flow would depend on the actual drawdown that occurs in these areas and the site-specific hydraulic connection between the groundwater system impacted by pumping and Lower Meadow Valley Wash stream. If this stream is hydraulically connected to the groundwater system impacted by pumping and within the drawdown area, it would likely experience a reduction in baseflow that could result in changes to available riparian habitat for yellow-billed cuckoo and southwestern willow flycatcher habitat. Model results suggest that in the full build out plus 200 years time frame, 2 percent of perennial streams in Pahranagat Valley (0.5 mile) could be impacted by project-related pumping. This valley is important to these two bird species.

- **Greater Sage-grouse (Federal Candidate):** In summer, greater sage-grouse hens with broods move to more mesic habitats with higher food availability in the form of insects and forbs. While this species uses sagebrush for much of the year, these mesic habitats, including habitats around springs, perennial streams, and ET wetland/meadow are the focus of this discussion as they would potentially be impacted by drawdown and are a key seasonal habitat for sage-grouse. At the full build out time frame and within PPH and PGH for greater sage-grouse, ET basin shrubland as well as springs may be impacted by drawdown. Perennial stream segments in Spring Valley could also be impacted during this time frame as suggested by model results. In the full build out plus 75 years time frame, 3 basins (Spring, Snake, and Hamlin) have ET vegetation types, springs or perennial stream segments at potential risk. By full build out plus 200 years, 5 basins contain these potential affected habitats based on groundwater model predictions, the 3 mentioned previously as well as Cave and Steptoe valleys. Potential pumping impacts, when combined with potential groundwater development surface impacts, could result in the reduction or even loss of some local sage-grouse populations in Cave, Snake, and Spring valleys. While there is greater sage-grouse brooding habitat in Pine Valley, groundwater in this valley is so deep that risk to groundwater dependent habitats from drawdown are unlikely (Section 3.3, Water Resources). Greater sage-grouse is a culturally sensitive species.

- **Additional Special Status Bird Species including Raptors and Important Bird Areas**: In the eight valleys with springs, perennial streams, or ET wetland/meadow or basin shrubland that could potentially be impacted by drawdown, there are many special status bird species that use these habitats for nesting, roosting, or foraging. See **Appendix F**, **Table F3.6-1** for special status bird species that occur or are suspected to occur in the various basins. Important bird areas that have springs or perennial streams that could potentially be impacted by drawdown include: GBNP (6 miles perennial stream in the full build out plus 75 years time frame, and 2 springs and 10 miles of perennial stream and 4 springs in the full build out plus 200 years time frame), D.E. Moore Bird and Wildlife Sanctuary (approximately 2 miles of perennial stream) in the full build out plus 75 and plus 200 years time frames; Lower Meadow Valley Wash important bird area (3 miles of perennial stream) at the full build out plus 200 years time frame; and Pahranagat Valley Complex (less than 1 mile of perennial stream) at the full build out plus 200 years time frame. The model suggests that impacts in flow are anticipated to Big Springs and approximately 10 miles of Lake Creek and 9 miles of Big Springs Creek are in areas that could be impacted in the full build out plus 75 years time frame. Therefore, it is anticipated that the bird habitat conservation area associated with Lake Creek/Big Springs Creek and Pruess Lake could be impacted. Groundwater pumping could result in reductions in flow as well as in vegetation composition and structure changes as described in the Section 3.4, Vegetation Resources. These potential habitat changes could result in reductions in local populations of other special status birds or changes in species composition as well as potential changes in prey base. Some species of raptors are culturally sensitive species.

- **Pygmy Rabbit**: While this species primarily uses sagebrush as forage, in the summer, forbs and grasses also can become part of its diet. Mesic foraging habitat that would potentially be at risk from drawdown includes habitats near springs, perennial streams, and ET wetland/meadow and basin shrubland. Pygmy rabbit mesic foraging habitat could be potentially impacted by drawdown in seven valleys including: Spring, Snake, Lake, Hamlin, Cave, Pahranagat, and Steptoe during the time frames explained above in the general pumping effects analysis. Pygmy rabbit is a culturally sensitive species.
- **Bats:** The 22 special status bats are insectivores and their most productive foraging habitats often include areas near water that support higher insect populations. These habitats, including springs, perennials streams, and ET wetland/meadows and the associated prey base could be at risk from drawdown. Eight valleys have habitats important to bat foraging that would potentially be impacted by drawdown including: Spring, Snake, Lake, Hamlin, Cave, Pahranagat, Steptoe, and Lower Meadow Valley Wash. See **Appendix F**, **Table F3.6-1** for special status bat species that occur or are suspected to occur in the various basins.
- **Gila Monster**: This species is found in canyon bottoms or arroyos with permanent or intermittent streams (Wildlife Action Plan Team 2006). Habitats this species uses with potential for impact from drawdown include springs and perennial streams. In Pahranagat Valley during the full build out plus 200 years time frame, model results indicate that less than 1 mile of perennial stream in the valley may be at risk from project-related pumping. In the same time frame in Lower Meadow Valley Wash Valley, approximately 3 miles are potentially at risk. In these two valleys, habitat used by the gila monster may be impacted by groundwater drawdown.
- **Baking Powder Flat Blue Butterfly and Other Terrestrial Invertebrates**: Blind Spring within the Baking Powder Flat ACEC (Spring Valley) could potentially be impacted by drawdown based on the model-predicted 10-foot drawdown in the full build out plus 75 years time frame. While the Baking Powder Flat blue butterfly has habitat in this area, it is not anticipated that the butterfly's host plant, Shockley's buckwheat, would be impacted by drawdown as it is an upland plant. White River valley skipper may be impacted in two valleys (Lake and Spring) as its apparent host plant is Mexican rush, a wetland species. McNeil's sooty wing skipper is not suspected to occur in a valley where potential drawdown impacts to springs, perennials streams or ET vegetation types are predicted.

<u>Other Wildlife Species of Interest</u>

Cave Species: As explained in Section 3.3, Water Resources, Baker (2009) has identified 6 caves in direct contact with the water table or surface water and within susceptibility areas (Elliott et al 2006). These are Model Cave, Ice Cave, Wheeler's Deep Cave and Systems Key Cave in the Baker Creek watershed; Squirrel Springs Cave in the Snake Creek watershed; and Water Trough Cave in the Can Young watershed. While available information suggests that stream flow within Ice Cave, Systems Key Cave, and Squirrel Springs Cave are likely not tied to regional groundwater, information is not available to determine the likely source of water in the other caves. **Table 3.6-16** lists water-associated cave biota found within all six caves.

Table 3.6-16 Cave Biota Associated with Water Found in Selected Great Basin National Park Caves

	Ice Cave	Model Cave	Squirrel Springs Cave	Systems Key Cave	Water Trough Cave	Wheeler's Deep Cave
Mollusca:Gastropoda:*Gyraulus parvus*	X	X	X	X		X
Nematoda		X				
Oligochaeta: *Haplotaxis* cf. *gordioides* (aquatic earthworm)		X		?	?	
Crustacea:Copepoda		X		X		
Crustacea:Ostracoda		X		X		
Arachnida:Acari:Rhagidiidae (Rhagidiid mite)	X	X	X	X	X	
Arachnida:Opiliones: *Cyptobunus ungulatus ungulatus*		X		X		X

Table 3.6-16 Cave Biota Associated with Water Found in Selected Great Basin National Park Caves (Continued)

	Ice Cave	Model Cave	Squirrel Springs Cave	Systems Key Cave	Water Trough Cave	Wheeler's Deep Cave
Arachnida:Pseudoscorpiones: Neobisiidae: *Microcreagris grandis*		X	X		X	
Diplopoda: *Idagona lehmansis* (millipede)		X	X	?	X	X
Diplopoda:*Nevadesmus ophimontis*	X	X				X
Hexapoda:Collembola: Arrhopalitidae: *Pygmarrhopalites shoshoneiensis* (springtail)		X				
Diplura		X				
Ephemeroptera (Mayflies)	X				X	
Plecoptera (Stoneflies)					X	
Trichoptera (Caddisflies)	X		X		X	
Amphipod		X				

Source: Baker (2009).

If these caves have waters associated with them that are dependent on discharge from the regional groundwater flow system, habitat for cave obligate species, like those listed in the table, may be impacted as a result of Proposed Action pumping. Loss or reduction in water flow could result in reduced habitat for these species and may result in the loss of individuals. As explained in Section 3.3, Water Resources, the upland setting of most of these caves may indicate that these cave waters are tied to locally derived precipitation. However, given the uncertainty regarding the source of water in these caves, potential for impacts to these cave obligate species is unclear. Ongoing work by the NPS on the water sources in caves will provide additional information in the future.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on terrestrial wildlife resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

ACMs and Monitoring and Mitigation Measures: ACMs would be implemented to reduce groundwater pumping effects on environmental resources. The measures would involve monitoring, management, and mitigation measures required by existing agreements and adaptive management measures. The following items highlight those measures relative to habitats important to terrestrial wildlife. The ACM number from **Appendix E** is noted in parentheses.

Existing Agreements

- Implement biological and hydrologic monitoring, management, and mitigation, as required by the Spring Valley Stipulation (ACM C.1.1), the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2011), and the Spring Valley Hydrologic Monitoring and Mitigation Plan (Hydrographic Area 184) (SNWA 2009b).
- Consider alternative withdrawal points from Shoshone Ponds, as part of the Spring Valley Stipulated Agreement (ACM C.1.3).
- Monitor groundwater levels at agreed-upon monitoring wells in the Spring Valley and Hamlin Valley basins, as required by the Spring Valley Stipulation (ACM C.1.8).
- Maintain a discharge monitoring site at Big Springs and Cleve Creeks, with regular public reporting (ACM C.1.16).

- Ensure continued groundwater monitoring at agreed-upon monitoring wells, to characterize the movement of groundwater from the Delamar, Dry Lake, and Cave basins to adjacent basins (White River, Pahroc, and Pahranagat valleys), as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.31).
- Implement biological monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42) and the Biological Monitoring Plan for the Delamar, Dry Lake, and Cave Stipulation (BRT 2011). Monitor sage-grouse breeding and late brood-rearing habitat that is groundwater dependent, as well as water-dependent ecosystems on the valley floors, as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42).
- Monitor selected sites for special status species and their habitat in Pahranagat Valley (Pahranagat NWR, Key Pittman WMA, and Ash, Crystal, and Hiko springs) and White River Valley (Hot Creek, Flag, Moorman, and Hardy springs and phreatophytic habitats that support special status species in the Middle and Lower White River Valley, including Kirch WMA), per the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42).
- Follow Candidate Conservation Agreements with Assurances for the greater sage-grouse and pygmy rabbit on SNWA private properties (to be provided when completed) **(Appendix E**, Section C.1. (Measures from SNWA Agreements).
- Implement hydrologic monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation and the Hydrologic Monitoring and Mitigation Plan for Delamar, Dry Lake, and Cave Valleys (SNWA 2009c).

Applicant-Committed Adaptive Management Measures

- Reduce or cease groundwater withdrawals. Reduction or cessation of pumping would be determined on a case-by-case basis for individual production wells or well field using technical and consultation processes indentified in the stipulated agreements.
- Acquire real property or water rights that are dedicated to the recovery of special status species within their current and historic habitat range (ACM C.2.1).
- Improve late brood-rearing habitat for sage-grouse at the Stonehouse and Larson parcels on the SNWA Robison Ranch property in north Spring Valley, by use of gabion structures to expand and enhance riparian meadow habitat (ACM C.2.2).
- Assist the BLM with pinyon-juniper control and sagebrush habitat improvement projects in suitable areas in the project-development basins (including Spring, Snake, and Cave valleys) and with secondary opportunities in non-project development basins (including Lake and White River valleys) (ACM C.2.3).
- Conduct large-scale seeding to assist with vegetation transitions from phreatophytic communities in Spring and Snake valleys, to benefit wildlife (ACM C.2.5).
- Conduct wetlands-area restoration at Big Springs and Pruess lakes in Snake Valley, to enhance habitat for bald eagle, migratory birds, greater sandhill crane, and long billed curlew (ACM C.2.7).
- Work with NDOW and private land owners at and downstream of Hiko, Crystal, and Ash Springs, as allowed, in Pahranagat Valley to conduct habitat restoration and remove nonnative species to benefit Hiko White River springfish, White River springfish, and Pahranagat roundtail chub (ACM C.2.9). Habitat restoration activities could also benefit southwestern willow flycatcher and yellow-billed cuckoo.
- Work with the irrigation district in Pahranagat Valley to develop system efficiencies and manage water releases to benefit native fish (ACM C.2.10). Water efficiency and releases can also be managed to benefit native wildlife.
- Work with USFWS and NDOW to improve and/or expand southwestern willow flycatcher habitat on Pahranagat NWR and Key Pittman WMA, respectively (ACM C.2.11 and ACM C.2.12).
- Assist the BLM with habitat-enhancement projects in Rainbow Canyon of Lower Meadow Valley Wash, to improve conditions for southwestern willow flycatchers and yellow-billed cuckoo (ACM C.2.14).

- Reduce or change grazing in wet meadows, to improve habitat for migratory birds, waterfowl, shore bird, sage-grouse, raptors, and bats in the BLM grazing allotments on which SNWA holds grazing permits (ACM C.2.18).
- Conduct facilitated recharge projects to offset local groundwater drawdown, to benefit sensitive biological areas (ACM C.2.21).

Monitoring and Mitigation Recommendations

The following proposed monitoring and mitigation measures are intended to supplement the existing monitoring and mitigation commitments included in the stipulated agreements, the ACMs described in **Appendix E,** and are included in the COM Plan (Section 3.20). These will be considered in subsequent NEPA.

GW-WL-8: Artificial Water Sources for Big Game. If groundwater pumping by the SNWA results in the loss of existing water sources used by big game, the SNWA, in coordination with the BLM or NPS and NDOW, would develop and maintain artificial water sources to maintain current distribution of big game. Water would come from SNWA allocations. Effectiveness: This measure would be effective in mitigating for loss of a big game water source. Effects on other resources: Creation of artificial water sources may benefit some species and negatively impacts others (e.g. kit fox can have difficulty competing with coyotes in habitat with artificial water sources) (Arjo et al. 2007).

GW-WL-9: Greater sage-grouse monitoring in Hamlin Valley. SNWA and BLM would coordinate with USFWS, UDWR, and NDOW to develop monitoring of the greater sage-grouse using leks in Hamlin Valley. Goals of the monitoring program would include, but not be limited to, determining if birds using Hamlin Valley leks are migratory and what, if any, groundwater dependent habitats the birds may be using. Effectiveness: This measure would be effective in determining whether greater sage-grouse in Hamlin Valley are migratory. Monitoring also would provide additional information, not currently available, to assess potential impacts to greater sage-grouse in Hamlin Valley.

GW-WL-10: Monitoring on BLM Lands within Greater Sage-grouse Habitat. In concert with GW-WR-3, on BLM lands, require biological and hydrologic monitoring of greater sage-grouse groundwater-dependent habitats in areas that may be affected by groundwater pumping. Hydrologic monitoring should be continuous (e.g., piezometers and soil tensiometer/piezometers) at all sites where sage-grouse habitat is being monitored. Effectiveness: This measure would provide additional information, not currently available, to assess potential impacts to greater sage-grouse and its habitat from groundwater pumping.

In order to minimize or mitigate potential effects if monitoring shows impacts to greater sage-grouse or to its habitat from SNWA's groundwater pumping GW-WR-7: Groundwater Development and Drawdown Effects to Federal Resources and Federal Water Rights also is recommended. Other monitoring and mitigation measures relevant to Terrestrial Wildlife include: GW-WR-3a (Comprehensive Water Resources Monitoring Plan), GW-WR-3b (Numerical Groundwater Flow Modeling Requirements), GW-WR-5 (Shoshone Ponds), GW-VEG-3 (Wetlands Monitoring), GW-VEG-4 (Phreatophytic Monitoring), and GW-VEG-5 (Swamp Cedar Monitoring) (see Water Resources, Section 3.3, for complete wording of GW-WR-3A, GW-WR-3b, GW-WR-5, and GW-WR-7).

As described in Water Resources, Section 3.3, GW-WR-3a (Comprehensive Water Resources Monitoring Plan) would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).

As described in Water Resources Section 3.3.2, GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights) would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7).

Mitigation planning also could be developed as part of the Snake Valley 3M plan (**Appendix B**). Management actions included in the Snake 3M Plan that will be considered will include geographic redistribution of groundwater withdrawls; reduction or cessation of groundwater withdrawls; provision of consumptive water supply requirements using surface and/or groundwater sources; acquisition of property or water rights dedicated to management of special status species; and augmentation of water supply and/or acquisition of existing water rights.

Potential residual impacts include:

As described in Section 3.3, Water Resources, there is a potential reduction in the surface discharge at perennial surface water areas that cannot be avoided as well as an unavoidable long-term reduction in groundwater discharge to ET areas. Successful implementation of ACMs and monitoring and mitigation recommendations would likely reduce adverse effects on terrestrial wildlife species and their groundwater dependent habitats at some locations. However, it is not possible to determine the level of impact reduction at this time. Residual effects on some terrestrial wildlife habitats and local populations of species could exist considering the regional scale of pumping. The objectives of the COM Plan include avoiding adverse impacts to listed species and critical habitat and avoiding, minimizing, or mitigating adverse impacts to habitat for wildlife. Groundwater dependent habitat types would decline in extent and/or productivity in some locations and local populations of species that use the habitat in these locations would likely decline as well.

A summary of impact information including ACMs and mitigation recommendations is provided for the Proposed Action in **Table 3.6-17**. This same tabular presentation is used in subsequent pumping effects analyses for Alternatives A through F and No Action.

Table 3.6-17 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Proposed Action Pumping

Effects/Conclusions
• Groundwater pumping under the Proposed Action would affect terrestrial wildlife resources in 8 hydrologic basins (Spring, Snake, Cave, Pahranagat, Steptoe, Hamlin, Lake, and Lower Meadow Valley Wash) during the 3 model time frames (full build out, full build out plus 75 years, and full build out plus 200 years). There are some reductions to total predicted flow from Snake Valley to Pine, Wah Wah, and Tule valleys that could eventually result in a reduction in discharge to Fish Springs if groundwater flow system is interconnected. For all species dependant on groundwater dependent habitats (i.e., springs, perennial streams and ET wetland/meadow and basin shrubland habitats), due to the limited amount of these habitats within the study area, it is assumed that species' habitats are currently at carrying capacity. As a result, while individuals displaced due to the reduction in these habitats may be able to move, it is assumed that adjacent habitats are already at their full carrying capacity and would not support additional animals. Therefore, some individuals would be lost from the population concentrating the remaining animals within smaller habitat areas. • Big Game: The reduction or loss of existing water sources could impact big game species use and movements. It is assumed that some individuals could be displaced due to the potential reduction in water availability and associated habitats and may move into adjacent areas that are already at their carrying capacity. These displaced individuals could be lost from the population; however, this loss cannot be quantified. • Other Terrestrial Species of Management Concern: A reduction in groundwater dependent vegetation communities would affect the amount of nesting, brooding, foraging, roosting habitat for management concern birds, and denning and foraging habitat for management concern small mammals and reptiles. A decline in available surface water would impact the extent of open water and these habitats along portions of perennial streams, springs, and seeps. Since these communities are limited within the study area, it cannot be assumed that displaced individuals would successfully relocate into adequate breeding or foraging habitat in adjacent areas, as it is assumed that these habitats already would be at carrying capacity. As a result, some animals could be lost from the population. Impacts on species would depend on the species' ability to move to adjacent habitats, especially smaller less mobile species. Impacts may also include reductions in prey populations. With potential change in abundance and distribution of prey species dependent on groundwater dependent habitats, there also is potential to impact predator species. Impacts on predator species would depend on the species' ability to move to adjacent habitats or switch prey type. • Important Bird Areas: There are two important bird areas with springs or streams where impacts to flow could occur (D.E. Moore and GBNP) at the full build out plus 75 years time frame. At the full build out plus 200 year timeframe, an additional two IBAs have springs or streams where impacts to flow could occur (Lower Meadow Valley Wash and Pahranagat Valley Complex).

Table 3.6-17 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Proposed Action Pumping (Continued)

Effects/Conclusions
• SWWF and YBC: Based on model results, there are two basins (Lower Meadow Valley Wash and Pahranagat) where model-predicted drawdown effects to water resources overlap with southwestern willow flycatcher habitat and where potential effects to water resources overlap with yellow-billed cuckoo migratory range at the full build out plus 200 years time frame. • Greater sage-grouse: At the full build out time frame and within PPH and PGH for greater sage-grouse, ET basin shrubland as well as springs may be impacted by drawdown. Perennial stream segments in Spring Valley could also be impacted during this time frame as suggested by model results. In the full build out plus 75 years time frame, 3 basins (Spring, Snake, and Hamlin) have ET vegetation types, springs or perennial stream segments at potential risk. By full build out plus 200 years, 5 basins contain these potential affected habitats based on groundwater model predictions, the 3 mentioned previously as well as Cave and Steptoe valleys. Potential pumping impacts, when combined with potential groundwater development surface impacts, could result in the reduction or even loss of some local sage grouse populations in Cave, Snake, and Spring valleys.
Impact Indicators by Model Timeframe
• **Full Build Out.** Valleys and miles of perennial streams where surface waters could be impacted include approximately 6 miles (3 percent of the perennial stream miles in the valley) in Spring Valley. Eight springs are located in high and moderate risk areas in one valley (Spring). This represents 1 percent of springs in Spring Valley. Small percentages of ET wetland meadow (1 percent) and basin shrubland (12 percent) in Spring Valley may be potentially affected (**Appendix F**, **Table F3.6-9**). • **Full Build Out Plus 75 Years.** Valleys and miles of perennial streams where surface waters could be impacted include 26 miles (13 percent of the stream miles in the valley) in Spring Valley and 54 miles (25 percent) in Snake Valley (of which 11 miles falls within Utah). The 212 springs are located in high and moderate risk areas in Spring, Snake, and Hamlin valleys, including nine springs in Utah. This represents 20 percent of springs in Spring Valley, 8 percent in Snake Valley, and 1 percent in Hamlin Valley. ET vegetation types are potentially impacted in two additional valleys (Snake and Hamlin) as compared to the full build out time frame; in the case of Hamlin Valley where there is limited ET vegetation, 100 percent of wetland meadow and 94 percent of basin shrubland ET types are in areas that may be potentially impacted. In Spring Valley the percent of ET wetland meadow and basin shrubland increases to 27 and 66 percent, respectively (**Appendix F**, **Table F3.6-9**). • **Full Build Out Plus 200 Years.** Valleys and miles of perennial streams where surface waters could be impacted include 38 miles (19 percent of the stream miles in the valley) in Spring Valley, 63 miles (29 percent) in Snake Valley (of which 13 miles falls within Utah), less than 1 mile (2 percent) in Pahranagat, 4 miles (3 percent) in Steptoe, 3 miles (35 percent) in Lake, and 3 miles (5 percent) in Lower Meadow Valley Wash. The 305 springs located in high to moderate risk areas in Spring, Snake, Hamlin, Cave, and Lake valleys. The number also includes 10 springs in Utah and 3 springs within the boundary of the GBNP (an important bird area). See **Appendix F**, **Table F3.6-9** for percentage of springs within each valley. ET vegetation types are potentially impacted in three additional valleys (Lake, Lower Meadow Valley Wash, and Pahranagat). The percent of ET wetland meadow and basin shrubland potentially impacted in Spring Valley increases to 34 and 71 percent, respectively (**Appendix F**, **Table F3.6-9**).
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures including ACMs and mitigation recommendations for wildlife resources are summarized below.
BLM RMP Direction and ACMs
• Implement biological and hydrologic monitoring, management, and mitigation, as required by the Spring Valley Stipulation (ACM C.1.1), the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2011), and the Spring Valley Hydrologic Monitoring and Mitigation Plan (Hydrographic Area 184) (SNWA 2009b). • Consider alternative withdrawal points from Shoshone Ponds, as part of the Spring Valley Stipulated Agreement (ACM C.1.3). • Monitor groundwater levels at agreed-upon monitoring wells in the Spring Valley and Hamlin Valley basins, as required by the Spring Valley Stipulation (ACM C.1.8). • Maintain a discharge monitoring site at Big Springs and Cleve Creeks, with regular public reporting (ACM C.1.16). • Ensure continued groundwater monitoring at agreed-upon monitoring wells, to characterize the movement of groundwater from the Delamar, Dry Lake, and Cave basins to adjacent basins (White River, Pahroc, and Pahranagat valleys), as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.31).

Table 3.6-17 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Proposed Action Pumping (Continued)

BLM RMP Direction and ACMs
• Implement biological monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42) and the Biological Monitoring Plan for the Delamar, Dry Lake, and Cave Stipulation (BRT 2011). Monitor sage-grouse breeding and late brood-rearing habitat that is groundwater dependent, as well as water-dependent ecosystems on the valley floors, as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42). • Monitor selected sites for special status species and their habitat in Pahranagat Valley (Pahranagat NWR, Key Pittman WMA, and Ash, Crystal, and Hiko springs) and White River Valley (Hot Creek, Flag, Moorman, and Hardy springs and phreatophytic habitats that support special status species in the Middle and Lower White River Valley, including Kirch WMA), per the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42). • Follow Candidate Conservation Agreements with Assurances for the greater sage-grouse and pygmy rabbit on SNWA private properties (to be provided when completed) (Appendix E, Section C.1. (Measures from SNWA Agreements). • Implement hydrologic monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation and the Hydrologic Monitoring and Mitigation Plan for Delamar, Dry Lake, and Cave Valleys (SNWA 2009c). Reduce or cease groundwater withdrawals. Reduction or cessation of pumping would be determined on a case-by-case basis for individual production wells or well field using technical and consultation processes indentified in the stipulated agreements. • Acquire real property or water rights that are dedicated to the recovery of special status species within their current and historic habitat range (ACM C.2.1). • Improve late brood-rearing habitat for sage-grouse at the Stonehouse and Larson parcels on the SNWA Robison Ranch property in north Spring Valley, by use of gabion structures to expand and enhance riparian meadow habitat (ACM C.2.2). • Assist the BLM with pinyon-juniper control and sagebrush habitat improvement projects in suitable areas in the project-development basins (including Spring, Snake, and Cave valleys) and with secondary opportunities in non-project development basins (including Lake and White River valleys) (ACM C.2.3). • Conduct large-scale seeding to assist with vegetation transitions from phreatophytic communities in Spring and Snake valleys, to benefit wildlife (ACM C.2.5). • Conduct wetlands-area restoration at Big Springs and Pruess lakes in Snake Valley, to enhance habitat for bald eagle, migratory birds, greater sandhill crane, and long billed curlew (ACM C.2.7). • Work with NDOW and private land owners at and downstream of Hiko, Crystal, and Ash Springs, as allowed, in Pahranagat Valley to conduct habitat restoration and remove nonnative species to benefit Hiko White River springfish, White River springfish, and Pahranagat roundtail chub (ACM C.2.9). Habitat restoration activities could also benefit southwestern willow flycatcher and yellow-billed cuckoo. • Work with the irrigation district in Pahranagat Valley to develop system efficiencies and manage water releases to benefit native fish (ACM C.2.10). Water efficiency and releases can also be managed to benefit native wildlife. • Work with USFWS and NDOW to improve and/or expand southwestern willow flycatcher habitat on Pahranagat NWR and Key Pittman WMA, respectively (ACM C.2.11 and ACM C.2.12). • Assist the BLM with habitat-enhancement projects in Rainbow Canyon of Lower Meadow Valley Wash, to improve conditions for southwestern willow flycatchers and yellow-billed cuckoo (ACM C.2.14). • Reduce or change grazing in wet meadows, to improve habitat for migratory birds, waterfowl, shore bird, sage-grouse, raptors, and bats in the BLM grazing allotments on which SNWA holds grazing permits (ACM C.2.18). • Conduct facilitated recharge projects to offset local groundwater drawdown, to benefit sensitive biological areas (ACM C.2.21).
Monitoring Recommendations
• **GW-WL-9: Greater sage-grouse monitoring in Hamlin Valley**. SNWA and BLM will coordinate with USFWS, UDWR, and NDOW to develop monitoring of the greater sage-grouse using leks in Hamlin valley. Goals of the monitoring program will include, but not be limited to, determining if birds using Hamlin valley leks are migratory and what, if any, groundwater dependent habitats the birds may be using. • **GW-WL-10: GW Monitoring on BLM Lands within Greater sage-grouse habitat**. In concert with GW-WR-3, on BLM lands, require biological and hydrologic monitoring of greater sage-grouse groundwater-dependent habitats in areas that may be affected by groundwater pumping. Hydrologic monitoring should be continuous (e.g., piezometers and soil tensiometer/piezometers) at all sites where sage-grouse habitat is being monitored. • Other monitoring measures relevant to Terrestrial Wildlife include **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, and **GW-VEG-5 (Swamp Cedar Monitoring)** (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).

Table 3.6-17 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Proposed Action Pumping (Continued)

Mitigation Recommendations
• **GW-WL-8: Artificial Water Sources for Big Game**. If groundwater pumping by the SNWA results in the loss of existing water sources used by big game, the SNWA, in coordination with the BLM or NPS and NDOW, will develop and maintain artificial water sources to maintain current distribution of big game. Water will come from SNWA allocations. • In order to minimize or mitigation potential effects if monitoring shows impacts to greater sage-grouse or to its habitat from SNWA's groundwater pumping **GW-WR-7: Groundwater Development and Drawdown Effects to Federal Resources and Federal Water Rights** also is recommended. Another mitigation measure relevant to Terrestrial Wildlife includes: **GW-WR-5 (Shoshone Ponds)** (see Water Resources, Section 3.3, for complete wording of GW-WR-5 and GW-WR-7). • Mitigation planning also could be developed as part of the Snake Valley 3M Plan (**Appendix B**).
Potential Residual Impacts
• As described in Section 3.3, Water Resources, there is a potential reduction in the surface discharge at perennial surface water areas that cannot be avoided as well as an unavoidable long-term reduction in groundwater discharge to ET areas. The objectives of the COM Plan include avoiding adverse impacts to listed species and critical habitat and avoiding, minimizing, or mitigating adverse impacts to habitat for wildlife. Successful implementation of ACMs and monitoring and mitigation recommendations would likely reduce adverse effects on terrestrial wildlife species and their groundwater dependent habitats at some locations. However, it is not possible to determine the level of impact reduction at this time. Residual effects on some terrestrial wildlife habitats and local populations of species could exist considering the regional scale of pumping. Groundwater dependent habitat types would decline in extent and/or productivity in some locations and local populations of species that use the habitat in these locations would likely decline as well.

3.6.2.10 Alternative A

Groundwater Development Area

As compared to the Proposed Action, Alternative A considers the same groundwater development areas in the five groundwater development basins (Snake, Spring, Delamar, Dry Lake, and Cave valleys), but would require fewer future facilities within those areas given the reduced volume of water proposed. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in a total surface disturbance of approximately 2,069 to 4,814 acres. A portion of this construction disturbance – approximately 66 percent or 1,370 to 3,171 acres – would be permanently converted to industrial uses for the operational life of the project. No specific development plans are available as they cannot be prepared at this time. As a result, it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas (**Table 3.5-9**, Vegetation Resources). Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland habitat types would be most extensively disturbed.

The species within the various groundwater development areas are the same as described for the Proposed Action (e.g. percent of groundwater development areas that are various species' habitat). The types of impacts to terrestrial wildlife that would result from construction and facility maintenance in groundwater development areas would be similar to the impacts described in the ROW areas (Section 3.6.2.4.1) including impacts related to habitat fragmentation and potential impacts from accidental wildfires and power lines. As compared to the Proposed Action, Alternative A could disturb approximately 43 percent fewer acres during construction and convert approximately 43 percent fewer acres to permanent facilities, while the same terrestrial wildlife species could be impacted, the extent of potential impacts would be less.

Groundwater Pumping

Alternative A would consist of reduced quantity pumping (114,755 afy) at distributed locations in Snake, Spring, Delamar, Dry Lake, and Cave valleys. Alternative A pumping could result in reductions in groundwater dependent terrestrial wildlife habitat and affect terrestrial wildlife species.

Groundwater pumping would have the potential to impact important habitats for wildlife including perennial springs and streams and their associated vegetation communities (e.g. wetlands, riparian areas, wet meadows) and phreatophytic wetland/meadow and basin shrubland vegetation types in ET areas. The degree of impacts to wildlife resources would depend on a number of variables, such as the existing habitat values and level of use, species' sensitivity (i.e. level of dependency on groundwater dependent habitats), and the extent of the anticipated water and habitat reductions/shifts. Given the limited amount of these habitat types within the study area, it is assumed that species dependent on these areas are currently at carrying capacity. As a result, any individuals displaced as a result of reduction in amount or quality of these habitats could be lost, concentrating the remaining animals within smaller habitat areas. Species groups likely affected by reduction in groundwater dependent habitats would include: big game, small mammals, upland game birds, waterfowl, nongame birds (e.g. raptors and passerines), bats, reptiles, and invertebrates.

The effects and conclusions of groundwater development on terrestrial wildlife are provided in **Table 3.6-18** along with ACMs and proposed mitigation.

Table 3.6-18 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative A Groundwater Pumping

Effects/Conclusions
• Alternative A pumping impacts to big game and other management concern species as well as special status species would be similar to those described in the Proposed Action, but the extent of impacts may be reduced given the reduced pumping volumes (**Appendix F**, **Figures F3.3.8A-4** through **F3.3.8A-6**). There are two important bird areas with springs or streams where impacts to flow could occur (D.E. Moore and GBNP) at the full build out plus 75 years and plus 200 years time frames. • Based on model results, Alternative A pumping is not anticipated to impact Lower Meadow Valley Wash basin or perennial stream, which are important to yellow-billed cuckoo and has southwestern willow flycatcher habitat, nor is it anticipated to impact Pahranagat Valley perennial streams or springs used by these two species. • At the full build out time frame and within PPH and PGH for greater sage-grouse, ET basin shrubland as well as perennial streams are in areas that may be impacted by drawdown in Spring Valley. In the full build out plus 75 years time frame, 3 basins have ET vegetation types, springs or perennial stream segments in areas at potential risk within this habitat. By full build out plus 200 years, 5 basins contain these potentially affected habitats based on groundwater model results. Potential pumping impacts, when combined with potential groundwater development surface impacts, could result in the reduction or even loss of some local sage-grouse populations in Cave, Snake, and Spring valleys.
BLM RMP Direction and ACMs
• Acquire real property or water rights that are dedicated to the recovery of special status species within their current and historic habitat range (ACM C.2.1). • Improve late brood-rearing habitat for sage-grouse at the Stonehouse and Larson parcels on the SNWA Robison Ranch property in north Spring Valley, by use of gabion structures to expand and enhance riparian meadow habitat (ACM C.2.2). • Assist the BLM with pinyon-juniper control and sagebrush habitat improvement projects in suitable areas in the project-development basins (including Spring, Snake, and Cave valleys) and with secondary opportunities in non-project development basins (including Lake and White River valleys) (ACM C.2.3). • Conduct large-scale seeding to assist with vegetation transitions from phreatophytic communities in Spring and Snake valleys, to benefit wildlife (ACM C.2.5). • Conduct wetlands-area restoration at Big Springs and Pruess lakes in Snake Valley, to enhance habitat for bald eagle, migratory birds, greater sandhill crane, and long billed curlew (ACM C.2.7). • Work with NDOW and private land owners at and downstream of Hiko, Crystal, and Ash Springs, as allowed, in Pahranagat Valley to conduct habitat restoration and remove nonnative species to benefit Hiko White River springfish, White River springfish, and Pahranagat roundtail chub (ACM C.2.9). Habitat restoration activities could also benefit southwestern willow flycatcher and yellow-billed cuckoo. • Work with the irrigation district in Pahranagat Valley to develop system efficiencies and manage water releases to benefit native fish (ACM C.2.10). Water efficiency and releases can also be managed to benefit native wildlife. • Work with USFWS and NDOW to improve and/or expand southwestern willow flycatcher habitat on Pahranagat NWR and Key Pittman WMA, respectively (ACM C.2.11 and ACM C.2.12). • Assist the BLM with habitat-enhancement projects in Rainbow Canyon of Lower Meadow Valley Wash, to improve conditions for southwestern willow flycatchers and yellow-billed cuckoo (ACM C.2.14). • Reduce or change grazing in wet meadows, to improve habitat for migratory birds, waterfowl, shore bird, sage-grouse, raptors, and bats in the BLM grazing allotments on which SNWA holds grazing permits (ACM C.2.18). • Conduct facilitated recharge projects to offset local groundwater drawdown, to benefit sensitive biological areas (ACM C.2.21).

Table 3.6-18 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative A Groundwater Pumping (Continued)

Impact Indicators by Model Timeframe

- **Full Build Out**. Spring Valley has small amounts of all three groundwater dependent habitat types (i.e. perennial streams, springs, or ET vegetation types) in areas that may be potentially impacted. Less than 1 percent of perennial stream miles, less than 1 percent of springs, and small percentages of ET wetland meadow (1 percent) and basin shrubland (8 percent) in the valley are in areas that may be potentially affected (**Appendix F**, **Table F3.6-10**; **Figure F3.3.8A-4**, and **Figure 3.5-7**, Section 3.5, Vegetation Resources).
- **Full Build Out Plus 75 Years**. Three valleys have one or more of the three groundwater dependent habitats in areas that may be potentially impacted at the full build out plus 75 years time frame. Thirteen percent of perennial stream miles in Spring Valley and 25 percent in Snake Valley are in areas that may be potentially affected. Springs in 3 valleys are in areas that could be impacted during this time frame including Spring, Snake, and Hamlin. These potentially impacted springs make up 1 percent of springs in Hamlin Valley and up to 8 percent of the springs in Spring Valley. ET vegetation types are potentially impacted in two additional valleys (Snake and Hamlin) as compared to the full build out time frame and the percent of ET wetland meadow and basin shrubland in areas that may be potentially impacted in Spring Valley increases to 20 percent and 49 percent, respectively (**Appendix F**, **Table F3.6-10**; **Figure F3.3.8A-5**, and **Figure 3.5-7**, Vegetation Resources).
- **Full Build Out Plus 200 Years**. Six valleys have one or more of the three groundwater dependent habitat types in areas that may be potentially impacted at the full build out plus 200 years time frame. Four valleys have streams in areas where flows could be potentially affected including Spring, Snake, Steptoe, and Lake valleys. These potentially impacted stream miles make up 3 percent of stream miles in Steptoe Valley to up to 28 percent of stream miles in Snake Valley. The potentially impacted springs are found in 6 valleys, adding Cave, Lake, and Steptoe Valley to those named for the previous time frames above. Percent of potentially impacted springs range from less than 1 percent in Steptoe Valley to 13 percent in Spring Valley. ET vegetation types are potentially impacted in one additional valley (Lake). The percent of ET wetland meadow and basin shrubland potentially impacted in Spring Valley increases to 23 percent and 53 percent, respectively, over the previous time frame. Snake and Hamlin valleys also show increases in the amount of ET vegetation types that may be impacted (**Appendix F**, **Table F3.6-10**; **Figure F3.3.8A-6**, and **Figure 3.5-7**, Vegetation Resources).

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures including ACMs and mitigation recommendations for wildlife resources are summarized below.

BLM RMP Direction and ACMs

- Implement biological and hydrologic monitoring, management, and mitigation, as required by the Spring Valley Stipulation (ACM C.1.1), the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2011), and the Spring Valley Hydrologic Monitoring and Mitigation Plan (Hydrographic Area 184) (SNWA 2009b).
- Consider alternative withdrawal points from Shoshone Ponds, as part of the Spring Valley Stipulated Agreement (ACM C.1.3).
- Monitor groundwater levels at agreed-upon monitoring wells in the Spring Valley and Hamlin Valley basins, as required by the Spring Valley Stipulation (ACM C.1.8).
- Maintain a discharge monitoring site at Big Springs and Cleve Creeks, with regular public reporting (ACM C.1.16).
- Ensure continued groundwater monitoring at agreed-upon monitoring wells, to characterize the movement of groundwater from the Delamar, Dry Lake, and Cave basins to adjacent basins (White River, Pahroc, and Pahranagat valleys), as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.31).
- Implement biological monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42) and the Biological Monitoring Plan for the Delamar, Dry Lake, and Cave Stipulation (BRT 2011). Monitor sage-grouse breeding and late brood-rearing habitat that is groundwater dependent, as well as water-dependent ecosystems on the valley floors, as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42).
- Monitor selected sites for special status species and their habitat in Pahranagat Valley (Pahranagat NWR, Key Pittman WMA, and Ash, Crystal, and Hiko springs) and White River Valley (Hot Creek, Flag, Moorman, and Hardy springs and phreatophytic habitats that support special status species in the Middle and Lower White River Valley, including Kirch WMA), per the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42).
- Follow Candidate Conservation Agreements with Assurances for the greater sage-grouse and pygmy rabbit on SNWA private properties (to be provided when completed) (Appendix E, Section C.1. (Measures from SNWA Agreements).
- Implement hydrologic monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation and the Hydrologic Monitoring and Mitigation Plan for Delamar, Dry Lake, and Cave Valleys (SNWA 2009c).
- Reduce or cease groundwater withdrawals. Reduction or cessation of pumping would be determined on a case-by-case basis for individual production wells or well field using technical and consultation processes indentified in the stipulated agreements.

Table 3.6-18 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative A Groundwater Pumping (Continued)

Monitoring Recommendations
• **GW-WL-9 (Greater sage-grouse monitoring in Hamlin Valley)**, and **GW-WL-10 (GW Monitoring on BLM Lands within Greater sage-grouse habitat)**, described for the Proposed Action, would be applied to Alternative A. • Other monitoring measures, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, and **GW-VEG-5 (Swamp Cedar Monitoring)**, would be relevant to Terrestrial Wildlife (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).
Mitigation Recommendations
• **GW-WL-8 (Artificial Water Sources for Big Game)**, as described for the Proposed Action, would be applied to Alternative A. • In order to minimize or mitigation potential effects if monitoring shows impacts to greater sage-grouse or to its habitat from SNWA's groundwater pumping **GW-WR-7 (Groundwater Development and Drawdown Effects to Federal Resources and Federal Water Rights)** also is recommended. Another monitoring measure relevant to Terrestrial Wildlife includes: **GW-WR-5 (Shoshone Ponds)** (see Water Resources, Section 3.3, for complete wording of GW-WR-5 and GW-WR-7). • Mitigation planning also could be developed as part of the Snake Valley 3M Plan (**Appendix B**).
Potential Residual Impacts
• As described in Section 3.3, Water Resources, there is a potential reduction in the surface discharge at perennial surface water areas that cannot be avoided as well as an unavoidable long-term reduction in groundwater discharge to ET areas. The objectives of the COM Plan include avoiding adverse impacts to listed species and critical habitat and avoiding, minimizing, or mitigating adverse impacts to habitat for wildlife. Successful implementation of ACMs and monitoring and mitigation recommendations would likely reduce adverse effects on terrestrial wildlife species and their groundwater dependent habitats at some locations. However, it is not possible to determine the level of impact reduction at this time. Residual effects on some terrestrial wildlife habitats and local populations of species could exist considering the regional scale of pumping. Groundwater dependent habitat types would decline in extent and/or productivity in some locations and local populations of species that use the habitat in these locations would likely decline as well.

3.6.2.11 Alternative B

Groundwater Development Area

As compared to the Proposed Action, this alternative considers points of diversion rather than groundwater development areas in the five groundwater development basins (Snake, Spring, Delamar, Dry Lake, and Cave valleys). Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in a total surface disturbance of approximately 4,664 acres. A portion of this construction disturbance – approximately 66 percent or 3,077 acres – would be permanently converted to industrial uses for the operational life of the project. No specific development plans are available as they cannot be prepared at this time. As a result, it is assumed that the habitat cover types would be affected in proportion to their relative surface area within 1 mile of the points of diversion within the 5 groundwater development basins. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and pinyon juniper woodland habitat types would be most extensively disturbed.

Alternative B would disturb approximately 45 percent fewer acres during construction and convert approximately 45 percent fewer acres to permanent facilities than the Proposed Action when the estimated maximum potential acreage for the two alternatives is compared. The percent of groundwater development areas that are various species' habitat is presented in **Appendix F**, **Table F3.6-6**. The types of impacts from construction and facility maintenance on terrestrial wildlife in groundwater development areas would be similar to the impacts described in the ROW areas (Section 3.6.2.4.1) including impacts related to habitat fragmentation and potential impacts from accidental wildfires and power lines.

Species impacts are similar to those discussed for the Proposed Action; however, because Alternative B concentrates facility construction to the points of diversion, the acreage impact is less and therefore, species impacts could be less overall (**Appendix F**, **Table F3.6-6**). Given the smaller size of the points of diversion as compared to the groundwater development areas, avoiding important species habitats within the points of diversion through facility siting decisions may be more difficult. Some key differences in potential wildlife impacts between Alternative B and the Proposed Action are:

- Mule deer crucial summer and winter ranges are not found within proposed points of diversion in Dry Lake Valley in this alternative; crucial summer range is not found within the points of diversion in Cave Valley. Desert bighorn sheep occupied habitat is not found within proposed points of diversion in Delamar or Dry Lake valleys; and
- There are 2 active greater sage-grouse leks within proposed points of diversion and 14 active leks within 4 miles. No greater sage-grouse habitat is found within points of diversion in Dry Lake Valley in this alternative.

Groundwater Pumping

Alternative B would consist of full quantity pumping (176,655 afy) at or near points of diversion in Snake, Spring, Delamar, Dry Lake, and Cave valleys. Alternative B pumping could result in reductions in groundwater dependent terrestrial wildlife habitat and affect terrestrial species.

Groundwater pumping would have the potential to impact important habitats for wildlife including perennial springs and streams and their associated vegetation communities (e.g. wetlands, riparian areas, wet meadows) and phreatophytic wetland/meadow and basin shrubland vegetation types in ET areas. The degree of impacts to wildlife resources would depend on a number of variables, such as the existing habitat values and level of use, species' sensitivity (i.e. level of dependency on groundwater dependent habitats), and the extent of the anticipated water and habitat reductions/shifts. Given the limited amount of these habitat types within the study area, it is assumed that species dependent on these areas are currently at carrying capacity. As a result, any individuals displaced as a result of reduction in amount or quality of these habitats could be lost, concentrating the remaining animals within smaller habitat areas. Species groups likely affected by reduction in groundwater dependent habitats would include: big game, small mammals, upland game birds, waterfowl, nongame birds (e.g. raptors and passerines), bats, reptiles, and invertebrates

The effects and conclusions of groundwater development on terrestrial wildlife resources are provided in **Table 3.6.19** along with ACMs and proposed mitigation.

Table 3.6-19 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative B Groundwater Pumping

Effects/Conclusions
• Pumping impacts to big game and other management concern species as well as special status species would be similar to those described in the Proposed Action, but the distribution of impacts on the landscape would vary (**Appendix F**, **Figures F3.3.8A-7** through **F3.3.8-9**). There are two important bird areas with springs or streams where impacts to flow could occur (D.E. Moore and GBNP) at the full build out plus 75 years time frame, and an additional two important bird areas (Lower Meadow Valley Wash and Pahranagat Valley Complex) would be impacted at the plus 200 years time frame. • Based on model results, Alternative B pumping may potentially impact perennial streams in Lower Meadow Valley Wash as well as in Pahranagat Valley in the full build out plus 200 years time frame. Impacts in Pahranagat Valley could reduce available breeding habitat for the southwestern willow flycatcher and in Lower Meadow Valley Wash could reduce habitat. Potential impact in these two valleys could reduce foraging habitat for yellow-billed cuckoo. • At the full build out time frame and within PPH and PGH for greater sage-grouse, ET wetland/meadow and basin shrubland as well as springs and perennial streams are in areas that may be impacted by drawdown in Spring Valley. In the full build out plus 75 years time frame, four basins have ET vegetation types, springs or perennial stream segments in areas at potential risk within this habitat. By full build out plus 200 years, five basins contain these potentially affected habitats based on groundwater model results. Potential pumping impacts, when combined with potential groundwater development surface impacts, could result in the reduction or even loss of some local sage-grouse populations in Cave, Snake, and Spring valleys.
BLM RMP Direction and ACMs
• Ensure continued groundwater monitoring at agreed-upon monitoring wells, to characterize the movement of groundwater from the Delamar, Dry Lake, and Cave basins to adjacent basins (White River, Pahroc, and Pahranagat valleys), as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.31). • Implement biological monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42) and the Biological Monitoring Plan for the Delamar, Dry Lake, and Cave Stipulation (BRT 2011). Monitor sage-grouse breeding and late brood-rearing habitat that is groundwater dependent, as well as water-dependent ecosystems on the valley floors, as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42). • Monitor selected sites for special status species and their habitat in Pahranagat Valley (Pahranagat NWR, Key Pittman WMA, and Ash, Crystal, and Hiko springs) and White River Valley (Hot Creek, Flag, Moorman, and Hardy springs and phreatophytic habitats that support special status species in the Middle and Lower White River Valley, including Kirch WMA), per the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42).

Table 3.6-19 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative B Groundwater Pumping (Continued)

BLM RMP Direction and ACMs
• Follow Candidate Conservation Agreements with Assurances for the greater sage-grouse and pygmy rabbit on SNWA private properties (to be provided when completed) (Appendix E, Section C.1. (Measures from SNWA Agreements). • Implement hydrologic monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation and the Hydrologic Monitoring and Mitigation Plan for Delamar, Dry Lake, and Cave Valleys (SNWA 2009c). • Reduce or cease groundwater withdrawals. Reduction or cessation of pumping would be determined on a case-by-case basis for individual production wells or well field using technical and consultation processes indentified in the stipulated agreements. • Acquire real property or water rights that are dedicated to the recovery of special status species within their current and historic habitat range (ACM C.2.1). • Improve late brood-rearing habitat for sage-grouse at the Stonehouse and Larson parcels on the SNWA Robison Ranch property in north Spring Valley, by use of gabion structures to expand and enhance riparian meadow habitat (ACM C.2.2). • Assist the BLM with pinyon-juniper control and sagebrush habitat improvement projects in suitable areas in the project-development basins (including Spring, Snake, and Cave valleys) and with secondary opportunities in non-project development basins (including Lake and White River valleys) (ACM C.2.3). • Conduct large-scale seeding to assist with vegetation transitions from phreatophytic communities in Spring and Snake valleys, to benefit wildlife (ACM C.2.5). • Conduct wetlands-area restoration at Big Springs and Pruess lakes in Snake Valley, to enhance habitat for bald eagle, migratory birds, greater sandhill crane, and long billed curlew (ACM C.2.7). • Work with NDOW and private land owners at and downstream of Hiko, Crystal, and Ash Springs, as allowed, in Pahranagat Valley to conduct habitat restoration and remove nonnative species to benefit Hiko White River springfish, White River springfish, and Pahranagat roundtail chub (ACM C.2.9). Habitat restoration activities could also benefit southwestern willow flycatcher and yellow-billed cuckoo. • Work with the irrigation district in Pahranagat Valley to develop system efficiencies and manage water releases to benefit native fish (ACM C.2.10). Water efficiency and releases can also be managed to benefit native wildlife. • Work with USFWS and NDOW to improve and/or expand southwestern willow flycatcher habitat on Pahranagat NWR and Key Pittman WMA, respectively (ACM C.2.11 and ACM C.2.12). • Assist the BLM with habitat-enhancement projects in Rainbow Canyon of Lower Meadow Valley Wash, to improve conditions for southwestern willow flycatchers and yellow-billed cuckoo (ACM C.2.14). • Reduce or change grazing in wet meadows, to improve habitat for migratory birds, waterfowl, shore bird, sage-grouse, raptors, and bats in the BLM grazing allotments on which SNWA holds grazing permits (ACM C.2.18). • Conduct facilitated recharge projects to offset local groundwater drawdown, to benefit sensitive biological areas (ACM C.2.21).
Impact Indicators by Model Timeframe
• **Full Build Out**. Spring Valley has small amounts of all three groundwater dependent habitat types (i.e. perennial streams, springs, or ET vegetation types) in areas that may be potentially impacted. Less than 1 percent of perennial stream miles, less than 1 percent of springs, and small percentages of ET wetland meadow (1 percent) and basin shrubland (8 percent) in the valley are in areas that may be potentially affected (**Appendix F**, **Table F3.6-10**; **Figure F3.3.8A-4**, and **Figure 3.5-7**, Section 3.5, Vegetation Resources). • **Full Build Out Plus 75 Years**. Three valleys have one or more of the three groundwater dependent habitats in areas that may be potentially impacted at the full build out plus 75 years time frame. Thirteen percent of perennial stream miles in Spring Valley and 25 percent in Snake Valley are in areas that may be potentially affected. Springs in 3 valleys are in areas that could be impacted during this time frame including Spring, Snake, and Hamlin. These potentially impacted springs make up 1 percent of springs in Hamlin Valley and up to 8 percent of the springs in Spring Valley. ET vegetation types are potentially impacted in two additional valleys (Snake and Hamlin) as compared to the full build out time frame and the percent of ET wetland meadow and basin shrubland in areas that may be potentially impacted in Spring Valley increases to 20 percent and 49 percent, respectively (**Appendix F**, **Table F3.6-10**; **Figure F3.3.8A-5**, and **Figure 3.5-7**, Vegetation Resources). • **Full Build Out Plus 200 Years**. Six valleys have one or more of the three groundwater dependent habitat types in areas that may be potentially impacted at the full build out plus 200 years time frame. Four valleys have streams in areas where flows could be potentially affected including Spring, Snake, Steptoe, and Lake valleys. These potentially impacted stream miles make up 3 percent of stream miles in Steptoe Valley to up to 28 percent of stream miles in Snake Valley. The potentially impacted springs are found in 6 valleys, adding Cave, Lake, and Steptoe Valley to those named for the previous time frames above. Percent of potentially impacted springs range from less than 1 percent in Steptoe Valley to 13 percent in Spring Valley. ET vegetation types are potentially impacted in one additional valley (Lake). The percent of ET wetland meadow and basin shrubland potentially impacted in Spring Valley increases to 23 percent and 53 percent, respectively, over the previous time frame. Snake and Hamlin valleys also show increases in the amount of ET vegetation types that may be impacted (**Appendix F3.6, Table F3.6-10**; **Figure F3.3.8A-6**, and **Figure 3.5-7**, Vegetation Resources).

Table 3.6-19 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative B Groundwater Pumping (Continued)

COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures including ACMs and mitigation recommendations for wildlife resources are summarized below.
BLM RMP Direction and ACMs
• Implement biological and hydrologic monitoring, management, and mitigation, as required by the Spring Valley Stipulation (ACM C.1.1), the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2011), and the Spring Valley Hydrologic Monitoring and Mitigation Plan (Hydrographic Area 184) (SNWA 2009b). • Consider alternative withdrawal points from Shoshone Ponds, as part of the Spring Valley Stipulated Agreement (ACM C.1.3). • Monitor groundwater levels at agreed-upon monitoring wells in the Spring Valley and Hamlin Valley basins, as required by the Spring Valley Stipulation (ACM C.1.8). • Maintain a discharge monitoring site at Big Springs and Cleve Creeks, with regular public reporting (ACM C.1.16).
Monitoring Recommendations
• **GW-WL-9 (Greater sage-grouse monitoring in Hamlin Valley)**, and **GW-WL-10 (GW Monitoring on BLM Lands within Greater sage-grouse habitat)**, described for the Proposed Action, would be applied to Alternative B. • Other monitoring measures, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, and **GW-VEG-5 (Swamp Cedar Monitoring)**, would be relevant to Terrestrial Wildlife (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).
Mitigation Recommendations
• **GW-WL-8 (Artificial Water Sources for Big Game)**, as described for the Proposed Action, would be applied to Alternative B. • In order to minimize or mitigation potential effects if monitoring shows impacts to greater sage-grouse or to its habitat from SNWA's groundwater pumping **GW-WR-7 (Groundwater Development and Drawdown Effects to Federal Resources and Federal Water Rights)** also is recommended. Another monitoring measure relevant to Terrestrial Wildlife includes: **GW-WR-5 (Shoshone Ponds)** (see Water Resources, Section 3.3, for complete wording of GW-WR-5 and GW-WR-7). • Mitigation planning also could be developed as part of the Snake Valley 3M Plan (**Appendix B**).
Potential Residual Impacts
• As described in Section 3.3, Water Resources, there is a potential reduction in the surface discharge at perennial surface water areas that cannot be avoided as well as an unavoidable long-term reduction in groundwater discharge to ET areas. The objectives of the COM Plan include avoiding adverse impacts to listed species and critical habitat and avoiding, minimizing, or mitigating adverse impacts to habitat for wildlife. Successful implementation of ACMs and monitoring and mitigation recommendations would likely reduce adverse effects on terrestrial wildlife species and their groundwater dependent habitats at some locations. However, it is not possible to determine the level of impact reduction at this time. Residual effects on some terrestrial wildlife habitats and local populations of species could exist considering the regional scale of pumping. Groundwater dependent habitat types would decline in extent and/or productivity in some locations and local populations of species that use the habitat in these locations would likely decline as well.

3.6.2.12 Alternative C

Groundwater Development Area

As compared to the Proposed Action, Alternative C considers the same groundwater development areas in the five groundwater development basins (Snake, Spring, Delamar, Dry Lake, and Cave valleys), but would require fewer future facilities within those areas given the reduced volume of water pumped (intermittent pumping up to same amount as Alternative A). Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in a total surface disturbance of approximately 2,069 to 4,814 acres. A portion of this construction disturbance – approximately 66 percent or 1,370 to 3,171 acres – would be permanently converted to industrial uses for the operational life of the project. No specific development plans are available as they cannot be prepared at this time. As a result, it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas (**Table 3.5-3**, Vegetation Resources). Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland habitat types would be most extensively disturbed.

The species and species habitat within the various groundwater development areas are the same as described for the Proposed Action. The percent of groundwater development areas that are various species' habitat is presented in **Appendix F**, **Table F3.6-5**. The types of impacts to terrestrial wildlife that would result from construction and facility maintenance in groundwater development areas would be similar to the impacts described in the ROW areas (Section 3.6.2.4.1) including impacts related to habitat fragmentation and potential impacts from accidental wildfires and power lines. When compared to the Proposed Action, Alternative C (like A) could disturb approximately 43 percent fewer acres during construction and convert approximately 43 percent fewer acres to permanent facilities. While the same terrestrial wildlife species could be impacted, the extent of potential impacts would be less.

Groundwater Pumping

Alternative C would consist of intermittent pumping (between 12,000 to 114,755 afy) at distributed locations in Snake, Spring, Delamar, Dry Lake, and Cave valleys based on a conceptual drought scenario. Alternative C pumping could result in reductions in groundwater dependent terrestrial wildlife habitat and affect terrestrial species.

Groundwater pumping would have the potential to impact important habitats for wildlife including perennial springs and streams and their associated vegetation communities (e.g. wetlands, riparian areas, wet meadows) and phreatophytic wetland/meadow and basin shrubland vegetation types in ET areas. The degree of impacts to wildlife resources would depend on a number of variables, such as the existing habitat values and level of use, species' sensitivity (i.e. level of dependency on groundwater dependent habitats), and the extent of the anticipated water and habitat reductions/shifts. Given the limited amount of these habitat types within the study area, it is assumed that species dependent on these areas are currently at carrying capacity. As a result, any individuals displaced as a result of reduction in amount or quality of these habitats could be lost, concentrating the remaining animals within smaller habitat areas. Species groups likely affected by reduction in groundwater dependent habitats would include: big game, small mammals, upland game birds, waterfowl, nongame birds (e.g. raptors and passerines), bats, reptiles, and invertebrates.

The effects and conclusions of groundwater development on terrestrial wildlife are provided in **Table 3.6-20** along with ACMs and proposed mitigation.

Table 3.6-20 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative C Groundwater Pumping

Effects/Conclusions
• Alternative C pumping impacts to big game and other management concern species as well as special status species would be similar to those described in the Proposed Action, but the extent of impacts may be reduced given the reduced pumping volumes and intermittent pumping regime **(Appendix F**, **Figures F3.3.8A-10** through **F3.3.8A-12**). There are two important bird areas with springs or streams where impacts to flow could occur (D.E. Moore and GBNP) at the full build out plus 200 years time frame. • Based on model results, Alternative C is not anticipated to impact Lower Meadow Valley Wash basin or perennial stream which are important to southwestern willow flycatcher and yellow-billed cuckoo nor is it anticipated to impact Pahranagat Valley perennial streams or springs used by these two species. • At the full build out time frame and within PPH and PGH for greater sage-grouse, ET basin shrubland as well as perennial streams are in areas that may be impacted by drawdown in Spring Valley. In the full build out plus 75 years time frame, three basins have ET vegetation types, springs or perennial stream segments at potential risk within this habitat. By full build out plus 200 years, greater impacts to habitats in these three basins would be anticipated based on groundwater model results. Potential pumping impacts, when combined with potential groundwater development surface impacts, could result in the reduction or even loss of some local sage-grouse populations in Snake and Spring valleys.

Table 3.6-20 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative C Groundwater Pumping (Continued)

Impact Indicators by Model Timeframe
• **Full Build Out**. Spring Valley has all three groundwater dependent habitat types (i.e. perennial streams, springs, and ET vegetation types) in areas that may be potentially impacted. Less than one percent of perennial stream miles in Spring Valley [184] are in areas that may be potentially impacted. Three springs in Spring Valley occur in areas that could be impacted during this time frame. A small percentage of ET wetland meadow (1 percent) and basin shrubland (8 percent) are in areas that may be potentially affected in Spring Valley (Appendix F, Table F3.6-12; Figure F3.3.8A-10, and Figure 3.5 9, Vegetation Resources). • **Full Build Out Plus 75 Years**. Three valleys have one or more of the three groundwater dependent habitats in areas that may be potentially impacted at the full build out plus 75 years time frame. Two percent of perennial stream miles in Spring and 15 percent in Snake valleys are in areas that may be potentially impacted. Springs in three valleys occur in areas that could be impacted during this time frame including Spring, Hamlin, and Snake. These potentially impacted springs make up less than 1 percent of springs in Hamlin Valley and up to 5 percent of the springs in Spring Valley. ET vegetation types are potentially impacted in Spring and Snake valleys. Six percent of ET wetland meadow and 16 percent of basin shrubland in Spring could be potentially impacted. In Snake Valley, 22 percent of wetland meadow and 8 percent of basin shrubland could be potentially impacted (**Appendix F**, **Table F3.6-12**; **Figure F3.3.8A-11**, and **Figure 3.5-9**, Vegetation Resources). • **Full Build Out Plus 200 Years**. Three valleys have one or more of the three groundwater dependent habitat types in areas that may be potentially impacted at the full build out plus 200 years time frame. No additional valleys have streams in areas that may be potentially affected, though 25 percent of stream miles in Snake Valley are in areas where impacts to flow could occur. The potentially impacted springs are found in the same three valleys mentioned in the previous time frame. ET vegetation types are potentially impacted in Spring, Snake, and Hamlin valleys. The percent of ET wetland meadow and basin shrubland potentially impacted in Spring Valley increases to 13 percent and 18 percent, respectively, over the previous time frame. Snake Valley also shows increases in the amount of ET vegetation types that may be impacted (**Appendix F**, **Table F3.6-12**; **Figure F3.3.8A-12**, and **Figure 3.5-9**, Vegetation Resources).
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures including ACMs and mitigation recommendations for wildlife resources are summarized below.
BLM RMP Direction and ACMs
• Implement biological and hydrologic monitoring, management, and mitigation, as required by the Spring Valley Stipulation (ACM C.1.1), the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2011), and the Spring Valley Hydrologic Monitoring and Mitigation Plan (Hydrographic Area 184) (SNWA 2009b). • Consider alternative withdrawal points from Shoshone Ponds, as part of the Spring Valley Stipulated Agreement (ACM C.1.3). • Monitor groundwater levels at agreed-upon monitoring wells in the Spring Valley and Hamlin Valley basins, as required by the Spring Valley Stipulation (ACM C.1.8). • Maintain a discharge monitoring site at Big Springs and Cleve Creeks, with regular public reporting (ACM C.1.16). • Ensure continued groundwater monitoring at agreed-upon monitoring wells, to characterize the movement of groundwater from the Delamar, Dry Lake, and Cave basins to adjacent basins (White River, Pahroc, and Pahranagat valleys), as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.31). • Implement biological monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42) and the Biological Monitoring Plan for the Delamar, Dry Lake, and Cave Stipulation (BRT 2011). Monitor sage-grouse breeding and late brood-rearing habitat that is groundwater dependent, as well as water-dependent ecosystems on the valley floors, as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42). • Monitor selected sites for special status species and their habitat in Pahranagat Valley (Pahranagat NWR, Key Pittman WMA, and Ash, Crystal, and Hiko springs) and White River Valley (Hot Creek, Flag, Moorman, and Hardy springs and phreatophytic habitats that support special status species in the Middle and Lower White River Valley, including Kirch WMA), per the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42). • Follow Candidate Conservation Agreements with Assurances for the greater sage-grouse and pygmy rabbit on SNWA private properties (to be provided when completed) (Appendix E, Section C.1. (Measures from SNWA Agreements). • Implement hydrologic monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation and the Hydrologic Monitoring and Mitigation Plan for Delamar, Dry Lake, and Cave Valleys (SNWA 2009c). • Reduce or cease groundwater withdrawals. Reduction or cessation of pumping would be determined on a case-by-case basis for individual production wells or well field using technical and consultation processes indentified in the stipulated agreements.

Table 3.6-20 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative C Groundwater Pumping (Continued)

BLM RMP Direction and ACMs
• Acquire real property or water rights that are dedicated to the recovery of special status species within their current and historic habitat range (ACM C.2.1). • Improve late brood-rearing habitat for sage-grouse at the Stonehouse and Larson parcels on the SNWA Robison Ranch property in north Spring Valley, by use of gabion structures to expand and enhance riparian meadow habitat (ACM C.2.2). • Assist the BLM with pinyon-juniper control and sagebrush habitat improvement projects in suitable areas in the project-development basins (including Spring, Snake, and Cave valleys) and with secondary opportunities in non-project development basins (including Lake and White River valleys) (ACM C.2.3). • Conduct large-scale seeding to assist with vegetation transitions from phreatophytic communities in Spring and Snake valleys, to benefit wildlife (ACM C.2.5). • Conduct wetlands-area restoration at Big Springs and Pruess lakes in Snake Valley, to enhance habitat for bald eagle, migratory birds, greater sandhill crane, and long billed curlew (ACM C.2.7). • Work with NDOW and private land owners at and downstream of Hiko, Crystal, and Ash Springs, as allowed, in Pahranagat Valley to conduct habitat restoration and remove nonnative species to benefit Hiko White River springfish, White River springfish, and Pahranagat roundtail chub (ACM C.2.9). Habitat restoration activities could also benefit southwestern willow flycatcher and yellow-billed cuckoo. • Work with the irrigation district in Pahranagat Valley to develop system efficiencies and manage water releases to benefit native fish (ACM C.2.10). Water efficiency and releases can also be managed to benefit native wildlife. • Work with USFWS and NDOW to improve and/or expand southwestern willow flycatcher habitat on Pahranagat NWR and Key Pittman WMA, respectively (ACM C.2.11 and ACM C.2.12). • Assist the BLM with habitat-enhancement projects in Rainbow Canyon of Lower Meadow Valley Wash, to improve conditions for southwestern willow flycatchers and yellow-billed cuckoo (ACM C.2.14). • Reduce or change grazing in wet meadows, to improve habitat for migratory birds, waterfowl, shore bird, sage-grouse, raptors, and bats in the BLM grazing allotments on which SNWA holds grazing permits (ACM C.2.18). • Conduct facilitated recharge projects to offset local groundwater drawdown, to benefit sensitive biological areas (ACM C.2.21).
Monitoring Recommendations
• **GW-WL-9 (Greater sage-grouse monitoring in Hamlin Valley)**, and **GW-WL-10 (GW Monitoring on BLM Lands within Greater sage-grouse habitat)**, described for the Proposed Action, would be applied to Alternative C. • Other monitoring measures, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, and **GW-VEG-5 (Swamp Cedar Monitoring)**, would be relevant to Terrestrial Wildlife (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).
Mitigation Recommendations
• **GW-WL-8 (Artificial Water Sources for Big Game)**, as described for the Proposed Action, would be applied to Alternative C. • In order to minimize or mitigation potential effects if monitoring shows impacts to greater sage-grouse or to its habitat from SNWA's groundwater pumping **GW-WR-7 (Groundwater Development and Drawdown Effects to Federal Resources and Federal Water Rights)** also is recommended. Another monitoring measure relevant to Terrestrial Wildlife includes: **GW-WR-5 (Shoshone Ponds)** (see Water Resources, Section 3.3, for complete wording of GW-WR-5 and GW-WR-7). • Mitigation planning also could be developed as part of the Snake Valley 3M Plan (**Appendix B**).
Potential Residual Impacts
• As described in Section 3.3, Water Resources, there is a potential reduction in the surface discharge at perennial surface water areas that cannot be avoided as well as an unavoidable long-term reduction in groundwater discharge to ET areas. The objectives of the COM Plan include avoiding adverse impacts to listed species and critical habitat and avoiding, minimizing, or mitigating adverse impacts to habitat for wildlife. Successful implementation of ACMs and monitoring and mitigation recommendations would likely reduce adverse effects on terrestrial wildlife species and their groundwater dependent habitats at some locations. However, it is not possible to determine the level of impact reduction at this time. Residual effects on some terrestrial wildlife habitats and local populations of species could exist considering the regional scale of pumping. Groundwater dependent habitat types would decline in extent and/or productivity in some locations and local populations of species that use the habitat in these locations would likely decline as well.

3.6.2.13 Alternative D

Groundwater Development Area

As compared to the Proposed Action and Alternative D considers the same groundwater development areas in Cave, Delamar, and Dry Lake valleys and only the southern portion of groundwater development areas in Spring Valley (within Lincoln County). Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in a total surface disturbance of approximately 2,513 to 4,005 acres. A portion of this construction disturbance – approximately 66 percent or 1,655 to 2,635 acres – would be permanently converted to industrial uses for the operational life of the project. No specific development plans are available as they cannot be prepared at this time. As a result, it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas (**Table 3.5-10**, Vegetation Resources). Consequently, it is expected that sagebrush shrubland and greasewood/saltbush shrubland habitat types would be most extensively disturbed.

The species and species habitat within the various groundwater development areas are the same as described for the Proposed Action except there would not be impacts from construction and maintenance of future facilities in Snake Valley and northern Spring Valley (north of Lincoln County). The percent of groundwater development areas that are various species' habitat is presented in **Appendix F**, **Table F3.6-7**. The types of impacts to terrestrial wildlife that would result from construction and facility maintenance in groundwater development areas would be similar to the impacts described in the ROW areas (Section 3.6.2.4.1) including impacts related to habitat fragmentation and potential impacts from accidental wildfires and power lines. As compared to the Proposed Action, Alternative D could disturb between 30 and 52 percent fewer acres overall during construction and convert between 30 and 52 percent fewer acres to permanent facilities. While the same terrestrial wildlife species could be impacted in Spring, Delamar, Dry Lake, and Cave (south of White Pine County line) valleys, the extent of potential impacts would be less than the Proposed Action in those valleys.

Some key differences in potential wildlife impacts between Alternative D and the Proposed Action are listed below:

- Pronghorn crucial winter range is not found within groundwater development areas in southern Spring Valley;
- There are 3 active greater sage-grouse leks within proposed groundwater development areas and 9 active leks within 4 miles; and
- The known occurrence of baking powder flat blue butterfly in the Baking Powder Flat ACEC is no longer within proposed groundwater development areas as it is north of the Lincoln County line.

Groundwater Pumping

Alternative D would consist of reduced pumping (78,755 afy) at distributed locations in southern Spring, Delamar, Dry Lake, and Cave valleys. No pumping would occur in Snake Valley. Alternative D pumping could result in reductions in groundwater dependent terrestrial wildlife habitat and affect terrestrial wildlife species.

- Groundwater pumping would have the potential to impact important habitats for wildlife including perennial springs and streams and their associated vegetation communities (e.g. wetlands, riparian areas, wet meadows) and phreatophytic wetland/meadow and basin shrubland vegetation types in ET areas. The degree of impacts to wildlife resources would depend on a number of variables, such as the existing habitat values and level of use, species' sensitivity (i.e. level of dependency on groundwater dependent habitats), and the extent of the anticipated water and habitat reductions/shifts. Given the limited amount of these habitat types within the study area, it is assumed that species dependent on these areas are currently at carrying capacity. As a result, any individuals displaced as a result of reduction in amount or quality of these habitats could be lost, concentrating the remaining animals within smaller habitat areas. Species groups likely affected by reduction in groundwater dependent habitats would include: big game, small mammals, upland game birds, waterfowl, nongame birds (e.g. raptors and passerines), bats, reptiles, and invertebrates.

The effects and conclusions of groundwater development on terrestrial wildlife are provided in **Table 3.6-21** along with ACMs and proposed mitigation.

Table 3.6-21 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative D Groundwater Pumping

Effects/Conclusions
• Alternative D pumping impacts to big game and other management concern species as well as special status species would be similar to those described in the Proposed Action, but the distribution of impacts on the landscape would vary given that pumping facilities would be located south of the White Pine County line (**Appendix F3.3**, **Figures F3.3.8A-13** through **F3.3.8-15**). There is one important bird area with springs or streams where impacts to flow could occur (GBNP) at the full build out plus 200 years time frame. • Based on model results, Alternative D is not anticipated to impact Lower Meadow Valley Wash basin or perennial stream, which are important to southwestern willow flycatcher and yellow-billed cuckoo nor is it anticipated to impact Pahranagat Valley perennial streams or springs used by these two species. • At the full build out time frame and within PPH and PGH for greater sage-grouse, one spring is in an area that may be impacted by drawdown in Hamlin Valley. In the full build out plus 75 years time frame, four basins have ET vegetation types, springs or perennial stream segments in areas at potential risk within this habitat. By full build out plus 200 years, six basins contain these potentially affected habitats based on groundwater model results. Potential pumping impacts, when combined with potential groundwater development surface impacts, could result in the reduction or even loss of some local sage-grouse populations in Cave, Snake, and Spring valleys.
BLM RMP Direction and ACMs
• Conduct large-scale seeding to assist with vegetation transitions from phreatophytic communities in Spring and Snake valleys, to benefit wildlife (ACM C.2.5). • Conduct wetlands-area restoration at Big Springs and Pruess lakes in Snake Valley, to enhance habitat for bald eagle, migratory birds, greater sandhill crane, and long billed curlew (ACM C.2.7). • Work with NDOW and private land owners at and downstream of Hiko, Crystal, and Ash Springs, as allowed, in Pahranagat Valley to conduct habitat restoration and remove nonnative species to benefit Hiko White River springfish, White River springfish, and Pahranagat roundtail chub (ACM C.2.9). Habitat restoration activities could also benefit southwestern willow flycatcher and yellow-billed cuckoo. • Work with the irrigation district in Pahranagat Valley to develop system efficiencies and manage water releases to benefit native fish (ACM C.2.10). Water efficiency and releases can also be managed to benefit native wildlife. • Work with USFWS and NDOW to improve and/or expand southwestern willow flycatcher habitat on Pahranagat NWR and Key Pittman WMA, respectively (ACM C.2.11 and ACM C.2.12). • Assist the BLM with habitat-enhancement projects in Rainbow Canyon of Lower Meadow Valley Wash, to improve conditions for southwestern willow flycatchers and yellow-billed cuckoo (ACM C.2.14). • Reduce or change grazing in wet meadows, to improve habitat for migratory birds, waterfowl, shore bird, sage-grouse, raptors, and bats in the BLM grazing allotments on which SNWA holds grazing permits (ACM C.2.18). • Conduct facilitated recharge projects to offset local groundwater drawdown, to benefit sensitive biological areas (ACM C.2.21).
Impact Indicators by Model Timeframe
• **Full Build Out**. Only Hamlin Valley has one of the three groundwater dependent habitat types (i.e. one spring) in areas that may be potentially impacted. This potentially impacted spring represents less than 1 percent of the springs in Hamlin Valley (**Appendix F**, **Table F3.6-13**; **Figure F3.3.8A-13**, and **Figure 3.5-10**, Vegetation Resources). • **Full Build Out Plus 75 Years**. Five valleys have one or more of the three groundwater dependent habitats in areas that may be potentially impacted at the full build out plus 75 years time frame. There are three valleys with perennial streams where impacts to flow could occur. Five percent of perennial stream miles in Spring, 22 percent in Lake, and less than 1 percent in Snake valleys are in areas that could be potentially impacted. Springs in five valleys could be impacted during this time frame including Spring [valleys 201 and 184], Hamlin, Lake, and Snake valleys. These potentially impacted springs make up less than 1 percent of springs in Snake Valley and up to 11 percent of the springs in Lake Valley. ET vegetation types are in areas that may be potentially impacted in three valleys (Spring, Snake, and Hamlin). Eleven percent of wetland meadow and 10 percent of basin shrubland are in areas that could be potentially impacted in Spring Valley. Sixty-eight percent of wetland meadow and 73 percent of basin shrubland are in areas that could be potentially impacted in Hamlin Valley (**Appendix F3.6**, **Table F3.6-13**; **Figure F3.3.8A-14**, and **Figure 3.5-10**, Vegetation Resources).

Table 3.6-21 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative D Groundwater Pumping (Continued)

Impact Indicators by Model Timeframe
• **Full Build Out Plus 200 Years**. Eight valleys have one or more of the three groundwater dependent habitat types in areas that may be potentially impacted at the full build out plus 200 years time frame. Five valleys have streams in areas where flows may be potentially affected including the three named above as well as Spring [184] and Hamlin valleys. The potentially impacted springs are found in 8 valleys, adding Cave, Steptoe, and Patterson valleys to those named above. One additional valley (Lake) has ET vegetation types in areas that may be potentially impacted in this time frame. The percent of ET wetland meadow and basin shrubland in areas that may be potentially impacted in Spring Valley is 18 percent and 23 percent, respectively, in this time frame. Snake and Hamlin valleys also show increases in the amount of ET vegetation types that may be impacted. Ninety-one percent of wetland meadow and 78 percent of basin shrubland are in areas that could be potentially impacted in Lake Valley in this time frame. (**Appendix F3.6**, **Table F3.6-13**; **Figure F3.3.8A 15**, and **Figure 3.5-10**, Vegetation Resources).
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures including ACMs and mitigation recommendations for wildlife resources are summarized below.
BLM RMP Direction and ACMs
• Implement biological and hydrologic monitoring, management, and mitigation, as required by the Spring Valley Stipulation (ACM C.1.1), the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2011), and the Spring Valley Hydrologic Monitoring and Mitigation Plan (Hydrographic Area 184) (SNWA 2009b). • Consider alternative withdrawal points from Shoshone Ponds, as part of the Spring Valley Stipulated Agreement (ACM C.1.3). • Monitor groundwater levels at agreed-upon monitoring wells in the Spring Valley and Hamlin Valley basins, as required by the Spring Valley Stipulation (ACM C.1.8). • Maintain a discharge monitoring site at Big Springs and Cleve Creeks, with regular public reporting (ACM C.1.16). • Ensure continued groundwater monitoring at agreed-upon monitoring wells, to characterize the movement of groundwater from the Delamar, Dry Lake, and Cave basins to adjacent basins (White River, Pahroc, and Pahranagat valleys), as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.31). • Implement biological monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42) and the Biological Monitoring Plan for the Delamar, Dry Lake, and Cave Stipulation (BRT 2011). Monitor sage-grouse breeding and late brood-rearing habitat that is groundwater dependent, as well as water-dependent ecosystems on the valley floors, as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42). • Monitor selected sites for special status species and their habitat in Pahranagat Valley (Pahranagat NWR, Key Pittman WMA, and Ash, Crystal, and Hiko springs) and White River Valley (Hot Creek, Flag, Moorman, and Hardy springs and phreatophytic habitats that support special status species in the Middle and Lower White River Valley, including Kirch WMA), per the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42). • Follow Candidate Conservation Agreements with Assurances for the greater sage-grouse and pygmy rabbit on SNWA private properties (to be provided when completed) (Appendix E, Section C.1. (Measures from SNWA Agreements). • Implement hydrologic monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation and the Hydrologic Monitoring and Mitigation Plan for Delamar, Dry Lake, and Cave Valleys (SNWA 2009c). • Reduce or cease groundwater withdrawals. Reduction or cessation of pumping would be determined on a case-by-case basis for individual production wells or well field using technical and consultation processes indentified in the stipulated agreements. • Acquire real property or water rights that are dedicated to the recovery of special status species within their current and historic habitat range (ACM C.2.1). • Improve late brood-rearing habitat for sage-grouse at the Stonehouse and Larson parcels on the SNWA Robison Ranch property in north Spring Valley, by use of gabion structures to expand and enhance riparian meadow habitat (ACM C.2.2). • Assist the BLM with pinyon-juniper control and sagebrush habitat improvement projects in suitable areas in the project-development basins (including Spring, Snake, and Cave valleys) and with secondary opportunities in non-project development basins (including Lake and White River valleys) (ACM C.2.3).

Table 3.6-21 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative D Groundwater Pumping (Continued)

Monitoring Recommendations
• **GW-WL-9 (Greater sage-grouse monitoring in Hamlin Valley)**, and **GW-WL-10 (GW Monitoring on BLM Lands within Greater sage-grouse habitat)**, described for the Proposed Action, would be applied to Alternative D. • Other monitoring measures, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, and **GW-VEG-5 (Swamp Cedar Monitoring)**, would be relevant to Terrestrial Wildlife (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).
Mitigation Recommendations
• **GW-WL-8 (Artificial Water Sources for Big Game)**, as described for the Proposed Action, would be applied to Alternative D. • In order to minimize or mitigation potential effects if monitoring shows impacts to greater sage-grouse or to its habitat from SNWA's groundwater pumping **GW-WR-7 (Groundwater Development and Drawdown Effects to Federal Resources and Federal Water Rights)** also is recommended. Another monitoring measure relevant to Terrestrial Wildlife includes: **GW-WR-5 (Shoshone Ponds)** (see Water Resources, Section 3.3, for complete wording of GW-WR-3a and GW-WR-7). • Mitigation planning also could be developed as part of the Snake Valley 3M Plan (**Appendix B**).
Potential Residual Impacts
• As described in Section 3.3, Water Resources, there is a potential reduction in the surface discharge at perennial surface water areas that cannot be avoided as well as an unavoidable long-term reduction in groundwater discharge to ET areas. The objectives of the COM Plan include avoiding adverse impacts to listed species and critical habitat and avoiding, minimizing, or mitigating adverse impacts to habitat for wildlife. Successful implementation of ACMs and monitoring and mitigation recommendations would likely reduce adverse effects on terrestrial wildlife species and their groundwater dependent habitats at some locations. However, it is not possible to determine the level of impact reduction at this time. Residual effects on some terrestrial wildlife habitats and local populations of species could exist considering the regional scale of pumping. Groundwater dependent habitat types would decline in extent and/or productivity in some locations and local populations of species that use the habitat in these locations would likely decline as well.

3.6.2.14 Alternative E

Groundwater Development Area

As compared to the Proposed Action, this alternative considers the same groundwater development areas in only four groundwater development basins (Spring, Delamar, Dry Lake, and Cave valleys). Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in a total surface disturbance of approximately 1,754 to 4,079 acres. A portion of this construction disturbance – approximately 66 percent or 1,158 to 2,683 acres – would be permanently converted to industrial uses for the operational life of the project. No specific development plans are available as they cannot be prepared at this time. As a result, it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas (**Table 3.5-11**, Vegetation Resources). Consequently, it is expected that sagebrush shrubland and greasewood/saltbush shrubland habitat types would be most extensively disturbed.

The species and species habitat within the various groundwater development areas are the same as described for the Proposed Action except that Snake Valley would not be impacted by construction and maintenance of future facilities. The percent of groundwater development areas that are various species' habitat is presented in **Appendix F**, **Table F3.6-8**. The types of impacts to terrestrial wildlife that would result from construction and facility maintenance in groundwater development areas would be similar to the impacts described in the ROW areas (Section 3.6.2.4.1) including impacts related to habitat fragmentation and potential impacts from accidental wildfires and power lines. Compared to the Proposed Action, Alternative E could disturb approximately 52 percent fewer acres overall during construction and convert approximately 52 percent fewer acres to permanent facilities. While the same terrestrial wildlife species could be impacted Spring, Delamar, Dry Lake, and Cave valleys, the extent of potential impacts would be less than the Proposed Action in those valleys.

The species and species habitat within the various groundwater development areas are the same as described for the Proposed Action except that Snake Valley would not be impacted by construction and maintenance of future facilities. The types of impacts to terrestrial wildlife that would result from construction and facility maintenance in groundwater development areas would be similar to the impacts described in the ROW areas (Section 3.6.2.4.1) including impacts related to habitat fragmentation and potential impacts from accidental wildfires and power lines. Given that Alternative E could disturb approximately 52 percent fewer acres overall during construction and convert approximately 52 percent fewer acres to permanent facilities, while the same terrestrial wildlife species could be impacted Spring, Delamar, Dry Lake, and Cave valleys, the extent of potential impacts would be less than the Proposed Action in those valleys (**Appendix F**, **Table F3.6-8**).

Some key differences in potential wildlife impacts between this alternative and the Proposed Action are listed below:

- Because Snake Valley is not included in the alternative, all big game ranges in this valley discussed in the Proposed Action groundwater development section would not be impacted (e.g. mule deer crucial summer range and rocky mountain bighorn sheep occupied habitat); and
- There are 12 active greater sage-grouse leks within proposed groundwater development areas and 19 active leks within 4 miles; no sage-grouse habitats would be impacted in Snake Valley.

Groundwater Pumping

Alternative E would consist of reduced pumping (78,755 afy) at distributed locations in Spring, Delamar, Dry Lake, and Cave valleys. No pumping would occur in Snake Valley. Alternative E pumping could result in reductions in groundwater dependent terrestrial wildlife habitat and affect terrestrial wildlife species.

Groundwater pumping would have the potential to impact important habitats for wildlife including perennial springs and streams and their associated vegetation communities (e.g. wetlands, riparian areas, wet meadows) and phreatophytic wetland/meadow and basin shrubland vegetation types in ET areas. The degree of impacts to wildlife resources would depend on a number of variables, such as the existing habitat values and level of use, species' sensitivity (i.e. level of dependency on groundwater dependent habitats), and the extent of the anticipated water and habitat reductions/shifts. Given the limited amount of these habitat types within the study area, it is assumed that species dependent on these areas are currently at carrying capacity. As a result, any individuals displaced as a result of reduction in amount or quality of these habitats could be lost, concentrating the remaining animals within smaller habitat areas. Species groups likely affected by reduction in groundwater dependent habitats would include: big game, small mammals, upland game birds, waterfowl, nongame birds (e.g. raptors and passerines), bats, reptiles, and invertebrates.

The effects and conclusions of groundwater development on terrestrial wildlife are provided in **Table 3.6-22** along with ACMs and proposed mitigation.

Table 3.6-22 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative E Groundwater Pumping

Effects/Conclusions
• Alternative E pumping impacts to big game and other management concern species as well as special status species would be similar to those described in the Proposed Action, but the distribution of impacts on the landscape would vary given that pumping facilities would not be located in Snake Valley (**Appendix F3.3**, **Figures F3.3.8A-16** through **F3.3.8A-18**). There are no important bird areas with springs or streams where impacts to flow could occur at any of the three model time frames. • Based on groundwater flow model results, this alternative is not anticipated to impact Lower Meadow Valley Wash basin or perennial streams, which are important to southwestern willow flycatcher and yellow-billed cuckoo nor is it anticipated to impact Pahranagat Valley perennial streams or springs used by these two species. • At the full build out time frame and within PPH and PGH for greater sage-grouse, ET basin shrubland as well as perennial streams are in areas that may be impacted by drawdown in Spring Valley. In the full build out plus 75 years time frame, two basins have ET vegetation types, springs or perennial stream segments in areas at potential risk within these two habitat ranges. By full build out plus 200 years, four basins contain these potentially affected habitats based on groundwater model results. Potential pumping impacts, when combined with potential groundwater development surface impacts, could result in the reduction or even loss of some local sage-grouse populations in Cave and Spring valleys.

Table 3.6-22 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative E Groundwater Pumping (Continued)

Impact Indicators by Model Timeframe
• **Full Build Out**. Spring Valley has all three groundwater dependent habitat types (i.e. perennial streams, springs, and ET vegetation types) in areas that may be potentially impacted. Less than one percent of perennial stream miles in Spring Valley may potentially be impacted. Less than 1 percent of the springs in Spring Valley could be impacted during this time frame. A small percentage of ET wetland meadow (1 percent) and basin shrubland (8 percent) are potentially affected in Spring Valley (**Appendix F3.3**, **Table F3.6 15**; **Figure F3.3.8A-16**, and **Figure 3.5-11**, Vegetation Resources). • **Full Build Out Plus 75 Years**. Two valleys have one or more of the three groundwater dependent habitats in areas that may be potentially impacted at the full build out plus 75 years time frame. There is one valley with perennial streams where impacts to flow could occur. Three percent of perennial stream miles in Spring Valley could potentially be impacted. Springs in two valleys are in areas that could be impacted during this time frame. These potentially impacted springs make up less than 1 percent of springs in Hamlin Valley and up to 8 percent of the springs in Spring Valley. ET vegetation types are potentially impacted in 2 valleys (Spring and Hamlin). Twenty percent of ET wetland meadow and 49 percent of basin shrubland could potentially be impacted in Spring Valley. In Hamlin Valley, 2 percent of wetland meadow and 6 percent of basin shrubland could potentially be impacted (**Appendix F3.6**, **Table F3.6-15**; **Figure F3.3.8A-17**, and **Figure 3.5-11**, Vegetation Resources). • **Full Build Out Plus 200 Years**. Six valleys have one or more of the three groundwater dependent habitat types in areas that may be potentially impacted at the full build out plus 200 years time frame. Four valleys have streams in areas that could potentially be impacted, including Spring, Snake, Steptoe, and Lake valleys. The potentially impacted springs are found in five valleys, adding Cave, Lake, and Steptoe valleys to those named above. ET vegetation types are potentially impacted in one additional valley (Lake). The percent of ET wetland meadow and basin shrubland potentially impacted in Spring Valley increases to 22 percent and 53 percent, respectively, over the previous time frame. Hamlin and Lake valleys also show increases in the amount of ET vegetation types that may be impacted (**Appendix F3.6**, **Table F3.6-15**; **Figure F3.3.8A-18**, and **Figure 3.5-11**, Vegetation Resources).
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures including ACMs and mitigation recommendations for wildlife resources are summarized below.
BLM RMP Direction and ACMs
• Implement biological and hydrologic monitoring, management, and mitigation, as required by the Spring Valley Stipulation (ACM C.1.1), the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2011), and the Spring Valley Hydrologic Monitoring and Mitigation Plan (Hydrographic Area 184) (SNWA 2009b). • Consider alternative withdrawal points from Shoshone Ponds, as part of the Spring Valley Stipulated Agreement (ACM C.1.3). • Monitor groundwater levels at agreed-upon monitoring wells in the Spring Valley and Hamlin Valley basins, as required by the Spring Valley Stipulation (ACM C.1.8). • Maintain a discharge monitoring site at Big Springs and Cleve Creeks, with regular public reporting (ACM C.1.16). • Ensure continued groundwater monitoring at agreed-upon monitoring wells, to characterize the movement of groundwater from the Delamar, Dry Lake, and Cave basins to adjacent basins (White River, Pahroc, and Pahranagat valleys), as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.31). • Implement biological monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42) and the Biological Monitoring Plan for the Delamar, Dry Lake, and Cave Stipulation (BRT 2011). Monitor sage-grouse breeding and late brood-rearing habitat that is groundwater dependent, as well as water-dependent ecosystems on the valley floors, as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42). • Monitor selected sites for special status species and their habitat in Pahranagat Valley (Pahranagat NWR, Key Pittman WMA, and Ash, Crystal, and Hiko springs) and White River Valley (Hot Creek, Flag, Moorman, and Hardy springs and phreatophytic habitats that support special status species in the Middle and Lower White River Valley, including Kirch WMA), per the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42). • Follow Candidate Conservation Agreements with Assurances for the greater sage-grouse and pygmy rabbit on SNWA private properties (to be provided when completed) (Appendix E, Section C.1. (Measures from SNWA Agreements). • Implement hydrologic monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation and the Hydrologic Monitoring and Mitigation Plan for Delamar, Dry Lake, and Cave Valleys (SNWA 2009c). • Reduce or cease groundwater withdrawals. Reduction or cessation of pumping would be determined on a case-by-case basis for individual production wells or well field using technical and consultation processes indentified in the stipulated agreements.

Table 3.6-22 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative E Groundwater Pumping (Continued)

BLM RMP Direction and ACMs
• Acquire real property or water rights that are dedicated to the recovery of special status species within their current and historic habitat range (ACM C.2.1). • Improve late brood-rearing habitat for sage-grouse at the Stonehouse and Larson parcels on the SNWA Robison Ranch property in north Spring Valley, by use of gabion structures to expand and enhance riparian meadow habitat (ACM C.2.2).Assist the BLM with pinyon-juniper control and sagebrush habitat improvement projects in suitable areas in the project-development basins (including Spring, Snake, and Cave valleys) and with secondary opportunities in non-project development basins (including Lake and White River valleys) (ACM C.2.3). • Conduct large-scale seeding to assist with vegetation transitions from phreatophytic communities in Spring and Snake valleys, to benefit wildlife (ACM C.2.5). • Conduct wetlands-area restoration at Big Springs and Pruess lakes in Snake Valley, to enhance habitat for bald eagle, migratory birds, greater sandhill crane, and long billed curlew (ACM C.2.7). • Work with NDOW and private land owners at and downstream of Hiko, Crystal, and Ash Springs, as allowed, in Pahranagat Valley to conduct habitat restoration and remove nonnative species to benefit Hiko White River springfish, White River springfish, and Pahranagat roundtail chub (ACM C.2.9). Habitat restoration activities could also benefit southwestern willow flycatcher and yellow-billed cuckoo. • Work with the irrigation district in Pahranagat Valley to develop system efficiencies and manage water releases to benefit native fish (ACM C.2.10). Water efficiency and releases can also be managed to benefit native wildlife. • Work with USFWS and NDOW to improve and/or expand southwestern willow flycatcher habitat on Pahranagat NWR and Key Pittman WMA, respectively (ACM C.2.11 and ACM C.2.12). • Assist the BLM with habitat-enhancement projects in Rainbow Canyon of Lower Meadow Valley Wash, to improve conditions for southwestern willow flycatchers and yellow-billed cuckoo (ACM C.2.14). • Reduce or change grazing in wet meadows, to improve habitat for migratory birds, waterfowl, shore bird, sage-grouse, raptors, and bats in the BLM grazing allotments on which SNWA holds grazing permits (ACM C.2.18). • Conduct facilitated recharge projects to offset local groundwater drawdown, to benefit sensitive biological areas (ACM C.2.21).
Monitoring Recommendations
• **GW-WL-9 (Greater sage-grouse monitoring in Hamlin Valley)** and **GW-WL-10 (GW Monitoring on BLM Lands within Greater sage-grouse habitat)**, described for the Proposed Action, would be applied to Alternative E. • Other monitoring measures, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, and **GW-VEG-5 (Swamp Cedar Monitoring)**, would be relevant to terrestrial wildlife (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).
Mitigation Recommendations
• **GW-WL-8 (Artificial Water Sources for Big Game)**, as described for the Proposed Action, would be applied to Alternative E. • In order to minimize or mitigation potential effects if monitoring shows impacts to greater sage-grouse or to its habitat from SNWA's groundwater pumping **GW-WR-7 (Groundwater Development and Drawdown Effects to Federal Resources and Federal Water Rights)** also is recommended. Another monitoring measure relevant to Terrestrial Wildlife includes: **GW-WR-5 (Shoshone Ponds)** (see Water Resources, Section 3.3, for complete wording of GW-WR-5 and GW-WR-7). • Mitigation planning also could be developed as part of the Snake Valley 3M Plan (**Appendix B**).
Potential Residual Impacts
• As described in Section 3.3, Water Resources, there is a potential reduction in the surface discharge at perennial surface water areas that cannot be avoided as well as an unavoidable long-term reduction in groundwater discharge to ET areas. The objectives of the COM Plan include avoiding adverse impacts to listed species and critical habitat and avoiding, minimizing, or mitigating adverse impacts to habitat for wildlife. Successful implementation of ACMs and monitoring and mitigation recommendations would likely reduce adverse effects on terrestrial wildlife species and their groundwater dependent habitats at some locations. However, it is not possible to determine the level of impact reduction at this time. Residual effects on some terrestrial wildlife habitats and local populations of species could exist considering the regional scale of pumping. Groundwater dependent habitat types would decline in extent and/or productivity in some locations and local populations of species that use the habitat in these locations would likely decline as well.

3.6.2.15 Alternative F

Groundwater Development Area

As compared to the Proposed Action, this alternative considers the same groundwater development areas in only four groundwater development basins (Spring, Delamar, Dry Lake, and Cave valleys). Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in a total surface disturbance of approximately 2,698 to 6,629 acres. A portion of this construction disturbance – approximately 66 percent or 1,782 to 4,359 acres – would be permanently converted to industrial uses for the operational life of the project. No specific development plans are available as they cannot be prepared at this time. As a result, it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas (**Table 3.5-3**, Vegetation Resources). Consequently, it is expected that sagebrush shrubland and greasewood/saltbush shrubland habitat types would be most extensively disturbed.

The species and species habitat within the various groundwater development areas are the same as described for the Proposed Action except that Snake Valley would not be impacted by construction and maintenance of future facilities. The percent of groundwater development areas that are various species' habitat is presented in **Appendix F**, **Table F3.6-9**. The types of impacts to terrestrial wildlife that would result from construction and facility maintenance in groundwater development areas would be similar to the impacts described in the ROW areas (Section 3.6.2.4.1) including impacts related to habitat fragmentation and potential impacts from accidental wildfires and power lines. As compared to the Proposed Action, Alternative F could disturb approximately 24 percent fewer acres overall during construction and convert approximately 24 percent fewer acres to permanent facilities. While the same terrestrial wildlife species could be impacted Spring, Delamar, Dry Lake, and Cave valleys, the extent of potential impacts would be less than the Proposed Action in those valleys.

Some key differences in potential wildlife impacts between this alternative and the Proposed Action are listed below:

- Because Snake Valley is not included in the alternative, all big game ranges in this valley discussed in the Proposed Action groundwater development section would not be impacted (e.g. mule deer crucial summer range and rocky mountain bighorn sheep occupied habitat); and
- There are 12 active greater sage-grouse leks within proposed groundwater development areas and 19 active leks within 4 miles; no sage-grouse habitats would be impacted in Snake Valley.

Groundwater Pumping

Alternative F would consist of reduced pumping (114,129 afy) at distributed locations in Spring, Delamar, Dry Lake, and Cave valleys. No pumping would occur in Snake Valley. Alternative F pumping could result in reductions in groundwater dependent terrestrial wildlife habitat and affect terrestrial wildlife species.

Groundwater pumping would have the potential to impact important habitats for wildlife including perennial springs and streams and their associated vegetation communities (e.g. wetlands, riparian areas, wet meadows) and phreatophytic wetland/meadow and basin shrubland vegetation types in ET areas. The degree of impacts to wildlife resources would depend on a number of variables, such as the existing habitat values and level of use, species' sensitivity (i.e. level of dependency on groundwater dependent habitats), and the extent of the anticipated water and habitat reductions/shifts. Given the limited amount of these habitat types within the study area, it is assumed that species dependent on these areas are currently at carrying capacity. As a result, any individuals displaced as a result of reduction in amount or quality of these habitats could be lost, concentrating the remaining animals within smaller habitat areas. Species groups likely affected by reduction in groundwater dependent habitats would include: big game, small mammals, upland game birds, waterfowl, nongame birds (e.g. raptors and passerines), bats, reptiles, and invertebrates.

The effects and conclusions of groundwater development on terrestrial wildlife are provided in **Table 3.6-23** along with ACMs and proposed mitigation.

Table 3.6-23 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative F Groundwater Pumping

Effects/Conclusions
• Alternative F pumping impacts to big game and other management concern species as well as special status species would be similar to those described for the Proposed Action. However, the distribution of impacts on the landscape would vary given that pumping facilities would not be located in Snake Valley (**Appendix F**, **Figures F3.3.8A-19** through **F3.3.8A-21**). There are two important bird areas (GBNP and Pahranagat Valley Complex) with springs or streams where impacts to flow could occur in the full build out plus 200 year model time frame. • Based on groundwater flow model results, Lower Meadow Valley Wash contains a perennial stream segment that could be impacted at the full build out plus 200 years time frame. Of the approximately 42 miles of Lower Meadow Valley Wash (stream) in Lower Meadow Valley Wash Valley, model results indicated that 8 percent of the length of the stream are in areas of risk from drawdown. Impacts in flow would depend on the actual drawdown that occurs in these areas and the site-specific hydraulic connection between the groundwater system impacted by pumping and Lower Meadow Valley Wash segment. If this stream is hydraulically connected to the groundwater system impacted by pumping and within the drawdown area, it would likely experience a reduction in baseflow that could result in changes to available riparian habitat for yellow-billed cuckoo and to southwestern willow flycatcher habitat. Model results suggest that in the full build out plus 200 years time frame, a small percent 2 percent of perennial streams in Pahranagat Valley (0.5 mile) could be impacted by project-related pumping. This valley is important to these two bird species. • At the full build out time frame and within PPH and PGH for greater sage-grouse, ET basin shrubland as well as springs and perennial streams are in areas that may be impacted by drawdown in Spring Valley. In the full build out plus 75 years time frame, two basins have ET vegetation types, springs or perennial stream segments in areas at potential risk within these two habitat ranges. By full build out plus 200 years, four basins contain these potentially affected habitats based on groundwater model results. Potential pumping impacts, when combined with potential groundwater development surface impacts, could result in the reduction or even loss of some local sage-grouse populations in Cave and Spring valleys.
BLM RMP Direction and ACMs
• Acquire real property or water rights that are dedicated to the recovery of special status species within their current and historic habitat range (ACM C.2.1). • Improve late brood-rearing habitat for sage-grouse at the Stonehouse and Larson parcels on the SNWA Robison Ranch property in north Spring Valley, by use of gabion structures to expand and enhance riparian meadow habitat (ACM C.2.2). • Assist the BLM with pinyon-juniper control and sagebrush habitat improvement projects in suitable areas in the project-development basins (including Spring, Snake, and Cave valleys) and with secondary opportunities in non-project development basins (including Lake and White River valleys) (ACM C.2.3). • Conduct large-scale seeding to assist with vegetation transitions from phreatophytic communities in Spring and Snake valleys, to benefit wildlife (ACM C.2.5). • Conduct wetlands-area restoration at Big Springs and Pruess lakes in Snake Valley, to enhance habitat for bald eagle, migratory birds, greater sandhill crane, and long billed curlew (ACM C.2.7). • Work with NDOW and private land owners at and downstream of Hiko, Crystal, and Ash Springs, as allowed, in Pahranagat Valley to conduct habitat restoration and remove nonnative species to benefit Hiko White River springfish, White River springfish, and Pahranagat roundtail chub (ACM C.2.9). Habitat restoration activities could also benefit southwestern willow flycatcher and yellow-billed cuckoo. • Work with the irrigation district in Pahranagat Valley to develop system efficiencies and manage water releases to benefit native fish (ACM C.2.10). Water efficiency and releases can also be managed to benefit native wildlife. • Work with USFWS and NDOW to improve and/or expand southwestern willow flycatcher habitat on Pahranagat NWR and Key Pittman WMA, respectively (ACM C.2.11 and ACM C.2.12). • Assist the BLM with habitat-enhancement projects in Rainbow Canyon of Lower Meadow Valley Wash, to improve conditions for southwestern willow flycatchers and yellow-billed cuckoo (ACM C.2.14). • Reduce or change grazing in wet meadows, to improve habitat for migratory birds, waterfowl, shore bird, sage-grouse, raptors, and bats in the BLM grazing allotments on which SNWA holds grazing permits (ACM C.2.18). • Conduct facilitated recharge projects to offset local groundwater drawdown, to benefit sensitive biological areas (ACM C.2.21).

Table 3.6-23 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative F Groundwater Pumping (Continued)

Impact Indicators by Model Timeframe
• **Full Build Out**. Spring Valley has all three groundwater dependent habitat types (i.e. perennial streams, springs, and ET vegetation types) in areas that may be potentially impacted. Less than 1 percent of perennial stream miles in Spring Valley may potentially be impacted. Less than 1 percent of the springs in Spring Valley could be impacted during this time frame. A small percentage of ET wetland meadow (1 percent) and basin shrubland (6 percent) are potentially affected in Spring Valley (Appendix F, Table F3.6 16; Figure F3.3.8A-19, and Figure 3.5-12, Vegetation Resources). • **Full Build Out Plus 75 Years**. Two valleys have one or more of the three groundwater dependent habitats in areas that may be potentially impacted at the full build out plus 75 years time frame. There is one valley with perennial streams where impacts to flow could occur. Ten percent of perennial stream miles in Spring Valley could potentially be impacted. Springs in two valleys are in areas that could be impacted during this time frame. These potentially impacted springs make up less than 1 percent of springs in Hamlin Valley and up to 18 percent of the springs in Spring Valley. ET vegetation types are potentially impacted in two valleys (Spring and Hamlin). Twenty-five percent of ET wetland meadow and 61 percent of basin shrubland could potentially be impacted in Spring Valley. In Hamlin Valley, 1 percent of wetland meadow and 4 percent of basin shrubland could potentially be impacted (Appendix F, Table F3.6-16; Figure F3.3.8A-20, and Figure 3.5-12, Vegetation Resources). • **Full Build Out Plus 200 Years**. Seven valleys have one or more of the three groundwater dependent habitat types in areas that may be potentially impacted at the full build out plus 200 years time frame. Five valleys have streams in areas that could potentially be impacted, including Spring, Snake, Steptoe, Pahranagat, and Lake valleys. The potentially impacted springs are found in 6 valleys, Cave, Hamlin, Lake, Spring, Snake, and Steptoe valleys. ET vegetation types are potentially impacted in one additional valley (Lake). The percent of ET wetland meadow and basin shrubland potentially impacted in Spring Valley increases to 31 percent and 69 percent, respectively, over the previous time frame. Hamlin increases to 2 percent of wetland meadow and 22 percent of basin shrubland and Lake valley has 91 percent of wetland meadow and 66 percent of basin shrubland types that may be impacted (Appendix F, Table F3.6-16; Figure F3.3.8A-21, and Figure 3.5-11, Vegetation Resources).
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures including ACMs and mitigation recommendations for wildlife resources are summarized below.
BLM RMP Direction and ACMs
• Implement biological and hydrologic monitoring, management, and mitigation, as required by the Spring Valley Stipulation (ACM C.1.1), the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2011), and the Spring Valley Hydrologic Monitoring and Mitigation Plan (Hydrographic Area 184) (SNWA 2009b). • Consider alternative withdrawal points from Shoshone Ponds, as part of the Spring Valley Stipulated Agreement (ACM C.1.3). • Monitor groundwater levels at agreed-upon monitoring wells in the Spring Valley and Hamlin Valley basins, as required by the Spring Valley Stipulation (ACM C.1.8). • Maintain a discharge monitoring site at Big Springs and Cleve Creeks, with regular public reporting (ACM C.1.16). • Ensure continued groundwater monitoring at agreed-upon monitoring wells, to characterize the movement of groundwater from the Delamar, Dry Lake, and Cave basins to adjacent basins (White River, Pahroc, and Pahranagat valleys), as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.31). • Implement biological monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42) and the Biological Monitoring Plan for the Delamar, Dry Lake, and Cave Stipulation (BRT 2011). Monitor sage-grouse breeding and late brood-rearing habitat that is groundwater dependent, as well as water-dependent ecosystems on the valley floors, as part of the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42). • Monitor selected sites for special status species and their habitat in Pahranagat Valley (Pahranagat NWR, Key Pittman WMA, and Ash, Crystal, and Hiko springs) and White River Valley (Hot Creek, Flag, Moorman, and Hardy springs and phreatophytic habitats that support special status species in the Middle and Lower White River Valley, including Kirch WMA), per the Delamar, Dry Lake, and Cave Stipulation (ACM C.1.42). • Follow Candidate Conservation Agreements with Assurances for the greater sage-grouse and pygmy rabbit on SNWA private properties (to be provided when completed) (Appendix E, Section C.1. (Measures from SNWA Agreements). • Implement hydrologic monitoring, management and mitigation as required by the Delamar, Dry Lake, and Cave Stipulation and the Hydrologic Monitoring and Mitigation Plan for Delamar, Dry Lake, and Cave Valleys (SNWA 2009c). • Reduce or cease groundwater withdrawals. Reduction or cessation of pumping would be determined on a case-by-case basis for individual production wells or well field using technical and consultation processes indentified in the stipulated agreements.

Table 3.6-23 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative F Groundwater Pumping (Continued)

Monitoring Recommendations
• **GW-WL-9 (Greater sage-grouse monitoring in Hamlin Valley)**, and **GW-WL-10 (GW Monitoring on BLM Lands within Greater sage-grouse habitat)**, described for the Proposed Action, would be applied to Alternative A. • Other monitoring measures, **GW-WR-3 (Comprehensive Water Resources Monitoring Plan)**, **GW-VEG-3 (Wetlands Monitoring)**, **GW-VEG-4 (Phreatophytic Vegetation Monitoring)**, and **GW-VEG-5 (Swamp Cedar Monitoring)**, would be relevant to Terrestrial Wildlife (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).
Mitigation Recommendations
• **GW-WL-8 (Artificial Water Sources for Big Game)**, as described for the Proposed Action, would be applied to Alternative F. • In order to minimize or mitigation potential effects if monitoring shows impacts to greater sage-grouse or to its habitat from SNWA's groundwater pumping **GW-WR-7 (Groundwater Development and Drawdown Effects to Federal Resources and Federal Water Rights)** also is recommended. Another monitoring measure relevant to Terrestrial Wildlife includes: **GW-WR-5 (Shoshone Ponds)**. (See Water Resources Section 3.3.2 for complete wording of GW-WR-5 and GW-WR-7.) • Mitigation planning also could be developed as part of the Snake Valley 3M Plan (**Appendix B**).
Potential Residual Impacts
• As described in Section 3.3, Water Resources, there is a potential reduction in the surface discharge at perennial surface water areas that cannot be avoided as well as an unavoidable long-term reduction in groundwater discharge to ET areas. The objectives of the COM Plan include avoiding adverse impacts to listed species and critical habitat and avoiding, minimizing, or mitigating adverse impacts to habitat for wildlife. Successful implementation of ACMs and monitoring and mitigation recommendations would likely reduce adverse effects on terrestrial wildlife species and their groundwater dependent habitats at some locations. However, it is not possible to determine the level of impact reduction at this time. Residual effects on some terrestrial wildlife habitats and local populations of species could exist considering the regional scale of pumping. Groundwater dependent habitat types would decline in extent and/or productivity in some locations and local populations of species that use the habitat in these locations would likely decline as well.

3.6.2.16 No Action

Groundwater Development

Under the No Action Alternative, the proposed groundwater development would not occur in the five pumping basins. Therefore, terrestrial wildlife resources would not be affected by surface disturbance or facility maintenance activities.

Groundwater Pumping

No Action pumping is limited to pumping activities that are already approved. This pumping could result in reductions in terrestrial wildlife habitat and affect terrestrial species.

The effects and conclusions of groundwater development on terrestrial wildlife are provided in **Table 3.6-24** along with ACMs and proposed mitigation.

Table 3.6-24 Summary of Terrestrial Wildlife Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for No Action Groundwater Pumping

Effects/Conclusions
• No Action pumping impacts to big game and other management concern species as well as special status species would be similar to those described in the Proposed Action, but the distribution of impacts on the landscape would vary (**Appendix F**, **Figures F3.3.8A-22** through **F3.3.8A-24**). There is one important bird areas with springs or streams where impacts to flow could occur (Lower Meadow Valley Wash) at all three model time frames. • Based on model results, No Action pumping could potentially impact perennial stream flow in Lower Meadow Valley Wash in the full build out plus 75 years and full build out plus 200 years model time frames potentially impacting habitat for southwestern willow flycatcher and foraging habitat for yellow billed cuckoo. Potential pumping impacts to perennial streams or springs are not anticipated in Pahranagat or Delamar valleys, so habitat impacts to these two bird species in these valleys are not anticipated. • At the full build out time frame and within PPH and PGH for greater sage-grouse, either ET basin shrubland, springs, or perennial streams are in areas that may be impacted by drawdown in three valleys (Steptoe, White River, and Lake). In the full build out plus 75 years time frame, three basins (Dry, Spring [184], and White River) have ET vegetation types, springs or perennial stream segments at potential risk within this habitat. By full build out plus 200 years, four basins contain these potentially affected habitats based on groundwater model results within this greater sage-grouse habitat.
Impact Indicators by Model Timeframe
• **Full Build Out**. Six valleys have one or more of the three groundwater dependent habitat types (i.e. perennial streams, springs, or ET vegetation types) in areas that may be potentially impacted. There are three valleys with perennial streams where impacts to flow could occur. Less than 1 percent of perennial stream miles in Clover Valley may potentially be impacted. Approximately 18 perennial stream miles in Spring Valley [201] are located within high or moderate risk areas where impacts could occur. Springs in six valleys occur in areas where impacts could occur during this time frame including Steptoe, Lake, Patterson, Panaca, Clover, and Lower Meadow Valley Wash. These potentially impacted springs make up less than 1 percent of springs in Steptoe Valley and up to 25 percent of the springs in Patterson Valley. No wetland meadow and a small percentage of basin shrubland (23 percent in Lake and 1 percent in Panaca) are potentially affected (Appendix F, Table F3.6-17; Figure F3.3.8A-22, and Figure 3.5-13, Vegetation Resources). • **Full Build Out Plus 75 Years**. Ten valleys have one or more of the three groundwater dependent habitats in areas that may be potentially impacted at the full build out plus 75 years time frame. There are six valleys with perennial streams located in areas where impacts to flow could occur. Less than 1 percent of perennial stream miles in Spring [201] and Clover valleys, 35 percent in Panaca, 7 percent in Lower Meadow Valley Wash, 11 percent in White River, and 22 percent in Lake valleys could potentially be impacted. Springs in eight valleys could be impacted during this time frame including Lake, Patterson, Panaca, Clover, Lower Meadow Valley Wash, White River, Dry, and Spring [184]. These potentially impacted springs make up less than 1 percent of springs in Spring Valley [184] and up to 39 percent of the springs in Patterson Valley. ET vegetation types are potentially impacted in one additional valley (White River) as compared to the full build out time frame. Two percent ET wetland meadow and 3 percent of basin shrubland could potentially be impacted in White River Valley (**Appendix F**, **Table F3.6-17**; **Figure F3.3.8A-23**, and **Figure 3.5-13**, Vegetation Resources). • **Full Build Out Plus 200 Years**. Twelve valleys have one or more of the three groundwater dependent habitat types in areas that may be potentially impacted at the full build out plus 200 years time frame. Seven valleys have streams located in areas where flows could potentially be affected including the six named above as well as Spring Valley [184]. Springs located in areas where impacts could occur are found in 12 valleys, adding Las Vegas, Spring [201], and Eagle valleys to those named above. ET vegetation types are potentially impacted in two additional valleys (Clover and Spring [184] valleys). The percent of basin shrubland potentially impacted in Spring Valley [184] increases to 1 percent over the previous time frame. Lake, White River, and Clover valleys also show increases in the amount of ET vegetation types that may be impacted (**Appendix F**, **Table F3.6 17**; **Figure F3.3.8A-24**, and **Figure 3.5-13**, Vegetation Resources).

3.6.3 Cumulative Impacts

3.6.3.1 Impacts Common to All Alternatives

Climate Change Effects

Climate change already appears to be influencing both natural and managed ecosystems of the American Southwest (Breshears et al. 2005, Westerling et al. 2006, Seager et al. 2007) and models indicate the likelihood of the Southwest being a climate change "hotspot" in the coming decades (Diffenbaugh et al. 2008). Recent warming in the Southwest is among the most rapid in the nation, significantly more than the global average in some areas (USGCRP 2009). Projections suggest continued strong warming in the region, with significant increases in temperature (USGCRP 2009) and decreases in precipitation (Seager et al. 2007). A warmer atmosphere and an intensified water cycle are likely to mean not only a greater likelihood of drought for the Southwest, but also an increased risk of flooding (USGCRP 2009). Greater variability in patterns of precipitation can be anticipated in the future. In the coming century, mean global temperature could increase significantly, with an associated increase in both the frequency of extreme events (heat waves, droughts, storms) and the frequency and extent of wildfire (IPCC 2007; Westerling & Bryant 2008; Krawchuk et al. 2009). Under such conditions, future impacts could be substantial for some resources, impacting biodiversity, protected areas, and agricultural lands.

Climate Change Effects to Terrestrial Wildlife Resources

Recent empirical studies strongly suggest that wildlife species are already responding to recent global warming trends with significant shifts in range distribution (generally northward) and phenology (i.e., seasonal timing of biological activities) (McCarty 2001; Walther et al. 2002; Root et al. 2003). These effects include earlier breeding, changes in timing of migration, changes in breeding performance (egg size, nesting success), changes in population sizes, changes in population distributions; and changes in selection differentials between components of a population. These responses are being seen in all different types of taxa, from insects to mammals, in North America (Field et al. 2007). Research suggests that the effects of global climate change on wildlife communities in parks and protected areas may be most noticeable, not as a drastic loss of species from their current ranges, but instead as a fundamental change in community structure as species associations shift due to influxes of new species (Burns et al. 2003). This trend may also be applicable to non-reserve landscapes as well.

Several traits may make wildlife species especially susceptible to climate change (Foden et al. 2008). These traits include specialized habitat and/or microhabitat requirements; narrow environmental tolerances or thresholds that are likely to be exceeded due to climate change at any stage in the life cycle; dependence on specific environmental triggers or cues that are likely to be disrupted by climate change; dependence on inter-specific interactions that are likely to be disrupted by climate change; and a poor ability to disperse to or colonize a new or more suitable range.

Climate change, in combination with other stresses to the landscapes in the project region, is predicted to exacerbate species declines, sedimentation, species invasions, disease, and other impacts (BLM 2010). Current and proposed land use activities (e.g., development, road building, etc.) could create additional habitat fragmentation and reduce movement corridors, limiting the ability for wildlife to shift their ranges in response to climate change (BLM 2010).

Climate change could affect wildlife in the GWD Project Area by:

- Altering or restricting the physical ranges of species present;
- Altering disease dynamics and the introduction of novel pathogens;
- Modifying, shifting, or eliminating habitats; and
- Altering species' phenology.

3.6.3.2 Issues

Rights-of-way and Groundwater Development Area Construction and Maintenance

- Short-term, long-term, and permanent changes in terrestrial wildlife habitat (loss or fragmentation) and species composition due to surface disturbance as a result of construction-related activities, and operational maintenance.
- Loss of individuals, or populations of federally listed, candidate, or special status terrestrial wildlife species due to surface disturbance, related potential impacts (e.g. accidental wildfires, invasive species) and indirect effects (displacement of individuals and loss of breeding success from exposure to construction movements, noise, and higher levels of human activity including traffic).
- Compliance with recovery plans, conservation agreements, and state wildlife action plans for special status species.
- Potential effects from collisions and electrocutions to raptors and other wildlife from power lines and power stations.
- Potential effects of additional infrastructure resulting in increased perches for raptors and corvids that may increase predation on other animals.
- Potential effects on culturally significant terrestrial wildlife species traditionally used as food by regional Tribes.

Groundwater Pumping

- Short term, long term, and permanent loss of phreatophytic and riparian wildlife habitat and surface-water availability.
- Potential effects of groundwater drawdown on water resources and habitat that support migratory waterfowl, bats, and important bird areas.
- Potential effects of groundwater drawdown on wildlife associated with cave habitats.
- Compliance with recovery plans, conservation agreements, and state wildlife action plans for special status species.

3.6.3.3 Assumptions

Rights-of-way and Groundwater Development Area Construction and Maintenance

- Study Areas. The cumulative impact study areas for terrestrial wildlife species vary by species or species group based either on the basins impacted or by a recognized management unit for the species (e.g. big game management units, greater sage-grouse population management units). Given the large number of species, cumulative effects were evaluated for a selected set of species. The overall rationale for these various cumulative study areas is the need to evaluate the impacts of the various alternatives in concert with PPAs and RFFA impacts on a scale that considers movement of the various species within their typical range, management units used by agencies (where established), or the basins crossed by the proposed GWD Project.
- Time frames. The effects analysis included time frames that ranged from several days to 2 years for a short-term effect and greater than 5 years for a long-term effect.
- The PPAs footprints are based on utility ROWs and other surface disturbance activities identified in the BLM and other data bases (Chapter 2).
- The reasonably foreseeable projects and activities are those outlined in **Table 2.9-1**, Chapter 2. No cumulative effects related to surface development activities are anticipated outside the selected species or species group cumulative study area.

Groundwater Pumping

- Wildlife habitats associated with water sources include perennial streams, springs, ET wetland meadows and ET basin shrubland phreatophytes, as described in Vegetation Resources.
- Assumptions made in the vegetation section also apply to wildlife with regard to vegetation communities, see Section 3.5, Vegetation Resources.
- Assumptions made in the water section also apply to wildlife with regard to spring and perennial stream habitats, see Section 3.3, Water Resources.
- Study area. The study area is the boundary for the groundwater model simulations (**Figure 1.1-1**).
- Time frames. The effects analysis included time frames from full build out of the entire project (approximately 2050) to full build out plus 200 years.

3.6.3.4 Methodology for Analysis

Rights-of-way and Groundwater Development Area Construction and Maintenance

- The cumulative surface disturbance effects to terrestrial wildlife resources were estimated by overlaying the existing surface disturbances for PPAs, RFFAs, and the ROW development areas for the project alternative being evaluated over the various species habitats within the cumulative impact study areas (**Appendix F**, **Figures F3.6-3** to **F3.6-12**). The estimated cumulative surface disturbance was then compared with the overall amount of habitat within the cumulative impact study area. Habitat for selected species are from the NDOW GIS layers for big game and greater sage-grouse, or SWreGAP animal habitat models for other species or groups of species, and for some species groups, the entire area within a cumulative impact study area was considered habitat.
- The cumulative surface disturbance effects to special status species were estimated from evaluating the cumulative surface disturbance footprint in relation to the habitat requirements of terrestrial wildlife species to provide a risk assessment for future effects on these species.

Groundwater Pumping

- The cumulative analysis focuses on those basins with groundwater dependent terrestrial wildlife habitats (i.e. springs, perennial streams, ET vegetation types [wetland meadow/basin shrubland]) predicted to be affected by each alternative. This represents the incremental effect of the alternative on groundwater dependent terrestrial wildlife habitat in combination with other cumulative pumping actions.
- Wetland meadow and basin shrubland (terrestrial wildlife habitat type at risk from pumping). The area enclosed by the maximum extent of the 10-foot drawdown contour was superimposed over the area of the primary ET units to calculate the area of vegetation that could experience reductions in soil moisture and long-term vegetation community composition changes caused by groundwater drawdown of 10 feet or more at different points in time (full build out, full build out plus 75 years, and full build out plus 200 years). Figures were generated to illustrate the expansion of the 10-foot and greater drawdown contours over time in relation to the vegetation communities within the hydrographic ET boundaries (Section 3.5, Vegetation Resources).
- Springs and perennial streams (terrestrial wildlife habitat at risk from pumping). The 10-foot drawdown contour was applied to the springs and perennial stream reaches that were classified as being at risk from groundwater drawdown. The springs included for analysis were those rated as presenting a "high" or "moderate" risk of effects. The number of springs and miles of perennial stream reaches potentially affected were enumerated for each alternative over time from the modeling results (see Section 3.3, Water Resources).
- **Appendix F**, **Tables F3.6-18** through **F3.6-25** display the potential relative effects to groundwater dependent habitats (springs, perennial stream reaches, and ET vegetation types) as compared to the No Action Cumulative impacts. The tables show where project-specific impacts will combine with other project impacts (i.e. yellow colored cells in the tables) or show where the impacts are due only to project-specific pumping (i.e. red colored cells in the tables). Please also see the discussion in Vegetation Resources (3.5.2.8) regarding the shift in vegetation composition due to groundwater pumping. These appendix tables provide information on the groundwater dependent habitat types (include perennial streams, springs, ET wetland meadows and ET basin shrubland phreatophytes) as a percent of the total amount of that type of habitat within each of the valleys. For

example, it shows whether 5 percent of the perennial stream reaches in a valley are potentially at risk from drawdown or if 60 percent of them are at risk. This provides information on the intensity of the potential impact to wildlife species that use these habitats within the valley.

General Discussion

The following cumulative impacts discussion is based on data presented in both Sections 3.3, Water Resources and 3.5, Vegetation Resources. These sections present cumulative analysis for springs and perennial streams and impacts on ET wetland meadow and basin shrubland which are the habitat types used by terrestrial wildlife that are at risk of impacts by groundwater pumping. The wildlife pumping effects analysis builds on data presented in these two sections and their associated appendices.

3.6.3.5 No Action

Groundwater Development

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Terrestrial wildlife habitats would continue to be influenced by natural events such as drought, fire, and land use activities such as grazing and existing water diversions. Management activities on public lands will continue to be directed by the Ely and Las Vegas RMPs, which include measures to maintain habitats for terrestrial wildlife species. Management guidance for other public lands in close proximity to the project study area would be provided by Great Basin Park General Management Plan and the Forest Plan for the Humbolt-Toiyabe National Forest.

Groundwater Pumping

In general, groundwater pumping has the potential to impact important habitats for wildlife including perennial springs and streams, their associated vegetation communities (e.g. wetlands, riparian areas, wet meadows), and phreatophytic wetland/meadow and basin shrubland vegetation types in ET areas, see **Appendix F3.3.8**, **Figures F3.3.8B-19** through **B-21** for the potentially impacted perennial waters for the three pumping time frames. **Table F3.6-18** in **Appendix F** provides a summary of basins that have groundwater dependent habitat that is in areas potentially impacted by No Action cumulative drawdown in the three time frames. Perennial streams, springs, and ET wetland meadow and basin shrubland types are presented as a percent of the total available in the valley (e.g., potentially impacted springs as a percent of the total springs in the valley). The No Action cumulative scenario has 17 basins with potentially impacted perennial streams or springs by the full build out plus 200 years time frame including Pahranagat, Lower Moapa, Panaca, Clover, Lower Meadow Valley Wash, White River, Lake, Muddy River Springs Area, Spring [201 and 184], Steptoe, Patterson, Coyote Springs, Las Vegas, Eagle, Rose, and Dry valleys. See **Appendix F**, **Table F3.6-1** for species that occur in these valleys. The degree of impacts to wildlife resources would depend on a number of variables, such as the existing habitat values and level of use, species' sensitivity (i.e. level of dependency on groundwater-dependent habitats), and the extent of the anticipated water and habitat reductions/shifts. Given the limited amount of these habitat types within the study area, it is assumed that species dependent on these areas currently are at carrying capacity. As a result, any individuals displaced as a result of reduction in amount or quality of these habitats could be lost, concentrating the remaining animals within smaller habitat areas. Species groups likely affected by reduction in groundwater dependent habitats would include: big game, small mammals, upland game birds, waterfowl, nongame birds (e.g. raptors and passerines), bats, reptiles, and invertebrates. Discussion of cumulative effects for species and species groups is addressed later in the section.

3.6.3.6 Proposed Action

Groundwater Development

Rights-of-way and Groundwater Development Area Construction and Maintenance

<u>Habitat Alteration and Direct/Indirect Effects on Terrestrial Wildlife Species</u>

PPAs consist primarily of existing roads, energy utility corridors, mining districts, and recent wildfires (**Figures 2.9-1** and **2.9-2**). Other activities that have influenced terrestrial wildlife habitat and species include livestock grazing over the majority of public lands, the development of towns and rural communities (see Section 3.5, Vegetation Resources), and vegetation treatments conducted by various agencies. The primary future actions consist of construction of new utilities (pipelines, electrical distribution lines), roads and turbine pads for wind energy projects, and the Coyote Springs Residential Development. These projects would be located in Spring, Pahranagat, Hidden Valley (north), Garnet, Dry Lake, Muleshoe, Lake, Delamar, and Coyote Springs valleys. The total estimated surface area disturbance for construction and maintenance of the main pipeline and ancillary facilities, plus the maximum anticipated groundwater development facilities, and RFFAs are displayed in **Table 2.9-1** for the Proposed Action. The reasonably foreseeable actions are described in **Table 2.9-1**.

Cumulative Effects. The areas where the GWD Project surface disturbance would potentially overlap with PPAs and RFFAs (**Figures 2.9-1** and **2.9-2** and **Table 2.9-1**) include existing road and highway crossings in all project hydrologic basins, the LCCRDA utility corridor that extends from southern Dry Lake Valley to the vicinity of Apex, and intersection with facilities associated with the ON Transmission Line and Eastern Nevada Transmission Project and TWE Transmission Line, the Coyote Springs Residential Development in Coyote Spring Valley, and future wind energy projects in Spring and northern Lake valleys. The additive cumulative effects would result in additional habitat disturbance and fragmentation. Fragmentation would continue until restoration is complete, which could take from 5 to 200 years depending on the vegetation type. Some areas would be permanently converted (e.g. new roads) to other uses. Habitat conversion or alteration would result in direct losses of smaller, less mobile species of wildlife such as small mammals and reptiles and displacement of more mobile species into adjacent habitats. Displacement would occur from various locations and would increase pressure on remaining habitats. This could result in some local reductions in wildlife populations, if adjacent habitats are at carrying capacity. Potential cumulative indirect impacts would include an incremental increase in noise, elevated human presence, dispersal of noxious and invasive weed species, and dust deposition if projects occurred during the same time frame within wildlife habitat. Agency implemented vegetation treatments would improve habitats over time and would be a beneficial cumulative effect.

Groundwater Pumping

PPAs are represented by the No Action pumping operations described in Section 3.3, Water Resources. The reasonably foreseeable actions are described in **Table 2.9-4**. The following discussions are based on an interpretation of the groundwater model simulations that predict groundwater drawdown elevations that have the potential to impact three groundwater dependent habitats (perennial streams, springs, and ET vegetation types) that are used by terrestrial wildlife species. The degree of impacts to terrestrial wildlife resources would depend on a number of variables, such as the existing habitat values and level of use, species' sensitivity (i.e. level of dependency on groundwater-dependent habitats), and the extent of the anticipated water and habitat reductions/shifts. Given the limited amount of these habitat types within the study area, it is assumed that species dependent on these areas currently are at carrying capacity. As a result, any individuals displaced as a result of reduction in amount or quality of these habitats could be lost, concentrating the remaining animals within smaller habitat areas. Species groups likely affected by reduction in groundwater dependent habitats would include: big game, small mammals, upland game birds, waterfowl, nongame birds (e.g. raptors and passerines), bats, reptiles, and invertebrates. Discussion of cumulative effects for species and species groups is addressed later in the section.

There are 11 valleys that have at least 1 of the 3 groundwater dependent habitats incrementally impacted by Proposed Action cumulative effects (i.e., have impacts beyond those attributable to the No Action cumulative effects) in at least one of the three model time frames; these include Spring (184), Snake, Hamlin, Lake, Lower Meadow Valley Wash, Cave, Steptoe, Muddy River Springs Area, Panaca, Spring [201], and Eagle. **Table F3.6-19, Appendix F** provides a summary of basins that have groundwater dependent habitats that are in areas potentially impacted by Proposed Action cumulative drawdown in the three model time frames. **Table F3.6-1, Appendix F** provides a list of terrestrial wildlife species that occur in these valleys. Figures in Section 3.5, Vegetation Resources, display the incremental contribution of the Proposed Action cumulative to wetland/meadow and basin shrubland ET vegetation types as well as the number of springs and miles of perennial streams that are in areas potentially impacted by drawdown in selected valleys. Of these 11 valleys, 6 (Spring [184], Snake, Cave, Steptoe, Hamlin, Eagle) have all the potential incremental impacts of at least 1 groundwater dependent habitat coming entirely from the Proposed Action cumulative pumping. The other five valleys (Panaca, Lower Meadow Valley Wash, Spring [201], Muddy River Springs Area, and Pahranagat) show potential impacts based on the No Action cumulative model results to which the Proposed Action cumulative contributes incrementally. The location and risk to springs and perennial streams in relation to cumulative drawdown at the various model time frames are displayed in **Appendix F3.3.8**, **Figures F3.3.8B-01** through **F3.3.8B-03**.

Cumulative Effects of Groundwater Development and Pumping on Terrestrial Wildlife Species

Management Concern Species

Big Game: The cumulative impact study areas for big game species were developed from the hunt units and management subunit boundaries used by the States of Nevada and Utah to manage these species (**Appendix F**, **Figures F3.6-3** through **F3.6-7**). Most big game species require large areas to meet seasonal habitat requirements and move between these habitats. While the proposed project surface impacts may not impact a large percent of the overall available habitat for these species, when considered together with the PPAs and RFFAs, impacts may be detrimental to local populations. The primary source of cumulative impacts to big game is the construction of roads and other infrastructure. These facilities reduce the quantity of available habitat both directly through habitat loss as well as indirectly through fragmentation and other fragmentation effects (e.g., increased noise, elevated human presence, dispersal of noxious and invasive weeds species, dust deposition). While research suggests that roadway impacts can have population-level effects on terrestrial species (Trombulak and Frissell 2000; Fahrig and Rytwinski 2009; Benitez-Lopez et al. 2010), the thresholds at which roads or other development features create movement barriers or population-level effects are rarely known (Frair et al. 2008) and can vary from species to species.

The future groundwater facilities development along with proposed wind power projects in Dry Lake and Spring valleys and the supporting facilities and roads would likely have cumulative effects particularly on pronghorn and mule deer winter range (NV Management units 11 and 22). By implementing ACMs, the proposed GWD Project would minimize impacts to big game species, but could not completely avoid contributing to incremental habitat fragmentation effects to these species in combination with other actions.

Groundwater pumping would be expected to change the distribution and movements of big game. As pumping would alter the availability of water and associated foraging habitat on the landscape, big game would make use of these high value habitats where they are found. Valleys where Proposed Action cumulative effects to at least one of the groundwater dependent habitats are likely to occur are listed above.

Other Terrestrial Species of Management Concern: The cumulative impact study area for other Terrestrial Species of Management Concern is the GWD Project ROW cumulative impact study area (**Appendix F**, **Figure F3.6-8**). The study area considers all the basins that are crossed by the GWD Project facilities. Most small mammals and reptiles have relatively small home ranges and are not long distance migrants. As with big game, cumulative impacts associated with the construction of roads and other infrastructure temporarily disturb habitat, potentially create barriers to movement, increase potential for vehicle collisions, and also convert habitat and contribute to fragmentation and associated effects as discussed previously. Future groundwater facilities development along with proposed wind, and power line projects in valleys impacted by the proposed project have the potential to contribute cumulatively to local population effects on small mammals and reptiles.

For birds, cumulative impacts from various projects would increase direct and indirect habitat loss, increase vehicle presence, and result in some direct mortalities to raptors and other birds from power lines and wind projects. Given the location of other RFFAs within basins where sagebrush habitat is the majority of the vegetation cover, (e.g., Spring Valley), impacts to sagebrush obligate birds would lead to additional long-term loss of habitat and further indirect impacts through displacement and habitat fragmentation.

By implementing ACMs, the proposed GWD Project would minimize impacts to management concern species but could not completely avoid contributing to incremental habitat fragmentation effects to these species in combination with other actions.

The potential reduced availability of spring, perennial streams, and ET wetland/meadow and basin shrubland habitats due to cumulative groundwater pumping, could result in reductions or even loss of local populations of less mobile species in specific areas and displacement of mobile species like birds. For migratory birds, pumping impacts could decrease the amount of stopover habitat available on the landscape. Valleys where Proposed Action cumulative effects to at least one of the groundwater dependent habitats are likely to occur are listed above.

Special Status Species

Desert Tortoise and Gila Monster: The cumulative impact study area for desert tortoise includes the valleys crossed by the proposed GWD Project facilities within desert tortoise range and also includes valleys that contain ACECs designated for desert tortoise protection (e.g. Kane Springs, Coyote Spring) crossed by the proposed GWD Project (**Appendix F**, **Figure F3.6-11**). The cumulative impact study area for gila monster includes the basins crossed by the proposed project facilities within gila monster habitat (based on the SWReGap animal habitat model) (see **Appendix F**, **Figure F3.6-12**).

PPAs including roads, utility corridors, human development, and wildfires have impacted large portions of these species' habitats. The major additive cumulative effects within these species' cumulative impact study areas would be the expansion in the width of adjacent utility ROWs and new transmission ROWs as well as the Coyote Springs Residential Development, which would convert and fragment habitat for desert tortoise, gila monster and other Mojave desert species habitat. Qualitatively, this would contribute to further fragmentation effects including isolating of populations, increasing potential for predation given additional above ground structures for perching and nesting of raptors and corvids, and increasing human-related disturbances (e.g., illegal collection, increased OHV use). By implementing ACMs, the proposed GWD Project would minimize direct take of desert tortoise and gila monsters and minimize impacts to habitat for these species once reclamation is complete. It would not completely avoid contributing to incremental habitat fragmentation effects to these species in combination with other actions. The Coyote Springs residential development has an associated habitat conservation plan and 40-year incidental take permit for desert tortoise. The habitat conservation plan also covers the banded gila monster and burrowing owl should they become listed in the future.

The Proposed Action pumping could contribute cumulatively to potential groundwater dependent habitat impacts within the range of the gila monster (stream miles in Lower Meadow Valley Wash at the 75 and 200 years plus full build out time frames). Desert tortoise is not dependent on groundwater dependent habitats.

Southwestern Willow Flycatcher, Yellow-billed Cuckoo, and Yuma Clapper Rail: These bird species would not be directly impacted by the proposed GWD Project facilities, so cumulative effects from surface impacts are not expected. For these species, the study area is water resources region of study. The southwestern willow flycatcher and yellow-billed cuckoo potentially could experience additional habitat impacts (forage and breeding), above those in the Cumulative No Action Alternative, under the cumulative Proposed Action pumping scenario by the full build out plus 200 years time frame or before. See **Table 3.6-25** for a summary of impacted habitat areas for these species by alternative. Note that groundwater dependent habitats in Las Vegas and streams in Muddy River Springs Area are impacted by the No Action Cumulative scenarios, but based on available data do not appear to interact cumulatively with the Proposed Action or other action alternatives. Lower Moapa valley model results show potential flow reductions at Overton which could potentially impact habitat for southwestern willow flycatcher and yellow-billed cuckoo. There are no recent records of occurrences for Yuma clapper rail in areas potentially impacted by drawdown.

Table 3.6-25 Potential for Cumulative Pumping Impacts to Springs or Perennial Streams in Valleys with Known Habitat for Southwestern Willow Flycatcher and Yellow-billed Cuckoo

	No Action	Proposed Action	A	B	C	D	E	F
Pahranagat (YBC, SWWF)	X	Y	X	Y	Y	X	X	X
Lower Meadow Valley Wash (YBC, habitat SWWF)	X	Y	Y	Y	Y	X	Y	Y
Muddy River Springs (YBC)	X	Y	X	Y	X	X	X	Y

N = no springs or perennial streams potentially impacted in the valley; X = no additional incremental effect on habitat and species from this alternative; Y = increases in impacts to springs or perennial streams above cumulative No Action pumping scenario.

SWWF = Southwestern Willow Flycatcher.

YBC = Yellow-billed Cuckoo.

Greater Sage-Grouse: The cumulative impact study area for greater sage-grouse was developed to include the NDOW population management units crossed by the GWD Project. Contiguous sage-grouse habitat areas across the Utah border were also included (**Appendix F**, **Figure F3.6-10**). While the GWD Project impacts less than 1 percent of the total habitat within the cumulative study area, when considered in context with the PPAs and RFFAs in the greater sage-grouse cumulative impact study area a large amount of sage-grouse habitat would be impacted because this species is a sagebrush obligate species sensitive to fragmentation effects. The major additive cumulative effects within these species' cumulative impact study areas would be the additional utility ROWs and wind power projects in Spring and Lake valleys. The increase in aboveground facilities including wind turbines and power lines would result in effects as described earlier in the section in ROW Areas and Groundwater Development Areas sections for this species. Cumulative effects within valleys could result in the reduction or loss of local populations. By implementing ACMs, the GWD Project would minimize impacts to habitat for greater sage-grouse species, but could not completely avoid contributing to incremental habitat fragmentation effects to this species in combination with other actions.

Proposed Action pumping would contribute incrementally to impacts to springs, perennial streams, and ET wetland/meadow and basin shrubland habitats, all important to greater sage-grouse. In valleys like Spring [184], Snake, Cave, and Hamlin, the Proposed Action would contribute all the impacts to at least one of the groundwater dependent habitats within the three model time frames, see **Table F3.6-17, Appendix F**. Cumulative pumping effects within valleys could result in the reduction or loss of local populations. Valleys where this species occurs that would have incremental contributions to groundwater dependent habitats from Proposed Action pumping include: Spring [184], Snake, Hamlin, Lake, Cave, Steptoe, Spring [201], and Eagle.

Additional Special Status Bird Species including Raptors and Important Bird Areas: For birds, cumulative impacts from various projects would increase direct and indirect habitat loss, increase vehicle presence, and could result in some direct mortalities to raptors and other birds from power lines and wind projects. Given the location of other RFFAs within basins where sagebrush habitat is the majority of the vegetation cover, (e.g., Spring Valley), impacts to sagebrush obligate birds would lead to additional long-term loss of habitat and further indirect impacts through displacement and habitat fragmentation. These cumulative surface impacts could result in reductions in local populations in specific areas. By implementing ACMs, the proposed GWD Project would minimize impacts to special status bird species but could not completely avoid contributing to incremental habitat fragmentation effects to these species in combination with other actions.

Proposed Action pumping would contribute incrementally to impacts to reduced availability of spring, perennial streams, and ET wetland/meadow and basin shrubland habitats which also could result in reductions or even loss of local populations in specific areas for bird species dependent on these habitat types. For special status migratory birds, pumping impacts could decrease the amount of stopover habitat available on the landscape. The location and risk to springs and perennial streams in relation to cumulative drawdown at the various model time frames are displayed in **Appendix F3.3.8**, **Figures F3.3.8B-1** through **F3.3.8B-3.** Refer to **Table F3.6-19, Appendix F** for data on the percent of groundwater dependent habitats potentially impacted by the cumulative pumping scenarios within valleys potentially impacted by Proposed Action cumulative pumping; and Section 3.4, Vegetation Resources, discusses the impacts to ET vegetation types from cumulative pumping and includes figures that include wetland meadow and basin shrubland information for cumulative with No Action, Proposed Action, and cumulative pumping with the Proposed Action as a way of identifying the incremental effects of the alternative.

Cumulative pumping also could potentially impact springs and perennial streams in important bird areas. **Table F3.6-17, Appendix F** includes a list and number of important bird areas with either springs or perennial streams in areas potentially impacted by drawdown in the various model time frames. Because the No Action cumulative pumping scenario impacts Lower Meadow Valley Wash and the Pahranagat Valley Complex important bird areas at the full build out time frame, the Proposed Action also shows impacts to these two areas. The Proposed Action pumping increases the length of perennial stream miles in areas where impacts to flows could occur in the Lower Meadow Valley Wash important bird area during the full build out plus 75 years time frame. The Proposed Action has additional miles in areas potentially impacted by drawdown (approximately 24 miles) in the full build out plus 200 years time frame. The stream miles in Pahranagat Valley Complex remain the same when the No Action and Proposed Action are compared (approximately 0.5 mile) as do miles in the Muddy River Springs area (approximately 0.5 mile by the plus 200 years time frame). The other important bird areas impacted in later time frames include GBNP and D.E. Moore Bird and Wildlife Sanctuary. Perennial stream miles and springs within GBNP are also potentially impacted by Proposed Action cumulative pumping.

Pygmy Rabbit: The cumulative impact study area for pygmy rabbits was developed to include valleys crossed by the GWD Project within SWReGap modeled habitat (**Appendix F**, **Figure F3.6-9**). Habitat fragmentation is thought to limit pygmy rabbit dispersal capabilities given an apparent hesitancy to cross open habitats. Given their typical mode of escape (maneuvering into dense cover), pygmy rabbits are likely more vulnerable to predation in open habitats. RFFA projects within the pygmy rabbit cumulative impact study area would contribute to habitat loss and fragmentation effects to this species (e.g. Spring Valley). Overhead power lines also could contribute to potential predator perching sites, increasing predation potential on this species. By implementing ACMs, the proposed GWD Project would minimize impacts to pygmy rabbits; but could not completely avoid contributing to the long-term incremental sagebrush habitat fragmentation effects to this species in combination with other actions.

Valleys where this species occurs that would have incremental contributions to groundwater dependent habitats from Proposed Action pumping include: Spring [184], Snake, Hamlin, Lake, Cave, Steptoe, Spring [201], Panaca, and Eagle.

Bats: The cumulative impact study area for bat species is the project ROWs' cumulative impact study area (**Appendix F**, **Figure F3.6-8**). Types of projects that would most contribute to the additive cumulative effects to bat species would be the development of wind projects and utility corridors with overhead power lines as well as other projects that temporarily or permanently impact foraging habitat. Wind projects and projects that include overhead power lines would contribute to collision and electrocution potential of bat species, particularly if facilities are located within daily movement corridors (between roosting and foraging sites). By implementing the ACMs, the proposed GWD Project would minimize impacts to habitat for bat species, but could not completely avoid contributing to incremental foraging habitat and collision potential effects to these species in combination with other actions.

The most productive bat foraging habitat is the area around springs, perennial streams, and ET wetland/meadows as these areas typically support insects. Bats could be impacted by incremental Proposed Action cumulative drawdown in the valleys where any of these groundwater dependent habitats are impacted, refer to the groundwater pumping section above for the valleys likely impacted by Proposed Action cumulative pumping as well as **Table F3.6-1, Appendix F** for the species of bats that occur in those valleys.

Baking Powder Flat Blue Butterfly and White River Valley Skipper: The cumulative impacts study area for baking powder flat blue butterfly is the Baking Powder Flat ACEC as it contains all currently known records. As explained in the groundwater development – future facilities section, this species is found inside a proposed groundwater development area in Spring Valley. At this time, there are some water development projects within the ACEC. The Ely RMP designates this ACEC as an avoidance area and has it closed to locatable and leasable minerals, renewable energy, and does not allow any new roads (BLM 2008b). As described in the pumping effects section, the host plant for this species is an upland plant and not expected to be impacted by drawdown impacts. Cumulative impacts on this butterfly species from surface disturbance would be possible, but cumulative effects from pumping would be unlikely.

The cumulative impacts study area for White River valley skipper is White River, Lake and Spring valleys. White River valley skipper is not recorded within ROWs or groundwater development areas, so cumulative impacts from surface disturbance are not considered. This species, if present, may be impacted by drawdown in White River, Lake, and Spring valleys as explained in the pumping effects section. The apparent host plant for this species is wetland dependent. Both Lake and Spring valleys would have additional incremental effects on the groundwater dependent habitats from all the Proposed Action cumulative pumping as compared to the No Action alternative.

Other Wildlife Species of Interest

Cave Species: The cumulative impacts study area for cave species were the known caves within the ROW ACEC. Since proposed project facilities are unlikely to be located close to caves, cumulative effects from surface impacts are not expected.

As discussed in project specific pumping effects section, there are 6 caves in direct contact with the water table or surface water within susceptibility areas. They are all located in Snake Valley. If these caves have waters associated with them that are dependent on discharge from the regional groundwater flow system in Snake valley, habitat for cave obligate species may be impacted as a result of Proposed Action pumping which contributes almost all of the cumulative effects in this valley.

3.6.3.7 Alternative A

Rights-of-way and Groundwater Development Area Construction and Maintenance

The effects of Alternative A surface disturbance resulting from ROWs and project facilities in combination with other cumulative actions on terrestrial wildlife resources would be the same as discussed for cumulative impacts with the Proposed Action. Maximum future groundwater development facility acreage would be less than under the Proposed Action, see **Table 3.6-26,** lowering the potential for cumulative effects with RFFAs.

Groundwater Pumping Effects

There are eight valleys that have at least one of the three groundwater dependent habitats incrementally impacted by Alternative A cumulative effects (i.e., have impacts beyond those attributable to the No Action cumulative effects) in at least one of the three model time frames; these include Spring [184], Snake, Hamlin, Steptoe, Lower Meadow Valley Wash, Cave, Spring [201], and Lake. **Table F3.6-20, Appendix F** provides a summary of basins that have groundwater dependent habitats that are in areas potentially impacted by Alternative A cumulative drawdown in the three model time frames. **Table F3.6-1, Appendix F** provides a list of terrestrial wildlife species that occur in these valleys. Figures in Section 3.5, Vegetation Resources, display the incremental contribution of the Alternative A cumulative to wetland/meadow and basin shrubland ET vegetation types as well as the number of springs and miles of perennial streams that are in areas potentially impacted by drawdown. Of these eight valleys, five (Spring, Snake, Cave, Steptoe, Hamlin) have all the potential incremental impacts of at least one groundwater dependent habitat coming entirely from the Proposed Action cumulative pumping. The other three valleys (Lake, Lower Meadow Valley Wash, and Spring [201]) show potential impacts based the No Action cumulative model results to which Alternative A cumulative contributes incrementally. The location and risk to springs and perennial streams in relation to cumulative drawdown at the various model time frames are displayed in **Appendix F**, **Figures F3.3.8B-04** through **F3.3.8B-06**.

Table 3.6-26 Summary of Surface Disturbance by Alternative

Alternative	Groundwater Development Future Facilities Construction Disturbance (Acres)	Percent Difference between Proposed Action and other Alternative Groundwater Development Future Facility Construction Disturbance[1]	Maximum Total Project Construction Disturbance (Acres)	Percent Difference between Proposed Action Total Project Acres and other Alternatives	Number of Groundwater Development Basins within which the Alternative would construct Future Facilities
Proposed Action	3,590-8,410	NA	20,713	NA	5
Alternatives A and C	2,069-4,814	43	17,117	17	5
Alternative B	4,664	45	16,967	18	5
Alternative D	2,513-4,005	52	12,848	38	4
Alternative E	1,754-4,079	51	14,775	29	4
Alternative F	2,698-6,629	24	17,325	17	4

[1] Based on maximum acres.

3.6.3.8 Alternative B

Rights-of-way and Groundwater Development Area Construction and Maintenance

The effects of Alternative B surface disturbance resulting from ROWs and project facilities in combination with other cumulative actions on terrestrial wildlife resources would be the similar to impacts discussed for cumulative impacts with the Proposed Action. Maximum future groundwater development facility acreage would be less than under the Proposed Action, see **Table 3.6-18,** lowering the potential for cumulative effects with RFFAs.

Groundwater Pumping Effects

There are 12 valleys that have at least one of the three groundwater dependent habitats incrementally impacted by Alternative B cumulative effects (i.e., have impacts beyond those attributable to the No Action cumulative effects) in at least one of the three model time frames; these include Spring [184], Snake, Hamlin, Steptoe, Lower Meadow Valley

Wash, Cave, Spring [201], Lake, White River, Panaca, Pahranagat, and Lower Moapa,. **Table F3.6-21, Appendix F** provides a summary of basins that have groundwater dependent habitats that are in areas potentially impacted by Alternative B cumulative drawdown in the three model time frames. **Table F3.6-1, Appendix F** provides a list of terrestrial wildlife species that occur in these valleys. Figures in Section 3.5, Vegetation Resources, display the incremental contribution of Alternative B cumulative to wetland/meadow and basin shrubland ET vegetation types as well as the number of springs and miles of perennial streams that are in areas potentially impacted by drawdown. Of these 12 valleys, 7 (Spring, Snake, Cave, Steptoe, Hamlin, Pahranagat, and Lower Meadow Valley Wash) have all the potential incremental impacts of at least one groundwater dependent habitat coming entirely from Alternative B cumulative pumping. The other five valleys (Panaca, Lake, Spring [201], Lower Moapa, and White River) show potential impacts based the No Action cumulative model results to which Alternative B cumulative contributes incrementally. The location and risk to springs and perennial streams in relation to cumulative drawdown at the various model time frames are displayed in **Appendix F3.3.8**, **Figures F3.3.8B-07** through **F3.3.8B-09**.

3.6.3.9 Alternative C

Rights-of-way and Groundwater Development Area Construction and Maintenance

The effects of Alternative C surface disturbance resulting from ROWs and project facilities in combination with other cumulative actions on terrestrial wildlife resources would be the same as discussed for cumulative impacts with the Proposed Action. Maximum future groundwater development facility acreage would be less than under the Proposed Action, see **Table 3.6-18,** lowering the potential for cumulative effects with RFFAs.

Groundwater Pumping Effects

There are seven valleys that have at least one of the three groundwater dependent habitats incrementally impacted by Alternative C cumulative effects (have impacts beyond those attributable to the No Action cumulative effects) in at least one of the three model time frames; these include Spring, Snake, Hamlin, Steptoe, Lower Meadow Valley Wash, Lake, and Cave. **Table F3.6-22, Appendix F** provides a summary of basins that have groundwater dependent habitats that are in areas potentially impacted by Alternative C cumulative drawdown in the three model time frames. **Table F3.6-1, Appendix F** provides a list of terrestrial wildlife species that occur in these valleys. Figures in Section 3.5, Vegetation Resources, display the incremental contribution of Alternative C cumulative to wetland/meadow and basin shrubland ET vegetation types as well as the number of springs and miles of perennial streams that are in areas potentially impacted by drawdown. Of these seven valleys, five (Spring, Snake, Cave, Steptoe, Hamlin) have all the potential incremental impacts of at least one groundwater dependent habitat coming entirely from Alternative C cumulative pumping. The other two valleys (Lake and Lower Meadow Valley Wash) show potential impacts based the No Action cumulative model results to which Alternative C cumulative contributes incrementally. The location and risk to springs and perennial streams in relation to cumulative drawdown at the various model time frames are displayed in **Appendix F3.3.8**, **Figures F3.3.8B-10** through **F3.3.8B-12**.

3.6.3.10 Alternative D

Rights-of-way and Groundwater Development Area Construction and Maintenance

Construction and facility maintenance in Snake Valley and White Pine County would be eliminated under Alternative D. As a result, construction of the remaining ROWs and project facilities in Lincoln and Clark County and the Lincoln County portion of Spring Valley would result in effects to terrestrial wildlife species and their habitats. This alternative would not interact with the Spring Valley Wind RFFA as that project occurs north of the county line in Spring Valley (**Figure 2.9-1**, Chapter 2). There would be no potential for cumulative impacts from surface impacts for Baking Powder Flat Blue butterfly as this species occurs north of the county line. Maximum future groundwater development facility acreage would be less than under the Proposed Action, see **Table 3.6-18,** lowering the potential for cumulative effects with RFFAs.

Groundwater Pumping Effects

There are seven valleys that have at least one of the three groundwater dependent habitats incrementally impacted by Alternative D cumulative effects (i.e., have impacts beyond those attributable to the No Action cumulative effects) in at least one of the three model time frames; these include Spring, Snake, Hamlin, Steptoe, Cave, Spring [201], and Lake. **Table F3.6-23, Appendix F** provides a summary of basins that have groundwater dependent habitats that are in areas potentially impacted by Alternative D cumulative drawdown in the three model time frames. **Table F3.6-1, Appendix F** provides a list of terrestrial wildlife species that occur in these valleys. Figures in Section 3.5, Vegetation

Resources, display the incremental contribution of Alternative D cumulative to wetland/meadow and basin shrubland ET vegetation types as well as the number of springs and miles of perennial streams that are in areas potentially impacted by drawdown. Of these seven valleys, six (Spring, Snake, Cave, Steptoe, Hamlin, and Spring [201]) have all the potential incremental impacts of at least one groundwater dependent habitat coming entirely from Alternative D cumulative pumping. The other valley (Lake) shows potential impacts based the No Action cumulative model results to which Alternative D cumulative contributes incrementally. The location and risk to springs and perennial streams in relation to cumulative drawdown at the various model time frames are displayed in **Appendix F3.3.8**, **Figures F3.3.8B-13** through **F3.3.8B-15**.

3.6.3.11 Alternative E

Rights-of-way and Groundwater Development Area Construction and Maintenance

Under Alternative E, surface disturbance impacts would exclude Snake Valley. With this exception, the effects of Alternative E surface disturbance resulting from ROWs and project facilities in combination with other cumulative actions on terrestrial wildlife resources would be the same as discussed for cumulative impacts with the Proposed Action. Maximum future groundwater development facility acreage would be less than under the Proposed Action, see **Table 3.6-18,** lowering the potential for cumulative effects with RFFAs.

Groundwater Pumping Effects

There are nine valleys that have at least one of the three groundwater dependent habitats incrementally impacted by Alternative E cumulative effects (i.e., have impacts beyond those attributable to the No Action cumulative effects) in at least one of the three model time frames; these include Spring, Snake, Hamlin, Steptoe, Lake, Lower Meadow Valley Wash, Cave, Spring [201], and White River. **Table F3.6-24, Appendix F** provides a summary of basins that have groundwater dependent habitats that are in areas potentially impacted by Alternative E cumulative drawdown in the three model time frames. **Table F3.6-1, Appendix F** provides a list of terrestrial wildlife species that occur in these valleys. Figures in Section 3.5, Vegetation Resources, display the incremental contribution of Alternative E cumulative to wetland/meadow and basin shrubland ET vegetation types as well as the number of springs and miles of perennial streams that are in areas potentially impacted by drawdown. Of these nine valleys, five (Spring, Snake, Cave, Steptoe, Hamlin) have all the potential incremental impacts of at least one groundwater dependent habitat coming entirely from Alternative E cumulative pumping. The other four valleys (Lake, Lower Meadow Valley Wash, White River and Spring [201]) show potential impacts based the No Action cumulative model results to which Alternative E cumulative contributes incrementally. The location and risk to springs and perennial streams in relation to cumulative drawdown at the various model time frames are displayed in **Appendix F3.3.8**, **Figures F3.3.8B-16** through **F3.3.8B-18**.

3.6.3.12 Alternative F

Rights-of-way and Groundwater Development Area Construction and Maintenance

Under Alternative F, surface disturbance impacts would exclude Snake Valley. With this exception, the effects of Alternative F surface disturbance resulting from ROWs and project facilities in combination with other cumulative actions on terrestrial wildlife resources would be the same as discussed for cumulative impacts with the Proposed Action. Maximum future groundwater development facility acreage would be less than under the Proposed Action, see **Table 3.6-18**, lowering the potential for cumulative effects with RFFAs.

Groundwater Pumping Effects

There are 12 valleys that have at least 1 of the 3 groundwater dependent habitats incrementally impacted by Alternative F cumulative effects (i.e., have impacts beyond those attributable to the No Action cumulative effects) in at least one of the 3 model time frames; these include Cave, Hamlin, Lake, Lower Meadow Valley Wash, Muddy River Springs Area, Panaca, Rose, Snake, Spring, Spring [201], Steptoe, and White River. **Table F3.6-25, Appendix F** provides a summary of basins that have groundwater dependent habitats that are in areas potentially impacted by Alternative F cumulative drawdown in the three model time frames. **Table F3.6-1, Appendix F** provides a list of terrestrial wildlife species that occur in these valleys. Figures in Section 3.5, Vegetation Resources, display the incremental contribution of Alternative F cumulative to wetland/meadow and basin shrubland ET vegetation types as well as the number of springs and miles of perennial streams that are in areas potentially impacted by drawdown. Of these 11 valleys, 6 (Spring, Snake, Cave, Steptoe, Hamlin, Rose) have all the potential incremental impacts of at least one groundwater dependent habitat coming entirely from Alternative F cumulative pumping. The other valleys (Lake, Lower Meadow Valley Wash, Panaca, Spring [201], and White River) show potential impacts based the No Action cumulative model results to which

Alternative F cumulative contributes incrementally. The location and risk to springs and perennial streams in relation to cumulative drawdown at the various model time frames are displayed in **Appendix F3.3.8**, **Figures F3.3.8B-19** through **F3.3.8B-21**.

3.7 Aquatic Biological Resources

3.7.1 Affected Environment

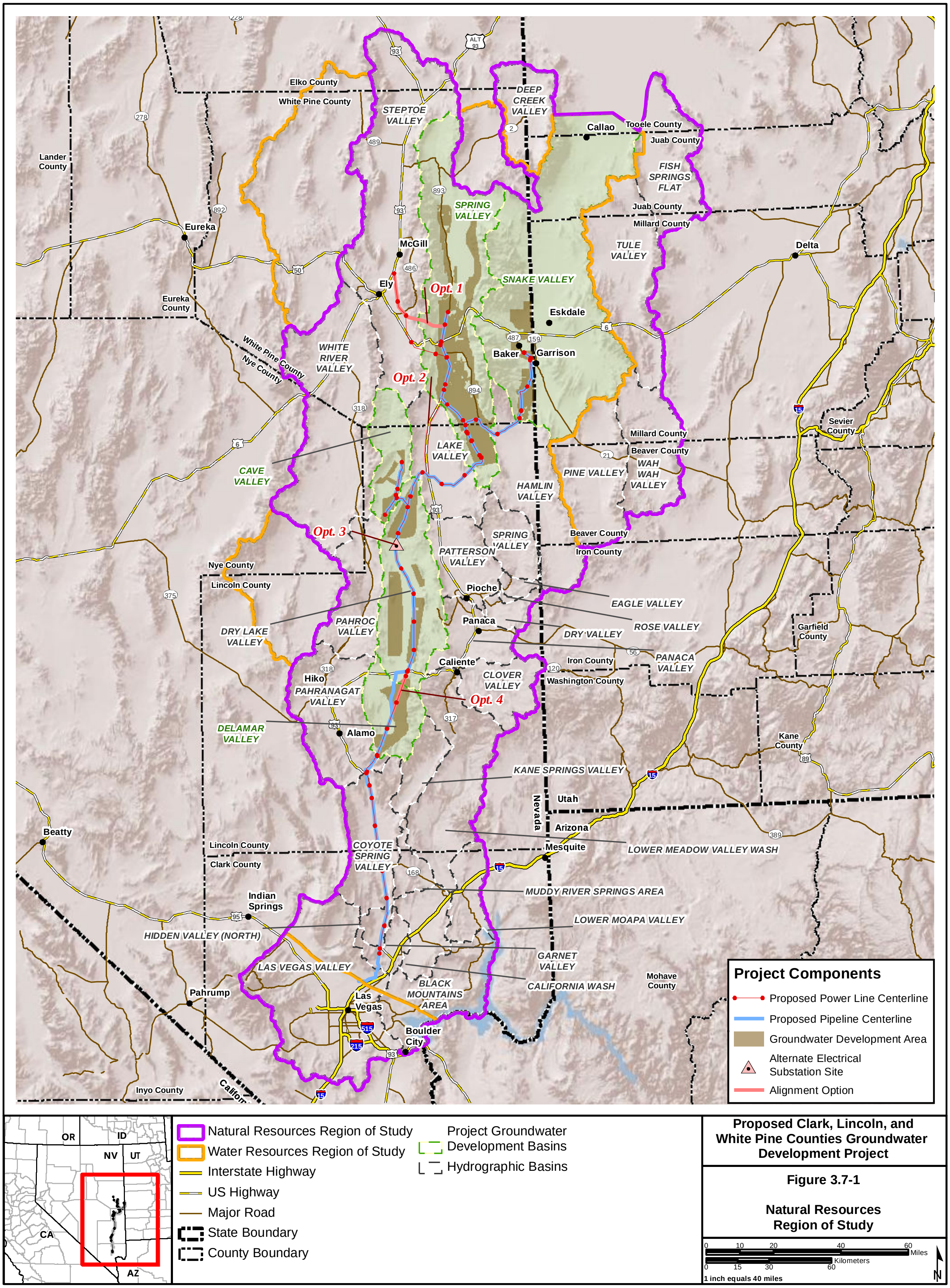
3.7.1.1 Overview

QUICK REFERENCE

afy – Acre-feet per year
BMP – Best Management Practice
cfs – Cubic-feet per second
ESA – Endangered Species Act
GBNP – Great Basin National Park
MOA – Memorandum of Agreement
NDOW – Nevada Department of Wildlife
NPDES – National Pollutant Discharge Elimination System
NWR – National Wildlife Refuge
POD – Plan of Development
RMP – Resource Management Plan
UDWR – Utah Division of Wildlife Resources
WMA – Wildlife Management Area

Aquatic biological resources within the study area include fish, invertebrates, amphibians, and their habitat. Species or groups that are emphasized in the baseline characterization are game fish species and special status fish, invertebrates, and amphibians. Other nongame native fish species also are included if they exhibit limited distribution or are considered in fish management actions. Information consists of game fish occurrence, macroinvertebrate composition, and special status species occurrence. An overview of aquatic resources within the study area is provided in this section. Detailed discussions of aquatic biological resources are included for specific portions of the study area in relation to ROW and groundwater development areas and the natural resources region of study as a broader geographical area (**Figure 3.7-1**). The natural resources region of study for aquatic biological resources includes 33 hydrologic basins that encompass portions of Nevada and Utah. The natural resources region of study is different than the water resources region of study in that seven basins (Butte, Tippett, Pleasant, Long, Jakes, Garden, and Coal) were excluded due to a lack of aquatic habitat for game fish and special status species. The natural resources region of study also included four basins (Pine, Wah Wah, Tule, and Deep Creek) that were not part of the model analysis area. The decision to include these basins was made by the Natural Resources Group because they contained aquatic habitats and special status species.

The study area is mainly in two ecoregions: the Mojave Desert and the Great Basin Desert. Both of these ecoregions are arid environments that receive relatively little precipitation, so aquatic environments generally are limited in number and often are isolated from one another. Aquatic habitat consisting of intermittent and ephemeral washes is common throughout the project study area, but this type of habitat is limited due to the lack of water on a consistent basis. Perennial springs and streams and reservoirs provide aquatic habitat throughout the year. Spring systems are scattered throughout the study area and represent the majority of the reliable water sources in the region (BIO-WEST 2007). As a result, the springs provide habitat for a variety of fish, invertebrate, and amphibian species. Permanent waterbodies in the form of perennial streams and lakes/reservoirs also are present in portions of the study area; the greatest number occur in the northern basins such as Snake, Spring (#184), Steptoe, Deep Creek, and White River. These habitats support the majority of the game fish populations within the study area.



No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Perennial – Waterbody with water present continuously during a normal year.

Intermittent – Waterbody that flows or exists sporadically or periodically.

Ephemeral – Waterbody with water presence that is short-lived or transitory.

The types of aquatic habitat within the ROW and groundwater development areas and the natural resources region of study were identified using USGS Hydrography Dataset (USGS 2008). Descriptions of these three levels of the project study area are provided in Chapter 3, Affected Environment and Environmental Consequences, Introduction. Habitat was defined in terms of perennial streams and lakes, springs, reservoirs, and ponds. Spring habitat also included map files that were produced by Sada (2007a) and BIO-WEST (2009, 2007).

A variety of data sources were used to identify occurrences for aquatic species. Information on game fish occurrences was obtained mainly from the NDOW and the UDWR. Occurrence information for special status aquatic species was based on the Nevada and Utah Natural Heritage databases, the NDOW, and the UDWR. Additional surveys also were conducted in the natural resources region of study by BIO-WEST (2009, 2007), which identified the occurrence of fish, amphibians, and invertebrates in spring habitats. Additional data on springsnail occurrences in the natural resources region of study were provided by Hershler (1998) and Sada (2007a,b). Sources of occurrence information for amphibians (especially northern leopard frog) include BIO-WEST (2009, 2007), SNWA (2009a, 2008), Freeman (2012), a geodatabase created by the SNWA (2007a) from Hitchcock (2001), and the Nevada and Utah Natural Heritage databases. Information on aquatic communities in the GBNP was provided by GBNP (2007), Baker (2009), and unpublished spring data. Numerous other published literature sources, such as recovery plans, conservation plans, and journal articles, were used for sensitive aquatic species occurrences. These references are cited in discussions for various species. As previously mentioned in the overview for vegetation and wildlife resources (Sections 3.5, Vegetation Resources and 3.6, Terrestrial Wildlife), the Natural Resources Group also provided input and evaluation on species occurrences (ENSR/AECOM 2008).

In Nevada and Utah public waters, fish species are managed by the state agencies (NDOW and the UDWR, respectively) with coordination and cooperation with federal agencies (BLM, NPS, USFS, and USFWS). One exception to species management is the NPS authority in parks such as Great Basin (GBNP). The NPS direction is to protect and manage resources in the park including fish and wildlife resources. Fishing regulations in the GBNP are under the jurisdiction of U.S. and State of Nevada laws. Aquatic habitat is managed by the agency who owns or manages the land (i.e., BLM, NPS, USFS Humboldt-Toiyabe National Forest, and USFWS refuges). On lands with federally listed species, such species are under the jurisdiction of the USFWS. The USFWS coordinates with the state agencies to develop and implement recovery and other plans for threatened and endangered species. Collectively, the state and federal agencies develop and implement management plans and strategies for both game and nongame fish species and determine management practices that involve fishing regulations and habitat protection. Management direction and guidance are provided through the implementation of management plans, agreements, and their wildlife plans (e.g., Wildlife Action Plan [2006] and the Utah Comprehensive Wildlife Conservation Strategy [Sutter et al. 2005]).

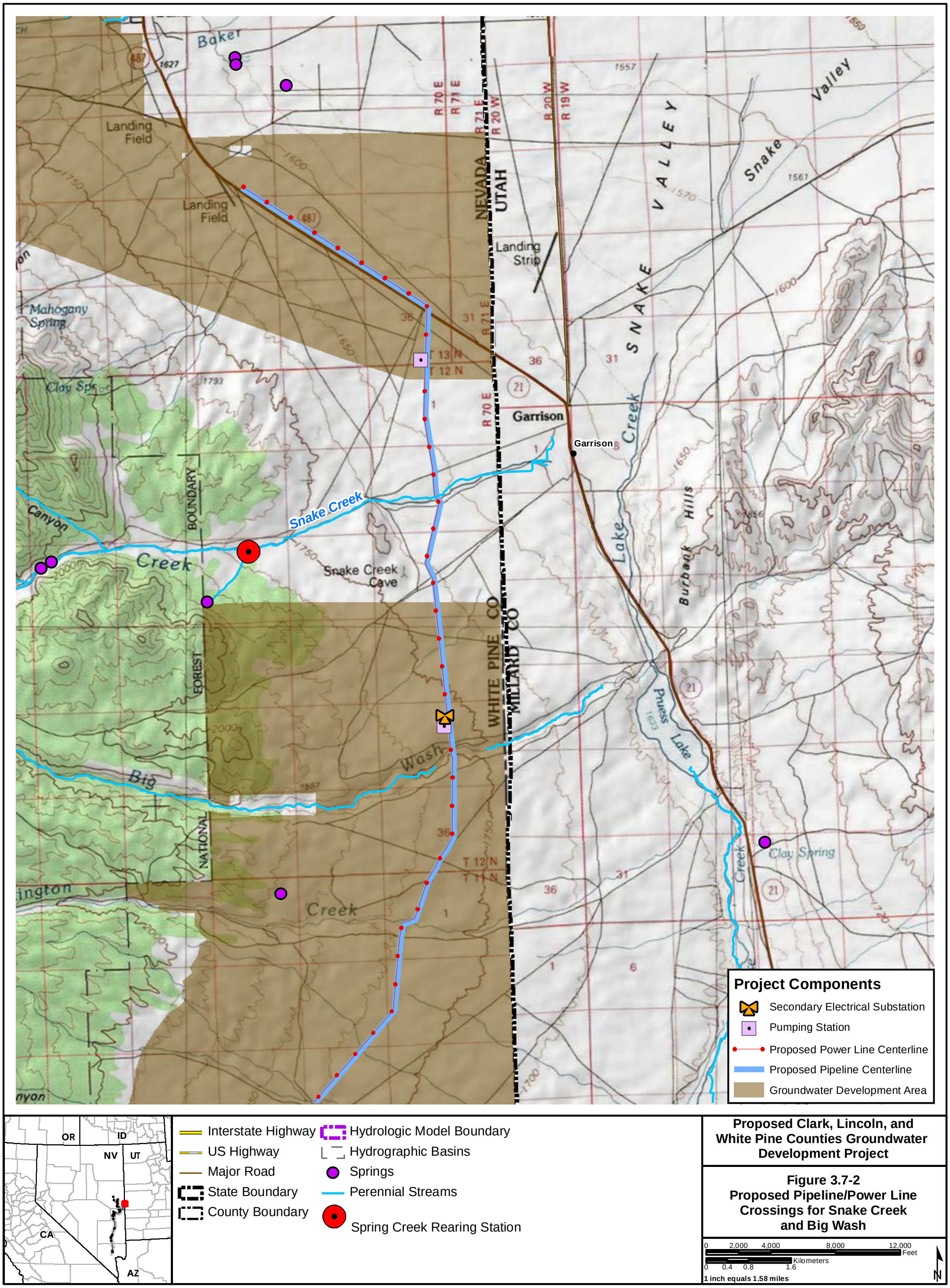
The discussions of special status aquatic species in the ROW, groundwater development areas, and the natural resources region of study include fish, amphibians, and invertebrates that are listed or proposed for listing under the ESA, and/or considered sensitive by the BLM or the USFS. Additional discussion on how the USFWS, BLM, and USFS define and manage these special status species is provided in Section 3.6, Terrestrial Wildlife. For this project, both the BLM and USACE must complete section 7 consultation under the ESA. The USACE has designated the BLM as the lead federal agency to act on their behalf for purposes of this consultation.

3.7.1.2 Right-of-way Areas

Habitats and General Aquatic Species

Streams

The pipeline ROWs would cross one perennial stream in the Snake Valley basin in Nevada (**Figure 3.7-2**). The pipeline ROWs also would cross intermittent streams (Lexington, Chokecherry, and Big Wash) and numerous ephemeral washes, such as Pahranagat. In addition, the power line ROWs would cross two perennial streams, Steptoe Creek in Steptoe Valley and Snake Creek in Snake Valley in Nevada. There are no ROWs in Utah. The Snake Creek crossing is the same for both the pipeline and power line ROW (**Figure 3.7-2**).



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-2
Proposed Pipeline/Power Line Crossings for Snake Creek and Big Wash

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Snake Creek supports a coldwater fishery with species including brook, brown, and rainbow trout. Brown trout occur throughout the stream on a year-round basis (Crookshanks 2010). Spawning and rearing habitat for brown trout exists in the area to be crossed by the pipeline ROW. Rainbow trout in this section of the stream are likely escapees from the NDOW Spring Creek Rearing Station, which is located approximately 2 miles upstream of the proposed pipeline crossing in Snake Creek. Brown and rainbow trout numbers in Snake Creek are maintained by natural reproduction. The NPS is considering stream eradication in 2012 to allow expansion of Bonneville cutthroat trout downstream to the hatchery, but the schedule has not been defined. The upper portion of the stream (upstream of the proposed pipeline and power line crossing) also contains Bonneville cutthroat trout. Rainbow trout and Bonneville cutthroat trout are spring spawners, while brook and brown trout spawn in the fall months. Snake Creek also supports native nongame species including mottled sculpin, speckled dace, and redside shiner that have been reintroduced in recent years.

One additional stream (Big Wash) to be crossed by the pipeline and power line is intermittent at the proposed crossing (**Figure 3.7-2**). No fish spawning or rearing habitat exists at this proposed crossing. The stream contains Bonneville cutthroat trout and three reintroduced native fish species (mottled sculpin, redside shiner, and speckled dace) in the perennial reach upstream of the proposed crossing (Crookshanks 2010). Some Bonneville cutthroat trout can be washed downstream during high flow periods (e.g., spring of 2005).

Steptoe Creek is the only additional perennial stream to be crossed by the power line ROW. This stream contains a coldwater game fishery consisting of brook, brown, and rainbow trout. The NDOW annually stocks rainbow trout in Steptoe Creek. Populations for the other two trout species are maintained by natural reproduction. The proposed crossing is considered spawning and rearing habitat for brown trout. Perennial streams also provide habitat for macroinvertebrate species. Macroinvertebrates serve important roles in the aquatic environment through their food-web dynamics and are indicators of water quality conditions (Barbour et al. 1999). Macroinvertebrate communities in Snake Creek were surveyed by the GBNP (2007) between 1997 and 2002. These sampling efforts revealed a total of 93 taxa, with trueflies (Diptera) representing the most abundant group by comprising approximately 29 percent of the total numbers. Beetles and mayflies were the next most abundant groups, which collectively comprised approximately 51 percent of the total numbers. Diversity indices and presence of mayflies, stoneflies, and caddisflies indicated nearly pristine water quality and habitat conditions. The mean abundance for 5 samples was 1,882 invertebrates per square meter, which is considered a moderate abundance value.

Springs

No springs are located within the pipeline or power line ROWs.

Special Status Aquatic Species

Waterbodies that would be crossed by the ROWs contain habitat for one special status fish species: Bonneville cutthroat trout. This species occurs in Big Wash and Snake Creek in White Pine County. As previously discussed, this species occurs in headwater areas located upstream of the proposed ROW crossings. No federally listed aquatic species or other special status species occur in waterbodies that would be crossed by the ROWs. The Bonneville cutthroat trout is a BLM Sensitive Species and USFS Sensitive Species and is managed under conservation agreements in Nevada and Utah (NDOW 2006; Lentsch et al. 2000). Cutthroat trout spawn in the spring and early summer months.

Based on a letter from the Confederated Tribes of the Goshute Reservation to the BLM (Steele 2010), streams crossed by the ROWs also contain “culturally significant plants and animals.” In particular, Snake Creek is located within the aboriginal territory of the Confederated Tribes of the Goshute Reservation and supports “various species of fish that are culturally significant.” In addition, the power line crossing of Steptoe Creek is located within the aboriginal territory of the Western Shoshone Tribe. This stream contains fish that may be culturally significant for this tribe. Fish in these streams include trout, minnow, and sculpin species.

Alignment Options 1 through 4

Aquatic habitat within three of the four Alignment Options (1, 3, and 4) is limited to intermittent streams or washes. No perennial streams are located within the ROWs of these alignment options. Aquatic communities in these intermittent streams consist of macroinvertebrates that have adapted to seasonal water availability. One perennial stream, Geyser Creek in Lake Valley, would be crossed by the pipeline and power line ROWs for Option 2 (North Lake Valley Pipeline Alignment). This stream contains rainbow and brook trout. Spring habitats are present near one of the alignment options: North Lake Valley Pipeline and Power Line Alignment (Option 2). Two special status aquatic species, northern leopard frog and Lake Valley springsnail (pyrg), occur in the Wambolt Spring Complex, which is located approximately 0.1 mile from the ROW for the North Lake Valley alignment (Option 2).

3.7.1.3 Groundwater Development Areas

Aquatic habitat within the groundwater development areas includes numerous intermittent washes, perennial streams, several small playas, and springs. Ephemeral streams and springs are the most abundant type of surface water features. There are no perennial streams in Delamar Valley, Dry Lake Valley, and Cave Valley groundwater development areas. Perennial streams occur within the groundwater development areas in Spring and Snake valleys. The following information describes aquatic resources in these areas.

Habitats and General Aquatic Species

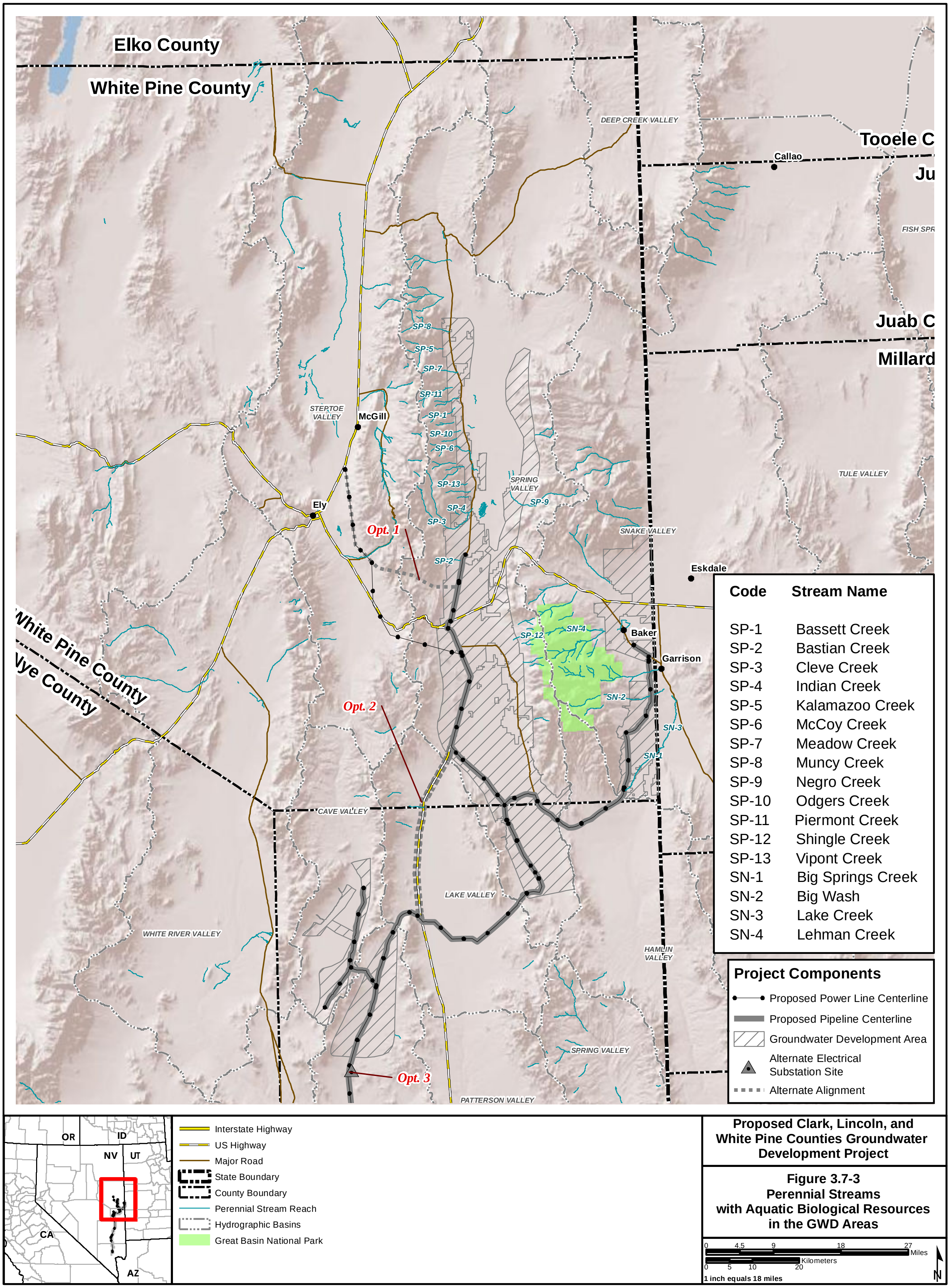
Streams

In total, the groundwater development areas in Spring and Snake valleys contain 13 and 4 perennial streams, respectively, that support coldwater game fish populations (**Table 3.7-1**) (**Figure 3.7-3**). The game species consist of four salmonid species (brook, Bonneville cutthroat, rainbow, and brown trout) and hybrids. In general, many of the stream reaches within the groundwater development areas have modified channels such as irrigation canals. The reaches support trout, but habitat quality has been reduced due to channel alterations.

Table 3.7-1 Perennial Streams[1] with Fish Species Occurrence Within the Groundwater Development Areas

Basin/Stream	Map Code (Figure 3.7-3)	Game Fish Species	Nongame Species
Spring Valley (Basin #184)			
Bassett Creek	SP-1	Rainbow trout	None
Bastian Creek and tributary	SP-2	Brown trout, rainbow trout	None
Cleve Creek and tributaries	SP-3	Brown trout, rainbow trout	None
Indian Creek	SP-4	Rainbow trout	None
Kalamazoo Creek	SP-5	Brown trout, rainbow trout	None
McCoy Creek	SP-6	Brown trout, rainbow trout, rainbow/cutthroat hybrid	None
Meadow Creek	SP-7	Brown trout	None
Muncy Creek	SP-8	Brook trout, brown trout, rainbow trout, rainbow/cutthroat hybrid	None
Negro Creek	SP-9	Brown trout, rainbow trout, trout hybrids	None
Odgers Creek	SP-10	Rainbow trout	None
Piermont Creek	SP-11	Brown trout	None
Shingle Creek	SP-12	Rainbow trout, rainbow/cutthroat hybrid	None
Vipont Creek	SP-13	Rainbow trout	None
Snake Valley			
Big Springs Creek	SN-1	None	Mottled sculpin, redside shiner, speckled dace, Utah chub, Utah sucker
Big Wash	SN-2	Bonneville cutthroat trout	None
Lake Creek	SN-3	Sacramento perch	Mottled sculpin, redside shiner, speckled dace, Utah chub, Utah sucker
Lehman Creek	SN-4	Brook trout, brown trout, rainbow trout, rainbow/cutthroat hybrid	None

1 Many of the stream reaches contain modified channels such as irrigation canals.



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-3 Perennial Streams with Aquatic Biological Resources in the GWD Areas

In general, other native and nonnative fish species do not occur in most of the perennial streams in the groundwater development areas. However, there are exceptions in four Snake Valley streams. Big Springs Creek/Lake Creek in Snake Valley contain native species such as redside shiner, speckled dace, mottled sculpin, Utah sucker, and Utah chub (NDOW 2007). In addition, mottled sculpin, redside shiner, and speckled dace occur in Upper Snake and Strawberry creeks and the South Fork of Big Wash. Big Springs Creek is the only stream in Nevada that supports this assemblage of Bonneville basin species. As a result of their limited distribution in Nevada, the NDOW considers this fish community to be unique.

The perennial streams in the groundwater development areas also support macroinvertebrate communities. Based on surveys conducted in Lehman Creek in 1997 and 1998 by the GBNP (2007), the macroinvertebrate communities were considered diverse (total of 58 taxa) and moderately abundant (mean of 6,600 invertebrates per square meter). Taxonomic composition was dominated by mayflies, which comprised approximately 66 percent of the total numbers. Other abundant taxonomic groups that comprised at least 10 percent of the total numbers included chironomid midges and beetles. Diversity indices and presence of mayflies, stoneflies, and caddisflies indicated nearly pristine water quality and habitat conditions.

Springs

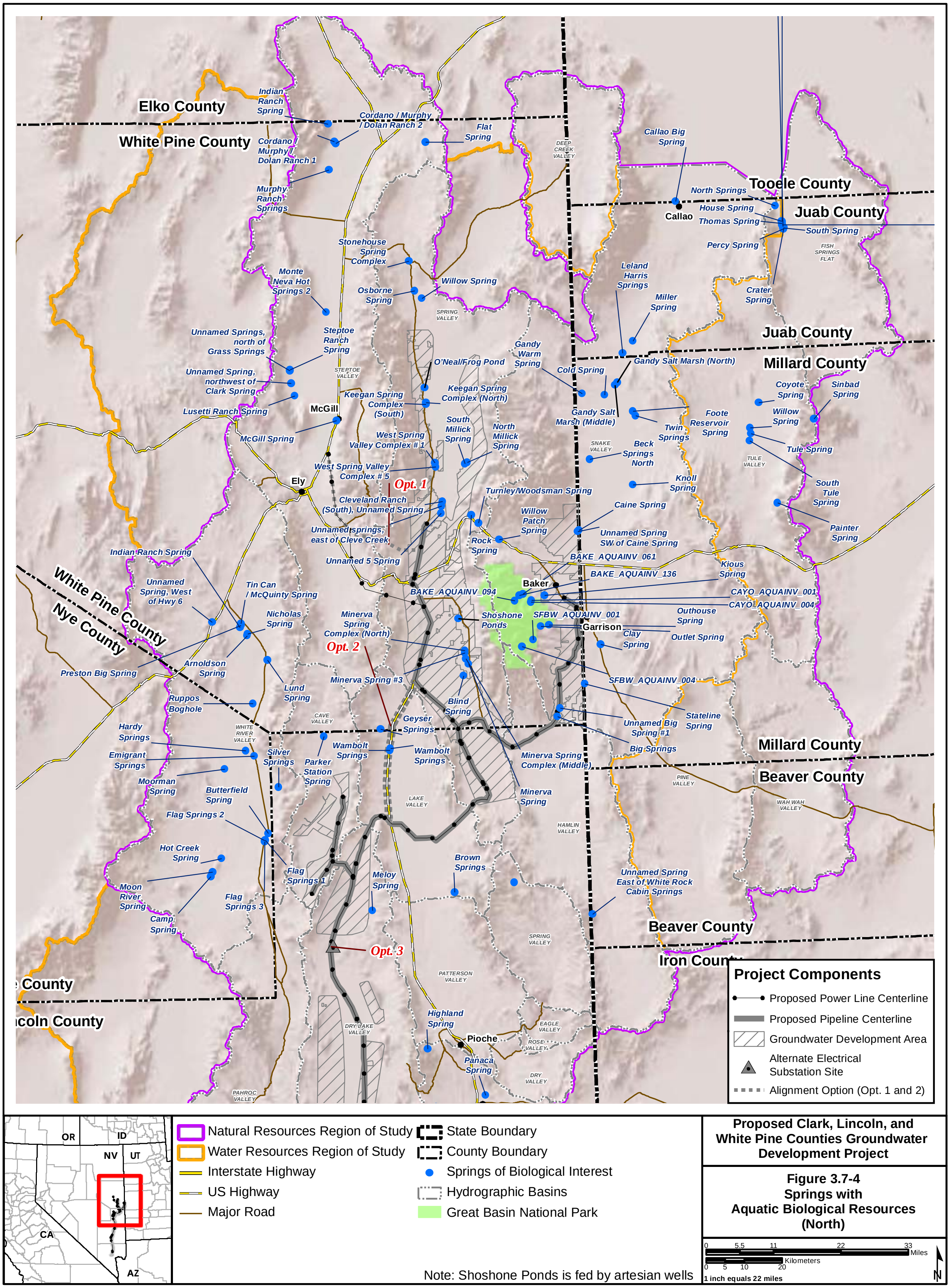
Springs with aquatic biological resources within and in the region of groundwater development areas are shown in **Figures 3.7-4** and **3.7-5**. Springs are located in all five basins associated with the groundwater development areas (**Figures 3.3.1-4** through **3.3.1-9**, in Section 3.3, Water Resources). The highest number of springs is within the Spring and Snake groundwater development areas (**Figures 3.3.1-4** and **3.3.1-5**). Previous aquatic biological surveys in springs within the groundwater development areas indicated that there was limited fish habitat (BIO-WEST 2007). No fish habitat was identified in the few springs located in the Cave and Dry Lake groundwater development areas due to shallow depths. Based on fish surveys conducted in springs within the Delamar, Snake, and Spring valley groundwater development areas, no fish are present (**Table 3.7-2**).

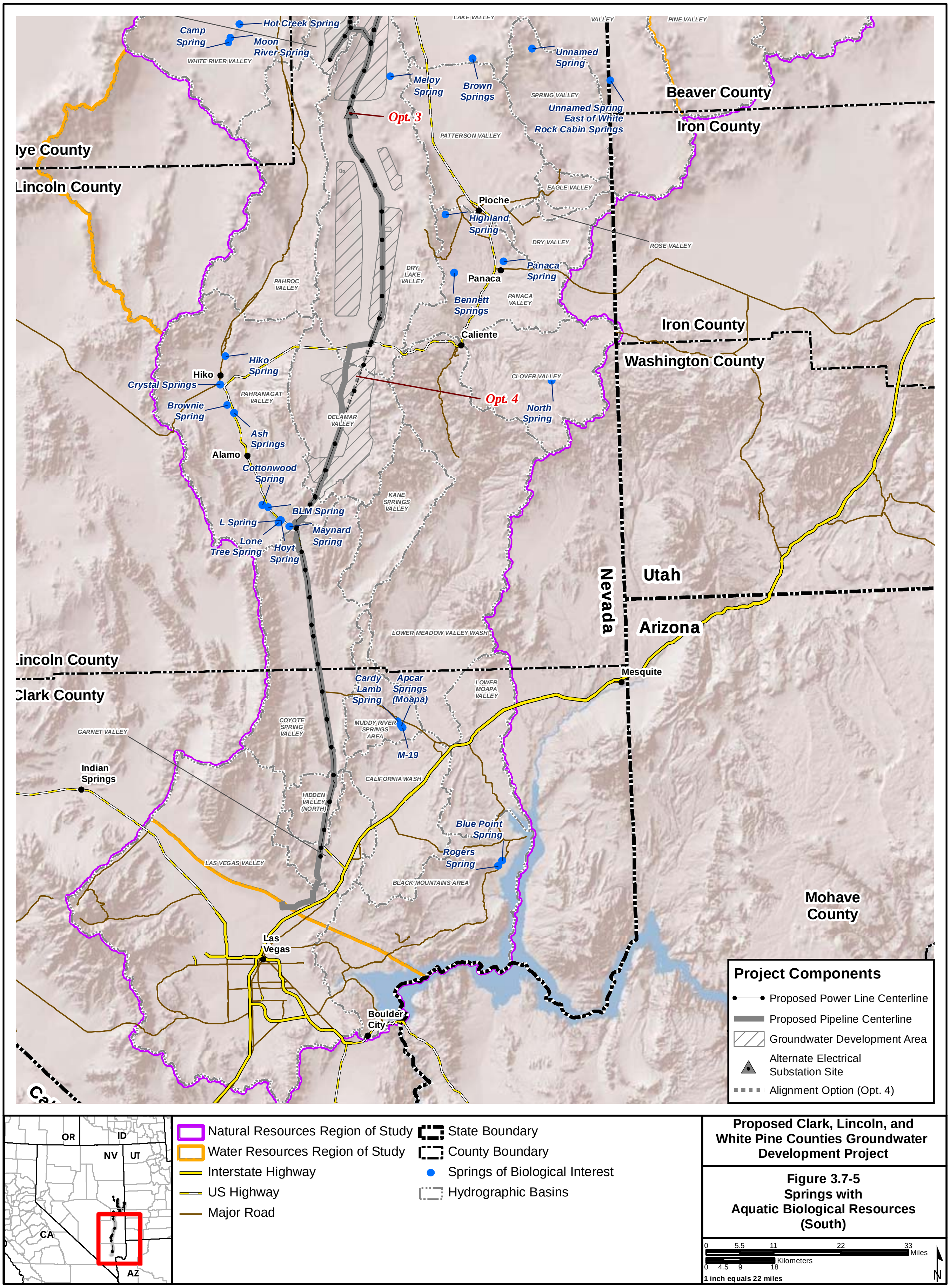
Nongame native fish species occur in Big Springs, which is located approximately 300 feet from the boundary of the Snake Valley groundwater development area. Species include mottled sculpin, redside shiner, Utah chub, Utah sucker, and speckled dace (BIO-WEST 2007; NDOW 2011a).

Based on surveys conducted in six of the springs in the Spring Valley groundwater development areas (Blind, Layton, North Millick, South Millick, South Bastian, and unnamed east of Cleve Creek), these waterbodies support fairly diverse and abundant macroinvertebrate communities (BIO-WEST 2009, 2007). Chironomid midges, oligochaete worms, amphipod crustaceans, dragonfly larvae, and ostracod crustaceans were the most abundant taxonomic groups. Mollusks also were present in most springs. The total number of taxa ranged from approximately 6 to 40. Macroinvertebrate abundances ranged from approximately 2,000 to 17,000 organisms per composite D-frame sampler. Springsnails, such as the Toquerville pyrg, also were present in two springs, an unnamed spring south of Caine Spring in Snake Valley and an unnamed spring east of Cleve Spring in Spring Valley.

Two additional springs, West Spring Complex #1 in Spring Valley and Caine Spring in Snake Valley, are located just outside the groundwater development area boundaries. The approximate distances from the development area boundaries are 20 feet and 170 feet, respectively. No fish were collected in either of these springs during field surveys (BIO-WEST 2007). Macroinvertebrate communities in these two springs were moderately diverse and abundant (17 taxa and mean density of 12,480 invertebrates per sample in Caine Spring and 29 taxa and mean density of 5,574 invertebrates/sample in West Valley Complex #1) (BIO-WEST 2007). The most abundant taxonomic groups included amphipod crustaceans and ostracods. Springsnails (Toquerville pyrg) were present in both springs.

Of the springs located within the groundwater development areas (**Figures 3.7-4** and **3.7-5**), amphibians (i.e., northern leopard frog) were observed in three springs (Blind, North Millick, and South Millick) in Spring Valley (BIO-WEST 2009, 2007). Potential suitable habitat may exist for other amphibian species in springs with perennial flow, as well as ephemeral (seasonal) waterbodies within the groundwater development areas. Examples of springs with perennial flow include Four Wheel Drive, Layton, North Millick, South Millick, and South Bastian. Regarding the two springs located just outside of the groundwater development areas (Caine Spring in Snake Valley and West Valley Complex #1 in Spring Valley), the northern leopard frog was collected in the West Valley Complex #1 (BIO-WEST 2007).


Elko County
White Pine County
Tooele County
Juab County
Millard County
Beaver County
Iron County
Nye County
Indian Ranch Spring
Cordano / Murphy / Dolan Ranch 2
Cordano / Murphy / Dolan Ranch 1
Flat Spring
Murphy Ranch Springs
Callao Big Spring
North Springs
House Spring
Thomas Spring
South Spring
Percy Spring
Callao
Stonehouse Spring Complex
Monte Neva Hot Springs 2
Osborne Spring
Willow Spring
Leland Harris Springs
Miller Spring
Crater Spring
Unnamed Springs, north of Grass Springs
Steptoe Ranch Spring
Gandy Warm Spring
O'Neal/Frog Pond
Cold Spring
Gandy Salt Marsh (North)
Unnamed Spring, northwest of Clark Spring
Keegan Spring Complex (South)
Keegan Spring Complex (North)
Coyote Spring
Sinbad Spring
Lusetti Ranch Spring
McGill
Gandy Salt Marsh (Middle)
Foote Reservoir Spring
Willow Spring
McGill Spring
West Spring Valley Complex # 1
South Millick Spring
North Millick Spring
Twin Springs
Beck Springs North
Tule Spring
West Spring Valley Complex # 5
Ely
Opt. 1
Knoll Spring
South Tule Spring
Cleveland Ranch (South), Unnamed Spring
Turnley/Woodsman Spring
Caine Spring
Painter Spring
Unnamed springs, east of Cleve Creek
Willow Patch Spring
Rock Spring
Unnamed Spring SW of Caine Spring
Indian Ranch Spring
Unnamed 5 Spring
BAKE_AQUAINV_061
Kious Spring
BAKE_AQUAINV_136
Baker
Unnamed Spring, West of Hwy 6
Tin Can / McQuinty Spring
BAKE_AQUAINV_094
CAYO_AQUAINV_001
CAYO_AQUAINV_004
Nicholas Spring
Minerva Spring Complex (North)
Shoshone Ponds
SFBW_AQUAINV_001
Outhouse Spring
Garrison
Clay Spring
Outlet Spring
Opt. 2
Arnoldson Spring
Preston Big Spring
Lund Spring
Minerva Spring #3
SFBW_AQUAINV_004
Ruppos Boghole
Blind Spring
Stateline Spring
Geyser Springs
Unnamed Big Spring #1
Hardy Springs
Wambolt Springs
Big Springs
Emigrant Springs
Silver Springs
Parker Station Spring
Minerva Spring Complex (Middle)
Moorman Spring
Butterfield Spring
Minerva Spring
Flag Springs 2
Hot Creek Spring
Flag Springs 1
Meloy Spring
Brown Springs
Unnamed Spring East of White Rock Cabin Springs
Moon River Spring
Flag Springs 3
Camp Spring
Opt. 3
Highland Spring
Pioche
Panaca Spring
Lincoln County
Project Components
Proposed Power Line Centerline
Proposed Pipeline Centerline
Groundwater Development Area
Alternate Electrical Substation Site
Alignment Option (Opt. 1 and 2)
OR
ID
NV
UT
CA
AZ
Natural Resources Region of Study
Water Resources Region of Study
Interstate Highway
US Highway
Major Road
State Boundary
County Boundary
Springs of Biological Interest
Hydrographic Basins
Great Basin National Park
Note: Shoshone Ponds is fed by artesian wells
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project
Figure 3.7-4
Springs with Aquatic Biological Resources (North)
0 5.5 11 22 33 Miles
0 5 10 20 Kilometers
1 inch equals 22 miles
N



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-5
Springs with Aquatic Biological Resources (South)

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Table 3.7-2 Results of Biological Surveys Conducted in Springs Within or Adjacent to the Groundwater Development Areas

Basin/Spring	Fish Present?	Northern Leopard Frog Present?	Springsnails Present?
Delamar			
Grassy Spring	No	No	No
Snake			
North Little Spring[1]	No	No	No
Unnamed spring #2 north of Big Springs[1]	No	No	No
Unnamed spring south of Caine Spring	No	No	Yes
Spring			
Blind	No	Yes	No
Four Wheel Drive	No	No	No
Layton Spring	No	No	No
North Millick Spring	No	Yes	No
South Bastian Spring	No	No	No
South Millick Spring	No	Yes	No
The Seep	No	No	No
Unnamed spring east of Cleve Creek	No	No	Yes

[1]Springs are located adjacent to the groundwater development areas.

Sources: BIO-WEST 2009, 2007; SNWA 209, 2008.

Ephemeral Pools and Playas

A number of ephemeral pools and playas are located in the groundwater development areas. Since the majority of these habitats hold water only briefly (i.e., they are rainfall dependent), they typically contain fewer taxa. However, when they hold water, ephemeral pools support an abundance of aquatic invertebrates, which are an important food source for migratory birds (Wildlife Action Plan Team 2006). They also play a crucial role in maintaining populations of aquatic invertebrates, such as brine, fairy, and tadpole shrimp, in desert systems, as well as providing breeding habitat for amphibians such as the Great Basin spadefoot (Wildlife Action Plan Team 2006).

Special Status Aquatic Species

Based on a review of occurrence data (Baker 2008; BIO-WEST 2009, 2007; NNHP 2006; Hershler and Sada 2002; Sada 2007a,b; Sada and Vinyard 2002; UNHP 2005), the potential occurrence of special status aquatic species was identified for the groundwater development areas. Species occurrence, by basin area, is provided in **Appendix F**, **Table F3.7-1**. **Figures F3.6-1** and **F3.6-2** (**Appendix F**) show the occurrence of federally listed species in the study area. Scientific names of aquatic species also are provided in **Appendix F**, **Table F3.7-1**.

Streams

Within the five groundwater development areas, one stream (Big Wash in Snake Valley) contains Bonneville cutthroat trout, a BLM sensitive species. One perennial stream, Big Springs Creek in Snake Valley, contains native species such as redside shiner, speckled dace, mottled sculpin, Utah sucker, and Utah chub. Although these fish species have no special status designation, they are considered unique because of their limited occurrence in Nevada.

Springs

No special status fish species have been collected in springs within the groundwater development areas, based on surveys conducted by BIO-WEST (2009, 2007).

Three springs within the Spring Valley groundwater development area (Blind, North Millick, and South Millick) contain known populations or suitable habitat for the special status amphibian species, northern leopard frog

(**Figure 3.7-4**). The status of this species is discussed in Section 3.7.1.4, Region of Study, Amphibians. The springs provide habitat for breeding and early life-stage development. In addition, northern leopard frog is present in the West Valley Complex #1, which is located just outside of the groundwater development in Spring Valley.

One group of aquatic species (springsnails) has been documented in the groundwater development areas in two basins: Snake and Spring (BIO-WEST 2009, 2007). The petitioned springsnails (bifid duct and longitudinal gland prygs) have been collected in Big Springs and an unnamed spring north of Big Springs, which are located approximately 300 feet from the groundwater development boundary in Snake Valley.

Springsnails are considered a special status group of mollusks because of their restricted distribution and native origin. Many species of springsnails are endemic to one or two spring complexes and are considered BLM sensitive and species of concern in Utah and Nevada. Additional information on springsnails, including those petitioned for listing under the ESA, is provided in Section 3.7.1.4, Region of Study, Special Status Aquatic Species.

3.7.1.4 Region of Study

Habitats and General Aquatic Species

Streams

Fourteen game fish species, including trout hybrids, occur within the natural resources region of study, which represents a broader geographical area (**Appendix F**, **Table F3.7-2**). The species represent both coldwater (trout) and warmwater (bullhead, catfish, sunfishes, crappies, largemouth bass, and Sacramento perch) species. In total, 16 valleys or basins within the overall region of study contain one or more game fish populations. Steptoe, Spring, and Snake valleys contain the highest number of waterbodies with game fisheries. Stream and lake/reservoir habitats contain the most productive and diverse game fisheries. Trout species can utilize both stream and lake/reservoir habitats, but they require streams for spawning. Species that prefer ponds and lakes include white crappie, bullhead (black and brown), and largemouth bass. As previously mentioned, the trout species are spring (rainbow and cutthroat) and fall (brook and brown) spawners. The warmwater species spawn in late spring or summer. Habitat and spawning periods for all game fish species are provided in **Appendix F**, **Table F3.7-3**.

A mixture of Bonneville Basin native nongame fish inhabits Big Springs Creek in the Nevada portion of Snake Valley and Lake Creek in the Utah portion of Snake Valley. The Big Springs system is considered unique because it is one of only two waters in Nevada that contain this suite of Bonneville Basin species. A survey in 2005 documented the presence of Utah chub, speckled dace, redside shiner, mottled sculpin, and Utah sucker in various reaches between the spring source and the Nevada-Utah stateline (Tallerico and Crookshanks 2005).

Big Springs Creek in Nevada is renamed Lake Creek when it enters Utah. Lake Creek flows in a northeasterly direction and provides water to Pruess Lake. Surveys conducted in Lake Creek in 2008 by BIO-WEST (2009) collected mottled sculpin, redside shiner, speckled dace, Utah sucker, and Utah chub. The most abundant species included speckled dace and mottled sculpin, which collectively comprised 59 percent of the total catch. The percent composition for the other species was 28 percent for Utah chub, 11 percent for redside shiner, and 2 percent for Utah sucker. A population of the game fish species, Sacramento perch, also exists in Lake Creek.

Stream systems in Sunnyside Creek (White River Valley) and Meadow Valley Wash (Dry and Panaca valleys) also provide habitat for native fish species. Sunnyside Creek contains populations of White River spinedace, speckled dace, and desert suckers. The upper portion of Meadow Valley Wash in Panaca and Dry valleys supports populations of Big Springs spinedace (federally threatened), speckled dace, and desert suckers, while the lower portion of Meadow Valley Wash contains dace and sucker species. Two of these species, Big Springs spinedace and White River spinedace (federally endangered), are discussed separately in the Federally Listed Species section. These stream systems provide the most extensive habitats for speckled dace and desert sucker subspecies within the natural resources region of study.

Based on fish surveys conducted in the GBNP, game fish composition and abundance is available for Lehman, Baker, and Snake creeks (GBNP 2007). The number of game fish species in the surveyed reaches ranged from one to two species in Snake Creek (brown and brook trout) to three species in Lehman and Baker creeks (brook, brown, and rainbow trout). Trout abundance varied depending on the stream and location of the survey reach. When considering surveys conducted since 2000, the following ranges in abundances were reported for these streams: lower reaches of

Baker Creek (300 to 600 fish per mile), lower reaches of Lehman Creek (2,100 to 3,000 fish per mile), and Snake Creek (2,500 to 3,200 fish per mile).

Three streams within the GBNP, South Fork Big Wash, Strawberry, and Snake creeks, also contain native nongame fish species such as mottled sculpin, speckled dace, and redside shiner. Native fish species are considered species of management concern due to their native origin and limited distribution within the GBNP and the general region.

A key source of information for characterizing stream macroinvertebrate communities within the region of study is the GBNP (2007) stream surveys. Macroinvertebrate communities in Lehman and Snake creeks were previously discussed in the ROW and groundwater development sections. In addition, macroinvertebrate surveys were conducted in Baker Creek in 1997 and 1998. Mayflies were the most abundant major taxonomic group in Baker Creek. Based on these surveys, macroinvertebrate communities are considered moderately abundant and diverse, as indicated by a mean density of 4,123 invertebrates per square meter and a total of 68 taxa.

Macroinvertebrates also are present in six caves within the GBNP that contain flowing water. These include Model, Ice, Wheeler's Deep, and System's Key caves in the Baker Creek watershed; Squirrel Spring Cave in the Snake watershed; and the Water Trough Cave in the Can Young watershed (Baker 2009, 2007). Taxonomic groups that have been collected in surface water habitat include mollusks, mayflies, caddisflies, stoneflies, trueflies, springtails, copepods, ostracods, oligochaete worms, and flatworms. Unique cave-dwelling species in close contact with water were collected in Model Cave, where a Nevada state record earthworm (*Haplotaxis gordiodes*) was found along with possible new species of an ostracod and an amphipod (S. Taylor, personal communication, as cited in Baker 2009).

Springs

Spring habitats, which include wetlands and riparian areas, are scattered throughout Clark, Lincoln, Nye, and White Pine counties in Nevada and Beaver, Millard, Juab, and Tooele counties in Utah (**Figures 3.7-4** and **3.7-5**). In arid areas such as the Great Basin, springs provide a reliable source of water that represents important habitat for aquatic species. As a result of their consistency as water sources, spring systems are considered "biodiversity hotspots" that are critical to the survival and persistence of numerous plant and animal species (Sada and Vinyard 2002). In addition, the Great Basin's hydrologic history has resulted in many of these spring systems being fragmented and isolated from adjacent springs. This situation has contributed to the presence of unique and endemic aquatic species.

Springs and associated wetlands do not support diverse game fish populations. Springs are often small and shallow and do not typically support trout species or other large predatory fish. Smaller game fish, such as green sunfish and bluegill, are present in some spring habitats. The only known occurrences of trout species in spring habitats within the region of study were noted in Swallow Spring in Spring Valley and Rowland Spring and an unnamed spring near Strawberry Creek in Snake Valley, where rainbow or brook trout have been reported (BIO-WEST 2009; Dickinson 2010).

Within the region of study, information on fish occurrence in spring habitats is provided in reports by BIO-WEST (2009, 2007) and occurrence data in the Natural Resources Baseline Summary Report (ENSR/AECOM 2008). Fish communities are known to occur in springs within the following natural resources region of study basins: Fish Springs, Spring (#184), Snake, Steptoe, Muddy River Area, White River, Pahranagat, and Panaca (**Appendix F**, **Table F3.7-4**). White River Valley contains the largest number of springs with fish populations. In general, the number of species ranges from one to four. Native species in these springs are represented by Utah chub, least chub, relict dace, speckled dace and subspecies, mottled sculpin and subspecies, desert sucker subspecies, springfishes, and Pahrump poolfish. Many of the native fish species occurring in these springs are special status species, which are discussed in Special Status Aquatic Species. The occurrence of federally listed species in spring habitats (e.g., White River spinedace within the Flag Spring complex in White River Valley) is discussed in the Federally Listed Species section.

Nonnative fish species, such as western mosquitofish, guppy, shortfin molly, convict cichlid, and common carp, have been introduced into waters within the study area (BIO-WEST 2007). These nonnative species have caused population declines in numerous waterbodies that are inhabited by rare endemic species. Many native species, including northern leopard frog and White River springfish, are threatened by nonnative species (Wildlife Action Plan Team 2006).

Macroinvertebrate and springsnail surveys were conducted in springs within the following natural resources region of study basins by BIO-WEST (2009, 2007): Tule, Fish Springs, Snake, Pleasant, Spring (#184), Lake, White River, Dry Lake, Delamar, Pahranagat, and Panaca. Macroinvertebrate diversity varied in the springs from approximately 4 to 44 taxa. The most abundant taxa typically included amphipods, ostracods (seed shrimp), and chironomid midges. Other taxonomic groups that were present in most springs included damselfly larvae, mayfly, stonefly, caddisfly larvae, oligochaete worms, and beetles. Springsnail occurrence in these springs is discussed in Special Status Aquatic Species, Aquatic Invertebrates.

A variety of nonnative invertebrate species have become established in aquatic habitats within the study area. These include red swamp crayfish and red-rimmed melania snail. Crayfish adversely affect warmwater fauna by feeding on early life stages of fish and amphibians, and also on adult life stages of small-bodied fish (most of the federally listed fish in Nevada) (Wildlife Action Plan Team 2006).

Springs also provide habitat for amphibians. Springs are numerous and widely distributed throughout the study area, although they are more abundant north of Clark County, Nevada. They vary greatly in size and quality of habitat. Many have been damaged by livestock, had their water diverted for human use, or were otherwise altered. Introduced aquatic species are present at many springs and have impacted native amphibian populations. Toads use the moist and vegetated areas for feeding, breeding, and shelter. Frogs, including introduced bullfrogs, may be found in springs year-round and may overwinter under water in colder areas. The following species occur within the natural resources region of study area springs: Arizona toad, bullfrog, Great Basin spadefoot, red-spotted toad, Woodhouse's toad, Pacific chorus frog, northern leopard frog, relict leopard frog, and Columbia spotted frog (SNWA 2008; NatureServe 2007).

At least two nonnative amphibian species have been documented within the region of study: tiger salamanders and bullfrogs. These are considered to be exotic species in Nevada (BIO-WEST 2007; NatureServe 2007). Aside from springs, both species potentially occur in all aquatic habitat types within the study area (NatureServe 2007). As mentioned for crayfish, bullfrogs also prey on other amphibians and small-size fish. Bullfrogs inhabit permanent waterbodies throughout the year.

Shoshone Ponds

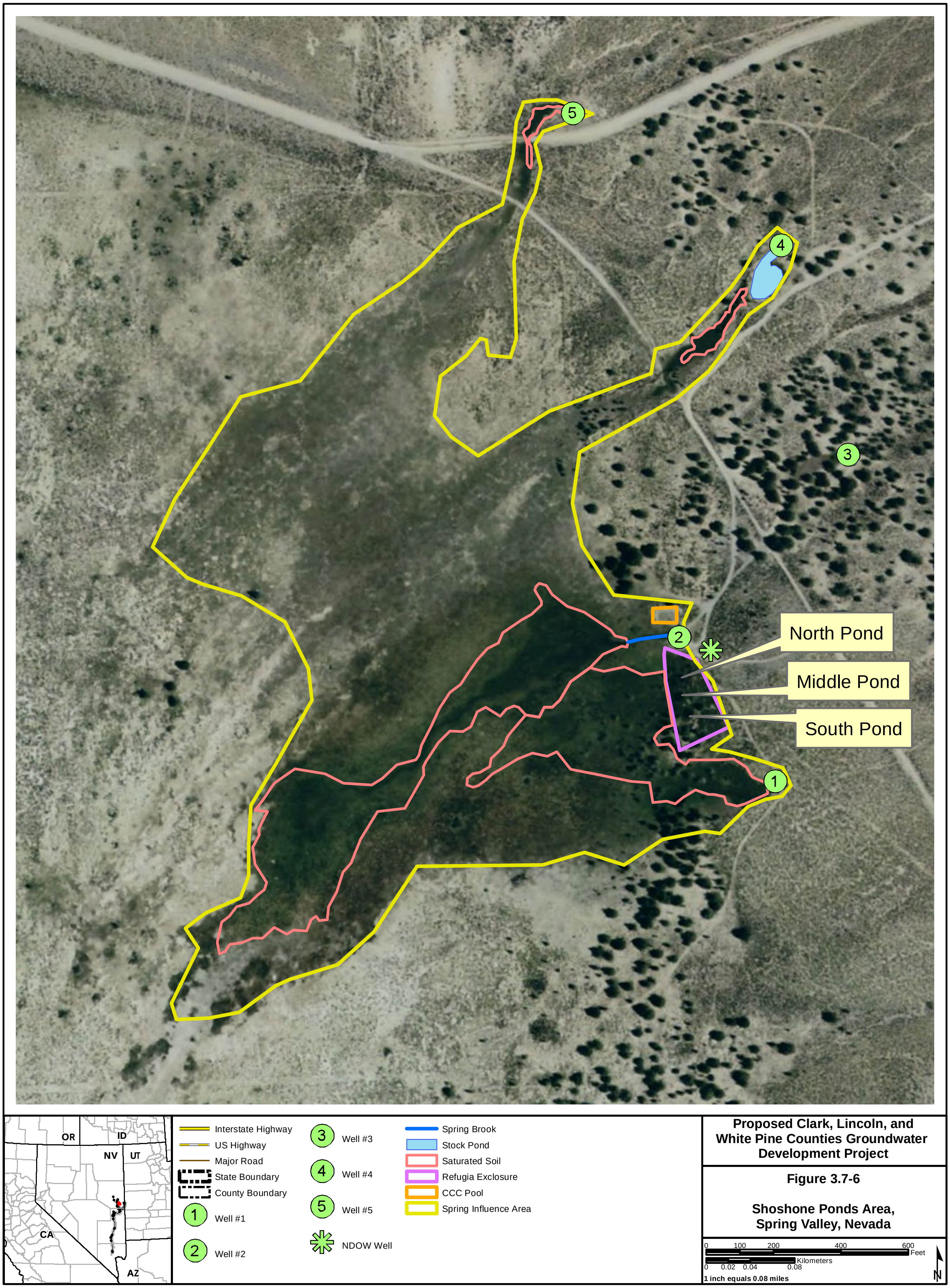
The natural resources region of study also includes a series of man-made ponds located in Spring Valley, White Pine County, Nevada, referred to as the Shoshone Ponds Native Fish Refugium. The refugium was established in the 1970s as a cooperative effort between the NDOW and the BLM Ely Field Office to help conserve and recover native fishes. Aquatic habitat consists of three small ponds that are fed by an artesian well within a fenced enclosure (**Figure 3.7-6**). A larger earthen pond (referred to as Stock Pond) is located outside of the enclosure and is maintained by a separate artesian well. Two refugium ponds (north and middle), the stock pond, and the springbrook created by well #2 outflow are inhabited by the federally listed Pahrump poolfish. Other special status species in the Shoshone Ponds area include relict dace (South Pond) and northern leopard frog.

Lakes/Reservoirs

Aquatic habitat also is provided by numerous lakes, reservoirs, and ponds within the natural resources region of study (**Appendix F**, **Table F3.7-5**). In total, one or more named lakes or reservoirs occur in the following basins: Deep Creek, Wah Wah, Pine, Spring (#201), Snake, Steptoe, Clover, Dry Lake, Patterson, Lake, Lower Moapa, White River, Pahranagat, and Las Vegas. The highest number of named lakes and reservoirs is located in the Snake and Steptoe hydrologic basins. Habitat for game fish occurs in Las Vegas, Pahranagat, White River, Lower Moapa, Spring (#201), Dry, Steptoe, Panaca, Rose, and Snake (**Appendix F**, **Tables F3.7-2** and **F3.7-5**). These waterbodies also provide occupied habitat for native and introduced fish species, invertebrates, and amphibians. The margins and nearshore areas of these waterbodies often provide feeding areas, cover, and breeding areas for fish and amphibians. Occurrence of other sensitive aquatic species in lakes or reservoirs includes Lahontan cutthroat trout in Baker Lake and California floater (freshwater mussel) in Pruess Lake. Further discussion of sensitive aquatic species is provided in the subsequent section.

Special Status Aquatic Species

The occurrence of special status aquatic species within the natural resources region of study is listed by basin in **Appendix F**, **Table F3.7-1**. The list includes over 50 species of fish, amphibian, and invertebrate species with federal, state, or BLM special status. The study area contains habitat for seven federally listed species. The occurrence of the



Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-6

Shoshone Ponds Area, Spring Valley, Nevada

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

federally listed fish species within the natural resources region of study is shown in **Appendix F**, **Figures F3.6-1** and **F3.6-2**. Two of these species (White River springfish and Hiko White River springfish) occur in spring habitats. Pahrump poolfish inhabit the Shoshone Ponds area with habitats consisting of a man-made refugium that is fed by artesian wells, the stock pond, and a springbrook created by well #2 outflow. The other four species (Pahranagat roundtail chub, Big Springs spinedace, White River spinedace, and Moapa dace) use springs or stream habitats. Critical habitat has been designated for four of the fish species (White River springfish, Hiko White River springfish, White River spinedace, and Big Springs spinedace). A summary of the occurrence information for the federally listed species is provided below. Additional habitat and life-history information is provided in **Appendix F**, **Table F3.7-6**. Management guidance for special status fish and amphibian species is described in recovery plans, habitat-management plans, and conservation agreements (**Table 3.7-3**). This section is followed by a summary of the BLM Sensitive Species or groups, with more detailed discussions for those species with conservation agreements or public scoping interest.

Table 3.7-3 Management Guidance for Special Status Fish and Amphibian Species

Species	Status	Plan/Citation
Pahrump poolfish	FE, NVP	Recovery Plan Pahrump Killifish (USFWS 1980)
Big Springs spinedace	FT, NVP	Big Springs Spinedace Recovery Plan (USFWS 1993a); Big Springs Spinedace Monitoring and Nonnative Species Control Plan (NDOW 1999a); Big Springs Spinedace Recovery Implementation Plan (Draft) (NDOW 1999b); Condor Canyon Habitat Management Plan (Guerrero et al. 1989); Determination of Threatened Status and Critical Habitat for Big Springs Spinedace (USFWS 1985a)
Hiko White River springfish White River springfish Pahranagat roundtail chub White River speckled dace White River desert sucker	FE, NVP FE, NVP FE, NVP BLM, NVP BLM, NVP	Recovery Plan for the Aquatic and Riparian Species of Pahranagat Valley (USFWS 1998); White River Valley Native Fishes Management Plan (NDOW 2000), Pahranagat Valley Native Fishes Management Plan (NDOW 1999c); Final Rule to Determine Endangered Status and Critical Habitat for White River Springfish and Hiko White River Springfish (USFWS 1985b)
Moapa dace	FE, NVP	Recovery Plan for Rare Aquatic Species of the Muddy River Ecosystem (USFWS 1996)
White River spinedace Virgin River chub Moapa White River springfish Moapa Speckled dace	FE, NVP NVP NVP NVP	White River Spinedace Recovery Plan (USFWS 1994a); Determination of Endangered Status and Determination of Critical Habitat for White River Spinedace (USFWS 1985c); White River Valley Native Fishes Management Plan (NDOW 2000)
Bonneville cutthroat trout	BLM, USFS, NVP, UTSC, CA, GF	Conservation Agreement and Conservation Strategy for Bonneville Cutthroat Trout in the State of Nevada (NDOW 2006); Range-Wide Conservation Agreement for Bonneville Cutthroat (Utah) (Lentsch et al. 2000)
Least chub	C, BLM, UTSC, CA, UT Tier I Species	Conservation Agreement and Strategy for the Least Chub in the State of Utah (Bailey et al. 2007); Utah Comprehensive Wildlife Conservation Strategy (Sutter et al. 2005)
Northern leopard frog	P, BLM, NVP, UT Tier III Species	Northern Leopard Frog: A Technical Conservation Assessment (Smith and Keinath 2007); Utah Comprehensive Wildlife Conservation Strategy (Sutter et al. 2005)
Relict leopard frog	C, NVP, CA	Conservation Agreement and Rangewide Conservation Assessment and Strategy for the Relict Leopard Frog (Relict Leopard Frog Conservation Team 2005)
Columbia spotted frog	BLM, NVP, UTSC, CA; UT Tier III Species	Conservation Agreement and Strategy for the Columbia Spotted Frog (*Rana lutreventris*) in the State of Utah (Bailey et al. 2005); Utah Comprehensive Wildlife Conservation Strategy (Sutter et al. 2005)

Status: FE = Federally endangered; FT = Federally threatened; C = candidate; P = petitioned for federal listing; BLM = BLM sensitive species; NVP = Nevada Protected; NLD = No special status but species has limited distribution in Nevada; UTSC = Utah Special Concern; CA = Conservation agreement species; USFS = Forest Service sensitive species; Utah Tier I = federally designated species, including endangered, threatened, candidate, and proposed species, as well as "conservation species" covered through a multiparty conservation agreement; Utah Tier III = Utah species of conservation need; and GF = game fish species.

Federally Listed Species

Pahrump Poolfish (Federally Endangered) (Spring Valley). This species was originally called the Pahrump killifish, but it was assigned the common name *poolfish* in 1991. Historically, separate populations occurred in three springs in Pahrump Valley in Nye County. Two of these populations are extinct (Pahrump Ranch and Raycraft Ranch). The Manse Ranch Spring population was extirpated in 1975, but it was transplanted to other sites to provide refugia populations. Presently, introduced populations exist in an irrigation reservoir fed by Sandstone Spring (Spring Mountain Ranch State Park, Clark County), a refuge tank facility at Corn Creek (Clark County), and man-made ponds maintained by artesian wells in Shoshone Ponds ACEC (White Pine County). Pahrump poolfish are present in three of the four ponds (North Shoshone, Middle Shoshone, and Stock Pond) within the Shoshone Ponds Native Fish Refugium (**Figure 3.7-6**). No critical habitat has been designated for Pahrump poolfish, but a recovery plan was prepared in 1980 (USFWS 1980). Population numbers in North and Middle Shoshone Ponds during 2008 and 2009 ranged from approximately 200 to 250 fish. Numbers were higher in the Stock Pond (approximately 2,200 in 2008 and 3,800 fish in 2009 (Hobbs 2009). Recent surveys in August 2011 reported no poolfish in the North Pond; 826 poolfish in the Middle Pond; and 5,762 poolfish in the Stock Pond (NDOW 2011b).

Hiko White River Springfish (Federally Endangered) (Pahranagat Valley). This species occupies pools in Hiko and Crystal springs in the Pahranagat Valley, Lincoln County (USFWS 1998). This species was extirpated from Hiko Spring in 1967 but reintroduced in 1984. These springs and their associated open outflows were designated as critical habitat for this species in 1985.

Pahranagat Roundtail Chub (Federally Endangered) (Pahranagat Valley). Historically, Pahranagat roundtail chub occurred in Crystal Spring, Hiko Spring, Ash Spring, and the Pahranagat River in Lincoln County, Nevada (Stein et al. 2001). The present distribution of this species is limited to a small section of Pahranagat Creek on private land. A recent survey conducted in the fall of 2011 detected eight chubs in this section of the creek (Freeman 2012). A population also is maintained at the Dexter National Fish Hatchery and Technology Center in Dexter, New Mexico. A new refugium was established for this species in 2004 at the Key Pittman WMA near Hiko, Nevada. A total of 2,400 individuals were stocked in the former irrigation reservoir, which was lined and filled with well water. In 2011, Pahranagat chubs also were stocked in Cottonwood Springs, which is located within the Pahranagat National Wildlife Refuge (Freeman 2011). No critical habitat has been designated for this species, although the species was included in a recovery plan for aquatic and riparian species in the Pahranagat Valley (USFWS 1998).

White River Springfish (Federally Endangered) (Pahranagat Valley). Historic and present distributions of White River springfish are restricted to Ash Spring and its outflow in Pahranagat Valley, Lincoln County, Nevada. The majority of the population is found in the pool; however, fish occasionally occur in the outflow stream (Tuttle et al. 1990). Designated critical habitat includes Ash Spring (Lincoln County, Nevada), its outflow, and the surrounding land for a distance of 50 feet (USFWS 1998).

White River Spinedace (Federally Endangered) (White River Valley). Historically, the White River spinedace occurred in the White River, near the confluence with Ellison Creek in White Pine County and below Adams-McGill Reservoir in Nye County (USFWS 1994a). Historic distribution also included springs in White Pine County (Preston Big, Cold, Nicholas, and Arnoldson) and Nye County (Flag). The present distribution for this species is limited to Flag Springs and the upper portion of Sunnyside Creek, which includes a series of three springs and a stream segment in the Kirch WMA (USFWS 1994a). White River spinedace was introduced into Indian Ranch Spring, but the species no longer is present. Critical habitat was designated for three springs and their outflows, plus the surrounding land areas at a distance of 48 feet (Preston Big Springs and Lund Spring in White Pine County and Flag Springs in Nye County). Recent snorkel surveys in Sunnyside Creek and Flag Springs reported total spinedace counts of 748 in March and 671 in September of 2011 (NDOW 2011c). These numbers are lower than the maximum counts of approximately 2,800 spinedace in 2004. Surveys have been conducted during most years since 1991.

Moapa Dace (Federally Endangered) (Muddy River Springs Area). The Moapa dace is endemic to the upper Muddy River and tributary thermal spring systems within the Warm Springs area (USFWS 1996). The Moapa Valley Refuge was established in 1979 to secure habitat for Moapa dace. Historically, this species inhabited approximately 25 individual springs and 10 miles of stream habitat. The present population consists of approximately 6 miles of stream channel, supported by flow from 6 thermal springs (Nevada State Parks 2007; USFWS 1996). The types of habitat used by this species in the Warm Springs area include spring pools, spring outflows, and the mainstem portion of the Muddy River (USFWS 1996). Habitat restoration has been implemented to improve the cover and the configuration of pools, riffles, and runs (Nevada State Parks 2007). A recent Memorandum of Understanding (MOA) regarding the groundwater withdrawal of 16,100 afy from the regional aquifer in Coyote Spring and California Wash basins established minimum instream flow levels that trigger conservation actions for the Moapa dace (USFWS 2006). The flow levels will be measured at the Warm Springs West Flume in the Moapa Valley NWR. Under the MOA, SNWA, the Moapa Valley Water District, and Coyote Springs Investments would restrict groundwater pumping from the Coyote Basin, if flow levels at the Warm Springs West Flume decline below 3 cfs. Details of the conservation measures that the SNWA is to implement as part of the MOA (USFWS 2006) are described in the Coyote Spring Well and Moapa Transmission System Project Final EA (SNWA 2007b).

Virgin River Chub (Nevada Protected) (Muddy River Springs Area, Lower Moapa, and California Wash Valleys). The Virgin River chub occurs within the Muddy River in Nevada and the mainstem portion of the Virgin River from Pah Tempe Hot Springs, Utah, downstream to the confluence with Lake Mead in Nevada (USFWS 1994b). The recovery needs of the Moapa population are covered in a separate plan (USFWS 1996). The Muddy River population is not considered to be part of the federal listing at this time. However, a proposed rule change regarding federal listing is under review by the USFWS. The present distribution of this species in the Muddy River extends from the Warm Springs area downstream to the Wells Siding Diversion (approximately 8 miles below the Meadow Valley Wash confluence). This species is usually associated with deep runs or pool habitats that have slow to moderate velocities and an abundance of cover provided by boulders, undercut banks or woody debris (USFWS 1996; 1994b). Spawning is suspected to occur in April through June (USFWS 1996).

Big Springs Spinedace (Federally Threatened) (Panaca and Dry Valleys). The present distribution of this species is restricted to a 4-mile section of Upper Meadow Valley Wash called the Condor Canyon reach, which is northeast of Panaca, Nevada. The boundaries of the occupied habitat area are defined by perennial flow. A barrier that consists of a falls at the north end of the canyon restricts movement. A second falls exists near private property, which also is a barrier to fish movement. Previous surveys in Upper Meadow Valley Wash showed that the species occurred throughout most of the canyon. Currently, the largest numbers of Big Springs spinedace exist below the upper barrier falls, near the Delmue property. Critical habitat also was designated for the species in a 4-mile section of Meadow Valley Wash (above and within Condor Canyon) in Lincoln County near Panaca, Nevada (USFWS 1985a).

Least Chub. The least chub was petitioned for listing under the ESA in 2007. The USFWS conducted a 12-month status review and released their finding in June 2010 (USFWS 2010). The USFWS determined that the status of the least chub was "warranted but precluded" and it was identified as a candidate species. The finding also concluded that current levels of water pumping represent a significant threat to least chub and contribute to the need to list the species. This species is endemic to the Bonneville Basin of Utah where it was once widely distributed and occupied a variety of habitats including rivers, streams, springs, ponds, marshes, and swamps (Sigler and Sigler 1983). Currently, there are five known wild, extant populations of least chub; three are in Snake Valley in Utah's West Desert (Leland Harris Spring Complex/Miller Spring, Gandy Salt Marsh Complex, and Bishop Springs Complex including Foote Reservoir Springs). Least chub also were transplanted into Walter's and Deadman springs in the Fish Springs NWR in 1995 and 1996 (Bailey et al. 2007) and Ibis and Pintail ponds in 2006 and 2007. Least chub introduced to Walter and Deadman springs (Fish Springs Flat) were replaced by mosquitofish. The USFWS considers these sites to be extirpated and unsuccessful. Since the transplantation and the completion of the initial Least Chub Conservation Agreement Strategy in 1998, the UDWR has had an ongoing monitoring program for least chub populations in Utah. This species has not been found in Deadman Spring since 1999 and the last observation at Walter's Spring occurred in 2001 (BIO-WEST 2007). Ibis and Pintail ponds have been monitored since their introduction. Although least chub has not been collected during monitoring, it could be present due to the large habitat area. The Snake Valley waterbodies also are used by other native fish species such as Utah sucker, Utah chub, speckled dace, redside shiner, and mottled sculpin (BIO-WEST 2007).

Bureau of Land Management Sensitive Fish Species

In total, 14 additional BLM sensitive or state-protected fish species occur within the overall region of study. The state-protected and the BLM sensitive fish species lists are generally the same (**Appendix F**, **Table F3.7-1**). All of these fish species are native to Nevada or Utah. The Bonneville cutthroat trout is associated with stream habitat. The other sensitive fish species are associated with spring environments (springfishes) or use both stream and spring habitats (dace and sucker species). Occurrence and habitat information is summarized below for the Bonneville cutthroat trout, a BLM sensitive species with a conservation agreement. Habitat and life history information for the other special status species is provided in **Appendix F**, **Table F3.7-6**. The occurrence of special status fish species within the natural resources region of study springs is listed in **Appendix F**, **Table F3.7-7**.

<u>Bonneville Cutthroat Trout</u>. The Bonneville cutthroat trout was petitioned for listing under the ESA, but the 12-month finding determined that the species was not warranted for listing under the ESA. This species was associated with Lake Bonneville, which covered parts of southern Idaho, eastern Nevada, southwestern Wyoming, and western Utah during the late Pleistocene era. Remaining populations became isolated in remaining headwaters and streams within the Bonneville drainage basin; an estimated 90 percent of these rivers and streams in the basin once had populations of Bonneville cutthroat trout. Within the natural resources region of study, Bonneville cutthroat trout occurs in perennial streams within Steptoe, Snake, Spring (#184), and Deep Creek valleys (**Appendix F**, **Table F3.7-1**). This species is only native to drainages in Snake and Deep Creek valleys. Populations in the other two valleys are introduced and outside of their historic range. In Nevada, Snake and Silver creeks and their associated tributaries have been proposed as reintroduction streams.

<u>Amphibians</u>. Five special status amphibian species were evaluated in terms of potential occurrence within or near the natural resources region of study: Columbia spotted frog, northern leopard frog, relict leopard frog, Arizona toad, and western toad. Western toad was eliminated from further consideration, since it does not occur in the natural resources region of study. A summary of their occurrence within the overall region of study is described below with spring locations shown in **Figures 3.7-4** and **3.7-5** and listed in **Appendix F**, **Table F3.7-1**.

- Columbia Spotted Frog – This species was placed on a candidate list in 1993 (USFWS 1993b). After the Candidate Notice of Review was completed in 1999, the West Desert population was taken off the candidate list (USFWS 1999). Based on surveys or distribution accounts by BIO-WEST (2007) and Bailey et al. (2005), the Columbia spotted frog occurs in springs or wetlands within Tule Valley (Coyote, South Tule, Tule, and Willow), Snake Valley (Leland Harris, Twin, Beck Springs North, Gandy Salt Marsh, and Miller), and Deep Creek Valley (unnamed wetlands in the valley floor). The population in this geographical area is considered part of the West Desert population, which is not a federal candidate.
- Northern Leopard Frog – This species has been petitioned for listing under the ESA. A 90-day finding was issued and a 12-month status review was conducted to determine if listing the species in the western part of its range is warranted (USFWS 2009). The status review and 12-month finding concluded that listing the western population or the entire species is not warranted at this time (USFWS 2011). Records for the northern leopard frog include springs in Fish Springs Flat Valley (Crater, House, Lost, and South), Snake Valley (Leland Harris, Twin Springs, Gandy Marsh and Bishop Springs Complex including Foote Reservoir Springs and private land in the community of Gandy), Spring Valley (Blind, Cleveland Ranch, Keegan Ranch Complex, Shoshone Ponds area, McCoy Creek Ranch, North Millick, South Millick, Minerva Complex, West Spring Complex, and unnamed #5), Lake Valley (Wambolt Complex and Geyser Spring), Steptoe Valley (Grass Springs/Lusetti Ranch and an unnamed spring near Borchert Spring), and Pahranagat Valley (Big, Hoyt, L, and Maynard springs) (Freeman 2011; BIO-WEST 2009, 2007; SNWA 2009a). This species also occurs in wet meadows within the Shoshone Ponds area. In White River Valley, historical records for northern leopard frog were documented in Kirch Wildlife Management Area (Hot Creek) and Ruppos Bog Hole by Hitchcock (2001). Water in the wet meadows is maintained by free-flowing artesian wells. Several springs such as L, Cottonwood, and Maynard in Pahranagat Valley currently are being evaluated as translocation sites for this species.
- Relict Leopard Frog – This amphibian is a federal candidate species. Records for relict leopard frog include springs and wetlands in the Black Mountains Area (Blue Point, Gnatcatcher, and Rogers).
- Arizona Toad – This species, also commonly referred to as the southwestern toad, is found in scattered localities throughout southeastern Utah and southern Nevada. Within the natural resources region of study, it is primarily limited to Clark and Lincoln counties (NatureServe 2007). It has been collected in standing water with marsh or riparian vegetation within Meadow Valley Wash (BIO-WEST 2005).

Habitat for special status amphibians includes rivers, streams, lakes, reservoirs, springs, and wetlands during at least a portion of their development. Most amphibian species found within the study area use springs, and all special status amphibians may use springs in some capacity. All special status amphibian species found within the study area use riverine or stream environments to varying extents. Riverine habitats are used for feeding and cover. Undercut stream banks are used by Columbia spotted frogs as overwintering sites (Wildlife Action Plan Team 2006). The northern leopard frog uses underwater areas as overwinter habitat. Arizona toads prefer streams for breeding.

Aquatic Invertebrates

Fifteen BLM sensitive aquatic invertebrates are present within the natural resources region of study (**Appendix F**, **Table F3.7-1**). The BLM sensitive species include California floater, the Pahranagat naucorid bug, the Moapa Warm Springs riffle beetle, and 12 snails or springsnails (**Appendix F**, **Table F3.7-1**). The California floater (Utah portion of Snake Valley) is the only invertebrate that occurs in larger rivers, streams, or lakes such as Pruess Lake in Snake Valley. This mollusk also has been reported from Redden Spring (north of Callao) in the Utah portion of Snake Valley. The Pahranagat naucorid bug lives among aquatic vegetation in spring and stream reaches in the White River drainage (USFWS 1998). The Moapa Warm Springs riffle beetle is restricted to the Warm Springs area within the Muddy River Valley (USFWS 1996).

Springsnails (or pyrgs), including the genera *Pyrgulopsis*, *Stenelmis*, and *Tryonia*, occur within the natural resources region of study and constitute the rarest and most unique macroinvertebrate fauna in the area. Springsnails are a group of mollusks found in perennial springs and seeps and usually are confined to the spring source and immediately downstream in the spring brook. Presence of species in this group is considered an important indicator of spring health. While springsnails as a whole can exist in a range of habitats, individual populations have been isolated by the distances between springs and seeps, and have become highly specialized to their habitats. Snails and springsnails have been reported from 17 of the basins within the overall region of study (**Appendix F**, **Table F3.7-1**). Springsnail occurrence within the region of study is listed in **Appendix F**, **Table F3.7-7**. The list of springsnail species includes those considered to be BLM sensitive or special status in Nevada or Utah. Other springsnail species are included in the list because they have limited distribution in Nevada or Utah.

Twenty-five BLM sensitive springsnails also have been petitioned for federal listing (**Appendix F**, **Table F3.7-1**). The current status of the petitioned species is that the USFWS negotiated a stipulated agreement with WildEarth Guardians that postpones a 12-month decision until the end of FY 2012 or early FY 2013 for four of the petitioned species that occur in the natural resources region of study (bifid duct pyrg, longitudinal gland pyrg, Hamlin Valley pyrg, and sub-globose Snake pyrg). The other petitioned species were included in a separate petition from the Center for Biological Diversity (2009). A 90-day finding on these species has not yet been published in the Federal Register.

The distribution of the petitioned springsnail (pyrg) species within the natural resources region of study is summarized by three categories, as listed below. Specific occurrence by springs is included in the impact analysis in Section 3.7.2, Environmental Consequences.

- Occurrence limited to one spring in one basin – Butterfield pyrg, Camp Valley pyrg, Emigrant pyrg, flat-topped Steptoe pyrg, Hamlin Valley pyrg, Lake Valley pyrg, Landyes pyrg, neretiform Steptoe pyrg, and sub-globose Snake pyrg.
- Occurrence in multiple springs in one basin – Corn Creek pyrg, Hubbs pyrg, longitudinal gland pyrg, Moapa pebblesnail, Moapa Valley pyrg, northern Steptoe pyrg, southeast Nevada pyrg, Spring Mountains pyrg, and White River Valley pyrg.
- Occurrence in multiple springs in multiple basins – Bifid duct pyrg, Flag pyrg, grated tyronia, Hardy pyrg, and Pahranagat pebblesnail.

Culturally Significant Fish

As indicated by the Confederate Tribes of the Goshute Reservation (Steele 2010), the region of study contains streams with various species of fish that are considered culturally significant in terms of food resources, spiritual resources, and traditional values. The occurrence of culturally significant fish species also would apply to other aboriginal territories used by the Western Shoshone, Chemehuevi, Southern Paiute, Hualapai, and Mojave Tribes. It is assumed that the fish would include native and non-native species. Based on aquatic species recovered from excavated sites in the Eastern Great Basin, freshwater mussels and fish (suckers, Utah chub, and salmon) were food sources (James 1981).

3.7.2 Environmental Consequences

3.7.2.1 Rights-of-way

Issues

The following issues for aquatic biological resources are discussed as part of the impact analysis for ROW construction and facility maintenance.

The number and type of waterbodies that are crossed or are located within project ROWs are an important impact parameter.

- Potential loss of individuals or habitat from short-term disturbance of stream channels by construction equipment.
- Potential loss of individuals or habitat from sediment delivery.
- Potential effects on fish spawning from habitat alteration.
- Effects of water use for hydrostatic testing and dust control on aquatic biota and their habitat.
- Potential damage to aquatic habitat and biota from fuel spills reaching a waterbody directly or leaching through soils.
- Potential direct mortalities to amphibians from vehicle traffic.
- Compliance with management objectives defined in recovery plans, conservation agreements, and state wildlife action plans for special status aquatic species.
- Potential effects on fish species traditionally used as food by regional Tribes.
- Short-term disturbance to aquatic habitat and species during pipeline and transmission line facility maintenance activities.

Assumptions

The following assumptions were used in the impact analysis for aquatic biological resources:

- Identification of aquatic habitat potentially affected by project actions focused on waterbodies that support aquatic species on a persistent basis throughout the year (perennial streams, springs, lakes, and reservoirs).
- Temporary (seasonal) waterbodies were considered as a general type of habitat in the ROW construction analysis, since they are used for amphibian breeding and early life stage development. However, seasonal waterbodies were not mapped.
- Temporary access roads and permanent roads would be located within the ROWs except for two 14-mile segments. No new road disturbance outside the ROWs would occur as a result of roads. The two 14-mile road segments do not cross perennial streams, springs, or wetlands.

Methodology for Analysis

Construction surface disturbance impacts were evaluated for each alternative using the following methods:

- The pipeline and transmission line ROWs were mapped along with access roads and other surface facilities. The location of these project facilities were related to perennial streams, ponds, lakes, and springs that are located within the corridors and footprint of the project facilities.
- For those waterbodies located within the ROWs, the affected environment section was used to identify the presence of game fish, native fish, and special status aquatic species.
- Literature information and the applicant's POD were used to describe the types of impacts that would result from pipeline and transmission line construction activities.
- As part of the impact analysis, impact parameters were used in combination with effects information for the purpose of quantifying impacts and as impact indicators. The impact parameters also allow comparison among alternatives or groups of alternatives. Examples of impact parameters for aquatic resources included the number of

waterbodies with game fisheries or special status aquatic species that are located within the pipeline and power line ROWs.

- The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect aquatic resources from ROW construction and operation activities.

3.7.2.2 Proposed Action, Alternatives A through C

Construction and Facility Maintenance

Pipeline construction would cross one perennial stream (Snake Creek in Snake Valley) that contains game fisheries and special status aquatic species (**Figure 3.7-2**). One other waterbody, Big Wash, would be crossed by the pipeline ROW in a section that is classified as an ephemeral stream. Water would be present in Big Wash during high flow such as the springtime runoff period. Open-cut trenching or jack and bore techniques would be used at the Snake Creek and Big Wash crossings in the Nevada portion of Snake Valley. Details on the construction procedures for stream crossings are provided in the POD. Open-cut trenching could result in impacts to aquatic biota, as discussed below for the habitat alteration, fish spawning, and water quality impact issues.

No springs would be crossed by the pipeline ROW. However, four springs are located within 500 feet and downgradient of the pipeline corridor. Three of these springs are unnamed and have not been inventoried for aquatic biological resources. The other spring (Big Springs in Snake Valley) is located 320 feet downgradient of the corridor. This spring contains fish (mottled sculpin, redside shiner, Utah sucker, Utah chub, and speckled dace) and springsnails (bifid duct pyrg and longitudinal gland pyrg) petitioned for federal listing.

Two perennial streams with game fisheries, Steptoe Creek in Steptoe Valley and Snake Creek in Snake Valley, would be crossed by a power line ROW. The Snake Creek crossing is the same corridor for the power line and pipeline ROW. Impact issues would include potential sedimentation and fuel spills and possible removal of riparian vegetation, as discussed below. Instream disturbance could occur if vehicles cross these streams during power line construction.

A construction support area is proposed for a location adjacent to the upper portion of Lower Meadow Wash near Caliente. However, the boundary for this area is located outside of the Meadow Valley Wash floodplain. This portion of Meadow Valley Wash contains potential habitat for rainbow trout and special status fish species (Meadow Valley Wash desert sucker and speckled dace). Since facilities for this construction support area would be located outside of the Meadow Valley Wash floodplain, impacts to aquatic species and their habitat are not expected.

In general, access roads would be located within the proposed pipeline and power line ROWs. There would be no additional surface disturbance outside the ROWs for access roads with two exceptions. These include a 14-mile road (south pipeline road) in northern Delamar Valley and southern Dry Lake Valley and a 14-mile road from the Gonder Substation. Improvements involving leveling along a 20-foot wide ROW would be required. Both of these road segments do not cross perennial streams or springs. Therefore, no surface disturbance or water quality changes involving sedimentation would affect perennial aquatic habitat or species.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on aquatic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Habitat Alteration and Loss of Individuals

Two construction techniques have been proposed for stream crossings: 1) jack-and-bore beneath the water, or 2) open-cut trenching with temporary water diversion. If the jack-and-bore technique is used, instream disturbance would not occur within the channel. A work area would be required on both sides of the stream located outside of the channel. Open-cut trenching and backfilling within the trenchline at the Snake Creek crossing would result in the physical alteration of channel morphology including streambanks and bottom substrates. Assuming a ROW width of 200 feet and a stream width of 16 feet, the estimated instream disturbance would be approximately 3,200 square feet. Disturbance to the stream bottom could alter substrates or other types of structure that are used by fish as cover, feeding areas, or spawning. Trenching also could result in possible mortalities to macroinvertebrates and small-size fish. Large-size fish are expected to move away from the construction area to avoid instream activities and noise. Based on previous studies, macroinvertebrate communities typically recolonize disturbed areas from pipeline construction within several months (Waters 1995). The BLM RMP Management Actions and BMPs would be followed regarding erosion control, limiting access roads across streams, and restoration of riparian vegetation (see management direction for Vegetation [VEG-23] and Appendix A of the FEIS for the Ely District [BLM 2008]).

The open-cut trenching with temporary water diversion method would maintain flow and associated aquatic habitat in a portion of the construction area and the entire stream wetted area downstream of the Snake Creek crossing, as defined in ACM A.5.77 (**Appendix E**). There would be a temporary reduction in wetted area or aquatic habitat in the trenched area of Snake Creek. This measure also would be used at the Big Wash crossing, if water was present during construction. The presence of water at the Big Wash crossing also would result in the addition of aquatic habitat at a 2 to 1 ratio (i.e., 2 acres of comparable aquatic habitat to every 1 acre affected by construction) (ACM A.5.78). The following information describes these measures:

- During pipeline construction, BMPs will be implemented to minimize effects to fish from the temporary rerouting of perennial flow in Snake Creek, and in Big Wash if water is present. Practices will comply with NDOW and the CWA permitting requirements (ACM A.5.77).
- Two acres of comparable habitat for every acre of lost habitat will be improved if construction across Big Wash occurs in a high water year and water is present (ACM A.5.78).

Power line construction could result in soil disturbance near Steptoe and Snake creeks, as well as possible instream habitat alteration because of any equipment crossing the stream. Impacts would be temporary and limited to the proximity of construction areas adjacent to or within the stream. The extent of bottom disturbance would be considerably less than described for pipeline trenching.

Vegetative cover along streambanks of a waterbody provides cover for fish, shading, bank stability, and increased food and nutrient supply because of the deposition of insects and vegetative matter into the watercourse. Disturbance to the streambank areas at the Snake Creek crossing may reduce cover and shading in a relatively small area (up to 100-foot wide) on each bank. Given the relatively small width of the disturbance area associated with the pipeline crossing, impacts would be considered minor relative to the entire stream system. These stream bank areas would be restored to preconstruction contours and stabilized slopes. Impacts to riparian vegetation would be reduced by implementing a 10-foot buffer strip adjacent to the pipeline ROW at the perennial stream crossing (ACM A.1.61). The details of this measure include:

The perennial stream bank disturbance area is relatively small (up to 100-feet wide on each bank), minimizing the impacts from reduced cover and shading.

- At a minimum, a 10-foot-long vegetation buffer strip or other erosion control measure such as straw bales will be maintained between the cleared ROW and the high-water mark of adjacent jurisdictional drainages if the time between clearing/grading is expected to exceed 10 days or a precipitation event is forecast.

Snake Creek supports one special status species, Bonneville cutthroat trout. Perennial sections of Big Wash also contain Bonneville cutthroat trout. Construction would not affect Bonneville cutthroat trout in these streams because occupied habitat is located upstream of the proposed pipeline crossings.

The power line ROW also would cross one perennial stream, Steptoe Creek, in Steptoe Valley. However, construction near this stream would not affect special status aquatic species, since none are present in this stream.

A construction support area is proposed for an area located adjacent to the upper portion of Lower Meadow Wash near Caliente. Although this section of Lower Valley Meadow Wash contains special status aquatic species (Meadow Valley Wash desert sucker, Meadow Valley Wash speckled dace, and southwestern Arizona toad [BIO-WEST 2005]), they would not be affected because surface disturbance would occur outside of the floodplain.

Conclusion. Aquatic habitat would be altered on a short-term duration by the pipeline construction in one perennial stream (Snake Creek) in Snake Valley. Ephemeral and intermittent streams such as Big Wash, Lexington Creek, and Chokecherry Creek in Snake Valley also would be crossed by the pipeline ROW. No springs would be crossed by the pipeline ROW. The BLM BMPs would reduce impacts by limiting the number of road crossings across streams and restoration of riparian vegetation associated with construction and maintenance activities for this project. Loss of riparian vegetation from construction at the Snake Creek and other intermittent stream crossings would be a long-term impact. ACMs would be used to minimize habitat alteration by maintaining flow at the Snake Creek and Big Wash crossings (if water is present), replacing affected habitat in Big Wash at a 2 to 1 ratio, and establishing a 10-foot buffer at the Snake Creek crossing. Power line construction could result in short-term disturbance (soil and instream alteration) to two perennial streams (Steptoe and Snake creeks).

Proposed mitigation measures:

ROW-AB-1: Habitat Restoration. If the open-cut trenching method is used, SNWA would restore substrate composition to preconstruction conditions at the Snake Creek pipeline crossing using procedures approved by the BLM and the NDOW. The results would be included in the detailed Restoration Plan to be prepared for the project. Effectiveness: This measure would be effective because it would restore substrate composition to preconstruction conditions. Effects on other resources: Implementation of this measure would extend the construction disturbance for a short-term period and result in temporary sedimentation.

ROW-AB-2: Avoidance of Instream Disturbance. Construction of the power line at the Steptoe Creek crossing would avoid instream disturbance from equipment and vehicles. Effectiveness: This measure would be effective, since it would avoid disturbance to Steptoe Creek. Effects on other resources: There would be no effects of implementing this measure on environmental resources.

Residual impacts include:

- Short-term temporary disturbance to aquatic habitat and associated species representing fish, macroinvertebrates, periphyton, and macrophyte communities in perennial (Snake Creek) and intermittent streams (including Big Wash).
- Long-term loss of riparian vegetation in a 100-foot section on either side of Snake Creek and intermittent stream crossings.

Fish Spawning

The construction schedule has not yet been determined at this time. If construction occurred during the fall months, direct impacts could affect brown trout spawning activity, cause mortalities to eggs or young fish, or alter spawning habitat. The other trout species in Snake Creek (brook trout) would not be affected by construction because it occupies headwater areas located upstream of the proposed crossing. The spawning periods generally range from October 1 through December 1 for brown trout. The effects of construction-related sediment on fish spawning are discussed in the water quality effects section. Mitigation measure ROW-AB-3 would be implemented to restrict construction during the brown trout spawning period. Measure ROW-AB-1 would restore channel substrate to preconstruction conditions.

Conclusion. If construction occurs in the fall months, instream disturbance at the Snake Creek crossing in Snake Valley could disturb spawning activity and alter spawning habitat for brown trout. No RMP-management direction, BMPs or ACMs are available to reduce impacts on trout spawning in Snake Creek.

Proposed mitigation measures:

ROW-AB-3: Spawning Restrictions. If the open-cut trenching method is used, timing restrictions between October 1 and December 1 would be required during pipeline construction at the Snake Creek crossing. If construction during this period is necessary, SNWA would prepare a site-specific plan that adopts mitigation measures recommended by the NDOW to minimize impacts to brown trout. Effectiveness: This measure would be effective because it would eliminate effects on brown trout spawning. Effects on other resources: There would be no effects of implementing this measure on environmental resources.

ROW-AB-1 (Habitat Restoration discussed above as mitigation for *Habitat Alteration*) also would result in reducing impacts to trout spawning habitat.

Residual impacts include:

- Potential short-term temporary disturbance to trout spawning habitat in Snake Creek.

Water Quality Effects

Instream construction activities would result in short-term increases in total suspended solids levels or turbidity in a section of the stream within or immediately downstream of the crossing. Other surface disturbance activities associated with work areas or access roads near streams also could contribute to short-term sedimentation. The extent of the area affected would depend on the type of soil composition and flow conditions. Streams with firm substrates such as sand, gravel, or cobble would exhibit lower levels of sedimentation compared to soft substrates such as silt. The extent of downstream movement of suspended sediment also would depend on flow and channel configuration. By constructing during a low flow period, movement of suspended sediment would be limited in downstream extent. The generation of a downstream turbidity plume is usually limited to the duration of instream construction (Reid and Anderson 1999). Typically, the peak in total suspended solids is associated with trench excavation.

Surface disturbance activities within the pipeline ROW also could contribute sediment to downgradient areas immediately outside of the corridor, if a precipitation event occurred after construction. As previously mentioned, Big Springs in Snake Valley is located downgradient and just outside of the pipeline ROW.

Increases in sediments entering the stream can adversely affect resident trout and other fish species by covering spawning and rearing areas, thereby reducing the survival of fish embryos and juvenile fish (Waters 1995). Excessive sedimentation also can fill in pool habitats and blanket structural cover for fish. Pool habitats provide important depth cover and overwintering habitat. The BLM BMPs would be followed regarding erosion control.

Vehicle and equipment use within and adjacent to waterbodies also could pose a risk to aquatic biota from fuel or lubricant spills. If fuel reached a waterbody, aquatic species could be exposed to toxic conditions. Impacts could include direct mortalities or reduced health of aquatic organisms. Impacts from fuel spills would be avoided by not allowing refueling to occur within 100 feet of streams (ACM A.1.43). Other ACMs would be implemented to reduce sediment and spill-related effects on water quality and aquatic biota. These measures are described in **Appendix E** as part of construction and storm water and erosion control activities. Reference numbers for these ACMs include A.1.40 and A.1.41 and A.1.43 through A.1.46, A.1.51, A.1.52, A.1.54 through A.1.59, and A.1.61 through A.1.68. Additional detail on sediment control is provided in Section 3.3, Water Resources. By implementing erosion control techniques as part of the Reclamation Plan, suspended sediment would be localized and expected to return to preconstruction levels within several days.

<u>Conclusion</u>. Construction activities at streams with standing or flowing water would result in short-term erosion and sedimentation. One perennial stream (Snake Creek in Snake Valley) would be crossed by the pipeline ROW. Soil disturbance within the ROW also could affect three unnamed springs and one named spring (Big Springs) in Snake Valley due to their location within 500 feet of the ROW boundary. Vehicle and equipment use within the ROWs also pose a short-term risk of fuel spills to aquatic habitat and species. These activities could alter water quality and cause physiological stress or mortalities. An ACM would restrict vehicle fueling within 100 feet of perennial streams. BMPs and numerous ACMs would be implemented to reduce erosion effects on waterbodies. These measures would result in low level impacts to aquatic habitat and species.

Proposed mitigation measures:

None.

Residual impacts include:

- Short-term sedimentation effects on one perennial stream (Snake Creek in Snake Valley) and intermittent streams (if water is present at the time of construction).

Construction Water Use

The SNWA is proposing to use groundwater or temporary construction wells for hydrostatic testing, dust control, trench backfill compaction, and fire suppression (if needed). It is estimated that between 5.5 and 8.7 million gallons of construction water would be needed for every pipeline mile (or one water supply well for each 10 miles of pipeline). Groundwater withdrawal for construction water use could result in localized drawdown effects. There could be potential short-term effects on surface water quantity and aquatic habitat depending on the hydraulic connection to groundwater and the surface water location. No diversion or modification of surface water flows is anticipated for temporary construction water use. However, any change in water use involving surface water sources would need to meet Nevada permit requirements, as well as a review by the BLM. If surface water use was approved, the BLM Ely BMP requirements involving the use of screening with a mesh size of 3/16 inch on intake hoses would be used to prevent fish from being entrained.

The discharge of hydrostatic test water would follow NPDES requirements, which would eliminate potential effects on water quality. Erosion effects would be minimized by implementing ACMs to reduce discharge velocities (ACM A.1.64 and A.1.65, as described in **Appendix E**). Additional details on hydrostatic test water discharge are provided in Section 3.4, Soil Resources.

Conclusion. Construction water use could adversely affect aquatic habitat and species, if surface water is located within the drawdown area and connected to groundwater sources.

Proposed mitigation measures:

As discussed in Section 3.3, Water Resources, mitigation measure ROW-WR-3 (Construction Water Supply Plan) would be required to determine the effects of construction water use on surface water and groundwater. Additional mitigation may be required, if surface water and aquatic habitats are adversely affected.

Residual impacts include:

- Residual effects from construction water use could occur if groundwater withdrawal reduces surface water quantity and aquatic habitat. Residual impacts will be quantified during subsequent BLM review of the Construction Water Supply Plan.

Vehicle Traffic/Equipment and Indirect Effects on Amphibians

Vehicle traffic could cause toad and frog mortalities during movement periods.

Construction activity in areas near streams and temporary waterbodies (if present at the time of construction) would cross potential habitat for amphibian species such as Great Basin spadefoot toad. Stream habitat crossed by the pipeline and power line ROWs includes Snake Creek in Snake Valley and Steptoe Creek in Steptoe Valley. No springs or wetlands are located within these ROWs. Vehicle traffic within the ROW could potentially cause mortalities to toads and frogs during breeding movement to waterbodies in the spring or summer and post-breeding movement to upland areas in late summer or fall (Andrews et al. 2008). No direct effects are expected for northern leopard frog, since the closest spring or wetland (Maynard Spring) to the ROW is 0.8 mile, which exceeds the maximum migration distance of 0.25 mile reported by Seburn et al. (1997). There also would be no effects on other special status amphibian species such as Columbia spotted frog, relict leopard frog, or Arizona toad, since the ROWs or access roads would not cross their habitats. Construction activities within waterbodies could alter habitat used for eggs and rearing of young, as well as possibly causing direct mortalities. Vehicle traffic also could cause increased sedimentation in the disturbance area near waterbodies as discussed in Section 3.3, Water Resources. In total, vehicle traffic would occur along approximately 431 miles of access roads. A small portion of this ROW distance could be near temporary waterbodies (i.e., small ponded areas that can develop after substantial rainfall events), which could be used as breeding habitat by amphibians. ACMs to reduce vehicle and traffic issues include A.1.3, A1.11, and A.1.28 through A.1.37. Control measures for fuel and hazardous materials would be provided by ACMs A.1.43 through A.1.46.

Amphibians also could be indirectly affected by construction-generated dust, noise, or accidental wildfire. The following ACMs would be implemented for these impacts: air emissions and dust (A.10.1 through A.10.8), construction noise (A.9.1 through A.9.3), and accidental wildfires (A.1.47).

Conclusion. Vehicle traffic along 431 miles of access roads could result in alteration of Great Basin spadefoot toad habitats (Snake Creek, Steptoe creek, and temporary waterbodies) and potential mortalities during breeding movements to waterbodies in the spring or summer and movement to upland areas in late summer and fall. Risk of mortalities would be highest near waterbodies. Construction traffic would be temporary and short term in duration. ACMs would be implemented to reduce impacts associated with vehicle traffic, construction dust and noise, and accidental wildfires.

Proposed mitigation measures:

None.

Residual impacts include:

- Potential short-term alteration of amphibian habitat if vehicles or equipment cause disturbance to waterbodies used by amphibians for breeding.
- Long-term effects on amphibians could occur if vehicles cause mortalities. The magnitude of potential mortalities would depend on the number affected, as well as population numbers for the species on a basin-wide distribution. Numbers could be reduced at particular waterbodies for one breeding year.

Compliance with Management Objectives

One special status species with a conservation agreement, Bonneville cutthroat trout, occurs near the ROW. Management objectives for the Bonneville cutthroat trout in Nevada are defined in the conservation agreement for this species (NDOW 2006). **Appendix F**, **Table F3.7-8** provides a list of the management objectives. Construction activities would not result in effects on habitat for Bonneville cutthroat trout in Snake Creek or Big Wash, since habitat is located upstream of the proposed pipeline crossings. Therefore, construction activities would not limit the achievement of management objectives for Bonneville cutthroat trout.

An impact issue for project maintenance could involve potential localized sediment and habitat disturbance.

Conclusion. Compliance with conservation agreements were evaluated for one special status species, Bonneville cutthroat trout. Since occupied habitat for the Bonneville cutthroat trout occurs in sections located upstream of proposed pipeline crossings of Snake Creek and Big Wash, construction activities would not conflict with conservation objectives for this species.

Proposed mitigation measures:

None.

Residual impacts include:

No residual effects on management objectives for Bonneville cutthroat trout.

Tribal Species

Snake Creek and Big Wash (pipeline and power line crossings) support one special status species, Bonneville cutthroat trout, and other native and non-native fish. These streams and their associated fish species also are located within the Confederated Tribes of the Goshute Reservation and are considered culturally significant species. Construction would not affect Bonneville cutthroat trout in these streams because occupied habitat is located upstream of the proposed pipeline crossings. Short-term disturbance to other fish species would occur as a result of construction. Implementation of ACMs (previously discussed in the habitat alteration and fish spawning sections) and mitigation measures ROW-AB-1, ROW-AB-3, and ROW-WR-1 would reduce impacts to habitat and fish species.

Steptoe Creek (power line crossing) in Steptoe Valley supports game fish species. Fish in Steptoe Creek are located within the Western Shoshone Tribe's aboriginal territory and may be considered culturally significant species. Implementation of mitigation measure ROW-AB-2 (no instream disturbance from vehicles and equipment) would avoid impacts to fish in Steptoe Creek.

Conclusion. Pipeline ROW construction would result in short-term impacts to Snake Creek and Big Wash, which contain fish traditionally used by the Confederated Tribes of the Goshute Reservation.

Proposed mitigation measures:

None.

Residual impacts include:

- Short-term temporary disturbance to fish habitat and associated species in Snake Creek and possibly Big Wash in Snake Valley.

Facility Maintenance

Routine maintenance of the pipeline and transmission line ROWs could consist of removing vegetation within the ROWs. Removal of riparian vegetation could affect overhanging cover in a small section of a stream. Surface disturbance also could disturb soil and contribute localized sediment to a waterbody if it is located immediately adjacent to the maintenance area. Pipeline repair within the waterbody would directly disturb aquatic habitat. However, the pipeline system is considered to be quite durable and therefore, repair activities are expected to be unlikely. Potential fuel spills from equipment near waterbodies also could be a risk to aquatic biota. However, impacts from fuel spills would be avoided by not allowing refueling to occur within 100 feet of streams (ACM A.1.43). Vehicle traffic near waterbodies could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods.

An impact issue for facility maintenance could involve potential localized sediment and habitat disturbance.

Proposed mitigation measures:

None.

Conclusion**.** Facility maintenance activities within ROWs could result in short-term effects on water quality, if surface disturbance occurred near Snake Creek or intermittent streams when water is present. Other potential effects would be the same as described for construction. The same BMPs and ACMs and mitigation measures would be applied to facility maintenance activities.

Residual impacts include:

- Same as construction, except that the magnitude would be lower due to the smaller amount of vehicle traffic and equipment use.

3.7.2.3 Alternative D

Construction and Facility Maintenance

Since no perennial streams or springs and associated biota are crossed by Alternative D ROWs, several of the impact areas discussed in the previous section are not applicable. The following information discusses the remaining potential impacts. The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on aquatic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Habitat Alteration and Water Quality Effects

Construction and facility maintenance in Snake Valley and White Pine County would be eliminated under Alternative D. As a result, construction of the remaining ROWs and project facilities in Lincoln and Clark counties and the Lincoln County portion of Spring Valley would result in effects on intermittent streams. If water is present at the time of construction, aquatic habitat, and aquatic communities such as macroinvertebrates and attached algae or macrophytes could be affected as a result of habitat alteration and water quality (i.e., sedimentation and potential fuel spills). Fish species are unlikely to be present in the intermittent streams due to a lack of water on a consistent basis throughout the year. No special status aquatic species are known to occur in these intermittent streams. The same BMPs and ACMs would be applied to construction and facility maintenance activities to reduce water quality effects on aquatic habitat and species.

Conclusion. Construction and facility maintenance activities could result in short-term water quality effects, fuel spill risks, and habitat alteration in intermittent streams in Clark and Lincoln counties, if water is present during these activities. These effects would be considered minor due to the lack of water being present throughout the year. No game fish or special status aquatic species are present in these intermittent streams. Riparian vegetation could be removed on a long-term basis as a result of stream crossing construction. BMPs and ACMs would be applied to construction and facility maintenance activities to reduce effects related to these impact topics. No additional mitigation would be required for effects on intermittent stream habitat and their associated species.

Proposed mitigation measures:

None.

Residual impacts include:

- Short-term temporary disturbance to aquatic habitat in intermittent streams and macroinvertebrate, periphyton, and macrophyte communities.
- Streamside vegetation could be affected on a long-term basis at intermittent stream crossings.

Vehicle Traffic/Equipment and Indirect Effects on Amphibians

Vehicle movements within the 315 miles of access roads potentially could cause Great Basin spadefoot toad mortalities as they move to and from temporary waterbodies. Effects could range from habitat alteration to amphibian mortalities. The types of habitat that could be affected are temporary waterbodies, which would depend on whether water is present during construction or facility maintenance activities. Northern leopard frog would not be directly affected by ROW construction, since the closest springs or wetlands exceed the maximum migration distances reported for this species. Amphibians also could be indirectly affected by construction-generated dust, noise, or accidental wildfire. As discussed for the Proposed Action Alternative, the same ACMs would be implemented to reduce potential impacts to amphibians from vehicle traffic, fuel spills, noise, dust, and accidental fires.

Conclusion. Vehicle traffic and movement along the ROWs could result in short-term effects on amphibians, as they move to and from permanent and temporary waterbodies. Vehicles could disturb habitat in short-term alteration of habitat in temporary waterbodies. Effects could range from habitat alteration to amphibian mortalities. Construction would occur along 315 miles of access roads, with the mortality risk being highest near waterbodies.

Proposed mitigation measures:

None.

Residual impacts include:

- Potential alteration of amphibian habitat near permanent and temporary waterbodies and mortalities due to vehicle traffic within 315 miles of access roads.

3.7.2.4 Alternatives E and F

Construction and Facility Maintenance

Since no perennial streams or springs and associated biota are crossed by Alternatives E and F, several of the impact areas discussed for the Proposed Action are not applicable. The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on aquatic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

Habitat Alteration and Water Quality Effects

Construction and facility maintenance in Snake Valley would be eliminated under Alternatives E and F. If water is present at the time of construction, aquatic habitat and aquatic communities such as macroinvertebrates and attached algae or macrophytes could be affected in intermittent streams as a result of habitat alteration and water quality (i.e., sedimentation and potential fuel spills). Alternatives E and F would cross additional intermittent streams in the White Pine County portion of Spring Valley (several small washes and Bastian Creek). No fish species occur in the intermittent streams due to a lack of water on a consistent basis throughout the year. No special status aquatic species are known to occur in these intermittent streams. The same BMPs and ACMs would be applied to construction and facility maintenance activities to reduce water quality effects on aquatic habitat and species.

<u>Conclusion</u>. Construction and maintenance activities could result in short-term water quality effects, fuel spill risks, and habitat alteration in intermittent streams in basins crossed by ROWs. These effects would be considered minor due to the lack of water being present throughout the year. No game fish or special status aquatic species are present in these intermittent streams. Riparian vegetation could be removed on a long-term basis as a result of stream crossing construction. BMPs and ACMs would be applied to construction and maintenance activities to reduce effects related to these impact topics.

Proposed mitigation measures:

None.

Residual impacts include:

- Short-term temporary disturbance to aquatic habitat in intermittent streams and macroinvertebrates, periphyton, and macrophyte communities.
- Streamside vegetation could be affected on a long-term basis at intermittent stream crossings.

Vehicle Traffic/Equipment and Indirect Effects on Amphibians

Vehicle movements within the 388 miles of access roads could potentially cause Great Basin spadefoot toad mortalities as they move to and from permanent and temporary waterbodies. Effects could range from habitat alteration to amphibian mortalities. The types of habitat that could be affected are temporary waterbodies, which would depend on whether water is present during construction or facility maintenance activities. Northern leopard frog would not be directly affected by ROW construction, since the closest springs or wetlands exceed the maximum migration distances reported for this species. Amphibians also could be indirectly affected by construction-generated dust, noise, or accidental wildfire. As discussed for the Proposed Action Alternative, the same ACMs would be implemented to reduce potential impacts to amphibians from vehicle traffic, fuel spills, noise, dust, and accidental fires.

<u>Conclusion</u>. Vehicle traffic and movement along the ROWs could result in short-term effects on amphibians, as they move to and from temporary waterbodies. Vehicles could disturb habitat in short-term alteration of habitat in temporary

waterbodies. Effects could range from habitat alteration to amphibian mortalities. Construction would occur along 388 miles of access roads, with the mortality risk being highest near waterbodies.

Proposed mitigation measures:

None.

Residual impacts include:

- Potential alteration of amphibian habitat near permanent and temporary waterbodies and mortalities due to vehicle traffic within 388 miles of access roads.

3.7.2.5 Alignment Options 1 through 4

Impacts for Alignment Options 1 through 4 are identified in relation to the relevant segment of the Proposed Action (**Table 3.7-4**).

Table 3.7-4 Aquatic Biology Impact Summary for Alignment Options 1 through 4

Alignment Option	Analysis
Alignment Option 1 (Humboldt-Toiybe Power Line Alignment) **Option Description**: Change the locations of a portion of the 230-kV power line from Gonder Substation near Ely to Spring Valley. **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• Impacts associated with Alignment Option 1 would be the same as the comparable Proposed Action segment (intermittent stream crossings but no perennial stream or spring crossings).
Alignment Option 2 (North Lake Valley Pipeline Alignment) **Option Description**: Change the locations of portions of the mainline pipeline and electrical transmission line in North Lake Valley. **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• Impacts associated with Alignment Option 2 would result in more impacts than the comparable Proposed Action segment. One perennial stream (Geyser Creek) would be crossed by the pipeline and spanned by the power line ROWs. This stream contains rainbow and brook trout. Impacts would include habitat alteration and short-term water quality changes due to sedimentation. Trenching could result in mortalities to macroinvertebrates and small-size fish. Mitigation measures ROW-AB-1 (Habitat Restoration) and ROW-AB-3 (Spawning Restrictions) would be implemented to reduce impacts on habitat and trout spawning.
Alignment Option 3 (Muleshoe Substation and Power Line Alignment) **Option Description**: Eliminate the Gonder to Spring Valley transmission line, and constructing a substation with an interconnection with an interstate, high voltage power line in Muleshoe Valley. **Applicable To**: Proposed Action and Alternatives A through C, E, and F.	• Impacts for Alignment Option 3 would be less than the comparable Proposed Action segment because of the elimination of the Steptoe Creek crossing associated with the Humboldt-Toiyabe Power Line ROW.
Alignment Option 4 (North Delamar Valley Pipeline and Power Line Alignment) **Option Description**: Change the location of a short section of mainline pipeline in Delamar Valley to follow an existing transmission line. **Applicable To**: All alternatives.	• Impacts for Alignment Option 4 would be the same as the comparable Proposed Action segment (i.e., no stream or spring crossings).

3.7.2.6 No Action

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Impacts to aquatic species and their habitat would continue at present levels as a result of natural conditions and existing and other proposed development within the project area. Habitat for aquatic species would continue to be influenced by natural events such as drought and fire and land use activities such as grazing, and existing water diversions. Management activities on public lands will be directed by the Ely and Las Vegas RMPs, which involve measures to maintain or improve aquatic habitat parameters such as riparian vegetation. Management guidance for other public lands in the project study area would be provided by the GBNP General Management and the Forest Plan for the Humboldt-Toiyabe National Forest.

3.7.2.7 Comparison of Alternatives

Table 3.7-5 provides a comparison of impacts for construction and facility maintenance of the action alternatives.

Table 3.7-5 Alternative Comparison of Aquatic Biological Resource Impacts for Construction and Facility Maintenance

Parameter	Proposed Action, Alternatives A through C	Alternative D	Alternatives E and F
Number of Perennial Streams with Game Fish Species Crossed by ROWs	1	0	0
Number of Perennial Streams with Game Fish Species Crossed by Power Line ROWs	2	0	0
Number of Springs with Aquatic Species Located within 500 feet of ROWs	4	0	0
Miles of Access Roads for Potential Great Basin Spadefoot Toad Mortalities	431	315	388

3.7.2.8 Groundwater Development and Groundwater Pumping

Issues

The following issues for aquatic biological resources are discussed as part of the impact analysis for ROW groundwater development and pumping.

Groundwater Development Construction and Facility Maintenance

- Potential loss of individuals or habitat from short-term disturbance of stream channels by construction equipment.
- Potential loss of individuals or habitat from sediment delivery.
- Potential effects on fish spawning from habitat alteration.
- Effects of water use on aquatic biota and their habitat.
- Potential damage to aquatic habitat and biota from fuel spills reaching a waterbody directly or leaching through soils.
- Potential direct mortalities to amphibians from vehicle traffic.
- Compliance with management objectives defined in recovery plans, conservation agreements, and state wildlife action plans for special status aquatic species.
- Potential effects on fish species traditionally used by regional Tribes.
- Short-term disturbance to aquatic habitat and species during facility maintenance activities.

Groundwater Pumping

- Potential effects on aquatic habitats and species, special status aquatic species and their habitats, and sensitive ecological areas because of reductions in surface water availability and quality caused by groundwater development.
- Compliance with management objectives defined in recovery plans, conservation agreements, and state wildlife action plans for special status aquatic species.
- Potential effects on fish traditionally used by regional Tribes.
- Potential effects of climate change on aquatic biological resources. Refer to Cumulative Impacts, Section 3.7.3.1.2 for a discussion of how climate change could contribute to groundwater development pumping effects on aquatic biological resources.

Assumptions

Groundwater Development Construction and Facility Maintenance

- Identification of aquatic habitat potentially affected by project actions focused on waterbodies that support aquatic species on a persistent basis throughout the year (perennial streams, springs, lakes, and reservoirs).
- Identification of aquatic habitat potentially affected by construction activities for groundwater development associated with the Proposed Action and Alternatives A through F included all waterbodies located within the groundwater development boundaries.
- Identification of aquatic habitat potentially affected by construction activities for groundwater development associated with Alternative B included all waterbodies located within approximately 1-mile of proposed diversion points.
- Compliance with management objectives included those defined in recovery plans, conservation agreements, and state wildlife action plans for special status aquatic species.
- Fish species traditionally used by Tribes included native and non-native species.

Groundwater Pumping

- Aquatic habitat potentially affected by groundwater drawdown included perennial streams, springs, permanent wetlands and mesic meadows, lakes, and reservoirs that were located within the 10-foot drawdown area as determined by groundwater modeling.
- Model-simulated flow changes for selected springs and streams also were used in determining pumping effects on aquatic habitat. Additional detail on assumptions used in the analysis is provided in Section 3.3, Water Resources.
- Risk to special status species populations is discussed if drawdown is predicted to affect a waterbody that supports a population with limited distribution (e.g., springsnail population in one spring and one basin).
- The magnitude of residual effects cannot be determined at this time because of the uncertainty regarding the magnitude of impacts and the level of impact reduction by ACMs and additional mitigation. Residual effects of pumping on environmental resources will be determined in subsequent NEPA analyses.
- Fish species traditionally used by Tribes included native and non-native species.

Methodology for Analysis

Groundwater Development Construction and Facility Maintenance

- Known aquatic biology resources (game fish and special status species) were identified for groundwater development areas in the basins for each alternative.
- Surface disturbance activities were described in general terms, since locations are not known at this time.
- As part of the impact analysis, impact parameters were used in combination with effects information for the purpose of quantifying impacts and as an impact indicator. The impact parameters also allow comparison amongst alternatives or groups of alternatives. Examples of impact parameters for aquatic resources included the number of waterbodies with game fisheries or special status aquatic species that could be affected by pumping.
- SNWA would be required to implement a comprehensive COM Plan that would include all future hydrographic basins and all facilities associated with the SNWA GWD Project. The COM Plan includes a requirement for comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary, along with measures to protect aquatic resources from ROW construction and operation activities.
- Mitigation measures discussed in this resource section focus on new measures. Where applicable, some of the ROW mitigation measures may apply to surface disturbance activities associated with groundwater development. These ROW mitigation measures also would be considered in subsequent NEPA tiers.

Groundwater Pumping

- The pumping effects analysis for aquatic biology focused on aquatic habitat (perennial springs and streams) located within the 10-foot drawdown contour. If groundwater and surface water connectivity was determined, these waterbodies were considered as potentially affected by groundwater pumping in terms of water level or flow reductions. Further discussion of this connectivity determination is provided in Section 3.3, Water Resources, **Table 3.3.2-3**.
- Springs in valley floor settings where there is a shallow depth to groundwater (i.e. <100 feet) were assumed to be controlled by discharge from the regional groundwater flow system. The impact analysis assumed a high risk to valley floor springs and stream reaches located within the drawdown area where there is a shallow depth to groundwater.
- Springs and stream reaches fed by springs located within valley margin settings may be controlled by discharge from local, intermediate, or in some cases, the regional groundwater flow system. Considering the uncertainty associated with the source of groundwater discharge to these springs, the impact analysis generally assumed a moderate risk to valley margin springs and stream reaches fed by springs located within the drawdown area.

- Springs and stream reaches fed by springs in upland areas (i.e., high elevation regions or mountain block settings) were assumed to be controlled by discharge from local or perched groundwater systems that are unlikely to be connected to the regional groundwater flow system. The impact analysis assumed a low risk to springs and stream reaches located in upland settings even if they were situated in the drawdown area.
- The types of impacts resulting from flow or water level reductions on aquatic biota were discussed in general terms using available literature. As part of the hydrologic modeling, the percent change in flow was estimated for individual springs or spring systems. In total, approximately 30 springs were analyzed with focus on the larger springs or stream segments within the hydrologic model study area. This step provided a quantitative estimate of flow changes for springs or streams in the study area. Section 3.3, Water Resources, provides a detailed discussion of the methodology used in the evaluation of pumping effects on perennial streams and springs.
- Pumping effects to spring flow were assumed if the spring is thought to be hydraulically connected to the regional groundwater flow system, and either occurs within the groundwater drawdown area or is simulated to have a greater than 5 percent flow reduction.
- Biological importance was based on the presence of fish and special status aquatic species.
- Assumptions about the potential changes in aquatic habitats (habitat area and flows) from groundwater pumping do not incorporate additional assumptions about the effects of climate change because specific long term effects of climate change are not presently known, and the incremental contribution of climate change effects to project effects cannot be reasonably estimated. A general discussion of climate change effects is provided in Section 3.7.3.1, Climate Change Effects to Aquatic Biological Resources.
- The COM Plan would be developed and implemented to monitor and mitigate the effects of pumping on aquatic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.
- As part of the COM Plan, the BLM would coordinate with the MOU partner agencies to define data gaps prior to initiating subsequent NEPA tiers. Several years of data collection may be required for studies such as occurrence of northern leopard frog and special status springsnails and flow/habitat relationships for special status aquatic species.

3.7.2.9 Proposed Action

Groundwater Development Area

Game Fish and Other Aquatic Communities

Since the location of well development facilities cannot be determined at this stage of the project, impact discussions are considered general in terms of applicability to aquatic biological resources within the pumping basins. Subsequent NEPA analyses will be required to describe impacts of construction at specific facility locations.

The impacts of constructing wells, roads, feeder lines, and other support facilities in Snake, Spring, Cave, Dry Lake, and Delamar basins potentially could include the same issues discussed for the pipeline and power line ROWs (Section 3.7.2.2). Surface disturbance and vehicle traffic could: 1) directly disturb aquatic habitats located within the footprint of construction areas; 2) contribute sediment to drainages that contain aquatic habitat; 3) cause water quality risks to aquatic biota from accidental fuel spills; and 4) potentially result in amphibian mortalities from vehicle traffic during movement periods. These impacts would occur only if well development occurs within, adjacent to, or immediately upstream/upslope of waterbodies that contain habitat for aquatic biota. Removal of riparian vegetation would be of long-term duration, while the other impacts would be considered short-term. Sedimentation and spill-related impacts would be minimized by ACMs previously discussed for Proposed Action ROW areas.

Well development also would require the use of drilling muds and small quantities of water. Drilling mud handling and disposal could result in sedimentation if the activity occurred in drainages or near waterbodies. Water for well development would be trucked in by the drilling contractors. The source of water is assumed to be from groundwater. Since well development water is not expected to be obtained from local water sources, reductions in aquatic habitat are not expected.

Game fish or special status species habitat is present in two basins. Construction-related impacts could occur.

Construction-related impacts in the groundwater development areas potentially could affect aquatic biological resources in all five basins (Snake, Spring, Cave, Dry Lake, and Delamar). In total, 17 perennial streams (Snake and Spring valleys) (**Table 3.7-1**) and over 40 springs (all 5 basins) are located within or immediately adjacent to the boundaries of the groundwater development area (**Figures 3.7-4** and **3.7-5**). All of these waterbodies likely contain aquatic macroinvertebrates. When focusing on game fish and special status aquatic species, two of the basins contain stream and spring habitat with these species. Groundwater development areas in Spring and Snake valleys overlap with 13 and 4 streams, respectively, that support game fish species (**Table 3.7-1**). However, many of the stream reaches within the Snake and Spring valleys groundwater development areas have channel modifications such as irrigation canals. The occurrence of special status aquatic species is discussed below.

Special Status Aquatic Species

One special status fish species, Bonneville cutthroat trout (BLM sensitive and a conservation agreement species), occurs in Big Wash in Snake Valley. This stream is located within the Snake Valley groundwater development area. One additional perennial stream in Snake Valley, Big Springs Creek, also contains native fish species considered to be unique because of their limited distribution in Nevada.

Three springs located within the groundwater development areas (Blind, North Millick, and South Millick in Spring Valley) contain potential habitat for the special status amphibian species, northern leopard frog. Vehicle traffic near these springs could result in mortalities as frogs move to waterbodies particularly during the breeding season. Surface disturbance activities near these springs could directly alter habitat or affect water quality from sedimentation or fuel spill risks.

Springsnail species (Toquerville pyrg) also are present in spring habitats within two of the groundwater development areas: Spring Valley (unnamed spring near Cleve Creek drainage) and Snake Valley (unnamed spring southwest of Caine Spring). This springsnail species is not a special status species due to its more widespread distribution. Surface disturbance activities near these springs could directly alter habitat or affect water quality from sedimentation or fuel spill risks.

Compliance with Management Objectives

If direct disturbance occurred in spring habitat, achievement of the conservation objective involving protection of known or potential breeding sites could be affected for northern leopard frog (Smith and Keinath 2007) (**Appendix F**, **Table F3.7-8**). Vehicle traffic near springs and seasonal waterbodies also could affect the objectives involving protection of dispersal pathways and reducing road-related mortality. Groundwater development in spring areas also could affect management objectives for protecting spring and springbrook habitats, as described by the Nevada Wildlife Action Plan Team (2006) (**Appendix F**, **Table F3.7-10**).

Habitat alteration or other surface disturbance effects on Big Wash could affect management objectives for Bonneville cutthroat trout involving maintenance of natural hydrologic characteristics and enhancing connectiveness and opportunities for migration.

Maintenance activities for groundwater development could affect aquatic biota and their habitat, if vehicles or equipment crossed waterbodies. The types of impacts would be the same effects discussed for ROW areas. The location of facility maintenance activities cannot be defined at this time. Implementation of ACMs would be used to avoid or minimize effects on aquatic habitat. These measures would control sediment input to waterbodies and reduce fuel spill risks. Removal of riparian vegetation near waterbodies could affect shade and cover for aquatic species on a long-term basis.

The COM Plan would be developed and implemented to monitor and mitigate the effects of surface disturbing activities on aquatic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The COM Plan also would be applied to other impact issues discussed in this section.

As part of the COM Plan, ACMs, and the BLM Management Actions and BMPs for ROWs (**Appendices D** and **E**) also would be incorporated for the groundwater development areas, as applicable. The BLM RMPs for development near springs also would be followed, which specifies that surface water sources and associated riparian areas be maintained. Additional project-specific measures would be determined as part of subsequent NEPA analysis for specific project locations. As part of the programmatic level of analysis for this EIS, additional ACMs would be incorporated in future COM Plans and could include the following design features to reduce impacts to aquatic biological resources. Other measures may be added during subsequent NEPA analyses.

- Location of production wells, collector lines, power lines, and secondary substations will consider the presence of special status species and their habitat and avoid springs, streams, and riparian/wetland areas (ACMs B.1.1 and B.1.3); and
- Construction practices to meet permit requirements will be implemented on well drilling, abandonment, drilling, and water discharge (ACMs B.2.1 through B.2.3).

Conclusion. Construction of well pads, gathering pipelines, and electrical service lines could disturb up to 17 perennial streams and approximately 40 springs in the 5 groundwater basins. All of these waterbodies likely support macroinvertebrates. Game fish species occur in perennial streams in the Snake and Spring valleys' groundwater development areas. Special status species within the groundwater development areas include Bonneville cutthroat trout (one stream in Snake Valley) and northern leopard frog (three springs in Spring Valley). Potential effects on Bonneville cutthroat trout and northern leopard frog could conflict with management objectives in their conservation plans. BMPs and ACMs would be implemented to reduce water quality and potential fuel spill effects. Direct effects on habitat would be reduced by ACMs that would consider the presence of special status species when siting facilities.

Mitigation Recommendations:

GW-AB-1: Avoid Disturbance to Springs. Avoid direct disturbance to springs and wetlands in Spring and Snake valleys with known special status aquatic species by establishing a 0.5-mile buffer around these areas. Effectiveness: This measure would be effective, since it would eliminate impacts to species in spring and wetland habitats. Effects on other resources: There would be no effects of implementing this measure on environmental resources.

GW-AB-2: Avoid Disturbance to Streams. Avoid locating wells, new roads or other linear facilities within 0.5 mile of or parallel to perennial streams and riparian areas with game fish and special status species. Effectiveness: This measure would be effective, since it would eliminate impacts to aquatic habitat in perennial streams. Effects on other resources: There would be no effects of implementing this measure on environmental resources.

Potential residual impacts include:

- Potential amphibian mortalities from vehicle traffic near temporary or permanent waterbodies.

A summary of effects and protection measures (ACMs and additional mitigation) is provided in **Table 3.7-6**. This same tabular presentation is used in subsequent groundwater development impact summaries for Alternatives A through F and the No Action alternative.

Table 3.7-6 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Proposed Action Groundwater Development

Effects
• Construction could alter aquatic habitat on a short-term basis in 17 perennial streams and 5 springs with aquatic biological resources. Riparian vegetation near waterbodies could be affected on a long-term basis. Surface disturbance and vehicle/equipment could affect water quality from sediment input and risks from fuel spills on a short-term basis. • Instream activities in the spring or fall could affect trout spawning on a short-term basis. • Vehicle traffic near waterbodies could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods.

Table 3.7-6 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Proposed Action Groundwater Development (Continued)

Effects
• Special status Bonneville cutthroat trout could be affected in one stream within the groundwater development areas (Big Wash in Snake Valley). • Special status amphibian species could be affected in three springs within the groundwater development areas. • Springsnail species could be affected in spring habitats within two of the groundwater development areas (one unnamed spring in Spring Valley and one spring in Snake Valley).Conflicts with conservation management objectives could occur for two species: Bonneville cutthroat trout (Big Wash) and northern leopard frog (three springs). • Game fish species considered to be traditional values to regional Tribes could be affected in Snake and Spring valleys.
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and mitigation recommendations.
BLM RMP Direction and ACMs
• BLM RMP direction for development near springs specifies that surface water resources and associated riparian areas be maintained. • ACM B.1.1 and ACM B.1.3 will consider the presence of special status species and their habitat in the location of production wells, collector lines, and secondary substations. • ACM B.2.1 through B.2.3 will implement permit requirements on well drilling, abandonment, drilling, and water discharge.
Proposed Mitigation
GW-AB-1 (avoidance of springs and wetlands with special status aquatic species) and **GW-AB-2 (establishing a 0.5-mile buffer near perennial streams with game fish and special status aquatic species)** would be implemented for the Proposed Action.
Conclusions
• By avoiding springs and streams with game fish or special status aquatic species, short-term disturbance would be limited to waterbodies with seasonal flow or limited water volumes. Macroinvertebrates likely would be present in these waterbodies. • Vehicle traffic could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods.
Potential Residual Impacts
• Potential amphibian mortalities from vehicle traffic near temporary and permanent waterbodies could occur during construction.

Groundwater Pumping

Pumping Effects Literature Review for Aquatic Habitat and Species (Background Information Applicable to All Alternatives)

Streams

The importance of a stream's flow regime for sustaining the biodiversity and ecological integrity of the aquatic environment is well established (Poff and Zimmerman 2010). Flow regime is considered the primary determinant regarding the structure and function of aquatic and riparian ecosystems for streams and rivers (Poff et al. 2010). Nearly all streams need to have some contribution from groundwater in order to provide reliable habitat for aquatic organisms (Winter 2007). The effects of stream flow changes on aquatic biota and their habitat have received considerable attention in the published literature. Of 165 papers reviewed by Poff and Zimmerman (2010), 152 (92 percent) reported negative ecological effects in relation to flow alterations. It should be noted that the majority of these studies evaluated changes related to relatively large flow alterations ranging from 50 to 100 percent compared to base flow conditions. This review indicated that there is a paucity of data in the low to middle range of flow alteration (0 to 50 percent). The overall conclusion of the literature review is that larger changes in flow alteration are associated with greater risk of ecological effects on aquatic communities. The effects of flow reductions on aquatic communities in streams are summarized below for habitat and aquatic biological groups (i.e., fish, invertebrates, and algae).

Habitat and Water Chemistry. The effects of flow reductions on stream habitat and water quality include decreases in water velocity, water depth, and wetted channel width (Dewson et al. 2007). The magnitude of change in aquatic habitat and water quality conditions depends on the quantity of flow reduction. Although flow reductions result in decreased wetted habitat for aquatic species, the quantity of change is not a 1:1 relationship. Riffles and other shallow areas (e.g., backwaters, shoreline areas associated all habitats) are affected by reduced flows more dramatically than pool habitats.

Flow reductions can affect water quality characteristics in streams in terms of increased sedimentation, thermal regimes, and the potential concentration of other water constituents. In terms of water chemistry, sedimentation is often a consequence of reduced flow because lower velocities enable more sediment to settle out of the water column (Dewson et al. 2007). Water temperature usually increases with reductions in discharge in the summer, with the magnitude of change dependent on the volume of reduction compared to the stream volume, stream velocity, and the time of year. Sufficient information is not available in the model analysis used in this EIS to predict quantitative effects on habitat or water chemistry.

Fish. Based on the literature review by Poff and Zimmerman (2010), fish was the only aquatic biological group to consistently respond negatively to changes in flow magnitude. Under reduced flow conditions, fish responses were negative in all 10 studies, with 8 of the changes exceeding 50 percent compared to base flow conditions. Fish diversity showed a consistently large decline, especially where reduced flow exceeded 50 percent. Reductions in abundance and demographic parameters also were shown for fish in these studies. Fish species that spend most of their time in riffle habitats (e.g., dace and suckers) are more likely affected by reduced flow and depth (Bradford and Heinonen 2008). Based on literature reviews by Bradford and Heinonen (2008), Bunn and Arthington (2002), Lake (2003), and Poff and Zimmerman (2010), the following direct effects of flow reductions on fish habitat have been reported. Minimum or threshold flows have not been identified in relation to these habitat effects.

- Reduced water velocity, water depth, and wetted channel areas;
- Reduced depths and velocities over spawning and rearing areas;
- Reduced depths in overwintering pools;
- Potential restrictions in fish movement or migration due to reduced stream depths;
- Potential shift in habitat use from riffles and runs to pools for some species;
- Changes in quantity and types of cover (e.g., undercut banks, woody debris, substrate, turbulence) as depths are reduced; and
- Potential loss of riparian vegetation and overhanging cover for fish.

These literature reviews also have reported indirect effects of flow reductions on fish species. Critical life events such as spawning, early life development, growth, physiological functions, and competition are linked to flow regime in combination with other ecological factors (Bunn and Arthington 2002). The following indirect effects could occur as a result of flow changes:

- Adverse effects on fish growth as a result of changes in food sources consisting of macroinvertebrates;
- Adverse effects on physiological and ecological requirements as a result of water quality changes involving temperature and increased sedimentation;
- Potential increase in parasite infestation; and
- Potential shift to habitat conditions that favor exotic species such as carp and mosquitofish.

Macroinvertebrates. The response of macroinvertebrate communities to reduced flow has been the subject of recent literature reviews by Poff and Zimmerman (2010) and Dewson et al. (2007). Based on a review of studies involving relatively large flow reductions (approximately 60 to 100 percent compared to base flow conditions), results showed that macroinvertebrate abundance and diversity declined in most cases. As discussed for fish, the lack of data points throughout the entire range of flow changes makes it difficult to identify any threshold levels that result in macroinvertebrate responses. Studies reviewed by Dewson et al. (2007) indicated varying changes in macroinvertebrate abundance in relation to reduced flow. It was suggested that density decreased as a result of reduced habitat diversity and food sources and changes in competition and predation. In situations with increased abundance after flow reduction, it was suggested that the reduction in wetted area resulted in a concentration of invertebrates in a smaller area. Flow reductions also usually result in compositional changes, as indicated by the number of taxa and their relative abundance. Compositional changes typically result from the effect of flow reduction on habitat suitability. Low flows would favor taxa that prefer slower velocities. Flow reductions also result in decreased macroinvertebrate taxonomic richness (i.e., number of taxa). Changes in water quality conditions due to increased temperature and sedimentation and altered attached algae assemblages also can contribute to changes in community composition and taxonomic richness.

As a result of low flow conditions, invertebrates can move from the surface of the stream bottom into the deeper substrate zone referred to as the hyporheic zones (saturated sediment area that exchanges water, nutrients, and fauna with flowing surface waters). Hyporheic water can be used as a thermal refuge for invertebrates because this deeper zone is often cooler than the surface water (Dewson et al. 2007).

Additional information on macroinvertebrate responses to flow reductions is provided in a study by McKay and King (2006). The study diverted between 28 and 97 percent of the total stream discharge in experimental reaches for the purpose of identifying macroinvertebrate responses. The diversions consistently reduced the mean density of total macroinvertebrates, mean density of sensitive mayfly/caddisfly/stonefly taxa, macroinvertebrate family richness (i.e., number of taxa), and density of a number of dominant taxa in the diversion reaches compared to control reaches. In terms of flow reduction effects on habitat, the entire range of diversions resulted in a decline in the wetted area or useable habitat for macroinvertebrates.

Field studies have demonstrated that mobile macroinvertebrate species, such as beetles and adult caddis and stoneflies, would disperse as flows decline (Boulton 2003). Those invertebrates that are unable to escape the aquatic environment may drift downstream or move upstream to more consistent water sources (Dewson et al. 2007). Time of the year, rapidity of the desiccation (drying), the duration, and the magnitude of the decreased flow all affect the severity of changes in the invertebrate community (Boulton 2003). As stream desiccation begins to occur, invertebrates with limited mobility experience mortality due to elevated temperatures and declining water quantity and quality (Dewson et al. 2007).

If flows are restored, recolonization is variable (Boulton 2003). Often mobile species will be the first to recolonize a restored stream, along with species with drought-resistant life stages. Less mobile and sensitive species will frequently lag in recolonization of an area. The ability and time frame of the aquatic invertebrate community to recover are dependent upon the proximity of a functional aquatic ecosystem that can recolonize the area.

Algae and Macrophytes. Flow regime is an important component of attached algae (periphyton) and macrophytes. Water velocity can affect the colonization, production, and composition of periphyton communities. Investigators have reported varying density changes in relation to reduced flows (Dewson et al. 2007). These contrasting results are probably caused by the different growth forms and physiological requirements of algae in stream environments. The periphyton community typically changes from a low-biomass diatom assemblage to a high-biomass filamentous green algal mat during low or reduced flows. This change occurs in response to increased temperatures, higher nutrient concentrations, and reduced current velocity. Responses of periphyton to reduced flow conditions also depend on the nutrient concentrations in the stream. In general, reduced flow or low flow increases the establishment and growth of macrophytes. Other factors involving nutrient concentrations and substrate play a role in macrophyte development.

Springs

Spring flow or discharge is an important component of spring habitat. Springs are points of concentrated discharge from groundwater flow systems (van der Kamp 1995). The stability and quantity of the flow mostly depends upon the extent and storage capacity of the contributing flow system. The size and configuration of the spring are dictated by flow quantity and topography in the area. Most large springs and some smaller spring systems generally support spring brook outflow habitat, hyporheic zones, downstream wetland and marsh habitats, and may contribute significant flow to associated tributary and first order stream and river systems such as the White and Muddy rivers (Wildlife Action Plan Team 2006). The following information summarizes the effects of flow or water level reductions on spring habitat and their associated aquatic biota. Available literature did not identify minimum flow or threshold water levels needed to maintain habitat and aquatic species populations in springs.

Habitat and Water Quality. The effects of flow reductions from groundwater pumping on spring habitat in southern Nevada were evaluated by Sada and Deacon (1994). Reductions in groundwater input to springs would result in decreased water depths and wetted area. The reduction in hyporheic zones and wetlands would decrease the areal extent or size of the spring. Water velocities and depth also would decrease in the spring inflow and outflow areas due to reduced groundwater input.

The magnitude and time frame of these habitat changes would depend on the quantity of decreased flow and the relative size of the spring. Small-size springs would be more susceptible to decreased spring discharges. Small springs could dry up if the water source is eliminated. If flow input is maintained to the spring, flow reductions would modify habitat in terms of depth and velocity changes, especially in riffle areas of spring brooks. Pool habitat would be affected by decreased depths and size.

Reduced groundwater input also can affect water quality in springs due to increased sedimentation, altered thermal regimes, and potential changes in the concentration of other water constituents. Flow reductions in riffle areas could result in sedimentation of gravel and cobble substrates. Lower flow also could modify the thermal dynamics of the spring system, which could have adverse effects on species adapted to particular temperature conditions in the spring.

Fish. Based on information provided in Sada and Deacon (1994) and literature summarized above for stream habitats, reduced groundwater input to springs would result in decreased fish abundance and diversity. These changes would result from direct and indirect effects on fish habitat and their ecological or physiological requirements. Habitat effects are related to the ecology of fish species. For example, the springfishes, spinedaces, and Pahrump poolfish utilize pool habitats for feeding, spawning, and other life processes. In contrast, sucker and dace species are associated with riffle areas for their ecological requirements (feeding, spawning, and other physiological requirements). The following direct effects of flow reductions on fish species in spring habitats have been identified.

- Reduced water velocity, water depth, and wetted areas in pool and riffle habitats;
- Reduced depths and velocities over spawning and rearing areas;
- Potential shift in habitat use from riffles to pools for some species; and
- Changes in quantity and types of cover (e.g., substrate, aquatic vegetation) as depths are reduced.

The following indirect effects on spring biota could occur as a result of flow changes:

- Adverse effects on fish growth as a result of changes in food sources consisting of macroinvertebrates;
- Adverse effects on physiological and ecological requirements as a result of water quality changes involving temperature and increased sedimentation; and
- Potential shift to habitat conditions that favor non-native species.

Invertebrates. Erman (2002) reported that the most diverse invertebrate assemblages were evident in the most stable springs, which showed the least change in water discharge and temperature during a 20-year period. Based on a long-term study of springs during varying drought conditions (Erman 2002), reduced flow or water levels resulted in decreased abundance and diversity of invertebrates, as well as compositional changes. The effects of reduced flows would likely be more pronounced in small springs where changes in habitat conditions would be more substantial. Literature pertaining to effects of flow reductions on stream invertebrates is considered to be applicable to the spring brook or outflow areas of springs. Flow changes could shift the occurrence of invertebrates along the spring brook segment. For example, spring invertebrates often move along a spring outflow gradient to change their thermal environment, locate better food sources, and find more suitable larval development sites. In addition, flow-related water quality changes could contribute to changes in community composition and taxonomic richness due to increased temperature and sedimentation and altered attached algae assemblages.

Reduced flow in springs also could affect springsnail populations. These mollusk species are restricted to spring sources and a limited distance of the spring brook (usually less than 600 feet) (Sada and Deacon 1994). Habitat typically consists of aquatic macrophyte areas, moderate velocities of approximately 10 centimeters/second, sand and/or gravel substrates, and thermal or cold temperatures.

Algae and Macrophytes. The effects of flow reductions on attached algae in spring brook areas of springs would be similar to responses discussed for stream habitats. Flow reductions in pool areas of springs would decrease depths and wetted areas. These changes could alter existing macrophyte areas by affecting depth and substrate combinations that are preferred by plant species.

Pumping Effects Analysis

Based on evaluations of the model-predicted 10-foot groundwater drawdown contour for Proposed Action pumping and geology and groundwater characteristics, aquatic biological resources could be affected in portions of six basins during the full build out plus 75 years and full build out plus 200 years time frames (White River, Pahranagat, Lower Meadow Valley Wash, Spring [#184], Snake, and Lake) (**Appendix F**, **Tables F3.7-11** and **F3.7-12**). The analysis indicated that Proposed Action pumping could reduce flows or water levels in 27 to 30 standing water bodies (springs, ponds, or lakes) and 25 to 31 perennial streams that contain game fish or special status aquatic species at the full build out plus 75 years and full build out plus 200 years time frames. Three springs/ponds/lakes were predicted to be affected at full build out. The predicted 10-foot drawdown contour for Proposed Action pumping is shown for streams in **Figure 3.7-7** and springs in **Figure 3.7-8**. It should be clarified that there are uncertainties associated with the model analysis, as described in Section 3.3, Water Resources, Methodology, Assumptions, and Limitations, Model Uncertainty. This would apply to all impact discussions for individual alternatives, as well as cumulative impacts associated with each alternative.

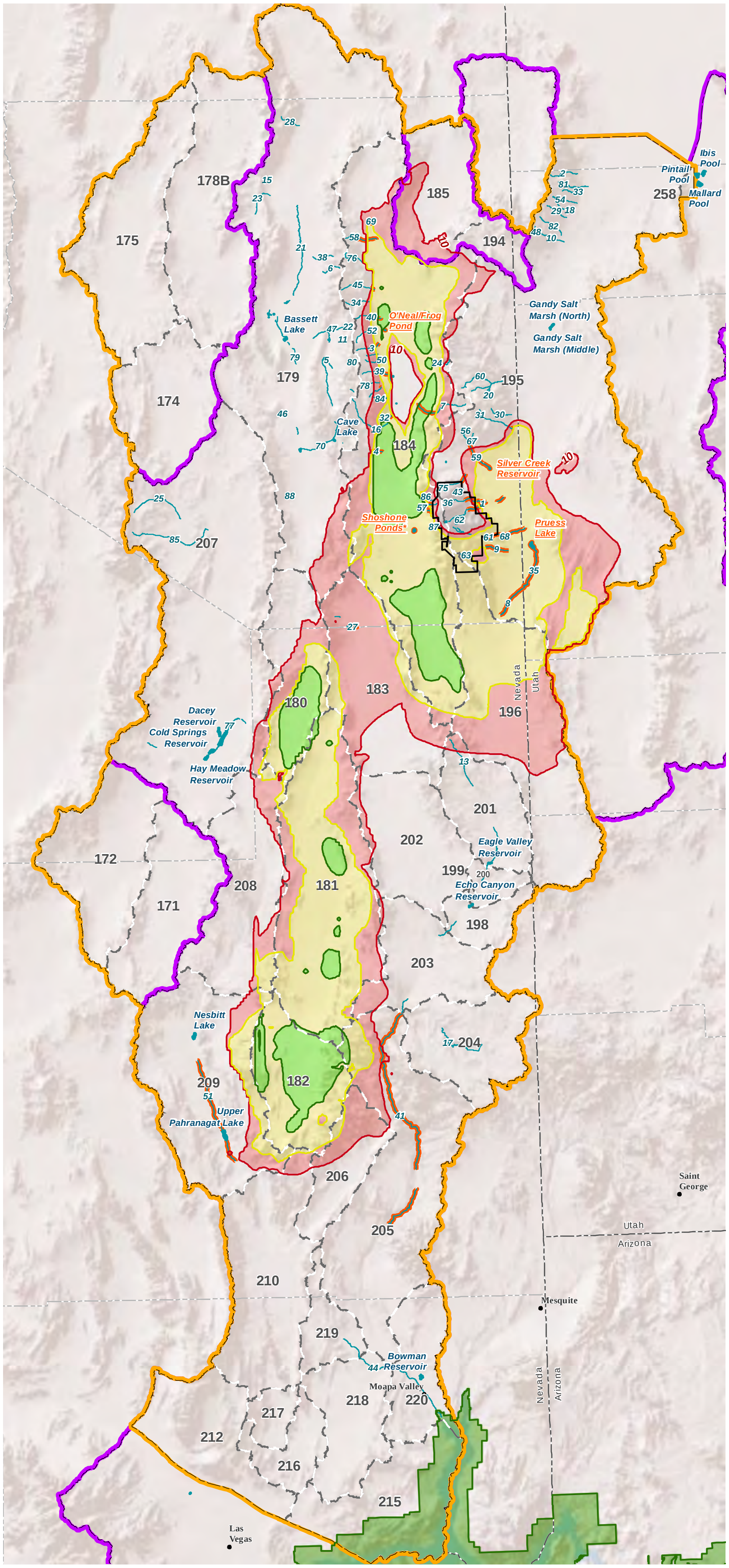
As part of the model simulation, percent change in flow was predicted for six springs located within the groundwater drawdown areas. The predicted percent flow reduction for these springs included the following ranges using the three model time frames: Butterfield Spring (-1 to -18) and Flag Springs (-1 to -17) in White River Valley; Keegan Spring (-58 to -100), North Millick Spring (-31 to -75), and South Millick Spring (-55 to -99) in Spring Valley; and Big Springs (-2 to -100) in Snake Valley. The model simulation results indicate that Keegan, North Millick, South Millick, and Big Springs could potentially experience substantial flow reductions or eventually cease flowing. Pumping impacts are discussed below for fish, amphibian, and invertebrate species.

Small springs (<100 gpm flow rate) also could experience substantial flow reductions or dry up as a result of pumping. The number of small springs with biological resources that could be affected was 0 (full build out), 13 (full build out plus 75 years), and 15 (full build out plus 200 years) for the three model time frames. The small springs included Wambolt in Lake Valley; Blind, Cleveland Ranch, Osborne, Stonehouse, Willow, unnamed near Cleve Creek, and unnamed # 5 in Spring Valley; and Caine, Clay, Kious, Outhouse, unnamed near Caine Springs, and two unnamed springs near Big Springs in Snake Valley. These springs could potentially dry up and result in a loss of all aquatic species (full build out plus 200 years).

Fish

Game Fish

Based on the groundwater drawdown analysis, game fish species could be affected in 4 to 29 streams for the 3 model time frames (full build out, full build out plus 75 years, and full build out plus 200 years). The analysis was based on the stream's topography and relationship to the 10-foot groundwater drawdown contour. If a valley floor or valley margin perennial stream overlapped with the 10-foot groundwater drawdown contour, potential stream flow reductions could result from Proposed Action pumping. During the full build out model time frame, flow reductions were predicted in four streams (Bastian, Meadow, Negro, and Shingle creeks). The analysis indicated that a total of 6 miles was located within the 10-foot drawdown contour. The full build out plus 75 years and full build out plus 200 years time frames indicated that 24 and 29 streams, respectively, could exhibit reduced flows. A list of these streams and their game fish species is provided in **Appendix F**, **Table F3.7-12**. Some of these stream reaches also contain non-native fish species. The analysis indicated that a total of 60 and 75 stream miles, respectively, were located within the 10-foot drawdown contours for these 2 model time frames. Stream flows could be affected within these stream lengths as well as downstream reaches. Game fish streams with the highest predicted affected lengths included Big Wash, Lehman, Silver, and Snake creeks in Snake Valley and Bastian, McCoy, Meadow, Negro, Shingle, and Siegel creeks in Spring Valley (**Appendix F**, **Table F3.7-12**). Water levels also could be reduced in two reservoirs that contain game fish (Pruess Lake and Silver Creek Reservoir in Snake Valley) (**Appendix F**, **Table F3.7-11**).



#	Stream Name	#	Stream Name
1	Baker Creek	46	Murry Creek
2	Basin Creek	47	North Creek
3	Bassett Creek	48	North Fork of Birch Creek
4	Bastian Creek	49	North Fork Snake Creek
5	Berry Creek	50	Odgers Creek
6	Big Indian Creek	51	Pahranagat Creek
7	Big Negro Creek	52	Piermont Creek
8	Big Springs Creek	53	Pine Creek
9	Big Wash	54	Red Cedar Creek
10	Birch Creek	55	Ridge Creek
11	Bird Creek	56	Second Fork Silver Creek
12	Board Creek	57	Shingle Creek
13	Camp Valley Creek	58	Siegel Creek
14	Cave Creek	59	Silver Creek
15	Cherry Creek	60	Smith Creek
16	Cleve Creek	61	Snake Creek
17	Clover Creek	62	South Fork Baker Creek
18	Cottonwood Creek	63	South Fork Big Wash
19	Deadman Creek	64	South Fork Snake Creek
20	Deep Canyon Creek	65	South Fork Willard Creek
21	Duck Creek	66	South Taft Creek
22	East Creek	67	Spring Creek (Tributary to Silver Creek)
23	Egan Creek	68	Spring Creek (Tributary to Snake Creek)
24	Eightmile Creek	69	Spring Valley Creek
25	Ellison Creek	70	Steptoe Creek
26	Forest Home Creek	71	Steptoe Ranch Stream 3
27	Geyser Creek	72	Steptoe Ranch Stream 4a
28	Goshute Creek	73	Steptoe Ranch Stream 4b
29	Granite Creek	74	Steptoe Ranch Stream 5
30	Hampton Creek	75	Strawberry Creek
31	Hendry's Creek	76	Sunkist (North) Creek
32	Indian Creek	77	Sunnyside Creek
33	Indian Farm Creek	78	Taft Creek
34	Kalamazoo Creek	79	Tailings Creek
35	Lake Creek	80	Timber Creek
36	Lehman Creek	81	Tom's Creek
37	Little Negro Creek	82	Trout Creek
38	Mattier Creek	83	Upper Snake Creek
39	McCoy Creek	84	Vipont Creek
40	Meadow Creek	85	White River
41	Meadow Valley Wash	86	Willard Creek
42	Middle Fork Snake Creek	87	Williams Canyon Creek
43	Mill Creek	88	Willow Creek
44	Muddy River		
45	Muncy Creek		

Underlined streams may be affected where "At Risk" stream segments intersect drawdown.

Potentially Affected "At Risk" Stream Segment

Potentially Affected "At Risk" Waterbody

Legend

Water Features Containing Sensitive Aquatic Biology or Game Fish

- Perennial Stream Reach
- Waterbody
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

* Fed by artesian well

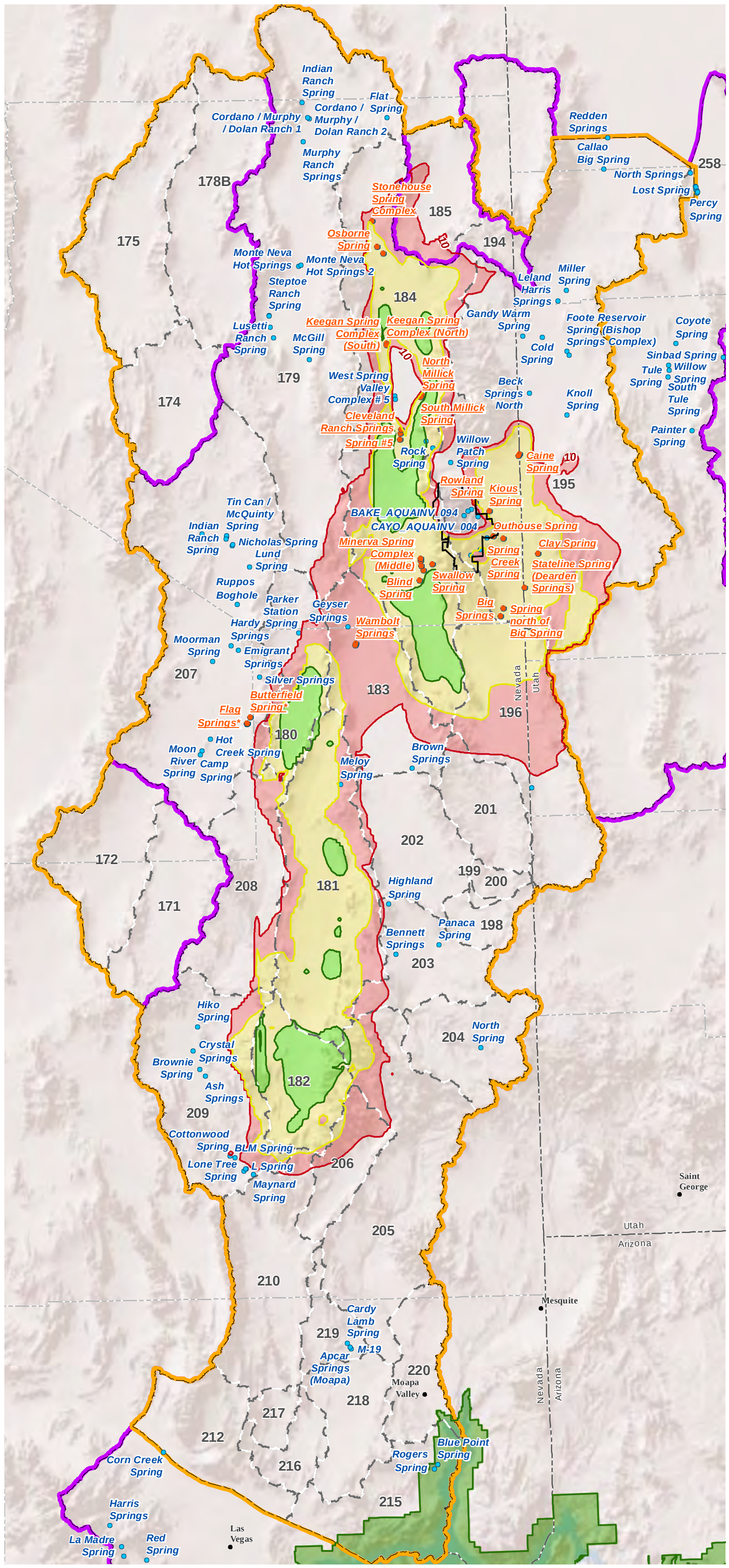
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

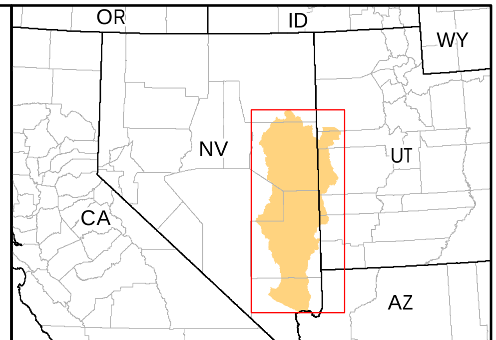
Figure 3.7-7

Proposed Action Drawdown and Streams/ Waterbodies with Aquatic Biological Resources

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N





Legend

- Spring Containing Sensitive Aquatic Biology or Game Fish
- Potentially Affected Spring Containing Sensitive Aquatic Biology or Game Fish
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

*Spring is outside 10-ft drawdown contour, but model-predicted flow reductions indicate potential effect.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-8

Proposed Action Drawdown and Springs with Aquatic Biological Resources

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

Proposed Action pumping also could reduce water levels in two springs (Swallow Spring in Spring Valley and Rowland Spring in Snake Valley) that support trout populations. Based on overlap with the 10-foot groundwater drawdown contour, water levels in Swallow Spring could be reduced at full build out plus 75 years and full build out plus 200 years. No data are available to predict the percent flow change for these springs. In Rowland Spring, flow reductions were predicted only at full build out plus 200 years. Spring Creek Spring in Snake Valley, which provides water for the Spring Creek Rearing Station (**Figure 3.7-2**), could be affected by groundwater pumping at the full build out plus 75 years and full build out plus 200 year time frames.

Federally Listed Aquatic Species

Seven federally listed fish species were evaluated as part of the pumping effects analysis. Based on a comparison of the 10-foot groundwater drawdown contours and model-predicted flows, Proposed Action pumping could affect 2 species, Pahrump poolfish and White River spinedace. Results of the impact analysis are discussed below:

- **Pahrump Poolfish**: Proposed Action pumping could potentially reduce flows or water levels in Shoshone Ponds in Spring Valley inhabited by Pahrump poolfish for two model time frames (full build out plus 75 years and continuing through full build out plus 200 years). No flow reductions were predicted for the full build out time frame. Data are not available to predict the percent change in flow resulting from Proposed Action pumping.
- **White River Spinedace**: Although the Flag Spring complex in White River Valley occupied by this species is not located within the 10-foot groundwater drawdown contour, model-simulated flow reduction was 17 percent for the full build out plus 200 years time frame. Flow reductions in the Flag Spring complex for the full build out and full build out plus 75 years are <1 and 7 percent, respectively, for these model time frames. Critical habitat for White River spinedace is designated in Flag Spring. Proposed Action pumping would not affect White River spinedace habitat at other locations (Preston Big Springs and Lund Spring in White Pine County, which are considered critical habitat but not occupied habitat for the species).
- **Other Federally Listed Species**: Since the 10-foot groundwater drawdown contour did not overlap with habitat for the other 5 federally listed species (Hiko White River springfish, Pahranagat roundtail chub, Big Springs spinedace, Moapa dace, and White River springfish), Proposed Action pumping would not affect these species. The predicted flow changes in waterbodies inhabited by these species ranged from 0 to -2 percent (Preston Big Springs in White River Valley; Ash, Crystal, and Hiko springs in Pahranagat Valley; and Muddy River in Muddy River Springs Area). Specific analyses for these species are provided in **Appendix F**, **Table F3.7-13A**. As discussed in Section 3.3, Water Resources, on model uncertainty and limitations, a simulated change in flow of less than 5 percent is inferred to indicate that measurable impacts are unlikely to occur for the species.

Other Special Status or Native Fish Species: Based on the model analysis, additional fish species or subspecies such as White River sculpin, White River desert sucker, White River speckled dace, relict dace, Meadow Valley Wash desert sucker, Meadow Valley Wash speckled dace, Pahranagat speckled dace, Utah chub, Utah sucker, redside shiner, speckled dace, and mottled sculpin potentially could be affected by Proposed Action pumping. Spring species are listed in **Appendix F**, **Table F3.7-11**, while stream species are provided in **Appendix F**, **Table F3.7-12**. Impacts are discussed separately for these two habitats. Impact analyses organized by species are provided in **Appendix F**, **Table F3.7-13A**.

Bonneville cutthroat trout could be adversely affected by Proposed Action pumping in six streams at the full build out plus 75 years and full build out plus 200-year time frames. No streams containing this species would be affected at full build out. The estimated stream lengths with potential flow reductions for these two longer term time frames are listed below along with the percent of occupied habitat potentially affected in each stream and time frame.

- Spring Valley – Pine Creek (0.1 to 0.4 mile or 12 to 50 percent of occupied habitat in this stream) and Ridge Creek (0.6 to 1.1 miles or 50 to 92 percent of occupied habitat in this stream).
- Snake Valley – Big Wash (4.8 miles or 100 percent of occupied habitat in this stream), Hendry's Creek (0.2 to 0.4 mile or 2 to 8 percent of occupied habitat in this stream), Strawberry Creek (0.8 mile or 12 percent of occupied habitat in this stream), and Snake Creek (0.1 mile or 1 percent of occupied habitat in this stream).

Other Bonneville cutthroat trout streams in Spring (#184), Snake, Steptoe, and Deep Creek valleys (**Appendix F**, **Table F3.7-2**) would not be affected by Proposed Action pumping because the occupied habitat is located outside of the 10-foot drawdown contour or it is considered low risk due to their occurrence in mountain block areas. Two additional streams (Silver and Snake creeks in Snake Valley), which have been targeted as future reintroduction sites, could have reduced flows as a result of pumping at the full build out plus 75 years and full build out plus 200 years time frames.

Seven streams (Big Springs, Lake, Snake, Strawberry, Spring Valley, Pahranagat, and Lower Meadow Valley Wash) that support native non-game fish species could be affected by Proposed Action pumping. Big Springs and Lake creeks support mottled sculpin, redside shiner, speckled dace, Utah chub, and Utah sucker. Strawberry Creek contains mottled sculpin, redside shiner, and speckled dace. The estimated miles located within the 10-foot drawdown contour is 27 miles at full build out plus 75 years and 34 miles at full build out plus 200 years. These stream reaches could have reduced flow due to Proposed Action pumping.

Special status fish species also occur in eight spring or pond locations including Butterfield and Flag Spring complex in White River Valley; Keegan, Stonehouse Spring complex, and Shoshone Ponds in Spring Valley; and Stateline and Big Springs in Snake Valley. Based on overlap with the 10-foot groundwater drawdown contour with occupied habitat for these species, potential flow reductions were predicted for Keegan Spring, Shoshone Ponds, Stonehouse Spring complex, and Stateline Springs. The estimated flow reductions for springs with available data included 2 to100 percent for Big Springs, 58 to 100 percent for Keegan Spring, and 1 to 18 percent for Butterfield Spring and 1 to 17 percent for Flag springs. The highest flow changes were predicted for the full build out plus 200 years time frame. Minor flow changes are predicted for least chub habitat in Foote Reservoir Springs due to the predicted percent reductions of 0 to 2.

Tribal Species

Native and non-native fish species potentially affected in Snake, Spring, Lake, and Lower Meadow Valley Wash basin streams (**Appendix F**, **Table F3.7-12**) are considered traditional values to regional Tribes. Streams and species affected are the same as discussed for game fish and special status species. The majority of the affected streams are located in Spring and Snake valleys.

Amphibians

Based on the modeling analysis, Proposed Action pumping potentially could affect habitat for one special status amphibian species, northern leopard frog. Impact analyses organized by species are provided in **Appendix F**, **Table F3.7-13B**. Northern leopard frog populations could be affected by pumping in 9 waterbodies in the full build out plus 75 years time frame and 10 waterbodies at the full build out plus 200 years time frame. These include Blind, Cleveland Ranch, Keegan, Minerva, North Millick, South Millick, and unnamed #5 springs and Shoshone Ponds (artesian well water sources) and O'Neal/Frog Pond in Spring Valley; and Wambolt Spring in Lake Valley. Model flow simulation results were available for three of the springs inhabited by this amphibian species. Model-simulated flow reductions ranged from 58 to 100 percent in Keegan Spring, 31 to 75 percent in North Millick Spring, and 55 to 99 percent in South Millick Spring. Flow changes in the springs would occur in one or both of the full build out plus 75 years and full build out plus 200 years time frames (**Appendix F**, **Table F3.7-11**). As discussed for fish species, flow reductions could result in substantial loss of wetted areas in these springs or ponds. Pumping effects on northern leopard frog habitat in Foote Reservoir are unlikely, based on the flow prediction analysis. Data are not available to predict percent flow changes in the other springs inhabited by this species. The effects of Proposed Action pumping on northern leopard frog would include reductions in habitat used for breeding and early development and adult life stages.

Proposed Action pumping also could adversely affect habitat for Arizona toad. The analysis indicated that flow could be reduced in a 3.3 mile length of Lower Meadow Valley Wash during the full build out plus 200-year time frame.

As discussed in the Utah pumping effects analysis section below, pumping effects on Columbia spotted frog habitat in Tule and Snake valleys are unlikely. Pumping would not affect relict leopard frog habitat in the Black Mountains area.

Invertebrates

Proposed Action pumping could adversely affect habitat for special status springsnails in seven springs (**Appendix F**, **Table F3.7-11**) and one perennial stream, Big Springs Creek (**Appendix F**, **Table F3.7-12**). Based on the model results, flow reductions could occur in seven and eight waterbodies, respectively, at the full build out plus 75 years and full build out plus 200 years time frames. Impact analyses organized by species are provided in **Appendix F**, **Table F3.7-13C**. Six petitioned species (Butterfield pyrg, Hardy pyrg, Flag pyrg, bifid duct pyrg, longitudinal gland pyrg, and Lake Valley pyrg) could be adversely affected by pumping, as discussed below. Pumping effects on the petitioned sub-globose Snake pyrg, which occurs in Foote Reservoir Springs in Utah, are unlikely, based on the flow prediction analysis.

- Bifid Duct Pyrg – Proposed Action pumping could reduce flows in one (Big Springs in Snake Valley) of three springs inhabited by this species in Nevada. The simulated flow reduction in this spring ranged from 2 to 100 percent for the 3 time frames. The 100 percent reduction at the two long-term time frames indicates that there could be a total loss of habitat for the species, which would eliminate the population at this location. Populations exist at two other springs in Spring Valley (Rock and Turnley/Woodsman), which would not be affected by Proposed Action pumping.
- Longitudinal Gland Pyrg – Flows could be reduced in four springs (Big Springs, unnamed spring north of Big Springs, Clay, and Stateline) and one stream (Big Springs Creek) inhabited by this species in Snake Valley. Flow reductions could eliminate or reduce habitat for this species in Nevada. Population effects could range from decreased numbers to a total loss of the population at a particular spring depending on the magnitude of flow reduction. Loss of one or more of these populations would represent a risk to the species viability due to its limited occurrence to these five locations in Snake Valley.
- Butterfield Pyrg – Flows could be reduced in Butterfield Spring in White River Valley, as indicated by simulated flow reductions of 1 to 18 percent. Habitat loss could reduce the population numbers for the only population in Nevada.
- Flag Pyrg – Flow reductions could adversely affect habitat and population numbers at one spring (Flag) in White River Valley. The simulated flow reduction was predicted to be 1 to 17 percent for the three model time frames. Habitat loss could reduce the population numbers for the only population in Nevada.
- Hardy Pyrg – Pumping could decrease flows in Butterfield Spring in White River Valley, as indicated by the simulated flow reductions of 1 to 18 percent. Flow reductions would decrease habitat, which could result in decreased population numbers for this species. Hardy pyrg is known to occur at seven springs in Cave and White River valleys.
- Lake Valley Pyrg – Flow reductions could decrease habitat for this species in one spring in Lake Valley, Wambolt Spring. The model analysis indicated potential flow reduction at full build out plus 200 years. The effect of habitat reduction could decrease population numbers in the only spring inhabited by this species.

Pumping also could reduce flows in 10 additional springs inhabited by non-petitioned springsnail species (designated as springsnails or Toquerville pyrg). Water levels also could be reduced in Pruess Lake, which contains California floater. It is important to note that water levels in Pruess Lake are controlled by upstream irrigators and therefore, water levels can vary extensively depending on irrigation activity.

Great Basin National Park Pumping Effects

Based on the groundwater drawdown analysis, Proposed Action pumping could reduce flows in two springs and two streams within the GBNP that contain game fish or nongame native fish species. The water resources analysis indicates that Rowland Spring (brook trout) occurs within an area of moderate risk of effects at full build out plus 200 years time frame. Outhouse Spring (Toquerville pyrg and glossy valvata snail) could have reduced flow and habitat at the full build out plus 75 years and full build out plus 200 years. Of the 2.2-mile-section of Lehman Creek that is located within the GBNP and model analysis area, approximately 0.5 mile could exhibit reduced flows at the full build out plus 200 years time frame. Of the 1.8-mile-section of Snake Creek in the GBNP and model analysis area, the entire 1.8 miles could have reduced flows at the full build out plus 75-year and 200-year time frames. As discussed in Section 3.3, Water Resources, a study by Elliott et al. (2006) indicated that other streams at risk include Shingle and Williams Canyon creeks in Spring Valley and Baker and Strawberry creeks in Snake Valley.

Utah Pumping Effects

In Utah, Proposed Action pumping could potentially affect two springs (Clay Spring and Stateline Springs) and two perennial streams (Lake Creek and Snake Creek) in Snake Valley. The analysis predicted that these waterbodies could be affected at full build out plus 75 years and full build out plus 200 years time frames. The following stream lengths in Utah were estimated to be affected by Proposed Action pumping for these model time frames: Snake Creek (1.2 miles) and Lake Creek (10.6 miles). Game fish and special status aquatic species associated with these waterbodies are listed in **Appendix F**, **Tables F3.7-11** and **F3.7-12**. Pumping effects on northern leopard frog, least chub, and sub-globose pyrg in Foote Reservoir Springs are unlikely, based on the flow prediction analysis. As discussed in Section 3.3, Water Resources, pumping effects to aquatic habitats in Pine, Tule, and Wah Wah valleys are unlikely. It is important to clarify that there is considerable uncertainty regarding the amount of subsurface flow between Snake Valley and Fish Springs Flat. A water balance analysis indicated a potential reduction of 4 to 10 percent in Fish Springs Flat at the 75 and 200 year after full build out time frames. If flows were reduced in Ibis and Pintail ponds in Fish Springs, least chub could be adversely affected by habitat loss. A separate model analysis by Halford and Plume (2011) indicated no effect in Fish Springs (see Section 3.3, Water Resources).

Compliance with Management Objectives

Six species were analyzed in terms of effects of Proposed Action pumping on management objectives (**Appendix F**, **Tables F3.7-8** and **F3.7-9**) for federally listed or conservation agreement species. Results of the analysis are listed below:

- Pahrump Poolfish – As part of the Spring Valley Stipulated Agreement, alternative withdrawal points would be considered for Shoshone Ponds. In addition, mitigation measure GW-WR-4 (drilling a deeper well to provide reliable water for Shoshone ponds) would eliminate pumping effects on Shoshone Ponds and habitat for this species. Therefore, Proposed Action pumping would not affect achievement of recovery plan conservation management objectives for Pahrump poolfish.
- White River Spinedace – Model-simulated percent flow reductions for the Flag Springs complex ranged from 1 to 17 for the 3 model time frames. The 17 percent reduction would conflict with the recovery plan objective of maintaining and enhancing aquatic habitat for White River spinedace at one of its critical habitat locations.
- Bonneville Cutthroat Trout – Flow reductions were predicted for six Bonneville cutthroat trout streams (Pine and Ridge creeks in Spring Valley and Big Wash, Hendry's, Snake, and Strawberry creeks in Snake Valley). Proposed Action pumping also could reduce flows in reintroduction sites in Silver and Snake creeks. Since Big Wash is considered one of the 14 conservation populations in Nevada (**Figure 3.7-7**), Proposed Action pumping would conflict with conservation management objectives for this species.
- Least Chub – Within the model anlaysis area, pumping effects on least chub are unlikely. Since there is a low risk of potential effects on least chub habitat in Fish Springs Flat and Foote Reservoir, conflict with the conservation agreement for this species is unlikely. The conservation agreement management objective specifies that the hydrological features of springs supporting least chub should be maintained. An ACM would be followed, which indicates that SNWA would comply with the conservation agreement for this species.
- Northern Leopard Frog – Flow reductions in 10 springs inhabited by northern leopard frog would conflict with the conservation management objective of protecting known or potential breeding sites for this species.
- Columbia Spotted Frog – Proposed Action pumping was not predicted to adversely affect habitat for Columbia spotted frog within the model analysis area. ACM C.1.49 also indicated that SNWA would comply with the conservation agreement for this species.

Flow or water level reductions also would conflict with management objectives for springs and spring brooks, as defined in the Wildlife Action Plan Team (2006) (**Appendix F**, **Table F3.7-10**).

The COM Plan would be developed and implemented to monitor and mitigate the effects of pumping on aquatic resources. The COM Plan would integrate protective measures from the following: BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation recommended in this EIS. The ACMs, Stipulated Agreements, and monitoring and mitigation recommendations that are part of the COM Plan are described below.

Applicant-committed Measures

As discussed in the Chapter 3, Affected Environment and Environmental Consequences, Introduction, ACMs would be implemented to reduce groundwater pumping impacts on environmental resources. The measures would involve monitoring, management, and mitigation measures required by existing agreements and adaptive management measures. The following items highlight those measures relative to aquatic biological resources. The ACM number from **Appendix E** is noted in parentheses.

Stipulated Agreements

These agreements follow an adaptive management framework such that changes to the monitoring program can occur based on new information and improved understanding of the groundwater-influenced ecosystems. Some potential mitigation and management options have been identified and the appropriate ones would be implemented based on the monitoring results. Thresholds for management action/response have not been identified, but this task would be initiated through the technical work groups. It will be important to link monitoring to appropriate management responses and mitigation to reduce or minimize adverse effects.

- Implement the Spring Valley Hydrologic Monitoring and Mitigation Plan (Hydrologic Area 184) (SNWA 2009b) and Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).
- Implement monitoring, management, and mitigation in Spring, Hamlin, and Snake valleys as required by the Spring Valley Stipulation (ACM C.1.1). Specifically, biological monitoring will be conducted in Spring Valley (Keegan, Minerva Complex, Shoshone Ponds, South Millick, Stonehouse Complex, Swallow, West Spring Valley Complex, Willard, Willow, 4WD Spring, unnamed spring #5) and Snake Valley (Big Springs Complex, Clay, North Little, and unnamed spring #1 north of Big Spring) (Biological Work Group 2009).
- Consider alternative withdrawal points from Shoshone Ponds as part of the Spring Valley Stipulated Agreement (ACM C.1.3).
- Ensure continued monitoring of Flag, Hot Spring, Moorman, Ash, Hiko, and Crystal springs as part of the Dry Lake, Delamar, Cave valleys Stipulation (ACM C.1.38).
- Monitor the biology of valley floor and range-front springs where special status species occur (with approved access) as part of the Dry Lake, Delamar, Cave valleys Stipulation (ACM C.1.42).
- Monitor selected sites for special status species and their habitat in Pahranagat Valley (Ash, Crystal, and Hiko springs) and White River Valley (Hot Creek, Flag, Moorman, and Hardy springs), as determined by the Biological Resource Team and Technical Review Panel (Dry Lake, Delamar, Cave valleys Stipulation) (ACM C.1.42).
- Implement the Hydrologic Monitoring and Mitigation Plan for Delamar, Dry Lake, and Cave Valleys (SNWA 2009c) and the Biological Monitoring Plan for the Dry Lake, Delamar, Cave valleys Stipulation (Biological Resource Team 2011).

Other Agreements

- The SNWA assists in the implementation of the Conservation Agreements for the least chub and Columbia spotted frog (ACMs C.1.48 and C.1.49). SNWA is a signatory to these agreements.

Applicant-committed Adaptive Management Measures

These measures to restore and enhance habitat for federally listed species would be implemented in cooperation with the Department of Interior agencies and the NDOW and UDWR.

- Reduce or cease groundwater withdrawals. Reduction or cessation of pumping would be determined on a case-by-case basis for individual production wells or well fields using technical and consultation processes identified in the stipulated agreements (ACM C.2.1).
- Conduct habitat enhancement for springsnails in Snake Valley by restoring natural fluvial morphology of spring flow systems (ACM C.2.6).

- Work with NDOW at the Flag Springs Complex in White River Valley to restore/enhance habitat for the White River spinedace, ensure long-term conservation for the species, and develop water management procedures that would optimize wetland conditions (ACM C.2.8).
- Work with the NDOW and private landowners in areas located at and downstream of Hiko, Crystal, and Ash springs to restore and remove non-native species to benefit Hiko White River springfish, White River springfish, and Pahranagat roundtail chub (ACM C.2.9).
- Work with the irrigation district in Pahranagat Valley to develop system efficiencies and manage water releases to benefit native fish (ACM C.2.10).
- Assist the BLM with habitat enhancement projects in Rainbow Canyon of Lower Meadow Valley Wash to improve conditions for White River speckled dace, southwestern willow flycatchers, and yellow-billed cuckoo (ACM C.2.14).
- Purchase property or obtain conservation easements on private lands in Snake Valley to reduce grazing impacts on springsnail habitat (ACM C.2.16).
- Purchase property or water rights to preserve or enhance habitat for White River spinedace (ACM C.2.17).
- Reduce or change grazing in wet meadows to improve habitat for northern leopard frog (ACM C.2.18).
- Conduct facilitated recharge projects to offset local groundwater drawdown to benefit sensitive biological areas (ACM C.2.21).

Monitoring Recommendations

GW-MN-AB-1: Stream Flow and Aquatic Biology Monitoring. Monitor flows in game fish streams with moderate and high risks where potential pumping effects could occur. See **Appendix F**, **Table F3.7-12** for a list of these streams for the Proposed Action. Monitoring measurements would include discharge and cross-sectional profiles. Cross-section data would be used to estimate flow changes on the wetted area of streams. Fish and macroinvertebrate surveys also would be conducted following methods approved by the DOI agencies and the NDOW.

Game fish streams to be monitored would include 1 stream in Lake Valley, 7 streams in Snake Valley, and 19 streams in Spring Valley (#184) (**Appendix F**, **Table F3.7-12**). Streams located on public lands are listed in **Table 3.3.2-9** in Water Resources. <u>Effectiveness</u>: This measure would be effective in providing baseline and post-project stream flows prior to and during groundwater pumping. <u>Effects on other resources</u>: Implementation of this measure could involve surface disturbance and operational pumping effects on resources, if alternative diversion points are developed.

GW-MN-AB-2: Spring and Aquatic Biology Monitoring. Monitor flows in moderate and high risk springs with game fish or special status species where potential pumping effects could occur. See Appendix **Table F3.7-11** for a list of these springs for the Proposed Action. Cross-sectional profile measurements would be taken in the springs. Biology surveys (fish, macroinvertebrates, springsnails, and amphibians) would follow methods described in the Spring Valley Stipulated Agreement. If monitoring indicates pumping effects, alternative diversion points would be considered.

Monitoring would be conducted at the following springs where pumping effects are predicted (Butterfield in White River Valley; Blind, Cleveland Ranch, North Millick, and Osborne in Spring Valley; Caine in Snake Valley; and Wambolt in Lake Valley). These springs contain special status aquatic species and would be in addition to springs being monitored as part of the Spring Valley and Delamar, Dry Lake, and Cave Valleys Stipulated Agreements (Keegan, Minerva, Shoshone Ponds, South Millick, Stonehouse, Swallow, West Spring Valley Complex, Willow, and unnamed spring #5 in Spring Valley; Big Springs, Clay, North Little, and unnamed spring #1 north of Big Springs in Snake Valley; Ash, Crystal, and Hiko springs in Pahranagat Valley; and Hot Creek, Flag, Moorman, and Hardy springs in White River Valley). Springs located on public lands are listed in **Table 3.3.2-9** in Water Resources. <u>Effectiveness</u>: This measure would be effective in identifying pumping effects on these springs. <u>Effects on other resources</u>: Implementation of this measure could involve surface disturbance and operational pumping effects on resources, if alternative diversion points are developed.

GW-MN-AB-3: Flow/habitat Determination. Flow- or water level-habitat relationships would be studied in selected streams and springs to determine minimum flow or water levels needed to support critical life stage of aquatic species in these habitats. The streams or springs would be selected from the list being monitored as part of the Stipulated Agreements or additional waterbodies recommended for Measures GWD-MN-AB-1 and GWD-MN-AB-2. Methods for determining minimum flows in stream habitats would be based on existing procedures involving flow-habitat measurements and flow preferences for fish species. It is anticipated that methods would need to be developed for spring habitats due to a general lack of studies. Effectiveness: This measure would be effective in determining flow-habitat relationships. Effects on other resources: This measure would not affect other resources.

A comprehensive monitoring, mitigation, and management plan would be developed for Snake Valley by the BLM in conjunction with the SNWA, other federal agencies, and the states of Utah and Nevada (**Appendix B**). Key concepts of the proposed Snake Valley 3M Plan are described in the monitoring and mitigation recommendations section in Section 3.3, Water Resources, Section 3.5, Vegetation Resources, and Section 3.6, Terrestrial Wildlife. The plan will include actions to manage or mitigate effects, such as geographic redistribution of groundwater withdrawals; reduction or cessation of groundwater withdrawals; acquisition of property or water rights for management of special status species; and augmentation of water supply or acquisition of exiting water rights. The establishment of technical working groups and baseline biological monitoring is also anticipated to be part of this plan. Biological monitoring could include population level studies for sensitive species or other surrogate species at representative locations. A Technical Work Group would be formed and they would determine through the Nature Conservancy's Conservation Action Planning process, if biological monitoring would be needed in Utah basins adjacent to Snake Valley.

Mitigation Recommendations

GW-AB-3: Flow Change Mitigation. The BLM would identify specific mitigation measures during subsequent NEPA for those springs or streams with game fish or special status aquatic species where flow or water level changes are identified during modeling or monitoring. Mitigation ideas are identified as part of ACMs under adaptive management (**Appendix E**). Mitigation options are identified in the COM Plan, ACMs under adaptive management, and water resource measure GW-WR-7. Effectiveness: This measure could be effective in reducing pumping effects on aquatic habitat, if impacts are avoided or offset by mitigation. The effectiveness would depend upon the additional mitigation that would be defined as part of the COM Plan and adaptive management. Without defining the actions to be implemented under this measure, it is not possible to describe effects of any actions on environmental resources.

As described in Section 3.3, Water Resources, mitigation measure **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies (see water resource monitoring measure GW-WR-3a) (see Water Resources, Section 3.3, for a complete wording of GW-WR-3a and GW-WR-7). If monitoring indicates that impacts are occurring or likely will occur in the future and are likely to cause or contribute to unnecessary or undue degradation to federal water resources and water rights, the BLM would determine if emergency action or a mitigation plan is required. The emergency action would involve the BLM issuing a "Cease and Desist" order to prevent additional impact and implementation of mitigation to alleviate impacts. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on water resources. These measures also would assist in protecting water-dependent resources such as aquatic species and their habitat. The specific mitigation measures may include but are not limited to the following:

- Reduction or cessation in groundwater withdrawals;
- Geographic redistribution of groundwater withdrawals;
- Recharge projects to offset local groundwater drawdown;
- Flow augmentation to maintain flow in specific water sources; or
- Other on-site or off-site improvements.

Monitoring of surface water resources and groundwater elevations under monitoring measure GW-WR-3a would be used to determine the effectiveness of the implemented measures.

As discussed in Section 3.3, Water Resources, Mitigation Measure GW-WR-5 would involve drilling a deeper well that would provide a reliable water source for Shoshone Ponds. The well would be drilled to a depth that would not be affected by pumping. Implementation of this measure would require surface disturbance at the well site, which would require erosion control measures to reduce sediment input to the ponds.

Mitigation planning could be developed as part of the Snake Valley 3M Plan (**Appendix B**). Management actions included in the Snake Valley 3M Plan that will be considered will include geographic redistribution of groundwater withdrawals; reduction or cessation of groundwater withdrawals; provision of consumptive water supply requirements using surface and/or groundwater sources; acquisition of property or water rights dedicated to management of special status species; and augmentation of water supply and/or acquisition of existing water rights.

Potential residual impacts include:

As discussed in Section 3.3, Water Resources, groundwater drawdown effects are predicted to extend for at least full build out plus 200 years. These potential effects on aquatic habitats including springs, ponds, lakes, and streams could occur during this time frame. Successful implementation of the COM Plan, ACMs, and monitoring and mitigation recommendations would likely reduce effects on aquatic habitat and their associated species at some locations. However, it is not possible to determine the level of impact reduction at this time. Effects on some aquatic habitats and species could exist considering the potential long recovery period that could occur in some aquatic habitats. Therefore, unavoidable impacts on aquatic habitat and species could occur at some locations.

A summary of impact information including ACMs and mitigation recommendations is provided for the Proposed Action in **Table 3.7-7**. This same tabular presentation is used in subsequent pumping effects analyses for Alternatives A through F and No Action.

Table 3.7-7 Summary of Aquatic Biological Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Proposed Action Pumping

Effects/Conclusions

- Flow reductions would modify habitat by decreasing depths, water velocities, and wetted area in spring/pond/lake and stream habitats. A total of 30 springs/ponds/lakes and 33 streams are at risk when considering the longest model time frame.
- Effects would be most pronounced in riffle habitats in streams and spring inflow and outflow areas. Effects on pool habitats would depend on the magnitude of the flow change and size of the pools. Reduced flows could adversely affect aquatic habitat by altering thermal regimes, increasing sedimentation, and reducing riparian cover. A complete loss of habitat could occur in small springs and larger springs such as Big Springs in Snake Valley.
- Flow reductions could adversely affect aquatic species by reducing abundance and diversity, altering composition, reducing food sources, limiting spawning and early life stage development, and decreasing individual health condition.
- Flow reductions in nine springs in Spring Valley and one spring in Lake Valley could result in habitat reductions and adverse effects on the special status amphibian, northern leopard frog. Flow reduction in Meadow Valley Wash could adversely affect Arizona toad.
- Flow reductions in Big Springs Creek and Lake Creek in Snake Valley could result in substantial loss of habitat and aquatic species.
- Flow reductions in four springs in Snake Valley could result in loss of bifid duct and longitudinal gland pyrg populations at these locations.
- Substantial flow reductions in Butterfield, Flag, and Wambolt springs could result in the loss of Butterfield, Flag, and Lake Valley pyrg populations due to their limited occurrence (one spring/one basin).
- Conflicts with recovery or conservation management objectives could occur for four species: Pahrump poolfish (Shoshone Ponds), White River spinedace (Flag Springs), Bonneville cutthroat trout (2 streams in Spring Valley and 4 streams in Snake Valley), and northern leopard frog (10 springs).
- Game fish species considered to be traditional values to regional Tribes could be affected in Snake, Spring, Lake, and Lower Meadow Valley Wash.

Impact Indicators[1] By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Number of Hydrologic Basins at Risk with Waterbodies Containing Game Fish or Special Status Species	1	3	6

Table 3.7-7 Summary of Aquatic Biological Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Proposed Action Pumping (Continued)

Impact Indicators[1] By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Estimated Percent Flow Reductions			
Butterfield Spring (White River Valley)	1	7	18
Flag Springs (White River Valley)	1	7	17
Keegan Spring (Spring Valley)	58	100	100
North Millick Spring (Spring Valley)	31	62	75
South Millick Spring (Spring Valley)	55	94	99
Big Springs (Snake Valley)	2	100	100
Federally Listed Species at Risk			
Pahrump poolfish	Unlikely effect	Potential effect	Potential effect
White River spinedace and critical habitat	Unlikely effect	Potential effect	Potential effect
Hiko White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
Pahranagat roundtail chub	Unlikely effect	Unlikely effect	Unlikely effect
Big Springs spinedace and critical habitat	No effect	No effect	No effect
Moapa dace	No effect	No effect	Unlikely effect
Number of Springs/Ponds/Lakes with Game or Special Status Fish Species at Risk	1	9	11
Number of Springs/Ponds/Lakes with Special Status Amphibian Species at Risk	3	9	10
Number of Springs/Ponds/Lakes with Special Status Invertebrate Species at Risk	0	7	8
Number of Small Springs (100 gpm) with Aquatic Species at Risk	0	13	15
Number of Streams with Game Fish or Special Status Species at Risk	4	25	31
Miles of Streams at Risk with Game Fish or Special Status Species	6	60	75
GBNP Springs and Streams[2] with Game Fish or Special Status Species at Risk			
Outhouse Spring	Unlikely effect	Potential effect	Potential effect
Rowland Spring	Unlikely effect	Unlikely effect	Potential effect
Lehman Creek	Unlikely effect	Unlikely effect	0.5 mile
Snake Creek	Unlikely effect	1.8 miles	1.9 miles
Utah Springs and Streams with Game Fish or Special Status Species at Risk			
Caine Spring	Unlikely effect	Potential effect	Potential effect
Clay Spring	Unlikely effect	Potential effect	Potential effect
Stateline Spring	Unlikely effect	Potential effect	Potential effect
Lake Creek	Unlikely effect	10.6 miles	10.6 miles
Snake Creek	Unlikely effect	1.2 miles	1.2 miles
COM Plan			
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and monitoring and mitigation recommendations.			

Table 3.7-7 Summary of Aquatic Biological Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Proposed Action Pumping (Continued)

ACMs
• Existing agreements include the Spring Valley Stipulation, Dry Lake, Delamar, Cave valleys Stipulation, Conservation Agreements (least chub and Columbia spotted frog), Utah and SNWA Snake Valley Environmental Monitoring and Management Agreement (not yet completed), and Candidate Conservation Agreement/Candidate Conservation Agreement with Assurances (not yet completed). • The Spring Valley and Dry Lake, Delamar, Cave valleys Stipulated Agreements will involve monitoring in selected springs in Spring, Snake, Delamar, Dry Lake, and Cave valleys (see Measures C.1.1 and C.1.42 in **Appendix E**). The Spring Valley Stipulated Agreement also would consider alternative withdrawal points from Shoshone Ponds. • Actions will be implemented as part of the Spring Valley and Dry Lake, Delamar, Cave valleys Stipulated Agreements to mitigate unreasonable adverse impacts to special status species (ACM C.2.1). Specific measures related to the mitigation will be developed as part of the monitoring and mitigation planning process. This process would extend into subsequent NEPA analyses for individual basins. • ACMs would be implemented to restore and enhance habitat for federally listed or special status species and would be done in cooperation with the USFWS. These measures would restore or enhance habitat for springsnails (ACM C.2.6 and C.2.16), White River spinedace (ACM C.2.8 and C.2.17), White River springfish (ACM C.2.9), Hiko White River springfish (ACM C.2.9), Pahranagat roundtail chub (ACM C.2.9), White River speckled dace (ACM C.2.14), and northern leopard frog (ACMC.2.18).
Monitoring Recommendations
GW-MN-AB-1 (Stream Flow and Aquatic Biology Monitoring) and **GW-MN-AB-2 (Spring and Aquatic Biology Monitoring)** would be applied to the Proposed Action. Springs and streams to be considered for monitoring are provided in **Appendix F3.7**, **Tables F3.7-11** and **F3.7-12**. Streams and springs located on public lands are listed in **Table 3.3.2-9** in Water Resources. **GW-MN-AB-3 (Flow/Habitat Determination)** would be conducted in selected springs and streams to be able to determine minimum flows or water levels for critical life stages of representative fish species. As described in Water Resources Section 3.3.2, GW-WR-3a (Comprehensive Water Resources Monitoring Plan) would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (See Water Resources, Section 3.3, for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-AB-3 (Flow Change Mitigation) would be applied to the Proposed Action. As described in Water Resources Section 3.3.2, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7). **GW-WR-5 (Shoshone Ponds Mitigation)** would avoid a conflict with management objectives for Pahrump poolfish (see Water Resources, Section 3.3, for complete wording of GW-RW-5).
Potential Residual Impacts
The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to aquatic habitats and species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate adverse impacts to fish. However, it is not possible to determine the level of impact reduction at this time. Effects on some aquatic habitats and species could exist considering the potential long recovery period that could occur in some aquatic habitats. Some unavoidable impacts on aquatic habitat and species could occur at some locations.

[1] Parameters are based on streams or springs that are located within the 10-foot drawdown contour and characterized as having moderate or high risk of pumping effects.

[2] A study by Elliott et al. (2006) indicated that other streams at risk include Shingle and Williams Canyon creeks in Spring Valley and Baker and Strawberry creeks in Snake Valley.

3.7.2.10 Alternative A

Groundwater Development Area

Surface disturbance would be dispersed throughout the five groundwater development basins (Snake, Spring, Delamar, Dry Lake, and Cave). The effects of constructing well pads, gathering pipelines, and electrical service lines would depend upon the location of the facilities in relation to aquatic biological resources. In total, 17 perennial streams and 5 springs with aquatic biological resources occur in the groundwater development areas. A more detailed account of the resource information includes:

- Game Fish – Species occur in 2 streams in Snake Valley and 13 streams in Spring Valley (**Table 3.7-1**; **Figure 3.7-3**).
- Special Status Fish – Bonneville cutthroat trout occurs in one stream (Big Wash in Snake Valley) (**Figure 3.7-3**).
- Special Status Amphibians – Northern leopard frog occurs in three springs (Blind, North Millick, and South Millick in Spring Valley) within the groundwater development areas (**Figure 3.7-4**).
- Springsnails – Toquerville pyrg (not a special status species) occurs in two springs within the groundwater development areas (unnamed spring southwest of Caine Spring in Snake Valley and unnamed spring near Cleve Creek in Spring Valley) (**Figure 3.7-4**).
- Macroinvertebrates – Species are present in all 17 perennial streams and 5 springs and waterbodies with seasonal water presence in the groundwater development area.

The effects and conclusions of groundwater development on aquatic biological resources are provided in **Table 3.7-8** along with ACMs and proposed mitigation.

Table 3.7-8 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative A Groundwater Development

Effects
• Construction could alter aquatic habitat on a short-term basis in 17 perennial streams and 5 springs with aquatic biological resources. Riparian vegetation near waterbodies could be affected on a long-term basis. Surface disturbance and vehicle/equipment could affect water quality from sediment input and risks from fuel spills on a short-term basis. • Instream activities in the spring or fall could affect trout spawning on a short-term basis. • Vehicle traffic near waterbodies could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods. • Special status Bonneville cutthroat trout could be affected in one stream within the groundwater development areas (Big Wash in Snake Valley). • Special status amphibian species (northern leopard frog) could be affected in three springs within the groundwater development areas. • Springsnail species could be affected in spring habitats within two of the groundwater development areas (one unnamed spring in Spring Valley and one spring in Snake Valley). • Conflicts with conservation management objectives could occur for two species: Bonneville cutthroat trout (Big Wash) and northern leopard frog (three springs). • Game fish species considered to be traditional values to regional Tribes could be affected in Snake and Spring valleys.
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and mitigation recommendations.
BLM RMP Direction and ACMs
• BLM RMP direction for development near springs specifies that surface water resources and associated riparian areas be maintained. • ACM B.1.1 and ACM B.1.3 will consider the presence of special status species and their habitat in the location of production wells, collector lines, and secondary substations. • ACM B.2.1 through B.2.3 will implement permit requirements on well drilling, abandonment, drilling, and water discharge.

Table 3.7-8 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative A Groundwater Development (Continued)

Proposed Mitigation
GW-AB-1 (avoidance of springs and wetlands with special status aquatic species) and **GW-AB-2 (establishing a 0.5-mile buffer near perennial streams with game fish and special status aquatic species)**, as described for the Proposed Action, would be applied to Alternative A.
Conclusions
• By avoiding springs and streams with game fish or special status species, short-term disturbance would be limited to waterbodies with seasonal flow or limited water volumes. Macroinvertebrates likely would be present in these waterbodies. • Vehicle traffic could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods.
Potential Residual Impacts
• Potential amphibian mortalities from vehicle traffic near temporary and permanent waterbodies during construction.

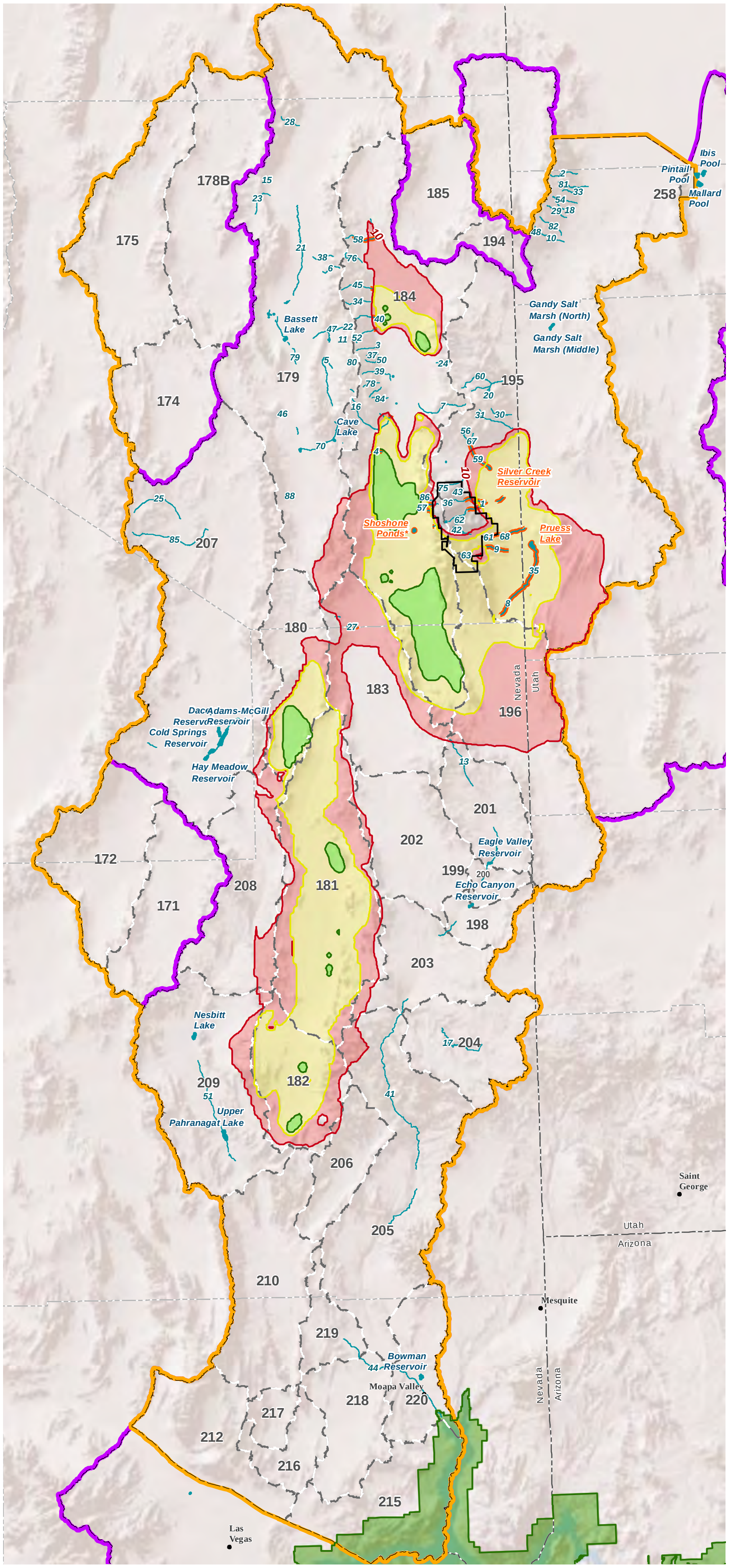
Groundwater Pumping

Alternative A would consist of reduced quantity pumping (114,755 afy) at distributed locations in Snake, Spring, and Delamar, Dry Lake, and Cave valleys. Alternative A pumping could result in reductions in aquatic habitat and affect aquatic species. Based on the model analysis, the predicted 10-foot drawdown contour for Alternative A pumping is shown for streams in **Figure 3.7-9** and springs in **Figure 3.7-10**. Flows could be reduced in the following number of habitats with aquatic biological resources for the three model time frames.

- Streams – 2 at full build out, 14 at full build out plus 75 years, and 19 at full build out plus 200 years; and
- Springs/Ponds/Lakes – 3 at full build out, 19 at full build out plus 75 years, and 28 at full build out plus 200 years.

Flow reductions could affect all types of aquatic communities including fish, amphibians, macroinvertebrates, macrophytes, and algae. For this EIS analysis, emphasis was placed on game fish and special status aquatic species. Alternative A could adversely affect the following game fish or special status species and their associated waterbody occurrences in at least one of the model time frames. Specific results for waterbodies and species at risk for each model time frame are provided in **Appendix F**, **Tables F3.7-14** and **F3.7-15**.

- Game Fish Streams – Geyser Creek in Lake Valley; Baker, Big Wash, Lake, Lehman, Silver, and Snake creeks in Snake Valley; Bastian, Indian, Meadow, Muncy, Piermont, Pine, Ridge, Shingle, Siegel, Willard, and Williams Canyon creeks in Spring Valley.
- Game Fish Springs/Ponds/Lakes – Swallow Spring in Spring Valley; Pruess Lake, Rowland Spring, and Silver Creek Reservoir in Snake Valley.
- Federally Listed Species – White River spinedace and critical habitat in Flag Springs (White River Valley) and Pahrump poolfish in Shoshone Ponds (Spring Valley).
- Bonneville Cutthroat Trout – Stream miles at risk for flow reductions include: Pine (0.1 to 0.4 mile or 12 to 50 percent of occupied habitat in this stream), Ridge (0.6 to 1.1 miles or 50 to 92 percent of occupied habitat in this stream), Big Wash (4.8 miles or 100 percent of occupied habitat in this stream), and Snake (<0.1 mile or <1 percent of occupied habitat in this stream).
- Other Special Status Fish Streams – Baker, Big Wash, and Snake creeks in Snake Valley and Ridge Creek in Spring Valley.
- Other Special Status Fish Springs/Ponds/Lakes – Butterfield and Flag springs in White River Valley; Keegan, and Shoshone Ponds in Spring Valley; and Big Springs and Stateline Springs in Snake Valley.



#	Stream Name
1	Baker Creek
2	Basin Creek
3	Bassett Creek
4	Bastian Creek
5	Berry Creek
6	Big Indian Creek
7	Big Negro Creek
8	Big Springs Creek
9	Big Wash
10	Birch Creek
11	Bird Creek
12	Board Creek
13	Camp Valley Creek
14	Cave Creek
15	Cherry Creek
16	Cleve Creek
17	Clover Creek
18	Cottonwood Creek
19	Deadman Creek
20	Deep Canyon Creek
21	Duck Creek
22	East Creek
23	Egan Creek
24	Eightmile Creek
25	Ellison Creek
26	Forest Home Creek
27	Geyser Creek
28	Goshute Creek
29	Granite Creek
30	Hampton Creek
31	Hendry's Creek
32	Indian Creek
33	Indian Farm Creek
34	Kalamazoo Creek
35	Lake Creek
36	Lehman Creek
37	Little Negro Creek
38	Mattier Creek
39	McCoy Creek
40	Meadow Creek
41	Meadow Valley Wash
42	Middle Fork Snake Creek
43	Mill Creek
44	Muddy River
45	Muncy Creek

#	Stream Name
46	Murry Creek
47	North Creek
48	North Fork of Birch Creek
49	North Fork Snake Creek
50	Odgers Creek
51	Pahranagat Creek
52	Piermont Creek
53	Pine Creek
54	Red Cedar Creek
55	Ridge Creek
56	Second Fork Silver Creek
57	Shingle Creek
58	Siegel Creek
59	Silver Creek
60	Smith Creek
61	Snake Creek
62	South Fork Baker Creek
63	South Fork Big Wash
64	South Fork Snake Creek
65	South Fork Willard Creek
66	South Taft Creek
67	Spring Creek (Tributary to Silver Creek)
68	Spring Creek (Tributary to Snake Creek)
69	Spring Valley Creek
70	Steptoe Creek
71	Steptoe Ranch Stream 3
72	Steptoe Ranch Stream 4a
73	Steptoe Ranch Stream 4b
74	Steptoe Ranch Stream 5
75	Strawberry Creek
76	Sunkist (North) Creek
77	Sunnyside Creek
78	Taft Creek
79	Tailings Creek
80	Timber Creek
81	Tom's Creek
82	Trout Creek
83	Upper Snake Creek
84	Vipont Creek
85	White River
86	Willard Creek
87	Williams Canyon Creek
88	Willow Creek

Underlined streams may be affected where "At Risk" stream segments intersect drawdown.

- Potentially Affected "At Risk" Stream Segment
- Potentially Affected "At Risk" Waterbody

Legend

Water Features Containing Sensitive Aquatic Biology or Game Fish

- Perennial Stream Reach
- Waterbody
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

* Fed by artesian well

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-9

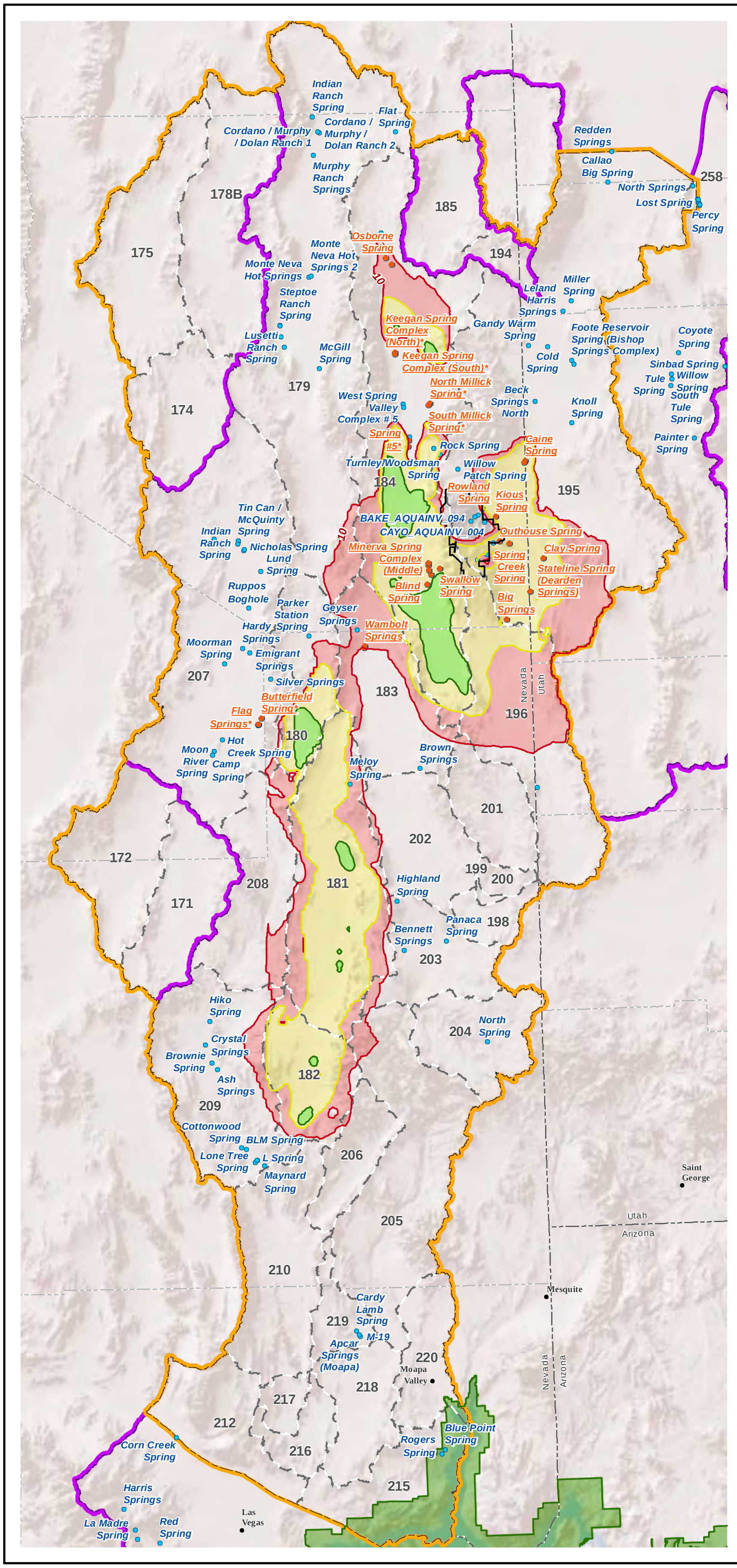
Alternative A Drawdown and Streams/ Waterbodies with Aquatic Biological Resources

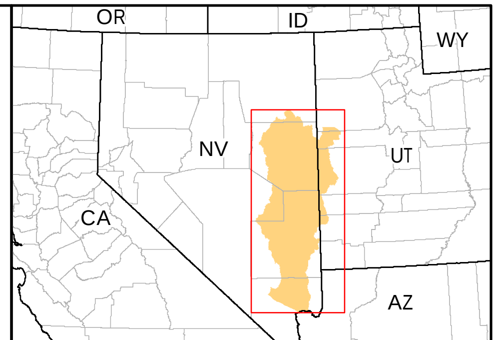
0 5 10 15 20 25 50 Miles

0 5 10 15 20 25 50 75 Kilometers

1:2,000,000

N





Legend

- Spring Containing Sensitive Aquatic Biology or Game Fish
- Potentially Affected Spring Containing Sensitive Aquatic Biology or Game Fish
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

*Spring is outside 10-ft drawdown contour, but model-predicted flow reductions indicate potential effect.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-10

Alternative A Drawdown and Springs with Aquatic Biological Resources

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

- Special Status Amphibian Species Springs/Ponds/Lakes – Blind, Keegan, Minerva, North Millick, South Millick, and unnamed #5 springs and Shoshone Ponds and O'Neal/Frog Pond in Spring Valley and Wambolt Spring in Lake Valley.
- Special Status Invertebrates Springs/Ponds/Lakes – Butterfield and Flag springs in White River Valley; Big Springs, Clay, Stateline Springs, one unnamed spring, and Pruess Lake in Snake Valley; and Wambolt Spring in Lake Valley.

The effects and conclusions of groundwater development on aquatic biological resources are provided in **Table 3.7-9** along with ACMs and proposed mitigation.

Table 3.7-9 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative A Pumping

Effects/Conclusions

- Flow reductions would modify habitat by decreasing depths, water velocities, and wetted area in spring/pond/lake and stream habitats. A total of 28 springs/ponds/lakes and 20 streams are at risk when considering the longest model time frame.
- Effects would be most pronounced in riffle habitats in streams and spring inflow and outflow areas. Effects on pool habitats would depend on the magnitude of the flow change and size of the pools. Reduced flows could adversely affect aquatic habitat by altering thermal regimes, increasing sedimentation, and reducing riparian cover. A complete loss of habitat could occur in small springs and larger springs such as Big Springs in Snake Valley.
- Flow reductions could adversely affect aquatic species by reducing abundance and diversity, altering composition, reducing food sources, limiting spawning and early life stage development, and decreasing individual health condition.
- Flow reductions in 8 springs/ponds in Spring Valley and 1 spring in Lake Valley could result in habitat reductions and adverse effects on the special status amphibian, northern leopard frog.
- Flow reductions in Big Springs Creek and Lake Creek in Snake Valley could result in substantial loss of habitat and aquatic species.
- Flow reductions in 4 springs in Snake Valley could result in loss of bifid duct and longitudinal gland pyrg populations at these locations.
- Due to their limited occurrence (one spring/one basin), populations of Butterfield pyrg (Butterfield Spring), Flag pyrg (Flag Springs), and Lake Valley pyrg (Wambolt Spring) could be lost if their spring habitat is substantially reduced.
- Conflicts with recovery or conservation management objectives could occur for four species: Pahrump poolfish (Shoshone Ponds), White River spinedace (Flag Springs), Bonneville cutthroat trout (2 streams in Spring Valley and 2 streams in Snake Valley), and northern leopard frog (9 springs/ponds).
- Game fish species considered to be traditional values to regional Tribes could be affected in Snake and Spring valleys.

Impact Indicators[1] By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Number of Hydrologic Basins at Risk with Waterbodies Containing Game Fish or Special Status Species	1	2	4
Estimated Percent Flow Reductions			
Butterfield Spring (White River Valley)	0	3	8
Flag Springs (White River Valley)	1	3	8
Keegan Spring (Spring Valley)	12	28	36
North Millick Spring (Spring Valley)	4	9	11
South Millick Spring (Spring Valley)	10	21	24
Big Springs (Snake Valley)	2	100	100
Federally Listed Species at Risk			
Pahrump poolfish	Unlikely effect	Potential effect	Potential effect
White River spinedace and critical habitat	Unlikely effect	Unlikely effect	Potential effect
Hiko White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
Pahranagat roundtail chub	No effect	No effect	No effect
Big Springs spinedace and critical habitat	No effect	No effect	No effect
Moapa dace	No effect	No effect	No effect

Table 3.7-9 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative A Pumping (Continued)

Impact Indicators[1] By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Number of Springs/Ponds/Lakes with Game or Special Status Fish Species at Risk	2	8	10
Number of Springs/Ponds/Lakes with Special Status Amphibian Species at Risk	2	6	9
Number of Springs/Ponds/Lakes with Special Status Invertebrate Species at Risk	0	5	8
Number of Small Springs (100 gpm) with Aquatic Species at Risk	0	7	12
Number of Streams with Game Fish or Special Status Species at Risk	2	14	19
Miles of Streams at Risk with Game Fish or Special Status Species	3	45	58
GBNP Springs and Streams[2] with Game Fish or Special Status Species at Risk			
Outhouse Spring	Unlikely effect	Potential effect	Potential effect
Rowland Spring	Unlikely effect	Unlikely effect	Potential effect
Lehman Creek	Unlikely effect	Unlikely effect	0.5 mile
Snake Creek	Unlikely effect	1.8 miles	1.9 miles
Utah Springs and Streams with Game Fish or Special Status Species at Risk			
Caine Spring	Unlikely effect	Potential effect	Potential effect
Clay Spring	Unlikely effect	Potential effect	Potential effect
Stateline Spring	Unlikely effect	Potential effect	Potential effect
Lake Creek	Unlikely effect	10.6 miles	10.6 miles
Snake Creek	Unlikely effect	1.2 miles	1.2 miles

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and monitoring and mitigation recommendations.

ACMs

- Existing agreements include the Spring Valley Stipulation, Dry Lake, Delamar, Cave valleys Stipulation, Conservation Agreements (least chub and Columbia spotted frog) Utah and SNWA Snake Valley Environmental Monitoring and Management Agreement with Assurances (not yet completed), and Candidate Conservation Agreement/Candidate Conservation Agreement with Assurances (not yet completed).
- The Spring Valley and Dry Lake, Delamar, Cave valleys Stipulated Agreements will involve monitoring in selected springs in Spring, Snake, Delamar, Dry Lake and Cave valleys (see Measures C.1.1 and C.1.42 in **Appendix E**). The Spring Valley Stipulated Agreement also would consider alternative withdrawal points from Shoshone Ponds.
- Actions will be implemented as part of the Spring Valley and Dry Lake, Delamar, Cave valleys Stipulated Agreements to mitigate unreasonable adverse impacts to special status species (ACM C.2.1). Specific measures related to the mitigation will be developed as part of the monitoring and mitigation planning process. This process would extend into subsequent NEPA analyses for individual basins.
- ACMs would be implemented to restore and enhance habitat for federally listed or special status species and would be done in cooperation with the USFWS. These measures would restore or enhance habitat for springsnails (ACM C.2.6 and ACM C.2.16), White River spinedace (ACM C.2.8 and ACM C.2.17), White River springfish (ACM C.2.9), Hiko White River springfish (ACM C.2.9), Pahranagat roundtail chub (ACM C.2.9), White River speckled dace (ACM C.2.14), and northern leopard frog (ACMC.2.18).

Table 3.7-9 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative A Pumping (Continued)

Monitoring Recommendations
GW-MN-AB-1 (Stream Flow and Aquatic Biology Monitoring) and **GW-MN-AB-2** (Spring and Aquatic Biology Monitoring) described for the Proposed Action, would be applied to Alternative A. Springs and streams to be considered for monitoring are provided in **Appendix F3.7**, **Tables F3.7-14** and **F3.7-15**. Streams and springs located on public lands are listed in **Table 3.3.2-9** in Water Resources. **GW-MN-AB-3 (Stream Flow and Aquatic Biology Monitoring)** will be conducted in selected springs and streams to be able to determine minimum flows or water levels for critical life stages of representative fish species. As described in Water Resources, Section 3.3, GW-WR-3a (Comprehensive Water Resources Monitoring Plan) would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-AB-3 (Flow Change Mitigation) described for the Proposed Action, also would be applied to Alternative A. As described in Water Resources, Section 3.3, GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights) would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7). **GW-WR-5 (Shoshone Ponds Mitigation)** would avoid a conflict with management objectives for Pahrump poolfish (see Water Resources, Section 3.3, for complete wording of GW-WR-5).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to aquatic habitats and species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate adverse impacts to fish. However, it is not possible to determine the level of impact reduction at this time. Effects on some aquatic habitats and species could exist considering the potential long recovery period that could occur in some aquatic habitats. Some unavoidable impacts on aquatic habitat and species could occur at some locations.

[1] Parameters are based on streams or springs that are located within the 10-foot drawdown contour and characterized as having moderate or high risk of pumping effects.

[2] A study by Elliott et al. (2006) indicated that other streams at risk include Shingle and Williams Canyon creeks in Spring Valley and Baker and Strawberry creeks in Snake Valley.

3.7.2.11 Alternative B

Groundwater Development Area

Surface disturbance would be focused on an approximate 1-mile radius of diversion points in five basins (Snake, Spring, Cave, Dry Lake, and Delamar). The effects of constructing well pads, gathering pipelines, and electrical service lines would depend upon the location of the facilities in relation to aquatic biological resources. In total, one perennial stream (Big Springs Creek in Snake Valley) and one spring (Kious Spring in Snake Valley) with aquatic biological resources occur within a 1-mile radius of diversion points. A more detailed account of the resource information includes:

- Game Fish – No species are present in Big Springs Creek or Kious Spring.
- Native Fish – Native species (mottled sculpin, redside shiner, speckled dace, and Utah chub) that have limited distribution in Nevada occur in Big Springs Creek.
- Special Status Amphibians – No species are present in Big Springs Creek or Kious Spring.
- Springsnails – Springsnails (species not identified) occur in Kious Spring.
- Macroinvertebrates – Species are present in Big Springs Creek, Kious Spring, and waterbodies with seasonal water presence in the groundwater development area.

The effects and conclusions of groundwater development on aquatic biological resources are provided in **Table 3.7-10** along with ACMs and proposed mitigation.

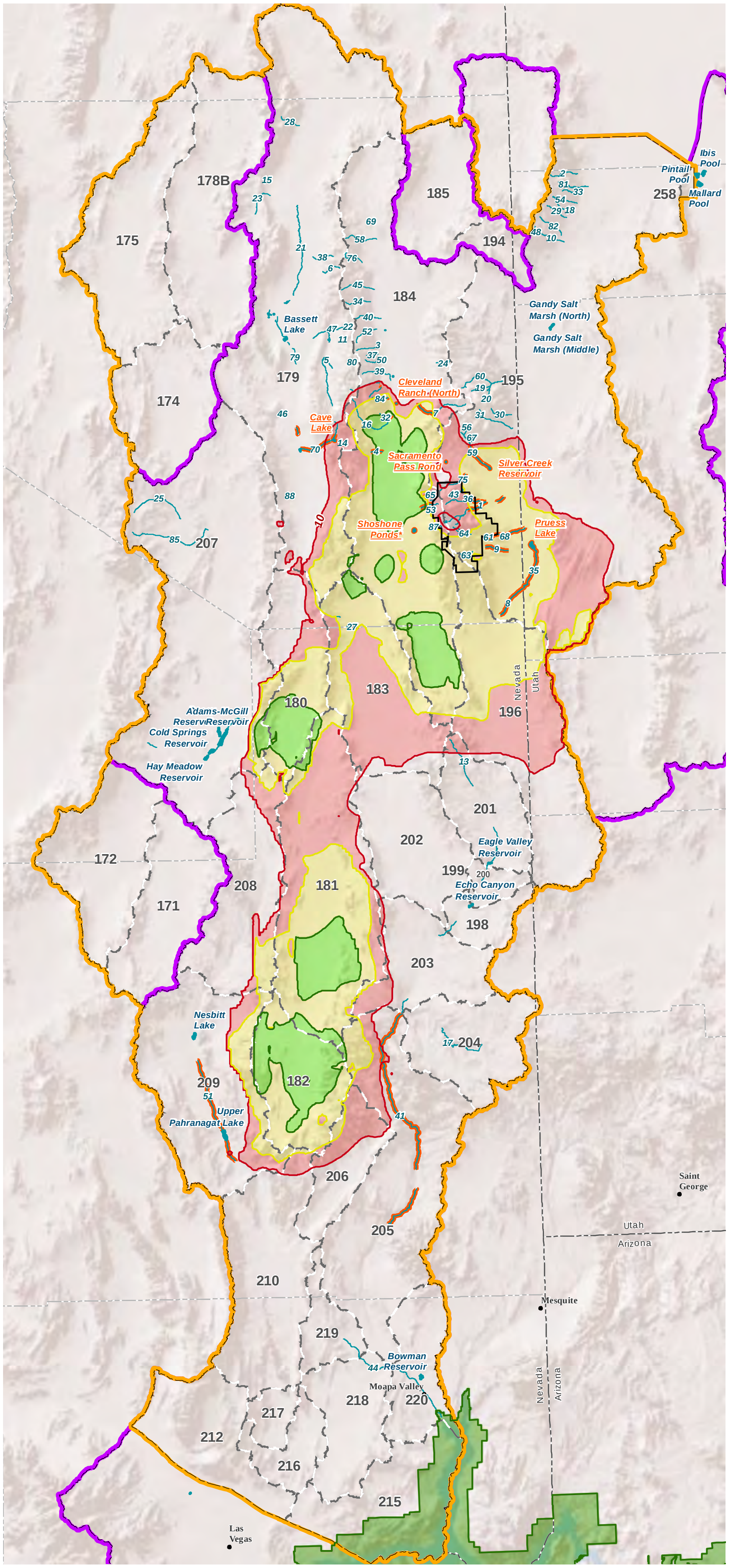
Table 3.7-10 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative B Groundwater Development

Effects
• Construction could alter aquatic habitat on a short-term basis in one perennial stream (Big Springs Creek) and one spring (Kious) in Snake Valley. Riparian vegetation near waterbodies could be affected on a long-term basis. Surface disturbance and vehicle/equipment could affect water quality from sediment input and risks from fuel spills on a short-term basis. • Vehicle traffic near waterbodies could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods. • Springsnail species could be affected in Kious Spring in one of the groundwater development areas in Snake Valley. • There would be no conflicts with management objectives for special status species. • There would be no effects on fish species considered to be traditional values to regional Tribes.
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and mitigation recommendations.
BLM RMP Direction and ACMs
• The BLM RMP direction for development near springs specifies that surface water resources and associated riparian areas be maintained. • ACMs B.1.1 and B.1.3 will consider the presence of special status species and their habitat in the location of production wells, collector lines, and secondary substations. • ACMs B.2.1 through B.2.3 will implement permit requirements on well drilling, abandonment, drilling, and water discharge.
Proposed Mitigation
GW-AB-1 (Avoidance of springs and wetlands with special status species) and **GW-AB-2 (Establishing a 0.5-mile buffer near perennial streams with game fish and special status species)**, as described for the Proposed Action, would be applied to Alternative B.
Conclusions
• By avoiding springs and streams with game or native fish or special status species, short-term disturbance would be limited to waterbodies with seasonal flow or limited water volumes. Macroinvertebrates likely would be present in these waterbodies. • Vehicle traffic could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods.
Potential Residual Impacts
• Potential amphibian mortalities from vehicle traffic near temporary and permanent waterbodies during construction.

Groundwater Pumping

Alternative B would consist of full quantity pumping (176,655 afy) at or near Points of Diversions in Snake, Spring, and Delamar, Dry Lake, and Cave valleys. Alternative B pumping could result in reductions in aquatic habitat and affect aquatic species. Based on the model analysis, the predicted 10-foot drawdown contour for Alternative B pumping is shown for streams in **Figure 3.7-11** and springs in **Figure 3.7-12**. Flows could be reduced in the following number of habitats with aquatic biological resources for the three model time frames.

- Streams – 3 at full build out, 18 at full build out plus 75 years, and 24 at full build out plus 200 years; and
- Springs/Ponds/Lakes – 8 at full build out, 27 at full build out plus 75 years, and 33 at full build out plus 200 years.



#	Stream Name	#	Stream Name
1	Baker Creek	46	Murry Creek
2	Basin Creek	47	North Creek
3	Bassett Creek	48	North Fork of Birch Creek
4	Bastian Creek	49	North Fork Snake Creek
5	Berry Creek	50	Odgers Creek
6	Big Indian Creek	51	Pahranagat Creek
7	Big Negro Creek	52	Piermont Creek
8	Big Springs Creek	53	Pine Creek
9	Big Wash	54	Red Cedar Creek
10	Birch Creek	55	Ridge Creek
11	Bird Creek	56	Second Fork Silver Creek
12	Board Creek	57	Shingle Creek
13	Camp Valley Creek	58	Siegel Creek
14	Cave Creek	59	Silver Creek
15	Cherry Creek	60	Smith Creek
16	Cleve Creek	61	Snake Creek
17	Clover Creek	62	South Fork Baker Creek
18	Cottonwood Creek	63	South Fork Big Wash
19	Deadman Creek	64	South Fork Snake Creek
20	Deep Canyon Creek	65	South Fork Willard Creek
21	Duck Creek	66	South Taft Creek
22	East Creek	67	Spring Creek (Tributary to Silver Creek)
23	Egan Creek	68	Spring Creek (Tributary to Snake Creek)
24	Eightmile Creek	69	Spring Valley Creek
25	Ellison Creek	70	Steptoe Creek
26	Forest Home Creek	71	Steptoe Ranch Stream 3
27	Geyser Creek	72	Steptoe Ranch Stream 4a
28	Goshute Creek	73	Steptoe Ranch Stream 4b
29	Granite Creek	74	Steptoe Ranch Stream 5
30	Hampton Creek	75	Strawberry Creek
31	Hendry's Creek	76	Sunkist (North) Creek
32	Indian Creek	77	Sunnyside Creek
33	Indian Farm Creek	78	Taft Creek
34	Kalamazoo Creek	79	Tailings Creek
35	Lake Creek	80	Timber Creek
36	Lehman Creek	81	Tom's Creek
37	Little Negro Creek	82	Trout Creek
38	Mattier Creek	83	Upper Snake Creek
39	McCoy Creek	84	Vipont Creek
40	Meadow Creek	85	White River
41	Meadow Valley Wash	86	Willard Creek
42	Middle Fork Snake Creek	87	Williams Canyon Creek
43	Mill Creek	88	Willow Creek
44	Muddy River		
45	Muncy Creek		

Underlined streams may be affected where "At Risk" stream segments intersect drawdown.

Potentially Affected "At Risk" Stream Segment

Potentially Affected "At Risk" Waterbody

Legend

Water Features Containing Sensitive Aquatic Biology or Game Fish

- Perennial Stream Reach
- Waterbody
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

* Fed by artesian well

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-11

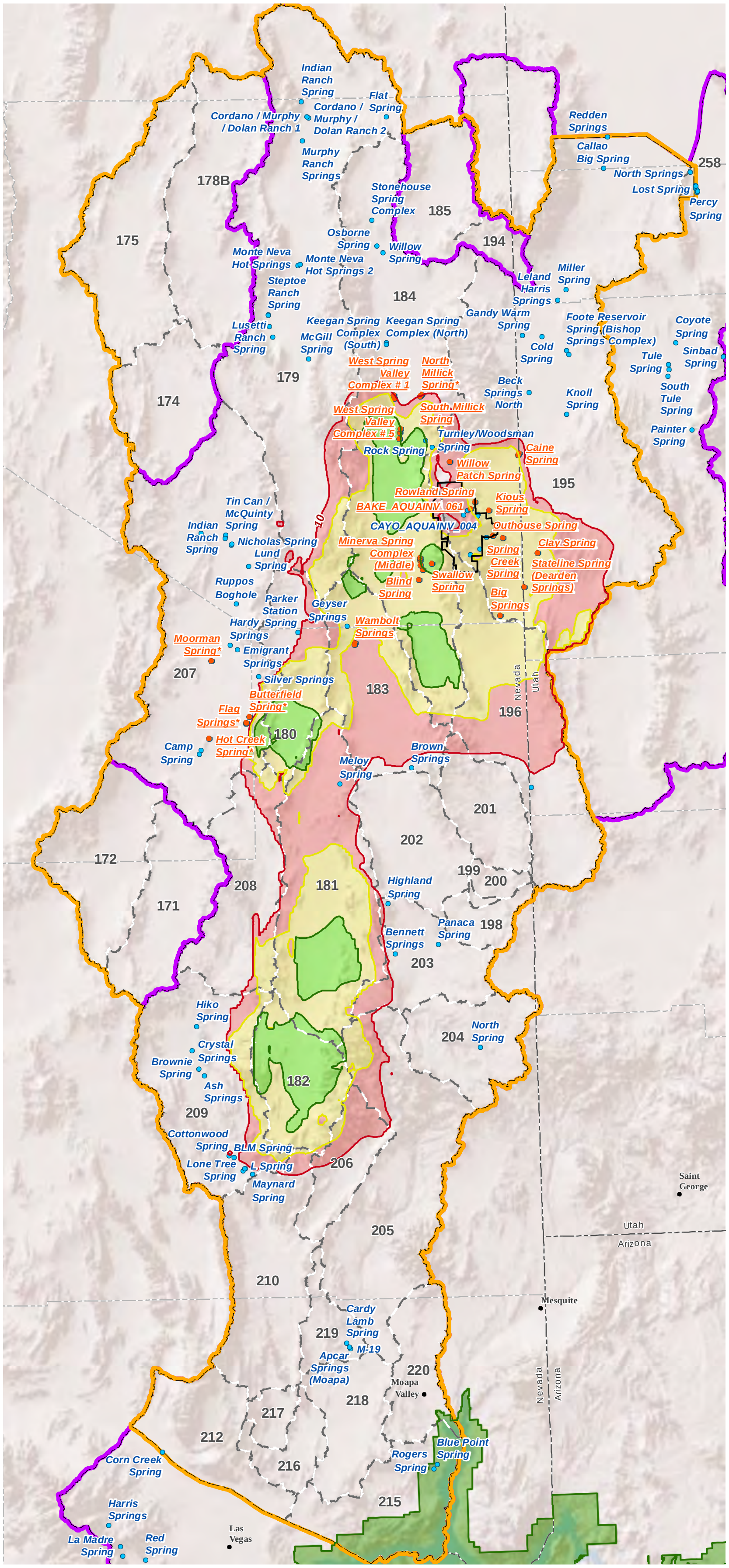
Alternative B Drawdown and Streams/ Waterbodies with Aquatic Biological Resources

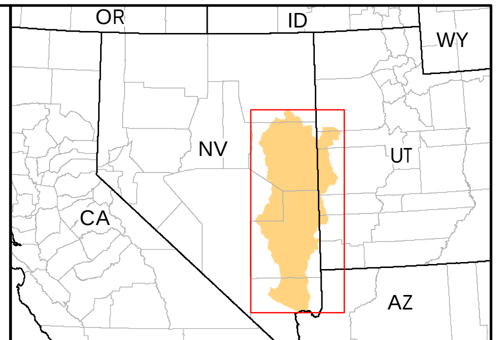
0 5 10 15 20 25 50 Miles

0 5 10 15 20 25 50 75 Kilometers

1:2,000,000

N





Legend

- Spring Containing Sensitive Aquatic Biology or Game Fish
- Potentially Affected Spring Containing Sensitive Aquatic Biology or Game Fish
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

*Spring is outside 10-ft drawdown contour, but model-predicted flow reductions indicate potential effect.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-12

Alternative B Drawdown and Springs with Aquatic Biological Resources

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000

N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Flow reductions could affect all types of aquatic communities including fish, amphibians, macroinvertebrates, macrophytes, and algae. For this EIS analysis, emphasis was placed on game fish and special status aquatic species. Alternative B could adversely affect the following game fish or special status species and their associated waterbody occurrences in at least one of the model time frames. Specific results for waterbodies and species at risk for each model time frames are provided in **Appendix F**, **Tables F3.7-16** and **F3.7-17**.

- Game Fish Streams – Steptoe Creek in Steptoe Valley; Geyser Creek in Lake Valley; Baker, Big Wash, Lake, Lehman, Silver, Snake, and Strawberry creeks in Snake Valley; Bastian, Indian, Negro, Pine, Ridge, Shingle, Taft, South Taft, Vipont, Willard, and Williams Canyon creeks in Spring Valley; and Lower Meadow Valley Wash (stream and basin name).
- Game Fish Springs/Ponds/Lakes – Swallow Spring in Spring Valley; Pruess Lake, Rowland Spring, and Silver Creek Reservoir in Snake Valley; and Cave Lake in Steptoe Valley.
- Federally Listed Species – White River spinedace and critical habitat in Flag Springs (White River Valley) and Pahrump poolfish in Shosone Ponds (Spring Valley).
- Bonneville Cutthroat Trout – Stream miles at risk for flow reductions include: Pine (0.1 to 0.4 mile or 12 to 50 percent of occupied habitat in this stream), Ridge (0.6 to 1.1 miles or 50 to 92 percent of occupied habitat in this stream), Big Wash (4.8 miles or 100 percent of occupied habitat in this stream), Strawberry (1.5 to 1.9 miles or 23 to 30 percent of occupied habitat in this stream), and Snake (<0.1 mile or < 1 percent of occupied habitat in this stream).
- Other Special Status Fish Streams – Baker, Big Wash, Snake, and Strawberry creeks in Snake Valley; Pine and Ridge creeks in Spring Valley; and Meadow Valley Wash (same valley name).
- Other Special Status Fish Springs/Ponds/Lakes – Butterfield, Flag, Hot Creek and Moorman springs in White River Valley; Keegan Spring and Shoshone Ponds in Spring Valley; and Big Springs and Stateline Springs in Snake Valley.
- Special Status Amphibian Species (Northern Leopard Frog) Springs/Ponds/Lakes – Blind, Cleveland Ranch, Keegan, Minerva, North Millick, South Millick, West Valley Complex, and unnamed # 5 springs and Shoshone Ponds in Spring Valley and Wambolt Spring in Lake Valley.
- Special Status Amphibian Species (Arizona Toad) – Lower Meadow Valley Wash.
- Special Status Invertebrates Springs/Ponds/Lakes – Butterfield, Flag, Hot Creek, and Moorman springs in White River Valley; Big Springs, Clay, Stateline, and one unnamed spring and Pruess Lake in Snake Valley; and Wambolt Spring in Lake Valley.

The effects and conclusions of groundwater development on aquatic biological resources are provided in **Table 3.7-11** along with ACMs and proposed mitigation.

Table 3.7-11 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative B Pumping

Effects/Conclusions			
• Flow reductions would modify habitat by decreasing depths, water velocities, and wetted area in spring/pond/lake and stream habitats. A total of 32 springs/ponds/lakes and 24 streams are at risk when considering the longest model time frame. • Effects would be most pronounced in riffle habitats in streams and spring inflow and outflow areas. Effects on pool habitats would depend on the magnitude of the flow change and size of the pools. Reduced flows could adversely affect aquatic habitat by altering thermal regimes, increasing sedimentation, and reducing riparian cover. A complete loss of habitat could occur in small springs and larger springs such as Big Springs in Snake Valley. • Flow reductions could adversely affect aquatic species by reducing abundance and diversity, altering composition, reducing food sources, limiting spawning and early life stage development, and decreasing individual health condition. • Flow reductions in 9 springs/ponds in Spring Valley and 1 spring in Lake Valley could result in habitat reductions and adverse effects on the special status amphibian, northern leopard frog. Flow reductions in Lower Meadow Valley Wash could adversely affect Arizona toad. • Flow reductions in Big Springs Creek and Lake Creek in Snake Valley could result in substantial loss of habitat and aquatic species. • Flow reductions in 4 springs in Snake Valley could result in loss of bifid duct and longitudinal gland pyrg populations at these locations. • Due to their limited occurrence (one spring/one basin), populations of Butterfield pyrg (Butterfield Spring) Flag pyrg (Flag Springs), and Lake Valley pyrg (Wambolt Spring) could be lost if their spring habitat is substantially reduced. • Conflicts with recovery or conservation management objectives could occur for 4 species: Pahrump poolfish (Shoshone Ponds), White River spinedace (Flag Springs), Bonneville cutthroat trout (2 streams in Spring Valley and 3 streams in Snake Valley), and northern leopard frog (10 springs). • Game fish species considered to be traditional values to regional Tribes could be affected in Snake, Spring, Lake, Steptoe, and Lower Meadow Valley Wash valleys.			
Impact Indicators[1] By Model Time Frame	**Full Build Out**	**Full Build Out Plus 75 Years**	**Full Build Out Plus 200 Years**
Number of Hydrologic Basins at Risk with Waterbodies Containing Game Fish or Special Status Species	3	4	7
Estimated Percent Flow Reductions			
Butterfield Spring (White River Valley)	20	34	45
Flag Springs (White River Valley)	19	29	37
Hot Creek Spring (White River Valley)	3	5	7
Moorman Spring (White River Valley)	2	4	6
Keegan Spring (Spring Valley)	0	3	5
North Millick Spring (Spring Valley)	2	18	42
South Millick Spring (Spring Valley)	8	47	99
Big Springs (Snake Valley)	7	100	100
Federally Listed Species at Risk			
Pahrump poolfish	Unlikely effect	Potential effect	Potential effect
White River spinedace and critical habitat	Potential effect	Potential effect	Potential effect
Hiko White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
Pahranagat roundtail chub	No effect	No effect	No effect
Big Springs spinedace and critical habitat	No effect	No effect	Unlikely effect
Moapa dace	No effect	No effect	Unlikely effect
Number of Springs/Ponds/Lakes with Game or Special Status Fish Species at Risk	4	10	14
Number of Springs/Ponds/Lakes with Special Status Amphibian Species at Risk	3	8	10
Number of Springs/Ponds/Lakes with Special Status Invertebrate Species at Risk	3	7	10
Number of Small Springs (100 gpm) with Aquatic Species at Risk	2	9	13
Number of Streams with Game Fish or Aquatic Species at Risk	3	18	24

Table 3.7-11 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative B Pumping (Continued)

Impact Indicators[1] By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Miles of Streams at Risk with Game Fish or Special Status Species	3	59	72
GBNP Springs and Streams[2] with Game Fish or Special Status Species at Risk			
Outhouse Spring	Unlikely effect	Potential effect	Potential effect
Rowland Spring	Unlikely effect	Potential effect	Potential effect
Baker Creek	Unlikely effect	1.2 miles	1.6 miles
Lehman Creek	Unlikely effect	2.0 miles	2.5 miles
Snake Creek	Unlikely effect	1.9 miles	1.9 miles
Utah Springs and Streams with Game Fish or Special Status Species at Risk			
Clay Spring	Unlikely effect	Potential effect	Potential effect
Stateline Spring	Unlikely effect	Potential effect	Potential effect
Lake Creek	Unlikely effect	10.6 miles	10.6 miles
Snake Creek	Unlikely effect	0.6 mile	0.6 mile

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional monitoring and mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and monitoring and mitigation recommendations.

ACMs

- Existing agreements include the Spring Valley Stipulation, Dry Lake, Delamar, Cave valleys Stipulation, Conservation Agreements (least chub and Columbia spotted frog) Utah and SNWA Snake Valley Environmental Monitoring and Management Agreement (not yet completed), and Candidate Conservation Agreement/Candidate Conservation Agreement with Assurances (not yet completed).
- The Spring Valley and Dry Lake, Delamar, Cave valleys Stipulated Agreements will involve monitoring in selected springs in Spring, Snake, Delamar, Dry Lake and Cave valleys (see ACMs C.1.1 and C.1.42 in **Appendix E**). The Spring Valley Stipulated Agreement also would consider alternative withdrawal points from Shoshone Ponds.
- Actions will be implemented as part of the Spring Valley and Dry Lake, Delamar, Cave valleys Stipulated Agreements to mitigate unreasonable adverse impacts to special status species (ACM C.2.1). Specific measures related to the mitigation will be developed as part of the monitoring and mitigation planning process. This process would extend into subsequent NEPA analyses for individual basins.
- ACMs would be implemented to restore and enhance habitat for federally listed or special status species and would be done in cooperation with the USFWS. These measures would restore or enhance habitat for springsnails (ACMs C.2.6 and C.2.16), White River spinedace (ACMs C.2.8 and C.2.17), White River springfish (ACMs C.2.9), Hiko White River springfish (ACM C.2.9), Pahranagat roundtail chub (ACM C.2.9), White River speckled dace (ACM C.2.14), and northern leopard frog (ACM C.2.18).

Monitoring Recommendations

GW-MN-AB-1 (Stream Flow and Aquatic Biology Monitoring) and **GW-MN-AB-2 (Spring and Aquatic Biology Monitoring)** described for the Proposed Action, would be applied to Alternative B. Springs and streams to be considered for monitoring are provided in **Appendix F3.7**, **Tables F3.7-16** and **F3.7-17**. Streams and springs located on public lands are listed in **Table 3.3.2-9** in Water Resources.

GW-MN-AB-3 (Flow/Habitat Determination) will be conducted in selected springs and streams to be able to determine minimum flows or water levels for critical life stages of representative fish species.

As described in Water Resources, Section 3.3, GW-WR-3a (Comprehensive Water Resources Monitoring Plan) would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).

Table 3.7-11 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative B Pumping (Continued)

Mitigation Recommendations
GW-AB-3 (Flow Change Mitigation) described for the Proposed Action, also would be applied to Alternative B. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7). **GW-WR-5 (Shoshone Ponds Mitigation)** would avoid a conflict with management objectives for Pahrump poolfish (see Water Resources, Section 3.3, for complete wording of GW-WR-5).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to aquatic habitats and species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate adverse impacts to fish. However, it is not possible to determine the level of impact reduction at this time. Effects on some aquatic habitats and species could exist considering the potential long recovery period that could occur in some aquatic habitats. Some unavoidable impacts on aquatic habitat and species could occur at some locations.

[1] Parameters are based on streams or springs that are located within the 10-foot drawdown contour and characterized as having moderate or high risk of pumping effects.

[2] A study by Elliott et al. (2006) indicated that other streams at risk include Shingle and Williams Canyon creeks in Spring Valley and Baker and Strawberry creeks in Snake Valley.

3.7.2.12 Alternative C

Groundwater Development Area

Surface disturbance would be dispersed throughout the five groundwater development basins (Snake, Spring, Cave, Dry Lake, and Delamar). The effects of constructing well pads, gathering pipelines, and electrical service lines would depend upon the location of the facilities in relation to aquatic biological resources. In total, 23 perennial streams and 5 springs with aquatic biological resources occur in the groundwater development areas. A more detailed account of the resource information includes:

- Game Fish – Species occur in 2 streams in Snake Valley and 13 streams in Spring Valley (**Table 3.7-1**; **Figure 3.7-3)**.
- Special Status Fish – Bonneville cutthroat trout occurs in one stream (Big Wash in Snake Valley) (**Figure 3.7-3)**.
- Special Status Amphibians – Northern leopard frog occurs in three springs (Blind, North Millick, and South Millick in Spring Valley) within the groundwater development areas (**Figure 3.7-4**).
- Springsnails – Toquerville pyrg (not a special status species) occurs in two springs within the groundwater development areas (unnamed spring southwest of Caine Spring in Snake Valley and unnamed spring near Cleve Creek in Spring Valley) (**Figure 3.7-4**).
- Macroinvertebrates – Species are present in all 17 perennial streams and 5 springs and waterbodies with seasonal water presence in the groundwater development area.

The effects and conclusions of groundwater development on aquatic biological resources are provided in **Table 3.7-12** along with ACMs and proposed mitigation.

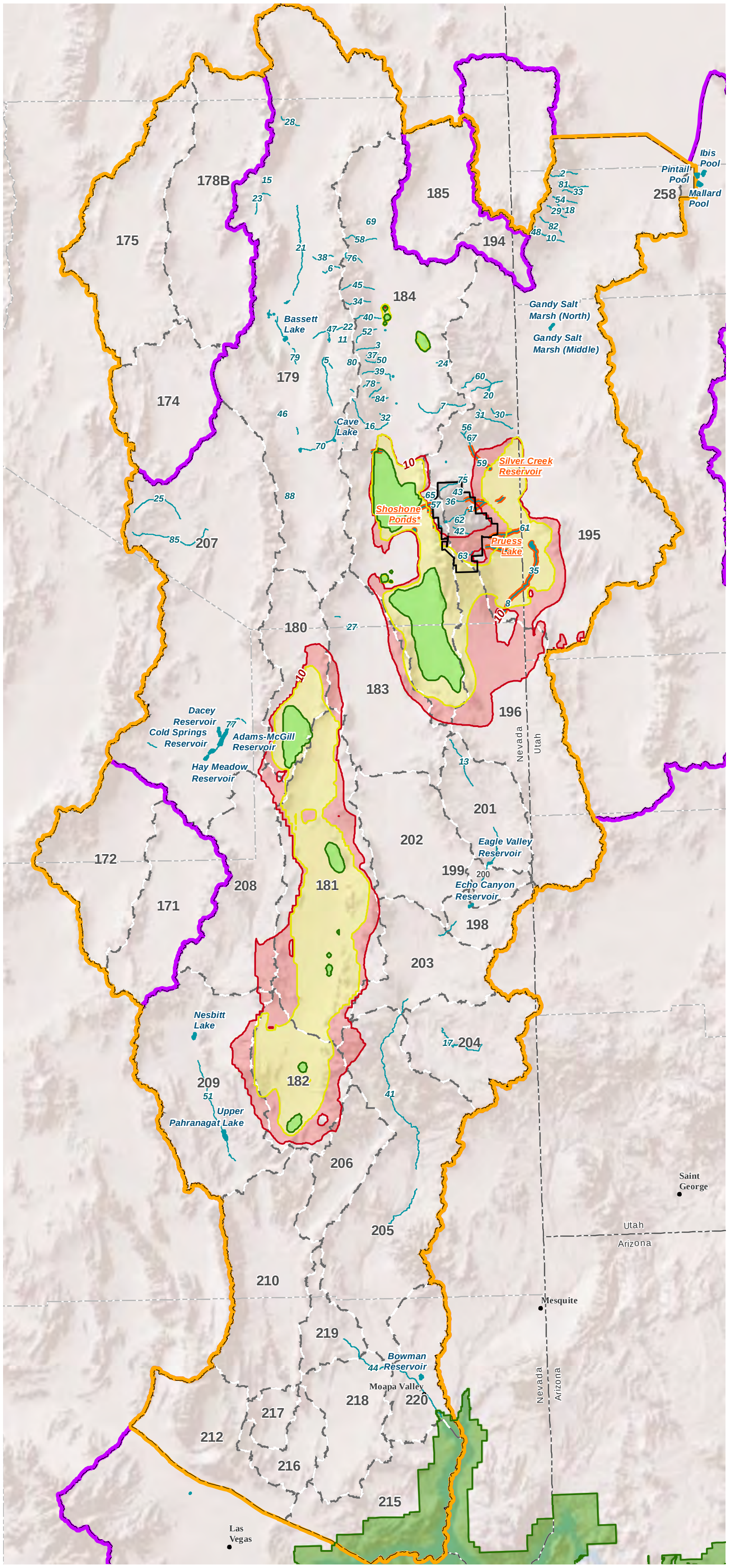
Table 3.7-12 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative C Groundwater Development

Effects
• Construction could alter aquatic habitat on a short-term basis in 17 perennial streams and 5 springs with aquatic biological resources. Riparian vegetation near waterbodies could be affected on a long-term basis. Surface disturbance and vehicle/equipment could affect water quality from sediment input and risks from fuel spills on a short-term basis. • Instream activities in the spring or fall could affect trout spawning on a short-term basis. • Vehicle traffic near waterbodies could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods. • Special status Bonneville cutthroat trout could be affected in one stream within the groundwater development areas (Big Wash in Snake Valley). • Special status amphibian species (northern leopard frog) could be affected in three springs within the groundwater development areas. • Springsnail species could be affected in spring habitats within two of the groundwater development areas (one unnamed spring in Spring Valley and one spring in Snake Valley). • Conflicts with conservation management objectives could occur for two species: Bonneville cutthroat trout (Big Wash) and northern leopard frog (3 springs). • Game fish species considered to be traditional values to regional Tribes could be affected in Snake and Spring valleys.
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and mitigation recommendations.
BLM RMP Direction and ACMs
• BLM RMP direction for development near springs specifies that surface water resources and associated riparian areas be maintained. ACM B.1.1 and B.1.3 will consider the presence of special status species and their habitat in the location of production wells, collector lines, and secondary substations. • ACM B.2.1 through B.2.3 will implement permit requirements on well drilling, abandonment, drilling, and water discharge.
Proposed Mitigation
GW-AB-1 (Avoidance of springs and wetlands with special status species) and **GW-AB-2 (Establishing a 0.5-mile buffer near perennial streams with game fish and special status species)**, as described for the Proposed Action, would be applied to Alternative C.
Conclusions
• By avoiding springs and streams with game fish or special status species, short-term disturbance would be limited to waterbodies with seasonal flow or limited water volumes. Macroinvertebrates likely would be present in these waterbodies. • Vehicle traffic could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods.
Potential Residual Impacts
• Potential amphibian mortalities from vehicle traffic near temporary and permanent waterbodies during construction.

Groundwater Pumping

Alternative C would consist of intermittent pumping (between 12,000 to 114,755 afy) at distributed locations in Snake, Spring, Delamar, Dry Lake, and Cave valleys based on a conceptual drought scenario. Alternative C pumping could result in reductions in aquatic habitat and affect aquatic species. Based on the model analysis, the predicted 10-foot drawdown contour for Alternative C pumping is shown for streams in **Figure 3.7-13** and springs in **Figure 3.7-14**. Flows could be reduced in the following number of habitats with aquatic biological resources for the three model time frames.

- Streams – 1 at full build out, 12 at full build out plus 75 years, and 13 at full build out plus 200 years; and
- Springs/Ponds/Lakes – 2 at full build out, 13 at full build out plus 75 years, and 20 at full build out plus 200 years.



#	Stream Name	#	Stream Name
1	Baker Creek	46	Murry Creek
2	Basin Creek	47	North Creek
3	Bassett Creek	48	North Fork of Birch Creek
4	Bastian Creek	49	North Fork Snake Creek
5	Berry Creek	50	Odgers Creek
6	Big Indian Creek	51	Pahranagat Creek
7	Big Negro Creek	52	Piermont Creek
8	Big Springs Creek	53	Pine Creek
9	Big Wash	54	Red Cedar Creek
10	Birch Creek	55	Ridge Creek
11	Bird Creek	56	Second Fork Silver Creek
12	Board Creek	57	Shingle Creek
13	Camp Valley Creek	58	Siegel Creek
14	Cave Creek	59	Silver Creek
15	Cherry Creek	60	Smith Creek
16	Cleve Creek	61	Snake Creek
17	Clover Creek	62	South Fork Baker Creek
18	Cottonwood Creek	63	South Fork Big Wash
19	Deadman Creek	64	South Fork Snake Creek
20	Deep Canyon Creek	65	South Fork Willard Creek
21	Duck Creek	66	South Taft Creek
22	East Creek	67	Spring Creek (Tributary to Silver Creek)
23	Egan Creek	68	Spring Creek (Tributary to Snake Creek)
24	Eightmile Creek	69	Spring Valley Creek
25	Ellison Creek	70	Steptoe Creek
26	Forest Home Creek	71	Steptoe Ranch Stream 3
27	Geyser Creek	72	Steptoe Ranch Stream 4a
28	Goshute Creek	73	Steptoe Ranch Stream 4b
29	Granite Creek	74	Steptoe Ranch Stream 5
30	Hampton Creek	75	Strawberry Creek
31	Hendry's Creek	76	Sunkist (North) Creek
32	Indian Creek	77	Sunnyside Creek
33	Indian Farm Creek	78	Taft Creek
34	Kalamazoo Creek	79	Tailings Creek
35	Lake Creek	80	Timber Creek
36	Lehman Creek	81	Tom's Creek
37	Little Negro Creek	82	Trout Creek
38	Mattier Creek	83	Upper Snake Creek
39	McCoy Creek	84	Vipont Creek
40	Meadow Creek	85	White River
41	Meadow Valley Wash	86	Willard Creek
42	Middle Fork Snake Creek	87	Williams Canyon Creek
43	Mill Creek	88	Willow Creek
44	Muddy River		
45	Muncy Creek		

Underlined streams may be affected where "At Risk" stream segments intersect drawdown.

Potentially Affected "At Risk" Stream Segment

Potentially Affected "At Risk" Waterbody

Legend

Water Features Containing Sensitive Aquatic Biology or Game Fish

- Perennial Stream Reach
- Waterbody
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

* Fed by artesian well

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-13

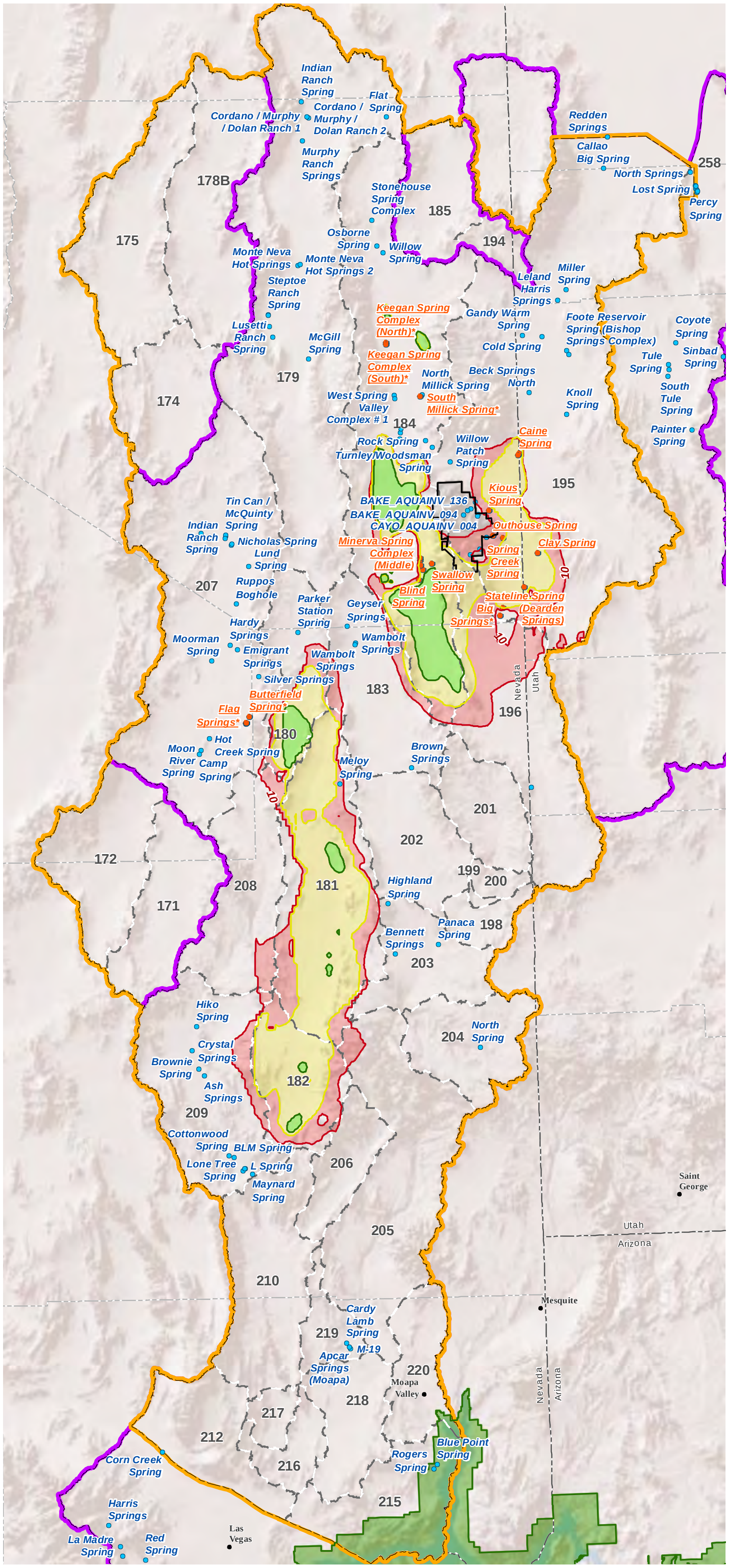
Alternative C Drawdown and Streams/ Waterbodies with Aquatic Biological Resources

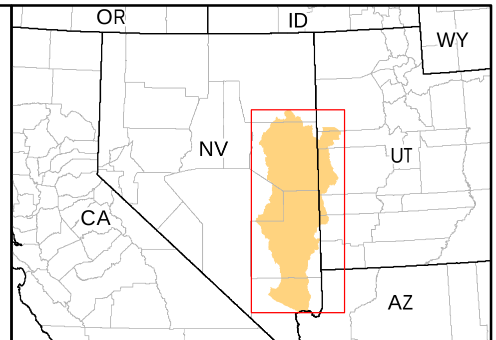
0 5 10 15 20 25 50 Miles

0 5 10 15 20 25 50 75 Kilometers

1:2,000,000

N





Legend

- Spring Containing Sensitive Aquatic Biology or Game Fish
- Potentially Affected Spring Containing Sensitive Aquatic Biology or Game Fish
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

*Spring is outside 10-ft drawdown contour, but model-predicted flow reductions indicate potential effect.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-14

Alternative C Drawdown and Springs with Aquatic Biological Resources

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

Flow reductions could affect all types of aquatic communities including fish, amphibians, macroinvertebrates, macrophytes, and algae. For this EIS analysis, emphasis was placed on game fish and special status aquatic species. Alternative C could adversely affect the following game fish or special status species and their associated waterbody occurrences in at least one of the model time frames. Specific results for waterbodies and species at risk for each model time frames are provided in **Appendix F**, **Tables F3.7-18** and **F3.7-19**.

- Game Fish Streams – Baker, Big Wash, Lake, Lehman, Silver, and Snake creeks in Snake Valley; Bastian, Pine, Ridge, Shingle, and Williams Canyon creeks in Spring Valley.
- Game Fish Springs/Ponds/Lakes – Swallow Spring in Spring Valley; Pruess Lake, Rowland Spring, and Silver Creek Reservoir in Snake Valley.
- Federally Listed Species – Pahrump poolfish in Shoshone Pones (Spring Valley).
- Bonneville Cutthroat Trout – Stream miles at risk for flow reductions include: Pine (0.1 mile or 12 percent of occupied habitat in this stream), Ridge (0.6 mile or 50 percent of occupied habitat in this stream), Big Wash (2.6 to 4.8 miles or 54 to 100 percent of occupied habitat in this stream), and Snake (<0.1 mile or <1 percent of occupied habitat in this stream).
- Other Special Status Fish Streams – Baker, Big Wash, and Snake creeks in Snake Valley; and Pine and Ridge creeks in Spring Valley.
- Other Special Status Fish Springs/Ponds/Lakes – Keegan and Shoshone Ponds in Spring Valley; and Big Springs and Stateline Springs in Snake Valley.
- Special Status Amphibian Species Springs/Ponds/Lakes – Blind, Keegan, Minerva, North Millick, South Millick, and Shoshone Ponds in Spring Valley.
- Special Status Invertebrates Springs/Ponds/Lakes – Big Springs, Clay, Stateline, and one unnamed spring, and Pruess Lake in Snake Valley.

The effects and conclusions of groundwater development on aquatic biological resources are provided in **Table 3.7-13** along with ACMs and proposed mitigation.

Table 3.7-13 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative C Pumping

Effects/Conclusions
• Flow reductions would modify habitat by decreasing depths, water velocities, and wetted area in spring/pond/lake and stream habitats. A total of 19 springs/ponds/lakes and 13 streams are at risk when considering the longest model time frame. • Effects would be most pronounced in riffle habitats in streams and spring inflow and outflow areas. Effects on pool habitats would depend on the magnitude of the flow change and size of the pools. Reduced flows could adversely affect aquatic habitat by altering thermal regimes, increasing sedimentation, and reducing riparian cover. A complete loss of habitat could occur in small springs and larger springs such as Big Springs in Snake Valley. • Flow reductions could adversely affect aquatic species by reducing abundance and diversity, altering composition, reducing food sources, limiting spawning and early life stage development, and decreasing individual health condition. • Flow reductions in 6 springs/ponds in Spring Valley could result in habitat reductions and adverse effects on the special status amphibian, northern leopard frog. • Flow reductions in Big Springs Creek and Lake Creek in Snake Valley could result in substantial loss of habitat and aquatic species. • Flow reductions in 4 springs in Snake Valley could result in loss of bifid duct and longitudinal gland pyrg populations at these locations. • Conflicts with management objectives could occur for three species: Pahrump poolfish (Shoshone Ponds), Bonneville cutthroat trout (2 streams each in Spring and Snake valleys), and northern leopard frog (5 springs/ponds). • Game fish species considered to be traditional values to regional Tribes could be affected in Snake and Spring valleys.

Table 3.7-13 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative C Pumping (Continued)

Impact Indicators[1] By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Number of Hydrologic Basins at Risk with Waterbodies Containing Game Fish or Special Status Species	1	2	2
Estimated Percent Flow Reductions			
Butterfield Spring (White River Valley)	0	2	5
Flag Springs (White River Valley)	1	2	5
Keegan Spring (Spring Valley)	12	14	15
North Millick Spring (Spring Valley)	4	5	5
South Millick Spring (Spring Valley)	10	12	11
Big Springs (Snake Valley)	2	87	100
Federally Listed Species at Risk			
Pahrump poolfish	Unlikely effect	Potential effect	Potential effect
White River spinedace and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
Hiko White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
Pahranagat roundtail chub	No effect	No effect	No effect
Big Springs spinedace and critical habitat	No effect	No effect	No effect
Moapa dace	No effect	No effect	No effect
Number of Springs/Ponds/Lakes with Game or Special Status Fish Species at Risk	1	7	9
Number of Springs/Ponds/Lakes with Special Status Amphibian Species at Risk	2	4	6
Number of Springs/Ponds/Lakes with Special Status Invertebrate Species at Risk	0	5	5
Number of Small Springs (100 gpm) with Aquatic Species at Risk	0	3	6
Number of Streams with Game Fish or Special Status Species at Risk	1	12	13
Miles of Streams at Risk with Game Fish and Special Status Species	1	29	43
GBNP Springs and Streams[2] with Game Fish or Special Status Species at Risk			
Outhouse Spring	Unlikely effect	Unlikely effect	Potential effect
Rowland Spring	Unlikely effect	Unlikely effect	Unlikely effect
Lehman Creek	Unlikely effect	Unlikely effect	<0.1 mile
Snake Creek	Unlikely effect	Unlikely effect	1.9 miles
Utah Springs and Streams with Game Fish or Special Status Species at Risk			
Caine Spring	Unlikely effect	Potential effect	Potential effect
Clay Spring	Unlikely effect	Potential effect	Potential effect
Stateline Spring	Unlikely effect	Potential effect	Potential effect
Lake Creek	Unlikely effect	10.6 miles	10.6 miles
Snake Creek	Unlikely effect	1.2 miles	1.2 miles
COM Plan			
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional monitoring and mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and mitigation recommendations.			

Table 3.7-13 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative C Pumping (Continued)

ACMs
• Existing agreements include the Spring Valley Stipulation, Dry Lake, Delamar, Cave valleys Stipulation, Conservation Agreements (least chub and Columbia spotted frog) Utah and SNWA Snake Valley Environmental Monitoring and Management Agreement (not yet completed), and Candidate Conservation Agreement/Candidate Conservation Agreement with Assurances (not yet completed). • The Spring Valley and Dry Lake, Delamar, Cave valleys Stipulated Agreements will involve monitoring in selected springs in Spring, Snake, Delamar, Dry Lake, and Cave valleys (see ACMs C.1.1 and C.1.42 in **Appendix E**). The Spring Valley Stipulated Agreement also would consider alternative withdrawal points from Shoshone Ponds. • Actions will be implemented as part of the Spring Valley and Dry Lake, Delamar, Cave valleys Stipulated Agreements to mitigate unreasonable adverse impacts to special status species (ACM C.2.1). Specific measures related to the mitigation will be developed as part of the monitoring and mitigation planning process. This process would extend into subsequent NEPA analyses for individual basins. • ACMs would be implemented to restore and enhance habitat for federally listed or special status species and would be done in cooperation with the USFWS. These measures would restore or enhance habitat for springsnails (ACM C.2.6 and C.2.16), White River spinedace (ACMs C.2.8 and C.2.17), White River springfish (ACM C.2.9), Hiko White River springfish (ACM C.2.9), Pahranagat roundtail chub (ACM C.2.9), White River speckled dace (ACM C.2.14), and northern leopard frog (ACM C.2.18).
Monitoring Recommendations
GW-MN-AB-1 (Stream Flow and Aquatic Biology Monitoring) and **GW-MN-AB-2 (Spring and Aquatic Biology Monitoring)** described for the Proposed Action, would be applied to Alternative C. Springs and streams to be considered for monitoring are provided in **Appendix F3.7**, **Tables F3.7-16** and **F3.7-17**. Streams and springs located on public lands are listed in **Table 3.3.2-9** in Water Resources. **GW-MN-AB-3 (Flow/Habitat Determination)** will be conducted in selected springs and streams to be able to determine minimum flows or water levels for critical life stages of representative fish species. As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-AB-3 (Flow Change Mitigation) described for the Proposed Action, also would be applied to Alternative C. As described in **Water Resources, Section 3.3, GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7). **GW-WR-5 (Shoshone Ponds Mitigation)** would avoid a conflict with management objectives for Pahrump poolfish (see Water Resources, Section 3.3 for complete wording of GW-WR-5).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to aquatic habitats and species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to fish. However, it is not possible to determine the level of impact reduction at this time. Effects on some aquatic habitats and species could exist considering the potential long recovery period that could occur in some aquatic habitats. Some unavoidable adverse impacts on aquatic habitat and species could occur at some locations.

[1] Parameters are based on streams or springs that are located within the 10-foot drawdown contour and characterized as having moderate or high risk of pumping effects.

[2] A study by Elliott et al. (2006) indicated that other streams at risk include Shingle and Williams Canyon creeks in Spring Valley and Baker and Strawberry creeks in Snake Valley.

3.7.2.13 Alternative D

Groundwater Development Area

Development in Snake Valley and the White County portion of Spring Valley would be eliminated. Surface disturbance could be dispersed throughout the remaining portions of Spring, Cave, Delamar, and Dry Lake basins. The effects of constructing well pads, gathering pipelines, and electrical service lines would depend upon the location of the facilities in relation to aquatic biological resources. No perennial streams or spring habitat with aquatic biological resources occur in the groundwater development areas. No game fish or special status species are present in intermittent streams or springs with the Alternative D development areas. Macroinvertebrates would likely occur in these waterbodies.

The effects and conclusions of groundwater development on aquatic biological resources are provided in **Table 3.7-14** along with ACMs and proposed mitigation.

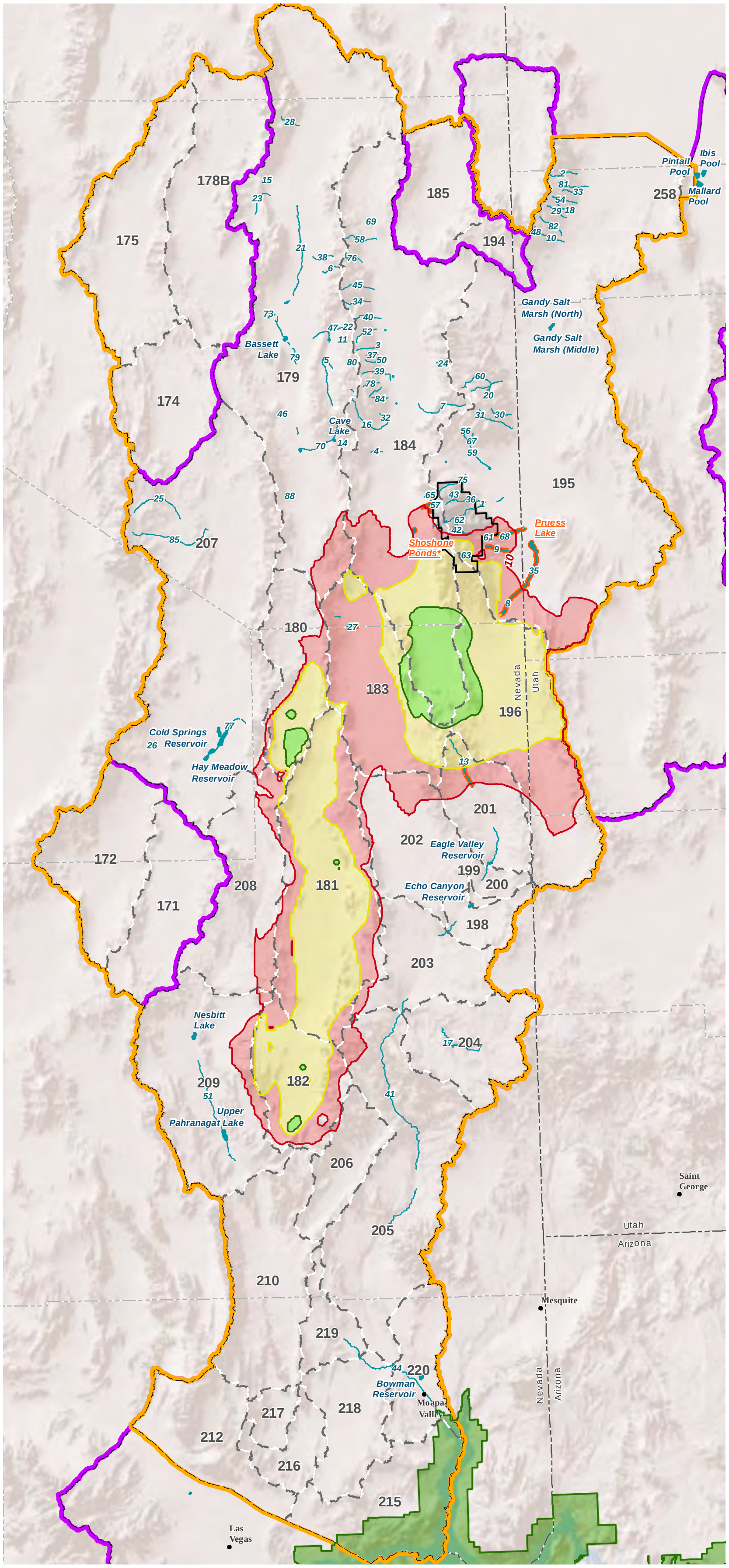
Table 3.7-14 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative D Groundwater Development

Effects
• Construction could alter aquatic habitat on a short-term basis in intermittent streams or springs that contain macroinvertebrates. Riparian vegetation near waterbodies could be affected on a long-term basis. Surface disturbance and vehicle/equipment could affect water quality from sediment input and risks from fuel spills on a short-term basis. • Vehicle traffic near waterbodies could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods. • There would be no conflicts with management objectives for special status species. • There would be no effects on fish species considered to be traditional values to regional Tribes.
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and mitigation recommendations.
BLM RMP Direction and ACMs
• BLM RMP direction for development near springs specifies that surface water resources and associated riparian areas be maintained. • ACM B.1.1 and B.1.3 will consider the presence of special status species and their habitat in the location of production wells, collector lines, and secondary substations. • ACM B.2.1 through B.2.3 will implement permit requirements on well drilling, abandonment, drilling, and water discharge.
Proposed Mitigation
No mitigation measures would be required for Alternative D because perennial and springs are not present within the groundwater development areas.
Conclusions • By avoiding springs and streams with game fish or special status species, short-term disturbance would be limited to waterbodies with seasonal flow or limited water volumes. Macroinvertebrates likely would be present in these waterbodies. • Vehicle traffic could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods.
Potential Residual Impacts
• Potential amphibian mortalities from vehicle traffic near temporary and permanent waterbodies during construction.

Groundwater Pumping

Alternative D would consist of reduced pumping (78,755 afy) at distributed locations in southern Spring, Delamar, Dry Lake, and Cave valleys. No pumping would occur in Snake Valley. Alternative D pumping could result in reductions in aquatic habitat and affect aquatic species. Based on the model analysis, the predicted 10-foot drawdown contour for Alternative D pumping is shown for streams in **Figure 3.7-15** and springs in **Figure 3.7-16**. Flows could be reduced in the following number of habitats with aquatic biological resources for the three model time frames.

- Streams – 0 at full build out, 2 at full build out plus 75 years, and 10 at full build out plus 200 years; and
- Springs/Ponds/Lakes - 1 at full build out, 4 at full build out plus 75 years, and 13 at full build out plus 200 years.



#	Stream Name	#	Stream Name
1	Baker Creek	46	Murry Creek
2	Basin Creek	47	North Creek
3	Bassett Creek	48	North Fork of Birch Creek
4	Bastian Creek	49	North Fork Snake Creek
5	Berry Creek	50	Odgers Creek
6	Big Indian Creek	51	Pahranagat Creek
7	Big Negro Creek	52	Piermont Creek
8	Big Springs Creek	53	Pine Creek
9	Big Wash	54	Red Cedar Creek
10	Birch Creek	55	Ridge Creek
11	Bird Creek	56	Second Fork Silver Creek
12	Board Creek	57	Shingle Creek
13	Camp Valley Creek	58	Siegel Creek
14	Cave Creek	59	Silver Creek
15	Cherry Creek	60	Smith Creek
16	Cleve Creek	61	Snake Creek
17	Clover Creek	62	South Fork Baker Creek
18	Cottonwood Creek	63	South Fork Big Wash
19	Deadman Creek	64	South Fork Snake Creek
20	Deep Canyon Creek	65	South Fork Willard Creek
21	Duck Creek	66	South Taft Creek
22	East Creek	67	Spring Creek (Tributary to Silver Creek)
23	Egan Creek	68	Spring Creek (Tributary to Snake Creek)
24	Eightmile Creek	69	Spring Valley Creek
25	Ellison Creek	70	Steptoe Creek
26	Forest Home Creek	71	Steptoe Ranch Stream 3
27	Geyser Creek	72	Steptoe Ranch Stream 4a
28	Goshute Creek	73	Steptoe Ranch Stream 4b
29	Granite Creek	74	Steptoe Ranch Stream 5
30	Hampton Creek	75	Strawberry Creek
31	Hendry's Creek	76	Sunkist (North) Creek
32	Indian Creek	77	Sunnyside Creek
33	Indian Farm Creek	78	Taft Creek
34	Kalamazoo Creek	79	Tailings Creek
35	Lake Creek	80	Timber Creek
36	Lehman Creek	81	Tom's Creek
37	Little Negro Creek	82	Trout Creek
38	Mattier Creek	83	Upper Snake Creek
39	McCoy Creek	84	Vipont Creek
40	Meadow Creek	85	White River
41	Meadow Valley Wash	86	Willard Creek
42	Middle Fork Snake Creek	87	Williams Canyon Creek
43	Mill Creek	88	Willow Creek
44	Muddy River		
45	Muncy Creek		

Underlined streams may be affected where "At Risk" stream segments intersect drawdown.

Potentially Affected "At Risk" Stream Segment
Potentially Affected "At Risk" Waterbody

Legend

Water Features Containing Sensitive Aquatic Biology or Game Fish

- Perennial Stream Reach
- Waterbody
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

* Fed by artesian well

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-15

Alternative D Drawdown and Streams/ Waterbodies with Aquatic Biological Resources

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
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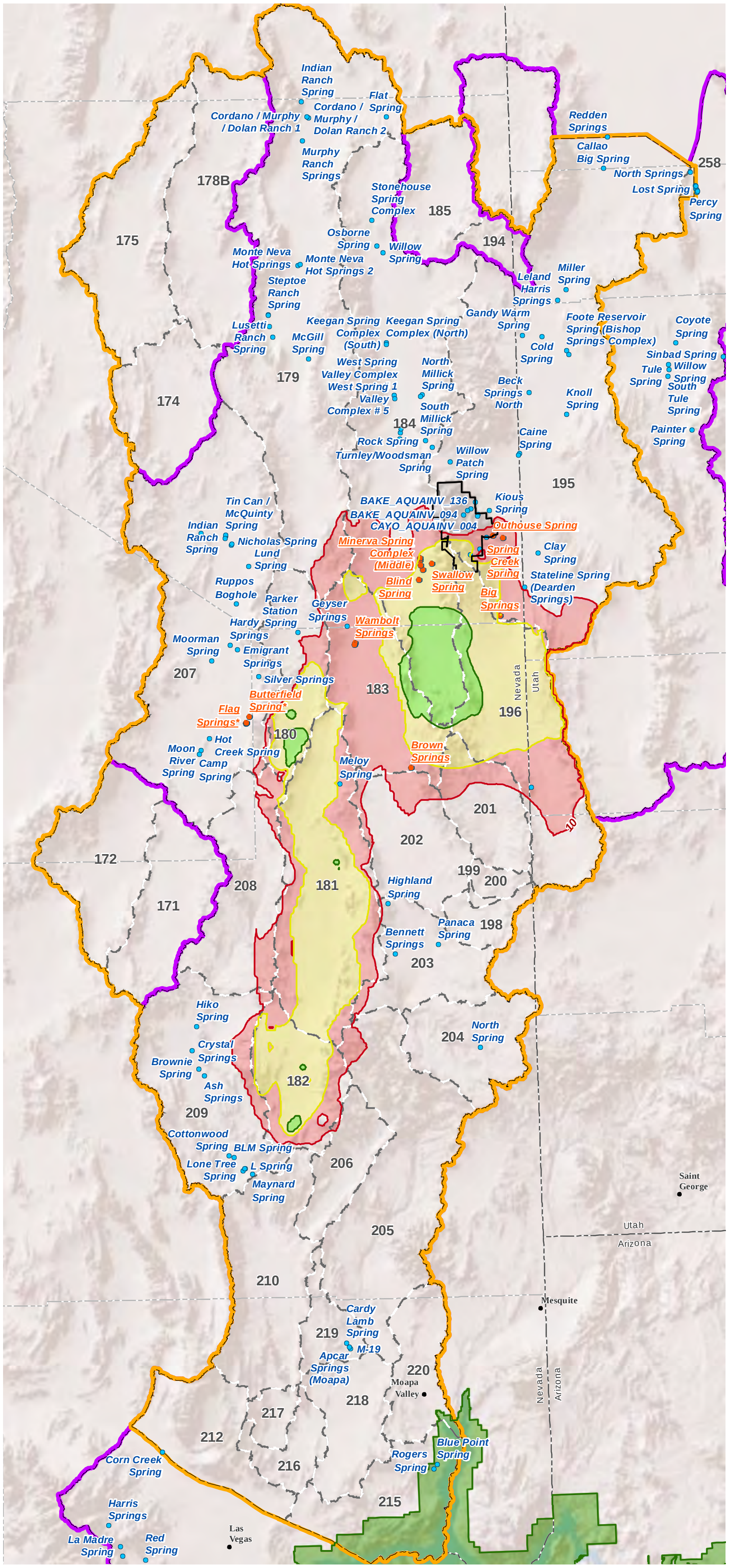
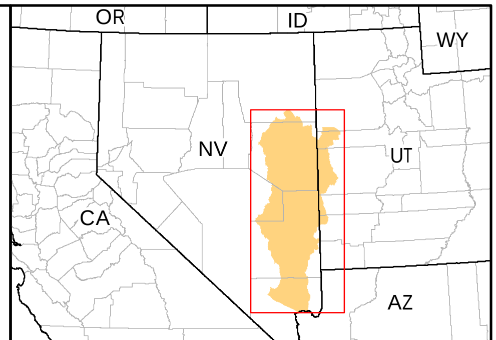
No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.





Legend

- Spring Containing Sensitive Aquatic Biology or Game Fish
- Potentially Affected Spring Containing Sensitive Aquatic Biology or Game Fish
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

*Spring is outside 10-ft drawdown contour, but model-predicted flow reductions indicate potential effect.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-16

Alternative D Drawdown and Springs with Aquatic Biological Resources

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Flow reductions could affect all types of aquatic communities including fish, amphibians, macroinvertebrates, macrophytes, and algae. For this EIS analysis, emphasis was placed on game fish and special status aquatic species. Alternative D could adversely affect the following game fish or special status species and their associated waterbody occurrences in at least one of the model time frames. Specific results for waterbodies and species at risk for each model time frames are provided in **Appendix F**, **Tables F3.7-20** and **F3.7-21**.

- Game Fish Streams – Geyser Creek in Lake Valley; Big Wash Lake, and Snake creeks in Snake Valley; Pine, Ridge, Shingle, and Williams Canyon creeks in Spring Valley (#184).
- Game Fish Springs/Ponds/Lakes – Swallow Spring in Spring Valley (#184).
- Federally Listed Species – White River spinedace and critical habitat in Flag Springs (White River Valley) and Pahrump poolfish in Shoshone Ponds (Spring Valley).
- Bonneville Cutthroat Trout – Stream miles at risk for flow reductions include: Pine (0.1 mile or 12 percent of occupied habitat in this stream), Ridge (0.6 mile or 50 percent of occupied habitat in this stream), Big Wash (4.8 miles or 100 percent of occupied habitat in this stream), and Snake (<0.1 mile or <1 percent of occupied habitat in this stream).
- Other Special Status Fish Streams – Big Wash and Snake creeks in Snake Valley; and Pine and Ridge creeks in Spring Valley (#184).
- Other Special Status Fish Springs/Ponds/Lakes – Butterfield and Flag springs in White River Valley; Shoshone Ponds in Spring Valley (#184); and Big Springs and Stateline Springs in Snake Valley.
- Special Status Amphibian Species Springs/Ponds/Lakes – Blind and Minerva springs and Shoshone Ponds in Spring Valley (#184); and Wambolt Spring in Lake Valley.
- Special Status Invertebrates Springs/Ponds/Lakes – Butterfield and Flag springs in White River Valley; Big Springs, and one unnamed spring, in Snake Valley; unnamed spring near Camp Valley Creek in Spring Valley (#201), and Wambolt Spring in Lake Valley.

The effects and conclusions of groundwater development on aquatic biological resources are provided in **Table 3.7-15** along with ACMs and proposed mitigation.

Table 3.7-15 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative D Pumping

Effects/Conclusions
• Flow reductions would modify habitat by decreasing depths, water velocities, and wetted area in spring/pond/lake and stream habitats. A total of 13 springs/ponds/lakes and 10 streams are at risk when considering the longest model time frame. • Effects would be most pronounced in riffle habitats in streams and spring inflow and outflow areas. Effects on pool habitats would depend on the magnitude of the flow change and size of the pools. Reduced flows could adversely affect aquatic habitat by altering thermal regimes, increasing sedimentation, and reducing riparian cover. A complete loss of habitat could occur in small springs and larger springs such as Big Springs in Snake Valley. • Flow reductions could adversely affect aquatic species by reducing abundance and diversity, altering composition, reducing food sources, limiting spawning and early life stage development, and decreasing individual health condition. • Flow reductions in 4 springs in Spring Valley could result in habitat reductions and adverse effects on the special status amphibian, northern leopard frog. • Flow reductions in Big Springs Creek and Lake Creek in Snake Valley could result in substantial loss of habitat and aquatic species. • Flow reductions in 2 springs in Snake Valley could result in loss of bifid duct and longitudinal gland pyrg populations at these locations. • Due to their limited occurrence (one spring/one basin), populations of Butterfield pyrg (Butterfield Spring), Flag pyrg (Flag Springs), Camp Valley pyrg (unnamed spring near Camp Valley Creek), and Lake Valley pyrg (Wambolt Spring) could be lost if their spring habitat is substantially reduced.

Table 3.7-15 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative D Pumping (Continued)

Effects/Conclusions

- Conflicts with recovery and conservation management objectives could occur for four species: Pahrump poolfish (Shoshone Ponds), White River spinedace (Flag Springs), Bonneville cutthroat trout (two streams each in Spring and Snake valleys), and northern leopard frog (four springs/ponds).
- Game fish species considered to be traditional values to regional Tribes could be affected in Snake, Spring (#184), Lake, and Spring (#201) valleys.

Impact Indicators[1] By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Number of Hydrologic Basins at Risk with Waterbodies Containing Game Fish or Special Status Species	1	2	45
Estimated Percent Flow Reductions			
Butterfield Spring (White River Valley)	1	3	9
Flag Springs (White River Valley)	1	3	9
Keegan Spring (Spring Valley)	0	0	0
North Millick Spring (Spring Valley)	0	0	0
South Millick Spring (Spring Valley)	0	0	0
Big Springs (Snake Valley)	19	100	100
Federally Listed Species at Risk			
Pahrump poolfish	Unlikely effect	Potential effect	Potential effect
White River spinedace and critical habitat	Unlikely effect	Unlikely effect	Potential effect
Hiko White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
Pahranagat roundtail chub	No effect	No effect	No effect
Big Springs spinedace and critical habitat	No effect	No effect	No effect
Moapa dace	No effect	No effect	No effect
Number of Springs/Ponds/Lakes with Game or Special Status Fish Species at Risk	1	2	5
Number of Springs/Ponds/Lakes with Special Status Amphibian Species at Risk	0	2	4
Number of Springs/Ponds/Lakes with Special Status Invertebrate Species at Risk	1	2	6
Number of Small Springs (100 gpm) with Aquatic Species at Risk	0	1	5
Number of Streams with Game Fish or Special Status Species at Risk	0	2	10
Miles of Streams at Risk with Game Fish and Special Status Species	0	3	29
GBNP Springs and Streams[2] with Game Fish or Special Status Species at Risk			
Outhouse Spring	Unlikely effect	Unlikely effect	Potential effect
Rowland Spring	Unlikely effect	Unlikely effect	Unlikely effect
Snake Creek	Unlikely effect	Unlikely effect	1.9 miles
Utah Springs and Streams with Game Fish or Special Status Species at Risk			
Caine Spring	Unlikely effect	Unlikely effect	Unlikely effect
Clay Spring	Unlikely effect	Unlikely effect	Unlikely effect
Stateline Spring	Unlikely effect	Unlikely effect	Unlikely effect
Lake Creek	Unlikely effect	Unlikely effect	10.6 miles
Snake Creek	Unlikely effect	Unlikely effect	Unlikely effect

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional monitoring and mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and mitigation recommendations.

Table 3.7-15 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative D Pumping (Continued)

ACMs
• Existing agreements include the Spring Valley Stipulation, Delamar, Dry Lake, and Cave Valley Stipulation, Conservation Agreements (least chub and Columbia spotted frog) Utah and SNWA Snake Valley Environmental Monitoring and Management Agreement (not yet completed), and Candidate Conservation Agreement/Candidate Conservation Agreement with Assurances (not yet completed). • The Spring Valley and Dry Lake, Delamar, and Cave valleys Stipulated Agreements will involve monitoring in selected springs in Spring, Snake, Delamar, Dry Lake, and Cave valleys (see Measures C.1.1 and C.1.42 in **Appendix E**). The Spring Valley Stipulated Agreement also would consider alternative withdrawal points from Shoshone Ponds. • Actions will be implemented as part of the Spring Valley and Dry Lake, Delamar, and Cave valleys Stipulated Agreements to mitigate unreasonable adverse impacts to special status species (ACM C.2.1). Specific measures related to the mitigation will be developed as part of the monitoring and mitigation planning process. This process would extend into subsequent NEPA analyses for individual basins. • ACMs would be implemented to restore and enhance habitat for federally listed or special status species and would be done in cooperation with the USFWS. These measures would restore or enhance habitat for springsnails (ACM C.2.6 and C.2.16), White River spinedace (ACM C.2.8 and C.2.17), White River springfish (ACM C.2.9), Hiko White River springfish (ACM C.2.9), Pahranagat roundtail chub (ACM C.2.9), White River speckled dace (ACM C.2.14), and northern leopard frog (ACMC.2.18).
Monitoring Recommendations
GW-MN-AB-1 (Stream Flow and Aquatic Biology Monitoring) and **GW-MN-AB-2 (Spring and Aquatic Biology Monitoring)** described for the Proposed Action, would be applied to Alternative D. Springs and streams to be considered for monitoring are provided in **Appendix F3.7**, **Tables F3.7-16** and **F3.7-17**. Streams and springs located on public lands are listed in **Table 3.3.2-9** in Water Resources. **GW-MN-AB-3 (Flow/Habitat Determination)** will be conducted in selected springs and streams to be able to determine minimum flows or water levels for critical life stages of representative fish species. As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-AB-3 (Flow Change Mitigation) described for the Proposed Action, also would be applied to Alternative D. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7). **GW-WR-5 (Shoshone Ponds Mitigation)** would avoid a conflict with management objectives for Pahrump poolfish (see Water Resources, Section 3.3, for complete wording of GW-WR-5).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to aquatic habitats and species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to fish. However, it is not possible to determine the level of impact reduction at this time. Effects on some aquatic habitats and species could exist considering the potential long recovery period that could occur in some aquatic habitats. Some unavoidable impacts on aquatic habitat and species could occur at some locations. The magnitude of effects would be less in Snake Valley and higher in Spring Valley compared to the Proposed Action.

[1] Parameters are based on streams or springs that are located within the 10-foot drawdown contour and characterized as having moderate or high risk of pumping effects.

[2] Other streams identified by Elliott et al. (2006) (Shingle and Williams Canyon creeks in Spring Valley and Baker and Strawberry creeks in Snake Valley) would not likely be affected.

3.7.2.14 Alternative E

Groundwater Development Area

Development in Snake Valley would be eliminated. Surface disturbance could be dispersed throughout the remaining portions of Spring, Cave, Delamar, and Dry Lake basins. The effects of constructing well pads, gathering pipelines, and electrical service lines would depend upon the location of the facilities in relation to aquatic biological resources. In total, 13 perennial streams and 4 springs with aquatic biological resources occur in the groundwater development areas. A more detailed account of the resource information includes:

- Game Fish – Species occur in 13 streams in Spring Valley (**Table 3.7-1**; **Figure 3.7-3**).
- Special Status Fish – No special status fish species occur in the groundwater development areas.
- Special Status Amphibians – Northern leopard frog occurs in three springs (Blind, North Millick, and South Millick in Spring Valley) within the groundwater development areas (**Figure 3.7-5**).
- Springsnails – Toquerville pyrg (not a special status species) occurs in one spring within the groundwater development areas (unnamed spring near Cleve Creek in Spring Valley) (**Figure 3.7-5**).
- Macroinvertebrates – Species are present in all 13 perennial streams and 4 springs and waterbodies with seasonal water presence in the groundwater development area.

The effects and conclusions of groundwater development on aquatic biological resources are provided in **Table 3.7-16** along with ACMs and proposed mitigation.

Table 3.7-16 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative E Groundwater Development

Effects
• Construction could alter aquatic habitat on a short-term basis in 13 perennial streams and 4 springs with aquatic biological resources. Riparian vegetation near waterbodies could be affected on a long-term basis. Surface disturbance and vehicle/equipment could affect water quality from sediment input and risks from fuel spills on a short-term basis. • Instream activities in the spring or fall could affect trout spawning on a short-term basis. • Vehicle traffic near waterbodies could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods. • Special status Bonneville cutthroat trout could be affected in one stream within the groundwater development areas (Pine/Ridge Creek in Spring Valley). • Special status amphibian species (northern leopard frog) could be affected in three springs within the groundwater development areas. • Springsnail species could be affected in spring habitats within one of the groundwater development areas (one unnamed spring in Spring Valley). • Conflicts with conservation management objectives could occur for one species: northern leopard frog (3 springs). • Game fish species considered to be traditional values to regional Tribes could be affected in Snake and Spring valleys.
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and mitigation recommendations.
BLM RMP Direction and ACMs
• BLM RMP direction for development near springs specifies that surface water resources and associated riparian areas be maintained. • ACM B.1.1 and B.1.3 will consider the presence of special status species and their habitat in the location of production wells, collector lines, and secondary substations. • ACM B.2.1 through B.2.3 will implement permit requirements on well drilling, abandonment, drilling, and water discharge.
Proposed Mitigation
GW-AB-1 (Avoidance of springs and wetlands with special status species) and **GW-AB-2 (Establishing a 0.5-mile buffer near perennial streams with game and special status species)** as described for the Proposed Action, would be applied to Alternative E.

Table 3.7-16 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative E Groundwater Development (Continued)

Conclusions
• By avoiding springs and streams with game fish or special status species, short-term disturbance would be limited to waterbodies with seasonal flow or limited water volumes. Macroinvertebrates likely would be present in these waterbodies. • Vehicle traffic could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods.
Potential Residual Impacts
• Potential amphibian mortalities from vehicle traffic near temporary and permanent waterbodies during construction.

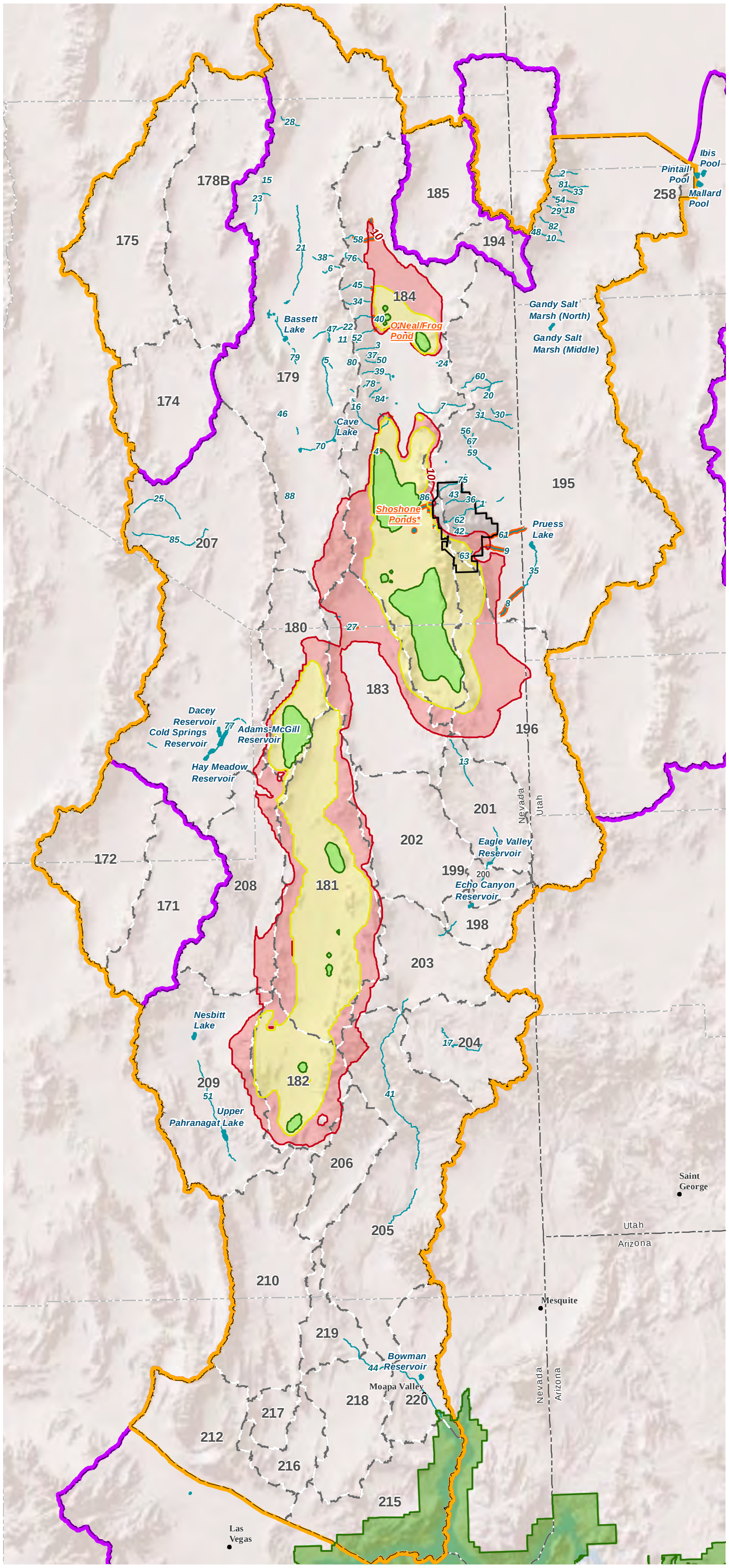
Groundwater Pumping

Alternative E would consist of reduced pumping (78,755 afy) at distributed locations in Spring, Cave, Dry Lake, and Lake valleys. No pumping would occur in Snake Valley. Alternative E pumping could result in reductions in aquatic habitat and affect aquatic species. Based on the model analysis, the predicted 10-foot drawdown contour for Alternative E pumping is shown for streams in **Figure 3.7-17** and springs in **Figure 3.7-18**. Flows could be reduced in the following number of habitats with aquatic biological resources for the three model time frames.

- Streams – 1 at full build out, 7 at full build out plus 75 years, and 15 at full build out plus 200 years; and
- Springs/Ponds/Lakes – 2 at full build out, 7 at full build out plus 75 years, and 14 at full build out plus 200 years.

Flow reductions could affect all types of aquatic communities including fish, amphibians, macroinvertebrates, macrophytes, and algae. For this EIS analysis, emphasis was placed on game fish and special status aquatic species. Alternative E could adversely affect the following game fish or special status species and their associated waterbody occurrences in at least one of the model time frames. Specific results for waterbodies and species at risk for each model time frames are provided in **Appendix F**, **Tables F3.7-22** and **F3.7-23**.

- Game Fish Streams – Geyser Creek in Lake Valley; Big Wash, Lake, and Snake creeks in Snake Valley; Bastian, Indian, Meadow, Muncy, Odgers, Pine, Ridge, Shingle, Siegel, Willard, and Williams Canyon creeks in Spring Valley.
- Game Fish Springs/Ponds/Lakes – Swallow Spring in Spring Valley.
- Federally Listed Species – White River spinedace and critical habitat in Flag Springs (White River Valley) and Pahrump poolfish in Shoshone Ponds (Spring Valley).
- Bonneville Cutthroat Trout – Stream miles at risk for flow reductions include: Pine (0.1 to 0.4 mile or 12 to 50 percent of occupied habitat in this stream), Ridge (0.6 to 1.1 miles or 50 to 92 percent of occupied habitat in this stream), Big Wash (0.8 mile or 17 percent of the occupied habitat in this stream), and Snake (<0.1 mile or <1 percent of occupied habitat in this stream).
- Other Special Status Fish Streams – Big Wash and Snake Creek in Snake Valley; and Pine and Ridge creeks in Spring Valley.
- Other Special Status Fish Springs/Ponds/Lakes – Butterfield and Flag springs in White River Valley; Keegan Spring and Shoshone Ponds in Spring Valley; and Big Springs and Stateline Springs in Snake Valley.
- Special Status Amphibian Species Springs/Ponds/Lakes – Blind, Keegan, Minerva, North Millick, South Millick, and one unnamed spring and Shoshone Ponds and O'Neal/Frog Pond in Spring Valley.
- Special Status Invertebrates Springs/Ponds/Lakes – Butterfield and Flag springs in White River Valley Big Springs in Snake Valley.



#	Stream Name	#	Stream Name
1	Baker Creek	46	Murry Creek
2	Basin Creek	47	North Creek
3	Bassett Creek	48	North Fork of Birch Creek
4	Bastian Creek	49	North Fork Snake Creek
5	Berry Creek	50	Odgers Creek
6	Big Indian Creek	51	Pahranagat Creek
7	Big Negro Creek	52	Piermont Creek
8	Big Springs Creek	53	Pine Creek
9	Big Wash	54	Red Cedar Creek
10	Birch Creek	55	Ridge Creek
11	Bird Creek	56	Second Fork Silver Creek
12	Board Creek	57	Shingle Creek
13	Camp Valley Creek	58	Siegel Creek
14	Cave Creek	59	Silver Creek
15	Cherry Creek	60	Smith Creek
16	Cleve Creek	61	Snake Creek
17	Clover Creek	62	South Fork Baker Creek
18	Cottonwood Creek	63	South Fork Big Wash
19	Deadman Creek	64	South Fork Snake Creek
20	Deep Canyon Creek	65	South Fork Willard Creek
21	Duck Creek	66	South Taft Creek
22	East Creek	67	Spring Creek (Tributary to Silver Creek)
23	Egan Creek	68	Spring Creek (Tributary to Snake Creek)
24	Eightmile Creek	69	Spring Valley Creek
25	Ellison Creek	70	Steptoe Creek
26	Forest Home Creek	71	Steptoe Ranch Stream 3
27	Geyser Creek	72	Steptoe Ranch Stream 4a
28	Goshute Creek	73	Steptoe Ranch Stream 4b
29	Granite Creek	74	Steptoe Ranch Stream 5
30	Hampton Creek	75	Strawberry Creek
31	Hendry's Creek	76	Sunkist (North) Creek
32	Indian Creek	77	Sunnyside Creek
33	Indian Farm Creek	78	Taft Creek
34	Kalamazoo Creek	79	Tailings Creek
35	Lake Creek	80	Timber Creek
36	Lehman Creek	81	Tom's Creek
37	Little Negro Creek	82	Trout Creek
38	Mattier Creek	83	Upper Snake Creek
39	McCoy Creek	84	Vipont Creek
40	Meadow Creek	85	White River
41	Meadow Valley Wash	86	Willard Creek
42	Middle Fork Snake Creek	87	Williams Canyon Creek
43	Mill Creek	88	Willow Creek
44	Muddy River		
45	Muncy Creek		

Underlined streams may be affected where "At Risk" stream segments intersect drawdown.

Potentially Affected "At Risk" Stream Segment

Potentially Affected "At Risk" Waterbody

Legend

Water Features Containing Sensitive Aquatic Biology or Game Fish

- Perennial Stream Reach
- Waterbody
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

* Fed by artesian well

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-17

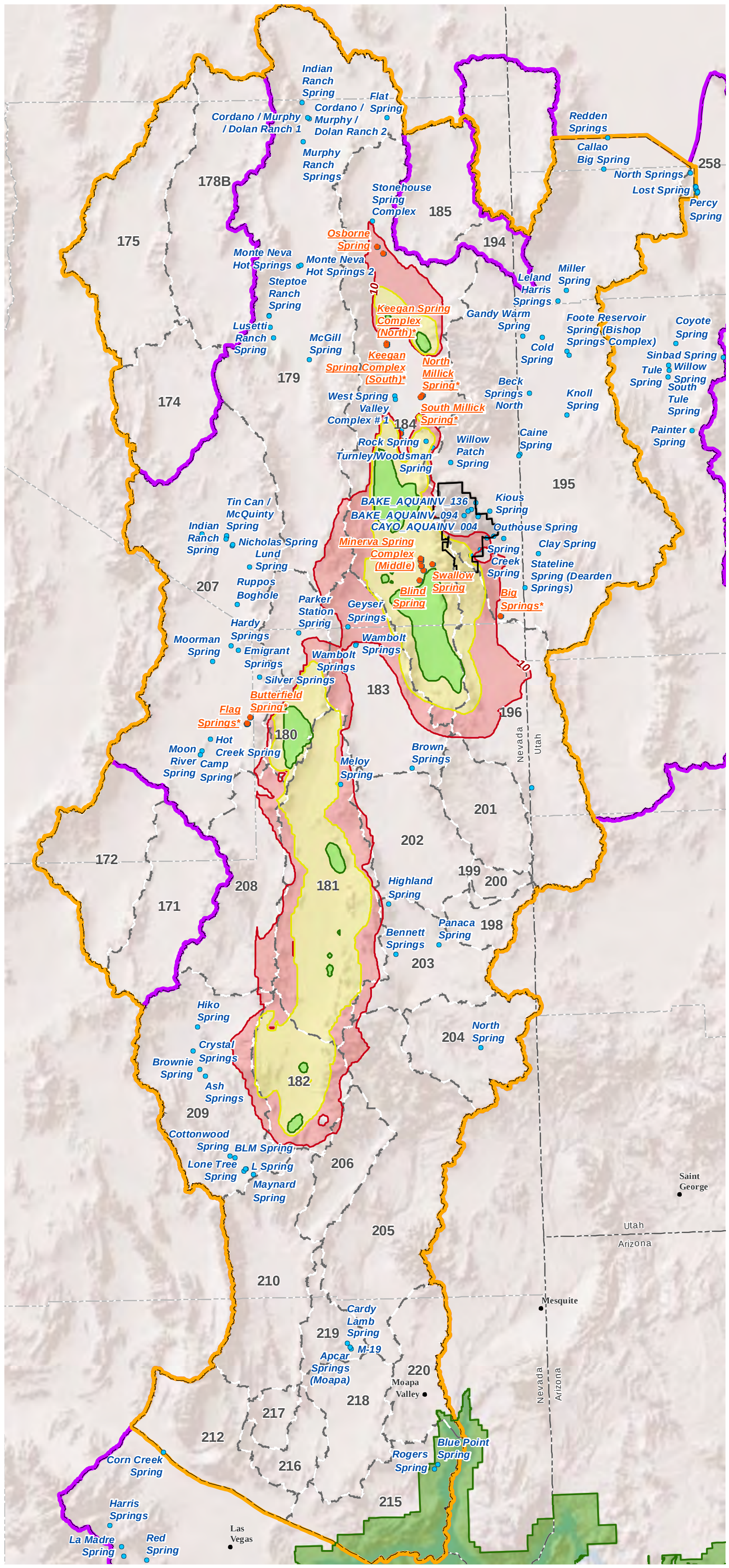
Alternative E Drawdown and Streams/ Waterbodies with Aquatic Biological Resources

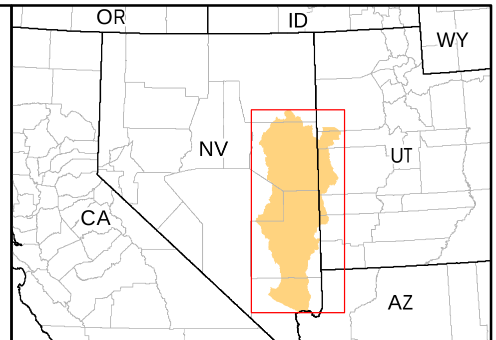
0 5 10 15 20 25 50 Miles

0 5 10 15 20 25 50 75 Kilometers

1:2,000,000

N





Legend

- Spring Containing Sensitive Aquatic Biology or Game Fish
- Potentially Affected Spring Containing Sensitive Aquatic Biology or Game Fish
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

*Spring is outside 10-ft drawdown contour, but model-predicted flow reductions indicate potential effect.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-18

Alternative E Drawdown and Springs with Aquatic Biological Resources

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

The effects and conclusions of groundwater development on aquatic biological resources are provided in **Table 3.7-17** along with ACMs and proposed mitigation.

Table 3.7-17 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative E Pumping

Effects/Conclusions

- Flow reductions would modify habitat by decreasing depths, water velocities, and wetted area in spring/pond/lake and stream habitats. A total of 15 springs/ponds/lakes and 15 streams are at risk when considering the longest model time frame.
- Effects would be most pronounced in riffle habitats in streams and spring inflow and outflow areas. Effects on pool habitats would depend on the magnitude of the flow change and size of the pools. Reduced flows could adversely affect aquatic habitat by altering thermal regimes, increasing sedimentation, and reducing riparian cover. A substantial loss of habitat could occur in small springs and larger springs such as Big Springs in Snake Valley.
- Flow reductions could adversely affect aquatic species by reducing abundance and diversity, altering composition, reducing food sources, limiting spawning and early life stage development, and decreasing individual health condition.
- Flow reductions in 8 springs in Spring Valley could result in habitat reductions and adverse effects on the special status amphibian, northern leopard frog.
- Flow reductions in Big Springs Creek and Lake Creek in Snake Valley could result in substantial loss of habitat and aquatic species.
- Flow reductions in Big Springs in Snake Valley could result in loss of bifid duct and longitudinal gland pyrg populations at this location.
- Due to limited occurrence (one spring/one basin), the populations of Butterfield pyrg (Butterfield Spring) and Flag pyrg (Flag Springs) could be lost if the spring habitat is substantially reduced.
- Conflicts with recovery and conservation management objectives could occur for 4 species: Pahrump poolfish (Shoshone Ponds), White River spinedace (Flag Springs), Bonneville cutthroat trout (2 streams each in Spring and Snake valleys), and northern leopard frog (8 springs/ponds).
- Game fish species considered to be traditional values to regional Tribes could be affected in Snake, Spring and Lake valleys.

Impact Indicators[1] By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Number of Hydrologic Basins at Risk with Waterbodies Containing Game Fish or Special Status Species	1	2	4
Estimated Percent Flow Reductions			
Butterfield Spring (White River Valley)	0	3	8
Flag Springs (White River Valley)	1	3	8
Keegan Spring (Spring Valley)	12	28	36
North Millick Spring (Spring Valley)	4	9	11
South Millick Spring (Spring Valley)	10	21	24
Big Springs (Snake Valley)	2	26	78
Federally Listed Species at Risk			
Pahrump poolfish	Unlikely effect	Unlikely effect	Potential effect
White River spinedace and critical habitat	Unlikely effect	Unlikely effect	Potential effect
Hiko White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
Pahranagat roundtail chub	No effect	No effect	No effect
Big Springs spinedace and critical habitat	No effect	No effect	No effect
Moapa dace	No effect	No effect	No effect
Number of Springs/Ponds/Lakes with Game or Special Status Fish Species at Risk	1	4	6
Number of Springs/Ponds/Lakes with Special Status Amphibian Species at Risk	2	6	8
Number of Springs/Ponds/Lakes with Special Status Invertebrate Species at Risk	0	1	3

Table 3.7-17 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative E Pumping (Continued)

Impact Indicators[1] By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Number of Small Springs (100 gpm) with Aquatic Species at Risk	0	1	5
Number of Streams with Game Fish or Special Status Species at Risk	1	7	15
Miles of Game Fish Streams at Risk	1	5	13
GBNP Springs and Streams[2] with Game Fish or Special Status Species at Risk			
Outhouse Spring	Unlikely effect	Unlikely effect	Unlikely effect
Rowland Spring	Unlikely effect	Unlikely effect	Unlikely effect
Lehman Creek	Unlikely effect	Unlikely effect	Unlikely effect
Snake Creek	Unlikely effect	Unlikely effect	<0.1 mile
Utah Springs and Streams with Game Fish or Special Status Species at Risk			
Clay Spring	Unlikely effect	Unlikely effect	Unlikely effect
Stateline Spring	Unlikely effect	Unlikely effect	Unlikely effect
Lake Creek	Unlikely effect	Unlikely effect	10.6 miles
Snake Creek	Unlikely effect	Unlikely effect	Unlikely effect

COM Plan

- The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional monitoring and mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and mitigation recommendations.

ACMs

- Existing agreements include the Spring Valley Stipulation, Delamar, Dry Lake, and Cave Valley Stipulation, Conservation Agreements (least chub and Columbia spotted frog) Utah and SNWA Snake Valley Environmental Monitoring and Management Agreement (not yet completed), and Candidate Conservation Agreement/Candidate Conservation Agreement with Assurances (not yet completed).
- The Spring Valley and Dry Lake, Delamar, Cave valleys Stipulated Agreements will involve monitoring in selected springs in Spring, Snake, Delamar, Dry Lake, and Cave valleys (see Measures C.1.1 and C.1.42 in **Appendix E**). The Spring Valley Stipulated Agreement also would consider alternative withdrawal points from Shoshone Ponds.
- Actions will be implemented as part of the Spring Valley and Dry Lake, Delamar, Cave valleys Stipulated Agreements to mitigate unreasonable adverse impacts to special status species (ACM C.2.1). Specific measures related to the mitigation will be developed as part of the monitoring and mitigation planning process. This process would extend into subsequent NEPA analyses for individual basins.
- ACMs would be implemented to restore and enhance habitat for federally listed or special status species and would be done in cooperation with the USFWS. These measures would restore or enhance habitat for springsnails (ACMs C.2.6 and C.2.16), White River spinedace (ACMs C.2.8 and C.2.17), White River springfish (ACM C.2.9), Hiko White River springfish (ACM C.2.9), Pahranagat roundtail chub (ACM C.2.9), White River speckled dace (ACM C.2.14), and northern leopard frog (ACMC.2.18).

Monitoring Recommendations

GW-MN-AB-1 (Stream Flow and Aquatic Biology Monitoring) and GW-MN-AB-2 **(Spring and Aquatic Biology Monitoring)** described for the Proposed Action, would be applied to Alternative E. Springs and streams to be considered for monitoring are provided in **Appendix F3.7**, **Tables F3.7-16** and **F3.7-17**. Streams and springs located on public lands are listed in **Table 3.3.2-9** in Water Resources.

GW-MN-AB-3 (Flow/Habitat Determination) will be conducted in selected springs and streams to be able to determine minimum flows or water levels for critical life stages of representative fish species.

As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).

Table 3.7-17 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative E Pumping (Continued)

Mitigation Recommendations
GW-AB-3 (Flow Change Mitigation) described for the Proposed Action, also would be applied to Alternative E. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7). **GW-WR-5 (Shoshone Ponds Mitigation)** would avoid a conflict with management objectives for Pahrump poolfish (see Water Resources, Section 3.3, for complete wording of GW-WR-5).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to aquatic habitats and species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to fish. However, it is not possible to determine the level of impact reduction at this time. Effects on some aquatic habitats and species could exist considering the potential long recovery period that could occur in some aquatic habitats. Some unavoidable impacts on aquatic habitat and species could occur at some locations. The magnitude of effects would be less in Spring and Snake valleys compared to the Proposed Action.

[1] Parameters are based on streams or springs that are located within the 10-foot drawdown contour and characterized as having moderate or high risk of pumping effects.

[2] Other streams identified by Elliott et al. (2006) (Shingle and Williams Canyon creeks in Spring Valley and Baker and Strawberry creeks in Snake Valley) would not likely be affected.

3.7.2.15 Alternative F

Groundwater Development Area

The groundwater development areas for Alternative F would be the same as described for Alternative E, which would involve facilities in portions of Spring, Cave, Delamar, and Dry Lake basins. No development would occur in Snake Valley. The effects of constructing well pads, gathering pipelines, and electrical service lines would depend upon the location of the facilities in relation to aquatic biological resources. In total, 13 perennial streams and 4 springs with aquatic biological resources occur in the groundwater development areas. A more detailed account of the resource information includes:

- Game Fish – Species occur in 13 streams in Spring Valley (**Table 3.7-1**; **Figure 3.7-3**).
- Special Status Fish – No special status fish species occur in the groundwater development areas.
- Special Status Amphibians – Northern leopard frog occurs in three springs (Blind, North Millick, and South Millick in Spring Valley) within the groundwater development areas (**Figure 3.7-5**).
- Springsnails – Toquerville pyrg (not a special status species) occurs in one spring within the groundwater development areas (unnamed spring near Cleve Creek in Spring Valley) (**Figure 3.7-5**).
- Macroinvertebrates – Species are present in all 13 perennial streams and 4 springs and waterbodies with seasonal water presence in the groundwater development area.

The effects and conclusions of groundwater development on aquatic biological resources are provided in **Table 3.7-18** along with ACMs and proposed mitigation.

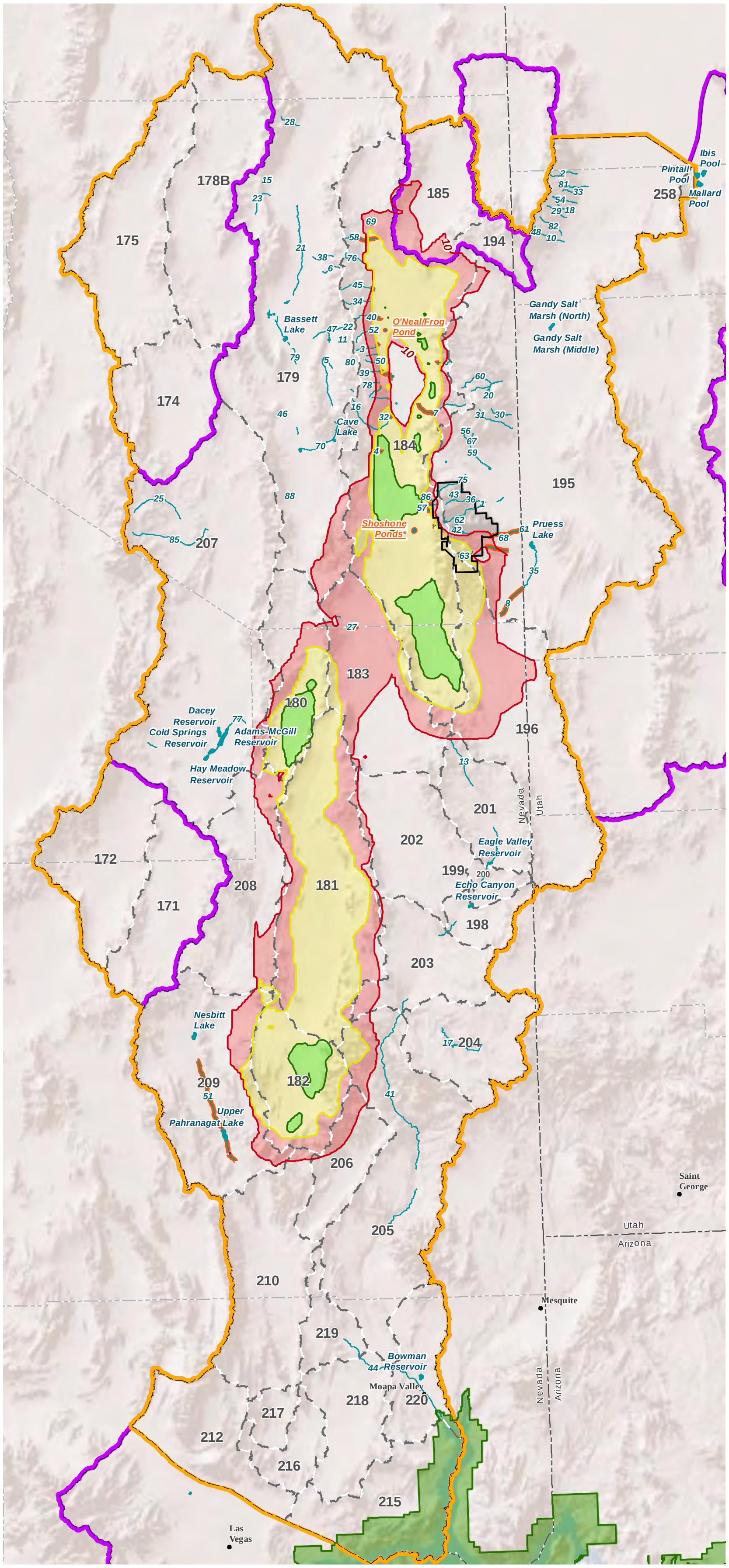
Table 3.7-18 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative F Groundwater Development

Effects
• Construction could alter aquatic habitat on a short-term basis in 13 perennial streams and 4 springs with aquatic biological resources. Riparian vegetation near waterbodies could be affected on a long-term basis. Surface disturbance and vehicle/equipment could affect water quality from sediment input and risks from fuel spills on a short-term basis. • Instream activities in the spring or fall could affect trout spawning on a short-term basis. • Vehicle traffic near waterbodies could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods. • Special status Bonneville cutthroat trout could be affected in one stream within the groundwater development areas (Pine/Ridge Creek in Spring Valley). • Special status amphibian species (northern leopard frog) could be affected in three springs within the groundwater development areas. • Springsnail species could be affected in spring habitats within one of the groundwater development areas (one unnamed spring in Spring Valley). • Conflicts with conservation management objectives could occur for one species: northern leopard frog (three springs). • Game fish species considered to be traditional values to regional Tribes could be affected in Snake and Spring valleys.
COM Plan
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and mitigation recommendations.
BLM RMP Direction and ACMs
• BLM RMP direction for development near springs specifies that surface water resources and associated riparian areas be maintained. • ACM B.1.1 and B.1.3 will consider the presence of special status species and their habitat in the location of production wells, collector lines, and secondary substations. • ACM B.2.1 through B.2.3 will implement permit requirements on well drilling, abandonment, drilling, and water discharge.
Proposed Mitigation
GW-AB-1 (Avoidance of springs and wetlands with special status species) and **GW-AB-2 (Establishing a 0.5-mile buffer near perennial streams with game and special status species)** as described for the Proposed Action, would be applied to Alternative F.
Conclusions
• By avoiding springs and streams with game fish or special status species, short-term disturbance would be limited to waterbodies with seasonal flow or limited water volumes. Macroinvertebrates likely would be present in these waterbodies. • Vehicle traffic could cause mortalities to amphibians during movement periods especially during the spring and summer breeding periods.
Potential Residual Impacts
• Potential amphibian mortalities from vehicle traffic near temporary and permanent waterbodies during construction.

Groundwater Pumping

Alternative F would consist of pumping a maximum of 114,129 afy at distributed locations in Spring, Delamar, Dry Lake, Cave, and Lake valleys. No pumping would occur in Snake Valley. Alternative F pumping could result in reductions in aquatic habitat and could adversely affect aquatic species. Based on the model analysis, the predicted 10-foot drawdown contour for Alternative F pumping is shown for streams in **Figure 3.7-19** and springs in **Figure 3.7-20**. Flows could be reduced in the following number of habitats with aquatic biological resources for the three model time frames.

- Streams – 1 at full build out, 15 at full build out plus 75 years, and 24 at full build out plus 200 years; and
- Springs/Ponds/Lakes – 2 at full build out, 13 at full build out plus 75 years, and 18 at full build out plus 200 years.



#	Stream Name
1	Baker Creek
2	Basin Creek
3	Bassett Creek
4	Bastian Creek
5	Berry Creek
6	Big Indian Creek
7	Big Negro Creek
8	Big Springs Creek
9	Big Wash
10	Birch Creek
11	Bird Creek
12	Board Creek
13	Camp Valley Creek
14	Cave Creek
15	Cherry Creek
16	Cleve Creek
17	Clover Creek
18	Cottonwood Creek
19	Deadman Creek
20	Deep Canyon Creek
21	Duck Creek
22	East Creek
23	Egan Creek
24	Eightmile Creek
25	Ellison Creek
26	Forest Home Creek
27	Geyser Creek
28	Goshute Creek
29	Granite Creek
30	Hampton Creek
31	Hendry's Creek
32	Indian Creek
33	Indian Farm Creek
34	Kalamazoo Creek
35	Lake Creek
36	Lehman Creek
37	Little Negro Creek
38	Mattier Creek
39	McCoy Creek
40	Meadow Creek
41	Meadow Valley Wash
42	Middle Fork Snake Creek
43	Mill Creek
44	Muddy River
45	Muncy Creek
46	Murry Creek
47	North Creek
48	North Fork of Birch Creek
49	North Fork Snake Creek
50	Odgers Creek
51	Pahranagat Creek
52	Piermont Creek
53	Pine Creek
54	Red Cedar Creek
55	Ridge Creek
56	Second Fork Silver Creek
57	Shingle Creek
58	Siegel Creek
59	Silver Creek
60	Smith Creek
61	Snake Creek
62	South Fork Baker Creek
63	South Fork Big Wash
64	South Fork Snake Creek
65	South Fork Willard Creek
66	South Taft Creek
67	Spring Creek (Tributary to Silver Creek)
68	Spring Creek (Tributary to Snake Creek)
69	Spring Valley Creek
70	Steptoe Creek
71	Steptoe Ranch Stream 3
72	Steptoe Ranch Stream 4a
73	Steptoe Ranch Stream 4b
74	Steptoe Ranch Stream 5
75	Strawberry Creek
76	Sunkist (North) Creek
77	Sunnyside Creek
78	Taft Creek
79	Tailings Creek
80	Timber Creek
81	Tom's Creek
82	Trout Creek
83	Upper Snake Creek
84	Vipont Creek
85	White River
86	Willard Creek
87	Williams Canyon Creek
88	Willow Creek

Underlined streams may be affected where "At Risk" stream segments intersect drawdown.

Potentially Affected "At Risk" Stream Segment

Potentially Affected "At Risk" Waterbody

Legend

Water Features Containing Sensitive Aquatic Biology or Game Fish

- Perennial Stream Reach
- Waterbody
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

* Fed by artesian well

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-19

Alternative F Drawdown and Streams/ Waterbodies with Aquatic Biological Resources

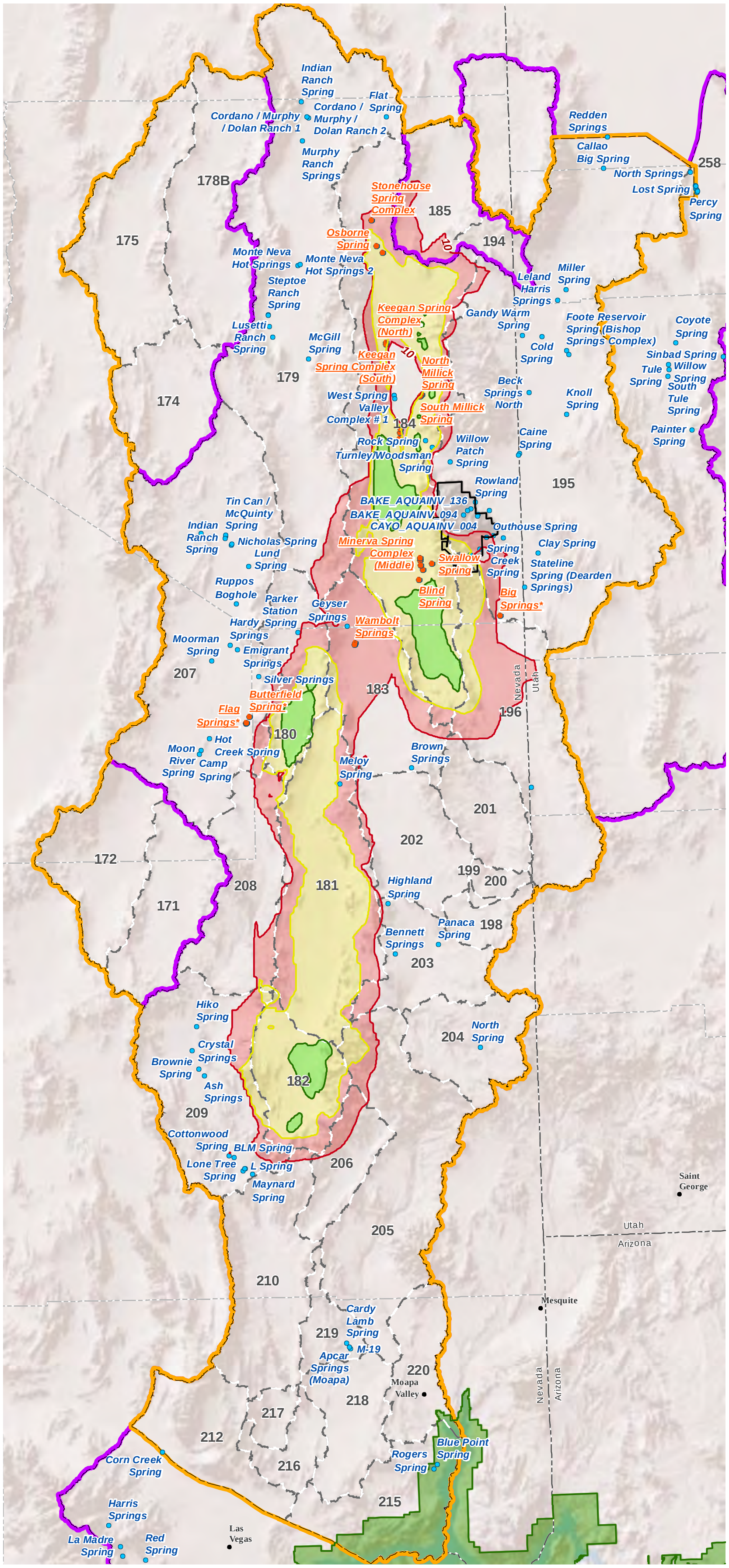
0 5 10 15 20 25 50 Miles

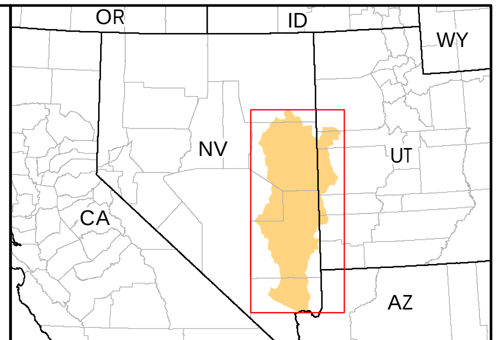
0 5 10 15 20 25 50 75 Kilometers

1:2,000,000

N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.





Legend

- Spring Containing Sensitive Aquatic Biology or Game Fish
- Potentially Affected Spring Containing Sensitive Aquatic Biology or Game Fish
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

*Spring is outside 10-ft drawdown contour, but model-predicted flow reductions indicate potential effect.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley		
199	Rose Valley	220	Lower Moapa Valley
200	Eagle Valley	258	Fish Springs Flat
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-20

Alternative F Drawdown and Springs with Aquatic Biological Resources

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Flow reductions could affect all types of aquatic communities including fish, amphibians, macroinvertebrates, macrophytes, and algae. For this EIS analysis, emphasis was placed on game fish and special status aquatic species. Alternative F could adversely affect the following game fish or special status species and their associated waterbody occurrences in at least one of the model time frames. Specific results for waterbodies and species at risk for each model time frames are provided in **Appendix F**, **Tables F3.7-24** and **F3.7-25**. Impact results organized by special status species also are listed in **Appendix F**, **Table F3.7-13A**, (Fish), **Table F3.7-13B** (Amphibians), and **Table F3.7-13C**, (Invertebrates).

- Game Fish Streams – Geyser Creek in Lake Valley; Big Wash Lake, and Snake creeks in Snake Valley; Bastian, Bassett, Eightmile, Indian, McCoy, Meadow, Muncy, Negro, Odgers, Piermont, Pine, Ridge, Shingle, Siegel, South Taft, Taft, Vipont, Willard, and Williams Canyon creeks in Spring Valley.
- Game Fish Springs/Ponds/Lakes – Swallow Spring in Spring Valley.
- Federally Listed Species – White River spinedace and critical habitat in Flag Springs (White River Valley) and Pahrump poolfish in Shoshone Ponds (Spring Valley).
- Bonneville Cutthroat Trout – Stream miles at risk for flow reductions include: Pine (0.1 to 0.4 mile or 12 to 50 percent of occupied habitat in this stream), Ridge (0.6 to 1.1 miles or 50 to 92 percent of occupied habitat in this stream), Big Wash (2.8 miles or 50 percent of occupied habitat in this stream) and Snake (<0.1 mile or <1 percent of occupied habitat in this stream).
- Other Special Status Fish Streams – Big Wash and Snake Creek in Snake Valley; and Pine and Ridge creeks in Spring Valley.
- Other Special Status Fish Springs/Ponds/Lakes – Butterfield and Flag springs in White River Valley; Keegan and Stonehouse springs and Shoshone Ponds in Spring Valley; and Big Springs and Stateline Springs in Snake Valley.
- Special Status Amphibian Species Springs/Ponds/Lakes – Blind, Cleveland Ranch, Keegan, Minerva, North Millick, South Millick, and one unnamed spring and Shoshone Ponds and O'Neal/Frog Pond in Spring Valley; and Wambolt Spring in Lake Valley.

Special Status Invertebrates Springs/Ponds/Lakes – Butterfield and Flag springs in White River Valley, Big Springs in Snake Valley, and Wambolt Spring in Lake Valley.The effects and conclusions of Alternative F groundwater pumping on aquatic biological resources are provided in **Table 3.7-19** along with ACMs and proposed mitigation.

Table 3.7-19 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative F Pumping

Effects/Conclusions
• Flow reductions would modify habitat by decreasing depths, water velocities, and wetted area in spring/pond/lake and stream habitats. A total of 18 springs/ponds/lakes and 24 streams are at risk when considering the longest model time frame. • Effects would be most pronounced in riffle habitats in streams and spring inflow and outflow areas. Effects on pool habitats would depend on the magnitude of the flow change and size of the pools. Reduced flows could adversely affect aquatic habitat by altering thermal regimes, increasing sedimentation, and reducing riparian cover. A substantial loss of habitat could occur in small springs and larger springs such as Big Springs in Snake Valley. • Flow reductions could adversely affect aquatic species by reducing abundance and diversity, altering composition, reducing food sources, limiting spawning and early life stage development, and decreasing individual health condition. • Flow reductions in 11 springs in Spring Valley could result in habitat reductions and adverse effects on the special status amphibian, northern leopard frog. • Flow reductions in Big Springs Creek and Lake Creek in Snake Valley could result in substantial loss of habitat and aquatic species. • Flow reductions in Big Springs in Snake Valley could result in loss of bifid duct and longitudinal gland pyrg populations at this location. • Due to limited occurrence (one spring/one basin), the populations of Butterfield pyrg (Butterfield Spring) and Flag pyrg (Flag Springs) could be lost if the spring habitat is substantially reduced. • Conflicts with recovery and conservation management objectives could occur for 4 species: Pahrump poolfish (Shoshone Ponds), White River spinedace (Flag Springs), Bonneville cutthroat trout (2 streams each in Spring and Snake valleys), and northern leopard frog (10 springs/ponds). • Game fish species considered to be traditional values to regional Tribes could be affected in Snake, Spring, and Lake valleys.

Table 3.7-19 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative F Pumping (Continued)

Impact Indicators[1] By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Number of Hydrologic Basins at Risk with Waterbodies Containing Game Fish or Special Status Species	1	2	5
Estimated Percent Flow Reductions			
Butterfield Spring (White River Valley)	1	6	17
Flag Springs (White River Valley)	1	6	16
Keegan Spring (Spring Valley)	35	98	100
North Millick Spring (Spring Valley)	20	52	60
South Millick Spring (Spring Valley)	36	86	95
Big Springs (Snake Valley)	2	25	83
Federally Listed Species at Risk			
Pahrump poolfish	Unlikely effect	Potential effect	Potential effect
White River spinedace and critical habitat	Unlikely effect	Unlikely effect	Potential effect
Hiko White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
White River springfish and critical habitat	Unlikely effect	Unlikely effect	Unlikely effect
Pahranagat roundtail chub	No effect	No effect	No effect
Big Springs spinedace and critical habitat	No effect	Unlikely effect	Unlikely effect
Moapa dace	No effect	No effect	Unlikely effect
Number of Springs/Ponds/Lakes with Game or Special Status Fish Species at Risk	1	5	7
Number of Springs/Ponds/Lakes with Special Status Amphibian Species at Risk	2	8	10
Number of Springs/Ponds/Lakes with Special Status Invertebrate Species at Risk	0	1	4
Number of Small Springs (100 gpm) with Aquatic Species at Risk	0	5	8
Number of Streams with Game Fish or Special Status Species at Risk	1	15	25
Miles of Game Fish Streams at Risk	1	16	28
GBNP Springs and Streams[2] with Game Fish or Special Status Species at Risk			
Outhouse Spring	Unlikely effect	Unlikely effect	Unlikely effect
Rowland Spring	Unlikely effect	Unlikely effect	Unlikely effect
Lehman Creek	Unlikely effect	Unlikely effect	Unlikely effect
Snake Creek	Unlikely effect	Unlikely effect	0.8 mile
Utah Springs and Streams with Game Fish or Special Status Species at Risk			
Clay Spring	Unlikely effect	Unlikely effect	Unlikely effect
Stateline Spring	Unlikely effect	Unlikely effect	Unlikely effect
Lake Creek	Unlikely effect	Unlikely effect	10.6 miles
Snake Creek	Unlikely effect	Unlikely effect	Unlikely effect
COM Plan			
• The COM Plan for designing and implementing monitoring and mitigation would integrate protective measures from the BLM RMP Management Actions and BMPs, BO, ACMs, Stipulated Agreements, and additional monitoring and mitigation are summarized below. Details of the COM Plan are provided in Section 3.20, Monitoring and Mitigation Summary. Protective measures for aquatic resources are summarized below for ACMs and mitigation recommendations.			

Table 3.7-19 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for Alternative F Pumping (Continued)

ACMs
• Existing agreements include the Spring Valley Stipulation, Delamar, Dry Lake, and Cave Valley Stipulation, Conservation Agreements (least chub and Columbia spotted frog) Utah and SNWA Snake Valley Environmental Monitoring and Management Agreement (not yet completed), and Candidate Conservation Agreement/Candidate Conservation Agreement with Assurances (not yet completed). • The Spring Valley and Dry Lake, Delamar, and Cave valleys Stipulated Agreements will involve monitoring in selected springs in Spring, Snake, Delamar, Dry Lake, and Cave valleys (see Measures C.1.1 and C.1.42 in **Appendix E**). The Spring Valley Stipulated Agreement also would consider alternative withdrawal points from Shoshone Ponds. • Actions will be implemented as part of the Spring Valley and Dry Lake, Delamar, and Cave valleys Stipulated Agreements to mitigate unreasonable adverse impacts to special status species (ACM C.2.1). Specific measures related to the mitigation will be developed as part of the monitoring and mitigation planning process. This process would extend into subsequent NEPA analyses for individual basins. • ACMs would be implemented to restore and enhance habitat for federally listed or special status species and would be done in cooperation with the USFWS. These measures would restore or enhance habitat for springsnails (ACM C.2.6 and C.2.16), White River spinedace (ACM C.2.8 and C.2.17), White River springfish (ACM C.2.9), Hiko White River springfish (ACM C.2.9), Pahranagat roundtail chub (ACM C.2.9), White River speckled dace (ACM C.2.14), and northern leopard frog (ACMC.2.18).
Monitoring Recommendations
GW-MN-AB-1 (Stream Flow and Aquatic Biology Monitoring) and **GW-MN-AB-2 (Spring and Aquatic Biology Monitoring)** described for the Proposed Action, would be applied to Alternative F. Springs and streams to be considered for monitoring are provided in **Appendix F3.7**, **Tables F3.7-16** and **F3.7-17**. Streams and springs located on public lands are listed in **Table 3.3.2-9** in Water Resources. **GW-MN-AB-3 (Flow/Habitat Determination)** will be conducted in selected springs and streams to be able to determine minimum flows or water levels for critical life stages of representative fish species. As described in Water Resources, Section 3.3, **GW-WR-3a (Comprehensive Water Resources Monitoring Plan)** would be implemented for sites identified as critical to providing early warning of potential effects to federal resources and federal water rights (see Water Resources, Section 3.3, for complete wording of GW-WR-3a).
Mitigation Recommendations
GW-AB-3 (Flow Change Mitigation) described for the Proposed Action, also would be applied to Alternative F. As described in Water Resources, Section 3.3, **GW-WR-7 (Groundwater Drawdown Effects to Federal Resources and Federal Water Rights)** would be implemented for federal resources and federal water rights where flow reductions are indicated during the comprehensive monitoring studies. If monitoring indicates that impacts are occurring or likely will occur in the future, the BLM would assess the impacts to determine if an emergency action involving a "Cease and Desist" order on pumping is required or if the development of a mitigation plan is more appropriate. If the BLM determines that a mitigation plan is required, SNWA would prepare a site-specific plan for avoiding, minimizing the magnitude of, or offsetting drawdown effects on federal water resources and federal water rights. The specific mitigation measures may include but are not limited to the following: reduction or cessation of pumping; geographical redistribution of groundwater withdrawals; recharge projects to offset local groundwater drawdown; flow augmentation; or other on-site or off-site improvements (see Water Resources, Section 3.3, for complete wording of GW-WR-7). **GW-WR-5 (Shoshone Ponds Mitigation)** would avoid a conflict with management objectives for Pahrump poolfish (see Water Resources, Section 3.3, for complete wording of GW-WR-5).
Potential Residual Impacts
• The COM Plan, ACMs, and monitoring and mitigation measures could be effective in reducing impacts to aquatic habitats and species. The objectives of the COM Plan are to avoid impacts to listed species and critical habitat and avoid, minimize, or mitigate impacts to fish. However, it is not possible to determine the level of impact reduction at this time. Effects on some aquatic habitats and species could exist considering the potential long recovery period that could occur in some aquatic habitats. Some unavoidable impacts on aquatic habitat and species could occur at some locations. The magnitude of effects would be less in Spring and Snake valleys compared to the Proposed Action.

[1] Parameters are based on streams or springs that are located within the 10-foot drawdown contour and characterized as having moderate or high risk of pumping effects.

[2] Other streams identified by Elliott et al. (2006) (Shingle and Williams Canyon creeks in Spring Valley and Baker and Strawberry creeks in Snake Valley) would not likely be affected.

3.7.2.16 No Action

Groundwater Development Area

Under the No Action Alternative, no groundwater activities would occur in the five pumping basins. Therefore, aquatic biological resources would not be affected by surface disturbance or facility maintenance activities.

Groundwater Pumping

No Action pumping could result in reductions in aquatic habitat and affect aquatic species. Based on the model analysis, the predicted 10-foot drawdown contour for No Action pumping is shown for streams in **Figure 3.7-21** and springs in **Figure 3.7-22**. Flows could be reduced in the following number of habitats with aquatic biological resources for the three model time frames.

- Streams – 2 at full build out, 3 at full build out plus 75 years, and 7 at full build out plus 200 years; and
- Springs/Ponds/Lakes – 3 at full build out, 7 at full build out plus 75 years, and 10 at full build out plus 200 years.

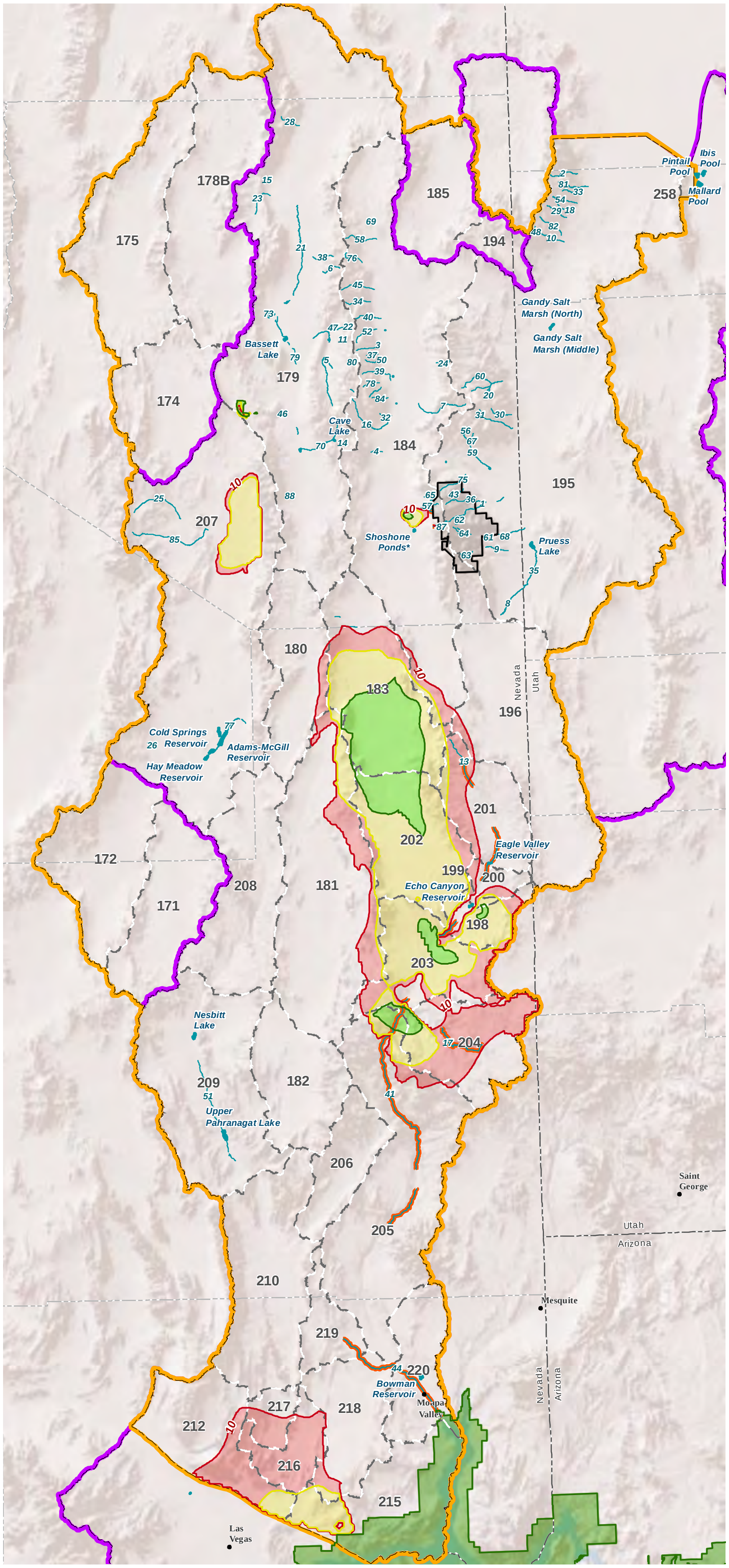
Flow reductions could affect all types of aquatic communities including fish, amphibians, macroinvertebrates, macrophytes, and algae. For this EIS analysis, emphasis was placed on game fish and special status aquatic species. No Action could adversely affect the following game fish or special status species and their associated waterbody occurrences in at least one of the model time frames. Specific results for waterbodies and species at risk for each model time frames are provided in **Appendix F**, **Tables F3.7-26** and **F3.7-27**.

- Game Fish Streams – Ridge and Williams Canyon creeks in Spring Valley (#184); Clover Creek in Clover Valley; Meadow Valley Wash (Lower Meadow Valley Wash); and Camp Valley Creek in Spring Valley (#201).
- Game Fish Springs/Ponds/Lakes – none.
- Federally Listed Species – Flag Springs (White River spinedace) in White River Valley, Shoshone Ponds (Pahrump poolfish) in Spring Valley, and Moapa dace in the Muddy River (Muddy River Springs Area).
- Other Special Status Fish Streams – Clover Creek in Clover Valley and Meadow Valley Wash (Lower Meadow Valley Wash and Panaca Valley).
- Other Special Status Fish Springs/Ponds/Lakes – Arnoldson, Indian Ranch, Nicolas, and Preston Big springs in White River Valley.
- Special Status Amphibian Species Springs/Ponds/Lakes –Wambolt Spring in Lake Valley.
- Special Status Invertebrates Springs/Ponds/Lakes – Arnoldson, Indian Ranch, Nicolas, and Preston Big springs in White River Valley; an unnamed spring near Camp Creek in Spring Valley (#201), and Wambolt Spring in Lake Valley.

The effects and conclusions of groundwater development on aquatic biological resources are provided in **Table 3.7-20** along with ACMs and proposed mitigation.

3.7.2.17 Alternatives Comparison

Impact parameter information for aquatic biological resources was tabulated for all action alternatives for the purpose of comparing pumping effects (**Table 3.7-21**). Impact parameters provide a quantitative indication of effects on aquatic habitat or species groups. A visual comparison of the impact parameter information also is shown in **Figure 3.7-23**. Information in **Figure 3.7-23** focuses on those parameters that show a noticeable difference amongst the alternatives.



#	Stream Name	#	Stream Name
1	Baker Creek	46	Murry Creek
2	Basin Creek	47	North Creek
3	Bassett Creek	48	North Fork of Birch Creek
4	Bastian Creek	49	North Fork Snake Creek
5	Berry Creek	50	Odgers Creek
6	Big Indian Creek	51	Pahranagat Creek
7	Big Negro Creek	52	Piermont Creek
8	Big Springs Creek	53	Pine Creek
9	Big Wash	54	Red Cedar Creek
10	Birch Creek	55	Ridge Creek
11	Bird Creek	56	Second Fork Silver Creek
12	Board Creek	57	Shingle Creek
13	Camp Valley Creek	58	Siegel Creek
14	Cave Creek	59	Silver Creek
15	Cherry Creek	60	Smith Creek
16	Cleve Creek	61	Snake Creek
17	Clover Creek	62	South Fork Baker Creek
18	Cottonwood Creek	63	South Fork Big Wash
19	Deadman Creek	64	South Fork Snake Creek
20	Deep Canyon Creek	65	South Fork Willard Creek
21	Duck Creek	66	South Taft Creek
22	East Creek	67	Spring Creek (Tributary to Silver Creek)
23	Egan Creek	68	Spring Creek (Tributary to Snake Creek)
24	Eightmile Creek	69	Spring Valley Creek
25	Ellison Creek	70	Steptoe Creek
26	Forest Home Creek	71	Steptoe Ranch Stream 3
27	Geyser Creek	72	Steptoe Ranch Stream 4a
28	Goshute Creek	73	Steptoe Ranch Stream 4b
29	Granite Creek	74	Steptoe Ranch Stream 5
30	Hampton Creek	75	Strawberry Creek
31	Hendry's Creek	76	Sunkist (North) Creek
32	Indian Creek	77	Sunnyside Creek
33	Indian Farm Creek	78	Taft Creek
34	Kalamazoo Creek	79	Tailings Creek
35	Lake Creek	80	Timber Creek
36	Lehman Creek	81	Tom's Creek
37	Little Negro Creek	82	Trout Creek
38	Mattier Creek	83	Upper Snake Creek
39	McCoy Creek	84	Vipont Creek
40	Meadow Creek	85	White River
41	Meadow Valley Wash	86	Willard Creek
42	Middle Fork Snake Creek	87	Williams Canyon Creek
43	Mill Creek	88	Willow Creek
44	Muddy River		
45	Muncy Creek		

Underlined streams may be affected where "At Risk" stream segments intersect drawdown.

- Potentially Affected "At Risk" Stream Segment
- Potentially Affected "At Risk" Waterbody

Legend

Water Features Containing Sensitive Aquatic Biology or Game Fish

- Perennial Stream Reach
- Waterbody
- Water Resources Region of Study
- Natural Resources Region of Study
- Hydrographic Basin
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

* Fed by artesian well

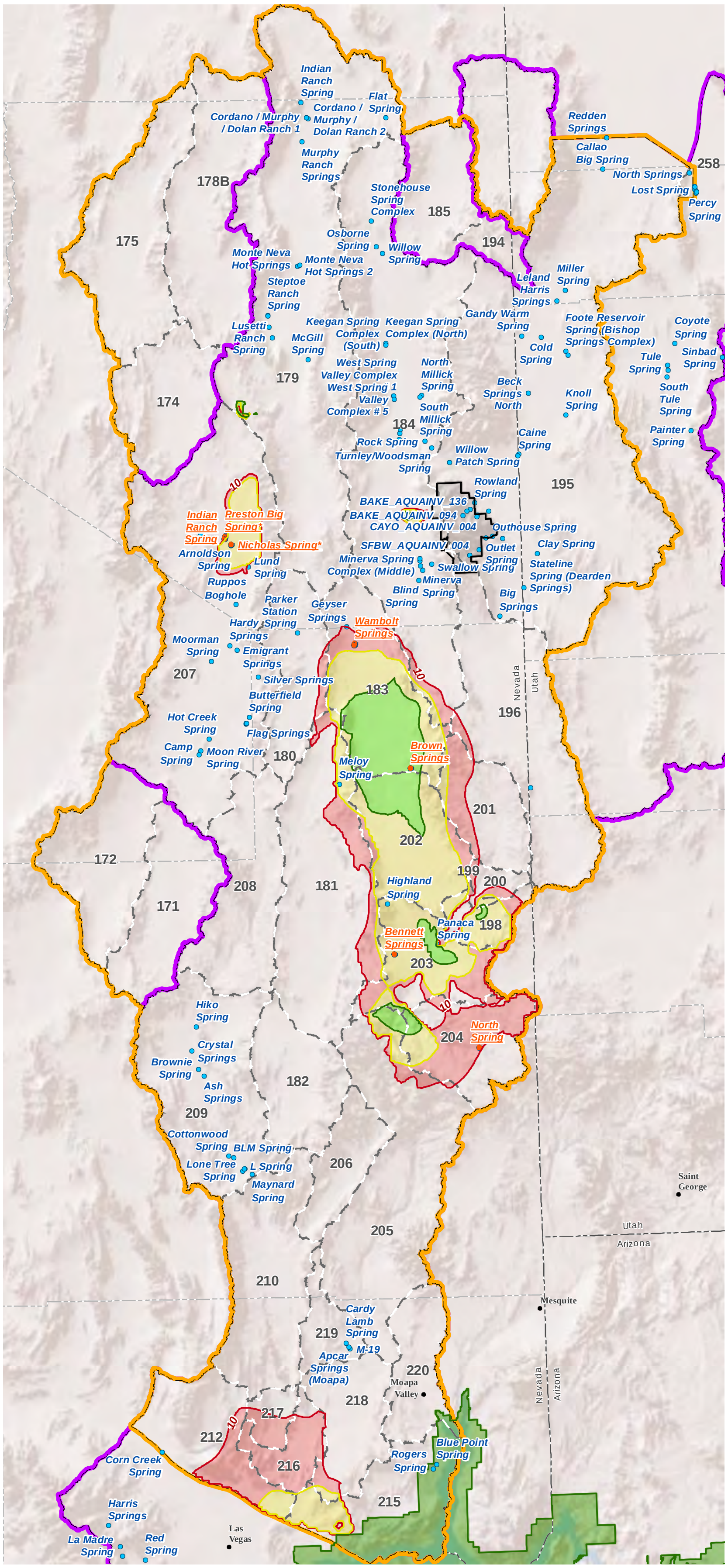
Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

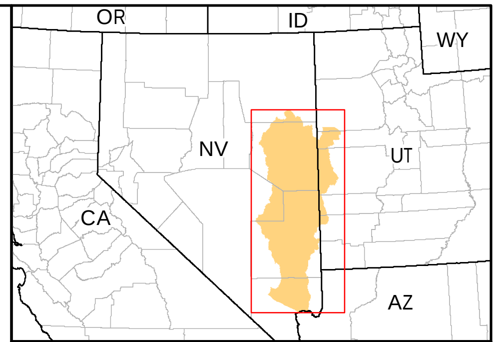
Figure 3.7-21

No Action Drawdown and Streams/ Waterbodies with Aquatic Biological Resources

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.





Legend

- Spring Containing Sensitive Aquatic Biology or Game Fish
- Potentially Affected Spring Containing Sensitive Aquatic Biology or Game Fish
- Water Resources Region of Study
- Hydrographic Basin
- Natural Resources Region of Study
- Great Basin National Park
- Lake Mead National Recreation Area
- 10 ft . Drawdown (Full Build Out)
- 10 ft. Drawdown (Full Build Out + 75 Years)
- 10 ft. Drawdown (Full Build Out + 200 Years)

*Spring is outside 10-ft drawdown contour, but model-predicted flow reductions indicate potential effect.

Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.7-22

No Action Drawdown and Springs with Aquatic Biological Resources

0 5 10 15 20 25 50 Miles
0 5 10 15 20 25 50 75 Kilometers
1:2,000,000
N

No Warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

Table 3.7-20 Summary of Aquatic Biological Resource Impacts, ACMs, and Monitoring and Mitigation Recommendations for No Action Pumping

Effects/Conclusions

- Flow reductions would modify habitat by decreasing depths, water velocities, and wetted area in spring/pond/lake and stream habitats. A total of nine springs/ponds/lakes and seven streams are at risk when considering the longest model time frame.
- Effects would be most pronounced in riffle habitats in streams and spring inflow and outflow areas. Effects on pool habitats would depend on the magnitude of the flow change and size of the pools. Reduced flows could adversely affect aquatic habitat by altering thermal regimes, increasing sedimentation, and reducing riparian cover. A complete loss of habitat could occur in small springs.
- Due to limited distribution (one spring/one basin), the population of Lake Valley pyrg (Wambolt Spring) in Lake Valley and Camp Valley pyrg (unnamed spring near Camp Valley Creek in Spring Valley [#201]) could be lost if flow is substantially reduced.
- Flow reductions could adversely affect aquatic species by reducing abundance and diversity, altering composition, reducing food sources, limiting spawning and early life stage development, and decreasing individual health condition.
- Conflicts with recovery and conservation management objectives could occur for four species: Pahrump poolfish (Shoshone Ponds), White River springfish (Flag Springs), Bonneville cutthroat trout (Ridge Creek in Spring Valley), and northern leopard frog (one spring).
- Game fish species considered to be traditional values to regional Tribes could be affected in Snake, Spring (#184 and 201), Clover, Panaca, and Lower Meadow Valley Wash.

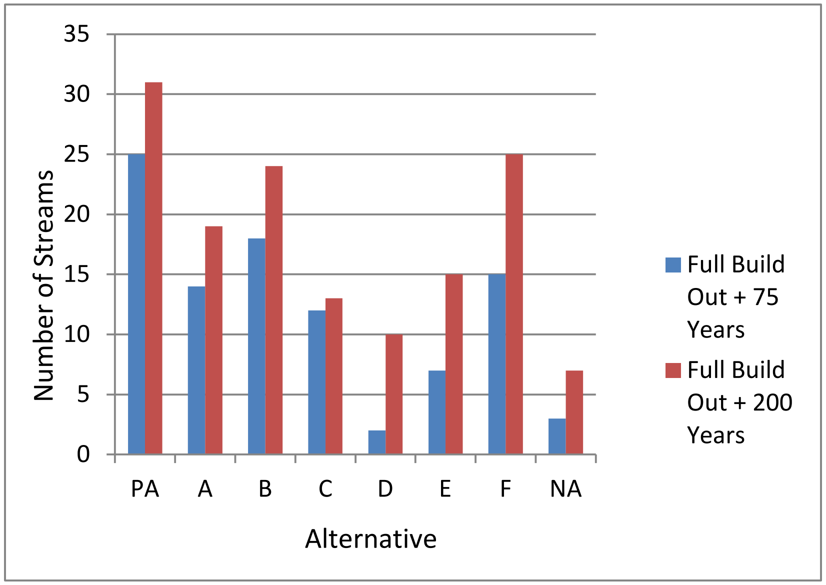
Impact Indicators[1] By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Number of Hydrologic Basins at Risk with Waterbodies Containing Game Fish or Special Status Species	4	5	7
Estimated Percent Flow Reductions			
Arnoldson Spring (White River Valley)	4	6	8
Butterfield Spring (White River Valley)	0	1	3
Flag Springs (White River Valley)	0	1	3
Nicolas Spring (White River Valley)	5	7	9
Preston Big Springs (White River Valley)	2	5	7
Keegan Spring (Spring Valley)	2	2	2
North Millick Spring (Spring Valley)	0	0	0
South Millick Spring (Spring Valley)	1	1	1
Big Springs (Snake Valley)	9	13	16
Muddy River near Moapa (Muddy Springs Area)	4	6	9
Federally Listed Species at Risk			
Pahrump poolfish	No effect	No effect	No effect
White River spinedace	Unlikely effect	Potential effect	Potential effect
Moapa dace	Unlikely effect	Potential effect	Potential effect
Number of Springs/Ponds/Lakes with Game or Special Status Fish Species at Risk	2	5	5
Number of Springs/Ponds/Lakes with Special Status Amphibian Species at Risk	0	0	1
Number of Springs/Ponds/Lakes with Special Status Invertebrate Species at Risk	2	4	6
Number of Small Springs (100 gpm) with Aquatic Species at Risk	1	1	2
Number of Streams with Game Fish or Special Status Species at Risk	2	3	7
Miles of Game Fish Streams at Risk	5	6	26
GBNP Springs and Streams with Game Fish or Special Status Species at Risk	No Effect	No effect	No effect
Utah Springs and Streams with Game Fish or Special Status Species at Risk	No Effect	No effect	No effect

[1] Parameters are based on streams or springs that are located within the 10-foot drawdown contour and characterized as having moderate or high risk of pumping effects.

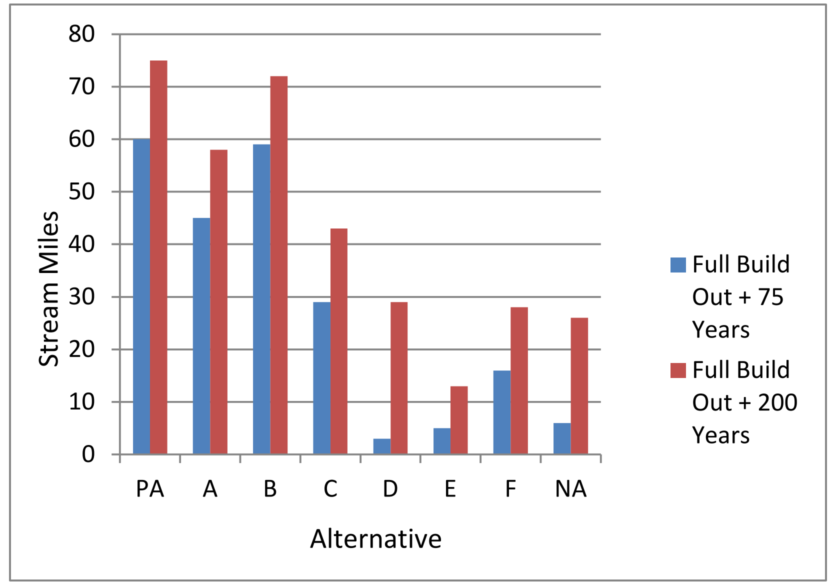
Table 3.7-21 Summary of Aquatic Biology Impact Parameters to Compare Groundwater Pumping Effects for the Proposed Action, Alternatives A through F, and No Action[1]

Impact Information	Proposed Action	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F	No Action
Impact Indicators								
Miles of Game Fish and Special Status Species Streams with Potential Flow Reductions (three model periods)	6, 60, and 75	3, 45, and 58	3, 59, and 72	1, 29, and 43	0, 3, and 29	1, 5, and 13	1, 16, and 28	5, 6, and 26
Number of Streams with Game Fish or Special Status Species Potentially Affected (three model periods)	4, 25, and 31	2, 14, and 19	3, 18, and 24	1, 12, and 13	0, 2, and 10	1, 7, and 15	1, 15, and 25	2, 3, and 7
Number of Springs/Ponds/Lakes Containing Game and Special Status Fish Species with Potential Water Level Reductions (three model periods)	1, 9, and 11	2, 8, and 10	4, 10, and 14	1, 7, and 9	1, 2, and 5	1, 4, and 6	1, 5, and 7	2, 5, and 5
Number of Springs/Ponds/Lakes Containing Special Status Amphibian Species with Potential Water Level Reductions (three model periods)	3, 9, and 10	2, 6, and 9	3, 8, and 10	2, 4, and 6	0, 2, and 4	2, 6, and 8	2, 8, and 10	0, 0, and 1
Number of Springs/Ponds/Lakes Containing Special Status Invertebrate Species with Potential Water Level Reductions (three model periods)	0, 7, and 8	0, 5, and 8	3, 7, and 10	0, 5, and 5	1, 2, and 6	0, 1, and 3	0, 1, and 4	2, 4, and 6
Number of Small Springs (< 100 gpm) with Aquatic Species in Drawdown Area with Potential Flow Reductions (three model periods)	0, 13, and 15	0, 7, and 12	2, 9, and 13	0, 3, and 6	0, 1, and 5	0, 1, and 5	0, 5, and 8	1, 1, and 2
Number of Springs with Aquatic Biological Importance Potentially Affected within GBNP (three model periods)	0, 1, and 2	0, 1, and 2	0, 2, and 2	0, 0, and 1	0, 0, and 1	0, 0, and 0	0, 0, and 0	0, 0, and 0
Stream Miles in GBNP with Aquatic Biological Importance Potentially Affected (three model periods)	0, 2, and 2	0, 2, and 2	0, 5, and 6	0, 0, and 2	0, 0, and 2	0, 0, and <1	0, 0, and <1	0, 0, and 0
Number of Springs with Aquatic Biological Importance Potentially Affected within Utah (three model periods)	0, 3, and 3	0, 3, and 3	0, 2, and 2	0, 3, and 3	0, 0, and 0	0, 0, and 0	0, 0, and 0	0, 0, and 0
Stream Miles in Utah with Aquatic Biological Importance Potentially Affected (three model periods)	0, 12, and 12	0, 12, and 12	0, 11, and 11	0, 12, and 12	0, 0, and 11	0, 0, and 11	0, 0, and 11	0, 0, and 0

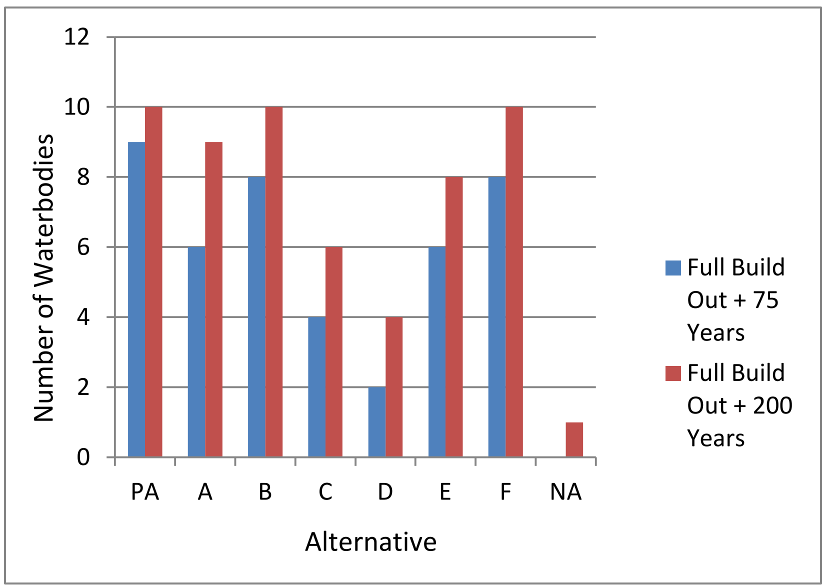
[1] Numbers are presented in sequence for the three model time frames: full build out, full build out plus 75 years, and full build out plus 200 years.



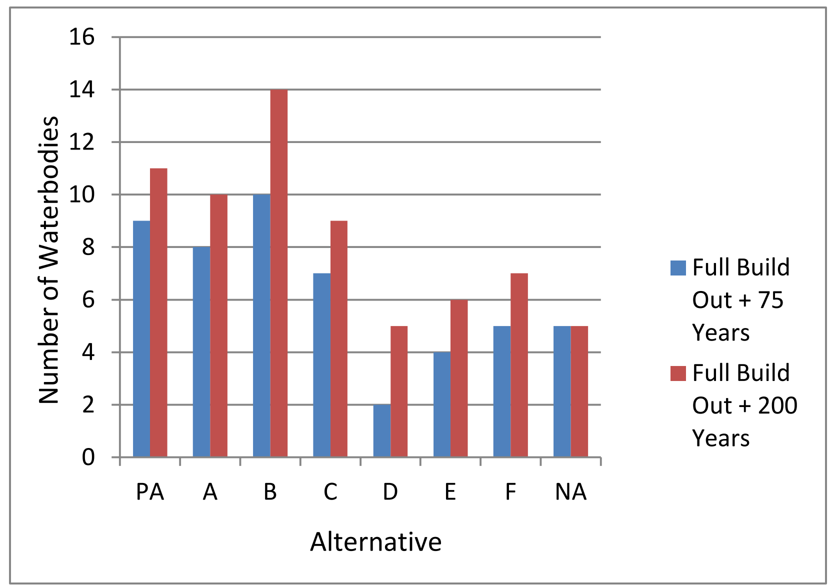
Streams with Aquatic Biology Resources with Potential Flow Reductions



Miles of Game Fish Streams with Potential Flow Reductions



Springs/Ponds/Lakes Containing Special Status Amphibian Species with Potential Flow Reductions



Springs/Ponds/Lakes Containing Game and Special Status Fish Species with Potential Flow Reductions

Figure 3.7-23 Comparison of Aquatic Biological Resource Pumping Impact Parameters

3.7.3 Cumulative Impacts

3.7.3.1 Impacts Common to All Alternatives

Climate Change Effects

Climate change already appears to be influencing both natural and managed ecosystems of the America Southwest (Breshears et al. 2005, Westerling et al. 2006, Seager et al. 2007) and models indicate the likelihood of the Southwest being a climate change "hotspot" in the coming decades (Diffenbaugh et al. 2008). Recent warming in the Southwest is among the most rapid in the nation, significantly more than the global average in some areas (USGCRP 2009). Projections suggest continued strong warming in the region, with significant increases in temperature (USGCRP 2009) and changes in precipitation regimes (Seager et al. 2007). A warmer atmosphere and an intensified water cycle are likely to mean not only a greater likelihood of drought for the Southwest, but also an increased risk of flooding (USGCRP 2009). Greater variability in patterns of precipitation can be anticipated in the future. In the coming century, mean global temperature could increase significantly, with an associated increase in both the frequency of extreme events (heat waves, droughts, storms) and the frequency and extent of wildfire (IPCC 2007; Westerling & Bryant 2008; Krawchuk et al. 2009). Under such conditions, future impacts could be substantial for some resources, impacting biodiversity, protected areas, and agricultural lands.

Climate Change Effects to Aquatic Biological Resources

Since 1950, there has been an increase from 6 to 16 percent in annual precipitation for most of the Great Basin. This has been accompanied by a decrease in snowpack at most monitoring sites and an earlier spring snowmelt contribution to stream flow (Chambers 2008). The extent of climate-related precipitation change on aquatic habitats would depend on the water source (runoff or groundwater), magnitude, and timing of the precipitation regime (Grimm et al. 1997). As the seasonal variability increases and the amount and form of precipitation changes, aquatic species and their habitat likely would be impacted. Impacts to species could include changes in abundance, distribution, phenology, community composition, and the introduction of noxious species in the ephemeral pools, playas, springs, streams, lakes, and reservoirs in the region of study.

Climate change is predicted to increase water temperature in most regions including the arid Southwest (Meyer et al. 1999). The effect of increased water temperature on aquatic habitat and species could include changes in water quality conditions (e.g., dissolved oxygen) and biological conditions such as direct mortality from acute temperature stress, sublethal stress on physiological functions, and shifts in species distributions. In North America, the Intergovernmental Panel on Climate Change predicted that coldwater fisheries would likely be adversely affected, warmwater fish species generally would be positively affected, and cool water fisheries would have a mixture of positive and negative changes in terms of habitat conditions and species distribution and diversity. In general, climatic warming would result in a general shift in species distributions northward, with extinctions of cool-water species at lower altitudes and range expansion of warmwater and cool-water species into higher altitudes (Meyer et al. 1999).

Climate change effects on amphibian species are related to habitat factors and ecological requirements. As mentioned for other aquatic species, temperature and precipitation changes can affect population abundance and distribution patterns. Other climate-related changes can include effects on survival, growth, reproduction, food availability, predator-prey relationships, and increased risk to disease (Blaustein et al. 2010). Changes in ambient temperature also may influence the timing of breeding and periods of hibernation (Field et al. 2007; Blaustein et al. 2010).

As a means of assessing the vulnerability of species to climate change, NatureServe initiated a collaborative effort to develop a Climate Change Vulnerability Index (Young et al. 2009). The Index was applied to a selection of test species in Nevada, where it will be used to modify the State Wildlife Action Plan by incorporating climate change species information. Based on this initial case study (Young et al. 2009) and subsequent analyses by the NNHP (2011), vulnerability index ratings for aquatic species provide some indication of potential effects of climate change in the region of study. Index scores were highly vulnerable for White River desert sucker, Lahontan cutthroat trout, and Columbia spotted frog and moderately vulnerable for Pahrump poolfish, White River speckled dace, California floater, and northern leopard frog. These species are representative of a variety of habitats in the region of study including streams (Lahontan cutthroat trout, White River speckled dace, and White River desert sucker), springs and wetlands (northern leopard frog and Columbia spotted frog), ponds (Pahrump poolfish), and rivers and lakes (California floater). The factors that were identified as vulnerable for these species included macro-scale temperature requirements, microand macro-scale precipitation requirements, migration movements, and physiological and historical hydrological niches.

Climate change could affect aquatic biological resources in the GWD Project Area by:

- Modification or alternation of aquatic habitats due to changes in precipitation;
- Potential changes in water temperature and other water quality parameters such as dissolved oxygen; and
- Potential changes in aquatic species abundance, distribution, phenology, and community composition in response to habitat and water quality changes.

3.7.3.2 Issues

Rights-of-way and Groundwater Development Area Construction and Maintenance

- Short-term, long-term, and permanent changes in aquatic habitat and species composition due to surface disturbance as a result of construction-related activities, and operational maintenance.
- Potential effects on fish spawning from habitat alteration.
- Loss of individuals, or populations of federal listed, candidate, or special status aquatic species due to surface disturbance.
- Compliance with management objectives defined in recovery plans, conservation agreements, and state wildlife action plans for special status aquatic species.
- Availability of fish species traditionally used for food by regional Tribes.
- Potential direct mortalities to amphibians from vehicle traffic.

Groundwater Pumping

- Short-term, long-term, and permanent changes in aquatic habitat and species, special status aquatic species and their habitats due to groundwater drawdown.
- Compliance with management objectives defined in recovery plans, conservation agreements, and state wildlife action plans for special status aquatic species.
- Changes in the availability of fish species traditionally used for food by regional Tribes in relation to groundwater drawdown.

3.7.3.3 Assumptions

Rights-of-way and Groundwater Development Area Construction and Maintenance

- Study Area. The study area is the proposed ROW project surface disturbance area (pipelines, power facilities, and roads) for each project alternative plus the total project surface disturbance estimate (well pads, roads, gathering pipelines, power lines) within groundwater development areas for each hydrographic basin. For ROWs, the focus was on perennial streams and springs with game fish or special status aquatic species that are crossed by ROWs, access roads, or other project facilities. For groundwater development areas, the presence of past, present, and reasonably foreseeable actions within the overall groundwater development area boundaries within each hydrographic basin was used as the basis for evaluating potential additive cumulative effects.
- Time frames. The effects analysis included time frames that ranged from several days to 2 years for a short-term effect and greater than 5 years for a long-term effect.
- The past and present action footprints are based on utility ROWs and other surface disturbance activities identified in the BLM and other data bases (Chapter 2).
- The reasonably foreseeable projects and activities are those outlined in **Table 2.9-1**, Chapter 2. No cumulative effects related to surface development activities are anticipated outside hydrographic basins occupied by project water development and conveyance facilities.

Groundwater Pumping

- Study area. The study area is the boundary for the groundwater model simulations.
- Time frames. The effects analysis included time frames from full build out of the entire project (approximately 2050) to full build out plus 200 years.

3.7.3.4 Methodology for Analysis

Rights-of-way and Groundwater Development Area Construction and Maintenance

- The cumulative surface disturbance effects to aquatic biological resources by hydrographic basin were estimated by overlaying the existing surface disturbances for (PPAs), RFFAs, and the development areas for the project alternative being evaluated. The estimated cumulative surface disturbance was then compared with the overall area of the hydrographic basin affected.
- The cumulative surface disturbance effects to special status aquatic species were estimated from evaluating the cumulative aquatic biological resource surface disturbance footprint in relation to the habitat requirements of special status plants to provide a risk assessment for future effects on these species.
- The potential cumulative changes in the availability of plants traditionally used for food and fiber by regional tribe were estimated from evaluating the cumulative vegetation community surface disturbance footprint in relation to the habitat requirements of food and fiber plants.

Groundwater Pumping

- The cumulative analysis focuses on those basins and waterbodies with aquatic biological resources that were predicted to be affected by each alternative. This represents the incremental effect of the alternative on aquatic biological resources in combination with other cumulative pumping actions.
- Figures were used to show the effects of pumping on springs and perennial streams with game fish and special status species using a spring and stream impact parameter. For each alternative, impact parameter information was shown in chart format for cumulative pumping with No Action, project alternative, and cumulative with the project alternative.
- The groundwater flow model was used to predict the groundwater drawdown from pumping. The overlap of the 10-foot drawdown contour with perennial streams and springs with game fish and special status aquatic species was used as the first step and key assumption in identifying areas of potential risk.
- Springs and Streams with Risk to Pumping. The 10-foot drawdown index was applied to the springs and perennial stream reaches that were classified as being at risk from groundwater drawdown (Section 3.3, Water Resources). The springs included for analysis were those rated as presenting a "high" or "moderate" risk of effects. The number of springs and miles of perennial stream reaches potentially affected were enumerated for each alternative over time from the modeling results.

3.7.3.5 No Action

Groundwater Development Area

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Vegetation communities would continue to be influenced by natural events such as drought and fire and land use activities such as grazing, and existing water diversions. Management activities on public lands will continue to be directed by the Ely and Las Vegas RMPs, which involve measures to maintain natural vegetation communities. Management guidance for other public lands in the project study area would be provided by Great Basin Park General Management Plan and the Forest Plan for the Humboldt-Toiyabe National Forest. Future actions would consist of six projects: Wilson Creek Wind (southern Spring and Lake valleys), Spring Valley Wind (Spring Valley), ON Transmission Line (Cave, Dry Lake, Delamar, Pahranagat, Coyote Spring, Hidden, and Garnett valleys), TransWest Express, Zephyr Transmission Lines (Delamar, Pahranagat, Coyote Spring, Hidden, and Garnett valleys), and Kane Springs Valley Ground Water Development (Kane Springs and Coyote Springs valleys). Surface disturbance activities associated with construction and maintenance activities could adversely affect aquatic habitat and species in Spring Valley. GWD Project areas in the other basins have limited perennial stream and spring habitats.

Groundwater Pumping Effects

The No Action Alternative includes past and present groundwater pumping, while No Action with cumulative adds RFFA pumping. Cumulative pumping with No Action could reduce flows and adversely affect aquatic biological resources in springs and streams within 8 to 13 hydrologic basins for the 3 model periods. Groundwater basins affected at the full build out plus 200 years would include Steptoe, Spring [#184], Snake, White River, Pahranagat, Lake, Dry Lake, Dry, Panaca, Clover, Muddy Springs Area, Lower Meadow Valley Wash, and Lower Moapa (**Appendix F**, **Tables F3.7-38** and **F3.7-39**). The effects of reduced flows would modify aquatic habitat in terms of decreased depth, water velocity, wetted area, and water quality parameters such as sedimentation and temperature. The effects of these habitat changes on aquatic biota could include reductions in abundance and taxonomic diversity, composition changes, loss of food sources, altered spawning and rearing success, restricted movement, and potential adverse effects on health.

Cumulative pumping with No Action could reduce flows and adversely affect aquatic biota in 9 and 14 springs/ponds/lakes at the full build out plus 75 and full build out plus 200 years time frames, respectively. Five springs/ponds/lakes would be affected at full build out. Pumping could affect the following number of springs or lakes with game fish or special status species for the three model periods: game fish and special status fish (2 to 8), special status amphibians (1 to 3), and special status invertebrates (1 to 6). Five or six small springs could dry up for the full build out plus 75 years and full build out plus 200 years time frames, respectively, which could result in a total loss of habitat and associated species. Three small springs could be affected at full build out. Loss of fish species such as dace and suckers and macroinvertebrates associated with spring inflow and outflow in riffle habitat could occur as a result of reduced flows. Reductions in population numbers and health of pool species such as springfishes, spinedaces, and macroinvertebrates could result from decreased water levels in pools.

Cumulative pumping with No Action also could reduce flows in the following number of streams for the 3 model time frames: full build out (4), full build out plus 75 years (6), and full build out plus 200 years (11). The estimated stream miles with game fish or special status species were 22, 26, and 51 for the 3 model time frames. The game fish streams have traditional values to regional Tribes. Loss of riffle and run habitats could result in the loss of trout, dace, and sucker species and macroinvertebrates that utilize these habitats. If stream segments should dry up, there would be a total loss of species.

Cumulative pumping with No Action could affect habitat for three federally listed fish species: White River spinedace, Big Springs spinedace, and Moapa dace. Spring flow or water level reductions were determined at the following locations for these species:

- **White River Spinedace:** The model-simulated flow reduction indicated a reduction of 7 percent at the full build out plus 200 years time frame in Preston Big Spring.
- **Big Springs Spinedace –** The 10-foot drawdown contour overlapped with 0.1 mile of occupied and critical habitat for this species in Meadow Valley Wash in Dry Valley during the full build out plus 200 years time frame. In total 3.1 miles of habitat exists in Meadow Valley Wash in this valley. Pumping would not affect flows in 2.1 miles of Big Springs spinedace habitat in Meadow Valley Wash in Panaca Valley.
- **Moapa Dace –** Model-predicted flow reductions were shown for all three model time frames in the Muddy River near Moapa, with percentages ranging from -37 to -61. This represents a substantial reduction in habitat for this species.
- **Pahrump Poolfish:** Since the 10-foot drawdown contour did not overlap Shoshone Ponds, No Action pumping would not affect Pahrump poolfish.
- **Other Federally Listed Species –** Cumulative pumping with No Action would not affect habitat for the following species: Hiko White River springfish (Hiko and Crystal springs), White River springfish (Ash Spring), and Pahranagat roundtail chub (Pahranagat Creek). Model-predicted flow reductions were less than 4 percent in Ash, Crystal, and Hiko springs for the three model periods.

Cumulative pumping with No Action would not affect flows or water levels in springs and streams in GBNP or Utah.

3.7.3.6 Proposed Action

Groundwater Development Area

Rights-of-way and Groundwater Development Area Construction and Maintenance

Habitat Alteration and Direct/Indirect Effects on Aquatic Species

PPAs consist primarily of existing roads, energy utility corridors, mining districts, and recent wildfires (**Figures 2.9-1** and **2.9-2**). Other activities that have influenced aquatic habitat and species include livestock grazing over nearly all public lands. The primary future actions consist of construction of the Wilson Creek Wind Project in southern Spring Valley and northern Lake Valley; the Spring Valley Wind Project in Spring Valley; the ON Transmission Line Project (overlaps with the GWD Project in Cave, Dry Lake, Delamar, Pahranagat, Coyote Springs, Hidden, and Garnett valleys); the TransWest Express and Zephyr Transmission Projects overlap with the GWD Project in Delamar, Pahranagat, Coyote Spring, Hidden, and Garnett valleys; Coyote Springs Development, and the Kane Springs Valley Groundwater Development Project in Kane Springs and Coyote Spring valleys. Of these cumulative projects, one (Spring Valley Wind Project) potentially could affect aquatic habitat and species that are located within the Spring Valley groundwater development for the GWD Project. Aquatic species located in perennial streams and springs in the Spring Valley groundwater development area are listed in **Tables 3.7-1** and **3.7-2**. The BLM BMPs, ACMs, and mitigation measures involving avoidance of springs and perennial streams would mean that the GWD Project would not contribute incremental effects to aquatic biological resources in the Spring Valley groundwater development area. No future projects overlap with the three streams (Snake, Steptoe, and Big Wash) that are located with the GWD Project ROWs or one stream (Geyser Creek) crossed by the Option 2 alignment in Lake Valley.

Cumulative Effects. The areas where the GWD Project surface disturbance would potentially overlap with PPAs, and reasonably foreseeable future actions (**Figures 2.9-1** and **2.9-2**) include existing road and highway crossings in all hydrographic basins; the LCCRDA utility corridor that extends from southern Dry Lake Valley to the vicinity of Apex (currently occupied by one electrical transmission line, but likely will contain one or more additional high voltage electrical transmission lines in the next 10 years), and intersection with the Spring Valley Wind Project in Spring Valley. The major additive cumulative effects would be the expansion in the width of adjacent utility ROWs, which could cross streams or be located adjacent to streams and springs in Spring Valley. Some new roads also could cross streams. It is not expected that cumulative development would substantially expand the surface disturbance to aquatic biological resources, based on only four perennial streams (Snake, Steptoe, Big Wash, and Geyser [Option 2 alignment]) that would be affected by the GWD Project. By implementing BMPs, ACMs, and mitigation recommendations involving avoidance of streams and springs in the groundwater development areas in Spring and Snake valleys, the GWD Project would not contribute incremental effects to aquatic biological resources in combination with other cumulative actions.

Compliance with Management Objectives for Special Status Aquatic Species

Cumulative Effects. Two special status aquatic species (Bonneville cutthroat trout and northern leopard frog) were evaluated as part of ROW and groundwater development surface disturbance activities for the GWD Project. Within the ROW and groundwater development areas analyzed as part of the GWD Project, Bonneville cutthroat trout occurs in headwater areas in 2 streams in Spring Valley (Pine and Ridge creeks) and 23 streams in Snake Valley (**Appendix F**, **Table F3.7-2**). Northern leopard frog occurs in numerous springs in Spring and Snake valleys (**Appendix F**, **Table F3.7-7**). The GWD Project would likely intersect service roads for wind energy projects in Spring Valley. Management objectives for these species are listed in **Appendix F**, **Table F3.7-8**. The following conclusions are made regarding cumulative effects to these two species:

- Bonneville Cutthroat Trout – Construction and maintenance activities would not affect two streams (Snake Creek and Big Wash) crossed by ROWs because this species occurs in headwater areas located upstream of the proposed crossings. For the groundwater development areas, implementation of mitigation recommendations involving avoidance of streams and springs in the groundwater development areas in Spring and Snake valleys would avoid impacts to Bonneville cutthroat trout. The GWD Project would not contribute incremental effects to this species in combination with other cumulative actions. Therefore, cumulative effects involving conflicts with management objectives for Bonneville cutthroat trout are not expected.
- Northern Leopard Frog – Construction and maintenance activities within the ROWs and groundwater development areas for the GWD Project could cause mortalities to northern leopard frog from vehicle traffic. These unquantifiable effects would contribute to potential mortalities from vehicle traffic for other cumulative actions.

No direct adverse effects are predicted for breeding habitat, since groundwater development ROWs do not cross springs and recommended mitigation for the groundwater development areas would avoid springs with special status aquatic species. When considering springs with known habitat for this species, cumulative effects could occur in Spring Valley. In conclusion, potential conflicts with management objectives (i.e., reduce road-related mortality) for northern leopard frog could result from cumulative actions.

Tribal Traditional Use of Fish

Cumulative Effects. Traditional use of native and non-native fish species occur in perennial streams in three hydrographic basins (Spring, Snake, and Steptoe) that have been affected by PPAs, and would be affected by reasonably foreseeable actions, and the proposed GWD Project facilities. It is not expected that cumulative development would substantially expand the surface disturbance to aquatic biological resources, based on only three perennial streams (Snake, Steptoe, and Big Wash) that would be affected by the GWD Project ROWs. By implementing BMPs, ACMs, and mitigation recommendations involving avoidance of streams in the groundwater development areas in Spring and Snake valleys, the GWD Project would not contribute incremental effects to Traditional use fish species in combination with other cumulative actions.

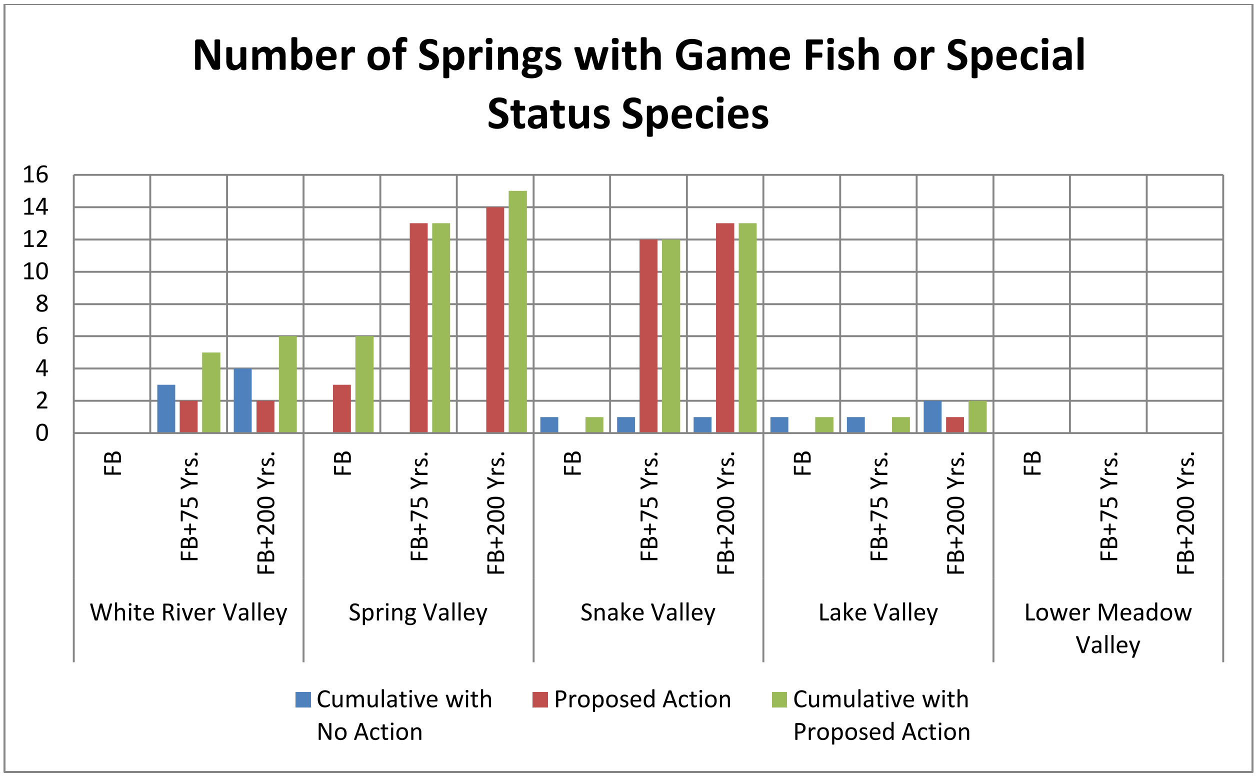
Groundwater Pumping Effects

PPAs are represented by the No Action pumping operations described in Section 3.3, Water Resources. The reasonably foreseeable actions are described in **Table 2.9-1**. The following discussions are based on an interpretation of the groundwater model simulations that predict groundwater drawdown elevations and changes in flow in springs and perennial streams that contain game fish and special status fish, invertebrate, and amphibian species.

Detailed results of the cumulative pumping analysis with the Proposed Action are provided in **Appendix F**, **Tables F3.7-26** and **F3.7-27** for springs/ponds/lakes and streams, respectively. As discussed in water resources (Section 3.3, Water Resources), the cumulative analysis focused on the incremental pumping effects that could be contributed by the Proposed Action in combination with other cumulative pumping activities. In total, 6 to 13 basins with aquatic biological resources could be affected by this cumulative analysis for the three model time frames. However, only six of these basins could be affected by the Proposed Action: White River, Spring (#184), Snake, Lake, Pahranagat, and Lower Meadow Valley Wash.

Percent flow reduction and impact indicator information are summarized in **Appendix F**, **Table F3.7-40** and shown in **Figure 3.7-24**. The summary and figure include impact parameter information for cumulative with No Action, Proposed Action, and cumulative pumping with the Proposed Action as a way of identifying the incremental effects of the alternative. The following conclusions were made based on this summary:

- Spring Valley (#184) – The Proposed Action could contribute to flow reductions (30 to 100 percent) in springs and streams in Spring Valley. These adverse effects on aquatic habitat could occur in all three model periods. For those springs with model-predicted flow changes, total or substantial loss of habitat could occur in Keegan, North Millick, and South Millick springs. The spring and stream impact parameters indicate that the Proposed Action could contribute most of the incremental cumulative effects on spring and stream habitat and species in this basin. In total, the Proposed Action could affect 3 to 14 springs and 4 to 20 streams with game fish or special status aquatic species for the 3 model time frames. No Action cumulative pumping could contribute reduced flows to three of the streams with biological resources in this valley (or 15 percent of the streams affected by Proposed Action pumping). No Spring Valley springs with biological resources could be affected by No Action cumulative pumping.
- Snake Valley – The Proposed Action could contribute reduced flows in Snake Valley springs and streams. Spring and stream habitat could be affected at the full build out plus 75 years and full build out plus 200 years time frame. Total loss of habitat could occur in Big Springs, based on model-predicted flow changes. The impact parameter information indicates that the Proposed Action contributes almost all of the cumulative effects on aquatic habitat and species in this basin. In total, the Proposed Action could reduce flows in 0 to 13 springs and 0 to 8 streams with game fish or special status aquatic species for the three model time frames.



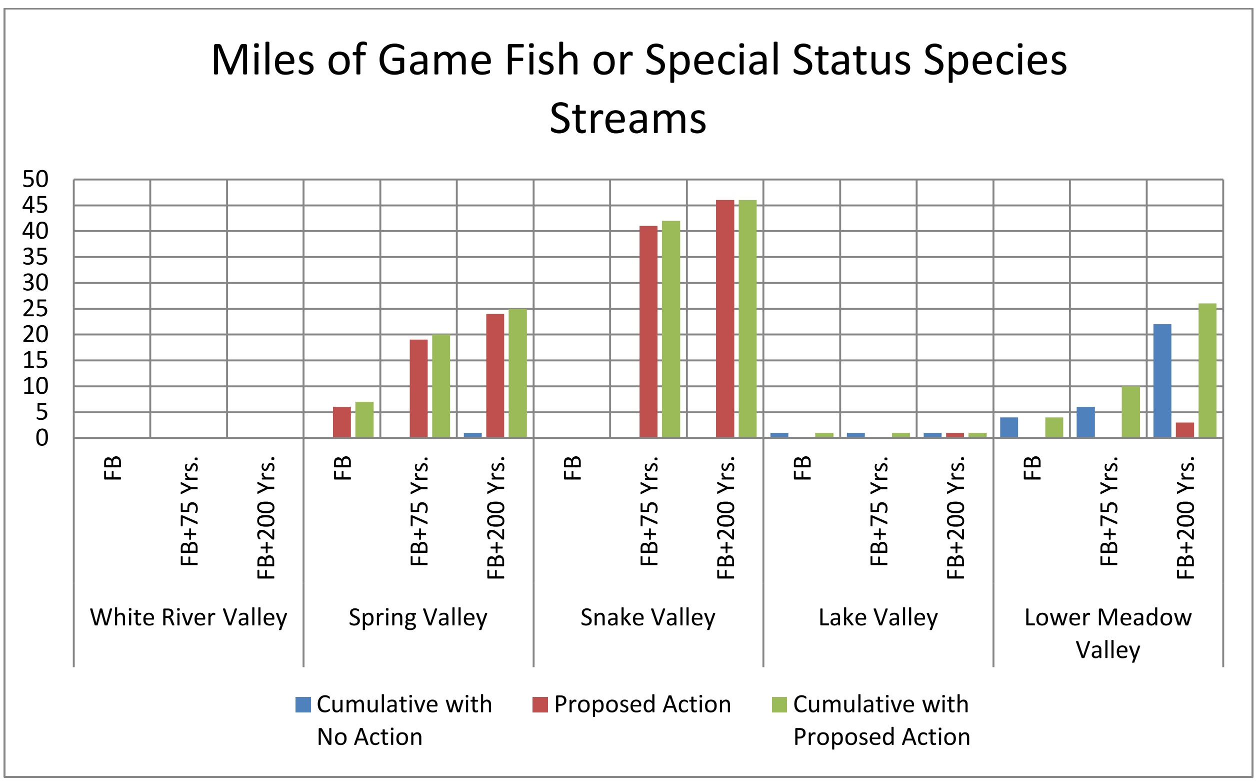


Figure 3.7-24 Cumulative Analysis with the Proposed Action and No Action Using Aquatic Biological Resource Impact Parameters

- White River Valley – The Proposed Action could contribute reduced flows (1 to 18 percent) in 2 springs (Butterfield and Flag) in White River. This alternative also could contribute very small flow reductions (1 to 3 percent) in 5 other springs (Arnoldson, Hot Creek, Moorman, Nicolas, and Preston Big). Most of the estimated flow reduction for Arnoldson, Nicolas, and Preston Big could result from No Action pumping. The spring and stream impact parameters indicate that the Proposed Action and No Action contribute cumulative effects on spring habitat and species in this basin. The impact parameter information shows that Proposed Action pumping could affect 0 to 2 springs. No Action also could reduce flows in 0 to 4 springs in this basin. Cumulative effects on spring habitat and species could result from No Action and Proposed Action pumping.
- Lake Valley – Proposed Action pumping could contribute to reduced flows in one spring and one stream at full build out plus 200 years time frame. No Action also could reduce flows in 1 to 2 springs (all 3 model time frames) and 0 streams (full build out plus 200 years). The spring and stream impact parameters indicate that the Proposed Action and No Action contribute cumulative effects on spring habitat and species in this basin.
- Pahranagat Valley – Proposed Action pumping could reduce flows in 1 stream (Pahranagat Creek) with game fish or special status aquatic species at full build out plus 200 years time frame. No Action pumping also could contribute to reduced flows in this same stream during all three model time frames.
- Lower Meadow Valley Wash – The Proposed Action could contribute very small flow reductions to Lower Meadow Valley Wash and Muddy River Springs Area. Most of the cumulative effects on stream habitat could result from cumulative pumping with No Action.

Cumulative pumping with the Proposed Action could affect habitat for four federally listed fish species, White River spinedace, Pahrump poolfish, Big Springs spinedace, and Moapa dace. The Proposed Action only could contribute effects to two of these species, White River spinedace and Pahrump poolfish. Spring flow or water level reductions were determined at the following locations for these species:

- White River Spinedace – Although the 10-foot groundwater drawdown contours did not overlap with springs occupied by this species, the model simulation predicted cumulative flow reductions of 2, 9, and 19 percent for the 3 model time frames in the Flag Spring complex. The Proposed Action could contribute most of the flow reduction in Flag Spring (-1 to -17). The predicted cumulative flow reduction in Preston Big Springs ranged from 2 to 8 for the 3 model time frames. Proposed Action pumping could contribute a very small portion of the predicted flow reduction (0 to -1) in Preston Big Springs. These springs are considered critical habitat for White River spinedace.
- Pahrump Poolfish – Potential water level reductions were predicted for all three model time frames in Shoshone Ponds. No information is available to quantify the potential flow reduction in the ponds. The Proposed Action pumping could contribute all of the reduced flow risk predicted for Shoshone Ponds.
- Big Springs Spinedace – No Action and other cumulative pumping could result in potential flow reductions in Meadow Valley Wash in Dry and Panaca valleys. In total, approximately 0.5 mile of the 5.2 miles of occupied and critical habitat could be adversely affected at the full build out plus 200 years time frame. The Proposed Action would not contribute to these effects on habitat for this species. Habitat in Condor Canyon in Upper Meadow Valley Wash in Panaca Valley could be affected in approximately 0.4 mile at the full build out plus 200 years time frame. No effect was indicated in the analysis for the full build out and full build out plus 75 years time frame.
- Moapa Dace – Cumulative pumping with No Action could result in flow reductions in the Muddy River. Proposed Action could not contribute to these effects on habitat for this species. Model-predicted cumulative flow reductions were shown for all three model time frames, with percentages ranging from -37 to -62. Proposed Action pumping could contribute a very small portion of this flow reduction (0 to -1 percent).
- Other Federally Listed Species – Cumulative pumping with the Proposed Action would not affect habitat for the following species: Hiko White River springfish (Hiko and Crystal springs), White River springfish (Ash Spring), and Pahranagat roundtail chub (Pahranagat Creek). Model-simulated flow reductions were estimated to be 0 to 5 percent in Ash and Crystal springs for the three model periods.

Cumulative pumping with the Proposed Action could contribute risks for habitat reductions for other special status fish, amphibians (northern leopard frog), and invertebrates (springsnails and California floater) in these six basins. Total loss of habitat could occur in Keegan, North Millick, and South Millick springs in Spring Valley and Big Springs in Snake Valley. Specific waterbodies and their associated species at risk are provided in **Appendix F**, **Tables F3.7-26** and

F3.7-27. In total, 7 to 29 springs/lakes with game fish or special status species could be affected by cumulative pumping in these 6 basins at the 3 model time frames. Cumulative effects on stream habitat for game fish or special status aquatic species would range from 29 to 127 miles for the 3 model time frames.

The Proposed Action could contribute to cumulative effects on two springs (Outhouse and Rowland) and two streams (Lehman and Snake) in Snake Valley with aquatic biological resources in GBNP. Data are not available to quantify the cumulative effect on habitat in these springs. Stream miles affected by this alternative included 1.8 miles for Snake Creek at the full build out plus 75 years and full build out plus 200 years time frame and 0.5 mile for Lehman Creek at the full build out plus 200 years time frame. Snake and Lehman creeks and Rowland Spring contain game fish species. Outhouse springs contain springsnails. Additional streams at risk include Shingle and Williams Canyon creeks in Spring Valley and Baker and Strawberry creeks in Snake Valley.

In Utah, cumulative pumping with the Proposed Action could reduce flows in two springs (Clay and Stateline) and two streams (Lake and Snake) in Snake Valley with aquatic biological resources. Data are not available to quantify the cumulative effect on habitat in these springs. Stream miles affected at the full build out plus 75 years and full build out plus 200 years time frame included 1.2 miles for Snake Creek and 10.6 miles for Lake Creek. Flow reductions in Lake Creek would result in reduced flow input to Pruess Lake in Utah. Snake Creek supports game fish species, while Lake Creek contains native fish species. Springsnails are present in Stateline and Clay Springs.

Cumulative pumping with the Proposed Action could conflict with conservation agreements for Bonneville cutthroat and northern leopard frog in Spring and Snake valleys and recovery plans for Pahrump poolfish and White River spinedace in Spring and White River valleys, respectively. Potential conflicts with the recovery plan for Big Springs spinedace would be caused by No Action and other cumulative action pumping.

The availability of fish species traditionally used for food by regional Tribes in relation to groundwater drawdown also could be affected in all six basins identified above with cumulative effects on native and non-native fish species. The majority of the streams at risk from pumping are located in Snake and Spring valleys. These streams were traditionally used by the Confederated Tribes of the Goshute Reservation.

3.7.3.7 Alternative A

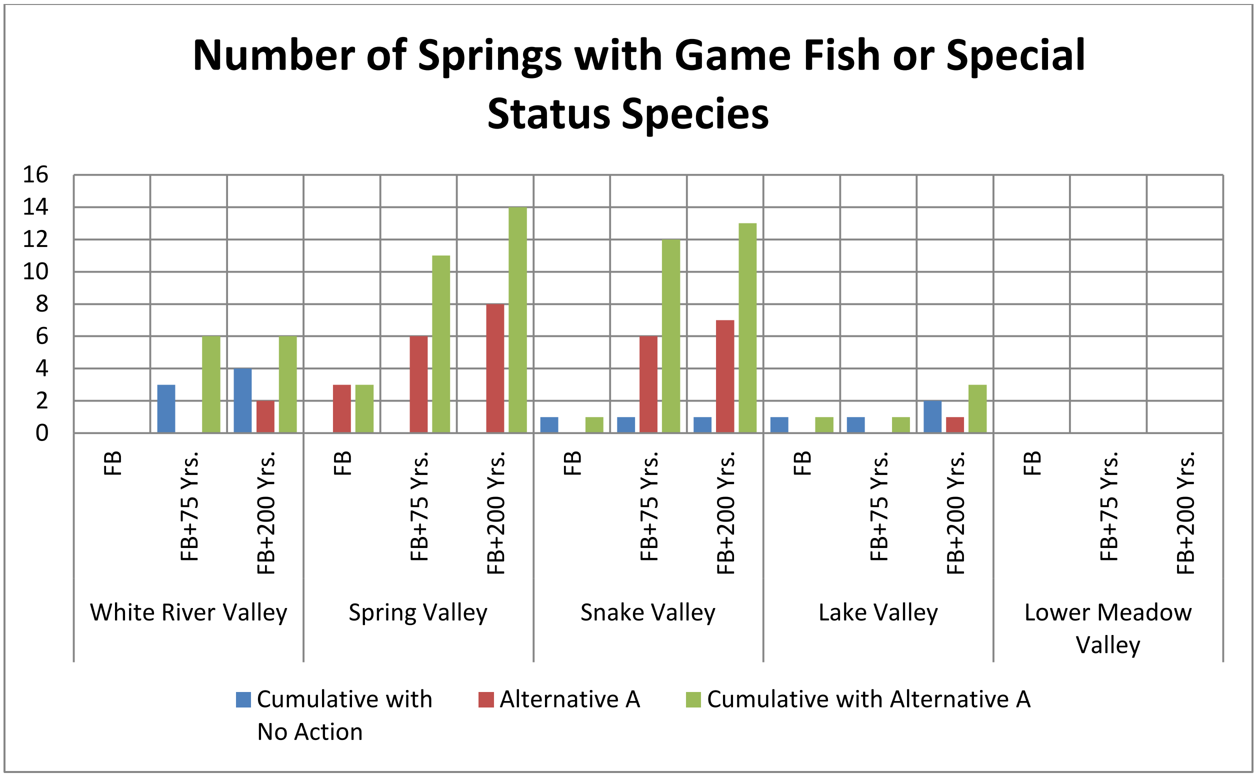
Right-of-ways and Groundwater Development Area Construction and Maintenance

The effects of Alternative A surface disturbance resulting from ROWs and project facilities in combination with other cumulative actions on aquatic biological resources would result in the same types of impacts discussed for cumulative impacts with the Proposed Action.

Groundwater Pumping Effects

Detailed results of the cumulative pumping analysis with Alternative A are provided in **Appendix F**, **Tables F3.7-28** and **F3.7-29** for springs/ponds/lakes and streams, respectively. The cumulative analysis focused on the incremental pumping effects that could be contributed by Alternative A in combination with other cumulative pumping activities. In total, 6 to 13 basins with aquatic biological resources could be affected by this cumulative analysis for the 3 model time frames. However, only four of these basins could be affected by the Proposed Action: White River, Spring (#184), Snake, and Lake valleys.

Percent flow reduction and impact indicator information are summarized in **Appendix F**, **Table F3.7-41** and shown in **Figure 3.7-25**. The summary and figure include impact parameter information for cumulative with No Action, Alternative A, and cumulative pumping with Alternative A as a way of identifying the incremental effects of the alternative. One notable difference for this cumulative pumping scenario would be that the magnitude of flow reduction would be smaller compared to cumulative pumping with the Proposed Action. Therefore, the magnitude of effects on reduced habitat would be lower in White River and Spring valleys. Based on the model-simulated flow predictions for Big Spring, the flow reduction would be the same for cumulative pumping with the Proposed Action and Alternative A.



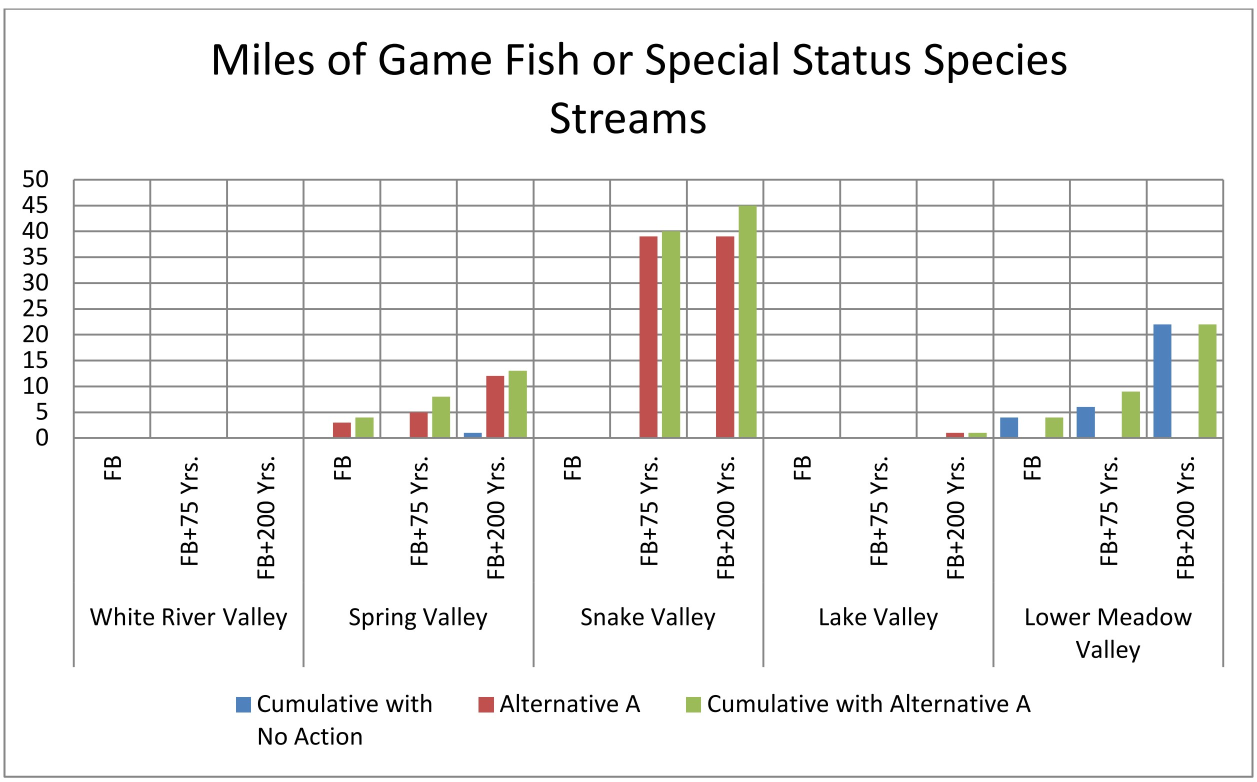


Figure 3.7-25 Cumulative Analysis with Alternative A and No Action Using Aquatic Biological Resource Impact Parameters

Based on the overlap of the 10-foot drawdown to springs and streams with aquatic biological resources, the number of affected springs and streams would be generally similar for cumulative pumping with the Proposed Action and Alternative A. The only notable exception could be Spring Valley, where the list of affected springs and streams would be less than cumulative pumping with the Proposed Action. For example, stream miles (i.e., streams containing game fish or special status aquatic species) affected by pumping could range from 2 to 12 for Alternative A model time frames, with the range for cumulative pumping being 4 to 13 miles. In contrast, the stream mile range for Proposed Action would be 6 to 24 for the three model time frames and 7 to 25 miles for cumulative pumping. Pumping effects on spring habitat and species in this basin also would be less than cumulative pumping with the Proposed Action.

The relative contribution of Alternative A to cumulative effects on aquatic habitat is shown in **Figure 3.7-25**. The figure includes impact parameter information for cumulative with No Action, Alternative A, and cumulative pumping with Alternative A. The same general pattern of relative contribution to cumulative pumping effects is evident for Alternative A and the Proposed Action. Alternative A could contribute a substantial portion of reduced habitat in Spring and Snake valleys. There could be more equal contribution of incremental effects from No Action and Alternative A in White River and Lake valleys. No Action pumping contributes all of the effects on habitat in Lower Meadow Valley Wash and Pahranagat Valley.

Cumulative pumping with Alternative A could affect habitat for four federally listed fish species, White River spinedace, Pahrump poolfish, Big Springs spinedace, and Moapa dace. Alternative A only would contribute effects to two of these species, White River spinedace and Pahrump poolfish. Spring flow or water level reductions were determined at the following locations for these species:

- White River Spinedace – Although the 10-foot groundwater drawdown contours overlap with springs occupied by this species, the model simulation predicted cumulative flow reductions of 1, 5, and 11 percent for the 3 model time frames in the Flag Spring complex. Most of this flow reduction could result from Alternative A pumping (-1 to -8 percent). Alternative A pumping could result in a very small percent flow reduction in Preston Big Springs (0 to -1 percent).
- Pahrump Poolfish – Potential water level reductions were predicted for all three model time frames in Shoshone Ponds. No information is available to quantify the potential flow reduction in the ponds. Alternative A pumping would contribute all of the incremental effects on habitat for Pahrump poolfish.
- Big Springs Spinedace – No Action and other cumulative pumping actions could affect flows in Meadow Valley Wash in Panaca Valley. Alternative A pumping is not expected to affect flows in this stream.
- Moapa Dace – Cumulative pumping with No Action would likely result in flow reductions in the Muddy River. Alternative A would not contribute to these effects on habitat for this species. Model-predicted cumulative flow reductions were shown for all three model time frames, with percentages ranging from -37 to -61. Alternative A could contribute a very small portion of flow reduction in the Muddy River (0 to -1 percent).

Other Federally Listed Species – Cumulative pumping with Alternative A would not affect habitat for the following species: Hiko White River springfish (Hiko and Crystal springs), White River springfish (Ash Spring), and Pahranagat roundtail chub (Pahranagat Creek). Model-simulated flow reductions of 0 to 4 percent were predicted for Ash and Crystal springs for the three model periods.

Cumulative pumping with Alternative A would contribute risks for habitat reductions for other special status fish, amphibians (northern leopard frog), and invertebrates (springsnails and California floater) in these five basins. Total loss of habitat could occur in Big Springs in Snake Valley, based on model-predicted flow changes. Specific waterbodies and their associated species at risk are provided in **Appendix F**, **Tables F3.7-28** and **F3.7-29**. In total, 4 to 27 springs with game fish or special status species could be affected by cumulative pumping in these 5 basins at the 3 model time frames. Cumulative effects on stream habitat for game fish or special status aquatic species would range from 25 to 109 miles for the 3 model time frames.

Alternative A would contribute to cumulative effects to the same springs and streams and associated aquatic species in GBNP and Utah, as discussed for cumulative pumping with the Proposed Action. Flow data are not available to predict the percent flow reduction for these aquatic habitats.

Cumulative pumping with Alternative A could conflict with conservation agreements for Bonneville cutthroat and northern leopard frog in Spring and Snake valleys and recovery plans for Pahrump poolfish and White River spinedace in Spring and White River valleys, respectively.

The availability of fish species traditionally used for food by regional Tribes in relation to groundwater drawdown also could be affected in all five basins identified above regarding cumulative effects on game fish or special status fish species.

3.7.3.8 Alternative B

Right-of-ways and Groundwater Development Area Construction and Maintenance

The effects of Alternative B surface disturbance resulting from ROWs and project facilities in combination with other cumulative actions on aquatic biological resources would be the same as discussed for cumulative impacts with the Proposed Action.

Groundwater Pumping Effects

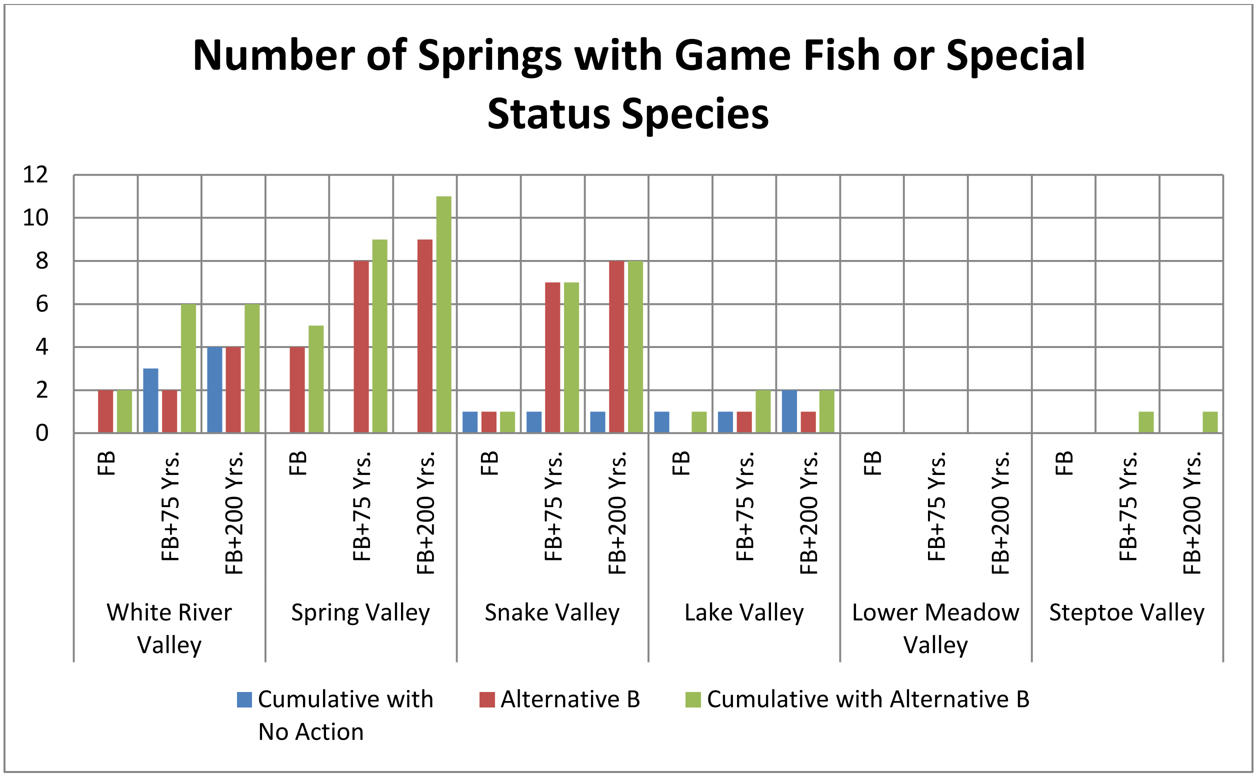
Detailed results of the cumulative pumping analysis with Alternative B are provided in **Appendix F**, **Tables F3.7-30** and **F3.7-31** for springs/ponds/lakes and streams, respectively. The cumulative analysis focused on the incremental pumping effects that would be contributed by the Alternative B in combination with other cumulative pumping activities. In total, 6 to 14 basins with aquatic biological resources would be affected by this cumulative analysis for the 3 model time frames. However, only seven of these basins would be affected by Alternative B: White River, Steptoe, Spring (#184), Snake, Lake, Pahranagat, and Lower Meadow Valley Wash. The addition of Steptoe Valley is unique to Alternative B, since this basin was not affected by the Proposed Action or Alternative A.

Percent flow reduction and impact indicator information are summarized in **Appendix F**, **Table F3.7-42**. Using model-simulated flow information, the magnitude of effects on reduced habitat would be higher in White River Valley and lower in Spring Valley in comparison to the Proposed Action. Based on the model-simulated flow predictions for Big Spring, the flow reduction would be similar for cumulative pumping with the Proposed Action and Alternative B.

The relative contribution of Alternative B to cumulative effects on aquatic habitat is shown in **Figure 3.7-26**. The figure includes impact parameter information for cumulative with No Action, Alternative B, and cumulative pumping with Alternative B. The same general pattern of relative contribution to cumulative pumping effects is evident for Alternative B and the Proposed Action. Alternative B would contribute a substantial portion of reduced habitat in Spring and Snake valleys. There would be more equal contribution of incremental effects from No Action and Alternative B in White River and Lake valleys. No Action and Alternative B pumping contribute most of the effects on habitat in Lower Meadow Valley Wash. No Action and Alternative B pumping contribute effects to aquatic habitat in Pahranagat Valley. One notable difference under cumulative pumping with Alternative B is that a higher number of springs with aquatic biological resources are affected at the full build out model time frame compared to the Proposed Action.

Cumulative pumping with Alternative B could affect habitat for four federally listed fish species, White River spinedace, Pahrump poolfish, Big Springs spinedace, and Moapa dace. Alternative B only would contribute effects to two of these species, White River spinedace and Pahrump poolfish. Spring flow or water level reductions were determined at the following locations for these species:

- White River Spinedace – Although the 10-foot groundwater drawdown contours did not overlap with springs occupied by this species, the model simulation predicted cumulative flow reductions of 19, 30, and 39 percent for the 3 model time frames in the Flag Spring complex. Alternative B pumping would contribute most of the flow reductions, as indicated by predicted percentages of -19 to -37. Cumulative pumping with Alternative B could result in percent flow reductions in Preston Big Springs (-3 to -9 percent). Alternative B pumping would contribute a small portion of the reduction as indicated by percentages of 0 to -2.



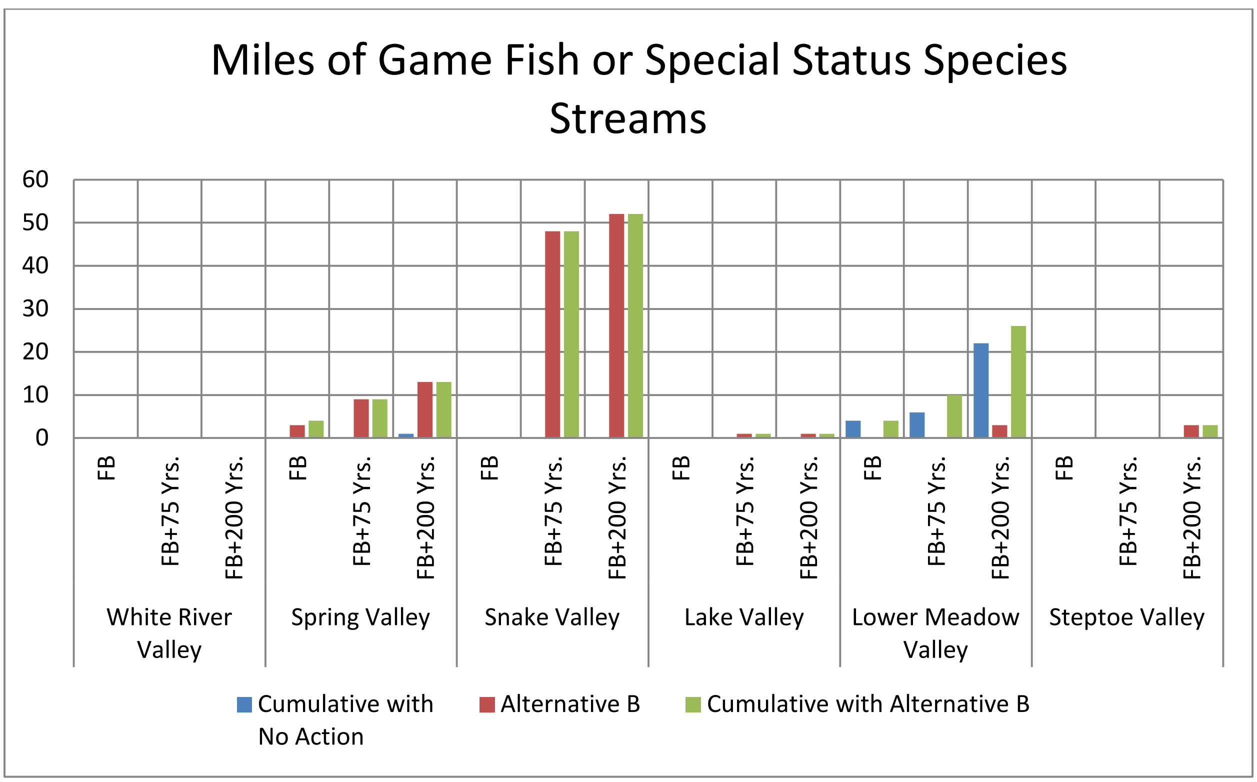


Figure 3.7-26 Cumulative Analysis with Alternative B and No Action Using Aquatic Biological Resource Impact Parameters

- Pahrump Poolfish – Potential water level reductions were predicted for all three model time frames in Shoshone Ponds. No information is available to quantify the potential flow reduction in the ponds. Alternative B would contribute all of the potential reduction in Shoshone Ponds.
- Big Springs Spinedace – No Action and other cumulative pumping actions would affect flows in Meadow Valley Wash in Panaca Valley (0.4 mile) and Dry Valley (0.1 mile). Alternative B pumping would not contribute reduced flows in Meadow Valley Wash.
- Moapa Dace – Cumulative pumping with No Action would likely result in flow reductions in the Muddy River. Alternative B would not contribute to these effects on habitat for this species. Model-predicted cumulative flow reductions were shown for all 3 model time frames, with percentages ranging from -37 to -62. The percent reduction for Alternative B pumping was 0 to -1.
- Other Federally Listed Species – Cumulative pumping with Alternative B would not affect habitat for the following species: Hiko White River springfish (Hiko and Crystal springs), White River springfish (Ash Spring), and Pahranagat roundtail chub (Pahranagat Creek). Model-simulated flow reductions of 0 to 5 percent were predicted for Ash and Crystal springs for the 3 model periods.

Cumulative pumping with Alternative B would contribute risks in habitat reductions for other special status fish, amphibians (northern leopard frog), and invertebrates (springsnails and California floater) in these seven basins. Total loss of habitat could occur in South Millick Spring in Spring Valley and Big Springs in Snake Valley. Specific waterbodies and their associated species at risk are provided in **Appendix F**, **Tables F3.7-30** and **F3.7-31**. In total, 8 to 28 springs with game fish or special status species could be affected by cumulative pumping in these 7 basins at the 3 model time frames. Cumulative effects on stream habitat for game fish or special status aquatic species would range from 26 to 122 miles for the 3 model time frames.

In GBNP, Alternative B could contribute to cumulative effects to three springs (Rowland, Outlet, and Outhouse) and four streams (Baker, Lehman, Snake, and Strawberry creeks) and associated aquatic species. In Utah, the same springs and streams could be affected, as discussed for cumulative pumping with the Proposed Action. Flow data are not available to predict the percent flow reduction for these aquatic habitats. Additional streams at risk include Shingle and Williams Canyon creeks in Spring Valley, based on the Elliott et al. (2006) study.

Cumulative pumping with Alternative B could conflict with conservation agreements for Bonneville cutthroat and northern leopard frog in Spring and Snake valleys and recovery plans for Pahrump poolfish and White River spinedace in Spring and White River valleys, respectively.

The availability of native and non-native fish species traditionally used for food by regional Tribes in relation to groundwater drawdown also could be affected in all seven basins identified above regarding cumulative effects on game fish or special status fish species.

3.7.3.9 Alternative C

Right-of-ways and Groundwater Development Area Construction and Maintenance

The effects of Alternative C surface disturbance resulting from ROWs and project facilities in combination with other cumulative actions on aquatic biological resources would be the same as discussed for cumulative impacts with the Proposed Action.

Groundwater Pumping Effects

Detailed results of the cumulative pumping analysis with Alternative C are provided in **Appendix F**, **Tables F3.7-32** and **F3.7-33** for springs/ponds/lakes and streams, respectively. The cumulative analysis focused on the incremental pumping effects that would be contributed by the Alternative C in combination with other cumulative pumping activities. In total, 6 to 13 basins with aquatic biological resources would be affected by this cumulative analysis for the 3 model time frames. However, only three of these basins would be affected by Alternative C: White River, Spring (#184), and Snake valleys.

Percent flow reduction and impact indicator information are summarized in **Appendix F**, **Table F3.7-43**. Using model-simulated flow information, the magnitude of effects on reduced habitat would be lower in White River and

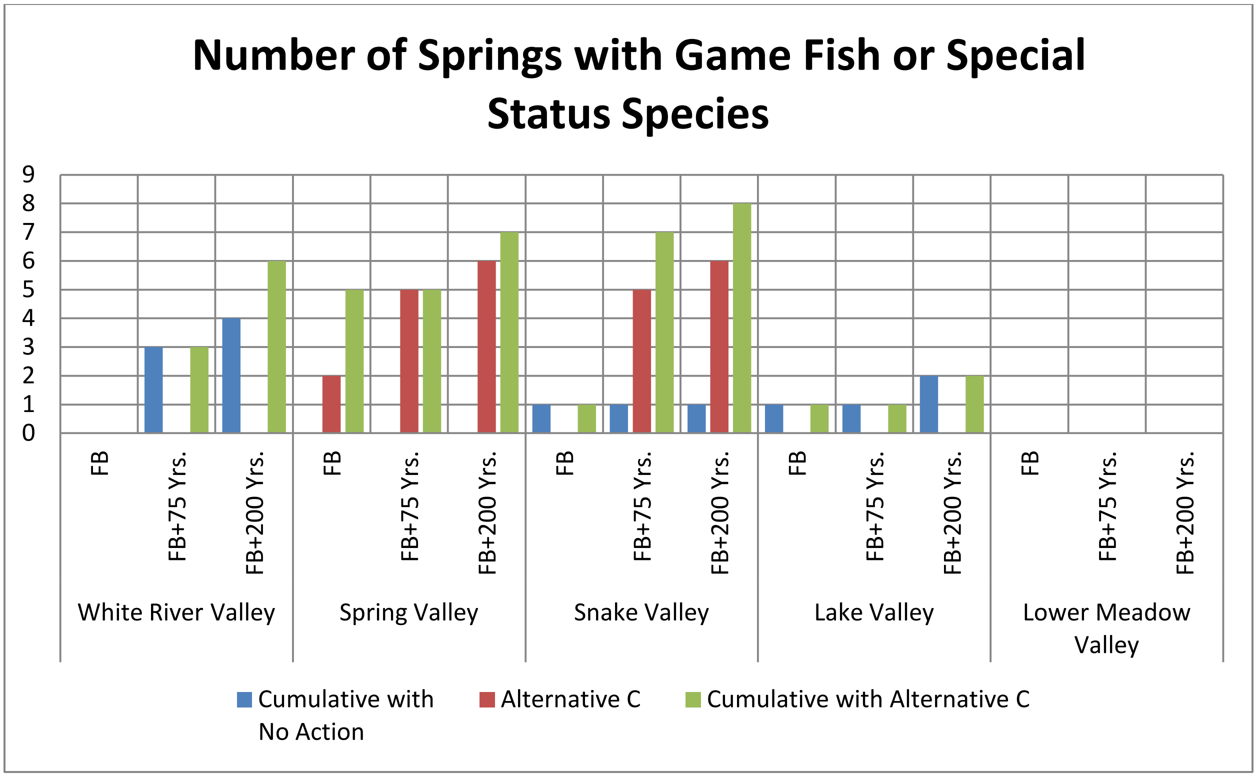
Spring valleys in comparison to the Proposed Action. Based on the model-simulated flow predictions for Big Spring, the flow reduction would be similar for cumulative pumping with the Proposed Action and Alternative C.

The relative contribution of Alternative C to cumulative effects on aquatic habitat is shown in **Figure 3.7-27**. The figure includes impact parameter information for cumulative with No Action, Alternative C, and cumulative pumping with Alternative C. Alternative C would contribute a substantial portion of reduced habitat in Spring and Snake valleys. There would be more equal contribution of incremental effects from No Action and Alternative C in White River Valley. No Action pumping contributes most of the effects on habitat in Pahranagat Valley and Lake Valley and all of the effects in Lower Meadow Valley Wash. One notable difference under cumulative pumping with Alternative C is that a lower number of spring and stream habitats would be affected in Spring Valley compared to the Proposed Action. The number of spring and stream habitat is similar in the other five valleys when comparing cumulative pumping with Alternative C and the Proposed Action.

Cumulative pumping with Alternative C could affect habitat for four federally listed fish species, White River spinedace, Pahrump poolfish, Big Springs spinedace, and Moapa dace. Alternative C only would contribute effects to two of these species, White River spinedace and Pahrump poolfish. Spring flow or water level reductions were determined at the following locations for these species:

- White River Spinedace – Although the 10-foot groundwater drawdown contours did not overlap with springs occupied by this species, the model simulation predicted cumulative flow reductions of 1, 4, and 8 percent for the 3 model time frames in the Flag Spring complex. Alternative C pumping would contribute most of the percent flow reductions in this spring (-1 to -5). Cumulative pumping could result in percent flow reductions in Preston Big Springs of 2 to 7 percent. Alternative C would not contribute to the predicted flow reduction in Preston Big Springs.
- Pahrump Poolfish – Potential water level reductions were predicted for all three model time frames in Shoshone Ponds. No information is available to quantify the potential flow reduction in the ponds. Alternative C would contribute all of the potential reduction in Shoshone Ponds.
- Big Springs Spinedace – No Action and other cumulative pumping actions could reduce flows in Meadow Valley Wash in Panaca Valley (0.1 mile). Potential flow reductions and reduced habitat were predicted at the full build out plus 200 years time frame. Alternative C pumping would not contribute to pumping effects on Meadow Valley Wash.
- Moapa Dace – Cumulative pumping with No Action would likely result in flow reductions in the Muddy River. Alternative C would not contribute to these effects on habitat for this species. Model-predicted flow reductions were shown for all 3 model time frames, with percentages ranging from -37 to -65.
- Other Federally Listed Species – Cumulative pumping with Alternative C would not affect habitat for the following species: Hiko White River springfish (Hiko and Crystal springs), White River springfish (Ash Spring), and Pahranagat roundtail chub (Pahranagat Creek). Model-simulated flow reductions of 0 to 4 percent were predicted for Ash and Crystal springs for the three model periods.

Cumulative pumping with Alternative C would likely contribute risks for habitat reductions for other special status fish, amphibians (northern leopard frog), and invertebrates (springsnails and California floater) in these six basins. Total loss of habitat could occur in Big Springs in Snake Valley, based on model-predicted flow changes. Specific waterbodies and their associated species at risk are provided in **Appendix F**, **Tables F3.7-32** and **F3.7-33**. In total, 6 to 25 springs with game fish or special status species could be affected by cumulative pumping in these 3 basins at the 3 model time frames. Cumulative effects on stream habitat for game fish or special status aquatic species would range from 25 to 102 miles for the 3 model time frames.



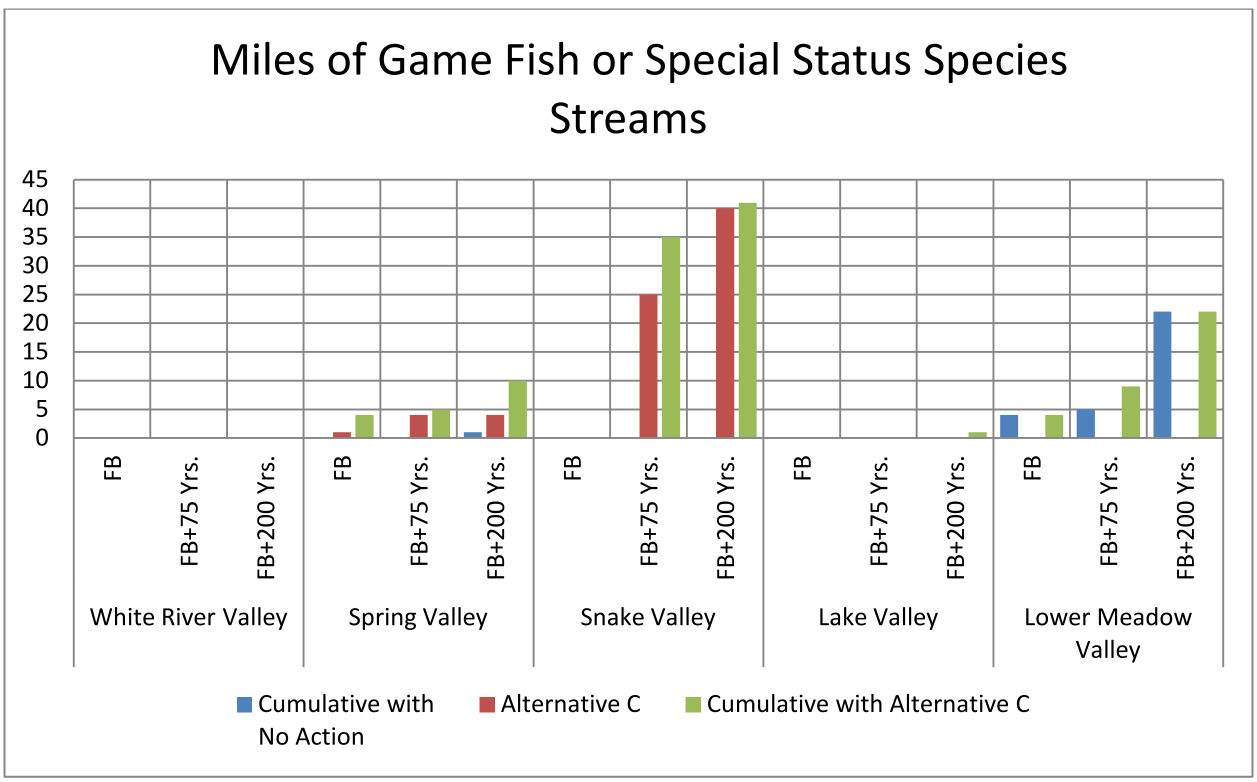


Figure 3.7-27 Cumulative Analysis with Alternative C and No Action Using Aquatic Biological Resource Impact Parameters

In GBNP, Alternative C could contribute to cumulative effects to three springs (Rowland and Outhouse) and two streams (Lehman and Snake creeks) and associated aquatic species. Additional streams at risk in GBNP include Shingle and Williams Canyon creeks in Spring Valley and Strawberry Creek in Snake Valley, based on the Elliott et al. (2006) study. In Utah, the same springs and streams would be affected, as discussed for cumulative pumping with the Proposed Action. Flow data are not available to predict the percent flow reduction for these aquatic habitats. Cumulative pumping with Alternative C could conflict with conservation agreements for Bonneville cutthroat and northern leopard frog in Spring and Snake valleys and recovery plans for Pahrump poolfish and White River spinedace in Spring and White River valleys, respectively.

The availability of fish species traditionally used for food by regional Tribes in relation to groundwater drawdown also could be affected in all six basins identified above regarding cumulative effects on game fish or special status fish species.

3.7.3.10 Alternative D

Right-of-ways and Groundwater Development Area Construction and Maintenance

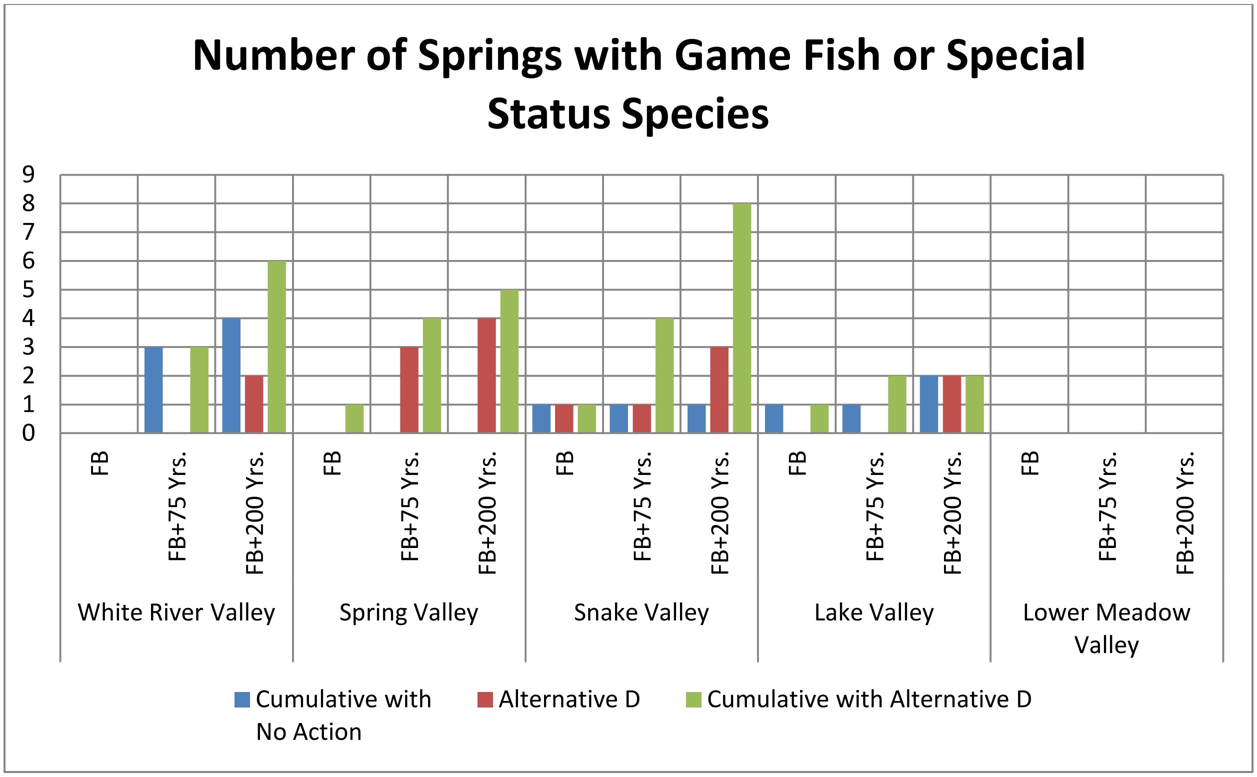
Construction and facility maintenance in Snake Valley and White Pine County would be eliminated under Alternative D. As a result, construction of the remaining ROWs and project facilities in Lincoln and Clark County and the Lincoln County portion of Spring Valley would result in effects on intermittent streams. No perennial streams or springs would be crossed by this alternative. Therefore, Alternative D impacts would contribute low level impacts after ACMs and additional mitigation in combination with past effects from grazing. Other past and future cumulative actions involving linear ROWs, wind projects, and the Kane Springs Valley Groundwater Development have or will result in surface disturbance and sedimentation impacts to streams and springs located in other portions of the cumulative effects study area. Alternative D would contribute minor impacts to the overall cumulative effects area due to the fact that no perennial streams or springs are affected.

Groundwater Pumping Effects

Detailed results of the cumulative pumping analysis with Alternative D are provided in **Appendix F**, **Tables F3.7-34** and **F3.7-35** for springs/ponds/lakes and streams, respectively. The cumulative analysis focused on the incremental pumping effects that would be contributed by the Alternative D in combination with other cumulative pumping activities. In total, 5 to 13 basins with aquatic biological resources would be affected by this cumulative analysis for the three model time frames. However, only six of these basins would be affected by Alternative D: White River, Spring (#184), Snake, Lake, Pahranagat, and Lower Meadow Valley Wash.

Percent flow reduction and impact indicator information are summarized in **Appendix F**, **Table F3.7-44**. Using model-simulated flow information, the magnitude of effects on reduced habitat would be considerably lower in White River and Spring valleys in comparison to the Proposed Action. Based on the model-simulated flow predictions for Big Spring, the flow reduction would be similar for cumulative pumping with the Proposed Action and Alternative D.

The relative contribution of Alternative D to cumulative effects on aquatic habitat is shown in **Figure 3.7-28**. The figure includes impact parameter information for cumulative with No Action, Alternative D, and cumulative pumping with Alternative D. Alternative D would contribute a substantial portion of reduced habitat in Snake and Spring valleys. This pattern is most evident in Snake Valley at the full build out plus 200 years time frame. There would be more equal contribution of incremental effects from No Action and Alternative D in White River and Lake valleys. No Action pumping contributes all of the effects on habitat in Pahranagat Valley and Lower Meadow Valley Wash. One notable difference under cumulative pumping with Alternative D is that a lower number of spring and stream habitats would be affected in Spring and Snake valleys compared to the Proposed Action. The number of spring and stream habitats is similar in the other five valleys when comparing cumulative pumping with Alternative D and the Proposed Action.



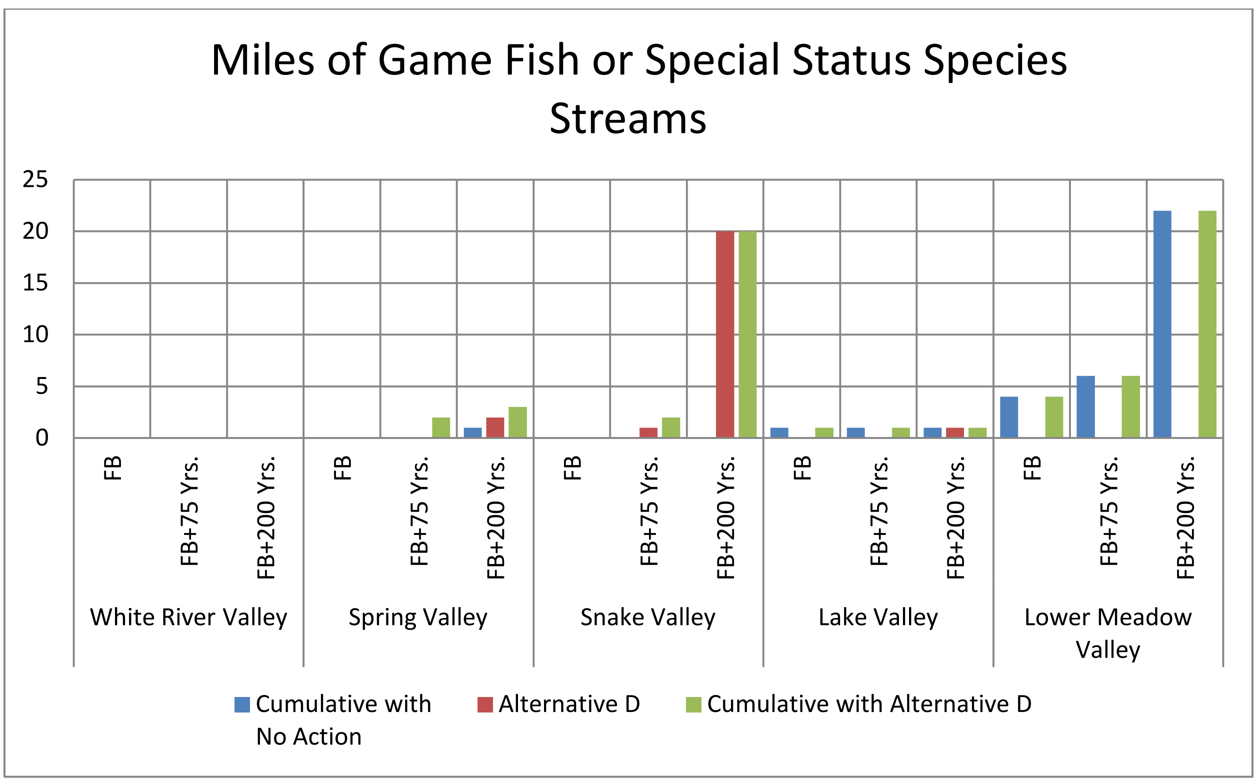


Figure 3.7-28 Cumulative Analysis with Alternative D and No Action Using Aquatic Biological Resource Impact Parameters

Cumulative pumping with Alternative D could affect habitat for four federally listed fish species, White River spinedace, Pahrump poolfish, Big Springs spinedace, and Moapa dace. Alternative D only would contribute effects to two of these species, White River spinedace and Pahrump poolfish. Spring flow or water level reductions were determined at the following locations for these species:

- White River Spinedace – Although the 10-foot groundwater drawdown contours did not overlap with springs occupied by this species, the model simulation predicted cumulative flow reductions of 1, 5, and 11 percent for the 3 model time frames in the Flag Spring complex. Most of the flow reduction would result from Alternative D, as indicated by a percent change of 0 to -9. Cumulative pumping could result in percent flow reductions in Preston Big Springs of 2 to 7 percent. None of this reduction would be caused by Alternative D pumping.
- Pahrump Poolfish – Potential water level reductions were predicted for the full build out plus 75 years and full build out plus 200 years time frame in Shoshone Ponds. No information is available to quantify the potential flow reduction in the ponds. Alternative D would contribute all of the potential reduction in Shoshone Ponds.
- Big Springs Spinedace – No Action and other cumulative pumping actions would likely affect flows in Meadow Valley Wash in Dry Valley (0.1 mile) at the full build out plus 200 years time frame. Alternative D pumping would not contribute to reduced flows in Meadow Valley Wash in Panaca Valley.
- Moapa Dace – Cumulative pumping with No Action would likely result in flow reductions in the Muddy River. Alternative D would not contribute to these effects on habitat for this species. Model-predicted cumulative flow reductions were shown for all three model time frames, with percentages ranging from -36 to -61. None of the predicted reduction would be caused by Alternative D.
- Other Federally Listed Species – Cumulative pumping with Alternative D would not affect habitat for the following species: Hiko White River springfish (Hiko and Crystal springs), White River springfish (Ash Spring), and Pahranagat roundtail chub (Pahranagat Creek). Model-simulated flow reductions of 0 to 4 percent were predicted for Ash and Crystal springs for the 3 model periods.

Cumulative pumping with Alternative D would likely contribute risks in habitat reductions for other special status fish, amphibians (northern leopard frog), and invertebrates (springsnails and California floater) in these three basins. Total loss of habitat could occur in Big Springs in Snake Valley, based on model-predicted flow changes. Specific waterbodies and their associated species at risk are provided in **Appendix F**, **Tables 3.7-34** and **3.7-35**. In total, 2 to 17 springs with game fish or special status species could be affected by cumulative pumping in these 6 basins at the 3 model time frames. Cumulative effects on stream habitat for game fish or special status aquatic species would range from 20 to 74 miles for the 3 model time frames.

Alternative D could contribute to cumulative effects to one spring (Outhouse) and one stream (Snake Creek) and associated aquatic species in the GBNP. In Utah, one spring (Stateline) and one stream (Lake Creek) could be affected, as discussed for cumulative pumping with the Proposed Action. Flow data are not available to predict the percent flow reduction for these aquatic habitats.

Cumulative pumping with Alternative D could conflict with conservation agreements for Bonneville cutthroat and northern leopard frog in Spring and Snake valleys and recovery plans for Pahrump poolfish and White River spinedace in Spring and White River valleys, respectively.

The availability of fish species traditionally used for food by regional Tribes in relation to groundwater drawdown also could be affected in all six basins identified above regarding cumulative effects on game fish or special status fish species.

3.7.3.11 Alternative E

Right-of-ways and Groundwater Development Area Construction and Maintenance

Under Alternative E, surface disturbance impacts would be limited to intermittent streams crossed by ROWs that would exclude Snake Valley. These impacts would be considered low level due to the implementation of BMPs and ACMs to reduce water quality effects involving sedimentation and potential fuel spills. Other past and future cumulative actions involving linear ROWs, wind projects, and groundwater development have or will result in surface disturbance and sedimentation impacts to waterbodies located in other portions of the cumulative effects study area. Alternative E would contribute minor impacts to the overall cumulative effects area due to the fact that no perennial streams or springs are affected.

Groundwater Pumping Effects

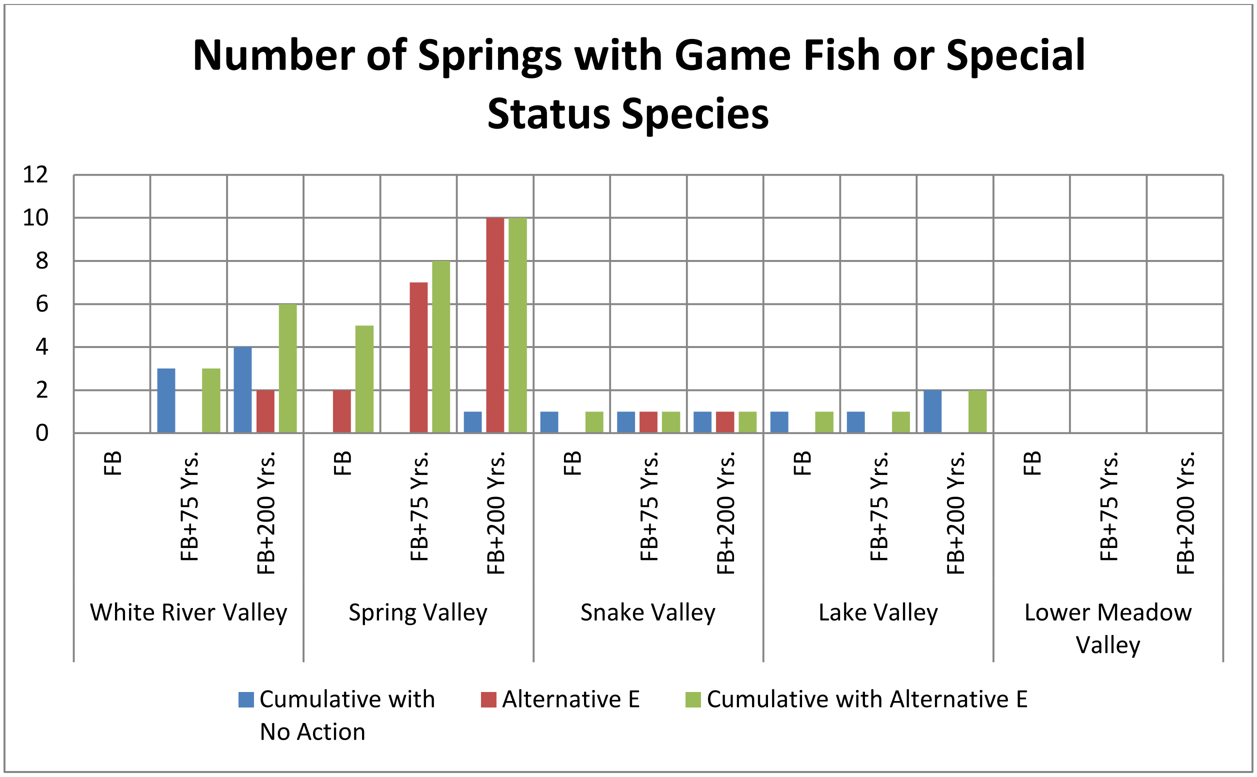
Detailed results of the cumulative pumping analysis with Alternative E are provided in **Appendix F**, **Tables F3.7-36** and **F3.7-37** for springs/ponds/lakes and streams, respectively. The cumulative analysis focused on the incremental pumping effects that would be contributed by the Alternative E in combination with other cumulative pumping activities. In total, 5 to 13 basins with aquatic biological resources would be affected by this cumulative analysis for the 3 model time frames. However, only five of these basins would be affected by Alternative E: White River, Spring (#184), Snake, Lake, and Spring (#201).

Percent flow reduction and impact indicator information are summarized in **Appendix F**, **Table F3.7-45**. Using model-simulated flow information, the magnitude of effects on reduced habitat would be considerably lower in White River and Spring valleys in comparison to the Proposed Action. Based on the model-simulated flow predictions for Big Spring, the flow reduction would be similar for cumulative pumping with the Proposed Action and Alternative E.

The relative contribution of Alternative E to cumulative effects on aquatic habitat is shown in **Figure 3.7-29**. The figure includes impact parameter information for cumulative with No Action, Alternative E, and cumulative pumping with Alternative E. Alternative E would contribute a substantial portion of reduced habitat in Spring Valley. There would be more equal contribution of incremental effects from No Action and Alternative E in White River, Snake, and Lake valleys. No Action pumping would contribute all of the effects on habitat in Pahranagat Valley and Lower Meadow Valley Wash. One notable difference under cumulative pumping with Alternative E is that a lower number of spring and stream habitats would be affected in Snake Valley compared to the Proposed Action. The number of spring and stream habitat is similar in the other five valleys when comparing cumulative pumping with Alternative E and the Proposed Action.

Cumulative pumping with Alternative E could affect habitat for four federally listed fish species, White River spinedace, Pahrump poolfish, Big Springs spinedace, and Moapa dace. Alternative E only would contribute effects to two of these species, White River spinedace and Pahrump poolfish. Spring flow or water level reductions were determined at the following locations for these species:

- White River Spinedace – Although the 10-foot groundwater drawdown contours did not overlap with springs occupied by this species, the model simulation predicted cumulative flow reductions of 1, 5, and 11 percent for the 3 model time frames in the Flag Spring complex. Most of the predicted reduction would be caused by Alternative E pumping (-1 to -8 percent). Model simulations indicate that cumulative pumping would result percent flow reductions in Preston Big Springs of 2 to 8 percent. A very small portion of this reduction would be caused by Alternative E pumping (0 to -1 percent).
- Pahrump Poolfish – Potential water level reductions were predicted for the full build out plus 75 years and full build out plus 200 years time frame in Shoshone Ponds. No information is available to quantify the potential flow reduction in the ponds. Alternative E would contribute all of this potential reduction in Shoshone Ponds.
- Big Springs Spinedace – No Action and other cumulative pumping actions could reduce flows in Meadow Valley Wash in Dry Valley (0.1 mile) at the full build out plus 200 years time frame. Alternative E pumping would not contribute reduced flow to Meadow Valley Wash in Panaca Valley.
- Moapa Dace – Cumulative pumping with No Action would likely result in flow reductions in the Muddy River. Alternative E would not contribute to these effects on habitat for this species. Model-predicted cumulative flow reductions were shown for all three model time frames, with percentages ranging from -37 to -61. Alternative E pumping would not contribute to his reduction.
- Other Federally Listed Species – Cumulative pumping with Alternative E would not affect habitat for the following species: Hiko White River springfish (Hiko and Crystal springs), White River springfish (Ash Spring), and Pahranagat roundtail chub (Pahranagat Creek). Model-simulated flow reductions would be 0 to 4 percent in Ash and Crystal springs for the 3 model periods.



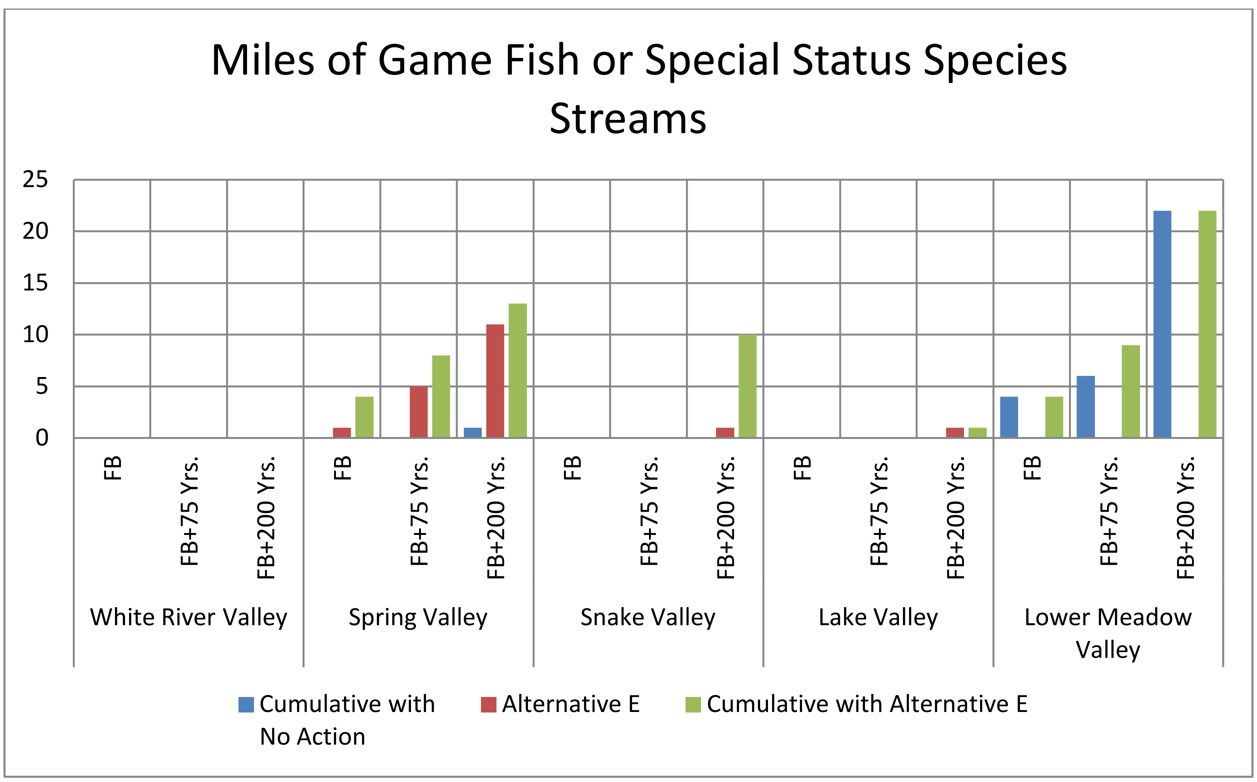


Figure 3.7-29 Cumulative Analysis with Alternative E and No Action Using Aquatic Biological Resource Impact Parameters

Cumulative pumping with Alternative E would contribute risks for habitat reductions for other special status fish, amphibians (northern leopard frog), and invertebrates (springsnails and California floater) in these five basins. Substantial loss of habitat could occur in Big Springs in Snake Valley, based on model-predicted flow reductions of 82 percent. Specific waterbodies and their associated species at risk are provided in **Appendix F**, **Tables 3.7-34** and **3.7-35**. In total, 6 to 21 springs with game fish or special status species could be affected by cumulative pumping in these 5 basins at the 3 model time frames. Cumulative effects on stream habitat for game fish or special status aquatic species would range from 26 to 75 miles for the 3 model time frames.

Alternative E could contribute to cumulative effects to one spring (Outhouse) and one stream (Snake Creek) and associated aquatic species in the GBNP. In Utah, no springs and one stream (Lake Creek) could be affected, as discussed for cumulative pumping with the Proposed Action. Flow data are not available to predict the percent flow reduction for these aquatic habitats.

Cumulative pumping with Alternative E could conflict with conservation agreements for Bonneville cutthroat and northern leopard frog in Spring and Snake valleys and recovery plans for Pahrump poolfish and White River spinedace in Spring and White River valleys, respectively.

The availability of fish species traditionally used for food by regional Tribes in relation to groundwater drawdown also could be affected in all six basins identified above regarding cumulative effects on game fish or special status fish species.

3.7.3.12 Alternative F

Right-of-ways and Groundwater Development Area Construction and Maintenance

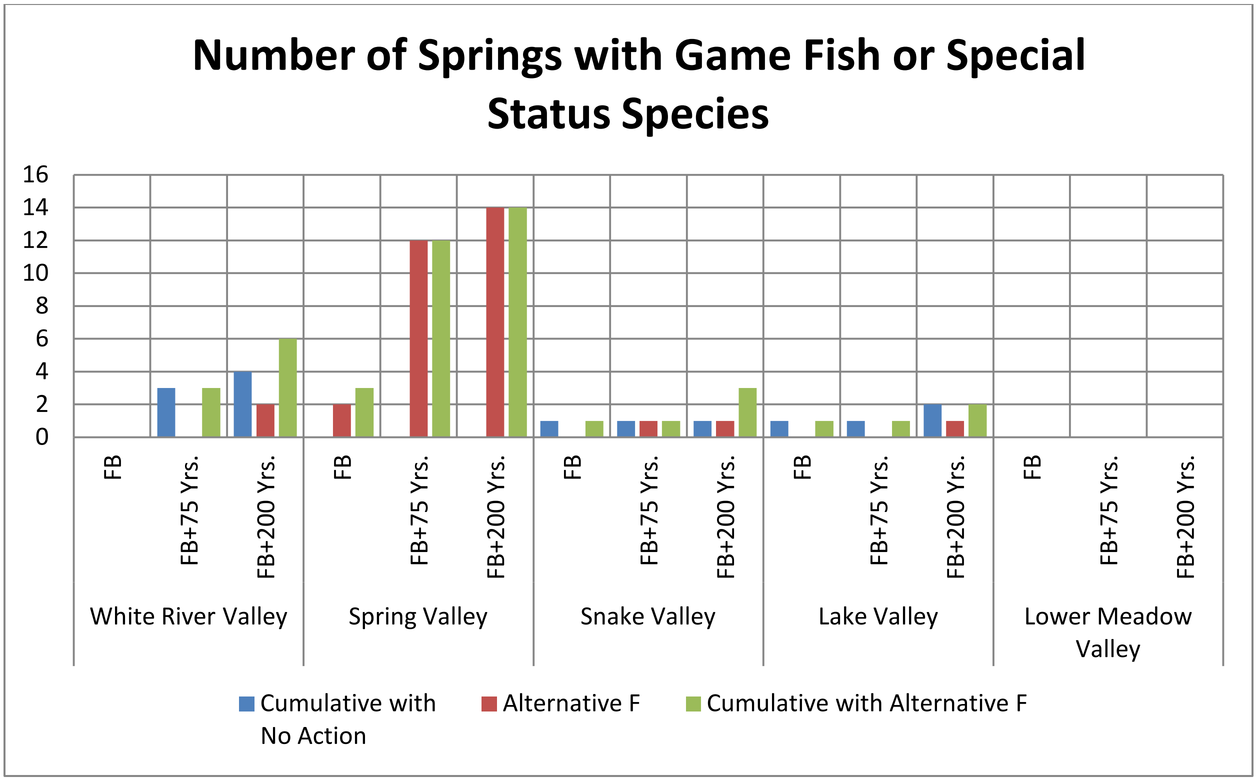
Under Alternative F, surface disturbance impacts would be limited to intermittent streams crossed by ROWs that would exclude Snake Valley. These impacts would be minimized due to the implementation of BMPs and ACMs to reduce water quality effects involving sedimentation and potential fuel spills. Other past and future cumulative actions involving linear ROWs, wind projects, and groundwater development have or will result in surface disturbance and sedimentation impacts to waterbodies located in other portions of the cumulative effects study area. Alternative F would not contribute impacts to the overall cumulative effects area due to the fact that no perennial streams or springs are affected.

Groundwater Pumping Effects

Detailed results of the cumulative pumping analysis with Alternative F are provided in **Appendix F**, **Tables F3.7-40** and **F3.7-41** for springs/ponds/lakes and streams, respectively. The cumulative analysis focused on the incremental pumping effects that would be contributed by the Alternative F in combination with other cumulative pumping activities. In total, 7 to 13 basins with aquatic biological resources would be affected by this cumulative analysis for the 3 model time frames. However, only five of these basins would be affected by Alternative F: White River, Spring (#184), Snake, Lake, and Pahranagat.

Percent flow reduction and impact indicator information are summarized in **Appendix F**, **Table F3.7-50**. Using model-simulated flow information, the magnitude of effects on reduced habitat would be considerably lower in White River and Spring valleys in comparison to the Proposed Action. Based on the model-simulated flow predictions for Big Springs, the flow reduction would be similar for cumulative pumping with the Proposed Action and Alternative F.

The relative contribution of Alternative F to cumulative effects on aquatic habitat is shown in **Figure 3.7-30**. The figure includes impact parameter information for cumulative with No Action, Alternative F, and cumulative pumping with Alternative F. Alternative F would contribute a substantial portion of reduced habitat in Spring Valley. There would be more equal contribution of incremental effects from No Action and Alternative F in White River, Snake, and Lake valleys. No Action pumping would contribute all of the effects on habitat in Pahranagat Valley and Lower Meadow Valley Wash. One notable difference under cumulative pumping with Alternative F is that a lower number of spring and stream habitats would be affected in Snake Valley compared to the Proposed Action. The number of spring and stream habitat is similar in the other five valleys when comparing cumulative pumping with Alternative F and the Proposed Action.



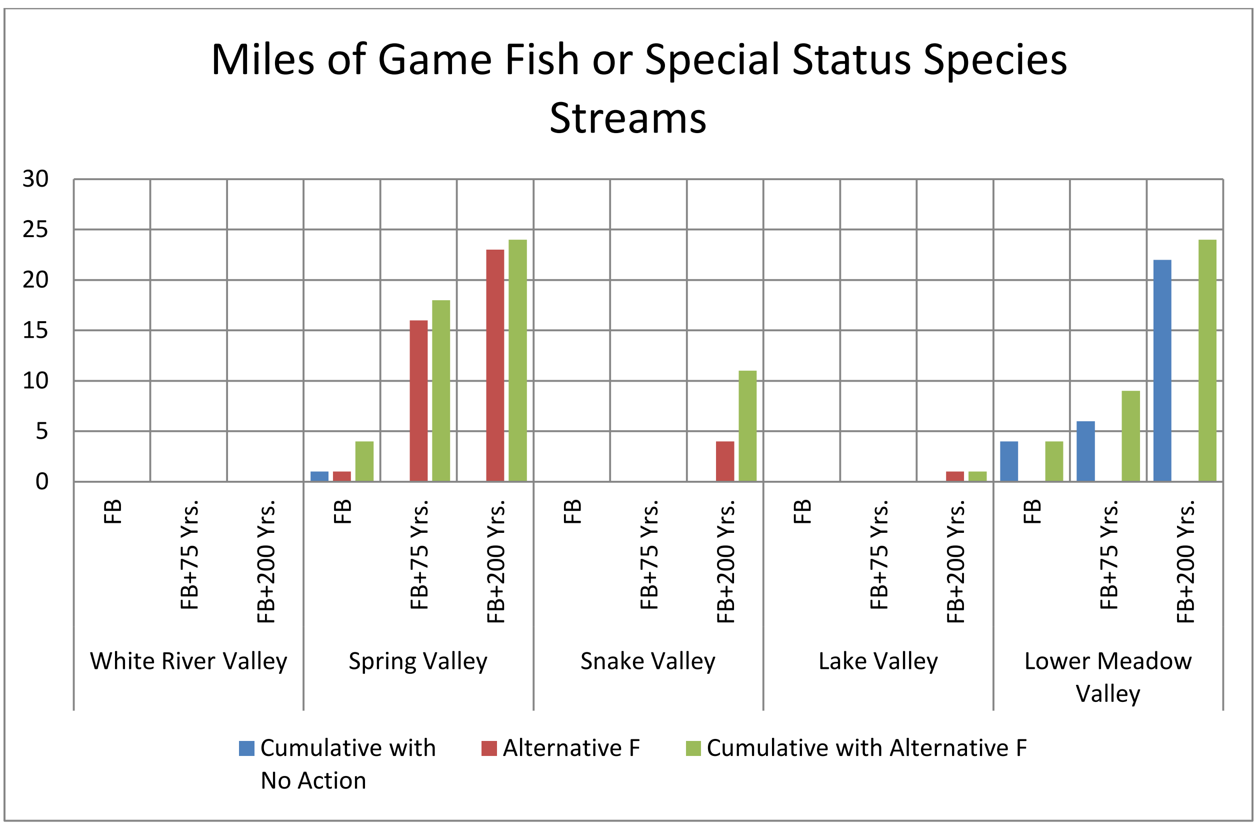


Figure 3.7-30 Cumulative Analysis with Alternative F and No Action Using Aquatic Biological Resource Impact Parameters

Cumulative pumping with Alternative F could affect habitat for four federally listed fish species, White River spinedace, Pahrump poolfish, Big Springs spinedace, and Moapa dace. Alternative F only would contribute effects to two of these species, White River spinedace and Pahrump poolfish. Spring flow or water level reductions were determined at the following locations for these species:

- White River Spinedace – Although the 10-foot groundwater drawdown contours did not overlap with springs occupied by this species, the model simulation predicted cumulative flow reductions of 1, 7, and 19 percent for the 3 model time frames in the Flag Spring complex. Most of the predicted reduction would be caused by Alternative F pumping (-1 to -16 percent). Model simulations indicate that cumulative pumping would result in percent flow reductions in Preston Big Springs of 2 to 8 percent. A very small portion of this reduction would be caused by Alternative F pumping (0 to -1 percent).
- Pahrump Poolfish – Potential water level reductions were predicted for the full build out plus 75 years and full build out plus 200 years time frame in Shoshone Ponds. No information is available to quantify the potential flow reduction in the ponds. Alternative F would contribute all of this potential reduction in Shoshone Ponds.
- Big Springs Spinedace – No Action and other cumulative pumping actions could reduce flows in Meadow Valley Wash in Dry Valley (0.1 mile) at the full build out plus 200 years time frame. Alternative F pumping would not contribute reduced flow to Meadow Valley Wash in Panaca Valley.
- Moapa Dace – Cumulative pumping with No Action would likely result in flow reductions in the Muddy River. Alternative F would not contribute to these effects on habitat for this species. Model-predicted cumulative flow reductions were shown for all 3 model time frames, with percentages ranging from -37 to -61. Alternative F pumping would not likely contribute to this reduction.
- Other Federally Listed Species – Cumulative pumping with Alternative F would not affect habitat for the following species: Hiko White River springfish (Hiko and Crystal springs), White River springfish (Ash Spring), and Pahranagat roundtail chub (Pahranagat Creek). Model-simulated cumulative flow reductions would be 0 to 5 percent in Ash, Crystal, and Hiko springs for the 3 model periods. Model-predicted flow reductions of 0 to 1 percent indicates a very small contribution from Alternative F pumping by itself.

Cumulative pumping with Alternative F would contribute risks for habitat reductions for other special status fish, amphibians (northern leopard frog), and invertebrates (springsnails and California floater) in these six basins. Specific waterbodies and their associated species at risk are provided in **Appendix F**, **Tables F3.7-40** and **F3.7-41**. In total, 7 to 31 springs with game fish or special status species could be affected by cumulative pumping in these 5 basins at the 3 model time frames. Cumulative effects on stream habitat for game fish or special status aquatic species would range from 26 to 89 miles for the 3 model time frames.

Alternative F could contribute to cumulative effects to one spring (Outhouse) and one stream (Snake Creek) and associated aquatic species in the GBNP. In Utah, no springs and one stream (Lake Creek) could be affected, as discussed for cumulative pumping with the Proposed Action. Flow data are not available to predict the percent flow reduction for these aquatic habitats.

Cumulative pumping with Alternative F could conflict with conservation agreements for Bonneville cutthroat and northern leopard frog in Spring and Snake valleys and recovery plans for Pahrump poolfish and White River spinedace in Spring and White River valleys, respectively.

The availability of fish species traditionally used for food by regional Tribes in relation to groundwater drawdown also could be affected in all six basins identified above regarding cumulative effects on game fish or special status fish species.