3. Affected Environment and Environmental Consequences

3.0.1 Introduction

This chapter describes the environment that would be affected by the construction and operation of the Proposed Action and alternatives analyzed in this EIS (**Table 2.1-1**). It is organized by individual environmental resource, with information on existing conditions, direct and indirect impacts, cumulative impacts, mitigation, and residual effects. This chapter answers the following questions for each environmental resource section:

- What are the current conditions from which an identification of environmental effects is made from implementing the Proposed Action and alternatives?
- What are the direct and indirect impacts of the Proposed Action and the alternatives as well as cumulative impacts on the resource?
- What are the ACMs and the BLM RMP Management Actions and BMPs that would be implemented to reduce impacts on the resource?
- If impacts still occur at a higher relative level of intensity after applying all avoidance and protection measures, what mitigation measures are recommended to provide additional resource protection? What is the effectiveness of proposed mitigation measures for avoiding or reducing the identified impacts?
- What are the residual effects after applying these resource protection measures and proposed mitigation measures?

The remaining portion of this introduction provides important background information on the characterization of existing resource conditions, as well as assumptions and approaches that were used in analyzing project impacts on each environmental resource.

Affected Environment. The affected environment is the physical area that bounds the natural and human resources that could be affected by the Proposed Action and other alternatives.

QUICK REFERENCE

ACM – Applicant Committed Protection Measures

BLM – Bureau of Land Management

BMP – Best Management Practice

GBNP – Great Basin National Park

EIS – Environmental Impact Statement

NEPA – National Environmental Policy Act

RFFA – Reasonably Foreseeable Future Actions

ROW – Right-of-way

3.0.2 Affected Environment

The affected environment is described at two geographic levels to provide the basis for the impact analysis sections in this chapter (**Figure 3.0-1**). The first geographic level involves the area of direct effects from the ROWs and groundwater development areas. The second level is the project study area included in the groundwater model to represent the area potentially affected by groundwater pumping. The BLM defined the natural resources study area, with assistance from the Natural Resources Technical Work Group, as the region of interest based on their assessment of the natural resources in the area. The work group included technical specialists with representatives from federal and state agencies and SNWA. When defining this area, the BLM and the work group took into account special status species and other resources of special management concern.

Figure 3.0-1 Rights-of-way and Groundwater Development Areas

Right-of-way/Groundwater Development Areas

The first geographic level represents the area of potential direct effects to natural and human resources from construction-related surface disturbance related to the ROW and ancillary facilities plus the construction and operation of future facilities related to groundwater withdrawal. A specific direct effects study area is further defined and discussed for each resource. The extent of the potential direct effects may extend beyond the immediate project disturbance footprint, depending on the resource being analyzed. This study area also includes the area of influence surrounding aboveground facilities (i.e., noise, visual resources). As described in Section 2.1, Introduction, specific groundwater pumping locations have not yet been identified. However, the BLM is able to make certain assumptions about the number of wells that may be required and the groundwater development area in which the wells would be located. Thus, this EIS provides a more general characterization of existing resource conditions within the groundwater development areas, and of the direct, indirect, and cumulative effects on those resources. Subsequent environmental analyses tiered to this EIS will focus on site-specific resource development areas where wells, associated gathering pipelines, roads, and electrical service lines are proposed.

Project Study Areas

The second geographic level was defined by an initial assessment of the areas with: 1) the potential to be affected by groundwater drawdown or 2) that contain species or habitat of special environmental concern. The area of potential effects is based upon results of groundwater modeling and initial species or habitat occurrence information. These initial assessments were conducted with the BLM and the Natural Resources Technical Task Group. The project study area varies depending on the resource. A description of the water resources region of study and natural resources region of study are found in Section 3.0.4, Environmental Consequences. Additionally, as part of the introduction for each resource discussion, a brief description of the resource-specific project study area is provided.

Potential effects on the Death Valley groundwater flow system were raised during public scoping. This area is not included in this EIS because the BLM, after consultation with an interagency technical review team, concluded that: 1) the five hydrologic basins proposed for groundwater pumping under the Proposed Action and alternatives are not within the Death Valley groundwater flow system; and 2) based on the conceptual understanding of the groundwater flow system for the region, pumping from these basins is unlikely to result in impacts to water availability in the Death Valley groundwater flow system.

Based on public scoping and internal review by the EIS Interdisciplinary Team (BLM management and resource specialists), the following resources were included in this EIS. The EIS section for each resource is noted.

- Air and Atmospheric Values – Section 3.1;
- Geologic Resources including Paleontology – Section 3.2;
- Water Resources including Surface Water, Groundwater, and Water Rights – Section 3.3;
- Soils – Section 3.4;
- Vegetation including Wetlands – Section 3.5;
- Terrestrial Wildlife – Section 3.6;
- Aquatic Biological Resources – Section 3.7;
- Land Use – Section 3.8;
- Recreation – Section 3.9;
- Transportation – Section 3.10;
- Mineral Resources – Section 3.11;
- Rangelands and Grazing – Section 3.12;
- Wild Horses and Burro Herd Management Areas – Section 3.13;

- Special Designations – Section 3.14;
- Visual Resources – Section 3.15;
- Cultural Resources – Section 3.16;
- Native American Traditional Values – Section 3.17;
- Socioeconomics and Environmental Justice – Section 3.18; and
- Public Safety and Health – Section 3.19.

As part of the baseline data collection effort for this EIS, a work group process was used to obtain all available and relevant information for water resources, biological resources, and soils (i.e., natural resources), and socioeconomics. A series of meetings were held to compile and evaluate baseline data for the EIS. Resource reports were prepared for water and natural resources. Details on these work groups and the reports are provided in Sections 3.3, Water Resources; and 3.5, Vegetation Resources. The work group process for socioeconomics is described in Section 3.18, Socioeconomics and Environmental Justice.

A key part of the baseline data collection for Native American Traditional Values was the preparation of an Ethnographic Assessment. The assessment included the identification, documentation, and evaluation of places of particular importance to Native Americans. The process involved contacts with tribal councils and individuals for participation in the data collection and evaluation. Details on the ethnographic process are provided in Section 3.17, Native American Traditional Values.

3.0.3 Incomplete and Unavailable Information

As required under Section 1502.22 of the CEQ NEPA regulations, an EIS must disclose any incomplete and unavailable information. For this EIS, information was incomplete or unavailable for the topics listed below. These areas of incomplete and/or unavailable information are relevant to different degrees for the evaluation of impacts. However, sufficient information was available to complete this Tier 1 NEPA analysis using a variety of information, professional assumptions, or processes. Subsequent NEPA analysis will focus on obtaining information for these, and any identified in the future, incomplete and unavailable areas where time, funds, and resources are available.

- **Affected Environment Resource Information** – The affected environment descriptions for resources were based on all available and known information. As a result of the relatively large regional study area for the pumping impact analysis (up to 35 hydrological basins), many springs and streams were lacking specific information regarding water resource characteristics and species occurrence. Additional information on limited or incomplete data is discussed in specific resource sections. If these waterbodies and associated sensitive resources are considered to be at moderate or high risk from the GWD Project pumping under this Tier 1 analysis, information will be collected as time and funds are available for subsequent NEPA analyses. Section 3.20 also contains a discussion of future data which will inform future NEPA analyses.
- **Climate Change** – In accordance with Secretarial Orders 3289 and 3226, the Final EIS considers and analyzes the potential effects of climate change. Secretarial Order No. 3289 establishes a Department-wide approach for applying scientific tools to increase understanding of climate change and to coordinate an effective response to its impacts on tribes and the land, surface and subsurface waters, fish and wildlife, and cultural heritage resources that the Department manages. Secretarial Order No. 3289 also reestablished the requirements set forth in Secretarial Order No. 3226 that each bureau and office of the Department must consider and analyze potential climate change impacts when undertaking long-range planning exercises, setting priorities for scientific research and investigations, developing multi-year management plans, and making major decisions regarding potential use of resources under the Department's purview. Secretarial Order No. 3289 did not alter or affect any existing duty or authority of individual bureaus. Consistent with Secretarial Order No. 3289 and Secretarial Order No. 3226, and to the extent reasonably possible, the BLM considers and analyzes potential climate change impacts in the EIS. Climate change effects are addressed for all affected resources. In addition, the findings of the Final EIS associated with the project's contribution to climate change were considered when making decisions regarding the

selection of the preferred alternative for this project. Finally, the information in the Final EIS will be considered when setting priorities for developing appropriate project monitoring and mitigation plans.

- **Groundwater Flow Modeling/Water Resource Information** – A detailed discussion of model limitations and unavailable water resource information is provided in Section 3.3, Water Resources. Two major limitations resulting from incomplete or unavailable information were identified as part of the water analysis: 1) lack of reliable information regarding hydraulic properties of faults; and 2) representation of future climate conditions. Other uncertainties with the model resulting from incomplete or unavailable information included historic pumping estimates, ET discharge estimates, hydrogeologic conditions in the region, hydraulic interconnection across the region, groundwater recharge rates, and presence and functioning of faults as possible hydrologic barriers. The best available information was used to make assumptions regarding these input parameters for the model. Future update and revisions to water resource information is expected and will be used as appropriate in future NEPA documents (see Section 3.3, Water Resources).
- **Project Descriptions for Groundwater Development and Pumping Locations** – Final groundwater development areas and specific pumping locations have not been defined at this stage of the GWD Project. Professional assumptions have been used to describe a reasonable representation of the number and location of pumping wells that might be sited, other than those requested in the SNWA groundwater applications, as part of this programmatic (Tier 1) level analysis. This information will be provided to the BLM before subsequent NEPA analyses of proposed locations for groundwater development facilities and pumping wells and groundwater pumping effects.
- **Floodplain (EO 11988) and Wetland (EO 11990) Protection**. 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 (42 *Federal Register* 26951), 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. The analysis for Tier I related to the main conveyance pipeline and related facilities is sufficient, however, subsequent NEPA analysis would need to further identify and quantify wetland associated with the groundwater development project and develop mitigation measures. The vegetation section (3.5) contains an analysis of the compliance of these EOs.
- **Soils** – Portions of Coyote Spring, Las Vegas, Pahranagat, Spring (#184), and Steptoe valleys have no detailed soils data at this time. New soil mapping is underway in Snake Valley (Soil Survey Area UT617), but it will not be available during the time frame of this EIS. It should be available for use in future NEPA analyses in Snake Valley.
- **Native American Traditional Values** – Native American traditional values vary greatly; some tribal concerns are highly focused geographically, and others are very large and landscape-level in nature. Possible changes to the physical environment resulting from implementation of the GWD Project (including movement of water), are described in this EIS. Tribal concerns that project implementation eventually may be associated with adverse or negative effects to both individual sites of tribal concern and to the larger landscape/environment are connected to loss of vegetation or animal species as related to groundwater drawdown. Inventories related to the Native American traditional values likely have not identified all resources or areas of concern. Additional future commitments in the PA are intended to complete and supplement the identification and determination of steps to be taken to avoid, minimize, or mitigate to the extent practicable, in accordance with law and regulation. Ongoing government-to-government consultation throughout the implementation of the project also would supplement current knowledge and inform the PA process, Historic Properties Treatment Plans, and subsequent NEPA analysis.
- **Caves** – The source of water in caves generally is unknown. Ongoing studies will help to determine the origin of the water. See Great Basin National Park, above.
- **Great Basin National Park** – An ongoing Snake Valley hydrogeological investigation, entitled A Study of the Connection Among Basin-fill Aquifers, Carbonate-Rock Aquifers, and Surface-Water Resources in Southern Snake Valley, Nevada, is being conducted by the USGS and the University of Nevada, Reno. The four principal

research elements include: 1) a characterization of geologic and hydraulic properties of basin-fill sediments; 2) a quantitative assessment of groundwater – surface water interactions along Lehman, Baker, and Snake creeks; 3) delineation of the sources of water to Rowland Spring and Big Springs; and 4) a refinement of estimates of inter-basin groundwater flow from southern Spring Valley to Snake Valley. The final report from this investigation will help to address current uncertainties regarding the interaction of groundwater and surface water in the Lehman, Baker, and Snake Creek watersheds within and adjacent to GBNP; and the source and hydrogeologic dynamics of Rowland Spring and Big Springs. Aside from this ongoing study, other ongoing studies in the area include preparation of a regional potentiometric-surface map of Snake Valley and adjacent basins; a USGS study of the water quality of caves, springs, and streams in the Baker Creek drainage; an independent dye-tracing study in the Baker Creek drainage; and development by the USGS of two or three hydrogeologic cross-sectional diagrams in the vicinity of Lehman, Baker, and Snake Creek drainages. All of this information could be used to further the understanding of the conceptualization of the flow system in these areas, especially with regard to the lateral connectivity of flow systems, and the connectivity among surface waters, basin-fill aquifers, and the karstic carbonate-rock aquifer. More detail is provided in **Appendix B**. As this information becomes available it will be utilized in the appropriate NEPA process.

3.0.4 Environmental Consequences

The environmental consequences section for each resource is divided into three impact analysis sub-sections, based on the proposed facilities, the geographic study areas previously described for the Affected Environment, and the decisions that the BLM will make as lead agency for this EIS. **Table 3.0-1** summarizes the three impact analysis categories.

Table 3.0-1 Impact Analysis Categories

Project Components or Effects Evaluated	BLM Decisions to be Made
ROWs and Ancillary Facilities. Project components include mainline pipeline, pump stations, water treatment and storage facility, and electrical power lines. The construction, operation, and maintenance of these facilities have been evaluated for site-specific locations.	The ROWs required for these facilities may be approved, modified or denied in the BLM ROD and ROW grant at the conclusion of the EIS process (Tier 1).
Groundwater Development Areas. Project components include groundwater wells, access roads, gathering water pipelines, and power lines distributed within broadly defined groundwater development areas within each hydrologic basin. With the exception of Alternative B, no site-specific locations have yet been defined for these facilities.	The effects of constructing and maintaining these project components will be considered by the BLM in the ROD for the current ROW applications. The applicable BMPs, ACMs, and mitigation measures may be applied or updated during the NEPA process (subsequent tiers) for future groundwater development proposals submitted to BLM by the SNWA.
Pumping Effects. Pumping effects (groundwater drawdown elevations, groundwater drawdown areas) on underlying aquifers have been estimated from the completion of a regional groundwater model. Groundwater modeling was completed for the No Action Alternative, the Proposed Action, the Pumping Alternatives (A through F), and a cumulative pumping scenario.	The effects of groundwater pumping on groundwater quantity and quality, as well as water-dependent natural resources and human uses, will be considered by the BLM in its ROW approval decisions. The multi-agency stipulations, ACMs, and additional mitigation measures will be required by the BLM, as appropriate, following assessment of any future groundwater development proposals by the SNWA. Updates and revisions to the Stipulated Agreements could occur to address requirements on future groundwater project proposals.

Rights-of-way and Ancillary Facilities

- ROW Surface Disturbance Assumptions. Based on the ROWs requested by the SNWA and the dimensions of these ROWS, the BLM estimated: 1) the total project construction surface disturbance area associated with each pumping alternative; 2) the disturbed area that would be revegetated after construction; and 3) the surface area committed to life of project industrial uses (e.g., access roads, aboveground facilities). **Table 3.0-2** summarizes these estimates. These numbers are based on GIS estimates of surface disturbance and areas to be reclaimed.

Table 3.0-2 Right-of-way and Ancillary Facility Disturbance Assumptions[1]

Assumptions	Alternatives					
	Proposed Action	A	B	C	D	E and F
Total Construction Disturbance Area (temporary and permanent) (acres)	12,288	12,288	12,288	12,288	8,828	10,681
Temporary Disturbed Area to be Revegetated (acres)	11,289	11,289	11,289	11,289	8,020	9,736
Permanent Disturbance (acres)	999	999	999	999	808	945

[1] Construction and permanent acreage numbers in the table 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. Disturbance information for the Alignment Options (1 through 4) is provided in Chapter 2, Section 2.7, Alignment Options 1 through 4.

- Impact Time Frames (Duration). Short-term impacts are considered to be those that occur within 2 years after the inception of project construction; most of the physical and human activity impacts of construction to resources at any particular location along the ROWs would occur within this time period. An example of a short-term impact is the potential displacement of wildlife from the mainline pipeline ROW as a result of human activity and construction equipment noise. Long-term impacts are considered those that occur over a period longer than 2 years. An example of a long-term impact is reestablishment of vegetation in a previously-cleared ROW to a composition and structure similar to adjacent undisturbed areas.
- Impact Assumptions and Methods. The impact assumptions and methods are documented under each resource. In addition to duration, the impact analysis for each resource also discusses effects in terms of intensity and context. In general, the intensity (extent) or degree of resource change resulting from project construction surface disturbance and human activity were estimated for short- and long-term time frames. Context describes the geographic, social, and environmental conditions within which the project may have effects on a resource. As discussed in the BLM NEPA Handbook (BLM 2008), direct and indirect effects often are difficult to differentiate; both direct and indirect effects have been evaluated in this EIS, but a specific differentiation in the EIS text between these effects has not been made. It has been assumed that surface disturbance effects to all natural resources are detrimental or adverse. This assumption is based on the multi-year native vegetation composition and structure recovery times in the ecosystems encompassed by the GWD Project, and the consequent long-term recovery of support functions that vegetation provides to other natural resources and human uses (e.g., soils, wildlife, aquatic biological resources, livestock, and visual resource quality). Construction-related socioeconomic effects may be both detrimental and beneficial.
- BMPs and ACMs. The following plans and commitments have been developed to date to address the effects of groundwater pumping on water dependent resources. Additional monitoring and mitigation also is recommended to supplement these existing plans and commitments. The SNWA would be required to implement a comprehensive COM Plan that would address all ROW and facilities associated with the SNWA GWD Project. The COM Plan framework includes a comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The following regulations and commitments provide direction for these actions: BLM RMP Management Actions, BMPs, BO, ACMs, Stipulated Agreements, Section 106 PA, and additional mitigation recommended in this EIS. See Section 3.20, Monitoring and Mitigation Summary, for a description of the COM Plan. For the programmatic impact analysis in this Final EIS, the COM Plan would help develop and focus on the process and key elements that would be considered in this and subsequent NEPA analyses.
- Proposed Mitigation and Mitigation Effectiveness. Proposed mitigation measures were developed that could be required or recommended by the BLM as part of its ROW grant. The effectiveness of each proposed measure (the degree to which a predicted effect could be avoided or further reduced) was then estimated. The potential for application of the proposed mitigation measure to create new environmental effects also was considered and documented.

- Residual Effects. Residual effects are "those effects remaining after mitigation has been applied to the proposed action or alternative" (BLM 2008).
- Comparison of Alternatives. The environmental effects of the Proposed Action are discussed in a separate text section. The relative surface disturbance and human activity effects of the other pumping alternatives (A through F) are systematically compared in summary tables so that the relative differences among the alternatives can be discerned. Impacts associated with the alignment options are discussed following the Proposed Action ROW section for each resource.

Groundwater Development Areas

- ROW Surface Disturbance Assumptions. Based on future facility assumptions provided by the SNWA and assumptions about land requirements, the BLM estimated: 1) the total project construction surface disturbance area associated with each pumping alternative; 2) the disturbed area that would be revegetated after construction; and 3) the surface area committed to life of project industrial uses (i.e., access roads, aboveground facilities). For purpose of this analysis, it was assumed that the maximum number of wells estimated by the SNWA would be installed and operated for each alternative (**Table 3.0-3**).

Table 3.0-3 Acres of Groundwater Development Area Surface Disturbance Assumptions

Assumptions	Proposed Action	A and C	B	D	E	F
Total Construction Disturbance Area (temporary and permanent)	3,590 – 8,410	2,069 – 4,814	4,664	2,513 – 4,005	1,754 – 4,079	2,698 – 6,629
Temporary Disturbed Area to be revegetated	1,216 – 2,874	699 – 1,643	1,587	858 – 1,370	595 – 1,396	916 – 2,270
Permanent Disturbance	2,374 – 5,536	1,370 – 3,171	3,077	1,655 – 2,635	1,158 – 2,683	1,782 – 4,359

- Impact Time Frames. Because the activities required to construct and maintain the groundwater development facilities and ROWs are the same as those described for the primary pipeline and ancillary facilities, the same time frames were used for the analysis.
- Impact Assumptions and Methods. The overall impact assessment process follows the same steps described for the ROWs and ancillary facilities. The impact assessment in this section primarily addresses the direct and indirect effects on surface resources (surface disturbance, human activities); the effects of groundwater drawdown from pumping are discussed separately (see below).
- BMPs and ACMs. The following plans and commitments have been developed to date to address the effects of groundwater pumping on water dependent resources. Additional monitoring and mitigation also is recommended to supplement these existing plans and commitments. The SNWA would be required to implement a comprehensive COM Plan that would address all ROW and facilities associated with the SNWA GWD Project. The COM Plan framework includes a comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The following regulations and commitments provide direction for these actions: BLM RMP Management Actions, BMPs, BO, ACMs, Stipulated Agreements, Section 106 PA, and additional mitigation recommended in this EIS. See Section 3.20, Monitoring and Mitigation Summary, for a description of the COM Plan. For the programmatic impact analysis in this Final EIS, the COM Plan would help develop and focus on the process and key elements that would be considered in this and subsequent NEPA analyses.
- Mitigation and Mitigation Effectiveness. The same proposed mitigation measures discussed for ROWs and ancillary facilities would be applicable to groundwater development areas. The BLM also has developed additional measures that are recommended for consideration in future NEPA analysis and associated ROW grants. Since there are no specific locations for the groundwater development surface facilities, the emphasis was placed on identifying sensitive resources and uses that should be avoided (or mitigated) when specific proposals for future well sites and associated facilities are developed. Proposed mitigation measure effectiveness was estimated

for measures specifically developed for the groundwater development areas in general terms. Subsequent NEPA analyses will discuss effectiveness for specific locations (where appropriate).

- Comparison of Alternatives. The format for presenting the effects of the Proposed Action and the other pumping alternatives (A through F) is the same as for ROWs and Ancillary Facilities.

Pumping Effects

- ROW Surface Disturbance Assumptions. No additional project construction surface disturbance is anticipated from groundwater pumping. However, groundwater drawdown could cause ground-surface subsidence with consequent changes in drainage patterns.
- Impact Time Frames. Three representative points in time were used to evaluate the potential groundwater related drawdown effects in the future:

    1. Full build out is defined as the completion of groundwater wells in all the hydrologic basins planned for pumping under each alternative. Because the project would be built progressively from south to north, pumping would be initiated in the southern basins (Delamar, Dry Lake, and Cave) before pumping would start in the northern basins (Spring and Snake). The time frames for complete build out of the Proposed Action plus Alternatives A through C would be the year 2050. The time frames for complete build out of Alternatives D through F would be the year 2043 (no facilities would be constructed in Snake Valley, resulting in an earlier project completion date).
    2. Full build out plus 75 years for each alternative.
    3. Full build out plus 200 years for each alternative.

For purposes of comparison among alternatives, the pumping effects of the No Action Alternative were compared to the Proposed Action and other action alternatives A through F at the same benchmark time frame intervals. In this case, the reference to "full build out" or "full build out time frame" refers to a benchmark time point, and not a specific groundwater development program.

- Impact Assumptions and Methods. The analysis of pumping effects on environmental resources followed a series of steps that linked the results of the groundwater flow modeling to those resources with dependence on surface water and/or groundwater as a source of water or habitat (**Figure 3.0-2**). The groundwater flow model was used to predict the reductions in groundwater elevation (i.e., drawdown) that would occur over time resulting from pumping from the Proposed Action or other action alternatives. The model predictions were then used to define a drawdown area to evaluate potential drawdown effects on surface water and associated habitat (i.e., springs, ponds, wetlands, meadows, perennial streams, playas, and swamp cedar woodlands) and phreatophytic shrubland vegetation. Surface water resources within the drawdown area were further evaluated to identify the potential risk to springs and streams and associated vegetation/habitats located within the defined drawdown area. In addition to the groundwater drawdown contour analysis, the groundwater flow model predicted potential flow changes in selected springs, streams, and rivers. The flow change was expressed as the percent reduction of the project-affected flow compared to base flow conditions. The methodology used for the groundwater flow modeling and the water resources impact evaluation is discussed in Section 3.3, Water Resources. The following were used in the analysis of pumping effects on environmental resources.
    - Predict Affected Areas – The calibrated groundwater flow model was used to predict the potential changes in groundwater elevation at representative times for each alternative. The defined drawdown area was used to identify the areas that were in an area of risk of pumping effects.
    - Identify Potentially Affected Surface Water – As part of the water resource impact analysis, perennial streams and springs were further evaluated to identify areas where impacts to perennial waters would likely occur. For example, if flow from a specific water resource was determined to be controlled by discharge from the regional groundwater flow system and the water resource is within the drawdown area, impacts to flow would likely occur. This step identified aquatic habitats that could be affected by pumping in terms of flow or water level reductions. The overall study area for water resources was defined as the water resource model area, as shown in **Figure 3.0-3**.

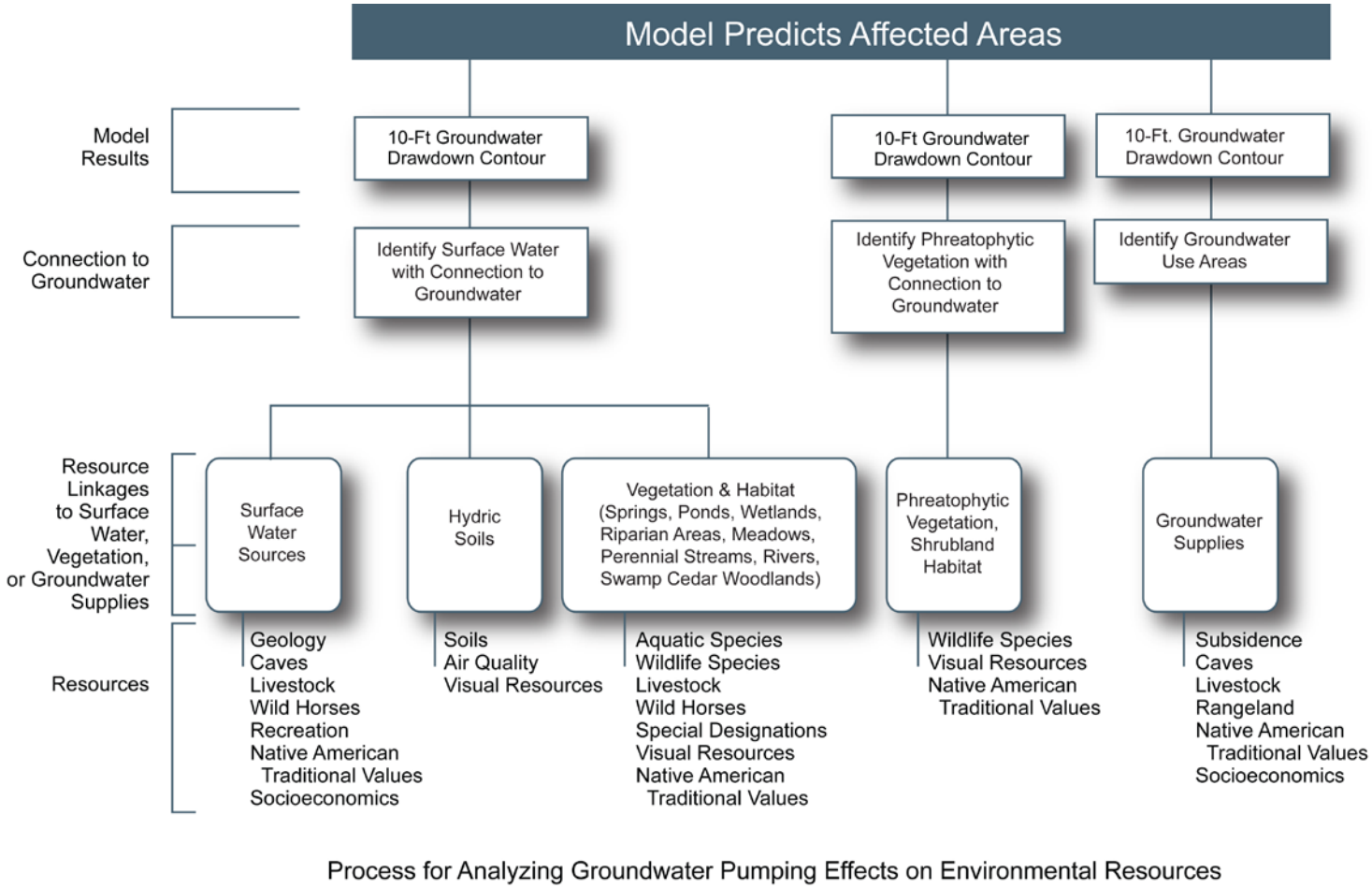

Figure 3.0-2 Process for Analyzing Groundwater Pumping Effects on Environmental Resources

Figure 3.0-3 Water Resources and Natural Resources, Region of Study

- Identify Effects on Water Sources and Vegetation/Habitat – The identified perennial streams and springs used to identify potential effects on surface water sources and vegetation/habitat consisting of springs, ponds, wetlands, meadows, perennial streams, playas, and swamp cedar woodlands. The overall study area for vegetation and other natural resources is shown in **Figure 3.0-3**.
- Identify Phreatophytic Shrublands with Connection to Groundwater – The defined drawdown area was used to identify and evaluate effects on phreatophytic vegetation.
- Identify Resource Connections to Surface Water and Vegetation/Habitat – Resource connections to surface water, hydric soils, vegetation, or habitat were used as the focus of the impact analysis. The potential reduction in water levels or flows were discussed relative to each resource's connection to surface water or associated vegetation and habitat types.
- Identify Other Resource Connections to Groundwater Drawdown – Other examples of resources where drawdown effects were evaluated: Air and Climate – dust generation risk from soil surface drying and vegetation alterations; Geology – effects on caves and ground surface subsidence; Soils – potential structural and functional changes in hydric soils; Wild Horses and Burros – changes in water availability and forage quality and quantity resulting in a decrease of the appropriate management level (AML) of horses; Rangeland and Livestock Grazing – changes in water sources and forage resulting in changes to the carrying capacity of a grazing allotment; Special Designations – potential changes in the natural and cultural values for which areas were designated; Recreation – potential changers in surface water and resources used for recreational activities; Visual Resources – potential changes in landscape views from soil and vegetation alterations; Native American Concerns – changes in vegetation, biological diversity, water quantity and quality that could affect resources and places of traditional value; and Socioeconomics – potential changes in economics and lifestyles.

- BMPs and ACMs. The following plans and commitments have been developed to date to address the effects of groundwater pumping on water dependent resources. Additional monitoring and mitigation also is recommended to supplement these existing plans and commitments. The SNWA would be required to implement a comprehensive COM Plan that would address all ROW and facilities associated with the SNWA GWD Project. The COM Plan framework includes a comprehensive monitoring and mitigation program for the entire project that would integrate the various required monitoring and mitigation actions. The following regulations and commitments provide direction for these actions: BLM RMP Management Actions, BMPs, BO, ACMs, Stipulated Agreements, Section 106 PA, and additional mitigation recommended in this EIS. See Section 3.20, Monitoring and Mitigation Summary, for a description of the COM Plan. For the programmatic impact analysis in this Final EIS, the COM Plan would help develop and focus on the process and key elements that would be considered in this and subsequent NEPA analyses.
- Groundwater, surface water, and water dependent resource monitoring requirements were established in existing agreements (Spring Valley Stipulation; Delamar, Dry Lake, and Cave Valley Stipulation; and their associate Hydrologic and Biologic Monitoring and Mitigation Plans).
- A conceptual adaptive management plan has been developed by the SNWA (Appendix C of the SNWA ACMs, included in **Appendix E**). The SNWA conceptual Adaptive Management Plan references the DOI NEPA regulations that define adaptive management as "a system of management practices based on clearly identified outcomes and monitoring to determine whether management actions are meeting desired outcomes; and if not, facilitating management changes that will best ensure that outcomes are met or re-evaluated 43 CFR Section 46.30." The plan includes goals to address adverse impacts; outlines baseline data collection and monitoring programs; identifies a process for selecting environmental indicators and establishing adaptive management thresholds; and outlines an interactive decision process for determining if adverse impacts are occurring, and an assessment of appropriate management responses. The conceptual plan includes a section on Adaptive Management Measures that the SNWA would implement in response to triggering of "early warning" environmental change thresholds. The measures include changes in operational practices, specific biological measures for managing terrestrial and aquatic habitats, changes in agricultural and rangeland management to benefit natural resources, and opportunities for groundwater recharge and precipitation enhancement.

- Additional Monitoring and Mitigation. Potential mitigation measures were focused on protecting sensitive water dependent resources. Monitoring and mitigation recommendations are made for streams and springs that could be adversely affected by pumping and are not identified in the Spring Valley and the Delamar, Dry Lake, and Cave valleys stipulations. In addition, a comprehensive monitoring and mitigation plan could be fully developed for Snake Valley in Utah and Nevada by the BLM, other Department of Interior agencies, and with input from the States of Utah and Nevada (see **Appendix B**). A description of the COM Plan and additional monitoring and mitigation is provided in Section 3.20, Monitoring and Mitigation Summary.
- Comparison of Alternatives. The format for presenting the effects of the Proposed Action and the other pumping alternatives (A through F) is the same as for ROWs and Ancillary Facilities.
- 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.

Cumulative Impacts

The Proposed Action and other action alternatives may result in cumulative effects when considered with other past and present actions (PPAs) and RFFAs in the project study area. Cumulative effects are the impacts associated with this project, combined with the effects of all PPAs and RFFAs (cumulative actions) in the project study area. Cumulative actions considered in this analysis are listed in Chapter 2, Description of the Proposed Action and Alternatives. A cumulative effects study area was defined in the overview section for each resource. The effects associated with the proposed project were evaluated together with the cumulative actions. For each alternative and cumulative effect issue, effects were described for the existing conditions (combination of natural conditions and past actions), present actions, and RFFAs. Cumulative impacts were analyzed for each alternative by identifying the impact contributions from No Action cumulative actions, the individual alternative, and cumulative with the specific alternative. Tables and/or bar charts were used as a way of identifying the relative contribution of impacts for these three cumulative action scenarios. This type of analysis was done for those resources where impact parameter information was available. The short- and long-term impact duration definitions for surface disturbance impacts are the same as those for ROWs and Ancillary Facilities. The same three benchmark time frames described for Pumping Effects above were used as the basis for the cumulative effects analysis.

Impacts on Productivity and Commitment of Resources

Project effects on the productivity and commitment of resources were evaluated. The short-term use of the environment relative to the long-term productivity is discussed for each resource. The GWD Project is unique because of the very long time frames for both project development and operation (which would be at least 75 years and likely much longer). Short-term use of the environment is defined as the period of construction and operation up to the point that the entire system would be operational (full build out). Long-term impacts are defined as effects that would continue past the project operation period (after full build out). Long-term productivity is the ability of a resource to maintain a stable level of production over a long period of time. The irreversible or irretrievable commitment of resources also is described for each resource in Chapter 4.