CHAPTER 3

CUMULATIVE EFFECTS

INTRODUCTION

This chapter presents descriptions of the collective or additive impacts of combining past, present, and reasonably foreseeable future activities associated with mining and land uses in the Carlin Trend. Past, present, and reasonably foreseeable future land uses and man-made and natural occurrences are described in Chapter 2. Potential cumulative effects for some resources are based on predictive modeling results (air quality and water quantity/quality) as described below.

Each resource analysis in this section begins with a description of the geographic area considered to be the "Cumulative Effects Study Area" for that resource and the rationale for the designation. The Cumulative Effects Study Area (Study Area) is typically a unique geographic area specific to individual resources.

This analysis tiers to and incorporates by reference the information and analyses contained in the SOAPA EIS (BLM 2002a). Updated information and monitoring data that have been collected since authorization of SOAPA are presented in this section. This information generally represents the time period since issuance of the Record of Decision to compilation of this Final SEIS. In some cases, no new data or information are available for a specific resource.

The cumulative effects description provided in this section incorporates mine components or portions of mine components that remain to be constructed in the SOAPA area with other past, present, and reasonably foreseeable future activities within the Cumulative Effects Study Area for each resource. Chapter 1 – *Project History and Status,* provides a description of the current status of the SOAPA project including mine components yet to be constructed. Chapter 2 provides a description of past and future land use activities that may have an effect on social and environmental resources within the Carlin Trend. Cumulative effects on the various resources are described in the following sections.

GEOLOGY AND MINERAL RESOURCES

Effects of mining on geology and mineral resources include the excavation and relocation of rock materials from the natural setting. Ore rock is processed in mill facilities or placed on heap leach pads and waste rock is placed in disposal facilities. In some cases, waste rock is used in construction of roads, leach pad foundations, ditch systems, stockpile areas, and backfill. Movement and disposition of rock materials in terms of volume and location varies by mine operation. Details of rock excavation, processing, and placement associated with SOAPA are included in the SOAPA EIS (BLM 2002a).

Potential release of trace metals is the primary issue associated with excavation and disposal of rock materials in the mining process. Early mining activity in the Carlin Trend focused on excavation of the oxidized rock (rock with low sulfide content). These rocks exhibit low potential to release trace metals because most of the sulfide minerals have been leached out of the rock. Later stages of mining in some operations have resulted in excavation and processing of refractory or sulfidic ore and waste rock. These rock materials have a greater potential to generate acid and release trace metals to the environment and, as a consequence, specific procedures have been implemented to manage release of trace metals from these rock types.

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for geology and mineral resources is depicted on **Figure 2-7** and incorporates existing and reasonably foreseeable mining activity through 2020. The Study Area includes the Carlin Trend, which currently encompasses the proposed Emigrant Project in the southeast to the proposed Hollister Development Block in the northwest, and areas currently under lease for geothermal and oil/gas resources as shown on **Figure 2-8**.

MONITORING DATA AND NEW INFORMATION

Past and current mining and exploration operations in the Study Area have resulted in approximately 33,500 acres of surface disturbance. A total of 1,920 acres have been reclaimed in the Carlin Trend, with release of reclamation bond for 833 acres. The remaining reclaimed acreage is pending review for bond release. Approximately 7,200 acres are projected to be disturbed from 2010 through 2020 (**Table 2-3**).

Of the original proposed acreage disturbance for SOAPA (1,392 acres), approximately 390 acres have been disturbed to date including the open pit expansion, haul road construction, a portion of the soil stockpile placement, and leach pad expansions. The remaining 1,000 acres will be disturbed during the life of SOAPA, including expansion of leach areas and waste rock disposal facilities. Details of the current status of the SOAPA operation are included in *Project History and Status* in Chapter 1.

Mining operations in the Carlin Trend have developed waste rock monitoring programs. These programs require periodic sampling and analysis of waste rock generated during mining operations. This program is described in the SOAPA EIS (BLM 2002a).

CUMULATIVE EFFECTS

Large-scale mining is projected to continue in the Carlin Trend with ongoing operations building out individual mine areas to permitted limits. Ongoing and future mine development would result in expansion to and creation of open pits; underground mines, waste rock disposal areas, heap leach pads, milling and tailing storage facilities, and the construction and operation of ore processing facilities.

Future exploration may also result in delineation of refractory ore zones that may require additional dewatering systems for economical recovery of ore. The total volume of ore, waste materials, and gold that could be economically excavated from the Carlin Trend in the future is not quantifiable as the price of gold and individual ore body characteristics dictate whether any particular ore body could be economically mined.

Topography of the area would continue to be modified as a result of mine excavation, waste rock and tailing disposal, reclamation, and other mine related surface disturbance. Construction and operation of the remaining mine components at SOAPA would add incrementally to the alteration of topography and the removal of mineral resources and mine waste within the Study Area.

Continued mining may afford the opportunity to backfill mined-out pits with waste rock from future operations. Such opportunities would be judged individually and based upon accessibility as well as influence on future mining activities.

Backfilling and subsequent reclamation would restore land to pre-mining uses, but backfilling may preclude access to additional or lower grade mineral resources.

Movement of overburden or waste rock and ore rock materials as a result of mining results in relocation of rock from natural emplacement to manmade waste rock disposal sites, heap leach piles, or tailing storage facilities. Rock that contains sulfides can react with oxygen and water (precipitation) to form acid that can liberate trace metals from the rock if sulfides and trace metals are in sufficient concentration and form to be released via this mechanism.

Carbonaceous waste rock that contains no or low concentrations of sulfide minerals and elevated concentrations of carbonate minerals provides neutralizing and/or buffering effects on acidic leachate that may form as a result of contact with sulfide bearing waste rock. The neutralization of acidic leachate can arrest the movement of trace metals in leachate through various chemical reactions including precipitation, co-precipitation, and adsorption.

Waste rock generated in the Carlin Trend is sampled, tested, and classified in accordance with Nevada Division of Environmental Protection (NDEP) Evaluation Guidelines for Waste Rock and Overburden (NDEP 1996) to determine potential to generate acid. Waste rock is sampled and analyzed daily for heavy metals and acid-base accounting. Potentially acid-generating (PAG) waste rock identified is segregated, encapsulated, and monitored.

Development of refractory (sulfide) ore deposits in the Carlin Trend has increased the amount of PAG material stored in stockpiles and deposited in waste rock disposal facilities. Volume of PAG rock varies by mine site as depicted in **Table 3-1**. Analytical methods used to determine PAG rock also vary by mine operation and over time. Methods employed during the early stages of development in the Carlin Trend such as static testing and whole rock analyses have evolved to include a variety of kinetic testing methods currently used. Tonnages portrayed in **Table 3-1** for the Genesis-Bluestar/Lantern and Emigrant Projects reflect predictions made through a variety of analytical methods including static and kinetic testing. Tonnages reported for other mining operations listed in **Table 3-1** are based on operational monitoring methods used since inception of mining to the present day at these mine sites.

Waste rock disposal facilities and sulfide ore stockpiles are designed and constructed in a consistent manner to minimize potential for acid drainage by control of the acid generation process. In general, these procedures are based on the strategy that acid generation can best be prevented by minimizing the amount of water which contacts potentially acid generating rock. Both refractory ore stockpiles and sulfide waste rock encapsulation units are designed and constructed to limit the exposure of sulfidic material to atmospheric oxygen, groundwater, direct precipitation, snowmelt, and storm water run-on. Design and construction criteria are described in the SOAPA EIS (BLM 2002a) and Newmont's Water Pollution Control Permit (Newmont 1985).

Acid rock drainage has been observed at the Hollister Project Area and the Rain Mine Waste Rock Disposal Facility. Some acid rock drainage has been observed at refractory ore stockpiles at Newmont's South Operations Area (Gold Quarry). This drainage occurs seasonally and is not measured by Newmont, but is captured and used in ore processing. Refractory ore stockpiles will be removed after project closure and, therefore, have a relatively short-term potential for producing acid drainage. To date, with the exception of groundwater at the Hollister Project, no surface water or groundwater monitoring stations indicate evidence of acid-rock drainage within the Carlin Trend (see *Water Quantity and Quality* in this chapter).

TABLE 3-1
Potentially Acid Generating (PAG) Waste Rock as a Percentage of all Waste Rock at Carlin Trend Mines

Mine	Non-PAG Waste Rock (million tons)	PAG Waste Rock (million tons)	Total Waste Rock (million tons)	Percent PAG of Total Waste Rock
Past Activity				
Carlin Mine	NA	NA	NA	NA
Bootstrap	105	11	116	9.5
Rain	21.25	0.75	25	3
Dee	72	NA	72	NA
Present Activity				
Leeville	3.5	0.4	3.9	11.4
Storm	0.335	0.046	0.38	12
Betze/	3,181.2	857.2	4,038.4	21
Pete	70	13	83	15.6
Genesis-Bluestar/Lantern	384.9	15.4	400.3	4
Lantern III	51	0.0	51	0
Gold	681	262.9	943.9	27.8
Reasonably Forseeable Future Activity				
Hollister	NA	1.0	1.0	100
	79	4	83	5
Genesis	421.5	28	449.5	6
Dee-Arturo	528	72	600	12
Greater Gold	699.1	114.9	814	14

NA = Data not available
[1] Proposed waste rock production – Emigrant Plan of Operations (POO) (Newmont 2007c).
[2] Includes Meikle Mine production.
[3] Proposed production – Genesis Project POO (Newmont 2007d)
[4] Includes past production and currently authorized future production.
[5] Proposed waste rock production; POO for this project has not been submitted for agency review.
Source: BLM 2002a, 2002b, 2009b, 2009c.

Oil and Gas Production

A Reasonable Development Scenario, based on a 15-year projection, was prepared by BLM to estimate potential environmental impacts resulting from oil and gas development in the Elko Field Office area (BLM 2005a). The development scenario is based on geophysical exploration activities occurring in the area between 1954 and 1991. These dates represent the most active period of exploration in the Elko District. The last geophysical survey for oil and gas in the District was in 2006 (BLM 2010b).

Currently, 24 tracts of land have been leased for oil and gas within the Study Area as shown on **Figure 2-8**. These tracts lie within Townships 31 North to 39 North; Ranges 46 East to 54 East. Recent oil exploration activity includes two "dry" holes; one drilled in Section 34, Township 31 North, Range 51 East in

February 2008, and one in Section 16, Township 34 North, Range 54 East. Two tracts have been issued leases for geothermal. The development scenario predicts an additional eight producing wells and 52 exploration (dry) wells will occur during the 15-year plan primarily in the Pine and Railroad Valley areas. These areas lie outside the Study Area for this resource.

Geothermal

No active explorations or development activities for geothermal resources are occurring within the lease areas depicted on **Figure 2-8**.

Sand and Gravel

Sand and gravel have not been sold nor permits issued for the use of sand and gravel on public land within the Study Area.

AIR QUALITY

Air pollutant sources within the Study Area include existing mining operations and other background sources. Emissions from mining include criteria air pollutants such as particulate matter (both particulate matter less than 10 microns in diameter ( ) and particulate matter less than 2.5 microns in diameter ($_{.5}$)), gaseous emissions of nitrogen oxides ( ), sulfur dioxide ( ), and carbon monoxide (CO), and trace metal Hazardous Air Pollutants (HAPs) such as mercury. Background emission sources include traffic on unpaved roads, windblown dust, agricultural activities, and emissions from existing and future power generation facilities. NDEP has classified the Study Area as an Attainment Area indicating air pollution levels in the area do not exceed ambient standards.

Mining operations in the Carlin Trend are required to obtain an air quality permit from NDEP Bureau of Air Pollution Control (BAPC). These permits establish air emission levels that meet air quality standards which are protective of human health and the environment. Air quality permits for mining operations are available for public review through NDEP.

On July 18, 1997, EPA promulgated National Ambient Air Quality Standards (NAAQS) for fine particulate matter ($_{.5}$), which was later revised in 2006. Particles less than 2.5 micrometers (microns) in aerodynamic diameter typically include particles from all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes. $_{.5}$ emissions are a subset of emissions, in that all $_{.5}$ is included in measurements of . Playas (dry lake beds) in Nevada have high ambient $_{.5}$ levels due to the chemical precipitate that forms on the surface.

EPA has only recently begun to adopt the necessary implementation rules to allow states to begin to review and assess $_{.5}$ emissions, and has not completed the necessary rulemakings to address all requirements applicable to $_{.5}$. EPA has required that each state submit a State Implementation Plan (SIP) that provides basic program elements specified in section 110(a)(2) of the Clean Air Act necessary to implement the $_{.5}$ NAAQS. States were required to submit SIPs to implement the $_{.5}$ NAAQS by 2008. The State of Nevada submitted the required SIP to EPA to comply with the $_{.5}$ NAAQS, but as of March 2010 the EPA had not approved the SIP.

By letter dated June 26, 2009, NDEP notified regulated sources that while it would require $_{.5}$ analyses for major stationary sources pursuant to the New Source Review/Prevention of Significant Deterioration (NSR/PSD) programs, it would not require such analyses for sources not subject to NSR/PSD permitting requirements (NDEP-BAPC 2009). As the SOAPA Project is not subject to these NSR/PSD requirements, NDEP has not required either $_{.5}$ modeling or monitoring of the Project for air permitting purposes.

CUMULATIVE EFFECTS STUDY AREA

Cumulative impacts for air resources may result from overlap of different sources of emission located in the same general area, but not necessarily in immediate proximity to each other. The cumulative analysis discussed here includes the Leeville and SOAPA projects, Barrick Goldstrike Betze/Post operations, new TS Power Plant, and other sources of air emissions in the vicinity of the Carlin Trend.

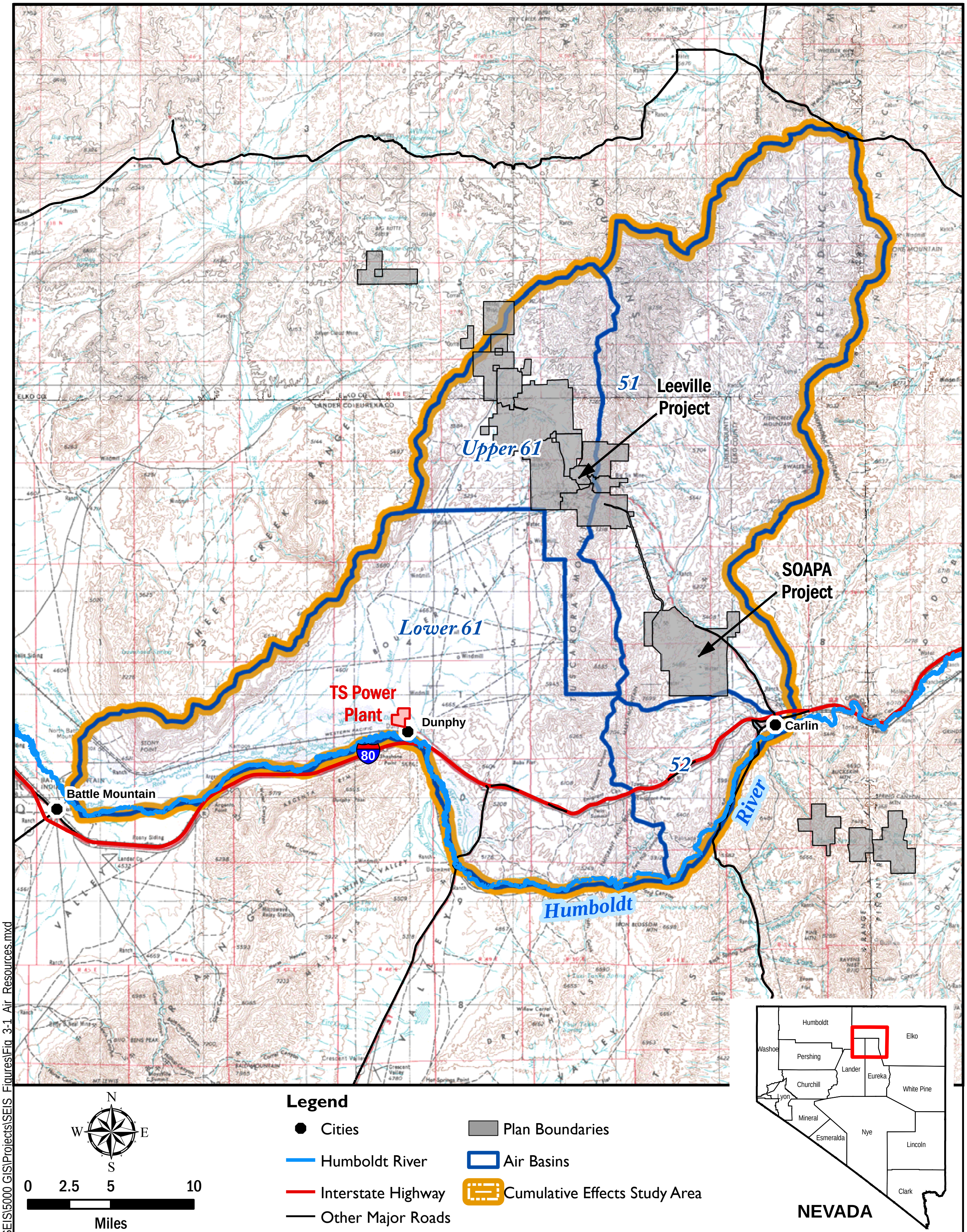
The State of Nevada has divided the state into 250 air quality planning areas based on hydrographic basins. The Cumulative Effects Study Area (Study Area) for air resources focuses on three of these basins, encompassing approximately 986 square miles. These air basins are: Basin 51 - Maggie Creek Basin; Basin 61 - Boulder Flat Basin (both upper and lower portions of this basis); and Basin 52 - Marys Creek Basin. The Leeville and SOAPA project elements are located entirely within two of these basins – Basin 51 and Basin 61. **Figure 3-1** illustrates locations of these air basins and facilities.

Rationale for selecting these air basins for the cumulative effects investigation is based on previous air quality modeling of Barrick's Betze/Post operations, Newmont's SOAPA and North Operations Area, and the TS Power Plant for regulated air pollutant sources conducted for the NDEP air quality permit process. Air modeling completed for the individual permits for these facilities has shown that, for each of these projects, air pollutant concentrations are localized near the project boundaries, and modeled air pollutant concentrations diminish rapidly with distance from project boundaries (EMA 2006, 2007a, 2007b). None of these air pollutant emission sources are located closer than 7 kilometers (km) from the outer boundaries of these three air quality basins. Based on previous air pollutant modeling, 7 km was judged to be sufficiently large that only other past, present, and reasonably foreseeable future emission sources in these three air quality basins needed to be modeled with the Leeville and SOAPA mine emission sources to determine potential for cumulative air quality impacts.

The Cumulative Effects Study Area for mercury differs from that used for evaluating cumulative effects associated with regulated pollutants (, , and CO) as described above. The study area for mercury emissions is broader and encompasses the geographic area depicted in (**Figure 3-2**). This study area was developed as a result of using EPA's Regional Modeling System for Aerosols and Deposition (REMSAD) model and reflects the cumulative effects resulting from mercury emission sources and deposition associated with mineral processing in the Carlin Trend.

Based on inquiry with NDEP, only four facilities with current permits issued by NDEP are located in air quality Basins 51, 52, or 61 (Upper or Lower), and no permit applications for other sources within these three basins were being reviewed by NDEP.

The North Operations Area (NOA) currently operates under Class II Air Quality Operating Permit No. 1041-0402.01 issued by NDEP. Newmont's NOA is a metal mining and processing operation that encompasses multiple mine areas (including the Leeville Mine) and facilities located approximately 24 miles northwest of Carlin (**Figure 2-7**). The NOA has no regulated emissions of , , or CO. NOA is a minor source (potential to emit less than 100 tons per year) of fine particulate matter and the Leeville Mine has a fine particulate matter potential to emit less than 1 ton per year.



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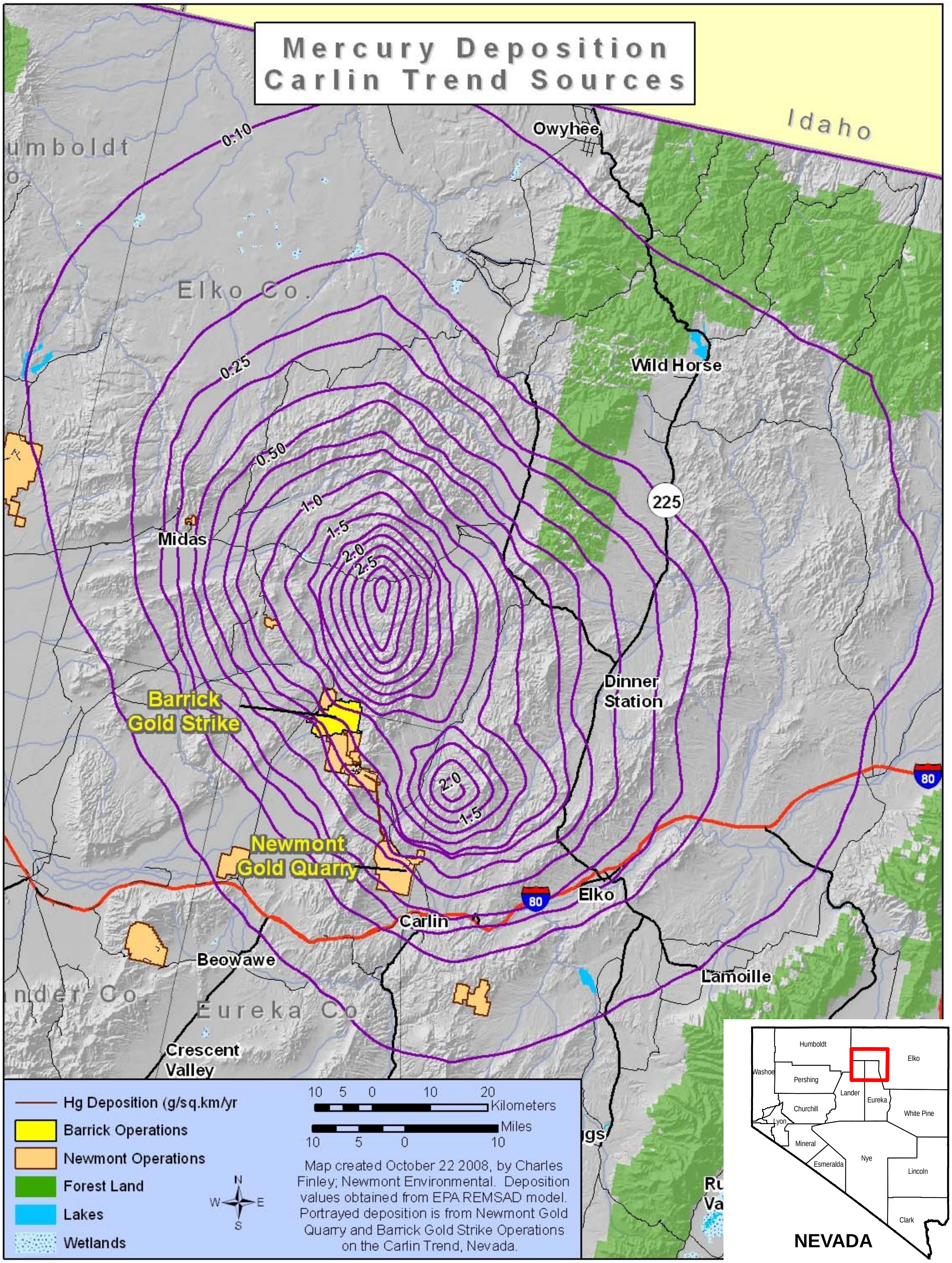
U.S. Department of the Interior
Bureau of Land Management
Elko District Office
Tuscarora Field Office
Elko, Nevada

AIR RESOURCES
CUMULATIVE EFFECTS STUDY AREA
SOAPA Project
Final Supplemental EIS
Eureka and Elko Counties, Nevada

FIGURE

3-1



U.S. Department of the Interior
Bureau of Land Management
Elko District Office
Tuscarora Field Office
Elko, Nevada

MERCURY DEPOSITION CARLIN TREND SOURCES
CUMULATIVE EFFECTS STUDY AREA
SOAPA Project
Final Supplemental EIS
Eureka and Elko Counties, Nevada

FIGURE

3-2

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SOAPA is a metal mining and processing facility located approximately 6 miles northwest of Carlin, Nevada (**Figure 2-7**). The mine is located entirely within the Maggie Creek Air Quality Basin (No. 51). SOAPA operates under Class I Air Quality Operating Permit No. 1041-0793, issued by NDEP. SOAPA is a major source (potential to emit greater than 100 tons/year) of fine particulate matter, , , and CO.

Barrick Goldstrike operates the Betze/Post Mine which is a metal mining and processing facility located approximately 25 miles north-northwest of Carlin, Nevada (**Figure 2-7**); entirely within the Boulder Flat Air Quality Basin (No. 61 - Upper) as shown on **Figure 3-1**. The Betze/Post Mine currently operates under Class I Air Quality Operating Permit No. 1041-0739.01. The Betze/Post Mine is a major source (potential to emit greater than 100 tons/year) of fine particulate matter, , , and CO.

The TS Power Plant is located approximately three miles north of Dunphy, Nevada. The plant is located entirely within the Boulder Flat Air Quality Basin (No. 61 - Lower) (**Figure 3-1**). The TS Power Plant operates under Class I Air Quality Operating Permit No. 4911-1349, issued by the NDEP. The TS Power Plant is a major source (potential to emit greater than 100 tons/year) of fine particulate matter, , , and CO

MONITORING DATA AND NEW INFORMATION

Air quality monitoring data, which include information collected for criteria air pollutants and mercury since 2002, are present in this section. Results of mercury emission levels as reported in the Nevada Mercury Control Program for companies in the Study Area for 2008 are also included in this section.

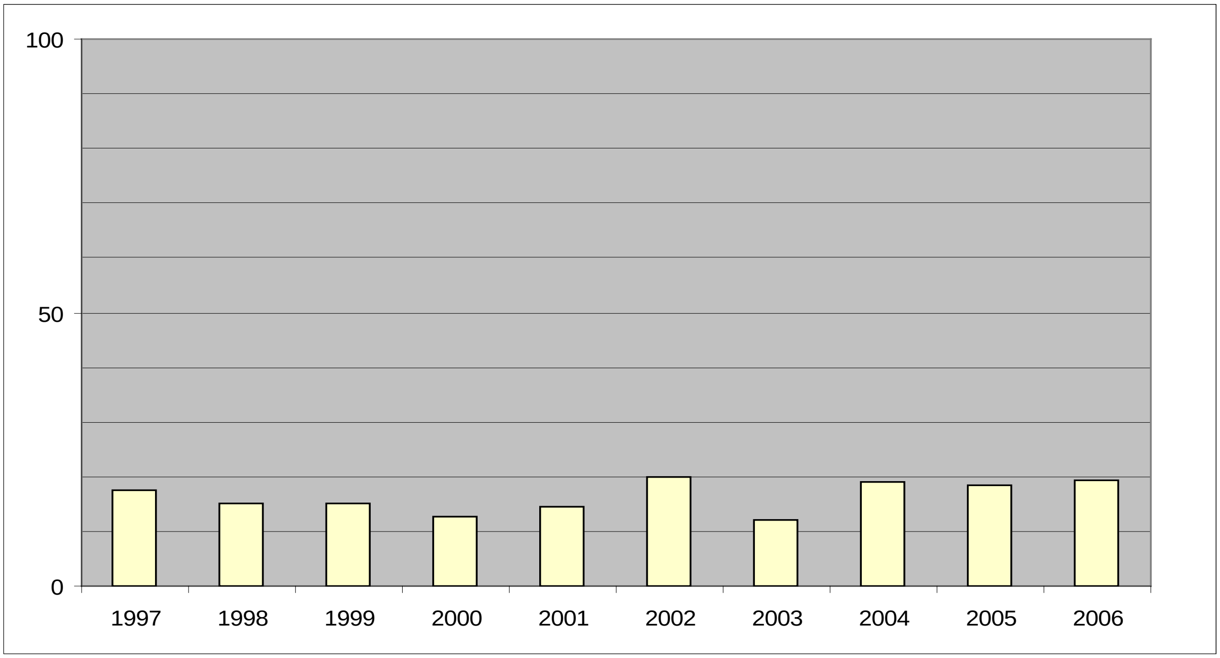
Particulate Matter Monitoring

and .5 Monitoring

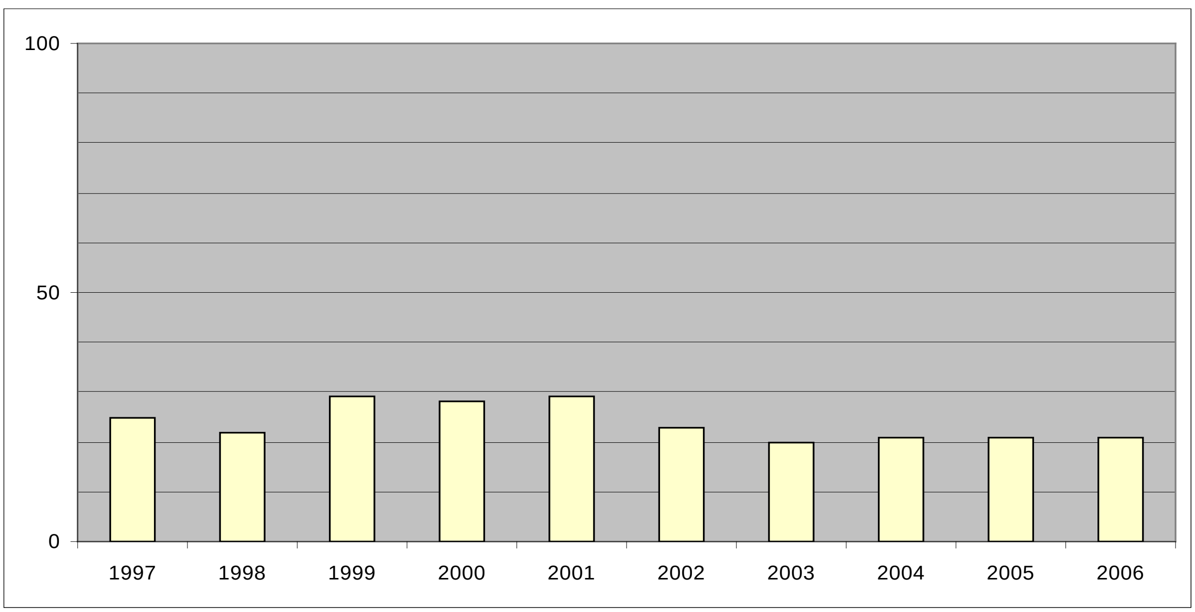
represents a criteria air pollutant consisting of small particles with an aerodynamic diameter less than or equal to a nominal 10 microns (about 1/7 the diameter of a single human hair). air quality monitoring data have been collected from the Gold Quarry mine site, within the Study Area, and the town of Elko, about 20 miles to the east of the Study Area. Data collected prior to and subsequent to startup of SOAPA were compared to determine if SOAPA operations have incrementally added to concentrations from other sources.

monitoring data were examined for 1997 through 2006 to evaluate potential cumulative air quality effects of Leeville and SOAPA operations since startup in 2002. The 10-year period of data presented in **Graph 3-1** (Gold Quarry) and **Graph 3-2** (Elko) represents the 5-year period before initiation of Leeville and SOAPA and the 5-year period after initiation. The term "mean" refers to calendar year average of the 24-hour concentrations for that year.

.5 air quality monitoring data were collected on six days in the summer of 1996 from the same Gold Quarry mine site location as the air quality monitoring stations (iml Air Science 1996). The and .5 data collected on the same days are presented in **Table 3-2**.



Graph 3-1. Gold Quarry - Mean Monitoring Data Summary (μg/)



Graph 3-2. Elko - Mean Monitoring Data Summary (μg/)

TABLE 3-2 South Operations Area (Gold Quarry) $_{.5/}$ Monitoring Data		
Sample Date	**Filter $_{.5}$ (µg/)**	**Filter (µg/)**
26 July 1996	11	27
01 August 1996	10	32
07 August 1996	11	30
13 August 1996	36	83
19 August 1996	15	32
25 August 1996	16	28
Averages	**16**	**39**

µg/ = micrograms per cubic meter
Source: iml Air Science 1996.

$_{.5}$ and ambient air concentration data have also been collected from two monitoring sites in northern Nevada that were part of the national Interagency Monitoring of Protected Visual Environments (IMPROVE) program (UC Davis 1995). The IMPROVE program stations were designed to collect data at national parks and wilderness areas to study and protect visibility in these areas Class I airsheds. These two northern Nevada IMPROVE $_{.5}$ and monitoring sites were located outside the cumulative effects Study Area for air quality, but are the nearest source of long-term cumulative $_{.5}$ and ambient air concentration monitoring data. The IMPROVE Jarbidge Wilderness site (JARB1), located approximately 85 miles north-northeast of the Gold Quarry $_{.5}$ and monitoring stations, collected ambient air data from collocated $_{.5}$ and monitoring stations from 1988 through 2004 (Colorado State University 2004). The IMPROVE Great Basin National Park site (GRBA1), located approximately 161 miles southeast of the Gold Quarry $_{.5}$ and monitoring stations, collected ambient air data from collocated $_{.5}$ and monitoring stations from 1992 through 2004. For the periods of record, the Jarbidge Wilderness and Great Basin National Park sites had average $_{.5}$ concentrations of 2.62 and 2.68 micrograms per cubic meter (µg/); and average concentrations of 6.54 and 5.97 µg/.

Mercury

The Nevada Mercury Control Program (NMCP) is a State regulatory program that requires mercury emissions controls on thermal units located at precious metal mines. The NMCP was adopted March 8, 2006 and made effective May 4, 2006. The Program achieves mercury reduction via add-on control technologies. The NMCP requires all precious metal processing facilities with SIC codes "1041" or "1044" be reviewed for applicability under the NMCP. At this time, the NMCP regulations focus on the potential for mercury emissions from thermal processing units only.

The USEPA has not established a National Emission Standard for Hazardous Air Pollutants (NESHAPS) for mercury emissions from gold ore processing facilities. Mercury is not considered a primary pollutant, and no National Ambient Air Quality Standards (NAAQS) have been established under the Clean Air Act.

Mercury, a trace metal Hazardous Air Pollutant identified in the Clean Air Act, is often bound in gold ore and can be released into the atmosphere through a variety of thermal treatment processes involved with the refining of gold including autoclaves, carbon kilns, furnaces, retorts, and roasters. When bound in mineral forms that typically appear in ore (e.g., cinnabar), mercury is a stable compound that remains in solid form. Ore processing has potential to liberate mercury from stable minerals by dissolving it in process solutions.

Because it has a boiling point of 675°F, mercury has potential to volatilize into a gaseous form when subjected to thermal processes in a recovery and refining circuit.

Mercury content of ore mined at Barrick's Betze/Post Mine ranges from 1.0 ppm to 10 ppm (BLM 2009b). Ore from Newmont operations has the following mercury content:

- Chukar 4.43 ppm;
- Gold Quarry 6.90 ppm;
- Genesis 4.80 ppm;
- Leeville 17.54 ppm; and
- Emigrant 4.00 ppm (Newmont 2008a).

The TS Power Plant emits approximately 0.02 pound of mercury per gigawatt hour (permit limit), on an annual basis. A 200 megawatt capacity for 8,760 hours/yr equates to 1,752 gigawatt hours emitting approximately 35 pounds of mercury annually. The TS Power Plant has installed activated carbon injection for mercury control, and recent performance tests showed emissions less than 35 pounds per year (AECOM Environment 2009).

In addition to manmade facilities such as mine and power plants that release mercury, Nevada has large areas of naturally occurring mercury. Natural sources include gases from volcanic areas and geothermal vents, as well as evaporation from naturally mineralized soil and wetlands. Global and local anthropogenic sources of mercury exist in the Study Area. Background levels vary from location to location and from one time period to another but generally fall in the range of 0.001 to 0.004 micrograms per cubic meter (µg/) (Slemr and Langer 1992; Lin and Pehkonen 1999) in remote locations far from human sources.

Mercury occurs in the environment as gaseous elemental mercury, reactive gaseous mercury, or particulate mercury. Reactive gaseous mercury and particulate mercury account for less than 2 percent of the total concentration in air, with elemental mercury accounting for more than 98 percent of the total (Fitzgerald *et al.* 1991). The fate of mercury emissions follows a progression from the emission source to transport, deposition and potential exposure. A portion of emissions are deposited locally near the source while the remaining portion is dispersed regionally and globally.

Gaseous elemental mercury is a relatively non-reactive chemical form that is not very soluble in water. Gaseous mercury must be transformed to particulate (oxidized) mercury in order to contribute substantially to mercury deposition and subsequent entry into water bodies where further transformation to methylmercury ($^{+}$) can make the mercury available in the aquatic food chain (Porcella 1994).

Average atmospheric residence time for particulate mercury ranges from hours to days (depending on the presence or absence of precipitation and the particle size). Particulate mercury has low volatility and is easily taken up in precipitation or adsorbed on small particles, falling out relatively close to the emission source in the presence of precipitation, or as dry deposition that may be transported longer distances if associated with smaller particle sizes. Particle-bound mercury is relatively stable and is not easily converted to methylmercury (EPA 1997).

Mercury deposition rate data have been collected from two wet-deposition monitoring sites in northern Nevada that are part of a national Mercury Deposition Network. These sites are outside the cumulative effects Study Area for mercury, but are the nearest source of cumulative mercury deposition monitoring data. The monitoring data presented here are from a wider geographic area than the Study Area, but are believed representative of the trends in mercury deposition rates associated with atmospheric releases of mercury in northern Nevada. The Lesperance Ranch site (NV02) is located approximately 85 miles northwest of the Study Area, and the Gibbs Ranch site (NV99) is located approximately 73 miles northeast of the Study Area. Collection of mercury wet deposition data began at these sites in early 2003, and data are available through 2009.

Measured wet deposition for the Mercury Deposition Network site Lesperance Ranch (NV02) in northeast Nevada decreased from an annual average of 173 nanograms per square meter (ng/) in 2003 to 84 ng/ by 2008. Deposition rates at the site ranged from 3 to 1,954 ng/ during the period. At the Gibb's Ranch monitoring site (NV99), annual mercury wet deposition decreased from 188 ng/ in 2003 to 116 ng/ in 2008. Deposition rates at the site ranged from 1 to 850 ng/ during the period (NADP 2010). Data for 2009 was incomplete at the time this document was prepared.

CUMULATIVE EFFECTS

Air Quality Modeling – , , , and CO

Gaseous criteria air pollutant emissions such as , , and CO typically result from combustion related activities. For most mining projects, the major air quality issues are emissions of particulate pollutants, not gaseous pollutants. Ambient monitoring of gaseous emissions at the SOAPA and Betze/Post mine projects is not required under the air quality permits. There are no other stations operated in northeastern Nevada to monitor gaseous ambient air pollutant concentrations. Accordingly, no measured data are available to characterize existing air quality for these gaseous air pollutants. The air quality modeling analysis discussed below addresses particulate and gaseous emissions at these facilities.

An air quality modeling analysis was conducted by Environmental Management Associates (EMA 2007a) for this cumulative effects analysis. EMA prepared a modeling protocol (July 2, 2007), which was submitted to and reviewed by BLM and others. The study was prepared in conformance with the protocol.

The EPA-approved AMS/EPA Regulatory Model (AERMOD) (Version 07026) was used to conduct the air quality analysis. Trinity Consultants' BREEZE AERMOD GIS Pro v6.1.6 modeling manager was used to prepare the input files and manage AERMOD processing. The model was run using elevated terrain, PRIME building downwash algorithms, and EPA regulatory defaults. **Table 3-3** summarizes emission sources considered in the cumulative air quality modeling analysis (EMA 2007a).

A total of 338 sources of emission were included in the modeling covering all emission sources in the five facility groups noted in **Table 3-3**. Emissions were organized into a series of emission source groups so that different combinations of source impacts could be evaluated separately (EMA 2007a). Consistent with direction from NDEP Bureau of Air Pollution Control for regulatory modeling, a background 24-hour concentration of 10.2 µg/, and an annual concentration of 9.0 µg/, were added to the maximum modeled 24-hour concentration and the maximum modeled annual concentration, respectively, to account for background concentrations and determine compliance with applicable Nevada Ambient Air Quality Standards.

TABLE 3-3
Summary of Emission Sources Included in Air Quality Modeling

Facility	Number of Model Sources	Emissions of (tons/year)	Emissions of CO (tons/year)	Emissions of (tons/year)	Emissions of (tons/year)
SOAPA	84	568	337	354	276
Leeville	7	0.5	0	0	0
North Operations Area without Leeville	40	93.8	0	0	0
Betze/Post	179	579	400	311	996
TS Power Plant	28	598	744	1.170	1,546
TOTAL	**338**	**1,840**	**1,480**	**1,835**	**2,818**

Note: CO = carbon monoxide; = nitrogen oxides; = sulfur dioxide.
Source: EMA 2007a.

Modeling incorporated 12 months of meteorological data (09/01/03 – 08/31/04) collected by Newmont Nevada Energy Investment, LLC from its TS Power Plant site, processed using AERMET Version 06341 using the corresponding 12 months of upper air data (09/01/03 – 08/31/04) from Elko. Processing these meteorological data was previously accepted by NDEP and, therefore, its use is justified for facility emission sources to be modeled based on proximity of the emission sources and the generally similar albedo, mid-day Bowen ratio, and surface roughness length of the locations (all are considered desert shrubland).

Modeling of criteria air pollutants was conducted to determine the first high ambient air concentration for the regulatory time periods presented in **Table 3-4**. Calculation of the first high concentration also ensures compliance with applicable NAAQS for the same averaging periods.

TABLE 3-4
Modeled Air Pollutants and Applicable Time Periods for Nevada First-High Standards

Criteria Pollutant	Averaging Period	Applicable Standard (µg/)
Particulate Matter - 10 Microns in Aerodynamic Diameter ( )	24-Hour	150
	Annual	50
Sulfur Dioxide ()	3-Hour	1,300
	24-Hour	365
	Annual	80
Nitrogen Oxides ( )	Annual	100
Carbon Monoxide (CO)	1-Hour	40,000
	8-Hour	10,000

Note: µg/ = micrograms per cubic meter
Source: EMA 2007a.

Modeling was conducted for oxides of nitrogen

( ), rather than nitrogen dioxide ( ), the pollutant for which ambient standards have actually been adopted. In general, emissions of , which consists of both and other oxides of nitrogen, provide an accurate estimate of emissions for each of the projects modeled in this assessment for the NDEP regulatory process. Since an assessment using is consistent with the EPA's Guideline on Air Quality Models (Appendix W to 40 CFR PART 51), and results in a conservative assessment which would over-predict the anticipated ambient concentrations of resulting from the sources modeled, emissions are usually calculated.

Receptors are the locations at which the model was directed to calculate concentrations. Modeling was conducted using Cartesian grid receptors, spaced at 1,000-meter intervals from the boundary of each facility which prevents or deters access by the public to the outer boundary of the three air quality basins (No. 51, No. 52 or No. 61 (Upper and Lower)). In addition, receptors were selected to address impacts in Class I areas. The closest Class I airshed to the Study Area is the Jarbidge Wilderness, the southwest corner of which is located approximately 109 and 104 km northeast of the closest SOAPA and Leeville Mine emission sources, respectively. To evaluate potential cumulative air quality impacts to this Class I airshed, model receptors were located 50 km from the Leeville Mine and SOAPA sources closest to the southwest corner of the Jarbidge Wilderness Class I airshed on a line from each source to this corner of the Class I airshed. Although located less than half the distance to the Class I airshed, placement of these receptors at 50 km from these sources is consistent with EPA's Guideline on Air Quality Models (Appendix W to 40 CFR PART 51). EPA's position is that 50 km is the nominal distance appropriate for Gaussian models such as AERMOD. Modeling results confirm no impact to the Class I airshed.

Table 3-5 shows the maximum first high ambient air pollutant concentrations of , , , and CO modeled from all modeled sources are below the applicable ambient air quality standard, even with the addition of the applicable background concentration. **Table 3-5** also shows that the maximum first high ambient air pollutant concentrations modeled at the Cartesian grid receptors from the SOAPA emission sources alone are nearly equal to the maximum cumulative modeled concentrations.

Although neither the SOAPA Mine nor the Leeville Mine are subject to the federal Prevention of Significant Deterioration regulations (40 CFR 52.21), ambient air pollutant concentrations modeled at the two receptors used to estimate potential impacts to the Class I airshed can be compared to Class I increments under the Prevention of Significant Deterioration regulations. As shown in **Table 3-6**, the maximum first high ambient air pollutant concentrations modeled from all modeled sources at the two receptors are below ten percent of the Class I Prevention of Significant Deterioration increments (EMA 2007a).

Potential cumulative .5 concentrations were evaluated using the modeling concentrations reported in the 2007 cumulative modeling report. The first high cumulative annual concentration from all modeled sources was 4.97 µg/ (without any background concentration; 13.97 µg/ with the NDEP background concentration of 9.0 µg/). Since both of these concentrations are below the annual .5 NAAQS (the 3-year average of the weighted annual mean .5 concentrations from single or multiple community-oriented monitors must not exceed 15 µg/), .5 concentrations would not exceed the annual .5 NAAQS.

TABLE 3-5
Results of Modeling for the Cartesian Grid Receptors

Criteria Pollutant	Averaging Period	First High Concentration (μg/)				Total % of Ambient Standard	First High Concentration (μg/)		
		Ambient Standard	Maximum Cumulative High	Background	Total		Maximum Cumulative High	Maximum SOAPA High	Maximum Incremental Increase
Particulate Matter <10 Microns in Aerodynamic Diameter ( )	24-hour	150	47.99	10.20	58.19	38.797%	47.99	47.74	0.2
	Annual	50	4.97	9.00	13.97	27.94%	4.97	4.73	0.24
Sulfur Dioxide ()	3-hour	1,300	37.45	0.00	37.45	2.88%	37.45	37.35	0.10
	24-hour	365	8.45	0.00	8.45	2.31%	8.45	8.07	0.38
	Annual	80	1.02	0.00	1.02	1.28%	1.02	0.90	0.12
Nitrogen Dioxide ()	Annual	100	1.09	0.00	1.09	1.09%	1.09	0.94	0.16
Carbon Monoxide (CO)	1-hour	40,000	218.21	0.00	218.21	0.55%	218.21	96.57	121.64
	8-hour	10,000	38.43	0.00	38.43	0.38%	38.43	17.14	21.30

μg/ = micrograms per cubic meter.

TABLE 3-6
Results of Class I Airshed Increment Modeling

Criteria Pollutant	Averaging Period	First High Concentration (μg/)		Percent of Class I Increment	First High Concentration (μg/)		
		Class I PSD	Maximum Cumulative High		Maximum Cumulative High	Maximum SOAPA High	Maximum Incremental Increase
Particulate Matter <10 Microns in Aerodynamic Diameter ( )	24-hour	8	0.5096	6.37%	0.5096	0.3056	0.2040
	Annual	4	0.0863	2.16%	0.0863	0.0307	0.0556
Sulfur Dioxide ()	3-hour	25	1.4386	5.75%	1.4386	0.6678	0.7708
	24-hour	5	0.4159	8.32%	0.4159	0.2160	0.1999
	Annual						
Nitrogen Dioxide ()	Annual	3	0.0593	2.37%	0.0593	0.0216	0.0377

μg/ = micrograms per cubic meter; PSD = Prevention of Significant Deterioration. Source: EMA 2007a.

The first high cumulative 24-hour concentration from all modeled sources was 47.99 µg/ (without any background concentration, 58.19 µg/ with the background concentration of 10.2 µg/), located at a point immediately north of the Gold Quarry project boundary. Although this was greater than the .5 24-hour NAAQS of 35 µg/, .5 emissions from these projects would be substantially lower than the modeled emissions. The current EPA emission estimating guidance for metallic minerals processing (AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Volume I, Chapter 11: Mineral Products Industry, Section 11.24 Metallic Minerals Processing [08/82]) contains no estimating factors for fine particle (.5) emissions from metallic mineral mining. However, emission review documents have suggested .5/ ratios for fugitive dust emissions from mining operations of from 0.10 to 0.15 (WRAP 2007; MRI 2006). The ambient air .5 and concentrations monitored on the Gold Quarry mine site, which were collected during ongoing mining operations, would suggest a higher .5/ emission ratio of 0.428 for all sources.

Using this range of .5/ emission ratios from the emission review studies and the Gold Quarry monitoring site (0.10 to 0.428), the first high cumulative 24-hour .5 concentration calculated from the modeled first high concentration from all modeled sources would be 4.80 to 20.54 µg/ (without any background concentration), By adding the average .5 concentration of 2.68 µg/ measured by the IMPROVE Great Basin National Park station as a background concentration, the calculated cumulative 24-hour .5 concentration would range from 7.48 to 23.22 µg/.

Note that these first-high .5 concentrations are conservative values to compare to the .5 24-hour NAAQS, which for attainment requires only that the 3-year average of the percentile of the 24-hour the .5 concentrations at each population-oriented monitor within an area, not exceed 35 µg/.

In addition to EMA's air quality dispersion modeling analyses of the Study Area, other air quality dispersion modeling studies of the region confirm that air quality impacts from these facilities tend to be confined to the facility area, with little potential for overlap or cumulative impact as discussed below. Reported concentrations in the following site-specific modeling analyses are conducted with the receptor placed at the fence line as per NDEP requirements for permitting. In the preceding discussion, receptors were placed outside of the project boundaries to simulate cumulative effects.

South Operations Area Modeling

The South Operations Area dispersion modeling analysis predicted maximum cumulative annual impacts of 15.03 µg/ and maximum 24-hour impacts of 76.67 µg/ (without any background concentrations, 24.03 µg/ and 86.87 µg/ with the NDEP background concentrations of 9.0 and 10.2 µg/, respectively. Predicted impacts (including background concentrations) represent 48 percent of the annual Nevada ambient air quality standard of 50 µg/ and 58 percent of the 24-hour ambient air quality standard of 150 µg/. Applying the ambient air quality standards as criteria, predicted air quality impacts from the South Operations Area dispersion modeling demonstrates that cumulative air impact issues would be below all applicable criteria in the air quality Study Area (air basins). Based on these results, NDEP concluded that SOAPA would comply with the ambient air quality standard and could be permitted and operated as proposed.

Using the same range of .5/ emission ratios from the emission review studies and the Gold Quarry monitoring site (0.10 to 0.428), the

South Operations Area dispersion modeling analysis would have predicted a maximum annual .5 concentration of from 1.50 to 6.43 µg/ (4.18 to 9.11 µg/ when including the annual average .5 concentration measured at the Great Basin National Park station as a background concentration), Applying the calculated ratio of the average percentile and first high 24-hour concentrations collected on site from the Gold Quarry monitoring stations (0.84) and the .5/ emission ratios (0.10 to 0.428) to the modeled South Operations Area 24-hour concentrations, the percentile of the 24-hour .5 concentration at the modeled point of the highest concentration would range from 6.44 to 27.24 µg/ (without the background concentration – 9.12 to 29.92 µg/ with the addition of the Great Basin National Park background concentration). These values are below the .5 24-hour NAAQS concentration of 35 µg/ for the percentile concentration.

The air quality dispersion modeling study for the South Operations Area included predicted impacts of gaseous criteria air pollutants , , and CO. This modeling was completed in 2006 (EMA 2006). The SOAPA dispersion modeling analysis predicted the following maximum cumulative effects:

3-hour : 122.09 µg/
(ambient air quality standard = 1,300 µg/)

24-hour : 29.58 µg/
(ambient air quality standard = 365 µg/)

Annual : 2.95 µg/
(ambient air quality standard = 80 µg/)

Annual : 3.50 µg/
(ambient air quality standard = 100 µg/)

1-hour CO: 101.08 µg/
(ambient air quality standard = 40,000 µg/)

8-hour CO: 25.21 µg/
(ambient air quality standard = 10,000 µg/)

Predicted air quality impacts range from 0.3 percent of the CO ambient air quality standard to 9 percent of the 3-hour ambient air quality standard. Background concentrations were not added to these impacts in the analysis, in part because the impacts were low and the lack of gaseous air pollutant monitoring data. By applying the ambient air quality standard as significance criteria, it is reasonable to conclude that the predicted , , and CO air quality impacts from the South Operations Area dispersion modeling demonstrate no significant effects issues in the Study Area (**Figure 3-1**). Based on this analysis, NDEP concluded that SOAPA would comply with the , , and CO ambient air quality standard and could be permitted and operated as proposed.

TS Power Plant Modeling

The TS Power Plant is a new 200-MW coal-fired electrical generating facility located in Lower Basin 61, approximately 18 miles west of the Leeville and SOAPA facilities. The TS Power Plant operates under Class I Air Quality Operating Permit No. 4911-1349, issued by NDEP – Bureau of Air Pollution Control.

The TS Power Plant air quality dispersion modeling analysis examined the potential impact of as well as , , and CO in Lower Basin 61, where the facility is located, as well as the impacts from the facility in nearby Upper Basin 61(where the Leeville Project is located), Basin 51(where South Operations Area is located), and Basin 62. Predicted potential air quality impacts from the TS Power Plant indicate no exceedance above air permitting Significant Impact Levels in any of the four air basins, eliminating the need for further cumulative analysis in the NDEP air permitting process. Prediction of maximum impacts below the Significant Impact Levels supports the conclusion that there would be no cumulative effect of consequence between the TS Power Plant and other sources in the Carlin Trend.

The maximum predicted 24-hour impact from the TS Power Plant facility is 3.86 µg/ and the maximum predicted annual impact is 0.48 µg/. Even without the application of any .5/ ratios, and with the addition of the 2.68 µg/ background .5 concentrations, these concentrations are below the 24-hour and annual .5 NAAQS. The expected contribution from the TS Power Plant in the Carlin Trend would be lower than these values given the additional dispersion that would occur over the distance to other sources. Predicted air quality impacts from the TS Power Plant dispersion modeling demonstrates cumulative air effects would be below ambient standards in the air quality Study Area (**Figure 3-1**).

Predicted potential , , and CO emissions from the TS Power Plant were below the air permitting Significant Impact Levels in each of the four air basins**.** Maximum predicted effects from the TS Power Plant for , , and CO are presented below:

3-hour : 24.69 µg/
(SIL = 25 µg/)

24-hour : 4.88 µg/
(SIL = 5 µg/)

Annual : 0.46 µg/
(SIL = 1 µg/)

Annual : 0.56 µg/
(SIL = 1 µg/)

1-hour CO: 181.07 µg/
(SIL = 2,000 µg/)

8-hour CO: 25.10 µg/
(SIL = 500 µg/)

Criteria Air Pollutant Impact Conclusions

monitoring data collected at SOAPA and Elko do not reflect a discernable increase in concentrations from before Leeville and SOAPA began operation in 2002 through 2009 (Newmont 2010c). No major increase in mean concentration of is evident and values remain within the ambient air quality standard of 50 micrograms per cubic meter (µg/) on an annual basis and 150 µg/ on a 24-hour basis. The lack of increase in concentrations indicate that neither Leeville nor SOAPA operations are resulting in cumulative air quality impacts since operations began. No violations of air quality permits have been issued by NDEP to date for any mine activities in the Study Area.

The , , , and CO modeling predictions and monitoring data presented in this section underscore the lack of cumulative air quality impacts in the Study Area. While changes in permitted criteria air pollutant emissions are expected in the Study Area and outside the region, known projects are not located in close proximity to Leeville, SOAPA, and other sources in the Study Area. Consequently cumulative impacts involving reasonably foreseeable projects would not result in exceedance of ambient air quality standards. Safeguards included in the NDEP permitting process would restrict air emissions such that cumulative effects to air quality from multiple sources would not violate ambient air quality standards.

During the period of 2010 to 2015, Newmont would transport approximately 915,000 tons of ore from the South Operations Area to the Sage Mill at Newmont's Twin Creeks Mine located near Winnemucca. During some years, ore would be shipped sporadically over a 5 or 6 month period (2010-2012), while no ore would be transported during other periods (2014). Ore would be shipped in over-the-road side-dump tractor trailer trucks that average 40 tons per load. Approximately 962,000 gallons of diesel fuel would be consumed emitting approximately 10,500 tons of . Emissions from over-the-road transport of ore from the South Operations Area to the Twin Creeks Mine represent a mobile source with emissions occurring over 130 miles of shipping distance. This source of emissions would not combine with existing stationary sources, and therefore would not result in additive emission concentrations within the Study Area.

Emissions from the Sage Mill at the Twin Creeks Mine from processing South Operations Area ore are within limitations imposed by Class I Air Quality Permit No. 1041-0793 issued by NDEP. Annual throughput of ore for the Sage Mill averaged 3.8Mt from 2006 to 2009. Ore shipped from SOAPA to the Sage Mill at Twin Creeks Mine would average approximately 183,000 tons annually representing 4.8 percent of annual throughput at the Sage Mill (Newmont 2010e). Approximately 980 lbs of mercury were emitted from the Sage Mill in 2008 (NDEP 2009a). Mercury content of ore shipped to the Sage Mill from SOAPA would account for about 47 pounds of total annual mercury emissions. Emissions from the Twin Creeks Sage Mill occurs within the Humboldt River Air Quality Basin and would have no additive or cumulative effect on emission levels in the Study Area.

Ruby Pipeline Project

Construction of the Ruby Pipeline Project would involve use of heavy equipment that would produce dust from soil disruption and air contaminants from combustion emissions. The Project would comply with state and local requirements and implement Best Management Practices for dust control.

The Wieland Flat Compressor Station would be constructed about 35 miles north of Elko. Emissions from the compressor station would be required to meet federal and state regulatory standards. Operational emissions would result from combustion associated with gas-fired turbines, emergency generators, and auxiliary heaters at the compressor station. Greenhouse gases (carbon dioxide (), methane (), and nitrous oxide ()) would be produced from combustion sources. Based on dispersion modeling analyses completed for the compressor station operation of the pipeline system would not cause nor contribute to an exceedance of ambient air quality standards (FERC 2009).

Mercury

Mercury deposition data for the Carlin Trend and State of Nevada were compiled using data from the EPA Regional Modeling System for Aerosols and Deposition (REMSAD) model. Results of REMSAD modeling are used to quantify contributions of specific sources and source categories of mercury deposition within the lower 48 states (EPA 2006). The REMSAD Model computes site-specific output of mercury deposition in grams per square kilometer per year (g//yr) based on a variety of parameters.

The output is in digital grid format encompassing EPA Region 9 as a set of 144 cells (n=347,606), each with a cell ID and total deposition value. The data are delivered in a geodatabase format specific to geospatial data and related tabular attributes. The geodatabase includes the total contribution for each cell from each source site within the region (total of 298 sources).

Regional Mercury Deposition

A recent modeling effort conducted by ICF International (ICF) for EPA compiled mercury emissions for the contiguous 48 States, Southern Canada, and Northern Mexico, and evaluated deposition rates of airborne mercury from both domestic and international sources (ICF 2008). The ICF study concluded, consistent with modeling results for other pollutants, the dominant influence on air quality for mercury is generally the source closest to the receptor. Overlapping or cumulative effects were not substantial at peak deposition locations and mercury levels across state boundaries are low. For example, model-predicted deposition rates at the peak location in Utah showed that mercury contribution at that point was caused predominantly by sources in Utah (74.7 percent) and secondarily by source from outside the US (21.9 percent). Neighboring states, including Nevada, accounted for approximately 0.2 percent of mercury deposition at the peak location in Utah.

Of the states bordering Nevada (*i.e.*, California, Arizona, Oregon, Utah, and Idaho), all had peak mercury deposition rates higher than Nevada; Oregon had slightly lower deposition rates. With the exception of Arizona, the contribution of mercury from neighboring states was less than 1 percent of the total at the peak deposition location (ICF 2008). Annual mercury emissions from Nevada and the surrounding five states are summarized in **Table 3-7.**

TABLE 3-7
Annual Mercury Emissions by State

State	Total Mercury (tons/year)
Arizona	1.043
California	6.095
Oregon	1.812
Nevada	3.082
Idaho	0.835
Utah	0.772
Total	**13.6390**

Source: ICF 2006.

Scientists are beginning to collect and analyze mercury air emission, dispersion, and deposition data. Annual emission measurements required by NDEP under the Nevada Mercury Control Program will contribute to understanding mercury in the environment. In addition to emissions measurements, the Nevada Mercury Control Program relies on using and maintaining mercury controls which are subject to a Maximum Achievable Control Technology determination, as well as testing, sampling, operation, maintenance, monitoring, recordkeeping, and reporting to meet permit requirements.

The largest source of atmospheric mercury in Nevada is caused from processing gold through precious metal mines operations. In 2008, annual mercury emissions from Barrick's Betze-Post and Newmont's Gold Quarry operations totaled 588 pounds per year (lbs/yr) (0.3 ton) as reported to the Nevada Bureau of Air Pollution Control (NDEP 2009a). This represents 19 percent of total annual mercury emissions (3,165 lbs) from precious metal processing sources in Nevada.

In July 2008, the EPA estimated that the U.S. is responsible for the release of 104 metric tons of mercury emissions each year (EPA 2008). Mercury emissions from Carlin Trend ore processing sources (588 lbs) and all Nevada ore processing operations (3,165 lbs) represents 0.25 percent and 1.4 percent of total US emissions, respectively.

Carlin Trend Mining Operations – Mercury Deposition

Figure 3-2 portrays the cumulative deposition values for mercury from Newmont's Gold Quarry Mill 5/6 and Barrick's Betze/Post facility. The deposition values are represented in concentric circles, with the lowest value portrayed as 0.10 g//yr, and increasing in increments of 0.25 g//yr to the highest predicted total deposition value from the specified source.

Because output data from the model is a grid of square cells (not conducive to accurate distribution mapping), predictions were created using Kriging. Kriging is a geostatistical method of predicting values at unmeasured locations based on weights of values at measured locations (in this case, the center of each grid square). Deposition contours were created based on the kriged dataset. The kriged dataset was contoured to display the extent of measurable deposition from the specified sources, as determined by the EPA REMSAD model.

Figure 3-2 displays two centers of deposition, approximately 20 km northeast of Barrick's Betze/Post facility, and about 15 km northeast of Newmont's Gold Quarry operation. The highest predicted value of deposition shown is 3.00 g//yr. The lowest displayed value of 0.10 g//yr is projected approximately 30 km to the southwest and 100 km to the northeast.

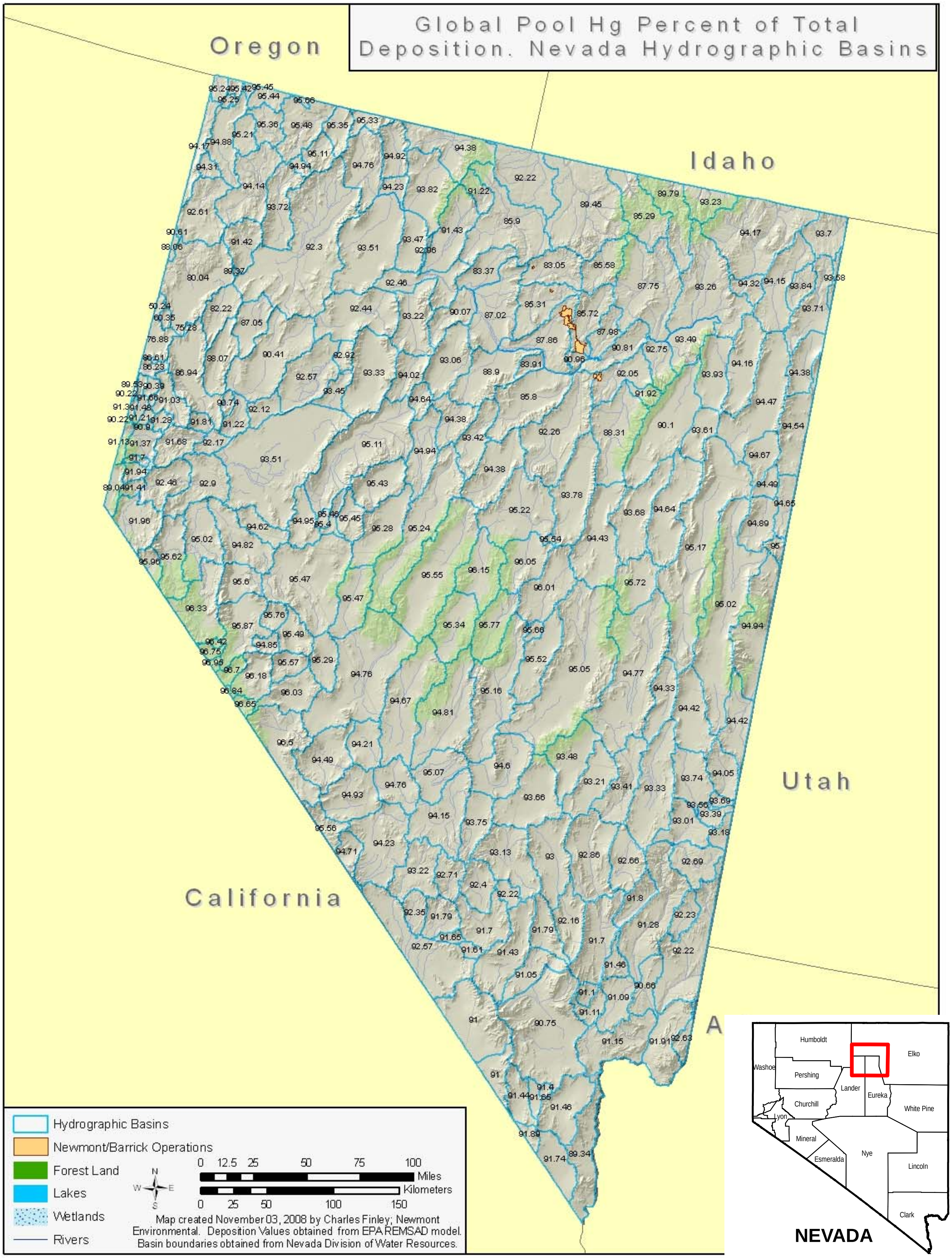
The percentage of total mercury deposition contributed by the global pool of mercury emissions to Nevada hydrographic basins is shown on **Figure 3-3**. The lowest percentages of contribution by the global pool of mercury are located in northern Nevada. The lowest percentage of global pool contributions is located in Skedaddle Creek Valley, on the western border of Nevada.

Contributions to the global pool of mercury emissions to Nevada hydrographic basins from the two facilities on the Carlin Trend (Newmont's Gold Quarry Mill 5/6 and Barrick's Betze/Post) are shown on **Figure 3-4**. The highest percentage of contributions from Carlin Trend facilities (8.91 percent) is in Maggie Creek basin, located just east of the Newmont and Barrick facilities.

No mercury concentrations exceeding water quality standards have been detected in area streams monitored by mining operations in the Carlin Trend (see *Water Quality and Quantity* section in this chapter).

Climate Change

On-going scientific research has identified the potential impacts of "greenhouse gas" (GHG) emissions (including carbon dioxide (); methane (); nitrous oxide (); water vapor; and several trace gasses) on global climate. Through complex interactions on a regional and global scale, these GHG emissions cause a net warming effect of the atmosphere (making surface temperatures suitable for life on Earth), primarily by decreasing the amount of heat energy radiated by the Earth back into space. Although GHG levels have varied for millennia (along with corresponding variations in climatic conditions), recent industrialization and burning of fossil carbon sources have caused concentrations to increase, and are likely to contribute to overall climatic changes, typically referred to as global warming. Increasing concentrations also lead to preferential fertilization and growth of specific plant species.



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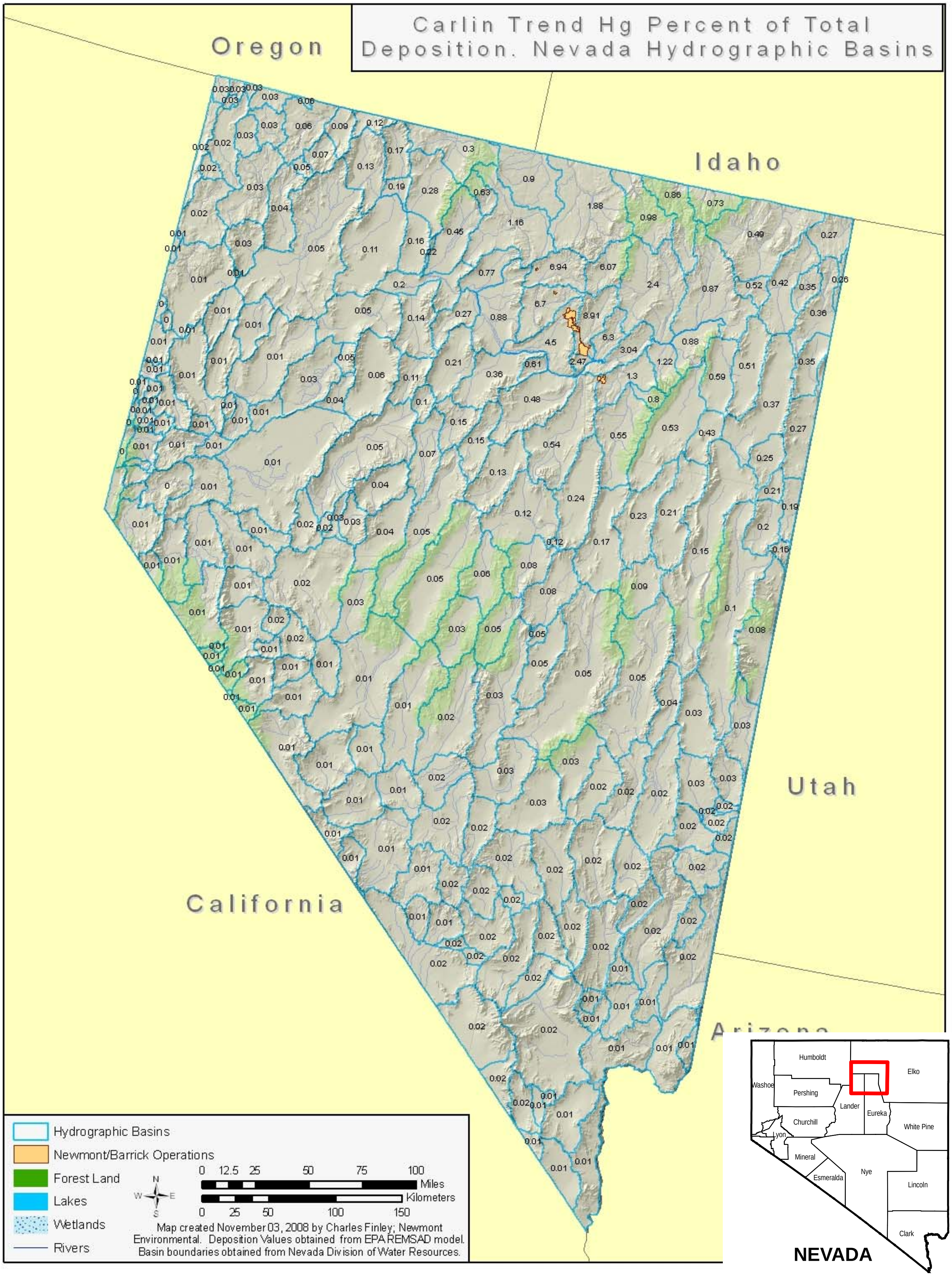
Elko District Office
Tuscarora Field Office
Elko, Nevada

GLOBAL POOL Hg PERCENT OF TOTAL DEPOSITION
NEVADA HYDROGRAPHIC BASINS
CUMULATIVE EFFECTS STUDY AREA
SOAPA Project
Final Supplemental EIS
Eureka and Elko Counties, Nevada

FIGURE

3-3



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U.S. Department of the Interior
Bureau of Land Management
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Elko, Nevada

CARLIN TREND Hg PERCENT OF TOTAL DEPOSITION
NEVADA HYDROGRAPHIC BASINS
CUMULATIVE EFFECTS STUDY AREA
SOAPA Project
Final Supplemental EIS
Eureka and Elko Counties, Nevada

FIGURE

3-4

Depending on where measurements are reported, some scientists believe global mean surface temperatures have increased nearly 1.0°C (1.8°F) from 1890 to 2006 (Goddard Institute for Space Studies 2007). The Intergovernmental Panel on Climate Change (IPCC 2007) and National Academy of Sciences (2006) indicated that by the year 2100, global average surface temperatures could increase 1.4 to 5.8°C (2.5 to 10.4°F) above 1990 levels, but also indicated that there are uncertainties in the modeled results; especially regarding how climate change may affect different regions. Observations and predictive models indicate that average temperature changes are likely to be greater in the Northern Hemisphere. Northern latitudes (above 24° N) have exhibited temperature increases of 1.2°C (2.1°F) since 1900, with nearly a 1.0°C (1.8°F) increase since 1970. Warming during the winter months is expected to be greater than during the summer, and increases in daily minimum temperatures is more likely than increases in daily maximum temperatures. Without additional meteorological monitoring systems, it is not possible to determine the spatial and temporal variability and change of climatic conditions.

Mining operations in the Carlin Trend involve combustion of coal, diesel, propane, and gasoline, all of which contribute to the atmosphere. In Nevada, total emissions from all combustion sources are approximately 56.3 million metric tons per year. Electrical power generation and transportation account for 78 percent of statewide emissions of (NDEP 2008). The TS Power Plant emits about 1.4 million metric tons of annually. Mining in the Carlin Trend represents about 3.5 percent (2.0 million metric tons per year) of total emissions from all sources within Nevada (NDEP 2008). Carbon dioxide is not regulated under any state or federal laws or regulations, and no air quality standard has been developed for this component of atmospheric gas.

The assessment of GHG emissions and climate change is in its formative phase; therefore, it is not yet possible to know with confidence the net impact to climate. The lack of scientific tools designed to predict climate change on regional or local scales limits the ability to quantify potential future impacts

WATER QUANTITY AND QUALITY

Water resources in the Study Area include surface water (streams, rivers, springs, and seeps) and groundwater. Principal drainages include Maggie Creek, Susie Creek, Marys Creek, Boulder Creek, Rock Creek, and Willow Creek – all tributary to the Humboldt River. These sources of surface water support livestock, wildlife, fish, aquatic animals, birds, and vegetation, and are hydrologically connected to groundwater systems.

Use of groundwater from aquifers in the Study Area includes mining, dewatering, municipal, stock water, irrigation, and other uses. Mining operations are the primary user of groundwater resources within the Cumulative Effects Study Area, including milling ore, heap leaching, dust control, and potable supply.

Some mining operations in the Carlin Trend extend below the groundwater table and, therefore, require dewatering wells to maintain water levels below the mine workings. Groundwater in excess of the needs of mine-related operations is discharged to streams, rivers, infiltration/evaporation ponds, injection wells, and irrigation systems. Groundwater management associated with dewatering and discharge activities is conducted under permits administered by the Nevada State Engineer and NDEP.

The Ninth Circuit Court of Appeals concluded that the SOAPA (BLM 2002a) and Leeville (BLM 2002b) EISs and *Cumulative Impact Analysis (CIA) of Dewatering and Water Management Operations for the Betze Project, South Operations Area Project*

Amendment, and Leeville Project (BLM 2000) report provided detailed analyses of cumulative effects associated with mine groundwater pumping. The analysis of water-related cumulative impacts in this Final SEIS tiers to and incorporates by reference those analyses.

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for water quantity and quality encompasses surface water and groundwater in the vicinity of the Carlin Trend, including hydrographic basins that contain mine development areas and receive dewatering water, and areas where groundwater drawdown has occurred and is predicted to expand due to mine dewatering. The basins included in the Study Area are: Susie Creek (No. 50), Maggie Creek (No. 51), Marys Creek (No. 52), Boulder Flat (No. 61), Rock Creek (No. 62), and Willow Creek (No. 63). All of these basins are tributary to the Humboldt River, beginning near the town of Carlin, and extending down-river to the town of Battle Mountain (**Figure 3-5**).

The Study Area for this analysis is the same as the area evaluated in BLM's April 2000 Cumulative Impact Analysis (CIA) report – *"Cumulative Impact Analysis of Dewatering and Water Management Operations for the Betze Project, South Operations Area Project Amendment, and Leeville Project"* (BLM 2000). For that assessment, mine discharges were evaluated from the SOAPA, Betze/Post, Leeville, and Lone Tree mines. The Lone Tree Mine ceased dewatering activities in December 2006 and is therefore not included in this cumulative effects analysis.

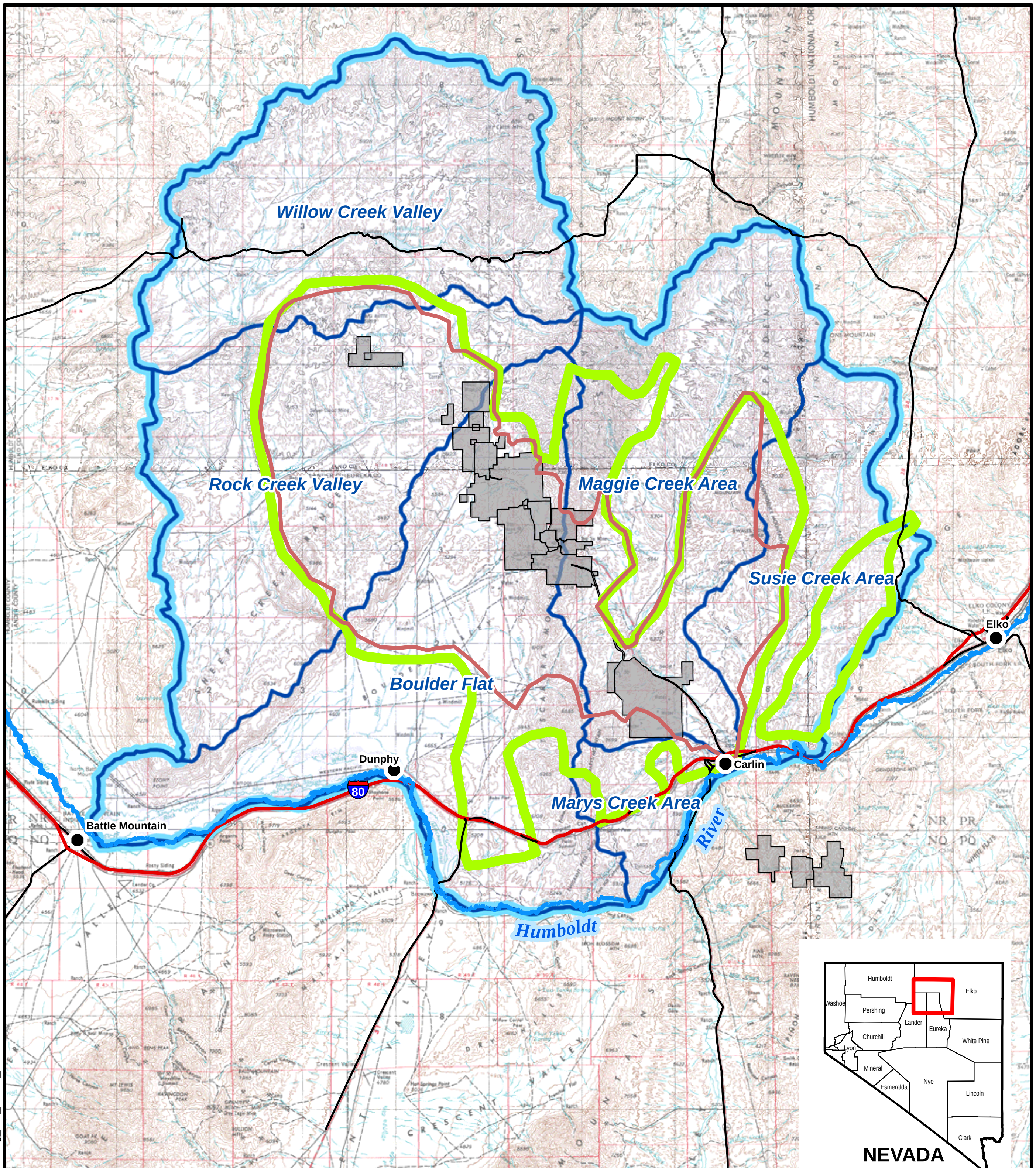
MONITORING DATA AND NEW INFORMATION

Water resources within the cumulative analysis area are monitored by several entities for a variety of purposes. Although most sites are established to monitor impacts from mining, impacts from livestock grazing, wildfires, industrial developments, and agricultural activities are also reflected in the data. Descriptions of the water monitoring sites and activities north of and including the Humboldt River are included in the SOAPA EIS (BLM 2002a), Leeville Project EIS (BLM 2002b), Betze Project Supplemental EIS (BLM 2003), and CIA report (BLM 2000).

The following primary water monitoring plans or programs incorporate monitoring activities for surface water and groundwater in the Carlin Trend area:

- Maggie Creek Basin Monitoring Plan (MCBMP): Since 1989, Newmont has been conducting monthly monitoring of surface water and groundwater in the Maggie Creek Basin related to mining and dewatering at Gold Quarry. The MCBMP, first submitted in 1991, includes measurement of surface water flow, depth to groundwater, and quality characteristics for surface water stations, wells, piezometers, and springs in the Maggie Creek, Marys Creek, Susie Creek, and the southeast portion of Boulder Flat hydrographic basins (Newmont 2009c).

- Leeville Hydrologic Monitoring Plan (LHMP): Since 2003, Newmont has been reporting the results of ongoing monitoring of water resources in the vicinity of the Leeville Project under the auspices of the LHMP. Results of this monitoring program are included in the MCBMP monitoring reports.



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Legend

- Cities
- Humboldt River
- Interstate Highway
- Other Major Roads
- Plan Boundaries
- Hydrographic Sub-basins
- Cumulative Effects Study Area

Area of Predicted Groundwater Drawdown In Water Table Aquifer Due To Dewatering of All Carlin Trend

- Updated 2007 Carlin Trend Model
- CIA Model (BLM 2000)

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Elko District Office
Tuscarora Field Office
Elko, Nevada

WATER QUANTITY AND QUALITY CUMULATIVE EFFECTS STUDY AREA
SOAPA Project
Final Supplemental EIS
Eureka and Elko Counties, Nevada

FIGURE

3-5

h:\Newmont Leeville-SOAPA SEIS\5000 GIS\Projects\SEIS_Figures\Fig_3-2_Water_Resources.mxd

- Boulder Valley Monitoring Plan (BVMP): Since 1990, Barrick has conducted monthly monitoring reported semi-annually of surface water and groundwater in Boulder Valley related to mining activities primarily at the Betze/Post Mine (Barrick 2007a). Surface water monitoring stations are located on Bell Creek, Brush Creek, Antelope Creek, Boulder Creek, Rodeo Creek, and Rock Creek. Groundwater monitoring wells and springs are also included in the Plan. These sites are monitored for surface water flow, depth to groundwater, and/or quality characteristics.

- Spring Survey by Barrick: Annual spring and seep monitoring is performed, characterizing chemistry, flow rates, and vegetation at 35 sites located in the Tuscarora Mountains (AATA International, Inc. 2009).

- Spring Survey by Newmont: Since 1990, Newmont has been monitoring springs and seeps in the same four hydrographic basins mentioned above as part of Gold Quarry Mine monitoring. A total of 33 springs are monitored annually in the fall. Thirteen of these are required by BLM in either the SOAPA Final EIS (BLM 2002a) or Leeville Final EIS (2002b). Monitoring consists of measuring flow and characterizing water quality and general site conditions (Newmont 2009d).

- The BLM Elko District Office has conducted lentic (springs, seeps, and pond) and lotic (streams) assessments at selected grazing allotments in the Carlin Trend and surrounding areas. These assessments primarily address effects of livestock grazing on springs, seeps, ponds, and streams.

All water resources monitoring data are made available in semi-annual monitoring reports submitted by Barrick and Newmont to the BLM, NDEP, and Nevada Division of Water Resources (NDWR). Some surface water stations in the Study Area are maintained by the U.S. Geological Survey (USGS 2009; Newmont 2009c).

Groundwater Quantity

As documented in the CIA report (BLM 2000) and MCBMP (Newmont 2009c), results of groundwater level monitoring show that drawdown has been occurring in a large portion of the Study Area, beginning between 1988 and 1990 for the Betze/Post and Gold Quarry mines. Dewatering at the Leeville Mine began in 2003. Around Leeville, up to 1,000 feet of groundwater drawdown has occurred in the lower plate carbonate rocks, and up to 200 feet of drawdown has occurred in the upper plate siltstone rocks (Newmont 2009c). About 800 feet of groundwater drawdown has occurred in the Gold Quarry Mine area (Newmont 2009c). By the end of mine life, maximum groundwater drawdown due to dewatering is expected to be approximately 1,700 feet in the vicinity of the Betze/Post Mine; 1,400 feet in the vicinity of Gold Quarry Mine (BLM 2002a); and 1,900 feet in the vicinity of Leeville Mine (BLM 2002b).

For the Gold Quarry and Leeville mines, average pumping rates during the six-month period consisting of quarter 2008 and quarter 2009 were approximately 23,000 and 18,000 gpm, respectively (Newmont 2009c). In 2007, average groundwater pumping rates for the Gold Quarry and Leeville mines were 14,000 and 13,000 gpm, respectively (Newmont 2008b). In comparison, the average pumping rate was 11,200 gpm from Gold Quarry in 2000, and 5,300 gpm from Leeville in 2003 (Paine 2007).

For the Betze/Post Mine, the average groundwater pumping rate during quarter 2006 and quarter 2007 was 18,000 gpm (Barrick 2007a).

Not all groundwater pumped for mine dewatering is lost to the water balance of the affected hydrologic basins because a percentage of the pumped water is reinfiltrated. Over 50 percent of pumped groundwater typically is infiltrated for the Betze/Post and Leeville mines, with less than 10 percent of pumped groundwater being subject to infiltration from the Gold Quarry Mine.

Two general areas of water infiltration and groundwater mounding in the Study Area are (1) TS Reservoir area and irrigated fields in the Boulder Valley; and (2) Maggie Creek Reservoir and irrigated Hadley fields in the Maggie Creek Valley. The Leeville and Betze/Post mines contribute to infiltration in Boulder Valley, and Gold Quarry dewatering provides infiltration water in Maggie Creek Valley. Up to 55 feet of groundwater mounding has been documented in the vicinity of the two reservoir sites (HCItasca 2009).

The TS Power Plant is located 3 miles north of Dunphy in the Boulder Valley. Groundwater pumping wells to supply makeup water needs for the plant are located approximately 12 miles north of the Humboldt River in Boulder Valley. Average groundwater pumping for the power plant is approximately 5.3 cfs or 2,400 gpm for its expected 50-year life (HCI 2007).

At the time the CIA report (BLM 2000) was prepared, numerical models were used to predict maximum extent of groundwater drawdown due to dewatering at the Gold Quarry, Betze/Post, and Leeville mines. Since that time, HCI has updated the Newmont model (i.e. Carlin Trend model) every two years, with the most recent update performed in 2009 (HCItasca) 2009). Dewatering associated with the Hollister Development Block Exploration Project (underground exploration decline) has not been included in the numerical models. Dewatering at Hollister ranges from 900 to 1,000 gpm and would not be expected to have a measurable effect on groundwater drawdown in the Study Area. The Hollister Development Block project is located within the area of predicted drawdown resulting from cumulative dewatering on the Carlin Trend (HCItasca 2009).

Using the Carlin Trend numerical flow model, dewatering predictions for years 2009 through 2016 show that the maximum future pumping rate for the Gold Quarry Mine would be about 17,500 gpm (HCItasca 2009). Similarly, the predicted maximum future pumping rate for the Leeville Mine through year 2019 would be about 24,000 gpm (HCItasca 2009).

Surface Water Quantity

Surface water flow in the Humboldt River and area streams can potentially increase due to mine discharges of excess dewatering water, or decrease due to dewatering activities that intercept groundwater that normally recharges these water bodies. Since 2000, flow rates for streams and the Humboldt River have remained within natural fluctuation ranges. Surface water flow hydrographs for Antelope, Bell, Boulder, Brush, Rock, and Rodeo creeks are presented in the Boulder Valley Monitoring Plan (Barrick 2007a). Hydrographs for gaging stations on the Humboldt River, Maggie Creek, Susie Creek, and Marys Creek are provided in the MCBMP (Newmont 2009c). No discharges of mine dewatering water to the Humboldt River via the Boulder Valley conveyance system have occurred since February 3, 1999.

Based on the CIA report (BLM 2000), a total of approximately 537 springs were identified within the predicted cumulative groundwater drawdown area in the Study Area. Of these, 186 springs were predicted to not be affected because they were located above 6000 feet amsl. Approximately 182 springs are located in areas where perennial surface water flow is predicted to be impacted by dewatering and drawdown of the groundwater table. Currently, 33 of these springs/seeps are monitored by Newmont (2009d) in the vicinity of the Gold Quarry and Leeville mines, and 35 springs/seeps are monitored by Barrick (AATA 2009) in the vicinity of the Betze/Post Mine. Most of these springs have been monitored annually or more frequently starting in the early 1990s. Initial surveys included a spring and fall sampling event; however, most spring/seep monitoring is now conducted only in the fall. All surface water monitoring results are provided to the BLM, NDEP, and NDWR in semi-annual or annual reports.

Surface water rights, including springs, within the Study Area are described in the SOAPA EIS (BLM 2002a), Leeville Project EIS (BLM 2002b), and CIA report (BLM 2000). Primary uses for surface water are stock watering, municipal, irrigation, and domestic. According to the CIA report (BLM 2000), a total of 121 surface water rights were recorded for the Study Area. Of these water rights, four notifications of public water reserve were filed for springs under the 1926 Executive Order, Order of Withdrawal, Public Water Reserve No. 107 (PWR 107). These four springs are located outside the area of predicted groundwater drawdown and are not expected to be affected by mine dewatering activities.

The Humboldt River adjudication appropriated water tributary to the Humboldt River. The Humboldt River was adjudicated under the Bartlett (October 20, 1931), Edwards (October 7, 1935), and the Nevada State Supreme Court (December 7, 1937) decrees.

Groundwater Quality

Assessment of the effects of Gold Quarry and Leeville mine operations on groundwater quality are provided by monitoring data generated by sampling and analyzing water samples quarterly from monitoring and dewatering wells at the Newmont mines. These results are reported semi-annually in accordance with Newmont's Maggie Creek Basin Monitoring Plan (Newmont 2009c). Similarly, monitoring wells in the vicinity of the Betze/Post Mine are sampled and analyzed quarterly by Barrick as part of its Boulder Valley Monitoring Plan (Barrick 1990), with data reports submitted semi-annually to the agencies.

With the exception of arsenic in bedrock units, groundwater concentrations of all parameters generally are below Nevada's primary drinking water standards. Groundwater quality analytical results obtained quarterly for wells remain virtually unchanged at Gold Quarry, Leeville, and Betze/Post mines, with no discernable trend establishing degradation of water quality due to mining or other activities (Newmont 2009c; Barrick 2007a). Elevated arsenic concentrations in groundwater from some bedrock wells in the Study Area represent naturally occurring concentrations in deep mineralized zones.

Surface Water Quality

Surface water quality samples collected quarterly in the Study Area, with analytical results submitted semi-annually, remain virtually unchanged with no discernable trend establishing degradation of water quality due to mining or other activities (Newmont 2009c; Barrick 2007a).

The Humboldt River and several tributary streams in the Study Area are listed as impaired on the EPA's 2006 303(d) list of impaired water bodies (NDEP 2009b). With respect to the Study Area, the Humboldt River is designated as impaired from Palisade to Battle Mountain, with the pollutants of concern listed as iron and turbidity. Maggie Creek is listed for phosphorus (upper creek) and pH (lower creek); and Willow Creek is listed for temperature (NDEP 2009b). To date, NDEP (2009b) has established Total Maximum Daily Loads (TMDLs) for total phosphorus and total suspended solids for the Humboldt River from Palisade to Battle Mountain.

CUMULATIVE EFFECTS

Cumulative effects on water resources can result from: (1) mine dewatering; (2) discharge of excess mine water; (3) land disturbance; (4) development of pit lakes; (5) grazing activities; (6) replacement of riparian/wetland plant communities with invasive non-native plants; and (7) wildfires. These activities can affect surface water and groundwater quantity and quality in the Study Area (BLM 2000).

Water Quantity

Newmont's Gold Quarry and Leeville projects and Barrick's Betze/Post and Meikle mines account for most of the dewatering projected to occur in the foreseeable future in the Study Area. The combined cones-of-depression in groundwater created by dewatering would create additive effects in regional groundwater drawdown.

Numerical groundwater models used to predict the maximum extent of cumulative groundwater drawdown, and results of those models, are included in the CIA report (BLM 2000), and in EIS documents for SOAPA and Leeville (BLM 2002a, 2002b). The Carlin Trend groundwater model is calibrated every two years and updated using more recent hydrologic data. The most recent model update (HCItasca 2009) shows that the maximum extent of the predicted 10-ft drawdown contour line or isopleth due to all Carlin Trend dewatering will be smaller than those predicted previously for the SOAPA EIS (BLM 2002a), Leeville Project EIS (BLM 2002b), and the CIA report (BLM 2000). The 10-ft drawdown line for the 2009 model, however, is similar to results from the 2007 and 2004 Carlin Trend model runs (HCItasca 2009).

Figure 3-5 shows the maximum extent of 10-ft drawdown depicted for the Carlin Trend and the updated modeled drawdown area presented by HCItasca (2009). The reduced size of the updated groundwater drawdown area predicted by the 2009 model as compared to the 2002 SOAPA EIS model is primarily in the northern portion into the Tuscarora Range (north of Leeville Mine) and in the southern portion across Marys Mountain (south-southwest of Gold Quarry Mine).

As previously mentioned, dewatering from the Hollister Development Block Project (underground decline) has not been included in the groundwater models; however, the effect of this relatively low dewatering rate (900 to 1,000 gpm) would not have a measurable influence on cumulative groundwater drawdown in the Study Area.

Surface Water Flows

Few surface water flow impacts (including those to streams, rivers, and springs) resulting from mine dewatering in the Study Area have been documented in over 15 years of monitoring (Newmont 2009c; Barrick 2007a). As discussed in the CIA report (BLM 2000), flow in some stream reaches could be reduced as a result of mine-induced drawdown, including lower Maggie Creek, lower Marys Creek, lower Susie Creek, Rock Creek, and Boulder Creek.

The most recent groundwater model update by HCItasca (2009) shows the following predicted effects on the Humboldt River and tributary streams in the Study Area due to all Carlin

Trend mine dewatering; no effect on base flows is predicted for the upper reaches of Susie and Marys creeks:

- Less decrease of base flow in Marys Creek, Maggie Creek, and the Humboldt River than was predicted for the SOAPA EIS (BLM 2002a).

- Lower Maggie Creek impacts are similar to those predicted during the SOAPA EIS. During mining operations at Gold Quarry, base flow would increase due to dewatering discharge, varying from about 3 to 35 cubic feet per second (cfs). After this period of discharge, natural base flow conditions of no flow would resume near the Humboldt River.

- In upper Maggie Creek between Jack Creek and the upper end of Maggie Creek Canyon, the 2009 Carlin Trend model predicts a maximum decrease of 0.5 cfs in about year 2045. The SOAPA EIS model had predicted a maximum decrease in upper Maggie Creek base flow of 0.6 cfs.

- Magnitude of decreases in lower Susie Creek flow are identical to those predicted for the SOAPA EIS, but the length of time that mine dewatering may affect lower Susie Creek has been extended by 20 years, with no base flow occurring between 2030 and 2090.

- Marys Creek is predicted to have a smaller decrease in base flow than was predicted for the SOAPA EIS (base flow reduction of up to about 1 cfs between years 2040 and 2050, compared to a predicted reduction of about 1.7 cfs for the SOAPA EIS).

- Beaver Creek base flow is predicted to have a decrease similar to that predicted in the Leeville EIS; the decrease is relatively minor (0.05 cfs).

- Base flow in the Humboldt River at Dunphy would decrease by a maximum of 3.4 cfs after cessation of mine dewatering in the Carlin Trend in year 2043; this is a reduction of impact previously predicted for the SOAPA EIS (predicted base flow reduction of about 4.9 cfs) and the BLM CIA report (predicted reduction of about 8 cfs). The long-term decrease in base flow between the Carlin Tunnels and Dunphy gages is predicted to be about 1.1 cfs. As previously discussed, Humboldt River base flow will increase during periods of excess mine water discharges to the river.

To date, surface water flow impacts resulting from mine dewatering have not been documented in over 15 years of monitoring with the following previously documented exceptions:

- Brush Creek: Reduced flow and drying of springs and stream flow, and effects on vegetation have been noted along portions of Brush Creek since 1993 (BLM 2000). Brush Creek is a tributary of Rodeo Creek in the Boulder Valley.

- Maggie Creek at Narrows: Beginning in the 1990s, dewatering associated with the Gold Quarry has affected flows in the narrows of Maggie Creek (BLM 2002a), with continuing reductions in observed flows (Newmont 2009c).

- Susie Creek: At the USGS gage above its confluence with the Humboldt River, Susie Creek flow decreased during the last quarter of 2008 and first quarter of 2009 (Newmont 2009c).

Trigger values for in-stream flow volumes that would require augmentation of flow as defined in mine site mitigation plans have not been reached to date, and therefore, no augmentation of in-stream flow has been required. Adverse effects to some surface water rights may occur if flow reductions occur in Study Area streams and/or the Humboldt River.

Predicted groundwater withdrawals for the TS Power Plant are not expected to have a measurable change on Humboldt River flows (ENSR 2004a; HCI 2007). A model performed by HCI (2007) shows a predicted decrease of 0.24 cfs or 110 gpm in Humboldt River flow between the Palisades and Battle Mountain gages due to pumping for the power plant. Average groundwater pumping for the power plant is approximately 5.3 cfs or 2,400 gpm for its expected 50-year life (HCI 2007).

Spring/Seep Flows

Based on the CIA (BLM 2000), a total of 182 springs in the Study Area are located in areas where surface water flow could potentially be impacted by mine dewatering in the Carlin Trend. Review of flow data indicates no substantial change in flow rates for 29 of the 33 springs currently monitored by Newmont in the vicinity of the Gold Quarry and Leeville mines. Four springs have exhibited variation in flow, reduction in flow, or have gone dry for one or more years. Groundwater monitoring at established "trigger" wells has not indicated any drawdown from mine dewatering operations in the direction of these springs (Newmont 2009c, 2009d). Hydrologic investigations have identified grazing, evolving streambed morphology, and anthropogenic flow controls as the primary factors influencing flow measurements at these springs.

Monitoring by Barrick for the Betze/Post Mine area indicates that four of the 23 springs monitored within the Study Area are consistently dry, and one spring shows decreased flow rates (AATA 2009).

It is expected that fewer springs/seeps could potentially be affected by cumulative groundwater drawdown than were originally identified in the CIA report (BLM 2000). All springs and seeps determined as being potentially affected by groundwater drawdown are located below an elevation of approximately 6,000 feet. The updated numerical groundwater flow model (HCItasca 2009) shows a smaller projected drawdown area as compared to the 2002 SOAPA EIS version of the model. The areas eliminated from predicted groundwater drawdown in the more recent versions of the model are located south-southwest of the Gold Quarry Mine (Marys Creek, James Creek, and Welches Creek areas), and north of the Leeville Mine (west of upper Maggie Creek) (HCItasca 2009).

Of the seeps and springs that could potentially be impacted from cumulative drawdown, analysis of the groundwater drawdown model projected that five of these springs may be incrementally impacted by SOAPA dewatering (BLM 2002a). No incremental impact to springs/seeps would occur as a result of mine dewatering at Leeville (BLM 2002b). None of the five springs potentially impacted by SOAPA would qualify as a PWR 107 water right since four of the springs occur on private land, and the water right for the remaining spring pre-dates PWR 107. Additionally, both Barrick and Newmont have obligations to mitigate loss of flow from mine dewatering at selected springs/seeps in the cumulative drawdown area.

Groundwater Levels

As previously discussed, the most recent groundwater model update (HCItasca 2009) shows that the maximum extent of the predicted 10-ft drawdown isopleth due to all

Carlin Trend dewatering is similar to the model predictions in 2004 and 2007, and smaller than predicted by the Carlin Trend model for the 2002 SOAPA EIS (**Figure 3-5**).

Continued mine dewatering at Gold Quarry through year 2016, Betze/Post through 2015, and Leeville through 2019 will result in continued expansion of the cumulative groundwater cone-of-depression beyond its current configuration (HCItasca 2009). The rates of groundwater drawdown from 2000-2009 are generally less than rates that occurred during early stages of dewatering prior to 2000. Prior to 2000, Carlin Trend pumping rates typically were higher in order to achieve sufficient lowering of the groundwater table to keep the advancing mine pits and underground workings relatively dry.

Dewatering at the Gold Quarry Mine started in 1992; whereas, dewatering at Betze/Post was initiated in 1990. Dewatering at Leeville did not start until 2003; however, groundwater in this area was already being lowered at that time due to the nearby Betze/Post Mine operations.

Maximum groundwater drawdown resulting from pumping at the TS Power Plant in Boulder Valley is predicted to be about 19 feet by year 2057. Average pumping rate for power plant makeup water is about 2,400 gpm from wells located in Boulder Valley (ENSR 2004b).

To date, groundwater drawdown measured in piezometers MK-1, MK-2, and CV-10, located north of SOAPA in alluvium or valley fill deposits (*i.e.*, Carlin Formation), has occurred gradually over the period of record (since 1993). Total water level decline in these piezometers has been less than 15 feet. No other drawdown trends have been recorded in valley fill deposits.

Impacts to groundwater rights associated with wells may occur where water levels decline such that water yield is reduced or a pump must be lowered to keep it in water. Water rights are administered and protected by the State Engineer.

Water Quality

Runoff and drainage from waste rock storage facilities, leach pads, tailing impoundments, process ponds and other mine-related facilities could potentially impact both surface or groundwater quality in the Study Area. To date, with the exception of the Hollister Development Block Project, none of the water monitoring stations in the Study Area has reported evidence of acid-rock drainage or elevated levels of metals. The South overburden stockpile at Hollister has generated acid in the past. Conditions that created the acid drainage have been addressed through a combination of improved surface water control measures that divert water that once reported, in part, to the stockpile, re-contouring to maximize shedding meteoric water, incorporating lime into cover material used to cap the stockpile, and installation of a collection and treatment system. Residual flow from the stockpile has elevated sulfate levels; this water reports to a constructed wetland where the water is consumed.

Acid-rock drainage has occurred at refractory ore stockpiles at Newmont's South Operations Area. This drainage is captured and used in ore processing. Refractory ore stockpiles may be a source of acid drainage over the life of the operation, but these stockpiles will be removed prior to project closure and, therefore, have a relatively short-term potential for producing acid drainage. Runoff or drainage from permanent facilities in the Study Area is unlikely, primarily due to encapsulation of any identified potentially acid producing rock. Future impacts to surface water would likely be recorded at one of the many water quality monitoring sites within the Study Area. Monitoring results are presented in Water Pollution Control Permits (Newmont 2007g; Barrick 2007c), Maggie Creek Basin Monitoring Plan (Newmont 2009c), and Boulder Valley Monitoring Plan (Barrick 2007a) reports.

Erosion of mine-related land disturbances can result in increased sedimentation to surface water bodies in the Study Area. All mine projects have storm water permits that incorporate best management practices (BMPs) to control erosion and capture runoff from disturbed areas. No data have been collected to quantify sediment loss from mine areas. NDEP conducts regular inspections of sediment control systems to ensure compliance with storm water permits. Reclamation of disturbed areas during and after mining will manage potential long term erosion and sedimentation from mine sites.

Wildfires and flooding, especially between 2001 and 2006, have resulted in impacts to Maggie and Susie creek basins including short-term increases in erosion and sedimentation to nearby surface water drainages. Other water quality impairments specified in Nevada's 2006 303(d) list of impaired water bodies (NDEP 2009b) for Maggie Creek (phosphorus and pH), Willow Creek (temperature), and the Humboldt River (iron and turbidity). To date, NDEP (2009b) has established TMDLs for total phosphorus and total suspended solids for the Humboldt River from Palisade to Battle Mountain.

Impacts to water quality within the Study Area also occur as a result of agricultural use. Grazing along stream corridors can result in a loss of bank stability, erosion, and sedimentation. Impacts to water quality include increasing suspended solids and turbidity, increasing temperature, decreasing riparian vegetation, and a variety of other effects (see *Riparian Areas and Wetlands* section in this chapter). Diversion of water for irrigation also potentially impacts water quality by increasing water temperature, as well as introducing a number of agricultural contaminants via return flow.

Other non-mining land uses such as recreation and transportation also contribute cumulatively to water quality impacts. These activities add to surface disturbance which increases potential of erosion and sedimentation of surface water resources.

Development of mine pit lakes and saturation of underground mine workings after cessation of mining have the potential to cumulatively impact groundwater quality in the Carlin Trend. Concentrations of total dissolved solids, sulfate, nitrate, and some metals may be elevated, at least in the short-term, for water that comes into contact with some mine pit walls and underground workings. These water quality conditions can be quite variable, depending on local conditions, including rock type, mineral composition, exposure to weathering, amount of rock submerged below the water surface, presence of potentially acid-generating rock, chemical equilibrium conditions, and pit lake turn-over. Comprehensive monitoring of evolving pit lake chemistry will be conducted by the mine operators.

Pit lakes that ultimately develop in the Gold Quarry and Betze/Post pits are not expected to discharge to ground surface and, therefore, would not directly affect surface water quality. Additionally, these pit lakes are expected to be long-term hydraulic sinks due to high evaporation rates and relatively low groundwater inflow rates when filled, thereby preventing potential impacts to surrounding groundwater quality.

For the Study Area, inflowing groundwater to pit lakes typically have sufficient alkalinity to maintain neutral pH conditions for the long-term (*i.e.*, high buffering capacity). In addition, most underground workings will be backfilled with cemented rock aggregate consisting of neutral or acid-neutralizing material. Evaporation from the pit lake surface generally would concentrate levels of total dissolved solids, sulfate, and other major ions in the water. Precipitation of ferric hydroxide in pit lakes, however, acts to continually remove some metals from solution.

Geochemical modeling conducted to predict the quality of water that would ultimately remain in the Gold Quarry pit indicated that the water quality would be of similar quality to existing groundwater in the vicinity of the pit (Geomega 2001). The quality of the water would be influenced by carbonate rock exposed in the pit that would buffer development of acidic conditions; removal of a large portion of the mineralized zone due to mining would reduce the amount sulfides that would be exposed in pit walls; and adsorption and deposition of trace metals on ferric hydroxides would reduce the concentration of trace metals in pit lake water. Pit lake water is predicted to be alkaline with cadmium and selenium exceeding the 96-hour average aquatic life standard but not exceeding the 1-hour standard. Molybdenum is predicted to exceed both standards. The Gold Quarry pit is expected to have an ultimate pit depth of 1,370 feet with a lake surface elevation of 5091 feet amsl. The pit lake is expected to require 150 years to form to this level with 95 percent of this recovery occurring in the first 60 years after cessation of dewatering (HCI 1999).

Geochemical modeling by Geomega (2007) predicts that the Tara pit lake would have a near-neutral pH, arsenic concentrations less than influent groundwater, and antimony concentrations less than the Nevada municipal domestic supply standard. The lake will not form until around year 2136 and will have consistently good water quality, comparable to existing groundwater in the Carlin Trend.

A study of the Betze/Post pit lake predicts that water would have a near-neutral pH, with the possible exception of acidic conditions during the early period of pit lake filling (BLM 2003). Also for the Betze/Post pit lake, concentrations of total dissolved solids, sulfate, and antimony are predicted to exceed drinking water standards (BLM 2003).

Pit lakes are not intended to be used for drinking water (humans and livestock), recreational swimming, or fisheries. Therefore, water quality standards for drinking water, livestock use, recreational use, and aquatic life are generally not applicable to pit lakes. These water bodies, however, could be accessed by waterfowl and wildlife. An evaluation of potential impacts to these receptors for the Betze/Post pit indicates that ingestion of pit lake water by waterfowl or wildlife would not result in adverse effects (BLM 2003).

Restoration Projects

Water quality improvements due to stream and habitat restoration efforts are documented in the site monitoring programs and reports. An example is total suspended solids (TSS) versus stream flow in Maggie Creek, where TSS has been lowered over time, likely as a result of re-vegetation and stabilization of stream banks. This in turn, improves habitat quality for aquatic life and sediment sensitive species such as Lahontan cutthroat trout.

Improvement and expansion of riparian/wetland in the Maggie Creek drainage due to the Maggie Creek Watershed Restoration Project has occurred since implementation of the program. Development of healthy, well-developed riparian zones in the Maggie Creek drainage has slowed water and dissipated energy during periods of high flow (Trout Unlimited 2007b), resulting in capture of sediment, development of floodplains, and overall habitat improvement. Reduced sediment loads reflect improved filtering capacity of a healthy, well-established riparian zone. Flooding in 2005 and 2006 caused erosion of streams throughout the Study Area; however, habitat improvements in the Maggie Creek drainage tended to moderate impacts.

The Upper Willow Creek Habitat Enhancement Plan area (including Willow, Lewis, and Nelson Creeks) is within the vicinity of, but external to, the area of potential impact from mine dewatering (CCA 2004). This Habitat Enhancement Plan has resulted in a watershed with improvements for aquatic organisms and sediment levels in the Willow/Rock Creek drainage (CCA 2004). Setbacks were experienced in 2005 and 2006 due to range fires and flooding.

Ruby Pipeline Project

Potential impact to surface water would result from temporary increase in sediment during in-stream construction of the Ruby Pipeline. Construction during low/no flow periods would minimize sedimentation and turbidity, streambank and bed disturbances, and limit the time it takes to complete in-stream construction.

Construction of the Ruby Pipeline would involve excavation of a trench to a typical depth of six feet and have no effect on groundwater resources in the Study Area.

Hydrostatic testing of the pipeline would be in accordance with applicable water withdrawal and National Pollutant Discharge Elimination System (NPDES) permits.

SOIL RESOURCES

Information on soil resources in the Study Area is developed on a project specific basis through soil surveys. Surveys include various levels of intensity depending on whether a specific tract of land is to be disturbed by proposed mine development. Soil survey information is described in a Plan of Operations submitted by mine applicants and includes the texture of the soil, depth or thickness, chemistry (including organic matter content), coarse fragment content, aerial extent of each soil type (map), and suitability rating of the soil for reclamation.

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for soil resources encompasses the Carlin Trend and watersheds that drain the Carlin Trend to the confluence with the Humboldt River. This Study Area is based on natural and manmade impacts to soil resources that result in soil movement or loss, soil fertility and productivity, and areas where additive effects of soil movement could impact other resources (e.g., surface water). The Study Area for Soil Resources is shown on **Figure 3-6.**

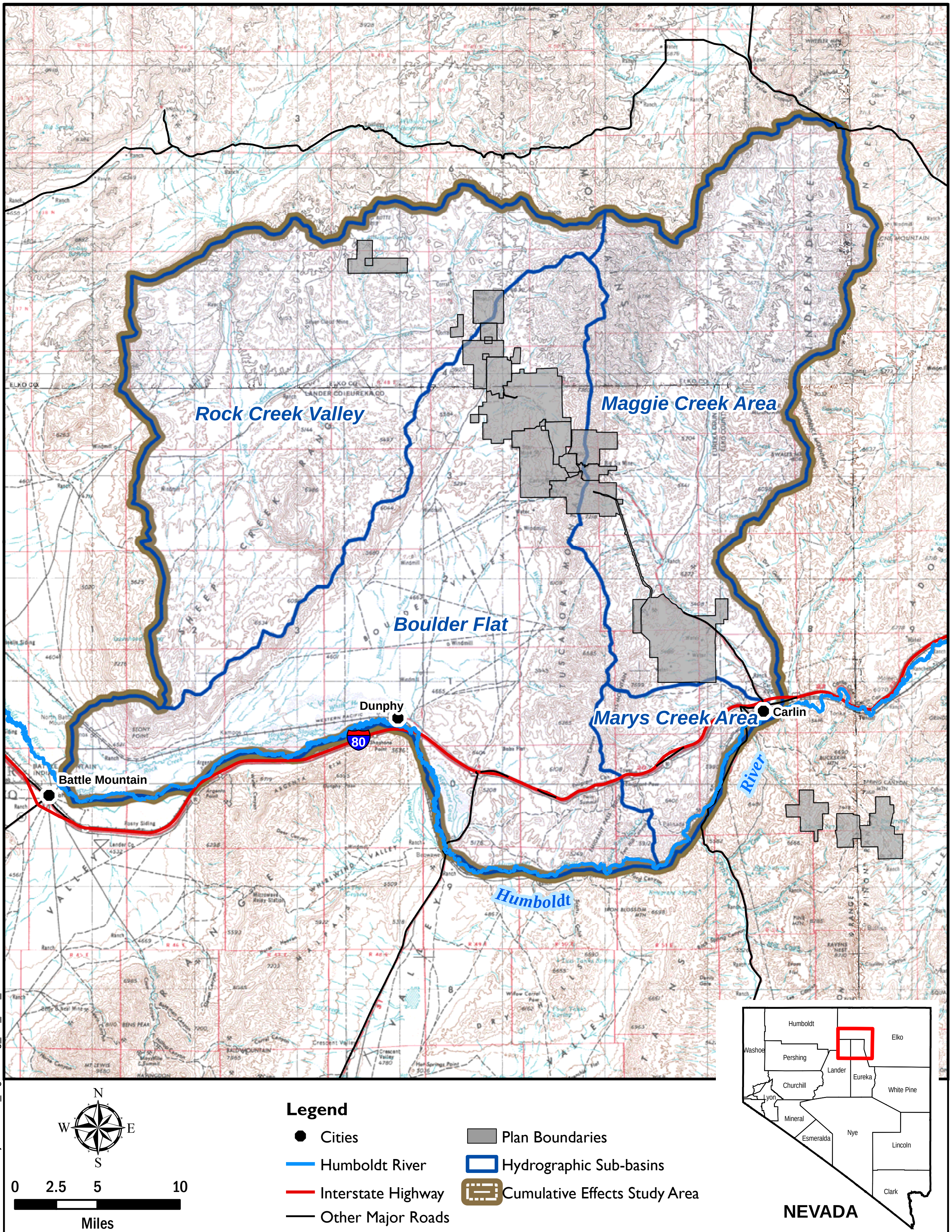
MONITORING DATA AND NEW INFORMATION

Additional soil data have been collected in the Study Area since 2002 in association with the TS Power Plant located in Boulder Valley.

TS Power Plant

The majority of soil located in the 600-acre TS Power Plant site is mapped as Dunphy, which is a silt loam that varies between slightly saline to strongly saline. This soil is usually in excess of 60 inches deep, moderately well-drained, and has a slight to moderate water and wind erosion hazard (USDA 1980).

Other soil types that would be affected by the power plant development range in texture from silty clay to loams to silty loam to gravelly and fine sandy loams. These soil types include non-saline to strongly saline and alkali. Soil depths range from 12 to 60+ inches.



U.S. Department of the Interior
Bureau of Land Management
Elko District Office
Tuscarora Field Office
Elko, Nevada

SOIL RESOURCES
CUMULATIVE EFFECTS STUDY AREA
SOAPA Project
Final Supplemental EIS
Eureka and Elko Counties, Nevada

FIGURE

3-6

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CUMULATIVE EFFECTS

Soil resources are cumulatively impacted through disturbance and/or removal by mining, fire, agriculture, recreation, and a variety of other natural and man-caused activities within the analysis area. These impacts are described in terms of the type of impact and the number of acres affected. Consideration is also given to the amount of those acres which are likely to be reclaimed.

Tables 2-1 and **2-3** in Chapter 2 – *Mine and Mineral Development,* provide information on past, present, and reasonably foreseeable activities in the vicinity of the Carlin Trend. Mining and livestock grazing are expected to continue as major activities in the Study Area and impacts to soil resources from wildfire in the area would also continue to occur. Impacts from these activities include loss of soil productivity due to changes in soil physical properties, soil fertility, soil movement in response to water and wind erosion, and loss of soil structure due to compaction

In addition to mining activities in the Study Area, several years of major wildfires have occurred, creating additional regional impacts to soil. Burned areas with damaged or destroyed vegetation are susceptible to soil erosion by wind and water. Emergency and remedial seeding has taken place in order to minimize soil erosion and stabilize surfaces. An undetermined amount of soil has eroded into drainages and waterways as a result of fire. Movement of soil from burn areas is dependent on weather conditions, duration of exposure, and success of seeding efforts to establish vegetative cover.

Mine construction and development practices in the Study Area include salvage and stockpile of soil for use in reclamation. Topsoil stripping occurs immediately following clearing and grubbing of the surface area and therefore, the time period between exposure of bare mineral soil to wind and water erosion is minimized. Soil movement is most evident from stockpiles of soil prior to establishment of cover crops. Once cover crops are established, soil movement from the surface of stockpiles is minimized. Also, standard practice is to install berms at the toe of each stockpile to collect soil that may move from the face of the stockpile. This soil is captured and is returned to the stockpile; resulting in minimal loss of soil.

Similarly, redistribution of soil during reclamation is a period of time where wind and water erosion can initiate soil movement. This time period is prior to establishment of vegetation on the reclaimed area. Standard practice in the mining industry is to use best management practices to control and minimize sediment movement until vegetation is established. Best management practices allow soil to be captured and returned to the reclaimed area minimizing soil loss.

Reclamation associated with past mining disturbance and future restoration activities would mitigate soil movement and productivity loss. Soil salvaged and used in reclamation would become viable and is expected to return to pre-mining productivity once vegetation is established. Seeding and revegetation of areas that have been burned will reduce soil movement and loss.

Data that quantify cumulative soil movement that result in soil loss in the Study Area from all land surfaces (mine areas, burn areas, grazing areas) are not available. As described above, soil movement in response to any of the land disturbing activities or phenomena are site specific, weather dependent, and subject to response to the timing and success of rehabilitation efforts.

VEGETATION RESOURCES

The cumulative effects discussion for vegetation focuses on changes in dominant plant communities that effect habitat for wildlife (*i.e.*, sagebrush/grasslands). Wildfires combined with displacement of native species by invasive annual grasses are the primary factors that have altered the structure, composition, and ecology of plant communities in the Study Area. One species of sensitive plant that may be present in the Study Area, Lewis buckwheat, is addressed.

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for vegetation encompasses the Carlin Trend and extends north and east to include mule deer and pronghorn antelope seasonal habitats. The Study Area includes past, present, and reasonably foreseeable mining developments in the Carlin Trend and includes a contiguous area that provides crucial seasonal habitat for mule deer, a species of concern because of loss of habitat associated with cumulative impacts on vegetation from wildfires.

MONITORING DATA AND NEW INFORMATION

Data and discussions of vegetation resources in the Study Area prior to 2002 are available in the SOAPA EIS (BLM 2002a) and Leeville Project EIS (BLM 2002b). Since 2002, mining operations in the Study Area have resulted in an additional 7,800 acres of surface disturbance. To date, approximately 1,920 acres have been reclaimed. Of these acres, reclamation bond has been released on 833 acres; the remaining acreage is pending review for bond release. Mining related disturbances are shown in **Table 2-1** in Chapter 2.

Since 1999, wildfires have burned nearly 942,000 acres of sagebrush and grassland habitat as shown on **Figure 2-4**. Areas damaged by wildfire and efforts to mitigate effects of fire are described in Chapter 2 – *Wildfires and Reseeding*.

CUMULATIVE EFFECTS

The primary past, present, and reasonably foreseeable changes that have affected vegetation in the Study Area include wildfires, mining and exploration activity. Existing mining and exploration projects are listed in **Table 2-1** and reasonably foreseeable mine development in the Carlin Trend from 2010 to 2020 is shown in **Table 2-3**.

Reclamation of mine-related disturbance in the Study Area will be incremental as various operations reach the end of mining and begin closure activities. Approximately 33,500 acres of mine disturbance is permitted or has occurred within the Study Area, of which about 7,800 acres would remain as open pits; some pits would be partially filled with water. Approximately 25,700 acres would be reclaimed to pre-mining conditions (BLM 2010a). Areas affected by mining on public land will be reclaimed to BLM standards and monitored to assess success of reclamation.

Vegetation on reclaimed areas likely would be dominated by grasses with low densities of native forbs and shrubs. Typically, communities of big sagebrush, the most extensive pre-mining plant community, have proven difficult to re-establish on reclaimed land (Schuman and Booth 1998; Vicklund *et al.* 2004). Establishment of big sagebrush on reclaimed land has been shown to benefit from application of mulch, inoculation with *arbusucular mychorrizae*, reduced competition with herbaceous species (lower seeding rate of grasses and forbs), and direct-placed topsoil (Schuman and Booth 1998). *Arbuscular mychorrizae* are soil fungi that form a symbiotic relationship with roots of sagebrush and other plants, which improves drought tolerance. *Arbuscular mychorrizae* are lost when topsoil and other growth media are stockpiled.

Most reclamation plans do not specify measures that favor establishment of big sagebrush over herbaceous species; consequently, plant communities that develop on reclaimed land would likely be dominated by herbaceous species. Once a dense cover of herbaceous species has developed, it is unlikely that natural colonization by big sagebrush would successfully increase sagebrush densities to pre-mining levels. Sagebrush seedlings do not compete effectively with grasses and forbs. Mitigation measures to enhance re-establishment of sagebrush would increase the density of sagebrush on reclamation sites and decrease the time required to establish sagebrush communities comparable to pre-mining levels.

Although post-mining vegetation may have fires within the Study Area is more pronounced because of the increased size and intensity of recent wildfires.

The general effect in some areas of recent fires has been conversion of primarily sagebrush habitat to expanses of cheatgrass, which form a persistent, non-native, monoculture that dominates some burned areas. The continued establishment of cheatgrass will increase the likelihood of wildfire, and could change the fire regime, community composition, and structure of plant communities indefinitely. Locally and regionally, wildfires have reduced the density of shrubs and trees. Many of the woody species in the area are slow growing, requiring 15 to 20 years to re-establish.

Reseeding within the Study Area (see Chapter 2 – *Wildfires and Reseeding*) will improve vegetation structure and composition in burned areas and benefit wildlife by providing forage, cover, and nesting habitat. Large areas affected by fire may take years to re-establish native lower densities of sagebrush and other shrubs than pre-mining vegetation, it is likely that stable and self-sustaining plant communities would develop on reclaimed land. Ross (2000) reports that successful revegetation is the norm even in the driest, hottest parts of Nevada and there is no area in the state where perennial native species have not been re-established after mining, at a cover and density equal to or greater than that of undisturbed areas.

Disturbed sites and recently seeded areas are candidates for invasion by undesirable species such as noxious weeds and cheatgrass. Aggressive revegetation and weed control programs are being implemented to prevent establishment of weed infestations on reclaimed sites.

Wildfires will continue to be a major factor in replacement of shrub communities by grass-dominated communities, often with a high cheatgrass component. The cumulative effect of vegetation. Completed and planned sagebrush and forage planting in burned areas will benefit a diversity of wildlife species including mule deer, pronghorn, sage grouse, and pygmy rabbit by providing forage, cover, and breeding habitat.

Livestock grazing has and will continue to influence vegetation composition and structure throughout the Study Area. Potential for overgrazing may increase as land is converted to mining and transportation uses or temporarily lost to wildfire; however, adjustment of stocking rates to account for changes in land use ensures vegetation communities are not overgrazed (see *Grazing Management and Agriculture* in this Chapter). Within the Study Area, reductions in permitted grazing use has and will continue to occur as a result of mine development and wildfires; however, these impacts will be short term as subsequent reclamation of mined areas and restoration of burned sites will allow for stocking rates to return to near pre-mining/pre-burn levels.

Special Status Species

Lewis' buckwheat (*Eriogonum lewisii*) is the only sensitive species with suitable habitat in the Study Area; although it has not been documented on any sites affected by mining. The plant occurs on dry, open ridges at elevations of 6,470 to 9,720 feet (Morefield 1996). Mining activities in the Carlin Trend occur below the elevation range of this plant and have not affected it or its habitat. Widespread wildfires could pose a risk to this species; however, habitat on which it occurs does not usually support intense fires that would harm this plant.

Invasive, Non-native Species

Cumulative effects on invasive and non-native species result from wildfire, livestock use, and mining disturbance. Grazing, while reduced to accommodate conversion of rangeland to active mine operations or as a result of wildfires, will continue in the area. Continued mine exploration and expansions and wildfires open niches for invasive plant colonization and provide a means of seed transport along roadways and trails. With continued activities that disturb soil and vegetation, the potential for areas to be colonized by noxious weeds and other invasive species will increase.

An estimated 8,000 acres on public and private land within the Study Area are infested with Scotch thistle, while more than 1,000 acres are affected by hoary cress (short white top). Smaller infestations of Russian knapweed and Canada thistle are scattered along roads and drainages. The McCann Creek drainage in the northern portion of the Tuscarora Mountains is experiencing an epidemic of hoary cress spreading into creek bottoms and uplands. The spread of weeds results in displacement of native vegetation vital to wildlife (Coca 2007).

Treatment programs to control noxious weeds are being implemented by BLM and private land owners. Since 2002, BLM has treated approximately 2,500 acres of Scotch thistle annually. Since 2005, Newmont has treated approximately 5,500 acres for Scotch thistle, salt cedar (tamarisk), and hoary cress. Treatment areas ranged from the Bootstrap Mine in the North to the Rain Mine in the South (Basin Tree Service and Pest Control, Inc. 2005, 2006, 2007). There was no treatment for invasive, non-native species in 2008. In 2009, approximately 7 acres were treated for whitetop. Future treatment for invasive, non-native species is expected to be similar too previous years.

While area ranches and mines are applying both chemical and biological control techniques, control is inadequate to keep up with the rate of spread, and adverse impacts to rangeland including upland and riparian areas are expected to increase (Coca 2007).

TERRESTRIAL WILDLIFE, T&E, CANDIDATE, AND SENSITIVE SPECIES

The cumulative effects discussion for wildlife emphasizes potential effects to mule deer, pronghorn antelope, elk (important big-game animals) and special status species (e.g., threatened, endangered, candidate, and sensitive species) for which reductions in important habitats (primarily sagebrush-grassland) have affected populations within the Study Area. Other terrestrial species associated with sagebrush-grasslands that occur within the Study Area include small mammals, passerine birds, waterfowl, and raptors, as well as amphibians, reptiles, and invertebrates. These species are described in detail in the SOAPA EIS (BLM 2002a) and Leeville Project EIS (BLM 2002b).

CUMULATIVE EFFECTS STUDY AREA

Big Game Animals

The Cumulative Effects Study Area (Study Area) for mule deer, antelope, and elk encompasses a portion of NDOW Wildlife Management Area 6 depicted in **Figure 3-7** and **Figure 3-8**. The Study Area was determined by BLM and NDOW and includes a contiguous area that provides crucial seasonal habitat for mule deer, a species of concern because of habitat losses associated with wildfires and mining. The Study Area extends from the northern end of the Independence Range in the North to southern end of the Piñon Range to the South.

Elk were first observed in the Independence Mountains portion of the Study Area in the mid-1980s and have increased to a population of approximately 290 animals (Wilkinson 2007a). Elk have been observed moving from the Maggie Creek Narrows to forage on adjacent reclaimed areas. Typically, elk are present in winter on Bob's Flat and Richmond Mountain near the southern end of the Tuscarora Mountains. Seasonal migration routes and timing of migration have not been well documented although some elk migrate to Marys Mountain during summer (Lamp 2007).

Special-Status Species

Special-status species are identified as those listed or proposed for listing as threatened or endangered under the Endangered Species Act (ESA), species that are candidates for listing under the ESA, species that are on BLM's list of Sensitive Species and State of Nevada Listed Species. Nevada BLM policy is to provide Nevada BLM Sensitive Species and State of Nevada Listed Species with the same level of protection as is provided for candidate species in BLM Manual 6840.06C.

The Study Area for special-status species includes hydrographic basins that could be affected by mining in the Carlin Trend (**Figure 3-5**). This area encompasses habitat that would have potential to be affected by drawdown from mine dewatering and therefore, potentially impact species described below.

Yellow-billed Cuckoo (Candidate for Federal Listing)

The yellow-billed cuckoo in western North America has undergone decline in population due to losses and degradation of riparian woodland habitats resulting from conversion to agriculture, overgrazing, and competition from exotic plants (Wiggins 2005). This species is closely linked with riparian woodlands, but has not been documented in the Study Area. One dead cuckoo was found at Ruby Lake National Wildlife Refuge in 1972 and constitutes the only recorded cuckoo in Elko County.

Sage Grouse (BLM Sensitive species)

Greater sage grouse occur throughout the Study Area and are typically associated with sagebrush habitats in rolling hills and benches along drainages (BLM 2002a). Sage grouse habitat within the hydrographic basins that could be affected by mine development in the Carlin Trend is shown on **Figure 3-9**.

Pygmy Rabbit (Sensitive Species)

Pygmy rabbits are sagebrush obligates that prefer areas of relatively tall, dense sagebrush with deep soil suitable for excavating burrows. Sagebrush is the primary food of pygmy rabbits, but they also eat grasses and forbs depending on the seasonal availability. In Nevada, pygmy rabbits are generally found in sagebrush-dominated broad valley floors, stream banks, alluvial fans, and other areas with friable soil.

Other Sensitive Species

The following Sensitive Species and State of Nevada-Listed Species are reliant on water sources for direct life support and/or prey base:

- Preble's Shrew
- Swainson's Hawk
- White-faced Ibis*
- Black Tern
- Ferruginous Hawk
- Northern Goshawk
- Burrowing Owl
- Sensitive Bat Species (Spotted Bat, Townsend's Big-Eared Bat, Long-Legged Myotis, Western Long-Eared Myotis, Western Small-Footed Myotis, and Fringed Myotis)
- Loggerhead Shrike
- Nevada Viceroy.

* denotes State of Nevada-Listed Species

Details regarding the type of habitats and prey base for these species are described in the SOAPA EIS (BLM 2002a).

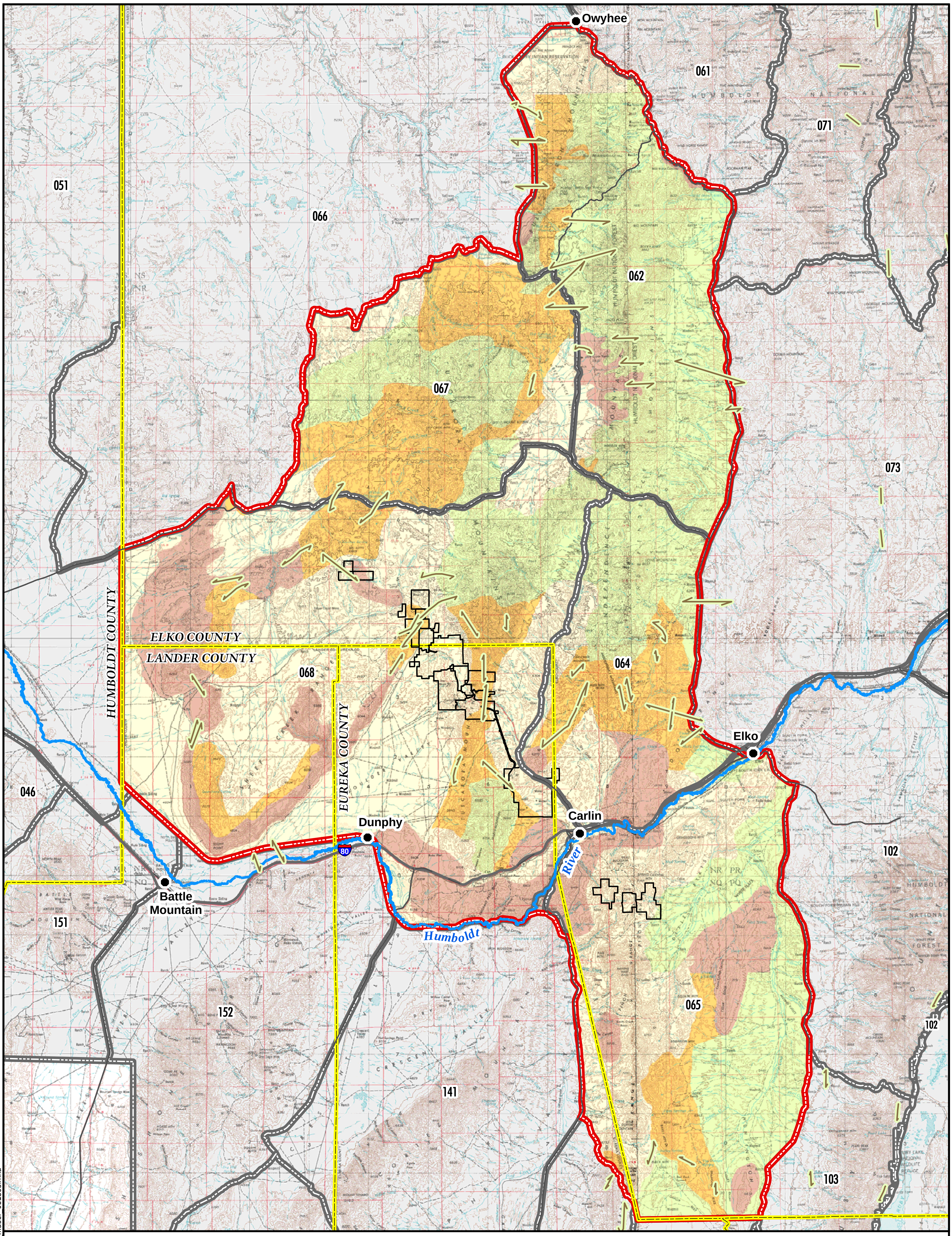
MONITORING DATA AND NEW INFORMATION

Results of ongoing studies and monitoring efforts from 2002 to 2009 are summarized in this section. To date, mining and exploration operations in the Study Area have resulted in approximately 33,500 acres of surface disturbance of which approximately 1,920 acres have been reclaimed. Approximately 7,200 acres of additional disturbance are expected to occur from 2010 to 2020 in the Study Area (**Table 2-3**).

From 1999 through 2008 approximately 1.1 million acres have been affected by wildfire in the Study Area. About 52,000 acres of habitat f or these species lies within Plan boundaries for the various mine operations and exploration projects as shown on **Figure 2-7**. Actual disturbance (mining and exploration) since initiation of mining operations in the Carlin Trend within the Plan boundaries is approximately 33,500 acres. The difference (18,500 acres) between the Plan boundaries (52,000 acres) and actual disturbance (33,500 acres) encompasses undisturbed land that may or may not be accessible to wildlife. Some mine components such as heap leach facilities, tailing storage facilities, and mill sites are fenced to preclude access by wildlife. Not all Plan boundaries are fenced at the present time (exploration Plan boundaries and the Bootstrap project site, for example) so wildlife continues to have access to these areas.

Tables 3-8 and **3-9** show the number of acres that have been impacted by mining and wildfire in the Study Area.

From 1999 through 2008, wildfire has damaged 996,234 acres of sage grouse habitat in the Study Area (**Table 3-10**). Wildfire has also burned portions of the Study Area prior to 1999. Approximately 383,000 acres have been seeded or managed for natural release (natural revegetation) to rehabilitate burned areas (see Chapter 2 – *Wildfires and Reseeding)*. Canopy cover in some areas has been reduced. Forb and grass diversity has also been reduced and recovery of these habitat types will vary in terms of time and cover across the burned areas (see *Vegetation* section in this Chapter).



SOURCE: USGS 1:250K TOPOGRAPHIC MAPS--ELKO, MC DERMITT, WELLS, AND WINNEMUCCA, NV.

Legend

- Cities
- Humboldt River
- Interstate Highway
- Other Major Roads
- Plan Boundaries
- Deer Migration Corridor
- Cumulative Effects Study Area
- NDOW Unit Boundaries

Mule Deer Habitat

- Summer
- Intermediate
- Crucial Winter
- Low Density

0 2.5 5 10 15
Miles

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Elko District Office
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Elko, Nevada

TERRESTRIAL WILDLIFE - MULE DEER HABITAT - CUMULATIVE EFFECTS STUDY AREA
SOAPA Project
Final Supplemental EIS
Eureka and Elko Counties, Nevada

FIGURE
3-7

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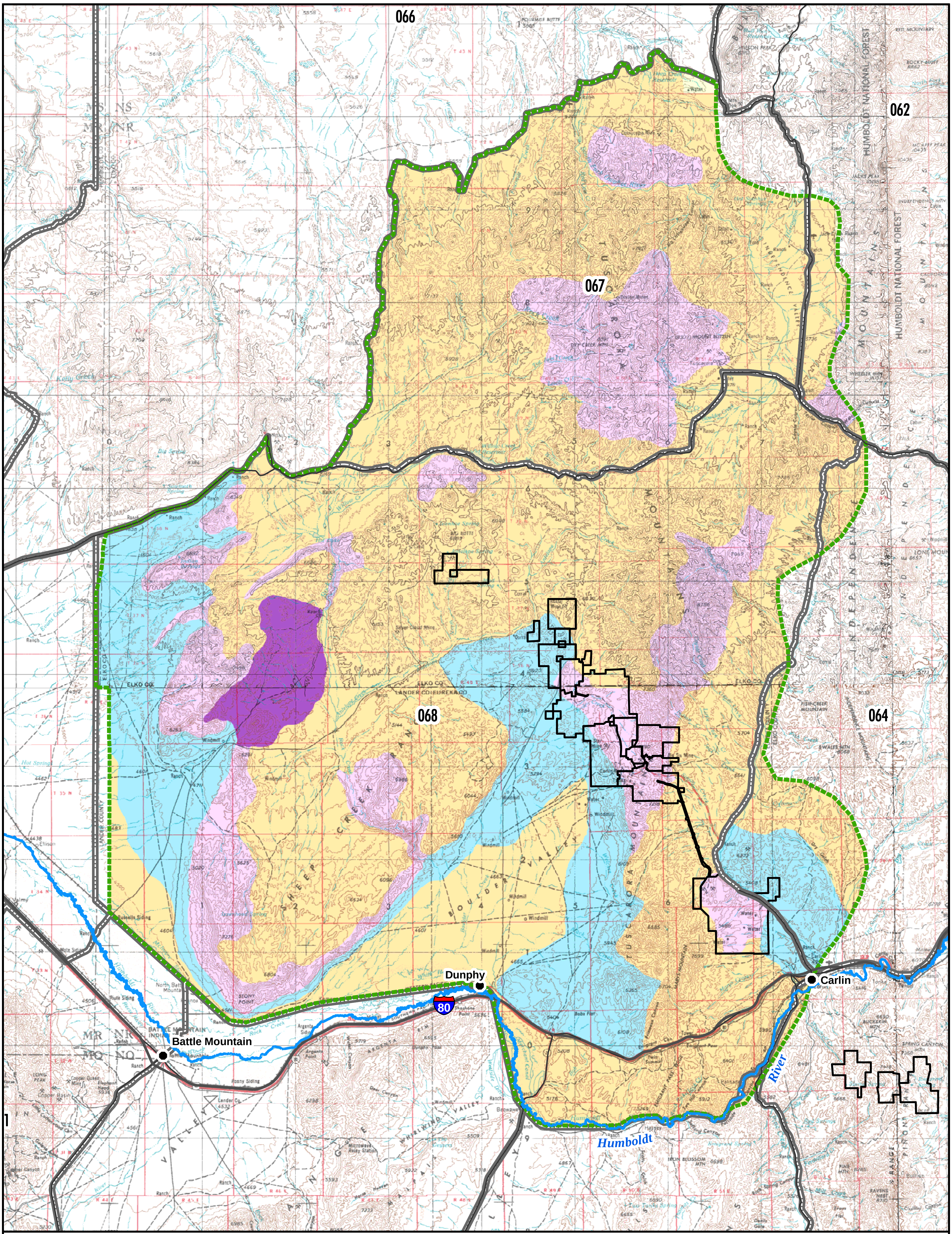


SOURCE: USGS 1:250K TOPOGRAPHIC MAPS--ELKO, MC DERMITT, WELLS, AND WINNEMUCCA, NV.

N W E S

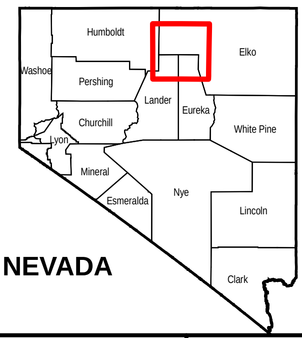
0 2.5 5 10
Miles

Legend

- Cities
- Humboldt River
- Interstate Highway
- Other Major Highway
- Plan Boundaries
- NDOW Unit Boundaries
- Pronghorn Antelope Cumulative Effects Study Area

Antelope Habitat

- All Year
- Crucial Winter
- Intermediate
- Summer
- Low Density
- Unidentified



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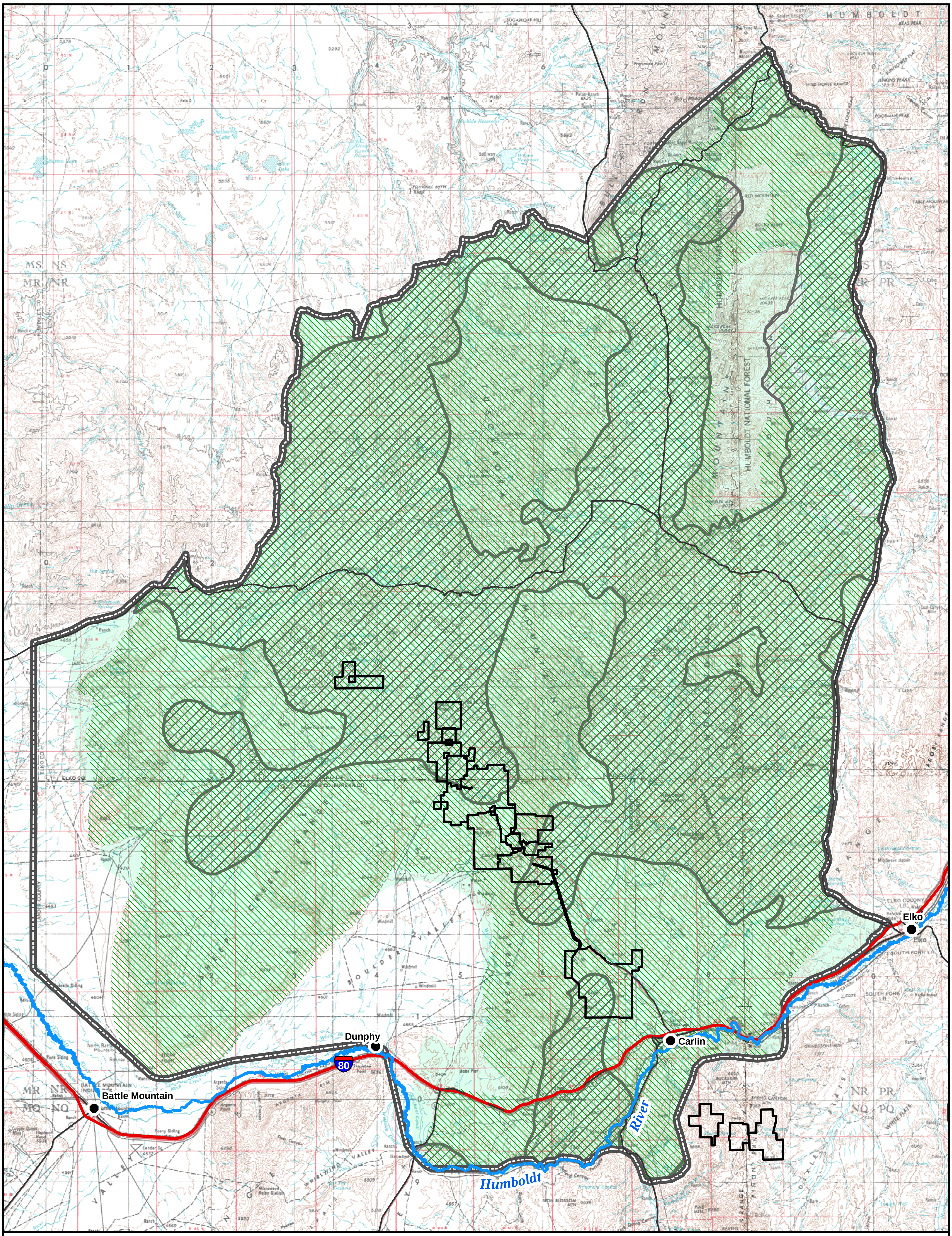
Elko, Nevada

TERRESTRIAL WILDLIFE - PRONGHORN ANTELOPE HABITAT
CUMULATIVE EFFECTS STUDY AREA
SOAPA Project
Final Supplemental EIS
Eureka and Elko Counties, Nevada

FIGURE 3-8



SOURCE: USGS 1:250K TOPOGRAPHIC MAPS--ELKO, MC DERMITT, WELLS, AND WINNEMUCCA, NV.

N
W E
S

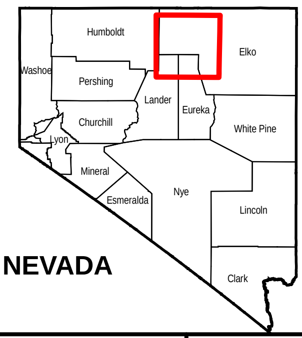
0 2.5 5 10
Miles

Legend

- Cities
- Humboldt River
- Interstate Highway
- Other Major Highway
- Plan Boundaries
- Cumulative Effects Study Area

Sage Grouse Habitat

- Winter Habitat
- Nesting and Early Brood Habitat
- Late Summer Habitat



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SAGE GROUSE HABITAT
CUMULATIVE EFFECTS STUDY AREA
SOAPA Project
Final Supplemental EIS
Eureka and Elko Counties, Nevada

FIGURE

3-9

TABLE 3-8 Effects of Mining and Fire on Mule Deer and Pronghorn Habitat			
Habitat	**Area (acres)**	**Area Included in Plan Boundaries (acres)**	**Area Effected by Fire (acres)**
Mule Deer			
Crucial Winter	386,589	1,097	267,057
Intermediate	544,078	11,030	295,201
Low Density Use	1,061,856	39,739	415,338
Summer	994,862	187	191,633
TOTAL	**2,987,385**	**52,053**	**1,169,**
% of Total		**1.7**	**39**
Pronghorn			
All Year	106	0	106
Crucial Winter	254,339	11,785	115,736
Intermediate	29,402	0	15,207
Low Density	247,344	28,988	109,473
Summer	1,059,524	11,280	508,942
Unidentified	2,556	0	1,287
TOTAL	**1,593,271**	**52,053**	**750,**
% of Total		**3.3**	**47**

[1] Includes Study Area for Terrestrial Wildlife and Special Status Species

TABLE 3-9 Percent of Mule Deer and Pronghorn Habitat Affected by Mining and Fire				
Habitat	**Mule Deer**		**Pronghorn**	
	Mining	**Fire**	**Mining**	**Fire**
All Year	---	---	0.0	100
Crucial Winter	0.3	69.0	4.6	45.5
Intermediate	2.0	54.3	0.0	51.7
Summer	0.02	19.3	1.1	48.0
Low Density	3.7	39.1	11.7	44.3
Unidentified	---	---	0.0	50.4

TABLE 3-10 Acreage and Percent of Sage Grouse Habitats Affected by Mining and Wildfire			
Habitat Type	**Study Area Acres**	**Mining (%)**	**Wildfire (%)**
All Sage	2,090,035	32,689 (1.5%)	996,234 (47.6%)
Nesting/Brood Rearing	1,065,587	24,397 (22.9%)	455,725 (42.7%)

[1] Includes winter, nesting and early brood rearing, and late summer habitats.

CUMULATIVE EFFECTS

Cumulative effects on wildlife in the Study Area have resulted primarily from wildfires, mineral exploration, mining activities, non-native invasive weeds, livestock grazing, drought, urbanization, and seeding of native range with introduced herbaceous species. Other industrial development activities in the area such as a power plant, transmission lines, and roads also contribute to impacts to wildlife.

Development of reasonably foreseeable mine projects and the Ruby Pipeline will continue to impact big game in the Study Area; however, mine areas proposed for development have been the site of human activity including exploration drilling and environmental monitoring programs or are within or adjacent to existing mine areas (Wilkinson 2007b). Wildlife has either moved from these areas or has become habituated to the activity and remains in the general area.

Wildfire and Mining

Within the Study Area, wildfire has created one of the primary cumulative effects on wildlife. Wildfire has resulted in the temporary to long-term loss of shrubs that provide forage and cover as habitat components, that has caused reductions in mule deer and antelope herds throughout the Study Area (see Chapter 2 – *Wildfires and Reseeding*).

Mining has removed approximately 52,000 acres of wildlife habitat as a function of fencing and/or land disturbance associated with mining operations. Mine dewatering programs could result in reduction or loss of flow in springs and seeps that support wildlife. Models predict that approximately 182 springs and seeps and associated wetlands may be affected by drawdown from mine dewatering (BLM 2000; HCItasca 2009). Reductions or elimination of flow in springs, seeps, and streams from dewatering could impact wildlife species dependent on these sites (*e.g.*, amphibians, springsnails, and birds) and may affect distribution of other species (*e.g.*, bats, mule deer and pronghorn antelope) that use these sites as part of a larger habitat complex (see *Water Quantity and Quality* and *Fisheries and Aquatic Resources* sections in this chapter). Mitigation programs implemented by mining operations include obligations to maintain or augment flow in springs and streams that are import to wildlife species.

Riparian habitat rehabilitation and stabilization programs implemented since 1993 have resulted in an increase in acres and health of riparian and wetland areas in the Study Area (see *Stabilization and Rehabilitation Programs* section of Chapter 2). Reseeding of areas burned by wildfires are described in the *Wildfires and Reseeding* section of Chapter 2.

Potential effects of dewatering on surface water features are described in the *Water Quantity and Quality* section of this Chapter. Habitat improvement resulting from various plans and programs implemented in the Study Area are described in Chapter 2 – *Stabilization and Rehabilitation Programs.*

Big Game

<u>Mule Deer and Pronghorn Antelope</u>

Mining activity in the Study Area occurs on less than 0.1 percent of mule deer summer range, approximately 2 percent of intermediate range, and 0.3 percent of crucial winter range. Mining disturbances have also affected 1.1 percent of pronghorn summer range and approximately 4.6 percent of crucial winter range in the Study Area (**Table 3-9**). Migration corridors are specific areas within intermediate range which are used based on, but not limited to, factors such as vegetation types, topography, and elevation. While the overall percentage of affected habitat is small, maintaining mule deer migration corridors around and between the various existing and foreseeable mining projects is an issue of concern (Wilkinson 2007b).

Traditionally, mule deer migrated along both flanks of the Tuscarora Mountains to and from wintering areas. Little Boulder Valley served as an intermediate range staging area prior to movements. With the reduction in the quantity and quality of the mule deer intermediate range, mule deer currently tend to move through this habitat more rapidly, therefore, onto winter range earlier in the season (Lamp 2007). With decreased availability and use of the intermediate range in the Study Area, increased demand is placed on forage on winter range areas.

Most deer migrating from the northern summer range to Dunphy Hills move east of the Leeville Mine and then south. Mining actions have impacted historic migration corridors in the southern portion of the Tuscarora Mountains. This has effectively reduced an historic 10-mile wide area on the Tuscarora Mountains which provided mule deer intermediate range (spring, fall) and migration corridors to less than a 0.5-mile wide area near the Pete Project. Encumbrances to mule deer movements include mineral exploration, active mining operations, livestock control fences, the North-South Haul Road, and vehicular traffic to mine areas along State Route 766 (Simon Creek Road). NDOW with support from Newmont and Barrick has begun to collect monitoring data using radio collars to identify migration routes of mule deer in this area. One radio-collared mule deer doe migrated through the area in 2006. (Wilkinson 2007b). In 2007, two radio-collared deer wintered in the Dunphy Hills and migrated north through Sheep Creek passing between Leeville and the 4-2 Tailing Storage Facility and continued north into the Tuscarora Mountains. A third radio-collared deer wintered in Maggie Creek, north of Gold Quarry, and then migrated up Maggie Creek into a 2-year old burn area. One radio-collared deer passed through the Pete Project area during spring 2007 (Pettit 2008).

A study was initiated in December 2007 to determine seasonal mule deer movements within the Carlin Trend. The study included radio telemetry from collars placed on six deer, ground observations, and ten aerial surveys conducted between October 2008 and April 2009. Conclusions based on observations made during the short study period are limited. Deer migrations in the Study Area are dependent on weather conditions, timing and depth of snow accumulation, and impacts of fire on cover and forage, especially fall forage (browse) and the nutritional quality of the spring forage (forbs).

Initial results of the study indicate that three corridors are used: Maggie Creek Corridor, East and West Flank of Tuscarora Range, and the Santa Reina. The Maggie Creek and Santa Reina corridors lie at the eastern and western edges of the Study Area. The East and West Flank corridors converge near Richmond Mountain. Development of the Carlin Mine, Pete Project, North-South Haul Road, and other projects in and around Little Boulder Valley has occurred within this corridor. The telemetry data indicates that deer continue to use this corridor (GBE 2009).

Based on observations made during the study period, mule deer are migrating to the winter range in Boulder Valley and Dunphy Hills (and beyond). It is not clear if the mining activity and wildfire related habitat removal have caused any shifts in this migration, but both of these factors create conditions that may alter deer movement.

Although one year of data does not allow for compelling conclusions, it appears that the entire width of the Study Area is being used for migration and deer adjust their movements to annual climatic conditions as well as changes on the landscape from wildfire and mining. In years like 2008 when fall migration is dispersed over time and space, the impacts of fires and mining appear to not be limiting factors to deer migration. However, in years when conditions require that the migration be direct and quick, the lack of cover and the need to find new pathways may create unsuitable conditions that are not easily negotiated (GBE 2009).

The Carlin Trend Mule Deer Working Group (consisting of representatives from Newmont, Barrick, NDOW, and BLM) has drafted a Mule Deer Habitat Management Plan for the Carlin Trend. Objectives of the group are to develop strategies that to the degree practicable provide the following:

- Maintain currently undisturbed migration corridors;
- Modify existing migration impediments to facilitate deer movement;
- Incorporate reclamation measures that reduce or eliminate impacts to migration corridors and habitat;
- Develop stable landform designs that complement surrounding topography and support mule deer habitat requirements;
- Enact fire management strategies to protect deer habitat, with an emphasis on crucial mule deer winter range, after each new fire;
- Rehabilitate burned areas as quickly as possible;
- Rehabilitate historic burns that do not currently provide adequate deer habitat; and,
- Ensure that there is sufficient forage and cover for mule deer.

Effects of wildfires to terrestrial wildlife species include loss of habitat (forage and cover) which can lead to die-offs of mule deer and pronghorn antelope as well as other species. Some native shrub communities have been replaced by cheatgrass-dominated grasslands.

Numbers of migrating mule deer are not well known because the herd has declined from 30,000 to about 8,000 animals due to effects of fire on winter ranges and the mild winter of 2006 which caused few mule deer to migrate (Lamp 2007). An emergency antlerless deer hunt was conducted in Area 6 during the 2006 hunting season. The purpose of this hunt was to reduce the deer population in response to the loss of crucial habitat destroyed by fires during the summer of 2006. A total of 1,116 permits were issued for this hunt and hunters harvested 646 animals.

Displacement of mule deer and pronghorn from wildfire, mining activities, and other land uses increases demands on adjacent habitats. Most habitats are at carrying capacities and can not support additional animals (Wilkinson 2007a). Displaced animals would be lost from the population until habitats are rehabilitated, restored, or mitigated, allowing population to expand into affected areas.

Pronghorn habitat in wildlife management Unit 067, 068, Western Elko and Northern Lander and Eureka counties, experienced range fires of over 500,000 acres during the summer of 2006 (NDOW 2007a). The Area 6 antelope herd was approximately 1,200 animals, but following the 2006 summer wildfires, NDOW (2007b) estimates that Area 6 can support 700 to 800 antelope.

<u>Elk</u>

Extensive fires in the Study Area have converted many shrub-dominated communities to grass-dominated communities. Elk, being primarily grazers, have benefited from increased grass production following fires; however, a multiple shrub component is needed for cover and forage diversity on a yearlong basis. Reclaimed areas on mine sites provide forage for elk because reclamation seed mixes have a large grass component, especially in early stages of reclamation. Mine perimeter fences may preclude use by elk until they are removed (Wilkinson 2007b).

Special Status Species

Fires have negatively impacted sagebrush-associated species' habitat in the short- to mid-term (5 to 15 years), due to loss of sagebrush canopy cover and vertical structure for nesting and cover. Diversity of forb and grass communities on cheatgrass dominated areas remains limited which also negatively impacts sagebrush obligates and associated species. Conversion of extensive areas of shrub steppe in the Study Area by fire to large expanses of burned area, dominated by exotic grass species, has reduced the prey base and foraging and nesting habitat for numerous sagebrush associated species. The *Wildfires and Reseeding* section of Chapter 2 provides a description of areas burned and reseeded in the Study Area. Seeding projects have reestablished forage for certain species; however, in some cases, reseeded areas have burned in later years after vegetation had become established.

If springs, seeps, or stream reaches become dry in response to mine dewatering activities, and associated vegetation is lost, potential nesting and foraging habitat would be reduced (see *Water Quantity and Quality* section in this chapter). To date, few springs have exhibited change in flow as a result of mine dewatering activities (see *Water Quantity and Quality* section in this chapter). Springs that have formed (Sand Dune, Knob, and Green) in Boulder Valley as a result of discharge of excess water from mine development have created additional riparian habitat that could benefit hawk and owl species due to increase in prey base supported by these springs. These springs will likely dry up after dewatering ceases.

Mine dewatering could potentially reduce available water and cause long-term effects to the riparian community within the Study Area, which could result in loss of breeding, foraging, and cover habitats; increased animal mortalities; reduction in overall biological diversity; possible genetic isolation; and possible long-term impacts to population numbers of some species. Recovery of groundwater and surface water would be gradual. Incremental habitat loss would affect big game, upland game birds, waterfowl, shorebirds, raptors, songbirds, non-game mammals (*e.g.* bats), area reptiles, and amphibians. Implementation of programs to rehabilitate and stabilize riparian and wetland areas (see *Stabilization and Rehabilitation Programs* section in Chapter 2) has increased the size, function, and health of these areas.

Federally listed species or special-status species have not been identified in the TS Power Plant project area; therefore, no impacts are anticipated (ENSR 2004a). Sensitive species that may occur in the area include the pygmy rabbit, bat species, Swainson's hawk, ferruginous hawk, loggerhead shrike, long-billed curlew, western burrowing owl, Nevada viceroy, and the Columbia spotted frog.

<u>Yellow-Billed Cuckoo (Candidate for Federal Listing)</u>

Mine dewatering could potentially reduce available water and cause long-term effects to the riparian community within the Study Area, which could result in the loss of breeding, foraging, and cover habitats for the yellow-billed cuckoo. To date, losses of riparian habitat due to mine dewatering have been minor, associated with reduced flows in several springs. Overall, improvement of riparian habitat in the Maggie Creek and Willow Creek drainages associated with enhancement projects have resulted in a net increase in riparian habitat quality, which could potentially benefit the yellow-billed cuckoo.

Sage Grouse (BLM Sensitive Species)

The primary factor affecting sage grouse habitat in the Study Area is wildfire (**Table 3-10**). Impacts on sage grouse habitat from fire (48% loss of sagebrush habitat subject to temporary to long-term reduction in shrub cover), mining (1.5% loss of sagebrush habitat), and other disturbances have reduced habitat for sage grouse by nearly 50 percent in the Study Area (**Figures 2-4** and **3-9**). Habitat has been affected on a temporary to long-term basis by wildfires dependent, in part, on time of natural recovery of vegetation including sagebrush, and success of post-fire habitat rehabilitation including shrub, grass, and forb seeding. Livestock grazing is a factor that affects sage grouse habitat. Trampling of springs and wet meadows, by livestock reduces the quality and quantity of water and vegetation. The 2006 fires affected habitat for an estimated 10,000 sage grouse and approximately 117 sage grouse leks on the Elko District. Additional leks were affected by fires between 1999 and 2005 and fires as of July 2007 (Wilkinson 2007b). NDOW is in the process of determining the status of fire-affected and non-affected leks in Northeastern Nevada. In the Study Area, fires have burned 996,234 acres of sage grouse habitat (**Table 3-10**).

Mining, construction of roads, power lines, fences, and reservoirs have resulted in loss and fragmentation of sage grouse habitat. Mining companies, BLM, and NDOW have implemented programs to mitigate direct impacts to sage grouse populations and habitat due to mining activities, as well as provide off-site mitigation measures to address permanent impacts to sage grouse and associated sagebrush habitats affected by mining activities. Re-seeding of burned areas to establish sagebrush-grassland communities has been widespread in the Study Area (see *Wildfires and Reseeding* in Chapter 2). From 1999 through 2008, approximately 287,000 acres of previously burned sage grouse habitat was reseeded; however, the success of re-establishment of sagebrush and other plants important to sage grouse, on re-seeded areas, has not been comprehensively studied.

Potential loss of springs and seeps due to mine dewatering activities has the potential to reduce amounts of riparian habitat and water sources for sage grouse. Springs and riparian areas are important for brood rearing because of drinking water, increased insect numbers, and succulent green vegetation, which are important summer sage grouse foods. To date, few springs or seeps have been affected by mine dewatering activities. Mine operators in the Carlin Trend monitor springs and seeps throughout the Study Area. Conditions of these water sources are described in the *Water Quantity and Quality* section of this chapter. Mitigation programs implemented by mining operations include obligations to maintain or augment flow in springs that are import to wildlife species.

Pygmy Rabbit (Sensitive Species)

Currently, in the Study Area, there are about 2 million acres of sagebrush habitat, but not all of this would provide suitable habitat for pygmy rabbits. As discussed for sage grouse, loss of sage brush habitat from fire (48% loss of sagebrush habitat), mining (1.5% loss of sagebrush habitat), and other disturbances have reduced habitat for pygmy rabbits by approximately 50 percent in the Study Area.

Preble's Shrew (Sensitive Species)

Preble's shrews occupy a diversity of habitats including wetland and marshy habitats with emergent vegetation and woody species. Mine dewatering could cause springs to dry or become smaller, which could reduce potential habitat for Preble's shrew. Widespread wildfires have altered and would continue to alter habitat for this species.

Swainson's Hawk

Swainson's hawks are seasonal residents and nesters in the Study Area, migrating to South and Central America in winter (Ryser 1985). This hawk nests in clumps of trees, often in agricultural and riparian areas or near springs. Swainson's hawks feed mostly on large insects and small mammals; however, they will also take bats, birds, and amphibians. If springs dry and associated vegetation is lost, potential nesting habitat could be reduced.

Ferruginous Hawk

Ferruginous hawks nest in scattered juniper trees at the interface of the piñon-juniper zone and desert shrub communities overlooking broad open valleys (Herron *et al.* 1985). The ferruginous hawk preys mostly on rodents and rabbits but will also take birds and reptiles. Because ferruginous hawks often nest in low trees and shrubs, wild fires have probably reduced nesting habitat.

Ferruginous hawks concentrate in the wet meadows along upper Maggie Creek during summer and early fall. This area appears to be a staging area where the birds feed on large populations of small mammals prior to migration (BLM 2002a). Groundwater drawdown from mining activities could reduce amounts of water that support riparian vegetation and wet meadows in the upper Maggie Creek drainage, and reduce habitat quality for small mammals – prey of ferruginous hawks staging to migrate.

White-faced Ibis (Sensitive Species)

The white-faced ibis is a shorebird that nests in heavy emergent wetland vegetation. Wet meadows (950 acres) along Maggie, Coyote, and Little Jack creeks are potential nesting and foraging areas for this species. Groundwater drawdown from mining activities could reduce amounts of water that support riparian vegetation and wet meadows in the upper Maggie, Coyote, and Little Jack drainages and reduce habitat quality for nesting and foraging.

Black Tern (Sensitive Species)

Black terns typically nest in marshes and small ponds often on old muskrat houses, floating mats of vegetation, or abandoned coot or grebe nests (Montana Natural Heritage Program 2007; Cornell Laboratory of Ornithology 2001). Water levels in most black tern breeding habitats are from 0.5 meters to 1.0 meter deep. Black tern habitat most likely occurs in the upper Maggie Creek drainage of the Study Area.

Impacts to existing or potential black tern nesting habitat could occur if groundwater drawdown from mine dewatering dries marshes or ponds or reduces recharge to breeding habitat associated with springs and stream flow.

Northern Goshawk (Sensitive Species)

Goshawks in the Study Area occupy shrub steppe habitat and usually nest within 100 yards of a spring or stream (BLM 2002a). Wide-spread wildfires may have affected foraging habitat for goshawk by converting shrub steppe habitats to grasslands dominated by annual grasses. The loss of shrub cover and density has probably reduced the prey base for many species associated with shrub habitats. If mine dewatering causes flow to decrease or stop in springs and seeps, potential nest sites could be affected.

Burrowing Owl (Sensitive Species)

The burrowing owl generally nests in abandoned rodent burrows in areas with low or desert vegetation. Widespread wildfires have altered diversity and structure of natural vegetation and converted many areas to stands of annual grass with few shrubs. Prey for burrowing owls (small mammals and insects) likely has been reduced by conversion of native communities to large expanses of burned area, dominated by exotic grass species.

The spadefoot toad is an important part of the burrowing owl's diet in parts of Nevada. If flows to springs and seeps decreases or stops as a result of mine dewatering potential breeding habitat for the spadefoot toad could be affected.

Loggerhead Shrike (Sensitive Species)

This species typically occupies open habitats where it perches on shrubs, trees, and other elevated structures. The shrike preys on small birds, insects, lizards, and small mammals. Conversion of extensive areas of shrub steppe in the Study Area by wildfire to large expanses of burned area, dominated by exotic grass species, has probably reduced the prey base and nesting habitat for this species.

Bats (Sensitive Species)

Wetlands and surface water associated with springs and seeps, sagebrush grasslands, juniper woodlands, and rocky outcrops in the Study Area provide habitat for sensitive bat species. Rock crevices may provide roosting habitat and marginal breeding habitat. Caves, abandoned mines, and abandoned buildings provide optimum habitat for roosting and breeding for colonies of bats. Water sources are critical to bats because they drink from open water and insects are more abundant around wetlands and open water. Studies in desert habitats have found that bat activity is 40 times greater near wetlands and riparian areas than in upland areas (Nevada Bat Working Group 2002). Even high-elevation tree-roosting bats fly to open water, wetlands, and riparian areas to drink and forage. Mine dewatering that reduces or eliminates flows from springs and seeps would adversely affect foraging habitat for bats. Based on the CIA report (BLM 2000), 182 springs potentially could be dewatered in the Study Area from mining activities.

Pit lakes are predicted to establish after mining is completed in the Gold Quarry, Betze/Post, and Tara pits. Water in these future pit lakes is predicted to contain varying concentrations of constituents that would be released from the exposed rocks in the pit walls (see *Water Quantity and Quality* section of this chapter). Pit lake water quality would be unique to each pit as the factors that influence water quality are unique to each pit including but not limited to pit depth, water table elevation, inflow rate, period of time to fill to premining water table levels, oxygen content, pit shape, stratification of the water column, and geology.

Bats, water fowl, and other wildlife may be attracted to the pit lakes as a source of water and for prey. Given the range of pit water quality conditions that could occur comparing one pit to another and within pits over time, the potential effect of pit lake water quality on wildlife species would also vary (see *Water Quantity and Quality* section in this Chapter).

Nevada Viceroy (Sensitive Species)

This butterfly occurs in moist areas that provide habitat for willow and cottonwood, host species for the larvae. Loss of riparian habitat or springs and seeps, as a result of mine dewatering, would reduce potential habitat for this species.

Oil, Gas, and Geothermal

Potential development of fluid minerals (oil, gas, and geothermal) would result in creation of roads and land disturbance in areas where these surface activities do not currently exist. Introduction of human activity in remote areas would cause displacement of animals in response to road use. Plans for oil and gas development within the Study Area have not been submitted to the BLM as of the date of this document. Recent oil exploration activity includes two "dry" holes; one drilled in Section 34, Township 31 North, Range 51 East in February 2008, and one in Section 16, Township 34 North, Range 54 East, which was plugged in September 2009. Two tracts have been issued leases for geothermal.

TG Power LLC proposes to construct a geothermal power plant near the Spanish Ranch north of Tuscarora. An associated 120 kV power line is proposed from this power plant to the Humboldt Substation north of Elko and will cross both public and private land.

Energy Development and Distribution

TS Power Plant

Operation of the TS Power plant may result in displacement of big game species from the Study Area. Potential impacts to mule deer would be minor since the majority of the southern Boulder Valley is designated as limited range for mule deer (habitat occasionally inhabited and/or contains a small population of scattered animals). Pronghorn occur throughout the valley, but are most common near the irrigated fields in northern and central Boulder Valley (ENSR 2004a). The area is not important habitat for mule deer, pronghorn antelope, or elk; but these species, which may transient in the area, will be excluded from the power plant site by a security fence around the perimeter.

No federally listed species or special-status species have been identified in the TS Power Plant project area; therefore, no impacts are anticipated (ENSR 2004a). Sensitive species that may occur in the area include the pygmy rabbit, bat species, Swainson's hawk, ferruginous hawk, loggerhead shrike, long-billed curlew, western burrowing owl, the Nevada viceroy, and the Columbia spotted frog (ENSR 2004a).

Vegetation in the area of the TS Power Plant is greasewood dominated and does not have high habitat value for big game species or sage grouse. The project involved removal of a relatively small amount of habitat, primarily used by nesting birds and small animals.

Clearing, construction, and on-going maintenance of the transmission power line rights-of-way have resulted in habitat loss, habitat degradation, and displacement of wildlife. Temporary loss of sagebrush-grassland would contribute to cumulative effects on mule deer, pronghorn, pygmy rabbits, raptors, sage grouse, songbirds, and small mammals. Natural revegetation and/or reclamation of disturbances within the new transmission corridor would change the species composition and densities of some wildlife species.

Water quality of the power plant cooling ponds is not expected to be hazardous to waterfowl or other wildlife. Power plant cooling ponds are fenced with a design specified by NDOW for artificial industrial ponds to prevent access by terrestrial wildlife. Additional measures (e.g., water balls, netting and hazing) may be required to prevent access by birds (ENSR 2004a).

Ruby Pipeline Project

The Ruby Pipeline Project would be constructed within a 115-foot wide construction corridor. Approximately 14 acres of sagebrush habitat would be disturbed per mile of pipeline construction. The additive effect of pipeline construction with other ongoing mining operations in the Study Area would continue a trend toward a reduction in sagebrush habitat/community types. The pipeline route would extend about 26 miles across the mule deer and pronghorn Study Area disturbing 358 acres of habitat. Construction would affect approximately 168 acres of mule deer habitat (112 acres of intermediate/56 acres crucial winter) and 112 acres of pronghorn crucial winter range. The remaining area for both species would be summer or low density range. The pipeline would extend across about 60 miles of sage grouse habitat disturbing approximately 850 acres of winter and nesting/early brood rearing habitat.

Impacts to sagebrush dominated community types would be long-term due to the time required to reestablish the vegetation characteristics of these community types. The arid environment in this region is not conducive to plant growth, and regeneration of vegetation following construction would be slow.

Noise

Some noises generated by mining and exploration activity are sporadic, impulsive, and fluctuate in intensity and duration (*e.g*., blasting, drilling, rock dumping) (Bowles 1995). Wild animals tend to move away from disturbances which cause these sporadic noises. Other noises are constant (24 hours/day; 7 days/week; 300 + days/year) such as mill operations and sprinkler operations. Animals tend to habituate to noises where there is repeated exposure and they adapt behaviorally and physiologically (Bowles 1995).

Sage-grouse numbers on leks within one mile of a coal bed methane compressor station in Campbell County, Wyoming, were consistently lower than on leks not affected by this disturbance. Lek activity by sage-grouse decreased downwind of drilling activities, suggesting that noise had measurable negative impacts on sage-grouse (Braun 2006). One sage grouse lek is located within one mile of the Pete Mine in the Study Area.

Urbanization

Land development in the Study Area including subdivision and commercial properties, are described in the *Land Development* section of Chapter 2. Current development has, and will likely continue to, affect mule deer and antelope habitat in the vicinity of the town of Carlin (Wilkinson 2007b).

Fences

Fences have been constructed in the Study Area to enclose mine development, preclude grazing on burned areas, and as a result of other land development activities such as subdivisions, commercial/industrial facilities, and public rights-of-way. Fences can impede wildlife migrations especially during winter and early spring when deer are in a weakened condition. New fences on BLM land and at mine sites are constructed to facilitate wildlife movement and implement standard operating procedures to minimize conflicts to wildlife. Modifications of existing fences by BLM and NDOW to facilitate movement of big game are ongoing in the Study Area.

Non-native, Invasive Weeds

Cumulative effects on wildlife from invasive, non-native species include displacement of riparian/wetland habitat and native vegetation vital to wildlife. Further discussion of infestations and treatment programs on-going in the Study Area is contained in the *Vegetation Resources* section of this chapter.

Livestock Grazing

Grazing practices in the Study Area have improved over the past 20 years, notably within the Dunphy Hills area and the Izzenhood Range (NDOW 2007a); however, grazing in some locations continues to have a negative impact on winter habitat and intermediate range, particularly on kochia and bitterbrush (NDOW 2007a). Continuation of reasonably foreseeable livestock grazing in the Study Area will affect wildlife and wildlife habitat with the extent of impact depending on intensity and duration of grazing on public and private land. Ongoing efforts to properly manage livestock grazing in the Study Area have demonstrated that livestock grazing and healthy riparian areas are compatible. For example, stream and riparian area restoration projects including the Maggie Creek Watershed Restoration Program, Upper Willow Creek Restoration Program, and projects on the TS Ranch have resulted in improvement and expansion of riparian and wetland habitat in the Study Area.

RIPARIAN AREAS AND WETLANDS

This Final SEIS provides new quantitative data collected between 2002 and 2008 to further characterize cumulative effects to riparian areas and wetland resources previously described in SOAP EIS (BLM 1993) and SOAPA EIS (BLM 2002a).

Thirteen vegetation types were previously identified along tributaries to the Humboldt River within the Study Area (BLM 2002a). A total of 4,530 acres of riparian/wetland habitat occur within the Study Area; including 2,218 acres in Maggie Creek, 1,685 acres in Rock Creek (including Boulder Flat), 228 acres in Susie Creek, 388 acres in Humboldt River watersheds, and 10 acres associated with small tributaries to the Humboldt River. Approximately 193 acres of riparian habitat have been added in the Maggie Creek Basin as a result of restoration activities (Open Range Consulting 2007).

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for riparian and wetland resources is located in the Humboldt River basin encompassing the following hydrographic areas: Susie Creek, Maggie Creek, Marys Creek, Boulder Flat, Rock Creek Valley, Willow Creek Valley, and the adjoining portion of the Humboldt River (**Figure 3-10**). The Study Area encompasses riparian and wetland areas that could be affected by groundwater drawdown associated with mine pit dewatering.

MONITORING DATA AND NEW INFORMATION

Newmont Spring Monitoring

In the fall of 1990, 182 springs were identified in the Study Area that could be affected by mine dewatering (BLM 2000). Currently, 33 of these seeps and springs are monitored (Newmont 2009d). Most of these springs were monitored biannually (fall and spring) between 1990 and 2002. The Record of Decision for SOAPA (BLM 2002a) changed the monitoring to fall only and removed many of the springs because of negligible flow in the fall. Spring monitoring was eliminated because flow was dominated by snow melt and rain. Monitoring results are provided to BLM in annual seep and spring reports (Newmont 2009d).

Review of flow data indicates no measurable change in flow rates for 28 of the 33 springs. Four springs have exhibited variation in flow, reduction in flow, or have gone dry for one or more years. Groundwater monitoring has not indicated any drawdown from mine dewatering operations in the direction of these springs. Hydrologic investigations have identified grazing, evolving streambed morphology, and anthropogenic flow controls as the primary factors influencing flow measurements at these springs. One spring exhibited an increase in flow since 2001 due to relocation of its monitoring point in accordance with the Maggie Creek Basin Monitoring Plan (Newmont 2009d).

Maggie Creek Basin Monitoring Plan and Leeville Hydrologic Monitoring Plan

Newmont conducts groundwater and surface water monitoring related to dewatering operations at its SOAPA and Leeville operations on a monthly basis. Data are reported on a semi-annual basis. The purpose is to evaluate impacts of dewatering at SOAPA and Leeville on the hydrological environment, which could have a potential impact on riparian/wetland resources. Monitoring since 2002 generally confirms the hydrologic analysis contained within the SOAPA EIS (BLM 2002a) and Leeville EIS (BLM 2002b) documents.

Barrick Spring Monitoring

Barrick's mitigation plan includes monitoring a number of springs, seeps and stream reaches within the Study Area (AATA 2009). Under an agreement with BLM, Barrick conducts a continuing seep and spring monitoring program that commenced in 1989. The study consists of evaluating water chemistry and measuring flow rates, as well as collecting vegetation data at designated sites. The Betze/Post Mine Seep and Spring Study 20 Year Summary Report indicated the following:

- 29 springs had no impact due to dewatering;
- 1 site shows changes in water chemistry but not in discharge volume;
- 4 sites consistently dry; and
- 1 spring shows decreased discharge volume.

Barrick Boulder Valley Monitoring

Barrick conducts a groundwater and surface water monitoring program that addresses "all aspects of potential impacts resulting from pumping of water including dewatering of the pit" (Barrick 1990). Surface water monitoring (hydrologic and water chemistry) is conducted on Antelope, Bell, Boulder, Brush, Rock and Rodeo creeks. Some of these fall within the possible impact area of the SOAPA and Leeville dewatering activities. Monitoring since 2002 generally confirms analysis contained in the Barrick Betze Project SEIS (BLM 2003), SOAPA EIS (BLM 2002a), and Leeville EIS (BLM 2002b).

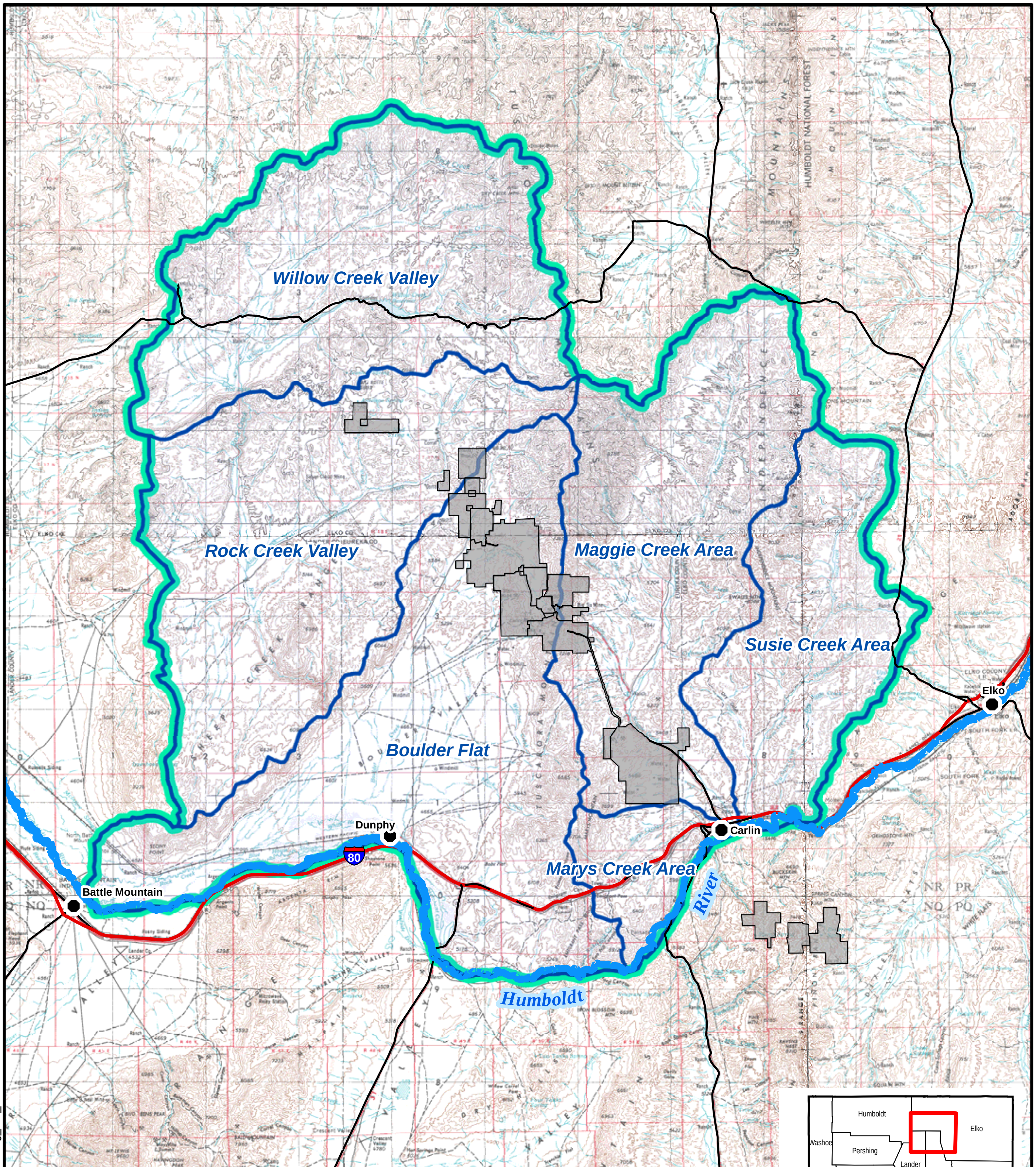
Maggie Creek Watershed Restoration Project Monitoring Program

A comprehensive monitoring plan for fisheries and aquatic resources, as well as riparian areas and wetlands, was developed through the Maggie Creek Watershed Restoration Project as part of the 1993 (SOAP) and 2002 (SOAPA) mitigation plans. Detailed stream and riparian habitat monitoring, as well as evaluation of prescriptive livestock grazing practices, has been conducted by BLM, Newmont, and other partners at regular intervals since 1994.

Studies by Open Range Consulting (2007) show an increase of 193 acres in wetland riparian acres and an increase of 1.8 miles stream length (due to increase in stream sinuosity) along Maggie Creek between 1994 and 2006. Sediment loading in Maggie Creek has reduced from more than 8,000 tons/day of sediment (as total suspended solids - TSS) during high flows in 1993 to a sediment load of less than 1,000 tons/day (as TSS) during similar flow in 2005 (Newmont 2009c). Increases in woody riparian vegetation overhanging the water column, pool quality, and depth at the shore-water interface on Coyote, Little Jack, and Maggie creeks have improved habitat quality for fish and many species of wildlife (Trout Unlimited 2007a).

Barrick Upper Willow Creek Habitat Enhancement Plan Monitoring Program

A monitoring plan for riparian areas and wetlands was developed as part of the Upper Willow Creek Habitat Enhancement Plan (BLM 2003). BLM and private consultants have been monitoring riparian conditions and water temperatures since 2001 at designated locations. In addition, Trout Unlimited, monitors fish populations in streams (see *Fisheries and Aquatic Resources* section in this chapter). Upland habitat monitoring at several designated locations has also been on-going.



Legend

- Cities
- Humboldt River
- Interstate Highway
- Other Major Roads
- Plan Boundaries
- Hydrographic Sub-basins
- Cumulative Effects Study Area

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U.S. Department of the Interior
Bureau of Land Management
Elko District Office
Tuscarora Field Office
Elko, Nevada

RIPARIAN AREAS AND WETLANDS CUMULATIVE EFFECTS STUDY AREA
SOAPA Project
Final Supplemental EIS
Eureka and Elko Counties, Nevada

FIGURE **3-10**

The Upper Willow Creek Habitat Enhancement Plan has resulted in watershed improvements for numerous terrestrial and aquatic organisms in riparian and steam habitats in the Willow/Rock Creek drainage (CCA 2004). Extent and condition of riparian areas has increased or improved since initiation of the project (CCA 2004; BLM 2006b; Open Range Consulting, Inc. 2007).

BLM Riparian Monitoring

Functioning condition surveys of lentic (standing water) riparian habitats have been completed by BLM on allotments within the Study Area since 2003 (**Table 3-11**). Seventy percent of inventoried seeps and springs were either nonfunctional or found to be functioning at-risk, with a downward or non-apparent trend. Overuse of riparian vegetation by livestock was identified as the primary cause of poor conditions. Although prescriptive grazing protocols have been employed in portions of the Study Area, many of the lentic functioning condition surveys occurred in allotments or parts of allotments receiving hot season grazing on an annual basis. In some cases (notably Squaw Valley Allotment) recent changes in grazing practices are improving conditions over the allotment as a whole.

BLM has completed monitoring on streams affected by recent wildfires in the Study Area (BLM 2005b, 2006c, 2006d). Healthy riparian areas have either not burned or have recovered rapidly following fire. In wet years such as 2006, high plant moisture content resulted in riparian corridors remaining mostly intact. Some riparian areas were scorched during 2001, but regeneration of burned riparian vegetation has been good. Where riparian habitat conditions were poor prior to the fire, effects have been more long-term and have included channel down-cutting with potential loss of associated wetland plant communities.

TABLE 3-11
Summary of Functioning Condition Surveys for Lentic Riparian Areas

	Total No. Sites Evaluated	**Rating (No. Sites)[2]**				
		PFC	**FARU**	**FARN**	**FARD**	**NF**
2005						
Blue Basin	37	8	1	4	19	5
Carlin Field	2	2	-	-	-	-
Hadley	3	1	-	-	2	-
Lone Mountain	19	6	3	2	6	2
T Lazy S	25	8	3	1	8	5
Twenty-five	40	11	2	3	16	8
2004						
Squaw Valley	58	1	11	0	37	9
2003						
Tuscarora	45	7	4	6	7	21
Totals (%)	**229**	**44 (19)**	**24 (10)**	**16 (7)**	**95 (41)**	**50 (22)**

within the Study Area for Wetlands and Riparian Areas.
: PFC = Proper Functioning Condition; FARU = Functional-at-Risk, Upward Trend; FARN = Functional-at-Risk, Trend Not Apparent; FARD=Functional-at-Risk, Trend Downward; NF=Non-functional.
Source: Prichard *et al.* 1999 (2003).

CUMULATIVE EFFECTS

Mining operations, industrial development, and agricultural activities in the Study Area are expected to interactively affect regional riparian areas and wetlands. Potential cumulative impacts to these resources would include degradation of riparian and wetland habitat from livestock grazing, mining (surface disturbance and dewatering activity), conversion of native riparian/wetland plant communities to communities dominated by invasive non-native species, other industrial development (e.g., power plants and transmission corridors), service roads, wildfire, and in some cases agricultural diversions. Riparian/wetland vegetation could be lost, either on a temporary or permanent basis. Currently, potential for impacts to riparian/wetland resources are associated with establishment of invasive non-native species (weeds) and with annual hot season grazing by livestock (where it occurs) resulting in loss of habitat and decrease/loss of vegetation.

With the exception of some localized impacts (reduced flow in Maggie Creek narrows and drying of three springs), dewatering impacts to approximately 618 acres of riparian and wetland habitats identified in previous EIS documents have not materialized. Improvement and expansion of riparian/wetland habitat has occurred in response to the Maggie Creek Watershed Restoration Project and Upper Willow Creek Habitat Enhancement Plan (Evans 2007).

Infiltration of excess mine water from dewatering operations has resulted in an increase in water levels, or mounding, south of Maggie Creek Reservoir (BLM 2002a), lower Maggie Creek, and upper Boulder Valley (BLM 2000). Mounding in the Maggie Creek area is likely due to seepage from the Maggie Creek Reservoir; reduced pumping from the Carlin Formation near SOAPA; and recharge along Maggie Creek as a result of mine dewatering discharge and irrigation**.**

In 1992-1993, seepage from the TS Ranch Reservoir resulted in the formation of three new springs (Sand Dune, Knob and Green Springs) in the northeastern portion of Boulder Flat approximately 5 miles south the of the TS Ranch Reservoir (BLM 2000). Extensive stands of riparian and wetlands vegetation has developed with formation of these springs, resulting in approximately 1,200 acres of habitat. The combined flow from these springs is about 6,000 gallons per minute (Listerud 2007). This flow and associated riparian and wetlands habitats will continue as long as water from mine dewatering is placed in the subsurface near the TS Reservoir. Eventually, these springs will disappear once discharge to the TS Ranch Reservoir is discontinued. Cessation of flow would result in a loss of the established riparian and wetland vegetation, as well as associated aquatic organisms. The spring areas would revert to pre-discharge conditions and would again support upland vegetation species.

Newmont's South Operations Area is the only mining operation discharging to Maggie Creek. Water quality associated with SOAPA and other mine discharges in the Humboldt River basin has been within permit limitations (BLM 2002a). Water quality data collected to date support the prediction that future mine discharges would not impact water quality in the river. Adverse impacts to surface water quality are not expected from mine dewatering at the Leeville, SOAPA, and Betze projects.

Recalibration of the numerical groundwater flow model (HCItasca 2009) indicates that impacts to riparian vegetation and aquatic habitats along the Humboldt River from base-flow reductions following cessation of pumping are less than projected in SOAPA (BLM 2002a) and CIA (BLM 2000). See *Water Quality and Quantity* section in this chapter.

Recent fires have affected some riparian and wetland habitats in the Study Area, many of these areas did not burn or have shown recovery in years following fires. Condition of riparian areas prior to wildfire represents the single most important influence in predicting effects of fire (Evans 2007). Many stream and riparian habitats burned by recent wildfires in the Study Area that are being managed under prescriptive livestock grazing programs continue to improve.

Potential effects of future wildfire on riparian areas and wetlands are dependent on site conditions at the time of a fire. Wetland and riparian areas that have retained sufficient moisture would likely survive wildfire with minimal loss of vegetation and aquatic life. Sites that enter the fire season in a dry state or are in poor ecological condition are more likely to be damaged by fire.

Previous predictions of higher loading of sediment due to mining activities, which could adversely affect wetlands in the Humboldt River, Humboldt Sink, and Wildlife Management Area 6 have not been documented. Sediment loading in Maggie Creek has been shown to be reduced during high flows in response to development of a healthy and well established riparian zone (see discussion of *Maggie Creek Watershed Restoration Project* in this section).

Quality of mine discharges is in compliance with permit limits, with no documented adverse impacts on receiving water including the Humboldt River (see *Water Quantity and Quality* section in this chapter). This supports the prediction that current and reasonably foreseeable mine discharges would not impact water quality and associated riparian/wetland resources in the Humboldt River.

Flooding in 2005 and 2006 throughout the Study Area resulted in erosion of some streams. Flooding impacts appeared to be moderated along portions of the Maggie Creek and Willow Creek drainages as a result of habitat restoration and re-vegetation efforts of the Maggie Creek Watershed Restoration Project and Upper Willow Creek Habitat Enhancement Plan (Evans 2007)

Grazing has affected and will continue to affect riparian areas to varying degrees. Depending on the level of management, livestock grazing may have minimal to extensive impacts on riparian management. Over the last several decades, riparian areas have generally improved throughout portions of the Study Area. As the need and opportunity for management changes are identified and implemented, riparian areas are expected to continue to improve. All allotments within the Study Area are scheduled for 10-year grazing permit renewals which include environmental analysis of impacts to riparian areas from livestock grazing.

The TS Power Plant, located in the lower Boulder Valley, does not have any discharges to area streams, including the nearby Humboldt River. In addition, no wetlands or riparian areas are located in the project area. No impacts to riparian/wetland vegetation are expected and, therefore, the power plant project would not contribute impacts to riparian and wetlands in the Study Area.

FISHERIES AND AQUATIC RESOURCES (Including Threatened, Endangered, and Candidate Species)

This Final SEIS provides new quantitative data collected between 2002 and 2009 to further characterize cumulative effects to fisheries and aquatic resources previously described in the SOAP EIS (BLM 1993), SOAPA EIS (BLM 2002a), and Leeville EIS (2002b).

Fish species found in streams in the Study Area include Lahontan speckled dace, Lahontan redside shiner, Tahoe and mountain suckers, and Lahontan cutthroat trout (BLM 2000). In

2006 and 2007, smallmouth bass were documented in Lower Maggie Creek (MFG, Inc. 2006; Evans 2007). According to BLM Elko District Office stream survey files, the lower reaches of Rock Creek support non-native warm water fish species and bullfrogs (Evans 2007). With the exception of the Lahontan cutthroat trout, no other trout species (including non-natives) have been found within the Maggie Creek sub-basin (Elliott 2004). Brook trout were found in Spring Creek in 1992, but none were found during a 1997 survey of the stream (BLM 2002a). Brook and rainbow trout were previously stocked in Willow Creek, Rock Creek, Nelson Creek, and Willow Creek Reservoir; but none had been found in recent surveys as reported in 2004 (Elliott 2004).

The Humboldt River is considered a warm water fishery with species tolerant of high sediment load and warm water temperatures. Twenty-three species, including many which are introduced, have been recorded for the Humboldt River. In addition to common native minnow and sucker species found in headwater streams, the Humboldt River also supports the Lahontan tui chub (BLM 2003).

In 2006, a population of bullfrogs was identified in the lower reaches of Susie Creek (Evans 2007), although none were known to occur in this stream prior to then. A single bullfrog was also reported about 10 to 15 miles upstream of this location (Warren 2006).

Currently there are four species that are federally threatened, candidate or BLM-sensitive (fish, amphibians, and invertebrates) that reportedly occur within the Study Area:

- Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) - federally listed (threatened) species;
- California floater (*Anodonta californiensis*) – BLM-sensitive species;
- Columbia spotted frog (*Rana luteiventris*) – federal-candidate species; and
- Springsnails (*Pyrgulopsis sp*.) – some species are BLM-sensitive; others have importance because of limited occurrence and/or potential for future listing.

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for fisheries and aquatic resources encompasses a portion of the Humboldt River basin including the following hydrographic areas: Susie Creek, Maggie Creek, Marys Creek, Boulder Flat, Rock Creek Valley, Willow Creek Valley, and the adjoining portion of the Humboldt River (**Figure 3-10**). This Study Area encompasses riparian areas and wetlands, as well as streams that could be affected by groundwater drawdown associated with mine pit dewatering.

MONITORING DATA AND NEW INFORMATION

Information collected as part of the following programs and projects is relevant to fisheries and aquatic resources and is summarized in the *Riparian Areas and Wetlands* section of this chapter:

- Newmont Spring Monitoring;
- Maggie Creek Basin Monitoring Plan;
- Barrick Spring Monitoring;
- Barrick Boulder Valley Monitoring;
- Maggie Creek Watershed Restoration Project (including Monitoring Program); and
- Barrick Upper Willow Creek Habitat Enhancement Plan (including Monitoring Program).

Additional programs, studies and monitoring efforts provide current information specific to fisheries and aquatic resources within the Study Area. These sources of information are summarized below.

Trout Unlimited Strategies for Restoring Native Trout Program – Maggie and Willow Rock Creek Drainages

A description of Trout Unlimited Strategies for Restoring Native Trout Program is contained in the *Stabilization and Rehabilitation Programs* section of Chapter 2. Results of Lahontan cutthroat trout monitoring in Maggie Creek watershed have shown fluctuations in Lahontan cutthroat trout populations since 2001, which are likely due to a combination of environmental and treatment influences (Neville and DeGraaf 2006). Poor recruitment in Beaver Creek in 2002 was likely due to a large fire in 2001 that affected riparian habitat allowing increased amounts of sediment to enter the stream. The population rebounded in 2003, but was exposed to a drought in 2004 when the population again declined. An abundance of water in 2005 and 2006 likely provided sufficient flow that Lahontan cutthroat trout were able to pass old culvert "barriers" still in place during spring 2005, allowing them to reach Beaver Creek to spawn. Presence of multiple age classes and higher numbers of Lahontan cutthroat trout in 2006, after culvert replacement in fall 2005, may indicate positive population responses to a combination of the culvert barrier removal and increased water flow. Additional post-barrier removal data are needed to detect a true trend in response to improved connectivity (Neville and DeGraaf 2006).

The Lahontan cutthroat trout population of Coyote Creek showed a decline during the 2004 drought from previously healthy numbers. Population of trout slowly rebounded in 2005 and remained stable in 2006 (Neville and DeGraaf 2006). Higher flows in 2006 caused erosion of upper elevation stream banks during spring runoff, resulting in increased amounts of sediment load in the creek. The increased sediment loading may have had negative impacts on spring spawning and may explain the absence of noticeable increases in Lahontan cutthroat trout numbers despite high water flow. Little Jack Creek may have also had negative effects due to drought conditions in 2003, but improved water conditions in 2005 and 2006 resulted in a higher number of Lahontan cutthroat trout surveyed along with higher pulses of young-of-year.

The Lahontan cutthroat trout population numbers in the Willow/Rock Creek watershed have been steadily increasing as the upper elevation habitat has been improving (Neville and DeGraaf 2006). Multiple classes of Lahontan cutthroat trout were present in 2005 and 2006, suggesting a natural reproducing population exists. Age class structure in the Study Area is mirroring that in the Frazier Creek control site, suggesting that habitat improvements in Willow Creek are affecting recruitment (defined as a measure of the number of fish that enter a class during some time period, such as the spawning class or fishing-size class). Multiple years of data are needed to detect a trend in response to on-going restoration efforts.

Benthic macroinvertebrates were sampled at six survey reaches in 2003 in Willow, Nelson, and Lewis creeks (Neville and DeGraaf 2006). Most reaches were dominated by the *Chironomidae* family (*Diptera* – flies), although one reach was dominated by the *Caenidae* family (*Ephemeroptera* – mayflies). Results of the survey indicated that Willow, Nelson, and Lewis creeks contained water with poor to marginal water quality (based on assessment of taxa richness and abundance of insect orders considered sensitive to pollution). Few taxa collected in upper Willow Creek basin were considered intolerant forms (resistant to pollution), indicating relative poor water quality. Willow, Nelson, and Lewis creeks also had slight to moderate organic enrichment.

Analyses performed on Lahontan cutthroat trout from Coyote Creek and Little Jack Creek indicated the organisms were pure. Genetic evaluations on four (Frazier Creek, Nelson Creek, Upper Rock Creek, and Toe Jam Creek) of the six Lahontan cutthroat trout recovery populations in the Rock Creek sub-basin indicated that no evidence of hybridization has been found (Elliott 2004). Trout Unlimited contracted with the Conservation Genetics of the University of Nevada-Reno in 2003 to examine population dynamics in the Maggie Creek Basin (Trout Unlimited 2007a). Results of the testing indicated that the Maggie Creek sub-basin (Beaver, Little Jack, and Coyote creeks) currently supports three distinct populations of Lahontan cutthroat trout.

Open Range Consulting - Evaluation of Factors Affecting Lahontan Cutthroat Trout in Three Large Watersheds

A description of this project is contained in the *Stabilization and Rehabilitation Programs* section of Chapter 2. Preliminary results indicate both upland and riparian plant cover has increased between 2003 and 2006. Correspondingly, percent bare ground in the watershed has deceased, while habitat for fisheries and aquatic resources has improved (Open Range Consultants, Inc. 2007).

Humboldt River Baseline Studies

As part of its NPDES Permit issued by NDEP, Barrick has conducted monitoring on the Humboldt River from 1995 to 2006. Barrick began discharging to the Humboldt River in late September 1997 and discontinued discharging in February 1999. Monitoring focused on the river's physical characteristics, aquatic habitat, mcaroinvertebrate communities, and to a limited extent, the fish communities in the Study Area (JBR 2007). The data essentially serve as baseline in the event Barrick were to resume discharge to the Humboldt River.

Effects of mine dewatering discharges on Humboldt River biota from the Gold Quarry, Lone Tree, and Betze mines were also evaluated by the USFWS (Wiemeyer *et al.* 2004). Besides serving as a baseline, the study concluded that there is no evidence that mine discharges have had adverse effects on biological resources in the Humboldt River.

BLM Stream Habitat Monitoring

Surveys conducted by BLM between 2000 and 2006 on streams within the Study Area show habitat conditions in response to improved livestock management practices (**Table 3-12**) (Elko District Office files). With the exception of Marys Creek (which is nonfunctional) and James Creek (which was rated non-functional in 2000), functioning condition studies done in conjunction with stream survey show streams are in proper functioning condition or are functioning-at-risk, with an upward trend (Pritchard *et al.* 1998). Flooding in 2005 and 2006 caused widespread impacts including erosion and deposition; however, streams that were in good condition prior to the flooding were less impacted and are recovering more quickly.

BLM Wildfire Impact Studies

As a result of the fires in 2006, BLM prepared an evaluation of fire impacts to threatened, endangered and candidate species for the Elko Fire Management Plan Amendment issued by the USFWS on December 5, 2003 (BLM 2006d). Information provided in this evaluation addresses monitoring activities and summary of observed impacts.

TABLE 3-12 Summary of BLM Stream Surveys in the Study Area between 2000 and 2006.			
Stream	**Year of Survey**	**Condition/**	**Riparian Grazing System**
Maggie Creek Subbasin (Maggie Creek Area Hydrographic Basin)			
James Creek	2005	Poor/unknown	No (exclosure on part)
Indian Jack Creek	2005	Poor/up (flood damage)	Yes
Maggie Creek**	2006	Good/up	Yes
Coyote Creek**	2006	Excellent/up (localized flood damage)	Yes
Little Jack Creek**	2006	Excellent/up (localized flood damage)	Yes
Beaver Creek drainage (includes tributaries)**	20000	Excellent/up (areas of flood damage)	Yes
Susie Creek	2003	Good/up	Yes
Rock/Willow Creek Subbasin (Willow Creek Valley Hyrdrographic Basin)			
Frazer Creek **	2003	Excellent/up (localized flood damage)	Yes
Trout Creek	2003	Fair/up	Yes
Toe Jam Creek**	2003	Fair/up	Yes
Upper Willow(*) **	2002	Poor/up	Yes
Lewis Creek(*) **	2002	Good/up	Yes
Nelson Creek(*) **	2002	Good-Excellent/up	Yes
Rock Creek Valley Hydrographic Basin			
Middle Rock Creek	2003	Fair/up	Yes
Lower Rock Creek	2004	Fair/up –flood damage	Yes
Marys Creek Hydrographic Basin			
Marys Creek	2005	Poor – down – severe flood damage	No

rating based on an average of bank cover and bank stability in relation to optimum (optimum is considered totally stable streambank densely vegetated by trees or tall shrubs).

(*) Surveys conducted more recently by Cedar Creek Associates show continued improvement, especially on Upper Willow Creek.

** Lahontan cutthroat trout stream

Note: Spotted frogs in Maggie, Upper Willow, Susie, Coyote, and Little Jack creeks, California floaters in Maggie, Middle and Lower Rock creeks.

A number of drainages occupied by the Lahontan cutthroat trout, a federally listed species, and spotted frogs, a candidate species for listing, were burned in 2006 (BLM 2006d). In most cases, uplands were scorched, but riparian zones were green at the time of the fires and remained intact. Approximately 12 miles of occupied Lahontan cutthroat trout habitat and approximately 59 miles (includes some areas outside the Study Area) of potential Lahontan cutthroat trout habitat were affected by the 2006 fire (BLM 2006d). Occupied and streams potentially affected in the Study Area included Susie, Frazer, Upper Rock, Lone Mountain and Trout creeks. Spotted frogs occur in Susie Creek. Documented loss of Lahontan cutthroat trout, or spotted frogs, as a result or indirect effects of the 2006 fires was not recorded.

The Coyote and Buffalo fires in 2001 and the Esmeralda Fire in 2005 also affected occupied Lahontan cutthroat trout and spotted frog habitat. Both the Frazer and Beaver creek drainages were burned during 2001; while only portions of the riparian zone along Upper Willow Creek burned in 2005. Both Frazer and Beaver creeks were in good condition at the time of the fire and have recovered (BLM 2005b, 2006c).

In addition, Trout Unlimited (2007a) conducted population monitoring on Lahontan cutthroat trout streams affected by recent fires. In areas where habitat conditions have been improving, Lahontan cutthroat trout populations appear to be resilient to effects of catastrophic fires. Lahontan cutthroat trout populations in Frazer and Beaver creeks appear to be increasing, even though both were impacted by fires in 2001. Cutthroat populations in upper Willow Creek appear to be increasing (Evans 2007). No population monitoring for spotted frogs was conducted in 2006.

CUMULATIVE EFFECTS

Mining operations, industrial development, presence of non-native plant and wildlife species, and agricultural activities in the Study Area are expected to act cumulatively in affecting regional aquatic resources where the same water bodies are impacted. Potential cumulative effects to aquatic resources include degradation of aquatic habitat from livestock grazing, conversion of native riparian/wetland plant communities to communities dominated by invasive non-native weeds, mining (surface disturbance and dewatering activity), other industrial development (e.g., power plants and transmission corridors), service roads, wildfire, and in some cases agricultural diversions. Non-native species including bass and bullfrogs have potential to impact Lahontan cutthroat trout and spotted frogs in the Study Area primarily through predation. Aquatic habitat or species could be lost, either on a temporary or permanent basis. Mitigation programs are expected to reduce these potential impacts.

Land use activities in the Study Area could result in temporary or permanent displacement of some species. One of the major potential impacts to fish and aquatic resources is associated with long-term mine dewatering and drawdown of surface water features, resulting in loss of habitat and decrease/loss of populations. Although the 2006 wildfires were the worst on record for Elko County, no documented loss of Lahontan cutthroat trout or spotted frogs was recorded as a result of the wildfires (BLM 2006d).

Limited surface water impacts resulting from mine dewatering in the Carlin Trend area have been documented in over 15 years of monitoring. Groundwater drawdown associated with initial dewatering effort at Betze/Post reduced flow or dried a few springs and changed the flow and vegetation types in Brush Creek, a tributary to Rodeo Creek before 1998. Near SOAPA, a reach in Maggie Creek approximately 3 miles in length (*the Narrows*) now loses water to the carbonate aquifer as a result of water withdrawals associated with mill supply groundwater pumping and dewatering of the Gold Quarry pit (see *Water Quantity and Quality* section in this chapter). Both of these impacts occurred prior to approval of SOAPA and Leeville and are not included in the predicted impacts of those projects. None of the predicted impacts to the 618 acres of wetland/riparian habitats identified in the SOAPA EIS (BLM 2002a) or Leeville EIS (BLM 2002b) documents have occurred (Newmont 2009c, 2009d).

Newmont's SOAPA and Leeville projects and Barrick's Betze/Post/Meikle Mine complex account for most of the dewatering that has occurred and will continue in the foreseeable future in the Study Area. The combined groundwater cones-of-depression created by dewatering operations could create effects in regional groundwater drawdown, increasing potential for long-term impacts to aquatic organisms and associated habitat. Such impacts would be associated primarily with potential alteration of surface water base-flows and spring flows. Reduced surface water base-flows could eliminate or reduce numbers of fish and many aquatic invertebrates. Extension of the ongoing dewatering discharges would extend the predicted period of reduced base-flows following cessation of mining and thus have the most potential to affect the Humboldt River (see *Water Quantity and Quality* section in this chapter). Mitigation measures implemented by Newmont and Barrick are described later in this section.

Improvement in function and size of wetland/riparian resources in the Study Area as a result of Maggie Creek Watershed Restoration Project, Upper Willow Creek Habitat Enhancement Plan, Susie Creek Riparian Restoration Project, Beaver Creek Riparian Pasture, and improved livestock grazing practices have occurred (see *Stabilization and Rehabilitation Programs* in Chapter 2). The level of recovery documented benefits wildlife including Lahontan cutthroat trout, California floaters, and other aquatic species (Trout Unlimited 2007b).

Infiltration of excess mine water from dewatering operations has resulted in an increase in water levels, or mounding, south of Maggie Creek Reservoir (BLM 2002a), lower Maggie Creek, and upper Boulder Valley (BLM 2000). This mounding in the Maggie Creek area is likely due to seepage from the Maggie Creek Reservoir; reduced pumping from the Carlin Formation near SOAPA; and recharge along Maggie Creek as a result of mine dewatering discharge and irrigation.

In 1992-1993, seepage from the TS Ranch Reservoir resulted in the formation of three new springs (Sand Dune, Knob and Green Springs) in the northeastern portion of Boulder Flat approximately 5 miles south the of the TS Ranch Reservoir (BLM 2000). Extensive stands of riparian and wetlands vegetation has developed with formation of these springs, resulting in approximately 1,200 acres of habitat. The combined flow from these springs is about 6,000 gallons per minute (Listerud 2007). This flow and associated aquatic habitat will continue as long as water from mine dewatering is placed in the subsurface near the TS Reservoir. Eventually, these springs will disappear once discharge to the TS Ranch Reservoir is discontinued. Cessation of flow would result in a loss of the established aquatic habitat and organisms. The spring areas would revert to pre-discharge conditions and would again support upland vegetation species.

Newmont's South Operations Area is the only mining operation discharging to Maggie Creek. Water quality associated with SOAPA and other mine discharges in the Humboldt River basin has been within permit limitations (BLM 2002a). Water quality data collected to date support the prediction that future mine discharges would not impact water quality in the river. Adverse impacts to surface water quality are not expected from mine dewatering at the SOAPA, Leeville, and Betze projects.

Recalibration of the numerical groundwater flow model (HCItasca 2009) indicates that impacts to riparian vegetation and aquatic habitats along the Humboldt River from base-flow reductions following cessation of pumping are less than projected in SOAPA (BLM 2002b) and CIA (BLM 2000). See *Water Quality and Quantity* section in this chapter.

Mine dewatering could reduce surface flows due to reductions in spring-fed portions of lower Little Jack/Jack, Beaver and Maggie creeks, which have been documented to support Lahontan cutthroat trout. Most Lahontan cutthroat trout habitat in Little Jack, Coyote and Beaver creeks would not be affected because the upper reaches are not connected to the regional aquifer. Flow reductions have also been predicted for lower Susie Creek (no base-flow between years 2033 and 2078), which is considered a potential recovery area for Lahontan cutthroat trout. No fish have been documented in middle Susie Creek (BLM 2006e).

The Maggie Creek Water Restoration Project has improved stream and riparian habitats in the Maggie Creek drainage since 1993, and further improvement is expected. Potential effects on Lahontan cutthroat trout habitat from dewatering activities are considered unlikely due to a relatively small amount of habitat potentially affected and the demonstrated habitat improvement includes all streams in the Maggie Creek drainage containing Lahontan cutthroat trout habitat except Lone Mountain Creek.

Long-term and cumulative mine dewatering could also adversely affect habitat for the Colombia spotted frog, California floater, and springsnails. Flow reductions in the Maggie Creek sub-basin and lower Rock Creek could decrease habitat used by the California floater. Colombia spotted frogs could also be affected in the Maggie Creek drainage. Springsnails are present in at least five springs in the Study Area that could potentially be affected by dewatering drawdown. If any springs are dewatered, the population in that spring would be lost unless it could be relocated.

Measures included in SOAP (BLM 1993), SOAPA (BLM 2002a), Leeville Project (BLM 2002b), and Betze/Post (BLM 2009b) mitigation plans address potential adverse impacts, including dewatering impacts, without regard to whether they occur on public or private land. These mitigation measures are designed to provide not only protection of natural resources but also improvement of most resources in the area, including aquatic habitat. Measures in the plans that deal directly with dewatering include extensive groundwater monitoring and reporting protocols. Monitoring data are used to trigger implementation of mitigation measures, including stream flow augmentation for individual streams, seeps and streams if and when the cone of depression impacts groundwater recharge to those water resources (*e.g.*, Maggie and Susie creeks stream flow augmentation plan). To date, implementation of mitigation plans has had a beneficial impact to fisheries and aquatic resources, including the Lahontan cutthroat trout, in the Study Area.

GRAZING MANAGEMENT AND AGRICULTURE

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for grazing management and agriculture is shown on **Figure 2-3.** Mining and livestock grazing are the dominant land use activities in the Carlin Trend. The rationale for the Study Area is based on the effect mine dewatering may have on the availability of water in springs, seeps, and streams used to provide water for livestock. The location and availability of water would be used to determine stocking rates and season of usage for pastures within the various allotments.

MONITORING DATA AND NEW INFORMATION

During 2006, an average of 53 pivots was used to irrigate approximately 7,900 acres on the TS Ranch in the Boulder Valley. When dewatering operations are discontinued at Betze/Post and Leeville and dewatering water no longer flows to the TS Ranch reservoir, irrigation in Boulder Valley will likely be reduced to 20 to 30 pivots (Newmont 2009b).

CUMULATIVE EFFECTS

Grazing Management

Cumulative effects on grazing result from wildfire, introduction of noxious weeds, energy development, and mining activity. Mine development in the Study Area has converted approximately 33,500 acres from livestock grazing in 4 allotments within the Study Area to mining and related activities. Reasonably foreseeable mine development in the Study Area between 2010 and 2020 would add approximately 7,200 acres of mining and exploration disturbance. This additional disturbance would have minimal affect on grazing allotments as most development would occur within existing permitted boundaries where adjustments to grazing use have previously occurred. Continued mine dewatering in the Study Area could cause changes in groundwater levels, surface water flow, and/or water quality resulting in reduced stocking rates, livestock distribution, and/or forage utilization.

Construction of the TS Power Plant resulted in conversion of 723 acres of private land from grazing and wildlife habitat to industrial use (ENSR 2004a). The power plant would not affect grazing allotments administered by BLM because the project is occurring on private land in Boulder Valley.

Adjustment to the term grazing permit on the T Lazy S Allotment as a result of the SOAPA project has already been made. Reduction in permitted use for grazing extends through the life of the mine in most cases. Following reclamation, the majority of mine sites will be made available for grazing. In addition, these sites are often more productive than adjacent native sites as native cultivars are used for reclamation and competition is limited to only those few species in the seed mixture.

Reclamation of mine related disturbances in the Study Area will be incremental as various operations reach the end of active mining and begin closure activities. Approximately 7,800 acres would remain as open pits, some partially filled with water. Approximately 25,700 acres would be reclaimed to provide livestock grazing.

From 1999 through 2008 about 55 percent (approximately 800,000 acres) of land encompassed by the 13 allotments comprising the Study Area have been affected by wildfire. Stocking rates and seasons of use are periodically reviewed and adjusted by BLM in response to the severity of burns in the various allotments effected. Restoration and reseeding efforts to mitigate losses from wildfire have had varying degrees of success. Some areas seeded during the first appropriate season following a fire (fall or winter) exhibited successful seedling establishment, while other areas became infested with noxious weeds (cheatgrass), re-burned within a year or two, or did not respond, possibly due to draught or other climatic conditions. Some areas had adequate native perennial grasses and did not require herbaceous reseeding following wildfires.

Other restoration projects have included fencing burned areas to allow vegetation to recover and adjusting stocking rates and seasonal use to reflect available forage in the various pastures within each effected allotment. Habitat restoration/reseeding projects from 2000 through 2008 within the Study Area resulted in reseeding a total of approximately 382,000 acres (approximately 55,000 private and 327,000 public).

Agriculture

Cumulative effects to agriculture would include a reduction in irrigated land in the Boulder Valley. Water currently provided by dewatering activities at Barrick's Betze/Post operation and Newmont's Leeville Mine will decrease at a rate commensurate with mining activity and eventually cease to be available for irrigation. At that point, irrigation in Boulder Valley would revert to pumping existing groundwater wells on the TS Ranch. These wells would support 20 to 30 pivots at current application rates (Newmont 2009b) described in Chapter 2 – *Grazing and Agriculture*.

RECREATION

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for recreation covers the administrative area of the Elko District Office as shown on **Figure 2-**

6. The administrative area of the Elko District Office encompasses communities where most of the population resides that use recreation facilities in the area.

MONITORING DATA AND NEW INFORMATION

In 2009, BLM developed recreational sites within the administrative area received 6,170 visits; up from previous years. Similar data are collected by Humboldt National Forest for use of developed recreational sites on National Forest System land.

CUMULATIVE EFFECTS

Dispersed recreation opportunities including off-highway vehicle use, hunting, hiking, and sightseeing in the vicinity of the Carlin Trend have been restricted since the early 1980s because of intensified mining and exploration activities in the Carlin Trend. Recent wildfires have further reduced the opportunity for recreation in northeast Nevada.

The gradual but continuous expansion of mining activities in the Carlin Trend would result in less area available for dispersed recreation activity during operation and after cessation of mining until reclamation is complete. Any increase in population associated with mine development would result in more demand for recreation on public land.

To date, recreational use of approximately 33,500 acres in the vicinity of the Carlin Trend has been restricted due to mine development. Reasonably foreseeable mine development from 2010 to 2020 in the Carlin Trend would affect an approximately 7,200 additional acres. Public access to these areas would be restricted to maintain safety and security during mine operations. Upon reclamation and closure these areas would be available for dispersed recreational use.

The overall changes in cumulative impact to recreation and hunting from past, present, and reasonably foreseeable mining related activities is likely to remain minimal, in part because of access restrictions related to mining areas currently exist and unrestricted areas adjacent to the Carlin Trend area remain available for dispersed recreational use.

Employment associated with mine operations, construction activity, and general population growth associated with employment in the Elko area affects the usage of recreational facilities throughout the Study Area. Downturns in employment result in an out migration of workers which in turn reduces the amount of usage of these areas.

ACCESS AND TRANSPORTATION

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for access and transportation includes Interstate 80, State Secondary Route 766, Union Pacific Railroad, and areas adjacent to past, present, and reasonably foreseeable mining operations. These are the primary transportation routes for goods and services in the Carlin Trend and areas where access may be affected by existing and future operations.

MONITORING DATA AND NEW INFORMATION

According to the Nevada Department of Transportation annual average daily traffic count on State Route 766 north of Carlin between 1999 and 2008 ranged from a low of 1,850 in 2002 up to 2,650 in 2006 for an average of 2,275 vehicles over the 10-year period. This amounts to approximately 20 percent of the traffic volume on Interstate 80 between the Elko and Dunphy exits (NDOT 2009).

CUMULATIVE EFFECTS

Access

Foreseeable mine development would result in access restrictions in the vicinity of the Emigrant Mine. Other routes exist in this area that would allow public access to locations blocked by this proposed development.

Numerous two-track roads provide access throughout the Study Area to support livestock grazing operations and public access for recreational purposes. Future mining operations could preclude use of these routes.

Transportation

Cumulative effects on transportation result from increased mining activity, energy development, and increases in population. Rail traffic would increase incrementally as a result of the coal fired TS Power Plant north of Dunphy. Approximately 800,000 tons of coal is delivered by rail annually to the TS Power plant. In addition, a fuel depot located at Dunphy provides diesel fuel to mines in the Carlin Trend.

Trucks are used to transport a variety of materials to mine sites. Shipments of diesel fuel from Dunphy are transported 34 miles to the town of Carlin via Interstate 80. From Carlin, fuel is transported 15 miles along State Route 766, a rural two-lane road to mine access roads.

Future mine development would not likely increase mine related traffic because as activity at some mine areas decreases, other mines begin operation resulting in a relatively static level of employment and corresponding level of traffic. Traffic in the Study Area would be re-directed in response to future mine developments, such as Newmont's Emigrant Project which lies south of Interstate 80. The Emigrant Project would employ approximately 100 people during construction and about 180 people during mine operations. Most of the work force for the project would come from existing mine-related work forces in the Carlin area (Newmont 2007h).

The majority of mine related traffic would continue to be directed toward Newmont's SOAPA and Barrick's Betze/Post areas for the foreseeable future. Both Newmont and Barrick offer bus transportation for employees from Elko to the mine sites.

VISUAL RESOURCES

Visual resources are evaluated within the context of BLM's Visual Resource Management program. This program has established categories of visual elements throughout the Elko Resource Area. BLM reviews proposed projects which are assessed against their surrounding landscape for compliance with this program.

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for visual resources encompasses the Carlin Trend extending from the Hollister Mine in the north to the Emigrant Mine in the south. Key observation points are located along public access points or areas frequented by the public. The rationale for selecting this geographic area is the relationship between mining level disturbance (creation of open pits, waste rock disposal facilities, tailing storage facilities, haul roads, and ancillary mine facilities that modify the natural landscape) and the viewshed from various points where public access is established.

The Study Area is predominately located in a Visual Resource Management (VRM) Class IV area under BLM's VRM program. The objective of Class IV is to provide for managing activities that require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. Management activities (*e.g*., developments) may dominate the view and be the major focus of viewer attention. Impacts of these activities are minimized through careful location, minimal disturbance, and repeating the basic elements (form, line, color, and texture). Class IV allows substantial modifications of the landscape but places emphasis on mitigation, where possible, of those impacts.

MONITORING DATA AND NEW INFORMATION

No new visual simulations have been compiled since 2002. The Emigrant Project would result in a modification of the natural landscape.

CUMULATIVE EFFECTS

Current and future mine development within the Carlin Trend would not exceed the visual prescriptions of the VRM Class IV designation. Reclamation measures are required for mine disturbances and reclamation would occur on current and future mining activities in the Carlin Trend. Major elements of certain mining facilities would remain after reclamation including pit highwalls and earth-fill structures. Visual contrasts in form, line, and color would remain in the post-mining landscape.

Mine development in the Carlin Trend has resulted in linear features comprised of mine pits, haul roads, waste rock disposal sites, heap leach pads, tailing storage facilities, and mills. Mine developments in many locations are not separable through visual observation. The linear characteristic of these mine developments is expected to be a visual element of the landscape for the foreseeable future. Visual contrast of structures is minimized using colors that blend with the land rather than the sky, and using finishes with low levels of reflectivity.

Night lighting resulting in a visible glow around mining and mill areas will likely continue throughout the life of the respective operations. Following mining operations and ore processing, lighting will be removed during reclamation and closure of the sites. As existing lighting fixtures age and require maintenance they are replaced with components designed to be energy efficient while providing adequate lighting for safety and security purposes. Fixtures with "Dark Sky" features are installed where practicable.

Other land use activities or conditions within these viewsheds have affected and would continue to affect the visual characteristics of the landscape. Burned areas (range fires), power plants, powerlines, pipeline corridors, highways and roads, and livestock grazing affect the natural landscape to varying degrees and at varying seasons and duration. These land use activities and natural phenomena would likely continue to affect visual elements of the landscape into the future. Mitigation of all the visual impacts resulting from mining disturbance may not be possible but the severity could be minimized through project design.

WASTE, SOLID AND HAZARDOUS

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for solid and hazardous wastes and hazardous materials encompasses the permitted mine sites shown on **Figure 2-7**.

MONITORING DATA AND NEW INFORMATION

Current and reasonably foreseeable levels of solid and hazardous waste and hazardous materials used, stored, transported and generated in the Carlin Trend are described in the *Mine and Mineral Development* section of Chapter 2.

CUMULATIVE EFFECTS

Hazardous materials may affect air, water, soil, and biological resources that could potentially be affected by an accidental release during transportation to and from the Carlin Trend and during storage and use at project sites. Solid and hazardous wastes and hazardous materials present in the Carlin Trend are transported, stored, and managed in accordance with applicable federal, state, and local regulations. Non-hazardous solid wastes are disposed in NDEP permitted Class III waivered landfills constructed on mine sites, generally within waste rock disposal facilities.

Trucks are used to transport a variety of hazardous waste and materials to and from mines in the Carlin Trend. Shipments of hazardous substances originate from locations such as Dunphy, Elko, Salt Lake City, and Reno and are transported to the town of Carlin via Interstate 80. From Carlin, the substances travel along State Route 766, a rural two-lane road to the respective mine access roads.

Based on total number of deliveries, the material of greatest concern is diesel fuel. The probability of an accident resulting in a release involving diesel fuel was calculated using Federal Highway Administration truck accident statistics (Rhyne 1994). According to these data, the average rate of truck accidents for transport along a rural interstate freeway is 0.64 accidents per million miles traveled. For rural two-lane roads (State Route 766), the average truck accident rate is 2.19 accidents per million miles traveled.

The probability analysis indicates that the potential for an accidental release of liquids during truck transport during the remaining life of the SOAPA Mine is less than one accident involving a spill of diesel fuel. The total number of truck deliveries of diesel fuel could increase by 500 times before an accidental spill would be expected. Newmont and Barrick have emergency response measures in place to remediate any spills.

To date, three spills are known to have occurred at the Maggie Creek narrows on Route 766. Spills include 2,000 gallons of diesel in 1999, 300 gallons of grease in 1997, and an unknown quantity of material from a cement truck in 1997. The turn in the road at Maggie Creek narrows is now equipped with flashing lights (McFarlane 2009).

Reasonably foreseeable future activities concerning solid and hazardous waste and hazardous materials are likely to remain at current levels or increase incrementally with expanded mine development. Typically as new mines come into production, others are entering closure and the overall quantity of these materials is maintained. Quantities of these materials used, stored, transported, and generated would begin to decline as reserves in the Carlin Trend are depleted and no new mines are developed.

NOISE

Noise associated with proposed activities on public land administered by BLM is evaluated to determine the potential impacts that could result from a source of noise in an otherwise ambient condition. Noise could impact sensitive receptors including human and animal. No specific noise standard has been adopted that would apply to conditions external to a facility. The Mine Safety and Health Administration and Occupational Safety and Health Administration regulate noise levels in the work place as those regulations apply to worker safety.

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) encompasses the active mining areas in the Carlin Trend (Barrick Betze/Post area to

SOAPA). Noise results from mining activities including drilling, blasting, loading, hauling, and processing of ore and waste rock. These activities encompass a wide range of noise levels which are affected by mobility of the source of noise (truck haulage), topography of the area (blocking noise), temperature of the air (cold air transmits noise more efficiently than warm air), and frequency of the source (blasting vs. milling operations). Distance to sensitive receptors also affects analysis of whether noise generated by a specific activity would be a nuisance.

MONITORING DATA AND NEW INFORMATION

Noise generated by mining and ore-processing activities in the Carlin Trend has changed over time with the advancement of exploration and mining operations. Noise generated by drilling equipment, blasting, truck haulage or ore and waste rock, and milling operations has affected ambient noise levels that existed prior to major mine development in the Carlin Trend. Noise generated from these activities ranges from infrequent noise resulting from blasting of rock in mine pits; periodic noise associated with haul truck traffic; and constant noise associated with milling operations. Noise levels associated with exploration and mining activity and locations of sensitive receptors are described in the SOAPA EIS (BLM 2002a).

Proposed development of Rodeo Creek Gold's Hollister Development Block would create a source of noise during construction and operation of the proposed mine. The proposed project is an underground mine and consequently, noise associated with blasting would not be noticeable at the surface; especially as workings advance to depth. Noise associated with surface operations is not known at this time and is dependent on the mine and ore processing plans currently in development.

Other sources of noise in the Study Area include off-highway vehicles, firearms, and highway traffic. No monitoring data are available to characterize these sources.

CUMULATIVE EFFECTS

Noise does not accumulate in the environment; it can have a direct impact on sensitive receptors but it does not form an additive or cumulative effect on the environment. No cumulative effects from noise in the Study Area have been determined.

SOCIAL AND ECONOMIC RESOURCES

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for social and economic resources encompasses the area between Elko and Winnemucca on Interstate 80, including Elko, Eureka, Humboldt and Lander counties (**Figure 3-11**). The rationale for selection of this Study Area is outlined below:

- Residential patterns of mining company employees determine where they are likely to spend their salaries. Employees of mining companies do not necessarily live in the closest community to their employment nor do they live in the local governmental unit which receives increased tax revenues as a result of the facility. According to the U.S. Department of Commerce (2009), commuting data for 2006 suggest that:
    - Elko County is a bedroom community (income derived from people commuting out of the county exceeds the income from people commuting into the county.) The net difference represents 16.4 percent of total income in the county.

U.S. Department of the Interior
Bureau of Land Management
Elko District Office
Tuscarora Field Office
Elko, Nevada

SOCIOECONOMIC RESOURCES
CUMULATIVE EFFECTS STUDY AREA
SOAPA Project
Final Supplemental EIS
Eureka and Elko Counties, Nevada

FIGURE

3-11

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  - Eureka County is an employment hub (income derived from people commuting into the county exceeds the income from people commuting out of the county.) The net difference represents approximately 649.3 percent of total income in the county.
  - Humboldt County is an employment hub (income derived from people commuting into the county exceeds the income from people commuting out of the county.) The net difference represents 6.5 percent of total income in the county.
  - Lander County is a bedroom community (income derived from people commuting out of the county exceeds the income from people commuting into the county.) The net difference represents 10.1 percent of total income in the county.

- Availability of local shopping opportunities determines where people are likely to spend their disposal income in the four-county Study Area. The majority of shopping opportunities, including availability of medical, financial, and personal services, are located in Elko (Elko County) and Winnemucca (Humboldt County). Dollars from Carlin and Battle Mountain "bleed" out of Eureka and Lander counties to Winnemucca and Elko.

- Most communities within the four-county area have a distinct sense of being a "local community" while sharing basic values and beliefs. Towns in the Study Area are remote from the rest of the state, connected by Interstate 80.

MONITORING DATA AND NEW INFORMATION

The following sections provide updated baseline data on social and economic resources, where available.

Population Trends and Demographic Characteristics

The Study Area contains predominantly white communities, with Hispanic, Basque, and American Indian (mostly members of the Te-Moak Tribe of Western Shoshone) populations. Nevada is one of the fastest growing states in the U.S. (24.9% since 2000 Census). The two largest counties (Elko and Humboldt) have shown modest growth, while the two smallest counties (Lander and Eureka) lost population during the same period (**Table 3-13**). The towns of Elko (Elko County) and Winnemucca (Humboldt County) are well-developed and growing communities on either side of the Study Area, with smaller communities of Carlin and Battle Mountain in between Elko and Winnemucca.

The Te-Moak Tribe of Western Shoshone Indians of Nevada is a coalition government with headquarters in Elko, serving four distinct Shoshone colonies in Nevada: Battle Mountain Colony, Elko Colony, South Fork Colony, and Wells Colony. The Elko Colony encompasses approximately 190 non-contiguous acres adjacent to the City of Elko. The Battle Mountain Reservation is located on the west side of the town of Battle Mountain.

Housing

The number of housing units available has not kept pace with population growth experienced in Elko and Humboldt counties from 2000 to 2007 (**Table 3-14**).

TABLE 3-13
General Demographic Information

Characteristic	Elko County	Eureka County	Humboldt County	Lander County	State of Nevada
Total population (2008 estimate)	47,071	1,628	17,763	5,086	2,600,167
Percent Population change (April 1, 2000 to July 1, 2008)	3.9	-1.4	10.3	-12.2	30.1
Percent White, not Hispanic (2007)	70.6	81.6	71.5	74.1	58.0
Percent Hispanic or Latino (2007)	21.8	12.0	21.4	18.6	25.1
Percent Black (2007)	1.1	0.4	0.7	0.5	8.0
Percent American Indian and Alaska Native persons, percent, 2007	5.3	1.7	4.9	5.2	1.4
Persons below poverty, percent, 2007	8.7	9.1	11.4	10.5	10.6

Source: U.S. Census Bureau 2009.

TABLE 3-14
Housing Data, 2000, 2005 and 2007

Characteristic	Elko County	Eureka County	Humboldt County	Lander County	State of Nevada
Total Housing Units (2007)	19,420	1,054	7,291	2,757	1,102,379
Percent Change (April 1, 2000 to July 1, 2005)	3.3	3.8	1.1	-0.5	23.2
Median Value of Owner-Occupied Housing Units, 2000	$123,100	$89,200	$117,400	$82,000	$142,000

Source: U.S. Census Bureau 2009.

Government

Residents of the Study Area are governed by elected county commissioners and city councils if they live within municipal boundaries. Residents of the Elko and Battle Mountain Bands elect Tribal Councils.

Tax Revenues

Mining generates tax revenue for government in various ways:

- Net Proceeds Tax on Minerals, is an *ad valorem* tax assessed on minerals mined or produced in Nevada when they are sold or removed from the state.
- Property Tax, based on personal property (such as equipment) and real property (buildings) and paid to a city or county.
- Sales Tax, based on goods and services purchased from Nevada registered vendors and paid where goods and services are delivered.

- Use Tax, based on purchases from non-Nevada registered vendors, paid at point of final destination.
- Excise Tax, based on purchases of specific commodities such as diesel fuel and paid as part of the bill for the product.
- Payroll Tax, based on direct employee payroll and paid to relevant government agencies.
- Federal income tax based on an individual company's corporate-wide profits, and filed and paid in a consolidated global return to the U.S. Treasury.

The State of Nevada collects taxes on a multitude of items, including gaming, sales, and use taxes. Estimated state and local taxes paid by the mining industry in 2007 increased by almost 3.7 percent over 2006 based on information from the Nevada Department of Taxation and industry surveys. This increase follows a 45 percent increase in estimated taxes paid in 2006 over 2005. This represents the highest estimate over the past two decades. Total estimated taxes paid by mining companies in 2007 were $199.5 million, up from $194.2 million in 2006. These figures include taxes paid by operators and does not include taxes paid by industry employees or suppliers (Dobra 2007).

Mining is the only industry that pays taxes to state and local government on the basis of "Net Proceeds," a classification in which proceeds from non-metal mining production is taxed. Mineral operations are allowed to deduct direct costs of production, such as mining and milling, and are taxed on the net amount (Newmont 2005).

In 2006, Net Proceeds of Minerals in the State of Nevada were $1.27 billion and increased to $1.53 billion in 2007. Taxes on those proceeds increased about 23 percent, from $61 million in 2006 to over $75 million in 2007. In 2007, approximately 51 percent of the Net Proceeds on Minerals tax generated went to the State of Nevada general fund (Dobra 2007).

Table 3-15 presents the amount of net proceeds tax distributed to counties in which it was earned for 1999 through 2008. Mining activity has increased in Eureka and Humboldt counties, and has decreased in Elko and Lander counties over the same period. This is common in the Study Area as mines close and new mines are developed. In Fiscal Year 1999-2000, mining in the Study Area contributed to over 88 percent of net proceeds in the state; by 2008, mining contributed only 53 percent of net proceeds in the state.

TABLE 3-15
Net Proceeds of Minerals Tax Distribution (in dollars), 2000 - 2008

Fiscal Year	Elko	Eureka	Humboldt	Lander	State of Nevada/Total County Distribution
2000	$3,189,780	$1,911,738	$59,589	$7,644,328	$14,525,017
2001	2,891,062	2,968,354	496,667	5,822,029	14,114,324
2002	1,264,908	1,278,428	535,710	5,656,449	11,425.034
2003	1,561,131	1,222,059	1,076,801	4,725,660	13,756,888
2004	2,049,505	3,331,918	1,577,453	6,415,111	19,093,251
2005	2,003,547	3,356,887	191,595	9,505,593	21,886,103
2006	2,044,142	5,272,665	1,333,320	6,602,800	23,357,518
2007	2,489,641	8,089,017	2,584,508	1,141,634	32,345,089
2008	1,207,086	9,946,215	5,380,223	3,067,539	36,624,590
Percent Change 2000-2008	-62.2	420.3	8,928.9	-59.9	152.1

Source: Nevada Department of Taxation 2009.

Property taxes paid on property, plant, and equipment stay almost exclusively in the counties and special tax districts where mines are located. A small portion of property taxes is dedicated toward state debt repayment (Dobra 2007).

Various components of sales and use taxes are distributed differently. A portion (2 percent) goes to the general fund, another goes to school districts statewide on a per pupil basis, but the bulk is distributed on a per capita basis – *i.e.*, most of these funds go to Clark County (Las Vegas) with about 72 percent of the state's population (Dobra 2007).

Employment

Employment in Nevada in 2008 was dominated by service industries (73.2%) and specifically the leisure and hospitality industries with over 26 percent of the workforce in the sector. The gaming industry drives Nevada's economy. Gaming, hotel, and recreation areas employ the largest numbers of workers in the state (332,550 in 2008). The next largest employment sector for the period was trade, transportation, and utilities with over 18 percent of the jobs statewide. Just over one percent of jobs statewide in 2008 were in the natural resource and mining industries (Nevada Department of Employment, Training, and Rehabilitation 2009).

The economy of the Study Area is dominated by government and the mining industry. Employment by major industry with statewide employment by the same sector is shown in **Table 3-16**. Employment numbers are based on work location not residence, which is why Eureka County has more employees in the natural resources and mining sector than it has residents. Several major mines are located in Eureka County including Barrick Goldstrike Mine's Betze/Post operation and Newmont Mining Corporation's North Operations Area.

Employees of mining companies do not necessarily live in the closest community to their employment nor do they live in the local governmental unit which receives tax revenues as a result of the facility. According to U.S. Department of Commerce (2009), commuting data for 2006 suggest that Elko County is a bedroom community where 16.4 percent of the total income in the county is derived from people commuting to jobs out of the county.

In addition to future mine development in the Carlin Trend, the new TS Power Plant near Dunphy, and rail terminals in Elko and Winnemucca, provide additional employment. These private sector investments will result in substantial contributions to employment levels in the Study Area.

Income

Mining provides its employees with the highest average salary of any industry in Nevada. Average earnings in Nevada for all mining increased from $69,368 in 2006 to $77,064 in 2008 (**Table 3-17**). Average earnings in metal ore mining increased from $73,892 in 2006 to $78,572 in 2008. The average salary paid to mine workers extracting gold ore in Nevada in 2008 was $78,728 (Nevada Department of Employment Training and Rehabilitation 2009).

Goods and Services

Detailed Information regarding total expenditures by Barrick and Newmont within the Study Area is not available, however data for the broad categories of contracted services, consumables, and supplies was provided. Information for contracted services, consumables, and supplies for Halliburton's Rossi Mine or Rodeo Creek Gold's Hollister Development Block was not available.

TABLE 3-16
Employment by Sector, State of Nevada and Study Area Counties, 2008

Sector	State of Nevada		Elko County		Eureka County		Humboldt County		Lander County	
	Employees	Percent	Employees	Percent	Employees	Percent	Employees	Percent	Employees	Percent
Goods Producing - Private	**179,100**	**14.3**	**3,950**	**18.5**	**3,960**	**90.8**	**2,440**	**32.1**	**1,370**	**50.6**
Natural Resources & Mining	14,570	1.2	2,480	11.6	3960	90.8	1,780	23.4	1,370	50.6
Construction	116,450	9.3	1,250	5.9	NA	NA	350	4.6	NA	NA
Manufacturing	48,080	3.8	220	1.0	NA	NA	310	4.1	NA	NA
Service Providing - Private	**916,350**	**73.2**	**13,620**	**63.8**	**190**	**4.4**	**3,740**	**49.1**	**810**	**29.9**
Trade, Trans., Warehouse & Util.	230,750	18.4	3,810	17.8	130	3.0	1,410	18.5	530	19.6
Information	15,080	1.2	190	0.9	NA	NA	80	1.1	NA	NA
Financial Services	61,480	4.9	540	2.5	NA	NA	110	1.4	20	0.7
Prof. & Business Services	152,010	12.1	970	4.5	10	0.2	490	6.4	20	0.7
Educational & Health Services	95,340	7.6	1,300	6.1	NA	NA	310	4.1	30	1.1
Leisure & Hospitality	332,550	26.6	6,190	29.0	50	1.1	1,180	15.5	210	7.7
Other Services	29,140	2.3	620	2.9	NA	NA	160	2.1	NA	NA
Unclassified	**1,370**	**0.1**	**0**	**0.0**	**90**	**2.1**	**-10**	**-0.1**	**110**	**4.1**
Subtotal - Private	**1,095,450**	**87.5**	**17,570**	**82.3**	**4,150**	**95.2**	**6,180**	**81.2**	**2,180**	**80.4**
Service Providing – Public	**156,120**	**12.5**	**3,790**	**17.7**	**210**	**4.8**	**1,430**	**18.8**	530	**19.6**
TOTAL PRIVATE AND PUBLIC	**1,251,570**	**99.9**	**21,360**	**100.0**	**4,360**	**98.0**	**7,610**	**100.1**	**2,710**	**96.1**

Source: Nevada Department of Employment, Training, and Rehabilitation 2009. NA = Information not available.

TABLE 3-17
Income and Earnings Data

Characteristic	Elko County	Eureka County	Humboldt County	Lander County	State of Nevada
Average Annual Wages, All Industries, 2008	$40,664	$76,856	$42,380	$52,208	$43,004
Average Annual Wages, All Mining, 2008	$93,496	$80,184	$74,932	$71,916	$77,064
Average Annual Wages, Metal Ore Mining, 2008	$85,540	$80,236	$77,428	$74,360	$78,572
Average Annual Wages, Gold Ore Mining, 2008	$85,540	$80,236	$77,636	$74,360	$78,728

Source: Nevada Department of Employment, Training, and Rehabilitation 2009.

Newmont and Barrick collectively spend in excess of $310 million annually on contracted services. The number of contracted employees for each company varies seasonally but ranges from 400 to 600. Total annual expenses for consumables (*e.g.*, diesel fuel, gasoline, propane, and cyanide) exceeded $650 million for Newmont and Barrick operations combined in 2006 Annual expenditures for supplies (e.g., office supplies, safety equipment, vehicle and equipment parts) ranged from $35 to $78 million for Barrick and Newmont, respectively in 2006 (Newmont 2007h; Barrick 2007d).

CUMULATIVE EFFECTS

Characteristics of the socioeconomic environment that could have cumulative impacts from the remaining development associated with the Leeville Project and other reasonably foreseeable projects in the area include population variations, availability of housing, public infrastructure and services, employment levels, tax revenues, and the effects of discharge and dewatering within in the Carlin Trend and the Humboldt River Basin. Chapter 2 – *Past, Present, and Reasonably Foreseeable Future Activities,* describes land uses that affect socioeconomic resources.

Population Trends and Demographic Characteristics

The number and variety of reasonably foreseeable projects planned in the Study Area would not likely result in additional workers moving into the area.

Transient workers are often involved in the construction of mines and related facilities. These workers are less likely to become part of the community through activities or socializing and they face a stigma for not being long time members of the community.

Prostitution is legal and regulated by the State in the Study Area. The Battle Mountain Social Impact Assessment (Newmont 2005) reported that prostitution does not seem to have a significant impact on social cohesion as it was not identified during discussions in the Battle Mountain community. Prostitution is impacted by the mining industry mainly through influx of contractors during construction phases of large-scale projects. These contractors are generally single men, or men who have left their families temporarily for work. These men tend to frequent local bars and gaming establishments.

Housing

Long-term housing impacts generated by the remaining development of the Leeville Project combined with other reasonably foreseeable projects in the Study Area depend in large part on where people (construction and operational workers) choose to live. The majority of workers in the Study Area live in Elko and Humboldt counties and commute to work in Eureka and Lander counties. Lack of new housing to meet current demand throughout the Study Area could create the need to build sub-standard homes – built to house people during a boom – but which later become blights which generate little to no property tax revenue, but continue to put pressure on public infrastructure and services budgets (Newmont 2005). **Table 3-14** presents housing data for 2000, 2005, and 2007. Housing in Eureka and Lander counties is less expensive than housing in Elko and Humboldt counties. This may be because much of the housing in Eureka and Lander counties consists of trailers, mobile homes, and pre-fabricated units built for a transitional group of home buyers.

The Battle Mountain Social Impact Assessment (Newmont 2005) indicates real estate markets and property values are determined by the quantity and perception of supply and demand. Perception in Battle Mountain in early 2005 was that the community was going through a boom and new, temporary, and permanent residents to the town required housing. The effect is often an increase in property values of existing structures and an added impetus for adding housing units. However, unrealistic speculation about home prices on the part of sellers and an overall trend of rising property values can price some people out, negatively affecting the availability and affordability of housing. In addition, previous experience throughout the Study Area is that property values dropped precipitously when mines have closed, with many owners choosing to abandon their properties and allow foreclosure given an inability to sell homes even at depreciated values (Newmont 2005).

In anticipation of the TS Power Plant, Newmont created additional housing supply with redevelopment of a trailer park in Battle Mountain. However, construction of the Power Plant brought upwards of 900 contracted employees and put pressure on availability of local housing.

Public Infrastructure and Services

Rapid population growth and loss (boom/bust cycles) also place a burden on fire, police, and Emergency Medical Services response to public safety incidents. Government agencies throughout the Study Area struggle with recruiting and retaining qualified personnel as many are drawn away from these occupations by the comparatively high wages of the mines.

The influx/loss of school-aged children into local school districts is also a major concern for local planners. With a state mandate of maximum class sizes of 16 in elementary and middle schools, the addition of several new students could necessitate hiring additional teachers. Funding for school districts is awarded on "two-year hold harmless," which compensates districts for either their actual student population or the student population in either of the two previous years, whichever is higher.

Regional Economy and Employment

Within a county economy or region, there are numerous economic employment sectors each fulfilling different demands of the local economy. All sectors are dependent upon each other to some degree. A change in employment level in one sector will impact either directly or indirectly the activity and viability of other employment sectors in the local economy. In order to show these interdependencies and interventions between sectors, an input–output model IMPLAN (Minnesota IMPLAN Group, Inc. 2006), was used to estimate economic, employment, and labor income impacts of the Hard Rock Mining Sector on the Elko Micropolitan Statistical Area, which includes both Elko and Eureka counties (**Table 3-18**).

TABLE 3-18
Economic, Employment, and Labor Income of the Hard Rock Mining Sector on the Elko Micropolitan Statistical Area, 2007

Category of Impacts	Direct	and Induced	Total Effects
Economic	$2,256.433,133	$681,372,997	$2,937,806,131
Employment	5,905	5,106	11,011
Labor Income	$537,516,769	$197,629,036	$735,145,806

Elko Micropolitan Statistical Area includes Elko and Eureka counties.

[1] Direct effects are those activities or expenditures associated directly with the Hard Rock Mining Sector.

[2] Indirect effects include those additional expenditures between economic sectors after the initial direct expenditure is made.

[3] Induced impacts or effects are the additional expenditures and economic activity attributable to household interactions.

Source: Ciciliano *et al*. 2008; Minnesota IMPLAN Group, Inc. "IMPLAN Pro Data for Elko County and Eureka County, 2004" Minnesota IMPLAN Group, Inc. Stillwater, Minnesota, 2006.

Direct effects are understood to be those activities or expenditures associated directly with the Hard Rock Mining Sector. Indirect effects include those additional expenditures between economic sectors after the initial direct expenditure is made. Induced impacts or effects are the additional expenditures and economic activity attributable to household interactions.

In addition to the direct employment and income provided by mines in the Study Area, economic activity creates indirect and induced employment income in the local county economies. Mine employees spend their income in the local area for goods and services.

The employment multiplier from mining has been estimated to be 1.7, although there is support for a range of 1.5 to 1.9 in some literature (Harrington 2005). Price and Harris (2007) estimated that each direct employee in the hard rock mining industry generates demand for an additional 0.85 indirect and induced employees in the Elko/Eureka counties economy.

Cumulative impacts on employment and income in the Study Area are dependent on timing of job openings because job losses may be offset or at least mitigated by new projects or expansions of existing ones. However, there is no guarantee the closure of one project and the construction/operation of another project will be offset in sequence or in number of jobs and economic opportunities. If any of the existing projects were to close without one of the reasonably foreseeable projects coming online, communities in the Study Area would be impacted as some people would lose their jobs and incomes. Economic benefits of extending mining operations in the Carlin Trend would help maintain the status quo of the Hard Rock Mining Sector influence on the economy in the Study Area.

The economy of the Study Area is dominated by government and the mining industry. Employment numbers are based on work location not residence, which is why Eureka County has more employees in the natural resources and mining sector than it has residents (**Tables 3-13** and **3-16**). Several major mines, which impact the Elko MSA, are located in Eureka County including Barrick's Betze/Post/Meikle operations and Newmont's North Operations Area, which includes the Genesis-Bluestar operations. In addition, the Cortez Mine in Lander County and the Bald Mountain Mine in White Pine County, both of which are closer to Elko than any community within their respective counties, contribute to employment and income in the Study Area.

Employees at these mining facilities do not necessarily live in the closest community to their place of employment or in the local governmental unit which receives tax revenues from those facilities. For example, more than 4,000 mine workers reside in the Elko, Carlin, and Spring Creek areas, but are employed at mines outside Elko County. The following are the major, but not the only, operations located outside Elko County that employ Elko area residents:

- Bald Mountain Mine – White Pine County (179)
- Cortez – Lander County (673)
- Barrick Betze Pit – Eureka County (1,131)
- Newmont Carlin Operations – Eureka County (2,127)

Newmont employs approximately 1,300 persons for its Carlin Trend surface operations which include several mining and exploration projects. Among them are Gold Quarry, Pete Project, Genesis-Bluestar, Bootstrap, and the proposed Emigrant Mine. Employees of the surface operations are moved from project to project as needed, thus one project may be vacant for an extended period of time before another project winds down releasing personnel. Thus mining companies gain some flexibility in producing cash flow, can adjust mining to feed particular ore types to processing facilities, and can maintain a stable work force, which is critically important given the training and skills required for mining.

Ongoing mineral exploration in Nevada has increased from $50 million in 2001 to nearly $168 million in 2007. Proven and probable reserves in Nevada (i.e., gold in the ground that can be mined at a profit) totaled over 70 million ounces in 2007. Most companies have used a price of under $600 per ounce to calculate reserves which equates to a conservative estimate of an additional 12 years of production at current levels. Over the past two decades reserve estimates have been consistently represented at 10 to 12 years worth of production, so there are no indications that Nevada is running out of gold (Dobra 2007).

Ruby Pipeline Project

Construction of that portion of the Ruby Pipeline located in the Study Area would occur within a 10-month period and employ 400 to 500 workers. An additional 150 to 200 workers would be required for construction of the Wieland Flat Compressor Station about 35 miles north of Elko. Up to 15 percent of the workforce would be local hires and about 85 percent would be non-local (FERC 2009).

The temporary influx of non-local construction workers would increase demand for housing, resulting in increased revenues to individuals and businesses with space for rent. Temporary housing in the Elko area is available in the form of daily, weekly, and monthly rentals at motels, hotels, casino hotels, campgrounds, and recreational vehicle (RV) parks, bed and breakfast, boarding houses, apartments, and houses. Construction workforce demands may compete for temporary housing with mine workers in the Elko area. Availability of local rental housing combined with the number of non-local workers from the Project may exceed the available housing in the Elko area (FERC 2009).

Expenditures for payroll and local purchases would provide a short-term beneficial impact to local businesses and long-term tax revenue to state and local governments.

Tax Revenues

In addition to employment taxes, Net Proceeds of Minerals taxes paid by mineral development are a primary tax revenue source. Net Proceeds taxes are generated for the state of Nevada in the county where the ore is mined, not the county where employees live. Companies pay property and sales taxes, and employees and supply chain contractors who reside locally generate tax revenue through their property and local purchases. For example, Net Proceeds of Minerals taxes generated in Eureka County by the multitude of mining activities but the majority of employees live in Elko County.

A large portion of Net Proceeds of Minerals tax benefits will accrue to Eureka and Humboldt counties where most mining activity occurs. In 2007, approximately 51 percent of the Net Proceeds on Minerals tax generated went to the state of Nevada general fund (Dobra 2007). Property tax from miners' homes and suppliers' businesses is the primary tax revenue Elko County receives from mining. The Battle Mountain Social Impact Assessment (Newmont 2005) provides a description of the potential impact of net proceeds tax:

> "In 2004, net proceeds taxes (largely from the non-Newmont Cortez mine) represented 16.00% of the $7,232,223.00 Lander County budget. Once Phoenix begins operations, Lander County is expected to receive approximately $1.4 million annually in taxes, which would have represented 19.36% of total Lander County revenue in 2004. Since 2000, Lander County has used net proceeds revenue to cover its operating expenses. A loss in this revenue stream would require cuts in county administration and basic services. In addition, Lander County's weak tax base (due to low-value and non-assessed residences and economic leakage of resident income) also makes it more dependent on the direct net proceeds and property tax revenue streams from Newmont. Unless the tax revenue streams associated with Phoenix mine are offset by other mines or employers and/or a more diversified tax base, Lander County's financial solvency will be vulnerable at the closure of Phoenix, potentially throwing Battle Mountain and the surrounding area back into the familiar "boom bust" economic cycle (Newmont 2005).

In 2007, Newmont paid $4.8 million in net proceeds taxes to Eureka County and $367,000 to Elko County. Sales and use taxes paid by Newmont in 2007 included $14.5 million to Eureka County and $6.2 million to Elko County. Newmont paid $172,000 in property taxes to Elko County and $4.2 million in property taxes to Eureka County (Newmont 2008c). In the period from 2006-2007, these payments represent 0.5 percent of Elko County's total property tax revenue ($29.8 million) and 34 percent of Eureka County's total property tax revenue ($12.3 million). Total taxes paid by Newmont in 2007 to Elko and Eureka counties were $30.2 million.

Net Proceeds on Minerals tax is clearly a vital part of revenue for counties that have mining benefit. Other counties that house and provide services to miners must find money from other sources to provide those services.

Dewatering and Discharge

Areas potentially affected by mine dewatering are described in the CIA report (BLM 2000), SOAPA EIS (BLM 2002a), Leeville Project EIS (BLM 2002b), and the Betze Pit Expansion Project Draft Supplemental EIS (BLM 2009b). Socioeconomic concerns in this area include potential impacts from lowered water levels in wells, reduced flow in springs (livestock and wildlife impacts), reduced stream flow (irrigation and livestock impacts), and development of sinkholes (possible damage to private property and/or natural resources) (BLM 2002a). Details regarding groundwater and surface water conditions in the Study Area are included in this chapter under the *Water Quantity and Quality* section.

ENVIRONMENTAL JUSTICE

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for environmental justice encompasses the area between Elko and Winnemucca on Interstate 80, including Elko (including the Elko Band Colony), Eureka, Lander (including the Battle Mountain Band), and Humboldt counties. Both bands are part of the Te-Moak Tribe of Western Shoshone Indians. These bands represent minority populations within the vicinity of the Carlin Trend.

MONITORING DATA AND NEW INFORMATION

No new census data for the period 2002 to 2009 has been collected. Information contained in this section is based on the most recent census (2000).

IDENTIFICATION OF MINORITY AND LOW INCOME POPULATIONS

Minority populations are persons of Hispanic or Latino origin of any race, Blacks or African Americans, American Indians or Alaska Natives, Asians, and Native Hawaiian and other Pacific Islanders. *Low-income populations* are persons living below the poverty level. In 2000, the poverty weighted average threshold for a family of four was $17,603 and $8,794 for an unrelated individual (U.S. Census Bureau 2002). Estimates of these two populations were then developed to determine if environmental justice populations exist in the Study Area.

The Council on Environmental Quality identifies these groups as environmental justice populations when either (1) the minority or low-income population of the affected area exceeds 50 percent or (2) the minority or low-income population percentage in the affected area is meaningfully greater than the minority population percentage in the general population or appropriate unit of geographical analysis. In order to be classified meaningfully greater, a formula describing the environmental justice threshold as being 10 percent above the State of Nevada rate is applied to local minority and low-income rates.

In 2008, the Study Area contained 71,548 persons of which approximately 19,535 (27.3%) were minorities and approximately 6,802 (9.5%) were living below the poverty level. Minority and low-income populations were consistently lower in each of the counties in the Study Area than for the State of Nevada (**Table 3-13**). Both the Elko Band Colony in Elko County and the Battle Mountain Band of the Te-Moak Western Shoshone tribe in Lander County meet the description of environmental justice populations, because of minority and poverty status (**Table 3-19**). For each Band the percent of minority persons and the percent of people below the poverty level are more than 10 percent above the State of Nevada rate.

TABLE 3-19 Minority and Low-Income Populations, 2000			
Location	**Total Population**	**Percent Minority**	**Percent Below Poverty (1999)**
Elko	47,114	29.1	8.7
Elko Band Colony [2]	*729*	*86%*	*23.0*
Eureka	1,480	16.8	9.0
Lander	17,446	26.8	9.8
Battle Mountain Band [2]	*124*	*90.3*	*28*
Humboldt	5,272	22.5	9.5
State of	2,495,529	40.0	11.1

Source: [1] U.S. Census Bureau 2007; [2] Sonoran Institute 2007.

CULTURAL RESOURCES

CUMULATIVE EFFECTS STUDY AREA

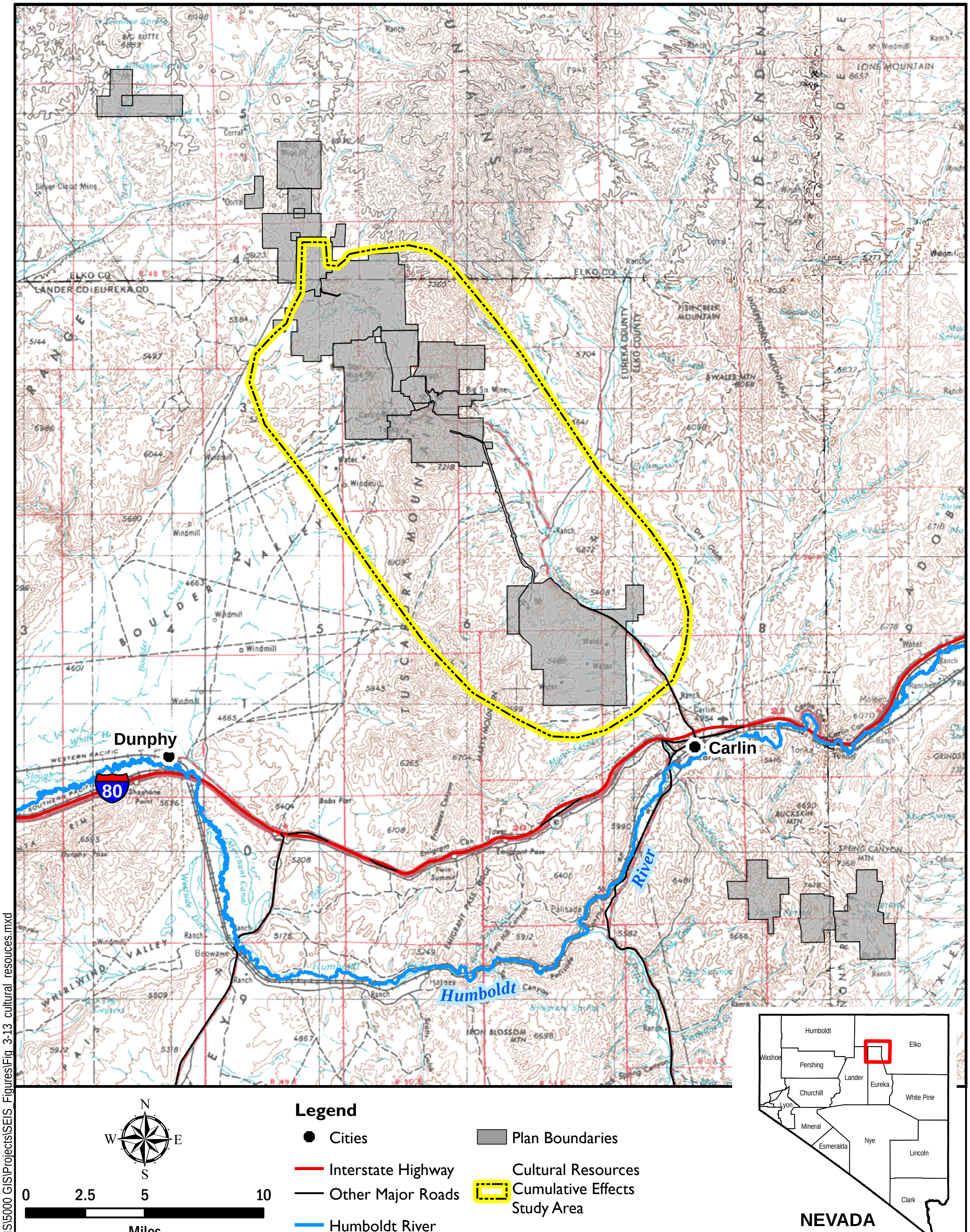
The Cumulative Effects Study Area (Study Area) and Area of Potential Effect for cultural resources extends from the Bootstrap Mine in the north to the SOAPA Project in the south (**Figure 3-12**). The Study Area boundary was determined by the BLM to include those mines and related facilities that encompass the core area of the Carlin Trend, including areas currently subjected to open pit and underground mining activities.

MONITORING DATA AND NEW INFORMATION

A summary of cultural resource inventories organized by company name/mine operator is presented in **Table 3-20**. A complete listing of all cultural surveys completed and sites mitigated in the Carlin Trend (Area of Potential Effect) is included as **Appendix C.**

Since 2002, the SOAPA project has been implemented as described in Chapter 1 – *Project History and Status*. Mine expansion is underway and new facilities have been constructed and placed in operation. Other projects have been constructed within the Carlin Trend during the period (see Chapter 2 – *Mine and Mineral Development*). Cultural resource surveys were completed prior to initiation of these projects (see SOAPA EIS [BLM 2002a] and Leeville EIS [BLM 2002b]).

TABLE 3-20 Summary of Cultural Resources Inventories by Mine Operator	
Barrick Goldstrike Mines Inc.	10 Cultural Resource Inventories/Reports
	248 Sites or Isolated Finds
	45 Eligible Sites, 37 Unevaluated, 166 Ineligible
Marigold Mining Co.	6 Cultural Resource Inventories/Reports
	55 Sites, 40 Isolated Finds
	15 Eligible Sites, 1 Unevaluated Site, 39 Ineligible
Newmont Mining Corp.	34 Cultural Resource Inventories/Reports
	343 Sites or Isolated Finds
	79 Eligible Sites, 6 Unevaluated, 272 Ineligible
Other	15 Cultural Resource Inventories/Reports
	90 Sites or Isolated Finds
	16 Eligible Sites, 20 Unevaluated, 54 Ineligible



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U.S. Department of the Interior
Bureau of Land Management
Elko District Office
Tuscarora Field Office
Elko, Nevada

CULTURAL RESOURCES AND AREA OF POTENTIAL EFFECT CUMULATIVE EFFECTS STUDY AREA
SOAPA Project
Final Supplemental EIS
Eureka and Elko Counties, Nevada

FIGURE
3-12

Approximately 5,800 acres would be disturbed in the Study Area between 2010 and 2020 by reasonably foreseeable projects (**Table 2-3**). (Note: The Emigrant Project [approx. 1,400 acres] is outside the Study Area for cultural resources). The 5,800 acres within the Study Area have been previously surveyed with five sites identified as potentially eligible for listing on the National Register of Historic Places. Barrick is currently mitigating these sites as part of its Betze/Post expansion (Hockett 2007).

CUMULATIVE EFFECTS

Compliance with Section 106 of the National Historic Preservation Act has minimized impacts to cultural resources in the Area of Potential Effect as a result of mining disturbance. Cultural resource inventories are completed by professional archaeologists (party contractors) that meet BLM and State Historic Preservation Office requirements prior to any mining-related disturbance. Contractors report results of surveys to BLM including recommendations of site eligibility and potential project effects to cultural resources. These reports are listed in **Table C-1** (**Appendix C**) and on file at the BLM Elko District Office. BLM reviews the contractor recommendations when making final determinations of site eligibility and project effects. These survey reports, along with BLM's final determinations, are submitted to the Nevada State Historic Preservation Office for review consultation, and inclusion into the Statewide Inventory.

Avoidance of sites determined eligible for the National Register is the preferred mitigation measure when sites are threatened. When possible, mining-related facilities are redesigned to avoid eligible sites or specific cultural resources. Due to the number of eligible sites present, avoidance is not always possible. In such cases, excavation by archaeologists is undertaken to mitigate adverse effects. Archaeologists prepare mitigation plans including a scope of work and specific scientific issues to be addressed as a result of the excavation for submittal to BLM. Approved plans are submitted by BLM to the State Historic Preservation Office for consultation. Upon final approval by BLM excavation and field work commence in accordance with the approved plan.

Analysis of artifacts recovered from site investigations are contained in reports to BLM and subsequently to State Historic Preservation Office for inclusion in the Statewide Inventory.

Mitigation has been carried out at 57 of the 155 sites determined eligible for the National Register (37%). Approximately two-thirds of all eligible sites recorded within the Area of Potential Effect remain available for future research. A listing of mitigated sites is contained in **Table C-2** (**Appendix C**).

In some cases, sites initially avoided, are subsequently damaged during mining related activities. In such instances, mining companies cease operations in the area, inform appropriate BLM authorities, and develop a mitigation and treatment plan for submittal to BLM and State Historic Preservation Office. Subsequent field and archival research completed for the site is compiled in a report in accordance with the National Historic Preservation Act and the Archaeological Resources Protection Act.

Some loss to archaeological resources occurs due to mining related disturbance within the Area of Potential Effect, particularly to sites determined not eligible for the National Register. All sites represent nonrenewable pieces of America's prehistoric or historic past. Recordation of these sites preserves a written record of their existence to be used by future researchers interested in understanding Nevada's past. Mitigation of cultural resources preserves a picture of the past through scientific archaeological research.

Archaeological sites do not remain intact forever. The paleo-environmental record of Nevada exhibits evidence of natural erosive forces that eradicate previous traces of human presence. These erosive forces continue to the present day. The fact that 3,000-year old sites are visible today on the surface of the landscape within the Area of Potential Effect indicates that these sites are slowly being exposed by the erosional forces of wind and water. As a result, recovery of scientific information from sites within the Area of Potential Effect reveals knowledge that would otherwise be lost.

Intact sites that are not currently subjected to erosive forces should be preserved for future generations. If all sites within the Area of Potential Effect were mitigated, then a case could be advanced for negative cumulative impacts to cultural resources. This is the case because archaeologists are continually identifying new issues about past human behavior, and new research methodologies are being advanced that may provide additional data about sites under investigation.

While some loss of archaeological values has occurred due to mining-related activities within the Area of Potential Effect from a cumulative perspective, this loss has been minimal. Reasonably foreseeable future actions include potential impacts to sites. However, the process in place mitigates direct and cumulative effects, which, leads to increased information regarding Nevada's cultural heritage.

NATIVE AMERICAN CONCERNS

In March 2007, BLM Elko District Office solicited input from local tribal entities for the SOAPA and Leeville Project Draft SEISs. Specifically, BLM stated "BLM wishes to gather information regarding specific tribal resources, sites, or activities that may have been missed by BLM and participating tribal groups and individuals, during the 2002 effort, or that have been identified or possibly impacted since 2002. Any new information provided will be used to update the cumulative effects analysis for these two authorized actions."

CUMULATIVE EFFECTS STUDY AREA

The Cumulative Effects Study Area (Study Area) for Native American Concerns includes the hydrographic basins identified on **Figure 3-5**. The rationale for the geographic area of cumulative effects is based on the importance of water sources to Newe/Western Shoshone traditionalists and land disturbance as it relates to loss of edible/medicinal plants, minerals, wildlife, potential loss of artifacts viewed as sacred objects and potential impacts to traditional/cultural/spiritual use sites and associated activities.

MONITORING DATA AND NEW INFORMATION

Past consultation with Tribal communities resulted in identification of two Traditional Cultural Properties in the vicinity of the Carlin Trend: 1) a location along Rock Creek; and 2) the Tosawihi Quarries.

BLM periodically contacts the various Tribes and Tribal representatives to solicit input to decisions made by BLM on internal and externally generated projects. Recent solicitation with Tribal members within the identified Study Area for Native American Concerns includes:

- Hollister Development Block Project 2002-2009: Underground exploration and proposed mining near Tosawihi Quarries Traditional Cultural Property (TCP) and Archaeological District;
- Esmeralda Fire 2005: Fire burned contributing element (Big Butte) of Tosawihi Quarries Traditional Cultural Property;

- Winters Fire 2006: Fire burned north of Tosawihi Quarries TCP and Archaeological District;
- Sheep Fire 2006: Fire burned near Rock Creek TCP;
- Ivanhoe/Buttercup Spring Protection (contributing element to Tosawihi Quarries TCP) – Exclosure - 2007: Supplemental to Barrick Betze Plan of Operations of 2003 – Dewatering Mitigation; and Barrick Expansion - Goldstrike Mine (Betze Project) – 2007.

The following information was received from tribal coordination/communications for the projects noted above.

Tribal members are concerned about impact fires and fire suppression activities have had directly to artifacts and medicinal/edible plant species. According to the tribes, data gathering and excavation of sites, as mitigation, are not acceptable, unless artifacts are returned to the Shoshone people and Shoshone participate in the excavations or are able to observe the activities. However, BLM must curate them to the Nevada State Museum and, according to cultural resource laws; artifacts taken from BLM- administered land are considered the property of the federal government. Therefore, BLM "mitigating" sites via excavation and data gathering may be considered an adverse impact to tribal sacred sites and associated sacred objects (artifacts), when viewed from a traditional Western Shoshone perspective. Loan agreements can be negotiated if the requesting tribes have the facilities and expertise to house the artifacts. Tribally designated observers have been used in the past when data gathering is the only option for preserving artifacts.

Tribal members have provided input to the types of fire suppression tactics to be used when fires occur within or near the two identified Traditional Cultural Properties. They request that fires be allowed to burn naturally, as they have for thousands of years. Tribal members do not want heavy equipment disturbing sites and have stated that impacts to most artifacts (stone tools) by fire are quite minimal. Normal fire fighting techniques such as cutting fire line with hand tools, use of heavy equipment, and air tankers dropping red mud or "slurry" would cause more of an adverse impact than allowing fires to burn through.

Impacts to edible/medicinal plant populations, within the Study Area, are unknown as BLM does not regularly monitor these species nor do most BLM personnel know how to identify them. BLM relies on tribal members to determine the locations and document changes to such plant populations. In general, tribal members note a decline in the number of edible and medicinal plant species across northern Nevada. "Yompa" and "Doza" are particularly difficult to locate. Whether the SOAPA mining action has had an adverse impact is not known. Perhaps the greatest impact occurs via wildfire, drought, cheat grass invasion, and livestock grazing.

Water source health, especially those within or near the Traditional Cultural Property areas, is a critical element in the maintenance of the spiritual integrity of those sacred sites. Western Shoshone have asked that they have an opportunity to participate in the design and creation of any spring or headwater protection projects within or near the identified Traditional Cultural Properties.

Mine development in the Study Area has removed native vegetation from approximately 33,500 acres since inception of large scale mining (see *Mine and Mineral Development* section in Chapter 2). An undetermined number of plants of Tribal concern have been affected by current mining. Similarly, wildfire has burned several thousand acres (see *Wildfires and Reseeding* section in Chapter 2) in and around the Study Area resulting in the loss of an undetermined amount of plants that are of importance to Tribe traditionalists. Livestock grazing continues to be a dominant land use that also likely affects many types of plants important to Tribal traditionalists.

Consultation with the various Tribal communities is described in the SOAPA EIS (BLM 2002a). Consultations completed during preparation of the SOAPA EIS identified the following concerns:

- Ground disturbance – impacts to spiritual energy and spirits, loss of edible and medicinal plants, and minerals used by traditionalists.
- Dewatering – Potential impacts to water sources and riparian areas from dewatering activities, medicinal/edible plant gathering, water spirits, and cleansing ceremonies (Tosawihi Quarry area springs and Rock Creek and associated springs – Traditional Cultural Properties).
- Artifacts – Powerful and sacred objects; artifacts used by traditionalists in healing practices; collection by looters and BLM approved data gathering of artifacts denies traditionalists the use of these powerful objects.
- Sage Grouse – Tribal participants noted that sage grouse populations appear to be decreasing (possibly due to fires and mining operations).
- Adequate water flow in Rock Creek.

CUMULATIVE EFFECTS

Located within the traditional territory of the Western Shoshone, the Study Area for Native American Concerns contains spiritual/traditional/cultural resources, sites and social practices that aid in maintaining and strengthening social, cultural and spiritual integrity. Recognized tribal entities with known interests in the Study Area are the Te-Moak Tribe of Western Shoshone and the four constituent Bands (Elko, Battle Mountain, Wells, and South Fork) and the Duck Valley Sho-Pai Tribes of Idaho and Nevada. Various community members and families from those tribes and bands have also identified themselves as belonging to the original Tosawihi Band of Shoshone (whose traditional territory generally lies north of Battle Mountain, to Golconda, Midas, Tuscarora, and Dunphy.

Some Western Shoshone have expressed a concern that cumulative effects may occur to their spiritual life and cosmology. Development of new projects that disturb stream flows, vegetation patterns, and wildlife distribution individually and collectively could impact the integrity of power spots, disrupt the flow of spiritual power (*Puha*), and cause the displacement of spirits (*e.g.*, Little Men and Water Babies). Any such impact would limit potential for Western Shoshone to participate in traditional religious activities (BLM 2002a).

Contributing elements that assist in maintaining social and spiritual integrity include, but are not limited to: Existing antelope traps; certain mountain tops used for prayer, guidance, and reflection; medicinal and edible plant gathering locations; prehistoric and historic village sites and gravesites; sites associated with creation stories; hot and cold springs; material used for making baskets and cradle boards; locations of stone tools such as points and grinding stones (mono and matate); chert and obsidian quarries; hunting sites; sage grouse leks; sweat lodge locations; locations of pine nut ceremonies, traditional gathering, and camping sites; rocks or boulders used for offerings and medicine gathering; tribally identified Traditional Cultural Properties; Traditional Cultural Properties found to be eligible to the National Register of Historic Places; rock shelters; locations of "rock art"; land that is near, within, or bordering current reservation boundaries; land that conflicts with tribal acquisition efforts involving the Nevada Congressional Delegation; and water sources in general, which are often considered the "life blood of the Earth and all who dwell upon it."

Information concerning potential effects of mining including dewatering activities associated with mine operations and potential impacts to vegetation and sage grouse in the Study Area are contained in the *Water Quantity and Quality*, *Vegetation Resources*, and *Terrestrial Wildlife, T&E, Candidate, and Sensitive Species* sections of this chapter.

During the last 15 to 20 years, BLM and the Tribes have witnessed increased use of land, administered by BLM, by various groups, organizations, and individuals. Livestock grazing; recreation opportunities (*e.g.*, hunting/fishing; oil, gas, geothermal, and mining exploration), along with relatively "newer" uses such as OHV use, mountain biking, equestrian, and interpretive trails are among many activities that are increasing within the BLM Elko District Office administrative boundary. In addition, existing growth and development uses of public land, mineral exploration, and extraction continues to contribute to the general decline of sites and associated activities of a cultural, traditional, and spiritual nature.

Archaeological sites and artifacts, including tribal resources and sites of cultural, traditional, spiritual use and associated activities are increasingly in danger of losing their physical and spiritual integrity. Use of public land administered by BLM is commensurate with the growth in population and the potential for decline of culturally sensitive areas. Different world views and social and spiritual practices and beliefs often conflict with each other. Because the traditional land of the Western Shoshone encompass most of Nevada including the Elko BLM District Office, BLM and affected Tribes must remain flexible and open to productive and proactive communication in order to assist each other in making decisions that will reduce or eliminate adverse affects to all parties and resources involved.