4 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

The BLM is required to assess impacts to a number of critical elements of the natural environment, as discussed in this chapter. Those elements that do not occur in the Project Area and would not be affected are not discussed further in this SEIS. This includes the following: prime and unique farmland; areas of critical environmental concern; and wild and scenic rivers. The elimination of nonrelevant issues follows CEQ policy as stated in 40 CFR 1500.4.

Analysis of some resources will be incorporated by reference, since those resources have been analyzed sufficiently in the South Pipeline Final EIS (BLM 2000a), which this document supplements. Since there is no additional surface disturbance, the analysis of the following critical elements and resources in the previous EIS is incorporated by reference and a citation to the previous EIS is included: vegetation (BLM 2000a, pages 4-117 to 126), soils (BLM 2000a, pages 4-6 to 9), range (BLM 2000a, pages 4-109 to 113), noxious weeds (BLM 2000a, pages 4-113 to 117), cultural resources (BLM 2000a, pages 4-138 to 144), ethnography (Native American traditional values) (BLM 2000a, pages 4-144 to 148), and paleontology (BLM 2000a, pages 215 to 216).The Scoping Document for this SEIS further addresses these resources and is incorporated by reference (BLM 2004). Data used in this SEIS are based on information available as of August 31, 2003.

The BLM has used environmental data collected in the Project Area to predict environmental effects that could result from the Proposed Action and alternatives. A level of uncertainty is associated with any set of data in terms of predicting outcomes, especially where natural systems are involved. The predictions described in this analysis are intended to allow comparison of alternatives to the Proposed Action, as well as provide a method to determine whether activities proposed by the applicant would be expected to comply with applicable regulations.

4.2 Geology and Mineral Resources

4.2.1 Regulatory Framework

Construction of mine facilities is regulated by standards of the Uniform Building Code (UBC). Lander County currently uses the 1994 Version of the UBC (Deborah Hinze, Community Development Specialist, Lander County Community Development Department, personal communication). The seismic zone designation throughout Lander County is zone 3 on a scale ranging from 1 (indicating less damage expected) to 4 (indicating the most damage expected). Historical earthquake activity for a 50-mile radius around the Project Area is listed in Table 3.2-1 of the Pipeline Final EIS (BLM 1996a).

4.2.2 Affected Environment

4.2.2.1 Study Methods

The baseline data presented below are based upon information from the Pipeline Final EIS (BLM 1996a, pages 3-9 through 3-11) and the South Pipeline Final EIS (BLM 2000a, pages 4-1 through 4-4). Discussions of geology, seismicity, and minerals are herein incorporated by reference. New and supplemental information is now available from more recent reports and studies. Summaries of studies completed in the area are included in the following sections. The Project Area is defined as a 39,350-acre area located in the southwest portion of the Crescent Valley extending north of the existing Highway infiltration site, south of the existing Rocky Pass infiltration site, east to the Cortez facility, and west to the Shoshone Range.

4.2.2.2 Existing Conditions

4.2.2.2.1 Geology

The geology of the Crescent Valley area has been thoroughly described in Characterization of Baseline Conditions for the South Pipeline Project (Geomega 2002b). The geology of the area is based on descriptions by Armbrustmacher and Wrucke (1978), Wrucke and Cole (1991), Roberts et al. (1958, 1967), Stewart and McKee (1977), Gilluly et al. (1965), Muffler (1964), Stewart (1980), and recent papers by McCormack and Hays (1996), and Foo et al. (1996a, 1996b). The geology in the vicinity of the Project Area is identical to that described in the Pipeline Final EIS (BLM 1996a, page 3-9).

The Crescent Valley area has a complex tectonic and depositional history. At least four major tectonic events have affected the structure and stratigraphy of the region. These events include the following: (1) the Devonian-Mississippian Antler orogeny and associated Roberts Mountains thrust; (2) the Permian-Triassic Sonoma orogeny and associated Golconda thrust; (3) the Jurasic Elko orogeny; and (4) the late Tertiary-early Quaternary Basin and Range tectonic events. Limestone with minor shale and quartzite are part of the eastern carbonate assemblage and are present in the Project Area. Clastic sedimentary rocks of the western siliceous and volcanic assemblage are found in the western part of the Project Area. Lithologic units deposited between the eastern and western assemblages are referred to as the transitional assemblage. Western and transitional assemblage lithologies underlie the Project Area. A geologic map of the Crescent Valley is shown in Figure 4.2.1 and a generalized stratigraphic column is shown in Figure 4.2.2.

The Project Area contains exposures of late Tertiary (two million to 24 million years ago) alluvial gravel and sand deposits and Quaternary (present to two million years ago) deposits of valley alluvium, alluvial fans flanking the mountains, playa, talus, and landslide deposits.

Excavation of the expanded open pit would be primarily in the Roberts Mountains Formation: a dark gray, carbon-rich calcareous to dolomitic siltstone that extends to an estimated depth of 2,500 feet beneath the surface of the proposed open pit location. Some small exposures of the Wenban Limestone could also be present in the western pit wall. Overlying alluvium at the location of the proposed open pit would be 50 to 80 feet thick in the west pit wall and 350 to 380 feet thick in the east pit wall. The alluvium is composed of alternating zones of fine- to coarse-grained materials with occasional silt- and clay-rich zones. Gravel present in the alluvial sequence is progressively finer grained with depth, grading to a poorly sorted sand and to a clay with some sand and gravel at the bedrock interface. Caliche layers are also present in the lower zones of the alluvial sequence.

4.2.2.2.2 Bedrock Topography

Bedrock topography in the Crescent Valley has been interpreted from geophysical data, including gravity, magnetic, and seismic reflection surveys (Figure 4.2.3). The data sets are consistent in

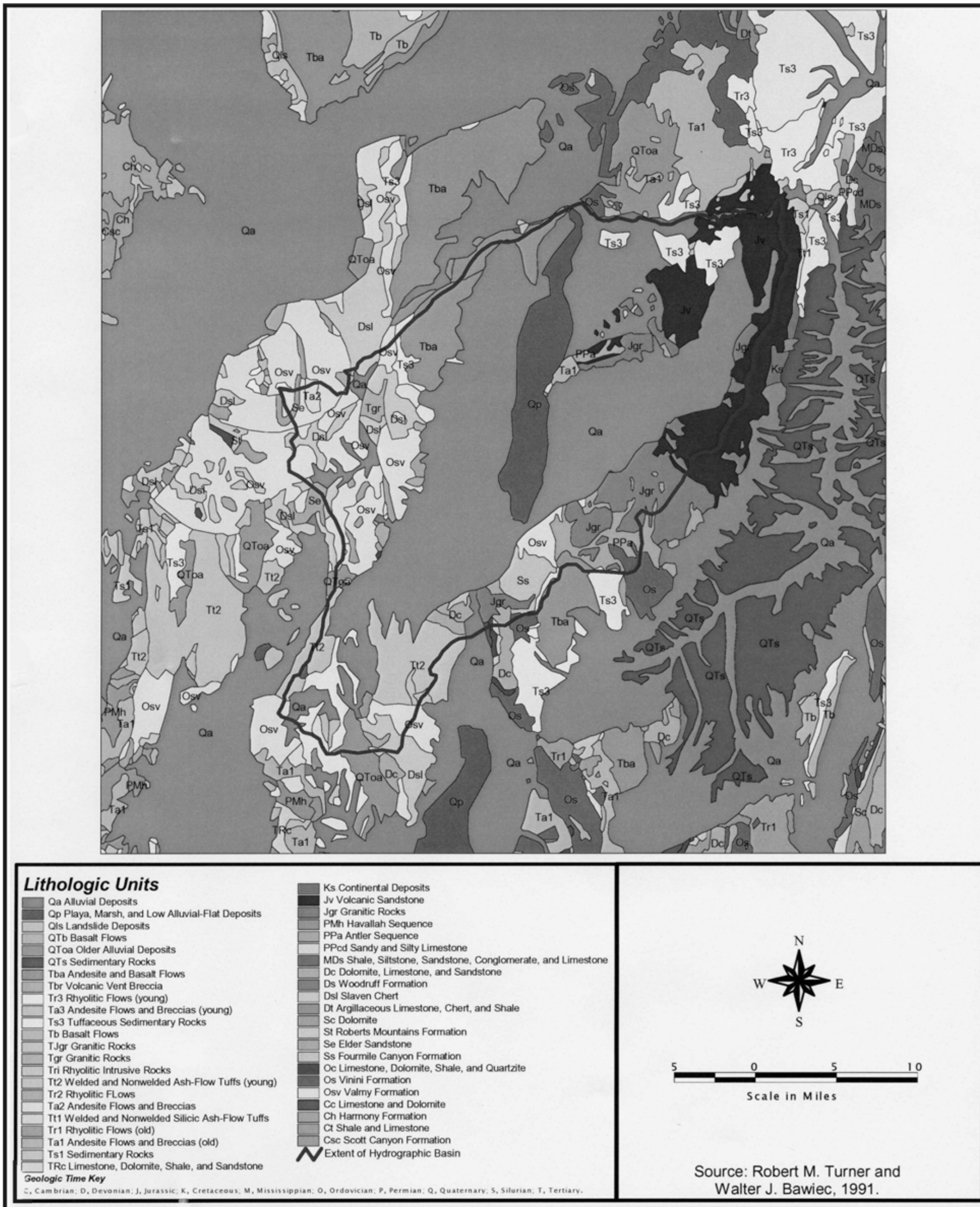

Figure 4.2.1 Geology of Crescent Valley, Nevada

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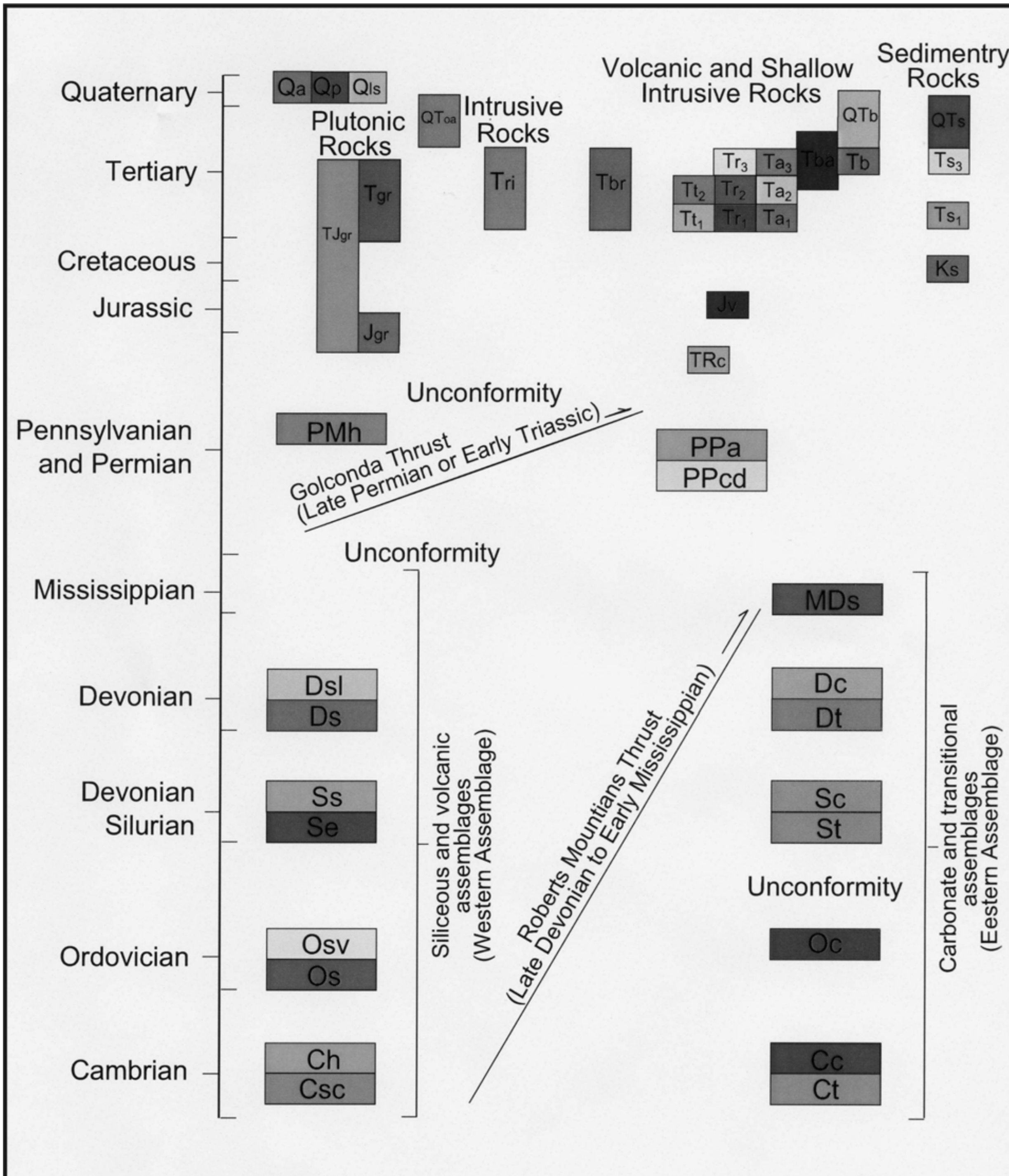

Figure 4.2.2 Generalized Stratigraphic Column Units Defined in Figure 4.2.1

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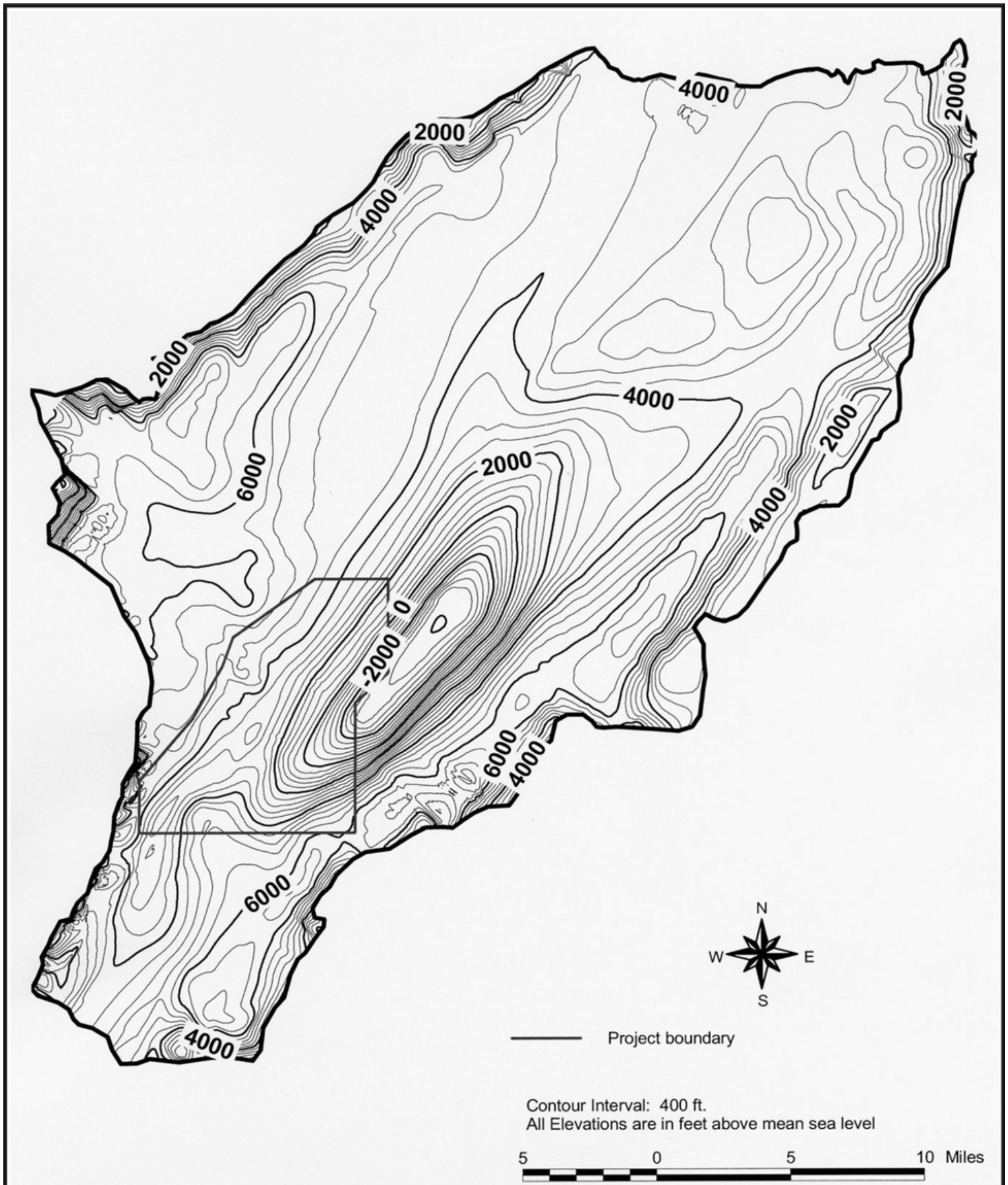

Figure 4.2.3 Crescent Valley Bedrock Elevation Map

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indicating that the bedrock surface dips eastward toward the Crescent fault, then rises abruptly near the Cortez Mountains.

4.2.2.2.3 Local Geologic Structures

The subsurface geology of the Gold Acres and Cortez Windows is shown in Figure 4.2.4. Figure 4.2.5 shows the known and inferred structures within the Gold Acres Window. A reconstruction model of Crescent Valley prior to Basin and Range extension and formation of the Cortez rift suggests that the Gold Acres and Cortez Windows were once united (McCormack and Hays 1996). Reconstruction of Basin and Range extension suggests that the Pipeline fault is associated with the Cortez fault and may have been the same structure. Also, the Gold Acres and Mill Creek stocks are shown to have originated as the same intrusive body, separated by the right-lateral offset of the Pipeline-Cortez fault during the Cortez rifting event.

The southwestern edge of the Gold Acres Window is the Roberts Mountains thrust, which dips approximately 25 degrees (^{o}) southwest. The fault is exposed in the bedrock to the west of the alluvial cover and extends under the alluvium to the east. The Gold Acres fault forms the northwestern boundary of the window (Figure 4.2.4) and is a normal fault dipping approximately 65^{o} northwest. The window is in the upthrown block southeast of the fault. The southeastern boundary is inferred from geophysical data and appears to be a truncating fault dipping steeply to the southeast. The northeastern boundary of the window is a right-lateral fault dipping approximately 60^{o} southwest.

The geologic structure within the Gold Acres window has been summarized in Water Management Consultants (WMC) (1995a). This summary is based on mapping, drilling, aerial photography, and geophysical and geochemical surveys. The structure is also discussed by Foo et al. (1996b).

Three distinct fault sets are observed in the Gold Acres window (Figure 4.2.5). One set of faults strikes north 15^{o} to 20^{o} west and includes the Pipeline fault (Foo et al. 1996b). Oriented core data indicate that the Pipeline fault has a 75^{o} to 85^{o} east dip. A second set of faults strikes north 30^{o} to 50^{o} east and dips steeply to the northwest; this set includes the Fence fault. These two sets are probably of the same age and are related to the Cortez rift (Foo et al. 1996b). The third set strikes north 60^{o} to 70^{o} west and appears to have greater length and; therefore, may be younger than the other sets (WMC 1995).

A fourth structural set with an east-west orientation is inferred from bedrock troughs observed from drilling (WMC 1995). Their short length suggests that they are older and segmented by the other faults.

4.2.2.2.4 Seismicity

The seismic baseline conditions in the Project Area are identical to those presented in the South Pipeline Final EIS (BLM 2000a, pages 3-9 and 3-10) and are herein incorporated by reference. The design criteria for the facilities remain the same as presented in the South Pipeline Final EIS (BLM 2000a, pages 2-19 through 2-22). The seismic zone of the Project Area is 3, based on a scale ranging from 1 (indicating the least damage expected) to 4 (indicating the most damage expected), as documented by the UBC.

4.2.2.2.5 Mineral Resources

The mineral baseline conditions in the Project Area are identical to those presented in the South Pipeline Final EIS (BLM 2000a, page 3-10) and are herein incorporated by reference. Substantial mineral exploration and production of metallic and industrial minerals have occurred, and continue to occur, in the Project Area and surrounding area. Most of the region's mineral production comes from gold mining and barite operations. Historically, the area has also been a producer of silver, turquoise, and lesser amounts of copper, lead, and arsenic.

The Pipeline/South Pipeline ore deposit is located along the Battle Mountain-Eureka mineral trend. The deposit occurs within a buried erosional window covered by alluvium ranging in thickness from approximately 25 feet to over 250 feet. Gold mineralization occurs in the Silurian Roberts Mountains Formation (eastern carbonate assemblage). The ore deposit occurs near the eastern margin of the Gold Acres stock, a buried quartz monzonite pluton centered approximately one mile south of the Gold Acres deposit. Based on exploration information, the geology of the Project is the same as the Pipeline/South Pipeline ore deposit with gold mineralization disseminated throughout the host rock and along structural shear zones. The top of the targeted mineralization begins at a depth of approximately 1,070 feet below ground surface. The projected size of the area containing the South Pipeline ore deposit is approximately 2,400 feet in a north-south direction by 3,000 feet in an east-west direction. An estimated 110 million tons of ore and 590 million tons of waste rock would be mined from the Pipeline/South Pipeline open pit expansion area under the Proposed Action.

4.2.3 Environmental Consequences and Mitigation Measures

Major issues related to geology and minerals include the following: a) geologic hazards created or magnified by Project development; b) failure of, or damage to, critical facilities caused by seismically-induced ground shaking; c) exclusion of future mineral resource availability caused by the placement of facilities (tailings, heap leach piles, waste rock storage areas); and d) potential land subsidence due to dewatering operations.

4.2.3.1 Significance Criteria

Environmental impacts to geology and minerals would be significant if the Proposed Action, the Pipeline Backfill Alternative, or No Action Alternative resulted in any of the following:

- Impacts to the facility site or design caused by geologic hazards, including landslides and catastrophic slope failures or ground subsidence;
- Structural damage or failure of a facility caused by seismic loading from earthquakes; or
- Restriction of future extraction of known mineral resources.

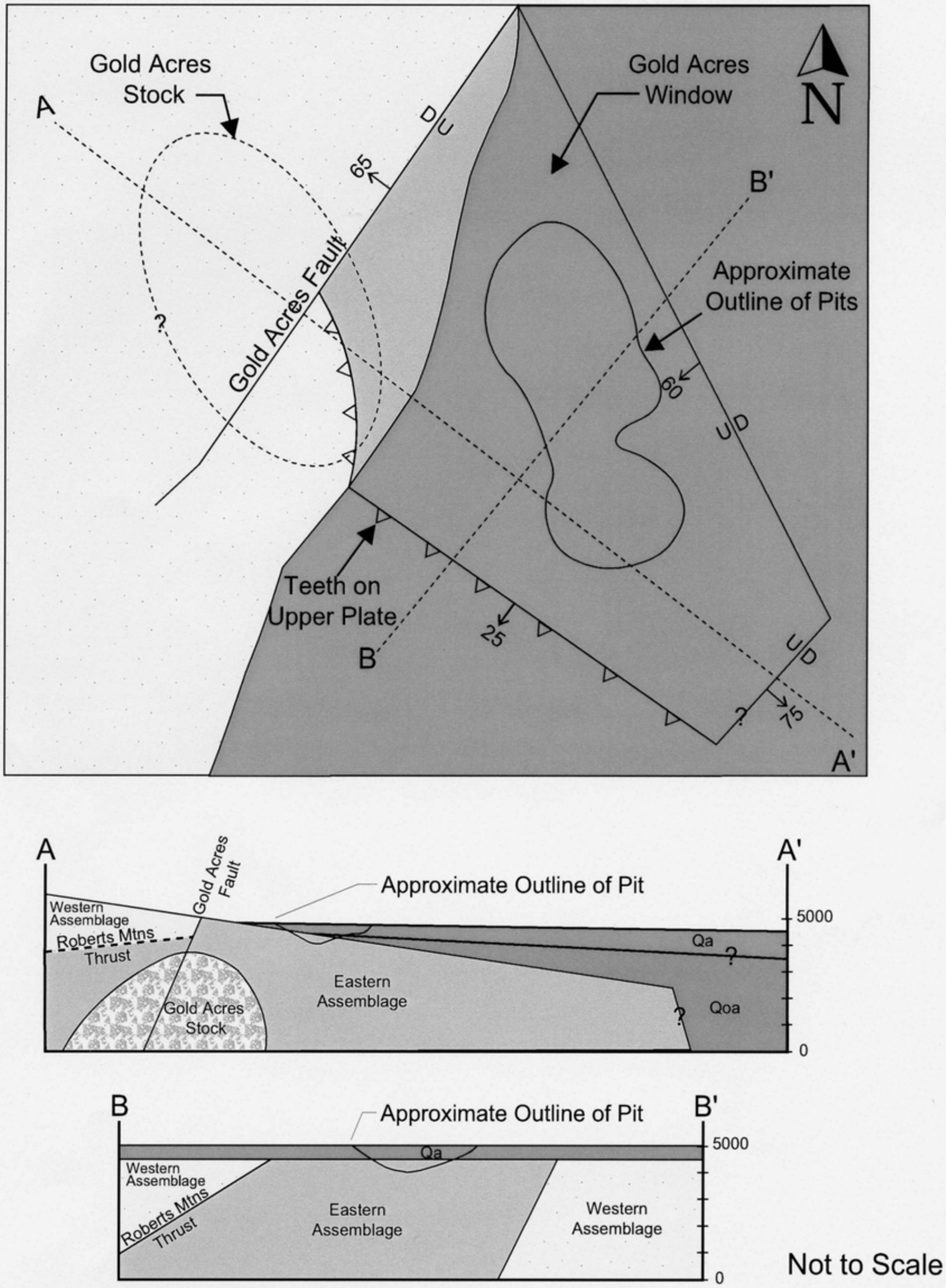

Figure 4.2.4 Generalized Geology and Geometry of the Gold Acres Window

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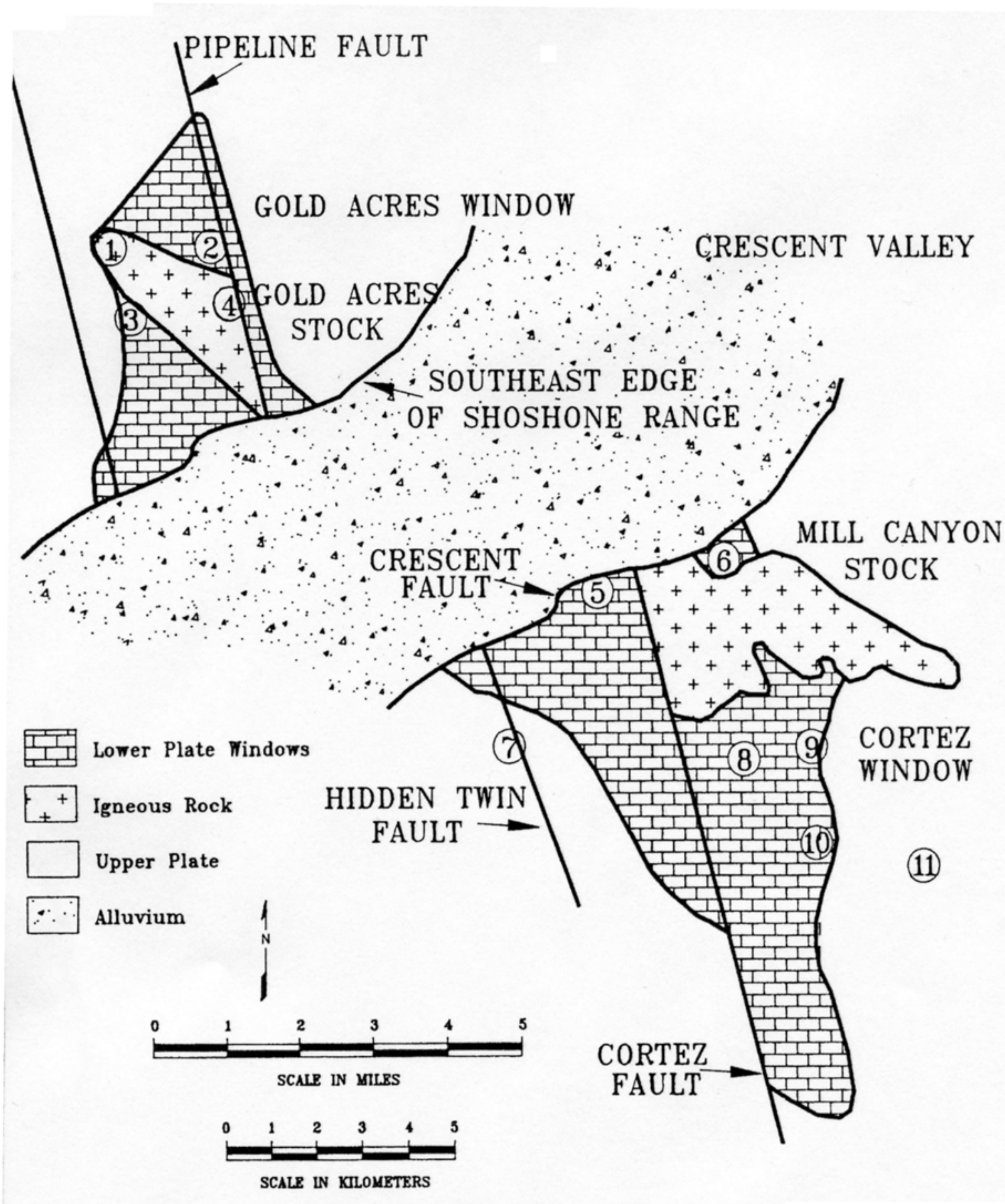

Figure 4.2.5 Simplified Geologic Map of Southern Crescent Valley

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4.2.3.2 Assessment Methodology

Impacts of the Proposed Action and Project Alternatives were assessed based on review of reports prepared in support of the Pipeline Project and presented in the Pipeline Final EIS (BLM 1996a), the South Pipeline Final EIS, review of the Project baseline characterization report (Geomega 1998a), review of the Plan for the Project (CGM 1996), and review of the Proposed Action. The significance of the impacts was evaluated based on the significance criteria listed above. Stability analysis of the Project waste rock dumps was analyzed in the Plan. A similar stability analysis for the Pipeline Project waste rock dump and heap leach facility was conducted by SHB (1993). Analysis of potential land subsidence was modeled by CGM (1993) for the Pipeline Project and the potential effects on mine facilities analyzed by SHB (1993). The results of the investigations are presented in the Pipeline Final EIS (BLM 1996a).

The stability analysis conducted for the proposed Project waste rock dump (Steffen, Robertson and Kirsten (U.S.), Inc. [SRK] 1996b) evaluated both the operating and reclaimed configurations using a peak ground acceleration of 0.21g (0.21 times the acceleration of gravity) for the Operating Basis Earthquake (OBE). The expected return period for the OBE event was estimated at approximately 450 years. The stability analysis was based on modeling the minimum factor of safety against failure using the computer program PC-STABL5M and considered three different material types present at the Project site. The stability analysis conducted by SHB (1993) for the Pipeline Project facilities was based on an OBE event of magnitude 4.5 assumed to occur directly beneath the site.

4.2.3.3 Proposed Action

4.2.3.3.1 Mineral Resources

Direct impacts of the Proposed Action on geologic and mineral resources would include the following: An estimated 110 million tons of ore could be mined in Stages 8 through 12 (Stages 1 through 7 are discussed in Section 2.2) under the Proposed Action. A majority of this ore would be leached on existing heap leach pads; the remainder would be processed at the approved Pipeline mill and tailings facility, at the existing Cortez mill, the roaster and tailings facility, or in the case of some roast ore, shipped offsite for processing. The waste-to-ore ratio is approximately 5.4:1, resulting in approximately 590 million tons of waste rock that would also be mined under the Proposed Action. The waste rock would be deposited on the approved/expanded Pipeline/South Pipeline waste rock dumps, and/or sequentially backfilled into the mined-out portions of open pits, and/or on a new dump planned on top of the completely backfilled Pipeline/South Pipeline portion of the open pit, and/or the Gap waste rock dump (Stage 9) (Section 3.1.2.2).

Impact 4.2.3.3.1-1: Implementation of the Proposed Action would result in the production of approximately 6.5 million ounces of gold, negligible amounts of silver, and byproduct production of minor amounts of other metals.

Significance of the Impact: This impact is considered potentially significant, and no mitigation measures appear feasible.

Impact 4.2.3.3.1-2: The restriction of future mineral resource extraction due to placement of waste rock in the Pipeline/South Pipeline/Gap/Crossroads open pits.

Significance of the Impact: This impact is considered potentially significant, and no mitigation measures appear feasible.

4.2.3.3.2 Geological Hazards

Seismic events could result in slope failures or structural damage to mine facilities due to an exceedance of the OBE. Stability analysis of the proposed waste rock dump in its operating configuration and its reclaimed configuration was conducted (SRK 1996b; Golder 2002). Factors of safety were calculated for accelerations ranging from 0.05g to 0.20g for static and pseudostatic (seismic) conditions. The OBE event has a peak ground acceleration of 0.21g and an expected return period of approximately 450 years. The expected 100-year return period seismic event for the site has a peak ground acceleration of 0.09g. Factors of safety greater than 1 indicate the facility is strong enough to support the designed load, and factors of safety less than 1 indicate that some failure of the facility could occur. The higher the calculated factor of safety, the greater certainty in the stability of the facility design. Factors of safety for the operational configuration of the waste rock dump were primarily greater than 1 for static conditions, and ranged from 0.70 to greater than 1,250, indicating some minor slope failures during an earthquake but no substantial damage would occur to the facility. Factors of safety for the reclaimed configuration of the waste rock dump ranged from 1.84 to 4.24 for static conditions, and ranged from 1.13 to 3.41 for pseudostatic conditions. The results indicate the slopes of the reclaimed waste rock dump will be stable under both static and pseudostatic conditions. A design analysis of the waste rock dump and heap leach/tailings facilities for the Pipeline Project based on an OBE event of magnitude 4.5 showed that only minor slope failures would occur (Golder 2002).

Proposed dewatering could create additional land subsidence from compression of the unconsolidated aquifer because of ground water removal. Many engineering design and protective measures have been completed; however, continued subsidence could result in damage to mine facilities. Refer to Section 4.3.2.2.4 for the discussion on subsidence related to dewatering.

Impact 4.2.3.3.2-1: Minor slope failures would occur from seismic events in the Project Area.

Significance of the Impact: This impact is considered less than significant and no mitigation measures are required.

4.2.3.3.3 Residual Impacts

The potential residual impacts to geology and mineral resources from the Proposed Action are the same as discussed under the impacts discussion, because there is no mitigation measures that are either feasible or considered required.

4.2.3.4 Complete Backfill Alternative

4.2.3.4.1 Mineral Resources

Implementation of the Complete Backfill Alternative would result in potential impacts that are similar to those outlined under the Proposed Action, as well as placement of all 590 million tons of waste rock mined under the Proposed Action being placed as backfill in the Pipeline/South Pipeline, Crossroads, and Gap open pits.

4.2.3.4.2 Geological Hazards

The potential geological hazards impacts from the Complete Backfill Alternative would be similar to those discussed under the Proposed Action.

4.2.3.4.3 Residual Impacts

The potential residual impacts to geology and mineral resources from the Complete Backfill are the same as discussed under the impacts discussion because there are no mitigation measures that are either feasible or considered required.

4.2.3.5 No Backfill Alternative

4.2.3.5.1 Mineral Resources

Implementation of the No Backfill Alternative would result in potential impacts that are similar to those outlined under the Proposed Action, as well as placement of all 590 million tons of waste rock mined under the Proposed Action being placed as waste rock dumps surrounding the Pipeline/South Pipeline, Crossroads, and Gap open pits.

4.2.3.5.2 Geological Hazards

The potential geological hazards impacts from the No Backfill Alternative would be similar to those discussed under the Proposed Action.

4.2.3.5.3 Residual Impacts

The potential residual impacts to geology and mineral resources from the No Backfill Alternative are the same as discussed under the impacts discussion, because no mitigation measures are either feasible or considered required.

4.2.3.6 No Action Alternative

4.2.3.6.1 Mineral Resources

As a result of the No Action Alternative, none of the impacts to the mineral resources generated by the Proposed Action or any other alternative would occur. Impacts on the mineral resources would result from implementation of the No Action Alternative because identified mineral resources would not be developed.

Impact 4.2.3.6.1-1: The restriction of future mineral resource extraction due to implementation of the No Action Alternative.

Significance of the Impact: This impact is considered significant; however, no mitigation measures appear feasible.

4.2.3.6.2 Geological Hazards

The potential geological hazards impacts from the No Action Alternative would be similar to those discussed under the Proposed Action.

4.2.3.6.3 Residual Impacts

Under the No Action Alternative, residual adverse impacts to mineral resources would occur because the identified mineral resource would not be developed.

4.3 Water Resources-Water Quantity

4.3.1 Regulatory Framework

Approval of the Proposed Action would require authorizing actions from other federal, state, and/or local agencies with jurisdiction over the water resources aspect of the Project. The regulation, appropriation, and preservation of water in Nevada falls under both state and federal jurisdiction. When a proposed project has the potential to directly or indirectly affect the waters under State of Nevada jurisdiction, then the State of Nevada is authorized to implement its own permit programs under the provisions of state law or the Federal Clean Water Act (CWA).

The NDEP requires compliance with National Pollution Discharge Elimination System (NPDES) permits related to discharge of wastewater to surface waters from discharge points such as tailings piles and wastewater ponds, as well as with NPDES permits related to discharge of stormwater runoff. NDEP also requires that discharges into subsurface waters be controlled if the potential for contamination of ground water supplies exists, such as a state ground water discharge permit or a zero-discharge permit.

The Nevada Water Pollution Control Law provides the state authority to maintain water quality for public use, wildlife, existing industries, agriculture, and the economic development of the site. The NDEP defines waters of the state to include surface water courses, waterways, drainage systems, and underground water. The Nevada Water Pollution Control Law also gives the State Environmental Commission authority to require controls on diffuse sources of pollutants, if these sources have the potential to degrade the quality of the waters of the state. The Environmental Protection Agency (EPA) has also granted Nevada authority to enforce drinking water standards established under the CWA. The Nevada Division of Health administers this program.

The Nevada State Engineer's Office of NDWR is responsible for the administration and adjudication of water rights. Water appropriation permits are obtained through the NDWR. The NDWR (Diana Lefler, March 2003, personal communication) reports that the water rights associated with the Project are in good standing.

The U.S. Army Corps of Engineers (Corps) requires a CWA Section 404 permit for any dredging or filling of wetlands or waters of the U.S. The Pipeline Project is approved for a total of 2,837 acres of disturbance to jurisdictional waters of the U.S. under existing nationwide permits. However, a more recent letter (June 25, 2002) from the Chief of the Nevada Office, Regulatory Branch of the Corps states that the Corps now concurs with the survey that there "are no jurisdictional waters of the United States on the subject property," and "your mining activity is not regulated by the Corps. Therefore, no Department of the Army authorization is necessary and no further review from this office is warranted." The jurisdictional determination is valid until June 25, 2007.

4.3.2 Affected Environment

4.3.2.1 Study Methods

Water resources information, descriptions, and data are based on information presented in the South Pipeline Final EIS (BLM 2000a) along with updated information from ongoing monitoring, literature review, an updated hydrologic baseline study (Geomega 2002b), and an updated ground water flow model (Geomega 2003a).

The baseline data, ground water flow computer models, and associated reports were developed over an eight-year period by CGM contractors. The recent report, Pipeline/South Pipeline Pit Expansion Project Baseline Characterization Report (Geomega 2002b) updates and summarizes the pertinent baseline hydrologic characterization; the monitoring data and interpretations; and incorporates comments and suggested revisions from BLM reviewers. The recent report Groundwater Flow Modeling Report for the Pipeline/South Pipeline Pit Expansion Project (Geomega 2003e) analyzes the expected Project impacts to the hydrogeologic system, and incorporates comments and suggested revisions from BLM reviewers. Wherever appropriate, information has been taken verbatim from these documents.

The above references have drawn heavily on previous studies. The hydrogeology of Crescent Valley and to a lesser degree, of the Cortez Mountains and Shoshone Range surrounding Crescent Valley, has been studied by the U.S. Geological Survey (USGS) and reported in Water-Supply Paper 1581 (Zones 1961). The USGS has recently published Potential Hydrologic Effects of Mining in the Humboldt River Basin (Crompton 1995), which includes an evaluation of Crescent Valley. Recent studies by USGS (Maurer et al. 1996) address ground water hydrology and potential effects of mining along the Carlin Trend, including the area immediately north of the study area across the Humboldt River from Crescent Valley (Plume 1995). Hydrogeologic reports prepared by WMC (1992a; 1992b; 1993; and 1995a) and Geomega (1998a; 1998b) for the applicant provide additional information on water resources in Crescent Valley.

4.3.2.2 Existing Conditions

4.3.2.2.1 Conceptual Crescent Valley Basin Description

General Physiography

The Crescent Valley hydrographic area is within the Great Basin section of the Basin and Range physiographic province. Physiographic features of Crescent Valley are typical of the Basin and Range province. Generally north-trending mountain ranges bound an intervening basin that is partly filled with deposits eroded from the adjacent mountain ranges. Elevations in the vicinity of the Project Area range from 9,687 feet at the summit of Mount Lewis in the northern Shoshone Range to approximately 4,700 feet amsl at Beowawe.

Crescent Valley trends north-northeast (Figure 4.3.1). Overall, the valley is approximately 45 miles long and 20 miles wide at its widest point. It has a drainage area of approximately 700 square miles. The valley constitutes State of Nevada Hydrographic Area 54 (Rush 1968).

Crescent Valley is semi-enclosed topographically. The Shoshone Range borders the valley on the west, and the Cortez Mountains border the valley on the east. A southern spur of the Shoshone Range and an extreme northward-reaching spur of the Toiyabe Range separate the south end of Crescent Valley from Carico Lake Valley to the west. The northeast part of the valley is bounded by the southernmost extremity of the Tuscarora Mountains. A low topographic divide in the northwestern part of Crescent Valley separates the rest of the valley from the Humboldt River, a few miles to the north (Gilluly and Gates 1965). In the northeastern part of the valley, a small bedrock ridge extends to the west-southwest from the main Cortez Mountains. This ridge forms the Dry Hills, which gives the floor of Crescent Valley its overall Y shape.

The Shoshone Range and the Cortez Mountains are both northeast-trending fault-block ranges, which are bounded on their northwest sides by steep scarps and have been tilted to the east. As a result, the western part of Crescent Valley is characterized by gentle slopes and large alluvial fans along the eastern flanks of the Shoshone Range, whereas the eastern part of the valley consists of steeply dipping slopes and smaller alluvial fans along the western side of the Cortez Mountains.

Humboldt River. The Humboldt River marks the northern extent of the Crescent Valley hydrographic area. The river flows along the northern edge of the valley for a distance of approximately 17 miles. At Palisade, the river is at an elevation of 4,825 feet amsl (USGS 1996). Drainage from Safford Canyon enters the river at Barth. Additional drainage enters from Rocky Canyon, approximately 2.5 miles to the west of Safford Canyon. The valley is narrow between Palisade and Rocky Canyon, and the river channel is incised into bedrock over much of that reach. From Rocky Canyon, the Humboldt River flows west toward Beowawe across the northern end of Crescent Valley. In this reach the channel widens and meanders, and the gradient becomes less steep. The river leaves the valley at the gap near Beowawe, where it turns to the north. At Beowawe, the river is at an elevation between 4,680 and 4,690 amsl feet amsl (Plume 1997).

Shoshone Range. The Shoshone Range is approximately 150 miles long and the northernmost 30 miles forms the western margin of Crescent Valley. At the crest of the range, Mount Lewis rises to an elevation of 9,687 feet amsl, approximately 4,600 feet amsl above the valley floor. Other major summits in the range located within the Crescent Valley hydrographic basin include Granite Mountain, Bullion Mountain, and Havingdon Peak, each over 8,000 feet amsl in elevation (Figure 4.3.1). The Shoshone Range forms the topographic divide between Crescent Valley and the Reese River Valley to the west. At the extreme north end of the Shoshone Range, a steep northeast-trending fault scarp splits the range into two spurs. The Whirlwind Valley is located between the two spurs. The eastern spur, which borders Crescent Valley, is called the Malpais. Whirlwind Valley lies immediately to the west-southwest of Beowawe and is separated from Crescent Valley by the Malpais. Whirlwind Valley contains extensive geothermal activity.

Toiyabe Range. The Toiyabe Range forms the southern margin of the hydrographic basin. Rocky Pass separates the Shoshone Range from the Toiyabe Range and marks the boundary between Crescent Valley and Carico Lake Valley to the southwest. Drainage enters Crescent Valley from Carico Lake Valley through Rocky Pass. The elevation of the pass is 5,240 feet amsl.

Bald Mountain (8,540 feet amsl) and Red Mountain (7,992 feet amsl) are the highest points in the northern part of the Toiyabe Range. Cortez Canyon, located in the southeast part of the valley, marks the boundary between the Toiyabe Range and the Cortez Mountains and leads to the divide between Crescent Valley and Grass Valley to the south.

Cortez Mountains. The Cortez Mountains extend 37 miles along the eastern margin of the valley, terminating in the north at Safford Canyon and the Humboldt River. Mount Tenabo is the highest point in the range, rising to an elevation of 9,162 feet amsl, almost 4,000 feet amsl above the valley floor. The Cortez Mountains form the topographic divide between Crescent Valley and Grass Valley to the south, and between Crescent Valley and Pine Valley to the east.

The Dry Hills form a spur of the Cortez Mountains extending for approximately 18 miles in a west-southwest direction from the Humboldt River to Hot Springs Point. The highest point in the Dry Hills is at an elevation of 6,614 feet amsl, approximately 1,640 feet amsl above the valley floor. The Dry Hills are separated from Iron Blossom Mountain (6,698 feet amsl) and the rest of the Cortez Mountains by Rocky Canyon.

Alluvial Fans. The alluvial fans at the base of the Cortez Mountains are distinct and well defined. In the interfan areas, the valley floor is locally within a few hundred yards of the range front. Most of the fans extend one to two miles into the valley and have gradients of 200 to 250 feet per mile.

The alluvial fans at the base of the Shoshone Range are considerably larger than those at the base of the Cortez Mountains. The former have coalesced to form an alluvial apron along the base of the range. Their apexes are 600 to 700 feet above the valley floor, whereas those at the base of the Cortez Mountains are only 300 to 400 feet above the floor.

The largest alluvial fan in the valley, deposited by Indian Creek, extends eastward a distance of five miles from the base of the Shoshone Range, and has a gradient of approximately 70 feet per mile. North of the Indian Creek fan, the alluvial apron becomes progressively narrower and less distinct. At the base of the Malpais, the upper apron becomes indistinct from the weathered surface of the volcanic rocks.

The contrast in size and thickness of the alluvial fans means that the lowest point in the valley lies close to the foot of the Cortez Mountains. Near the Project Area, the valley is approximately eight miles in width, and the axis of the valley lies approximately six to seven miles east of the site.

Valley Floor. The valley floor forms a relatively flat area downslope of the alluvial fans. The width of the valley floor increases from approximately one mile in the northeast arm of the valley to more than six miles in the area to the south of the Dry Hills.

The elevation of the valley floor falls from an elevation of approximately 4,760 feet amsl at the southern end to approximately 4,690 feet amsl at the Humboldt River near the northern end. The elevation gradient ranges from 40 feet per mile in the south to less than two feet per mile in the north. The floor of the valley extends approximately 30 miles in length from the Cortez Mine area in the south to the town of Beowawe in the north. The floor of the valley has a surface area of approximately 150 square miles. Playas that range in area from a few acres to more than one square mile occupy the lowest areas of the valley floor.

4.3.2.2.2 Surface Water Resources

Climate, Runoff, and Evaporation

Climate

The climate in Crescent Valley is characterized by low precipitation, high evapotranspiration, and extreme variations in temperature. Climatological data are available from the Cortez Mine (1963–73 and 1992–96), the Pipeline Mine (1996–2002), and the U.S. Weather Bureau Stations at Beowawe (1951–80) and Eureka (1978–87), Nevada. Details of the last ten years of climate data from the Cortez and Pipeline Mines' meteorological stations are provided in Geomega (2002b) and Section 4.5 Air Quality.

Over the last ten years, recorded temperatures in the southern part of Crescent Valley ranged from a low of –7.1 ^{O} Fahrenheit (F) to a high of 103.7^{O} F, with a mean temperature of 52.6^{O} F. Recorded monthly precipitation ranged from zero to 3.76 inches, with an average annual precipitation of 6.60 inches at CGM's meteorological stations. The recent precipitation recorded by CGM is lower than historical measurements taken at the town of Beowawe, where the average annual precipitation was 7.94 inches over the 55-year period from 1941 to 1995 (National Climatic Center 1941-1995). Shevenell (1996) summarized monthly average pan evaporation data collected at the University of Nevada Beowawe Ranch weather station, which is located in Grass Valley approximately 25 miles south of the Project Area. Figure 4.3.2 shows the relationship between monthly average precipitation and pan evaporation in the region on the basis of these data sets.

Runoff

Runoff within and through the Project Area is described in the South Pipeline Final EIS (BLM 2000a, Section 4.4.2.2.2, pages 4-15 and 4-16).

Evaporation

As with many weather stations in Nevada, pan evaporation data were only collected at the Beowawe Ranch weather station during the months of April through October. During these months, the total pan evaporation was 51.1 inches (Shevenell 1996). However, year-round pan evaporation also includes the months of November through March. At Fallon, Nevada, where year-round pan evaporation data have been collected, approximately 17 percent of the annual pan evaporation occurs during the months of November through March (Shevenell 1996). Assuming that this percentage is representative of the conditions at the Beowawe Ranch weather station, the annual average pan evaporation rate is estimated to be 61.6 inches (Figure 4.3.2). The average pan evaporation rate in the Project Area is probably slightly greater than 61.6 inches per year because the Project Area is several hundred feet lower in elevation than the Beowawe Ranch weather station.

Evaporation from pans is generally greater than from adjacent areas of open water or well-watered vegetation (Shuttleworth 1993). For the Middle Humboldt River Basin, Berger (2000) recently estimated an average annual evaporation rate of 4.2 feet from open-water bodies on the basis of pan

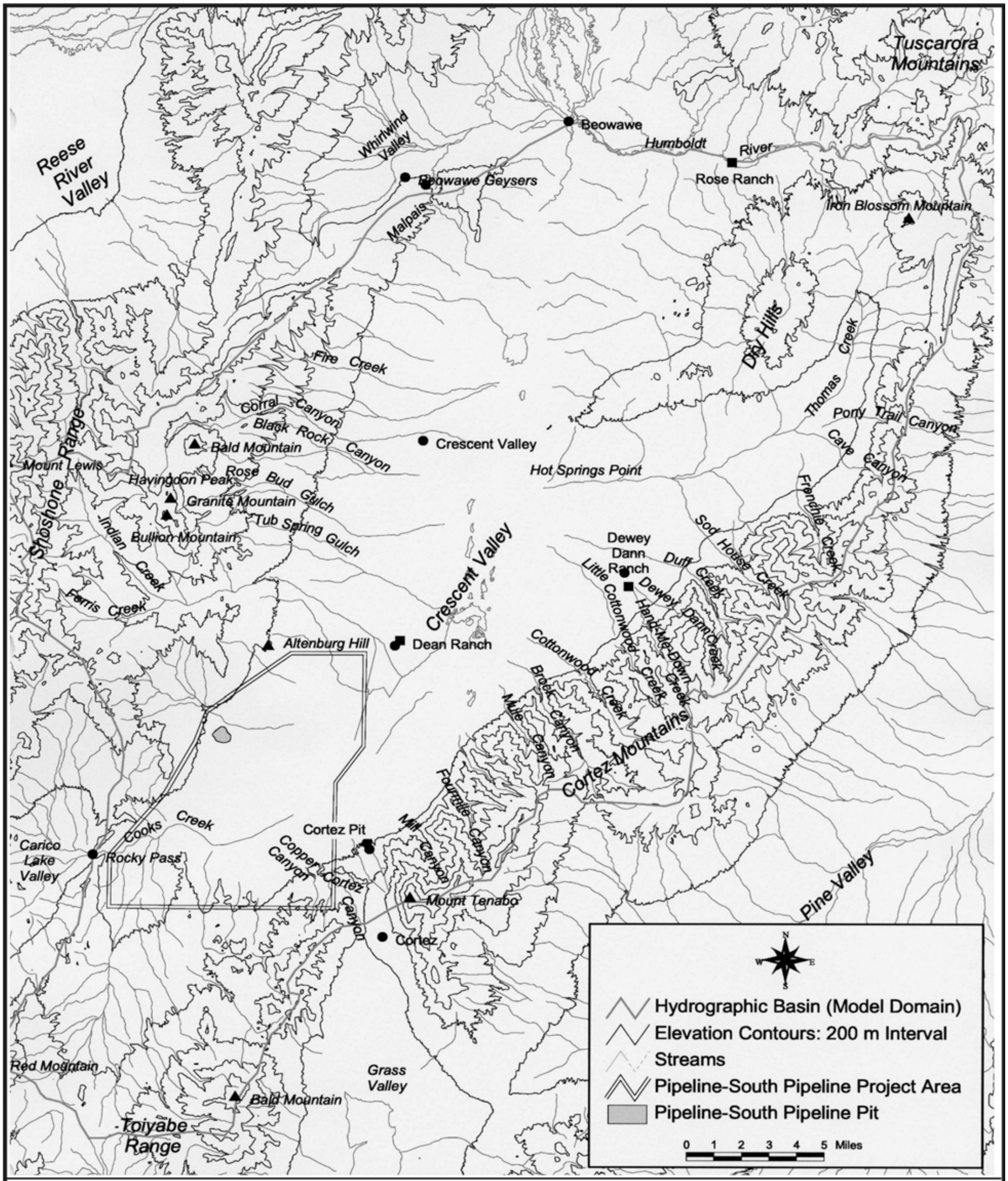

Figure 4.3.1 Physiographic and Hydrographic Features of Crescent Valley

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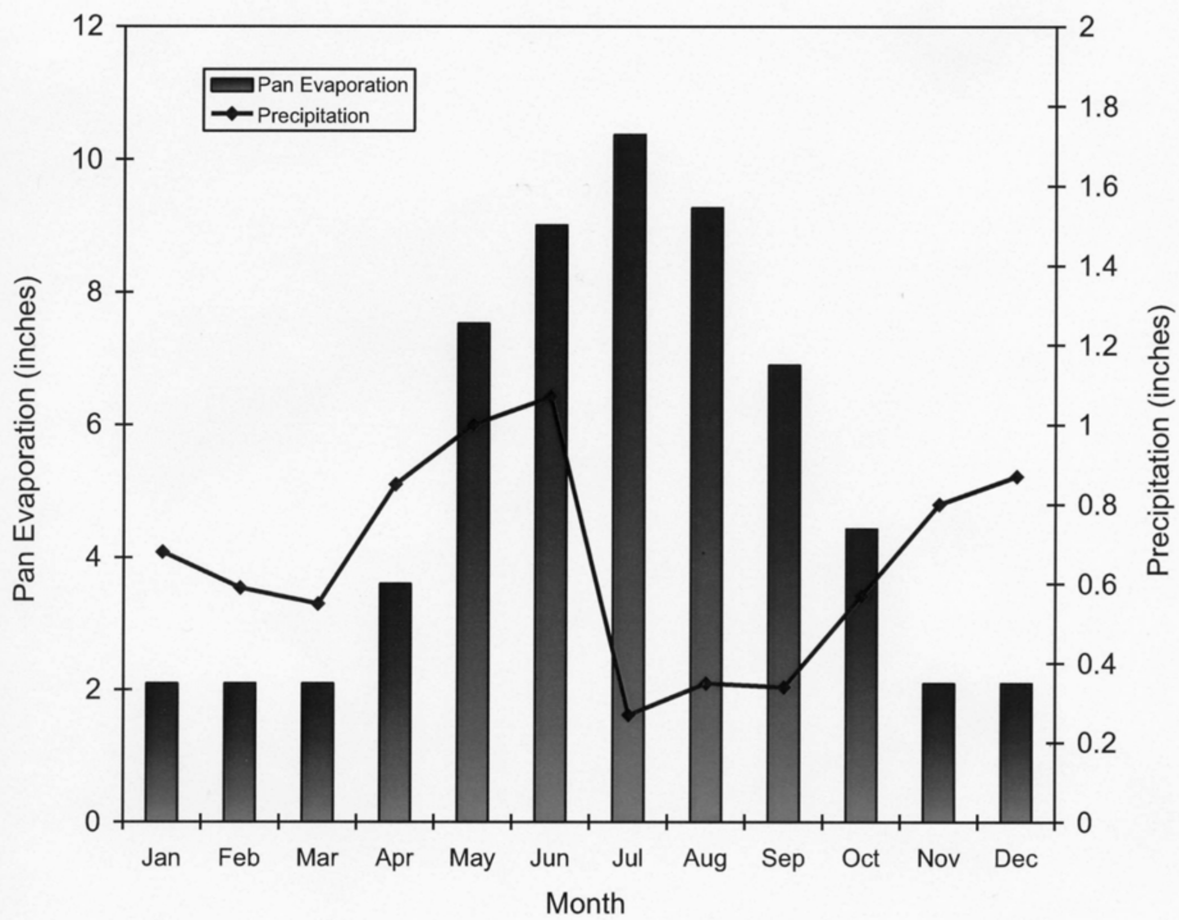

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Precipitation[1]	0.68	0.59	0.55	0.85	1.00	1.07	0.27	0.35	0.34	0.57	0.80	0.87	7.94
Pan Evap[2]	2.10	2.10	2.10	3.60	7.53	9.01	10.37	9.27	6.90	4.43	2.10	2.10	61.61

[1]Data from National Climatic Data Center's Beowawe Station
[2]Data for April through October from Beowawe Ranch Weather Station (Shevenell 1996). Evaporation for November through March estimated as 17% of annual average (See Section 2.2).

Note: precipitation and evaporation reported in inches.

Figure 4.3.2 Average Monthly and Annual Precipitation and Pan Evaporation

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evaporation measurements collected at Beowawe and Rye Patch Dam in the Humboldt River Basin and at Ruby Lake in northeastern Nevada. Based on a Class A pan evaporation rate of 61.6 inches per year (from the Beowawe Ranch weather station data) and an estimated open-water evaporation rate of 4.2 feet (50.4 inches) per year, the corresponding pan coefficient is 0.82. This is at the high end, but still within the range of Class A pan coefficient values reported by Linsley et al. (1975).

The net evaporation rate from an open-water body is the difference between the open-water evaporation rate and the incident precipitation rate. The net evaporation rate, in combination with total open-water surface area, determines the overall amount of water loss (or gain) annually from an open-water body. The average net evaporation rate for the Project Area was calculated to be 40.64 inches per year on the basis of an estimated open-water evaporation of 50.4 inches per year and an average precipitation rate of 9.76 inches per year at the location of the Pipeline/South Pipeline open pit, as determined from the PRISM, a recent precipitation model (Geomega 2002b). This value is similar to the net evaporation rate of 38.75 inches per year that was used for the Project Area in previous studies (Geomega 1998b, 1998d).

<u>Surface Water Use</u>. When available, surface water in some areas of Crescent Valley is used for irrigation, livestock water, mining, and by wildlife. There is no recorded historical or existing use of surface water for domestic purposes within the Project Area.

Surface water rights exist for springs and streams in the following areas of Crescent Valley (NDWR 1997): upper Indian Creek, Mud Spring, Corral Canyon, Hot Springs Point, Scotts Gulch, Dewey Dann Creek, Duff Creek, Fire Creek, Frenchie Creek, Mule Canyon, Brock Canyon, Hand-Me-Down Creek, Four Mile Canyon, Little Cottonwood Creek, and Mill Canyon. Former use of surface water from Indian Creek is reported at the Dean Ranch. There are no known surface water rights in the Project Area or the unnamed drainage basin to the west.

<u>Surface Water Distribution</u>. Surface water in Crescent Valley is limited to surface drainage in streams, seeps, and springs (JBR Environmental Consultants [JBR]1993). Each of these is described in this section.

Description of Surface Drainage

Precipitation in Crescent Valley is insufficient to support continual stream flow throughout the year. Streams that drain the mountains are primarily intermittent and carry water only after storms or during periods of snowmelt; however, some segments of streams do flow continuously throughout the year. These segments are fed by springs and seeps, although the water they carry usually infiltrates into the alluvial fans before reaching the valley floor. Water that does reach the valley floor during high intensity precipitation events is mostly lost to evaporation.

The steepest drainages occur in the Cortez Mountains. Channel lengths are generally less than three miles with gradients of approximately 500 feet per mile. Stream flows from the Cortez Mountains are more capable of reaching the valley floor because of their shorter length and the less extensive nature of the alluvial fans that they cross.

A detailed description of the Crescent Valley drainages is found in the South Pipeline Final EIS (BLM 2000a, Section 4.4.2.2.2, page 4-16).

Description of Seeps and Springs

Three of the spring systems in the valley are thermal springs; the remainder are cold springs (BLM 1996a). The largest spring system in the valley is at Hot Springs Point located at the southern extremity of the Dry Hills. This system consists of five springs with temperatures ranging from 79^{O} to 138^{O} F (WMC 1992b). Other hot springs in Crescent Valley are the Chillis Hot Springs in Rocky Pass, which has a water temperature of 102^{O} F, and an unnamed spring near the base of the Cortez Mountains west of Hand-Me-Down Creek (BLM 1996a).

In Crescent Valley, 68 seeps and springs were surveyed by the JBR in 1993 (JBR 1993). These springs are located in the southern parts of Crescent Valley. The survey did not locate all of the springs in the valley. Most were hillside seeps and springs associated with wet meadows and riparian areas below 6,000 feet amsl, classified as palustrine-type wetlands. Others were found emanating from the beds of drainages, classified as riverine-type wetlands.

Of the 68 sites surveyed, 24 were selected for quarterly monitoring, and seven were selected for semiannual monitoring. Of the monitored springs, four are in the Rocky Pass area, six are in the Toiyabe Catchment area, 12 are in the Shoshone Mountains west and northwest of the Project Area, eight are located in the east valley, and one is in a peripheral area in the Toiyabe Range. Results of the monitoring program are discussed in Cortez Gold Mines Pipeline Project Seep and Spring Monitoring: Fall Quarter 2002 (JBR 2003).

The two major hot spring systems in Crescent Valley are at Hot Springs Point at the southern terminus of the Dry Hills and Chillis Hot Springs in Rocky Pass. A major geothermal system, the Beowawe Geysers, is located in Whirlwind Valley, which is separated from Crescent Valley by the Malpais. Although the Beowawe Geysers are not located in Crescent Valley, they warrant further analysis because of their close proximity.

The thermal springs at Hot Springs Point issue from fault zones in the siliceous bedrock at the alluvial bedrock interface (WMC 1992b; Muffler 1964). The Chillis Hot Springs issues from the Caetano Tuff close to the alluvial bedrock contact (WMC 1992b).

A detailed discussion of the Beowawe Geysers is provided by Struhsacker (1986). The system consists of a 215-foot high and one mile long opaline sinter terrace produced by hot spring and natural geyser activities. A maximum downhole temperature of 415^{O} F has been recorded in the area. The present steam plume and hot water geyser that vents continuously at the terrace is not a natural geyser but a free flowing uncapped geothermal well.

The Beowawe geothermal system is associated with the Malpais fault system, a range front normal fault. Meteoric water is heated at depth and circulates upward along the range front fault system. On the basis of measured geothermal gradients, a depth of 4.3 miles is required to attain the measured temperatures (Struhsacker 1986). Mauer et al. (1996) reported that the source of thermal water at Beowawe could be restricted to the area contained in Whirlwind Valley.

Muffler (1964) mapped the hot spring at Hand-Me-Down Creek (also known as the Dewey Dann spring), associated with the Hot Springs Point geothermal system, near the contact of the alluvium and the Pony Trail Ground intrusions at the Crescent fault. The source of the hot spring is thought to be within the intrusions.

In Crescent Valley, outside of the Project Area, 68 seeps and springs supporting 40.5 acres of wetlands were identified. The wetlands are characterized by saturated soils and vegetation adapted to those conditions. The vegetative communities at most springs have been adversely affected by grazing (BLM 1996a). Many springs have been developed for livestock or other uses with the result that the spring is dry at the surface. The vegetation in damaged areas has been replaced by plants of the upland communities.

Former and Temporary Lakes

Cortez Pit Lake. The former Cortez Pit Lake was located in the open pit of the Cortez Mine and had a water depth of approximately 60 feet. Water level fluctuations in the pit lake were observed during its history, particularly when water has been used for mine-related purposes (Brown & Caldwell 1998, 1999; Geomega 2001c, 2002e). A steady decline of water level in the lake was noted starting in April 1997 and the pit became dry in early 1999.

Playa Lakes. Temporary ponding occurs on saline flats after snowmelt or prolonged rainfall. Saline flats exist where streams empty into areas with no outflow. Temporary ponding on saline flats soon evaporates.

Surface Water Hydrology in the Vicinity of the Proposed Action

Surface water hydrology (including Project Area drainage, analysis of storm runoff and floodplains) in the vicinity of the Proposed Action is described in detail in the South Pipeline Final EIS (BLM 2000a, page 4-17).

4.3.2.2.3 Ground Water Resources

Ground Water Flow

Overall Ground Water Flow in Crescent Valley

Ground water in the Cortez Mountains and Shoshone Range surrounding Crescent Valley occurs mainly in joints and fractures within the metamorphic and sedimentary bedrock. Most precipitation falling on the mountains travels downslope in ephemeral streams toward the valley floor. Recharge from the runoff enters the regional ground water system as it crosses the alluvial fan deposits of the valley at the base of the mountains. Ground water moves through these deposits toward the alluvial aquifer beneath the valley floor, where large quantities of ground water are stored. The valley floor is a relatively flat area of playas, small dunes, and some terraces.

Figure 4.3.3 shows regional well locations and ground water elevation contours prior to the startup of Pipeline Mine dewatering in April 1996. These data are consistent with the recharge-discharge scenario described above; ground water flows primarily from high elevations and from alluvial fan recharge areas toward the discharge areas of the valley floor. The contours indicate flow into the valley at Rocky Pass and flow out to the Humboldt River just east of Beowawe. General flow patterns within Crescent Valley are consistent with interpretations of the larger-scale regional movement of ground water (Harrill et al. 1988; Maurer et al. 1996).

Ground Water Flow System in the Project Area

Figure 4.3.4 shows ground water elevation contours in the Project Area in February 2002, and Figure 4.3.5 shows the average pumping rates during the first six years of dewatering the Pipeline open pit. Water levels in the bedrock monitoring wells located directly adjacent to the pit dropped approximately 600 feet between April 1996 (~4,790 feet amsl) and February 2002 (~4,200 feet amsl). Ground water mounds resulting from artificial infiltration of excess produced water (i.e., water that was pumped and not consumed by mining and milling operations) are apparent to the north and to the south of the open pit area.

Hydrolithologic Units and Properties. The general geology of Crescent Valley has been described in Section 4.2. This section will deal specifically with how the geology affects the movement and storage of water within the ground, and with evaluating existing physical ground water parameters.

Rocks and basin fill deposits have been grouped into six hydrolithologic units on the basis of lithologic and hydrologic similarities. Bedrock units consist of the following: 1) Cambrian to Devonian carbonate rocks, 2) Cambrian to Permian siliceous rocks, 3) Jurassic and Tertiary volcanic rocks, and 4) Jurassic and Tertiary intrusive rocks. These units form the mountain ranges and the structural basin in which the basin fill deposits have accumulated. Basin fill deposits comprise two units: older basin fill deposits (Tertiary to Quaternary) and younger basin fill deposits (Quaternary). The following description of hydrolithologic units in the Crescent Valley area is taken mainly from Maurer et al. (1996) and WMC (1995a).

Carbonate Rocks

Carbonate rocks belong primarily to the eastern and transitional assemblages, as defined by Stewart and Carlson (1976) and Stewart (1980). Although this hydrolithologic unit consists mostly of carbonate rocks, it also contains minor amounts of other rock types. Crescent Valley is thought to be near the western edge of the regional carbonate system (Plume 1996), but is structurally and hydraulically separated from it.

Within Crescent Valley, carbonate rocks are exposed only in the Cortez and Gold Acres window areas. At these locations, lower plate rocks of the Roberts Mountains thrust have been upwarped, and the upper plate rocks have been removed. The carbonate rocks within these two windows are thought to have been originally united and then subsequently separated by faulting (McCormack and Hayes 1996). However, carbonate rocks under the valley floor are probably not continuous between the Gold Acres and Cortez windows, in part owing to the large vertical displacement (approximately 10,000 feet) associated with the Crescent fault (Gilluly et al. 1965).

Drill hole data show substantial variation in the depth of carbonate rocks within the Shoshone Range. Carbonate rocks of the Roberts Mountains Formation were encountered at a depth of approximately 3,000 feet amsl in a USGS deep drill hole at Indian Creek (Wrucke and Cole 1991). Carbonate rocks were also reported at a depth of approximately 250 feet in a drill hole located three or four miles north of the Project Area near Altenburg Hill (WMC 1995a). Drill holes west of Beowawe in

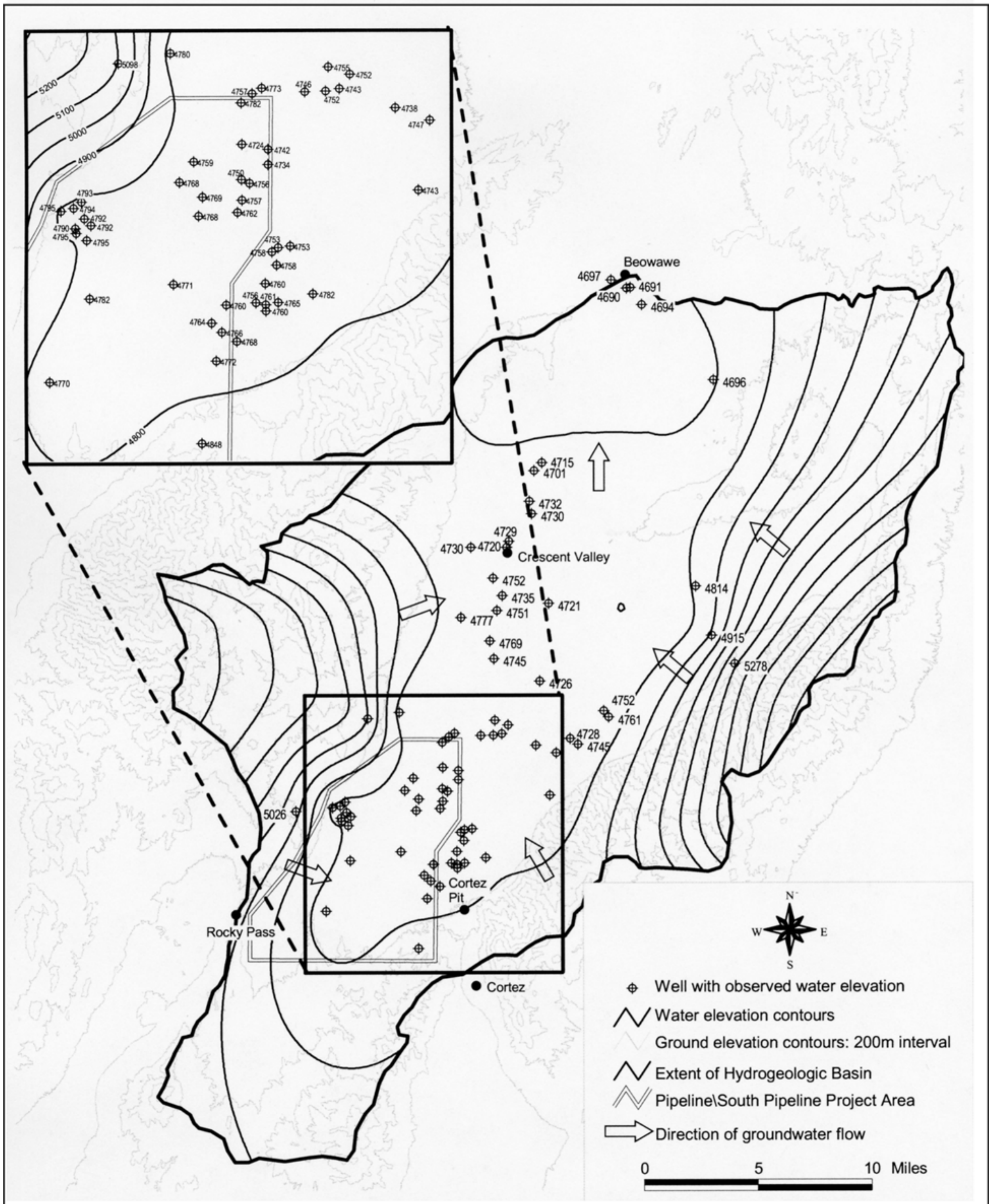

Figure 4.3.3 Regional Well Locations and Groundwater Elevations Prior to Pipeline Mine Dewatering

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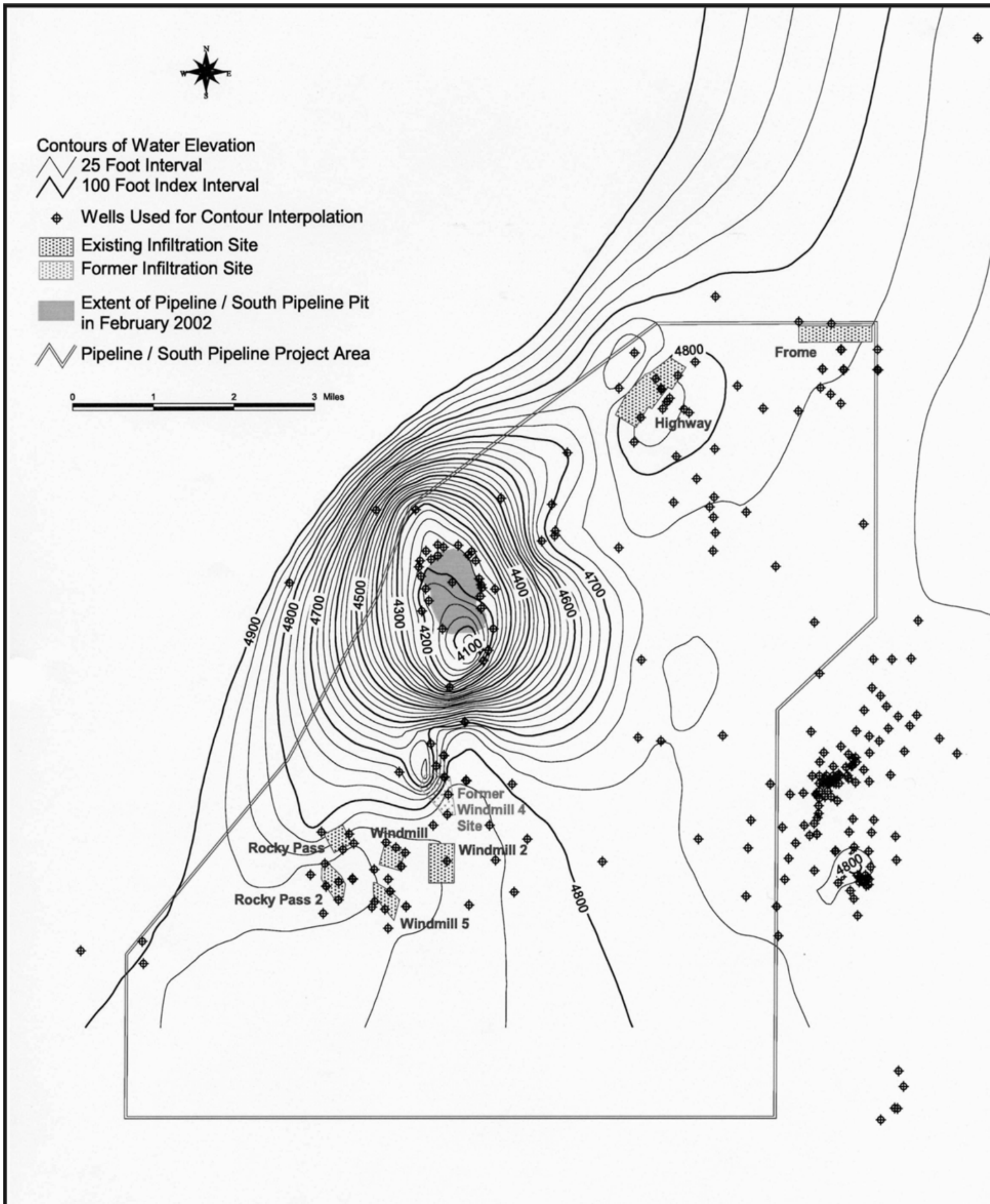

Figure 4.3.4 Pipeline/South Pipeline Project Area Generalized Ground Water Elevations, February 2002

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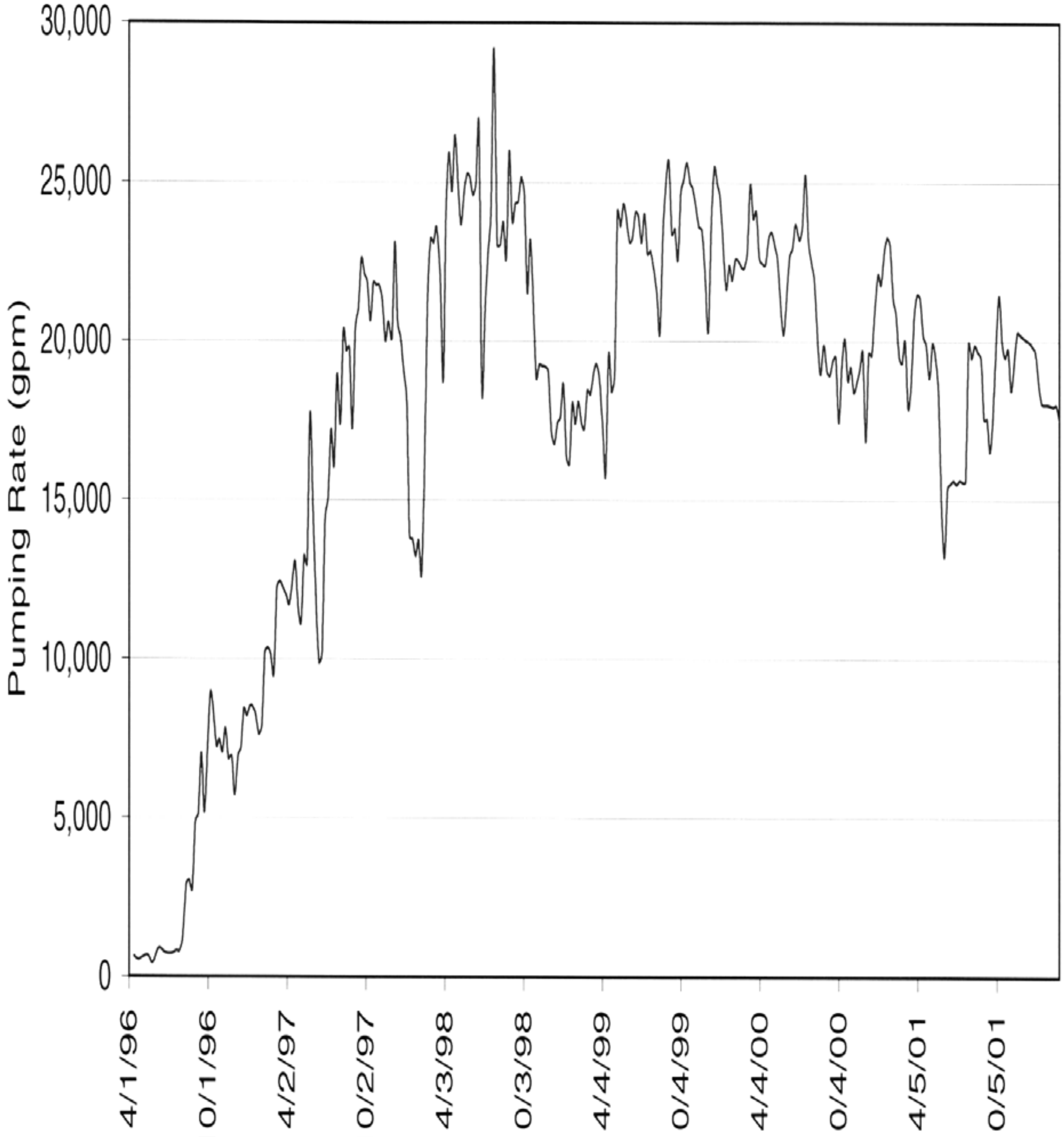

Figure 4.3.5 Weekly Average Combined Pumping Rate (gpm)

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Whirlwind Valley have not intersected carbonate rocks within 9,500 feet of the ground surface (Struhsacker 1986).

With the exception of the Cortez and Gold Acres windows, ground water elevations within the carbonate rocks of Crescent Valley are poorly constrained by field data. Bedrock-ground water elevations in the Cortez mine area have decreased from 4,805 feet amsl in early 1996 to 4,666 feet amsl in February 2002. This decrease has been the subject of an ongoing investigation (Brown & Caldwell 1998, 1999; Geomega 2001bc, 2002e). Ground water elevations within the Roberts Mountains Formation in the Gold Acres window were approximately 4,790 feet amsl before pumping began for the Pipeline Project (Figure 4.3.3).

Hydrologic properties of the Roberts Mountains Formation in the Project Area were evaluated from available aquifer test data and operational dewatering data collected during six years of operations at the Pipeline Project. Details of the evaluations are found in the South Pipeline Project Groundwater Flow Modeling report (Geomega 1998b). Aquifer pumping test data from the Pipeline area indicated that the local transmissivity of carbonate rocks ranges between 40,000 and 140,000 square feet per day in the Project Area. These values were interpreted from localized secondary permeability, most likely extensive fracturing along fault zones. Data from six injection and air-lift recovery tests in deep exploration holes within the Gold Acres window indicated that transmissivity of the carbonate rocks ranges from about 2,500 to 10,500 square-feet per day. Operational dewatering data, analyzed as a large-scale aquifer test, suggest that the transmissivity of carbonate rocks in the vicinity of the Pipeline open pit ranges from about 3,200 to 7,400 square-feet per day.

On the basis of other aquifer tests conducted in the Carlin trend area, just north of Crescent Valley, the horizontal hydraulic conductivity and storage coefficient of carbonate rocks are estimated to range from 0.1 to 150 feet per day and 0.00002 to 0.014, respectively (Maurer et al. 1996). Aquifer tests in Devonian to Cambrian carbonate rocks at the Nevada Test Site produced values of hydraulic conductivity that range from 0.7 to 700 feet per day (Winograd and Thordarson 1975). Plume (1996) reported values of hydraulic conductivity calculated from aquifer tests in Permian to Mississippian limestone in parts of eastern Nevada that range from 0.1 to 900 feet per day. The large ranges of conductivity values (several orders of magnitude) in widespread aquifer tests indicate that carbonate rocks are heterogeneous throughout Nevada.

Siliceous Rocks

The siliceous hydrolithologic unit consists of rocks of the Antler sequence and western assemblage, as defined by Stewart and Carlson (1976). The main rock types in this unit are chert, argillite, shale, siltstone, sandstone, conglomerate, and quartzite. The siliceous hydrolithologic unit also contains minor amounts of other rock types, including some carbonate rocks.

Siliceous rocks are exposed in the central part of the Shoshone Range and in the southern part of the Cortez Mountains. They are covered by Tertiary volcanic rocks and basin fill deposits in many parts of Crescent Valley. Rocks of the siliceous hydrolithologic unit overlie carbonate rocks throughout much of Crescent Valley, except in the Cortez and Gold Acres window areas.

The overall geometry of the siliceous hydrolithologic unit is difficult to assess, owing to structural complexities imparted by faulting (including thrusting) and folding. Furthermore, as with the carbonate rock unit, the thickness of the siliceous hydrolithologic unit varies greatly. In the Indian

Creek area, for example, drill-hole data suggest that the total thickness of siliceous rocks is approximately 3,000 feet (Wrucke and Cole 1991). Data from deep geothermal wells in Whirlwind Valley indicate that siliceous rocks are approximately 6,200 feet thick in the area west of Beowawe (Struhsacker 1986). In the Cortez Mountains, the estimated total thickness of siliceous rocks of the Antler sequence is just under 5,000 feet (Muffler 1964).

Ground water elevations in wells completed in siliceous bedrock have been measured at several locations in the Cortez Mountains and in the Shoshone Range. Recorded ground water elevations in siliceous bedrock in the Cortez Mountains range from 5,280 to 7,300 feet amsl. In the Shoshone Range, measured ground water elevations in siliceous bedrock are approximately 5,100 to 5,800 feet amsl (WMC 1995a). In general, only the lowest values within these ranges are consistent with regional water table elevations in the Crescent Valley area (Bedinger et al. 1984; Thomas et al. 1989). Therefore, the available data suggest that ground water flow within siliceous bedrock of the mountain ranges is limited, probably as a result of controls by geologic structures.

Detailed studies at other mining areas in north-central Nevada have shown that ground water flow in bedrock of the mountain ranges is typically restricted to individual hydrologic domains or compartments, which are separated by low-permeability barriers along faults, intrusions, and mineralized zones (Maurer et al. 1996). Hence, ground water levels and movement can vary greatly within the siliceous bedrock of the mountain ranges.

Few aquifer tests have been made in rocks of the siliceous hydrolithologic unit. Within Crescent Valley, the only available data are from a single air-lift recovery test performed in well PMW-01, which is located approximately two miles northeast of the Project Area. Results of the test indicate that the transmissivity of siliceous bedrock at that location is approximately 6,200 square feet per day (Geomega 1998b). In siliceous rocks of the Carlin trend area, reported ranges of hydraulic conductivity and storage coefficient are approximately 0.001 to 100 feet per day and 0.00001 to 0.03, respectively (Maurer et al. 1996). The hydraulic conductivities of siliceous rocks are low where the rocks have not been affected by faults and fracture zones. In general, these rocks are thought to act as potential barriers to regional ground water flow (Plume 1996).

Volcanic Rocks

Rocks composing the volcanic hydrolithologic unit are exposed along the Malpais in the northern part of the Shoshone Range; between Cortez Canyon and Rocky Pass in the Toiyabe Range; in the northern and southern parts of the Cortez Mountains; and in the Dry Hills. A northwest-trending magnetic anomaly suggests that volcanic flows in the Malpais may be continuous beneath basin fill deposits and extend to the southern part of the Cortez Mountains.

Volcanic deposits in the area west of Beowawe attain thicknesses of approximately 3,000 feet (Struhsacker 1986). The Caetano Tuff, which crops out over most of the Toiyabe Range, is estimated to have a total thickness of about 8,000 feet (Gilluly et al. 1965). Jurassic volcanic deposits in the northern Cortez Mountains and in the Dry Hills may be as much as 10,000 feet thick (Muffler 1964).

No hydrologic data exist for rocks of the volcanic hydrolithologic unit in Crescent Valley. Estimates of the hydraulic conductivity of volcanic rocks in Boulder Valley, just north of the Humboldt River, range from 0.01 to ten feet per day (Maurer et al. 1996). At the Nevada Test Site, measured values of the hydraulic conductivity of volcanic rocks, consisting of lava flows and ash-flow tuffs, range from about 1.5 to 17 feet per day (Winograd and Thordarson 1975). Plume (1996) reported that 54 drill stem tests in volcanic rocks in Railroad and White River Valleys in eastern Nevada produced hydraulic conductivity values that range from 0.000001 to 0.3 feet per day, with a mean value of 0.02 feet per day.

Intrusive Rocks

Intrusive rocks are exposed in the central and southern parts of the Cortez Mountains and in the vicinity of Granite Mountain in the Shoshone Range. Aeromagnetic data (Figure 4.3.6) suggest the presence of other intrusions not exposed at the surface. Intrusive rocks exposed within Crescent Valley are primarily composed of granodiorite and quartz monzonite.

No wells in Crescent Valley are known to have been completed in intrusive rocks. Results of aquifer tests in granodiorite near the Post-Betze mine in Boulder Valley indicate that the hydraulic conductivity of intrusive rocks is approximately three to five feet per day where the rocks are highly fractured (Maurer et al. 1996). However, where fracturing is less extensive, intrusive rocks generally have very poor permeability and impede the movement of ground water (Plume 1995).

Older Basin Fill Deposits

As described by Plume (1996), the older basin fill hydrolithologic unit consists of semi-consolidated deposits of conglomerate, sandstone, siltstone, claystone, freshwater limestone, evaporite, and interbedded volcanic rocks. These deposits accumulated in basins that predated basins that began to develop during the earliest stages of basin-and-range extension. As a result, older basin fill deposits constitute much of the valley fill in present day basins.

Older basin fill deposits are exposed near Horse Canyon on the flanks of the Toiyabe Range and in the Shoshone Range north of Rocky Pass (Figure 4.2.1). Older basin fill is inferred to underlie younger basin fill throughout the valley, although the depth of the contact between these two units is not well delineated. The total thickness of all basin fill deposits in the deepest part of the Crescent Valley structural basin is thought to be approximately 8,000 feet (based on Figures 4.2.3 and 4.3.1).

Most of the wells in Crescent Valley are completed in alluvial fans or in sand and gravel layers within the upper 500 feet of basin fill material. Presumably, many of these wells are completed in both younger and older basin fill deposits. Where older basin fill and younger basin fill have been distinguished as separate hydrolithologic units, the hydraulic conductivity of older basin fill deposits is reported to range between 0.1 and ten feet per day (WMC 1995a; Maurer et al. 1996).

Younger Basin Fill Deposits

The younger basin fill hydrolithologic unit comprises deposits of alluvial fans, landslides, stream flood plains, and playas. These deposits are a result of the erosion of bedrock and older basin fill material in the adjacent mountain ranges. Alluvial fans occur along the bases of mountain ranges. The largest alluvial fans on the western side of Crescent Valley reach a thickness of 700 to 800 feet. Silts and clays make up playa deposits on the valley floor (Figure 4.2.1), which are estimated to range in thickness from 15 to 80 feet (WMC 1995a). Ground water flow within the younger basin fill deposits is typically unconfined. In the vicinity of the Project Area, the water table was approximately 250 to 300 feet below ground surface prior to the start of Pipeline open pit dewatering. The depth to ground water decreases toward the center of the valley and northward to the Humboldt River. The distribution of phreatophytes within Crescent Valley (Figure 4.3.7) indicates places on the valley floor where the water table is closest to the ground surface and, hence, where the potential for discharge by evapotranspiration is the greatest. At some locations, ground water discharges from younger basin fill deposits at the toes of alluvial fans, primarily because of the contrast in hydrologic properties of the alluvial fan material and the underlying finer grained deposits. Most of these discharges occur at the toes of alluvial fans on the east side of the valley.

Hydrologic properties of younger basin fill materials were measured at four locations in the central part of Crescent Valley around 1950 by the USGS and also in the vicinity of the Cortez mine by several private consulting firms, as described in the South Pipeline Project Groundwater Flow Modeling report (Geomega 1998b). The aquifer tests conducted by the USGS indicate that transmissivity of alluvial fan deposits ranges from 4,000 to 8,200 square feet per day and that the transmissivity of finer grained deposits in the northern part of the valley floor is about 870 square feet per day. Aquifer tests conducted at the Cortez mine site indicate that the hydraulic conductivity of alluvial fan deposits in that area range from five to 45 feet per day, whereas the valley floor deposits have a much wider range of four to 2,230 feet per day. The larger hydraulic conductivity values for the valley floor deposits at the Cortez mine site occur in a depositional feature identified as a paleochannel (Dames & Moore 1994). Estimated values for the storage coefficient of alluvial deposits range from 0.003 to 0.05 (SHB AGRA 1993). The hydraulic properties of deposits similar to those composing the younger basin fill hydrolithologic unit have been extensively measured and reported (e.g., Bredehoeft 1963; Bunch and Harrill 1984; Plume 1995, 1996; Prudic and Herman 1996; Maurer et al. 1996; Thomas et al. 1989; Winograd and Thordarson 1975). In general, hydraulic conductivity values of younger basin fill deposits range from 0.5 to about 2,000 feet per day, with many values between about three and 74 feet per day. Specific yield of younger basin fill deposits ranges from about six percent for fine-grained deposits to nearly 30 percent for coarse-grained deposits. Values of ten percent to 15 percent are typically used in ground water flow models for other valleys in the Great Basin (Thomas et al. 1989).

Variations in Hydraulic Properties Caused By Intrusions, Metamorphism, and Faults

Ground water flow within the mountain ranges is complicated by the presence of faults and metamorphic aureoles surrounding intrusive stocks. Both the Pipeline and South Pipeline gold deposits occur on a domed feature related to the intrusion of the Gold Acres stock (depicted on Figure 4.2.4), where contact metamorphism from the intrusion of the stock has produced local low-grade and low-temperature changes in the Paleozoic host rock (Foo et al. 1996a, 1996b; Hays and Thompson 2000). Rocks that have been metamorphosed by intrusion of the stock tend to have lower hydraulic conductivities than their unaltered counterparts. Mineralization and alteration can also reduce fracture permeability (Stone et al. 1991).

Extensive faulting in the mountain ranges is hydrologically significant. Along fault zones, where fracturing can be extensive, bedrock can be extremely permeable. On the other hand, faults may truncate an aquifer by placing a relatively impermeable stratum against it. The faults themselves may act as either conduits or barriers to flow. Significant faults in the Project Area include the Pipeline fault, which appears to enhance ground water flow along a corridor surrounding the fault, and the faults that form the boundaries of the Gold Acres window (discussed in Section 4.2.2.2.3), which

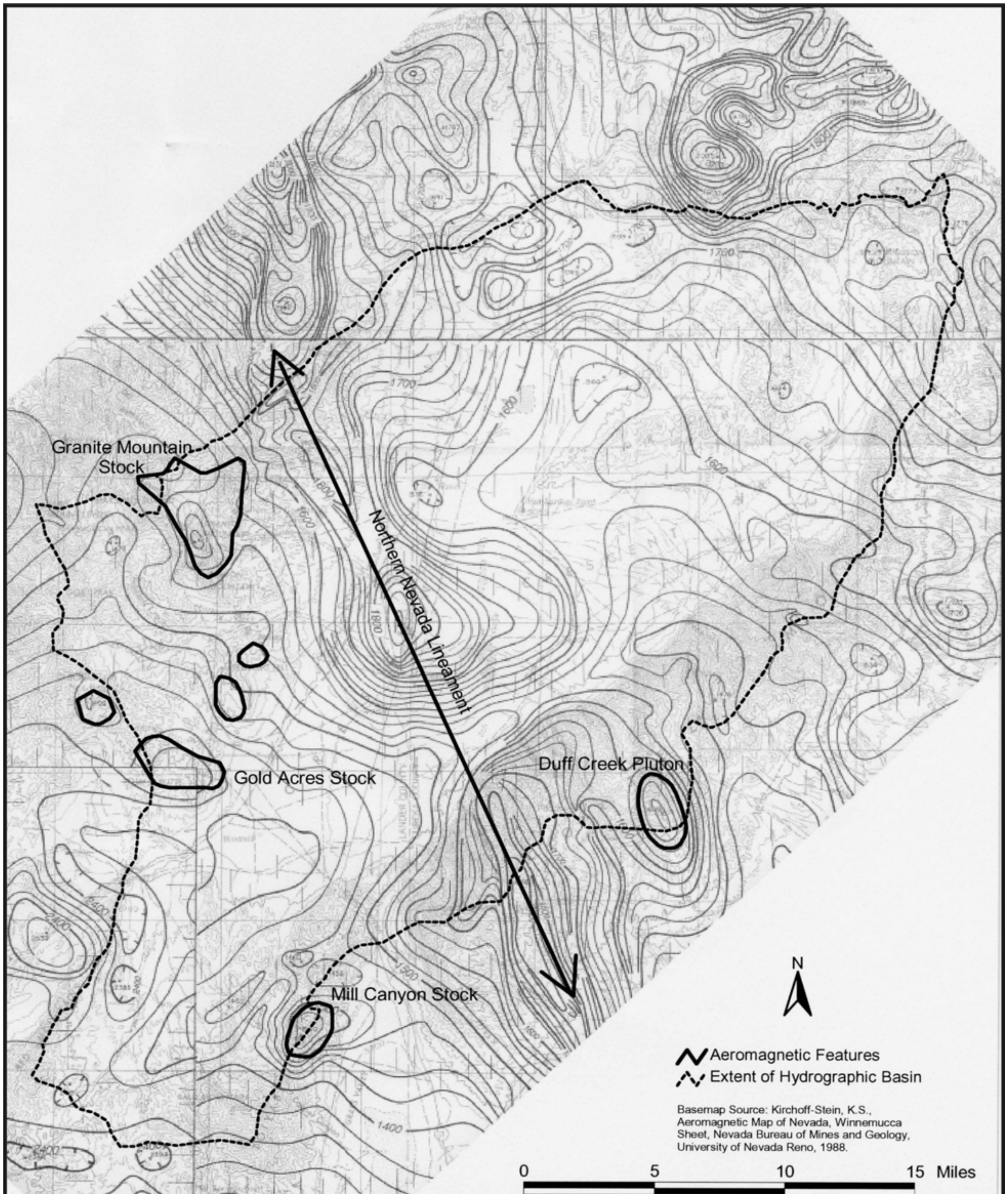

Figure 4.3.6 Aeromagnetic Map Showing Stocks and Plutons in Crescent Valley

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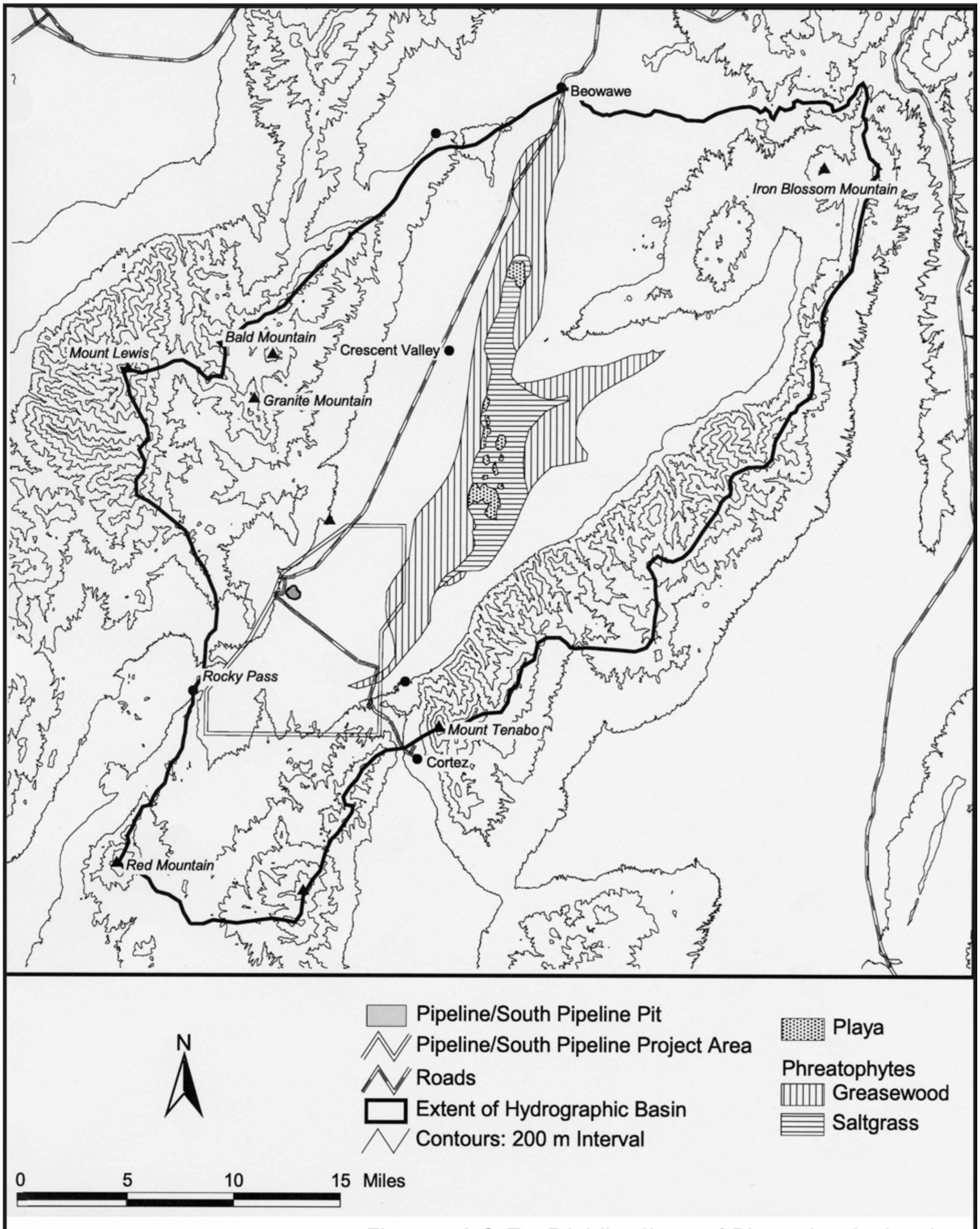

Figure 4.3.7 Distribution of Phreatophytes in Crescent Valley

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appear to act as partial barriers to flow on the basis of the behavior of ground water levels in bedrock and alluvium on opposite sides of the faults (Geomega 1998b, 2002b).

Detailed studies at other mining areas in north-central Nevada have shown that ground water flow in bedrock is typically restricted to individual hydrologic domains or compartments, which are separated by low-permeability barriers along faults, intrusions, and mineralized zones (Maurer et al. 1996b). Hence, ground water levels and movement can vary greatly between individual compartments, resulting in a complex pattern of ground water flow within the mountain ranges.

Variations in Hydraulic Conditions Caused by Faulting within the Gold Acres Window

Several hundred exploration borings were drilled within the Crossroads expansion area of the Gold Acres window during the time period 1999 to 2001. In addition, alluvial cores were obtained from three borings to provide an assessment of the geotechnical stability of the basin fill deposits in the Proposed Action area (Golder 2002). These borings also indicated the approximate location of the water table at the times they were drilled because the cores were also examined for degree of saturation. The majority of the exploration boreholes show that much of the alluvium in the Crossroads expansion area has been essentially desaturated down to the bedrock contact (approximately 500 feet to 1,100 feet below ground surface) as a result of dewatering from bedrock production wells.

Collectively, these borehole data suggest that there are quasi-vertical structures within the alluvium that act as partial barriers to horizontal ground water flow. These structures appear to be aligned with underlying bedrock faults of the Gold Acres window, in particular the fault forming the northeast boundary of the Gold Acres window, and are hypothesized to be the result of Basin and Range extension and bedrock fault motions subsequent to alluvial deposition. The potential presence of the alluvial barriers has been identified on the basis of observations during exploration and geotechnical drilling programs (Tim Thompson, CGM, personal communication, Jan. 2002; Golder 2002). These observations include the presence of bedrock faults exposed in the walls of the pit that continue upwards into the alluvium offsetting permeable lenses.

Although much of the alluvium overlying the Crossroads pit area appears to be effectively desaturated, there are some areas near the edges of the Gold Acres window where the alluvium is still partially saturated. For example, in the southwest corner of the Gold Acres window at monitoring well SH-05A, saturated alluvium is present near pre-dewatering ambient levels (water levels are approximately 90 to 150 feet below ground surface). The nearby bedrock monitoring well SH-04B indicates that hydraulic head in the bedrock aquifer is over 530 feet lower than in the overlying alluvial aquifer in that area. Thus, perched water appears to exist in that portion of the Gold Acres window, while the underlying bedrock has been significantly depressurized. Similarly, perched ground water conditions are present to the northeast of the Gold Acres window near alluvial monitoring well SMA-15. These water level differences suggest that at least some of the bedrock structures within and bounding the Gold Acres window have analogous expressions in the basinfill aquifer, which locally have a strong influence on lateral ground water flow.

Water Budget Components

The ground water budget comprises all sources of water supplied to the valley and all ground water losses from the valley (Table 4.3.1). The primary source of ground water for Crescent Valley is precipitation. Secondary sources are stream flow and underflow from the adjacent Carico Lake Valley. Mining related dewatering and infiltration are part of the ground water budget for Crescent Valley. The primary mechanism of ground water loss is evapotranspiration. Pumping, discharge from seeps and springs, evaporation from infiltration ponds, other Project related consumptive uses, and outflow to the Humboldt River are other means of ground water loss.

Ground Water Recharge

Natural recharge to the Crescent Valley ground water flow system is primarily derived from infiltration of precipitation, with a minor amount of recharge received as inflow from Carico Lake Valley. The total basin recharge due to infiltration of precipitation was estimated for Crescent Valley by using a recently derived empirical relation between precipitation and ground water recharge similar to that developed by Maxey and Eakin (1949) and Eakin et al. (1951). The revised "Maxey–Eakin" relation was derived by Nichols (2000) from an analysis of 16 basins in eastern Nevada where ground water outflow by evapotranspiration and interbasin flow had been estimated previously. Distribution of precipitation recharge within Crescent Valley was estimated according to the method of Stone et al. (2001). In that method, the hydrographic basin is subdivided into three general regions: 1) mountain subbasins, which receive the greatest amounts of precipitation, have limited infiltration capacity, and produce runoff to lower-lying areas; 2) alluvial fan subbasins, which receive runoff from the mountains and are areas of significant recharge within the basin; and 3) the valley floor, which typically receives insufficient precipitation to overcome the effects of evapotranspiration and therefore is not an area of ground water recharge. This breakdown of the hydrographic basin into three separate regions with distinct runoff and recharge characteristics is analogous to the hydrologic conceptualization in terms of landforms (mountain blocks, piedmont slopes, and valley lowlands) utilized by Berger (2000) in a recent analysis of water budgets for the 14 hydrographic areas in the Middle Humboldt River Basin, including Crescent Valley.

Precipitation

The PRISM was used to calculate precipitation amounts and distribution within Crescent Valley (Figure 4.3.8). The PRISM is a statistical-topographic model developed to simulate precipitation over mountainous areas at regional scales (Daly et al. 1994). The PRISM precipitation map of Nevada for the 30-year reference period from 1961-1990 (Oregon State University Spatial Climate Analysis Service 2002) delineates the modeled 30-year average annual precipitation at two-inch per year intervals. The PRISM precipitation map was superimposed on the previously defined mountain and alluvial subbasin and valley floor areas of Crescent Valley and the average annual precipitation was subsequently calculated for each area, as described in Stone et al. (2001). The resulting estimated total precipitation for Crescent Valley is similar to that reported by Berger (2000), with minor differences in the distribution of precipitation on individual landforms due to the different definitions of those landforms in the two papers.

Recharge from Infiltration of Precipitation

The revised Maxey-Eakin relation developed by Nichols (2000) is based on a distribution of average annual precipitation into four zones. Precipitation within each zone is then related to ground water recharge via empirically-derived recharge coefficients (Nichols 2000). Application of the revised coefficients to the precipitation distribution of Crescent Valley results in a ground water recharge

Table 4.3.1: Estimated Average Annual Water Budget for 2001

Water Budget Components	Inflow (acre-feet/year)	Outflow (acre-feet/year)
Precipitation in Crescent Valley Hydrographic Area	[1]432,000	---
Subsurface flow and surface infiltration of Cooks Creek at Rocky Pass	[2]100 - 400	---
Infiltration of dewatering excess	[3]26,200	---
Net ground water discharge to Humboldt River	---	[4]500 - 700
Consumptive use of ground water, excluding mining operations	---	[5]2,900
Mine dewatering	---	[6]30,800
Evaporation of open water from discharge of seeps and springs	---	[7]200 - 300
Evapotranspiration of precipitation and soil moisture	---	[8]413,000
Evapotranspiration of ground water from valley lowland	---	[9]15,100
Total	458,300 - 458,600	462,500 - 462,800

[1] Based on Table 4-1 (Geomega 2000)

[2] Subsurface flow (<300 acre-feet per year) from Everett and Rush (1966, page 17); surface infiltration of Cooks Creek (~100 acre-feet per year) from Zones (1961, page 20).

[3] Calculated as mine dewatering minus mining and milling usage, which includes evaporation from infiltration facilities and Dean Ranch irrigation, as reported by CGM (2002, Table 1) for annual period ending December 2001.

[4] Estimated from October 1992 measurements by U.S.G.S. (Emmett et al. 1994, page 475), as described in Geomega (1998, pages 209 through 2-11 and 4-4).

[5] Less than estimated amount prior to mining (Geomega 2002b, Table 14) because withdrawals at Dean Ranch were halted in 2000.

[6] CGM (2002, Table 1); part of this amount is consumed by mining and milling usage, evaporation from infiltration facilities, and Dean Ranch irrigation.

[7] WMC (1992, page 45).

[8] Calculated as difference between total precipitation and estimated recharge by revised Maxey-Eakin method (Geomega 2002b, Table 4-2).

[9] Based on basis of ground water model simulation result.

estimate of approximately 19,000 acre-feet per year. This estimate is comparable to the value (21,000 acre-feet per year) obtained by Berger (2000) using the revised Maxey–Eakin relation. By using a different approach involving mass balance calculations, Berger (2000) estimated ground water recharge to Crescent Valley to be slightly higher (25,000 to 26,000 acre-feet per year), but did not conclude which method (revised Maxey–Eakin relation or mass balance calculations) was more reliable. With the slightly lower estimate of the revised Maxey–Eakin relation, a conservative approach is adopted with regard to the assessment of potential impacts to ground water resources.

Other Sources of Recharge

A small amount of water (relative to the total water budget) recharges Crescent Valley from Carico Lake Valley at Rocky Pass. The combination of underflow and surface infiltration of Cooks Creek at Rocky Pass is estimated to be between 100 and 400 acre-feet per year (Everett and Rush 1966; WMC 1995a; Zones 1961).

In addition to natural recharge from precipitation and interbasin transfer, artificial recharge occurs in Crescent Valley as a result of mine dewatering. Excess produced water is returned to the Crescent Valley hydrologic basin via surface infiltration ponds (Geomega 2001b). Mine infiltration operations resulted in approximately 26,200 acre-feet of artificial recharge for the annual period ending December 2001 (CGM 2002).

Infiltration of Dewatering Water

This section summarizes the operational history of the Pipeline Project dewatering and infiltration systems. The dewatering and infiltration systems have been documented in these reports filed with the NDEP and/or BLM since 1996:

- Cortez Pipeline Gold Deposit Final Environmental Impact Statement (BLM 1996a);
- Amendment to the Pipeline Plan of Operations for the South Pipeline Project SRK 1996);
- Discussion of Arsenic, Boron, and Total Dissolved Solids (TDS) in Crescent Valley Groundwater (Geomega 1997a);
- An Evaluation of Potential Transient Water Chemistry Effects During Re-Infiltration of Pit Dewatering Water at the Proposed Frome Infiltration Site, Pipeline Project, Lander County, Nevada (Geomega 1997b);
- Geotechnical Investigations for the Pipeline Gold Project Infiltration Galleries (WESTEC 1997b);
- Characterization of Baseline Conditions for the South Pipeline Project (Geomega 1998a);
- Groundwater Flow Modeling Report for the South Pipeline Project (Geomega 1998b)
- Pipeline Infiltration Project Plan of Operations (CGM 1998a);
- Pipeline Injection Viability Report (Geomega 1998e);
- Hydrogeochemical Evaluation of Proposed Infiltration Sites, Pipeline Project, Lander County, Nevada (Geomega 1998f);
- Pipeline Infiltration Project Environmental Assessment (BLM 1999);
- Infiltration Permit Renewal Application, Pipeline Project, Lander County, Nevada (Geomega 2001b); and
- Cortez Gold Mines Pipeline Project Integrated Monitoring Plan and Infiltration Monitoring Reports (CGM 1997, 1998b, 1999, 2000, 2001 2002).

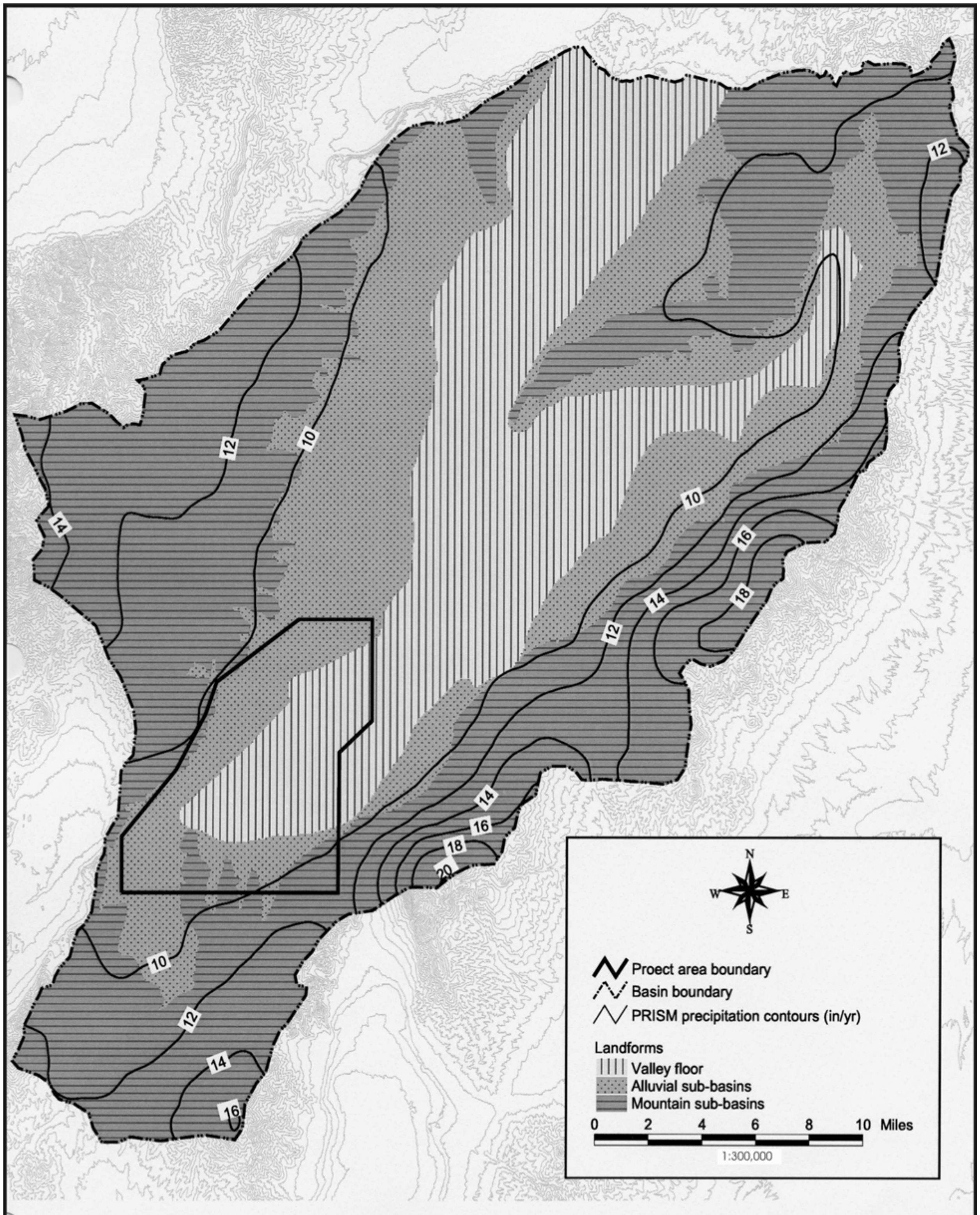

Figure 4.3.8 PRISM Precipitation Contours for Crescent Valley

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Dewatering System Operation

Since dewatering operations began on April 9, 1996, up to 24 pumping wells in bedrock have been used to lower water levels in the vicinity of the Pipeline/South Pipeline open pit. For the first four months, dewatering rates were less than 1,000 gpm and no water was released to the infiltration basins. Over the next year, dewatering rates increased to a range of 19,000 to 25,000 gpm with greater than 90 percent of the water returned to the basin via surface infiltration (Geomega 2001b).

Infiltration System Operation

The Project currently infiltrates water from dewatering operations at ten infiltration sites with a total of 55 individual basins (Figure 4.3.9). In addition to the current infiltration sites and basins, 18 basins have been taken off line and reclaimed at the former Filippini infiltration site and 12 basins have been taken off line and reclaimed at the Frome Site. Discharge to the infiltration system began at relatively low flow rates (approximately 4,000 gpm) in August 1996 and increased to a range of from 18,000 to 24,000 gpm after August 1997.

Highway Infiltration Site (Including North Highway and South Highway)

The Highway Infiltration Site is located on an outwash alluvial fan (Figure 4.3.10) that has source sediments from the upper-plate Valmy Formation, Slaven Chert, and intermediate intrusive rocks associated with the stock that is exposed at Altenburg Hill. The Highway Infiltration Site was expanded to the north (North Highway) and the south (South Highway) in 1998. The source rock for the alluvial fan crops out approximately 1.25 miles to the west of the infiltration site. The alluvial fan sediments exposed in the Highway Infiltration Site excavation consist of well-rounded, moderately to poorly sorted gravel with approximately 30 percent sand and silt matrix. The predominant rock type making up the pebble- and cobble-sized fraction of the gravel is fine- to medium-grained, slightly metamorphosed argillite and chert (CGM 1998a).

The original Highway Infiltration Site consists of 12 basins and has a total basin area of approximately 52 acres. The maximum water surface area of the basins is approximately 25 acres. Prior to operations, the water table was located at an elevation of 4,780 feet amsl, approximately 135 feet below ground surface. Prior to infiltration, the local ground water had a slight gradient (0.002) with flow from west to east, following the topography of that area.

The North Highway and South Highway extensions consist of an additional eight basins, four to the north of the existing Highway basins, and four to the south. These extensions have a combined total basin area of 35 acres, and a maximum water surface area of approximately 17 acres. Infiltration of water at the Highway site began in August 1996. The site initially received 8,000 to 10,000 gpm and achieved an infiltration rate of approximately 1.75 feet per day (CGM 1998a). With construction of the Rocky Pass and Windmill sites, the Highway sites currently receive a lower flow volume (Geomega 2001b). Infiltration at the Highway Sites has raised water levels east of the basins while levels west of the basins have remained unchanged (Figure 4.3.11). Water levels at the nearest downgradient monitoring well (IM-3S) increased approximately 90 feet between August and December 1996, reaching a steady level of approximately 4,880 feet amsl. The water level in IM-2, a monitoring well adjacent to the original Highway site basins, began to increase in September 1996. The increase in IM-2 was markedly slower than the increase in IM-3S and the water levels took longer to stabilize (i.e., January 1998). Water levels in distal downgradient monitoring wells began to show a water level increase in October 1996. Like IM-2, the water levels in these wells appear to have stabilized in January 1998 at elevations between 4,860 and 4,870 feet amsl. Water levels approximately one mile northeast of the infiltration area, have gradually increased from 4,752 to 4,778 feet amsl since the first measurements in June 1996, stabilizing at 4,778 feet amsl as of January 1998. Water levels in the upgradient monitoring well IM-1 have remained unchanged.

Based on the water level data from these monitoring wells, there appears to be an oblong ground water mound beneath the Highway Infiltration Sites. The mound is near the ground surface in the basin areas and decreases with distance from the basins, spreading preferentially downgradient to the east. The water table has been elevated within at least 1,000 feet east of the basins. The basins also appear to be slightly influencing water levels to the northeast as far as monitoring well IZ-9. The spread of the mound does not appear to have extended southeast to the former Filippini Infiltration Site, based on water levels in monitoring well IM-12, which did not show an increase in elevation until March 1997, following four months of infiltration at the former Filippini site.

Former Filippini Infiltration Site

The former Filippini Infiltration Site was situated entirely within fine-grained (silt-sized) playa lake sediments (Figure 4.3.12). The sediments were deposited in the large playa lake that formerly occupied the central part of Crescent Valley. The playa is flanked on the west and east by coalescing alluvial fans (CGM 1998a).

The former site consisted of 18 basins with a total basin area of 109 acres, with infiltration of dewatering water beginning in December 1996. The site is no longer in use and reclamation began in January 1998. Over that time period, the site received less than 2,000 gpm and achieved an infiltration rate of approximately 0.96 feet per day (CGM 1998a).

Prior to closure, the maximum water surface area of the ponds was approximately 44 acres. The pre-infiltration water table was located at an elevation of 4,760 feet amsl, approximately 44 feet below ground surface. There is little gradient in the local ground water (less than 0.001) at this location.

Water levels in the vicinity of the basins increased in response to infiltration (Figure 4.3.13). Unlike the Highway site, there is no pronounced ground water gradient at the Filippini site. Monitoring well IM-11 located in the midst of the infiltration basins showed an immediate response with water levels rising from 4,760 to 4,810 feet amsl between December 1996 and April 1997. The response in other proximal monitoring wells (IM-12 through IM-16 and the North McCoy well) was evident by March 1997, with water levels stabilizing at approximately 4,790 feet amsl by July 1997. Water levels in the proximal IM-10 well continued to increase through April 1998, stabilizing at 4,805 feet amsl. Water levels in distal monitoring wells (Gold Acres Well and IZ-7) have not varied significantly in response to infiltration operations.

Based on the water level data from these monitoring wells, the ground water mound was effectively at the ground surface in the basin area and decreased in height with distance from the basins. The mound was apparently symmetrical with respect to the infiltration site and did not appear to extend preferentially in any direction. The ground water mound apparently reached equilibrium quickly (within one year) and was delimited by the Gold Acres Well and IZ-7.

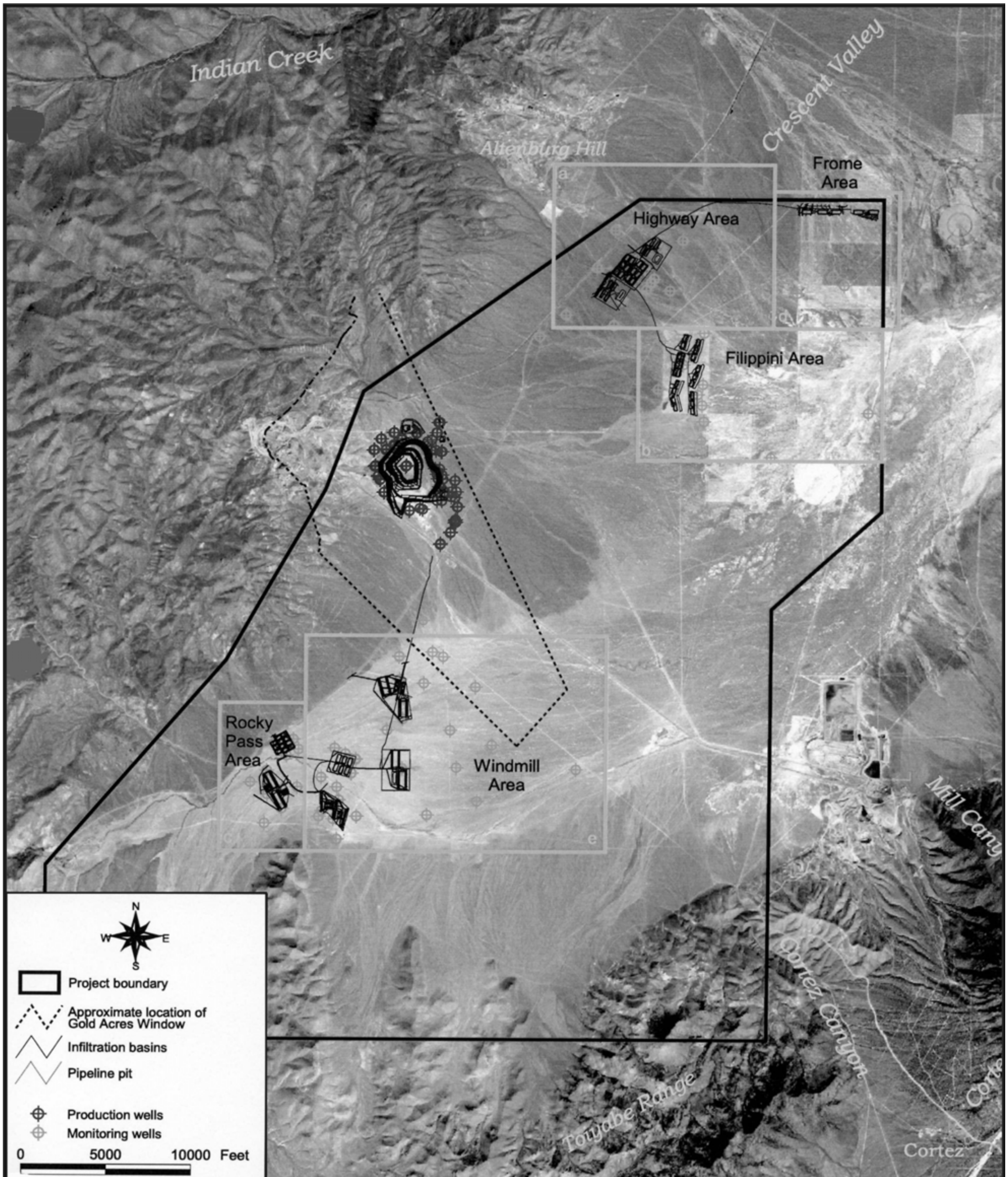

Figure 4.3.9 Infiltration Basin Location Map

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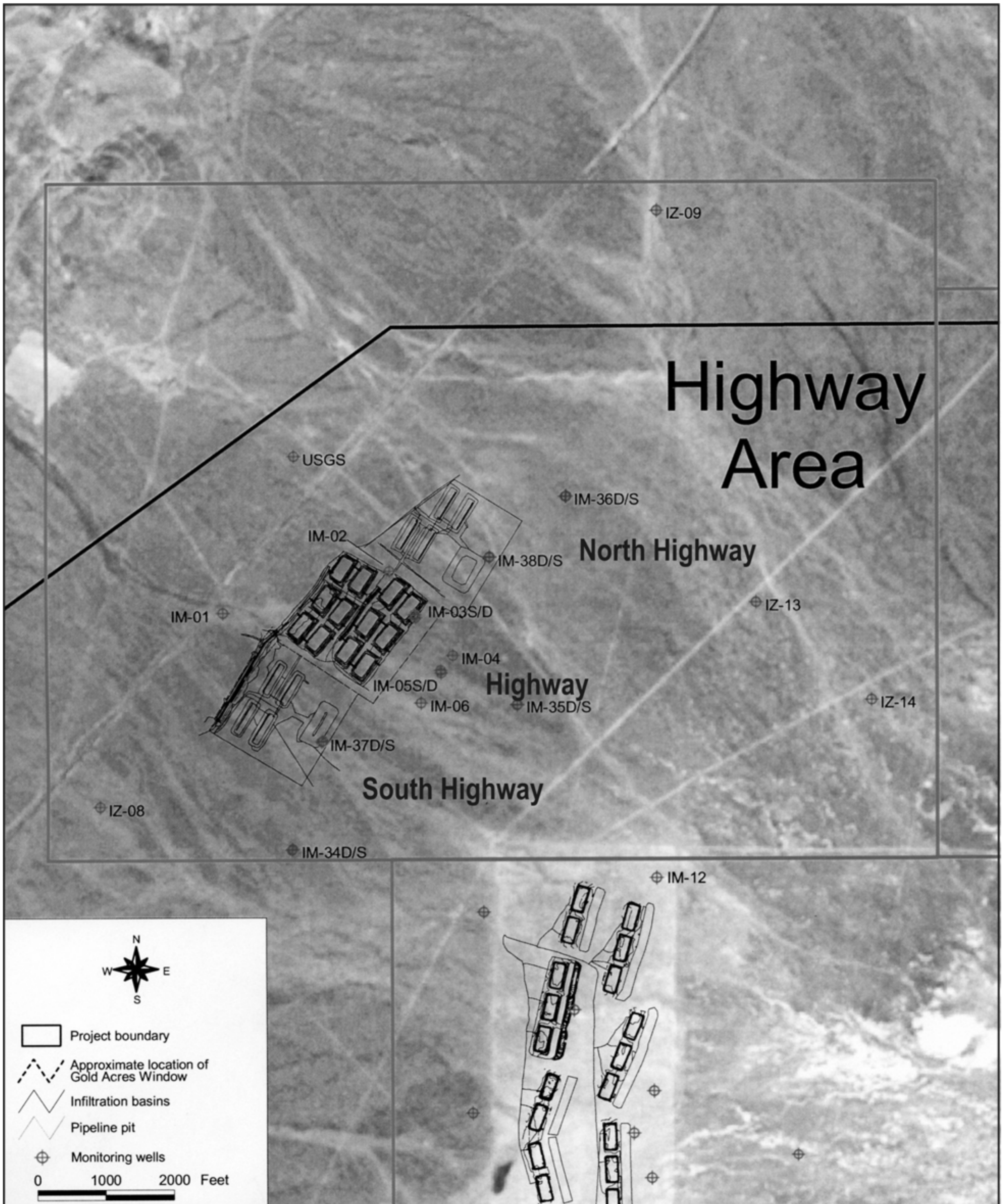

Figure 4.3.10 Infiltration Basin Location Map - Highway Area

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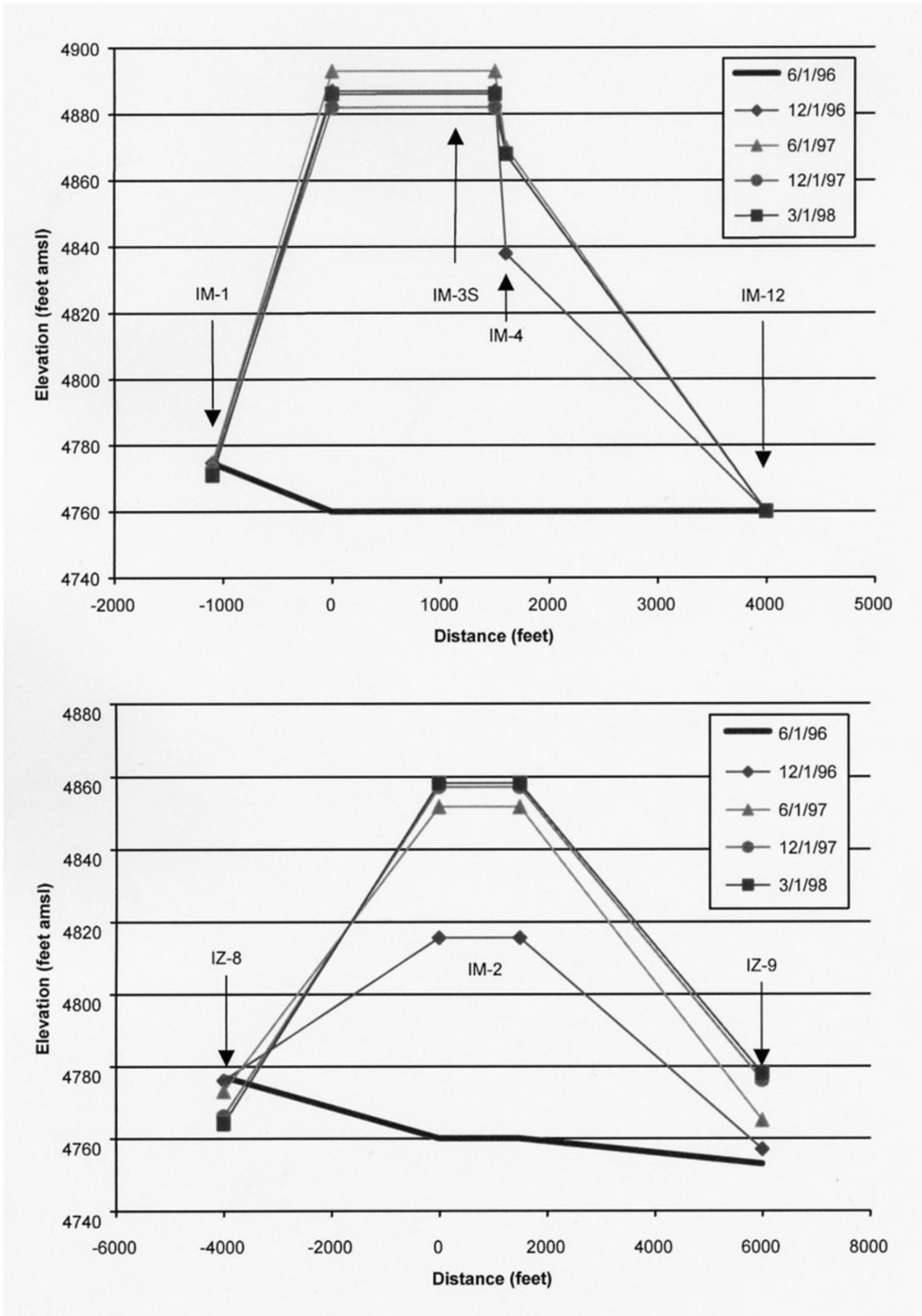

Figure 4.3.11 Water Levels at the Highway Infiltration Site

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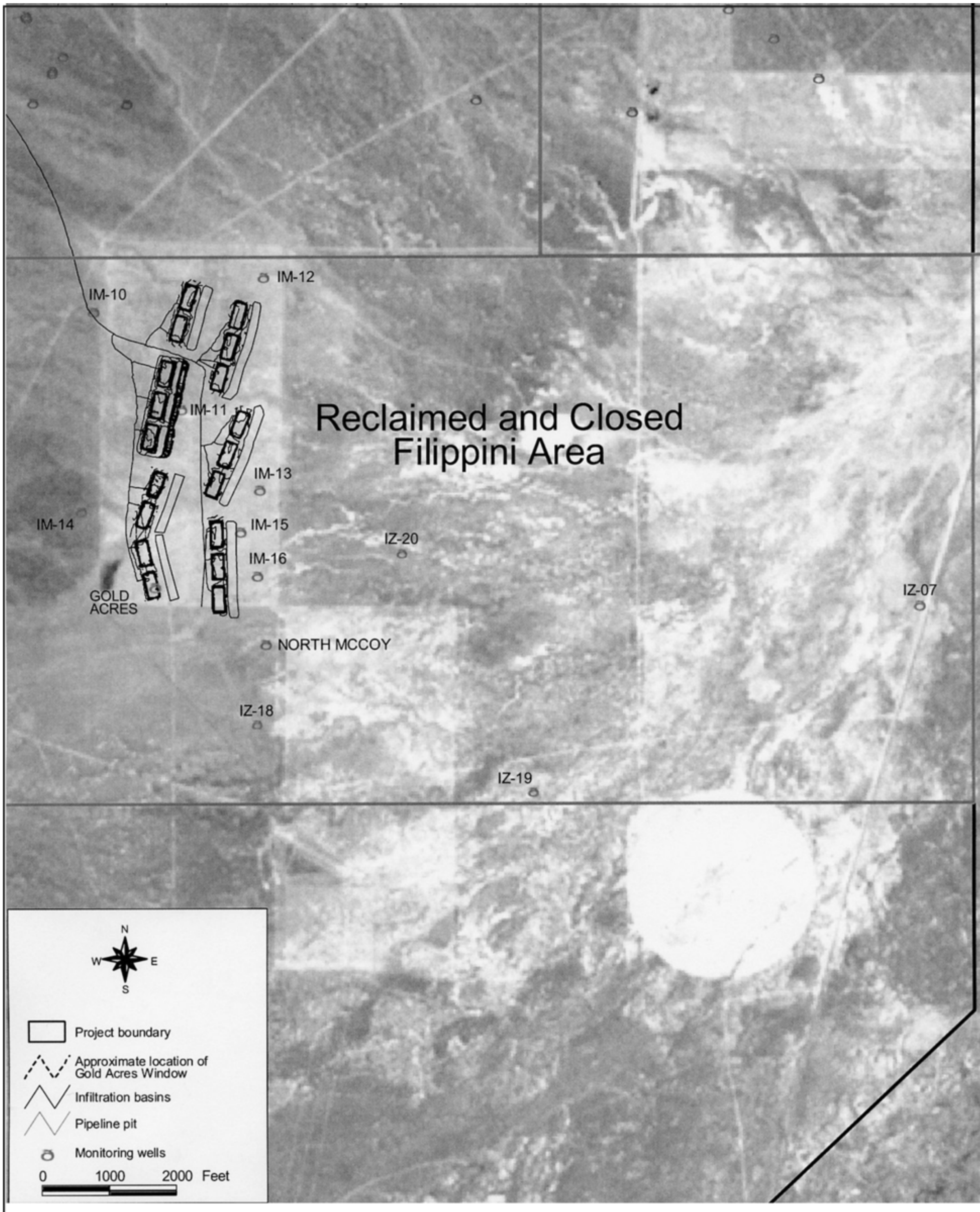

Figure 4.3.12 Infiltration Basin Location Map - Filippini Area

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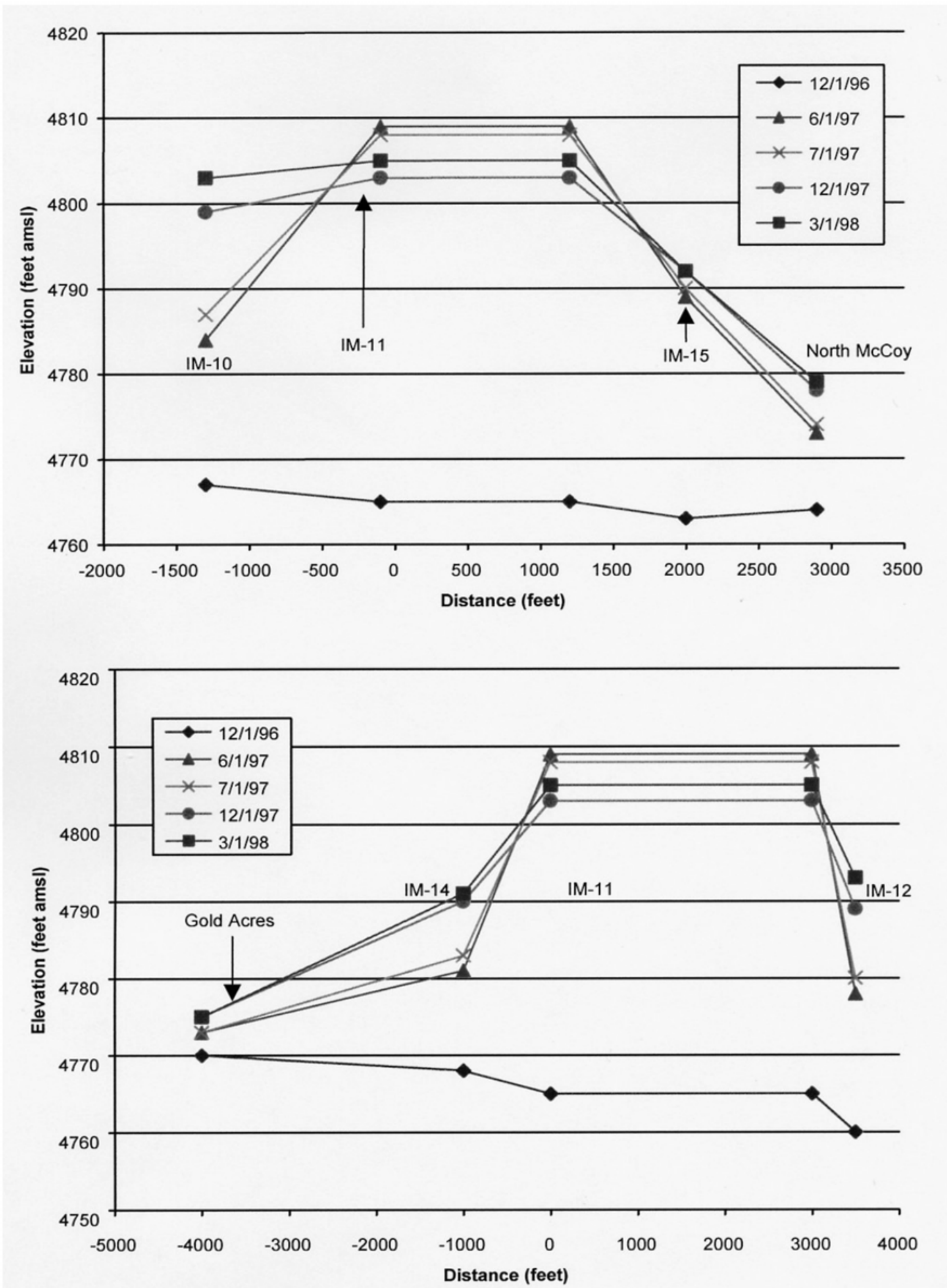

Figure 4.3.13 Water Levels at the Filippini Infiltration Site

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Rocky Pass and Rocky Pass II Infiltration Sites

The Rocky Pass Infiltration Site is situated within coarse-grained alluvial gravel and sediments northeast of the pass between the southern portion of Crescent Valley and Carico Lake Valley (Figure 4.3.14). The Rocky Pass II Infiltration site was constructed subsequently in 1999, approximately 1,200 feet south of the first Rocky Pass site.

The Rocky Pass Infiltration site consists of 11 basins with a total basin area of 34 acres and a maximum water surface area of approximately 17 acres, while the Rocky Pass II site has four basins with a total basin area of 40 acres and maximum water surface area of 11 acres. Prior to infiltration, the water table was located at an elevation of 4,800 feet amsl, approximately 107 feet below ground surface. The original local ground water had a slight gradient (0.004) with flow from west to east, following the topography of that area. Infiltration at the Rocky Pass site began in June 1997 and the Rocky Pass II site was brought on line in 1999. Initially, the site received approximately 5,000 gpm from the dewatering wells and achieved an infiltration rate of approximately 2.80 feet per day (CGM 1998a).

Water levels in proximal downgradient monitoring wells IM-17D, IM-18D, and IM-19D increased rapidly between July 1997 and September 1997, before stabilizing at approximately 4,885 feet amsl (Figure 4.3.15). The water level in the upgradient proximal monitoring well IM-20 increased more slowly, stabilizing in 1999. The water level in distal downgradient well IZ-1, located approximately 2,000 feet south of the basins, has responded in the same way as the proximal downgradient wells. Water levels in distal monitoring wells RP-3, PMW-2, and the Filippini Windmill well were not affected until the Windmill sites were constructed. In addition, monitoring wells installed for the Windmill Infiltration Site did not show an increase in water levels between their installation and the initiation of operations at that site in February 1998.

As with the Highway sites, an oblong ground water mound has formed due to infiltration of dewatering water. The water level is close to the ground surface in the immediate infiltration basin area and extends to the south and east. Upgradient, the height and extent of the mound are limited. The overall extent of the mound was delimited by monitoring wells RP-3, PMW-2, and the Filippini Windmill.

Frome Infiltration Site

The Frome Infiltration Site is located on the lower part of the southwest quadrant of the Indian Creek alluvial fan (Figure 4.3.16). This distinct fan overlaps the sediments deposited on the Highway Infiltration Site fan. The source rocks for the Indian Creek fan are largely upper plate Valmy Formation and Slaven Chert, with minor intrusive rocks including the Altenburg Hill stock. The fan sediments have been transported down Indian Creek, which has a fairly large associated drainage basin. Gravels predominate the Frome Site, though fine-grained playa sediments similar to those found at the Filippini Infiltration Site are also present (CGM 1998a).

When originally constructed, the site consisted of 17 basins with a total basin area of 156 acres and a maximum water surface area of approximately 36 acres. In 1999, 12 basins were reclaimed, leaving five basins in current operation with a total basin area of 48 acres and a maximum water surface area of approximately 12 acres. Prior to infiltration, the water table was located at an elevation of 4,760 feet amsl, approximately 60 feet below ground surface. There was little gradient in the local ground water (<0.001) at this location.

Infiltration at the Frome Infiltration Site began in September 1997. This site initially received approximately 4,000 gpm and achieved an infiltration rate of approximately 1.64 feet per day (CGM 1998a). Subsequently, infiltration at the Frome site was reduced and the basins currently receive approximately 1,000 gpm.

Water levels in proximal monitoring wells increased from approximately 4,770 to 4,800 feet amsl between September 1997 and December 1997 (Figure 4.3.17). Modifications in basin operations resulted in a decline in water levels between January 1998 and March 1998, with water levels increasing again in April 1998 due to renewed infiltration.

Water levels at the Frome site are currently maintained at prescribed depths to ensure that surface seepage does not occur. These water levels constrain infiltration rates by keeping water levels in the midst of the basins and at distal locations below prescribed elevations. Surface seepage has not occurred at these infiltration rates, as water levels in the midst of the basins are greater than 25 feet below ground surface compared to ten feet below ground surface when surface seepage occurred in January 1998. Since then, infiltration resulting in water levels up to 18 feet below ground surface has not resulted in surface seepage. This indicates that infiltration rates could be increased slightly, without causing surface seepage, in such a manner that water levels increase in proximal wells (e.g., IM-25S and IM-25D) but not in distal wells.

Windmill Infiltration Sites (I, II, IV, V)

The Windmill Infiltration Sites are located east of the Rocky Pass Infiltration Site, further along the same alluvial fan (Figure 4.3.18). Windmill I consists of six basins with a total basin area of 23 acres and a maximum water surface area of 12 acres; Windmill II has four basins with a total basin area of 40 acres and a maximum water surface area of 11 acres; Windmill IV has four basins with a total basin area of 50 acres and a maximum water surface area of 13 acres; Windmill V has three basins with a total basin area of 40 acres and a maximum water surface area of ten acres. Prior to infiltration in 1999, the water table was located at an elevation of 4,800 feet amsl, at an approximate depth of 100 feet below ground surface. The local ground water has a slight gradient (0.002) with flow from the southwest to the northeast, following the topography of that area. In response to infiltration, water levels in the vicinity of the Windmill sites rose from ambient ground water elevations, reaching equilibrium at elevations between 4,860 and 4,890 feet amsl in approximately two months.

Discharge

Ground water discharge in Crescent Valley is primarily through evapotranspiration. Other losses occur through pumping for domestic, municipal, industrial, and agricultural uses, discharge from seeps and springs, and outflow to the Humboldt River.

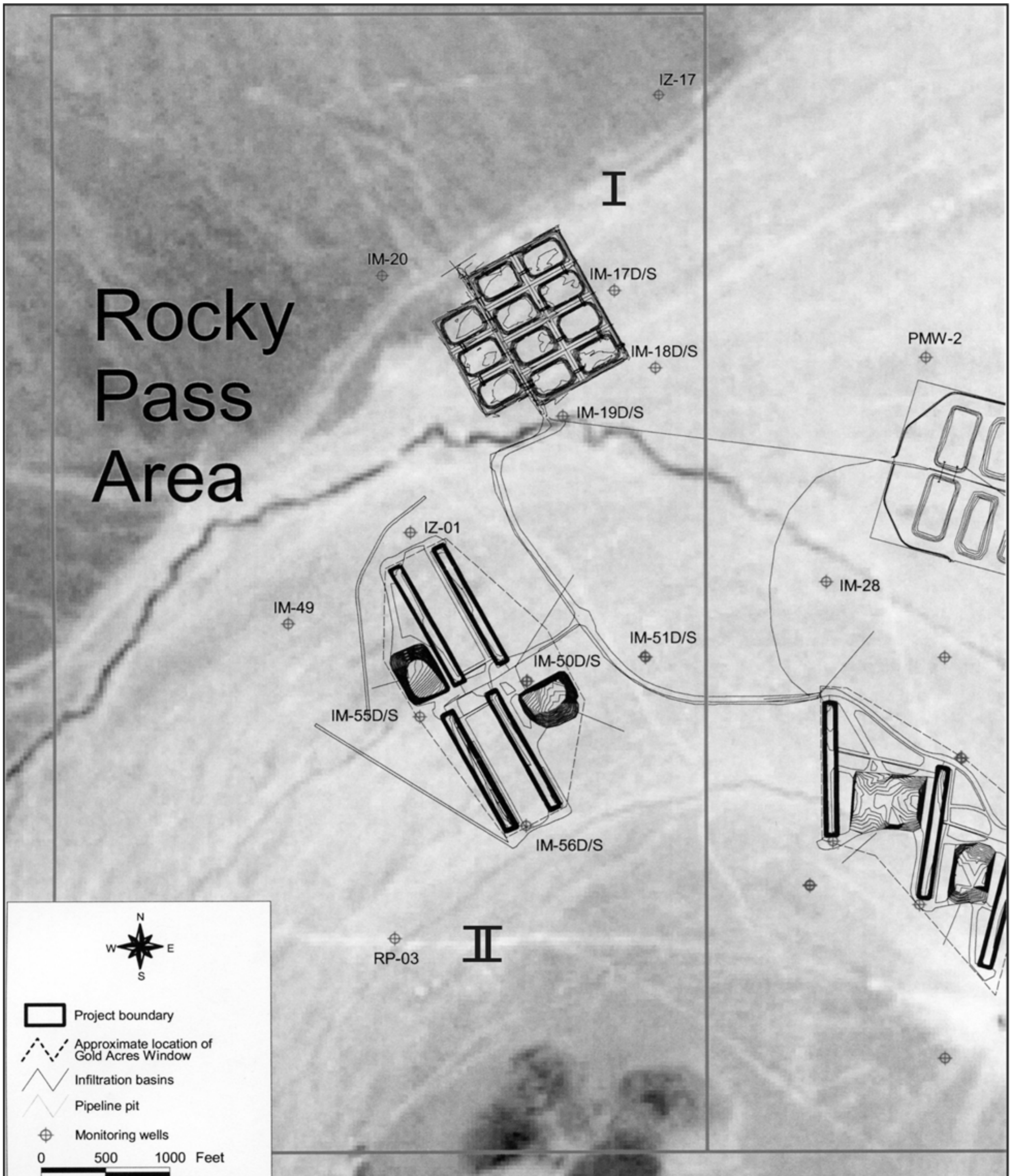

Figure 4.3.14 Infiltration Basin Location Map - Rocky Pass Area

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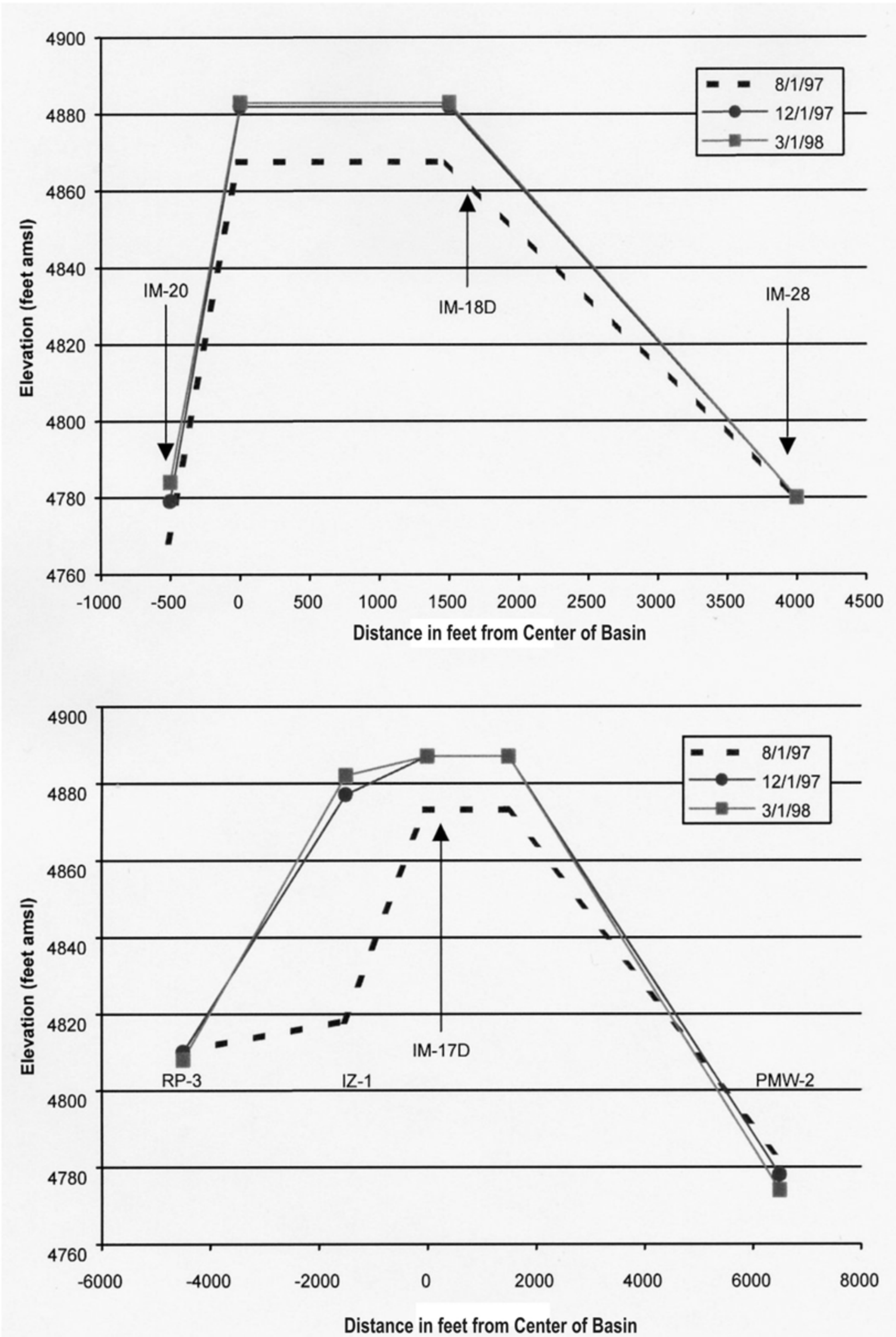

Figure 4.3.15 Water Levels at the Rocky Pass Infiltration Site

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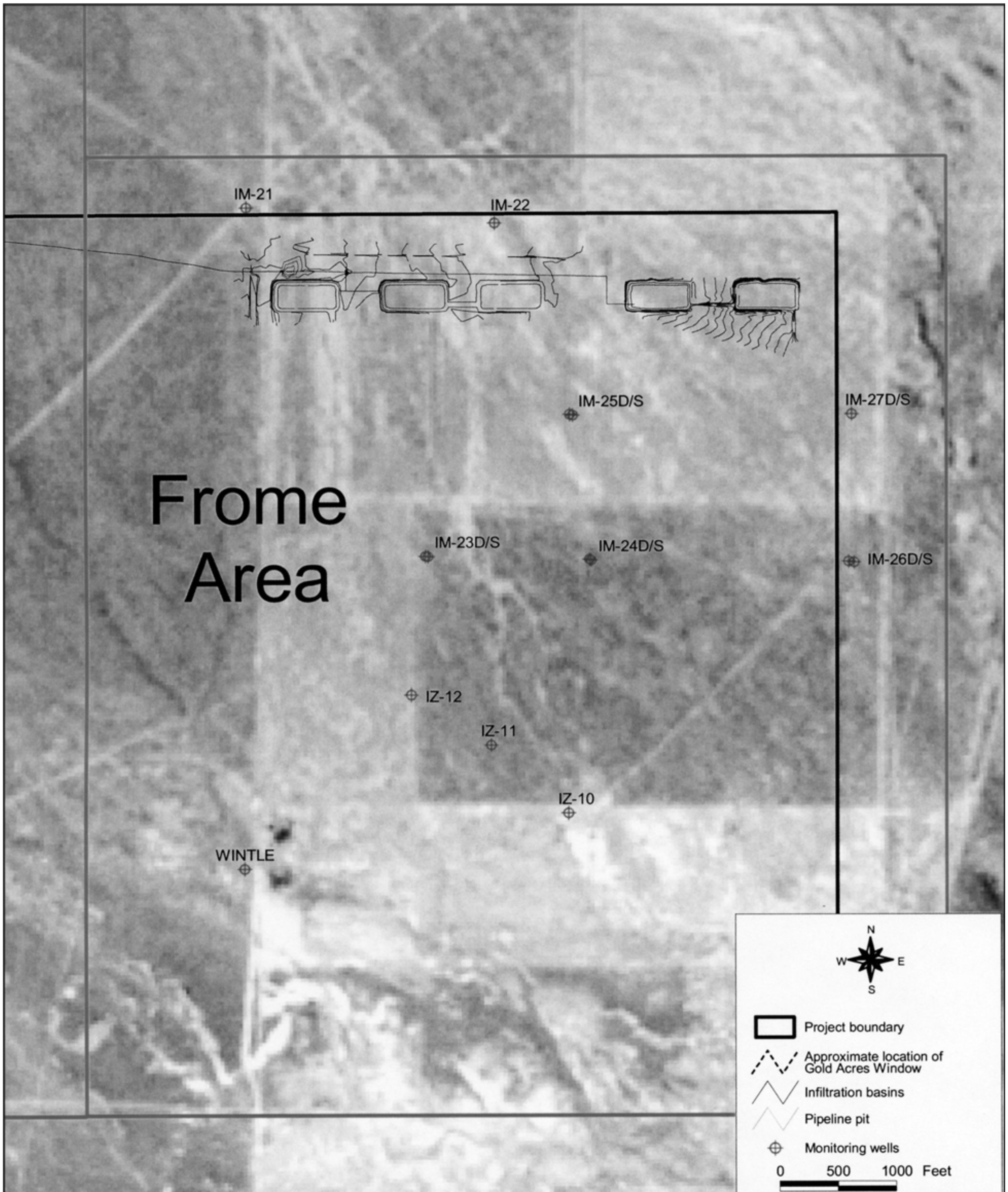

Figure 4.3.16 Infiltration Basin Location Map - Frome Area

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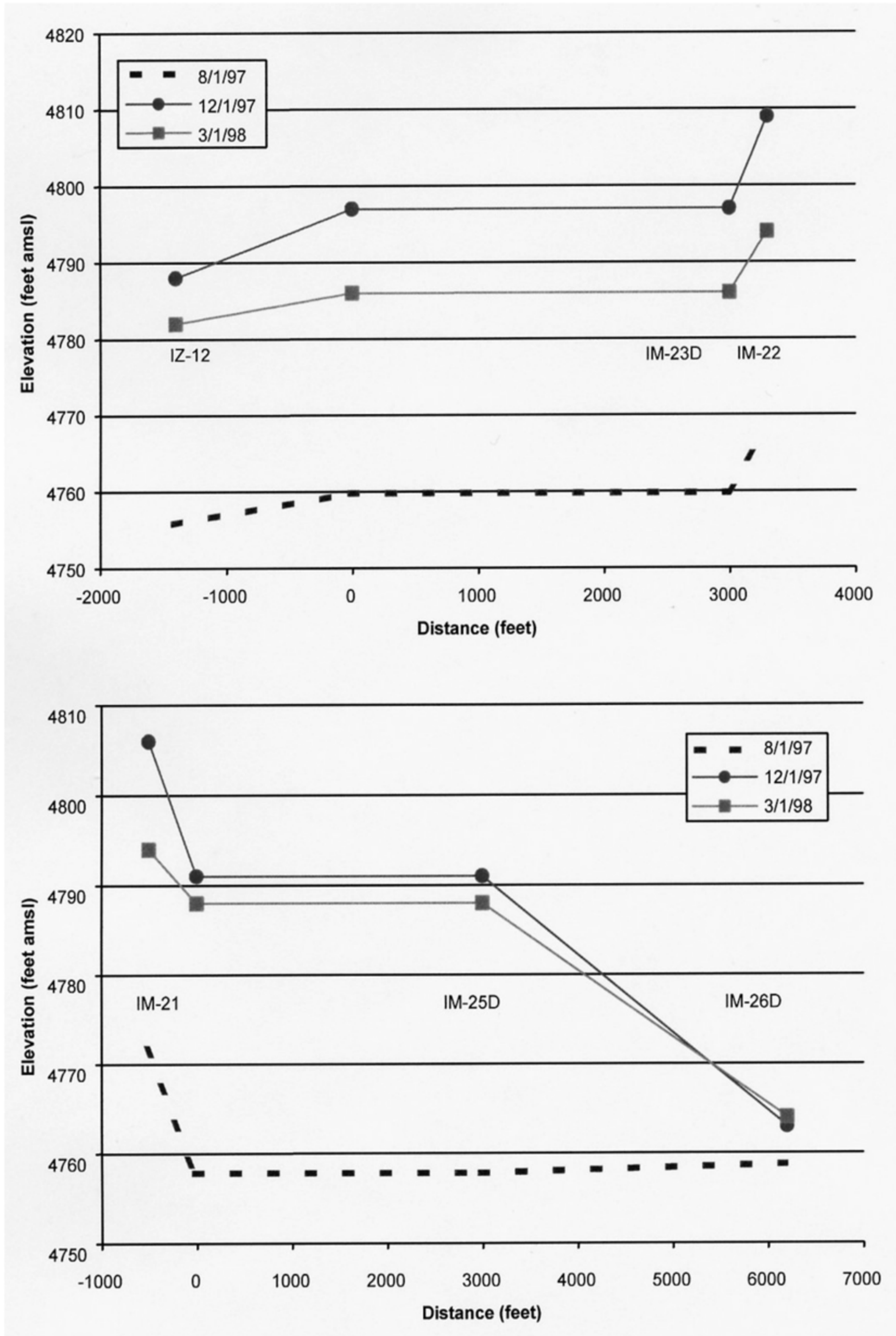

Figure 4.3.17 Water Levels at the Frome Infiltration Site

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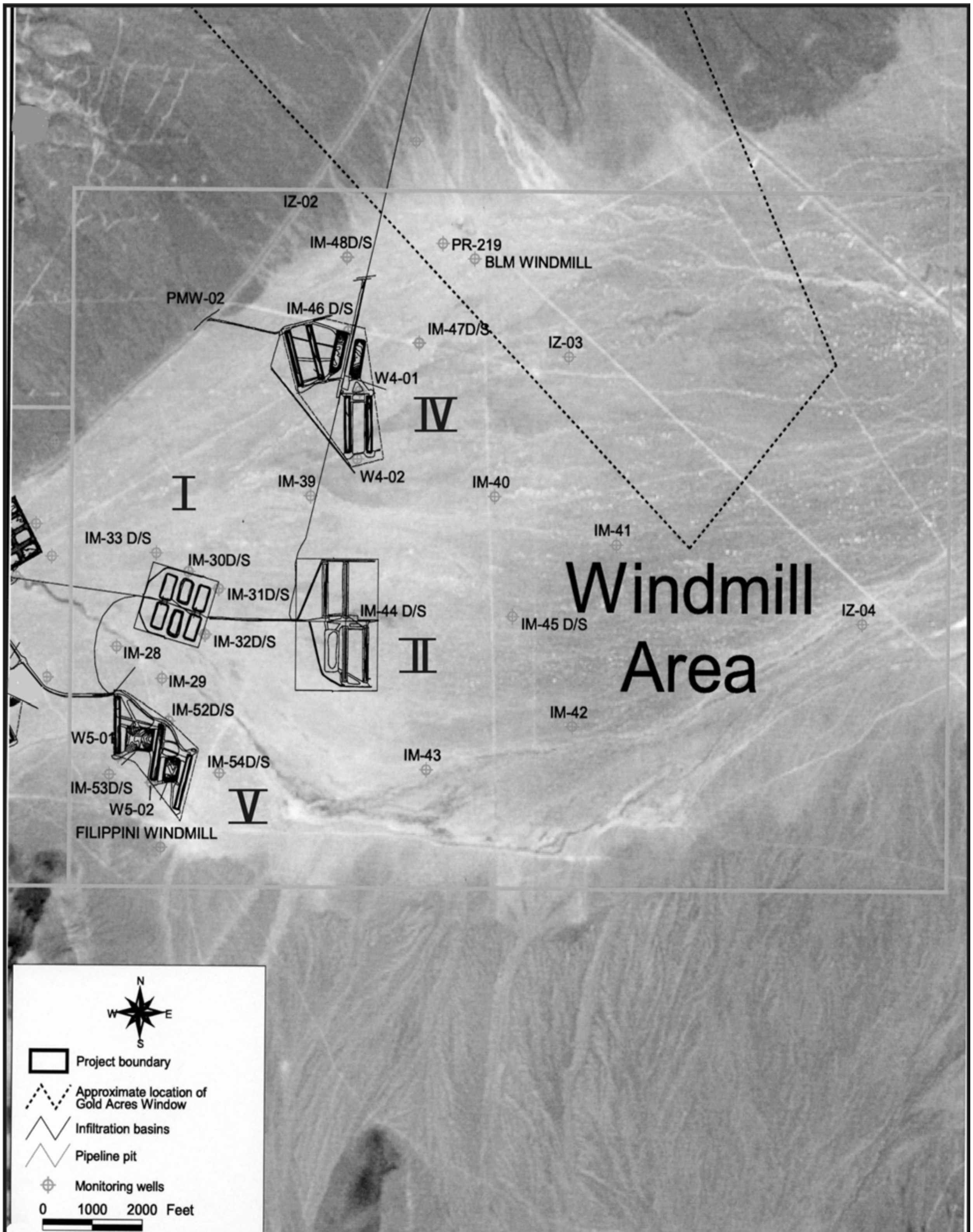

Figure 4.3.18 Infiltration Basin Location Map - Windmill Area

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Evapotranspiration

The amount of ground water lost through evapotranspiration is dependent on several factors, including depth to the water table, soil type, plant density, and species of phreatophytes (plants that send their roots to the water table). Evapotranspiration decreases with depth, approaching extinction at a depth of a few tens of feet. In northern and central Nevada, an extinction depth of 20 feet is typically assumed (Frick 1985; Thomas et al. 1989; Prudic et al. 1995), although it can be as great as 40 to 60 feet (Maurer et al. 1996).

Evapotranspiration provides a buffering capacity that tends to keep recharge and discharge in balance. As discharge from consumptive uses such as agriculture or mining increases and lowers the water table, eventually the discharge from evapotranspiration will correspondingly decrease. The vast majority of meteoric water incident upon Crescent Valley is removed by evaporation of precipitation and soil moisture before it reaches the water table and becomes ground water recharge. Evapotranspiration from the water table is primarily limited to the area of phreatophytes in Crescent Valley (Figure 4.3.7). Within this region, greasewood occupies approximately 33,300 acres, and the saltgrass area, which encompasses the playa areas and includes other associated phreatophytes such as rabbitbrush, greasewood, and scattered saltbrush, occupies approximately 14,000 acres (Zones 1961).

Differing rates of ground water usage have been defined for phreatophytes in the Great Basin. Estimated annual evapotranspiration rates in greasewood areas range from 0.15 to 1.45 feet per year (Zones 1961; Robinson and Waananen 1970). Annual evapotranspiration rates in areas that are a mixture of grasses (including saltgrass), rabbitbrush, and greasewood are estimated at 0.5 to 0.9 feet per year (Zones 1961; Plume 1995). Recent studies by the USGS have used Landsat data to map the distribution of plant cover and estimate total evapotranspiration from bare soil and phreatophytes in the Great Basin. Reported average evapotranspiration rates in those studies ranged from 0.13 to 1.60 feet per year for phreatophyte areas with less than 20 percent plant cover (Berger 2000; Nichols 2000), which is typical of the estimated 15 percent plant density in the phreatophyte area of Crescent Valley (Zones 1961).

Berger (2000) estimated the average annual evapotranspiration for Crescent Valley to be 19,600 acre-feet in 1989 and 37,100 acre-feet in 1995, including both bare soil and phreatophyte areas. Although the total area of phreatophyte vegetation was essentially the same for the two periods, the greater evapotranspiration in 1995 was attributed to an increase of area with plant cover in the range of at least ten percent but less than 20 percent and a corresponding decrease of area with plant cover in the range of less than ten percent (Berger 2000). Thus, subtle variations in plant cover over a fairly short period of time (six years) appears to be significant when estimating evapotranspiration rates with the methods employed by Berger (2000), making it difficult to identify a single representative value for average annual evapotranspiration. In the present study, a plausible range of "steady-state" annual evapotranspiration values for Crescent Valley was calculated as the difference between the sum of water budget inflow components and the sum of all other outflow components under pre mine dewatering conditions. The resulting estimate of annual evapotranspiration (14,100 to 14,700 acre-feet per year) corresponds to an evapotranspiration rate of approximately 0.3 feet per year averaged over the entire 47,300-acre area of phreatophytes in Crescent Valley. This estimate is thought to be reasonable on the basis of the large uncertainties associated with the estimation of average annual evapotranspiration rates. Within Nevada, evapotranspiration is typically a significant component of ground water discharge, but it is the component that has been the least quantified by direct measurement (Nichols et al. 1997).

Although there are currently no permanent open-water bodies in Crescent Valley, the typical evaporation rate from open water is an important quantity for predicting future pit lake recovery rates and ultimate pit lake water quality. In the present study, an average value of 4.2 feet per year was used for estimating evaporation from open-water bodies.

Other Ground Water Losses

Pumpage for domestic, municipal, industrial, and agricultural usage accounts for some of the ground water losses from the basin. Records of pumpage within the valley are incomplete, but it is estimated that current total consumptive usage is 2,900 acre-feet per year, accounting for the fact that some of the water pumped is returned as recharge. This value is less than the earlier estimate of 4,000 acre-feet per year (WMC 1995a), because ground water withdrawals at the Dean Ranch ceased in 2000. The Project related consumptive use is permitted up to 16,100 acre-feet per year (10,000 gpm). Crop and pumpage reports from the NDWR summarize annual checks of approximately 30 wells within the Crescent Valley hydrographic basin. The reports span the time period 1983 to 2001. On the basis of the wells listed in those reports, most of the water pumped in Crescent Valley was withdrawn from the central part of the valley, in an area encompassing the Crescent Valley Township and the Dewey Dann Ranch (Figure 4.3.1). Some water was also withdrawn from the Rose Ranch area along the southern margin of the Humboldt River and at the hydrocarbon remediation facility near the Cortez mine site in the southeastern corner of Crescent Valley.

Seeps and springs account for a minor amount of ground water discharge. The total combined discharge from seeps and springs in Crescent Valley is estimated to be approximately 200 to 300 acre-feet per year (WMC 1992a). At Hot Springs Point, the largest spring system in the valley, the discharge is estimated to be approximately 70 acre-feet per year, according to the results of a seep and spring survey conducted in March 1993 (JBR 1993). Flow measurements in August 1996 (JBR 1996) indicate that springs in the Rocky Pass area discharge approximately 20 acre-feet per year.

Net outflow from Crescent Valley to the Humboldt River can be estimated from the October 1992 stream-flow measurements reported in USGS (1994) as discussed in Section 4.3.2.2.2. However, there is some uncertainty in this approach because basins to the north of Crescent Valley might also interact with the Humboldt River, and currently there are insufficient data to assess any possible interactions (Plume 1997). Assuming that the river net gain between Pine Creek and Beowawe is derived entirely from Crescent Valley, the measurements would indicate that net outflow from Crescent Valley to the Humboldt River is between 500 and 700 acre-feet per year. This value is roughly consistent with a previous estimate by Zones (1961), who concluded that underflow from Crescent Valley into the Humboldt River is probably "only a few hundred acre-feet per year." Both the effective, upgradient discharge due to evapotranspiration and the low topographic divide in the northwestern part of Crescent Valley, which separates the rest of the valley from the Humboldt River, serve to limit the amount of water that the river receives from Crescent Valley.

Mine dewatering operations pumped approximately 30,800 acre-feet of ground water in 2001 (CGM 2002), of which 4,600 acre-feet (15 percent) were consumed and the remainder was returned to the basin as artificial recharge.

Existing Ground Water Usage

Water rights associated with the Proposed Action are discussed in detail in the South Pipeline Final EIS (BLM 2000a, page 4-41). An updated table of water rights is provided herein as Table 4.3.2.

4.3.2.2.4 Dewatering Induced Subsidence

Fissure Theory

Earth fissures in areas of large ground water decline in alluvial aquifers are probably associated with a process termed generalized differential compaction (Carpenter 1993). Three mechanisms are likely at play to ultimately form fissures. These mechanisms include bending of a plate above a horizontal discontinuity in compressibility (Lee and Shen 1969), dislocation representing a tensile crack (Carpenter 1993), and vertical propagation of tensile strain caused by draping of the alluvium over a horizontal discontinuity in compressibility (Haneberg 1992). Due to these probable mechanisms, fissures commonly develop along the perimeter of subsiding zones, often in apparent association with buried or protruding bedrock highs, suspected mountain-front faults, or distinct facies changes in the alluvial section.

Where differential rates and magnitudes of subsidence occur over relatively short distances, horizontal strains can become sufficient to cause earth fissuring. Jachens and Holzer (1982) concluded that most fissuring occurred at horizontal tensile strains in the range of 0.02 to 0.06 percent. This compares with the threshold strains for cracking of compacted clay zones in dam embankments (or compacted clay liners) of about 0.1 to 0.03 percent (Leonards and Narain 1963; Covarrubais 1969).

Fissures often manifest at the surface as subtle hairline cracks, or as alignments of small potholes, modified by burrowing animals. Overland flow can then be intercepted, and the surface manifestation of the fissure grows as piping and caving occur during runoff events. Weakly cemented surface soils often erode quickly providing ample sedimentation into the fissure during precipitation events. This promotes runoff capture. Underlying soils are often more cemented and resistant to erosion, resulting in the formation of ledges in the eroded fissure gullies at the contact between the cemented and relatively noncemented materials.

Windmill Fissures

As depicted on Figure 2.3.1 and evaluated in the Amec report (2003), the observable surface expressions of the Windmill Fissures occur in a zone approximately 2,500 feet long and 1,000 feet wide, with its western extent about 500 feet due east-southeast of the lined solution retention ponds of the SAHL. The trend of the fissures is east-northeast, with the most prominent fissures persisting for about 2,000 feet, and projecting south of the retention ponds. The observable fissure complex is comprised of multiple prominent discontinuities with many subordinate cracks, potholes and depressions. The terrain in and around the fissure field is gently sloping to the south, at the distal fringe of the alluvial fan. Vegetation is sparse and low-lying, with the surficial soils comprised of highly dispersive, low plasticity silt, overlying slightly cemented, fine gravel deposits.

Table 4.3.2: Wells and Water Rights within Five Miles of the Project Area

Map No.	Owner of Record	Town-ship	Range	Sect	1/4 of 1/4	Source	Abstract No.[1]	Use[2]	Data Reference[3]
1	BLM Windmill	27	47	08	NW of SW	Well	A-44757	Stk*	a,b,c
2	Filippini	27	47	17	NE of NW	Well	C-2773	Stk*	a,b,c
3	Filippini Windmill	27	47	19	SW of SW	Well		Stk	b,c
4	CGM[4]	28	47	10	SW of NW	Well	C-6656	MM	a,b,c
5	CGM[5]	28	47	11	NW of SW	Well	A-58398	Stk*	a,c
6	CGM[5]	28	47	13	NW of NE	Well	C-5458	Irr*	a,c
7	CGM[5]	28	47	13	NW of NE	Well		Dom	c
8	Little Gem	28	47	03	SW of NE	Well	C-4845	MM*	a,c
9	Mill Gulch Placer	28	47	22	NW of SE	Well	C-2599	MM*	a,b,c
10	USGS	28	47	16	SE of SE	Well		*	c
11	CGM[5]	28	48	09	NW of NW	Well	C-4066	Stk	a,c
12	CGM[5]	28	48	08	SE of SE	Well	C-4067	Stk	a,c
13	CGM[5]	28	48	17	SE of NE	Well	C-3997	Stk	a,c
14	CGM[5]	28	48	16	NW of SW	Well	C-3994	Stk	a,c
15	CGM[5]	28	48	27	NE of SE	Well	C-3995	Stk	a,c
16	CGM[5]	28	48	28	NW of NE	Well	C-3996	Stk	a,c
17	CGM[5]	28	48	19	NW of SE	Well	C-3998	Stk	a,c
18	CGM[5]	28	48	18	NE of NW	Well	A-63170	Stk	a,b,c
19	CGM[5]	28	48	14	NW of SE	Well	C-4271	Irr*	a,c
20	CGM[5]	28	48	15	NW of SW	Well	C-5044	Stk	a,c
21	CGM[5]	28	48	14	NE of SW	Well	C-5046	Stk	a,c
22	CGM[5]	28	48	17	SE of SW	Well	A-62977	Irr	a,c
23	CGM[5]	28	48	18	NE of SE	Well	A-62978	Irr	a,c
24	CGM[5]	28	48	17	SE of SW	Well	A-63168	Irr	a,c
25	CGM[5]	28	48	17	SE of NW	Well	A-63169	Irr	a,c
26	CGM[5]	29	48	34	SW of SW	Well	C-4309	Stk	a,c
27	CGM[5]	28	48	08	SE of SE	Well	A-63828	Stk	a,c

Map No.	Owner of Record	Town-ship	Range	Sect	1/4 of 1/4	Source	Abstract No.[1]	Use[2]	Data Reference[3]
28	CGM[5]	28	48	11	NE of SE	Well	A-63830	Stk	a,c
29	CGM[5]	28	48	14	SW of NE	Well	A-63831	Stk	a,c
30	CGM[5]	28	48	28	SE of NW	Well	A-63832	Stk	a,c
31	CGM[5]	29	48		Lot 1230	Well	C-3773	Stk*	a,c
32	CGM[5]	28	48	17	SW of SE	Well	A-63829	Stk	a,c
33	CGM[5]	28	48	33	NW of NW	Well		Dom	c
34	CGM[5]	28	48	08	SW of SE	Well		Dom	c
35	CGM[5]	28	48	28	SW of SE	Spring	V-09010	Stk	a,c
36	CGM[5]	28	48	28	SE of SW	Spring	V-09008	Stk	a,c
37	CGM[5]	28	48	28	SE of SW	Spring	V-09009	Stk	a,c
38	CGM[5]	28	48	32	SE of NE	Spring	V-09007	Stk	a,c
39	CGM[5]	28	48	32	SE of SW	Spring	V-09005	Stk	a,c
40	CGM[5]	28	48	32	SW of SW	Spring	V-09006	Stk	a,c
41	CGM[5]	27	48	17	NW of SE	Stream	C-5646	Irr	a,c
42	CGM[5]	27	48	17	NW of SE	Stream	C-5647	Irr	a,c
43	CGM[5]	27	48	07	SW of SW	Stream		Irr	c
44	CGM[5]	28	48	13	SW of SW	Stream		Irr	c
45	CGM[5]	27	48	19	SE of NE	Spring	C-3999	Stk	a,c

1 A = Application; C = Certificate; V = Vested
2 Stk: Stock; Dom: Domestic; Irr: Irrigation; MM: Mining and Milling; * : Inactive or abandoned
3 a: NDWR 1998; b: BLM 1996a; c: JBR 1998a
4 Previously owned by Komp
5 Previously owned by Oro Nevada Mining

4.3.3 Environmental Consequences and Mitigation Measures

The Proposed Action and alternatives have the potential to impact surface water and ground water in the Project Area. Potential impacts that may be associated with mining operations similar to the Proposed Action have been identified in the preparation of the South Pipeline Final EIS (BLM 2000a, Sections 4.4.3.3 - 4.4.3.5, pages 4-51 through 4-80) and through the scoping process for the Project. The analysis of the magnitude and significance of these potential water resource impacts in relation to the Proposed Action and alternatives are addressed in this section.

4.3.3.1 Significance Criteria

Criteria for assessing the significance of potential impacts to the quantity of water resources in the Project Area are described below. Impacts to water resources are considered to be significant if these criteria are predicted to occur as a result of the Proposed Action or the alternatives.

4.3.3.1.1 Surface Water Quantity

- Modification or sedimentation of natural drainages resulting in increased area or incidence of flooding.

- Reduction in flow of springs, seeps, or streams. Predicted impacts are considered to be significant where the modeled ten-foot ground water drawdown contour encompasses a spring, seep, or stream and where the surface water feature is hydraulically connected to the aquifer affected by drawdown.

- Diversion and/or consumptive use of ground water that adversely affects other water rights holders. This criterion includes flows to springs, seeps, or streams where existing beneficial water uses are affected.

4.3.3.1.2 Ground Water Quantity

- Lowering of the water table that results in impacts to other ground water users. The threshold for identifying significant impacts to wells is the modeled ten-foot drawdown contour. Therefore, for the purposes of this study, significant impacts are indicated where the ten-foot contour encompasses an existing well with an active water right and the well is hydraulically connected to the aquifer affected by drawdown.

- A long-term consumptive use of water resources that does not provide water for a beneficial use.

- A lowering of the water table that results in substantial ground subsidence. For the purposes of this study, significant impacts are indicted where hydraulic parameters of the aquifer are substantially changed, where differential subsidence results in open fissures at the land surface, or if subsidence is great enough to change drainage directions or cause ponding.

4.3.3.2 Assessment Methodology

The ground water flow model, MODFLOW (McDonald and Harbaugh 1988) has been utilized to quantify the Project's hydrologic effects on water table drawdown, pit inflow and refilling, and the water balance of Crescent Valley. A more refined ground water flow model than that used for the South Pipeline Final EIS was developed to provide greater detail in the open pit area and to enhance coupling of the ground water flow model with the pit water quality modeling. Modeling of the No Action Alternative represents the mining activities included in the South Pipeline Final EIS (BLM 2000a) and the Pipeline Infiltration Project EA (BLM 1999). Model results differ from those presented in the South Pipeline Final EIS because of subsequent model refinements and recalibration with additional actual dewatering pumping rates and observed drawdowns, and because some aspects (e.g., assumed pumping rates, and, hence, rates of infiltration of excess water) of the South Pipeline Plan of Operations have been changed. The uncertainties were reduced by the processes of calibrating the new model to 4.3 years (April 1996 through August 2000) of actual pumping, infiltration, and drawdown data, and subjecting it to extensive verification and sensitivity analyses. For example, 1.5 years of additional actual pumping data (August 2000 - February 2002) was used for calibration verification. Model packages that were used in conjunction with MODFLOW include the Interbed-Storage Package (Leake and Prudic 1988) to evaluate subsidence effects of dewatering, and the LAK2 package (Council 1997) to evaluate filling of the pit lake after mining. Details of the model including methods, hydraulic boundaries, model layers, grid layout, calibration, sensitivity analysis, and results are presented in Geomega (2003a). A supplemental assessment of potential impacts from the revision to the Stage 8 and 9 configurations was completed by Geomega (2004a).

Predicted drawdown contours are based on the inherent assumptions of the ground water flow model, including the assumed locations and efficiencies of infiltration basins, permitting and access constraints, and the observed impacts to ground water. Ground water modeling demonstrates that the inherent flexibility in locations of infiltration sites and possible injection wells can effectively control the shape of the resulting model-predicted drawdown contours.

4.3.3.3 Proposed Action

4.3.3.3.1 Stages 11 and 12 of the Proposed Action

Most water quantity impacts are the same for Stages 11 and 12 of the Proposed Action; therefore, the potential water quantity impacts of Stages 11 and 12 are considered together. Stages 11 and 12 of the Proposed Action, as well as the No Backfill Alternative and the Complete Backfill Alternative, all share the same dewatering schedule.

Surface Water Resources (Stages 11 and 12 of the Proposed Action)

Erosion, Sedimentation, and Flooding Within Rerouted Drainages

The Project would require the alteration or diversion of existing natural drainages and washes that contain surface flow during the infrequent periods of high rainfall and snowmelt from the Shoshone Range. The existing and expanded stormwater diversion structure is designed to divert flows of a 100-year, 24-hour storm event from the unnamed drainage west of the open pit and mine facilities. The heap leach and tailings facilities are designed to contain a 100-year, 24-hour storm event in addition to normal process fluids. Surface disturbance generally causes an increase in erosion. Therefore, sediment from increased erosion may be transported to and accumulate in the local surface drainages. During mine operation, standard erosion prevention and maintenance procedures (see Sections 2.9 and 3.1.8) would reduce impacts to less than significant levels.

Small drainages affected by roads and small facility structures would be returned to their natural condition during reclamation. Permanent drainage alterations around the open pit, waste piles, and heap leach pads would consist of open channels and berms. Such features would be left in place and reclaimed using revegetation or rock lining for stability and elimination of long-term maintenance under post-closure conditions.

Impact 4.3.3.3.1-1: Grading, earth moving, diversion of drainages, and placement of fill could accelerate erosion, sedimentation, and alter surface water flood runoff patterns during mining and post-closure.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Effects of Drawdown on Streams and Springs

The mine dewatering system is designed and operated by CGM to provide relatively dry pit conditions during mining. The open pit dewatering would be achieved by pumping ground water from the alluvium and/or bedrock aquifers and thereby lowering the water table in the vicinity of the proposed open pit. The open pit dewatering system would lower (drawdown) the water table in an area surrounding the proposed open pit. The predicted maximum drawdown (combined basin fill and bedrock) is approximately 1,400 feet at the center of the Crossroads open pit after 18 years of dewatering (under Stages 11 or 12 of the Proposed Action). This section investigates the potential for drawdown of the water table to affect surface water flow in certain streams and springs.

Figure 4.3.19 shows the modeled configuration of the water table at the end of mining under Stages 11 and 12 of the Proposed Action. This figure shows that significant changes to ground water gradients are mainly limited to the alluvial aquifer in the southern one-third of the basin.

Figures 4.3.20 and 4.3.21 show graphically the results of the numerical ground water flow model expressed as water table drawdown contours at the end of mining under Stages 11 and 12 of the Proposed Action. These ground water modeling results indicate that the ground water level will be drawn down by slightly more than ten feet in three of the East Valley springs at the end of mining. The three potentially affected alluvial springs appear to be associated with water right Nos. 38, 39, and 40 on Table 4.3.2. The plotted spring locations were mapped in the field, whereas the water rights locations were derived from NDWR files. Both data sets appear on the figures, but it should be understood that a single spring may be represented by more than one point (its actual location plus one or more associated water rights locations). The ground water level is not expected to be drawn down by more than ten feet at any other spring, nor at any of the perennial streams or springs at the end of mining. At the end of mining, the modeled ten-foot drawdown contour would extend approximately five miles to the north, 4.5 miles to the southeast, and seven miles to the east, and intercept the basin fill/bedrock contact along the range front of the Cortez Mountains. Drawdown is limited to the northeast and southwest by recharge from infiltration basins.

After dewatering ceases, the ground water level would begin to recover in the open pit area and the ground water mounds in the infiltration areas would dissipate as ground water flows toward the open pit from the perimeters of the Project Area. Drawdown would continue to increase in the perimeter areas as the open pit fills with ground water that is derived from storage. Figure 4.3.22 shows the predicted drawdown contours at the time of maximum areal extent of drawdown (ten years after the end of mining) for Stage 12 of the Proposed Action. Figure 4.3.23 shows the same time period for Stage 11 of the Proposed Action. There is no predicted difference between Stage 11 and Stage 12. In either case, to the northeast and southwest, the extent of the ten-foot drawdown contour is approximately two to three miles beyond its location at the end of mining. The drawdown ten years after the end of mining is selected as the most appropriate time to compare the significance of impacts

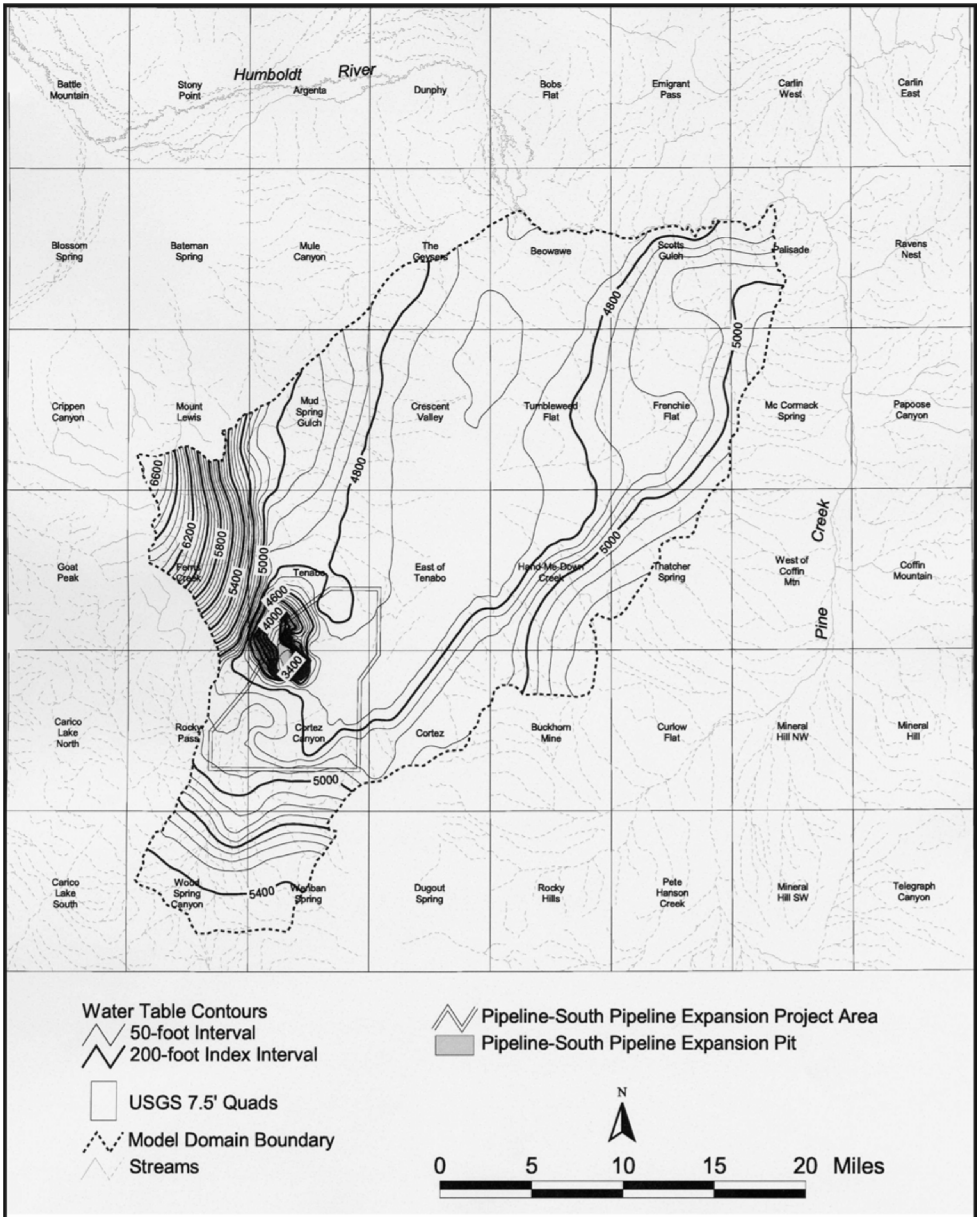

Figure 4.3.19 Simulated Water Table at End of Mining, Stages 11 and 12

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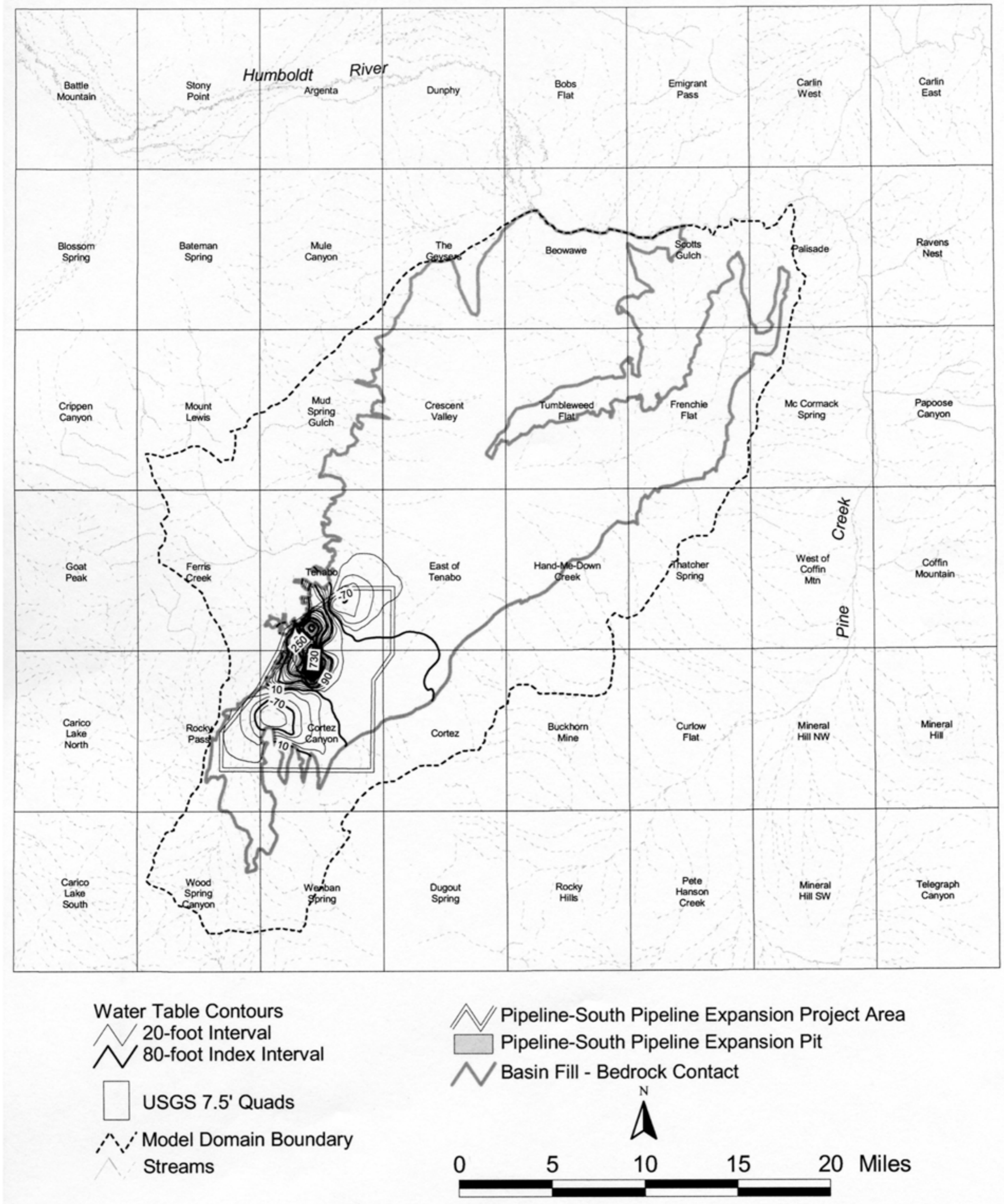

Figure 4.3.20 Isopleths of Water Table Drawdown in Basin Fill Deposits at End of Mining, Proposed Action Stages 11 and 12

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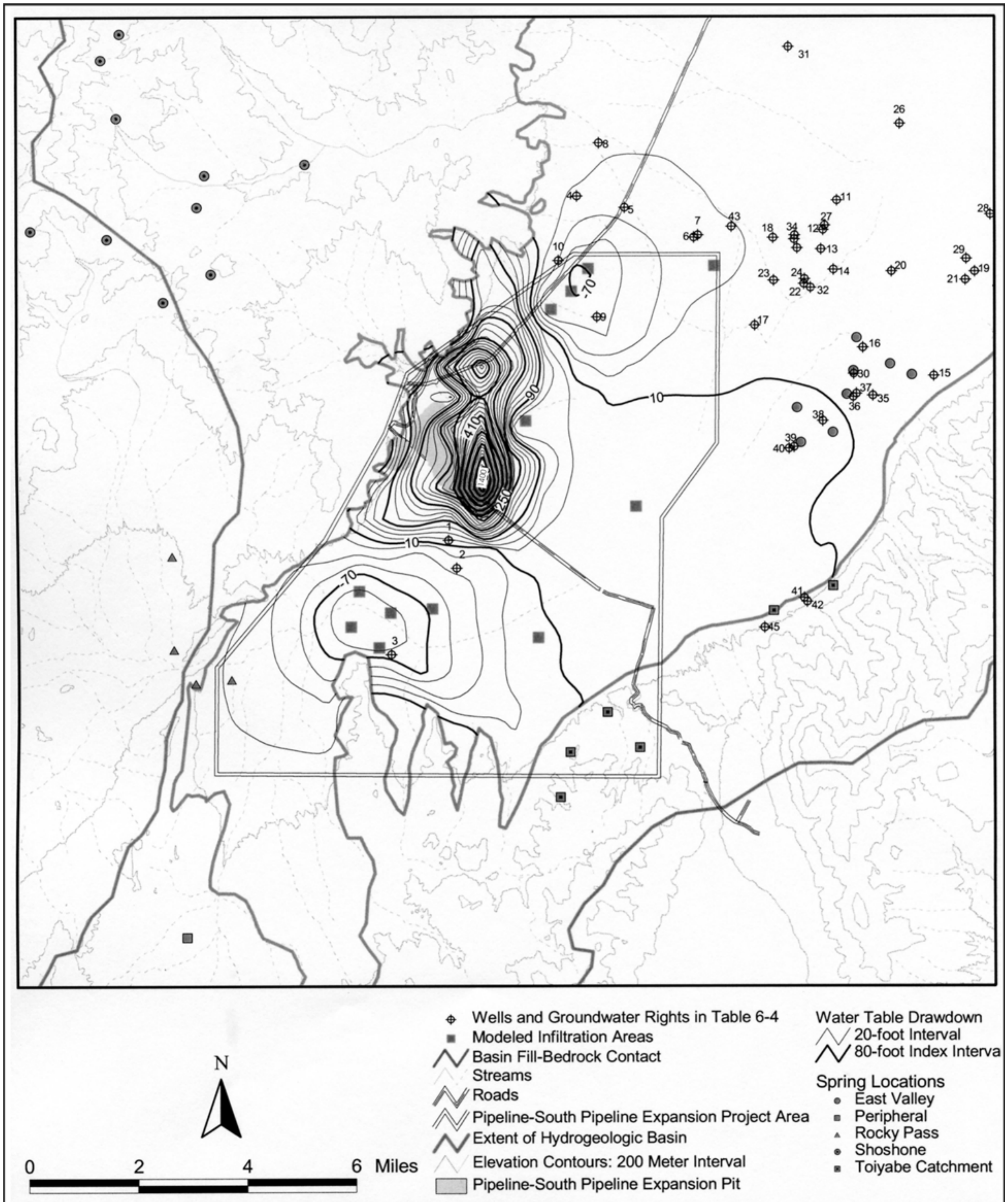

Figure 4.3.21 Water Table Drawdown in Basin Fill Deposits in Southern Crescent Valley at End of Mining, Proposed Action Stages 11 and 12

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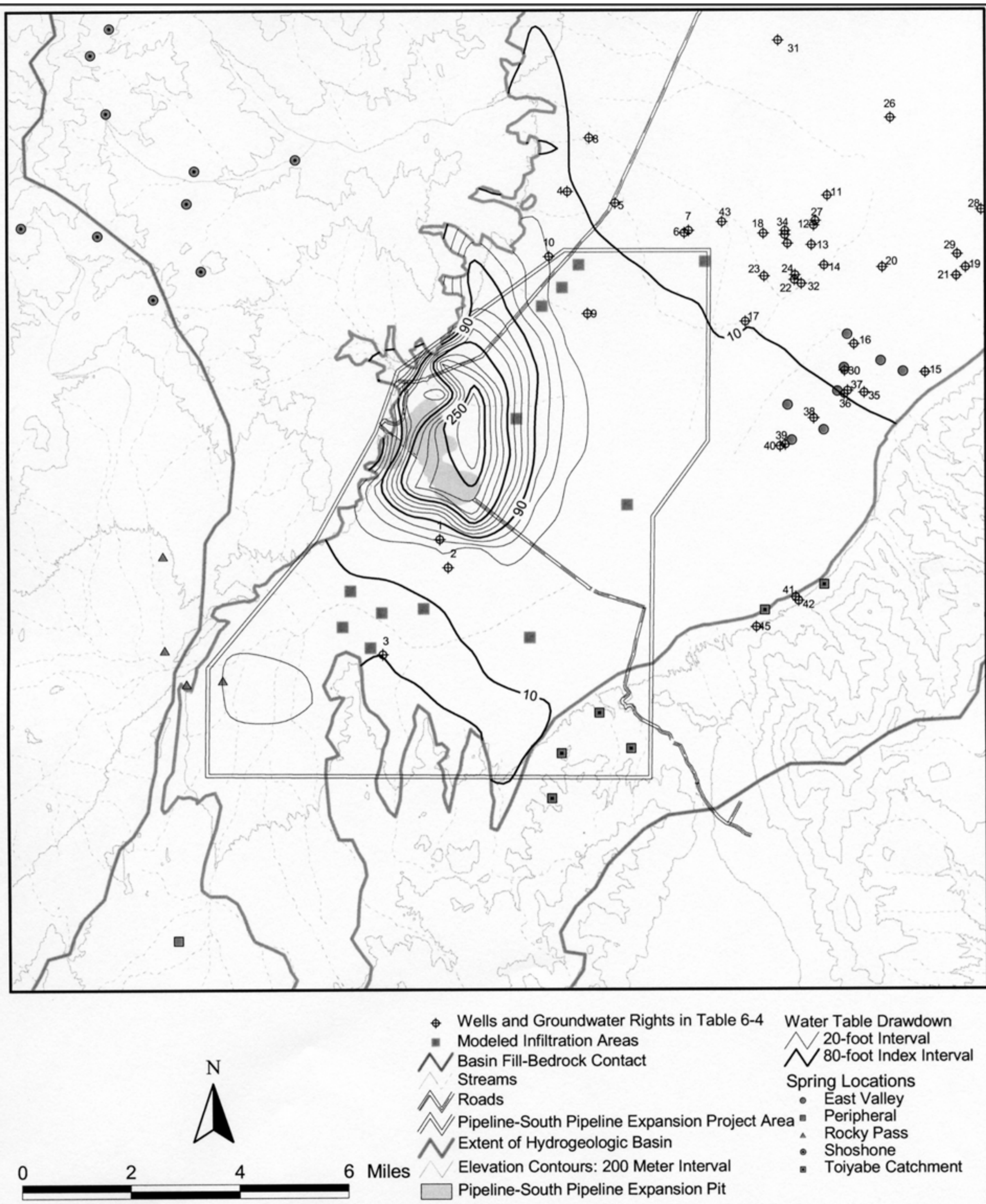

Figure 4.3.22 Water Table Drawdown in Basin Fill Depostis in Southern Crescent Valley at Time of Maximum Drawdown Extent, Proposed Action Stage 12

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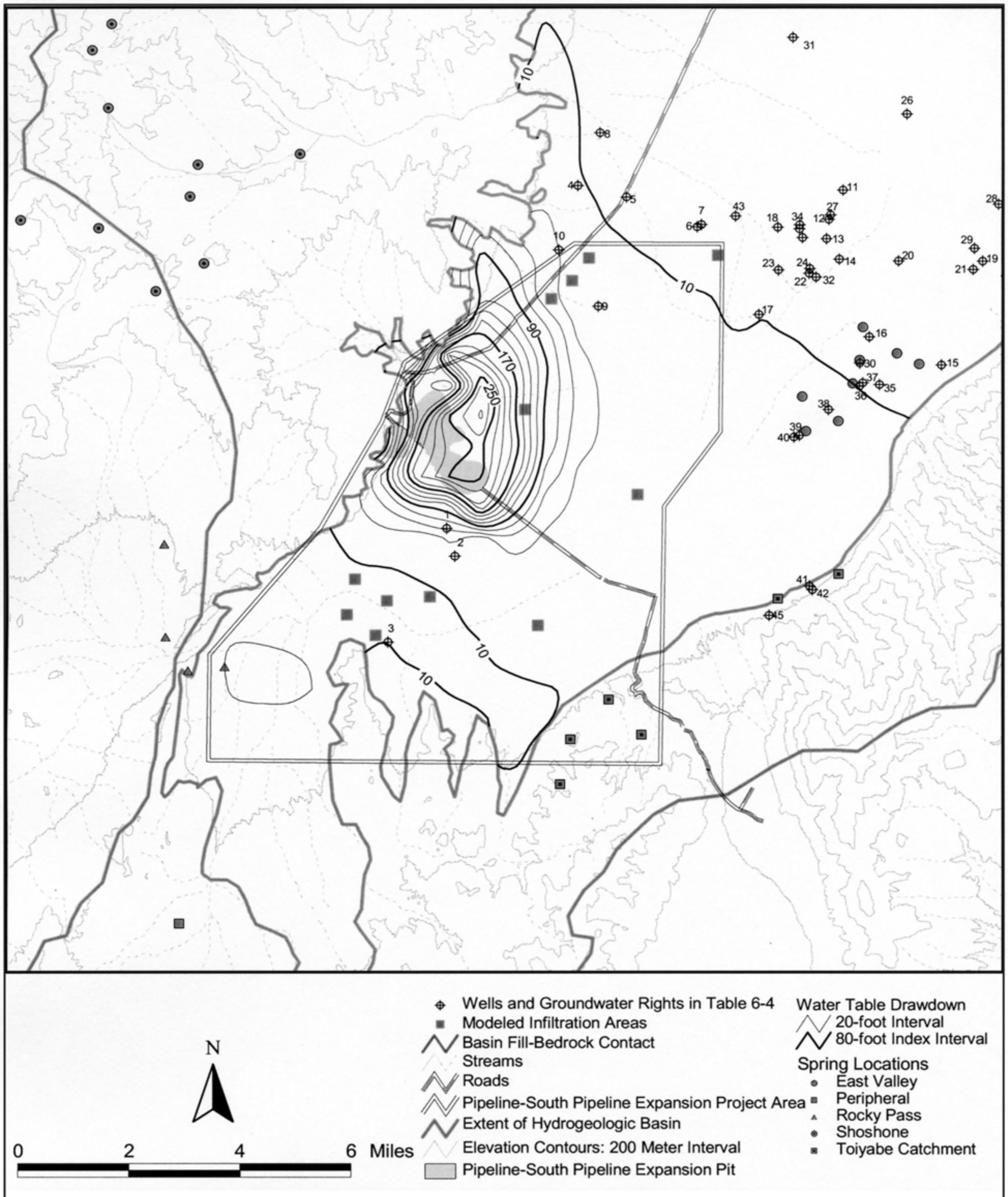

Figure 4.3.23 Water Table Drawdown in Basin Fill Deposits in Southern Crescent Valley at Time of Maximum Drawdown Extent, Proposed Action Stage 11

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because that is the point in time when the ground water model predicts that the ten-foot drawdown will have reached its maximum lateral extent. At this time, drawdown in the basin fill aquifer of ten feet or more would extend to the area of four East Valley springs (which surface in the alluvium), and no perennial streams. The potentially impacted springs appear to correspond to water rights Nos. 36, 38, 39, and 40 (Table 4.3.2). The flow to these springs probably originates from perched zones within alluvial fans that are recharged by flows from the Cortez Mountains. Flows from these springs are not expected to be impacted by pit dewatering. However, since more than ten feet of drawdown of the alluvial aquifer is predicted, the impacts to these springs are considered to be potentially significant. In addition, there is a potential impact to two Toiyabe Catchment springs (one of which appears to correspond to water right No. 45). Estimated drawdown is expected to be less than ten feet near springs issuing from the bedrock southeast of the proposed open pit at the foot of the Cortez Mountains near the Toiyabe Catchment area. However, the modeled ten-foot drawdown contour is very close to the location of two of these springs. The source of the springs is believed to be the bedrock that receives recharge from the higher elevations as snowmelt and precipitation. Ground water flow in the bedrock is known to occur mainly along faults and fracture zones. Aquifer testing at the Proposed Action site (WMC 1992b) revealed that flow within the aquifer unit is compartmentalized (occurs almost independently in separate blocks of the rock mass) due to the presence of faults and fractures. Such discontinuities within the flow system may isolate these springs from effects of drawdown, and potential impacts to flow from these springs are not expected to occur. In addition, these two springs issue from bedrock at points significantly above the valley alluvium and, therefore, appear to be hydraulically isolated from the main alluvial aquifer, so impact is unlikely to occur.

Two creeks enter the Project Area: Cooks Creek enters Crescent Valley at Rocky Pass at the southern end of the Project Area and an unnamed ephemeral drainage enters the Project Area from west of the open pit. Indian Creek is one of the largest drainages in the basin and enters Crescent Valley from the Shoshone Range about three miles north of the Project Area.

The flow in Cooks Creek is ephemeral and usually is a result of heavy precipitation or snowmelt runoff. The flow has been observed to completely infiltrate into the alluvium within a mile of the apex of its alluvial fan (WMC 1992b). The water table is not predicted to be lowered in the vicinity of Cooks Creek, so no impact to flow in Cooks Creek is expected. There has been no observed flow in the unnamed ephemeral drainage to date; therefore, no impact to this stream would be expected to occur.

Surface water flow in Indian Creek, located approximately three miles north of the Project Area, is fed by springs that flow into it or its tributaries. Spring-fed segments of Indian Creek are observed to flow throughout the year. The springs that flow into Indian Creek are believed to originate in areas of perched ground water or siliceous bedrock aquifers, neither of which are hydraulically connected to the aquifers affected by the dewatering operation. Indian Creek ceases to flow at the surface as it infiltrates into the alluvium of Crescent Valley shortly after the stream exits the mountain valley and crosses the alluvial fans. Since the predicted drawdown at Indian Creek at the end of mining is less than ten feet and the stream bed is at a higher elevation than the basin fill water table, flow in Indian Creek is unlikely to be affected. The other streams in Crescent Valley are either located farther from the area of drawdown induced by the Proposed Action than those described above, or are ephemeral streams that would not be expected to be significantly impacted by mine dewatering.

The Final EIS for the Pipeline Project included an inventory of 68 springs identified in the southern portion of Crescent Valley. A group of 31 of these springs including those closest to the Project Area and those most likely to be affected by the Project were selected for continued monitoring to identify potential impacts of mine dewatering. The 31 springs have been categorized into four subgroups of springs. Potential hydraulic impacts at each of these subgroups of springs are discussed below. Drawdown is not anticipated to extend as far as the springs at Rocky Pass. These springs will be effectively isolated from drawdown by existing infiltration basins.

Drawdown is not anticipated to extend to springs located in the upper Indian Creek drainage and the unnamed catchment west of the proposed open pit. In any case, these springs are believed to originate from localized perched ground water or fractures in siliceous and/or carbonate rocks (WMC 1995a). The water issuing from these springs is apparently derived from snowmelt and precipitation at higher elevations in the Shoshone Range. The compartmentalized nature of ground water flow is expected to isolate these springs from the area affected by mine dewatering.

The other inventoried springs in Crescent Valley are located farther from the area of drawdown expected to be induced by Stages 11 or 12 of the Proposed Action than those described above and are not expected to be significantly impacted by mine dewatering.

Impact 4.3.3.3.1-2: Mine dewatering is not expected to affect flows in streams. The drawdown under Stages 11 or 12 of the Proposed Action is modeled to be more than ten feet at four East Valley springs at ten years after the end of mining. In addition, two springs in the Toiyabe Catchment area are located close to the ten-foot drawdown contour and could potentially be impacted.

Significance of the Impact: The impacts are potentially significant at the six springs mentioned above, as predicted by more than ten feet of drawdown of the valley-fill aquifer in the ground water model. Although significant impacts are not predicted to occur in the other individual streams, springs, or spring groups, the uncertainty of predicting impacts to springs indicates a need for operational monitoring and contingent mitigation measures to be implemented if significant impacts occur. The uncertainty arises from the complex nature of ground water flow through fractured bedrock; the continued efficiency and ultimate locations of infiltration sites; and the assumptions used in the ground water model. If drawdown, reduced spring flows, or new ground water discharge areas are detected during mine operation, then mitigation measures would be implemented, as described below.

Mitigation Measure 4.3.3.3.1-2a: Monitoring of flows at streams and the 68 springs in the southern portion of Crescent Valley would be performed as dewatering progresses to assess whether the active infiltration areas are adequate to prevent potential impacts. Monitoring locations and monitoring frequency are summarized in the Pipeline Final EIS, Appendix D (BLM 1996a). Model simulations have indicated the ability to limit the extent of drawdown in the Crescent Valley alluvial aquifer through spatial variation of infiltration site locations and recharge volumes. Over time, the actual effectiveness of infiltration for recharging the alluvial aquifer as simulated will depend, in part, on the local hydraulic characteristics of the intervening soil sequences between the individual infiltration site and the aquifer area targeted for recharge. If monitoring shows that significant impacts are not mitigated by management of infiltration, then additional mitigation measures, including supplementing affected flows with mine water or installing wells at spring locations, or replacing affected water rights, would be implemented as described in the Integrated Monitoring Plan (WMC 1995b).

Mitigation Measure 4.3.3.3.1-2b: It is possible that some impacts to springs may only occur after the end of mining, when the operational measures described above may not be available. For the post-mining delayed impacts of drawdown, the ground water flow model would be updated during the final year of dewatering using actual field data for pumping rates, infiltration rates and locations, consumptive use, and observed drawdown to re-evaluate drawdown predictions that would occur after the end of mining. Streams and springs that are indicated to be significantly affected would be mitigated by one or more of the following measures, subject to approval of the BLM and NDWR:

- Installation of a well and pump at affected spring locations to restore the historical yield of the spring.

- Posting of an additional bond to provide for potentially affected water supplies in the future.

<u>Ground Water Resources (Stages 11 and 12 of the Proposed Action)</u>

Consumptive Losses

Consumptive losses through evaporation will continue to occur during mine operations from the surfaces of the infiltration basins and seeps associated with the water disposal operations for as long as dewatering occurs. Based upon a net evaporation of 3.387 feet per acre per year (Geomega 2002b, page 2-6), multiplied by the water surface area of 90 to 200 acres, evaporation is equal to 305 to 678 acre-feet per year of evaporative loss (189 to 420 gpm). As described in Section 4.3.2.2.3, the upper range of pond acreage is to allow for pond rotation, maintenance, and construction of future infiltration basins. In the event that seepage develops downgradient of an infiltration site, operational experience indicates that the seeps would generally be confined to small drainages and low-lying areas and not exceed 17 acres in size. Evaporation from these seepage areas would be less than open pond surfaces due to partial protection from wind and direct sunlight due to brush and grass growing along the drainages. A reasonable assumption is that less than 40 gpm of additional water would be lost due to evaporation from seepage areas and the associated collection and pump-back system (BLM 1999). This amount of evaporative loss is less than two percent of the total amount of pumping as described in Section 4.3.2.2.3. The losses are included within the Project's total estimated consumptive water use of up to 10,000 gpm (16,100 acre-feet per year), which also includes uses for the mill, tailings impoundments, leach pads, revegetation, irrigation, and dust control. The losses would occur only as long as dewatering occurs, rather than indefinitely as with losses from the pit lake. Evaporative losses during mine operation would not be expected to produce a significant impact.

After mining operations cease and the pit lake begins to fill, some pit lake water would be consumptively lost due to evaporation. The consumptive losses through evaporation would increase over time with the increasing pit lake stage and water surface area after mine closure. For Stage 12 of the Proposed Action after 100 years of pit refilling, the net consumptive losses through evaporation from the water surface of the two pit lakes (with a total area of 302 acres) would be about 1,023 acre-feet per year (see Table 4.3.3). For Stage 12 the consumptive losses through evaporation are 281 acre-feet per year less than the No Action net evaporation of 1,304 acre-feet per year from a 385-acre pit lake surface. For Stage 11 of the Proposed Action after 100 years of pit re-filling, the net consumptive losses through evaporation from the water surface of the four pit lakes (totaling 308 acres) would be about 1,043 acre-feet per year. The consumptive losses through evaporation are 261 acre-feet per year less than the No Action net evaporation. Hence, for either Stage 12 or Stage11 there is a net positive impact compared to the No Action Alternative. In addition, long-term evaporation losses from the pit lake would be partially balanced in the basin's water budget by a reduction of the natural evapotranspiration from the playa areas of the valley.

Table 4.3.3: Summary of Consumptive Water Losses 100 Years After Mining

	Proposed Action (stages)					Alternatives		
	8	9	10	11	12	No Action	Complete Backfill	No Backfill
Number of Pit Lakes	1	1	2	4	2	1	1	2
Total Acreage of Pit Lake(s)	306	306	350	308	302	385	269	749
Net Evaporation (acre ft/yr)	1,036	1,036	1,185	1,043	1,023	1,304	911	2,537
Ground Water Decrease to Humboldt River Ten Years After Cessation of Mining (acre ft/yr)	9	9	9	9	9	8	9	9

The Crescent Valley Hydrographic Area is classified as a designated basin by the Nevada State Engineer and the withdrawal and use of ground water is regulated. Evaporative losses may be treated as a consumptive use and accounted as a water right at the discretion of the Nevada State Engineer. The resulting annual volume of water is comparable to the annual water use allowed for a land parcel of equivalent area placed under irrigation. Since CGM holds senior certificated water rights for both agricultural and mining/milling uses in Crescent Valley, replacement of evaporative pit lake loss with a certificated water right would result in no net gain in permitted ground water withdrawal or consumptive use from Crescent Valley. The transfer of these water rights to offset the evaporative losses from the pit lake would render the impacts on water rights insignificant.

Impact 4.3.3.3.1-3: Consumptive use of water by evaporation during mining and delivery of water to the Dean Ranch for irrigation would support a beneficial use and would not be expected to adversely impact water resources; and CGM would have adequate water rights to cover the consumptive use. Evaporation of 1,023 (Stage 12) to 1,043 (Stage 11) acre-feet per year from the post-mining pit lake would continue into the foreseeable future after the mine has closed. This is a decrease compared to the No Action Alternative. Hence, there is a positive impact compared to the No Action Alternative.

Significance of the Impact: There is a positive impact compared to the No Action Alternative.

Lowering of the Water Table Due to Pit Dewatering

The mine dewatering system is designed and operated by CGM to provide dry pit conditions during mining. The open pit dewatering would be achieved by pumping ground water from the alluvium and/or bedrock aquifers and thereby lowering the water table in the vicinity of the proposed open pit.

The anticipated maximum annual dewatering pumping rate of 34,500 gpm (55,700 acre-feet/year) occurs during years 2007 through 2013 of the dewatering for Stages 11 and 12 of the Proposed Action. The Proposed Action would extend the time-frame of dewatering from ten years (under the No Action Alternative) to 18 years. For comparison, the anticipated maximum pumping rate for the No Action Alternative is 25,900 gpm (approved pumping rate is 34,5000 gpm). As a result, under Stages 11 and 12 of the Proposed Action the ten-foot drawdown contour of the water table is expected to extend to a distance of up to 6.5 miles beyond the open pit area at the end of mining. With the exception of up to 10,000 gpm to be used for the mill, evaporation, irrigation, and other consumptive uses, the remaining pumped ground water would be returned to the alluvial aquifer via the infiltration basins.

The infiltration system is designed to conserve ground water resources by returning a majority of the pumped water to the Crescent Valley ground water system. Infiltration also serves to reduce the amount and extent of drawdown due to the pit dewatering. Monitoring of wells located near the proposed open pit, infiltration areas, and regional wells throughout Crescent Valley would be used to evaluate the extent and magnitude of drawdown, and to verify the adequacy of measures taken to reduce drawdown effects. It should, therefore, be possible to effectively reduce potential impacts associated with dewatering drawdown during the period of active mine dewatering by optimizing the location and design of infiltration basins. The actual locations of infiltration basins, rates of pumping, and infiltration would be varied throughout the life of the Project. The locations of infiltration basins used in the model are indicated on Figure 4.3.24. The water table elevation would be monitored throughout the life of the operation and after mine closure as required under approved closure plans and permit conditions.

Ground water modeling has been performed to predict the amount and extent of drawdown after 18 years of mine dewatering and infiltration (Geomega 2003a). The amount and extent of drawdown are presented in this SEIS only for the alluvial aquifer because that is the primary aquifer of use and extent in Crescent Valley. Also, the complex fault-block-controlled nature of ground water flow in the mountain ranges causes greater uncertainty in drawdown predictions in those areas, compared to the relatively more continuous alluvial aquifer system. For these reasons, drawdown contours are only shown to the limit of the alluvial aquifer, and no drawdown contours are shown for the bedrock aquifer. Figure 4.3.21 shows predicted water table drawdowns in the alluvial aquifer after pumping for 18 years at a rate of up to 34,500 gpm and assuming infiltration at 12 sites. The infiltration rate used in the model is 10,000 gpm less than the pumping rate to account for consumptive water use, evaporation, water retained as storage in the unsaturated zone beneath infiltration basins.

The ground water level in the area of the open pits will begin to recover immediately after active mine dewatering ends. The ground water flow model was used to evaluate water-level recovery for a period of over 100 years after the end of dewatering. The water level in the vicinity of the Crossroads open pit is expected to recover by over 70 percent within six years of the end of dewatering.

Impacts to Water Rights

Potential impacts to ground water users within the area affected by drawdown were evaluated based on ground water flow modeling. Such impacts may involve lowering of ground water levels at wells, springs or streams. The analysis of drawdown includes modeling for two timeframes: 1) at the end of mine dewatering and 2) at ten years after the open pit(s) begins to refill.

Modeling results show that substantial water table drawdowns in the alluvial aquifer (in excess of ten feet) would be limited to an area within about seven miles from the proposed open pit at the end of mining under Stages 11 and 12 of the Proposed Action. The maximum drawdown in the open pit area during mine operation is expected to be as much as 1,400 feet. At the end of mining, four water rights are modeled as having more than ten feet of drawdown under Stages 11 and 12 of the Proposed Action (Figure 4.3.21). These water rights are well No. 1 (BLM windmill), and springs numbered 33, 38, 39, and 40 (all controlled by CGM). Well No. 1 (BLM windmill), which is inactive, is similarly impacted under the No Action Alternative. The potential impacts to springs associated with water rights 38, 39, and 40 were previously addressed under "Effects of Drawdown on Streams and Springs".

During the initial years of water level recovery, the replenishment of water to the dewatered aquifers and filling of the pit lake will draw water from the surrounding saturated portions of the aquifers, including the areas of mounding beneath the former infiltration mounds. As the infiltration mounds dissipate while the pit fills, the lateral extent of the ten-foot drawdown contour will expand somewhat further from the pit than at the end of mining. This occurs because ground water continues to be derived from storage in the valley aquifers as the pit fills. The maximum extent of the ten-foot drawdown contour is predicted by the model to occur about ten years after the end of mining (Geomega 2003a). Therefore, the predicted drawdown at ten years after mining (Figures 4.3.22 and 4.3.23) is an appropriate time to compare impacts between the Proposed Action and the alternatives.

The comparison of significant impacts focuses on the timeframe at ten years after mining ends. Impacts at known water wells, springs, and water rights sites were evaluated for potential water table drawdown as shown on Figures 4.3.22 and 4.3.23. Drawdown under either Stage 12 or 11 of the Proposed Action was predicted to exceed ten feet for nine water rights, including three inactive wells (Nos. 1, 2, and 9), one water level monitoring well (No. 10), one well controlled by CGM (No. 4), and four rights associated with springs (Nos. 36, 38, 39 and 40). However, the three inactive wells are also expected to be impacted under the No Action Alternative. A list of water rights corresponding to the numbered locations shown on Figure 4.3.22 is included on Table 4.3.2.

Changes to water levels at the location of the water right associated with the monitoring well (No. 10) are not considered significant because this well is not used to produce water. Similarly, water rights for the three inactive wells are not considered significant because these water rights are not active. All four of the non-CGM wells (Nos. 1, 2, 9, and 10) would also be drawn down by more than ten feet by the No Action Alternative. Impacts to well No. 4 and the four water rights for springs numbered 36, 38, 39, and 40 are not considered significant because they are controlled by CGM.

Impact 4.3.3.3.1-4: There are no active water rights, except those controlled by CGM, that are within the predicted area of the modeled ten-foot drawdown of the valley-fill aquifer that are not otherwise predicted (No Action Alternative) to be significantly affected.

Significance of the Impact: Impacts to the inactive wells are not considered significant until such time as the water rights holder chooses to utilize their valid rights, at which time impacts would be considered potentially significant. Impacts to well No. 4 and the four water rights for springs numbered 36, 38, 39, and 40 are not considered significant because they are controlled by CGM. Any potential impacts would become less than significant after implementation of the following mitigation measures:

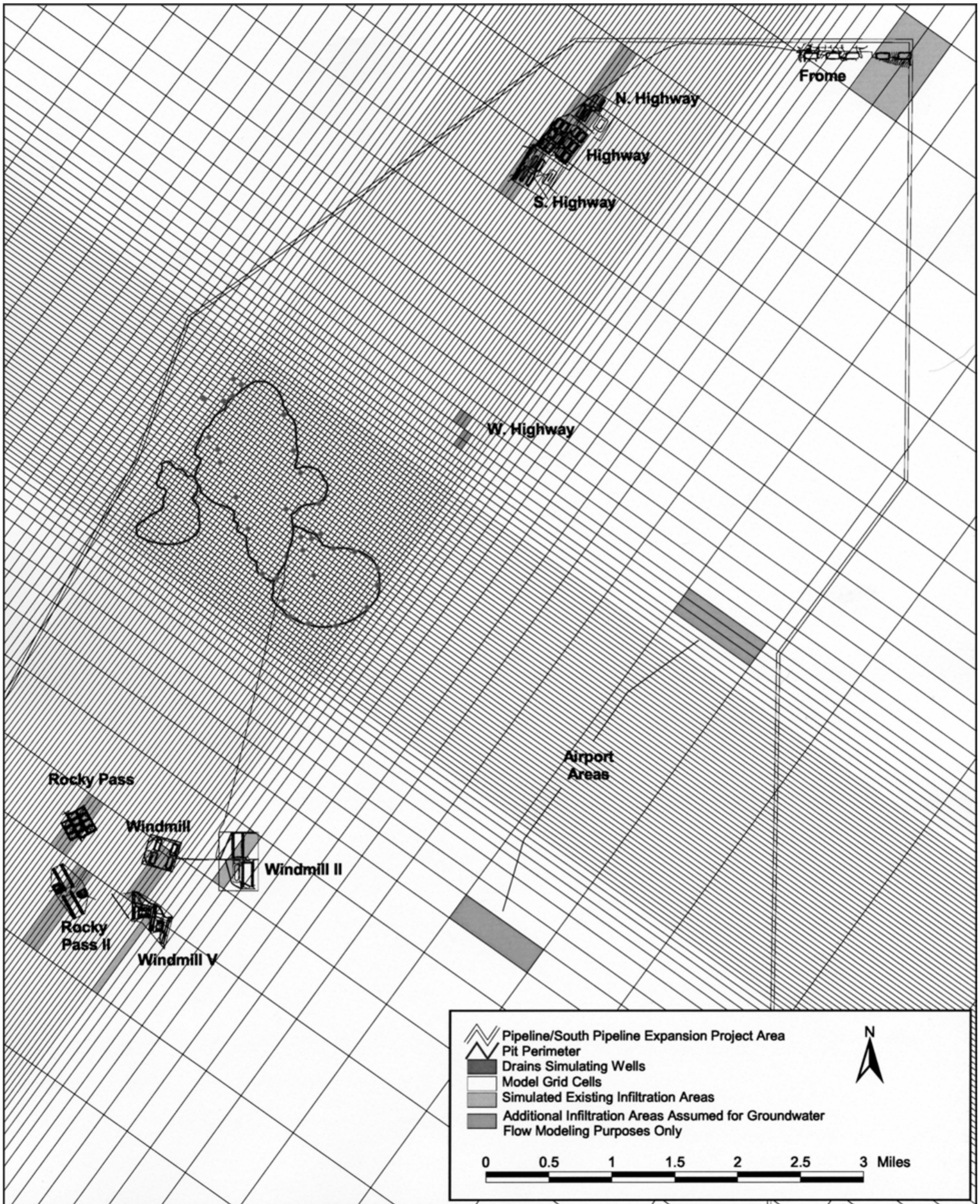

Figure 4.3.24 Drains and Infiltration Sites Used in Dewatering Simulations

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Mitigation Measure 4.3.3.3.1-4a: As part of the comprehensive monitoring program, CGM would be responsible for monitoring ground water levels between the mine and water supply wells, ground water rights, and surface water rights. Adverse impacts to ground water rights and surface water rights would be mitigated as required by the NDWR. Mitigation of impacts to ground water rights could include lowering the pump, deepening an existing well, drilling a new well for water supply wells, or providing a replacement water supply of equivalent yield and general water quality. For surface water rights, mitigation could require providing a replacement water supply of equivalent yield and general water quality.

Mitigation Measure 4.3.3.3.1-4b: For any significant impacts to wells that are not predicted to occur until after the end of mining, the operational measures described above may not be available. For the post-mining delayed impacts of drawdown, the ground water flow model would be updated during the final year of dewatering using actual field data for pumping rates, infiltration rates and locations, consumptive use, and observed drawdown to reevaluate drawdown predictions that would occur after the end of mining. Active water rights not controlled by CGM that are indicated to be significantly affected would then be mitigated by one or more of the following measures, subject to approval of BLM and NDWR:

- Replacement or purchase of the affected water right by the applicant.

- Installation of a deeper well and pump at affected locations to restore the historical yield of the well.

- Posting of an additional bond to provide for potential future impacts to potentially affected water supplies.

Ground Water Flow to Humboldt River

Some inflow of ground water into the Humboldt River is believed to occur at the northern edge of Crescent Valley. Based upon the basin water budget computed by the numerical ground water flow model (Geomega 2003a), the ground water contribution to the Humboldt River is estimated to be approximately 620 acre-feet per year under baseline conditions (Geomega 2003a). The area in the center of the valley is a natural ground water discharge area that accounts for the majority of outflow from the basin and would tend to buffer any effects of dewatering between the proposed mine and the Humboldt River. Since Crescent Valley is a semi-closed basin and the foreseeable mining projects are located over 20 miles from the Humboldt River, previous investigators have concluded that development of ground water resources or mine dewatering would not have a substantial effect on the flow of the Humboldt River (Zones 1961; Crompton 1995). The anticipated extent of drawdown for Stages 11 and 12 of the Proposed Action (Figure 4.3.21) shows that the effects would be limited to the southern portion of Crescent Valley, and do not appear to extend to within 20 miles of the Humboldt River. However, the modeled effects on the Crescent Valley water balance indicate a small effect on ground water contributions to the Humboldt River.

Stages 11 and 12 of the Proposed Action show a decrease of approximately nine acre-feet per year relative to the baseline ground water budget (Table 4.3.1) in the Crescent Valley Basin's ground water contribution to the Humboldt River ten years after the end of mine operations (the approximate time of maximum impact in this case) (see Table 4.3.3). The decrease is estimated to be exactly the same as for the No Action Alternative. As pit refilling begins, the reduced ground water flow to the

Humboldt River would continue for the foreseeable future (at six acre-feet per year under Stage 12, or nine acre-feet per year under Stage 11) as water in the basin is evaporated by the pit lake and ground water removed from storage is gradually replenished. The small predicted changes in flow to the river would be undetectable within the context of natural variability in recharge, evapotranspiration, and ground water flow to the Humboldt River. The predicted reduction in ground water flow to the Humboldt River (nine acre-feet per year for either the Proposed Action or the No Action Alternative) represents less than one tenth of one percent of the 1992 measurements of baseflow and diversions of the Humboldt River at Beowawe. The small magnitude of predicted impact to the flow of the Humboldt River illustrates the buffering effect of evapotranspiration in the central part of Crescent Valley and indicates that the Proposed Action would not result in significant direct or cumulative impacts on the Humboldt River.

Impact 4.3.3.3.1-5: Regarding ground water flow from Crescent Valley to the Humboldt River, ground water flow modeling indicates no impact compared to the No Action Alternative, and only a very slight reduction (nine acre-feet per year) compared to pre-mining conditions.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Potential Impacts Due to Subsidence

The land surface above an aquifer has the potential to subside when ground water is removed from an aquifer composed of unconsolidated fine-grained sediment, which thereby undergoes consolidation due to the loss of fluid. The most extensive subsidence typically occurs in unconsolidated sediments containing fine-grained sediments that are interbedded with sand and gravel aquifers. No subsidence would occur due to dewatering of the bedrock aquifers because the rock is considered competent (load bearing). The amount of consolidation is greater in the fine-grained sediments (clays) than in the coarser sand and gravel because of the more collapsible structure of clay beds and because clays contain more fluid per unit volume. When the pressure is reduced by withdrawal of the ground water by dewatering, unconsolidated materials undergo compaction, which is often irreversible. Typically, only a small part of the compression is reversible during ground water level recovery.

An analysis of the potential impacts to aquifer consolidation was performed using the interbed-storage package for MODFLOW (Leake and Prudic 1988) along with ground water flow modeling for Stages 11 and 12 of the Proposed Action (Geomega 2003a). The model is based on aquifer compositions observed in boring logs and hydraulic characteristics measured during pumping well tests. The Project Area is situated on the western margin of Crescent Valley and is underlain by a wedge of alluvium that overlies easterly dipping bedrock. Only a small portion of the alluvium is saturated with ground water underneath the pit, but this increases to the east toward the center of the valley. The saturated thickness of the alluvium increases from approximately 90 feet at the open pit to over 700 feet at a distance of 5,000 feet to the east of the open pit. The alluvial aquifer, which will become dewatered consists of silty sands and gravel, clayey sands, and sandy clay.

The model shows that for Stages 11 and 12, subsidence of up to approximately one-foot would occur at a distance of up to six miles east of the open pit, and subsidence of up to approximately two feet would occur at a distance of up to four miles southeast of the open pit (Figure 4.3.25). The estimated subsidence for Stages 11 and 12 of the Proposed Action is approximately double that estimated for the No Action Alternative.

Potential For Changes to Aquifer Productivity

The greatest potential for permanent deformation would occur in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer. The result would be a slight loss in aquifer interbed storage, but no noticeable loss in aquifer productivity of water supply wells. Thus, the potential impacts to the aquifer due to subsidence under the Proposed Action, if any, would be very localized and are not considered significant.

Impact 4.3.3.3.1-6: A small change in aquifer characteristics is expected to result from compaction of the aquifer materials. Ground subsidence of up to approximately one foot would occur at a distance of up to six miles east of the open pit, and a subsidence of up to two feet is expected to occur up to four miles southeast of the open pit. The subsidence would result primarily from a permanent reduction in porosity in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer.

Significance of the Impact: The potential for the aquifer to transmit or store water is not expected to be significantly affected. The incremental impact and the cumulative impact are each considered less than significant and no mitigation measures are required.

Potential For Significant Land Surface Alterations

Compaction of sediments that results in subsidence could also result in changes at the land surface. As noted above, ground subsidence of up to approximately one foot would occur at a distance of up to six miles east of the open pit, and a subsidence of up to two feet is expected to occur up to four miles southeast of the open pit. Subsidence of greater than four feet is expected near the open pit. If the future subsidence is smoothly distributed (as modeled by the interbed storage package) it would not be noticeable because the average slopes of the land surface would mask any effect.

However, subsidence is not always smoothly distributed and irregularities in subsidence may occur. Especially important is the potential for ground water withdrawals to induce fissures in the alluvium. Some fissures thought to be induced by subsidence have been studied in the vicinity of the Project Area by Amec (2003). Such newly-induced fissuring may be localized above previously-existing bedrock faults that offset alluvium at depth because there will be greater total subsidence where the alluvium is thicker. In addition, fissures without any offset may form above localized buried bedrock highs. Alternatively, newly induced fissures may occur due to differential compaction of sediment. This may occur where finer grained sediments (typically located closer to the center of a closed basin) compact more than coarser grained sediments (typically located closer to the mountain fronts). Hence, a newly induced tension crack may occur even if no pre-existing discontinuity exists. Such newly induced tension cracks could show visible offset at the land surface.

Newly induced fissuring in the alluvium has the potential to alter surface drainage by causing ponding adjacent to surface breaks, or by deflecting surface runoff to a new course which follows the newly induced fissures.

However, more important is the possibility of deflecting surface runoff directly into openings along the fissures. Fissures induced by subsidence are usually initially too narrow to be readily apparent, but may be substantially enlarged by erosion if exposed to significant overland flow. The erosion could result in deep, wide fissure gullies, which could be a hazard to people and animals. Fissure gullies could also damage roads or mining facilities.

In addition, such fissures may initially be open directly from the land surface to the aquifer, thus opening a shortcut for recharge to the aquifer. If any contaminants entered such a fissure, they would also be afforded a more direct route to the aquifer. Once subsidence stops, such fissures eventually naturally fill with sediment, but the natural process could take decades.

If differential subsidence induces fissuring of the alluvium, such fissures would be expected to occur in the areas of greatest subsidence (relatively near the mine) and while ground water levels are falling (during dewatering or soon after). Hence, any potential impacts would probably be noticed prior to cessation of mine reclamation. Measures have and are being implemented by CGM to prevent fissure enlargement in the area of the process facilities as described in Section 2.3.2.

Impact 4.3.3.3.1-7a: Differential subsidence could result in the development of fissures. Capture of surface runoff by the fissures may form erosional fissure gullies, which represent a safety risk to wildlife, livestock, and/or people.

Significance of the Impact: The impact would be significant if fissure gullies formed.

Mitigation Measure 4.3.3.3.1-7a: A monitoring program, as described in Section 2.3.2.2.10 (CGM 2004), shall be implemented to specifically watch for fissure development. If fissure gullies form, they shall be filled in with clean, coarse-grained alluvium in accordance with the fissure monitoring plan. The intent of using coarse-grained (permeable) backfill is to provide a rapid means of dissipation for any surface water entering the fissure, thereby reducing the propagation of the fissure through erosion.

Impact 4.3.3.3.1-7b: Differential subsidence could result in the opening of fissures creating a potential to degrade waters of the state. Fissures could provide a preferential flow path for uncontained process fluids, leachate, or hydrocarbons. If fissures form in the immediate vicinity of heap leach facilities (including pads, solution ponds, or the plant), or chemical or hydrocarbon storage facilities, the fissures could damage such facilities and result in a release to the environment.

Significance of the Impact: The impact would be significant if fissure gullies formed immediately adjacent to, or beneath engineered Project components that managed process solutions.

Mitigation Measure 4.3.3.3.1-7b: The BLM, under 43CFR 3809, has the authority to use the existing long-term trust fund or establish a new long-term trust fund for long-term mitigation of post-closure fissure development, if necessary.

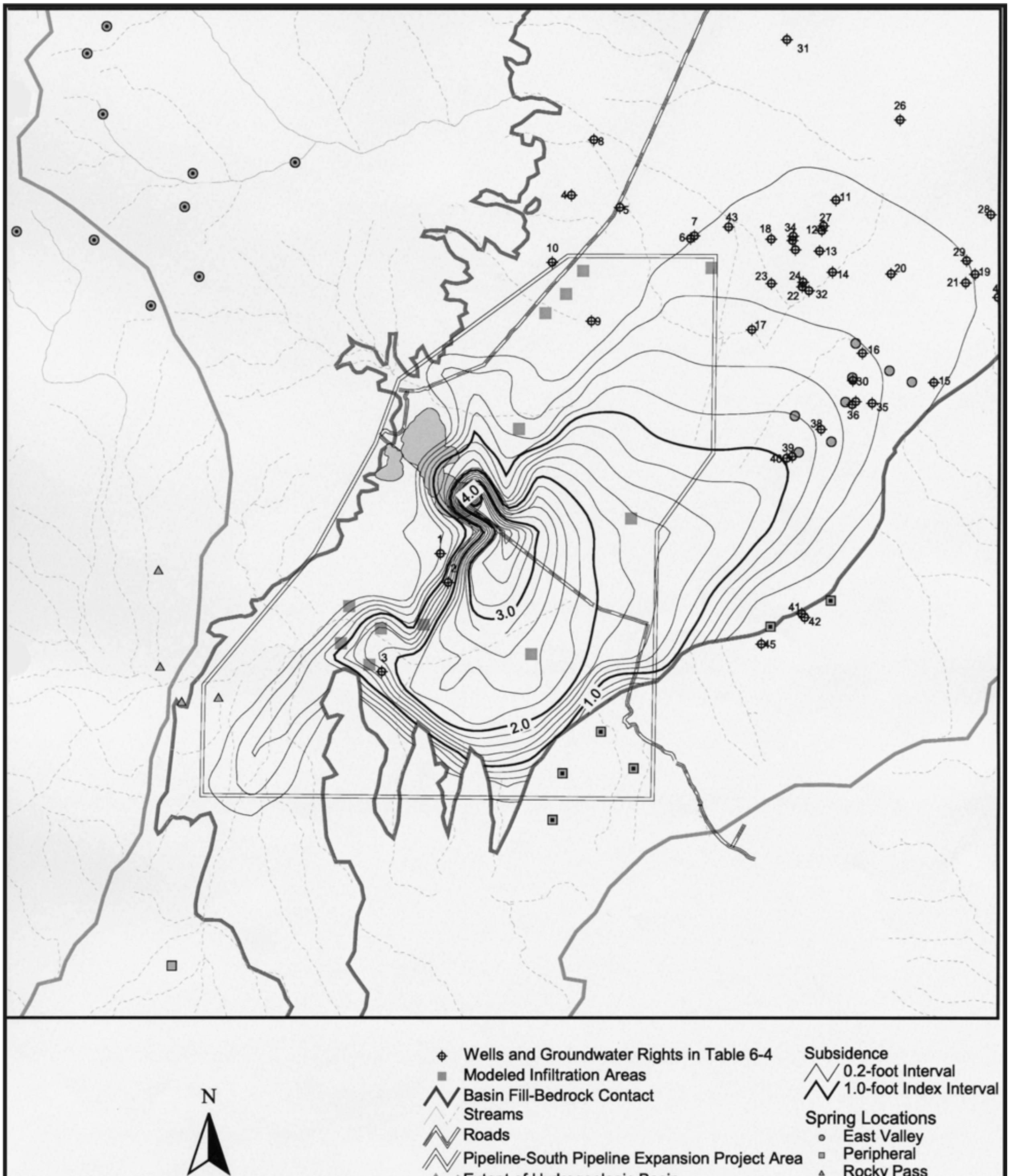

Figure 4.3.25 Simulated Subsidence at the End of Dewatering for the Proposed Action Stage, 11 and 12

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4.3.3.3.2 Stage 8 of the Proposed Action

The potential impacts of the Proposed Action through Stage 8 are described in this section.

Surface Water Resources (Stage 8 of the Proposed Action)

Erosion, Sedimentation, and Flooding Within Rerouted Drainages

The nature of the impact is addressed in Section 4.3.3.3.1 of this report on Stages 11 and 12 of the Proposed Action; therefore, it is not repeated here.

Impact 4.3.3.3.2-1: Grading, earth moving, diversion of drainages, and placement of fill could accelerate erosion, sedimentation, and alter surface water flood runoff patterns during mining and post-closure.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Effects of Drawdown on Streams and Springs

The nature of the impact is addressed in Section 4.3.3.3.1 of this report on Stages 11 and 12 of the Proposed Action. Therefore, the general nature of the potential impact will not be repeated here.

Figures 4.3.26 and 4.3.27 show graphically the results of the numerical ground water flow model expressed as water table drawdown contours at the end of mining under Stage 8 of the Proposed Action. The predicted maximum drawdown (combined basin fill and bedrock) is approximately 880 feet at the center of the Pipeline/South Pipeline open pit after 12 years of dewatering (under Stage 8 of the Proposed Action). This section investigates the potential for drawdown of the water table to affect surface water flow in certain streams and springs.

These ground water modeling results indicate that the ground water level will be drawn down by far less than ten feet at all springs at the end of mining. The drawdown in ground water level is likewise expected to be less than ten feet at all of the perennial streams at the end of mining. At the end of mining, the modeled ten-foot drawdown contour would extend approximately five miles to the north, 4.5 miles to the southeast, and five miles to the east. Drawdown is limited to the northeast and south of the open pits by recharge from infiltration basins.

After dewatering ceases, the ground water level would begin to recover in the open pit area and the ground water mounds in the infiltration areas would dissipate as ground water flows toward the open pit. Drawdown would continue to increase in the Project perimeter areas as the open pit fills with ground water that is derived from storage. Figure 4.3.28 shows the predicted drawdown contours at the time of maximum areal extent of drawdown (ten years after the end of mining) for Stage 8 of the Proposed Action. To the northeast and southwest, the extent of the ten-foot drawdown contour is approximately two to three miles beyond its location at the end of mining. The drawdown ten years after the end of mining is selected as the most appropriate time to compare the significance of impacts because that is the point in time when the ground water model predicts that the ten-foot drawdown will have reached its maximum lateral extent. At ten years after the end of mining, modeled drawdown in the basin fill aquifer of ten feet or more would not extend to any springs or perennial streams.

Impact 4.3.3.3.2-2: Mine dewatering is not expected to affect flows in any springs or streams under Stage 8 of the Proposed Action.

Significance of the Impact: There is no expected impact under Stage 8 of the Proposed Action. However, if the flow of the springs or streams substantially decreases due to dewatering activities, the impact would be deemed potentially significant.

Mitigation Measure 4.3.3.3.2-2a: No mitigation is expected to be required. However, monitoring of flows at streams and the 68 springs in the southern portion of Crescent Valley would be performed as dewatering progresses, and, if necessary, mitigation would be performed as described under Mitigation Measure 4.3.3.3.1-2a.

Mitigation Measure 4.3.3.3.2-2b: No mitigation is expected to be required because no impact is predicted under Stage 8 of the Proposed Action. However, it is possible that some impacts to springs may only occur after the end of mining, when the operational measures described under Mitigation Measure 4.3.3.3.1-2a may not be available. If this were to occur, mitigation would be performed as described under Mitigation Measure 4.3.3.3.1-2b.

Ground Water Resources (Stage 8 of the Proposed Action)

Consumptive Losses

Consumptive losses through evaporation will continue to occur during mine operations from the surfaces of the infiltration basins and seeps associated with the water disposal operations during active dewatering. The evaporative losses due to the infiltration basins are the same as those described under Stages 11 and 12 of the Proposed Action (Section 4.3.3.3.1), except through Stage 8 of the Proposed Action the basins would be in use for six fewer years.

After mining operations cease and the pit lake begins to fill, some pit lake water would be consumptively lost due to evaporation. The consumptive losses through evaporation would increase over time with the increasing pit lake stage and water surface area after mine closure. For Stage 8 of the Proposed Action after 100 years of pit refilling, the net consumptive losses through evaporation from the water surface of the single 306-acre pit lake would be approximately 1,036 acre-feet per year (see Table 4.3.3). The Stage 8 consumptive losses through evaporation are 13 acre-feet per year more than Stage 12 of the Proposed Action and 268 acre-feet per year less than the No Action Alternative. It should be noted that long-term evaporation losses from the pit lake will be partially balanced in the basin's water budget by a reduction of the natural evapotranspiration from the central area of the valley.

The Crescent Valley Hydrographic Basin is classified as a designated basin by the Nevada State Engineer and the withdrawal and use of ground water is regulated. Evaporative losses may be treated as a consumptive use and accounted as a water right at the discretion of the Nevada State Engineer. The resulting annual volume of water is comparable to the annual water use allowed for a land parcel of equivalent area placed under irrigation. Since CGM holds senior certificated water rights

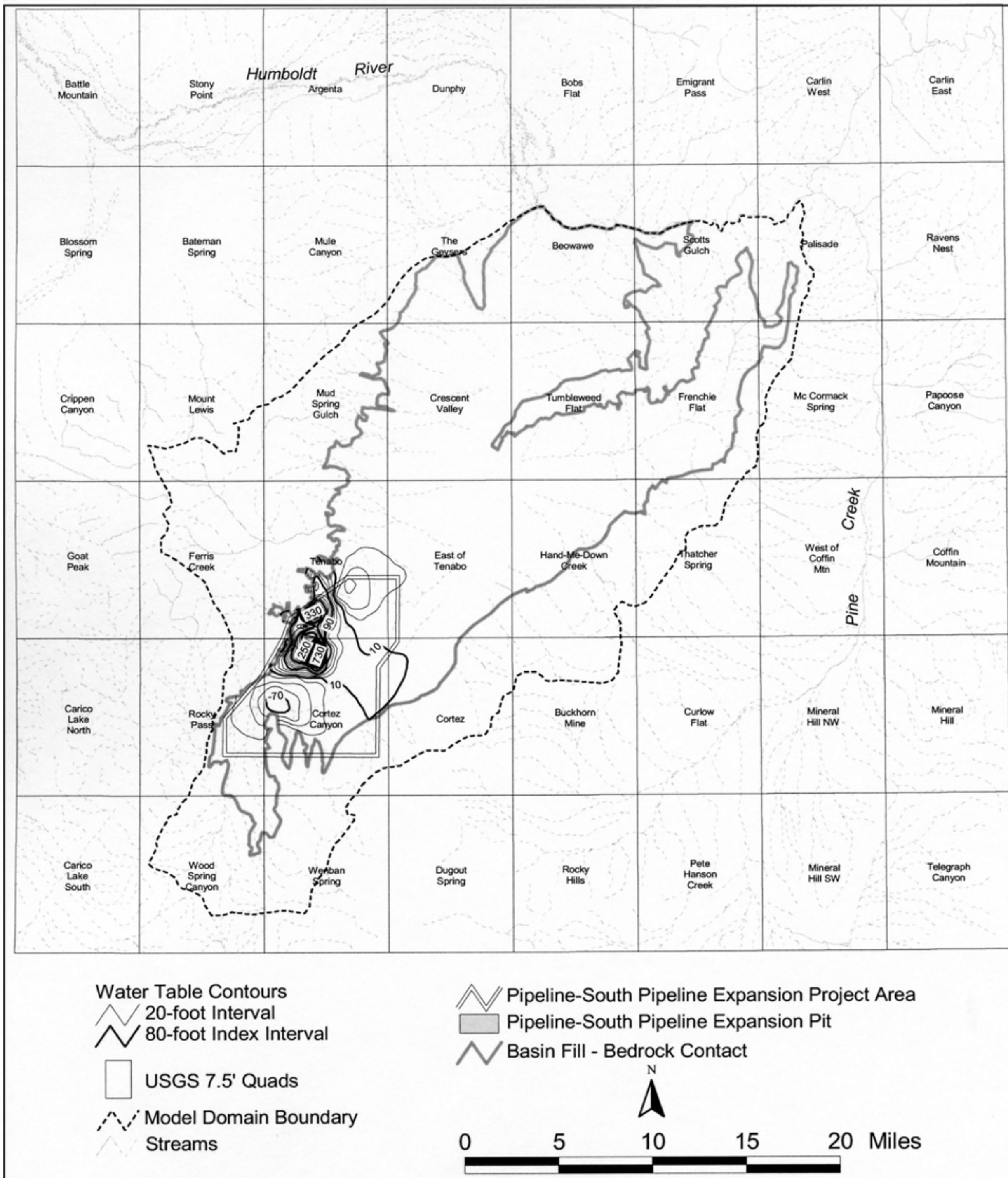

Figure 4.3.26 Water Table Drawdown in Basin Fill Deposits in Crescent Valley at the End of Mining, Proposed Action Stage 8

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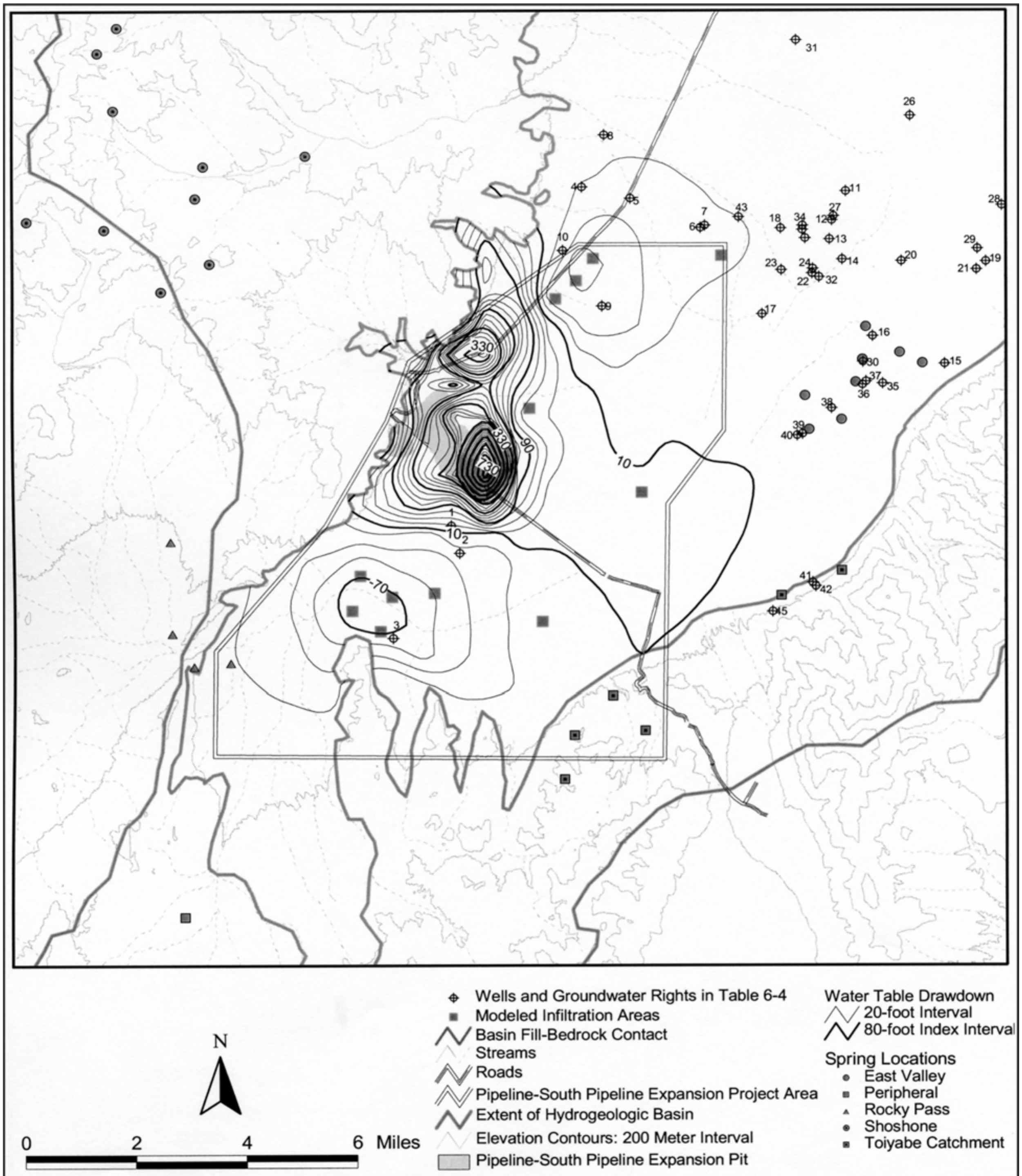

Figure 4.3.27 Water Table Drawdown in Basin Fill Deposits in Southern Crescent Valley at End of Mining Proposed Action Stage 8

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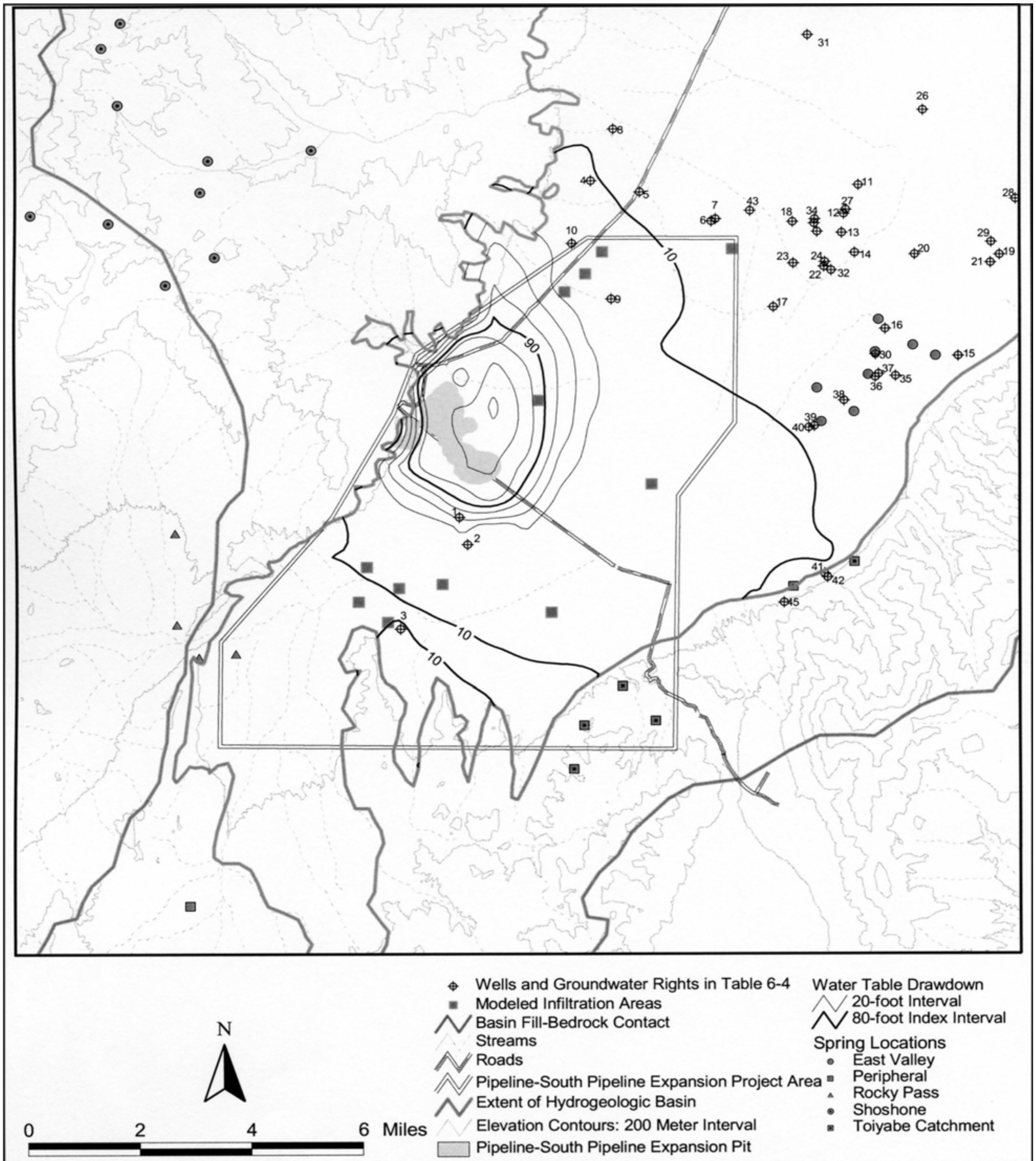

Figure 4.3.28 Water Table Drawdown in Basin Fill Deposits in Southern Crescent Valley at Time of Maximum Drawdown Extent, Proposed Action Stage 8

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for both agricultural and mining/milling uses in Crescent Valley, replacement of evaporative pit lake loss with a certificated water right would result in no net gain in permitted ground water withdrawal or consumptive use from Crescent Valley. The transfer of these water rights to offset the evaporative losses from the pit would render the impacts on water rights insignificant.

The revision to the western open pit rim under Stage 8 would increase the surface area of the pit lake from 306 acres to 321 acres. This would result in a 51 acre-foot increase in annual evaporative loss, from 1,036 acre-feet to 1,087 acre-feet, which is a relatively minor increase over the original analysis (Geomega 2004a).

Impact 4.3.3.3.2-3: Consumptive use of water by evaporation during mining and delivery of water to the Dean Ranch for irrigation would support a beneficial use, and would not be expected to adversely impact water resources; CGM would have adequate water rights to cover the consumptive use. Evaporation of 1,087 acre-feet per year from the post-mining pit lake would continue into the foreseeable future after the mine has closed. This is 64 acre-feet per year greater than Stage 12 of the Proposed Action, and approximately 217 acre-feet per year less than the No Action Alternative. Hence, there is a positive impact compared to the No Action Alternative.

Significance of the Impact: Impacts during the active mine life are less than significant. After mining, direct impacts of evaporation do not result in significant impacts, although the long-term consumptive use of water resources that do not contribute to beneficial use is considered to be a significant impact for which there are no mitigation measures that appear to be feasible. However, there is a positive impact compared to the No Action Alternative.

Lowering of the Water Table Due to Pit Dewatering

A general discussion of water table lowering due to mine dewatering is provided in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action and will not be repeated here. Under Stage 8 of the Proposed Action there is an anticipated maximum annual dewatering pumping rate of 27,200 gpm (43,900 acre-feet/year) occurring during 2007. Stage 8 of the Proposed Action would extend the timeframe of dewatering from ten years (under the No Action Alternative) to 12 years. For comparison, the maximum pumping rate for Stages 11 or 12 of the Proposed Action is 34,500 gpm. With the exception of up to 10,000 gpm to be used for the mill, evaporation, irrigation, and other consumptive uses, the remaining pumped ground water would be returned to the alluvial aquifer via the infiltration basins to conserve ground water resources.

Figure 4.3.27 shows predicted water table drawdowns in the alluvial aquifer at the end of mining for Stage 8 of the Proposed Action. The maximum drawdown in the open pit area during mine operation is expected to be as much as 880 feet.

The ground water level will begin to recover immediately after active mine dewatering ends. The ground water flow model was used to evaluate water level recovery for a period of over 100 years after the end of dewatering. The water level in the vicinity of the Pipeline/South Pipeline open pit is expected to recover by 75 percent within ten years of the end of dewatering.

Impacts to Water Rights

Modeling results indicate some potential for impacts to ground water rights holders in the vicinity of the Project Area. Such impacts may involve lowering of ground water levels at wells, springs, or streams. The analysis of drawdown includes modeling for two timeframes: 1) at the end of mine dewatering; and 2) at ten years later than that.

Under Stage 8 of the Proposed Action, ground water flow modeling results show that at the end of mining, substantial water table drawdowns in the alluvial aquifer (in excess of ten feet) would be limited to an area within approximately five miles from the site of the proposed open pit. At the end of mining one water right, well No. 1 (BLM windmill), would be affected by more than ten feet of modeled drawdown under Stage 8 of the Proposed Action. However, for reasons given in Section 4.3.3.3.1 of Stages 11 and 12 of the Proposed Action, the maximum extent of the ten-foot drawdown contour is modeled to occur about ten years after the end of mining (Geomega 2003a). Therefore, the predicted drawdown at ten years after mining (Figure 4.3.28) is an appropriate time to compare impacts between the various alternatives. Impacts at known water wells, springs, and water rights sites were evaluated for potential water table drawdown as shown on Figure 4.3.27. At ten years after the end of mining, five wells are modeled as being affected by more than ten feet of drawdown: well No. 1 (BLM windmill), No. 2 (Filippini), No. 4 (CGM), No. 9 (Mill Gulch Placer), and No. 10 (USGS). All four of the non-CGM wells are inactive. A list of water rights corresponding to the numbered locations shown on Figure 4.3.28 is included on Table 4.3.2.

Impact 4.3.3.3.2-4: There are no non-CGM active water rights that are within the predicted area of the modeled ten-foot drawdown of the valley-fill aquifer. However, there are four inactive water wells. There is also a water right (No. 4) owned by the applicant. Effects are generally similar to the No Action Alternative.

Significance of the Impact: Impacts to the inactive wells are not considered significant until such time as the water rights holder chooses to utilize his rights, at which time they would be considered potentially significant. The impacts would become less than significant after implementation of the mitigation measures described below.

Mitigation Measure 4.3.3.3.2-4a: As part of the comprehensive monitoring program, CGM would be responsible for monitoring ground water levels between the mine and water supply wells, ground water rights, and surface water rights. Adverse impacts to ground water rights and surface water rights would be mitigated as required by the NDWR. Mitigation of impacts to ground water rights could include lowering the pump, deepening an existing well, drilling a new well for water supply wells, or providing a replacement water supply of equivalent yield and general water quality. For surface water rights, mitigation could require providing a replacement water supply of equivalent yield and general water quality.

Mitigation Measure 4.3.3.3.2-4b: For any significant impacts to wells that do not occur until after the end of mining, the operational measures described above may not be available. For the post-mining delayed impacts of drawdown, the ground water flow model would be updated during the final year of dewatering using actual field data for pumping rates, infiltration rates and locations, consumptive use, and observed drawdown to re-evaluate drawdown predictions that would occur after the end of mining. Active water rights not owned by the applicant that are indicated to be significantly affected would then be mitigated by one or more of the following measures, subject to approval of the BLM and NDWR:

- Replacement or purchase of the affected water right by the applicant.

- Installation of a deeper well and pump at affected locations to restore the historical yield of the well.

- Posting of an additional bond to provide for potential future impacts to potentially affected water supplies.

Ground Water Flow to Humboldt River

The general situation with the Humboldt River is described in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action. Stage 8 of the Proposed Action shows a decrease of approximately nine acre-feet per year decrease relative to the baseline ground water budget (Table 4.3.1) in the Crescent Valley Basin's ground water contribution to the Humboldt River at the end of mine operations (the time of maximum impact for this particular case) (see Table 4.3.3). The decrease is estimated to be exactly the same as for the Stages 11 and 12 of the Proposed Action and only one acre-foot per year greater than the No Action Alternative. The relatively small changes in predicted flow to the Humboldt River would be undetectable within the context of natural variability in recharge, evapotranspiration, and ground water flow to the river. The predicted reduction in ground water flow to the Humboldt River represents less than one tenth of one percent of the 1992 measurements of baseflow and diversions of the river at Beowawe. The small magnitude of predicted impact to the flow of the Humboldt River is a result of the buffering effect of evapotranspiration in the central part of Crescent Valley and indicates that Stage 8 of the Proposed Action would not result in significant direct or cumulative impacts on the river.

Impact 4.3.3.3.2-5: Regarding ground water flow from Crescent Valley to the Humboldt River, modeling indicates that there will be a very slight reduction of ground water flow (nine acre-feet per year compared to pre-mining, or one acre-foot per year compared to the No Action Alternative).

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Potential Impacts Due to Subsidence

The general discussion of subsidence is provided in Section 4.3.3.3.1 for Stages 11 and 12 of the Proposed Action and will not be repeated here. The model shows that for Stage 8 of the Proposed Action subsidence of up to approximately one foot would occur at a distance of up to 3.5 miles southeast of the open pit, and up to approximately four miles south of the open pit (Figure 4.3.29). A subsidence of two feet would extend as far as two miles south of the open pit. The estimated subsidence for Stage 8 of the Proposed Action is slightly more than that estimated for the No Action Alternative. The most notable difference is that the two-foot subsidence contour extends approximately two miles farther south in Stage 8 than in the No Action Alternative.

Potential For Changes to Aquifer Productivity

The greatest potential for permanent deformation would occur in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer. The result would be a slight loss in aquifer interbed storage, but no noticeable loss in aquifer productivity of water supply wells. Thus, the potential impacts to the aquifer due to subsidence under Stage 8 of the Proposed Action, if any, would be very localized and are considered not significant.

Impact 4.3.3.3.2-6: A small change in aquifer characteristics is expected to result from compaction of the aquifer materials. Ground subsidence of up to approximately one foot would occur at a distance of up to 3.5 miles southeast of the open pit, and up to approximately four miles south of the open pit (Figure 4.3.29). A subsidence of two feet would extend as far as two miles south of the open pit. The subsidence would result primarily from a permanent reduction in porosity in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer.

Significance of the Impact: The potential for the aquifer to transmit or store water is not expected to be significantly affected. The incremental impact and the cumulative impact are each considered less than significant and no mitigation measures are required.

Potential For Significant Land Surface Alterations

Compaction of sediments that results in subsidence could also result in changes at the land surface. As noted above, ground subsidence of up to approximately one foot would occur at a distance of up to 3.5 miles southeast of the open pit, and up to approximately four miles south of the open pit (Figure 4.3.29). A subsidence of two feet would extend as far as two miles south of the open pit. As described fully in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action, potentially damaging fissuring at the ground surface could result from differential subsidence. Stage 8 of the Proposed Action is modeled as having slightly more subsidence than the No Action Alternative.

Compaction of sediments that results in subsidence could also result in changes at the land surface. As described fully in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action, potentially damaging fissuring at the ground surface could result from tension cracks induced by differential subsidence. Stage 8 of the Proposed Action is modeled as having somewhat more subsidence than the No Action Alternative. Hence, the potential for fissuring at the ground surface under Stage 8 is somewhat greater than the No Action Alternative. Measures have and are being implemented by CGM to prevent fissure enlargement in the area of the process facilities as described in Section 2.3.2.

Impact 4.3.3.3.2.-7a: Differential subsidence could result in the development of fissures. Capture of surface run off by the fissures may form erosional fissure gullies, which represent a safety risk to wildlife, livestock and/or people.

Significance of the Impact: The impact would be significant if fissure gullies form.

Mitigation Measure 4.3.3.3.2-7a: A monitoring program, as described in Section 2.3.2.2.10 (CGM 2004), shall be implemented to specifically watch for fissure gully development. If fissure gullies

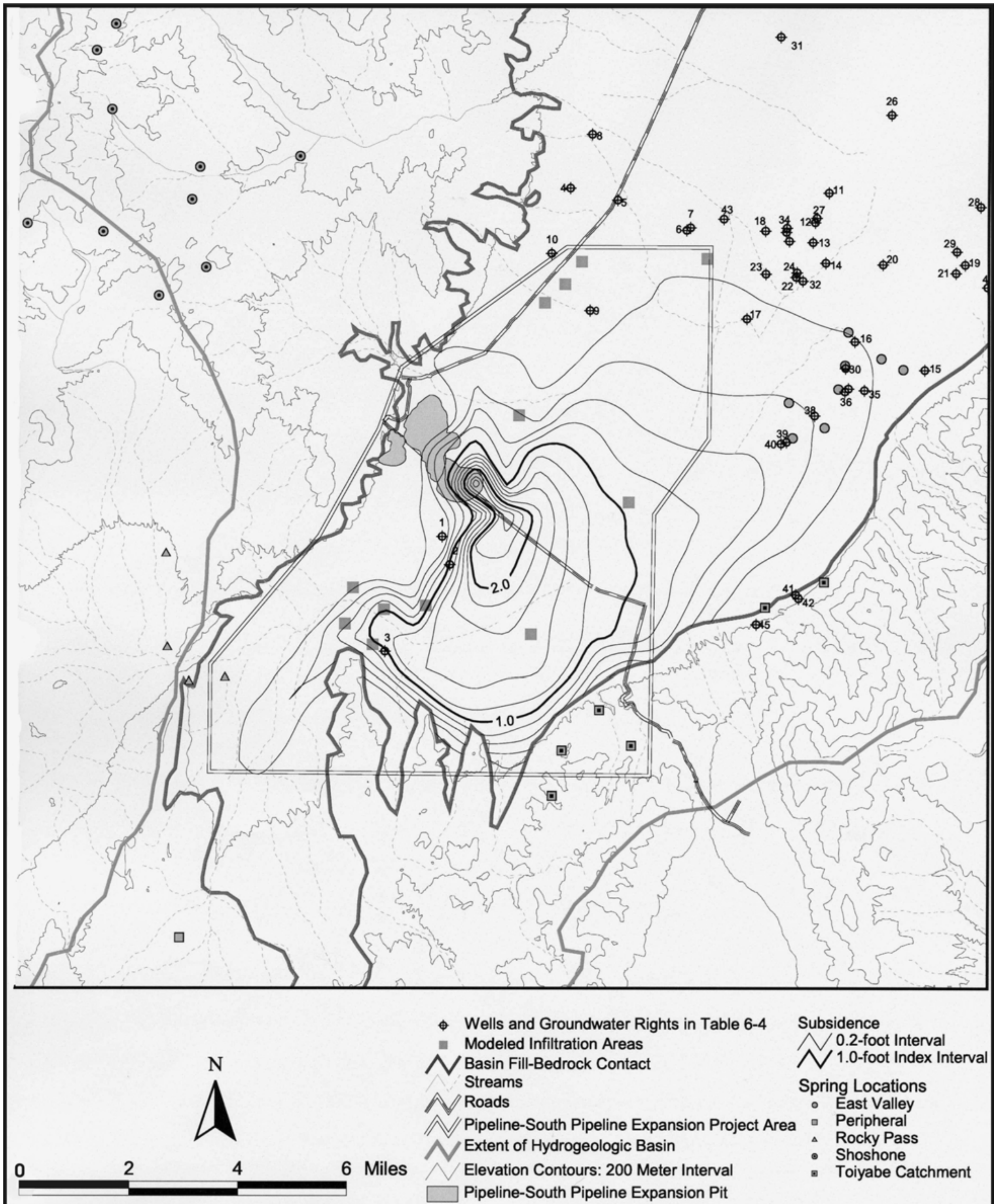

Figure 4.3.29 Simulated Subsidence at the End of Dewatering, Proposed Action Stage 8

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form, they shall be filled in with clean, coarse-grained alluvium in accordance with the fissure monitoring plan. The intent of using coarse-grained (permeable) backfill is to provide a rapid means of dissipation for any surface water entering the fissure.

Impact 4.3.3.3.2-7b: Differential subsidence could result in the opening of fissures creating a potential to degrade waters of the state. Fissures could provide a preferential flow path for uncontained process fluids, leachate, or hydrocarbons. If fissures form in the immediate vicinity of heap leach facilities (including pads, solution ponds, or the plant), or chemical or hydrocarbon storage facilities, the fissures could damage such facilities and result in a release to the environment.

Significance of the Impact: The impact would be significant if fissure gullies formed immediately adjacent to, or beneath engineered Project components that manage process solutions.

Mitigation Measure 4.3.3.3.2-7b: Mitigation of the impact is same as the mitigation measures described for Impact 4.3.3.3.1-7b.

4.3.3.3.3 Stage 9 of the Proposed Action

The potential impacts of the Proposed Action through Stage 9 are described in this section.

Surface Water Resources (Stage 9 of the Proposed Action)

Erosion, Sedimentation, and Flooding Within Rerouted Drainages

The nature of the impact is addressed in Section 4.3.3.3.1 of this report on Stages 11 and 12 of the Proposed Action; therefore, it is not be repeated here.

Impact 4.3.3.3.3-1: Grading, earth moving, diversion of drainages, and placement of fill could accelerate erosion, sedimentation, and alter surface water flood runoff patterns during mining and post-closure.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Effects of Drawdown on Streams and Springs

The nature of the impact is addressed in Section 4.3.3.3.1 of this report on Stages 11 and 12 of the Proposed Action. Therefore, the general nature of the potential impact will not be repeated here. Figure 4.3.30 shows graphically the results of the numerical ground water flow model expressed as water table drawdown contours at the end of mining under Stage 9 of the Proposed Action. The predicted maximum drawdown (combined basin fill and bedrock) is approximately 1,020 feet at the center of the Pipeline/South Pipeline open pit after 12 years of dewatering (under Stage 9 of the Proposed Action). This section investigates the potential for drawdown of the water table in the alluvial aquifer to affect surface water flow in streams and springs.

These ground water modeling results indicate that the ground water level will be drawn down by less than ten feet at all springs at the end of mining. The drawdown in ground water level is likewise expected to be less than ten feet at all of the perennial streams at the end of mining. At the end of mining, the modeled ten-foot drawdown contour would extend approximately five miles to the north, 4.5 miles to the southeast, and five miles to the east. Drawdown is limited to the northeast and south of the open pits by recharge from infiltration basins.

After dewatering ceases, the ground water level would begin to recover in the open pit area and the ground water mounds in the infiltration areas would dissipate as ground water flowed toward the open pit. Drawdown would continue to increase in the Project perimeter areas as the open pit filled with ground water derived from storage. Figure 4.3.31 shows the predicted drawdown contours at the time of maximum areal extent of drawdown (ten years after the end of mining) for Stage 9 of the Proposed Action. To the northeast and southwest, the extent of the ten-foot drawdown contour is about two to three miles beyond its location at the end of mining. The drawdown ten years after the end of mining is selected as the most appropriate time to compare the significance of impacts because that is the point in time when the ground water model predicts that the ten-foot drawdown will have reached its maximum lateral extent. At ten years after the end of mining, modeled drawdown in the basin fill aquifer of ten feet or more would not extend to any springs issuing from the alluvial aquifer or any perennial streams flowing on top of the alluvial aquifer.

Impact 4.3.3.3.3-2: Mine dewatering is not expected to affect flows in any springs or streams under Stage 9 of the Proposed Action. Hence, no impact is expected.

Significance of the Impact: There is no expected impact under Stage 9 of the Proposed Action. However, if the flow of the springs or streams is substantially decreased due to dewatering activities, the impact would be deemed potentially significant.

Mitigation Measure 4.3.3.3.3-2a: No mitigation is expected to be required. However, monitoring of flows at streams and the 68 springs in the Project Area would be performed as dewatering progresses, and, if necessary, mitigation would be performed as described under Mitigation Measure 4.3.3.3.1-2a.

Mitigation Measure 4.3.3.3.3-2b: No mitigation is expected to be required because no impact is predicted under Stage 9 of the Proposed Action. However, it is possible that some impacts to springs or streams may only occur after the end of mining when the operational measures described under Mitigation Measure 4.3.3.3.1-2a may not be available. If this were to occur, mitigation would be performed as described under Mitigation Measure 4.3.3.3.1-2b.

<u>Ground Water Resources (Stage 9 of the Proposed Action)</u>

Consumptive Losses

Consumptive losses through evaporation will continue to occur during mine operations from the surfaces of the infiltration basins and seeps associated with the water disposal operations during active dewatering. The evaporative losses due to the infiltration basins are the same as those described under Stages 11 and 12 of the Proposed Action (Section 4.3.3.3.1), except through Stage 9 of the Proposed Action the basins would be in use for six fewer years. Evaporative losses during mine operation would not be expected to produce a significant impact.

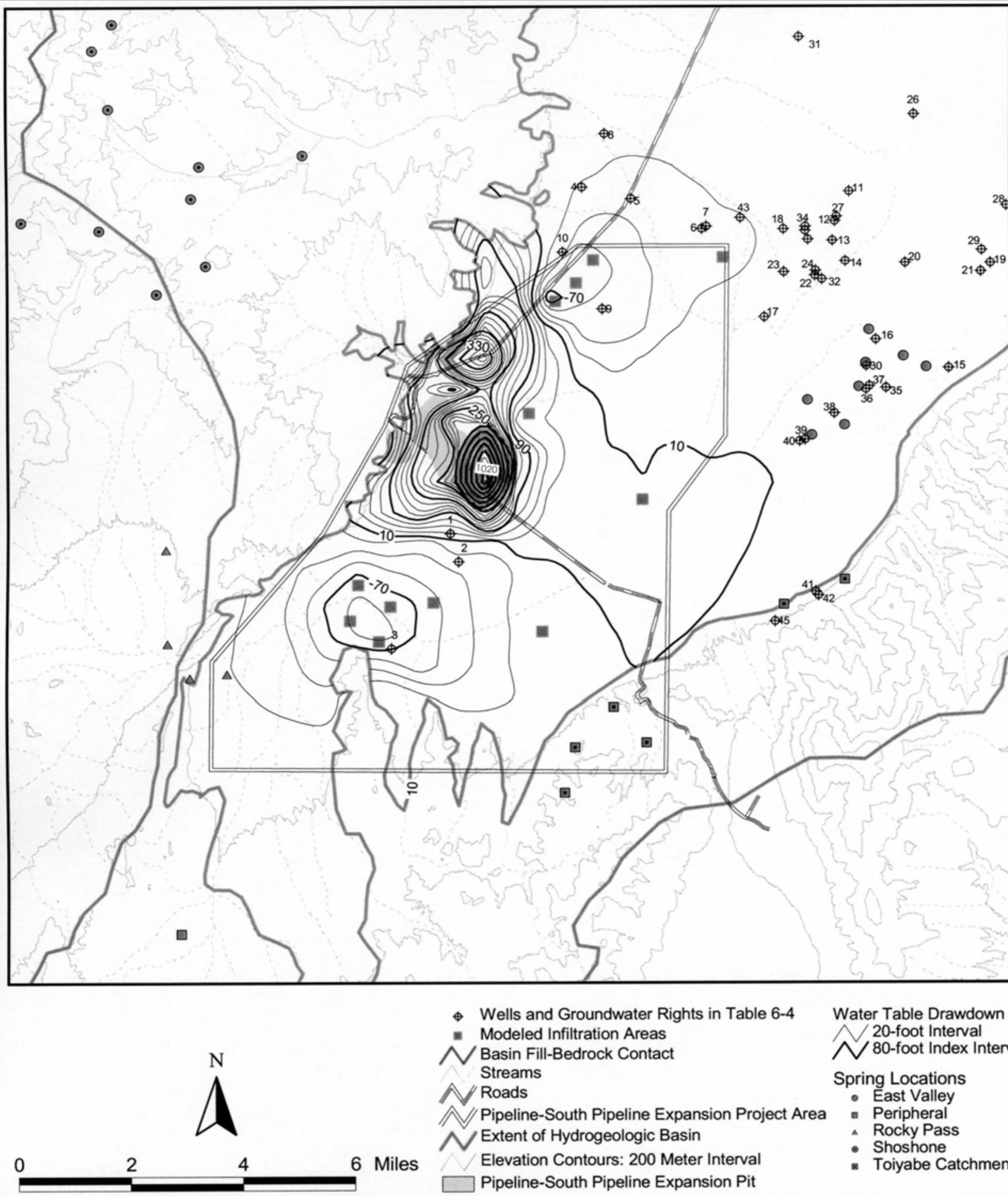

Figure 4.3.30 Water Table Drawdown in Basin Fill Deposits in Southern Valley at End of Mining, Proposed Action Stage 9

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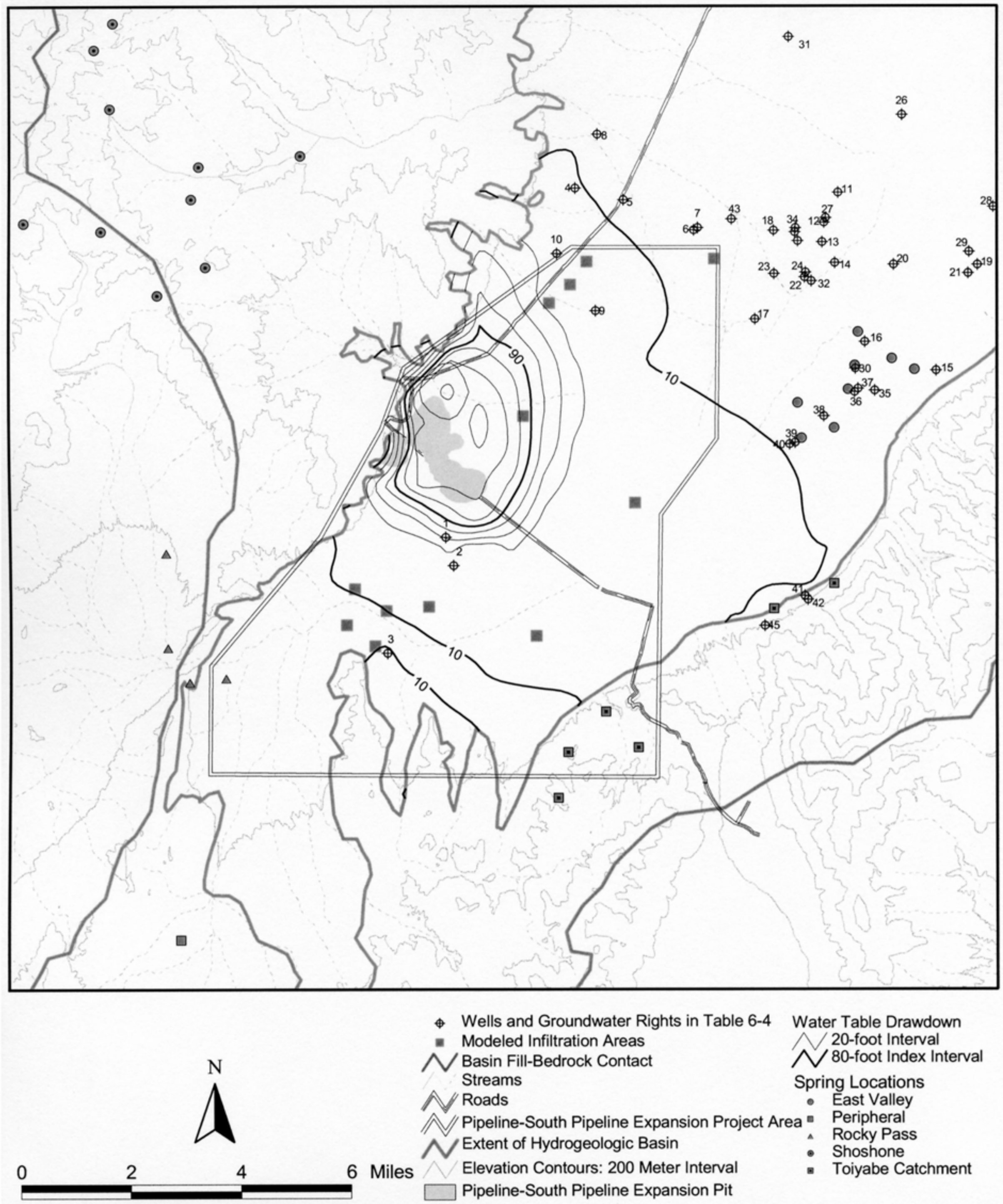

Figure 4.3.31 Water Table Drawdown in Basin Fill Deposits in Southern Crescent Valley at Time of Maximum Drawdown Extent, Proposed Action Stage 9

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After mining operations cease and the pit lake begins to fill, some pit lake water would be consumptively lost due to evaporation. The consumptive losses due to evaporation from the pit lake would increase over time with the increasing pit lake stage and water surface area after mine closure. For Stage 9 of the Proposed Action after 100 years of pit re-filling, the net consumptive losses through evaporation from the water surface of the single 306-acre pit lake would be approximately 1,036 acre-feet per year (see Table 4.3.3). The consumptive losses through evaporation for Stage 9 of the Proposed Action are 13 acre-feet per year more than the Stage 12 of the Proposed Action and 268 acre-feet per year less than the No Action Alternative. It should be noted that long-term evaporation losses from the pit lake will be partially balanced in the basin's water budget by a reduction of the natural evapotranspiration from the central area of the valley.

The Crescent Valley Hydrographic Basin is classified as a designated basin by the Nevada State Engineer and the withdrawal and use of ground water is regulated. Evaporative losses may be treated as a consumptive use and accounted as a water right at the discretion of the Nevada State Engineer. The resulting annual volume of water is comparable to the annual water use allowed for a land parcel of equivalent area placed under irrigation. Since CGM holds senior certificated water rights for both agricultural and mining/milling uses in Crescent Valley, replacement of evaporative pit lake loss with a certificated water right would result in no net gain in permitted ground water withdrawal or consumptive use from Crescent Valley. The transfer of these water rights to offset the evaporative losses from the pit lake would render the impacts on water rights insignificant.

The revision to the western open pit rim under Stage 9 would increase the surface area of the pit lake from 306 acres to 371 acres. This would result in a 220 acre-foot increase in annual evaporative loss, from 1,036 acre-feet to 1,256 acre-feet, which is a relatively minor increase over the original analysis (Geomega 2004a).

Impact 4.3.3.3.3-3: Consumptive use of water by evaporation during mining and delivery of water to the Dean Ranch for irrigation would support a beneficial use and would not be expected to adversely impact water resources, and CGM would have adequate water rights to cover the consumptive use. Evaporation of 1,256 acre-feet per year from the post-mining pit lake would continue into the foreseeable future after the mine has closed. This is 233 acre-feet per year greater than Stage 12 of the Proposed Action, and 48 acre-feet per year less than the No Action Alternative. Hence, there is a slightly positive impact compared to the No Action Alternative.

Significance of the Impact: Impacts during the active mine life are less than significant. After mining, direct impacts of evaporation do not result in significant impacts, although the long-term consumptive use of water resources that do not contribute to beneficial use is considered to be a significant impact for which there are no mitigation measures that appear to be feasible. However, there is a positive impact compared to the No Action Alternative.

Lowering of the Water Table Due to Pit Dewatering

A general discussion of water table lowering due to mine dewatering is provided in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action and will not be repeated here. Under Stage 9 of the Proposed Action there is an anticipated maximum annual dewatering pumping rate of 34,500 gpm (55,700 acre-feet/year) occurring during 2007. Stage 9 of the Proposed Action would extend the timeframe of dewatering from ten years (under the No Action Alternative) to 12 years. For comparison, the maximum pumping rate for Stages 11 or 12 of the Proposed Action is also 34,500 gpm. With the exception of up to 10,000 gpm to be used for the mill, evaporation, irrigation, and other consumptive uses, the remaining pumped ground water would be returned to the alluvial aquifer via the infiltration basins to conserve ground water resources.

Figure 4.3.30 shows predicted water table drawdowns in the alluvial aquifer at the end of mining for Stage 9 of the Proposed Action. The maximum drawdown in the Pipeline/South Pipeline open pit area during mine operation is expected to be approximately 1,020 feet.

The ground water level will begin to recover immediately after active mine dewatering ends. The ground water flow model was used to evaluate water level recovery for a period of over 100 years after the end of dewatering. The water level in the vicinity of the Pipeline/South Pipeline open pit is expected to recover by 80 percent within ten years of the end of dewatering.

Impacts to Water Rights

Modeling results indicate some potential for impacts to ground water rights holders in the vicinity of the Project Area. Such impacts may involve lowering of ground water levels at wells, springs, or streams. The analysis of drawdown includes modeling for two timeframes: 1) at the end of mine dewatering; and 2) at ten years later than that.

Ground water flow modeling results show that at the end of mining under Stage 9 of the Proposed Action, the ten-foot drawdown contour of the water table in the basin fill aquifer is expected to extend to a distance of approximately five miles to the north, five miles to the east, and 4.5 miles to the southeast of the center of the open pits (Figure 4.3.30). At the end of mining, one water right, well No. 1 (BLM windmill), would be affected by more than ten feet of modeled drawdown under Stage 9 of the Proposed Action.

However, for reasons given in Section 4.3.3.3.1 of Stages 11 and 12 of the Proposed Action, the maximum extent of the ten-foot drawdown contour is modeled to occur about ten years after the end of mining (Geomega 2003a). Therefore, the predicted drawdown at ten years after mining (Figure 4.3.31) is an appropriate time to compare impacts between the various alternatives. At ten years after the end of mining, five wells are modeled as being affected by more than ten feet of drawdown: well No. 1 (BLM windmill), No. 2 (Filippini), No. 4 (CGM), No. 9 (Mill Gulch Placer), and No. 10 (USGS monitoring). All four non-CGM wells are inactive. A list of water rights corresponding to the numbered locations shown on Figure 4.3.31 is included on Table 4.3.2. Water rights for the four inactive wells are not considered significant because these water rights are not active. Potential impacts to water rights owned by the applicant are not deemed significant.

Impact 4.3.3.3.3-4: There are no active non-CGM water rights that are within the predicted area of the modeled ten-foot drawdown of the valley-fill aquifer. However, there are four inactive water wells.

Significance of the Impact: Impacts to the inactive wells are not considered significant until such time as the water rights holder chooses to utilize their valid rights, at which time they would be considered potentially significant. The impacts would become less than significant after implementation of the mitigation measures described below. Potential impacts to water rights owned by the applicant are not deemed significant.

Mitigation Measure 4.3.3.3.3-4a: As part of the comprehensive monitoring program, CGM shall be responsible for monitoring ground water levels between the mine and water supply wells, ground water rights, and surface water rights. Adverse impacts to ground water rights and surface water rights shall be mitigated as required by the NDWR. Mitigation of impacts to ground water rights could include lowering the pump, deepening an existing well, drilling a new well for water supply wells, or providing a replacement water supply of equivalent yield and general water quality. For surface water rights, mitigation could require providing a replacement water supply of equivalent yield and general water quality.

Mitigation Measure 4.3.3.3.3-4b: For any significant impacts to wells that do not occur until after the end of mining, the operational measures described above may not be available. For the post-mining delayed impacts of drawdown, the ground water flow model shall be updated during the final year of dewatering using actual field data for pumping rates, infiltration rates and locations, consumptive use, and observed drawdown to reevaluate drawdown predictions that would occur after the end of mining. Active water rights not owned by the applicant that are indicated to be significantly affected shall then be mitigated by one or more of the following measures, subject to approval of BLM and NDWR:

- Replacement or purchase of the affected water right by the applicant.
- Installation of a deeper well and pump at affected locations to restore the historical yield of the well.
- Posting of an additional bond to provide for potential future impacts to potentially affected water supplies.

Ground Water Flow to Humboldt River

The general situation with the Humboldt River is described in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action. Stage 9 of the Proposed Action shows approximately a nine acre-feet per year decrease relative to the baseline ground water budget (Table 4.3.1) in the Crescent Valley Basin's ground water contribution to the Humboldt River at the end of mine operations (the time of maximum impact for this particular case) (see Table 4.3.3). The decrease is estimated to be exactly the same as for the Stages 11 and 12 of the Proposed Action. The decrease is estimated to be one acre-foot per year more than the No Action Alternative. The relatively small changes in predicted flow to the Humboldt River would be undetectable within the context of natural variability in recharge, evapotranspiration, and ground water flow to the Humboldt River. The predicted reduction in ground water flow to the river represents less than one tenth of one percent of the 1992 measurements of baseflow and diversions of the river at Beowawe. The small magnitude of predicted impact to the flow of the river is a result of the buffering effect of evapotranspiration in the central part of Crescent Valley and indicates that Stage 9 of the Proposed Action would not result in significant direct or cumulative impacts to the river.

Impact 4.3.3.3.3-5: Regarding ground water flow from Crescent Valley to the Humboldt River, modeling indicates that a very slight reduction of ground water flow (nine acre-feet per year) would occur compared to premining conditions. The estimated difference between Stage 9 and the No Action Alternative is one acre-foot per year.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Potential Impacts Due to Subsidence

The general discussion of subsidence is provided in Section 4.3.3.3.1 for Stages 11 and 12 of the Proposed Action and will not be repeated here. The model shows that for Stage 9 of the Proposed Action, subsidence of up to approximately one foot would occur at a distance of up to four miles southeast of the open pit, and up to approximately four miles south of the open pit (Figure 4.3.32). A subsidence of two feet would extend as far as two miles south of the open pit. The estimated subsidence for Stage 9 of the Proposed Action is somewhat more than that estimated for the No Action Alternative. The most notable differences are that the one-foot subsidence contour extends two miles farther east and the two-foot subsidence contour extends approximately two miles farther south in Stage 9 than in the No Action Alternative.

Potential For Changes to Aquifer Productivity

The greatest potential for permanent deformation would occur in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer. The result would be a slight loss in aquifer interbed storage, but no noticeable loss in aquifer productivity of water supply wells. Thus, the potential impacts to the aquifer due to subsidence under Stage 9 of the Proposed Action, if any, would be very localized and are considered not significant.

Impact 4.3.3.3.3-6: A small change in aquifer characteristics is expected to result from compaction of the aquifer materials. Ground subsidence of up to approximately one foot would occur at a distance of up to four miles southeast of the open pit, and up to approximately four miles south of the open pit (Figure 4.3.32). A subsidence of two feet would extend as far as two miles south of the open pit. The subsidence would result primarily from a permanent reduction in porosity in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer.

Significance of the Impact: The potential for the aquifer to transmit or store water is not expected to be significantly affected. The incremental impact and the cumulative impact are each considered less than significant and no mitigation measures are required.

Potential For Significant Land Surface Alterations

Compaction of sediments that results in subsidence could also result in changes at the land surface. As described fully in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action, potentially damaging fissuring at the ground surface could result from tension cracks induced by differential subsidence. Stage 9 of the Proposed Action is modeled as having somewhat more subsidence than the No Action Alternative. Hence, the potential for fissuring at the ground surface under Stage 9 is somewhat greater than the No Action Alternative. Measures have and are being implemented by CGM to prevent fissure enlargement in the area of the process facilities as described in Section 2.3.2.

Impact 4.3.3.3.3.-7a: Differential subsidence could result in the development of fissures. Capture of surface runoff by the fissures may form erosional fissure gullies, which represent a safety risk to wildlife, livestock and/or people.

Significance of the Impact: The impact would be significant if fissure gullies form.

Mitigation Measure 4.3.3.3.3-7a: A monitoring program, as described in Section 2.3.2.2.10 (CGM 2004), shall be implemented to specifically watch for fissure gully development. If fissure gullies form, they shall be filled in with clean, coarse-grained alluvium in accordance with the fissure monitoring plan. The intent of using coarse-grained (permeable) backfill is to provide a rapid means of dissipation for any surface water entering the fissure.

Impact 4.3.3.3.3-7b: Differential subsidence could result in the opening of fissures creating a potential to degrade waters of the state. Fissures could provide a preferential flow path for uncontained process fluids, leachate, or hydrocarbons. If fissures form in the immediate vicinity of heap leach facilities (including pads, solution ponds, or the plant), or chemical or hydrocarbon storage facilities, the fissures could damage such facilities and result in a release to the environment.

Significance of the Impact: The impact would be significant if fissure gullies formed immediately adjacent to, or beneath engineered Project components that managed process solutions.

Mitigation Measure 4.3.3.3.3-7b: Mitigation of the impact is same as the mitigation measures described for Impact 4.3.3.3.1-7b.

4.3.3.3.4 Stage 10 of the Proposed Action

The potential impacts of the Proposed Action through Stage 10 are described in this section.

Surface Water Resources (Stage 10 of the Proposed Action)

Erosion, Sedimentation, and Flooding within Rerouted Drainages

The nature of the impact is addressed in Section 4.3.3.3.1 of this report on Stages 11 and 12 of the Proposed Action. Therefore, it will not be repeated here.

Impact 4.3.3.3.4-1: Grading, earth moving, diversion of drainages, and placement of fill could accelerate erosion, sedimentation, and alter surface water flood runoff patterns during mining and post-closure.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Effects of Drawdown on Streams and Springs

The nature of the impact is addressed in Section 4.3.3.3.1 on Stages 11 and 12 of the Proposed Action. Therefore, the general nature of the potential impact will not be repeated here.

Figure 4.3.33 graphically shows the results of the numerical ground water flow model expressed as water table drawdown contours at the end of mining under Stage 10 of the Proposed Action. The predicted maximum drawdown (combined basin fill and bedrock) is approximately 1,020 feet at the center of the Pipeline and Crossroads open pits after 14 years of dewatering (under Stage 10 of the Proposed Action). This section investigates the potential for drawdown of the water table in the alluvial aquifer to affect surface water flow in streams and springs.

These ground water modeling results indicate that the ground water level will be drawn down by less than ten feet at all springs at the end of mining. The drawdown in ground water level is likewise expected to be less than ten feet at all of the perennial streams at the end of mining. At the end of mining, the modeled ten-foot drawdown contour would extend approximately five miles to the north, 4.5 miles to the southeast, and 5.5 miles to the east. Drawdown is limited to the northeast and south of the open pits by recharge from infiltration basins.

After dewatering ceases, the ground water level would begin to recover in the open pit area and the ground water mounds in the infiltration areas would dissipate as ground water flows toward the open pit. Drawdown would continue to increase in the Project perimeter areas as the open pit fills with ground water that is derived from storage. Figure 4.3.34 shows the predicted drawdown contours at the time of maximum areal extent of drawdown (ten years after the end of mining) for Stage 10 of the Proposed Action. To the northeast and southwest, the extent of the ten-foot drawdown contour is about two to three miles beyond its location at the end of mining. The drawdown ten years after the end of mining is selected as the most appropriate time to compare the significance of impacts because that is the approximate point in time when the ground water model predicts that the ten-foot drawdown will have reached its maximum lateral extent.

At ten years after the end of mining, modeled drawdown in the basin fill aquifer of ten feet or more would extend to three springs in the East Valley group that issue from the alluvial aquifer. The flow to these springs probably originates from perched zones within alluvial fans that are recharged by flows from the Cortez Mountains. Flows from these springs are not expected to be impacted by pit dewatering. The potentially impacted alluvial springs may be associated with water rights Nos. 38, 39, and 40. The plotted spring locations were mapped in the field, whereas the water rights locations were derived from the NDWR files. Both data sets appear on the figures, but it should be understood that a single spring may be represented by more than one point (its actual location plus one or more associated water rights locations). In addition, three springs in the Toiyabe Catchment area, which are related to bedrock aquifers, are near the area of the alluvial aquifer expected to have ten feet of drawdown. Hence, these three springs (one of which may be associated with water right No. 45) could potentially be impacted. In addition, the stream associated with water rights Nos. 41 and 42 (also in the Toiyabe Catchment area) could also potentially be affected. However, springs which have a source in bedrock (rather than the valley fill alluvium) and streams flowing over shallow bedrock are not expected to show an impact for the reasons provided in Section 4.3.3.3.1 of Stages 12 and 11 of the Proposed Action.

Impact 4.3.3.3.4-2: Mine dewatering could potentially impact three springs which issue from the alluvial aquifer (in the East Valley Group). In addition, three bedrock-sourced springs in the Toiyabe Catchment area are located close enough to be of concern, as is an ephemeral stream (which flows over shallow bedrock) associated with water rights 41 and 42.

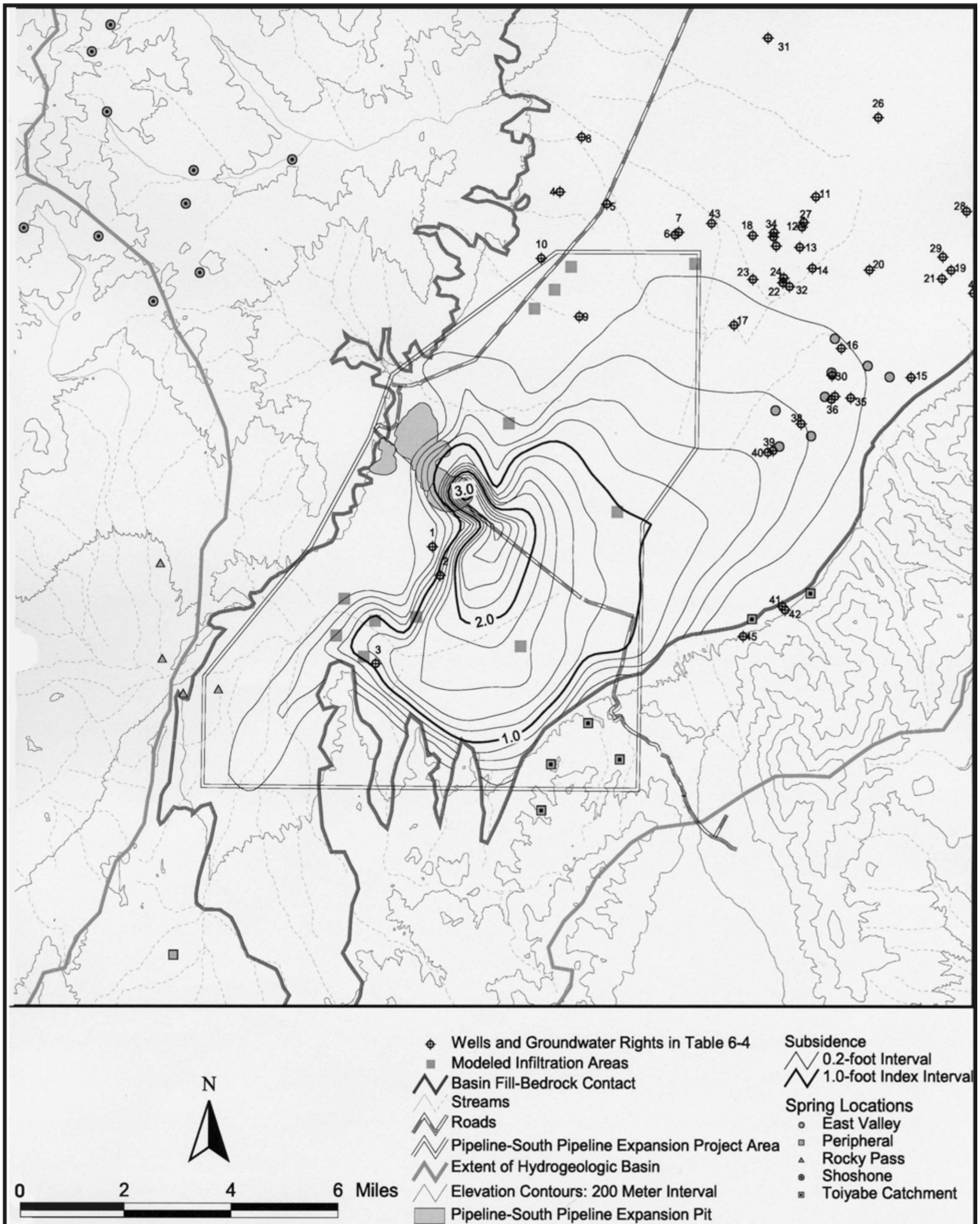

Figure 4.3.32 Simulated Subsidence at the End of Dewatering, Proposed Action Stages 9 and 10

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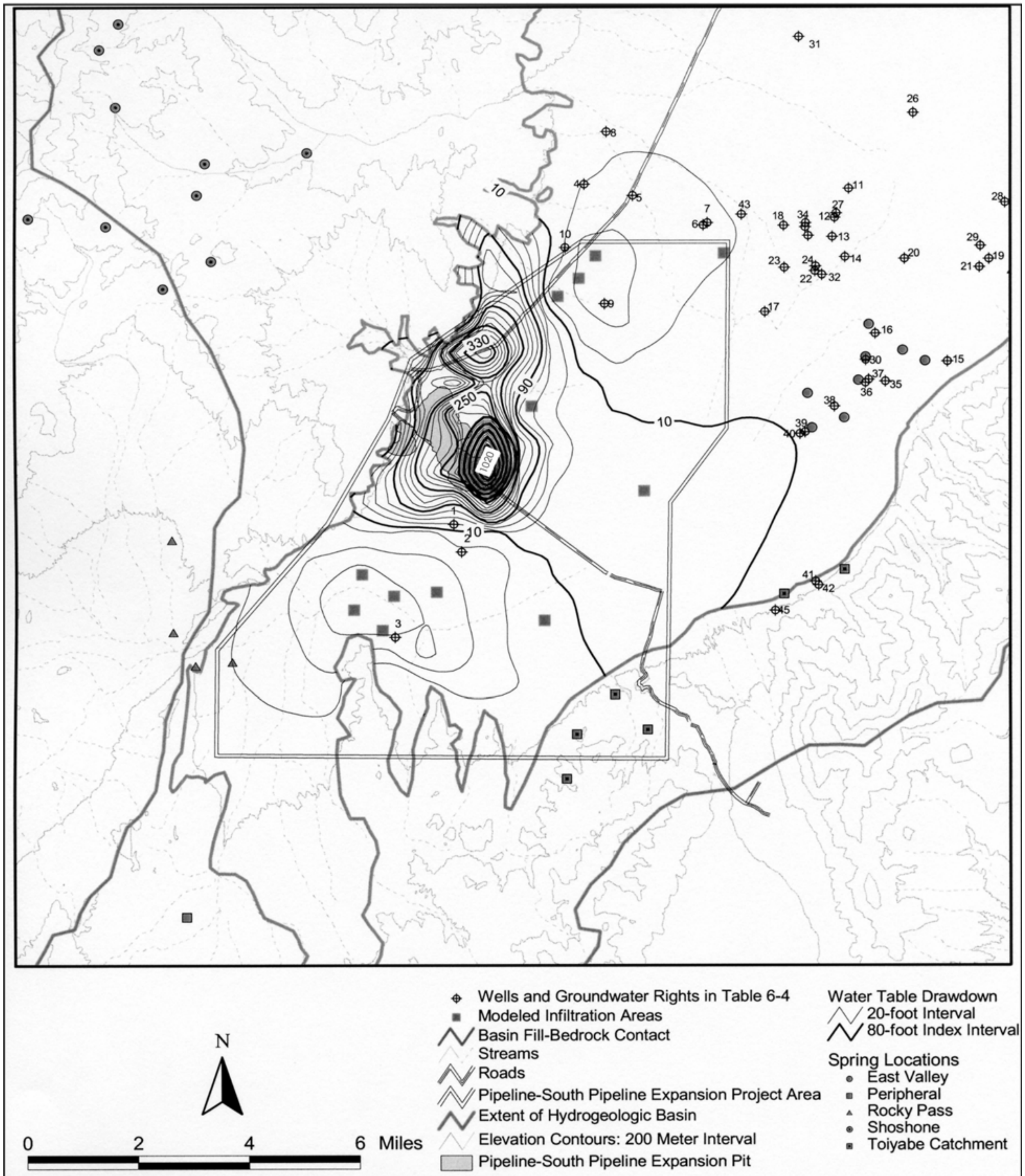

Figure 4.3.33 Water Table in Basin Fill Deposits in Southern Crescent Valley at End of Mining, Proposed Action Stage 10

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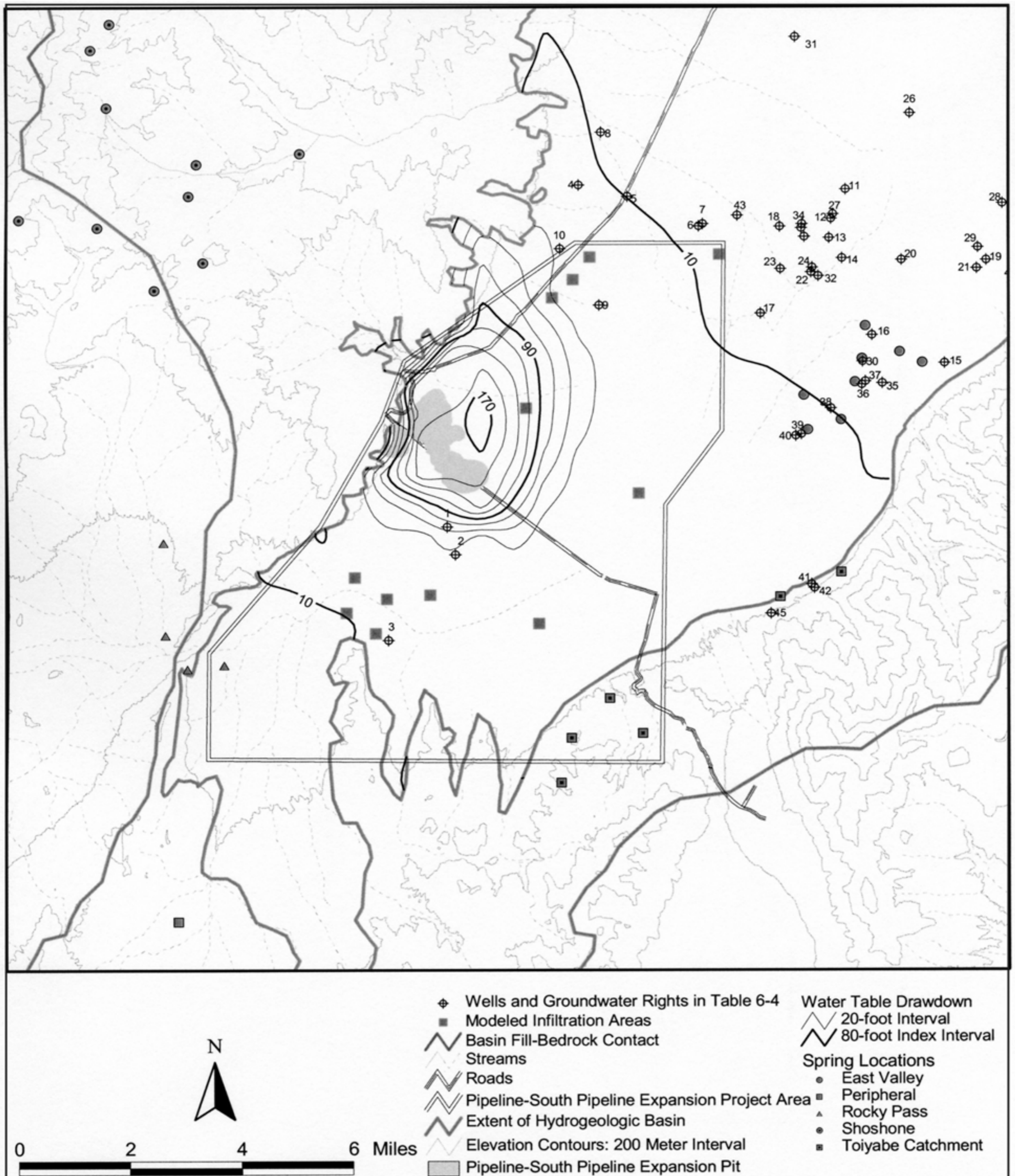

Figure 4.3.34 Water Table Drawdown in Basin Fill Deposits in Southern Crescent Valley at Time of Maximum Drawdown Extent, Proposed Action Stage 10

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Significance of the Impact: The aforementioned three springs which issue from the alluvial aquifer in the East Valley Group may be impacted under Stage 10 of the Proposed Action if mitigation measures do not take place. Such an the impact would be deemed significant if it occurred. In addition, if either of the three aforementioned bedrock-sourced springs in the Toiyabe Catchment or the nearby stream associated with water rights Nos. 41 and 42 substantially decreased, the impact would be deemed potentially significant.

Mitigation Measure 4.3.3.3.4-2a: Mitigation may be required for the three springs in the East Valley Group. Monitoring of flows at streams and the 68 springs in the Project Area shall be performed as dewatering progresses, and if necessary, mitigation shall be performed as described under Mitigation Measure 4.3.3.3.1-2a.

Mitigation Measure 4.3.3.3.4-2b: Under Stage 10 of the Proposed Action, it is possible that some impacts to springs or streams may only occur after the end of mining when the operational measures described under Mitigation Measure 4.3.3.3.1-2a may not be available. If this were to occur, mitigation shall be performed as described under Mitigation Measure 4.3.3.3.1-2b.

Ground Water Resources (Stage 10 of the Proposed Action)

Consumptive Losses

Consumptive losses through evaporation will continue to occur during mine operations from the surfaces of the infiltration basins and seeps associated with the water disposal operations during active dewatering. The evaporative losses due to the infiltration basins are the same as those described under Stages 12 and 11 of the Proposed Action (Section 4.3.3.3.1), except that through Stage 10 of the Proposed Action, the basins would be in use for four fewer years. Evaporative losses during mine operation would not be expected to produce a significant impact.

After mining operations cease and the pit lakes begin to fill, some pit lake water would be consumptively lost due to evaporation. The consumptive losses due to evaporation from the pit lake would increase over time with the increasing pit lake stage and water surface area after mine closure. For Stage 10 of the Proposed Action after 100 years of pit refilling, the net consumptive losses through evaporation from the water surface of the two pit lakes (with a total area of 350 acres) would total approximately 1,185 acre-feet per year (see Table 4.3.3). Through Stage 10 the consumptive losses through evaporation are 162 acre-feet per year more than Stage 12 of the Proposed Action and 119 acre-feet per year less than the No Action Alternative. It should be noted that long-term evaporation losses from the pit lake will be partially balanced in the basin's water budget by a reduction of the natural evapotranspiration from the central area of the valley.

The Crescent Valley Hydrographic Basin is classified as a designated basin by the Nevada State Engineer and the withdrawal and use of ground water is regulated. Evaporative losses may be treated as a consumptive use and accounted as a water right at the discretion of the Nevada State Engineer. The resulting annual volume of water is comparable to the annual water use allowed for a land parcel of equivalent area placed under irrigation. Since CGM holds senior certificated water rights for both agricultural and mining/milling uses in Crescent Valley, replacement of evaporative pit lake loss with a certificated water right would result in no net gain in permitted ground water withdrawal or consumptive use from Crescent Valley. The transfer of these water rights to offset the evaporative losses from the pit lake would render the impacts on water rights insignificant.

Impact 4.3.3.3.4-3: Consumptive use of water by evaporation during mining and delivery of water to the Dean Ranch for irrigation would support a beneficial use and would not be expected to adversely impact water resources; CGM would have adequate water rights to cover the consumptive use. Evaporation of 1,185 acre-feet per year from the two post-mining pit lakes would continue into the foreseeable future after the mine has closed. This is 162 acre-feet per year greater than Stage 12 of the Proposed Action, and 119 acre-feet per year less than the No Action Alternative. Hence, there is a positive impact compared to the No Action Alternative.

Significance of the Impact: Impacts during the active mine life are less than significant. After mining there is a positive impact compared to the No Action Alternative. After mining, direct impacts of evaporation do not result in significant impacts, although the long-term consumptive use of water resources that do not contribute to beneficial use is considered to be a significant impact for which there are no mitigation measures that appear to be feasible. However, there is a positive impact compared to the No Action Alternative.

Lowering of the Water Table Due to Pit Dewatering

A general discussion of water table lowering due to mine dewatering is provided in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action and will not be repeated here. Under Stage 10 of the Proposed Action there is an anticipated maximum annual dewatering pumping rate of 34,500 gpm (55,700 acre-feet/year) occurring during 2007. Stage 10 of the Proposed Action would extend the timeframe of dewatering from ten years (under the No Action Alternative) to 14 years. For comparison, the maximum pumping rate for Stages 11 or 12 of the Proposed Action is also 34,500 gpm. With the exception of up to 10,000 gpm to be used for the mill, evaporation, irrigation, and other consumptive uses, the remaining pumped ground water would be returned to the alluvial aquifer via the infiltration basins to conserve ground water resources.

Figure 4.3.33 shows predicted water table drawdowns in the alluvial aquifer at the end of mining for Stage 10 of the Proposed Action. The maximum drawdown in the Pipeline/South Pipeline/ Crossroads open pit area during mine operation is expected to be approximately 1,020 feet.

The ground water level will begin to recover immediately after active mine dewatering ends. The ground water flow model was used to evaluate water-level recovery for a period of over 100 years after the end of dewatering. The water level in the vicinity of the Pipeline/Crossroads open pits is expected to recover by 65 percent within ten years of the end of dewatering.

<u>*Impacts to Water Rights*</u>

Modeling results indicate potential for impacts to ground water rights holders in the vicinity of the Project Area. Such impacts may involve lowering of ground water levels at wells, springs, or streams. The analysis of drawdown includes modeling for two timeframes: 1) at the end of mine dewatering; and 2) at ten years later than that.

Ground water flow modeling results show that at the end of mining under Stage 10 of the Proposed Action, the ten-foot drawdown contour of the water table in the basin fill aquifer is expected to extend to a distance of approximately five miles to the north, 5.5 miles to the east, and 4.5 miles to the southeast of the center of the open pits (Figure 4.3.33). At the end of mining, one water right, well

No. 1 (BLM windmill), would be affected by more than ten feet of modeled drawdown under Stage 10 of the Proposed Action.

However, for reasons given in Section 4.3.3.3.1 of Stages 11 and 12 of the Proposed Action, the maximum extent of the ten-foot drawdown contour is modeled to occur about ten years after the end of mining (Geomega 2003a). Therefore, the predicted drawdown at ten years after mining (Figure 4.3.34) is an appropriate time to compare impacts between the various alternatives. At ten years after the end of mining, seven wells are modeled as being affected by more than ten feet of drawdown: well No. 1 (BLM windmill), No. 2 (Filippini), No. 3 (Filippini Windmill), No. 4 (a CGM well), No. 5 (a CGM well), No. 9 (Mill Gulch Placer), and No. 10 (USGS monitoring). Well Nos. 1, 2, 9, and 10 are inactive. Well Nos. 3, 4, and 5 are controlled by the applicant. Water right No. 3 (Filippini Windmill) corresponds to a well reported to be 130 feet deep, with a water level at a depth of 102 feet. Although the drawdown from mine dewatering at this well is only expected to be ten feet, the amount of drawdown caused by the well's own pumping is unknown. Hence, impact to water right No. 3 is potentially significant.

In addition, three water rights associated with alluvial springs (numbered 38, 39, and 40) are modeled as having more than ten feet of drawdown. Also, three other water rights in the bedrock area in the Toiyabe Catchment area (stream rights 41 and 42, and spring right 45) are located in bedrock terrain close to the ten foot drawdown in the alluvium and could potentially be impacted. However, springs which have a source in bedrock (rather than the valley-fill alluvium) and streams flowing over shallow bedrock are not expected to show an impact for the reasons provided in Section 4.3.3.3.1. of Stages 11 and 12 of the Proposed Action. In addition, all of the potentially impacted spring and stream water rights are controlled by the applicant. A list of water rights corresponding to the numbered locations shown on Figure 4.3.34 is included on Table 4.3.2.

Impact 4.3.3.3.4-4: Drawdown under Stage 10 of the Proposed Action was predicted to exceed ten feet for 13 water rights, four of which are inactive wells (Nos. 1, 2, 9, and 10), eight of which are controlled by the applicant (Nos. 4, 5, 38, 39, 40, 41, 42, and 45) and one of which is active and controlled by a third party.

Significance of the Impact: Impacts to water rights Nos. 4, 5, 38, 39, 40, 41, 42, and 45 are not deemed significant because they are owned by the applicant. Impacts to the inactive wells are not considered significant until such time as the water rights holder chooses to utilize their valid rights, at which time they would be considered potentially significant. The impact to water right No. 3 is potentially significant because it is controlled by a third party. The impacts would become less than significant after implementation of the mitigation measures described below.

Mitigation Measure 4.3.3.3.4-4a: As part of the comprehensive monitoring program, CGM shall be responsible for monitoring ground water levels between the mine and water supply wells, ground water rights, and surface water rights. Adverse impacts to ground water rights and surface water rights would be mitigated as required by the NDWR. Mitigation could include lowering the pump, deepening an existing well, drilling a new well for water supply wells, or providing a replacement water supply of equivalent yield and general water quality. For surface water rights, mitigation could require providing a replacement water supply of equivalent yield and general water quality.

Mitigation Measure 4.3.3.3.4-4b: For any significant impacts to wells that do not occur until after the end of mining, the operational measures described above may not be available. For the post-mining delayed impacts of drawdown, the ground water flow model shall be updated during the final year of dewatering using actual field data for pumping rates, infiltration rates and locations, consumptive use, and observed drawdown to reevaluate drawdown predictions that would occur after the end of mining. Active water rights not owned by the applicant that are indicated to be significantly affected shall then be mitigated by one or more of the following measures, subject to approval of the BLM and NDWR:

- Replacement or purchase of the affected water right by the applicant.
- Installation of a deeper well and pump at affected locations to restore the historical yield of the well.
- Posting of an additional bond to provide for potential future impacts to potentially affected water supplies.

Ground Water Flow to Humboldt River

The general situation with the Humboldt River is described in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action. Stage 10 of the Proposed Action shows a decrease of approximately nine acre-feet per year decrease relative to the baseline ground water budget (Table 4.3.1) in the Crescent Valley Basin's ground water contribution to the Humboldt River ten years after the end of mine operations (the time of maximum impact for this particular case) (see Table 4.3.3). The decrease is estimated to be the same as for Stages 11 and 12 of the Proposed Action, as well the No Action Alternative. The relatively small changes in predicted flow to the Humboldt River would be undetectable within the context of natural variability in recharge, evapotranspiration, and ground water flow to the Humboldt River. The predicted reduction in ground water flow to the Humboldt River (nine acre-feet per year for either Stage 10 of the Proposed Action or the No Action Alternative) represents less than one tenth of one percent of the 1992 measurements of baseflow and diversions of the Humboldt River at Beowawe. The small magnitude of predicted impact to the flow of the Humboldt River is a result of the buffering effect of evapotranspiration in the central part of Crescent Valley and indicates that Stage 10 of the Proposed Action would not result in significant direct or cumulative impacts on the Humboldt River.

Impact 4.3.3.3.4-5: There is no impact compared to the No Action Alternative. Ground water flow modeling indicates that a very slight reduction of ground water flow (nine acre-feet per year) from Crescent Valley to the Humboldt River would occur compared to pre-mining conditions.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Potential Impacts Due to Subsidence

The general discussion of subsidence is provided in Section 4.3.3.3.1 for Stages 11 and 12 of the Proposed Action and will not be repeated here. The model shows that for Stage 10 of the Proposed Action subsidence of up to approximately one foot would occur at a distance of up to four miles southeast of the open pit, and up to approximately four miles south of the open pit (Figure 4.3.32). A subsidence of two feet would extend as far as two miles south of the open pit. The estimated subsidence for Stage 10 of the Proposed Action is somewhat more than that estimated for the No Action Alternative. The most notable differences are that the one-foot subsidence contour extends two miles farther east and the two-foot subsidence contour extends approximately two miles farther south in Stage 10 than in the No Action Alternative.

Potential For Changes to Aquifer Productivity

The greatest potential for permanent deformation would occur in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer. The result would be a slight loss in aquifer interbed storage, but no noticeable loss in aquifer productivity of water supply wells. Thus, the potential impacts to the aquifer due to subsidence under Stage 10 of the Proposed Action, if any, would be very localized and are considered not significant.

Impact 4.3.3.3.4-6: A small change in aquifer characteristics is expected to result from compaction of the aquifer materials. Ground subsidence of up to approximately one foot would occur at a distance of up to four miles southeast of the open pit, and up to approximately four miles south of the open pit (Figure 4.3.32). A subsidence of two feet would extend as far as two miles south of the open pit. The subsidence would result primarily from a permanent reduction in porosity in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer.

Significance of the Impact: The potential for the aquifer to transmit or store water is not expected to be affected. The incremental impact and the cumulative impact are each considered less than significant and no mitigation measures are required.

Potential For Significant Land Surface Alterations

Compaction of sediments that results in subsidence could also result in changes at the land surface. As described fully in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action, potentially damaging fissuring at the ground surface could result from tension cracks induced by differential subsidence. Stage 10 of the Proposed Action is modeled as having somewhat more subsidence than the No Action Alternative. Hence, the potential for fissuring at the ground surface under Stage 10 is somewhat greater than the No Action Alternative. Measures have and are being implemented by CGM to prevent fissure enlargement in the area of the process facilities as described in Section 2.3.2.

Impact 4.3.3.3.4-7a: Differential subsidence could result in the development of fissures. Capture of surface runoff by the fissures may form erosional fissure gullies, which represent a safety risk to wildlife, livestock, and/or people.

Significance of the Impact: The impact would be significant if fissure gullies form.

Mitigation Measure 4.3.3.3.4-7a: A monitoring program, as described in Section 2.3.2.2.10 (CGM 2004), shall be implemented to specifically watch for fissure gully development. If fissure gullies form, they shall be filled in with clean, coarse-grained alluvium in accordance with the fissure monitoring plan. The intent of using coarse-grained (permeable) backfill is to provide a rapid means of dissipation for any surface water entering the fissure.

Impact 4.3.3.3.4-7b: Differential subsidence could result in the opening of fissures creating a potential to degrade waters of the state. Fissures could provide a preferential flow path for uncontained process fluids, leachate, or hydrocarbons. If fissures form in the immediate vicinity of heap leach facilities (including pads, solution ponds, or the plant), or chemical or hydrocarbon storage facilities, the fissures could damage such facilities and result in a release to the environment.

Significance of the Impact: The impact would be significant if fissure gullies formed immediately adjacent to, or beneath engineered Project components that managed process solutions.

Mitigation Measure 4.3.3.3.4-7b: Mitigation of the impact is the same as the mitigation measures described for Impact 4.3.3.3.1-7b.

4.3.3.4 No Backfill Alternative

The potential impacts to water quantity of the No Backfill Alternative are described in this section.

4.3.3.4.1 Surface Water Resources (No Backfill Alternative)

Erosion, Sedimentation, and Flooding Within Rerouted Drainages

The nature of the impact is addressed in Section 4.3.3.3.1 of this report on Stages 11 and 12 of the Proposed Action. Therefore, it will not be repeated here.

Impact 4.3.3.4-1: Grading, earth moving, diversion of drainages, and placement of fill could accelerate erosion, sedimentation, and alter surface water flood runoff patterns during mining and post-closure.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Effects of Drawdown on Streams and Springs

The nature of the impact is addressed in Section 4.3.3.3.1 of this report on Stages 11 and 12 of the Proposed Action. Therefore, the general nature of the potential impact will not be repeated here.

Figure 4.3.35 shows the modeled configuration of the water table at the time of maximum drawdown, ten year after the end of mining under the No Backfill Alternative. This figure shows that significant changes to ground water gradients are mainly limited to the alluvial aquifer in the southern one-third of the basin.

The drawdown at the end of mining is the same for the No Backfill Alternative as for the Proposed Action Stages 11 and 12. The predicted maximum drawdown (combined basin fill and bedrock) is approximately 1,400 feet at the center of the Crossroads open pit after 18 years of dewatering (under the No Backfill Alternative). This section investigates the potential for drawdown of the water table in the alluvial aquifer to affect surface water flow in streams and springs.

These ground water modeling results indicate that at the end of mining the ground water level will be drawn down by greater than ten feet at three springs in the East Valley Group. The flow to these springs probably originates from perched zones within alluvial fans that are recharged by flows from the Cortez Mountains. For this reason, flows from these springs are not expected to be impacted by pit dewatering, but there is a potential for impact. Two of the potentially affected East Valley springs appear to be associated with water rights Nos. 38, 39, and 40. The plotted spring locations were mapped in the field, whereas the water rights locations were derived from NDWR files. Both data sets appear on the figures, but it should be understood that a single spring may be represented by more than one point (its actual location plus one or more associated water rights locations). The drawdown in ground water level is expected to be less than ten feet at all of the perennial streams at the end of mining. At the end of mining, the modeled ten-foot drawdown contour would extend approximately five miles to the north, 4.5 miles to the southeast, and seven miles to the east. Drawdown is limited to the northeast and south of the open pits by recharge from infiltration basins.

After dewatering ceases, the ground water level would begin to recover in the open pit area and the ground water mounds in the infiltration areas would dissipate as ground water flows toward the open pit. Drawdown would continue to increase in the Project perimeter areas as the open pit fills with ground water that is derived from storage. Figure 4.3.35 shows the predicted drawdown contours at the time of maximum areal extent of drawdown (ten years after the end of mining) for the No Backfill Alternative. To the northeast and southwest, the extent of the ten-foot drawdown contour is from one to four miles beyond its location at the end of mining. The drawdown ten years after the end of mining is selected as the most appropriate time to compare the significance of impacts because that is the approximate point in time when the ground water model predicts that the ten-foot drawdown will have reached its maximum lateral extent. At ten years after the end of mining, modeled drawdown in the basin fill aquifer of ten feet or more would extend to four springs in the East Valley group that issue from the alluvial aquifer. The flow to these springs probably originates from perched zones within alluvial fans that are recharged by flows from the Cortez Mountains. For this reason, flows from these springs are not expected to be impacted by pit dewatering, but have some potential for impact. The potentially impacted alluvial springs may include the springs associated with water rights Nos. 35, 36, 37, 38, 39, and 40. The plotted spring locations were mapped in the field, whereas the water rights locations were derived from NDWR files. Both data sets appear on the figures, but it should be understood that a single spring may be represented by more than one point (its actual location plus one or more associated water rights locations). In addition, four springs in the Toiyabe Catchment area, which are related to bedrock aquifers, are near the area of the alluvial aquifer expected to have ten feet of drawdown. Hence, these four springs (including the spring associated with water right 45) could potentially be impacted. In addition, the stream associated with water rights 41 and 42 (also in the Toiyabe Catchment area) could also potentially be affected. However, springs which have a source in bedrock (rather than the valley-fill alluvium) and streams flowing over shallow bedrock are not expected to show an impact for the reasons provided in Section 4.3.3.3.1 of Stages 11 and 12 of the Proposed Action.

Impact 4.3.3.4-2: Mine dewatering could potentially impact four springs which issue from the alluvial aquifer (in the East Valley Group). In addition, four bedrock-sourced springs in the Toiyabe Catchment area are located close enough to be of concern. In addition, an ephemeral stream (which flows over shallow bedrock) associated with water rights Nos. 41 and 42 is also located close enough to be of concern.

Significance of the Impact: The aforementioned four springs, which issue from the alluvial aquifer in the East Valley Group, may be impacted under the No Backfill Alternative if mitigation measures do not take place. If this occurs, the impact would be deemed significant. In addition, if any of the four bedrock-sourced springs in the Toiyabe Catchment, or the nearby stream associated with water right Nos. 41 and 42 substantially decreased in flow, the impact would be deemed potentially significant.

Mitigation Measure 4.3.3.4-2a: Mitigation may be required for the four springs in the East Valley Group. Monitoring of flows at streams and the 68 springs in the southern portion of Crescent Valley shall be performed as dewatering progresses, and, if necessary, mitigation would be performed as described under Mitigation Measure 4.3.3.3.1-2a.

Mitigation Measure 4.3.3.4-2b: Under the No Backfill Alternative it is possible that some impacts to springs or streams may only occur after the end of mining when the operational measures described under Mitigation Measure 4.3.3.3.1-2a may not be available. If this were to occur, mitigation shall be performed as described under Mitigation Measure 4.3.3.3.1-2b.

4.3.3.4.2 Ground Water Resources (No Backfill Alternative)

Consumptive Losses

Consumptive losses through evaporation will continue to occur during mine operations from the surfaces of the infiltration basins and seeps associated with the water disposal operations during active dewatering. The evaporative losses due to the infiltration basins are the same as those described under Stages 11 and 12 of the Proposed Action (Section 4.3.3.3.1). Evaporative losses during mine operation would not be expected to produce a significant impact.

After mining operations cease and the pit lake begins to fill, some pit lake water would be consumptively lost due to evaporation. The consumptive losses due to evaporation from the pit lake would increase over time with the increasing pit lake stage and water surface area after mine closure. For the No Backfill Alternative after 100 years of pit refilling, the net consumptive losses through evaporation from the water surface of the two pit lakes (having areas of 716 and 33 acres) would total approximately 2,537 acre-feet per year (see Table 4.3.3). Under the No Backfill Alternative, the consumptive losses through evaporation are 1,514 acre-feet per year more than Stage 12 of the Proposed Action and 1,233 acre-feet per year more than the No Action Alternative. It should be noted that long-term evaporation losses from the pit lake will be partially balanced in the basin's water budget by a reduction of the natural evapotranspiration from the central area of the valley.

The Crescent Valley Hydrographic Basin is classified as a designated basin by the Nevada State Engineer and the withdrawal and use of ground water is regulated. Evaporative losses may be treated as a consumptive use and accounted as a water right at the discretion of the Nevada State Engineer. The resulting annual volume of water is comparable to the annual water use allowed for a land parcel of equivalent area placed under irrigation. Since CGM holds senior certificated water rights for both agricultural and mining/milling uses in Crescent Valley, replacement of evaporative pit lake loss with a certificated water right would result in no net gain in permitted ground water withdrawal or consumptive use from Crescent Valley. The transfer of these water rights to offset the evaporative losses from the pit lake would render the impacts on water rights insignificant.

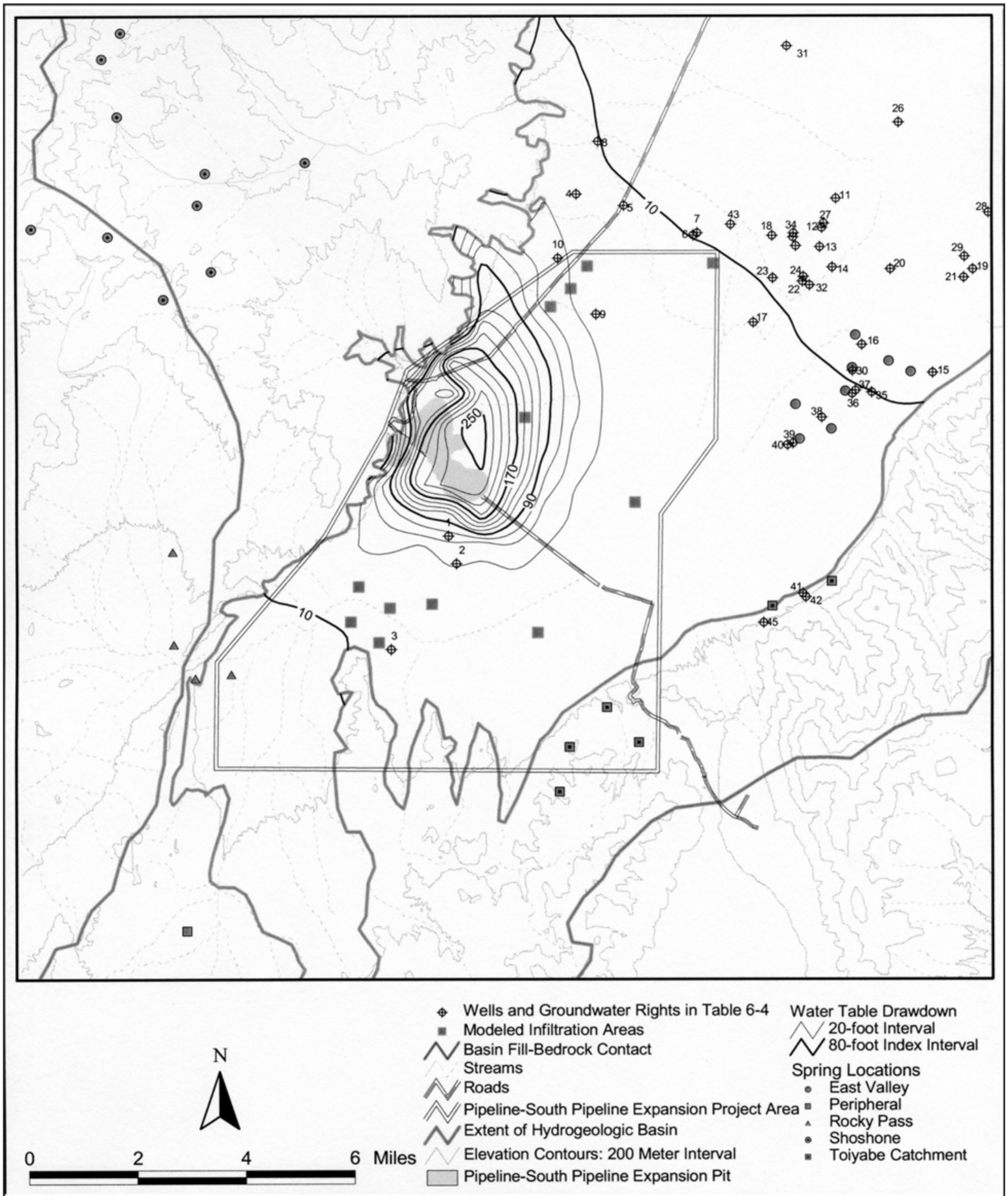

Figure 4.3.35 Water Table Drawdown in Basin Fill Deposits in Southern Crescent Valley at Time of Maximum Drawdown Extent, No Backfill Alternative

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Impact 4.3.3.4-3: Consumptive use of water by evaporation during mining and delivery of water to the Dean Ranch for irrigation would support a beneficial use and would not be expected to adversely impact water resources; CGM would have adequate water rights to cover the consumptive use. Evaporation of 2,537 acre-feet per year from the post-mining pit lake would continue into the foreseeable future after the mine has closed. This is 1,514 acre-feet per year more than Stage 12 of the Proposed Action, and 1,233 acre-feet per year more than the No Action Alternative.

Significance of the Impact: Impacts during the active mine life are less than significant. After mining, direct impacts of evaporation do not result in significant impacts, although the long-term consumptive use of water resources that do not contribute to beneficial use is considered to be a significant impact for which there are no mitigation measures that appear to be feasible.

<u>Lowering of the Water Table Due to Pit Dewatering</u>

A general discussion of water table lowering due to mine dewatering is provided in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action and will not be repeated here. Under the No Backfill Alternative there is an anticipated maximum annual dewatering pumping rate of 34,500 gpm (55,700 acre-feet/year) starting during 2007 and continuing through 2013. The No Backfill Alternative would extend the timeframe of dewatering from ten years (under the No Action Alternative) to 18 years. For comparison, the maximum pumping rate for Stages 11 or 12 of the Proposed Action is also 34,500 gpm. With the exception of up to 10,000 gpm to be used for the mill, evaporation, irrigation, and other consumptive uses, the remaining pumped ground water would be returned to the alluvial aquifer via the infiltration basins to conserve ground water resources.

Figure 4.3.35 shows predicted water table drawdowns in the alluvial aquifer at the maximum extent of drawdown, ten years after the end of mining for the No Backfill Alternative. The water table drawdowns at the end of mining are the same for this alternative as for Stage 12 of the Proposed Action. The maximum drawdown in the Pipeline/Crossroads open pit area during mine operation is expected to be approximately 1,400 feet.

The ground water level will begin to recover immediately after active mine dewatering ends. The ground water flow model was used to evaluate water level recovery for a period of over 100 years after the end of dewatering. The water level in the vicinity of the Crossroads open pit is expected to recover by more than 70 percent within ten years of the end of dewatering.

Impacts to Water Rights

Modeling results indicate potential for impacts to ground water rights holders in the vicinity of the Project Area. Such impacts may involve lowering of ground water levels at wells, springs, or streams. The analysis of drawdown includes modeling for two timeframes: 1) at the end of mine dewatering; and 2) ten years later than the end of dewatering.

Ground water flow modeling results show that at the maximum extent of drawdown, ten years after the end of mining under the No Backfill Alternative the ten-foot drawdown contour of the water table in the basin fill aquifer is expected to extend to a distance of approximately five miles to the north, seven miles to the east, and 4.5 miles to the southeast of the center of the open pits (Figure 4.3.35). At the end of mining, four water rights, well No. 1 (BLM windmill), and water rights which appear to be associated with three springs in the East Valley Group (numbered 38, 39, and 40) would be affected by more than ten feet of modeled drawdown under the No Backfill Alternative.

However, for reasons given in Section 4.3.3.3.1 of Stages 11 and 12 of the Proposed Action, the maximum extent of the ten-foot drawdown contour is modeled to occur about ten years after the end of mining (Geomega 2003a). Therefore, the predicted drawdown at ten years after mining (Figure 4.3.35) is an appropriate time to compare impacts between the various alternatives. At ten years after the end of mining, nine wells are modeled as being affected by more than ten feet of drawdown: well No. 1 (BLM windmill), No. 2 (Filippini), No. 3 (Filippini), No. 4 (CGM), No. 5 (CGM), No. 6 (CGM), No. 8 (Little Gem Mining), No. 9 (Mill Gulch Placer), and No. 10 (USGS monitoring). Well Nos. 1, 2, 8, 9, and 10 are inactive. Water right No. 3 (Filippini Windmill) corresponds to a well reported to be 130 feet deep, with a water level at a depth of 102 feet. Although the drawdown from mine dewatering at this well is only expected to be ten feet, the amount of drawdown caused by the well's own pumping is unknown. Hence, impact to water right No. 3 is potentially significant.

In addition, three water rights associated with alluvial springs (numbered 38, 39, and 40) are modeled as having more than ten feet of drawdown. Also, three other water rights in the bedrock area in the Toiyabe Catchment area (stream rights 41 and 42, and spring right 45) are located in bedrock terrain close to the ten-foot drawdown in the alluvium and could potentially be impacted. However, springs that have a source in bedrock (rather than the valley-fill alluvium) and streams flowing over shallow bedrock are not expected to show an impact for the reasons provided in Section 4.3.3.3.1 of Stages 11 and 12 of the Proposed Action. In addition, all of the potentially impacted spring and stream water rights are controlled by the applicant. A list of water rights corresponding to the numbered locations shown on Figure 4.3.35 is included on Table 4.3.2.

Impact 4.3.3.4-4: Drawdown under the No Backfill Alternative was predicted to exceed ten feet for 16 water rights, five of which are inactive wells (Nos. 1, 2, 8, 9, and 10), and ten of which are controlled by the applicant (Nos. 4, 5, 6, 36, 38, 39, 40, 41, 42, and 45). Only one active well not controlled by the applicant appears to have the potential to be impacted (No. 3 Filippini).

Significance of the Impact: Impacts to water rights Nos. 4, 5, 6, 36, 38, 39, 40, 41, 42, and 45 are not deemed significant because they are controlled by the applicant. Impacts to the inactive wells are not considered significant until such time as the water rights holder chooses to utilize their valid rights, at which time they would be considered potentially significant. The impact to water rights No. 3 (Filippini) is potentially significant. The impacts would become less than significant after implementation of the mitigation measures described below.

Mitigation Measure 4.3.3.4-4a: As part of the comprehensive monitoring program, CGM would be responsible for monitoring ground water levels between the mine and water supply wells, ground water rights, and surface water rights. Adverse impacts to ground water rights and surface water rights would be mitigated as required by the NDWR. Mitigation of impacts to ground water rights could include lowering the pump, deepening an existing well, drilling a new well for water supply wells, or providing a replacement water supply of equivalent yield and general water quality. For surface water rights, mitigation could require providing a replacement water supply of equivalent yield and general water quality.

Mitigation Measure 4.3.3.4-4b: For any significant impacts to wells that do not occur until after the end of mining, the operational measures described above may not be available. For the post-mining delayed impacts of drawdown, the ground water flow model shall be updated during the final year of dewatering using actual field data for pumping rates, infiltration rates and locations, consumptive use, and observed drawdown to reevaluate drawdown predictions that would occur after the end of mining. Active water rights not owned by the applicant that are indicated to be significantly affected shall then be mitigated by one or more of the following measures, subject to approval of the BLM and NDWR:

- Replacement or purchase of the affected water right by the applicant.
- Installation of a deeper well and pump at affected locations to restore the historical yield of the well.
- Posting of an additional bond to provide for potential future impacts to potentially affected water supplies.

Ground Water Flow to Humboldt River

The general situation with the Humboldt River is described in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action. The No Backfill Alternative shows a decrease of approximately nine acre-feet per year change from the baseline ground water budget (Table 4.3.1) in the Crescent Valley Basin's ground water contribution to the Humboldt River at ten years after the end of mine operations (se Table 4.3.3). The decrease is estimated to be the same as for the Stages 11 and 12 of the Proposed Action, as well the No Action Alternative. The relatively small changes in predicted flow to the Humboldt River would be undetectable within the context of natural variability in recharge, evapotranspiration, and ground water flow to the river. The predicted reduction in ground water flow to the river (nine acre-feet per year for either the No Backfill Alternative or the No Action Alternative) represents less than one tenth of one percent of the 1992 measurements of baseflow and diversions of the Humboldt River at Beowawe. The small magnitude of predicted impact to the flow of the river is a result of the buffering effect of evapotranspiration in the central part of Crescent Valley and indicates that the No Backfill Alternative would not result in significant direct or cumulative impacts on the river.

Impact 4.3.3.4-5: Ground water flow modeling indicates that a very slight reduction of ground water flow (nine acre-feet per year) from Crescent Valley to the Humboldt River would occur.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Potential Impacts Due to Subsidence

The general discussion of subsidence is provided in Section 4.3.3.3.1 for Stages 11 and 12 of the Proposed Action and will not be repeated here. For the No Backfill Alternative, subsidence would be approximately the same as for Stages 11 or 12 of the Proposed Action (which share the same dewatering schedule). Under the No Backfill Alternative (same as Stage 12 of the Proposed Action), subsidence of up to approximately one foot would occur at a distance of up to five miles east, southeast, and south of the open pit (Figure 4.3.25). A subsidence of two feet would extend as far as four miles south of the open pit and three miles southeast of the open pit. The estimated subsidence for the No Backfill Alternative is approximately double the amount estimated for the No Action Alternative.

Potential For Changes to Aquifer Productivity

The greatest potential for permanent deformation would occur in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer. The result would be a slight loss in aquifer interbed storage, but no noticeable loss in aquifer productivity of water supply wells. Thus, the potential impacts to the aquifer due to subsidence under the No Backfill Alternative, if any, would be very localized and are considered not significant.

Impact 4.3.3.4-6: A small change in aquifer characteristics is expected to result from compaction of the aquifer materials. The compaction would result primarily from a permanent reduction in porosity in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer.

Significance of the Impact: The potential for the aquifer to transmit or store water is not expected to be measurably affected. The incremental impact and the cumulative impact are each considered less than significant and no mitigation measures are required.

Potential For Significant Land Surface Alterations

Compaction of sediments that results in subsidence could also result in changes at the land surface. As described fully in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action, potentially damaging fissuring at the ground surface could result from tension cracks induced by differential subsidence. The No Backfill Alternative is modeled as having the same subsidence as Stage 12 of the Proposed Action, and approximately double the subsidence of the No Action Alternative. Measures have and are being implemented by CGM to prevent fissure enlargement in the area of the process facilities as described in Section 2.3.2.

Impact 4.3.3.4-7a: Differential subsidence could result in the development of fissures. Capture of surface runoff by the fissures may form erosional fissure gullies, which represent a safety risk to wildlife, livestock and/or people.

Significance of the Impact: The impact would be significant if fissure gullies form.

Mitigation Measure 4.3.3.4-7a: A monitoring program, as described in Section 2.3.2.2.10 (CGM 2004), shall be implemented to specifically watch for fissure gully development. If fissure gullies form, they shall be filled in with clean, coarse-grained alluvium in accordance with the fissure monitoring plan. The intent of using coarse-grained (permeable) backfill is to provide a rapid means of dissipation for any surface water entering the fissure.

Impact 4.3.3.4-7b: Differential subsidence could result in the opening of fissures creating a potential to degrade waters of the state. Fissures could provide a preferential flow path for uncontained process fluids, leachate, or hydrocarbons. If fissures form in the immediate vicinity of heap leach facilities (including pads, solution ponds, or the plant), or chemical or hydrocarbon storage facilities, the fissures could damage such facilities and result in a release to the environment.

Significance Measure 4.3.3.4-7b: The impact would be significant if fissure gullies formed immediately adjacent to, or beneath engineered Project components that managed process solutions.

Mitigation of the Impact: Mitigation of the impact is the same as the mitigation measures described for Impact 4.3.3.3.1-7b.

4.3.3.5 Complete Backfill Alternative

The potential impacts to water quantity of the Complete Backfill Alternative are described in this section.

4.3.3.5.1 Surface Water Resources (Complete Backfill Alternative)

Erosion, Sedimentation, and Flooding Within Rerouted Drainages

The nature of the impact is addressed in Section 4.3.3.3.1 of this report on Stages 11 and 12 of the Proposed Action. Therefore, it will not be repeated here.

Impact 4.3.3.5-1: Grading, earth moving, diversion of drainages, and placement of fill could accelerate erosion, sedimentation, and alter surface water flood runoff patterns during mining and post-closure.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Effects of Drawdown on Streams and Springs

The nature of the impact is addressed in Section 4.3.3.3.1 of this report on Stages 11 and 12 of the Proposed Action. Therefore, the general nature of the potential impact will not be repeated here.

Figure 4.3.36 shows the modeled configuration of the water table at the maximum extent of drawdown, ten years after the end of mining under the Complete Backfill Alternative. This figure shows that significant changes to ground water gradients are mainly limited to the alluvial aquifer in the southern one-third of the basin.

The drawdown at the end of mining is the same for the Complete Backfill Alternative as for the Proposed Action Stages 11 and 12. The predicted maximum drawdown (combined basin fill and bedrock) is approximately 1,400 feet at the center of the Crossroads open pit after 18 years of dewatering (under the Complete Backfill Alternative). This section investigates the potential for drawdown of the water table in the alluvial aquifer to affect surface water flow in streams and springs.

These ground water modeling results indicate that at the end of mining the ground water level will be drawn down by greater than ten feet at three springs in the East Valley Group. The flow to these springs probably originates from perched zones within alluvial fans that are recharged by flows from the Cortez Mountains. For this reason, flows from these springs are not expected to be impacted by pit dewatering, but there is a potential for impact. Two of the potentially affected East Valley springs appear to be associated with water rights Nos. 38, 39, and 40. The plotted spring locations were mapped in the field, whereas the water rights locations were derived from NDWR files. Both data sets appear on the figures, but it should be understood that a single spring may be represented by more than one point (its actual location plus one or more associated water rights locations). The drawdown in ground water level is expected to be less than ten feet at all of the perennial streams at the end of mining. At the end of mining, the modeled ten-foot drawdown contour would extend approximately five miles to the north, 4.5 miles to the southeast, and seven miles to the east. Drawdown is limited to the northeast and south of the open pits by recharge from infiltration basins.

After dewatering ceases, the ground water level would begin to recover in the open pit area, and the ground water mounds in the infiltration areas would dissipate as ground water flows toward the open pit. Drawdown would continue to increase in the Project perimeter areas as the open pit fills with ground water that is derived from storage. Figure 4.3.36 shows the predicted drawdown contours at the time of maximum areal extent of drawdown (ten years after the end of mining) for the Complete Backfill Alternative. To the northeast and southwest, the extent of the ten-foot drawdown contour is from one to three miles beyond its location at the end of mining. The drawdown ten years after the end of mining is selected as the most appropriate time to compare the significance of impacts because that is the approximate point in time when the ground water model predicts that the ten-foot drawdown will have reached its maximum lateral extent. At ten years after the end of mining, modeled drawdown in the basin fill aquifer of ten feet or more would extend to four springs in the East Valley group that issue from the alluvial aquifer. Some of the potentially impacted alluvial springs may be associated with water rights Nos. 38, 39, and 40. In addition, three springs in the Toiyabe Catchment area, which are related to bedrock aquifers, are near the area of the alluvial aquifer expected to have ten feet of drawdown. Hence, these three springs (one of which appears to be associated with water right 45) could potentially be impacted. In addition, the stream associated with water rights 41 and 42 (also in the Toiyabe Catchment area) could also potentially be affected. However, springs which have a source in bedrock (rather than the valley-fill alluvium) and streams flowing over shallow bedrock are not expected to show an impact for the reasons provided in Section 4.3.3.3.1 of Stages 11 and 12 of the Proposed Action.

Impact 4.3.3.5-2: Mine dewatering could potentially impact four springs which issue from the alluvial aquifer (in the East Valley Group). In addition, three bedrock-sourced springs in the Toiyabe Catchment area are located close enough to be of concern. In addition, an ephemeral stream (which flows over shallow bedrock) associated with water rights Nos. 41 and 42 is also located close enough to be of concern.

Significance of the Impact: The aforementioned four springs which issue from the alluvial aquifer in the East Valley Group may be impacted under the Complete Backfill Alternative if mitigation measures do not take place. If this occurs, the impact would be deemed potentially significant. In addition, if any of the three aforementioned bedrock-sourced springs in the Toiyabe Catchment, or the nearby stream associated with water rights Nos. 41 and 42, substantially decreased their flow, the impact would be deemed potentially significant.

Mitigation Measure 4.3.3.5-2a: Mitigation may be required for the four springs in the East Valley Group. Monitoring of flows at streams and the 68 springs in the southern portion of Crescent Valley

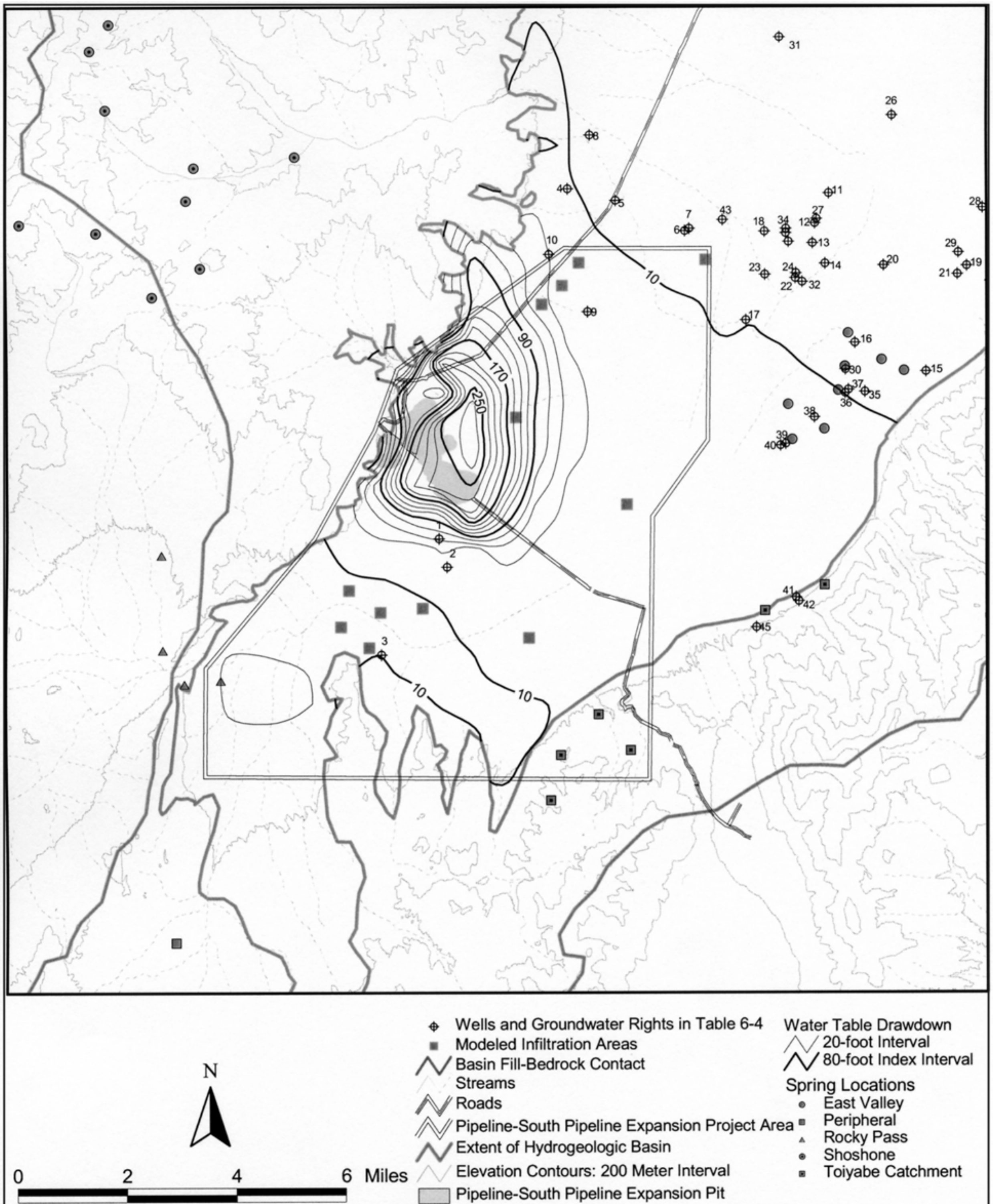

Figure 4.3.36 Water Table Drawdown in Basin Fill Deposits in Southern Crescent Valley at Time of Maximum Drawdown Extent, Complete Backfill Alternative

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shall be performed as dewatering progresses, and if necessary, mitigation would be performed as described under Mitigation Measure 4.3.3.3.1-2a.

Mitigation Measure 4.3.3.5-2b: Under the Complete Backfill Alternative it is possible that some impacts to springs or streams may only occur after the end of mining, when the operational measures described under Mitigation Measure 4.3.3.3.1-2a may not be available. If this were to occur, mitigation shall be performed as described under Mitigation Measure 4.3.3.3.1-2b.

4.3.3.5.2 Ground Water Resources (Complete Backfill Alternative)

Consumptive Losses

Consumptive losses through evaporation would continue to occur during mine operations from the surfaces of the infiltration basins and seeps associated with the water disposal operations during active dewatering. The evaporative losses due to the infiltration basins are the same as those described under Stages 11 and 12 of the Proposed Action (Section 4.3.3.3.1). Evaporative losses during mine operation would not be expected to produce a significant impact.

After mining operations cease and the pit lake begins to fill, some pit lake water would be consumptively lost due to evaporation. The consumptive losses due to evaporation from the pit lake would increase over time with the increasing pit lake stage and water surface area after mine closure. For the Complete Backfill Alternative after 100 years of pit refilling, the net consumptive losses through evaporation from the water surface of the single 269-acre pit lake would total approximately 911 acre-feet per year (see Table 4.3.3). Under the Complete Backfill Alternative, the consumptive losses through evaporation are 112 acre-feet per year less than Stage 12 of the Proposed Action and 393 acre-feet per year less than the No Action Alternative. It should be noted that long-term evaporation losses from the pit lake will be partially balanced in the basin's water budget by a reduction of the natural evapotranspiration from the central area of the valley.

The Crescent Valley Hydrographic Basin is classified as a designated basin by the Nevada State Engineer and the withdrawal and use of ground water is regulated. Evaporative losses may be treated as a consumptive use and accounted as a water right at the discretion of the Nevada State Engineer. The resulting annual volume of water is comparable to the annual water use allowed for a land parcel of equivalent area placed under irrigation. Since CGM holds senior certificated water rights for both agricultural and mining/milling uses in Crescent Valley, replacement of evaporative pit lake loss with a certificated water right would result in no net gain in permitted ground water withdrawal or consumptive use from Crescent Valley. The transfer of these water rights to offset the evaporative losses from the pit lake would render the impacts on water rights insignificant.

Impact 4.3.3.5-3: Consumptive use of water by evaporation during mining and delivery of water to the Dean Ranch for irrigation would support a beneficial use and would not be expected to adversely impact water resources, and CGM would have adequate water rights to cover the consumptive use. Evaporation of 911 acre-feet per year from the post-mining pit lake would continue into the foreseeable future after the mine has closed. This is 112 acre-feet per year less than Stage 12 of the Proposed Action, and 393 acre-feet per year less than the No Action Alternative. Hence, there is a positive impact compared to the No Action Alternative.

Significance of the Impact: Impacts during the active mine life are less than significant. After mining, direct impacts of evaporation do not result in significant impacts, although the long-term consumptive use of water resources that do not contribute to beneficial use is considered to be a significant impact for which there are no mitigation measures that appear to be feasible. Again, under the Complete Backfill Alternative there will be a positive impact compared to the No Action Alternative.

<u>Lowering of the Water Table Due to Pit Dewatering</u>

A general discussion of water table lowering due to mine dewatering is provided in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action and will not be repeated here. Under the Complete Backfill Alternative there is an anticipated maximum annual dewatering pumping rate of 34,500 gpm (55,700 acre-feet per year) starting during 2007 and continuing through 2013. The Complete Backfill Alternative would extend the timeframe of dewatering from ten years (under the No Action Alternative) to 18 years. For comparison, the maximum pumping rate for Stages 11 or 12 of the Proposed Action is also 34,500 gpm. With the exception of up to 10,000 gpm to be used for the mill, evaporation, irrigation, and other consumptive uses, the remaining pumped ground water would be returned to the alluvial aquifer via the infiltration basins to conserve ground water resources.

Figure 4.3.36 shows predicted water table drawdowns in the alluvial aquifer at the maximum extent of drawdown, ten years after the end of mining for the Complete Backfill Alternative. The water table drawdowns at the end of mining are the same for this alternative as for Stage 12 of the Proposed Action. The maximum drawdown in the Pipeline/Crossroads open pit area during mine operation is expected to be approximately 1,400 feet.

The ground water level will begin to recover immediately after active mine dewatering ends. The ground water flow model was used to evaluate water level recovery for a period of over 100 years after the end of dewatering. The water level in the vicinity of the Crossroads open pit is expected to recover by more than 70 percent within ten years of the end of dewatering.

Impacts to Water Rights

Modeling results indicate potential for impacts to ground water rights holders in the vicinity of the Project Area. Such impacts may involve lowering of ground water levels at wells, springs, or streams. The analysis of drawdown includes modeling for two timeframes: 1) at the end of mine dewatering; and 2) ten years later after the end of dewatering.

Ground water flow modeling results show that at the maximum extent of drawdown, ten years after the end of mining under the Complete Backfill Alternative the ten-foot drawdown contour of the water table in the basin fill aquifer is expected to extend to a distance of approximately five miles to the north, seven miles to the east, and 4.5 miles to the southeast of the center of the open pits (Figure 4.3.36). At the end of mining, four water rights, well No. 1 (BLM windmill), and three rights associated with springs in the East Valley Group (numbered 38, 39, and 40) would be affected by more than ten feet of modeled drawdown under the Complete Backfill Alternative.

However, for reasons given in Section 4.3.3.3.1 of Stages 11 and 12 of the Proposed Action, the maximum extent of the ten-foot drawdown contour is modeled to occur about ten years after the end of mining (Geomega 2003a). Therefore, the predicted drawdown at ten years after mining (Figure 4.3.36) is an appropriate time to compare impacts between the various alternatives. At ten years after the end of mining, five wells are modeled as being affected by more than ten feet of drawdown: well No. 1 (BLM windmill), No. 2 (Filippini), No. 4 (CGM), No. 9 (Mill Gulch Placer), and No. 10 (USGS monitoring). Well Nos. 1, 2, 9, and 10 are inactive. Well No. 4 is controlled by the applicant.

In addition, three water rights associated with alluvial springs (numbered 38, 39, and 40) are modeled as having more than ten feet of drawdown. Also, three other water rights in the bedrock area in the Toiyabe Catchment area (stream rights 41 and 42, and spring right 45) are located in bedrock terrain close to the ten foot drawdown in the alluvium and could potentially be impacted. However, springs which have a source in bedrock (rather than the valley-fill alluvium) and streams flowing over shallow bedrock are not expected to show an impact for the reasons provided in Section 4.3.3.3.1 of Stages 11 and 12 of the Proposed Action. In addition, all of the potentially impacted spring and stream water rights are controlled by the applicant. A list of water rights corresponding to the numbered locations shown on Figure 4.3.36 is included on Table 4.3.2.

Impact 4.3.3.5-4: Drawdown under the Complete Backfill Alternative was predicted to exceed ten feet for 12 water rights, four of which are inactive wells (Nos. 1, 2, 9, and 10), and eight of which are controlled by the applicant (Nos. 4, 36, 38, 39, 40, 41, 42, and 45).

Significance of the Impact: Potential impacts to water rights Nos. 4, 36, 38, 39, 40, 41, 42 and 45) are not deemed significant because they are controlled by the applicant. Impacts to the inactive wells are not considered significant until such time as the water rights holder chooses to utilize their valid rights, at which time they would be considered potentially significant. The impacts would become less than significant after implementation of the mitigation measures described below.

Mitigation Measure 4.3.3.5-4a: As part of the comprehensive monitoring program, CGM shall be responsible for monitoring ground water levels between the mine and water supply wells, ground water rights, and surface water rights. Adverse impacts to ground water rights and surface water rights would be mitigated as required by the NDWR. Mitigation of impacts to ground water rights could include lowering the pump, deepening an existing well, drilling a new well for water supply wells, or providing a replacement water supply of equivalent yield and general water quality. For surface water rights, mitigation could require providing a replacement water supply of equivalent yield and general water quality.

Mitigation Measure 4.3.3.5-4b: For any significant impacts to wells that do not occur until after the end of mining, the operational measures described above may not be available. For the post-mining delayed impacts of drawdown, the ground water flow model shall be updated during the final year of dewatering using actual field data for pumping rates, infiltration rates and locations, consumptive use, and observed drawdown to reevaluate drawdown predictions that would occur after the end of mining. Active water rights not owned by the applicant that are indicated to be significantly affected shall then be mitigated by one or more of the following measures, subject to approval of the BLM and NDWR:

- Replacement or purchase of the affected water right by the applicant.
- Installation of a deeper well and pump at affected locations to restore the historical yield of the well.

- Posting of an additional bond to provide for potential future impacts to potentially affected water supplies.

Ground Water Flow to Humboldt River

The general situation with the Humboldt River is described in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action. The Complete Backfill Alternative shows a decrease of approximately nine acre-feet per year from the baseline ground water budget (Table 4.3.1) in the Crescent Valley Basin's ground water contribution to the Humboldt River at ten years after the end of mine operations (the time of maximum impact for this particular case) (see Table 4.3.3). The decrease is estimated to be the same as for the Stages 11 and 12 of the Proposed Action, as well the No Action Alternative. The relatively small changes in predicted flow to the Humboldt River would be undetectable within the context of natural variability in recharge, evapotranspiration, and ground water flow. The predicted reduction in ground water flow to the river (nine acre-feet per year for either the Complete Backfill Alternative or the No Action Alternative) represents less than one tenth of one percent of the 1992 measurements of baseflow and diversions of the river at Beowawe. The small magnitude of predicted impact to the flow of the river is a result of the buffering effect of evapotranspiration in the central part of Crescent Valley and indicates that the Complete Backfill Alternative would not result in significant direct or cumulative impacts on the river.

Impact 4.3.3.5-5: Regarding ground water flow from Crescent Valley to the Humboldt River, modeling indicates no impact compared to the No Action Alternative and only a very slight reduction of ground water flow (nine acre-feet per year) compared to pre-mining conditions.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Potential Impacts Due to Subsidence

The general discussion of subsidence is provided in Section 4.3.3.3.1 for Stages 11 and 12 of the Proposed Action and will not be repeated here. For the Complete Backfill Alternative, subsidence would be approximately the same as for Stages 11 or 12 of the Proposed Action (which share the same dewatering schedule). Under the Complete Backfill Alternative (same as Stage 12 of the Proposed Action), subsidence of up to approximately one foot would occur at a distance of up to five miles east, southeast, and south of the open pit (Figure 4.3.25). A subsidence of two feet would extend as far as four miles south of the open pit and three miles southeast of the open pit. The estimated subsidence for the Complete Backfill Alternative is approximately double the amount estimated for the No Action Alternative.

Potential For Changes to Aquifer Productivity

The greatest potential for permanent deformation would occur in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer. The result would be a slight loss in aquifer interbed storage, but no noticeable loss in aquifer productivity of water supply wells. Thus, the potential impacts to the aquifer due to subsidence under the Complete Backfill Alternative, if any, would be very localized and are considered not significant.

Impact 4.3.3.5-6: A small change in aquifer characteristics is expected to result from compaction of the aquifer materials. The compaction would result primarily from a permanent reduction in porosity in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer.

Significance of the Impact: The potential for the aquifer to transmit or store water is not expected to be measurably affected. The incremental impact and the cumulative impact are each considered less than significant and no mitigation measures are required.

Potential For Significant Land Surface Alterations

Compaction of sediments that results in subsidence could also result in changes at the land surface. As described fully in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action, potentially damaging fissuring at the ground surface could result from tension cracks induced by differential subsidence. The Complete Backfill Alternative is modeled as having the same subsidence as Stage 12 of the Proposed Action, and approximately double the subsidence of the No Action Alternative. Measures have and are being implemented by CGM to prevent fissure enlargement in the area of the process facilities as described in Section 2.3.2.

Impact 4.3.3.5-7a: Differential subsidence could result in the development of fissures. Capture of surface runoff by the fissures may form erosional fissure gullies, which represent a safety risk to wildlife, livestock, and/or people.

Significance of the Impact: The impact would be significant if fissure gullies form.

Mitigation Measure 4.3.3.5-7a: A monitoring program, as described in Section 2.3.2.2.10 (CGM 2004), shall be implemented to specifically watch for fissure gully development. If fissure gullies form, they shall be filled in with clean, coarse-grained alluvium in accordance with the fissure monitoring plan. The intent of using coarse-grained (permeable) backfill is to provide a rapid means of dissipation for any surface water entering the fissure.

Impact 4.3.3.5-7b: Differential subsidence could result in the opening of fissures creating a potential to degrade waters of the state. Fissures could provide a preferential flow path for uncontained process fluids, leachate, or hydrocarbons. If fissures form in the immediate vicinity of heap leach facilities (including pads, solution ponds, or the plant), or chemical or hydrocarbon storage facilities, the fissures could damage such facilities and result in a release to the environment.

Significance of the Impact: The impact would be significant if fissure gullies formed immediately adjacent to, or beneath engineered Project components that managed process solutions.

Mitigation Measure 4.3.3.5-7b: Mitigation of the impact is same as the mitigation measures described for Impact 4.3.3.3.1-7b.

4.3.3.6 No Action Alternative

The No Action Alternative consists of the project described in the South Pipeline Final EIS (BLM 2000a) and the Pipeline Infiltration Project EA (BLM 1999). Some of the impacts and potential impacts of the No Action Alternative have been addressed in the South Pipeline Final EIS, and will only be summarized here. However, the recently recalibrated ground water flow model (Geomega 2003a) has estimated the combined effects of the South Pipeline Final EIS (BLM 2000a) and the Pipeline Infiltration Project EA (BLM 1999), and has allowed some additional refinement of impacts to water quantity. Hence, it is appropriate to describe the results of ground water modeling for the No Action Alternative herein. Also, some additional potential impacts due to subsidence have been identified.

4.3.3.6.1 Surface Water Resources (No Action Alternative)

Erosion, Sedimentation, and Flooding within Rerouted Drainages

The nature of the impact was addressed in the South Pipeline Final EIS (BLM 2000a) and in Section 4.3.3.3.1 of this report on the Proposed Action. Therefore, it will not be repeated here.

Impact 4.3.3.6-1: Grading, earth moving, diversion of drainages, and placement of fill could accelerate erosion, sedimentation, and alter surface water flood runoff patterns during mining and post-closure.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Effects of Drawdown on Streams and Springs

The nature of the impact was addressed in the South Pipeline Final EIS (BLM 2000a) and in Section 4.3.3.3.1 of this report on the Proposed Action. Therefore, the general nature of the potential impact will not be repeated here. However, additional data and a recalibration of the ground water flow model have allowed a refinement of the drawdown maps upon which the potential impacts have been predicted.

Figure 4.3.37 graphically shows the results of the recalibrated numerical ground water flow model expressed as water table drawdown contours at the end of mining under the No Action Alternative. The predicted maximum drawdown (combined basin fill and bedrock) is approximately 700 feet at the center of the Crossroads open pit after nine years of dewatering (under the No Action Alternative). The recalibrated model predicts a slightly smaller area of impact than the model presented in the South Pipeline Final EIS (BLM 2000a). This section investigates the potential for drawdown of the water table to affect surface water flow in certain streams and springs.

These ground water modeling results indicate that the ground water level will be drawn down by far less than ten feet at all springs at the end of mining. The drawdown in ground water level is also expected to be less than ten feet at all of the perennial streams at the end of mining. At the end of mining, the modeled ten-foot drawdown contour would extend approximately five miles to the north, 1.5 miles to the southeast, and two miles to the east. Drawdown is limited to the northeast and southwest by recharge from infiltration basins.

After dewatering ceases, the ground water level would begin to recover in the open pit area and the ground water mounds in the infiltration areas would dissipate as ground water flows toward the open pit from the perimeters of the Project Area. Drawdown would continue to increase in the perimeter areas as the open pit fills with ground water that is derived from storage. Figure 4.3.38 shows the predicted drawdown contours at the time of maximum areal extent of drawdown (ten years after the end of mining) for the No Action Alternative. To the northeast and southwest, the extent of the ten-foot drawdown contour is about two to three miles beyond its location at the end of mining. At this time, modeled drawdown in the basin fill aquifer of ten feet or more would not extend to any springs or perennial streams. The drawdown ten years after the end of mining is selected as the most appropriate time to compare the significance of impacts because that is the point in time when the ground water model predicts that the ten-foot drawdown will have reached its maximum lateral extent.

Impact 4.3.3.6-2: Mine dewatering is not expected to affect flows in any springs or streams. This section is included only for comparison to corresponding potential impacts listed in other sections and in the South Pipeline Final EIS (BLM 2000a).

Significance of the Impact: By definition, there is no impact under the No Action Alternative.

Mitigation Measure 4.3.3.6-2a: No mitigation is expected to be required. However, monitoring of flows at streams and the 68 springs in the southern portion of Crescent Valley shall be performed as dewatering progresses, and if necessary, mitigation shall be performed as described under Mitigation Measure 4.3.3.3.1-2a.

Mitigation Measure 4.3.3.6-2b: No new impact is predicted under the No Action Alternative. However, it is possible that some impacts to springs may only occur after the end of mining, when the operational measures described under Mitigation Measure 4.3.3.3.1-2a may not be available. If this were to occur, mitigation shall be performed as described under Mitigation Measure 4.3.3.3.1-2b.

4.3.3.6.2 Ground Water Resources (No Action Alternative)

Consumptive Losses

Consumptive losses through evaporation from the surfaces of the infiltration basins and seeps associated with the water disposal operations will continue for as long as dewatering occurs. The evaporative losses due to the infiltration basins are the same as those described under the Proposed Action (Section 4.3.3.3.1), except under the No Action Alternative the ponds would be in use for eight fewer years. Evaporative losses during mine operation would not be expected to produce a significant impact.

After mining operations cease and the pit lake begins to fill, some pit lake water would be consumptively lost due to evaporation. The consumptive losses through evaporation would increase over time with the increasing pit lake stage and water surface area after mine closure. For the No Action Alternative after 100 years of pit re-filling, the net consumptive losses through evaporation from the water surface of the single pit lake would be approximately 1,304 acre-feet per year (see Table 4.3.3). The consumptive losses through evaporation are 281 acre-feet per year more than Stage 12 of the Proposed Action. It should be noted that long-term evaporation losses from the pit lake will be partially balanced in the basin's water budget by a reduction of the natural evapotranspiration from the central area of the valley.

The Crescent Valley Hydrographic Basin is classified as a designated basin by the Nevada State Engineer and the withdrawal and use of ground water is regulated. Evaporative losses may be treated as a consumptive use and accounted as a water right at the discretion of the Nevada State Engineer. The resulting annual volume of water is comparable to the annual water use allowed for a land parcel of equivalent area placed under irrigation. Since CGM holds senior certificated water rights for both agricultural and mining/milling uses in Crescent Valley, replacement of evaporative pit lake loss with a certificated water right would result in no net gain in permitted ground water withdrawal or consumptive use from Crescent Valley. The transfer of these water rights to offset the evaporative losses from the pit lake would render the impacts on water rights insignificant.

Impact 4.3.3.6-3: Consumptive use of water by evaporation during mining and delivery of water to the Dean Ranch for irrigation would support a beneficial use and would not be expected to adversely impact water resources; and CGM would have adequate water rights to cover the consumptive use. Evaporation of 1,304 acre-feet per year from the post-mining pit lake would continue into the foreseeable future after the mine has closed. This is 281 acre-feet per year greater than Stage 12 of the Proposed Action.

Significance of the Impact: Impacts during the active mine life are less than significant. After mining, direct impacts of evaporation do not result in significant impacts, although the long-term consumptive use of water resources that do not contribute to beneficial use is considered to be a significant impact for which there are no mitigation measures that appear to be feasible.

Lowering of the Water Table Due to Pit Dewatering

A general discussion of water table lowering due to mine dewatering is provided in Section 4.3.3.3.1 of the Proposed Action and will not be repeated here. Under the No Action Alternative, there is an anticipated maximum annual dewatering pumping rate of 25,900 gpm (41,800 acre-feet/year) occurring during 2004. The Proposed Action would extend the timeframe of dewatering from ten years (under the No Action Alternative) to 18 years. For comparison, the maximum pumping rate for the Proposed Action is 34,500 gpm. Under the No Action Alternative, the ten-foot drawdown contour of the water table is expected to extend to a distance of up to five miles beyond the open pit area at the end of mining. With the exception of up to 10,000 gpm to be used for the mill, evaporation, irrigation, and other consumptive uses, the remaining pumped ground water would be returned to the alluvial aquifer via the infiltration basins to conserve ground water resources.

Figure 4.3.37 shows predicted water table drawdowns in the alluvial aquifer at the end of mining for the No Action Alternative. The maximum drawdown in the open pit area during mine operation is expected to be as much as 700 feet.

The ground water level will begin to recover immediately after active mine dewatering ends. The ground water flow model was used to evaluate water-level recovery for a period of over 100 years after the end of dewatering. The water level in the vicinity of the Crossroads open pit is expected to recover by 70 percent within ten years of the end of dewatering.

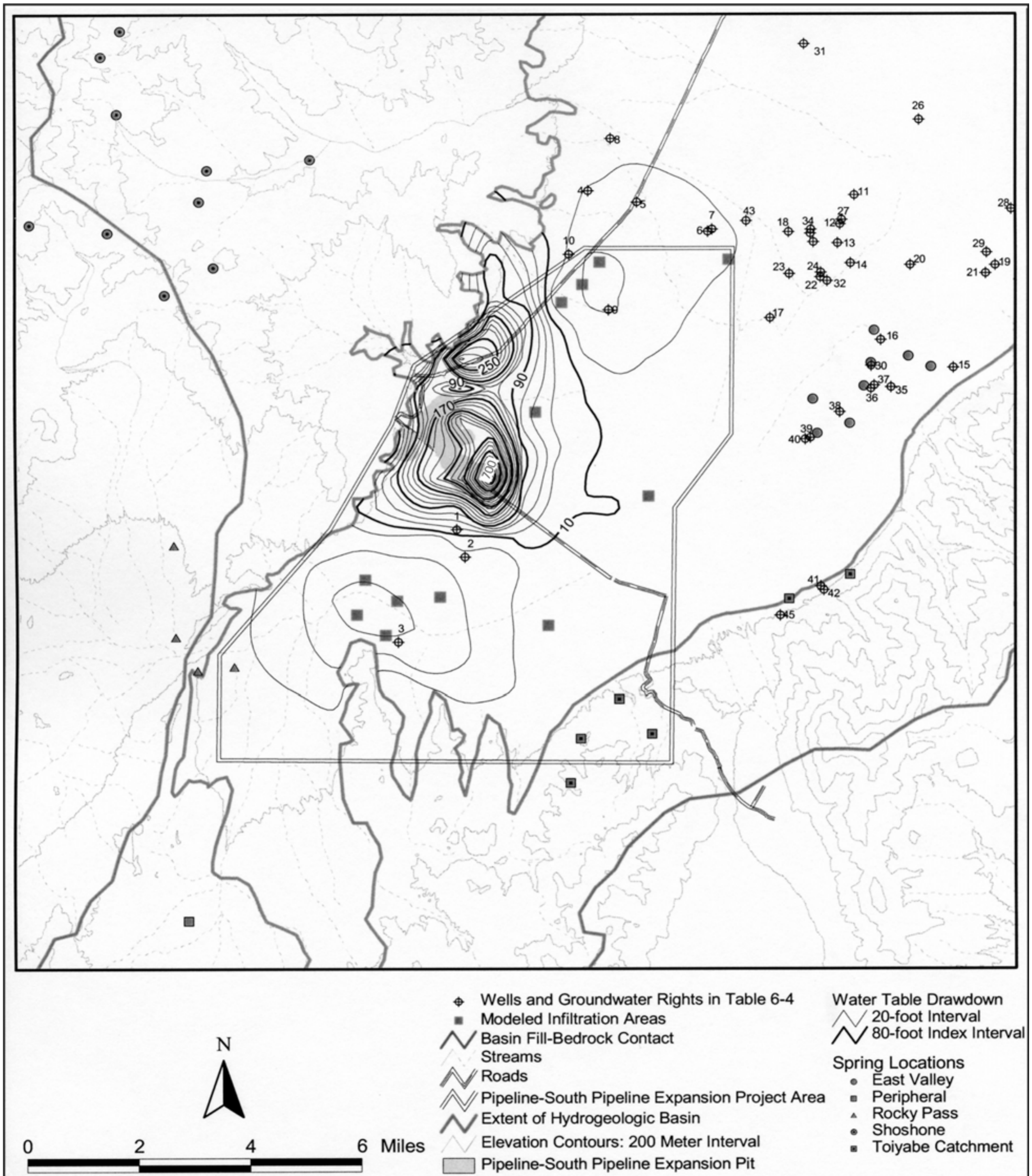

Figure 4.3.37 Water Table Drawdown in Basin Fill Deposits in Southern Crescent Valley at End of Mining, No Action Alternative

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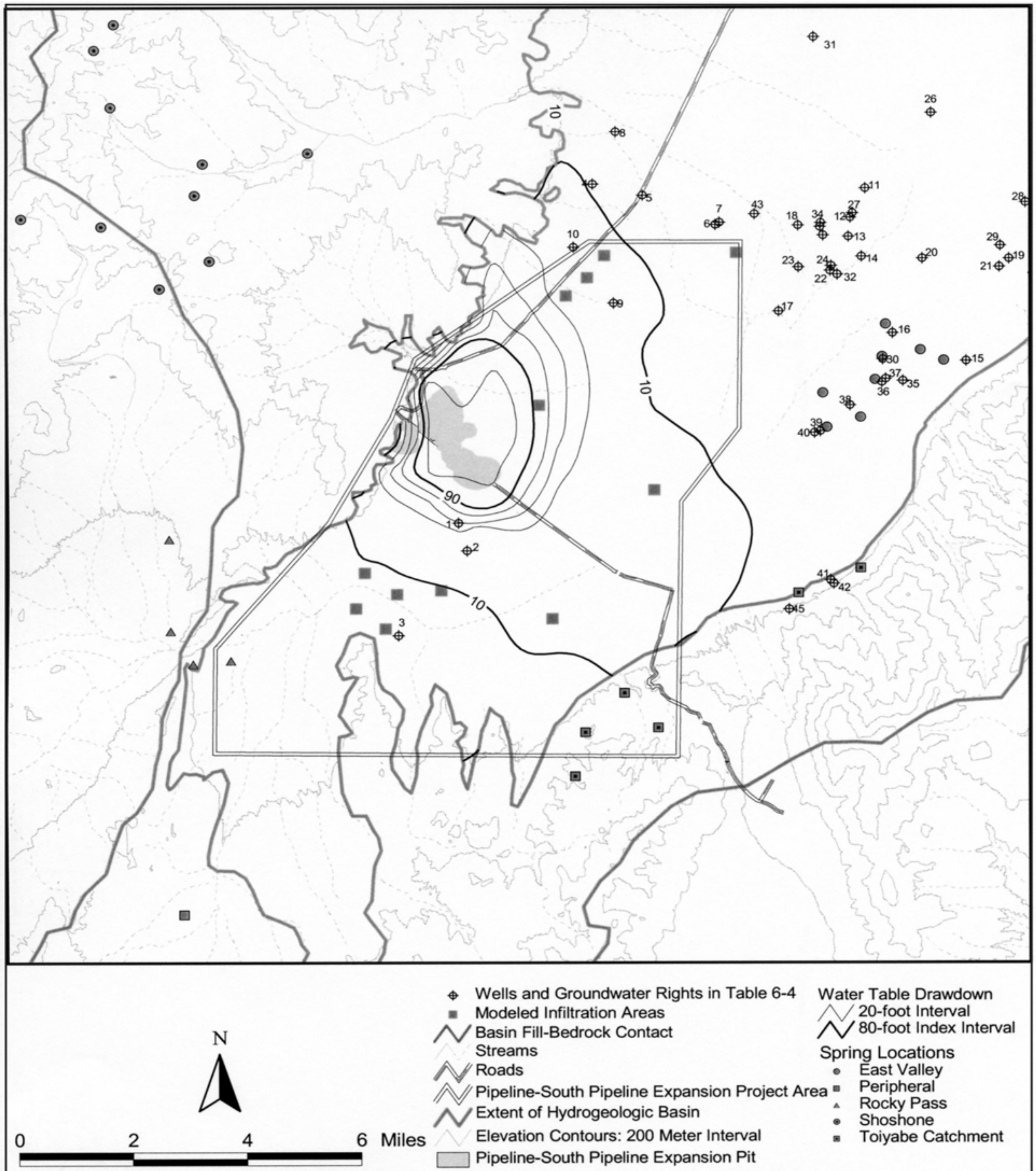

Figure 4.3.38 Water Table Drawdown in Basin Fill Deposits in Southern Crescent Valley at Time of Maximum Draw Extent, No Action Alternative

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Impacts to Water Rights

Ground water flow modeling results show that at the end of mining substantial water table drawdowns in the alluvial aquifer (in excess of ten feet) would be limited to an area within approximately five miles from the site of the proposed open pit under the No Action Alternative. At the end of mining, one water right, well No. 1 (BLM windmill), would be affected by more than ten feet of modeled drawdown under the No Action Alternative. However, for reasons given in Section 4.3.3.3.1 of the Proposed Action, the maximum extent of the ten-foot drawdown contour is predicted by the model to occur about ten years after the end of mining (Geomega 2003a). Therefore, the predicted drawdown at ten years after mining (Figure 4.3.38) is an appropriate time to compare impacts between the various alternatives. At ten years after the end of mining, four wells would be affected by more than ten feet of drawdown: well No. 1 (BLM windmill), No. 2 (Filippini), No. 9 (Mill Gulch Placer), and No. 10 (USGS monitoring). All four of these wells are inactive.

Modeling results indicate some potential for impacts to ground water rights holders in the vicinity of the Project Area. Such impacts may involve lowering of ground water levels at wells or springs. The analysis of drawdown includes modeling for two timeframes: 1) at the end of mine dewatering and 2) at ten years later than that. The comparison of significant impacts focuses on the timeframe at ten years after pit dewatering ends. Impacts at known water wells, springs, and water rights sites were evaluated for potential water table drawdown as shown on Figure 4.3.38. Drawdown under the No Action Alternative was predicted to exceed ten feet for four water rights, all four of which are inactive wells (Nos. 1, 2, 9, and 10). Wells No. 9 and No. 10 were predicted to have less than ten feet of drawdown in the South Pipeline Final EIS (BLM 2000a). The recalibration of the ground water flow model resulted in the difference in this area north of the open pit. A list of water rights corresponding to the numbered locations shown on Figure 4.3.38 is included on Table 4.3.2.

Water rights for the three inactive wells are not considered significant because these water rights are not active.

Impact 4.3.3.6-4: There are no active water rights that are within the predicted area of the modeled ten-foot drawdown of the valley-fill aquifer. However, there are four inactive water wells.

Significance of the Impact: Impacts to the inactive wells are not considered significant until such time as the water rights holder chooses to utilize his rights, at which time they would be considered potentially significant. The impacts would become less than significant after implementation of the mitigation measures described below.

Mitigation Measure 4.3.3.6-4a: As part of the comprehensive monitoring program, CGM would be responsible for monitoring ground water levels between the mine and water supply wells, ground water rights, and surface water rights. Adverse impacts to ground water rights and surface water rights shall be mitigated as required by the NDWR. Mitigation of impacts to ground water rights could include lowering the pump, deepening an existing well, drilling a new well for water supply wells, or providing a replacement water supply of equivalent yield and general water quality. For surface water rights, mitigation could require providing a replacement water supply of equivalent yield and general water quality.

Mitigation Measure 4.3.3.6-4b: For the significant impacts to wells that are not predicted to occur until after the end of mining, the operational measures described above may not be available. For the post-mining delayed impacts of drawdown, the ground water flow model shall be updated during the final year of dewatering using actual field data for pumping rates, infiltration rates and locations, consumptive use, and observed drawdown to re-evaluate drawdown predictions that would occur after the end of mining. Wells with active water rights that are indicated to be significantly affected shall then be mitigated by one or more of the following measures, subject to approval of the BLM and NDWR:

- Replacement or purchase of the affected water right by the applicant.
- Installation of a deeper well and pump at affected locations to restore the historical yield of the well.
- Posting of an additional bond to provide for potential future impacts to potentially affected water supplies.

Ground Water Flow to Humboldt River

The general situation with the Humboldt River is described in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action. The No Action Alternative shows a decrease of approximately nine acre-feet per year change from the baseline ground water budget (Table 4.3.1) in the Crescent Valley Basin's ground water contribution to the Humboldt River at ten years after the end of mine operations (the time of maximum impact) (see Table 4.3.3). The decrease is estimated to be exactly the same as for the Stages 11 and 12 of the Proposed Action. The relatively small changes in predicted flow to the Humboldt River would be undetectable within the context of natural variability in recharge, evapotranspiration, and ground water flow to the river. The predicted reduction in ground water flow to the Humboldt River nine acre-feet per year for either the Proposed Action or the No Action Alternative) represents less than one tenth of one percent of the 1992 measurements of baseflow and diversions of the Humboldt River at Beowawe. The small magnitude of predicted impact to the flow of the river is a result of the buffering effect of evapotranspiration in the central part of Crescent Valley and indicates that the No Action Alternative would not result in significant direct or cumulative impacts on the river.

Impact 4.3.3.6-5: Ground water flow modeling indicates that a very slight reduction of ground water flow (nine acre-feet per year) from Crescent Valley to the Humboldt River would occur (compared to pre-mining conditions).

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

<u>Potential Impacts Due to Subsidence</u>

The general discussion of subsidence is provided in Section 4.3.3.3.1 for Stages 11 and 12 of the Proposed Action and will not be repeated here. The model shows that for the No Action Alternative, subsidence of up to approximately one foot would occur at a distance of up to two miles east of the open pit, and up to approximately four miles south of the open pit (Figure 4.3.39). The estimated subsidence for Stages 11 and 12 of the Proposed Action is approximately double that estimated for the No Action Alternative.

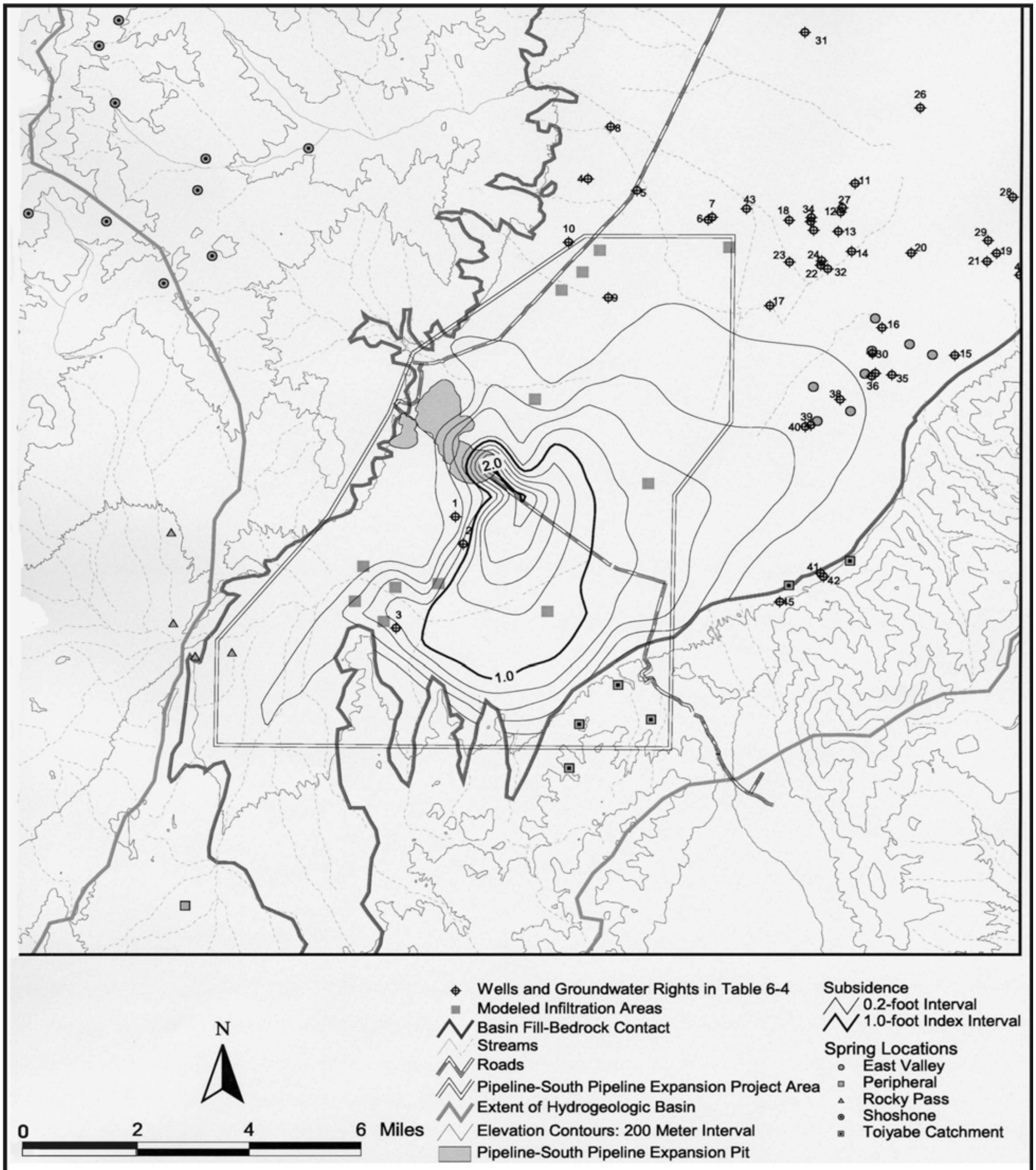

Figure 4.3.39 Simulated Subsidence at the End of Dewatering, No Action Alternative

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Potential For Changes to Aquifer Productivity

The greatest potential for permanent deformation would occur in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer. The result would be a slight loss in aquifer interbed storage, but no noticeable loss in aquifer productivity of water supply wells. Thus, the potential impacts to the aquifer due to subsidence under the No Action Alternative, if any, would be very localized and are considered not significant.

Impact 4.3.3.6-6: A small change in aquifer characteristics is expected to result from compaction of the aquifer materials. Ground subsidence of up to approximately one foot would occur at a distance of up to approximately two miles east of the open pit, and up to approximately four miles south of the open pit. The subsidence would result primarily from a permanent reduction in porosity in the finer grained sediments (clays and silty clays), which are not the primary water-bearing materials in the alluvial aquifer.

Significance of the Impact: The potential for the aquifer to transmit or store water is not expected to be affected. The incremental impact and the cumulative impact are each considered less than significant and no mitigation measures are required.

Potential For Land Surface Alterations

Compaction of sediments that results in subsidence could also result in changes at the land surface. As noted above, ground subsidence of up to approximately one foot would occur at a distance of up to approximately two miles east of the open pit, and up to approximately four miles south of the open pit. Subsidence of greater than four feet is expected near the open pit. As described fully in Section 4.3.3.3.1 under Stages 11 and 12 of the Proposed Action, potentially damaging fissuring at the ground surface could result from tension cracks induced by differential subsidence. The No Action Alternative is modeled as having approximately half the subsidence of Stages 11 or 12 of the Proposed Action. Hence, the potential for fissuring at the ground surface under the No Action Alternative is also approximately half as great. Measures have and are being implemented by CGM to prevent fissure enlargement in the area of the process facilities as described in Section 2.3.2.

Impact 4.3.3.6-7a: Differential subsidence could result in the development of fissures. Capture of surface runoff by the fissures may form erosional fissure gullies, which represent a safety risk to wildlife, livestock, and/or people.

Significance of the Impact: The impact would be significant if fissure gullies form.

Mitigation Measure 4.3.3.6-7a: A monitoring program, as described in Section 2.3.2.2.10 (CGM 2004), shall be implemented to specifically watch for fissure gully development. If fissure gullies form, they shall be filled in with clean, coarse-grained alluvium in accordance with the fissure monitoring plan. The intent of using coarse-grained (permeable) backfill is to provide a rapid means of dissipation for any surface water entering the fissure.

Impact 4.3.3.6-7b: Differential subsidence could result in the opening of fissures creating a potential to degrade waters of the state. Fissures could provide a preferential flow path for uncontained process fluids, leachate, or hydrocarbons. If fissures form in the immediate vicinity of heap leach facilities (including pads, solution ponds, or the plant), or chemical or hydrocarbon storage facilities, the fissures could damage such facilities and result in a release to the environment.

Significance of the Impact: The impact would be significant if fissure gullies formed immediately adjacent to, or beneath engineered Project components that managed process solutions.

Mitigation Measure 4.3.3.6-7b: Mitigation of the impact is same as the mitigation measures described for Impact 4.3.3.3.1-7b.

4.4 Water Resources-Water Quality

4.4.1 Regulatory Framework

Approval of the Proposed Action would require authorizing actions from other state agencies with jurisdiction over the water resources aspect of the Project. The regulation, appropriation, and preservation of water in Nevada falls under state jurisdiction, which implements state law and federally delegated programs. When a proposed project has the potential to directly or indirectly affect the waters under State of Nevada jurisdiction, then the State of Nevada is authorized to implement its own permit programs under the provisions of state law or the CWA.

The NDEP requires compliance with NPDES permits related to discharge of wastewater to surface waters from discharge points such as tailings piles and wastewater ponds, as well as with NPDES permits related to discharge of stormwater runoff. NDEP also requires that discharges into subsurface waters be controlled if the potential for contamination of ground water supplies exists, such as a state ground water discharge permit or a state zero-discharge permit.

The Nevada Water Pollution Control Law provides the state authority to maintain water quality for public use, wildlife, existing industries, agriculture, and the economic development of the site. The NDEP defines waters of the state to include surface water courses, waterways, drainage systems, and underground water. The Nevada Water Pollution Control Law also gives the State Environmental Commission authority to require controls on diffuse sources of pollutants, if these sources have the potential to degrade the quality of the waters of the state. The EPA has also granted Nevada authority to enforce drinking water standards established under the CWA. The Nevada Division of Health administers this program.

4.4.2 Affected Environment

4.4.2.1 Study Methods

Several studies of baseline water quality have been completed for the Pipeline and South Pipeline Projects, as well as for the currently Proposed Action.

Surface water quality has been monitored at several locations in the vicinity of the Proposed Action, including creeks, seeps and springs, playas and pit lakes. As there has been little change in existing conditions for surface water resources since publication of the South Pipeline Final EIS (BLM 2000a, pages 4-28, 4-30, 4-31, and 4-32), subsequent surface water data collection has been limited to seep and spring monitoring as reported by Geomega (2002b). Data in the South Pipeline Final EIS (BLM

2000a) that characterize surface water, along with the additional seep and spring data, are summarized in Section 4.4.2.2.1, page 4-10.

Future water quality has been predicted for the pit lakes that would result from the Proposed Action and the original pit lake water quality prediction has been updated (Geomega 2003b). This effort has involved modeling of ground water flow into the pit, prediction of interactions with the pit highwall and backfilled waste rock, mixing of inflowing water, evapoconcentration, and modeling the precipitation of minerals and trace element sorption. Anticipated seasonal changes in pit lake characteristics (such as stratification and overturn) have also been modeled. Revisions have relied primarily upon the data presented in the South Pipeline Final EIS (BLM 2000a, pages 4-33 and 4-68) but have also incorporated new evaporation data (Geomega 2003b).

Ground water quality data have been compiled from several sources in order to document baseline conditions. Ground water quality analytical data presented in the South Pipeline Final EIS (BLM 2000a, pages 4-32 and 4-34) have been expanded with data reported by Geomega (2002b) for the Proposed Action. Much of the additional information was collected to characterize ground water changes in response to use of infiltration galleries for management of open pit dewatering water. The ground water data are summarized below in Section 4.4.2.2.2.

The Crescent Valley ground water flow modeling was updated using field data to refine the previously determined extent and hydraulic properties of individual lithologic units, reevaluate estimates of recharge and discharge, and recalibrate the ground water model. This investigation also evaluated the influence of dewatering on the regional water table, infiltration of excess produced water, open pit refilling rates under various management options, and potential degradation associated with open pit throughflow (Geomega 2003b). Hydrologic information presented in this study is key to pit lake water quality predictions developed for the Project (Geomega 2000b).

Potential ground water degradation associated with drainage from waste rock was evaluated through laboratory and field geochemical analysis of waste rock samples from the various lithologies to be mined, and through modeling of potential seepage rates (Geomega 2003c).

4.4.2.2 Existing Conditions

4.4.2.2.1 Surface Water Quality

Surface water resources are described in Section 4.3.2.2.2. Surface water flow in the Project Area is limited, and in many cases as ephemeral drainages from the Cortez Mountains, Toiyabe Range, and Shoshone Range. There is no main drainage along the axis of the valley and saline flats (playas) are developed where streams discharge into portions of the valley with no outflow. A drainage divide isolates most of Crescent Valley from the Humboldt River, which is located to the north of the Project Area. The very slow rate of ground water flow in Crescent Valley indicates that many thousands of years would be required for any Project-related changes in ground water chemistry to affect the Humboldt River (Geomega 2003b).

Analytical data from three surface water samples collected in 1996 from Indian Creek, Mill Creek, and Fire Creek are reported in Table 4.4.2 of the South Pipeline Final EIS (BLM 2000a, page 4-30). The samples had relatively low TDS (253 to 394 milligram/liter [mg/l] and alkaline potential of hydrogen [pH] (8.02-8.28), and relatively high total alkalinity (average 159 mg/l). Most trace and minor constituents were below NDEP standards. The Indian Creek sample exceeded the NDEP standard for aluminum (0.139 mg/l) and the Mill Creek sample exceeded the NDEP standards for aluminum (0.13 mg/l), arsenic (0.074 mg/l), and silver (0.22 mg/l). The detection limits for cadmium, mercury and thallium exceeded the Nevada drinking water standards (DWSs). The Indian Creek sample had a detection of weak acid dissociable [WAD] cyanide (0.013 mg/l). Previous mining activities (unrelated to CGM) in the Indian and Mill Creek drainages are believed to be the source of elevated trace constituents (BLM 2000a, page 4-28).

Seeps and Springs. No additional water chemistry data have been collected for these surface water monitoring locations since the South Pipeline Final EIS was published in 2000 because previous assessments for the Pipeline and South Pipeline Projects (BLM 1996a; BLM 2000a) indicate that surface water resources are not influenced by mining operations. CGM continues to conduct spring and seep monitoring for flows.

Sixty-eight seeps and springs have been identified in the vicinity of the Project, a few of which are thermal springs. Wet meadows occur in association with some seeps and springs. Water quality data for three hot springs samples collected from the Chillis Hot Spring, Filippini Ranch stream, and Hot Springs Point are reported in the South Pipeline Final EIS (BLM 2000a, Table 4.4.3, page 4-31). The Hot Springs Point sample had a slightly lower TDS and a pH of 6.8. This sample exceeded DWSs for TDS, fluoride, and manganese. Water from the Chillis Hot Spring had a lab pH of 8.5 and exceeded DWSs for TDS, fluoride, magnesium, and potassium. The Filippini Ranch stream sample exceeded DWSs for chloride, magnesium, manganese, sulfate, and TDS, and also had elevated calcium, sodium, sulfur, and potassium concentrations.

The locations of 31 sampled seeps and springs are shown on Figure 4.3.21. These springs are divided into five groups:

- Rocky Pass group (four springs);
- Toiyabe Catchment group (six springs);
- Peripheral Area group (one spring);
- Shoshone group (12 springs); and
- East Valley group (eight springs).

Twenty-four springs have been designated for quarterly monitoring and seven have been designated for semi-annual monitoring. The springs are monitored for flow rate, conductivity, pH, temperature, and dissolved oxygen. Monitoring data are included in the baseline characterization report (Geomega 2002a, Table 5-3). The measured pH and conductivity reflect differences in the source of water discharged at each location. Most of the Rocky Pass group springs are fed by alluvial water, with one thermal spring, while the water discharged in the Toiyabe Catchment group springs comes from carbonate rocks. The spring described as the Peripheral Area group is similar to those of the Toiyabe Catchment group. The Shoshone group of springs have their source in the Shoshone range, where snowmelt and precipitation interact with bedrock. The East Valley group are located in alluvial fans at the base of the Cortez Mountains. The various springs are compared by group based on the range of conductivity measurements in Figure 4.4.1.

Former Cortez Pit Lake. Four samples were collected from the surface of the Cortez pit lake prior to 1997. Subsequent to that the water table in the area of the open pit dropped below the level of the open pit floor. The sample results summarized in Table 4.4.4 of the South Pipeline Final EIS (BLM 2000a) indicate characteristics typical of waters from carbonate systems. The pH of the samples ranged from 8.02 to 8.13, and alkalinity ranged from 225 to 282 mg/l. The samples had low metal concentrations with only fluoride and arsenic approaching their respective standards. TDS concentrations were between 425 and 438 mg/l.

4.4.2.2.2 Ground Water Quality

Ground water is present in both alluvial and bedrock aquifers. Infiltration basins are used to discharge excess water collected during dewatering to the alluvial aquifer system, but to date have not been shown to influence the bedrock system (Geomega 1998c). Six hydrolithologic units have been defined in the Project Area, including carbonate, siliceous, volcanic, and intrusive bedrock and two basin fill deposits. These units are defined and described in the modeling report (Geomega 2003a).

Alluvial Aquifer. Characterization of the alluvial aquifer water quality for Crescent Valley is based on samples from 48 wells including CGM monitoring wells and regional water wells. Of these wells, 12 are in the Project Area. For the modeling report the well samples from the first quarter of 1992 through the first quarter of 2002 were used. The minimum, maximum, and average constituent concentrations from the pre-dewatering and infiltration time period, along with the DWSs for reference, are summarized in Table 4.4.1. The locations and dates for alluvial ground water monitoring samples are reported in Geomega (2002b).

Alluvial ground water quality generally meets most of the primary and secondary drinking water standards. The average alluvial aquifer constituent concentrations exceeded the DWS for sulfate (secondary), arsenic, iron, and TDS (Table 4.4.1). Table 4.4.1 indicates that the maximum constituent concentrations also exceed the DWS for sulfate, antimony, arsenic, beryllium, chloride, fluoride, iron, magnesium, manganese, mercury, nickel, nitrate, selenium, thallium, TDS, zinc, and pH. In addition, the nitrite standard was exceeded. While certain wells exceeded standards only once for a given constituent, repeated exceedances in some wells were reported for antimony, arsenic, beryllium, cadmium, chloride, fluoride, iron, lead, magnesium, manganese, nickel, nitrate and nitrite, pH, selenium, sulfate, and TDS.

Infiltration Basins

Changes in alluvial ground water quality resulting from infiltration of dewatering water from the Project are discussed in the Pipeline Infiltration Project EA (BLM 1999) and the South Pipeline Final EIS (BLM 2000a, page 4-80). A more detailed discussion is provided by Geomega (2001b and 2002b) and summarized by Fennemore et al. (2001). Details of the dewatering and infiltration systems are provided in the baseline report (Geomega 2002a, Section 5.5).

Despite similar chemistries in the background alluvial ground water and the water produced by open pit dewatering (Geomega 2002a), the ground water near each of the infiltration sites (Highway, Filippini, Rocky Pass, Frome, and Windmill) initially showed increased concentrations of TDS and constituent analytes followed by a gradual decline to background conditions (Geomega 2002a). This trend is due to the dissolution of naturally occurring minerals, such as calcite, magnesite, gypsum, and halite in the saline alluvial soil beneath the infiltration sites.

Column leaching tests were conducted by Geomega (1998c) to evaluate the nature of the solute mobilization in the existing infiltration areas using core samples that are representative of the soils present at the Highway, Filippini, Rocky Pass, Frome, and Windmill infiltration sites. Leachates produced during column testing were generally in good agreement with ground water samples obtained from infiltration site monitoring wells (Geomega 2000b, Tables 5-13 and 5-14).

Initially, elevated solute release followed by a gradual decline to background conditions, similar to the trends observed in monitoring wells, were documented during column testing. This trend is demonstrated in the TDS monitoring data from the Frome Infiltration Site, as shown in Figure 4.4.2.

The results of background ground water quality characterization, infiltration monitoring, and column tests, demonstrate that infiltration of dewatering water results in a transitory increase in solute concentrations. Column-test data in conjunction with the monitoring well data indicate that water quality tends to return to near ambient background conditions after passage of approximately 13 pore volumes of infiltration water (Geomega 1998c; BLM 1999).

Bedrock Aquifer

Characterization of the bedrock aquifer water quality is based on samples from 32 sites collected from the first quarter of 1992 through the first quarter of 2002. Of these bedrock wells, 22 are in the Project Area. The minimum, maximum, and average constituent concentrations are summarized in Table 4.4.2 (Geomega 2002b, Table 5-8). Sampling locations and dates are detailed in Geomega (2002).

The bedrock water quality is similar to the alluvial aquifer, but has higher concentrations of major ions and trace elements. The average bedrock aquifer results meet the DWS, except for antimony, arsenic, cadmium, fluoride (secondary), iron, manganese (secondary), and TDS (secondary). Maximum concentrations of numerous constituents from bedrock wells exceeded the relevant drinking water standards. Individual exceedances for bedrock wells are listed in Geomega (2002b, Table 5-12). Constituents with exceedances in individual wells include antimony, arsenic, beryllium, cadmium, chloride (secondary), copper (secondary), fluoride (secondary), iron, manganese, mercury, thallium, TDS, zinc (secondary), and pH. Exceedances in bedrock wells were suggested to be due to their proximity to the mineralized zone where elevated metal concentrations are expected.

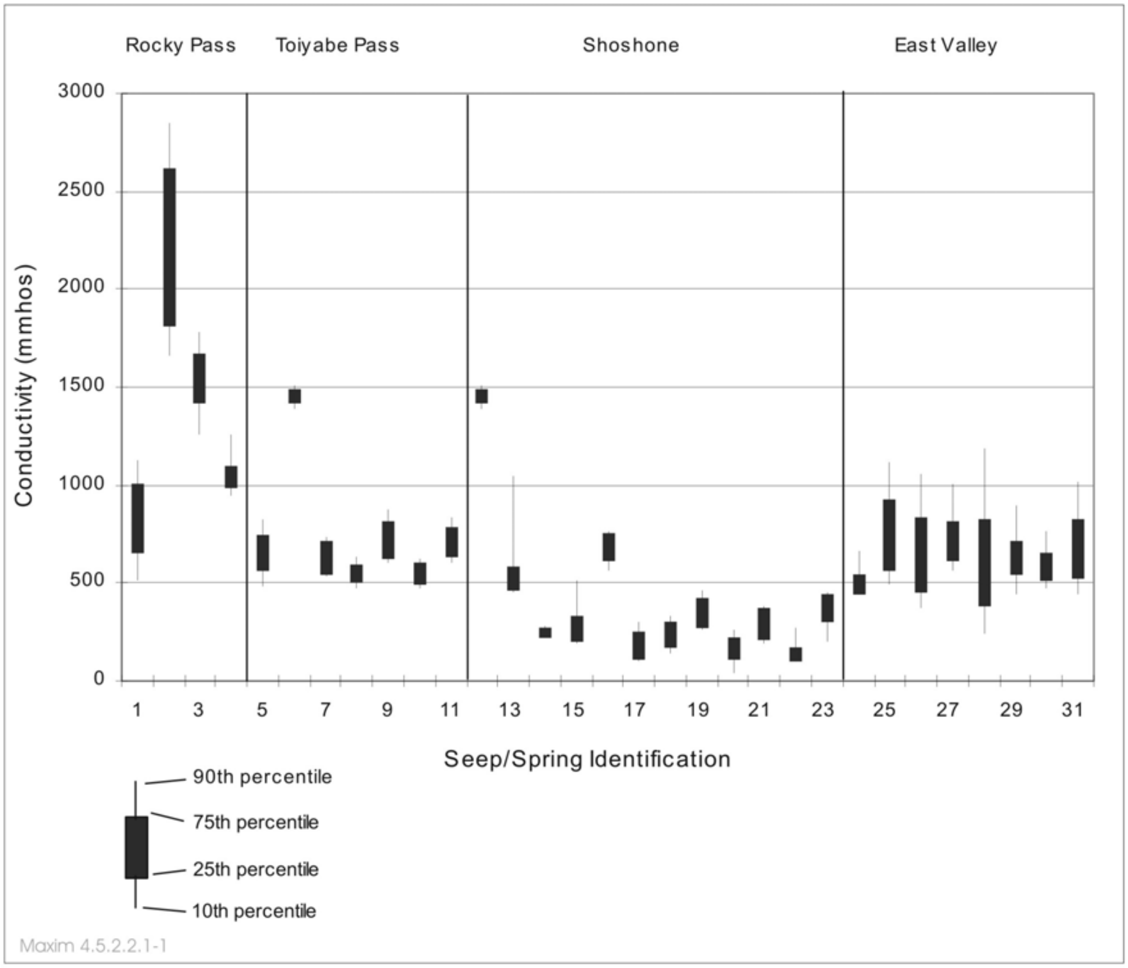

Figure 4.4.1 Comparison of Conductivity in Springs and Seeps

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Table 4.4.1: Summary of Project Alluvial Ground Water Chemistry

Parameter	DWS(SDWS)[1]	Min	Max	Avg	Count
Alkalinity (Total)		1	650	237	513
Specific Conductance (field)		0.36	13,800	1,520	180
Sulfate	500.0 (250.0)	82	4,900	442	210
Aluminum		0.005	1.07	0.045	253
Antimony	0.006	0.001	0.05	0.004	459
Arsenic[2]	0.05/0.010	0.002	0.18	0.01	526
Barium	2	0.005	0.5	0.065	519
Beryllium	0.004	0.001	0.01	0.002	455
Bicarbonate		0	650	248	329
Bismuth		0.05	0.1	0.057	7
Cadmium	0.005	0.001	0.01	0.003	526
Calcium		1.6	1,600	128	514
Chloride	400.0 (250.0)	4	4,270	152	314
Chromium	0.1	0.002	0.06	0.009	526
Cobalt		0.005	0.05	0.012	12
Copper[3]	(1.0)	0.002	0.13	0.011	526
Fluoride	4.0 (2.0)	0.1	20	1.63	208
Iron	0.6 (0.3)	0.008	16.8	0.166	526
Lead[3]		0.002	0.05	0.007	526
Magnesium	150.0 (125.0)	0.098	592	43	525
Manganese	0.1 (0.05)	0	2.72	0.048	525
Mercury	0.002	0.0001	0.5	0.002	525
Nickel	0.1	0.002	0.29	0.016	443
Nitrate	10	0.02	65	2.86	305
$NO_2 + NO_3$ as Nitrogen	10	0.02	65	3.68	420
Potassium		1.1	88.3	15.7	514
Selenium	0.05	0.002	0.13	0.007	526
Silver		0.002	2.51	0.012	526
Sodium		29	2,400	159	514
Thallium	0.002	0.001	0.02	0.001	239
Total Dissolved Solids	1,000.0 (500.0)	172	11,400	1,110	536
Cyanide	0.2	0.005	0.02	0.009	314
Zinc	(5.0)	0.002	1.13	0.027	526
pH (field)		5.22	12.84	8.34	98
pH (laboratory)	(6.5 - 8.5)	6.79	11.7	7.68	535

NOTE: All units are in mg/l except pH, which is in standard units.

1 - DWS equals primary Nevada drinking water standards and SDWS equals secondary Nevada drinking water standards. The primary standards are those that are enforceable and the secondary standards are those that are recommended. These standards are based on NAC445A.453 and 455.

2 - The current regulatory MCL for arsenic in Nevada is 0.05 mg/l. The federal arsenic MCL was revised to 0.010 mg/l on February 22, 2002. The State of Nevada has not adopted the revised standard and will evaluate the adoption according to state policy set forth for such adoption.

3 - The primary copper and lead standards are regulated by a Treatment Technique that requires systems to control corrosiveness of their water if more than ten percent of the tap water samples exceed the action levels. The action levels for copper and lead are 1.3 mg/l and 0.0015 mg/l, respectively.

Table 4.4.2: Summary of Project Bedrock Ground Water Chemistry

Parameter	DWS(SDWS)[1]	Min	Max	Avg	Count
Alkalinity Total		1	584	277	218
Specific Conductance (field)		0.728	1042	762	77
Sulfate	500.0 (250.0)	100	200	126	60
Aluminum		0.02	0.47	0.053	112
Antimony	0.006	0.002	0.05	0.007	170
Arsenic[2]	0.05/0.010	0.002	0.235	0.021	225
Barium	2	0.01	0.5	0.082	225
Beryllium	0.004	0.002	0.01	0.003	166
Bicarbonate		1	584	281	142
Bismuth		0.05	0.05	0.05	1
Cadmium	0.005	0.002	0.326	0.005	225
Calcium		22.4	140	60	219
Chloride	400.0 (250.0)	4	289	30	164
Chromium	0.1	0.002	0.051	0.009	225
Cobalt		0.007	0.012	0.009	7
Copper[3]	(1.0)	0.002	73.4	0.334	225
Fluoride	4.0 (2.0)	2.1	3.8	3.0	54
Iron	0.6 (0.3)	0.008	159	0.813	224
Lead[3]		0.002	0.062	0.007	225
Magnesium	150.0 (125.0)	1.7	55.1	23	224
Manganese	0.1 (0.05)	0.002	2.32	0.052	225
Mercury	0.002	0.0002	0.0052	0.001	225
Nickel	0.1	0.002	0.044	0.015	160
Nitrate	10	0.01	4.8	0.504	141
$NO_2 + NO_3$ as Nitrogen	10	0.01	4.2	0.42	164
Potassium		2.2	24.6	16.3	219
Selenium	0.05	0.002	0.014	0.004	225
Silver		0.002	0.048	0.008	224
Sodium		9	296	95.6	219
Thallium	0.002	0.001	0.002	0.001	69
Total Dissolved Solids	1000.0 (500.0)	434	1640	563	217
Cyanide	0.2	0.005	0.08	0.01	164
Zinc	(5.0)	0.005	35.1	0.18	225
pH (field)		7.1	9.74	8.01	42
pH (laboratory)	(6.5 - 8.5)	7.01	8.5	7.68	218

NOTE: All units are in mg/l except pH, which is in standard units.
1 - DWS equals primary Nevada drinking water standards and SDWS equals secondary Nevada drinking water standards. The primary standards are those that are enforceable and the secondary standards are those that are recommended. These standards are based on NAC445A.453 and 455.
2 - The current regulatory MCL for arsenic in Nevada is 0.05 mg/l. The federal arsenic MCL was revised to 0.010 mg/l on February 22, 2002. The State of Nevada has not adopted the revised standard and will evaluate the adoption according to state policy set forth for such adoption.
3 - The primary copper and lead standards are regulated by a Treatment Technique that requires systems to control corrosiveness of their water if more than ten percent of the tap water samples exceed the action levels. The action levels for copper and lead are 1.3 mg/l and 0.0015 mg/l, respectively.

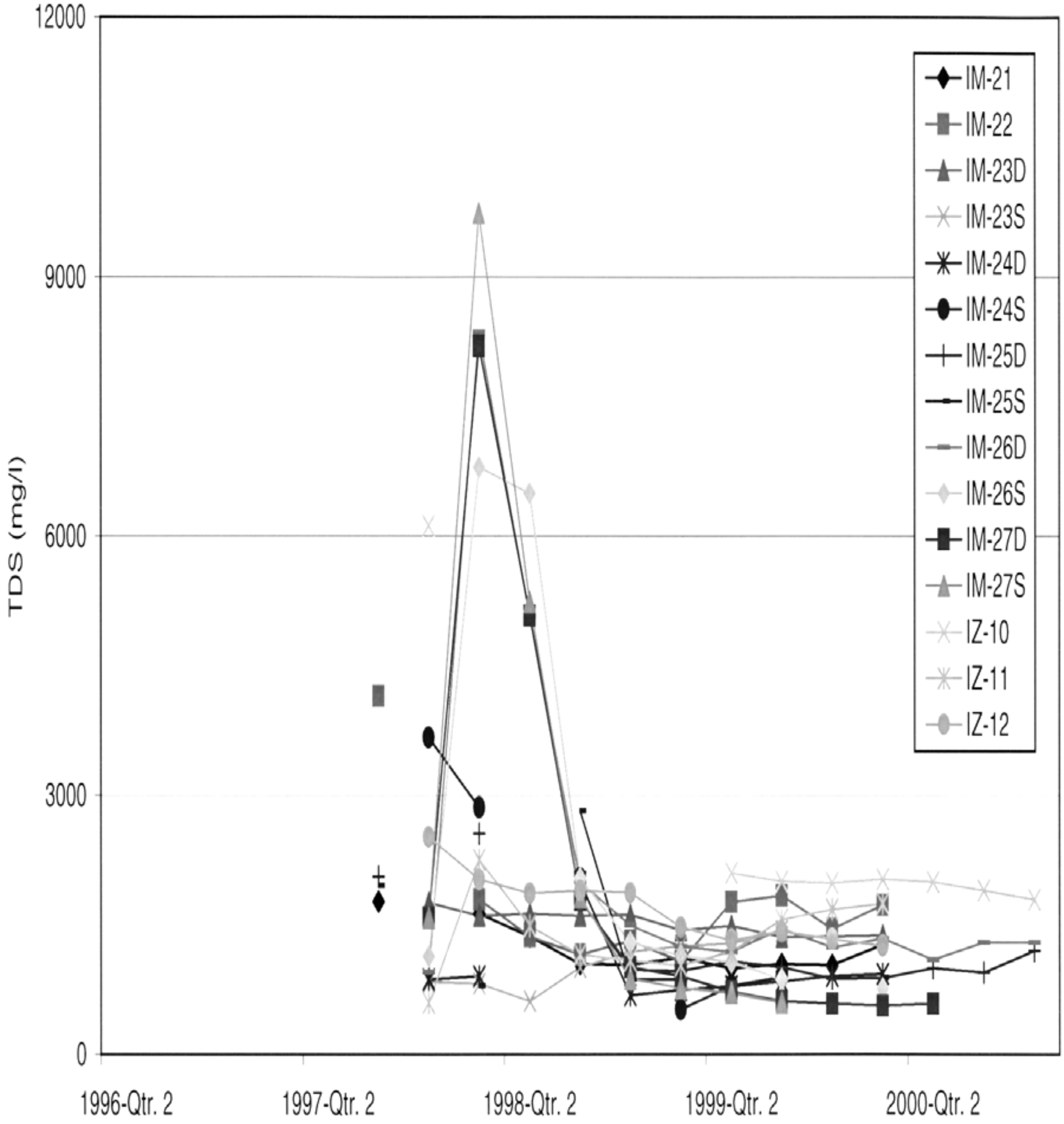

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Figure 4.4.2 TDS at the Frome Infiltraion Site

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4.4.3 Environmental Consequences and Mitigation Measures

The Proposed Action has the potential to impact surface and ground water quality in the Project Area. Potential impacts that may be associated with mining operations similar to the Proposed Action have been identified in the Pipeline Final EIS and the South Pipeline Final EIS (BLM 1996a and 2000a) and through the scoping process for the Project. The magnitude and significance of these potential water resource impacts are evaluated in relation to the Proposed Action (including various stages of development), the Complete Backfill Alternative, the No Backfill Alternative, and the No Action Alternative.

4.4.3.1 Significance Criteria

Criteria for assessing the significance of potential impacts to the quality of water resources in the Project Area are described below. Impacts to water quality resources are considered to be significant if these criteria are predicted to occur as a result of the Proposed Action or the alternatives.

4.4.3.1.1 Surface Water Quality

- Release of mining-related contaminants such as cyanide, or metals such as arsenic and lead, into drainages by spills or flooding that results in soil/sediment contamination in excess of the NDEP standards specified at NAC 445A.2272.1.(c) or release of fuels and lubricants into drainages resulting in soil contamination exceeding the NDEP guidance level (100 milligrams per kilogram [mg/kg] of total petroleum hydrocarbons [TPH]).

- A discharge or change in water quality that results in an exceedance of the applicable DWS standards presented in Table 4.4.1 or specified in NAC 445A.453, or NDEP standards (Table 4.4.3) for aquatic life, irrigation, or livestock or potential beneficial uses in perennial streams, springs, seeps, and the post-mining pit lake.

4.4.3.1.2 Ground Water Quality

- Degradation of natural ground water quality by chemicals such that concentrations exceed DWSs , or render water unsuitable for other existing or potential beneficial uses. For ground water that does not meet DWSs for baseline conditions, degradation would be considered significant where a change in water quality would render the water unsuitable for an existing or potential beneficial use. This criterion is based on NAC 445A.424.

- Degradation of natural soil chemistry by cyanide, trace metals, or other compounds such that concentrations exceed NDEP guidance levels. NDEP guidance levels for soils are based on results of meteoric water mobility testing that are ten times the DWS for each compound. This guidance is designed to protect ground water from contamination by leachate from overlying soils.

Table 4.4.3: Standards for Toxic Materials Applicable to Designated Waters

Chemical	Aquatic Water Quality (µg/l)	Irrigation (µg/l)	Watering Livestock (µg/l)
Antimony	-	-	-
Arsenic	-	100[b]	200[c]
Arsenic(III)	-	-	-
1-hour average	342[a,e]	-	-
96-hour average	180[a,e]	-	-
Barium	-	-	-
Beryllium	-	100[b]	-
hardness≤75mg/l	-	-	-
hardness≥=75mg/l	-	-	-
Boron	-	750[a]	5,000[c]
Cadmium	-	10[d]	50[c]
1-hour average	0.85 exp {1.128In(H)-3.828][a,e]	-	-
96-hour average	0.85 exp {0.7852In(h)-3.490}[a,e]	-	-
Chromium(total)	-	100[c]	1,000[c]
Chromium(VI)	-	-	-
1-hour average	15[a,e]	-	-
96-hour average	10[a,e]	-	-
Chromium(III)	-	-	-
1-hour average	0.85 exp {0.8190In(H)+3.688}[a,e]		-
96-hour average	0.85 exp {0.8190In(H)+1.561}[a,e]		-
Copper	-	200[c]	500[c]
1-hour average	0.85 exp{0.9422In(H)-1.464}[a,e]	-	-
96-hour average	0.85 exp {0.8545In(H)-1.465}[a,e]	-	-
1-hour average	22[a]	-	-
Cyanide	-	-	-
96-hour average	5.2[a]	-	-
Fluoride	-	1,000[c]	2,000[c]
Iron	1,000[a]	5,000[c]	-
Lead	-	5,000[c]	100[c]
1-hour average	0.50 exp {1.273In(H)-1.460}[a,e]	-	-
96-hour average	0.25 exp {1.273In(H)-4.705}[a,e]	-	-
Manganese	-	200[c]	-
Mercury	-	-	10[c]
1-hour average	2.0[a,e]	-	-
96-hour average	0.012[a]	-	-
Molybdenum	19[d]	-	-
Nickel	-	200[c]	-
1-hour average	0.85 exp {0.8460In(H)+3.3612}[a,e]		-
96-hour average	0.85 exp {0.8460In(H)+1.1645}[a,e]		-
Selenium	-	20[c]	50[c]
1-hour average	20[a]	-	-

Chemical	Aquatic Water Quality (µg/l)	Irrigation (µg/l)	Watering Livestock (µg/l)
96-hour average	5.0[a]	-	-
Silver	0.85 exp {1.72In(H)-6.52}[a,e]	-	-
Sulfide			
Undissociated hydrogen sulfide	2[a]	-	-
Thallium	-	-	-
Zinc	-	2,000[c]	25,000[c]
1-hour average	0.85 exp {0.8473In(H)+0.8604}[a,e]		-
96-hour average	0.85 exp {0.8473In(H)+0.7614}[a,e]		-

1 Single concentration limits and 24-hour average concentration limits must not be exceeded. One-hour average and 96-hour average concentration limits may be exceeded only once every three years. See reference a.
2 Hardness (H) is expressed as mg/1 calcium carbonate.
3 If a criterion is less than the detection limit of a method that is acceptable to the division, laboratory results which show that the substance was not detected will be deemed to show compliance with the standard unless other information indicates that the substance may be present.
4 If a standard does not exist for each designated beneficial use, a person who plans to discharge waste must demonstrate that no adverse effect will occur to a designated beneficial use. If the discharge of a substance will lower the quality of the water, a person who plans to discharge waste must meet the requirements of NRS 445A.565.
5 The standards for metals are expressed as total recoverable, unless otherwise noted.
a U.S. Environmental Protection Agency, Pub. No. EPA 440/5-86-001, Quality Criteria for Water (Gold Book) (1986).
b U.S. Environmental Protection Agency, Pub. No. EPA 440/9-76-023, Quality Criteria for Water (Red Book) (1976).
c National Academy of Sciences, Water Quality Criteria (Blue Book) (1972).
d California State Water Resources Control Board, Regulation of Agricultural Drainage to the San Joaquin River: Appendix D, Water Quality Criteria (March 1988 revision).
e This standard applies to the dissolved fraction. (Added to NAC by Environmental Comm'n, eff. 9-13-85; A 9-25-90; 7-5-94; A 11-29-95).

Source: NAC 445A.144, which states, except as otherwise provided in this section, the following standards for toxic materials are applicable to the waters specified in NAC 445A.123 to 445A.127, inclusive, and NAC 445A.145 to 445A.225, inclusive. If the standards are exceeded at a site and are not economically controllable, the commission will review and adjust the standards for the site.

A significant impact of the Proposed Action is indicated where an impact exceeds the threshold of a water quality criterion based on the effects of the Proposed Action alone, or in conjunction with the existing Pipeline/South Pipeline Project (No Action Alternative) if the impact was not significant prior to the Proposed Action. In some instances, the duration of a significant impact might be extended in comparing a Project alternative to the No Action Alternative. An example would be continued use of stockpile or infiltration basin facilities. For the purposes of this assessment, based on the preceding significance criteria, no additional significant impacts are attributed to actions or alternatives that continue to use approved facilities within the existing footprint because impact significance and any pertinent mitigation have already been established. If discharge to infiltration basins produces a temporary increase in solute concentrations under the No Action Alternative and the same alluvial well is affected to the same degree during an additional six years of dewatering for the Proposed Action, the additional duration of the impact is not considered to be significant.

4.4.3.2 Assessment Methodology

The Proposed Action would utilize (and therefore expand) the approved open pit, dewatering and infiltration, tailings and heap leach, ore stock piles, and waste rock pile facilities. Of the facilities, only the waste rock piles and open pits have the potential to impact water resources under the Proposed Action.

The lack of significant risk to existing surface water resources (creeks, seeps, and hot springs) has been documented in the Pipeline Final EIS (BLM 1996a) and South Pipeline Final EIS (BLM 2000a) and would not be altered under the Proposed Action and alternatives considered in this SEIS.

Continued operation of heap leach pads and tailings facilities has the potential to affect both ground water and surface water quality through drainage and/or seepage of process solutions. There is no plan, however, to expand the operational footprint of the existing, approved facilities. Most importantly, impacts to water quality from these sources would be less than significant because the facilities are inherently designed as zero discharge facilities with stringent operational and post-closure monitoring programs, reclamation plans, and performance bonding. Similarly, the ongoing use of existing, temporary ore stockpiles would not result in a change in impact from that discussed in Section 4.4.4 of the Pipeline Final EIS (BLM 1996a, Section 4.4.4, page 4-26) and therefore would not represent a change from currently approved operations.

Temporary increases in solute concentrations that result from dewatering system discharge to the alluvial aquifer through infiltration basins have been demonstrated to be short lived and insignificant in terms of long-term water quality at the Project Area (Geomega 1998e; BLM 1999), and will not be evaluated further in this document.

As discussed in the South Pipeline Final EIS (BLM 2000a), there is potential for spills of fuels, chemical reagents, and hazardous materials to affect water quality. Potential impacts of spills and accidental releases would be rendered less than significant because of preventive and corrective measures that are included in the Spill Prevention Control and Countermeasure Plan (SPCC).

Hydrogeochemical modeling was used to predict post closure pit lake water quality and waste rock seepage volume and quality for the purpose of evaluating the Proposed Action and alternatives. Details of the pit lake modeling are presented in Geomega (1998f) for the currently permitted No Action Alternative and in Geomega (2003a) for the Proposed Action and alternatives. Details of the waste rock seepage evaluation are provided by Geomega in the waste rock evaluation report (2003c). The methods used to evaluate these facilities are summarized briefly below. A supplemental assessment of potential impacts from the revision to the Stage 8 and 9 configurations was completed by Geomega (2004a).

4.4.3.2.1 Waste Rock Characterization and Seepage Prediction

Mining could impact surface water and ground water quality via seepage from stockpiled ore and waste rock piles. Water interacting with reactive minerals in mined rock could result in the formation of acid ARD and/or in the release of metals. Mining activities increase the amount of surface area of minerals, thus promoting reaction with water and air. ARD results from the oxidation of pyrite or other sulfide minerals, where there are not sufficient buffering minerals available to neutralize the acidity. Acidic (pH less than 5) waters enhance the solubility of many metals with potential environmental consequences. Neutral or alkaline leachates (pH > 7) may also contain elevated concentrations of dissolved constituents, such as arsenic or selenium, which can persist under alkaline conditions. Elevated concentrations of trace elements can also develop from the natural weathering of mineralized rock, influencing the natural background (or predisturbance) water quality. If seepage with elevated concentrations of trace elements reaches the water table, levels of dissolved constituents in ground water could increase to levels that exceed NDEP standards. Leachates derived from ore or waste rock can impact surface waters directly, or by depositing metals and other constituents in near-surface sediments within surface drainages that are available for transport and redeposition.

Net Carbonate Value (NCV) analyses were conducted on a total of 80 samples (Figure 4.4.3). A total of 73 geologic composites from exploration drill holes and surface samples were collected from the area to be mined under the Proposed Action. Seven additional surface grab samples collected from the Crescent open pit were also tested (Geomega 2003c, Table 2-2). These samples included all rock types expected to be encountered during mining, including alluvium (46 percent), calcareous siltstone (50 percent), marble (four percent) and skarn (one percent) (Figure 4.4.4).

The NCV test estimates the maximum potential for ARD formation from mined rock as it reacts with water and air. The tests measure the acid-generating potential (AGP), based on the total sulfide content using the assumption that all sulfide present is acid generating pyrite and that all sulfide in the rock is available for reaction. The acid-neutralizing potential (ANP) is measured directly by titration with acid. The ANP is a reflection of the abundance of minerals that can neutralize acidity and buffer pH, such as the carbonate mineral calcite. Samples with three times more ANP than AGP (i.e., an ANP:AGP ratio greater than 3) are considered to have a low potential to generate acid. Samples with an ANP:AGP ratio of less than 1 are considered to have a strong potential to generate acid. The geochemical reactivity of samples that fall between these two categories is uncertain and may have the potential to generate net acidity (BLM 2000a; BLM 1996a).

Results of the NCV analyses are summarized in Figure 4.4.5. All but one sample had an ANP:AGP ratio greater than 3, indicating that the materials were not acid generating (Geomega 2003c). The sample with ANP:AGP less than 3 consisted of skarn (ANP:AGP = 1) that is classified as ore to be processed, and would not be present in significant quantities in the waste rock.

Kinetic testing using the method of Sobek et al. (1978) was performed to further evaluate potential ARD and leachate characteristics under longer term tests that measure the rate of sulfide oxidation and solute release over time. Results of 42 20-week humidity cell tests indicate alkaline leachate with low concentrations of dissolved metals (Geomega 2003c, Appendix A). Chronic exceedances of the selenium DWS (0.05 mg/l) were limited to effluent from one sample of the carbonaceous siltstone in Stage 9 (up to 1.7 mg/l). This sample represents an extreme case for whole rock metals concentrations based on the 2,576 analyses completed since 1992. Therefore, while this material does release selenium when leached, it is representative of a small portion (<0.01 percent) of the pit surface (Geomega 2003c, Figure 3-11). Transient exceedances of the arsenic standard were observed in seven humidity cells, but multiple analyses later in the leaching test measured arsenic in concentrations below pertinent standards (Geomega 2003c). It is therefore unlikely that any of the geologic materials tested would generate ARD or release significant concentrations of metals.

With respect to the potential for generation of ARD, it is also important to note that the Proposed Action is located in an arid environment that receives an average of less than ten inches of precipitation per year. The relatively low precipitation rate reduces the amount of water available to move oxidation products away from their source. Oxidation would continue to occur, but given the very low concentrations of sulfide in the rocks at the Project, the potential for impacted water quality is very low.

To account for site specific effects, such as the arid climate, Geomega (2003c) performed bucket leach tests onsite near the Cortez core shed. These tests were analogous to humidity cell tests except that the samples were placed outside, exposed to ambient conditions, and leachate was collected five times following natural precipitation events. Leachates were alkaline with low solute concentrations (Geomega 2003c, Appendix B). There were no chronic exceedances of criteria for any solute, although transient exceedances of drinking water standards for antimony and arsenic were reported. Most of the antimony was attributed to background conditions (i.e., contamination by dust) since antimony was also detected in the control bucket that contained no rock (Geomega 2003c).

Predicted environmental impacts from the construction of the Pipeline/South Pipeline Pit Expansion Project waste rock dumps are limited to potential sediment generation and transport induced by large storm events. Impacts to surface water, ground water, and soils as a result of solute mobility are extremely unlikely because of limited surface water in the waste rock dump area, limited percolation, and leachate water chemistry with low levels of constituents. Under ambient conditions, water and solid material from the waste rock dumps are unlikely to be transported from the dump location except in the form of runoff and sediment generated by ten-year and 100-year storm events. The runoff water quality meets the drinking water standards and the sediment is physically and chemically similar to the alluvium in the area to which the runoff would be potentially relocated (Geomega 2003c).

The oxidation modeling indicates that most of the potential solutes in the waste rock dump would be available for leaching. However, the leachate chemistry derived from the waste rock meets the drinking water standards and is of higher quality than the local background ground water. In addition, the results of the percolation modeling indicate that the limited volume of water incident to the dump area is insufficient to transport solutes from the waste rock dump to the local ground water 340 feet below the ground surface (Geomega 2003c).

4.4.3.2.2 Pit Lake Water Quality Prediction

After mining operations cease, ground water would eventually refill the open pit to an elevation approaching that of the surrounding water table, thus forming a post-mine pit lake. This is true for all of the evaluated alternatives, although various pit and backfill configurations would create lakes of varying depths and surface area, with minor differences in relative sources of influent water and solute loading.

A hydrogeochemical model was developed to predict post-closure pit lake water quality for the Proposed Action and each alternative. Details of the modeling completed for the approved South Pipeline open pit (the No Action Alternative) are presented in the South Pipeline Final EIS (BLM 2000a) and Geomega's Pit Lake Water Quality Prediction report (1998c). This model was revised using a higher evaporation rate based on recently collected data, as part of the required five-year update for the Pipeline/South Pipeline pit water chemistry assessment (Geomega 2003b and 2003d). The hydrogeochemical modeling completed for the Proposed Action is described fully in Geomega's Pit Lake Chemistry Assessment (2003b). The modeling approach, methods, and results are summarized below.

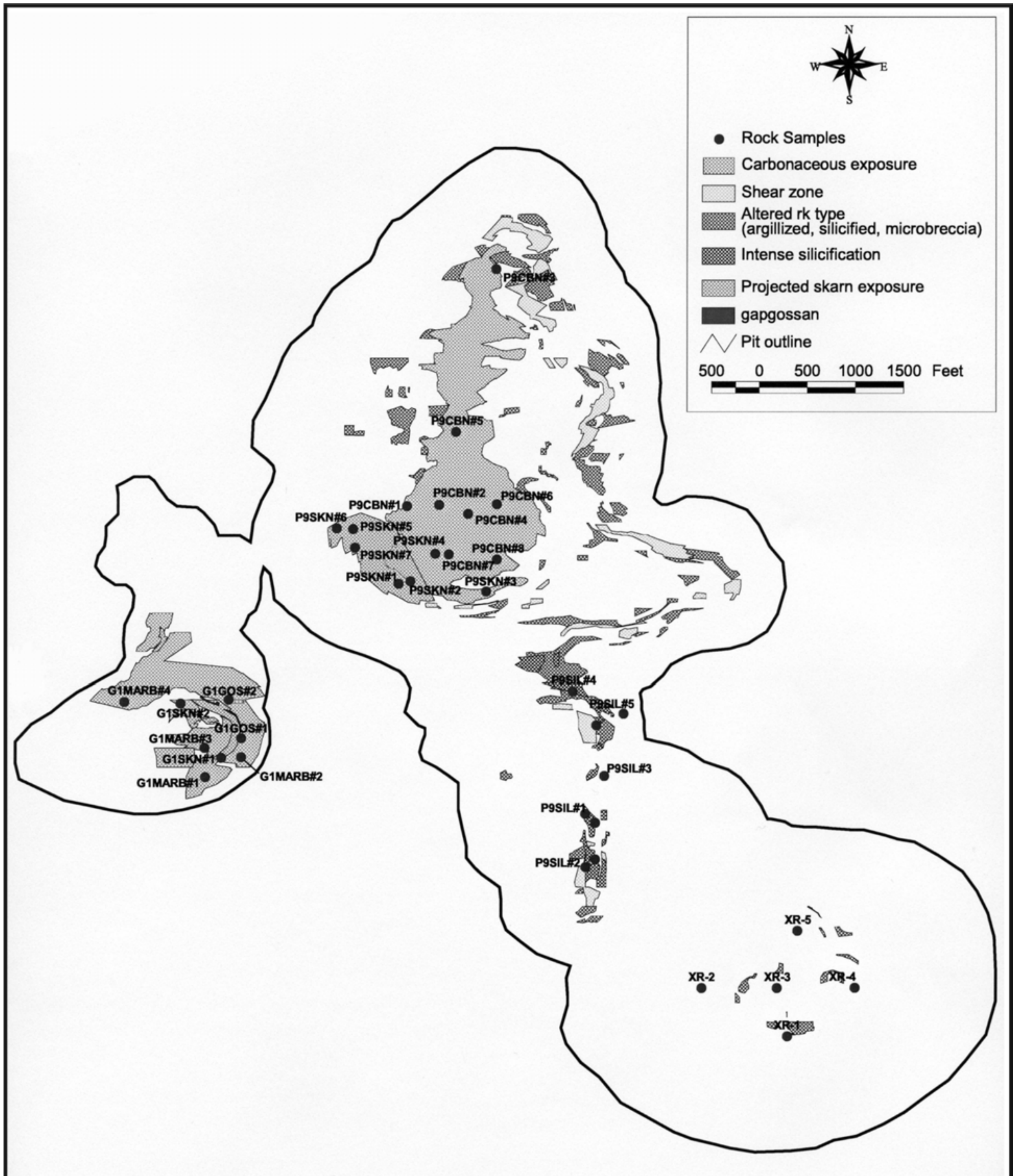

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Figure 4.4.3 Location of Pipeline/South Pipeline Pit Expansion Rock Samples

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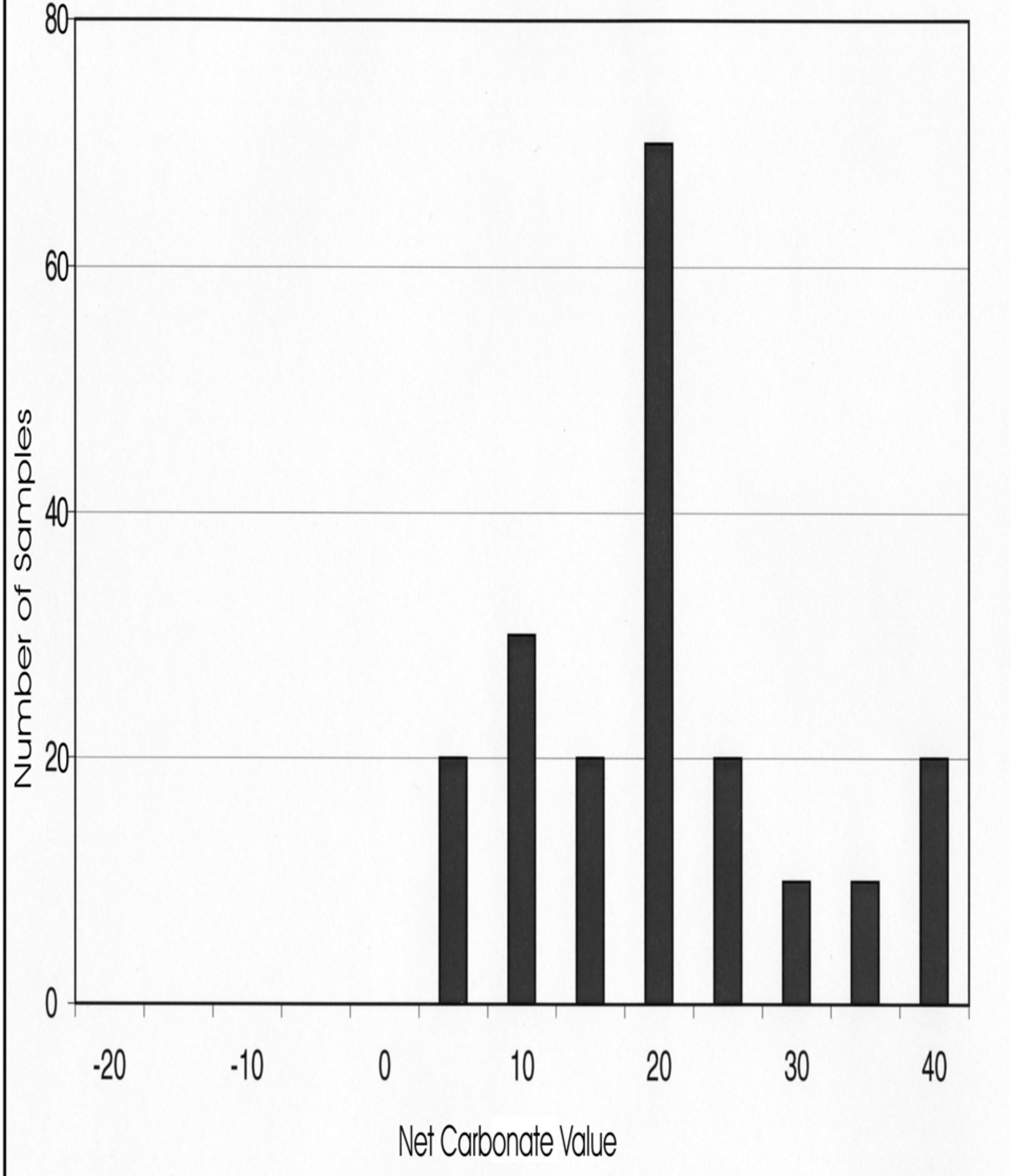

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Figure 4.4.4 Net Carbonate Value Distribution of Pipeline/South Pipeline Pit Expansion Lithologies

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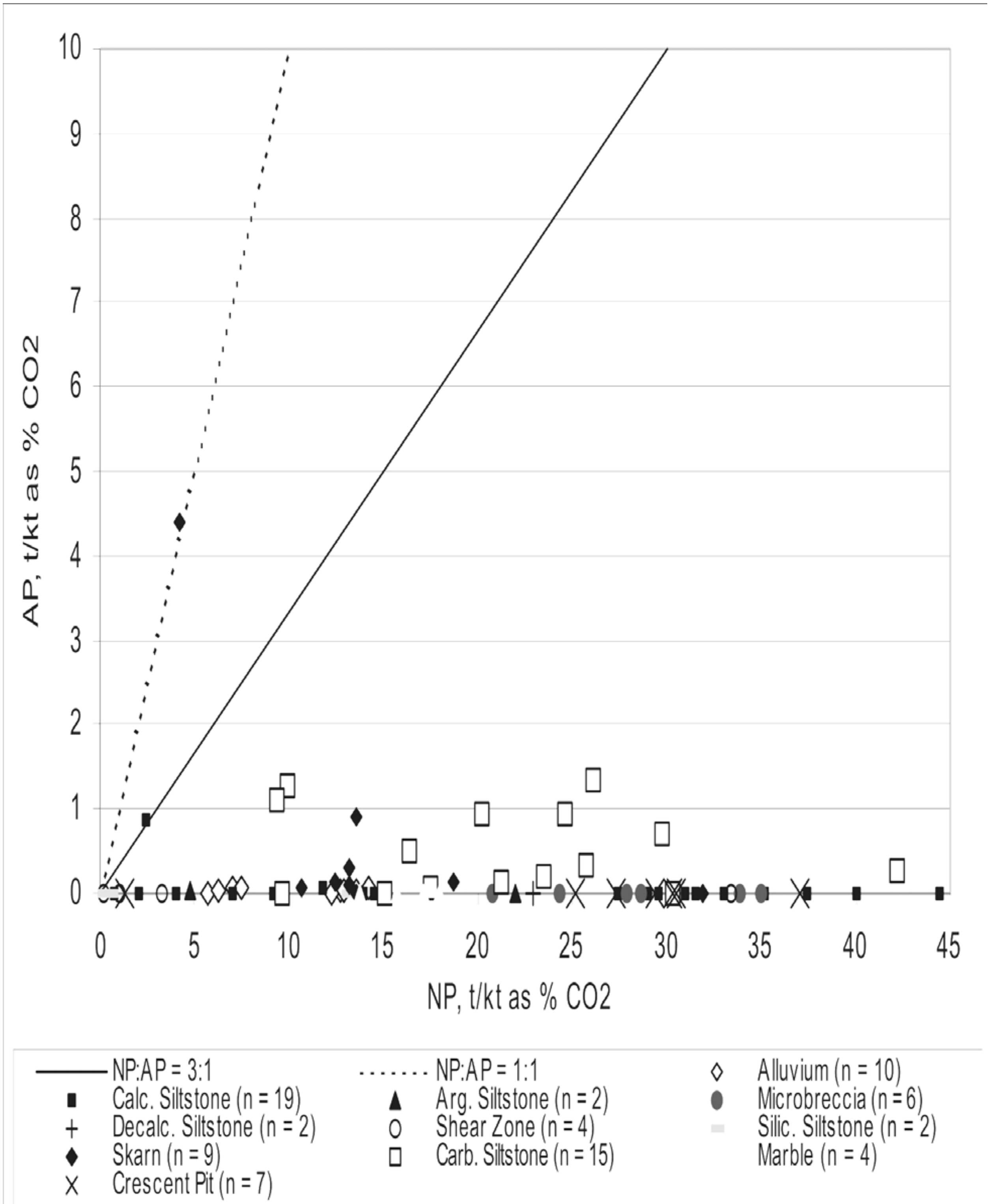

Figure 4.4.5 Comparison of ANP and AGP Characteristics by Lithology, Pipeline/South Pipeline, n=number of samples

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4.4.3.2.3 Pit Lake Hydrogeochemical Modeling

Model simulations were run for the Proposed Action (including the individual stages that comprise the Proposed Action), the Complete Backfill Alternative, the No Backfill Alternative, and the No Action (currently permitted) Alternative.

Pit lake chemistry evolves from the mixing of several different sources of water, as well as chemical processes that act on the solution, as shown schematically in Figure 4.4.6. Among the different sources of water are the solutions derived from dissolving the oxidation products of final pit wall weathering, which include the products of pyrite oxidation and metal leaching, and both bedrock and alluvial ground water. Rainfall directly onto the pit lake is exceeded by evaporation in the arid climate of the Project Area.

Modeling results from ground water predictions, developed using MODFLOW (HydroGeoLogic 1996), were coupled with results from the Fennemore-Neller-Davis (FND) model of pyrite oxidation (Fennemore et al. 1999), which was calibrated using site-specific laboratory humidity cell test data. Mixing of influent water, aqueous speciation and calculation of solubility and sorption controls of solute concentrations were accomplished using the USGS-supported geochemical model PHREEQC (Parkhurst 1995). The limnological model CE-QUAL-W2 (Cole and Wells 2002) was used to evaluate oxygen profiles, lake turnover, and mixing, which influence temperature and concentrations of dissolved gases in the lake. These factors in turn control the pH and oxidation status of the water that determines mineral precipitation and sorption. Results from CE-QUAL-W2 were therefore used to control chemical conditions such as temperature, pH, and redox potential imposed in the PHREEQC model calculations. Information from model components was organized using the PITQUAL modeling code (Davis et al. 2002). Each of the described model components has been validated previously through peer review and applied to similar predictions of post-mine open pit water quality.

Acid-generation and significant solute release from pit wall rock to be mined under the Proposed Action is not likely. Static and kinetic geochemical test results showed that samples of alluvium and bedrock from the proposed open pit area have low acid-producing potential and moderate to high neutralization potential. Field experiments also indicate that the rock walls have high acid-buffering capacity (Geomega 2002a, 2003b and 2003c). Based on these data, the pit lake has a low potential to become acidic. This generally applies to all of the alternatives discussed below, although the ratio of water contributed by specific lithologies does vary between alternatives.

The pit surface resulting from the Proposed Action would be comprised of 28 percent alluvium, 52 percent calcareous siltstone, and 17 percent carbonaceous siltstone with minor skarn, marble, and altered siltstones. This would vary depending upon the stage of development within the Proposed Action, but would remain constant between the complete Proposed Action, Complete Backfill and No Backfill Alternatives. The relative inflow from various lithologies and backfilled waste rock would vary over time, depending upon the stage of operations, filling history, and location. Changes in influent water sources and chemistry were considered in the modeled water quality predictions for the Proposed Action and alternatives.

Prior to mine dewatering, ground water in the proposed open pit area flowed in an easterly or southeasterly direction. The pit lake(s) that would develop under the evaluated alternatives would be expected, for the most part, to act as ground water sinks with all ground water moving toward the lake and being removed via evaporation. After the open pit fills, forming a lake(s), it is possible that a very small amount of ground water could migrate from the open pit into the surrounding aquifer under some alternatives. If the open pit water quality constituent concentrations increase as predicted, ground water dissolved constituent concentrations downgradient (east) of the open pit could also increase. The potential for this to occur has been evaluated for each alternative.

Over time, the chemistry of the pit lake would evolve as the ground water rebounds and post-mining ground water flow gradients become less steep. As the lake fills, the ratio of inflow from key lithologies would shift and constituents would be depleted from the weathered pit rim and backfilled waste rock surfaces, so that after ten years, water quality would be controlled more by the chemistry of the ground water than by the weathered pit rim. The modeling incorporated site-specific data from field experiments and laboratory tests to predict the rate of sulfide oxidation and chemical release for key highwall and waste rock lithologies that would contribute water to the lake over time. Chemical loading from the highwall was calculated based on the period of exposure to oxygen predicted by the fracture density and the rate of open pit filling in response to ground water flow. The entire mass of backfilled waste rock was conservatively assumed to be available to contribute solutes to the pit lake. Humidity cell tests of sulfide oxidation for key lithologies were conducted using materials with a range of particle sizes, to evaluate the sensitivity of the predicted loads to the particle size of rock leached in the laboratory test. Field tests involving bucket leach tests and monitoring of an analog pit lake were used to compare laboratory test results with field observations. Field tests showed generally lower rates of constituent release than laboratory tests (Geomega 2003b). Chemical loading for the open pit model was calculated using the most conservative humidity cell test results obtained for relatively fine-grained rock.

Evaporation of water from the pit lake surface would concentrate dissolved constituents in solution, and precipitation and adsorption would remove some dissolved constituents from the pit lake water. Minerals known to have precipitated in the former Cortez pit lake were used as precipitates in the expansion pit lake model, including amorphous iron oxide, calcite, gibbsite, barite and manganite (Geomega 2003b). As these minerals precipitate and form a sludge on the floor of the pit lake, a number of trace elements have the potential to sorb onto the iron oxide surface and thus be removed from the pit lake water. Sorption of a number of trace metals was calculated for the expansion pit lake alternatives, but due to the low expected rate of pyrite oxidation, only a small amount of iron would be released to the lake. Therefore, there is relatively little predicted iron oxide precipitation and associated sorption predicted for the Proposed Action pit lakes.

The modeling analysis indicates that evapoconcentration over time is the dominant factor affecting the geochemical evolution of post-mining pit lake water quality. Water quality was modeled for a period of 100 years for each alternative, roughly the time frame required for the pit lake(s) to reach full stage, steady state hydrologic conditions. Evapoconcentration during this time is quantified by calculation of an evapoconcentration factor, representing the ratio of the total volume of water entering the open pit to the volume of the lake after evaporative losses. For the most part, the open pit lake would behave as a sink, with the ground water flowing into the lake being removed only by evaporation from the lake surface. Under these conditions, some solute concentrations would remain constant in equilibrium with the minerals that precipitate, while others would increase under the influence of evaporative concentration. For example, calcium and associated co-precipitated manganese, magnesium, barium, and zinc concentrations, would be limited by equilibrium with calcite. Dissolved iron concentration would be controlled by equilibrium with precipitated iron

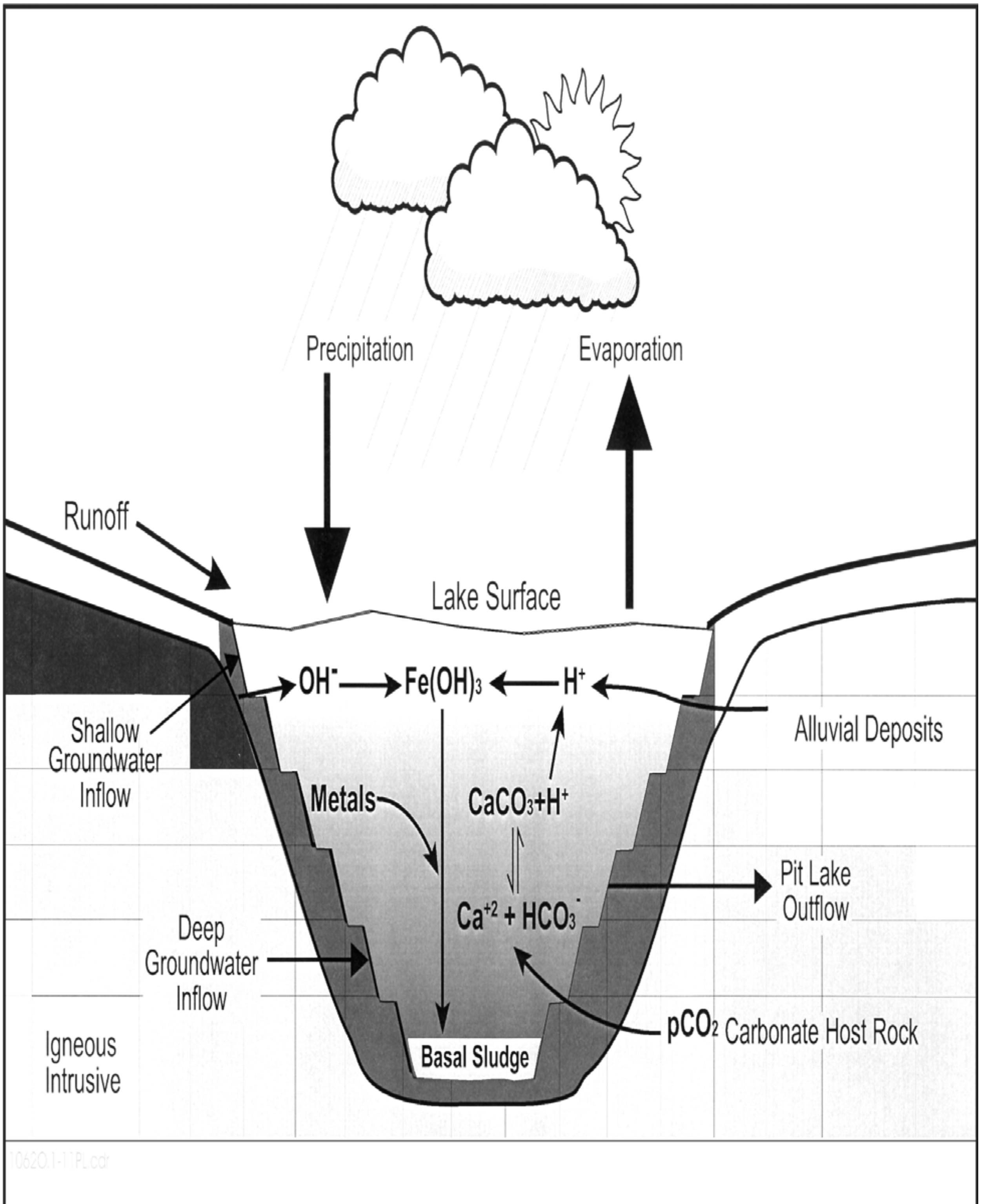

Figure 4.4.6 Conceptual Model of Pit Lake Chemistry Evolution

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oxyhydroxide. Conversely, sulfate and sodium are not limited by secondary mineral solubility and would be expected to increase in concentration over time. Longer term chemistry was not modeled but was instead evaluated by comparison with the chemistry of open pit dewatering water, which was evaporated to dryness in the laboratory (Geomega 2003b). Elements that would be expected to increase in the very long term, as ground water is concentrated by evaporation, include both major ions (chloride, nitrate, sulfate, potassium, magnesium, and sodium) and some trace elements (silver, arsenic, mercury, antimony, selenium, and zinc).

Prediction of water quality, based on forward-looking hydrogeochemical models, relies heavily on input data and assumptions, some of which influence model predictions more directly than others. Uncertainty in modeled predictions was reduced through conservative use of site-specific laboratory and field geochemical data. Models were appropriately calibrated to literature and field data for comparable systems. The predictions for the Proposed Action and alternatives at 20 years after mining ceases, agree well with water quality monitored in the Cortez pit lake after 20 years (Geomega 2003d).

Several elements of conservatism were incorporated into the modeling through the application of input data and assumptions. These include using loading factors that were based on the following: 1) laboratory leach tests of finer grained material, when field data from the open pit analog test indicated that lower concentrations that comply with most standards are likely for coarser rock; 2) use of a sulfide-oxidation based model to calculate the mass of available reactive rock, which for a low sulfide system predicts a very large mass of reactive rock; 3) assumption of atmospheric oxygen concentrations in highwall fractures; 4) assumption of a low sorption site density for precipitated iron oxyhydroxide minerals; 5) assumption of a limited suite of secondary minerals; and 6) the addition of background ground water concentrations to the loads predicted based on laboratory tests, which in many cases were below ground water concentrations.

Sensitivity analyses completed using the hydrogeochemical model (Geomega 1998f, Appendix F) estimate the remaining uncertainty in predicted analyte concentrations due to modeling assumptions for this complex interactive hydrogeochemical system. Sensitivity calculations were completed for changes in redox conditions, changes in carbon dioxide gas concentrations that influence pH and analyte solubility; degree of solid phase saturation (as an indicator of equilibrium), changes in sorption resulting from variation in iron oxyhydroxide substrate availability; and variation in evaporation. Results of these sensitivity analyses demonstrate that evapoconcentration is the dominant factor controlling predicted concentrations.

Impact significance is based on comparison of the simulation results to the significance criteria defined above for water quality. NDEP regulations (NAC 445A.446) limit post closure monitoring to 30 years or less. NDEP staff currently consider five-year plans with annual assessment of monitoring needs. NDEP aquatic toxicity standards apply only to classified surface waters (i.e., perennial streams) and would not be applicable to the pit lake water quality. According to NDEP guidance, aquatic wildlife water quality standards are not applied to mining project waters; therefore, predicted pit lake water quality is compared in this section to standards for human health (drinking water, NDEP Profile 1). In addition, avian and terrestrial water quality standards would be applicable (BLM 2000a, Section 4.9, page 4-131) addresses potential water quality impacts to wildlife, including impacts relative to terrestrial and avian wildlife as referenced in NAC445A.429.

4.4.3.3 Proposed Action

Very limited quantities of waste rock seepage are expected to result from the Proposed Action in the very arid climate of the Crescent Valley. Evaporation also causes most water into the pit lakes to be removed through the lake surface, so that very little water (less than two percent) would flow through the open pit into downgradient ground water. As a result, no discharge to surface water is expected to occur as a result of the Proposed Action.

4.4.3.3.1 Potential Water Quality Degradation Due to Waste Rock Seepage

Based on the waste rock characteristics and the arid conditions, which strongly limit the amount of infiltration into waste rock piles, the impacts to water quality from waste rock are considered to be less than significant. The water balance model for the waste rock piles, along with in-situ monitoring of water movement in existing piles, indicates that infiltration is unlikely to move below the upper four feet of the pile, effectively preventing the formation of seepage. Compared to the No Action Alternative, a lower volume of waste rock would be placed in the waste rock piles due to partial backfilling. Additional mining under the Proposed Action would, therefore, reduce, rather than increase, any waste rock seepage. The extent to which this is true would vary depending upon the extent of backfilling at any given stage of production (Stage 8, 9, 10, 11, or 12, see Figures 4.4.7 and 4.4.8).

Impact 4.4.3.3.1: There is a net positive impact compared to the No Action Alternative.

Significance of the Impact: The impact is positive compared to the No Action Alternative. No mitigation measures are required.

Residual Impact: No residual impact is predicted to result from waste rock seepage under the Proposed Action.

4.4.3.3.2 Potential Impacts Due to Pit Lake Water Quality

The Proposed Action is comprised of several stages of open pit development and backfill placement, which results in changes to the post-mine pit lake depth and surface area over time. Modeling results are described in detail by Geomega (2003a). Predicted post-mining open pit water quality under the Proposed Action (with the various stages) is shown with both DWSs and ambient water quality criteria in Table 4.4.4 for 100 years after dewatering ceases. Results for the No Action (the currently permitted pit lake), No Backfill, and Complete Backfill Alternatives are also summarized in Table 4.4.4, and are discussed individually below. The supplemental assessment of the Stages 8 and 9 push back, relative to the rock types that would be present in the pit walls, indicates that the only new rock type consists of a minor amount of thermally-altered rock (skarn). A review of test work on the skarn rock type (Geomega 2003b, Section 3.4 and Appendix A) indicates that substitution of this rock type for the corresponding exposed lithologies in the previously analyzed pit would not perceptibly change the predicted solute concentrations for evolved pit lake water (Geomega 2004a).

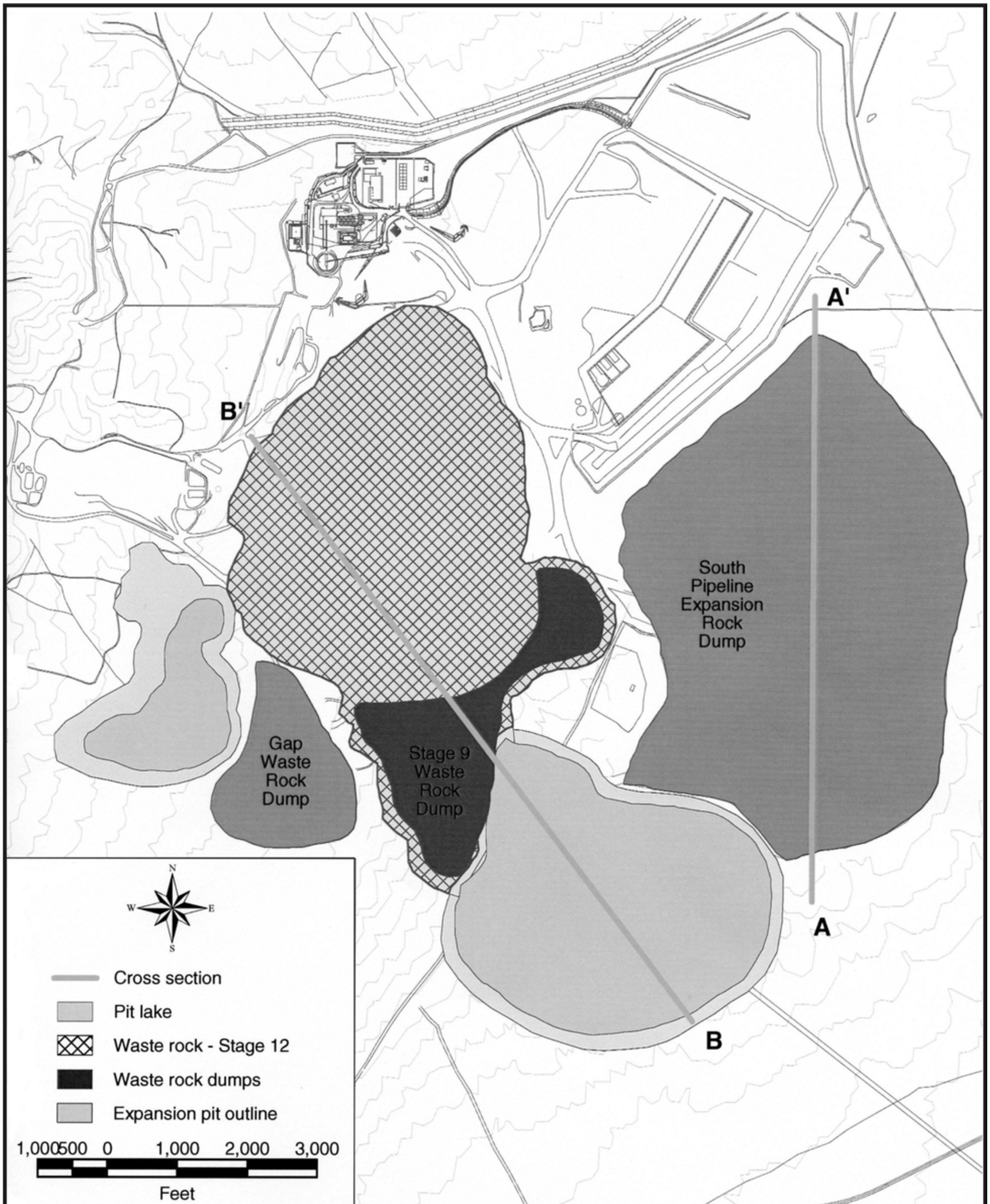

Figure 4.4.7 Location of the Pipeline/South Pipeline Pit Expansion and Stage 9 Waste Rock Dumps

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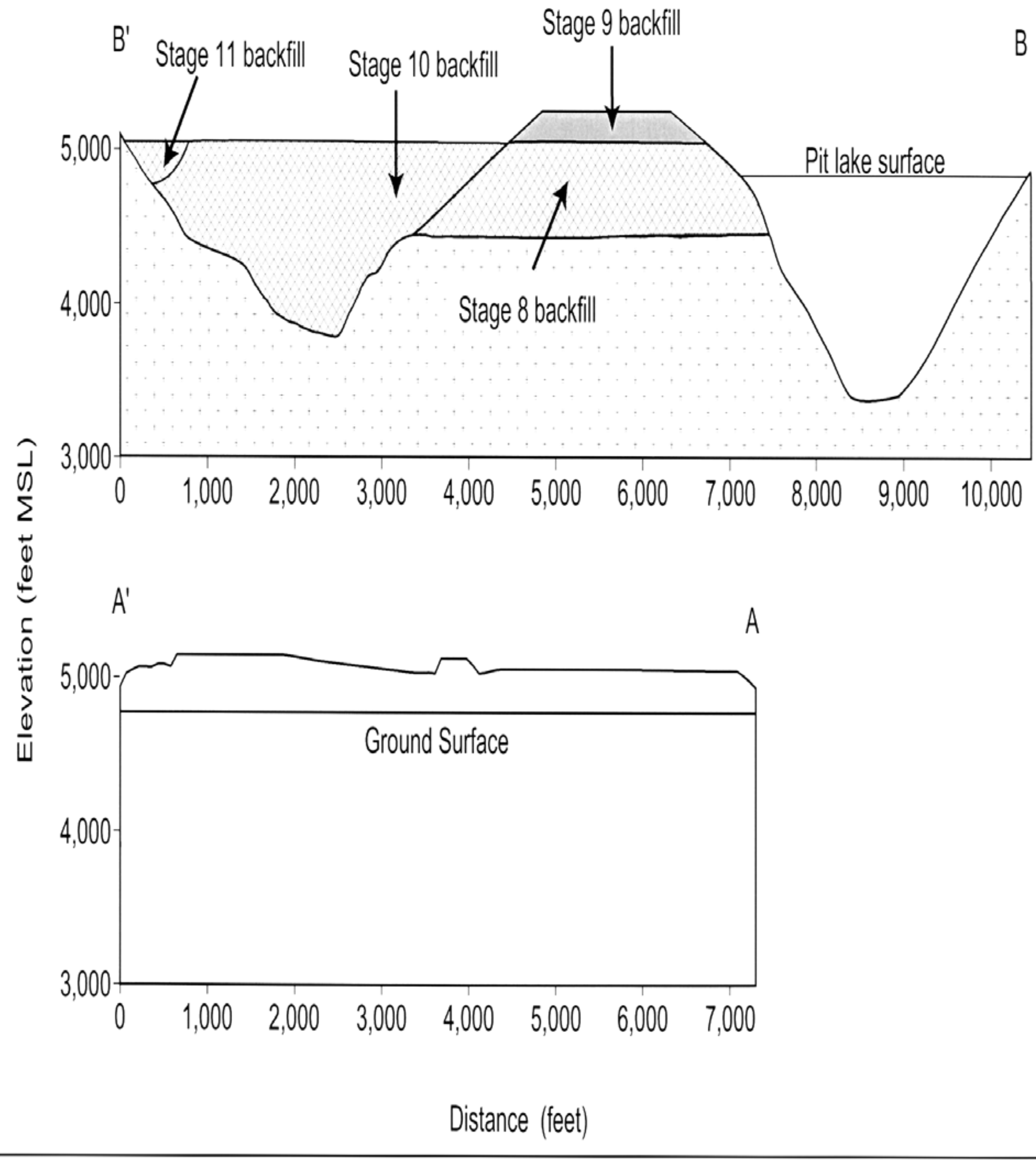

Figure 4.4.8 Cross Sections of the Pipeline/South Pipeline Expansion and Stage 9 Waste Rock Dumps

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Table 4.4.4: Comparison of Mature Pit Lake Chemistry 100 Years After Mining to Water Quality Standards[1]

	State Drinking Water Standards Primary (Secondary)	Ambient Water Quality Criteria[2]	Stage 8 Pipe / S. Pipe	Stage 9 Pipe / S. Pipe	Stage 10 Pipe / S. Pipe	Stage 10 Crossroads	Stage 11 Pipe / S. Pipe	Stage 11 Crossroads	Stage 11 Gap North	Stage 11 Gap South	Stage 12 Crossroads	Stage 12 Gap	No Action Pipe / S. Pipe	No Backfill Main	No Backfill Gap	Complete Backfill Crossroads
pH	6.5 - 8.5		8.39	8.41	8.36	8.43	8.39	8.42	8.31	8.43	8.42	8.40	8.40	8.44	8.39	8.43
Alkalinity			276	290	260	301	278	290	225	314	292	282	289	308	281	295
Silver		0.00012	**0.001**	**0.002**	**0.001**	**0.003**	<0.001	**0.003**	<0.001	**0.002**	**0.003**	**0.002**	**0.001**	**0.003**	**0.002**	**0.003**
Aluminum			0.037	0.025	0.025	0.023	0.029	0.019	0.024	0.029	0.020	0.023	0.032	0.022	0.025	0.020
Arsenic[3]	0.05/0.010	0.048	**0.045**	**0.039**	**0.038**	**0.027**	**0.042**	**0.023**	**0.038**	**0.049**	**0.024**	**0.036**	**0.044**	**0.033**	**0.034**	**0.025**
Barium	2		0.013	0.014	0.014	0.016	0.013	0.017	0.018	0.013	0.017	0.015	0.013	0.015	0.015	0.017
Beryllium	0.004		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium			22	20	24	17	22	17	27	18	17	20	21	17	20	17
Cadmium	0.005	0.011	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Chloride	400.0(250.0)		107	87	90	45	107	41	61	99	42	75	105	59	73	43
Chromium	0.1	0.21[4]	0.010	0.007	0.004	0.002	0.004	0.002	0.002	0.003	0.002	0.002	0.004	0.003	0.002	0.002
Copper	(1.0)		0.004	0.003	0.003	0.001	0.003	0.001	0.002	0.003	0.001	0.002	0.003	0.002	0.002	0.001
Fluoride	4.0(2.0)		**5.25**	**5.13**	**4.51**	**4.53**	**5.09**	**4.24**	3.00	**5.46**	**4.32**	**4.59**	**5.36**	**4.85**	**4.47**	**4.39**
Iron	0.6(0.3)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury	0.002	0.000012[5]	**0.000019**	**0.000024**	**0.000018**	**0.000032**	**0.000019**	**0.000030**	**0.000015**	**0.000029**	**0.000031**	**0.000025**	**0.000023**	**0.000032**	**0.000026**	**0.000032**
Potassium			31	31	27	29	30	27	18	34	27	29	32	30	28	28
Magnesium	150.0(125.0)		54	50	46	40	53	38	34	56	38	46	55	45	45	39
Manganese	0.1(0.05)		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrate	10		1.47	1.23	1.22	0.67	1.41	0.62	0.75	1.25	0.63	0.99	1.40	0.84	0.94	0.64
Sodium			223	206	191	163	221	150	134	229	153	185	226	181	182	156
Nickel	0.1	0.16	0.005	0.003	0.001	0.002	0.001	0.002	0.001	0.001	0.002	0.001	0.001	0.002	0.001	0.002
Lead		0.0032	0.003	0.003	0.003	0.002	0.003	0.002	0.002	0.003	0.002	0.002	0.003	0.002	0.002	0.002
Sulfate	500.0(250.0)		391	351	331	262	379	241	230	385	244	311	391	296	306	251
Antimony	0.006	1.6	0.005	0.004	0.004	0.003	0.005	0.003	0.003	0.005	0.003	0.004	0.005	0.003	0.004	0.003
Selenium	0.05	0.035	0.001	0.006	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.002	0.003	0.011	0.002	0.012
Thallium	0.002	0.04	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Zinc	(5.0)	0.11	0.029	0.031	0.026	0.035	0.028	0.033	0.019	0.035	0.033	0.030	0.031	0.035	0.030	0.034
TDS	1,000.0(500.0)		**1105**	**1035**	970	855	**1090**	802	728	**1133**	811	947	**1119**	933	935	826

[1] All values in mg/l.

[2] Ambient Water Quality Criteria are aquatic water quality standards.

[3] The current regulatory MCL for arsenic in Nevada is 0.05 mg/l. The federal arsenic MCL was revised to 0.010 mg/l on February 22, 2002. The State of Nevada has not adopted the revised standard and will evaluate the adoption according to state policy set forth for such adoption.

[4] Standard is for Cr(VI). Reported concentrations are total Cr, approximately 60 percent Cr(III) / 40 percent Cr(VI).

[5] Ecological risk is related to methylmercury which has a standard of 3 ng/l. Reported concentrations are total Hg. Methylmercury concentrations will be <0.5 ng/l in all cases.

Stage 12

When complete, the pit lakes resulting from Stage 12 of the Proposed Action are expected to function as sinks, with little ground water throughflow into downgradient ground water (Geomega 2003a). Under Stage 12 of the Proposed Action, the ground water throughflow is expected to be ten acre-feet per year. In comparison with the No Action Alternative, the Stage 12 Proposed Action pit lakes would be generally deeper and surface area would be reduced through placement of backfill, with a smaller surface area to volume ratio which would result in a somewhat lower evapoconcentration factor over time. At 100 years after mining, the evapoconcentration factor is 1.58 for the Stage 12 Crossroads open pit, and 1.38 for the Stage 12 Gap open pit under the Proposed Action, compared with 1.94 for the No Action Alternative.

The expected pit lake chemistry under Stage 12 of the Proposed Action is described first. Two pit lakes would result from Project activities through Stage 12: one in the Gap open pit and one in the Crossroads open pit. During the first 25 years of open pit inundation under the Stage 12 of the Proposed Action, pH of the pit lake in the Crossroads open pit is predicted to range from 8.25 to 8.34, and after 100 years pH is predicted to stabilize at 8.42 as the result of equilibration with calcite. In the Gap open pit, pH of the pit lake during the first 25 years is expected to range from 8.01 to 8.30, and after 100 years pH is predicted to stabilize at 8.40. At 100 years, the TDS of the pit lake in the Crossroads open pit is expected to be 811 mg/l, and the TDS of the pit lake in the Gap open pit is expected to be 947mg/l. For comparison, after 100 years the TDS of the single pit lake in the No Action Alternative is expected to be 1,119mg/l. At 100 years after dewatering ceases, concentrations of individual constituents are generally expected to meet Nevada primary drinking water standards. However, modeled fluoride concentrations (4.59 mg/l in the Gap open pit and 4.32 mg/l in the Crossroads open pit) exceed primary drinking water standards, but are predicted to be lower than fluoride concentrations for the No Action Alternative (5.36 mg/l). These exceedances result primarily from evapoconcentration of solutes derived from ground water, rather than from leaching of the exposed open pit highwall or backfill.

Predicted concentrations of arsenic in both of the pit lakes of Stage 12 are less than the present (2003) DWS of 0.05 mg/l (NAC 445A.453 and 455). The current regulatory maximum contaminant level (MCL) for arsenic in Nevada is 0.05 mg/l. The federal arsenic MCL was revised to 0.010 mg/l on February 22, 2002 and is currently scheduled for implementation in January 2006. The State of Nevada has not adopted the revised standard and will evaluate the adoption according to state policy set forth for such adoption. Therefore, for regulatory purposes under the Safe Drinking Water Act (SDWA) and other regulatory programs in Nevada incorporating MCLs by reference, the current enforceable standard is 0.05 mg/l. Additionally, the EPA has issued formal language stating that the revised arsenic MCL and the science used to develop the revision pertain solely to the risks evaluated for the SDWA purposes, and that careful evaluation is needed when using the revised MCL outside of the SDWA. The predicted arsenic concentration in both of the Project pit lakes exceeds the 2006 standard. The main source of the arsenic is naturally-occurring arsenic present in the ground water of the Project Area. Most area ground water exceeds the 2006 standard. The initial arsenic concentrations increase over time in the predictive model due to evaporation of water from the pit lake.

Under Stage 12 of the Proposed Action, predicted pit lake concentrations, apart from mercury and silver, do not exceed ambient water quality criteria (Table 4.4.4). After 100 years, mercury is modeled to be concentrated by evapoconcentration to a concentration of 31 nanograms per liter (ng/l) in the Crossroads pit lake and 25 ng/l in the Gap pit lake. After 100 years, silver is modeled to be at a concentration of 0.003 mg/l in the Crossroads pit lake and 0.002 mg/l in the Gap pit lake. However, although some naturally-occurring silver exists in area ground water, the silver concentrations are partially an artifact of the modeling process which assumes an initial concentration of one-half of the detection limit (0.0005 mg/l) whenever silver was not detected, and that modeled value is then concentrated over time by evaporation. The modeled minimum initial concentration of one half of the detection limit for silver (0.00025 mg/l) is already double the ambient water quality standard (0.00012 mg/l). However, it should be noted that the modeled values of both silver and mercury exceed those actually measured in similar pit lake systems due to modeled evapoconcentration of the input values (for naturally-occurring mercury and silver, and for assumed minimum concentrations where not detected) in ground water. For comparison, after 100 years, the modeled concentration of mercury for the single pit lake in the No Action Alternative is 23 ng/l and the modeled concentration of silver is 0.001 mg/l. All these values exceed the aquatic life criterion for either element, although less than two percent of the total mercury concentration is expected (based on monitoring in other post mine pit lakes) (Geomega 2003b, Table 6-5) to occur in the more bioavailable and toxic methylmercury form. Methylmercury concentrations measured in the studied pit lakes are less than 0.5 ng/L, below both the aquatic life criterion and the ecological risk threshold of 3.0 ng/l (Geomega 2003b).

As discussed for the permitted South Pipeline pit lake, the predicted Proposed Action pit lake chemistry would evolve in the distant future to a chemistry that approaches that of many of the natural lakes of the arid western United States where evaporation is a dominant process (BLM 1996a, Table 4.4-6). Such lakes are alkaline, with pH values often above 9.0 and TDS concentrations usually above 3,000 to 5,000 mg/l. The rate at which other dissolved solutes would increase to levels that exceed standards varies from element to element within each alternative, and many elements would remain below standards even at evapoconcentration factors that exceed 30, over time frames in excess of 1,000 years.

Stage 11

When complete, the pit lakes resulting from the Stage 11 of the Proposed Action would be expected to function as sinks, with little ground water throughflow into downgradient ground water (Geomega 2003a). Under Stage 11 of the Proposed Action, the ground water throughflow is expected to be 29 acre-feet per year. In comparison with the No Action Alternative, the Stage 11 pit lakes would be deeper and surface area would be reduced through placement of backfill, with a smaller surface area to volume ratio which would result in a somewhat lower evapoconcentration factor over time. For example, at 100 years after mining, the evapoconcentration factor is 1.7 for the Stage 11 Pipeline/South Pipeline pit lake, compared with 1.94 for the No Action Alternative (Geomega 2003b).

Four pit lakes would result from Project activities through Stage 11, one in each of the following locations: the Gap North open pit, the Gap South open pit, Pipeline/South Pipeline open pit and the Crossroads open pit. After dewatering has ceased for 25 years under the Stage 11 of the Proposed Action, pH in the pit lake in the Gap North open pit is predicted to be 8.25, and after 100 years the pH is predicted to be 8.31. In the Gap South open pit, after dewatering has ceased for 25 years the pH of the pit lake is expected to be 8.32, and after 100 years the pH is predicted to be 8.43. In the Pipeline/South Pipeline open pit, after dewatering has ceased for 25 years the pH of the pit lake is expected to be 8.30, and after 100 years the pH is predicted to be 8.39. In the Crossroads open pit, after dewatering has ceased for 25 years the pH of the pit lake is expected to be 8.34, and after 100 years the pH is predicted to be 8.42. At 100 years, the TDS of the pit lake in the Gap North open pit is expected to be 728 mg/l, the TDS of the pit lake in the Gap South open pit is expected to be 1,133 mg/l, the TDS of the pit lake in the Pipeline/South Pipeline open pit is expected to be 1,090 mg/l, and the TDS of the pit lake in the Crossroads open pit is expected to be 802 mg/l. For comparison, after 100 years the TDS of the single pit lake in the No Action Alternative is expected to be 1,119 mg/l and the pH is predicted to be 8.40. At 100 years after dewatering ceases, concentrations of individual constituents are generally expected to meet Nevada primary drinking water standards. However, modeled fluoride concentrations (3.0 mg/l in the Gap North open pit, 5.46 mg/l in the Gap South open pit, 5.09 mg/l in the Pipeline/South Pipeline open pit, and 4.24 mg/l in the Crossroads open pit) generally exceed the primary drinking water standard. All but one of these lakes are predicted to have lower fluoride concentrations than predicted for the No Action Alternative (5.36 mg/l). These exceedances result primarily from evapoconcentration of solutes derived from ground water, rather than from leaching of the exposed open pit highwall or backfill.

Predicted concentrations of arsenic in all four of the pit lakes of Stage 11 are less than the present (2003) DWS of 0.05 mg/l (NAC 445A.453 and 455). The current regulatory MCL for arsenic in Nevada is 0.05 mg/l. The federal arsenic MCL was revised to 0.010 mg/l on February 22, 2002 and is currently scheduled for implementation in January 2006. The State of Nevada has not adopted the revised standard and will evaluate the adoption according to state policy set forth for such adoption. Therefore, for regulatory purposes under the SDWA and other regulatory programs in Nevada incorporating MCLs by reference, the current enforceable standard is 0.05 mg/l. Additionally, the EPA has issued formal language stating that the revised arsenic MCL and the science used to develop the revision pertain solely to the risks evaluated for the SDWA purposes, and that careful evaluation is needed when using the revised MCL outside of the SDWA. The modeled arsenic concentration in all of the Project pit lakes exceeds the 2006 Nevada drinking water standard. In addition, the predicted arsenic concentration in the pit lake of the Gap South open pit after 100 years (0.049 mg/l) exceeds present ambient water quality criteria (0.048 mg/l). The main source of the arsenic is naturally-occurring arsenic present in the ground water of the Project Area. Most area ground water exceeds the 2006 standard. The initial arsenic concentrations of the model increase over time in the predictive model due to evaporation of water from the pit lake.

Under Stage 11 of the Proposed Action, modeled pit lake concentrations, apart from mercury and silver, generally do not exceed ambient water quality criteria. After 100 years, mercury is modeled to be concentrated by evaporation to a concentration of 15 ng/l in the Gap North pit lake, 29 ng/l in the Gap South pit lake, 19 ng/l in the Pipeline/South Pipeline pit lake, and 30 ng/l in the Crossroads pit lake. After 100 years, silver is modeled to be at a concentration of 0.003 mg/l in the Crossroads pit lake, 0.002 mg/l in the Gap pit lake, and less than 0.001 mg/l in the other two pit lakes. However, although some silver is naturally present in area ground water, the silver concentrations are partially an artifact of the modeling process that assumes an initial concentration of one-half of the detection limit (0.0005 mg/l) whenever silver was not detected, and that modeled value is then concentrated over time by evaporation. The modeled minimum initial concentration of one half of the detection limit for silver (0.00025 mg/l) is double the ambient water quality standard (0.00012 mg/l). However, it should be noted that the modeled values of both silver and mercury exceed those actually measured in similar pit lake systems due to modeled evapoconcentration of the input values (for naturally occurring mercury and silver, and for assumed minimum concentrations where not detected) in ground water. For comparison, after 100 years, the modeled concentration of mercury for the single pit lake of the No Action Alternative is 23 ng/L and the modeled concentration for silver is 0.001 mg/l. All these values exceed the aquatic life criterion of 12 ng/L for mercury, although less than two percent of the total mercury concentration is expected (based on monitoring in other post mine pit lakes, [Geomega 2003b, Table 6-5] to occur in the more bioavailable and toxic methylmercury form. Methylmercury concentrations measured in the studied pit lakes are less than 0.5 ng/L, which is below both the aquatic life criterion and the ecological risk threshold of 3.0 ng/l (Geomega 2003b).

Stage 10

When complete, the pit lakes resulting from Stage 10 of the Proposed Action would be expected to function as sinks, with little ground water throughflow into downgradient ground water (Geomega 2003a). Under Stage 10 of the Proposed Action, the ground water throughflow is expected to be 50 acre-feet per year. Stage 10 would have reduced evapoconcentration rates relative to the No Action Alternative.

Two pit lakes would result from Project activities through Stage 10, one in Pipeline/South Pipeline open pit and one in the Crossroads open pit. After dewatering has ceased for 25 years under Stage 10 of the Proposed Action, the pH of the pit lake in the Pipeline/South Pipeline open pit is expected to be 8.30, and after 100 years the pH is predicted to be 8.36. In the pit lake of the Crossroads open pit, after dewatering has ceased for 25 years the pH is expected to be 8.35, and after 100 years the pH is predicted to be 8.43. At 100 years, the TDS of the pit lake in the Pipeline/South Pipeline open pit is expected to be 970 mg/l, and the TDS of the pit lake in the Crossroads open pit is expected to be 855 mg/l. For comparison, after 100 years the TDS of the pit lake in the No Action Alternative is expected to be 1,119 mg/l and the pH is expected to be 8.40. At 100 years after dewatering ceases, concentrations of individual constituents are generally expected to meet Nevada primary drinking water standards. However, modeled fluoride concentrations (4.51 mg/l in the pit lake of the Pipeline/South Pipeline open pit, and 4.53 mg/l in the pit lake of the Crossroads open pit) exceed the primary drinking water standard. Both of these lakes are predicted to have lower fluoride concentrations than predicted for the No Action Alternative (5.36 mg/l). These exceedances result primarily from evapoconcentration of solutes derived from ground water, rather than the exposed open pit highwall or backfill.

Predicted concentrations of arsenic in both of the pit lakes of Stage 10 are less than the current (2003) DWS of 0.05 mg/l (NAC 445A.453 and 455). The current regulatory MCL for arsenic in Nevada is 0.05 mg/l. The federal arsenic MCL was revised to 0.010 mg/l on February 22, 2002 and is currently scheduled for implementation in January 2006. The State of Nevada has not adopted the revised standard and will evaluate the adoption according to state policy set forth for such adoption. Therefore, for regulatory purposes under the SDWA and other regulatory programs in Nevada incorporating MCLs by reference, the current enforceable standard is 0.05 mg/l. Additionally, the EPA has issued formal language stating that the revised arsenic MCL and the science used to develop the revision pertain solely to the risks evaluated for the SDWA purposes, and that careful evaluation is needed when using the revised MCL outside of the SDWA. The predicted arsenic concentration in both of the Project pit lakes exceeds the 2006 standard. The main source of arsenic is naturally-occurring arsenic present in the ground water of the Project Area. Most area ground water exceeds the 2006 standard. The initial arsenic concentrations of the model increase over time in the predictive model due to evaporation of water from the pit lake.

Under Stage 10 of the Proposed Action, modeled pit lake concentrations, apart from mercury and silver, do not exceed ambient water quality criteria. After 100 years, mercury is modeled to be concentrated by evaporation to a concentration of 18 ng/l in the Pipeline/South Pipeline pit lake and 32 ng/l in the Crossroads pit lake. After 100 years, silver is modeled to be at a concentration of 0.003 mg/l in the Crossroads pit lake, and 0.001 mg/l in the pit lake of the Pipeline/South Pipeline open pit. However, although some silver naturally occurs in area ground water, the silver concentrations are partially an artifact of the modeling process that assumes an initial concentration of one-half of the detection limit (0.0005 mg/l) whenever silver was not detected, and that modeled value is then concentrated over time by evaporation. The modeled minimum initial concentration of one-half of the detection limit for silver (0.00025 mg/l) is double the ambient water quality standard (0.00012 mg/l). However, it should be noted that the modeled values of both silver and mercury exceed those values actually measured in similar pit lake systems due to modeled evapoconcentration of the input values (for naturally occurring mercury and silver and for assumed minimum concentrations where not detected) in ground water. For comparison, after 100 years, the modeled concentration of mercury for the single pit lake of the No Action Alternative is 23 ng/l and the modeled concentration of silver is 0.001 mg/l. All of these values exceed the aquatic life criterion of 12 ng/l for mercury, although less than two percent of the total mercury concentration is expected (based on monitoring in other post mine pit lakes, Geomega 2003b, Table 6-5) to occur in the more bioavailable and toxic methylmercury form. Methylmercury concentrations measured in the studied pit lakes are less than 0.5 ng/l, which is below both the aquatic life criterion and the ecological risk threshold of 3.0 ng/l (Geomega 2003b).

Stage 9

When complete, the pit lake resulting from Stage 9 of the Proposed Action would be expected to function as a sink, with no ground water throughflow into downgradient ground water (Geomega 2003a). Stage 9 would deepen the Pipeline/South Pipeline open pit, yielding a greater pit lake depth relative to surface area; therefore, Stage 9 would be expected to have a reduced evapoconcentration rate relative to the No Action Alternative.

One pit lake (in the Pipeline/South Pipeline open pit) would result from Project activities through Stage 9. After dewatering has ceased for 25 years under the Stage 9 of the Proposed Action, the pH in the Pipeline/South Pipeline pit lake is expected to be 8.32, and after 100 years the pH is predicted to be 8.41. At 100 years, the TDS in the Pipeline/South Pipeline pit lake is expected to be 1,035 mg/l. For comparison, after 100 years the TDS of the pit lake in the No Action Alternative is expected to be 1,119 mg/l and the pH is expected to be 8.40. At 100 years after dewatering ceases, concentrations of individual constituents are generally expected to meet Nevada primary drinking water standards. However, fluoride concentration (5.13 mg/l) is predicted to exceed the primary drinking water standard. The Stage 9 pit lake is thus predicted to have lower concentrations than predicted for the No Action Alternative (5.36 mg/l). This exceedance results primarily from evapoconcentration of solutes derived from ground water, rather than from leaching of the exposed open pit highwall or backfill.

The predicted concentration of arsenic in the pit lake of Stage 9 is less than the current (2003) DWS of 0.05 mg/l (NAC 445A.453 and 455). The current regulatory MCL for arsenic in Nevada is 0.05 mg/l. The federal arsenic MCL was revised to 0.010 mg/l on February 22, 2002 and is currently scheduled for implementation in January 2006. The State of Nevada has not adopted the revised standard and will evaluate the adoption according to state policy set forth for such adoption. Therefore, for regulatory purposes under the SDWA and other regulatory programs in Nevada incorporating MCLs by reference, the current enforceable standard is 0.05 mg/l. Additionally, the EPA has issued formal language stating that the revised arsenic MCL and the science used to develop the revision pertain solely to the risks evaluated for the SDWA purposes, and that careful evaluation is needed when using the revised MCL outside of the SDWA. The predicted arsenic concentration in the Stage 9 pit lake exceeds the 2006 standard. The main source of the arsenic is naturally-occurring arsenic present in the ground water of the Project Area. Most area ground water exceeds the 2006 standard. The initial arsenic concentrations of the model increase over time in the predictive model due to evaporation of water from the pit lake.

Under Stage 9 of the Proposed Action, modeled pit lake concentrations, apart from mercury and silver, do not exceed ambient water quality criteria. After 100 years, mercury is modeled to be concentrated by evaporation to a concentration of 24 ng/l in the Pipeline/South Pipeline open pit. However, it should be noted that the modeled value exceeds those actually measured in similar pit lake systems due to modeled evapoconcentration of input values for naturally occurring mercury in ground water. After 100 years, silver is modeled at a concentration of 0.002 mg/l in the Pipeline/South Pipeline pit lake. However, although some silver is naturally present in area ground water, the silver concentrations are partially an artifact of the modeling process which assumes an initial concentration of one-half of the detection limit (0.0005 mg/l) whenever silver was not detected, and that modeled value is then concentrated over time by evaporation. The modeled minimum initial concentration of one-half of the detection limit for silver (0.00025 mg/l) is double the ambient water quality standard (0.00012 mg/l). However, it should be noted that the modeled values of both silver and mercury exceed those actually measured in similar pit lake systems due to modeled evapoconcentration of the input values (for naturally occurring mercury and silver, and for assumed minimum concentrations where not detected) in ground water. For comparison, after 100 years, the modeled concentration of mercury for the single pit lake of the No Action Alternative is 23 ng/l and the modeled concentration of silver is 0.001 mg/l. These values exceed the aquatic life criterion of 12 ng/l for mercury, although less than two percent of the total mercury concentration is expected (based on monitoring in other post mine pit lakes, Geomega 2003b, Table 6-5) to occur in the more bioavailable and toxic methylmercury form. Methylmercury concentrations measured in the studied pit lakes are less than 0.5 ng/L, below both the aquatic life criterion and the ecological risk threshold of 3.0 ng/l (Geomega 2003b). The supplemental assessment of the Stage 9 push back would result in a small increase in the area-to-volume ratio (eight percent) and would correspond to a general increase in the pit lake solute concentrations of less than three percent at 100 years after the end of dewatering and would not result in new exceedences of regulatory standards (Geomega 2004a).

Stage 8

When complete, the pit lake resulting from Stage 8 of the Proposed Action would be expected to function as a sink, with no ground water throughflow into downgradient ground water (Geomega 2003a).

One pit lake (in the Pipeline/South Pipeline open pit) would result from Project activities through Stage 8. After dewatering has ceased for 25 years under Stage 8 of the Proposed Action, the pH in the Pipeline/South Pipeline pit lake is expected to be 8.30, and after 100 years the pH is predicted to be 8.39. At 100 years, the TDS in the Pipeline/South Pipeline pit lake is expected to be 1,105 mg/l. For comparison, after 100 years the TDS of the pit lake in the No Action Alternative is expected to be 1,119 mg/l and the pH is expected to be 8.40. At 100 years after dewatering ceases, concentrations of individual constituents are generally expected to meet Nevada primary drinking water standards. However, the modeled fluoride concentration (5.25 mg/l) is predicted to exceed the primary drinking water standard (4 mg/l). This lake is thus predicted to have a lower concentration of fluoride than predicted for the No Action Alternative (5.36 mg/l). This exceedance results primarily from evapoconcentration of solutes derived from ground water, rather than the exposed open pit highwall or backfill.

The predicted concentration of arsenic in the pit lake of Stage 8 is less than the current (2003) DWS of 0.05 mg/l (NAC 445A.453 and 455). The current regulatory MCL for arsenic in Nevada is 0.05 mg/l. The federal arsenic MCL was revised to 0.010 mg/l on February 22, 2002 and is currently scheduled for implementation in January 2006. The State of Nevada has not adopted the revised standard and will evaluate the adoption according to state policy set forth for such adoption. Therefore, for regulatory purposes under the SDWA and other regulatory programs in Nevada incorporating MCLs by reference, the current enforceable standard is 0.05 mg/l. Additionally, the EPA has issued formal language stating that the revised arsenic MCL and the science used to develop the revision pertain solely to the risks evaluated for the SDWA purposes, and that careful evaluation is needed when using the revised MCL outside of the SDWA. The predicted arsenic concentration in the Stage 8 pit lake exceeds the 2006 standard. The main source of the arsenic is naturally-occurring arsenic present in the ground water of the Project Area. Most area ground water exceeds the 2006 standard. The initial arsenic concentrations of the model increase over time in the predictive model due to evaporation of water from the pit lake.

Under Stage 8 of the Proposed Action, modeled pit lake concentrations (apart from mercury and silver) do not exceed ambient water quality criteria. After 100 years, mercury is modeled to be concentrated by evaporation to a concentration of 19 ng/l in the Pipeline/South Pipeline open pit. After 100 years, silver is modeled to be at a concentration of 0.001 mg/l in the Pipeline/South Pipeline pit lake. However, although some silver is naturally present in area ground water, the silver concentrations are partially an artifact of the modeling process which assumes an initial concentration of one-half of the detection limit (0.0005 mg/l) whenever silver was not detected, and that modeled value is then concentrated over time by evaporation. The modeled minimum initial concentration of one-half of the detection limit for silver (0.00025 mg/l) is double the ambient water quality standard (0.00012 mg/l). However, it should be noted that the modeled values of both silver and mercury exceed those actually measured in similar pit lake systems due to modeled evapoconcentration of the input values (for naturally occurring mercury and silver, and for assumed minimum concentrations where not detected) in ground water. For comparison, after 100 years, the modeled concentration of mercury for the single pit lake of the No Action Alternative is 23 ng/L and the modeled concentration of silver is 0.001 mg/l. However, it should be noted that the modeled value exceeds those actually measured in similar pit lake systems due to modeled evapoconcentration of input values for naturally occurring mercury in ground water. These values exceed the aquatic life criterion of 12 ng/l, although less than two percent of the total mercury concentration is expected (based on monitoring in other post mine pit lakes, Geomega 2003b, Table 6-5) to occur in the more bioavailable and toxic methylmercury form. Methylmercury concentrations measured in the studied pit lakes are less than 0.5 ng/l, below both the aquatic life criterion and the ecological risk threshold of 3.0 ng/l (Geomega 2003b).

As discussed for the permitted South Pipeline pit lake, the predicted Pipeline/South Pipeline expansion pit lake chemistry would evolve in the distant future to a chemistry that approaches that of many of the natural lakes of the arid western United States where evaporation is a dominant process (BLM 1996a, Table 4.4-6). Such lakes are alkaline, with pH values often above 9.0 and TDS concentrations usually above 3,000 to 5,000 mg/l. The rate at which other dissolved solutes would increase to levels that exceed standards varies from element to element within each alternative, and many elements would remain below standards even at evapoconcentration factors that exceed 30, over timeframes in excess of 1,000 years.

Comparison of the Stage 8 water quality with that predicted for the No Action Alternative indicates a 20 percent increase in major ion concentrations as a result of partial backfilling. Differences in trace metal concentrations vary: silver, barium, mercury, selenium, and zinc concentrations are lower due to the increased availability of sorption sites in the backfilled waste rock and aluminum, arsenic, chromium, copper, and nickel are slightly higher, due to increased loading. The supplemental assessment of the Stage 8 push back would result in a small increase in the area-to-volume ratio (one percent) and would correspond to a general increase in the pit lake solute concentrations of less than three percent at 100 years after the end dewatering and would not result in new exceedences of regulatory standards (Geomega 2004a).

Impact 4.4.3.3.2: Compared to the No Action Alternative, there would be less concentration by evaporation; therefore, Stage 12 of the Proposed Action would generally yield a positive impact. The predicted open pit water quality would initially meet the DWSs, and acidic mine waters are not predicted to develop. With time, evapoconcentration is predicted to increase constituent concentrations, eventually exceeding primary drinking water standards for some constituents. As evaporation concentrates open pit waters over time, the quality would generally resemble that of natural lakes developed in closed basins in an arid climate. Migration of relatively small volumes of open pit water into the adjacent bedrock aquifers may occur, although very slow ground water flow rates and existing water quality in the Crescent Valley suggest that downgradient migration of very small volumes of open pit water would not result in significant changes in water quality.

Significance of the Impact: The significance of open pit water quality impacts is time dependent. Over the normal timeframe of post-closure monitoring and maintenance (30 years), impacts are less than significant. Pit lake modeling indicates that there would be an immediate exceedance of the future (2006) Nevada primary drinking water standard for arsenic, and after 100 years there would be an exceedence of the standard for fluoride. However, both the arsenic and fluoride concentrations are predicted to be less than for the No Action Alternative. In addition, chemical modeling predicts exceedences of the ambient water quality standards for mercury and silver. The modeled exceedences for silver and mercury are slightly more than for the No Action Alternative. Comparison to existing pit lakes indicates that the modeled exceedences of silver and mercury are probably an artifact of the conservative chemical modeling technique, and would probably not actually occur. Area ground water generally already exceeds the future (2006) primary drinking water standard for arsenic, although pit lakes would tend to concentrate the existing arsenic through evaporation. Area ground water generally exceeds the secondary drinking water standard for fluoride, but evaporation in the pit lakes is expected to eventually cause exceedance of the primary standard. Long-term impacts are considered to be potentially significant because solute concentrations would continue to increase under the influence of evapoconcentration, although increasing uncertainty of predictions extended far into the future makes longer term predictions more qualitative.

The pit lake would be a water of the State of Nevada, and applicable water quality standards would depend on the present and potential beneficial uses of the lake. Access to the open pit by humans and livestock would be restricted. The lake is not intended to be a drinking water source for humans or livestock or to be used for recreational purposes. Therefore, standards to protect these beneficial uses would not be directly applicable. Aquatic standards would also not be applicable since CGM does not plan to have the pit lake(s) stocked with fish.

Although it is concluded that the current beneficial uses described above would not apply to the pit lake, Nevada law and regulations prohibit the creation of pit lakes that have the potential to degrade waters of the State (NAC 445A.429). Pit lake water quality is predicted to meet all applicable water quality standards within the 30-year post-closure monitoring period. At 100 years, only the fluoride and future arsenic standards would be of concern, but longer-term predictions of open pit water quality would be less certain. However, the existing ground water also has slightly elevated TDS and generally exceeds water quality standards (Geomega 2003b) for fluoride, arsenic, and in some cases, manganese. The constituents for which there are exceedances in the existing ground water are fundamentally the same constituents for which the pit lake water quality model predicts exceedances in the very long term.

Although open pit water is not intended to be used as a source of drinking water, the long-term predictions indicate that pit lake solute concentrations may increase to levels above DWSs due principally to evaporative concentration. Pit throughflow in the distant future, if any, may result in limited solute migration from the pit lake to the immediately adjacent ground water (CGM 2000b). This water would be regulated under NAC 445A.424 or 445A.429. However, this does not necessarily constitute a violation because potential receiving waters had solute concentrations in excess of some DWSs under ambient pre-mining conditions. In addition, there is uncertainty in predicting ground water flow and pit lake chemistry conditions.

The analysis in the Pipeline/South Pipeline EIS (BLM 2000a, pages 4-135 through 4-137) on the potential water quality impacts to wildlife, including impacts relative to terrestrial and avian wildlife, as referenced in NAC445A.429, is applicable to the analysis in this SEIS. The water chemistry analysis in this SEIS identifies that the modeled concentrations of selenium in the pit lake are lower than those used in the previous analysis (BLM 2000a), with the exception of stage 9 (Table 4.4.4). Therefore, if the Project terminates at Stage 9. An updated ecological risk assessment (ERA) has been completed that evaluated potential impacts to wildlife species from pit lake water quality (Geomega 2004b). The conclusions of the updated ERA are that any potential impacts would be less than significant because the Draft SEIS used data from the 2000 ERA, which used one-half of the detection level where the 2004 ERA used actual data.

The Proposed Action provides for operational evaluation of pit lake water quality and monitoring of ground water quality in the vicinity of the open pit. Samples of pit lake water and ground water samples in monitoring wells surrounding the proposed pit lake would be collected and analyzed for the following NDEP Profile 1 parameters: 36 metals, total suspended solids, and turbidity, at least quarterly, to document water quality.

If problems occur in the future, the BLM has the authority to use the existing long-term trust fund established by CGM and the BLM (BLM 1996a, Section 2.2.8). This fund would be used at the BLM's discretion for long-term monitoring, and to provide for a program of corrective action, using the best available technology, should long-term monitoring indicate the need to take such action.

Residual Adverse Impacts:

Pit Lake Water Quality: Initial water quality of the pit lake would meet Nevada drinking water standards, except for arsenic. Within approximately 100 years, it is predicted that evapoconcentration would result in exceedances of primary standards for fluoride and arsenic (but less than under the No Action Alternative), and some other elements in the distant future. At 100 years post-mining, the TDS of the pit lake is predicted to be as high as 947 mg/l, but this is less than the predicted TDS under the No Action Alternative. In the distant future, open pit water quality could approach that of natural saline lakes, but the very low predicted rates of communication with ground water indicates that such changes would exist only in the immediate vicinity of the open pit.

4.4.3.4 Complete Backfill Alternative

As discussed in Section 4.4.3.3 Proposed Action, no impacts to surface water are expected under the Complete Backfill Alternative.

4.4.3.4.1 Potential Water Quality Degradation due to Waste Rock Seepage

Significant seepage from waste rock facilities is not predicted under any of the evaluated alternatives. The Complete Backfill Alternative would result in additional decreased volume of seepage from waste rock piles, and thus theoretically in a decreased load, due to the greater reduction in surface footprint associated with this alternative. However, due to the predicted lack of significant seepage from waste rock piles and the likelihood that any such seepage would have good water quality, implementation of the Complete Backfill Alternative would not result in any significant difference in potential impact to water resources.

Impact 4.4.3.4.1: There would be a low potential for impacts to surface water and ground water quality due to drainage from waste rock piles under the Complete Backfill Alternative. A slight positive impact would be expected compared to the No Action Alternative.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Residual Impact: No residual impact is predicted to result from waste rock seepage under the Complete Backfill Alternative.

4.4.3.4.2 Potential Impacts Due to Pit Lake Water Quality

The Complete Backfill Alternative involves backfilling of all but the final phase of the proposed Crossroads open pit, resulting in a single post mine pit lake that is predicted to meet all the Nevada primary drinking water standards except for fluoride and arsenic (2006 standard) at 100 years. Chemistry reported in Table 4.4.4. is similar to that predicted for interim stages under the Proposed Action (such as Stage 10 and 11 in the Crossroads open pit), but is predicted to be lower in TDS and major ion concentrations.

Under the Complete Backfill Alternative, a maximum throughflow rate of 14 acre-feet per year is predicted. This value is slightly higher than that predicted for Stage 12 of the Proposed Action because net water loss by evaporation is lower. Under the Complete Backfill Alternative, the evapoconcentration factor for the Crossroads open pit is predicted to be 1.62 after 100 years. Given the very low predicted rates of flux and the quality of ground water, impacts are unlikely to be significant, however. The areal extent of the fluoride concentrations resulting from minor (less than two percent of annual inflow) open pit seepage is unlikely to be discernable due to the ambient fluoride concentration of the ground water.

Impact 4.4.3.4.2: The predicted open pit water quality would initially meet the Nevada DWSs under the Complete Backfill Alternative. The development of acidic mine waters is not predicted. With time, evapoconcentration is predicted to increase constituent concentrations, eventually exceeding some primary drinking water standards in the distant future. As evaporation concentrates open pit waters over time, the quality would generally resemble that of natural closed basin lakes in an arid climate. Potential migration of open pit waters into the adjacent aquifers would not occur until hydraulic steady-state is reached, beyond 100 years after the end of mining.

There would be a no potential for impacts to surface water and low potential impact to ground water quality due to seepage from the post mine pit lakes that would form under the Complete Backfill Alternative. Water quality would be slightly better than that predicted for the other alternatives. Hence, there is a positive impact compared to the No Action Alternative.

Significance of the Impact: As discussed for the Proposed Action, the significance of open pit water quality impacts is time dependent. Over the normal time frame of post-closure monitoring and maintenance (30 years), impacts are less than significant. Potential exceedances of drinking water standards relate mainly to fluoride and future (2006) arsenic standards, and these exceedences are significantly less than for the No Action Alternative. Long-term impacts are considered to be potentially significant because solute concentrations would continue to increase under the influence of evapoconcentration, although increasing uncertainty of predictions extended far into the future makes longer term predictions more qualitative. No mitigation measures appear to be feasible for potential long-term impacts, although a long-term trust fund has been established by CGM and BLM (BLM 1996a, Section 2.2.8). This fund will be used at the BLM's discretion for long-term monitoring, and to provide for a program of corrective action, using the best available technology, should long-term monitoring indicate the need to take such action.

Residual Adverse Impacts:

Pit Lake Water Quality: Initial water quality of the pit lake would meet Nevada drinking water standards, except for arsenic. Within approximately 100 years, it is predicted that evapoconcentration would result in exceedances of some drinking water quality standards, with primary standards exceeded for some elements in the distant future. At 100 years post-mining, the TDS of the pit lake is predicted to be approximately 826 mg/l, whereas the predicted TDS under the No Action Alternative is 1,119 mg/l. In the distant future, open pit water quality would approach that of natural saline lakes, but the very low predicted rates of communication with ground water indicates that such changes would exist only in the immediate vicinity of the proposed mine pit.

4.4.3.5 No Backfill Alternative

As discussed for the Proposed Action, no impacts to existing surface water resources are expected under the No Backfill Alternative.

4.4.3.5.1 Potential Water Quality Degradation due to Waste Rock Seepage

Significant seepage from waste rock facilities is not predicted under any of the evaluated alternatives, and geochemical assessments indicate that any minor volume seepage would have good water quality. Placement of waste rock solely in external dumps may result in minor increases in seepage over the long term, relative to the Proposed Action, Complete Backfill and No Action Alternatives, but water quality for any such seepage is predicted to meet water quality standards and thus is not predicted to degrade ground water resources.

Impact 4.4.3.5.1: There would be a low potential for impacts to surface water and ground water quality due to drainage from waste rock piles under the No Backfill Alternative.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Residual Impact: No residual impact is predicted to result from waste rock seepage under the No Backfill Alternative.

4.4.3.5.2 Potential Impacts due to Pit Lake Water Quality

The No Backfill Alternative would not involve placement of waste rock in post mine pit lakes. Two pit lakes would result from operations under this alternative, which would be separated by a topographic high. Chemistry shown in Table 4.4.4. is provided for both the Main open pit and the Gap open pit under the No Backfill Alternative. The predicted pit lake chemistry for the No Backfill Alternative is comparable to Stage 12 of the Proposed Action stages for the Crossroads and Gap open pits and has lower TDS concentrations than predicted for the Stage 8 through 11 Pipeline/South Pipeline open pits. Under the No Backfill Alternative, water is expected to exceed fluoride standards, but would meet TDS standards at 100 years. The full stage, static water level would be lower for the No Backfill Alternative, due to higher rates of evaporation, The No Backfill Alternative evapoconcentration factor was 1.85 for the Pipeline/South Pipeline and Crossroads open pits and 1.36 for the Gap open pit.

Water quality would be slightly better at 100 years under the No Backfill Alternative, when compared with the Proposed Action, despite the relative higher rate of long term evapoconcentration. This is because of the lower initial solute loading associated with backfill placement in the pit lake, as discussed for Stage 8 of the Proposed Action. The supplemental assessment of the No Backfill Alternative would result in a small increase in the area-to-volume ratio (four percent) and would correspond to a general increase in the pit lake solute concentrations of less than three percent at 100 years after the end dewatering and would not result in new exceedences of regulatory standards (Geomega 2004a).

Ground water throughflow in the open pit is predicted to be zero for the No Backfill Alternative.

Impact 4.4.3.5.2: There would be no potential for impacts to surface water or ground water quality due to seepage from the post mine pit lake that would form under the No Backfill Alternative. The predicted open pit water quality would initially meet the Nevada DWSs under the No Backfill Alternative. Development of acidic mine waters is not predicted. With time, evapoconcentration is predicted to increase constituent concentrations, immediately exceeding the future (2006) Nevada primary drinking water standard for arsenic and eventually exceeding the standard for fluoride. As evaporation concentrates open pit waters over time, the quality would generally resemble that of natural closed basin lakes in an arid climate. Under the No Backfill Alternative no seepage is expected from the pit lake into the ground water.

Significance of the Impact: As discussed under Stage 12 of the Proposed Action, the significance of open pit water quality impacts is time dependent. Over the normal time frame of post-closure monitoring and maintenance (30 years), impacts are less than significant. Long-term impacts are considered to be potentially significant because solute concentrations would continue to increase under the influence of evapoconcentration, although increasing uncertainty of predictions extended far into the future makes longer term predictions more qualitative. No mitigation measures appear to be feasible for potential long-term impacts, although a long-term trust fund has been established by CGM and BLM (BLM 1996a, Section 2.2.8, page 2-39). This fund will be used at the BLM's discretion for long-term monitoring, and to provide for a program of corrective action, using the best available technology, should long-term monitoring indicate the need to take such action.

Residual Adverse Impacts:

Pit Lake Water Quality: Initial water quality of the pit lake would meet Nevada drinking water standards, except for the future (2006) standard for arsenic. It is predicted that evapoconcentration would result in exceedances of Nevada drinking water standards for fluoride within 100 years, with primary standards exceeded for some elements in the distant future. At 100 years post-mining, the TDS of the pit lake is predicted to be approximately 935 mg/l, whereas under the No Action Alternative the TDS is expected to be 1,119 mg/l. In the distant future, pit water quality would approach that of natural saline lakes, but no changes in water quality outside of the open pit would result.

4.4.3.6 No Action Alternative

As discussed for the Proposed Action, no impacts to existing surface water resources are expected under the No Action Alternative.

The No Action Alternative is essentially the currently permitted operation, although minor changes in predicted water quality for the pit lake have resulted from a recent model revision to incorporate higher evaporation rates. These changes do not alter compliance with water quality standards at 100 years, and result in a chemistry (Table 4.4.4) that is similar to water quality predicted at several stages for the Proposed Action (Stages 8, 9, and 11).

4.4.3.6.1 Potential Water Quality Degradation due to Waste Rock Seepage

Significant seepage from waste rock facilities is not predicted under any of the evaluated alternatives, and geochemical assessments indicate that any minor volume seepage would have good water quality. Placement of waste rock solely in external dumps could result in minor increases in seepage over the long term, relative to the Proposed Action and Complete Backfill Alternatives, but water quality for any such seepage is predicted to meet water quality standards and would not degrade ground water resources.

Impact 4.4.3.6.1: There would be a low potential for impacts to surface water and ground water quality due to drainage from waste rock piles under the No Action Alternative.

Significance of the Impact: The impact is considered less than significant and no mitigation measures are required.

Residual Impact: No residual impact is predicted to result from waste rock seepage under the No Action Alternative.

4.4.3.6.2 Potential Impacts Due to Pit Lake Water Quality

The updated model for the No Action Alternative indicates higher concentrations of aluminum, arsenic, chloride, fluoride, potassium, magnesium, sodium, sulfate, selenium, zinc, and TDS at 100 years than were originally predicted (Geomega 1998c; BLM 2000a), but revised predictions of water quality continue to comply with all but fluoride, future (2006) arsenic, and secondary TDS drinking water standards. This change in the predicted concentrations is primarily due to an upwardly revised evaporation rate, which increased due to evapoconcentration.

Under the revised flow predictions for the No Action (currently permitted) pit lake, no ground water discharge is predicted at 100 years.

Impact 4.4.3.6.2: There would be a slight potential for impacts to surface water or ground water quality due to seepage from the post mine pit lake that would form under the No Action Alternative. The predicted open pit water quality would initially meet the Nevada DWSs under the No Action Alternative. The development of acidic mine waters is not expected to develop. With time, evapoconcentration is predicted to increase constituent concentrations, eventually exceeding some primary drinking water standards in the distant future. As evaporation concentrates open pit waters over time, the quality would generally resemble that of natural closed basin lakes in an arid climate. Seepage from the open pit lake into ground water is not predicted for the No Action Alternative.

Significance of the Impact: As discussed for the Proposed Action, the significance of open pit water quality impacts is time dependent. Over the normal time frame of post-closure monitoring and maintenance (30 years), impacts are less than significant. Since potential exceedances relate strictly to secondary fluoride and TDS standards, impacts at 100 years are also less than significant. Long-term impacts are considered to be potentially significant because solute concentrations would continue to increase under the influence of evapoconcentration, although increasing uncertainty of predictions extended far into the future makes longer term predictions more qualitative. No mitigation measures appear to be feasible for potential long-term impacts, although a long-term trust fund has been established by CGM and BLM (BLM 1996a, Section 2.2.8). This fund would be used at the BLM's discretion for long-term monitoring, and to provide for a program of corrective action, using the best available technology, should long-term monitoring indicate the need to take such action.

Residual Adverse Impacts:

Pit Lake Water Quality: Initial water quality of the pit lake would meet Nevada drinking water standards. Within approximately 100 years, it is predicted that evapoconcentration would result in exceedances of the primary water quality standard for fluoride, with primary standards for some other elements potentially exceeded in the distant future. At 100 years post-mining, the TDS of the pit lake is predicted to be approximately 1,119 mg/l. In the distant future, open pit water quality would approach that of natural saline lakes, but no changes in water quality outside of the open pit is expected to result.

4.5 Air Resources

4.5.1 Regulatory Framework

Ambient air quality and the emission of air pollutants are regulated under both federal and state laws and regulations. Regulations potentially applicable to the Proposed Action and alternatives include the following: National Ambient Air Quality Standards (NAAQS); Nevada State Ambient Air Quality Standards (NSAAQS); Prevention of Significant Deterioration (PSD); New Source Performance Standards (NSPS); Federal Operating Permit Program (Title V); and State of Nevada air quality regulations (NAC 445B).

4.5.1.1 Federal Clean Air Act

The Federal Clean Air Act (CAA), and the subsequent Clean Air Act Amendments of 1990 (CAAA), require the EPA to identify NAAQS to protect the public health and welfare. The CAA and the CAAA established NAAQS for six pollutants, known as "criteria" pollutants because the ambient standards set for these pollutants satisfy "criteria" specified in the CAA. A list of the criteria pollutants regulated by the CAA and their currently applicable NAAQS set by the EPA for each, are listed in Table 4.5.1. The list of criteria pollutants was amended by the EPA on July 18, 1997 and now includes two new standards for particulate matter of aerodynamic diameter less than 2.5 micrometers ($PM_{2.5}$), and revised standards for PM_{10} and ozone (O_3) (see 62 Federal Register 38652-38760 [$PM_{2.5}$ and PM_{10}]; 62 Federal Register 38856-38896 [O_3]). An EPA accepted monitoring network for $PM_{2.5}$ is still being installed and initial data are still being collected. The EPA has yet to make determinations on attainment status designations based on the $PM_{2.5}$ measurements currently being collected. Although the EPA recently revised both the ozone and $PM_{2.5}$ NAAQS, these revised limits will not be effective until the Nevada State Implementation Plan (SIP) is formally approved by the EPA. The final implementation rule for the 8-hour O_3 standard was published April 30, 2004 (see 69 Federal Register 23857-23951) and became effective June 15, 2004. The EPA intends to revoke the one-hour O_3 standard on June 15, 2005.

Table 4.5.1: Federal and State Ambient Air Quality Standards for Criteria Pollutants

Criteria Pollutant	Averaging Period	Nevada Standards	Federal Standards	
		Concentration[a]	Primary[a]	Secondary[a]
Ozone (O_3)	1-Hour	120 ppbv (235 $\mu g/m^3$)	120 ppbv (235 $\mu g/m^3$)	Same as Primary Standards
	8-Hour [b]	---	80 ppbv (157 $\mu g/m^3$)	
Carbon Monoxide (CO)	8-Hour (<5,000') [c]	9 ppmv (10 mg/m^3)	9 ppmv (10 mg/m^3)	---
	8-Hour (≥5,000') [c]	6 ppmv (6.67 mg/m^3)	9 ppmv (10 mg/m^3)	
	1-Hour [c]	35 ppmv (23 mg/m^3)	35 ppmv (40 mg/m^3)	
Nitrogen Dioxide (NO_2)	Annual	100 $\mu g/m^3$ (53 ppbv)	100 $\mu g/m^3$ (53 ppbv)	Same as Primary Standards
Sulfur Dioxide (SO_2)	Annual	80 $\mu g/m^3$ (30 ppbv)	80 $\mu g/m^3$ (30 ppbv)	---
	24-Hour [c]	365 $\mu g/m^3$ (140 ppbv)	365 $\mu g/m^3$ (140 ppbv)	---
	3-Hour [c]	1,300 $\mu g/m^3$ (500 ppbv)	---	1,300 $\mu g/m^3$ (500 ppbv)
Particulate Matter ≤ 10 Microns in Aerodynamic Diameter (PM_{10})	24-Hour [c]	150 $\mu g/m^3$	150 $\mu g/m^3$	Same as Primary Standards
	24-Hour (Based on the 99th Percentile Averaged over Three Years)	---	150 $\mu g/m^3$	
	Annual Arithmetic Mean	50 $\mu g/m^3$	50 $\mu g/m^3$	
Particulate Matter ≤ 2.5 Microns in Aerodynamic Diameter ($PM_{2.5}$)	24-Hour (Based on the 98th Percentile Averaged over Three Years)	---	65 $\mu g/m^3$	Same as Primary Standard
	Annual Arithmetic Mean Averaged Over Three Years	---	15 $\mu g/m^3$	
Lead (Pb)	Calendar Quarter	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$	Same as Primary Standards

[a] Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 mm mercury. Measurements of air quality are corrected to a reference temperature of 25°C and a reference pressure of 760 mm mercury (1,013.2 millibar); ppmv and ppbv in this table refer to parts per million by volume and parts per billion by volume, respectively, or micro-moles of pollutant per mole of gas. $\mu g/m^3$ ≡ micrograms per cubic meter.

[b] The 8-hour ozone standard was implemented on June 15, 2004.

[c] A violation of the federal standard occurs on the second exceedence during a calendar year; a violation of the State of Nevada standard occurs on the first exceedence during a calendar year.

4.5.1.2 Attainment and Nonattainment Areas

Pursuant to the CAA, the EPA has developed classifications for distinct geographic regions known as air quality management areas. Under these classifications, for each federal criteria pollutant, each air basin (or portion of an air quality management area [or "planning area"]) is classified as in "attainment", if the air quality management area (or planning area) has "attained" compliance with (that is, not exceeded) the adopted NAAQS for that pollutant, is classified as "nonattainment" if the levels of ambient air pollution exceed the NAAQS for that pollutant, or is classified as "maintenance" if the monitored pollutants have fallen from nonattainment levels to attainment levels. Air quality management areas for which sufficient ambient monitoring data are not available are designated as "unclassified" for those particular pollutants until actual monitoring data support formal "attainment" or "nonattainment" classification.

In addition to the designations relative to attainment of conformance with the NAAQS, the CAA requires the EPA to place each planning area within the United States into one of three classes, which are designed to limit the deterioration of air quality when it is "better than" the NAAQS. "Class I" is the most restrictive air quality category, and was created by Congress to prevent further deterioration of air quality in National Parks and Wilderness Areas of a given size, which were in existence prior to 1977, or those additional areas that have since been designated Class I under federal regulations (40 CFR 52.21). All remaining areas outside of the designated Class I boundaries were designated Class II planning areas, which allow a relatively greater deterioration of air quality once the Minor Source Baseline Date has been set. No Class III areas have been designated. Regardless of the class of the planning area, the air quality cannot exceed the NAAQS. The nearest Class I planning area to the Project, the Jarbidge Wilderness Area, is located approximately 118 miles northeast of the Project Area (BLM 1996a). There are no Class I airsheds within 60 miles (100 kilometers) of the Project Area.

4.5.1.3 Prevention of Significant Deterioration

Federal prevention of significant deterioration (PSD) regulations limit the maximum allowable increase in ambient particulate matter in a Class I planning area resulting from a major or minor stationary source to five $\mu g/m^3$ (annual geometric mean) and ten $\mu g/m^3$ (24-hour average). Increases in other criteria pollutants are similarly limited. Specific types of facilities that emit, or have the potential to emit, 100 tons per year (tpy) or more of PM_{10} or other criteria air pollutants, or any facility that emits, or has the potential to emit, 250 tpy or more of PM_{10} or other criteria air pollutants, is considered a major stationary source.

However, most fugitive emissions are not counted as part of the calculation of emissions for PSD. Major stationary sources are required to notify federal land managers of Class I planning areas within 100 kilometers of the major stationary source. There are no Class I planning areas within 100 kilometers of the Project Area. As stated above, the nearest Class I planning area to the Project Area is the Jarbidge Wilderness Area. Neither the existing Pipeline/South Pipeline Project air pollutant emission sources, nor the Proposed Action and alternatives emission sources, are major stationary sources subject to PSD regulatory requirements.

4.5.1.4 New Source Performance Standards

NSPSs were established by the CAA. The standards, which are for new or modified stationary sources, require the sources to achieve the best demonstrated emissions control technology. The NSPS apply to specific types of processes, which in the case of the Proposed Action include certain units used to process metallic minerals. The requirements applicable to these existing units are found in 40 CFR Part 60, Subpart LL (Standards of Performance for Metallic Mineral Processing Plants).

4.5.1.5 Federal Operating Permit Program

As part of the CAA and its subsequent amendments, a facility-wide permitting program was established for larger sources of pollution. This program, known as the Title V program, requires that these "major sources" of air pollutants submit a Title V permit application. To be classified as a "major source", a facility must emit more than 100 tpy of any regulated pollutant, ten tpy of any single hazardous air pollutant (HAP), or 25 tpy or more of any combination of HAPs (including hydrogen cyanide and mercury), from applicable sources.

4.5.1.6 Nevada Bureau of Air Pollution Control

The CAA delegates primary responsibility for air pollution control to state governments, which in turn often delegates this responsibility to local or regional organizations. The SIP was originally the mechanism by which a state set emission limits and allocated pollution control responsibility to meet the NAAQS. The function of a SIP broadened after passage of the 1990 CAAA, and now includes the implementation of specific technology-based emission standards, permitting of sources, collection of fees, coordination of air quality planning, and prevention of significant deterioration of air quality within regional planning areas and statewide. Section 176 of the CAA, as amended, requires that federal agencies must not engage in, approve, or support in any way any action that does not conform to a SIP for the purpose of attaining ambient air quality standards.

The Bureau of Air Pollution Control (BAPC) is the agency in the State of Nevada which has been delegated the responsibility for implementing a SIP (excluding Washoe and Clark Counties, which have their own SIPs). Included in a SIP are the State of Nevada air quality permit programs (NAC 445B.001 through 445B.3485, inclusive). Also part of a SIP are the NSAAQS (see Table 4.5.1). The NSAAQS are generally identical to the NAAQS, with the exception of the following: a) an additional standard for carbon monoxide (CO) in areas with an elevation in excess of 5,000 feet amsl; b) the recently promulgated NAAQS for $PM_{2.5}$; c) the revised NAAQS for PM_{10}; d) O_3 (Nevada has yet to adopt the new and revised standards); and e) a violation of a state standard occurs with the first annual exceedance of an ambient standard, while federal standards are generally not violated until the second annual exceedance. In addition to establishing the NSAAQS, the BAPC is responsible for permit and enforcement activities throughout the State of Nevada.

The Proposed Action and alternatives are located in Lander County, Nevada. The permitting authority for the county is the BAPC. Before any construction of a potential source of air pollution can occur, an air quality permit application must be submitted to the BAPC in order to obtain an Air Quality Operating Permit.

4.5.2 Affected Environment

4.5.2.1 Study Methods

The existing meteorological and air quality conditions in the air quality study area were obtained from the source documents listed in the following sections. Baseline air quality and meteorological conditions representative of the Project Area were assessed using data from the Pipeline/South Pipeline Project and other nearby monitoring stations in northern Nevada. Meteorological and air quality data are currently being collected at the Pipeline/South Pipeline Project. The Cortez Monitoring Station measures ambient temperature, wind speed, and wind direction at 33 feet above ground surface, as well as PM_{10} concentrations and precipitation.

The Project Area is located in the Crescent Valley Air Quality Management Area (CVAQMA), which includes the area bounded by the crest of the Shoshone Range and the Humboldt River to the west and north and the crest of the Toiyabe and Cortez Mountains to the south and east. The CVAQMA has the same boundary as the Crescent Valley Hydrographic Basin, which is shown on Figure 4.3.1.

4.5.2.2 Existing Conditions

The Pipeline/South Pipeline Project currently operates under a valid air quality permit, AP1041-0619.01, issued by the BAPC. The Pipeline/South Pipeline Project is not included in any of the source categories listed in the Federal PSD Regulations, and the PSD applicable emissions from the Pipeline/South Pipeline Project are below the 250 tpy PSD threshold. In addition, no minor source baseline date has been set for the CVAQMA. Therefore, the Pipeline/South Pipeline Project is not in a PSD triggered planning area, increment is not being consumed, and the Project is not subject to PSD regulation. The Pipeline/South Pipeline Project currently operates specific mineral processing equipment which is subject to NSPS. The requirements under the NSPS are addressed in the current air quality operating permit, AP1041-0619.01. The Pipeline/ South Pipeline Project is not a “major source” of air pollutants in the Title V program, and therefore is not required to submit a Title V application or obtain a Title V permit.

BAPC regards the Project as a minor source of HAPs because it emits less than ten tons per year of any individual HAP and 25 total tons per year of HAPs combined (NAC 445B.094). The Project’s primary HAP emissions are from refining (mercury), leaching (cyanide) and combustion (methyl tert-butyl ether [MTBE], propylene, toluene and xylene) sources. The current HAP emissions for Pipeline/South Pipeline Mine are documented in the 2003 Toxic Release Inventory.

CGM’s participation in the VMRP has led to a decrease in overall mercury emissions from the Project. The mercury emissions reported in 2003 were 1,380.6 pounds, 61 percent of the total mercury emissions in 2000.

Most of the sodium cyanide used in the process solution is recycled as part of normal operations. However, there is some loss to the atmosphere as hydrogen cyanide. Cyanide is primarily volatilized from the leach pads, the associated ponds, and to a lesser extent, the tailing facility and milling operations. The chemistry of the ore determines the concentration of cyanide required in the leach solution, which affects the emission rate. Cyanide emissions for 2003 were calculated at 8,700 pounds, an increase over 2002, but less than 2001.

Combustion-related HAPs are either components of fuels or byproducts of the combustion process. The handling or burning of any hydrocarbon-based fuel can release one or more these compounds.

4.5.2.2.1 Climate and Meteorology

The Project Area is a high-desert environment characterized by arid-to-semiarid conditions, with bright sunshine, low annual precipitation, and large daily ranges in temperatures. The climate is controlled primarily by the rugged and varied topography to the west, in particular the Sierra Nevada Mountain Range. Prevailing westerly winds move warm, moist Pacific air over the western slopes of the Sierra Nevada where the air cools, condensation takes place, and most of the moisture falls as precipitation. As the air descends the eastern slope, compressional warming takes place resulting in minimal rainfall.

CGM monitors meteorological data at the Cortez Station, which is located approximately 0.25 mile east of the South Pipeline waste rock dump (Figure 4.5.1). Based on meteorological monitoring data collected from the Cortez Station over the period 1997 through 2001, the average temperature was 52.8°F, with temperatures ranging from 104°F to minus eight°F. Annual precipitation in the Project Area during the same period (1999 excluded for missing data) ranged from 6.34 to 10.84 inches (Gelhaus 1998, 1999, 2000, 2001, 2002).

Atmospheric dispersion is influenced by several parameters, including wind speed, temperature inversions (mixing heights), and atmospheric stability. Prevailing winds at the Cortez Station, based on the 2001 meteorological data, were from the west, with average annual wind speeds at 6.9 miles per hour (mph). Month-to-month variations were small, with average wind speeds ranging from 4.9 to 8.8 mph (Gelhaus 2002). These wind speeds tend to promote atmospheric mixing, and generally transport locally generated air emissions away from the area. Inversions restrict vertical movement of the air in the lower atmosphere, thereby preventing atmospheric pollutants from mixing with the air above the inversion layer. Lower mixing heights can be expected to produce higher pollutant concentrations since the volume of air with which the pollutants can mix is limited (BLM 1996a). As is typical of cold night/hot day weather patterns, mixing heights can be quite high in the afternoon. Conversely, mixing heights can be quite low at night and early morning due to nighttime cooling. Mixing heights in the Project Area are estimated at 250 feet (annual average) in the morning and approximately 2,400 feet (annual average) in the late afternoon (BLM 1996a).

Another factor that can be used to assess the ability of the atmosphere to disperse pollutants is atmospheric stability. Atmospheric stability is expressed in terms of Pasquill-Gifford categories ranging from Class A (very unstable) to Class F (very stable), and is a measure of the degree of atmospheric turbulence which results in different levels of atmospheric mixing and resulting in dispersion of pollutants. The greater the instability, the greater the tendency to disperse. Meteorological data from the Cortez Station indicate that good dispersion conditions (Classes A-D) occurred 70 percent of the time during the year 1997, and are representative of on-site conditions.

4.5.2.2.2 Air Quality

Air quality in the Project Area is governed by pollutant emissions and meteorological conditions. As discussed above, wind speeds, mixing heights, and stability all affect the circulation and dilution of emissions in the area.

The Project Area is located within the CVAQMA, which is currently unclassified for all pollutants having an air quality standard (40 CFR 81.329). No nitrogen dioxide (NO_2) or lead nonattainment areas are located within the State of Nevada. Washoe County, Nevada (within which the city of Reno is located) is the PM_{10}, CO, and O_3 nonattainment area located closest to the Project Area, although it is greater than 100 miles (167 kilometers) to the west. With the reclassification of the Steptoe Valley nonattainment area to attainment for sulfur dioxide (SO_2), there are no SO_2 nonattainment areas located in Nevada.

At present, the BAPC does not conduct ambient air quality monitoring in the CVAQMA. However, ambient PM_{10} monitoring was conducted by CGM between 1997 and 2001, with a total of three monitors at two separate locations. Two PM_{10} monitors were co-located at the Cortez Station (Site 1A and Site 1B), and one monitor was located approximately 1.5 miles south southwest of the Pipeline Mill (Site 2A). The locations for these monitoring sites are shown in Figure 4.5.1. Ambient monitoring data for 2001 from these PM_{10} monitors are presented in the annual air quality monitoring report (Gelhaus 2002), and are summarized in Table 4.5.2. For 2001, the annual ambient PM_{10} concentrations were 16 $\mu g/m^3$, 16 $\mu g/m^3$, and 19 $\mu g/m^3$ at Site 1A, Site 1B, and Site 2A, respectively. The highest measured 24-hour average PM_{10} concentration at each of the three sites was 64 $\mu g/m^3$, 62 $\mu g/m^3$, and 90 $\mu g/m^3$, for Site 1A, Site 1B, and Site 2A, respectively, while the second highest values were 63 $\mu g/m^3$, 57 $\mu g/m^3$, and 58 $\mu g/m^3$, respectively. The lowest measured 24-hour average PM_{10} concentration during 2001 at each of the three sites was one $\mu g/m^3$. The highest values were collected on days with generally low average wind speeds, indicative of stable atmospheric conditions and low mixing heights.

The location of Site 2A, on the southwest side of the Project (Figure 4.5.1), was considered to be upwind of the existing Pipeline/South Pipeline Project. The site was selected because the monitored PM_{10} concentrations could be considered to be representative of background PM_{10} concentrations. That assumption seemed valid for 1997 when the monitored annual ambient PM_{10} concentrations were 25 $\mu g/m^3$, 27 $\mu g/m^3$, and 22 $\mu g/m^3$ at Site 1A, Site 1B, and Site 2A, respectively (Gelhaus 1998). However, during each year from1998 through 2001, Site 2A has recorded slightly worse air quality, based on the annual ambient average PM_{10} concentrations, than Sites 1A and 1B (Table 4.5.3) (Gelhaus 1998, 1999, 2000, 2001, and 2002). Relatively higher 24-hour PM_{10} concentrations for Site 2A relative to Sites 1A and 1B typically occur on low-wind days, when atmospheric conditions are stable. During June through September, winds below three mph are as likely to be from the east as from the west, while moderate five to ten mph winds are only from the east 15 to 30 percent of the time. Monitoring Site 2A was as likely to be affected by mine-generated particulates as Sites 1A and 1B during those conditions which were most likely to produce high ambient concentrations.

4.5.3 Environmental Consequences and Mitigation Measures

The Proposed Action and alternatives would not increase emissions from the permitted air pollutant sources above the levels specified in the permit, nor would any additional sources of air pollutants requiring a permit need to be added. Thus, a revised air quality operating permit would not be required.

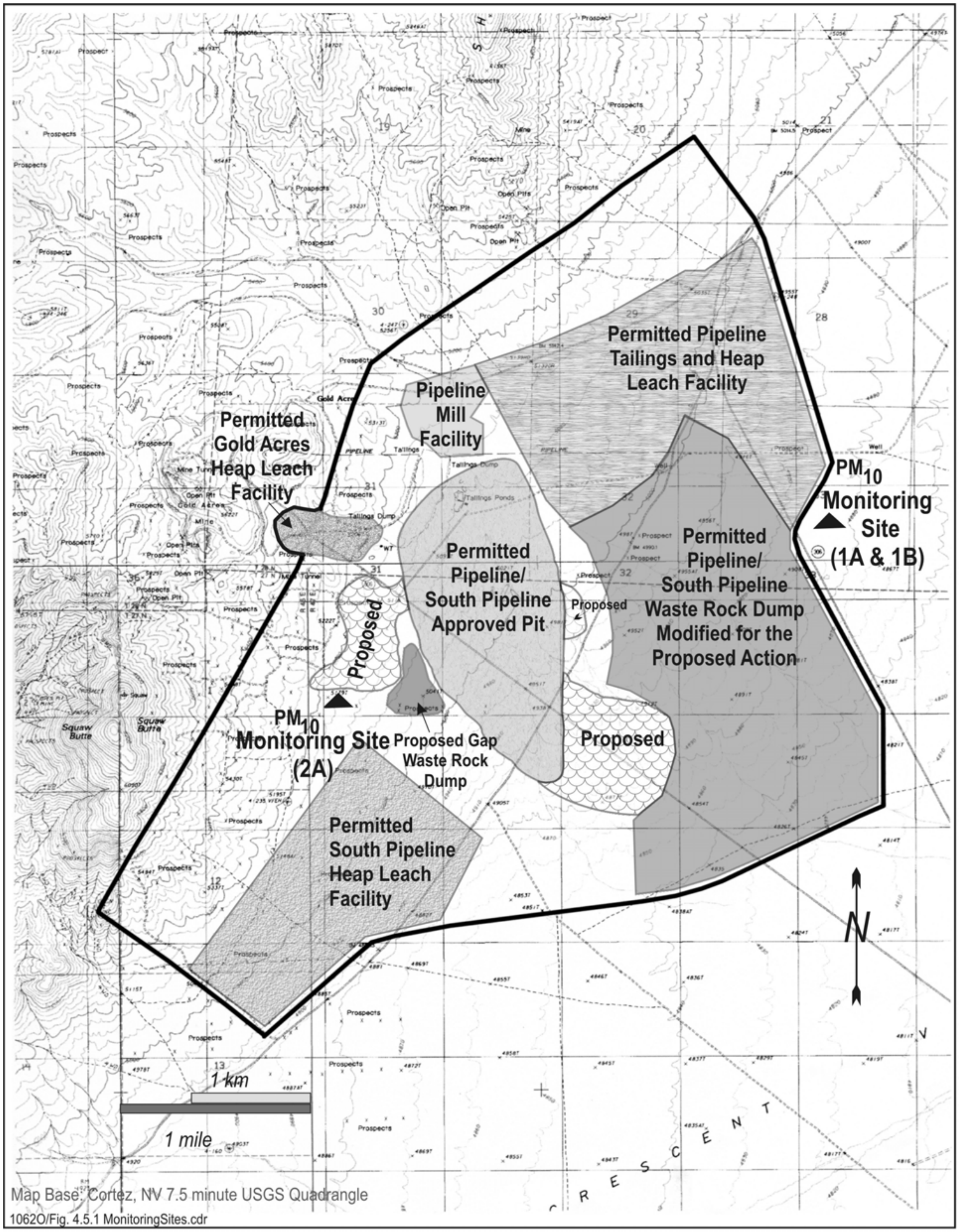

Figure 4.5.1 Monitoring Sites

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Table 4.5.2: Ambient PM_{10} Monitoring Data from Site 1A, Site 1B, and Site 2A

Date	PM_{10} Concentration (µg/m^3)		
	Site 1A	Site 1B	Site 2A
01/01/01	5	4	10
01/07/01	12	12	22
01/13/01	4	4	5
01/19/01	16	14	14
01/25/01	3	3	2
01/31/01	4	3	12
02/06/01	6	4	11
02/12/01	1	2	2
02/18/01	4	3	2
02/24/01	3	6	3
03/02/01	7	7	3
03/08/01	7	9	16
03/14/01	10	9	14
03/20/01	20	18	32
03/26/01	9	10	14
04/01/01	9	8	12
04/07/01	3	8	7
04/13/01	17	18	22
04/19/01	25	25	20
04/25/01	9	10	21
05/01/01	24	24	24
05/07/01	22	24	41
05/13/01	14	13	17
05/19/01	16	17	31
05/25/01	21	22	48
05/31/01	--	15	35
06/06/01	11	12	18
06/12/01	13	13	20
06/18/01	17	18	37
06/24/01	32	31	21
06/30/01	26	20	37
07/06/01	18	18	9
07/12/01	--	29	29
07/18/01	18	18	25
07/24/01	7	8	32
07/30/01	31	33	27
08/05/01	32	32	14
08/11/01	35	28	27
08/17/01	40	41	58
08/23/01	31	29	18
08/29/01	63	57	46

Date	PM$_{10}$ Concentration (µg/m^3)		
	Site 1A	Site 1B	Site 2A
09/04/01	17	25	26
09/10/01	25	--	40
09/16/01	21	14	28
09/22/01	64	62	90
09/28/01	18	18	32
10/04/01	20	22	12
10/10/01	17	17	3
10/16/01	20	19	2
10/22/01	14	16	7
10/28/01	20	--	9
11/03/01	13	13	13
11/09/01	18	16	11
11/15/01	10	10	9
11/21/01	19	19	7
11/27/01	2	3	1
12/03/01	3	1	1
12/09/01	2	3	1
12/15/01	1	1	1
12/21/01	2	1	1
12/27/01	1	1	3
Average	16	16	19

Table 4.5.3: Annual Average PM$_{10}$ Monitoring Data from Site 1A, Site 1B, and Site 2A for the Years 1997 to 2001.

Year	Annual Average PM$_{10}$ Concentration (µg/m^3)		
	Site 1A	Site 1B	Site 2A
1997	23	25	22
1998	12.0	11.7	13.1
1999	12.9	13.8	17.2
2000	14.3	13.6	16.1
2001	16.0	16.0	19.2
Average 98-01	13.8	13.8	16.4
Average 97-01	15.6	16.0	17.5

The Proposed Action and alternatives would not increase emissions of any regulated pollutant from PSD applicable sources above 250 tpy, subjecting the Project to PSD regulations. Additionally, the Proposed Action and alternatives would not add additional sources applicable to the NSPS regulations, nor be subject to the Title V application requirements.

4.5.3.1 Significance Criteria

The Proposed Action and alternatives would have a significant effect on the environment if the following would occur:

- Violate any regulatory requirement of the BAPC;
- Violate any state or federal ambient air quality standard;
- Contribute substantially to an existing or projected air quality violation; or
- Expose sensitive receptors to substantial pollutant concentrations.

4.5.3.2 Assessment Methodology

In assessing the impacts of the Proposed Action and alternatives, an assessment of the significance of the impacts was made based on the significance criteria listed above. The air quality analyses quantified the emissions of the applicable criteria pollutants from the mining and processing of ore from the Proposed Action and Project Alternatives. These analyses include the processing of ore at the existing Cortez Mill, as well as truck traffic between the Cortez Mill and the Project Area and in the vicinity of the Cortez Mill (Figure 4.5.2). Air emission estimates were calculated based on the maximum material throughput for each applicable time period, EPA approved emission factors, existing air quality permit and the past air quality permit applications for both the Pipeline/South Pipeline Project and the Cortez Facility, and information provided by CGM.

4.5.3.2.1 Model Selection and Options

Ambient concentrations of criteria air pollutants, which may be emitted by the Project were calculated using EPA's Industrial Source Complex - Short Term (ISCST3) (EPA Version 02035) computer dispersion model. Dispersion models use mathematical equations to simulate the transport and diffusion of emitted pollutants within the atmosphere and can calculate ambient air pollutant concentrations at any discrete location. Air pollutant emissions may be from point sources (such as stacks or vents); volume sources (such as buildings or elevated conveyors); area sources (regions with a distinct square footage and little or no vertical velocity, such as a lagoon or heap); or open pit sources (below-grade operations such as an open pit mine). Non-reactive gasses, or particles such as PM_{10}, which behave like gases, emitted from these sources are modeled based on a Gaussian distribution, which is a relatively good mathematical approximation of plume behavior (Schulze 1991).

According to the Guideline on Air Quality Models (as revised) (40 CFR 51, Appendix W), the ISCST3 model is approved for use in calculating ambient air pollutant concentrations resulting from the emissions of sources such as those within the Project Area and with terrain similar to that found within and adjacent to the Project Area. The ISCST3 Model is used to calculate concentrations at specific receptor points in and around the Project Area for which elevations are either at stack height or below (simple terrain); between the stack height and the plume centerline (intermediate terrain); or above the plume centerline (complex terrain).

The dispersion modeling, performed for the Proposed Action and alternatives, used the EPA's regulatory default model options as outlined in Appendix A of the Guideline on Air Quality Models (as revised), including the following:

- Use stack-tip downwash;
- Use buoyancy-induced dispersion;
- No gradual plume rise;
- Use calms processing routines;
- Use default wind profile exponents; and
- Use default vertical potential temperature gradients.

The following additional model options were used:

- Rural dispersion parameters; and
- Concentration values calculated for elevated terrain and surface-based receptors (no flagpole receptors).

Where applicable, and where the information was readily available, EPA's Building Profile Input Program (BPIP) algorithm was used to account for the downwash of point sources due to nearby buildings and/or structures. The Plume Rise Mode Enhancement (PRIME) algorithm for modeling building downwash was not used. It has not yet been included in the Guideline for Air Quality Models (as revised) (40 CFR 51, Appendix W).

4.5.3.2.2 Receptors

Three different classes of receptors were used in the modeling (see Figure 4.5.3). The first class was a discrete, "fenceline" receptor set, consisting of individual receptors placed at 165-foot intervals along the boundaries of those portions of the modeled Project Area not accessible to the public (such as fenced areas and other areas where topographic or other features prevented public access). The second class of receptors consisted of receptor "grids," the size and spacing of which were designed to cover the entire Project Area and a larger area outside of the Project Area, which was potentially accessible to the public. These included the following:

- A coarse Cartesian receptor grid, with receptors spaced at 3,300-foot intervals, covering an area of ten miles by 8.5 miles, including both the Project Area and the area of the Cortez Facility and extending out approximately two miles beyond these areas; and
- Two fine Cartesian receptor grids, with receptors spaced at 820-foot intervals. One covered the entire Project Area and extended out at least 820 feet from the boundary of the Project

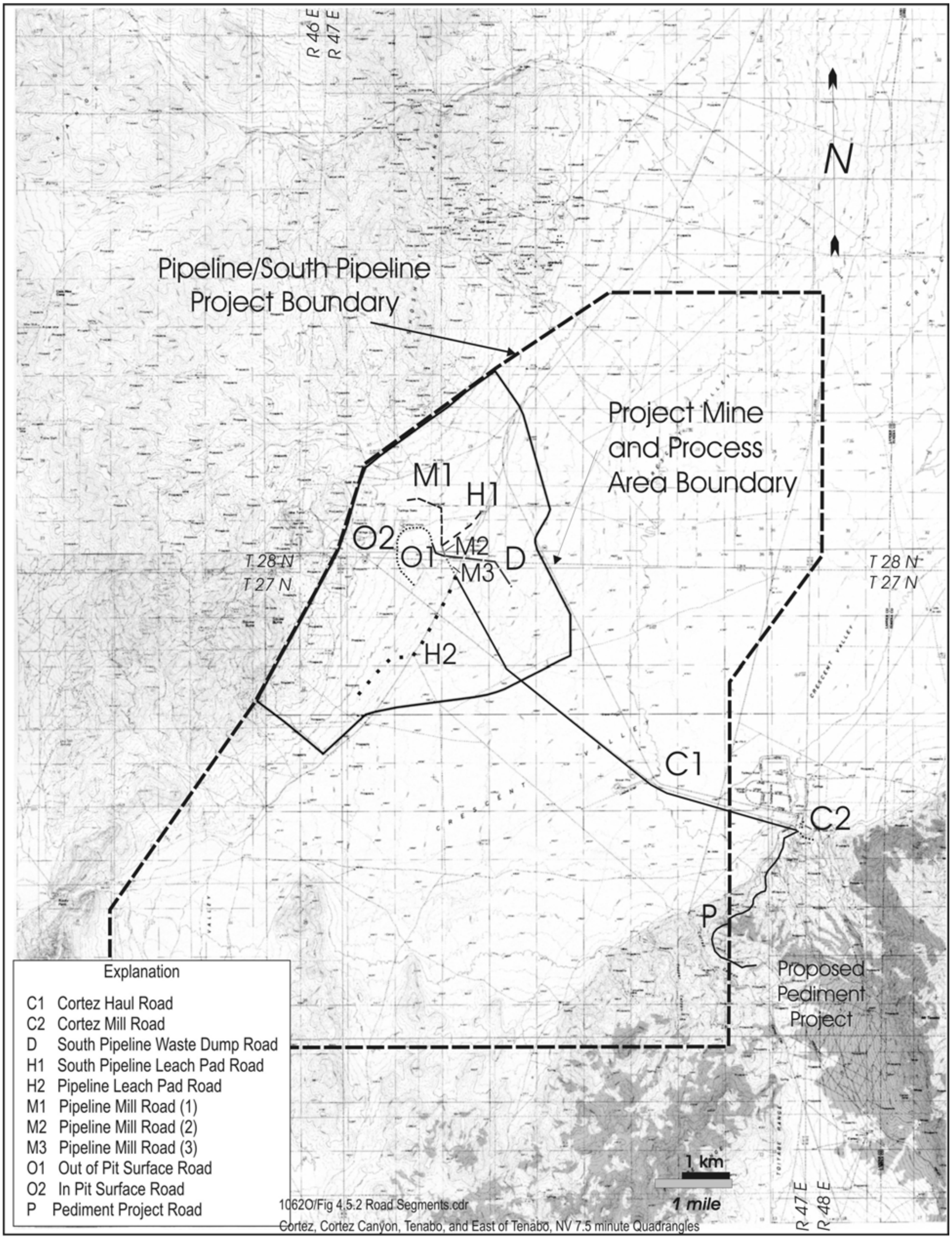

Figure 4.5.2 Road Segments Used to Model Fugitive Emissions

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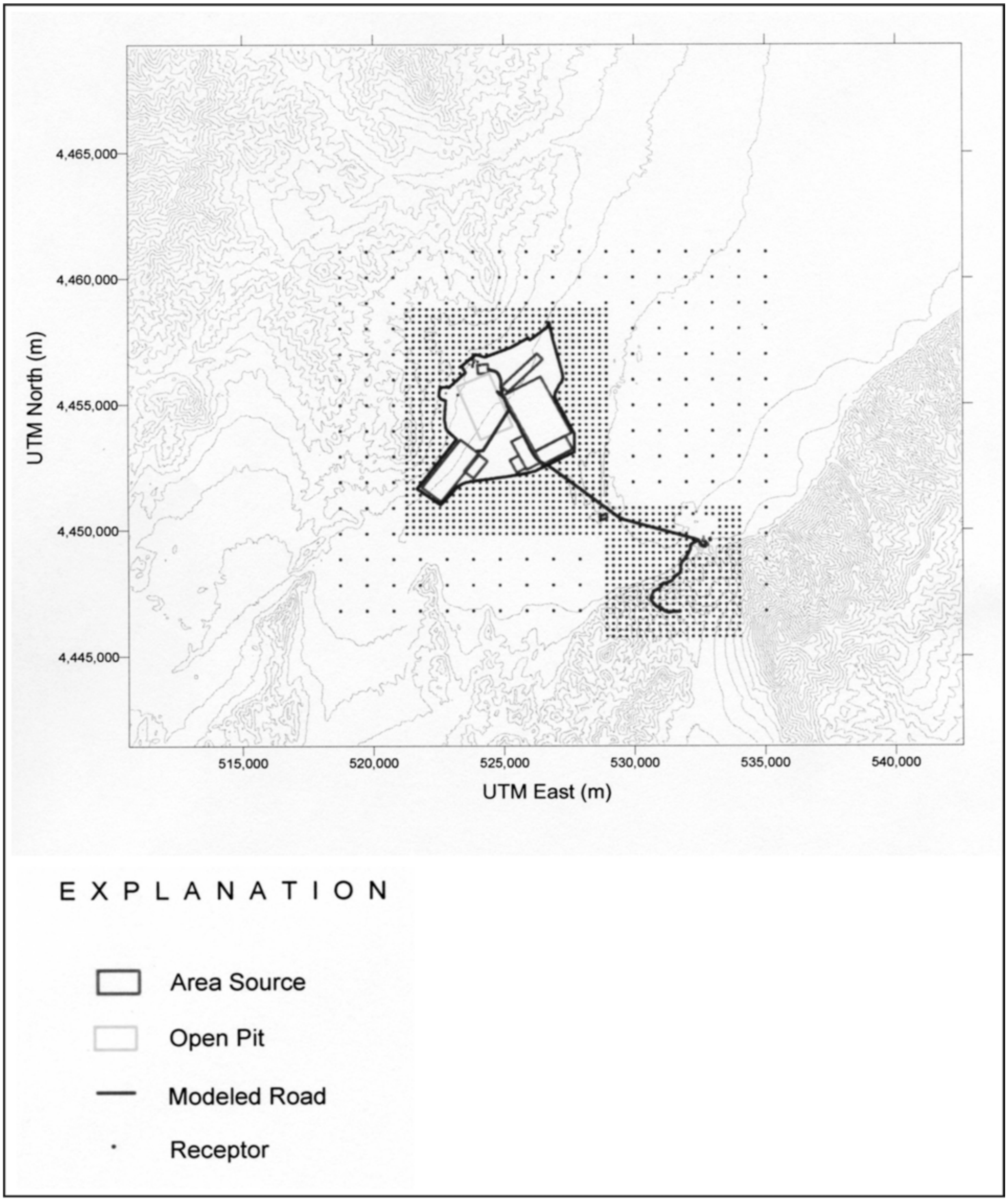

Figure 4.5.3 Model Sources, Fenceline, Discrete, and Cartesian Receptor Locations

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Area. The second grid was placed over the haul road to the Cortez Mill, the Mill itself and the roads in the vicinity of the Cortez Mill. Although outside of the Project Area, the model includes the haulage of ore from the South Pipeline open pit to the Cortez Facilities for processing, and traffic in the vicinity of the Cortez Mill.

Elevations for each of these two classes of receptors were taken from the USGS Digital Elevation Model (30 meter DEM) data for the following 7.5 minute series (topographic) maps, as applicable:

- Cortez, NV Quadrangle;
- Cortez Canyon, NV Quadrangle;
- Tenabo, NV Quadrangle;
- East of Tenabo, NV Quadrangle;
- Ferris Creek, NV Quadrangle; and
- Rocky Pass, NV Quadrangle.

The third class of receptors were defined, discrete receptor points used to assess the potential impact of the Project on specific sensitive receptors. For the purpose of this assessment, these receptors were defined as areas that are frequently visited by the public (i.e., schools, hospitals); nearby residences; and the nearest Class I planning area. The selected sensitive receptors were as follows:

- Filippini Ranch;
- Tenabo Ranch;
- Wintle Ranch;
- Dean Ranch;
- Dann Ranch;
- Crescent Valley School;
- Beowawe School; and
- Jarbidge Wilderness (the nearest mandatory federal PSD Class 1 Area).

Elevations for these receptors were obtained from the appropriate USGS 7.5 minute topographic maps. Each sensitive receptor was represented by a single modeling point except for the Jarbidge Wilderness, which was represented by four modeled receptor points aligned along the wilderness area boundary nearest the Project, selected with elevations ranging from the lowest to the highest along the border of the wilderness area.

4.5.3.2.3 Meteorological Data

Surface meteorological data representative of the Project Area are required to perform air quality dispersion modeling. The same meteorological data (from the Elko, Nevada meteorological station, 1991) that were used in the air quality impact analysis for the South Pipeline Air Quality Impact Assessment Report (Environment Management Associates [EMA] 1998) and Final EIS (BLM 2000a) were used for this report. The data-selection process for that study (EMA 1998) involved the review and model testing of five years of meteorological data and the selection of the data set with the greatest impact. That approach is quite conservative and remains valid. Significantly greater impacts are unlikely from the review of additional newer data sets, and no post-1992 meteorological data are available from the EPA Support Center for Regulatory Air Modeling (SCRAM) web site (www.epa.gov/scram001/). The process of selecting the most suitable meteorological data made for the dispersion model undertaken for the South Pipeline Air Quality Impact Assessment Report (EMA 1998) is described below.

Meteorological data are available from several sources, including the current Cortez Station and the Elko station. The Cortez Station monitors wind speed, wind direction, and temperature, and is located adjacent to the Project Area (Figure 4.5.1). Unfortunately, the algorithms used in the air quality dispersion modeling require additional measured parameters that were unavailable at the Cortez Station; thus, meteorological data from the Elko Station, which is representative of conditions in northeast Nevada, were used in the air quality analysis. According to the Guideline on Air Quality Models (as revised), air quality modeling analyses utilizing representative meteorological data are acceptable if site-specific data are unavailable.

In addition to surface meteorological data, mixing height data representative of the Project Area are also required to create a meteorological data file for use in the air quality dispersion modeling. These data, as well as surface meteorological data from the Elko Station, are available from the SCRAM internet web site. Review of the mixing height data from SCRAM for stations in Nevada showed that mixing height data were available from two sites: Desert Rock, located in southern Nevada, and the Winnemucca airport, in north-central Nevada. The mixing height data from the Winnemucca airport are believed to be more representative of conditions in the Project Area, and were used in the modeling.

Review of the surface and mixing height data available from SCRAM show that, in general, data are available from approximately 1984 through 1992; however, Elko surface data for 1987 and Winnemucca mixing height data for 1992 were unavailable. Due to the extensive runtime of the dispersion model, the five most recent years of complete data available from SCRAM (1986, 1988, 1989, 1990, and 1991) (available at this website: http://www.epa.gov/scram001/) were used to perform a sensitivity analysis utilizing 165-foot discrete fenceline receptors and Project 24-hour PM_{10} emissions to determine which single year resulted in the most conservative 24-hour PM_{10} concentrations. It was found that calendar year 1991 produced the “maximum” modeling results; thus, this single year (1991) was used in the final dispersion modeling analysis.

4.5.3.2.4 Modeled Pollutants and Assumptions

Dispersion modeling was conducted for four of the criteria air pollutants (PM_{10}, CO, NO_2, and SO_2) resulting from the Proposed Action and the No Backfill Alternative that were identified as having the greatest potential for air quality impact. Dispersion modeling for the Proposed Action and the No Backfill Alternative utilized emissions from all identified sources and was performed for all four pollutants for all applicable averaging times, for a total of eight pollutant-averaging time combinations, as presented in Table 4.5.4.

A screening model was employed for O_3. The Scheffe screening model (Scheffe 1988) was run to evaluate the Facility's potential to contribute to low-level O_3 concentrations, and to demonstrate compliance with the one-hour ozone standard. The Facility does not directly produce O_3. It is produced by photo-chemical reactions involving certain volatile organic compounds (VOCs) and oxides of nitrogen. The emission of these compounds can be calculated and used in the Scheffe model to evaluate potential O_3 generation.

Modeling was not performed for the criteria pollutants $PM_{2.5}$, lead (Pb) or O_3 (for the eight-hour standard). As previously stated, detailed emissions information is not available for $PM_{2.5}$; neither are sufficient ambient monitoring data available to characterize the surrounding region, nor is the standard yet applicable (see Section 4.5.1.1). Therefore, no dispersion modeling was performed for $PM_{2.5}$. Lead is an air pollutant that can potentially be emitted from certain facilities. However, lead emissions from the Project are considered to be negligible; therefore, no analyses were performed with respect to lead. At the time of this writing, the EPA's implementation plan for the eight-hour O_3 standard has not been filed, and the data necessary for a suitable dispersion model are not available. Only the one-hour O_3 standard was considered.

Table 4.5.4: Air Pollutants and Applicable Averaging Times for the Air Quality Modeling

Pollutant	Averaging Time[a]
Particulate Matter of Aerodynamic Diameter less than 10 Micrometers (PM_{10})	24-Hour Annual
Carbon Monoxide (CO)	1-Hour 8-Hour
Nitrogen Dioxide (NO_2)	Annual
Sulfur Dioxide (SO_2)	3-Hour 24-Hour Annual

[a] All concentrations are applicable at any point of public access.

The existing facilities and the Project contain numerous sources of air pollutants. In order to analyze the impacts of the Proposed Action and the No Backfill Alternative, assumptions had to be made in many different areas, including facility configuration, future haul road locations, and the quantities of material processed and/or handled at certain locations (such as how much material is transported per day to the South Pipeline leach pad, how much is transported to the Cortez Facilities, etc.). The main difference in the modeling of the Proposed Action and the No Backfill Alternative is in the handling of the waste rock. For the No Backfill Alternative, all waste rock is modeled as being transported out of the Pipeline/South Pipeline Pit to the Pipeline/South Pipeline and Gap waste dumps. For the Proposed Action, a portion of the mined waste rock is transported approximately 0.6 miles and dumped within the Pipeline/South Pipeline open pit. The assumptions, as well as all supporting documentation relating to the air quality analysis performed for the document are contained in the Pipeline/South Pipeline Expansion Project Air Quality Impact Assessment Report (Enviroscientists 2003). A copy of the report is available for review during normal business hours at the BLM Battle Mountain Field Office.

4.5.3.2.5 Applicable Air Quality Standards

As discussed previously, and shown in Table 4.5.1, NSAAQS and NAAQS exist for PM_{10}, CO, NO_2 and SO_2. Dispersion modeling for the Proposed Action and the Project alternatives utilized all identified sources and was performed for all four pollutants for all applicable averaging times. The results of the dispersion modeling were then compared to the most stringent NSAAQS or NAAQS. For the short term modeling results (e.g., 1-Hour, 3-Hour, 8-Hour, and 24-Hour averaging times), the NSAAQS were the most stringent and the modeled results were compared against those standards. For the long term modeling (e.g., annual averaging time,), the NSAAQS and the NAAQS were equally stringent. Details of the dispersion modeling and analysis are discussed in the air quality report prepared by Enviroscientists (2003).

4.5.3.2.6 Background Concentrations

To assess the impact of the Proposed Action and alternatives on the ambient air quality, it was necessary to account for existing, or background, levels for each pollutant. For PM_{10}, the BAPC modeling guidance recommends a background value of 10.2 $\mu g/m^3$ for the 24-hour PM_{10} concentrations and 9.0 $\mu g/m^3$ for the annual average PM_{10} concentrations. The ambient PM_{10} monitoring performed at the current Pipeline/South Pipeline Project, as previously discussed, has included the operation of three PM_{10} monitors located near the existing Pipeline/South Pipeline facilities (Figure 4.5.1). Monitoring commenced at these sites in 1997, approximately three years after mining began in the Project area. Therefore, the assumption can be made that the monitoring program has not collected data representing true background. For this impact analysis, the BAPC recommended that background values for PM_{10} be used.

No monitoring has been performed within Crescent Valley for ambient concentrations of CO, NO_2, O_3, or SO_2, nor does the BAPC specify background concentrations for these pollutants. However, background values are necessary for the purpose of NEPA analysis. Most monitoring is undertaken in locations with relatively high population density where high pollutant levels might be expected. It is difficult to find monitoring data from locations as remote and undeveloped as southern Crescent Valley. Almost all of the monitoring conducted by the State of Nevada is done in the Reno/Carson City or Las Vegas areas. Monitoring data from throughout the United States is available at the EPA Air Data web site (http://www.epa.gov/air/data/index.html). Monitoring data from most of the western states was reviewed, and the most suitable surrogates considered for each pollutant. Not all monitoring sites monitor all of the criteria pollutants. Table 4.5.5 lists the pollutant, time frame, monitor location, years of data reviewed, and assumed background value based on the first-high value from the years reviewed. The first-high value from the monitoring data was used rather than the second-high value because the BAPC uses the more stringent first-high value to determine compliance with the ambient standards (see Table 4.5.1, footnote c).

Rural background values recommended and used by the BAPC were selected for PM_{10}. The BAPC considers these values appropriate for remote mining facilities. Trona, California was chosen for background values for SO_2 and NO_2. Trona is a small desert in southern California. Unfortunately, the monitoring at Trona does not include CO. Barstow, California was chosen for CO, although this southern California town is located at the junction of two interstates and is a major railroad center. Monitored combustion emissions would be expected to be higher in Barstow than in Crescent Valley. All O_3 monitoring stations in southern California record very high values. These values probably reflect local combustion sources, down-wind transport of pollutants from the Los Angeles basin and northern Mexico, and persistent warm, sunny weather ideal for the creation of ozone. Craters of the Moon National Monument in Idaho was chosen for the background value for the one-hour O_3 standard. The monument is remote, and in a sagebrush dominated landscape similar to Crescent Valley.

Table 4.5.5: Background Values for Criteria Pollutants

Pollutant and Averaging Time	Monitor Location	Years of Data Reviewed	Std (μg/m^3)	Background Value (μg/m^3)
PM_{10} 24-Hour	BAPC Value	-	150	10.2
PM_{10} Annual	BAPC Value	-	50	9
CO One-Hour	Barstow, CA	1997-2001	40,000	4,800
CO Eight-Hour	Barstow, CA	1997-2001	10,000	2,444
NO_2 Annual	Trona, CA	1998-2001	100	12
SO_2 Three-Hour	Trona, CA	1997-2001	1,300	31
SO_2 24-Hour	Trona, CA	1997-2001	365	18
SO_2 Annual	Trona, CA	1997-2001	80	5
O_3 One-Hour	Craters of the Moon Nat'l Monument	1997-2001	235	161

4.5.3.3 Proposed Action

The Proposed Action consists of many activities and actions, each of which may have the potential to emit air pollutants. NAC 445B.187 defines "stationary source" as "...any building, structure, facility, or installation, including temporary sources which emits or may emit any regulated air pollutant that is regulated under ...NAC445B.001 to NAC445B.3485." NAC 445B.059 further defines "emission unit" as, "...a part of a stationary source that emits or has the potential to emit any regulated air pollutant." A comprehensive list of the sources of air pollutant emissions, resulting either directly from the Proposed Action or from indirectly related facilities used to process ore from the Proposed Action are presented in Table 4.5.6.

Table 4.5.6: List of Sources Analyzed for the South Pipeline Project

Emission Unit No.	Emission Unit Description	Emitted Pollutants
SOUTH PIPELINE SOURCES		
Emission Unit Group 1: Mining Activity		
1.001	Drilling - Ore	PM_{10}
1.002	Drilling - Waste	PM_{10}
1.003	Ammonium Nitrate Prill Silo Loading	PM_{10}
1.004	Ammonium Nitrate Prill Silo Unloading	PM_{10}
1.005	Blasting - Ore	PM_{10}
1.006	Blasting -Waste	PM_{10}
1.007	Explosive Detonation - Ore Blasting	CO, SO_2, NOx
1.008	Explosive Detonation - Waste Blasting	CO, SO_2, NOx
1.009	Loading - Ore	PM_{10}
1.010	Loading - Waste	PM_{10}
1.011	Loaders (Pit) - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.012	Hauling of Ore - South Pipeline Pit to Pipeline Mill	PM_{10}
1.013	Hauling of Ore - South Pipeline Pit to Cortez CFB Roaster	PM_{10}
1.014	Hauling of Ore - South Pipeline Pit to Cortez CIL Mill	PM_{10}
1.015	Hauling of Ore - South Pipeline Pit to Pipeline Leach Pad	PM_{10}
1.016	Hauling of Ore - South Pipeline Pit to SP Leach Pad	PM_{10}
1.017	Hauling of Ore to Pipeline Mill - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.018	Hauling of Ore to Cortez CFB Roaster - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.019	Hauling of Ore to Cortez CIL Mill - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.020	Hauling of Ore to Pipeline Leach Pad - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.021	Hauling of Ore to SP Leach Pad - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.022	Unloading Ore - Pipeline Mill	PM_{10}
1.023	Unloading Ore - Cortez CFB Roaster	PM_{10}
1.024	Unloading Ore - Cortez CIL Mill	PM_{10}
1.025	Hauling of Waste - Haul SP Waste to SP Waste Dump	PM_{10}
1.026	Hauling of Waste - SP Waste Dump - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.027	Unloading of Waste - South Pipeline Waste Rock Dump	PM_{10}
1.028	Waste Dozing - South Pipeline Waste Rock Dump	PM_{10}
1.029	Waste Dozers - SP Waste Dump - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.030	Hydraulic Shovel - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.031	Rotary Drills - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.032	Motor Grader - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.033	Blasting Trucks - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.034	Water Trucks - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.035	Water Trucks - Fugitive Emissions	PM_{10}
1.036	Wind Erosion - South Pipeline Waste Rock Dump	PM_{10}
1.037	Wind Erosion - Ore Storage Piles	PM_{10}
1.038	Cortez Mill Traffic	PM_{10}
1.039	Cortez Mill Traffic - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
1.040	Hauling of Waste-Inpit Backfill	PM_{10}
1.041	Hauling of Waste-Inpit Backfill-*Combustion*	CO, PM_{10}, SO_2, VOCs, NOx

Emission Unit No.	Emission Unit Description	Emitted Pollutants
1.042	Unloading Waste-Inpit Backfill	PM_{10}
	Emission Unit Group 2: Pipeline/South Pipeline Heap Leaching	
2.001	Unloading Ore - Pipeline Leach Pad	PM_{10}
2.002	Unloading Ore - South Pipeline Leach Pad	PM_{10}
2.003	Ore Dozing - Pipeline Leach Pad	PM_{10}
2.004	Ore Dozing - South Pipeline Leach Pad	PM_{10}
2.005	Ore Dozing (Pipeline Leach Pad)- *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
2.006	Ore Dozing (South Pipeline Leach Pad)- *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
2.007	100 Ton Lime Silo - Loading	PM_{10}
2.008	100 Ton Lime Silo - Unloading	PM_{10}
2.009	Wind Erosion - Pipeline Leach Pad	PM_{10}
2.010	Wind Erosion - South Pipeline Leach Pad	PM_{10}
	Emission Unit Group 3: Cortez Gravel Pit	
3.001	Wind Erosion (Gravel Pit)	PM_{10}
	Emission Unit Group 4: Permanent Crushing System	
4.001	Loader (Crusher) - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
4.002	Crusher Dump Pocket	PM_{10}
4.003	Transfer Dump Pocket to Jaw Crusher (JC) Apron Feeder	PM_{10}
4.004	Transfer from JC Apron Feeder To Conveyor #1	PM_{10}
4.005	Vibrating Grizzly Screen	PM_{10}
4.006	Transfer Grizzly Chute to Conveyor #1	PM_{10}
4.007	Rock Breaker	PM_{10}
4.008	Rock Breaker - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
4.009	Jaw Crusher	PM_{10}
4.010	Transfer from Conveyor #1 to Conveyor #2	PM_{10}
4.011	Transfer from Conveyor #2 to Ore Stockpile	PM_{10}
4.012	Transfer Ore Stockpile Apron Feeder #1 to Conveyor #3	PM_{10}
4.013	Transfer Ore Stockpile Apron Feeder #2 to Conveyor #3	PM_{10}
4.014	Wind Erosion - Coarse Ore Stockpile	PM_{10}
	Emission Unit Group 5: Wet Grinding	
5.001	Transfer from Conveyor #3 to Wet Mill	PM_{10}
5.002	Wet Mill Lime Silo - Loading	PM_{10}
5.003	Wet Mill Lime Silo - Discharge	PM_{10}
	Emission Unit Group 6: Carbon Stripping	
6.001	Carbon Strip Vessels Boiler #1	CO, PM_{10}, SO_2, VOCs, NOx
6.002	Carbon Strip Vessels Boiler #2	CO, PM_{10}, SO_2, VOCs, NOx
6.003	Carbon Strip Vessels Boiler #3	CO, PM_{10}, SO_2, VOCs, NOx
	Emission Unit Group 7: Refinery	
7.001	Refinery Induction Furnace #1	PM_{10}
7.002	Refinery Induction Furnace #2	PM_{10}
7.003	Gold Sludge Dryer Oven	PM_{10}
	Emission Unit Group 8: Carbon Reactivation	
8.001	Carbon Reactivation Kiln #1	PM_{10}
8.002	Carbon Reactivation Kiln #2	PM_{10}
	Emission Unit Group 9: Mill Lime Handling System	
9.001	Mill Lime Handling System - Loading	PM_{10}

Emission Unit No.	Emission Unit Description	Emitted Pollutants
9.002	Mill Lime Handling System - Discharge	PM_{10}
	Emission Unit Group 10: Assay Laboratory	
10.001	Assay Laboratory	PM_{10}
	Emission Unit Group 11: Standby Generators	
11.001	Diesel Fuel Tanks (Pipeline)	VOCs
11.002	Diesel Fuel Tank (Pipeline Fuel Skid)	VOCs
11.003	Diesel Fuel Tanks (Pipeline Emergency Generators)	VOCs
11.004	Gasoline Tank (Small Vehicle Station)	VOCs
	Emission Unit Group 12: Standby Generators	
12.001	2,220 HP Stand-By Generator #1	CO, PM_{10}, SO_2, VOCs, NOx
12.002	2,220 HP Stand-By Generator #2	CO, PM_{10}, SO_2, VOCs, NOx
12.003	2,220 HP Stand-By Generator #3	CO, PM_{10}, SO_2, VOCs, NOx
	Emission Unit Group 13: Portable Crushing System	
13.001	Truck Dump to Primary Crusher	PM_{10}
13.002	Primary Crusher	PM_{10}
13.003	Primary Screen	PM_{10}
13.004	Secondary Crusher	PM_{10}
13.005	Transfer Conveyor #7 to Stockpile #1	PM_{10}
13.006	Transfer Conveyor #5 to Radial Stacker #6	PM_{10}
13.007	Transfer Radial Stacker #6 to Stockpile #2	PM_{10}
13.008	Wind Erosion - Stockpile #1	PM_{10}
13.009	Wind Erosion - Stockpile #2	PM_{10}
	Emission Unit Group 14: Other Sources	
14.001	Light Plants (Within Pit) - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
14.002	Light Plants (Waste Rock) - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
14.003	Gold Acres Lime Silo, 100 ton/Loading	PM_{10}
14.004	Gold Acres Lime Sio, 100 ton /Discharge	PM_{10}
14.005	Gold Acres Lime Silo, 20 ton/Loading	PM_{10}
14.006	Gold Acres Lime Silo, 20 ton/Discharge	PM_{10}
	CORTEZ MINE SOURCES	
	Cortez Emission Unit Group 1: Ore Crushing Circuit	
C1.001	Loader (Crusher) - *Combustion*	CO, PM_{10}, SO_2, VOCs, NOx
C1.002	Wind Erosion - Ore Storage Pile	PM_{10}
C1.003	50 Ton Ore Bin	PM_{10}
C1.004	Transfer from 50 Ton Ore Bin to Hydrastoke Feeder	PM_{10}
C1.005	Hydrastoke Feeder	PM_{10}
C1.006	Transfer from Hydrastoke Feeder to Jaw Crusher	PM_{10}
C1.007	Jaw Crusher	PM_{10}
C1.008	Transfer from Conveyor #1 to Conveyor #2	PM_{10}
C1.009	Transfer from Conveyor #2 to Vibrating Screen	PM_{10}
C1.010	Vibrating Screen	PM_{10}
C1.011	Transfer from Conveyor #3a to Conveyor #3b	PM_{10}
C1.012	Transfer from Conveyor #3a to Conveyor #3	PM_{10}
C1.013	Transfer from Conveyor #3 to Crushed CIL Ore Stockpile	PM_{10}

Emission Unit No.	Emission Unit Description	Emitted Pollutants
C1.014	Transfer from Conveyor #3b to Conveyor #10	PM_{10}
C1.015	Transfer from Conveyor #10 to Roast Ore Stockpile	PM_{10}
C1.016	Cone Crusher	PM_{10}
C1.017	Transfer Crushed CIL Ore Stockpile to Conveyor #4A	PM_{10}
C1.018	Transfer Crushed CIL - Alternate	PM_{10}
C1.019	Transfer from Conveyor #4A to #4B	PM_{10}
C1.020	Transfer from Conveyor #4B to Rod Mill	PM_{10}
C1.021	Transfer from Roast Ore Stockpile to Conveyor #11A	PM_{10}
C1.022	110 Ton Roaster Lime Silo Baghouse	PM_{10}
C1.023	110 Ton Roaster Lime Silo - Discharge	PM_{10}
C1.024	Wind Erosion (Roast Ore Stockpile)	PM_{10}
C1.025	Wind Erosion (Crushed CIL Ore Stockpile)	PM_{10}
	Cortez Emission Unit Group 2: Coal Feed System for Roaster	
C2.001	60 Ton Coal Bin & Apron Feeder	PM_{10}
C2.002	Transfer from Coal Bin to Screw Conveyor	PM_{10}
C2.003	Transfer from Screw Conveyor to Conveyor #11B	PM_{10}
C2.004	Transfer from Conveyor #11B to Conveyor #11A	PM_{10}
C2.005	Transfer from Conveyor #11A to Dry Grind SAG Mill Feed Belt	PM_{10}
	Cortez Emission Unit Group 3: Dry Grinding System for Roaster	
C3.001	Dry Grinding Process Baghouse - Controlling emissions from the SAG mill, the classifier, two vibrating screens, a bucket elevator, an air preheater, and a surge bin	CO, PM_{10}, SO_2, VOCs, NOx
C3.002	1,400 Ton Ore Storage Silo Baghouse - Controlling emissions from the 1,400 ton ore storage silo and Conveyor #12	PM_{10}
	Cortez Emission Unit Group 4: Roasting Circuit	
C4.001	Ore Surge Bin Baghouse	PM_{10}
C4.002	Roaster Venting System	CO, PM_{10}, SO_2, VOCs, NOx
C4.003	Calcine Cooler Wet Scrubber	PM_{10}
	Cortez Emission Unit Group 5: Lime Handling System	
C5.001	Lime Handling System - Loading	PM_{10}
C5.002	Lime Handling System - Discharge	PM_{10}
C5.003	Transfer Lime from Screw to Wet Mill	PM_{10}
	Cortez Emission Unit Group 6: Carbon Strip Circuit	
C6.001	Carbon Reactivation Kiln	CO, PM_{10}, SO_2, VOCs, NOx
C6.002	Carbon Strip Vessels Boiler	CO, PM_{10}, SO_2, VOCs, NOx
	Cortez Emission Unit Group 7: Refinery	
C7.001	Wabi Iron Works Furnace #1	CO, PM_{10}, SO_2, VOCs, NOx
C7.002	Wabi Iron Works Furnace #2	CO, PM_{10}, SO_2, VOCs, NOx
C7.003	Denver Fire Clay Furnace	CO, PM_{10}, SO_2, VOCs, NOx
	Cortez Emission Unit Group 8: Assay Laboratory	
C8.001	Jaw Crushers	PM_{10}
C8.002	Pulverizers	PM_{10}
C8.003	Electric Furnaces	PM_{10}
	Cortez Emission Unit Group 9: Other Sources	
C9.001	256 kW Backup Generator - CIL Mill	CO, PM_{10}, SO_2, VOCs, NOx
C9.002	256 kW Backup Generator - GW Remediation	CO, PM_{10}, SO_2, VOCs, NOx
C9.003	Thermal / Catalytic Oxidizer	CO, PM_{10}, SO_2, VOCs, NOx

The Proposed Action is essentially an extension of the current operations at the Pipeline/South Pipeline Project, and will allow CGM to further develop the South Pipeline ore deposit. This Action would result in expansion of the Pipeline/South Pipeline open pit, and raising the final height of the waste dump and South Pipeline Leach Pad. Total surface disturbance area for the Pipeline/South Pipeline mine would be unchanged.

4.5.3.3.1 Environmental Consequences and Mitigation Measures

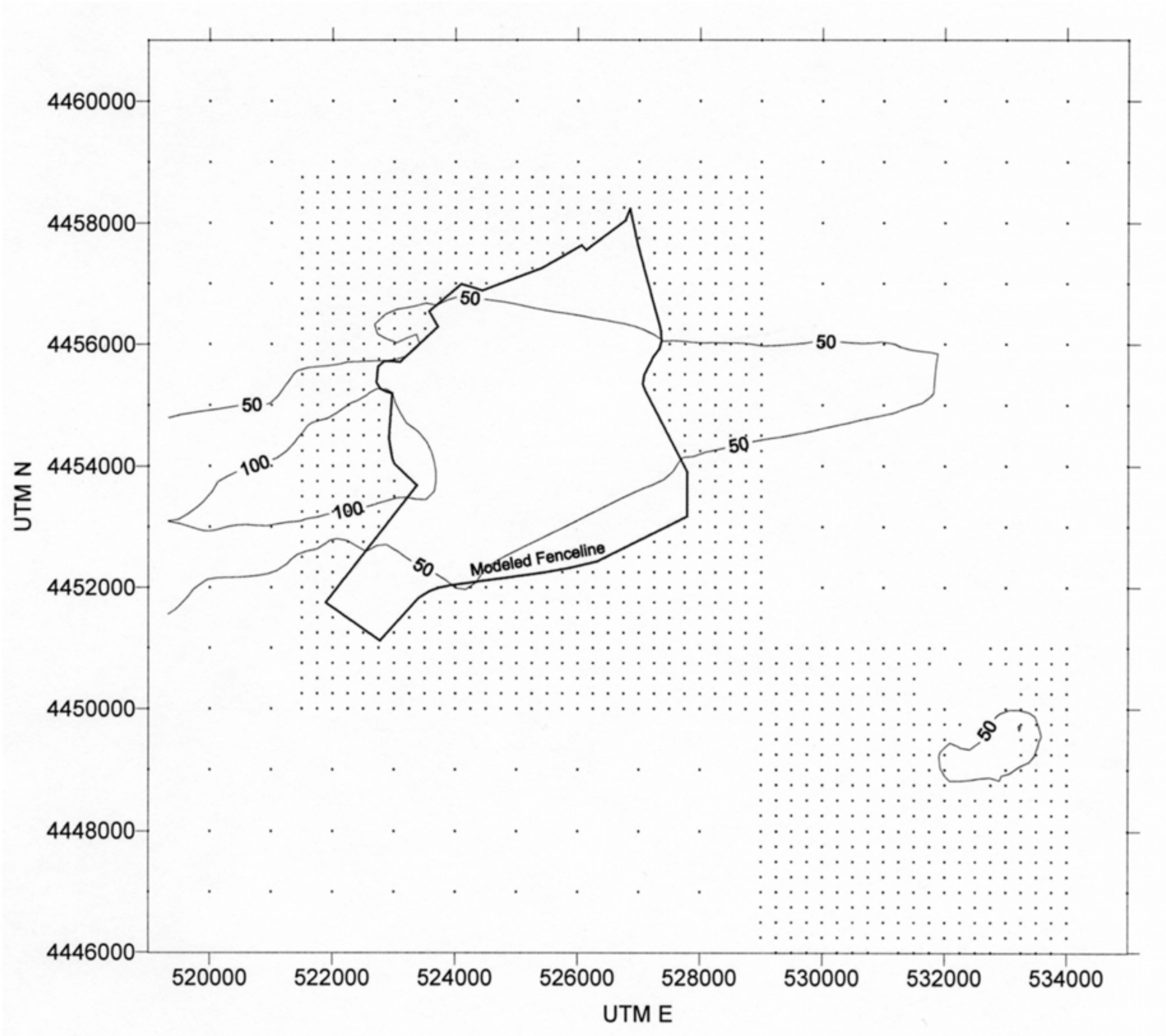
PM_{10} Emissions

PM_{10} emissions are generated by almost all sources listed in Table 4.5.6, although the largest single source of PM_{10} is the resuspension of unpaved-road dust from haul trucks. The haul trucks (ranging in size from 150 to 400 tons, empty weight and carrying capacity) are used to transport material from the open pit to the waste rock dump and the ore processing facilities. PM_{10} emissions from the unpaved haul roads are controlled using a combination of chemical dust suppressant and water. The suppressant is applied approximately every two weeks during the summer, or dusty months, and as environmental conditions warrant during the winter. Water is applied daily during summer and as conditions warrant during the winter. In addition to resuspended road dust, the haul trucks also produce combustion, or tailpipe, PM_{10} emissions. Other major sources of PM_{10} emissions include wind erosion of the waste rock dump, the leach pads and the ore storage stockpiles, as well as processing material using crushers, screens, and conveyors, and emissions from blasting operations. Ongoing reclamation activities and leaching operations minimize PM_{10} emissions from the waste rock dump and the leach pads, respectively, while high moisture ore, water sprays, and an agglomerated dust reduction system minimize emissions from the material process equipment (i.e., crushers, screens, conveyors, etc.).

The control measures substantially reduce PM_{10} emissions from the Proposed Action, resulting in the maximum modeled ambient PM_{10} concentration, including background concentrations, at any point of public access of 134 $\mu g/m^3$ per 24-hour time period, and 27.1 $\mu g/m^3$, annual arithmetic average (Table 4.5.7 and Figure 4.5.4). Plots showing the isopleths of concentration for the 24-hour and annual PM_{10} models are shown in Figures 4.5.4 and 4.5.5. Dispersion modeling was also performed to determine the impacts on the "sensitive" receptors listed in Section 4.5.3.2.2. The highest 24-hour PM_{10} impact from the proposed action on the defined sensitive receptors was found to be 15.0 $\mu g/m^3$ at the Wintle ranch, which is located approximately eight miles northeast of the Pipeline Mill. The highest annual PM_{10} impact from the Proposed Action on the defined sensitive receptors was found to be 3.38 $\mu g/m^3$, at the Fillipini ranch (Table 4.5.8 and Figure 4.5.5).

Impact 4.5.3.3.1-1: Fugitive dust (PM_{10}) would be generated by numerous processes as a result of the Proposed Action, including the resuspension of road dust, wind erosion of exposed dirt surfaces, and activities related to the processing of ore materials. These activities are inherent to the mining process and would be ongoing throughout the life of the proposed action. The modeled PM_{10} concentrations show levels below the NSAAQS and NAAQS, even with the addition of the BAPC recommended background values.

Significance of the Impact: This impact is considered less than significant and no mitigation measures are required.



EXPLANATION

Isopleths Displayed for 50 and 100 ug/m3 Contour Intervals

Ambient 24-Hour Pm10 Standard is 150 ug/m3

Figure 4.5.4 Isopleth of the Modeled Highest 24-Hour PM10 Concentrations for the Proposed Actions

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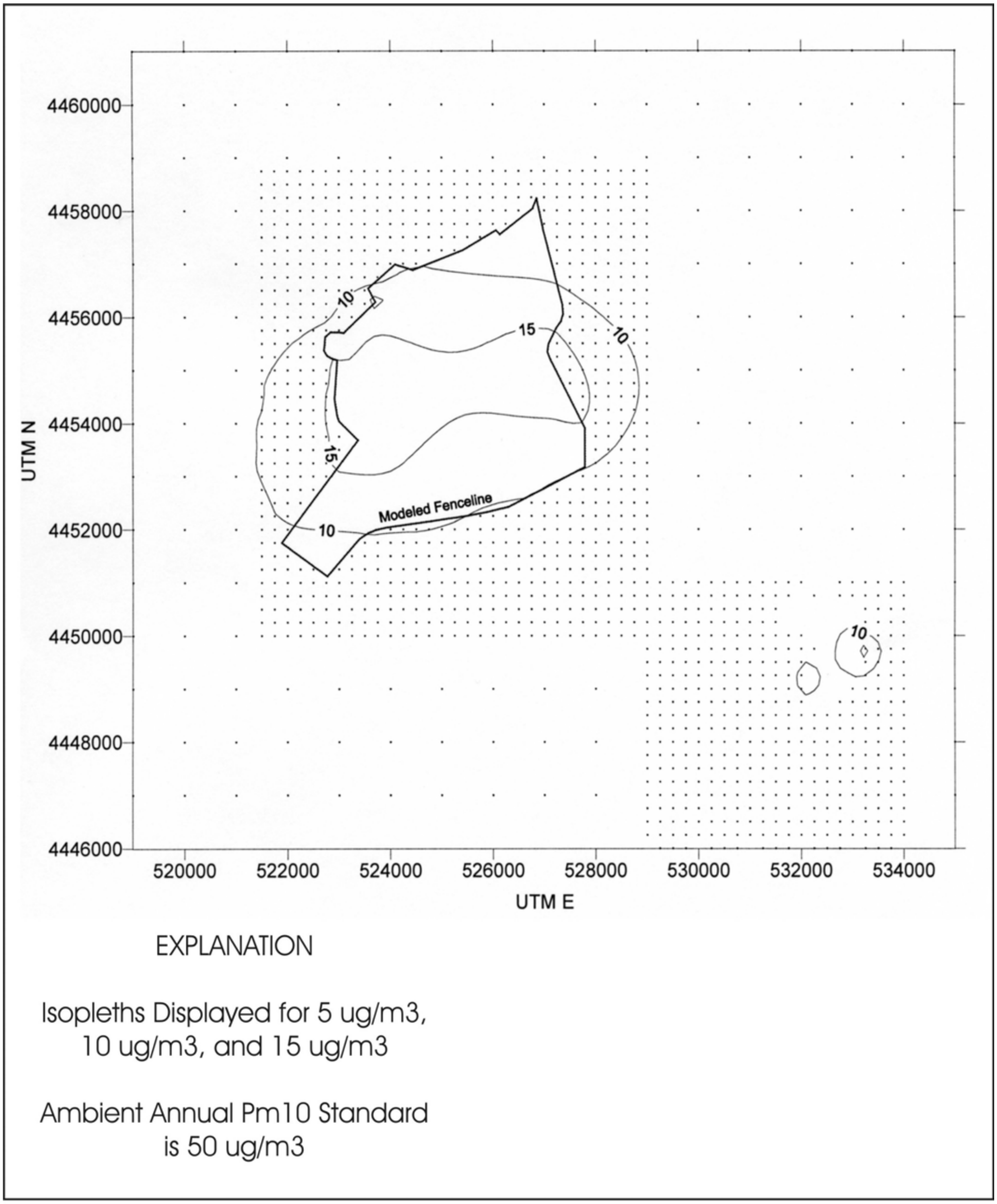

Figure 4.5.5 Isopleth of the Modeled Highest Annual PM10 Concentrations for the Proposed Action

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Combustion Emissions

Combustion of diesel in the haul trucks and mobile equipment, such as loaders, dozers, etc., the combustion of propane in processing units such as the Carbon Strip Vessels Boilers, and the combustion of fuel oil and/or coal in units such as the Cortez CFB Roaster, can produce elevated ambient levels of CO, NO_2, SO_2, and O_3 (from VOC emissions). In some instances, potential emissions from stationary combustion units are reduced by the use of existing pollution control devices such as scrubbers (the Cortez CFB Roaster), but in most cases, combustion emissions are generally uncontrolled at the tailpipe. Despite the lack of tailpipe emissions control technology for combustion sources throughout the Project Area, the maximum modeled CO, NO_2, and SO_2 concentrations are well below either the NSAAQS or the NAAQS. The modeled results, including background concentrations, for each pollutant for each applicable averaging time are shown in Table 4.5.7. Isopleths of the modeled gaseous pollutant impacts can be found in air quality report prepared by Enviroscientists (2003).

Dispersion modeling was also performed to determine the impacts of the gaseous pollutants from the Proposed Action on the defined sensitive receptors, including the Jarbidge Wilderness, for each applicable averaging time shown in Table 4.5.8. In all instances, the concentrations are a small fraction of the ambient standards, and in the case o f the Jarbidge Wilderness, much less than the PSD Class I increments.

The highest 24-hour and annual PM_{10} concentrations modeled from the Proposed Action emissions at the Jarbidge Wilderness Area are 0.468 $\mu g/m^3$ and 0.032 $\mu g/m^3$, respectively. Although the Project is not subject to limitations by the PSD Class I increments (8 $\mu g/m^3$ and 4 $\mu g/m^3$, 24-hour and annual averaging times, respectively), the ambient concentration increases modeled from Proposed Action emissions values are far below these PSD Class I increments and the EPA's modeling significance level of 1 $\mu g/m^3$.

Impact 4.5.3.3.1-2: Combustion emissions of CO, NO_2, SO_2 and VOC would be generated by numerous processes as a result of the Proposed Action, including combustion emissions from diesel engines; and burning propane, fuel oil, and/or coal in various process equipment. The modeled CO, NO_2, SO_2 and O_3 show levels below the NSAAQS and NAAQS.

Significance of the Impact: This impact is considered less than significant and no mitigation measures are required.

Hazardous Air Pollutants

HAP emissions from stationary sources are unchanged with the Proposed Action. Mobile sources constitute the primary contributors to combustion-related HAP emissions, and increased fuel usage will result in increased emissions. Total 2003 emissions of the four combustion-related HAPs was 8,910 pounds.

Impact 4.5.3.3.1-3: Mercury, cyanide, MTBE, propylene, toluene, and xylene would continue to be released by ore refining and processing and fuel combustion.

Table 4.5.7: Highest Modeled Air Pollutant Concentrations from the Proposed Action at Receptor Points Accessible to the Public

Pollutant	Averaging Time	Highest Modeled Receptor Point			Lowest Applicable Ambient Standard ($\mu g/m^3$)
		Receptor Location[1]		Dispersion Modeling Results ($\mu g/m^3$)[2]	
		UTM East (m)	UTM North (m)		
Particulate Matter of Aerodynamic diameter less than 10 micrometers (PM_{10})	24-Hour	523,641	4,456,405	134	150
	Annual	523,371	4,453,679	27.1	50
Sulfur Dioxide (SO_2)	3-Hour	533,750	4,449,000	674	1,300
	24-Hour	533,750	4,449,000	195	365
	Annual	532,500	4,449,000	29.4	80
Carbon Monoxide (CO)	1-Hour	533,250	4,449,250	6,074	40,000
	8-Hour (< 5,000')	533,500	4,449,250	2,882	10,000
	8-Hour (≥ 5,000')	523,500	4,449,250	2,882	6,667
Ozone (O_3)	1-Hour	NA	NA	191	235
Nitrogen Dioxide (NO_2)	Annual	523,250	4,456,250	30.0	100

[1] All coordinates in UTM projection, North American Datum 1927.
[2] Background values, as listed in Table 4.5.5 are included.

Significance of the Impact: This impact is considered less than significant and no mitigation measures are required.

4.5.3.3.2 Residual Adverse Impacts

The residual adverse impacts of the Proposed Action include fugitive PM_{10} emissions from vehicular traffic, blasting, and material handling and processing operations. Other impacts include combustion emissions of PM_{10}, CO, NO_2, SO_2 and VOC generated by numerous processes as a result of the Proposed Action, including combustion emissions from diesel engines; and burning propane, fuel oil, and/or coal in various process equipment.

The Proposed Action includes no increases in refinery operations so mercury emissions are not expected to increase and may continue to decrease with the implementation of the VMRP. Cyanide emissions are expected to vary over time, as ore with different chemistry is processed. Combustion-related HAPs would continue to be emitted with diesel, gasoline, and propane usage.

Table 4.5.8: Highest Modeled Air Pollutant Concentration Impacts from the Proposed Action at the Defined Sensitive Receptors

Pollutant	Averaging Time	Highest Modeled Concentration		Lowest Applicable Ambient Standard
		Jarbidge Wilderness	Other Sensitive Receptors[1]	
Particulate Matter of Aerodynamic Diameter of less than 10 Micrometers (PM_{10})	24-Hour	0.468 μg/m^3	25.2 μg/m^3	150 μg/m^3
	Annual	0.032 μg/m^3	12.4 μg/m^3	50 μg/m^3
Carbon Monoxide (CO)	1-Hour	3.35 μg/m^3	4,886.1 μg/m^3	40,000 μg/m^3
	8-Hour (< 5,000')	0.749 μg/m^3	2,475.0 μg/m^3	10,000 μg/m^3
	8-Hour (≥ 5,000')	0.749 μg/m^3	2,475.0 μg/m^3	6,667 μg/m^3
Nitrogen Dioxide (NO_2)	Annual	0.011 μg/m^3	13.4 μg/m^3	100 μg/m^3
Sulfur Dioxide (SO_2)	3-Hour	0.024 μg/m^3	61.0 μg/m^3	1,300 μg/m^3
	24-Hour	0.112 μg/m^3	16.0 μg/m^3	365 μg/m^3
	Annual	0.008 μg/m^3	6.0 μg/m^3	80 μg/m^3

[1] Background values included as listed in Table 4.5.5.

4.5.3.4 Complete Backfill Alternative

The Complete Backfill Alternative would be the same as the Proposed Action, except that the waste rock generated during the mining operations and placed in the Pipeline/South Pipeline waste rock dump would be placed back into the open pit at the end of the mining operations. Activities would generally occur along the same time frame as the Proposed Action, with the exception of the final placement of the waste rock back into the open pit. These activities would extend the time frame for overall activities. Qualitative analysis of the potential air quality impacts from the Complete Backfill Alternative are presented below. A quantitative analysis was not completed because the analyses for the Proposed Action sufficiently encompasses the potential impacts of the Complete Backfill Alternative.

4.5.3.4.1 Environmental Consequences and Mitigation Measures

Activities under the Complete Backfill Alternative will be the same as under the Proposed Action through the completion of the mining operation. Therefore, the analysis of the potential air quality impacts for the Proposed Action appropriately characterize the potential air quality of the Complete Backfill Alternative. After mining operations have ceased under the Complete Backfill Alternative, approximately 300 million tons of waste rock deposited at the Pipeline/South Pipeline waste rock dump would be transferred to the open pit to complete the backfilling of the waste rock mined under this alternative. The emissions associated with this activity are fugitive dust and combustion emissions associated with the loader transport and dumping of the waste rock. These emissions are a subset of the type and location of emissions evaluated for the placement of the waste rock under the analysis for the Proposed Action. Since the Proposed Action did not result in an identified exceedance of the NAAQS, activities under this portion of the Complete Backfill Alternative are also not expected to result in an exceedance of the NAAQS.

4.5.3.4.2 Residual Adverse Impacts

The residual adverse impacts of the Complete Backfill Alternative include fugitive PM_{10} emissions from vehicular traffic, blasting, and material handling and processing operations. Other impacts include combustion emissions of PM_{10}, CO, NO_2, SO_2 and VOC generated by numerous processes as a result of the Proposed Action, including combustion emissions from diesel engines; and burning propane, fuel oil, and/or coal in various process equipment.

4.5.3.5 No Backfill Alternative

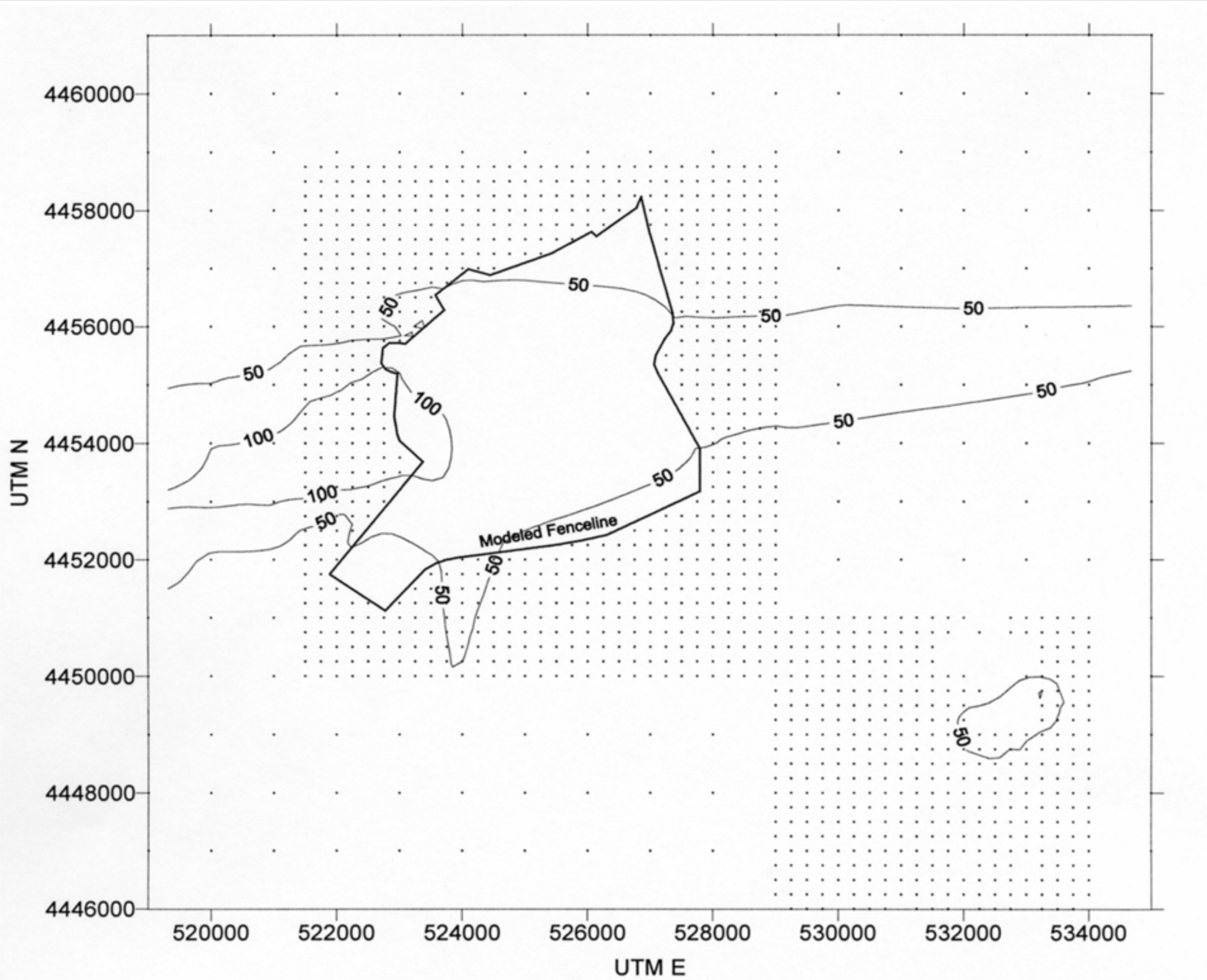
Activities under the No Backfill Alternative would be the same as the Proposed Action, except that all the waste rock generated during the mining operations would be placed in the existing Pipeline/South Pipeline waste rock dump. Activities would generally occur over the same time frame as the Proposed Action. Haulage distances for the waste rock are somewhat longer, and fugitive and tailpipe emissions are increased.

The results of the dispersion modeling, including background concentrations, for the activities under the No Backfill Alternative are presented in Table 4.5.9. The table shows the highest modeled results at any point of public access for all eight pollutant-averaging time combinations; the location (in UTM coordinates) of the highest modeled public access receptor; and the highest applicable standard (NSAAQS or NAAQS) for each of the eight pollutant-averaging time combinations. Table 4.5.9 demonstrates that for all pollutant-averaging time combinations, the No Backfill Alternative modeled ambient concentrations are below the applicable ambient standards at any modeled point of public access, even with the addition of the background values listed in Table 4.5.5. Thus, the No Backfill Alternative will not cause or contribute to a violation of a NSAAQS or NAAQS for PM_{10}, SO_2, CO, NO_2 or O_3.

The results for each of the No Backfill Alternative modeled pollutant-averaging time combinations are also displayed graphically in Figures 4.5.6 and 4.5.7. Figure 4.5.6 displays the isopleths for the modeled 24-hour PM_{10} concentrations, while Figure 4.5.7 displays the isopleths for the modeled annual PM_{10} concentrations.

An assessment was also made to estimate the potential impact of the No Backfill Alternative on selected sensitive receptors. Separate model runs were made for each of the eight pollutant-averaging time combinations using only the defined sensitive receptors and the same dispersion modeling inputs used for the modeling previously discussed. The results of the modeling for the sensitive receptors for the No Backfill Alternative are presented in Table 4.5.10.

The highest modeled 24-hour PM_{10} concentration from the No Backfill Alternative emissions on the defined sensitive receptors was 52.1 $\mu g/m^3$, at the Wintle ranch, which is located approximately eight miles northeast of the Pipeline Mill. The next (or "second") highest 24-hour PM_{10}



EXPLANATION

Isopleths Displayed for 50
and 100 ug/m3 Contour Intervals

Ambient 24-Hour Pm10 Standard
is 150 ug/m3

Figure 4.5.6 Isopleth of the Modeled Highest 24-Hour PM10 Concentrations for the No Backfill Alternative

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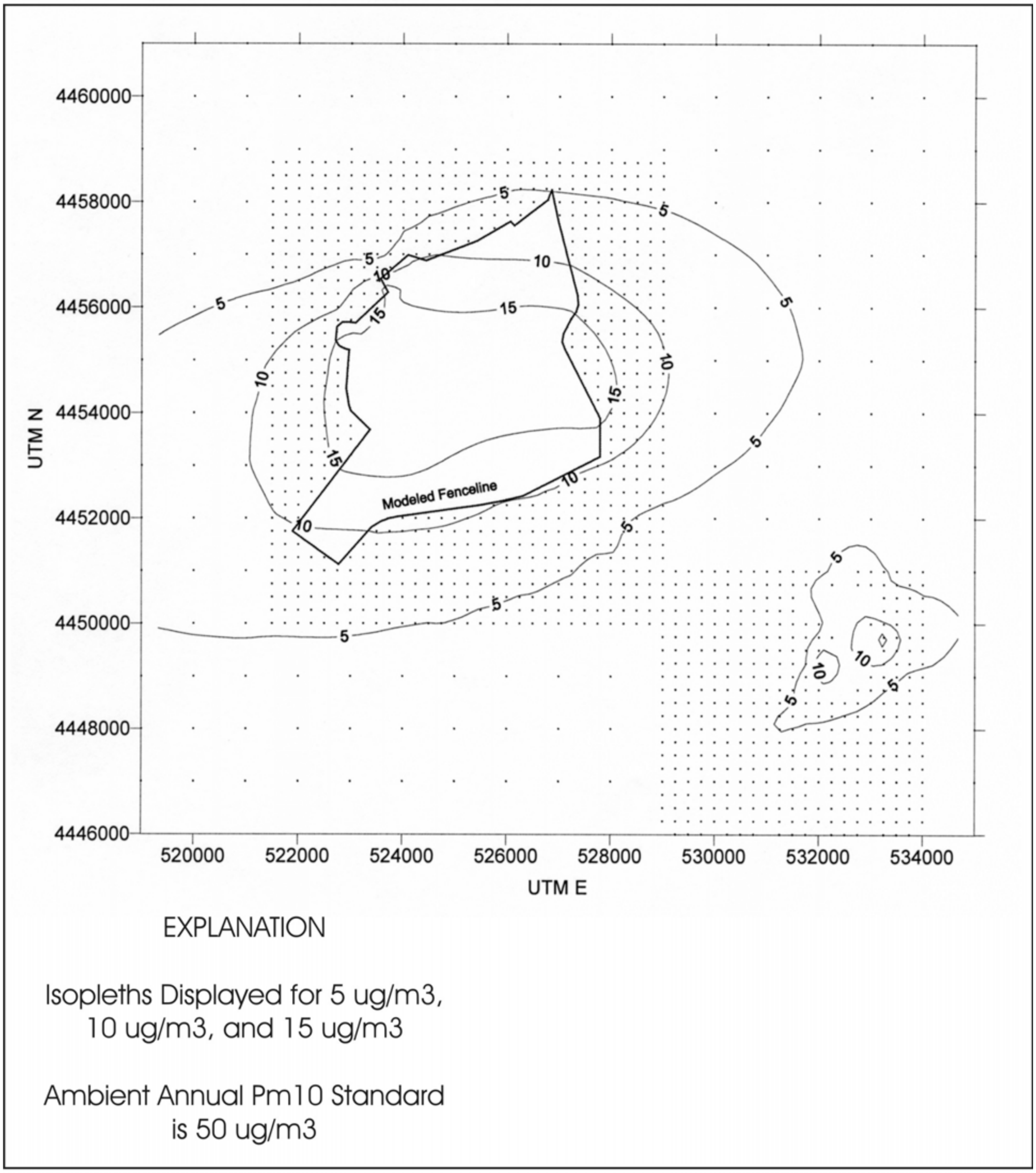

Figure 4.5.7 Isopleth of the Modeled Highest Annual Concentrations for the No Backfill Alternative

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Table 4.5.9: Highest Modeled Air Pollutant Concentrations from the No Backfill Alternative at Receptor Points Accessible to the Public

Pollutant	Averaging Time	Highest Modeled Receptor Point: Receptor Location[1] UTM East (m)	Receptor Location[1] UTM North (m)	Dispersion Modeling Results (µg/m³)[2]	Lowest Applicable Ambient Standard (µg/m³)
Particulate Matter of Aerodynamic diameter less than 10 micrometers (PM_{10})	24-Hour	523,641	4,456,405	143	150
	Annual	532,000	4,449,000	28.7	50
Sulfur Dioxide (SO_2)	3-Hour	533,750	4,449,000	673	1,300
	24-Hour	533,750	4,449,000	195	365
	Annual	532,500	4,449,000	29.7	80
Carbon Monoxide (CO)	1-Hour	527,250	4,455,250	6,074	40,000
	8-Hour (< 5,000')	523,148	4,453,893	2,882	10,000
	8-Hour (≥ 5,000')	523,148	4,453,893	2,882	6,667
Ozone (O_3)	1-Hour			191	235
Nitrogen Dioxide (NO_2)	Annual	523,250	4,456,250	30	100

[1] All coordinates in UTM projection, North American Datum 1927.
[2] Background values are included as listed in Table 4.5.5.

concentration from the No Backfill Alternative emissions at the Wintle ranch was 11.1 µg/m³, which is less than one-quarter of the highest 24-hour PM_{10} concentration. Although the first-high value would exceed the Class II PSD increment limit of 30 µg/m³, the second-high value is used to determine compliance with the standard. All of the sensitive receptors would be in compliance with the Class II increment limits, if they were in an air quality management area that had been triggered for PM_{10}. The highest annual PM_{10} concentration from the No Backfill Alternative emissions on the sensitive receptors was 3.38 µg/m3 at the Fillippini ranch.

The highest 24-hour and annual PM_{10} concentrations modeled from the No Backfill Alternative emissions at the Jarbidge Wilderness Area are 0.511 µg/m³ and 0.032 µg/m³, respectively. Although the No Backfill Alternative is not subject to limitations by the PSD Class I increments (eight µg/m³ and four µg/m³, 24-hour and annual averaging times, respectively), the ambient concentration increases modeled from the No Backfill Alternative emissions values are far below these PSD Class I increments.

Modeling was also performed to determine the concentrations of the gaseous pollutant emissions (SO_2, CO, and NO_2) from the Project on the defined sensitive receptors. The highest modeled concentration for each modeled air pollutant at all sensitive receptors (and at Jarbidge Wilderness) for each applicable averaging time is also presented in Table 4.5.10. In all instances, the modeled concentrations are less than the applicable ambient air quality standard(s), and in the case of the

Jarbidge Wilderness, much less than the PSD Class I increments. Thus, further analyses for these pollutants are not warranted.

Table 4.5.10: Highest Modeled Air Pollutant Concentration Impacts from the No Backfill Alternative at the Defined Sensitive Receptors

Pollutant	Averaging Time	Highest Modeled Concentration		Lowest Applicable Ambient Standard
		Jarbidge Wilderness	Other Sensitive Receptors[1]	
Particulate Matter of Aerodynamic Diameter of less than 10 Micrometers (PM_{10})	24-Hour	0.511 µg/m^3	62.3 µg/m^3	150 µg/m^3
	Annual	0.032 µg/m^3	12.4 µg/m^3	50 µg/m^3
Carbon Monoxide (CO)	1-Hour	3.37 µg/m^3	4,886.1 µg/m^3	40,000 µg/m^3
	8-Hour (< 5,000')	80.1 µg/m^3	2,475.0 µg/m^3	10,000 µg/m^3
	8-Hour (≥ 5,000')	0.749 µg/m^3	2,475.0 µg/m^3	6,667 µg/m^3
Nitrogen Dioxide (NO_2)	Annual	0.012 µg/m^3	13.5 µg/m^3	100 µg/m^3
Sulfur Dioxide (SO_2)	3-Hour	0.566 µg/m^3	61.0 µg/m^3	1,300 µg/m^3
	24-Hour	0.114 µg/m^3	26.1 µg/m^3	365 µg/m^3
	Annual	0.008 µg/m^3	6.0 µg/m^3	80 µg/m^3

1 - Background values are included as listed in Table 4.5.5.

4.5.3.6 No Action Alternative

Under the No Action Alternative, the existing Pipeline/South Pipeline Project would continue to operate under current operational conditions, with an expected mine life of 17 years. Air emissions, and thus ambient air pollutant concentrations, resulting from the existing Pipeline/South Pipeline Project would not be expected to increase over current levels and, therefore, no additional air quality impacts would occur. The potential air quality impacts from the No Action Alternative were evaluated in the South Pipeline Air Quality Impact Assessment Report (EMA 1998) and the South Pipeline Final EIS (BLM 2000a). Table 4.5.11 presents the results of the 1998 report for all pollutant-averaging time combinations, and shows that the No Action Alternative modeled ambient concentrations are below the applicable ambient standards at any modeled point of public access, even with the addition of the background values listed in Table 4.5.5. Thus, the No Action Alternative would not cause or contribute to a violation of a NSAAQS or NAAQS for PM_{10}, SO_2, CO, or NO_2. O_3 concentrations as a result of the No Action Alternative would likely be less than the O_3 standard. The No Action Alternative would result in less VOC and NO_2 emissions as compared to the Proposed Action because of less fuel combustion (see Table 4.5.7).

An assessment was also made to estimate the potential impact of the No Action Alternative on selected sensitive receptors (EMA 1998). Separate model runs were made for each of the eight pollutant-averaging time combinations using only the defined sensitive receptors and the same

Table 4.5.11: Highest Modeled Air Pollutant Concentrations from the No Action Alternative at Receptor Points Accessible to the Public

Pollutant	Averaging Time	Highest Modeled Receptor Point			Lowest Applicable Ambient Standard ($\mu g/m^3$)
		Receptor Location [1]		Dispersion Modeling Results ($\mu g/m^3$)[2]	
		UTM East (m)	UTM North (m)		
Particulate Matter of Aerodynamic diameter less than 10 micrometers (PM_{10})	24-Hour	523,154	4,453,895	97.2	150
	Annual	523,700	4,456,290	18.0	50
Sulfur Dioxide (SO_2)	3-Hour	533,000	4,449,000	146	1,300
	24-Hour	533,000	4,449,000	51	365
	Annual	532,000	4,449,000	8	80
Carbon Monoxide (CO)	1-Hour	524,200	4,456,921	7,767	40,000
	8-Hour (< 5,000')	523,000	4,456,500	2,519	10,000
	8-Hour (≥ 5,000')	523,000	4,456,500	2,519	6,667
Nitrogen Dioxide (NO_2)	Annual	532,000	4,449,000	17	100

[1] All coordinates in UTM projection, North American Datum 1927.
[2] Background values are included as listed in Table 45.5.

dispersion modeling inputs used for the modeling previously discussed. The results of the modeling for the sensitive receptors with background values listed in Table 4.5.5 are presented in Table 4.5.12.

The highest modeled 24-hour PM_{10} concentration from the No Action Alternative emissions on the defined sensitive receptors was 33 $\mu g/m^3$, at the Wintle ranch, which is located approximately eight miles northeast of the Pipeline Mill. The next (or second) highest 24-hour PM_{10} concentration from the No Action Alternative emissions at the Wintle ranch was 7.7 $\mu g/m^3$, which is only about one-quarter of the highest 24-hour PM_{10} concentration. Although the first-high value would exceed the Class II PSD increment limit of 30 $\mu g/m^3$, the second-high value is used to determine compliance with the standard. All of the sensitive receptors would be in compliance with the Class II increment limits, if they were in an air quality management area that had been triggered for PM_{10}. The highest annual PM_{10} concentration from the Project emissions on the sensitive receptors was 0.94 $\mu g/m^3$, also at the Wintle ranch. This value is below the EPA's defined annual PM_{10} modeling significance level of one $\mu g/m^3$ [40 CFR 51.165(b)(2)], and should be indistinguishable from existing PM_{10} concentrations within the CVAQMA.

The highest 24-hour and annual PM_{10} concentrations modeled from the No Action emissions at the Jarbidge Wilderness Area are 0.31 $\mu g/m^3$ and 0.009 $\mu g/m^3$, respectively. Although the No Action Alternative is not subject to limitations by the PSD Class I increments (eight $\mu g/m^3$ and four $\mu g/m^3$, 24-hour and annual averaging times, respectively), the ambient concentration increases modeled from Project emissions values are far below these PSD Class I increments.

Modeling was also performed to determine the concentrations of the gaseous pollutant emissions (SO_2, CO, and NO_2) from the No Action on the defined sensitive receptors. The highest modeled concentration for each modeled air pollutant at all sensitive receptors (and at Jarbidge Wilderness) for each applicable averaging time is also presented in Table 4.5.12. In all instances, the modeled concentrations are a small fraction of the applicable ambient air quality standard(s), and in the case of the Jarbidge Wilderness, much less than the PSD Class I increments. Thus, further analyses for these pollutants are not warranted.

Table 4.5.12: Highest Modeled Air Pollutant Concentration Impacts from the No Action Alternative at the Defined Sensitive Receptors

Pollutant	Averaging Time	Highest Modeled Concentration		Lowest Applicable Ambient Standard
		Jarbidge Wilderness	Other Sensitive Receptors[1]	
Particulate Matter of Aerodynamic Diameter of less than 10 Micrometers (PM_{10})	24-Hour	0.31 $\mu g/m^3$	43.2 $\mu g/m^3$	150 $\mu g/m^3$
	Annual	0.009 $\mu g/m^3$	9.9 $\mu g/m^3$	50 $\mu g/m^3$
Carbon Monoxide (CO)	1-Hour	63 $\mu g/m^3$	5,461 $\mu g/m^3$	40,000 $\mu g/m^3$
	8-Hour (< 5,000')	0.47 $\mu g/m^3$	2,456 $\mu g/m^3$	10,000 $\mu g/m^3$
	8-Hour (≥ 5,000')	0.47 $\mu g/m^3$	2,456 $\mu g/m^3$	6,667 $\mu g/m^3$
Nitrogen Dioxide (NO_2)	Annual	0.008 $\mu g/m^3$	12.7 $\mu g/m^3$	100 $\mu g/m^3$
Sulfur Dioxide (SO_2)	3-Hour	0.27 $\mu g/m^3$	41.0 $\mu g/m^3$	1,300 $\mu g/m^3$
	24-Hour	0.04 $\mu g/m^3$	21.0 $\mu g/m^3$	365 $\mu g/m^3$
	Annual	0.003 $\mu g/m^3$	5.3 $\mu g/m^3$	80 $\mu g/m^3$

[1]Background values are included as listed in Table 4.5.5.

4.6 Visual Resources

4.6.1 Regulatory Framework

Scenic quality is a measure of the visual appeal of a parcel of land. Section 102(a)(8) of FLPMA placed an emphasis on the protection of the quality of scenic resources on public lands. Section 101(b) of the NEPA of 1969 required that measures be taken to ensure that aesthetically pleasing surroundings be retained for all Americans.

To ensure that these objectives are met, the BLM devised the Visual Resources Management (VRM) System. The VRM system provides a means to identify visual values; establish objectives for managing these values; and provide information to evaluate the visual effects of proposed projects. The inventory of visual values combines evaluations of scenic quality, sensitivity levels, and distance zones to establish visual resource inventory classes, which are "informational in nature and provide the basis for considering visual values in the land use planning process. They do not establish management direction and should not be used as a basis for constraining or limiting surface disturbing activities" (BLM 1986b).

VRM classes are typically assigned to public land units through the use of the visual resource inventory classes in the BLM's land use planning process. One of four visual resource management classes is assigned to each unit of public lands. The specific objectives of each visual resource management class are presented in Table 4.6.1.

4.6.2 Affected Environment

4.6.2.1 Study Methods

Visual resources are characterized according to guidelines given in the Visual Resource Inventory Manual (BLM 1986b). The three primary components of the VRM system are scenic quality, visual sensitivity, and visual distance zones. Based on these three factors, land is placed into one of four visual resource inventory classes. The inventory classes rank the relative value of the visual resources and provide the basis for considering visual values in the RMP process.

Table 4.6.1: BLM Visual Resource Management Classes

Class	Description
I	The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
II	The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any change must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
III	The objective of this class is to partially retain the existing character of the landscape. The level of change to the character should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
IV	The objective of this class is to provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. Management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

Source: BLM 1986b

The study area for visual resources includes those landscapes that viewers would travel through, recreate in, or reside, where existing views would be affected by the Proposed Action or its ancillary facilities. The study area for the Proposed Action is bound on the west by the crest of the Shoshone Range; on the east by the crest of the Cortez Mountains; and on the south by the Toiyabe Mountains; on the north, the boundary is located several miles north of the town of Crescent Valley (BLM 2000a, page 4-151, Figure 4.12.1).

4.6.2.2 Existing Conditions

The Project Area is located in the northern Great Basin section of the Basin and Range Physiographic Province. The Great Basin is characterized by a rhythmic pattern of isolated north-south trending mountain ranges and wide basins with broad, open vistas. Vast areas of sagebrush and scattered grasses cover the valley basins. Infrequent linear patterns of riparian willows and cottonwoods outline the larger drainages. At higher elevations, mixed shrubs and scattered piñon-juniper forests cover the mountains.

The existing Pipeline/South Pipeline mine development and surrounding area are characteristic of the province, a broad, flat-to-gently rolling landscape with abruptly rising foothills to the west (see the photograph on the cover of this SEIS and Figure 1.2). The elevation of the Proposed Action is approximately 5,100 feet amsl. Vegetation is a homogeneous pattern of sagebrush and grasses at lower elevations and piñon-juniper and mixed shrubs at higher elevations. The Proposed Action is located within the vicinity of the existing visually dominant mine disturbance areas. Vegetation colors include tawny, gray, brown, and dark green. Soils range from beige to a chalky off-white color, which when exposed, contrasts highly with the surrounding vegetation. Rock colors vary from mauve, light to dark brown, to burnt orange.

The Gold Acres area contains smooth, rounded, and moderately steep landforms. Vegetation is mottled and finely textured. Colors range from tawny to sage green. A network of lighter colored chalky beige roads are located on foothill slopes. No water forms are apparent. A few blocky-shaped, light colored, smooth textured structures are located in the vicinity of the existing mining disturbance. The previously permitted disturbed area contains waste rock piles of lighter brown to reddish-beige colors, which contrast with the surrounding vegetation. Dust plumes from haul truck activity are sometimes visible.

The BLM has established VRM classes for the study area. Land within the study area has been designated VRM Class IV. To the east and southeast of the Proposed Action area are two areas of VRM Class III land. For Class IV lands, the level of visual change to the landscape can be high, dominate the view, and be a major focus of a viewer's attention. For Class III land, the level of change to the landscape should be moderate and should not dominate the view of the casual observer. Despite the Class III and IV designation of land adjacent to and within the Proposed Action area, every attempt should be made to minimize the impact of the proposed activities on the area's visual resources through careful location of Proposed Action facilities, minimal land disturbance, and replication of the basic landscape elements in Proposed Action design and implementation.

4.6.3 Environmental Consequences and Mitigation Measures

4.6.3.1 Significance Criteria

The assessment of visual impacts is based upon impact criteria and methodology described in the BLM Visual Contrast Rating System (BLM Manual Handbook, Section 8431-1). Effects to visual resources are assessed for the construction, operation, and closure of the Proposed Action. Quality of the visual environment is defined by BLM VRM classes. Two issues, as follows, are addressed in determining impacts: (a) the type and extent of actual physical contrast resulting from the Proposed Action and alternatives and related activities, and (b) the level of visibility of a facility, activity, or structure. These impacts are considered significant if visual contrasts that result from landscape modifications affect:

- The quality of any scenic resources; scenic resources having rare or unique values.
- Views from, or the visual setting of, designated or planned parks, wilderness areas, natural areas, or other visually sensitive land uses; or
- Views from, or the visual setting of, travel routes; and/or views from, or the visual setting of, established, designated, or planned recreational, educational, or scientific facilities, use areas, activities, viewpoints, or vistas.

The extent to which the Proposed Action would affect the visual quality of its viewshed depends upon the amount of visual contrast created between the proposed facilities and the existing landscape elements (form, line, color, and texture) and features (land and water surface, vegetation, and structures). The magnitude of change relates to the contrast between each of the basic landscape elements and each of the features. Assessing the Proposed Action's contrast in this manner indicates the potential impacts and guides the development of mitigation measures that fulfill the VRM objectives.

4.6.3.2 Assessment Methodology

As discussed in Section 4.6.1, the BLM prescribes VRMs for all BLM administered lands, including the area of the Proposed Action and alternatives. The visual effects of the facilities and operations of the Proposed Action were evaluated with respect to conformance with the established VRM. The Analysis was initiated through a review of USGS topographic maps to identify line-of-site points of Project visibility and potential key observation points (KOPs) from which the Project facilities may be visible from routinely accessible vantage points. The KOPs for the Project are shown on Figure 4.6.1.

4.6.3.3 Proposed Action

4.6.3.3.1 Environmental Consequences and Mitigation Measures

Landscape modifications resulting from the construction and operation of the Proposed Action would be within the BLM VRM Class IV objectives (see Figures 1.1.2 and 2.2.1 for a depiction of the Proposed Action). The Project Area is located on VRM Class IV lands, where changes to the characteristic landscape can be high and be the major focus of viewer attention. Although the proposed activity involves expansion of existing mining facilities as well as the construction of new facilities, the additive increase in visual contrast would not draw significant visual attention.

As is common throughout the Great Basin Physiographic region, views are open and expansive. Potentially sensitive viewing locations (places where people travel, recreate, or reside) were examined and from these, three KOPs were identified and evaluated in the South Pipeline Final EIS (BLM 2000a, Figure 4.12.1, page 4-151).

KOP #1 is located on Nevada SR 306, at the intersection of SR 306, the Tenabo road, and the Dean Ranch road (Figure 4.6.1). This KOP is located at the point where the Project Area first becomes visible over the horizon when traveling southbound on SR 306 and where the majority of the public would first view the Project. KOP #2 is located on Lander County Road 225 at the point where the Project Area first becomes visible over the horizon when traveling northbound on Lander County Road 225. KOP #3 is located on Lander County Road 1068 at the point where the Project Area first becomes visible when exiting Cortez Canyon traveling northbound on Lander County Road 106. This point in the only elevated view of the Project Area. Due to their remote locations, SR 306, Lander County Road 225, and Lander County Road 106 are not routinely traveled by the general public, but rather by persons local to the area who are involved in mineral exploration and development, ranching, hunting, and camping.

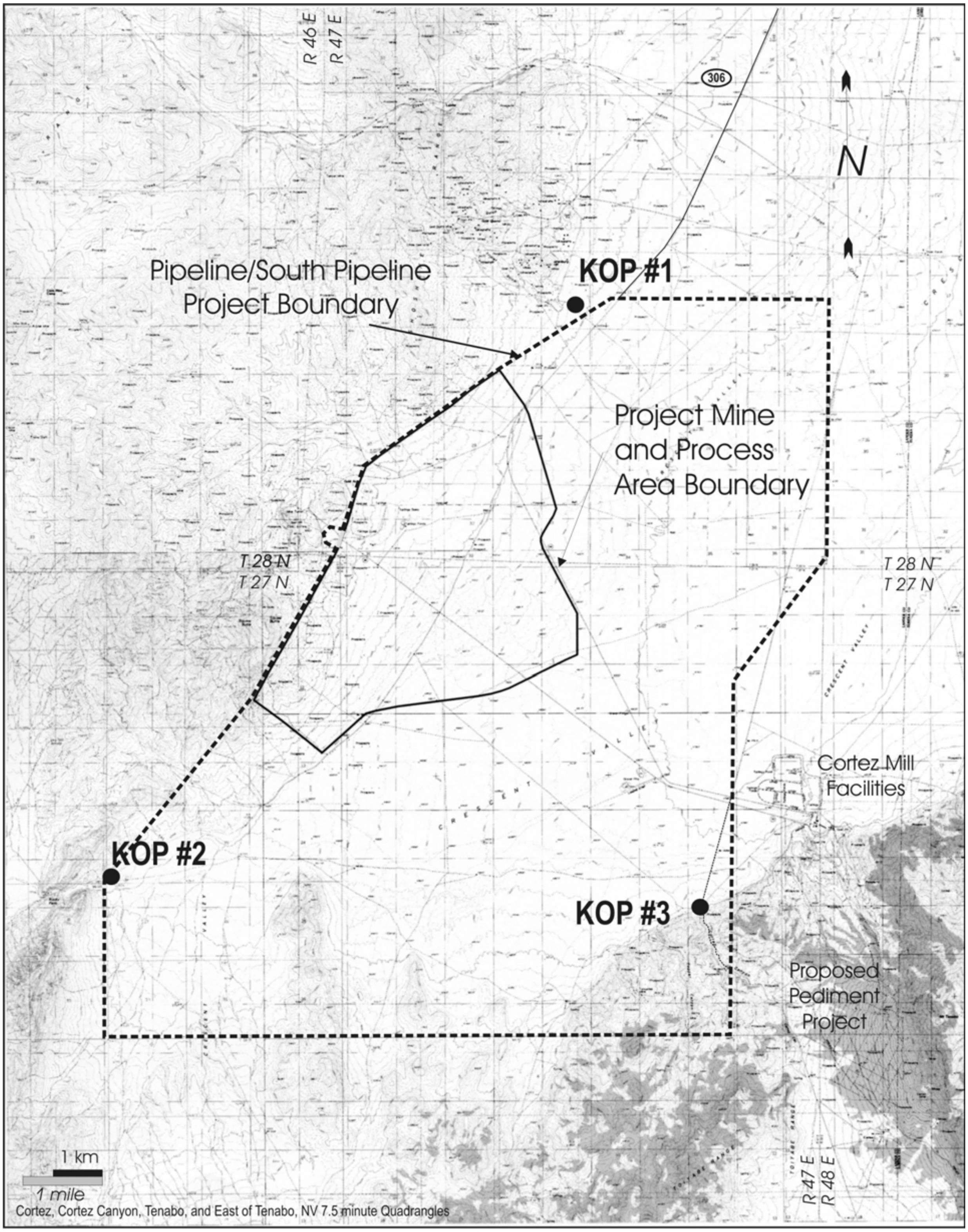
Visual impacts resulting from the proposed activities would be similar to those that already exist from past and existing mining activities. When the Proposed Action is viewed in contrast to these activities, it would contrast only slightly with the existing situation and not substantially different from that of the existing operations.

The proposed mining activities would be visible from KOP #1. The KOP is approximately 6.5 miles northeast of the Project Area and represents the view of the majority of viewers traveling through this portion of the study area. Within this distance zone, particularly during midday light conditions, color, form, and line contrasts created by the Proposed Action would be evident. However, the Proposed Action would represent an insignificant additive change to an already highly modified landscape and would not draw strong visual attention.

The proposed mining activities would also be visible from KOP #2. The KOP is approximately 5.5 miles southwest of the Project Area. Visual impacts resulting from the Proposed Action would be similar to those that already exist from past and present mining activities. The Proposed Action would represent an insignificant additive change to an already modified landscape and would not draw strong visual attention.

The entire Project Area is visible from KOP #3, an elevated vantage point approximately six miles from the Project site. The Cortez Canyon KOP is located in the saddle in the southeastern portion from which the Project Acres area is visible. Due to its proximity to the open vistas of the Crescent Valley, an expansive viewshed, incorporating hundreds of square miles of landscape, is visible. This viewshed includes the landscape features that characterize the Basin and Range Physiographic Province. Within the context of this expansive vista, the Proposed Action would display the expansion of mining activities, which would create additive visual contrast. While shadow colors would accentuate the appearance of the open pits, the visual change created by the addition of the South Pipeline open pit would be negligible from this viewpoint. The Proposed Action would, therefore, represent a moderate additive change to an existing disturbed landscape that would not draw strong visual attention.

Visual contrast would be reduced by reclamation practices, which would consist of recontouring and revegetating waste dump and heap leach/tailings facility slopes; recontouring and revegetating exploration roads; and removing all buildings, structures, and equipment brought to the site, before recontouring and revegetation of all building sites. Following successful reclamation, the visual



1062O/Fig 4.6.1 Location of KOPs.cdr

Figure 4.6.1: Location of Key Observation Points

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contrast of the Proposed Action would be slightly reduced. The use of surrounding landscape colors and native plant materials are appropriate means of reducing visual contrast. Over the long term, natural vegetation would begin to blend with the color and texture of the existing natural landscape. Although recontouring and revegetation of the disposal and heap leach/tailings areas would help to reduce the color and form contrasts, the scale of visual disturbance of these modified pyramidal landforms would remain visually evident. The Proposed Action would not otherwise impact visual resources.

Impact 4.6.3.3.1-1: The proposed mining activities would be visible from KOP #1, #2, and #3.

Significance of the Impact: This impact is considered less than significant and no mitigation measures are required, but the following mitigation measure would reduce the adverse effects of the impact.

Mitigation Measure 4.6.3.3.1-1: For reducing visual contrast, minimization of disturbance is the most effective mitigation technique. Where disturbance is proposed, repetition of the basic landscape elements (form line, color, and texture) would minimize visual change. Clearing of land for waste rock dumps and facility construction would create curvilinear boundaries instead of straight lines to minimize disturbance of the landscape. Grading would proceed in a manner that would minimize erosion and conform to the natural topography.

4.6.3.3.2 Residual Adverse Impacts

The Proposed Action would result in unavoidable but minimal additive physical change in the existing contour and character of the Project Area. The changes would be visibly most apparent over the active life of the Project, but would diminish through the completion of reclamation and revegetation activities contained as part of the Proposed Action. The physical changes to the area would be permanent, but would continue to lessen following the completion of final reclamation as natural processes continue to soften the line and form to match the surrounding landscape.

4.6.3.4 Complete Backfill Alternative

4.6.3.4.1 Environmental Consequences and Mitigation Measures

Changes to the characteristic landscape associated with implementation of the Complete Backfill Alternative would be different from those of the Proposed Action. Approximately 290 million tons of waste rock would be returned to the open pit in lieu of adding it to the waste rock dump. The amount of waste rock returned to the pit would minimize contrasts in form, line and color of the waste rock returned to the open pit would minimize contrasts in form, line and color of the waste rock dump and have the same result as the current Pipeline/South Pipeline Project or the No Action Alternative.

4.6.3.4.2 Residual Adverse Impacts

Residual impacts to visual resources would be similar to those described under the No Action Alternative.

4.6.3.5 No Backfill Alternative

4.6.3.5.1 Environmental Consequences and Mitigation Measures

Changes to the characteristic landscape associated with implementation of the No Backfill Alternative would be greater than those from the Proposed Action. All of the waste rock (approximately 590 million tons) would be disposed of in the Pipeline/South Pipeline and Gap waste rock dumps. The Pipeline/South Pipeline waste rock dump would be increased to 500 feet above surface level and the footprint would be expanded leaving no space for sideslope contouring and shaping.

Impact 4.6.3.5.1-1: The proposed mining activities would be visible from KOP #1, #2, and #3.

Significance of the Impact: This impact is considered less than significant and no mitigation measures are required, but the following mitigation measure would reduce the adverse effects of the impact.

Mitigation Measure 4.6.3.5.1-1: Where disturbance is proposed, repetition of the basic landscape elements (form, line, color, and texture) would minimize visual change. Clearing of land for waste rock dumps and facility construction would create curvilinear boundaries instead of straight lines to minimize disturbance of the landscape. Grading would proceed in a manner that would minimize erosion and conform to the natural topography.

4.6.3.5.2 Residual Adverse Impacts

The No Backfill Alternative would result in additive physical change in the existing contour and character of the Project Area. The changes would be visibly most apparent over the active life of the Project, but would diminish through the completion of reclamation and revegetation activities. The physical changes to the area would be permanent, but would continue to lessen following the completion of final reclamation as natural processes continue to soften the line and form to match the surrounding landscape.

4.6.3.6 No Action Alternative

4.6.3.6.1 Environmental Consequences and Mitigation Measures

Under the No Action Alternative, additional disturbance and development as described in the Proposed Action would not occur within the Project Area. The visual environment would remain in its current state. CGM would be required to reclaim surface disturbances associated with its currently permitted operations.

4.6.3.6.2 Residual Adverse Impacts

The additional proposed disturbance associated with the Proposed Action would not occur with the No Action Alternative. Visual resources impacts would be limited to ongoing, permitted mining and exploration activities.

4.7 Auditory Resources

4.7.1 Regulatory Framework

The State of Nevada and Lander County do not have auditory resources criteria or standards for evaluating auditory resource impacts associated with mining operations. Therefore, auditory resource impacts will be evaluated in this document according to the estimated degree of disturbance to the nearest sensitive receptor sites.

4.7.2 Affected Environment

This section explains the terminology used to describe sound levels and auditory resources and the existing noise conditions at selected locations near the Project. Hearing a sound occurs when rapid variations in air pressure are stimulating or moving the ear drum (tympanic membrane) and this mechanical movement, in turn, stimulates various components of the peripheral and central auditory system. Noise is a sound which is unwanted or not desired and which may disrupt or degrade human activities. Air pressure variations are measured as the change in sound pressure exerted on the diaphragm of a microphone attached to a sound level meter.

Sound is measured in units of decibels (dB) and for environmental purposes usually is measured in units of decibels A-weighted (dBA). A-weighting refers to an electronic technique which simulates the relative response of the human auditory system to the various frequencies comprising all sounds. The sound levels are described in units of dBA, unless stated otherwise. The sound measurement scale (dB) is not linear, it is logarithmic. A logarithmic scale is used because sound levels can span over a very large range and the logarithmic scale permits use of relatively small numbers. For example, sound pressures of about 115 dBA are not uncommon in discotheques or near loudspeakers at rock concerts. A sound pressure at 115 dBA is equal to 10,000,000 micropascals[1]. In contrast, zero dBA is the threshold of human hearing, which is equivalent to 20 micropascals. Thus, a range of about ten million pressure units can be described with only 115 dB units. This range is specific to this example, but sound pressure levels of 140 dBA and above have been recorded near rocket engines.

Logarithmic scales cannot be added arithmetically. For example, one sound at 80 dB plus another sound at 80 dB would not equal 160 dB. Because sound is measured on a logarithmic scale, the combined 80 dB sounds would result in a total sound level of about 83 dB. The combined total sound level from two sources is only 40.3 dBA if one sound is at 40 dBA and the second sound is at 29 dBA. The following are rules that may be helpful in understanding this analysis:

- In general, one sound must be at least three dB louder than another sound for people to reliably determine that one sound source is louder than a second source; and
- A sound that is about ten dB louder than a second sound would be perceived as being about twice as loud as the second sound.

[1] Micropascal is the unit of pressure. It is equivalent to 0.00001 Newton/square meter.

Table 4.7.1 shows the approximate sound levels associated with various common sources. Note that the range of sound levels is 75 dBA (from 25 to 100 dBA) and ranges between the very quiet (rustling leaves) to a loud auto horn. The measured sound level decreases with increasing distance between a sound source and the sound-measuring device or the listener. Distances are specified for some sources in Table 4.7.1.

Table 4.7.1: Relative Scale of Various Noise Sources

Noise Level (dBA)[a]	Common Indoor Noise Levels	Common Outdoor Noise Levels
110	Rock band	--
105	--	Jet flyover at 1,000 feet
100	Inside New York subway train	--
95	--	Gas lawn mower at 3 feet
90	Food blender at 3 feet	--
80	Garbage disposal at 3 feet, or shouting at 3 feet	Noisy urban daytime
70	Vacuum cleaner at 10 feet	Gas lawn mower at 100 feet
65	Normal speech at 3 feet	Commercial area, heavy traffic at 300 feet
60	Large business office	--
50	Dishwasher in next room	Quiet urban daytime
40	Small theater, large conference room	Quiet urban nighttime
35	--	Quiet suburban nighttime
33	Library	--
28	Bedroom at night	--
25	Concert hall (background)	Quiet rural nighttime
15	Broadcast and recording studio	--
5	Threshold of hearing	--

[a] A-weighted decibel sound scale.

At relatively high levels, noise can be a nuisance because it may interfere with daytime activities such as hearing and understanding speech, it may disrupt sleep, or more generally degrade the quality of life. However, there is no simple answer to the question of "how much noise is too much?" In part, the answer depends on the loudness of the noise relative to ambient or background noise level, when it occurs, what the listener is doing, what the noise source is, and the listener's attitude toward the source. Nonetheless, some reasonably accurate estimates of how communities of people may respond to noise can be made based on measurements and predictions of the A-weighted noise levels expected at some locations. These estimates are based on a fairly large number of scientific studies of community responses to noise at many average noise levels from a wide variety of noise sources (Harris 1991; Kryter 1985; and May 1978). The studies and empirically validated techniques for estimating (predicting) noise levels at receptors (Edison Electric Institute 1984) are used in predicting and evaluating noise effects on humans.

4.7.2.1 Study Methods

The closest noise-sensitive receptors where noise from the existing and proposed operations is or could be heard are assessed in this section. These receptors include the following:

- The Dean Ranch located approximately seven miles northeast of the permitted Pipeline/South Pipeline Project;
- The Wintle Ranch located approximately 4.7 miles northeast of the permitted Pipeline/South Pipeline Project; and
- The Filippini Ranch located approximately seven miles southwest of the permitted Pipeline/South Pipeline Project and Rocky Pass.

4.7.2.2 Existing Conditions

Ambient noise levels within, and adjacent to, the Project Area, have not been measured. However, ambient noise levels around the exterior boundaries of the Project Area are assumed to be relatively low and typical of isolated desert areas (i.e., 35 to 50 dBA), with the exception of traffic traversing existing highways and roads. However, as one travels closer to the permitted Pipeline/South Pipeline mine and process area, noise associated with existing mining operations and blasting becomes much more apparent.

Mining

Using the information provided in Table 4.7.2, levels of existing mine-generated noise (excluding blasting) at the permitted Pipeline/South Pipeline Project were estimated to provide a baseline noise level of approximately 90 dBA at a distance of 50 feet from a source. At two of the three sensitive receptors, noise, excluding blasting, generated from the permitted Pipeline/South Pipeline Project is estimated to be approximately 40 dBA when weather and wind conditions are such that they attenuate sound.

Blasting

Although blasts are perceived to be one large explosion, mining blasts are actually a series of smaller, single-hole explosions. Each hole is sequentially delayed and detonated independently of the other holes. Less noise and ground vibrations are generated because several small blasts (delays) are detonated in sequence rather than as one large instantaneous blast. Blasting can be further controlled by varying the amount of explosive, the type of delay, the delay sequence, and the type of explosives.

Blasting at the Pipeline/South Pipeline Project generally occurs once per day, depending on mining activities in the open pit. Blast holes are drilled with diesel-powered blast hole rigs and blast holes are loaded with an ammonium nitrate/fuel oil mixture (ANFO) or a water resistant blasting agent.

Table 4.7.2: Average Sound Levels for Equipment and Mine Operations

Noise Level (dBA)[a]	Equipment/Operation
115-125 dBA at 900 feet	Blasting
95 dBA at source	Crusher
90 dBA at 50 feet	Haul Trucks
87 dBA at 50 feet	Loaders
86 dBA at 50 feet	Blasthole Drilling
85 dBA at 50 feet	Bulldozers

[a] A-weighted decibel sound scale.

Blasting takes place only during daylight hours and is conducted under strict Mine Safety and Health Administration (MSHA) safety procedures. Estimated noise levels from blasting are assumed to be approximately 115 to 125 dBA at 900 feet. Estimated noise from blasting associated with the permitted Pipeline/South Pipeline Project at two of the three sensitive receptor sites, excluding the Filippini Ranch, is estimated to be approximately 85 to 95 dBA during the blasting event which lasts no longer than 15 seconds, one time each day. In addition, as the open pit increases in depth, the noise from blasting is increasingly reflected upward by the open pit walls, thus further reducing the noise level. Therefore, the actual noise levels at the sensitive receptors are likely less than 85 dBA.

Other potential noise sources in the vicinity of the Project Area include the following: wind, wildlife, traffic, off-highway vehicle (OHV) usage, and overhead commercial/military flights.

4.7.3 Environmental Consequences and Mitigation Measures

4.7.3.1 Significance Criteria

Noise impacts from mining would be considered significant if the Proposed Action would result in noise levels in excess of 55 dBA, as measured outside the Project Area at a sensitive receptor site. Noise impacts from blasting would be considered significant if the Proposed Action resulted in the following:

- Maximum noise levels in excess of 70 dBA measured at a sensitive receptor site; or
- Ground vibration as a result of blasting that could initiate or extend observable cosmetic cracking of structures at a sensitive receptor site.

4.7.3.2 Assessment Methodology

Noise impacts were evaluated according to the estimated degree of disturbance to the nearest sensitive receptor sites.

4.7.3.3 Proposed Action

Noise levels associated with the Project would represent a continuation of Pipeline/South Pipeline Project mining and construction operations and blasting activities. Mining activities would continue to generate noise and would be perceptible at the previously identified sensitive receptor sites. Noise would also be generated from the expansion of the heap leach facility and waste rock dump.

Construction Operations. Existing noise is currently generated by the permitted Pipeline/South Pipeline Project and would be subsequently generated by the Project. Noise generated by Project would involve the continuation of operation of stationary equipment and facilities, the operation of heavy mobile construction equipment, and the movement of traffic to and from the mine site.

Noise levels associated with construction related activities (i.e., construction of the waste rock dumps) are expected to be less than noise levels during active mining operations and are not expected to adversely affect nearby sensitive receptor sites due to their relatively short duration.

Mining Operations. The Project would be expected to continue to operate 24 hours a day, 365 days per year during the projected seven year mine extension. The Proposed Action would increase the mining rate to an average of 350,000 tpd with a maximum of 500,000 tpd. Increased production involves several components that would contribute to the auditory resource environment. The first component includes a greater number of diesel powered blast hole rigs for drilling into rock formations. The next component involves excavating an increased volume of rock from the open pit using electric and hydraulic shovels, loaders, trucks, and a variety of ancillary equipment. The haul trucks would then transport ore and waste from the open pit to either the heap leach pad or milling facility, or to the waste rock dump. Ore going to the heap leach pad is directly placed by the truck in appropriate areas, and ore delivered to the milling facility is either placed on a stockpile or dumped directly into a hopper that feeds the primary crusher. Ore placed in the stockpile is later delivered to the feed hopper by a rubber-tired loader. The ore is then crushed and delivered to a second stockpile, then sent by conveyor into the mill and mixed with process water in the grinding circuit where it is ground into material the size of baking flour. From the grinding circuit, it is classified and slurried to the CIL circuit where the gold, now in solution, is adsorbed onto activated carbon. At the end of the CIL process stream, the carbon is screened out of the slurry and sent to the refinery where the gold is stripped and refined. The slurry, now tailings with nearly all of the gold removed, is sent through a cyanide reduction process and piped to a lined tailings facility for storage. Waste rock removed during mining is hauled to the appropriate waste rock dump, or, when available, into the mined-out areas of the pit.

Specific components and equipment would generate higher levels of noise, but the increase in equipment on site would not significantly alter the overall noise level. A maximum sound level of 100 dBA at 50 feet from any source has been assumed for the purposes of this analysis. 100 dBA is higher than a diesel engine in good repair and is also much louder than a typical processing plant. At a distance of five miles from the source, this noise level would reduce to background. Ground absorption effects have not been assumed in this calculation, but atmospheric absorption was included. Any topographic shielding, including increasing the level of the approved heap leach pad and the waste rock dump would reduce this value. In addition, the Proposed Action includes a substantial increase in the depth of the Pipeline/South Pipeline open pit. As the depth of the pit increases, the noise level will decrease. In conclusion, it is unlikely that mining and construction noise associated with the Project would be audible at the three sensitive receptor sites, except in extreme cases, when it would be barely detectable. The Proposed Action would not otherwise impact auditory resources associated with construction and mining operations.

Impact 4.7.3.3.1-1: The Proposed Action would extend and slightly increase the existing mining- and construction-related noise impacts, excluding blasting, which would likely not exceed 55 dBA at the sensitive receptor sites.

Significance of the Impact: This impact is considered less than significant and no mitigation measures are required.

Blasting Activities. Blasting within the open pit would continue to occur on average once per day at either 10 a.m. or 1 p.m. and only during daylight hours. The Proposed Action will increase the depth of the Pipeline/South Pipeline pit decreasing the blasting related noise levels at sensitive receptors by reflecting the noise upward. The Proposed Action would not otherwise impact auditory resources associated with blasting.

Impact 4.7.3.3.1-2: Blasting associated with the Proposed Action would continue at a frequency of one blast a day and estimated blasting-related noise levels would be similar to existing levels, which would likely exceed 55 dBA at two of the three sensitive receptor sites. As the Proposed Action continues over time, the estimated blasting-related noise level is expected to decrease as the overall depth of the pit increases.

Significance of the Impact: This impact is considered potentially significant. The following mitigation measure is provided to reduce the adverse effects of the impact, but the impact would remain significant after implementation of the mitigation measure.

Mitigation Measure 4.7.3.3.1-2: Blasting shall occur on average once per day and be no longer than 15 seconds in duration per blast.

4.7.3.4 Complete Backfill Alternative

4.7.3.4.1 Environmental Consequences and Mitigation Measures

The Noise related impact under the Complete Backfill Alternative would be similar to that described for the Proposed Action, except that the duration of the mining related noise would last for two years longer. The Complete Backfill Alternative requires all waste rock removed during mining to be dumped within the boundaries of the pit. The equipment required for moving and dumping waste rock would remain on site longer than under the Proposed Action. The impacts and mitigation measures outlined for the Proposed Action (Section 4.8.3.3.1) incorporates the Complete Backfill Alternative.

4.7.3.4.2 Residual Adverse Impacts

The residual adverse effects on the environment from noise generated during mining activities associated with the Complete Backfill Alternative would be blasting related noise levels similar to existing levels, which would likely exceed 55 dBA at two of the three sensitive receptors.

4.7.3.5 No Backfill Alternative

4.7.3.5.1 Environmental Consequences and Mitigation Measure

The noise related impact under the No Backfill Alternative would be similar to that described for the Proposed Action with the exception of a slightly elevated perceptible noise level resulting from alternative mining operations. The No Backfill Alternative would require the removal of all waste rock from the pit to waste rock dumps. Waste rock dumping requires driving 85-ton to 310-ton haul trucks from the pit to the top of a dump site and dumping the material. The increased production rate and the inability to transfer waste rock within the confines of the pit to dump will result in an increase in the frequency of haul truck travel. In addition, the excess waste rock material will extend the dumping area and the associated haul truck traffic towards the Pipeline/South Pipeline Project Area boundary. Although the perceptible noise level will increase, the No Backfill Alternative is not anticipated to significantly differ from the current or Proposed Action noise levels. The impacts and mitigation measures outlined for the Proposed Action (Section 4.8.3.3.1) incorporates the No Backfill Alternative.

4.7.3.5.2 Residual Adverse Impacts

The residual adverse effects on the environment from noise generated during mining activities associated with the No Backfill Alternative would be similar to levels described in the Proposed Action which would likely exceed 55dBA at two of the three sensitive receptor sites. Topographic shielding created by the increased size of the Pipeline/South Pipeline waste rock dump could slightly decrease the overall noise level and is not anticipated to have an affect that would be considered significant.

4.7.3.6 No Action Alternative

4.7.3.6.1 Environmental Consequences and Mitigation Measure

The noise related impact under the No Action Alternative would be similar to that described for the Proposed Action, except duration of the impact would not be extended for up to seven additional years. The impacts and mitigation measures outlined for the Proposed Action are also applicable to the Action Alternative.

4.7.3.6.2 Residual Adverse Impacts

The residual adverse effects on the environment from noise generated during mining activities associated with the No Action Alternative would be blasting-related noise levels similar to existing levels, which would likely exceed 55 dBA at two of the three sensitive receptor sites.

4.8 Socioeconomic Values

4.8.1 Regulatory Framework

The following three sections list publications and information that were reviewed in the process of preparing the South Pipeline Final EIS (BLM 2000a) and to update this SEIS.

4.8.1.1 Elko County

- Elko County General Plan (County of Elko 1971);
- City of Elko General Plan - Population Element (City of Elko undated);
- Carlin General Plan - Economy, Population and Public Facilities and Services Elements (City of Carlin 1991);
- Draft Elko County Economic Development Plan (Board of Elko County Commissioners 1997); and
- Elko County Economic and Demographic Profile, 1999 (University Center for Economic Development, University of Nevada Reno (UNR), Department of Applied Economics and Statistics) (UCED).

4.8.1.2 Eureka County

- Eureka County Economic and Demographic Profile, 1999 (UCED);
- A Community Profile of Eureka County, Nevada (Eureka County Economic Development Program, January 2002);
- Economic Information Regarding Eureka County (County of Eureka undated);
- Targeted Economic Development for Eureka County Part I Analysis of Socio-Economic Data and Trends (UCED 2001/02-09);
- Targeted Economic Development for Eureka County Part II Screening of Economic Sectors (UCED 2001/02-10); and
- Comprehensive Economic Development Strategy 2001 for Eureka County, Nevada (Stantec Consulting, Reno, Nevada).

4.8.1.3 Lander County

- Lander County Master Plan - Population, Housing, Economics, and Public Facilities and Services Elements (County of Lander 1994);

- Lander County Revised Policy Plan for Federally Administered Lands - November 1999 (Lander County 1999);
- Overall Economic Development Plan for Lander County (Tri-County Development Authority 1997);
- Lander County Socioeconomic Overview (Nevada Division of Water Planning, undated);
- Lander County Economic and Demographic Profile, 1999 (UCED);
- Targeted Economic Development for Lander County Part I Analysis of Socio-Economic Data and Trends (UCED 2001/02-17); and
- Targeted Economic Development for Lander County Part II Screening of Economic Sectors (UCED 2001/02-14).

4.8.2 Affected Environment

4.8.2.1 Study Methods

The baseline data presented below are based upon information from the South Pipeline Final EIS (BLM 2000a, pages 4-183 through 4-206) and its precursor, the Pipeline Final EIS (BLM 1996a, pages 3-45 through 3-52). Discussions of existing socioeconomic, employment, housing, public service, and public finance characteristics are incorporated by reference. New and supplemental information obtained from more recent publications and from telephone communications with federal, state, county, and local officials has been added.

The assessment area for socioeconomic values and public services includes the Project Area, as well as portions of Elko, Eureka, and Lander Counties (Study Area). As discussed in both the Pipeline Final EIS and South Pipeline Final EIS (BLM 1996a; BLM 2000a), this Study Area was defined to encompass the region where the majority of CGM employees reside, which is up to 70 miles from the Project Area. Approximately 60 percent of CGM employees live in the Elko/Spring Creek area, 15 percent live in Crescent Valley/Beowawe, 11.5 percent live in Battle Mountain, eight percent live in Carlin, and 5.5 percent live in other locations (Email Correspondence - Jim Collord, Superintendent of Environmental Services, Cortez Gold Mines, June 18, 2002 and a November 12, 2003 CGM Memorandum).

Socioeconomic data were collected from a variety of state and federal sources including the 2000 U.S. Census; U.S. Department of Commerce, Bureau of Economic Affairs; Nevada State Demographer; Nevada Department of Employment, Training and Rehabilitation; and Nevada Department of Taxation. Other information was obtained at the county level, including the Eureka County Assessor's Office and Elko, Eureka, and Lander County School Districts. After this information was assembled, the most pertinent information was summarized in the tables included in this section. For most topics, the information collected for the Study Area was also collected for the State of Nevada to provide a comparison by which to evaluate socioeconomic characteristics of the Study Area.

4.8.2.2 Existing Conditions

4.8.2.2.1 Population and Demography

Population

Actual, present, and projected populations of the counties and communities within the Study Area and the State of Nevada are presented in Table 4.8.1. Nevada was the fastest growing state in the U.S. between 1990 and 2000, experiencing a more than 66 percent increase in population. The population growth rate for Nevada from 2000 to 2001 increased by 5.4 percent, a rate slightly behind the ten-year period from 1990 to 2000. Much of the increase in population has occurred in the Las Vegas area, and has resulted from the influx of workers in the casino gaming and tourism industries, with an associated boom in the construction industry. Mining played a much smaller role in attracting additional residents than it did in the 1980s. Nevada's growth is projected to slow during the next period (2000 to 2010), with the average annual growth rate decreasing by approximately 35 percent to 3.1 percent per year.

As shown in Table 4.8.1, Elko County's population increased more dramatically during the 1990s than did the remainder of the Study Area, rising 35.1 percent from 33,350 to 45,291 residents by Census year 2000. Elko County's average annual growth rate of approximately three percent was half that of the state, but far surpassed the other Study Area counties. Eureka County's growth rate from 1990 to 2000 was 6.7 percent. The decrease in mining activity during the later 1990s precipitated a significant population decrease of 7.5 percent in Lander County. Its largest community, Battle Mountain, experienced a loss of nearly 19 percent of its population from 1990 to 2000. Impending closure of Echo Bay's McCoy-Cove mine will further affect Lander County's population (Las Vegas SUN, Inc., via Elko Daily Free Press, February 27, 2002). As indicated in the table, growth during the next period (2000 to 2010) is expected to be the greatest for Lander County, steady for Elko County, and significantly slower for Eureka County compared to the previous decade. Growth rates for all three counties are expected to mirror the state average of approximately 30 percent.

Carlin, Elko, and Spring Creek are the largest communities in Elko County. Combined, the three communities comprised 65 percent of the population of the entire county in 2000 (Table 4.8.1). In the decade 1980 to 1990, these communities experienced major booms in population associated with increased gold mining activities in Elko County, as well as in Eureka and Lander Counties. During the period 1990 to 2000, however, average annual growth rates in Carlin and Elko fell dramatically, with Elko increasing by 12.5 percent and Carlin experiencing a 2.7 percent loss in population. However, Spring Creek showed a growth rate of nearly 80 percent during the period.

The population of Beowawe/Crescent Valley is difficult to determine accurately. For research purposes, Census 2000 statistics from the Eureka County Economic Development Office were used, which include the outlying areas near the two communities. Based on this information and the number of water meter hookups (Personal Communication - Kathy Kinkade, Meter Reader, Town of Crescent Valley, June 4, 2002), the population of the two communities ranges between 500 and 600 residents.

Battle Mountain comprises approximately half of Lander County's population. The Battle Mountain Census Designated Place (CDP) decreased by nearly 19 percent from 1990 to 2000. Population decreased further in the year 2000 to 2001, with an additional 11.5 percent loss. The discrepancy between the July 2000 Governor Certified population and the U.S. Census statistics may be due to errors in the U.S. Census, or differences in estimation methods.

At the time of evaluation, 407 employees work at the Cortez operation. Of these, 61 reside in Beowawe and the town of Crescent Valley, 47 in Battle Mountain, 34 in Carlin, 245 in Elko/Spring Creek, and 2 in Eureka, with the remaining 18 living outside the Study Area. Based on the 2001 County population statistics presented in Table 4.8.1, CGM employees account for approximately 4.2 percent of the Eureka County population, 1.5 percent of Battle Mountain's, 1.5 percent of Carlin's, and nearly one percent of Elko/Spring Creek's population.

Demography

Age Distribution

Table 4.8.2 shows the age distribution of the Study Area and State of Nevada populations as recorded during the 2000 U.S. Census. The Study Area had a higher percentage than the state of children ages five to 19, approximately 25 percent versus 21 percent. The 20 to 24 age group represented the smallest age group in the Study Area based on percent of the population, while the group aged 25 to 64 represented the greatest percentage and is only slightly lower than the state as a whole. The Study Area counties and communities, with the exception of Eureka County, had a significantly lower percentage of senior citizens (age 65 and over) than the State of Nevada.

Ethnic Composition

Table 4.8.3 summarizes the ethnic characteristics of the populations in the Study Area based on the 2000 U.S. Census. Compared to the State of Nevada, counties and communities within the Study Area had significantly greater percentages of White (78 percent versus 65 percent) and American Indian, Eskimo, or Aleut persons (four percent versus one percent). The ethnic composition of the Study Area in 2000 also revealed that substantially fewer persons of Black and Asian or Pacific Islander ethnic groups were present than for the state as a whole with 0.4 percent Blacks and 0.7 percent Asian or Pacific Islander. The Study Area as a whole had a lower percentage of persons of Hispanic or Latino origin than the state at 16 percent; however, Battle Mountain had a higher percentage of persons of Hispanic or Latino origin at 24 percent.

Personal Income

Table 4.8.4 summarizes 1999 income data (U.S. Census Bureau, Census 2000 (based on a sample) for the Study Area and State of Nevada. Per capita personal income (PCPI) for Nevada was $21,989, higher than any of the counties or communities in the Study Area. However, median household income, with the exception of Battle Mountain and Eureka County, equaled or exceeded that of the state. Spring Creek had the highest median household income at $60,109 and Eureka County had the lowest at $41,417, which is lower than the median household income for Nevada ($44,581). Median earnings for male workers were significantly higher than those for female workers in the Study Area. This is also true at the state level, however the distinction is not as great.

Table 4.8.1: Actual, Present, and Projected Populations of the Study Area and State of Nevada

Location	U.S. Census Population		% Change	Population[a]	Population[a]	% Change	Population Projection[d]	% Change	
	1990	2000	1990 to 2000	July 2001	July 2000	July 2000 to July 2001	2010	2000 to 2010	Average Annual Rate
Elko County	33,530	45,291	35.1%	46,668	45,633	2.3%	60,155	32.8%	3.3%
Carlin	2,220	2,161	-2.7%	2,215	2,395	-7.5%	n/a	n/a	n/a
Elko City	14,853	16,708	12.5%	17,093	17,191	-0.6%	n/a	n/a	n/a
Spring Creek (CDP)[b]	5,866	10,548	79.8%	n/a	n/a	n/a	n/a	n/a	n/a
Eureka County	1,547	1,651	6.7%	1,506	1,651	-8.8%	2,129	29.0%	2.9%
Beowawe[c]	n/a	348	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Crescent Valley[c]	n/a	253	n/a	298[c]	303[c]	-1.7%	n/a	n/a	n/a
Lander County	6,266	5,794	-7.5%	5,761	5,794	-0.6%	7,743	33.6%	3.4%
Battle Mountain (CDP)	3,542	2,871	-18.9%	3,056	3,453	-11.5%	n/a	n/a	n/a
State of Nevada	1,201,833	1,998,257	66.3%	2,132,498	2,023,378	5.4%	2,611,453	30.7%	3.1%

a Population of Nevada's Counties, Cities and Towns; Governor Certified 7-1986 to 7-2001 includes 4-2000 Census
NV Department of Taxation and NV State Demographer, NV Small Business Development Center - UNR

b CDP=Census Designated Place

c Eureka County Census 2000, Eureka County Ecnoomic Development Office, June 20, 2002.

d Nevada County Population Projections 2000 to 2010, June 2000, NV State Demographer's Office. Projections are available only for the county and state level.

Table 4.8.2: 2000 Age Distribution of Study Area and State of Nevada Populations

Location[a]	Age 0-4		Age 5-14		Age 15-19		Age 20-24		Age 25-64		Age 65+		Total Population
	Qty.	% of Total	Qty.	% of Total	Qty.	% of Total	Qty.	% of Total	Qty.	% of Total	Qty.	% of Total	
Elko County	3,842	8%	8,287	18%	3,891	9%	2,642	6%	23,953	53%	2,676	6%	45,291
Carlin	172	8%	370	17%	186	9%	96	4%	1,179	55%	158	7%	2,161
Elko	1,480	9%	2,735	16%	1,341	8%	1,155	7%	8,729	52%	1,268	8%	16,708
Spring Creek (CDP)[b]	859	8%	2,234	21%	859	8%	389	4%	5,867	56%	340	3%	10,548
Eureka County	97	6%	279	17%	119	7%	50	3%	901	55%	205	12%	1,651
Beowawe[c]/Crescent Valley[c]	26	5%	83	17%	22	5%	16	3%	269	56%	66	14%	482
Lander County	433	7%	1,131	20%	442	8%	253	4%	3,132	54%	403	7%	5,794
Battle Mountain (CDP)[b]	242	8%	582	20%	217	8%	162	6%	1,475	51%	193	7%	2,871
State of Nevada	145,817	7%	288,515	14%	127,169	6%	130,006	7%	1,087,821	55%	218,929	11%	1,998,257

a U.S. Census Bureau, Census 2000, Table DP1, Profile of General Demographic Characteristics

b CDP = Census Designated Place.

c U.S. Census Bureau, Census 2000, Data Set: Census 2000 Summary File 1 (SF1) 100-Percent Data 5-Digit ZCTA 89821; may include outlying areas. Figures for Beowawe and Crescent Valley are variable depending on data source.

Table 4.8.3: 2000 Ethnic Composition of Study Area and State of Nevada Population

Location[a]	Total Population	White		Black		American Indian, Eskimo, or Aleut		Asian or Pacific Islander		Some Other Race		Two or More Races		Hispanic or Latino of Any Race	
		Qty.	% of Total	Qty.	% of Total	Qty.	% of Total	Qty.	% of Total	Qty.	% of Total	Qty.	% of Total	Qty.	% of Total
Elko County	**45,291**	32,771	72%	257	0.6%	2,150	5%	344	0.8%	41	0.1%	793	2%	8,935	20%
Carlin	**2,161**	1,890	87%	1	0.0%	38	2%	14	0.6%	3	0.1%	34	2%	181	8%
Elko City	**16,708**	12,248	73%	58	0.3%	399	2%	200	1.2%	16	0.1%	259	2%	3,528	21%
Spring Creek (CDP)[b]	**10,548**	9,477	90%	20	0.2%	133	1%	51	0.5%	7	0.1%	170	2%	690	7%
Eureka County	**1,651**	1,402	85%	6	0.4%	25	2%	14	0.8%	0	0.0%	46	3%	158	10%
Beowawe[c]	**185**	148	80%	0	0.0%	5	3%	0	0.0%	0	0.0%	13	7%	19	10%
Crescent Valley[c]	**361**	311	86%	3	0.8%	5	1%	3	0.8%	0	0.0%	10	3%	29	8%
Lander County	**5,794**	4,385	76%	10	0.2%	216	4%	22	0.4%	7	0.1%	81	1%	1,073	19%
Battle Mountain (CDP)[b]	**2,871**	2,050	71%	4	0.1%	63	2%	15	0.5%	7	0.2%	55	2%	677	24%
State of Nevada	**1,998,257**	1,303,001	65%	131,509	6.6%	21,397	1%	96,362	4.8%	2,787	0.1%	49,231	2%	393,970	20%

a Source: U.S. Census Bureau, Census 2000 Redistricting Data (Public Law 94-171) Summary File, Matrices PL1, PL2, PL3, and PL4.

b CDP=Census Designated Place

c U.S. Bureau of the Census, Census 2000 Redistricting Data (Public Law 94-171) Summary File, Table PL2, Eureka VTD 4 and 5, Beowawe and Crescent Valley, Eureka County, Nevada. These numbers are based on Eureka Voting Districts 4 and 5 data, which include areas outlying from the actual towns of Beowawe and Crescent Valley.

The following PCPI information comes from the U.S. Department of Commerce, Bureau of Economic Analysis (BEA) Regional Economic Information System, known as BEARFACTS, for 1990 to 2000 and for 1999 to 2000:

For the year 2000, Nevada's PCPI was $29,506. This PCPI ranked 16th in the U.S. and was 100 percent of the national average of $29,469. In 1990, the PCPI of Nevada was $20,639 and ranked 13th in the U.S. The average annual growth rate of PCPI over the past ten years was 3.6 percent. The average annual growth rate for the nation was 4.2 percent. The state's 2000 PCPI reflected an increase of 2.5 percent from 1999. While the national change was 5.8 percent.

Eureka County's PCPI for 2000 was $24,604, ranking tenth in the state. Eureka's PCPI was 83 percent of the state average, and 83 percent of the national average. For 1990, the PCPI was $20,977, ranking third in the state. The average annual growth rate over the past ten years was 1.6 percent, compared with the state's 3.6 percent and the nation's 4.2 percent. The 2000 PCPI reflected an increase of 7.9 percent from 1999, compared with 2.5 percent for the state and 5.8 for the nation.

Lander County's 2000 PCPI in 2000 was $25,308, 86 percent of the state average, 86 percent of the national average and ranking eighth in the state. In 1990, Lander County's PCPI was $18,380 and ranked seventh in the state. The average annual growth rate was 3.3 percent, with the state's at 3.6 percent and the nation's at 4.2 percent. The 2000 PCPI reflected an increase of 5.6 percent from 1999, compared with the state's 2.5 percent and the nation's 5.8 percent.

Poverty

Table 4.8.5 summarizes the poverty status in the Study Area and the State by race. Lander County had the highest incidence of poverty by percent for Black persons, and with the exception of Carlin, for American Indian, Eskimo or Aleut. Battle Mountain had the highest incidence of poverty for Other Race in the study area. Lander County had the highest percentage of the total population living below the poverty level in the study area, and a higher percentage than the State of Nevada.

Elko County's 2000 PCPI was $24,909, 84 percent of the state average, 85 percent of the national average, and ranked ninth of 17 counties in the state. In 1990, the PCPI of Elko was $18,178, ranking eighth in the state. The average annual growth of Elko County PCPI over the past ten years was 3.2 percent. The average annual growth rate for the state was 3.6 percent and 4.2 percent for the nation. The 2000 PCPI for Elko reflected an increase of 3.8 percent from 1999, compared with 2.5 percent for the state and 5.8 percent nationally.

4.8.2.2.2 Economy and Employment

Employment by industry for each of the Study Area counties and communities is summarized in Table 4.8.6. The prevalence of the mining industry in the Study Area is readily apparent. Eureka County had the highest percentage (over 90 percent) of its work force employed in mining in September 2001. In Lander County 34 percent of the work force worked in mining, while Elko’s percentage was approximately seven percent. It should be noted, however, that during the period September 2000 to 2001, the number of people employed in mining decreased in Elko, Eureka, and

Table 4.8.4: 1999 Income Level of the Study Area Compared with the State of Nevada Based on a Sample

Location	1999 Per Capita Income	Median Income		Median Earnings	Median Earnings
		Household	Family	Male Full Time, Year-round	Female Full Time, Year-round
Elko County	$18,482	$48,383	$52,206	$41,322	$24,653
Carlin	$19,377	$49,571	$51,716	$47,396	$21,812
Elko City	$20,101	$48,608	$52,754	$43,397	$27,366
Spring Creek (CDP)[a]	$20,606	$60,109	$61,650	$50,053	$27,260
Eureka County	$18,629	$41,417	$49,437	$45,167	$25,000
Beowawe/ Crescent Valley	n/a	n/a	n/a	n/a	n/a
Lander County	$ 16,998	$46,067	$51,537	$45,375	$22,197
Battle Mountain (CDP)[a]	$16,975	$42,981	$50,995	$45,313	$25,417
State of Nevada	$21,989	$44,581	$50,849	$35,794	$27,089

Source: U.S. Census Bureau, Census 2000, Table DP-3, Profile of Selected Economic Characteristics: 2000
[a] CDP= Census Designated Place

Table 4.8.5: Persons Below Poverty Level by Race in the Study Area Compared with the State of Nevada (1989).

Location[a]	White		Black		American Indian, Eskimo, or Aleut		Asian or Pacific Islander		Other Race		Total Population	
	Number Below Poverty Level[b]	% Total Race	Number Below Poverty Level	% Total Race	Number Below Poverty Level	% Total Race	Number Below Poverty Level	% Total Race	Number Below Poverty Level	% Total Race	Number Below Poverty Level	% Total Pop.
Elko County	1,963	7%	14	5%	614	30%	26	8%	472	25%	3,089	9%
Carlin	116	6%	0	0%	12	43%	0	0%	0	0%	128	6%
Elko/Spring Creek (CDP)[c]	905	5%	14	24%	57	14%	16	7%	307	25%	1,299	6%
Eureka County	142	10%	2	50%	5	16%	0	0%	8	21%	157	10%
Beowawe[d]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2	3%
Crescent Valley[d]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	14	5%
Lander County	494	9%	6	55%	123	39%	0	0%	45	19%	668	11%
Battle Mountain (CDP)[c]	280	9%	6	55%	48	32%	0	0%	45	30%	379	11%
State of Nevada	83,235	8%	17,262	22%	4,766	23%	3,843	10%	10,554	20%	119,660	10%

[a] U.S. Department of Commerce, Bureau of the Census, 1990 U.S. Census, Summary Tape File 3A and 3C1 unless otherwise noted.
[b] The average poverty threshold for a family of four persons was $12,674 in 1989. The poverty threshold is not adjusted for regional, state, or local variations in the cost of living.
[c] CDP = Census Designated Place.
[d] Bureau of Business and Economic Research, University of Nevada, Reno, Geodemographic Analysis - Crescent Valley, Beowawe and Battle Mountain, July 1997 Block Group Level Estimates Produced by Claritas (analysis performed at the request of EMA).

Table 4.8.6: Employment by Industry in Study Area Counties, September 2000 to September 2001

Industry	Elko County			Eureka County			Lander County		
	9-2001	9-2000	% Change	9-2001	9-2000	% Change	9-2001	9-2000	% Change
Mining	1,310	1,380	-5.1%	3,430	3,620	-5.2%	640	750	-14.7%
Construction	1,050	1,190	-11.8%	10	10	0.0%	30	30	0.0%
Manufacturing	170	210	-19.0%	0	0	0.0%	40	40	0.0%
TCPU	880	880	0.0%	20	30	-33.3%	70	90	-22.2%
Trade	3,680	3,790	-2.9%	70	90	-22.2%	390	410	-4.9%
FIRE	460	490	-6.1%	10	10	0.0%	20	30	-33.3%
Services	7,740	8,600	-10.0%	10	30	-66.7%	110	140	-21.4%
Government	3,580	3,610	-0.8%	250	260	-3.8%	580	580	0.0%
Total All Industries	18,870	20,160	-6.4%	3,800	4,040	-5.9%	1,880	2,070	-9.2%

TCPU=Transportation, Communications and Public Utilities
Trade=Wholesale & Retail Trade
FIRE=Finance, Insurance, and Real Estate
Source: Nevada Research and Analysis Bureau, Department of Employment, Training, and Rehabilitation, Last Updated 4-2-02

Table 4.8.7: Top Employers by Number of Employees for Elko, Eureka and Lander Counties

Employer and Number of Employees		
Elko County	**Eureka County**	**Lander County**
Elko County School District (1,300-1,399)	Barrick Goldstrike Mines, Inc. (1,800-1,899)	Cortez Gold Mines (400-499)
Cactus Petes, Inc. (800-899)	Newmont Gold Company (1,500-1,599)	Lander County (100-199)
Rainbow Casino and Hotel (600-699)	Eureka County Auditor (100-199)	Echo Bay Minerals Co. (100-199)
Peppermill Hotel Casino - Wendover (600-699)	Ruby Hill Project (0-99)	Lander County School District (100-199)
Elko Red Lion Casino (500-599)	Eureka County School District (0-99)	Battle Mountain General Hospital (0-99)
Stateline Hotel, Inc. (500-599)	Mine Service and Supply Co. Inc. (0-99)	M - I Holdings LLC (0-99)
State of Nevada (400-499)	Tonto Drilling Services, Inc. (0-99)	Bureau of Land Management (0-99)
Silver Smith Casino Resort (300-399)	Busy B-Drive-In (0-99)	Colt Broadway Flying J (0-99)
AngloGold (Jerritt Canyon) (300-399)	Robinson Petroleum (0-99)	Etcheverry Foodtown (0-99)
Dynatec Mining Corp. (300-399)	Nevada Dept. of Transportation (0-99)	McDonald’s Restaurant (0-99)
	Owl Club & Steak House (0-99)	

Source: NDETR. Data is from the third quarter of 2001 and may not reflect current conditions.

Lander Counties by 5.1 percent, 5.2 percent, and 14.7 percent, respectively (Nevada Department of Employment, Training and Rehabilitation [NDETR]).

Although mining is a major industry in all of the Study Area counties, Elko County shows the most diversification of its economy compared to the rest of the Study Area. According to the NDETR, mining in Elko County ranked fourth behind services, trade, and government during the year September 2000 to 2001. During this time period, all but one segment of the Elko County economy declined, with manufacturing dropping by 19 percent, construction by nearly 12 percent, services by ten percent, and mining by five percent. Eureka's economy was the least diversified, with mining employing approximately 90 percent of workers from September 2000 to 2001. Declines occurred in all Eureka County categories except finance, insurance and real estate (FIRE), and all far outpaced that of mining during this time period. More workers were employed in mining than any other industry in Lander County between September 2000 and 2001. All Lander County industries declined during this time, with FIRE decreasing by more than 37 percent, services by over 20 percent, construction by nearly 20 percent, and mining by 14.5 percent.

The composition of each county's economy is further exhibited in Table 4.8.7, which lists the top employers in each county. As shown in the table, mining is the top employer in two of the Study Area counties, with CGM being the largest employer in Lander County. Barrick and Newmont are the top two employers in Eureka County. In Elko County, the School District is the top employer, with the hotel/casino industry occupying the next five highest places of employment.

Estimates of average weekly wages are provided by the NDETR. For the third quarter of 2001, the highest average weekly wage in both Elko and Eureka Counties was earned in the mining industry ($1,128 and $1,141 respectively). The second highest industry for these two counties, transportation, communications, & public utilities (TCPU), was approximately $750 to $800. The highest average weekly wage in Lander County was earned in manufacturing ($1,071), with the mining wage in second place, approximately $50 lower (NDETR 2002).

The average monthly payroll for CGM's current operations during the past 12 months was $1,915,000 (Jim Collord, email, June 18, 2002). Assuming that approximately 70 percent of this is disposable income (based on an average tax rate of 30 percent), then approximately $1.3 million per month is spent in the Study Area.

Labor force and employment statistics for 1994 through 2001 for the Study Area counties and the State of Nevada are presented in Table 4.8.8. Total employment for the state has grown steadily during this time period, from 731,500 to 968,800, or an increase of more than 32 percent. Elko County's employment peaked in 1997 at 20,170, and has generally declined to an eight-year low in 2001 of 18,130. Lander County shows the greatest decline during this time, a decrease of 25 percent from 1994 to 2001, reflecting its dependence on the declining mining industry. Eureka County's employment peaked in 1998 at 900 workers, and has since declined by 13 percent to 780 in 2001. Unemployment in Lander County was the highest within the Study Area at 9.6 percent in 2001. Eureka was lowest at 3.6 percent, with Elko County at six percent. State of Nevada unemployment in 2001 was 5.3 percent, an increase of 1.2 percent from the year 2000. Elko, Eureka, and Lander Counties all show an increase in unemployment for the same time period, at 1.5 percent, one percent, and 1.9 percent, respectively (NDETR 2002).

Housing

Housing characteristics from the 2000 Census are summarized for the Study Area in Table 4.8.9. The median value for homes and rentals within the Study Area increased substantially in 2000, with Spring Creek having the highest median value at $129,800, and Battle Mountain having the lowest at $79,600. Median rent in 2000 was highest in Spring Creek ($762) and lowest in Battle Mountain ($475). A summary of the housing characteristics and temporary housing facilities presented in Table 4.8.9 is discussed below by county.

Table 4.8.8: Labor Force Statistics for the Study Area Compared with the State of Nevada

Location	Yearly Averages[a]							
	1995	1996	1997	1998	1999	2000	2001	2002
ELKO COUNTY								
Total Labor Force:	19,880	20,780	21,090	21,000	20,090	20,130	19,280	20,260
Employment:	18,720	19,680	20,170	19,800	19,030	19,230	18,130	19,180
Total Unemployment:	1,160	1,100	920	1,200	1,060	900	1,150	1,080
Unemployment Rate:	5.8 %	5.3 %	4.3 %	5.7 %	5.3 %	4.5 %	6.0 %	5.3%
EUREKA COUNTY								
Total Labor Force:	750	800	910	950	860	850	810	750
Employment:	680	740	860	900	820	830	780	720
Total Unemployment:	70	60	50	50	40	20	30	30
Unemployment Rate:	8.7 %	7.5 %	5.6 %	5.5 %	4.4 %	2.6 %	3.6 %	4.6%
LANDER COUNTY								
Total Labor Force:	2,900	3,060	3,050	2,900	2,540	2,320	2,170	2,210
Employment:	2,640	2,800	2,840	2,600	2,300	2,140	1,960	2,030
Total Unemployment:	260	260	210	300	240	180	210	180
Unemployment Rate:	9.1 %	8.6 %	6.9 %	10.3 %	9.4 %	7.7 %	9.6 %	8.4%
STATE OF NEVADA								
Total Labor Force:	802,300	839,900	882,500	919,900	941,600	986,100	1,023,500	1,128,500
Employment:	759,000	794,500	846,300	880,300	899,700	946,100	968,800	1,066,400
Total Unemployment:	43,300	45,400	36,200	39,600	41,900	40,000	54,700	62,100
Unemployment Rate:	5.4 %	5.4 %	4.1%	4.3 %	4.4 %	4.1 %	5.3 %	5.5%

[a] Nevada Department of Employment, Training and Rehabilitation,
http://detr.state.nv.us/cgi/dataanalysis
Same address for years 1994-2000

Elko County

Vacancy rates in Elko County ranged from a low of seven percent in Spring Creek to a high of 22 percent for Carlin. The quantity of single family units in communities throughout the county was on par with the State of Nevada (approximately 51 percent of total housing units). Communities in Elko County had a much lower rate of multiple family housing units than the State of Nevada (a high of 28 percent of housing units in Elko City compared with 38 percent in the State of Nevada), and more mobile homes (a high of 43 percent in Carlin compared with ten percent in the state). Housing units in Elko County tended to be owner-occupied, ranging from 63 percent in Elko to 89 percent in Spring Creek.

Table 4.8.9: Housing Characteristics of the Study Area and State of Nevada, 2000

Location[a]	HOUSING UNITS									TENURE		HOUSING COSTS		
	Single Family (Detached)		Multiple Family (Attached)		Mobile Homes		Other							
	Qty.	% of Total	Qty.	% of Total	Qty.	% of Total	Qty.	% of Total	Total Units	Owner-Occupied (%)	Tenant-Occupied (%)	Median Value ($)	Median Rent ($)	Vacancy Rate (%)
Elko County	9,330	51%	3,263	18%	5,636	31%	227	1%	18,456	70%	30%	$123,100	$583	15%
Carlin	485	47%	78	8%	436	42%	27	3%	1,026	73%	28%	$92,200	$610	22%
Elko	3,578	51%	1,922	28%	1,396	20%	64	1%	6,960	63%	37%	$126,600	$614	11%
Spring Creek (CDP)[b]	2,240	60%	168	5%	1,333	36%	0	0%	3,741	89%	12%	$129,800	$762	7%
Eureka County	334	33%	57	6%	599	58%	35	3%	1,025	74%	26%	$89,200	$469	35%
Beowawe/Crescent Valley[c]	19	n/a	n/a	n/a	149	n/a	n/a	n/a	365	n/a	n/a	n/a	n/a	n/a
Lander County	947	34%	143	5%	1,543	56%	147	5%	2,780	77%	23%	$82,400	$496	25%
Battle Mountain (CDP)[b]	508	36%	126	9%	728	52%	49	3%	1,411	69%	31%	$79,600	$475	28%
State of Nevada	432,437	52%	311,297	38%	79,861	10%	3,862	1%	827,457	61%	39%	$142,300	$699	9%

[a] US Census Bureau, Census 2000, Table DP4, Profile of General Demographic Characteristics; and US Census Bureau, Census 2000, Summary File 1

[b] CDP = Census Designated Place.

[c] Eureka County Assessor

Three hotel/motel establishments are located in Carlin (USA Lodging 2002, http://www.usa-lodging.com/motels/nevada/Carlin.htm). Elko has approximately 36 hotel/motel establishments (City of Elko Website 2002, http://www.ci.elko.nv.us/econderev/area_description.htm). In addition, there are three RV parks in the vicinity of Elko (Personal Communication, Paulette Bill, Elko Chamber of Commerce, June 4, 2002). Several campground facilities are located within the county, but most are in the outlying areas and are suitable for recreational rather than residential use.

Eureka County

As shown in Table 4.8.9, vacancy rates in Eureka County were the highest in the Study Area, with 35 percent of the housing units vacant in the county compared to nine percent for the state. Eureka County had the lowest percentage of multiple family and single family units in the Study Area at six percent and 33 percent respectively. The majority of housing units in Eureka County are mobile homes (58 percent), which is the highest for the counties in the Study Area and almost six times that of the state (ten percent).

Three hotel/motels are located in the town of Eureka. No traditional hotels or motels are located in Crescent Valley or Beowawe. Some residents have in the past offered nightly rates for mobile homes in Crescent Valley. Currently, rentals are occupied due to activity associated with the Cortez construction projects (Personal Communication, Kathy Kinkade, Town of Crescent Valley, June 4, 2002).

Lander County

Like Eureka County, Lander County and Battle Mountain have a lower percentage of single and multiple family units compared with the State of Nevada, and a much higher percentage of mobile homes. The percentages of mobile homes in Lander County and Battle Mountain were 56 percent and 52 percent, respectively. At 25 percent and 28 percent, vacancy rates in Lander County and Battle Mountain were not as high as in Eureka County, but were approximately triple the rate for the state (nine percent) and substantially higher than Elko County, which had a vacancy rate of 15 percent. Like the other two Study Area counties, Lander County had more housing units listed as owner-occupied (77 percent) than did the State of Nevada (61 percent).

Hotels and motels may be rented by the night or week in Battle Mountain. Approximately seven hotel/motels offer temporary housing in Battle Mountain (Nevada North 2002 phone directory). Some RV facilities are available in Battle Mountain, but are largely unoccupied due to mine layoffs.

4.8.2.2.3 Public Utilities and Services

Water

Elko County

The majority of the residents living in unincorporated Elko County rely on individual wells and surface springs for domestic use. Residents of incorporated areas have access to public or private water systems as described below.

The City of Carlin is responsible for supplying water to approximately 927 customers within the city limits. The water sources are one deep well and one ground water spring, which is the main source. The City also maintains three storage tanks, as well as a series of distribution mains. (Personal Communication, Teri Feasel, Secretary, Carlin Public Works, June 6, 2002). The City's water system has the capacity to serve an additional 200 to 250 customers, a 25 percent increase, without modifications to the existing system (Personal Communication, Tom Ballew, Summit Engineering, and email of June 12, 2002). The City of Elko Engineering Department is responsible for supplying water to approximately 20,000 customers within the city limits, as well as to a few customers located directly adjacent to the city limits. The City of Elko's water system consists of 18 municipal wells with a combined production capacity of 17 million gallons per day (mgd), ten water storage tanks, and a series of distribution mains. There is storage capacity for 23.7 million gallons. The Elko Engineering Department is hoping to drill another well in 2003 (Personal Communication, Lisa Hermansen, Senior Engineering Technician, June 17, 2002).

Spring Creek Utilities (SPU) is responsible for supplying water to approximately 3,530 customers in the unincorporated community of Spring Creek. SPU maintains ten water wells with a combined production capacity of 2.5 mgd, eight water storage tanks, and a series of distribution mains. SPU needs to upgrade the water system, as they have had to impose odd/even day watering restrictions in the summer (Personal Communication, Ryan Limberg, Spring Creek Utilities Manager, June 6, 2002).

Eureka County

Residents of unincorporated Eureka County, including Beowawe, rely on individual wells and surface springs for domestic use. The Crescent Valley Town Board is responsible for supplying water to approximately 247 customers. It maintains two water wells, three storage tanks with a combined capacity of approximately 350,000 gallons, and a series of distribution mains. The water system has the capacity to serve additional customers without modifications to the existing system. An additional 200,000-gallon water storage tank was constructed in mid-1999. (Personal Communication, Kathy Kinkade, Meter Reader, Town of Crescent Valley, June 4, 2002).

Lander County

The majority of the residents of unincorporated Lander County rely on individual wells and surface springs for domestic use. Residents in the town of Battle Mountain are provided with water by Battle Mountain Water and Sewer (BMWS), which is responsible for supplying approximately 1,200 customers. BMWS maintains four water wells (currently used at 50 percent capacity), two water storage tanks, and a series of distribution mains. BMWS has the capacity to serve additional customers without modifications to the existing system (Personal Communication, Mimi Wildeman, Secretary, Lander County Public Works Department, June 12, 2002).

Wastewater Treatment

Elko County

Residents of unincorporated Elko County rely on private septic systems to dispose of domestic sewage. Residents of incorporated areas rely on public collection and treatment facilities as described below.

The City of Carlin's wastewater treatment plant has the capacity to treat approximately 500,000 gallons per day (gpd). The existing plant could handle an increase of approximately 25 percent. Part of the industrial park north of town can be served; however, some septic systems are presently allowed, depending on the size of the individual sites (Personal Communication, Tom Ballew, Summit Engineering, and email June 12, 2002).

The City of Elko Engineering Department's wastewater treatment plant has the capacity to treat approximately 4.5 mgd. The Elko wastewater treatment plant has the capacity to treat an additional 2.5 to 2.7 mgd, and could handle 4.3 mgd according to the ten-year master plan. The plant is presently operating at about 50 percent of capacity. There has been a decrease in the plant flow rate since 1997, due to population declines (Personal Communication, Fritz Sawyer, Elko Wastewater Treatment Plant Manager, June 8, 2002).

SPU maintains a limited series of public sewers and provides wastewater treatment services to approximately 59 customers. Other residents rely on private septic systems. The Spring Creek wastewater treatment plant currently treats approximately 22,000 gpd and is operating at capacity. No additional capacity is possible without expanding the existing facility (Personal Communication, Ryan Limberg, SPU Manager, June 7, 2002.)

Eureka County

Residents of unincorporated Eureka County, including Beowawe and Crescent Valley, rely on private septic systems to dispose of domestic sewage. The Community Development Block Grant program that was considered for the purpose of funding a wastewater feasibility study was not done. At the present time, a new community wastewater treatment plant is in progress (Personal Communication, Kathy Kinkade, Town of Crescent Valley, June 4, 2002).

Lander County

Residents of unincorporated Lander County rely on private septic systems to dispose of domestic sewage. Residents of the town of Battle Mountain are provided public sewer and wastewater treatment services by BMWS. An upgraded system consisting of a sequential batch reactor-type plant is currently being brought into service. The old plant can treat approximately 450,000 gpd. The first phase of the new plant will handle 800,000 gpd, and the planned second phase will have a 1.2 mgd capacity (Personal Communication, John Snapp, BMWS Leadman, June 12, 2002).

Solid Waste Disposal

Elko County

The majority of solid waste generated in the unincorporated areas of Elko County as well as the City of Elko, City of Carlin, and Spring Creek, is collected by the Elko Sanitation Company and transported to the Elko Landfill, which is owned and operated by the City of Elko. The landfill is considered a Class I industrial/municipal landfill. The Elko Landfill currently processes approximately 140 tons per day (tpd) of solid waste, and has the capacity to serve additional development for the next 100 years without modifications to the existing facility (Personal Communication, Evan Dodson, City of Elko Public Works Department, Solid Waste Superintendent, June 7, 2002).

Eureka County

Solid waste generated in the town of Crescent Valley is collected by Hoss Disposal and transported to the Eureka Landfill which is owned and operated by Eureka County. Residents of rural areas of Eureka County may haul their household waste to collection bins which are collected on a regular basis (Personal Communication, Tom Hoss, owner of Hoss Disposal, June 7, 2002).

Lander County

Most of the solid waste generated in the unincorporated areas of Lander County, as well as the town of Battle Mountain, is collected by Hoss Disposal and transported to the Battle Mountain Landfill. This is a Class II landfill which accepts commercial and residential solid waste in the amount of approximately 60 cubic yards per day. The Battle Mountain Landfill was re-permitted to include more land to the south of the existing facility in order to extend the life of the landfill. Water monitoring is completed twice a year. Four gas monitoring wells were installed late in 2002. (Personal Communication, Roger Sutton, Lander County Public Works Director, November 22, 2004).

4.8.2.2.4 Emergency Services

Law enforcement, fire protection, and ambulance services available in the Study Area are summarized by county and community in Table 4.8.10.

4.8.2.2.5 Health Care and Social Services

Elko County

Major medical services in Elko County are provided by Northeastern Nevada Regional Hospital (NNRH), which serves all of northeastern Nevada including portions of the Study Area located in Elko, Eureka, and Lander counties. This new 127,000 square foot hospital opened in September of 2001. It has 75 all-private acute care rooms and an adjacent medical office building. The new facility replaced the old Elko General Hospital. At the present time, 36 doctors are on the active staff.

Table 4.8.10: Emergency Services Serving Study Area Counties and Communities

Service Type	Agency	Description of Staff	Description of Facilities	Jurisdiction/Additional Areas Covered	Adequacy
Elko County					
Law Enforcement	Elko County Sheriff's Department	47 law enforcement officers 11 civilian staff members	Headquarters in City of Elko; 5 substations; 140-bed jail facility and regional juvenile probation center in City of Elko.	Unincorporated Elko County; participates in a mutual assist program with the Nevada Highway Patrol (NHP), adjacent county sheriffs' departments and city police departments.	Jail facility is currently over capacity on weekends and officer to inmate ratio is below the national average.
Fire Protection	State of Nevada Division of Forestry (NDF); Northeastern Fire Protection District (NFPD)	8 paid firefighters Other volunteers as needed from various departments	Spring Creek: 3 stations; 2 engines; 2 pumpers; 2 tenders; 2 wildland trucks; 1 command vehicle	Unincorporated Elko County, including Spring Creek; BLM responsible for fighting wildland fires on federal land; has a mutual aid agreement with NFPD for Spring Creek area.	Unknown; depends on extent of fire.
Ambulance	Elko Ambulance	2 full-time paid directors 2 unpaid assistant directors 60 volunteers	8 ambulances: 3 in Elko, 2 in Jackpot, 3 in Wells.	Elko County; emergencies are transported to Elko General Hospital, Twin Falls, or Ely, depending on location of incident.	Existing facilities, equipment, and staff are adequate.

Service Type	Agency	Description of Staff	Description of Facilities	Jurisdiction/Additional Areas Covered	Adequacy
			Elko (City)		
Law Enforcement	Elko Police Department	35 law enforcement officers 36 civilian staff members	1 station; utilizes county jail facility and regional juvenile probation center.	Incorporated City of Elko; participates in a mutual assist program with NHP and Elko County Sheriff's Department	Existing staff and equipment are adequate.
Fire Protection	Elko Fire Department	15 career firefighters 2 administrative staff 34 volunteers	3 stations; 7 engines; 3 airport crash trucks; access to 4 NDF vehicles.	Incorporated City of Elko; will respond to calls approximately 8 miles from city limits; participates in aid agreement with NDF for areas outside city limits.	Existing staff and equipment are adequate, although equipment needs to be updated.
			Carlin		
Law Enforcement	Carlin Police Department	1 chief 4 law enforcement officers 2 civilian staff members	One station; utilizes county jail facility and regional juvenile probation center, both located in Elko.	Incorporated City of Carlin. Participates in mutual assist program with NHP, Elko County Sheriff's Department, and Elko Police Department. Also has new "Joining Forces" program.	Existing facilities, equipment, and staff are not adequate to maintain a sufficient level of service; for example, the vehicle budget has been cut.
Fire Protection	Carlin Volunteer Fire Department	35 volunteer firefighters	1 station; 3 fire trucks; 2 ambulances; 1 service truck.	Incorporated City of Carlin; will respond to calls 50 miles north, 70 miles south, 12 miles east, and 25 miles west of Carlin. Participates in mutual aid agreement with NDF, and Elko and Eureka counties; department has staff capable of responding to medical emergencies.	Existing staff and equipment are adequate.

Service Type	Agency	Description of Staff	Description of Facilities	Jurisdiction/Additional Areas Covered	Adequacy
			Eureka County		
Law Enforcement	Eureka County Sheriff's Department	1 sheriff 6 law enforcement officers (2 assigned to CV substation) 5 dispatchers 4 jailers 3 civilian staff members	Headquarters in Eureka; 1 substation in Crescent Valley; 20-bed detention facility in Eureka to house all inmates.	Unincorporated areas in Eureka County; participates in mutual assist program with NHP and adjacent county sheriffs' departments.	Existing facilities and staff are adequate.
Fire Protection	Eureka Volunteer Fire Department	1 full-time battalion chief (NDF employee) 74 volunteer firefighters	6 Stations, including 1 in Beowawe and 1 in Crescent Valley. Each station has its own volunteer chief.	Populated areas of Eureka County; NDF and BLM fight wildland fires in rural areas.	Existing facilities and staff are adequate.
Ambulance	Eureka County	15 EMTs	4 ambulances; 2 in Eureka, 2 in Crescent Valley	Eureka County; emergencies are transported to Northeastern Nevada Regional Hospital in Elko.	Existing facilities, equipment, and staff are adequate.
			Beowawe/Crescent Valley		
Fire Protection	Beowawe Volunteer Fire Department; Crescent Valley Volunteer Fire Department	Beowawe: 9 firefighters Crescent Valley: 10 volunteer firefighters	Beowawe: 1 water tender, 3,200 gallons; 1 heavy pumper, 500 gallons; 1 light engine, 150 gallons. Crescent Valley: 2 pumpers (in 2001, a new all-wheel drive wildland fire truck with Class A foam system was purchased); 1,500-gallon tanker truck	Beowawe: serves the town of Beowawe, and responds to calls outside of town boundaries such as Crescent Valley, Dunphy, and I-80. Crescent Valley: serves the town of Crescent Valley; responds to calls as far as Boulder Valley to north and Grass Valley to south.	Beowawe: could always use more volunteers, but staff is adequate. New station (3 bay) was built two years ago. Crescent Valley: existing staff is not adequate to serve area; staff of 25 would be an improvement.
Ambulance	Eureka County				

Service Type	Agency	Description of Staff	Description of Facilities	Jurisdiction/Additional Areas Covered	Adequacy
Lander County					
Law Enforcement	Lander County Sheriff's Department	1 sheriff, 1 chief deputy sheriff, 1 assistant sheriff, 3 sergeants, 9 deputy sheriffs, 7 dispatchers, 7 detention officers, 2 animal control officers, 4 civilian staff members	Headquarters in Battle Mountain; 1 substation; 50-bed detention facility in Battle Mountain; transport juveniles to Winnemucca facility.	Unincorporated Lander County, including Battle Mountain; participates in a mutual assist program with NHP and adjacent county sheriff's departments.	Existing facilities are adequate.
Fire Protection	Battle Mountain Volunteer Fire Department	25 volunteer firefighters	1 station in Battle Mountain; 3 engines; 2 pumpers; 1 aerial ladder; 4,000-gallon tanker truck.	Populated areas of Lander County, including the unincorporated town of Battle Mountain; will respond to emergencies 25 miles north, 55 miles south, 35 miles east, and 27 miles west of Battle Mountain; NDF and BLM fight wildland fires in rural areas.	Existing staff and equipment are adequate. A new 750-gallon tank truck will replace the mini-pumper.
Ambulance	Battle Mountain Ambulance	25 volunteer EMTs	3 ambulances located in Battle Mountain	Lander County, including Battle Mountain; emergencies are transported to Battle Mountain General Hospital.	Existing facilities, equipment, and staff are adequate.

Source: Personal communications with the following: Linda Seldin, Lander County Sheriff's Department, April 26, 2002; Jody Rogers and Phyllis Jaramillo, Battle Mountain Ambulance Service, April 26, 2002; Cathy Kolsch, Elko Ambulance, May 8, 2002; Jim Urresti, Fire Captain, NV Department of Forestry, May 8, 2002; Charolette Felton, Elko County Sheriff's Department, May 10, 2002; Clair Morris, Chief of Police, Elko Police Depatment, May 10, 2002; Lee Killeen, May 13, 2002; Pam Lyninger, Eureka County Sheriff's Department May 13, 2002; Darla Hoadley, Carlin Police Department, May 13, 2002; Carla Jones, Carlin Volunteer Fire Department, May 13, 2002; Bill Killion, volunteer firefighter, Elko Fire Department, May 13, 2002; Kevin Jackson, Crescent Valley Volunteer Fire Department Chief, June 6, 2002; Mike Rebaleati, Eureka County Fire Chief via email, 6-10-02; Mike Sansinena, Beowawe Volunteer Fire Department Chief, June 26, 2002.

Patients with life-threatening injuries are flown via Care Flight to Salt Lake City, Utah, for medical care (Internet and Personal Communication, Yvonne Moore, Human Resources Assistant/Nursing Administration, June 7, 2002).

Additional medical services are provided by the Elko County Public Health Department, the Elko Clinic, Pioneer Urgent Care, Pinion Road Clinic, Nevada Home Health Service, and Home Health Services of Nevada.

Nevada Rural Health Centers, Inc. opened the Carlin Community Health Clinic in 1998, with one doctor available (Rhonda Smith, Receptionist, June 17, 2002).

Spring Creek residents rely on the medical, dental, and pharmaceutical facilities and services offered in the City of Elko.

Eureka County

The Eureka Medical Clinic was built in October 1998. One physician and one physician's assistant provide medical care. Emergencies are taken to NNRH in Elko. The doctor goes to Austin on

Wednesdays, but is usually on call through the Sheriff's Department (Personal Communication, Diane Podborny, Eureka Medical Clinic Office Manager, June 20, 2002).

Currently, there are no health care facilities established in Beowawe; however, the Crescent Valley Medical Center has been opened, with a doctor available two days a week. The Crescent Valley facility is operated by Nevada Rural Health Centers, Inc. and provides primary and urgent care and pharmaceutical services (Rhonda Smith, Receptionist, Carlin Community Health Clinic, June 17, 2002).

Eureka County maintains a senior center to support the seniors who live in the Crescent Valley area. The center maintains a staff of five part-time people and provides lunch to approximately 25 to 35 people a day, including homebound seniors. Additional services offered include assistance with medications and food bank services (Personal Communication, Heidi Hopper, Senior Center Manager, June 4, 2002).

Lander County

Medical services in the town of Battle Mountain are provided primarily by Battle Mountain General Hospital, which serves north-central Nevada, including the portions of the Study Area located in Lander and Eureka Counties. Battle Mountain General has an active staff of three doctors and maintains 25 patient beds. Patients with life-threatening injuries are flown via Care Flight to Reno or Salt Lake City, Utah, for medical care.

Lander County also contributes to health care in Battle Mountain through its Public Health Department, which offers limited preventive health services. Additional health services in Battle Mountain are offered by the Nevada Home Health Service and the Battle Mountain Medical Clinic, a family practice consisting of three doctors and facilities adjacent to the hospital.

4.8.2.2.6 Library and Recreational Facilities

Library services in the Study Area are provided by the Elko County Library, which serves most of northeastern Nevada. The Elko County main library is located in the City of Elko. In addition, the Elko County Library provides the services of part-time librarians for branch libraries in Crescent Valley, Beowawe, and Battle Mountain on a contractual basis. The County also staffs a bookmobile, which serves Carlin on a bi-weekly basis, as well as schools and rural areas. Existing library facilities in Elko are adequate to serve the existing population in northeastern Nevada. (Personal communication, David Ellefsen, Elko County Library, June 6, 2002). A law library is located in the county courthouse.

Recreational facilities in the Study Area are described in Section 4.15.2.2.1 of the South Pipeline Final EIS (BLM 2000a).

4.8.2.2.7 Public Education

The Project Area is located within the service boundaries of several public school districts, including the Elko County School District, Eureka County School District, and Lander County School District. In addition, universities, private schools, and other institutions offer educational services in the Project Area , and are documented in this section.

Elko County School District

The Elko County School District provides public educational services in both the incorporated and unincorporated areas of Elko County. These services are summarized in Table 4.8.11. Seven of the ten schools located within the Project Area are operating at or above capacity, with student-teacher ratios ranging from 11.9 to 17.9, for an average of 15.45. Table 4.8.12 summarizes historic district-wide student enrollment and teaching staff, which shows that student-teacher ratios for the district have remained stable, ranging from 15.35 in 1997-1998 to 15.36 in 2000-2001, with little variation in the two intervening years (Personal Communication via email, Mary Ann Kenley, Superintendent's Assistant, Elko County School District, April 6, 2002).

Of the 10,444 students in the Elko County School District, approximately 2,800 are bussed to and from school daily. The District maintains approximately 73 buses, ranging in size from 19- to 84-passenger vehicles (Personal Communication by email, Mary Ann Kenley, Superintendent's Assistant, Elko County School District, June 5, 2002). In addition to the standard public educational services, the following programs are available: a) Elko County School District Adult High School Program; b) Alternative Education Program; c) Incarcerated Program; d) Northeastern Nevada Regional Professional Development Program (NNRPDP); (e) University of Nevada Reno and Great Basin Community College; f) private schools that provide alternative education opportunities.

Eureka County School District

The Eureka County School District provides public educational services in both the incorporated and unincorporated areas of Eureka County. These are summarized in Table 4.8.13. All schools

Table 4.8.11: Enrollment, Capacity and Teaching Staff for Schools in the Elko County School District

20001-02 School Year	Grades Served	Current Enrollment	Ultimate Capacity [1]	Available Capacity	Number of Teachers	Student Teacher Ratio
Elko High School	9-12	1,223	1,425	202	74	16.52
Spring Creek High School	9-12	768	950	182	48	16.0
Elko Junior High School	7-8	647	425	-222	44	14.7
Spring Creek Middle School	7-8	752	675	-77	36	18.16
Northside Elementary School	K-6	598	506	-92	42	14.9
Southside Elementary School	K-6	623	436	-187	44	14.15
Mountain View Elementary School	K-6	717	574	-143	44	16.2
Carlin Combined School	K-12	454	647	193	38	11.9
Spring Creek Elementary School	K-6	669	590	-79	40	16.72
Sage Elementary School	K-6	577	577	at capacity [2]	37	15.59

Source: Personal Communication, Mary Ann Kenley, Elko County School District, Secretary of the Superintendent, May 2, 2002.

[1] Ultimate capacity does not include portables or special use areas such as special education, music, art, ESL, Chapter, gyms, multipurpose, libraries, etc.

[2] This school consists entirely of modular classrooms.

Table 4.8.12: Historic Student Enrollment and Teaching Staff Levels in Study Area School Districts

Year	ELKO COUNTY SCHOOL DISTRICT			EUREKA COUNTY SCHOOL DISTRICT			LANDER COUNTY SCHOOL DISTRICT		
	Students	Teachers	Student to Teacher Ratio	Students	Teachers	Student to Teacher Ratio	Students	Teachers	Student to Teacher Ratio
1997-98	10,624	692	15.35	378	41	9.21	1,777	87	20.43
1998-99	10,444	693	15.07	358	38	9.42	1,703	102	16.69
1999-00	10,161	684	14.86	347	33	10.51	1,534	98	15.65
2000-01	10,444	680	15.36	305	31	9.83	1,449	90	16.1

Source: Personal Communication, Mary Ann Kenley, Elko County School District, Secretary of the Superintendent, May 2, 2002; Personal Communication, Robin Hicks, Eureka County School District, Secretary of the Superintendent, April 28, 2002; and Personal Communication, Mary Belton, Secretary of the Superintendent, Lander County School District, April 23, 2002.

Table 4.8.13: Enrollment, Capacity and Teaching Staff for Schools in the Eureka County School District

School	Grades Served	Current Enrollment	Ultimate Capacity	Available Capacity	Number of Teachers	Student to Teacher Ratio
Eureka County Jr./Sr. High School	7-12	125	200	75	15	8.33
Eureka County Elementary School	K-6	93	240	147	10	9.30
Crescent Valley Elementary School	K-6	50	180	130	5	10.0

Source: Personal Communication, Robin Hicks, Secretary to the Superintendent, Eureka County School District, April 28, 2002.

located within the district area are operating well below capacity, with student-teacher ratios ranging from 8.33 to 10, for an average of 9.2. Table 4.8.12 summarizes historic district-wide information, showing that student-teacher ratios for the district have ranged from 9.21 in 1997-1998 to 9.83 in 2000-2001, with an average of 9.74 (Personal Communication by email, Robin Hicks, Secretary to the Superintendent, Eureka County School District, April 28, 2002).

Of the 305 students in the Eureka County School District, an average of 239 are bussed to and from school daily. The district maintains approximately 13 buses, ranging in size from 12- to 84-passenger vehicles (Personal Communication by email, Robin Hicks, Secretary to the Superintendent, June 3, 2002). In addition to the public educational services offered by the district, the Great Basin Community College system currently offers adult classes in the community.

Lander County School District

The Lander County School District provides public educational services in both the incorporated and unincorporated areas of Lander County, as summarized in Table 4.8.14. Two of the five schools in the district are operating at a small margin over capacity. Eleanor Lemaire Elementary School was built and opened as scheduled, and together with a decreasing enrollment, has eased the crowded conditions that previously existed. Student-teacher ratios range from 14.50 to 19.27, with an average of 17.18 (Personal Communication by email, Mary Belton, April 23, 2002). Table 4.8.12 shows that as enrollment declined between 1997-1998 and 2000-2001, the student teacher ratio decreased from 20.43 to 16.1 (Personal Communication via email, Mary Belton, Secretary to the Superintendent, Lander County School District, April 23, 2002).

Of the 1,449 students in the Lander County School District, an average of 175 are bussed to and from school daily. The district maintains approximately 14 buses, ranging in size from 12- to 84-passenger vehicles. The Lander County School District offers an adult diploma program. Great Basin Community College maintains a branch facility in Battle Mountain with on-site instructors, interactive video classes, and a computer lab. There is also an after-school program for children of working parents (Personal Communication via email, Mary Belton, Secretary to the Superintendent, June 4, 2002).

Table 4.8.14: Enrollment, Capacity and Teaching Staff for Schools in the Lander County School District

School	Grades Served	Current Enrollment	Ultimate Capacity	Available Capacity	Number of Teachers	Student to Teacher Ratio
Battle Mountain High School	9-12	337	350	13	23	14.65
Battle Mountain Junior High	6-8	212	200	-12	11	19.27
Eleanor Lemaire Elementary School	4-6	320	480	160	17	18.82
Mary Black Elementary School	3-5	187	250	63	10	18.70
Eliza Pierce Elementary School	K-2	203	150	-53	14	14.50

Source: Personal Communication, Mary Belton, Secretary to the Superintendent, Lander County School District, April 23, 2002.

4.8.2.2.8 Public Finance

Forms of Government

In Nevada, the powers of local governments are established by statute, subject to change by the state legislature. County governments are designated by the state legislature, whereas, city governments may be established by general law or special charter. In Nevada, special districts are the most common form of local government. The Nevada constitution does not reserve any governmental authority to either county or city governments. Counties and cities share a similar range of governmental authority including general police powers, control of land use, and health, welfare, and recreation responsibilities. Counties have some additional powers including property assessment courts, tax collections, and administration of special licenses. Unincorporated towns may, with county approval, take on most functions of a city government (Ebel 1990).

Elko County

The state legislature created Elko County, the sixth largest county in the U.S., from part of Lander County in 1869. Elko County is governed by a five-member Board of County Commissioners, each elected to a four-year term. The Board of County Commissioners appoints a seven-member planning commission. The County Commissioners oversee county operations, including administration, law enforcement, judicial, public works, and economic development. The county school district serves the entire county and is governed by an elected board, with the superintendent and administration responsible for day-to-day operations. The City of Elko incorporated in 1917 and has a council-manager form of government. A mayor and four supervisors are elected to four-year terms, while the city manager and other municipal officials are appointed by the city council. The City of Carlin incorporated in 1971 and has a mayor-council form of government. The mayor, vice mayor, and four council members are each elected to four-year terms. The city clerk, police chief, and public works director are appointed by the city council.

Eureka County

The primary governing bodies in Eureka County are the Board of County Commissioners and the Eureka County School District. The County Commissioners oversee county operations, including administration, law enforcement, judicial, public works, and economic development. The County also administers the budgets of the Town of Eureka, Town of Crescent Valley, and various special districts. The county school district serves the entire county and is governed by an elected board, with the superintendent and administration responsible for day-to-day operations. The Town of Crescent Valley is governed by the Crescent Valley Town Board. Beowawe is unincorporated and is governed by the Eureka County Board of Commissioners.

Lander County

Lander County is governed by a three-member Board of Commissioners, each elected to a four-year term. A seven-member planning commission, public administrator, and budget director are appointed to serve the region. The county commissioners administer the following services and properties: fire protection; roads; recreational facilities; library; water, wastewater; and planning. The county school district serves the entire county and is governed by an elected board, with the superintendent and administration responsible for day-to-day operations. Battle Mountain is unincorporated and receives administrative services from Lander County.

Current Fiscal Condition

Public finances in Nevada include locally derived and state-shared revenues. Locally derived finances consist of ad valorem property taxes on real and personal property and the net proceeds of mines located within the county. State-shared revenues include sales, motor vehicle, fuel, and gaming revenues. Intergovernmental transfers have become important because of economic disparities between metropolitan areas of Clark and Washoe counties and rural agricultural and mining counties.

Table 4.8.15 presents the actual budget revenues and expenditures for 1999 and 2000 for each Study Area county. As shown in Table 4.8.15, Elko County is somewhat less dependent on tax revenue than Eureka and Lander Counties, which have similar sources of revenue; however, all three counties are very reliant on tax revenue and intergovernmental transfers. Tax revenues rose modestly in Elko and Lander Counties from 1999 to 2000, but declined substantially in Eureka County. In 2000, intergovernmental transfers accounted for 37 percent of Elko County's revenue, 54 percent of Eureka County's revenue, and 41 percent of Lander County's revenue. The largest portion of 1999 and 2000 budget expenditures in Elko County was spent on Public Safety. In Eureka County, the greatest amount was spent on General Government, while in Lander County, General Government and Public Safety expenses were similar for both years. Elko County's Debt Service expenditure was two percent in 1999 and 2000, compared with zero for Eureka and Lander.

Tax Revenue from Mining

The state and local governments receive revenue from mining in two ways: a tax on net proceeds of mineral operations and a property tax on mining-related property. The tax on mining proceeds is constitutionally-mandated. Net proceeds are calculated by subtracting certain deductions from the gross yield of mining production. Deductions include the costs of extraction, transportation to mill, reduction and refining, marketing, and insurance, as well as depreciation of the plant, machinery, and equipment and royalties paid. Until 1987, all mining tax receipts on net proceeds were allocated to local governments. Currently, the state may tax up to five percent on net proceeds and subsequently distributes tax receipts to the counties on the basis of their ad valorem tax rate. Current ad valorem tax rates (FY 2001-2002) for the Study Area counties are 2.7669 in Elko, 1.7088 in Eureka, and 3.1515 in Lander (Nevada Department of Taxation, Division of Assessment Standards, 2002).

As shown in Table 4.8.16, the three-year assessed valuation of net proceeds has declined by nearly nine percent for Elko County and over 12 percent for Lander County, while Eureka County rebounded from a large decline in 1999-2000 to a higher valuation than that of 1998-1999. Mining tax revenue in 2000-2001 was down by nine percent in Elko County from 1999-2000, but was similar to 1998-1999. In Eureka for 2000-01, revenue was up dramatically from the previous year by approximately 58 percent and surpassed the revenue levels of 1998-1999. Lander County's 2000-2001 revenue declined approximately 11 percent from its 1998-1999 amount, and was down approximately 24 percent from 1999-2000. For the five year period from 1999 through 2003, CGM paid $9,100,000 in property tax to Lander County. The net proceeds tax for CGM's operations during that same time period was $53,144,000 paid to the State of Nevada. Approximately 50 percent of the net proceeds tax is returned to Lander County by the State of Nevada (Jim Collord, verbal communication March 29, 2004).

Table 4.8.17 shows the total assessed valuation of mining property according to the Department of Taxation, and its percentage of the total assessed property value for each Study Area county and the State of Nevada. Eureka County had the greatest percentage of mining property valuation compared to the other counties and the state, with over 60 percent for each year. Lander County had the next highest percentage, of over 20 percent for each year, while Elko had the least of the Study Area Counties, varying from 7.5 in 1998-99 to 6.2 percent in 2000-01, which was higher than the state (2.5 percent to 2.2 percent). The percentage of mining valuation of the total assessed property value of the counties and state has varied somewhat over the three fiscal years. Overall, Elko County's mining value percentage declined by 1.4 percent, Eureka County gained 1.5 percent, Lander County declined 3.6 percent, and the state declined 0.3 percent for the three fiscal years.

Table 4.8.15: Revenues and Expenditures in Study Area Counties, 1999 and 2000 (in dollars)

Revenues/Expenditures	Elko County 1999	% of Total	2000	% of Total	Eureka County 1999	% of Total	2000	% of Total	Lander County 1999	% of Total	2000	% of Total
Revenues												
Taxes (Property and Other)	3,612,463	25%	3,975,175	24%	3,005,485	41%	2,673,520	35%	2,414,290	38%	2,748,583	41%
Licenses and Permits	748,468	5%	717,910	4%	10,299	0%	10,070	0%	89,107	1%	93,993	1%
Intergovernmental Resources	5,981,833	42%	6,011,201	37%	3,654,277	50%	4,145,325	54%	2,805,304	44%	2,780,462	41%
Charges for Services	1,448,292	10%	1,442,629	9%	304,461	4%	321,856	4%	616,553	10%	465,832	7%
Fines and Forfeits	1,078,462	8%	1,110,067	7%	84,375	1%	98,309	1%	288,082	4%	293,373	4%
Miscellaneous Revenues	850,134	6%	1,216,533	7%	272,889	4%	384,420	5%	209,476	3%	392,999	6%
Other Financing Sources	651,475	5%	1,780,131	11%								
Total Revenues	14,371,127	100%	16,253,646	100%	7,331,786	100%	7,633,500	100%	6,422,812	100%	6,775,242	100%
Expenditures												
General Government	4,339,622	29%	4,574,577	28%	1,981,269	37%	1,885,429	34%	2,307,380	38%	2,317,609	38%
Judicial	3,629,397	24%	4,220,224	26%	613,750	12%	655,273	12%	1,384,205	23%	1,225,382	20%
Public Safety	5,715,731	39%	6,196,721	38%	1,389,311	26%	1,396,223	26%	2,386,122	39%	2,469,636	41%
Public Works	639,850	2%	560,479	3%	-	0%	-	0%	-	0%	-	0%
Health and Sanitation	229,466	2%	247,252	2%	339,519	6%	474,352	9%	-	0%	-	0%
Welfare	-	2%	-	0%	-	0%	-	0%	-	0%	-	0%
Culture and Recreation	-	0%	-	0%	582,017	11%	598,994	11%	-	0%	-	0%
Community Support	-	0%	-	0%	390,978	7%	390,589	7%	-	0%	-	0%
Intergovernmental Expenditures	-	0%	-	0%	-	0%	72,000	1%	42,092	1%	12,283	0%
Debt Service (Principal plus Interest)	269,404	2%	300,361	2%	-	0%	-	0%	-	0%	-	0%
Total Expenditures	14,823,470	99%	16,099,614	100%	5,296,844	100%	5,472,860	100%	6,119,799	100%	6,024,910	100%
Excess (Deficiency) of Revenues Over Expenditures	(452,343)	-	154,032	-	2,034,942	-	2,160,640	-	303,013	-	750,332	-

Source: Nevada Department of Taxation, 2002

Table 4.8.16: Assessed Valuation and Tax Revenue Distribution of Net Proceeds of Minerals by Study Area County

County		Fiscal Year 1998-99	Fiscal Year 1999-00	Fiscal Year 2000-01
Elko	Assessed Valuation	$139,600,605	$140,134,722	$127,092,163
	Tax Revenue Distribution	$6,763,846	$7,006,737	$6,241,783
Eureka	Assessed Valuation	$185,631,362	$117,763,439	$185,854,627
	Tax Revenue Distribution	$9,107,946	$5,881,592	$9,428,158
Lander	Assessed Valuation	$223,122,561	$255,752,529	$195,507,746
	Tax Revenue Distribution	$10,904,757	$12,781,662	$9,660,750

Source: Nevada Department of Taxation email April 16, 2002; rnw@govmail.state.nv.us

Table 4.8.17: Mining Property Valuation as a Percentage of Total Property in the Study Area Counties

	FY 1998-1999			FY 1999-2000			FY 2000-2001			Percent Change	
County	Mining Property Assessed Valuation[a]	Total Assessed Value[b]	% Mining	Mining Property Assessed Valuation	Total Assessed Value	% Mining	Mining Property Assessed Valuation	Total Assessed Value	% Mining	FY 1998-99 To FY 1999-00	FY 1999-00 To FY 2000-01
Elko	$71,911,050	$952,822,299	7.5%	$71,007,900	$981,549,892	7.2%	$60,787,470	$987,195,980	6.2%	-0.3%	-1.1%
Eureka	$385,001,200	$622,549,357	61.8%	$358,301,590	$532,228,222	67.3%	$391,362,020	$617,820,838	63.3%	5.5%	-4.0%
Lander	$111,788,520	$434,681,461	25.7%	$98,153,910	$462,387,416	21.2%	$89,518,040	$403,833,455	22.2%	-4.5%	0.9%
State of Nevada[c]	$1,071,357,910	$43,045,689,217	2.5%	$1,165,931,280	$47,606,607,533	2.4%	$1,101,255,910	$51,172,070,842	2.2%	0.0%	-0.3%

Sources: [a] State of Nevada, Department of Taxation, Annual Reports, Fiscal 1998-1999, 1999-2000, 2000-2001
[b] State of Nevada, Department of Taxation, Statistical Analysis of the Roll, Fiscal Year 2000-2001
[c] Nevada Department of Taxation, email communication, May 29, 2002, bmoore@tax.state.nv.us

4.8.3 Environmental Consequences and Mitigation Measures

4.8.3.1 Significance Criteria

NEPA (Section 1508.14) states that "...economic or social effects are not intended by themselves to require preparation of an environmental impact statement. When an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment." This means that social or economic differences are not enough to result in a potentially significant adverse effect, but they need to manifest themselves with some physical change, as described in NEPA (Section 1508.8(b)), "...effects may include growth inducing impacts and other effects related to induced changes in the pattern of land use, population density or growth rate".

As identified during the scoping process and from the South Pipeline Final EIS (BLM 2000a, pages 4-206 through 4-208), the Proposed Action would normally have a significant effect on the environment if the following would occur:

- Induce substantial growth or concentration of population;
- Displace a large number of people;
- Cause a substantial reduction in employment;
- Substantially reduce wage and salary earnings;
- Cause a substantial net increase in County expenditures; or
- Create a substantial demand for public services.

4.8.3.2 Assessment Methodology

The social and economic characteristics of the Study Area are analyzed to determine the effects or impacts of the Proposed Action and alternatives on population, employment, housing, and public services. Fiscal effects are also assessed based on information obtained from Elko, Eureka, and Lander Counties.

4.8.3.3 Proposed Action

The Proposed Action would account for up to an additional seven years of mining and processing as well as the continued employment of 450-500 individuals beyond the 18 years outlined in the South Pipeline Final EIS (BLM 2000a, page 3-1). As described in Section 2.6.2, it is estimated that up to 50 contractors would be working on the Project Area at any time during the life of the Project. The majority of current employees would continue to be transported by bus to the Project site each day. CGM does not intend to build living facilities at or near the Project Area. Although additional permanent employees are not expected to be necessary, CGM would hire any new personnel from the local area if possible.

4.8.3.3.1 Population Effects

Because the Proposed Action would utilize the existing permanent CGM work force, the Proposed Action would not impact the population of the Study Area beyond existing conditions under the South Pipeline Project. The Proposed Action may have up to 50 contractors on site at any time during the life of the Project; however, the impact of contractors or temporary construction personnel on the population of the Study Area is short-term and is not considered significant. The Proposed Action would have a beneficial effect of maintaining population stability in the Study Area by providing an additional seven years of employment to current staff (450-500 employees). By utilizing the existing CGM work force, the Proposed Action would not induce substantial growth or concentration of population and would not create a substantial demand for public services. In addition, CGM has a commitment to work with other companies in the Study Area and the affected counties and communities to minimize impacts to those communities as the mines close down (see Section 2.10).

Impact 4.8.3.3-1: Implementation of the Proposed Action would continue employment of CGM's existing work force for an additional seven years, thus maintaining population stability in the Study Area during the life of the Project and would then cease at the end of the Project.

Significance of the Impact: This would be a beneficial impact during the life of the Proposed Action, and no mitigation measures would be required.

4.8.3.3.2 Employment Effects

It is likely that the 50 contractors and short-term construction personnel would be selected from the Study Area. Review of Table 4.8.6 reveals that the Study Area counties and communities could each accommodate the 50 workers employed in a given industry.

As described in Section 4.8.2.2.2, unemployment levels in two of the Study Area counties were higher than the state average in 2001 and have been rising due to the recent decline in the price of gold and subsequent layoffs in the mining industry. The continued employment of 450-500 workers by the Proposed Action would be welcome in an area facing shrinking job opportunities and growing unemployment. At least seven years of continued employment in the mining industry, one of the highest paying industries in the area, would be a positive benefit to the Study Area. In addition, CGM has a commitment to work with other companies in the Study Area and the affected counties and communities to minimize impacts to those communities as the mines close down (see Section 2.10).

In addition, the Proposed Action would have an indirect positive impact on Study Area employment. Based on the current employment of 407 workers and using an employment multiplier of 1.25 (Dobra 1989), a total employment impact of 916 jobs, or 509 additional jobs, would continue as a result of the Proposed Action. Of these 509 indirect jobs, 305 jobs in the local economy and 204 jobs in the urban service and supply centers of Nevada would continue under the Proposed Action. Similarly, using the 2002 monthly payroll of $1.9 million and the income multiplier of 1.57 (Dobra

1989), an estimated annual indirect payroll of $13.2 million would continue for at least seven years as a result of the Proposed Action.

Both direct and indirect employment would continue through approximately 2023. Workers and their families would continue to enjoy the same quality of life and would continue to spend disposable income at local businesses in the Study Area. As estimated in Section 4.8.2.2.2, CGM's existing payroll generates approximately $13 million in direct disposable income annually, which in turn generates an additional $20 million of indirect disposable income spent annually throughout the Study Area and the state.

Impact 4.8.3.3-2: Implementation of the Proposed Action may require employment of up to 50 short-term contractors or construction personnel during the life of the Project and would continue long-term employment for the existing CGM work force (450-500). It is expected that temporary and/or potential long-term employment positions could be accommodated by the Study Area population and no ingress of employees from outside of the Study Area would result. The Proposed Action would continue to employ current CGM employees for an additional seven years, resulting in a continuance of current indirect employment, as well as direct and indirect spending in the Study Area and the state during the life of the Project and would then cease at the end of the Project.

Significance of the Impact: These would be beneficial impacts during the life of the Proposed Action. No adverse impact due to increased short-term and continued long-term employment opportunities would be expected, and no mitigation measures would be required.

4.8.3.3.3 Housing Effects

Assuming the employment analysis is correct in determining that the Study Area has a sufficient resident population in the needed industry classifications to meet the demand for approximately 50 contractors during the life of the Project, no additional housing would be required. Nevertheless, this analysis assumes that 50 rental residences would be needed. The housing characteristics outlined in Table 4.8.9 for 2000 depict ample rental opportunities. Fifteen percent or 2,768 housing units were vacant in Elko County; 35 percent or 359 housing units were vacant in Eureka County; and 25 percent or 973 housing units were vacant in Lander County. Assuming the occupancies follow the county proportions for renter or tenant occupied versus owner occupied housing units (30 percent tenant occupied in Elko County; 26 percent tenant occupied in Eureka County; and 23 percent tenant occupied in Lander County), approximately 830 rental units in Elko county, 93 rental units in Eureka County, and 224 rental units in Lander County would be available. In addition to these rental units, temporary housing in hotel/motels and RV parks is available throughout the Study Area. Based on the availability of vacant housing in the Study Area, the Proposed Action would cause no housing shortage.

Continued employment of existing CGM employees through 2023 under the Proposed Action may result in additional home sales to employees that have been renting. However, this is not expected to affect housing availability in the Study Area. In addition, CGM has a commitment to work with other companies in the Study Area and the affected counties and communities to minimize impacts to those communities as the mines close down (see Section 2.10).

Impact 4.8.3.3.-3: Implementation of the Proposed Action may increase demand for local rental housing during the life of the Project and would then cease at the end of the Project. The demand can be accommodated with existing housing supply.

Significance of the Impact: This would be a beneficial impact during the life of the Proposed Action since housing vacancy levels for the Study Area far exceed the state average. No mitigation measures would be required.

4.8.3.3.4 Public Service Effects

The Proposed Action would not induce growth in the Study Area; therefore it would not create additional demand for public services. Public services such as utility services (water, sewage, and solid waste), emergency services, health care and social services, library and recreational facilities, and educational facilities would be affected by the Project only for the additional length of time (seven years) that CGM employees would require such services. As discussed in Section 4.8.2.2.1, population growth in the Study Area is expected to increase over the next decade. However, since no population growth would be caused by the Proposed Action, the public service providers in the Study Area should be able to meet the needs of current residents, including existing CGM employees, through the life of the Project. In addition, CGM has a commitment to work with other companies in the Study Area and the affected counties and communities to minimize impacts to those communities as the mines close down (see Section 2.10).

Impact 4.8.3.3-4: Public service requirements as a result of implementing the Proposed Action would remain the same as current levels.

Significance of the Impact: This would be neither an adverse nor a beneficial impact of the Proposed Action. No mitigation measures are proposed.

4.8.3.3.5 Fiscal Effects

Under the Proposed Action, an additional 110 million tons of ore would be mined in the Project Area. This additional gold production capacity translates into increased gross yield from mining production in Lander County, and subsequently, increased taxable net proceeds and property tax at levels similar to those described in Section 4.8.2.2.8. The latest breakdown of net proceeds by mining operation (2001) showed that CGM had the highest net proceeds in Lander County and paid over 51 percent of the total taxes on net proceeds (State of Nevada 2002). The Proposed Action would result in the continuation of, and potential increase in, CGM's tax contribution to Lander County from net proceeds. In addition, development of the Proposed Action would increase the value of CGM's real and personal mining property, thus increasing the amount of property taxes paid to Lander County. As discussed in Section 4.8.2.2.10, tax revenues as a proportion of Lander County's total revenues increased between 1999 and 2000 from 38 to 41 percent. However, Lander County lost approximately $60 million in the assessed value of the net proceeds of minerals between 1999-2000 and 2000-2001. This drop in assessed valuation resulted in nearly a 24 percent loss of tax revenue from net proceeds. Implementation of the Proposed Action would have the beneficial impact of preventing another significant drop in the net proceeds tax revenue by extending the producing life of CGM's operations by seven years. At the termination of the Proposed Action the tax revenues from the Project would cease and this fiscal benefit would end. If another economic activity were not to replace the Proposed Action, then the loss of the fiscal benefit would continue into the future.

Although Elko and Eureka Counties would not receive mining-related increased tax revenues from the Proposed Action, these counties would be affected due to the majority of CGM employees residing in these communities. While the Proposed Action would not increase the number of long-term residents in the Study Area, it would extend the residency period of 450-500 CGM employees by seven years. This would result in a continued demand for government services in Elko and Eureka Counties where 68 and 15 percent of current employees reside. However, since both counties had a budget surplus in 2000 (see Table 4.8.15) and CGM employees residing in Elko and Eureka Counties represent a very small percentage of each county's total population, the impact on public finance in these counties is not considered significant. The effects of the continued presence of CGM employees on Elko and Eureka County expenditures are likely to be offset by the taxes (i.e., property and sales taxes) paid by these residents, who are typically the highest-earning in the Study Area, as well as other revenue generated from county residents (i.e., service fees, license and permit fees, etc.). In addition, CGM has a commitment to work with other companies in the Study Area and the affected counties and communities to minimize impacts to those communities as the mines close down (see Section 2.10).

Impact 4.8.3.3-5: Implementation of the Proposed Action would result in a continuation of and a potential increase in revenues for the State of Nevada and Lander County, which would then cease at the end of the Project.

Significance of the Impact: This would be a beneficial impact of the Project. No adverse impact due to continued and increased revenue would be expected. There could be significant impact at the end of the Project when the fiscal benefits of the Project cease. No mitigation measures would be required.

4.8.3.3.6 Residual Adverse Impacts

No residual adverse effects would be associated with the Proposed Action. If additional economic activities are not in place at the end of the Proposed Action, then there is the potential for residual impacts to income levels, housing, public finance, the economy, and employment.

4.8.3.4 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented. As a result, current CGM employees would not continue employment beyond the current life of the South Pipeline Project. The potential significant impact at the end of the South Pipeline Project when the fiscal benefits cease would occur seven years soon than under the Proposed Action.

4.8.3.4.1 Socioeconomic Effects

The No Action Alternative would result in the loss of the beneficial socioeconomic effects associated with the Proposed Action. Current employment at CGM's operation would cease with the termination of the South Pipeline Project, thus causing a reduction of employment seven years earlier than under the Proposed Action. In addition, CGM has a commitment to work with other companies in the Study Area and the affected counties and communities to minimize impacts to those communities as the mines close down (see Section 2.10).

Impact 4.8.3.4-1: Impacts resulting from implementation of the No Action Alternative would be the elimination of up to seven additional years of payroll for 450 to 500 CGM employees, decreased revenues to local and state jurisdictions, and reduced wages spent in the Study Area.

Significance of the Impact: This impact is considered significant. There could be significant impact at the end of the South Pipeline Project when the fiscal benefits of the Project cease. No mitigation measures appear feasible.

4.8.3.4.2 Residual Adverse Impacts

The residual adverse impacts from the implementation of the No Action Alternative stem from the loss of potential beneficial socioeconomic impacts associated with the Proposed Action. These beneficial impacts include the following: a) increased population stability in the Study Area; b) continued and increased employment opportunities; c) increased demand for local housing; and d) continued and increased revenues for the state and Lander County. The South Pipeline Final EIS did not identify any unavoidable adverse effects for socioeconomic values or public services (BLM 2000a, page 4-212). If additional economic activities are not in place at the end of the Proposed Action, then there is the potential for residual impacts to income levels, housing, public finance, the economy, and employment.

4.8.3.5 No Backfill Alternative

Socioeconomic and public service impacts from the No Backfill Alternative are identical to those described for the Proposed Action. The No Backfill Alternative would require the same number of short-term contractors (up to 50) as the Proposed Action and would continue to employ the 450-500 existing CGM employees for an additional seven years beyond the South Pipeline Project.

4.8.3.5.1 Socioeconomic Effects

Impacts to socioeconomic values resulting from implementation of the No Backfill Alternative would be the same as those described for the Proposed Action.

4.8.3.5.2 Residual Adverse Impacts

No residual adverse effects would be associated with the No Backfill Alternative. If additional economic activities are not in place at the end of the Proposed Action, then there is the potential for residual impacts to income levels, housing, public finance, the economy, and employment.

4.8.3.6 Complete Backfill Alternative

Socioeconomic and public service impacts from the Complete Backfill Alternative are similar to those described for the Proposed Action. However, for this analysis it is assumed that the Complete Backfill Alternative would continue to employ approximately 50 of the existing CGM employees for one additional year beyond the seven years specified in the Proposed Action. In addition, CGM has a commitment to work with other companies in the Study Area and the affected counties and communities to minimize impacts to those communities as the mines close down (see Section 2.10).

4.8.3.6.1 Population Effects

The Complete Backfill Alternative would have a beneficial effect of maintaining population stability in the Study Area by providing an additional seven years of employment to current staff (450-500 employees) and an eighth year of employment to a portion of the staff (approximately 50). By utilizing the existing CGM work force, the Proposed Action would not induce substantial growth or concentration of population and would not create a substantial demand for public services.

Impact 4.8.3.6-1: Implementation of the Complete Backfill Alternative would continue employment of CGM's existing work force for an additional seven years and a portion of the workforce for an eighth year, thus maintaining population stability in the Study Area.

Significance of the Impact: This would be a beneficial impact of the Complete Backfill Alternative, and no mitigation measures would be required.

4.8.3.6.2 Employment Effects

At least seven years of continued employment in the mining industry, one of the highest paying industries in the area, would be a positive benefit to the Study Area. In addition, CGM has a commitment to work with other companies in the Study Area and the affected counties and communities to minimize impacts to those communities as the mines close down (see Section 2.10).

Impact 4.8.3.6-2: Implementation of the Complete Backfill Alternative would continue long-term employment for the existing CGM work force (450-500) and an additional year for a portion of the current work force. The No Backfill Alternative would continue to employ current CGM employees for an additional eight years, resulting in a continuance of indirect employment, as well as direct and indirect spending in the Study Area and the state.

Significance of the Impact: These would be beneficial impacts of the Complete Backfill Alternative. No adverse impact due to increased short-term and continued long-term employment opportunities would be expected, and no mitigation measures would be required.

4.8.3.6.3 Housing Effects

Housing and rental unit occupancy would be extended for an additional year based on implementation of the Complete Backfill Alternative. This would be a beneficial impact similar to the Proposed Action.

4.8.3.6.4 Public Service Effects

Implementation of the Complete Backfill Alternative would have the same impacts as the Proposed Action for seven years. In the eighth year, a decline in demand for services would occur; thus, no additional impact would be associated with the Complete Backfill Alternative.

4.8.3.6.5 Fiscal Effects

The Fiscal impacts of implementing the Complete Backfill Alternative are identical to those described for the Proposed Action.

4.8.3.6.6 Residual Adverse Impacts

No residual adverse effects would be associated with the Complete Backfill Alternative. If additional economic activities are not in place at the end of the Proposed Action, then there is the potential for residual impacts to income levels, housing, public finance, the economy, and employment.

4.9 Environmental Justice

4.9.1 Regulatory Framework

On February 11, 1994, President William Clinton issued Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. This Executive Order was designed to focus the attention of federal agencies on the human health and environmental conditions in minority communities and low-income communities. In an accompanying Presidential memorandum, the President emphasized that existing laws, including NEPA, provide opportunities for federal agencies to address environmental hazards in minority and low-income communities. In April of 1995, the EPA released the document titled Environmental Justice Strategy: Executive Order 12898. The document established EPA-wide goals and defined the approaches by which the EPA would ensure that disproportionately high and adverse human health or environmental effects on minority communities and low-income communities are identified and addressed.

4.9.2 Affected Environment

4.9.2.1 Study Methods

The baseline data presented below are based upon information from the South Pipeline Final EIS (BLM 2000a, pages 4-212 through 4-214), the Pipeline Final EIS (BLM 1996a, pages 3-45 through 3-52), and its precursor, the Cortez Gold Mine Expansion Project Draft EIS (BLM 1992, pages 3-47 through 3-51). Discussion of existing socioeconomics are incorporated by reference. New and supplemental socioeconomics data information obtained from a variety of state and federal sources including the 1990-2000 U.S. Census; U.S. Department of Commerce, Bureau of Economic Affairs; and the Nevada State Demographer have been added.

The study area for environmental justice effects includes the Project Area, as well as portions of Elko, Eureka, and Lander Counties. As discussed in the Pipeline/South Pipeline Final EIS, this study area was defined based on the fact that employees may live up to 70 miles from the Project Area, with approximately 60 percent living in the Elko/Spring Creek area, 15 percent in Crescent Valley and Beowawe, 11.5 percent in Battle Mountain, and eight percent in Carlin (see Section 4.8.2.1).

4.9.2.2 Existing Conditions

4.9.2.2.1 Minority Population

Table 4.8.3 summarizes the ethnic composition of study area counties and communities and the State of Nevada. Most notable is the higher percentage of American Indian, Eskimo, or Aleut in the study area compared to the State of Nevada. For Nevada, the American Indian, Eskimo, or Aleut population constituted approximately one percent of the total. However, in the study area, the percentages were five, four, and two percent for Elko County, Lander County, and Battle Mountain respectively.

In accordance with the EPA's Environmental Justice Guidelines (EPA 1998), these minority populations should be identified when either:

- The minority population of the affected area exceeds 50 percent; or
- The minority population of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

Although the population of American Indians does not exceed 50 percent, the population of American Indians occurring in portions of the study area is "meaningfully greater" than the minority population in the general population, in this case the State of Nevada. Therefore, for the purposes of screening for environmental justice concerns, a minority population, as defined in the EPA's guidance (EPA1998), exists within the study area.

The White population in the study area is also much higher than for the State of Nevada, with the study area counties and communities each having White populations that comprise more than 70 percent of the total population. In comparison, the State of Nevada has a White population comprising 65 percent of the total. However, the study area has much lower populations of Blacks and Asian or Pacific Islanders compared to the State of Nevada. The remainder of the study area has a comparable proportion of Other Race, Hispanic, and Two or More Races to the state. This population is not considered "meaningfully greater" than the minority population in the general population and is not considered a minority population as defined in the EPA's guidance (EPA 1998).

4.9.2.2.2 Low-Income Population

Except for Eureka County and Battle Mountain, the median household incomes for the population living in the study area are substantially higher than those in the State of Nevada (see Table 4.8.4). Analysis of the percentage of persons below the poverty level for the State of Nevada and study area counties and communities reveals that a higher incidence of poverty occurs for in Eureka and Lander

Counties (see Table 4.8.5). However, of any significant ethnic population in the study area, the incidence of poverty tended to be higher for the American Indian, Eskimo, or Aleut population living in Carlin, Lander County, and Battle Mountain. The percentage of American Indians within the American Indian, Eskimo, and Aleut groupings in Carlin, Lander County, and Battle Mountain were 93, 100, and 100, respectively. Lander County, where the Project is planned to be located, also had the lowest per capita income of the study area. This data indicates that American Indians are a low-income population group, as defined in the EPA's guidance (EPA 1998), for the purposes of screening for environmental justice concerns.

4.9.2.2.3 Protection of Children

The Environmental Justice analysis includes a protection of children component to determine if the Proposed Action would place an undue burden on children. Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks (April 27, 1997) recognizes a growing body of scientific knowledge that demonstrates that children may suffer disproportionately from environmental health risks and safety risks. These risks arise because 1) children's bodily systems are not fully developed, 2) children eat, drink, and breath more in proportion to their body weight, 3) their size and weight may diminish protection from standard safety features, and 4) their behavior patterns may make them more susceptible to accidents. Based on these factors, the President directed each federal agency to make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children. The President also directed each federal agency to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks and safety risks.

In 2000, the Beowawe and Crescent Valley area 482 individuals of whom 26 (five percent) were less than five years of age and a total of 131 individuals (25 percent) were less than 20 years of age. Both figures are less than the State of Nevada averages (Table 4.8.2).

4.9.3 Environmental Consequences and Mitigation Measures

4.9.3.1 Significance Criteria

EPA's Guidance For Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses (EPA 1998) suggests a screening process to identify environmental justice concerns. This two-step process defines the significance criteria for this issue; if either criteria is unmet, there is little likelihood of environmental justice effects occurring. The two-step process is as follows:

(1) Does the potentially affected community include minority and/or low-income populations?

(2) Are the environmental impacts likely to fall disproportionately on minority and/or low-income members of the community and/or tribal resource?

If the two-step process discussed under Study Methods indicates that there exists a potential for environment justice effects to occur, the following analyses are conducted to consider the following:

- whether there exists a potential for disproportionate risk of high and adverse human health or environmental effects;

- whether communities have been sufficiently involved in the decision-making process; and
- whether communities currently suffer, or have historically suffered, from environmental and health risks and hazards.

4.9.3.2 Assessment Methodology

The socioeconomic characteristics of the study area counties and communities are first analyzed for the presences of minority and/or low-income populations. Second, if minority and/or low-income populations are identified based on the EPA's *Environmental Justice Guidelines* (EPA 1998), the project and alternatives are evaluated for potential effects which may be expected to disproportionally impact any such populations. If the two-step process above indicates that a potential for environmental justice effects exists, additional analyses under the significance criteria are then applied to determine if the adverse effects would be considered significant impacts if the Project or an alternative were implemented.

4.9.3.3 Proposed Action

4.9.3.3.1 Environmental Justice Effects

Initial analysis concluded that the potential effects of the Proposed Action under any of the proposed stages of development would not be expected to disproportionately affect any particular population. The area in the immediate vicinity of the proposed Project is sparsely inhabited, the nearest residence located approximately five miles to the southwest. The nearest residential area is located in the town of Crescent Valley, approximately 13 miles northeast of the Project area. Crescent Valley does not have an unusually high minority or low-income population, but does have a substantially greater proportion of Whites compared to the rest of the study area and the state (see Table 4.8.3). Environmental effects that may occur at a greater distance, such as auditory resource or air impacts, would affect the area's population equally, without regard to nationality or income level.

However, a second provision of this criteria requires consideration of "impacts that may affect a cultural, historical, or protected resource of value to an Indian tribe or a minority population, even when the population is not concentrated in the vicinity." According to Section 4.11 of the South Pipeline Final EIS (BLM 2000a, pages 4-144 through 4-148), no traditional cultural properties or E.O. 13007 (Executive Order on the Indian Sacred Sites) sites have been identified within the Project Area that might be impacted by the Proposed Action or any of the alternatives. Therefore, there are no impacts associated with the Proposed Action on traditional Native American concerns.

On the basis of the second part of the criteria, the Proposed Action would not result in a disproportionate effect on a minority population. Because there is no disproportionate effect on an identified minority population as a result of the Proposed Action, no further environmental justice analyses are required.

4.9.3.3.2 Residual Effects

There are no residual adverse effects associated with the Proposed Action.

4.9.3.4 Complete Backfill Alternative

4.9.3.4.1 Environmental Justice Effects

The environmental justice impacts associated with the Complete Backfill Alternative are similar to the Proposed Action.

4.9.3.4.2 Residual Effects

There are no residual adverse effects associated with the Complete Backfill Alternative.

4.9.3.5 No Backfill Alternative

4.9.3.5.1 Environmental Justice Effects

The environmental justice impacts associated with the No Backfill Alternative are similar to the Proposed Action.

4.9.3.5.2 Residual Effects

There are no residual adverse effects associated with the No Backfill Alternative.

4.9.3.6 No Action Alternative

4.9.3.6.1 Environmental Justice Effects

There are no environmental justice impacts associated with the No Action Alternative.

4.9.3.6.2 Residual Effects

There are no residual adverse effects associated with the No Action Alternative.

4.10 Wildlife and Fisheries Resources

4.10.1 Regulatory Framework

This section discusses the laws, regulations, guidelines, and procedures that apply to management of wildlife and fisheries resources potentially affected by the Project.

4.10.1.1 BLM/NDOW Memorandum of Understanding

Wildlife and fisheries resources and their habitat on public lands are managed cooperatively by BLM and NDOW under a Memorandum of Understanding (MOU) as established in 1971. The MOU describes the BLM's commitment to manage wildlife and fisheries resource habitat, and NDOW's role in managing populations. The BLM meets its obligations by managing public lands to protect and enhance food, shelter, and breeding areas for wild animals. NDOW assures healthy wildlife numbers through a variety of management tools including wildlife and fisheries stocking programs, hunting and fishing regulations, land purchases for wildlife management, cooperative enhancement projects, and other activities.

4.10.1.2 Nevada Department of Wildlife Programs

The NDOW is the state agency responsible for the restoration and management of fish and wildlife resources within the state. NDOW administers state wildlife management and protection programs as set forth in Nevada Revised Statutes (NRS) Chapter 501, Wildlife Administration and Enforcement, and NAC Chapter 503, Hunting, Fishing and Trapping; Miscellaneous Protective Measures. NRS 501.110 defines the various categories of wildlife in Nevada, including protected categories. NAC 503.010-503.080, 503.110, and 503.140 list the wildlife species currently placed in the state's various legal categories, including protected species, game species, and pest species.

4.10.1.3 Special Status Species

Species in need of additional management and protection are termed special status species because of declining numbers or loss of habitat. These animals are protected under provisions of the Endangered Species Act of 1973, as amended (ESA) or the Nevada BLM sensitive status (BLM Manual 6800 et seq.), as explained in The South Pipeline Final EIS (BLM 2000a, pages 4-117 and 4-118). In addition, the BLM has incorporated, in part, a Nevada State Protected Animal List (NAC 501.100 - 503.104) into the sensitive species list.

4.10.1.4 Migratory Bird Treaty Act

Migratory bird means any bird listed in the 50 Code of CFR 10.13. All native birds commonly found in the United States, with the exception of native resident gallinaceous birds, are protected under the provisions of the Migratory Bird Treaty Act (16 USC 701-718h). Under this act, nests with eggs or the young of migratory birds may not be harmed, nor may any migratory birds be killed. Measures to prevent bird mortality must be incorporated into the project design.

4.10.1.5 Bald Eagle Protection Act

The Bald Eagle Protection Act (PL 92-535) provides federal protection to the bald eagle (*Haliaeetus leucocephalus*). Amendments to the Bald Eagle Protection Act provide additional federal protection to the golden eagle (*Aquila chrysaetos*). The act prohibits the direct or indirect take of an eagle, eagle part or product, or nest. The golden eagle is not listed under the ESA as a threatened or endangered species; however, it is a protected species under the provisions of this act.

4.10.2 Affected Environment

The Project Area is a semi-enclosed basin with no wetlands, riparian areas, or forested lands. The dominant vegetation is shadscale/budsage.

4.10.2.1 Study Methods

The information made available during the scoping process for this SEIS (Geomega 2003a; Geomega 2003b) determined that the potential impacts to the water resources of the southern portion of Crescent Valley include a lowering of the water table at a greater distance from the open pit than that analyzed in the previous EIS (BLM 2000a). Sections 4.3.3.3 through 4.3.3.6 describe the potential water table drawdown effects resulting from the Proposed Action and the Alternatives. As a result of water table drawdown, additional springs may be impacted by the Proposed Action and Alternatives analyzed in this SEIS than those analyzed in the previous EIS (BLM 2000a). Due to the potential decrease in flows from the springs, potential impacts to these springs could include a change in vegetation and habitat for wildlife that utilize the springs. Therefore, this section of the SEIS focuses on those potential impacts to wildlife habitat that result from water table declines in the vicinity of the springs affected by the Proposed Action and Alternatives. Other potential impacts to wildlife resources were identified and discussed in the previous EIS and are incorporated herein by reference (BLM 2000a, pages 4-126 through 4-138).

A screening-level ecological risk assessment (SLERA) has been completed for the Proposed Action (Geomega 2004b). The objective of the SLERA was to characterize potential wildlife exposure and risk to metal constituents in a pit lake that is predicted to form in the expanded and partially backfilled Pipeline/South Pipeline open pit when dewatering ceases. The SLERA is a companion to the groundwater flow model and pit lake chemistry assessment for the Proposed Action (Geomega 2003a, 2003b). This SLERA updates the previous ecological risk assessment for the South Pipeline open pit (EVS 1998).

The existing condition for wildlife resources was determined utilizing baseline data collected by the NDOW (NDOW 1997a; 1997b), JBR (JBR 1995a; 1995b; 1996; 1997a; 1997b; 1997c), and wildlife information contained in the South Pipeline Project Final EIS (BLM 2000a, pages 4-126 through 4-138), which are incorporated herein by reference.

4.10.2.2 Existing Conditions

4.10.2.2.1 Wildlife

The existing condition for wildlife resources is described in the South Pipeline Final EIS (BLM 2000a, pages 4-127 and 4-128) and is incorporated herein by reference.

4.10.2.2.2 Fisheries and Aquatic Resources

The existing condition for fisheries and aquatic resources is described in the South Pipeline Final EIS (BLM 2000a, page 4-128) and is incorporated herein by reference.

4.10.2.2.3 Special Status Species

The existing condition for special status species is described in the South Pipeline Final EIS (BLM 2000a, pages 4-128 through 4-131) and is incorporated herein by reference.

From 1994 through 1996 springsnails of the genus *Pyrgulopsis* were listed by the USFWS as Candidates; however, the USFWS no longer includes springsnails in its Candidate list. Instead, the BLM now lists seven snails, including four species within the genus *Pyrgulopsis,* as Sensitive. None of the BLM Sensitive springsnails occur within the geographic range of the Project Area. A survey of the seeps and springs in the area was conducted by JBR (1995a) in December 1994 in response to a request by the USFWS during preparation of the Pipeline Project FEIS. A discussion of the results of that survey in the Pipeline Project FEIS (BLM 1996a; pages 3-40 through 3-42) is incorporated herein by reference. The survey documented the location of a population of *Pyrgulopsis* (red rock springsnail) at a single location in the high elevation section east of the Project Area. The host spring is outside the potential drawdown zone area (Geomega 2003a). A second survey was conducted in May 1997 (JBR 1997b) of springs that were previously inaccessible or not previously surveyed, which were thought to be within the potential drawdown zone. No additional springsnail populations were found during the 1997 survey.

4.10.3 Environmental Consequences and Mitigation Measures

4.10.3.1 Significance Criteria

Based upon NEPA guidelines and commonly accepted criteria, a project would normally be considered to have a significant effect on wildlife resources if it could:

- Substantially disturb critical wildlife habitat;
- Cause the loss of a species or habitat afforded protection under either the ESA or state law; or designated as having special status (e.g., Species of Concern, Sensitive Species, etc.) by an overseeing agency;
- Cause loss of birds or nests with eggs protected by the Migratory Bird Treaty Act;
- Eliminate a natural plant community from the Project Area;
- Result in acute or chronic toxicity resulting from exposure to toxic materials in the tailings or heap leach facilities; or
- Cause destruction of active bat roosts or maternity sites.

4.10.3.2 Assessment Methodology

Potential effects on wildlife resources are described as direct or indirect, short-term (i.e., during the life of the Project) and long-term. Direct impacts are those that would result in the death or injury of an animal. Indirect impacts include the degradation of wildlife or fisheries habitat to the extent that population numbers decline. Short-term impacts are those that could occur during implementation of the Project. Long-term impacts are those occurring after dewatering activities are completed. The effects are determined to be significant or not significant based on the applicable significance criteria listed in Section 4.10.3.1.

4.10.3.3 Proposed Action

4.10.3.3.1 Water Table Drawdown

As discussed in Section 4.3.3.3, the mine dewatering system is expected to drawdown the ground water table in an area surrounding the open pit. The maximum extent of the ten-foot drawdown contour is a radius of approximately 8.5 to 9.5 miles beyond the pit area at ten years after the end of mining, based on ground water modeling results (Section 4.3.3.3.1). As described in Section 4.3.3.3 under the Proposed Action at ten years after the end of mining, drawdown in the basin fill aquifer of ten feet or more could extend to four East Valley springs, three Toiyabe Catchment springs, and an ephemeral stream in the Toiyabe Catchment area.

No sensitive species occur at the springs or stream listed above. Based on information in the 1993 Seep and Spring Survey Report by JBR, the Toiyabe Catchment springs support riparian vegetation. Additionally, spring 27-47-35-32 feeds into a wetland complex in a stream channel. Due to their scarcity, riparian habitats and wetland areas are critical habitat components for wildlife and support a high diversity of species relative to adjacent habitat.

Impact 4.10.3.3-1: Flows from these springs and stream are not expected to be impacted by pit dewatering for reasons stated in Sections 4.3.3.3 and 4.3.3.4. However, since more than ten feet of drawdown of the alluvial aquifer is predicted, the impacts to these springs and stream are considered to be potentially significant (Sections 4.3.3.3.1 through 4.3.3.3.4; Section 4.3.3.4.1). It follows that the impacts to these springs are potentially significant to wildlife resources since they may result in substantial disturbance to critical wildlife habitat. However, Mitigation Measure 4.3.3.3.1-2a establishes a monitoring program that is designed to detect reduced spring flows during mine operation and stipulates the development of methods of supplementing affected flows as described in the Integrated Monitoring Plan (WMC 1995b). In addition, Mitigation Measure 4.3.3.3.1-2b reduces the potential post-mining impacts to springs by restoring the historical yield of the springs (including the springs that feed the ephemeral stream).

Significance of the Impact: Therefore, potential impacts to wildlife habitat that is supported by spring flows would be below the level of significance.

4.10.3.3.2 Ecological Risk Assessment

In the problem formulation step of the SLERA, site characteristics, exposure opportunities, and chemical and biological information was integrated to generate a set of assessment endpoints, an ecological conceptual model, and an analysis plan. The assessment endpoints identified during problem formulation included the following: a) the survival and protection of growth, development and reproduction of populations of avian and mammalian species, including waterfowl, insectivorous birds, opportunistic raptors, and insectivorous mammals; and b) the survival, and protection of growth, development and reproduction of individual threatened and endangered species that may use the future pit lake habitats against adverse impacts due to metal constituent concentrations in surface water of the pit lake. Chemicals of potential concern (COPCs) identified in the problem formulation phase of the SLERA included aluminum, antimony, arsenic, barium, cadmium, chromium, copper, fluoride, manganese, lead, mercury (as methylmercury), selenium, thallium and zinc.

These COPCs were selected based primarily on the COPCs identified from the previous SLERA (EVS 1998). In addition, concentrations of COPCs were screened against available ecological screening benchmarks. No new COPCs were identified in the screening procedure.

Future habitats expected at the pit lake include the lake itself, a littoral and riparian zone, and the upland area, which includes the walls of the open pit. Five indicator species were identified to represent the kinds of exposure of wildlife species to COPCs and to provide a comprehensive update to the previous SLERA evaluation. Indicator species included these: mallard duck *(Anas platyrhynchos*), cliff swallow (*Hirundo pyrrhonota*), little brown bat (*Myotis lucifugus*), western grebe (*Aechmophorus occidentalis*), and bald eagle (*Haliaeetus leucocephalus*).

The analysis phase of the SLERA examines the two primary components of risk: exposure and effects. In the exposure analysis, exposure for each indicator species was estimated based on the deterministic dose model developed by EPA (1993). Exposure scenarios of receptors to COPCs were considered for a "mature" stage of pit lake development, and ingestion was considered the primary exposure pathway of receptors. COPC concentrations were estimated directly for water and sediment and indirectly for food through the use of biota-sediment accumulation factors (BSAFs). The toxicity reference values (TRVs) were derived to compare to the estimated dose of each receptor. TRVs are estimates of exposure levels below which unacceptable adverse effects are not expected to occur. Detailed review of toxicological databases was undertaken to select studies from which to derive TRVs that were based on phylogenically similar species exposed via similar routes of exposure (i.e., ingestion) and that measured toxicological endpoints comparable to the assessment endpoints identified in the SLERA. After the study No Observed Adverse Effect Levels (NOAELs) and Lowest Observed Adverse Effect Levels (LOAELs) were calculated, additional uncertainty factors were added to ensure that the TRVs represented conservative benchmarks against which exposure profiles of receptors could be confidently screened. Risks were characterized by comparing the exposure and effect values. This ratio is called a Hazard Quotient (HQ), which is the ratio of the exposure concentration to the effects concentration. For each receptor-COPC combination, upper bound and lower bound HQs were calculated to estimate the likelihood of ecological risk.

Both TRV_{NOAEL}s and TRV_{LOAEL}s were derived for each receptor-COPC combination. The TRV_{LOAEL}s and TRV_{NOAEL}s represent the upper and lower bounds, respectively, of potential effects to receptors due to exposure to COPC concentrations. In toxicity tests, the NOAEL represents the highest intake (or experimental oral dose) of a chemical administered during the toxicity study below which no observed adverse effects were observed in the individuals studied. The LOAEL, on the other hand, represents the lowest dose of a chemical administered during the toxicity study above which statistically significant sublethal adverse effects were observed. These types of toxicity tests result in the generation of two endpoints, but the relationship of stressor-response between the NOAEL and LOAEL is not known. Therefore, the TRV_{LOAEL} and TRV_{NOAEL} represent the upper and lower bounds, respectively, of effects concentrations with which to compare to the estimated dose.

When comparing dose to the TRVs, two sets of hazard quotients (HQs) were generated: an HQ_{LOAEL} and an HQ_{NOAEL}. If the HQ_{LOAEL} is greater than one, risk is likely to exist; an HQ_{NOAEL} of less than one indicates unlikely risk. However, an HQ_{NOAEL} above one and HQ_{LOAEL} below one indicates uncertainty with regard to potential risks to the receptor from exposure to a particular COPC. Where

HQ_{NOAEL} greater than one and HQ_{LOAEL} less than one for a particular COPC-receptor combination, an uncertainty analysis is performed to help guide risk management decisions.

The results of the risk characterization did not identify any COPCs predicted for the pit lake scenarios under the Proposed Action that are likely to cause ecological risk. HQ_{NOAELS} and HQ_{LOAELS} were below one for aluminum, antimony, arsenic, barium, cadmium, chromium, copper, lead, manganese, thallium and zinc, indicating that the reproduction, growth and survival of populations of avian and mammalian species that may use the future pit lake habitat are protected from adverse effects resulting from exposure to concentrations of these metals predicted for the pit lake system. HQ_{NOAEL}s were slightly above one for fluoride, selenium and mercury, but HQ_{LOAEL}s were below one and given that several conservative assumptions were made about receptor exposure, including bioavailability assumptions, and likely receptor area use, risks to receptors from exposure to these COPCs in the pit lake system are unlikely (Geomega 2004b).

The results of the updated SLERA differ from the previous risk assessment in part because recent developments in the field of ecological risk assessment have increased our understanding of the processes controlling bioaccumulation of metals by aquatic organisms. In the previous SLERA, it was assumed that metal concentrations in invertebrates and plants were directly proportional to surface water concentrations. This relationship was used to derive a set of bioconcentration factors. However, recent research has shown that the relationship between bioaccumulation of metals by aquatic organisms and the source of metals in the environmental media is species dependent; for sediment-dwelling invertebrates and macrophytic plants, tissue metal concentrations are more directly related to sediment concentrations. Therefore, a set of biota-sediment accumulation factors was derived to estimate receptor exposure to prey concentrations in this SLERA. The relationship between metal concentrations in invertebrates and plants resulting from pit lake conditions described in the updated SLERA more realistically reflect the biological processes that would occur in a pit lake (Geomega 2004b).

A major difference between this SLERA and the previous risk assessment was the assumption in this SLERA that a productive littoral zone could develop upon pit lake formation that is capable of supporting receptor populations. Although oligotrophic lakes typically have a minimal littoral zone associated with the lake habitat, the purpose of this risk assessment was to screen out constituents that do not have a potential for ecological risk. Thus, a number of conservative assumptions were made regarding the variety of exposure pathways of the receptors to assure that the risk assessment did not underpredict potential receptor risk (Geomega 2004b).

The predicted changes in evapoconcentration and resulting pit lake water quality under the potential Stage 8 and 9 push backs would result in an increase of solute concentrations of approximately three percent, which would result in only an average dose increase of 0.00007 mg/kg BW-dat of chromium and aluminum for avian and mammalian receptors (Geomega 2004a).Other solute concentrations would remain below levels corresponding to the maximum doses predicted in the updated SLERA. The slightly increased doses are still lower than NOAELs. Therefore the conclusions in the SLERA are consistent for the changes to the open pit configurations under Stages 8 and 9.

Impact 4.10.3.3-2: The results of the SLERA demonstrate that potential impacts from pit lake chemistry for the Proposed Action are not expected to result in adverse ecological effects to wildlife populations or individual threatened or endangered species that may be attracted to the pit lake. The SLERA was conducted in a conservative manner, and the results of the SLERA are expected to overestimate rather than underestimate potential risks associated with the pit lake habitat.

Significance of the Impact: Potential impacts to wildlife from use of the pit lake habitat would be below the level of significance.

4.10.3.3.3 Residual Adverse Impacts

No residual adverse impacts to wildlife resources would occur as a result of the Proposed Action.

4.10.3.4 No Backfill Alternative

4.10.3.4.1 Water Table Drawdown

Impacts to wildlife habitat from the No Backfill Alternative are generally the same as those described for the Proposed Action (Section 4.10.3.3). The No Backfill Alternative has the potential to impact one additional spring in the Toiyabe Catchment area.

4.10.3.4.2 Residual Adverse Impacts

No residual adverse impacts to wildlife resources would occur as a result of the No Backfill Alternative.

4.10.3.5 Complete Backfill Alternative

4.10.3.5.1 Water Table Drawdown

Impacts to wildlife habitat from the Pipeline Backfill Alternative are the same as those described for the Proposed Action (Section 4.10.3.3).

4.10.3.5.2 Residual Adverse Impacts

No residual adverse impacts to wildlife resources would occur as a result of the Complete Backfill Alternative.

4.10.3.6 No Action Alternative

4.10.3.6.1 Water Table Drawdown

Impacts to wildlife habitat under the No Action Alternative would be the same as those described and analyzed in the South Pipeline Final EIS (BLM 2000a; pages 4-133 through 4-138).

4.10.3.6.2 Residual Adverse Impacts

No residual adverse impacts to wildlife resources would occur as a result of the No Action Alternative

4.11 Relationship between the Local Short-Term Uses of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity

Short term is defined as the life of the Project through closure and reclamation. Long term is defined as the future beyond reclamation. Many of the impacts associated with the Proposed Action would be short term and would cease following successful reclamation. However, decreases in long-term soil and vegetation productivity in reclaimed areas are expected until the areas have fully recovered. Long-term soil and vegetation productivity under all alternatives is expected to be generally similar as under the Proposed Action.

4.12 Irreversible/Irretrievable Commitment of Resources

Construction and operation of the Project could result in either the irreversible or irretrievable commitment of certain resources. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over very long periods of time. Irretrievable is a term that applies to the loss of production, harvest, or use of natural resources. For example, livestock forage production from an area is lost while an area is serving as a mining area. The production lost is irretrievable, but the action is not irreversible. If the use changes and the mine is reclaimed, it is possible to resume forage production. Irreversible and irretrievable impacts of the Proposed Action are summarized in Table 4.12.1.

4.13 Energy Requirements and Conservation Potential

Energy for the Proposed Action would be supplied by electricity, propane, and diesel fuel. Electricity would be used to power all equipment in the process plant and ancillary facilities, pump water used in the operation, and provide lighting for mining and processing activities. The electrical load would be approximately 25 to 30 megawatts. Propane would be used to heat buildings, and approximately 622,593 gallons per year would be consumed. Diesel fuel would be used to power all mobile equipment and emergency back-up generators. About 70,000,000 pounds per year would be used. Life-of-Project consumption is presented below:

- Electricity - 1,264 Megawatt-hours
- Propane - 4,980,744 gallons
- Diesel Fuel - 366 million pounds

The only alternative that would have a substantial energy consumption different from the Proposed Action is the No Action Alternative.

Table 4.12.1: Irreversible and Irretrievable Commitment of Resources by the Proposed Action

Resource	Irreversible Impacts	Irretrievable Impacts	Explanation
Geology and Minerals	Yes	Yes	Mineral resources that are mined would no longer be available for future production.
Soils and Watershed	No	No	Soils from the open pit, waste rock dump, and heap leach facilities would be salvaged for use in the reclamation activities.
Water Resources	No	Yes	Water that is removed from the aquifer and used in the operations would not be available for other uses.
Air Resources	No	No	Emissions from the Project would not deteriorate the existing air quality of the air quality management area.
Range Resources	Yes	Yes	There would be a temporary loss of 352 Animal Unit Months (AUMs) throughout the life of the Project and a permanent loss of 36 AUMs.
Noxious Weeds	No	No	Successful reclamation and mitigation measures designed to exclude noxious weeds from the Project Area would result in no impacts.
Vegetation Resources	Yes	Yes	A total of 605 acres of vegetation would be lost as a result of the open pit development.
Wildlife and Fisheries Resources	Yes	Yes	A total of 605 acres of wildlife habitat would be lost as a result of the open pit development.
Visual	No	No	Impacts to visual resources would result from the expansion of the existing operations. Successful reclamation procedures at the end would return the visual continuity.
Auditory Resources	No	No	Noise is not considered irreversible because it would cease when mining operations cease.
Land Use, Access, and Public Safety	Yes	Yes	There would be irreversible and irretrievable impacts to public access and land use from the commitment of 605 acres to an open pit.
Recreation and Wilderness	No	No	The disturbance as a result of the open pit development would create a minimal loss of recreation area no loss or impacts to wilderness.
Socioeconomic Values	Yes	No	The economic wealth generated from the production and further use of the gold resources underlying the South Pipeline Project would be irreversible. The jobs, income, and taxes created over the life of the Project reflects irreversible resource commitment to achieve such production, but also represents a measure of economic benefits associated with the Project.