November). The average total phosphorus value near Rye Patch (0.09 mg/L as P) was less than the standard value (Table 3.2-20). Since phosphorous is typically associated with suspended particles in river flows, this result is consistent with the total suspended solids and turbidity results and likely reflects the settling of suspended particles in Rye Patch reservoir.

During the period of record, metal and semi-metal concentrations in the Humboldt River near Carlin and Rye Patch were typically near or below water quality standards (Table 3.2-20). In addition, most average constituent concentrations in the upstream river reach near Carlin were similar to average concentrations in the downstream reach near Rye Patch. The notable exceptions were arsenic and boron. Average arsenic concentrations increased from 7.2 µg/L near Carlin to 31 µg/L near Rye Patch. One dissolved arsenic measurement of 60 µg/L near Rye Patch exceeded the municipal or domestic supply standard of 50 µg/L. The average concentration of boron in the Humboldt River also increased from Carlin (150 µg/L) to Rye Patch (471 µg/L).

Humboldt Sink Water Quality. The Humboldt River terminates in the Humboldt Sink (Figure 1-6). The wetlands associated with the sink are characterized by extreme wet and dry cycles. From a historical perspective, prior to the upstream agricultural development, the wetland areas completely dried up during dry periods and spread out to encompass up to 20 square miles or more during wet periods. In addition, prior to agricultural development, the area of the wetlands is estimated to have averaged about 4.5 times greater than its present size (Seiler et al. 1993). Agricultural development resulted in the construction of dikes and drains along the lower Humboldt River that drained much of the wetlands for crops. Currently, the sink area consists of the Toulon Lake and upper and lower Humboldt Lakes. Water depths in the lakes typically range between 2 and 18 inches (Seiler et al. 1993).

The water quality of the Humboldt Sink wetland areas has been studied and monitored on an intermittent basis since 1987 jointly by the USGS and U.S. Fish and Wildlife Service (USGS 1991; Seiler et al. 1993; Seiler and Tuttle 1997). As stated in the 1993 report, these studies were initiated to "determine whether the quality of irrigation drainage in and near the Wildlife Management Area (WMA), Nevada, has caused or has potential to cause harmful effects on human health or fish and wildlife, or adversely affect the suitability of water for other beneficial uses" (Seiler et al. 1993). The studies concluded that arsenic, boron, mercury, molybdenum, sodium, un-ionized ammonia, selenium, and dissolved solids exceeded biological effects levels or Nevada standards for the protection of aquatic life. Causes of contamination were identified as irrigation drainage, hydrogeologic setting, and drought (Seiler et al. 1993; Seiler and Tuttle 1997). In addition, historic ore processing along the margin of the Humboldt Sink may be the source of some trace elements in the wetlands. Specifically, two mills located along the edge of what is now Toulon Lake operated from around 1915 through the 1920s. Both plants produced tungsten, and one later produced arsenic. Tailings from these operations could have been deposited or blown into what is now Toulon Lake (Seiler et al. 1993).

3.2.2 Environmental Consequences

The primary issues related to water resources include (1) reduction in surface and ground water quantity for current users and water-dependent natural resources due to mine-induced drawdown (mine dewatering and postmining pit lake development); (2) ground water or surface water quality impacts resulting from drawdown or infiltration; (3) water quality impacts associated with development of the pit lake in the postmining period; and (4) impacts to water quantity and water quality, flooding, erosion, and sedimentation in the Humboldt River resulting from direct mine discharge to the river. Impacts associated with mine drawdown, localized water management activities (such as infiltration), and postmining pit lake development are presented in Section 3.2.2.1; impacts to the Humboldt River resulting from discharge of excess mine water are addressed in Section 3.2.2.2.

3.2.2.1 Impacts from Mine Dewatering and Localized Water Management Activities

Hydrologic Study Area

The hydrologic study area for the assessment of impacts from mine dewatering and localized water management activities and pit lake development encompasses approximately 2,060 square miles and includes six designated ground water basins established by the Nevada Department of Water Resources (Figure 3.2-1). This hydrologic study area was selected to include the area potentially affected by drawdown and mounding and localized water management activities resulting from Barrick's Goldstrike Mine.

Dewatering and Infiltration Activities

The Goldstrike Mine dewatering and water management system components are described in Section 1.4. The Betze-Post Pit and Meikle Mine extend to depths below the regional ground water level. Dewatering is accomplished with a system of perimeter wells and in-pit wells, horizontal drains, and sumps designed to maintain water levels below the floor of the pit and underground mine as mining progresses.

Historic dewatering rates for the Goldstrike Mine through 1998 are presented in Figure 3.2-21 (Barrick 1999a). Ground water pumping for mine water supply was initiated at the Goldstrike Mine in 1987. Mine dewatering commenced in 1990 and will continue through the life of the Goldstrike Mine. Pumping rates have been variable and have ranged up to approximately 68,000 gpm (average rate for 3-month period). After active mining ceases, Barrick plans to continue pumping at a reduced rate for up to 10 years to provide for continued ore processing and reclamation activities. As of the end of 1998, a total volume of approximately 621,000 acre-feet of ground water had been pumped to achieve a maximum drawdown of over 1,500 feet (Table 3.2-21). Current plans are to continue to lower the ground water elevation in the vicinity of the mine to 3,576 feet amsl (drawdown of 1,689 feet). Once this target is reached, pumping would continue in order to maintain the ground water at the target elevation throughout the remaining mine life. At closure, the total pumped volume would be approximately 1,085,000 acre-feet with an estimated 645,000 acre-feet reinfiltrated to the ground water system through water management activities (including infiltration at ponds, injection, and infiltration during irrigation).

Impacts to Ground Water Levels

For this impact analysis, the area that is predicted to experience a change in ground water elevation of 10 feet or more from mine dewatering and mine water management activities was selected as the area of potential concern regarding impacts to water resources. Changes in the water table elevation of less than 10 feet generally were not considered in the analysis because these changes would probably be indistinguishable from natural seasonal and annual fluctuations in ground water levels.

Impacts to Date (1991 – 1998). Ground water levels have been closely monitored in the region surrounding the Goldstrike Mine. The monitoring results are presented in Barrick's Boulder Valley Monitoring Plan Quarterly Reports (Barrick 1999a) submitted to the Nevada State Engineer and the BLM. Areas of drawdown and mounding are determined by comparing the estimated and measured premine ground water elevations and the current ground water elevations measured at a series of monitoring wells.

The results of monitoring through the fourth quarter of 1998 were used to evaluate the ground water level changes to-date. As of the end of 1998, over 1,500 feet of drawdown had occurred in the vicinity of the Goldstrike Mine. As illustrated in Figure 3.2-22 (JBR 1990a; RTi 1994; Barrick 1999a), a cone of depression has formed around the project. The cone of depression exhibits a northwest-southeast elongation. In addition, the southwest margins of the cone appear to be controlled by one or more geologic barriers. The area with at least 10 feet of measured drawdown extends approximately 15 miles northwest-southeast and 5 miles northeast-southwest. Note that the 10-foot drawdown toward the south is not defined since Barrick's drawdown begins to merge or overlap with drawdown from Newmont's dewatering operations. This elongated northwest-oriented drawdown pattern is controlled in large part by removing water in storage within the

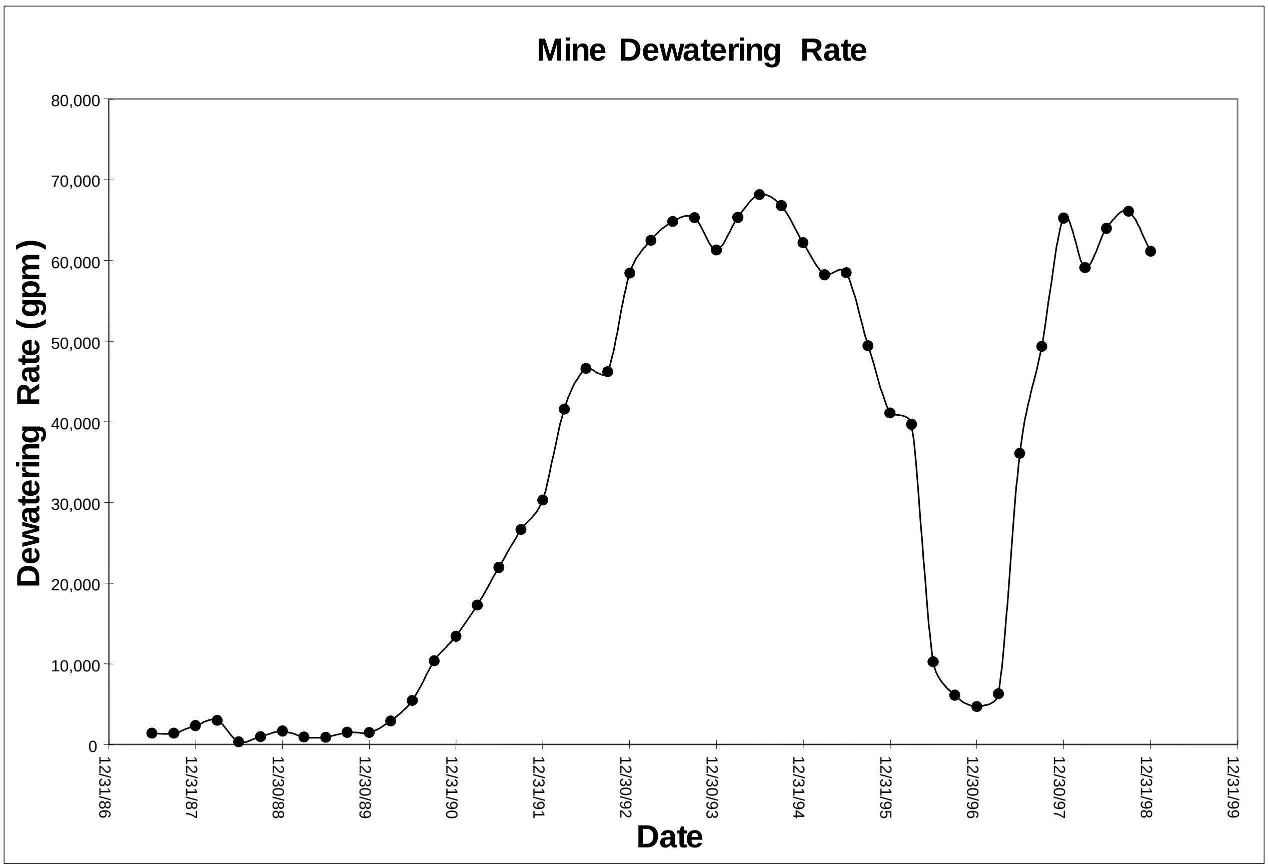
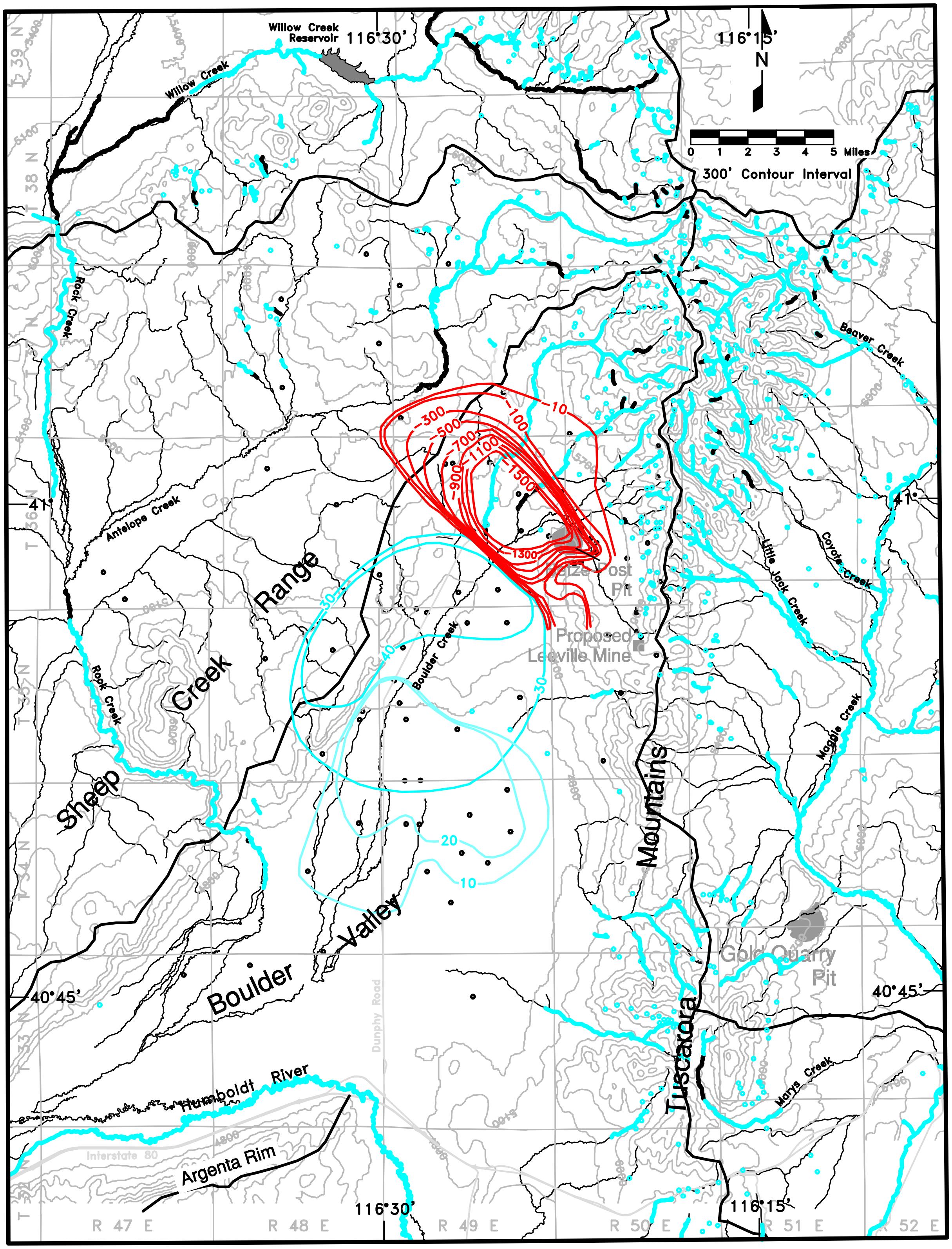


Figure 3.2-21

Barrick Pumping Rate



Legend

- Stream (Intermittent and Ephemeral)
- Road
- Perennial Streams and Springs
- Discontinuous Flowing Stream Reach ①
- Springs and Seeps
- Monitoring wells (Barrick Gold Mines Inc. 1999a)
- Water Level Decline in Area of Pumping in Feet
- Water Level Mounding in Area of Infiltration/Injection in Feet
- Water Level Mounding in Area of Irrigation in Feet

① During baseflow these stream segments are characterized by discontinuous flowing and dry reaches.

Figure 3.2-22

Drawdown and Mounding, End of 1998

Table 3.2-21
Elevations of the Regional Ground Water System, Drawdown, and Mounding at Selected Timeframes

Timeframe	Goldstrike Mine Area		TS Ranch Reservoir Area		
	Elevation (feet amsl)	Total Drawdown (feet)	Elevation (feet amsl)	Depth from Surface (feet)	Total Mounding (feet)
Estimated Premining Ground Water Surface	5,265[1]	0	4,704[2]	383	0
End of 1998 Ground Water Surface	3,738[3]	1,527	4,756[4]	331[3]	52
Planned or Projected End of Mining Ground Water Surface	3,576	1,689	NA	NA	NA

Source: Barrick 1999a.
[1]Based on Monitoring Wells SJ-144.
[2]Based on Monitoring Well NA-14.
[3]Based on Monitoring Wells PZ97-3.
[4]Barrick 1998c.
NA = not available.

carbonate rocks in the hydrologic compartment bounded between the Siphon and Post faults.

Infiltration and injection of excess mine water from the dewatering operations has resulted in an increase in water levels, or mounding, in upper Boulder Valley; this area of mounding is illustrated in Figure 3.2-22. As of the end of 1998, water levels in the Boulder Valley region had risen approximately 70 feet in the rhyolite in the Sheep Creek Range and 50 feet in the alluvium in upper Boulder Valley. Barrick currently plans to continue to infiltrate excess mine water in the upper Boulder Valley area through the end of mining.

Barrick began delivering water to the TS Ranch Reservoir in May 1990. Monitoring of discharge quantities and reservoir levels indicated that the reservoir was not filling as initially anticipated because of the appearance of the fracture described in Section 3.1. A large percentage of the water that flowed into the reservoir seeped through the fracture in the floor of the reservoir and flowed into the rhyolite formation. In 1992 and 1993, seepage from the reservoir apparently resulted in three new springs (Sand Dune, Knob, and Green springs) in the northeastern portion of Boulder Flat approximately 5 miles south of the TS Ranch Reservoir. The locations of TS Ranch Reservoir and Sand Dune, Knob, and Green springs are shown in Figure 3.2-1. Barrick continued to deliver water to the TS Ranch Reservoir, and the majority of the water infiltrated into the rhyolite formation underlying the reservoir until early 1996. Additional information on monitored flow from new springs is summarized later under the heading Impacts to Perennial Springs and Streams.

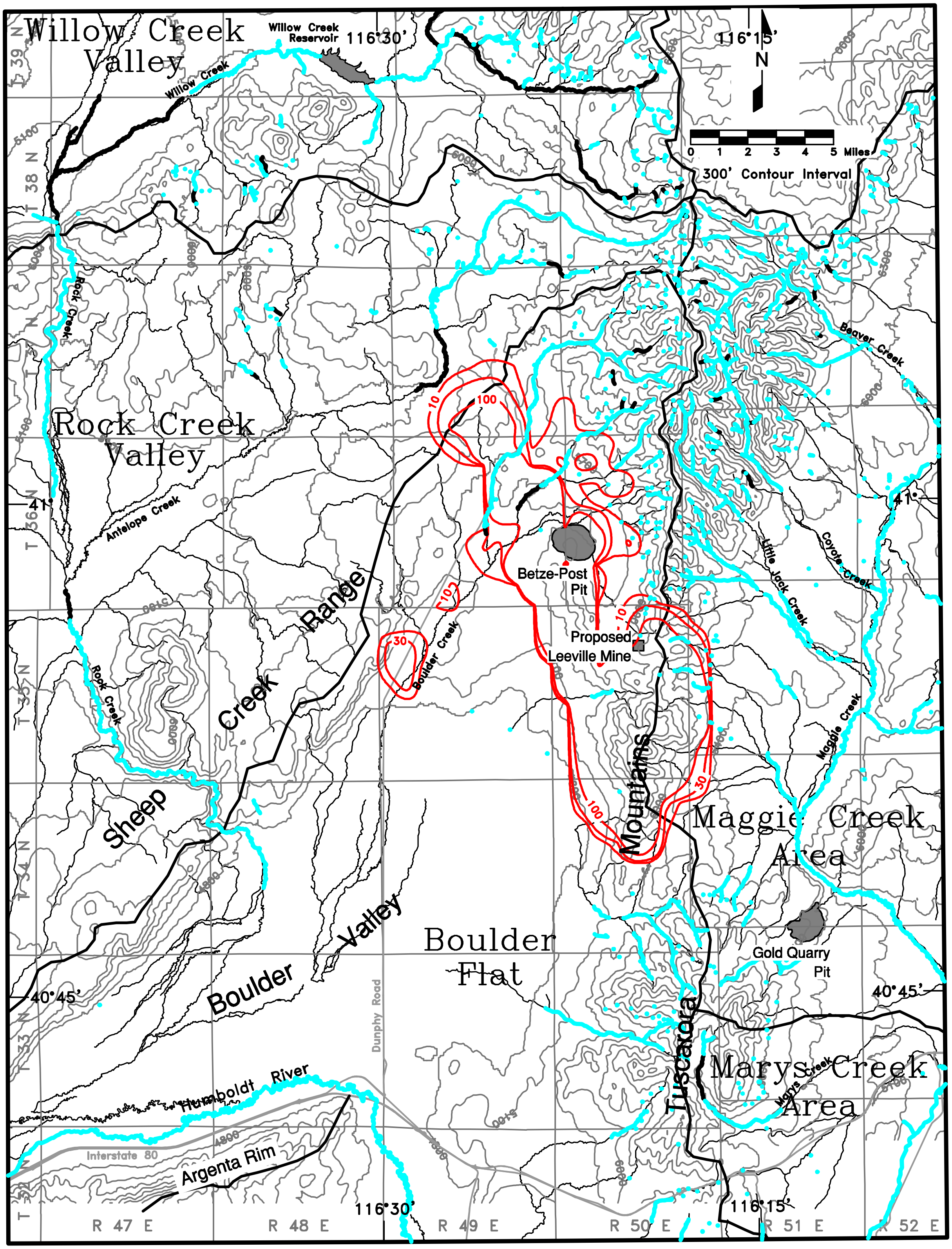
Predicted Future Impacts (Post-1998). Barrick's ground water modeling contractor, McDonald Morrissey Associates, Inc. developed a numerical ground water model that encompasses the regional hydrologic study area to predict changes in ground water levels resulting from dewatering and water management activities at the Goldstrike Mine through the end of mining and into the postmining period. Barrick's numerical model uses the USGS modular, three-dimensional, finite-difference ground water flow model MODFLOW (McDonald and Harbaugh 1988) to simulate mine dewatering and water management activities. The model design, modifications, calibration, simulations, and sensitivity analyses are presented in McDonald Morrissey Associates, Inc. (1998) and are summarized in Appendix D.

Actual hydrogeologic conditions throughout the model domain are complex; however, regional ground water flow models are based on a simplified conceptual understanding of the hydrostratigraphic and hydrostructural conditions, recharge and evapotranspiration processes, and ground water flow patterns. The model has been substantially revised, refined, and recalibrated on an annual basis since 1990. During this process, the model was revised to incorporate new hydrologic information. It should be noted that several of the key hydrologic features that currently control the patterns of drawdown and mounding (such as the Siphon Fault and Boulder Narrows Fault) were only identified after monitoring the effects of dewatering and infiltration activities over several years. Therefore, it is possible that other unknown or undetected conditions may exist, such as hydraulic barriers or zones of unusually high permeability, that could influence the future drawdown patterns, particularly in the post-dewatering period. For long-term predictions (several decades to hundreds of years), there is uncertainty regarding future climatic conditions. The model assumed that precipitation amounts and patterns observed over the last several decades are representative of future conditions. Despite these limitations, numerical models based on an accurate conceptual model of the hydrologic and hydrogeologic system, and calibrated to monitored steady state and transient ground water elevations, represent the best available tool for predicting the general areal extent, magnitude, and timing of drawdown and recovery that should be anticipated from Barrick's mine dewatering and water management activities.

Simulations of mine-induced drawdown resulting from the Goldstrike Mine for the end of mining, 50 years postmining, 100 years postmining, and at final steady state were evaluated to determine the relative maximum extent and timing of the drawdown cone (Figures 3.2-23, 3.2-24, 3.2-25, and 3.2-26, respectively). As shown in Figure 3.2-23 (Barrick 1998c), at the end of mining the drawdown area as defined by the 10-foot drawdown contour is predicted to extend approximately 7 miles northwest and approximately 12 miles south-southeast from the center of the Betze-Post Pit. Comparison of the three postmining periods indicates that the maximum extent of the 10-foot drawdown contour would expand after mining ceases and would reach a maximum extent approximately 100 years postmining. At 100 years postmining (Figure 3.2-25) (Barrick 1998c), the 10-foot drawdown contour is predicted to extend 11 miles northwest, 15 miles southeast, and up to 12 miles southwest from the center of the Betze-Post Pit. The expansion of the area of drawdown results in part from continual long-term passive inflow of ground water to the pit.

As described previously, in prior years a large percentage of the excess mine water was reinfiltrated into the ground water system because of seepage at the TS Ranch Reservoir and infiltration ponds and injection wells located in the northern portion of the Boulder Valley area. A water treatment and conveyance structure also was constructed to discharge excess water to the Humboldt River. The latter substantially reduced the amount of water infiltrating the rhyolite and alluvial aquifer systems in the Boulder Valley area through 1998. Under Barrick's current water management plans for 1999 through the end of mining, excess water would again be allowed to infiltrate to the rhyolite bedrock and alluvium, and no additional water would be discharged to the Humboldt River. Under this scenario, the area affected by ground water mounding would persist through the end of mining and would gradually dissipate in the postmining period.

Once dewatering operations cease, a pit lake would begin to develop in the Betze-Post Pit. The pit lake is predicted to attain 95 percent steady state (or equilibrium) conditions (Radian International, LLC and Baker Consultants, Inc. 1997a) at approximately 233 years postmining. After the pit lake level reaches equilibrium, the numerical ground water model predicts there would be a long-term drawdown cone that would persist for the foreseeable future. The area of this long-term residual drawdown, as shown in Figure 3.2-26 (Barrick 1998c), is predicted to extend approximately 7 miles northwest and 11 miles south-southeast from the center of the Betze-Post Pit. This permanent drawdown would be maintained by continuous inflow of ground water into the pit lake to replace water lost through evaporation (net loss of approximately 2,700 gpm).



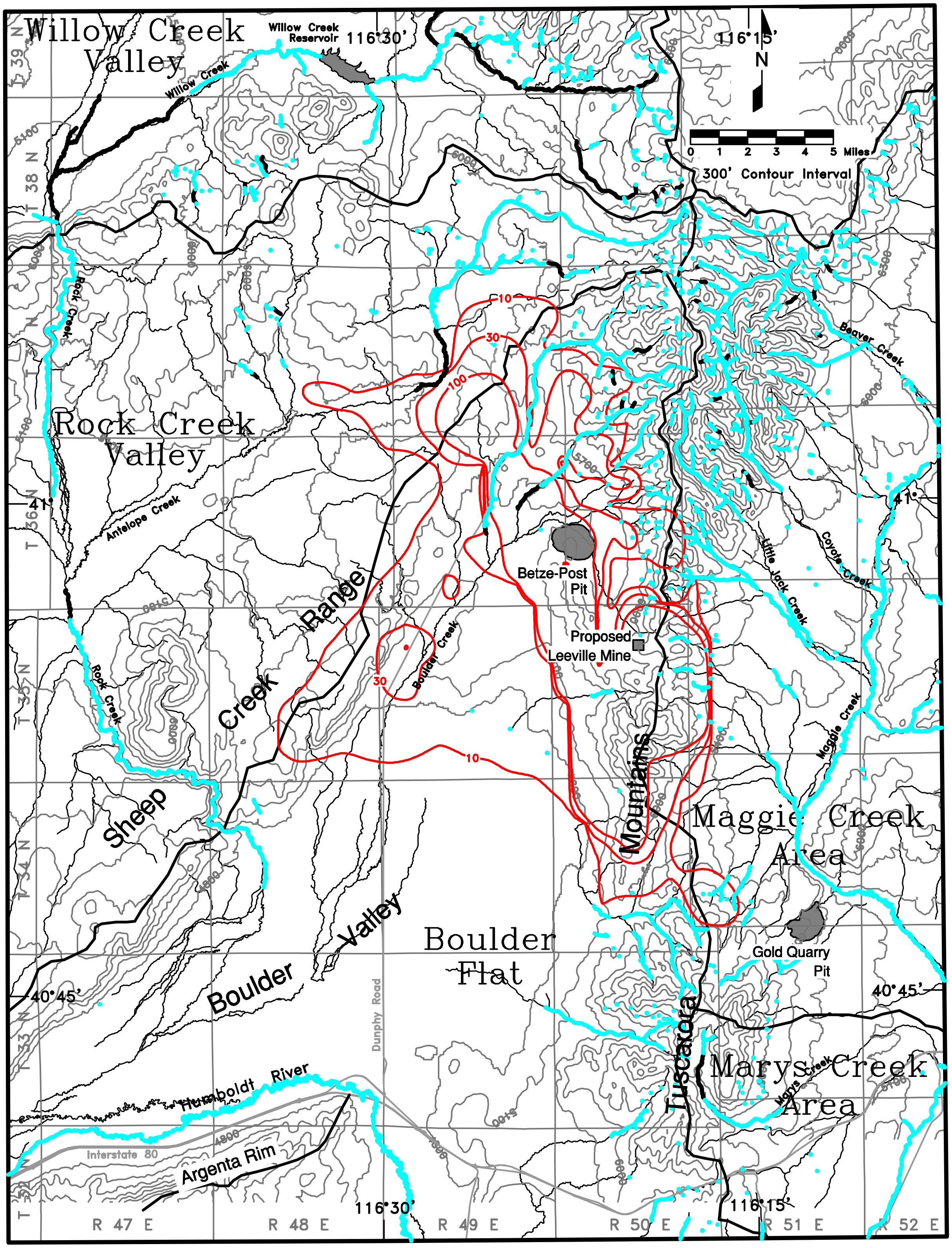
Legend

- Stream (Intermittent or Ephemeral)
- Road
- Perennial Streams and Springs
- Discontinuous Flowing Stream Reach ①
- Contour of Drawdown in Feet
- Ground Water Basin Boundary
- Springs and Seeps

① During baseflow these stream segments are characterized by discontinuous flowing and dry reaches.

Figure 3.2-23

Predicted Drawdown at End of Mining



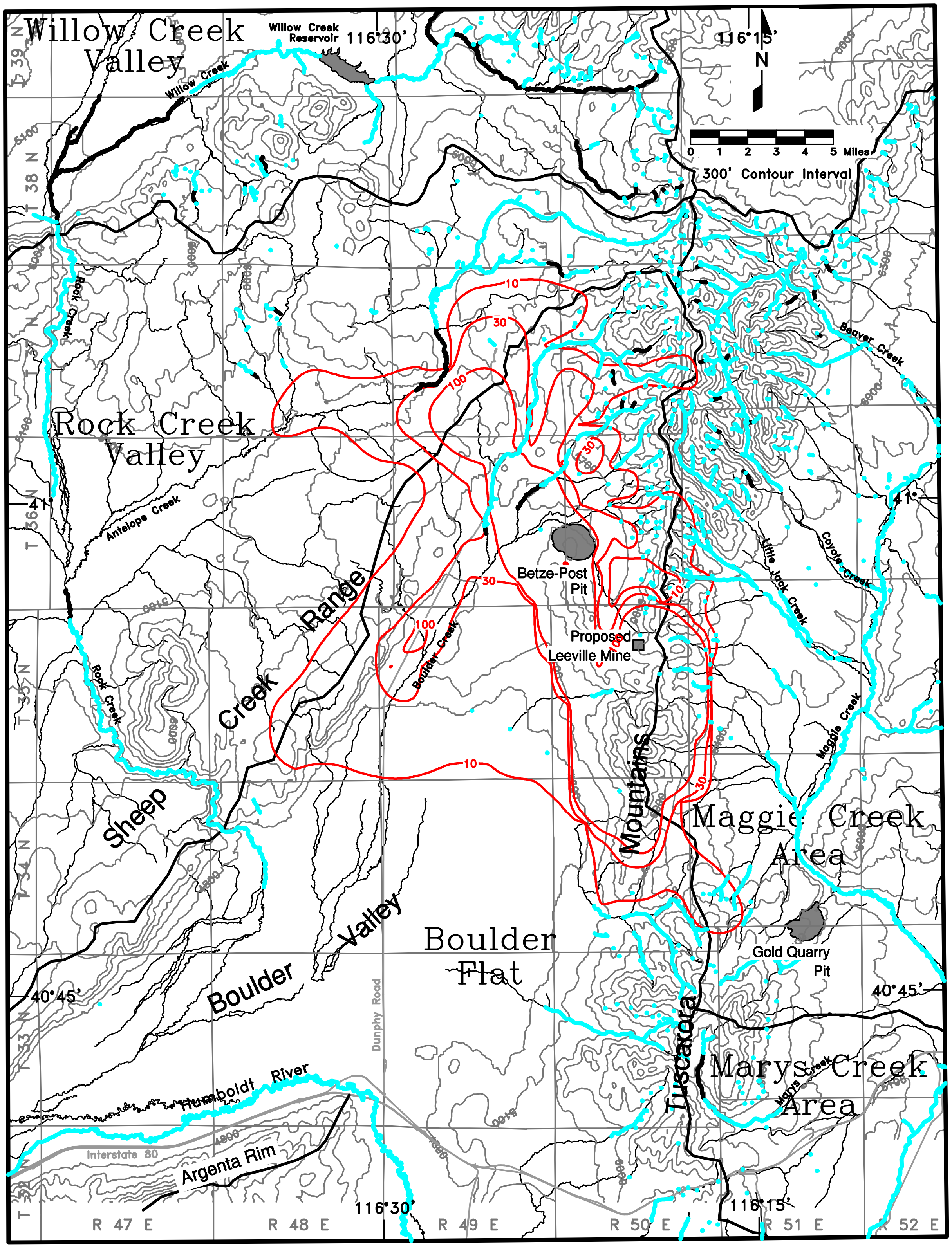
Legend

- Stream (Intermittent or Ephemeral)
- Road
- Perennial Streams and Springs
- Discontinuous Flowing Stream Reach (1)
- Contour of Drawdown in Feet
- Ground Water Basin Boundary
- Springs and Seeps

(1) During baseflow these stream segments are characterized by discontinuous flowing and dry reaches.

Figure 3.2-24

Predicted Drawdown at 50 Years Postmining



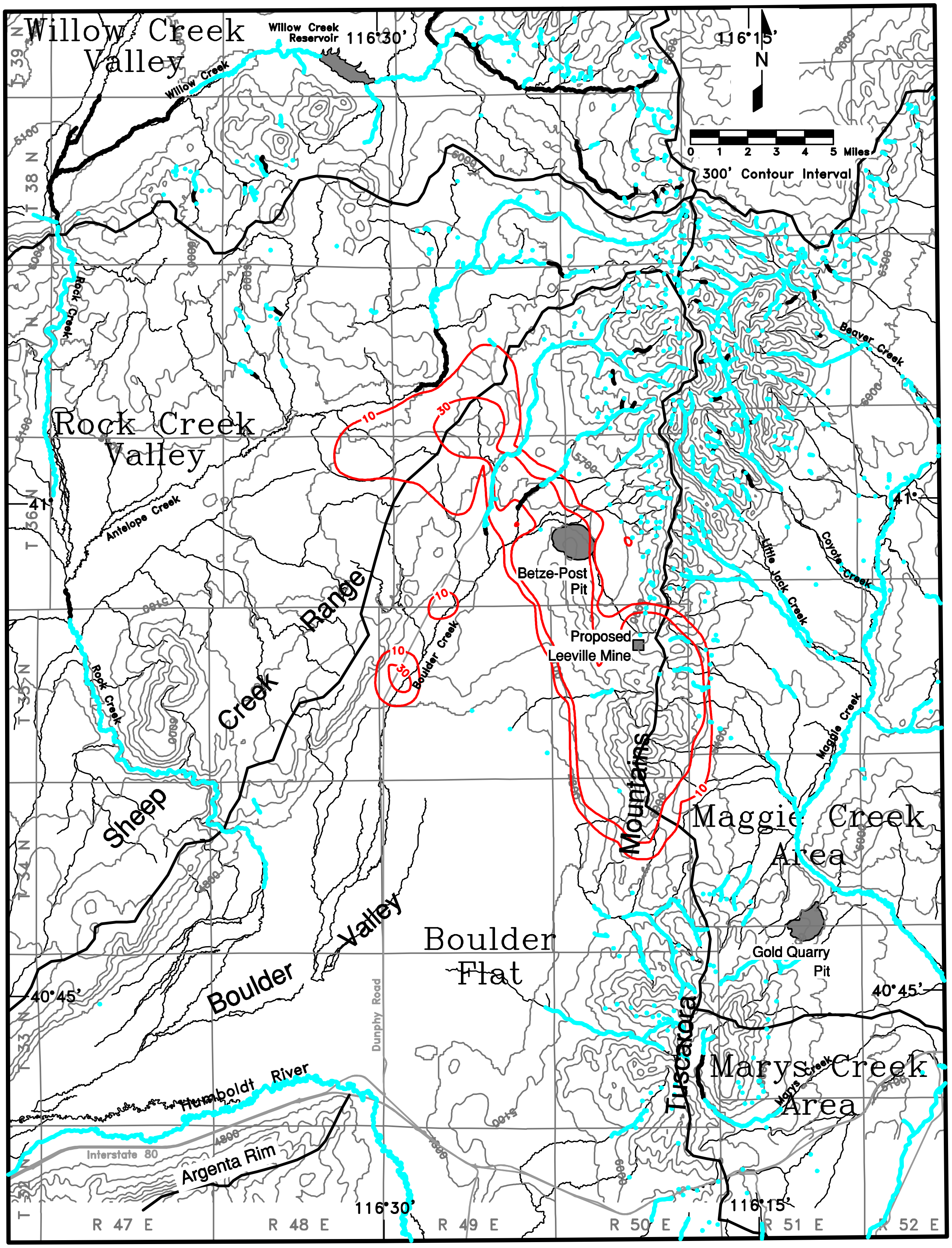
Legend

- Stream (Intermittent or Ephemeral)
- Road
- Perennial Streams and Springs
- Discontinuous Flowing Stream Reach (1)
- Contour of Drawdown in Feet
- Ground Water Basin Boundary
- Springs and Seeps

(1) During baseflow these stream segments are characterized by discontinuous flowing and dry reaches.

Figure 3.2-25

Predicted Drawdown at 100 Years Postmining



Legend

- Stream (Intermittent or Ephemeral)
- Road
- Perennial Streams and Springs
- Discontinuous Flowing Stream Reach (1)
- Contour of Drawdown in Feet
- Ground Water Basin Boundary
- Springs and Seeps

(1) During baseflow these stream segments are characterized by discontinuous flowing and dry reaches.

Figure 3.2-26

Predicted Drawdown at Recovery

Impacts to Perennial Springs and Streams

Drawdown from Barrick's Goldstrike Mine dewatering operations is lowering the ground water levels in the region surrounding the mine, as described above. In the vicinity of the projected drawdown area, the late summer to fall flows (or baseflow) in individual springs and perennial stream reaches are supported by discharge from either the regional ground water aquifer system or from more isolated or perched aquifers residing above the regional ground water system. A reduction in the ground water levels from mine-induced drawdown could potentially reduce the discharge to the perennial source and reduce the length of perennial reaches, eliminate springs, and reduce the associated riparian/wetland areas.

Impacts to Date (1991-1998). The conditions at selected stream sites have been monitored annually from 1991 through 1998 (Adrian Brown Consultants, Inc. 1991, 1993, 1994, 1995, 1996, 1997, 1998, and 1999). The annual seep and spring monitoring consists of measuring flow, collecting field water quality data, and water quality and isotopic sampling and analysis. This sampling has been expanded over time and as of 1998 consisted of 28 spring and 8 stream sites, as shown in Figure 3.2-27 (Adrian Brown Consultants 1999; Barrick 1999a). The area of drawdown as of the end of 1998 also is shown in Figure 3.2-22.

Springs located within the 1998 10-foot drawdown contour are listed in Table 3.2-22. As of the end of 1998, there were 13 identified spring sites located within the area having at least 10 feet of drawdown. As shown in Table 3.2-22, several of the monitored springs have either dried up or have had a reduction in flow. Springs JBR6 and JBR88 located along Boulder Creek west of the Betze-Post Pit had flows of 1.5 and 0.5 gpm, respectively, in 1989, but were dry from 1995 to 1998. Flow in spring JBR130 located in the upper Rodeo Creek watershed diminished from 4.3 gpm in 1989 to zero during the 1993 to 1998 monitoring period. The drying up of these three springs was probably caused by mine dewatering activities. Several other springs located both within and outside of the 1998 10-foot drawdown area have shown a reduction in flow. For example, in the Brush Creek watershed, the flow in spring JBR98 was reduced from 0.5 gpm in 1995 to 0.03 gpm in 1997 and then increased to 0.47 gpm in 1998. The flow of spring JBR100 was reduced from 0.2 gpm in 1991 to zero flow from 1995 to 1998. Spring JBR126 in the Rodeo Creek area has shown an irregular downward trend from 1991 to 1997 and then increased substantially in 1998 (Adrian Brown Consultants, Inc. 1999). Other springs with monitored flow reductions also are listed in Table 3.2-22. Although the cause of these flow reductions is not conclusive, some spring flows appear to correlate with annual precipitation variations, while other reductions in flow may be related to mine dewatering. In general, spring flows controlled by annual precipitation variations tend to correlate with annual (or multi-year below normal or above normal) precipitation patterns, whereas springs impacted by mine dewatering appear to show a reduction of flow (or dry up) irrespective of precipitation patterns. However, it is possible that some springs could be controlled by a combination of both mine drawdown and precipitation effects. It is also likely that springs other than those currently included in the annual monitoring program have been impacted by mine dewatering.

Noticeable leakage and subsequent discovery of a fracture in the floor of the TS Ranch Reservoir occurred in the summer of 1990. In May 1992, a spring (referred to as Sand Dune Spring) was discovered approximately 5.5 miles south of the reservoir on the eastern side of Boulder Valley. In October 1992, a second spring (referred to as Knob Spring) was discovered approximately 1.5 miles northwest of Sand Dune Spring. In April 1993, Green Spring was discovered approximately 1.5 miles northwest of Knob Spring.

These new springs are the result of seepage out of the TS Ranch Reservoir. The combined discharge from these springs initially increased over time. As of October 1993, the flow from Knob Spring and Sand Dune Spring merged approximately 1.5 miles downstream from where they first appeared. The combined spring discharge then flowed several miles farther downstream before the water infiltrated the alluvium in lower Boulder Valley. Green Spring

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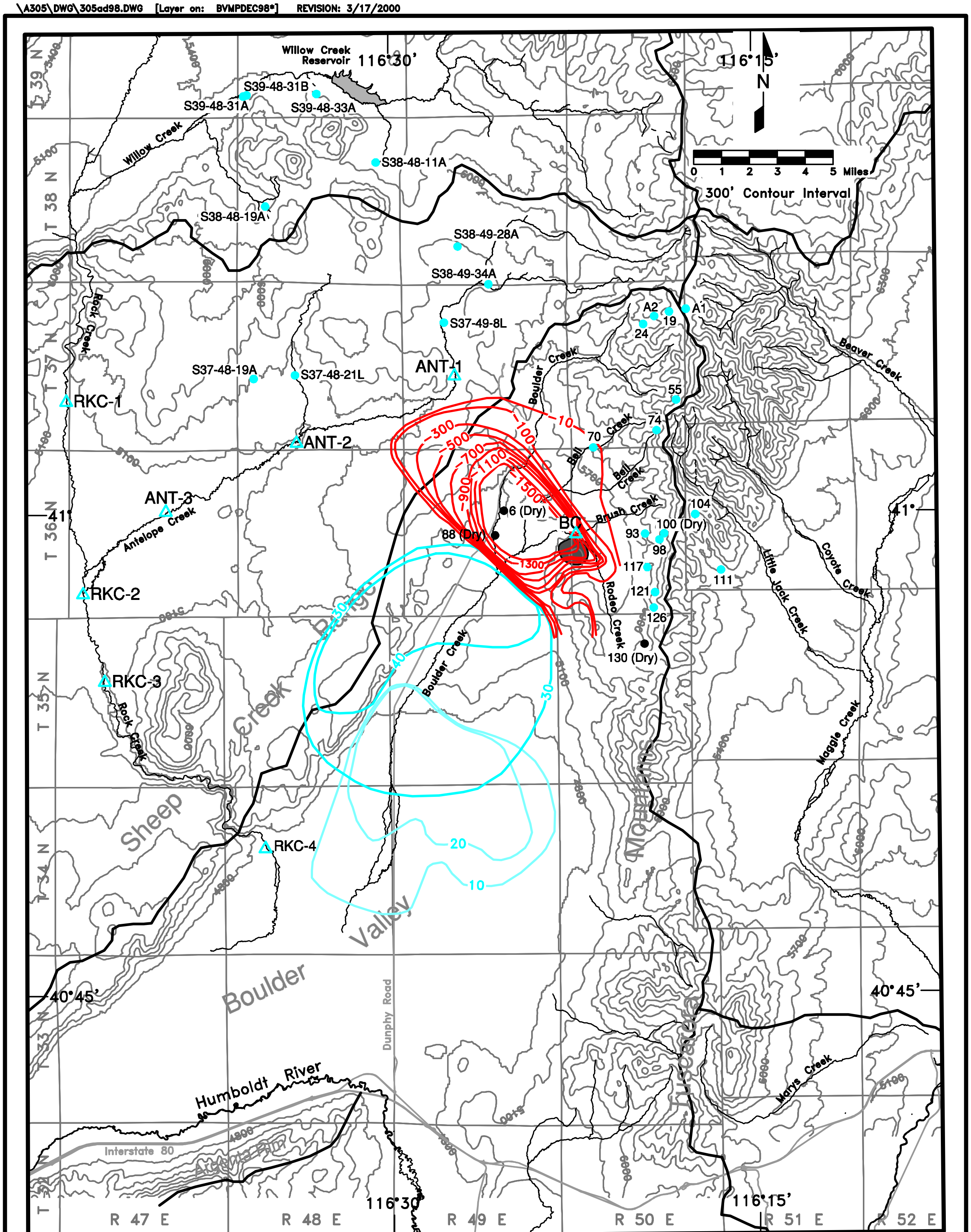

Legend

- Stream
- Road
- Ground Water Basin Boundary
- 130 Spring and Seep Sampling Site①
- RKC-4 Surface Water Monitoring Sites②
- Water Level Decline in Area of Pumping in Feet
- Water Level Mounding in Area of Infiltration/Injection in Feet
- Water Level Mounding in Area of Irrigation in Feet

① Adrian Brown's spring and seep monitoring site locations were modified according to JBR Consultants Group 1990a, and Riverside Technology, inc. 1994 spring locations.

② Adrian Brown's surface water monitoring site locations were modified according to Barrick Goldstrike Mines Inc. 1999a surface water sampling locations.

Figure 3.2-27

1998 Drawdown Relative to Annual Spring and Stream Monitoring Sites

Table 3.2-22
Springs Located Within or Near the Predicted Drawdown Area[1,2]

Spring and Surface Water Monitoring Site	Elev. (ft-amsl)	Flow Range (gpm)	Geochem. Data	Tritium Data	Year Last Measured	Springs Included in Annual Monitoring (X)	Apparent Monitored Flow Trend	Monitoried Drawdown	Predicted Drawdown			Likelihood of Impacts From Drawdown
								End of 1998	End of Mining	100-Yr Post-mining	Post Recovery Period	
Upper Antelope Creek / Squaw Creek Area												
SW37-49-08A (Antelope Creek)	5400	22			9/30/93			<10	<10	<10	<10	Low to Moderate
S37-49-8L	5420	172-0	X	X	98	X	Variable	<10	<10	<10	<10	Low to Moderate
S37-49-8B	5460	<1			93			<10	<10	<10	<10	Low to Moderate
S37-49-8A	5460	4			93			<10	<10	<10	<10	Low to Moderate
S37-49-5C	5460	1			93			<10	<10	<10	<10	Low to Moderate
S37-49-5A	5460	1-5			93			<10	<10	<10	<10	Low to Moderate
S37-49-5B	5460	1			93			<10	<10	<10	<10	Low to Moderate
S38-49-33M	5530	<1			93			<10	<10	<10	<10	Low to Moderate
S38-49-33L	5580	<1			93			<10	<10	<10	<10	Low to Moderate
SW37-50-05A (Antelope Creek below Squaw Creek Confluence)	5540	17			9/30/93			<10	<10	<10	<10	Low to Moderate
SW37-50-05B (Squaw Creek at confluence with Antelope Creek)	5550	20			10/1/93			<10	<10	<10	<10	Low to Moderate
S38-49-34A	5600	4.8-0.36	X	X	98	X	Variable	<10	<10	<10	<10	Low to Moderate
S37-49-3A	5600	<1			93			<10	<10	<10	<10	Low to Moderate
S38-49-34L	5600	NA	X	X	93			<10	<10	<10	<10	Low to Moderate
JBR7	6200	1.95			89			<10	<10	<10	<10	Low to Moderate
S37-49-15L	5800	32.6	X		93			<10	<10	30-100	~10	Moderate to High
Boulder Creek Area												
JBR88	5400	0.5-Dry	X		98	X	Dry Since 92	>1500	10-30	30-100	<10	High
JBR6	5400+B 42	1.5-Dry	X		98	X	Dry Since 92	>1500	>100	>100	>30	High
JBR5	5720	<1.0			89			<10	<10	10-30	<10	Moderate to High
JBR4	5680	<1.0			89			<10	<10	10-30	<10	Moderate to High
SW37-49-24A (Upper Boulder Creek)	5680	45	X		10/3/93			<10	<10	10-30	<10	Moderate to High
JBR3	5720	<1.0			89			<10	<10	10-30	<10	Low to Moderate
JBR2	5860	1.53			89			<10	<10	<10	<10	Low to Moderate
JBR1	5900	<1.0			89			<10	<10	10-30	<10	Low to Moderate
JBR32	5940	<1.0			89			<10	<10	<10	<10	Low to Moderate

Table 3.2-22 (Continued)
Springs Located Within or Near the Predicted Drawdown Area[1,2]

Spring and Surface Water Monitoring Site	Elev. (amsl) (ft)	Flow Range (gpm)	Geochem. Data	Tritium Data	Year Last Measured	Springs Included in Annual Monitoring (X)	Apparent Monitored Flow Trend	Monitored Drawdown	Predicted Drawdown			Likelihood of Impacts From Drawdown
								End of 1998	End of Mining	100-Yr Post Mining	Post Recovery Period	
JBR31	6040	<1.0			89			<10	<10	<10	<10	Low
JBR30	6040	<1.0			89			<10	<10	~10	<10	Low
JBR29	6080	<1.0			89			<10	<10	10-30	<10	Low
JBR28	6230	0			89			<10	<10	10-30	<10	Low
JBR47	6280	<1.0			89			<10	<10	<10	<10	Low
JBR48	6700	<1.0			89			<10	<10	10-30	<10	Low
S37-50-28L (JBR-49)	5960	0.8	X		93			<10	<10	10-30	<10	Low
JBR50	6720	<1.0			89			<10	<10	<10	<10	Low
JBR51	6700	3			89			<10	<10	10-30	<10	Low
JBR52	6840	1			89			<10	<10	10-30	<10	Low
JBR53	6920	4			89			<10	<10	10-30	<10	Low
JBR54	7120	<1.0			89			<10	<10	~10	<10	Low
JBR55	7220	26.9-0.5	X	X	98	X	Variable	<10	<10	~10	<10	Low
JBR43	7600	<1.0			89			<10	<10	<10	<10	Low
JBR44	7680	<0.25			89			<10	<10	<10	<10	Low
S37-50-15A (JBR45)	7120	1-0.23	X		93			<10	<10	<10	<10	Low
JBR46	7000	1.8			89			<10	<10	<10	<10	Low
JBR56	7160	<1.0			89			<10	<10	<10	<10	Low
Bell Creek Area												
JBR71	5550	1.2	X		89			10-100	10-30	10-30	<10	Moderate
JBR72	5560	0.3			89			10-100	10-30	10-30	<10	Moderate
JBR70	5740+B72	33.6-4.95	X	X	98	X	No Reduction	10-100	10-30	10-30	<10	Moderate
JBR69	5780	0			89			10-100	10-30	10-30	<10	Moderate
JBR68	6040	0.3			89			<10	<10	10-30	<10	Low to Moderate
JBR67	6020	22			89			<10	<10	<10	<10	Low to Moderate
JBR66	6080	3.15			89			<10	<10	<10	<10	Low to Moderate
JBR63	6100	<1.0			89			<10	<10	10-30	<10	Low to Moderate
JBR62	6160	0.3			89			<10	<10	10-30	<10	Low to Moderate
JBR65	6120	1.5			89			<10	<10	<10	<10	Low to Moderate
JBR64	6320	0			89			<10	<10	<10	<10	Low to Moderate
S37-50-29A(JBR61)	6320	<1.0-0.6	X		93			<10	<10	10-30	<10	Low

Table 3.2-22 (Continued)
Springs Located Within or Near the Predicted Drawdown Area[1,2]

Spring and Surface Water Monitoring Site	Elev. (amsl) (ft)	Flow Range (gpm)	Geochem. Data	Tritium Data	Year Last Measured	Springs Included in Annual Monitoring (X)	Apparent Monitored Flow Trend	Monitored Drawdown	Predicted Drawdown			Likelihood of Impacts From Drawdown
								End of 1998	End of Mining	100-Yr Post Mining	Post Recovery Period	
JBR60	6360	<1.0			89			<10	<10	30-100	<10	Low
JBR58	6400	-			89			<10	<10	<10	<10	Low
JBR59	6640	0.5	X		89			<10	<10	10-30	<10	Low
S37-50-27A (JBR57)	6960	0.6	X		93			<10	<10	<10	<10	Low
Brush Creek Area												
JBR73	5680	1.05			89			<10	10-30	10-30	<10	Moderate to High
JBR90	5550	0.5	X		89			<10	<10	~10	<10	Moderate to High
JBR91	5700	0.42			89			<10	10-30	30-100	<10	Moderate to High
JBR93	5920	5-0.0	X	X	98	X	Variable	<10	<10	10-30	<10	Moderate to High
JBR92	5920	0.5	X		89			<10	<10	10-30	<10	Moderate to High
JBR96	5940	<1.0	X		89			<10	<10	10-30	<10	Moderate to High
JBR82	6000	7.5			89			<10	<10	<10	<10	Moderate to High
JBR94	6040	0.5	X		89			<10	<10	10-30	<10	Moderate to High
JBR80	6040	1.35			89			<10	<10	<10	<10	Moderate to High
JBR83	6160	2.55	X		89			<10	<10	<10	<10	Moderate to High
JBR81	6200	1.58			89			<10	<10	<10	<10	Moderate to High
JBR97	6220	<1.0			89			<10	<10	10-30	<10	Moderate to High
JBR98	6240	0.5-0.03	X	X	98	X	Variable	<10	<10	10-30	<10	Moderate to High
JBR99	6360	<1.0			89			<10	<10	10-30	<10	Moderate to High
JBR101	6260	4.0-1.2	X		91			<10	<10	10-30	<10	Moderate to High
JBR100	6440	0.2-dry	X	X	98	X	No flow since 95	<10	<10	10-30	<10	High
JBR102	6460	0.5	X		89			<10	<10	10-30	<10	Moderate
JBR84	6400	0.6			89			<10	<10	<10	<10	Moderate
JBR85	6520	0.3			89			<10	<10	<10	<10	Moderate
JBR86	6650	1			89			<10	<10	10-30	<10	Moderate
Rodeo Creek Area												
JBR89	5220	<1.0			89			>1500	>100	>100	>30	High
JBR95	5780	<1.0			89			<10	10-30	30-100	<10	Moderate to High
JBR117	5960	1.3-<0.1	X	X	98	X	Variable	<10	<10	10-30	<10	Moderate to High
S36-50-35A (JBR120)	5960	2.0-1.6	X		93			<10	<10	<10	<10	Moderate to High
JBR116	6000	0.5	X		89			<10	<10	10-30	<10	Moderate to High
JBR115	6080	-			89			<10	<10	10-30	<10	Moderate to High

Table 3.2-22 (Continued)
Springs Located Within or Near the Predicted Drawdown Area[1,2]

Spring and Surface Water Monitoring Site	Elev. (amsl) (ft)	Flow Range (gpm)	Geochem. Data	Tritium Data	Year Last Measured	Springs Included in Annual Monitoring (X)	Apparent Monitored Flow Trend	Monitored Drawdown	Predicted Drawdown			Likelihood of Impacts From Drawdown
								End of 1998	End of Mining	100-Yr Post Mining	Post Recovery Period	
JBR128	6300	4.0			89			100-300 (a)	30-100	>100	10-30	Moderate to High
S35-50-2A (JBR129)	6280	3-1.9	X		93			300-500 (a)	30-100	>100	>30	Moderate to High
JBR130	6100	4.3-Dry	X	X	98	X	Dry since 93	300-500 (a)	>100	>100	>30	High
JBR118	6260	0.5	X		89			<10	<10	<10	<10	Moderate to High
JBR126	6250	1.4-0.09	X	X	98	X	Variable	10-100 (a)	10-30	30-100	<10	Moderate to High
JBR125	6280	1			89			10-100 (a)	~10	30-100	<10	Moderate to High
JBR122	6320	<1.0			89			<10	<10	<10	<10	Moderate to High
JBR124	6320	3			89			<10	<10	<10	<10	Moderate to High
JBR121	6200	1.4-<0.1	X	X	98	X	Reduction since 96	<10	<10	<10	<10	High
JBR127	6380	0.45			89			10-100 (a)	~10	~30	<10	Moderate to High
JBR119	6400	<1.0			89			<10	<10	<10	<10	Moderate to High
JBR123	6400	<1.0			89			<10	<10	<10	<10	Moderate to High
East Slope Tuscarora (Maggie Creek Drainage Area)												
S35-51-32L	5560	NA	X	X	93			(b)	<10	<10	<10	Low
S35-51-30L	5560	0.4	X		93			(b)	30-100	~30	10-30	Low
NGC 56	~5600	Dry			98	X	Dry	(b)	>100	>100	>30	Low
S35-51-19A	5760+B 125	1.1	X		93			(b)	>100	>100	>30	Low
S35-51-19B	5700	1.6			93			(b)	>100	>100	>30	Low
NGC 55	~5800	1.44-dry			98	X	Dry in Fall	(b)	~10	~30	<10	Low
NGC 1	~6200	59-0	X		98	X	Dry in Fall	(b)	>100	>100	>30	Low
NGC 54	~5890	8.1-dry			98	X	Dry in Fall	(b)	~30	~100	10-30	Low
S35-51-18A	5880	<1.0	X		93			(b)	<10	10-30	<10	Low
S35-50-12L (JBR131)	6200	1.1	X		93			(b)	~100	>100	>30	Low
JBR114	6180	1.2			89			<10	<10	~10	<10	Low
JBR113	5840	<1.0			89			<10	<10	<10	<10	Low
S36-50-25A	6400	0.6	X		93			<10	<10	10-30	<10	Low
S36-51-30A (JBR109)	5950	14-7	X		93			<10	<10	<10	<10	Low
JBR110	6200	<1			89			<10	<10	<10	<10	Low
JBR107	6250	2			89			<10	<10	10-30	<10	Low
JBR108	6280	<1			89			<10	<10	<10	<10	Low
JBR105	6560	<1			89			<10	<10	10-30	<10	Low

Table 3.2-22 (Continued)
Springs Located Within or Near the Predicted Drawdown Area[1,2]

Spring and Surface Water Monitoring Site	Elev. (amsl) (ft)	Flow Range (gpm)	Geochem. Data	Tritium Data	Year Last Measured	Springs Included in Annual Monitoring (X)	Apparent Monitored Flow Trend	Monitored Drawdown	Predicted Drawdown			Likelihood of Impacts From Drawdown
								End of 1998	End of Mining	100-Yr Post Mining	Post Recovery Period	
JBR106	6320	<1			89			<10	<10	<10	<10	Low
JBR103	6520	<1			89			<10	<10	<10	<10	Low
JBR104	6390	7.5-0.5	X	X	98	X		<10	<10	<10	<10	Low
JBR87	6600	<1			89			<10	<10	<10	<10	Low
S37-50-27L	7400	1.3			93			<10	<10	<10	<10	Low
S37-50-27M	7600	1.4			93			<10	<10	<10	<10	Low
S37-51-31L	7400	0.6	X		93			<10	<10	<10	<10	Low
S37-51-29B	7800	3.7	X		93			<10	<10	<10	<10	Low
S37-51-30B	7800	1.3			93			<10	<10	<10	<10	Low
S37-51-29A	7380	1.8			93			<10	<10	<10	<10	Low
S37-51-30A	7450	<1			93			<10	<10	<10	<10	Low
West Flank of Richmond Mountain												
S34-50-4A	5150	<1.0	X		93			(b)	>100	>100	>30	Moderate to High
Welches Canyon												
NGC 16	~5540	20-dry	X		98	X	Variable	(b)	<10	<10	<10	Low
NGC 14	~5800	168.3-4.0			98	X	Variable	(b)	<10	10-30	<10	Low to Moderate
NGC 15	~5800	26.0-0.1			98	X	Variable	(b)	<10	10-30	<10	Low to Moderate
NGC 50	~5360	564.5-1.22	X		98	X	Variable	(b)	<10	<10	<10	Low
NGC 51	~5400	2.3-1.0			98	X	Constant	(b)	<10	10-30	<10	Moderate to High

[1] Includes all springs located with 10-foot drawdown contour, and springs located outside of, but within approximately 2 miles of the 10-foot drawdown contour.
[2] Estimates of spring impacts are based on general hydrogeologic conditions, projected drawdown, and geochemical and isotopic signature.
(a) Spring is located southeast of the Betze-Post Pit in an area where drawdown contours have not been defined in the Boulder Valley Monitoring Plan (BVMP) (Barrick 1999a). Drawdown was estimated by extrapolating the BVMP contours to the southeast.
(b) Spring site is located on the east of the Tuscarora Mountain divide, in areas that may be experiencing drawdown from dewatering at the Gold Quarry Mine.

also flowed several thousand feet prior to infiltrating Boulder Valley.

The combined flows from these springs have ranged up to a peak of approximately 30,000 to 35,000 gpm in the first quarter of 1996. From April 1996 through 1998, water management activities were modified such that excess mine water no longer seeped through the fracture. These activities substantially reduced the amount of water that infiltrated the rhyolite and alluvial aquifer systems in the Boulder Valley area from 1997 through 1998. As a result, the flows in the springs diminished to approximately 5,000 gpm by the end of 1998.

Substantial decreases in spring flow reduced the surface area affected by the flows. As illustrated in Figure 3.2-28 (Barrick 1999a), the maximum extent of the spring flow area was approximately 4,500 acres (7 square miles) and occurred in January of 1996 (Barrick 1999a). At the end of 1998, the land areas directly affected by these flows had been reduced to approximately 12.5 acres (0.02 square mile) and were restricted to the immediate vicinity of the springs (Barrick 1999a).

Impacts to streamflows are identified by comparing recent monitoring data to data recorded in the late 1980s and early 1990s (Barrick 1999a; BLM 1991a). Noticeable changes to seasonal streamflow durations are evident for Rodeo Creek and Brush Creek in the vicinity of the Betze-Post Pit. Formerly perennial or frequently flowing intermittent reaches of these streams are now dry during much of the year. Since the 1988 and 1989 data reflect years of substantially lower precipitation than normal, it is likely that substantial flow reductions have taken place along these streams. These or similar impacts were predicted in the Betze Project Final EIS, and related mitigation measures were identified in Section 2.3.4 of that document (BLM 1991b).

The flow and vegetation in Brush Creek, a tributary to Rodeo Creek, have changed substantially since 1993, indicating that this drainage has been impacted by mine dewatering (Adrian Brown Consultants, Inc. 1999). Brush Creek has been dry since 1994 (Adrian Brown Consultants, Inc. 1999). Wetland species have been eliminated, and vegetation coverage has been reduced from 79 percent in 1993 to less than 24 percent in 1998 (Adrian Brown Consultants, Inc. 1999).

Predicted Future Impacts (Post-1998). The model predicts that the area within the 10-foot drawdown contour would expand after mining ceases and reach a maximum extent on the order of 100 years postmining. As stated previously, individual springs and perennial stream reaches are supported by discharge from either the regional ground water aquifer system or from more isolated or perched aquifers residing above the regional ground water system. Only those perennial sources that are hydraulically connected to the regional ground water system could potentially be impacted by mine-induced drawdown. Therefore, impacts to individual springs and perennial stream reaches that are supported by perched aquifers residing above the regional ground water system are not anticipated. Conversely, perennial springs that are hydraulically connected to the regional ground water system, and experience any drawdown could be impacted.

The actual impacts to an individual spring or stream reach would depend on the source of ground water that sustains perennial flow and the actual mine-induced drawdown that occurs at the site. The extensive spring and stream data collected to-date, including flow measurements, field water quality parameters, laboratory water quality isotopic determinations, and hydrogeologic conditions at each site are quite variable throughout the region. As a result, it is not possible to conclusively identify regions or specific springs or stream sites that would or would not be impacted by future mine-induced drawdown. However, there are several generalizations that can be made regarding the source of perennial waters and relative likelihood of impacts for different regions.

As listed in Table 3.2-22, there are 70 identified spring sites located within the predicted maximum extent of the 10-foot drawdown contour. Of these 70 spring sites, 26 were estimated to have a low likelihood of impacts from drawdown, and the remaining 44 were estimated to have a higher likelihood of impacts from drawdown. The relative potential for impacts was estimated based on the

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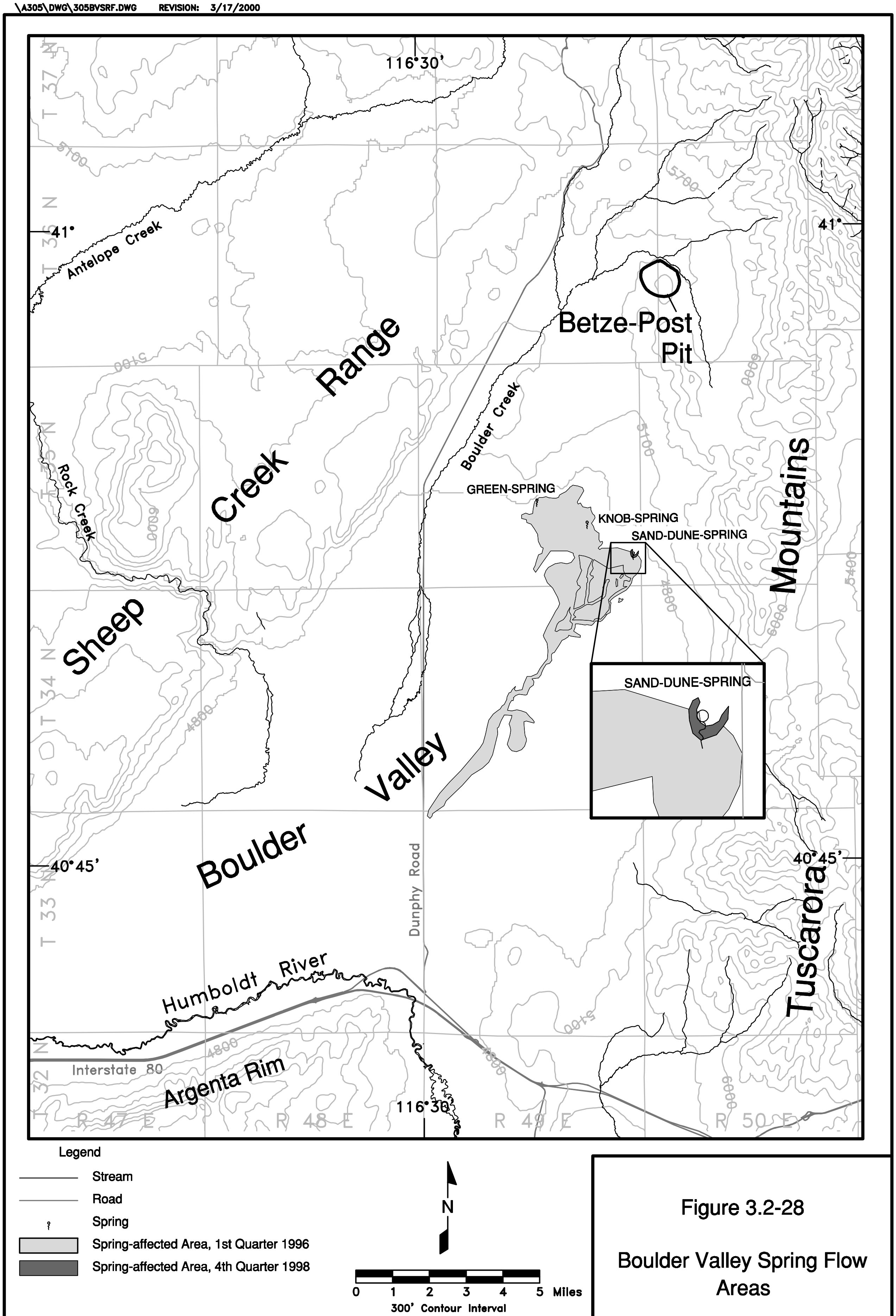

Figure 3.2-28

Boulder Valley Spring Flow Areas

general hydrogeologic setting, projected drawdown, and geochemical and isotopic signature from monitored springs. The areas where these 44 spring sites occur are shaded in Figure 3.2-29 to illustrate where perennial waters could potentially be affected (within the 10-foot drawdown area). Perennial springs and stream reaches located outside the 10-foot contour also could be affected by drawdowns of less that 10 feet. Identified spring sites located outside, but adjacent to, the 10-foot drawdown contour also are listed in Table 3.2-22 and include local perennial springs in the upper Antelope and Squaw Creek area, and Boulder, Bell, Brush, and Rodeo Creek areas. Potential impacts to perennial springs and streams are summarized by regions in the following paragraphs.

Upper Antelope Creek Area. This area includes several springs and seeps and the spring-fed perennial reaches of upper Antelope Creek and its tributaries Squaw Creek and the lower portion of North Antelope Creek. Current drawdown patterns and projected drawdown indicate that the cone of depression is expanding in a northwest direction toward the upper Antelope Creek and Squaw Creek areas. Model predictions indicate that the future drawdown would stop short of, but near, the upper Antelope Creek and lower Squaw Creek areas. The springs in this region generally have intermediate to high ionic concentrations and very low tritium concentrations. This signature suggests that these waters are older and probably derived from a more regional ground water source. Considering the uncertainty associated with long-term model predictions, there may be some risk that future drawdown could affect this area. If drawdown does extend to this area in the future, some springs and perennial stream reaches, particularly in upper Antelope Creek (below the confluence with Squaw Creek) and lower Squaw Creek, could potentially be impacted.

Rock Creek/Willow Creek Area. As summarized in Section 3.2.1.2, flow data indicate that baseflow in the segment of Rock Creek immediately north of the Sheep Creek Range is controlled predominately by flow from Willow Creek and Rock Creek tributaries located upstream from the Antelope Creek confluence. During low flow periods, flows in Rock Creek (north of the Sheep Creek Range) appear to be controlled by discharge from Hot Lake, located in the northern portion of the Rock Creek drainage near the confluence of Rock Creek and Willow Creek. In contrast, baseflow contributions from the Antelope Creek tributary watershed appear to be negligible. This is supported by the fact that approximately 12 miles of lower Antelope Creek are ephemeral (or generally dry during the low-flow season), and that baseflows have not been observed to increase significantly below the Antelope Creek confluence. For these reasons, it is reasonable to assume that even if drawdown did eventually impact upper Antelope Creek (as discussed previously), impacts to Rock Creek baseflows would likely be negligible (or not measurable). Therefore, based on the current model predictions, impacts to the perennial surface water resources in the Rock Creek/Willow Creek areas are not anticipated.

Western Slope of Tuscarora Mountains. Numerous springs and short, isolated perennial stream reaches occur on the western slope of the Tuscarora Mountains located southeast, east, and northeast of the Betze-Post Pit. These springs occur in the upper Rodeo Creek, Brush Creek, Bell Creek, and Boulder Creek watershed areas. As stated above, several springs and at least one stream reach (Brush Creek) have apparently been impacted by drawdown. The magnitude and area of drawdown is predicted to expand toward the end of mining and particularly in the postmining period. Springs in this region have variable characteristics and include a mixture of perennial water sources, including (1) springs with lower ionic concentrations and higher tritium content suggesting that they may be isolated or perched springs situated above the regional ground water system, and (2) springs with higher ionic concentrations and low tritium content suggesting they represent older ground water discharged from a deeper ground water system. Assuming that many of the higher elevation springs in this region are fed by perched ground water systems, springs and perennial streams at higher elevations (generally above 6,000 feet) are less likely to be affected as compared with lower elevation areas. However, perennial springs and streams located in the higher elevation areas (above 6,000 feet) with higher ionic and low tritium concentrations could be affected as the magnitude and area of drawdown expands in the future.

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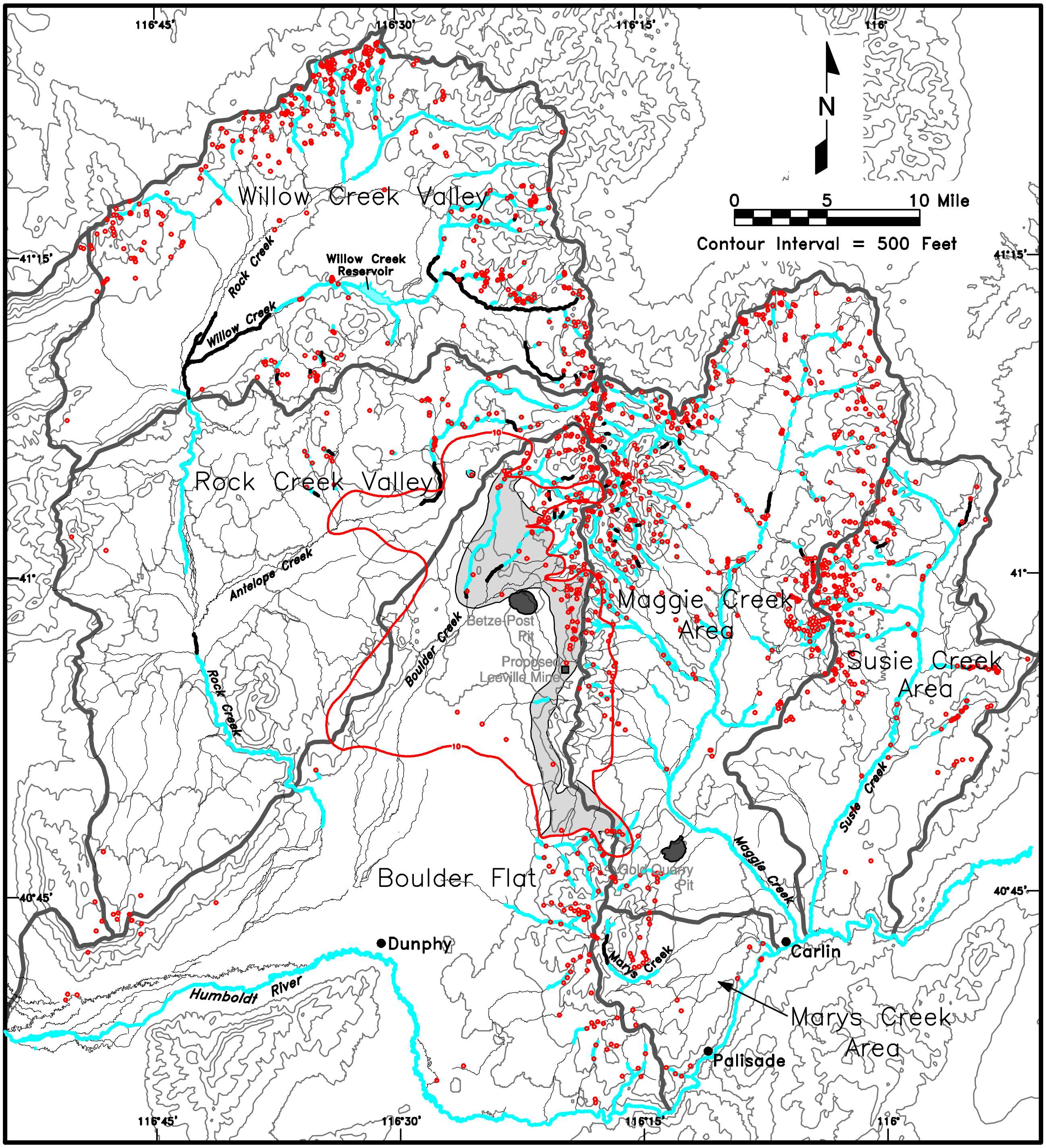

Legend

Ground Water Basin Boundary

Maximum Extent of 10-foot Drawdown Contour

Perennial Steams

Discontinuous Flowing Stream Reach

Spring and Seep

Areas where Perennial Waters could Potentially be Impacted by Drawdown[1]

Areas where Perennial Waters have a Low Probability of Being Impacted by Drawdown[1]

Note: [1] Does not include potential impacts to perennial waters located outside the maximum 10-foot drawdown contour.

Figure 3.2-29

Potentially Impacted Perennial Waters Within the 10-Foot Drawdown Area

Eastern Slope of Tuscarora Mountains. Numerous springs support perennial stream segments on the eastern slope of the Tuscarora Mountains that are part of the headwater tributaries of Maggie Creek including, from north to south, Beaver Creek, Little Beaver Creek, Coyote Creek, Spring Creek, Little Jack Creek, Indian Creek, Cottonwood Creek, Lynn Creek, and Simon Creek. According to the current model projections, in the postmining period, mine-induced drawdown is projected to extend into the Indian Creek, Cottonwood Creek, Lynn Creek, and Simon Creek areas. Springs within this area occur as discharges from low permeability Paleozoic bedrock that outcrops throughout this portion of the Tuscarora Mountains, and from thin alluvium over bedrock in the valleys. These springs generally are characterized by low total dissolved solids and high tritium concentrations (RTi 1994). The low ionic concentrations and high tritium content indicate that the ground water source for most springs and perennial waters in this area has a very short residence time that probably spans no more than a few years. Balleau (1992) collected and analyzed chemical and isotopic data from springs and streams, and conducted a geologic reconnaissance along Little Jack, Coyote and Beaver creeks, which drain the eastern side of the Tuscarora Range. Based on these data, Balleau developed a conceptual model for the streams along the eastern slope of the Tuscarora Mountains wherein baseflow in springs and perennial streams at higher elevation (approximately 6,000 feet) is supported by locally recharged water stored in colluvial material. The Desert Research Institute (DRI) evaluated the surface and ground water relationships in the Tuscarora Mountains (DRI 1998) and concluded that the existing data are consistent with this conceptual model of locally derived water. In summary, the chemical, isotopic, and hydrogeologic setting suggest that most springs in this region occur as isolated or perched springs that are not hydraulically connected to the deeper regional ground water system. Therefore, impacts to springs and perennial waters within this region from future mine-induced drawdown are generally not anticipated.

Impacts to Ground Water Rights

To evaluate potential impacts to ground water rights, the drawdown predictions were compared to the point of diversion locations. Information on these rights and applications for rights is summarized in Appendix A, Table A-1; the point of diversion locations listed for the water right or application for water right are shown in Figure 3.2-8 (Nevada State Engineer's Office 1999, 2000). Water rights and applications listed as mining and milling were excluded from this analysis since these rights correspond to the network of mine dewatering wells centered around the Betze-Post and Gold Quarry pits. All other water rights and water right applications owned by Barrick or Newmont and their affiliates were included in the inventory. Since water rights are not necessary for most domestic wells, this inventory (based on information on file at the Nevada Division of Water Resources) does not include all domestic or stock watering wells that may exist within the regional study area. However, included in Table A-1 are five known water supply wells that are apparently used for domestic or stock watering and that do not have a water rights permit or application number. Other domestic water supply wells that are not included in this inventory likely exist in the vicinity of Carlin in the southeastern portion of the hydrologic study area.

As shown in Figure 3.2-30 and summarized in Table 3.2-23, the results of the modeling indicate that water levels in 64 underground water rights with current permit, certificated, or vested status could be lowered by at least 10 to over 100 feet during the mine life or in the postmining period as a result of Barrick's mine-induced drawdown. Considering the uncertainty of model predictions, the actual drawdown could be larger or smaller.

Specific impacts to individual wells would depend on the well completion, including pump setting, depth, yield and premining static and pumping water levels. Lowering the water levels in these water supply wells could potentially reduce yield, increase pumping cost. The pump setting in the well needs to be located a sufficient distance below the water table to allow for drawdown around the well during pumping without exposing the submersible pump. Therefore, mine-induced drawdown could render some wells unusable unless the pump setting were lowered or the well were deepened. For this reason, wells located within the areas affected by 10 feet of drawdown could potentially experience impacts.

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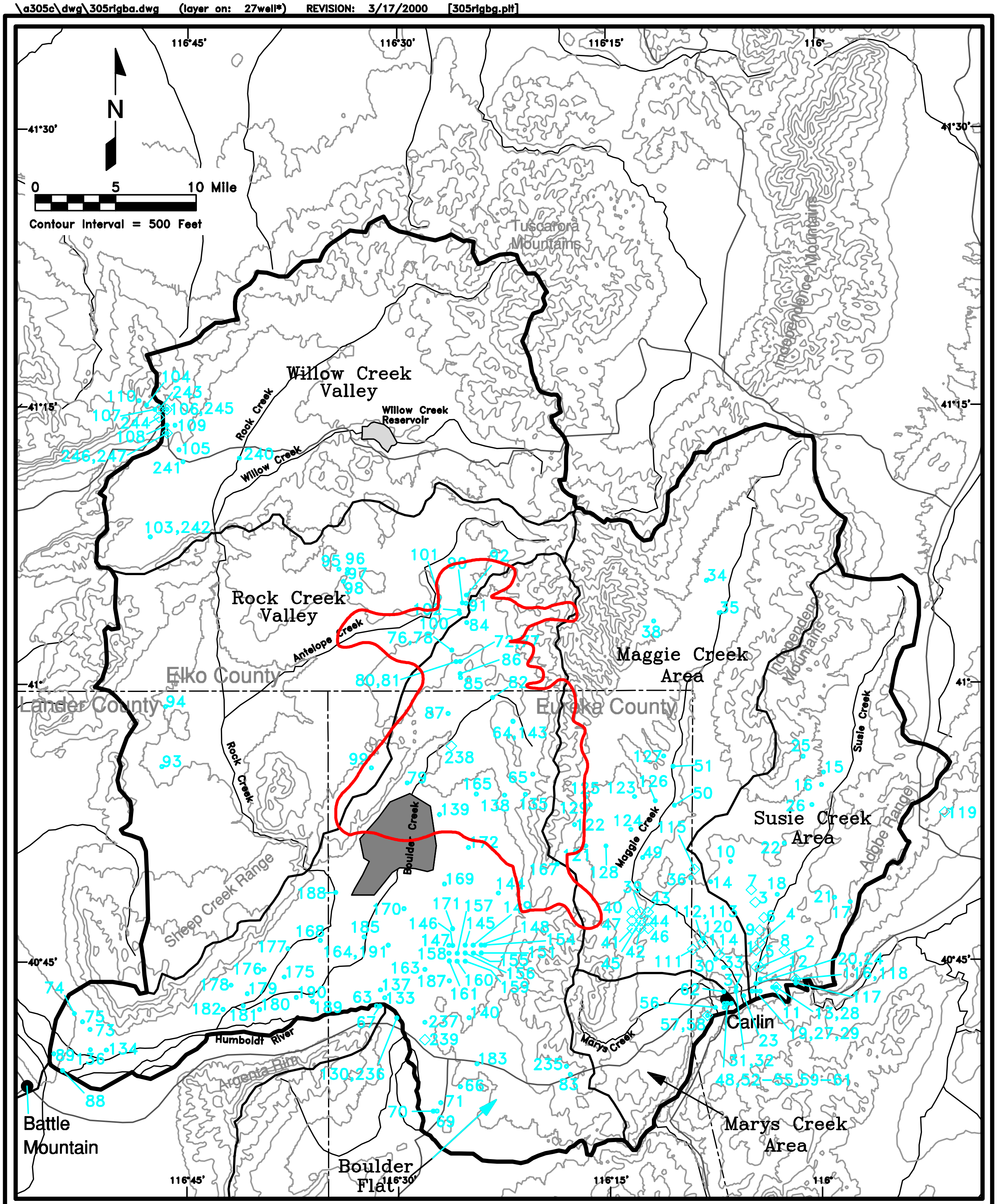


Legend

- Study Area
- Ground Water Basin Boundary
- County
- Maximum Extent of 10-foot Drawdown
- 70 Point of Diversion for Ground Water Right with Current Permit, Certificate, or Vested Status
- 47 Listed Point of Diversion for Applications for Ground Water Right (Application, Ready for Action, and Ready for Action Protested), and other known well locations

This area contains 54 ground water rights and application for ground water rights (Numbers 68, 131, 132, 141, 142, 150, 152 153, 162, 166, 173, 174, 184 186, 192-215, and 218-233). The point of diversion locations are provided in Table A-1.

See Table A-1 for details

Figure 3.2-30

Potential Drawdown Impacts to Ground Water Rights, Application for Ground Water Rights, and Other Known Wells

Table 3.2-23
Ground Water Rights and Application for Ground Water Rights Located Within the Predicted Drawdown Area

Map Well Location Number	Application Number	Status Permit/ Certificate[1]	Use[2]	Predicted Drawdown (feet)			
				End 1998	End of Mining	100 Yrs Post-Mining	Recovery
64	28197	CER	MM	10-100	>100	>100	>30
65	30615	CER	MM	?	>100	>100	>30
72	53715	PER	MM	>1100	>100	>100	>30
76	57755	PER	MM	700-900	>100	>100	>30
77	57756	PER	MM	>1100	>100	>100	>30
78	57757	PER	MM	700-900	>100	>100	>30
79	57789	PER	STK	30-40[3]	>30	30-100	>30
80	57882	PER	MM	>1100	>100	>100	10-30
81	57883	PER	MM	>1100	>100	>100	10-30
82	58254	PER	MM	>1100	>100	>100	>30
84	62579	PER	MM	10-100	30-100	>100	10-30
85	57758E	PER	ENV	>1100	>100	>100	10-30
86	57759E	PER	ENV	>1100	>100	>100	10-30
87	57788	PER	STK	>40[3]	~10	30-100	<10
90	42931	PER	MM	<10	<10	10-30	10-30
91	42932	PER	MM	<10	<10	10-30	10-30
92	42934	PER	MM	<10	<10	10-30	<10
99	59063	CER	STK	>40[3]	<10	10-30	<10
100	61410	PER	MM	<10	10-30	>100	10-30
101	62577	PER	MM	<10	<10	10-30	<10
102	62578	PER	MM	<10	10-30	>100	10-30
122	39874	CER	STK	<10	>100	~100	10-30
135	23881	CER	STK	?	>100	>100	>30
138	8659	CER	STK	?	>100	>100	10-30
139	27956	CER	STK	30-40[3]	<10	10-30	<10
143	28969	CER	STK	10-100	>100	>100	>30
165	46042	CER	STK	30-40[3]	<10	10-30	<10
166	46043	CER	STK	30-40[3]	<10	10-30	<10
167	46044	CER	STK	<10	30-100	30-100	10-30
192	52941	PER	IRR	30-40[3]	<10	10-30	<10
193	52942	PER	IRR	30-40[3]	<10	10-30	<10
194	52943	PER	IRR	30-40[3]	<10	10-30	<10
195	52944	PER	IRR	30-40[3]	<10	10-30	<10
196	52945	PER	IRR	30-40[3]	<10	10-30	<10
197	52946	PER	IRR	30-40[3]	<10	10-30	<10
198	52947	PER	IRR	30-40[3]	<10	10-30	<10
199	52948	PER	IRR	30-40[3]	<10	10-30	<10
200	52949	PER	IRR	30-40[3]	<10	10-30	<10
201	52950	PER	IRR	30-40[3]	<10	10-30	<10
203	54827	PER	IRR	30-40[3]	<10	10-30	<10
204	54828	PER	IRR	30-40[3]	<10	10-30	<10
205	54829	PER	IRR	30-40[3]	<10	10-30	<10
238	64229	RFP	STO	30-40[3]	<10	10-30	<10

See Appendix A-1 for Details on the Ground Water Rights, Application for Ground Water Rights, or Other Known Wells.

[1]Use: CER - Certificate
PER - Permit
RFP - Ready for Action (protested)

[2]Use: ENV - Environmental
IRR - Irrigation
MM - Mining and Milling
STK –Stock
STO - Storage

[3]Ground water mounding (not drawdown).

Impacts to Surface Water Rights

A potential reduction in the baseflow of perennial springs and streams could affect surface water rights within the drawdown area (Figure 3.2-31) (Barrick 1998c; Nevada State Engineer's Office 1999). As shown in Table 3.2-24, there are 18 surface water rights that could potentially be impacted by mine dewatering induced drawdown. Twelve of these surface water rights are directly associated with Barrick's water management activities (as noted in footnotes 4 and 5 of Table 3.2-24). These water rights are dependent on Barrick's dewatering rights which terminate with completion of dewatering activities. Of the remaining six surface water rights, three are used for irrigation and three for stock watering.

The actual potential for impacts to individual water rights (not controlled by Barrick) would depend on the site-specific hydrologic conditions that control surface water discharge. For example, as discussed previously under springs and seeps, only those waters that are sustained by discharge from the regional ground water system are likely to be impacted by mine-induced drawdown. Some surface water rights divert only surface water runoff or local perched ground water that is not dependent on discharge from the regional ground water system. In these cases, impacts to surface water flows from mine-induced drawdown are not anticipated.

Channel Erosion and Sedimentation Impacts

Impacts to Date. The discharge conveyance system has not and is not expected to substantially accelerate erosion and sedimentation in Boulder Valley. Best management practices have been employed during construction activities related to the conveyance system that avoid the use of natural channels in the discharge program. A reclamation plan revision is in place with the State of Nevada to account for reclamation of the conveyance system, and updates to the overall reclamation plan for the project are being submitted every 3 years as required by the State (Barrick 1996a, 1996b). Bonding in the plan revisions accounts for the conveyance system and includes a provision for $1 million for additional reclamation activities, the need for which is currently unforeseen.

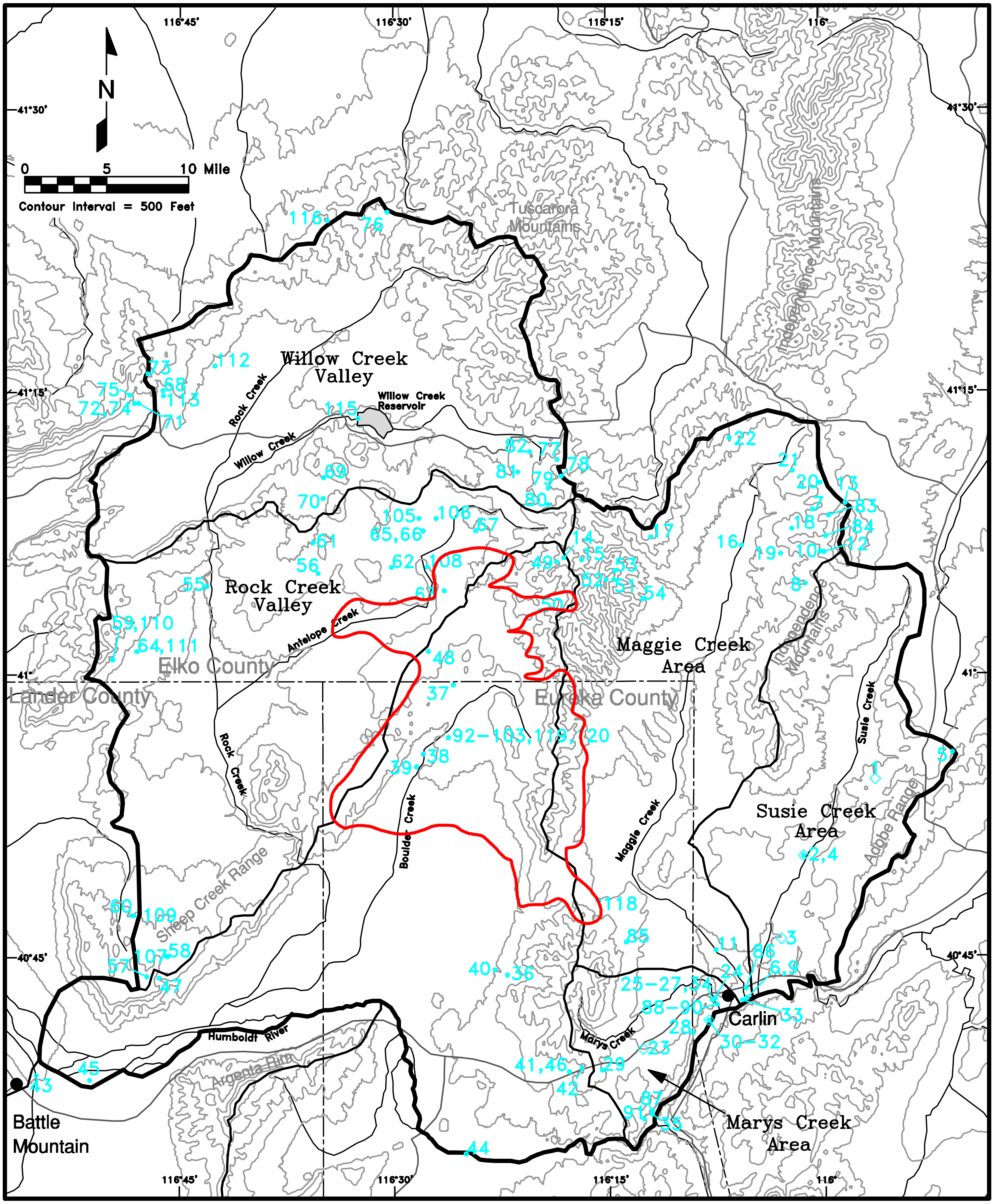
The water management program has created agricultural land uses on thousands of additional acres in the Boulder Valley watershed. Vegetation density is estimated to be higher in these areas than in the native plant communities. The present system of cropland use and irrigation likely reduces the erosion and sediment yield than occurs naturally on undisturbed ground; however, this has not been quantified.

Projected Future Impacts. When dewatering and discharges cease, additional impacts may occur to local Boulder Valley watersheds in the form of impacts to soil resources. As mine dewatering ceases, it is assumed that approximately 10,000 acres of land would be taken out of agricultural production. At that time, accelerated erosion may occur on former croplands and affect land and water resources. If former croplands are not adequately reclaimed, increased erosion would contribute to sediments in Boulder Valley channels, which would most likely be transported downstream as suspended load and bed load. Additional sediment loading to local streams and the Humboldt River could affect biological resources (see Sections 3.3, 3.4, and 3.5) and other water uses.

Water Quality Impacts

Water quality impacts are possible in areas affected by mine water management activities. These activities include or have included:

- The use of infiltration basins and injection wells to dispose of mine dewatering water into the alluvium and fractured rhyolite in upper Boulder Valley
- Seasonal irrigation of approximately 10,000 acres of alfalfa in Boulder Valley using mine dewatering water
- Temporary storage of mine dewatering water in TS Ranch Reservoir
- Various pipelines, canals, and ditches to transport and utilize excess dewatering water
- Water treatment facilities



Legend

- Study Area
- Ground Water Basin Boundary
- County
- Maximum Extent of 10-foot Drawdown Contour
- 46 Point of Diversion for Surface Water with Current Permit, Certificate, or Vested Status
- 23 Listed Point of Diversion for Applications for Surface Water Right (Application, Ready for Action, and Ready for Action Protested)

See Table A-2 for details

Figure 3.2-31

Potential Drawdown Impacts to Surface Water Rights and Application for Surface Water Rights

Table 3.2-24
Surface Water Rights Located
Within the Predicted Drawdown Area

Map Location Number	Application Number	Status Permit/ Certificate[1]	Use[2]	Drawdown (Feet)			
				End of 1998	End of Mining	100 Yrs Post-Mining	Recovery
37	3035	CER	IRR	>1100	<10	30-100	<10
38	3146	CER	IRR	30-40[3]	<10	30-100	<10
39	3147	CER	IRR	30-40[3]	10-30	30-100	<10
48	V06236	VST	STK	500-700	<10	30-100	10-30
50	V06242	VST	STK	<10	<10	~10	<10
63	V06237	VST	STK	<10	<10	30-100	~10
92	55272 S01[4]	PER	IRR	>40[3]	<10	10-30	<10
93	55272 S02[4]	PER	STK	>40[3]	<10	10-30	<10
94	55272 S03[4]	PER	IRR	>40[3]	<10	10-30	<10
95	55272 S04[4]	PER	STK	>40[3]	<10	10-30	<10
97	55272 S06[4]	PER	IRR	>40[3]	<10	10-30	<10
98	55272 S07[4]	PER	IRR	>40[3]	<10	10-30	<10
99	55272 S08[4]	PER	STK	>40[3]	<10	10-30	<10
100	55272 S010[4]	PER	WLD	>40[3]	<10	10-30	<10
101	55272 S011[4]	PER	WLD	>40[3]	<10	10-30	<10
103	55272 S013[4]	PER	STK	>40[3]	<10	10-30	<10
119	55272[5]	PER	STO	30-40[3]	<10	10-30	<10
120	55272 SO9[4]	PER	STK	30-40[3]	<10	10-30	<10

[1]Status: CER - Certificate
PER - Permit
VST - Vested Right
[2]Use: IRR - Irrigation
STK –Stock
STO - Storage
WLD- Wildlife
[3]Ground water mounding (not drawdown).
[4]Secondary storage right at the TS Ranch Reservoir associated with mine dewatering rights.
[5]Primary storage right at the TS Ranch Reservoir associated with mine dewatering rights.

Impacts from Infiltration Activities. Some of these activities have resulted in ground water mounding in the alluvium and volcanic rocks in the upper Boulder Valley and, to a lesser extent, in the Rock Creek ground water basins. The water management operations associated with these springs are described in Chapter 1.0. As described in Chapter 1.0, three new springs (Green, Knob, and Sand Dune) appeared when a fracture developed beneath the TS Ranch Reservoir. Figure 3.2-28 illustrates the surface expression of the spring area as of the first quarter of 1996 and the fourth quarter of 1998.

Impacts to Date. No detectable changes in ground water quality have been observed in monitoring wells located in areas of Boulder Valley where water management activities have caused ground water mounding. Water quality data from seven monitoring wells in this area were analyzed to determine if there were any noticeable changes in the concentration of constituents that have State drinking water standards. Although there are fluctuations in the concentrations of some constituents in some wells, these trends were not consistent from well to well. For example, the concentration of total dissolved solids has increased slightly over time in monitoring well NA-14, but other monitoring wells showed no major changes in total dissolved solids concentrations.

Flow and water quality samples have been collected at Green, Knob, and Sand Dune springs in Boulder Valley. Trends in flow and constituent concentrations are discussed briefly in the following paragraphs. Since flows from each spring originate over large areas, flow measurements and water quality samples were taken at a downgradient point where flows can be channelized. For this reason, water quality data may be influenced by spring flows contacting soil or by other surface condition prior to sample collection.

Green Spring water quality has changed over time, as reflected by total dissolved solids concentrations, which were at a maximum from 1993 to 1995 but have shown a decreasing trend through 1997 (Figure 3.2-32) (Barrick 1999a). Values of pH from the spring remained alkaline with a relatively high pH from 1993 to 1995 (maximum value of 9.0); however, monitoring has shown a slight decreasing trend through 1997. Alkalinity remained fairly constant from 1993 to 1997 other than a slight rise in 1994 (maximum value of 320 mg/L as $CaCO_3$ measured). Arsenic concentrations were elevated slightly above drinking water standards from 1993 to 1995, with a maximum measured value of 0.15 mg/L (Figure 3.2-32), but decreased to concentrations near or below 0.01 mg/L in 1996 and 1997. Sodium concentrations were relatively high from 1993 to 1995 (approximately 500 to 1,000 mg/L), but they have decreased an order of magnitude through 1997.

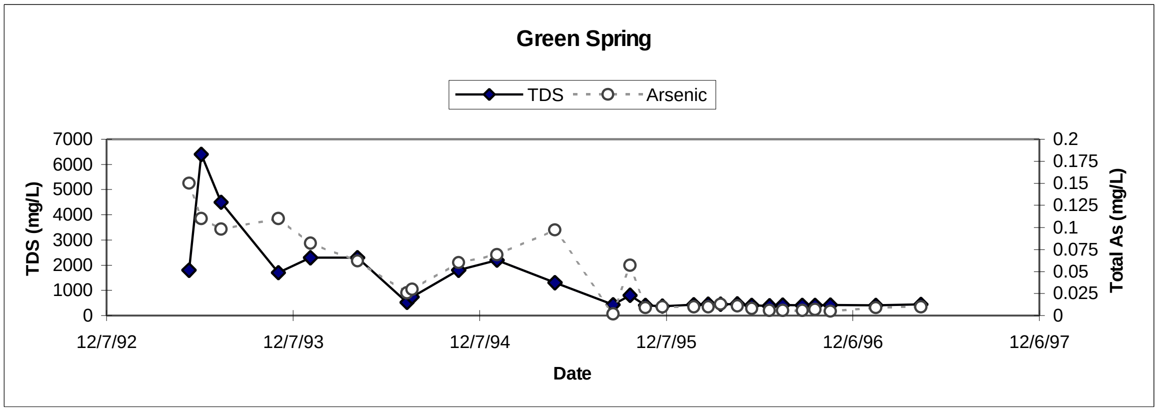
Knob Spring water quality also changed over time with a maximum TDS concentration of 920 mg/L in 1993 and a decreasing trend through 1997 (Figure 3.2-32). Values of pH from the spring have remained alkaline with their highest levels measured from 1993 to 1995 (maximum value of 9.0) and a slight decreasing trend through 1997. Alkalinity has remained fairly constant from 1993 to 1997, with concentrations typically between 250 and 350 mg/L as $CaCO_3$. Arsenic concentrations were elevated from 1993 to 1995 with a maximum measured value of 0.09 mg/L (Figure 3.2-32), but have since decreased through 1997. Sodium concentrations were relatively high from 1993 to 1994, but have decreased to less than 50 mg/L through 1997.

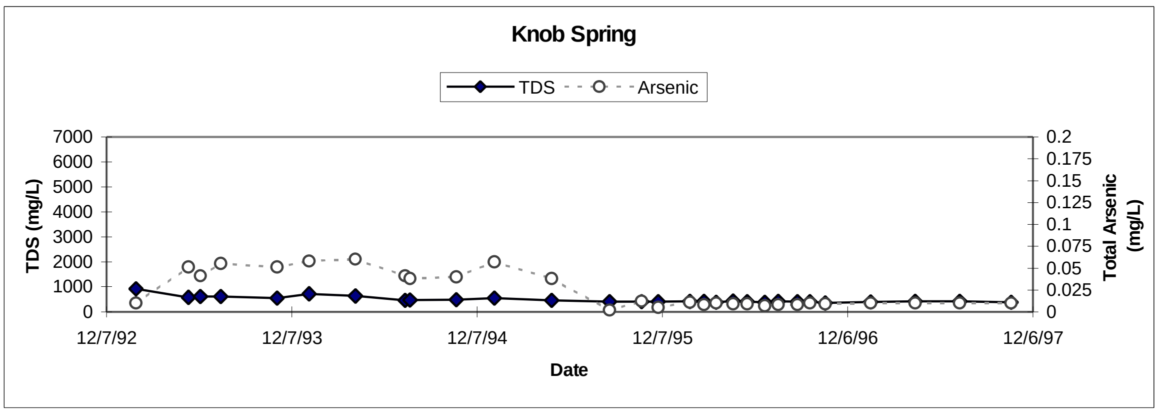
Sand Dune Spring water quality has displayed the least fluctuation during the period of record as indicated by a fairly constant to a very slightly decreasing trend in total dissolved solids over time (Figure 3.2-32). Values of pH also have remained fairly constant (most values between 7.5 and 8.0) as have alkalinity concentrations, values of which were approximately 240 mg/L as $CaCO_3$. Arsenic concentrations have decreased slightly over time for the period of record (Figure 3.2-32). Sodium concentrations have decreased slightly from 59 mg/L in August 1992 to 37 mg/L in November 1998.

Based on anecdotal observations of soils in the formerly saturated areas of Boulder Valley, evaporation of spring water has resulted in an increased accumulation of salts at the surface and within the shallow surface soils in Boulder Valley.

<u>Projected Future Impacts</u>. The basic chemistry and concentration of trace metals in ground water that is pumped from marine clastic and marine carbonate rocks to dewater the pit area is similar to that of the native ground water in the alluvium and volcanic rocks in Boulder Valley. Figure 3.2-13 is a Piper diagram that shows that the basic chemistry of these ground waters is similar. In addition, trace metals that have State drinking water standards are found in similar concentrations in both mine dewatering water and the native ground water in Boulder Valley. Changes to water quality, including increasing total dissolved solids, can occur locally where movement of the infiltrating water causes dissolution of minerals within the substrate, especially where previously unsaturated. However, water quality impacts to the ground water in Boulder Valley due to mine water management activities are expected to be minimal.

Additional soil salinity accumulations would likely develop on formerly saturated lands below TS Ranch Reservoir. These areas are expected to collect additional runoff as long as containment berms are in place. Through capillary rise, naturally occurring background salts would accumulate on and near the soil surface under conditions of wetting and drying or plant uptake. Therefore, there is a potential for this condition to limit postmining land uses and create saline and/or alkaline runoff conditions. Barrick has





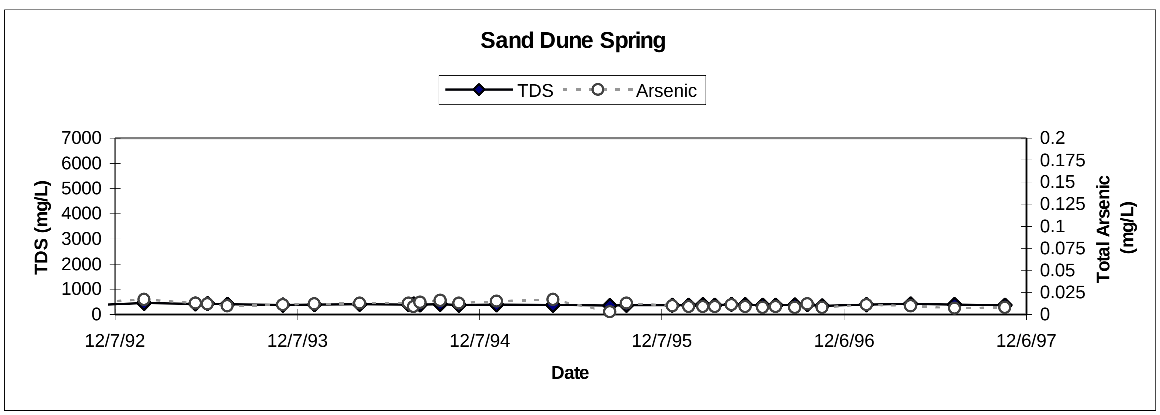


Figure 3.2-32

Total Dissolved Solids and Dissolved Arsenic Over Time for the New Springs in Boulder Valley reclamation and supplemental mitigation bonding in place to address such impacts if they occur.

Impacts from Drawdown. The primary issue related to the quality of surface water is degraded stream water quality resulting from drawdown.

<u>Impacts to Date</u>. Impacts to flows in springs, seeps, and perennial streams from pit dewatering and water management activities are addressed in Section 3.2.2.1. In summary, monitoring results suggest that drawdown from mine dewatering at the Goldstrike Mine has resulted in flow reductions and drying up of some perennial water sources. Depending on the origin of the ground water that discharges at the surface as a seep, spring, or stream, a reduction of flow could potentially be accompanied by a change in water quality. Where the source of the surface discharge is a single hydrostratigraphic unit (or aquifer) with relatively constant water quality, lowering the water level within the unit, and thereby reducing the surface discharge rate, should not result in a substantial change in water quality. Changes in flow could affect temperatures, and temperature-dependent water quality constituents could vary, however. Conversely, where the source of surface discharge is a mixture of waters from two different sources, such as a deeper, older more regional ground water aquifer, and a younger perched or more isolated ground water aquifer, a reduction in discharge from one of the sources could potentially skew the discharge water quality toward the less affected source. To-date, no substantial water quality trends have been observed within the drawdown area that could be attributed to flow reductions from drawdown.

<u>Projected Future Impacts</u>. Based on hydrologic modeling results, and seep, spring, and stream characteristics, there is some potential for additional flow reductions to perennial water sources in localized areas from future mine-induced drawdown (Section 3.2.2.1). Flow changes could potentially be accompanied by changes in water quality. The actual changes in water quality would depend on the magnitude of the flow change and the source of the surface discharge, as discussed above. Considering the complex hydrogeologic conditions, any change in water quality resulting from flow reduction is likely to be localized and is not possible to predict accurately.

Based on documented exceedences of Nevada Division of Environmental Protection stream water quality standards for water temperature and dissolved oxygen concentrations in LCT streams (Appendix B, Table B-8), both upper Rock Creek and Nelson Creek would be sensitive to any reduced flows resulting from drawdowns. However, Barrick's hydrologic model predictions and the impact assessment indicate that none of the LCT streams are likely to be impacted by drawdown.

Pit Lake Water Quality. Once dewatering operations cease, a pit lake would begin to develop in the Betze-Post Pit. Water quality predictions for the future Betze-Post Pit lake are based on a pit lake study and modeling by Radian International, LLC and Baker Consultants, Inc. (1997a, b). The primary processes controlling the pit lake water quality include ground water inflow composition, sulfide oxidation and acid generation in the pit walls, leaching of metals from the wall rock, chemical reactions in the lake, evapoconcentration, hydrodynamic mixing, and biological activity. Postmining conditions in existing mine pit lakes vary widely from high quality, pH-neutral conditions to metal-bearing, highly acidic conditions. Therefore, site-specific conditions are important to predict pit lake water quality. Water quality in the Betze-Post Pit lake was approximated using a series of quantitative models to simulate the chemical loading processes and ongoing chemical reactions that would occur in the lake water. The results of the pit lake study, including laboratory and field testing and hydrodynamic and geochemical modeling, are presented in a technical report prepared by Radian International, LLC and Baker Consultants, Inc. (1997a, b).

<u>Pit Water Balance and Final Pit Lake Configuration</u>. The variation in water level over time as the pit lake fills and the final pit lake elevation after filling would depend on the amount of water entering the pit through ground water inflow, surface runoff from the pit walls, direct precipitation onto the lake surface, ground water outflow, and the amount of water removed from the lake surface through evaporation. Barrick's hydrologic model was used to simulate the

ground water inflow and outflow as the lake fills. Other gains and losses of water to and from the lake were calculated from documented meteorological sources or computed using the U.S. Army Corps of Engineers reservoir model CE-QUAL-W2. The estimated pit lake water balance over time is presented in Radian International, LLC and Baker Consultants, Inc. 1997a. Based on numerical modeling estimates, the pit lake would fill to within 95 percent (elevation 5,128 feet amsl) of its final recovery elevation in 233 years. The estimated near steady-state lake elevation at full recovery is estimated to be approximately 5,190 feet amsl, (Radian International, LLC and Baker Consultants, Inc., 1997a, b). During the final stages of pit filling, seasonal variations in precipitation and evaporation would dominate the pit lake water balance, adding uncertainty to the actual time required for complete filling. Once the lake is filled, the lake is predicted to have a net water loss through evaporation (evaporation losses minus precipitation inputs) at an average rate of approximately 2,800 acre-feet/year.

The estimated size and depth of the final Betze-Post Pit lake are illustrated in Figure 3.2-33 (Radian International, LLC and Baker Consultants, Inc. 1997a). At closure, the final pit as currently planned would actually consist of two distinct segments or lobes: the eastern segment, referred to as the Betze-Post area, would have an ultimate pit bottom elevation of 3,940 feet amsl; the western segment, referred to as the West Bazza-Screamer area, would have an ultimate pit bottom elevation of 3,990 feet amsl. The two pit bottoms would be separated by a rise in the pit floor reaching an elevation of 4,400 feet amsl. The final pit lake measured along the center line of the pit would be approximately 10,300 feet long, have a maximum depth of approximately 1,260 feet, and have a surface area of approximately 985 acres (1.5 square miles).

<u>Ground Water and Surface Water Inflow</u>. The water quality of the pit lake would depend, in part, on the composition of inflowing ground water. Ground water inflows to the pit can be classified into two primary types based on source: (1) warm, calcium-bicarbonate-enriched ground water from the Rodeo Creek and Popovich formations exposed on the west wall of the pit; and (2) lower temperature calcium-bicarbonate-type water containing higher silica concentrations and associated with the igneous intrusive rocks, Carlin Formation, and Vinini Formation exposed on the east and south walls of the pit.

For the pit lake model, it is assumed that 30 percent of incident precipitation falling on the unsubmerged pit surface would eventually contribute to the pit lake. The pit lake model simulations assumed that a percentage of this surface water would enter the lake as direct runoff, and the remainder would infiltrate the benches and eventually discharge to the pit lake as shallow ground water flow. Runoff was characterized by collecting flow measurements at selected locations in the pit and collecting samples for laboratory analysis of major ions and metal concentrations.

<u>Pit Wall Rock</u>. Pit wall rock would contribute solute to the pit lake. Therefore, the type of rock comprising the pit walls and its potential for generating acid and mobilizing metals and other constituents is an important part of the water quality predictions. The wall rock materials exposed in the ultimate pit surface were subdivided into nine major geochemical rock types based on geologic units, mineralization, and alteration types. Representative samples of the nine geochemical rock types were collected and tested to determine whole rock geochemistry (acid-base accounting, kinetic cell tests, and other column tests). The acid-base accounting tests and kinetic tests indicated that some of the unoxidized rock materials would be potentially acid generating (Radian International, LLC and Baker Consultants, Inc. 1997a, b).

The primary source of acid and metals to the lake is assumed to be wall rock that would oxidize in the time interval between excavation and submergence by the pit lake. In situ pore oxygen concentrations measured in wall rock exposed within the pit indicated that the pyrite oxidation had penetrated several meters into the pit walls. Calculations using the field-derived data indicate that pyrite oxidation could extend between 9 and 17 meters into the pit wall after approximately 225 years of exposure to weathering (Radian International, LLC and Baker Consultants, Inc. 1997a, b).

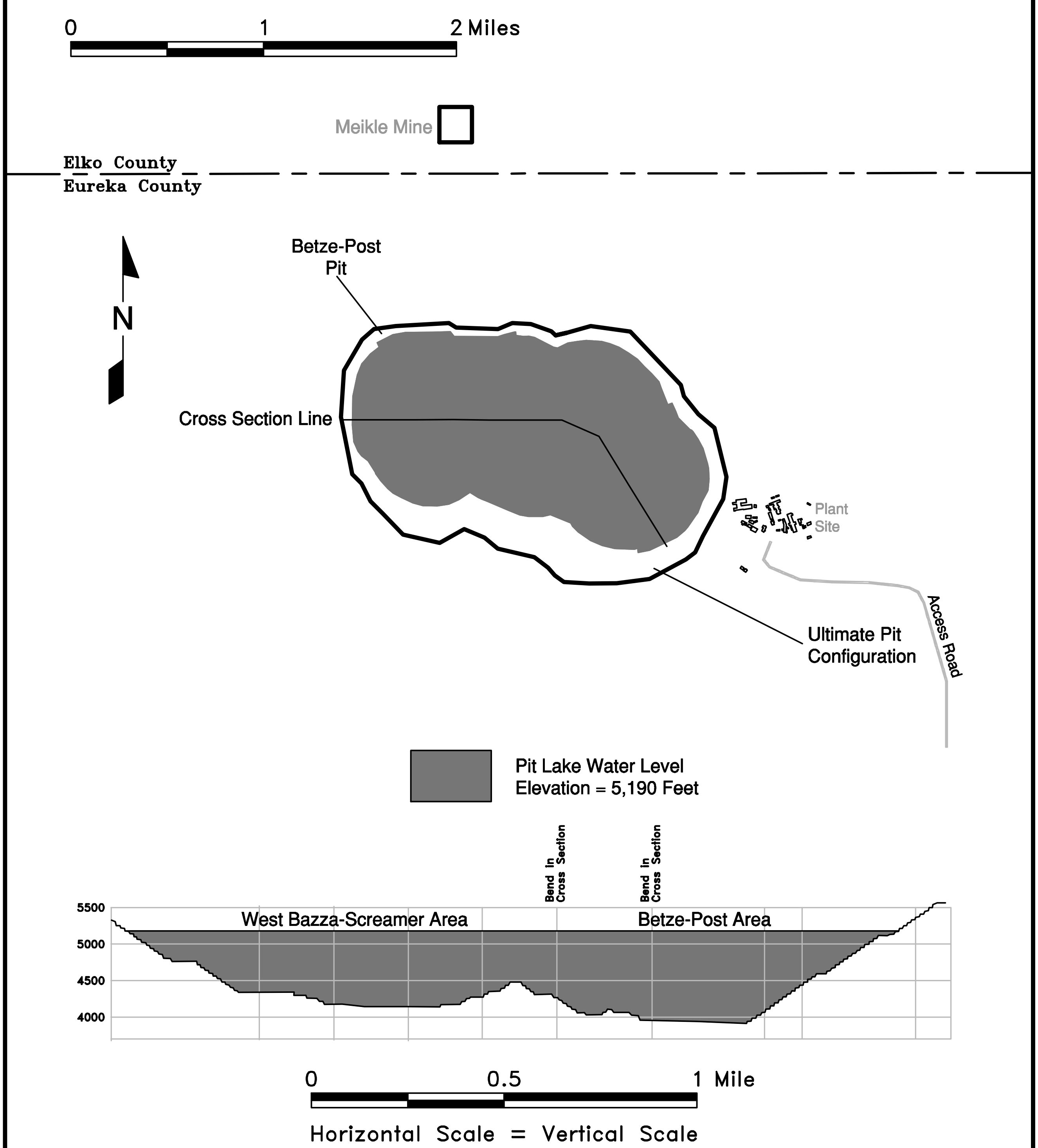


Figure 3.2-33

Estimated Final Betze-Post Pit Lake

Note: Final pit configuration was based on information provided in Radian International, LLC and Baker Consultants, Inc., 1997b

Pit Lake Water Quality Modeling. Water quality in the Betze-Post Pit lake was approximated using a series of quantitative models designed to simulate the natural processes that are expected to occur within the pit lake. The hydrodynamics and geochemistry of the pit lake were simulated using the U.S. Army Corps of Engineers CE-QUAL-W2 reservoir model and the U.S. Environmental Protection Agency MINTEQA2 model. CE-QUAL-W2 was used to represent the volume, bathymetry, stage and water balance relationships associated with the pit lake. MINTEQA2 was used to simulate the combined effects of the major geochemical reactions expected to occur during lake filling, including aqueous speciation, acid neutralization, mineral dissolution-precipitation, oxidation-reduction reactions, and sorption of trace metals onto precipitated amorphous ferric hydroxide. Lake hydrodynamics were simulated using CE-QUAL-W2 to account for thermal inputs and outputs to the lake, gas exchange from the lake surface, distribution of temperature and dissolved oxygen throughout the water column, algal growth, and nutrient mass loading.

Pit Lake Water Quality Modeling Results. The hydrodynamic modeling (CE-QUAL-W2) was performed in conjunction with the geochemistry modeling (MINTEQA2) for simulation years 10, 26, 50,100, 175, and 233 years postmining. It is important to understand that the input parameter values used for the water quality modeling contained a certain level of variability. The variability is due to the fact that the input parameter values are estimated from laboratory tests, field measurements, and even other modeling results. Because this variability was included in the modeling process, the modeling results generated a range of values for each parameter that represent a probability distribution (Radian International, LLC and Baker consultants, Inc. 1997a). The summary of results presented in Table 3.2-25 includes median predicted concentrations for each time period. There also are uncertainties regarding the future predicted water quality in the Betze-Post Pit lake. Because of uncertainties of future climatic conditions, ground water flow rates, and ground water compositions, the confidence in predictions of pit lake water quality tend to decrease with increasing time after the end of mining. Therefore, predictions made several decades or more into the future should be viewed as indicators of relative trends in concentrations rather than absolute values.

Because of the geometry of the final pit surface, during the early years of ground water recovery two separate pit lakes would develop and are predicted to persist for the initial 28 years of the postmining period. These two initial lakes, herein called the east and west pit lakes, have different predicted ground water inflow rates and compositions and different wall rock chemistries; therefore, they have different predicted water chemistries. Although water quality results presented in Table 3.2-25 indicate that at year 10, the median pH is predicted to be near neutral, there is potential for the initial east and west pit lakes to be acidic (pH of approximately 4) and gradually increase to near neutral to slightly alkaline conditions by year 26 (Radian International, LLC and Baker Consultants, Inc. 1997a, b). Until inflowing ground water could add enough buffering capacity to neutralize the pit water, sulfide oxidation of exposed pit wall rocks could produce enough acidic water to cause low pH conditions during the early years of filling. Initial metal loads are generally high during this period. However, precipitation of ferric hydroxide acts to continually remove trace metals, such as arsenic, cadmium, copper, lead, and zinc from solution. In year 26, predicted concentrations of total dissolved solids and sulfate in the west pit lake and concentrations of antimony in both pit lakes are predicted to exceed Nevada drinking water standards. However, substantial outflow from the pit lake to the surrounding regional ground water system is not anticipated (Radian International, LLC and Baker Consultants, Inc. 1997a).

The east and west pit lakes would coalesce into one combined lake at approximately 28 years postmining. The lake water quality results for two stages of pit filling corresponding to 10 and 26 years postmining for the east and west lakes and 50 and 233 years postmining for the combined lake are presented in Table 3.2-25. The predicted variations or trends in concentration over time for total dissolved solids, pH, sulfate, and antimony are shown in Figure 3.2-34 (Radian International, LLC and Baker Consultants, Inc. 1997a). The carbonate chemistry of the inflowing ground water is predicted to maintain the median pH of the lake

Table 3.2-25
Median Predicted Betze-Post Pit Lake Chemical Concentrations

		West Pit	East Pit	West Pit Lake	East Pit Lake	Combined Pit Lake	
Constituent	Units	Year 10	Year 10	Year 26	Year 26	Year 50	Year 233
Aluminum	mg/L	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
Ammonia as N	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Antimony	mg/L	0.038	0.055	0.032	0.066	0.041	0.032
Arsenic	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.004	0.007	0.005	0.006	0.007	0.009
Boron	mg/L	0.685	0.083	0.584	0.106	0.453	0.654
Cadmium	mg/L	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024
Calcium	mg/L	141	73.1	121	83.8	61.6	68.1
Carbonate	mg/L	51.9	64.2	50.7	62.2	64.6	48.9
Chloride	mg/L	20.3	18.9	17.0	22.5	18.8	23.4
Chromium	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Fluoride	mg/L	1.62	0.950	1.65	1.14	1.45	1.72
Iron	mg/L	<0.024	<0.024	<0.024	<0.024	<0.024	<0.024
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L	50.1	44.3	42.0	53.3	44.0	36.8
Manganese	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Mercury	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	mg/L	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017
Nitrate as N	mg/L	1.93	<0.05	1.84	0.321	0.654	0.274
pH	--	8.06	8.16	8.08	8.14	8.20	8.08
Phosphate	mg/L	<0.01	0.044	<0.01	<0.01	<0.01	<0.01
Potassium	mg/L	19.8	8.48	16.5	10.2	16.7	22.2
Selenium	mg/L	0.006	0.004	0.005	0.004	0.004	0.003
Silica	mg/L	19.2	29.1	16.0	34.8	29.9	34.7
Silver	mg/L	0.022	0.021	0.028	0.018	0.022	0.023
Sodium	mg/L	64.0	27.1	53.7	32.7	55.8	75.3
Strontium	mg/L	0.114	0.154	0.095	0.185	0.107	0.073
Sulfate	mg/L	671	329	562	396	356	283
Total Dissolved Solids	mg/L	1042	594	883	697	657	603
Thallium	mg/L	0.001	0.001	0.001	0.001	0.001	0.001
Zinc	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

Source: Radian International, LLC and Baker Consultants, Inc. 1997a.

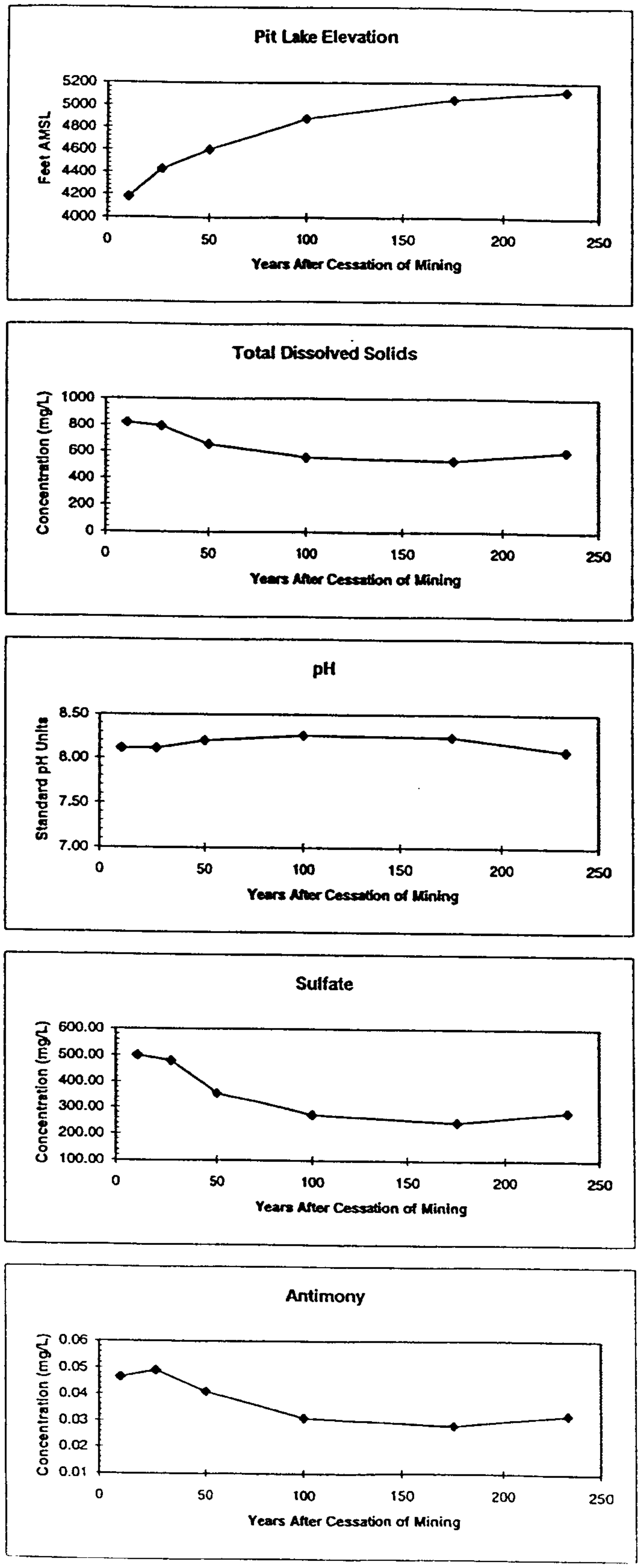


Figure 3.2-34

Betze-Post Pit Lake Trends in Median Predicted Chemical Concentrations