SAMPLING AND ANALYSIS PLAN

Section 8.0

Surface Water

OCTOBER 2009

Submitted To:

New Mexico Mining and Minerals Division
&
U.S. Forest Service (Cibola National Forest)

Prepared by:

Roca Honda Resources, LLC
4001 Office Court, Suite 102, Santa Fe, NM 87507

Contents

Figures

Tables

8.0 Surface Water

8.1 Introduction and Background

The Roca Honda permit area is drained by ephemeral arroyos that in turn drain to San Mateo Creek. San Mateo Creek joins the Rio San Jose north of the community of Milan, and the Rio San Jose joins the Rio Puerco southwest of the city of Belen. The Rio Puerco joins the Rio Grande near the community of Bernardo, south of the city of Belen (Figure 8-1). The Rio San Jose is perennial in its upper reaches in the Zuni Mountains, but becomes ephemeral in the Malpais area of its lower reaches (Stone et al., 1983). It flows only occasionally at its confluence with San Mateo Creek. Discharge from the Grants sewage plant augments the flow of the stream, and east of the city, the Rio San Jose has a fairly perennial artificial flow for a number of miles, most of which is diverted for irrigation purposes. Although physically much wider and longer than the other water courses, the Rio Puerco is also an intermittent to ephemeral stream below the point where it is joined by the Rio San Jose, losing most if its water to the underlying alluvium except during periods of precipitation or snowmelt. The permit area lies in the Upper San Mateo Creek Watershed (Figure 8-2).

San Mateo Creek begins in San Mateo Canyon on the north flank of Mount Taylor. In its upper reaches above the community of San Mateo, the creek is perennial, but its flow disappears into the stream bed below the community of San Mateo. During peak runoff from snow melt in the late spring or during heavy rain storms, which typically occur during the summer/early fall, flow in San Mateo Creek can extend downgradient until it discharges to the Rio San Jose north of the community of Milan. Neither San Mateo Creek nor the Rio San Jose contains Outstanding National Resource Water as defined in NMAC 20.6.4. San Mateo Creek will be the receiving drainage from mine discharge water.

Dewatering of the proposed mine will result in discharge of an estimated average of 8.9 cfs (4,000 gpm) of ground water. This estimate is based on experience of Gulf Mineral Resources Company (RGRC 1994), which discharged ground water at a rate of 5.6 to 11.1 cfs (2,500 to 5,000 gpm) from the Mount Taylor mine when it was in operation. Discharge from the Roca Honda mine may create surface flow that could reach the Rio San Jose about 4 miles north of the community of Milan.

Mine water will be discharged into a dry arroyo in the SE¼ SW¼ Section 16 T13N R8W; this drainage heads in the NE¼ Section 16. Discharge water would flow southwestward across the NW¼ Section 21 and southward along the border between Sections 20 and 21 before entering San Mateo Creek approximately 1.5 miles from the discharge point. The drainage and the portions of San Mateo Creek that will be affected directly by discharged water are ephemeral. The proposed discharge will change the ephemeral nature of the flow regime. Portions of the drainage will change temporarily to a perennial regime during mine operations.

An NPDES permit and NMED ground water discharge permit will be required for RHR to discharge mine water. The assessment of requirements to prepare these permits will include reviewing the existing data, conducting a survey of the water quality of the receiving drainage, and developing a monitoring plan to measure the quality of water once discharge begins.

Existing data relevant to surface water issues are discussed in Section 8.1.1 below. The baseline data needed to develop the discharge plan for water produced during dewatering, the baseline information needed to determine if mining activities affect sediments in the basin, and the baseline data necessary to determine the effects of dewatering on springs in the vicinity of the Roca Honda permit area will be collected. Existing data for each of these issues is described below in the respective subsequent sections. Data needs identified in the baseline data are summarized in Section 8.3.

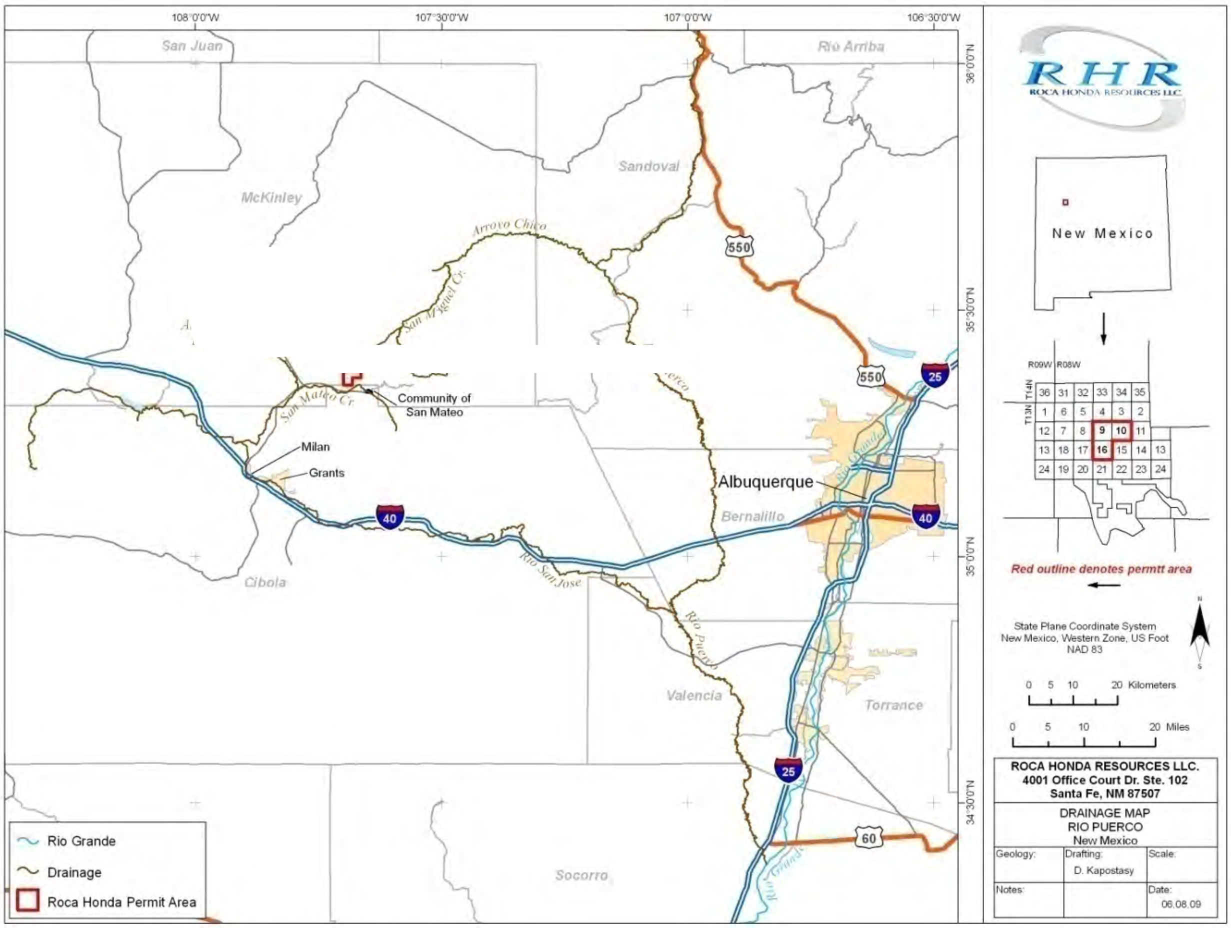

Figure 8-1. Drainage Map of San Mateo Creek

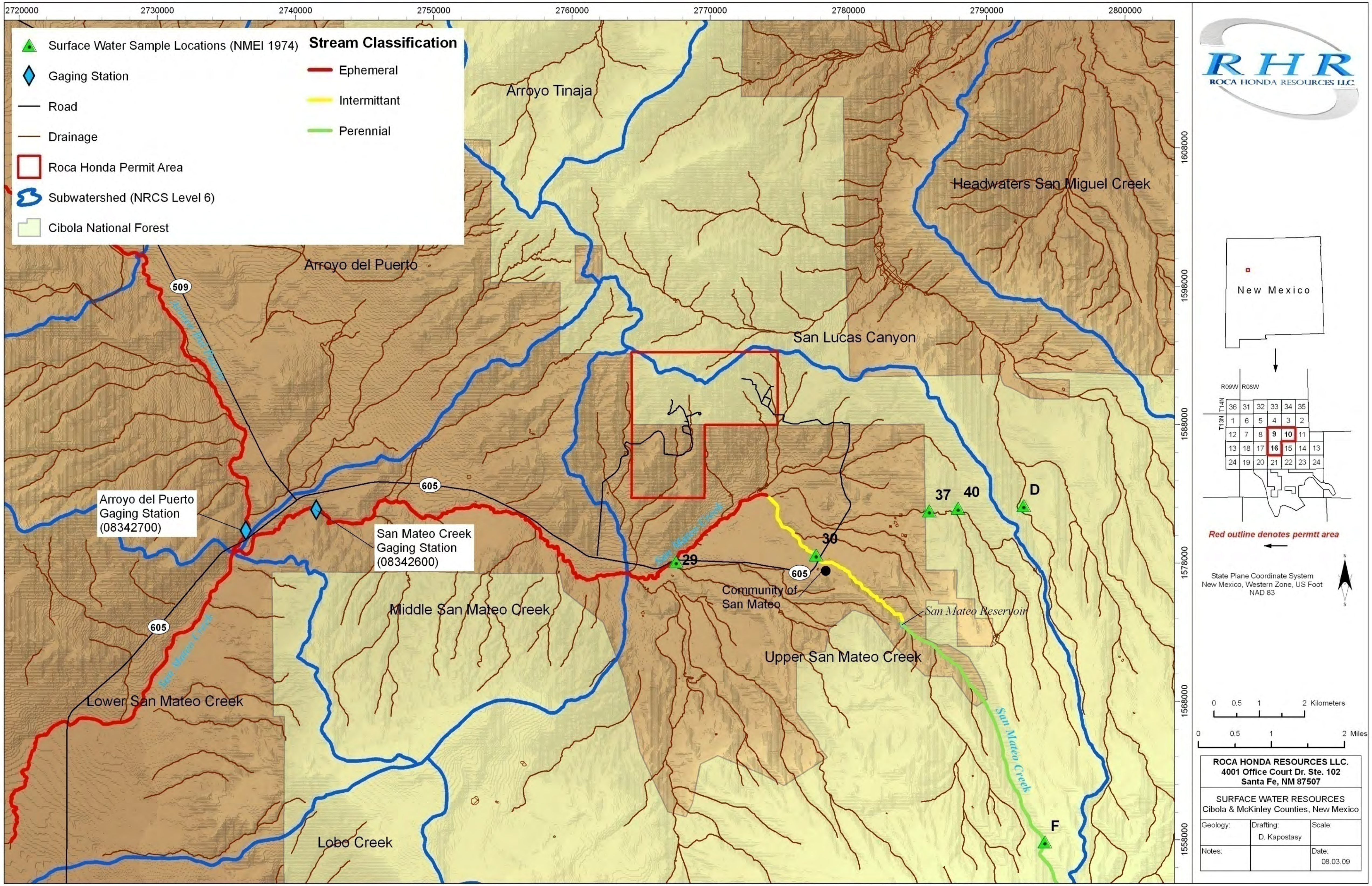

Figure 8-2. Surface Water Resources Map

8.1.1 Existing Baseline Surface Water Information

Two USGS stream flow gaging stations that operated in the late 1970s and early 1980s provide flow data for San Mateo Creek and Arroyo del Puerto (which drains Ambrosia Lake Valley). The gaging stations, designated as San Mateo Creek near San Mateo, NM (Station 08342600) and Arroyo del Puerto near San Mateo, NM (Station 08342700), are approximately 1 mile apart (Figure 8–2). A third gaging station is located on Rio San Jose at Grants, NM (Station 08343000).

The San Mateo gaging station was located about 10 miles downgradient from the community of San Mateo. It recorded daily flow of the creek from a watershed drainage area of 75.6 square miles from May 1977 to October 1982. Daily streamflow data for the 5-year operational period are shown on Figure 8-3. Monthly average flow of San Mateo Creek is shown on Figure 8-4. Elevated base flow of the creek—from 2 to 12 cfs (900 to 5,400 gpm) prior to March 1978—was the result of mine dewatering discharge during active mining of the Johnny M mine and excavation of the shafts for development of the Mount Taylor mine. Sporadic high flows of the creek after that period generally reflect high rainfall episodes during the summer/early fall and spring snowmelt runoff periods.

The Arroyo del Puerto gaging station is about 0.1 mile north of the confluence with San Mateo Creek. The station operated from September 1979 to October 1982, and the daily streamflow data for this 3-year operational period are shown on Figure 8-3. Elevated flows of this drainage are less frequent than those for San Mateo Creek and mainly reflect high rainfall episodes during the summer/early fall period.

The Rio San Jose gaging station was located just downgradient from the confluence with San Mateo Creek at Grants. This station was operational from October 1912 through September 2004. Daily streamflow data are plotted for the 6-year period from 1977 through 1982 to coincide with data from the two stations above (Figure 8-3). Elevated flow in this drainage generally reflects high rainfall episodes during the summer/early fall period. Mine-water discharge from the Johnny M and Mount Taylor mines into San Mateo Creek from May 1977 to February 1978 had no apparent effect on flows in the Rio San Jose. It should also be noted that high peak flows of 30 to 40+ cfs at the San Mateo gaging station during the summers of 1977 and 1978 had little or no expression at the Rio San Jose Station, suggesting that there is little chance that an 8.9-cfs (4,000-gpm) discharge will have effects this far downgradient (approximately 20 miles).

A previous investigation of the stream flow in San Mateo Creek was conducted in 1974 by the New Mexico Environmental Institute (NMEI) as part of the environmental baseline study of the Mount Taylor area associated with the permitting of the proposed Mount Taylor uranium mine by Gulf Mineral Resources Company (NMEI 1974). Flow measurements were made for tributaries to San Mateo Canyon to determine base flow in San Mateo Creek. Mean annual runoff of the creek was calculated. NMEI estimated that the mean annual runoff of San Mateo Canyon is 1,800 ac-ft/yr, and that of this volume, about 0.5 cfs, or 360 ac-ft/yr, was contributed by spring and ground water discharge (NMEI 1974). Three observed rainfall events varied from 0.22 to 0.90 inch.

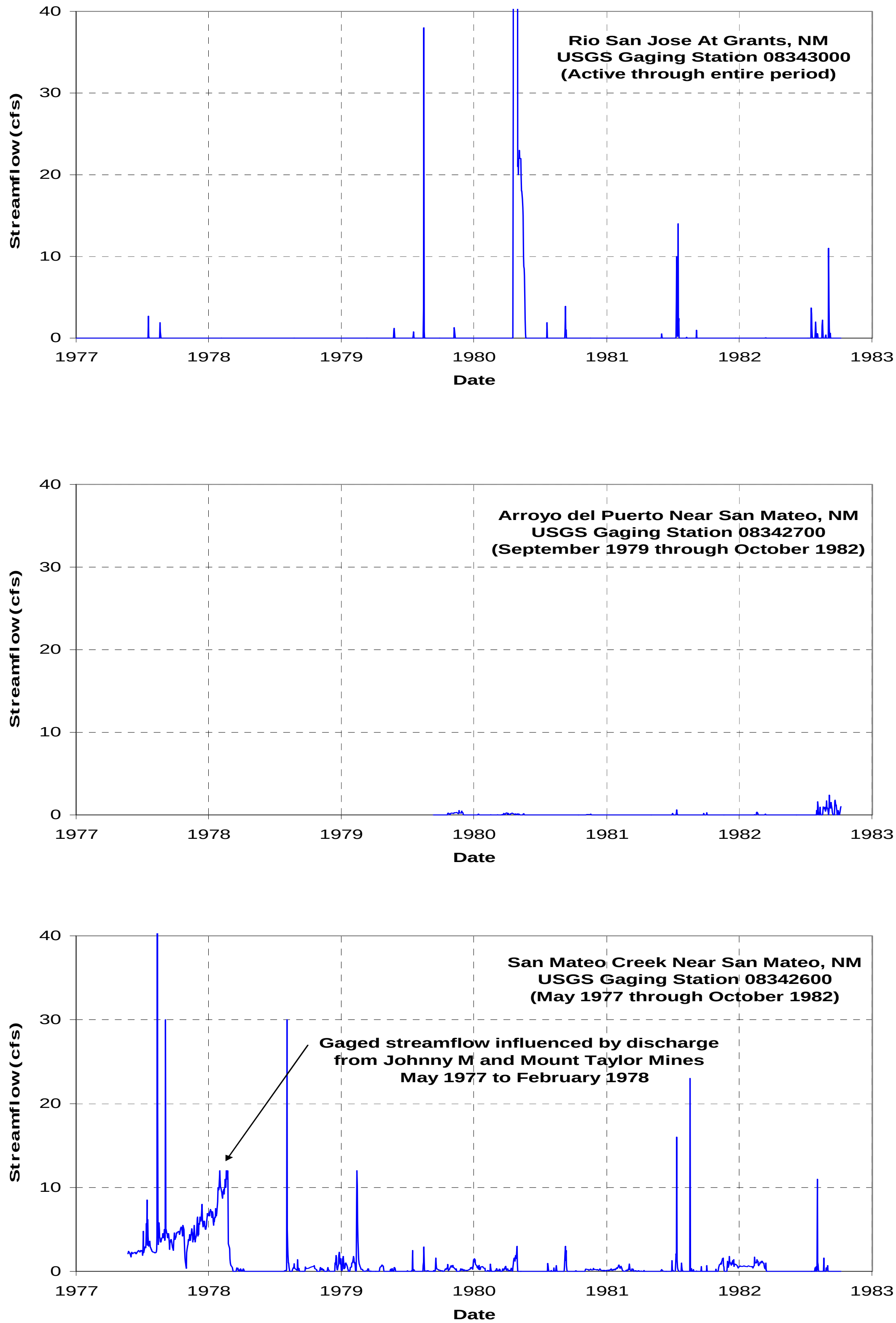

Figure 8-3. Daily Streamflow for San Mateo Creek, Arroyo del Puerto, and Rio San Jose

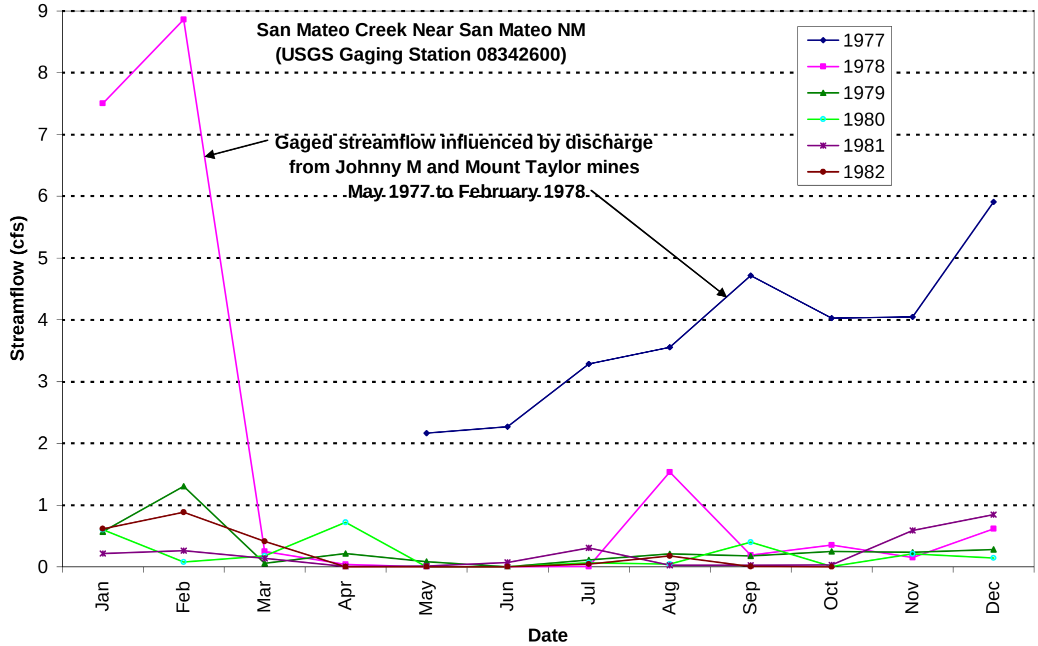

Figure 8-4. Monthly Average Flow of San Mateo Creek

The data needs for surface water flow are the rate at which flow is lost to the creek and the length of stream bed that could be affected by the discharge under normal (and storm) flow conditions. Historical aerial photographs will be reviewed in conjunction with gaging data to evaluate flow loss to the stream bed.

The 1974 baseline study collected data on surface water chemistry in the vicinity of the Roca Honda permit area. Surface water samples were collected from springs and perennial portions of San Mateo Creek and from ephemeral water sources during rain or spring runoff events. The study distinguished between upper elevation (higher than 7,950 ft) and lower elevation locations. The upper elevations generally contain snowpack for most of the winter and contributed snowmelt to the stream in late April and early May, but all springs were observed to be dry by mid to late June except American Canyon Spring. Lower elevations receive runoff in mid to late March. Watersheds in and around the Roca Honda permit area with springs and gaging stations are shown on Figure 8-2.

The historical study did not target all of the chemical constituents of interest for licensing purposes, but does provide general information on water quality. Surface water collected from higher elevations tended to be lower in total dissolved solids (TDS), but more acidic and higher in sulfate than water from lower elevations. Water from high elevation springs was of the calcium-sulfate bicarbonate type, and water from low elevation areas was of the calcium-bicarbonate type. Samples from some locations, for example, near the community of San Mateo, exhibited high levels of sodium. High levels of suspended solids were associated with high flow rates (NMEI 1974).

Data for some surface water constituents are available for San Mateo Creek and the Marquez Canyon drainage in the upper San Mateo Creek watershed, where the Roca Honda permit area is located (Table 8-1). The table shows concentration data for two locations along San Mateo Creek south of and closest to the permit area (locations 29 and 30 on Figure 8-2). Water flowed only periodically at these locations due to removal of water for irrigation. Also shown are data for two locations (37 and 40 on Figure 8-2) in Marquez Canyon, which is drained by an ephemeral stream that flows as a result of snowmelt or heavy rainfalls during the summer/early fall period. It is estimated that the drainage in Marquez Canyon had an annual discharge of 7.5 ac-ft/yr (NMEI 1974).

Table 8-1. Range of Constituents from San Mateo Creek and Marquez Canyon Sample (See Figure 8-2 for sample locations)

Constituent	San Mateo Creek at State Highway 605 Bridge (Loc. 29)	San Mateo Creek at Marquez Ranch (Loc. 30)	Marquez Canyon (Loc. 37, 2 Samples)	Junction with Maruca Canyon (Loc. 40)
pH	8.62–8.97	8.16–8.45	9.17–9.18	8.46–8.69
Specific conductance (µmhos)	650–1,090	187–241	522–526	405–1180
Calcium (mg/L)	24.53–93.76	22.98–88.01	5.98	61.01–102.5
Magnesium (mg/L)	16.12–30.40	4.32–6.21	1.46–2.13	11.38–33.75
Potassium (mg/L)	3.85–204	3.93–5.65	3.63–4.42	9.40–28.93
Sodium (mg/L)	148–281	11.83–19.89	127.1–129.5	67.48–249.0
Chloride (mg/L)	16.7–41.4	2.4–7.0	3.4–3.8	13.3–130
Sulfate (mg/L)	42–250	6–23	2	37–352
Phosphate (mg/L)	0.02–0.38	0.28–0.53	0.07–0.18	0.20–0.39
Nitrate (mg/L)	0.33–1.71	0.20–1.64	0.32–0.33	0.76–1.26
Bicarbonate (mg/L)	369.2–550.8	78.8–134.8	244.2–249.0	288.2–387.2
Alkalinity ($CaCO_3$) (mg/L)	336.8–469.7	64.6–112.5	244.2–246	256.0–350.3
Total solids (mg/L)	535–2020	180–620	640–896	850–7450

Abbreviations: mg/L = milligrams per liter µmhos = micromhos
Data from NMEI 1974.

8.1.2 Receiving Surface Water

The primary requirements for characterizing receiving drainages affected by discharges are identified in NMAC 20.6.4, which establishes water quality standards for surface waters and includes an anti-degradation policy. The discharge from the Roca Honda mine will enter an ephemeral drainage in the SE¼ SW¼ Section 16 and will flow southward to San Mateo Creek as shown in Figure 8-5. The proposed discharge will change the ephemeral nature of the flow regime. Portions of the drainage will change temporarily to a perennial regime during mine operations. Flow in the receiving part of San Mateo Creek is intermittent based on field observations, although the USGS mapped the stream as perennial in 1963. The potential for discharge to reach areas of intermittent or perennial flow constitutes a data need for the proposed discharge. RHR will perform a field survey to detail the classification of the reaches of San Mateo Creek as ephemeral, intermittent and perennial according to the criteria proposed in the draft “Hydrology Protocol for Determination of Ephemeral, Intermittent, and Perennial Waters,” prepared by the SWQB of the NMED.

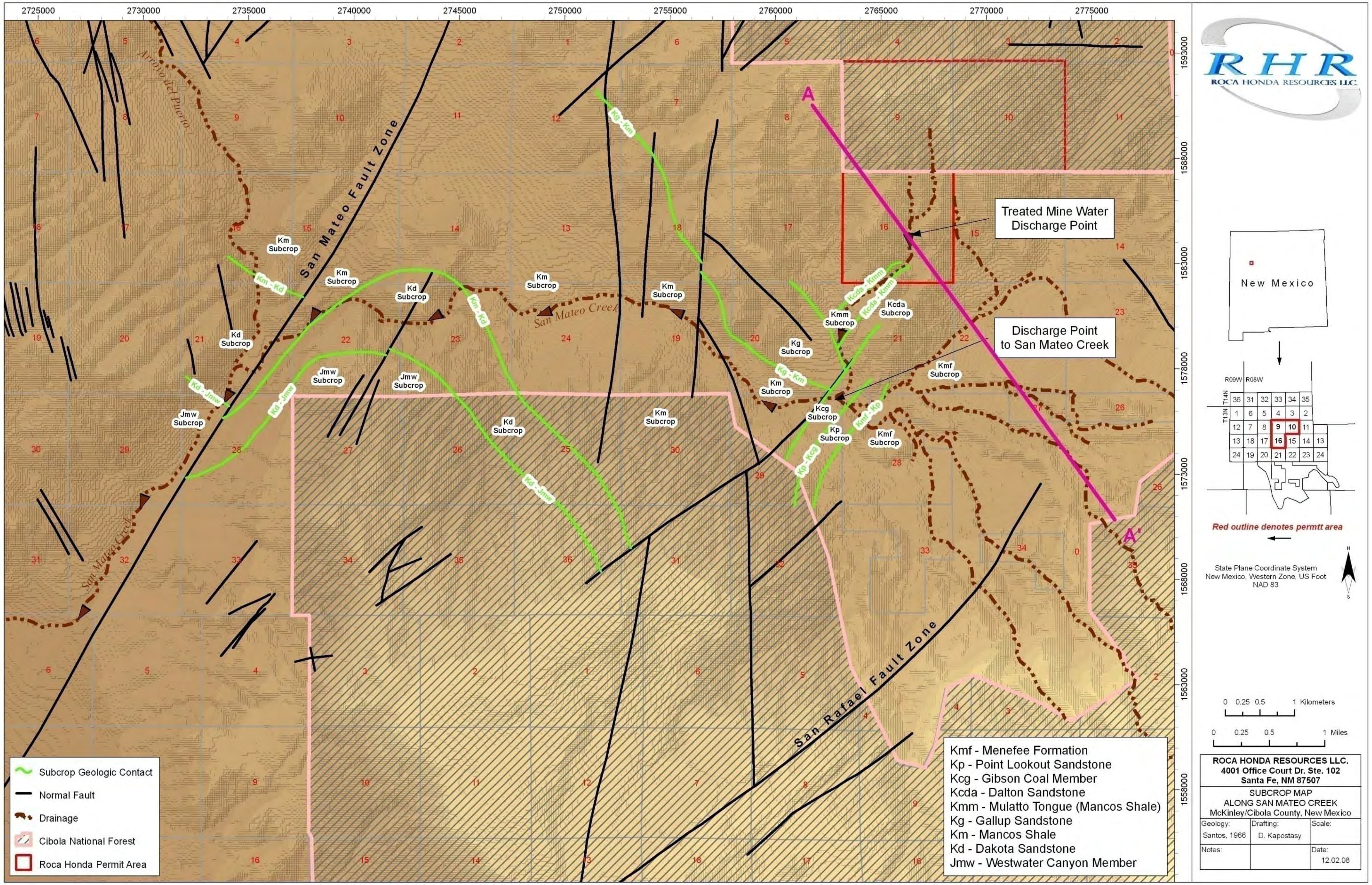

Figure 8-5. Surface and Subcrop Geology along the San Mateo Creek Drainage

8.1.2.1 *General Monitoring Requirements for Drainages*

The general requirements for surveying the quality of the receiving drainage, including ephemeral, intermittent, and perennial water bodies, are established in NMAC 20.6.4.13 and include limits on the following:

- Suspended or settleable solids,
- Floating solids,
- Oil and grease,
- Color,
- Odor and taste of water,
- Concentrations of plant nutrients,
- Toxic pollutants,
- Radioactivity,
- Pathogens,
- Temperature,
- Turbidity,
- TDS, and
- Dissolved gases (nitrogen, oxygen and ammonia).

8.1.2.2 *Pollutants Requirements for Ephemeral Drainage*

Ephemeral waters have designated uses of livestock watering, wildlife habitat, limited aquatic life, and secondary (human) contact. The standard for secondary (human) contact is a monthly geometric mean *Escherichia coli* (*E. coli*) bacterial concentration of 548 colony forming units (cfu)/100 mL and single sample of 2,507 cfu/100 mL. The acute requirements for aquatic habitats also include limits for ammonia and oxygen. The ammonia requirements are dependent on pH and temperature of the receiving drainage, and the dissolved oxygen requirements are dependent on elevation and temperature. Tables of both sets of values are included in NMAC 20.6.4.900 J, K, L, and M, and are not listed here.

8.1.2.3 *Other Requirements for Intermittent and Perennial Surface Waters*

The more stringent numerical criteria for intermittent and perennial receiving drainages is that they must meet all standards for aquatic life, including chronic limits. The chronic limits are lower than the acute limits for 22 compounds, and the standards include one additional compound (polychlorinated biphenyls). The chronic criteria for aquatic habitats also include requirements for ammonia. The limits for ammonia are dependent on pH and temperature. There are no additional targeted analytes for intermittent or perennial waters, although the detection limits required are more stringent.

8.1.2.4 *Other Requirements for Potential Recharge Areas*

The pathway of the discharged water from the proposed Roca Honda mine related to the underlying (subcropping) bedrock units is shown in the detailed map in Figure 8–5. Normal faults affect the geologic units along the drainage pathway to the south through Section 16 and the NW¼ Section 21.

As the drainage continues southward into the SW¼ Section 21 and crosses the San Rafael fault, subcropping geologic units are the Dalton Sandstone Member and the Gibson Coal Member of the Crevasse Canyon Formation. West of the confluence of the drainage with San Mateo Creek, the creek passes back over the Gibson Coal and Dalton Sandstone Members, crosses the San Rafael fault, and passes over the increasingly older units of the Dilco Coal Member of the Crevasse Canyon Formation, Gallup Sandstone, and Mancos Shale.

The San Mateo Creek drainage, westward from where the mine discharge water will enter, is shown in Figure 8–5. After passing over subcrop of Mancos Shale for approximately 4 miles, the course of the creek crosses the subcrop of Dakota Sandstone on the nose of a north-trending anticline. For a short distance, the creek bed crosses subcrop of the Mancos Shale before crossing the San Mateo normal fault. West of the fault, the creek passes over subcrop of the Morrison Formation to its confluence with Arroyo del Puerto. All of these units may contain water, although the Gibson Coal Member and the Mancos Shale are typically aquitards rather than aquifers, except where sandstone units occur in the Mancos Shale.

The effects of discharge water on the quality and flow characteristics of water in the shallow alluvium is a data need and will be discussed in more detail in Section 9.0, "Ground Water". The discharge water initially will be of high quality and is expected to dilute existing background water constituents present in alluvial water flushing existing poor background quality water from the alluvium. The extent of communication between the alluvium and underlying formations that contain potable ground water is not clear and will be investigated as part of the effort to fill ground water data needs. The NMAC 20.6.4 standards for domestic water supplies may apply to surface water that recharges ground water used for human consumption.

8.1.3 Sediments in the Drainage from Section 16 and San Mateo Creek Basin

The current concentrations of constituents in sediments downgradient of the proposed discharge are not known and constitute a data need. Water flowing over sediments may pick up constituents from the sediments. The concentrations of water soluble constituents in the drainage from Section 16 and San Mateo Creek are not known and represent a data need. The data necessary to address these data needs are discussed in more detail in Section 8.3.

Increased flow in the Section 16 drainage and San Mateo Creek also may increase the movement of sediments downgradient. Such movement depends on the grain size of the sediments, any existing and potential armoring of the stream bed, the quantity of water flowing under normal and flood conditions, and the slope of the stream bed. The slope of the stream bed is known from USGS topographic maps, but more detailed information will help quantify movement potential in the San Mateo Creek bed. Grain size of the sediments, presence and extent of armoring, potential to form additional armor, and water flow under normal and storm conditions are all data needs. The data that will be collected to address these data needs are described in more detail in Section 8.3.

8.1.4 Existing Baseline Springs Information

Bridge Spring, North Spring, and South Spring are within 2 miles of the Roca Honda permit area. All are to the south in and near San Mateo Creek (Figure 8–2 and Table 8–2).

Table 8-2. Springs within 2 Miles of the Roca Honda Permit Area.

Spring Designation	Northing*	Easting*	Watershed
Bridge Spring	3913747	255976	Upper San Mateo Creek
North Spring	3914036	255981	Upper San Mateo Creek
South Spring	3912891	254949	Upper San Mateo Creek

*NAD83 datum and UTM Zone 13 projection

These springs are located 2/3 mile east and up-channel of the arroyo into which RHR proposes to discharge mine water. The springs get their water from the Menefee Formation rocks on the east side of the San Rafael Fault (See Figure 8-5). The location of cross-section A-A´ in Figure 8-6 is shown on Figure 8-5. Some of the spring water is consumed by salt cedars, some evaporates, and some enters San Mateo Creek, flowing briefly westward in the stream channel until it seeps into channel alluvium and the sandstones of the Point Lookout Sandstone. Figure 8-6 shows the geology in the area of and downstream of the springs. The Menefee Formation and Point Lookout Sandstone are unsaturated in the vicinity of the Permit Area.

Confirming the presence and seasonal persistence of springs along San Mateo Creek and within the permit area and their flow rate and water chemistry are data needs. No water rights are associated with these springs.

Table 8–3 is a summary of the range of water quality data collected from springs farther from the Roca Honda permit area: San Lucas Spring and San Mateo Spring (Figure 8–2). Generally, San Mateo Spring had lower concentrations of most constituents than San Lucas Spring.

Table 8-3. Range of Constituents from Spring Samples

Constituent	San Lucas Spring (Loc. D) (mg/L)	San Mateo Spring (Loc. F) (mg/L)
pH	7.85–8.20	6.89–7.21
Specific conductance (mmhos)	159–228	83.9–116
Calcium	20.68–32.34	211.66–13.04
Magnesium	5.28–9.45	2.04–2.86
Potassium	2.61–4.84	1.28–1.61
Sodium	8.90–21.02	3.15–3.72
Chloride	3.6–12.0	2.9–4.2
Sulfate	1–5	9–13
Phosphate	0.11–0.21	0.09–0.90
Nitrate	0.18–0.58	0.28–0.56
Bicarbonate	102.0–128.0	20.0–34.2
Alkalinity ($CaCO_3$)	83.6–105.1	16.4–28.0
Total solids	115–180	60–108

Abbreviations: mg/L = milligrams per liter mmhos = millimhos Data from NMEI 1974

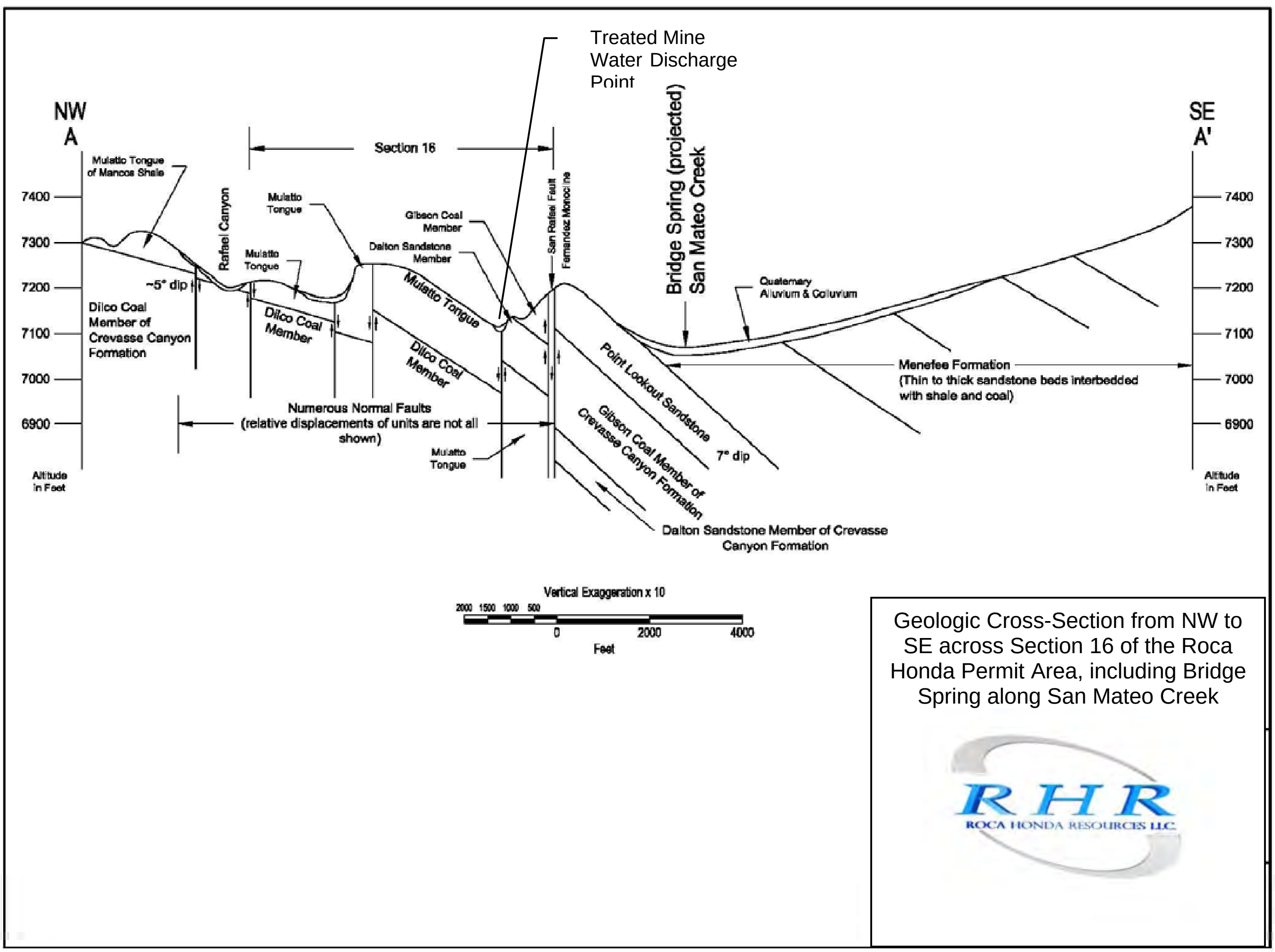

Figure 8-6. Geologic Cross-Section across Section 16 and San Mateo Creek.

8.2 Sampling Objectives

The objective of surface water sampling is to fill data needs identified for baseline surface water conditions as shown in Table 8-4. The information collected in this effort will supplement existing information and provide the baseline information necessary to assess potential and actual affects of mining on surface water.

8.3 List of Data to be Collected

This section provides detailed information to direct the collection of baseline data related to surface water. The data needs identified for surface water are presented in Table 8-4.

Table 8-4. Data Needs Identified for Surface Water

Data Need	Plan to Address Data Need
Historical extent of flow in San Mateo Creek.	Review historical aerial photographs.
Nature of flow in San Mateo Creek.	Ground surveys will determine the nature of flow in the drainage from Section 16 that will be receiving discharge water. The stream reaches of San Mateo Creek from the reservoir above San Mateo to 5 miles below the point where mine dewatering water will enter the Creek will be classified as ephemeral, intermittent and perennial according to the criteria proposed in the Draft "Hydrology Protocol for Determination of Ephemeral, Intermittent, and Perennial Waters," prepared by the SWQB of the NMED. The presence or absence of water in the alluvium at the base of the stream bed will be determined. Work to be performed will be described in detail in the ground water section of the SAP.
Potential for the discharge to affect reaches with intermittent or perennial flow.	Aerial photographs and ground surveys will be used to determine the location of the nearest downgradient intermittent or perennial water.
Baseline water quality for receiving drainage.	Samples of surface water will be collected upgradient and downgradient of planned discharge and analyzed. Targeted information will include major cations, major anions, radionuclides, and constituents regulated under WQCC water quality standards as specified in 20.6.4.900 NMAC for ephemeral, intermittent, and perennial receiving drainages. Constituents not detected in the initial round of analyses may not be targeted in subsequent sampling events. Four quarterly sampling events are anticipated.
Baseline information on the chemistry of sediments.	Samples will be analyzed for the same suites of constituents targeted in water samples.
Concentration of water soluble constituents in sediments.	Samples collected for baseline information on the chemistry of sediments will be analyzed to determine the concentrations of soluble constituents. Analyses will be limited to constituents positively detected in the analysis of the total concentrations of constituents in sediments.
Grain size of sediments.	Grain size information will be obtained in the laboratory to evaluate the effects on geochemistry.
Presence and extent of armoring in the drainage from Section 16 and San Mateo Creek bed.	Field surveys will be conducted to document the extent of armoring present or that may form. The field survey will note the presence and approximate abundance of large clasts too large to collect for analysis.
Detailed topography of drainage channels.	Stream bed profiles will be collected at appropriate intervals across the channel of the drainage from Section 16 to quantify stream cross sections under various flow conditions.
Flow conditions in San Mateo Creek.	ACSGs will be installed in San Mateo Creek to determine the frequency and volume of flow and the rate of flow loss to the creek bed.
Location of springs and their water quality.	The locations of springs near the Roca Honda permit area will be verified in the field. Selected springs will be sampled for flow and water quality.

8.4 Methods of Collection

Table 8-5 lists the types and amounts of data to be gathered, the objectives and purpose of the proposed samples, the number of locations that would be sampled and the map where the locations are plotted, the frequency of sampling, and the parameters to be analyzed. Final selection of sampling sites is contingent upon obtaining access agreements. The rows of the table are discussed sequentially in the following sections along with details of sample collection

8.5 Parameters to be Analyzed

Table 8-6 lists the parameters to be analyzed.

8.5.1 Nature of Flow in the Drainages

8.5.1.1 *Data Collection*

The nature of historical flow in San Mateo Creek is important because it will help in the calculation of the rate water is lost to the drainage bed, and it will help evaluate the potential for discharge water to affect the drainage. The nature and extent of flow will be determined using available historical aerial photographs. The analysis will determine the presence or absence of water in each reach extending from the proposed discharge point to the maximum expected extent of flow (22 miles from the point of discharge). The information will be supplemented by depth/flow information obtained using automatic data loggers at the locations shown in Figure 8–8.

8.5.1.2 *Intermittent or Perennial Water and Structures*

Recent aerial photographs will be used to determine the location of the nearest intermittent and perennial water bodies and structures that could be impacted by the proposed discharge. Once the aerial photographic analysis is completed, a ground survey will be conducted to confirm the location of perennial water bodies and the location and use of structures. The reaches of San Mateo Creek from the reservoir above San Mateo to 5 miles below the point where mine dewatering water will enter the Creek will be classified as stated in Section 8.1.2 above.

As noted in the ground water section of this SAP (Section 9.0), monitor wells will be installed to determine the thickness and extent of the alluvium at the Roca Honda permit area and at a location in San Mateo Creek below the proposed point of Roca Honda Mine water discharge.

8.5.1.3 *Baseline Water Quality*

Surface water samples will be collected to characterize the water quality of receiving drainages. Characterization will include perennial, intermittent, and ephemeral reaches of the drainage; all reaches will be characterized initially for the complete list of targeted analytes shown in Table 8-6.

RHR will employ the services of a qualified laboratory that has all of the appropriate laboratory certifications. The laboratory will be required to perform its analyses to the detection limits required in its certification. Sample location, number of samples, field protocols, etc. will be determined using USGS National Water-Quality Assessment (NAWQA) Program protocols, specifically those outlined in USGS Open File Report (OFR) 94-455, "Field Guide for Collecting and Processing Stream-Water Samples for the National Water-Quality Assessment Program" and USGS (OFR) 97-223, "Quality-Control Design for Surface-Water Sampling in the National Water-Quality Assessment Program and the techniques outlined in USGS Techniques of Water-Resources Investigation (TWRI) Reports 9, "National Field Manual for Collection of Water Quality Data," Chapters A1 through A9. Protocols identified in Section 8.8 of this SAP will be followed to the extent appropriate and/or applicable to site conditions during collection and processing of the samples. The documents referenced herein describe in detail how sample sites should be selected, how to determine the number of sample sites, and how to collect, process and store the samples, and which parameters should be taken in the field.

Sampling will be accomplished using a combination of autosampling equipment co-located with pressure transducers, flow meters, and field collection. Sampling of flow events will extend across one or more years to determine seasonal variability. An exact schedule cannot be established because sampling events will coincide with flow within the reaches. Flow is not expected at all of the locations because most of the effected reaches are ephemeral or intermittent. Targeted analytes include those of interest in ground water as discussed in Section 9.0 of the SAP.

The number of samples needed to define variance between sites and between seasons will vary from constituent to constituent, from site to site, and from season to season. The size of these variances cannot be estimated until data is collected. Data for each constituent will be analyzed as it is collected to estimate total variance, variance between sample sites, and seasonal variance. Variance results for all constituents will be tested for statistical significance as they become available, and the degree of confidence in the analysis for each constituent will be determined.

Proposed sampling locations are shown in Figure 8-8. These locations and the number of samples may be adjusted once the perennial or intermittent reaches are identified and in conformance with the field protocols discussed in Section 8.5.1.3. Samples will be analyzed for the parameters shown in Table 8-6.

Samples to be collected for each sampling event will include a field duplicate sample as a part of the QA/QC program. Sample size and preservation and holding time requirements for each group of analytes are specified in Table 8-7. Analyte suites with no positive detections above levels of concern in the initial round of analyses will not be targeted in subsequent sampling events.

Table 8-5. Proposed Data Gathering Activities

Type of Data Gathering	Purpose	Locations	Frequency	Parameters to be Analyzed
1. Ground survey (Section 8.5.1.1)	Determine nature of historical flow.	Aerial photographs and ground survey.	Once.	Observations.
2. Ground survey (Section 8.5.1.2)	Determine location of intermittent or perennial water, and locations of any houses and structures potentially affected.	Aerial photographs with a ground survey confirmation. The stream reaches of San Mateo Creek from the reservoir above San Mateo to 5 miles below the point where dewatering water enters the Creek will be classified as ephemeral, intermittent and perennial according to the criteria proposed in the Draft “Hydrology Protocol for Determination of Ephemeral, Intermittent, and Perennial Waters,” prepared by the NMED SWQB.	Once.	Observations.
3. Surface water sampling (Section 8.5.1.3)	Characterize receiving drainage.	A sufficient number of sample locations, as determined in the field and in conformance with Section 8,8 of this SAP, extending over the drainage downgradient of the point where the proposed mine dewatering discharge enters San Mateo Creek.	When flow event occurs, if possible.	Major cations; major anions; radionuclides, and constituents regulated under WQCC water quality standards as specified in 20.6.4.900 NMAC for ephemeral, intermittent, and perennial receiving drainages.
4. Samples of sediments (Section 8.5.1.4)	Characterize the sediment constituents in the drainage bed.	A representative number of sample locations (including quality control samples) extending downgradient from the discharge.	Once.	Major cations; major anions; radionuclides; and constituents regulated under WQCC water quality standards as specified in 20.6.4.900 NMAC for ephemeral, intermittent, and perennial receiving drainages.
6. Samples of sediments (Section 8.5.1.6)	Grain size of sediments.	Representative samples in the lab from field samples.	Once.	Grain size distribution information.
7. Field survey (Section 8.5.1.7)	Armoring of the stream bed.	Walkover surveys will be conducted along the beds of the arroyo and drainages downgradient from the discharge point.	Once.	Field descriptions of the distribution of clasts. Photographic documentation of armoring.
8. Topographic information (Section 8.5.1.8)	Baseline topographic information for arroyo and drainage.	Profiles across stream bed at 500-ft intervals for the first 5 miles and 1,000-ft intervals thereafter. GPS surveys linked to GIS.	Once.	Stream bed profiles at intervals across the channel of the arroyo and drainages.
9. Install ACSGs on the arroyo and San Mateo Creek (Section 8.5.1.9)	Determine volume, rate and timing of water flow of water loss to the channel.	In the arroyo and in the creek bed up-channel of the planned discharge, and down-channel of the planned discharge.	Information will be collected for 1 or more years.	Gages and flow meters will be automated to capture storm events.
10. Field surveys and local interviews to gather historic springs data and characterize springs (Section 8.5.1.10)	Determine the completeness of the database. Sample where possible.	Springs present near the permit area and that issue from the geologic units that may be affected by depressurization/dewatering.	Quarterly for one year where possible.	Interviews and field surveys will be documented. Sample analyses per item 3 above.

Table 8-6. Analytes and Methods to be Used

Analyte	Method for Determination in Water (EPA* or SMEWW**)	Lab detection limits for Water (mg/L unless noted)	Method for Determination in Sediment	Lab Detection Limits for Sediments(mg/L unless noted
Suspendable or settleable solids	SMEWW Method 2540F		NA	
Floating solids	SMEWW Method 2530B		NA	
Oil and grease	SW846 Method 1664A		SW846 Method 9071B	
Particle size analysis/texture			ASA 15-5	1(%) 1 (%)
Moisture			USDA26	0.1 (%)
pH	EPA Method 150.1	.01 (s.u.)	SW846 Method 9045D	.01
Color	SMEWW Method 2120B	5.0 (c.u.)	NA	5.0
Odor	SMEWW Method 2150B	1 (T.O.N.)	NA	1
Hardness as CaCO3	A2340B	1	NA	1
Concentrations of plant nutrients	See specific methods below		See specific methods below	
E. coli	EPA Method 1103.1		NA	
Toxic pollutants	See specific methods below		See specific methods below	
Radioactivity	See specific methods below		See specific methods below	
Pathogens	See specific methods below		NA	
Temperature	Field Measurement; SMEWW Method 2550B		NA	
Turbidity	Field Measurement using EPA Method 180.1		NA	
Conductivity	EPA Method 2510B	1 (umhos/cm)		
Solids, TDS @ 180C	Field Measurement using SMEWW Method 2540B	10	NA	10
Dissolved gases (nitrogen, oxygen, and ammonia)	Field Measurement		SMEWW Method 2710B	
MAJOR IONS				
Alkalinity, Total as CaCO3	A2320 B	1.0	NA	
Carbonate as CO3	A2320 B	1.0	NA	
Bicarbonate as HCO3	A2320 B	1.0	NA	
Hydroxide as OH	A2320 B	1.0	NA	
Calcium	EPA Method 200.7	1	Total. SW846 Method 6010B	
Chloride	EPA Method 300.0	1		
Fluoride	A4500-F C	0.1		
Magnesium	EPA Method 200.7	1	Total. SW846 Method 6010B	
Nitrogen, Nitrate as N	EPA Method 353.2	0.1	NA	
Nitrogen, Nitrate+Nitrite as N	EPA Method 353.2	0.1	NA	
Nitrogen, Kjeldahl Total as N	EPA Method 351.2	0.5	NA	
Potassium	EPA Method 200.7	1	Total. SW846 Method 6010B	
Sulfate	EPA Method 300.0	1		

Table 8-6. Analytes and Methods to be Used (Continued)

Analyte	Method for Determination in Water (EPA* or SMEWW**)	Lab detection limits for Water (mg/L unless noted)	Method for Determination in Sediment	Lab Detection Limits for Sediments(mg/L unless noted
NON-METALS				
Cyanide, Total	Kelada mod	.005	NA	
Phosphate	SMEWW Method 365.1		NA	
METALS_DISSOLVED				
Aluminum	EPA Method 200.7	0.1	Total. SW846 Method 6010B	.5
Antimony	EPA Method 200.8	0.05	Total. SW846 Method 6010B	. 5
Arsenic	EPA Method 200.8	0.001	Total. SW846 Method 6020	.5
Barium	EPA Method 200.8	0.1	Total. SW846 Method 6010B	.5
Beryllium	EPA Method 200.7	0.01	Total. SW846 Method 6010B	.5
Boron	EPA Method 208.7	0.1	Total. SW846 Method 6010B	.5
Cadmium	EPA Method 208.8	0.01	Total. SW846 Method 6020	.5
Chromium	EPA Method 208.8	0.05	Total. SW846 Method 6010B	..5
Cobalt	EPA Method 208.8	0.01	Total. SW846 Method 6010B	.5
Copper	EPA Method 208.8	0.01	Total. SW846 Method 6010B	.5
Iron	EPA Method 208.8	0.03	Total. SW846 Method 6010B	.03
Lead	EPA Method 208.8	0.05	Total. SW846 Method 6020	.05
Manganese	EPA Method 200.7	0.01	Total. SW846 Method 6020	.01
Mercury	Total. Not filtered and analyzed by EPA Method 245.1	.0001	Total. SW846 Method 7471A	.05
Molybdenum	EPA 200.8	.1	Total. SW846 Method 6020	.5
Nickel	EPA Method 200.8	.05	SW846 Method 6010B	.5
Selenium, total recoverable	Not filtered and analyzed by EPA Method 200.8	.001	SW846 Method 6020	0.5
Silver	EPA Method 200.8	.01	Total. SW846 Method 6010B	.5
Thallium	EPA Method 200.8	0.1	Total. SW846 Method 6020	.5
Uranium	EPA Method 200.8	.0003	Total. SW846 Method 6020	.5
Vanadium	EPA Method 200.8	0.1	Total. SW846 Method 6020	.5
Zinc	Dissolved. Filtered and analyzed by EPA Method 200.8	0.01	Total. SW846 Method 6010B	.5
METALS-TOTAL				
Uranium	EPA Method 200.8	.0003	SW846 Method 6020	.5
RADIONUCLIDES-TOTAL		pCi/L		

Table 8-6. Analytes and Methods to be Used (Continued)

Analyte	Method for Determination in Water (EPA* or SMEWW**)	Lab detection limits for Water (mg/L unless noted)	Method for Determination in Sediment	Lab Detection Limits for Sediments(mg/L unless noted
Gross alpha	EPA Method 900.0		EPA Method 900.1 modified	0.1
Radium 226	EPA Method 903.0		EPA Method 903.0	
Radium 226 +Radium 228	EPA Method 903.0 and 904.0		EPA Method 903.0 and 904.0 modified	
Radon-222	D5072-92	100	NA	
Strontium 90	EPA Method 905.0		EPA Method 905.0	0.5
Thorium	EPA Method 907.0		EPA Method 907.0	0.1
Tritium	EPA Method 906.0			
ORGANOCHLORINE PESTICIDES		(mg/kg)		(mg/kg)
2,3,7,8-TCDD dioxin	EPA Method 1613B		SW846 Method 8290	
Aldrin	EPA Method 608		SW846 Method 8081A	.00170 (mg/kg)
alpha-BHC	EPA Method 608		SW846 Method 8081A	.00170 (mg/kg)
beta-BHC	EPA Method 608		SW846 Method 8081A	.00170 (mg/kg)
gamma-BHC (Lindane)	EPA Method 608		SW846 Method 8081A	.00170 (mg/kg)
Chlordane	EPA Method 608		SW846 Method 8081A	.0170 (mg/kg)
4,4'-DDT and derivatives	EPA Method 608		SW846 Method 8081B	.00170 (mg/kg)
Dieldrin	EPA Method 608		SW846 Method 8081A	.00170 (mg/kg)
Alpha-Endosulfan	EPA Method 608		SW846 Method 8081A	.00170 (mg/kg)
Toxaphene	EPA Method 608		SW846 Method 8081A	0.167(mg/Kg)
PCBs	EPA Method 608		SW8082	.00170 (mg/kg)
SYNTHETIC ORGANIC COMPOUNDS		ug/L		
1,2,4 Trichlorobenzene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
1,2 Diphenylhydrazine	EPA Method 625		SW846 Method 8270C	
1,2,4,-Trichlorobenzene	EPA Method 625		SW846 Method 8270C	
1,3-Dichlorobenzene	EPA Method 625		SW846 Method 8270C	0.33 (mg/kg)
2-Methyl-4, 6-dinitrophenol	EPA Method 625		SW846 Method 8270C	
2,4,6-Trichlorophenol	EPA Method 625		SW846 Method 8270C	.33 (mg/kg)
2,4-Dichlorophenol	EPA Method 625	10	SW846 Method 8270C	.33 (mg/kg)
2,4-Dimethylphenol	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)

Table 8-6. Analytes and Methods to be Used (Continued)

Analyte	Method for Determination in Water (EPA* or SMEWW**)	Lab detection limits for Water (mg/L unless noted)	Method for Determination in Sediment	Lab Detection Limits for Sediments(mg/L unless noted
2,4-Dinitrophenol	EPA Method 625	10	SW846 Method 8270C	1.7 (mg/kg)
2,4-Dinitrotoluene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
2-Chloronaphthalene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
2-Chlorophenol	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
3,3', Dichlorobenzidine	EPA Method 625	10	SW846 Method 8270C	0.67 (mg/kg)
Acenaphthene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Anthracene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Benzidine	EPA Method 625	20	SW846 Method 8270C	0.33 (mg/kg)
Benzo(a)anthracene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Benzo(a)pyrene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Benzo(b)fluoranthene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Benzo(k)fluoranthene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Bis(2-chloroethyl) ether	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Bis(2-chloroisopropyl) ether	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Bis(2-ethylhexyl) phthalate	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Butylbenzyl phthalate	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Chrysene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Dibenz(a,h)anthracene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Di-n-butyl phthalate	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Diethyl phthalate	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Dimethyl phthalate	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Fluorene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Fluoranthene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Hexachlorobenzene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Hexachlorobutadiene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Hexachlorocyclopentadiene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Hexachloroethane	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Ideno(1,2,3-cd)pyrene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)

Table 8-6. Analytes and Methods to be Used (Continued)

Analyte	Method for Determination in Water (EPA* or SMEWW**)	Lab detection limits for Water (mg/L unless noted)	Method for Determination in Sediment	Lab Detection Limits for Sediments(mg/L unless noted
Isophorone	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Nitrobenzene	EPA Method 625		SW846 Method 8270C	0.33 (mg/kg)
N-Nitrosodimethylamine	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
N-Nitrosodi-n-propylamine	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
N-Nitrosodiphenylamine	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Penta-chlorophenol	EPA Method 625	10	SW846 Method 8270C	1.7 (mg/kg)
Penanthrene	EPA Method 625	10		
Phenol	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
Pyrene	EPA Method 625	10	SW846 Method 8270C	0.33 (mg/kg)
VOLATILE ORGANIC COMPOUNDS				
1,1,2,2, Tetrachloroethane	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
1,1,2-Trichloroethane	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
1,1-Dichloroethylene	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
1,2, Dichlorobenzene	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
1,2-Dichloroethane	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
1,2 Dichloropropane	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
1,3 Dichlorobenzene	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
1,3 Dichloropropene	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
1,4 Dichlorobenzene	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Acrolein	EPA Method 624		SW846 Method 8260B	2.0 (mg/kg)
Acrylonitrile	EPA Method 624		SW846 Method 8260B	2.0 (mg/kg)
Benzene	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Bromoform	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Carbon tetrachloride	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Chlorobenzene	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Chlorodibromomethane	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Chloroform	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Dichlorobromomethane	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)

Table 8-6. Analytes and Methods to be Used (Continued)

Analyte	Method for Determination in Water (EPA* or SMEWW**)	Lab detection limits for Water (mg/L unless noted)	Method for Determination in Sediment	Lab Detection Limits for Sediments(mg/L unless noted
Ethylbenzene	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Methyl bromide	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Methylene chloride	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Tetrachloroethylene	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Toluene	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Trans-1,3-dichloropropene	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Trichloroethyene	EPA Method 624	1.0	SW846 Method 8260B	0.2 (mg/kg)
Vinyl chloride	EPA Method 624	1.0	SW846 Method 8260B	.20 (mg/Kg)

*EPA U.S. Environmental Protection Agency
**SMEWW Standard Methods for the Examination of Water and Wastewater
NA Not applicable

8.5.1.4 *Sediment Constituents*

A representative number of samples (including quality control samples) will be collected to characterize the existing drainage downgradient from the discharge. Twenty two miles is the approximate upper limit on the distance mine discharge water is anticipated to flow. Sample sites will be selected in areas where sediments are expected to be added to the drainage, such as downstream of tributaries and other areas identified in the field that provide a representative characterization of the drainage. Much of the San Mateo Creek basin is used for agriculture, and agricultural areas are a potential source of non-point source sediments. Samples will be relatively closely spaced near the point of discharge and will be spaced at greater intervals farther away from the discharge. The approximate sampling locations are shown in Figure 8-9. Samples will be analyzed for the parameters shown in Table 8-6.

Sample collection shall be in conformance with procedures consistent with those described by Shelton and Capel (1994) streamlined and simplified for conditions in the vicinity of the Roca Honda site and modified to include elements of SW-846 (USEPA, 2007), Guy (2005), and Edwards and Glysson (1999).

Samples will not be sieved prior to analysis. Gravel larger than the mouth of the sample jars will be excluded from the sediments because of physical constraints. The amount of excluded material as a volume percentage of the undisturbed sediments will be estimated and documented in the field notes when gravel is excluded from samples. As Shelton and Capel (1994) note "fine-grained particles…are natural accumulators of trace elements and hydrophobic organic compounds", but samples will not be sized in the field or laboratory because of their initial fine-grained nature. Sizing tends to overstate the concentrations of many constituents. Grain-size information will be obtained in the laboratory to allow the effects of grain size on geochemistry to be evaluated. Geochemical measurements that vary systematically with grain-size such as aluminum content also will be used in evaluating data. Biasing samples toward fine-grain sizes would tend to overstate the concentration of constituents in pre-minig background samples.

All samples will be discrete grab samples from the uppermost five cm of sediment rather than composites. Samples will be scooped from the upper five cm of soil. Approximately one kg of sample will be collected. Sufficient numbers of samples and duplicates will be analyzed to characterize the variability of sediments. After the initial sampling, statistical tests will be performed to determine the adequacy of sample numbers to characterize populations and variances. The statistical analysis will direct additional sampling if necessary.

For QA/QC purposes, duplicate, matrix spike samples, and matrix spike duplicate samples will be co-collected from the same site, but will not be splits of single samples. This convention was adopted to determine the variance at a sample site from all sources.

San Mateo Creek and its tributaries are braided river systems lacking gravel because of the parent material. Flow in the system is episodic through flash floods, and large fluctuations in flow are common. As with most such systems, flow is concentrated in a fairly defined zone with a broad surrounding area of abandoned channels and bars. Such systems are characterized by ephemeral bars which develop on several scales (Reading 1978). These bars form in response to fluctuations in discharge and can be divided into three types: 1. longitudinal bars, 2. bars in curved channel reaches, and 3. transverse bars. Sampling will concentrate in depositional areas of each bar type as near as possible to the designated sampling point.

8.5.1.5 *Soluble Constituents in Sediments*

Samples will be co-collected with the sediment samples described in Section 8.5.1.4 for analyzing soluble constituents. The samples will be analyzed following EPA SW846 Method 1312, "Synthetic Precipitation Leaching Procedure," to determine the concentrations of water soluble constituents in the sediments.

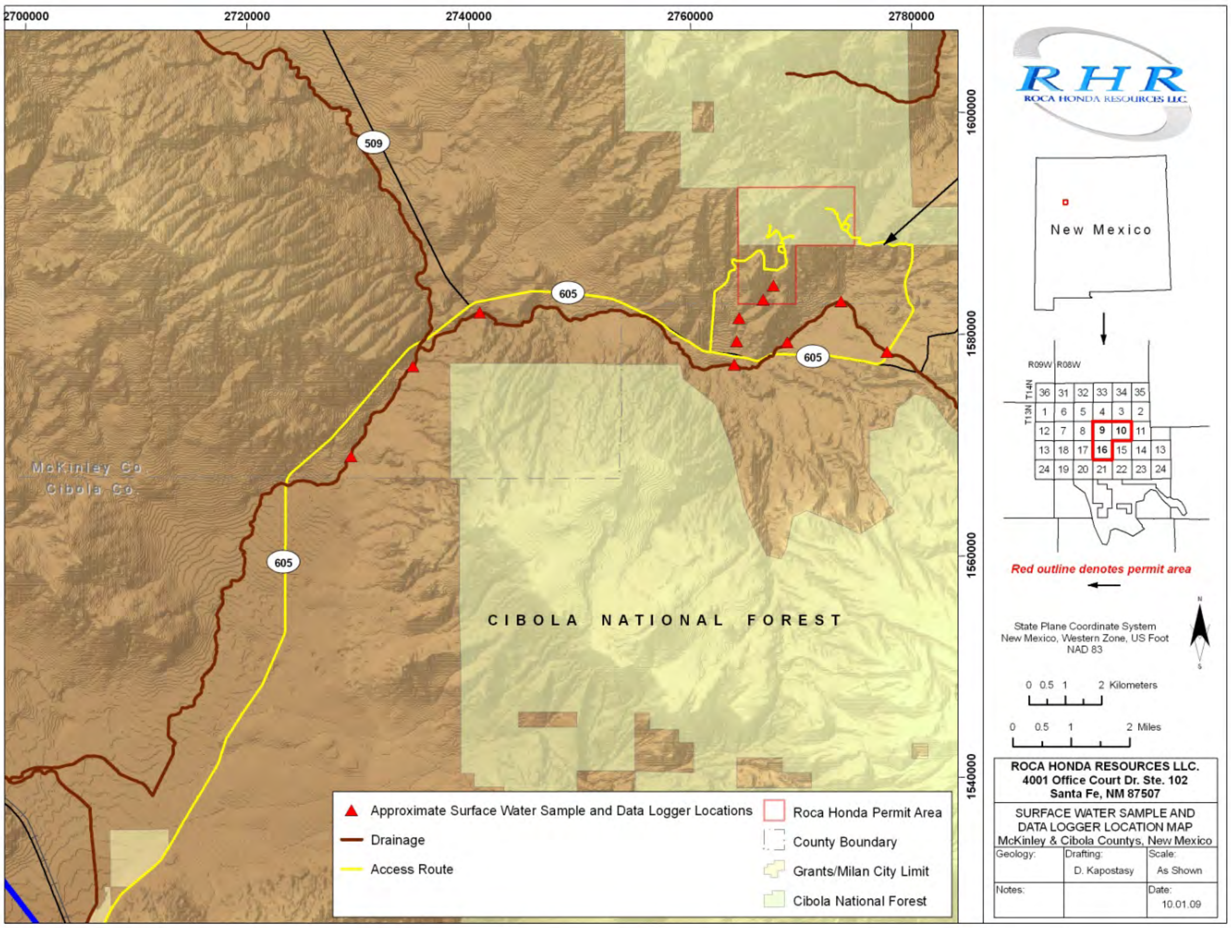

Figure 8-7. Approximate ACSG and Surface Water Sampling Locations

Table 8-7. Analytical Method, Container, Preservation, and Holding Time Requirements

Analytical Method	Analyte	Containers P=Plastic G=Glass	Preservation	Holding Times
Water Samples				
EPA Method 1103.1	E. coli	P	None	24 hours
SMEWW Method 2540F	Suspendable or Settleable Solids (water)	P or G	Cool, 4 °C	7 days
SMEWW Method 2530B	Floating solids (water)	P	None	7 days
SW846 Method 1664A	Oil and Grease (water)	G	H_2SO_4 to pH<2 cool, 4 °C	20 days
SMEWW Method 2120B	Color	P or G	Cool, 4 °C	NA
SMEWW Method 2150B	Odor and Taste	G	None	48 hours
EPA Method 200.7	Metal ions by ICP (filtered water)	P or G	Filter (0.45 micron), then add HNO_3 to pH<2	6 months
EPA Method 200.7	Metal ions by ICP (unfiltered water)	P or G	HNO_3 to pH<2	6 months
SMEWW 4500-Cl G	Residual chlorine (water)	P or G	None	Analyze immediately
SMEWW Method 4500 CN^- I (macro distillation, colorimetric finish).	Cyanide (weak acid dissociable) (water)	P or G	N_2O_4 to pH>12 cool, 4 °C	14 days
SMEWW Method 4500 CN-C	Cyanide dissolved (water)	P or G	N_2O_4 to pH>12 cool, 4 °C	14 days
SMEWW Method 353.1	Nitrite (water)	P or G	Cool, 4 °C	48 hours
SMEWW Method 353.2	Nitrate (water)	P or G	Cool, 4 °C	48 hours
SMEWW Method 4500-Norg B	TKN (water)	P	H_2SO_4 to pH<2, cool, 4 °C	28 days
SMEWW Method 365.1	Phosphate (water)	P or G	H_2SO_4 to pH<2, cool, 4 °C	28 days
EPA Method 200.8	Uranium (water)	P or G	HNO_3 to pH<2	6 months
SMEWW 7110C	Adjusted gross alpha (water)	P or G	HNO_3 to pH<2	6 months
SMEWW Methods 903.0 and 904.0	Radium 226 + Radium 228 (water)	P or G	HNO_3 to pH<2	6 months
SMEWW Method 7500-Rn B	Radon-222 (water)	G	Cool, 4 °C	4 days
EPA Method 608	Organochlorine Pesticides (water)	G	None	7 days
EPA Method 100.1	Asbestos (water)	P	None	48 hours
SMEWW Method 625	Semivolatile Organics (water)	G	$Na_2S_2O_3$	7 days extraction, 40 days analysis
SMEWW Method 624	Volatile Organic Compounds (water)	VOA vials	HCL<2	14 days
EPA Method 1613B	2,3,7,8-TCDD Dioxin (water)	G	None	21 days
Sediment Samples				
SW846 Method 9071B	Oil and Grease (sediments)	G	None	28 days
SW846 Method 6010B	Metal ions by ICP (soil)	100-g soil jar	NA	NA
SW346 Method 6020	Uranium (soil)	100 g	NA	NA
EPA Method 900.0 modified	Adjusted gross alpha (soil)	100 g	NA	NA

Table 8-7. Analytical Method, Container, Preservation, and Holding Time Requirements (Continued)

Analytical Method	Analyte	Containers P=Plastic G=Glass	Preservation	Holding Times
EPA Method 903.0 modified and 904.0 modified	Radium 226 + Radium 228 (soil)	100 g	NA	NA
SW846 Method 8081B	Organochlorine Pesticides (soil)	G	None	14 days
SW846 Method 8270	Semivolatile Organics (soil)	G	None	14 days
SW846 Method 8260B	Volatile Organic Compounds (soil)	G	None	14 days
SW846 Method 8270	2,3,7,8-TCDD Dioxin (soil)	G	None	21 days

SMEWW Standard Methods for the Examination of Water and Wastewater

8.5.1.6 *Sediment Grain Size*

Thirty one samples will be collected to determine grain size information. Samples will be collected once from the same locations used to sample for sediment chemistry described in Section 8.5.1.4 and to determine the concentration of soluble constituents described in Section 8.5.1.5. The abundance of large gravel clasts will be described in the field to estimate the abundance of this size class. This size class will be excluded from samples submitted to the laboratory for estimates.

8.5.1.7 *Stream Bed Armoring*

Armoring present in the drainage will be evaluated through a field survey. Walkover surveys will be conducted along the beds of the drainage. The surveys will document the presence and extent of bedrock, natural and man-made armoring, including the presence of vegetation, and the potential for the formation of armoring during erosion. The survey will provide field descriptions of the distribution of medium to large gravel clasts. The presence of existing vegetation will also be noted as its presence may affect channel morphology. Photographic documentation will be obtained to demonstrate the presence and type of armoring, the presence of large clasts that could form armor, or the lack of such features.

8.5.1.8 *Topography of Drainage Channels*

Topographic information will be collected using standard engineering techniques (high accuracy GPS surveys linked to GIS). These data will be collected to establish baseline conditions and to evaluate potential impacts from expected flow at several distances downgradient from the proposed discharge. Drainage profiles will be collected at appropriate intervals. If possible, profiles will be collected at 500-ft intervals for the first 5 miles of channel downgradient of the proposed discharge. For the next 17 miles of channel, profiles will be collected at 1,000-ft intervals. Permanent monuments will be emplaced for each transect. These monuments will allow the transects to be resurveyed to document changes in the channel.

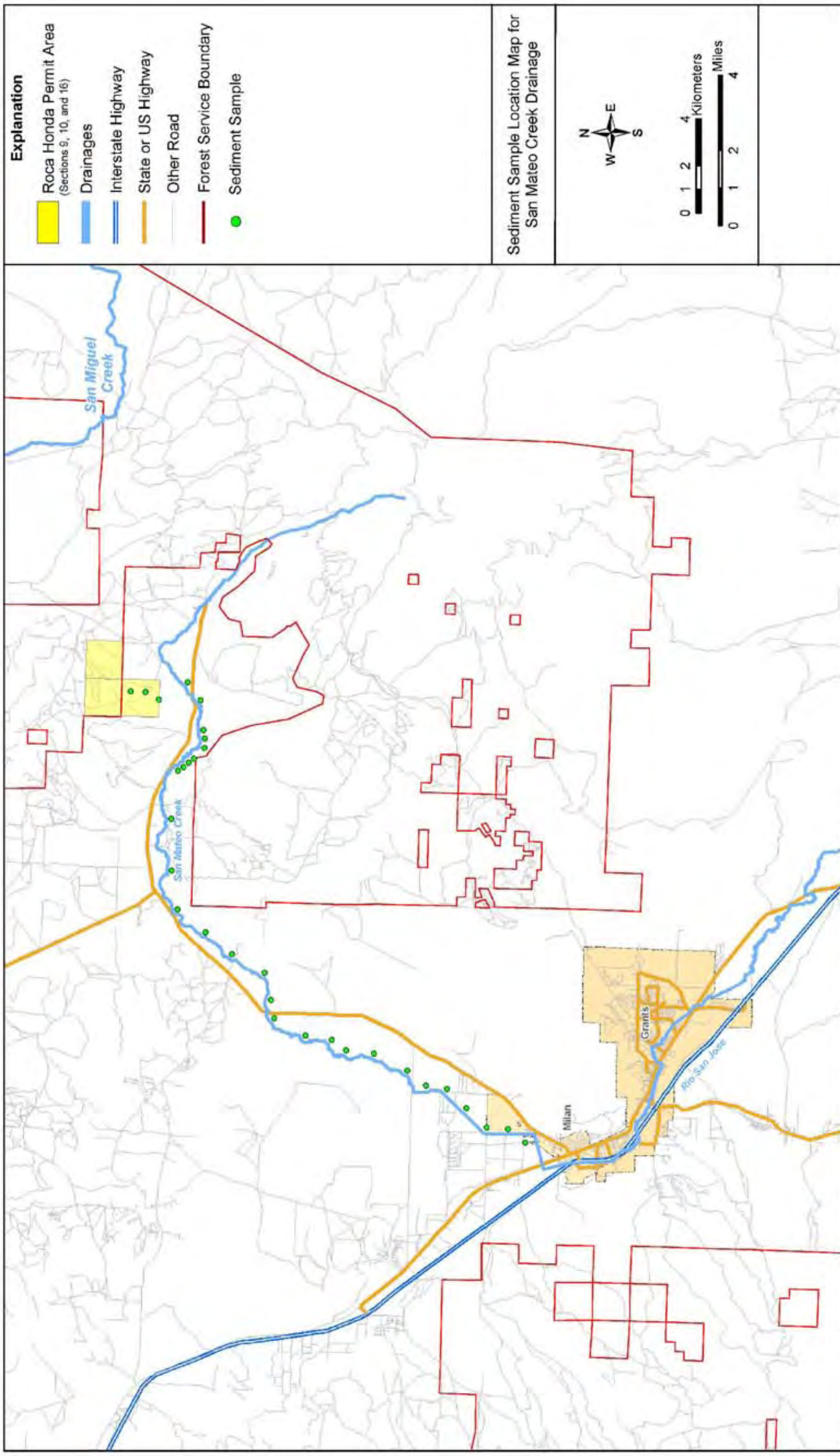

Figure 8-8. Sediment Sampling Locations

8.5.1.9 *Flow Conditions in San Mateo Creek*

RHR originally planned to co-locate stream gages and automatic flow meters with the water sample locations on San Mateo Creek to determine the volume and timing of water flow and the rate of water loss to the channel (Figure 8–8). Observation of San Mateo Creek over the past year has caused RHR to recognize that except above San Mateo Reservoir, the Creek is mostly ephemeral. As such, development of accurate stream flow gage rating tables would be impossible under current conditions. Therefore, automatic crest-state gages (ACSGs) will be installed at a number of sites along San Mateo Creek as shown on Table 8-8. ACSGs are self-contained data-logging pressure transducers installed in CSG (crest-stage gage) pipes, and are capable of recording date, time, and continuous stage data at intervals of .15 feet. Initial sites for the sites for the ACSGs will be selected during the stream survey described during the stream survey described in item 2 of Table 8-5, and then refined by a hydrologist or engineer.

To determine the rate of stream loss to the alluvium of the stream bed over various reaches of the river, RHR will measure the flow of the Creek at various points along the Creek using portable weirs or AA stream flow meters after a sufficiently large precipitation event has caused the creek to flow.

8.5.1.10 *Springs Database*

Springs in the vicinity of the permit area provide water for livestock and other uses. RHR is developing a database of springs around the permit area. The completeness of the database will be determined by interviewing those familiar with the area. This process will be documented with interview notes on standard forms. Samples for baseline water quality will be collected and flow will be estimated for springs within 2 miles of the boundary of the site. This information may vary seasonally. Four sampling events will be performed if possible to allow the estimation of seasonal variation. Water quality will be established for the complete list of constituents in Table 8–6.

8.6 Maps Providing Sampling Locations

Locations for stream gage and surface water samples, and sediment samples are indicated on Figures 8-8 and 8-9, respectively.

8.7 Sampling Frequency

See Table 8-5 for sampling frequency.

8.8 Laboratory and Field Quality Assurance Plan

The surface water data collection will be conducted in conformance with the Strathmore QA/QC program and field procedures for sampling and the recording of observations in a log book. Field notes will be retained in the project files as a record of the data collected. USGS NAWQA protocols, specifically those outlined in USGS OFR 94-455 and USGS OFR 97-223 and techniques outlined in USGS TWRI 9 will be followed to the extent appropriate and/or applicable to site conditions.

The new aerial photograph discussed in Section 3.0, Topography, will be used to direct a ground survey to confirm the location of perennial water bodies and the location and use of structures that could potentially be impacted by mine water discharge. Photographs and detailed field notes will be important for future design efforts to enhance channels and/or protect channels and water bodies.

Sampling of flowing streams will be accomplished using auto-sampling equipment co-located with pressure transducers, flow meters, and auto-loggers. Calibration procedures will be implemented for the applicable equipment. The locations of the stream gages and samplers will be GPS surveyed. Intermittent water bodies and springs will be sampled manually and on a seasonal basis. Sampling activities will follow Strathmore SOPs. The samples for chemical analysis will be properly preserved and sent to an EPA certified analytical laboratory. Sample packages will randomly include quality control samples to include duplicates and equipment blanks.

8.9 Brief Discussion Supporting Proposal

The results of the sample collection strategy outlined in this section will supplement existing surface water quality and quantity data, and sediment quality from past activities in the San Mateo drainage basin. The characterization will establish baseline surface water, sediment conditions and channel morphology within the Roca Honda permit area and the potentially affected portion of San Mateo Creek in advance of mining in order to assess potential and actual affects of mining on surface water. The data will also aid in design of features to protect drainages during the mine water discharge.

8.10 References

ASTM (American Society for Testing and Materials) Standard E 112. *Standard Test Methods for Determining Average Grain Size,* American Society for Testing and Materials.

Edwards, T.K. and Glysson, G.D., 1999, Field Methods for Measurement of Fluvial Sediment – USGS Techniques of Water-Resources Investigations, Book 3, Chapter C2. USGS, Arlington, VA, 89 pp.

Guy, H.P., 1970, Fluvial sediment concepts: USGS, Techniques of Water-Resources Investigations, Book 3 Applications of hydraulics: USGS, Arlington, VA, 55 pp.

Muller, D.K, Martin, J.D., and T.J. Lopez, 1997, Quality-Control Design for Surface-Water Sampling in the National Water-Quality Assessment Program: USGS OFR 97-223.

NMAC (New Mexico Administrative Code) 20.6.4. *New Mexico Administrative Code* Title 20, “Environmental Protection,” Chapter 6 “Water Quality,” Part 4 “Standards for Interstate and Intrastate Surface Waters,” Water Quality Control Commission.

NMAC (New Mexico Administrative Code) 20.6.2. Title 20, “Environmental Protection,” Chapter 6 “Water Quality,” Part 2 “Ground and Surface Water Protection,” New Mexico Administrative Code, Water Quality Control Commission.

——— 20.6.4. Title 20, “Environmental Protection,” Chapter 6 “Water Quality,” Part 4 “Standards for Interstate and Intrastate Surface Waters,” New Mexico Administrative Code, Water Quality Control Commission.

NMEI (New Mexico Environmental Institute), 1974. *An Environmental Baseline Study of the Mount Taylor Project Area of New Mexico*, prepared by Whitson, M.A., and Study Team for Gulf Mineral Resources Company, March.

NMHED (New Mexico Health and Environmental Department), 1980. *Water Quality Data for Discharge from Uranium Mines and Mills in New Mexico*, Environmental Improvement Division, Water Pollution Control Bureau, July.

Reading, H.G. (ed.), 1978, Sedimentary Environments and Facies: Elsevier, New York, 569 pp.

RGRC (Rio Grande Resources Corporation), 1994. Environmental Site Assessment, Mt. Taylor Uranium Mine Operation, June.

Santos, E.S. 1966. *Geologic Map of the San Mateo Quadrangle, McKinley and Valencia Counties, New Mexico,* U.S. Geological Survey Map GQ-517, scale 1:24,000.

Shelton, L. R., 1994, *Field Guide for Collecting and Processing Stream-Water Samples for the National Water Quality Assessment Program*: USGS OFR-94-455.

Shelton, L.R. and P.D. Capel, 1994, *Guidelines for Selecting and Processing Samples of Stream Bed Sediment for Analysis of Trace Elements and Organic Contaminants for the National Water Quality Assessment Program:* USGS OFR 94-458.

Thaden, R.E., E.S. Santos, and E.J. Ostling, 1967. *Geologic Map of the Dos Lomas Quadrangle, Valencia and McKinley Counties, New Mexico,* U.S. Geological Survey Map GQ-680, scale 1:24,000.

USEPA, updated 2008, Test Methods for Evaluating Solid Wastes Physical/Chemical Methods: SW-846 (on line).

U.S. Geological Survey, variously dated, *National Field Manual for the Collection of Water Quality Data*: U.S. Geological Survey Techniques of Water Resource Investigations Book 9, Chapters A1-A9, available on-line at http://pubs.water.usgs.gov/twri9A.