BASELINE DATA REPORT

Section 9.0

Groundwater

JANUARY 2011

Revision 1

Submitted To:

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

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9.0 Groundwater

NMAC §19.10.6.602 D.(13) (g)

Baseline data shall include, as applicable:

(g) Ground water information shall include the following:

(iii) Lithology and thickness of each geologic unit below the site indicating which units are water bearing, cross sections and potentiometric maps indicating the location of wells and the ground water flow direction in the vicinity of the site, and references or sources for this information.

(iv) A description of the aquifer characteristics including total dissolved solids concentration, maximum and minimum depths to ground water, direction of flow and gradients, transmissivity and storativity, and a general description of ground water quality, and references or sources for this information.

(v) A determination of the probable hydrologic consequences of the operation and reclamation, on both the permit and affected areas, with respect to the hydrologic regime, quantity and quality of surface and ground water systems that may be affected by the proposed operations, including the dissolved and suspended solids under seasonal flow conditions.

9.1 Introduction

The Roca Honda permit area is located in the southeastern part of the San Juan structural basin, within the southeast part of the Ambrosia Lake uranium subdistrict, which was the site of previous uranium mining and associated mine dewatering activities from the 1960s through the 1980s. The permit area lies within the Bluewater Underground Water Basin as extended by the OSE on May 14, 1976.

Large amounts of data on groundwater exist for the San Juan basin because the area contains deposits of recoverable uranium and valuable groundwater resources. The USGS, the New Mexico Bureau of Mines and Mineral Resources, and the New Mexico State Engineer cooperated in several hydrogeologic studies of the San Juan basin. These studies have described area aquifers and compiled and analyzed groundwater quality data and estimates of hydraulic parameter values (Brod and Stone 1981, Frenzel and Lyford 1982, Stone et al. 1983, Craigg et al. 1989, Dam et al. 1990, Dam 1995, and Craigg 2001). Moreover, as part of the Regional Aquifer System Analysis program, the USGS developed a steady–state multi–aquifer groundwater flow model of the San Juan basin (Kernodle 1996).

The Roca Honda permit area is approximately three miles northwest of the Mt. Taylor uranium mine, formerly operated by GMRC and others and now owned by RGRC. This mine was dewatered during the 1970s and early 1980s. Groundwater quality data and hydraulic parameter estimates were collected both at the Mt. Taylor mine and at various mines west of the Roca Honda permit area in the Ambrosia Lake subdistrict (NMEI 1974, GMRC 1979a, and Kelley et al. 1980). The groundwater quality and hydraulic characteristics of the Westwater Canyon Member of the Morrison Formation were re-evaluated more recently by Hydro

Resources, Inc. (HRI) and the U.S. Nuclear Regulatory Commission (USNRC) during site licensing in the Crownpoint and Church Rock areas (HRI 1988 and 1991 and USNRC 1997).

Historic exploratory drilling conducted by others, and more recent drilling conducted by RHR, determined that the strata beneath the permit area represent the same sequence of rocks found in the San Juan structural basin. Potentiometric data collected from wells in and near the permit area indicate that groundwater moves continuously through the permit area in the same aquifers found to the west. The aquifers and aquitards encountered in the permit area likely have hydraulic characteristics similar to those found in the same units elsewhere in the San Juan structural basin.

In general, the hydraulically significant structural features of the southeastern San Juan basin have been previously identified, and the groundwater quality and hydraulic characteristics of the aquifers in the Roca Honda permit area lie within the ranges identified in previous studies. Historical data on water quality and aquifer hydraulic characteristics within the permit area are sparse. Consequently, RHR has compiled the relevant published and unpublished information near the permit area and begun a groundwater sampling program. This effort included an inventory of wells previously identified in published and unpublished reports as being present near the Roca Honda permit area. The inventory includes location, completion dates, well depth, producing formation, measured water levels, and availability of chemical data for each well. The wells were field-checked, and RHR incorporated some of them as discussed in more detail later in this section, along with the three wells drilled by RHR within the permit area in 2007, into the water quality sampling program. The data for these wells is contained in Appendices 9-A through 9-H.

The well data inventory, earlier studies, recent drilling by RHR, and the water quality sampling program provide a great deal of baseline information useful to understanding regional groundwater quality and aquifers in and around the vicinity of permit area. This Section 9.0 presents the existing data as it pertains to regional hydrogeology (Section 9.2), hydrology of the general permit area (Section 9.3), aquifer and groundwater characteristics of the general permit area (Section 9.4), and aquitards (Section 9.5). These sections, together with pertinent sections of Section 7.0, Geology, contain descriptions of lithology and thickness of each geologic unit below the site. The sufficiency of the existing information to characterize groundwater conditions within the Roca Honda permit area is discussed in each section. Section 9.6 discusses a multi-well aquifer test of the Westwater Canyon Member performed by RHR within the permit area during 2010. Section 9.6 also outlines a groundwater flow model constructed by RHR as a tool for analyzing potential impacts of the depressurization of the RHR mine. Section 9.7 describes the Regional Groundwater Sampling Program RHR has implemented.

Additionally, RHR has submitted a proposed detailed Groundwater Monitoring Plan and a Work Plan to Establish Baseline Groundwater Quality in response to an NMED request pursuant to RHR's Discharge Plan Application. The data provided in this BDR will be used in conjunction with data generated in future monitoring by RHR to further refine its understanding of existing water quality. These plans will be incorporated into the BDR when approved.

9.2 Regional Hydrology

The Roca Honda permit area is in the southeastern part of the San Juan structural basin in northwestern New Mexico as shown in Figure 9-1. The basin is a roughly circular asymmetric

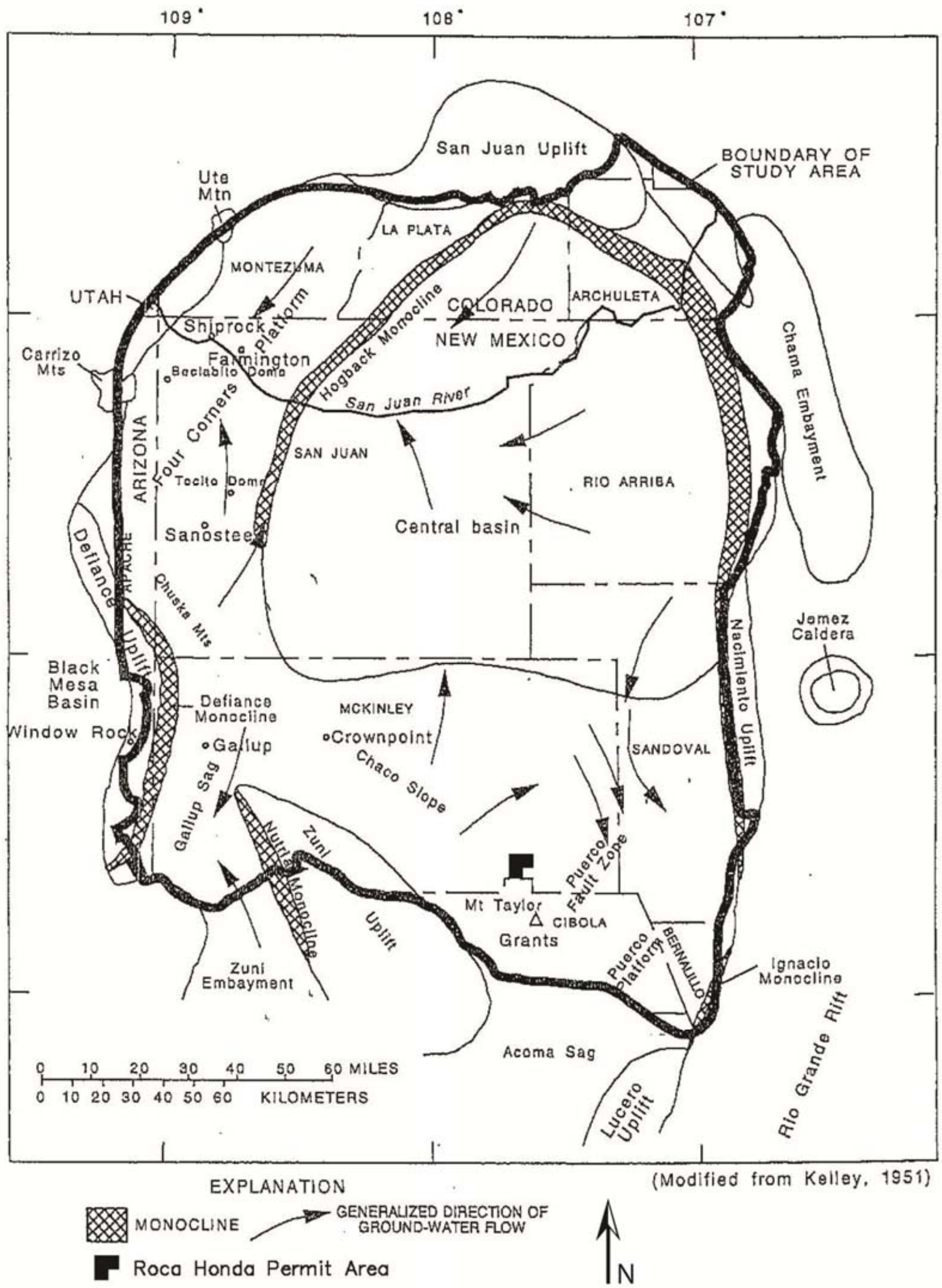


Figure 9-1. Structural Elements of the San Juan Structural Basin and Adjacent Areas and Generalized Patterns of Groundwater Flow in Rocks of Jurassic and Cretaceous Age (Modified from Dam, 1995, Figure 2)

structural depression at the eastern edge of the Colorado Plateau. It is bounded on the northwest by laccoliths associated with the Four Corners platform, on the north by the San Juan uplift, and on the northeast by a broad arch. The basin is bounded on the east by the structurally complex Nacimiento uplift and on the southeast by the extensively fractured Rio Grande rift, the Ignacio monocline, and the Lucero uplift. The Precambrian dome of the Zuni uplift (the southwestern limb of which is known as the Nutria monocline) and the Defiance uplift form the south-central and southwestern margins of the basin, and the northern end of the Defiance uplift forms the western margin of the basin (Craigg 2001 and Woodward 1987). These structural boundaries appear to also form hydrogeologic boundaries.

The San Juan structural basin is an artesian basin. In general, recharge enters the groundwater flow systems as precipitation on permeable formations which crop out along the southern margin of the basin and on the flanks of the Zuni, Chuska, and San Mateo Mountains. Groundwater then flows downgradient northwestward to discharge along the San Juan River, and northeastward and eastward to discharge to tributaries of the Rio Grande including the Rio Salado, Rio Puerco, and Rio San Jose, and to springs which discharge along faults (Stone et al. 1983). Discharge also occurs artificially from wells. An undetermined amount of subsurface, inter-formational movement of water may occur. As groundwater moves downgradient from the recharge area within permeable formations, it is prevented from moving vertically by overlying shale units which act as aquitards, causing high artesian heads in most bedrock aquifers at the center of the basin. This BDR identifies the aquifers and aquitards.

The San Juan structural basin contains a number of internal structural boundaries that affect the movement of groundwater through aquifers. Potentiometric surface maps indicate that the pattern of groundwater movement in the southeastern part of the basin is greatly influenced by the Zuni uplift, San Mateo dome, and McCartys syncline. Figure 9-1 shows the general pattern of deep groundwater flow in the Jurassic and Cretaceous aquifers. Additional information on deep flow is available in Stone et al. (1983) and Kernodle (1996). The movement of groundwater through the alluvium of valleys and through shallow aquifer systems in some Upper Cretaceous rocks is influenced by topography and surface water drainages, and is independent of and sometimes trends in a different direction than groundwater movement in the deep aquifers.

According to Stone et al. (1983), the steady-state inflow/outflow rate of groundwater through the basin is approximately 40 cfs for Cretaceous and Jurassic sandstone aquifers and less than half of that for Cenozoic aquifers. Kernodle (1996) simulated a total steady-state outflow from the entire 19,380-square-mile San Juan basin aquifer system of 195 cfs, all of which was simulated as being discharged to the surface water system in the lower reaches of the San Juan River and Rio Puerco (Kernodle 1996). That simulation indicated 135 cfs of the recharge to the aquifers was from stream bed infiltration, 56 cfs was from direct precipitation, and 4 cfs was leakage from the Chuska Sandstone.

Aquifers within the southeastern part of the San Juan basin include, from deepest to shallowest, the Permian Glorieta Sandstone and San Andres Limestone, the Middle Jurassic Entrada Sandstone, the Upper Jurassic Westwater Canyon Member of the Morrison Formation, the Upper Cretaceous Dakota Sandstone, the Upper Cretaceous Gallup Sandstone of the Mesaverde Group, the Upper Cretaceous Crevasse Canyon Formation of the Mesaverde Group, and the Upper Cretaceous Point Lookout Sandstone and Menefee Formation of the Mesaverde Group. Within topographic valleys, Quaternary alluvium can contain local aquifers. Although formations deeper than the San Andres Limestone may contain groundwater, their depths generally preclude groundwater exploration or development except along the margins of the basin where they are close to the surface. Whether a particular formation is used as an aquifer in an area of the basin is dependent on the depth to groundwater, formation yield, and quality of groundwater as well as the presence of shallower aquifers (NMEI 1974, Stone et al. 1983, Brod and Stone 1981, and Kernodle 1996).

Figure 9-2 is a typical stratigraphic section of the San Juan Basin in the vicinity of the permit area. Thick aquitards separate the aquifers. Groundwater in the Westwater Canyon Member is hydraulically isolated from groundwater in deeper aquifers by the Recapture Member of the Morrison Formation and, in unfaulted areas, from groundwater in the overlying Dakota Sandstone by the Brushy Basin Member of the Morrison Formation. The main body of the Mancos Shale functions as an aquitard between the Dakota Sandstone and the Gallup Sandstone. A similar aquitard, the Mulatto Tongue of the Mancos Shale, lies above the Gallup Sandstone between the Dilco Coal Member and the Dalton Sandstone Member of the Crevasse Canyon Formation. The Satan Tongue of the Mancos Shale splits the sandstones of the Point Lookout Sandstone. Shale units in the lower Menefee Formation may form hydraulic barriers between groundwater in it and the Point Lookout Sandstone.

9.3 Hydrogeology of the Permit Area Locality

The term “Roca Honda/San Mateo area” is used herein to refer to an area which encompasses T13N R8W and a few additional miles to the east and west. It includes the upper and middle San Mateo Creek valley and the Roca Honda permit area. Groundwater is present in the Roca Honda/San Mateo area within the stream bed alluvium of San Mateo Creek and in the following bedrock formations, from deepest to shallowest; the Westwater Canyon Member of the Morrison Formation, the Dakota Sandstone, the Gallup Sandstone, the Point Lookout Sandstone, and the Menefee Formation (Cooper and John 1968, NMEI 1974, Brod and Stone 1981, OSE 2008, GMRC 1979a, and Metric 2005a). The Dalton Sandstone of the Crevasse Canyon Formation is a minor source of water to stock wells north and east of the permit area.

Area geologic structure (see Figure 9-3) and the presence of multiple aquifers and aquitards have caused the development of complex aquifer systems in the Roca Honda/San Mateo area. From deepest to shallowest, these include; (1) a deep confined system in the Westwater Canyon Member, which in faulted areas may be in local hydraulic connection with groundwater in the Dakota Sandstone and the lower sandstones in the Mancos Shale; (2) a confined system in the Gallup Sandstone; (3) an unconfined system in the Point Lookout Sandstone, which transforms into a confined system as groundwater moves eastward downgradient; (4) an unconfined system in the Menefee Formation in hydraulic connection with San Mateo Creek; and (5) a shallow unconfined system that is locally perched in the alluvium of the stream bed of San Mateo Creek. These aquifer systems are described in more detail below. The latter three systems are not present within the permit area, except in the eastern part of Section 10, where the Point Lookout Sandstone is present, though they are present in the San Mateo Creek valley.

9.3.1 Westwater Canyon Member of the Morrison Formation

The deepest aquifer system of interest in the Roca Honda/San Mateo area and the Roca Honda permit area is a deep confined system present within the Westwater Canyon Member of the Morrison Formation and possibly the overlying Dakota Sandstone and the sandstones in the lower part of the Mancos Shale. Faulting may have allowed local inter-aquifer connection of

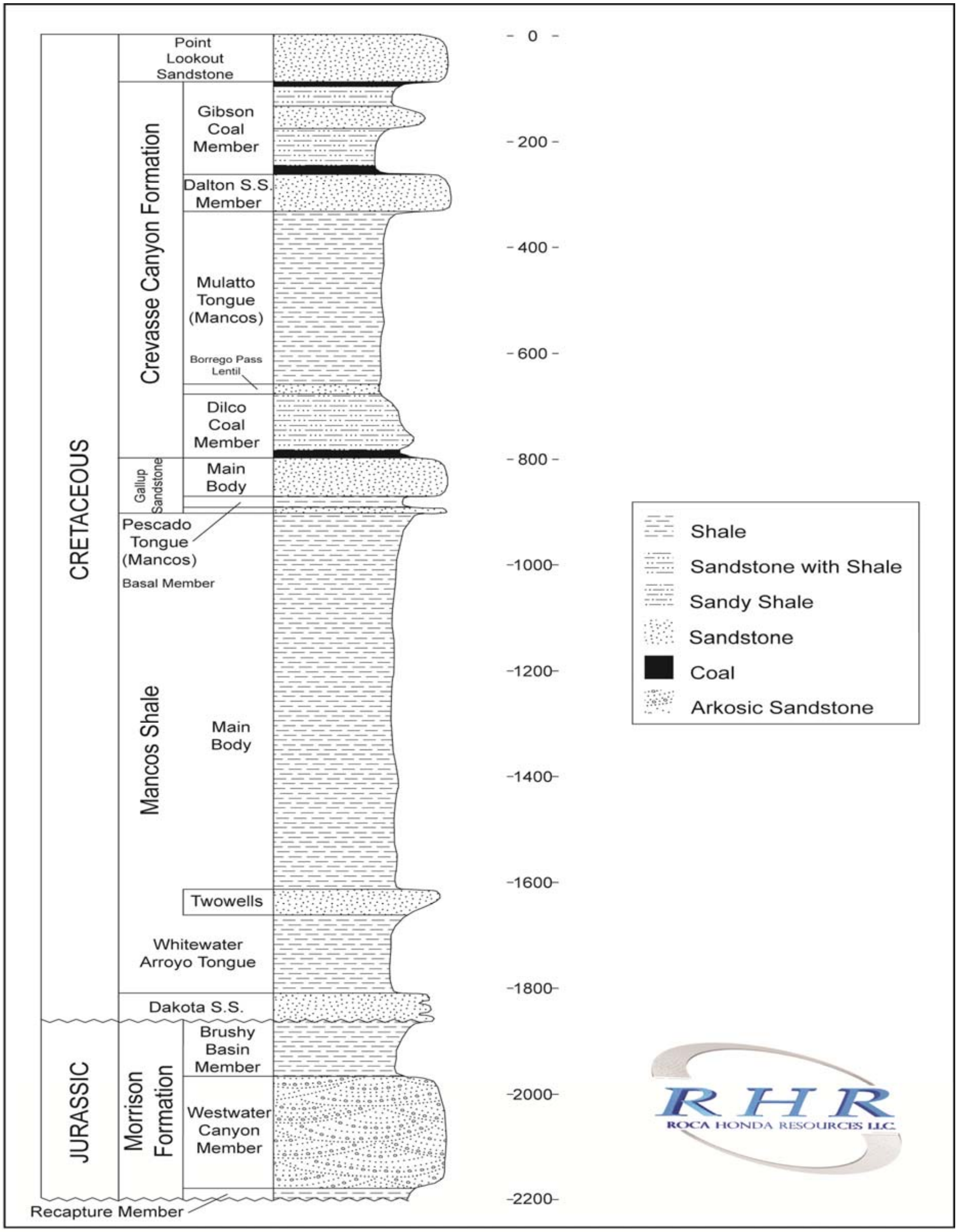


Figure 9-2. Typical Stratigraphy of the Permit Area

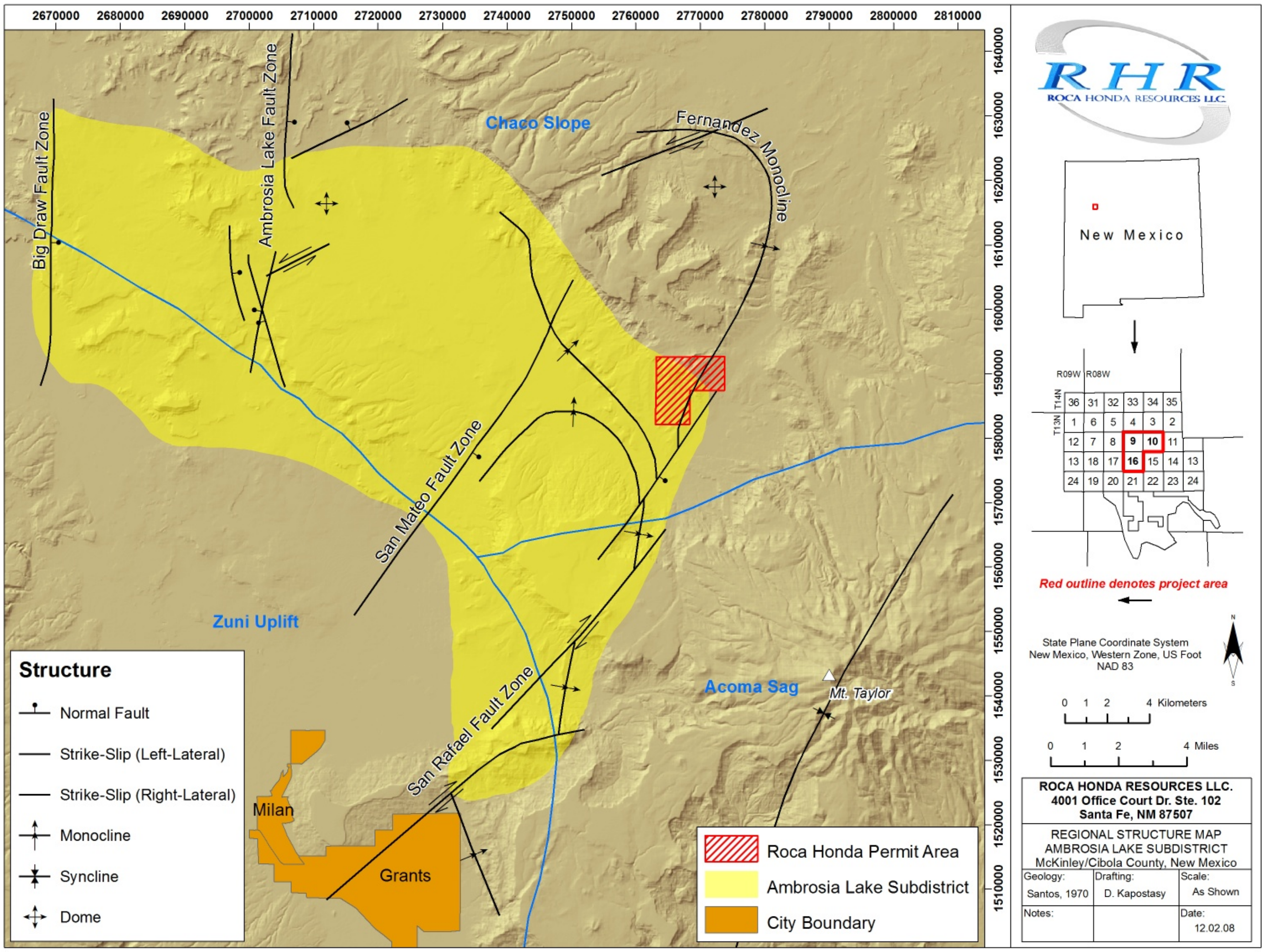


Figure 9-3. Regional Structure near the Permit Area

groundwater among these formations in the faulted areas, and the rock units may function as a single aquifer system in these areas, although drilling done to date indicates that the water-bearing units are separated from one another. Movement of groundwater within this deep confined system is controlled largely by geologic structure. The rate of groundwater movement is influenced by intergranular and fracture permeability of the rocks.

The Westwater Canyon Member is an aquifer as well as the major uranium ore horizon in the Grants district (Stone et al. 1983). It is an example of a classic artesian aquifer. Recharge occurs when surface water infiltrates the geologic strata in and around the Zuni and Defiance uplifts and moves downdip toward the deeper parts of the San Juan basin. Brod and Stone (1981) indicate that much of the groundwater recharge to the deep confined system occurs in drainage-ways on the bedrock outcrops along the western basin margins, and as seepage into fractures. They note that San Mateo Creek is a source of recharge to this deep aquifer system, contributing recharge where it flows over outcrop areas. The topographically high recharge area produces high hydraulic head in the aquifers in the center of the basin where groundwater is under confined pressure (USNRC 1997). Dewatering of the Westwater Canyon Member for the purpose of underground mining lowered the potentiometric surface in the local area of uranium mines during the 1970s, but water levels have substantially recovered since mining ceased (see Figure 6 in Kelley et al. 1980, for a 1979 potentiometric contour map). Figures 9-4 and 9-5 show two interpretations of the pre-development potentiometric surface for the Westwater Canyon Member in the San Juan basin.

Groundwater within this deep system moves through the Roca Honda permit area. Three deep monitor wells were completed by RHR in the Westwater Canyon Member within the Roca Honda permit area. The water level elevations measured in these wells indicate that the groundwater system within that aquifer is continuous with the system in the Westwater Canyon Member in the southern San Juan basin. The projected potentiometric surface for the Westwater Canyon Member in the Roca Honda/San Mateo area as constructed from available data is shown in Figure 9-6. The potentiometric surface in the Westwater Canyon Member through the Roca Honda permit area is shown in the cross sections in Figures 9-7 and 9-8. Section 7.0, Geology, of this BDR contains a detailed discussion of the geology of the permit area.

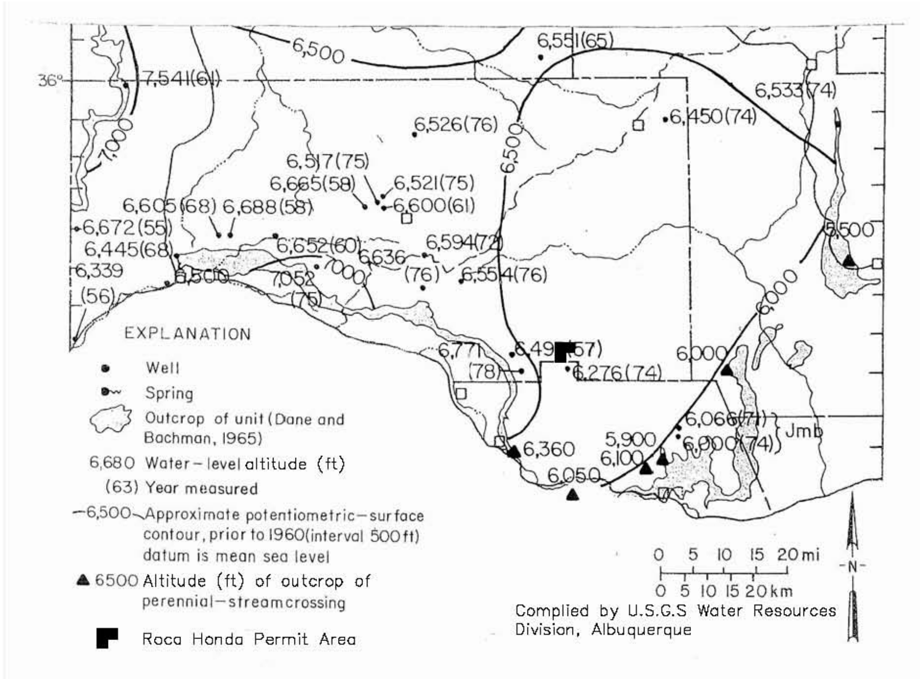


Figure 9-4. Water-Level Elevations and Potentiometric Surface for Westwater Canyon Member in the Southern Portion of the San Juan Basin (Modified from Stone et al. 1983, Figure 72)

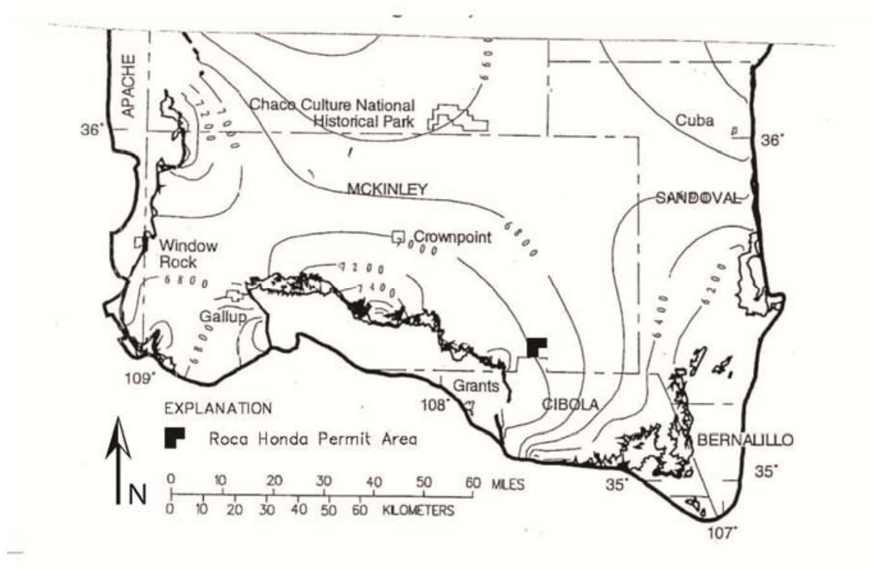
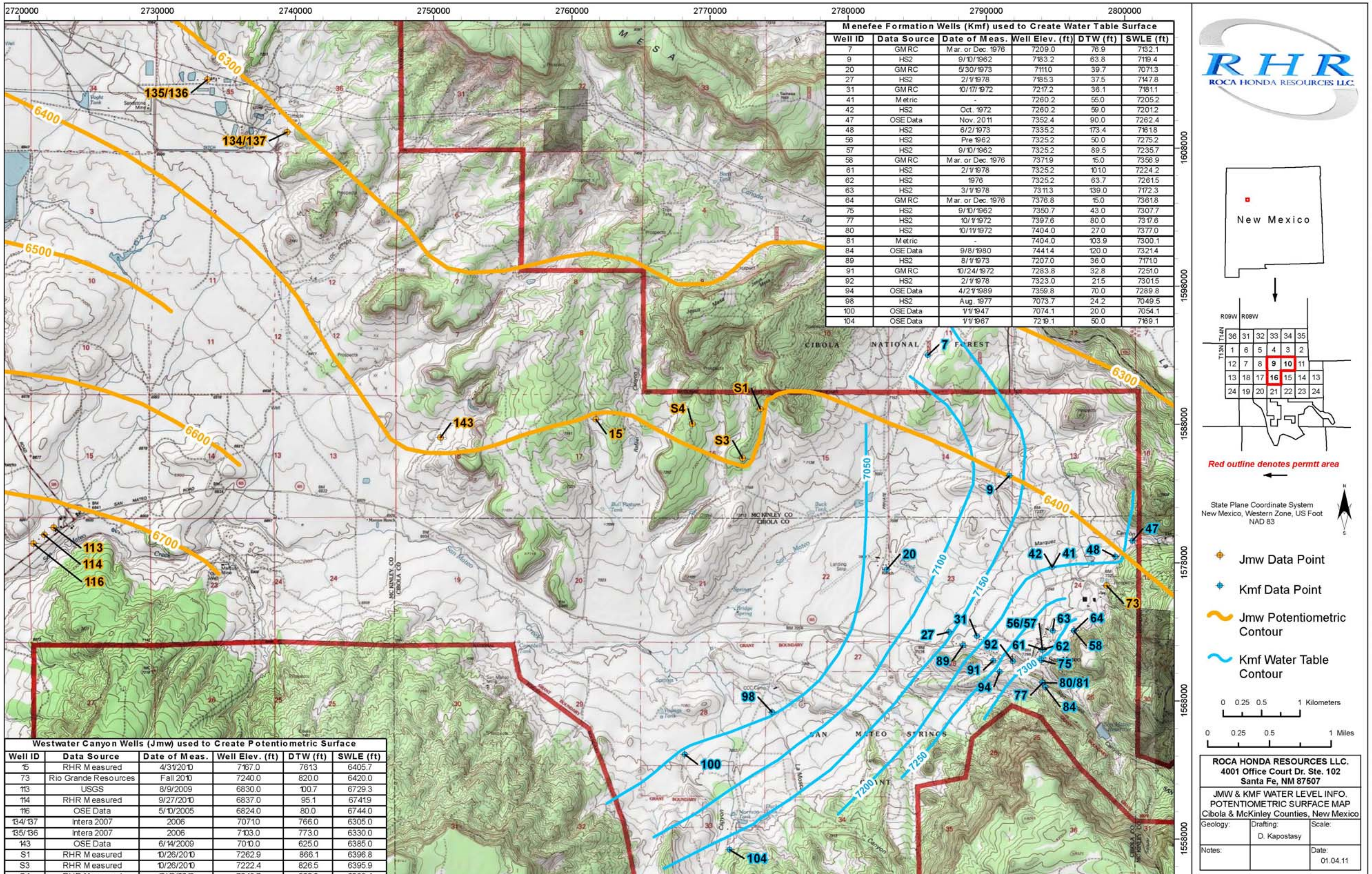


Figure 9-5. Simulated Steady-State Head in the Westwater Canyon Member (Modified from Kernodle 1996, Figure 52)



Menefee Formation Wells (Kmf) used to Create Water Table Surface

Well ID	Data Source	Date of Meas.	Well Elev. (ft)	DTW (ft)	SWLE (ft)
7	GMRC	Mar. or Dec. 1976	7209.0	76.9	7132.1
9	HS2	9/10/1962	7183.2	63.8	7119.4
20	GMRC	5/30/1973	7111.0	39.7	7071.3
27	HS2	2/1/1978	7185.3	37.5	7147.8
31	GMRC	10/17/1972	7217.2	36.1	7181.1
41	Metric	-	7260.2	55.0	7205.2
42	HS2	Oct. 1972	7260.2	59.0	7201.2
47	OSE Data	Nov. 2011	7352.4	90.0	7262.4
48	HS2	6/2/1973	7335.2	173.4	7161.8
56	HS2	Pre 1962	7325.2	50.0	7275.2
57	HS2	9/10/1962	7325.2	89.5	7235.7
58	GMRC	Mar. or Dec. 1976	7371.9	15.0	7356.9
61	HS2	2/1/1978	7325.2	101.0	7224.2
62	HS2	1976	7325.2	63.7	7261.5
63	HS2	3/1/1978	7311.3	139.0	7172.3
64	GMRC	Mar. or Dec. 1976	7376.8	15.0	7361.8
75	HS2	9/10/1962	7350.7	43.0	7307.7
77	HS2	10/1/1972	7397.6	80.0	7317.6
80	HS2	10/11/1972	7404.0	27.0	7377.0
81	Metric	-	7404.0	103.9	7300.1
84	OSE Data	9/8/1980	7441.4	120.0	7321.4
89	HS2	8/1/1973	7207.0	36.0	7171.0
91	GMRC	10/24/1972	7283.8	32.8	7251.0
92	HS2	2/1/1978	7323.0	21.5	7301.5
94	OSE Data	4/21/1989	7359.8	70.0	7289.8
98	HS2	Aug. 1977	7073.7	24.2	7049.5
100	OSE Data	1/1/1947	7074.1	20.0	7054.1
104	OSE Data	1/1/1967	7219.1	50.0	7169.1

Westwater Canyon Wells (Jmw) used to Create Potentiometric Surface

Well ID	Data Source	Date of Meas.	Well Elev. (ft)	DTW (ft)	SWLE (ft)
15	RHR Measured	4/31/2010	7167.0	761.3	6405.7
73	Rio Grande Resources	Fall 2010	7240.0	820.0	6420.0
113	USGS	8/9/2009	6830.0	100.7	6729.3
114	RHR Measured	9/27/2010	6837.0	95.1	6741.9
116	OSE Data	5/10/2005	6824.0	80.0	6744.0
134/137	Intera 2007	2006	7071.0	766.0	6305.0
135/136	Intera 2007	2006	7103.0	773.0	6330.0
143	OSE Data	6/14/2009	7010.0	625.0	6385.0
S1	RHR Measured	10/26/2010	7262.9	866.1	6396.8
S3	RHR Measured	10/26/2010	7222.4	826.5	6395.9
S4	RHR Measured	10/19/2010	7248.7	860.3	6388.4

Figure 9-6. Potentiometric Surface of Westwater Canyon Member and Water Table Surface for the Menefee Formation – Roca Honda/San Mateo Area

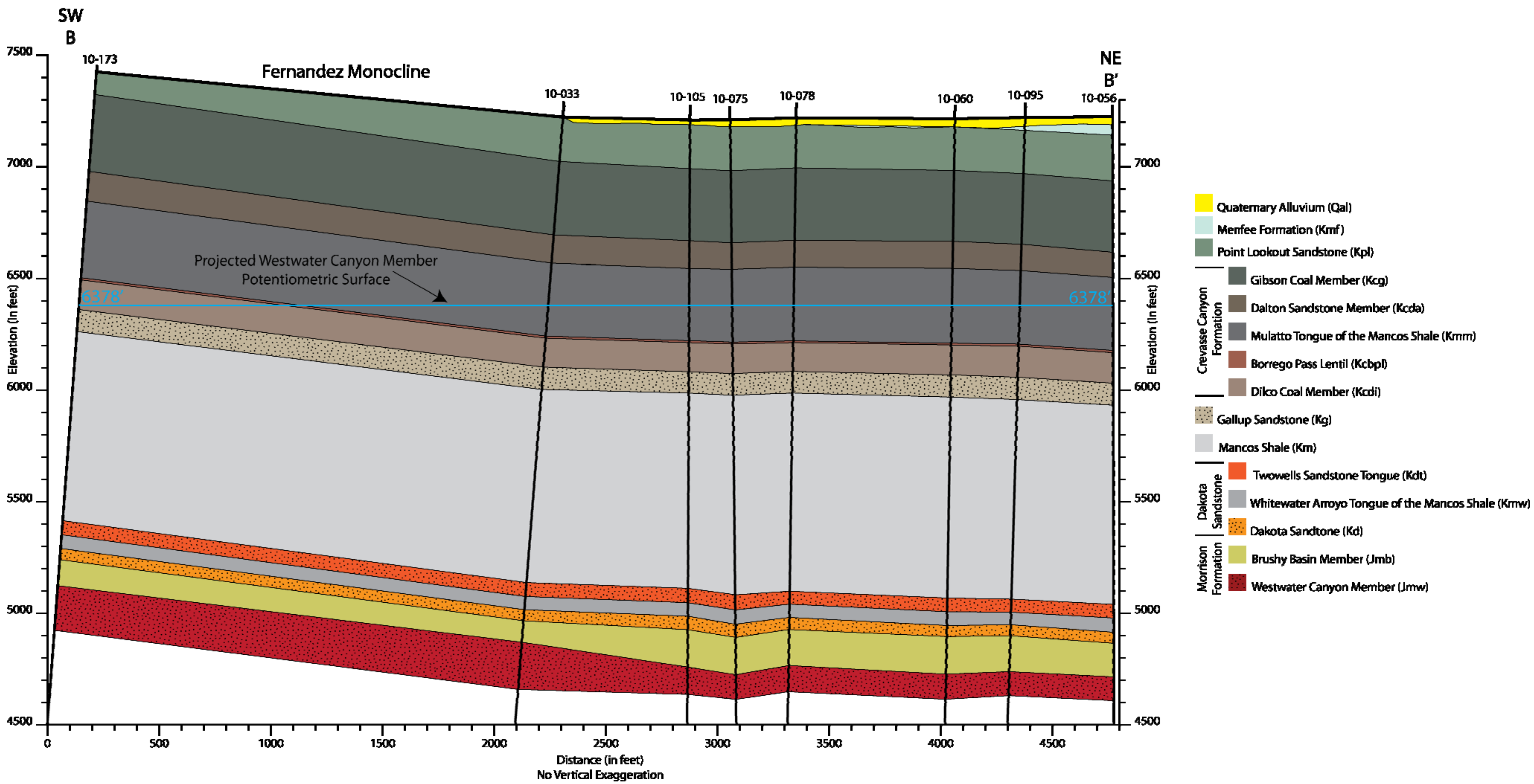
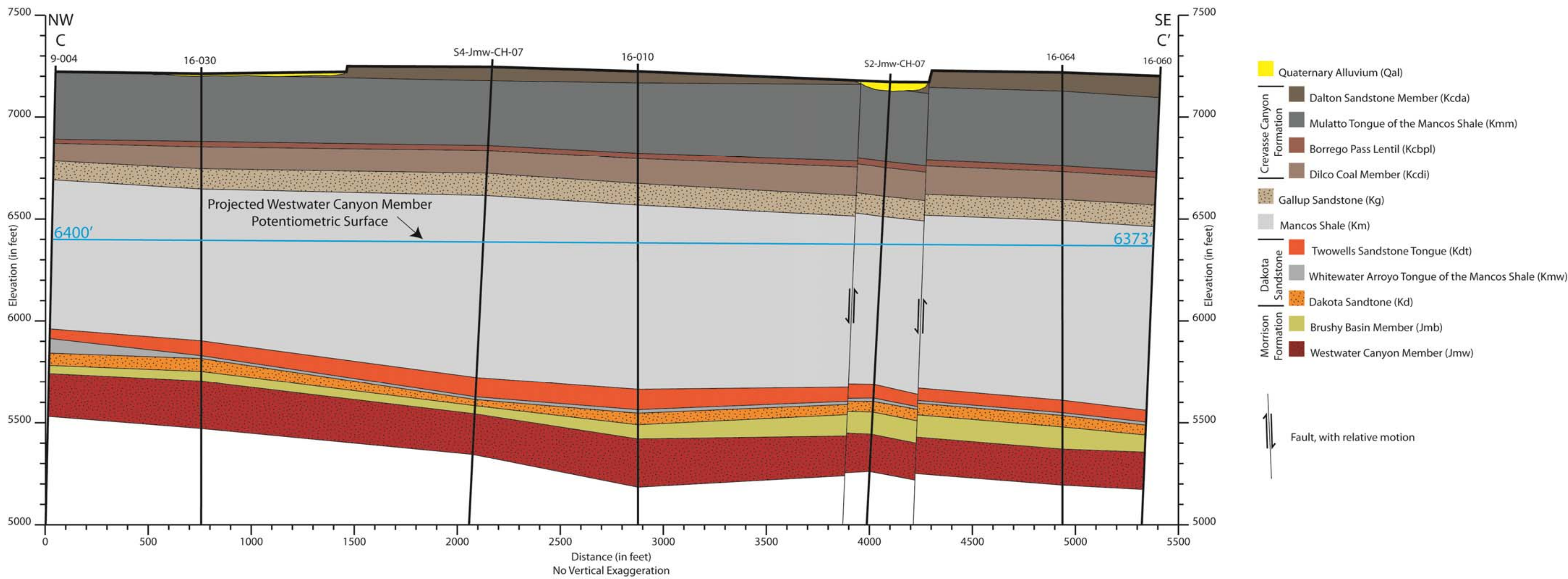


Figure 9-7. Cross-Section Across Section 10 of the Permit Area Showing Potentiometric Surface of the Westwater Canyon Member
(Cross-Section Location can be found in Section 7.0 Geology, Figure 7-7)



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ROCA HONDA RESOURCES LLC

Figure 9-8. Cross-Section Across Section 16 of the Permit Area Showing Potentiometric Surface of the Westwater Canyon Member
(Cross-Section Location can be found in Section 7.0 Geology, Figure 7-7)

9.3.2 Gallup Sandstone

The Gallup Sandstone is present in the subsurface within the permit area. Groundwater moves through the Gallup Sandstone in a confined system separate from the deep aquifer system, although an unknown amount of inter-formation movement of groundwater may occur. Dam (1995) and Kernodle (1996) show a potentiometric surface within Gallup Sandstone that indicates flow to the east-northeast in the Roca Honda/San Mateo area. Few water level or water quality data are available for the Gallup Sandstone in the Roca Honda/San Mateo area, though an irrigation well recently drilled by the Lee Ranch may produce partially from the Gallup Sandstone. Permission will be obtained from the Lee Ranch to monitor this well during pump testing. Figure 9–9 shows the water level elevation, potentiometric surface, and outcrop areas for the Gallup Sandstone in the San Juan basin as interpreted by Stone et al. (1983).

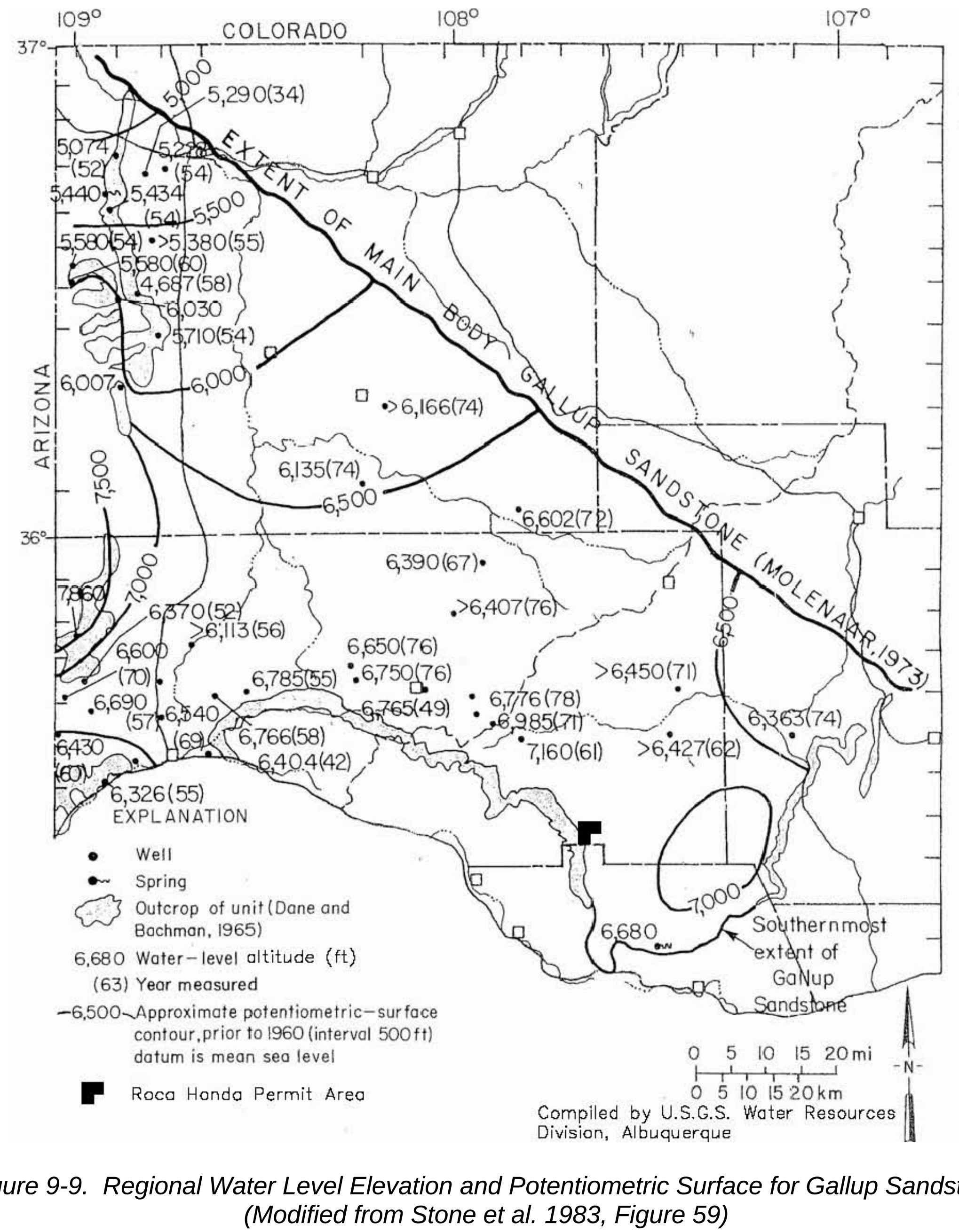

Figure 9-9. Regional Water Level Elevation and Potentiometric Surface for Gallup Sandstone (Modified from Stone et al. 1983, Figure 59)

9.3.3 Point Lookout Sandstone

The Point Lookout Sandstone is present at the surface within the Roca Honda permit area (see Figure 7-3 "Geologic Map of the Roca Honda Permit Area," in Section 7.0, Geology). It is probably not saturated in most areas, but functions as a recharge zone on the eastern side of the Fernandez monocline and an aquifer in the vicinity of the community of San Mateo.

Groundwater moves eastward through sandstones of the Point Lookout Sandstone under both unconfined and confined conditions. Recharge enters the fractured sandstones along San Mateo Creek, where water in the arroyo flows over the outcrops and along the Fernandez monocline, where the formation crops out extensively (see Figure 7-3, Section 7.0, Geology). As groundwater within the Point Lookout Sandstone moves eastward, it is confined by the overlying Menefee Formation. Figure 9-10 shows the water-level elevation and potentiometric surface for the Point Lookout Sandstone in the San Juan basin.

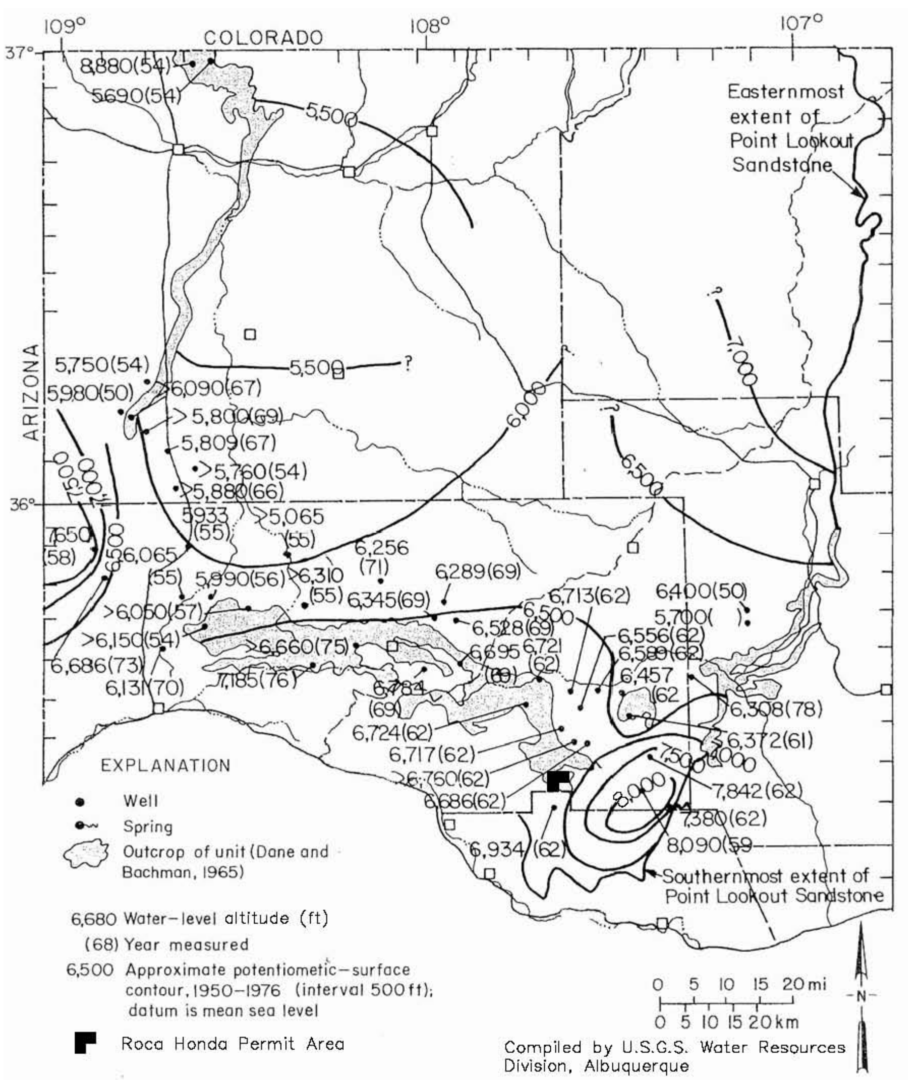

Figure 9-10. Water Level Elevations and Potentiometric Surface for Point Lookout Sandstone (Modified from Stone et al. 1983, Figure 51)

9.3.4 Menefee Formation and Alluvium

Unconfined aquifer systems are also present in the Roca Honda/San Mateo area, both in the alluvium of San Mateo Creek stream bed and in the Menefee Formation. The Menefee Formation is present only in a small area of the Roca Honda permit area and is probably unsaturated. The alluvium of San Mateo Creek is not present in the permit area. The water tables within these aquifers conform to area topography rather than geologic structure and are therefore closely related to surface drainages (Brod and Stone 1981). Although Menefee Formation strata dip eastward into the McCartys syncline like the underlying rocks, groundwater within it follows the topography and moves westward generally parallel to San Mateo Creek rather than eastward down the dip of geologic strata. Groundwater in the Menefee Formation is recharged from infiltration at San Mateo Creek, from mountain front recharge along the flank of Mt. Taylor, and from precipitation on outcrops. East of the community of San Mateo, groundwater in the Menefee Formation appears to have a slight confined head, probably caused by mountain-front recharge and the presence of shale and silt within the formation which impede vertical movement of groundwater and cause local confined and perched conditions. As groundwater moves westward through the Menefee Formation, unconfined conditions prevail and the potentiometric surface merges with the unconfined surface of the stream bed alluvium. Water level elevation and the projected water table in the Menefee Formation are shown in Figure 9-6.

The stream bed alluvium contains an unconfined aquifer fed by the flow of San Mateo Creek, which flows westward over the Menefee Formation, losing water to that formation (Brod and Stone 1981). In some areas on the flats west of the community of San Mateo, the stream and unconfined aquifer may be locally perched on the Menefee Formation shales. It appears that where San Mateo Creek crosses the outcrop contact between the Menefee Formation and the more permeable fractured sandstones of the Point Lookout Sandstone a few miles west of the community of San Mateo, the stream loses flow and becomes ephemeral (see Figure 8-2 in Section 8.0, “Surface Water”). The stream infiltration is probably a major source of recharge to the Point Lookout Sandstone.

9.4 Aquifer Characteristics in the Permit Area

Geologic formations that function as aquifers within the Roca Honda/San Mateo area are discussed below. The terminology follows that of the geology section presented earlier (see Figure 9-2 and Figure 7-4, Section 7.0, Geology). Descriptions of the physical nature, hydraulic characteristics, and typical groundwater quality are readily available in published and unpublished reports. Reports that contain data or information specific to the Roca Honda/San Mateo area include: Cooper and John (1968), NMEI (1974), Brod and Stone (1981), GMRC (1979a), RGRC (1994), and Metric (2005a). Additional information on permit area geology and groundwater chemistry has been collected by RHR. The geologic information has been incorporated in the “Geology” section of this BDR, while the new water chemistry data is included in Tables 9-1 through 9-10 presented later herein with each respective aquifer discussion. The hydraulic parameters of all the aquifers are heterogeneous and anisotropic, meaning that they are spatially and directionally variable.

In the Roca Honda/San Mateo area, aquifers are the Westwater Canyon Member of the Morrison Formation, Dakota Sandstone, Gallup Sandstone, Point Lookout Sandstone, Menefee Formation, and the San Mateo Creek alluvium. The Westwater Canyon Member is regionally an important aquifer in the San Juan basin, but east of the R8W line within T13N, the Westwater Canyon

Member is too deep to be targeted by local wells. The principal locally-used aquifers within the Roca Honda/San Mateo area are the Menefee Formation and the Point Lookout Sandstone. Some wells also produce from valley alluvium (NMOSE WATERS database). The Dalton Sandstone Member of the Crevasse Canyon Formation is not relied on as an aquifer within the area, but supplies poor quality water to a stock well northeast of San Mateo Mesa (Brod and Stone 1981). There are no production wells from any aquifers within the Roca Honda permit area.

Except for stream bed alluvium, the geologic units in the Roca Honda/San Mateo area crop out or are in the shallow subsurface of the Roca Honda permit area. The Menefee Formation, Point Lookout Sandstone, and Crevasse Canyon Formation are not saturated everywhere within the permit area. Figure 7-3 (Section 7.0, Geology) shows where these units crop out in the permit area.

The available water quality analyses of groundwater from the alluvium, Menefee Formation, Point Lookout Sandstone, Gallup Sandstone, and Westwater Canyon Member of the Morrison Formation are presented in Tables 9-1 through 9-10, located in the following discussion sections for each respective formation, i.e., Sections 9.4.1 through 9.4.8. These tables include information on groundwater quality and well location from the 1960s and 1970s within approximately 5 miles of the Roca Honda permit area and data collected as part of the recent RHR groundwater sampling program. The database from which these tables are derived is discussed in more detail in Section 9.7, including 149 wells identified by RHR. The precision, accuracy, and comparability of the older data are commonly unclear because information is not available about well construction, sampling methods, or laboratory analytical methods. Nevertheless, the data can be considered a good general indication of background groundwater quality.

Tables 9-1 through 9-10 provide a subset of this larger database. Major and minor constituents are tabulated in these tables in the discussion section for each respective formation that follows. The term “major” refers to the major ions, while “minor” refers to dissolved metals, total metals, non-metals and radionuclides. No qualitative judgment as to the importance of the individual constituents for regulatory purposes is intended with use of these designations. The historical water chemistry data abstracted from published and unpublished reports are also included in these tables. These data generally provide information on groundwater quality from the 1960s and 1970s within approximately 5 miles of the Roca Honda permit area.

Water level data collected from three monitor wells drilled by RHR into the Westwater Canyon Member in the permit area indicate that the potentiometric surface within that unit beneath the permit area is continuous with the potentiometric surface in the Westwater Canyon Member in the southeastern San Juan structural basin. The data obtained from these wells indicates that the hydraulic characteristics and groundwater quality within the aquifers beneath the permit area are within the same range as those encountered in the same geologic units in the southeastern portion of the basin, an area which includes the Ambrosia Lake and Roca Honda/San Mateo areas. Within the Roca Honda permit area, northwest-striking faults related to the San Rafael fault zone and strain features over the crest of the San Mateo dome may have increased hydraulic conductivity in that direction. Detailed information on the aquifers within the Roca Honda permit area is presented below from shallowest to deepest.

9.4.1 Alluvium

Quaternary alluvial material overlies bedrock throughout the San Mateo Creek valley. Although it probably accepts and transmits groundwater from precipitation to underlying bedrock units, it is most likely unsaturated except near San Mateo Creek. San Mateo Creek alluvial materials consist of unconsolidated sands and silts. Well logs indicate this material is from 10 to 80 ft thick although it may be significantly thicker in some areas (OSE 2008). A few wells produce solely from the alluvium, but most also penetrate the underlying Menefee Formation.

Groundwater in stream bed alluvium is under unconfined conditions, and the depth to water is typically a few tens of feet. The stream bed alluvium is recharged by San Mateo Creek, which receives flow from precipitation and runoff from Mt. Taylor and from spring flow in its upper reaches. The stream bed aquifer loses water to sandstone layers in the underlying Menefee Formation, but because the Menefee Formation contains a significant amount of shale and siltstone (65 percent), the unconfined aquifer may be semi-perched in some areas (GMRC 1979b). The GMRC speculated that the many springs within the valley may represent local unconfined or perched groundwater conditions caused by impermeable shale or siltstone units that interrupt vertical infiltration and force water horizontally to valley walls. A few miles west of the community of San Mateo, San Mateo Creek usually disappears into the alluvium and the fractured sandstones of the Point Lookout Sandstone.

Aquifer tests conducted in San Lucas Canyon as part of GMRC's pipeline and mill siting investigations indicated that the transmissivity of the stream bed alluvium was 708 to 1,450 ft^2/day, and hydraulic conductivity was 27 ft/day (Hydro-Search, Inc., and Jacobs Engineering Group, Inc. 1979). The stream bed alluvium of San Mateo Canyon likely exhibits similar values. It is expected that the permeabilities will be less than those of other stream bed deposits composed of sandier source materials because the stream bed alluvium within San Mateo and San Lucas Canyons was derived from bedrock formations composed largely of shale and siltstone.

Figure 9-11 is a map showing the location of the alluvial wells that were either sampled or for which historical chemistry data are available. Tables 9-1 and 9-2 show analyses of major and minor chemical constituents, respectively, in groundwater samples from wells producing from the alluvium. Complete laboratory reports are provided in Appendix 9-B. Water is of the sodium-bicarbonate-sulfate type with total dissolved solids (TDS) of 325 to 748 mg/L (Brod and Stone 1981).

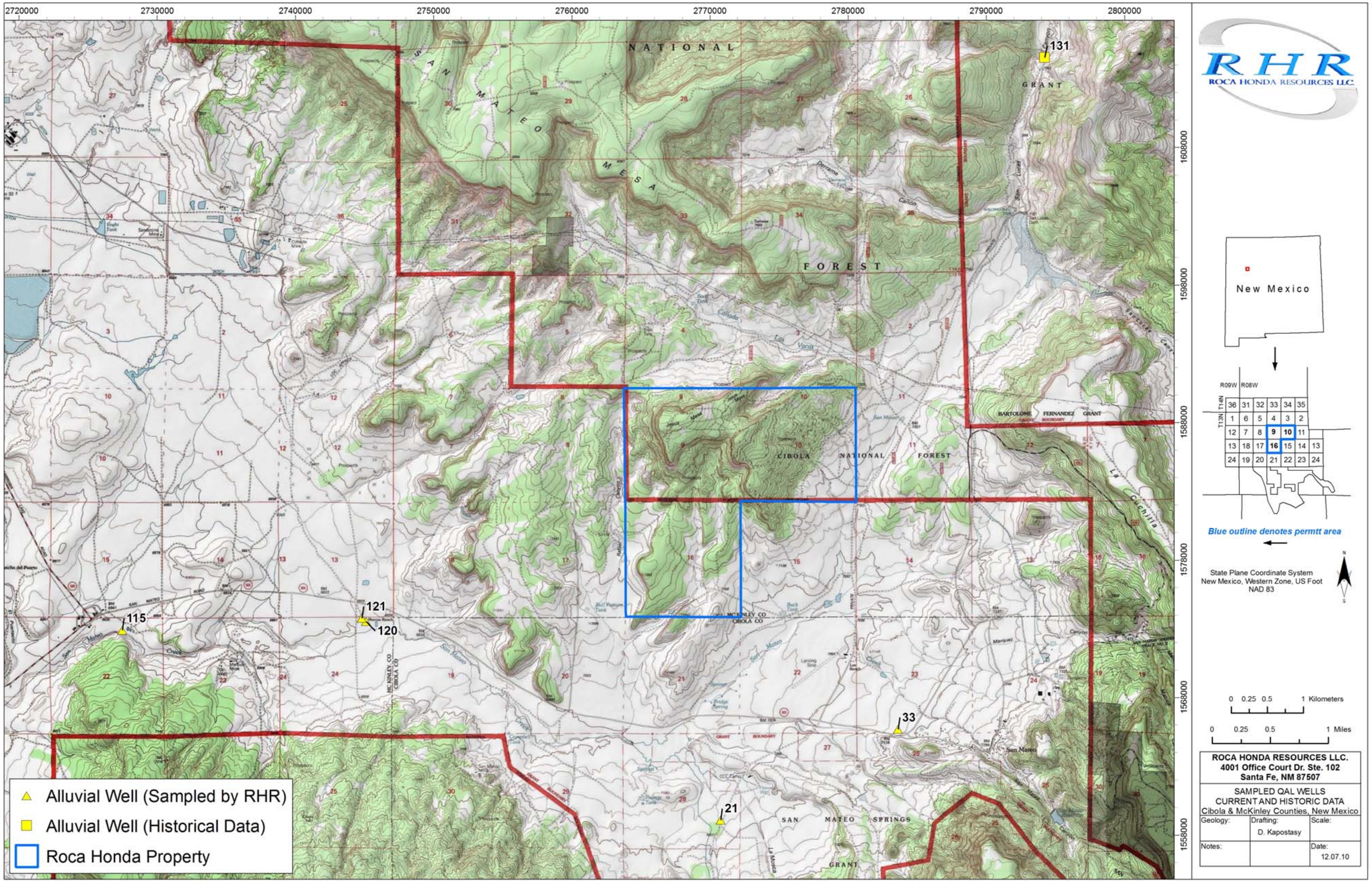

Figure 9-11. Location of Alluvial Wells with Major and Minor Constituent Data

Table 9-1. Water Quality in Alluvium - Major Constituents

Roca Honda/San Mateo Area Ground Water Major Constituent Quality Data for Alluvium (mg/L unless otherwise specified)																				
WELL LOCATIONS				**Data Source**	**Sample Date**	**Specific Conductance (umhos)**	**pH (s.u.)**	**Temp (F)**	**Hardness (mg/L as CaCO3)**	**Alkalinity (as CaCO3)**	**Ca (Dissolved)**	**Mg**	**Na (Dissolved)**	**K (Dissolved)**	**Bicarbonate (as HCO3)**	**Sulfate (as SO4)**	**Cl**	**F**	**Silica (as SiO2)**	**Nitrogen Nitrate (as NO3)**	**TDS**
Well ID #	**Township (N)**	**Range (W)**	**Section**																		
120	13	9	24	RH	8/6/2008	1,370	7.61	67.00	276	330	69	25	227	3	400	356	26	1.3	18.4	-	882
					11/18/2008	1,440	8.05	53.52	218	329	54	20	279	3	401	364	24	1.6	17.1	ND	919
					2/18/2009	1,600	8.69	43.00	41	442	10	4	313	4	472	273	34	2.8	8.7	ND	982
					5/26/2009	1,330	7.84	60.21	263	332	65	25	186	3	405	338	23	1.3	17.4	ND	881
					5/3/2010	1,250	7.69	53.00	302	334	76	27	167	3	407	333	28	1.1	18.5	ND	771
					10/13/2010	1,420	7.99	62.48	215	356	54	20	246	3	424	372	27	1.4	17.3	ND	915
121	13	9	24	RH	8/18/2008	1,510	9.42	56.60	26	207	4	4	368	3	161	452	42	0.5	1.1	-	941
21	13	8	22	RH	8/21/2008	608	7.60	60.15	200	313	54	16	78	1	382	22	7	1.0	67.2	-	409
					11/8/2008	662	7.70	54.45	204	328	56	16	86	1	401	26	7	1.1	70.9	-	452
					2/11/2009	593	7.46	51.48	165	340	41	15	81	ND	415	16	5	1.1	59.0	ND	457
					5/19/2009	649	7.78	59.93	160	345	43	13	76	ND	421	19	6	1.1	45.7	ND	439
					4/29/2010	672	7.72	52.47	161	361	44	12	100	ND	441	27	6	1.1	57.9	ND	432
					10/6/2010	636	7.84	59.70	155	347	43	12	91	ND	424	27	5	1.0	55.3	0.4	438
115	13	8	23	RH	9/16/2008	907	7.81	56.41	157	281	49	9	15.4	3	343	137	15	1.1	19.8	-	566
					11/13/2008	911	8.04	57.50	153	286	47	9	157	3	349	129	15	1.1	20.6	5.6	575
					5/26/2009	905	7.98	58.19	140	297	43	8	144	3	348	123	13	1.1	16.9	5.7	582
					5/4/2010	2,450	7.84	56.81	1,070	439	300	78	125	38	536	1120	33	0.4	15.2	ND	1610
					10/13/2010	893	8.00	58.26	142	319	45	8	149	3	381	136	11	1.1	18.2	7.3	566
33	14	8	25	RH	9/23/2008	1,500	7.56	-	250	443	71	17	263	2	540	300	39	0.9	30.6	-	988
					11/17/2008	1,410	7.70	54.98	249	421	71	17	264	2	514	264	34	0.7	27.7	2.7	894
					5/19/2009	392	8.61	64.26	14	229	4	1	88	1	261	1	ND	1.1	9.6	0.1	265
					5/3/2010	416	8.42	56.69	17	238	5	1	97	1	273	3	2	1.1	13.0	ND	271
					10/12/2010	1,270	7.96	59.90	197	478	57	13	227	2	583	215	12	0.7	25.1	2.2	803
131	14	8	25	D, E	10/2/1979	1,010	8	11.9 ('C)	-	-	75	69	70	1.7	454	202	18	0.8	-	0.09	672

Data Source:
A NMEI 1974 (see particularly Table 7.5, Table 7.7)
B Cooper and John 1968 (see particularly Table 1)
C GMRC 1979a (see particularly Pt. 1: Table 2.6-2, Table 2.6-4, Table 2.2-19; also Pt. 1 Appendix B, Table B-1, Table B-3, Table B-4, Table B-6, Table B-7, Table B-9, Table B-10)
D GMRC 1979c (App. D to source E below) (see particularly Table 4)
E GMRC 1979d (see particularly Table II-4, Table III-1)
F Metric Corp. 2005b
F[a] Metric Corp. 2005a (see particularly Figure 7, Table 1)
G RGRC 1994
H NMED DP-61 file
I Brod and Stone 1981
O OSE 2008
RH Roca Honda 2008, 2009, 2010

Table 9-2. Water Quality in Alluvium – Minor Constituents

Roca Honda/San Mateo Area Ground Water Minor Constituent Quality Data for Alluvium (mg/L unless otherwise specified)

WELL LOCATIONS				Data Source	Sample Date	Ba	B	Se	Zn	Cu	Pb	As	Cr	Co	Mn	Fe	Cd	Ni	Mo	Hg	Ag	Al	Gross Alpha (pCi/L)	Ra-226 (pCi/L)	Ra-228 (pCi/L)	U
Well ID #	Township (N)	Range (W)	Section																							
120	13	9	24	RH	8/6/2008	ND	0.2	ND	ND	ND	ND	ND	ND	ND	0.07	ND	ND	ND	ND	ND	ND	ND	6.7	0.41	0.42	0.0033
					11/18/2008	ND	0.3	0.002	0.01	ND	ND	0.001	ND	ND	0.07	ND	ND	ND	ND	ND	ND	ND	11.8	0.41	0.25	0.0027
					2/18/2009	ND	0.5	ND	ND	ND	ND	ND	ND	ND	0.01	0.08	ND	ND	ND	ND	ND	ND	2.1	-0.06	0.71	ND
					5/26/2009	ND	0.2	ND	ND	ND	ND	ND	ND	ND	0.10	ND	ND	ND	ND	ND	ND	ND	5.3	0.51	2.6	0.0036
					5/3/2010	ND	0.1	0.001	0.02	ND	ND	ND	ND	ND	0.09	ND	ND	ND	ND	ND	ND	ND	8.3	0.21	0.74	0.0041
					10/13/2010	ND	0.2	ND	ND	ND	ND	ND	ND	ND	0.06	ND	ND	ND	ND	ND	ND	ND	-8	0.51	2.3	0.0032
121	13	9	24	RH	8/18/2008	ND	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.8	-0.02	0.27	ND
21	13	8	22	RH	8/21/2008	0.10	ND	ND	ND	ND	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.8	0.03	0.31	0.0049
					11/8/2008	0.1	0.1	ND	ND	ND	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.4	0.09	2.40	0.0053
					2/11/2009	0.2	ND	ND	ND	ND	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.6	-0.2	0.46	0.0055
					5/19/2009	0.1	ND	ND	0.03	ND	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.6	-0.1	1.00	0.0051
					4/29/2010	0.2	0.1	ND	ND	ND	ND	0.004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.5	0.0	0.55	0.0059
					10/6/2010	0.2	0.1	ND	ND	ND	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.7	-0.02	0.10	0.0056
115	13	8	23	RH	9/16/2008	ND	0.2	0.026	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	205.0	-0.10	0.32	0.1800
					11/13/2008	ND	0.2	0.026	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	228	-0.1	0.01	0.166
					5/26/2009	ND	0.2	0.028	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	166	-0.1	0.03	0.192
					5/4/2010	0.2	0.2	0.003	0.02	ND	ND	0.006	ND	ND	0.76	0.1	ND	ND	ND	ND	ND	ND	29	0.5	-0.7	0.0087
					10/13/2010	ND	0.1	0.022	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	277	0.13	1.5	0.1860
33	14	8	25	RH	9/23/2008	ND	0.3	0.003	ND	ND	ND	ND	ND	ND	0.26	0.05	ND	ND	ND	ND	ND	ND	26.8	-0.03	0	0.0085
					11/17/2008	ND	0.3	0.002	ND	ND	ND	ND	ND	ND	0.14	ND	ND	ND	ND	ND	ND	ND	13.7	-0.3	0.01	0.0080
					5/19/2009	0.4	ND	ND	0.02	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.5	0.3	0.05	ND
					5/3/2010	0.5	0.1	ND	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.7	0.2	0.34	ND
					10/12/2010	ND	0.2	0.001	ND	ND	ND	ND	ND	ND	0.04	0.14	ND	ND	ND	ND	ND	ND	17.3	0.36	1.2	0.0073
131	14	8	25	D, E	10/23/1979	0.9	0.15	<0.002	0.25	0.01	0.02	<0.01	<0.02	<0.01	0.55	0.1	<0.005	<0.02	<0.05	<0.002	<0.005	0.2	<5	0.06	<1	<0.013

Data Source:

A NMEI 1974 (see particularly Table 7.5, Table 7.7)
B Cooper and John 1968 (see particularly Table 1)
C GMRC 1979a (see particularly Pt. 1: Table 2.6-2, Table 2.6-4, Table 2.2-19; also Pt. 1 Appendix B, Table B-1, Table B-3, Table B-4, Table B-6, Table B-7, Table B-9, Table B-10)
D GMRC 1979c (App. D to source E below) (see particularly Table 4)
E GMRC 1979d (see particularly Table II-4, Table III-1)
F Metric Corp. 2005b
Fa Metric Corp. 2005a (see particularly Figure 7, Table 1)
G RGRC 1994
H NMED DP-61 file
I Brod and Stone 1981
O OSE 2008
RH Roca Honda, 2008, 2009, 2010

9.4.2 Menefee Formation

Within the Roca Honda permit area and the western part of the San Mateo Creek valley, the Menefee Formation has been removed by erosion and does not crop out. It is present only in the extreme eastern part of the permit area beneath colluvium in the southeast part of Section 10. The formation is preserved east of the Fernandez monocline in the McCartys syncline. The formation crops out in places in the San Mateo Creek valley around the community of San Mateo.

The Menefee Formation is the uppermost unit of the Mesaverde Group present in the Roca Honda permit area. It is composed of shales interbedded with thin to thick sandstones and minor coal seams. The fine-grained, fluvial sandstone units constitute the aquifer beds. Logs from Mt. Taylor mine wells indicate that the thickness of the Menefee Formation is 767 ft in that area (RGRC 1994). Logs for domestic wells indicate that in the upper San Mateo Creek Valley, the Menefee Formation lies at the surface or under a veneer of alluvial material, and the thickness of the Menefee Formation penetrated was several hundred feet. However, it is noted that most of the wells did not penetrate the entire thickness of Menefee Formation.

Groundwater is present within the Menefee Formation under slightly confined conditions in the area of the community of San Mateo and unconfined conditions a few miles to the west. The depth to water ranges from a few feet along the western outcrop area to several hundred feet in the community of San Mateo. As shown on Figure 9-6, the movement of groundwater within the Menefee Formation is topographically controlled. Groundwater in the Menefee Formation moves westward through the formation, parallel to San Mateo Creek at a gradient of 150 ft per mile. Groundwater from San Mateo Creek recharges the Menefee Formation in some areas. Groundwater in the Menefee Formation probably moves laterally into the Point Lookout Sandstone at the outcrop contact between the units and downward into the Point Lookout Sandstone in the subsurface.

The Menefee Formation is a sufficiently productive aquifer for domestic and stock purposes within the upper San Mateo Creek valley, and a number of wells within the valley reportedly produce from the Menefee Formation. Production is small, probably from discrete sandstone beds, but the depth to water is relatively shallow and in this area the groundwater quality is good. Brod and Stone (1981) estimated that the maximum yield of wells producing from the Menefee Formation is less than 0.05 cfs (22 gpm). Figure 9-12 indicates the location of the Menefee wells that were sampled or for which historical chemistry data are available, and Tables 9-3 and 9-4 present reported analyses of major and minor chemical constituents, respectively, in groundwater samples from wells producing from the Menefee Formation. Complete laboratory reports are provided in Appendix 9-C. The water is of sodium-bicarbonate type with some sulfate. The TDS concentration in most samples ranged from 180 to 616 mg/L, although the TDS in Well #7 had a TDS of up to 3,320 mg/L.

GMRC performed aquifer tests using the pilot hole for the Mt. Taylor mine shaft and, though the Menefee Formation was not tested, it was concluded that it probably had transmissivity and hydraulic conductivity values similar to the Point Lookout Sandstone which, within the San Lucas Canyon area, was determined to have a hydraulic conductivity of 3.7 ft/day (Hydro-Search, Inc. and Jacobs Engineering Group, Inc. 1979). Stone et al. (1983) noted that the transmissivity of the Menefee Formation as calculated in aquifer tests depends largely on the total thickness of the sandstone units penetrated. They reported a range of transmissivity values for the Menefee Formation from 10 to 100 ft^2/day.

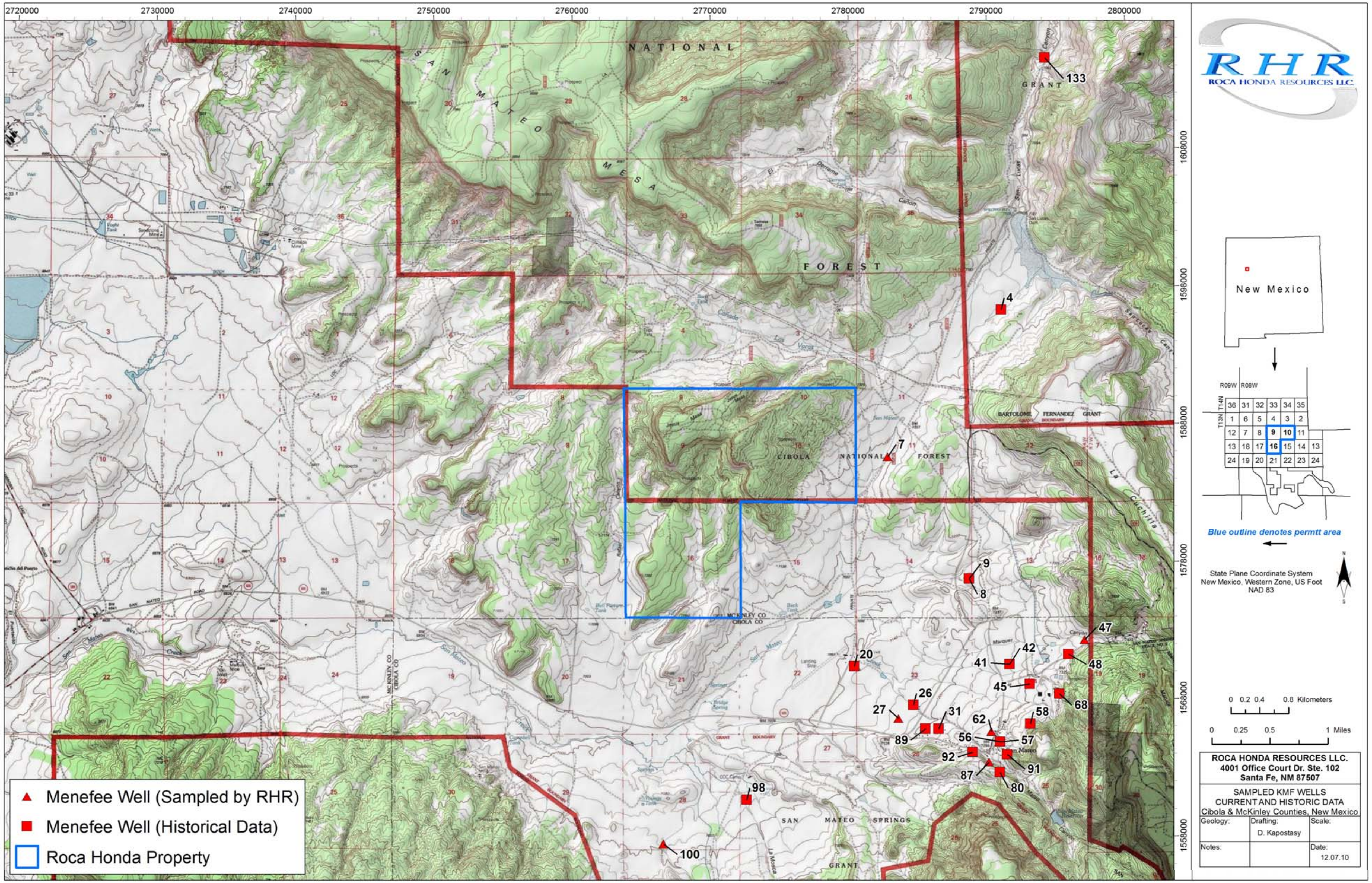

Figure 9-12. Location of Menefee Wells with Major and Minor Constituent Data

Table 9-3. Water Quality in Menefee Formation Wells – Major Constituents

Roca Honda/San Mateo Area Ground Water Major Constituent Quality Data For Menefee Formation (mg/L unless otherwise specified)																					
WELL LOCATIONS				**Data Source**	**Sample Date**	**Specific Conductance (umhos)**	**pH (s.u.)**	**Temp (F)**	**Hardness (mg/L as CaCO3)**	**Alkalinity (as CaCO3)**	**Ca (Dissolved)**	**Mg**	**Na (Dissolved)**	**K (Dissolved)**	**Bicarbonate (as HCO3)**	**Sulfate (as SO4)**	**Cl**	**F**	**Silica (as SiO2)**	**Nitrogen Nitrate (as NO3)**	**TDS**
Well ID #	**Township (N)**	**Range (W)**	**Section**																		
27	13	8	23	RH	8/6/2008	505	7.17	68.73	224	250	72	11	38	4	310	21	6	0.4	51.6	-	338
27					11/13/2008	507	7.71	56.39	196	249	63	10	34	4	304	20	6	0.4	55.9	ND	330
27					2/16/2009	417	7.62	46.60	179	248	57	9	35	4	302	18	6	0.4	38.7	ND	297
27					5/19/2009	500	7.79	59.81	176	257	56	9	41	4	314	17	5	0.5	34.7	0.1	338
27					5/3/2010	510	7.39	48.90	191	262	61	9	36	4	319	24	7	0.4	44.6	ND	318
27					10/1/2010	499	7.94	73.70	192	270	62	9	37	4	329	24	7	0.4	46.2	ND	356
87	13	8	25	RH	8/12/2008	632	8.20	68.89	83	309	21	7	135	2	377	23	4	1.8	18.9	-	4
87					11/12/2008	665	8.04	53.70	118	329	36	11	129	2	402	26	5	1.5	29.3	0.5	424
87					2/16/2009	606	8.17	46.42	105	326	27	9	113	2	398	22	4	1.6	21.3	0.8	413
87					5/19/2009	662	8.33	64.95	91	344	23	8	111	2	401	24	4	1.7	16.7	0.2	425
87					5/3/2010	667	8.11	50.81	88	354	22	8	127	2	411	27	4	1.8	21.5	0.2	446
87					10/13/2010	666	8.27	59.62	92	369	25	7	130	2	428	27	4	1.7	23.4	0.3	380
62	13	8	24	RH	8/20/2008	1,070	7.87	57.90	176	340	48	14	188	2	415	74	106	0.6	14.0	-	616
62					11/11/2008	909	7.82	58.55	110	328	30	9	183	1	400	67	45	0.6	13.8	0.1	520
62					2/18/2009	812	8.02	55.17	72	321	19	6	154	1	376	62	35	0.6	9.4	ND	502
62					5/26/2009	873	8.11	57.46	84	329	22	7	168	1	380	60	40	0.6	10.8	0.1	529
62					5/3/2010	780	8.08	55.28	43	332	12	3	168	1	387	72	16	0.6	10.8	ND	493
62					10/14/2010	1,360	8.02	57.97	234	354	65	17	201	1	432	73	203	0.6	12.7	0.1	760
100	13	8	28	RH	8/21/2008	287	7.73	56.59	64	130	18	5	39	9	158	13	13	0.2	5.2	-	181
100					11/8/2008	337	7.79	50.93	108	187	29	9	39	11	228	6	8	0.3	3.2	-	229
100					2/11/2009	300	7.41	53.93	124	208	33	10	35	8	254	6	4	0.5	26.6	ND	279
100					5/19/2009	380	7.61	63.68	128	211	34	10	34	6	258	4	4	0.5	19.1	ND	241
100					4/29/2010	425	7.40	54.69	147	232	42	10	35	6	284	13	3	0.6	50.8	ND	266
100					10/6/2010	428	7.83	61.90	149	243	43	10	36	6	297	11	4	0.6	53.4	ND	286
7	13	8	11	RH	9/17/2008	4,600	9.09	62.45	50	976	14	4	1,190	5	870	1,260	92	2.8	14.9	-	3,000
7					11/16/2008	4,860	9.54	55.35	37	1,220	8	4	1,260	5	918	1,250	82	2.8	14.0	ND	3,320
7					2/16/2009	4,450	8.38	55.02	65	803	18	5	986	4	947	1,300	77	2.8	7.2	ND	2,830
7					5/18/2009	4,320	8.77	58.12	64	888	18	5	1,110	4	948	1,240	76	2.8	7.6	ND	2,910
7					9/30/2010	3,740	8.35	68.90	80	702	21	6	939	5	815	1,290	99	2.2	7.8	ND	2,680
47	13	8	24	RH	8/7/2008	1,290	7.99	67.49	274	330	68	26	175	3	400	323	25	1.2	121	-	859
					11/18/2008	1,350	7.97	52.82	273	321	68	25	229	3	392	335	24	1.4	18.7	ND	868
4	13	8	1	D,E	10/16/1979	1,050	8.3	14.4 (°C)	-	-	30	10	200	3.3	460	50	65	3.8	-	0.62	625
				I	3/10/1978	960	-	-	-	-	4	17.8	89	4.6	386	90.5	19	-	-	0	494
9	13	8	14	A,I	10/11/1972	2,123	7.61	-	-	-	78.6	36	350	4.6	514.9	430	18.1	0.5	11.1	1.45	1,445
8	13	8	14	C	3/10/1976	-	8.6	-	20	-	5.4	1.6	370	1.7	456	277	12	4.5	-	-	476
20	13	8	22	A,C	10/18/1972	332	7.86	-	-	-	6.1	2.1	60	1.3	217.2	8	4	0.56	24.8	0.02	324
				C	3/9/1976	-	8.2	-	20	-	5.6	1.4	81	1.2	172	6.9	<2	0.62	-	-	222
				C	Dec-76	-	7.8	-	31	-	5.5	1.9	75	<2	202	9	-	1.2	-	-	189
				I	Aug-77	360	-	-	-	-	7	1.7	76	1.5	207	22	4.9	-	22	0.8	240
26	13	8	23	I	2/9/1978	460	-	-	-	-	45	3.2	21	3.3	188	-	5	-	-	0	172

Table 9-3. (Continued)

Roca Honda/San Mateo Area Ground Water Major Constituent Quality Data For Menefee Formation (mg/L unless otherwise specified)																					
WELL LOCATIONS				Data Source	Sample Date	Specific Conductance (umhos)	pH (s.u.)	Temp (F)	Hardness (mg/L as CaCO3)	Alkalinity (as CaCO3)	Ca (Dissolved)	Mg	Na (Dissolved)	K (Dissolved)	Bicarbonate (as HCO3)	Sulfate (as SO4)	Cl	F	Silica (as SiO2)	Nitrogen Nitrate (as NO3)	TDS
Well ID #	Township (N)	Range (W)	Section																		
31	13	8	23	A	10/17/1972	315	7.38	-	-	-	42.3	6.4	20	3.4	197.7	9.5	8	0.32	70.8	0.03	358
				C	3/9/1976	-	7.4	-	113	-	41	4.9	20	2.8	136	12	8	0.22	-	-	214
				C	Dec-76	-	7.2	-	153	-	49	8.1	25	3.6	226	20	-	0.64	-	-	253
				I	Feb-78	310	-	-	-	-	40	6.1	20.1	3.3	188	-	0.14	-	-	0	169
42	13	8	24	I	2/21/1978	1,150	-	-	-	-	3	0.8	268	1.1	431	185	6	-	-	0	680
41	13	8	24	C	3/9/1976	-	8.8	-	11	-	3.4	0.97	270	1.3	300	199	8	1.3	-	-	702
				I	3/9/1978	880	-	-	-	-	1.2	0.4	206	1.1	385	99	4	-	-	0.1	510
45	13	8	24	C	3/9/1976	-	8.4	-	16	-	5.1	1.4	165	1.2	363	82	3	1.7	-	-	534
					Dec-76	-	8.5	-	9	-	2.3	0.61	220	0.82	380	99	-	2.2	-	-	513
48	13	8	24	A,B	9/10/1962	836	9	13.8 (°C)	-	-	1.6	0	206	0.9	379	70	4.2	-	12	0.4	674
				A	10/17/1972	800	8.75	-	-	-	3	0.5	190	0.9	417.3	48.5	12	1.7	13	0.11	685
				C	3/9/1976	-	8.9	-	4	-	1.1	0.17	205	0.71	250	69	6	1.7	-	-	478
					Dec-76	-	7.8	-	63	-	9.7	2.8	300	1.4	552	165	-	4	-	-	731
56	13	8	24	I	2/9/1978	790	-	-	-	-	26.4	9.2	154	1.5	365	96	18	-	-	0	448
57	13	8	24	I	2/9/1978	1,000	-	-	-	-	74	25	131	1.5	381	169	42	-	-	13	647
58	13	8	24	C	3/9/1976	-	7.9	-	65	-	19	4.4	165	1.4	285	104	5	0.73	-	-	462
					3/10/1976	-	7.9	-	65	-	18	4.4	165	1.4	267	104	10	0.71	-	-	978
91	13	8	26	A,I	10/24/1972	964	8.25	-	-	-	3.1	0.9	258	1.3	654	9.9	8	3	17.5	0.27	953
89	13	8	26	I	Jul-76	729	-	-	-	-	54	27	74	3.1	375	71	10	-	-	1.4	460
92	13	8	26	I	2/21/1978	450	-	-	-	-	55	9.5	27	5.4	244	37	8	-	-	0.65	265
98	13	8	27	I	8/22/1977	850	-	-	-	-	4	1.4	205	2	502	1.1	15	-	-	-	531
133	14	8	25	D,E	10/13/1979	2,970	7.5	13.8 (°C)	-	-	205	73	460	15	785	1,120	20	0.3	-	0.13	2,299

Data Source:

A	NMEI 1974 (see particularly Table 7.5, Table 7.7)
B	Cooper and John 1968 (see particularly Table 1)
C	GMRC 1979a (see particularly Pt. 1: Table 2.6-2, Table 2.6-4, Table 2.2-19; also Pt. 1 Appendix B, Table B-1, Table B-3, Table B-4, Table B-6, Table B-7, Table B-9, Table B-10)
D	GMRC 1979c (App. D to source E below) (see particularly Table 4)
E	GMRC 1979d (see particularly Table II-4, Table III-1)
F	Metric Corp. 2005b
Fa	Metric Corp. 2005a (see particularly Figure 7, Table 1)
G	RGRC 1994
H	NMED DP-61 file
I	Brod and Stone 1981
O	OSE 2008
RH	Roca Honda, 2008, 2009, 2010

Table 9-4. Water Quality in Menefee Formation Wells - Minor Constituents

Roca Honda/San Mateo Area Ground Water Minor Constituent Quality Data For Menefee Formation (mg/L unless otherwise specified)

WELL LOCATION				Data Source	Sample Date	Ba	B	Si	Se	Zn	Cu	Pb	As	Cr	Co	Mn	Fe	Cd	Ni	Mo	Hg	Ag	Al	V	Gross Beta (pCi/L)	Gross Alpha (pCi/L)	Ra-226 (pCi/L)	Th-230 (pCi/L)	Ra-228 (pCi/L)	U
Well ID #	Township (N)	Range (W)	Section																											
27	13	8	23	RH	8/6/2008	0.2	ND	-	ND	0.15	0.06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.2	5.5	-0.03	-0.2	0.03	0.0049
					11/13/2008	0.2	ND	-	ND	0.26	0.08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.4	5.8	-0.07	-0.1	-0.2	0.0041
					2/16/2009	0.2	ND	-	0.001	0.11	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.1	5.3	-0.006	-0.1	1.3	0.0054
					5/19/2009	0.2	ND	-	ND	0.22	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.3	11.1	-0.1	0.02	-0.09	0.0049
					5/3/2010	0.2	ND	-	ND	0.17	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2	4	-0.04	-0.004	0.25	0.0051
					10/1/2010	0.2	ND	-	0.001	0.33	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.6	3.8	-0.1	-0.02	1.1	0.0054
87	13	8	25	RH	8/12/2008	0.2	0.4	-	ND	0.01	0.02	ND	0.008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.3	8.0	0.12	-0.2	0.39	0.0024
					11/12/2008	0.1	0.4	-	ND	0.02	0.04	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.6	8.4	-0.2	0.1	-0.4	0.0015
					2/16/2009	ND	0.3	-	ND	ND	0.01	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.7	2.0	-0.08	-0.02	2.1	0.0016
					5/19/2009	ND	0.3	-	ND	0.02	0.01	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.8	7.3	-0.05	0.2	-0.2	0.0014
					5/3/2010	ND	0.4	-	ND	ND	0.02	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.6	1.8	-0.07	0.08	0.02	0.0017
					10/13/2010	ND	ND	-	ND	ND	0.02	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.1	-4.0	0.26	-0.2	1.4	0.0016
62	13	8	24	RH	8/20/2008	ND	ND	-	ND	0.03	ND	ND	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND	0.6	4.2	-0.10	1.7	0.77	0.0047
					11/11/2008	ND	0.1	-	ND	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-3.0	5.5	-0.03	0.0	-0.3	0.0027
					2/18/2009	ND	0.1	-	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-3	3.1	0.16	0.02	0.85	0.0016
					5/26/2009	ND	0.1	-	ND	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-2	3.8	0.14	0.06	0.7	0.0018
					5/3/2010	ND	0.1	-	ND	0.06	ND	ND	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND	3.2	4.4	-0.04	0.1	0.35	0.0008
					10/14/2010	ND	0.1	-	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2	-1	0.4	-0.06	0.3	0.0042
100	13	8	28	RH	8/21/2008	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	0.10	ND	ND	ND	ND	ND	ND	ND	ND	3.5	1.9	0.13	1.5	0.79	0.0005
					11/8/2008	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	0.30	ND	ND	ND	ND	ND	ND	ND	ND	14.1	6.6	0.009	0.0	1.5	ND
					2/11/2009	0.1	ND	-	0.002	ND	ND	ND	ND	ND	ND	0.26	ND	ND	ND	ND	ND	ND	ND	ND	5.3	6.3	0.12	0.05	0.60	0.0036
					5/19/2009	0.1	ND	-	ND	ND	ND	ND	ND	ND	ND	0.21	ND	ND	ND	ND	ND	ND	ND	ND	8.2	8.2	0.005	0.06	0.58	0.0031
					4/29/2010	0.2	ND	-	0.001	ND	ND	ND	0.002	ND	ND	0.04	ND	ND	ND	ND	ND	ND	ND	ND	7.4	6.9	-0.03	-0.01	0.47	0.0054
					10/6/2010	0.2	ND	-	ND	ND	ND	ND	0.003	ND	ND	ND	0.06	ND	ND	ND	ND	ND	ND	ND	8.1	8.4	-0.01	-0.03	0.34	0.0057
7	13	8	11	RH	9/17/2008	ND	0.4	-	ND	0.08	ND	ND	0.004	ND	ND	0.01	0.12	ND	ND	ND	ND	ND	ND	ND	-7.0	6.9	-0.06	2.8	0.1	ND
					11/16/2008	ND	0.5	-	ND	0.08	ND	ND	0.009	ND	ND	0.01	0.51	ND	ND	ND	ND	ND	ND	ND	21.0	48.9	0.89	-0.5	0.14	0.0009
					2/16/2009	ND	0.5	-	0.001	0.05	ND	ND	ND	ND	ND	0.06	0.57	ND	ND	ND	ND	ND	ND	ND	14.2	15.8	1.3	-0.2	2.6	ND
					5/18/2009	ND	0.5	-	ND	0.02	ND	ND	0.002	ND	ND	0.06	0.54	ND	ND	ND	ND	ND	ND	ND	4.4	35.9	0.37	-0.02	0.45	ND
					9/30/2010	ND	0.3	-	0.001	2.49	ND	ND	ND	ND	ND	0.16	ND	ND	ND	ND	ND	ND	ND	ND	-50	-8	-0.04	-0.2	2.2	0.0003
47	13	8	24	RH	8/7/2008	ND	ND	-	ND	0.01	ND	ND	ND	ND	ND	0.09	ND	ND	ND	ND	ND	ND	ND	ND	4.2	4.3	0.34	-0.1	0.05	0.0046
					11/18/2008	ND	0.20	-	0.002	ND	ND	ND	ND	ND	ND	0.08	ND	ND	ND	ND	ND	ND	ND	ND	0.9	6.2	0.38	-0.1	-0.05	0.0033
4	13	8	1	D,E	10/16/1979	0.2	0.3	-	<0.002	0.3	0.06	0.02	0.01	<0.02	<0.01	0.02	<0.01	<0.005	<0.02	<0.05	<0.002	<0.005	0.7	-	-	<6	0.13±0.03	-	<1	<0.006
9	13	8	14	A	10/11/1972	<1	1.2	12	-	0.03	0.031	0.0026	<0.0005	-	<0.001	0.115	9	<0.0016	<0.001	<0.003	<0.001	-	-	-	<0.02	-	-	-	-	-
8	13	8	14	C	3/10/1976	<0.5	0.73		<0.005	0.02	0.03	0.04	<0.01	<0.005	-	0.08	6.9	0.002	-	-	-	<0.002	-	-	-	-	-	-	-	<0.002
20	13	8	22	A,C	10/18/1972	<1	<0.1	17	-	0.06	0.0059	<0.00025	0.013	-	<0.001	0.003	0.132	0.0019	<0.001	<0.003	<0.001	-	-	-	<0.02	-	-	-	-	-
				C	3/9/1976	<0.3	0.1	-	-	0.03	<0.005	0.01	<0.01	0.04	-	0.008	0.64	<0.002	-	-	-	<0.005	-	-	-	-	-	-	-	<0.002
					Dec-76	0.5	0.1	-	-	0.03	<0.005	<0.001	<0.001	<0.005	-	<0.002	0.03	<0.002	-	-	-	<0.002	-	-	-	-	-	-	-	0.005

Roca Honda/San Mateo Area Ground Water Minor Constituent Quality Data For Menefee Formation (mg/L unless otherwise specified)

WELL LOCATIONS																														
Well ID #	Township (N)	Range (W)	Section	Data Source	Sample Date	Ba	B	Si	Se	Zn	Cu	Pb	As	Cr	Co	Mn	Fe	Cd	Ni	Mo	Hg	Ag	Al	V	Gross Beta (pCi/L)	Gross Alpha (pCi/L)	Ra-226 (pCi/L)	Th-230 (pCi/L)	Ra-228 (pCi/L)	U
26	13	8	23	A	10/17/1972	<1	<0.1	33	-	0.138	0.03	0.0014	<0.0005	-	<0.001	0.0008	0.09	0.003	<0.001	<0.003	<0.001	-	-	-	<0.02	-	-	-	-	-
				C	3/9/1976	<0.5	<0.1	-	<0.005	0.17	<0.005	<0.01	<0.001	<0.005	-	<0.002	0.04	<0.002	-	-	-	<0.002	-	-	-	-	-	-	-	<0.002
					Dec-76	<0.5	0.1	-	<0.005	0.24	0.01	0.02	<0.01	<0.005	-	<0.002	0.1	<0.002	-	-	-	<0.002	-	-	-	-	-	-	-	0.004
41	13	8	24	C	3/9/1976	<0.5	0.31	-	<0.005	0.22	<0.005	0.01	<0.01	<0.005	-	0.02	0.49	<0.002	-	<0.01	-	<0.002	-	<0.001	-	-	-	-	-	0.002
					3/9/1976	<0.1	0.3	-	<0.01	0.37	<0.003	<0.001	<0.01	0.009	-	0.024	0.8	<0.001	-	0.002	-	<0.002	-	<0.01	-	-	-	-	-	0.0053
45	13	8	24	C	3/9/1976	<0.5	0.42	-	<0.005	0.08	<0.005	0.09	<0.190	<0.005	-	0.01	0.2	<0.002	-	0.05	-	<0.002	-	<0.001	2±9	2.3±2.0	0.1±0.2	0.0±0.4	-	<0.002
					Dec-76	<0.5	0.3	-	<0.005	0.06	<0.01	0.01	<0.01	<0.005	-	0.008	0.15	<0.002	-	<0.01	-	<0.002	-	<0.002	6±10	0.9±1.5	0.0±0.2	0.0±0.1	2±3	0.004
48	13	8	24	A,B	9/10/1962	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				A	10/17/1972	<1	0.7	11	-	0.03	0.076	<0.00025	<0.0005	-	<0.001	0.0024	0.17	0.0005	<0.001	<0.003	<0.001	-	-	-	<0.02	-	-	-	-	-
				C	3/9/1976	<0.5	0.5	-	<0.005	0.04	<0.005	<0.01	<0.01	<0.005	-	0.005	0.06	<0.002	-	-	-	<0.002	-	-	-	-	-	-	-	<0.002
					Dec-76	<0.5	0.4	-	<0.005	1	0.03	0.03	0.03	<0.005	-	0.007	0.33	<0.002	-	-	-	<0.002	-	-	-	-	-	-	-	<0.002
62	13	8	24	A,B	9/10/1962	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				C	3/9/1976	<0.5	0.2	-	<0.005	0.08	<0.005	0.01	<0.01	<0.005	-	0.005	0.03	<0.002	-	-	-	<0.002	-	-	-	-	-	-	-	0.002
					Dec-76	<0.5	0.2	-	<0.005	0.35	0.05	0.09	<0.01	<0.005	-	<0.002	0.05	<0.002	-	-	-	<0.002	-	-	-	-	-	-	-	0.008
58	13	8	24	C	3/9/1976	<0.5	0.11	-	<0.005	0.15	0.02	-	<0.01	<0.005	-	0.02	0.17	<0.002	-	-	-	<0.002	-	-	-	-	-	-	-	<0.002
					3/10/1976	<0.5	0.13	-	<0.005	0.17	0.02	0.01	<0.01	<0.005	-	0.03	0.27	<0.002	-	-	-	<0.002	-	-	-	-	-	-	-	<0.002
68	13	8	24	C	8/26/1976	0.4	0.2	-	-	0.004	-	<0.001	<0.01	<0.001	-	0.013	0.129	<0.001	-	<0.001	-	-	-	-	0±1	-	3.62±1.29	-	3.7±1.8	-
80	13	8	25	A	10/11/1972	<1	<0.1	16	-	0.295	0.024	0.0084	<0.005	-	<0.001	0.001	1.55	0.0064	<0.001	<0.003	<0.001	-	-	-	<0.02	-	-	-	-	-
91	13	8	26	A,B	9/11/1962	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				A	10/24/1972	<1	1.3	20	-	0.74	0.12	0.0025	0.026	-	<0.001	0.035	4.3	0.0038	<0.001	<0.003	<0.001	-	-	-	<0.02	-	-	-	-	-
133	14	8	25	D,E	10/13/1979	1	0.85	-	<0.002	0.62	0.02	0.03	<0.01	<0.02	<0.01	0.53	0.17	<0.005	<0.02	<0.05	<0.002	<0.005	100	-	-	<7	2.9±0.03	-	<1	<0.006

Data Source:

A NMEI 1974 (see particularly Table 7.5, Table 7.7)
B Cooper & John 1968 (see particularly Table 1)
C GMRC 1979a (see particularly Pt. 1: Table 2.6-2, Table 2.6-4, Table 2.2-19; also Pt. 1 Appendix B, Table B-1, Table B-3, Table B-4, Table B-6, Table B-7, Table B-9, Table B-10)
D GMRC 1979c (App. D to source E below) (see particularly Table 4)
E GMRC 1979d (see particularly Table II-4, Table III-1)
F Metric Corp. 2005b
F[a] Metric Corp. 2005a (see particularly Figure 7, Table 1)
G RGRC 1994
H NMED DP-61 file
I Brod and Stone 1981
O OSE 2008
RH Roca Honda Resources 2008, 2009, 2010

9.4.3 Point Lookout Sandstone

The Point Lookout Sandstone underlies the Menefee Formation and is another unit of the Upper Cretaceous Mesaverde Group. The Point Lookout Sandstone is a very fine- to medium-grained sandstone with thin interbeds of dark shale in the lower part (Craigg 2001). In the Roca Honda permit area, the sandstone is dense, with low primary permeability. Logs from Mt. Taylor mine wells indicate that the Point Lookout Sandstone in that area consists of two sandstone units, each 115 ft thick, separated by the Satan Tongue of the Mancos Shale (RGRC 1994). Within the middle San Mateo Valley, the Point Lookout Sandstone crops out in a northeast-striking band about 2 miles west of the community of San Mateo. This outcrop band along the Fernandez monocline passes through Sections 9 and 10 of the Roca Honda permit area. The formation dips eastward beneath the Menefee Formation.

Groundwater moves eastward through sandstones of the Point Lookout Sandstone under both unconfined and confined conditions. Recharge enters the fractured sandstone along San Mateo Creek where it flows over the outcrops, along the Fernandez monocline where the formation crops out extensively, and likely from inter-formation movement of groundwater from the Menefee Formation. Well and water level data indicate that as groundwater within the Point Lookout Sandstone moves downdip eastward, it becomes confined. There are insufficient data to create a potentiometric surface for the Point Lookout Sandstone in the immediate vicinity of the permit area.

The Point Lookout Sandstone is an aquifer in the area of the community of San Mateo, likely because fracturing and faulting has enhanced permeability. The Point Lookout Sandstone is reported to yield up to 0.1 cfs (50 gpm) to wells, though smaller rates are more common. Groundwater in the Point Lookout Sandstone is a sodium bicarbonate water, similar to that of the Menefee Formation but lacking sulfate and magnesium. It contains from 200 to 650 mg/L TDS concentration. Figure 9-13 indicates the locations of the Point Lookout Sandstone wells sampled or for which historical data are available, and Tables 9-5 and 9-6 present analyses of major and minor chemical constituents, respectively, in groundwater samples from wells producing from the Point Lookout Sandstone. Complete laboratory reports are provided in Appendix 9-D. The Point Lookout Sandstone is present at the surface within the Roca Honda permit area (see Figure 7- 3, Section 7.0, Geology). It is likely not saturated within the permit area, but may capture recharge on the eastern side of the Fernandez monocline.

The GMRC performed aquifer tests using the pilot hole for the Mt. Taylor mine shaft, and found the Point Lookout Sandstone to have a transmissivity of 200 ft^2/day and a hydraulic conductivity of 1.5 ft/day (Brod and Stone 1981). Within the San Lucas Canyon area, the Point Lookout Sandstone was determined to have a hydraulic conductivity of 3.7 ft/day (Hydro-Search, Inc., and Jacobs Engineering Group, Inc. 1979). Stone et al. (1983) reported that a test by Dames and Moore northeast of Crownpoint gave a transmissivity of about 240 ft^2/day for the main body of the Point Lookout Sandstone and a transmissivity of about 70 ft^2/day for the Hosta Sandstone Tongue.

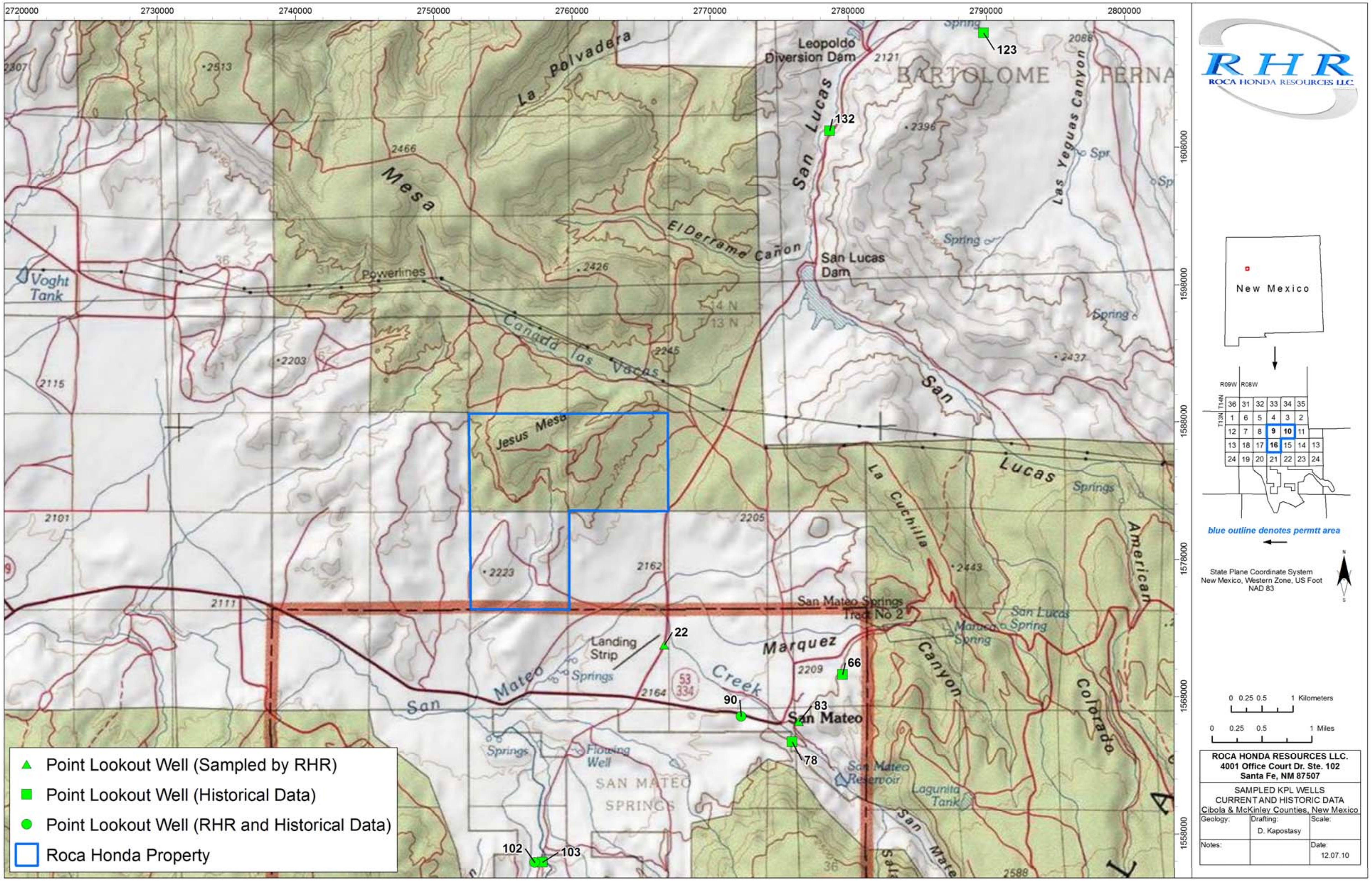

Figure 9-13. Location of Point Lookout Wells with Major and Minor Constituent Data

Table 9-5. Water Quality in Point Lookout Sandstone Wells - Major Constituents

Roca Honda/San Mateo Area Ground Water Major Constituent Quality Data for Point Lookout Sandstone (mg/L unless otherwise specified)																					
WELL LOCATIONS				Data Source	Sample Date	Specific Conductance (umhos)	pH (s.u.)	Temp (F)	Hardness (mg/L as CaCO3)	Alkalinity (as CaCO3)	Ca (Dissolved)	Mg	Na (Dissolved)	K (Dissolved)	Bicarbonate (as HCO3)	Sulfate (as SO4)	Cl	F	Silica (as SiO2)	Nitrogen Nitrate (as NO3)	TDS
Well ID #	Township (N)	Range (W)	Section																		
90	13	8	26	RH	8/11/2008	404	8.42	68.98	18	215	5	1	101	1	253	2	1	1.0	16.6	-	249
					11/10/2008	378	8.52	56.07	16	230	4	1	104	1	259	3	ND	1.0	14.2	ND	258
					2/16/2009	937	8.62	65.75	11	475	3	ND	229	1	531	44	8	3.3	8.6	ND	626
					5/19/2009	390	8.64	69.26	14	228	3	1	79	1	265	1	ND	1.0	11.1	ND	261
					5/3/2010	929	8.76	59.77	8	455	2	ND	232	ND	505	85	14	2.9	10.0	ND	560
					10/12/2010	406	8.58	65.10	15	244	4	1	97	1	278	3	ND	1.0	13.2	ND	242
22	13	8	22	RH	8/21/2008	306	8.29	-	21	172	6	2	77	1	192	6	ND	0.6	14.2	-	204
					11/13/2008	327	8.49	57.97	22	174	6	2	78	1	200	6	ND	0.6	14.4	0.2	212
					2/11/2009	186	8.40	55.32	18	172	4	2	68	1	210	4	ND	0.6	11.7	ND	221
					5/19/2009	305	8.57	63.90	18	178	5	2	69	1	204	5	ND	0.6	8.7	ND	204
					4/29/2010	327	8.36	60.02	19	184	5	2	78	1	216	7	ND	0.6	12.2	ND	192
					10/13/2010	327	8.55	61.96	19	189	5	2	75	1	219	9	1	0.6	12.8	ND	270
102	13	8	33	RH	9/24/2008	1090	8.29	-	15	586	4	1	311	2	670	ND	7	7.6	12.3	-	655
					11/8/2008	723	8.52	52.53	12	389	3	1	195	2	443	ND	3	3.3	15.5	ND	446
					2/11/2009	808	8.43	35.30	10	454	2	ND	192	2	537	ND	4	5.0	11.4	ND	554
					10/6/2010	742	8.56	60.40	10	446	2	ND	187	1	509	ND	4	3.8	13.4	ND	491
83	13	8	25	RH	8/20/2008	878	9.30	56.05	2	465	ND	ND	219	ND	401	4	3	4.3	2.3	-	485
					11/10/2008	900	9.34	53.49	2	466	ND	ND	249	ND	408	2	2	4.2	1.9	ND	508
66	13	8	24	C	3/8/1976	-	8.2	-	24	-	6.4	1.8	78	1.3	174	6	2	0.63	-	-	276
					Dec-76	-	7.8	-	26	-	5.5	2	75	1.3	197	7	-	1.2	-	-	-
					Dec-76	-	8.45	-	64.4	-	5.11	1.84	89	<0.1	176	<1	-	0.46	-	-	-
78	13	8	25	A	10/11/1972	509	7.4	-	-	-	22.6	5.7	70.1	21.9	263.6	11.5	17	0.72	20.6	0.84 (total Nitrogen)	434
				C	3/10/1976	-	7.4	-	149	-	44	10	44	2.7	184	40	16	0.4	-	-	320
90	13	8	26	A,B,C,I	9/11/1962	808	8.1	13.8 (°C)	-	-	74	24	76	3	365	103	22	-	14	14 (total Nitrogen)	695
102	13	8	33	C	6/1/1972	730	8	-	29	-	6.4	3.2	170	1.2	348	83	10	-	-	-	490
103	13	8	33	I	8/2/1977	940	-	-	-	-	2	0.4	218	4	-	10	20	-	-	0	538
132	14	8	25	D,E	10/18/1979	909	7.9	14.7 (°C)	-	-	75	27	109	3	419	156	10	0.2	-	0.04	595

Data Source:

A NMEI 1974 (see particularly Table 7.5, Table 7.7)
B Cooper and John 1968 (see particularly Table 1)
C GMRC 1979a (see particularly Pt. 1: Table 2.6-2, Table 2.6-4, Table 2.2-19; also Pt. 1 Appendix B, Table B-1, Table B-3, Table B-4, Table B-6, Table B-7, Table B-9, Table B-10)
D GMRC 1979c (App. D to source E below) (see particularly Table 4)
E GMRC 1979d (see particularly Table II-4, Table III-1)
F Metric Corp. 2005b
F[a] Metric Corp. 2005a (see particularly Figure 7, Table 1)
G RGRC 1994
H NMED DP-61 file
I Brod and Stone 1981
O OSE 2008
RH Roca Honda Resources 2008, 2009, 2010

Table 9-6. Water Quality in Point Lookout Sandstone Wells - Minor Constituent

Roca Honda/San Mateo Area Ground Water Minor Constituent Quality Data for Point Lookout Sandstone (mg/L unless otherwise specified)																														
WELL LOCATIONS				Data Source	Sample Date	Ba	B	Si	Se	Zn	Cu	Pb	As	Cr	Co	Mn	Fe	Cd	Ni	Mo	Hg	Ag	Al	V	Gross Beta (pCi/L)	Gross Alpha (pCi/L)	Ra-226 (pCi/L)	Th-230 (pCi/L)	Ra-228 (pCi/L)	U
Well ID #	Township (N)	Range (W)	Section																											
90	13	8	26	RH	8/11/2008	0.4	0.1	-	ND	0.09	0.02	ND	ND	ND	ND	ND	0.03	0.03	ND	ND	ND	ND	ND	ND	-2.0	0.3	0.24	0.4	2.1	ND
					11/10/2008	0.4	0.1	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.7	6.0	0.01	0.0	0.32	ND
					2/16/2009	0.2	0.4	-	ND	0.04	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-3	0.4	-0.04	-0.05	1.1	ND
					5/19/2009	0.4	ND	-	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-2	1.3	0.36	-0.08	0.76	ND
					5/3/2010	0.2	0.4	-	ND	0.01	ND	ND	ND	ND	ND	ND	0.05	ND	ND	ND	ND	ND	ND	ND	4.3	4.9	-0.07	-0.007	0.23	ND
					10/12/2010	0.4	0.1	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.9	-0.7	0.05	0.03	0.95	ND
22	13	8	22	RH	8/21/2008	0.3	ND	-	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-0.6	0.9	0.31	1.2	1.1	ND
					11/13/2008	0.3	ND	-	ND	0.03	ND	ND	ND	ND	ND	ND	0.03	ND	ND	ND	ND	ND	ND	ND	-0.06	0.8	0.24	0.0	0.57	ND
					2/11/2009	0.3	ND	-	ND	0.02	ND	ND	ND	ND	ND	ND	0.04	ND	ND	ND	ND	ND	ND	ND	-0.9	1.5	0.28	-0.05	0.22	ND
					5/19/2009	0.3	ND	-	ND	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-2	0.6	0.21	-0.08	0.6	ND
					4/29/2010	0.3	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	0.04	ND	ND	ND	ND	ND	ND	ND	7.2	5.7	0.09	-0.02	0.57	ND
					10/13/2010	0.3	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.5	-3	0.39	-0.03	1.2	ND
102	13	8	33	RH	9/24/2008	0.2	0.5	-	ND	0.09	ND	ND	0.001	ND	ND	0.02	0.04	ND	ND	ND	ND	ND	ND	ND	-3.0	1.5	0.08	0.6	-0.2	ND
					11/8/2008	ND	0.5	-	ND	0.05	ND	ND	0.001	ND	ND	ND	0.25	ND	ND	ND	ND	ND	ND	ND	-2	0.4	-0.01	-0.5	1.6	ND
					2/11/2009	0.1	0.4	-	ND	0.06	ND	ND	0.002	ND	ND	ND	0.09	ND	ND	ND	ND	ND	ND	ND	-0.5	0.5	0.06	0.1	1.3	ND
					10/6/2010	ND	0.4	-	ND	0.04	ND	ND	0.001	ND	ND	ND	0.31	ND	ND	ND	ND	ND	ND	ND	2.8	-0.6	-0.01	-0.04	0.2	ND
83	13	8	25	RH	8/20/2008	ND	0.70	_	ND	0.07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-6	-0.6	-0.02	3.1	0.1	ND
					11/10/2008	ND	0.70	_	ND	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-3	-0.9	-0.2	0	2.4	ND
66	13	8	24	C	3/8/1976	<0.5	0.11	-	<0.005	0.02	0.08	0.02	<0.01	<0.005	-	0.01	1.2	<0.002	-	-	-	<0.002	-	-	2±6	1.1±1.0	0.4±0.3	0.0±0.4	-	<0.002
					Dec-76	0.5	0.1	-	<0.005	0.006	<0.005	0.01	<0.01	<0.005	-	0.006	0.11	<0.002	-	-	-	<0.002	-	-	0±6	2.3±1.3	0.0±0.3	0.0±0.2	0±3	0.004
102	13	8	33	C	6/1/1972	<0.1	-	13.3	-	-	-	-	-	-	-	<0.05	<0.1	-	-	<0.02	-	-	-	-	-	-	-	-	-	-
123	14	7	19	C	3/9/1976	<0.5	0.13	-	-	0.005	<0.005	-	<0.01	<0.005	-	0.006	0.18	<0.002	-	-	-	-	-	-	1±6	0.3±0.6	0.3±0.7	0.0±0.4	-	<0.002
132	14	8	25	D,E	10/18/1979	0.45	0.25	-	<0.002	0.26	0.005	0.01	<0.01	<0.02	<0.01	0.02	<0.01	<0.005	<0.02	<0.05	<0.002	<0.005	<0.1	-	-	<7	0.41±0.03	-	2±1	<0.006

Data Source:

A NMEI 1974 (see particularly Table 7.5, Table 7.7)
B Cooper & John 1968 (see particularly Table 1)
C GMRC 1979a (see particularly Pt. 1: Table 2.6-2, Table 2.6-4, Table 2.2-19; also Pt. 1 Appendix B, Table B-1, Table B-3, Table B-4, Table B-6, Table B-7, Table B-9, Table B-10)
D GMRC 1979c (App. D to source E below) (see particularly Table 4)
E GMRC 1979d (see particularly Table II-4, Table III-1)
F Metric Corp. 2005b
F[a] Metric Corp. 2005a (see particularly Figure 7, Table 1)
G RGRC 1994
H NMED DP-61 file
I Brod and Stone 1981
O OSE 2008
RH Roca Honda Resources 2008, 2009, 2010

9.4.4 Crevasse Canyon Formation

A unit of the Mesaverde Group, the Crevasse Canyon Formation is divided into three members, in descending order: the Gibson Coal, the Dalton Sandstone, and the Dilco Coal (Stone et al. 1983). The Dalton Sandstone Member is the most permeable unit and consists of interbedded sequences of lenticular sandstone, siltstone, shale, and claystone with carbonaceous shale and coal common in the lower and upper parts (Craigg 2001). In the area of the community of San Mateo, the Dalton Sandstone Member is generally a clean, white to buff, massive fine- to medium-grained sandstone that is as much as 70 ft thick (NMEI 1974). The unit lies approximately 500 ft below land surface in the San Mateo Creek valley, and wells in that area do not appear to produce from the Dalton Sandstone Member, probably because sufficient water is available in the shallower Menefee Formation and the Point Lookout Sandstone. The Gibson Coal and Dilco Coal Members contain more coal and shale, and are less permeable. NMEI (1974) reports that the Dilco Coal Member is about 90 ft thick and the Gibson Coal Member is about 165 ft in the area of the Mt. Taylor mine.

The Dalton Sandstone is exposed in Sections 9 and 16 of the Roca Honda permit area along the Fernandez monocline, but is probably not saturated. There are insufficient data to contour the potentiometric surface in the Dalton Sandstone Member, but it is highly likely that groundwater within it moves northeastward where the formation is saturated.

Brod and Stone (1981) report that a stock well producing from the Dalton Sandstone Member northeast of San Mateo Mesa has sodium sulfate water with a TDS of 4,500 mg/L. Stone et al. (1983) report that in other parts of the San Juan basin, TDS concentrations in the Dalton Sandstone Member are approximately 2,000 mg/L. Chemistry data are not available for the Dalton Sandstone in the San Mateo Creek valley.

Brod and Stone (1981) note that because of the lower concentration of matrix material, the sandstone units in the Dalton Sandstone Member can be expected to have a higher intergranular permeability than the Point Lookout Sandstone. Stone et al. (1983) report that the transmissivity of the Dalton Sandstone Member is probably less than 50 ft^2/day, and note that Dames and Moore reported a possible transmissivity range for the Dalton Sandstone Member of 10 to 30 ft^2/day (Stone et al. 1983). As part of its alternative sites analysis, GMRC extensively evaluated the field permeability of the Dilco Coal Member in the area of La Polvadera Canyon and the area of the community of San Mateo. It was determined that the Dilco Coal Member had a weighted average permeability (hydraulic conductivity) of 4.43 ft/yr in La Polvadera Canyon and 5.3 ft/yr in the area of the community of San Mateo, with a range of 0 to 56 ft/yr. The transition zone between the Dilco Coal Member and the underlying Gallup Sandstone had a permeability range of 0 to 1,200 ft/yr (GMRC 1979a).

9.4.5 Gallup Sandstone

The Gallup Sandstone is predominantly a fine-to medium-grained arkosic sandstone with some conglomerate, shale, and coal (Stone et al, 1983 and Dam 1995). It lies conformably on the main body of the Mancos Shale. The thickness of the Gallup Sandstone ranges from approximately 600 ft in the outcrop area along the southern margin of the San Juan basin to 0 ft along a northwest-trending pre-Niobrara erosion limit in the center of the basin (Stone et al. 1983 and Dam 1995). In the Roca Honda permit area, the Gallup Sandstone is composed of two sandstone units totaling approximately 85 ft thick, split by approximately 20-ft of the Pescado Tongue of the Mancos Shale. The Pescado Tongue of the Mancos Shale probably causes a hydraulic separation between the two sandstone units. The Gallup Sandstone is 265 ft thick in the area of the Mt. Taylor mine (RGRC 1994). The top of the Gallup is at an elevation of about 6,700 - 6,900 ft in Section 16 of the permit area, which is about 450 ft below land surface, according to RHR's geophysical logs for holes S-2, S-3, and S-4. Groundwater is present in the Gallup Sandstone under unconfined conditions along the southern margin of the San Juan basin and under confined conditions farther into the basin. Although the aquifer is relied on in some areas, providing the municipal supply of the towns of Gallup and Crownpoint to the northwest and the community of Marquez to the east, in general the depth and poor quality of the groundwater make it an undesirable water supply target. Discharge from 49 water wells completed in the Gallup Sandstone ranged from 0.002 to 1.4 cfs (1 to 645 gpm), with a median production rate of 0.09 cfs (42 gpm). Reported specific capacity ranged from 0.12 to 2.10 gpm/ft (Kernodle 1996).

Two unused wells in the San Mateo/Roca Honda area that may penetrate the upper Gallup Sandstone are in Section 17, T13N R8W and in Section 36, T14N R9W. The water levels in these wells are 100 to 200 ft below land surface at elevations of 7,092 and 7,132 ft, respectively. The Lee Ranch has recently drilled an irrigation well in Section 23 of T13N R8W that may produce partially from the Gallup Sandstone. It is expected that groundwater will be present in the Gallup Sandstone aquifer under confined conditions in the Roca Honda permit area. Insufficient data are available to contour the potentiometric surface of the Gallup Sandstone aquifer in the Roca Honda permit area. Because groundwater in the formation is deep and of poor quality, Brod and Stone (1981) do not consider the Gallup Sandstone an aquifer in the Ambrosia Lake/San Mateo area.

Figure 9-14 indicates the locations of the sampled Gallup Sandstone wells and a well for which historical chemistry data area available, and Tables 9-7 and 9-8 present summary analyses of major and minor constituents in Gallup Sandstone groundwater, Appendix 9-E includes the complete laboratory reports.

Groundwater in the Gallup Sandstone within the Roca Honda permit area vicinity is a sodium-bicarbonate water which has a TDS of about 550 mg/L. One of the wells sampled under the Regional Groundwater Sampling Program (RGWSP) is also high in sulfate.

Aquifer tests performed at 17 wells in the San Juan basin indicated that the transmissivity of the Gallup Sandstone ranged from 15 to 390 ft^2/day, with a median value of 123 ft^2/day. Values of storage coefficient ranged from 2×10^{-6} to 3.3×10^{-5} (Kernodle 1996). Lyford and Frenzel (1979) indicate that in the Roca Honda permit area, the transmissivity of the Gallup Sandstone is less than 100 ft^2 per day. As part of its alternative sites analysis, GMRC extensively evaluated the field permeability of the Gallup Sandstone in the area of La Polvadera Canyon and the San Mateo area. It was determined that the Gallup Sandstone had a weighted average permeability (hydraulic conductivity) of 8.8 ft/yr in La Polvadera Canyon and 31 ft/yr in the San Mateo area, with a range of 0 to 70 ft/yr.

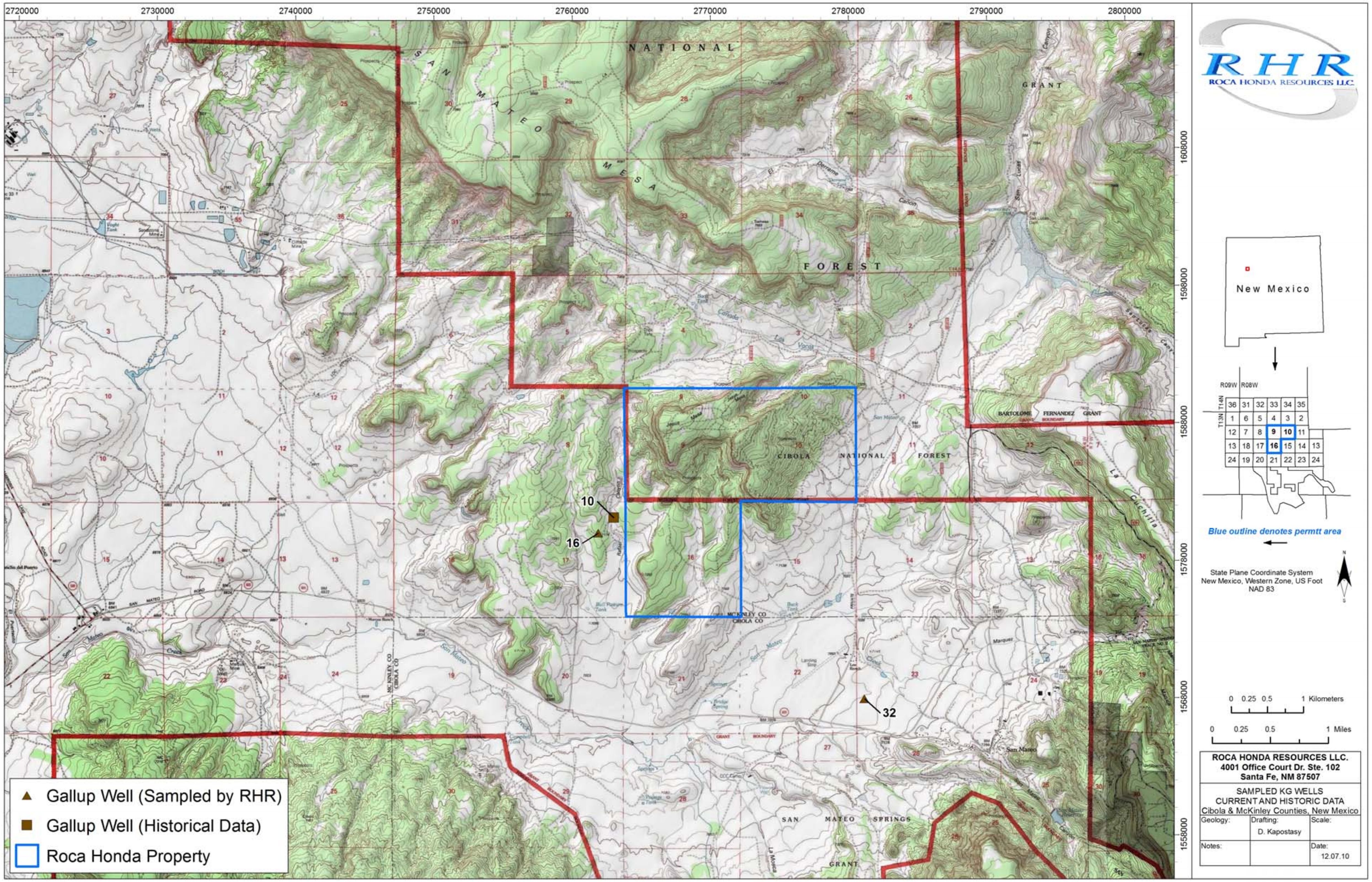

Figure 9-14. Location of Gallup Wells with Major and Minor Constituent Data

Table 9-7. Water Quality in Gallup Sandstone Wells - Major Constituents

Roca Honda/San Mateo Area Ground Water Major Constituent Quality Data For Gallup Sandstone (mg/L unless otherwise specified)																					
WELL LOCATIONS																					
Well ID #	**Township (N)**	**Range (W)**	**Section**	**Data Source**	**Sample Date**	**Specific Conductance (umhos)**	**pH (s.u.)**	**Temp (F)**	**Hardness (mg/L as CaCO3)**	**Alkalinity (as CaCO3)**	**Ca (Dissolved)**	**Mg**	**Na (Dissolved)**	**K (Dissolved)**	**Bicarbonate (as HCO3)**	**Sulfate (as SO4)**	**Cl**	**F**	**Silica (as SiO2)**	**Nitrogen Nitrate (as NO3)**	**TDS**
32	13	8	23	RH	8/21/2008	857	8.64	61.57	6	470	2	ND	237	1	496	8	4	2.9	19.6	-	546
16	13	8	17	RH	8/25/2008	1,030	8.14	60.80	213	240	32	32	169	5	293	285	7	0.5	8.3	-	647.0
					11/11/2008	993	8.37	56.10	173	215	24	28	172	5	250	265	6	0.4	6.8	ND	610
					2/12/2009	932	8.58	55.77	135	201	17	22	152	6	245	258	5	0.4	6.2	0.5	613
					5/19/2009	907	8.75	62.18	119	201	14	20	158	4	226	229	5	0.4	3.9	ND	578
					4/28/2010	839	8.67	-	91	189	12	15	155	4	210	232	7	0.4	3.3	0.2	530
					9/20/2010	856	8.73	-	116	215	15	19	147	4	240	232	8	0.4	4.1	ND	545
10	13	8	17	I	8/23/1977	1,100	-	-	-	-	29	22	170	5.5	254	289	7.3	-	-	2.9	669

Data Source:

A NMEI 1974 (see particularly Table 7.5, Table 7.7)
B Cooper and John 1968 (see particularly Table 1)
C GMRC 1979a (see particularly Pt. 1: Table 2.6-2, Table 2.6-4, Table 2.2-19; also Pt. 1 Appendix B, Table B-1, Table B-3, Table B-4, Table B-6, Table B-7, Table B-9, Table B-10)
D GMRC 1979c (App. D to source E below) (see particularly Table 4)
E GMRC 1979d (see particularly Table II-4, Table III-1)
F Metric Corp. 2005b
F[a] Metric Corp. 2005a (see particularly Figure 7, Table 1)
G RGRC 1994
H NMED DP-61 file
I Brod and Stone 1981
RH Roca Honda Resources 2008, 2009, 2010

Table 9-8. Water Quality in Gallup Sandstone Wells - Minor Constituent

Roca Honda/San Mateo Area Ground Water Minor Constituent Quality Data For Gallup Sandstone (mg/L unless otherwise specified)																														
WELL LOCATIONS				**Data Source**	**Sample Date**	**Ba**	**B**	**Si**	**Se**	**Zn**	**Cu**	**Pb**	**As**	**Cr**	**Co**	**Mn**	**Fe**	**Cd**	**Ni**	**Mo**	**Hg**	**Ag**	**Al**	**V**	**Gross Beta (pCi/L)**	**Gross Alpha (pCi/L)**	**Ra-226 (pCi/L)**	**Th-230 (pCi/L)**	**Ra-228 (pCi/L)**	**U**
Well ID #	**Township (N)**	**Range (W)**	**Section**																											
32	13	8	23	RH	8/21/2008	ND	0.4	-	ND	ND	ND	ND	ND	ND	ND	0.01	0.06	ND	ND	ND	ND	ND	ND	ND	-5.0	2.2	0.13	1.8	1.2	ND
16	13	8	17	RH	8/25/2008	ND	0.3	-	ND	0.02	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	-7.0	3.9	0.85	0.7	1.1	ND
					11/11/2008	ND	0.5	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.1	5.7	0.32	-0.2	-0.05	ND
					2/12/2009	ND	0.4	-	ND	0.05	0.01	ND	ND	ND	ND	0.08	13.8	ND	ND	ND	ND	ND	ND	ND	3.6	6.0	0.71	0.04	0.13	ND
					5/19/2009	ND	0.4	-	ND	ND	ND	ND	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.6	8.8	0.48	-0.07	0.53	ND
					4/28/2010	ND	0.4	-	ND	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.3	3.7	0.50	-0.02	0.25	ND
					9/20/2010	ND	0.3	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.8	3.1	0.15	-0.40	0.75	ND

Data Source:

A NMEI 1974 (see particularly Table 7.5, Table 7.7)
B Cooper and John 1968 (see particularly Table 1)
C GMRC 1979a (see particularly Pt. 1: Table 2.6-2, Table 2.6-4, Table 2.2-19; also Pt. 1 Appendix B, Table B-1, Table B-3, Table B-4, Table B-6, Table B-7, Table B-9, Table B-10)
D GMRC 1979c (App. D to source E below) (see particularly Table 4)
E GMRC 1979d (see particularly Table II-4, Table III-1)
F Metric Corp. 2005b
F[a] Metric Corp. 2005a (see particularly Figure 7, Table 1)
G RGRC 1994
H NMED DP-61 file
I Brod and Stone 1981
RH Roca Honda Resources 2008, 2009, 2010

9.4.6 Dakota Sandstone

In the San Juan basin, the Dakota Sandstone is a sequence of sandstone, mudstone, and coal. The generally fine- to medium-grained arkosic sandstones contain limited amounts of groundwater except where secondary permeability has been created by faults or where the sandstone layers are thinly bedded rather than massive (Brod and Stone 1981). GMRC described the Dakota Sandstone in the area of the Mt. Taylor mine as "yellow-gray, massive, well-cemented quartz sandstone, locally interbedded with carbonaceous shales and conglomerates." It was noted that the Dakota Sandstone is locally hydraulically connected to the underlying Westwater Canyon Member of the Morrison Formation (GMRC 1979a). Core logs indicate that in the permit area, the Dakota Sandstone has an average thickness of about 50 ft. In the area of the Mt. Taylor mine, a thickness of 58 ft was reported (RGRC 1994). The top of the Dakota Sandstone is at an elevation of about 5,600 to 5,400 ft in the permit area. In the "Geologic Map of the San Mateo Quadrangle," Santos (1966) contours the base of the Dakota Sandstone.

Along the southern margin of the San Juan basin, groundwater is present in the Dakota Sandstone under unconfined conditions; farther into the basin, groundwater in the Dakota Sandstone is confined. Some investigators note that under pre-development conditions the hydraulic head of groundwater in the Dakota Sandstone was 200 ft higher than that in the Morrison Formation aquifer. Such changes in hydraulic head appear to be localized (Stone et al. 1983, Kelley et al. 1980, Cooper and John 1968, and Dam 1995). Stone et al. (1983) speculate that because the recharge areas for the Dakota Sandstone and the Morrison Formation are at similar elevations, the original head difference probably reflected more lateral flow in the Morrison Formation because of higher transmissivities or more continuity of the sandstones. They suggest that the persistence of the hydraulic head differences in other parts of the San Juan basin indicate that the vertical permeability of the confining layer between the two units is low (Stone et al. 1983).

A few wells may produce from the Dakota Sandstone for stock watering purposes north of the Roca Honda permit area. A few wells penetrate the Dakota Sandstone in the south-central part of the San Juan basin, but most wells do not produce solely from the Dakota Sandstone because water of superior quality is available within a short drilling distance in the underlying Westwater Canyon Member of the Morrison Formation. Wells producing from the Dakota Sandstone yield from 0.002 to 0.17 cfs (1 to 75 gpm), with a median value of 0.03 cfs (13 gpm) (Kernodle 1996). GMRC (1979a) noted that its depressurization wells for the Mt. Taylor mine had produced water at a rate of more than 0.22 cfs (100 gpm) from the Dakota Sandstone, and RHR encountered significant quantities of groundwater in the Dakota Sandstone during drilling of deep monitor wells on the south side of Jesus Mesa.

Because most historic wells which penetrate the Dakota Sandstone are completed in multiple aquifers, water quality data are sparse for the Dakota Sandstone alone. Brod and Stone (1981), and Kelley et al. (1980) report that water in the Dakota Sandstone is typically sodium-sulfate water, with a TDS in the range of 600 to 1,400 mg/L. Within the Roca Honda permit area vicinity no wells are finished exclusively in the Dakota Sandstone and no water quality data area available. Transmissivity values of 44 to 85 ft^2/day and hydraulic conductivities of 0.7 to 1.5 ft/day have been reported for the Dakota Sandstone from aquifer tests northeast of Crownpoint, though transmissivities for this formation are generally less than 50 ft^2/day (Stone et al. 1983). Kernodle (1996) reports that a transmissivity of 2,000 ft^2/day was measured in a test east of Grants. GMRC determined a transmissivity of 134 ft^2/day and a hydraulic conductivity of 1.6

ft/day for the Dakota Sandstone (Brod and Stone 1981). Specific capacities in 13 wells completed in the Dakota Sandstone ranged from 0.03 to 3.67 gpm/ft (Kernodle 1996).

9.4.7 Morrison Formation

The Morrison Formation consists of fine- to coarse-grained, locally conglomeratic sandstone, sandy siltstone, shale, and claystone that contains thin beds of limestone. In the San Juan basin, the Morrison Formation consists of five members, in ascending order: the Salt Wash, Recapture, Westwater Canyon, Brushy Basin, and Jackpile Sandstone (Craigg 2001). Although coarser-grained units within each of the members function as aquifers, the numerous shaley and clayey zones within the members act as aquitards. The Westwater Canyon Member is a sequence of non-marine sandstone, conglomeratic sandstone, and mudstone deposited by a braided stream complex. The sandstones are mainly a yellow-gray to pale-red, fine- to medium-grained, poorly sorted to unsorted, arkose to lithic arkose (NMEI 1974). Geophysical logs indicate that the thickness of the Westwater Canyon Member in the vicinity of the Roca Honda permit area ranges from 100 to 250 ft.

Recent drilling in the Roca Honda permit area has determined that the Westwater Canyon Member contains large quantities of groundwater under confined conditions. Groundwater in the member rose to an elevation of 6,370 ft, within 850 to 900 ft of land surface, although the top of the Westwater Canyon Member is between 1,700 and 1,850 ft below land surface on the south side of Jesus Mesa, or 5,400 to 5,700 ft in elevation. This aquifer is referred to as the “deep confined aquifer” in Section 9.1.2, “Hydrogeology of General Permit Area Locality.” Groundwater movement in this aquifer is eastward with a gradient of about 50 ft per mile. Figure 9–5 shows the potentiometric surface for the deep confined aquifer in the Roca Honda/San Mateo area. Figures 9-6 and 9-7 show the potentiometric surface in the permit area.

Brod and Stone (1981) report that the highest measured permeability for the Westwater Canyon Member in the San Juan basin was near the community of San Mateo near the San Rafael fault zone along the Fernandez monocline. In that area, GMRC calculated hydraulic conductivity as 3.2 ft/day and transmissivity as 494 ft^2/day. They note that this value is 100 times the value determined in laboratory tests, because of the effect of fracturing. Hydraulic conductivity typically ranges from about 0.5 to 1.5 ft/day, though a few much higher and lower values have been reported. Lyford and Frenzel (1979) indicate that the range of transmissivity for the Morrison Formation in the Roca Honda permit area is 200 to 300 ft^2 per day. Kernodle (1996) reports that within the San Juan Basin, transmissivity, storage coefficient, and hydraulic conductivity values are available for the Morrison Formation from 31 aquifer tests. Transmissivity ranged from 2 to 480 ft^2/day with a median value of 115 ft^2/day, hydraulic conductivity for three of these wells ranged from 0.035 to 0.39 ft/day, and storage coefficient values calculated for nine wells ranged from 2×10^{-4} to 2×10^{-5} (Kernodle 1996). Kernodle calibrated his steady-state model of groundwater flow within the San Juan Basin using a horizontal hydraulic conductivity of 0.1 ft/day and vertical hydraulic conductivity of 0.001 ft/day for the Morrison Formation.

An aquifer test of the Westwater Canyon Member within the RHR permit area was performed by RHR in May, 2010. RHR’s well S-4-Jmw-CH-07 was pumped at an average rate of 133.6 gpm for 120 hours while hydraulic heads in other RHR wells fully screened in the same formation were monitored. Analysis of the test data indicated that within the permit area the Westwater

Canyon Member exhibits an average transmissivity of between 80p and 200 ft^2/day, and a storage coefficient of 0.0002. The aquifer test is discussed in detail in Appendix 9-I.

Wells completed in the Westwater Canyon Member have been pumped at rates between 0.02 and 1.25 cfs (10 and 560 gpm), with typical values of around 0.22 cfs (100 gpm). The GMRC reported that its Mt. Taylor dewatering wells pumped several hundred gpm from the Westwater Canyon Member and that a well at the mine was pumped at a rate of 0.89 cfs (400 gpm) for industrial use. Specific capacity is only moderate, and pumping at high rates will cause large drawdowns.

Figure 9-15 shows the locations of the sampled Westwater Canyon Member wells and wells for which historical chemistry data area available. Tables 9-9 and 9-10 present summary analyses of major and minor constituents in Westwater Canyon Member wells. Complete laboratory reports are included in Appendices 9-F and 9-G. Water quality data collected during the RGWSP indicates that water quality in the Westwater Canyon Member in the vicinity of the Roca Honda permit area is variable. Water collected from RHR monitor wells S-1, S-3 and S-4, drilled within the permit area, indicate that in the permit area the TDS is about 500 mg/L, and the water is a sodium-sulfate-bicarbonate water. The groundwater collected from Westwater Canyon Member wells along San Mateo Creek has a TDS of about 3,300 mg/L, is high in sulfates, and high in calcium and sodium. Historical data from other wells located in the vicinity of the permit area show a similar water quality. Table 9-11 presents the average water quality in the Westwater Canyon Member in the area of the Gulf Mt. Taylor mine as reported by Gulf Mineral Resources Corporation in 1979.

Where the Westwater Canyon Member and the Dakota Sandstone are hydraulically separated, groundwater quality in the Dakota Sandstone is generally significantly poorer than groundwater quality in the Westwater Canyon Member at the same location. In the Roca Honda permit area where that faulting has facilitated inter-formational movement of groundwater, it is expected that the water quality in the two formations will be similar (Brod and Stone 1981). Table 9-12 presents water quality analyses for mine dewatering water pumped from three mines near the permit area. The quality of groundwater pumped from the permit area will be similar.

9.4.8 Summary of Aquifer Characteristics

Table 9-13 on page 9-51 summarizes the physical and hydraulic characteristics of the aquifers in the San Mateo Creek area, Roca Honda permit area, and the San Juan basin. The probable thicknesses in the Roca Honda permit area were determined from drilling conducted by RHR and previous exploration companies within the area.

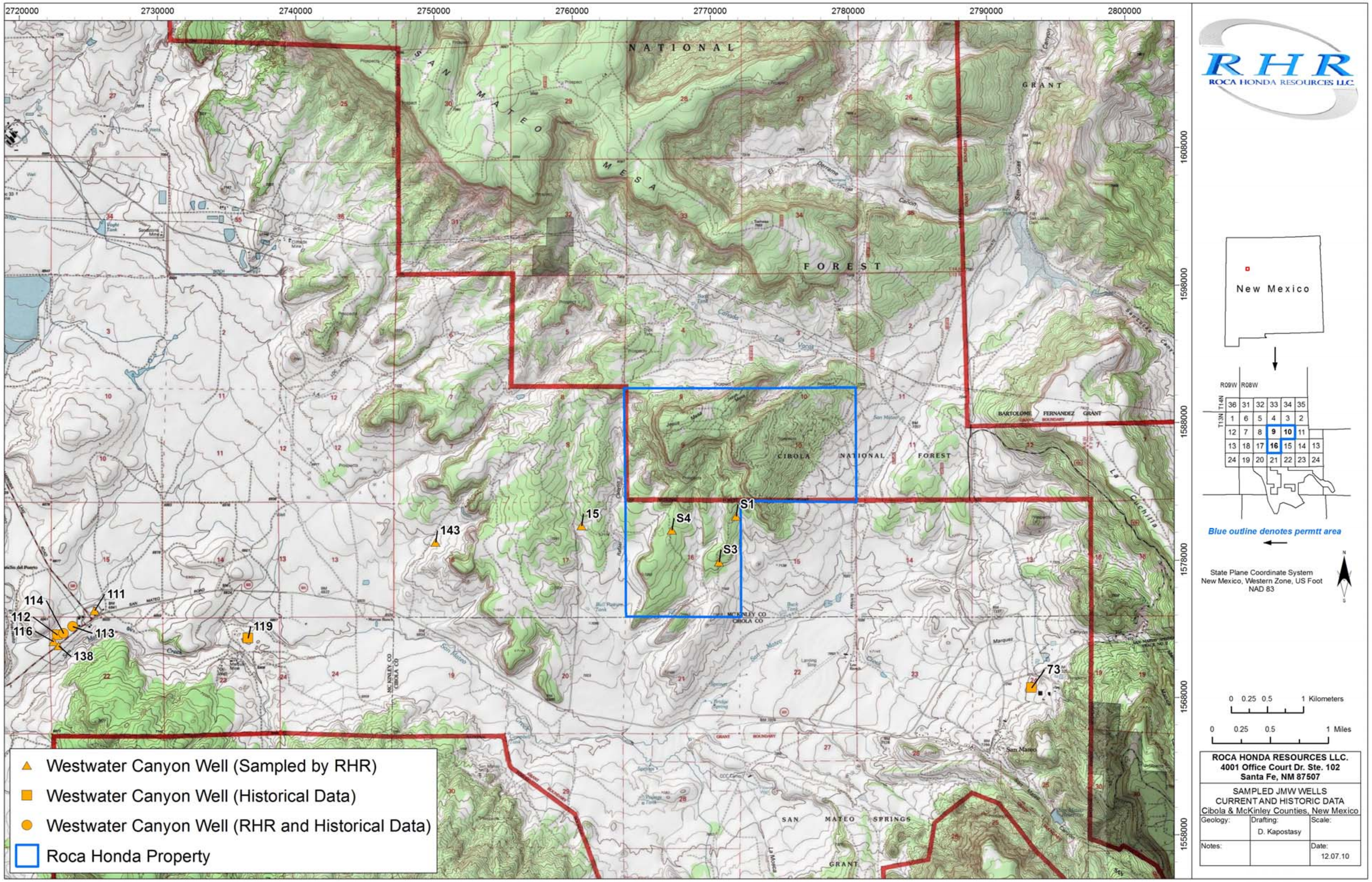

Figure 9-15. Location of Westwater Canyon Wells with Major and Minor Constituent Data

Table 9-9. Water Quality in Westwater Canyon Member Wells – Major Consituents

Roca Honda/San Mateo Area Ground Water Major Constituent Quality Data For Westwater Canyon Member (mg/L unless otherwise specified)

WELL LOCATIONS																					
Well ID #	Township (N)	Range (W)	Section	Data Source	Sample Date	Specific Conductance (umhos)	pH (s.u.)	Temp (F)	Hardness (mg/L as CaCO3)	Alkalinity (as CaCO3)	Ca (Dissolved)	Mg	Na (Dissolved)	K (Dissolved)	Bicarbonate (as HCO3)	Sulfate (as SO4)	Cl	F	Silica (as SiO2)	Nitrogen Nitrate (as NO3)	TDS
116	13	9	22	RH	8/19/2008	3,580	7.45	63.94	1,960	175	544	146	236	6	-	2080	57	0.6	15.6	-	3290
					11/13/2008	3,590	7.56	51.51	1,890	175	518	144	240	6	213	1970	52	0.7	16.9	21.3	3330
					2/10/2009	3,740	7.38	50.43	1,930	172	538	142	240	6	210	1940	48	0.7	18.3	20.1	3310
					5/21/2009	3,540	7.52	62.78	1,800	182	496	136	242	6	222	1920	48	0.7	18.7	18.2	3260
					5/5/2010	3,500	7.20	55.79	1,860	188	513	141	245	6	229	2020	50	0.6	14.3	18.7	3300
					9/23/2010	3,460	7.73	70.52	1,810	195	500	137	245	6	238	2060	56	0.6	18.0	16.2	3270
114	13	9	22	RH	9/18/2008	3,490	7.45	59.44	1,770	175	504	125	208	10	213	1910	51	0.5	20.0	-	3140
					2/18/2009	3,640	7.35	53.44	1,870	188	524	135	215	11	229	1880	48	0.5	18.8	18.9	3210
					5/26/2009	3,350	7.48	57.72	1,550	172	433	114	201	11	210	1802	45	0.5	18.9	22.8	3100
					5/4/2010	884	7.90	58.14	133	304	41	7	143	3	371	131	15	1.1	17.3	6.2	575
					9/27/2010	2,300	7.33	63.30	1,150	201	327	80	138	25	245	1330	38	0.4	14.6	1.4	1980
					2/23/2011	2760	7.44		1430	201	407	100	174	18	245	1520	43	0.4	18.4	7	2460
					9/18/2011	3600	7.74		1920	186	548	134	234	9	227	2190	44	0.5	21.2	21.4	3360
					4/16/2012	3530	7.53		1840	179	514	134	232	6	219	2090	50	0.6	20	25.2	3460
113	13	9	22	RH	9/22/2008	3,770	7.37	60.61	1,980	168	548	147	236	7	205	2090	52	0.5	21.9	-	3320
					11/10/2008	3,820	7.54	52.34	1,960	173	539	148	224	6	212	2030	50	0.5	20.0	19.8	3280
					2/12/2009	3,780	7.51	54.27	1,840	168	507	138	231	6	205	2010	48	0.6	18.3	22.3	3440
					5/26/2009	3,640	7.54	59.99	1,840	179	501	142	237	7	219	2000	48	0.5	21.6	23.9	3390
					9/27/2010	3,470	7.72	75.90	1,950	192	542	145	232	6	234	2150	55	0.5	21.8	26.4	3320
138	13	9	22	RH	9/23/2008	3,510	7.56	-	1,970	167	542	151	221	9	204	2040	51	0.3	22.7	-	3290
15	13	8	17	RH	11/13/2008	894	7.90	52.58	189	267	51	15	143	4	326	177	8	0.8	22.3	ND	567
					2/12/2009	857	7.52	39.84	168	261	46	13	127	3	318	176	7	0.8	19.4	0.1	588
					5/18/2009	887	7.81	68.49	179	275	48	14	136	4	331	169	7	0.8	21.4	ND	591
					4/28/2010	865	7.63	57.99	171	285	47	13	135	4	347	181	9	0.7	19.5	ND	568
					9/20/2010	845	7.85	-	163	292	45	12	139	4	356	180	8	0.7	19.8	ND	523
143	13	8	18	RH	9/23/2010	1020	7.89	77.01	348	295	105	21	104	4	360	276	18	0.8	24.4	ND	737
S1	13	8	16	RH	4/7/2008	792	8.12	91.68	51	166	16	3	143	3	203	210	4	0.7	19.9	-	506
					8/27/2008	-	-	88.85	-	-	18	3	167	3	-	-	-	-	ND	-	-
					11/6/2008	798	8.16	90.56	63	176	19	4	169	3	203	204	4	0.7	29.2	ND	509
					2/17/2010	722	8.06	88.84	48	171	14	3	139	2	200	205	3	0.7	20.2	ND	526
					6/23/2010	777	8.00	90.02	52	171	16	3	147	2	209	209	4	0.6	25.6	ND	525
					6/24/2010	749	8.04	-	51	177	16	3	150	2	216	209	3	0.6	24.7	-	493
S3	13	8	16	RH	8/28/2008	-	-	94.69	-	-	20	3	135	2	-	-	-	-	ND	-	-
					11/5/2008	640	7.96	92.86	67	170	21	3	134	2	198	152	3	0.8	32.5	ND	437
					2/19/2009	661	8.01	92.52	53	168	18	2	123	3	205	148	3	0.7	25.0	-	425
					5/27/2009	661	8.12	92.85	60	172	19	3	129	2	198	156	3	0.7	28.7	ND	435
					6/24/2010	660	7.99	-	60	181	19	3	128	3	221	151	ND	0.7	23.3	ND	442

Table 9-9. Continued

Roca Honda/San Mateo Area Ground Water Major Constituent Quality Data For Westwater Canyon Member (mg/L unless otherwise specified)																					
WELL LOCATIONS				Data Source	Sample Date	Specific Conductance (umhos)	pH (s.u.)	Temp (F)	Hardness (mg/L as CaCO3)	Alkalinity (as CaCO3)	Ca (Dissolved)	Mg	Na (Dissolved)	K (Dissolved)	Bicarbonate (as HCO3)	Sulfate (as SO4)	Cl	F	Silica (as SiO2)	Nitrogen Nitrate (as NO3)	TDS
Well ID #	Township (N)	Range (W)	Section																		
S4	13	8	16	RH	8/27/2008	-	8.27	92.05	98	174	29.6	5.05	144	3.63	213	188	3	0.6	31.5	-	506
					11/5/2008	775	7.93	91.69	99	177	31	5	137	3	205	201	3	0.6	27.8	ND	523
					3/5/2009	762	8.20	89.59	85	176	26	5	126	3	214	194	2	0.6	21.7	ND	524
					6/23/2009	771	7.87	90.66	95	175	30	5	132	3	214	208	3	0.6	27.5	ND	529
					5/12/2010	775	7.74	87.67	95	186	30	5	136	3	226	220	ND	0.5	26.0	ND	486
					10/19/2010	765	8.04	90.81	98	181	31	5	132	3	221	213	3	0.6	25.7	ND	532
111	13	9	15	RH	8/13/2008	726	7.6	64.76	278	253	87	14	58	5	309	97	18	0.2	19.0	-	444
					11/10/2008	722	7.69	54.80	279	260	87	15	59	5	317	93	16	0.2	17.4	1	435
					2/12/2009	668	7.63	48.40	245	256	75	14	54	6	313	88	15	0.2	16.0	1.1	463
					5/26/2009	732	7.66	63.73	250	269	78	13	59	5	328	98	17	0.2	116.5	1	461
					9/27/2010	711	7.91	66.70	271	294	85	14	58	5	359	104	18	0.2	18.1	1	504
73	13	8	24	I	1974	900	-	-	-	-	4	0.5	240	2	280	265	10	-	-	0.8	650
112	13	9	22	I	8/24/1977	2,720	-	-	-	-	285	91	230	9.2	192	1,188	54	-	-	47	2,255
113	13	9	22	I	2/26/1975	2,150	-	-	-	-	-	-	-	-	-	-	36	-	-	18	2,200
114	13	9	22	I	2/26/1975	3,100	-	-	-	-	-	-	-	-	-	-	40	-	-	4.7	2,000
119	13	9	23	I	Mar-75	1,300	-	-	-	-	-	-	-	-	-	-	4.8	-	-	0.06	720

Data Source:
A NMEI 1974 (see particularly Table 7.5, Table 7.7)
B Cooper and John 1968 (see particularly Table 1)
C GMRC 1979a (see particularly Pt. 1: Table 2.6-2, Table 2.6-4, Table 2.2-19; also Pt. 1 Appendix B, Table B-1, Table B-3, Table B-4, Table B-6, Table B-7, Table B-9, Table B-10)
D GMRC 1979c (App. D to source E below) (see particularly Table 4)
E GMRC 1979d (see particularly Table II-4, Table III-1)
F Metric Corp. 2005b
F[a] Metric Corp. 2005a (see particularly Figure 7, Table 1)
G RGRC 1994
H NMED DP-61 file
I Brod and Stone 1981
RH Roca Honda Resources 2008, 2009, 2010 (S1, S3, and S4 are RHR Monitoring Wells)

Table 9-10. Water Quality in Westwater Canyon Member Wells – Minor Constituents

Roca Honda/San Mateo Area Ground Water Minor Constituent Quality Data For Westwater Canyon Member (mg/L unless otherwise specified)																													
WELL LOCATION				Data Source	Sample Date	Ba	B	Se	Zn	Cu	Pb	As	Cr	Co	Mn	Fe	Cd	Ni	Mo	Hg	Ag	Al	V	Gross Beta (pCi/L)	Gross Alpha (pCi/L)	Ra-226 (pCi/L)	Th-230 (pCi/L)	Ra-228 (pCi/L)	U
Well ID #	Township (N)	Range (W)	Section																										
116	13	9	22	RH	8/19/2008	ND	0.3	0.079	0.21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.2	22.6	0.35	0.0	0.77	0.0109
					11/13/2008	ND	0.2	0.061	0.07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.5	17.9	0.37	0.2	0.50	0.0106
					2/10/2009	ND	0.2	0.064	0.08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-6	23.7	0.27	0.1	0.58	0.0121
					5/21/2009	ND	0.3	0.052	0.11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.8	20.6	0.47	0.1	1.3	0.0103
					5/5/2010	ND	0.2	0.063	0.12	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	5.5	22.5	0.49	-0.1	0.7	0.0134
					9/23/2010	ND	0.2	0.05	0.12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-4	10.4	0.54	-0.2	0.38	0.0135
114	13	9	22	RH	9/18/2008	0.2	0.2	0.048	0.02	ND	ND	ND	ND	ND	0.07	ND	ND	ND	ND	ND	ND	ND	ND	16.9	50.4	0.96	1.8	0.79	0.0199
					2/18/2009	0.1	0.3	0.039	0.04	ND	ND	ND	ND	ND	0.07	ND	ND	ND	ND	ND	ND	ND	ND	27.1	50.3	0.45	0.07	0.90	0.0217
					5/26/2009	0.2	0.3	0.047	0.01	ND	ND	0.001	ND	ND	0.06	ND	ND	ND	ND	ND	ND	ND	ND	15.4	36	0.47	-0.04	0.50	0.0208
					5/4/2010	ND	0.2	0.022	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	39.5	149	0.06	-0.002	0.27	0.1880
					9/27/2010	0.2	0.1	0.017	ND	ND	ND	0.001	ND	ND	0.33	0.05	ND	ND	ND	ND	ND	ND	ND	26.8	15.2	0.54	-0.1	1.00	0.0145
					2/23/2011	0.1	0.2	0.022	0.01	0.01	0.05	0.001	0.05	0.01	0.2	0.03	0.01	0.05	0.1	0.001	0.01	0.1	0.1	25.9	16.5	0.43	-0.03	0.2	0.0182
					9/18/2011	0.1	0.4	0.042	0.01	0.01	0.05	0.001	0.05	0.01	0.22	0.03	0.01	0.05	0.1	0.001	0.01	0.1	0.1	73	64.9	0.39	1	0.2	0.0233
					4/16/2011	0.1	0.2	0.36	0.01	0.01	0.05	0.001	0.05	0.01	0.01	0.03	0.01	0.05	0.1	0.001	0.01	0.1	0.1	33.6	27	0.64	0.8	0.2	0.0243
113	13	9	22	RH	9/22/2008	ND	0.3	0.027	0.20	ND	ND	0.001	ND	ND	0.11	ND	ND	ND	ND	ND	ND	ND	ND	6.0	25.4	0.26	1.8	-0.3	0.0158
					11/10/2008	ND	0.2	0.024	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6.0	28.2	0.27	0.3	0.35	0.0155
					2/12/2009	ND	ND	0.023	0.46	ND	ND	ND	ND	ND	0.17	11.0	ND	ND	ND	ND	ND	0.2	ND	2.0	21.0	0.31	-0.1	0.32	0.0169
					5/26/2009	ND	0.3	0.027	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-20.0	25.4	-0.10	-0.1	0.53	0.0161
					9/27/2010	ND	0.2	0.020	0.03	ND	ND	ND	ND	ND	0.07	ND	ND	ND	ND	ND	ND	ND	ND	6.2	15.2	0.42	0.80	0.92	0.0178
138	13	9	22	RH	9/23/2008	ND	0.3	0.031	0.02	0.01	ND	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND	9.4	44.4	0.12	0.3	0.38	0.0329
15	13	8	17	RH	11/13/2008	ND	0.2	ND	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-1	2.1	0.25	-0.2	0.47	ND
					2/12/2009	ND	0.2	ND	0.15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12.0	3.4	0.43	-0.07	0.78	ND
					5/18/2009	ND	0.2	ND	0.08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.3	2.1	-0.1	-0.02	0.85	ND
					4/28/2010	ND	0.2	ND	0.08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.9	2.4	0.5	-0.1	0.61	ND
					9/20/2010	0.1	0.2	ND	0.09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.2	3.3	0.32	-0.04	1.3	ND
143	13	8	18	RH	9/23/2010	ND	ND	ND	0.40	ND	ND	ND	ND	ND	0.06	ND	ND	ND	ND	ND	ND	ND	ND	2.4	6	3.2	0.5	1.7	0.0032
S1	13	8	16	RH	4/7/2008	ND	0.2	ND	ND	ND	ND	0.003	ND	-	0.03	ND	ND	ND	ND	ND	ND	ND	ND	178	418	62.9	6.0	0.9	0.0032
					8/27/2008	ND	0.3	ND	ND	ND	ND	0.0031	ND	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	35.2	136	28	0.3	-0.1	0.002
					11/6/2008	ND	0.2	ND	ND	ND	ND	0.003	ND	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	72.0	229	69	0.7	0.06	0.0023
					2/17/2010	ND	0.1	ND	ND	ND	ND	0.003	ND	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND	88.4	290	56	0.2	1.0	0.0019
					6/23/2010	ND	0.2	ND	ND	ND	ND	0.003	ND	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND	117	350	65	0.2	0.81	0.0020
					6/24/2010	ND	0.2	ND	ND	ND	ND	0.003	ND	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND	50.1	135	27	-0.1	0.86	0.0006
S3	13	8	16	RH	8/28/2008	ND	0.2	ND	0.07	ND	ND	0.0039	ND	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	3.3	17.8	3.1	0.0	0.33	0.0065
					11/5/2008	ND	0.2	ND	ND	ND	ND	0.003	ND	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	4.9	22.2	4.6	0.0	0.23	0.0060
					2/19/2009	ND	0.1	ND	ND	ND	ND	0.003	ND	ND	0.03	ND	ND	ND	ND	ND	ND	ND	ND	9.4	21.9	4.0	0.04	0.25	0.0066
					5/27/2009	ND	0.2	ND	0.02	ND	ND	0.003	ND	ND	0.03	0.03	ND	ND	ND	ND	ND	ND	ND	7.1	30.9	3.6	-0.1	0.17	0.0057
					6/24/2010	ND	0.2	ND	ND	ND	ND	0.003	ND	ND	0.02	ND	ND	ND	ND	ND	ND	ND	ND	10.6	35.2	4.0	-0.09	0.64	0.0050

Table 9-10. Continued

Roca Honda/San Mateo Area Ground Water Minor Constituent Quality Data For Westwater Canyon Member (mg/L unless otherwise specified)																										
WELL LOCATION				Data Source	Sample Date	Ba	B	Se	Zn	Cu	Pb	As	Cr	Co	Mn	Fe	Cd	Ni	Mo	Hg	Ag	Al	V	Gross Beta (pCi/L)	Gross Alpha (pCi/L)	Ra-226 (pCi/L)	Th-230 (pCi/L)	Ra-228 (pCi/L)	U
Well ID #	Township (N)	Range (W)	Section																										
S4	13	8	16	RH	8/27/2008	ND	0.2	ND	ND	ND	ND	0.0035	ND	ND	0.02	0.19	ND	ND	ND	ND	ND	ND	ND	0.3	10.9	0.45	0.0	-0.04	0.0017
					11/5/2008	ND	0.2	ND	ND	ND	ND	0.004	ND	ND	0.02	0.05	ND	ND	ND	ND	ND	ND	ND	5.6	8.5	0.26	0.0	0.93	0.0020
					3/5/2009	ND	ND	ND	0.03	ND	ND	0.003	ND	ND	0.02	ND	0.03	ND	ND	ND	ND	ND	ND	3.3	6.6	0.32	0.2	-0.2	0.0019
					6/23/2009	ND	0.2	0.012	0.02	ND	ND	ND	ND	ND	0.02	0.04	ND	ND	ND	ND	ND	ND	ND	8.7	10.9	0.18	-0.06	1.2	0.0017
					5/12/2010	ND	0.2	ND	0.02	ND	ND	0.003	ND	ND	0.01	0.04	ND	ND	ND	ND	ND	ND	ND	3.4	7.3	0.21	-0.1	-0.3	0.0020
					10/19/2010	ND	0.2	ND	ND	ND	ND	0.004	ND	ND	0.01	0.04	ND	ND	ND	ND	ND	ND	ND	2.9	2.8	-0.02	-0.2	0.61	0.0029
111	13	9	25	RH	8/13/2008	ND	ND	0.071	0.02	ND	ND	ND	ND	ND	0.08	ND	ND	ND	ND	ND	ND	ND	ND	20.3	55	1.1	1.3	0.61	0.0586
					11/10/2008	ND	ND	0.074	0.01	ND	ND	ND	ND	ND	0.07	ND	ND	ND	ND	ND	ND	ND	ND	29.7	75	0.98	-0.1	2.1	0.0576
					2/12/2009	ND	ND	0.071	0.02	0.01	ND	ND	ND	ND	0.06	ND	ND	ND	ND	ND	ND	ND	ND	27.3	48.2	1	-0.01	0.62	0.0603
					5/26/2009	ND	ND	0.082	0.02	ND	ND	ND	ND	ND	0.07	ND	ND	ND	ND	ND	ND	ND	ND	22.4	56.7	1.1	0.1	1.3	0.0608
					9/27/2010	ND	ND	0.073	0.05	0.01	ND	ND	ND	ND	0.08	ND	ND	ND	ND	ND	ND	ND	ND	16.8	65.1	1.3	0.4	0.99	0.0593

Data Source:

A NMEI 1974 (see particularly Table 7.5, Table 7.7)
B Cooper and John 1968 (see particularly Table 1)
C GMRC 1979a (see particularly Pt. 1: Table 2.6-2, Table 2.6-4, Table 2.2-19; also Pt. 1 Appendix B, Table B-1, Table B-3, Table B-4, Table B-6, Table B-7, Table B-9, Table B-10)
D GMRC 1979c (App. D to source E below) (see particularly Table 4)
E GMRC 1979d (see particularly Table II-4, Table III-1)
F Metric Corp. 2005b
F[a] Metric Corp. 2005a (see particularly Figure 7, Table 1)
G RGRC 1994
H NMED DP-61 file
I Brod and Stone 1981
O OSE 2008
RH Roca Honda Resources 2008, 2009, 2010 (S1, S3, and S4 are RHR Monitoring Wells)

Table 9-11. Average Water Quality for Westwater Canyon Member Wells

Constituent	mg/L	Constituent	mg/L
Al	<0.1	Mo	<0.05
Sb	<0.01	Ni	<0.05
As	0.01	N (nitrate)	<0.2
Ba	<0.5	P (ortho-phosphate)	Nil
Bi	<0.01	Phenols	0.003
B	0.3	K	8
Cd	<0.005	Ra-226+228	<7 pCi/L
Ca	5	Se	<0.01
Cl	18	Si	50
Cr	<0.01	Ag	<0.02
Co	<0.03	Na	230
Cyanide	<0.01	SO_4	280
F	<0.1	TDS	630
Fe	0.7	U	<0.005
Pb	<0.05	V	<0.005
Mg	<0.01	Zn	<0.01
Mn	0.4	Chemical oxygen demand	Nil
Hg	<0.001	pH (s.u.)	7.6

From Table B-10, Appendix B of Environmental Report (GMRC 1979)
s.u. = standard units

Table 9-12. Mine Dewatering Water Quality

Mine Dewatering Water Quality Primarily Westwater Canyon Member, with Some Mixing with Dakota Sandstone (except conductivity and pH, values are dissolved and in mg/L; radium and gross alpha in pCi/L)			
	11/05/1979	11/09/1979	11/07/1979
Constituent	Mt. Taylor	Bokum Marquez	Johnny M
TDS	696	1190	753
Conductivity (µmhos)	1061	1760	756
pH (s.u.)	9.02	8.43	7.85
As	0.007	<0.005	0.044
Ba	0.149	<0.001	0.212
Se	0.018	0.005	0.128
Mo	0.13	<0.01	0.612
NH_3	0.08	0.4	0.36
Na	225.4	361.1	101.2
Cl	11.9	38.7	8.53
SO_4	251.9	574.6	188.5
Ca	3.2	25.8	51.6
K	1.56	3.9	3.9
Bicarbonate	246	277.8	256
Cd	<0.001	<0.001	<0.001
Nitrate/Nitrite	0.25	0.18	0.36
Mg	0	0.6	15.6
V	<0.01	<0.01	1.408
Zn	<0.25	<0.25	<0.25
Al	1.12	0.53	17.8
Pb	<0.005	<0.005	0.008
Gross alpha	990±50	450±40	1,700±100
Ra-226	17±5	0.21± 0.06	Not analyzed
U	0.45	<0.005	5.09

µmhos = micromhos
NMEID 1980

Table 9-13. Summary of Aquifer Characteristics in the Vicinity of the Roca Honda Permit Area

Aquifer	Thickness Range in the San Juan Basin (ft)	Thickness at the Roca Honda Permit Area (ft)	Transmissivity Range (median) (ft^2/day)	Hydraulic Conductivity (horizontal) (ft/day)	Hydraulic Conductivity (vertical) (ft/day)	Yield Range (gpm) (median)	TDS (mg/L)	Storativity	
								Specific Yield (Sy)	Storativity
Alluvium	10–80[a]	0 to variable[g]	700—1,450[h]	27[h]	NA	<20[a]	[270-1000][j] 590-14,000[a]	0.1 to 0.25[f]	NA
Menefee	400–1,000[b]	0[g]	10–100[b]	0.05–0.01[b] 0.05[f]	0.00001[f]	<20[a]	[180-3300][j] 200–1400	0.1 [g]	0.00001 [g]
Point Lookout Sandstone	40–415[b]	138-176[g]	<1—240[b]	0.002–0.02[cb] 0.1[f]	0.01–0.002[c] 0–0.0001[f]	To >50[a]	[200-660][j] 200–700[a]	0.1 [g]	0.000041[f]
Dalton Sandstone	80–180[bd]	35-75[g]	10–<50	0-0.1[f]	0–0.0001[f]	NA	4,500[a]	NA	0.0001 estimate
Gallup Sandstone	90–700[b]	45-175[g]	15–390 (123)[bhf]	0.1—1.0[h] 1.00[f]	0.002[f]	1–645(30)[ef]	[530-650][j] 1,200-2,200[h]	0.09[h]	0.000002 to 0.000033[f]
Lower Mancos Shale Sandstones	125	125[g]	134[a]	0.05[f]	0.002[f]	0–2,000[ag]	2,500–9,000[a]	0.05 [g]	0.000001 [g]
Dakota Sandstone	50–350[b]	19-79[g]	44–134[abf]	0.25–1.5[b] 0.25[f]	0.002[f]	1–200 (13)[e]	600–1,400[a]	0.1[g]	0.0001[fg]
Westwater Canyon	100–250[b]	100–250[g]	50–500[ab] [65-125][j]	0.5-3.2[h] [0.3-0.6][j]	0.001-0.003[g]	1–401 (32)[e]	[150–3,400][j] 600-1,400[a]	0.1[g]	0.0002[f] [0.00024][j].
Morrison Formation undifferentiated	700-900[f]	Approx. 400[g]	2-480[f]	0.025-0.39[f] .1[f]	0.001[f]	1-2,250 (30)[f]	0.01-3.98 (0.42)[f]	0.1[f].	0.0002 to 0.00002[bf]

[a]Brod and Stone 1981
[b]Stone et al., 1983
[c]Craigg et al. 1989
[d]RGRC 1994
[e]Dam 1995
[f]Kernodle 1996 Many of the ranges and values reported in Kernodle are from Levings, Kernodle, and Thorn (USGS WRI 95-4188, 1996); values that Kernodle obtained from model simulatations are in blue.
[g]Roca Honda Resources drilling; values from RHR BDR Table **Error! No text of specified style in document.**-1, "Typical Stratigraphic Thickness Data for the Permit Area" and Figure 7-5 "Typical Upper-Jurassic Stratigraphy of the Roca Honda Permit Area."
[h]GMRC 1979a
[i]Pike 1947
[j]Roca Honda sampling and testing; values determined by Roca Honda during aquifer testing or water quality sampling are in red.
[k]INTERA, November 2011, revised March and August, 2012. Values were estimated in the groundwater flow model and are shown in blue.

9.5 Aquitards in the Permit Area

Aquitards are geologic strata which, because of low permeability, cannot transmit sufficient quantities of water to function as aquifers. An aquitard will retard or prevent groundwater movement from or into overlying or underlying aquifers. In the San Juan basin, most aquifers are separated by aquitards consisting of shale. Aquitards in the Roca Honda/San Mateo area are, from deepest to shallowest, the Recapture Member of the Morrison Formation, the Brushy Basin Member of the Morrison Formation, and the Mancos Shale. The shale layers within the Menefee Formation and the Crevasse Canyon Formation also function as aquitards. The principal water-bearing units and aquitards in the Roca Honda permit area are shown in Figure 9-2 and Figure 7-4 of Section 7.0, Geology.

9.5.1 Mancos Shale

The Mancos Shale is a thick, dark gray, calcareous marine shale that represents the transgression of the Western Interior Seaway (NMEI 1974). The Mancos Shale conformably overlies the Dakota Sandstone and intertongues with the upper sandstones of the Dakota Sandstone. It is thickest in the northeastern part of the San Juan basin and consists of a main body and two tongues through most of the area. The main body of the Mancos Shale forms an aquitard above the Dakota Sandstone aquifer. The Mulatto Tongue of the Mancos Shale is an aquitard between the Dilco Coal Member and Dalton Sandstone Member of the Crevasse Canyon Formation.

The Satan Tongue of the Mancos Shale divides the Point Lookout Sandstone into upper and lower sandstones. Recent drilling in the Roca Honda permit area in Section 16 found approximately 720 ft of Mancos Shale, the top of which was about 700 ft below land surface at an elevation of 6,500–6,700 ft (RHR geophysical logs for holes S-2, S-3, and S-4). In the San Mateo Creek valley to the southwest of the permit area, the Mancos Shale crops out about 4 miles west of the community of San Mateo. In the area of the community of San Mateo, the Mancos Shale is at a depth of more than 1,500 ft.

Shales have low primary permeability and restrict movement of groundwater. The main body of Mancos Shale acts as a barrier to movement of water into or out of the Dakota Sandstone from or into overlying formations. The USNRC staff agreed with the determination by HRI that it was unnecessary to monitor rocks of the Mesaverde Group in the area of HRI's proposed in-situ uranium recovery operation from the Westwater Canyon Member of the Morrison Formation because of the "hydrologic separation" between the aquifers and the "thick, laterally extensive Mancos Shale separating the two systems" (USNRC 1997, EIS Docket 40-8968). The Mancos Shale is represented in the USGS model of the San Juan basin as a confining unit (Kernodle 1996).

In the Roca Honda permit area, the lower and middle Mancos Shale contain sandstone beds totaling about 125 ft in thickness. In the upper part of the Mancos Shale, a discontinuous, 45 ft thick sandstone unit in the Mulatto Tongue of the Mancos Shale crops out in the western half of Section 16. This sandstone may be the Borrego Pass Lentil of the Crevasse Canyon Formation, previously referred to as the Stray sandstone of local usage (Santos 1966) and is expected to be hydrologically similar to other Cretaceous sandstone aquifers in the area (Brod and Stone 1981).

Brod and Stone (1981) indicate that sandstones in the lower part of the Mancos Shale may transmit large quantities of water. Cooper and John (1968) report that two mines in the

San Mateo area dewatered the middle Mancos Shale sandstones at rates of 2.0 and 4.5 cfs (900 and 2,000 gpm). Brod and Stone (1981) report that the hydrologist for GMRC indicated that the “Tres Hermanos unit” (a sandstone in the lower Mancos Shale) yielded large quantities of water at the Mt. Taylor mine. RGRC reports that the Mt. Taylor mine found 118 ft of sandstone in the Mancos Shale. RHR , however, recently drilled three monitor wells south of Jesus Mesa that penetrated the Mancos Shale and down into the Westwater Canyon Member without finding producible quantities of groundwater in the Mancos Shale.

As part of its alternative sites assessment, GMRC extensively evaluated the field permeability of the Mancos Shale in the area of La Polvadera Canyon and the San Mateo area. It was determined that the upper part of the main body of the Mancos Shale had a weighted average permeability (hydraulic conductivity) of 0.05 ft/yr in La Polvadera Canyon.

9.5.2 Other Aquitards

The Recapture Member of the Morrison Formation is below the Westwater Canyon Member aquifer and above the Bluff Sandstone. The Recapture Member consists of interbedded red shale and white sandstone. It is present throughout the San Juan basin, although it is thickest in the south and southeast part of the basin, where it ranges from 125 to 300 ft thick. The USNRC (1997) reported that the Recapture Member at HRI’s Church Rock facility is about 180 ft thick. Roca Honda Resources, LLC drilled 100 ft into the Recapture Member without fully penetrating the unit, although RGRC reported a total thickness of 78 ft of the Recapture Member was penetrated by the Mt. Taylor mine (RGRC 1994). Geophysical logs run in RHR’s monitor well holes indicate that the top 50 ft of the Recapture Member in the Roca Honda permit area was siltstone or mudstone (well S-4).

The Brushy Basin Member of the Morrison Formation is present between the Dakota Sandstone and the Westwater Canyon Member over most of the San Juan basin. The Brushy Basin Member consists primarily of variegated calcareous and bentonitic claystone and mudstone of lacustrine origin, with some fluvial sandstone and conglomeratic sandstone, and freshwater limestone (NMEI 1974). In some areas of the San Juan basin, the Brushy Basin Member is as much as 200 ft thick. Borehole geophysical data collected in the permit area indicate that the Brushy Basin Member is as much as 269 ft thick (See Table 7-1, Section 7.0, Geology). Where the Brushy Basin Member is thickest, there is a sandstone stringer (~5 to 10 ft thick) in the upper part that may be water bearing; this thin sandstone is referred to as the Brushy Basin Member B sandstone aquifer. Risser, Davis, Baldwin and McAda (1984) reported that a slug-type aquifer test conducted by the USGS north of Laguna, New Mexico determined that the 60-foot thick Brushy Basin Shale Member had a transmissivity of 20 ft^2 per day and a hydraulic conductivity of 0.33 ft/day. In the Ambrosia Lake area, the Brushy Basin Shale Member was less permeable and effectively separated groundwater in the Dakota Sandstone from that in the Westwater Canyon Member.

An aquifer test conducted by HRI in September and October of 1988 to determine the degree of interconnectedness between the Westwater Canyon Member aquifer, the Dakota Sandstone aquifer, and the Brushy Basin Member B sandstone aquifer found no aquifer interconnection in the area of HRI’s proposed Church Rock In-situ Recovery facilities (HRI 1988, NRC 1997). The USNRC reports that aquifer tests performed by HRI at its proposed Crownpoint mine site found no aquifer interconnection between the Westwater Canyon Member and the Dakota Sandstone (NRC 1997). While faulting in the Roca Honda permit area and the relative limited thickness of the Brushy Basin Shale Member shales in the area make it possible that the formation may not form an impermeable hydrogeologic barrier to movement of groundwater between the Westwater Canyon Member and the Dakota Sandstone, the drilling to date has not found this to be so. For example, a detailed re-analysis of the drill logs of the holes drilled by RHR into the Westwater Canyon Member in 2007 and 2010 indicates that the Brushy Basin Member ranges from 75 to 180 feet in thickness between the Dakota Sandstone and the Westwater Canyon Member, and is composed almost entirely of mudstones. Mudstones typically exhibit very low permeability and function as good aquitards. Kerr-McGee Corporation's (KMC) hydrologist, W.J. Ganus, came to the same conclusion regarding the Brushy Basin Member's nature and effectiveness as an aquitard, stating, "

> It consists of bentonitic mudstones and some thin sandstone lenses. It is generally less than 100 feet thick in the Ambrosia Lake area and acts as a good aquitard overlying the Westwater. It is documented that uncased wells left open in the unit will quickly seal off because of the expansive nature of the clay. For this reason, it is logical to conclude that faults and fractures do not remain open to permit interaquifer communication across this formation unless there is a significant difference between aquifers.

Ganus (1980, p. 6). Additionally, the aquifer test of the Westwater Canyon Member performed by RHR in 2010 demonstrated that faulting within the permit area does not appear to provide a conduit for vertical groundwater movement.

9.6 Potential Impacts of the Proposed Mine

The Roca Honda permit area is in the Bluewater Underground Water basin, as extended by the New Mexico State Engineer on May 14, 1976. The State Engineer has jurisdiction over both mine dewatering and appropriation of water for beneficial use in this area.

The Roca Honda mine project could impact area water resources in three ways:

1. Dewatering of the Roca Honda mine may cause local water level declines within the confined aquifer system present in the Westwater Canyon Member of the Morrison Formation. Water levels in the Dakota Sandstone, and possibly sandstone units in the lower part of the Mancos Shale may be locally affected. It is unlikely that dewatering will impact water levels in the aquifers relied on by water users in the San Mateo area, who use wells that produce from the shallow aquifers in the alluvium, i.e., the Menefee Formation, and the Point Lookout Sandstone. These geologic units are from 2,000 to 2,300 ft above the units to be depressurized. Water level monitoring during and after operation of the Gulf Mt. Taylor mine (which also depressurized the Westwater Canyon Member) in wells completed in the Point Lookout Sandstone found that water levels were unaffected by withdrawal of water from the Westwater Canyon Member. (See records in NMED files for DP-61 for the Gulf Mt. Taylor mine)

2. Shallow aquifers which may be vulnerable to potential impacts from facility activity or from discharged water include the alluvium, the Point Lookout Sandstone, and the Dalton Sandstone Member of the Crevasse Canyon Formation. Although the Menefee Formation is used as an aquifer in the San Mateo Creek watershed, it is not present downgradient of the proposed surface facility area. The Menefee Formation, however, is present beneath

colluvium just east of proposed Shaft No. 2 in the SE¼ Section 10. The Mine Operations Plan describes in detail the measures that will be taken to protect those aquifers, including stormwater protection, ponding, lining, and water treatment.

3. The discharge of mine dewatering water into San Mateo Creek in the quantities anticipated will raise the level of the water table in the alluvium, at least locally. The water produced from dewatering activities will be treated to state and federal water discharge standards. Therefore, there will be no adverse impact on water quality within the alluvial aquifer or other formations recharged by the discharge where they outcrop in the arroyo.

RHR has addressed estimating the impacts on ground and surface water systems due to mine dewatering by performing groundwater flow modeling. The model incorporates analytic calculations of the probable volume of mine water production. The model has been completed and is discussed in Section 9.6.3 below.

9.6.1 Potential Impacts on Deep Aquifers

Groundwater in aquifers below the Westwater Canyon Member will not be impacted by mine dewatering because geologic units of low vertical permeability underlie the Westwater Canyon Member and separate the Westwater Canyon Member from underlying aquifers.

Beneath the Westwater Canyon Member in the project area the following formations presumably exist, from youngest to oldest: the Jurassic age Recapture Member of the Morrison Formation, the Jurassic San Rafael Group (Bluff Sandstone, Summerville Formation, Todilto Limestone, and Entrada Sandstone); the Triassic Chinle Formation, and the Permian San Andres Limestone/Glorieta Sandstone and Yeso formations. Although a few domestic wells produce from the Bluff Sandstone, Todilto Limestone, and Chinle Formation, the Permian San Andres Formation is the stratigraphically highest aquifer with large quantities of good quality water. About 2000 feet of overlying strata separate the San Andres/Glorieta and the Westwater Canyon.

When the RHR mine depressurizes the Westwater Canyon Member in the project area, the hydraulic head in the Westwater Canyon Member will be reduced. Reduction in the hydraulic head in an overlying aquifer could affect a stratigraphically lower aquifer in two situations: if the upper aquifer recharges the lower aquifer, or if the reduction in hydraulic head in the upper aquifer allows more water from the lower aquifer to move upward. For the first situation to occur, the hydraulic head in the upper aquifer would have to be downward; i.e., the aquifer could not be artesian and/or there would not be an aquitard between the upper and lower aquifers. For the second situation to occur there could not be an aquitard between the upper and the lower aquifers. Neither of these conditions is present in the area which could be impacted by the withdrawal of water in the RHR permit area.

The RHR permit area lies within the San Juan structural basin, a Laramide-age basin that dips to the northeast. Hydrogeologically, the structural basin is also an artesian groundwater basin. Water enters the geologic formations through bedrock exposures along the southern basin rim and then moves northeastward down the dip of the rocks deeper into the basin. Groundwater is trapped below low permeability layers and prevented from moving into overlying formations, becoming more artesian as it moves farther into the basin.

The Westwater Canyon Member of the Morrison Formation is the ore-bearing horizon for the RHR mine and most other uranium mines in the San Juan Basin, and is also an artesian aquifer. Away from the recharge area the groundwater in the Westwater Canyon Member has a strong upward hydraulic gradient. In the vicinity of the RHR project area the hydraulic head in the Westwater Canyon Member is about 1000 feet above the top of that formation, meaning that if a well penetrates the top of the Westwater Canyon Member at 1800 feet below land surface, then the water level in the well will rise to within 800 feet of the surface. Groundwater in the Westwater Member does not move downward into underlying formations in that area.

The mine workings of the RHR mine will be in the Westwater Canyon Member, and the RHR shaft will extend through the Westwater Canyon Member a few 10s of feet into the underlying Recapture Member of the Morrison Formation. The Recapture Member is described in the literature as an aquitard, meaning that it retards the movement of groundwater and yields little or no water to wells. The description in Brod and Stone (1980) is typical of that found in geohydrologic reports of the area:

> The Recapture Member of the Morrison Formation consists of medium, even beds of siltstone and friable, silty sandstone. Thin beds of red and green limestone are frequently present in the upper part of the unit. No water supply wells tap the Recapture Member in the study area, and it is generally considered to be an aquitard.

Brod and Stone (1980). The Recapture Member is therefore a hydraulic barrier to the movement of groundwater upward or downward across it or through it. Underlying the Recapture Member is the Bluff Sandstone Member of the San Rafael Formation. Water in the Bluff Sandstone is under artesian conditions in the Ambrosia Lake area and undoubtedly is also under artesian conditions beneath the RHR project area because of the hydrogeologic structure of the San Juan Basin, described above. The presence of the Recapture Member prevents groundwater in the Bluff Sandstone Member from moving upward into the Westwater Canyon Member. The effectiveness of this aquitard is evidenced by the fact that the Bluff Sandstone reportedly yields small quantities of highly mineralized water, whereas groundwater in the Westwater Canyon Member is typically of good quality.

This conclusion is supported by observations at Ambrosia Lake reported by KMC hydrologist Ganus. Ganus reports (1980) that water levels measured in a well that had been constructed in the Bluff Sandstone at the KMC mill site in 1961, but abandoned because of low yield and poor quality, showed essentially no change over the period of mining. KMC noted that the water level in the well was 465 feet below land surface in January, 1961. In July, 1977, after 19 years of extensive dewatering of the Ambrosia Lake area during uranium mining activities, the depth to water was measured at 469 feet below land surface. Ganus concluded “The water level for the Bluff aquifer has been virtually unaffected by the mining and milling operations during the past 19 years.”(Ganus, 1980, p. 12)

It is virtually impossible for withdrawal of groundwater from the Westwater Canyon Member to impact hydraulic heads in groundwater in deeper aquifers, such as the San Andres, if those withdrawals do not first impact groundwater in the Bluff Sandstone.

9.6.2 Westwater Canyon Member Aquifer Test

During May, 2010, RHR and Hydroscience Associates, Inc. (HAI) performed an aquifer test of the Jurassic age Westwater Canyon Member of the Morrison Formation within the RHR proposed permit area. The aquifer test was performed for the purposes of determining the hydraulic characteristics of the Westwater Canyon Member within the RHR permit area, and of identifying sub-surface hydrogeologic boundaries. RHR's well S-4-Jmw-CH-007 was pumped at an average rate of 133.6 gallons per minute (gpm) for 120 hours (five days) while the hydraulic heads in two other RHR wells fully screened in the Westwater Canyon Member were monitored (wells S-3-Jmw-CH-07 and S-1-Jmw-CH-007). Figure 2 of Appendix 9-I shows the locations of the wells. The RHR wells had been drilled in 2007 as deep groundwater monitor wells in Section 16 of T13N, R8W, New Mexico Prime Meridian. Water levels in well B-851, the Lee Mine shaft, which bottomed near the top of the Westwater Canyon Member, and water levels in well B-1084, which is screened in the Cretaceous Gallup Sandstone, were also monitored.

Table 9-13 is a presentation of the range of reported values of hydraulic parameters for geologic units in the RHR area, including the Westwater Canyon Member of the Morrison Formation. Analysis of the aquifer test data indicates that within the RHR permit area the Westwater Canyon Member exhibits an average transmissivity of between 80 and 200 ft^2/day, and a storage coefficient of 0.0002 (2.0×10^{-4}). These values are in the middle of the documented range of transmissivity and storage of the Westwater Canyon Member in the Ambrosia Lake/San Mateo area of the San Juan Basin of northwestern New Mexico. The values are not surprisingly lower than the high values estimated by Brod and Stone within the San Rafael fault zone. The aquifer test results indicate that the hydrogeologic nature of the Westwater Canyon Member in the area of the RHR permit area is consistent with its nature in other parts of the San Juan basin of northwestern New Mexico where the unit has not been heavily faulted. The experiences of other mining companies that mined from the Westwater Canyon Member regarding the appropriate number of depressurization wells, the expected rate of depressurization/dewatering, and the expected mine discharge should therefore be applicable to the Roca Honda permit area. The results of the test were incorporated in the groundwater flow model. A report on the aquifer test is attached as Appendix 9-I, "Aquifer Test Analysis of the Westwater Canyon Member of the Morrison Formation Using RHR Well S-4-Jmw-CH-07 Located at 13N.8W.16.141, McKinley County, NM."

9.6.3 Groundwater Flow Model

RHR's groundwater modeling consultant, Intera, has constructed a groundwater flow model which has been used to estimate the effects of Roca Honda mine depressurization on local and regional water levels and surface water systems. The model is a modified version of a groundwater flow model developed in 2007 by the consultant to assess the effects of uranium mine dewatering in the Ambrosia Lake area. This model was adapted in large part from a USGS model (USGS WRIR 95-4187) of groundwater flow within the San Juan Basin. The 2007 model has been accepted by the NMED as a predictive tool. MODFLOW-2000, a multi-dimensional, finite-difference, block-centered, saturated groundwater flow code, is used as the simulator.

Like the predecessor models, the modified model covers the entire San Juan Basin in northwestern New Mexico and southwestern Colorado. The model grid of the model has been refined in the area of the Roca Honda mine, and the model incorporates site-specific information on sub-surface structure in the Roca Honda mine area.

The model grid has 96 rows, 102 columns, and 10 layers. From highest to lowest, the geologic units represented in the model are: the San Jose Formation (layer 1), the Animas and Nacimiento formations (layer 2), the Ojo Alamo Sandstone, Kirtland and Fruitland formations and Pictured Cliffs Sandstone (layer 3), the Lewis Shale (layer 4), the Cliff House Sandstone, Menefee Formation and Point Lookout Sandstone (layer 5), the Mancos Shale (SW only) and Gallup Sandstone (SW only) (layer 6), the Mancos Shale (layer 7), the Dakota Sandstone (layer 8), the Brushy Basin Member of the Morrison Formation (layer 9), and the Westwater Canyon Member of the Morrison Formation (layer 10). Boundary conditions include areally-distributed recharge, perennial steams, ephemeral drainages, and wells.

The model was calibrated to pre-development (steady-state) conditions and to transient stresses. The simulated hydraulic heads were compared to water level data compiled from USGS monitor wells, published and unpublished records of water levels measured in uranium company wells and mines, and water level data from OSE files. The calculated residuals and pattern of potentiometric surface contours were considered reasonable. The model was updated to incorporate the results of the RHR aquifer test, discussed in Section 9.6.2 above, and Appendix 9-I.

Analytic calculations were applied to estimate the pumping rates which may be necessary to temporarily dewater the Westwater Canyon Member, the Dakota Sandstone, and the Gallup Sandstone in the Roca Honda mine area. The effects of this dewatering were estimated by simulating the calculated pumping rates in the calibrated model as stresses in the Roca Honda mine area. The model predicted that the maximum drawdown in the Gallup Sandstone causes a 10-foot drawdown contour to extend two miles out from the mine area; the maximum drawdown in the Dakota Sandstone causes a 10-foot drawdown contour to extend one mile out from the mine area; and the maximum drawdown in the Westwater Canyon Member causes a 10-foot drawdown contour to extend eight miles out from the mine area. These drawdowns would be expected to cause temporary water level declines within these radii in one existing well within each of these three geologic units.

The potential impact of mine dewatering on perennial stream systems was analyzed using the RIVER package of MODFLOW-2000. The groundwater flow model simulated that the impact of dewatering on area streams would be very small.

9.7 RHR Regional Groundwater Sampling Program (RGWSP)

Published and unpublished reports were reviewed to construct a database of water quality and water level data from historically existing wells. Figure A-1 of Appendix 9-A shows the locations of these wells and indicates the formations in which they are completed. Table A-1 in Appendix 9-A tabulates the available information about these wells. Some of the precision, accuracy, and comparability of the data are uncertain because the information was collected by various researchers at different times. Data about well construction, sampling methods, or laboratory analytical methods are not always known. The data is nonetheless useful in constructing a baseline for the area. The database in Appendix 9-A currently contains 149 wells, including 142 wells originally identified (see October 2009 BDR), the three wells drilled by RHR in 2007, and four wells discovered since October 2009.

RHR drilled three deep monitoring wells into the Westwater Canyon Member within Section 16 of the permit area. The wells were drilled for the purposes of: 1) providing background groundwater chemistry data; 2) monitoring water levels within the Westwater Canyon member as the Roca Honda mine is developed; and 3) running aquifer pump tests to allow RHR to better assess hydraulic parameters of the Westwater Canyon aquifer within the permit area.

In August of 2008, RHR began a regional quarterly groundwater sampling program (RGWSP) for a subset of the wells shown on Figure A-1 of Appendix 9-A. Table A-2 of Appendix 9-A identifies the subset of wells that were sampled during the initial phase of the RGWSP. Twenty nine wells were originally sampled. Figure A-2 of Appendix 9-A shows the location of these wells. Wells were selected for inclusion in the RGWSP on the following basis: 1) the depth of the well and the screened interval were known with some certainty; 2) the well was screened within one aquifer; 3) an even distribution of wells over the permit area vicinity was considered desirable; 4) water from as many aquifers as possible was collected; 5) the well owner was willing to allow sampling; 6) the well could be located in the field and access was possible; and 7) historical water chemistry data were available for the well.

As of October, 2010, water samples have been collected and analyzed from the wells in the RGWSP on six occasions. Appendix 9-B through 9-H provide the analytical results for these wells by aquifer. Every effort has been made to sample all the wells each quarter. However, in some cases it has not been possible to do so, usually because the owner could not be contacted. The samples were collected and electrical conductivity, pH, and temperature were measured in the field. The samples were properly packaged and shipped to an Environmental Protection Agency-accredited laboratory. The water samples were analyzed for major ions, dissolved metals, non-metals, total metals (uranium), total radionuclides, volatile organic compounds, and synthetic organic compounds.

The RGWSP has been modified based on knowledge that has been developed over the previous sampling periods. Figure 9-16 and Table 9-14 identify the wells that will be included in future sampling. The current RGWSP consistes of 23 wells. These 23 wells are a subset of the original 29 wells sampled. These wells have been chosen because we expect to be able to consistently access to sample them and provide the best opportunity to develop reliable regional baseline characterization.

This RGWSP may be modified over time as other wells not previously known are identified, as new wells are constructed, and as the RHR project develops as a result of input from MMD, NMED, and USFS.

As noted in Section 9.1, RHR has submitted a Groundwater Monitoring Plan and a Work Plan to establish baseline water quality. RHR has relied on guidance provided in USEPA's *Unified Guidance: Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (2009) to develop a statistically valid baseline for existing water quality constituents present in concentrations greater than those set forth in Section 20.6.2.3103 NMAC in the Westwater Canyon Member. The proposed RHR "Work Plan to Establish Existing Concentrations (i.e., Baseline) Groundwater Quality," submitted to NMED, NM MMD, and USFS in January 2011, proposes reliance on the USEPA statistical program ProUCL 4.0. The Work Plan is currently under review and will be incorporated into the BDR when approved.

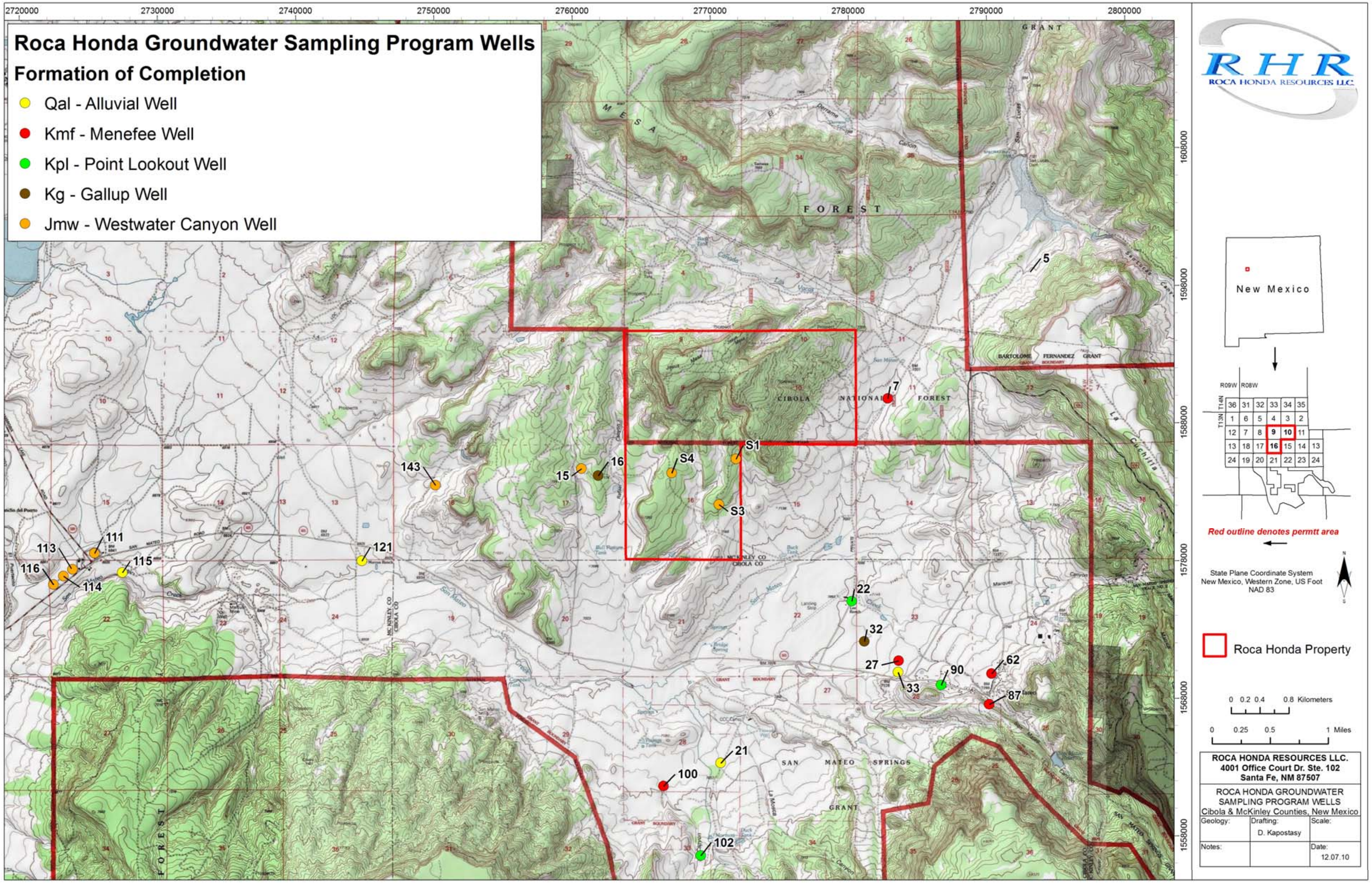

Figure 9-16. Wells Included in RHR's Groundwater Sampling Program

Table 9-14. Details of Wells Included in RHR's Groundwater Sampling Program

Well ID	OSE File No.	Comment	Designation in Previous Inventories				Public Land Survey System Location						UTM NAD 83		Producing Formation	Well Depth	DTW	Water Elevation	Date of Water Level Measurement	Well Elevation (ft)	Included in present groundwater monitoring program
			GMRC ER	NMEIBS	NMBMMR HS2	Metric Corp.	Twp.	Rng.	Sec.	1st Q	2nd Q	3rd Q	Easting	Northing							
7							13	8	11	3	2	1	258514	3917002	Kmf	192.3	76.9	7121		7198	Yes
15	B 00851-DW3	Sec.17/Lee Mine shaft					13	8	17	2	1	4	254310	3916112	Jmw	1469				7178	Yes
16	B 01084					50	13	8	17	2	3	2	254295	3915909	*Kg*	320	60	7092	1/1/1963	7152	Yes
21	B 00415 O-4					40	13	8	22	2	1	2	255983	3911840	*Qal*	32	15	7062	3/23/1978	7077	Yes
22	B 01085					7, 51?	13	8	22	2	4	2	257866	3914204	Kpl	476	90	7013	12/31/1920	7103	Yes
27					MF4		13	8	23	3	4	2	258687	3913397	Kmf	305	37.5	7138	2/1/1978	7175	Yes
32	B 01442 EXP L-2	Lee Ranch Sec. 23 Pivot Well					13	8	23	3	1	3	258063	3913591	Kg	1150	107	7016	5/28/2002	7123	Sampled Once - Sampled when Available
33	B 00544						13	8	23	3	4	3	258355	3913491	Qal	68	30	7122	6/17/1978	7152	Yes
62			S-12	5	MF11	25	13	8	24	3	3	4	259898	3913131	Kmf	200	87.4	7209	1976	7297	Yes
87	B-00829					34	13	8	25	1	3	2	259818	3912539	Kmf	210	50	7352	8/18/1980	7402	Yes
90				11a	P2a		13	8	26	2	2	1	259251	3913007	Kpl	336	281	6973	9/11/1962	7254	Yes
100	B-01086					52	13	8	28	3	4	3	255202	3911899	*Kmf*	210	20	7050	1/1/1947	7070	Yes
102				22		41	13	8	33	2	3	4	255740	3910867	Kpl	600				7169	Yes
111	B-01115						13	9	15	3	4	4	247479	3915109	*Jmw*	478	204	6643	7/21/1986	6847	Yes
113		USGS monitor well			W7		13	9	22	1	1	2	247233	3914945	Jmw	297	100.67	6729.3	8/6/2009	6830	Yes
114					W8		13	9	22	1	2	1	247233	3914945	Jmw	330	198.5	6639	10/1/1962	6837	Yes
115					A11		13	9	22	2	1	2	247917	3914916	Qal	130	37.1	6797	3/1/1975	6834	Yes
116	B-01636						13	9	22	1	2		247377	3914802	*Jmw*	260	80	6744	5/10/2005	6824	Yes
120				13	A12		13	9	24	2	2	1	251266	3914846	Qal	80	56.5	6856	12/1/1957	6913	Yes
143	B-1778						13	8	18	1	4	1	252142	3916113	Jmw	940	625	6385	6/14/2009	7010	Yes
RHR S-1		RHR					13	8	16				256317	3916362	Jmw	2108	866.1	6396.8	10/26/2010	7262.9	Yes
RHR S-3		RHR					13	8	16				256063	3915732	Jmw	2043	826.5	6395.9	10/26/2010	7222.4	Yes
RHR S-4		RHR					13	8	16				255425	3916193	Jmw	1919	860.3	6388.4	10/19/2010	7248.7	Yes

Note: Additional wells may be added to this sampling program as more wells are drilled or discovered.

Previous Inventory Designations:

GMRC ER	GMRC Environmental Report, 1979
NMEIBS	New Mexico Environmental Institute Environmental Baseline Study, 1974
San Lucas Canyon	GMRC "Hydrologic Effects of Tailings Pipeline and Mill Site Facilities, Mt. Taylor Uranium Mill Project", 1979 (App. D to GMRC Groundwater Discharge Plan, December, 1979
Polvadera Canyon	GMRC Groundwater Discharge Plan (December, 1979)
DP-61 Monitor Wells	NMED DP-61 file for GMRC
NMBMMR HR2	NMBMMR Hydrologic Sheet 2
Metric Corp.	Consultant report to RGRC 12/2005, 3/2005

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Appendix 9-A

Regional Groundwater Sampling
Program Wells

Figure A-1 is located in the pocket

Figrue A-1.
Regional Groundwater Database Well Location Map
1:32,000

Table A-1. Regional Groundwater Database Wells

Well ID	OSE File No.	Comment	Designation in Previous Inventories							Public Land Survey System Location						UTM NAD 83		Producing Formation	Well Depth	DTW	Water Elevation	Date of Water Level Measurement	Well Elevation (ft)	Included in present groundwater monitoring program
			GMRC ER	NMEIBS	San Lucas Canyon	Polvadera Canyon	DP-61 Monitor Wells	NMBMMR HS2	Metric Corp.	Twp.	Rng.	Sec.	1st Q	2nd Q	3rd Q	Easting	Northing							
1										13	7	30	4	2	1	262362	3912136	Jmw	4207	>500	7709		8209	
2				17						13	7	30	4	3	2	262181	3911689		>1980	<300	8004		8304	
3				16						13	7	33	2	3	4	265362	3910527		1500 approx	>400	8120	9/29/1972	8520	
4					M-1					13	8	1		2	3	260080	3919138	*Kpl*	400				7162	
5	RG 33107 EXPL									13	8	1	4	1	1	260480	3918556	*Kmf, Kpl*	394	72	7159	8/18/1979	7231	Sampled Once - Discontinued
6		Johnny M potable well						DK1		13	8	7	4	3	4	252786	3916502	Kd	1090	775			7221	
7										13	8	11	3	2	1	258514	3917002	Kmf	192.3	76.9	7121		7198	Yes
8			S-16							13	8	14	4	2	2	259532	3915410	Kmf					7185	
9				1				MF1		13	8	14	4	2	2	259532	3915410	Kmf	200	71.5	7114	9/10/1962	7185	
10								U1		13	8	17	2	2	3	254510	3916097	*Kg*					7174	
11		Does not exist								13	8	17	2	4	1	254501	3915937						7169	
12	B 00848	Not drilled							46 (?)	13	8	17	2	1	3	254110	3916112						7165	
13	B 00848 S	Not drilled								13	8	17	2	1	3	254110	3916112						7165	
14	B 00848 O	KMC LMW-1							3,47	13	8	17	2	1	4	254310	3916112	Jmw	1611	1315	5863	4/1/1981	7178	
15	B 00851-DW3	Sec.17/Lee Mine shaft								13	8	17	2	1	4	254310	3916112	Jmw	1469				7178	Yes
16	B 01084								50	13	8	17	2	3	2	254295	3915909	*Kg*	320	60	7092	1/1/1963	7152	Yes
17	B 01544									13	8	18	1	2	3	252103	3916155	*Kd*	715	624	6417	6/14/2003	7041	
18	B 00390	Johnny M Mine								13	8	18	2	2	1	252904	3916338	*Kd,Jmw*	1800	800	6333	12/31/1974	7133	
19	B 00557								6	13	8	21	4	3	2	255825	3913453	Qal					7037	
20			S-4	2				MF2		13	8	22	2	4	2	257902	3914232	Kmf	157.3	37.5	7066	10/23/1962	7103	
21	B 00415 O-4								40	13	8	22	2	1	2	255983	3911840	*Qal*	32	15	7062	3/23/1978	7077	Yes
22	B 01085								7, 51?	13	8	22	2	4	2	257866	3914204	Kpl	476	90	7013	12/31/1920	7103	Yes
23	B 00415 O-3									13	8	22	4	2	2	256194	3912240	*Qal*	32	15	7055	3/23/1978	7070	
24	B 00415 O-3									13	8	22	4	2	2	256194	3912240	Qal	32	15	7055	3/23/1978	7070	
25	B 01442									13	8	22	4	4	4	257845	3913200	*Kpl*	620	87	7049	6/15/2000	7136	
26								MF3		13	8	23	3	2	4	258687	3913538	Kmf					7172	
27								MF4		13	8	23	3	4	2	258687	3913397	Kmf	305	37.5	7138	2/1/1978	7175	Yes
28									9	13	8	23	4	1	3	258857	3913552	Qal	79	34	7144		7178	
29									61	13	8	23	4	2	4	259386	3913592	Qal	100				7224	
30									10	13	8	23	4	3	1	258867	3913340	Qal	?				7185	
31			S-10	3				MF5	11	13	8	23	4	3	2	259049	3913332	Kmf	92	35	7170	10/17/1972	7205	
32	B 01442 EXP L-2	Lee Ranch Sec. 23 Pivot Well								13	8	23	3	1	3	258063	3913591	Kg	1150	107	7016	5/28/2002	7123	Sampled Once - Sampled when Available
33	B 00544									13	8	23	3	4	3	258355	3913491	Qal	68	30	7122	6/17/1978	7152	Yes
34	B 00815									13	8	23	3	4	2	258652	3913380	*Kpl*	300	260	6915	1981	7175	
35	B 00734								12	13	8	23	4	4	1	259248	3913362	Qal	73				7224	
36	B 00735									13	8	23	4	4	1	259248	3913362	Qal	65	30	7194	7/3/1980	7224	
37	B 00736									13	8	23	4	4	2	259448	3913362						7247	
38	B 00737								13	13	8	23	4	4	2	259448	3913362	Qal	80				7247	
39									MW-1	13	8	24	1	2	1	260072	3914591	Kmf	63				7257	
40							MW-3			13	8	24	1	2	4	260330	3914334	Qal	65				7274	
41			S-14					MF7	19	13	8	24	1	4	1	260056	3914201	Kmf	285	55	7202		7257	
42								MF16		13	8	24	1	4	1	260056	3914201	Kmf	250	59	7198	Oct-72	7257	
43							MW-1			13	8	24	1	4	2	260330	3914201	Qal	60				7277	
44							MW-2			13	8	24	1	4	2	260330	3914201	Qal	65				7277	

Table A-1 (Continued)

Well ID	OSE File No.	Comment	Designation in Previous Inventories							Public Land Survey System Location						UTM NAD 83		Producing Formation	Well Depth	DTW	Water Elevation	Date of Water Level Measurement	Well Elevation (ft)	Included in present groundwater monitoring program
			GMRC ER	NMEIBS	San Lucas Canyon	Polvadera Canyon	DP-61 Monitor Wells	NMBMMR HS2	Metric Corp.	Twp.	Rng.	Sec.	1st Q	2nd Q	3rd Q	Easting	Northing							
45			S-8						18	13	8	24	1	4	4	260330	3913919	Kmf	160				7290	
46										13	8	24	1	4	4	260330	3913919	Kmf	160				7290	
47	B 01429								55	13	8	24	2	2	2	261110	3914516	*Kmf*	245	90	7335		7425	Sampled Twice - Discontinued
48			S-13	4				MF8	24	13	8	24	2	2	3	260877	3914317	Kmf	?	184.5	7138	6/2/1973	7323	
49	B 00404									13	8	24	2	3	4	260753	3913903						7333	
50	B-516-(1)-S								27	13	8	24	2	4	3	260877	3913911	Kpl	1125	470	6899		7369	
51	B-516-(1)-S-2								28	13	8	24	2	4	3	260877	3913911	Kpl	1045	453	6916		7369	
52	B-516-(1)-S-3								29	13	8	24	2	4	3	260877	3913911	*Kpl*	1065				7369	
53									MW-2	13	8	24	3	2	2	260321	3913786	*Qal*	44				7303	
54							MW-4			13	8	24	3	2	4	260321	3913496	*Qal*	prob.60				7310	
55							MW-5			13	8	24	3	2	2	260321	3913786	*Qal*	prob.60				7303	
56				6				MF9	22	13	8	24	3	3	4	259898	3913127	Kmf	200	50	7247	pre-1962	7297	
57				7				MF10	23	13	8	24	3	3	4	259898	3913129	Kmf	140	89.5	7207	9/10/1962	7297	
58			S-19, S-9						21	13	8	24	3	4	2	260321	3913363	Kmf	250	15	7301		7316	
59									MW-3	13	8	24	3	4	4	260305	3913123	*Qal*	46				7362	
60									20	13	8	24	3	4	4	260305	3913123	*Qal*	?				7362	
61								MF12		13	8	24	3	3	4	259898	3913131	Kmf	120	101	7196	2/1/1978	7297	
62			S-12	5				MF11	25	13	8	24	3	3	4	259898	3913131	Kmf	200	87.4	7209	1976	7297	Yes
63								MF14		13	8	24	3	4	1	260039	3913372	Kmf	500	139	7141	3/1/1978	7280	
64			S-9							13	8	24	3	4	2	260313	3913363	Kmf	250	15	7301	March or Dec, 1976	7316	
65										13	8	24	3	4	2	260313	3913363	*Kmf*					7316	
66			S-1							13	8	24	4	1	2	260736	3913770	*Kmf*	800	260	7092		7352	
67			S-22							13	8	24	4	1	2	260736	3913770	*Km*	2000	700	6652		7352	
68				SM2443						13	8	24	4	1	2	260736	3913770						7352	
69									MW-5	13	8	24	4	1	1	260479	3913770	*Qal*	32.5				7326	
70									MW-4	13	8	24	4	1	3	260454	3913496	*Qal*	47.5				7326	
71	B-00516								26	13	8	24	4	2	1	260869	3913778	Kpl	925				7382	
72										13	8	24	4	1	2	260728	3913778	*Km*	2000	700	6649	1976	7349	
73	B-00516							Mw(W1)	26	13	8	24	2	3	4	260350	3913856	Jmw	3535	1062	6238	10/1/1976	7300	
74	B-00524								17	13	8	24	3	4	4	260251	3913154	Kpl?	520	260	7089	1978	7349	
75				8				MF15		13	8	25	1	1	2	259882	3912990	Kmf	150	43	7260	9/10/1962	7303	
76				9a				MF17	32a	13	8	25	1	1	4	259890	3912700	Kmf,Qal	120	36	7303	9/1/1962	7339	
77				9b				MF18	32b	13	8	25	1	1	4	259890	3912700	Kmf	250	80	7259	10/1/1972	7339	
78			S-15	9						13	8	25	1	1	4	259890	3912700	Kmf		103.87	7235	1976	7339	
79				10				A7	42	13	8	25	1	1	1	259633	3912982	Qal	21	19.5	7267	9/1/1962	7287	
80				15				MF16	43	13	8	25	1	1	4	259882	3912700	Kmf	35	27	7312	10/11/1972	7339	
81									45	13	8	25	1	1	4	259882	3912700	Kmf		103.9	7235		7339	
82	B-00428								44?	13	8	25	1	2	3	259998	3912716	Kpl,Kmf	325	75	7317	7/31/1971	7392	
83			S-20							13	8	25	1	2	1	260006	3912990	Kpl		269.35	7044	1976	7313	Sampled Twice - Discontinued
84	B-00839								33	13	8	25	1			259920	3912641	Kmf	420	120	7229	9/8/1980	7349	
85	B-00906								48	13	8	25	1	1		259733	3912847	*Kmf,Qal*	230	50	7250	6/22/1981	7300	
86	B-00729									13	8	25	1	3	3	259618	3912339	*Kmf*					7333	
87	B-00829								34	13	8	25	1	3	2	259818	3912539	Kmf	210	50	7352	8/18/1980	7402	Yes
88			S-11	12				MF19	38	13	8	26	2	1	1	258846	3912971	Kmf,Qal	40	33.4	7181	1976	7215	
89								MF20		13	8	26	2	1	1	258849	3912971	Kmf	180	36	7179	8/1/1973	7215	
90				11a				P2a		13	8	26	2	2	1	259251	3913007	Kpl	336	281	6973	9/11/1962	7254	Yes

Table A-1 (Continued)

Well ID	OSE File No.	Comment	Designation in Previous Inventories							Public Land Survey System Location						UTM NAD 83		Producing Formation	Well Depth	DTW	Water Elevation	Date of Water Level Measurement	Well Elevation (ft)	Included in present groundwater monitoring program
			GMRCER	NMEIBS	San Lucas Canyon	Polvadera Canyon	DP-61 Monitor Wells	NMBMMR HS2	Metric Corp.	Twp.	Rng.	Sec.	1st Q	2nd Q	3rd Q	Easting	Northing							
91				11b				P2b(P3)		13	8	26	2	2	1	259251	3913007	Kmf	200	32.8	7221	10/24/1972	7254	
92								MF21		13	8	26	2	2	2	259508	3912990	Kmf	57.5	21.5	7255	2/1/1978	7277	
93	B-00428 S								37	13	8	26	2	1	2	259231	3912957	Kpl	703	210	7041		7251	
94	B-01185								53	13	8	26	2	2		259332	3912858	Kmf	185	70	7200	4/21/1989	7270	
95	B-00385								54	13	8	26	2	2	1	259231	3912957	*Kpl*	707	196	7055	10/27/1976	7251	
96	B-00738								36	13	8	26	2	2	2	259431	3912957	Qal	80	36	7238	12/12/1979	7274	
97									35	13	8	26	2	3	3	258812	3912368	*Kmf*					7261	
98								MF22		13	8	27	1	3	3	256356	3912418	Kmf		24.2	7046	8/1/1977	7070	
99	RG-43456			21					59	13	8	27	1	3	4	256604	3912429	*Kmf*	300				7080	
100	B-01086								52	13	8	28	3	4	3	255202	3911899	*Kmf*	210	20	7050	1/1/1947	7070	Yes
101	B-00997									13	8	30				252287	3912456	*Km*					7267	
102				22					41	13	8	33	2	3	4	255740	3910867	Kpl	600				7169	Yes
103								MF23(P4?)		13	8	33	2	3	4	255792	3910858	Kpl	500	113	7056	8/1/1977	7169	
104	RG-43457								60	13	8	33	4	1	2	255750	3910641	*Kmf*	320	50	7142	1/1/1967	7192	
105	B-01046									13	8	33	4	4	3	255937	3910028	*Tb*					7402	
106	B-01190									13	9	11	3	3	3	248512	3916669	*Qal/Jmw*	390	37	6863	8/31/1989	6900	Sampled Once - Discontinued
107								DK2		13	9	13	1	1	1	250097	3916461	*Km*	155	142.9	6799	2/1/1958	6942	
108	B-00456									13	9	14	2	3		249391	3915949						6939	
109	B-01104									13	9	14	4	3		249372	3915145	*Jmw*	303	247	6643	4/2/1986	6890	
110								W2		13	9	15	3	4	3	247253	3915094	Jmw	260	223.7	6614	12/1/1957	6837	
111	B-01115									13	9	15	3	4	4	247479	3915109	*Jmw*	478	204	6643	7/21/1986	6847	Yes
112								W6		13	9	22	1	1	1	246876	3914945	Jmw		220	6611		6831	
113		USGS monitor well						W7		13	9	22	1	1	2	247233	3914945	Jmw	297	100.67	6729.3	8/6/2009	6830	Yes
114								W8		13	9	22	1	2	1	247233	3914945	Jmw	330	198.5	6639	10/1/1962	6837	Yes
115								A11		13	9	22	2	1	2	247917	3914916	Qal	130	37.1	6797	3/1/1975	6834	Yes
116	B-01636									13	9	22	1	2		247377	3914802	*Jmw*	260	80	6744	5/10/2005	6824	Yes
117	B-00659									13	9	22	2	1	3	246883	3914717	*Jmw*	220	190	6641	1/18/1979	6831	
118	B-00861									13	9	22	2	3	1	246981	3914003						6854	
119								W9		13	9	23	2	1	2	249502	3914856	*Qal/Jmw*	280	50.5	6816	3/1/1976	6867	
120				13				A12		13	9	24	2	2	1	251266	3914846	Qal	80	56.5	6856	12/1/1957	6913	Yes
121				14				A3		13	9	24	2	2	1a	251266	3914846	Qal	80	56.6	6856	12/1/1957	6913	Sampled Once - Discontinued
122						Laguna Well				14	7	34?				267604	3920147	Uk					7805	
123			S-7							14	7	19	2	2	1	263316	3924150	Kpl					6913	
124								DL2(1)		14	8	4	3	3	4	255438	3927731	Kcda		150.3	6982	10/16/1962	7133	
125										14	8	4	3	3	4	255438	3927731			500	6633		7133	
126						Section 4 Well				14	8	4	3	3	4	255438	3927731	Kcda					7133	
127				18						14	8	12	2	3	4	260942	3926787	*Kmf,Kpu*					6972	
128								MN1		14	8	15	2	4	4	258241	3925189	Km	1320	500	6701		7201	
129						Polvadera Well				14	8	15	2	4	4	258241	3925189	Kd	830	670	6531	3/1/1979	7201	
130				19						14	8	15	4	3	3	257531	3924423	Km	1320				7247	
131					SL-1					14	8	25	2	1	2	260783	3922629	Qal	50				7021	
132					SL-2					14	8	25	2	1	2	260783	3922629	Kpl	230				7021	
133					SL-3					14	8	25	2	1	2	260783	3922629	Kmf	260				7021	

Table A-1 (Continued)

Well ID	OSE File No.	Comment	Designation in Previous Inventories							Public Land Survey System Location						UTM NAD 83		Producing Formation	Well Depth	DTW	Water Elevation	Date of Water Level Measurement	Well Elevation (ft)	Included in present groundwater monitoring program
			GMRC ER	NMEIBS	San Lucas Canyon	Polvadera Canyon	DP-61 Monitor Wells	NMBMMR HS2	Metric Corp.	Twp.	Rng.	Sec.	1st Q	2nd Q	3rd Q	Easting	Northing							
134		134 & 137 are same well						W-28		14	9	36	3	1	3	250260	3920147	Jmw	1500	766	6511	2006	7071	
135		135 & 136 are the same well								14	9	35	4	2	2	248571	3920456	Jmw	1004	773	6330	2006	7103	
136	B-00993	135 & 136 are the same well								14	9	35	4	1	1	249310	3920611	Jmw	1398				7077	
137	B-00993-S	134 & 137 are same well								14	9	36	4	1	3	250527	3920058	Jmw	1553	0	7133		7133	
138										13	9	22				246874	3914825	Jmw	170	86	6645		6815	Sampled Once - Discontinued
139		KMC LMD-1								13	8	17	1	4	1			Kd	1320	849 756.4	6308 6400.6	late 1981 10/26/2010	7157	
140																258825	3913271		66	18.6				
141																248514	3915237		>410					
142										13	9	22				247749	3915037							
143	B-1778									13	8	18	1	4	1	252142	3916113	Jmw	940	625	6385	6/14/2009	7010	Yes
144		GMR monitor well SM-15-59								13	8	15	4	1	2			Jmw						
145		GMR monitor well SM-13-74M								13	8	13	4	2	3			Jmw?						
146	B1786 Exp									13	8	15	2	2	2	257834	3916765	Kg	1420	164.3	7005.7	9/13/2010	7170	Pending inclusion
RHR S-1		RHR								13	8	16				256317	3916362	Jmw	2108	866.1	6396.8	10/26/2010	7262.9	Yes
RHR S-3		RHR								13	8	16				256063	3915732	Jmw	2043	826.5	6395.9	10/26/2010	7222.4	Yes
RHR S-4		RHR								13	8	16				255425	3916193	Jmw	1919	860.3	6388.4	10/19/2010	7248.7	Yes

Previous Inventory Designations:

GMRC ER	GMRC Environmental Report, 1979
NMEIBS	New Mexico Environmental Institute Environmental Baseline Study, 1974
San Lucas Canyon	GMRC “Hydrologic Effects of Tailings Pipeline and Mill Site Facilities, Mt. Taylor Uranium Mill Project”, 1979 (App. D to GMRC Groundwater Discharge Plan, December, 1979
Polvadera Canyon	GMRC Groundwater Discharge Plan (December, 1979)
DP-61 Monitor Wells	NMED DP-61 file for GMRC
NMBMMR HR2	NMBMMR Hydrologic Sheet 2
Metric Corp.	Consultant report to RGRC 12/2005, 3/2005

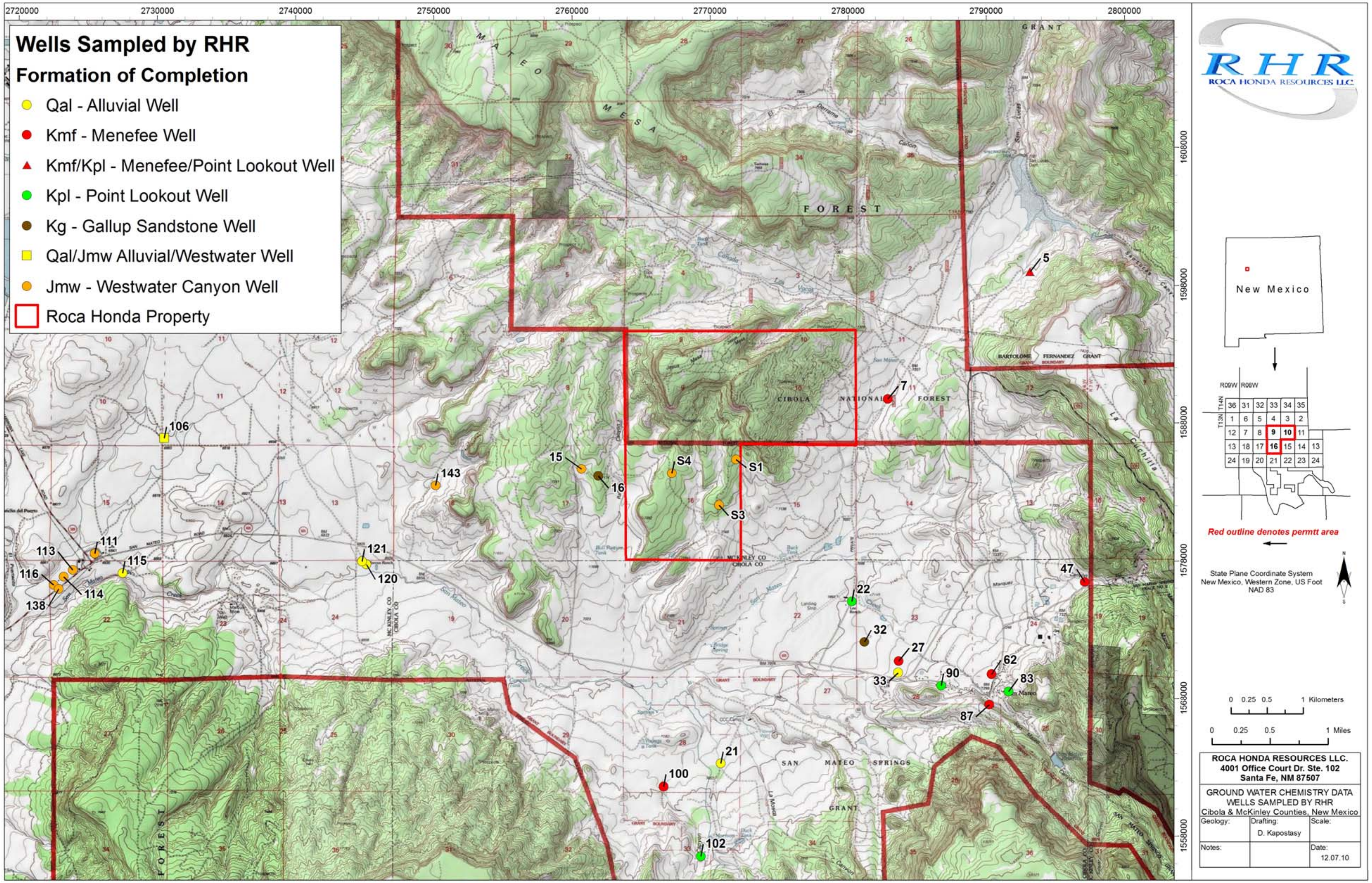

Figure A-2. Map Showing Locations of Data Given in Appendices B-H

Table A-2. Details of Wells with Data Given in Appendices B-H

Well ID	OSE File No.	Comment	Designation in Previous Inventories				Public Land Survey System Location						UTM NAD 83		Producing Formation	Well Depth	DTW	Water Elevation	Date of Water Level Measurement	Well Elevation (ft)	Included in present groundwater monitoring program
			GMRC ER	NMEIBS	NMBMMR HS2	Metric Corp.	Twp.	Rng.	Sec.	1st Q	2nd Q	3rd Q	Easting	Northing							
5	RG 33107 EXPL						13	8	1	4	1	1	260480	3918556	*Kmf, Kpl*	394	72	7159	8/18/1979	7231	Sampled Once - Discontinued
7							13	8	11	3	2	1	258514	3917002	Kmf	192.3	76.9	7121		7198	Yes
15	B 00851-DW3	Sec.17/Lee Mine shaft					13	8	17	2	1	4	254310	3916112	Jmw	1469				7178	Yes
16	B 01084					50	13	8	17	2	3	2	254295	3915909	*Kg*	320	60	7092	1/1/1963	7152	Yes
21	B 00415 O-4					40	13	8	22	2	1	2	255983	3911840	*Qal*	32	15	7062	3/23/1978	7077	Yes
22	B 01085					7, 51?	13	8	22	2	4	2	257866	3914204	Kpl	476	90	7013	12/31/1920	7103	Yes
27					MF4		13	8	23	3	4	2	258687	3913397	Kmf	305	37.5	7138	2/1/1978	7175	Yes
32	B 01442 EXP L-2	Lee Ranch Sec. 23 Pivot Well					13	8	23	3	1	3	258063	3913591	Kg	1150	107	7016	5/28/2002	7123	Sampled Once - Sampled when Available
33	B 00544						13	8	23	3	4	3	258355	3913491	Qal	68	30	7122	6/17/1978	7152	Yes
47	B 01429					55	13	8	24	2	2	2	261110	3914516	*Kmf*	245	90	7335		7425	Sampled Twice - Discontinued
62			S-12	5	MF11	25	13	8	24	3	3	4	259898	3913131	Kmf	200	87.4	7209	1976	7297	Yes
83			S-20				13	8	25	1	2	1	260006	3912990	Kpl		269.35	7044	1976	7313	Sampled Twice - Discontinued
87	B-00829					34	13	8	25	1	3	2	259818	3912539	Kmf	210	50	7352	8/18/1980	7402	Yes
90				11a	P2a		13	8	26	2	2	1	259251	3913007	Kpl	336	281	6973	9/11/1962	7254	Yes
100	B-01086					52	13	8	28	3	4	3	255202	3911899	*Kmf*	210	20	7050	1/1/1947	7070	Yes
102				22		41	13	8	33	2	3	4	255740	3910867	Kpl	600				7169	Yes
106	B-01190						13	9	11	3	3	3	248512	3916669	*Qal/Jmw*	390	37	6863	8/31/1989	6900	Sampled Once - Discontinued
111	B-01115						13	9	15	3	4	4	247479	3915109	*Jmw*	478	204	6643	7/21/1986	6847	Yes
113		USGS monitor well			W7		13	9	22	1	1	2	247233	3914945	Jmw	297	100.67	6729.3	8/6/2009	6830	Yes
114					W8		13	9	22	1	2	1	247233	3914945	Jmw	330	198.5	6639	10/1/1962	6837	Yes
115					A11		13	9	22	2	1	2	247917	3914916	Qal	130	37.1	6797	3/1/1975	6834	Yes
116	B-01636						13	9	22	1	2		247377	3914802	*Jmw*	260	80	6744	5/10/2005	6824	Yes
120				13	A12		13	9	24	2	2	1	251266	3914846	Qal	80	56.5	6856	12/1/1957	6913	Yes
121				14	A3		13	9	24	2	2	1a	251266	3914846	Qal	80	56.6	6856	12/1/1957	6913	Sampled Once - Discontinued
138							13	9	22				246874	3914825	Jmw	170	86	6645		6815	Sampled Once - Discontinued
143	B-1778						13	8	18	1	4	1	252142	3916113	Jmw	940	625	6385	6/14/2009	7010	Yes
RHR S-1		RHR					13	8	16				256317	3916362	Jmw	2108	866.1	6396.8	10/26/2010	7262.9	Yes
RHR S-3		RHR					13	8	16				256063	3915732	Jmw	2043	826.5	6395.9	10/26/2010	7222.4	Yes
RHR S-4		RHR					13	8	16				255425	3916193	Jmw	1919	860.3	6388.4	10/19/2010	7248.7	Yes

Previous Inventory Designations:

GMRC ER	GMRC Environmental Report, 1979
NMEIBS	New Mexico Environmental Institute Environmental Baseline Study, 1974
San Lucas Canyon	GMRC "Hydrologic Effects of Tailings Pipeline and Mill Site Facilities, Mt. Taylor Uranium Mill Project", 1979 (App. D to GMRC Groundwater Discharge Plan, December, 1979
Polvadera Canyon	GMRC Groundwater Discharge Plan (December, 1979)
DP-61 Monitor Wells	NMED DP-61 file for GMRC
NMBMMR HR2	NMBMMR Hydrologic Sheet 2
Metric Corp.	Consultant report to RGRC 12/2005, 3/2005

Appendix 9-B

Water Quality Data
2008-2010 Sampling
Alluvial Wells

(Note: Volatile Organic Compounds and Synthetic Organic Compounds were not detected during sampling and are not given in the tables below. These data will be available upon request)

Table B-1. Alluvial Well Water Quality Data (Page 1 of 4)

Well ID	120	120		120	120	120	120	121	21	21	21	21	21	21	UNITS	R.L.	METHOD
Sample Date	8/6/2008	11/18/2008		2/18/2009	5/26/2009	5/3/2010	10/13/2010	8/18/2008	8/21/2008	11/8/2008	2/11/2009	5/19/2009	4/29/2010	10/6/2010			
Sample Number	RH08-0051	RH08-0097	RH08-0098	RH9-0018	RH09-0044	RH10-0003	RH10-0047	RH08-0057	RH08-0064	RH08-0081	RH09-0004	RH09-0032	RH10-0001	RH10-0041			
FIELD MEASUREMENTS																	
Water Level (Altitude)	6832	6832	6832	-	-	-	-	6838	7061	7061	7076.9	-	-	7072.3	ft.		HANNA Multi-meter
pH	7.13	7.71	7.71	9.29	8.33	7.93	7.57	9.16	6.99	7.78	7.66	7.74	7.80	7.72	s.u.		HANNA Multi-meter
Conductivity	1218	1206	1206	1496	1344	1183	1229	1573	601	669	649	651	671	595	umhos/cm		HANNA Multi-meter
Temperature	67.00	53.52	53.52	43.00	60.21	53.00	62.48	56.60	60.15	54.45	51.48	59.93	52.47	59.70	degrees F		HANNA Multi-meter
Dissolved Oxygen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	%		HANNA Multi-meter
Total Dissolved Solids, TDS	-	603	603	748	672	591	614	-	-	334	325	325	335	297	mg/l		HANNA Multi-meter
Turbidity	0	0	0	0	0	0.87	0.36	38.16	17.85	9.14	0.39	12.01	2.6	0.76	t.u.		HANNA Multi-meter
MAJOR IONS																	
Alkalinity, Total as CaCO3	330	329	324	442	332	334	356	207	313	328	340	345	361	347	mg/l	1.0	A2320 B
Carbonate as CO3	ND	ND	ND	33	ND	ND	ND	45	ND	ND	ND	ND	ND	ND	mg/l	1.0	A2320 B
Bicarbonate as HCO3	400	401	395	472	405	407	424	161	382	401	415	421	441	424	mg/l	1.0	A2320 B
Hydroxide as OH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	1.0	A2320 B
Calcium	69	54	67	10	65	76	54	4	54	56	41	43	44	43	mg/l	1	E200.7
Chloride	26	24	24	34	23	28	27	42	7	7	5	6	6	5	mg/l	1	E300.0
Fluoride	1.3	1.6	1.4	2.8	1.3	1.1	1.4	0.5	1.0	1.1	1.1	1.1	1.1	1.0	mg/l	0.1	A4500-F C
Magnesium	25	20	25	4	25	27	20	4	16	16	15	13	12	12	mg/l	1	E200.7
Nitrogen, Ammonia as N	0.1	0.1	0.1	0.10	0.07	ND	0.08	1.3	ND	ND	ND	ND	ND	ND	mg/l	0.1	E350.1
Nitrogen, Kjeldahl, Total as N	ND	ND	ND	ND	ND	ND	ND	1.7	ND	ND	ND	ND	ND	0.7	mg/l	0.5	E351.2
Nitrogen, Nitrate as N	-	ND	ND	ND	ND	ND	ND	-	-	-	ND	ND	ND	0.4	mg/l	0.1	E353.2
Nitrogen, Nitrate + Nitrite as N	-	ND	ND	ND	ND	ND	ND	-	-	ND	ND	ND	ND	0.40	mg/l	0.05	E353.2
Nitrogen, Nitrite as N	ND	ND	ND	ND	ND	ND	ND	ND	0.14	ND	ND	ND	ND	ND	mg/l	0.1	A4500-NO2 B
Nitrogen, Total	ND	ND	ND	ND	ND	ND	ND	1.7	ND	ND	ND	ND	ND	1.1	mg/l	0.5	A4500-N A
Potassium	3	3	3	4	3	3	3	3	1	1	ND	ND	ND	ND	mg/l	1	E200.7
Silica	18.4	17.1	18.7	8.7	17.4	18.5	17.3	1.1	67.2	70.9	59.0	45.7	57.9	55.3	mg/l	0.2	E200.7
Sodium	227	279	232	313	186	167	246	368	78	86	81	76	100	91	mg/l	1	E200.7
Sulfate	356	364	334	273	338	333	372	452	22	26	16	19	27	27	mg/l	1	E300.0
NON-METALS																	
Organic Carbon, Total (TOC)	1.6	2.7	2.5	1.9	2.9	1.5	1.6	ND	ND	2.4	1	1.2	0.7	1.6	mg/l	0.5	A5310 C
Carbon, Total	1.5	57.6	58.2	9.3	73.3	83.4	81.0	4.1	1.6	47.4	19.1	80.0	88.9	88.0	mg/l	9.7	SW9060
Phenolics, Total Recoverable	-	ND	ND	0.02	0.03	ND	ND	-	-	ND	ND	0.02	ND	ND	mg/l	0.0	E420.1
Cyanide, Total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.005	Kelada mod
PHYSICAL PROPERTIES																	
Color	5.0	20.0	15.0	5.0	10.0	ND	5.0	160.0	5.0	5.0	ND	ND	ND	5.0	c.u.	5.0	A2120 B
Conductivity	1370	1440	1350	1600	1330	1250	1420	1510	608.00	662	593	649	672	636	umhos/cm	1	A2510 B
Corrosivity	0.40	0.8	0.7	0.8	0.6	0.6	0.7	0.82	0.38	0.5	0.1	0.5	0.5	0.6	unitless		Calc.
Hardness as CaCO3	276	218	270	41	263	302	215	26	200	204	165	160	161	155	mg/l	1	A2340 B
Odor	NOO	NOO	NOO	NOO	NOO	NOO	1	NOO	NOO	NOO	NOO	NOO	NOO	NOO	T.O.N	1	A2150 B
pH	7.61	8.05	7.91	8.69	7.84	7.69	7.99	9.42	7.60	7.70	7.46	7.78	7.72	7.84	s.u.	0.01	A4500-H B
Solids, TDS @ 180 C	882	919	859	982	881	771	915	941	409.00	452	457	439	432	438	mg/l	10	A2540 C

Table B-1. Alluvial Well Water Quality Data (Page 2 of 4)

Well ID Sample Date Sample Number	115 9/16/2008 RH08-0069	115 11/13/2008 RH08-0092	115 5/26/2009 RH09-0045	115 5/4/2010 RH10-0012	115 10/13/2010 RH10-0046	33 9/23/2008 RH08-0073	33 11/17/2008 RH08-0096	33 5/19/2009 RH09-0036	33 5/3/2010 RH10-0013	33 10/12/2010 RH10-0045	UNITS	R.L.	METHOD
FIELD MEASUREMENTS													
Water Level (Altitude)	6736	6722	-	-	-	7133	7132	-	-	-	ft.	HANNA Multi-meter	
pH	7.10	7.71	8.12	8.28	8.04	-	7.52	8.84	8.77	7.64	s.u.	HANNA Multi-meter	
Conductivity	765	875	862	872	869	-	1309	412	415	372	umhos/cm	HANNA Multi-meter	
Temperature	56.41	57.50	58.19	56.81	58.26	-	54.98	64.26	56.69	59.90	degrees F	HANNA Multi-meter	
Dissolved Oxygen	-	-	-	-	-	-	-	-	-	-	%	HANNA Multi-meter	
Total Dissolved Solids, TDS	-	437	431	437	434	-	655	206	207	626	mg/l	HANNA Multi-meter	
Turbidity	0	0	1.47	2.54	0.00	5.81	121	0	0	372.00	t.u.	HANNA Multi-meter	
MAJOR IONS													
Alkalinity, Total as CaCO3	281	286	297	439	319	443	421	229	238	478	mg/l	1.0	A2320 B
Carbonate as CO3	ND	ND	7	ND	ND	ND	ND	9	9	ND	mg/l	1.0	A2320 B
Bicarbonate as HCO3	343	349	348	536	381	540	514	261	273	583	mg/l	1.0	A2320 B
Hydroxide as OH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	1.0	A2320 B
Calcium	49	47	43	300	45	71	71	4	5	57	mg/l	1	E200.7
Chloride	15	15	13	33	11	39	34	ND	2	12	mg/l	1	E300.0
Fluoride	1.1	1.1	1.1	0.4	1.1	0.9	0.7	1.1	1.1	0.7	mg/l	0.1	A4500-F C
Magnesium	9	9	8	78	8	17	17	1	1	13	mg/l	1	E200.7
Nitrogen, Ammonia as N	ND	ND	ND	31	ND	ND	ND	ND	0.09	ND	mg/l	0.1	E350.1
Nitrogen, Kjeldahl, Total as N	ND	ND	ND	29	ND	ND	ND	ND	ND	ND	mg/l	0.5	E351.2
Nitrogen, Nitrate as N	-	5.6	5.7	ND	7.3	-	2.7	0.1	ND	2.2	mg/l	0.1	E353.2
Nitrogen, Nitrate + Nitrite as N	-	5.6	5.7	ND	7.3	-	2.7	0.1	ND	2.2	mg/l	0.05	E353.2
Nitrogen, Nitrite as N	5.71	ND	ND	ND	ND	2.00	ND	ND	ND	ND	mg/l	0.1	A4500-NO2 B
Nitrogen, Total	5.7	5.6	5.7	28.6	7.3	2.0	2.8	ND	ND	2.2	mg/l	0.5	A4500-N A
Potassium	3	3	3	38	3	2	2	1	1	2	mg/l	1	E200.7
Silica	19.8	20.6	16.9	15.2	18.2	30.6	27.7	9.6	13.0	25.1	mg/l	0.2	E200.7
Sodium	15.4	157	144	125	149	263	264	88	97	227	mg/l	1	E200.7
Sulfate	137	129	123	1120	136	300	264	1	3	215	mg/l	1	E300.0
NON-METALS													
Organic Carbon, Total (TOC)	0.6	1.8	0.7	15.1	0.6	0.9	2.2	ND	ND	2.7	mg/l	0.5	A5310 C
Carbon, Total	1.9	48.2	65.3	68.0	71.0	2.9	47.0	45.3	55.5	111.0	mg/l	9.7	SW9060
Phenolics, Total Recoverable	-	0.02	0.02	0.16	ND	-	0.02	ND	ND	ND	mg/l	0.0	E420.1
Cyanide, Total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.005	Kelada mod
PHYSICAL PROPERTIES													
Color	ND	5.0	ND	50.0	ND	220.0	118	ND	ND	ND	c.u.	5.0	A2120 B
Conductivity	907	911	905	2450	893	1500	1410	392	416	1270	umhos/cm	1	A2510 B
Corrosivity	0.50	0.7	0.6	1.3	0.7	0.50	0.6	0.1	0.04	0.90	unitless		Calc.
Hardness as CaCO3	157	153	140	1070	142	250	249	14	17	197	mg/l	1	A2340 B
Odor	NOO	NOO	NOO	200	NOO	NOO	NOO	NOO	NOO	NOO	T.O.N	1	A2150 B
pH	7.81	8.04	7.98	7.84	8.00	7.56	7.70	8.61	8.42	7.96	s.u.	0.01	A4500-H B
Solids, TDS @ 180 C	566	575	582	1610	566	988	894	265	271	803	mg/l	10	A2540 C

Table B-1. Alluvial Well Water Quality Data (Page 3 of 4)

Well ID	120	120		120	120	120	120	121	21	21	21	21	21	21			
Sample Date	**8/6/2008**	**11/18/2008**		**2/18/2009**	**5/26/2009**	**5/3/2010**	**10/13/2010**	**8/18/2008**	**8/21/2008**	**11/8/2008**	**2/11/2009**	**5/19/2009**	**4/29/2010**	**10/6/2010**	**UNITS**	**R.L.**	**METHOD**
Sample Number	**RH08-0051**	**RH08-0097**	**RH08-0098**	**RH9-0018**	**RH09-0044**	**RH10-0003**	**RH10-0047**	**RH08-0057**	**RH08-0064**	**RH08-0081**	**RH09-0004**	**RH09-0032**	**RH10-0001**	**RH10-0041**			
METALS-DISSOLVED																	
Aluminum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.7
Antimony	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Arsenic	ND	0.001	0.001	ND	ND	ND	ND	ND	0.003	0.003	0.003	0.003	0.004	0.003	mg/l	0.001	E200.8
Barium	ND	ND	ND	ND	ND	ND	ND	ND	0.10	0.1	0.2	0.1	0.2	0.2	mg/l	0.1	E200.8
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.7
Boron	0.2	0.3	0.2	0.5	0.2	0.1	0.2	0.3	ND	0.1	ND	ND	0.1	0.1	mg/l	0.1	E200.7
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Copper	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Iron	ND	ND	ND	0.08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.03	E200.8
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Manganese	0.07	0.07	0.08	0.01	0.10	0.09	0.06	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E245.1
Molybdenum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Nickel	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Selenium	ND	0.002	0.002	ND	ND	0.001	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E200.8
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.10	E200.8
Uranium	0.0033	0.0027	0.0032	ND	0.0036	0.0041	0.0032	ND	0.0049	0.0053	0.0055	0.0051	0.0059	0.0056	mg/l	0.0003	E200.8
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Zinc	ND	0.01	0.02	ND	ND	0.02	ND	ND	ND	ND	ND	0.03	ND	ND	mg/l	0.01	E200.8
METALS-TOTAL																	
Uranium	0.0032	0.0027	0.0031	ND	0.0035	0.0041	0.0035	ND	0.0055	0.0060	0.0057	0.0057	0.0055	0.0051	mg/l	0.0003	E200.8
RADIONUCLIDES-TOTAL																	
Gross Alpha	6.7	11.8	8.2	2.1	5.3	8.3	-8	1.8	8.8	7.4	5.6	8.6	6.5	4.7	pCi/L		E900.0
Gross Alpha precision (+/-)	3.1	3.5	3.1	2.6	2.9	3.3	4.1	3.2	2.3	2.2	2.0	2.4	2.4	2.2	pCi/L		E900.0
Gross Alpha MDC	4.3	4.2	4.1	4.2	4.2	4.6	7.8	5.2	2.6	2.8	2.5	2.8	3.4	3.1	pCi/L		E900.0
Gross Beta	0.9	4.9	9.0	1.8	-3	3.1	3.6	3.6	3.5	6.1	-2	-2	1	2.4	pCi/L		E900.0
Gross Beta precision (+/-)	3.7	3.4	3.4	2.7	3.3	2.6	4.3	3.5	1.8	1.9	1.9	1.8	1.7	1.8	pCi/L		E900.0
Gross Beta MDC	6.2	5.5	5.5	4.4	5.7	4.3	7.2	5.8	2.9	3.0	3.3	3.0	2.8	2.9	pCi/L		E900.0
Radium 226	0.41	0.41	0.23	-0.06	0.51	0.21	0.51	-0.02	0.03	0.09	-0.2	-0.1	0.0	-0.02	pCi/L		E903.0
Radium 226 precision (+/-)	0.21	0.18	0.15	0.12	0.19	0.13	0.13	0.16	0.12	0.13	0.09	0.10	0.11	0.07	pCi/L		E903.0
Radium 226 MDC	0.27	0.22	0.21	0.23	0.22	0.16	0.09	0.28	0.20	0.20	0.21	0.20	0.19	0.14	pCi/L		E903.0
Radium 228	0.42	0.25	0.66	0.71	2.6	0.74	2.3	0.27	0.31	2.40	0.46	1.00	0.55	0.10	pCi/L		RA-05
Radium 228 precision (+/-)	0.67	0.71	0.73	0.71	0.78	0.71	0.96	0.72	0.68	0.82	0.71	0.75	0.72	0.54	pCi/L		RA-05
Radium 228 MDC	1.1	1.2	1.2	1.1	1.1	1.1	1.4	1.2	1.1	1.2	1.2	1.2	1.2	0.93	pCi/L		RA-05
Radon 222	636	373	421	208	567	1120	504	-162	1510	298	1510	1030	1400	615	pCi/L	100	D5072-92
Radon 222 precision (+/-)	63.1	50.1	50.6	49.7	52.3	83	44.5	51.9	56.0	62.5	66.8	51.4	89.2	46.1	pCi/L		D5072-92
Thorium 228	0.0	0.1	0.2	0.05	0.03	0.04	0.2	0.0	0.0	0.1	0.009	-0.030	0.050	0.5	pCi/L		E907.0
Thorium 228 precision (+/-)	0.1	0.2	0.2	0.09	0.07	0.09	0.1	0.2	0.1	0.1	0.07	0.07	0.10	0.30	pCi/L		E907.0
Thorium 228 MDC	-	-	-	0.2	0.1	0.2	0.1	-	-	-	0.1	0.2	0.3	0.3	pCi/L		E907.0
Thorium 230	0.1	0.1	0.0	0.1	-0.02	-0.02	-0.1	1.7	0.0	0.0	-0.02	-0.01	0.03	-0.1	pCi/L		E907.0
Thorium 230 precision (+/-)	0.2	0.3	0.3	0.1	0.1	0.1	0.08	0.5	0.2	0.1	0.07	0.10	0.20	0.1	pCi/L		E907.0
Thorium 230 MDC	-	-	-	0.2	0.2	0.2	0.1	-	-	-	0.1	0.2	0.3	0.3	pCi/L		E907.0
Thorium 232	0.1	0.0	0.1	0.03	-0.04	-0.02	0.005	0.0	0.0	0.0	0.008	0.050	0.060	0.05	pCi/L		E907.0
Thorium 232 precision (+/-)	0.1	0.1	0.2	0.09	0.06	0.06	0.07	0.1	0.1	0.09	0.05	0.09	0.10	0.1	pCi/L		E907.0
Thorium 232 MDC	-	-	-	0.2	0.2	0.2	0.2	-	-	-	0.1	0.2	0.3	0.2	pCi/L		E907.0
DATA QUALITY																	
A/C Balance (+/- 5)	2.30	5.21	4.69	-3.58	-3.42	-3.61	-2.01	6.19	3.15	2.97	-3.66	-7.02	-2.73	-4.33	%		Calc.
Anions	14.80	14.9	14.2	15.6	14.4	14.4	15.7	14.80	6.95	7.39	7.34	7.48	8.01	7.73	meq/l		Calc.
Cations	15.50	16.5	15.6	14.5	13.4	13.4	15.1	16.70	7.40	7.84	6.82	6.50	7.58	7.09	meq/l		Calc.
Solids, Total Dissolved Calc.	909	964	904	916	862	859	958	998	412	480	439	422	481	460	mg/l		Calc.
TDS Balance (0.80 - 1.20)	0.97	0.950	0.950	1.07	1.02	0.9	0.960	0.94	0.99	0.940	1.04	1.04	0.90	0.950			Calc.

Table B-1. Alluvial Well Water Quality Data (Page 4 of 4)

Well ID	115	115	115	115	115	33	33	33	33	33	UNITS	R.L.	METHOD
Sample Date	9/16/2008	11/13/2008	5/26/2009	5/4/2010	10/13/2010	9/23/2008	11/17/2008	5/19/2009	5/3/2010	10/12/2010			
Sample Number	RH08-0069	RH08-0092	RH09-0045	RH10-0012	RH10-0046	RH08-0073	RH08-0096	RH09-0036	RH10-0013	RH10-0045			
METALS-DISSOLVED													
Aluminum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.7
Antimony	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Arsenic	ND	ND	ND	0.006	ND	ND	ND	ND	ND	ND	mg/l	0.001	E200.8
Barium	ND	ND	ND	0.2	ND	ND	ND	0.4	0.5	ND	mg/l	0.1	E200.8
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.7
Boron	0.2	0.2	0.2	0.2	0.1	0.3	0.3	ND	0.1	0.2	mg/l	0.1	E200.7
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Copper	ND	ND	ND	ND	ND	ND	ND	0.01	0.01	ND	mg/l	0.01	E200.8
Iron	ND	ND	ND	0.1	ND	0.05	ND	ND	ND	0.14	mg/l	0.03	E200.8
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Manganese	ND	ND	ND	0.76	ND	0.26	0.14	ND	ND	0.04	mg/l	0.01	E200.8
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E245.1
Molybdenum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Nickel	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Selenium	0.026	0.026	0.028	0.003	0.022	0.003	0.002	ND	ND	0.001	mg/l	0.001	E200.8
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.10	E200.8
Uranium	0.1800	0.166	0.192	0.0087	0.1860	0.0085	0.0080	ND	ND	0.0073	mg/l	0.0003	E200.8
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Zinc	0.02	ND	0.03	0.02	0.04	ND	ND	0.02	ND	ND	mg/l	0.01	E200.8
METALS-TOTAL													
Uranium	0.1700	0.169	0.185	0.015	0.203	0.0100	0.0074	ND	ND	0.0084	mg/l	0.0003	E200.8
RADIONUCLIDES-TOTAL													
Gross Alpha	205.0	228	166	29	277	26.8	13.7	3.5	2.7	17.3	pCi/L		E900.0
Gross Alpha precision (+/-)	8.1	8.6	7.4	8.9	10.4	5.0	5.2	1.0	1.4	6.4	pCi/L		E900.0
Gross Alpha MDC	2.3	2.3	2.7	11.7	5.0	5.2	7.0	1.2	2.0	8.8	pCi/L		E900.0
Gross Beta	54.4	66.4	71.8	47.0	65.1	5.4	8.9	2.3	1.9	19.3	pCi/L		E900.0
Gross Beta precision (+/-)	3.2	3.3	3.3	7.0	2.9	3.5	3.7	2.0	1.5	5.2	pCi/L		E900.0
Gross Beta MDC	3.9	3.8	3.8	10.4	3.2	5.7	6.0	3.4	2.5	8.1	pCi/L		E900.0
Radium 226	-0.10	-0.1	-0.1	0.5	0.13	-0.03	-0.3	0.3	0.2	0.36	pCi/L		E903.0
Radium 226 precision (+/-)	0.07	0.07	0.10	0.13	0.08	0.13	0.12	0.17	0.12	0.14	pCi/L		E903.0
Radium 226 MDC	0.17	0.17	0.22	0.12	0.09	0.24	0.29	0.22	0.17	0.14	pCi/L		E903.0
Radium 228	0.32	0.01	0.03	-0.7	1.5	0	0.01	0.05	0.34	1.2	pCi/L		RA-05
Radium 228 precision (+/-)	0.72	0.71	0.67	0.67	0.93	0.80	1.0	0.8	0.7	0.65	pCi/L		RA-05
Radium 228 MDC	1.2	1.2	1.1	1.2	1.4	1.3	1.8	1.3	1.2	0.99	pCi/L		RA-05
Radon 222	732	909	1010	254	890	820	946	65	432	511	pCi/L	100	D5072-92
Radon 222 precision (+/-)	53.4	50.9	57.2	65.9	49.5	46.8	67.8	38.6	71.4	45.5	pCi/L		D5072-92
Thorium 228	-0.1	0.1	0.1	0.4	0.2	1.1	0.2	0.1	0.02	0.20	pCi/L		E907.0
Thorium 228 precision (+/-)	0.2	0.1	0.1	0.5	0.1	0.9	0.1	0.1	0.1	0.1	pCi/L		E907.0
Thorium 228 MDC	-	-	0.2	0.8	0.1	-	-	0.2	0.3	0.1	pCi/L		E907.0
Thorium 230	0.3	-0.1	-0.1	0.04	-0.06	2.6	-0.2	-0.2	0.04	-0.1	pCi/L		E907.0
Thorium 230 precision (+/-)	0.1	0.1	0.1	0.5	0.08	0.2	0.1	0.1	0.2	0.1	pCi/L		E907.0
Thorium 230 MDC	-	-	0.2	0.8	0.1	-	-	0.2	0.3	0.1	pCi/L		E907.0
Thorium 232	0.0	0.0	0.0	0.2	0.008	0.5	0.0	-0.008	0.020	0.05	pCi/L		E907.0
Thorium 232 precision (+/-)	0.1	0.1	0.1	0.4	0.05	0.1	0.1	0.09	0.10	0.07	pCi/L		E907.0
Thorium 232 MDC	-	-	0.2	0.8	0.1	-	-	0.2	0.3	0.1	pCi/L		E907.0
DATA QUALITY													
A/C Balance (+/- 5)	2.83	3.48	-1.11	-4.76	-3.62	0.30	4.44	-6.34	-3.24	-2.44	%		Calc.
Anions	9.36	9.28	9.34	33.10	10.1	16.40	15.1	4.7	4.9	14.6	meq/l		Calc.
Cations	9.91	9.95	9.13	30.10	9.39	16.50	16.5	4.1	4.6	13.9	meq/l		Calc.
Solids, Total Dissolved Calc.	586	583	560	1980	598	1010	981	247	268	856	mg/l		Calc.
TDS Balance (0.80 - 1.20)	0.97	0.990	1.040	0.810	0.950	0.98	0.910	1.070	1.010	0.940			Calc.

Appendix 9-C

Water Quality Data
2008-2010 Sampling
Menefee Formation Wells

(Note: Volatile Organic Compounds and Synthetic Organic Compounds were not detected during sampling and are not given in the tables below. These data will be available upon request)

Table C-1. Menefee Formation Well Water Quality Data (Page 1 of 4)

Well ID	27	27	27	27	27	27		87	87	87	87	87	87	62	62	62		UNITS	R.L.	METHOD
Sample Date	**8/6/2008**	**11/13/2008**	**2/16/2009**	**5/19/2009**	**5/3/2010**	**10/1/2010**		**8/12/2008**	**11/12/2008**	**2/16/2009**	**5/19/2009**	**5/3/2010**	**10/13/2010**	**8/20/2008**	**11/11/2008**	**2/18/2009**	**2/18/2009**			
Sample Number	**RH08-0050**	**RH08-0090**	**RH09-0014**	**RH09-0035**	**RH10-0002**	**RH10-0038**	**RH10-0039**	**RH08-0054**	**RH08-0089**	**RH09-0012**	**RH09-0034**	**RH10-0011**	**RH10-0049**	**RH08-0058**	**RH08-0087**	**RH09-0019**	**RH09-0020**			
FIELD MEASUREMENTS																				
Water Level (Altitude)	7131	7131	-	-	-	-		7277	7277	-	-	-	-	7229	7229	-	-	ft.		HANNA Multi-meter
pH	6.82	7.38	7.73	7.65	6.15	7.78		7.78	8.54	8.46	8.27	8.30	8.30	7.40	8.03	8.39	8.39	s.u.		HANNA Multi-meter
Conductivity	505	498	499	507	493	504		587	643	663	673	655	656	956	893	834	834	umhos/cm		HANNA Multi-meter
Temperature	68.73	56.39	46.60	59.81	48.90	73.70		68.89	53.70	46.42	64.95	50.81	59.62	57.90	58.55	55.17	55.17	degrees F		HANNA Multi-meter
Dissolved Oxygen	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	%		HANNA Multi-meter
Total Dissolved Solids, TDS	-	249	250	254	246	252		-	322	331	337	328	328	-	446	417	417	mg/l		HANNA Multi-meter
Turbidity	0	0	0	0.25	1.32	0.00		0	0	0.75	0.92	3.86	0.11	0	0	0	0	t.u.		HANNA Multi-meter
MAJOR IONS																				
Alkalinity, Total as CaCO3	250	249	248	257	262	270	267	309	329	326	344	354	369	340	328	321	320	mg/l	1.0	A2320 B
Carbonate as CO3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9	10	11	ND	ND	8	9	mg/l	1.0	A2320 B
Bicarbonate as HCO3	310	304	302	314	319	329	326	377	402	398	401	411	428	415	400	376	371	mg/l	1.0	A2320 B
Hydroxide as OH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	1.0	A2320 B
Calcium	72	63	57	56	61	62	61	21	36	27	23	22	25	48	30	19	20	mg/l	1	E200.7
Chloride	6	6	6	5	7	7	7	4	5	4	4	4	4	106	45	35	35	mg/l	1	E300.0
Fluoride	0.4	0.4	0.4	0.5	0.4	0.4	0.4	1.8	1.5	1.6	1.7	1.8	1.7	0.6	0.6	0.6	0.6	mg/l	0.1	A4500-F C
Magnesium	11	10	9	9	9	9	9	7	11	9	8	8	7	14	9	6	6	mg/l	1	E200.7
Nitrogen, Ammonia as N	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E350.1
Nitrogen, Kjeldahl, Total as N	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.5	E351.2
Nitrogen, Nitrate as N	-	ND	ND	0.1	ND	ND	ND	-	0.5	0.8	0.2	0.2	0.3	-	0.1	ND	0.1	mg/l	0.1	E353.2
Nitrogen, Nitrate + Nitrite as N	-	ND	0.08	0.10	ND	ND	ND	-	0.5	0.78	0.20	0.20	0.3	-	0.1	0.09	0.10	mg/l	0.05	E353.2
Nitrogen, Nitrite as N	0.07	ND	ND	ND	ND	ND	ND	0.11	ND	ND	ND	ND	ND	0.13	ND	ND	ND	mg/l	0.1	A4500-NO2 B
Nitrogen, Total	ND	ND	ND	ND	ND	ND	ND	ND	0.5	0.8	ND	ND	ND	ND	ND	ND	ND	mg/l	0.5	A4500-N A
Potassium	4	4	4	4	4	4	4	2	2	2	2	2	2	2	1	1	1	mg/l	1	E200.7
Silica	51.6	55.9	38.7	34.7	44.6	46.2	46.4	18.9	29.3	21.3	16.7	21.5	23.4	14.0	13.8	9.4	10.1	mg/l	0.2	E200.7
Sodium	38	34	35	41	36	37	37	135	129	113	111	127	130	188	183	154	156	mg/l	1	E200.7
Sulfate	21	20	18	17	24	24	25	23	26	22	24	27	27	74	67	62	62	mg/l	1	E300.0
NON-METALS																				
Organic Carbon, Total (TOC)	0.7	1.8	0.8	0.8	0.8	1.0	1.0	0.6	1.4	0.8	0.8	0.8	0.6	1.0	1.9	0.9	0.9	mg/l	0.5	A5310 C
Carbon, Total	ND	46.5	124	56.2	65.0	66.0	64.0	ND	69.9	155	67	83.3	82.0	ND	56.0	7.7	7.5	mg/l	9.7	SW9060
Phenolics, Total Recoverable	-	0.02	0.021	0.040	ND	ND	ND	-	ND	ND	0.04	ND	ND	-	ND	0.02	0.02	mg/l	0.0	E420.1
Cyanide, Total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.005	Kelada mod
PHYSICAL PROPERTIES																				
Color	ND	5.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.0	ND	ND	ND	c.u.	5.0	A2120 B
Conductivity	505	507	417	500	510	499	500	632	665	606	662	667	666	1070	909	812	816	umhos/cm	1	A2510 B
Corrosivity	0.00	0.5	0.4	0.5	0.2	0.7	0.7	0.58	0.7	0.7	0.8	0.5	0.8	0.59	0.3	0.3	0.4	unitless		Calc.
Hardness as CaCO3	224	196	179	176	191	192	192	83	118	105	91	88	92	176	110	72	76	mg/l	1	A2340 B
Odor	NOO	NOO	NOO	NOO	NOO	NOO	NOO	NOO	NOO	NOO	NOO	2	NOO	NOO	NOO	NOO	NOO	T.O.N	1	A2150 B
pH	7.17	7.71	7.62	7.79	7.39	7.94	7.96	8.20	8.04	8.17	8.33	8.11	8.27	7.87	7.82	8.02	8.03	s.u.	0.01	A4500-H B
Solids, TDS @ 180 C	338	330	297	338	318	356	352	3.67	424	413	425	446	380	616	520	502	491	mg/l	10	A2540 C

Table C-1. Menefee Formation Well Water Quality Data (Page 2 of 4)

Well ID	62	62	62	100	100	100	100	100	100	7	7	7	7	7	47	47			
Sample Date	**5/26/2009**	**5/3/2010**	**10/14/2010**	**8/21/2008**	**11/8/2008**	**2/11/2009**	**5/19/2009**	**4/29/2010**	**10/6/2010**	**9/17/2008**	**11/16/2008**	**2/16/2009**	**5/18/2009**	**9/30/2010**	**8/7/2008**	**11/18/2008**	**UNITS**	**R.L.**	**METHOD**
Sample Number	**RH09-0046**	**RH10-0007**	**RH10-0050**	**RH08-0063**	**RH08-0080**	**RH09-0006**	**RH09-0031**	**RH10-0004**	**RH10-0043**	**RH08-0070**	**RH08-0095**	**RH09-0011**	**RH09-0028**	**RH10-0040**	**RH08-0052**	**RH08-0099**			
FIELD MEASUREMENTS																			
Water Level (Altitude)	-	-	-	7049	7047	7044.2	-	-	7038.6	7066	7067	-	-	-	-	-	ft.		HANNA Multi-meter
pH	8.53	8.19	7.84	6.97	7.81	7.56	7.61	7.30	7.58	8.30	9.53	8.69	8.97	8.15	7.16	7.68	s.u.		HANNA Multi-meter
Conductivity	835	848	1306	378	404	418	389	425	414	3742	4759	3976	4147	3585	1200	1233	umhos/cm		HANNA Multi-meter
Temperature	57.46	55.28	57.97	56.59	50.93	53.93	63.68	54.69	61.90	62.45	55.35	55.02	58.12	68.90	67.49	52.82	degrees F		HANNA Multi-meter
Dissolved Oxygen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	%		HANNA Multi-meter
Total Dissolved Solids, TDS	417	424	653	-	202	209	194	212	207	-	2377	1988	2073	1792	-	616	mg/l		HANNA Multi-meter
Turbidity	0	0.38	0.00	83	68	54	57	54	71.00	233	253	246	173	67.00	0	0	t.u.		HANNA Multi-meter
MAJOR IONS																			
Alkalinity, Total as CaCO3	329	332	354	130	187	208	211	232	243	976	1220	803	888	702	330	321	mg/l	1.0	A2320 B
Carbonate as CO3	11	9	ND	ND	ND	ND	ND	ND	ND	158	280	16	67	20	ND	ND	mg/l	1.0	A2320 B
Bicarbonate as HCO3	380	387	432	158	228	254	258	284	297	870	918	947	948	815	400	392	mg/l	1.0	A2320 B
Hydroxide as OH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	1.0	A2320 B
Calcium	22	12	65	18	29	33	34	42	43	14	8	18	18	21	68	68	mg/l	1	E200.7
Chloride	40	16	203	13	8	4	4	3	4	92	82	77	76	99	25	24	mg/l	1	E300.0
Fluoride	0.6	0.6	0.6	0.2	0.3	0.5	0.5	0.6	0.6	2.8	2.8	2.8	2.8	2.2	1.2	1.4	mg/l	0.1	A4500-F C
Magnesium	7	3	17	5	9	10	10	10	10	4	4	5	5	6	26	25	mg/l	1	E200.7
Nitrogen, Ammonia as N	ND	0.08	ND	ND	0.5	0.14	0.22	ND	ND	0.2	0.3	0.17	0.2	0.24	ND	ND	mg/l	0.1	E350.1
Nitrogen, Kjeldahl, Total as N	ND	ND	ND	ND	0.8	ND	ND	ND	ND	1	0.9	1.0	0.7	0.6	ND	ND	mg/l	0.5	E351.2
Nitrogen, Nitrate as N	0.1	ND	0.1	-	-	ND	ND	ND	ND	-	ND	ND	ND	ND	-	ND	mg/l	0.1	E353.2
Nitrogen, Nitrate + Nitrite as N	0.11	ND	0.1	-	ND	ND	ND	ND	ND	-	ND	ND	ND	ND	-	ND	mg/l	0.05	E353.2
Nitrogen, Nitrite as N	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05	ND	ND	ND	ND	ND	ND	mg/l	0.1	A4500-NO2 B
Nitrogen, Total	ND	ND	ND	ND	0.8	ND	ND	ND	ND	1.0	0.9	1.0	0.7	0.6	ND	ND	mg/l	0.5	A4500-N A
Potassium	1	1	1	9	11	8	6	6	6	5	5	4	4	5	3	3	mg/l	1	E200.7
Silica	10.8	10.8	12.7	5.2	3.2	26.6	19.1	50.8	53.4	14.9	14.0	7.2	7.6	7.8	121.0	18.7	mg/l	0.2	E200.7
Sodium	168	168	201	39	39	35	34	35	36	1190	1260	986	1110	939	175	229	mg/l	1	E200.7
Sulfate	60	72	73	13	6	6	4	13	11	1260	1250	1300	1240	1290	323	335	mg/l	1	E300.0
NON-METALS																			
Organic Carbon, Total (TOC)	0.8	0.9	ND	1.5	3.2	1.1	0.9	0.7	0.7	19.8	31.7	23.4	2.7	12.7	1.2	2.4	mg/l	0.5	A5310 C
Carbon, Total	69.4	77.1	80.0	1.4	27.4	2.9	44.4	61.3	57.0	4.0	206.0	184	186	172	1.4	60.6	mg/l	9.7	SW9060
Phenolics, Total Recoverable	0.06	ND	ND	-	ND	ND	0.03	ND	ND	-	ND	ND	0.04	ND	-	ND	mg/l	0.0	E420.1
Cyanide, Total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.005	Kelada mod
PHYSICAL PROPERTIES																			
Color	ND	ND	ND	189.0	20.0	ND	70.0	5.0	ND	235.0	263	40.0	200.0	10.0	10.0	10.0	c.u.	5.0	A2120 B
Conductivity	873	780	1360	287	337	300	380	425	428	4600.0	4860	4450	4320	3740	1290	1350	umhos/cm	1	A2510 B
Corrosivity	0.5	0.2	0.9	-0.29	0.1	-0.2	0.1	-0.02	0.40	1.50	1.8	0.8	1.3	0.8	0.80	0.8	unitless		Calc.
Hardness as CaCO3	84	43	234	64	108	124	128	147	149	50	37	65	64	80	274	273	mg/l	1	A2340 B
Odor	NOO	NOO	NOO	NOO	NOO	NOO	NOO	NOO	1	NOO	NOO	NOO	NOO	2.0	NOO	NOO	T.O.N	1	A2150 B
pH	8.11	8.08	8.02	7.73	7.79	7.41	7.61	7.40	7.83	9.09	9.54	8.38	8.77	8.35	7.99	7.97	s.u.	0.01	A4500-H B
Solids, TDS @ 180 C	529	493	760	181	229	279	241	266	286	3000.0	3320	2830	2910	2680	859	868	mg/l	10	A2540 C

Table C-1. Menefee Formation Well Water Quality Data (Page 3 of 4)

Well ID	27	27	27	27	27	27		87	87	87	87	87	87	62	62	62				
Sample Date	**8/6/2008**	**11/13/2008**	**2/16/2009**	**5/19/2009**	**5/3/2010**	**10/1/2010**		**8/12/2008**	**11/12/2008**	**2/16/2009**	**5/19/2009**	**5/3/2010**	**10/13/2010**	**8/20/2008**	**11/11/2008**	**2/18/2009**	**2/18/2009**	**UNITS**	**R.L.**	**METHOD**
Sample Number	**RH08-0050**	**RH08-0090**	**RH09-0014**	**RH09-0035**	**RH10-0002**	**RH10-0038**	**RH10-0039**	**RH08-0054**	**RH08-0089**	**RH09-0012**	**RH09-0034**	**RH10-0011**	**RH10-0049**	**RH08-0058**	**RH08-0087**	**RH09-0019**	**RH09-0020**			
METALS-DISSOLVED																				
Aluminum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.7
Antimony	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Arsenic	ND	ND	ND	ND	ND	ND	ND	0.008	0.002	0.002	0.002	0.003	0.002	ND	ND	ND	ND	mg/l	0.001	E200.8
Barium	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.7
Boron	ND	ND	ND	ND	ND	ND	ND	0.4	0.4	0.3	0.3	0.4	ND	ND	0.1	0.1	0.1	mg/l	0.1	E200.7
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Copper	0.06	0.08	0.05	0.03	0.05	0.05	0.04	0.02	0.04	0.01	0.01	0.02	0.02	ND	ND	ND	ND	mg/l	0.01	E200.8
Iron	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.03	E200.8
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Manganese	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	ND	ND	ND	mg/l	0.01	E200.8
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E245.1
Molybdenum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Nickel	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Selenium	ND	ND	0.001	ND	ND	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E200.8
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.10	E200.8
Uranium	0.0049	0.0041	0.0054	0.0049	0.0051	0.0054	0.0050	0.0024	0.0015	0.0016	0.0014	0.0017	0.0016	0.0047	0.0027	0.0016	0.0016	mg/l	0.0003	E200.8
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Zinc	0.15	0.26	0.11	0.22	0.17	0.33	0.09	0.01	0.02	ND	0.02	ND	ND	0.03	0.03	0.02	0.02	mg/l	0.01	E200.8
METALS-TOTAL																				
Uranium	0.0049	0.0049	0.0051	0.4140	0.0052	0.0050	0.0049	0.0025	0.0018	0.0016	0.0016	0.0017	0.0016	0.0048	0.0029	0.0016	0.0017	mg/l	0.0003	E200.8
RADIONUCLIDES-TOTAL																				
Gross Alpha	5.5	5.8	5.3	11.1	4	3.8	3.2	8.0	8.4	2.0	7.3	1.8	-4.0	4.2	5.5	3.1	3.5	pCi/L		E900.0
Gross Alpha precision (+/-)	1.9	1.4	1.5	2.3	1.8	1.7	1.7	2.1	2.0	1.4	1.7	1.9	2.1	2.9	2.2	1.8	1.7	pCi/L		E900.0
Gross Alpha MDC	2.4	1.6	1.9	2.6	2.6	2.4	2.4	2.4	2.2	2.1	1.8	2.9	4	4.4	2.9	2.5	2.4	pCi/L		E900.0
Gross Beta	-0.2	4.4	4.1	5.3	1.2	3.6	1.3	0.3	5.6	0.7	-0.8	1.6	2.1	0.6	-3.0	-3	-2	pCi/L		E900.0
Gross Beta precision (+/-)	1.9	1.7	1.7	1.7	1.6	1.6	1.5	1.4	1.7	1.6	2	1.6	1.6	2.7	2.3	2.1	1.7	pCi/L		E900.0
Gross Beta MDC	3.1	2.7	2.7	2.7	2.6	2.5	2.6	2.4	2.7	2.7	3.4	2.6	2.6	4.5	3.9	3.7	2.9	pCi/L		E900.0
Radium 226	-0.03	-0.07	-0.006	-0.1	-0.04	-0.1	-0.04	0.12	-0.2	-0.08	-0.05	-0.07	0.26	-0.10	-0.03	0.16	0.0	pCi/L		E903.0
Radium 226 precision (+/-)	0.14	0.08	0.09	0.07	0.09	0.09	0.11	0.15	0.10	0.10	0.10	0.09	0.10	0.09	0.11	0.15	0.13	pCi/L		E903.0
Radium 226 MDC	0.26	0.16	0.17	0.18	0.17	0.23	0.22	0.23	0.24	0.22	0.2	0.18	0.09	0.22	0.20	0.22	0.23	pCi/L		E903.0
Radium 228	0.03	-0.2	1.3	-0.09	0.25	1.1	1.3	0.39	-0.4	2.1	-0.2	0.02	1.4	0.77	-0.3	0.85	0.55	pCi/L		RA-05
Radium 228 precision (+/-)	0.65	0.70	0.66	0.63	0.73	0.74	0.72	0.66	0.54	0.85	0.69	0.74	0.93	0.70	0.72	0.70	0.71	pCi/L		RA-05
Radium 228 MDC	1.1	1.2	1.0	1.1	1.2	1.2	1.1	1.1	0.9	1.3	1.2	1.2	1.4	1.1	1.2	1.1	1.1	pCi/L		RA-05
Radon 222	724	455	494	518	825	480	506	422	461	631	363	948	352	606	676	626	573	pCi/L	100	D5072-92
Radon 222 precision (+/-)	64.9	46.1	51.4	44.8	79.1	44.2	43.6	46.0	54.5	53.6	42.9	80.7	42	54.0	51.6	54.5	53.6	pCi/L		D5072-92
Thorium 228	0.1	0.0	0.08	0.03	0.004	1.6	0.3	-0.1	0.1	0.04	0.09	0.005	0.1	-0.1	0.0	0.04	0.05	pCi/L		E907.0
Thorium 228 precision (+/-)	0.1	0.1	0.1	0.1	0.07	0.5	0.1	0.1	0.2	0.08	0.1	0.06	0.1	0.1	0.1	0.1	0.08	pCi/L		E907.0
Thorium 228 MDC	-	-	0.2	0.3	0.2	0.2	0.1	-	-	0.1	0.2	0.2	0.2	-	-	0.2	0.1	pCi/L		E907.0
Thorium 230	-0.2	-0.1	-0.1	0.02	-0.004	-0.02	-0.1	-0.2	0.1	-0.02	0.2	0.08	-0.2	1.7	0.0	0.02	-0.02	pCi/L		E907.0
Thorium 230 precision (+/-)	0.2	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.2	0.1	0.2	0.1	0.1	0.5	0.1	0.1	0.1	pCi/L		E907.0
Thorium 230 MDC	-	-	0.2	0.3	0.2	0.2	0.2	-	-	0.2	0.2	0.2	0.2	-	-	0.2	0.2	pCi/L		E907.0
Thorium 232	0.0	0.0	-0.02	-0.02	0.02	0.04	0.04	-0.1	0.1	0.05	-0.01	0.08	-0.04	0.0	0.0	0.08	0.01	pCi/L		E907.0
Thorium 232 precision (+/-)	0.1	0.1	0.07	0.08	0.07	0.1	0.08	0.1	0.2	0.09	0.06	0.1	0.07	0.1	0.1	0.1	0.08	pCi/L		E907.0
Thorium 232 MDC	-	-	0.2	0.2	0.1	0.3	0.2	-	-	0.2	0.2	0.1	0.2	-	-	0.2	0.2	pCi/L		E907.0
DATA QUALITY																				
A/C Balance (+/- 5)	4.57	-0.732	-3.10	-2.59	-3.84	-4.62	-4.38	4.74	6.15	-1.31	-6.35	-2.92	-3.99	1.63	4.80	-3.46	-2.06	%		Calc.
Anions	5.69	5.56	5.52	5.68	5.94	6.09	6.07	6.87	7.37	7.24	7.58	7.76	8.17	11.30	9.26	8.73	8.69	meq/l		Calc.
Cations	6.24	5.48	5.19	5.39	5.5	5.55	5.56	7.56	8.34	7.05	6.68	7.32	7.55	11.70	10.2	8.14	8.34	meq/l		Calc.
Solids, Total Dissolved Calc.	317	331	327	331	356	363	363	391	447	405	402	430	450	644	550	482	486	mg/l		Calc.
TDS Balance (0.80 - 1.20)	1.07	1.00	0.910	1.020	0.890	0.980	0.970	0.94	0.950	1.02	1.06	1.04	0.840	0.96	0.950	1.04	1.01			Calc.

Table C-1. Menefee Formation Well Water Quality Data (Page 4 of 4)

Well ID	62	62	62	100	100	100	100	100	100	7	7	7	7	7	47	47			
Sample Date	**5/26/2009**	**5/3/2010**	**10/14/2010**	**8/21/2008**	**11/8/2008**	**2/11/2009**	**5/19/2009**	**4/29/2010**	**10/6/2010**	**9/17/2008**	**11/16/2008**	**2/16/2009**	**5/18/2009**	**9/30/2010**	**8/7/2008**	**11/18/2008**	**UNITS**	**R.L.**	**METHOD**
Sample Number	**RH09-0046**	**RH10-0007**	**RH10-0050**	**RH08-0063**	**RH08-0080**	**RH09-0006**	**RH09-0031**	**RH10-0004**	**RH10-0043**	**RH08-0070**	**RH08-0095**	**RH09-0011**	**RH09-0028**	**RH10-0040**	**RH08-0052**	**RH08-0099**			
METALS-DISSOLVED																			
Aluminum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.7
Antimony	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Arsenic	ND	ND	ND	ND	ND	ND	ND	0.002	0.003	0.004	0.009	ND	0.002	ND	ND	ND	mg/l	0.001	E200.8
Barium	ND	ND	ND	ND	ND	0.1	0.1	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1	ND	mg/l	0.01	E200.7
Boron	0.1	0.1	0.1	ND	ND	ND	ND	ND	ND	0.4	0.5	0.5	0.5	0.3	ND	0.2	mg/l	0.1	E200.7
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Copper	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Iron	ND	ND	ND	ND	ND	ND	ND	ND	0.06	0.12	0.51	0.57	0.54	ND	ND	ND	mg/l	0.03	E200.8
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Manganese	ND	0.01	ND	0.10	0.30	0.26	0.21	0.04	ND	0.01	0.01	0.06	0.06	0.16	0.09	0.08	mg/l	0.01	E200.8
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E245.1
Molybdenum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Nickel	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Selenium	ND	ND	ND	ND	ND	0.002	ND	0.001	ND	ND	ND	0.001	ND	0.001	ND	0.002	mg/l	0.001	E200.8
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.10	E200.8
Uranium	0.0018	0.0008	0.0042	0.0005	ND	0.0036	0.0031	0.0054	0.0057	ND	0.0009	ND	ND	0.0003	0.0046	0.0033	mg/l	0.0003	E200.8
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Zinc	0.03	0.06	0.02	ND	ND	ND	ND	ND	ND	0.08	0.08	0.05	0.02	2.49	0.01	ND	mg/l	0.01	E200.8
METALS-TOTAL																			
Uranium	0.0017	0.0008	0.0042	0.0004	0.0009	0.0053	0.0024	0.0058	0.0056	0.0007	0.0004	ND	ND	ND	0.0034	0.0032	mg/l	0.0003	E200.8
RADIONUCLIDES-TOTAL																			
Gross Alpha	3.8	4.4	-1	1.9	6.6	6.3	8.2	6.9	8.4	6.9	48.9	15.8	35.9	-8	4.3	6.2	pCi/L		E900.0
Gross Alpha precision (+/-)	1.9	2.1	3.1	1.0	1.6	1.6	2	2	2.0	7.5	16.2	9.3	12.4	8.4	2.8	3.0	pCi/L		E900.0
Gross Alpha MDC	2.7	3	5.5	1.4	1.8	1.9	2.2	2.5	2.5	11.6	21.3	13.4	16	15.3	4.2	4.1	pCi/L		E900.0
Gross Beta	-2	3.2	1.2	3.5	14.1	5.3	8.2	7.4	8.1	-7.0	21.0	14.2	4.4	-50	4.2	0.9	pCi/L		E900.0
Gross Beta precision (+/-)	2.2	1.6	2.5	1.7	1.9	1.9	1.7	1.8	1.6	8.2	8.7	8.5	11.5	8.7	3.8	3.3	pCi/L		E900.0
Gross Beta MDC	3.8	2.6	4.2	2.7	2.8	3.0	2.7	2.7	2.4	14.0	13.9	13.9	19.1	16.2	6.2	5.5	pCi/L		E900.0
Radium 226	0.14	-0.04	0.4	0.13	0.009	0.12	0.005	-0.03	-0.01	-0.06	0.89	1.3	0.37	-0.04	0.34	0.38	pCi/L		E903.0
Radium 226 precision (+/-)	0.12	0.08	0.13	0.14	0.12	0.13	0.11	0.1	0.09	0.13	0.33	0.24	0.19	0.11	0.22	0.17	pCi/L		E903.0
Radium 226 MDC	0.18	0.16	0.11	0.22	0.20	0.19	0.19	0.18	0.16	0.24	0.38	0.16	0.24	0.22	0.30	0.21	pCi/L		E903.0
Radium 228	0.7	0.35	0.3	0.79	1.5	0.60	0.58	0.47	0.34	0.1	0.14	2.6	0.45	2.2	0.05	-0.05	pCi/L		RA-05
Radium 228 precision (+/-)	0.66	0.69	0.59	0.70	0.79	0.72	0.69	0.68	0.64	1.00	1.1	0.67	0.82	0.74	0.66	0.70	pCi/L		RA-05
Radium 228 MDC	1	1.1	0.97	1.1	1.2	1.2	1.1	1.1	1.1	1.7	1.8	0.95	1.3	1.1	1.1	1.2	pCi/L		RA-05
Radon 222	591	1020	559	656	322	964	413	1270	933	134	204	336	175	356	600	484	pCi/L	100	D5072-92
Radon 222 precision (+/-)	51.8	81.8	44.6	47.1	63.4	59.9	44.3	86.7	49	50.8	55.4	50.2	39.6	42.2	55.1	51.2	pCi/L		D5072-92
Thorium 228	0.02	0.04	0.1	0.1	0.1	0.3	0.05	0.02	0.2	-0.4	0.3	0.3	0.4	0.4	0.0	0.1	pCi/L		E907.0
Thorium 228 precision (+/-)	0.1	0.09	0.1	0.1	0.1	0.2	0.1	0.06	0.1	0.8	0.3	0.2	0.2	0.2	0.1	0.2	pCi/L		E907.0
Thorium 228 MDC	0.2	0.2	0.1	-	-	0.2	0.2	0.1	0.1	-	-	0.3	0.2	0.1	-	-	pCi/L		E907.0
Thorium 230	0.06	0.1	-0.06	1.5	0.0	0.05	0.06	-0.01	-0.03	2.8	-0.5	-0.2	-0.02	-0.2	-0.1	-0.1	pCi/L		E907.0
Thorium 230 precision (+/-)	0.2	0.1	0.2	0.5	0.1	0.09	0.2	0.09	0.1	0.3	0.1	0.2	0.2	0.08	0.1	0.2	pCi/L		E907.0
Thorium 230 MDC	0.3	0.2	0.2	-	-	0.2	0.2	0.1	0.2	-	-	0.4	0.3	0.1	-	-	pCi/L		E907.0
Thorium 232	-0.04	0.02	0.01	0.0	0.0	0.01	0.05	0.02	0.04	0.0	0.0	-0.07	-0.01	0.03	0.0	0.0	pCi/L		E907.0
Thorium 232 precision (+/-)	0.1	0.08	0.08	0.1	0.07	0.05	0.1	0.07	0.1	0.1	0.1	0.2	0.1	0.06	0.1	0.1	pCi/L		E907.0
Thorium 232 MDC	0.3	0.2	0.2	-	-	0.1	0.2	0.1	0.2	-	-	0.4	0.3	0.1	-	-	pCi/L		E907.0
DATA QUALITY																			
A/C Balance (+/- 5)	0.0989	-2.29	-3.29	-0.82	0.667	-2.33	-2.88		-5.62	4.15	2.59	-1.23	3.98	-1.49	-2.93	4.58	%		Calc.
Anions	9.01	8.59	14.4	3.25	4.12	4.43	4.45		5.25	48.60	52.9	45.4	45.9	43.9	14.00	14.1	meq/l		Calc.
Cations	9.03	8.2	13.4	3.19	4.17	4.23	4.2		4.69	52.80	55.7	44.3	49.7	42.6	13.20	15.5	meq/l		Calc.
Solids, Total Dissolved Calc.	511	486	790	177	301	256	244		324	3170	3360	2880	3000	2800	897	901	mg/l		Calc.
TDS Balance (0.80 - 1.20)	1.04	1.01	0.960	1.02	0.760	1.09	0.99		0.880	0.95	0.990	0.980	0.970	0.960	0.96	0.960			Calc.

Appendix 9-D

Water Quality Data
2008-2010 Sampling
Point Lookout Sandstone Wells

(Note: Volatile Organic Compounds and Synthetic Organic Compounds were not detected during sampling and are not given in the tables below. These data will be available upon request)

Table D-1. Point Lookout Sandstone Well Water Quality (Page 1 of 2)

Well ID	90	90	90	90	90	90	22	22	22	22	22	22	102	102	102	102	83	83	UNITS	R.L.	METHOD
Sample Date	8/11/2008	11/10/2008	2/16/2009	5/19/2009	5/3/2010	10/12/2010	8/21/2008	11/13/2008	2/11/2009	5/19/2009	4/29/2010	10/13/2010	9/24/2008	11/8/2008	2/11/2009	10/6/2010	8/20/2008	11/10/2008			
Sample Number	RH08-0053	RH08-0084	RH09-0013	RH09-0033	RH10-0014	RH10-0044	RH08-0062	RH08-0091	RH09-0003	RH09-0030	RH10-0005	RH10-0048	RH08-0075	RH08-0082	RH09-0005	RH10-0042	RH08-0060	RH08-0083			
FIELD MEASUREMENTS																					
Water Level (Altitude)	6963	6963	-	-	-	-	6925	6920	-	-	-	-	6975	6974	-	-	7106	7106	ft.		HANNA Multi-meter
pH	8.03	8.92	9.03	8.75	7.35	8.71	-	8.53	8.76	8.83	6.12	8.66	-	8.82	8.83	8.55	9.06	9.91	s.u.		HANNA Multi-meter
Conductivity	404	430	992	414	394	408	-	316	323	325	306	328	-	706	837	726	840	859	umhos/cm		HANNA Multi-meter
Temperature	68.98	56.07	65.75	69.26	59.77	65.10	-	57.97	55.32	63.90	60.02	61.96	-	52.53	35.30	60.40	56.05	53.49	degrees F		HANNA Multi-meter
Dissolved Oxygen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	%		HANNA Multi-meter
Total Dissolved Solids, TDS	-	215	496	207	197	204	-	249	162	162	153	164	-	353	418	363	-	429	mg/l		HANNA Multi-meter
Turbidity	0	0	1.89	0	5.12	0.20	-	0	0.85	0	1.12	0.29	0	0	0	0.65	7.21	4.6	t.u.		HANNA Multi-meter
MAJOR IONS																					
Alkalinity, Total as CaCO3	215	230	475	228	455	244	172	174	172	178	184	189	586	389	454	446	465	466	mg/l	1.0	A2320 B
Carbonate as CO3	5	11	24	6	25	9	9	6	ND	6	ND	6	22	15	8	18	82	79	mg/l	1.0	A2320 B
Bicarbonate as HCO3	253	259	531	265	505	278	192	200	210	204	216	219	670	443	537	509	401	408	mg/l	1.0	A2320 B
Hydroxide as OH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	1.0	A2320 B
Calcium	5	4	3	3	2	4	6	6	4	5	5	5	4	3	2	2	ND	ND	mg/l	1	E200.7
Chloride	1	ND	8	ND	14	ND	ND	ND	ND	ND	ND	1	7	3	4	4	3	2	mg/l	1	E300.0
Fluoride	1.0	1.0	3.3	1.0	2.9	1.0	0.6	0.6	0.6	0.6	0.6	0.6	7.6	3.3	5.0	3.8	4.3	4.2	mg/l	0.1	A4500-F C
Magnesium	1	1	ND	1	ND	1	2	2	2	2	2	2	1	1	ND	ND	ND	ND	mg/l	1	E200.7
Nitrogen, Ammonia as N	ND	ND	0.13	0.09	0.13	0.09	ND	ND	0.07	0.07	ND	0.08	0.2	0.1	0.17	0.09	0.2	0.2	mg/l	0.1	E350.1
Nitrogen, Kjeldahl, Total as N	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.5	E351.2
Nitrogen, Nitrate as N	-	ND	ND	ND	ND	ND	-	0.2	ND	ND	ND	ND	-	ND	ND	ND	-	ND	mg/l	0.1	E353.2
Nitrogen, Nitrate + Nitrite as N	-	ND	ND	ND	ND	ND	-	0.20	ND	ND	ND	ND	-	ND	ND	ND	-	ND	mg/l	0.05	E353.2
Nitrogen, Nitrite as N	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	A4500-NO2 B
Nitrogen, Total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.5	A4500-N A
Potassium	1	1	1	1	ND	1	1	1	1	1	1	1	2	2	2	1	ND	ND	mg/l	1	E200.7
Silica	16.6	14.2	8.6	11.1	10.0	13.2	14.2	14.4	11.7	8.7	12.2	12.8	12.3	15.5	11.4	13.4	2.3	1.9	mg/l	0.2	E200.7
Sodium	101	104	229	79	232	97	77	78	68	69	78	75	311	195	192	187	219	249	mg/l	1	E200.7
Sulfate	2	3	44	1	85	3	6	6	4	5	7	9	ND	ND	ND	ND	4	2	mg/l	1	E300.0
NON-METALS																					
Organic Carbon, Total (TOC)	ND	1.2	0.5	ND	0.6	ND	ND	0.8	ND	ND	ND	ND	ND	1.2	ND	ND	ND	4.6	mg/l	0.5	A5310 C
Carbon, Total	ND	34.0	204	45	104	52	ND	17.3	9.2	38.0	44.1	41.0	3.8	56.8	10.0	98	ND	65.2	mg/l	9.7	SW9060
Phenolics, Total Recoverable	-	ND	ND	0.01	ND	ND	-	ND	ND	0.03	ND	ND	-	0.05	ND	ND	-	ND	mg/l	0.0	E420.1
Cyanide, Total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.005	Kelada mod
PHYSICAL PROPERTIES																					
Color	ND	ND	ND	ND	ND	ND	ND	5.0	ND	ND	ND	ND	5.0	10.0	ND	5.0	5.0	5.0	c.u.	5.0	A2120 B
Conductivity	404	378	937	390	929	406	306	327	186	305	327	327	1090	723	808	742	878.0	900.0	umhos/cm	1	A2510 B
Corrosivity	0.04	0.1	0.3	0.1	0.3	0.2	-0.12	0.1	-0.1	0.1	-0.07	0.1	0.10	0.1	0.0	0.1	0.37	0.4	unitless		Calc.
Hardness as CaCO3	18	16	11	14	8	15	21	22	18	18	19	19	15	12	10	10	2	2	mg/l	1	A2340 B
Odor	NOO	NOO	NOO	NOO	NOO	2	NOO	NOO	NOO	NOO	NOO	NOO	NOO	NOO	NOO	NOO	NOO	NOO	T.O.N	1	A2150 B
pH	8.42	8.52	8.62	8.64	8.76	8.58	8.29	8.49	8.40	8.57	8.36	8.55	8.29	8.52	8.43	8.56	9.30	9.34	s.u.	0.01	A4500-H B
Solids, TDS @ 180 C	249	258	626	261	560	242	204	212	221	204	192	270	655	446	554	491	485.0	508	mg/l	10	A2540 C

Table D-1. Point Lookout Sandstone Well Water Quality (Page 2 of 2)

Well ID	90	90	90	90	90	90	22	22	22	22	22	22	102	102	102	102	83	83	UNITS	R.L.	METHOD
Sample Date	8/11/2008	11/10/2008	2/16/2009	5/19/2009	5/3/2010	10/12/2010	8/21/2008	11/13/2008	2/11/2009	5/19/2009	4/29/2010	10/13/2010	9/24/2008	11/8/2008	2/11/2009	10/6/2010	8/20/2008	11/10/2008			
Sample Number	RH08-0053	RH08-0084	RH09-0013	RH09-0033	RH10-0014	RH10-0044	RH08-0062	RH08-0091	RH09-0003	RH09-0030	RH10-0005	RH10-0048	RH08-0075	RH08-0082	RH09-0005	RH10-0042	RH08-0060	RH08-0083			
METALS-DISSOLVED																					
Aluminum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.7
Antimony	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Arsenic	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.001	0.001	0.002	0.001	ND	ND	mg/l	0.001	E200.8
Barium	0.4	0.4	0.2	0.4	0.2	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.2	ND	0.1	ND	ND	ND	mg/l	0.1	E200.8
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.7
Boron	0.1	0.1	0.4	ND	0.4	0.1	ND	ND	ND	ND	ND	ND	0.5	0.5	0.4	0.4	0.7	0.7	mg/l	0.1	E200.7
Cadmium	0.03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Copper	0.02	ND	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Iron	0.03	ND	ND	ND	0.05	ND	ND	0.03	0.04	ND	0.04	ND	0.04	0.25	0.09	0.31	ND	ND	mg/l	0.03	E200.8
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Manganese	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E245.1
Molybdenum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Nickel	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E200.8
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.10	E200.8
Uranium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.0003	E200.8
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Zinc	0.09	ND	0.04	0.02	0.01	ND	0.02	0.03	0.02	0.04	ND	ND	0.09	0.05	0.06	0.04	0.07	0.04	mg/l	0.01	E200.8
METALS-TOTAL																					
Uranium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0024	0.0003	ND	ND	ND	ND	ND	mg/l	0.0003	E200.8
RADIONUCLIDES-TOTAL																					
Gross Alpha	0.3	6.0	0.4	1.3	4.9	-0.7	0.9	0.8	1.5	0.6	5.7	-3	1.5	0.4	0.5	-0.6	-0.9	2.4	pCi/L		E900.0
Gross Alpha precision (+/-)	1.0	1.5	1.9	1.1	2.5	1.2	0.9	0.8	1	0.9	1.7	1.3	2.3	1.5	1.7	1.8	2.0	2.1	pCi/L		E900.0
Gross Alpha MDC	1.7	1.7	3.1	1.6	3.6	2.1	1.4	1.2	1.4	1.4	2.3	2.5	3.7	2.6	2.8	3.2	3.6	3.2	pCi/L		E900.0
Gross Beta	-2.0	6.7	-3	-2	4.3	1.9	-0.6	-0.06	-0.9	-2	7.2	0.5	-3.0	-2	-0.5	2.8	-6.0	-3	pCi/L		E900.0
Gross Beta precision (+/-)	1.8	1.8	2.3	1.5	1.9	1.5	1.6	1.6	1.7	1.5	1.7	1.5	2.7	1.9	1.9	1.7	2.0	2.4	pCi/L		E900.0
Gross Beta MDC	3.0	2.8	3.9	2.6	3.1	2.4	2.7	2.6	2.9	2.6	2.7	2.5	4.7	3.2	3.4	2.7	3.6	4.1	pCi/L		E900.0
Radium 226	0.24	0.01	-0.04	0.36	-0.07	0.05	0.31	0.24	0.28	0.21	0.09	0.39	0.08	-0.01	0.06	-0.01	-0.02	-0.2	pCi/L		E903.0
Radium 226 precision (+/-)	0.16	0.11	0.09	0.16	0.08	0.1	0.18	0.13	0.17	0.14	0.12	0.11	0.10	0.12	0.14	0.08	0.12	0.09	pCi/L		E903.0
Radium 226 MDC	0.22	0.19	0.18	0.18	0.16	0.16	0.23	0.17	0.22	0.19	0.18	0.09	0.16	0.21	0.22	0.15	0.22	0.22	pCi/L		E903.0
Radium 228	2.1	0.32	1.1	0.76	0.23	0.95	1.1	0.57	0.22	0.6	0.57	1.2	-0.2	1.6	1.3	0.2	0.1	2.4	pCi/L		RA-05
Radium 228 precision (+/-)	0.74	0.68	0.67	0.68	0.68	0.69	0.72	0.74	0.71	0.7	0.68	0.9	0.79	0.79	0.75	0.59	0.67	0.83	pCi/L		RA-05
Radium 228 MDC	1.1	1.1	1.0	1.1	1.1	1.1	1.1	1.2	1.2	1.1	1.1	1.4	1.3	1.2	1.2	0.98	1.1	1.2	pCi/L		RA-05
Radon 222	306	182	447	137	641	201	267	232	270	154	450	171	71	229	146	438	133	145	pCi/L	100	D5072-92
Radon 222 precision (+/-)	51.6	54.8	51.1	39.9	75.7	41.7	42.8	42.5	52.7	40.9	74.2	39.8	31.1	60.3	50.4	43.7	48.8	54.6	pCi/L		D5072-92
Thorium 228	0.1	0.0	0.01	0.07	0.05	-0.02	0.0	0.0	0.6	0.05	0.04	0.09	-0.1	0.1	0.03	0.4	0.2	0.0	pCi/L		E907.0
Thorium 228 precision (+/-)	0.2	0.09	0.09	0.2	0.07	0.09	0.1	0.1	0.2	0.1	0.09	0.1	0.1	0.2	0.07	0.2	0.3	0.08	pCi/L		E907.0
Thorium 228 MDC	-	-	0.2	0.4	0.1	0.2	-	-	0.2	0.2	0.2	0.2	-	-	0.1	0.2	-	-	pCi/L		E907.0
Thorium 230	0.4	0.0	-0.05	-0.08	-0.007	0.03	1.2	0.0	-0.05	-0.08	-0.02	-0.03	0.6	-0.5	0.1	-0.04	3.1	0.0	pCi/L		E907.0
Thorium 230 precision (+/-)	0.4	0.1	0.1	0.4	0.1	0.1	0.5	0.1	0.1	0.1	0.1	0.07	0.1	0.4	0.09	0.1	0.9	0.1	pCi/L		E907.0
Thorium 230 MDC	-	-	0.3	0.4	0.1	0.2	-	-	0.2	0.3	0.2	0.1	-	-	0.1	0.2	-	-	pCi/L		E907.0
Thorium 232	0.1	0.0	-0.01	-0.03	0.02	-0.02	0.0	0.0	0.006	-0.02	0.04	0.05	0.0	0.0	-0.003	-0.02	0.0	0.0	pCi/L		E907.0
Thorium 232 precision (+/-)	0.1	0.08	0.1	0.2	0.07	0.05	0.1	0.1	0.06	0.1	0.09	0.08	0.1	0.3	0.03	0.06	0.1	0.06	pCi/L		E907.0
Thorium 232 MDC	-	-	0.2	0.5	0.1	0.2	-	-	0.1	0.2	0.2	0.1	-	-	0.1	0.2	-	-	pCi/L		E907.0
DATA QUALITY																					
A/C Balance (+/- 5)	3.71	1.48	-2.80	-5.36	-4.47	-4.30	2.33	2.56	-3.46	-4.62	-0.606	-4.54	5.97	4.26	-4.60	-4.89	-0.28	6.35	%		Calc.
Anions	4.45	4.74	10.8	4.65	11.3	4.98	3.63	3.67	3.57	3.71	3.86	4.04	12.30	8.04	9.43	9.25	9.67	9.62	meq/l		Calc.
Cations	4.79	4.88	10.2	4.18	10.3	4.57	3.80	3.86	3.33	3.38	3.81	3.69	13.90	8.76	8.60	8.38	9.62	10.90	meq/l		Calc.
Solids, Total Dissolved Calc.	295	375	585	249	621	270	205	211	198	200	220	224	701	460	492	485	514	571	mg/l		Calc.
TDS Balance (0.80 - 1.20)	0.84	0.690	1.07	1.05	0.9	0.900	1.00	1.00	1.12	1.02	0.87	1.21	0.93	0.970	1.13	1.01	0.94	0.890			Calc.

Appendix 9-E

Water Quality Data
2008-2010 Sampling
Gallup Sandstone Wells

(Note: Volatile Organic Compounds and Synthetic Organic Compounds were not detected during sampling and are not given in the tables below. These data will be available upon request)

Table E-1. Gallup Sandstone Well Water Quality Data (Page 1 of 2)

Well ID Sample Date Sample Number	32 8/21/2008 RH08-0061	16 8/25/2008 RH08-0065	16 11/11/2008 RH08-0088	16 2/12/2009 RH09-0008	16 5/19/2009 RH09-0029	16 4/28/2010 RH10-0006	16 9/20/2010 RH10-0031	UNITS	R.L.	METHOD
FIELD MEASUREMENTS										
Water Level (Altitude)	6944	6946	6944	-	-	-	-	ft.	HANNA Multi-meter	
pH	8.41	7.92	8.61	8.92	9.05	-	-	s.u.	HANNA Multi-meter	
Conductivity	797	947	961	932	842	-	-	umhos/cm	HANNA Multi-meter	
Temperature	61.57	60.80	56.10	55.77	62.18	-	-	degrees F	HANNA Multi-meter	
Dissolved Oxygen	-	-	-	-	-	-	-	%	HANNA Multi-meter	
Total Dissolved Solids, TDS	-	-	481	466	420	-	-	mg/l	HANNA Multi-meter	
Turbidity	1.69	19.43	28.47	61	44.94	-	-	t.u.	HANNA Multi-meter	
MAJOR IONS										
Alkalinity, Total as CaCO3	470	240	215	201	201	189	215	mg/l	1.0	A2320 B
Carbonate as CO3	38	ND	6	ND	10	10	11	mg/l	1.0	A2320 B
Bicarbonate as HCO3	496	293	250	245	226	210	240	mg/l	1.0	A2320 B
Hydroxide as OH	ND	ND	ND	ND	ND	ND	ND	mg/l	1.0	A2320 B
Calcium	2	32	24	17	14	12	15	mg/l	1	E200.7
Chloride	4	7	6	5	5	7	8	mg/l	1	E300.0
Fluoride	2.9	0.5	0.4	0.4	0.4	0.4	0.4	mg/l	0.1	A4500-F C
Magnesium	ND	32	28	22	20	15	19	mg/l	1	E200.7
Nitrogen, Ammonia as N	0.2	0.4	0.3	0.5	0.49	0.07	ND	mg/l	0.1	E350.1
Nitrogen, Kjeldahl, Total as N	ND	0.6	ND	0.6	0.6	ND	ND	mg/l	0.5	E351.2
Nitrogen, Nitrate as N	-	-	ND	0.5	ND	0.2	ND	mg/l	0.1	E353.2
Nitrogen, Nitrate + Nitrite as N	-	-	ND	0.49	ND	0.20	ND	mg/l	0.05	E353.2
Nitrogen, Nitrite as N	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	A4500-NO2 B
Nitrogen, Total	ND	0.6	ND	1.1	0.6	ND	ND	mg/l	0.5	A4500-N A
Potassium	1	5	5	6	4	4	4	mg/l	1	E200.7
Silica	19.6	8.3	6.8	6.2	3.9	3.3	4.1	mg/l	0.2	E200.7
Sodium	237	169	172	152	158	155	147	mg/l	1	E200.7
Sulfate	8	285	265	258	229	232	232	mg/l	1	E300.0
NON-METALS										
Organic Carbon, Total (TOC)	ND	ND	0.8	1.1	1.2	1.2	1.6	mg/l	0.5	A5310 C
Carbon, Total	ND	2.1	42	3.5	40.7	47.1	43.0	mg/l	9.7	SW9060
Phenolics, Total Recoverable	-	-	ND	0.03	0.01	0.01	ND	mg/l	0.0	E420.1
Cyanide, Total	ND	ND	ND	ND	ND	ND	ND	mg/l	0.005	Kelada mod
PHYSICAL PROPERTIES										
Color	5.0	185.0	40.0	-	20	5	ND	c.u.	5.0	A2120 B
Conductivity	857	1030.0	993	932	907	839	856	umhos/cm	1	A2510 B
Corrosivity	0.07	0.53	0.6	0.6	0.7	0.5	0.8	unitless		Calc.
Hardness as CaCO3	6	213	173	135	119	91	116	mg/l	1	A2340 B
Odor	NOO	NOO	NOO	-	NOO	NOO	NOO	T.O.N	1	A2150 B
pH	8.64	8.14	8.37	8.58	8.75	8.67	8.73	s.u.	0.01	A4500-H B
Solids, TDS @ 180 C	546	647.0	610	613	578	530	545	mg/l	10	A2540 C

Table E-1. Gallup Sandstone Well Water Quality Data (Page 2 of 2)

Well ID Sample Date Sample Number	32 8/21/2008 RH08-0061	16 8/25/2008 RH08-0065	16 11/11/2008 RH08-0088	16 2/12/2009 RH09-0008	16 5/19/2009 RH09-0029	16 4/28/2010 RH10-0006	16 9/20/2010 RH10-0031	UNITS	R.L.	METHOD
METALS-DISSOLVED										
Aluminum	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.7
Antimony	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Arsenic	ND	ND	ND	ND	0.002	ND	ND	mg/l	0.001	E200.8
Barium	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Beryllium	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.7
Boron	0.4	0.3	0.5	0.4	0.4	0.4	0.3	mg/l	0.1	E200.7
Cadmium	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Chromium	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Cobalt	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Copper	ND	ND	ND	0.01	ND	ND	ND	mg/l	0.01	E200.8
Iron	0.06	ND	ND	13.8	ND	ND	ND	mg/l	0.03	E200.8
Lead	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Manganese	0.01	0.02	ND	0.08	ND	ND	ND	mg/l	0.01	E200.8
Mercury	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E245.1
Molybdenum	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Nickel	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Selenium	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E200.8
Silver	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Thallium	ND	ND	ND	ND	ND	ND	ND	mg/l	0.10	E200.8
Uranium	ND	ND	ND	ND	ND	ND	ND	mg/l	0.0003	E200.8
Vanadium	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Zinc	ND	0.02	ND	0.05	ND	0.10	ND	mg/l	0.01	E200.8
METALS-TOTAL										
Uranium	ND	0.0015	ND	ND	ND	ND	ND	mg/l	0.0003	E200.8
RADIONUCLIDES-TOTAL										
Gross Alpha	2.2	3.9	5.7	6.0	8.8	3.7	3.1	pCi/L		E900.0
Gross Alpha precision (+/-)	2.0	2.3	2.4	2.1	2.5	2.2	2.1	pCi/L		E900.0
Gross Alpha MDC	2.9	3.2	3.2	2.8	2.9	3.3	3.1	pCi/L		E900.0
Gross Beta	-5.0	-7.0	2.1	3.6	6.6	7.3	5.8	pCi/L		E900.0
Gross Beta precision (+/-)	2.2	2.4	2.4	2.0	1.9	1.9	1.7	pCi/L		E900.0
Gross Beta MDC	3.8	4.3	4.0	3.2	3.0	3.0	2.6	pCi/L		E900.0
Radium 226	0.13	0.85	0.32	0.71	0.48	0.50	0.15	pCi/L		E903.0
Radium 226 precision (+/-)	0.16	0.18	0.15	0.20	0.18	0.16	0.13	pCi/L		E903.0
Radium 226 MDC	0.24	0.13	0.20	0.18	0.20	0.16	0.17	pCi/L		E903.0
Radium 228	1.2	1.1	-0.05	0.13	0.53	0.25	0.75	pCi/L		RA-05
Radium 228 precision (+/-)	0.72	1.10	0.73	0.67	0.73	0.67	0.59	pCi/L		RA-05
Radium 228 MDC	1.1	1.7	1.2	1.1	1.2	1.1	0.93	pCi/L		RA-05
Radon 222	198	190	147	285	23.4	204.0	86.4	pCi/L	100	D5072-92
Radon 222 precision (+/-)	42.1	48.7	44.3	99.3	39.3	82.1	48.5	pCi/L		D5072-92
Thorium 228	0.2	0.4	0.2	0.2	0.2	0.04	0.20	pCi/L		E907.0
Thorium 228 precision (+/-)	0.2	0.2	0.2	0.1	0.1	0.1	0.2	pCi/L		E907.0
Thorium 228 MDC	-	-	-	0.1	0.2	0.2	0.2	pCi/L		E907.0
Thorium 230	1.8	0.7	-0.2	0.04	-0.07	-0.02	-0.40	pCi/L		E907.0
Thorium 230 precision (+/-)	0.7	0.3	0.1	0.08	0.10	0.10	0.10	pCi/L		E907.0
Thorium 230 MDC	-	-	-	0.1	0.2	0.2	0.2	pCi/L		E907.0
Thorium 232	0.2	0.0	0.0	0.0	0.009	-0.030	0.030	pCi/L		E907.0
Thorium 232 precision (+/-)	0.2	0.1	0.1	0.03	0.07	0.06	0.10	pCi/L		E907.0
Thorium 232 MDC	-	-	-	0.08	0.20	0.20	0.20	pCi/L		E907.0
DATA QUALITY										
A/C Balance (+/- 5)	3.14	3.41	5.02	-0.651	2.330	-0.935	-2.930	%		Calc.
Anions	9.83	11.00	10.0	9.59	8.96	8.84	9.35	meq/l		Calc.
Cations	10.50	11.70	11.1	9.47	9.38	8.67	8.81	meq/l		Calc.
Solids, Total Dissolved Calc.	549	679	637	591	557	544	559	mg/l		Calc.
TDS Balance (0.80 - 1.20)	0.99	0.95	0.960	1.04	1.04	0.97	0.970			Calc.

Appendix 9-F

Water Quality Data
2008-2010 Sampling
Westwater Canyon Member Regional Wells

(Note: Volatile Organic Compounds and Synthetic Organic Compounds were not detected during sampling and are not given in the tables below. These data will be available upon request)

Table F-1. Westwater Canyon Member Regional Well Water Quality (Page 1 of 4)

Well ID	116	116	116	116		116	116	114	114	114	114	114	UNITS	R.L.	METHOD
Sample Date	**8/19/2008**	**11/13/2008**	**2/10/2009**	**5/21/2009**		**5/5/2010**	**9/23/2010**	**9/18/2008**	**2/18/2009**	**5/26/2009**	**5/4/2010**	**9/27/2010**			
Sample Number	**RH08-0059**	**RH08-0093**	**RH09-0002**	**RH09-0047**	**RH09-0048**	**RH10-0017**	**RH10-0033**	**RH08-0071**	**RH09-0017**	**RH09-0050**	**RH10-0009**	**RH10-0035**			
FIELD MEASUREMENTS															
Water Level (Altitude)	-	-	-	-		-	-	6725	-	-	6730	6729.9	ft.		HANNA Multi-meter
pH	6.48	6.89	7.31	7.51		7.01	7.15	6.64	7.79	7.52	7.60	7.24	s.u.		HANNA Multi-meter
Conductivity	3458	3374	3467	3481		3529	3469	3246	3376	3477	2594	2456	umhos/cm		HANNA Multi-meter
Temperature	63.94	51.51	50.43	62.78		55.79	70.52	59.44	53.44	57.72	58.14	63.30	degrees F		HANNA Multi-meter
Dissolved Oxygen	-	-	-	-		-	-	-	-	-	-	-	%		HANNA Multi-meter
Total Dissolved Solids, TDS	-	1687	1727	1741		1771	1734	-	1688	1737	1297	1228	mg/l		HANNA Multi-meter
Turbidity	0	0	0	0		0.76	0.00	406	160	817	52	16.00	t.u.		HANNA Multi-meter
MAJOR IONS															
Alkalinity, Total as CaCO3	175	175	172	182	183	188	195	175	188	172	304	201	mg/l	1.0	A2320 B
Carbonate as CO3	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	1.0	A2320 B
Bicarbonate as HCO3	-	213	210	222	224	229	238	213	229	210	371	245	mg/l	1.0	A2320 B
Hydroxide as OH	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	1.0	A2320 B
Calcium	544	518	538	496	504	513	500	504	524	433	41	327	mg/l	1	E200.7
Chloride	57	52	48	48	48	50	56	51	48	45	15	38	mg/l	1	E300.0
Fluoride	0.6	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.5	0.5	1.1	0.4	mg/l	0.1	A4500-F C
Magnesium	146	144	142	136	138	141	137	125	135	114	7	80	mg/l	1	E200.7
Nitrogen, Ammonia as N	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.81	ND	2.36	mg/l	0.1	E350.1
Nitrogen, Kjeldahl, Total as N	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.3	mg/l	0.5	E351.2
Nitrogen, Nitrate as N	-	21.3	20.1	18.2	17.6	18.7	16.2	-	18.9	22.8	6.2	1.4	mg/l	0.1	E353.2
Nitrogen, Nitrate + Nitrite as N	-	21.3	20.1	18.20	17.6	18.70	16.2	-	19.2	23	6.2	9	mg/l	0.05	E353.2
Nitrogen, Nitrite as N	19.70	ND	ND	ND	ND	ND	ND	24.30	0.3	0.2	ND	ND	mg/l	0.1	A4500-NO2 B
Nitrogen, Total	19.7	21.3	20.1	18.2	17.6	18.7	16.2	24.3	19.2	23.3	6.2	13.3	mg/l	0.5	A4500-N A
Potassium	6	6	6	6	6	6	6	10	11	11	3	25	mg/l	1	E200.7
Silica	15.6	16.9	18.3	18.7	18.8	14.3	18.0	20.0	18.8	18.9	17.3	14.6	mg/l	0.2	E200.7
Sodium	236	240	240	242	243	245	245	208	215	201	143	138	mg/l	1	E200.7
Sulfate	2080	1970	1940	1920	1910	2020	2060	1910	1880	1802	131	1330	mg/l	1	E300.0
NON-METALS															
Organic Carbon, Total (TOC)	2.6	3.3	2.7	2.9	2.9	2.6	2.8	4.9	4.2	6.2	0.8	9.6	mg/l	0.5	A5310 C
Carbon, Total	2.8	32.5	11.6	39.3	39.4	50.8	49.0	1.6	8.1	46.8	73.5	59.0	mg/l	9.7	SW9060
Phenolics, Total Recoverable	-	ND	0.03	ND	ND	ND	ND	-	0.01	0.02	ND	ND	mg/l	0.0	E420.1
Cyanide, Total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.005	Kelada mod
PHYSICAL PROPERTIES															
Color	ND	ND	ND	ND	ND	ND	ND	10.0	5.0	5.0	ND	40.0	c.u.	5.0	A2120 B
Conductivity	3580	3590	3740	3540	3550	3500	3460	3490	3640	3350	884	2300	umhos/cm	1	A2510 B
Corrosivity	0.70	0.8	0.6	0.8	0.8	0.5	1.0	0.70	0.6	0.6	0.5	0.5	unitless		Calc.
Hardness as CaCO3	1960	1890	1930	1800	1830	1860	1810	1770	1870	1550	133	1150	mg/l	1	A2340 B
Odor	NOO	NOO	NOO	NOO	NOO	NOO	2	NOO	NOO	NOO	NOO	12	T.O.N	1	A2150 B
pH	7.45	7.56	7.38	7.52	7.52	7.20	7.73	7.45	7.35	7.48	7.90	7.33	s.u.	0.01	A4500-H B
Solids, TDS @ 180 C	3290	3330	3310	3260	3300	3300	3270	3140	3210	3100	575	1980	mg/l	10	A2540 C

Table F-1. Westwater Canyon Member Regional Well Water Quality (Page 2 of 4)

Well ID	113	113	113	113	113	138	15	15	15	15	15	111	111	111	111	111	143	UNITS	R.L.	METHOD
Sample Date	9/22/2008	11/10/2008	2/12/2009	5/26/2009	9/27/2010	9/23/2008	11/13/2008	2/12/2009	5/18/2009	4/28/2010	9/20/2010	8/13/2008	11/10/2008	2/12/2009	5/26/2009	9/27/2010	9/23/2010			
Sample Number	RH08-0072	RH08-0086	RH09-0010	RH09-0053	RH10-0037	RH08-0074	RH08-0094	RH09-0007	RH09-0027	RH10-0008	RH10-0030	RH08-0055	RH08-0085	RH09-0009	RH09-0052	RH10-0036	RH10-0032			
FIELD MEASUREMENTS																				
Water Level (Altitude)	6728	6733	-	-	6732.8	6729	-	-	-	-	-	6641	6641	-	-	-	-	ft.	HANNA Multi-meter	
pH	6.59	7.42	7.59	7.72	7.45	-	7.43	8.28	8.40	5.65	-	6.92	7.61	8.20	7.58	7.43	7.47	s.u.	HANNA Multi-meter	
Conductivity	3327	3665	3430	3497	3591	-	832	840	898	910	-	670	718	712	708	706	1005	umhos/cm	HANNA Multi-meter	
Temperature	60.61	52.34	54.27	59.99	75.90	-	52.58	39.84	68.49	57.99	-	64.76	54.80	48.40	63.73	66.70	77.01	degrees F	HANNA Multi-meter	
Dissolved Oxygen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	%	HANNA Multi-meter	
Total Dissolved Solids, TDS	-	1833	1715	1747	1796	-	416	420	449	465	-	-	351	356	354	353	504	mg/l	HANNA Multi-meter	
Turbidity	89	38.12	98	16.11	3.85	0	0	0	0	0.12	-	0	0	1.59	0	0.00	0.31	t.u.	HANNA Multi-meter	
MAJOR IONS																				
Alkalinity, Total as CaCO3	168	173	168	179	192	167	267	261	275	285	292	253	260	256	269	294	295	mg/l	1.0	A2320 B
Carbonate as CO3	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	1.0	A2320 B
Bicarbonate as HCO3	205	212	205	219	234	204	326	318	331	347	356	309	317	313	328	359	360	mg/l	1.0	A2320 B
Hydroxide as OH	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	1.0	A2320 B
Calcium	548	539	507	501	542	542	51	46	48	47	45	87	87	75	78	85	105	mg/l	1	E200.7
Chloride	52	50	48	48	55	51	8	7	7	9	8	18	16	15	17	18	18	mg/l	1	E300.0
Fluoride	0.5	0.5	0.6	0.5	0.5	0.3	0.8	0.8	0.8	0.7	0.7	0.2	0.2	0.2	0.2	0.2	0.8	mg/l	0.1	A4500-F C
Magnesium	147	148	138	142	145	151	15	13	14	13	12	14	15	14	13	14	21	mg/l	1	E200.7
Nitrogen, Ammonia as N	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E350.1
Nitrogen, Kjeldahl, Total as N	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.5	E351.2
Nitrogen, Nitrate as N	-	19.8	22.3	23.9	26.4	-	ND	0.1	ND	ND	ND	-	1.0	1.1	1.0	1.0	ND	mg/l	0.1	E353.2
Nitrogen, Nitrate + Nitrite as N	-	19.8	22.3	23.9	26.4	-	ND	0.11	ND	ND	ND	-	1.0	1.09	1.07	1.1	ND	mg/l	0.05	E353.2
Nitrogen, Nitrite as N	24.60	ND	ND	ND	ND	22.80	ND	ND	ND	ND	ND	1.08	ND	ND	ND	ND	ND	mg/l	0.1	A4500-NO2 B
Nitrogen, Total	24.6	19.8	22.3	23.9	26.4	22.8	ND	ND	ND	ND	ND	1.1	1.0	1.1	1.1	1.1	ND	mg/l	0.5	A4500-N A
Potassium	7	6	6	7	6	9	4	3	4	4	4	5	5	6	5	5	4	mg/l	1	E200.7
Silica	21.9	20.0	18.3	21.6	21.8	22.7	22.3	19.4	21.4	19.5	19.8	19.0	17.4	16.0	116.5	18.1	24.4	mg/l	0.2	E200.7
Sodium	236	224	231	237	232	221	143	127	136	135	139	58	59	54	59	58	104	mg/l	1	E200.7
Sulfate	2090	2030	2010	2000	2150	2040	177	176	169	181	180	97	93	88	98	104	276	mg/l	1	E300.0
NON-METALS																				
Organic Carbon, Total (TOC)	2.2	3.9	3.2	2.6	3.2	2.5	1.5	0.6	0.6	ND	0.7	ND	1.9	0.5	0.6	1.1	0.6	mg/l	0.5	A5310 C
Carbon, Total	2.1	36.5	5.2	42.8	46.0	1.1	52	6.6	55.8	70.7	64.0	ND	36.8	6.3	61.0	64.0	67.0	mg/l	9.7	SW9060
Phenolics, Total Recoverable	-	ND	ND	ND	ND	-	ND	ND	0.02	0.02	ND	-	ND	0.015	ND	ND	ND	mg/l	0.0	E420.1
Cyanide, Total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.005	Kelada mod
PHYSICAL PROPERTIES																				
Color	256.0	5.0	-	ND	ND	20.0	ND	ND	ND	ND	ND	ND	ND	-	ND	ND	ND	c.u.	5.0	A2120 B
Conductivity	3770	3820	3780	3640	3470	3510	894	857	887	865	845	726	722	668	732	711	1020	umhos/cm	1	A2510 B
Corrosivity	0.60	0.8	0.7	0.8	1.0	0.80	0.6	0.1	0.4	0.3	0.5	0.49	0.6	0.5	0.5	0.8	0.9	unitless		Calc.
Hardness as CaCO3	1980	1960	1840	1840	1950	1970	189	168	179	171	163	278	279	245	250	271	348	mg/l	1	A2340 B
Odor	NOO	NOO	-	NOO	3	NOO	NOO	NOO	NOO	NOO	NOO	NOO	NOO	-	NOO	NOO	NOO	T.O.N	1	A2150 B
pH	7.37	7.54	7.51	7.54	7.72	7.56	7.90	7.52	7.81	7.63	7.85	7.60	7.69	7.63	7.66	7.91	7.89	s.u.	0.01	A4500-H B
Solids, TDS @ 180 C	3320	3280	3440	3390	3320	3290	567	588	591	568	523	444	435	463	461	504	737	mg/l	10	A2540 C

Table F-1. Westwater Canyon Member Regional Well Water Quality (Page 3 of 4)

Well ID	116	116	116	116		116	116	114	114	114	114	114	UNITS	R.L.	METHOD
Sample Date	8/19/2008	11/13/2008	2/10/2009	5/21/2009		5/5/2010	9/23/2010	9/18/2008	2/18/2009	5/26/2009	5/4/2010	9/27/2010			
Sample Number	RH08-0059	RH08-0093	RH09-0002	RH09-0047	RH09-0048	RH10-0017	RH10-0033	RH08-0071	RH09-0017	RH09-0050	RH10-0009	RH10-0035			
METALS-DISSOLVED															
Aluminum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.7
Antimony	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Arsenic	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.001	ND	0.001	mg/l	0.001	E200.8
Barium	ND	ND	ND	ND	ND	ND	ND	0.2	0.1	0.2	ND	0.2	mg/l	0.1	E200.8
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.7
Boron	0.3	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.2	0.1	mg/l	0.1	E200.7
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Copper	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Iron	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.05	mg/l	0.03	E200.8
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Manganese	ND	ND	ND	ND	ND	0.02	ND	0.07	0.07	0.06	ND	0.33	mg/l	0.01	E200.8
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E245.1
Molybdenum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Nickel	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Selenium	0.079	0.061	0.064	0.052	0.053	0.063	0.05	0.048	0.039	0.047	0.022	0.017	mg/l	0.001	E200.8
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.10	E200.8
Uranium	0.0109	0.0106	0.0121	0.0103	0.0096	0.0134	0.0135	0.0199	0.0217	0.0208	0.1880	0.0145	mg/l	0.0003	E200.8
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Zinc	0.21	0.07	0.08	0.11	0.33	0.12	0.12	0.02	0.04	0.01	0.05	ND	mg/l	0.01	E200.8
METALS-TOTAL															
Uranium	0.0119	0.0107	0.0118	0.0112	0.0113	0.0654	0.0133	0.0229	0.0222	0.0212	0.1840	0.0134	mg/l	0.0003	E200.8
RADIONUCLIDES-TOTAL															
Gross Alpha	22.6	17.9	23.7	20.6	28.3	22.5	10.4	50.4	50.3	36	149	15.2	pCi/L		E900.0
Gross Alpha precision (+/-)	10.8	7.6	14.8	8.9	9.5	10.7	13.6	12.1	12	10.1	9.4	10.2	pCi/L		E900.0
Gross Alpha MDC	15.2	9.9	21.3	12.1	12.1	15.2	21.8	13.9	13.7	12.3	5.8	15.5	pCi/L		E900.0
Gross Beta	5.2	9.5	-6	7.8	10	5.5	-4	16.9	27.1	15.4	39.5	26.8	pCi/L		E900.0
Gross Beta precision (+/-)	8.2	8.2	17.4	10.6	10.6	8.3	9.6	8.3	8.7	10.8	6.5	9.9	pCi/L		E900.0
Gross Beta MDC	13.6	13.5	29.4	17.5	17.6	13.7	16.2	13.3	13.8	17.6	9.8	15.8	pCi/L		E900.0
Radium 226	0.35	0.37	0.27	0.47	0.47	0.49	0.54	0.96	0.45	0.47	0.06	0.54	pCi/L		E903.0
Radium 226 precision (+/-)	0.17	0.15	0.16	0.16	0.16	0.17	0.18	0.20	0.19	0.19	0.08	0.2	pCi/L		E903.0
Radium 226 MDC	0.21	0.17	0.21	0.1	0.14	0.2	0.2	0.16	0.23	0.21	0.13	0.22	pCi/L		E903.0
Radium 228	0.77	0.50	0.58	1.3	1.30	0.7	0.38	0.79	0.90	0.50	0.27	1.00	pCi/L		RA-05
Radium 228 precision (+/-)	0.74	0.73	0.72	0.65	0.62	0.66	0.46	0.83	0.72	0.67	0.73	0.64	pCi/L		RA-05
Radium 228 MDC	1.2	1.2	1.2	0.99	1.0	1.1	0.75	1.3	1.2	1.1	1.2	0.99	pCi/L		RA-05
Radon 222	812	824	819	813	674	933	407	127	106	634	1360	120	pCi/L	100	D5072-92
Radon 222 precision (+/-)	53.5	49.3	67.2	101	98.6	98.9	43.6	67.5	48.5	53	84.1	41.3	pCi/L		D5072-92
Thorium 228	-	0.0	0.05	0.02	-0.01	0.0005	0.09	0.2	0.2	0.2	0.08	2.8	pCi/L		E907.0
Thorium 228 precision (+/-)	-	0.2	0.1	0.1	0.3	0.05	0.1	0.6	0.2	0.2	0.08	0.8	pCi/L		E907.0
Thorium 228 MDC	-	-	0.2	0.3	0.7	0.1	0.2	-	0.2	0.3	0.1	0.4	pCi/L		E907.0
Thorium 230	0.0	0.2	0.1	0.1	-0.2	-0.1	-0.2	1.8	0.07	-0.04	-0.002	-0.1	pCi/L		E907.0
Thorium 230 precision (+/-)	0.2	0.1	0.2	0.2	0.4	0.09	0.2	0.2	0.2	0.2	0.1	0.3	pCi/L		E907.0
Thorium 230 MDC	-	-	0.2	0.3	0.7	0.1	0.4	-	0.3	0.3	0.1	0.4	pCi/L		E907.0
Thorium 232	-	0.0	-0.04	-0.04	0.10	0.03	-0.05	-0.1	0.1	-0.02	0.02	0.04	pCi/L		E907.0
Thorium 232 precision (+/-)	-	0.1	0.07	0.09	0.30	0.05	0.1	0.1	0.1	0.1	0.06	0.20	pCi/L		E907.0
Thorium 232 MDC	-	-	0.2	0.3	0.6	0.1	0.4	-	0.2	0.2	0.1	0.5	pCi/L		E907.0
DATA QUALITY															
A/C Balance (+/- 5)	-0.14	0.839	2.7	0.300	1.25	-0.691	-2.520	-1.90	1.27	-4.97	-3.75	-5.83	%		Calc.
Anions	49.70	47.5	46.6	46.3	46.0	48.7	49.5	46.50	45.7	44.3	9.66	33.40	meq/l		Calc.
Cations	49.60	48.3	49.2	46.6	47.2	48	47	44.80	46.9	40.1	8.97	29.70	meq/l		Calc.
Solids, Total Dissolved Calc.	3260	3150	3130	3060	3060	3200	3210	3290	3040	2850	572	2120	mg/l		Calc.
TDS Balance (0.80 - 1.20)	1.01	1.06	1.06	1.07	1.08	1.03	1.02	0.95	1.06	1.09	1.01	0.930			Calc.

Well ID	113	113	113	113	113	138	12	15	15	15	15	111	111	111	111	111	143			
Sample Date	9/22/2008	11/10/2008	2/12/2009	5/26/2009	9/27/2010	9/23/2008	11/13/2008	2/12/2009	5/18/2009	4/28/2010	9/20/2010	8/13/2008	11/10/2008	2/12/2009	5/26/2009	9/27/2010	9/23/2010	UNITS	R.L.	METHOD
Sample Number	RH08-0072	RH08-0086	RH09-0010	RH09-0053	RH10-0037	RH08-0074	RH08-0094	RH09-0007	RH09-0027	RH10-0008	RH10-0030	RH08-0055	RH08-0085	RH09-0009	RH09-0052	RH10-0036	RH10-0032			
METALS-DISSOLVED																				
Aluminum	ND	ND	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.7
Antimony	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Arsenic	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E200.8
Barium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.7
Boron	0.3	0.2	ND	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.2	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.7
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Copper	ND	ND	ND	ND	ND	0.01	ND	ND	ND	ND	ND	ND	ND	0.01	ND	0.01	ND	mg/l	0.01	E200.8
Iron	ND	ND	11.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03	ND	mg/l	0.03	E200.8
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Manganese	0.11	ND	0.17	ND	0.07	0.01	ND	ND	ND	ND	ND	0.08	0.07	0.06	0.07	0.08	0.06	mg/l	0.01	E200.8
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E245.1
Molybdenum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Nickel	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Selenium	0.027	0.024	0.023	0.027	0.020	0.031	ND	ND	ND	ND	ND	0.071	0.074	0.071	0.082	0.073	ND	mg/l	0.001	E200.8
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.10	E200.8
Uranium	0.0158	0.0155	0.0169	0.0161	0.0178	0.0329	ND	ND	ND	ND	ND	0.0586	0.0576	0.0603	0.0608	0.0593	0.0032	mg/l	0.0003	E200.8
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Zinc	0.20	0.02	0.46	0.01	0.03	0.02	0.10	0.15	0.08	0.08	0.09	0.02	0.01	0.02	0.02	0.05	0.40	mg/l	0.01	E200.8
METALS-TOTAL																				
Uranium	0.0221	0.0158	0.0176	0.0154	0.0841	0.0348	ND	ND	ND	ND	ND	0.0625	0.0570	0.0573	0.0612	0.0607	0.0032	mg/l	0.0003	E200.8
RADIONUCLIDES-TOTAL																				
Gross Alpha	25.4	28.2	21.0	25.4	15.2	44.4	2.1	3.4	2.1	2.4	3.3	55.0	75.0	48.2	56.7	65.1	6	pCi/L		E900.0
Gross Alpha precision (+/-)	11.3	11.0	8.7	10.1	12.7	10.7	1.6	1.6	2	2.3	2.2	4.4	5.0	3.7	4.5	5.1	3.7	pCi/L		E900.0
Gross Alpha MDC	15.6	14.8	11.7	13.4	19.8	12.3	2.3	2.2	3.1	3.5	3.2	2.9	2.6	2.2	2.7	3.9	5.6	pCi/L		E900.0
Gross Beta	6.0	6.0	2.0	-20.0	6.2	9.4	-1	12.0	3.3	5.9	5.2	20.3	29.7	27.3	22.4	16.8	2.4	pCi/L		E900.0
Gross Beta precision (+/-)	8.3	11.2	8.4	8.4	10.1	8.6	2.3	1.9	2.3	2	1.8	2.1	2.4	2.3	2.4	2.1	2.3	pCi/L		E900.0
Gross Beta MDC	13.7	18.5	14.0	14.5	16.7	14.2	3.8	2.8	3.7	3.1	2.8	2.9	3.2	3.1	3.4	3.0	3.8	pCi/L		E900.0
Radium 226	0.26	0.27	0.31	-0.10	0.42	0.12	0.25	0.43	-0.1	0.5	0.32	1.10	0.98	1.0	1.1	1.3	3.2	pCi/L		E903.0
Radium 226 precision (+/-)	0.13	0.14	0.14	0.10	0.19	0.10	0.13	0.18	0.11	0.17	0.15	0.26	0.23	0.25	0.29	0.29	0.39	pCi/L		E903.0
Radium 226 MDC	0.16	0.19	0.16	0.22	0.22	0.15	0.17	0.22	0.23	0.17	0.17	0.23	0.21	0.20	0.26	0.23	0.19	pCi/L		E903.0
Radium 228	-0.3	0.35	0.32	0.53	0.92	0.38	0.47	0.78	0.85	0.61	1.3	0.61	2.1	0.62	1.3	0.99	1.7	pCi/L		RA-05
Radium 228 precision (+/-)	0.78	0.68	0.63	0.71	0.65	0.81	0.73	0.73	0.8	0.72	0.59	0.71	0.81	0.76	0.87	0.69	0.57	pCi/L		RA-05
Radium 228 MDC	1.3	1.1	1.0	1.2	1.0	1.3	1.2	1.2	1.3	1.2	0.89	1.2	1.2	1.2	1.4	1.1	0.83	pCi/L		RA-05
Radon 222	1010	1120	1000	1130	881	756	87	257	36.5	258	116	1580	1190	1530	1520	1080	260	pCi/L	100	D5072-92
Radon 222 precision (+/-)	66.3	64.5	108	59	50.3	45.5	39.5	101	37.9	83.5	49.4	63.8	65.7	115	63	52.7	41.6	pCi/L		D5072-92
Thorium 228	0.0	0.3	0.1	0.1	0.2	0.1	1.7	0.03	0.09	0.06	-0.04	0.0	0.3	0.08	0.01	-0.02	0.06	pCi/L		E907.0
Thorium 228 precision (+/-)	0.8	0.3	0.2	0.1	0.2	0.4	0.5	0.08	0.1	0.09	0.1	0.2	0.3	0.1	0.1	0.07	0.1	pCi/L		E907.0
Thorium 228 MDC	-	-	0.3	0.3	0.3	-	-	0.2	0.3	0.2	0.3	-	-	0.2	0.2	0.2	0.3	pCi/L		E907.0
Thorium 230	1.8	0.3	-0.1	-0.1	0.80	0.3	-0.2	-0.07	-0.02	-0.1	-0.04	1.3	-0.1	-0.01	0.10	0.40	0.5	pCi/L		E907.0
Thorium 230 precision (+/-)	0.2	0.3	0.2	0.1	0.4	0.2	0.1	0.08	0.1	0.1	0.1	0.5	0.2	0.1	0.1	0.3	0.3	pCi/L		E907.0
Thorium 230 MDC	-	-	0.3	0.3	0.2	-	-	0.1	0.3	0.2	0.3	-	-	0.2	0.1	0.2	0.3	pCi/L		E907.0
Thorium 232	-0.1	0.0	-0.07	0.02	-0.010	-0.1	0.0	0.03	-0.03	-0.03	0.009	0.0	0.0	0.03	-0.008	0.030	0.02	pCi/L		E907.0
Thorium 232 precision (+/-)	0.1	0.2	0.1	0.1	0.07	0.1	0.1	0.07	0.09	0.1	0.1	0.1	0.2	0.09	0.04	0.10	0.09	pCi/L		E907.0
Thorium 232 MDC	-	-	0.3	0.3	0.2	-	-	0.1	0.2	0.2	0.3	-	-	0.2	0.1	0.2	0.2	pCi/L		E907.0
DATA QUALITY																				
A/C Balance (+/- 5)	-0.28	0.339	-1.45	-1.08	-2.77	0.37	4.00	-0.94	1.83	-1.9	-2.47	3.56	3.73	-0.364	-1.870	-3.410	-2.54	%		Calc.
Anions	50.20	48.60	48.3	48.2	52.0	48.90	9.29	9.12	9.25	9.74	9.87	7.66	7.67	7.45	7.99	8.65	12.2	meq/l		Calc.
Cations	49.90	49.0	46.9	47.2	49.2	49.30	10.1	8.95	9.6	9.38	9.39	8.22	8.26	7.40	7.69	8.08	11.6	meq/l		Calc.
Solids, Total Dissolved Calc.	3290	3390	3170	3170	3390	3210	578	554	572	586	590	448	593	431	458	490	737	mg/l		Calc.
TDS Balance (0.80 - 1.20)	1.01	0.970	1.09	1.07	0.980	1.02	0.980	1.06	1.03	0.97	0.890	0.99	0.730	1.07	1.01	1.03	1.000			Calc.

Appendix 9-G

Water Quality Data
2008-2010 Sampling
Westwater Canyon Member Permit Area Wells

(Note: Volatile Organic Compounds and Synthetic Organic Compounds were not detected during sampling and are not given in the tables below. These data will be available upon request)

Table G-1. Westwater Canyon Member Permit Area Well Water Quality (Page 1 of 2)

Well ID Sample Date Sample Number	S1 4/7/2008 RH08-0008	S1 8/27/2008 RH08-0066	S1 11/6/2008 RH08-0079	S1 2/17/2009 RH09-0016	S1 6/23/2009 RH09-0055	S1 6/24/2010 RH10-0027	S3 8/28/2008 RH08-0068	S3 11/5/2008 RH08-0078	S3 2/19/2009 RH09-0023	S3 5/27/2009 RH09-0054	S3 6/24/2010 RH10-0026	S4 8/27/2008 RH08-0067	S4 11/5/2008 RH08-0077	S4 3/5/2009 RH09-0021	S4 6/23/2009 RH09-0056	S4 5/12/2010 RH10-0021	S4 10/19/2010 RH10-0051	UNITS	R.L.	METHOD
FIELD MEASUREMENTS																				
Water Level (Altitude)	6382.05	6383.00	6383.80	6385.39	6390.50	6389.80	6382.85	6384.66	6385.40	6387.08	-	-	-	6379.05	6382.30	6384.15	6386.00	ft.		HANNA Multi-meter
pH	7.50	7.45	8.07	8.38	8.27	-	7.25	7.99	8.35	8.26	-	6.89	7.80	8.27	8.01	7.96	8.03	s.u.		HANNA Multi-meter
Conductivity	667	748	732	795	803	-	550	295	681	678	-	564	607	792	796	778	802	umhos/cm		HANNA Multi-meter
Temperature	91.68	88.85	90.56	88.84	90.02	-	94.69	92.86	92.52	92.85	-	92.05	91.69	89.59	90.66	87.67	90.81	degrees F		HANNA Multi-meter
Dissolved Oxygen	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	%		HANNA Multi-meter
Total Dissolved Solids, TDS	333	-	366	398	402	-	-	148	340	339	-	-	303	396	398	393	401	mg/l		HANNA Multi-meter
Turbidity	4.13	-	-	1.47	0	-	-	-	0	0	-	-	-	-	0.49	0	8.29	t.u.		HANNA Multi-meter
MAJOR IONS																				
Alkalinity, Total as CaCO3	166	-	176	171	171	177	-	170	168	172	181	174	177	176	175	186	181	mg/l	1.0	A2320 B
Carbonate as CO3	ND	-	6	4	ND	ND	-	4	ND	6	ND	0	5	ND	ND	ND	ND	mg/l	1.0	A2320 B
Bicarbonate as HCO3	203	-	203	200	209	216	-	198	205	198	221	213	205	214	214	226	221	mg/l	1.0	A2320 B
Hydroxide as OH	ND	-	ND	ND	ND	ND	-	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	mg/l	1.0	A2320 B
Calcium	16	18	19	14	16	16	20	21	18	19	19	29.6	31	26	30	30	31	mg/l	1	E200.7
Chloride	4	-	4	3	4	3	-	3	3	3	ND	3	3	2	3	ND	3	mg/l	1	E300.0
Fluoride	0.7	-	0.7	0.7	0.6	0.6	-	0.8	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.5	0.6	mg/l	0.1	A4500-F C
Magnesium	3	3	4	3	3	3	3	3	2	3	3	5.05	5	5	5	5	5	mg/l	1	E200.7
Nitrogen, Ammonia as N	ND	-	ND	ND	ND	ND	-	ND	ND	0.05	0.09	0.25	0.2	0.13	0.11	0.06	0.05	mg/l	0.1	E350.1
Nitrogen, Kjeldahl, Total as N	ND	-	ND	ND	ND	ND	-	ND	ND	ND	ND	0.15	ND	ND	ND	ND	ND	mg/l	0.5	E351.2
Nitrogen, Nitrate as N	-	-	ND	ND	ND	-	-	ND	-	ND	ND	-	ND	ND	ND	ND	ND	mg/l	0.1	E353.2
Nitrogen, Nitrate + Nitrite as N	ND	-	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E353.2
Nitrogen, Nitrite as N	-	-	ND	ND	ND	-	-	ND	ND	ND	ND	-	ND	ND	ND	ND	ND	mg/l	0.1	A4500-NO2 B
Nitrogen, Total	ND	-	ND	ND	ND	ND	-	ND	ND	ND	ND	0.6	ND	ND	ND	ND	ND	mg/l	0.5	A4500-N A
Potassium	3	3	3	2	2	2	2	2	3	2	3	3.63	3	3	3	3	3	mg/l	1	E200.7
Silica	19.9	ND	29.2	20.2	25.6	24.7	ND	32.5	25.0	28.7	23.3	31.5	27.8	21.7	27.5	26.0	25.7	mg/l	0.2	E200.7
Sodium	143	167	169	139	147	150	135	134	123	129	128	144	137	126	132	136	132	mg/l	1	E200.7
Sulfate	210	-	204	205	209	209	-	152	148	156	151	188	201	194	208	220	213	mg/l	1	E300.0
NON-METALS																				
Organic Carbon, Total (TOC)	ND	-	1.2	ND	3.7	ND	-	1.1	0.7	1.2	ND	-	1.0	ND	2.3	ND	ND	mg/l	0.5	A5310 C
Carbon, Total	-	-	47.9	3.9	28.0	42	-	15.5	3.9	30.5	43	-	25.6	46.0	30.1	43.8	ND	mg/l	9.7	SW9060
Phenolics, Total Recoverable	-	-	ND	ND	0.06	ND	-	ND	0.05	0.02	ND	-	ND	ND	0.02	ND	ND	mg/l	0.0	E420.1
Cyanide, Total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	41	mg/l	0.005	Kelada mod
PHYSICAL PROPERTIES																				
Color	ND	-	ND	ND	ND	-	-	ND	5.0	ND	ND	-	ND	5.0	ND	ND	ND	c.u.	5.0	A2120 B
Conductivity	792	-	798	722	777	749	-	640	661	661	660	-	775	762	771	775	765	umhos/cm	1	A2510 B
Corrosivity	-	-	0.2	-0.02	-0.04	0.02	-	0.06	0.03	0.2	0.07	-	0.2	0.4	0.1	0.02	0.3	unitless		Calc.
Hardness as CaCO3	51	-	63	48	52	51	-	67	53	60	60	98	99	85	95	95	98	mg/l	1	A2340 B
Odor	NOO	-	NOO	NOO	NOO	-	-	NOO	present	NOO	1	-	NOO	NOO	NOO	1	1	T.O.N	1	A2150 B
pH	8.12	-	8.16	8.06	8.00	8.04	-	7.96	8.01	8.12	7.99	8.27	7.93	8.20	7.87	7.74	8.04	s.u.	0.01	A4500-H B
Solids, TDS @ 180 C	506	-	509	526	525	493	-	437	425	435	442	506	523	524	529	486	532	mg/l	10	A2540 C

Table G-1. Westwater Canyon Member Permit Area Well Water Quality (Page 2 of 2)

Well ID	S1	S1	S1	S1	S1	S1	S3	S3	S3	S3	S3	S4	S4	S4	S4	S4	S4	UNITS	R.L.	METHOD
Sample Date	4/7/2008	8/27/2008	11/6/2008	2/17/2009	6/23/2009	6/24/2010	8/28/2008	11/5/2008	2/19/2009	5/27/2009	6/24/2010	8/27/2008	11/5/2008	3/5/2009	6/23/2009	5/12/2010	10/19/2010			
Sample Number	RH08-0008	RH08-0066	RH08-0079	RH09-0016	RH09-0055	RH10-0027	RH08-0068	RH08-0078	RH09-0023	RH09-0054	RH10-0026	RH08-0067	RH08-0077	RH09-0021	RH09-0056	RH10-0021	RH10-0051			
METALS-DISSOLVED																				
Aluminum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.7
Antimony	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Arsenic	0.003	0.0031	0.003	0.003	0.003	0.003	0.0039	0.003	0.003	0.003	0.003	0.0035	0.004	0.003	ND	0.003	0.004	mg/l	0.001	E200.8
Barium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.7
Boron	0.2	0.3	0.2	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	ND	0.2	0.2	0.2	mg/l	0.1	E200.7
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03	ND	ND	ND	mg/l	0.01	E200.8
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Cobalt	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Copper	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Iron	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.03	ND	0.19	0.05	ND	0.04	0.04	0.04	mg/l	0.03	E200.8
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Manganese	0.03	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.01	0.01	mg/l	0.01	E200.8
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.001	E245.1
Molybdenum	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Nickel	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.05	E200.8
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.012	ND	ND	mg/l	0.001	E200.8
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.01	E200.8
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.10	E200.8
Uranium	0.0032	0.002	0.0023	0.0019	0.0020	0.0006	0.0065	0.0060	0.0066	0.0057	0.0050	0.0017	0.0020	0.0019	0.0017	0.0020	0.0029	mg/l	0.0003	E200.8
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	mg/l	0.1	E200.8
Zinc	ND	ND	ND	ND	ND	ND	0.07	ND	ND	0.02	ND	ND	ND	0.03	0.02	0.02	ND	mg/l	0.01	E200.8
METALS-TOTAL																				
Uranium	-	0.0036	0.0023	0.0022	0.0022	0.0020	0.0071	0.0076	0.0069	0.0091	0.0054	0.0022	0.0018	0.0017	0.0019	0.0019	0.0028	mg/l	0.0003	E200.8
RADIONUCLIDES-TOTAL																				
Gross Alpha	418	136	229	290	350	135	17.8	22.2	21.9	30.9	35.2	10.0	8.5	6.6	10.9	7.3	2.8	pCi/L		E900.0
Gross Alpha precision (+/-)	9.7	5.9	8.2	8.5	9.3	7.4	2.3	2.6	2.5	3.1	4.0	2.1	2.0	2.1	2.1	2.6	2.6	pCi/L		E900.0
Gross Alpha MDC	1.7	2.5	2.6	1.8	2.3	4.2	2.2	2.2	1.9	2.3	3.7	2.5	2.2	2.6	2.3	3.6	4.1	pCi/L		E900.0
Gross Beta	178	35.2	72.0	88.4	117	50.1	3.3	4.9	9.4	7.1	10.6	0.3	5.6	3.3	8.7	3.4	2.9	pCi/L		E900.0
Gross Beta precision (+/-)	3.6	2.4	3.1	2.9	3.6	2.7	1.9	1.7	1.7	1.8	1.8	1.8	2.3	2.1	2.1	1.6	1.6	pCi/L		E900.0
Gross Beta MDC	2.6	3.0	3.4	2.8	3.3	3.2	3.0	2.7	2.6	2.9	2.7	3.0	3.8	3.4	3.3	2.7	2.6	pCi/L		E900.0
Radium 226	62.9	28	69	56	65	27	3.1	4.6	4.0	3.6	4.0	0.45	0.26	0.32	0.18	0.21	-0.02	pCi/L		E903.0
Radium 226 precision (+/-)	1.4	1.1	1.8	1.5	1.6	1.1	0.37	0.42	0.40	0.36	0.42	0.17	0.25	0.14	0.14	0.15	0.09	pCi/L		E903.0
Radium 226 MDC	0.2	0.22	0.21	0.20	0.21	0.20	0.21	0.14	0.18	0.18	0.19	0.19	0.34	0.17	0.19	0.21	0.2	pCi/L		E903.0
Radium 228	0.9	-0.1	0.06	1.0	0.81	0.86	0.33	0.23	0.25	0.17	0.64	-0.04	0.93	-0.2	1.2	-0.3	0.61	pCi/L		RA-05
Radium 228 precision (+/-)	0.7	0.66	0.79	0.9	0.66	0.86	0.69	0.67	0.81	0.62	0.81	0.67	1.5	0.52	0.64	0.64	0.65	pCi/L		RA-05
Radium 228 MDC	1.2	1.1	1.3	1.4	1.0	1.4	1.1	1.1	1.3	1.0	1.3	1.1	2.5	0.90	0.98	1.1	1	pCi/L		RA-05
Radon 222	120000	-	128000	73500	83100	863000	-	13800	11500	19400	14900	-	1070	1070	835	989	1100	pCi/L	100	D5072-92
Radon 222 precision (+/-)	436	-	378	312	335	494	-	143	207	171	161	-	59.9	66.6	54.7	68.3	52.8	pCi/L		D5072-92
Thorium 228	-	-	0.0	0.01	0.1	0.06	-	0.0	0.04	0.06	0.05	-	0.0	0.07	0.06	0.01	0.09	pCi/L		E907.0
Thorium 228 precision (+/-)	-	-	0.1	0.09	0.2	0.09	-	0.06	0.1	0.09	0.09	-	0.07	0.1	0.1	0.06	0.1	pCi/L		E907.0
Thorium 228 MDC	-	-	-	0.2	0.4	0.2	-	-	0.2	0.1	0.2	-	-	0.2	0.2	0.1	0.1	pCi/L		E907.0
Thorium 230	6.0	0.3	0.7	0.2	0.2	-0.1	0.0	0.0	0.04	-0.1	-0.09	0.0	0.0	0.2	-0.06	-0.1	-0.2	pCi/L		E907.0
Thorium 230 precision (+/-)	0.6	0.2	0.3	0.2	0.3	0.1	0.09	0.08	0.1	0.1	0.1	0.05	0.09	0.1	0.1	0.1	0.1	pCi/L		E907.0
Thorium 230 MDC	-	-	-	0.2	0.3	0.2	-	-	0.2	0.2	0.3	-	-	0.2	0.3	0.2	0.2	pCi/L		E907.0
Thorium 232	-	-	0.0	0.02	-0.02	0.0007	-	0.0	0.04	0.03	0.08	-	0.0	-0.004	-0.02	-0.01	0.03	pCi/L		E907.0
Thorium 232 precision (+/-)	-	-	0.08	0.09	0.1	0.07	-	0.06	0.09	0.09	0.1	-	0.05	0.08	0.08	0.05	0.08	pCi/L		E907.0
Thorium 232 MDC	-	-	-	0.2	0.3	0.2	-	-	0.2	0.2	0.2	-	-	0.2	0.2	0.1	0.2	pCi/L		E907.0
DATA QUALITY																				
A/C Balance (+/- 5)	-3.41		4.72	-4.92	-2.58	-2.61	-	3.96	-0.753	0.444	0.25	-	1.16	-2.46	-1.35	-2.58	-2.45	%		Calc.
Anions	7.83		7.90	7.81	7.91	8.01	-	6.67	6.57	6.80	6.80	-	7.82	7.64	7.95	8.31	8.17	meq/l		Calc.
Cations	7.32		8.68	7.08	7.51	7.60	-	7.22	6.47	6.86	6.83	-	8.01	7.27	7.74	7.90	7.78	meq/l		Calc.
Solids, Total Dissolved Calc.	498		545	496	485	521	-	459	430	452	449	-	521	490	522	538	529	mg/l		Calc.
TDS Balance (0.80 - 1.20)	1.02		0.930	1.06	1.08	0.950	-	0.950	0.990	0.960	0.980	-	1.00	1.07	1.01	0.900	1.01			Calc.

Appendix 9-H

Water Quality Data
2008-2010 Sampling
Multiple Aquifer/Unknown Formations of Completion

(Note: Volatile Organic Compounds and Synthetic Organic Compounds were not detected during sampling and are not given in the tables below. These data will be available upon request)

Table H-1. Multiple Aquifer/Unknown Formations of Completion Well Water Quality (Page 1 of 2)

Well ID Sample Date Sample Number	5 9/25/2008 RH08-0076	106 8/13/2008 RH08-0056	UNITS	R.L.	METHOD
FIELD MEASUREMENTS					
Water Level (Altitude)	7132	6835	ft.	HANNA Multi-meter	
pH	-	6.72	s.u.	HANNA Multi-meter	
Conductivity	-	3168	umhos/cm	HANNA Multi-meter	
Temperature	-	57.95	degrees F	HANNA Multi-meter	
Dissolved Oxygen	-	-	%	HANNA Multi-meter	
Total Dissolved Solids, TDS	-	-	mg/l	HANNA Multi-meter	
Turbidity	13.29	1.23	t.u.	HANNA Multi-meter	
MAJOR IONS					
Alkalinity, Total as CaCO3	333	154	mg/l	1.0	A2320 B
Carbonate as CO3	28	ND	mg/l	1.0	A2320 B
Bicarbonate as HCO3	349	188	mg/l	1.0	A2320 B
Hydroxide as OH	ND	ND	mg/l	1.0	A2320 B
Calcium	2	524	mg/l	1	E200.7
Chloride	4	46	mg/l	1	E300.0
Fluoride	1.0	0.5	mg/l	0.1	A4500-F C
Magnesium	ND	175	mg/l	1	E200.7
Nitrogen, Ammonia as N	0.1	ND	mg/l	0.1	E350.1
Nitrogen, Kjeldahl, Total as N	ND	ND	mg/l	0.5	E351.2
Nitrogen, Nitrate as N	-	-	mg/l	0.1	E353.2
Nitrogen, Nitrate + Nitrite as N	-	-	mg/l	0.05	E353.2
Nitrogen, Nitrite as N	ND	12.70	mg/l	0.1	A4500-NO2 B
Nitrogen, Total	ND	12.7	mg/l	0.5	A4500-N A
Potassium	ND	5	mg/l	1	E200.7
Silica	10.1	11.8	mg/l	0.2	E200.7
Sodium	177	243	mg/l	1	E200.7
Sulfate	57	2440	mg/l	1	E300.0
NON-METALS					
Organic Carbon, Total (TOC)	0.7	3.4	mg/l	0.5	A5310 C
Carbon, Total	2.1	3.6	mg/l	9.7	SW9060
Phenolics, Total Recoverable	-	-	mg/l	0.0	E420.1
Cyanide, Total	ND	ND	mg/l	0.005	Kelada mod
PHYSICAL PROPERTIES					
Color	20.0	5.0	c.u.	5.0	A2120 B
Conductivity	754	3650	umhos/cm	1	A2510 B
Corrosivity	0.30	0.51	unitless		Calc.
Hardness as CaCO3	6	2030	mg/l	1	A2340 B
Odor	NOO	NOO	T.O.N	1	A2150 B
pH	8.95	7.33	s.u.	0.01	A4500-H B
Solids, TDS @ 180 C	458	3440	mg/l	10	A2540 C

Table H-1. Multiple Aquifer/Unknown Formations of Completion Well Water Quality (Page 2 of 2)

Well ID Sample Date Sample Number	5 9/25/2008 RH08-0076	106 8/13/2008 RH08-0056	UNITS	R.L.	METHOD
METALS-DISSOLVED					
Aluminum	ND	ND	mg/l	0.1	E200.7
Antimony	ND	ND	mg/l	0.05	E200.8
Arsenic	ND	ND	mg/l	0.001	E200.8
Barium	ND	ND	mg/l	0.1	E200.8
Beryllium	ND	ND	mg/l	0.01	E200.7
Boron	0.4	0.1	mg/l	0.1	E200.7
Cadmium	ND	ND	mg/l	0.01	E200.8
Chromium	ND	ND	mg/l	0.05	E200.8
Cobalt	ND	ND	mg/l	0.01	E200.8
Copper	ND	ND	mg/l	0.01	E200.8
Iron	0.42	ND	mg/l	0.03	E200.8
Lead	ND	ND	mg/l	0.05	E200.8
Manganese	ND	0.12	mg/l	0.01	E200.8
Mercury	ND	ND	mg/l	0.001	E245.1
Molybdenum	ND	ND	mg/l	0.1	E200.8
Nickel	ND	ND	mg/l	0.05	E200.8
Selenium	ND	0.008	mg/l	0.001	E200.8
Silver	ND	ND	mg/l	0.01	E200.8
Thallium	ND	ND	mg/l	0.10	E200.8
Uranium	ND	0.0106	mg/l	0.0003	E200.8
Vanadium	ND	ND	mg/l	0.1	E200.8
Zinc	0.01	ND	mg/l	0.01	E200.8
METALS-TOTAL					
Uranium	0.0006	0.0112	mg/l	0.0003	E200.8
RADIONUCLIDES-TOTAL					
Gross Alpha	2.8	11.7	pCi/L		E900.0
Gross Alpha precision (+/-)	1.2	9.9	pCi/L		E900.0
Gross Alpha MDC	1.6	15.2	pCi/L		E900.0
Gross Beta	-2.0	0.9	pCi/L		E900.0
Gross Beta precision (+/-)	1.8	7.9	pCi/L		E900.0
Gross Beta MDC	3.0	13.2	pCi/L		E900.0
Radium 226	0.04	0.13	pCi/L		E903.0
Radium 226 precision (+/-)	0.10	0.13	pCi/L		E903.0
Radium 226 MDC	0.16	0.19	pCi/L		E903.0
Radium 228	-0.02	2.1	pCi/L		RA-05
Radium 228 precision (+/-)	0.79	0.78	pCi/L		RA-05
Radium 228 MDC	1.3	1.2	pCi/L		RA-05
Radon 222	205	493	pCi/L	100	D5072-92
Radon 222 precision (+/-)	67.9	51.7	pCi/L		D5072-92
Thorium 228	ND	0.1	pCi/L		E907.0
Thorium 228 precision (+/-)	0.2	0.2	pCi/L		E907.0
Thorium 228 MDC	-	-	pCi/L		E907.0
Thorium 230	0.5	1.1	pCi/L		E907.0
Thorium 230 precision (+/-)	0.2	0.4	pCi/L		E907.0
Thorium 230 MDC	-	-	pCi/L		E907.0
Thorium 232	0.0	0.0	pCi/L		E907.0
Thorium 232 precision (+/-)	0.1	0.1	pCi/L		E907.0
Thorium 232 MDC	-	-	pCi/L		E907.0
DATA QUALITY					
A/C Balance (+/- 5)	-1.08	-4.47	%		Calc.
Anions	8.03	56.00	meq/l		Calc.
Cations	7.85	51.20	meq/l		Calc.
Solids, Total Dissolved Calc.	456	3590	mg/l		Calc.
TDS Balance (0.80 - 1.20)	1.00	0.96			Calc.

Appendix 9-I

Analysis of Aquifer Test of the Westwater Canyon Member of the Morrison Formation
Using RHR Well S-4-Jmw-CH-07 Located at 13N.8W.16.141, McKinley County, NM

AQUIFER TEST ANALYSIS OF THE WESTWATER CANYON MEMBER OF THE MORRISON FORMATION USING RHR WELL S-4-JMW-CH-007 LOCATED AT 13N.8W.16.141 MCKINLEY COUNTY, NM

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Prepared for

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Acronyms and Abbreviations

AF	acre-feet
BDR	Baseline Data Report
BE	Barometric Efficiency
bgs	below ground surface
dtw	depth to water
ft	foot (feet)
ft/yr	feet per year
ft/day	feet per day
ft^2/day	feet squared per day
gpd/ft	gallons per day per foot
GMRC	Gulf Mineral Resources Company
gpm	gallons per minute
HAI	Hydroscience Associates, Inc.
K	hydraulic conductivity
KMC	Kerr-McGee Corporation
LSD	Land surface datum
MP	measuring point
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMPM	New Mexico Prime Meridian
RGRC	Rio Grande Resources Corporation
RHR	Roca Honda Resources, LLC
S	storage coefficient
SAP	Sampling and Analysis Plan
Sy	specific yield
T	transmissivity
TDS	total dissolved solids
USGS	United States Geological Survey
µg/L	micrograms per liter
µmhos	micromhos

1.0 Executive Summary

During May, 2010, Roca Honda Resources, LLC (RHR) and Hydroscience Associates, Inc. (HAI) performed an aquifer test of the Jurassic age Westwater Canyon Member of the Morrison Formation within the RHR proposed permit area. The aquifer test was performed for the purposes of determining the hydraulic characteristics of the Westwater Canyon Member within the RHR permit area, and of identifying sub-surface hydrogeologic boundaries. RHR's well S-4-Jmw-CH-007 was pumped at an average rate of 133.6 gallons per minute (gpm) for 120 hours (five days) while the hydraulic heads in two other RHR wells fully screened in the Westwater Canyon Member were monitored (wells S-3-Jmw-CH-07 and S-1-Jmw-CH-007). The RHR wells had been drilled in 2007 as deep groundwater monitor wells on the proposed RHR uranium property in Section 16 of Township 13 North, Range 8 West, NMPM. Water levels in well B-851, the Lee Mine shaft, which bottomed in the Westwater Canyon Member, and water levels in well B-1084, which is screened in the Cretaceous Gallup Sandstone, were also monitored.

Analysis of the test data indicates that within the RHR permit area the Westwater Canyon Member exhibits an average transmissivity of between 80 and 200 ft^2/day, and a storage coefficient of 0.0002 (2.0×10^{-4}). These values are in the middle of the documented range of transmissivity and storage of the Westwater Canyon Member in the Ambrosia Lake/San Mateo area of the San Juan Basin of northwestern New Mexico. *See* RHR BDR, Section 9 (January 2011)[1].

A probable sub-surface barrier to the movement of groundwater was identified at a location of 1,100 feet east of wells S-1 and S-3. This may represent an extension of the San Rafael fault.

1.1 Location

The aquifer test site is located in the N ½ of Section 16 in Township 13 North, Range 8 West, NMPM, within the boundaries of the RHR permit area. The permit area encompasses Sections 9, 10, and 16 of T13 N, R8 W, and is located about 22 miles northeast of the town of Grants, New Mexico, seven miles east of the center of the Ambrosia Lake uranium mining district, and a few miles northwest of the community of San Mateo. The permit area is currently in the process of being permitted for an underground uranium mine. Figure 1 shows the location of the permit area.

The aquifer test site straddles two low mesas separated by a broad arroyo. The RHR wells are located on top of the mesas at elevations of 7,220 (S-3) and 7,260 (S-4 and S-1) feet above sea level. Well B-851 well and B-1084 are about 100 feet lower and located just west of the permit area and across Rafael Canyon in the NE ¼ of Section 17, T13N R8W. The groundwater pumped from well S-4 was discharged into a one-acre square pond in Rafael Canyon lined with synthetic material. The pond had a capacity of approximately 12 acre-feet (AF). Figure 2 shows the location of the pumping and observation wells and the pond.

[1] The reference is to Revision 1 of the RHR BDR, dated January 2011. This aquifer test analysis report has been updated to incorporate references to that document rather than to the 2009 RHR BDR.

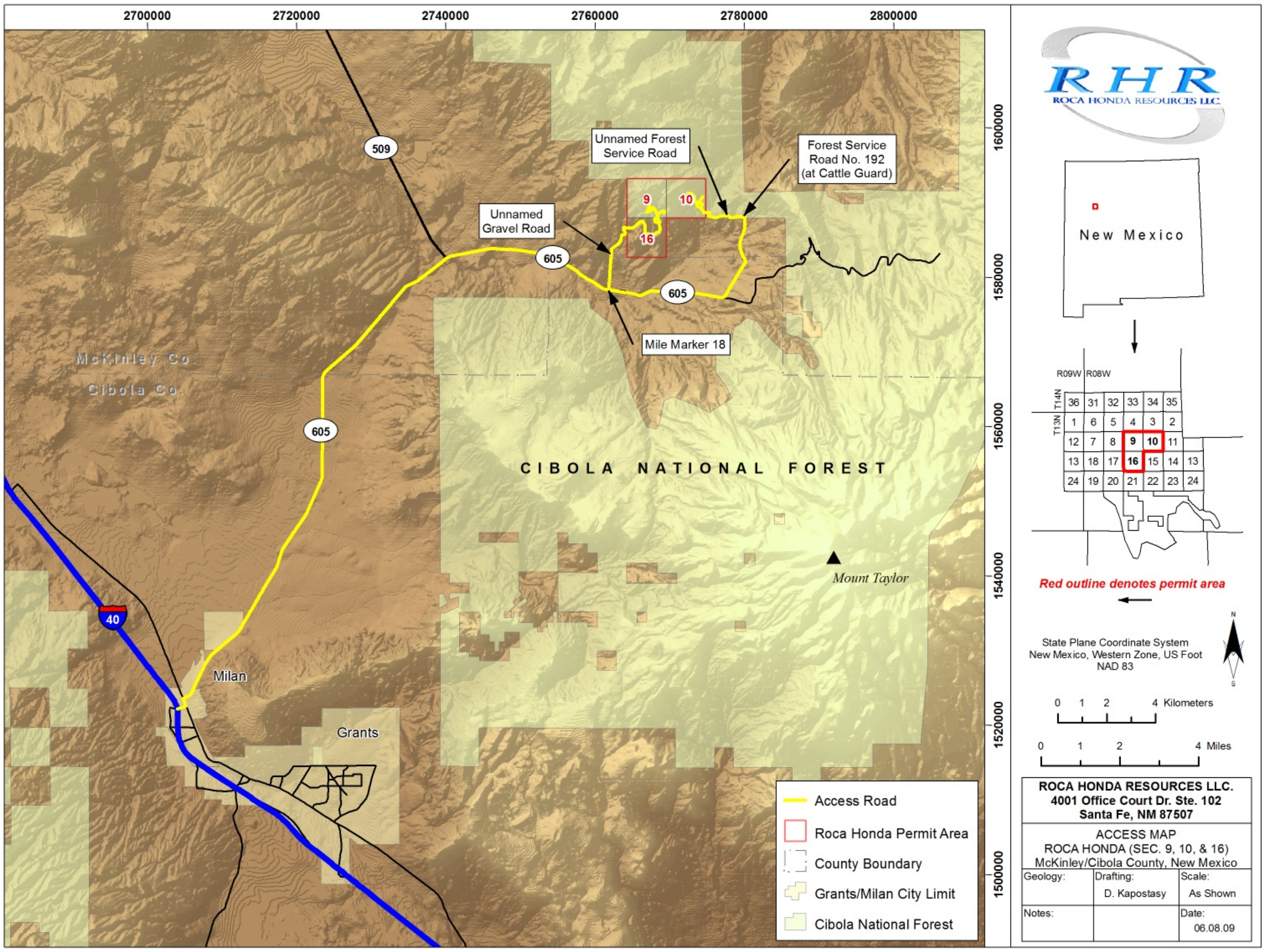

Figure 1. Location of RHR Permit Area[2]

[2] Figure 1 is from the RHR Baseline Data Report (January 2011).

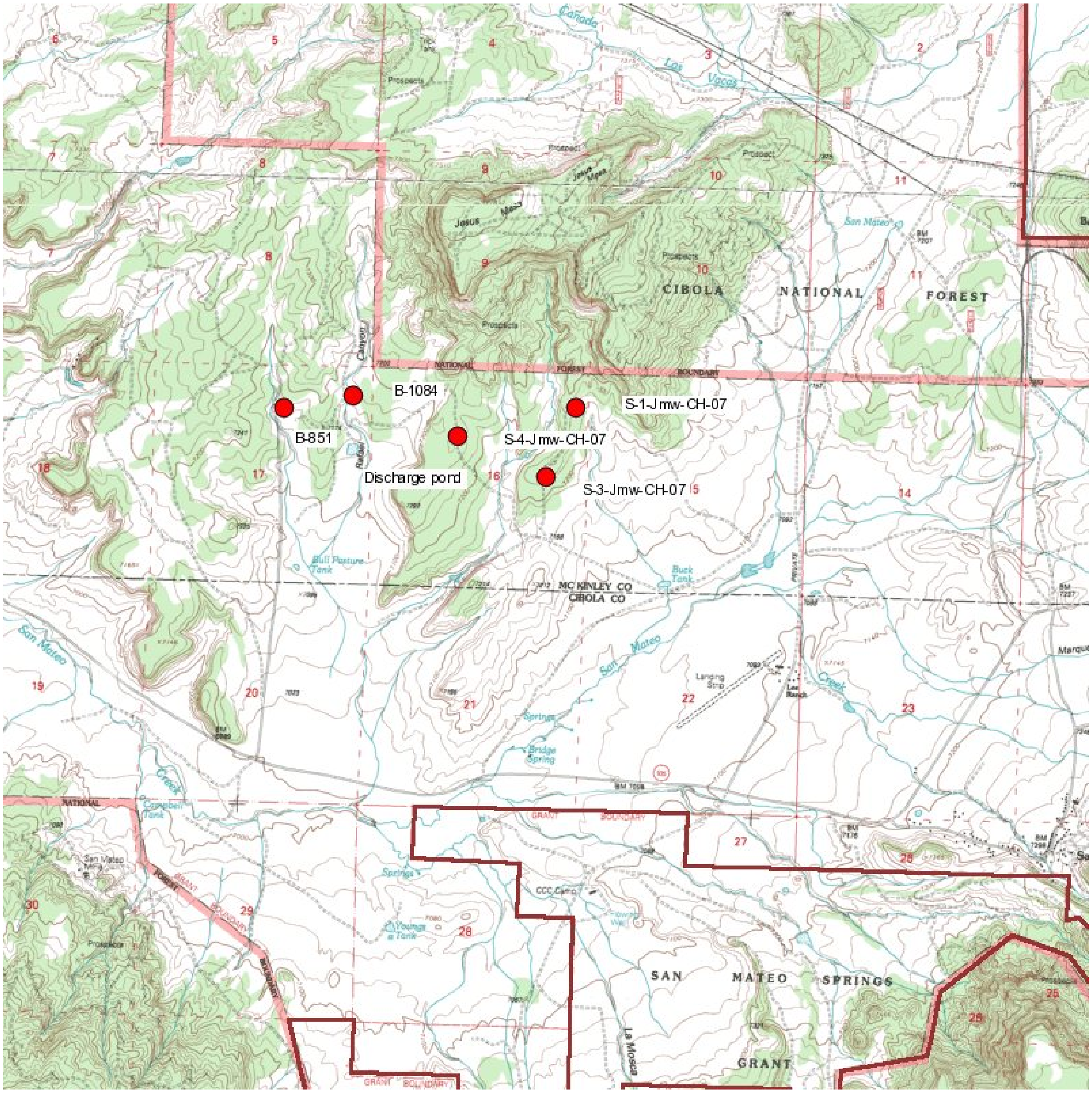

Figure 2. Location of Wells used in RHR Aquifer Test

2.0 Physical Characteristics of Wells used in the Test

2.1 RHR Wells

Wells S-4-Jmw-CH-07, S-3-Jmw-CH-07, and S-1-Jmw-CH-07 were drilled in 2007 within Section 16 of Township 13 North, Range 8 West, NMPM, for monitoring and aquifer testing purposes. Water chemistry data and hydraulic head collected from these wells are included in RHR's Baseline Data Report (RHR BDR, 2011). The continuing data collection program is described in the RHR Sampling and Analysis Plan (RHR SAP, 2009). The three wells fully penetrate the Westwater Canyon Member of the Morrison Formation and are screened across the entire aquifer. S-4 is 1919 feet in depth; S-3 is 2043 feet deep, and S-1 is 2108 feet deep. Table 1 summarizes information about the wells. The Well Records for these wells are included in Appendix A. Schematics of the well designs are presented in Figure 3.

Table 1. RHR Westwater Canyon Member Well Characteristics Summary Table

Well	S-4-Jmw-CH-07	S-3-Jmw-CH-07	S-1-Jmw-CH-07
Date Completed	8/07/07	10/7/07	12/30/07
Location TRS ¼ ¼ ¼	13N 8W 16.141	13N 8W 16.421	13N 8W 16.224
Location (NAD 83 State Plane)	y=1585983 x=2765285	y=1584534 x=2767419	y=1586623 x=2768192
LSD Elevation (ft)	7248	7222	7262
Depth (ft)	1919	2043	2108
Formation	Jmw	Jmw	Jmw
Screened Interval (ft)	1707.43-1897.9	1851.68-2022.3	1880.1-2098.0
Screen Length (ft)	190.5	170.6	217.9
Screen material	A304 stainless steel slotted casing	A304 stainless steel slotted casing	A304 stainless steel slotted casing
Casing diameter (in)	18" surface casing to 25' bgs, 8 5/8" 0 to 1897' bgs	18" surface casing to 25'bgs, 8 5/8" 0 to 2042'bgs	18" surface casing to 29'bgs, 10 5/8" 0 to 1437'bgs, 8 5/8" surface to 1870'bgs, 4" from 1870' to 2108'bgs
Casing Material	A304 stainless steel	A304 stainless steel	A304 stainless steel
Pump	Grundfos 60 HP	Grundfos 60 HP	Grundfos 10 HP
Pump capacity (gpm)	150	150	16
Pump setting (ft bgs)	1697.0	1848.9	1818.7
Distance from S-4 (ft)	0	2580.9	2978.1
E-line MP	From top of sounder tube, 2.37' above LSD	From top of sounder tube, 1.8' above LSD	From top of sounder tube, 2.8' above LSD
Static MP DTW (ft)	865.55	830.22	871.12

During the aquifer test, well S-4 was pumped and hydraulic heads were monitored at S-4 and observation wells S-3 and S-1.[3]

2.2 Additional Observation Wells

The water levels in well B-851 in the NE ¼ of Section 17, T13N, R8W was also monitored during the aquifer test. Well B-851 is the Lee Mine uranium mine shaft sunk by Kerr McGee in the early 1980s. The well record reports that the shaft bottomed at 1469 feet bgs in the upper part of the Westwater Canyon Member of the Morrison Formation and is open to this geologic unit. The shaft walls were reportedly sealed as the shaft was sunk, meaning that the water level measured in the shaft should represent the hydraulic head in the Westwater Canyon Member. The shaft opening is covered with a steel plate. The Lee Ranch has installed a well casing through the shaft covering and dropped in a small pump that pumps at less than 10 gpm to keep a small tank filled. The measured hydraulic heads and water chemistry are consistent with that of groundwater in the Westwater Canyon Member. A few hundred yards east of well B-851, also in the NE of Section 17 of T13N R8W, is well B-1084, owned by the Lee Ranch. This well is reportedly 320 feet deep and produces from the Cretaceous Gallup Sandstone.

[3] The term "hydraulic head" refers to total energy of groundwater, produced by elevation, pressure, and velocity. The velocity term is very small in groundwater and is usually disregarded. The "head" of an unconfined aquifer (the water table is exposed to the atmosphere) is essentially equivalent to the elevation of the water column. The "head" of a confined aquifer is the sum of the elevation head and the confined pressure head, which is the distance between the top of the aquifer and the water level in the well.

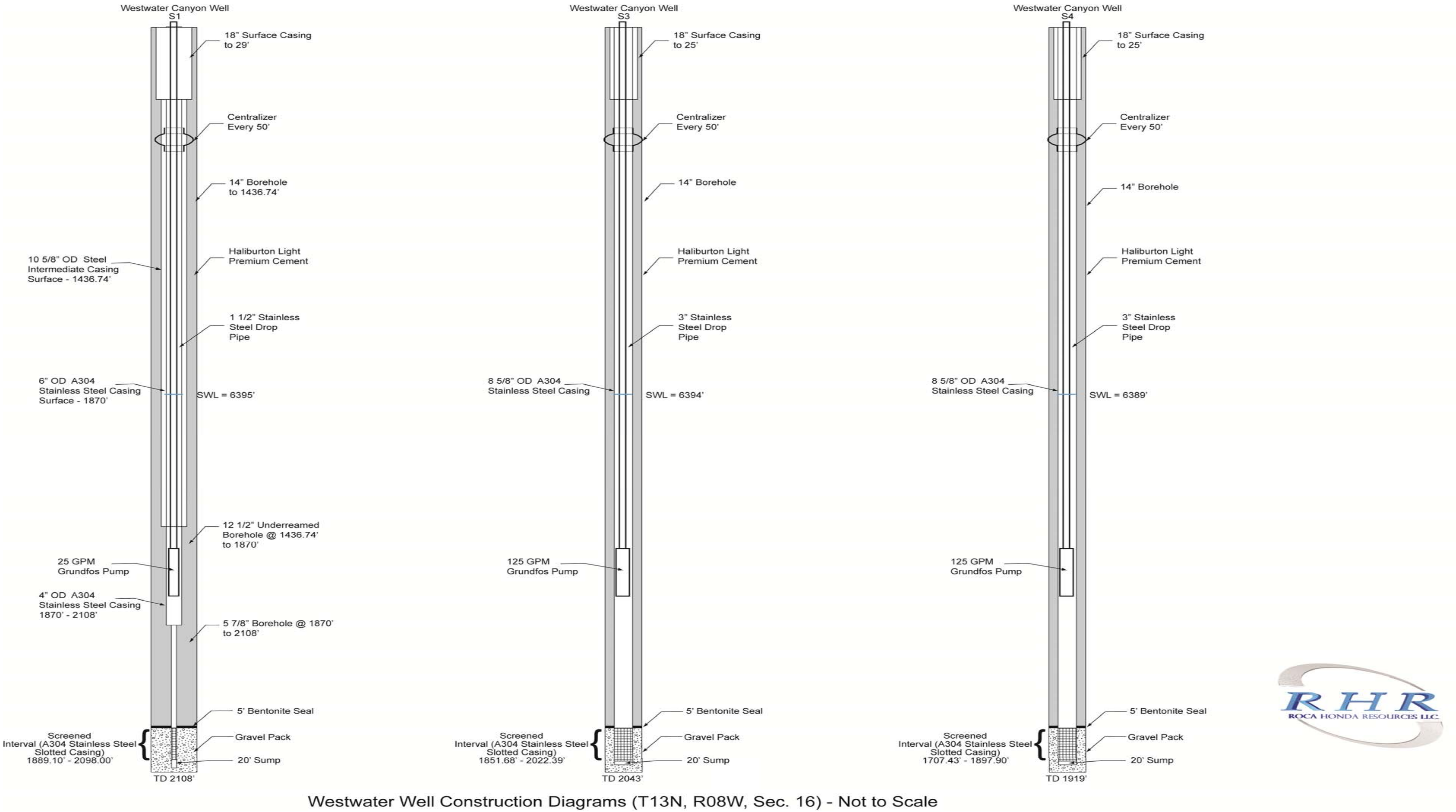

Figure 3. RHR Westwater Canyon Member Well Contruction Diagrams[4]

[4] Figure 3 is from the RHR BDR.

3.0 Geologic Setting

3.1 Regional Geologic Setting

The Roca Honda permit area is located in the southeastern part of the Colorado Plateau physiographic province on the south flank of the San Juan basin (referred to as the Chaco slope) near the boundary between the Chaco slope and the Acoma sag.[5] Within the permit area, sedimentary strata mainly of Mesozoic age dip gently northeast into the central basin part of the San Juan basin. The Neogene age volcano Mt. Taylor rises less than 5 miles south of the permit area.

The permit area is structurally complex and bounded by faults and fold axes oriented north to north-northeast, probably resulting from Laramide age compression. Located on the right flank of the faulted Fernandez monocline, the permit area is bounded by two large fault zones. To the southeast of the permit area, the San Rafael fault zone cuts the Fernandez monocline and has right-lateral displacement. Two miles to the west, the large northeast-striking normal San Mateo fault has vertical displacement of as much as 450 ft. Other faults in or near the permit area are mostly normal with dip-slip displacement and vertical movement less than 40 ft. Strata in the permit area along the Fernandez monocline dip east to southeast at 4 to 8 degrees toward the McCartys syncline, an expression of the Acoma sag. Figure 4 shows the regional structural features and the locations of the faults.

3.2 Aquifer Test Site Geology

The surface geology of the permit area is shown in Figure 5. It should be noted that there are differences between this map and the 1966 Geologic Map of the San Mateo Quadrangle by Santos (USGS GQ-517, 1966). RHR geologists re-mapped the geology of the permit area and determined that some large outcrops in Section 16 in the area of the aquifer test that were mapped as Mancos Shale by Santos (1966) are actually rocks of the Dalton Sandstone Member of the Crevasse Canyon Formation, a lower unit of the Mesaverde Group. The Dalton Sandstone Member is a regressive marine beach sandstone that is as much as 100 ft thick.

[5] For a more detailed discussion of the regional geologic setting, see RHR BDR (2009).

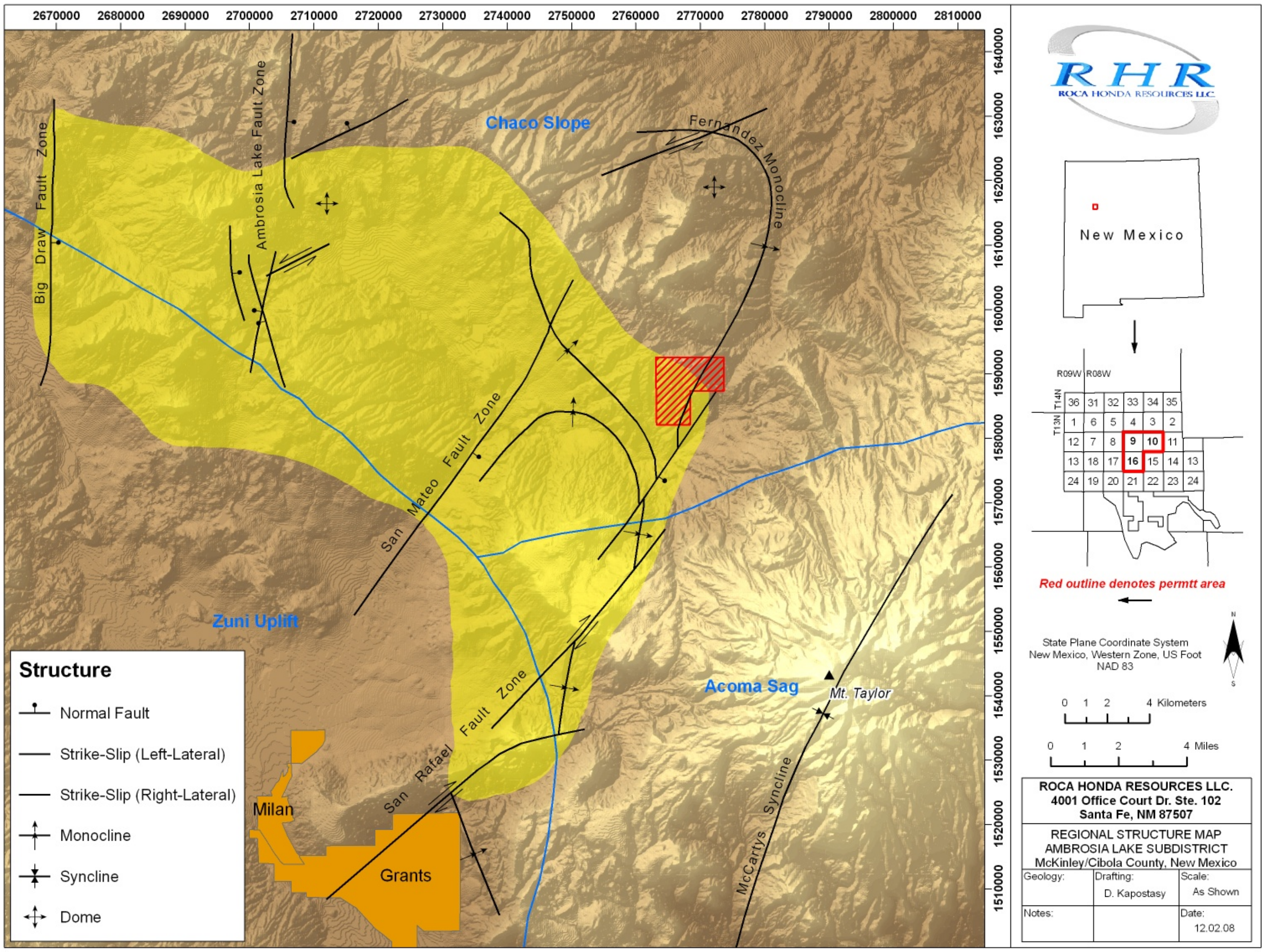

Figure 4. Location of RHR Permit Area and Major Structural Features of the Southeastern San Juan Basin[6]

[6] Figure 4 is Figure 9-3 from Section 9 of the RHR BDR (January 11, 2011).

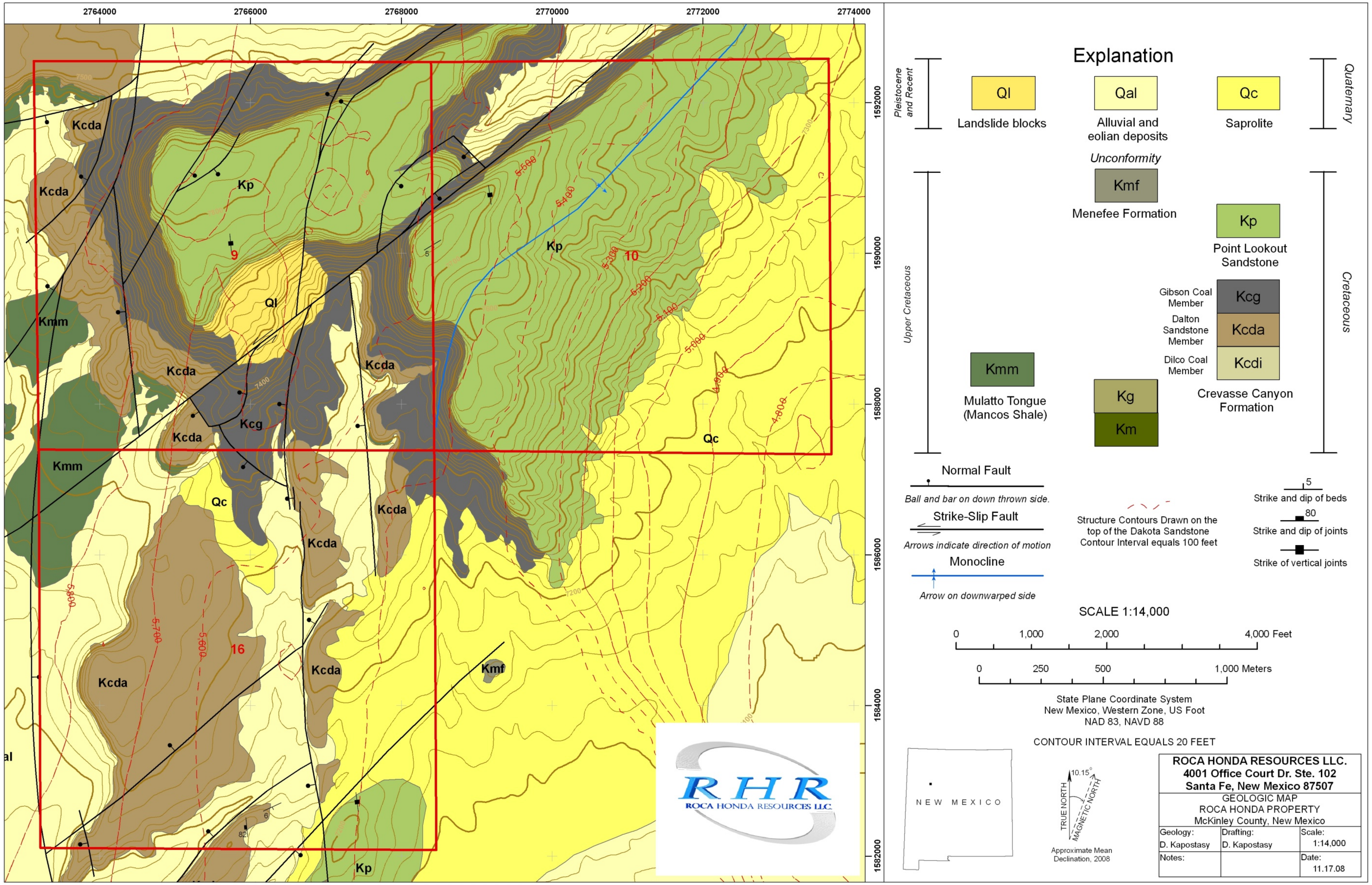

Figure 5. Surface Geology of the RHR Permit Area[7]

[7] Figure 5 is taken from Section 7 "Geology" of the RHR BDR (January 2011)

The sub-surface geology in Section 16 is shown in Figures 6 and 7.[8] Below the Dalton Sandstone Member is the Mulatto Tongue of the Mancos Shale, a deposit of marine shale and silty sandstone approximately 300 feet thick in the permit area. Underlying the Mulatto Tongue is the Borrego Pass Lentil, a transgressive marine sandstone that boreholes drilled in 2007 in the permit area indicate is about 40 ft thick. Below this unit is the Dilco Coal Member, also part of the Crevasse Canyon Formation. This unit is comprised of an average thickness of about 120 ft of thin sandstone, shale, and discontinuous coal beds representative of a back-shore swamp environment. The lowest formation of the Mesaverde Group is the Gallup Sandstone, which is separated into two units by the thin Pescado Tongue of the Mancos Shale. The upper unit (or main body) of the Gallup Sandstone is a regressive marine beach sandstone that is fine- to medium-grained and is about 75 ft thick. The approximately 20-ft thick Pescado Tongue, consists of thin alternating and inter-fingering beds of sandstone, siltstone, and shale. A thin, fine- to coarse-grained sandstone (average thickness of about 10 ft) forms the basal bed of the Gallup Sandstone.

Underlying the Gallup Sandstone is the main body of Mancos Shale, which in the Roca Honda permit area averages about 710 ft. The marine deposits of this formation consist mainly of dark gray to black silty shale with minor interbedded sandstone. In the permit area, the main body of Mancos Shale is underlain by the Twowells Sandstone Tongue of the Dakota Sandstone, which is about 50 ft thick. Underlying the Twowells Sandstone Tongue is the Whitewater Arroyo Shale Tongue of the Mancos Shale, which is about 150 ft thick. In the permit area, the base of the Mancos Shale is considered to be the base of the Whitewater Arroyo Shale Tongue. The marine shore-face deposits of Dakota Sandstone are composed mainly of fine-grained gray sandstone. In the permit area, the Dakota Sandstone is approximately 50 ft thick.[9] The Dakota Sandstone is the lowermost Upper Cretaceous formation, and unconformably overlies the Upper Jurassic Morrison Formation.

Four members of the Morrison Formation are recognized by the USGS in the Grants uranium district.[10] These members are, in descending order; Jackpile Sandstone Member, Brushy Basin Member, Westwater Canyon Member, and Recapture Member. The uppermost fluvial sandstone in the formation, the Jackpile Sandstone Member, was not deposited in the permit area, but is present east of Mt.Taylor where it hosts uranium mineralization in the Laguna subdistrict. The uppermost member of the Morrison Formation in the Roca Honda permit area is the Brushy Basin Member. The Brushy Basin Member is a mostly greenish-gray mudstone of variable thickness (22 to 269 ft), which in the permit area averages approximately 105 ft. The underlying Westwater Canyon Member sediments consist of gray, light yellow-brown, and reddish-gray fluvial sandstone and claystone that are as much as 250 ft thick in the permit area. About 200 feet of Westwater Canyon Member were encountered in each of the three RHR wells used in the aquifer test. The Westwater Canyon Member is the major uranium ore-bearing formation in the southeastern San Juan Basin. It is underlain by grayish-red siltstone and claystone of the Recapture Member.

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[8] Much of the discussion in this section is taken from Section 9 of the January 2011RHR BDR.

[9] The main unit of Dakota Sandstone is considered to be comprised of four members, which in descending stratigraphic order are: Paguate Sandstone Tongue of the Dakota Sandstone, Clay Mesa Shale Tongue of the Mancos Shale, Cubero Sandstone Tongue of the Dakota Sandstone, and Oak Canyon Member of the Dakota Sandstone. These members are not separated out in Figures 6 and 7.

[10] The nomenclature used by RHR reflects the classic terminology and division of members of the Morrison Formation as defined in the 1950s and 1960s. A more simplified division of the Morrison Formation based on sequence stratigraphy was developed in the 1990s by the New Mexico Bureau of Geology and Mineral Resources (Lucas and Anderson 1998), but has recently been discredited. (Turner, in NMGS, 2010).

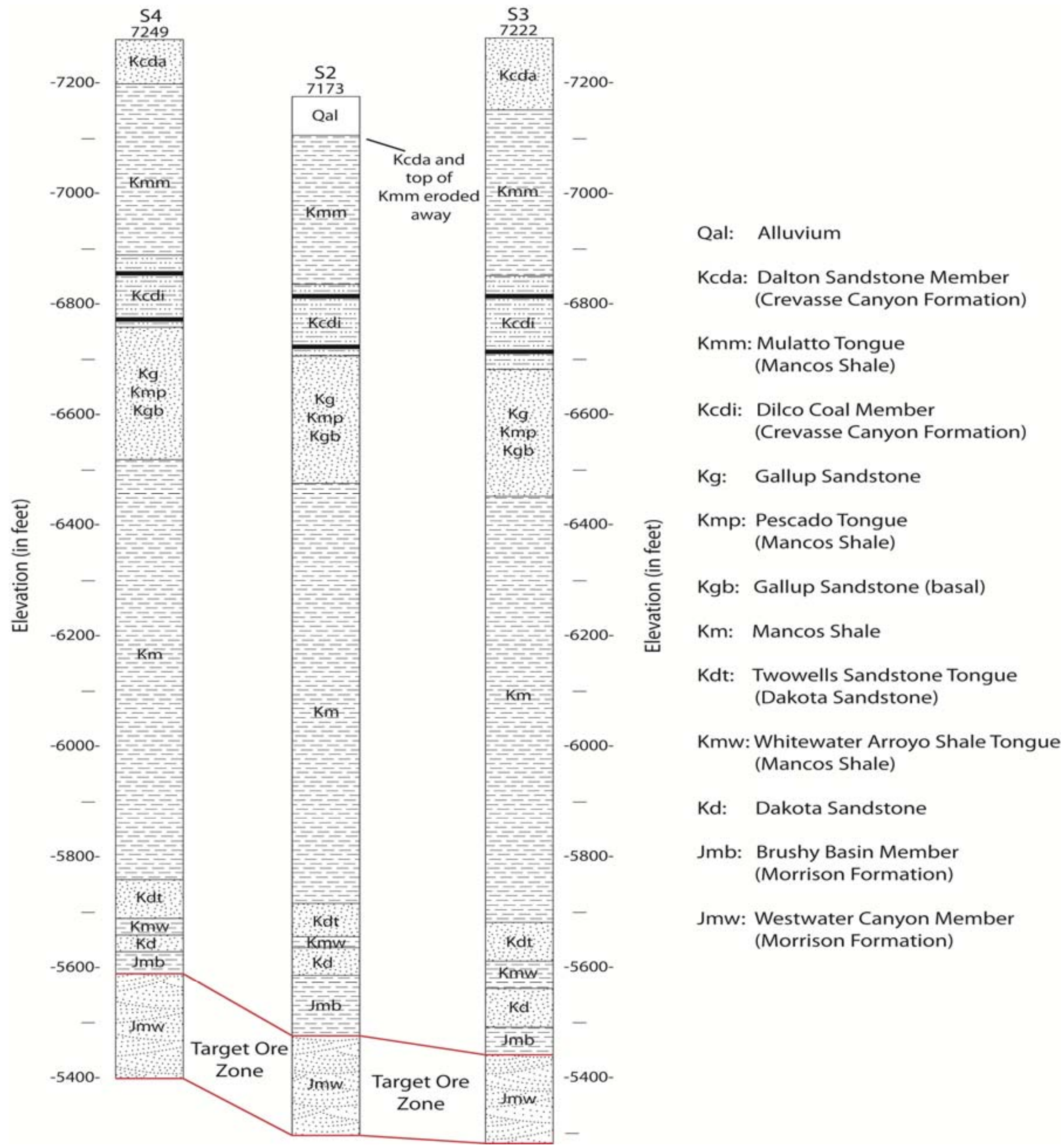

Figure 6. Stratigraphy of the RHR's Monitor Wells/Borehole[11]

[11] Figure 6 is Figure 9-2 from Section 9 of the RHR BDR (January 2011). Well S-2 was located between Wells S-4 and S-3 but collapsed prior to completion and was abandoned according to approved OSE procedures

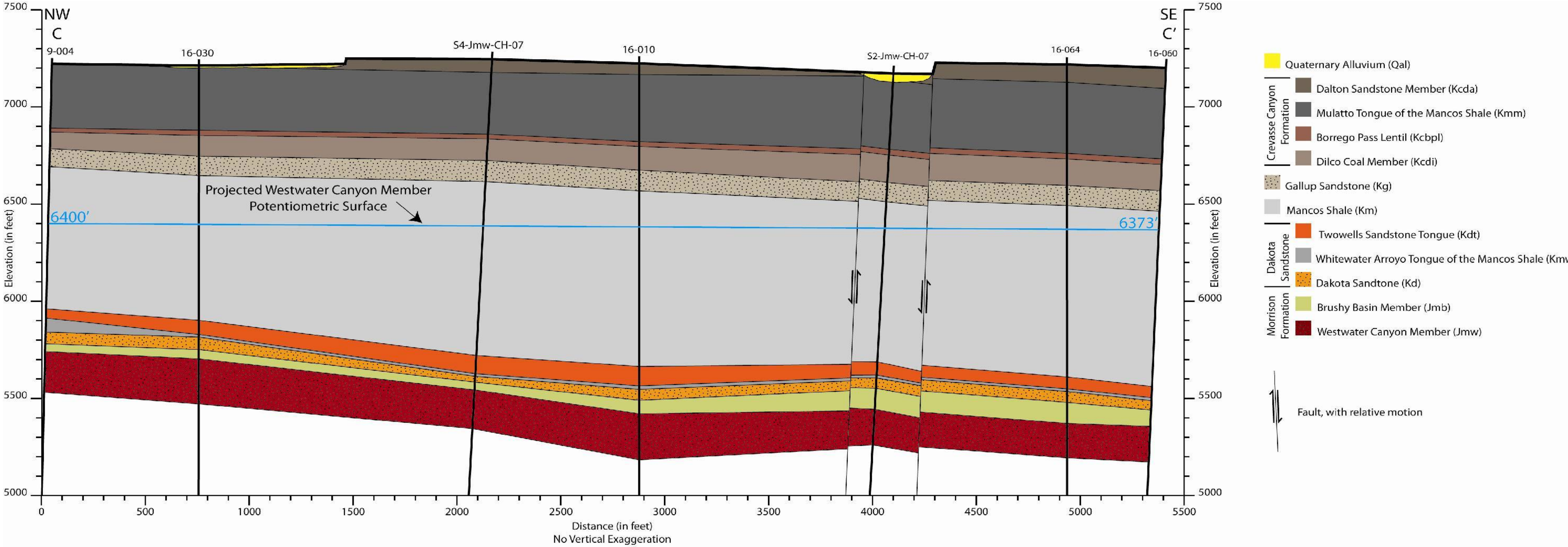

Figure 7. Schematic Geologic NW-SE Cross-section through the Aquifer Test Area

4.0 Hydrology

4.1 Regional Hydrology[12]

The Roca Honda permit area is in the southeastern part of the San Juan structural basin in northwestern New Mexico. The San Juan structural basin is an artesian basin. In general, recharge enters the groundwater flow systems as precipitation on permeable formations which crop out along the southern margin of the basin and on the flanks of the Zuni, Chuska, and San Mateo Mountains. Groundwater then flows down-gradient northwestward to discharge along the San Juan River, and northeastward and eastward to discharge to tributaries of the Rio Grande including the Rio Salado, Rio Puerco, and Rio San Jose, and to springs which discharge along faults (Stone et al. 1983). As groundwater moves down-gradient from the recharge area within permeable formations, it is prevented from moving vertically by overlying shale units which act as aquitards, and at the center of the basin, high artesian heads are present in most bedrock aquifers. The general pattern of deep groundwater flow in the Jurassic and Cretaceous aquifers through the southeastern San Juan Basin seems to be east-northeastward.

Jurassic and Cretaceous aquifers within the southeastern part of the San Juan basin include, from deepest to shallowest, the Upper Jurassic Westwater Canyon Member of the Morrison Formation, the Upper Cretaceous Dakota Sandstone, the Upper Cretaceous Gallup Sandstone of the Mesaverde Group, the Upper Cretaceous Crevasse Canyon Formation of the Mesaverde Group, and the Upper Cretaceous Point Lookout Sandstone and Menefee Formation of the Mesaverde Group.[13] Whether a particular formation is used as an aquifer in an area of the basin is dependent on the depth to groundwater, formation yield, and quality of groundwater as well as the presence of shallower aquifers. Thick aquitards separate the aquifers. Groundwater in the Westwater Canyon Member is hydraulically isolated from groundwater in deeper aquifers by the Recapture Member of the Morrison Formation and, in unfaulted areas, from groundwater in the overlying Dakota Sandstone by the Brushy Basin Member of the Morrison Formation. The main body of the Mancos Shale functions as an aquitard between the Dakota Sandstone and the Gallup Sandstone. A similar aquitard, the Mulatto Tongue of the Mancos Shale, lies above the Gallup Sandstone between the Dilco Coal Member and the Dalton Sandstone Member of the Crevasse Canyon Formation. The Satan Tongue of the Mancos Shale splits the sandstones of the Point Lookout Sandstone. Shale units in the lower Menefee Formation may form hydraulic barriers between groundwater in it and the Point Lookout Sandstone.

4.2 Aquifer Test Site Hydrology

Two aquifers are present within 2,100 feet of land surface in the aquifer test site area: 150 feet of Gallup Sandstone, the top of which is found between 520 and 660 feet bgs, and 200 feet of Westwater Canyon Member of the Morrison Formation, the top of which is found between 1700 and 1900 feet bgs, depending on well location. The aquifer test was conducted in the Westwater Canyon Member. Between the two aquifers lie other Cretaceous and Jurassic strata, including over 850 feet of Mancos Shale. The Mancos Shale is a dark marine shale that is usually considered to be an aquitard.

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[12] The text in this section is taken from Section 9 of the RHR BDR (2011).

[13] Because of the poor quality of groundwater in it, and the availability of better aquifers above and just below it, the Dakota Sandstone is rarely used as an aquifer. Geologic units within the Crevasse Canyon rarely function as aquifers for a number of reasons.

The Westwater Canyon Member is a confined aquifer in the area of the aquifer test. It is a classic example of an artesian aquifer. Recharge occurs when surface water infiltrates the geologic strata in and around the Zuni and Defiance uplifts and moves downdip toward the deeper parts of the San Juan basin. Brod and Stone (1981) indicate that much of the groundwater recharge to the deep confined system occurs in drainage-ways on the bedrock outcrops along the western basin margins, and as seepage into fractures. They note that San Mateo Creek is a source of recharge to this deep aquifer system, contributing recharge where it flows over outcrop areas.

Groundwater within this deep system moves through the RHR permit area. Water levels measured in the three deep monitor wells completed by RHR in the Westwater Canyon Member within the permit area indicate that the groundwater system within that aquifer in the aquifer test area is continuous with the system in the Westwater Canyon Member in the southern San Juan basin.[14] The potentiometric surface in the Westwater Canyon Member through the Roca Honda permit area is shown in the cross section in Figure 7. The depth to groundwater in well S-4 was 865.55 feet bgs prior to commencement of the aquifer test.

Reported transmissivity values of the Westwater Canyon Member range from 50 to 500 ft^2/day, and the horizontal hydraulic conductivity has been estimated to be about 0.1 ft/day. Reported storage coefficients range from $2x10^{-4}$ to 2×10^{-5}. See RHR BDR, Table 9-13, (2011). The section of the present report entitled "Comparison of aquifer test results with reported hydraulic parameter values" discusses previously reported hydraulic parameter values in more detail.

Groundwater moves through the Gallup Sandstone in a confined system separate from the deep aquifer system. Dam (1995) and Kernodle (1996) show a potentiometric surface within Gallup Sandstone that indicates flow to the east-northeast in the Roca Honda/San Mateo area. Insufficient data exist to further refine this projection in the area of the aquifer test. The transmissivity of the Gallup Sandstone is reported to range from 15 to 389 ft^2/day, and the horizontal hydraulic conductivity to range from of .1 to 1.0 ft/day. Storage values from $2x10^{-6}$ to 3.3×10^{-6} have been reported. See RHR BDR, Table 9-13 (2011). The depth to groundwater in the 1150 foot well B-1442-EXPL-2, located in the SW ¼ NW ¼ SW ¼ of Section 23 in 13N 8W and partly screened in the Gallup Sandstone, was reported to be 107 feet in 2002.

5.0 Aquifer Test

An aquifer is a saturated geologic formation or group of formations that is capable of yielding a sufficient quantity of water to wells. The nature of the geologic materials that constitute the aquifer and the physical extent of the aquifer determine the ability of the aquifer to store and transmit groundwater. The hydraulic parameters that describe these factors are called "storage" (S), "specific storage" (Ss: S divided by aquifer thickness), or "specific yield" (Sy, for unconfined aquifers) for storage properties; and "hydraulic conductivity" (K) or "transmissivity" (T, which is hydraulic conductivity multiplied by aquifer thickness), for transmission properties. S and Sy are dimensionless; K is expressed in length per time (L/T), and transmissivity is in length squared per time (L^2 /T). These parameters cannot be measured directly, but can be

[14] The projected potentiometric surface for the Westwater Canyon Member in the Roca Honda/San Mateo area as constructed from available data is shown in Figure 9-6 of the RHR Baseline Date Report (2011). Groundwater appears to be moving to the northeast. However, very few data points were available to construct the potentiometric surface map, and it is possible that subsurface movement has a more easterly trend.

quantitatively estimated through analysis of measurements of the decline in hydraulic head vs. time collected while an aquifer is stressed by pumping a well at a known rate. The collection of these data during the pumping of a well is called an “aquifer test.” Aquifer tests provide *in situ* hydraulic parameter values that are averaged over a large representative aquifer volume. Analysis of aquifer test data can also provide valuable insight into the presence of sub-surface geologic boundaries whose presence might affect the movement of groundwater through the aquifer.

5.1 Summary of the S-4 Aquifer Test

The pumping portion of the aquifer test was run for 120 hours from May 12 through May17, 2010, using RHR well S-4-Jmw-CH-2007 as the pumping well. RHR wells S-3-Jmw-CH-2007 and S-1-Jmw-Ch-2007, well B-851, and Gallup Sandstone well B-1084 were observation wells. Water level declines were measured using transducers and e-lines. Recovery of water levels after the pumping well was turned off was monitored regularly using transducers and e-lines for 190 hours after cessation of the pumping portion of the test. A final set of measurements was taken with e-lines at 25 days after the end of the test. The aquifer test was run according to RHR’s standard procedures as outlined in Appendix A “Aquifer Test Design Procedure and Protocol” to the RHR SAP, (2009). RHR personnel were on site at all times during the test until the transducers were pulled after eight days of recovery. Hydroscience Associates, Inc. was on site during pre-test set up and during the first days of the pumping and recovery portions of the test.

Transducers were installed in the pumping well and all observation wells except Gallup Sandstone well B-1084 on April 30 and 31st, two weeks prior to commencement of the aquifer test. Water level measurements were taken in all wells with electronic water level tapes (“e-lines”) prior to and at regular intervals during the test. Figure 8 is a photograph of the aquifer test set-up at the pumping well, S-4. Barometric pressure was monitored at the RHR weather station, located near the aquifer test site.

Pumping commenced at 11:15 AM on May 12. The pumped water was transported through a pipeline to a lined pond 4,300 feet to the west. Figure 9 is a photograph of the discharge pond. The discharge rate was measured with a totalizing meter and a magmeter. The meter readings were consistent. The initial discharge rate was 146 gpm, but this rate quickly dropped and averaged 133.6 gpm for the test. Table 2 (at end of report) tabulates the pumping rates as measured during the test. Figure 10 is a graphical presentation of the pumping rates.

The initial static water level in the pumping well was 865.55 feet below the measurement point, which was at the top of the casing, 2.37’ above LSD. The total hydraulic head drop in well S-4 was 318.34 feet after 120 hours of pumping. Water levels in observation wells RHR S-3 began to respond after 35 hours; S-1 began to respond after about 20 hours. By the end of 120 hours both wells had declined about 5 feet. Water levels in these observation wells continued to decline for about 100 hours after the pump was shut off. Water levels in well B-851 and the Gallup Sandstone well B-1084 did not respond to the test.[15]

[15] Up until the morning of the aquifer test, the Lee Ranch had been pumping water from well B-851 at a rate of 5 to 10 gpm. A few hours before the test began, that well was turned off. Any response of the water levels in that well to the RHR test was obscured by the recovery of water levels due to cessation of pumping of well B-851.

The pump was turned off at 11:30 AM on May 17 after 120 hours of continuous pumping at an average rate of 133 gpm. Recovery was consistent with drawdown, although some residual drawdown still remained a month after the test ended. The field sheets and e-line data are included in Appendix B. Tables of drawdown and recovery measurement data from the transducers are in Appendix C (attached CD).

Figure 8. RHR Pumping Well S-4 during Aquifer Test

Figure 9. Discharge Pond for RHR S-4 Aquifer Tests at End of Test

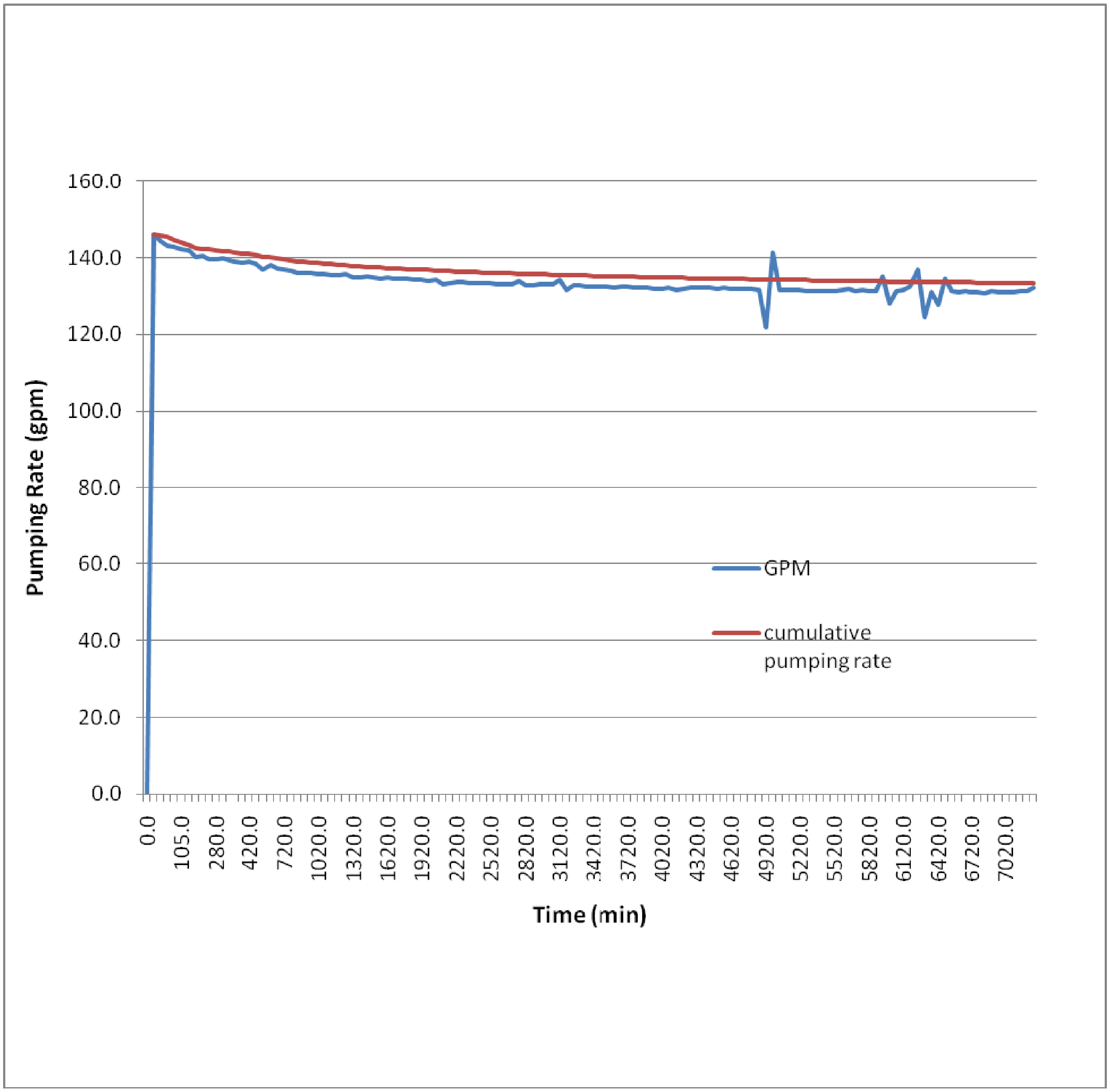

Figure 10. RHR S-4 Aquifer Test Pumping Rate vs. Time

5.2 Barometric Pressure Adjustment

The hydraulic head of groundwater in confined aquifers is the sum of the head in the aquifer and the barometric pressure head. Changes in barometric pressure will therefore cause changes in the hydraulic head measured during an aquifer test that are unrelated to the head changes caused by the test due to the properties of the aquifer. These unrelated changes are measured by down-hole non-vented transducers according to the barometric efficiency (BE)-essentially the relationship between the change in barometric pressure and the change in measured hydraulic head in a non-pumping well. Under such circumstances, the aquifer test data must be adjusted to remove the barometric effects. E-line measurements and measurements taken with properly operating vented transducers do not need to be adjusted.

The RHR test used vented transducers.[16] To verify that the transducers were operating properly and that the recorded pressure data need not be adjusted for barometric pressure, standard methodologies for calculating the BE of the well were applied.[17] Figure 11 presents the barometric pressure at the S-4 test site prior to and over the period of the aquifer test. As can be seen on Figure 12, there was no relationship between the change in barometric pressure and change in pre-pumping head in well S-4 as measured at the transducer, meaning that the transducer was operating properly. Similar graphs generated for wells S-3 and S-1 verified that those transducers were operating properly as well. Therefore, no adjustments for barometric pressure changes were needed to the pumping period transducer data.

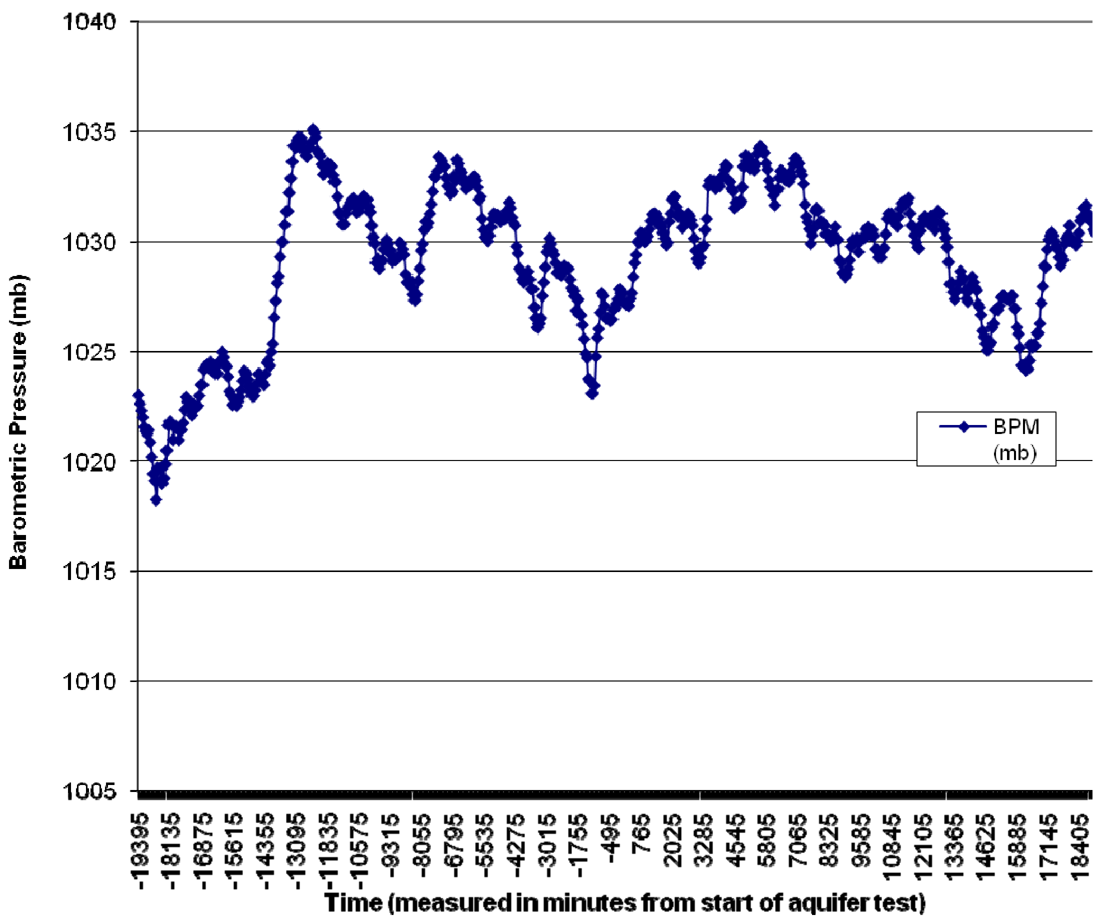

Figure 11. Barometric Pressure at RHR Meteorological Station in the Permit Area

[16] Vented transducers automatically adjust for barometric pressure. However, it is possible for them to become clogged and behave as if they are not vented. It is therefore wise to assess whether they are working properly.
[17] A standard method is to graph change in hydraulic head (x) vs. change in barometric pressure (y). The slope is BE. Because hydraulic head change is inversely related to change in barometric pressure, the slope is negative. BE is then multiplied times the change in barometric pressure between one transducer measurement and the next, and the product subtracted from the transducer measurement to obtain the adjusted hydraulic head change caused by the aquifer test alone.

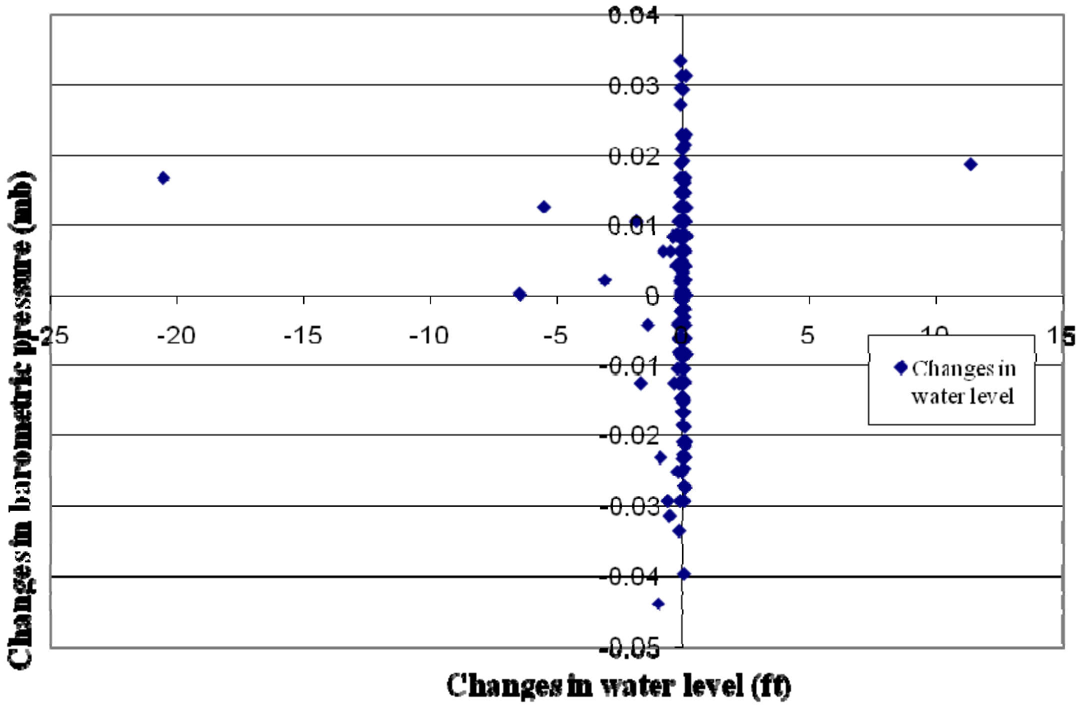

Figure 12. Relationship between Change in Water Level and Barometric Pressure

5.3 Groundwater Temperature

As can be seen in Tables 3, 4, and 5 (on CD), the temperature of groundwater in S-4 differed significantly from the temperatures measured in wells S-3 and S-1. The pre-test temperature of groundwater in S-4 averaged 85 °F while the groundwater temperature measured in S-3 was 71.5 °F, and in S-1, 71.8 °F. During the period of the aquifer test the temperatures of the groundwater measured in S-1 and S-3 did not change. However, as is evident in Figure 13, the groundwater temperature in S-4 increased 8 °F to 93 °F almost immediately when the pumping portion of the aquifer test began and maintained this temperature until the pump was turned off. The S-4 groundwater temperature fell off to 88 °F fairly quickly after the pump was turned off, and then gradually declined towards pre-test temperatures. The increase in temperature in the pumping well during the pumping portion of the test is probably due in part to heat generated by operation of the pump. The reason for the significant difference in pre-test temperatures between S-4 and the observation wells is unknown. The proximity of Mt. Taylor, a recently active (1.5-3.3 million years ago) stratovolcano is an indication that magma is probably present at not too deep a depth. Local faulting may be allowing heat to be conducted upward in the area of well S-4.

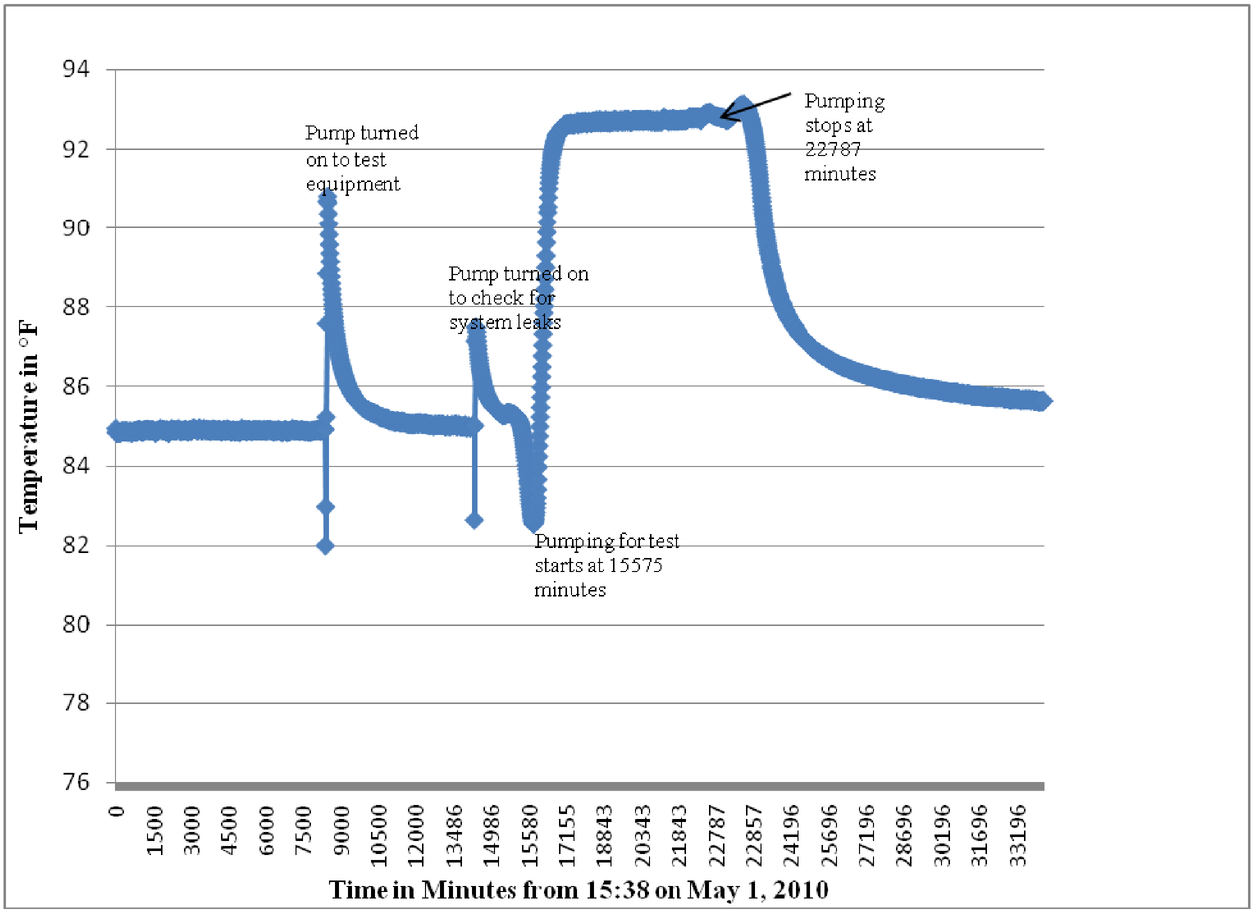

Figure 13. Groundwater Temperature Measured in Well S-4 Before, During and After Pumping

5.4 Analysis of Aquifer Test Results

5.4.1 Analysis of Pumping Well Data

The analysis of water level declines vs. time for the pumping well S-4 using the Papadopulos-Cooper (1967) method, the methodology which best fits the data, is presented on Figure 14. The assumptions for the equations applied in this analysis are that the aquifer is confined and early time data are affected by borehole storage. Appendix B (on CD) includes the e-line measurements and field notes; Appendix C (on CD) contains the transducer data (Table 3); The value of transmissivity calculated from this graph is 95 ft^2/day or 710 gal/day/ft. Hydraulic conductivity is therefore 0.45 ft/day. Although the computer program used (AQTESOLV) reports a value for storage, storage cannot accurately be calculated from pumping well data alone. The reported value is therefore not relied on. AQTESOLV input are provided in Appendix D on the CD.

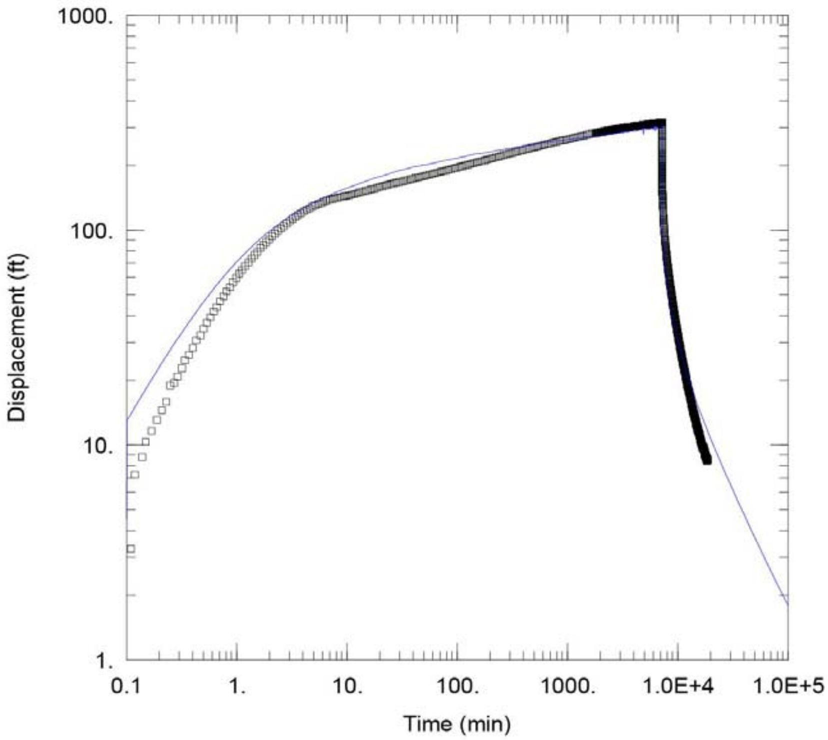

FIGURE 14. RHR AQUIFER TEST: ANALYSIS OF PW S-4 USING PAPADOPULOS-COOPER METHOD

Data Set: C:\...\S4AQfinalactualpumping.aqt
Date: 11/20/10 Time: 12:47:45

PROJECT INFORMATION

Company: Roca Honda Resources
Client: Roca Honda Resources
Location: Roca Honda
Test Well: S-4-Jmw-CH-07
Test Date: 5/12/10-5/25/10

AQUIFER DATA

Saturated Thickness: 212. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
S-4	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ S-4	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Papadopulos-Cooper

T = 85.78 ft^2/day
S = 0.002652
r(w) = 1. ft
r(c) = 0.36 ft

Figure 14. RHR Aquifer Test: Analysis of PW S-4

5.4.2 Analysis of Observation Well Data

Figure 15 presents the analysis of water level change vs. time data for observation well S-3; Figure 16 presents the analysis for observation well S-1. The assumptions for the equations applied in this analysis are that the aquifer is confined and early time data are affected by borehole storage. Appendix C (on CD) contains the transducer data for these wells (Table 4 and Table 5); Appendix B includes the field notes and e-line measurements. The values of transmissivity calculated from these graphs are 65 ft^2/day or 490 gal/day/ft for S-3 and 125 ft^2/day or 935 gal/day/ft. Hydraulic conductivity values are 0.3 ft/da for S-3 and 0.6 ft/da for S-1. Storage coefficient is about $2.4x10^{-4}$. The S-1 data indicate that a sub-surface barrier to groundwater flow was encountered at a distance of about 1,100 feet from that well. Analysis of the S-4 and S-3 data did not improve with the presence of a barrier; it is therefore likely that the barrier is to the east of well S-1.

5.5 Comparison of Aquifer Test Results with Reported Hydraulic Parameter Values

Brod and Stone (1981) report that the highest measured permeability for the Westwater Canyon Member in the San Juan basin is near the community of San Mateo near the San Rafael fault zone along the Fernandez monocline. In that area, GMRC calculated hydraulic conductivity as 3.2 ft/day and transmissivity as 494 ft^2/day. They note that this value is 100 times the value determined in laboratory tests, undoubtedly because of the effect of fracturing. Hydraulic conductivity for the Westwater Canyon Member typically ranges from about 0.5 to 1.5 ft/day, though a few much higher and lower values have been reported. Lyford (1979) indicates that the range of transmissivity for the Morrison Formation in the Roca Honda permit area is 200 to 300 ft^2 per day. Kernodle (1996) reports that transmissivity, storage coefficient, and hydraulic conductivity values from 31 aquifer tests for the Morrison Formation indicate that transmissivity ranged from 2 to 480 ft^2/day with a median value of 115 ft^2/day. Hydraulic conductivity values for three of these wells ranged from 0.035 to 0.39 ft/day, and storage coefficient values calculated for nine wells ranged from 2×10^{-4} to 2×10^{-5} (Kernodle 1996).

Table 9-13 of Section 9 of the RHR BDR (2011) tabulates the range of reported values of hydraulic parameters for geologic units in the RHR area, including the Westwater Canyon Member of the Morrison Formation. The values of hydraulic conductivity, transmissivity, and storage calculated from the RHR aquifer test lie in the center of the ranges for these parameters. The values are-not surprisingly-lower than the high values estimated by Brod and Stone within the San Rafael fault zone. The aquifer test results indicate that the hydrogeologic nature of the Westwater Canyon Member in the area of the RHR permit area is consistent with its nature in other parts of the San Juan Basin of northwestern New Mexico where the unit has not been heavily faulted. The experiences of other mining companies that mined from the Westwater Canyon Member regarding the appropriate number of depressurization wells, the expected rate of depressurization/dewatering, and the expected mine discharge should therefore be applicable to the Roca Honda permit area.

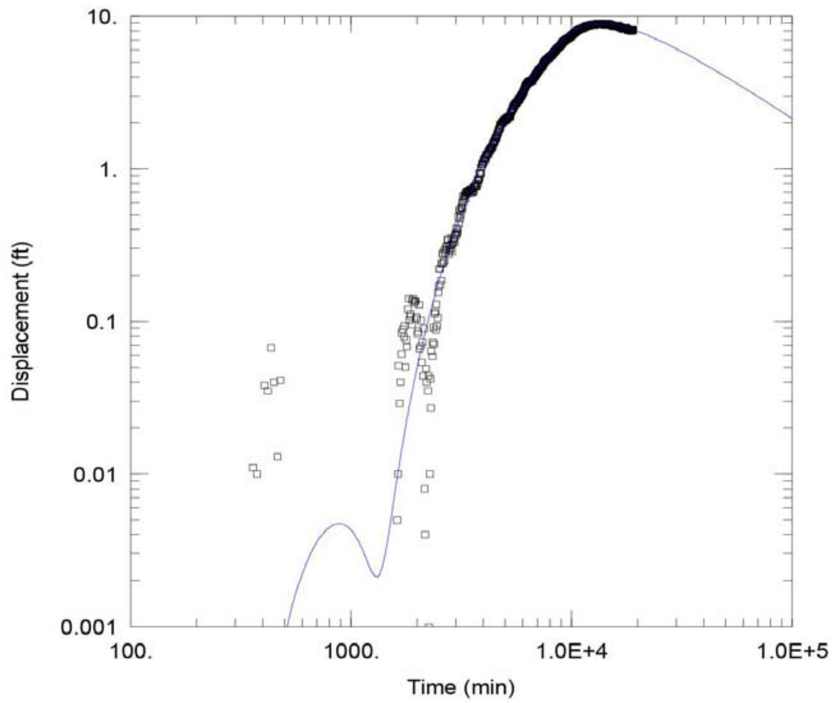

FIGURE 15. RHR AQUIFER TEST: ANALYSIS OF OW S-3 USING PAPADOPULOS-COOPER

Data Set: C:\...\S3AQFinalPC.aqt
Date: 11/20/10 Time: 12:45:56

PROJECT INFORMATION

Company: Hydroscience Associates, Inc.
Client: Roca Honda Resources
Location: Roca Honda
Test Well: S-4-Jmw-CH-07
Test Date: 5/12/10-5/25/10

AQUIFER DATA

Saturated Thickness: 212. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
S-4	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ S3	2134	-1449

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 65.13 ft^2/day S = 0.0002459
r(w) = 0.58 ft r(c) = 0.36 ft

Figure 15. RHR Aquifer Test: Analysis of OW S-3

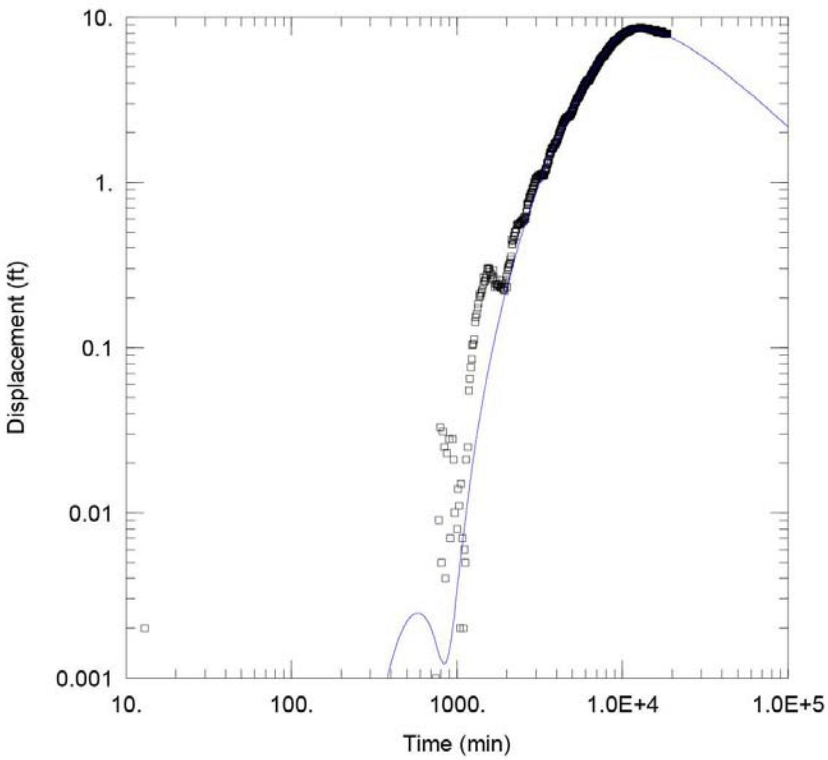

FIGURE 16. RHR AQUIFER TEST: ANALYSIS OF OW S-1 USING PAPADOPULOS-COOPER

Data Set: C:\...\S1AQfinalPC.aqt
Date: 11/20/10 Time: 12:47:08

PROJECT INFORMATION

Company: Hydroscience Associates, Inc.
Client: Roca Honda Resources
Location: Roca Honda
Test Well: S-4-Jmw-CH-07
Test Date: 5/12/10-5/25/10

AQUIFER DATA

Saturated Thickness: 212. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
S-4	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ S1	2907	640

SOLUTION

Aquifer Model: Confined
Solution Method: Papadopulos-Cooper

T = 125.2 ft^2/day
S = 0.0002327
r(w) = 0.58 ft
r(c) = 0.36 ft

Figure 16. RHR Aquifer Test: Analysis of OW S-1

6.0 References

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Appendix A

1. Table of S-4 Pumping Rates
2. Well Records for S-4, S-3, and S-1

Table 2. Pumping Rates During RHR Aquifer Test Using Well S-4

Elapsed Time	Meter Reading (gal)	Gallons Pumped during period (gal)	Q during period (gpm)	Number of Minutes at rate Q	Cumulative Pumping Rate (gpm)
0	0	0	0.0	0	
42	6135.8	6135.8	146.1	42	146.1
50	7289.7	1153.9	144.2	8	145.8
55	8005.1	715.4	143.1	5	145.5
82	11860	3854.9	142.8	27	144.6
105	15130	3270	142.2	23	144.1
160	22930	7800	141.8	55	143.3
220	31345	8415	140.3	60	142.5
240	34156	2811	140.6	20	142.3
260	36949	2793	139.7	20	142.1
280	39743	2794	139.7	20	141.9
300	42538	2795	139.8	20	141.8
330	46717	4179	139.3	30	141.6
360	50889	4172	139.1	30	141.4
390	55048	4159	138.6	30	141.1
420	59220	4172	139.1	30	141.0
480	67525	8305	138.4	60	140.7
540	75743	8218	137.0	60	140.3
600	84038	8295	138.3	60	140.1
660	92278	8240	137.3	60	139.8
720	100491	8213	136.9	60	139.6
780	108691.9	8200.9	136.7	60	139.3
840	116861.1	8169.2	136.2	60	139.1
900	125031.1	8170	136.2	60	138.9
960	133192.1	8161	136.0	60	138.7
1020	141341.1	8149	135.8	60	138.6
1080	149484.5	8143.4	135.7	60	138.4
1140	157611.7	8127.2	135.5	60	138.3
1200	165735.9	8124.2	135.4	60	138.1
1260	173886.1	8150.2	135.8	60	138.0
1320	181981	8094.9	134.9	60	137.9
1380	190081	8100	135.0	60	137.7
1440	198196.8	8115.8	135.3	60	137.6
1500	206297.8	8101	135.0	60	137.5
1560	214365	8067.2	134.5	60	137.4
1620	222449.6	8084.6	134.7	60	137.3
1680	230530.2	8080.6	134.7	60	137.2
1740	238601	8070.8	134.5	60	137.1
1800	246676	8075	134.6	60	137.0
1860	254730	8054	134.2	60	137.0
1920	262789	8059	134.3	60	136.9
1980	270834.9	8045.9	134.1	60	136.8

Table 2 (Continued)

Elapsed Time	Meter Reading (gal)	Gallons Pumped during period (gal)	Q during period (gpm)	Number of Minutes at rate Q	Cumulative Pumping Rate (gpm)
2040	278900.7	8065.8	134.4	60	136.7
2100	286891.6	7990.9	133.2	60	136.6
2160	294904.3	8012.7	133.5	60	136.5
2220	302925.8	8021.5	133.7	60	136.5
2280	310944	8018.2	133.6	60	136.4
2340	318950.8	8006.8	133.4	60	136.3
2400	326956	8005.2	133.4	60	136.2
2460	334953	7997	133.3	60	136.2
2520	342948.6	7995.6	133.3	60	136.1
2580	350942.9	7994.3	133.2	60	136.0
2640	358936.8	7993.9	133.2	60	136.0
2700	366915	7978.2	133.0	60	135.9
2760	374950	8035	133.9	60	135.9
2820	382915	7965	132.8	60	135.8
2880	390882	7967	132.8	60	135.7
2940	398872	7990	133.2	60	135.7
3000	406859	7987	133.1	60	135.6
3060	414845	7986	133.1	60	135.6
3120	422910	8065	134.4	60	135.5
3180	430805	7895	131.6	60	135.5
3240	438765	7960	132.7	60	135.4
3300	446737	7972	132.9	60	135.4
3360	454695	7958	132.6	60	135.3
3420	462642	7947	132.5	60	135.3
3480	470585	7943	132.4	60	135.2
3540	478535	7950	132.5	60	135.2
3600	486472.5	7937.5	132.3	60	135.1
3660	494421.2	7948.7	132.5	60	135.1
3720	502375	7953.8	132.6	60	135.0
3780	510311	7936	132.3	60	135.0
3840	518239	7928	132.1	60	135.0
3900	526170	7931	132.2	60	134.9
3960	534091	7921	132.0	60	134.9
4020	541999	7908	131.8	60	134.8
4080	549926	7927	132.1	60	134.8
4140	557831.5	7905.5	131.8	60	134.7
4200	565753.6	7922.1	132.0	60	134.7
4260	573683.9	7930.3	132.2	60	134.7
4320	581613	7929.1	132.2	60	134.6
4380	589545.4	7932.4	132.2	60	134.6
4440	597487.2	7941.8	132.4	60	134.6
4500	605407.8	7920.6	132.0	60	134.5
4560	613334.3	7926.5	132.1	60	134.5
4620	621250.4	7916.1	131.9	60	134.5
4680	629162.5	7912.1	131.9	60	134.4
4740	637073.6	7911.1	131.9	60	134.4

Table 2 (Continued)

Elapsed Time	Meter Reading (gal)	Gallons Pumped during period (gal)	Q during period (gpm)	Number of Minutes at rate Q	Cumulative Pumping Rate (gpm)
4800	644981.9	7908.3	131.8	60	134.4
4860	652883.8	7901.9	131.7	60	134.3
4920	660193.5	7309.7	121.8	60	134.2
4980	668681.5	8488	141.5	60	134.3
5040	676581	7899.5	131.7	60	134.2
5100	684483.7	7902.7	131.7	60	134.2
5160	692375.2	7891.5	131.5	60	134.2
5220	700269.6	7894.4	131.6	60	134.2
5280	708156.9	7887.3	131.5	60	134.1
5340	716035.5	7878.6	131.3	60	134.1
5400	723917.5	7882	131.4	60	134.1
5460	731792.3	7874.8	131.2	60	134.0
5520	739671.1	7878.8	131.3	60	134.0
5580	747563	7891.9	131.5	60	134.0
5653	757186.5	9623.5	131.8	73	133.9
5700	763364	6177.5	131.4	47	133.9
5760	771266.4	7902.4	131.7	60	133.9
5820	779154	7887.6	131.5	60	133.9
5880	787038.7	7884.7	131.4	60	133.9
5940	795151	8112.3	135.2	60	133.9
6000	802829.7	7678.7	128.0	60	133.8
6060	810712.6	7882.9	131.4	60	133.8
6120	818610	7897.4	131.6	60	133.8
6180	826562.5	7952.5	132.5	60	133.7
6240	834778.4	8215.9	136.9	60	133.8
6300	842256	7477.6	124.6	60	133.7
6360	850125	7869	131.2	60	133.7
6420	857800	7675	127.9	60	133.6
6480	865868	8068	134.5	60	133.6
6540	873743	7875	131.3	60	133.6
6600	881599	7856	130.9	60	133.6
6660	889471	7872	131.2	60	133.6
6720	897333	7862	131.0	60	133.5
6780	905195	7862	131.0	60	133.5
6840	913047	7852	130.9	60	133.5
6900	920920	7873	131.2	60	133.5
6960	928775	7855	130.9	60	133.4
7020	936639.2	7864.2	131.1	60	133.4
7080	944510	7870.8	131.2	60	133.4
7140	952384.1	7874.1	131.2	60	133.4
7200	960258	7873.9	131.2	60	133.4
7216	962371.6	2113.6	132.1	16	133.4
				7216	

Average Q = 133.37
Average Q to 240 min = 142.34
Average Q 240 to 2100 min = 135.9
Average Q 2100 to 7216 min = 132.0

Strathmore
Resources, U.S. Ltd
4001 Office Court Drive, Suite 602 Santa Fe, New Mexico 87507

Memo:

To: Kathleen Grassel, NMOSE

From: Matt Hartmann

CC: Doug Rappuhn, NMOSE

Date: February 14, 2008

Re: Water Well Record, TRN: 378372, File No.: B-1706-POD 1

Attached is the NMOSE Water Well Record for TRN: 378372, File No.: B-1706-POD 1. A copy of this record has also been submitted to Doug Rappuhn of the NMOSE Hydrology Bureau.

For additional information please contact:

Matt Hartmann, P.G.
Senior Development Geologist
Strathmore Resources, US Ltd.
4001 Office Court, Suite 602
Santa Fe, NM 87508

505.471.4132 (office)
505-231-9671 (cell)

OSE FILE NUMBER ____________
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD and DRILLING LOG

1. PERMIT HOLDER(S)

Name: Roca Honda Resource, LLC
Address: 4001 Office Court, Suite 602
City: Santa Fe
State: NM Zip: 87505
Phone: 505-474-6696
Contact: John DeJoia or Matt Hartmann
Contact Phone: 474-6646 or 471-4132

Name: ____________
Address: ____________
City: ____________
State: ______ Zip: ____________
Phone: ____________

2. STATE ENGINEER REFERENCE NUMBERS:
File # B-1706 , Well # POD 1

3. LOCATION OF WELL (The Datum Is Assumed To Be WGS 84 Unless Otherwise Specified)

Latitude: 35 Deg 21 Min 38.5 Sec
Longitude: 107 Deg 40 Min 55.4 Sec
(Enter Lat/Long To At Least 1/10th Of A Second)
Datum If Not WGS 84: NAD 83

4. DRILLING CONTRACTOR
License Number: 331
Name: Stewart Brothers Drilling Co. Work Phone: 505-287-2986

Drill Rig Serial Number: Rig 49

List The Name Of Each Drill Rig Supervisor That Managed On-Site Operations During The Drilling Process: Phillip Stewart

5. DRILLING RECORD

Drilling Began: 11/4/07; Completed: 12/30/07; Drilling Method: Mud Rotary;

Diameter Of Bore Hole: 4 7/8 (in) through production interval;

Total Depth Of Well: 2108.0 (ft);

Completed Well Is (Circle One): Shallow / $\boxed{\text{Artesian}}$;

Depth To Water First Encountered: Unknown, assume Gallup Fm. @ 660 (ft);

Depth To Water Upon Completion Of Well: ~891 (ft).

Do Not Write Below This Line

TRN Number: ____________ File Number: ____________
Form: wr-20 May 07

page 1 of 4

OSE FILE NUMBER ____________________
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD and DRILLING LOG

6. RECORD OF CASING

Diameter (inches)	Pounds (per ft.)	Threads (per inch)	Depth (feet)	Length Top to Bottom (feet)	Type of Shoe	Perforations (from to)
16" O.D.	Schedule 40 Low Carbon Steel	Welded	29.0 ft	29.5 ft	N/A	None
10 _" O.D.	J-55 Low Carbon Steel	Welded	1436.7 ft	1437.2 ft	Standard Drillable, Welded on Casing	None
6 5/8" O.D.	Schedule 40 Stainless Steel T304/A312	Welded	1870.0 ft	1872.0 ft	Standard Drillable, Welded on Casing	None
4" O.D.	Schedule 40 Stainless Steel T304/A312	Welded	2108.0 ft	273.2 ft	N/A	1889.1 to 2098.0 ft

7. RECORD OF MUDDING AND CEMENTING

Depth (feet)	Hole (diameter)	Cement Weight (lbs/gal)	Cement (cubic feet)	Method of Placement
Surface to 29 ft	20"	14.0	~130	Tremie
Surface to 1440 ft	14 _"	12.3	782	Positive Displacement
Surface to 1870 ft	9 7/8"	12.3	926	Positive Displacement

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Trn Number: File Number: ____________
Form: wr-20 May 07

page 2 of 4

OSE FILE NUMBER ______________
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD

8. LOG OF HOLE. For Each Water Bearing Strata, Estimate The Yield Of The Formation In Gallons Per Minute.

Depth (feet) From	Depth (feet) To	Thickness (Feet)	For Water Bearing Strata Enter The Estimated Yield in GPM	Color and Type of Material Encountered
0	15	15		Soil/Colluvium
15	55	70		Dalton Sandstone Member
55	585	305		Mancos Shale – Mullato Tongue
585	660	135		Dilco Coal Member
660	765	105	Unknown	Gallup Formation
765	No Recovery / Geophysical Logs			Mancos Shale
				Dakota Formation – Two Wells Ss Tongue
	1760	150		Mancos – Whitewater Arroyo Sh tongue
1760	1820	60	Unknown	Dakota Sandstone
1820	1896	76		Brushy Basin Member
1896	2100	200	15	Westwater Canyon Member
2100	2108+	8+		Recapture Member

Enter Method Used To Estimate Yield: Max pump output at surface. Limited production capabilities with the installed casing sizes and TDH.

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Trn Number: ______________ File Number: ______________
Form wr-20 May 07 page 3 of 4

OSE FILE NUMBER ______________________
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD

9. ADDITIONAL STATEMENTS OR EXPLANATIONS:

Duplicate well record will be submitted to Doug Rappuhn, NMOSE. In addition, Doug Rappuhn witnessed and approved the MIT on the 6 5/8" production casing on December 15, 2007. Held within 5% of 300 psi for one hour.

No water production estimates are available for aquifers above the Westwater Canyon Member. It is assumed that the Gallup Fm. and the Dakota Ss both contain water in producible quantities.

This well will be utilized by Roca Honda Resources, LLC to collect ground water characterization samples for the purposes of mine permitting.

The undersigned hereby certifies that, to the best of his or her knowledge and belief, the foregoing is a true and correct record of the above described bore hole. The undersigned further certifies that he or she will file this well record with the Office Of The State Engineer and permit holder within 20 days after completion of the well drilling.

______________________ 02/12/2008
Driller (mm/dd/year)

Do Not Write Below This Line

Trn Number: ______________ File Number: ______________
Form wr-20 May 07 page 4 of 4

OSE FILE NUMBER B-1706-POD 3
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD and DRILLING LOG

1. PERMIT HOLDER(S)

Name: Roca Honda Resource, LLC	Name:
Address: 4001 Office Court, Suite 602	Address:
City: Santa Fe	City:
State: NM Zip: 87505	State: Zip:
Phone: 505-474-6696	Phone:
Contact: John DeJoia or Matt Hartmann	
Contact Phone: 474-6646 or 471-4132	

2. STATE ENGINEER REFERENCE NUMBERS:
File # B-1706 , Well # POD 3

3. LOCATION OF WELL (The Datum Is Assumed To Be WGS 84 Unless Otherwise Specified)

Latitude: 35 Deg 21 Min 14.6 Sec
Longitude: 107 Deg 41 Min 04.1 Sec
(Enter Lat/Long To At Least 1/10th Of A Second)

4. DRILLING CONTRACTOR
License Number: 331
Name: Stewart Brothers Drilling Co. Work Phone: 505-287-2986

Drill Rig Serial Number: Rig 49

List The Name Of Each Drill Rig Supervisor That Managed On-Site Operations During The Drilling Process: Phillip Stewart

5. DRILLING RECORD

Drilling Began: 8/29/07; Completed: 10/7/07; Drilling Method: Mud Rotary;

Diameter Of Bore Hole: 14 (in);

Total Depth Of Well: 2038.0 (ft);

Completed Well Is (Circle One): Shallow / Artesian;

Depth To Water First Encountered: Unknown, assume Gallup Fm. @ 600 (ft);

Depth To Water Upon Completion Of Well: 841.5 (ft).

2009 JAN 13 PM 3: 00

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TRN Number: 378372 File Number: B-1706 POD3
Form: wr-20 May 07

OSE FILE NUMBER B-1706 POD3
For OSE Use Only

WELL RECORD and DRILLING LOG

6. RECORD OF CASING

Diameter (inches)	Pounds (per ft.)	Threads (per inch)	Depth (feet)	Length Top to Bottom (feet)	Type of Shoe	Perforations (from to)
16" OD	Schedule 40 Low Carbon Steel	N/A	29.0	30.0	N/A	N/A
8 5/8" O.D.	Schedule 40 Stainless Steel T304/A312	API 8 Round	2038.0	2040	N/A	1846.7 – 2017.4 ft bgs 160 slots/ft

2008 JAN 13 PM 3:01
STATE ENGINEER OFFICE

7. RECORD OF MUDDING AND CEMENTING

Depth (feet)	Hole (diameter)	Cement Weight (lbs/gal)	Cement (cubic feet)	Method of Placement
Surface Casing				
Surface to 29	20"	15.0	~130	Tremie
Production Casing				
Surface to ~1020	14 _"	12.3	1144	Tremie
~1020 to 1768	14 _"	14.1	745	Tremie
~1768 to 1825	14 _"	15.0	~170	Tremie
~1825 to 1835	14 _"	Bentonite Seal	~32	Tremie

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Trn Number: 378372 File Number: B-1704 POD3
Form: wr-20 May 07

page 2 of 4

OSE FILE NUMBER B-1706 POD3
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD

8. LOG OF HOLE. For Each Water Bearing Strata, Estimate The Yield Of The Formation In Gallons Per Minute.

Depth (feet) From	Depth (feet) To	Thickness (Feet)	For Water Bearing Strata Enter The Estimated Yield in GPM	Color and Type of Material Encountered
0	2	2		Soil/Colluvium
2	132	130		Dalton Sandstone Member
132	550	418		Mancos Shale – Mullato Tongue
550	600	50		Dilco Coal Member
600	695	95	Unknown	Gallup Formation
695	1420	725		Mancos Shale
1420	1510	90		Dakota Formation – Two Wells Ss Tongue
1510	1720	210		Mancos – Whitewater Arroyo Sh tongue
1720	1790	70	Unknown	Dakota Sandstone
1790	1840	50		Brushy Basin Member
1840	2020	180	80	Westwater Canyon Member
2020	2070+	50+		Recapture Member

2008 JAN 18 PM 3:01

STATE ENGINEER OFFICE

Enter Method Used To Estimate Yield: Air lifting, dedicated pump not yet installed

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Trn Number: 378372 File Number: B-1704 POD3

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OSE FILE NUMBER B-1706 POD3
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD

9. ADDITIONAL STATEMENTS OR EXPLANATIONS:

Duplicate well record and cement bond log will be submitted to Doug Rappuhn, NMOSE.

No water production estimates are available for aquifers above the Westwater Canyon Member. It is assumed that the Gallup Fm. and the Dakota Ss both contain water in producible quantities.

Production estimate for the well is based upon air lifting results.

This well will be utilized by Roca Honda Resources, LLC to collect ground water characterization samples, and pump testing for the purposes of mine permitting.

Delay in filing due to field delay in pump setting and instrumentation.

The undersigned hereby certifies that, to the best of his or her knowledge and belief, the foregoing is a true and correct record of the above described bore hole. The undersigned further certifies that he or she will file this well record with the Office Of The State Engineer and permit holder within 20 days after completion of the well drilling.

2008 JAN 18 PM 3:01

Driller

01/16/2008
(mm/dd/year)

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Trn Number: 378379
Form wr-20 May 07

page 4 of 4

File Number: B-1706 POD3

K✓

Strathmore
Resources, U.S. Ltd
4001 Office Court Drive, Suite 602 Santa Fe, New Mexico 87507

Memo:

To: Kathleen Grassel, NMOSE

From: Matt Hartmann

CC: Doug Rappuhn, NMOSE

Date: January 17, 2008, 2007

Re: Water Well Record, TRN: 378372, File No.: B-1706-POD 3

Attached is the NMOSE Water Well Record for TRN: 378372, File No.: B-1706-POD 3. A copy of this record, as well as the cement bond log, has also been submitted to Doug Rappuhn of the NMOSE Hydrology Bureau.

Strathmore delayed the submittal of this report until the pump was successfully installed. Initial problems with the set required us to ensure that it was corrected before submitting the final well record.

For additional information please contact:

Matt Hartmann, P.G.
Senior Development Geologist
Strathmore Resources, US Ltd.
4001 Office Court, Suite 602
Santa Fe, NM 87508

505.471.4132 (office)
505-231-9671 (cell)

2008 JAN 18 PM 3:00

Strathmore
Resources, U.S. Ltd
4001 Office Court Drive, Suite 602 Santa Fe, New Mexico 87507

Memo:

To: Kathleen Grassel, NMOSE

From: Matt Hartmann

CC: Doug Rappuhn, NMOSE

Date: October 1, 2007

Re: Water Well Record, TRN: 378372, File No.: B-1706-POD 4

Attached is the NMOSE Water Well Record for TRN: 378372, File No.: B-1706-POD 4. A copy of this record, as well as the cement bond log, has also been submitted to Doug Rappuhn of the NMOSE Hydrology Bureau.

Please note that the well permit is now in the name of Roca Honda Resources, LLC., a joint venture between Sumitomo Corporation and Strathmore Minerals Corporation.

For additional information please contact:

Matt Hartmann, P.G.
Senior Development Geologist
Strathmore Resources, US Ltd.
4001 Office Court, Suite 602
Santa Fe, NM 87508

505.471.4132 (office)
505-231-9671 (cell)

OSE FILE NUMBER ______________
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD and DRILLING LOG

1. PERMIT HOLDER(S)

Name: Roca Honda Resource, LLC
Address: 4001 Office Court, Suite 602
City: Santa Fe
State: NM Zip: 87505
Phone: 505-474-6696
Contact: John DeJoia or Matt Hartmann
Contact Phone: 474-6646 or 471-4132

Name: ______________
Address: ______________
City: ______________
State: ______ Zip: ______________
Phone: ______________

2. STATE ENGINEER REFERENCE NUMBERS:
File # B-1706 , Well # POD 4

3. LOCATION OF WELL (The Datum Is Assumed To Be WGS 84 Unless Otherwise Specified)

Latitude: 107 Deg 41 Min 29.9 Sec
Longitude: 35 Deg 21 Min 33.1 Sec
(Enter Lat/Long To At Least 1/10th Of A Second)
Datum If Not WGS 84: ______________

4. DRILLING CONTRACTOR
License Number: 331
Name: Stewart Brothers Drilling Co. Work Phone: 505-287-2986

Drill Rig Serial Number: Rig 49

List The Name Of Each Drill Rig Supervisor That Managed On-Site Operations During The Drilling Process: Phillip Stewart

5. DRILLING RECORD

Drilling Began: 6/26/07; Completed: 8/7/07; Drilling Method: Mud Rotary;

Diameter Of Bore Hole: 14 (in);

Total Depth Of Well: 1919.0 (ft);

Completed Well Is (Circle One): Shallow / Artesian.

Depth To Water First Encountered: Unknown, assume Gallup Fm. @ 520 (ft);

Depth To Water Upon Completion Of Well: 875 (ft).

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TRN Number: ______________ File Number: ______________
Form: wr-20 May 07

page 1 of 4

OSE FILE NUMBER ______
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD and DRILLING LOG

6. RECORD OF CASING

Diameter (inches)	Pounds (per ft.)	Threads (per inch)	Depth (feet)	Length Top to Bottom (feet)	Type of Shoe	Perforations (from to)
8 5/8 O.D.	Schedule 40 Stainless Steel T304/A312	API 8 Round	1919.0	1921	N/A	1707.5 – 1898.0 ft bgs 160 slots/ft

7. RECORD OF MUDDING AND CEMENTING

Depth (feet)	Hole (diameter)	Cement Weight (lbs/gal)	Cement (cubic feet)	Method of Placement
Surface to ~630	14 _	12.3	1061	Tremie
~630 to 1576	14 _	14.1	747	Tremie
1576 to 1637	14 _	15.0	~65	Tremie

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Form: wr-20 May 07

File Number: ______

page 2 of 4

OSE FILE NUMBER ____________
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD

8. LOG OF HOLE. For Each Water Bearing Strata, Estimate The Yield Of The Formation In Gallons Per Minute.

Depth (feet) From	Depth (feet) To	Thickness (Feet)	For Water Bearing Strata Enter The Estimated Yield in GPM	Color and Type of Material Encountered
0	10	10		Soil/Colluvium
10	80	70		Dalton Sandstone Member
80	385	305		Mancos Shale – Mullato Tongue
385	520	135		Dilco Coal Member
520	635	115	Unknown	Gallup Formation
635	1330	695		Mancos Shale
1330	1385	55		Dakota Formation – Two Wells Ss Tongue
1385	1525	140		Mancos – Whitewater Arroyo Sh tongue
1525	1590	65	Unknown	Dakota Sandstone
1590	1700	110		Brushy Basin Member
1700	1900	200	80	Westwater Canyon Member
1900	1919	19		Recapture Member

Enter Method Used To Estimate Yield: Air lifting, dedicated pump not yet installed

Do Not Write Below This Line

Trn Number: ____________ File Number: ____________
Form wr-20 May 07 page 3 of 4

OSE FILE NUMBER ______
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD

9. ADDITIONAL STATEMENTS OR EXPLANATIONS:

Duplicate well record and cement bond log will be submitted to Doug Rappuhn, NMOSE.

No water production estimates are available for aquifers above the Westwater Canyon Member. It is assumed that the Gallup Fm. and the Dakota Ss both contain water in producible quantities.

Production estimate for the well is based upon air lifting results. A dedicated pump will be installed in the next two months.

This well will be utilized by Roca Honda Resources, LLC to collect ground water characterization samples, and pump testing for the purposes of mine permitting.

The undersigned hereby certifies that, to the best of his or her knowledge and belief, the foregoing is a true and correct record of the above described bore hole. The undersigned further certifies that he or she will file this well record with the Office Of The State Engineer and permit holder within 20 days after completion of the well drilling.

______ 09/26/07
Driller (mm/dd/year)

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Trn Number: ______ File Number: ______
Form wr-20 May 07 page 4 of 4

Appendix 9-J

Baseline Groundwater and Surface Water Conditions
San Lucas Canyon, Arroyo Chico, and the Northern Branch of the Rio Puerco
and
Probable Hydrological Consequences of Proposed RHR Discharge

Table of Contents

Tables

Figures

1.0 Executive Summary

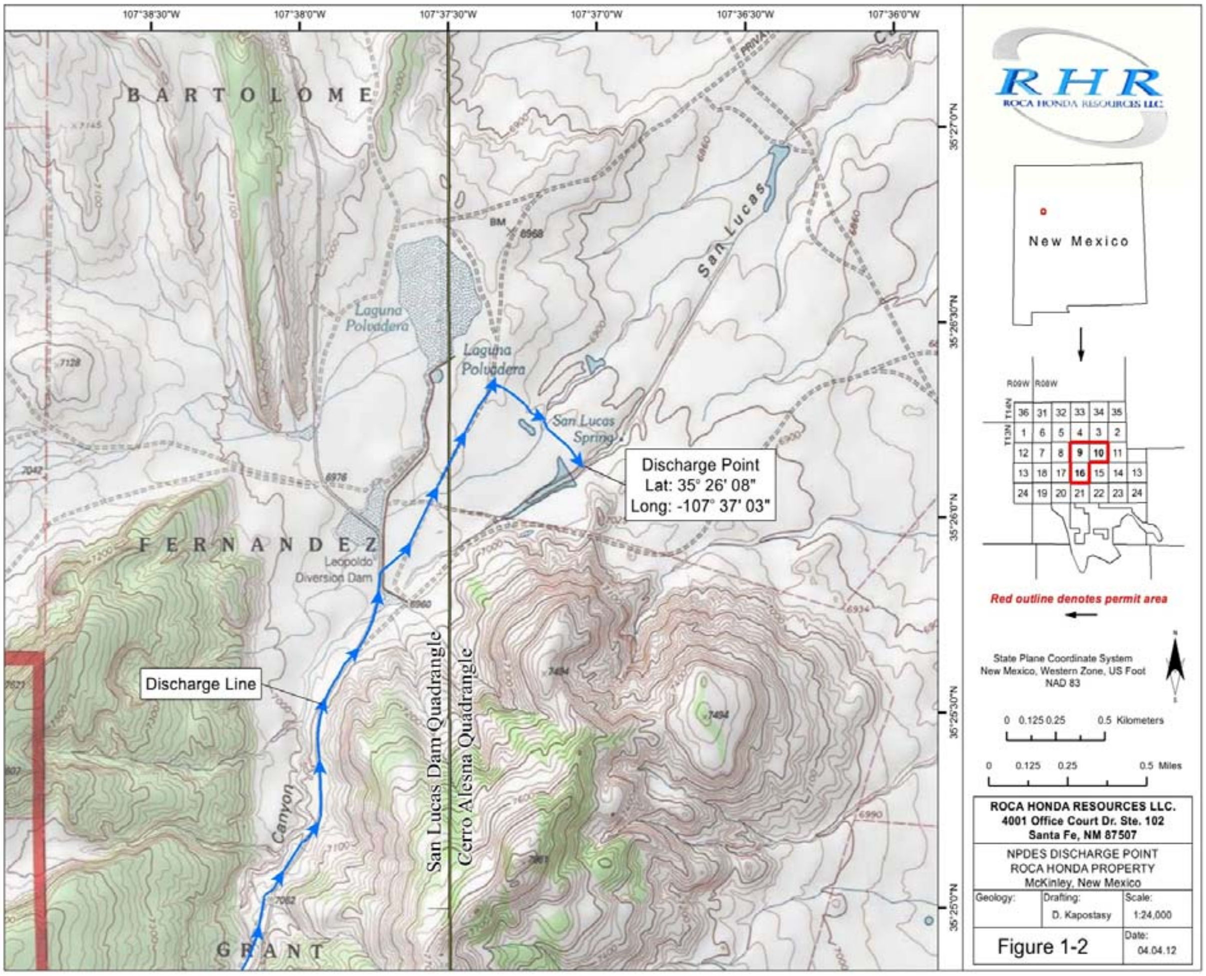
Roca Honda Resources (RHR) will be discharging treated water produced during mine dewatering operations to San Lucas wash. The discharged water will meet EPA NPDES and New Mexico groundwater quality standards. A review was made of information and data available about the baseline condition of groundwater and surface water of the stream system into which discharge will occur. Information regarding stream flow, the presence of groundwater, and geology are available from RHR field investigations, published reports, and from investigations generated by uranium mining companies that discharged mine dewatering water into the stream system from 1978 through 1990 under the Mt. Taylor mine NPDES NM permit 028100.

The information available is sufficient to allow an assessment of the potential of RHR's proposed discharge to impact the water courses. Analysis of the available data indicates that it is highly unlikely that discharge of water by RHR will adversely impact groundwater or surface water quality within San Lucas Canyon, San Miguel Creek, the Arroyo Chico, or the Rio Puerco. The discharge may at times augment the currently ephemeral to intermittent surface flow within these stream channels, but the high evapotranspiration rate in the area and the fact that the discharged water will be consumed by vegetation present in the stream channels will tend to minimize surface flow.

1.1 Location

The discharge point will be Lat: 35 26' 08, Long: -107 37' 03, as shown on Figure 1 (Figure 1-2 from RHR's NPDES permit application). Figure 1 shows the location of the RHR discharge point within San Lucas Canyon.

Figure 1: Location of RHR Discharge Point in San Lucas Canyon



1.2 Hydrogeologic Baseline Information Sources

Various documents are available regarding the hydrogeology and baseline condition of the San Lucas/San Miguel Creek/Arroyo Chico/Rio Puerco stream system at and below RHR's proposed discharge point. Information is available about: 1) The geology and hydrogeology of the surface and groundwater system; 2) the nature of surface flow within San Lucas/San Miguel Creek/Arroyo Chico/Rio Puerco stream system; 3) the chemistry and quantity of water discharged into San Lucas wash over the 1978-1990 period by Gulf Mineral Resource Co. (GMRC) and Chevron Mt. Taylor under NPDES NM 028100; 4) the effect of water discharged under NPDES permit NM 028100 on surface water, groundwater and streambed materials.

Some of this information was obtained from documents and water quality reports generated by GMRC and Chevron Mt. Taylor in association with those companies' discharge of water from the Mount Taylor mine into San Lucas Canyon under Federal and State permits, and with GMRC's plans to develop a pipeline through San Lucas Canyon and a mine/mill complex in the late 1970's. An environmental report by GMRC's successor, Rio Grande Resource Co, (RGR) provides summary information about GMRC operations. The water quality data are available on microfiche from the NMED upon request. The GMRC and RGR reports were obtained by RHR from the US Nuclear Regulatory Commission (US NRC) and are available from the NRC or RHR.

A baseline environmental study done for GMRC prior to construction of the Mt. Taylor Mine, *An Environmental Baseline Study of the Mount Taylor Project Area of New Mexico* (1974) (NMEIS) provides information regarding area springs. The hydrogeology of the reach of the Arroyo Chico that extends from 12 miles above USGS gaging station NM 08340500, Arroyo Chico Nr Guadalupe, downstream to seven miles below the stream's confluence with Rio Puerco is discussed in detail in Hydrologic Sheet HS-4, *Hydrogeology of Arroyo Chico-Torreon Wash Area* (Craig & Stone, 1983). This hydrogeologic sheet includes information about the geology of the watershed, aquifers and their relationship to stream flow, springs, wells, and stream flow. Chemistry data for springs, wells, and the Arroyo Chico are included. Work for HS-4 appears to have been mostly completed by the end of water year 1978; no mention is made of GMRC mine discharge water entering the area. Stream flow gaging records collected by the USGS report stream flow over this portion of the Rio Puerco stream system. In addition, field investigations by RHR personnel and consultants have been made to San Lucas Canyon and the area of the proposed discharge point to assess current hydrogeologic conditions.

2.0 Baseline Hydrogeologic Data

2.1 Hydrogeologic Characteristics of the San Lucas/San Miguel Creek/Arroyo Chico/Rio Puerco

Upstream of the discharge point, San Lucas Canyon is a broad canyon with a narrow, generally steep-sided channel that has been eroded 10 to 30 feet deep into the stream channel fill. At the discharge point, the channel is flatter and broader. In the area of the discharge point and below, the channel fill is underlain by shales, mudstones, and coals of the relatively impermeable Menefee Formation.

The hydrogeology of San Lucas Canyon shortly upstream of the proposed RHR discharge point was characterized by GMRC. GMRC had planned to develop a uranium mill in Section 1 of T13N, R9W and a tailings disposal area in La Polvadera Canyon, which drains into San Lucas Canyon, in Section 14 of T14N, R9W. The company submitted a Groundwater Discharge Plan (Discharge Plan) (1979) pursuant to Section 3-106 of the New Mexico Water Quality Control Commission (NMWQCC) regulations. It was approved pursuant to Section 3-109. The Discharge Plan addressed the potential impacts to groundwater associated with the operation of GMRC's proposed uranium mill project. Section III of the Discharge Plan and Appendix D to that Plan ("Hydrologic Effects-Tailings Pipeline and Mill Site facilities, Mt. Taylor Uranium Mill Project, New Mexico, November 30, 1079," by Jacobs Engineering Group, Inc. and Hydro-Search, Inc) presented testing of stream channel materials and baseline evaluation of shallow groundwater within San Lucas arroyo. GMRC undertook the study after discharge of treated mine water into the streambed had been going on for more than a year, and the company assumed that the natural hydrologic regime had been altered by the discharge.

As part of this evaluation, Jacobs Engineering drilled three hydrogeologic test wells across San Lucas Canyon about a half a mile south of the point where the stream enters the north pond of Leopoldo Diversion Dam. One well was completed in the stream channel fill (SL-1), one in the Point Lookout Sandstone (SL-2), and one in the Menefee Formation (SL-3) (Figure 2 and Figure 3). The Menefee and the Point Lookout underlay the stream channel fill within San Lucas Canyon. 24-hour aquifer tests were conducted on all wells.

Figure 2: Location of Historical Hydrogeologic Testing in the Area of Proposed RHR Discharge

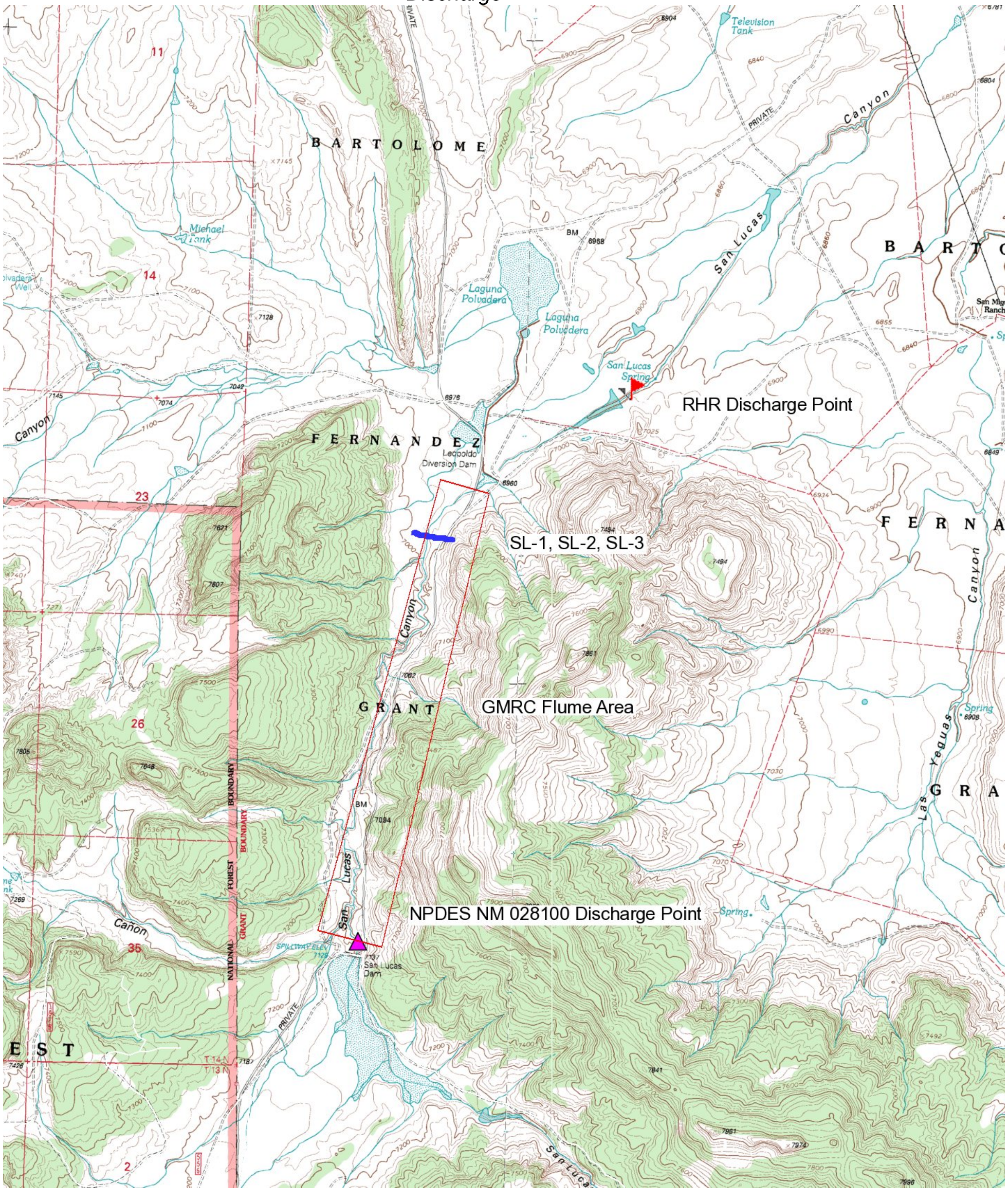
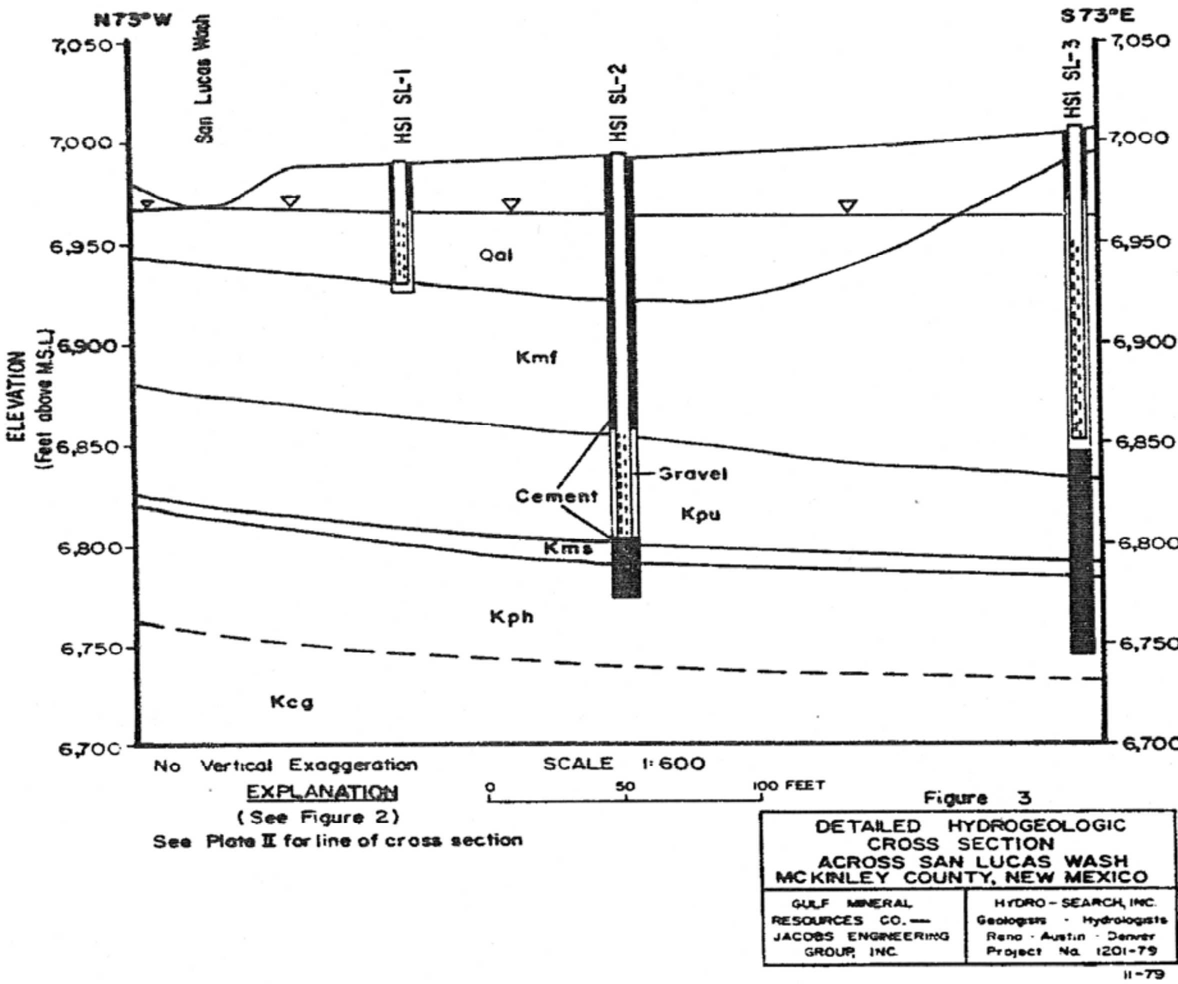


Figure 3: Cross-section across San Lucas Arroyo Showing Locations of GMRC Test Wells SL-1, SL-2, and SL-3



(Figure 3 of Jacobs Engineering & Hydro-Search, 1979)

Jacobs determined that the thickness of saturated alluvium at the alluvial well (SL-1) was 35 feet. The well was pumped at a rate of 15 gpm and hydraulic conductivity was calculated to be 200 gpd/ft^2. Although San Lucas wash was flowing with GMRC discharge and the well was only 70 feet from wash, no recharge effect of the stream was noted during the aquifer test. Jacobs determined that the Menefee Formation immediately underlies the stream channel alluvial fill. When well SL-3 was pumped at a rate of 5 gpm, a hydraulic conductivity of 0.8 gpd/ft^2 was calculated. No effect of pumping SL-3 was discerned at wells SL-1 or SL-2. Jacobs determined that the Point Lookout lies beneath the low-permeability Menefee. Well SL-2 was pumped at a rate of 10 gpm and a hydraulic conductivity of 3.7 gpd/ft^2 was calculated. The pumping of SL-2 did not affect water levels in wells SL-1 and SL-3 (Jacobs Engineering and Hydro-Search (1979).

Water samples were taken from each of the wells at the end of pumping (Table 1). The waters of SL-1 and SL-2 were determined to be calcium-magnesium-carbonate-sulfate waters with a TDS of about 600 mg/L. Water from the Menefee (SL-3) was determined to be much higher in TDS. The mine discharge water was a sodium-sulfate type. Jacobs considered it unlikely that the origin of the water collected from SL-1, SL-2 or SL-3 was derived from the mine discharge water (Jacobs Engineering and Hydro-Search (1979). Table 1 tabulates the groundwater quality collected from SL-1, SL-2, and SL-3.

Jacobs also installed three flumes along San Lucas Canyon between the point of GMRC discharge and the Leopoldo Diversion Dam to determine whether discharge was entering the alluvial fill of the stream channel, and whether the chemistry of the discharged water was changing as it moved downstream. Figure 2 above shows the location of the GMRC discharge point, the location of the GMRC test wells across San Lucas Canyon (blue line), the area where the flumes were installed (red rectangle), and RHR's proposed discharge point. Jacobs found negligible variation in water chemistry downstream from the discharge point.[1] On this basis, they concluded that: 1) the surface stream appeared to not be receiving seepage discharge from groundwater, and 2) mineral salts were not being dissolved by the GMRC discharge from either the stream bed or the bank materials. (Jacobs Engineering and Hydro-Search (1979)

[1] These data are included on Table 5.

Table 1: Water Chemistry of Groundwater Downstream of Mount Taylor
Discharge (from Table 4, Jacobs Engineering, 1979)

Constituent	Units	Well SL-1	Well SL-2	Well SL-3
		Alluvium	Point Lookout SS	Menefee Fmt.
		10-23-1979	10-18-1979	10-13-1979
pH	su	8.0	7.9	7.5
TDS	mg/l	672	595	2,299
EC	µmho/cm	1,010	909	2,970
Temp.	°C	11.9	14.7	13.8
Bicarbonate	mg/l	454	419	785
Carbonate	mg/l			
Chloride	mg/l	18	10	20
Sulfate	mg/l	202	156	1,120
Fluoride	mg/l	0.8	0.2	0.3
Nitrate	mg/l	0.09	0.04	0.13
Sodium	mg/l	70	109	460
Potassium	mg/l	1.7	3.0	15
Calcium	mg/l	75	75	205
Magnesium	mg/l	69	27	73
Silica	mg/l	12	9	20
Arsenic	mg/l	<0.01	<0.01	<0.01
Barium	mg/l	0.9	0.45	1.0
Cadmium	mg/l	<0.005	<0.005	<0.005
Chromium	mg/l	<0.02	<0.02	<0.02
Lead	mg/l	0.02	0.01	0.03
Magnesium	mg/l	<0.0002	<0.0002	<0.0002
Selenium	mg/l	<0.002	<0.002	<0.002
Silver	mg/l	<0.005	<0.005	<0.005
Copper	mg/l	0.01	0.005	0.02
Iron	mg/l	0.1	<0.01	0.17
Manganese	mg/l	0.55	0.02	0.53
Zinc	mg/l	0.25	0.26	0.62
Aluminum	mg/l	0.2	<0.1	0.1
Boron	mg/l	0.15	0.25	0.85
Cobalt	mg/l	<0.01	<0.01	<0.01
Molybdenum	mg/l	<0.05	<0.05	<0.05
Nickel	mg/l	<0.02	<0.02	<0.02
Vanadium	mg/l	<0.05	<0.05	<0.05
Phosphate	mg/l	<0.01	<0.01	<0.01
Uranium	mg/l	<0.013	<0.006	<0.006
Radium 226	pCi/l	0.06+-0.03	0.41+-0.03	2.9+-0.03
Radium 228	pCi/l	1	2+-1	<1.0
Radium 226+228	pCi/l	<1.06	2.41	<3.9
Gross alpha	pCi/l	<5	<7	<7.0

Based on geologic conditions along San Lucas Canyon and the results of hydrogeologic testing, GMRC developed a cross-section of the streambed and a concept of the surface water/groundwater relationship within the streambed (Figure 4).

Figure 4 illustrates Jacob's concept that mine water discharged by GMRC mostly flowed downstream as surface flow, but a portion of it entered the stream channel fill of San Lucas wash and saturated those materials. Some of this recharge would probably enter the underlying Menefee, but because that unit was thick and relatively impermeable, the surface discharge would not move through this unit and enter the main regional aquifer within the Point Lookout.

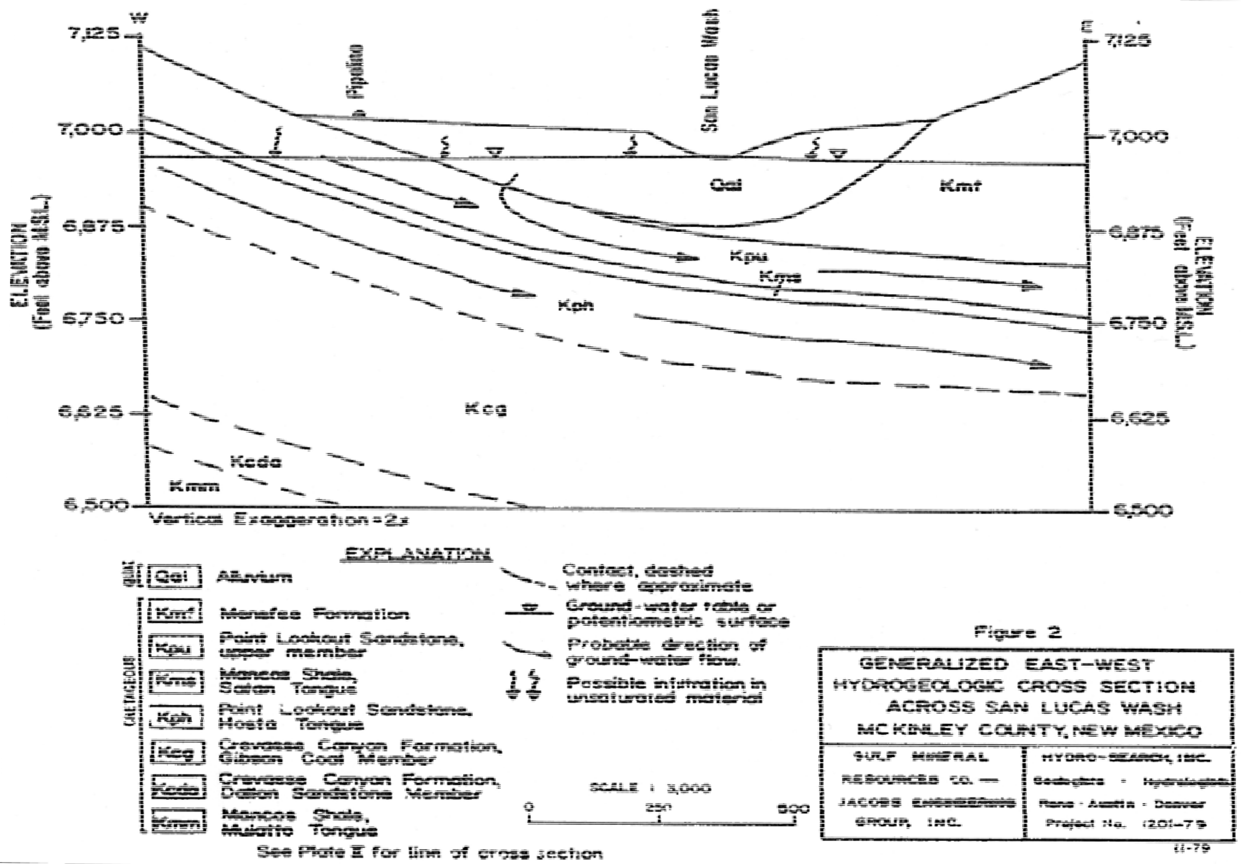
This concept is consistent with the work of Craigg and Stone (1983) farther downstream within the Arroyo Chico area (Craigg and Stone, 1983). They estimated that in the Arroyo Chico/Torreon Wash area, the thickness of stream channel materials ranges from 40 to 80 feet, and from drilling logs, determined that bedrock underlying the channel throughout the area is the Menefee Formation. Craig and Stone report that the Arroyo Chico flows intermittently through a short reach due to discharge from springs that flow from the Menefee Formation or rocks on the flanks of Mt. Taylor. They found no clear evidence of discharge to the stream from the deeper, regional flow system and determined that most groundwater discharge in the Arroyo Chico-Torreon Wash area was either shallow spring flow or evapotranspiration along channels. They concluded that overall, however, Arroyo Chico and other ephemeral and intermittent streams in the stream system were losing water throughout most of their water courses. They concluded that the potentiometric surface of groundwater within the deeper Point Lookout Sandstone was not in connection with groundwater in the overlying Menefee, or with water in the channel fill or the surface flow (Craigg and Stone, 1983).

2.2 Nature of Surface Flow

San Lucas Canyon is part of the Arroyo Chico watershed, which is a small part of the much larger Rio Puerco watershed. San Lucas Canyon joins Miguel Creek about three miles below the proposed RHR discharge point, after which point the Creek trends ten miles northeast to confluence with the Arroyo Chico. The Arroyo Chico makes a broad arch from the northwest to the southeast and is joined by Torreon Wash about 17 miles farther downstream, 30 miles downstream of the proposed point of discharge. The drainage joins the Rio Puerco about five miles farther downstream. Plate 1 (attached) shows the location of the RHR discharge point and course of the stream system.

San Lucas Canyon is ephemeral at and above the point of proposed discharge, with surface water flow occurring only as runoff from storms. A few springs drain into the wash from the volcanics of Mesa Chivato, but they are not connected with the groundwater system. NMEIS (1974) located San Lucas Spring and other springs (Figure 1 above) and determined that they did not flow from the streambed of San Lucas Canyon or bedrock aquifers, but originated from beneath the volcanic cap and seeped down the canyon walls to the streambed. No permanent surface water is present above or below the proposed discharge point. Laguna La Polvadera (Figure 1 above) is not a permanent surface water body, but may occasionally hold runoff during part of the year, depending on rainfall. The reservoir of water shown behind San Lucas Dam on Figure 2 above does not contain surface water (RHR field investigations).

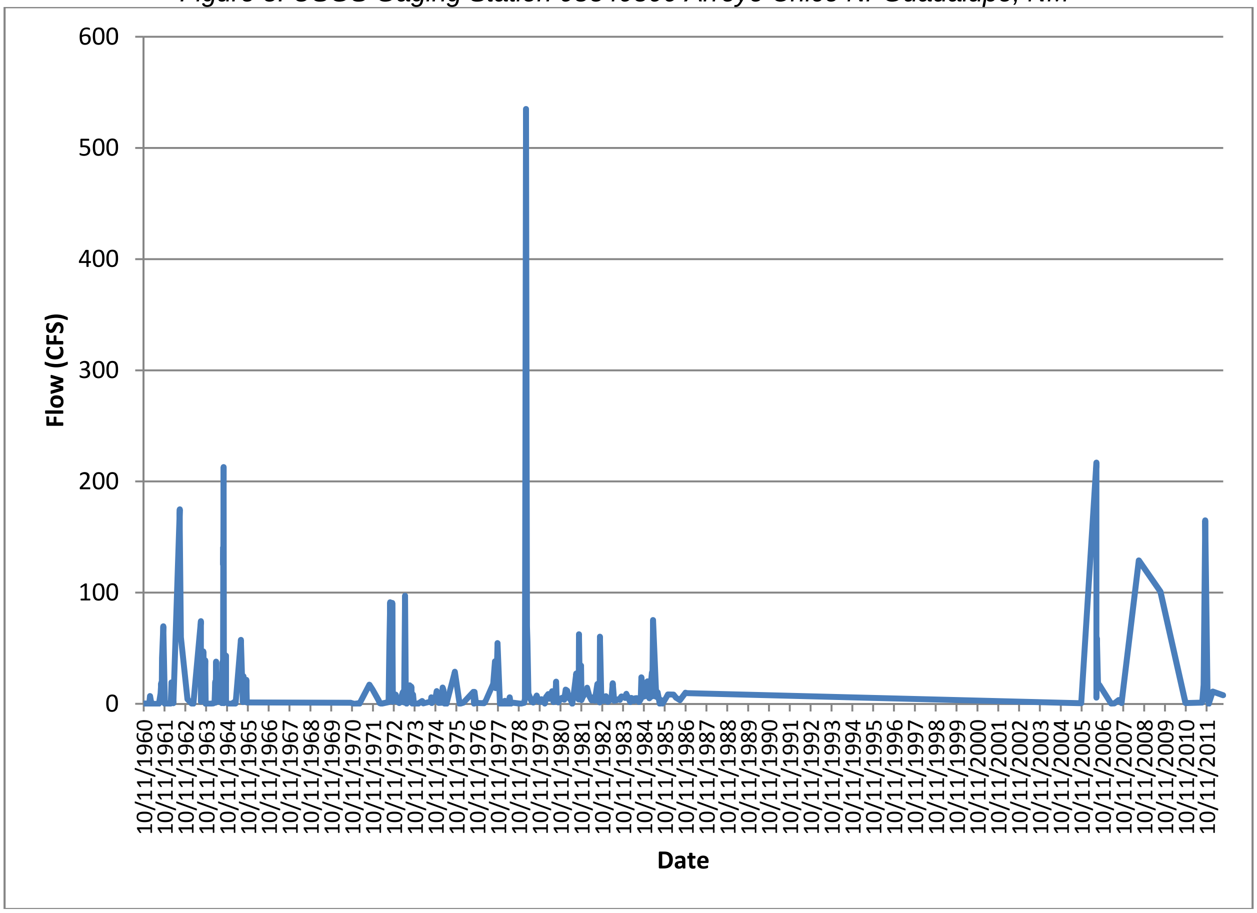
Figure 4: Generalized Hydrogeology within San Lucas Drainage



(Figure 2 from Jacobs Engineering and Hydro-Search (1979))

The closest surface water gaging station to the RHR discharge point area is USGS gaging station 08340500, "Arroyo Chico Nr Guadalupe," located about 35 miles downstream of the discharge point immediately upstream of the confluence of Arroyo Chico and Rio Puerco. USGS 08340500 records flow from an area of 1,390 square miles. Between water years 1943 and 2011, the discharge of Arroyo Chico at this gaging station averaged 19.6 cfs or 14,170 acre-feet per year (afy). Figure 5 is a graph of streamflow measured at this gaging station. Over the 1966 through 1977 period, an average of over 75 % of the total annual measured streamflow occurred during the July through September period.

Figure 5: USGS Gaging Station 08340500 Arroyo Chico Nr Guadalupe, NM



2.3 Chemistry and Quantity of Mt. Taylor Mine Discharge

With the exception of the discharge of treated mine water into San Lucas Canyon by GMRC during the late 1970s through June 1990, no man-made changes have been made to the surface or groundwater regime of San Lucas Canyon. GMRC began the development of the Mt. Taylor mine in 1971; the mine began production in 1979. Water production and treatment occurred continuously from first production to mine shutdown on June 25, 1990, and the treated mine water was discharged into San Lucas Canyon through a 4.5 mile pipeline since 1978 (RGR, 1994).[2] RGR reports that withdrawal of water from the Westwater Canyon Member of the Morrison Formation averaged 2,600 to 2,800 gpm during the 1979 through 1990 period. Discharge records filed under NPDES NM28100 indicate that discharge over this period was higher, averaging approximately 4,200 gpm. The discharged water was used by wildlife, livestock, and irrigation by local ranchers. No water was discharged after June 25, 1990.

Groundwater was discharged from the Mt Taylor mine under two groundwater discharge permits, NM State permit NM DP-61, and Federal EPA Permit NPDES NM 0028100. The Federal mine water discharge permit authorized discharge of treated mine water commingled with liquid wastewater (sewage treatment plant discharge) into an unnamed arroyo located approximately 4.5 mile north of the mine. The water was carried by a 24 inch pipeline. Average discharge was 4,200 gpm. The discharge activity was placed on standby June 25, 1990 when pumps were pulled from the mine. The sewage treatment plant was converted to a leach field system (RGR, (1994)).

Routine sampling of the discharge was performed during the discharge period under both NPDES NM 0028100 and NM DP-61. The water chemistry reports submitted to the agencies under NPDES NM028100 are available on microfiche at NMED offices. They have been transcribed and are presented on Table 2. These samples were taken from treated discharge water. The reports show uranium levels averaging 0.370 mg/l-values higher than would be allowed today, although in compliance with standards at the time. The concentrations of the other constituents are within present EPA drinking water standards.

RGR included additional water chemistry data for mine discharge water in Table G of the 1994 Environmental Report, and in Table 1 of the 1999 groundwater discharge plan. These data were originally provided to the NMED in compliance with conditions of DP-61, and constituents reported are somewhat different than those reported under the NPDES permit. RGR reported that mine water chemistry changed to a small degree over the mining period due to mining materials used and oxidation of the primary ore deposit, and noted that although radium levels actually increased, they were reduced prior to discharge by barium chloride treatment. These data are listed in Table 3.

[2] Other records disagree to some extent with the RHR report, and state that discharge of water from the mine actually began as early as 1972 during pre-shaft construction dewatering, and that part of the initial dewatering water was discharged into San Mateo Creek.

Table 2: Chemistry of Mount Taylor Discharge Reported Under NMDES 0028100 (Page 1 of 5)

Date	Temp °F		Chemical Oxygen demand (COD)		pH		Solids, Total Suspended (mg/l)		Molybdenum, Total as Mo (mg/l)		Vanadium, Total as V (mg/l)		Zinc, Total as Zn (mg/l)		Selenium, Total (mg/l)		Radium 226, Total (pCi/l)		Radium 226, Dissolved (pCi/l)		Uranium, Total (mg/l)		Flow in Conduit or thru Treatment Plant (MGD)	
	Avg.	Max.	Avg.	Max.	Min.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.
1978																								
Jan.																								
Feb.																								
March																								
April																								
May																								
June																								
July																								
Aug.	114		30	32	8.6	8.8	26.75	56	0.003	0.006	0.01	0.01	0.02	0.02	0.01	0.01	2.9	3.8	2.63	3.2	0.003	0.01		
Sept.	112	112	7.3	9	8.7	9.15	103.6	190	0.003	0.006	0.05	0.05	0.05	0.09	0.01	0.01	3.5	5.3	1.3	2.7	0.022	0.024		
Oct.	123	132	9.2	12	8.7	9.2	61.25	114	0.014	0.05	<0.01	<0.01	0.05	0.07	<0.01	<0.01	5.05	7.8	1.98	3.2	0.049	0.093	5.56	
Nov.	80.3	84	<5	<5	8.9	9.15	13	20	0.03	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	3.08	4.9	<1	<1	0.001	0.004	5.62	
Dec.	85	90	<5	<5	8.9	9.2	9	20	<0.02	<0.02	<0.01	<0.01	0.01	0.02	<0.01	<0.01	1.47	2.3	0.61	1.12	0.004	0.007	5.75	
1979																								
Jan.	95.8	131	<5	<5	8.7	8.95	10.4	16	0.05	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.75	1.2	<0.5	<0.5	0.007	0.012	5.55	
Feb.	94.3	132	<5	<5	8.8	8.85	12	20	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.94	1.96	0.59	0.84	0.007	0.009	5.76	
March	79.8	83	<5	<5	8.85	9.05	24	67	0.11	0.2	<0.01	<0.01	<0.01	<0.01	<0.03	<0.08	2.55	6.17	0.57	1.38	0.037	0.075	5.71	
April	77.75	81	<5	<5	8.9	8.95	17.75	23	<0.08	<0.16	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	6	19.2	2.25	6.7	0.08	0.12	5.88	
May																								
June																								
July	67	99	159.86	367.3	8.8	8.9	1.75	4	0.12	0.39	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	4.72	18.7	2.75	13.97	0.24	0.37	5.74	
Aug.	84.4	88	32.25	78.2	8.8	9	3.4	9	0.16	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.54	3.96	0.75	2.98	0.131	0.14	5.89	
Sept.	80	88	24.45	72.1	8.9	9	3.25	10	0.03	0.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.7	5.61	1.03	4.89	0.088	1.29	5.84	
Oct.	75	83	15.1	32.3	8.7	9	4.8	10	0.05	0.09	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	1.83	2.87	1.09	2.18	0.097	0.121	5.75	
Nov.	68	74	10.7	32.8	8.75	9	12	22	<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	3.09	7.28	1.77	4.52	0.09	0.115	5.76	
Dec.	68	77	12.9	24.9	8.16	8.99	8	17	0.03	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.25	4.68	1.07	2.17	0.109	0.196	5.74	
1980																								
Jan.	66	72	7.59	12.6	8.32	8.7	3.8	8	<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	2.441	5.56	1.37	4.92	0.084	0.137	5.74	
Feb.	67.7	71	3.49	7.3	7.97	8.98	9.5	27	0.015	<0.02	<0.01	<0.01	0.015	0.03	<0.01	<0.01	3.65	8.05	1.63	3.43	0.083	0.096	5.65	
March	72	96	9.03	15.6	8.31	8.89	7.25	14	0.07	0.12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.13	2	0.53	1.46	0.064	0.078	5.65	
April	70	76	19	35.6	8.45	8.93	5.4	11	0.19	0.22	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.79	2.71	1.02	2.19	0.081	0.093	5.46	
May	73.7	80	10.38	18.7	8.04	8.91	3.75	15	0.1	0.22	<0.01	<0.01	0.05	0.1	<0.01	<0.01	1.54	2.81	0.604	1.038	0.065	0.075	5.63	
June	79	85	14.4	31	8.11	8.91	2.5	6	0.1	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	1.06	2.2	0.5	0.64	0.043	0.065	5.58	
July	86	90	13.2	23.9	8.21	8.85	5	6	0.13	0.21	<0.01	<0.01	0.02	0.05	<0.01	<0.01	1.62	2.9	0.63	1.12	0.027	0.068	5.74	

Table 2: Chemistry of Mount Taylor Discharge Reported Under NMDES 0028100 (Page 2 of 5)

Date	Temp °F		Chemical Oxygen demand (COD)		pH		Solids, Total Suspended (mg/l)		Molybdenum, Total as Mo (mg/l)		Vanadium, Total as V (mg/l)		Zinc, Total as Zn (mg/l)		Selenium, Total (mg/l)		Radium 226, Total (pCi/l)		Radium 226, Dissolved (pCi/l)		Uranium, Total (mg/l)		Flow in Conduit or thru Treatment Plant (MGD)	
	Avg.	Max.	Avg.	Max.	Min.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.
Aug.	87	90	15.3	23.1	8.56	8.86	4.5	9	0.28	0.29	<0.01	<0.01	0.01	0.02	<0.01	<0.01	1.03	2.62	0.68	1.22	0.016	0.057	5.63	
Sept.	80	84	19.8	31.6	8.36	8.88	10.3	16	0.24	0.37	<0.02	<0.02	0.04	0.11	<0.02	<0.02	1.67	3.6	1.02	1.59	0.024	0.037	5.7	
Oct.	76	80	5.58	7.9	8.44	8.88	1.6	3	0.58	0.7	<0.01	<0.02	0.05	0.15	<0.01	<0.02	5.5	15.9	0.8	1.3	0.084	0.16	5.76	
Nov.	73	78	7.8	12	8.51	8.79	8.5	15	0.69	0.92	<0.01	<0.01	0.04	0.09	<0.01	<0.01	8.11	20.4	3.6	14.4	0.16	0.27	5.92	
Dec.	71	77	14.8	32.5	8.35	8.79	15	29	0.69	0.86	0.02	0.04	0.06	0.17	<0.01	<0.01	7.98	18.96	1.12	3	0.164	0.31	5.85	
1981																								
Jan.	73	82	0.91	3.5	7.76	8.76	5.6	13	0.5	0.75	0.06	0.12	0.01	0.01	0.03	0.04	2.7	5.2	0.3	0.4	0.166	0.204	5.81	
Feb.	71	76	1.41	5.6	6	9	5.8	9	0.25	0.42	0.03	0.06	0.02	0.02	0.02	0.04	1.4	3.1	0.3	0.6	0.081	0.104	5.87	
March	74	77	2.43	5.4	7.81	8.81	4.35	7	0.34	0.44	0.04	0.05	0.09	0.25	0.01	0.01	2.2	3.5	0.3	0.4	0.152	0.19	4.21	
April	75	80	2.88	11.6	8.58	8.76	7.8	15	0.54	0.6	0.01	0.03	0.03	0.03	0.03	0.04	4.8	8.7	0.6	1.4	0.184	0.208	6.35	
May	76	80	2.2	5.3	7.93	8.79	5.4	8.2	0.63	0.7	0.02	0.03	0.15	0.58	0.04	0.04	5.7	8	0.6	0.8	0.215	0.279	6.35	
June	81	85	4.26	7.52	8.55	8.86	8.1	9.4	0.61	0.74	0.02	0.02	0.03	0.05	0.07	0.07	11.5	18.6	0.6	0.7	0.237	0.309	4.22	
July	81	85	2.5	6.1	8.2	8.91	4.8	8.6	0.47	1	0.02	0.03	0.05	0.11	0.05	0.07	7.4	14	0.9	1.7	0.33	0.37	5.93	
Aug.	83	90	4.8	9.3	7.88	8.94	5.6	10	0.7	0.79	0.01	0.01	0.23	0.31	0.04	0.05	5.6	12.7	0.6	0.7	0.31	0.38	6.28	
Sept.	80	83	3.2	5.2	7.92	8.94	0.5	1	0.55	0.76	0.01	0.02	0.21	0.37	0.03	0.05	3.8	6	0.4	0.6	0.17	0.21	6.27	
Oct.	78	81	7	11.1	8.07	9.17	2.7	6.2	0.81	0.93	0.01	0.01	0.26	0.74	0.06	0.1	7.4	11.6	0.6	0.9	0.22	0.34	6.48	
Nov.	74	78	2.6	2.8	8.32	8.96	4.2	10	1.02	1.4	0.01	0.01	0.06	0.2	0.06	0.07	7.7	10.8	1.1	1.4	0.17	0.27	6.4	
Dec.	73	76	6.6	19	8.4	8.88	2.9	6.4	0.66	0.66	<0.01	<0.01	0.02	0.05	0.05	0.05	7.1	14.4	0.3	0.7	0.179	0.233	6.6	
1982																								
Jan.	69	74	10.5	28.1	8.62	8.96	3.8	8	0.55	0.55	<0.01	<0.01	0.02	0.04	0.01	0.01	2.9	4.4	0.7	1.2	0.19	0.284	6.61	7.2
Feb.	71	75	3.6	6.4	7.54	9	4.3	10	0.46	0.46	<0.01	<0.01	0.02	0.06	0.02	0.02	3.6	6.8	<0.6	<0.6	0.224	0.306	6.54	6.9
March	73	75	4.6	19	7.75	8.86	3.8	7	0.78	0.92	<0.01	<0.01	<0.01	<0.01	0.02	0.02	6.6	10.2	<0.6	<0.6	0.251	0.342	6.67	7.67
April	70	81	6.3	12	8.09	8.96	4.6	9	0.78	0.83	<0.01	<0.01	0.01	0.03	0.02	0.02	6.9	19.3	<0.6	<0.6	0.2	0.34	6.7	7.97
May	72	77	7.5	19	8.45	8.95	3.6	7	0.69	0.69	<0.01	<0.01	0.01	0.02	0.01	0.01	3.6	11.2	1.3	6.5	0.22	0.28	6.67	7.28
June	79	85	11.3	18	8.5	8.91	4.7	9	0.76	0.76	<0.01	<0.01	0.02	0.03	0.02	0.02	5.7	12	0.7	0.8	0.31	0.33	6.96	7.75
July	77	79	11.7	24	8.5	8.9	9	12	0.2	0.2	<0.01	<0.01	<0.01	<0.01	0.03	0.03	6.9	10	2.2	4	0.24	0.38	6.68	7.2
Aug.	78	81	6	15	8.4	9	3.2	12	0.74	0.93	0.01	0.01	<0.01	<0.01	0.04	0.04	4.9	11	<0.6	<0.6	0.28	0.34	6.61	7.04
Sept.	75	81	5.3	12	8.4	8.85	1.4	3	0.73	0.73	0.01	0.01	<0.01	<0.01	0.05	0.05	9.5	22.5	1.1	2.7	0.22	0.3	6.58	6.8
Oct.	69	75	3.4	7.4	8.5	8.83	4.4	7	0.68	0.68	<0.01	<0.01	0.01	0.02	0.05	0.05	9.1	18.4	1	3	0.22	0.26	6.38	6.79
Nov.	66	72	2.2	4	8.6	8.8	2.4	4	0.59	0.59	<0.01	<0.01	<0.01	<0.01	0.02	0.02	6.9	13.4	2.1	6.2	0.41	0.65	6.72	7.77
Dec.	72	74	3.2	6.1	8.58	8.87	3.3	7.7	2.6	2.6	<0.01	<0.01	0.01	0.02	0.07	0.07	3.7	5.8	1.2	2.8	0.57	0.71	6.89	7.33
1983																								
Jan.	72	74	2.6	3.7	8.83	8.96	3	9	1.7	1.7	<0.01	<0.01	0.01	0.01	0.01	0.01	0.5	1.2	0.4	0.6	0.47	0.61	6.78	7.86
Feb.	70	72	2.5	5.2	8.66	8.93	1.8	3	1.4	1.4	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.2	0.5	0.2	0.3	0.36	0.41	6.59	7.14

Table 2: Chemistry of Mount Taylor Discharge Reported Under NMDES 0028100 (Page 3 of 5)

Date	Temp °F		Chemical Oxygen demand (COD)		pH		Solids, Total Suspended (mg/l)		Molybdenum, Total as Mo (mg/l)		Vanadium, Total as V (mg/l)		Zinc, Total as Zn (mg/l)		Selenium, Total (mg/l)		Radium 226, Total (pCi/l)		Radium 226, Dissolved (pCi/l)		Uranium, Total (mg/l)		Flow in Conduit or thru Treatment Plant (MGD)	
	Avg.	Max.	Avg.	Max.	Min.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.
March	71	76	1.4	2.9	8.73	8.93	2.6	6	1	1	<0.01	<0.01	<0.01	<0.01	0.01	0.01	1.1	2.4	0.6	1.4	0.32	0.38	6.31	6.85
April	70	72	1.7	3.9	8.62	8.91	5.3	6	1.1	1.1	<0.01	<0.01	0.01	0.02	0.01	0.01	1	1.6	0.3	0.7	0.27	0.31	6.61	7.02
May	71	74	3.8	9.1	8.65	8.86	3	5	0.9	0.9	<0.01	<0.01	0.01	0.02	0.01	0.01	0.6	1.5	<0.1	<0.1	0.21	0.23	6.52	7.95
June	79	83	2.3	4.1	8.72	8.94	2	4	0.6	0.6	0.05	0.05	<0.01	<0.01	0.08	0.08	<0.1	<0.1	<0.1	<0.1	0.22	0.24	6.73	7.3
July	85	85	2.4	4	8.71	8.87	12.8	15	0.53	0.53	0.03	0.03	0.02	0.04	<0.01	<0.01	0.4	1.1	<0.1	<0.1	0.2	0.21	5.92	8.21
Aug.	85	86	1.8	2.6	8.75	8.79	1.5	2	0.34	0.34	<0.01	<0.01	0.01	0.01	0.04	0.04	<0.1	<0.1	<0.1	<0.1	0.19	0.23	6.83	7.94
Sept.		83	3.3	5.3	8.83	8.95	9	12	0.33	0.33	<0.01	<0.01	0.01	0.01	0.04	0.04	<0.1	<0.1	<0.1	<0.1	0.18	0.24	6.54	7.07
Oct.		79	3.58	8.3	8.8	8.91	7.75	9	0.48	0.48	<0.01	<0.01	<0.01	<0.01	0.03	0.03	0.57	2	0.78	2.8	0.31	0.69	6.3	6.91
Nov.		78	2.4	4.6	8.64	8.82	4	8	0.45	0.45	<0.01	<0.01	<0.01	<0.01	0.02	0.02	3.8	13.7	1.46	6.9	0.22	0.25	6.39	8.84
Dec.		69	1.98	3.2	8.6	8.73	2.75	4	0.63	0.63	<0.01	<0.01	0.03	0.09	0.02	0.02	5.98	13.8	1.48	5.6	0.18	0.19	6.83	7.41
1984																								
Jan.		65	1.7	3.7	8.78	8.89	2.8	18	0.3	0.3	<0.01	<0.01	<0.01	<0.01	0.02	0.02	1.95	3.6	1.05	2.9	0.161	0.184	6.96	7.31
Feb.		67	3.1	5.4	8.82	8.96	5.25	10	0.33	0.33	<0.01	<0.01	0.04	0.1	0.04	0.04	3.43	4.1	0.8	2.4	0.096	0.146	6.75	7.04
March		70	3.74	8.2	8.42	8.7	6.8	22	0.42	0.42	<0.01	<0.01	<0.01	<0.01	0.02	0.02	2.1	3.1	0.68	2.5	0.105	0.195	6.56	7.07
April		73	3.08	5.6	8.76	8.82	3.8	8	0.45	0.45	<0.01	<0.01	0.01	0.01	0.03	0.03	2	3.9	0.46	0.6	0.201	0.399	6.29	8.28
May		78	4.9	7.3	8.6	8.8	3.4	11	0.4	0.4	<0.01	<0.01	0.01	0.01	0.03	0.03	2.4	4.9	0.5	1.1	0.118	0.167	6.37	7.11
June		81	4.9	5.5	8.8	9	2	4	2.1	2.1	<0.01	<0.01	0.02	0.02	0.02	0.02	3.6	4.2	0.7	0.9	0.108	0.15	6.18	7.09
July		85	4.75	10	8.8	8.9	7	20	0.22	0.22	<0.01	<0.01	0.01	0.01	0.02	0.02	4.1	7.3	1.8	3.3	0.126	0.16	6.41	7.12
Aug.		84	2.8	3.8	8.8	8.9	2	4	0.43	0.43	<0.01	<0.01	0.02	0.06	0.02	0.02	2.5	3.4	1.2	1.8	0.14	0.148	6.32	6.79
Sept.		78	3.1	4.3	8.6	8.7	3.3	6	0.31	0.31	<0.01	<0.01	0.5	1	<0.01	<0.01	3.2	4.8	0.9	1.2	0.142	0.151	5.46	6.34
Oct.		72	1.4	3.1	8.6	8.7	4.8	8	0.26	0.26	<0.01	<0.01	0.02	0.08	0.01	0.01	3.4	5.8	1	1.9	0.16	0.169	4.59	5.47
Nov.		71	4.5	8.5	8.6	8.7	7	10	0.4	0.4	<0.01	<0.01	<0.01	0.01	0.02	0.02	2.5	4.8	1	1.4	0.323	0.45	5.43	5.9
Dec.		68	4.5	7.5	8.7	8.8	3.5	9	0.31	0.31	<0.01	<0.01	<0.01	<0.01	0.01	0.01	1.6	2.6	0.4	0.8	0.4	0.45	5.11	5.25
1985																								
Jan.		66	1.1	1.3	8.68	8.74	2.2	4	0.43	0.43	<0.01	<0.01	0.01	0.01	0.02	0.02	2.38	4.7	0.72	1.3	0.36	0.453	5.62	6.46
Feb.																								
March		67	3.3	5.4	8.72	8.87	1.3	2	0.25	0.25	<0.01	<0.01	0.01	0.01	0.07	0.07	4.9	5.8	1.8	2.6	0.24	0.26	6.57	7.11
April		73	4	6.6	8.81	8.86	3.3	5	0.32	0.32	<0.01	<0.01	<0.01	<0.01	0.01	0.01	3.9	5.5	1.6	3.9	0.269	0.276	6.89	7.35
May		78	2.8	4.4	8.78	8.93	5.4	9	0.26	0.26	<0.01	<0.01	0.01	0.01	0.02	0.02	4.7	9	0.7	1.9	0.341	0.365	6.79	7.04
June		83	3.7	4.5	8.32	8.88	2.8	8	0.14	0.14	<0.01	<0.01	0.02	0.03	0.01	0.01	2.9	4.5	0.8	1.6	0.342	0.375	6.38	6.56
July		83	3	6.6	8.72	8.94	5.6	14	0.14	0.14	<0.01	<0.01	0.01	0.01	0.03	0.03	4.5	5.3	2.2	4	0.302	0.325	6.26	6.93
Aug.		84	2.4	6.6	8.78	8.97	5.6	12	0.15	0.15	<0.01	<0.01	0.01	0.02	0.01	0.01	3.3	4.6	1.5	3.1	0.274	0.288	6.24	7.23
Sept.		79	2.6	7.2	8.85	8.97	2	3	0.28	0.28	<0.01	<0.01	0.01	0.01	<0.01	<0.01	2.5	3.8	1	1.9	0.271	0.347	5.89	6.13
Oct.		73	2.5	4	8.87	8.93	2.8	7	0.26	0.26	<0.01	<0.01	0.01	0.02	0.01	0.01	2.9	7.9	1.2	2.2	0.24	0.26	6.73	7.1

Table 2: Chemistry of Mount Taylor Discharge Reported Under NMDES 0028100 (Page 4 of 5)

Date	Temp °F		Chemical Oxygen demand (COD)		pH		Solids, Total Suspended (mg/l)		Molybdenum, Total as Mo (mg/l)		Vanadium, Total as V (mg/l)		Zinc, Total as Zn (mg/l)		Selenium, Total (mg/l)		Radium 226, Total (pCi/l)		Radium 226, Dissolved (pCi/l)		Uranium, Total (mg/l)		Flow in Conduit or thru Treatment Plant (MGD)	
	Avg.	Max.	Avg.	Max.	Min.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.
Nov.		70	1.3	2.3	8.95	8.98	4	8	0.24	0.24	<0.01	<0.01	0.01	0.02	0.01	0.01	1.5	2.4	0.5	1.8	0.293	0.3	6.18	6.97
Dec.															0.02	0.02	4.3	5.1	2.2	3.3	0.287	0.327	6.4	6.96
1986																								
Jan.		71	4.5	10	8.82	8.88	2.2	4	0.38	0.38	<0.01	<0.01	<0.01	<0.01	0.01	0.01	3.7	4.4	0.5	1.4	0.266	0.279	6.49	6.87
Feb.		70	<1	<1	8.84	8.89	3	4	0.45	0.45	<0.01	<0.01	0.01	0.02	0.002	0.02	3.7	5.1	1.1	2.5	0.299	0.35	6.6	6.77
March		75	2	3.4	8.85	8.96	6.8	20	0.57	0.57	<0.01	<0.01	0.01	0.01	0.02	0.02	3.3	3.8	1.3	2.7	0.295	0.357	6.47	6.85
April		76	1.2	4.2	8.77	8.93	5.7	8	0.49	0.49	<0.01	<0.01	0.01	0.02	0.01	0.01	5.4	10.1	0.6	1.1	0.374	0.455	6.22	6.53
May		76	2.9	7	8.77	8.85	3.3	7.6	0.68	0.68	<0.01	<0.01	0.01	0.01	<0.01	0.01	4.1	7.1	0.2	0.3	0.4	0.452	6.27	6.62
June		78	7.7	9.6	8.48	8.81	2.5	6	0.51	0.51	<0.01	<0.01	<0.01	<0.01	0.01	0.01	3.8	7.2	0.7	1.5	0.337	0.365	6.25	6.42
July		83	2.5	3.7	8.21	8.9	6.4	14	0.64	0.64	<0.01	<0.01	0.01	0.02	0.01	0.01	7	21.4	0.8	2.3	0.46	0.605	6.14	6.46
Aug.		83	3.6	5.6	8.81	8.92	5.7	7.3	0.53	0.53	0.01	0.01	0.01	0.02	0.01	0.01	4.8	6.6	0.7	1.4	0.524	0.58	6.53	6.84
Sept.		80	0.5	1.8	8.87	8.93	3	3.9	0.84	0.84	0.02	0.02	<0.01	<0.01	<0.01	<0.01	5.1	5.5	0.9	2.8	0.563	0.61	6.06	6.46
Oct.		76	2.8	8.1	8.88	8.96	4.7	6	0.59	0.59	<0.01	<0.01	<0.01	<0.01	0.01	0.01	16.4	31.3	8.9	22.7	0.57	0.65	6.15	6.91
Nov.		70	1.6	2.4	8.9	8.93	6.7	8	0.72	0.72	<0.01	<0.01	0.1	0.02	0.01	0.01	4.56	7.5	1.83	3.9	0.59	0.62	5.9	6.2
Dec.		68	1.1	2.8	8.65	8.97	2.6	5.6	0.82	0.82	<0.01	<0.01	<0.01	<0.01	0.02	0.02	4.2	10.1	1.3	3.2	0.605	0.649	6.83	6.12
1987																								
Jan.		68	3.6	7.1	8.56	8.89	3.2	4.8	0.67	0.67	<0.01	<0.01	0.01	0.02	0.02	0.02	3.9	5.7	0.2	0.4	0.63	0.67	5.84	6.64
Feb.		68	1.2	3.7	8.99	8.96	4.7	6.2	0.56	0.56	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.1	<0.1	4.4	4.9	0.53	0.58	5.82	
March		70	3.6	8.1	8.78	8.91	3.6	6.1	0.7	0.7	<0.01	<0.01	0.01	0.01	0.02	0.02	6.6	18	2.2	5.8	0.55	0.65	5.9	6.1
April		72	3.8	5.9	8.88	8.92	2.7	4	0.91	0.91	<0.01	<0.01	<0.01	<0.01	0.02	0.02	4.4	6.6	1.7	3.3	0.39	0.59	5.93	6.08
May		73	3.8	7.2	88.78	8.96	1.6	2.3	0.79	0.79	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	3.4	4.3	0.4	0.7	0.58	0.63	6.22	6.56
June		83	2.1	3.7	8.78	8.89	0.9	1.1	0.87	0.87	<0.01	<0.01	<0.01	<0.1	0.02	0.02	<0.1	<0.1	<0.1	<0.1	0.77	0.92	6.32	6.78
July		84	12.9	22	8.47	8.75	1.4	2.1	1.6	1.6	<0.01	<0.01	0.04	0.09	0.315	0.315	4.7	5.6	3.5	4.8	0.78	0.98	6.35	7.02
Aug.		85	10.1	15.4	8.73	8.871	2	2.9	1.6	1.6	<0.3	<0.3	0.03	0.04	0.15	0.15	4.1	6.4	3.2?	5.2	0.78	0.82	6.09	7.1
Sept.		78	1.8	4.9	8.83	8.91	1.8	4.1	1.2	1.2	<1.0	<1.0	0.03	0.05	0.12	0.12	3.3	3.7	2.6	4.2	0.87	1.03	5.77	6.06
Oct.		73	2	5	8.91	8.93	2.6	3.3	1.12	1.12	<1	<1	0.02	0.04	0.05	0.05	3.28	4.4	1.85	2.9	0.76	0.91	5.46	6.33
Nov.		76	1.5	3.1	8.89	8.97	2.3	2.7	0.6	0.6	<1.0	<1.0	0.021	0.029	0.022	0.022	6.47	7.2	1.28	1.4	0.49	0.7	5.28	6.18
Dec.		70	<1.0	<1.0	8.9	8.96	3.7	5.2	0.59	0.59	<1.0	<1.0	0.031	0.035	0.022	0.022	7.7	15	1.5	1.9	0.61	0.76	6.45	6.96
1988																								
Jan.		67	3.25	4	8.9	8.97	2.5	3.2	0.92	0.92	0.02	0.02	0.023	0.04	0.118	0.118	4.7	8.5	0.8	1.8	0.692	0.795	6.75	7.05
Feb.		65	1.8	4	8.76	8.96	2.3	3	0.87	0.87	0.01	0.01	0.012	0.021	0.124	0.124	6.7	7.7	0.5	0.6	0.969	1.58	6.69	6.87
March		70	5.8	12	8.77	8.93	1.7	1.9	0.8	0.8	0.01	0.01	0.006	0.008	0.079	0.079	7.9	13	0.5	0.6	0.825	0.877	6.19	7.03
April		72	4.5	8	8.78	8.96	2.4	3	0.64	0.64	<0.01	<0.01	0.021	0.053	0.098	0.098	4.5	6.5	0.8	0.9	0.653	0.67	6.08	6.37
May		75	1.6	4	8.71	8.91	2.9	3.2	0.69	0.69	<0.01	<0.01	<0.008	0.012	0.1	0.1	4.9	6.5	1.1	1.5	0.71	0.76	5.65	6.17

Table 2: Chemistry of Mount Taylor Discharge Reported Under NMDES 0028100 (Page 5 of 5)

Date	Temp °F		Chemical Oxygen demand (COD)		pH		Solids, Total Suspended (mg/l)		Molybdenum, Total as Mo (mg/l)		Vanadium, Total as V (mg/l)		Zinc, Total as Zn (mg/l)		Selenium, Total (mg/l)		Radium 226, Total (pCi/l)		Radium 226, Dissolved (pCi/l)		Uranium, Total (mg/l)		Flow in Conduit or thru Treatment Plant (MGD)	
	Avg.	Max.	Avg.	Max.	Min.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.	Avg.	Max.
June		80	5.5	8	8.73	8.94	2.9	4.3	1.18	1.18	0.01	0.01	0.024	0.053	0.202	0.202	6.08	8.6	0.98	1.6	0.99	1.27	5.84	6.29
July		82	6.3	8	8.81	8.93	5.1	11.6	0.81	0.81	<0.01	<0.01	0.04	0.117	0.11	0.11	4.5	7.8	2.2	5.6	0.764	0.84	5.75	6.04
Aug.		83	<1	<1	8.65	8.96	1.8	2.7	0.74	0.74	0.01	0.01	<0.005	<0.005	0.091	0.091	3.4	5.4	0.9	1.1	0.682	0.682	5.5	6.23
Sept.		82	<1	<1	8.73	8.82	2	3.5	2.3	2.3	0.02	0.02	0.157	0.157	0.013	0.013	4.5	5.3	1.83	3.4	1.12	1.12	5.19	5.67
Oct.		81	4	4	8.73	8.79	1.6	2.2	1.52	1.52	0.01	0.01	0.06	0.06	0.31	0.31	4.5	5.4	1.6	2.6	1.05	1.05	4.79	5.83
Nov.		75	4	4	8.75	8.83	1.1	1.9	1.41	1.41	0.01	0.01	0.183	0.183	0.053	0.053	6.02	9.5	1.28	2.5	0.909	0.909	4.74	5.27
Dec.		72	<1	<1	8.83	8.93	1.5	1.8	1.09	1.09	<0.01	<0.01	0.121	0.121	0.217	0.217	8.5	11.2	0.8	1.9	0.883	0.883	4.71	5.05
1989																								
Jan.		72	<1	<1	8.89	8.94	1.8	2.5	1.06	1.06	<0.01	<0.01	0.07	0.07	0.056	0.056	5.98	7.7	0.65	1	0.887	0.887	5.91	6.31
Feb.		72	<1	<1	8.84	8.96	3.3	3.7	1.11	1.11	<0.02	<0.02	0.009	0.009	0.064	0.064	9.05	11	0.85	1	0.974	0.974	5.97	6.14
March		74	16	16	8.68	8.83	2.3	3.2	1.1	1.1	0.02	0.02	0.024	0.024	0.034	0.034	5.9	7.5	1.6	2.8	0.093	0.093	5.86	6.26
April		78	<1	<1	7.82	7.82	2.2	2.6	0.99	0.99	<0.01	<0.01	0.052	0.052	0.017	0.017	5.4	5.9	1.3	1.5	0.781	0.781	5.79	6.1
May																							NO DISCHARGE	
June		83	<1	<1	8.83	8.91	1.5	2	1.96	1.96	0.02	0.02	0.024	0.024	0.102	0.192	3.9	4.7	1.3	1.9	1.45	1.45	6.59	7.67
July		85	8	8	8.72	8.82	2	3.2	1.22	1.22	0.02	0.02	0.015	0.015	0.055	0.055	2.5	3.5	1.3	1.9	1.02	1.02	6.57	7.39
Aug.		86	<1	<1	8.78	8.88	2.4	3.1	1.15	1.15	0.03	0.03	0.064	0.064	0.062	0.069	3.84	5	0.94	1.6	0.922	0.922	6.7	7.2
Sept.		84	4	4	8.84	8.87	1.3	1.5	0.92	0.92	<0.01	<0.01	0.019	0.019	0.083	0.109	3.43	5.59	0.83	1.5	1.18	1.18	6.38	6.91
Oct.		76	<1	<1	8.85	8.91	1.7	2	0.95	0.95	<0.01	<0.01	0.011	0.011	0.8	0.8	2.8	3	1.1	1.5	0.685	0.685	6.44	7.52
Nov.		74	<1	<1	8.81	8.88	2.6	4.2	0.87	0.87	<0.01	<0.01	0.019	0.019	0.059	0.059	5.9	14.4	1.2	2.2	0.753	0.753	6.7	7.6
Dec.		70	<5	<5	8.85	8.91	2.9	3.6	0.84	0.84	0.01	0.01	0.025	0.025	0.089	0.089	3.7	4.7	0.8	1	0.659	0.659	6.89	7.56
1990																								
Jan.		69	4	4	8.86	8.91	3.4	6	0.76	0.76	0.02	0.02	0.015	0.015	0.056	0.056	2.1	3.8	0.6	0.9	0.658	0.658	6.9	7.9
Feb.		72	<1	<1	8.85	8.9	2.1	2.1	0.67	0.67	<0.01	<0.01	0.024	0.024	0.151	0.151	3.8	6.3	0.6	0.8	0.495	0.495	7.61	8.56
March		74	<1	<1	8.91	8.95	2	2.4	0.65	0.65	<0.01	<0.01	0.037	0.037	0.104	0.104	2.9	3.3	0.8	1.8	0.42	0.42	7.85	9.1
April		75	16	16	8.89	8.95	1.5	2.3	0.62	0.62	0.02	0.02	<0.005	<0.005	0.072	0.072	3.8	5	1.1	1.4	0.36	0.36	8.13	8.87
May			<1	<1	8.89	8.94	1.4	2.2					0.058	0.058			2.9	4.3	1.4	1.9	0.368	0.368	8.02	8.85
June			<1	<1	7.98	8.68	0.9	1.2					0.093	0.093			1.4	2.2	0.7	1.4	0.353	0.353	4.1	8.84
July																							NO DISCHARGE	
Aug.																							NO DISCHARGE	
Sept.																							NO DISCHARGE	
Oct.																							NO DISCHARGE	
Nov.																							NO DISCHARGE	
Dec.																							NO DISCHARGE	

* Three companies discharged groundwater under NPDES NM0028100: GMRC from August, 1978 through September, 1980; Chevron from October, 1980 through December, 1987; and RGRC from January, 1988 through December, 1990.

Table 3: Mount Taylor Mine Discharge Water Chemistry
(Table G, RGRC, 1994 and Table 1, RHR, 1999)

Water Parameters	Units	January 1980*	November 1, 1989**	January 1990*
Arsenic	mg/l	<0.02	0.017	0.01
Barium	mg/l	<0.518	0.05	0.12
COD			<0.1	
Chloride	mg/l	25.0	11.0	14.0
Fluoride	mg/l	0.854	0.903	0.900
Lead	mg/l	<0.02	<0.005	0.003
Selenium	mg/l	<0.01	0.059	0.048
Uranium	mg/l	0.087	0.753	0.588
Nitrate as Nitrogen	mg/l	0.542	0.1	<.100
Radium 226	pCi/l	1.370+-0.140	2.1	0.700+-0.30
Lead 210	pCi/l		0.8	
Polonium 210	pCi/l		5.1	
pH			8.88	
Molybdenum	mg/l	<0.02	0.87	0.73
TDS	mg/l	696.0	730	742.0
TSS			1.4	
Sulfate	mg/l	251.0	350	342.0
Zinc			0.019	
Vanadium			0.01	

None of the reported constituent levels listed in Tables 1 and 2 exceeded contemporaneous water quality standards. This is still true today for all constituents with the exception of uranium. Federal and State uranium groundwater standards today are now 0.03 mg/l, and samples reported in Tables 1 and 2 exceeded modern drinking water standards for uranium.

2.4 Historical Impacts of Discharge under NPDES NM028100 on the San Lucas/Arroyo Chico/Rio Puerco System

As was previously noted, with the exception of the discharge of treated mine water into San Lucas Canyon by GMRC during the late 1970s through June, 1990, no man-made changes have been made to the surface or groundwater regime of San Lucas Canyon.

2.4.1 Impact of Discharge on Stream Sediments

The historical impact of the discharge of mine water into the San Lucas drainage on stream sediments is inconclusive. Two sets of sediment samples were collected in 1980 by Alara, Inc. above and below the point of discharge for the 24 inch GMRC pipeline (RHR, 1994). There appears to be a significant difference in the concentrations of radium 226, thorium 230 (one sample) and uranium above and below the discharge point in the June samples. However, the October 13, 1980 samples show only slight anomalies for the three parameters. RGR attributed the sample results as attributable to questionable laboratory accuracy (1994).

Table 4: Radionuclide Concentrations in Sediment Samples from San Lucas Canyon near the GMRC Point of Discharge
(from Table A, RGR, 1994)

Constituent	Sample #1 above discharge point	Sample #2 above discharge point	Sample #3 below discharge point	Sample #4 below discharge point
Samples collected June 24, 1980				
Ra 226 pCi/g	1.0	1.1	38.0	10.0
Th 230 pCi/g	1.8	1.7	1.6	7.8
Pb 210 pCi/g	0.22	0.92	0.55	0.69
Total U308% Dry Weight	0.0001	0.0006	0.002	0.002
U 238 pCi/g	0.3	1.7	5.6	5.6
Samples collected October 13, 1980				
Ra 226 pCi/g	1.6	1.3	5.1	1.1
Th 230 pCi/g	2.1	0.66	0.24	0.32
Pb 210 pCi/g	1.5	2.1	3.1	1.2
Total U308% Dry Weight	0.0003	0.0001	0.0004	0.0001
U 238 pCi/g	0.8	0.3	1.1	0.3

2.4.2 Impact of Discharge on Groundwater Chemistry

As was discussed earlier, in an effort to assess the effect of mine water discharge on stream sediments and groundwater and vice versa, in 1979 GMRC consultants Jacobs Engineering and Hydro-Search installed three flumes in San Lucas Canyon between the point of discharge for NPDES NM028100 and the Leopoldo Diversion Dam (See Figure 2 above). Discharge was measured and water samples were collected at the three flumes. Jacobs Engineering concluded that the surface stream did not appear to be picking up groundwater discharge, and that mineral salts were not being dissolved from the stream bed or bank materials by the flowing water between the discharge point and the flumes (Jacobs Engineering, 1979). A greater concentration of dissolved constituents was, however, found in water quality samples collected north of Laguna La Polvadera and at the gage on Arroyo Chico stream flow gaging station 30 miles downstream. The water chemistry results for surface water samples taken at the flumes and north of Laguna La Polvadera, and for Arroyo Chico sampling are presented in Table 5. However, it is uncertain whether the 4/13/1978 Arroyo Chico water sample represents mine discharge water or natural water (mine discharge began February/March of 1978). Additionally, water chemistry data reported by Craigg and Stone (1983) for groundwater and springs near this gaging station indicate poor quality water in this area. Craigg and Stone relate this to the presence of coal in the Menefee Formation.

Jacobs Engineering noted that groundwater encountered in the alluvial well SL-1 was a calcium-magnesium-carbonate-sulfate type, as opposed to the sodium-sulfate type that characterized the mine discharge water. Jacobs believed that although the alluvium and the underlying Point Lookout (well SL-2) were in hydraulic connection, the chemistry of the groundwater and the discharge waters indicated that it was unlikely that the groundwater was being recharged from surface water (Jacobs Engineering, 1979).

Table 5: Water Chemistry of Surface Water Downstream of Mount Taylor
Discharge (from Table 1, Jacobs Engineering, 1979)

Constituent	Units	Flume #1	Flume #2	Flume #3	Laguna La Polvadera, North	Arroyo Chico at gage	Arroyo Chico at gage
		10-24-1979	10-24-1979	10-24-1979	10-11-1979	10-11-1979	4/13/1978
pH	su	8.4	8.4	8.4	7.9	8.3	8.8
TDS	mg/l	622	617	608	952	1,570	2,377
EC	µmho/cm	1,060	1,070	1,060	1,400	2,230	3,350
Temp. C	C	25.4	22.3	21.4	11.7	14.2	11.5
Bicarbonate	mg/l	277	277	277	395	360	382
Carbonate	mg/l	5.8	5.8	5.8		12	14
Chloride	mg/l	21	20	20	36	68	54
Sulfate	mg/l	220	218	211	356	777	1,300
Fluoride	mg/l	0.8	0.8	0.8	1.4	1.2	1.1
Nitrate	mg/l	0.75	0.84	0.71	1.33	0.22	0.13
Sodium	mg/l	200	200	195	300	460	750
Potassium	mg/l	2.3	2.7	2.7	19	5	3.9
Calcium	mg/l	13	10	10	12	30	50
Magnesium	mg/l	2	2.7	2.7	13	25	11
Silica	mg/l	20	20	23	19	15	4.7
Arsenic	mg/l	<0.01	<0.01	<0.01	0.01	<0.01	0.002
Barium	mg/l	0.25	0.20	0.20	0.03	0.03	
Cadmium	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	0
Chromium	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	0
Lead	mg/l	0.01	0.01	0.01	0.01	0.02	0.003
Magnesium	mg/l	0.0009	<0.0002	<0.0002	0.0009	0.0004	0
Selenium	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	0
Silver	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	
Copper	mg/l	0.01	0.01	0.01	0.01	0.005	0.001
Iron	mg/l	<0.01	<0.01	<0.01	<0.01	0.03	0.03
Manganese	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	0.03
Zinc	mg/l	0.22	0.22	0.20	0.28	0.28	0.01
Aluminum	mg/l	0.2	0.2	0.2	1.9	0.4	
Boron	mg/l	0.2	0.3	0.6	0.35	0.4	0.21
Cobalt	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0
Molybdenum	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	0.004
Nickel	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	
Vanadium	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	0
Phosphate	mg/l	<0.01	<0.01	<0.01	0.11	0.02	0.02
Uranium	mg/l	0.10+-0.006	0.08+-0.004	0.12+-0.006	0.19+-0.009	0.11+-0.006	0.0033
Radium 226	pCi/l	<0.03	0.29+-0.03	0.14+-0.03	0.05+-.03	<0.03	0.05
Radium 228	pCi/l	<1.0	<2.0	<1.0	3+-1	<2	
Radium 226+228	pCi/l	<1.03	<2.29	<1.14	3.05	<2.03	
Gross alpha	pCi/l	87+-2	60+-4	112+-6	120+-7	101+-7	

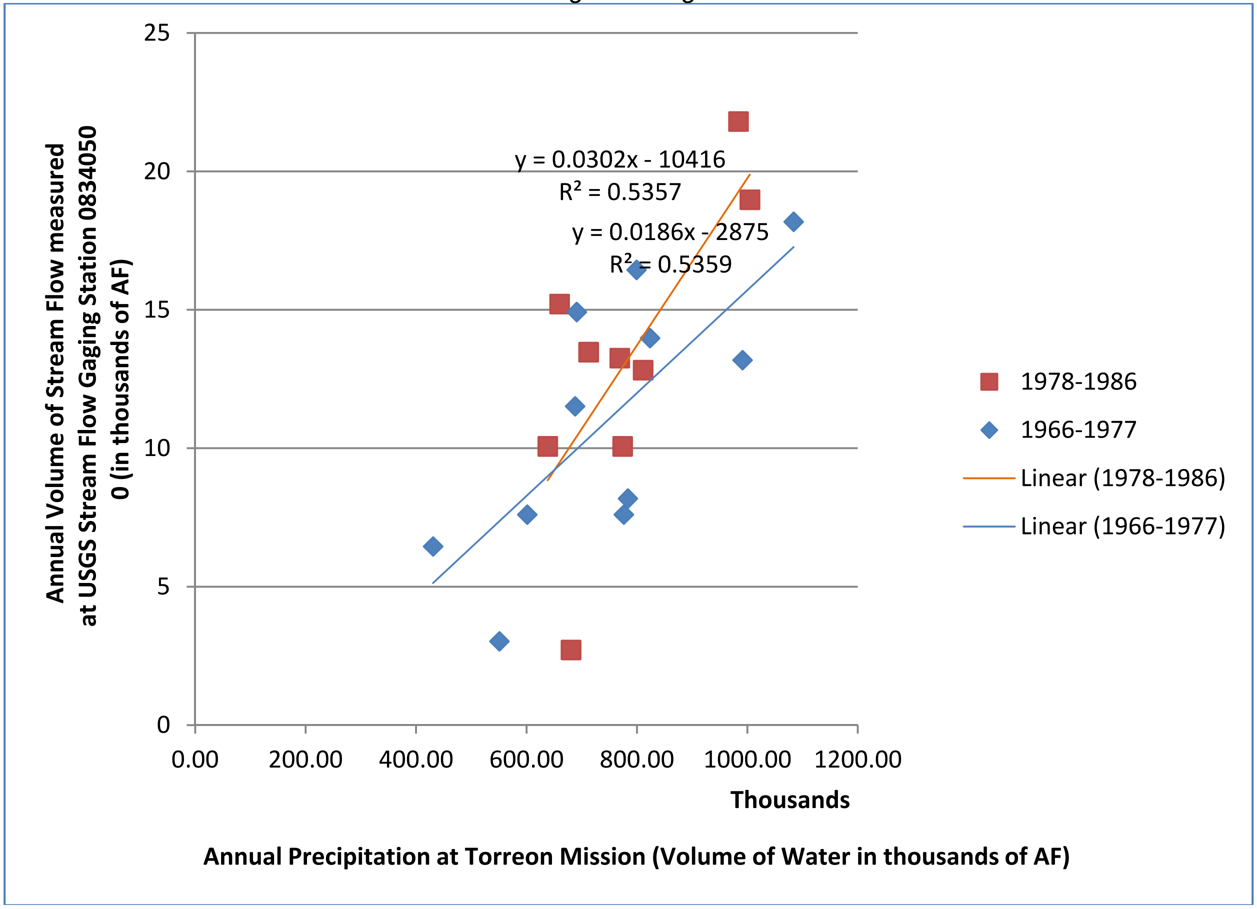
2.4.3 Impact of Discharge on Surface Water

During the period of time when GMRC discharged water from the Mount Taylor mine the flow regime of San Lucas Canyon changed to perennial flow from below San Lucas Dam to the Leopoldo Diversion Dam, 2.5 miles downstream. RGR reported that the perennial reach eventually extended 22 miles from the point of discharge (RGR, 1994), although a contemporaneous report by Jacobs Engineering (1979) explained that aerial reconnaissance and field work determined that the flow actually extended farther, up to 40 miles depending on whether discharged water was being routed into San Lucas Canyon or into Laguna La Polvadera. When the water was routed into Laguna La Polvadera on October 9, 1979, aerial reconnaissance determined that the water flowed northward out through a break in the embankment and then moved 22 miles downstream. On October 11, 1979 when the discharged water was discharged into San Lucas Canyon, Jacobs Engineering collected a water sample at the Arroyo Chico gage 35 miles downstream, and observed damp sand approximately six miles downstream from the Arroyo Chico/Rio Puerco confluence (Jacobs Engineering, 1979). Jacobs did not report why the company considered this water to represent discharged groundwater rather than surface flow from rainfall. Jacobs projected that if mine discharge increased and continued for a number of years, surface flow could flow as far as the intersection of Rio Puerco and I-40 or beyond (Jacobs Engineering Group, Inc., 1979).

Whether or not Jacobs' projection was correct is uncertain. No records have been found that describe tracking of groundwater discharged under NPDES NM028100 downstream from the point of discharge. However, analysis indicates that the relationship between USGS stream flow gaging data for gaging station 08340500 Arroyo Chico nr Guadalupe and precipitation recorded at the Torreon Mission weather station may be different over the 1978 through 1986 period than over the 1966 through 1977 period (Figure 6).[3] Figure 6 appears to indicate that during the time period when the Mt. Taylor mine discharged into San Lucas Canyon, the same amount of precipitation appeared to result in an increased amount of flow as measured at the gaging station.

[3] Precipitation data are not available for this station for the 1987-1990 period.

Figure 6: Relationship between Annual Precipitation and Annual Streamflow within the Arroyo Chico Watershed Prior to and During Discharge under NPDES NM028100



3.0 Probable Impacts of RHR Mine Dewatering Discharge

The historical impacts of discharge under NPDES NM028100 to the hydrogeologic regime of San Lucas drainage provide an upper limit to the potential hydrologic impacts of RHR discharge. GMRC discharged mine water that had been treated to contemporaneous water quality standards at a rate of 4,200 gpm continually for 12 years. The discharge appears to have made the drainage perennial in its upper reaches and at least intermittent down to the confluence of Arroyo Chico with the Rio Puerco. There is no evidence that the treated water adversely impacted groundwater quality either in the stream channel sediments, the underlying Menefee Formation, or the Point Lookout Sandstone, the deeper regional aquifer. It is highly unlikely that the discharge water entered the Point Lookout: the aquifer underlying the streambed fill is the relatively impermeable Cretaceous Menefee Formation, a unit of shales, mudstones, and coal. Water quality in the Menefee is already poor because of numerous coal beds and could not have been worsened by infiltration of GMRC's discharge.

The water discharged by GMRC met all applicable contemporaneous water quality standards. The average level of uranium in GMRC's treated mine water (0.36 mg/L) would not be expected to have had any lasting presence in the streambed materials. This conclusion is supported by the Alara, Inc. results which did not provide evidence that mobile uranium was present in stream sediments during the period of active GMRC discharge. Given the low levels of uranium in the

GMRC discharge, there is an insignificant potential for remobilizing uranium in RHR discharge water.

No adverse impact of RHR's proposed discharge is therefore anticipated. The water will be consumed in irrigation under normal operations. Discharge will occur only if unused by the irrigation activities. The amount that will flow down San Lucas wash will, therefore, be very insignificant. RHR will treat all of the water produced from mine dewatering to discharge standards. AS such, if water is discharged it will meet specified standards. Water quality downstream in Arroyo Chico is already poor because of discharge from coaly Menefee. If RHR discharge reaches the Arroyo Chico, it will tend to dilute this water and improve water quality.

4.0 Documents Relied On

Craig, S.D. and Stone, W.J., 1983, *Hydrogeology of Arroyo Chico-Torreon Wash Area, McKinley and Sandoval Counties, New Mexico:* NMBMMR HS-4, 1:62,000.

Jacobs Engineering Group, Inc. and Hydro-Search, Inc., November 30, 1979, "Hydrologic Effects Tailings Pipeline and Mill Site Facilities Mt. Taylor Uranium Mill Project," in Gulf Mineral Resources Co., December 1979, *Groundwater Discharge Plan Mt. Taylor Uranium Mill Project*, Appendix D.

NPDES NM028100 Discharge chemistry and discharge rate records, 1978-1990: on file with NMED (microfiche).

Rio Grande Resources, 1994, *Environmental Site Assessment Mt. Taylor Uranium Mine Operation*: report provided to NMMMD and NMED pursuant to the New Mexico Mining Act (law in 1993).

Rio Grande Resources, 1999, *Mt. Taylor Mine Groundwater Discharge Plan DP-61*: submitted to NMED for renewal.

USGS stream flow gaging station records.

ATTACHMENT

Plate 1 – Roca Honda Resources, LLC. Reuse Water Discharge Route