Golden Queen Mining Company, LLC

DRAFT FINAL HYDROGEOLOGY REPORT (2019 UPDATE)

Soledad Mountain Mine
Kern County, California

November 15, 2019

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(Supersedes March 10, 2011 Hydrogeology Study)

Soledad Mountain Mine
Kern County, California

Prepared for:

Golden Queen Mining Company, LLC

Prepared by:

Arcadis U.S., Inc.
630 Plaza Drive
Suite 100
Highlands Ranch
Colorado 80129
Tel 720 344 3500
Fax 720 344 3535

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Martha Wulftange

Martha Wulftange, PG-CA 9040
Project Scientist
ARCADIS U.S. Inc

PROFESSIONAL GEOLOGIST
ROBERT R.
RUSCITTO
No. 7038
STATE OF CALIFORNIA

Robert Ruscitto

Robert R. Ruscitto, PG 7083, CHG 943
Principal Geologist
ARCADIS U.S. Inc.

Phillip DeDycker

Phillip DeDycker
Sr. Project Director
ARCADIS U.S. Inc.

TABLES

FIGURES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

ABA	acid base accounting
AF	Acre feet
ARD	acid rock drainage
AVEK	Antelope Valley – East Kern Water Agency
BLM	U.S. Bureau of Land Management
BSK	BSK & Associates, Inc.
°C	degrees Celsius
CAM 17	California Administrative Manual 17
CCR	California Code of Regulations
CDPH	California Department of Public Health
CIMIS	California Irrigation Management Informational System
cm/sec	centimeter per second
COC	constituent of concern
DWR	Department of Water Resources
°F	degree Fahrenheit
FOD	frequency of detection
ft AMSL	feet above mean sea level
gpm	gallons per minute
GQM	Golden Queen Mining Company, LLC
HLF	Heap Leach Facility
IRWM	Integrated Regional Water Management
LDCS	leak detection and collection system
M&RP	monitoring and reporting program
MAF	million acre-feet
MCL	Maximum Contaminant Level
mg/kg	milligram per kilogram
mg/L	milligram per liter
MOU	Memorandum of Understanding
MPUD	Mojave Public Utilities District

NNP	net neutralization potential
NPR	neutralization potential ratio
project	Soledad Mountain Project
PVC	polyvinyl chloride
ROWD	Report of Waste Discharge
RWMG	Regional Water Management Group
RWQCB	Regional Water Quality Control Board, Lahontan Region
SBB&M	San Bernardino Baseline and Meridian
SGMA	Sustainable Groundwater Management Act
study	2011 Hydrogeologic Study
STLC	Soluble Threshold Limit Concentration
SVOC	semi-volatile organic compound
$tCaCO_3/kt$	tons of calcium carbonate per 1000 tons
TDS	total dissolved solids
TTLC	Total Threshold Limit Concentration
µg/L	micrograms per liter
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
UTL	upper tolerance limit
VOC	volatile organic compound
WAD	weak acid dissociable
WDID	Waste Discharge Identification
WDR	Waste Discharge Requirement
WET	waste extraction test
WMW	Wilcoxon-Mann-Whitney
WWL	Water Waste & Land, Inc.

EXECUTIVE SUMMARY

Introduction

Golden Queen Mining Company, LLC (GQM) is planning to expand an open-pit precious metal mine to the east and south slopes of Soledad Mountain (**Figure 1**). The mine started initial development of the mine in 2014, with production initiated in early 2016. This Hydrogeology Report (the Report) of the Soledad Mountain Mine (the mine, "site", or "project") updates previous hydrogeologic studies completed for the proposed mine which included the initial Hydrogeology Study conducted by Golder Associates Inc. (Golder 2007) for GQM, which was Appendix 8.0 of the Report of Waste Discharge (ROWD; GQM 2007). In 2011, Arcadis updated the understanding of hydrogeology in the area of the proposed mine (Arcadis 2011) for GQM (Appendix 8.0 of the 2011 updated ROWD; GQM 2012). The previous Hydrogeology Study (Study) is integrated herein and is updated with new groundwater information developed through 2018, including the current understanding of groundwater flow and geochemistry in the vicinity of the mine. This updated Report will supersede the 2011 Hydrogeology Study included in Appendix 8.0 of the ROWD.

Soledad Mountain is an isolated mountain located in a broad expanse of otherwise flat-lying lands of the western Mojave Desert in southern California. The area is arid and very hot and dry during the summer months. Soledad Mountain is composed of a core of Tertiary and Pre-tertiary volcanic and metavolcanic rocks. The surrounding desert is composed of alluvial sequences consisting of clays, silts, sands, and gravels and, in some places, capped with dune deposits. As a region, this broad expanse of desert is wedge-shaped and bounded to the northwest and southwest by mountain ranges that are recharge areas for groundwater in the alluvial aquifers beneath the desert floor. There is little or no groundwater recharge from Soledad Mountain. The most important source of groundwater in the area of Soledad Mountain is the alluvial aquifer developed in the Fremont Valley groundwater basin.

Hydrogeology

Groundwater flow in the regional alluvial aquifer in the Fremont Valley is generally to the east, from the Tehachapi Mountains to the dry lake beds. Groundwater elevations are near 2,575 feet above mean sea level (ft AMSL) along the northern Soledad Mountain front. Groundwater in the regional alluvial aquifer is only present below the northern approximate one third of the Phase 1 heap leach pad (**Figure 1**). The bedrock beneath the historical Gold Fields tailings and Phase 1 heap leach pad contains minimal, if any, groundwater based on available information obtained from condemnation drilling in this area.

The hydrogeology in the mine area has been documented by five characterization/monitoring wells, four production wells, and four domestic water wells on the northern and western aspects of Soledad Mountain. In the vicinity of Soledad Mountain, groundwater flow in the alluvial aquifer bifurcates in order to flow around the low-permeability bedrock of the mountain. Near the northern mountain front, groundwater flow is southeasterly toward the mountain, and the gradient flattens as the groundwater flows around the mountain. Numerous site-specific and regional groundwater studies conducted in the area have demonstrated that groundwater in the alluvial sediments is deep, at a depth of 200 to 260 feet below ground surface (bgs). Aquifer tests have shown the alluvial material exhibits relatively low hydraulic conductivity, on the order of 1×10^{-4} centimeters per second.

Groundwater Quality

The groundwater quality in the area is generally poor and characterized as a calcium-sodium-sulfate-bicarbonate type with pH values ranging from the mid 7s to 9. Concentrations of sulfate, total dissolved solids, arsenic, iron, and manganese exceeded their respective federal and state Maximum Contaminant Levels (MCLs) in at least one monitoring well on site. Although arsenic concentrations in some of the wells are above the MCL of 0.010 milligram per liter (mg/L), the concentrations are within naturally occurring ranges reported for the region and are not attributed to historical mining activities at the site. Concentration limits were calculated for constituents of concern, and the values represent an “upper tolerance limit” of background conditions. The concentration limits were established for the mine in Waste Discharge Requirements (WDRs) Order Number (No.) R6V-2010-0031, adopted by the California Regional Water Quality Control Board, Lahontan Region (RWQCB) on July 14, 2010 (RWQCB 2010, 2011). Concentration limits were set for pH, total dissolved solids, total cyanide, weak acid dissociable (WAD) cyanide, and arsenic. These were based on sample results from the fourth quarter of 2007 through third quarter of 2009. The concentration limits are used, per the methodology established in the WDRs, to indicate whether or not a “measurably significant” release from the heap leach facilities may occur.

A conceptual geochemical model was developed for the mine based on results of comprehensive analyses of host rock, ore, and historical tailings. Leaching of the host rock or historical tailings by natural processes does not influence groundwater quality in the area because of: 1) low precipitation and low net recharge, 2) considerable depth to groundwater (>210 feet), and 3) significant thickness of vadose-zone alluvial soils with sorptive capacity for arsenic that inhibits the potential for migration in the subsurface.

Past and Future Potential Impacts to Groundwater

Numerical model simulations of the unsaturated zone beneath the historical tailings indicated that any hypothetical seepage front from the tailings deposited between 1936 and 1942 does not reach a depth equivalent to the regional water table along the northern mountain front. The model results indicate that historical tailings seepage does not affect groundwater quality.

The probability of water or process solutions from the Phase I heap leach pad or storm water from unlined areas on site to adversely affect groundwater quality is low because of: 1) the arid climate preventing recharge from occurring, 2) the depth to groundwater (>210 feet), and 3) interbedded alluvium containing layers of lower-permeability fine-grained sediment are present, which would greatly impede vertical flow to groundwater. The probability of industrial storm water discharges to adversely impact groundwater was evaluated. It was determined that the industrial stormwater discharges met the criteria for exemption from the California Statewide Industrial General Permit and a notice of non-applicability application was submitted to the RWQCB. The heap leach pad construction includes a composite liner system with a leachate collection system above the composite liner to minimize hydraulic head on the liner. The composite liner system consists of a 1-foot-thick compacted low-permeability soil layer and overlying geomembrane liner. Vadose-zone monitoring and leak detection systems were part of the design and construction of the heap leach pad and provide additional protection and advance warning of any potential seepage from the heap leach facilities. Given these conditions, mine operations are not anticipated to impact groundwater.

1 INTRODUCTION

Golden Queen Mining Co., LLC (GQM) is proposing an expansion of the ultimate footprint and permit boundary for mining operations on Soledad Mountain, approximately 5 miles south of the Town of Mojave in southeast Kern County, California (Soledad Mountain Mine; the “mine”, “site” or “project”). This expansion is needed to support the evolving mine plan within the expanded footprint of the mine. In the process of permitting the mine, GQM has prepared a comprehensive Report of Waste Discharge (ROWD, GQM 2007 and 2012) and will submit a revised ROWD for the mine expansion. This report updates previous Hydrogeologic Study for the proposed mine, which was initially prepared by Golder Associates Inc. (Golder 2007) as Appendix 8.0 of the 2007 ROWD and subsequently updated by Arcadis (Arcadis 2011) for GQM as Appendix 8.0 of the 2011 updated ROWD.

The proposed mine expansion and support facilities are largely extensions of current mining activities that are approved by the California Regional Water Quality Control Board, Lahontan Region (RWQCB), the U.S. Bureau of Land Management (BLM), the State Water Resources Control Board, and Kern County. In addition, GQM is proposing an exploratory drilling program on private and BLM-administered lands.

This updated report presents a summary of the regional and local hydrogeology of the mine area. Numerous site-specific studies have been completed over the last 10 to 20 years, each having differing investigative goals and objectives. This report builds on the work of previous investigations (both public and private) and adds to that understanding with additional data from more recent studies. The 2011 Hydrogeologic Study is presented herein and updated with new groundwater information developed since 2011, including the current understanding of groundwater flow and chemistry in the vicinity of the mine. This updated report supersedes the previous Hydrogeologic Study in Appendix 8.0 of the ROWD.

1.1 Location

The Soledad Mountain Mine is located in southeastern Kern County, California, on the southern end of the Fremont Valley groundwater basin. The area is part of the western Mojave Desert, which is a wedge-shaped, expansive area bordered by mountain ranges on the west, southwest, and northwest sides (Dibblee 1967). The mine, ore processing facilities, and other infrastructure are primarily situated on the northern and western flanks of Soledad Mountain and occupy Section 6 of Township 10 North, Range 12 West (abbreviated as T10N, R12W), Section 1 of T10N, R13W, and the southern part of Section 31, T11N, R12W (San Bernardino Baseline and Meridian [SBB&M]). A map of the site and surrounding area is presented as **Figure 1**. The current mine permit boundary includes approximately 1,440 acres, of which 905 acres are projected to be directly affected by mine development. GQM is proposing an expansion of the existing permit boundary to 2,000 acres with 1,188 acres directly affected by mining activities including pit expansion and haul road extension, two additional waste rock storage dumps, exploratory drilling, clay borrow area, and an aggregate processing area. There are no springs or perennial streams within 1 mile of the mine site.

1.2 Mine Operations and Facility Features

A dilute cyanide solution and the Merrill-Crowe process are used to recover gold and silver from crushed and agglomerated ore stacked on the heap leach pad. The Heap Leach Facility (HLF) Phase 1 – Stage 1 construction was completed in 2015, and cyanide leaching commenced on February 2, 2016. HLF Phase

1 – Stage 2 construction was completed on August 15, 2017, and cyanide leaching commenced on September 22, 2017. Quarterly monitoring reports have been submitted to the RWQCB since 2010 through 2018.

There are four surface impoundments at the mine site: East Sediment Pond, West Sediment Pond, Western Overflow Pond, and Eastern Overflow Pond. The Western and Eastern Overflow Ponds are one large contiguous pond that has a central divider berm with a spillway separating the ponds. The surface impoundments are shown on **Figure 1**. A fifth surface impoundment is proposed on west side of Soledad Mountain, with construction anticipated to be completed by the end of 2019.

The leak detection and collection system (LDCS) consists of a geocomposite drainage layer located between the primary and secondary geomembranes in the solution collection channel and overflow ponds that drain via gravity to sumps. Four sumps (LD-1, LD-5, LD-6, and LD-7) have been installed as part of the HLF Phase 1 – Stage 1. One sump (LD-2) has been installed as part of the HLF Phase 1 – Stage 2. The locations of these sumps are shown on **Figure 1**. Two additional sumps (LD-3 and LD-4) will be installed during future construction of the HLF Phase 1 – Stages 3 and 4 (tentatively scheduled completion in 2020).

The vadose monitoring system consists of a series of stainless-steel suction lysimeters installed in the subgrade under the liner system. Five lysimeters (VM-1, VM-2, and VM-9 through VM-11) were installed as part of the HLF Phase 1 – Stage 1. Two lysimeters (VM-3 and VM-4) were installed as part of the HLP Phase 1 – Stage 2. In May 2017, lysimeter VM-2 malfunctioned and was replaced by lysimeter VM-2R. Monitoring of VM-2R began in July 2017. Lysimeter locations are shown on **Figure 1**. Installation of four additional lysimeters (VM-5 through VM-8) is planned during development of HLF Phase 1 – Stages 3 and 4 (tentatively scheduled for 2019).

Six groundwater monitoring wells were installed to characterize baseline and background groundwater quality near the heap leach facilities before the start of mine operations. These wells are designated as MW-1, MW-2, MW-3, MW-4, MW-5, and MW-6 and shown on **Figure 1**. Monitoring well MW-1 was abandoned in 2013, and MW-4 has been dry since installation. Quarterly groundwater monitoring has been conducted at the other five wells since installation.

Four groundwater production wells have been installed to supply water for mine operations. These wells are designated as PW-1, PW-2, PW-3, and PW-4 and are shown on **Figure 1**. Water currently produced from wells PW-1 and PW-4 is used for dust suppression on the roads and for industrial mining activities. Produced water is used for a domestic water supply system at the site that was completed in January 2016.

1.3 Regulatory Requirements

The RWQCB regulates the discharge of mine waste to land where water quality could be affected and requires a ROWD. GQM submitted a complete ROWD for construction and operation of the mine to the RWQCB in October 1997, in accordance with the California Code of Regulations (CCR), Title 27, Chapter 4, Subchapter 3, Article 4 and Subchapter 4. The RWQCB issued a Board Order imposing Waste Discharge Requirements (WDRs) for the construction and operation of the facility in March 1998. GQM updated the mine plan to incorporate technological and process enhancements and improve the HLF layout, eliminating the requirement for in-heap surface impoundments. To address open-pit backfilling requirements introduced in 2002, GQM modified the mine plan to incorporate backfilling of waste rock into mined-out phases of the open pits. The updated and new information was used to prepare a revised ROWD (April 2012) in accordance with all applicable regulations and replaces the original ROWD prepared in 1997. The intent of the WDRs is to ensure that measures have been taken to safeguard the receiving waters of the state (surface water and groundwater) while the mine is operating and following closure. The ROWD and WDRs define the constituents of concern (COCs), establish COC concentration limits, and outline water quality monitoring and reporting requirements.

The facility identification number (Waste Discharge Identification [WDID] No.) associated with the WDRs is 6B159708001. All monitoring at the mine since 2011 has been performed in accordance with the WDRs Order Number (No.) R6V-2010-0031, adopted by the RWQCB on July 14, 2010 (RWQCB 2010, 2011).

1.3.1 Demonstrate an Adequate Understanding of the Site Hydrogeology Before Discharging

Previous studies conducted in the mine area present data that relate directly to characterizing the hydrogeology of the mine site and surrounding areas. Most of the information in this report is specific to the northern and western aspects of Soledad Mountain, as ore processing facilities are on the north side of the mountain. Much of the data collected through 2018 is presented in the following sections of this report. In particular, Sections 5 and 6 present an overview of the site regional geologic and hydrogeologic conditions, and existing groundwater quality, respectively.

1.3.2 Develop an Approved Groundwater Sampling and Analysis Program Before Discharging

Groundwater sampling and analysis has been ongoing on site for more than 19 years. Section 7.0 of the Updated ROWD (GQM 2012) presented a detailed sampling and analysis program for the project with details of the proposed characterization and monitoring program to be implemented before the start of mine operations and during operations. Specifics included field, custody, and analytical procedures; analytical suites; sampling frequencies; and reporting limits.

1.3.3 Develop a Groundwater Characterization and Monitoring Program for the Phase 2 Heap Leach Pad

No groundwater monitoring wells have been completed in the area of the proposed Phase 2 heap leach facilities. If the Phase 2 heap leach facilities are need, an understanding of the hydrogeologic conditions (described in detail in subsequent sections of this report) will be used to develop a groundwater characterization and monitoring program for the Phase 2 area.

Analysis of regional groundwater data indicates that the alluvial aquifer in the mine expansion area is fed principally from the Tehachapi and San Gabriel Mountains located many miles west, southwest, and northwest of Soledad Mountain. Groundwater flowing south-southeasterly through the alluvium bifurcates around Soledad Mountain (including the Phase 2 pad). The elevation of the regional water table is several hundreds of feet lower than the base elevation of the Phase 2 pad, and the regional aquifer may only underlie the southwesterly perimeter of the Phase 2 pad based on observations from mineral condemnation boreholes.

2 PHYSIOGRAPHIC AND GEOGRAPHIC SETTING

The mine is located in a large, triangular expanse of the western Mojave Desert. This triangular expanse encompasses several hundred square miles and is bordered by the Tehachapi Mountains and Garlock Fault zone on the northwest and the San Gabriel Mountains and the San Andreas Fault zone on the southwest. The eastern side of this triangular wedge is open to the much larger expanse of lower-lying Mojave Desert stretching eastward and northeastward.

The mine is located at elevations ranging from approximately 2,700 feet above mean sea level (ft AMSL) at the desert floor to approximately 4,190 ft AMSL at the summit of Soledad Mountain. The desert floor generally slopes from west to east across the region, except for low bedrock outcrops protruding from the valley floor.

There are two regional groundwater basins in this western portion of the Mojave Desert, the Antelope Valley groundwater basin and the Fremont Valley groundwater basin (**Figure 2**). The mine is located in the Fremont Valley groundwater basin. The much larger of the two systems, the Antelope Valley groundwater basin, is located south of Soledad Mountain. The Antelope Valley groundwater basin has been developed extensively for agricultural, industrial, and domestic purposes and serves the larger population centers located approximately 30 miles south of Soledad Mountain.

Soledad Mountain is located in an extremely arid area of California. According to Bloyd (1967), losses from surface flow under these dry conditions are so great that stream flow in this region rarely occurs at elevations less than 3,500 ft AMSL. Precipitation that reaches the desert floor is usually subjected immediately to high losses from evaporation and transpiration. Nevertheless, runoff occasionally originates on or crosses the desert floor and sometimes reaches the dry lake beds or playas following high-intensity rainfall events. Nearly all of the water that reaches the playas is eventually lost to evaporation, as the playas are not areas of aquifer recharge.

The average annual precipitation for the western Mojave Desert is about 4 inches (Londquist 1995). At the Mojave weather station, located approximately 5 miles north of the site, the average annual recorded rainfall is 5.93 inches (Western Regional Climate Center undated). Most of the precipitation occurs between December and March. Cyclonic storms in the fall and convectional storms in the summer occur infrequently (Blodgett 1995). Temperatures in the western Mojave Desert commonly exceed 100 degrees Fahrenheit (°F) in summer months, and drop below freezing in winter months, occasionally causing precipitation to fall as snow. According to data from the Mojave weather station, the warmest month is July, with an average high temperature of 97.6°F, and the coldest month is December, with an average low temperature of 32.9°F (Western Regional Climate Center undated). Diurnal temperature changes in the Mojave Desert commonly exceed 50°F. The Palmdale weather station, located approximately thirty miles south of the site, is the nearest station that measures the average annual evapotranspiration (evaporation and transpiration). The rate at the station is on average 68.5 inches, which exceeds precipitation by a multiple of nearly 12 (California Irrigation Management Information System [CIMIS] 2019). The maximum evaporation has been documented to occur in July (9.61 inches), and the minimum evaporation has been documented to occur in December (2.07 inches; CIMIS 2019).

Vegetation in the western Mojave Desert consists primarily of sagebrush scattered across the landscape. Joshua trees are common along sandy flats. After unusually heavy winter rains, grasses and flowering annuals may grow in the spring (Dibblee 1967).

3 GROUNDWATER PROTECTIONS

Groundwater in the Freemont Valley groundwater basin is protected for future use through the implementation of regulatory and planning programs of the RWQCB. The primary plan is the RWQCB's Basin Plan, which identifies beneficial uses for groundwater and stipulates that groundwater resources must be protected to ensure that beneficial uses are not impacted. The passage of the Integrated Regional Water Management Planning Act (CA Senate Bill 1672) initiated planning programs for the sustainable use of groundwater resources. Recently, the Fremont Basin Integrated Regional Water Management (IRWM) Plan was submitted to the Lahontan RWQCB for final approval. The following section presents information regarding beneficial uses of the site area and the Freemont Basin IRWM Plan.

3.1 Beneficial Groundwater Uses

The four beneficial uses defined in the region are municipal and domestic supply, agricultural supply, industrial supply, and freshwater replenishment (RWQCB 1994). Despite the numerous wells in the Soledad Mountain area (shown on **Figure 3**), groundwater in the area has historically been relatively undeveloped.

The RWQCB defines municipal and domestic supply as waters used for community, military, or individual water supply systems including, but not limited to, drinking water supply. Most wells in the area surrounding the mine are small-diameter and are used for domestic supply. Wells are typically only capable of producing 20 to 40 gallons per minute (gpm) (WZI 1996). A number of the wells in the area are no longer in service and can no longer be located. Wells in the region around Soledad Mountain are shown on **Figure 3**, and wells within a 1-mile radius of the mine are shown on **Figure 4**. Wells are numbered and available water levels are provided in Attachment A.

The RWQCB defines agricultural supply as waters used for farming, horticulture, or ranching, including but not limited to irrigation, stock watering, and support of vegetation for range grazing. Wells in the Jameson Ranch area, approximately 4 miles northeast of Soledad Mountain, provided water for alfalfa farming from approximately 1959 through 1971 (WZI 1996). This area is no longer used to grow alfalfa.

The RWQCB defines industrial supply as water used for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, geothermal energy production, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization. GQM uses groundwater for the mine operations.

The RWQCB defines freshwater replenishment as waters used for natural or artificial maintenance of surface water quantity or quality. Limited wetlands in the area provide critical habitat for migratory birds and the area is considered an important component of the Pacific Flyway (Fremont Valley Regional Water Management Group [RWMG] 2018).

3.2 Fremont Basin Integrated Regional Water Management Plan

The Fremont Basin IRWM Plan was recently submitted to the Lahontan RWQCB for final approval. The objective of the plan is to ensure sustainable use of the Fremont Valley Groundwater Basin. The plan was developed in response to the Integrated Regional Water Management Planning Act (CA Senate Bill

1672), which was passed in 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies and to improve water quality, quantity, and reliability.

The Fremont Valley Groundwater Basin encompasses 992 square miles in eastern Kern County and western San Bernardino County in the western edge of the Mojave Desert. The Fremont Valley IRWM Plan was developed by the RWMG, which was formally established on October 21, 2014 when the City of California City (California City or City), the Mojave Public Utilities District (MPUD), and the Antelope Valley-East Kern Water Agency (AVEK) signed a memorandum of understanding (MOU). The Fremont Basin IRWM Plan was developed in response to the Sustainable Groundwater Management Act (SGMA), which requires groundwater-dependent regions to halt overdraft and bring basins into balanced levels of pumping and recharge.

Development of the Fremont Basin IRWM Plan started in 2017, when the Fremont Basin IRWM Region was awarded a grant to develop its first IRWM Plan. GQM is included as a stakeholder for industrial organizations. The final document includes several plans including a groundwater management plan and salt and nutrient management plan. Because the Fremont Valley Groundwater Basin is currently designated as low priority under the SGMA, the basin is currently not subject to SGMA requirements. However, the Fremont Basin IRWM Plan did include goals for sustainable water management. While the provisions are not enforceable, it does include a goal to "manage the Fremont Valley Groundwater Basin such that the 10-year average change in groundwater levels is zero." Additionally, it is anticipated that the plan will be revised every 5 years, and it was noted that enforceable provisions to support sustainable management of the Fremont Valley Groundwater Basin will be incorporated into future versions.

4 PREVIOUS STUDIES ON GROUNDWATER CONDITIONS

A number of studies have been conducted on the hydrogeology of the western Mojave Desert as well as the site-specific hydrogeology. Several of these studies were water-resource-related studies conducted by the U.S. Geological Survey (USGS), and data from those reports have been used to prepare this report. In the discussions that follow, the information is first presented from a regional perspective and then from a local viewpoint.

4.1 Regional Groundwater Studies

Studies of the regional groundwater date back to the early 1900s, with early studies consisting mainly of water supply investigations completed by the USGS (Johnson 1911 and Thompson 1929). These early studies provide overviews of climate, natural resources, geology, and water resources for the western Mojave Desert region. The reports identify the alluvium as the main water-bearing formation and that the principal source of groundwater for the region is runoff and recharge from the surrounding mountains. Surface water in perennial streams seeps into the alluvium rapidly once the streams reach the valley floor. Because of the very high evaporation rates, precipitation falling in the valley makes a negligible contribution to the groundwater supply. According to Bloyd (1967), precipitation falling directly in the valley comprises, at most, 5 percent of the total aquifer recharge.

Studies specific to water resources have refined the understanding of the hydrogeology and water quality of the region. Two reports were completed in the 1960s: USGS Water Resources Report for the Antelope Valley – East Kern Water Agency by Bloyd (1967), and a USGS Report on the Geology of the Western Mojave Desert, by Dibblee (1967). In 2003, the California Department of Water Resources (DWR) published the California Groundwater Bulletin 118 (California DWR 2003), which provided an updated groundwater basin delineation map of the state. More recently, an update of groundwater conditions for the South Lahontan Hydrologic Region was issued as part California’s Groundwater Update 2013 (California DWR 2015).

In the Soledad Mountain area, bedrock and/or faults are interpreted to have created a groundwater divide that separates the western Mojave Desert into two groundwater basins: Antelope Valley basin and the Fremont Valley Groundwater Basin, in which the mine is located. The Rosamond Hills and Bissell Hills, consisting of intrusive igneous quartz monzonite, are impermeable when compared to the alluvium that fills the valleys, and creates such a divide south of Soledad Mountain. The divide runs more or less from the mouth of Oak Creek through Middle Butte to exposed basement rock near Gem Hill (California DWR 2003). The regional groundwater basins and sub-basins of the western Mojave Desert are shown on **Figure 2**.

4.2 Local Groundwater Studies

Three groundwater studies were previously completed for the site and surrounding area: Hydrology Study Summary for the Soledad Mountain Project, prepared for P.M. DeDycker and Associates in 1990 (Water, Waste & Land, Inc. [WWL] 1990); Groundwater Supply Evaluation, Soledad Mountain Project, prepared for GQM in 1996 (WZI 1996); and Summary of Hydrogeological Conditions in the Vicinity of the Soledad Mountain Project, prepared for GQM in 1998 (BSK 1998). The studies were completed to support the Soledad Mountain Mine Project, including installation of four groundwater production wells, two of which are active (PW-1 and PW-4). Well logs and completion diagrams for the four productions wells are included in **Attachment B**. The attachment also includes the pumping logs for the production wells. Information for the wells is summarized in **Tables 1** and **2.**

4.2.1 Determination of Potential Production Rate at the Site

The study completed by WWL (1990) included an evaluation of local groundwater conditions as an initial step in determining the optimum location for a well with an adequate production rate for future mine use. Data collected during the study showed that, to achieve high production rates, a well would need to be located a sufficient distance from the bedrock outcrop to provide an adequate thickness of saturated alluvium. Wells were drilled in Section 36, T11N, R13W, northwest of Soledad Mountain, with total depths of more than 600 feet and initial water levels of approximately 300 feet bgs. Pumping tests showed that the wells were capable of producing up to 750 gpm (Gaines 1990). Another significant finding from the WWL report described groundwater flow in the immediate vicinity of the site as poorly defined due to the absence of well information on the west side of Soledad Mountain. WWL suggested that regional southeasterly groundwater flow paths are disrupted on the west side of Soledad Mountain as groundwater flows around the low-permeability bedrock.

4.2.2 1996 WZI Groundwater Supply Evaluation and Installation of PW-1

WZI submitted a report to GQM that evaluated the groundwater supply potential at the site (WZI 1996). The 1996 WZI Groundwater Supply Evaluation was performed as supporting documentation for the initial permitting process conducted for the mine. The evaluation included a projection for well performance (i.e. predicted drawdowns) and this was used to assess potential impacts such as declining water levels in nearby wells.

The study reviewed yields of wells in the vicinity of Soledad Mountain. Most wells in the area were identified as domestic water wells with low yields (below 50 gpm). The well with the highest reported yield was the Jameson Ranch Irrigation Well, approximately 4 miles northeast of the mountain (well number 13 on **Figure 3**), which was used to irrigate alfalfa from approximately 1959 through 1971 (WZI 1996). According to the Perennial Yield Assessment of Chaffee Subunit in the Fremont Valley Groundwater Basin by Slade (1994), the average withdrawal rate of the Jameson Ranch well was approximately 2,500 gpm. The MPUD wells, also located approximately 4 miles northeast of the mountain (wells 36 and 38 on **Figure 3**), reportedly tested at rates from 250 to 1,000 gpm. Additionally, the Gillis well, located nearby and approximately 1-mile northwest of the mountain (well number 10 on **Figure 3**), was reportedly tested at rates of 750 to 900 gpm (WZI 1996).

The Groundwater Supply Evaluation used the actual aquifer response from the Jameson Ranch well as the basis for the predicted drawdowns. Data from 1959 to 1987 was used to calculate general aquifer characteristics, along with knowledge and construction criteria from the then newly installed PW-1. An iterative process was then used to curve-fit the known-rebound curve and the governing equations assumed an infinite aquifer. The iterative process for curve fitting included varying values for production rates, porosity, permeability, thickness, and compressibility. The modelling was conservative and did not account for the steady yearly declines in basin groundwater levels nor did it account for basin recharge. Goodness of fit was determined to be satisfactory after correlation analysis was completed using data from PW-1. Subsequently, the model was used to predict water level response when a total production of

750 gpm was occurring for three scenarios (750 gpm, 350 gpm and 250 gpm for one, two, and three wells, respectively) at different time periods from an assumed start of pumping. The following is a key summary from the WZI Groundwater Supply Evaluation of worst case (one well) vs. best case (three wells) predicted model scenarios:

- One well at 750 gpm: predicted drawdown of groundwater levels at an assumed pumping well (PW-1) of 121 ft in 90 days (PW-1 was predicted to go dry within the life of the mine since the assumed saturated thickness was 135 ft).
- Two wells at 350 gpm: predicted drawdown of groundwater levels in both wells of 78 ft in 90 days and 97 ft in 10 years.
- Three wells at 250 gpm: predicted drawdown of groundwater levels in the three wells of 64 ft in 90 days and 83 ft in 10 years.

WZI determined that up to three wells could be used to sustain the estimated 750 gpm pumping rate needed by GQM for an approximate 10-year mine operation. Additionally, the report examined impacts to nearby domestic wells if the maximum predicted drawdowns occurred. The impact at nearby wells was considered negligible, and it was noted that impacts may be less than calculated if aquifer recharge was taken into account. Based on the recommendations of the WZI report, production well PW-1 was drilled and developed in October 1996 in Section 31, T11N, R12W (**Figure 1**). The 300-foot-deep well was drilled to the top of bedrock and completed with 115 feet of well screen. On October 11, 1996, a step-rate pumping test was performed in production well PW-1 to evaluate aquifer characteristics. Based on a total thickness of saturated alluvium of 135 feet, the hydraulic conductivity was determined to be 5.67×10^{-4} centimeters per second (cm/sec).

4.2.3 Installation of Production Wells 2 through 4

In 2005, a second production well (PW-2) was drilled approximately 100 feet east of Gold Town Road in Section 32, T11N, R12W, approximately 1,000 feet north of PW-1 (WZI 2005). The well was completed to a total depth of 285 feet with 170 feet of slotted casing. In June 2005, American Well Technologies, Inc. conducted a pumping test. WZI analyzed the data for PW-2 and estimated the well was capable of sustaining a production rate of 200 to 300 gpm. PW-2 was re-tested with a pump test in 2013 and was found to have a lower yield than originally tested (GQM 2015).

A third possible production well (PW-3) was drilled in October 2008 and is located west of the proposed Phase 2 heap leach facilities (**Figure 1**). A 12-inch-diameter well was completed to a depth of 600 feet, with screen extending from 310 to 590 feet bgs. Water was encountered in this well at approximately 285 feet bgs. Initial development and testing of the well indicated that the alluvium in this area is significantly less transmissive than that in the vicinity of PW-1 and PW-2, and PW-3 has not been used for production.

Production well PW-4 was drilled in 2015 and is located to the northwest of the mine, approximately 4,860 feet from MW-3. The well was completed to a total depth of 740 feet with 370 feet of slotted casing. The depth to water in this well is approximately 330 feet bgs (2,571 ft AMSL).

4.3 Site Monitoring Wells

Six monitoring wells have been installed at the site. Well logs and completion diagrams for the six monitoring wells are included in **Attachment B**. Information for the wells is summarized in **Tables 1** and **2.**

Three characterization/monitoring wells (MW-1, MW-2, and MW-3) were drilled and installed in 1996 on the north side of the proposed Phase 1 heap leach pad at the approximate locations shown on **Figure 1**.

Characterization/monitoring wells MW-4 and MW-5 were drilled and installed in 2007 along the northern perimeter of the proposed Phase 1 heap leach pad (**Figure 1**). MW-4 was drilled to a depth of 177 feet and terminated at that depth because it encountered bedrock, which is likely a localized “bedrock high.” Groundwater has not been detected in the well, as the bottom of the well is approximately 50 feet above the regional water table. MW-5 was competed to a depth of 272 feet, and groundwater in the well is encountered at approximately 225 feet bgs.

Monitoring well MW-6 was installed by Boart Longyear on November 16 and 17, 2010, approximately 800 feet northeast of MW-4, to monitor potential releases from the proposed heap leach facilities. The 8-inch-diameter boring was completed to a depth of 212 feet bgs; bedrock was encountered at 189 feet bgs. The well was constructed of 4-inch-diameter Schedule 80 polyvinyl chloride (PVC) casing and screen. The screen extended from 168 to 207 feet bgs. MW-6 was developed by purging 117 gallons (five well volumes); the depth to water in MW-6 after development was 180 feet bgs (2,582.8 ft AMSL).

BSK prepared a report for GQM in May 1998 summarizing the hydrogeologic conditions in the area of the proposed mine. BSK reviewed groundwater levels in the three monitoring wells installed in 1996 (MW-1, MW-2, and MW-3) as well as production well (PW-1), and a nearby unused domestic water well (Peltier well) and concluded that the groundwater flow direction beneath the site was to the northwest at a gradient of approximately 0.036 foot/feet. For further discussion of the more current groundwater flow direction, refer to Section 5.5.

5 GEOLOGY AND HYDROGEOLOGY

In this section, the regional geology and hydrogeology are presented first, followed by a discussion of the local geology and hydrogeology in the vicinity of the project.

5.1 Regional Geology

According to Dibblee (1967), rocks in the western Mojave Desert region are grouped into three main categories: (1) crystalline rocks of pre-Tertiary age, (2) sedimentary and volcanic rocks of Tertiary age, and (3) unconsolidated sediments and local basalt flows of Quaternary age. The unconsolidated Quaternary alluvial deposits of the western Mojave Desert are primarily alluvial fan deposits and consist of poorly sorted gravel, sand, silt, and clay of igneous origin.

Soledad Mountain is an erosional remnant of a Tertiary rhyolitic age volcanic intrusion consisting of quartz latite, rhyolite, felsite and porphyritic felsite, extrusive tuff and tuff breccia, and basalt. Soledad Mountain is penetrated by vertical and near-vertical veins oriented just west of north and were conduits for hydrothermal fluids that deposited the gold and silver (Dibblee 1967). The ore occurs in epithermal fissures and veins that formed in brecciated and sheared zones in the intrusive host rock.

The unconsolidated alluvium of the western Mojave Desert has been deposited in alluvial fans extending from the source areas along basin boundaries and from the igneous outcrops located throughout the valleys. The deposition of sediments within alluvial fans can vary considerably. However, the alluvial fan deposits typically occur as wedges of sediment that have been shed off of the higher bedrock areas and have been transported from the source areas by a combination of gravity, water, and wind. Sediment transport by water is the major source of the alluvial deposits. The alluvial fan deposits are generally composed of a number of these sedimentary wedges stacked upon each other. The fan deposits typically form as fining-upward sequences wherein the coarsest sediment has been deposited near the source area. This deposition of the coarsest sediment fraction near the source area results when the velocity of the water flowing from the bedrock areas lessens and is unable to support the coarser sediment load. Finer-grained material continues to be deposited farther away from the source areas as the water velocity declines. A succession of these fining-upward sequences is typically seen when looking at cross-sections through the alluvium. However, during infrequent storm events, surface water forms braided streams that migrate across the surface of the fans. These streams may erode and partially remobilize the finer sediments, disrupting the typical fining-upward sequences.

The Quaternary alluvium locally overlies older fan deposits of Tertiary rocks, on which an erosional surface of considerable relief has developed. Investigations have shown, however, that unconsolidated deposits are as thick as 1,900 feet throughout the basin (Dibblee 1967). These deposits are mostly older alluvium underlying a veneer of younger alluvium of varying thickness.

Numerous faults have been mapped throughout the western Mojave Desert over the past few decades. The major fault systems include the Garlock fault zone and the San Andreas fault zone, as shown on **Figure 2**. The Garlock fault zone north of the mine separates the Tehachapi Mountains from the Western Mojave Groundwater Basin. The San Andreas fault zone forms the boundary between the San Gabriel Mountains and the southern Mojave Basin south of the mine. The nearest fault within 10 miles and with documented Holocene movement is the Garlock West fault zone, located approximately 9 miles northwest of the mine area as shown on **Figure 2**. The next two closest Holocene fault zones are the Garlock East fault zone, located 21 miles northeast of the mine, and the San Andreas fault (Carrizo segment), located approximately 25 miles southwest of the project (USGS 2019; California Geological Survey 2001). The recent July 5, 2019 earthquake, with a 7.1 magnitude, occurred within the Little Lake Fault zone, which is located 65 miles to the north-northwest of the site.

Several smaller-scale faults have been mapped in the region:

- Muroc fault, located about 12 miles northeast of the mine
- Rosamond fault, mapped in the Rosamond Hills less than 10 miles south of the mine
- Southwest-northeast trending Randsburg-Mojave fault, located about 6 miles west of the mine
- Small-scale Gloster fault, mapped just east-southeast of Soledad Mountain.

None of these smaller-scale faults located within the Fremont Valley Groundwater Basin have confirmed Holocene movement. Some of these faults have little, if any, surface expression, but have been mapped in the field because they form hydraulic barriers that can cause abrupt changes in water levels at depth. Faults can significantly alter groundwater flow dynamics such that water levels on either side of the fault differ by several hundred feet. One of the better-documented instances of this occurrence is the Muroc fault located northeast of the mine (Dibblee 1967).

5.2 Regional Hydrogeology

The primary source of groundwater recharge in the area west of and around Soledad Mountain is from precipitation falling on the bordering El Paso Mountains. At the mountain fronts, coalesced alluvial fans (termed a bajada) act as the area of recharge, receiving surface water runoff from the higher mountains. Surface drainage from the mountains infiltrates rapidly upon encountering the alluvium on the desert floor. As the groundwater flows from west to east, faults and bedrock outcrops act as barriers to groundwater flowing through the alluvium. These flow barriers contributed to the demarcation of groundwater basin and sub-basin divisions developed by Bloyd (1967) and Thayer (1946). The Fremont Valley Groundwater Basin also receives subsurface flow from the Antelope Valley Groundwater Basin (Fremont Valley RWMG 2018). In the Fremont Basin, Soledad Mountain is located near the center of the Gloster sub-basin, which is bordered by the Chaffee sub-basin to the north. The basin and sub-basin boundaries are shown on **Figure 2**.

The Quaternary age alluvial sediments and the Tertiary age fan deposits form the primary aquifers in this region. Pre-Tertiary crystalline rocks and Tertiary volcanics, conglomerates, sandstones, shales, and carbonates form localized barriers to groundwater movement through the alluvium. Wells installed in these units may yield groundwater at rates measured in tens of gallons per minute at best. The largest well yields in the Mojave Desert, from several hundred to several thousand gallons per minute, occur in confined layers of sand or gravel in the alluvium that thin out into impervious clay near the lowest parts of the internally drained valleys (Bloyd 1967).

Groundwater flow in the Gloster sub-basin (south of the Chaffee sub-basin) is predominantly eastward (Bloyd 1967). However, east of Soledad Mountain, groundwater in the Gloster sub-basin flows northeastward into the Chaffee sub-basin (**Figure 2**). The groundwater flows east across the Muroc fault into the California City sub-basin and further downgradient to Koehn Lake, a dry lakebed. Koehn Lake, at an elevation of 1,940 ft AMSL, is the lowest point in the Fremont Valley Groundwater Basin.

The estimated annual recharge to the Fremont Valley Groundwater Basin is 13,800 acre-feet (AF) (Fremont RWMG 2019). Different estimates of groundwater storage are reported for the basin. However, the DWR estimates the storage capacity of the basin to be 4.8 million acre-feet (MAF; California DWR 2004a). By comparison, the much larger Antelope Valley Groundwater Basin to the south has a storage capacity of 70 MAF (Fremont RWMG 2019). The Antelope Valley Groundwater Basin was determined to be in a state of overdraft in 2011 with a safe yield of 110,000 AF a year (DWR 2004b). It is estimated that only 5 percent of the total precipitation that falls in the Fremont Valley Groundwater Basin infiltrates into the alluvium and reaches the aquifer. Most of the precipitation is lost through evaporation.

The Antelope Valley Groundwater Basin to the south of Soledad Mountain was adjudicated in 2015 due to lawsuits filed by two private groundwater users between 1999 and 2000. The basin is estimated to have permanently lost 50,000 AF of storage due to subsidence caused by severe groundwater overdraft. The basin has been the subject of numerous studies related to declining water levels, diminishing water quality, and land subsidence, especially in the areas near Edwards Air Force Base (Londquist 1995, USGS 2003). The causes for the declining water levels are related to population increases and agricultural usage. While long-term groundwater data for the Fremont Valley Groundwater Basin indicate significant declines in groundwater levels since 1955, the basin has not incurred the same subsidence problems as the Antelope Valley Groundwater Basin.

Declining water levels in the Fremont Valley Groundwater Basin are attributed to the prolonged drought period from 1945 to 1964 and excessive groundwater extraction in the late 1950s through the 1970s (Fremont Valley RWMG 2018). Groundwater levels appeared to stabilize after the 1980s and had been recovering as a result of decreased groundwater pumping for agriculture and imported surface water deliveries to urban users being introduced to the Plan area. However, California entered a drought period in 2006, and regional water levels have correspondingly been declining (Fremont Valley RWMG 2018) over the last decade.

To determine the regional trends of groundwater levels in the area north of Soledad Mountain, a review of historical groundwater levels for wells listed in the U.S. Geological Survey National Water Information System was conducted. Water levels were reviewed for wells in T11N R13W, T11N R12W, T10N R13W, and T10N R12W. Hydrographs for wells with water level data available after 2010 are included as **Attachment C**. Six wells had water level data available after 2010 (wells numbered 3, 5, 11, 29, 30, and 31 on **Figure 4**) and water levels have fallen over the time period as follows:

- Well 3 (located approximately 9,000 ft south of the project boundary): water levels have declined 15.5 feet from 1973 to the present.
- Wells 5 and 29 (located over 3.6 miles to the east of the mine boundary): water levels have declined 7.05 feet (from 1978 to 2013) and 14.52 feet (from 1956 to 2017), respectively.
- Well 11 (located approximately 5 miles to the west of Soledad Mountain): has fallen 57.78 feet from 1954 to the present.
- Wells 30 and 31 (located over 2 miles to the southeast of Soledad Mountain): water levels have declined 25.58 feet (from 1956 to 2011) and 17.56 feet (from 1956 to 2017), respectively.

Data for the Jameson Ranch well (well number 13 on **Figure 3**) was also reviewed. Water levels were monitored at this well from 1968 to 2013. Irrigation water was supplied from the Jameson Ranch well up through 1971. Water levels at this well had an increasing trend, and the increasing trend is attributed to groundwater recovery after nearby irrigation for alfalfa farming ceased in 1971.

A groundwater balance model was developed for the years 1945 to 2017 in support of the Fremont Valley Management Plan. Based on the analysis, current groundwater demands (as of 2015) were estimated at 7,367 AF for three categories of use: 5,278 AF for residential use, 647 AF for agricultural use, and 1,442 AF for industrial use (Fremont Valley RWMG 2018) with this last category including 1,105 AF for mining. (The estimated water requirement for the mine was stated as 654 gpm [GQM 2012], approximately 1,045 AF[1].) The groundwater balance analysis included projects through 2040 and assumed groundwater pumping would increase over time due to population growth, cannabis cultivation, and agricultural growth (Fremont Valley RWMP 2018). The area near Soledad Mountain and the Town of Mojave has not experienced the population gains and industrial or agricultural developments seen elsewhere in the Mojave Desert and the aquifer north of Soledad Mountain is not being overdrawn. If predicted use of groundwater in the basin conforms to the low growth projection in the Fremont Basin IRWM Plan, the aquifer will continue to be able to meet the demands of its users. The aquifer should be able to provide sufficient water to support continued mining operation at Soledad Mountain.

5.3 Local Hydrogeologic Conditions

The flanks of Soledad Mountain are covered with a wedge of sediments (colluvium) consisting of boulders, rock fragments, cobbles, gravel, sand, silt, and clay. The colluvium (talus, scree, and slopewash) is found on steeper slopes of the mountain and eventually flattens out and merges downslope into the alluvial fan deposits near the base of the mountain. The older alluvium, which comprises the principal aquifer in the area, is widely distributed and, in most places, is of considerable thickness. The older alluvium has a moderate permeability and, where 200 to 500 feet of the older alluvium are saturated, wells may yield 500 to 2,000 gpm (Bloyd 1967).

The younger alluvium consists of unconsolidated sand and angular boulders, cobbles and gravel, with small quantities of silt, clay, and fine to medium windblown sand. These materials are widespread, particularly in the basin areas, but are generally less than 150 feet thick (Bloyd 1967). In drill cuttings from mineral condemnation boreholes and wells developed by GQM, it is difficult to differentiate the younger from older underlying alluvium. The younger alluvium, where saturated, will yield water to wells. However, in the Antelope Valley-East Kern area, the younger alluvium is usually found above the water table and does not therefore comprise significant water-bearing units.

Interbedded Quaternary colluvial and alluvial deposits lie beneath shallow surface soils in the area beneath the Phase 1 heap leach facilities. Three geologic cross-sections were developed by WZI (1997) for the project. The three cross-sections (A-A’, B-B’, and C-C’) bisect or are within the location of the Phase 1 pad. Two additional cross-sections (E-E’ and D-D’) have been developed using recent lithologic

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[1] During 2018, the average sustained groundwater extraction from PW-1 and PW-4 was approximately 201 and 396 gpm, respectively, for a combined production of 597 gpm.

information from mineral condemnation boreholes in addition to information from other boreholes. In general, the borehole data indicate discontinuous stratified deposits of sandy gravel, silty sand, sandy silt, and clayey sand. The locations of the geologic cross-sections are shown on **Figure 5**.

Cross-section A-A’ trending east-west across a distal area of the alluvial fan deposits is provided as **Figure 6**. PW-4 lithology was added to WZI’s cross-section A-A’. The surface slopes from the northwest to southeast from PW-4 to MW-3. The primary sources of data for this cross-section are monitoring wells MW-2 and MW-3 and production well PW-4. Although the distance between the MW-2 and MW-3 is approximately 600 feet, only a few of the individual subsurface units can be correlated laterally across the distance, and general correlation from MW-2 to PW-4 is lacking given the distance between the wells of over 4,800 feet. This cross-section highlights the lateral (and vertical) heterogeneity of the alluvial materials on the distal flanks of Soledad Mountain. The sedimentary units can be grouped into depositional packages based on sediment types and differing hydraulic conditions as the alluvial fans formed out from the mountain. Silty sand with gravel predominates as represented by MW-2 and MW-3, and no obvious lacustrine or playa deposits are evident. In the upper portions of well MW-3, between a depth of 60 and 120 feet bgs, there is significant clay content in the sand. These materials were probably deposited along the distal portion of the alluvial fan. The overall grain size decreases from east to west and further out on the alluvial fan. The sandy gravel lenses noted in the upper 50 feet of well MW-3 are probably remnants of braided stream deposits that were laid down during large desert storms, where a coarser-grained bed load could be sustained further out onto the fan.

Groundwater was detected in MW-2 at a depth of approximately 242 feet bgs in silty, sandy gravel composed primarily of volcanic rock fragments. This is interpreted to be the edge of the regional aquifer as it abuts the northern flank of the mountain.

Mineral condemnation boreholes drilled into the bedrock beneath the historical Gold Fields tailings did not encounter groundwater at depths that would be equivalent to the regional water table. In well MW-3, groundwater was detected at a depth of approximately 260 feet bgs in silty sand within the regional alluvial aquifer. It is likely that the groundwater is under semi-confined conditions.

Cross-section B-B that includes well MW-1 is provided as **Figure 7**. The cross-section is oriented sub-parallel to the alluvial fan that extends out from the northwestern edge of Soledad Mountain. The lateral distance on this cross-section is approximately 2,600 feet. Again, the interpreted dip of the various subsurface units is westward, but the lateral continuity of the units would appear to be more readily apparent than in the previous cross-section. The apparent lateral continuity appears to be an artifact of the more generalized characterization of the subsurface units and the scale used to represent them in this cross-section.

At MW-1, quartz latite bedrock of Soledad Mountain was encountered at a depth of 260 feet. Groundwater was encountered in the clay horizons immediately above the bedrock. The clay is interpreted as a weathering product of the quartz latite. Previous investigations correlated the water level in well MW-1 with the water levels in MW-2 and MW-3 as one continuous, static water table. The current interpretation is that the occurrence of groundwater in MW-1, just above the bedrock surface, is contained in localized clay lenses and is separate from the regional alluvial aquifer system. The groundwater level at MW-1 is discussed later in more detail.

The third cross-section C-C’ (**Figure 8**) has a general southwest to northeast orientation with the view looking northwest. Because this cross-section is nearly 6,000 feet long and contains a limited number of data points, subsurface relationships presented here are assumed. The overall dip of the beds in this cross-section is northward, mimicking the overall interpreted declining bedrock surface. With increased distance from Soledad Mountain, an overall fining sequence is apparent in the subsurface materials. Coarser materials are closer to Soledad Mountain in the southern portion of the cross-section, and more sand and clay are present in the northern portion of the cross-section. As previously mentioned, however, the clay at the bottom of well MW-1 appears to be a weathering product of the quartz latite.

Two additional cross-sections have been prepared using lithologic information from condemnation boreholes (Golder 2009): cross-section D-D’ (**Figure 9**) is oriented east-west while cross-section E-E’ (**Figure 10**) is oriented north-south. **Figure 5** shows the locations of these cross-sections (D-D’ and E-E’).

Cross-section D-D’ (**Figure 9**) runs west to east through the historical Gold Fields tailings and Phase 1 heap leach pad. Lithologic descriptions from mineral condemnation boreholes (GQ-621, -623, -624, and -630) do not describe the alluvial sediments in detail and only identify the alluvium as undifferentiated overburden. The bedrock contact and occurrence of groundwater are identified on the borehole logs. The cross-section shows the west-dipping bedrock surface. Beneath the historical tailings, the thicknesses of alluvial fan deposits range from approximately 120 feet on the east side to 260 feet on the west side. No detectable groundwater was encountered in the condemnation boreholes, indicating that minimal groundwater, if any, occurs in bedrock and overlying alluvium at these locations. The regional aquifer is encountered in MW-2 and MW-3; however, it is absent farther to the south as evidenced by the absence of groundwater in borehole GQ-621.

Cross-section E-E’ (**Figure 10**) is a north to south section that also runs through the historical Gold Fields tailings and the Phase 1 heap leach pad. Lithologic information from condemnation boreholes shows a slight bedrock high beneath the upslope end (GQ-629) of the historical tailings. No detectable groundwater was encountered in condemnation boreholes (GQ-628, -629, and -630) indicating that absence of groundwater in the alluvium at these locations. As previously indicated, the water level in MW-1 is perched and not connected to the regional aquifer. The regional alluvial aquifer is encountered at MW-5, and the aquifer is interpreted to terminate somewhere between MW-5 and MW-1.

Aquifer testing was performed in the monitoring and production wells. Specifically, slug tests were conducted in wells MW-2 and MW-3 (Earth Systems 1997), and step-rate pumping tests were conducted in PW-1 in 1996 and in PW-2 in 2005 (WZI 1996; WZI 2005). All of the tests indicated a relatively low hydraulic conductivity for the area. Both wells MW-2 and MW-3 were very slow to respond to the inserted solid slug and exhibited little recovery within 3 hours. Representative hydraulic conductivity values for such protracted responses in these wells likely fall in the range of approximately 1 x 10^{-5} to 1 x 10^{-6} cm/sec. The aquifer test in PW-1 yielded a higher permeability value of 5.67 x 10^{-4} cm/sec.

5.4 Water Levels

Information on water wells in the region is summarized in **Table 1**. Additional information for those wells within 1 mile of the Project is provided in **Table 2**. The approximate locations of the wells are shown on **Figures 3** and **4**. See also sub-section 4.2 for information on the six characterization/monitoring wells and four production wells that have been completed in the area.

5.4.1 Water Levels in Monitoring Wells

Water levels for the five characterization/monitoring wells are presented in **Table 3**, and available water levels for other wells in the mine area are contained in **Attachment A** (locations of wells are shown on **Figure 4**). The depths to water in the vicinity of the Phase 1 facilities range from approximately 150 to 300 feet bgs, with most water levels between 200 and 250 feet bgs. Hydrographs for the monitoring wells are plotted on **Figure 11**.

Water levels have decreased over time in MW-2, MW-3, MW-5, and MW-6. Before mining operation commenced in 2016, groundwater elevations at MW-2, MW-3, and MW-5 generally showed decreasing groundwater elevations. Water levels have decreased as follows:

- MW-2 and MW-3: water levels are approximately 10 feet lower than levels in 1996 (when wells were installed) compared with December 2018 water levels. Approximately half of that decline (5.5 feet) has occurred before mining operations commenced.
- MW-5: water levels are 8 feet lower than levels in 2007 (time of installation) compared to water levels in December 2018. Of the 8 feet of decline seen at the well, 3 feet had occurred before mining operations commenced.
- MW-6: water levels at MW-6 have declined by approximately 17 feet since the time of installation (2010) compared with levels in December 2018. The water level in MW-6 in December 2010 was approximately 5 feet higher than the other four sampled monitoring wells. A possible explanation for the slightly higher water level in MW-6 is that the alluvial aquifer is constricted by the bedrock of Soledad Mountain and Standard Hill, which may result in higher water levels as groundwater flows through the constriction.

The hydrologic response of MW-1 was inconsistent with the other wells at the site and it was determined that the groundwater at MW-1 was perched or isolated and not part of the regional alluvial aquifer. In contrast to the other monitoring wells, the water level in MW-1 remained constant from 1996 to 2008, when monitoring of MW-1 was discontinued. If the groundwater in MW-1 was hydraulically part of the regional aquifer, its water level would have a decreasing trend, but this was not observed. Because MW-1 was located within the area of the Phase 1 heap leach facilities, it was decommissioned in 2013 (Arcadis 2013b). Well MW-4 has had no detectable groundwater since it was drilled in 2007, most likely because it was terminated in bedrock that is interpreted to be a “bedrock high.”

5.4.2 Water Levels in Production Wells

Wells PW-1 and PW-4 are used to supply water to the water supply system that was completed in January 2016. Water levels at these wells are recorded during periods of production and non-production (when pumps are not operating). The water level data is included in **Attachment B.**

Water levels during periods of pumping in production wells PW-1 and PW-4 were compared to the predicted water levels by the groundwater drawdown model prepared by WZI (discussed in Section 4.2.2). The model included three scenarios (1, 2, or 3 production wells in use) with a total pumping rate of 750 gpm. Wells PW-1 and PW-4 are pumped simultaneously and the average pumping rates for the wells are 212 gpm and 407 gpm, respectively, based on data collected through 2018. Therefore, the following scenarios were selected for the comparison:

- PW-1 water levels were compared to the scenario for three wells which estimated pumping at 250 gpm. At the pumping rate of 250 gpm per well, the predicted drawdown of groundwater levels for an assumed three wells were 64 ft in 90 days, 76 ft in 3 years and 83 ft in 10 years. However, for comparison, only one well (PW-1) is actually being pumped at a flow rate less than 250 gpm.
- PW-4 water levels were compared to the scenario for two wells which estimated pumping at 350 gpm. At the pumping rate of 350 gpm per well, the predicted drawdown of groundwater levels for an assumed two wells were 78 ft in 90 days, 91 ft in 3 years and 97 ft in 10 years. However, for comparison, only one well (PW-4) is actually being pumped at a flow rate less than 350 gpm.

Under any scenario, the modelling and results assumed an infinite aquifer and no recharge to the groundwater basin.

Groundwater elevations during pumping in the production wells PW-1 and PW-4 over time were plotted and are presented on **Figure 12**. Static water levels for PW-2 are also plotted on the figure. The water levels during pumping through December 2018 are as follows:

- Measured water levels in PW-1 during pumping are 54 feet lower than the established 2013 baseline water level of 2,580 feet-amsl. Compared with the predicted drawdown over 10 years of 83 ft, the change in water levels is less than the predictions from the WZI model.
- For PW-4, measured water levels in the well during pumping are 88 ft lower than the established 2016 baseline water level at the time of installation of 2,575 feet-amsl. The predicted drawdown over 3 years is 91 feet and over 10 years is 97 ft. The change in the water levels is less than the predictions from the WZI model.

For further comparison, the predicted drawdown assuming a single pumping well at 750 gpm was 121, 128 and 140 ft after 1, 3 and 10 years of pumping. Water level declines observed in PW-1 and PW-4 have not exceeded the drawdowns predicted by the WZI model (WZI 1996).

5.5 Groundwater Flow Directions

The primary groundwater flow direction in the Fremont Valley Groundwater Basin is generally eastward from the mountains toward the central valley areas and then northeast toward Koehn Lake (dry), which is an evaporative sump located 30 miles northeast of Soledad Mountain (Fremont Valley RWMG 2018). WWL (1990) also described groundwater flow directions in the Fremont Valley Groundwater Basin as generally east, then northeast towards Koehn Lake. The regional groundwater gradient is approximately 0.02, or 100 feet per mile. Groundwater gradient maps were included in the Fremont Valley Basin Groundwater Management Plan for three time periods: spring 1990, spring 2010, and spring 2017 (Fremont Valley RWMG 2018). The groundwater gradient is generally toward Koehn Lake, and the recent 2017 groundwater levels tend to be lower than the levels in 1990 and 2010.

The local groundwater flow direction in the vicinity of Soledad Mountain changes to the southeast as illustrated on the groundwater contour map developed by WZI (1997), which is shown on **Figure 13**. Arrows showing the interpreted groundwater flow direction are shown on the contour map to facilitate the illustration of flow directions. As groundwater approaches Soledad Mountain, its low-permeability bedrock causes groundwater to flow south and around the mountain.

Based on the groundwater data from wells MW-1, MW-2 and MW-3, a continuous piezometric surface does not exist under and to the north of the Phase 1 heap leach pad. Monitoring well MW-1 was completed in a saturated sandy-clay/clayey-sand, which is situated directly upon the quartz latite bedrock of Soledad Mountain and is not hydraulically connected to the groundwater in the other wells at the site. The predominantly clay lithology represented in MW-1 is a local feature and is not laterally continuous. Furthermore, as mentioned in the previous section, the water level in MW-1 was constant from 1996 to 2008, when monitoring was discontinued, whereas the water levels in MW-2 and MW-3 exhibit a steadily decreasing trend consistent with other wells in the regional alluvial aquifer.

An updated evaluation of the water table along the northern mountain front was performed by plotting the November 2018 groundwater elevations for wells MW-2, MW-3, MW-5, MW-6, and production well PW-2 to create a water table contour map (**Figure 14**). Estimated water levels were also incorporated for productions wells PW-1 and PW-4, The regional groundwater before mine operations generally flowed from northwest to southeast, as shown on the regional groundwater contour map (inset on **Figure 14**). Groundwater elevation measurements from November 2018 show that groundwater near Soledad Mountain is influenced by pumping from PW-1. Historical groundwater flow analyses (before pumping at PW-1) indicate that, as groundwater nears Soledad Mountain, the groundwater is constrained by the low-permeable bedrock (Tertiary volcanics) of Soledad Mountain and Standard Hill to the northeast. This results in a localized change in the groundwater flow direction. Some groundwater flows between the two mountains, and some is forced to flow around the west side of Soledad Mountain. There is little groundwater flow between Soledad Mountain and Standard Hill because there is shallow bedrock in the area; however, a well is located approximately 3,000 feet southeast of the Robinson Well, and the water level in the well suggests that some groundwater flows between the Soledad Mountain and Standard Hill (GQM 2012).

6 VADOSE-ZONE MONITORING

If leakage from the liner system of the Phase 1 heap leach pad occurs, the leakage would percolate downward until reaching low-permeability strata and then flow as perched seepage down-dip (north) until reaching the regional water table. The potential of leakage to reach the regional water table, however, is very low due to the thickness (>210 feet) of low-permeability, interbedded alluvial sediments. Vadose-zone monitoring along the northern perimeter of the Phase 1 pad, as proposed in the Heap Leach Facility Revised Geotechnical Design Report (Golder 2006), is the basis for monitoring of potential leakage from the Phase 1 Heap Leach Facility. The vadose-zone monitoring system consists of a series of stainless-steel suction lysimeters installed in the subgrade under the liner system. Lysimeters are used to monitor soil moisture in the unsaturated sediments along the northern perimeter of the Phase 1 pad. A change in moisture content warns of possible leakage, and detection of elevated COC concentrations indicates a possible release from the HLF.

Once the HLF Phase 1 – Stage 1 cyanide leaching commenced in February 2016, five lysimeters (VM-1, VM-2, VM-9, VM-10, and VM-11) were installed, and monthly monitoring was initiated. If a sufficient volume of water is present, samples are collected for laboratory analysis of total cyanide and weak acid dissociable (WAD) cyanide. In May 2017, lysimeter VM-2 was malfunctioning and decommissioned. Lysimeter VM-2 was replaced by lysimeter VM-2R and monitoring of VM-2R began in July 2017. Once the HLF Phase 1 – Stage 2 cyanide leaching commenced in September 2017, lysimeters VM-3 and VM-4 were installed and monitored monthly. Lysimeters VM-5 through VM-8 are planned to be installed when operations are active at the additional heap leach facilities.

A summary of monitoring events and sample collection for the lysimeters is included as **Table 4**. Total cyanide has been detected in VM-1, VM-9, and VM-10 at concentrations ranging from 0.0051 mg/L to 0.012 mg/L. WAD cyanide has been detected in VM-10 at a concentration of 0.14 mg/L. It is suspected that this low level of total cyanide is attributed to the historical tailings on site that was used as construction material below the liner system. Analysis of the historical tailings reflects very low levels of total cyanide and discussed further in Section 9.

7 ORE AND WASTE ROCK MONITORING

Before construction and initiation of mining, geochemical characterization and monitoring for the potential of acid rock drainage (ARD) related to ore and waste rock was performed. Based on the results of the characterization, the rock to be mined met Group C Solid Mine Waste classification. As required by Section II – "Ore and Waste Rock Monitoring" of the WDRs per the Amended Monitoring and Reporting Program (M&RP) Order No. R6V-2010-0031-A01 (RWQCB 2011), upon commencement of mining, supplemental sampling and analytical work were performed on newly exposed mined surfaces for geochemical characterization and to evaluate ARD potential. Supplemental sampling and analytical work began in 2016 and has continued through the present.

7.1 Pre-Operational Ore and Waste Rock Monitoring Results

Before commencement of mining, GQM conducted a geochemical evaluation to characterize ore, waste rock, leached and rinsed residues, and historical tailings to assess the potential to generate acid and leach metals. The characterization program consisted of acid-base accounting (ABA) to evaluate ARD potential, elemental analysis to determine the solid-phase elemental concentrations, and leach tests using the waste extraction test (WET) procedure to assess the potential for release of constituents due to exposure to meteoric precipitation. The ABA results are fully described in the 2012 amended ROWD (GQM 2012) and briefly summarized here, with a focus on paste pH, net neutralization potential (NNP), and ARD classification based on sulfide-sulfur content and neutralization potential ratios (NPRs).

- Ore samples exhibited a sulfide-sulfur content of less than 0.01 percent. This indicates a very low level of sulfide sulfur in the ore and therefore no ARD potential (GQM 2012).
- Drill cuttings of the four primary rock types exhibited paste pH ranging from 4.46 to 6.15 (at or near reagent-grade water pH), NNP values ranging from -1.5 to -4.9 tons of calcium carbonate per 1,000 tons ($tCaCO_3/kt$), and NPRs ranging from 0.02 to 0.08. Although these samples contained relatively low sulfur content (0.05 to 0.17 percent), the NPR results suggest that the material has a potential to eventually generate acid (GQM 2012).
- Two composite samples of leached and rinsed residues from column leach tests exhibited paste pH of 10.40 and 11.24, and NNP values of 13.9 and 21.9 tCaCO3/kt. The NPRs of 140 and 210, respectively, indicate that there is no ARD potential (GQM 2012).
- Three composite samples of historical tailings exhibited paste pH ranging from 7.13 to 7.57 and NNP values ranging from 4.1 to 7.3 tCaCO3/kt. NPRs ranging from 14.7 to 74.0 indicate that there is no ARD potential for these tailings (GQM 2012).
- Eleven representative samples of rock tested in 1995 exhibited sulfide-sulfur contents ranging from <0.01 to 0.04 percent, paste pH ranging from 4.85 to 8.33, NNP values ranging from 0.7 to 5.0 tCaCO3/kt, and NPRs ranging from 0.5 to 51.0 (GQM 2012).

A general guideline presented by Price (1997) states that rock with a sulfide-sulfur content below 0.3 percent and a paste pH above 5.5 are considered safe for excavation and disposal if no metal-leaching concern is present. Results of leaching tests are presented below.

7.1.1 Metals Leach Tests Results

Leach tests were conducted on ore, waste rock, and leached and rinsed residues from column leach tests to determine the potential for mobilizing metals. No test values from the ore or waste rock samples exceeded the Soluble Threshold Limit Concentration (STLC). A single sample of historical tailings exhibited a leachate result for lead of 13.0 mg/L, which exceeded its STLC of 5.0 mg/L. It is speculated that the historical tailings may have been contaminated with lead during processing of ore in the early 1900s. Results from other analyses for lead were well below the STLC (GQM 2012); therefore, the leaching of lead is expected to be very low (GQM 2012).

Mercury was not leached at concentrations above the STLC (0.2 mg/L) from any of the samples tested. Mercury was not detected in the majority of the WET extraction fluids, and in most cases, leached at concentrations <0.01 mg/L, indicating that it is highly non-leachable in the samples tested (GQM 2012).

Testing was also performed to determine the elemental content of the various samples by chemical digestion (strong acid digestion) of solid samples in accordance with various United States Environmental Protection Agency (USEPA) test methods. The test values were compared to the Total Threshold Limit Concentration (TTLC). Results from samples of ore and waste rock did not exceed the TTLC limits. The concentration of mercury was low in all of the samples tested and was below the TTLC for mercury (20 milligrams/kilogram [mg/kg]). The average concentration for the principal lithology was 5.16 mg/kg (ranging from 0.9 to 6.9 mg/kg). Leached residues contained lower concentrations of mercury (average of 2.3 mg/kg; ranging from 0.4 to 3.06 mg/kg). Mercury leaching is therefore expected to be very low, consistent with the WET testing of the leached residues (GQM 2012).

7.2 Operational Ore and Waste Rock Monitoring Results

Once mining began in 2016, supplemental sampling and analytical work were performed on mined surfaces for geochemical characterization and to evaluate the potential to generate acid. Representative samples were collected from each rock type and underwent ABA, leaching using the WET procedure, and elemental analysis. Samples were collected and analyzed based on state and industry guidance (as described in GQM 2012). Analytical results are summarized in the annual reports submitted to the RWQCB. The following is a summary of the results, as presented in the Annual WDR Monitoring Reports from 2016 to 2018 (Arcadis 2017, 2018, and 2019).

A total of 15 rock samples were collected during active mining in 2016. Each sample was subjected to ABA, leaching using the WET procedure, and elemental analysis. Using the guidance from Price (1997), and considering the low levels of sulfide-sulfur present across the samples, the general tendency of samples to generate a paste pH greater than 5.5, the non-leachability of metals, and the low concentrations of elements of concern in the material, there is a low potential that rock samples collected in 2016 will generate appreciable acid or leached metals.

A total of 15 rock samples were collected in 2017. Each sample was subjected to ABA, leaching using the WET procedure, and elemental analysis. Using the guidance from Price (1997), and considering the low levels of sulfide-sulfur present in nine of the 15 samples, paste pH greater than 5.5 in all samples, the non-leachability of metals, and the low concentrations of elements of concern in the material, there is a low potential that nine of the 15 rock samples collected in 2017 from the East Pit (East Pit Sample #1, East Pit Sample #2), Main Pit (Main Pit Sample #2), and West Main Pit (West Main Pit Sample #3, #177, #222, #266, #302, and #305) will generate acid or leached metals and a moderately low potential that six of the 15 samples collected in 2017 (Main Pit Sample #1, #194, #195, #218, #236, and #314) will generate acid or leached metals.

A total of 22 rock samples were collected during mining in 2018. Each sample was subjected to ABA, leaching using the WET procedure, and elemental analysis. Sulfide-sulfur content was low for the samples collected in 2018, with a maximum sulfide-sulfur content of 0.28 percent. All of the 22 samples exhibited a sulfide-sulfur concentration of less than 0.3 percent. These results indicate a low level of sulfide-sulfur, and therefore low ARD potential, in each of the samples. Past pH was equal to or greater than pH 5.5 for all 22 samples. Using the guidance from Price (1997), and considering the low sulfide-sulfur present in all samples, paste pH greater than 5.5 in all samples, the non-leachability of metals (except for arsenic in two of the 22 samples), and the low concentrations of elements of concern in the material, there is a low potential that 21 of the 22 rock samples collected in 2018 will generate acid or leached metals. Due to the arsenic concentration in two of the samples (005/ORE and 009/ORE), there is a moderately low potential that two of the samples collected in 2018 could generate leached metals.

8 GROUNDWATER QUALITY

The groundwater in the Fremont Valley Groundwater Basin is characterized as sodium bicarbonate in the southeast; sodium bicarbonate or calcium-sodium sulfate in the southwest; sodium sulfate-bicarbonate to sodium chloride in the north; and complex with variable mixtures of sodium, calcium, chloride, sulfate, and bicarbonate in the central region (California DWR 2004a). Groundwater quality generally improves from east to west, with lower concentrations of dissolved solids near the mountains, where recharge occurs.

High concentrations of nitrate and boron have been measured in groundwater in the region (Kennedy/Jenks Consultants 1995). High concentrations of boron are expected, as the Mojave Desert is a well-known source for borax. In addition, groundwater in Kern County is known to have high levels of naturally occurring arsenic (Pipes 2005). Arsenic concentrations within the Fremont Valley Groundwater Basin were evaluated for the Fremont Valley Basin Groundwater Management Plan. Wells throughout the Fremont Valley Groundwater Basin have elevated arsenic concentrations above the regulated primary Maximum Contaminant Level (MCL) of 0.010 milligram per liter (mg/L; Fremont Valley RGMG 2018). However, the study identified two hot spots in the northeastern and southeastern regions around Soledad Mountain. Concentrations of arsenic in wells around Soledad Mountain typically exceed the MCL.

The following sections discuss groundwater well locations, monitoring, procedures for sample collection and analysis, identification of COCs in groundwater, statistical summaries of water quality data, and an assessment of groundwater quality.

8.1 Groundwater Well Locations and Monitoring

Groundwater quality in the mine area is documented by five monitoring wells, four production wells, and four domestic water wells. The monitoring and requirements for the wells are discussed below.

8.1.1 Groundwater Wells for Monitoring and Reporting Program

The groundwater monitoring system at the project consists of several groundwater monitoring wells originally installed for the purpose of characterizing baseline and background groundwater quality in the vicinity of the planned heap leach facilities. These wells have been designated MW-1, MW-2, MW-3, MW-4, MW-5, and MW-6. Monitoring of MW-1 was discontinued after 2009, and the well was decommissioned in June 2013 (Arcadis 2013b). MW-4 has routinely been dry. In addition to the project groundwater monitoring wells, production and domestic water wells near the project provide additional information about groundwater quality in the area. Well construction details are summarized in **Tables 1** and **2**. Quarterly sampling and reporting for these wells has been a requirement under the Amended M&RP Order No. R6V-2010-0031-A01 (RWQCB 2011).

The groundwater characterization program primarily includes wells developed along Silver Queen Road around the northern perimeter of the Phase 1 heap leach facilities. The year and depth of installation for wells is as follows:

- In 1996, three wells (MW-1, MW-2, and MW-3) were completed on the north flank of the mountain (**Figure 1**). Depths of the three wells are 256, 280, and 290 feet bgs, respectively. MW-2 and MW-3 are completed in alluvial sediments of the regional alluvial aquifer. MW-1 was also completed in alluvial sediments; however, based on an interpretation of the data collected, it was theorized that this well monitored an isolated zone of water perched above the regional water table.

- In 2007, wells MW-4 and MW-5 were drilled and equipped with dedicated pumps at the northern perimeter of the proposed Phase 1 heap leach facilities. MW-4 was completed to a depth of 177 feet, and the borehole terminated in bedrock. Groundwater has not been detected in the well due to its shallow completion, which was caused by the bedrock high. MW-5 was competed to a depth of 272 feet and into the regional alluvial water table.
- MW-6 was completed in 2010 and situated approximately 800 feet to the northeast of MW-4. MW-6 was installed in response to a request by the RWQCB to monitor regional groundwater and was completed to a depth of 212 feet.

8.1.2 Groundwater Production Wells

Production wells have been drilled and equipped north of Silver Queen Road to supply water for the project. Production well PW-1 was drilled in October 1996. The 300-foot-deep well was drilled to the top of bedrock and completed with 115 feet of well screen in the regional aquifer. In 2005, a second production well (PW-2) was installed approximately 100 feet east of Gold Town Road. The well was completed to a total depth of 288 feet with 170 feet of slotted casing. A third possible production well (PW-3) was drilled and equipped to a depth of 600 feet in October 2008 but has not yet been developed for pumping and mine use. Production well PW-4 was drilled in 2015. The well was completed to a total depth of 740 feet with 370 feet of slotted casing. Produced groundwater is used to support the mine’s water system (Soledad Mountain Project Water System No. 1503664). The system is regulated under Title 22, CCR 64431. While the compliance status of monitoring and reporting required by Title 22 is not required in the WDRs, monitoring data does provide information about the water quality in the mine area. Therefore, results of water quality analysis for samples collected from the production wells are included in the discussion in Section 8.4, Groundwater Quality Assessment.

8.1.3 Private Groundwater Production Wells

Five domestic water wells are also located in the vicinity of the mine, including the Flynn, Gainey, Peltier, and Robinson wells (along the northern mountain front), and the Garcia well, which is southwest of the mine. These domestic wells, all completed in the alluvial aquifer, have been sampled and provide additional data on groundwater characteristics. Available results of water quality analysis of samples collected from the private wells are included in Section 8.4, Groundwater Quality Assessment.

8.2 Groundwater Sampling Procedures and Analysis for Monitoring Wells

Before third quarter 2012, the sampling method for the four active monitoring wells (MW-2, MW-3, MW-5, and MW-6) involved conventional large-volume purging with high-capacity pumps, as described in the Water Quality Monitoring and Data Management Procedures Manual, Revision 3 (Arcadis 2009). With this conventional sampling method, wells were rapidly pumped dry before the target purge volumes were removed. This, along with slow recharge rates, created logistical challenges and increased sampling time. Alternative sampling methods (the conventional method, Snap Samplers^{TM} and bladder pumps) were compared during three subsequent sampling events using well MW-2 from third quarter 2011 to the first quarter 2012. Based on this evaluation, Arcadis recommended the installation of dedicated low-flow bladder pumps in the four monitoring wells that are sampled quarterly (Arcadis 2012). The RWQCB approved the low-flow sampling method on May 18, 2012. Dedicated low-flow bladder pumps were installed in the four active monitoring wells in 2012 and have been used since the third quarter 2012 water quality monitoring event. Protocols for low-flow bladder pump groundwater sampling and analysis are specified in the Water Quality Monitoring and Data Management Procedures Manual, Revision 4 (Arcadis 2013a).

To ensure consistent and accurate collection and reporting of monitoring results for internal review, planning, and external compliance reporting, quality assurance/quality control requirements for the mine have been established and are described in the Water Quality Monitoring and Data Management Procedures Manual, Revision 4 (Manual; Arcadis 2013a). The Manual outlines procedures and associated quality control for all field activities, sample collection, sample handling and shipping, and contracted laboratory services. Procedures for executing a comprehensive review and validation process of both field and laboratory data are also provided to ensure that the data meet defined quality requirements. The Manual also provides the basis to document the quality of data at each monitoring and analysis level. Wells are sampled according to the approved sampling protocol, which includes methods for sample collection, sample preservation and shipment, analytical procedures, field and laboratory quality control, and chain-of-custody control outlined in the Manual (Arcadis 2013a).

Groundwater samples collected from the monitoring and production wells are tested for field parameters (pH, specific conductivity, redox potential, and temperature) and analyzed for major cations and anions, total dissolved solids (TDS), fluoride, nitrate/nitrite, WAD and total cyanide, and dissolved metals. All samples for “dissolved” analysis are field-filtered (through a 0.45-micron [µm] filter) before preservation and laboratory analysis. Samples collected from the Flynn and Gainey domestic wells are also analyzed for field and laboratory parameters; however, metals are analyzed on a “total” basis (i.e., unfiltered) as opposed to a “dissolved” basis. Total and WAD cyanide are not analyzed for domestic groundwater samples.

Review of field and laboratory documentation revealed that, before December 2006, field filtering of samples was not performed. In some cases, the laboratory filtered samples after receipt at the laboratory before performing metals analysis. However, it cannot be confirmed that laboratory filtering of samples before analysis was performed in all cases. Due to inconsistencies in field and laboratory procedures, and the difficulty in establishing whether laboratory results for metals were performed on a “total” or ‘dissolved” basis, interpretation of metals results before December 2006 can be problematic and not suitable for direct comparisons to metals results after that timeframe. Additionally, sampling procedures in the late 1990s at times generated turbid water samples containing elevated suspended particles. The delay in performing sample filtration (i.e., samples not filtered until after receipt at the laboratory) may have affected the integrity of analytical results. This is particularly true for constituents that are highly sorptive to suspended solids or colloids (e.g., iron and arsenic).

The M&RP stipulates quarterly monitoring of the wells for parameters pH, TDS, WAD cyanide, total cyanide, and dissolved arsenic, listed in **Table 5**. Analytical results from 2011 through 2018 for groundwater sampling of monitoring wells are included as **Attachment D**. Water quality data from prior sampling events are available in Groundwater Quality Summary Reports prepared by Arcadis (Arcadis 2010a; 2016). The following rationale was provided for the establishment of the COCs in the WDRs:

- **pH** - The groundwater pH could be changed by a leak in the lined heap leach pad, which could release high-pH solution. Because pH can potentially affect groundwater quality, it is included in the list of COCs.
- **TDS -** TDS is a water quality indicator parameter of possible leakage and is included for this reason.
- **Cyanide and WAD Cyanide** - In the event of an excursion of leach solution from the lined heap leach facilities, cyanide could be released to the alluvium beneath the liner system. Analyses of cyanide levels includes both WAD cyanide and total cyanide.
- **Arsenic** - Arsenic is present in both the host rock and ore as arsenic minerals in veins, as heterogeneous deposits, or as a minor element in rock-forming minerals. Naturally occurring arsenic is present in groundwater in the mine area and in the regional aquifer. Arsenic will be present in the pregnant and barren solutions once the crushed ore is exposed to the cyanide lixiviate on the lined heap leach pad.

The M&RP requires additional groundwater analyses (listed in **Table 5**) to be performed on the wells once every 3 years (beginning in 2011). These additional analyses include the following:

- Volatile organic compounds (VOCs; USEPA Test Method 8260 or equivalent).
- Semi-volatile organic compounds (SVOCs; USEPA Test Method 8270 or equivalent).
- California Administrative Manual 17 (CAM 17) Metals.

Sample collection and lab analyses for these additional parameters were performed during the third quarter 2011, the first quarter 2015, and the first quarter 2018 monitoring events. In 2011, toluene was detected in monitoring wells MW-5 and MW-6 at concentrations of 0.67 micrograms per liter (µg/L) and 1.1 µg/L, respectively. In 2011, m,p-xylenes were detected in the sample collected from MW-6 at a concentration of 0.60 µg/L. Chloroform was detected in monitoring well MW-2 in samples collected during the 2015 and 2018 sampling events at concentrations of 2.3 and 2.1 µg/L, respectively.

8.3 Constituent Statistical Summaries

Summary statistics for groundwater sample results from all site wells were developed using analytical data from MW-2, MW-3, MW-5, and MW-6 from fourth quarter 2007 to fourth quarter 2018 (**Table 6**). No data are available for MW-4, as it never produced water. Snap Samplers^{TM} and bladder pump data associated with the alternative sampling methods comparison at monitoring well MW-2 (as described in Section 8.2) were not included in the analysis. A conventional sample was collected within 1 day of each of these sampling events, so no data resolution is lost through the omission of these data.

The summary tables show the detection frequencies, the minimum and maximum detected concentrations, and the range of detection limits reported for the non-detect data. The average concentration for each analyte was calculated assuming that the laboratory reporting limit is representative of non-detects. Consequently, the calculated average concentrations are likely higher than the true average concentrations of the detected values. A comparison between regulatory standards and the maximum observed value is also presented in the summary tables. Concentrations were compared to the USEPA MCLs, USEPA Secondary Drinking Water Standards, and the California Department of Public Health (CDPH) primary and secondary MCLs.

The maximum field measured pH value for samples collected from the monitoring wells since 2007 is 11.34 (10.20 in the laboratory), exceeding the USEPA Secondary Drinking Water range, which is 6.5 to 8.5. The high pH occurred in MW-3 and is likely due to cement grouting of the bottom of the well. The average measured pH value for the mine site was within the regulatory range. During the same monitoring period, the maximum and average concentrations of sulfate, TDS, arsenic, iron, and manganese also exceeded their respective USEPA MCLs or Secondary Drinking Water Standards (**Table 6**). The maximum and average arsenic concentrations in the samples exceeded the California MCL as well. CDPH has not established MCLs or Secondary Drinking Water Standards for pH, sulfate, and TDS.

8.4 Groundwater Quality Assessment

Groundwater quality characterization in the following subsections is based on data from fourth quarter 2007 through the fourth quarter 2018 (**Table 6**). No notable changes have occurred in groundwater chemistry in the wells previously included in the Water Quality Summary Report Update 2007-2015 (Arcadis 2016), except for an apparent increase in arsenic in monitoring well MW-5 and production wells PW-1 PW-2 and PW-3 which is discussed in Section 8.4.3. The increasing concentrations of arsenic are likely due to movement and/or liberation of naturally high background arsenic through increased pumping at the production wells.

As noted in Section 8.2, before December 2006, field filtering of samples was not performed, and it could not be confirmed that laboratory filtering of samples before analysis was performed in all cases. Because it is unknown if results are for total or dissolved metals, interpretation of metals results from before December 2006 can be problematic and are not suitable for direct comparisons to metals results for samples collected after that timeframe. Therefore, comparisons of dissolved concentrations only include data after December 2006.

8.4.1 Water Quality Parameters

Groundwater temperatures in the Mojave area generally range from 20 to 25 degrees Celsius (°C). Groundwater is moderately oxic and mildly oxidizing, with dissolved oxygen typically between 2 and 5 mg/L and reduction-oxidation potentials at approximately 100 millivolts as Eh. The groundwater is neutral to moderately alkaline, with bicarbonate values typically between 50 and 150 mg/L, and pH generally ranges from the mid 7s to 9. A box and whisker plot of pH values in monitoring, domestic, and production wells since fourth quarter 2007 is shown on **Figure 15**. Box and whisker plots show the minimum, maximum, and median values, as well as the 25th and 75th percentiles.

8.4.2 Major Cations/Anions

The groundwater chemistry in the mine area was assessed by plotting a Piper diagram of the major cation and anion chemistry from site wells and the Flynn and Gainey domestic wells (**Figures 16 and 17**). The Piper diagrams were prepared using data from the fourth quarter 2007 through fourth quarter 2018. On a Piper diagram, the major cation and anion concentrations are converted to milligram-equivalents per liter, and the ion concentrations are proportioned on each axis. The Piper diagrams are useful to determine the dominant ion chemistry and show similarities or differences in ion chemistry by how wells group together on the figure. The first Piper diagram shows data from MW-1, MW-2, MW-3, MW-5, and MW-6 (**Figure 16**), and the second shows all available data from wells MW-1, MW-2, MW-3, MW-5, MW-6, PW-1, PW-2, PW-3, and PW-4 and the Flynn and Gainey domestic water wells (**Figure 17**).

Water quality in the alluvial aquifer north and northwest of Soledad Mountain is characterized as a calcium-sodium-sulfate-bicarbonate type water. One exception to this is MW-1, which was richer in calcium and sulfate and is characterized as a calcium-sulfate water type. The Piper diagram shows that water quality from the wells tended to group together except at MW-1, the ion chemistry of which is distinct from the other wells, a difference that has persisted over the entirety of its monitoring (Arcadis 2016). This difference in water quality at MW-1 is attributed to groundwater encountered in MW-1 being contained in localized clay lenses and is separate from the regional alluvial aquifer system, as discussed in Section 5.3.

Stiff diagrams for each of the monitoring, production, and nearby Flynn and Gainey domestic water wells are shown on **Figure 18**. The Stiff diagrams were plotted using fourth quarter 2018 data. Stiff diagrams plot the ion concentrations in milligram-equivalents per liter, and the shape of the diagram is useful in evaluating similarities or differences in the major ion chemistries in the groundwater, which can be affected by local geology. Former well MW-1 was decommissioned in 2013 and is not included on **Figure 18**. The domestic water wells, production wells PW-1 and PW-2, and MW-3 and MW-6 all have similar diagrams, and therefore also have similar water chemistries. The diagram for MW-5 is somewhat different, having slightly more calcium and sulfate than the other wells. MW-2 and PW-4 have less sulfate, and PW-4 has more carbonate/bicarbonate, sodium, and potassium than nearby wells.

8.4.3 Constituents of Concern

Total Dissolved Solids –The Federal Secondary Drinking Water Standard for TDS of 500 mg/L has been exceeded in samples collected from MW-5. TDS concentrations in all other samples collected from the fourth quarter 2007 to fourth quarter 2018 have been below the Federal Secondary Drinking Water Standard for TDS. Concentrations of TDS in samples collected from MW-5 have ranged from 460 mg/L to 560 gm/L which is slightly above the Drinking Water Standard. Time series plots of TDS concentrations detected in the monitoring, production, and nearby domestic water wells over the monitoring period are presented on **Figure 19**.

Arsenic – Dissolved arsenic has exceeded the USEPA and California MCL for arsenic of 0.010 mg/L in seven of the 11 wells from the fourth quarter 2007 to fourth quarter 2018. Monitoring of arsenic has been conducted in the five monitoring wells (MW-1, MW-2, MW-3, MW-5, and MW-6), four production wells (PW-1, PW-2, PW-3, and PW-4), and two domestic wells (Flynn and Gainey; **Figure 20**). Dissolved arsenic concentrations are highest in MW-2 and PW-2, with maximum concentrations detected in second quarter 2008 of 0.15 and 0.095 mg/L, respectively.

Recent trends in the concentrations of dissolved arsenic in groundwater have been increasing at wells PW-1, PW-2, and MW-5. At PW-1, dissolved arsenic has increased from 0.029 mg/L in 2012 to 0.046 mg/L in 2018. Arsenic concentrations in samples collected from PW-2 have increased from 0.028 mg/L in 2013 to 0.160 mg/L in 2014, and 0.110 mg/L in 2015. Similarly, at MW-5, arsenic has increased from 0.011 mg/L in 2011 to 0.019 mg/L in 2018.

The concentrations of arsenic in other monitoring wells have been stable or declining slightly. Arsenic data from domestic wells in the area are not monitored routinely, and samples (when collected) are obtained from a spigot. The data are included here for comparison purposes and to augment the dataset used to develop the geochemical site model for the mine. The only available data point during the fourth quarter 2007 to fourth quarter 2018 time period for the domestic wells occurs in the Garcia well during the second quarter of 2009 and shows dissolved arsenic at 0.075 mg/L, exceeding the MCL. **Figure 21** shows that arsenic in the area has generally decreased since 1997, except for PW-1, PW-2, and MW-6.

Although arsenic concentrations in some of the wells are higher than the MCL of 0.010 mg/L, the concentrations are within naturally occurring ranges reported for the region. The desert region of Kern County is documented as having naturally elevated arsenic concentrations in groundwater (Welch et al. 2000). Regional groundwater studies have identified naturally occurring arsenic concentrations on the order of 0.05 mg/L, citing evaporative concentration as a contributing factor leading to high arsenic values (Welch et al. 2000). Groundwater quality was assessed as part of the Fremont Valley Groundwater Management Plan (Fremont Valley RWMG 2018). Of the 166 wells inventoried in the groundwater basin, 59 wells (36 percent) reported average arsenic concentrations above 10 µg/L. Arsenic concentrations in groundwater wells in the vicinity of Soledad Mountain exhibited average concentrations of 0.012 mg/L. However, arsenic concentrations have been as high as 0.19 mg/L in the site's PW-2 production well (in October 2016) and as high as 0.3 mg/L in a domestic water well near the mine. Arsenic has been measured to be as high as 0.06 mg/L in production wells of the Kern Water Bank Authority (Boockoff 2005).

Total and WAD Cyanide – Total cyanide and WAD cyanide samples are collected from the monitoring wells and production wells. Results for groundwater samples collected from 2007 to 2018 detected total cyanide in four samples (Table 6). The results were compared to the EPA MCL for free cyanide of 0.2 mg/L and all results were below the MCL. Total cyanide was detected at a concentration of 0.05 mg/L in MW-5 in September 2008; in MW-2 and PW-1 in May 2012 at concentrations of 0.0068 and 0.013 mg/L, respectively; and in PW-4 at a concentration of 0.014 mg/L in July 2015. WAD cyanide has not been detected in any site monitoring wells or production wells. Total and WAD cyanide are not analyzed for the domestic wells. The detections of low levels of total cyanide occurred prior to the start of mining and ore processing in 2016. Cyanide found in groundwater may also have non-anthropogenic sources as part of the natural nitrogen cycle. While alkali or alkaline earth metal-cyanide salts which occur in mine tailings are readily soluble in water, WAD cyanide was not detected, indicating that the dissociated form associated with metal-cyanide complexes from mining operations is not present in groundwater. An assessment of the potential for cyanide from the historic Goldfield tailings to impact groundwater were assessed and the assessment is discussed is Section 9.

8.4.4 Other Select Metals and Inorganic Compounds

Chromium – Dissolved chromium was not detected at a concentration higher than the CDPH standard of 0.05 mg/L in samples collected from 2007 to 2018. Dissolved chromium was detected at a concentration higher than the laboratory reporting limit of 0.01 mg/L only twice: when MW-3 was measured to contain 0.03 mg/L dissolved chromium in December 2012 and MW-5 yielded 0.012 mg/L dissolved chromium in October 2011. Production and domestic wells do not exhibit detectable chromium concentrations.

Fluoride – Fluoride concentrations have not been detected higher than the CDPH standard of 2 mg/L in any samples.

Iron – Dissolved iron concentrations in groundwater samples collected from the site monitoring wells, production wells, and domestic wells (Flynn and Gainey) are present at a wide range from lower than a reporting limit of 0.04 mg/L to 11 mg/L (**Figure 22**). The highest concentration of dissolved iron detected was 11 mg/L. The sample was collected from MW-5 in March 2009 and the concentration has decreased in that well to <0.03 mg/L during the fourth quarter 2018. Elevated concentrations of iron in groundwater may be due to a low oxidation-reduction potential of the groundwater, resulting in dissolution of naturally occurring iron oxyhydroxides from the aquifer soils.

Manganese – Dissolved manganese concentrations in samples collected from 2007 to 2018 range from lower than a reporting limit of 0.01 to 0.9 mg/L in samples collected from site and production wells (**Figure 23**). The highest value was detected in MW-5 in March 2009. Other groundwater samples from site wells typically exhibit manganese values near the reporting limit of 0.01 mg/L. Similar to iron, elevated concentrations of manganese in groundwater may be due to a low oxidation-reduction potential of the groundwater, resulting in dissolution of naturally occurring manganese oxides from the aquifer soils.

Nickel – Dissolved nickel was not detected at a concentration higher than a reporting limit of 0.01 mg/L in any groundwater sample collected from existing site wells from 2007 to 2018.

Selenium – Dissolved selenium concentrations in groundwater samples were not higher than the CDPH standard of 0.050 mg/L for any sample.

Sulfate – Sulfate was detected in groundwater samples collected from each monitoring and production well at concentrations ranging from 49 to 930 mg/L (**Figure 24**) from 2007 to 2018. Concentrations in groundwater collected from monitoring, production, and domestic water wells typically exhibit sulfate concentrations in the 70 to 200 mg/L range; lower than the USEPA MCL of 250 mg/L.

8.5 Background Concentrations

Background water quality concentrations from the monitoring well data were calculated for the project to characterize background and baseline concentrations before commencing mining. Development of concentration limits for COCs associated with MW-2, MW3, MW-4 and MW-6 using statistical analysis is a requirement of the MR&P (RWQCB 2011). The background values represent an upper tolerance limit (UTL) to be used in the future to determine if a release has occurred. Groundwater monitoring data for MW-2, MW-3, MW-5, and MW-6 were used to establish concentration limits greater than background (concentration limits) for COCs in groundwater, presented in **Table 5**. The UTLs were developed based on the results from fourth quarter 2011 through fourth quarter 2015. Concentration limits were previously determined and included in the 2011 MRP (RQQCB 2011) and were based on data from 2007 to 2009; however, data collected before 2011 were gathered according to variable procedures and lacked consistency in terms of methods used for sampling. Therefore, the calculated UTLs provided in Table 7 are based on data collected since 2011. The concentration limits calculated hereafter will be used in an update of the ROWD associated with the proposed mine expansion.

Based upon WDRs approved for the mine by the RWQCB the following constituents were identified; therefore, concentration limits have been calculated for each. Data below a laboratory reporting limit are considered censored data and are treated specially in statistical calculations as described in the following section, “Establishment of Concentration Limits”. Datasets containing non-detects and/or flagged data (censored data) are indicated here:

Constituent	Censored Data
pH (COC)	No
Total dissolved solids (COC)	No
Total cyanide (COC)	Yes
WAD cyanide (COC)	Yes
Arsenic (COC)	No

8.5.1 Establishment of Concentrations Limits

According to 27 CCR 20415 paragraph (e)(10), background values for COCs may be established based on reference to baseline data (¶(e)(10)(A)). Concentration limits were developed based on the results from fourth quarter 2011 through fourth quarter 2015. The data from 2011 through 2015 are considered background data, as they were collected before the commencement of ore processing in 2016. The concentration limits, COCs, and additional discussion of groundwater quality are summarized in the Water Quality Summary Report Update 2007-2015 (Arcadis 2016) which was submitted to the RWQCB on April 20, 2016 and serves as an update to the previous Groundwater Quality Report (Arcadis 2010a). The concentration limits serve as a basis to identify any potential “measurably significant” release, as required by the WDRs and discussed below.

The Shapiro-Wilk test and/or the Lilliefors test were used to see if the data were normally distributed (Gilbert 1987). Whether or not the data were normal, lognormal, or neither determined the suitability of parametric or non-parametric statistical analyses for the background data. Some data sets contained more than 70 percent non-detects and therefore were not suitable for statistical analysis (results included in **Attachment D**). The USEPA recommends that the “maximum detected” concentration should be used as the background concentration for data sets with more than 50 percent non-detects (USEPA 2006). Therefore, for data that fit this criterion, the maximum detected value was used as the tolerance limit for the concentration greater than background.

The UTL was calculated using the USEPA software ProUCL (USEPA 2013). The results of the statistical analyses are presented in **Table 7**, with superscripts provided to indicate which method was used to derive the concentration limits representative of background conditions.

8.5.2 Alternate Statistical Tests for Identifying a Potential Measurably Significant Release

According to 27 CCR 20514 paragraph (e)(8), the statistical analysis of the data presented above provides for the establishment of a UTL (or concentration limit), which will be used to define when a release has occurred. The updated concentration limits were provided to the RWQCB and recommended as an update to the 2012 ROWD and 2010 WDRs.

As of the fourth quarter 2018 sampling event, 12 consecutive quarters of operational data have been collected, thereby allowing for statistical hypothesis test comparisons of pre-mining data to operational data. The operational data set included 12 sampling events from 2016 to 2018. The pre-mining data set consisted of 20 events from 2011 to 2015. Statistical hypothesis test comparisons were conducted in accordance with the recommendations in Section IX.A. of the M&RP, which states (RWQCB 2011):

"When sufficient monitoring data (eight consecutive quarters) become available, the Discharger shall consider alternative tests (e.g., t-test, Mann-Whitney test, Wilcoxon Rank Sum test, etc.) to compare the two data populations under consideration, namely, the background (pre-mining) data set versus the data sets from the operational periods."

The monitoring parameters analyzed include pH (laboratory), TDS, total cyanide, WAD cyanide, and dissolved arsenic. The hypothesis test selected (e.g., t-test, Mann-Whitney test, Wilcoxon Rank Sum test) was determined based on frequency of detection (FOD) and data distribution. Overall, the data met the requirements for the t-test and Wilcoxon-Mann-Whitney (WMW) test, as described below:

- If both the pre-mining and operational data sets were 100 percent detections and fit a normal distribution, the t-test was selected.
- If both the pre-mining and operational data sets were between 40 and 100 percent detections and the data fit a normal, lognormal, gamma, or non-parametric distribution, the WMW test was selected.

In total, three data sets met the criteria for the t-test, and nine data sets met the criteria for the WMW test (**Table 8**). There were insufficient data for hypothesis testing for an additional eight data sets. Specifically, statistical comparisons could not be made for total cyanide and WAD cyanide in all wells due to both the pre-mining and operational data sets being 100 percent non-detect (or 95 percent non-detect in one instance; total cyanide has been detected once in MW-2 at a concentration of 0.0068 mg/L in August 2012).

The t-tests and WMW tests were performed using ProUCL software, and the results are summarized below and in **Table 8**. The null hypothesis test is that the operational mean/median is equal to the 2011-2015 pre-mining mean/median (two-sided alternative), and the alternative hypothesis is that the 2016-2018 operational mean/median is not equal to the pre-mining mean/median.

The results of the t-tests and WMW tests for each analyte are summarized below:

- **pH** – While a statistically significant difference between pre-mining and operational conditions was observed in monitoring wells MW-2 and MW-3, the difference between mean and median measurements for the pre-mining and operational data sets is negligible (i.e., MW-2 mean operational pH = 8.2 and MW-2 pre-mining pH = 8.3; and MW-3 mean operational pH = 8.1 and MW-3 mean pre-mining pH = 8.3). In wells MW-5 and MW-6, a statistically significant difference between pre-mining and operational pH measurements was not observed.
- **TDS** – In monitoring wells MW-2, MW-3, and MW-5, a statistically significant difference between pre-mining and operational TDS measurements was not observed. In monitoring well MW-6, a statistically significant difference between pre-mining and operational conditions was observed, with operational

TDS measurements slightly less than pre-mining measurements. The difference between mean and median measurements between the pre-mining and operational data sets is negligible (i.e., MW-6 mean operational TDS = 329 mg/L and MW-6 pre-mining TDS = 343 mg/L).

- **Total cyanide** – Statistical hypothesis testing could not be conducted for total cyanide due to insufficient detections. Total cyanide has not been detected in any operational samples and has only been detected in one pre-mining sample (i.e., MW-2 at a concentration of 0.0068 mg/L in August 2012).
- **WAD cyanide** – Statistical hypothesis testing could not be conducted for WAD cyanide due to insufficient detections. WAD cyanide has not been detected in any pre-mining or operational samples.
- **Dissolved arsenic** – In monitoring wells MW-2 and MW-6, a statistically significant difference between 2011-2015 pre-mining dissolved arsenic concentrations and 2016-2018 operational dissolved arsenic concentrations was not observed. In monitoring well MW-3, a statistically significant difference between pre-mining and operational conditions was observed, with operational dissolved arsenic concentrations slightly less than pre-mining concentrations. The difference between mean and median concentrations between the pre-mining and operational data sets is negligible (i.e., MW-3 mean operational Dissolved Arsenic = 0.028 mg/L and MW-3 pre-mining dissolved arsenic = 0.054 mg/L). In well MW-5, a statistically significant difference between pre-mining and operational conditions was observed, with operational dissolved arsenic concentrations slightly greater than pre-mining concentrations. Similarly, the difference between mean and median concentrations between the pre-mining and operational data sets is negligible (i.e., MW-5 mean operational dissolved arsenic = 0.017 mg/L and MW-5 pre-mining dissolved arsenic = 0.012 mg/L).

Generally, statistical differences between 2011-2015 pre-mining data set and 2016 to 2018 operational data were not observed. When statistical differences were observed, the differences in mean and median concentrations between the pre-operational and operational data sets were negligible.

9 EVALUATION OF POTENTIAL SEEPAGE FROM GOLD FIELDS HISTORICAL TAILINGS

To evaluate the possibility of seepage from the historical Gold Fields tailings impacting groundwater, a numerical modeling investigation of the unsaturated zone beneath the tailings was conducted in 2010 (Arcadis 2010b; **Attachment E**). The objective of the modelling was to evaluate the potential migration of seepage from the historical tailings through the unsaturated zone beneath the tailings and the potential time it might take for seepage to reach groundwater. The summary of the 2010 leaching modelling and results is included in this report for completeness.

The historical Gold Fields tailings were located on the north-facing front of Soledad Mountain (**Figure 1**). Approximately 165,000 tons of tailings were in the tailings pile deposited from 1936 to 1942. The tailings covered approximately 27 acres and reach a thickness of approximately 30 feet, tapering to only a few feet at the footprint edge in some areas. The tailings were hydraulically deposited as slurry, and tailings water was likely to have collected on the surface of the tailings at the time they were deposited. Some of the tailings were used in the construction of the composite liner system for the Phase 1 heap leach pad. The water table elevation of the regional aquifer is about 2,580 feet amsl along the northern mountain front, placing the tailings 220 to 370 feet above the regional water table, creating a relatively thick unsaturated zone beneath the tailings and the alluvial aquifer; in addition, the Phase 1 heap leach pad is also situated above unsaturated bedrock, or, as in the case of MW-1, have some groundwater that may not be representative of regional groundwater.

The model used a conceptualized stratigraphy beneath the tailings and site-specific soil properties supplemented with data from other applicable sources. Climatic data, such as precipitation and evaporation, were also included in the model. The model consisted of a vertical column that extended from the tailings to the approximate depth of the regional water table. Model simulations were performed to predict the migration of tailings seepage beginning around the 1936 to 1942 timeframe through the present and approximately 30 years into the future. Model results show that a seepage front reaches a depth of only 50 feet after 70 years, which is approximately 200 feet above the regional water table and assumes a sufficiently wet vadose zone to infiltrate water from the surface. The model results indicate that tailings seepage would not have impacted groundwater and is unlikely to affect groundwater quality in the future. Sumps on the Phase 1 heap leach pads are inspected weekly; along with onsite lysimeters (see Section 6), the sumps would produce the first indications of a release.

10 CONCEPTUAL GEOCHEMICAL MODEL

Groundwater quality in the Soledad Mountain area is influenced by the geology and mineralogy of the region. Soledad Mountain is an eroded silicic volcanic core of Early to Middle Miocene age (21.5 million to 16.9 million years). The volcanic units consist of felsic flows, tuffs, and breccias of the Gem Hill formation. The flanks of Soledad Mountain are mantled by Quaternary alluvial deposits consisting of sandstones and conglomerates.

The mineral deposits mined historically in the area are hosted in a volcanic sequence of rhyolite porphyries, quartz latites, and bedded pyroclastics. Precious metals mineralization is associated with steeply dipping epithermal fissure veins in faults and fracture zones that cross-cut the rock units. The veins are contained within siliceous envelopes of lower-grade material that form the bulk of the mineral resources. The mineralization extends to depths within the mountain below the water table of the surrounding regional alluvial aquifer and the flanks of the mountain at depths that likely contribute to the geochemical characteristics of the groundwater. **Figure 25** provides a conceptual geochemical model that shows the mineralogical association of arsenic with various environmental compartments, including the surficial environment, historical tailings, and at depth below the regional water table.

The ore body hosts native gold and electrum (gold with more than approximately 20 percent silver) ranging in size from less than 10 µm to more than 150 µm, with the silver content of the electrum as high as 25 percent. Silver is also present as the mineral acanthite (Ag_2S), with some native silver, pyrargyrite ($Ag_3Sb_2S_3$), and polybasite ($Ag_6Sb_2S_7$). In addition, pyrite (FeS_2), galena (PbS), and chalcopyrite ($CuFeS_2$) are present in minor amounts, with no indicated acid-generating potential. Arsenic is present in both the host rock and ore as arsenic minerals (including arsenopyrite) concentrated in veins or heterogeneous deposits, or as a minor element in rock-forming minerals.

Arsenic incorporates into common rock-forming minerals because its chemistry closely follows that of sulfur (Smedley and Kinniburgh 2002). For example, arsenic can comprise up to 10 percent by weight of pyrite (FeS_2) and marcasite (FeS_2), chalcopyrite ($CuFeS_2$), and galena (PbS). In sedimentary environments, pyrite may precipitate from groundwater as a result of anoxic reducing conditions. This process can also co-precipitate arsenic. Likewise, arsenic can incorporate into iron (hydr)oxides because of its very strong affinity for the surfaces of these iron minerals. The soluble arsenite (As[III]) and arsenate (As[V]) oxyanions (H_3AsO_3 and $HAsO_4^{-2}$, respectively) form strong surface complexes with iron (hydr)oxide minerals. Freshly precipitated iron (hydr)oxide, such as ferrihydrite, has an extremely high specific surface area and can accumulate arsenic in high concentrations (up to 76,000 mg/kg; Pichler et al. 1999). Finally, arsenic may also be present sorbed to clays and calcite and in phosphate minerals (up to 1,000 mg/kg in apatite).

As presented in this report, groundwater in the general vicinity of the mine is characterized by naturally elevated pH, alkalinity, TDS, and elevated arsenic concentrations due to evapotranspiration processes that occur in the basin-fill sediments of the region. The groundwater in the region exhibits elevated TDS and alkaline pH (>8), and also contains characteristically high concentrations of arsenic (Welch et al. 2000, Fremont Valley RWMG 2018). The water quality assessment for the Fremont Valley IRWM Plan found that 36 percent of the wells inventoried exhibited average arsenic concentrations above 10 µg/L. Similarly, a study by the USGS documented that, under conditions of elevated pH, up to 0.08 mg/L of arsenic was detected in groundwater at sample locations in the western Mojave Desert, approximately 50 miles to the southeast of Soledad Mountain (Izbicki et al. 2008).

As depicted in the conceptual arsenic model for the mine (**Figure 25**), leaching of the host rock or historical tailings by natural processes does not influence groundwater quality in the area. The conceptual model is based on the results of the comprehensive analyses of host rock, ore, and historical tailings in the mine area. The elements of the conceptual model (numbers [1] - [4]) are described here. Arsenic incorporated into pyrite within the ore deposit is stable [1], while arsenic in the historical tailings is immobilized through sorption to iron hydroxides and incorporation into pyrite [2]. The combination of low precipitation, insufficient sulfur for acid generation, and 180 to 260 feet of unsaturated zone alluvial soils with sorptive capacity for arsenic greatly inhibits the potential for development of acid rock or acid mine drainage that could result in degradation of the quality of any receiving water at the site [3]. Groundwater in the region contains naturally elevated arsenic concentrations, which are well documented and due to the flow of alkaline groundwater with high TDS through natural mineralized zones in the subsurface, mobilizing arsenic through competition for sorption sites, dissolution from labile mineral phases (alunite), or dissolution from iron sulfide and and/or iron hydroxides [4].

11 REFERENCES

Arcadis. 2009. Soledad Mountain Project – Water Quality Monitoring and Data Management Procedures Manual, Revision 3, prepared for Golden Queen Mining Co. Ltd., March.

Arcadis. 2010a. Groundwater Quality Summary Report, prepared for Golden Queen Mining Co. LLC., February.

Arcadis. 2010b. Gold Fields Historical Tailings Unsaturated Zone Model, Soledad Mountain Project, Kern County, California, prepared for Golden Queen Mining Co. Inc., March.

Arcadis. 2011. Soledad Mountain Project Hydrogeology Study (Update). March 10.

Arcadis. 2012. Installation of Low-Flow Sampling Equipment. September 10.

Arcadis. 2013a. Soledad Mountain Project Water Quality Monitoring and Data Management Procedures Manual, Revision 4, prepared for Golden Queen Mining Co. Ltd., April.

Arcadis. 2013b. Soledad Mountain Project MW-1 Well Destruction Report. July 31.

Arcadis. 2016. Water Quality Summary Report Update 2007 – 2015. April 20.

Arcadis. 2017. Annual WDR Monitoring Report – 2016. January 15.

Arcadis. 2018. Annual WDR Monitoring Report – 2017. January 15.

Arcadis. 2019. Annual WDR Monitoring Report – 2018. January 15.

Blodgett, James C. 1995. Precipitation Depth-Duration and Frequency Characteristics for Antelope valley, Mojave Desert, California. U.S. Geological Survey Water-Resources Investigations Report 95-4056.

Bloyd, R.M., Jr. 1967. Water Resources of the Antelope Valley – East Kern Water Agency Area, California. USGS Water Resources Division, Open File Report 67-21.

Boockoff, L.A. 2005. Arsenic in Groundwater from Water Bank Well 30S/25E-23H01 San Joaquin Valley, California; California State University, Bakersfield, California.

BSK & Associates. 1998. Summary of Hydrogeological Conditions in the Vicinity of the Soledad Mountain Project, BSK Job 03400169, May 28.

California Department of Water Resources (DWR). 2003. California’s Groundwater Bulletin 118, Update, October.

California DWR. 2004a. California’s Groundwater Bulletin 118, South Lahontan Hydrologic Region, Fremont Valley Groundwater Basin. February 2004. Available at: http://www.water.ca.gov/pubs/groundwater/bulletin_118/basindescriptions/6-46.pdf

California DWR. 2004b. California's Groundwater Bulletin 118, South Lahontan Hydrologic Region, Antelope Valley Groundwater Basin. February 2004. Available at: http://www.water.ca.gov/groundwater/bulletin118/basindescriptions/6-44.pdf

California DWR. 2015. California's Groundwater Update 2013: A Compilation of Enhanced Content for California Water Plan Update 2013, South Lahontan Hydrologic Region, April. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Docs/Update2013/GroundwaterUpdate/Californias-Groundwater-Update-2013--A-Compilation-of-Enhanced-Content-for-California-Water-Plan-Upd.pdf

California Geological Survey. 2001. GIS Files of the Official Alquist-Priolo Earthquake Fault Zones, Southern Region, CD 2001-05.

California Irrigation Management Information System (CIMIS). 2019. Data for Palmdale No. 197 Station since April 2005. Accessed July 9, 2019 from: www.cimis.water.ca.gov/Stations.aspx

California Regional Water Quality Control Board – Water Quality Control Plan for the Lahontan Region, October 1994. Available at: https://www.waterboards.ca.gov/lahontan/water_issues/programs/basin_plan/references.shtml updated

California Regional Water Quality Control Board, Lahontan Region (RWQCB). 2010. Adopted Waste Discharge Requirements and Additional Order for Technical Report for the Bureau of Land Management and the Golden Queen Mining Company, Inc., Soledad Mountain Project, Kern County, WDID 6B159708001. Board Order No. R6V-2010-0031. July 23, 2010.

California Regional Water Quality Control Board, Lahontan Region (RWQCB). 2011. Rescission of Existing Monitoring and Reporting Program (MRP) and Issuance of Amended MRP No. R6V-2010-0031-A01, for the Soledad Monitoring Project, Kern County, WDID No. 6B159708001. February 14, 2011

Dibblee, Thomas W., Jr. 1967. Areal Geology of the Western Mojave Desert California. U.S. Geological Survey Professional Paper 522.

Earth Systems Consultants, Southern California. 1997. Monitoring Well Installation and Groundwater Quality Assessment Report. SG-4754-L01.

Fremont Valley Regional Water Management Group (RWMG). 2018. Fremont Valley Bains Groundwater Management Plan. Prepared by Woodard and Curran for the Regional Water Management Group of the Fremont Basin Integrated Regional Water Management Region. December.

Fremont Valley Regional Water Management Group (RWMG). 2019. Fremont Basin Integrated Regional Water Management Plan. Prepared by Woodard and Curran for the Regional Water Management Group of the Fremont Basin Integrated Regional Water Management Region. February.

Gaines, Bruce. 1990. Personal Communication. Mojave Public Utilities District, Mojave, CA. April.

Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, New York.

Golden Queen Mining Company, LLC (GQM). 2007. Report of Waste Discharge for the Soledad Mountain Project. Golden Queen Mining Co. LLC, April 2007, GAI 043-2299A.

GQM. 2012. Revised Report of Waste Discharge for the Soledad Mountain Project. Golden Queen Mining Co. LLC, April 2012, GAI 043-2299A.

GQM. 2015. Soledad Mountain Project Technical Report and Updated Feasibility Study. Golden Queen Mining Co., Inc., February.

Golder Associates, Inc. 2006. "Soledad Mountain Project Heap Leach Facility – Revised Geotechnical Design Report," prepared for Golden Queen Mining Co. Ltd., December.

Golder Associates, Inc. 2007. Soledad Mountain Project Hydrogeology Study, submitted to Golden Queen Mining Co. Ltd., March 8.

Golder Associates, Inc. 2009. Cross-sections showing condemnation boreholes; prepared for Golden Queen Mining Co.; March.

Izbicki, J.A., J.W. Ball, T.D. Bullen, and S.J. Sutley. 2008. Chromium, chromium isotopes and selected trace elements, western Mojave Desert, USA. Applied Geochemistry 23: 1325-1352.

Johnson, Harry R. 1911. Water Resources of Antelope Valley, California. U.S. Geological Survey Water Supply Paper 278.Kennedy/Jenks Consultants. 1995. Antelope Valley Water Resources Study, prepared for the Antelope Valley Water Group, November 1995.

Londquist, C.J. 1995. Hydrogeology and land subsidence, Antelope Valley, California, in Prince, K.R., Galloway, D.L., and Leake, S.A., eds., U.S. Geological Survey Subsidence Interest Group Conference, Edwards Air Force Base, Antelope Valley, California, November 18-19, 1992, Abstracts and Summary: U.S. Geological Survey Open-File Report 94-0532.

Pichler, T., J. Veiser, and G.E.M. Hall. 1999. Natural input of arsenic into a coral-reef ecosystem by hydrothermal fluids and its removal by Fe(III) oxyhydroxide. Environmental Science and Technology 33(9): 1373-1378.

Pipes, William. 2005. GRA's Arsenic in Groundwater Symposium – Tales of Trial, Tribulation, and Treatment, HydroVisions Volume 14, No. 1, Groundwater Resources Association of California, Spring 2005.

Price, W.A. 1997. Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia. Reclamation Section, Energy and Minerals Division, April.

Slade, R.C. 1994. Perennial Yield Assessment of Chaffee Subunit in the Fremont valley Groundwater Basin, Richard C. Slade & Associates, Report.

Smedley, P.L. and D.G. Kinniburgh. 2002. A review of the source, behaviour and distribution of arsenic in natural waters. Applied Geochemistry 17: 517-568.

State Water Resources Control Board. 2016. Soledad Mountain Project Water System (Water System No. 1503664) Compliance Order for Violation of Arsenic MCL, No. 03-19-16R-004. July 7.

Thayer, W.N. 1946. Geologic features of Antelope Valley, California: Los Angeles County Flood Control District.

Thompson, D.G. 1929. The Mojave Desert Region, California, U.S. Geological survey Water-Supply Paper 578.

USEPA. 2006. On the Computation of a 95% Upper Confidence Limit of the Unknown Population Mean Based Upon Data Sets with Below Detection Limit Observations. Las Vegas, NV: United States Environmental Protection Agency. EPA/600/R-06/022. March.

USEPA. 2013. ProUCL Version 5.0.00 Technical Guide. Las Vegas, NV: United States Environmental Protection Agency. September 2013, EPA/600/R-07/041.

U.S. Geological Survey. 2003. Simulation of Ground-Water Flow and Land Subsidence, Antelope Valley Ground-Water Basin, California, Water Resources Investigations Report 03-4016, prepared in cooperation with the Antelope Valley Water Group

U.S. Geological Survey National Earthquake Information Center, California and Preliminary Determination of Epicenters (PDE) catalogs <http://neic.usgs.gov./> Accessed 2019.

U.S. Geological Survey National Water Information System. < https://waterdata.usgs.gov/nwis/gw/> Accessed 2019.

Water, Waste & Land, Inc., 1990, Hydrology Study Summary for the Soledad Mountain Project. Prepared for P.M. DeDycker and Associates. July.

Welch, A.H., Westjohn, D.B., Helsel, D.R., and Wanty, R.B. 2000. Arsenic in ground water of the United States - Occurrence and Geochemistry: U.S Geological Survey; Ground Water v.38 no.4, p.589-604.

Western Regional Climate Center. Undated. Mojave, California (045756). Period of Record Monthly Climate Summary. Period of Record: 01/01/1904 to 06/08/2016. <web page> Locate at: https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca5756. Accessed July 8, 2019.

WZI Inc. 1996. Groundwater Supply Evaluation, Soledad Mountain Project. December.

WZI Inc. 1997. Report of Waste Discharge for Soledad Mountain Project, Golden Queen Mining Company, June 1997.

WZI Inc. 2005. Water Supply Well PW-2, Golden Queen Mine, Kern County, California.

TABLES

Table 1
Summary of Existing Water Well Information in the Region
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

Map ID	Location[1]			Northing[2] UTM NAD27	Easting[2] UTM NAD27	Source[3]	Total Depth (feet)	Depth to Water[4] (feet)	Ground-water date	Ground Surface Elevation[5] (feet)	Ground-water Elevation (feet)	Yield (gpm)	Comments
	Twnshp	Range	Section/ Quarter										
1	10N	13W	32M	382182	3864086	B	-	202	Mar-65	2740	2538	-	
2	10N	13W	19M	380777	3867340	A & B	-	319	Oct-89	2905	2586	-	
3	10N	12W	20C(1)	392557	3867964	B	-	111	Mar-99	2655	2544	-	
4	10N	12W	20C(2)	*392557*	*3867964*	B	-	98	Mar-65	2645	2547	-	
5	10N	12W	12K	399258	3870599	A & B	224	86	Mar-99	2520	2434	-	
6	10N	12W	9A	394770	3871293	B	-	-	-	2595	-	-	
7	11N	13W	36K	389403	3873547	B & E	630	286	Mar-71	2888	2602	-	destroyed
8	11N	13W	36L	389075	3873675	B & E	585	303	Sep-55	2913	2610	-	destroyed
9	11N	13W	36C	389209	3874289	B	-	301	Apr-67	2910	2609	-	destroyed
10	11N	13W	36B	389464	3874378	B	580	295	Sep-55	2900	2605	-	'Gillis' well, destroyed
11	11N	13W	29M	382250	3875301	B	-	293	Nov-99	3350	3057	-	
12	11N	12W	29D	391917	3875982	B	-	177	Nov-52	2765	2588	-	
13	11N	12W	26J	*398192*	*3875244*	A & B	230	171	Feb-87	2594	2423	2500*	Former Jameson Ranch irrigation well
14	11N	13W	24A	390163	3877698	B	-	248	Feb-75	2840	2592	-	
15	11N	13W	19C	381243	3877748	B	-	270	Nov-99	3610	3340	-	
16	11N	12W	14D	396999	3879405	B	-	268	Feb-30	2705	2437	-	
17	11N	12W	18B	391197	3879410	B	-	242	Sep-55	2825	2583	-	
18	11N	12W	12M	398555	3880311	B	-	274	Feb-82	2695	2421	-	
19	10N	12W	4(1)	*394126*	*3872591*	A	340	135	-	2650	2515	-	terminated on 'hard rock'
20	10N	12W	4(2)	*394126*	*3872591*	A	275	175	-	2650	2475	3	
21	10N	12W	4(3)	*394126*	*3872591*	A	222	186	-	2650	2464	1	terminated on 'hard rock'
22	10N	12W	2B	397830	3872798	A & B	257	187	-	2575	2388	-	terminated on 'granite'
23	10N	12W	9	*394770*	*3871293*	A	238	163	-	2595	2432	6	alluvium total depth

Table 1
Summary of Existing Water Well Information in the Region
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

Map ID	Location[1]			Northing[2] UTM NAD27	Easting[2] UTM NAD27	Source[3]	Total Depth (feet)	Depth to Water[4] (feet)	Ground-water date	Ground Surface Elevation[5] (feet)	Ground-water Elevation (feet)	Yield (gpm)	Comments
	Twnshp	Range	Section/ Quarter										
24	10N	12W	10(1)	*395955*	*3870653*	A	200	87	-	2565	2478	30	alluvium total depth
25	10N	12W	10(2)	*395955*	*3870653*	A	204	93	-	2565	2472	35	alluvium total depth
26	10N	12W	10(3)	*395955*	*3870653*	A	202	93	-	2565	2472	35	
27	10N	12W	10(4)	*395955*	*3870653*	A	200	92	-	2565	2473	30	
28	10N	12W	10(5)	*395955*	*3870653*	A	200	85	-	2565	2480	25	
29	10N	12W	13H	400005	3869296	A & B	185	64	Mar-99	2505	2441	-	
30	10N	12W	15M	395207	3868919	B	-	84	Jul-98	2560	2476	-	
31	10N	12W	22J	396431	3867272	A & B	242	47	Mar-99	2530	2483	-	
32	11N	12W	31	*390839*	*3873597*	A	350	215	-	2810	2595	40	pump limitation
33	11N	12W	33(1)	*394834*	*3873666*	A	240	175	-	2625	2450	Fair	
34	11N	12W	33(2)	*394834*	*3873666*	A	252	190	-	2625	2435	-	terminated in 'bedrock'
35	11N	12W	22F	*396063*	*3877034*	A & B	350	243	Mar-99	2663	2420	-	
36	11N	12W	22(1)	*396063*	*3877034*	A	350	260	-	2660	2400	250	Mojave P.U.D. well
37	11N	12W	22(2)	*396063*	*3877034*	A	348	270	-	2660	2390	-	'rock' at total depth
38	11N	12W	22(3)	*396063*	*3877034*	A	395	223	-	2660	2437	1000	Mojave P.U.D. well
39	11N	12W	32E(1)	*391930*	*3874085*	A	300	-	-	2759	-	40	
40	11N	12W	32E(2)	*391930*	*3874085*	A	265	180	-	2759	2579	40	
41	11N	12W	32E(3)	*391930*	*3874085*	A	-	176	-	2759	2583	-	
42	11N	12W	32R	*393431*	*3873044*	A	245	188	-	2690	2502	-	
43	11N	13W	36	*389994*	*3873601*	A	630	280-380	-	2855	-	750	alluvium total depth
44	11N	13W	32	*382989*	*3873784*	A	300	180	-	-	-	-	top 50 feet alluvium
45 (Garcia)	10N	13W	12	*389743*	*3870639*	E	275	261.45	Jul-10	2810	-	-	

Table 1
Summary of Existing Water Well Information in the Region
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

Map ID	Location[1]			Northing[2] UTM NAD27	Easting[2] UTM NAD27	Source[3]	Total Depth (feet)	Depth to Water[4] (feet)	Ground-water date	Ground Surface Elevation[5] (feet)	Ground-water Elevation (feet)	Yield (gpm)	Comments
	Twnshp	Range	Section/ Quarter										
46	10N	12W	5B	*392843*	*3872773*	E	-	154	Apr-90	2715	2561	-	in Goldtown subdivision
47 (Robinson)	11N	12W	32	*391908*	*3873223*	F	-	-	-	2765	-	-	Domestic well
Gainey	11N	12W	31	NA	NA	NA	NA	NA	NA	NA	NA	NA	Domestic well
MW-1	10N	12W	6C	391007	3872879	D	330	**211.89**	Dec-08	**2834.6**	2622.74	-	Golden Queen well
MW-2	10N	12W	6D	390418	3872811	D	280	**247.15**	Dec-10	**2825.4**	2578.20	-	Golden Queen well
MW-3	10N	12W	6D	390239	3872856	D	290	**257.89**	Dec-10	**2835.9**	2577.97	-	Golden Queen well
MW-4	11N	12W	31	**2185182**	**6505222**	D	177	DRY	Dec-10	**2775.0**	Dry	-	Golden Queen well
MW-5	11N	12W	31	**2184960**	**6502681**	D	272	**226.72**	Dec-10	**2805.6**	2578.88	-	Golden Queen well
MW-6	11N	12W	32	**2185599**	**6506125**	D	212	**179.65**	Dec-10	**2762.8**	2583.15		Golden Queen well
Peltier well	11N	12W	31	*391117*	*3873250*	C	-	**216.5**	Mar-98	**2799.1**	2582.6	-	Private well
PW-1	11N	12W	32M	391925	*3873744*	D	300	**179.64**	Dec-10	**2760.3**	2580.64	750	Golden Queen well
PW-2	11N	12W	32	391930	*3874085*	D	288	**181.07**	Dec-10	**2761.8**	2580.77	200-300	Golden Queen well
PW-3	10N	13W	1	**2181765**	**6498109**	D	600	285.87	Jun-09	**2856.0**	2570.11	-	Golden Queen well
PW-4	11N	13W	36	2186723	6496618	D	740	333	May-19	**2901.0**	2568.0	400	Golden Queen well

Notes:

[1] Quarter locations are identified according to the California numbering system. Numbers in parentheses represent multiple wells with the same location.

[2] Coordinates in italics are approximate locations. Coordinates not in italics or bold are from either the California Department of Water Resources or were surveyed by GQM; bold coordinates are based on state plane coordinate system.

[3]
A = WZI Inc. (1996) Groundwater Supply Evaluation, Soledad Mountain Project.
B = California Department of Water Resources.
C = BSK & Associates (1998) Summary of Hydrogeological Conditions in the Vicinity of the Soledad Mountain Project, BSK Job 03400169.

D = Golden Queen Mining Company.
E = WZI Inc. (1997) Golden Queen Mining Company, Report of Waste Discharge for Soledad Mountain Project.
F = Personal communication with owner, Butch Robinson (2006).

[4] Depth to water is from ground surface, unless the value is in bold, representing measurements from top of casing.

[5] Ground surface elevation, except values in bold, which are top of casing elevations.

🟩 Cells highlighted in green indicate that groundwater measurements for additional dates are available in Attachment B.

*2,500 gpm is the average pumping rate of all Jameson Ranch wells (Richard C. Slade & Associates [1994] Perennial Yield Assessment of Chaffee Subunit in the Fremont Valley Groundwater Basin).

Definitions:

gpm = Gallons per minute.
GQM = Golden Queen Mining Co., Inc.
NA = Not applicable
NAD27 = North American Datum of 1927.
Sec/Qtr = Section/Quarter
Twnshp = Township.
UTM = Universal Transverse Mercator.

Table 2
Additional Information for Wells within One Mile of the Site
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

Map ID	Total Depth (feet)	Casing Diameter (inches)	Drilling Method	Screen Interval (feet)	Owner	Driller	Year Drilled	Use of Well	Seals	Well Logs Available	Additional Information
7	630	16	Rotary	-	destroyed	-	1954	Unused	-	-	900 gpm, Greenshale at total depth
8	585	14	Rotary	-	destroyed	-	1954	Unused	-	-	900 gpm (turbine)
32	350	65/8	Rotary	200-350	-	Bryant Pump and Drilling	1984	Domestic	0-50 feet	-	195 Coliform absent, Yes-1984
39	300	10	-	-	Dr. L. Schultz	-	1950s	Public supply	-	-	Yield=40 gpm, 1972: TDS=376.1 mg/L, Arsenic=0.12 mg/L
40	265	10	-	-	-	-	1922	Unused domestic	-	-	Yield=40 gpm, 1972: TDS=413.7 mg/L, Arsenic=0.06 mg/L
41	-	5	Cable	-	-	-	1955	Unused domestic	-	-	5 gpm rate
42	245	5	Rotary	-	Verdi Development		1955	Unused	-	-	Maintained by Darryl Westerfield
43	630	-	-	-	-	-	-	-	-	-	Alluvium total depth, 750 gpm yield
45 (Garcia)	275	-	-	-	GQM	-	1986	Domestic	-	-	TDS= 280 mg/L Arsenic 0.3 mg/L Well deepened in 1988
46	-	-	-	-	-	-	-	-	-	-	Reported by locals, contaminated with cyanide, no verification
47 (Robinson)	-	-	-	-	Butch Robinson	-	-	Domestic	-	-	-
MW-1	330	5	Mud rotary	210-330	GQM	Bryant Pump and Drilling	1996	Monitoring	0-50 feet, cement	Lithologic, Attachment A	-
MW-2	280	5	Mud rotary	233-273	GQM	Bryant Pump and Drilling	1996	Monitoring	0-70 feet, cement	Lithologic, Attachment A	-
MW-3	290	5	Mud rotary	250-290	GQM	Bryant Pump and Drilling	1996	Monitoring	0-55 feet, cement	Lithologic, Attachment A	-
MW-4	177	4	Sonic	147-177	GQM	Boart Longyear	2007	Monitoring	3 – 132	Attachment A	-
MW-5	272	4	Sonic	212-272	GQM	Boart Longyear	2007	Monitoring	3 – 203	Attachment A	-
MW-6	212	8	Sonic	168 - 207	GQM	Boart Longyear	2010	Monitoring	7 – 165	Attachment A	-
Gainey	NA	-	-	-	-	Gainey	-	Domestic	-	Attachment A	-
Peltier	-	-	-	-	-	-	-	Unused domestic	-	-	-
PW-1	300	12	Rotary	180-295	GQM	Bryant Pump and Drilling	1996	Supply well for mine ops	0-50 feet	Lithologic, Attachment A	-

Table 2
Additional Information for Wells within One Mile of the Site
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

Map ID	Total Depth (feet)	Casing Diameter (inches)	Drilling Method	Screen Interval (feet)	Owner	Driller	Year Drilled	Use of Well	Seals	Well Logs Available	Additional Information
PW-2	288	12	Mud rotary	170-285	GQM	RL Red Fairn Drilling	2005	Supply well for future mining	0-55 feet, cement	Lithologic, Attachment A	-
PW-3	600	12	Mud rotary	310 to 590	GQM	Red Fairn Drilling	2008	Supply well for future mining	0 - 238 feet	Well completion, Attachment A	-
PW-4	740	12		330 to 700	GQM	Boart Longyear	2015	Supply well for mine ops	0-280 ft cement; 280-290 ft Bentonite	Well completion, Attachment A	-

Notes:
Modified from WZI Inc., 1997, *Golden Queen Mining Company, Report of Waste Discharge for Soledad Mountain Project*
gpm = Gallons per minute.
GQM = Golden Queen Mining Company.
mg/L = Milligrams per liter.
NA = Not applicable.
TDS = Total dissolved solids

Table 3
Water Levels at Site Wells
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

Well ID	Date	TOC	Depth to Water	Groundwater Elevation
		ft AMSL	ft BTOC	ft AMSL
MW-2	2/23/2011	2825.35	247.19	2578.16
MW-2	5/11/2011	2825.35	247.30	2578.05
MW-2	8/23/2011	2825.35	247.35	2578.00
MW-2	10/18/2011	2825.35	247.31	2578.04
MW-2	2/28/2012	2825.35	247.66	2577.69
MW-2	5/21/2012	2825.35	247.20	2578.15
MW-2	8/15/2012	2825.35	247.46	2577.89
MW-2	11/12/2012	2825.35	248.17	2577.18
MW-2	2/26/2013	2825.35	248.15	2577.20
MW-2	5/29/2013	2825.35	248.24	2577.11
MW-2	8/22/2013	2825.35	249.03	2576.32
MW-2	10/22/2013	2825.35	248.47	2576.88
MW-2	2/10/2014	2825.35	248.52	2576.83
MW-2	5/21/2014	2825.35	248.61	2576.74
MW-2	8/4/2014	2825.35	248.70	2576.65
MW-2	10/20/2014	2825.35	248.94	2576.41
MW-2	2/17/2015	2825.35	249.17	2576.18
MW-2	5/12/2015	2825.35	249.15	2576.20
MW-2	8/11/2015	2825.35	245.96*	2579.39*
MW-2	11/19/2015	2825.35	245.92*	2579.43*
	January 2016	Water supply system was completed		
MW-2	2/2/2016	2825.35	249.73	2575.62
MW-2	4/7/2016	2825.35	249.42	2575.93
MW-2	9/15/2016	Water levels were not measured.		
MW-2	10/24/2016	2825.35	247.10	2578.25
MW-2	2/1/2017	2825.35	246.70	2578.65
MW-2	4/6/2017	2825.35	251.15	2574.20
MW-2	7/13/2017	2825.35	247.84	2577.51
MW-2	11/15/2017	2825.35	252.21	2573.14
MW-2	2/12/2018	2825.35	252.45	2572.90
MW-2	4/17/2018	2825.35	252.81	2572.54
MW-2	7/24/2018	2825.35	253.46	2571.89
MW-2	10/15/2018	2825.35	254.00	2571.35
MW-2	11/1/2018	2825.35	253.85	2571.50
MW-2	1/22/2019	2825.35	254.05	2571.30
MW-2	4/23/2019	2825.35	254.14	2571.21
MW-3	2/23/2011	2835.86	257.94	2577.92
MW-3	5/12/2011	2835.86	258.02	2577.84
MW-3	8/23/2011	2835.86	258.00	2577.86
MW-3	10/19/2011	2835.86	257.99	2577.87

Table 3
Water Levels at Site Wells
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

Well ID	Date	TOC	Depth to Water	Groundwater Elevation
		ft AMSL	ft BTOC	ft AMSL
MW-3	2/28/2012	2835.86	258.40	2577.46
MW-3	5/23/2012	2835.86	258.21	2577.65
MW-3	8/16/2012	2835.86	258.39	2577.47
MW-3	11/13/2012	2835.86	258.75	2577.11
MW-3	2/26/2013	2835.86	258.79	2577.07
MW-3	5/29/2013	2835.86	258.86	2577.00
MW-3	8/22/2013	2835.86	259.65	2576.21
MW-3	10/22/2013	2835.86	259.10	2576.76
MW-3	2/10/2014	2835.86	259.20	2576.66
MW-3	5/21/2014	2835.86	259.21	2576.65
MW-3	8/4/2014	2835.86	259.33	2576.53
MW-3	10/20/2014	2835.86	259.40	2576.46
MW-3	2/17/2015	2835.86	259.68	2576.18
MW-3	5/12/2015	2835.86	259.63	2576.23
MW-3	8/11/2015	2835.86	256.57*	2579.29*
MW-3	10/12/2015	2835.86	256.23*	2579.63*
	January 2016	Water supply system was completed		
MW-3	2/2/2016	2835.86	260.30	2575.56
MW-3	4/7/2016	2835.86	259.93	2575.93
MW-3	9/15/2016	Water levels were not measured.		
MW-3	10/24/2016	2835.86	257.10	2578.76
MW-3	2/1/2017	2835.86	256.70	2579.16
MW-3	4/6/2017	2835.86	257.43	2578.43
MW-3	7/13/2017	2835.86	257.96	2577.90
MW-3	11/15/2017	2835.86	262.13	2573.73
MW-3	2/12/2018	2835.86	262.65	2573.21
MW-3	4/17/2018	2835.86	263.10	2572.76
MW-3	7/24/2018	2835.86	263.48	2572.38
MW-3	10/15/2018	2835.86	264.31	2571.55
MW-3	11/1/2018	2835.86	264.84	2571.02
MW-3	1/21/2019	2835.86	264.89	2571.37
MW-3	4/23/2019	2835.86	264.83	2571.03
MW-4	2/15/2011	DRY		
MW-4	5/11/2011	DRY		
MW-4	8/23/2011	DRY		
MW-4	10/19/2011	DRY		
MW-4	2/29/2012	DRY		
MW-4	5/24/2012	DRY		
MW-4	8/15/2012	DRY		
MW-4	11/12/2012	DRY		

Table 3
Water Levels at Site Wells
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

Well ID	Date	TOC	Depth to Water	Groundwater Elevation
		ft AMSL	ft BTOC	ft AMSL
MW-4	2/27/2013	DRY		
MW-4	5/30/2013	DRY		
MW-4	8/22/2013	DRY		
MW-4	10/23/2013	DRY		
MW-4	2/11/2014	DRY		
MW-4	5/22/2014	DRY		
MW-4	8/5/2014	DRY		
MW-4	10/20/2014	DRY		
MW-4	2/18/2015	DRY		
MW-4	5/13/2015	DRY		
MW-4	8/11/2015	DRY		
MW-4	10/13/2015	DRY		
MW-4	2/2/2016	DRY		
MW-4	4/7/2016	DRY		
MW-4	9/15/2016	DRY		
MW-4	10/24/2016	DRY		
MW-4	2/1/2017	DRY		
MW-4	4/6/2017	DRY		
MW-4	7/13/2017	DRY		
MW-4	11/15/2017	DRY		
MW-4	2/12/2018	DRY		
MW-4	4/17/2018	DRY		
MW-4	7/24/2018	DRY		
MW-4	10/15/2018	DRY		
MW-4	11/1/2018	DRY		
MW-4	1/21/2019	DRY		
MW-4	4/23/2019	DRY		
MW-5	2/23/2011	2805.60	226.79	2578.81
MW-5	5/11/2011	2805.60	226.94	2578.66
MW-5	8/24/2011	2805.60	227.01	2578.59
MW-5	10/19/2011	2805.60	227.03	2578.57
MW-5	2/29/2012	2805.60	227.04	2578.56
MW-5	5/23/2012	2805.60	227.26	2578.34
MW-5	8/15/2012	2805.60	228.06	2577.54
MW-5	11/12/2012	2805.60	227.72	2577.88
MW-5	2/26/2013	2805.60	228.50	2577.10
MW-5	5/29/2013	2805.60	227.74	2577.86
MW-5	8/22/2013	2805.60	228.52	2577.08
MW-5	10/22/2013	2805.60	227.55	2578.05
MW-5	2/11/2014	2805.60	227.64	2577.96

Table 3
Water Levels at Site Wells
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

Well ID	Date	TOC	Depth to Water	Groundwater Elevation
		ft AMSL	ft BTOC	ft AMSL
MW-5	5/21/2014	2805.60	227.71	2577.89
MW-5	8/5/2014	2805.60	227.93	2577.67
MW-5	10/21/2014	2805.60	227.92	2577.68
MW-5	2/17/2015	2805.60	228.12	2577.48
MW-5	5/12/2015	2805.60	227.76	2577.84
MW-5	8/11/2015	2805.60	225.50*	2580.10*
MW-5	10/12/2015	2805.60	225.63*	2579.97*
	January 2016	Water supply system was completed		
MW-5	2/2/2016	2805.60	228.92	2576.68
MW-5	4/7/2016	2805.60	228.91	2576.69
MW-5	9/15/2016	Water levels were not measured.		
MW-5	10/24/2016	2805.60	226.38	2579.22
MW-5	2/1/2017	2805.60	226.34	2579.26
MW-5	4/6/2017	2805.60	230.67	2574.93
MW-5	7/13/2017	2805.60	227.41	2578.19
MW-5	11/15/2017	2805.60	231.54	2574.06
MW-5	11/15/2017	2805.60	231.54	2574.06
MW-5	2/12/2018	2805.60	232.04	2573.56
MW-5	4/18/2018	2805.60	232.42	2573.18
MW-5	7/24/2018	2805.60	233.0	2572.60
MW-5	10/15/2018	2805.60	233.55	2572.05
MW-5	11/1/2018	2805.60	233.29	2572.31
MW-5	1/21/2019	2805.60	233.45	2572.15
MW-5	4/23/2019	2805.60	233.87	2571.73
MW-6	2/15/2011	2762.80	179.65	2583.15
MW-6	5/12/2011	2762.80	179.68	2583.12
MW-6	8/24/2011	2762.80	179.77	2583.03
MW-6	10/19/2011	2762.80	179.77	2583.03
MW-6	2/29/2012	2762.80	179.90	2582.90
MW-6	5/24/2012	2762.80	179.93	2582.87
MW-6	8/15/2012	2762.80	179.99	2582.81
MW-6	11/13/2012	2762.80	180.12	2582.68
MW-6	2/27/2013	2762.80	180.30	2582.50
MW-6	5/30/2013	2762.80	180.70	2582.10
MW-6	8/20/2013	2762.80	181.10	2581.70
MW-6	10/23/2013	2762.80	181.10	2581.70
MW-6	2/11/2014	2762.80	181.54	2581.26
MW-6	5/22/2014	2762.80	182.17	2580.63
MW-6	8/4/2014	2762.80	182.29	2580.51
MW-6	10/21/2014	2762.80	182.72	2580.08

Table 3
Water Levels at Site Wells
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

Well ID	Date	TOC	Depth to Water	Groundwater Elevation
		ft AMSL	ft BTOC	ft AMSL
MW-6	2/18/2015	2762.80	183.15	2579.65
MW-6	5/13/2015	2762.80	184.32	2578.48
MW-6	8/12/2015	2762.80	183.04*	2579.76*
MW-6	10/12/2015	2762.80	183.50*	2579.30*
	January 2016	Water supply system was completed		
MW-6	2/2/2016	2762.80	187.07	2575.73
MW-6	4/7/2016	2762.80	187.83	2574.97
MW-6	9/15/2016	Water levels were not measured.		
MW-6	10/24/2016	2762.80	188.00	2574.80
MW-6	2/1/2017	2762.80	189.46	2573.34
MW-6	4/6/2017	2762.80	190.39	2572.41
MW-6	7/13/2017	2762.80	191.52	2571.28
MW-6	11/15/2017	2762.80	196.00	2566.80
MW-6	2/13/2018	2762.80	197.15	2565.65
MW-6	4/17/2018	2762.80	197.54	2565.26
MW-6	7/24/2018	2762.80	198.15	2564.65
MW-6	10/15/2018	2762.80	198.87	2563.93
MW-6	11/1/2018	2762.80	199.67	2563.13
MW-6	1/22/2019	2762.80	199.10	2563.70
MW-6	4/23/2019	2762.80	199.36	2563.44

Notes:

ft BTOC = feet below top of casing

ft AMSL = feet above mean sea level

TOC = Top of Casing

* = suspect depth to water measurement and groundwater elevation due to potentially erroneous water level tape.

Table 4
Lysimeter Monitoring Results
Soledad Mountain Mine, Golden Queen Mining, LLC
Kern County, California

Month	Monitoring Date	VM-1		VM-2/VM-2R*		VM-3		VM-4		VM-9		VM-10		VM-11		Notes
		WAD CN	Total CN	WAD CN	Total CN	WAD CN	Total CN	WAD CN	Total CN	WAD CN	Total CN	WAD CN	Total CN	WAD CN	Total CN	
February 2016	2/29/2016	WATER		DRY		Lysimeters were installed as part of the Phase 1 Stage 2 Heap Leach Facility. Monthly monitoring began in September 2017.				DRY		DRY		--		Unable to sample VM-11, as the connection was blocked.
March 2016	3/30/2016	WATER		DRY						DRY		DRY		DRY		
April 2016	4/29/2016	DRY		DRY						DRY		<0.010	<0.0050	DRY		The lab received the 4/29/2016 VM-10 sample above the standard acceptable temperature range. The lysimeter was resampled on 5/3/2016.
	5/3/2016	--		--						--		<0.010	<0.0050	--		
	5/5/2016	--		--						--		DRY		--		On May 3rd, a water-cyanide solution between the primary liner and secondary liner in the solution collection pump box at the collection point of the Heap Leach Facility was observed. VM-10, the closest lysimeter to the pump box (located within 15 feet from the pump box) was sampled on 5/5/2016 and was dry. This indicated that the water detected in VM-10 on May 3rd may have been residual soil moisture.
May 2016	5/27/2016	<0.010	<0.0050	DRY						DRY		<0.010	**0.012**	DRY		
	6/6/2016	WATER		--						--		<0.010	**0.0065**	--		The lab received the 5/27/2016 VM-1 and VM-10 samples above the standard acceptable temperature range. The lysimeters were resampled on 6/6/2016.
June 2016	6/21/2016	WATER		DRY						DRY		WATER		DRY		
July 2016	7/28/2016	WATER		DRY						DRY		WATER		DRY		
August 2016	8/31/2016	WATER		DRY						DRY		DRY		DRY		
September 2016	9/29/2016	WATER		DRY						DRY		DRY		DRY		
October 2016	10/28/2016	DRY		DRY						DRY		DRY		DRY		
November 2016	11/30/2016	<0.010	**0.0070**	DRY						DRY		<0.010	**0.0051**	DRY		
December 2016	12/23/2016	DRY		DRY						DRY		<0.010	**0.0098**	DRY		
January 2017	1/30/2017	DRY		DRY						**0.014**	**0.094**	DRY		DRY		To confirm the analytical results from VM-9, the lysimeter was monitored again on 2/7/17 and the lysimeter was dry. The lysimeter was monitored again on 2/14/2017, but did not meet the minimum 50 mL volume of water required for laboratory analysis.
	2/7/2017	--		--						DRY		DRY		--		
	2/14/2017	--		--						WATER		DRY		--		
February 2017	2/28/2017	DRY		DRY						DRY		DRY		DRY		
March 2017	3/29/2017	DRY		DRY						DRY		DRY		DRY		
April 2017	4/25/2017	DRY		DRY						DRY		DRY		DRY		
May 2017	5/25/2017	DRY		--						DRY		DRY		DRY		Lysimeter VM-2 was malfunctioning and decommissioned. The lysimeters required maintenance. Maintenance consisted of rewetting the meniscus within the lysimeters and removing debris which was clogging the tubing
June 2017	6/28/2017	DRY		--						DRY		DRY		DRY		Lysimeter VM-2 was malfunctioning and decommissioned.
July 2017	7/24/2017	DRY		DRY						WATER		DRY		DRY		
August 2017	8/18/2017	WATER		DRY						DRY		DRY		DRY		
September 2017	9/22/2017	DRY		DRY		DRY		DRY		DRY		DRY		DRY		
October 2017	10/30/2017	WATER		DRY		DRY		DRY		DRY		DRY		WATER		
November 2017	11/29/2017	WATER		DRY		DRY		DRY		DRY		DRY		DRY		
December 2017	12/29/2017	DRY		DRY		DRY		DRY		WATER		DRY		DRY		
January 2018	1/31/2018	DRY		DRY		**0.010**	**0.012**	DRY		DRY		DRY		DRY		
February 2018	2/28/2018	DRY		DRY		DRY		DRY		DRY		DRY		DRY		
March 2018	3/29/2018	DRY		DRY		DRY		DRY		DRY		DRY		DRY		
April 2018	4/26/2018	DRY		DRY		DRY		DRY		DRY		DRY		DRY		
May 2018	5/31/2018	DRY		DRY		DRY		DRY		DRY		DRY		DRY		
June 2018	6/29/2018	DRY		DRY		DRY		DRY		DRY		DRY		DRY		
July 2018	7/30/2018	DRY		DRY		DRY		DRY		DRY		DRY		DRY		
August 2018	8/17/2018	DRY		DRY		DRY		DRY		DRY		DRY		DRY		
September 2018	9/18/2018	DRY		DRY		DRY		DRY		DRY		DRY		DRY		
October 2018	10/26/2018	DRY		DRY		DRY		WATER		DRY		DRY		DRY		
November 2018	11/30/2018	DRY		DRY		DRY		DRY		DRY		DRY		DRY		
December 2018	12/27/2018	DRY		DRY		DRY		DRY		DRY		DRY		DRY		

Notes:

Bold = Analyte detected at concentration above reporting limit.

-- = not available

* = Lysimeter VM-2R replaced lysimeter VM-2. Monitoring of VM-2R began in July 2017.

CN = cyanide

DRY = Lysimeter was dry; therefore, no sample was collected.

WAD = Weak Acid Dissociable

WATER = Lysimeter contained water but did not meet the minimum 50 milliliter volume of water required for laboratory analysis of WAD and total cyanide; therefore, samples were not submitted for analysis.

Table 5
Required Groundwater Monitoring Parameters
Soledad Mountain Mine, Golden Queen Mining, LLC
Kern County, California

Parameter	Sampling Frequency	Units	Analytical Method
pH	quarterly	s.u.	SM20 4500 H+B
Total Dissolved Solids	quarterly	mg/L	SM20 2540C
WAD Cyanide	quarterly	mg/L	C,E SM20 4500-CN I
Total Cyanide	quarterly	mg/L	SM20 4500-CN
Dissolved Arsenic	quarterly	mg/L	EPA 200.8
Volatile Organic Compounds	once every three years*	µg/L	EPA 8260 or equivalent
Semi-Volatile Organic Compounds	once every three years*	µg/L	EPA 8270 or equivalent
California Administrative Manual 17 Metals	once every three years*	µg/L	EPA 200.8

Notes:

* = sample collection and lab analyses for these parameters were performed during the 3Q 2011, 1Q 2015, and 1Q 2018 monitoring events.

EPA (200.8) = EPA Method 200.8, Trace Elements by ICP-MS, Revision 5.4, 1994

s.u. = standard pH units

SM20 = Standard Methods for the Examination of Water and Waste, 20th Edition (1998)

mg/L = milligrams per liter

WAD = weak acid dissociable

µg/L = micrograms per liter

Table 6
Summary Statistics of Chemical Data for Site Monitoring Wells (4th Quarter 2007 through 4th Quarter 2018)
Soledad Mountain Mine, Golden Queen Mining, LLC
Kern County, California

Analyte	Units	Range of Detection Limits	Minimum Detected Value	Maximum Detected Value*	Maximum Sample Location	Average	EPA MCL[e]	Max Detect Exceeds MCL	CA Standard[e]	Max Detect Exceeds CA Standard
Field Parameters										
pH	std. units	NA	6.31	11.34	MW-3	7.99	6.5-8.5[a]	Yes	--	NA
Electrical conductivity	micromohs	NA	199	2700	MW-1	527	--	NA	--	NA
Temperature	deg.C	NA	9.0	32.8	MW-5	23	--	NA	--	NA
Eh	mv	NA	-29	390	MW-5	119	--	NA	--	NA
Dissolved oxygen	mg/L	NA	0	7.2	MW-3	3	--	NA	--	NA
Turbidity	ntu	1100 (upper limit)	0	1100	MW-2, -3, and -5	110	--	NA	--	NA
Major Cations										
Calcium	mg/L	NA	22	290	MW-1	53	--	NA	--	NA
Magnesium	mg/L	NA	0.9	44	MW-1	9.5	--	NA	--	NA
Sodium	mg/L	NA	24	80	MW-5	45	--	NA	--	NA
Potassium	mg/L	2	2.0	56	MW-1	4.9	--	NA	--	NA
Major Anions										
Total alkalinity	mg/L	NA	17	150	MW-6	103	--	NA	--	NA
Carbonate alkalinity	mg/L	1-3	2	48	MW-1	8	--	NA	--	NA
Bicarbonate alkalinity	mg/L	3	14	150	MW-6	105	--	NA	--	NA
Hydroxyl alkalinity	mg/L	1-3	6	12	MW-3	9	--	NA	--	NA
Sulfate	mg/L	NA	49	930	MW-1	148	250[a]	Yes	--	NA
Chloride	mg/L	NA	5	71	MW-6	9	250[a]	No	--	NA
Fluoride	mg/L	NA	0.1	1.1	MW-2	0.5	4.0	No	2	No
Minor Anions										
Nitrate as nitrogen	mg/L (as N)	0.2 - 1.0	0.2	2.6	MW-6	0.6	10	No	10.17	No
Nitrite as nitrogen	mg/L (as N)	0.05 - 0.3	0.05	0.08	MW-6	0.067	1	No	--	NA
Weak Acid Dissociable Cyanide	mg/L	0.01 - 0.02	ND	ND	ND	ND	--	NA	--	NA
Total cyanide	mg/L	0.005	0.007	0.05	MW-5	0.03	0.2[d]	No	0.15	No
General and Calculated Parameters										
pH (lab)	std. units	NA	7.7	10.2	MW-3	8.2	6.5-8.5[a]	Yes	--	NA
TDS	mg/L	NA	210	1400	MW-1	371	500[a]	Yes	--	NA
Dissolved Metals										
Arsenic	mg/L	NA	0.005	0.150	MW-2	0.047	0.010	Yes	0.010	Yes
Barium	mg/L	NA	0.008	0.060	MW-5	0.018	2.0	No	1.000	No
Cadmium	mg/L	0.001	ND	ND	ND	ND	0.005	No	0.005	No
Chromium	mg/L	0.01	0.011	0.030	MW-3	0.018	0.1	No	0.05	No
Copper	mg/L	0.005	0.007	0.008	MW-5	0.008	1.3	No	1.3[c]	No
Iron	mg/L	0.03-0.05	0.04	11	MW-5	1.08	0.3[a]	Yes	0.3[b]	Yes
Lead	mg/L	0.005	0.006	0.006	MW-5	0.006	0.015	No	0.015[c]	No
Manganese	mg/L	0.01	0.01	0.90	MW-5	0.11	0.05[a]	Yes	0.05[b]	Yes
Mercury	mg/L	0.00006-0.0004	ND	ND	ND	ND	0.002	No	0.002	No
Nickel	mg/L	0.01	0.020	0.020	MW-1	0.020	--	NA	0.1	No
Selenium	mg/L	0.002	0.002	0.006	MW-1, -2, -3 -5, and -6	0.003	0.050	No	0.050	No
Silver	mg/L	0.01	ND	ND	ND	ND	0.1[a]	No	0.1[b]	No
Zinc	mg/L	0.05	0.06	0.26	MW-5	0.11	5[a]	No	5[b]	No

Notes:

[a] USEPA Secondary Drinking Water Standard

[b] California Department of Public Health Secondary Drinking Water Standard

[c] California Department of Public Health Regulatory Action Level

[d] US EPA MCL based on free cyanide

[e] Regulatory standards are based on total metal concentrations

-- No Regulatory standard set for the analyte

mg/L = milligrams per liter

mV = millivolts

ND Not detected

NA Not applicable

ntu = nephelometric turbidity units

TDS = total dissolved solids

Note: Non-detect values were excluded from calculations of average concentrations.

Table 7
Concentration Limits above Background (4th Quarter 2007 through 4th Quarter 2018)
Soledad Mountain Mine, Golden Queen Mining, LLC
Kern County, California

Analyte	2011-2015							
	n	Detects	NDs	%NDs	Max ND	Max Detect	UTL	UTL Basis
MW-2								
pH	20	20	0	0%	NA	8.4	8.4	Maximum detect (non-parametric)
TDS	20	20	0	0%	NA	250	250	Maximum detect (non-parametric)
Total Cyanide	20	1	19	95%	0.005	0.007	0.007	Single detection (detects < 5)
WAD Cyanide	20	0	20	100%	0.01	NA	0.01	Max detection limit (100% non-detects)
Dissolved Arsenic	20	20	0	0%	NA	0.12	0.12	Maximum detect (non-parametric)
MW-3								
pH	20	20	0	0%	NA	8.4	8.4	Maximum detect (non-parametric)
TDS	20	20	0	0%	NA	290	290	Maximum detect (non-parametric)
Total Cyanide	20	0	20	100%	0.005	NA	0.005	Max detection limit (100% non-detects)
WAD Cyanide	20	0	20	100%	0.01	NA	0.01	Max detection limit (100% non-detects)
Dissolved Arsenic	20	20	0	0%	NA	0.063	0.069	95/95 Normal UTL
MW-5								
pH	20	20	0	0%	NA	8.2	8.3	95/95 Normal UTL
TDS	20	20	0	0%	NA	560	572	95/95 Normal UTL
Total Cyanide	20	0	20	100%	0.005	NA	0.005	Max detection limit (100% non-detects)
WAD Cyanide	20	0	20	100%	0.01	NA	0.01	Max detection limit (100% non-detects)
Dissolved Arsenic	20	20	0	0%	NA	0.014	0.015	95/95 Normal UTL
MW-6								
pH	20	20	0	0%	NA	8.1	8.1	Maximum detect (non-parametric)
TDS	20	20	0	0%	NA	400	419.5	95/95 Normal UTL
Total Cyanide	20	0	20	100%	0.005	NA	0.005	Max detection limit (100% non-detects)
WAD Cyanide	20	0	20	100%	0.01	NA	0.01	Max detection limit (100% non-detects)
Dissolved Arsenic	20	20	0	0%	NA	0.036	0.040	95/95 Normal UTL

Notes:

Concentration limits are based on 95% Upper Tolerance Limits (UTLs) with 95% coverage

Unless otherwise noted, data fit a normal distribution

* field pH used

[a] non-parametric dataset

[b] lognormal dataset

[c] >50% non-detects; UTL set at maximum concentration detected

U = parameter not detected; the most recent reporting limit is listed

TDS = Total Dissolved Solids

WAD = Weak Acid Dissociable

mg/L = milligrams per liter

Table 8
Annual Monitoring Report Statistical Analysis
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

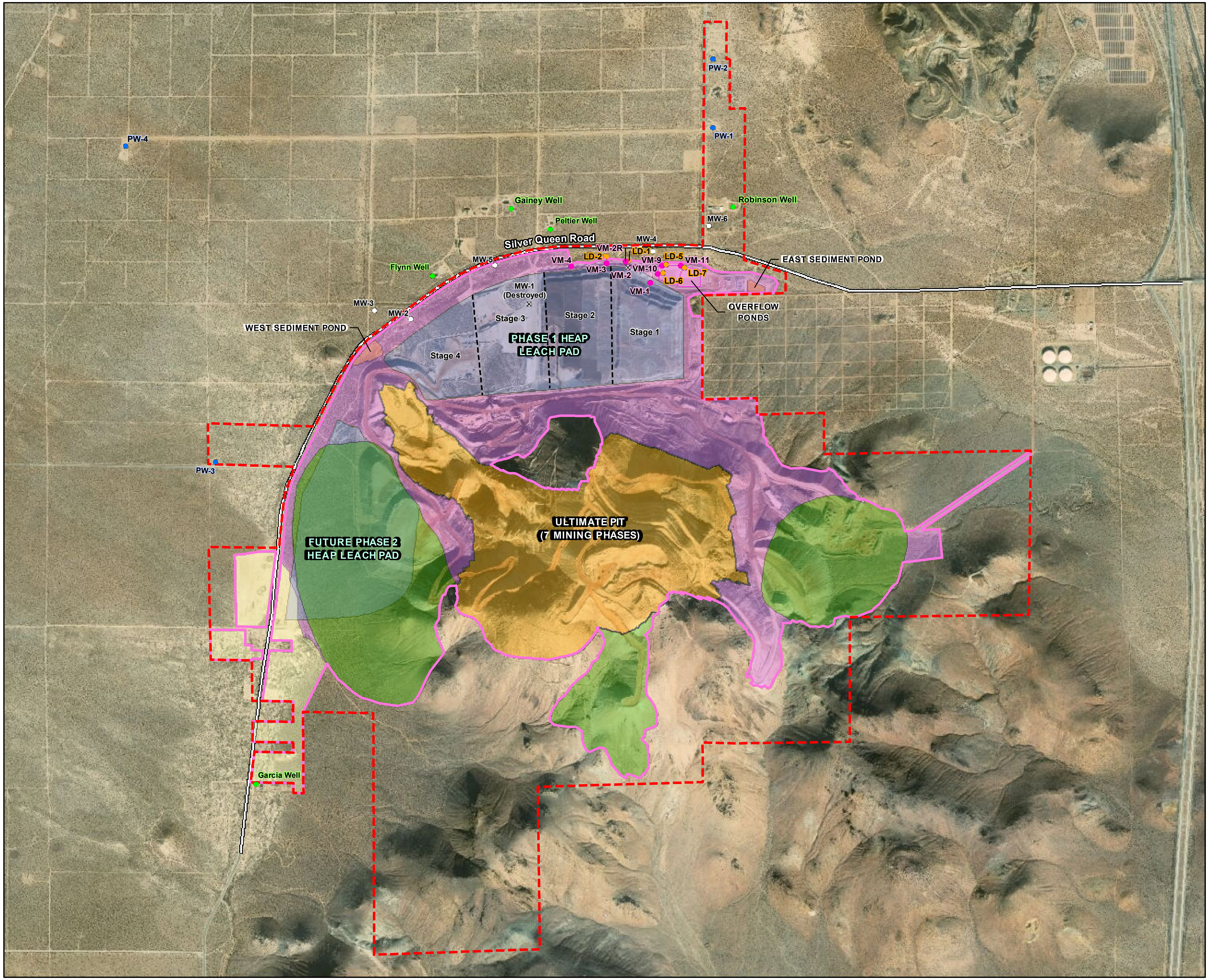
Well ID	Analytical Group	Analyte	Operational Data Set						Pre-Mining Data Set						Difference between Pre-Mining & Operational Concentrations[2]		Central Tendency Test[3,4]		
			n	Detects	Mean	Median	FOD (%)	Distribution[1]	n	Detects	Mean	Median	FOD (%)	Distribution[1]	Mean	Median	Test	P-Value	Pre-Mining Statistically Different from Operational?
MW-2	Miscellaneous	pH, Laboratory	12	12	8.2	8.2	100%	NP	20	20	8.3	8.3	100%	NP	-0.11	-0.10	**WMW**	**0.001**	**YES***
		Total Dissolved Solids	12	12	241	240	100%	NP	20	20	237	240	100%	Ln	4.3	0	**WMW**	**0.167**	**no**
	Inorganics	Total Cyanide	12	0	NA	NA	0%	NA	20	1	0.0068	0.0068	5%	NA	NA	NA	NA (insufficent detections for hypothesis testing)		
		WAD Cyanide	12	0	NA	NA	0%	NA	20	0	NA	NA	0%	NA	NA	NA	NA (insufficent detections for hypothesis testing)		
		Dissolved Arsenic	12	12	0.10	0.1	100%	N/G/Ln	20	20	0.10	0.11	100%	NP	0.0020	0	**WMW**	**0.640**	**no**
MW-3	Miscellaneous	pH, Laboratory	12	12	8.1	8.1	100%	NP	20	20	8.3	8.3	100%	NP	-0.16	-0.15	**WMW**	**<0.001**	**YES***
		Total Dissolved Solids	12	12	274	270	100%	N/Ln	20	20	275	275	100%	NP	-0.8	-5	**WMW**	**0.712**	**no**
	Inorganics	Total Cyanide	12	0	NA	NA	0%	NA	20	0	NA	NA	0%	NA	NA	NA	NA (insufficent detections for hypothesis testing)		
		WAD Cyanide	12	0	NA	NA	0%	NA	20	0	NA	NA	0%	NA	NA	NA	NA (insufficent detections for hypothesis testing)		
		Dissolved Arsenic	12	12	0.028	0.025	100%	G/Ln	20	20	0.054	0.056	100%	N/G	-0.027	-0.031	**WMW**	**<0.001**	**YES***
MW-5	Miscellaneous	pH, Laboratory	12	12	7.9	7.9	100%	N/G/Ln	20	20	8.0	8.0	100%	N/Ln	-0.083	-0.1	**t-test**	**0.056**	**no**
		Total Dissolved Solids	12	12	488	505	100%	G	20	20	523	520	100%	N/Ln	-34.7	-15	**WMW**	**0.115**	**no**
	Inorganics	Total Cyanide	12	0	NA	NA	0%	NA	20	0	NA	NA	0%	NA	NA	NA	NA (insufficent detections for hypothesis testing)		
		WAD Cyanide	12	0	NA	NA	0%	NA	20	0	NA	NA	0%	NA	NA	NA	NA (insufficent detections for hypothesis testing)		
		Dissolved Arsenic	12	12	0.017	0.0165	100%	N/G/Ln	20	20	0.012	0.012	100%	N/G/Ln	0.0046	0.0045	**t-test**	**<0.001**	**YES**
MW-6	Miscellaneous	pH, Laboratory	12	12	8.0	8.0	100%	N/G/Ln	20	20	8.0	8.0	100%	NP	-0.0050	0.000	**WMW**	**0.654**	**no**
		Total Dissolved Solids	12	12	329	330	100%	N/G/Ln	20	20	343	335	100%	N/G/Ln	-14.2	-5.0	**t-test**	**0.065**	**no**
	Inorganics	Total Cyanide	12	0	NA	NA	0%	NA	20	0	NA	NA	0%	NA	NA	NA	NA (insufficent detections for hypothesis testing)		
		WAD Cyanide	12	0	NA	NA	0%	NA	20	0	NA	NA	0%	NA	NA	NA	NA (insufficent detections for hypothesis testing)		
		Dissolved Arsenic	12	12	0.018	0.017	100%	G/Ln	20	20	0.021	0.020	100%	N/G/Ln	-0.00340	-0.0030	**WMW**	**0.179**	**no**

Abbreviations:
FOD = frequency of detection
Ho = null hypothesis
n = sample size
NA = not available or not applicable
ND = nondetect
WAD = Weak Acid Dissociable
WMW = Wilcoxon-Mann-Whitney

Notes:

1. Distribution assessed by goodness-of-fit tests based on regression on order statistics (ROS) using ProUCL at a 95% confidence level (a = 0.05).
   Distributions:
   Normal (N): dataset follows a normal distribution according to the Shapiro-Wilk test (n ≤ 50) or Lilliefors test (n > 50).
   Gamma (G): dataset follows a gamma distribution, according to the Kolmogorov-Smirnov test.
   Lognormal (Ln): dataset follows a lognormal distribution according to the Shapiro-Wilk test (n ≤ 50) or Lilliefors test (n > 50).
   Nonparametric (NP): dataset does not follow any of the three distributions listed above.
2. Site mean or median concentration minus background mean or median concentration.
3. Appropriate hypothesis test selected based on degree of censoring, and range of nondetect, and distribution of the data set:
   t-test: FOD = 100%, N; WMW test: 40% < FOD ≤ 100%, dataset includes nondetects with a single reporting limit, N/Ln/G/NP
4. Two-sided Alternative Null hypothesis H_o: Site Mean/Median = Background Mean/Median. Reject H_o if p-value is less than 0.05. Conclusions are based on α = 0.05.
   Pink shading indicates there is a statistically significant difference between pre-mining and operational concentrations with the operational concentrations slightly greater than the pre-mining concentrations.
   Green shading and asterisk (*) indicates that there is a statistical difference between pre-mining and operational concentrations with the operational concentrations generally less than pre-mining concentrations.

FIGURES



Legend

☒ Destroyed
● Vadose Zone Monitoring Lysimeter
○ Monitoring Well
● Private Well
● Production Well
● Leak Detection Collection System Sump
— — Approved Project Boundary
☐ Total Disturbed Area
🟧 Partially Backfilled Pit
🟩 Reclaimed Surge Piles
🟦 Reclaimed Heap Leach Pad
🟨 Reclaimed Clay Borrow Area
🟪 Reclaimed Working Area and Roads

N
W E
S

0 900 1,800 2,700
Feet

Aerial Source: Google Earth Imagery, dated in 04/2015.
Projection: NAD1983, StatePlane California V,
FIPS 0405, Feet

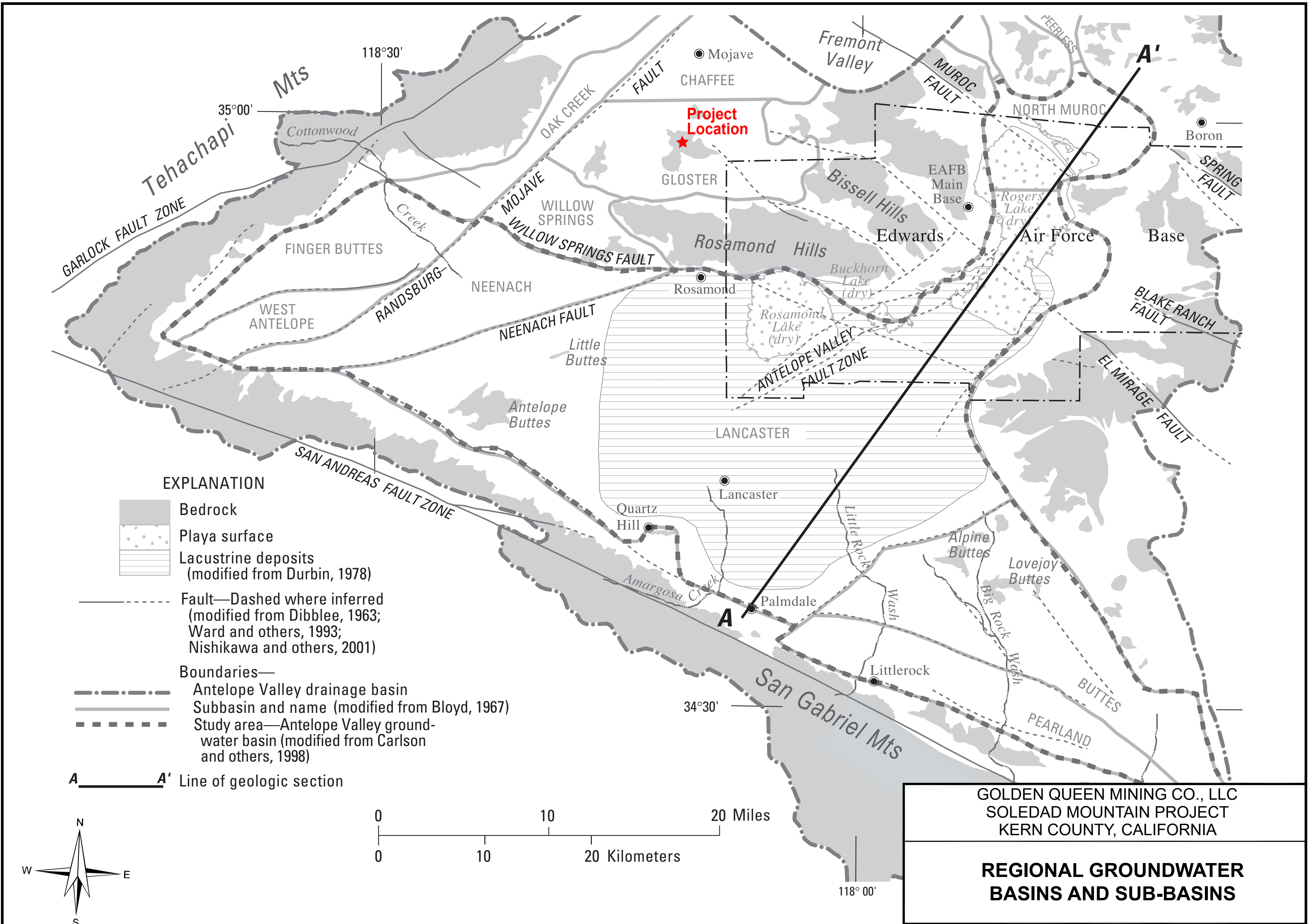
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

MONITORING LOCATIONS

ARCADIS

FIGURE
1

CITY: Boulder, CO DIV/GROUP: AIT PM: T. COX TM: TR: J.CHEN
Project (Project #): AO000100.0012 Path: K:\AO000100_Soledad\GIS\ArcMap_MXD\QuarterlyMonitoringReport\Fig_1_Monitoring_Well_Locs.mxd Last Saved: 11/15/2019 Saved By: akens



Source: USGS (2003)

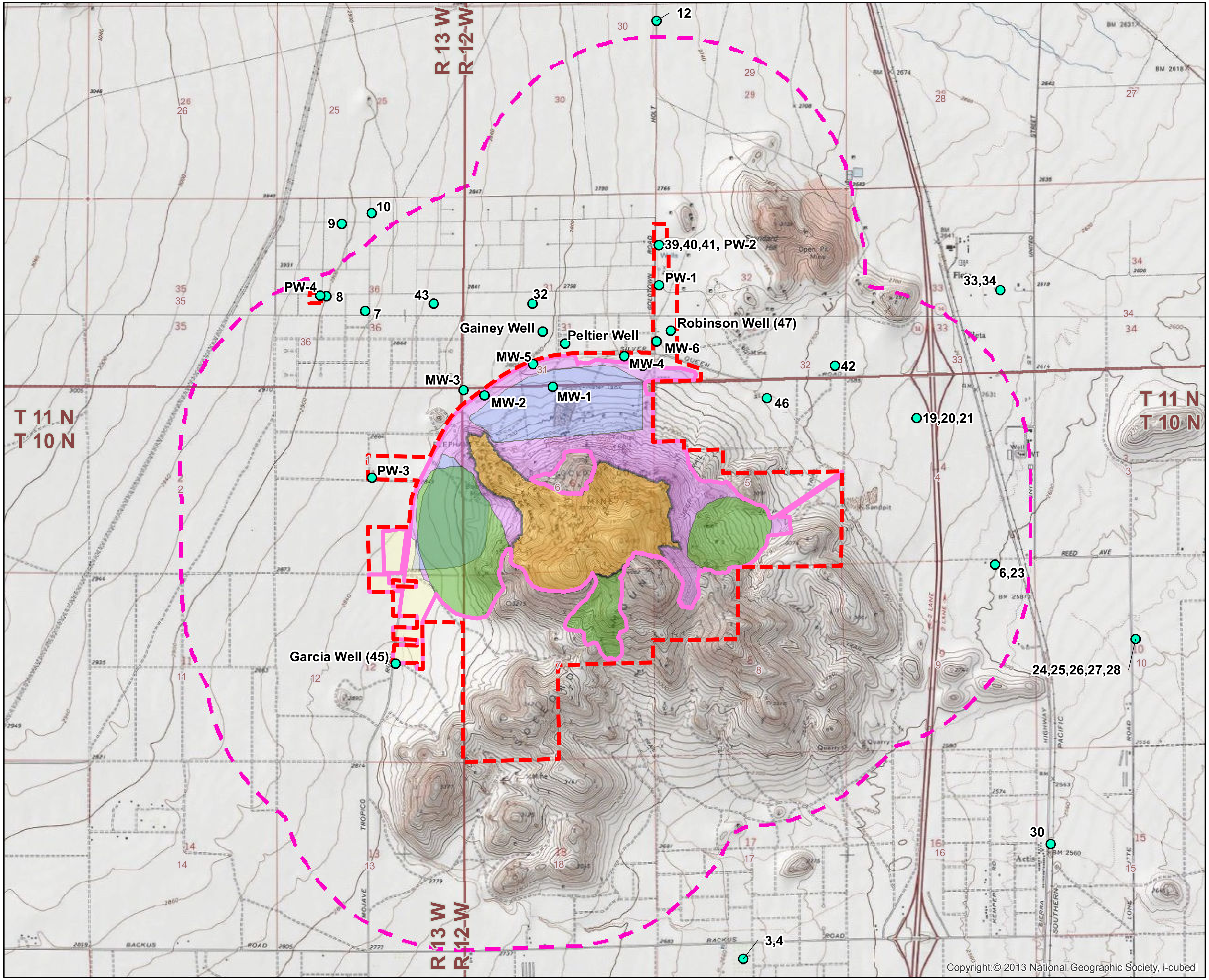
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

REGIONAL GROUNDWATER BASINS AND SUB-BASINS

ARCADIS

FIGURE
2

Path: Z:\ArcGisData\GISPROJECTS_ENV\AO000100_Soledad\Illustrators\2019\Figure 2 - Regional Groundwater Basins and Subbasins.ai
Last Saved By: JCHEN
Last Saved On: 06/27/2019



Legend

- ● Existing Well Location
- ▭ Approved Project Boundary
- ▭ One-Mile Buffer
- ▭ Total Disturbed Area
- ■ Reclaimed Working Area and Roads
- ■ Reclaimed Clay Borrow Area
- 🟩 Reclaimed Surge Piles
- ■ Reclaimed Heap Leach Pad
- 🟧 Partially Backfilled Pit

N
W E
S

1,300 0 1,300 2,600
Feet

Sources of Well Locations:
WZI, Inc. 1996,
California Department of Water Resources,
Golden Queen Mining Company.

Basemap:
USA Topo Maps, serviced by
ESRI ArcGIS Online.

Projection:
NAD1983, StatePlane California V,
FIPS 0405, Feet

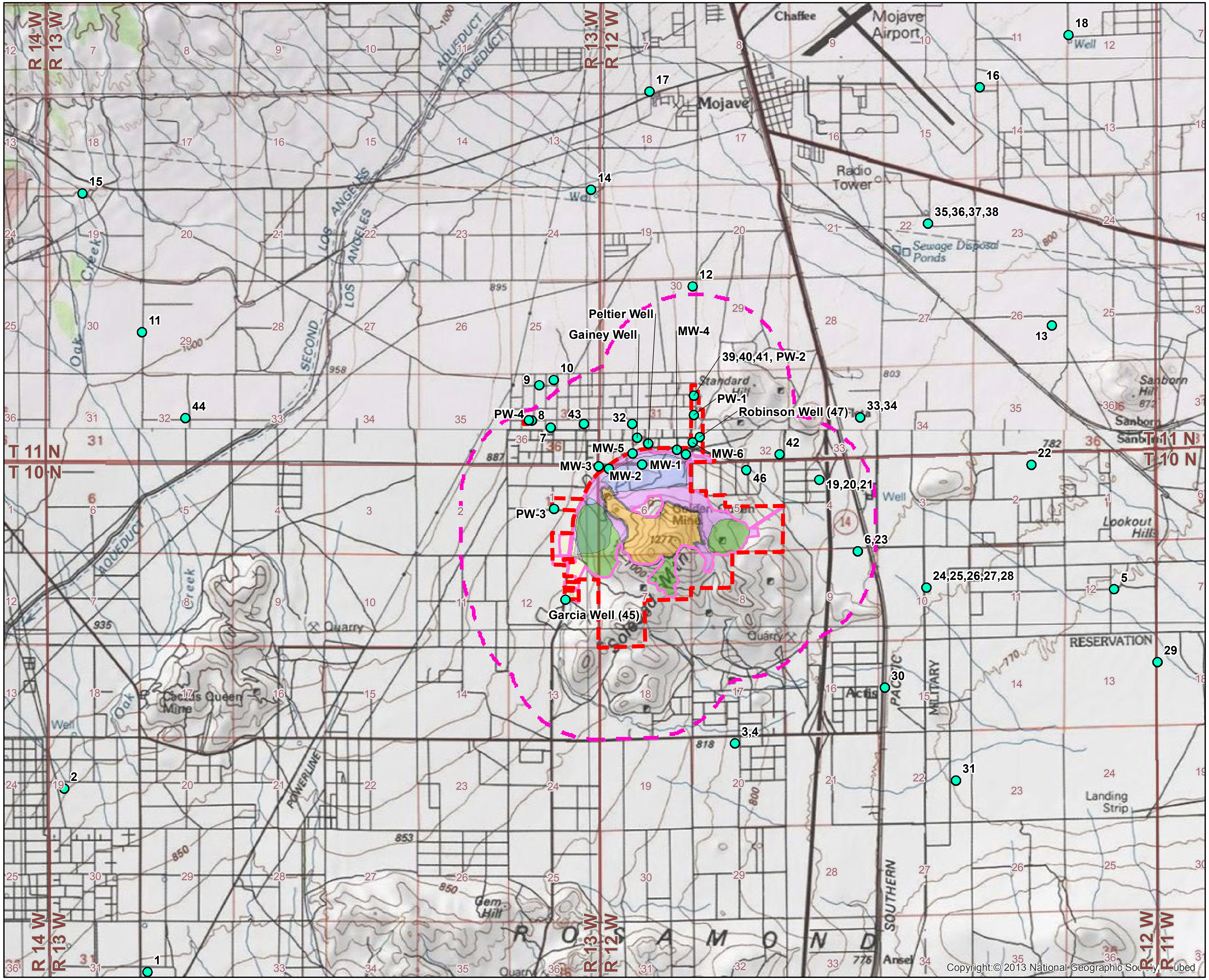
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

MAP OF EXISTING WELLS WITHIN ONE MILE OF PROJECT SITE

ARCADIS

FIGURE
3

CITY: Boulder, CO DIV/GROUP: AIT PM: T. COX TM: TR: J.CHEN
Project (Project #): AO000100.0012



Legend

● Existing Well Location

⬚ Approved Project Boundary

⬚ One-Mile Buffer

☐ Total Disturbed Area

🟪 Reclaimed Working Area and Roads

🟨 Reclaimed Clay Borrow Area

🟩 Reclaimed Surge Piles

🟦 Reclaimed Heap Leach Pad

🟧 Partially Backfilled Pit

N W E S

0.5 0 0.5 1

Miles

Sources of Well Locations:
WZI, Inc. 1996,
California Department of Water Resources,
Golden Queen Mining Company.

Basemap:
USA Topo Maps, serviced by
ESRI ArcGIS Online.

Projection:
NAD1983, StatePlane California V,
FIPS 0405, Feet

GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

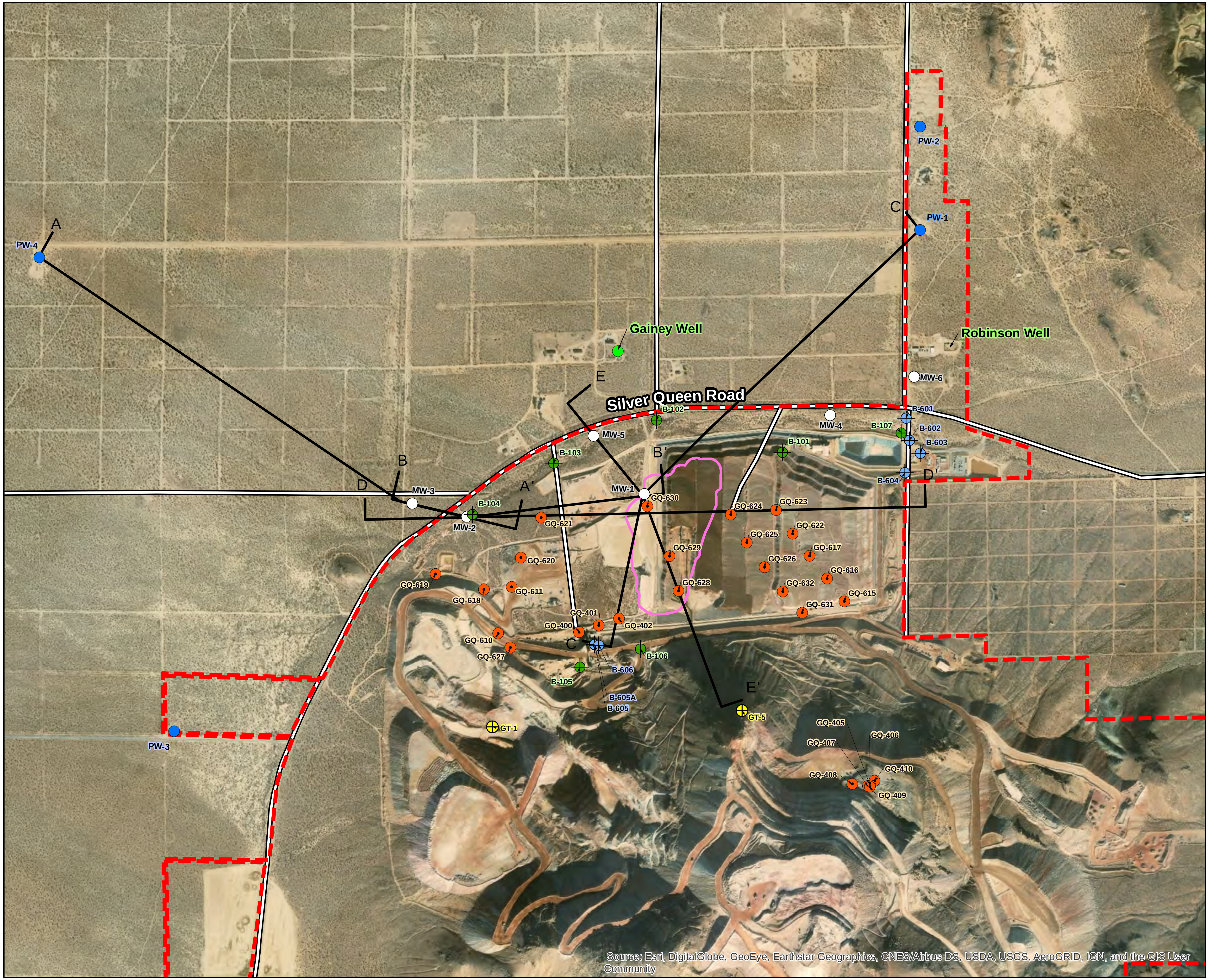
MAP OF EXISTING WELLS IN VICINITY OF PROJECT SITE

ARCADIS

FIGURE
4

CITY: Boulder, CO DIV/GROUP: AIT PM: T. COX TM: TR: J.CHEN
Project (Project #): AO000100.0012

City: Div/Group: Created By: Last Saved By: kkelley
Z:\GISProjects_ENV\AO000100_Soledad\GIS\ArcMap_MXD\2019\Reclamation_Plan\Fig_5_Exploration_Boreholes_and_Cross_Sections_rev1.mxd 7/26/2019 1:12:39 PM



Legend

⊕	Diamond Drill Hole (Seegmiller International 1996)
⊕	Exploratory Boring (Golder 2004)
⊕	Exploratory Boring (Golder 2006)
●	Condemnation Boring (Golden Queen Mining Company)
●	Private Well
○	Monitoring Well
●	Production Well
┘	Cross Section
▭	Historical Gold Fields Tailings
▭	Disturbed Area Boundary

Source: Golder (2009)

N
W E
S

1,000 0 1,000

Feet

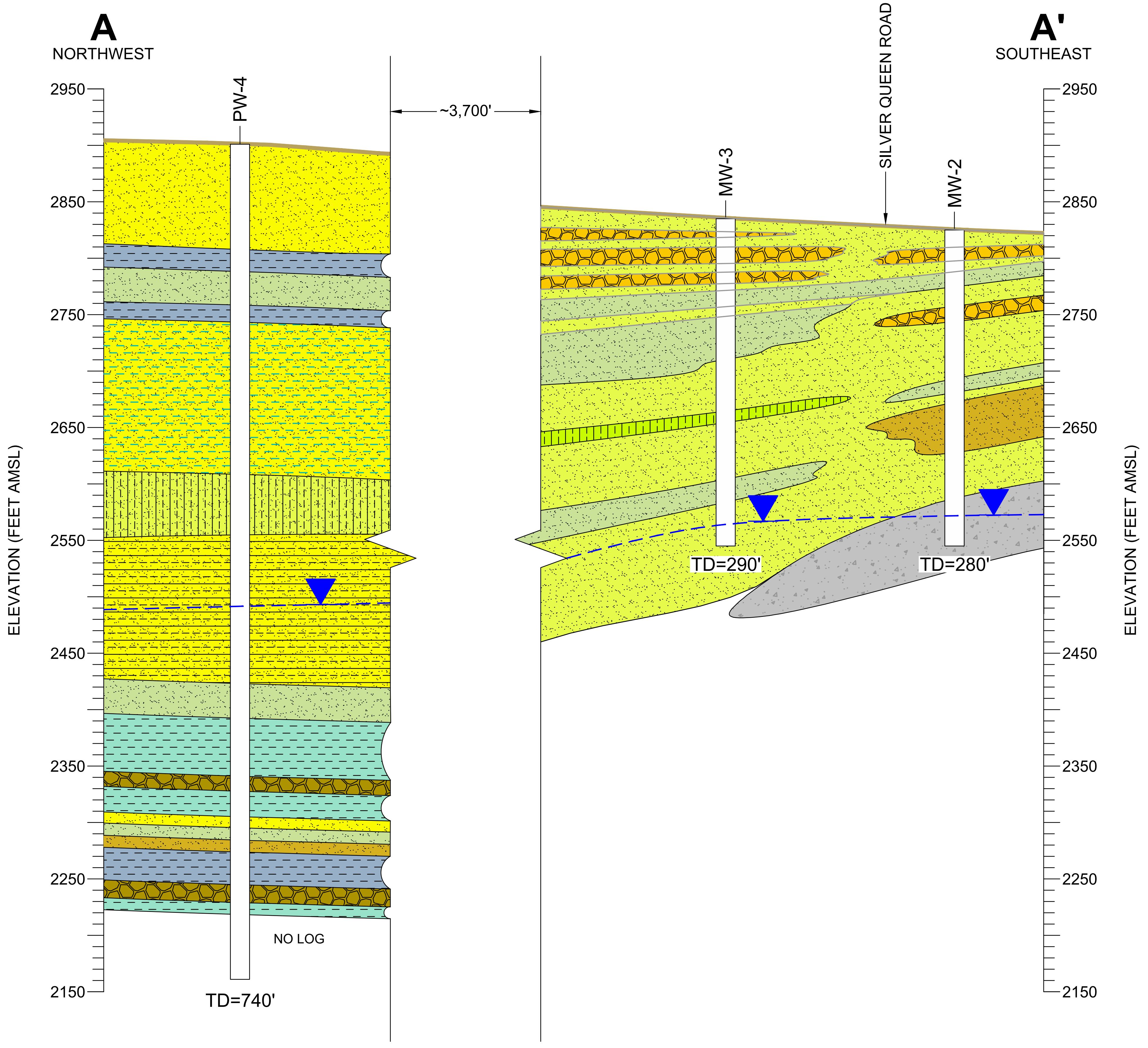
Aerial Source: NAIP 2009
Projection: NAD1983, StatePlane California V,
FIPS 0405, Feet

GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

EXPLORATION BOREHOLES, WELLS, AND CROSS SECTION LINES

ARCADIS

FIGURE
5

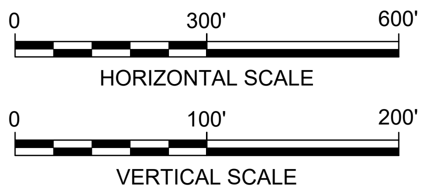


LEGEND:

MW-3 WELL/BORING ID
EXISTING GRADE
LITHOLOGIC CONTACT (DASHED WHERE INFERRED)
▼ GROUNDWATER ELEVATION (SEE NOTE 2)
TD=290' TOTAL DEPTH IN FEET
AMSL ABOVE MEAN SEA LEVEL
▨ SANDY GRAVEL
▨ CLAYEY GRAVEL
▨ GRAVELLY SAND
▨ SAND
▨ SILTY SAND
▨ CLAYEY SAND
▨ INTERBEDDED CLAY, SAND, SILTY SAND, GRAVELLY SAND & SANDY CLAY
▨ SILTY SAND, SANDY CLAY
▨ INTERBEDDED SAND, GRAVELLY SAND, CLAY & SILTY SAND
▨ SAND WITH SILT
▨ SANDY CLAY
▨ CLAY
▨ VOLCANIC ROCK FRAGMENTS

NOTES:

1. LITHOLOGY AND INTERPRETATION FOR MW-2 AND MW-3 FROM WZI, INC., CROSS SECTION B-B' DATED JUNE 1997.
2. WATER ELEVATIONS FOR MW-2 AND MW-3 WERE COLLECTED ON 11/1/2018. WATER ELEVATION FOR PW-4 IS A TWO-YEAR AVERAGE OF LEVELS DURING PUMPING (2017 AND 2018).



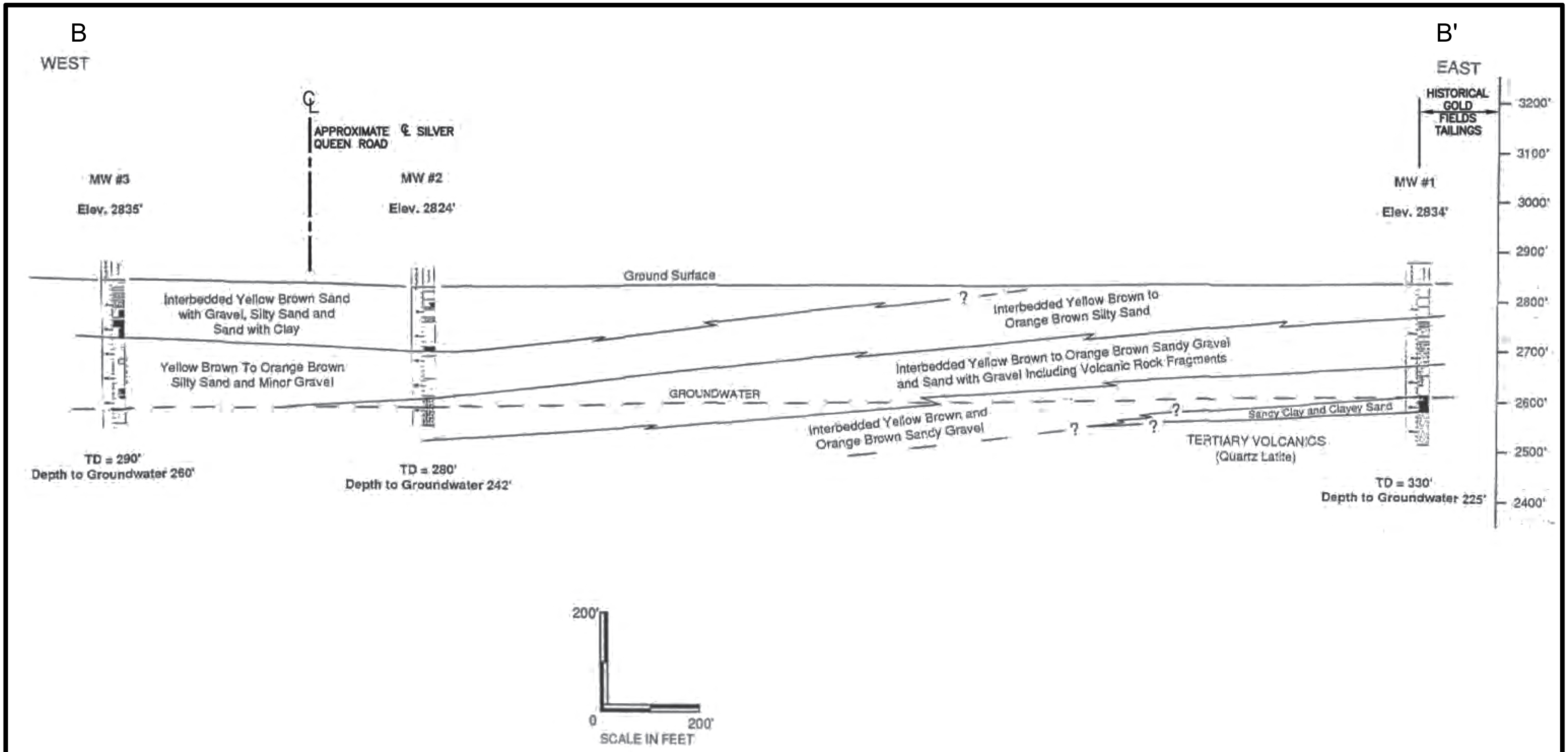
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

GEOLOGIC CROSS SECTION A-A'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
6

CITY: SAN RAFAEL, CA DIV/GROUP: ENVCAD DB: J. HARRIS
C:\BIM\OneDrive - ARCADIS\BIM 360 Docs\GOLDEN QUEEN MINING CO., LLC\SOLEDAD MOUNTAIN\2019\CO002316.0002\01-DWG\Soledad Mtn - Cross Section A-A.dwg LAYOUT: 6 SAVED: 8/7/2019 3:11 PM ACADVER: 23.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB
PLOTTED: 8/7/2019 4:30 PM BY: HARRIS, JESS
XREFS: IMAGES: PROJECTNAME: ----
a-a'_x-section_sketch.jpg
cross section a_a ruscitto edits.jpg



REFERENCES

1. BOREHOLE LOGS AND INTERPRETED CROSS SECTION PROVIDED BY GOLDEN QUEEN, PREPARED BY WZI INC. TITLED: CROSS SECTION C–C', DATED: 9/97.

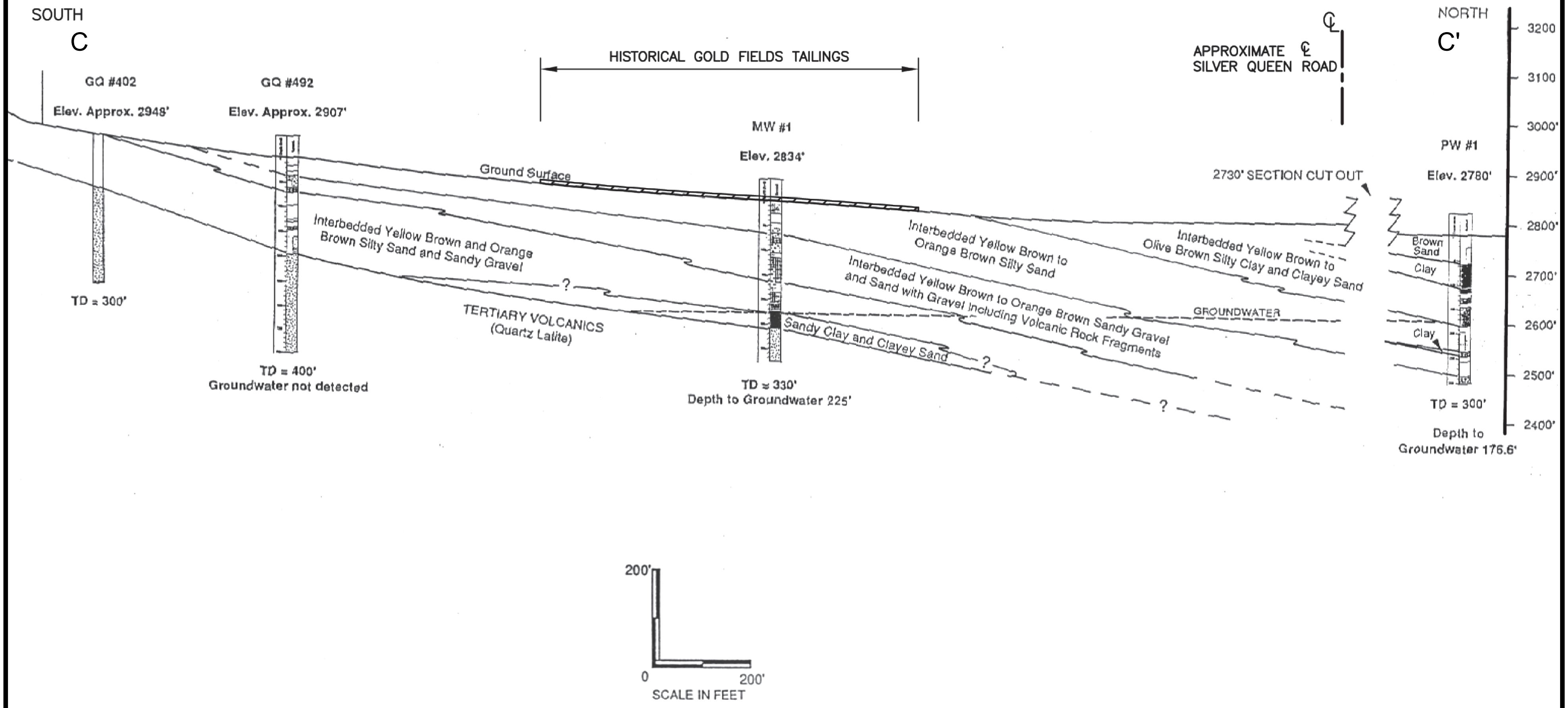
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

GEOLOGIC CROSS SECTION B-B'

ARCADIS

FIGURE
7

Path:Z:\ArcGisData\GISPROJECTS_ENV\AO000100_Soledad\Illustrators\2019\Figure 7 - B-B' Section.ai   Last Saved By: JCHEN   Last Saved On: 06/27/2019



REFERENCES

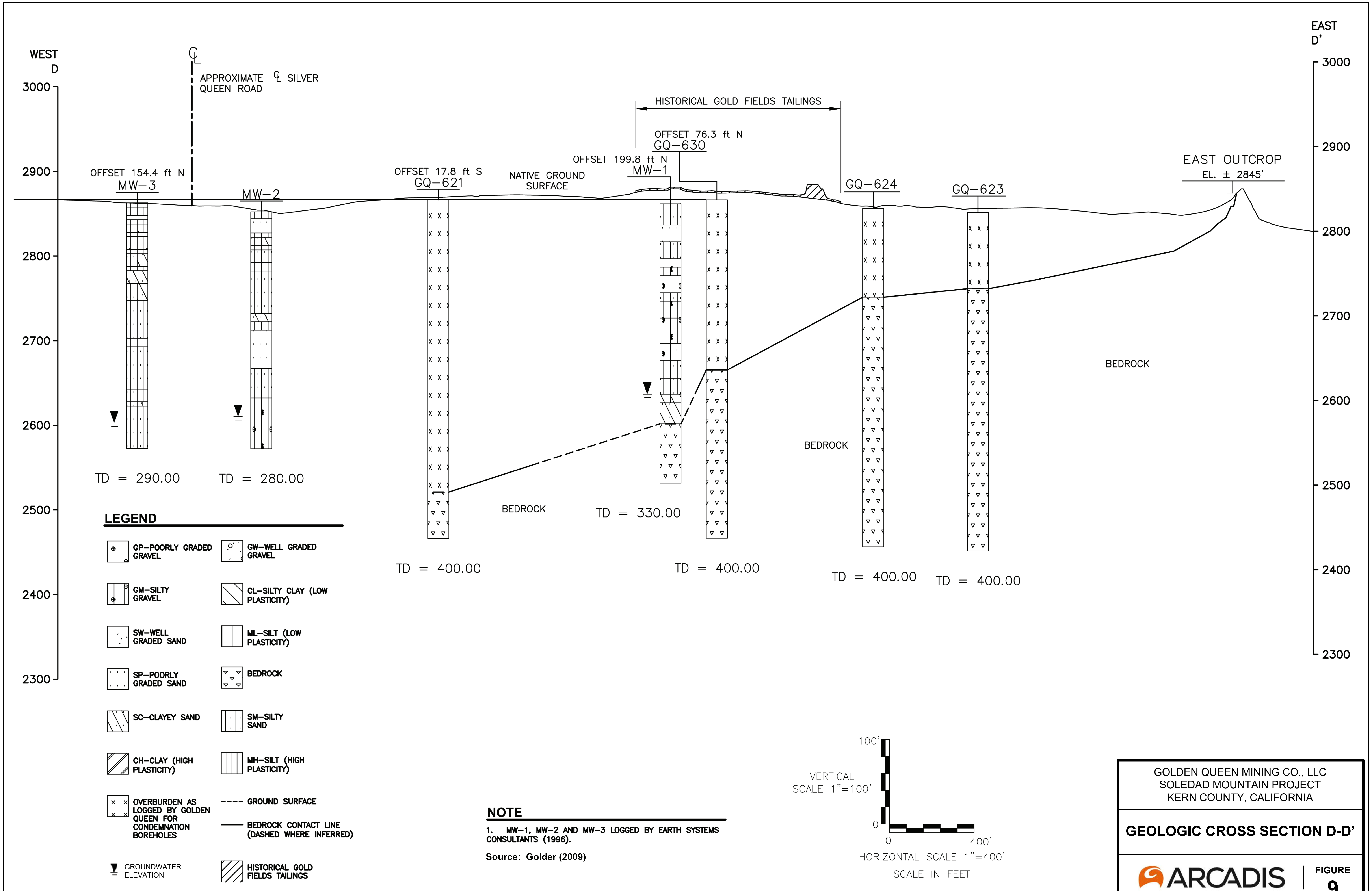
1. BOREHOLE LOGS AND INTERPRETED CROSS SECTION PROVIDED BY GOLDEN QUEEN, PREPARED BY WZI INC. TITLED: CROSS SECTION D–D', DATED: 9/97.

GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

GEOLOGIC CROSS SECTION C-C'

ARCADIS

FIGURE
8



NOTE

1. MW-1, MW-2 AND MW-3 LOGGED BY EARTH SYSTEMS CONSULTANTS (1996).

Source: Golder (2009)

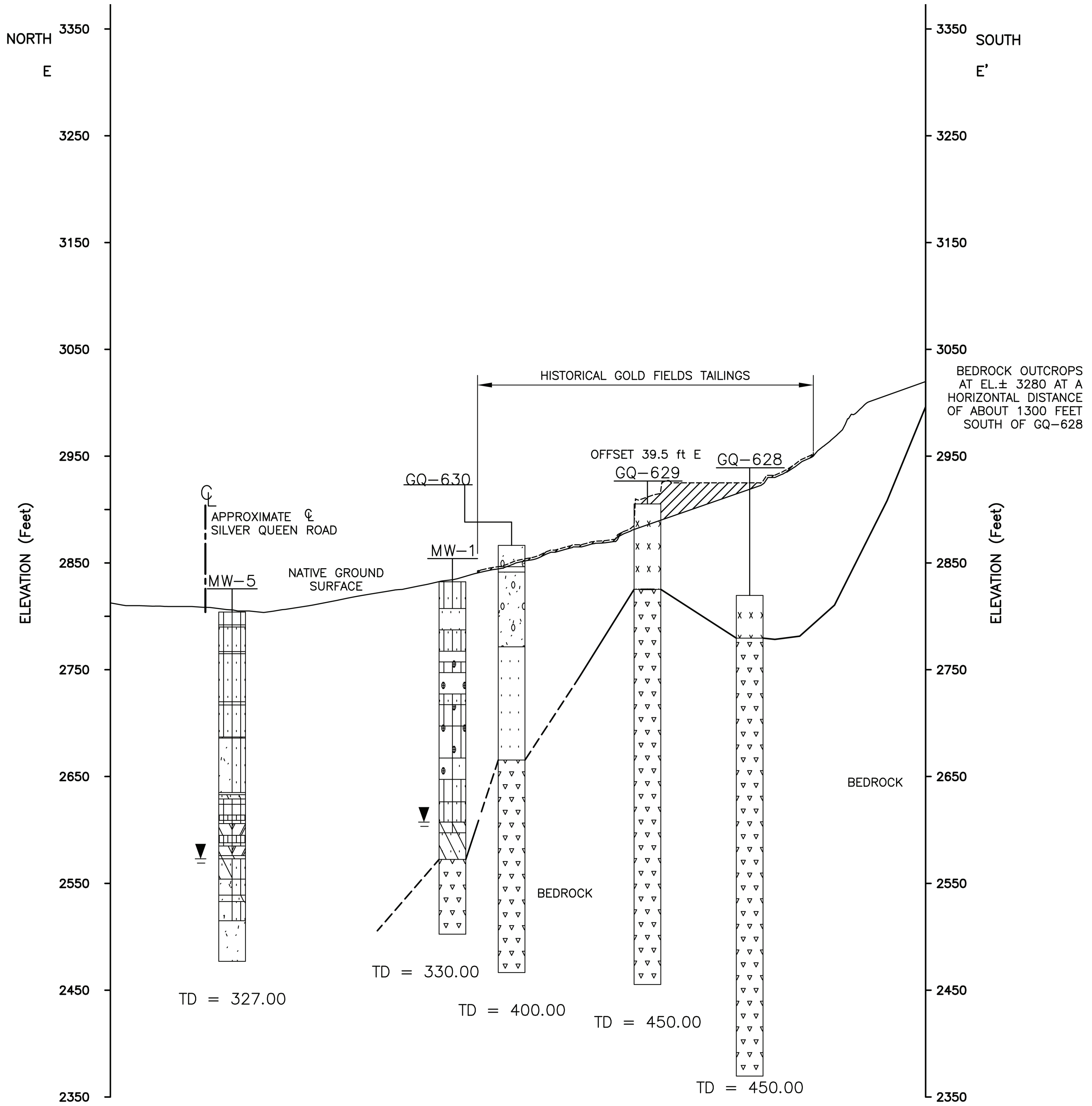
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

GEOLOGIC CROSS SECTION D-D'

ARCADIS

FIGURE
9

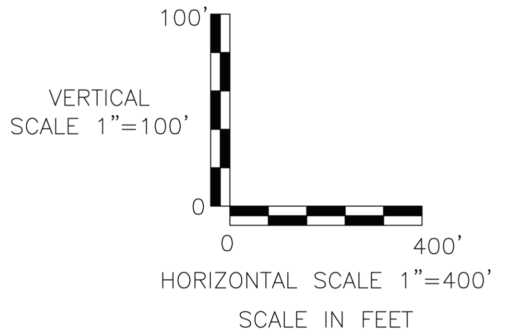
Path:Z:\ArcGisData\GISPROJECTS_ENV\AO000100_Soledad\Illustrators\2019\Figure 9 - D-D' Section.ai Last Saved By: JCHEN Last Saved On: 06/27/2019



LEGEND

- ⊡ GP–POORLY GRADED GRAVEL
- ⊡ GM–SILTY GRAVEL
- ⊡ SW–WELL GRADED SAND
- ⊡ SP–POORLY GRADED SAND
- ▧ SC–CLAYEY SAND
- ▨ CH–CLAY (HIGH PLASTICITY)
- ☒ OVERBURDEN AS LOGGED BY GOLDEN QUEEN FOR CONDEMNATION BOREHOLES
- ▼ GROUNDWATER ELEVATION
- ▧ CL–SILTY CLAY (LOW PLASTICITY)
- ◫ ML–SILT (LOW PLASTICITY)
- ▽ BEDROCK
- ⊡ SM–SILTY SAND
- ▥ MH–SILT (HIGH PLASTICITY)
- ---- GROUND SURFACE
- —— BEDROCK CONTACT LINE (DASHED WHERE INFERRED)
- ▨ HISTORICAL GOLD FIELDS TAILINGS

Source: Golder (2009)



VERTICAL SCALE 1"=100'

HORIZONTAL SCALE 1"=400'

SCALE IN FEET

GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

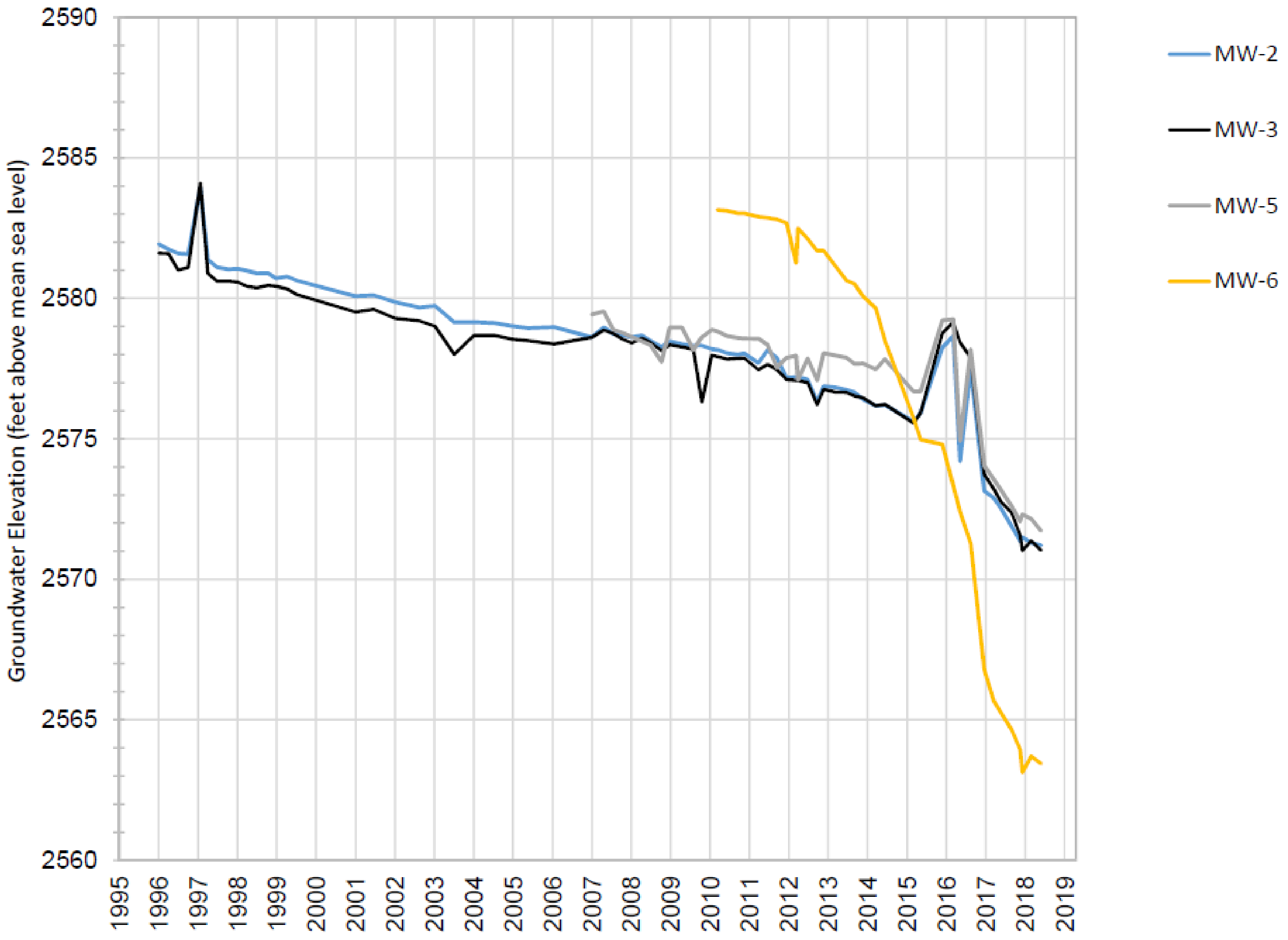
GEOLOGIC CROSS SECTION E-E'

ARCADIS

FIGURE
10

Path:Z:\ArcGisData\GISPROJECTS_ENVAO000100_Soledad\Illustrators\2019\Figure 9 - E-E' Section.ai Last Saved By: JCHEN Last Saved On: 06/27/2019

Path:Z:\ArcGisData\GISPROJECTS_ENV\AO000100_Soledad\Illustrators\2019\Figure 11 - Hydrographs.ai Last Saved By: JCHEN Last Saved On: 06/28/2019

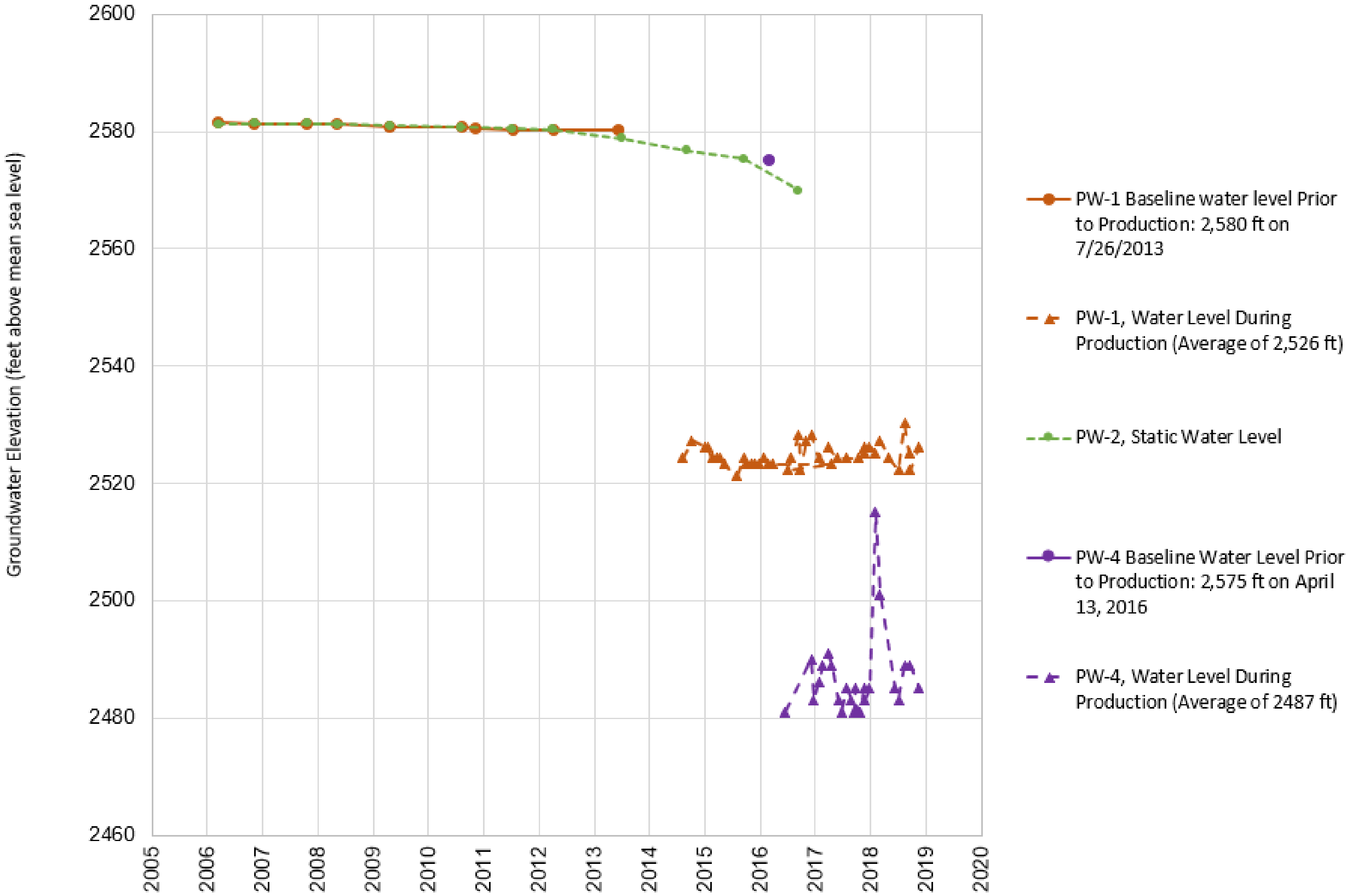


GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

GROUNDWATER ELEVATION OVER TIME IN MONITORING WELLS

ARCADIS

FIGURE
11



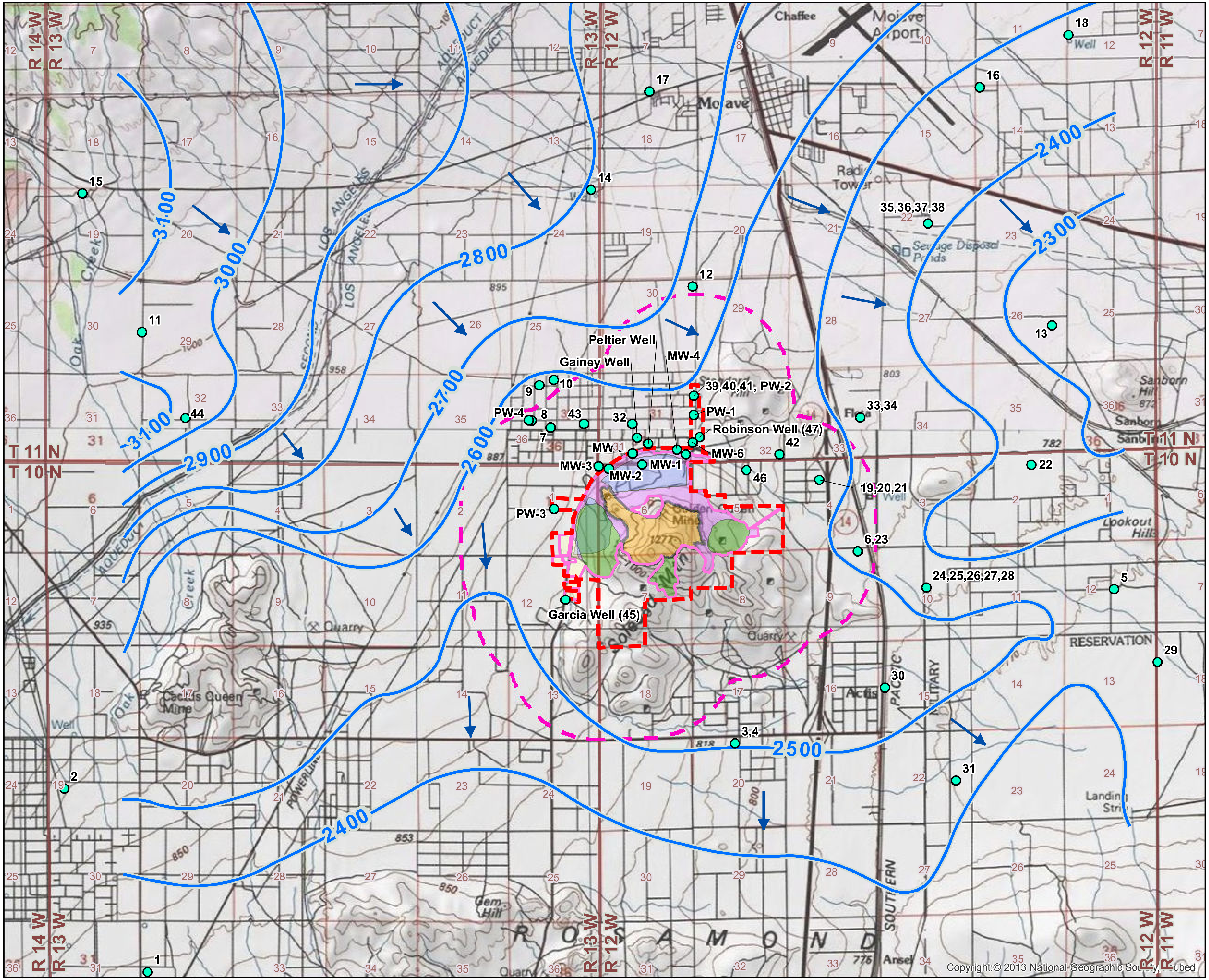
Wells currently used for production are PW-1 and PW-4. Static water levels are not recorded for these wells, groundwater elevations shown are based on water levels recorded at the time of pumping and may reflect slight variability in pumping rates at the time of data collection.

GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

GROUNDWATER ELEVATION OVER TIME IN PRODUCTION WELLS

ARCADIS

FIGURE
12



Legend

● Existing Well Location

🟥 Approved Project Boundary

One-Mile Buffer

Pit Boundary

Total Disturbed Area

Reclaimed Working Area and Roads

Reclaimed Clay Borrow Area

🟩 Reclaimed Surge Piles

Reclaimed Heap Leach Pad

Partially Backfilled Pit

Regional Groundwater Elevation Contour (feet above mean sea level)

Groundwater Flow Direction

N W E S

0.5 0 0.5 1

Miles

Sources of Well Locations:
WZI, Inc. 1996,
California Department of Water Resources,
Golden Queen Mining Company.

Source of Regional Groundwater Contours:
WZI, Inc. 1990.

Basemap:
USA Topo Maps, serviced by
ESRI ArcGIS Online.

Projection:
NAD1983, StatePlane California V,
FIPS 0405, Feet

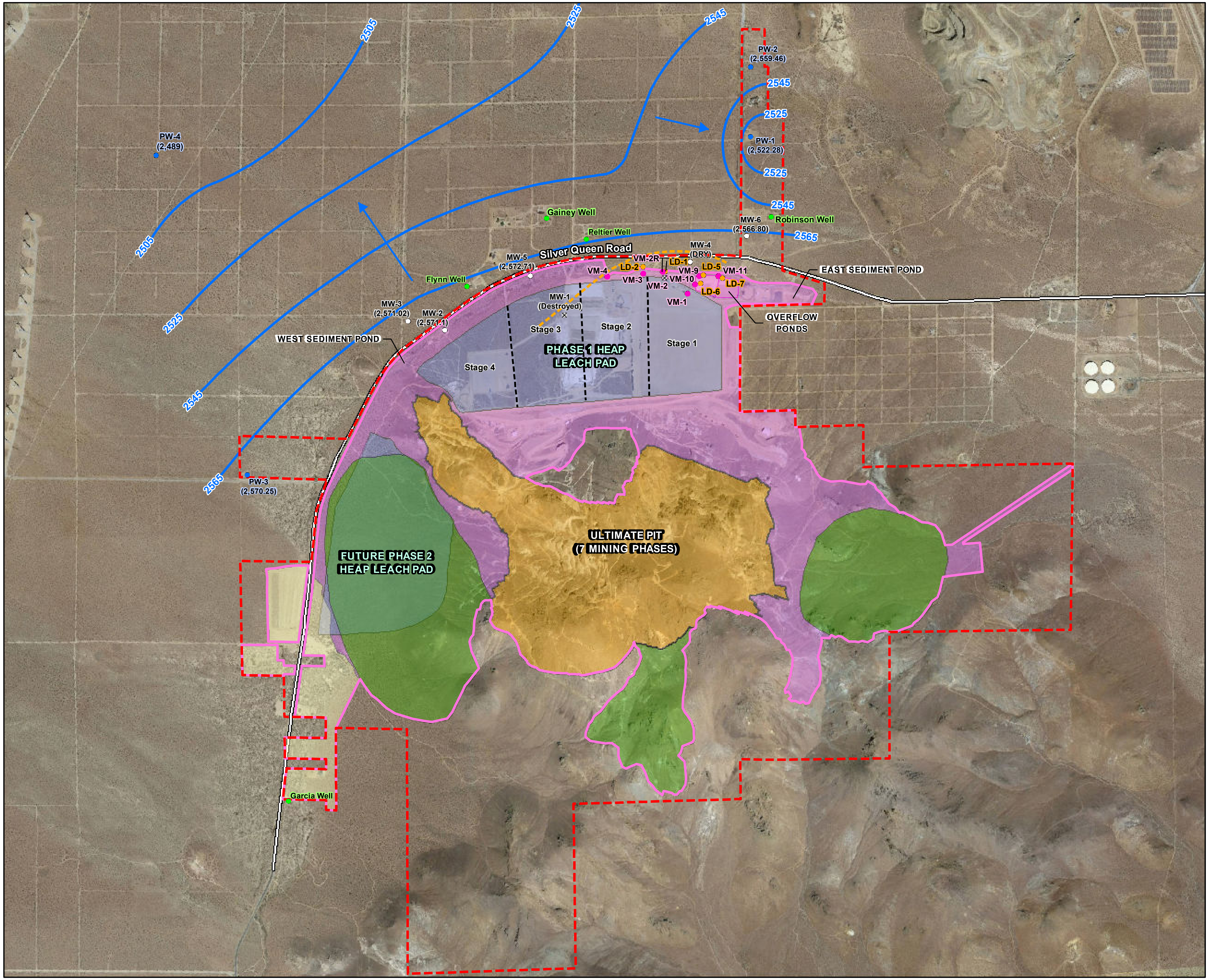
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

REGIONAL GROUNDWATER CONTOURS

ARCADIS

FIGURE
13

CITY: Boulder, CO DIV/GROUP: AIT PM: T. COX TM: TR: J.CHEN
Project (Project #): AO000100.0012



Legend

- ☒ Destroyed
- ● Vadose Zone Monitoring Lysimeter
- ○ Monitoring Well
- ● Private Well
- ● Production Well
- ● Leak Detection Collection System Sump
- Approved Project Boundary
- Edge of Boundary Between Alluvium and Bedrock Based on Lithology from Condemnation or Monitoring Well Logs
- Elevation Contour (feet above mean sea level)
- Groundwater Flow Direction
- ☐ Total Disturbed Area
- ▨ Reclaimed Working Area and Roads
- ▨ Reclaimed Clay Borrow Area
- ▨ Reclaimed Surge Piles
- ▨ Reclaimed Heap Leach Pad
- ▨ Partially Backfilled Pit

NOTES:
1) Estimated groundwater contours based on Nov. 1, 2018 water level measurements.
2) PW-1 and PW-4 are pumping.

N
W E
S

0 750 1,500 2,250

Feet

Aerial Source: Google Earth Imagery, dated in 04/2015.
Projection: NAD1983, StatePlane California V, FIPS 0405, Feet

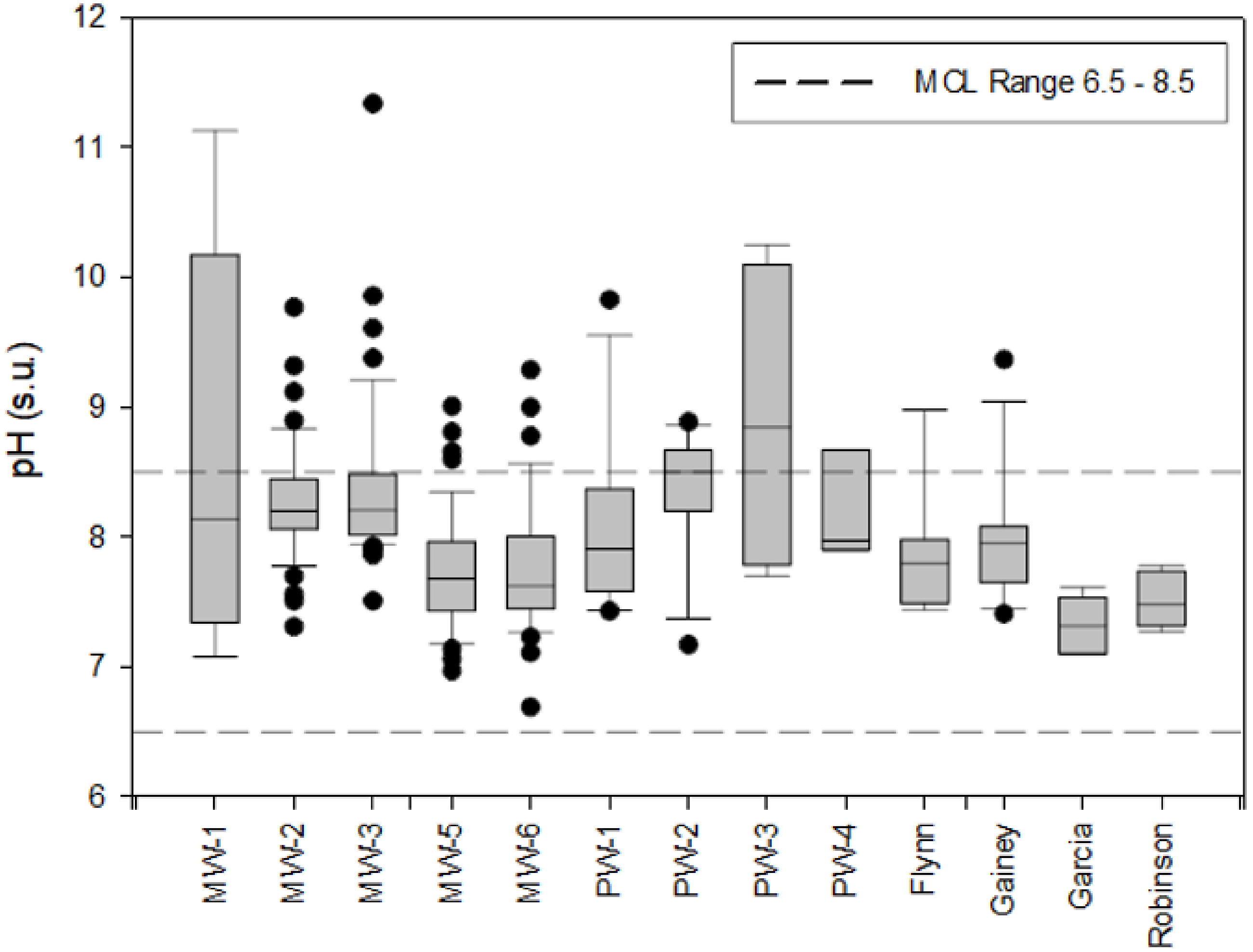
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

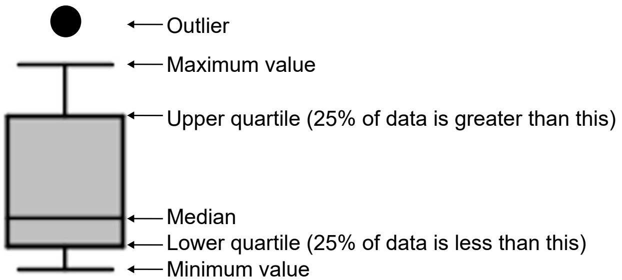
GROUNDWATER CONTOUR MAP ALONG NORTHERN FRONT OF SOLEDAD MOUNTAIN (NOVEMBER 2018)

ARCADIS

FIGURE
14

Z:\GISProjects_ENV\AO000100_Soledad\GIS\ArcMap_MXD\2019\Reclamation_Plan\Fig_14_Groundwater_Contour_Map_Along_Northern_Front_of_Soledad_Mountain.mxd





MCL = maximum contaminant level
s.u. = standard units

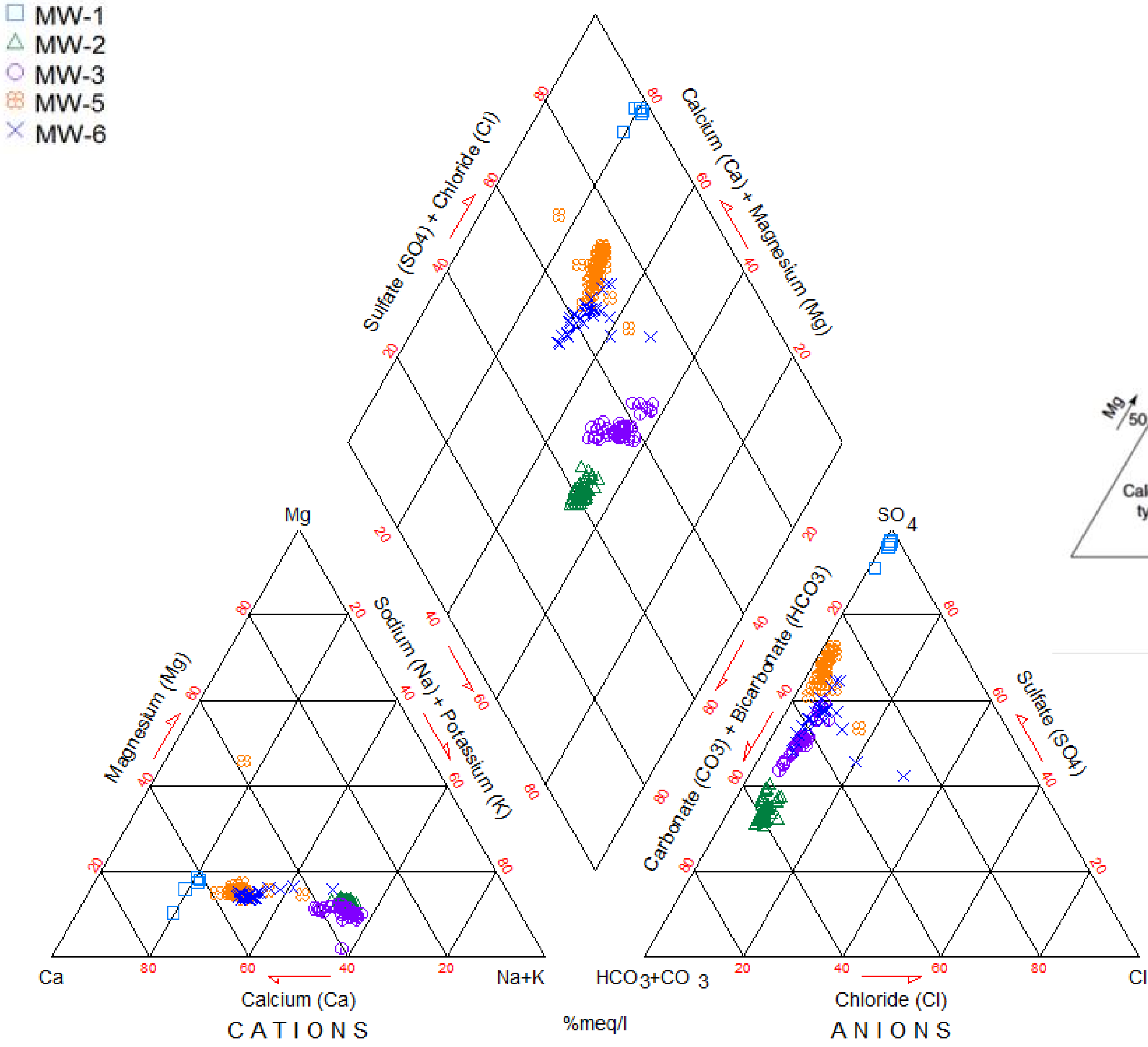
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

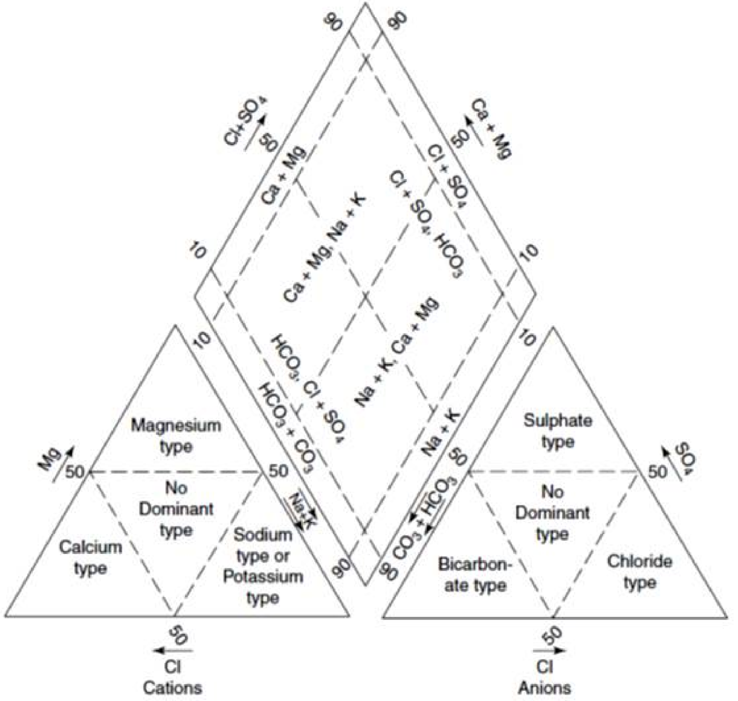
pH IN PROJECT AREA WELLS
Q4 2007 TO Q4 2018

ARCADIS

FIGURE
15

Path:Z:\ArcGisData\GISPROJECTS_ENV\AO000100_Soledad\Illustrators\2019\Figure 14 - pH in Project Area Wells.ai Last Saved By: JCHEN Last Saved On: 06/28/2019





Data are from 4th Quarter 2007 to 4th Quarter 2018

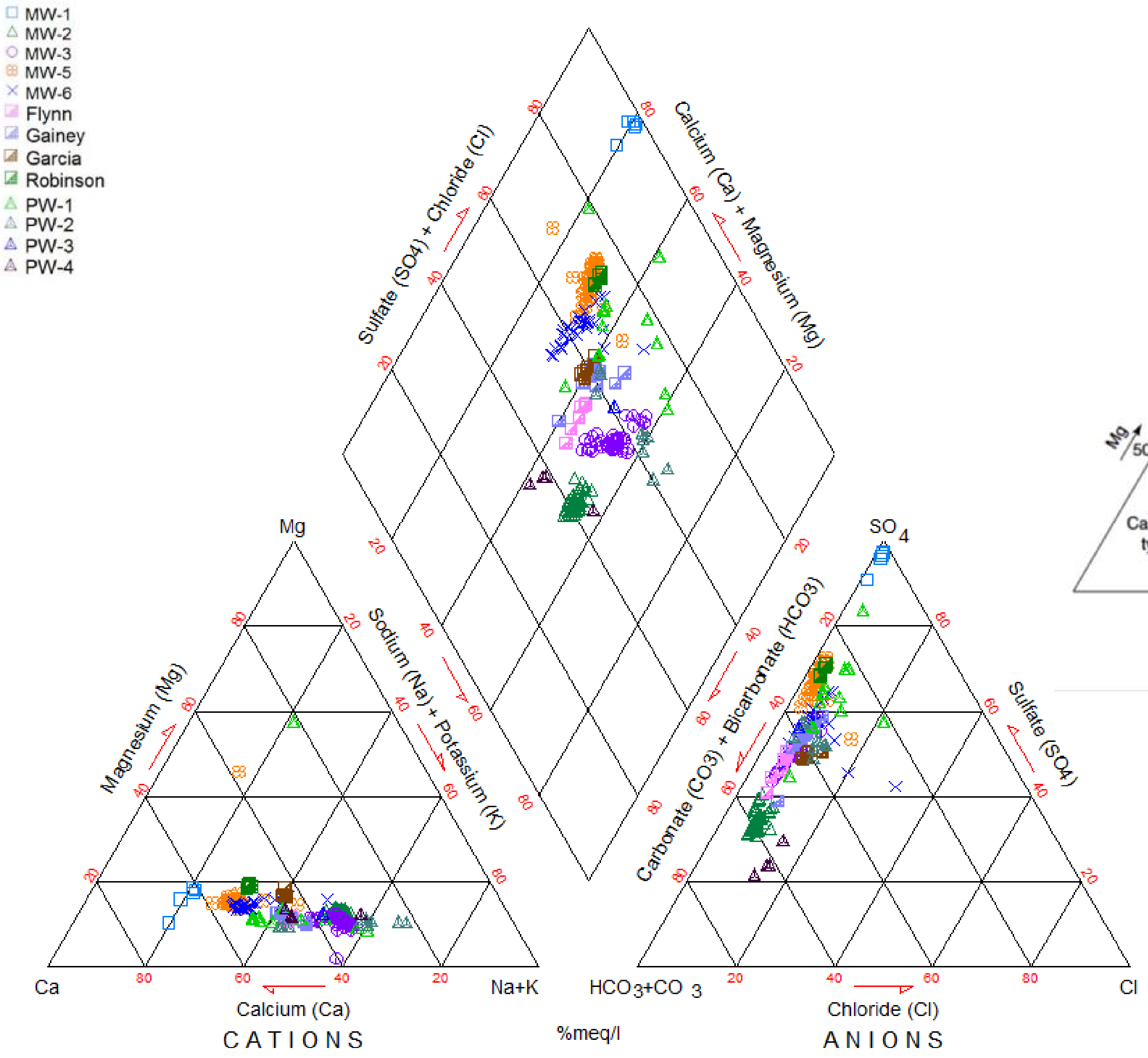
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

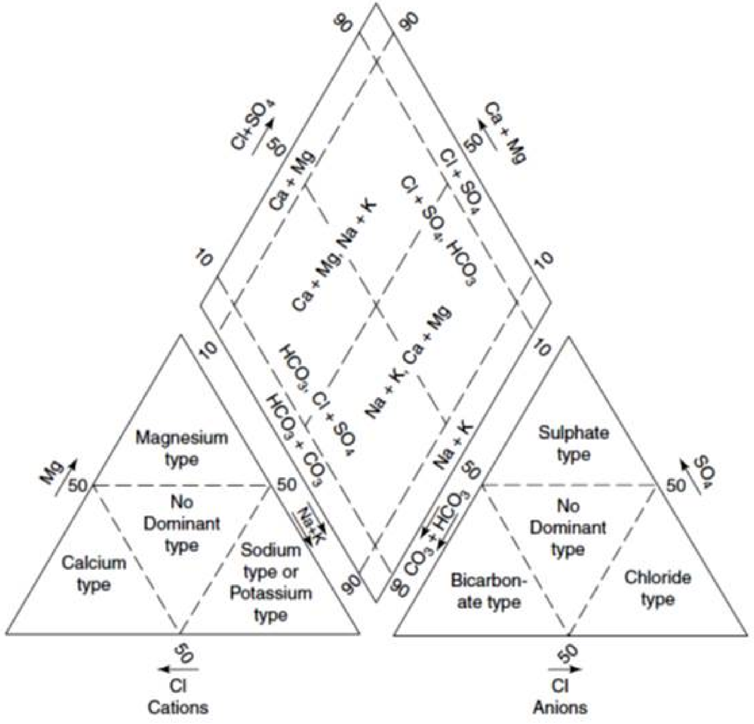
PIPER DIAGRAM OF GROUNDWATER FROM MONITORING WELLS IN PROJECT AREA

ARCADIS

FIGURE
16

CITY: Boulder, CO DIV/GROUP: AIT PM: T. COX TM: TR: J.CHEN
Project (Project #): AO000100.0012 Path: Z:\GISPROJECTS_ENV\AO000100_Soledad\GIS\ArcMap_MXD2016\Fig5_PiperDiagram_GWfromMW.mxd Last Saved: 1/11/2016 Saved By: vellingworth





Data are from 4th Quarter 2007 to 4th Quarter 2018

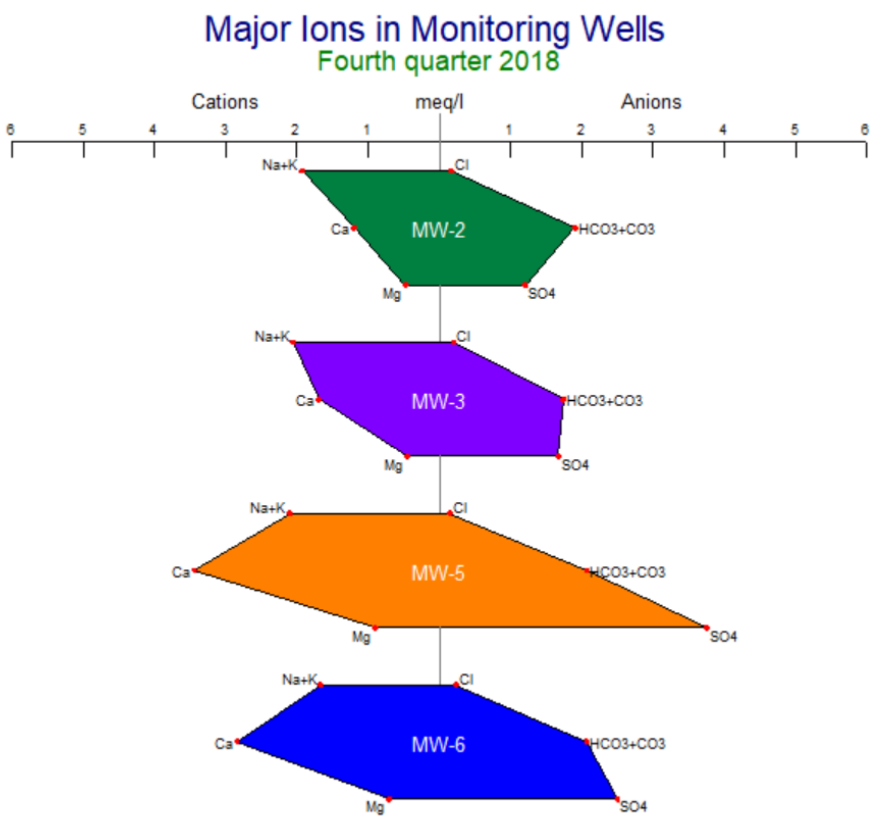
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

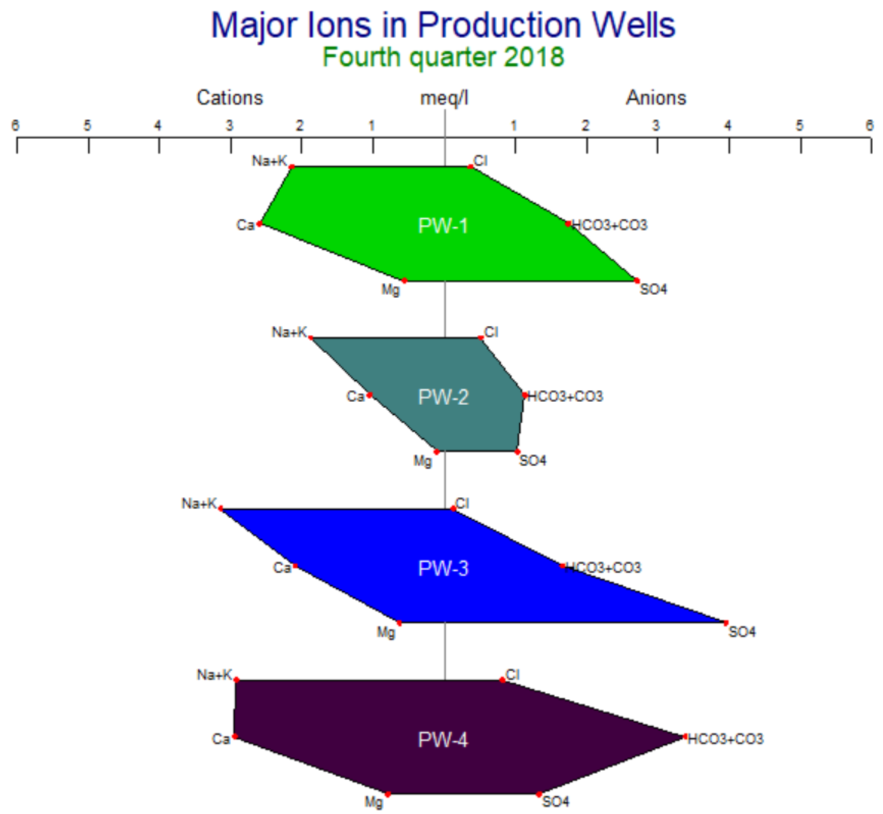
PIPER DIAGRAM OF GROUNDWATER FROM MONITORING, RESIDENTIAL, AND PRODUCTION WELLS IN PROJECT AREA

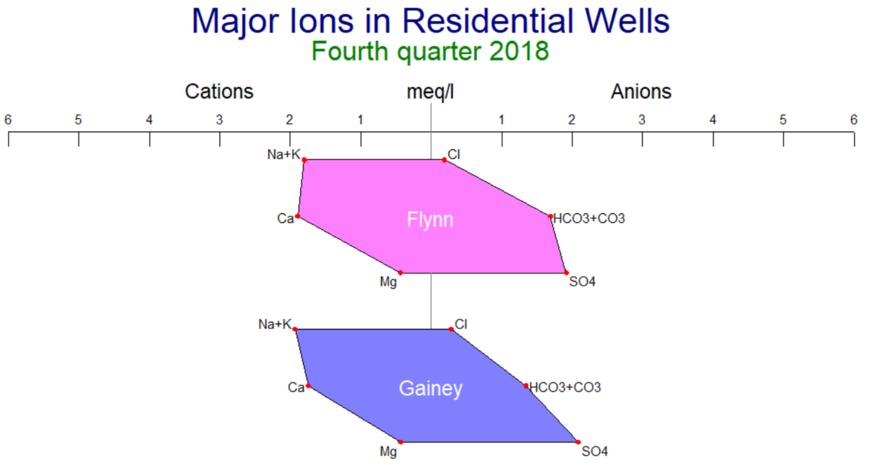
ARCADIS

FIGURE
17

CITY: Boulder, CO DIV/GROUP: AIT PM: T. COX TM: TR: J.CHEN
Project (Project #): AO000100.0012 Path: Z:\GISPROJECTS_ENV\AO000100_Soledad\GIS\ArcMap_MXD\2016\Fig6_PiperDiagram_GWfromMWResandProdWells.mxd Last Saved: 1/11/2016 Saved By: vellingworth







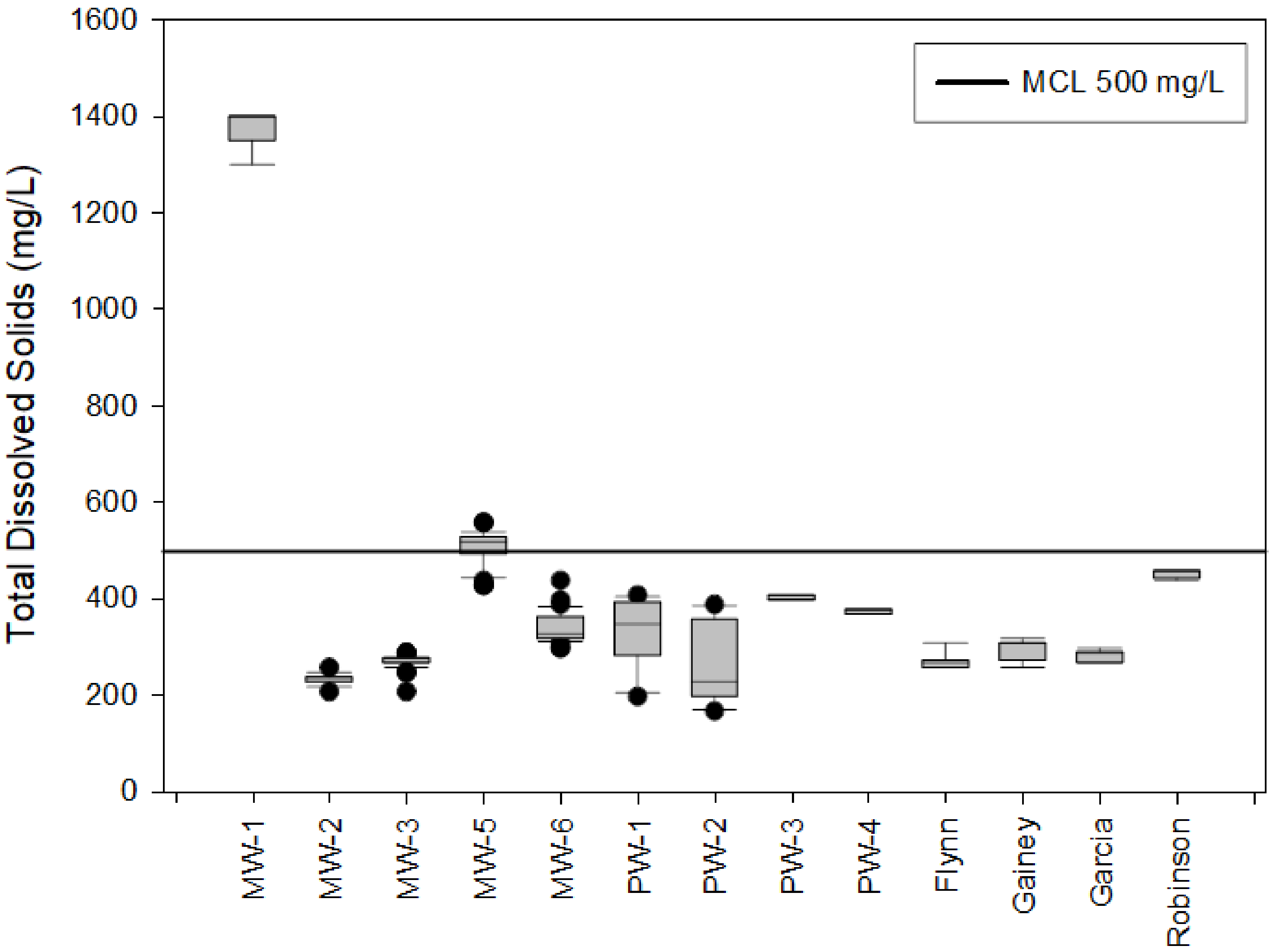
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

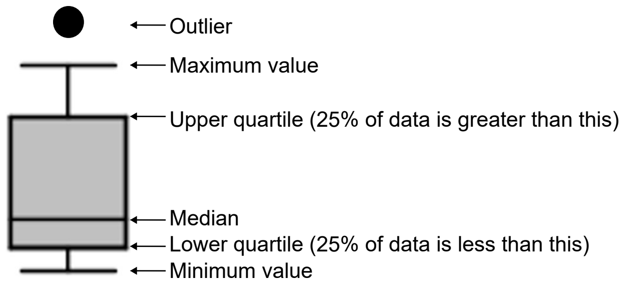
STIFF DIAGRAM OF GROUNDWATER FROM MONITORING, RESIDENTIAL, AND PRODUCTION WELLS IN PROJECT AREA

ARCADIS

FIGURE
18

CITY: Boulder, CO DIV/GROUP: AIT PM: T. COX TM: TR: J.CHEN
Project (Project #): AO000100.0012 Path: Z:\GISPROJECTS_ENV\AO000100_Soledad\GIS\ArcMap_MXD\2016\Fig7_StiffDiagram_GWinMWResandProdWells.mxd Last Saved: 1/11/2016 Saved By: vellingworth





MCL = maximum contaminant level
mg/L = milligrams per liter

GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

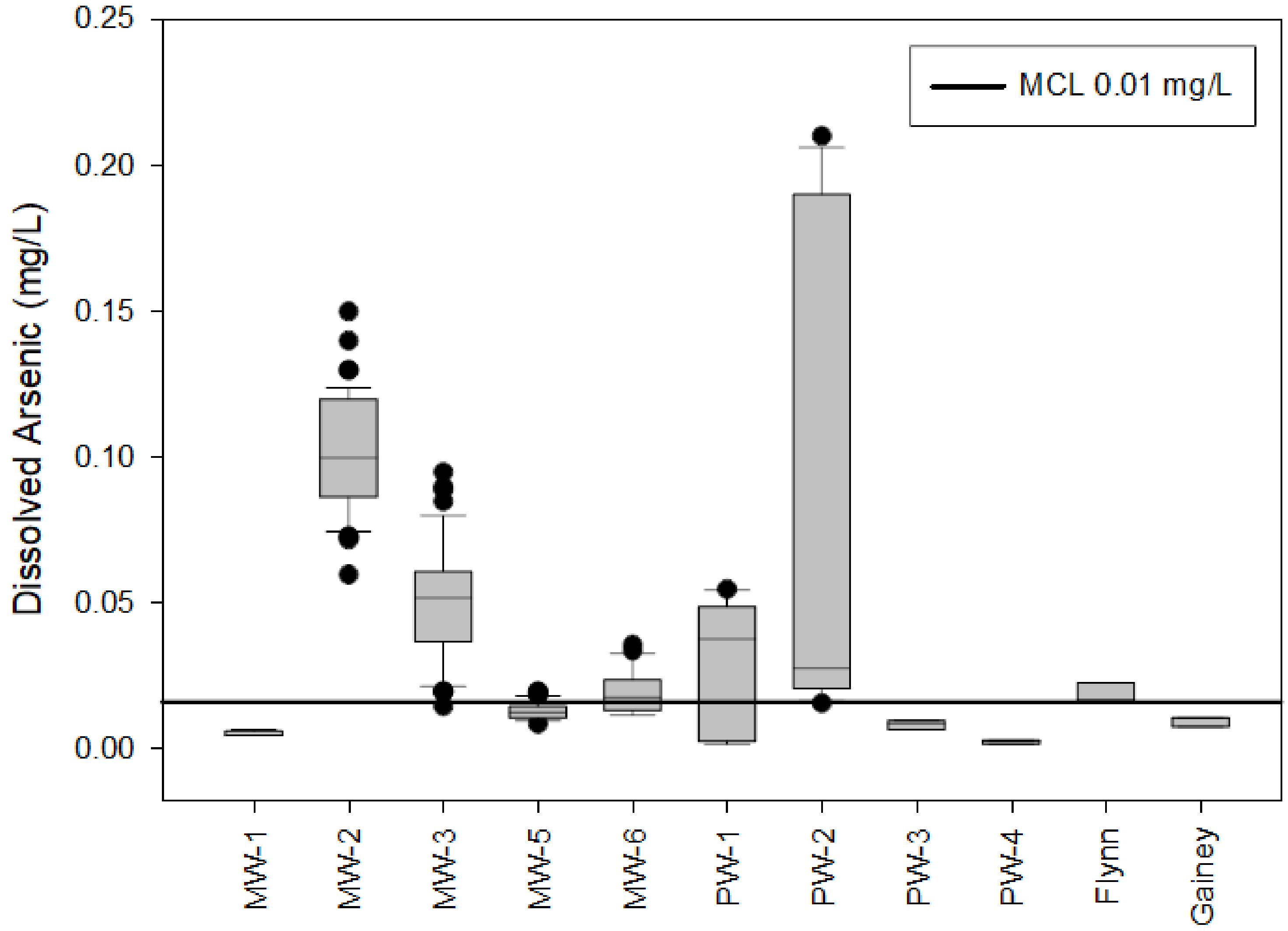
**TOTAL DISSOLVED SOLIDS
IN PROJECT AREA WELLS
Q4 2007 TO Q4 2018**

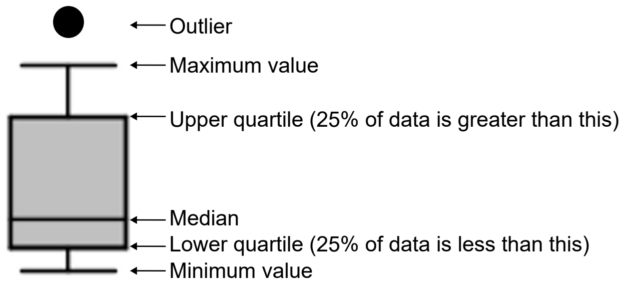
ARCADIS

FIGURE
19

Path:Z:\ArcGisData\GISPROJECTS_ENV\AO000100_Soledad\Illustrators\2019\Figure 18 - Total Dissolved Solids.ai   Last Saved By: JCHEN   Last Saved On: 06/28/2019

Path:Z:\ArcGisData\GISPROJECTS_ENV\AO000100_Soledad\Illustrators\2019\Figure 19 - Dissolved Arsenic.ai   Last Saved By: JCHEN   Last Saved On: 06/28/2019





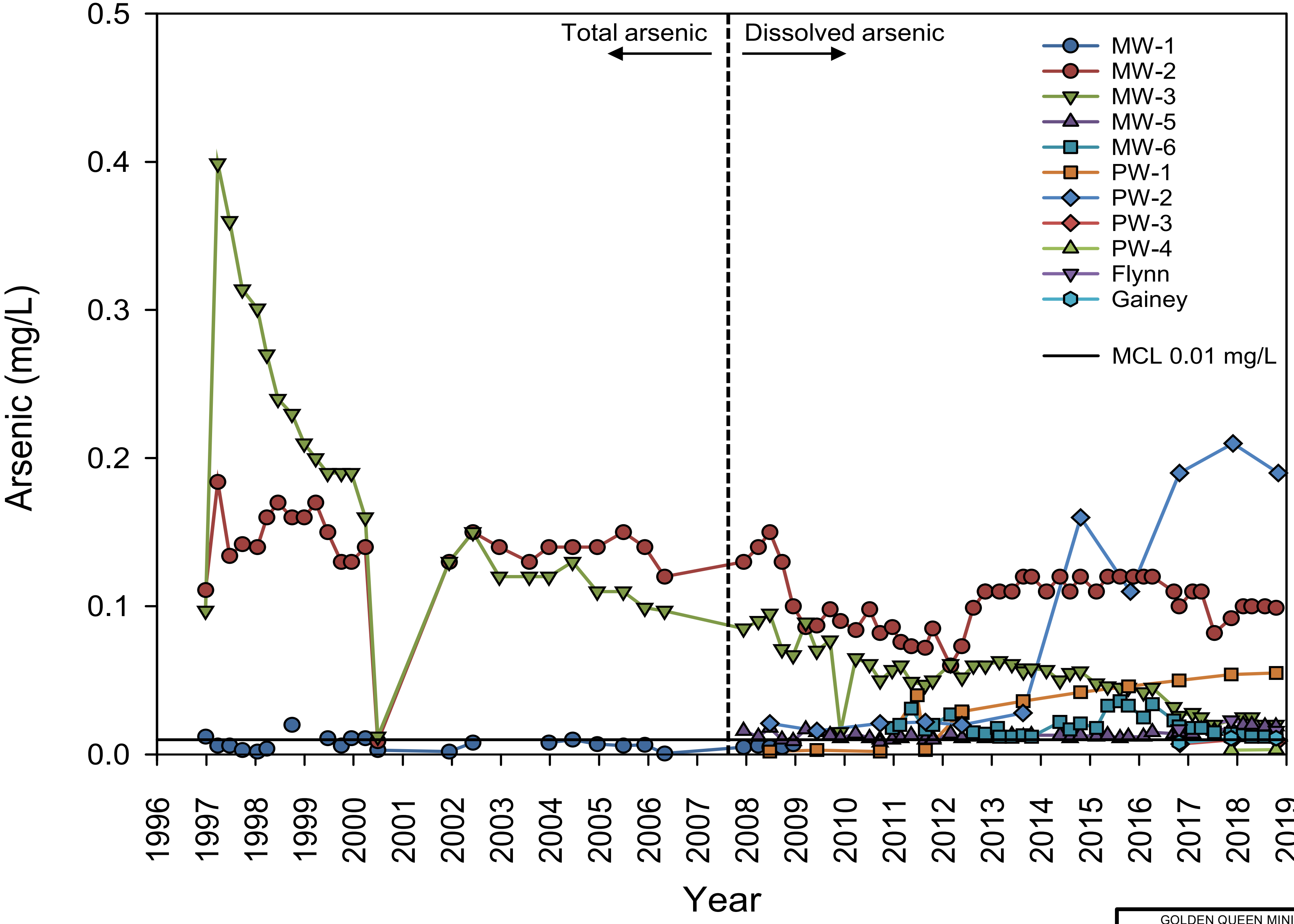
MCL = maximum contaminant level
mg/L = milligrams per liter

GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

DISSOLVED ARSENIC
IN PROJECT AREA WELLS
Q4 2007 TO Q4 2018

ARCADIS

FIGURE
20



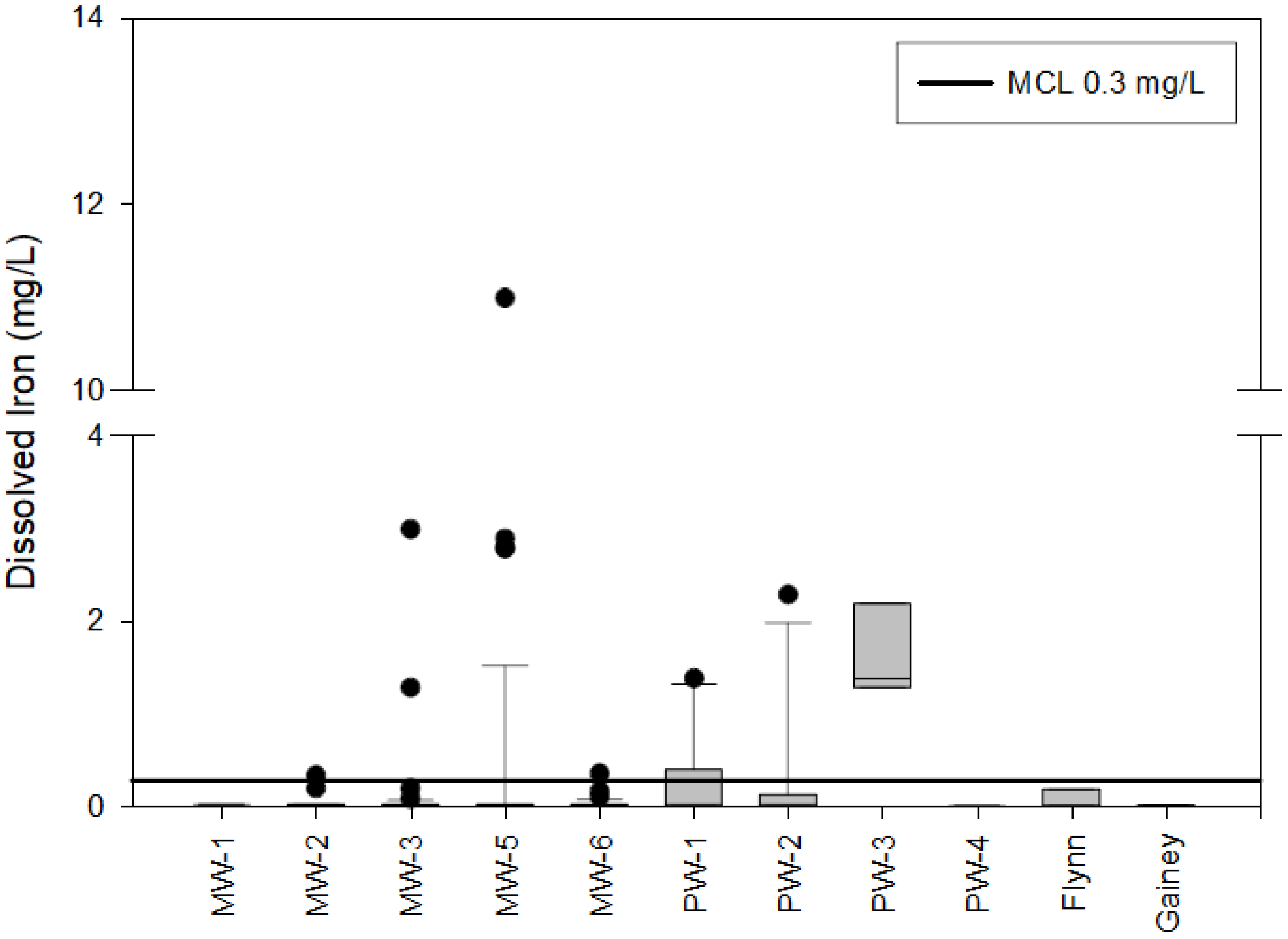
MCL = maximum contaminant level
mg/L = milligrams per liter

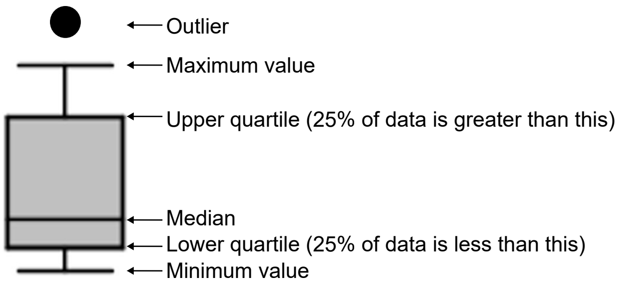
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

ARSENIC OVER TIME IN PROJECT AREA WELLS

ARCADIS

FIGURE
21





MCL = maximum contaminant level
mg/L = milligrams per liter

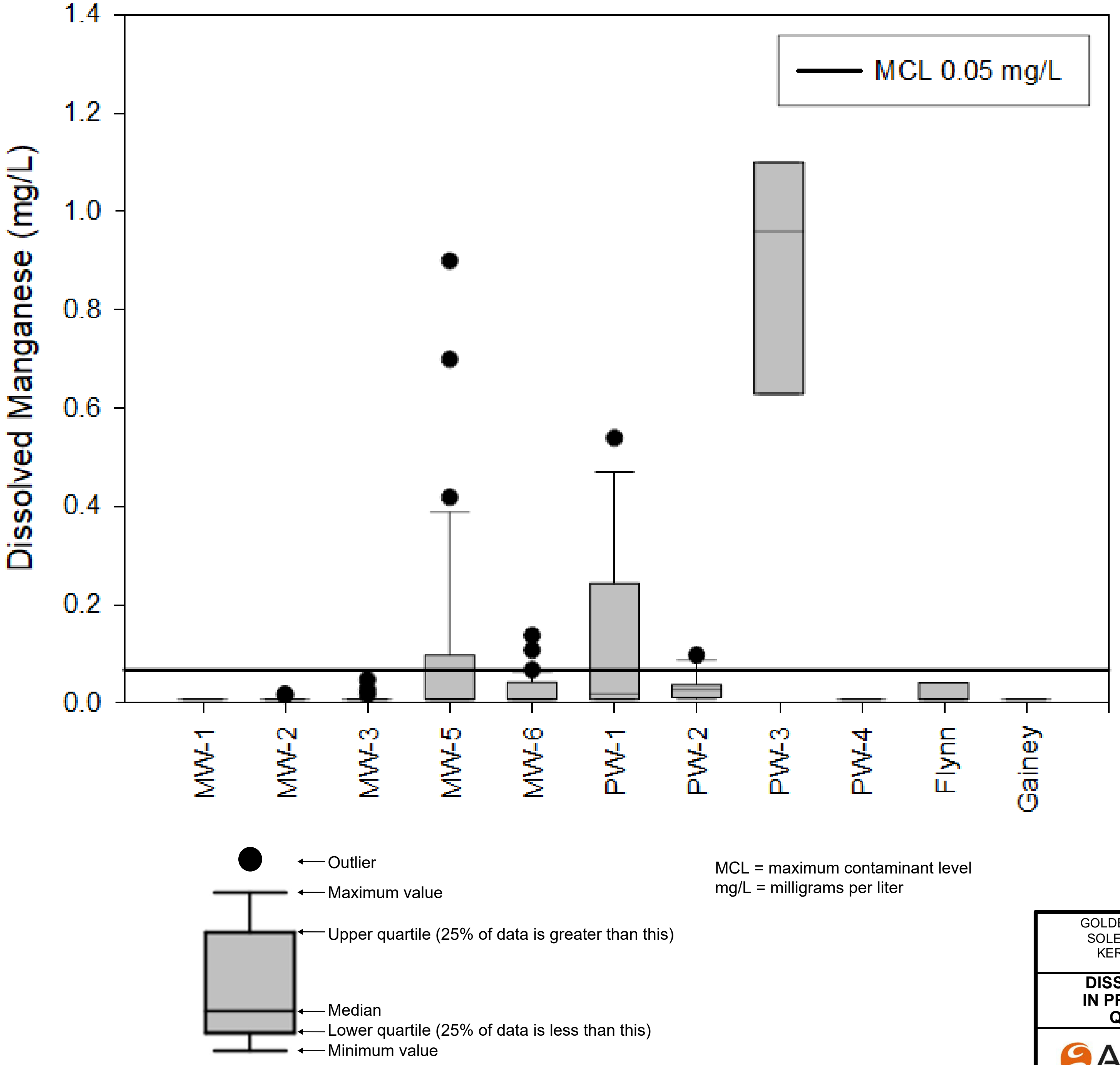
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

DISSOLVED IRON
IN PROJECT AREA WELLS
Q4 2007 TO Q4 2018

ARCADIS

FIGURE
22

Path:Z:\ArcGisData\GISPROJECTS_ENV\AO000100_Soledad\Illustrators\2019\Figure 21 - Dissolved Iron.ai Last Saved By: JCHEN Last Saved On: 06/28/2019



MCL = maximum contaminant level
mg/L = milligrams per liter

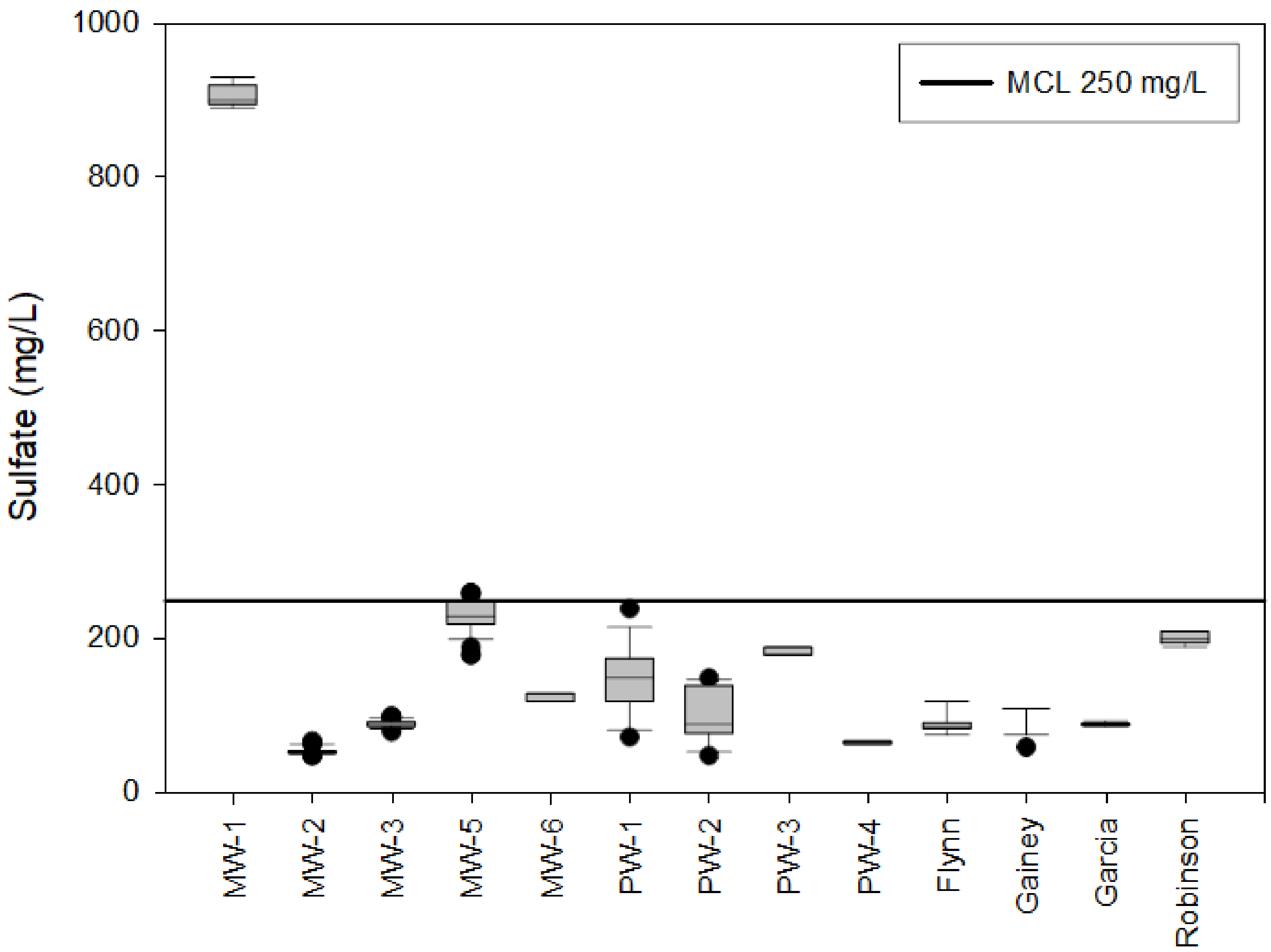
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

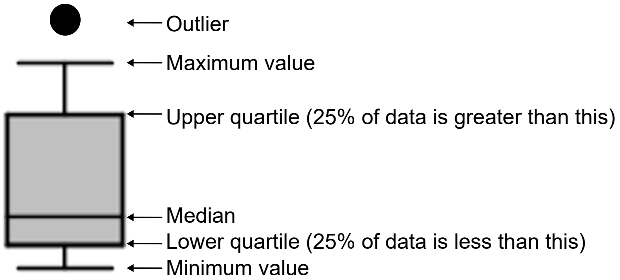
DISSOLVED MANGANESE
IN PROJECT AREA WELLS
Q4 2007 TO Q4 2018

ARCADIS

FIGURE
23

Path:Z:\ArcGisData\GISPROJECTS_ENV\AO000100_Soledad\Illustrators\2019\Figure 22 - Dissolved Manganese.ai   Last Saved By: JCHEN   Last Saved On: 06/28/2019





MCL = maximum contaminant level
mg/L = milligrams per liter

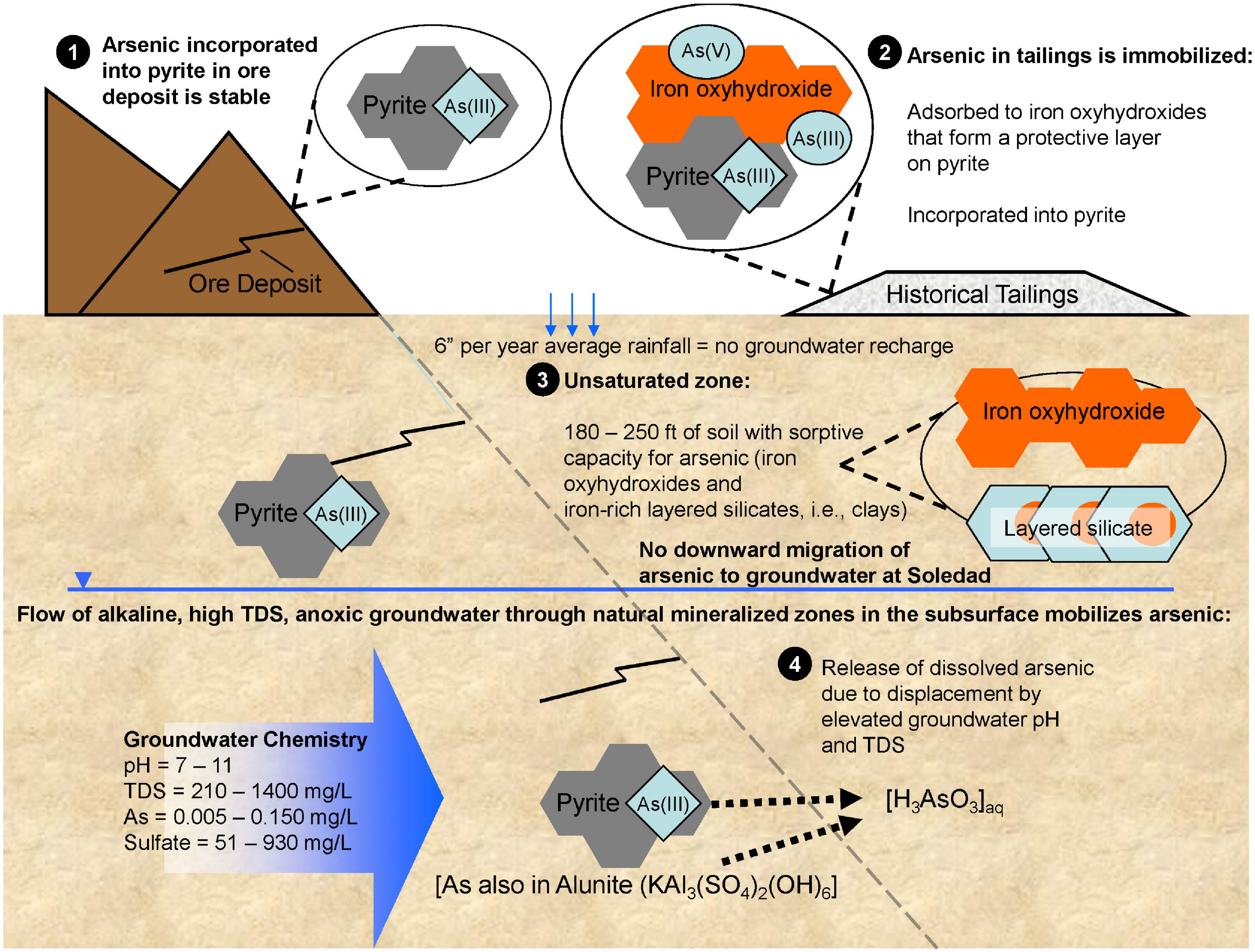
GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

SULFATE
IN PROJECT AREA WELLS
Q4 2007 TO Q4 2018

ARCADIS

FIGURE
24

Path:Z:\ArcGisData\GISPROJECTS_ENV\AO000100_Soledad\Illustrators\2019\Figure 23 - Sulfate.ai   Last Saved By: JCHEN   Last Saved On: 06/28/2019



1 **Arsenic incorporated into pyrite in ore deposit is stable**

2 **Arsenic in tailings is immobilized:**

Adsorbed to iron oxyhydroxides that form a protective layer on pyrite

Incorporated into pyrite

6” per year average rainfall = no groundwater recharge

3 **Unsaturated zone:**

180 – 250 ft of soil with sorptive capacity for arsenic (iron oxyhydroxides and iron-rich layered silicates, i.e., clays)

No downward migration of arsenic to groundwater at Soledad

Flow of alkaline, high TDS, anoxic groundwater through natural mineralized zones in the subsurface mobilizes arsenic:

Groundwater Chemistry
pH = 7 – 11
TDS = 210 – 1400 mg/L
As = 0.005 – 0.150 mg/L
Sulfate = 51 – 930 mg/L

4 Release of dissolved arsenic due to displacement by elevated groundwater pH and TDS

$[H_3AsO_3]_{aq}$

[As also in Alunite $(KAl_3(SO_4)_2(OH)_6)$]

Notes:
mg/L = milligrams per liter
TDS = total dissolved solids

GOLDEN QUEEN MINING CO., LLC
SOLEDAD MOUNTAIN PROJECT
KERN COUNTY, CALIFORNIA

CONCEPTUAL GEOCHEMICAL MODEL FOR ARSENIC IN THE SOLEDAD MOUNTAIN PROJECT AREA

ARCADIS

FIGURE
25

CITY: Boulder, CO DIV/GROUP: AIT PM: T. COX TM: TR: J.CHEN
Project (Project #): AO000100.0012 Path: Z:\GISPROJECTS_ENV\AO000100_Soledad\GIS\ArcMap_MXD\2016\Fig14_ArsenicGeochemModel.mxd Last Saved: 1/7/2016 Saved By: vellingworth

APPENDIX A

Groundwater Levels in Vicinity of the Project

Golden Queen Mining Co.

Groundwater Monitoring Log Sheet

Sampler	Time	Date (DD/MM/YY)	Well ID	SWL (ft-BGS)	PWL (ft-BGS)	Well Flow Rate (gpm)	Well Discharge Pressure (psi)	Comments
N.S.	08:45 Am	23/08/13	PWI	181.25	—	—	—	
N.S.	3:33pm	26/08/13	PWI	—	199.75	± 250	—	
N.S.	07:00 Am	28/08/13	PWI	—	199.25	± 250	—	
N.S.	07:00 Am	29/08/13	PWI	181.50	—	—	—	
N.S.	04:05 Pm	29/08/13	PWI	—	200.00	± 250	—	
	4:05:30 Pm		PWI	190.5	—	—	—	30 sec after shutting
	4:07 pm			184.0				pump off
	4:09 pm			183.50				
	4:12 pm			183.0				
	4:15 pm			182.6				
N.S.	08.00 AM	30/08/13	PWI	181.50	—	—	—	IDLE AFTER ± 12 HOURS
N.S.	05:10 Pm	03/09/13	PWI	—	200.00	± 250	—	
N.S.	06:30 Am	04/09/13	PWI	—	200.00	± 250	—	
N.S.	8:00 Am	16/09/14	PWI	182.5				
N.S.	10:15 AM	20/09/14	PWI	—	236.0	± 250	—	
N.S.	11:00 AM	25/09/14	PWI	183.0				
N.S.	11:30 Am	25/09/14	PWI	—	236.0	± 250	—	
W.A	10:30 am	10-10-14	PWI	184.				
WA	8:45am	10-29-14	PWI	184				
WA	10:00 am	11-4-14	PWI		233			
WA	12:30pm	11-14-14	PWI	184				
WA	10 am	11-20-14	PWI		233			
WA	2 pm	11-28-14	PWI	184				
WA	1 pm	12-5-14	PWI	184				
WA	10 am	12-12-14	PWI	184				
WA	1 pm	12-19-14	PWI	184				
WA	10 am	1-9-15	PWI	184				
WA	11 am	1-23-15	PWI	184				
WA	2pm	1-30-15		184				
WA		2-6-15		184				
WA	10 am	2-13-15			234			
WA	12 am	3-6-15			234			
WA	745	3-13-15			235			
WA	11 am	4-2-15			236	299		
WA	10am	4-10-15			236	297		

*Water Level to be measured to top of concrete well pad.

*SWL = Static Water Level

*PWL = Pumping Water Level

Golden Queen Mining Co.

Groundwater Monitoring Log Sheet

Sampler	Time	Date (DD/MM/YY)	Well ID	SWL (ft-BGS)	PWL (ft-BGS)	Well Flow Rate (gpm)	Well Discharge Pressure (psi)	Comments
N.S.	11:50Am	25/07/13	PW1	—	198.5	± 250	-	
N.S.	7:15 Am	26/07/13	PW1	181.0	-	-	-	
N.S.	3:15 PM	26/07/13	PW1	-	199.0	± 250	-	
N.S.	7:20 AM	29/07/13	PW1	182.0	-	-	-	
N.S.	3:45 Pm	29/07/13	PW1	-	199.0	± 250	-	
N.S.	7:00 Am	30/07/13	PW1	181.0	-	-	-	
N.S.	4:55 PM	30/07/13	PW1	181.5	-	-	-	
N.S.	6:50 AM	31/07/13	PW1	-	199.0	±250	-	
N.S.	3:50 PM	31/07/13	PW1	182.5	-	-	-	
N.S.	6:55 Am	01/08/13	PW1	181.0	-	-	-	
N.S.	2:30 PM	01/08/13	PW1	-	199.0	± 250		
N.S.	7:00 Am	02/08/13	PW1	181.0	-	-	-	
N.S.	1:50 PM	02/08/13	PW1	-	199.0	± 250		
N.S.	7:10 Am	05/08/13	PW1	181.0	-	-		
N.S.	3:48 PM	05/08/13	PW1	-	199.0	± 250		
	3:50 PM		PW1	185.5				
	3:52 PM			182.5				
	4:00 PM			182.0				
N.S.	6:50 AM	06/08/13	PW1	181.0	-	-		
N.S.	3:40 PM	06/08/13	PW1	182.0				
N.S.	6:50 Am	07/08/13	PW1	181.0				
N.S.	3:00 PM	07/08/13	PW1		199.0	± 250		
N.S.	7:35 Am	08/08/13	PW1	181.0	-	-		
N.S.	3:10 PM	08/08/13	PW1		199.0	± 250		
	3:11 pm			185.0				
	3:12 pm			182.5				
	3:13 pm			182.5				
N.S.	7:25 Am	08/09/13	PW1	181.0	—	—		
N.S.	8:07 Am	08/12/13	PW1	181.0	-	-	-	
N.S.	3:25 Pm	08/12/13	PW1	[illegible]	199.0	± 250	-	
N.S.	7:45 Am	08/13/13	PW1	181.0	-	—	—	
N.S.	3:30 PM	08/14/13	PW1	-	199.0	± 250	-	
N.S.	7:35 Am	08/16/13	PW1	-	199.0	± 250	—	
N.S.	4:15 Pm	08/19/13	PW1	—	199.5	± 250	-	
N.S.	7:00 Am	08/21/13	PW1	181.0	-	-	-	
N.S.	2:00 pm	08/21/13	PW1	-	200.0	± 250	-	

*Water Level to be measured to top of concrete well pad.

*SWL = Static Water Level

*PWL = Pumping Water Level

Golden Queen Mining Company

Groundwater Monitoring Log Sheet

Sampler	Time	Date	Well ID	Swl (ft-BGS)	PWL (ft-BGS)	Well Flow Rate GPM
WA	1030	4-24	PW1		236'	291
WA	830	5-1-15	PW1		236'	289
WA	11:25	5-8-15		189'		0
NA	11:00	5-15-15			236.5'	
		5-22-15				
WA	8:15	5-29-15	~~B~~PW1		236'	282
WA	11:00	6-19-15	PW1		237'	
WA	10:00	6-26-15	PW1		237'	
WA		7-20-15	PW1	189'		
WA		9-16-15	PW1		239'	284
WA		9-25-15	PW1	190'		
WA	10 am	10-2-15	PW1	190'		
WA	8:15 am	10-8-15	PW1	189'		
WA		10-16-15		189'		
WA		10-23-15		189'		
[illegible]	3pm	10-29-15			236'	
[illegible]		11-6-15		190		
WA	230	11-13-15			237'	
WA	1230	11-20-15	PW1			
NA		12-4-15		220'		
WA	2:00	12-15-15	PW1		237'	249
WA	11:00	12-22-15	PW1		236'	
WA	9:00	1-8-16	PW1		237'	
WA	9:00	1-29-16	PW1		237'	
WA	10:00	2-12-16	PW1		237'	
WA	12:30	3-10-16	PW1		236'	
WA		3-25-16			237'	
WA/DE		4-6-16	PW1		237'	249
			PW4	324'		
Dle	8:12am	4-13-16	PW1		237	250
Dle	8:30 am	4-13-16	PW4	326		0
Dle	7:45am	4-20-16	PW1		236	252
Dle	8:00am	4-20-16	PW4	325		0
Dle	9:00am	4-27-16	PW1		236	252
Dle	9:15am	4-27-16	PW4	326		0

GOLDEN QUEEN

Groundwater Monitoring Log Sheet

Sampler	Time	Date	Well ID	SWL (Ft-BGS)	PWL (Ft-BGS)	Well Flow Rate (gpm)	Well Discharge Pressure (PSI) Comments
Dle	8:15am	5-3-16	PW1		237	252	
Dle	8:30am	5-3-16	PW2	326		0	was not running
Dle	2:00pm	5-12-16	PW1		236	249	
Dle	2:15pm	5-12-16	PW4	334		0	was not running
Dle	7:00am	5-20-16	PW1	[illegible]	238	243	
Dle	7:15 am	5-20-16	PW4	334		0	was not running
Dle	1:15 pm	5-26-16	PW1		236	239	
Dle	1:30pm	5-26-16	PW4	326		0	was not running
Dle	2:00pm	6-2-16	PW1		237	250	
Dle	2:15pm	6-2-16	PW4	334		0	was not running
Dle	9:00am	6-21-16	PW1		236	242	
Dle	9:15am	6-21-16	PW4	326		0	was not running
Dle	8:23am	7-28-16	PW1	244		0	was not running
Dle	8:45am	7-28-16	PW4		420	427	
JR	1:20P.M.	8-12-16	PW1		238	247	~~NOT RUNNING~~ OR
JR	1:40p.M.	8-12-16	PW4	335 [illegible]		[illegible] 325	
JR	11:00	9-6-16	PW4	335		0	NOT RUNNING - BEING REPAIRED
JR	11:10	9-6-16	PW1		236	236	
JR	10:45	9-12-16	PW1		226	237	
JR	11:00	9-12-16	PW4	326		0	NOT RUNNING
JR	10:00	10-1-16	PW1		238	236	
JR	12:00	10-1-16	PW4	410		0	NOT Running
JR	2:00	10-24-16	PW4	410		0	NOT Running
JR	2:35	10-24-16	PW1		232	234.2	
JR	11:05	11-6-16	PW4	408		0	
JR	11:30	11-6-16	PW1		238	236	
JR	8:00	11-22-16	PW4	410		0	
JR	8:26	11-2216	PW1		235	237.6	
JR	11:32	12-5-16	PW4	410		0	working on generator
JR	11:52	12-5-16	PW1		234	238	
JR	1:00	12-16-16	PW4	416		0	
JR	1:24	12-16-16	PW1		233	235	
JR	8:42	12-23-16	PW4	410		0	
JR	9:06	12-23-16	PW1		238	236	
JR	9:59	1-17-17	PW1		232	234	
JR	10:18	1-17-17	PW4		411	440.1	
JR	12:45	2-1-17	PW4		418	432.1	leaking H20 on ground

*Water Level to be measured to top of concrete well pad.
*SWL = Static Water Level
*PAWL = Pumping Water Level

GOLDEN QUEEN

Groundwater Monitoring Log Sheet

Sampler	Time	Date	Well ID	SWL (Ft-BGS)	PWL (Ft-BGS)	Well Flow Rate (gpm)	Well Discharge Pressure (PSI) Comments
JR	8:52	3/8/17	PW-1		236	223.4	
JR	9:15	3/8/17	PW-4		415	427.4	
JR	1:00	3/17/17	PW-1		234	224.2	
JR	1:32	3/17/17	PW-4		410	425	
JR	2:30	3/28/17	PW-1		238	220.9	
JR	3:12	3/28/17	PW-4		414	417.8	
JR.	1:12	4/4/17	PW-1		236	222.4	
JR	1:30	4/4/17	PW-4		412	416	
Dle	9:00	4-13-17	PW-1		236	220	
Dle	9:20	4-13-17	PW-4		380	0	
JR	10:03	4-20-17	PW-1		235	222.6	
JR	10:22	4-20-17	PW-4		414	416.9	
JR	12:00	4-27-17	PW-1		235	223.2	
JR	12:26	4-27-17	PW-4		412	415.4	
JR	10:00	5-5-17	PW-1		234	221.4	
JR	10:22	5-5-17	PW-4		410	426.3	
JR	0800	5-19-17	PW-1		236	218	
JR	0824	5-19-17	PW-4		416	412	
JR	1:00	6-2-17	PW-1		234	220	
JR	1:24	6-2-17	PW-4		412	415	
JR	9:05	6-16-17	PW-1		235	222	
JR	9:22	6-16-17	PW-4		415	418	
JR	11:03	6-23-17	PW-1		236	223	
JR	11:26	6-23-17	PW-4		414	424	
JR	7:38	6-28-17	PW-1		236	220.3	
JR	7:53	6-28-17	PW-4		418	411.8	
JR	6:41	7/7/17	PW-1		236	211	
JR	6:56	7/7/17	PW-4	334		0	NOT RUNNING
JR	6:44	7/14/17	PW-1		236	213	
JR	7:00	7/14/17	PW-4		418	409	
JR	10:25	7/21/17	PW-1		236	214.5	
JR	10:43	7/21/17	PW-4		418	401.5	
JR	9:00	7/28/17	PW-4		414	413.1	
JR	2:30	7/28/17	PW-1		236	211	
JR	6:43	8/4/17	PW-1	200		0	NOT RUNNING
JR	6:55	8/4/17	PW-4		420	410	
JR	4:33	8/11/17	PW-1		238	211	
JR	4:45	8/11/17	PW-4		418	415	
JR	8:20	8/15/17	PW-1		236	220	
JR	8:30	8/15/17	PW-4		418	403	

*Water Level to be measured to top of concrete well pad.
*SWL = Static Water Level
*PAWL = Pumping Water Level

K:/mydoc/denglish/forms/Groundwater Monitoring Log Sheet

GOLDEN QUEEN

Groundwater Monitoring Log Sheet

Sampler	Time	Date	Well ID	SWL (Ft-BGS)	PWL (Ft-BGS)	Well Flow Rate (gpm)	Well Discharge Pressure (PSI) Comments
JR	10:20	8/25/17	PW-1		235	214	
JR	10:30	8/25/17	PW-4		418	412	
JR	12:35	8/31/17	PW-1		236	214	
JR	12:46	8/31/17	PW-4		418	404	
JR	0800	9/1/17	PW-1		236	212	
JR	0817	9/1/17	PW-4		418	414	
JR	1:00	9/8/17	PW-1		235	216	
JR	1:17	9/8/17	PW-4		416	408	
JR	9:14	9/15/17	PW-1		236	214	
JR	9:28	9/15/17	PW-4		418	416	
JR	2:00	9/22/17	PW-1		234	212	
JR	2:19	9/22/17	PW-4		420	412	
JR	11:17	9/29/17	PW-1		235	214	
JR	11:34	9/29/17	PW-4		416	408	
JR	10:12	10/6/17	PW-1		236	214	
JR	10:28	10/6/17	PW-4		418	414	
Dle	9:30	10-13-17	PW-1		234	212	
Dle	9:45	10-13-17	PW-4	332			Not Running
Dle	1:00	10-16-17	PW-1		236	214	
Dle	1:15	10-16-17	PW-4	333			Not Running
J.R.	10:00	10-27-17	PW-1		235	212	
J.R	10:22	10-27-17	PW-4		420	416	
J.R.	9:00	11-3-17	PW-1		234	212	
J.R.	9:17	11-3-17	PW-4		416	410	
J.R.	11:10	11-10-17	PW-1		236	214	
J.R.	11:30	11-10-17	PW-4		418	414	
J.R.	7:00	11-16-17	PW-1	204			NOT RUNNING
J.R.	7:17	11-16-17	PW-4	334			NOT RUNNING
J.R.	10:00	11-23-17	PW-1		234	212	
J.R.	10:17	11-23-17	PW-4		420	416	
J.R.	12:03	11-30-17	PW-1		236	214	
J.R.	12:22	11-30-17	PW-4		418	414	
J.R.	8:00	12-1-17	PW-1		234	214	
J.R	8:22	12-1-17	PW-4		418	416	
J.R.	12:00	12-8-17	PW-1		236	212	
J.R	12:21	12-8-17	PW-4		420	414	
J.R.	9:30	12-15-17	PW-1		234	212	
J.R	9:48	12-19-17	PW-4	334			NOT RUNNING
J.R.	11:19	12-22-17	PW-1		235	216	
J.R.	11:37	12-22-17	PW-4		416	408	

*Water Level to be measured to top of concrete well pad.
*SWL = Static Water Level
*PAWL = Pumping Water Level

Groundwater Monitoring Log Sheet

Sampler	Time	Date	Well ID	SWL (Ft-BGS)	PWL (Ft-BGS)	Well Flow Rate (gpm)	Well Discharge Pressure (PSI) Comments
J.R.	8:05	12-29-17	PW-1		234	212	
J.R.	8:19	12-29-17	PW-4		416	410	
J.R.	7:30	1-5-18	PW-1		235	212	
J.R.	7:56	1-5-18	PW-4		418	416	
J.R.	2:00	1-12-18	PW-1		234	212	
J.R.	2:17	1-12-18	PW-4		418	412	
J.R.	9:07	1-19-18	PW-1		236	214	
J.R.	9:18	1-19-18	PW-4		418	414	
J.R.	10:02	1-26-18	PW-1		236	216	
J.R.	10:22	1-26-18	PW-4		418	416	
J.R.	1:00	2-2-18	PW-1		234	212	
J.R.	1:18	2-2-18	PW-4		416	412	
J.R.	12:00	2-9-18	PW-1		235	204	
J.R.	12:17	2-9-18	PW-4		412	385	
J.R.	11:08	2-16-18	PW-1		234	203	
J.R.	11:22	2-16-18	PW-4		400	376	
J.R.	2:12	2-23-18	PW-1		234	206	
J.R.	2:24	2-23-18	PW-4		388	374	
J.R.	8:30	2-28-18	PW-1		233	202	
J.R.	9:02	2-28-18	PW-4		388	371	
J.R.	11:08	3-17-18	PW-1		235	206	
J.R.	11:32	3-17-18	PW-4		386	374	
J.R.	10:00	4-16-18	PW-1		233	204	
J.R.	10:19	4-16-18	PW-4		400	371	
Dle	7:53am	5-30-18	PW-1	202		0	Not Running
Dle	8:08am	5-30-18	PW-4	333	[redacted]	0	Not Running
J.R.	6:49am	6-11-18	PW-4	334		0	NOT RUNNING
J.R.	7:03a.m.	6-11-18	PW-1		236	207	
Dle	8:27am	7-24-18	PW-1	204			NOT Running
Dle	8:52am	7-24-18	PW-4		416	409	
J.R.	11:30 a.m.	8-17-18	PW-4		418	402	
J.R.	1200	8-17-18	PW-1		238	190	
Dle	1:20 pm	9-27-18	PW-1	[redacted]	230	97	
J.R.	2:00 p.m.	9/27/18	PW-4		412	378	
J.R.	7:31 a.m.	10/24/18	PW-1		235	194	
J.R.	7:42am	10/24/18	PW-4		342	390	
J.R.	1:00	11/1/18	PW-1		238	190	
J.R.	1:20	11/1/18	PW-4		412	378	
J.R.	11:00	12/27/18	PW-1		234	194	
J.R.	11:17	12/27/18	PW-4		416	390	

*Water Level to be measured to top of concrete well pad.
*SWL = Static Water Level
*PAWL = Pumping Water Level

GOLDEN QUEEN

Groundwater Monitoring Log Sheet

Sampler	Time	Date	Well ID	SWL (Ft-BGS)	PWL (Ft-BGS)	Well Flow Rate (gpm)	Well Discharge Pressure (PSI) Comments
DLe	7:38am	1-29-19	PW-1	202		0	Not Running
DLe	7:55am	1-29-19	PW-2	336		0	Not Running
J.R.	10:00 a.M	2/15/19	PW-1		238	194	
J.R.	10:20 a.M	2/15/19	PW-4		418	402	
J.R.	8:05 a.m.	3/20/19	PW-1		235	204	
J.R.	8:20 a.m.	3/20/19	PW-4		388	374	
DLe	7:15am	5/8/19	PW-1		236	187.2	
DLe	7:45am	5/8/19	PW-4	333		0	Not Running

*Water Level to be measured to top of concrete well pad.
*SWL = Static Water Level
*PAWL = Pumping Water Level

K:/mydoc/denglish/forms/Groundwater Monitoring Log Sheet

Well	Date	Depth to Water (ft)	Water Level Elevation (ft)
Map ID: MW-3 ***Top of Casing Elev. (ft): 2835.86***	12/26/1996	253.6	2582.26
	3/26/1997	253.5	2582.36
	6/23/1997	254.1	2581.76
	9/25/1997	254.01	2581.85
	1/15/1998	251	2584.86
	3/26/1998	254.22	2581.64
	6/17/1998	254.5	2581.36
	9/29/1998	254.5	2581.36
	12/29/1998	254.53	2581.33
	3/25/1999	254.69	2581.17
	6/22/1999	254.73	2581.13
	10/1/1999	254.65	2581.21
	12/15/1999	254.68	2581.18
	3/28/2000	254.78	2581.08
	6/28/2000	254.98	2580.88
	12/12/2001	255.59	2580.27
	6/6/2002	255.5	2580.36
	12/19/2002	255.82	2580.04
	7/31/2003	255.91	2579.95
	12/23/2003	256.11	2579.75
	6/17/2004	257.1	2578.76
	12/16/2004	256.43	2579.43
	6/29/2005	256.43	2579.43
	12/6/2005	256.56	2579.3
	5/2/2006	256.62	2579.24
Map ID: PW-1 ***Top of Casing Elev.(ft): 2760.28***	5/2/1997	177.5	2582.78
	9/25/1997	177.5	2582.78
	3/26/1998	177.7	2582.58
	5/2/2006	178.95	2581.33
Map ID: 1 ***State Well ID: 10N13W32M001S*** ***Reference Point Elev.(ft): 2740***	3/1/1962	172.08	2567.92
	11/7/1962	185.02	2554.98
	3/4/1964	190	2550
	10/8/1964	211.61	2528.39
	3/15/1965	202.17	2537.83
Map ID: 2 ***State Well ID: 10N13W19M001S*** ***Reference Point Elev.(ft): 2905***	11/4/1976	316.33	2588.67
	3/7/1977	316.49	2588.51
	10/12/1977	316.69	2588.31
	3/27/1978	316.8	2588.2
	10/17/1978	316.56	2588.44
	2/28/1979	316.59	2588.41
	10/24/1979	317.15	2587.85
	4/16/1980	317.18	2587.82
	10/15/1980	316.97	2588.03
	4/17/1981	316.83	2588.17
	11/19/1981	317.23	2587.77
	2/18/1982	317.27	2587.73
	10/6/1982	317.32	2587.68
	4/26/1983	317.25	2587.75
	10/27/1983	317.28	2587.72
	3/5/1984	317.23	2587.77

Well	Date	Depth to Water (ft)	Water Level Elevation (ft)
	10/30/1984	317.2	2587.8
	3/25/1985	317.13	2587.87
	10/30/1985	317.28	2587.72
	3/25/1986	317.14	2587.86
	10/22/1986	317.2	2587.8
	2/23/1987	316.81	2588.19
	11/3/1987	317.3	2587.7
	3/28/1988	317.33	2587.67
	3/23/1989	317.89	2587.11
	10/19/1989	319.47	2585.53
Map ID: 3 ***State Well ID: 10N12W20C006S*** ***Reference Point Elev.(ft): 2655***	3/7/1977	104.19	2550.81
	3/27/1978	101.6	2553.4
	4/23/1980	107.56	2547.44
	4/17/1981	104.59	2550.41
	2/18/1982	107.11	2547.89
	4/14/1983	106.36	2548.64
	3/5/1984	106.24	2548.76
	3/25/1985	106.51	2548.49
	3/25/1986	106.98	2548.02
	2/23/1987	107.85	2547.15
	3/28/1988	107.04	2547.96
	3/23/1989	107.38	2547.62
	3/15/1990	107.62	2547.38
	3/22/1991	109.2	2545.8
	4/16/1992	108.7	2546.3
	4/21/1993	108.68	2546.32
	4/11/1994	108.75	2546.25
	4/20/1995	109.2	2545.8
	3/3/1997	109.77	2545.23
	3/19/1998	111.87	2543.13
	3/18/1999	111.25	2543.75
Map ID: 5 ***State Well ID: 10N12W12K001S*** ***Reference Point Elev.(ft): 2520***	9/14/1978	82.32	2437.68
	2/28/1979	82.03	2437.97
	4/18/1980	81.83	2438.17
	4/24/1981	81.78	2438.22
	2/18/1982	81.71	2438.29
	4/14/1983	81.81	2438.19
	3/6/1984	81.91	2438.09
	3/25/1985	81.43	2438.57
	3/25/1986	82.81	2437.19
	2/22/1987	83.02	2436.98
	3/28/1988	84	2436
	3/23/1989	84.1	2435.9
	3/15/1990	84.24	2435.76
	3/21/1991	84.56	2435.44
	4/16/1992	85.65	2434.35
	4/20/1993	85.68	2434.32
	4/12/1994	86.18	2433.82
	4/20/1995	86.56	2433.44
	4/19/1996	87.52	2432.48

Well	Date	Depth to Water (ft)	Water Level Elevation (ft)
	3/3/1997	86.22	2433.78
	3/17/1998	85.87	2434.13
	3/18/1999	86.33	2433.67
Map ID: 7 ***State Well ID: 11N13W36K001S*** ***Reference Point Elev.(ft): 2888***	9/28/1955	281.79	2606.21
	4/13/1967	282.98	2605.02
	4/2/1968	283.25	2604.75
	4/16/1969	298.35	2589.65
	3/16/1970	303.24	2584.76
	3/20/1970	303.38	2584.62
	3/16/1971	285.6	2602.4
Map ID: 9 ***State Well ID: 11N13W36C001S*** ***Reference Point Elev.(ft): 2910***	9/28/1955	301.8	2608.2
	4/13/1967	300.91	2609.09
Map ID: 11 ***State Well ID: 11N13W29M001S*** ***Reference Point Elev.(ft): 3350***	11/4/1976	331.91	3018.09
	3/7/1977	335.9	3014.1
	10/12/1977	333.96	3016.04
	3/30/1978	335.02	3014.98
	10/17/1978	336.19	3013.81
	12/4/1978	335.68	3014.32
	2/14/1979	332.6	3017.4
	10/24/1979	307.42	3042.58
	3/26/1980	304.02	3045.98
	10/15/1980	301.55	3048.45
	4/17/1981	302.65	3047.35
	10/14/1981	305.75	3044.25
	11/19/1981	306.45	3043.55
	12/1/1981	306.69	3043.31
	12/9/1981	306.8	3043.2
	1/11/1982	307.45	3042.55
	2/11/1982	308.25	3041.75
	3/3/1982	308.69	3041.31
	4/2/1982	309.23	3040.77
	4/26/1982	309.8	3040.2
	5/24/1982	310.51	3039.49
	6/24/1982	311.1	3038.9
	7/22/1982	311.73	3038.27
	8/23/1982	312.57	3037.43
	9/21/1982	313.17	3036.83
	10/18/1982	313.75	3036.25
	11/15/1982	314.36	3035.64
	12/21/1982	315	3035
	1/18/1983	315.54	3034.46
	2/16/1983	316.24	3033.76
	3/16/1983	316.66	3033.34
	4/12/1983	317.15	3032.85
	5/10/1983	317.7	3032.3
	6/9/1983	318.13	3031.87
	7/7/1983	316.94	3033.06
	8/9/1983	309.27	3040.73
	9/6/1983	304	3046
	10/6/1983	301.02	3048.98

Well	Date	Depth to Water (ft)	Water Level Elevation (ft)
	11/8/1983	298.73	3051.27
	12/6/1983	297.4	3052.6
	1/11/1984	295.42	3054.58
	2/6/1984	293.59	3056.41
	3/10/1984	291.08	3058.92
	4/4/1984	288.58	3061.42
	5/2/1984	285.74	3064.26
	5/30/1984	283.17	3066.83
	6/27/1984	281.19	3068.81
	7/27/1984	279.98	3070.02
	8/29/1984	279.09	3070.91
	9/29/1984	278.6	3071.4
	11/1/1984	278.4	3071.6
	11/28/1984	278.47	3071.53
	12/20/1984	278.46	3071.54
	1/14/1985	278.79	3071.21
	7/10/1985	282.15	3067.85
	8/7/1985	282.68	3067.32
	8/30/1985	283.2	3066.8
	9/28/1985	283.7	3066.3
	11/7/1985	284.6	3065.4
	3/25/1986	287.09	3062.91
	2/22/1987	295.95	3054.05
	3/28/1988	306.76	3043.24
	3/22/1989	315.39	3034.61
	10/19/1989	319.68	3030.32
	3/14/1990	322.26	3027.74
	10/15/1990	325.36	3024.64
	3/22/1991	327.6	3022.4
	10/21/1991	330.24	3019.76
	4/16/1992	332.57	3017.43
	11/2/1992	335.14	3014.86
	4/19/1993	336.93	3013.07
	11/17/1993	323.28	3026.72
	4/12/1994	312.72	3037.28
	10/27/1994	311.83	3038.17
	4/19/1995	308.59	3041.41
	12/6/1995	287.97	3062.03
	4/18/1996	289.58	3060.42
	11/13/1996	293.95	3056.05
	3/3/1997	297.35	3052.65
	11/17/1997	305.49	3044.51
	3/18/1998	308.99	3041.01
	11/4/1998	289.05	3060.95
	3/17/1999	288.23	3061.77
	11/16/1999	292.88	3057.12
Map ID: 13 ***State Well ID: 11N12W26J001S***	3/30/1978	176.74	2417.26
	2/14/1979	175.99	2418.01
	3/26/1980	165.27	2428.73

Well	Date	Depth to Water (ft)	Water Level Elevation (ft)
Reference Point Elev.(ft): 2594	4/17/1981	174.76	2419.24
	2/18/1982	174.29	2419.71
	4/14/1983	173.8	2420.2
	3/6/1984	173.32	2420.68
	3/26/1985	172.8	2421.2
	3/26/1986	172.54	2421.46
	2/22/1987	171.04	2422.96
Map ID: 14 ***State Well ID: 11N13W24A001S*** ***Reference Point Elev.(ft): 2840***	12/5/1952	250	2590
	2/14/1974	248.5	2591.5
	2/5/1975	248.4	2591.6
Map ID: 5 ***State Well ID: 11N13W19C001S*** ***Reference Point Elev.(ft): 3610***	11/4/1976	333.7	3276.3
	3/7/1977	335.55	3274.45
	10/12/1977	340.87	3269.13
	3/30/1978	344.69	3265.31
	11/6/1978	232.8	3377.2
	2/14/1979	238.45	3371.55
	10/24/1979	242.69	3367.31
	3/26/1980	255.77	3354.23
	10/15/1980	253.3	3356.7
	4/17/1981	261.49	3348.51
	11/19/1981	275.58	3334.42
	2/19/1982	282.2	3327.8
	10/6/1982	308.81	3301.19
	4/27/1983	207.4	3402.6
	10/27/1983	180.88	3429.12
	3/5/1984	186.78	3423.22
	10/31/1984	222.95	3387.05
	3/25/1985	225.68	3384.32
	10/30/1985	226.06	3383.94
	3/25/1986	249	3361
	10/23/1986	263.5	3346.5
	2/22/1987	268.36	3341.64
	11/4/1987	288.76	3321.24
	3/28/1988	310.53	3299.47
	3/22/1989	334.44	3275.56
	10/19/1989	341.1	3268.9
	3/14/1990	344.1	3265.9
	10/15/1990	348.19	3261.81
	3/22/1991	351.33	3258.67
	10/21/1991	354.18	3255.82
	4/16/1992	356.53	3253.47
	4/19/1993	253.12	3356.88
	4/20/1993	250.47	3359.53
	11/17/1993	219.2	3390.8
	4/12/1994	220.73	3389.27
	10/27/1994	250.42	3359.58
	4/19/1995	223.6	3386.4
	12/6/1995	235.7	3374.3
	4/18/1996	248.32	3361.68
	11/13/1996	256.98	3353.02

Well	Date	Depth to Water (ft)	Water Level Elevation (ft)
	3/3/1997	262.95	3347.05
	11/17/1997	273.26	3336.74
	3/18/1998	276.89	3333.11
	11/4/1998	256.75	3353.25
	3/17/1999	261.59	3348.41
	11/16/1999	269.96	3340.04
Map ID: 16 ***State Well ID: 11N12W14D001S*** ***Reference Point Elev.(ft): 2705.4***	12/12/1929	267.5	2437.9
	2/28/1930	268.2	2437.2
Map ID: 18 ***State Well ID: 11N12W12M001S*** ***Reference Point Elev.(ft): 2695***	11/4/1976	272.61	2422.39
	3/9/1977	272.91	2422.09
	10/12/1977	273.17	2421.83
	3/30/1978	273.28	2421.72
	11/6/1978	273.5	2421.5
	2/14/1979	273.92	2421.08
	10/24/1979	273.81	2421.19
	3/26/1980	273.85	2421.15
	10/15/1980	274.06	2420.94
	4/17/1981	274.21	2420.79
	11/19/1981	274.34	2420.66
	2/19/1982	274.47	2420.53
Map ID: 29 ***State Well ID: 10N12W13H001S*** ***Reference Point Elev.(ft): 2505***	3/9/1977	61.55	2443.45
	3/30/1978	60.71	2444.29
	2/28/1979	60.15	2444.85
	4/18/1980	59.65	2445.35
	4/24/1981	59.28	2445.72
	2/18/1982	59.19	2445.81
	4/14/1983	59.15	2445.85
	3/6/1984	59.06	2445.94
	3/25/1985	58.93	2446.07
	3/25/1986	59.08	2445.92
	2/22/1987	59.42	2445.58
	3/28/1988	60.12	2444.88
	3/23/1989	60.62	2444.38
	3/15/1990	61.15	2443.85
	3/21/1991	61.74	2443.26
	4/16/1992	62.25	2442.75
	4/19/1993	59.62	2445.38
	4/12/1994	62.7	2442.3
	4/20/1995	62.88	2442.12
	4/18/1996	63.07	2441.93
	3/3/1997	63.27	2441.73
	3/17/1998	63.46	2441.54
	3/18/1999	63.57	2441.43
Map ID: 31 ***State Well ID: 10N12W22J001S*** ***Reference Point Elev.(ft): 2530***	3/7/1977	40.4	2489.6
	3/30/1978	40.27	2489.73
	2/28/1979	40.19	2489.81
	4/18/1980	40.85	2489.15
	4/24/1981	41.05	2488.95
	2/18/1982	41.18	2488.82
	4/14/1983	42.67	2487.33

Well	Date	Depth to Water (ft)	Water Level Elevation (ft)
	3/5/1984	41.8	2488.2
	3/25/1985	41.78	2488.22
	3/25/1986	42.16	2487.84
	2/22/1987	43.01	2486.99
	3/28/1988	43.14	2486.86
	3/23/1989	43.73	2486.27
	3/15/1990	44.34	2485.66
	3/21/1991	44.63	2485.37
	4/16/1992	44.77	2485.23
	4/19/1993	44.59	2485.41
	4/11/1994	45.15	2484.85
	4/20/1995	45.15	2484.85
	4/19/1996	47.14	2482.86
	3/3/1997	45.96	2484.04
	3/16/1998	45.95	2484.05
	3/18/1999	46.63	2483.37
Map ID: 35 ***State Well ID: 11N12W22F002S*** ***Reference Point Elev.(ft): 2663***	3/9/1977	253.13	2409.87
	3/30/1978	252.48	2410.52
	2/14/1979	251.9	2411.1
	3/26/1980	251.52	2411.48
	4/17/1981	250.74	2412.26
	2/18/1982	250.1	2412.9
	4/14/1983	250	2413
	3/6/1984	248.81	2414.19
	3/26/1985	248.29	2414.71
	3/26/1986	248.07	2414.93
	2/22/1987	247.02	2415.98
	3/28/1988	246.82	2416.18
	3/22/1989	245.92	2417.08
	3/14/1990	245.81	2417.19
	3/22/1991	245.64	2417.36
	4/16/1992	244.84	2418.16
	4/19/1993	244.41	2418.59
	4/13/1994	244.04	2418.96
	6/16/1995	243.39	2419.61
	4/18/1996	243.39	2419.61
	3/4/1997	243.38	2419.62
	3/17/1998	242.73	2420.27
	3/17/1999	242.53	2420.47

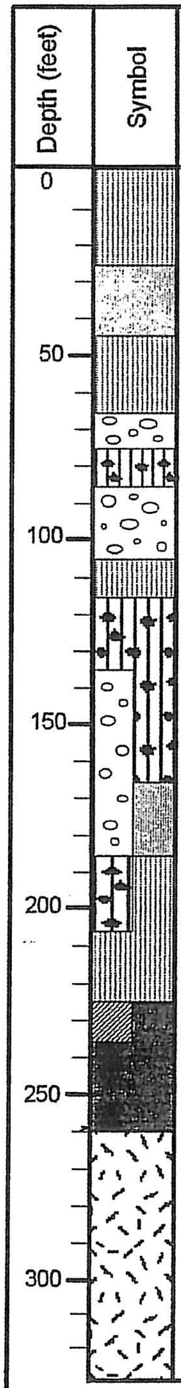
APPENDIX B

Well Logs, Construction Diagrams, and Production Well Pumping Logs

Earth Systems Consultants
Southern California

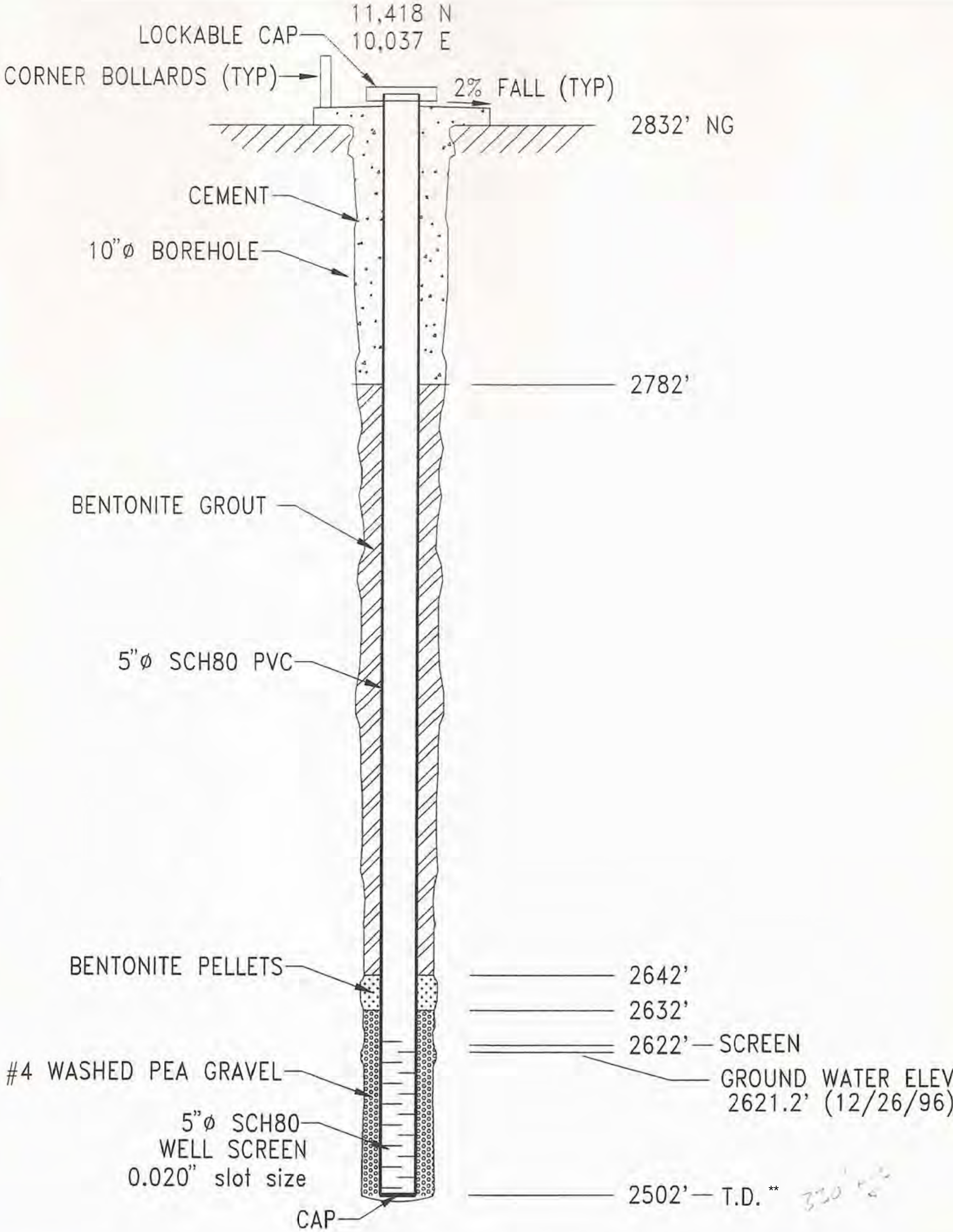
GEOLOGIC WELL LOG MW-1

Project: Golden Queen Mine	**Date(s) Drilled:** 9/26&27/96	**Sheet** 1 **of** 1
Project No.: SG-4754-L01	**Location:** Mine Grid: 11,418N, 10,037E Elev. TOC 2,834', Ground Surface 2,832'	**Diameter of Hole:** ~10"
Drill Rig Type: Mud Rotary	**Drilled By:** Bryant Pump and Drilling	**Logged By:** DCS



Descriptions	Soil Type USCS Class.
light orange brown silty fine to medium sand with gravel **Alluvium**	SM
light yellow brown coarse sand with gravel (volcanic rock and quarts fragments)	SP
light orange brown silty fine to coarse sand	SM
light orange brown silty medium to coarse sand	
light yellow brown sandy gravel (volcanic rock fragments)	GP
light yellow brown sandy/silty gravel	GM
light yellow brown sandy gravel	GP
light yellow brown silty sand with gravel	SM
light yellow brown silty gravel with sand	GM
light yellow brown sandy gravel with silt	GP/GM
light orange brown sandy gravel with silt	
light yellow brown sandy gravel/gravelly sand	GP/SP
light orange brown silty/sandy gravel	GM/SM
light orange brown silty sand with gravel	SM
olive brown sandy clay with gravel	CL/SC
olive brown clayey sand	SC
moderate brown clayey sand with gravel	
light bluish gray volcanic rock (quartz latite?) **Bedrock**	
few small pyrite crystals	

Total depth 330 feet
Depth to groundwater 225 feet on October 1, 1996
Log based on cutting samples collected by driller every 10 feet, actual stratification may be more complex than represented by this log, geologist not present to observe drilling conditions.



A-1

**As originally constructed, Well MW-1 had a relatively large screen interval and a water column of ~118ft. In order to improve the efficiency of well purging and monitoring tasks, Earth System Consultants recommended in Jan 1997 that the lower portion of the Well be sealed with cement. On 3/18/1997, Bryant Pump and Supply sealed the lower 74 feet of Well MW-1 with cement reducing the total depth from 330 feet to 256 feet.

SCALE: NONE	
DESIGNED BY: TK Casagranda	DATE 10/03/96
DRAFTED BY: GC Sande	01/21/97
APPROVED:	
REVISED	
APPROVED	
REVISED	
APPROVED	

Golden Queen
MINING CO. INC.

MONITOR WELL MW-1
AS-BUILT DIAGRAM

DRAWING NUMBER:
970121-A

DRAWING NAME:
MW-1.DWG

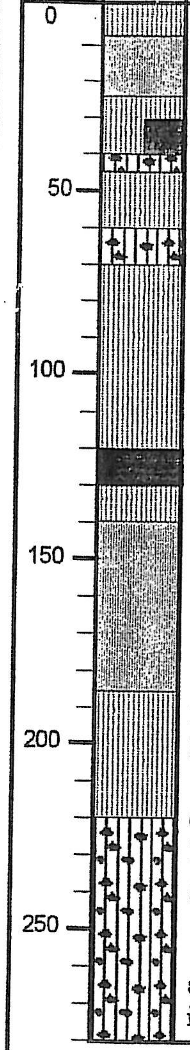
Earth Systems Consultants
Southern California

GEOLOGIC WELL LOG MW-2

Project: Golden Queen Mine
Date(s) Drilled: 12/6 to 16/96
Sheet 1 **of** 1

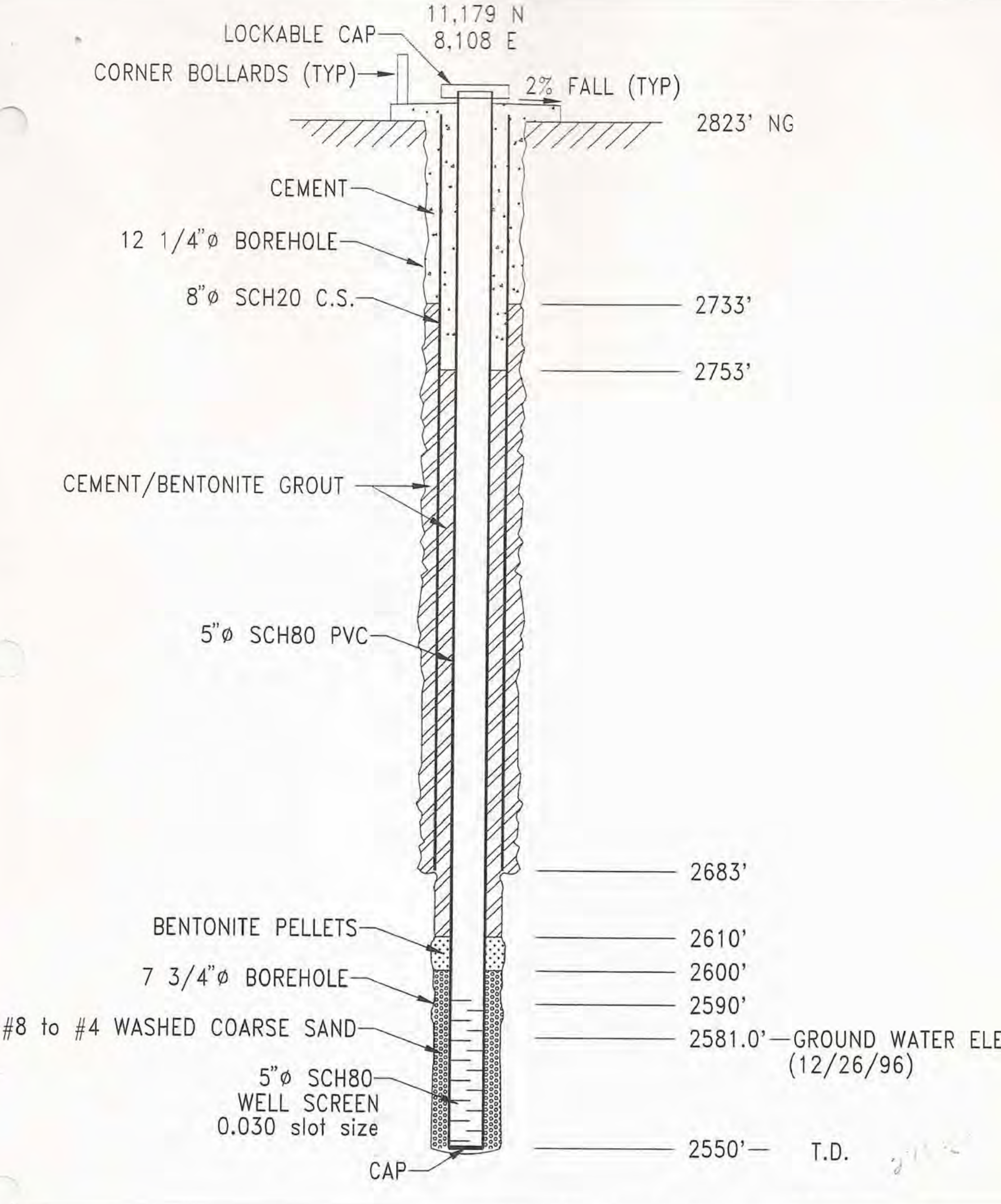
Project No.: SG-4754-L01
Location: Mine Grid: 11,178N, 8,108E
Elev. TOC 2,824', Ground Surface 2,823'
Diam. of Hole: ~12" to 140'
~8" to T.D.

Drill Rig Type: Air Rotary
Mud Rotary
Drilled By: Bryant Pump and Drilling
Logged By: DCS



Descriptions	Soil Type USCS Class.
light yellow/orange brown silty fine to coarse sand	SM
light yellow/orange brown medium to coarse sand with gravel	SP
light yellow brown silty fine to coarse sand with gravel **Alluvium**	SM
light yellow/orange brown silty fine to medium sand with clay	SM/SC
light yellow brown silty sand gravel with clay	GM
light yellow brown silt fine to medium sand	SM
light yellow/orange brown silty fine to coarse sandy gravel	GM
light yellow brown silty fine to coarse sand with gravel	SM
light yellow brown clayey fine to coarse sand with small amount of gravel	SC
light yellow brown silty fine to coarse sand with gravel	SM
@ 140 feet - Air Rotery	
light yellow brown fine to medium sand with gravel, moist	SP
increase of silt at 185'	
light yellow brown silty fine to medium sand, moist	SM
light orange brown silty fine to medium sand at 200'	SP/SM
Caving at 220', revert to mud rotery drilling	
light orange brown silty sandy gravel, gravel of various volcanic types (colors)	GM
abundant rock fragments (gray, yellow and red volcanics) indicate broken clasts, last 15' slow drilling, possible boulders	

Total depth drilled 280 feet, well completed to 273 feet
Depth to groundwater ~242 feet on December 18, 1996
Log based on cutting samples collected by driller every 5 feet, actual stratification may be more complex than represented by this log.



SCALE:	NONE
DESIGNED BY: TK Casagranda	DATE 10/03/96
DRAFTED BY: GC Sande	01/21/97
APPROVED:	
REVISED	
APPROVED	
REVISED	
APPROVED	

Golden Queen
MINING CO. INC.

MONITOR WELL MW-2
AS-BUILT DIAGRAM

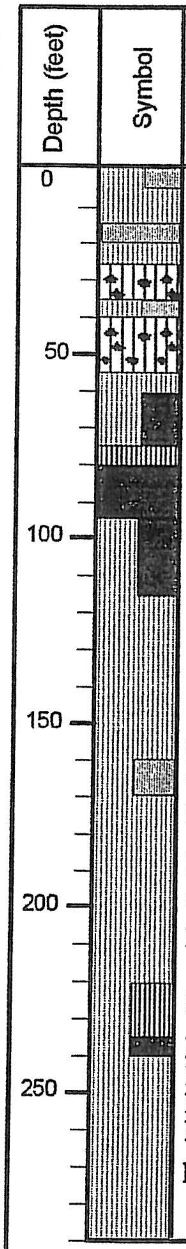
DRAWING NUMBER: 970121-B

DRAWING NAME: MW-2.DWG

Earth Systems Consultants
Southern California

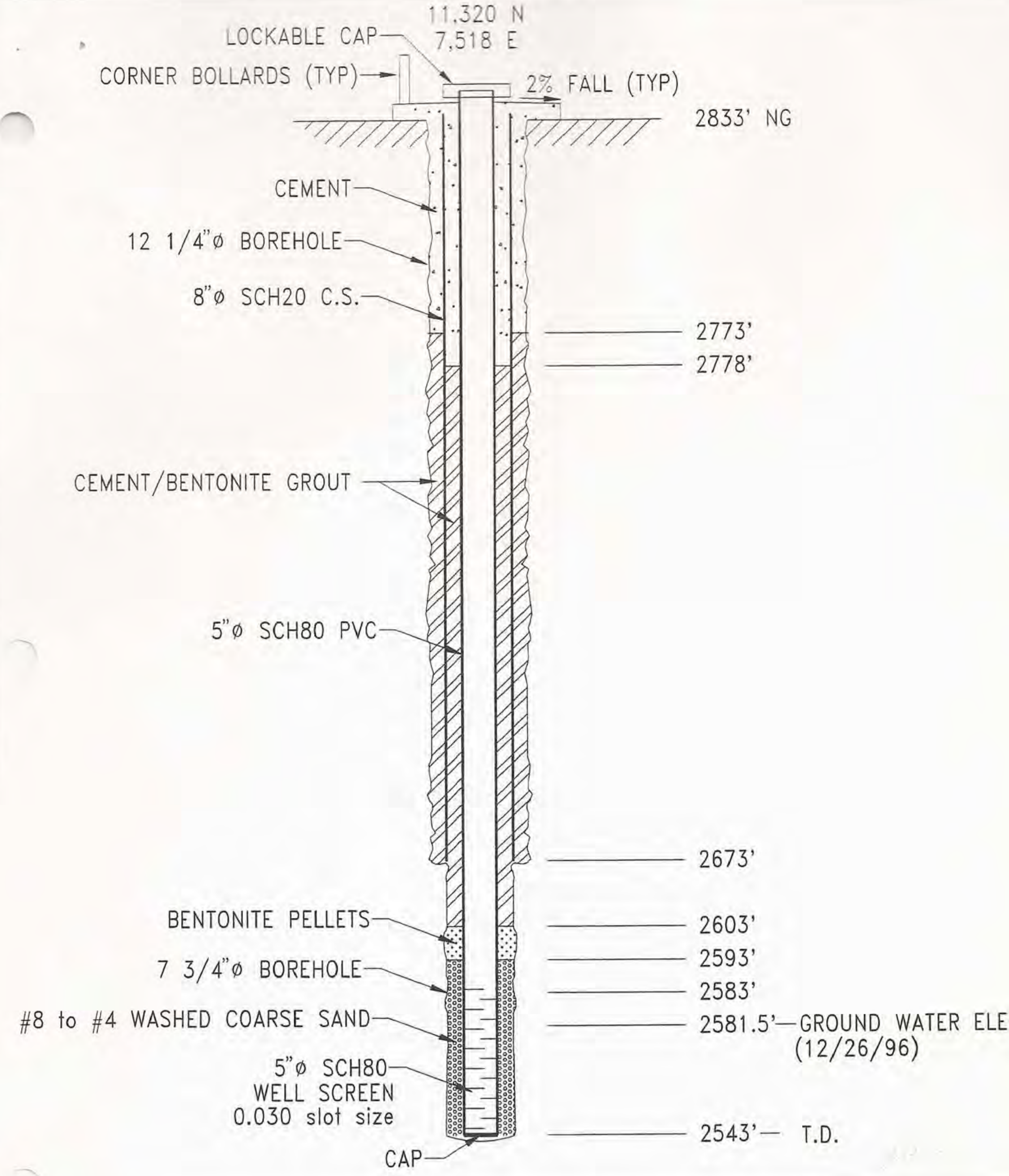
GEOLOGIC WELL LOG MW-3

Project: Golden Queen Mine
Date(s) Drilled: 12/9 to 19/96
Sheet 1 **of** 1
Project No.: SG-4754-L01
Location: Mine Grid: 11,320N, 7,518E Elev. TOC 2,835, Ground Surface 2,833
Diam. of Hole: ~12" to 160' ~8" to T.D.
Drill Rig Type: Air Rotary Mud Rotary
Drilled By: Bryant Pump and Drilling
Logged By: DCS



Descriptions	Soil Type USCS Class.
light yellow/orange brown medium to coarse sand with silt and gravel	SM/SP
light yellow brown silty fine to coarse sand with gravel	SM
light yellow brown medium to coarse sand with gravel	SP
light yellow brown silty fine to coarse sand with gravel **Alluvium**	SM
light yellow brown silty sandy gravel (various volcanic rock fragments)	GM
light yellow brown gravelly sand with silt	SM/SP
light yellow brown coarse sandy gravel with silt	GM
light yellow brown silty sand with gravel	SM
light yellow brown silty fine to medium sand with clay	SM/SC
medium yellow brown clayey silt with sand	ML
light yellow/orange brown silty fine sand with clay	SC
light yellow/orange brown silty fine to medium sand with clay, some gravel	SM/SC
light yellow brown silty fine to coarse sand with gravel	SM
air rotary dilling started at 160'	
light yellow/orange brown fine to medium sand with silt, slightly moist	SM/SP
light orange brown silty fine to medium sand, slightly moist	SM
light orange brown silty fine to medium sand with some coarse sand and gravel, slightly moist	
light yellow brown silty fine to medium sand, moist (@ 205')	
light yellow brown very silty fine to medium sand, moist	SM/ML
light yellow/orange brown silty fine to medium sand with clay, moist	SM/SC
light yellow/orange brown silty fine to coarse sand, moist	SM
light orange brown silty fine to coarse sand with gravel, moist	
little more moisture @ 260'	
light orange brown gravelly silty sand, moist	

Total depth 290 feet
Depth to groundwater ~260 feet on December 14, 1996
Log based on cutting samples collected by driller every 5 feet, actual stratification may be more complex than represented by this log.



SCALE: NONE

DESIGNED BY: TK Casagranda DATE: 10/03/96

DRAFTED BY: GC Sande 01/21/97

APPROVED:

REVISED:

APPROVED:

REVISED:

APPROVED:

Golden Queen
MINING CO. INC.

MONITOR WELL MW-3
AS-BUILT DIAGRAM

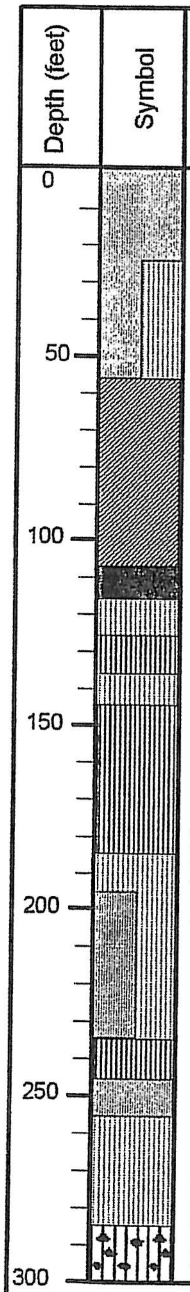
DRAWING NUMBER: 970121-C

DRAWING NAME: MW-3.DWG

Earth Systems Consultants
Southern California

GEOLOGIC WELL LOG PW-1

Project: Golden Queen Mine
Date(s) Drilled: 9/4&5/96
Sheet 1 **of** 1
Project No.: SG-4754-L01
Location: Mine Grid: 14,200N, 13,000E Elev. TOC 2,760', Ground Surface 2,759'
Diameter of Hole: 23"
Drill Rig Type: Mud Rotary
Drilled By: Bryant Pump and Drilling
Logged By: DCS



Descriptions	Soil Type USCS Class.
light grayish brown medium to coarse sand, some silt and gravel	SP
Alluvium	
@ 30' increase of silt @ 40' increase of gravel (rock fragments)	SP/SM
light grayish brown fine to coarse sand with silt and gravel	
light yellow brown silty clay	CL
light olive brown silty clay	
light olive brown clayey sand with silt	SC
light yellow brown silty fine to medium sand	SM
light yellow brown sandy silt with clay	ML
light yellow brown silty medium to coarse sand	SM
light yellow brown sandy silt with clay	ML
yellow brown sandy silt with clay	
light yellow brown silty fine to medium sand	SM
light yellow brown medium to coarse sand, some silt	SP/SM
yellow brown sandy silt with clay	ML
light yellow brown medium to coarse sand	SP
light yellow brown silty fine to medium sand light yellow brown silty fine to coarse sand	SM
yellow brown silty fine to coarse sand with gravel	
yellow brown clayey/silty gravel	GM

Total depth 300 feet
Depth to groundwater 176.6 feet on September 8, 1996
Log based on cutting samples collected by driller every 10 feet, actual stratification may be more complex than represented by this log, geologist was not present to observe drilling conditions.

TRIPLICATE
Owner's Copy

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. **574636**

DWR USE ONLY — DO NOT FILL IN —

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

Page ___ of ___
Owner's Well No. PW#1
Date Work Began 9-2-96, Ended 9-17-96
Local Permit Agency MOJAVE
Permit No. EH-169-96 Permit Date 8-27-96

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DEPTH TO FIRST WATER ______ (Ft.) BELOW SURFACE

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	6	MED TO FINE SAND
6	40	CHICHE
40	70	MED TO COARSE SAND
70	210	BROWN CLAY MED SAND
210	220	MED TO COARSE SAND
220	290	BROWN CLAY MED TO COARSE SAND
290	300	MED TO COARSE SAND BROWN CLAY TIGHT FORMATION.

TOTAL DEPTH OF BORING 300 (Feet)
TOTAL DEPTH OF COMPLETED WELL 300 (Feet)

WELL OWNER

Name GOLDEN QUEEN MINING CO
Mailing Address P.O. BOX 878
CITY ROSAMOND STATE CA ZIP 93560

WELL LOCATION

Address gold TOWN RD.
City MOJAVE
County KERN
APN Book 427 Page 130 Parcel 01
or
Township 11N Range 12W Section 32
or
Latitude ___ DEG. ___ MIN. ___ SEC. NORTH Longitude ___ DEG. ___ MIN. ___ SEC. WE

LOCATION SKETCH

Illustrate or Describe Distance of Well from Landmarks such as Roads, Buildings, Fences, Rivers, etc.
PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
- ___ Deepen
- ___ Other (Specify)

___ DESTROY *(Describe Procedures and Materi Under "GEOLOGIC LO*

PLANNED USE(S (✓)

___ MONITORING

WATER SUPPLY
- ___ Domestic
- ___ Public
- ___ Irrigation
- X Industrial

___ "TEST WELL"
___ CATHODIC PROTECTION
___ OTHER (Specify)

DRILLING METHOD ROTARY FLUID MUD

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL 176 (Ft.) & DATE MEASURED 9-28-96
ESTIMATED YIELD* 750 (GPM) & TEST TYPE PUMP
TEST LENGTH 10 (Hrs.) TOTAL DRAWDOWN 80.8.5 (Ft.)
** May not be representative of a well's long-term yield.*

CASING(S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
180	295	23"		X			A53 STEEL	12"	.250	2½X1/8
295	300	23"	X				A53 STEEL	12"	.250	
0	180	23"	X				A53 STEEL	12"	.250	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
50	300			X	#4 PEA
0	50	X			GROUT

ATTACHMENTS (✓)

- ___ Geologic Log
- ___ Well Construction Diagram
- ___ Geophysical Log(s)
- ___ Soil/Water Chemical Analyses
- ___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

NAME BRYANT PUMP & DRILLING
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

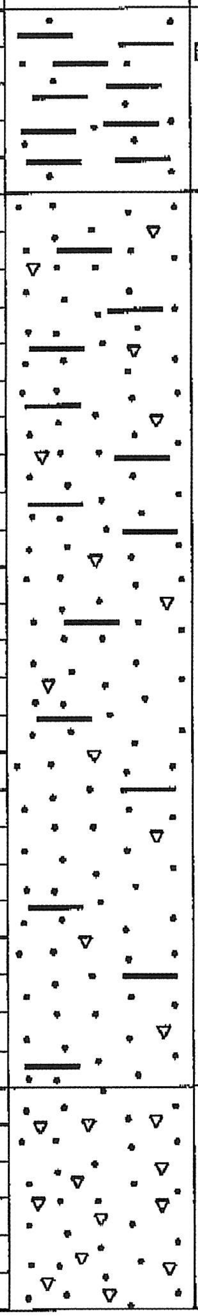
45239 N. SIERRA HWY LANCASTER CA 93534
ADDRESS CITY STATE ZIP

Signed George W Bryant Jr.
WELL DRILLER/AUTHORIZED REPRESENTATIVE
9/26/96 DATE SIGNED
249624 C-57 LICENSE NUMBER

DWR 188 REV. 7-90

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

LOG OF Water Well #2



Cutting Description	Depth (feet)	Lithology	Casing/Liner	u.s.c.s. desig.	Remarks
Tan sandy SILT, fine grained, loose.	0		12" Blank	ML	
Brown SAND, some silt, gravel, medium course grained.	5 10 15 20 25			SP	
Tan Brown SAND and gravel, course grained, angular abundant quartz and feldspar.	30 35			SP	

Surface Elevation: 2,760' (Top Csg)
Total Depth: 288'
Date Drilled:3/11/05
Logged By: R. McRae
Supervised By:
Diameter of Boring: 18"
Water Encountered At: ± 179.2'

Location: Golden Queen Mine

Project #: 700330030

LOG OF Water Well #2

Cutting Description	Depth (feet)	Lithology	Casing/Liner	u.s.c.s. desig.	Remarks
Tan brown SAND and gravel, course grained, angular abundant quartz and feldspar.	35 40 45		12" Blank	SP	
Gray brown silty SAND fine-medium grained.	50			SM	
Gray brown sandy SILT.	55			ML	
Gray brown SAND fine-medium grained.				SP	
Gray brown silty SAND fine grained.	60			SM	
Gray brown SAND fine-medium grained.	65 70			SP	

Surface Elevation: 2,760' (Top Csg)
Total Depth: 288'
Date Drilled:3/11/05
Logged By: R. McRae
Supervised By:
Diameter of Boring: 18"
Water Encountered At: ± 179.2'

Location: Golden Queen Mine

Project #: 700330030

WZI

LOG OF Water Well #2

Soil Description	Depth (feet)	Lithology	Casing/Liner	u.s.c.s. desig.	Remarks
Gray brown SAND fine-medium grained.	70		12" Blank	SM	
Gray brown SAND fine-medium grained.	75 80			SM	Harder SAND.
Tan brown clayey SILT.				ML	
Gray brown silty SAND fine-medium grained.	85 90			SM	Hard drilling.
Gray brown silty SAND medium grained.	95			SM	
Gray brown SAND medium-course grained.	100 105			SP	

Surface Elevation: 2,760' (Top CSG)
Total Depth: 288'
Date Drilled: 3/11/05
Logged By: R. McRae
Supervised By:
Diameter of Boring: 18"
Water Encountered At: ± 179.2'

Location: Golden Queen Mine

Project #: 700330030

WZI

LOG OF Water Well #2

Soil Description	Depth (feet)	Lithology	Casing/Liner	u.s.c.s. desig.	Remarks
Gray brown SAND course grained, some silt.	105 110 115 120		12" Blank	SM	
Gray brown SAND medium-course grained.	125 130 135 140			SW	

Surface Elevation: 2,760'
Total Depth: 288'
Date Drilled:3/11/05
Logged By: R. McRae
Supervised By:
Diameter of Boring: 18"
Water Encountered At: ± 179.2'

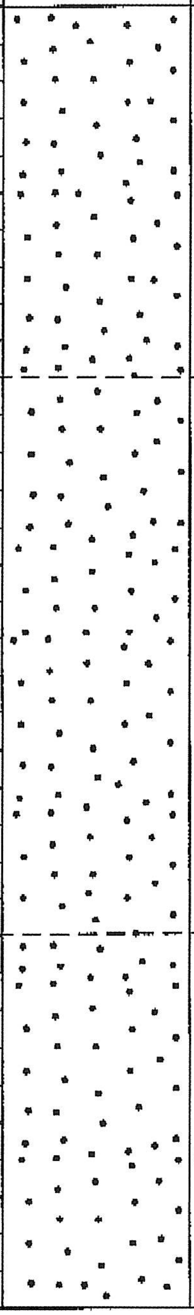
Location: Golden Queen Mine

Project #: 700330030

WZI

LOG OF Water Well #2

Soil Description	Depth (feet)	Lithology	Casing/Liner	u.s.c.s. desig.	Remarks
Gray brown SAND course grained.	140		12" Blank	SW	
	145				
Gray brown SAND course grained, well sorted.	150		SW		
	155				
	160				
Gray brown SAND course grained, well sorted.	165		SW		Hard drilling, bit chatter.
	170		12" Slotted		
	175				



Surface Elevation: 2,760' (Top CSG)
Total Depth: 288'
Date Drilled:3/11/05
Logged By: R. McRae
Supervised By:
Diameter of Boring: 18"
Water Encountered At: ± 179.2'

Location: Golden Queen Mine

Project #: 700330030

WZI

LOG OF Water Well #2

Soil Description	Depth (feet)	Lithology	Casing/Liner	u.s.c.s. desig.	Remarks
Gray brown SAND course grained, well sorted.	175		12" Slotted	SP	Hard drilling, bit chatter.
			▼		Water Contact.
White red brown SAND course grained, well sorted.	180			SP	
	185				
	190				
	195				
White red brown SAND medium grained, well sorted.				SP	
White red brown SAND course grained, well sorted.	200			SP	
White red brown SAND fine-medium grained, well sorted.	205			SM	
	210				

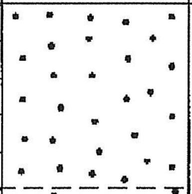
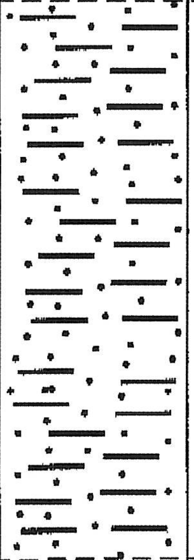
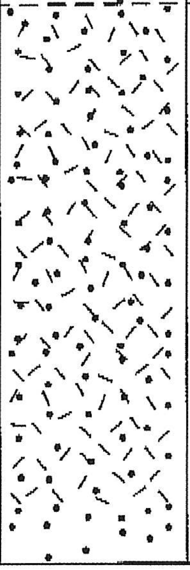
Surface Elevation: 2,760' (Top CSG)
Total Depth: 288'
Date Drilled:3/11/05
Logged By: R. McRae
Supervised By:
Diameter of Boring: 18"
Water Encountered At: ± 179.2'

Location: Golden Queen Mine

Project #: 700330030

WZI

LOG OF Water Well #2

Soil Description	Depth (feet)	Lithology	Casing/Liner	u.s.c.s. desig.	Remarks
White red brown SAND fine-medium grained, well sorted.	210		12" Slotted	SW	
White red brown silty SAND fine-medium grained, some clay.	215 220 225			SW	Bit chatter.
White red brown SAND medium-course grained, angular quartz and feldspar (decomposed granite?).	230 235 240 245			SW	Trip for hard button bit.

Surface Elevation: 2,760' (Top CSG)
Total Depth: 288'
Date Drilled:3/11/05
Logged By: R. McRae
Supervised By:
Diameter of Boring: 18"
Water Encountered At: ± 179.2'

Location: Golden Queen Mine

Project #: 700330030

WZI

LOG OF Water Well #2

Soil Description	Depth (feet)	Lithology	Casing/Liner	u.s.c.s. desig.	Remarks
White gravely SAND course grained, angular quartz and feldspar (granite).	245		12" Slotted	SW	Dull bit.
	250				
	255				
	260				
	265				
	270				
	275				
	280				

Surface Elevation: 2,760' (Top CSG)
Total Depth: 288'
Date Drilled:3/11/05
Logged By: R. McRae
Supervised By:
Diameter of Boring: 18"
Water Encountered At: ± 179.2'

Location: Golden Queen Mine

Project #: 700330030

WZI

LOG OF Water Well #2

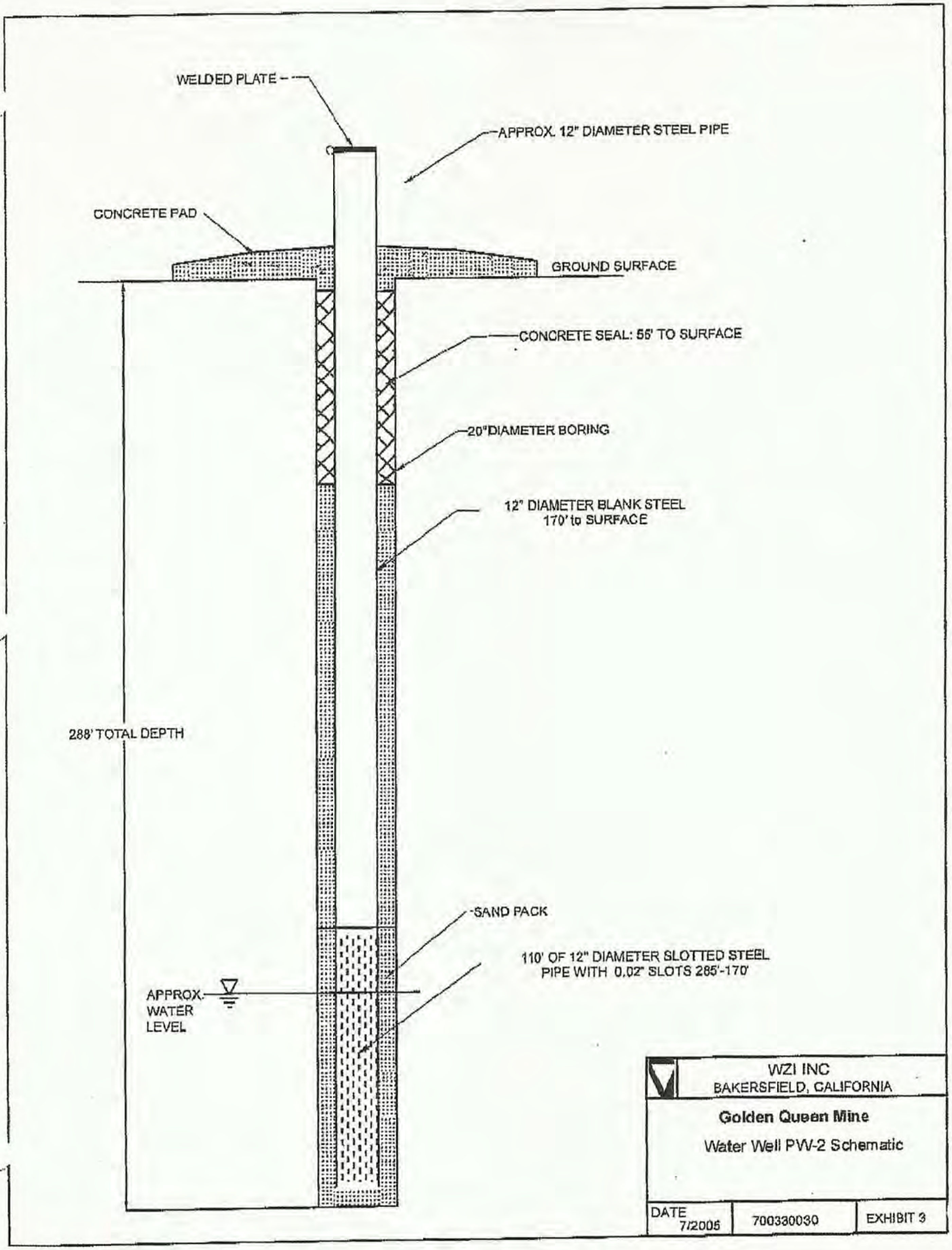
Soil Description	Depth (feet)	Lithology	Casing/Liner	u.s.c.s. desig.	Remarks
White gravely SAND course grained, angular quartz and feldspar (granite).	280 285		12" Slotted	SW	Total Depth = 288'
	290 295 300 305 310 315				

Surface Elevation: 2,760' (Top CSG)
Total Depth: 288'
Date Drilled:3/11/05
Logged By: R. McRae
Supervised By:
Diameter of Boring: 18"
Water Encountered At: ± 179.2'

Location: Golden Queen Mine

Project #: 700330030

WZI



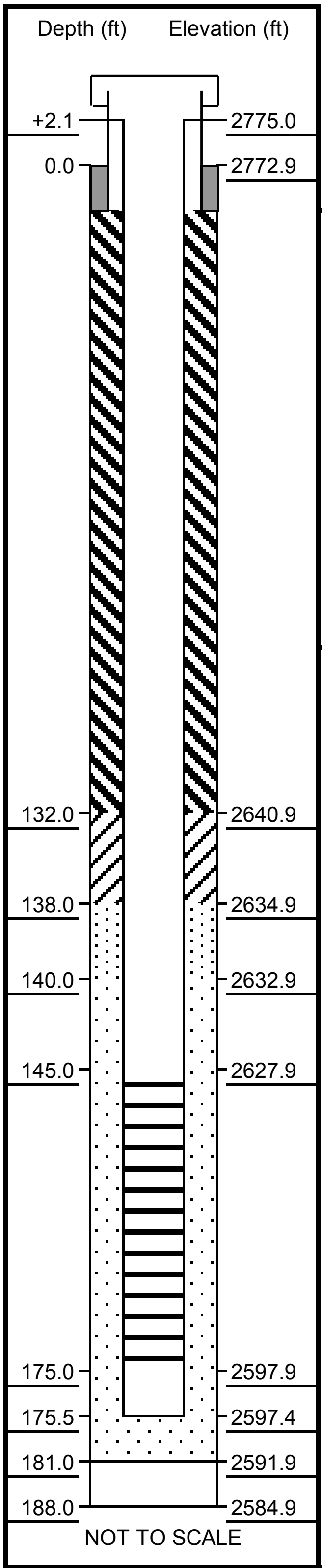
WZI INC
BAKERSFIELD, CALIFORNIA

Golden Queen Mine

Water Well PW-2 Schematic

DATE 7/2005
700330030
EXHIBIT 3

MONITORING WELL CONSTRUCTION SUMMARY



Site Location:	Soledad Mountain Project	**Well No.**	**MW-4**
Project Number:	043-2299A	**Boring No. X-Ref:**	MW-4
Survey Coordinates:	E: 6505222.30	Elevation (top of slab)	2772.9 ft
UTM Z13 NAD83	N: 2185182.50	Top of Casing	2775.0 ft

Drilling Summary

Total Depth: 188.0 ft

Borehole Diameter: 8.0 in

Casing Stickup Height: 2.13 ft

Driller: Boart-Longyear: Jose Hernandez

Rig: SR-117 Sonic Rig

Bits(s):

Drilling Fluid: Water (via hydrant)

Protective Casing: 8" steel casing

Construction Time Log

Task	Start Date	Start Time	Finish Date	Finish Time
drilling	10/1			
	10/2			
	10/3			
	10/5			
construction	10/15	700	10/16	1400
development	10/19	1300	10/19	1435

Well Design and Specifications

Basis:

Casing String(s): C = Casing, S = Screen

Depth	String(s)	Elevation
+-2.5 - 145.0	C1	2775.4 - 2627.9
145.0 - 175.0	S1	2627.9 - 2597.9
175.0 - 175.5	C2	2597.9 - 2597.4
-		-
-		-
-		-

Casing: C1 4 inch Sch 80 PVC
147.5'

C2 4-in diameter Sch 80 w/
PVC threaded end cap

Screen: S1 4 inch 0.020 Slot Sch 80 PVC
30ft

S2

Filter Pack: #2/12 sand 138-181'

Grout Seal: Quick-gel + Portland cement
3-132'

Bentonite Seal: Enviroplug (hydrated)
132-138'

Well Development

Depth to water initial: 156.5 ft final: 174.8 ft

Removed approx. 25 gallons; water level did not recover (not within GW).

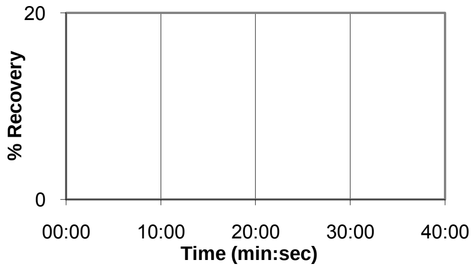
Stabilization Test Data

Time	pH	Spec. Cond.	Temp (˚C)
1300	8.54		23.7

Recovery Data

Q= 0.2 gal/min

S= -157 ft

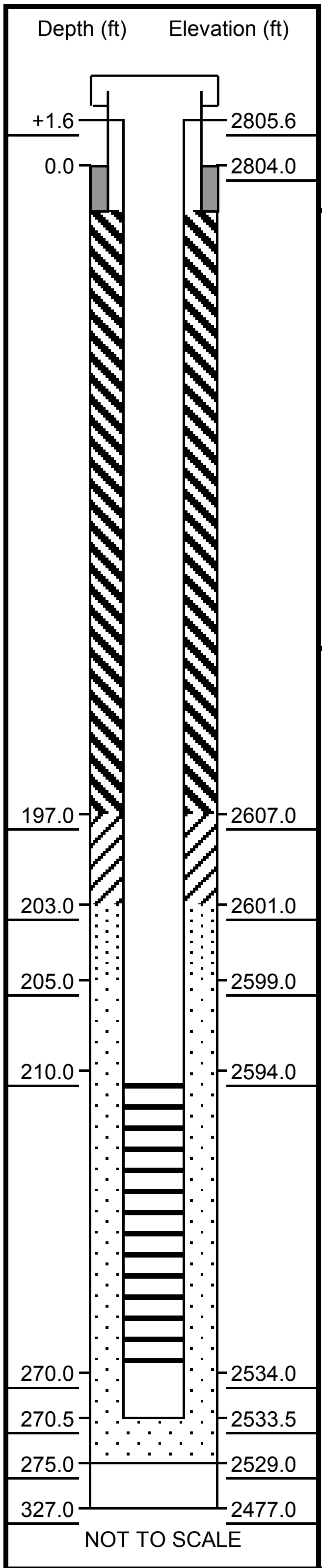


Comments Backfilled bottom of hole with Enviroplug 181-188'.

Supervised by: DJL

Date: 11/26/07

MONITORING WELL CONSTRUCTION SUMMARY



Site Location: Soledad Mountain Project
Project Number: 043-2299A
Survey Coordinates: E: 6502681.40
UTM Z13 NAD83 N: 2184966.10

Well No. MW-5
Boring No. X-Ref: MW-5
Elevation (top of slab) 2804.0 ft
Top of Casing 2805.6 ft

Drilling Summary

Total Depth: 327.0 ft
Borehole Diameter: 8.0 in
Casing Stickup Height: 1.63 ft
Driller: Boart-Longyear: Jose Hernandez
Rig: SR-117 Sonic Rig
Bits(s):
Drilling Fluid: Water (via hydrant)
Protective Casing: 8" steel casing

Construction Time Log

Task	Start Date	Start Time	Finish Date	Finish Time
drilling	10/6			
	10/7			
	10/8			
	10/10			
	10/11			
construction	10/12	700	10/15	1200
development	10/19	700	10/31	1400

Well Design and Specifications

Basis:
Casing String(s): C = Casing, S = Screen

Depth	String(s)	Elevation
+-2 - 210.0	C1	2806.0 - 2594.0
210.0 - 270.0	S1	2594.0 - 2534.0
270.0 - 270.5	C2	2534.0 - 2533.5
-		-
-		-
-		-

Casing: C1 4 inch Sch 80 PVC
212.0'
C2 4-in diameter Sch 80
PVC threaded end cap

Screen: S1 4 inch 0.020 Slot Sch 80 PVC
60ft
S2

Filter Pack: #3 and #2/12 sand 203-275'

Grout Seal: Quick-gel + Portland cement
3-132'

Bentonite Seal: Enviroplug (hydrated)
132-138'

Well Development

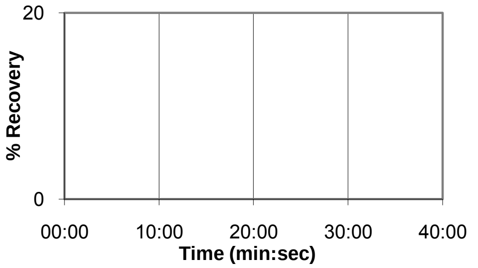
Depth to water initial: 222 ft final: 224 ft

Stabilization Test Data

Time	pH	Spec. Cond.	Temp (˚C)
1400	9.45		24
915	8.18	0.64	22.4
1015	8.10	0.65	22.9
1130	7.87	0.61	23.2
1400	8.00	0.59	23.5

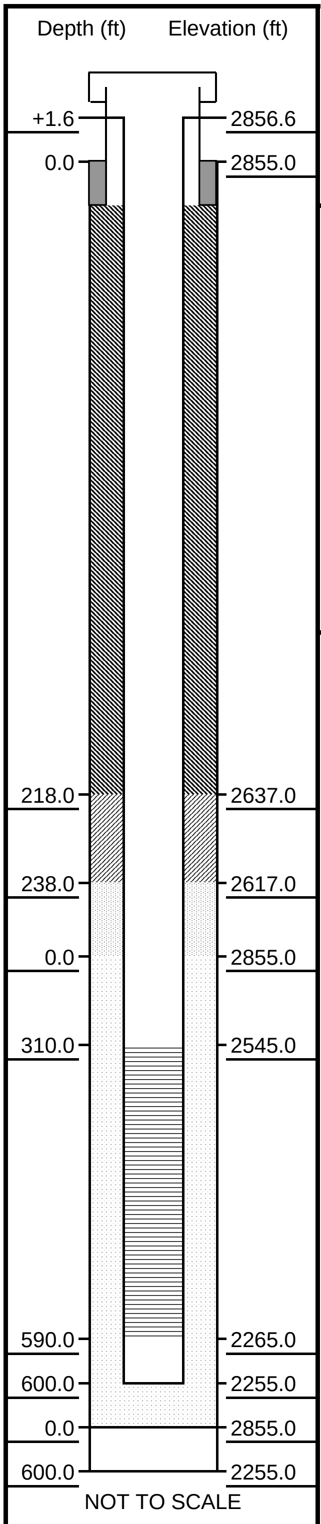
Recovery Data

Q= 0.2 gal/min
S= -222 ft



Comments Backfilled bottom of hole with Enviroplug + soil cuttings 275-327'.

Supervised by: DJL
Date: 11/26/07



MONITORING WELL CONSTRUCTION SUMMARY

Site Location: Soledad Mountain Project
Project Number: 043-2299C
Survey Coordinates: Lat: 34.987343
Long: -118.212207

Well No. PW-03
Boring No. X-Ref: 0
Elevation (top of slab) 2855.0 ft
Top of Casing 2856.6 ft

Drilling Summary

Total Depth: 600.0 ft
Borehole Diameter: 20.0 in
Casing Stickup Height: 1.60 ft
Driller: Redfairn Drilling

Rig:
Bits(s): 8", 14", 20"

Drilling Fluid: Bentonite mud, Thermathin

Protective Casing:

Construction Time Log

	Start		Finish	
Task	Date	Time	Date	Time
drilling	10/1	1500		
			10/6	1600
construction	10/15	0830	10/16	1800
development	10/17	0830	10/24	1600
~5900 gallons	11/19	1212	11/19	1600
~11,620 gallons	11/20	900	11/20	1330

Well Design and Specifications

Basis:
Casing String(s): C = Casing, S = Screen

Depth	String(s)	Elevation
+-1.6 - 310.0	C1	2856.6 - 2545.0
310.0 - 590.0	S1	2545.0 - 2265.0
590.0 - 600.0	C2	2265.0 - 2255.0
-		-
-		-
-		-

Casing: C1 12-in Steel Casing
C2

Screen: S1 12-in diameter, tripple roll, 0.08-in openings, vertical mill slotted.
S2

Filter Pack: 1/8-in pea gravel

Grout Seal: 10-sack slurry cement

Bentonite Seal: Bentonite slurry - tremied.

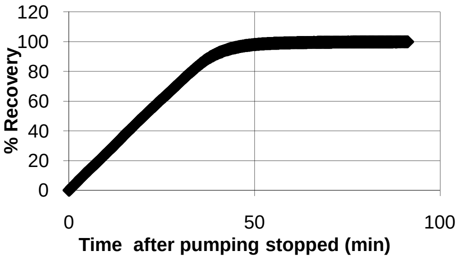
Well Development

Depth to water initial: - final: 286.35
measured from top of casing. Stickup: 1.6 ft

Stabilization Test Data (11/19 & 11/20)

Time	pH	Spec. Cond.	Temp (˚C)
1333	7.81	691	26.5
1619	7.52	489	26.3
1006	8.02	470	26.7
1008	7.91	469	26.7
1019	7.59	482	25.6

Recovery Data 11/20/08
Q= 43.5 gal/min
S= >241 ft



Comments

Supervised by: DL
Date: 11/26/07

PROJECT: Soledad Mountain Project
PROJECT NUMBER: 043-2299D

LOCATION: Mojave, CA

RECORD OF BORING **MW-6**

COORDINATES: N: 2,185,599 E: 6,506,125
GROUND SURFACE ELEVATION: 2,760.1 ft

DRILL RIG: Prosonic SR-083

INCLINATION: -90°

DRILLING METHOD: Rotosonic

DATE STARTED: 11/16/10 09:45

DATE COMPLETED: 11/17/10 15:10

DRILL FLUIDS: None

DRILL LUBRICANTS: Well-Guard Monitor Well Thread Compound

PROJECTION: California State Plane Zone 5

DATUM: NAD83 (horiz.), NAVD88 (vert.)

HORIZONTAL UNITS: feet

TOTAL DEPTH: 212.0 ft

BOTTOM ELEVATION: 2,548.1 ft

TOP OF CASING ELEVATION: 2,762.8 ft

HOLE DIAMETER: 8 inches

DEPTH (ft)	ELEVATION (ft)	LITHOLOGY DESCRIPTION	GRAPHIC LOG	ELEV. / DEPTH (ft)	MATERIAL TYPE	MOISTURE DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	REC / RUN (ft)	COMMENTS
0.0	2760	0.0 - 3.5 Moderate yellowish brown (10YR 5/4) - dark yellowish orange (10YR 6/6) fine clayey SAND, little silt, trace roots, dry (SC)	▨	2756.6 3.5	SC	Dry	1	CORE	7/7	
		3.5 - 5.0 Dark yellowish orange (10YR 6/6) fine SAND, poorly graded, some medium sand, little silt, dry (SP)	⁘	2755.1 5.0	SP					
5.0 10.0	2755 2750	5.0 - 14.0 Yellowish gray (5Y 7/2) fine silty SAND, dry - sli moist (SM)	⁘	2746.1 14.0	SM	Dry - Sli Moist	2	CORE	8/10	7 - 17 feet: Driller noted very loose/unconsolidated sand during Run #2.
15.0	2745	14.0 - 17.0 Yellowish gray (5Y 7/2) SILT, some fine sand, sli moist (ML)	‖	2743.1 17.0	ML	Sli Moist				
20.0	2740	17.0 - 22.0 Yellowish gray (5Y 7/2) fine SAND, poorly graded, some medium sand and silt, dry (SP/SM)	⁘	2738.1 22.0	SP/SM	Dry	3	CORE	10/10	
25.0	2735	22.0 - 25.5 Dark yellowish orange (10YR 6/6) fine SAND, poorly graded, little silt, becoming fine clayey SAND at base, sli moist (SP/SC)	⁘	2734.6 25.5	SP/SC	Sli Moist				
30.0		25.5 - 30.0 Moderate yellow (5Y 7/6) - yellowish gray (5Y 7/2) SILT, little fine sand, sli moist (ML)	‖	2730.1	ML		4	CORE	10/10	Unconsolidated material sloughing over core barrel so driller adds water (approx. 75 gallons) to drive outer casing to 27 feet.

Log continued on next page

DRILLING CONTRACTOR: Boart Longyear
DRILLER: Eddie Ramos

GEOLOGIST: Ryan Tolene
CHECKED: Steve Lofholm
DATE: 12/6/2010

PROJECT: Soledad Mountain Project
PROJECT NUMBER: 043-2299D
LOCATION: Mojave, CA

RECORD OF BORING **MW-6**

COORDINATES: N: 2,185,599 E: 6,506,125
GROUND SURFACE ELEVATION: 2,760.1 ft

DEPTH (ft)	ELEVATION (ft)	LITHOLOGY DESCRIPTION	GRAPHIC LOG	ELEV. / DEPTH (ft)	MATERIAL TYPE	MOISTURE DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	REC / RUN (ft)	COMMENTS
30.0	2730	30.0 - 35.0 Yellowish gray (5Y 7/2) fine silty SAND, sli moist (SM)		30.0 2725.1	SM	Sli Moist	4	CORE	10/10	
35.0 40.0	2725 2720	35.0 - 43.0 Yellowish gray (5Y 7/2) fine-coarse SAND, well graded, trace-little fine gravel, little silt, sli moist (SW)		35.0 2717.1	SW		5	CORE	5/5	
		43.0 - 45.0 Moderate yellow (5Y 7/6) SILT, some fine sand, sli moist (ML)		43.0 2715.1	ML		6	CORE	5/5	
45.0	2715	45.0 - 47.0 Dark yellowish orange (10YR 6/6) fine SAND, poorly graded, little silt, sli moist (SP)		45.0 2713.1	SP					
50.0	2710	47.0 - 52.0 Yellowish gray (5Y 7/2) fine-coarse SAND, well graded, little silt and fine gravel, sli moist (SW)		47.0 2708.1	SW		7	CORE	5/5	Unconsolidated material continues to slough over core barrel so driller adds water (approx. 100 gallons) to drive outer casing to 47 feet.
55.0	2705	52.0 - 58.0 Dark yellowish orange (10YR 6/6) fine silty SAND, sli moist (SM)		52.0 2702.1	SM		8	CORE	5/5	
60.0 65.0	2700 2695	58.0 - 79.0 Light brown (5YR 5/6) - dark yellowish orange (10YR 6/6) fine silty SAND, sli moist (SM)		58.0	SM		9 10	CORE CORE	10/10	

Log continued on next page

DRILLING CONTRACTOR: Boart Longyear
DRILLER: Eddie Ramos

GEOLOGIST: Ryan Tolene
CHECKED: Steve Lofholm
DATE: 12/6/2010

PROJECT: Soledad Mountain Project
PROJECT NUMBER: 043-2299D

LOCATION: Mojave, CA

RECORD OF BORING **MW-6**

COORDINATES: N: 2,185,599 E: 6,506,125
GROUND SURFACE ELEVATION: 2,760.1 ft

DEPTH (ft)	ELEVATION (ft)
70.0	2690
75.0	2685
80.0	2680
85.0	2675
90.0	2670
95.0	2665
100.0	2660
105.0	

LITHOLOGY DESCRIPTION	GRAPHIC LOG	ELEV. / DEPTH (ft)	MATERIAL TYPE	MOISTURE DESCRIPTION
58.0 - 79.0 Light brown (5YR 5/6) - dark yellowish orange (10YR 6/6) fine silty SAND, sli moist (SM)		2681.1 79.0	SM	Sli Moist
79.0 - 84.0 Yellowish gray (5Y 7/2) fine clayey SAND, sli moist - moist (SC)		2676.1 84.0	SC	Sli Moist - Moist
84.0 - 87.0 Yellowish gray (5Y 7/2) fine silty SAND, some clay, sli moist (SM)		2673.1 87.0	SM	Sli Moist
87.0 - 96.0 Yellowish gray (5Y 7/2) SILT, mottled, some clay, trace-little fine sand, sli moist (ML)		2664.1 96.0	ML	
96.0 - 99.0 Grayish yellow (5Y 8/4) - yellowish gray (5Y 8/1) fine silty SAND, sli moist (SM)		2661.1 99.0	SM	
99.0 - 106.0 Grayish yellow (5Y 8/4) fine-medium SAND, poorly graded, little silt, sli moist (SP)			SP	

SAMPLE NUMBER	SAMPLE TYPE	REC / RUN (ft)	COMMENTS
10	CORE	5/5	
11	CORE	5/5	
12	CORE	10/10	77 - 87 feet: Driller noted easy drilling during Run #12.
13	CORE	10/10	
14	CORE	10/10	

Log continued on next page

Golder Associates

DRILLING CONTRACTOR: Boart Longyear
DRILLER: Eddie Ramos

GEOLOGIST: Ryan Tolene
CHECKED: Steve Lofholm
DATE: 12/6/2010

PROJECT: Soledad Mountain Project
PROJECT NUMBER: 043-2299D

LOCATION: Mojave, CA

RECORD OF BORING **MW-6**

COORDINATES: N: 2,185,599 E: 6,506,125
GROUND SURFACE ELEVATION: 2,760.1 ft

DEPTH (ft)	ELEVATION (ft)	LITHOLOGY DESCRIPTION	GRAPHIC LOG	ELEV. / DEPTH (ft)	MATERIAL TYPE	MOISTURE DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	REC / RUN (ft)	COMMENTS
105.0	2655			2654.1 106.0	SP		14	CORE	10/10	
110.0 115.0 120.0	2650 2645 2640	106.0 - 125.0 Dark yellowish orange (10YR 6/6) - pale yellowish orange (10YR 8/6) fine SAND AND SILT, sli moist (SM)		2635.1 125.0	SM	Sli Moist	15 16	CORE CORE	10/10 8/8	
125.0	2635	125.0 - 127.0 Dark yellowish orange (10YR 6/6) fine SAND, little silt and fine gravel, sli moist (SP)		2633.1 127.0	SP		17	CORE	2/2	
		127.0 - 130.0 Light brown (5YR 5/6) fine clayey SAND, sli moist (SC)		2630.1 130.0	SC		18	CORE	10/10	
130.0 135.0	2630 2625	130.0 - 136.0 Light brown (5YR 5/6) clayey SILT, sli moist (ML)		2624.1 136.0	ML					
140.0	2620	136.0 - 141.0 Light brown (5YR 5/6) fine-medium SAND, little-some clay, little silt, trace fine gravel, sli moist (SC)		2619.1 141.0	SC		19	CORE	10/10	
					SM					

Log continued on next page

Golder Associates

DRILLING CONTRACTOR: Boart Longyear
DRILLER: Eddie Ramos

GEOLOGIST: Ryan Tolene
CHECKED: Steve Lofholm
DATE: 12/6/2010

PROJECT: Soledad Mountain Project
PROJECT NUMBER: 043-2299D

LOCATION: Mojave, CA

RECORD OF BORING **MW-6**

COORDINATES: N: 2,185,599 E: 6,506,125
GROUND SURFACE ELEVATION: 2,760.1 ft

DEPTH (ft)	ELEVATION (ft)	LITHOLOGY DESCRIPTION	GRAPHIC LOG	ELEV. / DEPTH (ft)	MATERIAL TYPE	MOISTURE DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	REC / RUN (ft)	COMMENTS
145.0	2615	141.0 - 152.0 Light brown (5YR 5/6) - dark yellowish orange (10YR 6/6) fine silty SAND, little-some clay, sli moist (SM)			SM	Sli Moist	19	CORE	10/10	
150.0	2610			2608.1 152.0			20	CORE	5/5	
155.0	2605	152.0 - 157.0 Light brown (5YR 5/6) fine-coarse SAND, some silt, little clay and fine gravel, trace coarse gravel, sli moist (SW/SM)		2603.1 157.0	SW/SM		21	CORE	5/5	
160.0	2600	157.0 - 161.0 Dark yellowish orange (10YR 6/6) fine silty SAND, little clay, sli moist (SM)		2599.1 161.0	SM		22	CORE	10/10	
165.0	2595	161.0 - 167.0 Dark yellowish orange (10YR 6/6) medium-coarse SAND AND fine-coarse GRAVEL, trace cobbles and clay, sli moist (SW)		2593.1 167.0	SW					
170.0	2590	167.0 - 175.0 Dark yellowish orange (10YR 6/6) fine-medium clayey SAND, some silt, sli moist - moist (SC)		2585.1 175.0	SC	Sli Moist - Moist	23	CORE	6/6	167 feet: Pause drilling on 11/16/2010 at 1720, resume on 11/17/2010 at 0715. Borehole dry.
175.0	2585	175.0 - 181.0 Dark yellowish orange (10YR 6/6) medium-coarse clayey SAND, little silt, trace fine-coarse gravel, sli moist - moist (SC)			SC		24	CORE	4/4	
180.0							25	CORE	10/10	177 feet: Depth to water below ground surface after well development on 11/20/2010

Log continued on next page

DRILLING CONTRACTOR: Boart Longyear
DRILLER: Eddie Ramos

GEOLOGIST: Ryan Tolene
CHECKED: Steve Lofholm
DATE: 12/6/2010

PROJECT: Soledad Mountain Project
PROJECT NUMBER: 043-2299D

LOCATION: Mojave, CA

RECORD OF BORING **MW-6**

COORDINATES: N: 2,185,599 E: 6,506,125
GROUND SURFACE ELEVATION: 2,760.1 ft

DEPTH (ft)	ELEVATION (ft)	LITHOLOGY DESCRIPTION	GRAPHIC LOG	ELEV. / DEPTH (ft)	MATERIAL TYPE	MOISTURE DESCRIPTION	SAMPLE NUMBER	SAMPLE TYPE	REC / RUN (ft)	COMMENTS
180.0	2580			2579.1 181.0	SC					
		181.0 - 186.0 Dark yellowish orange (10YR 6/6) CLAY, little-some fine-medium sand, trace fine gravel, sli moist - moist (CL)		2574.1 186.0	CL	Sli Moist - Moist	25	CORE	10/10	
185.0	2575									
		186.0 - 189.0 Grayish yellow (5Y 8/4) - yellowish gray (5Y 7/2) fine-medium silty SAND, little fine gravel, some iron and manganese oxide staining on surfaces, dry - sli moist (SM)		2571.1 189.0	SM	Dry - Sli Moist				
		189.0 - 202.0 Slightly weathered, grayish red (10R 4/2) - moderate brown (5YR 4/4), strong-very strong LATITE, dry (BEDROCK)		2558.1 202.0			26	CORE	10/10	189 - 202 feet: Driller noted hard drilling through bedrock.
190.0	2570									
195.0	2565									
						Dry	27	CORE	6/6	
200.0	2560									
		202.0 - 212.0 Highly weathered, bluish white (5B 9/1) - dark yellowish orange (10YR 6/6), very weak TUFF, dry (BEDROCK)		2548.1 212.0						
205.0	2555						28	CORE	9/9	
210.0	2550									

Boring completed at 212 ft.

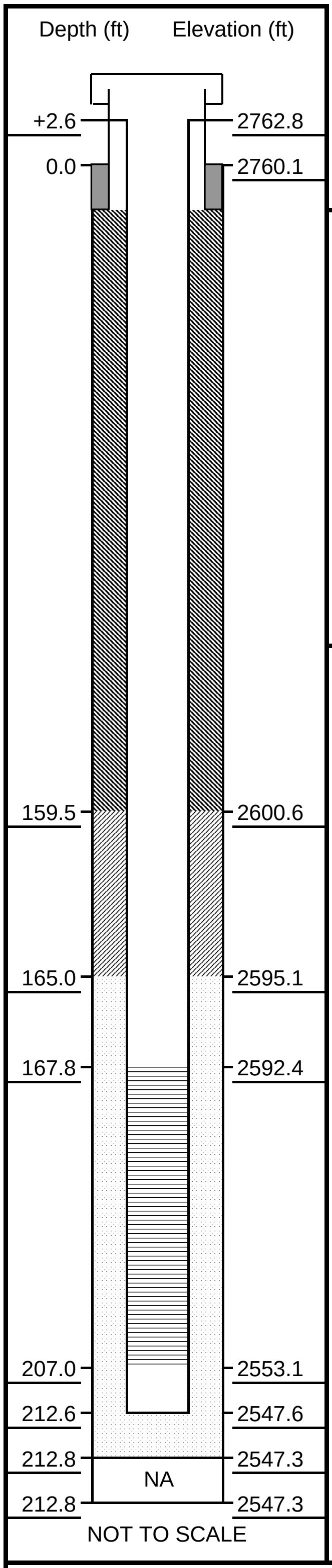
Boring completed at 212 ft.
212 feet: Pause drilling on 11/17/2010 at 1015 to allow for groundwater to accumulate in the borehole. Slow recharge of groundwater. End drilling by driving casing to 212 feet on 11/17/2010 at 1510.

215.0

DRILLING CONTRACTOR: Boart Longyear
DRILLER: Eddie Ramos

GEOLOGIST: Ryan Tolene
CHECKED: Steve Lofholm
DATE: 12/6/2010

MONITORING WELL CONSTRUCTION SUMMARY



Site Location: Soledad Mountain
Project Number: 043-2299D
Survey Coordinates: E: 6506125.3
State Plane Zone 5, NAD83 N: 2185599.2

Well No. **MW-6**
Boring No. X-Ref: MW-6
Elevation Ground Level 2760.1 ft
Elevation Top of Casing 2762.8 ft

Drilling Summary

Total Depth: 212.0 ft
Borehole Diameter: 8 in
Casing Stickup Height: 2.63 ft
Driller: Boart Longyear: Eddie Ramos

Rig: Prosonic SR-083
Bit(s): 7-inch hollow button bit

Drilling Fluid: None, minimal water to drive casing
Protective Casing: 8.5-inch diameter steel

Construction Time Log

	Start		**Finish**	
Task	**Date**	**Time**	**Date**	**Time**
Drilling	11/16	0945	11/17	1510
Well Install:				
PVC	11/17	1525	11/17	1602
Sand Pack	11/17	1530	11/17	1658
Bentonite Seal	11/17	1658	11/17	1708
Grout	11/18	0750	11/18	0830
Grout	11/18	1010	11/18	1050
Surface Compl.	11/18	1255	11/18	1530
* Dates are 2010				

Well Design and Specifications

Basis:
Casing String(s): C = Casing, S = Screen

Depth	String(s)	Elevation
+2.6 - 167.8	C1	2762.8 - 2592.4
167.8 - 207.0	S1	2592.4 - 2553.1
207.0 - 212.6	C2	2553.1 - 2547.6
-		-
-		-
-		-

Casing: C1 4-inch Schedule 80 PVC Riser
C2 4-inch Schedule 80 PVC Sump and end cap
Screen: S1 4-inch Schedule 80 PVC 0.020-inch machine slotted
S2

Sand Pack: Cemex Lapis Lustre #2/12 grit Monterey Sand (165.0 - 212.8 feet)

Bentonite Seal: Wyo-Ben Enviroplug Medium Bentonite Chips (159.5 - 165.0 feet)

Grout Seal: California Portland Cement Type II/V and Wyo-Ben Hydrogel bentonite (7.0 - 159.5 feet)

Well Development

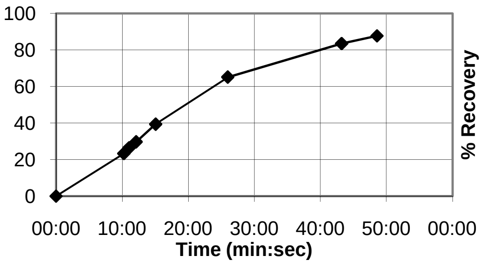
Depth to water initial: 179.60 ft final: 179.63 ft
Developed using swab and 3-inch Grundfos pump on 11/19/2010. Purged a total of 117 gallons (five well volumes).

Stabilization Test Data 11/19/2010

Time	pH	Spec. Cond. (µS/cm)	Temp (˚C)
1653	7.84	632	20.0
1708	7.72	587	20.3
1716	7.85	590	20.6

Recovery Data

Q= 4.5 gal/min
S= 15.52 ft



Comments Drilled TD = 212.0 feet, driller cleaned out borehole to TD = 212.8 feet. Install well through 8-inch diameter steel casing. Sections of casing removed incrementally after materials were placed. Bentonite chips hydrated with water. Stainless steel centralizer placed at bottom of sump and 1 foot above top of screen. Concrete pad and protective guard posts at ground surface.

Supervised by: Ryan Tolene
Date: 11/17/2010

MONITORING WELL DEVELOPMENT FORM

Project Name: Soledad Mountain
Well Number: MW-6
Project Number: 043-2299D
Project Location: Mojave, CA

Elevation of Well:
Ground Surface Elevation (GS): 2760.1 feet
Top of Casing Elevation (TOC): 2762.8 feet

Well Information
Date Well Installed: 11/17/2010 - 11/18/2010
Total Depth of Well: 215.19 feet btoc
Depth to Top of Screen: 170.41 feet btoc
Length of Screen: 40 feet
Type of Formation Screened: Alluvium

Well Volume Calculation: (5xWell Volume)+ 3xAmt H20 added,
4-inch diameter well contains 0.653 gallons of water per foot of depth

Water Level = 179.60 ft btoc
(215.19 - 179.60 ft) x 0.653 gal/ft = 23.2 gallons/well vol.

5 Well Volumes = 116.2 gallons

Well Development Method:

Equipment:

Surge	X	Bail	X
Airlift		Pump	X

Method Description:
Surge screen for 5 minutes per 2-foot interval with stainless steel swab on wireline.
Purge with stainless steel bailer and 3-inch Grundfos pump.

Observations During Well Development:

Date	Time	Depth to Water (ft btoc)	Total Depth (ft btoc)	Fluid Removed		Temp. (degrees C)	pH (units)	S.C. (µS/cm)	Relative Turbidity
				(Gallons)	Total				
11/19/10	0812	179.60	215.19						
	0912	Start surging screened interval with stainless steel swab							
	1045	Start purging with bailer		8	8				High
	1402	Start purging with Grundfos pump. Pumping rate 4.5 gallons per minute (gpm).							High - Mod.
	1408	Water level below pump intake. Turn pump off.		15	23				
	1408 - 1534	Measure recovery of water level. See recovery data on well construction summary form.							
	1534	Resume purging with Grundfos pump. Pumping rate 0.75 gpm.			30	23.6	5.85	2017	High
	1543				40	22.1	6.50	1595	High
	1554				55	19.6	7.09	1014	Mod.
	1607				65	19.0	7.65	695	Mod.
	1614				70	21.5	7.43	655	Mod.
	1627				80	20.3	7.61	675	Mod.
	1640				90	19.9	7.59	662	Sli. - Mod.
	1653				100	20.0	7.84	632	Sli.
	1708				111	20.3	7.72	587	Sli.
	1716	End purging. Turn pump off.			117	20.6	7.85	590	Sli.
	1748	183.95	Partially-recovered water level						
11/20/10	0740	179.63	Recovered water level						

ft btoc = feet below top of casing
Mod. = Moderately Turbid
Sli. = Slightly Turbid

Supervised by: Ryan Tolene

*The free Adobe Reader may be used to view and complete this form. However, software must be purchased to complete, save, and reuse a saved form.

File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. xxxxxxx

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N Latitude

W Longitude

APN/TRS/Other

Page 1 of 1

Owner's Well Number PW-4

Date Work Began 05/15/2015 Date Work Ended 7/7/2015

Local Permit Agency KERN COUNTY ENVIRONMENTAL HEALTH DIVISON

Permit Number WP 15903 Permit Date 5/13/15

Geologic Log

Orientation ● Vertical ○ Horizontal ○ Angle Specify

Drilling Method Dual-Tube Reverse Circulation Rotary Drilling Fluid Bentonite mud

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc
		** SEE ATTACHED LITHOLOGY LOG**

Total Depth of Boring 750 Feet

Total Depth of Completed Well 740 Feet

Well Owner

Name GOLDEN QUEEN MINING CO. LLC

Mailing Address 15772 K STREET

City MOJAVE State CA Zip 93501

Well Location

Address 4750 EUROPE AVENUE

City REEFER CITY County Kern

Latitude 35 Deg. 0 Min. 11 Sec. N Longitude 118 Deg. 13 Min. 4 Sec. W

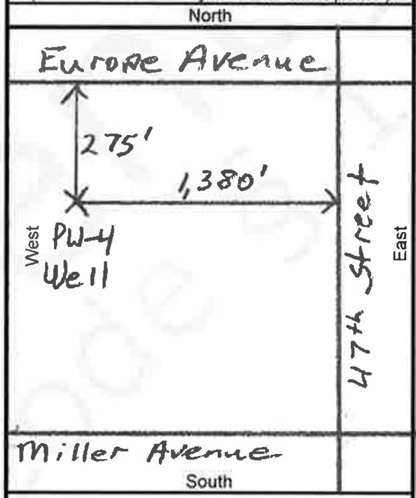
Datum WGS84 Dec. Lat. 0388875.1 Dec. Long. 3874084.4

APN Book 326 Page 102 Parcel 02

Township 11N Range 13W Section 36

Location Sketch

(Sketch must be drawn by hand after form is printed.)



Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

● New Well
○ Modification/Repair
  ○ Deepen
  ○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

● Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☑ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
○ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water 324 (Feet below surface)

Depth to Static Water Level 324 (Feet) Date Measured 07/04/2015

Estimated Yield * 350 (GPM) Test Type Constant Rate

Test Length 12.0 (Hours) Total Drawdown 64 (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	52	36	Conductor	Low Carbon Steel	.375	24		
0	330	22	Blank	Low Carbon Steel	.375	12.75		
330	700	22	Screen	Low Carbon Steel	.312	12.75	Louver	0.090
700	740	22	Blank	Low Carbon Steel	.375	12.75		
0	425	22	Sounder	Low Carbon Steel	.154	2.375		
0	305	22	Fill pipe	Low Carbon Steel	.216	3.5		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	280	Cement	neat cement
280	290	Bentonite	TR tablets
290	750	Filter Pack	

Attachments

☑ Geologic Log
☑ Well Construction Diagram
☑ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☑ Other Well Permit

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name BOART LONGYEAR
Person, Firm or Corporation

2745 WEST CALIFORNIA AVE SALT LAKE CITY UT 84104
Address City State Zip

Signed
C-57 Licensed Water Well Contractor

7/20/2015 Date Signed

694686 C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

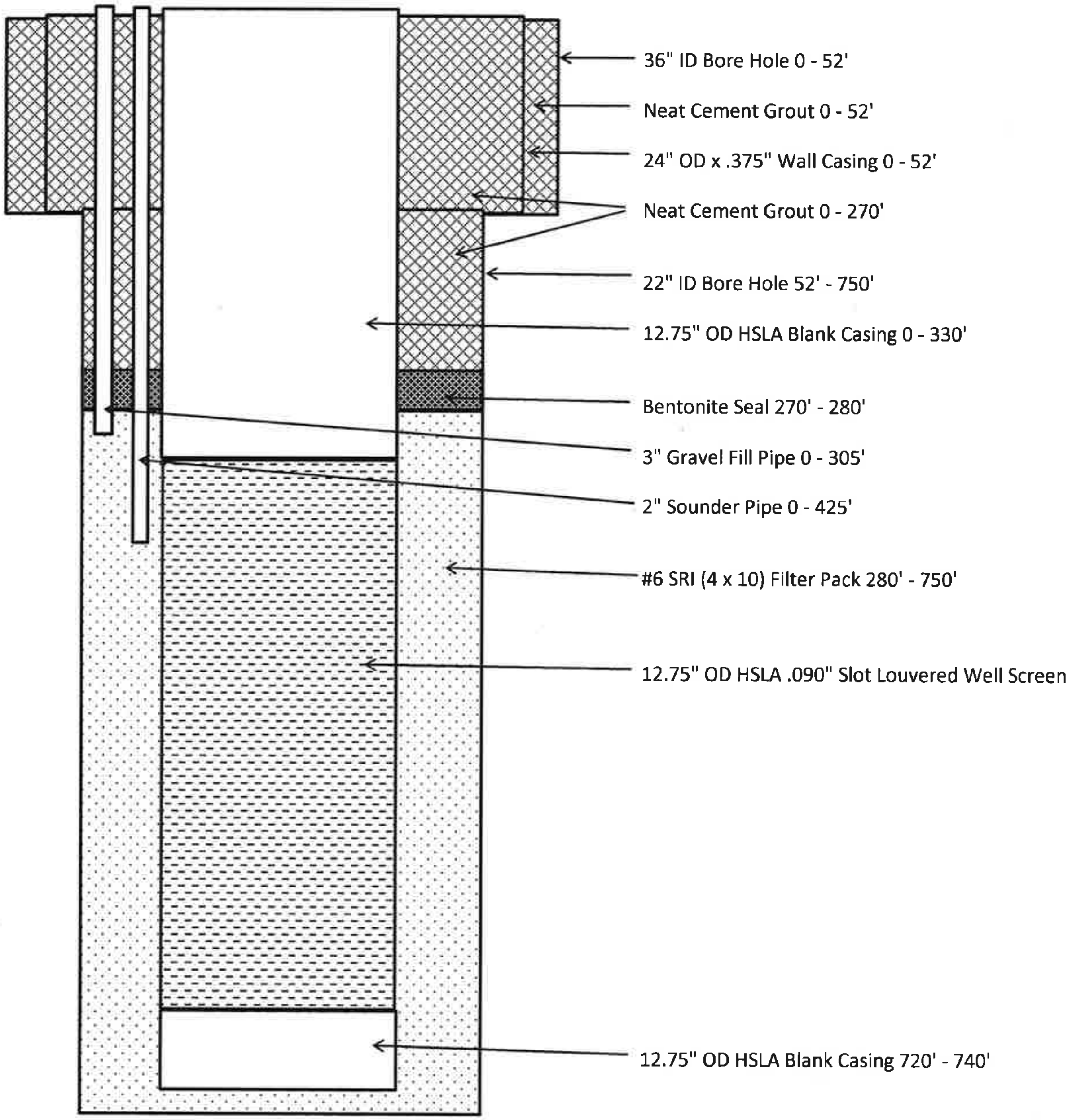
Well PW-4

Golden Queen Mining Company, LLC - Soledad Mountain Project

Depth Interval (feet)		Unified Soil Classification	Soil Description
0	10	SW	Medium-grained sand, well graded
10	20	SW	Medium-grained sand, well graded
20	30	SW	Medium-grained sand, well graded
30	40	SW	Medium-grained sand, well graded
40	50	SW	Medium-grained sand, well graded
50	60	SW	Medium-grained sand w/some coarse sand, well graded
60	70	SW	Medium-grained sand, well graded
70	80	SM	Medium-grained sand w/silt
80	90	SP	Medium-coarse grained sand, poorly graded
90	100	CL	Clay
100	110	CL	Sandy clay
110	120	SW	Well graded sand
120	130	SC	Clayey sand
130	140	SW	Well graded sand
140	150	CL	Sandy clay
150	160	SW	Well graded sand
160	170	SM	Silty sand
170	180	SW	Well graded sand
180	190	SM	Silty sand
190	200	SW	Well graded coarse-grained sand
200	210	CL	Clay
210	220	SM	Silty sand
220	230	SM	Silty sand
230	240	CL	Sandy clay
240	250	SM	Sandy silt
250	260	SW	Gravelly sand
260	270	CL	Sandy clay
270	280	CL	Sandy clay
280	290	SM	Silty sand w/trace clay
290	300	CL	Sandy clay
300	310	SM	Silty sand w/some clay
310	320	SM	Silty sand
320	330	SM	Silty sand
330	340	SW	Well graded coarse-grained sand
340	350	CL	Sandy clay
350	360	SW	Gravelly sand
360	370	SM	Silty sand w/trace clay
370	380	SM	Silty sand w/some coarse-grained sand
380	390	SW	Well graded sand w/trace clay
390	400	CL	Clay
400	410	CL	Sandy clay
410	420	GC	Gravelly clay
420	430	SW	Well graded sand
430	440	SM	Silty sand
440	450	SM	Silty sand
450	460	SW	Well graded sand
460	470	SM	Silty sand, well graded
470	480	SM	Silty sand
480	490	SC	Clayey sand
490	500	CL	Sandy clay

Well PW-4			
Golden Queen Mining Company, LLC - Soledad Mountain Project			
Depth Interval (feet)		Unified Soil Classification	Soil Description
500	510	CH	Sandy clay, light gray in color
510	520	CH	Sandy clay, light gray in color
520	530	CH	Sandy clay, light gray in color
530	540	CH	Sandy clay, light gray in color
540	550	GC	Clayey gravel
550	560	CH	Sandy clay, light gray in color
560	570	CH	Sandy clay, light gray in color
570	580	SP	Poorly graded sand, medium-coarse w/trace clay, light gray
580	590	SC	Clayey sand, poorly graded, medium-coarse grained, light gray
590	600	SP	Gravelly sand, poorly graded, medium-coarse grained w/trace clay, light gray
600	610	CH	Sandy clay, light gray in color
610	620	CH	Clay w/trace sand, light gray in color
620	630	CH	Sandy clay, light gray in color
630	640	GC	Clayey gravel, light gray in color
640	650	CH	Sandy clay, light gray in color

Golden Queen Mining Co., LLC Well # PW-4



PACIFIC SURVEYS

ELECTRIC LOG
GAMMA RAY

Job No.
19426

File No.

Company BOART LONGYEAR
Well GOLDEN QUEEN PW-4
Field MOJAVE
County KERN State CA

Location:
1.4 MILES WEST OF HWY 14 ON SILVER QUEEN RD.
.3 MILES NORTH ON HOLT RD. & 1.8 MILES WEST OF HOLT RD
GPS: N35o0.088' W118o13.049'
Sec. Twp. Rge.

Other Services:
CALIPER

Permanent Datum	G.L.		Elevation
Log Measured From	G.L.	0' above perm. datum	K.B.
Drilling Measured From	G.L.		D.F. G.L.

Date	5-30-2015		
Run Number	ONE		
Depth Driller	750'		
Depth Logger	750'		
Bottom Logged Interval	750'		
Top Log Interval	30'		
Casing Driller	24" @ 50'		
Casing Logger	50'		
Bit Size	22"		
Type Fluid in Hole	BENTONITE		
Density / Viscosity	9.7 : 43		
pH / Fluid Loss	8 : 10		
Source of Sample	TANK		
Rm @ Meas. Temp	5.37 @ 77F		
Rmf @ Meas. Temp	5.12 @ 77F		
Rmc @ Meas. Temp	N/A		
Source of Rmf / Rmc	MEASURE		
Rm @ BHT	N/A		
Time Circulation Stopped	3 HOURS		
Time Logger on Bottom	9:00 AM		
Max. Recorded Temperature	N/A		
Equipment Number	PS-5		
Location	L.A.		
Recorded By	ABREAU		
Witnessed By	J. WATKINS		

<<< Fold Here >>>

Comments

Calibration Report

Database File	19426.db
Dataset Pathname	elog
Dataset Creation	Sat May 30 08:30:22 2015

ELOG Calibration Report

Serial:	D4
Model:	DTQ
Shop Calibration Performed:	Tue Mar 03 16:25:53 2015
Before Survey Verification Performed:	Tue Mar 03 16:22:41 2015
After Survey Verification Performed:	Tue Mar 03 16:23:12 2015

Shop Calibration

	Readings			References			Results	
	Zero	Cal		Zero	Cal		Gain	Offset
Short	9.332	100.892		10.200	102.200	Ohm-m	1.005	0.823
Long	9.764	99.525		10.200	102.200	Ohm-m	1.025	-17.000
IEE	220.940	8904.920	counts	0.242	9.746	A		
VSN	68.200	10148.760	counts	1.301	193.575	V		
VLN	87.620	2572.260	counts	1.671	49.063	V		

Before Survey Verification

	Readings			References			Results	
	Zero	Cal		Zero	Cal		Gain	Offset
Short	26.077	101.434		27.475	101.439	Ohm-m	0.982	1.879
Long	144.935	102.833		102.842	102.842	Ohm-m	0.911	9.170
IEE	221.720	8915.120	counts	0.243	9.757	A		
VSN	64.960	10159.840	counts	1.239	193.787	V		
VLN	90.260	2575.000	counts	1.722	49.115	V		

After Survey Verification

	Readings			References			Results	
	Zero	Cal		Zero	Cal		Gain	Offset
Short	25.938	101.430		26.077	101.434	Ohm-m	0.998	0.186
Long	144.084	102.829		102.833	102.833	Ohm-m	1.021	-2.108
IEE	222.980	8921.480	counts	0.244	9.764	A		
VSN	64.980	10166.720	counts	1.239	193.918	V		
VLN	90.240	2576.740	counts	1.721	49.148	V		

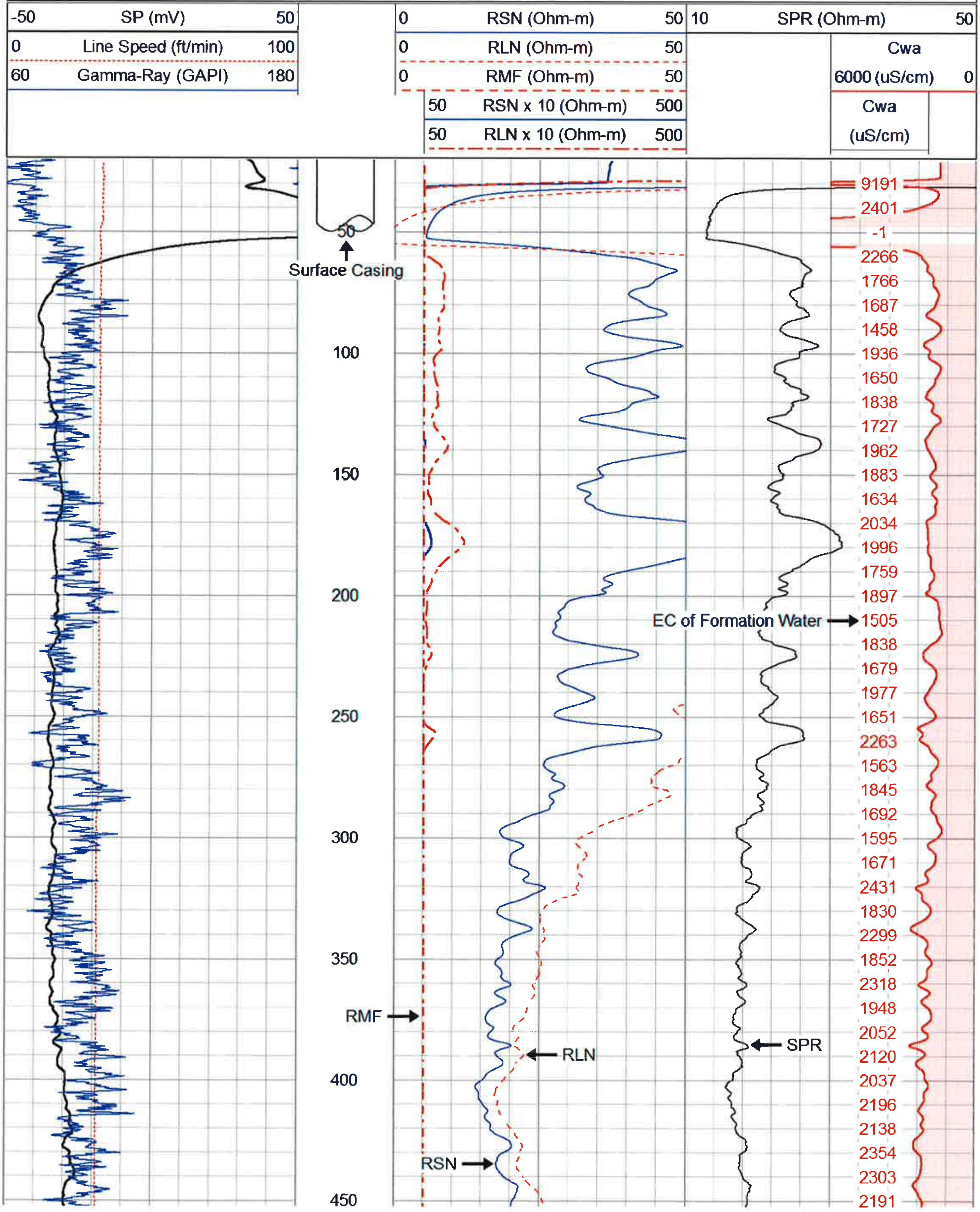
After Survey Verification compared to Before Survey Calibration

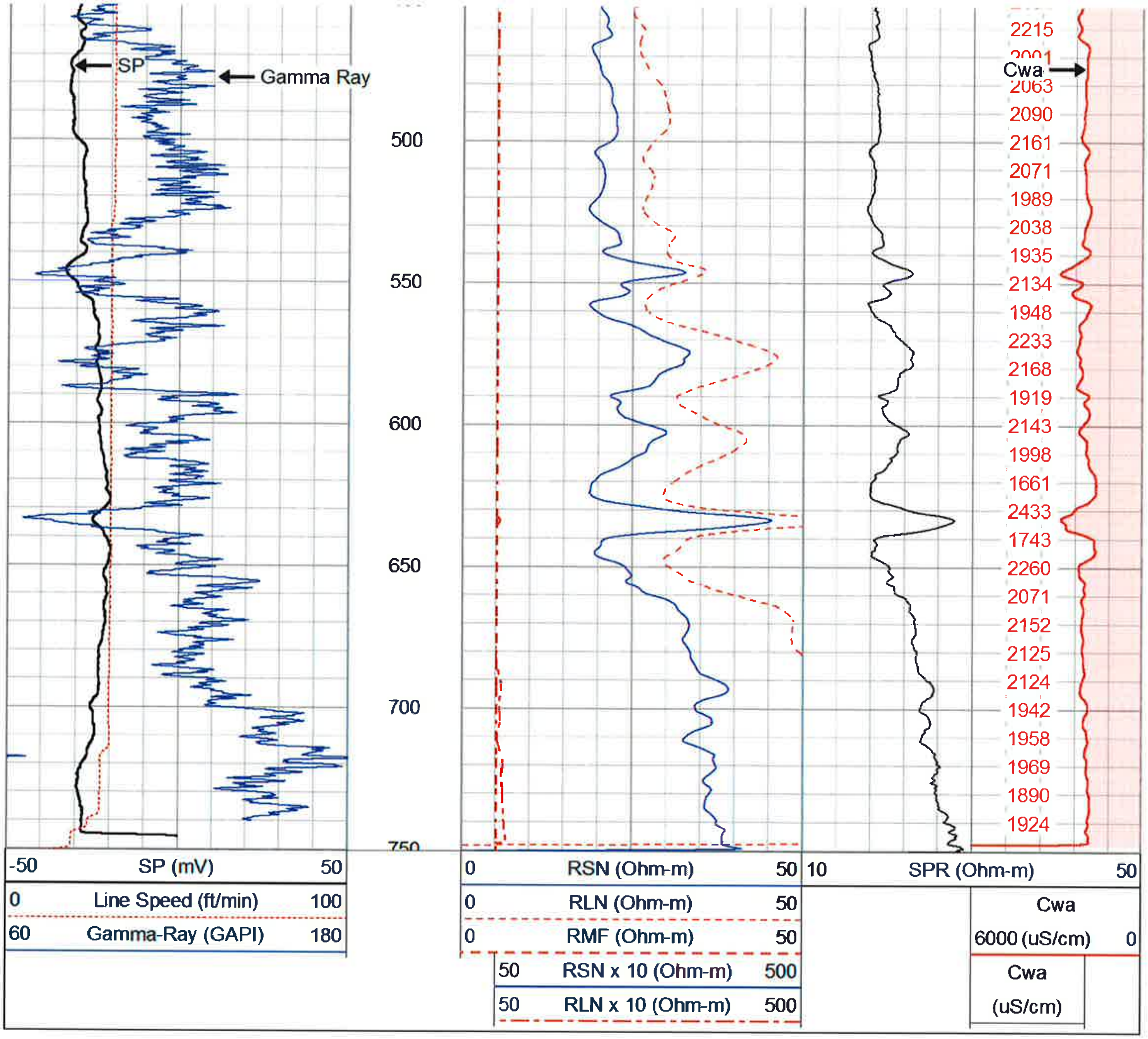
	Zero			Cal		
	Before	After		Before	After	
Short	27.475	26.077	Ohm-m	101.439	101.434	Ohm-m
Long	141.193	144.935	Ohm-m	102.842	102.833	Ohm-m

Gamma Ray Calibration Report

Serial Number:	D4	
Tool Model:	ELOG	
Performed:	Tue Mar 03 16:50:57 2015	
Calibrator Value:	162.0	GAPI
Background Reading:	124.7	cps
Calibrator Reading:	352.0	cps
Sensitivity:	0.7129	GAPI/cps

Database File	19426.db
Dataset Pathname	elog
Presentation Format	elog_cwa
Dataset Creation	Sat May 30 08:30:22 2015
Charted by	Depth in Feet scaled 1:600




SP
Gamma Ray
500
550
600
650
700
750
Cwa
2215
2001
2063
2090
2161
2071
1989
2038
1935
2134
1948
2233
2168
1919
2143
1998
1661
2433
1743
2260
2071
2152
2125
2124
1942
1958
1969
1890
1924
-50 SP (mV) 50
0 Line Speed (ft/min) 100
60 Gamma-Ray (GAPI) 180
0 RSN (Ohm-m) 50
0 RLN (Ohm-m) 50
0 RMF (Ohm-m) 50
50 RSN x 10 (Ohm-m) 500
50 RLN x 10 (Ohm-m) 500
10 SPR (Ohm-m) 50
Cwa
6000 (uS/cm) 0
Cwa
(uS/cm)

KERN COUNTY
Public Health Services
DEPARTMENT

MATTHEW CONSTANTINE
DIRECTOR

2700 M STREET, SUITE 300 BAKERSFIELD, CALIFORNIA 93301-2370 VOICE 661-862-8740 FAX 661-862-8701 WWW.CO.KERN.CA.US/EH

May 13, 2015

Golden Queen Mining Co LLC
15772 K St.
Mojave, CA 93501

Ladies and Gentleman:

This is to advise you that your application for a permit to construct a domestic water well located in T 11N, R 13W, Section 36, APN 326-102-02, has been received and reviewed. Your permit number is WP 15903.

No additional conditions will be required at this time.

Guidelines for obtaining final approval of your water well are outlined in the enclosure.

If you will not be able to install your pump, obtain the necessary water quality results, and receive final approval by this Division within ninety (90) days of the completion of drilling, please complete and return the Out of Service form to the Public Health Services Department, Environmental Health Division.

If you have any questions about your well, please contact our office at (661) 862-8740.

Sincerely,

Jeremy Ryan, R.E.H.S.
Environmental Health Specialist I
Water Quality Program

Enclosure

cc: Boart Longyear
File WP 15903

From:	Christensen, Jay
Sent:	Monday, June 08, 2015 7:51 PM
To:	'Jeremy Ryan'
Cc:	KWilcox@djacivil.com; jbalas@goldenqueen.com; Watkins, Jesse; Boart Longyear / Jesse Watkins; Long, David; Kent, Jeffrey
Subject:	WP 15903 Surface Cement Seal Records
Attachments:	Cement Record WP 15903.pdf; Cement Samples WP 15903.pdf

Jeremy,

Surface seal operation was started at 6:00 AM 6/6 and completed at 4:00 PM same 6/6.
Calculated volume; 508 cubic feet or 3,089 gallons.
22" ID bore hole x 12-3/4" OD Casing 280' to 50', 23-1/4" ID Casing x 12-3/4" OD Casing 50' to surface.
Pumped volume; 322.84 cubic feet at 2,415 gallons (78.18% of calculated hole volume)

Pumped in 14 stages thru tremie pipe from bottom up.
Weight ranged from 15.7 ppg to 16.1 ppg.; Lifts;
1 - 15.8 ppg 170 gallons 6:30 am
2 - 16.0 ppg 160 gallons 8:00 am
3 – 15.5 ppg 175 gallons 11:45 am
4 – 16.1 ppg 175 gallons 12:00 noon
5 – 15.8 ppg 170 gallons 12:30 pm
6 – 14.6 ppg 165 gallons 1:00 pm
7 – 14.7 ppg 175 gallons 1:22 pm
8 – 15.7 ppg 175 gallons 1:44 pm
9 – 15.8 ppg 175 gallons 2:02 pm
10 – 15.9 ppg 175 gallons 2:22 pm
11 – 15.9 ppg 175 gallons 2:37 pm
12 – 15.9 ppg 175 gallons 3:00 pm
13 – 15.8 ppg 175 gallons 3:27 pm
14 – 15.9 ppg 175 gallons 3:45 pm

Samples of all grout pumped are available.
If I can be of any assistance please do not hesitate to contact me.

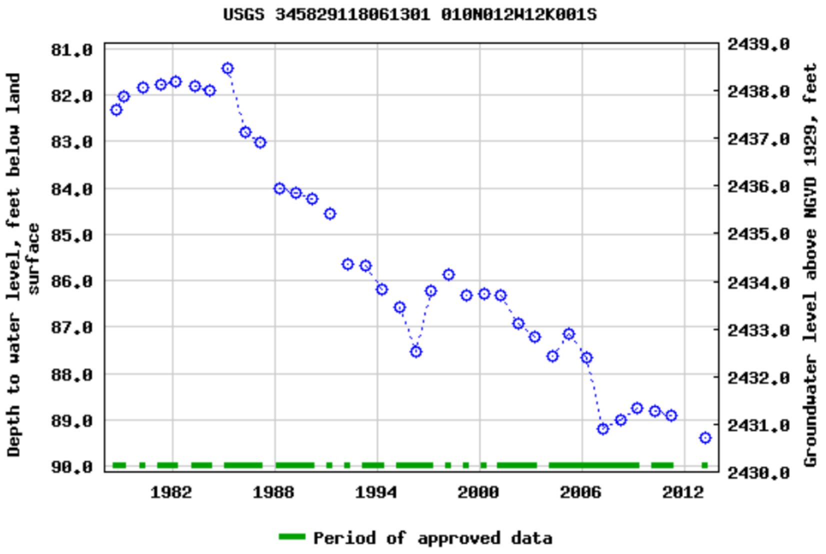
Best regards,
Jay Christensen
Boart Longyear Drilling Services
2745 West California Avenue
Salt Lake City, Utah 84104
jchristensen@boartlongyear.com
Direct: (385) 234-3872
Fax: (801) 973-4572
Cellular: (801) 556-7151

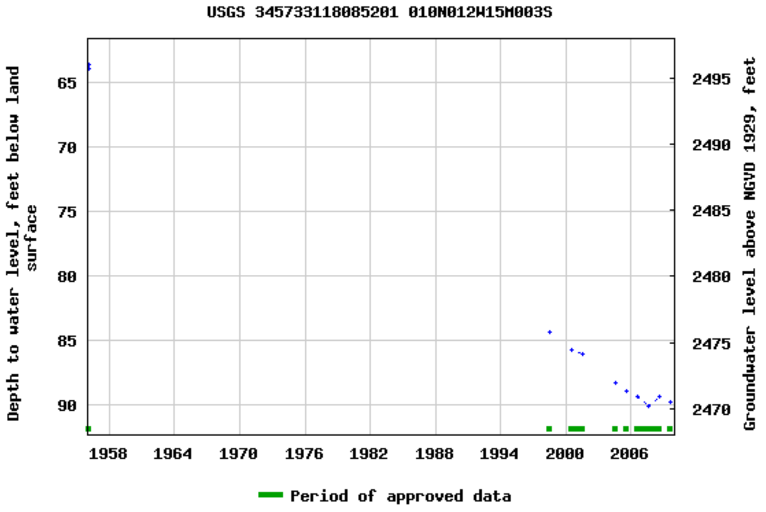
APPENDIX C

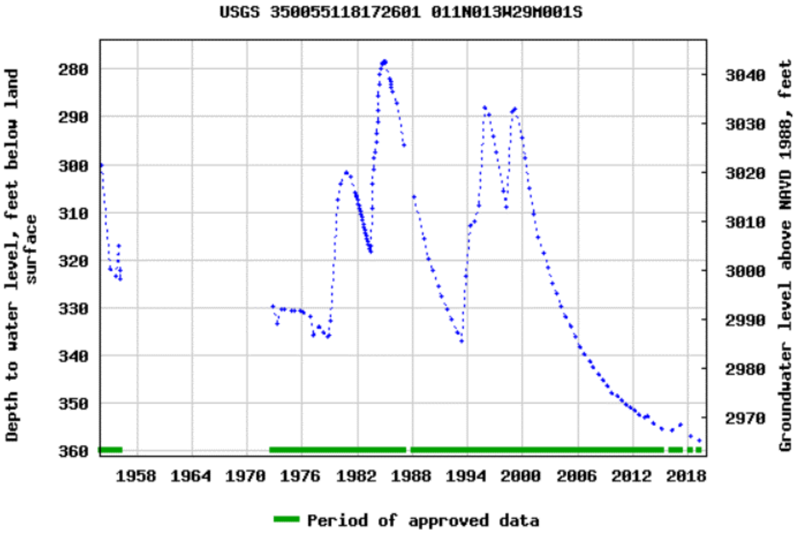
Hydrographs of Selected Water Wells

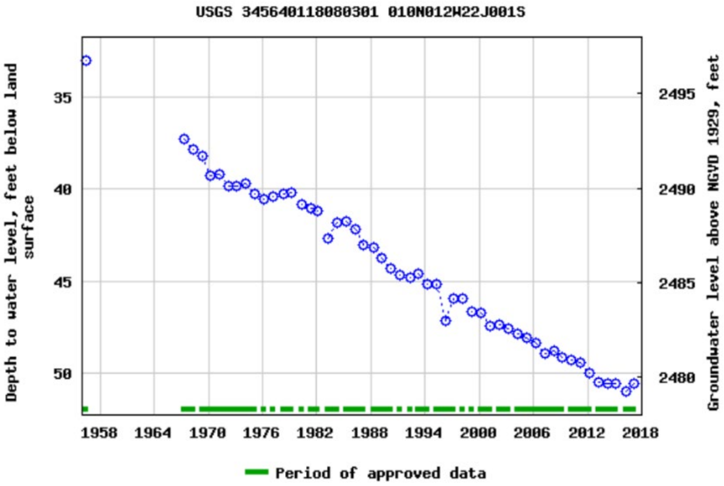
Hydrographs of Selected Wells Monitored by the USGS

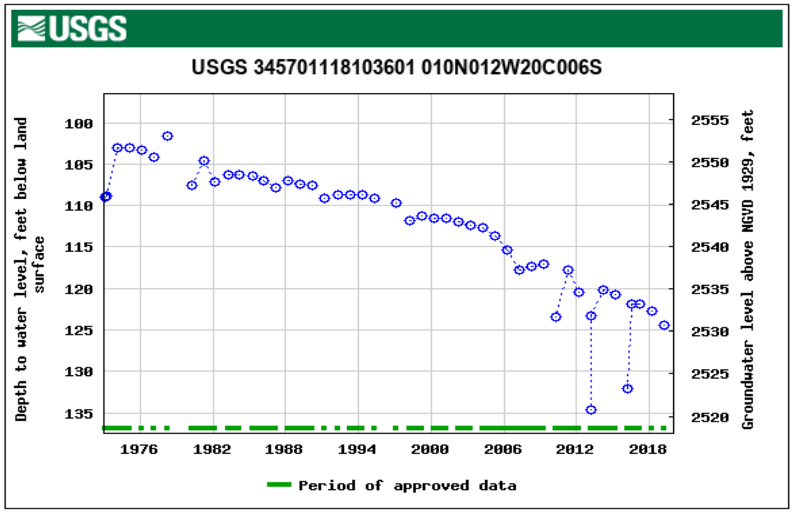
USGS Well Number	Labeled Number of Well on Figure 4	First Monitoring Date	Last Monitoring Date	Change in H_2O level since monitoring initiated	Rate of Drawdown (ft/yr)
345701118103601	3	1973	Active	15.5	0.34
345829118061301	5	1978	2013	7.05	0.2
350055118172601	11	1954	Active	57.78	0.89
345747118054301	29	1956	2017	14.52	0.24
345733118085201	30	1956	2011	25.85	0.49
345640118080301	31	1956	2017	17.56	0.29

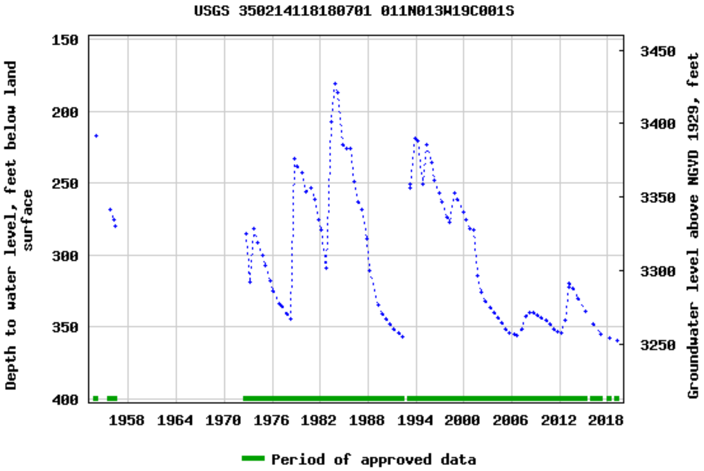





USGS 350055118172601 011N013W29M001S
Depth to water level, feet below land surface
280
290
300
310
320
330
340
350
360
Groundwater level above NAVD 1988, feet
3040
3030
3020
3010
3000
2990
2980
2970
1958
1964
1970
1976
1982
1988
1994
2000
2006
2012
2018
Period of approved data


USGS 345640118080301 010N012W22J001S
Depth to water level, feet below land surface
35
40
45
50
Groundwater level above NGVD 1929, feet
2495
2490
2485
2480
1958
1964
1970
1976
1982
1988
1994
2000
2006
2012
2018
Period of approved data


USGS
USGS 345701118103601 010N012W20C006S
Depth to water level, feet below land surface
100
105
110
115
120
125
130
135
Groundwater level above NGVD 1929, feet
2555
2550
2545
2540
2535
2530
2525
2520
1976
1982
1988
1994
2000
2006
2012
2018
Period of approved data


USGS 350214118180701 011N013W19C001S
Depth to water level, feet below land surface
150
200
250
300
350
400
Groundwater level above NGVD 1929, feet
3450
3400
3350
3300
3250
1958
1964
1970
1976
1982
1988
1994
2000
2006
2012
2018
Period of approved data

APPENDIX D

Soledad Mountain Mine Water Quality Results

Attachment D1
Quarterly Monitoring Results, 2011-2018
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

		Field Parameters				Lab Parameters			Major Cations, Dissolved				Major Anions, Dissolved					Nutrients, Dissolved		Cyanide, Dissolved	
		pH, field	Specific Conductivity	Temperature		pH, lab	TDS	Fluoride	Calcium	Magnesium	Sodium	Potassium	Bicarbonate	Carbonate	Hydroxide	Sulfate	Chloride	Nitrate	Nitrite	WAD Cyanide	Total Cyanide
Well ID	Sample Date	s.u.	µS/cm	°C	°F	s.u.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L as $CaCO_3$	mg/L as $CaCO_3$	mg/L as $CaCO_3$	mg/L	mg/L	mg/L as N	mg/L as N	mg/L	mg/L
MW-2	2/23/2011	8.16	360	21.7	71.06	8.3	240	0.8	25	6.1	46	2.6	110	5	< 3	53	9	0.3	< 0.05	< 0.01	< 0.005
	5/11/2011	7.99	376	26.9	80.42	8.3	230	0.7	26	5.8	44	2.4	120	< 3	< 3	51	8	0.3	< 0.05	< 0.01	< 0.005
	8/23/2011	7.31	371	25.9	78.62	8.3	240	0.7	27	6.4	48	2.8	110	3	< 3	54	10	0.3	< 0.05	< 0.01	< 0.005
	10/18/2011	8.18	361	22.4	72.32	8.3	260	0.86	27	6.2	47	3	110	3.8	< 3	56	9.2	0.55	< 0.05	< 0.01	< 0.005
	2/28/2012	7.82	394	22.6	72.68	8.3	240	0.7	26	6	43	2.4	120	120	< 3	55	8.7	0.27	< 0.05	< 0.01	< 0.005
	5/21/2012	7.7	405	28.3	82.94	8.3	240	0.73	26	6.1	44	2.6	110	< 3	< 3	54	8.1	0.26	< 0.05	< 0.01	< 0.005
	8/15/2012	7.96	313	24.6	76.28	8.4	250	0.74	25	5.6	42	2.6	110	6.2	< 3	52	8	0.41	< 0.05	< 0.01	0.0068
	11/12/2012	7.88	331	19.9	67.82	8.2	230	0.83	25	5.8	43	2.6	110	< 3	< 3	52	7.7	0.26	< 0.05	< 0.01	< 0.005
	2/26/2013	8.28	343	21.5	70.7	8.3	240	0.83	25	5.7	41	2.4	120	< 3	< 3	52	7.9	0.3	< 0.05	< 0.01	< 0.005
	5/29/2013	8.2	278	24.8	76.64	8.4	250	0.84	26	5.9	43	2.7	120	4.1	< 3	51	7.5	0.3	< 0.05	< 0.01	< 0.005
	8/22/2013	8.09	328	24.2	75.56	8.3	240	0.83	25	5.8	44	2.4	110	< 3	< 3	53	7.7	0.25	< 0.05	< 0.01	< 0.005
	10/22/2013	8.14	363	19.94	67.892	8.3	230	0.84	26	5.7	43	2.4	120	< 3	< 3	56	8.1	0.22	< 0.05	< 0.01	< 0.005
	2/10/2014	8.52	464	20	68	8.3	230	0.82	25	5.7	42	2.5	110	< 3	< 3	54	7.9	< 0.22	< 0.05	< 0.01	< 0.005
	5/21/2014	8.12	342	22.46	72.428	8.3	230	0.82	24	5.2	41	2.3	120	< 3	< 3	53	7.8	0.24	< 0.05	< 0.01	< 0.005
	8/4/2014	8.09	356	24.67	76.406	8.3	240	0.79	23	5.3	42	2.4	110	< 3	< 3	54	8	0.25	< 0.05	< 0.01	< 0.005
	10/20/2014	8.08	338	22.03	71.654	8.2	230	0.82	24	5.4	42	2.4	100	< 3	< 3	52	7.6	0.24	< 0.05	< 0.01	< 0.005
	2/17/2015	8.11	336	21.72	71.096	8.2	220	0.9	23	5.2	42	2.4	110	< 3	< 3	55	7.9	0.2	< 0.05	< 0.01	< 0.005
	5/12/2015	8.08	330	21.2	70.16	8.3	220	0.84	24	5.5	43	2.5	100	< 3	< 3	52	8	< 0.2	< 0.05	< 0.01	< 0.005
	8/11/2015	7.81	359	22.19	71.942	8.3	230	0.8	23	5.7	40	2.5	110	< 3	< 3	49	7.7	< 0.2	< 0.05	< 0.01	< 0.005
	11/19/2015	8.54	238	23.4	74.12	8.2	240	0.8	22	5.6	40	2.3	100	< 3	< 3	50	8.1	0.4	< 0.05	< 0.01	< 0.005
	2/2/2016	8.81	283	15.43	59.774	8.2	240	0.84	23	5.5	42	2.4	100	< 3	< 3	51	7.5	< 0.23	< 0.05	< 0.01	< 0.005
	4/7/2016	8.65	352	22.01	71.618	8.3	230	0.89	23	5.4	41	2.2	100	< 3	< 3	52	7.8	< 0.23	< 0.05	< 0.01	< 0.005
	9/15/2016	8.7	464	22.86	73.148	8	230	0.91	24	5.9	43	2.6	100	< 3	< 3	51	8.2	< 0.23	< 0.05	< 0.01	< 0.005
	10/24/2016	9.32	368	21.88	71.384	8.2	240	0.84	26	6.2	44	2.7	110	< 3	< 3	56	6.6	0.31	< 0.05	< 0.01	< 0.005
	2/1/2017	9.77	366	21.09	69.962	8.3	240	0.88	25	6.2	44	2.7	110	< 3.0	< 3.0	59	6.2	0.32	< 0.050	< 0.010	< 0.0050
	4/6/2017	8.21	374	22.63	72.734	8.2	240	0.84	26	6.2	45	2.4	110	< 3.0	< 3.0	60	6.1	0.34	< 0.050	< 0.010	<0.0050
	7/13/2017	8.28	390	26.48	79.664	8.2	250	0.8	27	6	41	2.4	110	< 3.0	< 3.0	65	6	0.49	< 0.050	< 0.010	< 0.0050
	11/15/2017	8.27	390	22.85	73.13	8.1	240	0.77	27	6.1	45	2.4	110	< 3.0	< 3.0	65	5.9	0.38	< 0.050	< 0.010	< 0.0050
	2/12/2018	8.33	580	9	48.2	8.2	240	0.86	27	6.3	45	2.4	100	< 3.0	< 3.0	68	6.2	0.39	< 0.050	< 0.010	< 0.0050
	4/17/2018	7.81	488	11.15	52.07	8	250	0.85	26	6.2	44	2.2	100	< 3.0	< 3.0	64	6.1	0.35	< 0.050	< 0.010	< 0.0050
	7/24/2018	6.62	380	26.96	80.528	8.2	250	0.83	27	6.6	45	2.6	110	< 3.0	< 3.0	64	6.4	0.34	< 0.050	< 0.010	< 0.0050
	10/15/2018	6.92	370	22.26	72.068	8.2	240	0.83	24	5.8	43	2.3	100	< 3.0	< 3.0	58	5.8	--	--	< 0.010	< 0.0050
	11/1/2018	6.55	373	22.95	73.31	--	--	--	--	--	--	--	--	--	--	--	--	0.33	--	--	--
MW-3	2/23/2011	8.24	392	21.9	71.42	8.4	280	0.5	26	4.8	49	2.4	78	10	< 3	91	9	0.5	< 0.05	< 0.01	< 0.005
	5/12/2011	8.15	404	24.3	75.74	8.3	280	0.4	28	5.1	51	2.5	85	< 3	< 3	90	9	0.5	< 0.05	< 0.01	< 0.005
	8/23/2011	7.95	408	29.2	84.56	8.3	270	0.4	30	5.7	53	2.6	90	< 3	< 3	92	10	0.5	< 0.05	< 0.01	< 0.005
	10/19/2011	8.31	404	29.4	84.92	8.3	290	0.5	28	5.2	48	2.6	92	< 3	< 3	93	8	0.4	< 0.05	< 0.01	< 0.005
	2/28/2012	8.08	424	23.8	74.84	8.3	280	0.5	29	5.4	50	2.4	92	< 3	< 3	96	8.7	0.47	< 0.05	< 0.01	< 0.005
	5/23/2012	8.17	410	21.62	70.916	8.4	280	0.44	28	5.4	48	2.4	86	4.7	< 3	91	8.7	0.46	< 0.05	< 0.01	< 0.005
	8/16/2012	8.35	356	25.2	77.36	8.3	270	0.49	28	5.3	49	2.4	92	< 3	< 3	94	8.2	0.52	< 0.05	< 0.01	< 0.005
	11/13/2012	7.93	371	20.5	68.9	8.1	280	0.5	28	5.5	46	2.4	90	< 3	< 3	90	7.9	0.45	< 0.05	< 0.01	< 0.005
	2/26/2013	8.33	380	22.5	72.5	8.2	270	0.46	27	5.3	47	2.4	95	< 3	< 3	88	7.7	0.46	< 0.05	< 0.01	< 0.005
	5/29/2013	8.25	309	25.9	78.62	8.3	280	0.46	28	5.5	47	2.4	96	< 3	< 3	87	7.7	0.48	< 0.05	< 0.01	< 0.005
	8/22/2013	8.02	386	29.4	84.92	8.3	270	0.44	27	5.5	48	2.2	95	< 3	< 3	90	7.6	0.45	< 0.05	< 0.01	< 0.005
	10/22/2013	7.95	404	20.77	69.386	8.2	270	0.43	27	5.2	45	2.2	95	< 3	< 3	93	8	0.46	< 0.05	< 0.01	< 0.005
	2/10/2014	8.52	542	21.06	69.908	8.2	270	0.42	28	5.5	47	2.4	97	< 3	< 3	91	7.8	0.43	< 0.05	< 0.01	< 0.005
	5/21/2014	8.12	394	22.93	73.274	8.3	270	0.42	26	5.1	45	2.2	97	< 3	< 3	90	7.9	0.45	< 0.05	< 0.01	< 0.005
	8/4/2014	8.08	405	24.56	76.208	8.2	280	0.39	27	5.5	48	2.3	90	< 3	< 3	91	7.9	0.46	< 0.05	< 0.01	< 0.005
	10/20/2014	8	393	22.1	71.78	8.2	270	0.41	28	5.7	49	2.4	89	< 3	< 3	88	7.6	0.45	< 0.05	< 0.01	< 0.005
	2/17/2015	7.99	385	21.65	70.97	8.2	260	0.4	27	5.5	48	2.4	98	< 3	< 3	92	7.8	0.5	< 0.05	< 0.01	< 0.005
	5/12/2015	7.99	389	21.65	70.97	8.2	270	0.36	29	5.8	49	2.4	92	< 3	< 3	89	7.8	0.38	< 0.05	< 0.01	< 0.005
	8/11/2015	7.86	422	24.16	75.488	8.2	280	0.3	29	6.2	47	2.5	98	< 3	< 3	84	7.5	0.4	< 0.05	< 0.01	< 0.005

Attachment D1
Quarterly Monitoring Results, 2011-2018
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

		Field Parameters				Lab Parameters			Major Cations, Dissolved				Major Anions, Dissolved					Nutrients, Dissolved		Cyanide, Dissolved	
		pH, field	Specific Conductivity	Temperature		pH, lab	TDS	Fluoride	Calcium	Magnesium	Sodium	Potassium	Bicarbonate	Carbonate	Hydroxide	Sulfate	Chloride	Nitrate	Nitrite	WAD Cyanide	Total Cyanide
Well ID	Sample Date	s.u.	µS/cm	°C	°F	s.u.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L as $CaCO_3$	mg/L as $CaCO_3$	mg/L as $CaCO_3$	mg/L	mg/L	mg/L as N	mg/L as N	mg/L	mg/L
MW-3 (continued)	10/12/2015	8.27	393	25	77	8.1	280	0.4	28	6	47	2.5	96	< 3	< 3	87	7.9	0.4	< 0.05	< 0.01	< 0.005
	2/2/2016	8.7	343	13.28	55.904	8.2	280	0.34	28	6	47	2.3	94	< 3	< 3	87	7.4	0.32	< 0.05	< 0.01	< 0.005
	4/7/2016	8.89	410	23.93	75.074	8.2	280	0.41	28	6	47	2.3	97	< 3	< 3	90	7.8	0.29	< 0.05	< 0.01	< 0.005
	9/15/2016	8.1	438	22.33	72.194	7.9	270	0.4	31	6	47	2.4	98	< 3	< 3	86	7.7	< 0.23	< 0.05	< 0.01	< 0.005
	10/24/2016	9.38	421	22.29	72.122	8.1	280	0.28	32	6.1	48	2.3	100	< 3	< 3	84	7.8	0.32	< 0.05	< 0.01	< 0.005
	2/1/2017	9.61	426	21.12	70.016	8.2	270	0.31	33	6.3	49	2.5	110	< 3.0	< 3.0	85	7.6	0.28	< 0.050	< 0.010	< 0.0050
	4/6/2017	7.96	432	22.41	72.338	8	270	0.27	35	6.2	49	2.3	110	< 3.0	< 3.0	83	7.6	0.28	< 0.050	< 0.010	< 0.0050
	7/13/2017	8	435	25.07	77.126	8.2	280	0.25	34	5.8	45	2.3	120	< 3.0	< 3.0	85	7.8	0.38	< 0.050	< 0.010	< 0.0050
	11/15/2017	8.03	441	22.72	72.896	8.1	260	0.25	35	5.7	49	2.2	110	< 3.0	< 3.0	84	7.5	0.29	< 0.050	< 0.010	< 0.0050
	2/12/2018	8.11	657	9.3	48.74	8.1	270	0.29	35	6.1	49	2.1	110	< 3.0	< 3.0	88	7.8	0.29	< 0.050	< 0.010	< 0.0050
	4/17/2018	7.81	522	13.53	56.354	7.9	270	0.27	36	6.1	49	2.1	110	< 3.0	< 3.0	84	7.5	0.28	< 0.050	< 0.010	< 0.0050
	7/24/2018	6.31	436	26.95	80.51	8.1	290	0.25	38	6.4	49	2.3	120	< 3.0	< 3.0	85	7.6	0.28	< 0.050	< 0.010	< 0.0050
	10/15/2018	6.38	432	21.41	70.538	8.1	270	0.25	34	5.6	46	2.1	110	< 3.0	< 3.0	80	7.1	--	--	< 0.010	< 0.0050
	11/1/2018	7.05	427	23.07	73.526	--	--	--	--	--	--	--	--	--	--	--	--	0.28	--	--	--
MW-5	2/23/2011	7.73	671	25.9	78.62	8	490	0.2	76	13	50	4.5	120	< 3	< 3	210	8	0.3	< 0.05	< 0.01	< 0.005
	5/11/2011	7.51	681	24.7	76.46	8	510	0.2	80	14	49	4.7	120	< 3	< 3	220	6	< 0.4	< 0.1	< 0.01	< 0.005
	8/24/2011	7.72	662	32.8	91.04	8.2	520	0.2	79	13	50	4.7	110	< 3	< 3	230	6	< 0.2	< 0.05	< 0.01	< 0.005
	10/19/2011	7.72	667	26.7	80.06	8	520	0.3	81	14	51	4.8	120	< 3	< 3	230	6	< 0.2	< 0.05	< 0.01	< 0.005
	2/29/2012	7.58	702	27	80.6	8.1	520	0.22	80	14	50	4.6	120	< 3	< 3	220	5.8	0.23	0.07	< 0.01	< 0.005
	5/23/2012	7.47	722	24.81	76.658	8	520	0.17	84	14	49	4.4	110	< 3	< 3	260	5.2	< 0.44	< 0.10	< 0.01	< 0.005
	8/15/2012	7.21	798	25.3	77.54	8	480	0.21	81	14	48	4.4	120	< 3	< 3	230	5.8	0.25	< 0.05	< 0.01	< 0.005
	11/12/2012	6.97	682	20.9	69.62	7.9	540	0.24	84	14	49	4.6	110	< 3	< 3	250	4.9	0.24	< 0.05	< 0.01	< 0.005
	2/26/2013	7.46	681	25	77	8.1	530	0.19	85	14	47	4.4	110	< 3	< 3	260	5.2	0.31	< 0.05	< 0.01	< 0.005
	5/29/2013	7.44	565	25.4	77.72	8	560	0.18	87	15	49	4.5	110	< 3	< 3	250	5	0.24	< 0.05	< 0.01	< 0.005
	8/22/2013	7.19	682	26.1	78.98	8	520	0.16	82	14	49	4.2	110	< 3	< 3	250	4.9	0.3	< 0.05	< 0.01	< 0.005
	10/22/2013	7.14	714	21.02	69.836	7.9	520	0.14	85	14	48	4.3	120	< 3	< 3	250	6.1	< 0.44	< 0.10	< 0.01	< 0.005
	2/11/2014	7.55	905	19.68	67.424	8	540	0.15	85	14	47	4.2	120	< 3	< 3	250	5.4	< 0.44	< 0.10	< 0.01	< 0.005
	5/21/2014	7.18	709	23.4	74.12	8	530	0.15	79	13	46	4.2	120	< 3	< 3	250	5.7	< 0.44	< 0.10	< 0.01	< 0.005
	8/5/2014	7.26	716	23.97	75.146	7.9	540	0.14	81	13	48	4	110	< 3	< 3	240	5.3	< 0.44	< 0.10	< 0.01	< 0.005
	10/21/2014	7.18	665	20.24	68.432	7.9	520	0.15	82	14	48	4.3	130	< 3	< 3	240	5.5	< 0.44	< 0.10	< 0.01	< 0.005
	2/17/2015	7.22	695	22.33	72.194	7.7	490	0.16	81	14	48	4.3	120	< 3	< 3	250	5.5	< 0.4	< 0.1	< 0.01	< 0.005
	5/12/2015	7.32	718	23.5	74.3	7.8	520	0.14	89	15	51	4.7	110	< 3	< 3	250	5.2	< 0.2	< 0.05	< 0.01	< 0.005
	8/11/2015	7.06	748	24.13	75.434	7.8	530	0.1	88	14	48	4.5	110	< 3	< 3	240	4.9	< 0.2	< 0.05	< 0.01	< 0.005
	10/12/2015	7.5	693	29.6	85.28	7.7	560	0.1	85	14	48	4.4	110	< 3	< 3	260	5	< 0.2	< 0.05	< 0.01	< 0.005
	2/2/2016	7.91	604	16.24	61.232	7.8	540	0.38	86	14	49	4.4	110	< 3	< 3	250	8.6	< 0.23	< 0.05	< 0.01	< 0.005
	4/7/2016	8.6	717	21.2	70.16	7.9	530	0.16	84	14	48	4.3	110	< 3	< 3	250	4.9	< 0.23	< 0.05	< 0.01	< 0.005
	9/15/2016	8.66	740	23.42	74.156	7.8	540	0.19	87	14	49	4.6	120	< 3	< 3	250	5.5	< 0.23	< 0.05	< 0.01	< 0.005
	10/24/2016	8.81	731	22.92	73.256	7.9	530	0.17	86	16	50	4.6	120	< 3	< 3	240	5	< 0.23	< 0.05	< 0.01	< 0.005
	2/1/2017	9.01	738	22.33	72.194	8	530	0.17	87	15	50	4.5	130	< 3.0	< 3.0	250	4.9	< 0.23	< 0.050	< 0.010	< 0.0050
	4/6/2017	7.54	742	23.16	73.688	7.8	510	0.16	88	14	52	4.7	130	< 3.0	< 3.0	240	5.1	< 0.23	< 0.050	< 0.010	< 0.0050
	7/13/2017	7.72	730	26.71	80.078	8	500	0.18	84	15	47	4.4	130	< 3.0	< 3.0	240	5.3	< 0.23	< 0.050	< 0.010	< 0.0050
	11/15/2017	7.96	669	23.01	73.418	7.8	450	0.18	75	12	47	4.2	120	< 3.0	< 3.0	200	5.4	< 0.23	< 0.050	< 0.010	< 0.0050
	2/12/2018	8.23	986	9.5	49.1	7.9	440	0.2	74	12	47	4.1	120	< 3.0	< 3.0	200	5.8	< 0.23	< 0.050	< 0.010	< 0.0050
	4/18/2018	7.21	638	21.21	70.178	7.7	430	0.19	73	11	47	4.1	120	< 3.0	< 3.0	190	5.6	< 0.23	< 0.050	< 0.010	< 0.0050
	7/24/2018	6.69	623	28.31	82.958	7.9	430	0.2	72	12	46	4.1	130	< 3.0	< 3.0	180	5.7	< 0.23	< 0.050	< 0.010	< 0.0050
	10/15/2018	6.94	633	22.52	72.536	7.9	430	0.19	69	11	46	4	120	< 3.0	< 3.0	180	5.2	--	--	< 0.010	< 0.0050
	11/1/2018	7.06	638	23.35	74.03	--	--	--	--	--	--	--	--	--	--	--	--	< 0.23	--	--	--
MW-6	2/15/2011	7.61	567	19.7	67.46	8.1	380	0.5	52	12	53	6.3	110	< 3	< 3	120	39	1.2	0.08	< 0.01	< 0.005
	5/12/2011	7.53	485	31.5	88.7	8	340	0.4	44	9.2	39	5.6	81	< 3	< 3	120	16	2.2	< 0.05	< 0.01	< 0.005
	8/24/2011	7.39	521	26.4	79.52	8.1	390	0.4	54	11	43	5.8	98	< 3	< 3	130	24	1.9	< 0.05	< 0.01	< 0.005
	10/19/2011	7.69	496	27.2	80.96	8	360	0.5	51	9.2	37	4.9	92	< 3	< 3	130	13	1.8	< 0.05	< 0.01	< 0.005
	2/29/2012	7.64	501	24.8	76.64	8	350	0.45	49	8.9	36	5.2	89	< 3	< 3	120	11	1.9	< 0.05	< 0.01	< 0.005

Attachment D1
Quarterly Monitoring Results, 2011-2018
Soledad Mountain Mine, Golden Queen Mining Company, LLC
Kern County, California

		Field Parameters				Lab Parameters			Major Cations, Dissolved				Major Anions, Dissolved					Nutrients, Dissolved		Cyanide, Dissolved	
		pH, field	Specific Conductivity	Temperature		pH, lab	TDS	Fluoride	Calcium	Magnesium	Sodium	Potassium	Bicarbonate	Carbonate	Hydroxide	Sulfate	Chloride	Nitrate	Nitrite	WAD Cyanide	Total Cyanide
Well ID	Sample Date	s.u.	µS/cm	°C	°F	s.u.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L as $CaCO_3$	mg/L as $CaCO_3$	mg/L as $CaCO_3$	mg/L	mg/L	mg/L as N	mg/L as N	mg/L	mg/L
MW-6 (continued)	5/24/2012	7.53	513	26.2	79.16	8.1	340	0.37	58	10	39	4.6	120	< 3	< 3	130	12	0.87	< 0.1	< 0.01	< 0.005
	8/15/2012	7.44	494	26.5	79.7	8	330	0.39	49	8.5	34	4.9	88	< 3	< 3	120	11	1.9	< 0.05	< 0.01	< 0.005
	11/13/2012	7.11	523	22	71.6	8	400	0.44	65	11	39	4.9	120	< 3	< 3	130	12	0.7	< 0.05	< 0.01	< 0.005
	2/27/2013	7.59	531	22.9	73.22	8	370	0.37	63	10	38	4.7	140	< 3	< 3	130	11	0.39	< 0.05	< 0.01	< 0.005
	5/30/2013	7.68	438	23.9	75.02	8.1	380	0.39	65	10	39	4.6	140	< 3	< 3	120	11	0.37	< 0.05	< 0.01	< 0.005
	8/20/2013	7.3	576	30.2	86.36	8.1	370	0.39	66	11	41	5.2	150	< 3	< 3	130	12	0.43	< 0.05	< 0.01	< 0.005
	10/23/2013	7.61	507	20.84	69.512	8	320	0.41	52	8.5	35	4.5	91	< 3	< 3	110	13	3.1	< 0.05	< 0.01	< 0.005
	2/11/2014	7.79	635	21.04	69.872	8	320	0.43	50	8	33	4.3	94	< 3	< 3	120	14	2.5	< 0.05	< 0.01	< 0.005
	5/22/2014	7.51	443	22.26	72.068	8	320	0.42	45	7.2	32	4.2	86	< 3	< 3	120	12	2.6	< 0.05	< 0.01	< 0.005
	8/4/2014	7.45	470	24.14	75.452	8	330	0.41	49	7.6	34	4.3	87	< 3	< 3	120	12	1.9	< 0.05	< 0.01	< 0.005
	10/21/2014	7.41	440	20.7	69.26	8	320	0.43	48	7.7	33	4.4	100	< 3	< 3	120	11	1.9	< 0.05	< 0.01	< 0.005
	2/18/2015	7.55	456	21.94	71.492	7.8	320	0.42	42	6.5	28	3.6	89	< 3	< 3	120	11	1.6	< 0.05	< 0.01	< 0.005
	5/13/2015	7.43	403	20.1	68.18	7.8	300	0.36	45	7.1	32	4.6	61	< 3	< 3	120	9.7	2.2	< 0.05	< 0.01	< 0.005
	8/12/2015	7.23	448	22.3	72.14	7.7	300	0.4	44	6.8	30	4.2	63	< 3	< 3	120	8.6	1.9	< 0.05	< 0.01	< 0.005
	10/12/2015	6.69	432	24.7	76.46	7.8	320	0.4	46	7	31	4.3	68	< 3	< 3	120	8.8	1.9	< 0.05	< 0.01	< 0.005
	2/2/2016	8.17	391	14.16	57.488	7.9	330	0.14	51	8.2	33	4.2	80	< 3	< 3	120	8	1.4	< 0.05	< 0.01	< 0.005
	4/7/2016	8.22	457	17.15	62.87	7.9	310	0.42	46	7	31	3.9	94	< 3	< 3	130	8.7	1.6	< 0.05	< 0.01	< 0.005
	9/15/2016	8.78	484	23.04	73.472	7.9	320	0.45	52	8.3	33	4.8	88	< 3	< 3	120	9.5	1.2	< 0.05	< 0.01	< 0.005
	10/24/2016	9	489	22.79	73.022	8	330	0.43	52	8.7	35	4.3	92	< 3	< 3	120	9.3	1.2	< 0.05	< 0.01	< 0.005
	2/1/2017	9.29	501	22.32	72.176	8.1	320	0.44	55	9.1	35	4.5	100	< 3.0	< 3.0	130	9.1	0.98	< 0.050	< 0.010	< 0.0050
	4/6/2017	7.62	509	22.59	72.662	7.9	330	0.41	56	8.8	36	4.4	110	< 3.0	< 3.0	130	9	0.89	< 0.050	< 0.010	< 0.0050
	7/13/2017	7.76	520	27.53	81.554	8.1	340	0.41	55	8.7	33	4.2	110	< 3.0	< 3.0	130	9.2	0.89	< 0.050	< 0.010	< 0.0050
	11/15/2017	8.01	530	22.73	72.914	8	340	0.39	59	9.1	37	4.3	120	< 3.0	< 3.0	120	8.8	0.66	< 0.050	< 0.010	< 0.0050
	11/15/2017 (Field Duplicate)	8.01	530	22.73	72.914	8	330	0.39	56	8.5	36	4.1	120	< 3.0	< 3.0	120	8.8	0.67	< 0.050	< 0.010	< 0.0050
	2/13/2018	7.63	531	20.9	69.62	8	320	0.41	60	8.7	37	4.1	110	< 3.0	< 3.0	130	9.5	0.68	< 0.050	< 0.010	< 0.0050
	4/17/2018	7.75	536	21.67	71.006	7.8	330	0.39	59	9.3	36	3.9	120	< 3.0	< 3.0	130	8.9	0.72	< 0.050	< 0.010	< 0.0050
	7/24/2018	6.4	526	24.71	76.478	8.1	350	0.39	60	9.2	36	4.2	120	< 3.0	< 3.0	130	8.9	0.71	< 0.050	< 0.010	< 0.0050
	10/15/2018	6.84	525	22.77	72.986	8	330	0.36	57	8.6	36	4	120	< 3.0	< 3.0	120	8.1	--	--	< 0.010	< 0.0050
	11/1/2018	6.82	521	22.83	73.094	--	--	--	--	--	--	--	--	--	--	--	--	0.66	--	--	--

Notes:

-- = not analyzed

< = the analyte was not detected above the reporting limit shown

°C = degrees Celcius

°F = degrees Fahrenheit

ID = identification

mg/L = milligrams per liter

mg/L as $CaCO_3$ = milligrams per liter as calcium carbonate

mg/L as N = milligrams per liter as nitrogen

s.u. = standard pH units

TDS = total dissolved solids

µg/L = micrograms per liter

µS/cm = microsiemens per centimeter

WAD = weak acid dissociable

Attachment D1
Quarterly Monitoring Results, 2011-2018
Soledad Mountain Project, Golden Queen Mining Company, LLC
Kern County, California

		Metals, Dissolved																		
		Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
Well ID	**Sample Date**	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MW-2	2/23/2011	--	0.076	0.013	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	< 0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	5/11/2011	--	0.073	0.015	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	0.06
	8/23/2011	0.003	0.072	0.012	< 0.001	< 0.001	< 0.01	< 0.01	< 0.005	< 0.05	< 0.005	< 0.01	< 0.0004	< 0.01	< 0.01	< 0.002	< 0.01	< 0.001	< 0.01	0.06
	10/18/2011	--	0.085	0.018	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	< 0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/28/2012	--	0.06	0.016	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	0.015	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	5/21/2012	--	0.099	0.015	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/15/2012	--	0.073	0.014	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	< 0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	0.054
	11/12/2012	--	0.11	0.015	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0004		< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/26/2013	--	0.11	0.014	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	5/29/2013	--	0.11	0.014	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/22/2013	--	0.12	0.013	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	10/22/2013	--	0.12	0.013	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/10/2014	--	0.11	0.012	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	5/21/2014	--	0.12	0.013	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/4/2014	--	0.11	0.012	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	10/20/2014	--	0.12	0.013	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/17/2015	< 0.002	0.11	0.011	< 0.001	< 0.001	< 0.01	< 0.01	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.002	< 0.01	< 0.001	0.005	< 0.05
	5/12/2015	--	0.12	0.011	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/11/2015	--	0.12	0.011	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	11/19/2015	--	0.12	0.011	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.00006	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/2/2016	--	0.12	0.011	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	--	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	4/7/2016	--	0.12	0.012	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	--	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	9/15/2016	--	0.11	0.011	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	--	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	10/24/2016	--	0.1	0.011	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/1/2017	--	0.11	0.011	--	< 0.001	< 0.01	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.0002	--	< 0.010	< 0.002	< 0.010	--	--	< 0.050
	4/6/2017	--	0.11	0.011	--	< 0.001	< 0.01	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.0002	--	< 0.010	0.0023	< 0.010	--	--	< 0.050
	7/13/2017	--	0.082	0.011	--	< 0.001	< 0.01	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.0002	--	< 0.010	0.0046	< 0.010	--	--	< 0.050
	11/15/2017	--	0.092	0.011	--	< 0.001	< 0.01	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.0002	--	< 0.010	< 0.002	< 0.010	--	--	< 0.050
	2/12/2018	< 0.0020	0.1	0.01	< 0.001	< 0.0010	< 0.01	< 0.01	< 0.0050	< 0.030	< 0.0010	< 0.010	< 0.00020	< 0.01	< 0.01	0.0055	< 0.01	< 0.001	0.0055	< 0.05
	4/17/2018	--	0.1	0.01	--	< 0.0010	< 0.01	--	< 0.0050	< 0.030	< 0.0010	< 0.010	< 0.00020	--	< 0.01	0.002	< 0.01	--	--	< 0.05
	7/24/2018	--	0.1	0.011	--	< 0.0010	< 0.01	--	< 0.0050	< 0.030	< 0.0010	< 0.010	< 0.00020	--	< 0.01	< 0.0020	< 0.01	--	--	< 0.05
	10/15/2018	--	0.099	0.01	--	< 0.0010	< 0.01	--	< 0.0050	< 0.030	< 0.0010	< 0.010	< 0.00020	--	< 0.01	< 0.0020	< 0.01	--	--	< 0.05
	11/1/2018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-3	2/23/2011	--	0.06	0.018	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	< 0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	5/12/2011	--	0.049	0.021	--	< 0.001	< 0.01	--	< 0.005	0.22	< 0.005	< 0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	0.11
	8/23/2011	0.002	0.047	0.02	< 0.001	< 0.001	< 0.01	< 0.01	< 0.005	0.08	< 0.005	0.01	< 0.0004	< 0.01	< 0.01	< 0.002	< 0.01	< 0.001	0.017	0.1
	10/19/2011	--	0.05	0.023	--	< 0.001	< 0.01	--	< 0.005	0.11	< 0.005	< 0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/28/2012	--	0.061	0.021	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	< 0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	5/23/2012	--	0.06	0.024	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/16/2012	--	0.052	0.02	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	< 0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	0.056
	11/13/2012	--	0.06	0.021	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/26/2013	--	0.063	0.022	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	5/29/2013	--	0.061	0.022	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/22/2013	--	0.058	0.02	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	10/22/2013	--	0.058	0.021	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/10/2014	--	0.057	0.022	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	5/21/2014	--	0.05	0.02	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/4/2014	--	0.055	0.021	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	10/20/2014	--	0.056	0.024	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/17/2015	< 0.002	0.048	0.021	< 0.001	< 0.001	< 0.01	< 0.01	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.002	< 0.01	< 0.001	0.021	< 0.05
	5/12/2015	--	0.046	0.022	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/11/2015	--	0.045	0.023	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05

Attachment D1
Quarterly Monitoring Results, 2011-2018
Soledad Mountain Project, Golden Queen Mining Company, LLC
Kern County, California

		Metals, Dissolved																		
		Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
Well ID	Sample Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MW-3 (continued)	10/12/2015	--	0.045	0.022	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.00006	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/2/2016	--	0.042	0.023	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	--	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	4/7/2016	--	0.045	0.024	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	--	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	9/15/2016	--	0.032	0.024	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	--	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	10/24/2016	--	0.026	0.023	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/1/2017	--	0.028	0.025	--	< 0.001	< 0.010	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.0002	--	< 0.010	< 0.002	< 0.010	--	--	< 0.050
	4/6/2017	--	0.025	0.025	--	< 0.001	< 0.010	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.0002	--	< 0.010	< 0.002	< 0.010	--	--	< 0.050
	7/13/2017	--	0.02	0.023	--	< 0.001	< 0.010	--	< 0.050	< 0.030	< 0.001	< 0.010	< 0.00020	--	< 0.010	< 0.002	< 0.001	--	--	< 0.050
	11/15/2017	--	0.023	0.027	--	< 0.001	< 0.010	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.00020	--	< 0.010	< 0.002	< 0.001	--	--	< 0.050
	2/12/2018	< 0.0020	0.025	0.025	< 0.001	< 0.0010	< 0.01	< 0.01	< 0.0050	< 0.030	< 0.0010	< 0.010	< 0.00020	< 0.01	< 0.01	< 0.0020	< 0.01	< 0.001	0.018	< 0.05
	4/17/2018	--	0.025	0.026	--	< 0.0010	< 0.01	--	< 0.0050	< 0.030	< 0.0010	< 0.010	< 0.00020	--	< 0.01	< 0.0020	< 0.01	--	--	< 0.05
	7/24/2018	--	0.02	0.027	--	< 0.0010	< 0.01	--	< 0.0050	< 0.030	< 0.0010	< 0.010	< 0.00020	--	< 0.01	< 0.0020	< 0.01	--	--	< 0.05
	10/15/2018	--	0.02	0.024	--	< 0.0010	< 0.01	--	< 0.0050	0.058	< 0.0010	< 0.010	< 0.00020	--	< 0.01	< 0.0020	< 0.01	--	--	< 0.05
	11/1/2018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-5	2/23/2011	--	0.011	0.024	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	0.06	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	0.06
	5/11/2011	--	0.013	0.027	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	0.02	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	0.18
	8/24/2011	< 0.002	0.01	0.028	< 0.001	< 0.001	< 0.01	< 0.01	< 0.005	< 0.05	< 0.005	0.02	< 0.0004	< 0.01	< 0.01	< 0.002	< 0.01	< 0.001	< 0.01	0.1
	10/19/2011	--	0.011	0.029	--	< 0.001	0.012	--	< 0.005	< 0.05	< 0.005	0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/29/2012	--	0.014	0.027	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	0.078	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	0.19
	5/23/2012	--	0.012	0.017	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	0.02	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/15/2012	--	0.011	0.027	--	<0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	0.019	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	0.26
	11/12/2012	--	0.011	0.016	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/26/2013	--	0.012	0.015	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	5/29/2013	--	0.013	0.016	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/22/2013	--	0.012	0.014	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	10/22/2013	--	0.013	0.017	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/11/2014	--	0.012	0.016	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	0.0032	< 0.01	--	--	< 0.05
	5/21/2014	--	0.013	0.016	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/5/2014	--	0.011	0.016	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	10/21/2014	--	0.013	0.017	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/17/2015	< 0.002	0.012	0.017	< 0.001	< 0.001	< 0.01	< 0.01	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	< 0.01	< 0.01	< 0.002	< 0.01	< 0.001	0.003	< 0.05
	5/12/2015	--	0.013	0.019	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/11/2015	--	0.011	0.018	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	10/12/2015	--	0.012	0.016	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/2/2016	--	0.012	0.018	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	--	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	4/7/2016	--	0.015	0.019	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	--	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	9/15/2016	--	0.014	0.021	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	--	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	10/24/2016	--	0.015	0.021	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/1/2017	--	0.014	0.023	--	< 0.001	< 0.010	--	< 0.050	< 0.03	< 0.001	< 0.010	< 0.00020	--	< 0.010	< 0.002	< 0.001	--	--	< 0.050
	4/6/2017	--	0.017	0.023	--	< 0.001	< 0.010	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.00020	--	< 0.010	< 0.002	< 0.001	--	--	< 0.050
	7/13/2017	--	0.016	0.021	--	< 0.001	< 0.010	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.00020	--	< 0.010	< 0.002	< 0.001	--	--	< 0.050
	11/15/2017	--	0.018	0.022	--	< 0.001	< 0.010	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.00020	--	< 0.010	< 0.002	< 0.001	--	--	< 0.050
	2/12/2018	< 0.0020	0.02	0.02	< 0.001	< 0.0010	< 0.01	< 0.01	< 0.0050	0.056	< 0.0010	< 0.010	< 0.00020	< 0.01	< 0.01	< 0.0020	< 0.01	< 0.001	< 0.0030	< 0.05
	4/18/2018	--	0.02	0.02	--	< 0.0010	< 0.01	--	< 0.0050	< 0.030	< 0.0010	< 0.010	< 0.00020	--	< 0.01	< 0.0020	< 0.01	--	--	< 0.05
	7/24/2018	--	0.019	0.021	--	< 0.0010	< 0.01	--	< 0.0050	< 0.030	< 0.0010	< 0.010	< 0.00020	--	< 0.01	< 0.0020	< 0.01	--	--	< 0.05
	10/15/2018	--	0.019	0.021	--	< 0.0010	< 0.01	--	< 0.0050	< 0.030	< 0.0010	< 0.010	< 0.00020	--	< 0.01	< 0.0020	< 0.01	--	--	< 0.05
	11/1/2018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-6	2/15/2011	--	0.02	0.008	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	0.11	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	5/12/2011	--	0.031	0.01	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	0.05	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	0.18
	8/24/2011	< 0.002	0.017	0.009	< 0.001	< 0.001	< 0.01	< 0.01	< 0.005	< 0.05	< 0.005	0.07	< 0.0004	< 0.01	< 0.01	< 0.002	< 0.01	< 0.001	< 0.01	0.08
	10/19/2011	--	0.02	0.013	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	0.01	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/29/2012	--	0.027	0.01	--	< 0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	0.03	< 0.0004	--	< 0.01	0.0022	< 0.01	--	--	0.15

Attachment D1
Quarterly Monitoring Results, 2011-2018
Soledad Mountain Project, Golden Queen Mining Company, LLC
Kern County, California

Well ID	Sample Date	Metals, Dissolved																	
		Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MW-6 (continued)	5/24/2012	--	0.015	0.016	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	0.048	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/15/2012	--	0.028	0.01	--	<0.001	< 0.01	--	< 0.005	< 0.05	< 0.005	0.031	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	0.12
	11/13/2012	--	0.014	0.013	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	0.024	< 0.0004	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/27/2013	--	0.012	0.012	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	0.027	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	5/30/2013	--	0.012	0.013	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	0.054	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/20/2013	--	0.013	0.015	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	0.058	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	10/23/2013	--	0.019	0.01	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	0.0022	< 0.01	--	--	< 0.05
	2/11/2014	--	0.018	0.0092	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	0.0023	< 0.01	--	--	< 0.05
	5/22/2014	--	0.022	0.009	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/4/2014	--	0.017	0.0087	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	10/21/2014	--	0.021	0.0097	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/18/2015	< 0.002	0.018	0.008	< 0.001	< 0.001	< 0.01	< 0.01	< 0.005	0.039	< 0.005	< 0.01	< 0.0002	< 0.01	< 0.01	0.002	< 0.01	< 0.001	< 0.003	< 0.05
	5/13/2015	--	0.033	0.009	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	8/12/2015	--	0.036	0.012	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	0.003	< 0.01	--	--	< 0.05
	10/12/2015	--	0.033	0.011	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	0.002	< 0.01	--	--	< 0.05
	2/2/2016	--	0.025	0.011	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	--	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	4/7/2016	--	0.034	0.01	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	--	--	< 0.01	0.0024	< 0.01	--	--	< 0.05
	9/15/2016	--	0.023	0.012	--	< 0.001	< 0.01	--	< 0.005	0.13	< 0.005	0.018	--	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	10/24/2016	--	0.019	0.011	--	< 0.001	< 0.01	--	< 0.005	< 0.03	< 0.005	< 0.01	< 0.0002	--	< 0.01	< 0.002	< 0.01	--	--	< 0.05
	2/1/2017	--	0.018	0.014	--	< 0.001	< 0.010	--	< 0.005	0.38	< 0.001	0.042	< 0.0002	--	< 0.010	< 0.002	< 0.010	--	--	< 0.050
	4/6/2017	--	0.018	0.013	--	< 0.001	< 0.010	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.0002	--	< 0.010	< 0.002	< 0.010	--	--	< 0.050
	7/13/2017	--	0.015	0.013	--	< 0.001	< 0.010	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.0002	--	< 0.010	< 0.002	< 0.010	--	--	< 0.050
	11/15/2017	--	0.014	0.013	--	< 0.001	< 0.010	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.0002	--	< 0.010	< 0.002	< 0.010	--	--	< 0.050
	11/15/2017 (Field Duplicate)	--	0.014	0.012	--	< 0.001	< 0.010	--	< 0.005	< 0.030	< 0.001	< 0.010	< 0.0002	--	< 0.010	< 0.002	< 0.010	--	--	< 0.050
	2/13/2018	< 0.0020	0.013	0.013	< 0.001	< 0.0010	< 0.01	< 0.01	< 0.0050	0.054	< 0.0010	< 0.010	< 0.00020	< 0.01	< 0.01	< 0.0020	< 0.01	< 0.001	< 0.0030	< 0.05
	4/17/2018	--	0.012	0.012	--	< 0.0010	< 0.01	--	< 0.0050	< 0.030	< 0.0010	< 0.010	< 0.00020	--	< 0.01	< 0.0020	< 0.01	--	--	< 0.05
	7/24/2018	--	0.012	0.014	--	< 0.0010	< 0.01	--	< 0.0050	0.19	< 0.0010	0.015	< 0.00020	--	< 0.01	< 0.0020	< 0.01	--	--	< 0.05
	10/15/2018	--	0.012	0.013	--	< 0.0010	< 0.01	--	< 0.0050	< 0.030	< 0.0010	< 0.010	< 0.00020	--	< 0.01	< 0.0020	< 0.01	--	--	< 0.05
	11/1/2018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

-- = not analyzed

< = the analyte was not detected

°C = degrees Celcius

°F = degrees Fahrenheit

ID = identification

mg/L = milligrams per liter

mg/L as $CaCO_3$ = milligrams per l

mg/L as N = milligrams per liter a

s.u. = standard pH units

TDS = total dissolved solids

μg/L = micrograms per liter

μS/cm = microsiemens per centim

WAD = weak acid dissociable

Attachment D2
Volatile and Semi-Volatile Organic Results, 2011-2018
Soledad Mountain Project, Golden Queen Mining Company, LLC
Kern County, California

Well ID	MW-2			MW-3			MW-5			MW-6		
Sample Date	8/23/2011	2/17/2015	2/12/2018	8/23/2011	2/17/2015	2/12/2018	8/24/2011	2/17/2015	2/12/2018	8/24/2011	2/18/2015	2/13/2018
Volatile Organics (µg/L)												
1,1,1,2-Tetrachloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1,1-Trichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1,2,2-Tetrachloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1,2-Trichloro-1,2,2-trifluoroethane	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
1,1,2-Trichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1-Dichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1-Dichloropropene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
1,2,3-Trichlorobenzene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
1,2,3-Trichloropropane	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
1,2,4-Trichlorobenzene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
1,2,4-Trimethylbenzene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
1,2-Dibromoethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,2-Dichlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,2-Dichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,2-Dichloropropane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,3,5-Trimethylbenzene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
1,3-Dichlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,3-Dichloropropane	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
1,4-Dichlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
2,2-Dichloropropane	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
2-Butanone	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
2-Chlorotoluene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
2-Hexanone	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
4-Chlorotoluene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4-Methyl-2-pentanone	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
Acetone	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
Benzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Bromobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Bromochloromethane	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Bromodichloromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Bromoform	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Bromomethane	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Carbon disulfide	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Carbon Tetrachloride	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chlorobenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chloroform	< 0.5	2.3	2.1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chloromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
cis-1,2-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
cis-1,3-Dichloropropene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dibromochloromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dibromochloropropane	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Dibromomethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Dichlorodifluoromethane	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Dichloromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Ethylbenzene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Hexachlorobutadiene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Hexachloroethane	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Iodomethane	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Isopropylbenzene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
m,p-Xylenes	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.60	< 0.5	< 0.5
Methyl-t-butyl ether	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

Attachment D2
Volatile and Semi-Volatile Organic Results, 2011-2018
Soledad Mountain Project, Golden Queen Mining Company, LLC
Kern County, California

Well ID	MW-2			MW-3			MW-5			MW-6		
Sample Date	**8/23/2011**	**2/17/2015**	**2/12/2018**	**8/23/2011**	**2/17/2015**	**2/12/2018**	**8/24/2011**	**2/17/2015**	**2/12/2018**	**8/24/2011**	**2/18/2015**	**2/13/2018**
n-Butylbenzene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
n-Propylbenzene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
o-Xylene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
p-Isopropyltoluene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
sec-Butylbenzene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Styrene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
tert-Butylbenzene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Tetrachloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Toluene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.67	< 0.5	< 0.5	1.1	< 0.5	< 0.5
trans-1,2-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
trans-1,3-Dichloropropene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Trichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Trichlorofluoromethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vinyl Chloride	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Semi-Volatile Organics (µg/L)												
1,2,4-Trichlorobenzene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
1,4-Dichlorobenzene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
2,4,6-Trichlorophenol	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
2,4-Dichlorophenol	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
2,4-Dimethylphenol	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
2,4-Dinitrophenol	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
2,4-Dinitrotoluene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
2,6-Dinitrotoluene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
2-Chloronaphthalene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
2-Chlorophenol	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
2-Nitrophenol	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
3,3-Dichlorobenzidine	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4,6-Dinitro-2-methylphenol	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4-Bromophenyl phenyl ether	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4-Chloro-3-methylphenol	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4-Chlorophenyl phenyl ether	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
4-Nitrophenol	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Acenaphthene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Acenaphthylene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Anthracene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Benzo(a)anthracene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Benzo(a)pyrene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Benzo(b)fluoranthene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Benzo(g,h,i)perylene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Benzo(k)fluoranthene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Bis(2-chloroethoxy)methane	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Bis(2-chloroethyl) ether	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Bis(2-chloroisopropyl) ether	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Butyl benzyl phthalate	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Chrysene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Dibenzo(a,h)anthracene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Diethyl phthalate	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Dimethyl phthalate	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Di-n-butyl phthalate	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Di-n-octyl phthalate	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Diphenylamine	< 5	< 5	--	< 5	< 5	--	< 5	< 5	--	< 5	< 5	--
Fluoranthene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Fluorene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Hexachlorobenzene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Hexachlorobutadiene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

Attachment D2
Volatile and Semi-Volatile Organic Results, 2011-2018
Soledad Mountain Project, Golden Queen Mining Company, LLC
Kern County, California

Well ID	MW-2			MW-3			MW-5			MW-6		
Sample Date	8/23/2011	2/17/2015	2/12/2018	8/23/2011	2/17/2015	2/12/2018	8/24/2011	2/17/2015	2/12/2018	8/24/2011	2/18/2015	2/13/2018
Hexachloroethane	< 5	< 5	--	< 5	< 5	--	< 5	< 5	--	< 5	< 5	--
Indeno(1,2,3-cd)pyrene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Isophorone	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Naphthalene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Nitrobenzene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
N-Nitrosodi-n-propylamine	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
N-Nitrosodiphenylamine	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Pentachlorophenol	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Phenanthrene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Phenol	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Pyrene	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Bis(2-ethylhexyl) phthalate	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

Notes:

-- = not analyzed

< = the analyte was not detected above the reporting limit shown

ID = identification

µg/L = micrograms per liter

APPENDIX E

Gold Field Historical Tailings Unsaturated Zone Model

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Soledad Mountain Project
Kern County, California

Gold Fields Historical Tailings Unsaturated Zone Model

March 3, 2010

ARCADIS

Gold Fields Historical Tailings Unsaturated Zone Model

Soledad Mountain Project, CA

Tim J. Cox

Tim J. Cox, P.G., CGWP
Principal Geohydrologist

Gaston Lee

Gaston Leone, P.E.
Modeling Supervisor

Prepared for:

Golden Queen Mining Co., Inc.
6411 Imperial Avenue
West Vancouver, BC, Canada V7W 2J5

Prepared by:

ARCADIS
630 Plaza Drive
Suite 100
Highlands Ranch
Colorado 80129
Tel 720.344.3500
Fax 720.344.3535

Our Ref.:

AO000100.0013.00001

Date:

March 3, 2010

Table of Contents

Tables

Figures

1. Introduction

Golden Queen Mining Co., Inc. (GQM) plans to construct and operate an open pit mine on Soledad Mountain in southeastern Kern County, California. The location of the proposed mine, known as the Soledad Mountain Project (Project), is provided on **Figure 1**. The project is planned to profitably mine and process gold and silver bearing ore, produce aggregate materials and, upon the end of the mine life, to reclaim the project area. The planned project will commence upon receipt of full regulatory approval.

GQM is considering the purchase of parcels of land currently managed by the U.S. Department of the Interior, Bureau of Land Management (BLM) that are within and adjacent to the projected footprint of the Project. As a prerequisite to considering a land sale, BLM requested that GQM complete an Environmental Site Assessment (ESA) for the subject parcels to establish the existing environmental conditions of subject parcels. An ESA was submitted to BLM's Ridgecrest Field Office on October 3, 2008. The ESA addressed the historical mine features, existing physical hazards on the property, and the physical and chemical makeup of historical mill tailing and waste rock remaining from the historic mining operations (GQM and ARCADIS, 2008). In an email dated December 16, 2008 from Karl Ford of BLM, he raised the issue of the potential for seepage from the historical Gold Fields tailings to mobilize arsenic and impact groundwater quality beneath the tailing piles and north of the Project area. Other mines in the area have reportedly been linked to elevated concentrations of arsenic in groundwater. However, evaluation of available hydrogeologic and geochemical data from the historical tailings and subsurface sediments indicate that there is minimal, if any, potential for historical seepage to reach groundwater.

To further evaluate the possibility of tailings seepage to impact groundwater, a numerical modeling investigation of the unsaturated zone beneath the historical Gold Fields tailings was conducted. The objective of the modeling is to evaluate the potential migration of historical tailings seepage through the unsaturated zone beneath the tailings and how long it might take for seepage to reach groundwater.

1.1 Background

The historical Gold Fields tailings are located on the north-facing front of Soledad Mountain (**Figure 2**). Approximately 165,000 tons of tailings currently remain in the tailings pile that was deposited from 1936 to 1942. The tailings cover approximately 27 acres and reach a thickness of approximately 30 feet, tapering to only a few feet at the pile's edges in some areas. The tailings were hydraulically deposited as slurry and tailings water was likely to have ponded on the surface of the tailings. The elevation of the tailings ranges from approximately 2,800 feet above mean sea level (amsl) near the toe of the pile to approximately 2,950 feet amsl at the southern end of the pile. Current plans for the historical tailings include use in the construction of the composite liner for the Phase 1 heap leach pad for the Project.

The flanks of Soledad Mountain are covered with a wedge of sediments (colluvium) consisting of interbedded boulders, rock fragments, cobbles, gravel, sand, silt, and clay. The colluvium (talus, scree, and slope-wash) is found on steeper slopes of the mountain and eventually flattens out and merges down-slope into the alluvial fan deposits around the base of the mountain. The regional alluvial aquifer is present within the Fremont Basin and is of considerable thickness. The water table elevation of the regional aquifer is about 2,580 feet amsl along the northern mountain front, placing the tailings from 220 feet to 370 feet above the water table and creating a relatively thick unsaturated zone beneath the tailings. Deep borehole data at the site indicate that the regional aquifer does not extend into the mountain interior due to the low permeability of the bedrock mass causing the groundwater to flow around the mountain.

1.2 Technical Approach

The technical approach for the modeling investigation is to first develop a conceptualization of the unsaturated zone stratigraphy beneath the tailings and soil properties to formulate an understanding of potential seepage movement through the subsurface unsaturated zone. Site-specific soil properties have been estimated from boreholes samples and are supplemented with data from other applicable sources when needed. Climatic data such as precipitation and evaporation are also considered in the conceptual understanding. Next, a one-dimensional numerical model is developed and simulates the tailings and underlying conceptualized stratigraphy of the alluvium. The model consists of a vertical column that extends from the tailings to an approximate depth of the regional water table. Model simulations are then performed to predict the migration of tailings seepage through the unsaturated zone. This is followed by additional model simulations to assess the sensitivity of model predictions to changes in permeability of the tailings and alluvium.

2. Conceptual Stratigraphy

A conceptual depiction of the unsaturated zone stratigraphy beneath and/or immediately down gradient from the Gold Field tailings was developed. GQM has drilled several boreholes through the tailings and adjacent area into the underlying alluvial material. The lithologic information from these boreholes was used to develop several cross sections through the northern mountain front where the tailings are located (**Figure 2**). Cross section C-C’ trends north to south through the tailings and illustrates the interbedded alluvial sediments beneath the tailings (**Figure 3**).

Groundwater characterization well MW-1 is located near the toe of the tailings pile and its borehole log provided detailed stratigraphic information on the subsurface alluvium. The log for MW-1 forms the basis for the conceptual stratigraphy and both the log and conceptual stratigraphy simulated in the numerical model are shown on **Figure 4**. The alluvium beneath the tailings has a wide range of grain sizes from silty sand to poorly graded gravels composed of gravelly sand mixtures with little or no fine-grained sediment. The soil types encountered include the Unified Soil Classification System (USCS) symbols of SM, SP, GP, and GM. As shown on the log for well MW-1, the alluvium occurs in beds up to 20 feet thick or is interbedded with smaller layers of alternating silt, sand, and gravel. The water table in the regional aquifer along the northern mountain front is also shown and corresponds to a depth of approximately 250 feet below native ground near well MW-1 location.

The alluvial units simulated in the numerical model are shown next to the well MW-1 log on **Figure 4**. A generalized soil classification was estimated that correlates to the log. In some instances, several soil classifications are identified on the log or there are interbedded soil types and an overall soil classification was interpreted. The numerical model also simulated the maximum observed thickness of tailings. Although not shown on the MW-1 log, the maximum tailings thickness was estimated to be approximately 30 feet and this thickness of tailings was simulated in the numerical model.

3. Numerical Model

A one-dimensional model was used to simulate seepage through the unsaturated zone. Potential seepage from the historical tailings was assumed to have been vertical with negligible horizontal flow. Realistically, some horizontal flow would have been expected due to the interbedded nature of the alluvial stratigraphy and bedding that dips to the north. The assumption of vertical seepage, however, is conservative and results in a greater downward movement of seepage than if horizontal flow was also simulated.

3.1 Model Code

The one-dimensional version of the computer program *HYDRUS* (Simunek et al. 2008) was used to simulate seepage from the tailings into the unsaturated zone. For the flow component, the code solves the mixed form of the Richards' equation, which is the governing equation for one-dimensional uniform flow in a partially saturated porous medium. The equation incorporates the water pressure head, volumetric water content, angle between the flow direction and the vertical axis, and the unsaturated hydraulic conductivity. The code also includes a database of soil hydraulic properties and allows for system-dependent boundary conditions such as pressure heads, seepage face, zero flux, or atmospheric boundaries, depending on the position of the water level. For solute transport, the code solves the advection-dispersion equation.

The vertical column model is divided into 1,000 nodes, and material properties were assigned to each element based on the conceptualized stratigraphy shown on **Figure 4**. The column model included 260 feet of alluvium to the bedrock surface and an additional 30 feet of tailings to represent the historical tailings pile, for a total simulated material thickness of 290 feet.

It is of note that a sandy clay unit was observed near the base of the alluvium (225 to 260 feet) above the bedrock contact, but the textural properties of the clayey unit are not simulated in the model. The clayey unit was not observed in any other boreholes in the area and believed to be a localized occurrence. Instead the clayey unit is conservatively represented in the model as silty sand (SM), which will allow for a greater rate of seepage.

3.2 Model Parameters

The following sections discuss the parameters used in the numerical model. Input parameters include climate data and soil properties (e.g. moisture content and hydraulic conductivity).

3.2.1 Climate Data

Soledad Mountain is located in an extremely arid region of California. Precipitation on the desert floor is usually subjected immediately to high losses from evaporation and transpiration. Runoff may occur after high intensity rainfall events and flows to the valley floor where it is eventually lost to evaporation, as the valley is not an area of aquifer recharge. Because the Project area is located in the rain shadow of the Tehachapi and San Gabriel Mountain ranges, the average annual precipitation for the western Mojave is sparse. At the Mojave weather station, located approximately 5 miles north of the site, the average annual rainfall is 5.7 inches (U.S. Weather Bureau, 1982). The average annual evaporation rate for the Mojave weather station is 80 inches, which exceeds precipitation by a multiple of nearly 14. The precipitation and evaporation values were specified as input parameters in the model. Although precipitation and evaporation change from month to month, the average annual rates were used in the model and assumed to represent long-term, steady-state conditions.

3.2.2 Soil Properties

The soil-water properties of the historical tailings and alluvium dictate how water moves and the rate of vertical movement. Site-specific values were used in the model when available; otherwise, soil moisture characteristics were estimated based on available data for similar soil types.

Tailings

Samples of historical tailings have been collected and tested for soil properties as part of the geotechnical design of the proposed Heap Leach Facility (Golder 2006). Triaxial permeability tests found the saturated hydraulic conductivity of the tailings material to be 5 x 10^{-6} centimeters per second (cm/sec). The tailings have a USCS soil type of silt (ML) based on grain size analyses. The total porosity of the tailings was measured to be 38 percent. Modeling of unsaturated flow requires input of the residual moisture content that was estimated using the database in *HYDRUS 1D*. The residual moisture content was estimated to be 7.5 percent. The van Genuchten parameters, α and N, are used in the equation and were estimated. A summary of the soil properties for the tailings is contained in **Table 1**.

Alluvium

The soil properties for the alluvium were estimated using the database in *HYDRUS 1D*. Properties were estimated for the three soil types depicted on the conceptualized stratigraphy (**Figure 4**) including silty sand (SM), poorly-graded sand (SP), and poorly-graded gravel (GP). The total porosity for each of the soil types was estimated to be 0.3. The residual moisture content was estimated to be 0.035 for the silty sand and 0.049 for the poorly-graded sand and gravel. The hydraulic conductivity was estimated to range from 4.6 x 10^{-4} cm/sec for the silty sand to 9.9 x 10^{-2} cm/sec for the poorly-graded gravel. Estimated soil properties used in the numerical model for the alluvium are summarized in **Table 1**.

Table 1 Soil Properties for Tailings and Alluvium Used in Model Simulations

	Tailings	***Alluvium***		
	ML	**SM**	**SP**	**GP**
Soil Properties	**Silt**	**Silty Sand**	**Poorly-Graded Sand**	**Poorly-Graded Sand**
Residual Moisture Content (%)	7.5	3.5	4.9	4.9
Total Porosity (%)	**38**	30	30	30
Hydraulic Conductivity (cm/sec)	**5.0E-06**	4.6E-04	9.9E-03	9.9E-02
van Genuchten Parameters				
Alpha (1/meter)	1.4	5.38	3.08	3.08
N	1.32	1.62	4.02	4.02

Note:
Bold underlined values are measured; otherwise, values are estimated using the database in *HYDRUS 1D*.

4. Model Simulations and Results

The numerical model was used in a predictive manner to simulate the potential migration of seepage from the historical Gold Fields tailings. A base simulation was first performed that included the conceptualized stratigraphy described in Section 2 and site-specific and estimated model parameters identified in Section 3. This was followed by a sensitivity analysis during which the hydraulic conductivity of the tailings and alluvial units were changed, and ponding of water on top of the tailings was simulated to represent a worst-case scenario for the development and migration of tailings seepage (i.e., highest migration potential).

A non-reactive solute was simulated in the model to illustrate the position of the seepage front within the unsaturated zone profile. A non-reactive solute results in a conservative estimate of seepage migration in that the seepage is uninhibited to migrate without retardation or chemical reactions that slow and reduce the solute concentration. Simulations were run for 100 years and predictions were made at 30, 70, and 100 years. The model runs were assumed to begin around the 1940 time frame and predictions made at 70 years roughly correspond to present-day conditions considering tailings deposition occurred from 1936 to 1942.

4.1 Base Simulation

The base simulation includes the conceptualized stratigraphy (**Figure 4**) and the tailings and alluvium properties contained in **Table 1**. The tailings at the top of the model were assumed to be fully saturated to approximate conditions when the tailings were deposited from 1936 to 1942, and the tailings were allowed to freely drain. A free-drainage (unit gradient) boundary condition was applied at the bottom of the model. The 30-foot thickness of saturated tailings is a conservative assumption and results in a large amount of stored water that is available to seep from the tailings pile into the underlying alluvium.

The predicted volumetric water content in the tailings and alluvial profile is shown on **Figure 5**. After 30 years the moisture content of the tailings is highest at approximately 29 percent and decreases only a few percent after 100 years. This is due to the high capacity of the fine-grained tailings to retain moisture. Moisture contents in the silty sands range from 9 to 11 percent for the simulated timeframes. The moisture content is lowest for the poorly-graded gravel, which is due to the coarse-grained material that has little capacity to retain moisture. The moisture content of the gravel is at its residual moisture content of 0.05 for each of the simulated timeframes.

The seepage front is illustrated by the concentration lines on **Figure 6**. The concentration of the conservative solute was specified as one (unity) at the beginning of the simulations and predicted values represent the relative concentration measured in percent. Concentrations near one represent solute moving through the tailings and uppermost alluvium, and the midpoint of the flattened concentration line approximates the downward flowing seepage front. The seepage front is estimated to be at depths of about 30 feet below native ground at 30 years and only slightly deeper at approximately 50 feet after 70 and 100 years. These depths are 200 to 220 feet above the regional water table along the northern mountain front, as projected into Soledad Mountain beneath the Gold Fields tailings. The model results suggest that historical tailings seepage has not reached or impacted groundwater based on the conceptualized stratigraphy and estimated soil parameters. Moreover, the model simulations suggest that a seepage front cannot reach the regional water table in the foreseeable future because the free-draining water in the tailing is limited.

The predicted seepage fronts from the base simulation are judged to be conservative and likely overestimate actual seepage migration for the following reasons:

- The one-dimensional model restricts all flow to occur in the vertical downward direction and there is no horizontal (lateral) flow. Certainly some degree of lateral flow would occur, which would lessen the downward flow rate.
- The saturated tailings were assumed to be 30 feet thick, which is the maximum estimated thickness. This translates into a large volume of stored water in the tailings that is the source of seepage to the underlying alluvium.
- Metals, such as arsenic, would have some degree of attenuation due to chemical reactions or sorption that slows the rate of migration or lowers concentrations, as compared to the conservative solute that was simulated in the model. Additionally and more important, is that leach test results show that concentrations of leachable metals within the historical tailings deposits are below California EPA Soluble Threshold Limit Concentrations for each metal analyzed (GQM and ARCADIS 2008). Therefore, the metals concentrations would be very low if seepage occurred in the past and the conservative transport of the solute overestimates actual transport of metals.

4.2 Sensitivity Analysis

As with most numerical modeling investigations, there are inherent uncertainties. These uncertainties stem from the lack or absence of site-specific data on hydraulic properties and the fate and transport of constituents in groundwater. Because of these limitations, simplifying assumptions and estimated parameters have to be used. Additional simulations were performed to assess the sensitivity of model predictions to some of these limitations. Results of the sensitivity simulations are summarized in **Table 2,** which show the estimated depth of the seepage front after 70 years (i.e., present day).

The first sensitivity simulation was performed using a higher hydraulic conductivity for the tailings. The 5 x 10^{-6} cm/sec value in the base simulation was increased by an order of magnitude to 5 x 10^{-5} cm/sec. All other parameters remained the same. The depth to the seepage front after 30 years is estimated to be 50 feet, and 60 feet after 70 and 100 years. Results of this simulation show that the predicted seepage front does not reach the depth of the regional water table (~250 feet) after 100 years.

A second sensitivity simulation was performed assuming the alluvium beneath the tailings was not interbedded, but instead homogeneous having a uniform hydraulic conductivity representative of poorly–graded sand (SP) of 9.9 x 10^{-3} cm/sec. This allows seepage to migrate vertically without being impeded by interbedded layers of low-permeability alluvium, such as silty sands. The depth to the seepage front after 30, 70, and 100 years is estimated to be approximately 70 feet. Results of this sensitivity simulation show that the predicted seepage front does not reach the depth of the regional water table after 100 years.

The last sensitivity simulation was performed with the soil parameters from the base simulation, except infiltration of ponded water on the tailings pile was assumed to occur. Tailings from the milling operations were hydraulically deposited and it is possible that some of the tailings water ponded on the surface of the tailings. This was represented in the model by maintaining saturated conditions in the tailings for 40 percent of the 7-year period from 1936 to 1942, or about 3 years. This simulation represents a worst-case scenario of “focused” seepage. Results of this sensitivity simulation show that the predicted seepage front reaches a depth of the approximately 230 feet in 30 years and the equivalent depth of the regional water table of approximately 250 feet in 70 years. Although possible, the set of assumptions for this simulation are judged to be improbable given the sloping topography of the mountain front and arid conditions where tailings water most likely flowed to the north and evaporated, leaving little opportunity for tailings water to pond. It is possible for some ponding to have occurred, but ponding was probably localized and short-lived.

Table 2 Results of Sensitivity Analysis

Simulation	***Predicted Depth of Seepage Front after 70 Years - Present Day*** ***(Depth to Regional Water Table ~250 feet)***	
Base Simulation	$K_{tailings} = 5 \times 10^{-6}$ $K_{alluvium} = 4.6 \times 10^{-4}$ to 9.9×10^{-2}	50 feet
Sensitivity 1- High Tailings Hydraulic Conductivity	$K_{tailings} = 5 \times 10^{-5}$ $K_{alluvium} = 4.6 \times 10^{-4}$ to 9.9×10^{-2}	60 feet
Sensitivity 2 - High Tailings and Alluvium Hydraulic Conductivity	$K_{tailings} = 5 \times 10^{-5}$ $K_{alluvium} = 9.9 \times 10^{-3}$	70 feet
Sensitivity 3 – “Focused Seepage” (Ponding on Tailings for 7 Years)	$K_{tailings} = 5 \times 10^{-6}$ $K_{alluvium} = 4.6 \times 10^{-4}$ to 9.9×10^{-2}	250 feet

Note: hydraulic conductivity units are cm/sec

5. Summary

A numerical model of the unsaturated zone beneath the Gold Fields tailings was constructed. The model was used to evaluate the potential for seepage from historical tailings deposited from 1936 to 1942 to impact groundwater. A conceptualization of the alluvial stratigraphy beneath the tailings was developed based on borehole lithologic descriptions. Measured and estimated soil properties of tailings and the alluvial units were used in the model.

Predictive simulations were performed assuming 30 feet of saturated tailings could freely drain into the underlying alluvium. Models results show that a seepage front reaches a depth of only 50 feet after 70 years, which is approximately 200 feet above the regional water table, as projected into Soledad Mountain. The model results indicate that tailings seepage has not and is unlikely to affect groundwater quality. The results are judged to be conservative and represent an overestimation of seepage flow due to the one-dimensional model that simulates all water to flow in the vertical direction, substantial thickness of saturated tailings, and that a conservative solute was simulated to approximate the seepage front.

Additional simulations were performed to assess the model’s sensitivity to soil properties where the hydraulic conductivity of the tailings and alluvium were increased. Results of the sensitivity simulations showed that even with an increase in the hydraulic conductivity of the tailings and alluvium, the seepage front reached a depth of only 70 feet in 70 years. A sensitivity simulation was performed assuming a worst-case scenario where ponding of tailings water was maintained for 3 years, which showed seepage arriving at the water table in 70 years. However, ponding of water over this long period of time is unlikely to have occurred given the method of tailings deposition and high evaporation rate in the Mojave area.

Limitations

It is emphasized that the model is not intended to replicate all details of the complex unsaturated zone and geochemical processes that control solute fate and transport beneath the Gold Fields historical tailings. Simplifying assumptions were made that result in some degree of uncertainty. The model should simulate the primary soil properties that control unsaturated flow and solute migration, and we believe that the model and sensitively analysis account for most of these important factors. Predictions from the modeling analysis, however, carry some degree of uncertainty and should be viewed as approximations only.

6. References

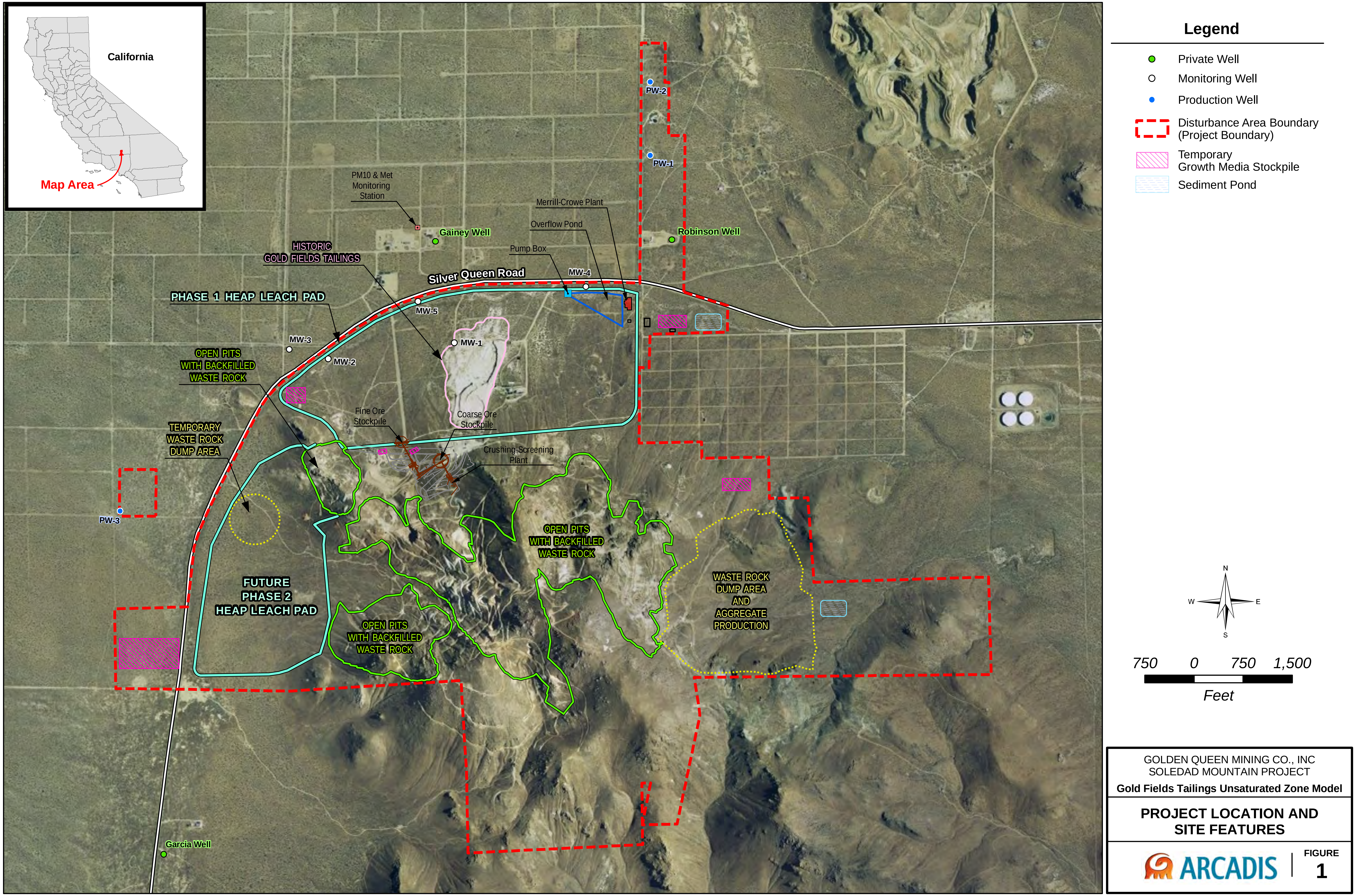
Golden Queen Mining Company (GQM). 2007. Report of Waste Discharge; submitted to California Regional Water Quality Control Board. March 8.

GQM and ARCADIS. 2008. Soledad Mountain Project Environmental Site Assessment; submitted to the U.S. Department of Interior Bureau of Land Management, September.

Golder Associates, Inc. (Golder). 2006. Soledad Mountain Project Heap Leach Facility – Revised Geotechnical Design Report; prepared for Golden Queen Mining Co. Ltd., December.

Simunek, J, Sejna, M, Saito, H, Sakai, M., van Genuchten, M.T. 2008. The *HYDRUS*-1D Software Package for Simulating the One-Dimensional Movement of Water, Heat, and Multiple Solutes in Variably-Saturated Media.

FIGURES



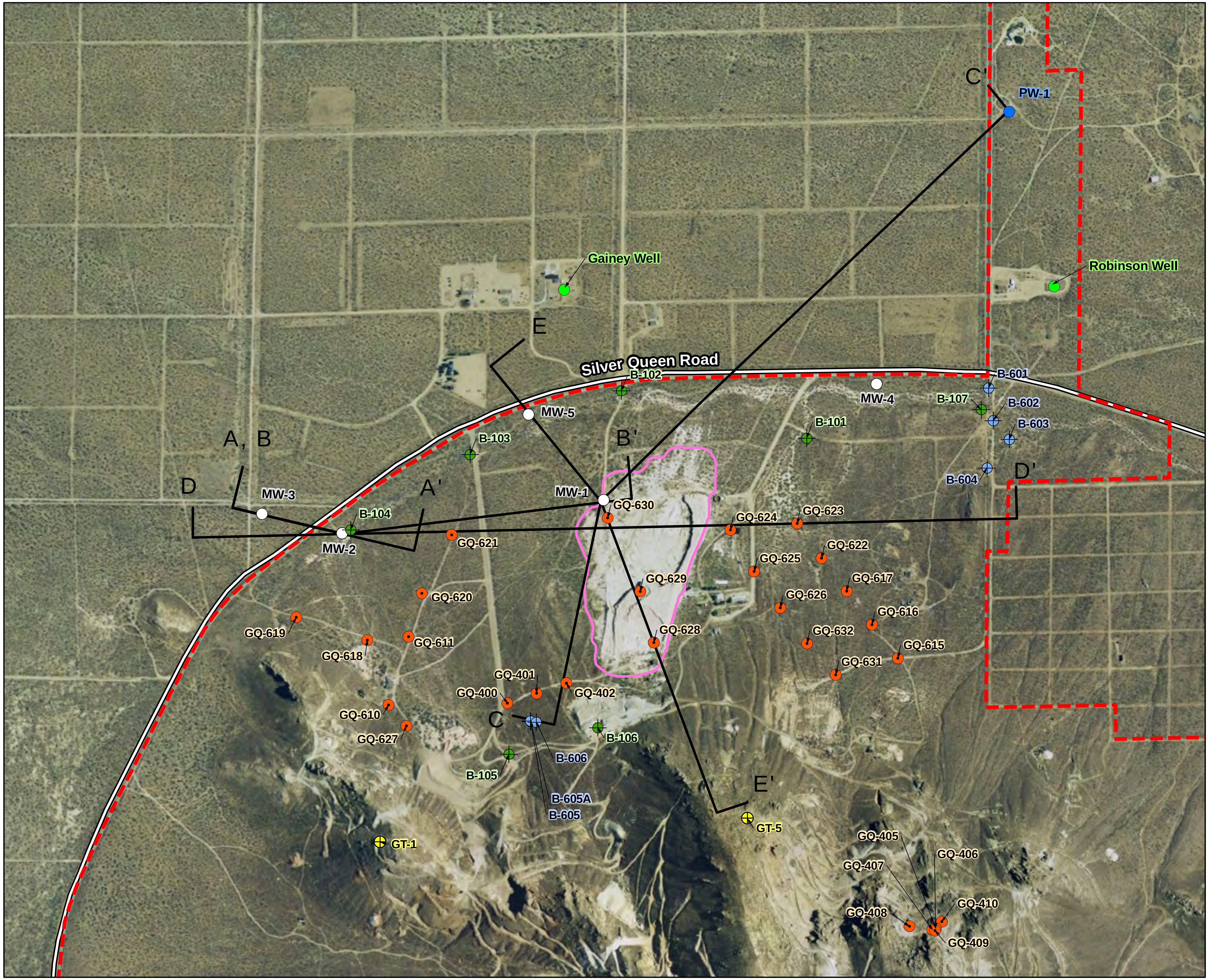
GOLDEN QUEEN MINING CO., INC
SOLEDAD MOUNTAIN PROJECT
Gold Fields Tailings Unsaturated Zone Model

PROJECT LOCATION AND SITE FEATURES

ARCADIS

FIGURE
1

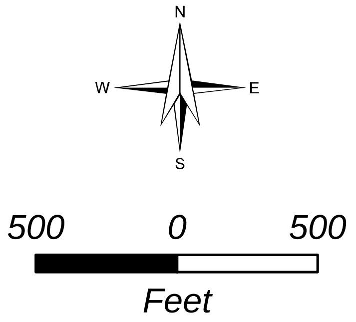
CITY: Boulder, CO DIV/GROUP: AIT PM: T. COX TM: TR: J.CHEN
Project (Project #): AO000100.0012 \\Co3fp\gis-cadd\AO000100_Soledad\GIS\ArcMap_MXD\UM_Fig1_ProjectLoc.mxd - 2/25/2010 @ 8:46:15 AM



Legend

⊕ Diamond Drill Hole Seegmiller International 1996)
⊕ Exploratory Boring (Golden 2004)
⊕ Exploratory Boring (Golder 2006)
● Condemnation Boring (Golden Queen Mining Company)
● Private Well
○ Monitoring Well
● Production Well
⌐ Cross Section
▭ Historic Gold Feilds Tailings
▭ Disturbed Area Boundary

Source: Golder (2009)



GOLDEN QUEEN MINING CO., INC
SOLEDAD MOUNTAIN PROJECT

Gold Fields Historical Tailings Unsaturated Zone Model

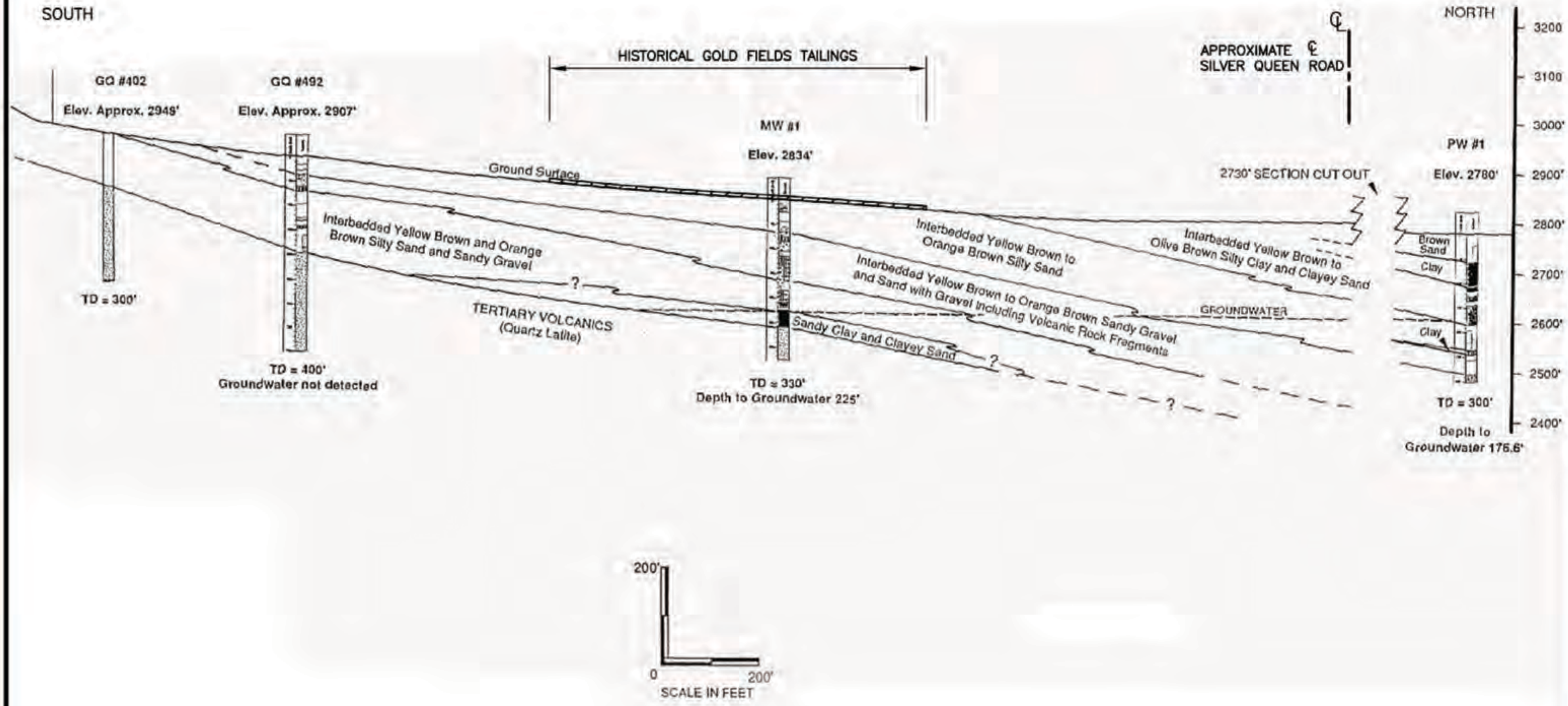
EXPLORATION BOREHOLES AND CROSS SECTIONS

ARCADIS

FIGURE
2

CITY: Boulder, CO DIV/GROUP: AIT PM: T. COX TM: TR: J.CHEN
Project (Project #): AO000100.0012 \\Co3fp\gis-cadd\AO000100_Soledad\GIS\ArcMap_MXD\UM_Fig2_Exploration_Boreholes_and_XS.mxd - 2/25/2010 @ 8:46:15 AM

Dwg Name: N:\04\043-2299C\H-GEO SEC\0432299H003.dwg
Layout Name: 8.5x11 FIG 4 Machine: NOT SET
Last Update: Feb 27, 2009 18:01 By: MTMorke
Last Plot: Mar 03, 2009 17:28 By: MTMorke



REFERENCES

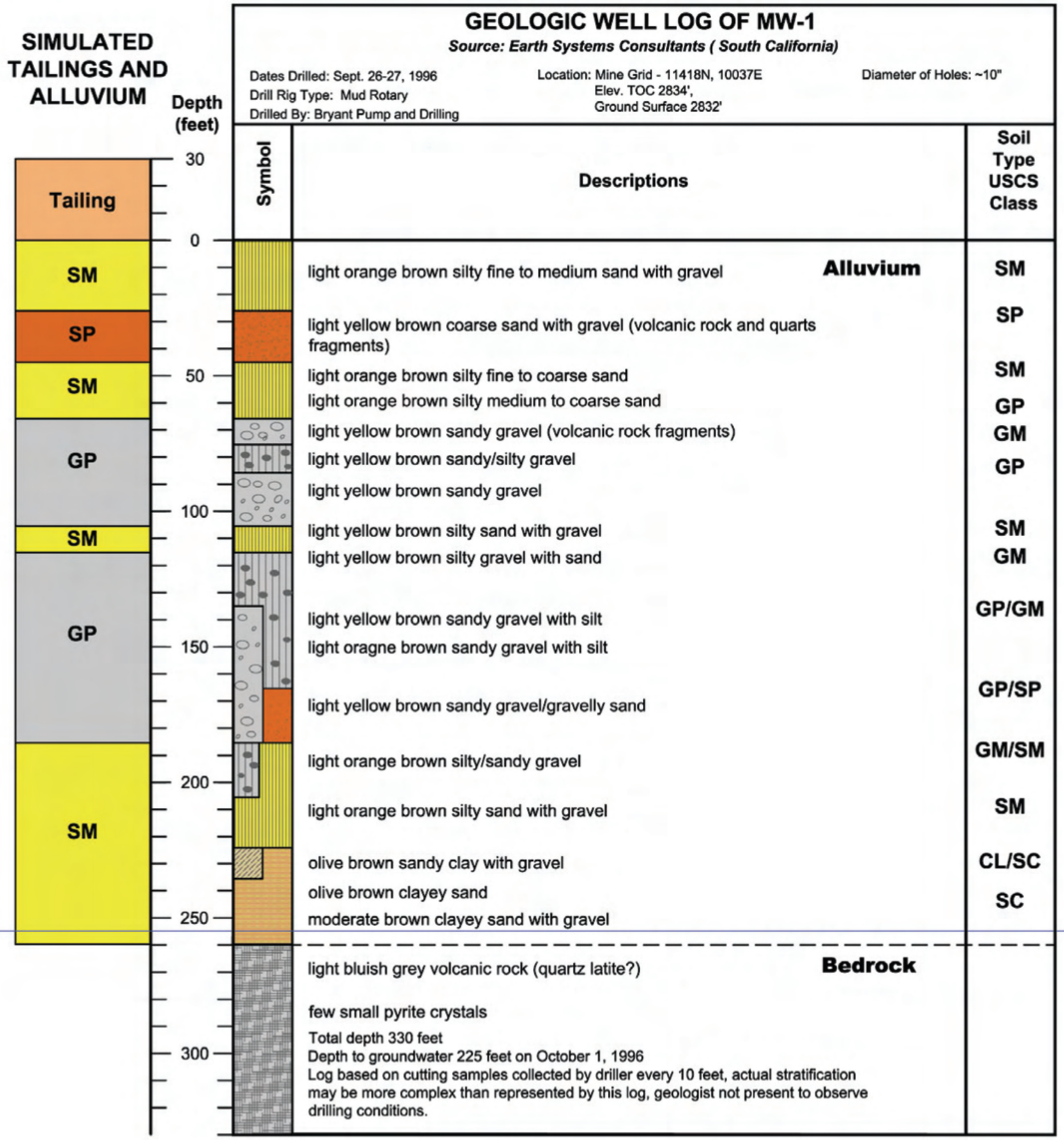
1. BOREHOLE LOGS AND INTERPRETED CROSS SECTION PROVIDED BY GOLDEN QUEEN, PREPARED BY WZI INC. TITLED: CROSS SECTION D-D', DATED: 9/97.

GOLDEN QUEEN MINING CO., INC.
SOLEDAD MOUNTAIN PROJECT
Gold Fields Historical Tailings Unsaturated Zone Model

GEOLOGIC CROSS SECTION C-C'

ARCADIS

FIGURE
3



Total depth 330 feet
Depth to groundwater 225 feet on October 1, 1996
Log based on cutting samples collected by driller every 10 feet, actual stratification may be more complex than represented by this log, geologist not present to observe drilling conditions.

▼ Approximate Water Table in the Regional Aquifer Projected Beneath the Gold Fields Tailings

GOLDEN QUEEN MINING CO., INC
SOLEDAD MOUNTAIN PROJECT
Gold Fields Historical Tailings Unsaturated Zone Model

OBSERVED AND SIMULATED SOIL TYPES IN THE UNSATURATED ZONE MODEL

ARCADIS

FIGURE
4

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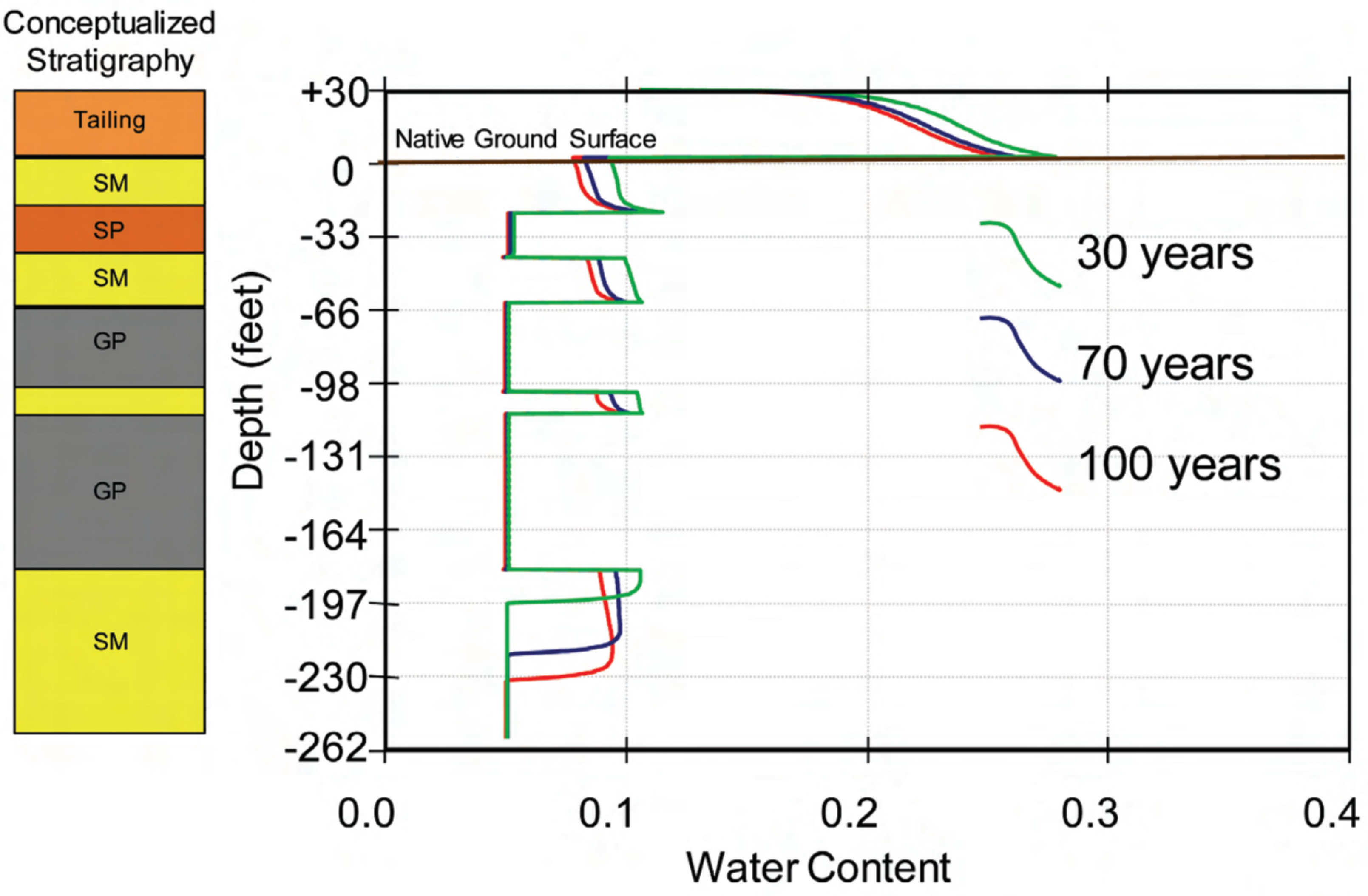

GOLDEN QUEEN MINING CO., INC.
SOLEDAD MOUNTAIN PROJECT
Gold Fields Historical Tailings Unsaturated Zone Model

SIMULATED
WATER CONTENT

ARCADIS

FIGURE
5

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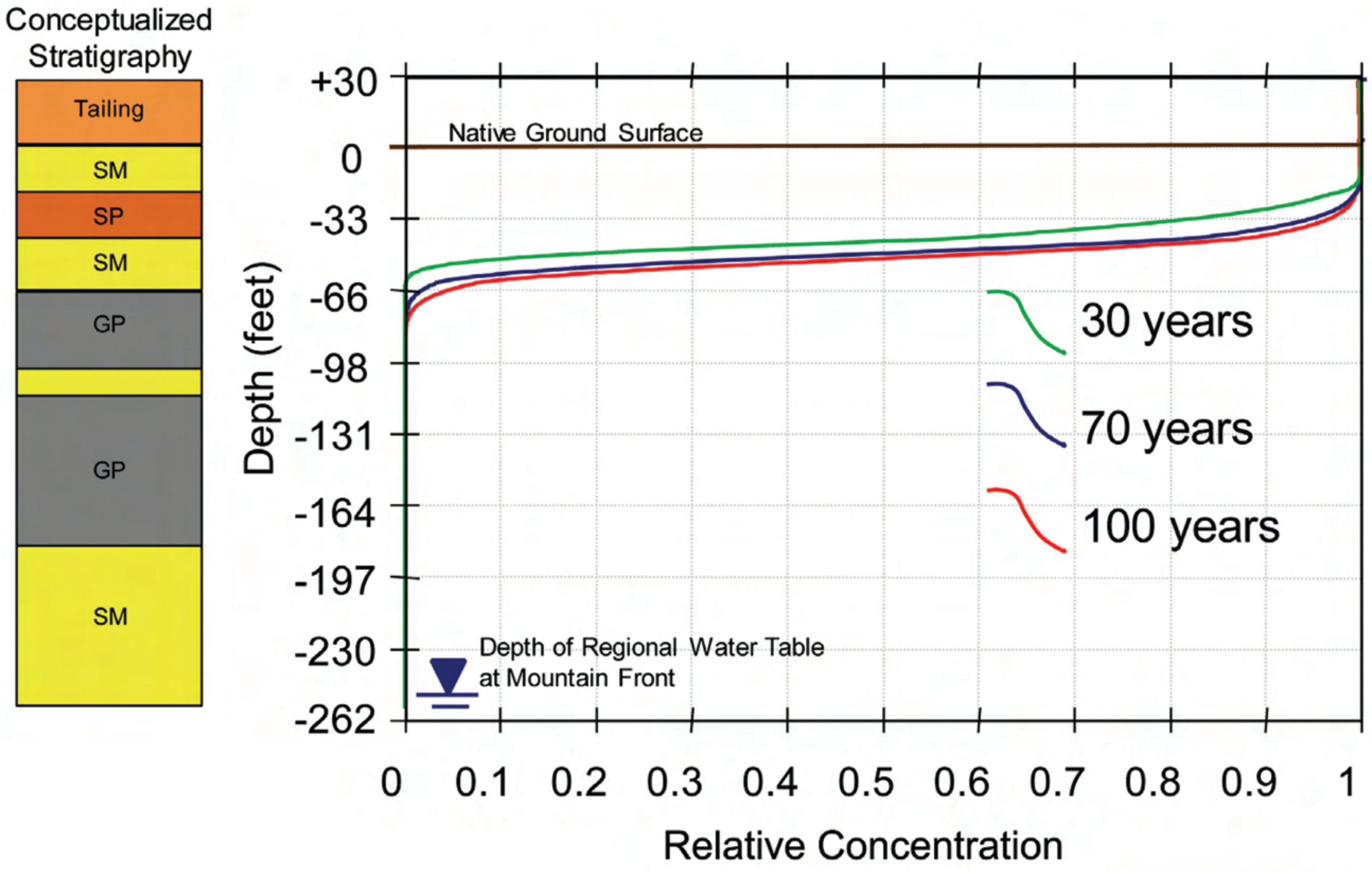

GOLDEN QUEEN MINING CO., INC.
SOLEDAD MOUNTAIN PROJECT
Gold Fields Historical Tailings Unsaturated Zone Model

SIMULATED CONCENTRATION
(SEEPAGE FRONT)

ARCADIS

FIGURE
6

K:\AO000100_Soledad\Illustrators\UM_UnsaturatedModel\UM_Fig6_SimulatedConc.ai @02/01/2010 PREPARED BY: JC PROJECT NAME (Or No.): AO000100 - SOLEDAD MOUNTAIN