



# REPORT

## HYDROLOGIC INVESTIGATION

(REVISION 1.0)

### PERMANENTE QUARRY RECLAMATION PLAN UPDATE SANTA CLARA COUNTY, CALIFORNIA

**Submitted To:** Lehigh Southwest Cement Company  
24001 Stevens Creek Boulevard  
Cupertino, California 95014

**Submitted By:** Golder Associates Inc.  
425 Lakeside Drive  
Sunnyvale, California 94085

Golder Associates Inc.  
18300 NE Union Hill Road, Suite 200  
Redmond, Washington 98052

May 2010  
November 2011 (Rev. 1)

Project No. 063-7109

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## PROFESSIONAL CERTIFICATION

### HYDROLOGIC INVESTIGATION (REVISION 1.0)

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NOVEMBER 2011

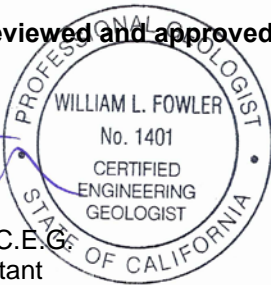
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425 Lakeside Drive  
Sunnyvale, California 94085

Golder Associates Inc.  
18300 NE Union Hill Road, Suite 200  
Redmond, Washington 98052

**This report has been reviewed and approved by:**

  
William L. Fowler, P.G., C.E.G.  
Associate/Senior Consultant



  
David Banton  
Principal/Practice Leader

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## EXECUTIVE SUMMARY

Golder Associates Inc. (Golder) has prepared this report for Lehigh Southwest Cement Company (Lehigh) in May 2010 in support of permitting and reclamation efforts related to the ongoing development and reclamation of the existing North Quarry, located at the Lehigh Permanente Quarry (the Quarry) in Santa Clara County, California.

An earlier version of this report dated May 2010 included the analysis of the impacts of a proposed mining excavation known as the South Quarry, located south of the Permanente Creek. The South Quarry proposal has since been removed from the reclamation plan amendment project. Because the data collected relative to the proposed South Quarry remains relevant to the hydrologic evaluation of the North Quarry's operation and reclamation in various respects, this report includes a discussion of that data where appropriate.

The objective of this report is to provide an overall characterization of the hydrologic conditions of the Quarry such that (1) the current conditions are documented and (2) potential changes to the hydrologic systems associated with future mining and reclamation efforts are evaluated. The hydrologic investigations, starting in 2008 continuing through January 2010, comprised a series of tasks directed toward an evaluation of surface water and groundwater occurrence, flow, and chemistry. The tasks included historical research, hydraulic testing (pumping and packer tests), collecting and analyzing groundwater elevation and stream flow data, and collecting and analyzing of surface water, groundwater, mine water, rock core, and wall washing samples.

The results from the hydrologic investigations were used to further our understanding in developing a site conceptual model, and as the foundation of a groundwater numerical model (MODFLOW). The numerical model was developed to evaluate potential hydrogeologic changes associated with future mining and reclamation activities.

## Hydrology Discussion

The following current hydrologic conditions were determined by Golder:

- Two separate stream drainages are present in the overall study area: Monte Bello Creek located approximately 3500 feet from the North Quarry perimeter; and Permanente Creek situated immediately adjacent to the south of the North Quarry perimeter within approximately 200 feet at its closest approach.
- Groundwater flow is preferentially within the more permeable limestone units compared to the greenstone and graywacke. However, because the limestone units occur as large blocks, and are of limited extent, the limestone units behave as a compartmentalized, isolated hydrogeologic system and the overall groundwater system is controlled by the less permeable greenstone and graywacke units.
- Locally, groundwater flow is primarily to the north and northeast from a groundwater divide located beneath the ridge separating Permanente Creek from Monte Bello Creek.

- The average annual baseflow for water year 2009 was estimated to be 0.30 cubic feet per second (cfs) along the upper section of Permanente Creek (south of the West Materials Storage Area) and approximately 1 cfs approximately 500 feet downstream of the North Quarry dewatering discharge point. The average annual baseflow for Monte Bello Creek for water year 2009 was estimated to be 0.08 cfs in the headwaters of the Creek and 0.14 cfs approximately one mile downstream.
- The North Quarry acts as a sump and is subject to groundwater seepage into the quarry excavation. During the dry season it is estimated that the ambient groundwater seepage into the North Quarry is about 200 gpm.

During future mining activities, the following changes are estimated based on the modeling results:

- The average annual groundwater inflow into the North Quarry will initially increase by approximately 60 gpm as the North Quarry is deepened to 440 ft amsl. The groundwater inflow rate in the North Quarry will subsequently decrease as the North Quarry is reclaimed (backfilled) from 440 to 990 ft above mean sea level.
- The operation and reclamation of the North Quarry will have no measurable impact on groundwater discharge to Monte Bello Creek and to the upper reaches of Permanente Creek. A decrease in groundwater discharge to the middle reach of Permanente Creek (i.e., adjacent to the quarry) of 0.1 cfs (40 gpm) is estimated to occur with the deepening of the North Quarry. However, once the North Quarry is reclaimed and fully backfilled, then the middle reach of Permanente Creek will receive 0.46 cfs (206 gpm) more groundwater discharge than under current conditions.
- The post-mining water level in the North Quarry will reach a maximum elevation equal to the backfill elevation of 990 ft amsl (which is the low-point surface water overflow to Permanente Creek). At equilibrium, the estimated total annual average inflow (groundwater, surface water, and precipitation) into the North Quarry is 169 gpm. These quantities are expected to discharge to Permanente Creek primarily as groundwater depending on the permeability of the materials separating the quarry from the creek. During periods of intense rainfall, and during seasonal high groundwater conditions, there is a potential that discharge from the reclaimed North Quarry to Permanente Creek may occur as surface water if appropriate water management techniques are not employed.
- The planned quarry operation and reclamation will have no significant impact to groundwater levels in supply wells located along Monte Bello Ridge, approximately 1 ¼ mile from the center of the North Quarry. Therefore, operation of these wells, or any other nearby wells, will not be adversely affected by the reclamation plan amendment project.

## Current Geochemistry Conditions

The objective of the geochemical evaluation was to establish and document current conditions for surface water and groundwater quality. Water quality conditions were characterized over a one-year period. The program entailed sampling of five groundwater wells located south of Permanente Creek, three surface water locations (two at Permanente Creek and one at Monte Bello Creek), and mine water quality from the North Quarry. Furthermore, to evaluate the environmental behavior of geologic materials present at the proposed quarry, geochemical characterization of overburden (rock and soil) and ore materials was conducted. Both laboratory and field-scale testing (wall wash sampling) were conducted to evaluate the potential for metal leaching. A separate report discusses the analysis of collected data and projected water quality.

## 1.0 INTRODUCTION

### 1.1 Objective

Golder Associates Inc. (Golder) has prepared this report for Lehigh Southwest Cement Company (Lehigh) in support of permitting and reclamation efforts related to the existing North Quarry, located at the Lehigh Permanente Quarry (the Quarry) in Santa Clara County, California (Figure 1.1).

The objective of this work effort was to provide an overall characterization of the hydrologic and hydrogeologic conditions of the Quarry such that (1) the current conditions are documented and (2) potential changes to the hydrologic systems associated with future mining and proposed reclamation efforts can be evaluated.

The hydrologic investigations were initiated in the fall of 2008 with field work continuing through January, 2010. The hydrologic investigations are comprised of a series of tasks directed toward an evaluation of both surface water occurrence, flow and chemistry, and hydrogeologic investigations of the occurrence, flow and chemistry of groundwater. The background for the overall reclamation project is discussed in Section 1.2. The scope of work completed for the project is discussed in detail in Section 1.3.

### 1.2 Project Background

#### 1.1.1 Existing Operations

The Quarry is a limestone and aggregate mining operation in the unincorporated foothills of western Santa Clara County, approximately two miles west of the City of Cupertino (Figure 1.1). The Quarry occupies a portion of a 3,510-acre property owned by Hanson Permanente Cement, Inc., and is operated by Lehigh Southwest Cement Company (collectively, Lehigh) (Figure 1.2).

The Quarry comprises approximately 614 acres of current and planned operational areas, which include surface mining excavations, overburden stockpiling, crushing and processing facilities, access roads, administrative offices and equipment storage. The Quarry also includes other predominantly undisturbed areas, either held in reserve for future mining or which buffer operations from adjacent land uses. The main operational areas of the Quarry are currently as follows:

- **North Quarry:** The North Quarry is where mineral extraction currently occurs and has historically taken place. The North Quarry features a large mining pit with elevations that currently range from approximately 750 feet to 1,750 feet above mean sea level (amsl). Limestone and greenstone mined from the North Quarry are crushed and either processed into aggregate products at Lehigh's on-site Rock plant or for used for cement manufacture at Lehigh's adjacent cement plant.
- **East Materials Storage Area (EMSA):** The EMSA is located to the east of the North Quarry and is currently the primary storage site for overburden and waste rock. Elevations at the EMSA range from approximately 550 feet to 920 feet amsl.

- **West Materials Storage Area (WMSA):** The WMSA is a second overburden and waste rock storage site, located west of the North Quarry. Elevations in the WMSA range from 1,500 to 1,950 feet amsl. The WMSA is approaching the final elevation and contours described in the Quarry's existing reclamation plan.
- **Rock Plant:** The Rock Plant is located in the southeast portion of the Quarry, and processes mined material into aggregate products. The Rock Plant occupies gentle slopes from approximately 580 feet to 770 feet amsl.

Mining operations take place subject to California's Surface Mining and Reclamation Act (SMARA). SMARA mandates that surface mining operations have an approved reclamation plan that describes how mined lands will be prepared for alternative post-mining uses, and how residual hazards will be addressed. Santa Clara County acts as lead agency under SMARA. The County approved the Quarry's current reclamation plan in March 1985, covering 330 acres.

A cement manufacturing plant lies adjacent to the Quarry on the east. The cement plant also is owned and operated by Lehigh. The cement plant is a separately- permitted industrial use which is not considered part of the Quarry and is not subject to SMARA's requirements.

### **1.1.2 Proposed Project**

The proposed project is the approval of an amendment to the Quarry's reclamation plan. The proposed amendment would broaden the reclamation plan, and associated reclamation requirements, to include all areas that are currently disturbed by mining activities, and lands scheduled to be disturbed by mining over approximately the next 20 years. The amendment would incorporate 1238.6 acres of Lehigh's 3,510-acre ownership ( the "project area"), and address mining and reclamation activities over approximately the next 20 years. Under the amendment, areas disturbed by mining would be reclaimed for open space uses.

The proposed reclamation plan amendment would result in the following major conditions and changes at the Quarry (Figure 1.3):

- **North Quarry:** The project would amend the current reclamation plan for the North Quarry to reflect the use of the North Quarry as a permanent Storage Area for overburden relocated from the WMSA. The placement of fill will serve to support and stabilize existing slope instabilities. Reclamation activities would establish final slopes and vegetation in the North Quarry consistent with the surrounding topography.
- **EMSA:** The project would amend the reclamation plan to provide final grading contours and revegetation for this area. Overall slope angles will be 2.6(H):1.0(V) or flatter.
- **WMSA:** The project would amend the current reclamation plan for the WMSA to reflect the removal of approximately 48 million tons of overburden and restoration of the WMSA topography to approximate original contours prior to the use of this area for overburden storage. The project also would update the current WMSA revegetation and drainage design.
- **Rock Plant and Surge Pile:** The project would amend the reclamation plan to provide a reclamation design for the Rock Plant and the Surge Pile.

### 1.3 Scope of Work

Golder conducted a detailed hydrologic and hydrogeologic investigation directed toward characterization of surface water and ground water conditions in support of the reclamation project. The general tasks conducted for the investigations are described below, more specific details on each task are provided as necessary, in the following chapters of this report:

- Research and compilation of published and unpublished literature pertaining to surface water and groundwater in the vicinity of the Permanente Creek and Monte Bello Creek watersheds
- Compilation and evaluation of site-specific geologic data from existing historical drillholes located both south and north of Permanente Creek
- Compilation and evaluation of available historical information regarding pumping rates, duration, and corresponding pit water elevation measurements for the active North Quarry
- Installation and monitoring of streamflow monitoring stations in Permanente Creek and Monte Bello Creek
- Sampling and chemical analysis of surface water samples from Permanente Creek, Monte Bello Creek, and North Quarry pit water
- Implementation of pit wall wash samples and chemical analyses of resulting data
- Drilling, logging and instrumentation of nine hydrogeologic exploratory boreholes south of Permanente Creek
- Drilling, logging and instrumentation of two exploratory boreholes in the Main Slide area in the North Quarry
- Drilling, logging and instrumentation of four exploratory boreholes in the south wall of the North Quarry to evaluate groundwater conditions between Permanente Creek and the North Quarry pit
- Installation of fourteen vibrating wire transducers and data loggers for long term measurement of water levels/pore pressure conditions
- Installation and development of four groundwater wells for water level measurements and water quality sampling
- Air lift testing of completed coreholes to provide a preliminary estimate of sustained groundwater yield
- Downhole hydraulic injection tests (packer tests) of borehole intervals to estimate the hydraulic conductivity of various bedrock lithologies
- Installation of one deep pumping well and one monitoring well for a long-term pumping test to evaluate bulk hydraulic properties
- Review and analysis of the geochemistry of representative overburden materials (provided by Geocon Consultants, Inc.) as it pertains to potential influences on surface and groundwater geochemistry
- Data analysis of hydraulic test results
- Data analysis of streamflow data and preparation of rating curves for Monte Bello and Permanente Creeks
- Development of a conceptual hydrogeological model and related MODFLOW groundwater numerical model using available site-specific geologic and hydrogeologic data to model existing conditions and to evaluate future mining and reclamation activities

- Compilation of current geochemistry data for surface water and groundwater
- Preparation of this hydrologic report summarizing the findings, conclusions and recommendations of our investigation

## 1.4 Project Team

The team for the Permanente Quarry hydrology project is comprised of geologists and engineers from Golder's Sunnyvale, California and Redmond, Washington offices. The primary professionals associated with this project included:

- William L. Fowler, P.G., C.E.G. (California) – Project Manager and Lead Engineering Geologist
- David Banton, P.G. (Licensed Geologist/Hydrogeologist, Washington) – Principal-In-Charge/Lead Hydrogeologist
- Stephen Thomas, P.G., C.HG. (California) – Senior Hydrologist/Lead Groundwater Modeler
- Rens Verburg, Ph.D. – Lead Geochemist
- Cheryl Ross (Licensed Hydrogeologist, Washington) – Project Geochemist
- George Wegmann – Project Hydrogeologist
- Derek Holom – Staff Hydrogeologist

The above individuals were supported by numerous staff geologists and engineers from several Golder offices for assistance with various office tasks (e.g., data compilation and analysis, cross sections, map preparations, etc.) and field tasks (e.g., stream monitoring and sampling, well sampling, drilling and well installations, borehole logging, data collection, etc.) performed in support of the hydrologic characterization and evaluations.

## 2.0 REGIONAL SETTING

### 2.1 Topography

The Quarry is situated in the foothills of the rugged, northwest-trending Santa Cruz Mountains segment of the California Coast Ranges (Figure 2.1). The Quarry is bisected by the east-flowing Permanente Creek. Historic mining has primarily occurred north of Permanente Creek, although historic exploration work has occurred across a large portion of the property including areas south of Permanente Creek. Topography in the area consists of moderately to steeply-sloped terrain with rounded ridges and drainages (Figure 2.2). Relief at the Quarry ranges from about 2,000 feet along the higher ridge crests to less than 500 feet amsl along the eastern portions of Permanente Creek. Average overall slope angles are typically around 25°. The steepest natural slopes are on the order of 40° over smaller slope heights (100 to 200 feet) and generally correspond to limestone outcrops.

### 2.2 Geologic Setting

The majority of the Quarry addressed by this report is underlain by complexly deformed and faulted rocks of the Franciscan Assemblage (Figure 2.3). The eastern portion of the Quarry, including portions of the Plant and the EMSA, are underlain by Plio-Pleistocene rocks of the Santa Clara Formation. Overlying the bedrock are modern alluvial deposits associated with Permanente Creek (restricted to the eastern portion of the property), and relatively shallow surficial deposits comprised of soil and colluvium. Several large, ancient landslide deposits have been mapped by various investigators along the slopes flanking Permanente Creek. The geology of the area has been mapped in various levels of detail for published maps by the following:

- Rogers and Armstrong (1973)
- Sorg and McLaughlin (1975)
- Vanderhurst (1981)
- Brabb, Graymer, and Jones (2000)

In addition, site-specific mapping at various scales, and utilizing both surface outcrop and subsurface drill core data, has also been completed by various geologists including:

- E. Mathieson (unpublished internal mapping, 1982)
- J. Foruria (unpublished internal mapping, 2004)
- R. Fousek (unpublished internal mapping, 2009)
- Mine Reserves Associates (Surpac 3-D Model, 2007)
- TerraSource Software (Surpac 3-D Model, 2009)

For the purposes of this report, all the available sources in addition to supplemental mapping by Golder have been utilized to create a compilation geologic map for the Quarry (Figure 2.4). The following provides an overview of the primary geologic units at the Quarry. More detailed descriptions of hydraulic properties of geologic units are presented in Section 4.

### 2.2.1 *Franciscan Terrane*

The following information regarding the Franciscan rocks as exposed in the North Quarry has been excerpted from Foruria (2004) who performed detailed geologic mapping for the Quarry.

Cement-grade limestone and aggregate are extracted from the intricately folded and faulted limestones and metabasalts (greenstones) in the North Quarry. These rocks are part of the Permanente Terrane of the Jurassic-Cretaceous age Franciscan Assemblage. The Franciscan Assemblage represents a subduction zone assemblage of highly deformed, variably metamorphosed, marine sedimentary rocks with oceanic crust-related submarine basalt (greenstone), chert, and limestone. This limestone-metabasalt assemblage reaches a minimum total thickness of approximately 1,100 feet and dips to the southeast.

All major stratigraphic horizons within the Franciscan rocks of the North Quarry are separated by low-angle faults forming a structurally imbricated thrust stack of layered and folded rock units (Figure 2.4). The Franciscan rocks are tectonically juxtaposed against an overlying section of undated, continentally-derived graywackes, shales, and argillites. The deformed thrust stack is a gently folded, northeast-trending, southeast dipping sequence in the eastern area of the North Quarry pit and transitions southwestward to a series of en-echelon, northwest-trending, southeast-plunging, anticlinal and synclinal folds in the western area of the North Quarry. High angle, brittle faults crosscut the Franciscan rocks, dissecting the rocks along prominent north-south and northwest-southeast orientations. A major through-going regional fault, the northwest strand of the Berrocal fault, crosses through the western end of the quarry. Figure 2.6 shows the major faults in the Quarry vicinity.

### 2.2.2 *Santa Clara Formation*

The Santa Clara Formation overlies a portion of the Franciscan Complex rocks in the north-central portion of the property (Figure 2.4). The Santa Clara Formation is a continental fluvial and alluvial deposit that is composed of unconsolidated to slightly consolidated conglomerate, sandstone, siltstone, and claystone (Vanderhurst, 1981). The age of the Santa Clara Formation ranges from late Tertiary to Pleistocene. Uplift of the Coast Ranges during this time resulted in increased erosion of the mountains and deposition of the Santa Clara Formation. The contact between the Franciscan rocks and Santa Clara Formation is considered to be unconformable, with the Santa Clara Formation deposited on an eroded Franciscan terrain (Rogers and Armstrong, 1973).

Subsequent uplift of the nearby foothills along the Monte Vista fault, which lies along the margin of the valley floor to the east of the Quarry, has resulted in deformation of the Santa Clara Formation. In addition, faulting within the uplifted geologic terrane between the Monte Vista and Berrocal faults has juxtaposed the Santa Clara formation in fault contact with older Franciscan rocks in the western portion of the EMSA (Figures 2.3 and 2.4). To the east of the unnamed fault, the deformed Santa Clara formation overlies the Franciscan with south-southwest trending dips of up to 50 degrees (Rogers and Armstrong,

1973). As mapped by Golder, a large erosional window east of the unnamed fault in the EMSA exposes greenstone, graywacke and limestone of the Franciscan Assemblage.

### **2.2.3 Surficial Deposits**

#### **2.2.3.1 Alluvium**

This includes modern unconsolidated alluvial deposits along the active stream channel of Permanente Creek. These deposits are comprised of a poorly-sorted mixture of cobbles, gravels, sand, silt and clay. Deposits range from a few inches thick in the upper reaches of the watershed where erosion has cut the channel down into bedrock (which is limestone in the vicinity of the North Quarry), to tens of feet thick where the channel widens and deepens as it approaches the flatter terrain of the Santa Clara Valley.

#### **2.2.3.2 Colluvium**

Colluvial deposits exist throughout the Quarry on natural slopes including areas underlying existing older overburden fills (i.e. EMSA and WMSA). The natural slopes in general are overlain with approximately one to two feet of soil and colluvial materials, which thickens to several feet to perhaps tens of feet thick in the larger natural swales in the region.

Where colluvial materials were encountered in exploratory activities they were described as predominantly clayey sand with gravel to clayey gravel, with some gravelly clay. Gravel size was up to 3-inches. In general, at the time of the investigations, the colluvium was dry and ranged from loose to very stiff or dense. During winter rainfall months, the colluvium likely becomes saturated from ephemeral runoff and infiltration.

#### **2.2.3.3 Landslide Deposits**

Several large, ancient landslides have been mapped by various investigators in various areas of the 3,510-acre Lehigh property, and throughout the broader foothills region. These landslides are generally described as possible old landslides, generally considered to be early Holocene or possibly late-Pleistocene features, and are identified on the basis of geomorphic features such as eroded scarps and irregular topography. Boundaries are generally subtle and poorly defined and there is no evidence of modern activity.

## **2.3 Structural Setting**

The San Andreas Fault zone is located approximately two miles southwest of the quarry (Figure 2.5). The Sargent-Berrocal Fault Zone (SBFZ), part of the Santa Cruz Mountains front-range thrust fault system, parallels the San Andreas to the east and forms the eastern-most structural boundary to the Permanente Terrain.

Near the Site, the SBFZ consists of two northwest-trending, sub-parallel faults, namely the northeastern-most Monta Vista Fault Zone and the southwestern-most Berrocal Fault Zone (Sorg and McLaughlin,

1975) (Figure 2.5). The Monta Vista Fault Zone is located approximately one mile to the northeast of the North Quarry. A strand of the Berrocal Fault Zone lies beneath the adjacent cement plant area to the south of the EMSA, and extends west to other portions of the Quarry (Mathieson, 1982; Sorg and McLaughlin, 1975).

## 2.4 Hydrogeologic Setting

For the purposes of this hydrologic investigation, the Quarry, which includes the North Quarry and the study areas south of Permanente Creek, lies entirely within the Franciscan Terrane. As described previously, the Franciscan Terrane is a highly-chaotic assemblage of rocks, or *mélange*, comprised primarily of altered meta-volcanic rocks (i.e., greenstone), graywacke and meta-graywacke units separated by zones of highly sheared matrix oftentimes comprised of mudstone or shale (Blake and Jones, 1981). In the area of the Quarry, the “blocks” in the matrix are primarily comprised of limestone (with chert interbeds) and graywacke which are “floating” in the highly sheared greenstone matrix. Most major structural boundaries in the Franciscan are fault boundaries as contrasted with depositional geologic contacts. Within major blocks, i.e., a limestone block, geologic contacts can be discerned. This structure makes for complex hydrogeologic conditions with numerous boundaries and variable flow paths.

The occurrence of groundwater in the Franciscan is almost exclusively within secondary openings such as joints, fractures, shear zones and faults. In general, groundwater occurs under unconfined conditions; however, the structural complexity also locally creates perched and semi-confined conditions. The hydraulic properties of the Franciscan are highly variable. Most published values for hydraulic conductivity of the Franciscan are in the range of  $1 \times 10^{-5}$  to  $1 \times 10^{-6}$  cm/sec. Well yields are typically low, in the range of a few gallons per minute (gpm) to tens of gpm and are restricted to domestic use. Specific yields are very low on the order of less than 3% (DWR Bulletin, 1975).

## 3.0 DATA COLLECTION

### 3.1 Hydrologic data

#### 3.1.1 Precipitation

Precipitation data for the past ten years was compiled from the Los Altos Hills Station of the California Department of Water Resources California Data Exchange Center. The station is located approximately 3.3 miles from the Quarry at a comparable elevation of 2,001 feet amsl.

#### 3.1.2 Stream Monitoring

As depicted on Figure 3.1 and noted on Table 3.1, Golder installed four monitoring stations, MS-1, MS-2, MS-3 and MS-4 in January 2009 in the two stream drainage areas present within project area. Two stations are located along Monte Bello Creek and two are located in Permanente Creek. The locations of the stations were selected after a site reconnaissance by Golder in December 2008.

**TABLE 3.1**  
**Stream Monitoring Station Summary**

Site ID	Stream Location	Station Elevation (ft amsl)	Watershed Area (acres)
MS-1	Upstream Permanente Creek	1,330	662
MS-2	Downstream Permanente Creek	650	1,707
MS-3	Upstream Monte Bello Creek	1,160	419
MS-4	Downstream Monte Bello Creek	993	688

Each monitoring station consists of a staff gauge and a stilling well equipped with a pressure transducer programmed to record stream height (or stage) at a frequency of every half hour. In addition, cross sectional velocity measurements were made at designated areas by the stilling wells to determine discharge of the creeks and establish a relationship between gage height and discharge rate.

### 3.2 Hydrogeologic Data

#### 3.2.1 Well and Piezometer Installation

A total of 11 boreholes (HG-1 through HG-11) were drilled in 2008 and 2009 as part of the hydrogeologic investigation (Figure 3.1). The boreholes were drilled by using either direct or dual-tube air rotary methods. The boreholes ranged in depth from 94 to 600 feet below ground surface (bgs), or 970 to 1,628 feet amsl. Five of the boreholes were completed as two-inch diameter monitoring wells. Borehole HG-11 was completed as a six-inch diameter monitoring well. Vibrating wire transducers (VWT) were installed in

the remaining boreholes except for boring HG-1, which could not be instrumented because of borehole instability. Borehole HG-1 was abandoned by filling with grout. The VWT installations involved attaching the VWTs and their cables to a string of PVC pipe as it was inserted into the borehole; and then fully-grouting the hole, using the PVC string as a tremie pipe. The boring completion details are summarized in Table 3.2 and shown graphically in Appendix A. Additionally, Golder installed four VWTs in boreholes GT2-7, GT4-25, GT1-4, and GEO3-34, which were previously completed as part of the geologic/geotechnical investigation.

**TABLE 3.2**  
**Borehole Completion Summary**

Boring ID	Total Depth (bgs)	Ground Elevation (ft amsl)	Completion Type	Screen Depth or Interval (ft amsl)	Lithology at Screen Location
GT1-4	268	1,119	VWT	951	Greenstone
GT2-7	477	1,281	VWT	1,010	Limestone/Graywacke
GT3-4	513	1,739	VWT	1,469	Limestone
GT4-25a	392	1,671	VWT	1,394	Limestone
HG-1a	590	1,585	--	--	--
HG-2	560	1,613	VWT	1,256	Limestone/Graywacke
HG-3	460	1,548	VWT	1,178	Limestone/Greenstone
HG-4	300	1,857	2" MW	1,562-1,582	Greenstone
HG-5	400	1,615	VWT	1,377	Greenstone
HG-6	400	1,822	2" MW	1,549-1,569	Greenstone
HG-7	300	1,254	2" MW	116-136	Greenstone/Graywacke
HG-8	200	1,148	VWT	1,002	Greenstone
HG-9	200	1245	2" MW	1,136-1,156	Weathered Graywacke
HG-10s	580	1,585	2" MW	1,431-1,451	Limestone
HG-10int	580	1,585	VWT	1,290	Limestone
HG-10d	580	1,585	VWT	1,090	Limestone
HG-11	600	1,585	6" MW	985-1,085	Limestone

### 3.2.2 Airlift Testing

Airlift testing was usually performed after each borehole was completed as part of the development process, and to provide a preliminary estimate of well yield. The airlift test consisted of using compressed air from the air rotary rig to lift groundwater to the surface with an estimate of sustained flow over a period of 15 to 30 minutes.

### 3.2.3 Packer Tests

In November 2008, Golder completed a series of packer tests in several boreholes to estimate the hydraulic conductivity of the rock units. Fourteen (14) tests were completed in boreholes HG-2, HG-3, HG-4, HG-5, HG-8, and HG-9. Tests were conducted in boreholes HG-6 and HG-7; however, the tests could not be analyzed due to packer failure (poor borehole conditions prevented an adequate packer seal) or downhole transducer failure. Packer tests were not completed at HG-1 due to borehole instability. The packer tests consisted of a water level stabilization period after packer inflation followed by a constant rate injection test and a recovery phase. The results of the packer tests are discussed in Section 4.4.

### 3.2.4 Pumping Tests

In September 2009, a step-rate pumping test was conducted in borehole HG-10S followed by a 72-hour constant-rate pumping test (Figure 3.1). The pumping rate for the constant-rate test was chosen based on the results of the step-rate pumping test. The constant-rate pumping test in HG-10S began on September 28, 2009 at 9:00 AM and continued until October 1, 2009 at 9:01 AM. Borehole HG-10S was pumped at an average rate of 48 gallons per minute (gpm) for three days. The pumping rate was determined from the totalized discharge readings using an in-line flow meter.

Groundwater levels were recorded in the monitoring wells using submerged INW® PT2X™ pressure transducer dataloggers as well as manual depth to water level measurements. The water levels at monitoring points GT4-25, GT3-4, HG-2, HG-10INT, and HG-10D were recorded using grouted-in Geo-Slope® VWTs. Figure 3.1 depicts the monitoring locations. The results of the pumping tests are discussed in Section 4.4.

### 3.2.5 Groundwater Level Monitoring

Groundwater levels were measured throughout 2009 to establish current groundwater elevations and record changes in potentiometric surface over time. Water levels were measured with pressure transducer dataloggers and electric water level tapes in the monitoring wells and with Geo-Slope® Miniloggers or VWT Recorders for the VWTs.

## 3.3 Geochemical Data

To characterize groundwater and surface water quality in the project area, sampling of surface water, groundwater, and wall washing sampling was conducted. Groundwater and surface water monitoring locations are shown in Figure 3.1. Table 3.3 summarizes the analytical parameter list. Results are discussed in Section 6.

**TABLE 3.3**  
**Analytical Parameter Summary**

Parameter	Groundwater and Surface Water Sampling				Wall Washing	North Quarry
	1 <sup>st</sup> Round February 2009	2 <sup>nd</sup> Round April 2009	3 <sup>rd</sup> Round October 2009	4 <sup>th</sup> Round January 2010	November 2009	January 2010
VOCs	x	x				
Metals <sup>1</sup> (total and dissolved)	x	x	x	x	x	x
Additional Metals -						
Vanadium			x	x	x	x
Boron		x	x	x	x	x
Low Level Mercury	x	x	x	x	x	x
Hexavalent Chromium	x	x	x	x		x
General Chemistry <sup>2</sup>	x	x	x	x	x <sup>3</sup>	x
Oil and Grease	x	x				
SVOCs	x	x				
Pesticides	x	x				
PCBs	x	x				
Dioxin	x	x				
Asbestos	x	x				
Acute Whole Effluent Toxicity (96-hr (% survival))	x	x				
Cyanide	x	x	x	x		x

- 1) Metals = aluminium, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, copper, iron, lead, manganese, molybdenum, nickel, selenium, silver, thallium, zinc
- 2) General chemistry = calcium, magnesium, sodium, potassium, Silicon as SO<sub>2</sub>, bicarbonate, carbonate, alkalinity, chloride, fluoride, sulfate, hardness, total dissolved solids, total suspended solids, residual chlorine, ammonia, nitrate, nitrite, phosphorous, sulfide, odor, turbidity, pH, electrical conductivity
- 3) Select general chemistry parameters analyzed due to limited sample volume

### 3.3.1 Groundwater Quality Sampling

Prior to collection of groundwater samples, the monitoring wells were developed to remove residual drilling fluid and to ensure proper hydraulic connection to the surrounding aquifer. Monitoring well HG-4 produced little water during development and subsequent sampling events.

A total of four rounds of samples were collected from monitoring wells HG-4, -6, -7, and -9 in accordance with Golder's standard operating procedures (SOPs). The wells were sampled at different times of the year (2009) to account for potential seasonal variations in water quality and water levels. In addition, a groundwater sample was collected from the discharge of the pump test from well HG-10s during the 72-hour pump test in September. HG-10s was also sampled as part of the fourth round of groundwater sampling.

For the first round sampling event, each monitoring well was purged of at least three well casing volumes, except for well HG-4 which was purged less because of limited recharge. After the first round, Golder collected the groundwater samples using the Environmental Protection Agency (EPA) low-flow recommended procedure. Field parameters were recorded with an YSI 556 water-quality meter and a LaMotte turbidity meter and included temperature, electrical conductivity, pH, dissolved oxygen, oxidation reduction potential, and turbidity. Field instruments were calibrated daily before starting sampling. Samples for dissolved metals analysis were either filtered (0.45 µm filter) in the field or upon receipt by the laboratory.

All samples, including field quality control samples, were labeled and packed with ice in a cooler at a temperature of 4 °C or lower and sent to a California-certified laboratory for analysis.

### 3.3.2 Surface Water Quality Sampling

Surface water samples, SW-1, SW-2, and SW-3, were collected from three locations as shown on Figure 3-1. Sample locations SW-1 and SW-2 are from upstream and downstream Permanente Creek, respectively. Sample location SW-3 is from Monte Bello Creek. Four rounds of samples were collected throughout the year to establish current water quality conditions, and account for seasonal variations in flow and quality. Samples of the North Quarry sump, and runoff from the North Quarry western haul road were collected in January 2010 as well.

The samples were collected in accordance with Golder's SOPs. In addition, the EPA recommended "clean hands/dirty hands" sampling protocol was followed for the collection of the sample to be analyzed by EPA method 1631 (low level mercury). Field parameters (as described above) were recorded with an YSI 556 water-quality meter and a LaMotte turbidity meter. Samples for dissolved metals analysis were either filtered (0.45 µm filter) in the field or upon receipt by the laboratory

All samples, including field quality control samples, were labeled and packed with ice in a cooler at a temperature of 4 °C or lower and sent for laboratory analysis.

### 3.3.3 Wall Washing and North Quarry Sampling

To collect data regarding metal leaching potential under field scale conditions, wall washing was performed on exposed faces within the North Quarry in November 2009. A total of six samples were collected following the standard procedure outlined in *Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia* (Price, 1997) from different rock types and/or different exposure times. The test involved washing an approximately one-meter square area of rock face with a known volume of water. The wall washing rinsate was collected and submitted for chemical analysis. Samples were submitted for laboratory analysis. Samples for dissolved metals analysis were filtered (0.45 µm filter) upon receipt by the laboratory. Field parameters were recorded with an YSI 556 water-quality meter and a LaMotte turbidity meter.

### 3.3.4 *Quality Control*

As part of the sampling program, Golder collected field quality control (QC) samples. One duplicate sample was collected per sampling event to verify the precision of laboratory analysis and field sampling procedures. If VOCs were being analyzed, trip blanks provided by the laboratory were submitted for VOC analysis to determine whether samples may have been compromised as a result of sample container handling or transport. Equipment blanks were collected on any non-dedicated equipment used during sampling to ensure decontamination procedures were adequate. Field blanks were collected to ensure that ambient air was not influencing the samples. All equipment and field blanks were prepared with laboratory-supplied deionized water.

## 4.0 CURRENT HYDROGEOLOGIC CONDITIONS

### 4.1 Site Setting

#### 4.1.1 Climate

The regional climate is Mediterranean with the majority of precipitation occurring between November and April. Average annual precipitation is about 22 inches, consistent with the intermediate altitudes of the Santa Clara Valley, and more than 50 inches in the surrounding mountains (Hanson, 2004). The climate is also yearly variable with dryer and wetter seasons from year to year. Recently, there was significantly less precipitation in 2007 and 2008 compared to the preceding and subsequent years. Section 4.6 discusses precipitation and storm water runoff in further detail.

#### 4.1.2 Surface Water Flow

Two separate stream drainages are present within the project area, which include Permanente Creek to the north and Monte Bello Creek to the south. The drainages are divided by a northwest-southeast trending ridge. Current elevations range from 1,990 feet amsl along the ridge in the southwest corner of the project area to 1,110 feet amsl in the northeast corner near Permanente Creek. Average overall slope angles are typically around 25 degrees with steeper slopes over limited sections.

Monte Bello Creek is entrenched mainly in greenstone. Monitoring station MS-3 is located at elevation 1,160 ft and is just downstream of the North Fork of Monte Bello Creek, which is dry under baseflow conditions (Figure 3.1). Monitoring station MS-4 is located at elevation 993 feet amsl approximately 2000 feet downstream of MS-3.

Permanente Creek is situated just south of existing North Quarry and is mainly entrenched in limestone. Monitoring station MS-1 is located at elevation 1,330 feet amsl and upstream of the existing North Quarry (Figure 3.1). Monitoring station MS-2 is located at elevation 650 ft amsl downstream of the North Quarry and approximately 1 ¾ miles downstream of MS-1. MS-2 is also located downstream of the North Quarry dewatering discharge point. Permanente Creek is generally dry in certain segments adjacent to the North Quarry during the dry season and flows typically year-round both upstream of and downstream from the North Quarry.

#### 4.1.3 Seeps and Springs

Seepage in the existing North Quarry has been observed along the Main (1987) Failure headscarp between elevations 1,400 and 1,600 feet and from the reclaimed slope between the Main (1987) Failure and the WMSA, above elevation 1,350 feet, during field mapping in June 2007. Golder observed an additional seep at approximately elevation 1,050 feet along the southwest portion of the existing North Quarry pit wall.

#### 4.1.4 Geologic Units

The major lithologic units that occur in the project area include limestone, greenstone, graywacke, fault breccia, and metabasalt. These are described briefly as follows:

- Metabasalt is medium to dark gray and fine-grained, and commonly contains abundant milky calcite veins and scattered pyrite crystals. Vesicles are present locally and occasionally filled with calcite. Chlorite content is variable but generally low.
- Greenstone developed from the same parent lithologies as metabasalt but has higher chlorite content. It is greenish-gray and contains scattered pyrite crystals and opaque minerals. Vesicles, calcite-filled vesicles, and milky calcite veins occur locally.
- Graywacke ranges from yellowish brown to black, and is generally very fine grained to fine grained, although local conglomeratic intervals exist. Slickensides are common, and may be coated with graphite. Scattered milky calcite veins and pyrite occur locally.
- Limestone is light gray to medium dark gray, and fine to medium grained. Stylolites (contacts marked by irregular interlocking penetrations of the two sides) are common, and black chert nodules are usually present in concentrations of 15% or less. The limestone is locally dolomitic.
- Fault breccia is dark gray to black and may be clast- or matrix-supported. The matrix consists of soft, very fine fault gouge. Clasts are limestone, greenstone, graywacke, or metabasalt, or some combination thereof. This unit may be highly sheared and deformed, and well-developed slickensides are common. Milky calcite veins and scattered pyrite occur locally.

The occurrence of these rock types is complex and consistent with a *mélange* sequence.

## 4.2 Hydrogeologic Units

The occurrence of groundwater is almost exclusively within secondary openings such as joints, fractures, shear zones and faults within the bedrock. The three main hydrogeologic units in the bedrock within the project area are grouped into limestone, greenstone, and graywacke units.

### 4.2.1 Limestone

Three different grades of limestone are differentiated within the limestone unit. As observed in the project area limestone occurs in blocks that range in thickness from less than 50 feet to approximately 600 feet in dimension. Generally, the limestone unit mapped south of Permanente Creek dips gently (approximately 20 degrees) to the northeast and extends under Permanente Creek to the north where it appears continuous with limestone exposed in the south wall of the North Quarry. To the south, the limestone unit is truncated by greenstone unit, which is likely an offset of the Northwest Berrocal Fault Strand and is the dominant thrust contact identified in the TerraSource Model.

The limestone is moderately fractured with a moderate permeability. Several north-northeast striking thrust faults are present throughout the limestone unit. The faults may act as boundaries which will cause the limestone unit to behave as separate, compartmentalized units. Section 4.4 discusses the hydraulic properties in more detail.

### 4.2.2 Greenstone

The second major hydrogeologic unit at the Quarry is greenstone, including metabasalt. Based on the geological coreholes, fault breccia comprises up to 40% of the greenstone unit. The fault breccia usually is highly sheared and deformed with a matrix of soft and very fine fault gouge. As noted previously, the greenstone is likely the footwall of the main thrust fault structure in the project area and is predominately present in the southern portion of the project area, and extends further south to and under Monte Bello Creek. Greenstone also underlies the limestone unit located south of Permanente Creek and intermittently between the limestone blocks. The greenstone is highly weathered in areas and has a lower permeability compared to the limestone. Section 4.4 discusses the hydraulic properties in more detail.

### 4.2.3 Graywacke

Graywacke is predominately present along the eastern portion of the project area as part of the hanging wall associated with the Northwest Berrocal Fault Strand. Based on the geological coreholes, fault breccia and greenstone comprise 60% of the graywacke unit. The graywacke is highly weathered in areas and has similar hydrogeologic properties as the greenstone unit.

## 4.3 Water Level Response

Figure 4.1 is a hydrograph showing groundwater elevations in monitoring wells and piezometers from early September through October 2009. Groundwater levels and precipitation for the individual monitoring locations are included in Appendix B. Precipitation is plotted against the secondary y-axis and represents cumulative precipitation from October 1, 2008 through the end of October 2009. Precipitation data were obtained from the Los Altos Hills climate station (ID: LSA), available from the California Department of Water Resources Data Exchange Center (<http://cdec.water.ca.gov/>). The Los Altos Hills climate station is located approximately 3.3 miles northwest of the North Quarry at an elevation of 2,001 ft amsl.

A significant rainstorm event occurred between October 12, 2009 and October 14, 2009, 11 days after the pumping test ended (discussed in Section 4.4.2). A total of 4.2 inches of precipitation occurred during this 36-hour period, Table 4.2 summarizes the groundwater level responses from the rainstorm event.

**TABLE 4.2**  
**Summary of Groundwater Level Responses (October 2009 Rainstorm Event)**

Well ID	Lithology	Completion Depth (feet bgs)	Peak Groundwater Level Rise (feet)	Elapsed Time After Beginning of Storm When Response First Observed (hours)
GT3-4	Limestone	270	0.53	7.0
GT4-25A	Limestone	277	0.69	11.0

The peak groundwater level responses to the rainstorm event in these two wells occurred on October 12th. No measurable response was observed in HG-10INT or HG-10D, which are wells completed in limestone at a depth of 295 and 495 feet bgs, respectively. Response to this storm in the remaining monitoring wells (HG-4, HG-6, HG-7, HG-9, and HG-10S) cannot be verified because they were not continuously monitored during the rainstorm event. The water level responses in the two piezometers in the limestone indicate that groundwater recharge occurred as a result of the rainstorm. Assuming a storativity ranging from  $3 \times 10^{-3}$  to  $1 \times 10^{-2}$  (Section 4.4.2.4), the recharge from the rainstorm is approximately 0.02 to 0.08 inches.

Relative groundwater changes recorded in the monitoring wells and vibrating-wire piezometers are plotted on Figure 4.2. The significant water level change in GT3-4 and GT4-25A between late September and early October was due to the constant-rate pumping test conducted in HG-10S on September 30 through October 1, 2009. The relative natural (antecedent) groundwater changes (i.e. seasonal groundwater level decline) before and after the pumping test are notably different for monitoring wells/piezometers completed in limestone versus graywacke and greenstone. The average rate of water level decline in the wells/piezometers completed in graywacke or greenstone (HG-4, HG-6, HG-7, and HG-9) was 0.006 feet per day, whereas the average water level decline in wells/piezometers completed in limestone or dolomitic limestone (HG-10S, GT3-4, and GT4-25A) was 0.08 feet per day. This suggests a higher diffusivity (that is, transmissivity divided by storativity) for the limestone units compared to the graywacke and greenstone.

The individual hydrographs included in Appendix B show an overall water level decline during monitoring. The limestone monitoring wells show a net decrease in water levels of 25 feet during the 2009 water year (October-September), with a total decline of 40 feet from late March 2008 through October 2009. The general trend in declining water levels is likely due to the drier than average years in 2007 and 2008. Furthermore, the December 2008 Water Condition Report by the Santa Clara Valley Water District reported that groundwater elevations were about 17 feet lower on average than the five year average from 2004 through 2008 (SCVWD, 2008).

## 4.4 Hydraulic Properties

The hydraulic properties of the hydrogeologic units at the Quarry were estimated from the packer tests conducted in several boreholes and from a constant-rate pumping test conducted in HG-10S. Tables 4.3 and 4.4 summarize the hydraulic properties estimated from the packer tests and constant-rate pumping test, respectively.

### 4.4.1 Packer Test Results

Table 4.3 is a summary of the hydraulic properties from the packer testing. Packer tests were carried out in the more fractured sections of the boreholes. The data collected for the packer testing is included in

Appendix C. The hydrogeologic units tested included the greenstone, limestone, and graywacke. The estimated hydraulic conductivity of the greenstone ranges from 0.11 to 3.26 ft/d with a geometric mean of 0.41 ft/d. The estimated hydraulic conductivity of the limestone ranges from 0.06 to 6.30 ft/d, with a geometric mean of 0.60 ft/d. Two zones of graywacke were tested, resulting in hydraulic conductivities of 2.51 and 29.8 ft/d (weathered graywacke), with a mean of 8.64 ft/d. Overall, the hydraulic conductivities estimated for the greenstone from the packer tests are biased towards the high-end for the entire unit because the zones tested in each borehole tended to be the more fractured (and therefore, more permeable) zones. Therefore, the overall bulk hydraulic conductivity of the greenstone (fractured and unfractured sections) is expected to be lower than those indicated by these localized tests.

The hydraulic conductivity of the limestone estimated from the packer testing are considered to be biased toward the low-end of the bulk hydraulic conductivity, because the more competent zones were tested due to a poor seal in the more fractured and permeable zones.

#### **4.4.2 Constant-Rate Pumping Test**

Figure 4.3 is a semi-log plot of the corrected drawdown and recovery observed in the pumping well (HG-10S) during the constant-rate pumping test. Drawdown data were corrected (and plotted as “corrected drawdown”) taking into account the antecedent groundwater level decline, which was observed in all monitored wells/piezometers. The total drawdown in the pumping well at the end of the test was about 32 feet. Drawdown for the first 5 minutes of pumping was affected by well casing storage. The data between 5 and 200 minutes of pumping appears to be more representative of the aquifer, because the rate of drawdown stabilized (i.e. plots as a straight-line on semi-log chart). After 200 minutes, the rate of drawdown increased. The increasing rate of drawdown is interpreted to be the result of the cone of depression encountering a boundary between the limestone and lower permeability greenstone and graywacke.

##### **4.4.2.1 Pumped Well Response and Interpretation**

Figure 4.4 is a plot of the derivative of drawdown and recovery in the pumped well. The purpose of the derivative drawdown plot was to confirm the responses identified from the semi-log plot in Figure 4.3 and to identify any other conditions affecting the drawdown. The derivative drawdown plot validates the assertion that the response of the pumping test in the first 5 minutes of pumping was affected by storage in the well casing. From 5 to 200 minutes, the derivative of drawdown indicates that the response to pumping is affected by partial penetration, which has a negative half-slope. After 200 minutes, the drawdown derivative sharply increases, indicating the flow is dominated by lower-permeability boundary conditions.

The water levels recovered after pumping stopped. After 6.5 days of recovery, the water level in the pumped well had recovered to within 2.5 feet of the pre-test water level. The incomplete recovery

indicates that the tested limestone unit is of limited extent and receives limited recharge. In effect, the well resulted in a partial dewatering of the limestone unit of 2.5 feet after three days of pumping.

#### 4.4.2.2 Observation Well Responses and Interpretation

Figure 4.5 presents semi-log plots of the drawdown observed in wells HG-10INT, GT4-25A, and GT3-4 that are all completed in the same limestone unit as test well HG-10S. The total drawdown response to pumping in the closest well (HG-10INT, located 7 feet from HG-10S) was 10.5 feet at the end of the test. HG-10INT is a vibrating wire piezometer completed in limestone at a depth of 295 feet bgs, which is almost 150 feet lower in elevation than HG-10S (see Table 3.2). GT4-25A (625 feet southeast of HG-10S) and GT3-4 (850 feet west of HG-10S) are completed at similar elevations as HG-10S and had maximum drawdown during the test of 2.82 feet and 1.61 feet, respectively.

#### 4.4.2.3 Analysis Results and Interpretation

Table 4.4 summarizes the interpreted hydraulic properties based on the results of the constant-rate pumping test. The drawdown and recovery data collected in the pumping well were first analyzed using the Cooper-Jacob (1946) straight-line method (Figure 4.3). The transmissivity (T) was estimated from the drawdown and recovery data to be 2,400 and 2,600 ft<sup>2</sup>/d, respectively. However, the derivative plot (see Figure 4.4) indicates that the drawdown was affected by partial penetration effects and no-flow boundary conditions that are not accounted for using the Cooper-Jacob method. Therefore, the pumping test data were analyzed using the Theis unconfined partial penetration solution (Theis, 1935) with no-flow boundary conditions (Figures 4.6 and 4.7). The type curves for each observation well are plotted as solid red lines, where the position and shape of the type curves are based on hydraulic properties (transmissivity and storativity), the radial distance from the pumping well to each observation well, and the distances to the inferred boundary conditions. An iterative process was employed with the best fit obtained using four no-flow boundaries (at distances of 100 to 2,000 feet) to represent a block of limestone bounded by either faults or lithologic changes.

Based on the two analyses presented on Figures 4.6 and 4.7, the results indicate the limestone is of limited extent (i.e., analogous to a compartmentalized hydrogeologic system) with a transmissivity of 2,224 ft<sup>2</sup>/d, and an estimated storativity (S) of  $2.6 \times 10^{-3}$  to  $9.3 \times 10^{-3}$ . For both analyses, the limestone block was assumed to be elongated in the northwest – southeast direction (parallel to the main structural fabric). The Theis type curve match for GT3-4 (Figure 4.7) resulted in a higher estimate of storativity and more distant interpreted boundary conditions, but smaller in size than the compartment estimated for GT4-25A (about 60% smaller). No unique combination of hydraulic properties coupled with compartment geometry was found to match the Theis type curve to all three observation points, indicating a degree of heterogeneity in the hydraulic system within the limestone compartment.

Figure 4.8 is a distance versus drawdown plot of the observed drawdown in HG-10INT, GT4-25A, and GT3-4 after 12 hours of pumping (i.e. before drawdown in these wells was affected by the lateral

boundaries). Ideally, the drawdowns observed at various distances should plot on a straight-line if the observation wells are completed in the same hydraulic system as the pumped well. The distance drawdown plot presented in Figure 4.8 is based on a transmissivity of 2,224 ft<sup>2</sup>/d and a range of storativity values from  $1 \times 10^{-4}$  to  $1 \times 10^{-3}$ . The results of the distance versus drawdown plot show that the observed drawdown in GT4-25A and GT3-4 after 12 hours of pumping are consistent with the predicted drawdown using the estimated storativity from the Theis partial penetration solution (Figure 4.6 and Figure 4.7).

The estimated storativity at HG-10INT (Table 4.4 and Figure 4.5) is 0.9. This value is not representative of the storativity of the limestone aquifer which would be expected to be in the range of 0.0001 to 0.001. The high storativity value appears to be related to the analysis method (Cooper Jacob, 1946) which assumes that the pumping well and the observation well are fully screened within the limestone when in fact the well partially penetrates the limestone and the observation well HG-10INT is screened in the lower part of the limestone aquifer.

Figure 4.8 shows that both horizontal and vertical hydraulic connections exist between the shallow and intermediate depths within the limestone. Observation well HG-10INT responded to the pumping of the well within a drawdown range predicted by the overall hydraulic properties (transmissivity and storativity) estimated for the limestone unit.

The predicted drawdown in pumping well HG-10S after 12 hours ranges from 5.23 to 6.25 feet based on different storativity values of  $1 \times 10^{-4}$  to  $1 \times 10^{-3}$  (Figure 4.8); the actual observed drawdown in the pumping well was 26.03 feet. Therefore, the total well losses in the pumping well after 12 hours were approximately 19.8 to 20.8 feet. Well losses are primarily caused by turbulent flow inside or immediately adjacent to the well screen. Well losses are also greater in partially penetrating than in fully penetrating wells because pumping induces vertical flow from below the screened or open interval in the well.

## 4.5 Groundwater Flow Conditions

### 4.5.1 Groundwater Levels and Flow

Figure 4.9 presents the recorded groundwater elevations and interpreted groundwater level contours and flow directions south of Permanente Creek. The elevations represent conditions measured in October 2009. The highest groundwater elevations were observed in HG-4 and HG-6 which are located on the northwest-southeast trending ridge that separates Permanente Creek and Monte Bello Creek watersheds. In October 2009, the groundwater elevations at HG-4 and HG-6 were approximately 1,752 and 1,658 ft amsl, respectively. The lowest groundwater elevations at that time were observed in HG-8 and GT1-4 (both located near Permanente Creek), with elevations ranging from 1,038 to 1,066 ft amsl, respectively. These elevations are 90 and 50 feet higher than the nearby creek elevations, respectively.

The regional-scale direction of groundwater flow is interpreted to be from west to east, flowing from the topographic high at Black Mountain toward the Santa Clara Valley. Locally, groundwater discharges to

Permanente Creek, Monte Bello Creek and an unnamed creek in the eastern half of the Quarry. Groundwater also discharges to the North Quarry. Figure 4.10 shows the recent pit water level in the North Quarry, ranging between 738 and 776 ft amsl, which is between 300 and 400 feet lower than Permanente Creek. Groundwater flow through the limestone and graywacke/greenstone locally is primarily to the north and northeast from a groundwater divide located beneath the ridge separating Permanente Creek from Monte Bello Creek. Based on the pumping test evaluation, groundwater flow is preferentially within the more permeable limestone units. However because the limestone units are of limited extent (truncated by greenstone and graywacke), the overall groundwater flow system is controlled by the lower permeability of the greenstone/graywacke units.

#### 4.5.2 Hydraulic Gradients

Figure 4.11 shows the groundwater elevation versus well completion elevation for observation wells completed in the limestone and greenstone/graywacke units. The groundwater levels in HG-10 (i.e. HG-10S, HG-10INT, and HG-10D) show a steep downward vertical component of hydraulic gradient among the shallow, intermediate, and deep monitoring wells/piezometers. The vertical hydraulic gradient is the difference in water level (head) versus the difference in elevation of the two monitoring wells/piezometers. A negative vertical component of hydraulic gradient indicates an area of discharge, or upward groundwater flow; whereas a positive vertical component of hydraulic gradient indicates an area of recharge, or downward groundwater flow. The vertical component of hydraulic gradient between HG-10S and HG-10INT is about 0.45, indicating downward groundwater flow. The vertical component of hydraulic gradient between HG-10INT and HG-10D is about 1.6, indicating that the shallow and intermediate depth wells and piezometers are completed in a shallow aquifer which is hydraulically separated (perched) from a deeper aquifer.

The horizontal component of the hydraulic gradient ranges from 0.25 to 0.77, where the steeper hydraulic gradients are near the groundwater divide separating Monte Bello Creek from Permanente Creek. The horizontal component of the hydraulic gradient in the greenstone is steeper than the gradient observed in the limestone because the greenstone has lower hydraulic conductivity (Figure 4.11).

### 4.6 Water Balance

#### 4.6.1 Approach

Water balances were developed for Water Year 2009 for the existing North Quarry, and Permanente and Monte Bello Creeks using a combination of field monitoring data and data obtained from public records. As well as forming part of the hydrogeologic conceptual model, these water balances were developed to act as inputs and calibration data for the numerical groundwater flow model in order to predict the future inflows to the North Quarry and potential impacts to the streamflows in Permanente Creek and Monte Bello Creek.

Pit water elevations in the North Quarry were measured daily over a period from early-February 2009 to mid-October 2009. The total volume of water in the pit was calculated by the sum of the water level elevation multiplied by the surface area of the pit water on ten-foot increments, to account for the change in volume versus height. Pumping was recorded daily and was based on the total amount of time the pump was operated at full capacity (1,150 gpm). Therefore, the total daily amount of water pumped from the North Quarry was determined by the pumping rate multiplied by the operating duration.

Streamflow data for Permanente Creek and Monte Bello Creek were collected from four stations, two on each stream. The stations are identified as MS-1 through MS-4, where MS-1 and MS-2 are the upstream and downstream gauges on Permanente Creek, respectively, and MS-3 and MS-4 are the upstream and downstream gauges on Monte Bello Creek, respectively. Each station had a pressure transducer and datalogger installed to measure the change in water depth in the stream. The water level, or pressure, was then converted to streamflow based on a rating-curve developed from a series of manual flow measurements collected throughout the season.

## **4.6.2 Hydrologic Data**

### **4.6.2.1 Precipitation**

The closest precipitation station to the Quarry is Los Altos Hills, located approximately 3.3 miles northwest of the North Quarry at an elevation of 2,001 ft amsl. Table 4.5 is a summary of the monthly average rainfall at the Los Altos station from 1999 through 2009 (water years<sup>1</sup>). The annual average rainfall over this period of time was 22.2 inches. For Water Year (WY) 2009, the precipitation was 21.9 inches. The annual variability for this station is relatively low, with minimum and maximum of 17.4 and 26.4 inches. Although the Los Altos station is not physically located within the Permanente and Monte Bello watershed, the data can be considered reasonably representative for the purpose of this water budget. Within the basins, higher elevation areas would be expected to receive more precipitation than lower-lying areas.

### **4.6.2.2 Permanente Creek Flow**

Figures 4.12 and 4.13 are hydrographs of the streamflow in MS-1 and MS-2, respectively, from February to October 2009. MS-1 is the upstream gauge and has a drainage area of 662 acres, and MS-2 is the downstream gauge and has a total drainage area of 1,706 acres. Therefore, the watershed area for the reach between the two gauges is 1,045 acres. From February to July, the streamflow at MS-1 ranged from approximately 30 cubic feet per second (cfs) during the wet part of the season (February and March) to less than 0.1 cfs from July to October. At MS-2, the streamflow ranged from 13 cfs in February to about 2 cfs in July. The streamflow observed from mid-March to July are mostly affected by pumping from the North Quarry into Permanente Creek. The large spike and subsequent elevated streamflows

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<sup>1</sup> A water year is from October 1 through September 30.

observed from March 18, 2009 correlates to pumping at the North Quarry, where the average pumping rate from March to July was 2 cfs.

Figures 4.12 and 4.13 also show the baseflow estimates separated from the streamflow observed in Permanente Creek at MS-1 and MS-2. Based on these hydrographs, the average annual baseflow for WY 2009 at MS-1 and MS-2 was estimated to be 0.30 cfs and 1.02 cfs, respectively. The average annual baseflow contribution to Permanente Creek between the two stations (representing a catchment area of 1,045 acres) was 0.73 cfs. Therefore, the total annual groundwater discharge to these reaches of Permanente Creek is 215 and 740 acre-feet.

#### 4.6.2.3 Monte Bello Creek Flow

Figures 4.14 and 4.15 are hydrographs of the streamflow in MS-3 and MS-4, respectively, from February to October 2009. MS-3 is the upstream gauge and has a drainage area of 419 acres, and MS-4 is the downstream gauge with a total drainage area of 688 acres. Therefore, the watershed area for the reach between the two stream gauges is 269 acres. From February to July, the streamflow at MS-3 and MS-4 ranged from over 100 cfs to approximately 0.1 cfs. The high streamflows were observed in early February and March, after the area received over 15 inches of rainfall.

Figures 4.14 and 4.15 also show the baseflow estimates separated from the streamflow observed in Monte Bello Creek at MS-3 and MS-4. Based on these hydrographs, the average annual baseflow for WY 2009 at MS-3 and MS-4 was estimated to be 0.08 cfs and 0.14 cfs, respectively. The average annual baseflow to Monte Bello Creek between the two stations (representing a watershed area of 269 acres) was 0.06 cfs. Therefore, the total annual groundwater discharge to these reaches of Monte Bello Creek is 61.5 and 104 acre-feet.

#### 4.6.2.4 North Quarry Pumping

Figure 4.16 is a plot of the water level elevation in the North Quarry with the total daily precipitation measured at the Los Altos Hills climate station. Surface water runoff to the North Quarry occurs from precipitation within the watershed of the pit and varies with storm intensity. For intense storm events, runoff from precipitation will be greater, because there is less recharge and evaporation.

From mid-February to mid-March 2009, nearly 13 inches of precipitation occurred, which resulted in a water level increase in the North Quarry of 39 feet (increase in water elevation from 737 feet amsl to 776 feet amsl). From mid-March to early-August, the total precipitation measured at Los Altos Hills was about 1.2 inches. During this same period of time, the average daily pumping rate from the North Quarry was about 1,100 gallons per minute (gpm), or approximately 2.45 cfs (Figure 4.17). As a result, the water level in the North Quarry declined back to an elevation of 737 feet amsl by early-August.

Another significant rainstorm event occurred in mid-October 2009, with a total precipitation of 4.2 inches over a two-day period. As a result, the water level in the North Quarry increased from an elevation of 738

feet amsl to 745 feet amsl, with a total change in the volume of water of 1,738,000 cubic feet (40 acre-ft). To determine the amount of surface runoff that entered the North Quarry, a storm water coefficient was estimated based on the following formula:

$$RO = A \times P \times C = \Delta s + Q$$

Where:

RO is the surface runoff into the North Quarry [ft<sup>3</sup>/d]

A is the surface area of the watershed area contributing to the North Quarry [ft<sup>2</sup>]

P is the daily precipitation [ft/d]

C is the storm water coefficient [dimensionless]

Δs is the change in storage, or the change in volume of the water in the North Quarry [ft<sup>3</sup>/d]

Q is the pumping rate of water out of the North Quarry [ft<sup>3</sup>/d]

It was assumed that there was no groundwater inflow to the pit during this short-term event. Based on this equation, the storm water coefficient of runoff to the North Quarry for this October rain event was estimated to be 0.3 based on a total watershed area of 375.25 acres (16,345,890 ft<sup>2</sup>), precipitation of 4.2 inches (0.35 ft), and a total change in water storage of 1,738,000 ft<sup>3</sup> (including pumping) over a 4 day period. The total change in storage of water in the North Quarry included the sum of the change in volume of water in the pit, as well as the total amount pumped out from October 12th through October 16th to account for the lag time for surface water to runoff into the North Quarry.

#### 4.6.3 Water Balance Estimates

The 2009 water year annual water balance summaries for Permanente Creek and Monte Bello Creek are provided in Table 4.6. Evapotranspiration was estimated by taking the difference between annual precipitation and the annual total streamflow for each station. The water balance for the North Quarry from February 2009 to mid-October 2009 is provided in Table 4.7. The results of the estimated water balance for each are described below.

##### 4.6.3.1 Permanente Creek

The annual water balance for Permanente Creek for WY 2009 is presented on Table 4.6. The total annual streamflow observed at MS-1 was 8.1 inches, of which 3.9 inches is estimated to be from baseflow and 4.2 inches is estimated to be surface runoff. At MS-2, the total annual streamflow was 6.8 inches, with 5.2 inches coming from baseflow and 1.6 inches coming from surface runoff.

##### 4.6.3.2 Monte Bello Creek

The annual water balance for Monte Bello Creek for WY 2009 is presented on Table 4.6. The total annual streamflow observed at MS-3 and MS-4 for was 13.4 and 8.8 inches, respectively. Baseflow is estimated to be 1.8 inches at both locations; therefore, the annual surface water runoff at MS-3 and MS-4 is estimated to be 11.6 and 7.0 inches, respectively.

#### 4.6.3.3 North Quarry

Table 4.7 is a summary of the water balance for the North Quarry from February 2009 to mid-October 2009. The primary goal of estimating the water balance for the North Quarry was to provide a calibration point for the numerical groundwater flow model. Using the data provided by Lehigh, the groundwater inflow into the North Quarry was estimated from the following formula:

$$V_{GW} = V_{PIT} + V_{PUMPED} + V_{EVAP} - V_{PRECIP} - V_{RUNOFF}$$

Where:

$V_{GW}$  is the total volume of groundwater entering the pit

$V_{PIT}$  is the change in volume of the water in the pit

$V_{PUMPED}$  is the volume of water pumped out of the pit

$V_{PRECIP}$  is the volume of water from direct precipitation into the pit

$V_{EVAP}$  is the volume of water lost to evaporation based on the surface area of the pit water

$V_{RUNOFF}$  is the volume of water from runoff using the catchment area of the North Quarry and a runoff coefficient of 0.3

Figure 4.18 is a semi-log plot of the various components of inflow calculated from the water balance estimated for the North Quarry. Over the available period of record, the total amount of inflow into the North Quarry was 37,395,000 ft<sup>3</sup> (858 acre-ft), with a range of flow from 210 gpm to 5,700 gpm. The total surface water runoff that entered the North Quarry from February 2009 to mid-October 2009 was estimated to be 7,729,000 ft<sup>3</sup> (177 acre-ft), with a range of inflows from 0 to over 8,800 gpm. The total estimated amount of groundwater that entered the North Quarry was 29,412,000 ft<sup>3</sup> (675 acre-ft), with a range of inflows from about 210 gpm (5<sup>th</sup>-percentile) to 1,480 gpm (95<sup>th</sup>-percentile), and a geometric mean of 687 gpm. From early September to mid-October, the North Quarry water level remained constant at 738 feet amsl while the daily pumping rate remained steady at 211 gpm; therefore, suggesting that the ambient groundwater seepage into the North Quarry is about 0.47 cfs (211 gpm) during the dry season.

## 4.7 Groundwater Recharge

Groundwater recharge is estimated to range from about 2 to 4 inches based on the water balance summaries presented on Table 4.6. Recharge is expected to be greater in the limestone units rather than the greenstone/graywacke units, because the limestone is more permeable than the greenstone/graywacke. The greater recharge in the limestone is demonstrated by the observed response to recharge in piezometers completed in the limestone while those in the greenstone/graywacke did not respond (Section 4.3).

## 5.0 HYDROGEOLOGICAL MODELING

### 5.1 Modeling Objectives

Groundwater modelling evaluated the ongoing operation and future reclamation of the North Quarry. Notably, previous modelling included evaluation of the proposed South Quarry, but as the South Quarry proposal is not part of the current project, those aspects of the modelling are not presented here.

Specifically, the following issues are addressed:

1. Groundwater inflows into the North Quarry as mining in the North Quarry continues to its ultimate depth (at about 440 ft amsl);
2. The effect that reclamation of the North Quarry will have on the local surface hydrology, in particular, Permanente and Monte Bello Creeks;
3. The effect that reclamation of the North Quarry will have on local groundwater supply wells.

The numerical flow model used the United States Geologic Survey (USGS) code *MODFLOW-2000* (Harbaugh et al, 2000). The numerical model was developed using the hydrogeologic data described in the previous sections. The key elements of this conceptual model are as follows:

- Hydrostratigraphy – the distribution of the principal lithologies in the area (greenstone/graywacke and limestone) both vertically and laterally.
- Hydraulic properties – the hydraulic conductivity, transmissivity, storativity and porosity of the hydrostratigraphic units.
- Groundwater levels and flow – the piezometric heads, flow directions and hydraulic gradients (lateral and vertical).
- Water balance – groundwater sources (infiltration of precipitation) and sinks (discharge to the local creeks, the Santa Clara Valley and the existing North Quarry)

The conceptual hydrogeologic model for the Quarry is described in further detail in the following sections.

### 5.2 Conceptual Model Description

The hydrostratigraphy of the Quarry consists of a complex heterogeneous groundwater system within greenstone, limestone and graywacke units. The groundwater flow at the Quarry generally mimics surface topography, with recharge occurring at higher elevations and prominent ridges, and discharge occurring at low-lying areas, several creeks and the North Quarry.

#### 5.2.1 Groundwater Flow

Figure 4.9 shows the interpreted piezometric contours south of Permanente Creek based on measured groundwater levels in monitoring wells and piezometers during October 2009. These wells and piezometers are completed in either limestone or greenstone units. The highest heads were recorded in

the three wells located along the ridgeline (between 1,560 and 1,750 ft amsl) and the lowest levels were recorded in the wells located near Permanente Creek (between 1,030 and 1,060 ft amsl).

Groundwater flow is preferentially within the more permeable limestone blocks. However, because the limestone blocks are limited in extent, the overall groundwater flow system is controlled by the less permeable greenstone unit. Additionally, because of the higher permeability within the limestone blocks, the horizontal hydraulic gradient is flatter within the limestone than the greenstone.

The groundwater encountered in most of the monitoring wells and geotechnical boreholes completed in the greenstone and limestone is perched over a much deeper regional groundwater system. The perched groundwater is interpreted to be separated from the deeper system by low permeability greenstone. Evidence for this deeper groundwater system was observed during the drilling of HG-11, when lost circulation of the drilling fluid occurred at an elevation of approximately 1,015 feet amsl.

### **5.2.2 Recharge and Discharge**

Recharge to the groundwater system is by the infiltration of precipitation. The areas with flatter slopes or areas in topographic lows receive more recharge, because runoff of the rainfall is less than the runoff generated from the steeper slopes. Runoff from the steeper slopes accumulates in topographically low spots, thereby increasing infiltration.

Discharge of groundwater is to surface water bodies, such as Permanente Creek and Monte Bello Creek and their tributaries where the groundwater table intersects ground surface. The areas of discharge are in the southeast and northeast area of the Quarry, where the groundwater intercepts Permanente Creek and Monte Bello Creek in the topographically low areas.

The private vineyards located on the southern crest of Monte Bello ridge are believed to be irrigated using groundwater pumped from several supply wells. The exact locations, depths and water column height in these wells are unknown at this time. Figure 5-1 shows the location of the vineyards.

## **5.3 Numerical Groundwater Flow Model**

### **5.3.1 Model Code**

The numerical groundwater flow model uses the USGS finite-difference code *MODFLOW-2000* (Harbaugh et al, 2000) to simulate flow, and is implemented using the commercial graphical user interface program GMS (version 7.0).

### **5.3.2 Model Geometry**

Figure 5.1 shows the lateral extent (domain) of the *MODFLOW* model. The model domain coincides with the surface watershed for Permanente and Monte Bello Creeks to the west and south, and for an unnamed creek to the north. The model's eastern limit coincides with the western edge of the Santa

Clara Valley/Monta Vista Fault). The model occupies an area of approximately nine square miles, and is roughly centered on the North Quarry. The model contains 370 rows and 500 columns (although not all cells are active). All model cells have dimensions of 50 feet by 50 feet in plan view (Figure 5.2).

### 5.3.3 Layering and Hydrostratigraphy

The model employs six layers to represent the hydrostratigraphy (Figures 5.3 and 5.4). The top surface of the model was developed based on the digital elevation model (DEM) data at a 10-meter resolution (Figure 5.5). The model's base was developed as sloping from about 900 feet amsl at the western boundary to 200 feet below msl at the east.

Apart from in the area of the quarries where limestone occurs, the model represents greenstone. The layering near the quarries was developed to enable the detailed lithologic interpretation of the limestone and greenstone units to be represented. For example, the north-south section through the North Quarry (Figure 5.3) illustrates how the limestone unit in that area extends to a depth of about 400 feet amsl, through layers 1 through 5, inclusive. On the same figures, the base of the limestone block south of Permanente Creek is notably shallower, and is contained solely within model layer 1.

### 5.3.4 Hydraulic Properties

The initial hydraulic properties assigned to the modelled units were based on the results and interpretation from the aquifer pumping test and other single-well (packer) tests reported in Section 4.4.2.3. These values were adjusted as part of the calibration task (see Section 5.3.6).

### 5.3.5 Boundary Conditions

Discrete boundary conditions were assigned to the model to enable groundwater to enter or leave the model in agreement with the general and local water budget described in Section 4.6. These boundary conditions are:

- Constant heads – assigned along the up-gradient (western) and down-gradient (eastern) limits to represent groundwater inflow and outflow, respectively (Figure 5.1).
- Rivers – head-dependent conditions simulating the movement of groundwater into or out of the main creek reaches. The creek bed elevation was set based on the top surface elevation of the model, and the creek stage (water level) was set at 2 feet above the bed elevation.
- Drains – head-dependent conditions simulating the extraction of groundwater in the North Quarry as a seepage face along the slopes and in the base of the pit. The drain elevation was set at 2 feet below the land surface.
- Recharge – applied at the uppermost model layer, ranging from 2 inches/year in the low-lying east to 8 inches/year on the north-facing upland areas.

The other lateral boundaries and the base of the model were assigned as no-flow conditions.

### 5.3.6 Model Calibration

#### 5.3.6.1 Approach

The model was initially run to steady-state conditions, and an initial piezometric head result obtained. From there, the model calibration approach involved manually adjusting the key model parameters – principally the hydraulic properties, and to a lesser extent, the boundary conditions and layering – until the model results reasonably represented the observed data. The calibration targets consisted of the following during 2009:

- Piezometric levels measured in wells and vibrating-wire piezometers completed in the limestone and greenstone units (HG-2, etc.)
- Estimated groundwater discharge at the North Quarry (based on the water budget)
- Estimated groundwater discharge (baseflow) to the monitored reaches of Permanente and Monte Bello Creeks

#### 5.3.6.2 Calibration Results (Current Conditions)

##### 5.3.6.2.1 Piezometric Heads

Figures 5.6 and 5.7 show the simulated groundwater levels in the topmost model layer in the entire model and in the quarry areas, respectively. In general, the modeled groundwater flow is from west to east, with local discharge at the creeks and the North Quarry. Figure 5.8 plots the observed and modeled piezometric heads for the ten key monitoring wells and piezometers.

South of Permanente Creek, the simulated groundwater flow direction is towards the northeast. The simulated heads south of the Creek are generally lower than those measured in October 2009. The largest differences (or residuals) occur for the three wells near the ridge crest to the south (HG-4, HG-5 and HG-6), and the smallest differences are for the wells located near Permanente Creek. The effect of this apparent discrepancy is that the model underpredicts the groundwater elevations and local hydraulic gradient near the groundwater divide between Permanente and Monte Bello Creeks.

Numerous variations of hydraulic properties and layering within a reasonable range were tested to improve the head match in this area, but the results were relatively insensitive to these changes. Also, features such as barrier faults and fault gouge layers were tested to improve the head match, but were also relatively insensitive to these variations. It is likely that complex geological structure of the greenstone and limestone units results in the groundwater in the ridge area being more compartmentalized and heterogeneous than the model is able to simulate without suffering mathematical instability. Although the modeled heads are lower than measured, the model is expected to reasonably predict overall flow of groundwater, and in particular, discharge to Monte Bello Creek and Permanente Creek.

#### 5.3.6.2.2 Water Budget

Table 5.1 summarizes the overall steady-state (annual average) water budget for the calibrated model. The largest inflow is precipitation-derived recharge (accounting for 90 percent of the total inflows), and the largest outflows are to the creeks (totaling more than 60 percent of the outflows).

**Table 5.1 - Modeled Annual Groundwater Budget (Current Conditions)**

Feature	INFLOWS		OUTFLOWS		NET		Comments
	afv	cfs	afv	cfs	afv	cfs	
Constant Heads	121	0.20	305	0.40	-184	-0.3	
Recharge	1,955	2.7	0	0	1,955	2.7	Ranging from 2 to 6 in/yr
North Quarry	0	0	500	0.70	-500	-0.7	Using Drain Boundary condition
Permanente Creek – upper	0	0	293	0.40	-293	-0.40	Upstream from MS-1
Permanente Creek – middle	60	0.08	290	0.40	-230	-0.32	Between MS-1 and MS-2
Permanente Creek – lower	0	0	66	0.09	-63	-0.09	Downstream from MS-2
Monte Bello Creek – upper	0	0	63	0.09	-63	-0.09	Upstream from MS-3
Monte Bello Creek – middle	0	0	102	0.14	-102	-0.14	Between MS-3 and MS-4
Monte Bello Creek – lower	0	0	156	0.22	-154	-0.21	Downstream from MS-4
Other creeks	30	0.04	396	0.55	-366	-0.51	
Totals	2,166	3.0	2,171	3.0	-	-	

The simulated current groundwater discharge to the North Quarry (500 AFY or 310 gpm) is within the average annual range of 200 to 600 gpm estimated based on the field measurements and water balance (Section 4.6). The simulated and observed groundwater discharge rates to the monitored Permanente and Monte Bello Creek reaches are as shown in Table 5.2. The middle reach of Permanente Creek is affected by the current North Quarry, with the creek bed (1,000 to 1,100 ft amsl) more than 250 feet higher than the base of the nearby North Quarry (750 ft amsl). The North Quarry's groundwater influence area includes part of Permanente Creek.

**Table 5.2 - Observed and Modeled Groundwater Discharge to Creeks**

Creek Reach	Observed (cfs)	Simulated (cfs)	Location
Permanente Creek – upper	0.31	0.40	Upstream from MS-1
Permanente Creek – middle	0.73	0.32	Between MS-1 and MS-2
Monte Bello Creek – upper	0.08	0.09	Upstream from MS-3
Monte Bello Creek – middle	0.06	0.14	Between MS-3 and MS-4

The hydraulic properties and layering are summarized in Table 5.3.

**Table 5.3 - Modeled Hydraulic Conductivity Values**

Model Layer	Limestone		Greenstone		Comments
	Kh (ft/d)	Kz (ft/d)	Kh (ft/d)	Kz (ft/d)	
1	0.4	0.08	0.075	0.0015	
2	0.4	0.08	0.075	0.0015	
3	0.4	0.08	0.0375	0.00075	Limestone only in N Quarry area
4	0.4	0.08	0.0375	0.00075	Limestone only in N Quarry area
5	0.4	0.08	0.025	0.0005	Limestone only in N Quarry area
6	NA	NA	0.01	0.0004	

### 5.3.7 Simulation of Quarry Development and Reclamation

#### 5.3.7.1 Approach

The calibrated (current conditions) model was used to simulate the discrete “phases” of the future Quarry development and reclamation (the phases referred to here describe the sequential excavation and backfilling of the North Quarry and do not correspond to the general reclamation phasing described in the proposed reclamation plan amendment). These phases consist of a series of conditions defined by the different topography at and near the Quarry area. These are shown in Figures 5.9 through 5.14. Some of interim phases (i.e., phases 3 and 4) were utilized to model potential effects from the formerly proposed South Quarry, which is no longer part of the Reclamation Plan project. These interim phases do not substantively affect the model results for Phase 1, which simulates the final proposed elevation of mining in the North Quarry; or Phase 5, which simulates the final reclamation condition. Table 5.4 presents the lowest pit elevation and approximate affected area for each phase that were used to develop each discrete simulation case.

**Table 5.4 - Summary of Quarry Development and Reclamation Phasing**

Phase No.	Lowest Pit Elevation (ft amsl)	Approx. Model Footprint Area (acres)	Comments
Current Conditions	750	346	Current Conditions
1	440	346	Parts of layers 1-4 were inactivated at the center of North Quarry
2	840	346	

3	990	346	
4	990	346	
5 - Post backfill	990	346	

The MODFLOW model simulated the hydrologic effects of these phases by a combination of (1) revising the upper model surface at the quarry areas to equal the planned topographic surfaces, and (2) the addition of *Drain* boundary conditions at both the base of the pit and along the sloping areas to enable groundwater intercepting the land surface to discharge. The elevations of the *Drain* conditions were set at one foot below groundwater in each cell. For Phase 1, the model cells at the center of the North Quarry were made inactive. North-south sections through the model (B-B'; see Figures 5.10 – 5.14) illustrate the layering for each phase. For backfill, a high hydraulic conductivity (1,000 ft/day for Kh and Kv) was assigned to the new material in place of the extracted limestone. Drain conditions were set with elevations of one foot below land surface to extract groundwater that intercepts land surface. Each case was run to steady-state, thereby representing average annual conditions.

#### 5.3.7.2 Simulation Results

Figures 5.15 and 5.16 show the simulated piezometric heads in the uppermost model layer for Phases 1 and 5. Under Phase 1, the North Quarry will continue to act as a major groundwater inflow feature (i.e., a sump). Groundwater discharge to Permanente Creek in this area will continue to be mostly from the south.

By Phase 5, the North Quarry will have been fully reclaimed, and the highly-permeable pit backfill material (extending from 990 to 440 ft amsl) will continue to act as a groundwater sink (i.e., groundwater will flow into the pit).

Table 5.5 presents the average annual changes in groundwater discharge for the North Quarry and the four monitored reaches of Permanente and Monte Bello Creeks.

**Table 5.5 - Summary of Predicted Changes in Groundwater Discharge Compared to Current Conditions**

Phase No.	North Quarry	Permanente Creek – upper <sup>(1)</sup>	Permanente Creek - middle <sup>(2)</sup>	Monte Bello Creek – upper <sup>(3)</sup>	Monte Bello Creek – middle <sup>(4)</sup>
	gpm	cfs	cfs	cfs	cfs
Current Conditions	310	0.40	0.32	0.09	0.14

1	+61	<0.01	-0.09	-0.01	<0.01
2	+60	<0.01	-0.11	-0.01	<0.01
3	+58	<0.01	+0.46	-0.01	<0.01
4	+62	<0.01	+0.46	-0.01	-0.01
5 - Post Backfill	-230	<0.01	+0.47	<0.01	<0.01

Notes: (1) – upstream from MS-1; (2) – between MS-2 and MS-1; (3) – upstream from MS-3; (4) – between MS-3 and MS-4. Positive changes indicate a net increase in annual average groundwater discharge to feature.

The results indicate the following:

- The average annual groundwater inflow into the North Quarry will increase during Phase 1 compared to current conditions by an additional 61 gpm. The inflow rate will decrease during Phases 2 through 5 as the North Quarry is reclaimed (backfilled) from 440 to 990 ft amsl.
- The mining of the North Quarry to the ultimate pit depth will result in a decrease in groundwater discharge to the middle reach (between MS-1 and MS-2) of Permanente Creek of 0.09 cfs (40 gpm) during Phase 1. This reflects the effect of substantially deepening of the North Quarry.
- If no groundwater inflow into the North Quarry is removed for Phases 3 and 4 (when the quarry is essentially fully backfilled), then the middle reach of Permanente Creek will receive 0.46 cfs more groundwater discharge than under current conditions.
- Groundwater will continue to flow into the North Quarry under post-mining conditions, albeit at a lower rate than under current conditions. The water level in the North Quarry will reach a maximum elevation equal to the backfill elevation of 990 ft amsl. The post-mining water balance is discussed further in Section 5.4.

## 5.4 Post-Mining Quarry Water Balance

### 5.4.1 Approach

The results of the groundwater (MODFLOW) modeling and analytical water budget were used to determine the water budget for Quarry under post-mining (reclaimed) conditions. The main assumptions for this are described below.

The total amount of backfill placed in, and water flowing into the quarry, was calculated on monthly increments. For the North Quarry, it was assumed that four years was required to backfill the quarry to an elevation of 990 ft amsl. During filling, the water table elevation in the quarry was calculated based on the total cumulative amount of water in the quarry compared to the total cumulative backfill volume, assuming a backfill porosity of 30 percent. The net total water entering the quarry was calculated based on the monthly precipitation, surface water runoff, and groundwater inflow.

The assumptions used for the water balance are as follows:

- **Precipitation** - Water entering the quarry from direct precipitation was equal to the 1999-2009 monthly average precipitation observed at the Los Altos Hills station. The monthly precipitation inflow rate was equal to the product of the monthly precipitation and the surface area of the backfill or flooded portion of the quarry from the previous month.
- **Surface Water** - Water entering each quarry as surface water runoff was based on the surface capture area, monthly precipitation and a surface water runoff coefficient of 0.1. The runoff coefficient was provided by Chang Consultants (Chang, 2010), and is based on soil type "B" for shrub land. The monthly surface capture area of the pit decreased as the surface area of the flooded quarry/backfill area increased. It was also assumed that 90% of the runoff within the surface water capture area will be diverted to a sedimentation basin and routed to Permanente Creek before it reaches the backfill of the North Quarry.
- **Groundwater Inflow** - Groundwater entering the quarry was based on the results of the *MODFLOW* model. The water balance assumed that groundwater inflow declined over time as the quarries backfill filled with water. The groundwater inflow to the North Quarry ranged from 371 gpm (end of Phase 1) to 80 gpm (Phase 5, post-backfill).
- **Evaporation** - Evaporation was not accounted for as the water elevations in the reclaimed North and South Quarries are equal to or below the elevations of the backfill.

#### 5.4.2 Results

Tables 5.6 summarizes the results of the estimated post-mining monthly water balance when the water level has reached equilibrium for the North Quarry.

The estimated time to flood the North Quarry backfill is approximately 14 years, and the estimated total average annual inflow at equilibrium is 169 gpm. At equilibrium, these quantities are expected to discharge to Permanente Creek primarily as groundwater depending on the permeability of the materials separating the North Quarry from the creek. During periods of intense rainfall, and during seasonal high groundwater conditions, there is a potential that discharge from the reclaimed North Quarry to Permanente Creek may occur as surface water if appropriate water management techniques are not employed.

## 6.0 GEOCHEMICAL DATA COLLECTION AND REVIEW

### 6.1 Objectives

The objective of the geochemical evaluation was to establish and document current conditions for surface water and groundwater quality. A separate report will provide the analysis of projected water quality after implementation of the project and recommendations for water-quality management.

Water quality conditions of the Quarry were characterized over a one-year period. To evaluate the environmental behavior of geologic materials, geochemical characterization of both overburden (rock and soil) and ore materials was conducted. Both laboratory and field-scale testing was conducted to evaluate the potential for metal leaching. Mine water quality sampling was also conducted at the North Quarry.

### 6.2 Data Collection

#### 6.2.1 Surface Water and Groundwater Quality Monitoring

As discussed in Sections 3.3.1 and 3.3.2., surface water and groundwater sampling was conducted to characterize current groundwater and surface water quality in the overall project area. Groundwater and surface water monitoring locations are shown in Figure 3.1. Surface water samples were collected from two locations on Permanente Creek (SW-1 and SW-2) and one location on Monte Bello Creek (SW-3). SW-1 is located upstream of the North Quarry; however, this monitoring location is downstream of the West Material Storage Area (WMSA) created during development of the North Quarry and therefore subject to potential influences associated with this operation. SW-2 is located downgradient of the North Quarry sump discharge location.

Groundwater sampling was conducted at five monitoring wells located south of Permanente Creek: HG-4, HG-6, HG-7, HG-9 and HG-10S. Monitoring well details, including observations on sulfide occurrence, are provided in Table 6.1. Four of the five wells are completed within the greenstone or graywacke/greenstone units. Well HG-10S is completed in the limestone unit.

Four rounds of water quality monitoring were conducted: February 2009; April 2009; September/October 2009 and January 2010. Storm water from the North Quarry was being discharged to Permanente Creek during the first three sampling events. During the final sampling event in January 2010, there was no storm water discharge to Permanente Creek.

Climatic conditions affect surface water quality. During dry periods, stream baseflow is maintained by groundwater discharge. During wet periods, streamflow represents a combination of surface runoff and groundwater discharge. Precipitation data for the Los Altos Hills station over the period of water quality monitoring are shown in Figure 6.1. The September 2009 sampling event occurred following an extended dry period. Surface water sampling in January 2010 was conducted on three separate days. Stations

SW-3, SW-1 and SW-2 were sampled on January 14<sup>th</sup>, 19<sup>th</sup>, and 20<sup>th</sup>, respectively. On January 19<sup>th</sup> and 20<sup>th</sup>, greater than 2 inches of precipitation was recorded at the Los Altos Hills station on each day.

### 6.2.2 North Quarry Mine Water Quality Monitoring Data

The following North Quarry samples were collected on January 13, 2010:

- **North Quarry (NQ)** - A water sample collected from the southern portion of the North Quarry. The estimated depth of water in the North Quarry at the time of sampling was approximately 10 feet.
- **Storage Area Runoff (SP)** – A runoff sample collected from the haul road located on the west wall of the North Quarry and downgradient of the WMSA. This water ultimately discharges into the North Quarry.

### 6.2.3 North Quarry Storm Water Monitoring

Storm water monitoring is an operational requirement for the North Quarry. Considerable rainfall (more than 0.5 inches) is required to generate runoff at the Quarry (URS, 2008). The storm water monitoring program includes collection of a number of samples along Permanente Creek, both upstream and adjacent to the North Quarry. Storm water monitoring locations are shown in Figure 6.2. Creek monitoring locations are identified by “CR” in the name. Descriptions for selected monitoring stations are listed in Table 6.2. The background Permanente Creek storm water monitoring station (SL-BG-CR) is located approximately 1,400 feet upstream of SW-1. Station SL-14-CR is located approximately 270 feet downstream of SW-2.

Storm water monitoring samples are analyzed for pH, temperature and conductivity in the field. Laboratory analysis includes total suspended solids (TSS), oil and grease, chemical oxygen demand, pH and conductivity. An estimate of stream flow rate (assumed to be a visual estimation reported in cubic feet/sec) is also recorded. Data from two monitored storm events in 2006 (January 18, 2006 and February 27, 2006) are presented in this report.

### 6.2.4 Published Data - Regional Water Quality Data Compilation

Additional water quality data for Permanente Creek were obtained from the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB, 2007). Between 2000 and 2003, watershed monitoring was conducted in nine watersheds, including the Stevens Creek/Permanente Creek watershed, over a range of climatic conditions. The goals of this monitoring included documentation of ambient water quality conditions in potentially clean and impacted areas and identification of specific water quality problems preventing the realization of beneficial uses of water in targeted watersheds. Watershed data were compared with water quality thresholds for assigned beneficial uses and analyzed for spatial and temporal trends and linkages with land use (SFBRWQCB, 2007).

As part of this study, station PER070 (location shown in Figure 6.3) was sampled in June 2002, April 2002 and January 2003. PER070 is located about one mile downstream of the Permanente Facility on

Permanente Creek. Sample collection was intended to be representative of the following climatic conditions:

- Dry – June 2002
- Spring – April 2002
- Wet – January 2003

Sampling did not occur during storm events. Samples were collected in well-mixed stream sections by uncapping, filling and recapping the container just below the water surface. Samples collected for dissolved metals analyses were collected into a clean syringe and syringe-filtered into the sample container. Sample analysis included organics, total and dissolved organic carbon (TOC and DOC), total and dissolved metals, nutrients and conventional parameters (SFBRWQCB, 2007).

### 6.2.5 Geochemical Laboratory Testing

The Quarry stratigraphy consists of alternating series of limestone and metabasalt (greenstone) units separated by low-angle faults. These units are overlain by continentally-derived graywackes, shales, and argillites (Foruria, 2004).

Geologic conditions were characterized by Geocon Consultants, Inc. (Geocon) for the purposes of geochemical testing of representative geologic rock units. Geocon's evaluation of both the surficial and subsurface geologic conditions included the following: a literature review; geologic reconnaissance of the North Quarry; review of boring logs and core sample photographs for 48 borings; review of select core samples from 13 of the 48 borings; and, outcrop reconnaissance. Geocon described following major rock types (Geocon Consultants, Inc., 2009a):

- **Graywacke:** Generally medium to dark grey quartzose graywacke comprising grains of quartz, chert, feldspar, and feldspathic lithic fragments. Crystalline calcite appears to be present as secondary fillings.
- **Limestone and Dolomitic Limestone:** Very light grey to medium dark grey with common white to very light grey veining. The limestone has a fine crystalline texture. Geocon's report (2009) made no mention of the occurrence of sulfides within the limestone; however, weathered faces and the faces of open fractures were described as grayish yellow to pale yellowish orange. Foruria (2004) noted that the "*black limestones, deposited in an anoxic environment, often possess trace amounts of diagenetic pyrite, locally ranging up to 2%. Pyrite also occurs in trace amounts within the light grey micritic limestone units.*"
- **Fault Breccia –** Highly fractured and sheared rock that includes a mixture of the following identifiable lithologies: graywacke, limestone, dolomitic limestone, greenstone, metabasalt and chert.
- **Greenstone –** Generally dark greenish grey to dusky yellow green chloritic meta-basalt.
- **Metabasalt –** Generally medium to dark grey fine crystalline rock. Dominant minerals include feldspars, hornblende and quartz.

- **Chert** – White to very light grey to grayish pink very fine crystalline rock. The chert is typically interbedded with or occurs as inclusions in the limestone and dolomitic limestone.

For the purposes of overburden characterization, Geocon noted that the metabasalt and greenstone could be combined into a single rock type and that the chert could be combined with the limestone (Geocon Consultants, Inc., 2009).

Geocon prepared six composite rock samples, representative of each of the six major rock types listed above, for geochemical characterization (Geocon Consultants, Inc., 2009b). The number of samples collected for each composite sample was based on the observed variability within a rock type (i.e., more samples were collected for the rock types with the most variability) (Table 6.3). An overburden soil sample was also submitted for analysis (sample ID CS-01).

Geochemical analysis included the following (Table 6.4):

- Acid base accounting
- Elemental analysis
- Static leach testing

Samples were submitted to a California-certified laboratory for analysis.

The California modified Waste Extraction Test (WET) was used to characterize the metal leaching potential of the rock and soil samples. The WET test is a 48-hour leach test conducted on a crushed rock sample (minus 2 mm) using a 10 to 1 liquid to solid ratio. The test lixiviant was deionized water. For non-acid generating material, defined as having a ratio of neutralization potential (NP) to acid generation potential (AGP) of greater than 3:1, deionized water may be used in place of the standard sodium citrate lixiviant.

### 6.2.6 Geochemical Field Testing – Pit Wall Washing

To evaluate metal leaching potential under field scale conditions, wall washing was performed on exposed faces within the North Quarry (Figure 6.4). At six sampling locations, field scale leach tests (wall washing) were conducted following the standard procedure outlined in *Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia* (Price, 1997). Sample location selection targeted the major rock types and a range of weathering conditions (i.e., fresh faces versus faces following an extended period of exposure). Sample locations are listed in Table 6.5 (site photographs of sample locations shown in Figures 6.5 to 6.10).

The test involves washing an approximately one-meter square area of rock face with a known volume of water. The wall washing rinsate is collected and submitted for chemical analysis. Metal leaching rates are calculated on an area basis by multiplying the leachate concentration (mg/L) by the wash volume (L). At each location, between three and five liters of water was applied to an area of 0.6 to 0.8 m<sup>2</sup>. Due to

loss of water to the wall face (adsorption), approximately 1.5 liters of rinsate was collected at each site. Samples were submitted for laboratory analysis. Samples for dissolved metals analysis were filtered (0.45  $\mu\text{m}$  filter) upon receipt by the laboratory. Field measurement of pH, electrical conductivity, temperature, dissolved oxygen and oxidation reduction potential (ORP) was conducted.

Wall washing was performed on November 24, 2009. Four days prior to testing, 0.2 inches of rainfall was recorded in the area (Los Altos Hills precipitation record for November 20, 2009). This event was too small to generate sufficient runoff for collection of water samples. Prior to the November 20, 2009 rainfall event, the area had experienced a five-week period without rainfall (Figure 6.1). The most recent prior event recorded 3.9 inches in this area on October 13, 2009 (Los Altos Hills precipitation records). The results of the wall washing tests are therefore representative of conditions that reflect approximately a one-month period of weathering.

### **6.2.7 Quality Assurance/Quality Control Program**

The QA/QC program for sample collection included the following: (1) collection and analysis of field duplicate water samples; (2) collection and analysis of equipment blank and field blank samples; and, (3) calculation of charge balance errors. Components of the QA/QC program are described in Appendix E.

## **6.3 Monitoring Results**

### **6.3.1 Water Quality Monitoring**

A complete summary of water quality results is presented in Appendix D (Table D-1). For comparison, this table includes the following water quality criteria:

- Basin Plan Water Quality Criteria (California Regional Water Quality Control Board San Francisco Bay Region, 2007)
- Environmental Protection Agency (EPA) Region 9 drinking water maximum contaminant levels (MCLs) (EPA Region IX, 2007)

Water quality results for selected parameters are shown in Figures 6.11 to 6.17. A Piper plot of surface water and groundwater quality results from the first three rounds of monitoring is shown in Figure 6.18. Compositional diagrams, such as Piper plots, facilitate the identification of water types. Piper plots present the relative concentrations of major cations (calcium, magnesium and sodium) and anions (chloride, sulfate and bicarbonate) in milliequivalents per liter (meq/L).

#### **6.3.1.1 Groundwater Quality**

Groundwater quality results for selected parameters are presented in Table 6.6 (see Table D-1 for comprehensive results). Major ion chemistry at most groundwater wells (i.e., HG-6, HG-7, HG-9 and HG-10S) is similar and classified as Ca-Mg-HCO<sub>3</sub> or Mg-Ca-HCO<sub>3</sub> type (Figure 6.18). The pH values for samples from these four wells ranged from 7.3 to 8.5 s.u. Total dissolved solids (TDS) concentrations ranged from 340 to 550 mg/L (Figure 6.11).

Groundwater quality at well HG-4 is distinct from the other wells. This well consistently reported the highest groundwater pH values, ranging from 8.0 to 8.6 (Figure 6.11). Unlike the other groundwater wells, sodium and sulfate are the dominant cation and anion at this well, respectively. The TDS concentration at this well, which ranged from 880 to 1,500 mg/L, was elevated relative to the other groundwater wells (Figure 6.11). Groundwater quality at this well exhibited greater temporal variability than the other wells. For example, between February 2009 and January 2010, chloride concentrations decreased by a factor of two (from 51 to 25 mg/L) (Figure 6.12).

Groundwater quality at HG-4 may be indicative of older groundwater at this location relative to the other wells. The observed differences in groundwater quality may also be attributed to contamination from drilling fluids or grout that was remnant in the well. The latter would explain the elevated pH and decline in TDS and chloride over time.

Groundwater quality results for selected parameters are summarized below:

- **Dissolved Metals** - The following dissolved metals were consistently below detectable limits in groundwater samples, or when detected, were present at low concentrations ( $\leq 1$   $\mu\text{g/L}$ ): antimony (Sb), beryllium (Be), cadmium (Cd), lead (Pb), mercury (Hg), silver (Ag) and thallium (Tl). With the exception of well HG-10S, dissolved arsenic was detected in all groundwater samples, ranging from less than a microgram per liter ( $< 1$   $\mu\text{g/L}$ ) to nine micrograms per liter (9  $\mu\text{g/L}$ ) (Figure 6.13). Dissolved molybdenum, nickel and zinc groundwater concentrations ranged from less than a microgram per liter ( $< 1$   $\mu\text{g/L}$ ) to tens of micrograms per liter (10s  $\mu\text{g/L}$ ) (Figures 6.14 and 6.15). Maximum dissolved molybdenum (45  $\mu\text{g/L}$ ) and nickel (24  $\mu\text{g/L}$ ) were both measured at well HG-4. With the exception of HG-4, dissolved selenium concentrations were less than a microgram per liter ( $< 1$   $\mu\text{g/L}$ ). HG-4 selenium concentrations ranged from less than a microgram per liter to 4  $\mu\text{g/L}$ .
- **Dissolved Iron and Manganese** – Dissolved manganese concentrations in groundwater samples ranged from less than a microgram per liter to 0.3 mg/L. Well HG-7 reported the highest dissolved manganese concentrations (up to 0.33 mg/L) (Figure 6.14). Peak dissolved iron concentrations were also measured at this well (up to 0.33 mg/L) (Figure 6.15).
- **Nutrients** – Nutrient concentrations in groundwater samples were generally low. Ammonia and phosphorus concentrations ranged from below detectable limits to 0.3 mg/L-N and 0.6 mg/L, respectively. With the exception of well HG-9, nitrate concentrations were below 0.1 mg/L-N. Nitrate concentrations at HG-9 range from 0.7 to 1.3 mg/L-N (Figure 6.12).

#### 6.3.1.2 Surface Water Quality

Surface water quality results for selected parameters are presented in Table 6.6 (see Table D-1 for comprehensive results). The major ion chemical signature of the Monte Bello Creek (SW-3) surface water sample is similar to groundwater (i.e., Ca-Mg-HCO<sub>3</sub>). For the Permanente Creek samples (SW-1 and SW-2), similar to SW-3, calcium is the dominant cation; however, sulfate is the dominant anion (Figure 6.18). Between SW-1 and SW-2, the concentration of calcium, relative to magnesium, increases.

The pHs of all surface water samples ranged from 7.1 to 8.4 (Figure 6.11). The TDS concentration of Monte Bello Creek was relatively stable, ranging from 340 mg/L to 360 mg/L during the four sampling events. TDS concentrations were higher in Permanente Creek, ranging from 350 to 1,800 mg/L. Monitoring stations SW-1 and SW-2 reported a significant decline in TDS in January 2010. During the monitoring period, TDS at the upstream Permanente Creek monitoring location (SW-1) exhibited greater variability than TDS at the downstream monitoring location (SW-2) (Figure 6.11). The observed TDS concentration trends are primarily attributed to sulfate (Figure 6.12). Sulfate concentrations at SW-1 ranged from 110 to 1,100 mg/L. Sulfate concentrations at SW-2 were relatively stable during the first three monitoring events, ranging from 550 to 600 mg/L. In January 2010, sulfate at SW-2 declined to 160 mg/L. Sulfate concentrations in Monte Bello Creek remained below 30 mg/L.

Surface water quality results for selected parameters are summarized below:

- **Dissolved Metals** - The following dissolved metals were consistently below detectable limits in surface water samples, or when detected, were present at low concentrations ( $\leq 2 \mu\text{g/L}$ ): Be, Cd, chromium (Cr), Pb, Hg, Ag and Tl. Dissolved arsenic (As) and antimony (Sb) concentrations were also below detectable limits or low ( $\leq 1 \mu\text{g/L}$ ) at SW-1 and SW-3. These constituents were detected at part per billion levels (up to  $6 \mu\text{g/L}$ ) at SW-2 (Figure 6.13). For both constituents, peak concentrations were measured at SW-2 in February 2009 and the lowest concentrations were measured in January 2010. Dissolved selenium (Se), nickel (Ni), molybdenum (Mo), manganese (Mn) and vanadium (V) concentrations are lower at SW-1 and SW-3 than SW-2 (Figures 6.13 to 6.15). Dissolved manganese concentrations are lower in surface water than groundwater (maximum measured concentration of  $4 \mu\text{g/L}$  at SW-2).
- **Permanente Creek Dissolved Metal Trends** - The following metals (dissolved phase) consistently demonstrate an increasing trend between SW-1 and SW-2: Sb, As, Mn, Hg, Mo, Ni, Se, and V.
- **Nutrients** – Nitrate concentrations are low in Monte Bello Creek ( $<0.1 \text{ mg/L-N}$ ). Nitrate concentrations at SW-1 ranged from 0.8 to 5.6 mg/L. Nitrate concentrations typically decreased between SW-1 and SW-2 (Figure 6.12). Ammonia ( $<0.2 \text{ mg/L-N}$ ) and phosphorus ( $<0.6 \text{ mg/L}$ ) concentrations were low in all surface water samples.

### 6.3.2 North Quarry Mine Water Quality Monitoring Data

Water quality results for the North Quarry and WMSA runoff are presented in Appendix D (Table D-1). Water quality results for selected parameters are shown in Figures 6.11 to 6.17.

Inflows to the North Quarry include direct precipitation, groundwater, and surface runoff. Surface runoff to the North Quarry includes both runoff from undisturbed areas and runoff from disturbed areas and mine facilities (e.g., WMSA runoff, runoff that contacts the quarry walls and quarry road runoff). The North Quarry was sampled on January 13, 2010. The Los Altos Hills station recorded 0.24 inches of precipitation on this date and 0.43 inches of precipitation on the previous day. Based on results for a single sampling event during a rainfall event, North Quarry water quality is characterized as follows:

- **Water Type** - The major ion signature of the North Quarry sample was similar to SW-2. Sulfate and calcium were the dominant major ions, reporting concentrations of 550 mg/L

and 210 mg/L, respectively. The pH and TDS of the North Quarry sample were 7.9 and 790 mg/L, respectively.

- **Dissolved Metals** – The following metals were below detectable limits in the North Quarry sample: Al, Be, Cr, Fe, Pb and Ag. Many metals reported concentrations similar to those measured at SW-2 during the first three sampling events. Metals that were detected in the North Quarry sample include: Sb (8.2 µg/L); As (4.5 µg/L); Cu (1.5 µg/L); Mn (21 µg/L); Hg (0.01 µg/L); Mo (540 µg/L); Ni (160 µg/L); Se (82 µg/L) and V (400 µg/L).
- **Nutrients** - The nitrate concentration of the North Quarry sample was 0.7 mg/L-N. Total phosphorus and ammonia concentrations were below detectable limits.

The WMSA runoff sample, also collected on January 13, 2010, provides water quality data on one of the inflows to the North Quarry (although the sampling location is subject to contact with the mined face of the North Quarry's west wall). The TDS of this sample (900 mg/L) was slightly higher than the TDS of the North Quarry sample. The sulfate concentration (550 mg/L) was equivalent to the North Quarry sample. The runoff sample reported 7.6 mg/L-N. The trace metals detected in the North Quarry sample were also typically present in the runoff sample. Metal concentrations in the runoff sample were typically lower than those measured in the North Quarry sample.

### 6.3.3 North Quarry Storm Water Monitoring

Permanente Creek storm water monitoring data from 2006 are shown in Figures 6.19 and 6.20. The storm water monitoring program includes measurement of conductivity in both the field and the laboratory. Data from the two storm events indicate a general increasing trend in Permanente Creek conductivity from upstream to downstream across the Quarry. Permanente Creek conductivity (lab measured) increases from approximately 400 µS/cm (SL-BG-CR) to approximately 900 µS/cm (SL-14-CR). The data indicate an increase in conductivity within the reach of Permanente Creek adjacent to the WMSA. The January 2006 field conductivity data also suggest an increase in conductivity along the reach of Permanente Creek adjacent to the North Quarry.

### 6.3.4 Regional Water Quality Data Compilation

San Francisco Bay Regional Water Quality Control Board data for Station PER070 are provided in Appendix D (Table D-2) (SFBRWQCB, 2007). Results for selected constituents are presented in Table 6.7.

Water quality results for PER070 show temporal variability. Dissolved selenium concentrations ranged from approximately 6 to 19 µg/L, with the wet season sample reporting the highest concentration.

Seasonal water quality trends for PER070 were different than the other monitored watersheds. The SFBRWQCB report noted that *"In general, ambient concentrations of contaminants were highest during the dry season, which may be due to dilution during wet weather."* (SFBRWQCB, 2007). For site PER070, specific conductance and TDS were highest during the wet sampling event. Many metals (i.e., Cd, Ni, Zn, Cr, Hg and Se) reported the highest concentrations in the wet season sample. Sulfate and

nitrate concentrations were also highest in the wet season sample. The wet season pH value (7.5) was slightly lower than the other two sampling events (~8.2).

### **6.3.5 Geochemical Laboratory Testing**

#### **6.3.5.1 Acid Generation Potential**

Acid base accounting (ABA) analysis is performed to assess the acid rock drainage (ARD) potential of a material (Table 6.4). ABA analysis results are presented in Table 6.8. Based on the ABA analysis results, all samples are classified as having no acid generation potential (Price, 2009). The paste pH values of all rock samples were alkaline, ranging from 8.0 to 8.6. The overburden soil sample yielded a paste pH value of 7.3. Neutralization potential (NP) values ranged from 62 to 867 kg CaCO<sub>3</sub>/t for the rock samples. The metabasalt sample reported a higher NP than the limestone sample (644 kg CaCO<sub>3</sub>/t). The overburden soil sample yielded the lowest NP value of 23 kg CaCO<sub>3</sub>/t.

The sulfide contents of the rock samples ranged from below detectable limits (<0.01 wt. %) for the greenstone and metabasalt samples to 0.92 wt. % for the fault breccia sample. The sulfide concentration of the graywacke, limestone and chert samples were similar (approximately 0.10 wt. %). Acid potential, calculated from sulfide sulfur for the rock samples, ranged from <0.3 to 29 kg CaCO<sub>3</sub>/t. The total sulfur content of the overburden soil sample was low (0.01 wt. %). Sulfur speciation was not performed on this sample.

A common approach for assigning an ARD potential to a material, using ABA results, is to apply the neutralization potential ratio (NPR = NP/AP where AP is acid potential). The actual threshold value for a particular solid is material specific and depends on many factors. An NPR value greater than two (2) is an accepted guideline for a determination of “no ARD potential” (Price, 2009). California has adopted a threshold NPR guideline value of three (3) for a determination of low ARD potential (RWQCB, 2008). All samples reported NPR values of three or greater and are therefore classified as having no ARD potential.

#### **6.3.5.2 Sulfide Occurrence – Sample Representativeness**

One composite limestone sample was submitted for ABA analysis. To evaluate if this sample is representative of typical sulfide occurrence, the ABA analysis result was compared to additional sulfide data.

The limestone sample, which reported a sulfide content of 0.10 wt. %, appears to be representative of average conditions. Sulfide data for 850 ore samples obtained from exploratory drilling conducted south of Permanente Creek are shown in Figure 6.21. Sulfide concentrations range from below detectable limits to 4.7 wt. %, with an average concentration of 0.09 wt. %. Samples with sulfide concentrations greater than 1 wt. % are generally restricted to depths of approximately 400 to 700 feet below ground surface (bgs). The borehole logs suggest that pyrite may not be visually identifiable, even when present at concentrations greater than 1 wt. %. For example, the sample that reported the highest sulfide

concentration of 4.7 wt. % was collected from borehole Geo 4-31A-08 between 534 and 547 feet. The borehole log did not identify pyrite across this interval (borehole descriptions provided below):

- **FAULT BRECCIA:** 534.0 - 540.8 feet; medium light gray; matrix supported; dolomitic limestone.
- **DOLOMITIC LIMESTONE:** 540.8 - 558.0 feet; medium light gray; finely- to medium-crystalline; scattered milky calcite; **no visible pyrite**; weak reaction to 10% HCl; scattered clasts of greenstone; poor recovery, core broken.

Borehole log geologic descriptions for the intervals corresponding to geochemical sample selection are presented in Table 6.9. With the exception of the chert sample, pyrite is present in association with all rock types. Although sulfide was below detectable limits in the greenstone and graywacke samples, the geologic logs indicate that pyrite is present in these units. The apparent discrepancy between the geologic logs and the sulfide analysis results is likely attributed to sample heterogeneity and the size of the sample used for sulfide analysis (i.e., a few grams). Many of the logs describe pyrite occurrence as “scattered”. Therefore, a single sample cannot adequately represent the range of sulfur conditions throughout the geologic unit.

References to pyrite in the geologic logs are summarized in Table 6.10. With the exception of chert, pyrite occurs in association with all rock types. Pyrite is observed near surface (i.e., at depths of less than 50 feet in a number of borehole logs) and at depth. Pyrite occurrence is most often described as “scattered”. In boreholes GEO 4-24A-08 (173 to 197 feet bgs) and GEO 4-28A-08 (281.3 to 289.8 feet bgs), pyrite cubes up to approximately 5 mm across were observed in the fault breccia and metabasalt, respectively. Framboidal pyrite was observed in borehole GEO 4-26A-08 (680.1 to 698.0 feet) at the limestone/fault breccia contact.

#### 6.3.5.3 Elemental Concentration and Metal Leaching Potential

Elemental analysis (CAM 17 TTLC) results are presented in Table 6.11. The trace-metal content of each rock type was evaluated to identify potential metals of concern, although an elevated concentration of a particular element does not necessarily imply that this element will be mobilized in concentrations that may lead to environmental impacts. The antimony, arsenic, selenium and nickel concentrations of the rock samples are elevated in comparison to average crustal abundance concentrations (Figure 6.22). Nickel, chromium and antimony concentrations are elevated in the greenstone in comparison to the other rock types (Figure 6.23). Arsenic and selenium occur at similar concentrations in most rock types.

WET test leach test results are also shown in Table 6.11. The results of leach tests tend to be sensitive to the methodology used (e.g., solid to solution ratio, nature of the lixiviant, grain size reduction). Therefore, although leach tests provide an estimation of which metals are most likely to leach from a particular material, leachate metal concentrations will exhibit variability related to the specific test methodology used and may not be representative of field scale conditions. Actual surface water runoff and seepage quality will be affected by site-specific conditions (e.g. climate, hydrology and degree of

exposure). Therefore, although the WET test results provide an indication of potential constituents of concern, they may not be indicative of future site concentrations. Static leach test methods (e.g., the WET test) do not simulate kinetic processes, such as sulfide oxidation, that can enhance metal leaching.

The WET test leachate pHs ranged from 7.6 to 8.4. Leach test results are therefore representative of metal leaching under moderately alkaline conditions. Constituents that are typically mobile under neutral to alkaline pH conditions were detected in the leachates (e.g., Sb, As, Mo and Ni). Leachate antimony, arsenic and nickel concentrations ranged from microgram per liter levels ( $\mu\text{g/L}$ ) to almost  $10 \mu\text{g/L}$  (Table 6.11 and Figure 6.24). Antimony and arsenic leachate concentrations did not demonstrate a positive correlation with solid phase concentration. For these constituents, leachate concentrations generally declined as solid phase concentration increased (Figure 6.24). Molybdenum leachate concentrations ranged from a few micrograms per liter to tens of micrograms per liter. Nickel and molybdenum leaching generally increased as solid phase concentration increased (Figure 6.24). The greenstone sample reported the highest leachate nickel concentration. Selenium was only detected in the limestone sample leachate ( $6 \mu\text{g/L}$ ). Mercury was only detected in the limestone and overburden soil sample leachates ( $0.21 \mu\text{g/L}$  and  $0.19 \mu\text{g/L}$ , respectively). Leachate sulfate concentrations ranged from 1.3 to 29 mg/L. Figures 6.26 through 6.32 compare the results of site water quality sampling (i.e., groundwater, surface water, mine water) with laboratory and field scale leach test results for selected constituents.

### **6.3.6 Geochemical Field Testing – Pit Wall Washing**

Wall washing results are presented in Table 6.12. The wall washing samples were turbid and often colored (Figure 6.25). Leachate total suspended solids (TSS) concentrations ranged from 530 mg/L to 68,000 mg/L. Total dissolved solids concentrations ranged from 61 to 110 mg/L.

Leachate field measured pH values ranged from 6.9 to 9.0. Wall washing test results are therefore representative of metal leaching under circum-neutral to moderately alkaline conditions. Dissolved antimony (up to  $0.6 \mu\text{g/L}$ ) and selenium (up to  $49 \mu\text{g/L}$ ) were detected in all limestone leachate samples. These constituents were below detectable limits in the graywacke, chert and greenstone leachate samples. Total recoverable selenium concentrations in the limestone leachates ranged from 60 to 230  $\mu\text{g/L}$ . Using the TSS data for these three samples, the solid phase selenium concentration is calculated to range from approximately 2 mg/kg to 430 mg/kg (high grade limestone sample). Dissolved nickel ( $0.9$  to  $10 \mu\text{g/L}$ ) and molybdenum ( $0.4$  to  $98 \mu\text{g/L}$ ) were detected in all leachates. Similar to selenium, the high grade limestone sample reported the highest dissolved nickel and molybdenum concentrations.

Dissolved arsenic was detected in all leachates, at concentrations ranging from  $12 \mu\text{g/L}$  to  $33 \mu\text{g/L}$ . Dissolved arsenic concentrations in the limestone leachates were relatively consistent at approximately  $20 \mu\text{g/L}$ . Dissolved aluminum ( $0.06$  to  $1.8 \text{ mg/L}$ ), iron ( $0.01$  to  $1.4 \text{ mg/L}$ ) and manganese ( $1.2$  to  $19 \mu\text{g/L}$ ) were present in all wall washing leachates.

Sulfate concentrations in the limestone leachates (15 to 100 mg/L) were elevated relative to sulfate concentrations in the graywacke, chert and greenstone leachates (3 to 5 mg/L). The high grade limestone sample reported the highest sulfate concentration (100 mg/L).

Leachate nitrate concentrations ranged from 0.3 to 12 mg/L-N. The three locations that reported nitrate concentrations greater than 1 mg/L were sites that have been exposed for one year or less. The two oldest sites (exposed for greater than 5 years), reported low nitrate concentrations (0.3 mg/L-N). Ammonia concentrations were less than 0.2 mg/L in four of the six samples. The chert (CT-01) and greenstone (GS-01) leachates reported ammonia concentrations of 0.8 and 4.9 mg/L-N, respectively. Both these locations have been exposed for less than one month. The Quarry uses ammonium nitrate /fuel oil (ANFO) as a blasting agent. Leaching of blasting residuals is a likely source of nitrate and ammonia in wall wash leachates.

#### **6.3.7 Quality Assurance/Quality Control**

Results of the QA/QC program are presented in Appendix E. Results of this analysis indicated that the data are of acceptable quality for their intended purpose.

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## TABLES

**TABLE 4.3**  
**Summary of Hydraulic Properties from Packer Testing**

Point ID	Top (ft bgs)	Bottom (ft bgs)	Interval Length (ft)	Lithology	Test Interval Transmissivity (ft <sup>2</sup> /d)	Transmissivity (ft <sup>2</sup> /d)	Hydraulic Conductivity (ft/d)	Hydraulic Conductivity (ft/d)
HG-2	505.35	554	48.65	Limestone	32.6	121.7	0.7	0.67
	463.9	492.6	28.7	Limestone	15.6			0.54
	421.9	450.6	28.7	Limestone	1.6			0.06
	379.9	408.6	28.7	Graywacke	71.9			2.51
HG-3	400	453	53	Greenstone	128.1	312.1	2.0	2.42
	358.9	387.6	28.7	Greenstone	3.4			0.12
	295.89	324.56	28.67	Limestone	180.6			6.30
HG-4	274	296.6	22.6	Greenstone		7.6	0.09	<0.2
	211.89	240.56	28.67	Greenstone	7.6			0.27
HG-5	337.9	366.5	28.6	Greenstone	6.1	9.4	0.08	0.21
	253.9	283.6	29.7	Greenstone	3.3			0.11
HG-8	149	178	29	Greenstone	9.4	103.8	1.1	0.33
	86	115	29	Greenstone	94.4			3.26
HG-9	66	94	28	Weathered Graywacke	834.7	834.7	29.8	29.81

**TABLE 4.4**  
**Summary of Hydraulic Properties from Constant-Rate Pumping Test**

Point ID	Radius from Center of Pumping Well (feet)	Transmissivity (feet <sup>2</sup> /day)	Storativity (dimensionless)	Hydraulic Conductivity* (feet/day)	Analytical Solution
HG-10S	0.1	2392	---	6.0	Cooper-Jacob Straight Line (Drawdown)
	0.1	2584	---	6.5	Cooper-Jacob Straight Line (Recovery)
	0.1	2224	---	5.6	Theis Partial Penetration (AQTESOLV)
HG-10INT	7.0	1,847	0.887	4.6	Cooper-Jacob Straight Line (Drawdown)
GT4-25A	625	2,074	0.0010	5.2	Cooper-Jacob Straight Line (Drawdown)
	625	2224	0.0026	5.6	Theis Partial Penetration (AQTESOLV)
GT3-4	850	2,059	0.0028	5.1	Cooper-Jacob Straight Line (Drawdown)
	850	2224	0.0093	5.6	Theis Partial Penetration (AQTESOLV)

Note:

\* Hydraulic conductivity based on aquifer thickness of 400 feet from AQTESOLV analysis

**TABLE 4.5**  
**Los Altos Hills Station (LSA)**

Precipitation in INCHES													
WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
1999	0.61	3.98	1.04	4.56	5.65	3.11	0.7	0.02	0.16	0	0	0.19	20.02
2000	0.23	2.26	0.32	6.84	10.54	1.99	1.26	0.54	0.18	0	0.01	0.06	24.23
2001	3.71	0.76	0.28	5.17	7	2.01	0.73	0	0	0	0	0.12	19.78
2002	0.21	9.15	6.7	1.24	1.59	1.84	0.43	0.85	0	0	0	0	22.01
2003	0	3.83	9.84	0.55	2.75	1.28	5.49	0.58	0	0	0	0	24.32
2004	0.05	2.28	6.33	2.29	5.83	0.53	0.03	0.08	0	0	0	0	17.42
2005	2.55	1.14	6.96	4.88	4	3.24	2	1.26	0.32	0	0	0.05	26.4
2006	0.09	0.41	4.48	3.65	2.51	7.77	4.18	0.59	0	0.03	0	0	23.71
2009	0.55	2.43	2.27	1.12	10.4	4.32	0.28	0.25	0.04	0	0.1	0.12	21.88
<b>Average</b>	<b>0.89</b>	<b>2.92</b>	<b>4.25</b>	<b>3.37</b>	<b>5.59</b>	<b>2.90</b>	<b>1.68</b>	<b>0.46</b>	<b>0.08</b>	<b>0.00</b>	<b>0.01</b>	<b>0.06</b>	<b>22.20</b>

**TABLE 4.6**  
**Water Year 2009 Annual Water Balance Summary**

		<b>Permanente Creek</b>		<b>Monte Bello Creek</b>	
	<b>Units</b>	<b>MS-1</b>	<b>MS-2</b>	<b>MS-3</b>	<b>MS-4</b>
Drainage Area	sq ft	28,845,896	74,349,225	18,243,154	29,957,284
Precipitation	inches	21.9	21.9	21.9	21.9
Evapotranspiration	inches	13.8	15.0	8.5	13.1
Runoff	inches	4.2	1.6	11.6	7.0
Baseflow	inches	3.9	5.2	1.8	1.8
Total Streamflow*	inches	8.1	6.8	13.4	8.8
Annual Average Runoff	cfs	0.32	0.32	0.56	0.55
	gpm	143	144	251	247
Annual Average Baseflow	cfs	0.30	1.02	0.08	0.14
	gpm	133	459	38	64
Annual Average Total Streamflow	cfs	0.62	1.34	0.64	0.69
	gpm	276	603	289	312

Note:

\* Total streamflow is the sum of runoff and baseflow.

**TABLE 4.7**  
**North Quarry Water Balance 2009**

North Quarry	Units	February	March	April	May	June	July	August	September	October	Total
Precipitation	cu ft	120,782	97,727	6,815	6,085	894	0	0	215	33,867	266,384
	acre-ft	2.8	2.2	0.2	0.1	0.0	0.0	0.0	0.0	0.8	6.1
	gpm (ave)	39.2	16.4	1.2	1.0	0.2	0.0	0.0	0.1	8.8	6.5
Evaporation	cu ft	24,632	78,143	99,301	109,417	109,702	68,139	5,640	18,151	18,077	531,201
	acre-ft	0.6	1.8	2.3	2.5	2.5	1.6	0.1	0.4	0.4	12.2
	gpm (ave)	8.0	13.1	17.2	18.3	19.0	11.4	5.9	5.0	4.7	13.0
Surface Runoff	cu ft	3,831,638	1,787,546	115,859	103,446	16,551	0	0	12,414	1,862,027	7,729,481
	acre-ft	88.0	41.0	2.7	2.4	0.4	0.0	0.0	0.3	42.7	177.4
	gpm (ave)	1,244	300	20	17	3	0	0	3	484	189
Groundwater Inflow	cu ft	3,997,430	5,983,579	4,983,218	5,670,036	4,095,389	3,374,523	686,736	863,506	2,251,850	31,906,266
	acre-ft	91.8	137.4	114.4	130.2	94.0	77.5	15.8	19.8	51.7	732.5
	gpm (ave)	1,298	1,003	863	950	709	566	714	236	585	778

Notes:

gpm is the average flow rate in gallons per minute.

February includes 16 days data; August includes 5 days of data; September includes 19 days of data; and October includes 20 days of data.

**TABLE 5.6 (pg 1 of 4)**  
**Summary of Inflows in North Quarry**

Month	Precipitation (gpm)	Surface Runoff (gpm)	Groundwater Inflow (gpm)	Total Pit Inflow (gpm)
1/1/2023	8	5	371	384
2/1/2023	18	8	352	378
3/1/2023	11	4	337	351
4/1/2023	7	2	323	333
5/1/2023	3	1	315	319
6/1/2023	1	0	310	311
7/1/2023	0	0	302	302
8/1/2023	0	0	297	297
9/1/2023	0	0	292	292
10/1/2023	7	1	286	295
11/1/2023	25	4	281	310
12/1/2023	38	6	276	319
1/1/2024	31	4	270	306
2/1/2024	60	7	268	335
3/1/2024	36	4	263	302
4/1/2024	21	2	260	283
5/1/2024	6	1	257	264
6/1/2024	1	0	255	256
7/1/2024	0	0	249	249
8/1/2024	0	0	247	247
9/1/2024	1	0	244	245
10/1/2024	12	1	241	255
11/1/2024	41	4	239	283
12/1/2024	60	5	236	301
1/1/2025	48	4	233	286
2/1/2025	81	7	231	318
3/1/2025	42	4	228	274
4/1/2025	25	2	226	252
5/1/2025	7	1	223	230
6/1/2025	1	0	220	221
7/1/2025	0	0	218	218
8/1/2025	0	0	215	215
9/1/2025	1	0	215	216
10/1/2025	16	1	212	229
11/1/2025	53	4	210	266
12/1/2025	78	5	210	292
1/1/2026	63	4	207	274
2/1/2026	105	7	204	316
3/1/2026	55	3	202	260
4/1/2026	32	2	199	233
5/1/2026	9	1	199	209
6/1/2026	2	0	196	198
7/1/2026	0	0	194	194
8/1/2026	0	0	194	194
9/1/2026	1	0	191	192
10/1/2026	18	1	191	210
11/1/2026	60	3	188	252
12/1/2026	87	5	188	281
1/1/2027	71	4	186	261
2/1/2027	120	7	183	310
3/1/2027	64	3	181	248
4/1/2027	37	2	181	219
5/1/2027	10	1	178	189
6/1/2027	2	0	178	180
7/1/2027	0	0	175	175

**TABLE 5.6 (pg 2 of 4)**  
**Summary of Inflows in North Quarry**

Month	Precipitation (gpm)	Surface Runoff (gpm)	Groundwater Inflow (gpm)	Total Pit Inflow (gpm)
8/1/2027	0	0	175	176
9/1/2027	1	0	173	174
10/1/2027	20	1	173	194
11/1/2027	67	3	170	240
12/1/2027	97	5	170	272
1/1/2028	78	4	167	249
2/1/2028	130	6	167	303
3/1/2028	68	3	165	236
4/1/2028	41	2	162	205
5/1/2028	11	1	162	174
6/1/2028	2	0	162	164
7/1/2028	0	0	159	159
8/1/2028	0	0	159	160
9/1/2028	2	0	159	161
10/1/2028	23	1	157	181
11/1/2028	76	3	157	236
12/1/2028	112	5	154	271
1/1/2029	89	4	154	247
2/1/2029	149	6	151	307
3/1/2029	78	3	151	232
4/1/2029	45	2	149	196
5/1/2029	13	1	149	162
6/1/2029	2	0	146	148
7/1/2029	0	0	146	146
8/1/2029	0	0	146	146
9/1/2029	2	0	146	148
10/1/2029	25	1	143	169
11/1/2029	81	3	143	228
12/1/2029	120	5	141	265
1/1/2030	95	4	141	239
2/1/2030	159	6	138	304
3/1/2030	83	3	138	224
4/1/2030	50	2	136	187
5/1/2030	14	1	136	150
6/1/2030	2	0	136	138
7/1/2030	0	0	136	136
8/1/2030	0	0	133	133
9/1/2030	2	0	133	135
10/1/2030	28	1	133	161
11/1/2030	90	3	133	226
12/1/2030	134	5	130	269
1/1/2031	106	4	130	240
2/1/2031	179	6	128	313
3/1/2031	93	3	128	224
4/1/2031	55	2	125	181
5/1/2031	15	0	125	141
6/1/2031	3	0	125	128
7/1/2031	0	0	125	125
8/1/2031	0	0	122	123
9/1/2031	2	0	122	124
10/1/2031	29	1	122	153
11/1/2031	97	3	122	222
12/1/2031	143	4	120	267
1/1/2032	113	4	120	236
2/1/2032	188	6	120	313

**TABLE 5.6 (pg 3 of 4)**  
**Summary of Inflows in North Quarry**

Month	Precipitation (gpm)	Surface Runoff (gpm)	Groundwater Inflow (gpm)	Total Pit Inflow (gpm)
3/1/2032	99	3	117	219
4/1/2032	57	2	117	176
5/1/2032	16	0	114	131
6/1/2032	3	0	114	117
7/1/2032	0	0	114	115
8/1/2032	0	0	114	115
9/1/2032	2	0	114	117
10/1/2032	31	1	112	144
11/1/2032	103	3	112	218
12/1/2032	150	4	112	266
1/1/2033	119	3	112	234
2/1/2033	205	6	109	320
3/1/2033	107	3	109	219
4/1/2033	64	2	106	172
5/1/2033	18	0	106	125
6/1/2033	3	0	106	110
7/1/2033	0	0	106	107
8/1/2033	0	0	106	107
9/1/2033	2	0	104	106
10/1/2033	35	1	104	139
11/1/2033	114	3	104	220
12/1/2033	166	4	104	274
1/1/2034	134	3	101	239
2/1/2034	223	6	101	329
3/1/2034	116	3	101	220
4/1/2034	68	2	99	168
5/1/2034	19	0	99	118
6/1/2034	3	0	99	102
7/1/2034	0	0	99	99
8/1/2034	0	0	99	99
9/1/2034	2	0	99	101
10/1/2034	37	1	96	133
11/1/2034	120	3	96	219
12/1/2034	175	4	96	275
1/1/2035	139	3	96	238
2/1/2035	234	5	93	332
3/1/2035	121	3	93	217
4/1/2035	70	2	93	165
5/1/2035	20	0	91	111
6/1/2035	3	0	91	94
7/1/2035	0	0	91	91
8/1/2035	1	0	91	91
9/1/2035	3	0	91	93
10/1/2035	38	1	91	129
11/1/2035	124	3	91	217
12/1/2035	184	4	88	276
1/1/2036	146	3	88	237
2/1/2036	242	5	88	335
3/1/2036	128	3	85	216
4/1/2036	74	2	85	161
5/1/2036	20	0	85	106
6/1/2036	3	0	85	89
7/1/2036	0	0	83	83
8/1/2036	1	0	83	83
9/1/2036	3	0	83	85

**TABLE 5.6 (pg 4 of 4)**  
**Summary of Inflows in North Quarry**

Month	Precipitation (gpm)	Surface Runoff (gpm)	Groundwater Inflow (gpm)	Total Pit Inflow (gpm)
10/1/2036	40	1	83	124
11/1/2036	133	3	83	218
12/1/2036	193	4	83	280
1/1/2037	158	3	80	241
2/1/2037	263	5	80	348
3/1/2037	136	3	80	219
4/1/2037	79	2	80	160
5/1/2037	22	0	80	102
6/1/2037	4	0	80	84
7/1/2037	0	0	80	80
8/1/2037	1	0	80	81
9/1/2037	3	0	80	83
10/1/2037	42	1	80	123
11/1/2037	137	3	80	220
12/1/2037	200	4	80	284
1/1/2038	158	3	80	241
2/1/2038	263	5	80	348
3/1/2038	136	3	80	219
4/1/2038	79	2	80	160
5/1/2038	22	0	80	102
6/1/2038	4	0	80	84
7/1/2038	0	0	80	80
8/1/2038	1	0	80	81
9/1/2038	3	0	80	83
<b>10/1/2038</b>	<b>42</b>	<b>1</b>	<b>80</b>	<b>123</b>
<b>11/1/2038</b>	<b>137</b>	<b>3</b>	<b>80</b>	<b>220</b>
<b>12/1/2038</b>	<b>200</b>	<b>4</b>	<b>80</b>	<b>284</b>
<b>1/1/2039</b>	<b>158</b>	<b>3</b>	<b>80</b>	<b>241</b>
<b>2/1/2039</b>	<b>263</b>	<b>5</b>	<b>80</b>	<b>348</b>
<b>3/1/2039</b>	<b>136</b>	<b>3</b>	<b>80</b>	<b>219</b>
<b>4/1/2039</b>	<b>79</b>	<b>2</b>	<b>80</b>	<b>160</b>
<b>5/1/2039</b>	<b>22</b>	<b>0</b>	<b>80</b>	<b>102</b>
<b>6/1/2039</b>	<b>4</b>	<b>0</b>	<b>80</b>	<b>84</b>
<b>7/1/2039</b>	<b>0</b>	<b>0</b>	<b>80</b>	<b>80</b>
<b>8/1/2039</b>	<b>1</b>	<b>0</b>	<b>80</b>	<b>81</b>
<b>9/1/2039</b>	<b>3</b>	<b>0</b>	<b>80</b>	<b>83</b>

Annual Average Total Steady-State Inflow to North Quarry:

169 gpm

**TABLE 6.1**  
**Groundwater Wells Completion Details and Sulfide Occurrence**

<b>Well</b>	<b>Ground Elevation (ft amsl)</b>	<b>Screen Interval (ft bgs)</b>	<b>Screen Interval (ft amsl)</b>	<b>Screen Interval Geologic Unit</b>	<b>Groundwater Elevation (ft amsl)</b>	<b>Sulfide Occurrence</b>
HG-4	1,857	275 - 295	1,562 - 1,582	Greenstone	1,600	scattered pyrite (50 - 80 ft bgs)
HG-6	1,822	253 - 273	1,549 - 1,569	Greenstone	not noted on log	not noted on log
HG-7	1,254	116 - 136	116 - 136	Greenstone /Graywacke	1,174	not noted on log
HG-9	1,245	89 - 109	1,136 - 1,156	Weathered Graywacke	1,140	(some) scattered pyrite (20 to 200 ft bgs)
HG-10S	1,585	134 - 154	1,431 - 1,451	Limestone	1,495	not noted on log

**TABLE 6.2**  
**Permanente Creek Stormwater Monitoring Locations**

<b>Station Name</b>	<b>Description</b>
SL-BG-CR	Background - Upstream Permanente Creek
SL-1-CR	Adjacent to West Material Stockpile Area (WMSA)
SL-4-CR	Downstream of WMSA before concrete footing
SL-5-CR	Upstream of Ore Feeder and the Primary Crusher
SL-5A-CR	Downstream of Ponds 4A & 4B
SL-11-CR	Inlet to Pond 13

**TABLE 6.3**  
**Overburden (Waste Rock) and Ore Composite Samples**

Sample ID		Sample Number	Boring Number	Approximate Sample Depth (feet)	General Rock Type
Composite 5	Metabasalt	4-20A-08-49	4-20A-08	49	Metabasalt
		4-23B-08-322	4-23B-08	322	Metabasalt
		GT1-4-08-80	GT1-4-08	80	Metabasalt
		4-20A-08-343	4-20A-08	343	Metabasalt
		4-20A-08-348	4-20A-08	348	Metabasalt
		4-24A-08-76	4-24A-08	76	Metabasalt
Composite 3	Fault Breccia	GT1-2-08-224	GT1-2-08	224	Undifferentiated Fault Breccia
		4-20A-08-345	4-20A-08	345	Undifferentiated Fault Breccia
		4-28A-08-115	4-28A-08	115	Undifferentiated Fault Breccia
Composite 4	Greenstone	4-27A-08-153	4-27A-08	153	Greenstone
		4-24A-08-74	4-24A-08	74	Greenstone
		4-20A-08-429	4-20A-08	429	Greenstone
Composite 1	Graywacke	4-23B-08-245	4-23B-08	245	Graywacke
		4-20A-08-94	4-20A-08	94	Graywacke
Composite 2	Limestone and Dolomitic Limestone	4-20A-08-437	4-20A-08	437	Limestone
		4-27B-08-420	4-27B-08	420	Limestone
		4-34A-08-153	4-34A-08	153	Limestone
		GT3-4-08-353	GT3-4-08	353	Limestone
GT1-2-08-213	Chert	GT1-2-08-213	GT1-2-08	213	Chert

Source: Geocon Consultants, Inc.

**TABLE 6.4**  
**Summary of Geochemical Analyses**

<b>Analysis</b>	<b>Method</b>	<b>Analytes</b>
Acid Base Accounting	EPA 600/2-78-054	paste pH sulfur speciation - total, sulfate, pyritic and non-extractable neutralization potential (NP)
Static Leach Test	Modified WET Test (STLC)	metals - Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Mn, Mo, Ni, Se, Ag, Tl, V, Zn major ions - Ca, Mg, K, Na, Cl, SO <sub>4</sub> pH alkalinity electrical conductivity
Elemental Analysis	Total Concentrations (TTLC)	metals - Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Mo, Ni, Se, Ag, Tl, V, Zn

**TABLE 6.5**  
**Wall Washing Sampling Locations**

<b>Sample ID</b>	<b>Lithology</b>	<b>Approximate Exposure Time - Age of Face</b>	<b>Location</b>	<b>Water Applied (L)</b>	<b>Water Collected (L)</b>	<b>Sample Area (m<sup>2</sup>)</b>
GW-01	<b>GRAYWACKE</b> - light brown, highly weathered, fine-grained, no sulfides visible	> 5 years	access road by office	3.5	1.7	0.69
CT-01	<b>CHERT</b> - reddish brown, some greenstone present, gouge zone, no sulfides visible	< 1 month fresh face	southwest corner of bench 900	3.0	1.5	0.79
GS-01	<b>GREENSTONE</b> - dark greenish gray, very soft, slickensides evident, gouge zone, no sulfides visible	< 1 month fresh face	southwest corner of bench 900	5.0	1.5	0.80
MG-01	<b>LIMESTONE</b> - medium to high grade, light to dark gray, some oxidation present, no sulfides visible	2 months	south wall, bench 900	4.1	1.5	0.77
HG-01	<b>LIMESTONE</b> - high grade, dark gray, interlayered with chert (gray), no sulfides visible, no evidence of oxidation	> 5 years	east wall, bench 850	3.5	1.5	0.76
HMG-01	<b>LIMESTONE</b> - light to dark gray, mixture of high and medium/low grade, oxidation present and silt/dust covering	1 year	south Wall, bench 950	3.7	1.5	0.69
FB-01	Equipment blank collected in field of spray bottle	-	-	-	-	-

**TABLE 6.6**  
**Groundwater and Surface Water Quality Data Summary - Select Parameters**

Monitor Location	No. of Sampling Events	Water Type	pH	Average Concentrations <sup>(a)</sup>							
				TDS	SO <sub>4</sub>	NO <sub>3</sub>	As (D)	Mn (D)	Mo (D)	Ni (D)	Se (D)
		Fall 2009	(s.u.)	(mg/L)	(mg/L)	(mg/L-N)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
Groundwater											
HG-4	4	Na-SO <sub>4</sub> -HCO <sub>3</sub>	8.0 - 8.6	1,220	605	<0.1	6	85	38	9	1.4
HG-6	4	Mg-Ca-HCO <sub>3</sub>	7.9 - 8.0	470	13	<0.1	1	45	3	1	<0.4
HG-7	3	Mg-Ca-HCO <sub>3</sub>	7.3 - 7.4	537	30	<0.1	3	323	1	3	<0.4
HG-9	4	Ca-Mg-HCO <sub>3</sub>	7.4 - 8.0	470	36	0.9	1	7	3	2	0.6
HG-10S	2	Ca-Mg-HCO <sub>3</sub>	7.5 - 8.5	370	30	<0.1	<0.5	43	11	6	1.6
Surface Water											
SW-1	4	Ca-Mg-SO <sub>4</sub>	7.1 - 8.1	1,110	578	3.6	0.7	0.9	4	3	7
SW-2	4	Ca-Mg-SO <sub>4</sub> -HCO <sub>3</sub>	7.5 - 8.3	903	468	1.2	2.6	3	441	63	62
SW-3	4	Ca-Mg-HCO <sub>3</sub>	8.2 - 8.4	353	23	<0.1	<0.7	0.6	10	1	0.4

<sup>(a)</sup> Average concentrations presented. Non-detect concentrations assumed equal to the detection limit in calculation of average.

(D) - dissolved phase

**TABLE 6.7**  
**Summary of Selected PER070 Water Quality Results**

Date	Season	TDS	pH	SO <sub>4</sub>	NO <sub>3</sub>	Se (D)	Ni (D)
		(mg/L)	(s.u.)	(mg/L)	(mg/L-N)	(µg/L)	(µg/L)
Jun-02	Dry	720	8.2	336	-	5.8	1.6
Apr-02	Spring	724	8.3	326	1.5	5.1	7.9
Jan-03	Wet	850	7.5	379	2.1	18.8	30.9

Source: SFBRWQCB, 2007

**TABLE 6.8**  
**Acid Base Accounting Results**

Parameter	Unit	Sample Identification						
		CS-01	Composite # 1	Composite # 2	GT1-2-08-213	Composite # 3	Composite # 4	Composite # 5
		Overburden Soil	Graywacke	Limestone and Dolomitic Limestone	Chert	Fault Breccia	Greenstone	Metabasalt
Paste pH	s.u.	7.34	8.00	8.39	8.17	8.14	8.63	8.55
Sulfur - Total	wt. %	0.01	0.32	0.18	0.51	1.41	0.02	0.12
Sulfur - Sulfate	wt. %	-	0.08	<0.01	0.35	0.07	0.01	0.01
Sulfur - Sulfide	wt. %	-	0.12	0.10	0.07	0.92	<0.01	<0.01
Sulfur - Non-Extractable	wt. %	-	0.12	0.13	0.07	0.42	0.01	0.17
Neutralization Potential (NP)	kg CaCO <sub>3</sub> /t	23	62	644	94	112	205	867
Acid Potential (AP)	kg CaCO <sub>3</sub> /t	<0.3	3.8	3.1	2.2	29	<0.3	<0.3
NNP (NP - AP)	kg CaCO <sub>3</sub> /t	23	58	641	92	83	205	867
NPR (NP/AP)	-	>77	17	206	43	4	>656	>2,774

**TABLE 6.9**  
**Overburden (Waste Rock) and Ore Composite Samples - Drill Log Descriptions**

Sample ID		Sample Number	Boring Number	Approximate Sample Depth (Feet)	General Rock Type	Drill Log Description	Total S (%)	Sulfide S (%)
Composite 5	Metabasalt	4-20A-08-49	4-20A-08	49	Metabasalt	METABASALT: 35.6-55.0 feet; medium dark gray to dark gray to greenish gray; very fine-grained; scattered layers of greenstone up to 0.5 feet thick, abundant milky quartz veins with some calcite; core is highly fractured; some poorly-developed slickensides.	0.12	<0.01
		4-23B-08-322	4-23B-08	322	Metabasalt	METABASALT: 257.5-384.0 feet; medium dark gray to dark gray to greenish gray; bands of greenstone to 1.0 feet thick; bands of vesicular metabasalt with milky calcite-filled vesicles up to 2.0 feet thick; abundant milky calcite; <b>scattered pyrite</b> ; some poorly-developed slickensides; scattered bands of brownish gray limestone to 0.3 feet thick; bands of soft fault gouge up to 3.0 feet thick; some heavily sheared bands up to 3.0 feet thick; a few scattered bands of iron-rich metabasalt to 0.4 feet thick.		
		GT1-4-08-80	GT1-4-08	80	Metabasalt	METABASALT: 71.2-127.4 feet; medium dark gray to dark gray with thin bands of grayish green greenstone; very fine-grained; abundant calcite veins and calcite filled vugs (vesicles?); numerous zones of fault breccia up to 1.0 foot thick - fault breccia consists of soft, clayey, very fine-grained fault gouge with clasts of metabasalt and some greenstone up to 2.0 inches across; some white to light gray chert.		
		4-20A-08-343	4-20A-08	343	Metabasalt	FAULT BRECCIA: 325.4-345.6 feet; brownish gray to reddish brown to greenish gray; generally matrix supported with clasts up to 2.0 feet of hematite-rich metabasalt and greenstone; some well-developed slickensides; numerous milky calcite veins; <b>some pyrite</b> .		
		4-20A-08-348	4-20A-08	348	Metabasalt	METABASALT: 345.6-354.4 feet; medium dark gray to dark gray; highly sheared; thin bands of fault gouge up to 0.3 feet thick; some sheared greenstone.		
		4-24A-08-76	4-24A-08	76	Metabasalt	METABASALT: 75.1-88.6 feet; medium dark gray to pale reddish brown; reddish brown intervals are hematite-rich metabasalt; abundant milky calcite veins; thin (up to 4 inches) bands of fault gouge; some slickensides, <b>trace pyrite</b> .		
Composite 3	Fault Breccia	GT1-2-08-224	GT1-2-08	224	Undifferentiated Fault Breccia	FAULT BRECCIA: 221.4-225.8 feet; dark gray with grayish yellow greenstone.	1.41	0.92
		4-20A-08-345	4-20A-08	345	Undifferentiated Fault Breccia	FAULT BRECCIA: 325.4-345.6 feet; brownish gray to reddish brown to greenish gray; generally matrix supported with clasts up to 2.0 feet of hematite-rich metabasalt and greenstone; some well-developed slickensides; numerous milky calcite veins; <b>some pyrite</b> .		
		4-28A-08-115	4-28A-08	115	Undifferentiated Fault Breccia	FAULT BRECCIA: 101.0-136.8 feet; medium gray to medium dark gray; matrix supported, matrix composed of soft, clayey, very fine-grained fault gouge with clasts up to 1.0 inches across of metabasalt, greenstone, and some greywacke.		
Composite 4	Greenstone	4-27A-08-153	4-27A-08	153	Greenstone	FAULT BRECCIA: 146.2-199.0 feet; medium dark gray to dark gray; matrix supported, matrix composed of soft, clayey fault gouge, clasts up to 1.0 inches across of metabasalt, some hematite-rich metabasalt, and some greenstone; some clasts of milky calcite.	0.02	<0.01
		4-24A-08-74	4-24A-08	74	Greenstone	FAULT BRECCIA: 30.0-75.1 feet; dark yellowish orange to pale yellowish brown to medium gray to moderate greenish yellow; matrix supported, matrix composed of soft, clayey fault gouge with clasts up to 4 inches across of metabasalt, graywacke and greenstone with greenstone dominate from 73.4-75.1 feet; some very scattered milky calcite veins; some poorly- to well-developed slickensides; <b>trace amounts of pyrite</b> .		
		4-20A-08-429	4-20A-08	429	Greenstone	GREENSTONE: 414.0-433.6 feet; greenish gray; highly fractured; numerous milky calcite veins; highly fractured; bands of fault gouge up to 1.0 feet thick; well-developed slickensides; <b>some pyrite</b> ; highly fractured.		
Composite 1	Graywacke	4-23B-08-245	4-23B-08	245	Graywacke	GRAYWACKE: 216.3-250.8 feet; medium gray to medium dark gray; very fine-grained; greenstone and metabasalt rock fragments to 2.0 mm; <b>scattered pyrite</b> ; some milky calcite; a few bands of brownish gray limestone to 1.0 feet thick; a few poorly developed slickensides; core broken below 244.0 feet.	0.32	0.12
		4-20A-08-94	4-20A-08	94	Graywacke	GRAYWACKE: 79.0-104.0 feet; medium dark gray to dark gray with thin bands of greenish gray greenstone to 0.4 feet thick; numerous well developed slickensides coated with graphite; some milky calcite with minor quartz veining; highly fractured and sheared; core very broken; many fractures coated with moderate yellowish brown clay.		
Composite 2	Limestone and Dolomitic Limestone	4-20A-08-437	4-20A-08	437	Limestone	LIMESTONE: 433.6-443.2 feet; medium gray; micritic; some forams and microfossils; scattered black chert, chert content estimated at 1-3%; calcite veins, a few slickensides.	0.18	0.10
		4-27B-08-420	4-27B-08	420	Limestone	LIMESTONE: 406.1-466.9 feet; light gray to medium gray; micritic; numerous stylolites; numerous thin bands of black limestone; a few forams and other microfossils; <b>no visible pyrite</b> ; very scattered milky calcite; scattered black chert nodules, chert content estimated at 3-5%; a few thin (<6 inches) bands of fault gouge; a few brecciated bands; strong reaction to 10% HCl.		
		4-34A-08-153	4-34A-08	153	Limestone	LIMESTONE: 153.7-174.2 feet; light gray; micritic; very abundant stylolites; some forams; <b>no visible pyrite</b> ; bands of soft, clayey fault gouge to 0.3 feet thick; some thin fractures lined with light gray clay; some milky calcite veining; some dark gray to black chert nodules, chert content estimated at 5-8%; strong reaction to 10% HCl.		
		GT3-4-08-353	GT3-4-08	353	Limestone	LIMESTONE: 340.1-355.9 feet; brecciated and broken.		
GT1-2-08-213	Chert	GT1-2-08-213	GT1-2-08	213	Chert	CHERT: 212.8-221.4 feet; white, brecciated; some dolomitic limestone and medium gray chert clasts.	0.51	0.07

**TABLE 6.10**  
**Geologic Logs - Summary of Pyrite Occurrence**

Log	Pyrite Occurrence in Log Notes
GEO 2-1A-08	None
GEO 2-4A-07	None
GEO 2-4AA-07	None
GEO 2-6A-07	None
GEO 2-6B-07	None
GEO 2-10A-08	None
GEO 4-16A-08	LIMESTONE (256.0-361.7 feet) - scattered pyrite in fractures
GEO 4-18A-08	LIMESTONE (457.0 - 494.2 feet) - very scattered pyrite
GEO 4-20A-08	None
GEO 4-22A-08	METABASALT (281.6 - 303.0 feet) - some scattered pyrite FAULT BRECCIA (303.0 - 325.4 feet) - some scattered pyrite FAULT BRECCIA (325.4 - 345.6 feet) - some pyrite METABASALT (364.0 - 376.0 feet) - some pyrite GREENSTONE (414.0 - 433.6) - some pyrite
GEO 4-23A-08	GREENSTONE (142.9 - 198.2 feet) - scattered pyrite FAULT BRECCIA (50.0-105.5 feet) - scattered pyrite METABASALT (105.5-116.2 feet) - scattered pyrite FAULT BRECCIA (116.2-163.9 feet) - scattered pyrite METABASALT (163.9-184.5 feet) - scattered pyrite FAULT BRECCIA (184.5-198.4 feet) - scattered pyrite METABASALT (198.4-238.4) - scattered pyrite FAULT BRECCIA (238.4-263.7 feet) - scattered pyrite METABASALT (263.7-285.6 feet) - scattered pyrite FAULT BRECCIA (296.4-317.5 feet) - scattered pyrite METABASALT (317.5-323.4 feet) - scattered pyrite METABASALT (330.1-342.2 feet) - scattered pyrite METABASALT (353.5-384.5 feet) - scattered pyrite FAULT BRECCIA (384.5-393.4 feet) - scattered pyrite METABASALT (393.4-479.3 feet) - scattered pyrite
GEO 4-23B-08	FAULT BRECCIA (479.3-496.0) - scattered pyrite FAULT BRECCIA (77.0-119.0 feet) - scattered pyrite GRAYWACKE (119.0-140.0 feet) - scattered pyrite FAULT BRECCIA (140.0-146.8 feet) - scattered pyrite GREENSTONE ( 146.8-216.3 feet) - scattered pyrite GRAYWACKE (216.3-250.8 feet) - scattered pyrite METABASALT (257.5-384.0 feet) - scattered pyrite FAULT BRECCIA (384.0-392.1 feet) - scattered pyrite GRAYWACKE (392.1-432.2 feet) - scattered pyrite GRAYWACKE (440.3-499.0 feet) - scattered pyrite.
GEO 4-24A-08	FAULT BRECCIA (30.0-75.1) - trace amounts of pyrite METABASALT (75.1-88.6 feet) - trace pyrite FAULT BRECCIA (92.3-115.3 feet) - scattered pyrite METABASALT (115.3-137.4 feet) - some pyrite FAULT BRECCIA (137.4-151.7 feet) - scattered pyrite METABASALT (151.7-172.9 feet) - some scattered pyrite FAULT BRECCIA (172.9-197.2 feet) - scattered pyrite cubes to 5 mm across METABASALT (197.2-304.0 feet) - scattered pyrite METABASALT (312.0-320.2 feet) - scattered milky calcite veining and pyrite FAULT BRECCIA (320.0-362.2 feet) - scattered pyrite METABASALT (362.2-397.9 feet) - scattered pyrite FAULT BRECCIA (397.9-406.6 feet) - scattered pyrite FAULT BRECCIA (412.8-468.1 feet) - scattered pyrite FAULT BRECCIA (468.1-481.7 feet) - scattered pyrite GREENSTONE (486.7-500.2 feet) - scattered pyrite.

	FAULT BRECCIA (148.3-177.8 feet) - some pyrite GREENSTONE (177.8-186.8 feet) - some pyrite FAULT BRECCIA (186.8-214.4 feet) - some pyrite METABASALT (214.4-269.0 feet) - some pyrite FAULT BRECCIA (269.0-288.2 feet) - scattered pyrite FAULT BRECCIA (288.2-308.7 feet) - scattered pyrite FAULT BRECCIA (315.3-340.4 feet) - scattered pyrite METABASALT (340.4-352.3 feet) - scattered pyrite METABASALT (360.7-387.0 feet) - scattered pyrite METABASALT (393.2-418.8 feet) - scattered pyrite METABASALT (418.8-434.1 feet) - some pyrite GREENSTONE (434.1-459.8 feet) - scattered pyrite GREENSTONE (459.8-468.6 feet) - some pyrite
GEO 4-26A-08	FAULT BRECCIA (680.1-698.0 feet) - framboidal pyrite at limestone/fault breccia contact, scattered pyrite elsewhere.
GEO 4-27A-08	METABASALT: 232.8-248.0 feet - trace pyrite FAULT BRECCIA: 248.0-308.9 feet - scattered pyrite
GEO 4-27B-08	FAULT BRECCIA: 84.0-155.3 feet - scattered pyrite METABASALT: 167.4-191.6 feet - scattered pyrite GRAYWACKE: 195.0-230.0 feet - scattered pyrite FAULT BRECCIA: 230.0-261.5 feet - scattered pyrite METABASALT: 261.5-306.5 feet - scattered pyrite METABASALT: 316.0-329.6 feet - scattered pyrite FAULT BRECCIA: 349.8-368.0 feet - scattered pyrite METABASALT: 368.0-406.1 - scattered pyrite
GEO 4-28A-08	METABASALT: 281.3-289.8 feet - some pyrite cubes to 1/4 inch
GEO 4-31A-08	GREENSTONE: 20.0-159.0 feet - scattered FAULT BRECCIA: 159.0-175.0 feet - scattered GREENSTONE: 175.0-199.6 feet - scattered FAULT BRECCIA: 199.6-246.7 feet - scattered GREENSTONE: 256.2-268.0 feet - scattered FAULT BRECCIA: 558.0-593.5 feet - some scattered
GEO 4-31B-08	METABASALT: 36.0-120.0 feet - scattered pyrite FAULT BRECCIA: 120.0-174.4 feet - scattered pyrite GREENSTONE: 174.4-183.1 feet - scattered pyrite FAULT BRECCIA: 183.1-222.0 feet - scattered pyrite GREENSTONE: 222.0-266.4 feet - scattered pyrite FAULT BRECCIA: 266.4-284.2 feet - scattered pyrite GREENSTONE: 284.2-293.1 feet - scattered pyrite FAULT BRECCIA: 293.1-338.6 feet - scattered pyrite GREENSTONE: 338.6-350.0 feet - scattered pyrite
GEO 4-34A-08	WEATHERED FAULT BRECCIA: 14.0-39.4 feet - some oxidized pyrite FAULT BRECCIA: 80.0-111.0 feet - scattered pyrite METABASALT: 111.0-133.4 feet - some scattered pyrite FAULT BRECCIA: 133.4-153.7 feet - scattered pyrite
GEO 4-35A-08	WEATHERED METABASALT: 19.0-62.0 feet - scattered pyrite and oxidized pyrite FAULT BRECCIA: 62.0-172.2 feet - scattered pyrite GREENSTONE: 172.2-247.0 feet - scattered pyrite METABASALT: 247.0-286.6 feet - scattered pyrite FAULT BRECCIA: 286.6-463.0 feet - scattered pyrite
GEO 4-38A-08	FAULT BRECCIA: 40.0-119.8 feet - scattered pyrite GRAYWACKE: 119.8-224.0 feet - scattered pyrite FAULT BRECCIA: 224.0-241.5 feet - scattered pyrite GRAYWACKE: 241.5-338.5 feet - scattered pyrite GRAYWACKE: 343.8-444.7 feet - scattered pyrite GRAYWACKE: 456.0-535.3 feet - scattered pyrite FAULT BRECCIA: 535.3-543.8 feet - scattered pyrite GRAYWACKE: 543.8-581.0 feet - scattered pyrite FAULT BRECCIA: 581.0-651.0 feet - some scattered pyrite

	GRAYWACKE: 80.0-91.0 feet - scattered pyrite METABASALT: 155.7-186.5 feet - scattered pyrite FAULT BRECCIA: 186.5-210.9 feet - scattered pyrite GRAYWACKE: 210.9-394.4 feet - scattered pyrite METABASALT: 394.4-424.0 feet - scattered pyrite FAULT BRECCIA: 424.0-440.6 feet - scattered pyrite GRAYWACKE: 440.6-554.4 feet - scattered pyrite FAULT BRECCIA: 554.4-619.0 feet - scattered pyrite
GEO 4-38B-08	
GEO 4-40A-08	None
GEO 4-41B-08	FAULT BRECCIA: 50.0-86.0 feet - scattered pyrite FAULT BRECCIA: 534.8-572.0 feet - scattered pyrite
GT 1-1-08	None
GT 1-2-08	None
GT 1-3-08	None
GT 1-4-08	None
GT 2-1A-08	FAULT BRECCIA: 112.5-123.0 feet - scattered pyrite GRAYWACKE: 129.0-146.8 feet - some scattered pyrite FAULT BRECCIA: 146.8-207.0 feet - scattered pyrite METABASALT: 223.6-235.6 feet - scattered pyrite FAULT BRECCIA: 235.6-269.0 feet - scattered pyrite FAULT BRECCIA: 273.3-348.5 feet - scattered pyrite
GT 2-7-07	None
GT 3-2A-08	None
GT 3-3A-08	None
GT 3-3B-08	DOLOMITIC LIMESTONE: 357.6-367.8 feet - scattered METABASALT: 375.4-427.0 feet some pyrite filled fractures GRAYWACKE: 435.4-449.0 feet - abundant pyrite GRAYWACKE: 456.0-463.0 feet - pyrite GREENSTONE: 520.8-527.2 feet - some pyrite LIMESTONE: 534.0-549.0 feet - some scattered pyrite
GT 3-4-08	None
GT 3-4A-08	None
GT 4-25A-08	GRAYWACKE: 300.9-310.6 feet - pyrite
GT 4-25B-08	None
GT 4-29A-08	FAULT BRECCIA: 128.5-166.3 feet - scattered pyrite METABASALT: 166.3-217.6 feet - scattered pyrite FAULT BRECCIA: 217.6-252.7 feet - scattered pyrite METABASALT: 252.7-276.4 feet - scattered pyrite FAULT BRECCIA: 276.4-293.0 feet - scattered pyrite METABASALT: 293.0-356.4 feet - scattered pyrite FAULT BRECCIA: 356.4-374.4 feet - scattered pyrite METABASALT: 374.4-421.4 feet - scattered pyrite METABASALT: 425.9-441.4 feet - scattered pyrite METABASALT: 457.7-498.0 feet - scattered pyrite
GT 4-29B-08	WEATHERED GREENSTONE: 116.3-144.5 feet - scattered pyrite WEATHERED GREENSTONE: 151.0-190.4 feet - scattered pyrite GREENSTONE: 195.2-221.4 feet - scattered pyrite FAULT BRECCIA: 221.4-247.6 feet - scattered pyrite FAULT BRECCIA: 247.6-304.5 feet - scattered pyrite GREENSTONE: 304.5-320.5 feet - scattered pyrite FAULT BRECCIA: 320.5-374.5 feet - scattered pyrite GREENSTONE: 374.5-383.9 feet - scattered pyrite METABASALT: 395.8-426.9 feet - scattered pyrite METABASALT: 429.4-500.0 feet - scattered pyrite
GT 4-30A-08	METABASALT: 198.7-286.0 feet - scattered pyrite FAULT BRECCIA: 286.0-363.0 feet - some scattered pyrite METABASALT: 363.0-384.8 feet - scattered pyrite FAULT BRECCIA: 384.8-401.8 feet - scattered pyrite LIMESTONE: 401.8-454.4 feet - some scattered pyrite LIMESTONE: 569.4-593.0 feet - scattered pyrite DOLOMITIC LIMESTONE: 598.7-622.0 feet - scattered pyrite FAULT BRECCIA: 622.0-640.0 feet - scattered pyrite METABASALT: 673.2-713.0 feet - scattered pyrite

GT 4-30B-08	FAULT BRECCIA: 128.3-174.9 feet - some scattered pyrite
	FAULT BRECCIA: 174.9-186.5 feet - scattered pyrite
	FAULT BRECCIA: 186.5-223.0 feet - scattered pyrite
	FAULT BRECCIA: 228.5-299.4 feet - scattered pyrite
	METABASALT: 299.4-337.7 feet - scattered pyrite
	FAULT BRECCIA: 337.5-363.0 feet - scattered pyrite
	METABASALT: 363.0-461.8 feet - scattered pyrite
	FAULT BRECCIA: 461.8-487.0 feet - scattered pyrite
	FAULT BRECCIA: 487.0-526.6 feet - scattered pyrite
	FAULT BRECCIA: 530.9-569.5 feet - scattered pyrite
	METABASALT: 569.5-584.6 feet - scattered pyrite
	FAULT BRECCIA: 584.6-613.0 feet - scattered pyrite
	METABASALT: 613.0-623.0 feet - scattered pyrite
	FAULT BRECCIA: 623.0-639.0 feet - scattered pyrite
	METABASALT: 639.0-683.0 feet - scattered pyrite
GT 4-33A-08	FAULT BRECCIA: 73.0-161.8 feet - scattered pyrite
	GREENSTONE: 161.8-178.8 feet - scattered pyrite
	FAULT BRECCIA: 178.8-253.5 feet - scattered pyrite
	GREENSTONE: 253.5-269.3 feet - scattered pyrite
	FAULT BRECCIA: 269.3-392.5 feet - scattered pyrite
	GREENSTONE: 392.5-495.3 feet - scattered pyrite
	FAULT BRECCIA: 495.3-516.5 feet - scattered pyrite
	FAULT BRECCIA: 559.0-577.0 feet - scattered pyrite
	METABASALT: 577.0-599.4 feet - scattered pyrite
	FAULT BRECCIA: 599.4-614.4 feet - scattered pyrite
GT 4-33B-08	FAULT BRECCIA: 621.8-654.3 feet - scattered pyrite
	METABASALT: 654.4-700.0 feet - scattered pyrite
	FAULT BRECCIA: 95.0-133.0 feet - scattered pyrite
	GREENSTONE: 133.0-138.6 feet - scattered pyrite
	FAULT BRECCIA: 138.6-217.5 feet - scattered pyrite
	GREENSTONE: 217.5-236.8 feet - scattered pyrite
	FAULT BRECCIA: 236.8-260.5 feet - scattered pyrite
	GREENSTONE: 260.5-302.8 feet - scattered pyrite
	FAULT BRECCIA: 302.8-323.2 feet - scattered pyrite
	GREENSTONE: 323.2-435.3 feet - scattered pyrite
HG 2	GRAYWACKE: 360.0-420.0 feet - scattered pyrite
	GRAYWACKE: 360.0-420.0 feet - scattered pyrite
HG 4	GREENSTONE: 50.0-300.0 feet - scattered pyrite
HG 5	GREENSTONE: 30.0-400.0 feet - scattered pyrite
HG 9	WEATHERED GRAYWACKE: 20.0-120.0 feet - some scattered pyrite
	GREENSTONE: 120.0-200.0 feet - scattered pyrite
P2-03-07	None
P2-7-07	None
P2-11-07	LIMESTONE: 161.4-208.6 feet - scattered wide pyrite veins up to 1/2 inch in width, pyrite estimated at <1.0%
P2-11A-07	LIMESTONE: 385.0-542.0 feet - scattered pyrite
P2-11B-07	LIMESTONE: 180.3-304.7 feet - a few scattered grains of pyrite are present but pyrite total is <0.1%
	LIMESTONE: 304.7-366.0 feet - some scattered pyrite, pyrite <0.1% many fractures and joint surfaces coated with grayish orange clay
RH 1-1-08	LIMESTONE: 395.4-625.0 feet - very scattered grains of pyrite, pyrite content <0.1%
	LIMESTONE: 395.4-625.0 feet - very scattered grains of pyrite, pyrite content <0.1%
RH 1-2-08	None

TABLE 6.11  
Overburden and Ore - TTLC and STLC Results

Parameter		Unit	Detection Limit	PQL	CS-01		Composite 1		Composite 2		GT1-2-08-213		Composite 3		Composite 4		Composite 5	
					Top Soil		Graywacke		Limestone and Dolomitic Limestone		Chert		Fault Breccia		Greenstone		Metabasalt	
					Result	Q <sup>(b)</sup>	Result	Q <sup>(b)</sup>	Result	Q <sup>(b)</sup>	Result	Q <sup>(b)</sup>	Result	Q <sup>(b)</sup>	Result	Q <sup>(b)</sup>	Result	Q <sup>(b)</sup>
pH		s.u.	0.05	0.05	7.63	B,H	8.11		8.16		8.27		8.24		8.29		8.36	
Electrical Conductivity (@ 25 °C)		umhos/cm	1	1	140		160		130		190		160		160		130	
Total Alkalinity		mg/L as CaCO <sub>3</sub>	4.1	4.1	70		37		42		49		56		76		46	
Antimony	Sb	mg/L	0.00017	0.002	0.00029	J	0.0072		0.0015	J	0.0032		0.0058		0.00098	J	0.0085	
Aluminum	Al	mg/L	0.038	1	0.1	J	-		-		-		-		-		-	
Arsenic	As	mg/L	0.00052	0.002	<0.00052		0.003		0.0013	J	0.0012	J	0.0062		0.0027		0.0073	
Barium	Ba	mg/L	0.00012	0.001	0.012		0.059		0.22		0.17		0.12		0.037		0.12	
Beryllium	Be	mg/L	0.00018	0.001	<0.00018		<0.00018		<0.00018		<0.00018		<0.00018		<0.00018		<0.00018	
Boron	B	mg/L	0.0097	0.1	0.049	J	-		-		-		-		-		-	
Cadmium	Cd	mg/L	0.00013	0.001	<0.00013		<0.00013		<0.00013		<0.00013		<0.00013		<0.00013		<0.00013	
Calcium	Ca	mg/L	0.016	0.1	17		18		16		14		13		17		11	
Chloride	Cl	mg/L	0.059	0.5	2.3	B	1.6		1.1		1.4		1.3		2		1.3	
Chromium	Cr	mg/L	0.00055	0.003	0.00098	J	<0.00055	B	<0.00055	B	<0.00055	B	<0.00055	B	0.0019	B,J	<0.00055	B
Cobalt	Co	mg/L	0.000033	0.001	0.00012	J	0.00029	J	0.00015	J	0.00025	J	0.00013	J	0.00034	J	0.0001	J
Copper	Cu	mg/L	0.00068	0.002	0.0025		0.0013	J	<0.00068		0.0012	J	<0.00068		<0.00068		<0.00068	
Iron	Fe	mg/L	0.0093	0.5	0.16	J	-		-		-		-		-		-	
Lead	Pb	mg/L	0.000054	0.001	0.000071	J	0.0012		0.00011	J	0.00012	J	<0.000054		<0.000054		0.000092	J
Magnesium	Mg	mg/L	0.029	0.05	5.5		4.3		4.2		14		6.8		8.3		5.4	
Manganese	Mn	mg/L	0.00011/0.0025 <sup>(c)</sup>	0.001/0.1 <sup>(c)</sup>	0.0034	J	0.0052		0.0025		0.0012		0.0075		0.003		0.0031	
Mercury	Hg	mg/L	0.000016	0.01	0.00019	J	<0.000016		0.00021	J	<0.000016		<0.000016		<0.000016		<0.000016	
Molybdenum	Mo	mg/L	0.00013	0.001	0.00085	J	0.011		0.027		0.012		0.0073		0.0023		0.028	
Nickel	Ni	mg/L	0.00015	0.002	0.002		0.0017	J	0.0017	J	0.0032		0.002		0.0081		0.00089	J
Potassium	K	mg/L	0.074	1	5.5		3.7		2.8		2		3.9		0.96	J	4.1	
Selenium	Se	mg/L	0.00038	0.002	<0.00038		<0.00038		0.006		<0.00038		<0.00038		<0.00038		0.00058	J
Silver	Ag	mg/L	0.000065	0.001	<0.000065		<0.000065		<0.000065		<0.000065		<0.000065		<0.000065		<0.000065	
Sodium	Na	mg/L	0.12	0.5	2.6	B	8.8		4		2.7		7.9		5.9		6.6	
Sulfate	SO <sub>4</sub>	mg/L	0.21	1	1.3		22		12		29		16		3		8.8	
Thallium	Tl	mg/L	0.00011	0.001	<0.00011		<0.00011		<0.00011		<0.00011		<0.00011		<0.00011		<0.00011	
Vanadium	V	mg/L	0.0012	0.003	0.0019	J	0.0015	J	<0.0012		<0.0012		0.012		0.018		0.0049	
Zinc	Zn	mg/L	0.0019	0.005	0.0093		0.022		0.0081		0.037		0.011		0.011		0.01	
Dissolved Non-Volatile Organic Carbon		mg/L	0.31	5	8	B	-		-		-		-		-		-	
Antimony	Sb	mg/kg	1.7 <sup>(a)</sup>	5 <sup>(a)</sup>	3.7	J	<1.7		6.5		5.3		4.2	J	<17		<1.7	
Arsenic	As	mg/kg	0.71 <sup>(a)</sup>	1 <sup>(a)</sup>	<0.71		5.1		8.4		5.7		2.4		<7.1		4.8	
Barium	Ba	mg/kg	0.13 <sup>(a)</sup>	0.5 <sup>(a)</sup>	77		60		800		560		180		46		110	
Beryllium	Be	mg/kg	0.026 <sup>(a)</sup>	0.5 <sup>(a)</sup>	0.068	J	0.17	J	0.3	J	0.11	J	<0.026		<0.26		0.032	J
Cadmium	Cd	mg/kg	0.033 <sup>(a)</sup>	0.5 <sup>(a)</sup>	0.12	J	0.071	B,J	0.068	B,J	0.15	B,J	<0.033	B	<0.33	B	<0.033	B
Chromium	Cr	mg/kg	0.045 <sup>(a)</sup>	0.5 <sup>(a)</sup>	120		95		29		6.6		260		400		110	
Cobalt	Co	mg/kg	0.18 <sup>(a)</sup>	2.5 <sup>(a)</sup>	29		20		21		8.4		34		93		26	
Copper	Cu	mg/kg	0.13 <sup>(a)</sup>	1 <sup>(a)</sup>	63		50		56		27		56		45		62	
Lead	Pb	mg/kg	0.59 <sup>(a)</sup>	2.5 <sup>(a)</sup>	3.4		9.7		6.8		2	J	8.3		<5.9		11	
Mercury	Hg	mg/kg	0.014	0.16	0.078	J	0.033	J	0.15	J	<0.014		0.053	J	<0.014		<0.014	
Molybdenum	Mo	mg/kg	0.18 <sup>(a)</sup>	2.5 <sup>(a)</sup>	<0.18		0.22	J	2.3	J	0.74	J	<0.18		<1.8		1	J
Nickel	Ni	mg/kg	0.12 <sup>(a)</sup>	0.5 <sup>(a)</sup>	73	B	120		120		220		250		1200		100	
Selenium	Se	mg/kg	0.76 <sup>(a)</sup>	1 <sup>(a)</sup>	3.3		10		8.5		2.4		15		15		13	
Silver	Ag	mg/kg	0.086 <sup>(a)</sup>	0.5 <sup>(a)</sup>	<0.086		<0.086		0.63		<0.086		0.13	J	<0.86		0.16	J
Thallium	Tl	mg/kg	0.94 <sup>(a)</sup>	5 <sup>(a)</sup>	<0.94		<0.94		<0.94		<0.94		0.97	J	<9.4		<0.94	
Vanadium	V	mg/kg	0.062 <sup>(a)</sup>	0.5 <sup>(a)</sup>	120		64		15		5.9		75		53		70	
Zinc	Zn	mg/kg	0.25 <sup>(a)</sup>	2.5 <sup>(a)</sup>	51	B	250	B	67	B	150	B	75	B	64	B	71	B

Notes:  
PQL - practical quantitation limit  
<sup>(a)</sup> Composite 4 sample detection limit or PQL is 10x higher (raised due to matrix interference).  
<sup>(b)</sup> Laboratory qualifiers: B - constituent detected in method blank  
J - estimated value  
H - holding time exceeded  
<sup>(c)</sup> Higher MDL and PQL for CS-01 sample.

**TABLE 6.12**  
**Wall Washing Results**

		Limestone - High Grade		Graywacke		Limestone - med to high		Chert		Limestone - high and med/low		Greenstone			
		HG-01		GW-01		MG-01		CT-01		HMG-01		GS-01		FB-01	
	Age	11/24/2009	Q	11/24/2009	Q	11/24/2009	Q	11/24/2009	Q	11/24/2009	Q	11/24/2009	Q	11/24/2009	Q
	> 5 years	> 5 years		> 5 years		2 months		< 1 month		1 year		< 1 month			
<b>Field Parameters</b>															
pH	s.u.	7.87		6.94		7.53		7.53		7.32		8.95			
Specific Conductance	µS/cm	137		283		42		78		46		94			
Temperature	°C	16.43		18.6		13.78		17.35		11.91		18.36			
Dissolved Oxygen	mg/L	7.42		6.57		7.95		8.03		16.5		7.4			
ORP		-32.7		70.0		11.4		92.8		25.1		73.7			
<b>Lab Parameters</b>															
Aluminum	µg/L	220		1800		59		1400		220		650		<38	
Antimony	µg/L	0.56	J	0.43	J	<0.17		<0.17		0.18	J	<0.17		<0.17	
Arsenic	µg/L	20		33		21		16		22		12		<0.52	
Hexavalent Chromium	µg/L	0.75	J	<0.70		<0.70		0.9	J	<0.70		<0.70		<0.70	
Barium	µg/L	79		150		83		520		180		660		1.2	
Beryllium	µg/L	<0.18		<0.18		<0.18		<0.18		<0.18		<0.18		<0.18	
Boron	µg/L	19	J	28	J	14	J	52	J	24	J	52	J	<9.7	
Cadmium	µg/L	0.2	J	<0.13		<0.13		<0.13		<0.13		<0.13		<0.13	
Chromium	µg/L	0.81	J	<0.55		<0.55		3.6		<0.55		2.6	J	<0.55	
Copper	µg/L	2.1		2.1		<0.68		<0.68		0.86	J	1.1	J	<0.68	
Iron	µg/L	130		720		11	J	1400		160		970		<9.3	
Lead	µg/L	0.063	J	0.29	J	<0.054		<0.054		0.065	J	<0.054		<0.054	
Manganese	µg/L	19		8.6		2.6		7.9		1.2		11		<0.11	
Molybdenum	µg/L	98		2.6		6.7		1.4		14		0.37	J	<0.13	
Nickel	µg/L	9.9		1.7	J, J+	0.91	J, J+	5.9		4.9		3.5		0.18	J
Selenium	µg/L	49		<0.38		14		<0.38		0.7	J	<0.38		<0.38	
Silicon as SiO <sub>2</sub>	µg/L	1900		10000		810		12000		3700		8000		<65	
Silver	µg/L	<0.065		<0.065		<0.065		<0.065		<0.065		<0.065		<0.065	
Thallium	µg/L	<0.11		0.22	J	<0.11		<0.11		<0.11		<0.11		<0.11	
Vanadium	µg/L	44		2.9	J	<1.2		7.3		6.3		39		<1.2	
Zinc	µg/L	23		7.5	J+	3.6	J, J+	6.6	J+	16	J+	5.8	J+	2	J
Calcium	mg/L	46		7.8		31		17		34		21		0.14	
Magnesium	mg/L	1.7		6.1		2.2		6.6		2.6		3.1		<0.029	
Sodium	mg/L	1.6		4.2		1.2		6.1		2.3		7.3		<0.12	
Potassium	mg/L	0.43	J, J+	1.2		0.21	J, J+	1.8		0.85	J, J+	0.86	J, J+	0.099	J
Total Recoverable Aluminum	µg/L	40000		77000		28000		960000		1800000		990000		<38	
Total Recoverable Antimony	µg/L	7.7	J	<4.0		6.8	J	<4.0		<20		<4.0		<0.20	
Total Recoverable Arsenic	µg/L	88		80		81		<22		290		<22		<1.1	
Total Recoverable Barium	µg/L	7900	B	2800	B	13000	B	12000	B	140000	B	23000	B	0.69	B, J
Total Recoverable Beryllium	µg/L	<4.0		6.7	J	<4.0		36		92	J	30		<0.20	
Total Recoverable Boron	µg/L	36	J	33	J	86	J	160	J	650	J	230		<12	
Total Recoverable Cadmium	µg/L	45		14	J	6.6	J	5.7	J	680		5.1	J	<0.11	
Total Recoverable Chromium	µg/L	490		120		63		7000		4500		7100		<0.64	
Total Recoverable Copper	µg/L	420		160		370		2000		17000		3100		<0.66	

**TABLE 6.12**  
**Wall Washing Results**

		Limestone - High Grade		Graywacke		Limestone - med to high		Chert		Limestone - high and med/low		Greenstone		FB-01	
		HG-01		GW-01		MG-01		CT-01		HMG-01		GS-01		FB-01	
	Age	11/24/2009	Q	11/24/2009	Q	11/24/2009	Q	11/24/2009	Q	11/24/2009	Q	11/24/2009	Q	11/24/2009	Q
		> 5 years		> 5 years		2 months		< 1 month		1 year		< 1 month			
Total Recoverable Iron	µg/L	83000		100000		69000		1100000		2400000		940000		<30	
Total Recoverable Lead	µg/L	25		130		43		27		1300		15	J	<0.19	
Total Recoverable Manganese	µg/L	2000	B	3000	B	7200	B	22000	B	56000	B	44000	B	0.63	B,J
Total Recoverable Mercury	µg/L	<0.016		0.032	J	<0.016		<0.016		0.032	J	<0.016		<0.016	
Total Recoverable Molybdenum	µg/L	320		16	J	23		<4.6		<23		<4.6		<0.23	
Total Recoverable Nickel	µg/L	1300		210		1100		9300		150000		5800		0.84	J
Total Recoverable Selenium	µg/L	230		<11		60		<11		160	J	<11		<0.54	
Total Recoverable Silver	µg/L	5.4	J	2	J	3.4	J	<1.8		<8.8		<1.8		<0.088	
Total Recoverable Thallium	µg/L	4.3	J	<2.2		<2.2		<2.2		57	J	<2.2		<0.11	
Total Recoverable Vanadium	µg/L	960		230		220		<100		2100		<52		<2.6	
Total Recoverable Zinc	µg/L	3300		460		700		2800		390000		2100		4.6	J
Total Recoverable Calcium	mg/L	1000		180		3100		2300		33000		1500		0.18	
Total Recoverable Magnesium	mg/L	67		44		68		1600		1700		1700		<0.038	
Total Recoverable Sodium	mg/L	3.6		4.2		3.9		5.4		8.5	J	5.6		<0.070	
Total Recoverable Potassium	mg/L	4.1		13		4	J	14		64		4.2		<0.092	
Bicarbonate	mg/L	25		50		24		68		41		57		<5.0	
Carbonate	mg/L	<2.5		<2.5		<2.5		<2.5		<2.5		<2.5		<2.5	
Total Alkalinity (as CaCO <sub>3</sub> )	mg/L	20		41		20		56		33		47		<4.1	
Chloride	mg/L	0.95		1.3		0.97		1.3		1.4		0.44	J	<0.059	
Fluoride	mg/L	0.34		1.3		0.46		2.4		0.86		1.2		<0.010	
Nitrate as N	mg/L	0.28		0.31		1.4		0.49		12		6.7		<0.026	
Sulfate	mg/L	100		4.9		61		2.6		15		3.3		<0.21	
Hardness (as CaCO <sub>3</sub> )	mg/L	120		45		86		69		96		64		0.43	J
pH	pH Units	8.06	H	7.89	H	7.95	H	8.16	H	8.09	H	8.24	H	5.81	H
Electrical Conductivity @ 25 C	umhos/cm	259		101		199		135		222		160		2.2	
Total Dissolved Solids @ 180 C	mg/L	110		61		65		67		91		100		<6.7	
Total Suspended Solids (Glass Fiber)	mg/L	540		3400		4800		35000		68000		50000		<4.0	
Turbidity	NT Units	850		1600		2500		28000		44000		23000		0.31	
Residual Chlorine	mg/L	<0.10	H	<0.20	H	<0.10	H	<0.50	H	<0.10	H	<0.50	H	<0.10	H
Ammonia as N	mg/L	0.038	J	0.22		0.025	J	0.84		0.16		4.9		<0.025	
Nitrite as N	mg/L	0.012	J	0.015	J	<0.0081		0.049	J	<0.0081		0.12		<0.0081	
Total Phosphorus	mg/L	4.1		2.2		3.7		91		140		100		<0.016	

## Notes:

Q - Laboratory qualifiers

B - constituent detected in method blank

J - estimated value

H - holding time exceeded

J+ - qualified as biased high due to detection in field blank.

## FIGURES



## REFERENCES

Spatial Reference:  
 NAD 1983 StatePlane California III FIPS 0403 feet Aerial  
 background: <http://services.arcgisonline.com/arcgis/services>  
 1) ESRI\_ShadedRelief\_World\_2D  
 2) 13\_Imagery\_Prime\_World\_2D

### PROJECT

HYDROLOGIC INVESTIGATION  
 PERMANENTE QUARRY RECLAMATION PLAN UPDATE  
 SANTA CLARA COUNTY, CALIFORNIA

### TITLE

**REGIONAL LOCATION MAP**



PROJECT No. 063-7109			FILE No.	
DESIGN	DLM	1/28/2010	SCALE: AS SHOWN	REV. 0
GIS	DLM	1/28/2010	<b>FIGURE 1.1</b>	
CHECK	GW	1/28/2010		
REVIEW	BF	1/28/2010		

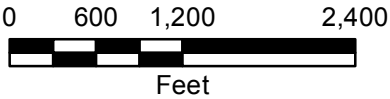


**LEGEND**

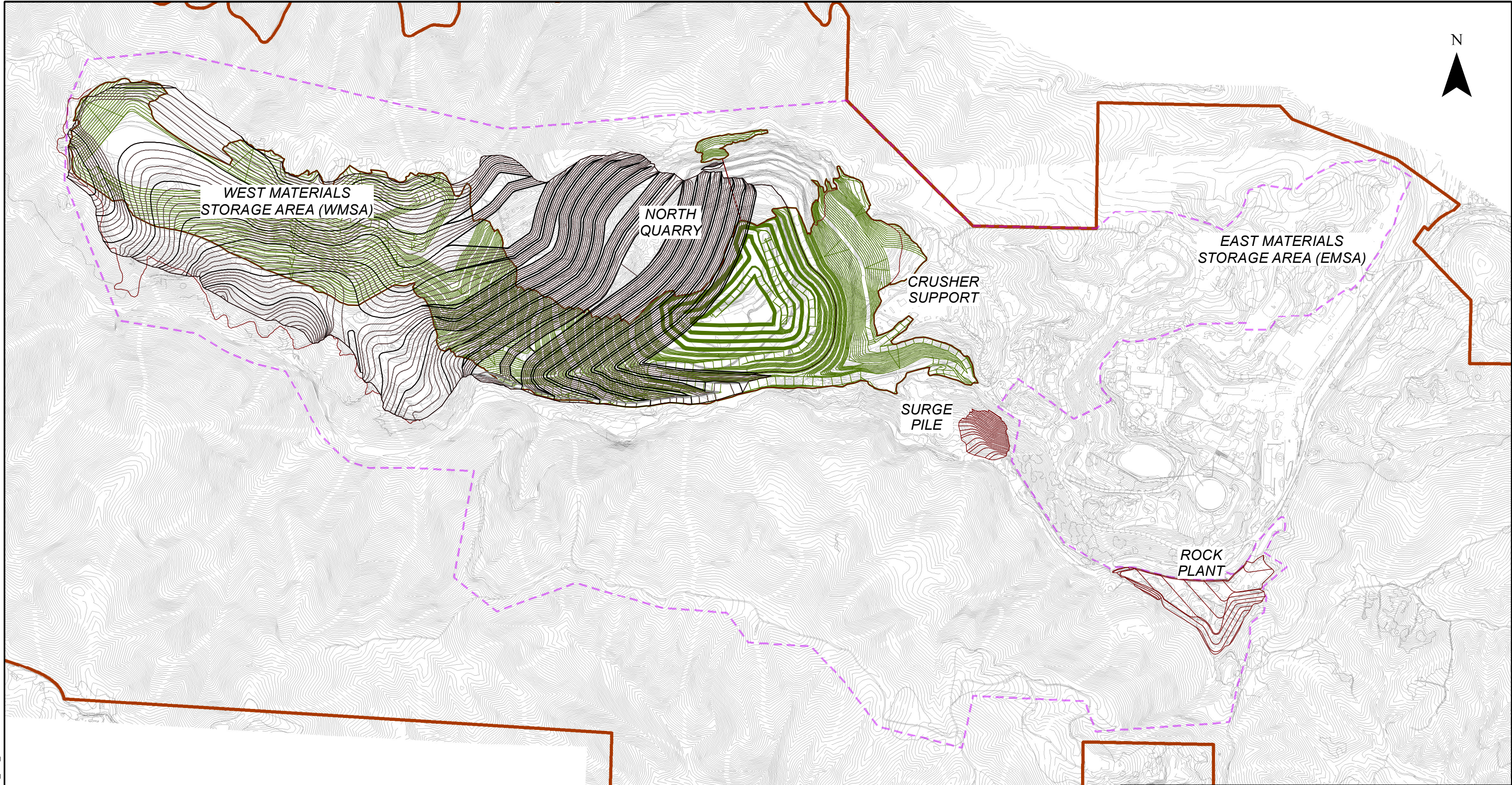
Disturbance Area Boundary

**REFERENCES**

Spatial Reference:  
NAD 1983 StatePlane California III FIPS 0403 feet Aerial background:  
[http://services.arcgisonline.com/arcgis/services/13\\_Imagery\\_Prime\\_World\\_2D](http://services.arcgisonline.com/arcgis/services/13_Imagery_Prime_World_2D)



PROJECT		HYDROLOGIC INVESTIGATION PERMANENTE QUARRY RECLAMATION PLAN UPDATE SANTA CLARA COUNTY, CALIFORNIA			
TITLE		PROJECT OVERVIEW			
		PROJECT No.	063-7109	FILE No.	
		DESIGN	DLM	11/18/2011	SCALE: AS SHOWN
		GIS	DLM	11/18/2011	REV. 1
		CHECK	GW	11/18/2011	
		REVIEW	WLF	11/18/2011	
		FIGURE 1.2			

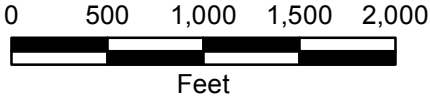



## LEGEND

- Reclamation Plan Boundary
- Lehigh Property Boundary

## REFERENCES

From Enviromine (2010).  
Spatial Reference:  
NAD 1983 StatePlane California III FIPS 0403 Feet



PROJECT				HYDROLOGIC INVESTIGATION PERMANENTE QUARRY RECLAMATION PLAN UPDATE SANTA CLARA COUNTY, CALIFORNIA			
TITLE				FINAL RECLAMATION PLAN			
		PROJECT No.		063-7109		FILE No.	
		DESIGN	DLM	11/18/2011		SCALE: AS SHOWN	REV. 0
		GIS	DLM	11/18/2011		<b>FIGURE 1.3</b>	
		CHECK	GW	11/18/2011			
		REVIEW	WLF	11/18/2011			

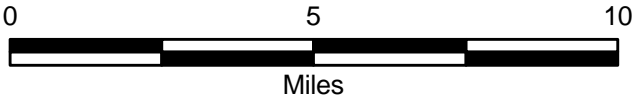


**LEGEND**

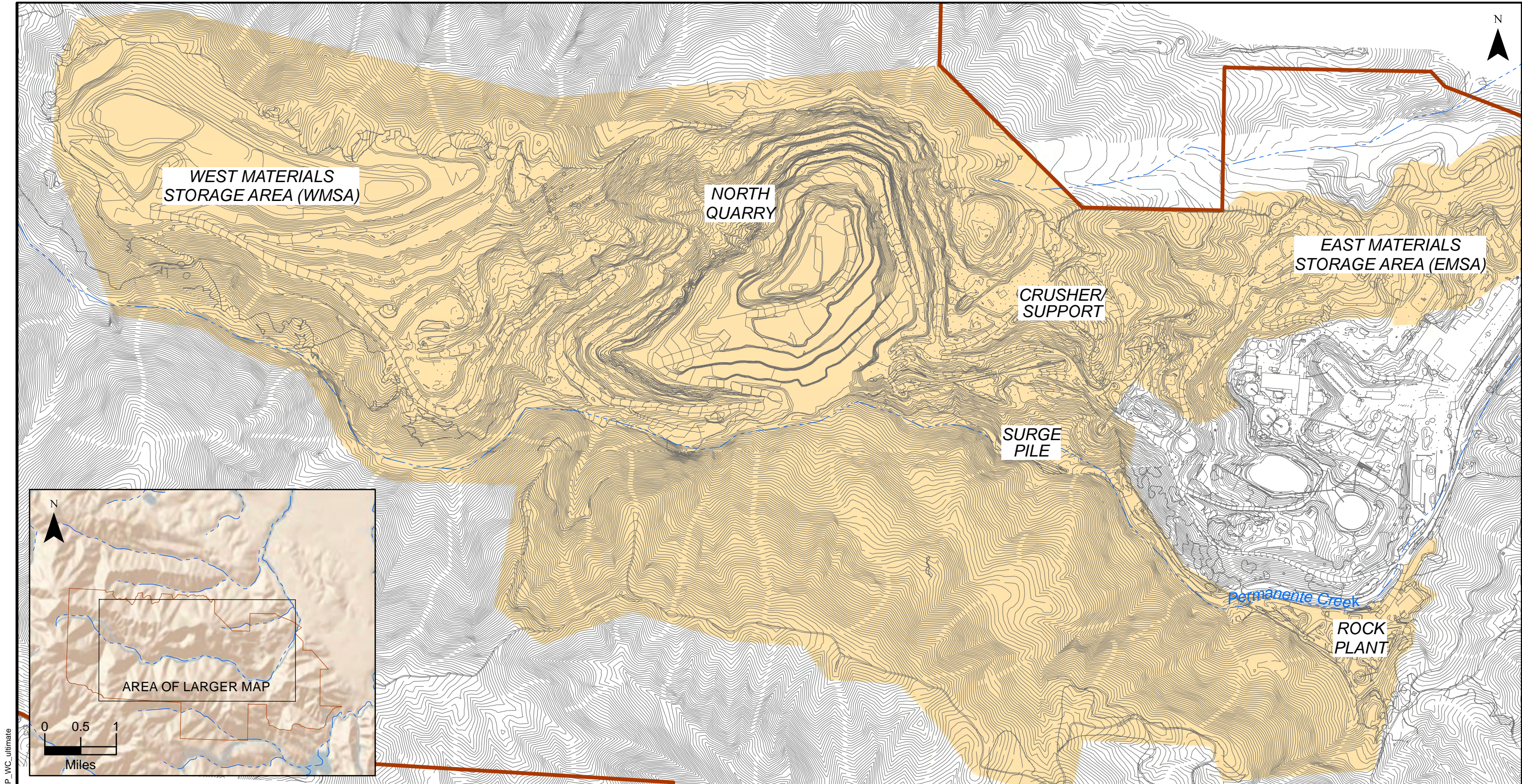
Facility boundary

**REFERENCES**

ESRI:World\_Shaded\_Relief  
(<http://services.arcgisonline.com/arcgis/services>)  
Spatial Reference:  
NAD 1983 StatePlane California III FIPS 0403 Feet



PROJECT				
HYDROLOGIC INVESTIGATION PERMANENTE QUARRY RECLAMATION PLAN UPDATE SANTA CLARA COUNTY, CALIFORNIA				
TITLE				
REGIONAL TOPOGRAPHIC SETTING				
	PROJECT No.		063-7109	
	FILE No.			
	DESIGN	DLM	2/8/2010	SCALE: AS SHOWN
	GIS	DLM	2/8/2010	REV. 0
	CHECK	GW	2/8/2010	<b>FIGURE 2.1</b>
	REVIEW	WLF	2/8/2010	

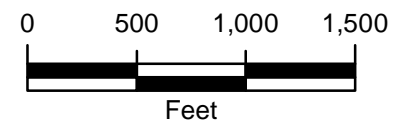


## LEGEND

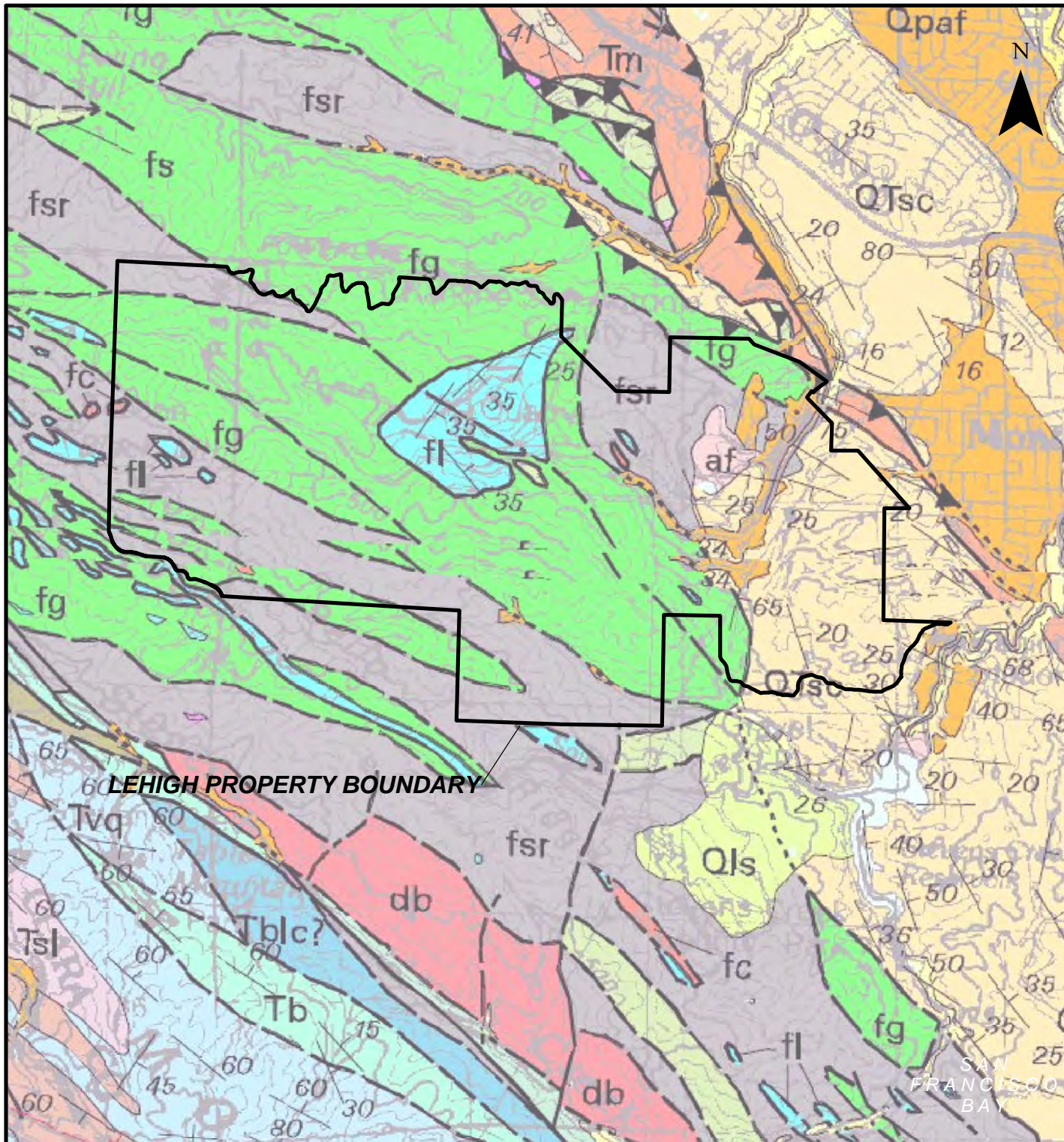
- Lehigh Property Boundary
- Reclamation Plan Boundary

## REFERENCES

Topo from Enviromine (2010).  
Spatial Reference:  
NAD 1983 StatePlane California III FIPS 0403 Feet

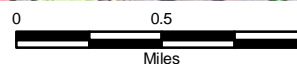


PROJECT			
HYDROLOGIC INVESTIGATION PERMANENTE QUARRY RECLAMATION PLAN UPDATE SANTA CLARA COUNTY, CALIFORNIA			
TITLE			
LOCAL TOPOGRAPHIC SETTING			
		PROJECT No.	063-7109
		DESIGN	DLM 11/10/2011
		GIS	DLM 11/10/2011
		CHECK	WLF 11/10/2011
		REVIEW	WLF 11/10/2011
		FILE No.	
		SCALE: AS SHOWN	REV. 0
FIGURE 2.2			

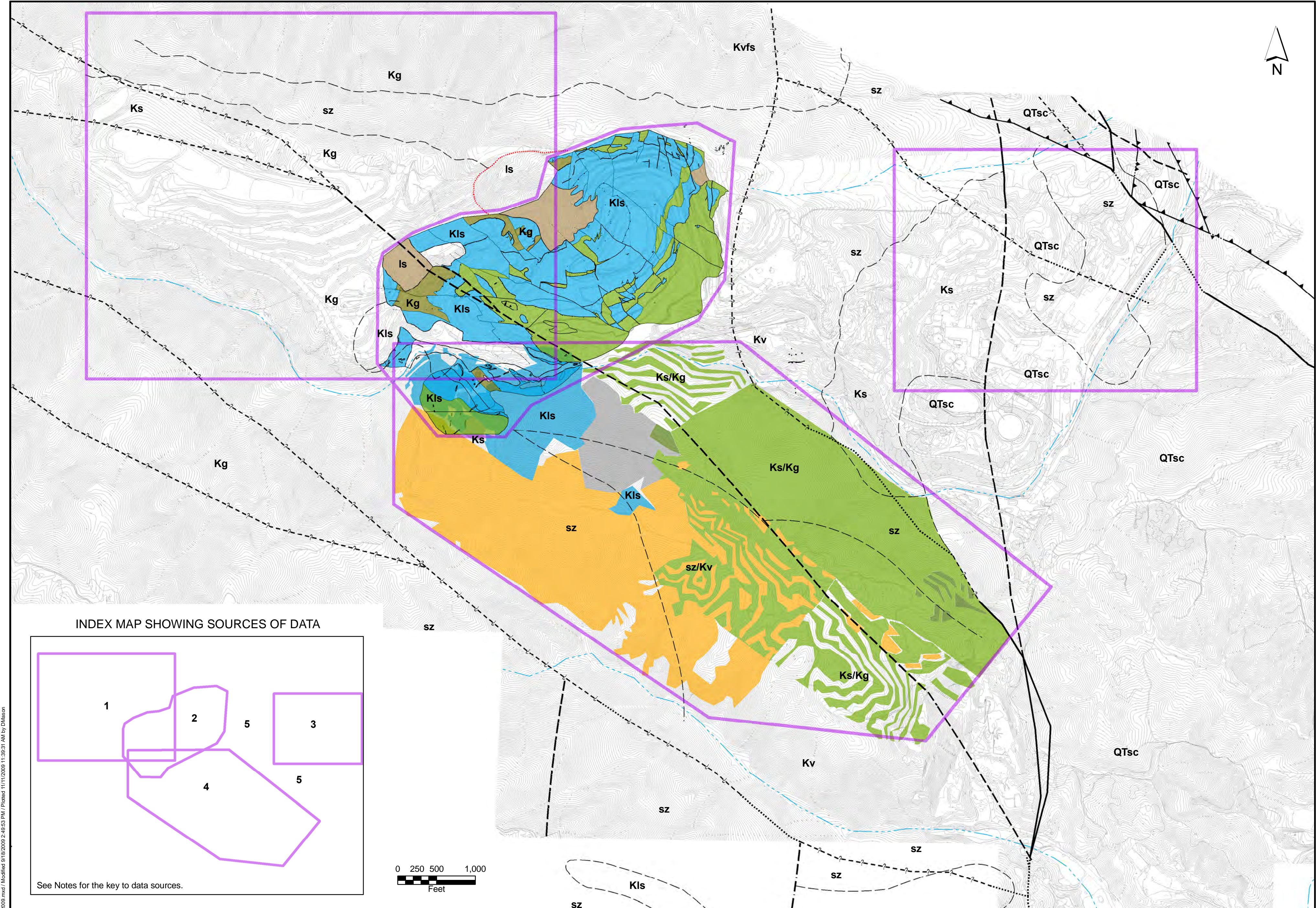


## REFERENCES

US Geological Survey, Geologic Map and Map Database of the Palo Alto 30' x 60' Quadrangle, California; Brabb, E.E., R.W. Graymer, and D.L., Jones, 2000. MF Studies Map MF-2332.  
(<http://pubs.usgs.gov/mf/2000/mf-2332/mf2332m.pdf>)



PROJECT			
HYDROLOGIC INVESTIGATION PERMANENTE QUARRY RECLAMATION PLAN UPDATA SANTA CLARA COUNTY, CALIFORNIA			
TITLE			
REGIONAL GEOLOGIC MAP			
PROJECT No.		FILE No.	
DESIGN	DLM	1/28/2010	SCALE: AS SHOWN
GIS	DLM	1/28/2010	REV. 0
CHECK	GW	1/28/2010	<b>FIGURE 2.3</b>
REVIEW	WLF	1/28/2010	



LEGEND

- Geologic contact, certain
- Geologic contact, approximate
- Geologic contact, concealed
- Landslide

Rock Type (Surpac Model):

- Fault breccia/metabasalt (sz/Kv)
- Graywacke (Ks)
- Graywacke/greenstone (Ks/Kg)
- Greenstone (Kg)
- Greenstone/metabasalt (Kg)
- Limestone (Kls)

Rock Type (Fouria, simplified):

- Landslide (Is)
- Greenstone; all types
- Limestone; all types
- Metabasalts
- Alteration

NOTES

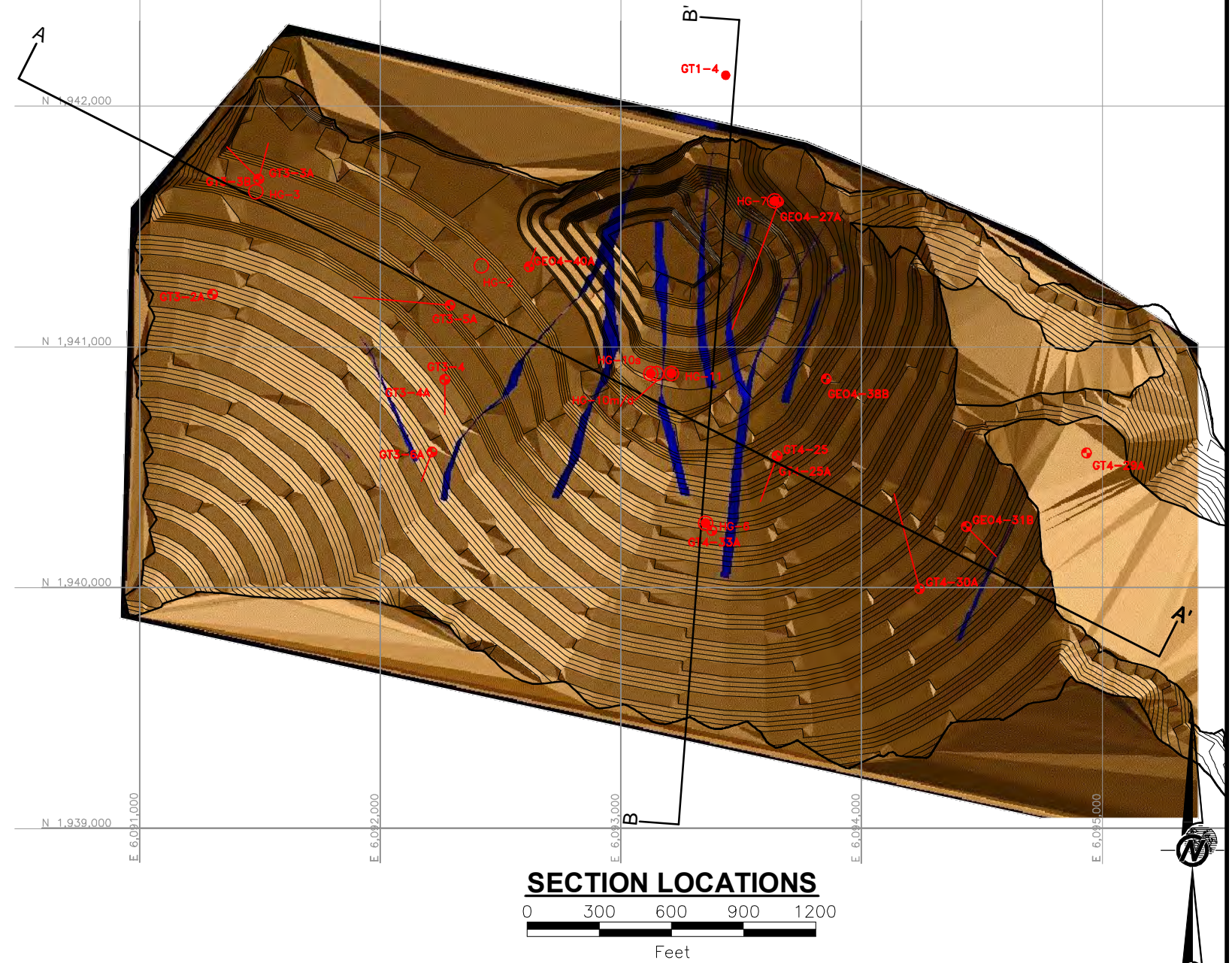
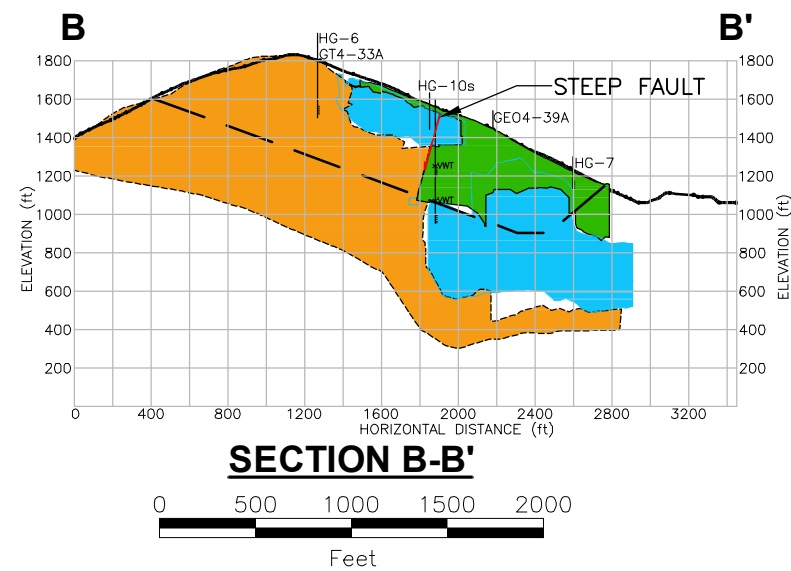
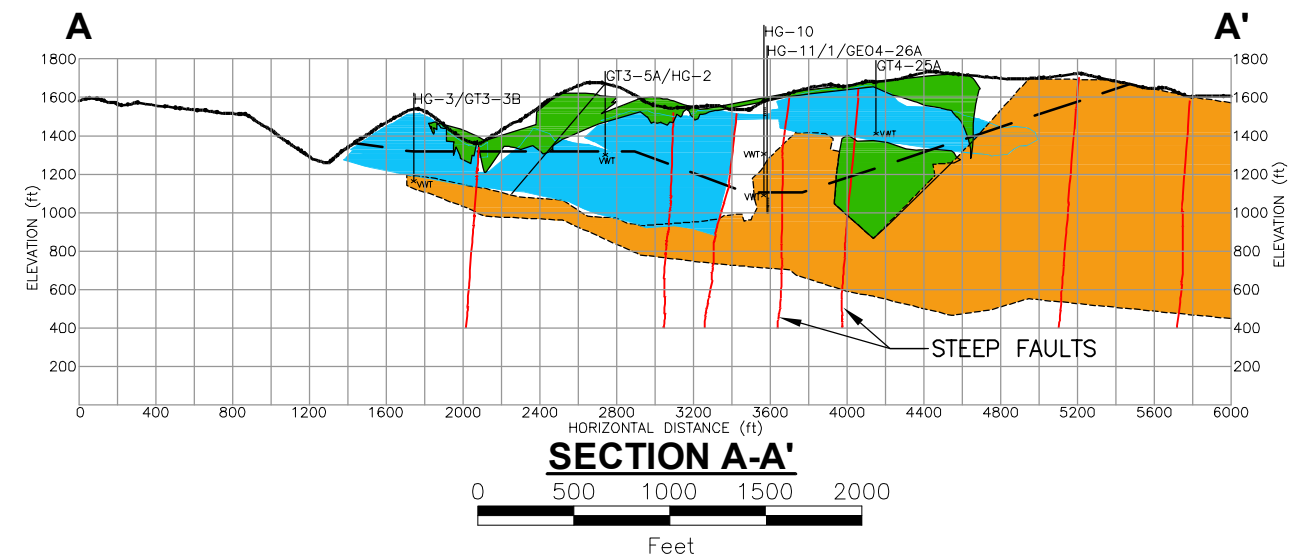
- 1) Modified after Rogers, T.H. and Armstrong, C.F., CDMG Preliminary Report 17 (1973) and Fouria, J. Geology of the Pemanente Limestone and Aggregate Quarry (2004).
- 2) Fouria, J. Geology of the Pemanente Limestone and Aggregate Quarry (2004).
- 3) Modified after Rogers, T.H. and Armstrong, C.F (1973).
- 4) Gemcom SURPAC results of geologic model.
- 5) Modified after Rogers, T.H. and Armstrong, C.F (1973).

REFERENCES

- Topography (2007, 2008, 2009 composite; Chang Consultants (2010).
- Spatial Reference:  
NAD 1983 StatePlane California III FIPS 0403 Feet

PROJECT					
HYDROLOGIC INVESTIGATION PERMANENTE QUARRY RECLAMATION PLAN UPDATE SANTA CLARA COUNTY, CALIFORNIA					
TITLE					
GEOLOGIC COMPILATION MAP					
PROJECT No.		063-7109		FILE No.	
DESIGN	DLM	10/27/2008	SCALE: AS SHOWN	REV.	0
GIS	DLM	10/27/2008			
CHECK	WLF	10/27/2008			
REVIEW	XXX	10/27/2008			

FIGURE 2.4



## LEGEND

- |        |                                     |
|--------|-------------------------------------|
| GT3-6A | SOUTH QUARRY GEOTECH COREHOLE       |
| GT1-4  | NORTH QUARRY GEOTECH COREHOLE       |
| HG-2   | BOREHOLE WITH TRANSDUCER            |
| HG-7   | GROUND WATER MONITOR WELL           |
| — —    | ULTIMATE PIT PROFILE                |
| — — —  | EXISTING GROUND PROFILE             |
|        | GRAYWACKE (INCLUDES GREENSTONE)     |
|        | LIMESTONE                           |
|        | FAULT BRECCIA (INCLUDES GREENSTONE) |

## NOTES

1. ULTIMATE PIT PLAN PRIOR TO BACKFILLING  
PROVIDED BY LEHIGH AS AN ELECTRONIC FILE  
DATED JANUARY 22, 2010; FILENAME  
"topo\_total\_rec\_plan\_before\_backfill\_submittal7\_clipped.dxf".

PROJECT	<b>GEOLOGIC INVESTIGATION PERMANENTE QUARRY RECLAMATION PLAN UPDATE SANTA CLARA COUNTY, CALIFORNIA</b>
TITLE	<b>GEOLOGICAL CROSS SECTIONS A-A' AND B-B'</b>



0 1 2 Miles



### Legend

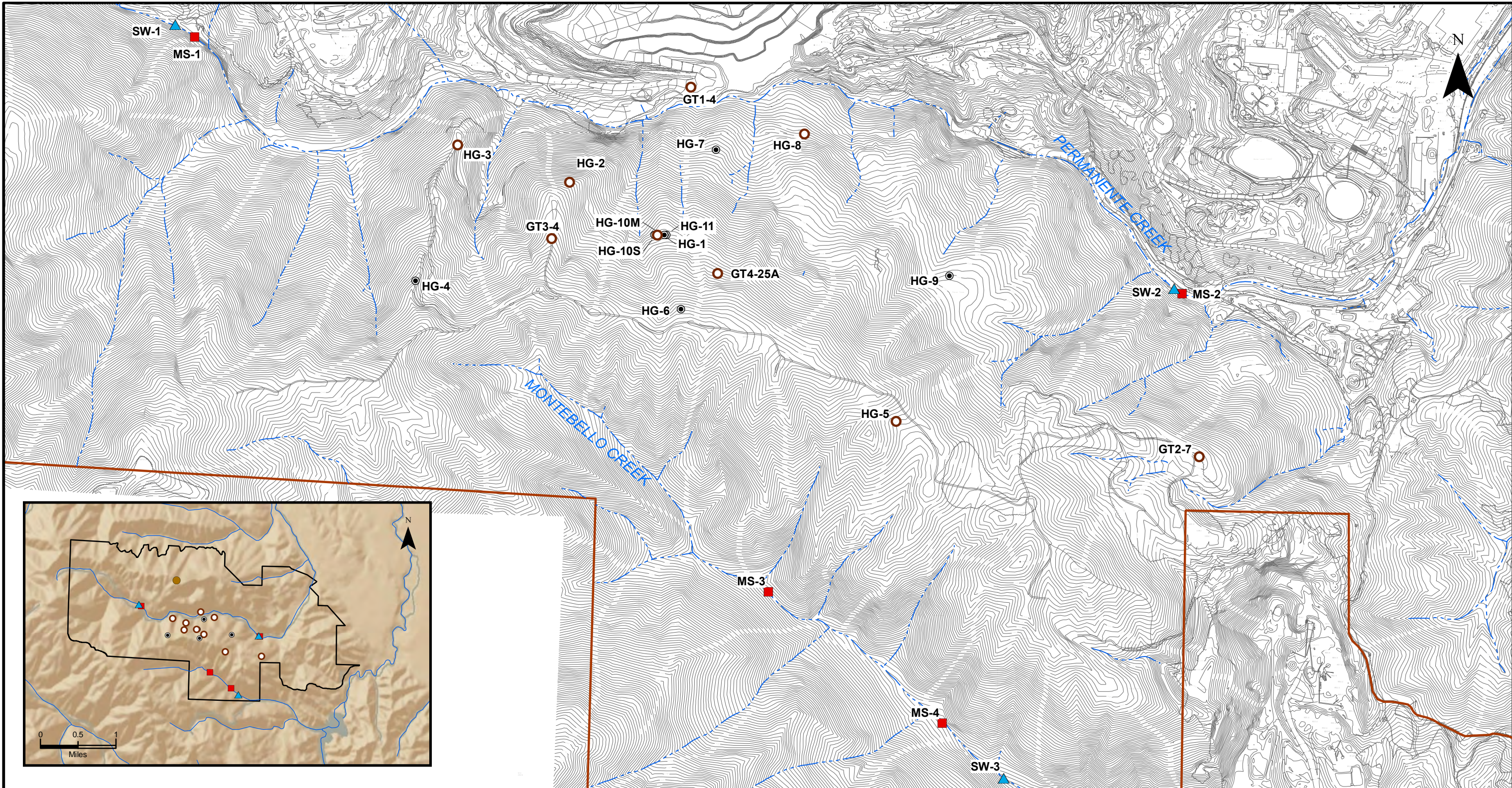
- Stream
- Fault (surface expression):**
  - Certain
  - ..... Concealed
  - - - Inferred
  - ▲ Thrust (teeth in dip direction)
- Dashed where approx., queried where uncertain; dotted where concealed.

Fault source: Brabb, et. al. (2000)

REV.	DATE	DES	REVISION DESCRIPTION	GIS	CHK	RVW
PROJECT						
HYDROLOGIC INVESTIGATION PERMANENTE QUARRY RECLAMATION PLAN UPDATE SANTA CLARA COUNTY, CALIFORNIA						
TITLE						
REGIONAL GEOTECTONIC MAP						
PROJECT No.			063-7109	FILE No.		
DESIGN	DLM	3/13/2009		SCALE: AS SHOWN	REV.	0
GIS	DLM	3/13/2009		<b>FIGURE 2.6</b>		
CHECK	WLF	3/25/2009				
REVIEW	WLF	3/25/2009				



G:\GIS\Site\Lehigh\_Permanente\_Quarry\mxd\H\_well\_map

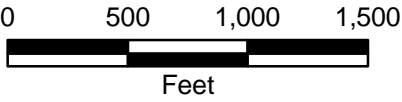


**LEGEND**

- Groundwater monitor well
- Hydrogeology borehole
- Borehole with transducer
- ▲ Surface water sample location
- Surface water station
- Facility boundary

**REFERENCES**

Spatial Reference:  
NAD 1983 StatePlane California III FIPS 0403 Feet

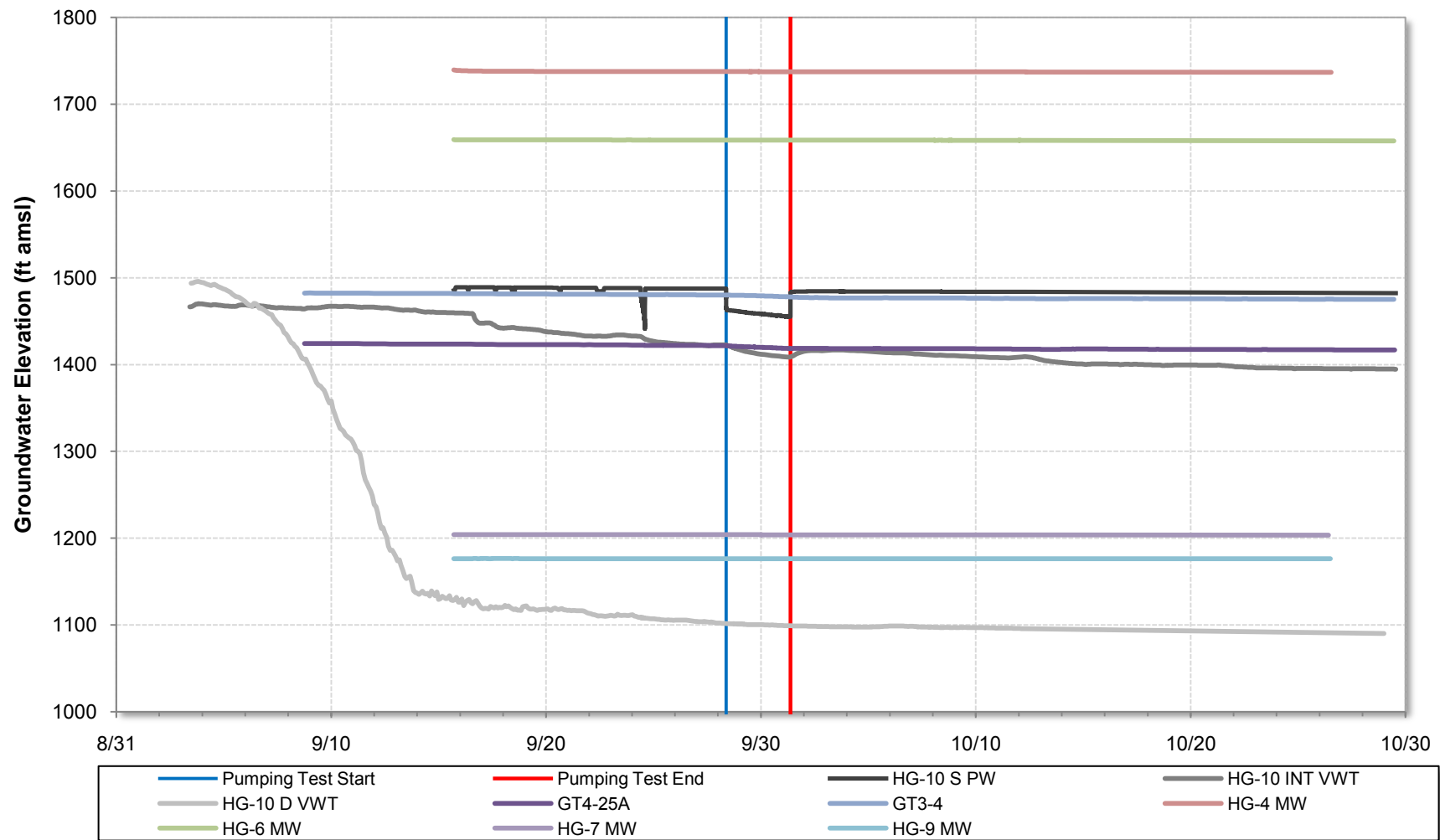


PROJECT  
HYDROLOGIC INVESTIGATION  
PERMANENTE QUARRY RECLAMATION PLAN UPDATE  
SANTA CLARA COUNTY, CALIFORNIA

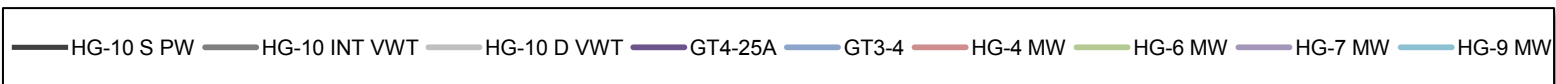
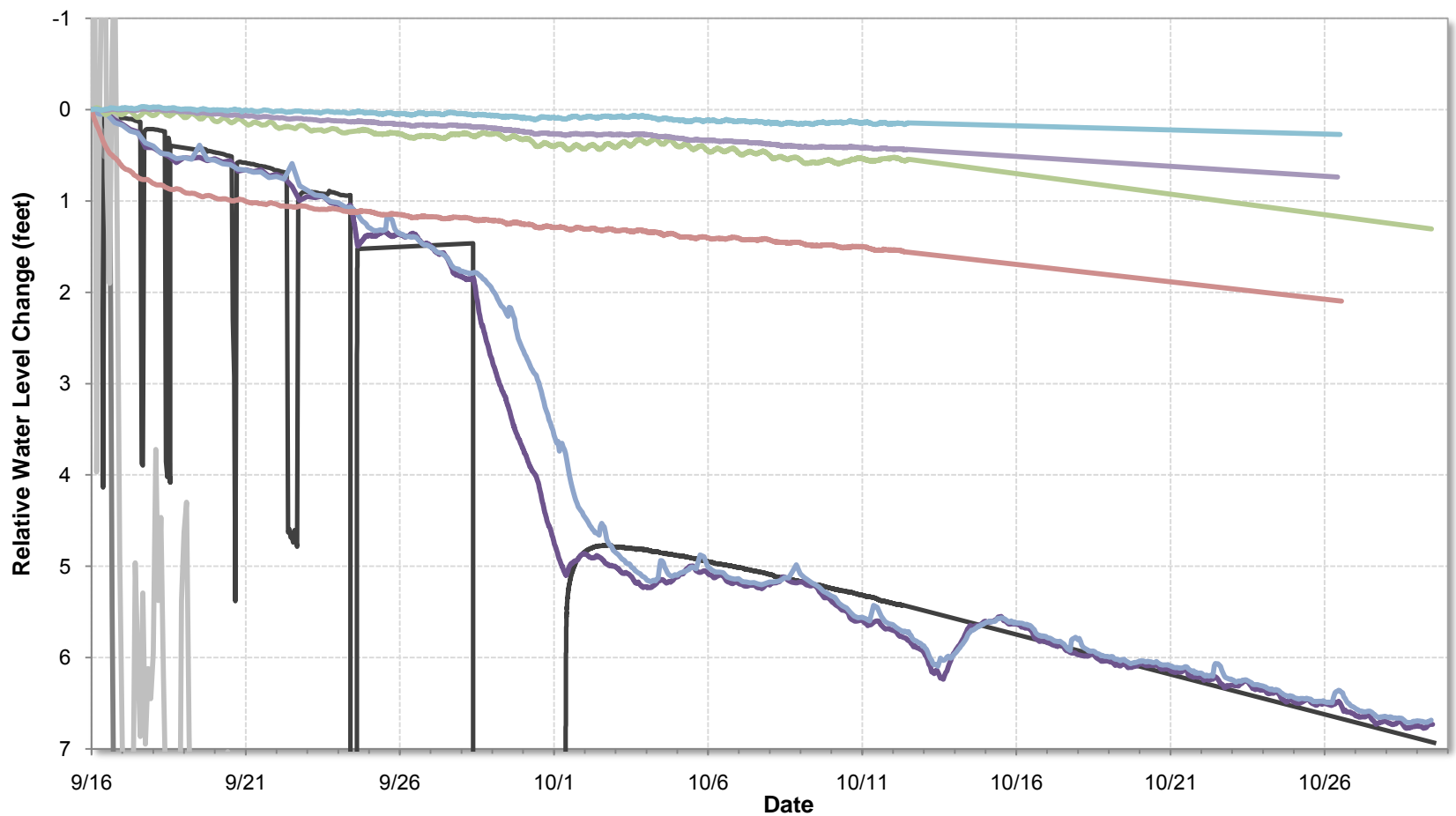
TITLE  
**MONITORING LOCATIONS**



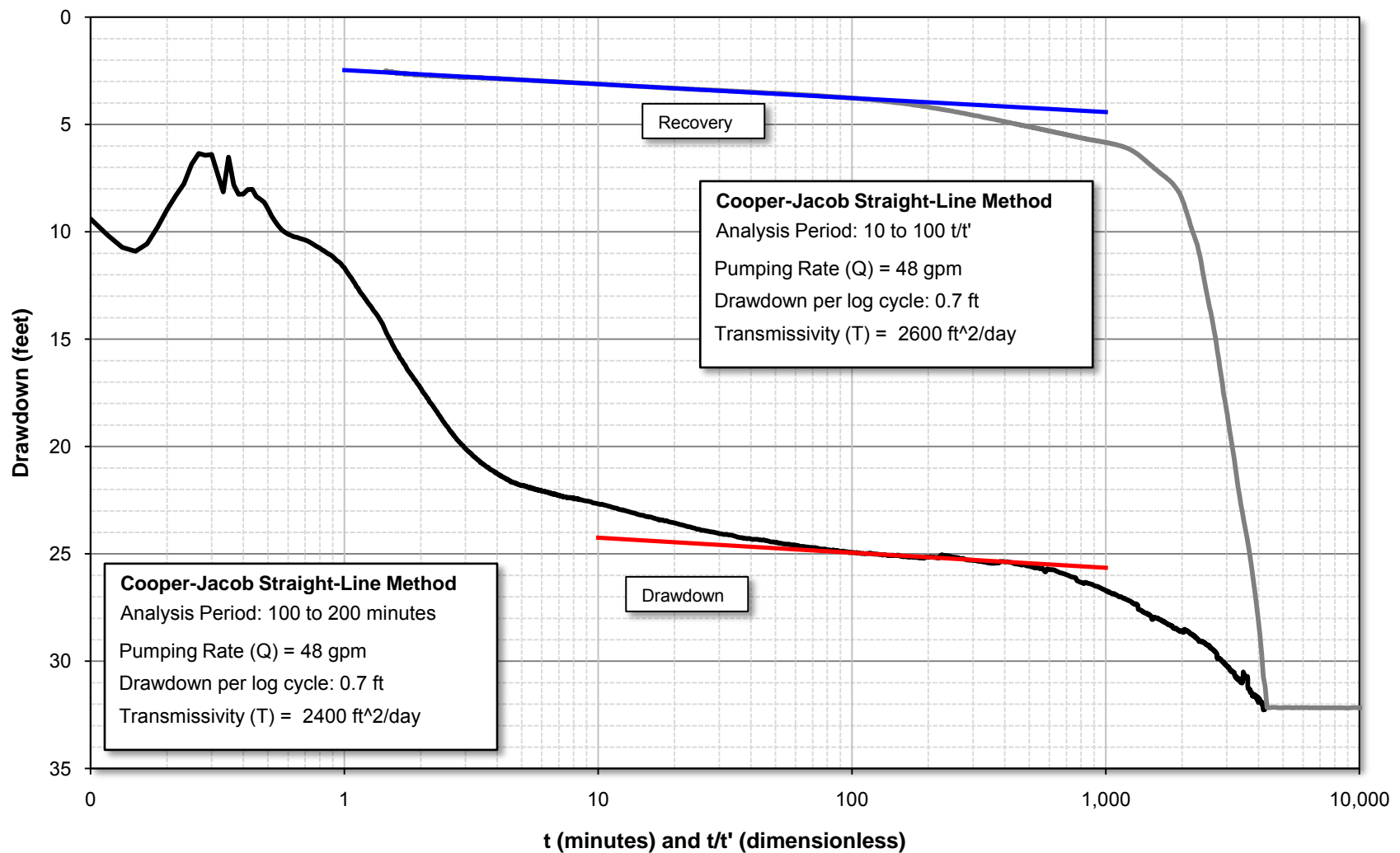
PROJECT No.	063-7109	FILE No.	
DESIGN	DLM	2/8/2010	SCALE: AS SHOWN
GIS	DLM	2/8/2010	REV. 0
CHECK	GW	2/8/2010	<b>FIGURE 3.1</b>
REVIEW	WLF	2/8/2010	



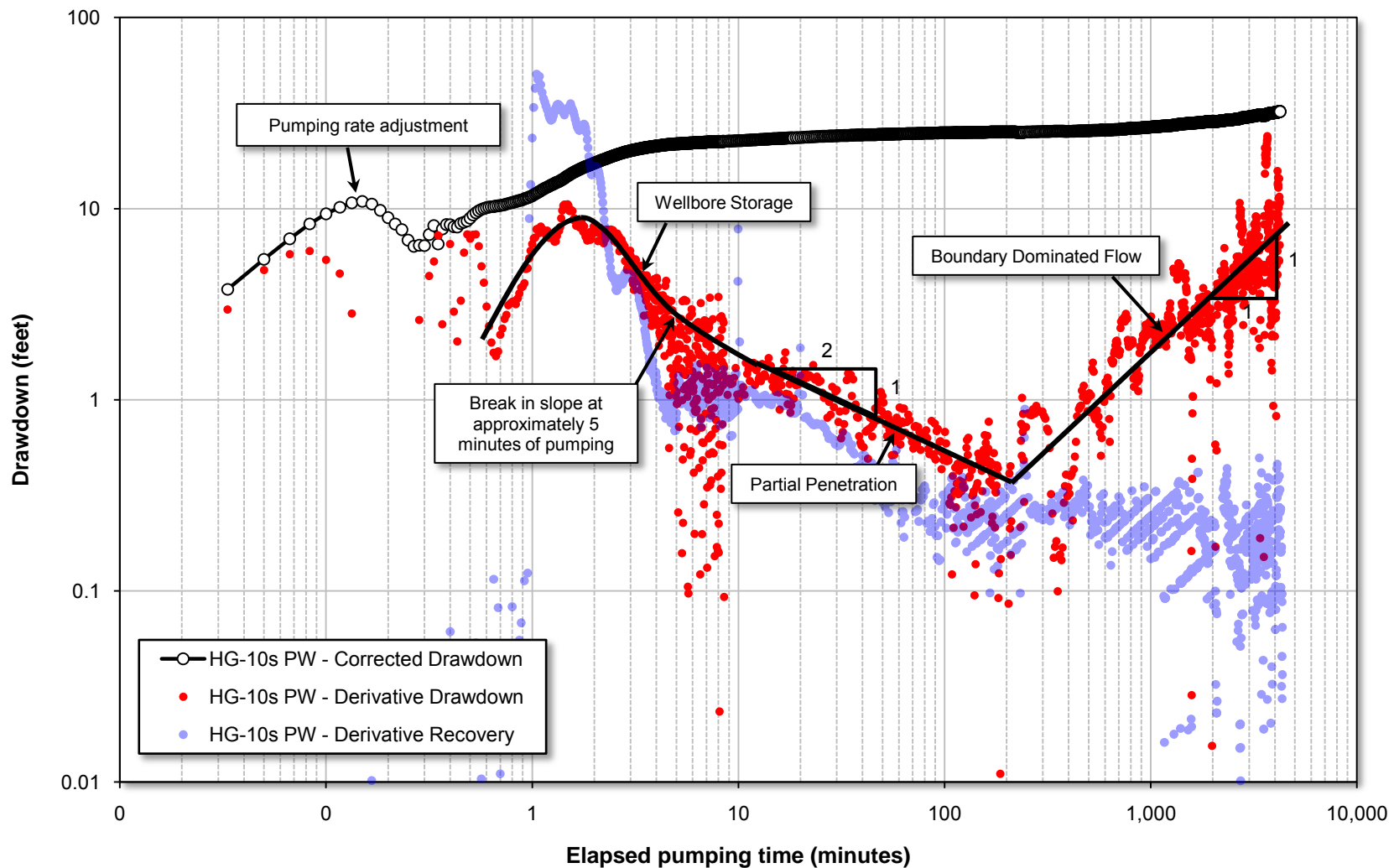
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Project Name		Hydrologic Investigation		Checked	SDT
Client Name		Project No. 063-7109-500		Reviewed	DB
Permanent Quarry Reclamation Plan Update		Date May 2010		FIGURE 4.1	



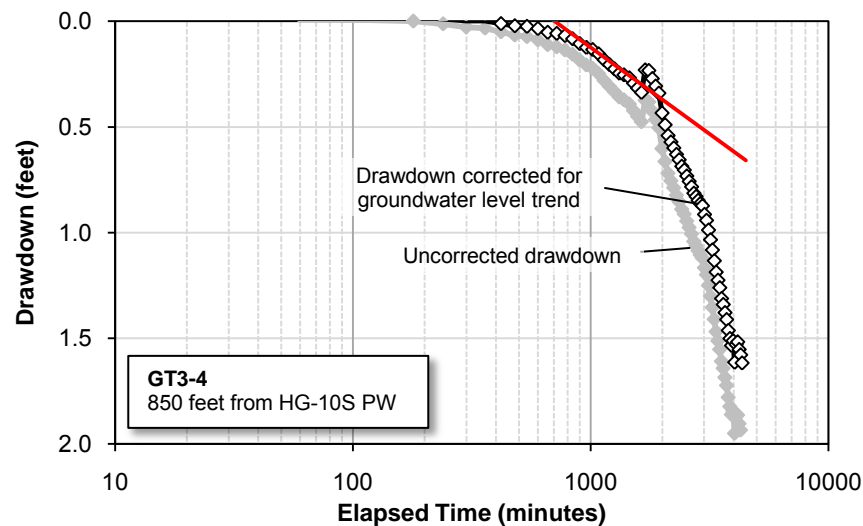
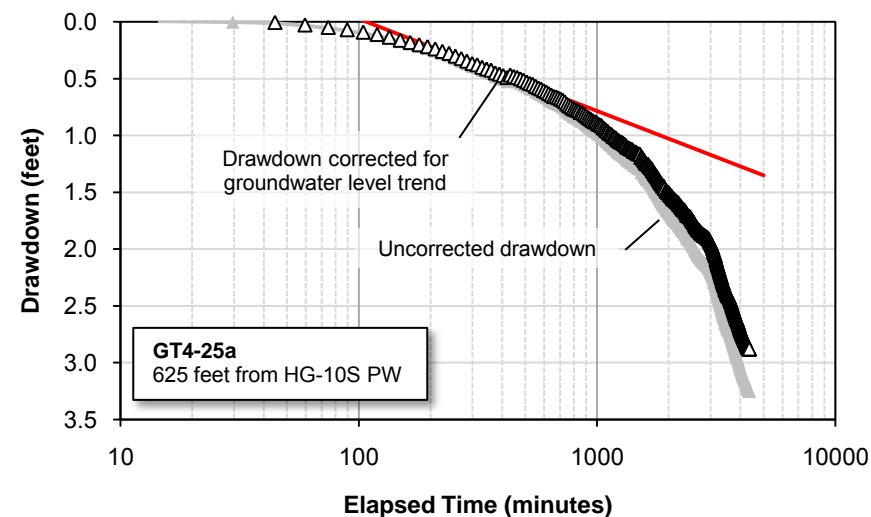
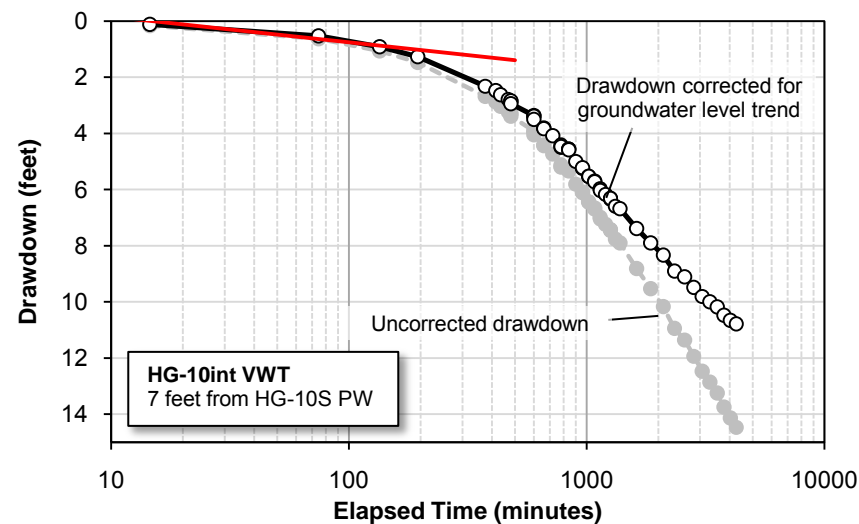
Title Relative Groundwater Changes		Drawn	DH
		Checked	SDT
Project Name	Hydrologic Investigation	Project No.	063-7109-500
		Reviewed	DB
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010
		FIGURE 4.2	



Title		HG-10S Drawdown and Recovery Semi-Log Plot		Drawn	DH
Project Name		Hydrologic Investigation		Checked	MPK
Client Name		Permanente Quarry Reclamation Plan Update		Reviewed	DB
		Project No.	063-7109-500	FIGURE 4.3	
		Date	May 2010		



Title		HG-10S Drawdown and Recovery Derivative Log-Log Plot		Drawn	DH
Project Name		Hydrologic Investigation		Checked	MPK
Client Name		Permanente Quarry Reclamation Plan Update		Reviewed	DB
		Project No.	063-7109-500	FIGURE 4.4	
		Date	May 2010		



#### Legend

- Cooper-Jacob Straight-Line Analysis
- HG-10INT VWT
- ◇ GT3-4
- △ GT4-25A

#### Cooper-Jacob Straight-Line Analysis Results

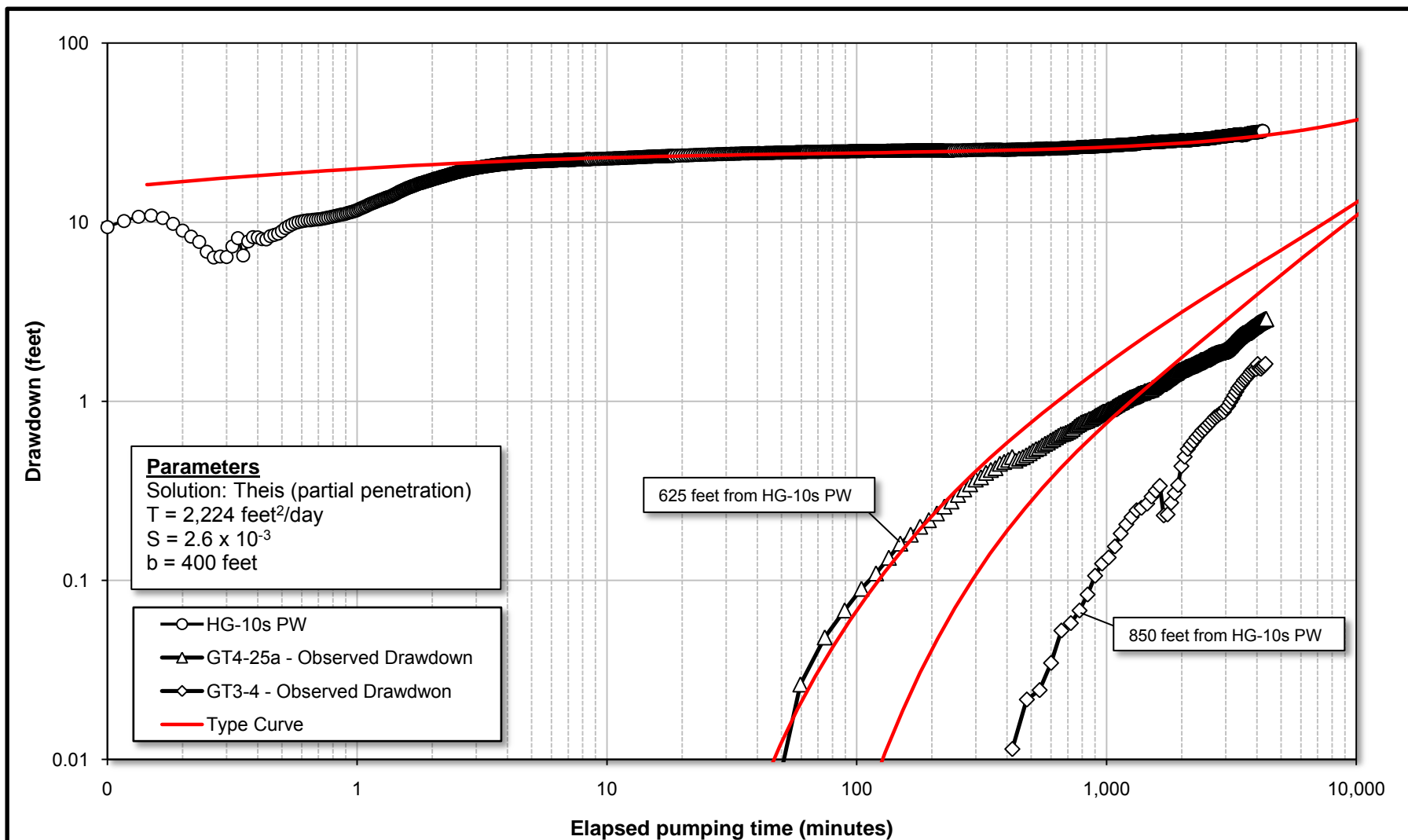
HG-10INT VWT  
 $T = 1,847 \text{ ft}^2/\text{d}$   
 $S = 0.9$

GT3-4  
 $T = 2,059 \text{ ft}^2/\text{d}$   
 $S = 3 \times 10^{-3}$

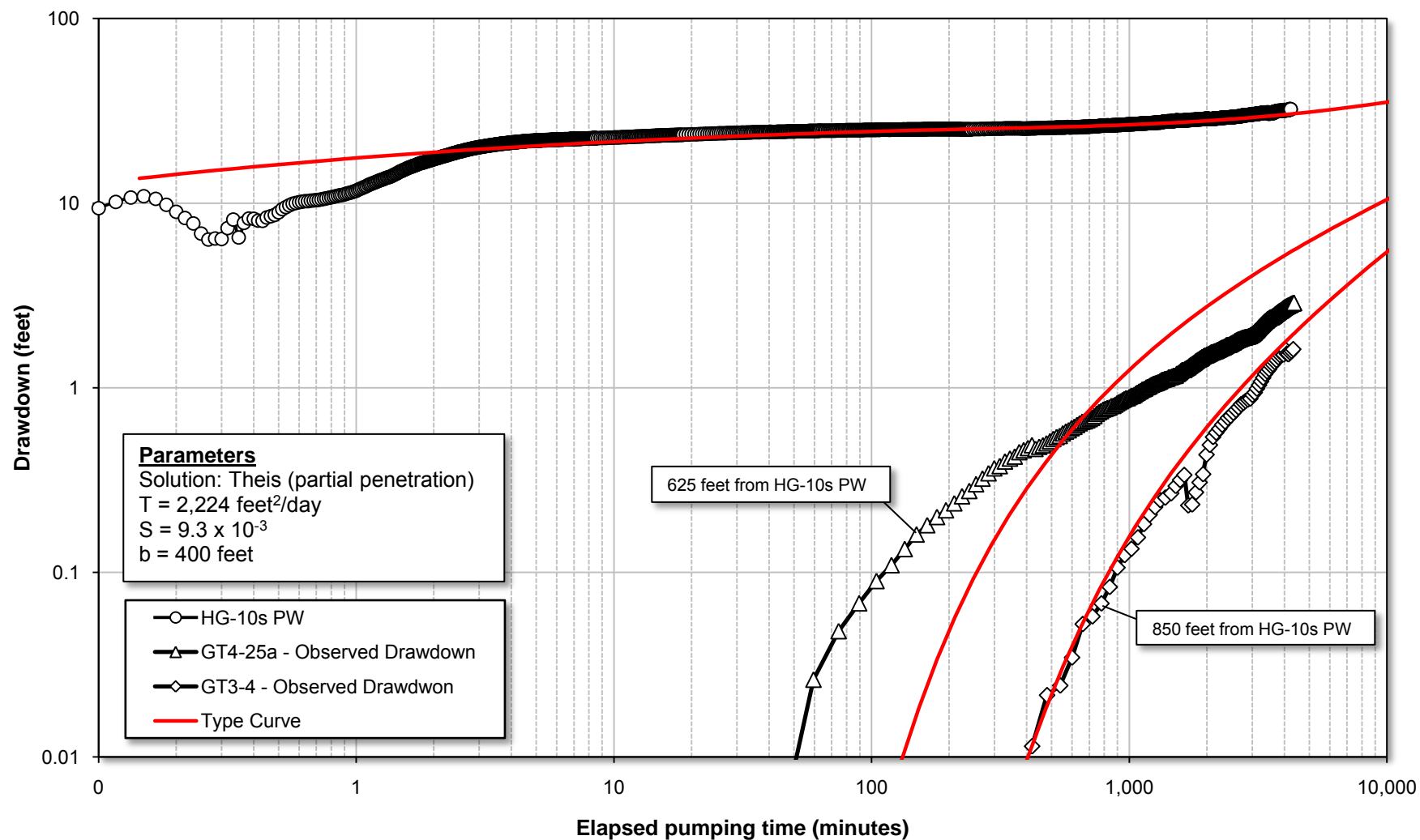
GT4-25A  
 $T = 2,074 \text{ ft}^2/\text{d}$   
 $S = 1 \times 10^{-3}$



Title		Corrected Drawdown Hydrographs for Observation Wells	Drawn	DH
Project Name		Hydrologic Investigation	Checked	MPK
Client Name		Permanente Quarry Reclamation Plan Update	Reviewed	DB
		Project No.	063-7109-500	FIGURE 4.5
		Date	May 2010	



Title Theis Partial Penetration Analysis Results from AQTESOLV			Drawn	DH	
			Checked	MPK	
Project Name Hydrologic Investigation		Project No.	063-7109-500	Reviewed	DB
Client Name Permanente Quarry Reclamation Plan Update		Date	May 2010	FIGURE 4.6	



Title Theis Partial Penetration Analysis Results from AQTESOLV

Project Name Hydrologic Investigation

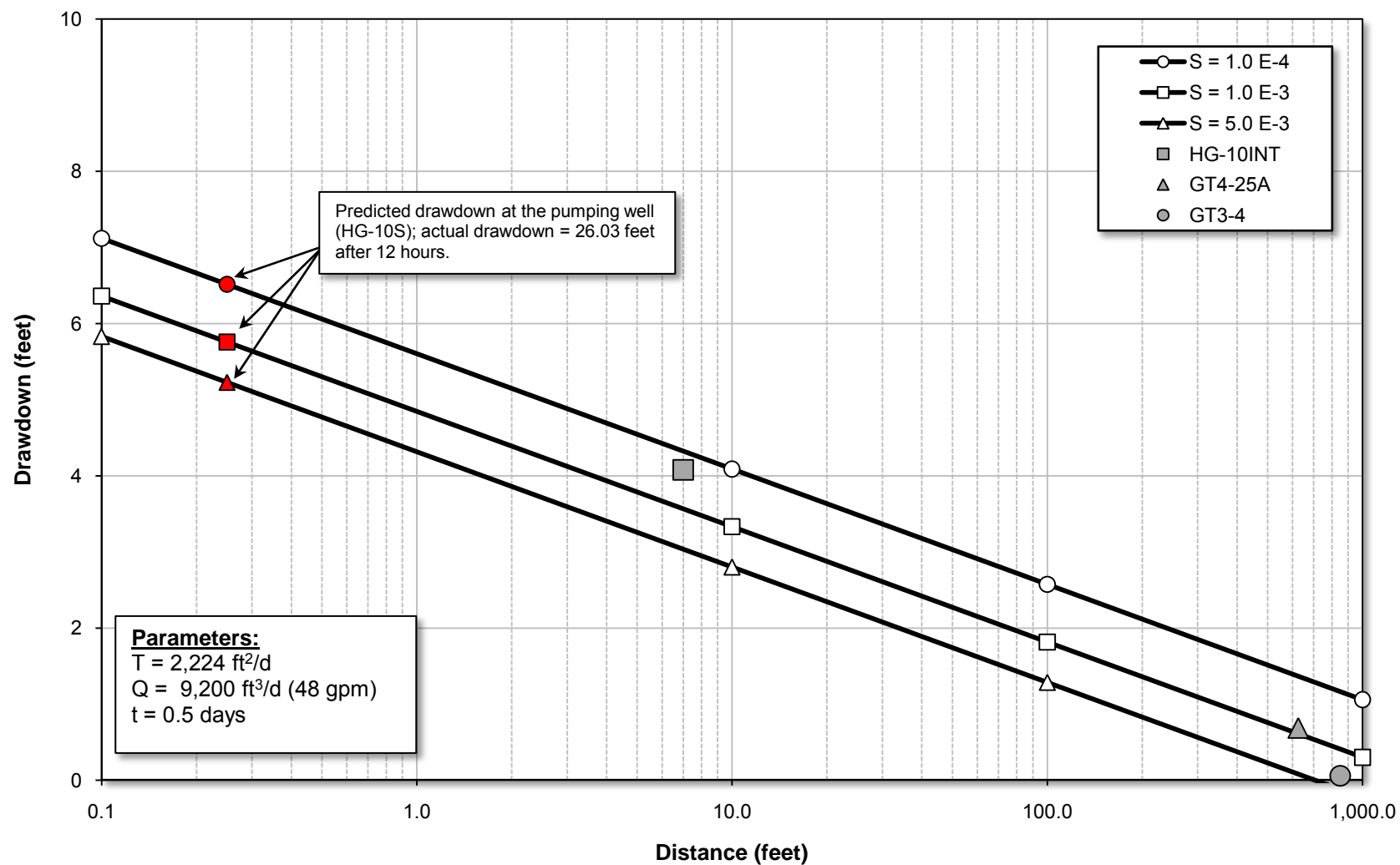
Project No. 063-7109-500

Client Name Permanente Quarry Reclamation Plan Update

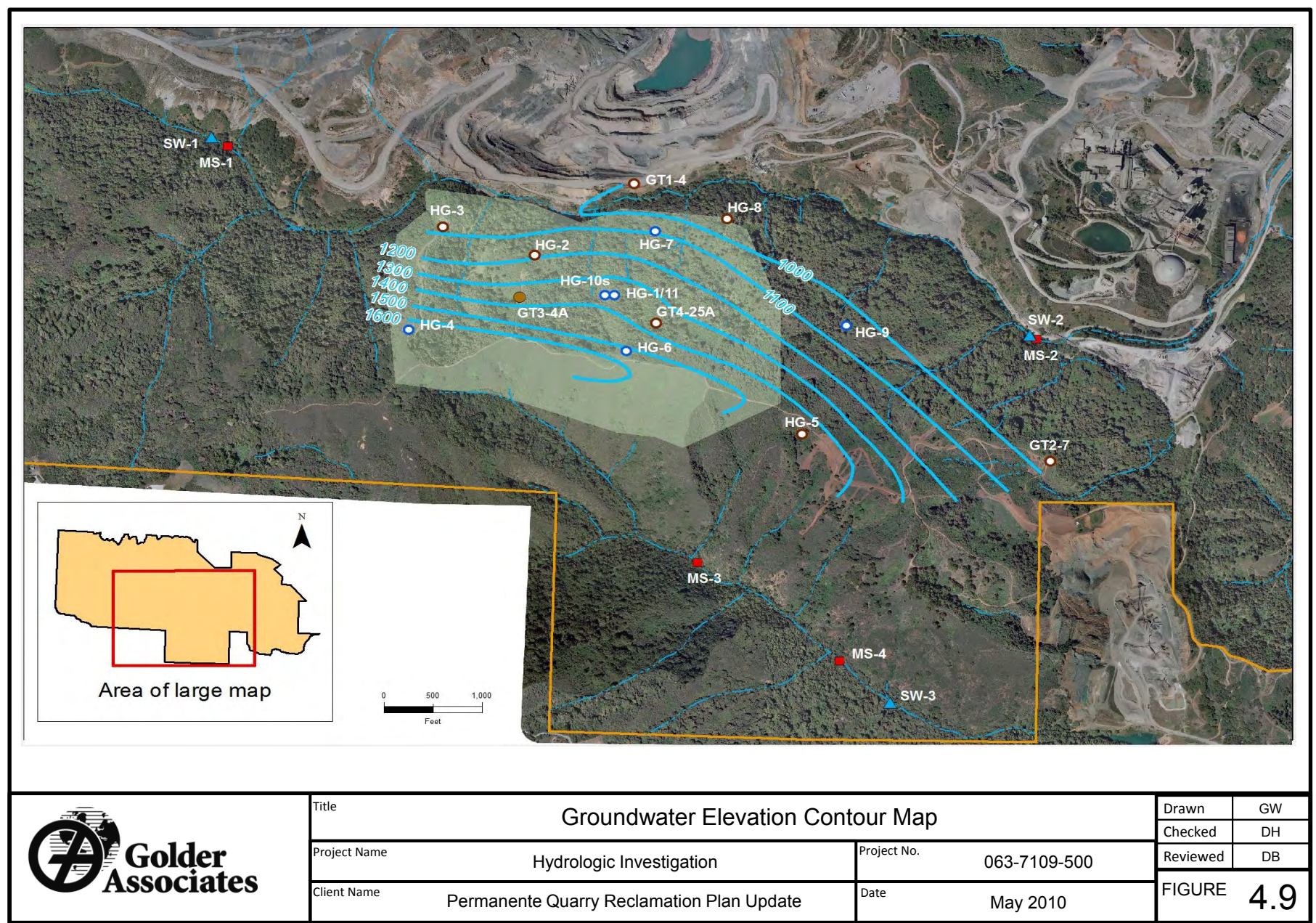
Date May 2010

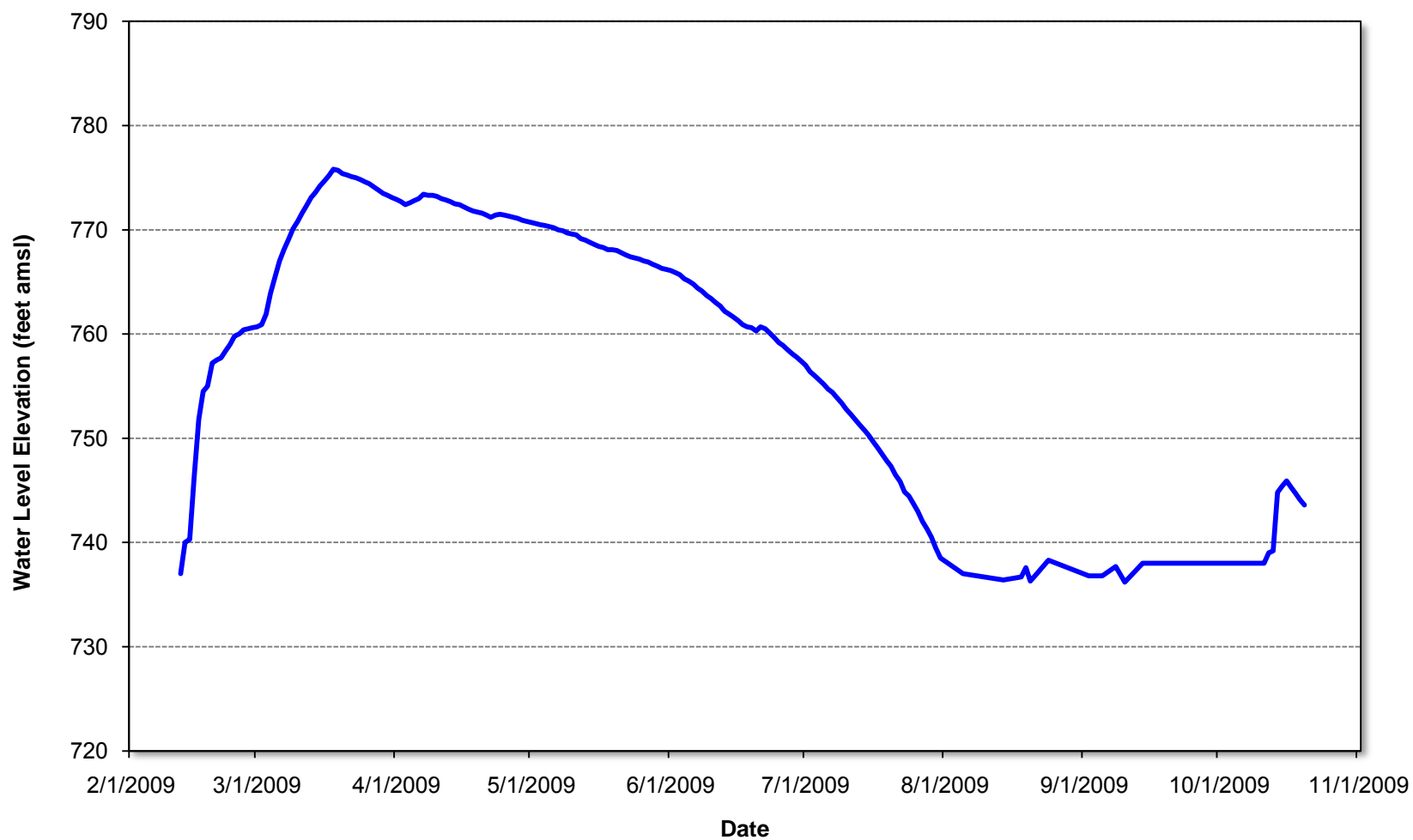
Drawn	DH
Checked	MPK
Reviewed	DB

FIGURE 4.7



TitleDistance vs. Drawdown Semi-Log Plot				Drawn	DH
				Checked	MPK
Project NameHydrologic Investigation		Project No.063-7109-500		Reviewed	DB
Client NamePermanente Quarry Reclamation Plan Update		DateMay 2010		FIGURE4.8	

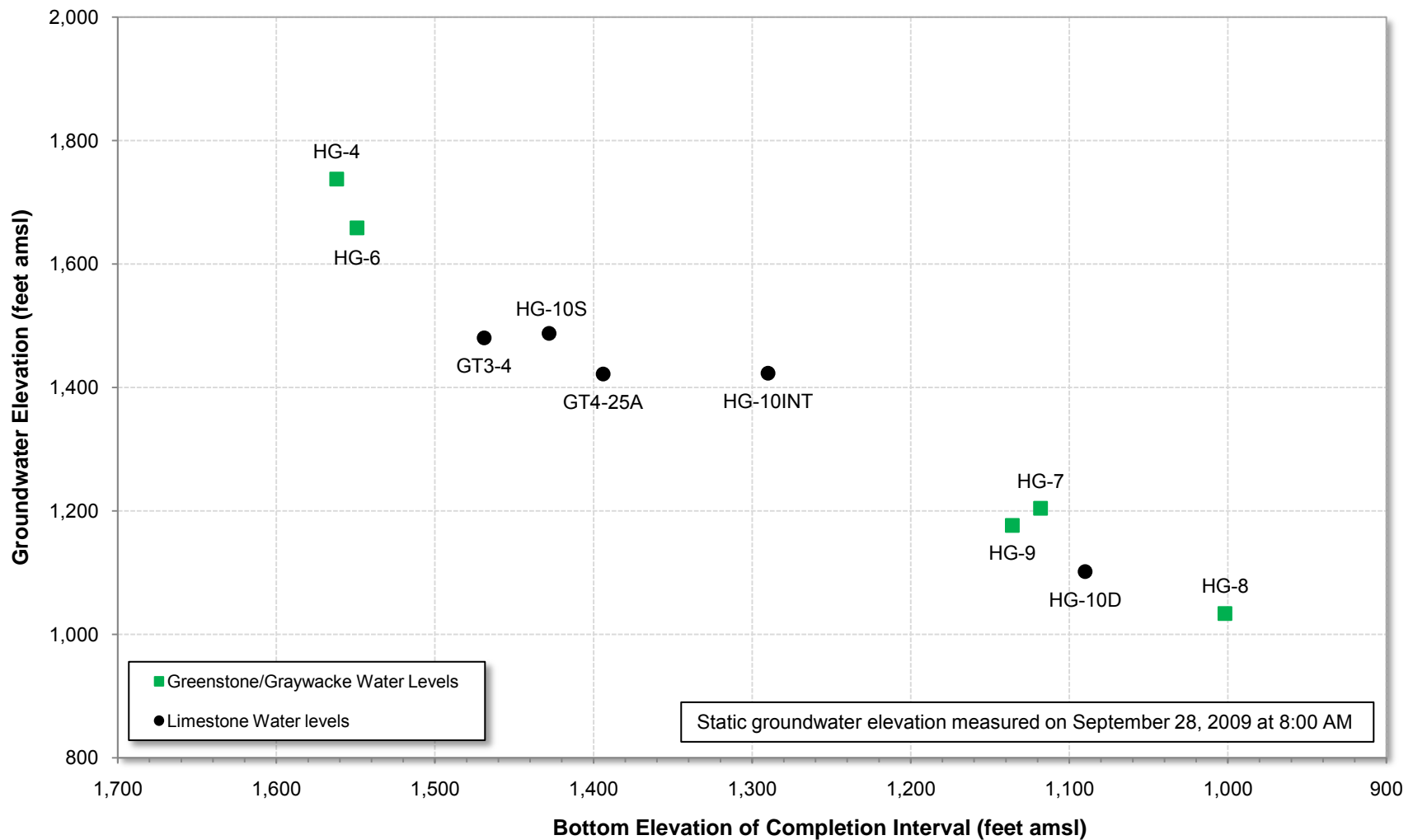




— Water Level



Title North Quarry Water Level - February to October 2010			Drawn	DH	
			Checked	SDT	
Project Name	Hydrologic Investigation	Project No.	063-7109-500	Reviewed	DB
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010	FIGURE	4.10



Title Groundwater Elevation vs. Well Completion Elevation

Project Name Hydrologic Investigation

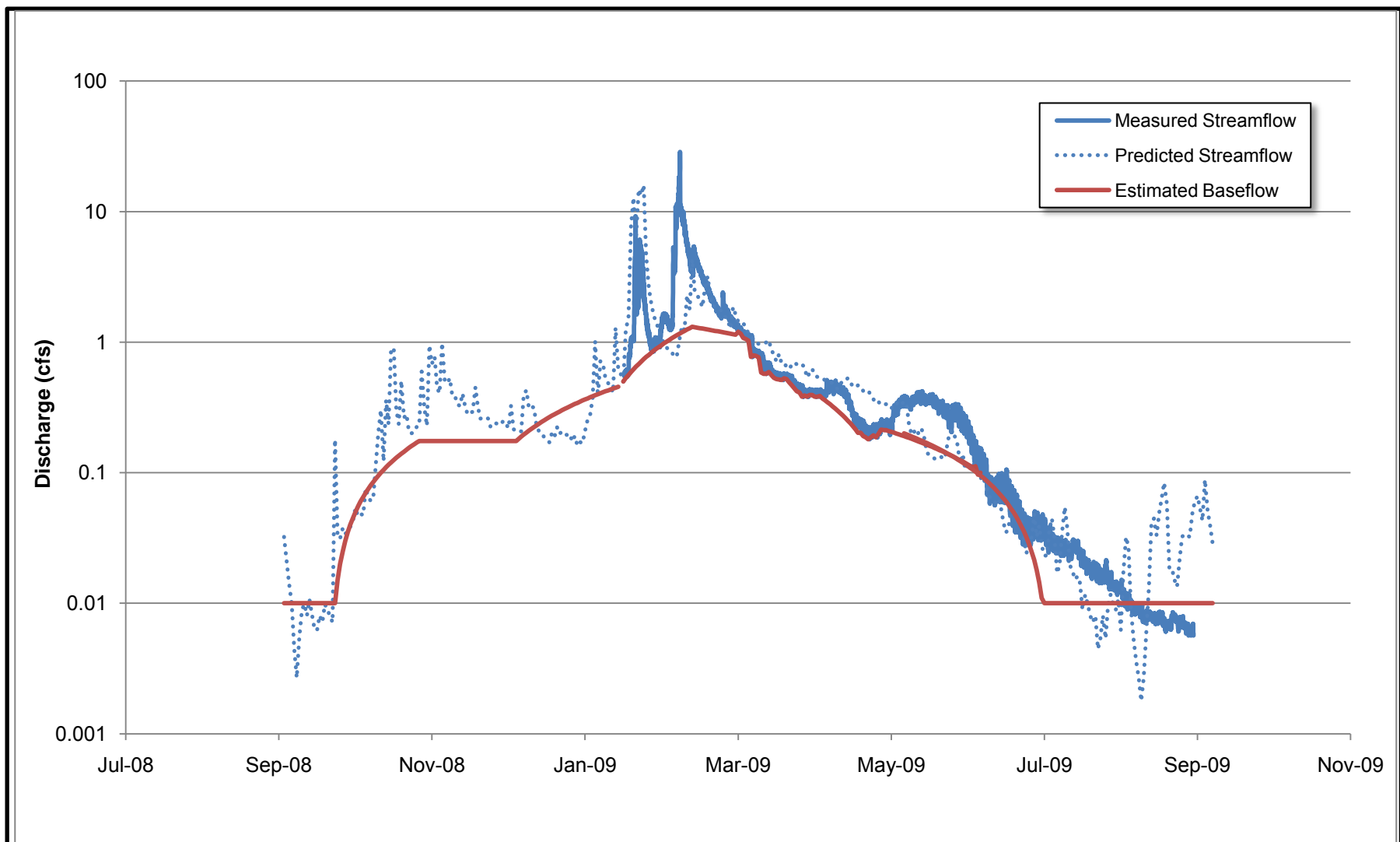
Project No. 063-7109-500

Client Name Permanente Quarry Reclamation Plan Update

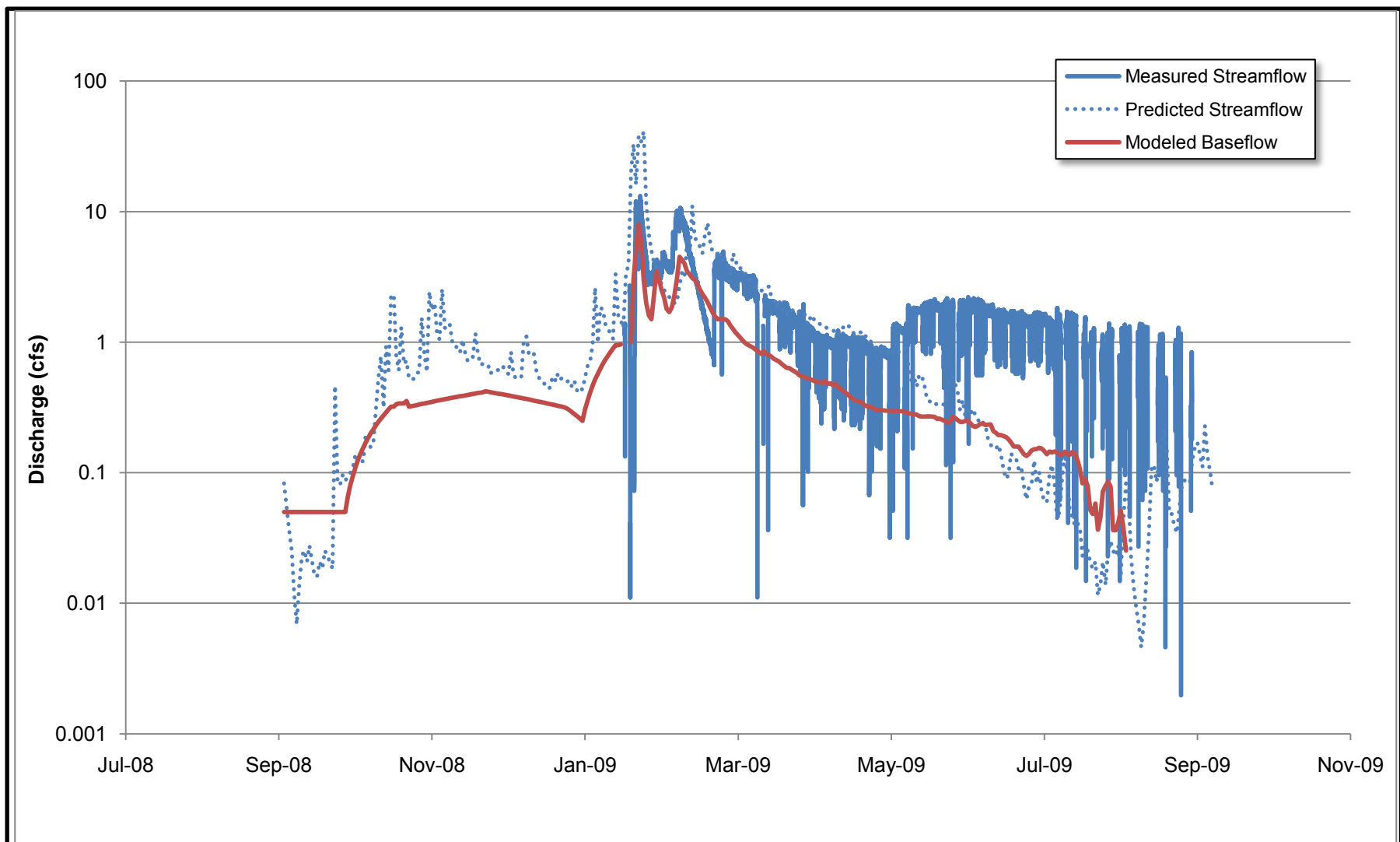
Date May 2010

Drawn	DH
Checked	SDT
Reviewed	DB

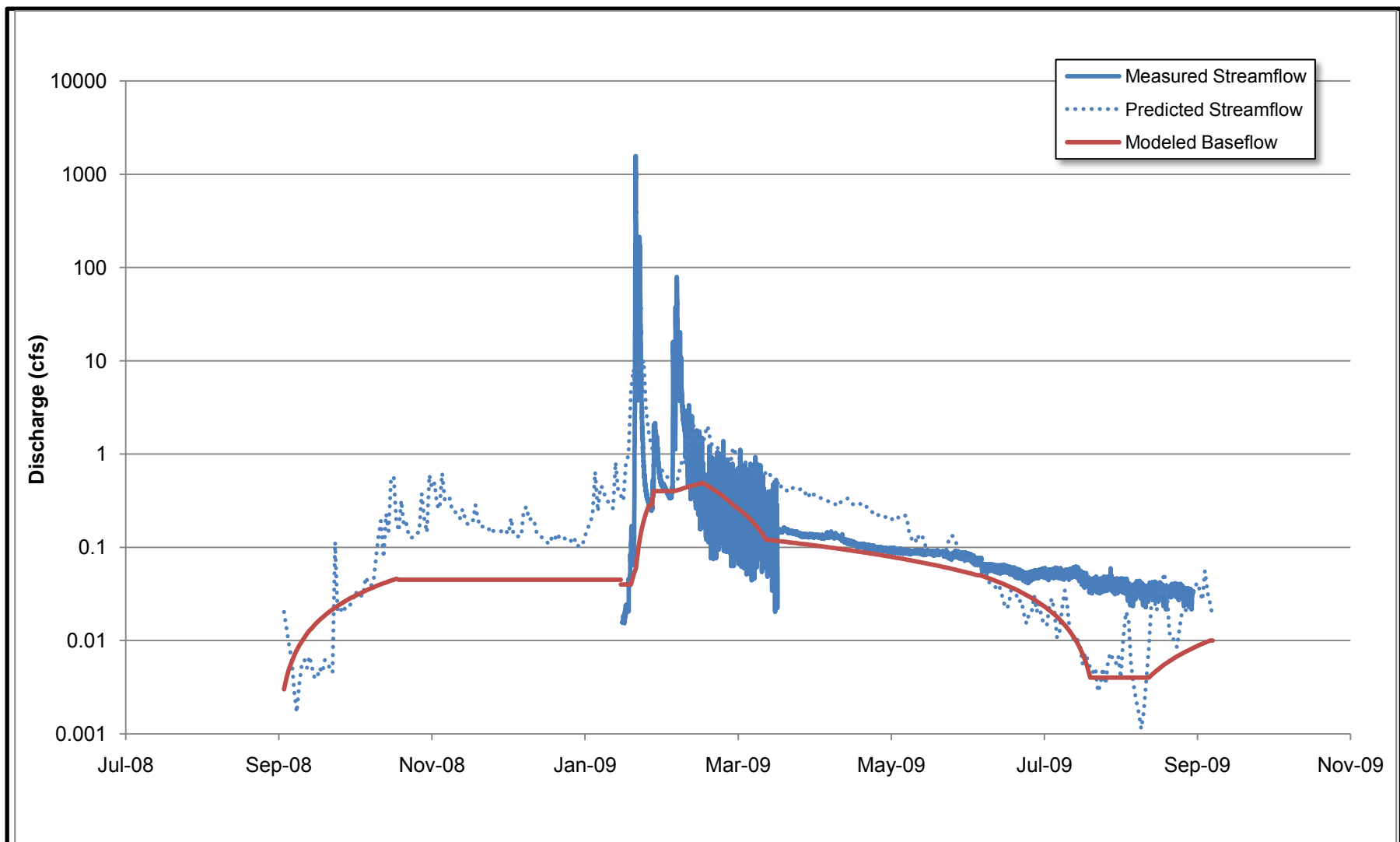
FIGURE 4.11



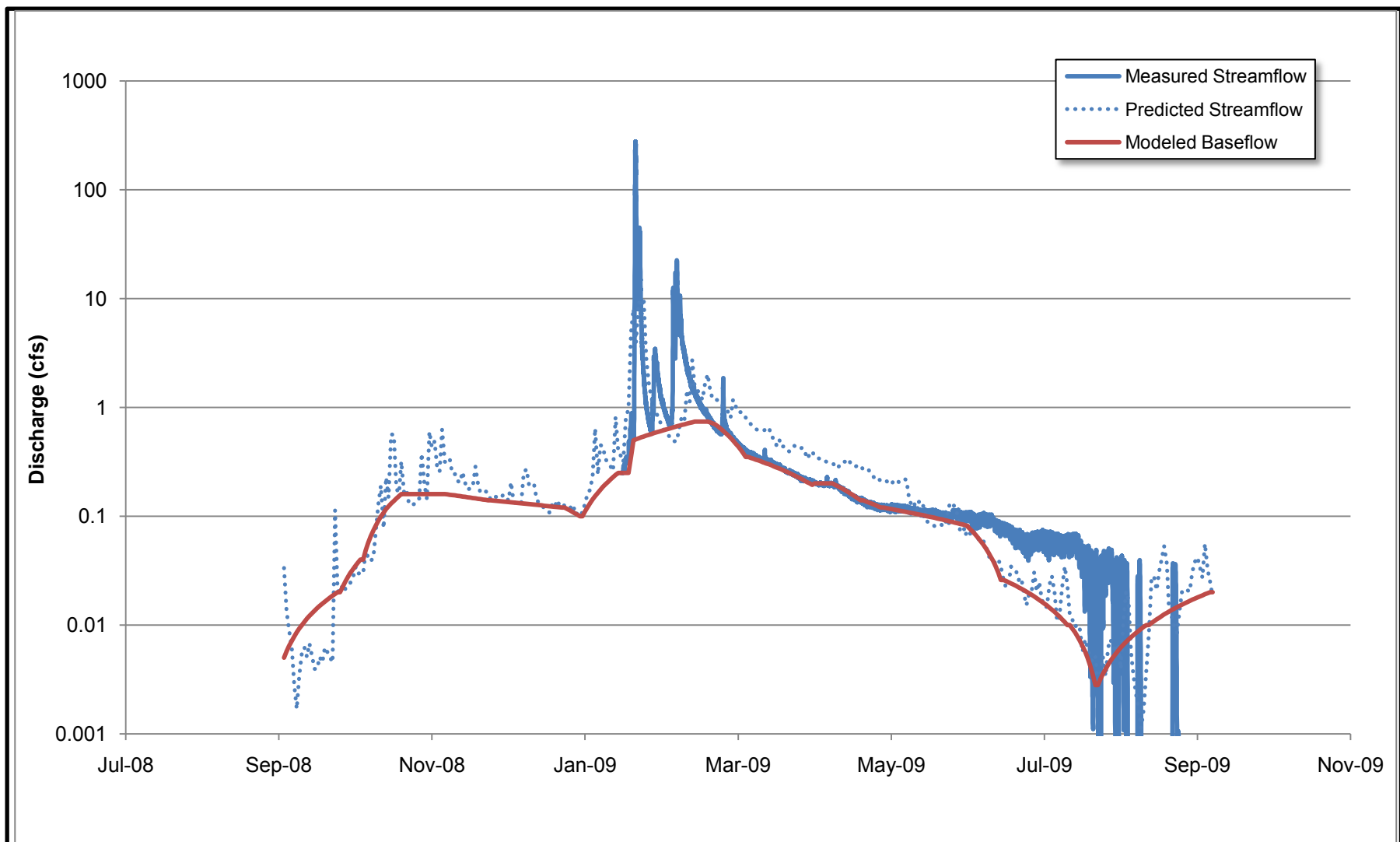
Title MS-1 Baseflow Separation Hydrograph			Drawn	JP/DH	
			Checked	SDT	
Project Name Hydrologic Investigation		Project No.	063-7109-500	Reviewed	DB
Client Name Permanente Quarry Reclamation Plan Update		Date	May 2010	FIGURE 4.12	



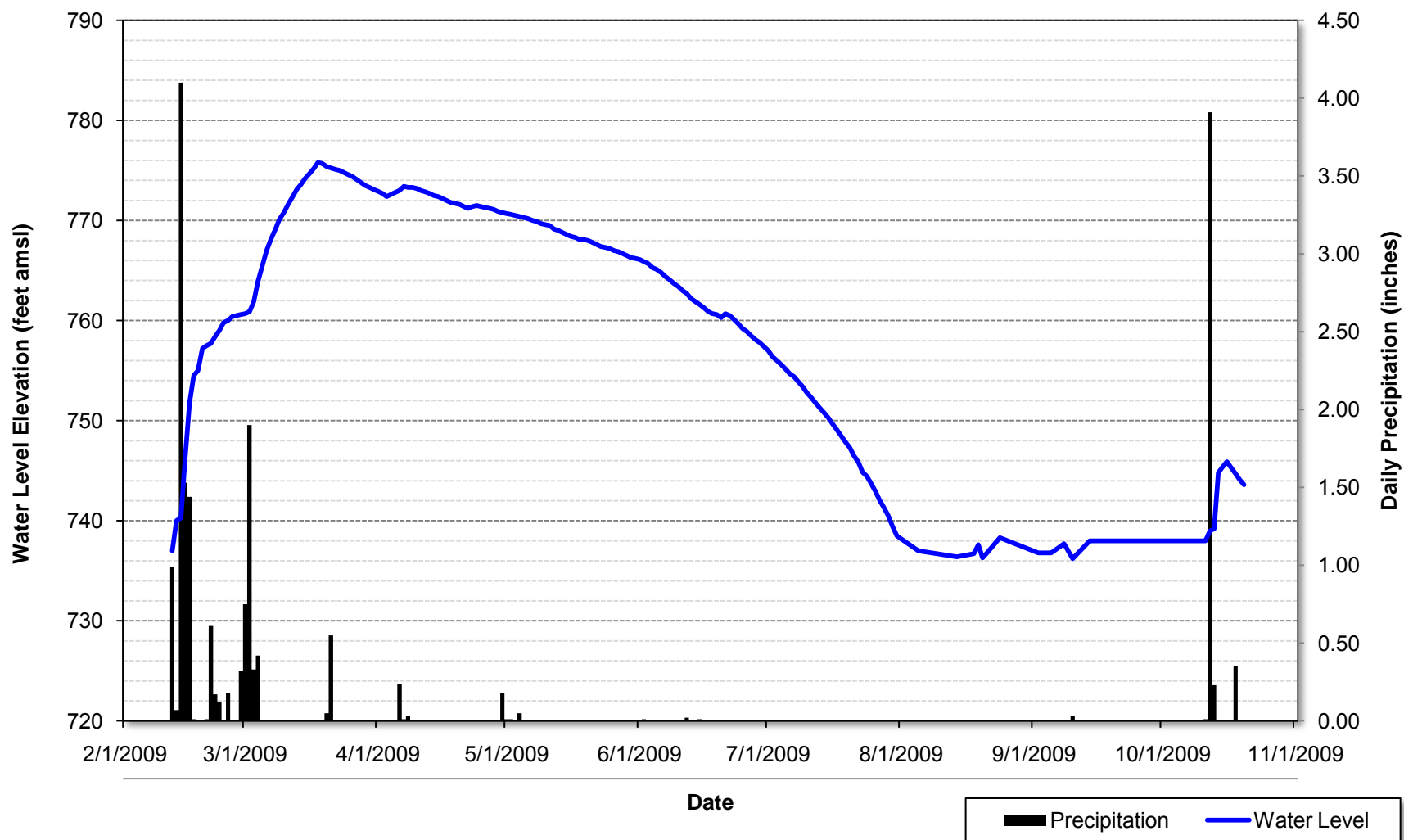
TitleMS-2 Baseflow Separation Hydrograph				Drawn	JP/DH
				Checked	SDT
Project NameHydrologic Investigation		Project No.063-7109-500		Reviewed	DB
Client NamePermanent Quarry Reclamation Plan Update		DateMay 2010		FIGURE4.13	



TitleMS-3 Baseflow Separation Hydrograph				Drawn	JP/DH
				Checked	SDT
Project NameHydrologic Investigation		Project No.063-7109-500		Reviewed	DB
Client NamePermanent Quarry Reclamation Plan Update		DateMay 2010		FIGURE4.14	



Title MS-4 Baseflow Separation Hydrograph				Drawn	JP/DH
				Checked	SDT
Project Name Hydrologic Investigation		Project No. 063-7109-500		Reviewed	DB
Client Name Permanente Quarry Reclamation Plan Update		Date May 2010		FIGURE 4.15	



Title North Quarry Water Level and Daily Precipitation

Project Name Hydrologic Investigation

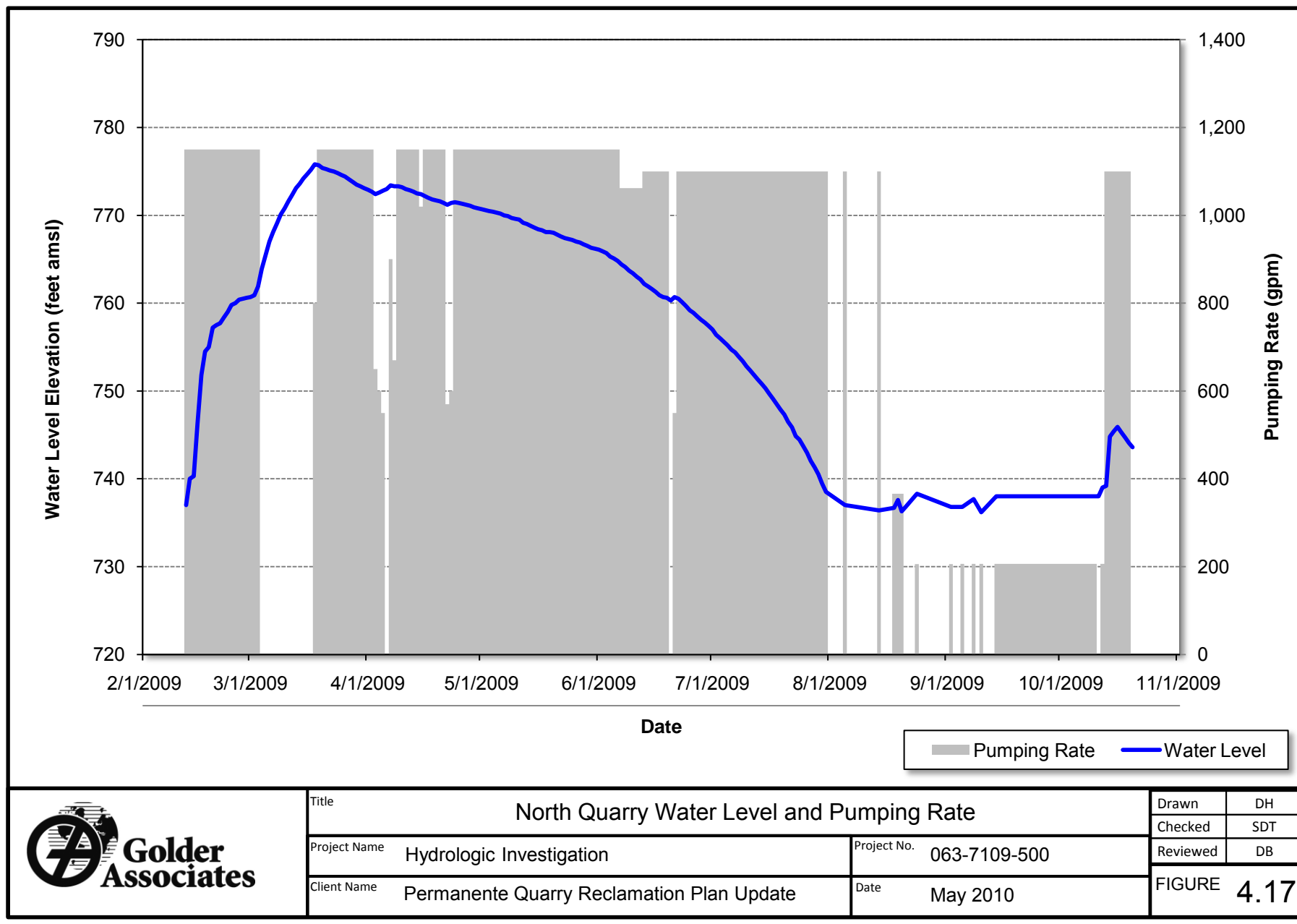
Project No. 063-7109-500

Client Name Permanente Quarry Reclamation Plan Update

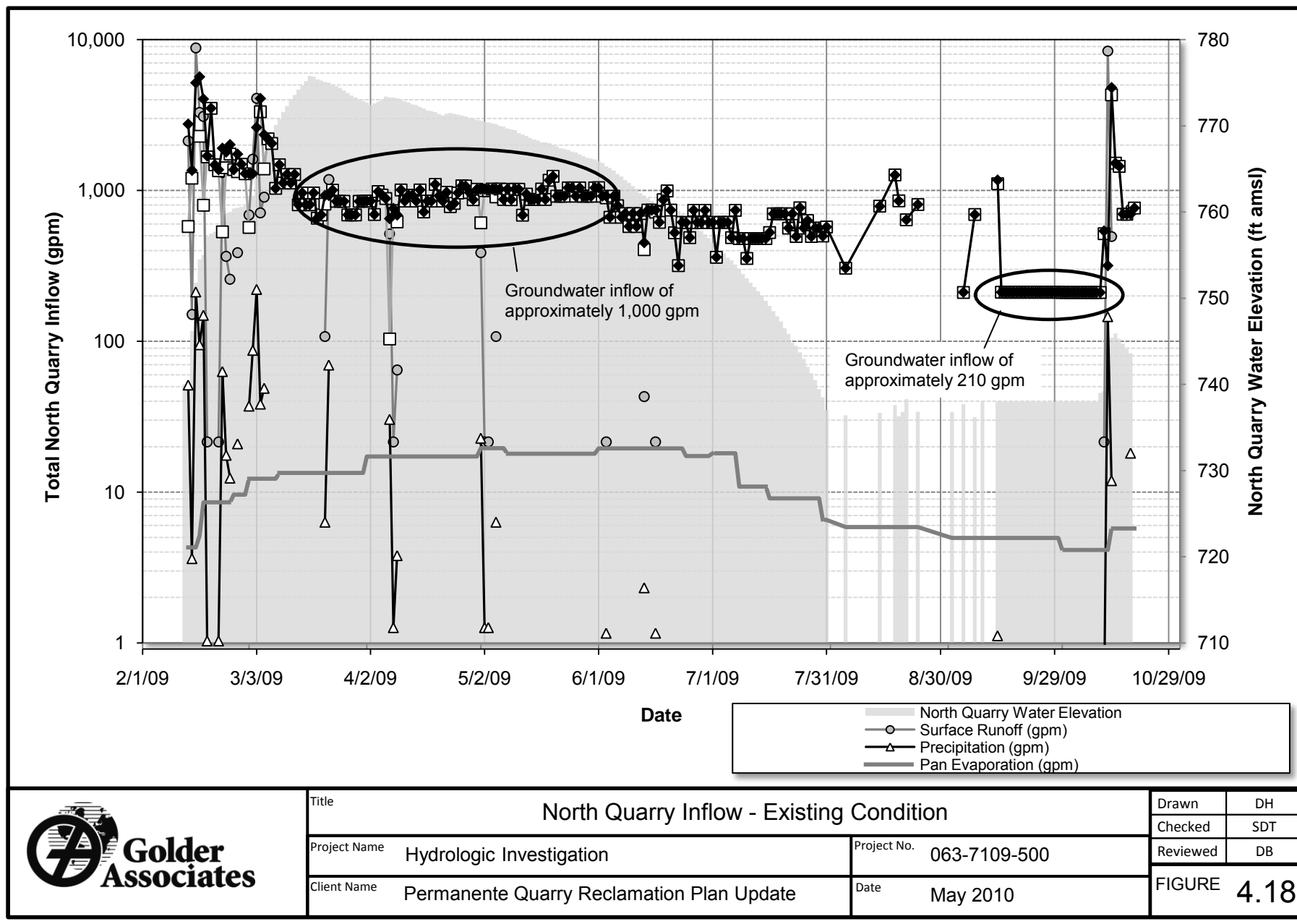
Date May 2010

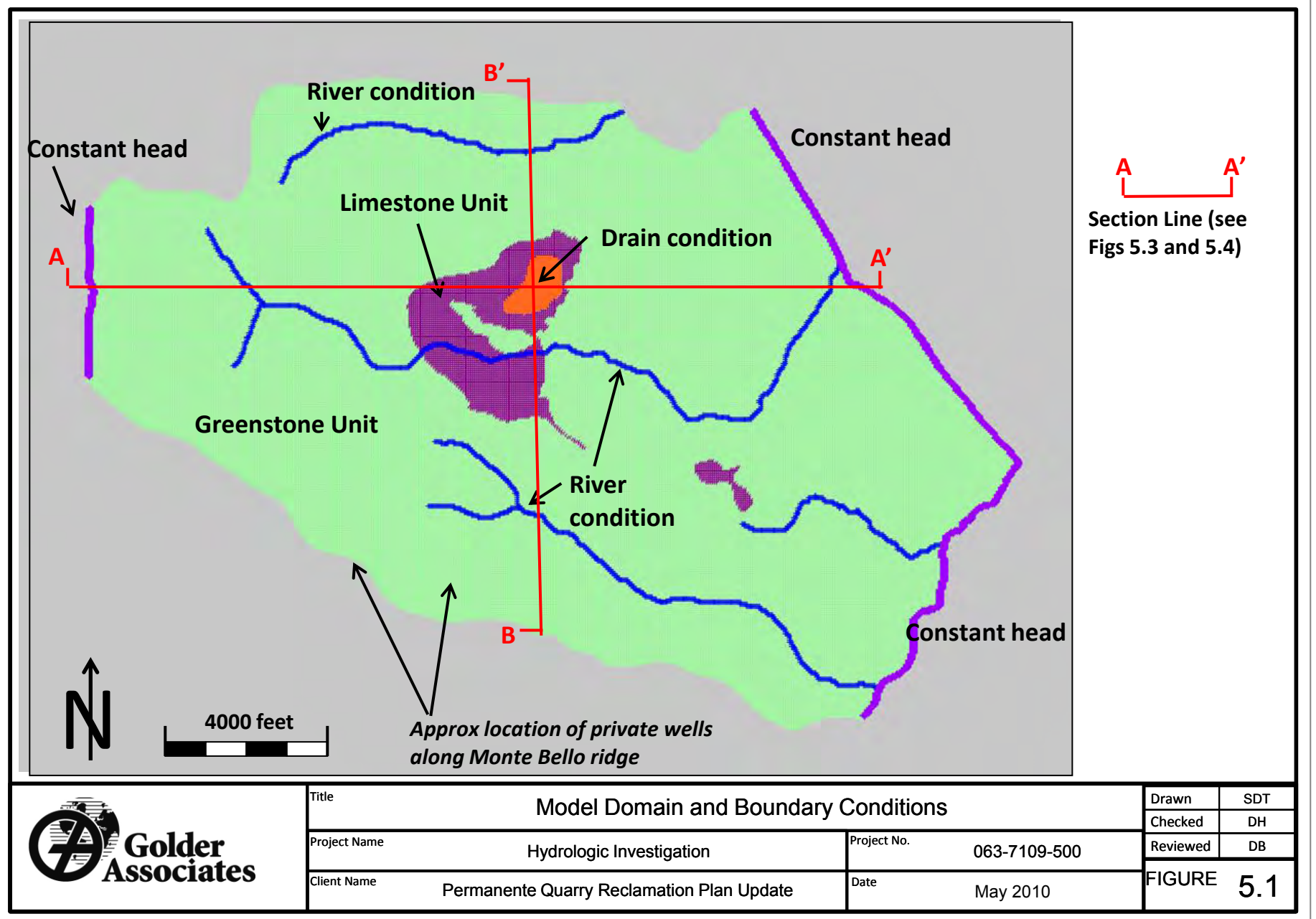
Drawn	DH
Checked	SDT
Reviewed	DB

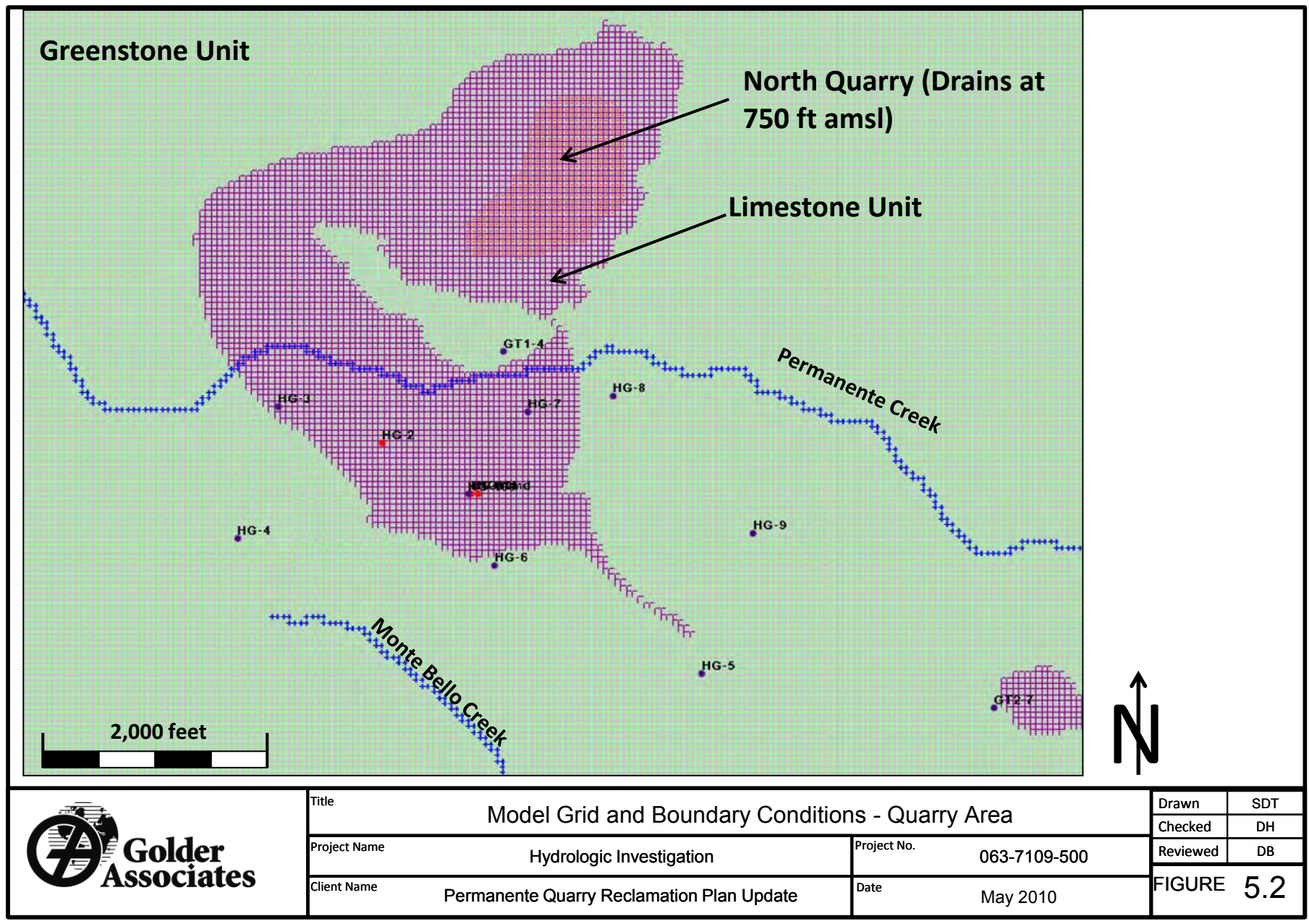
FIGURE 4.16

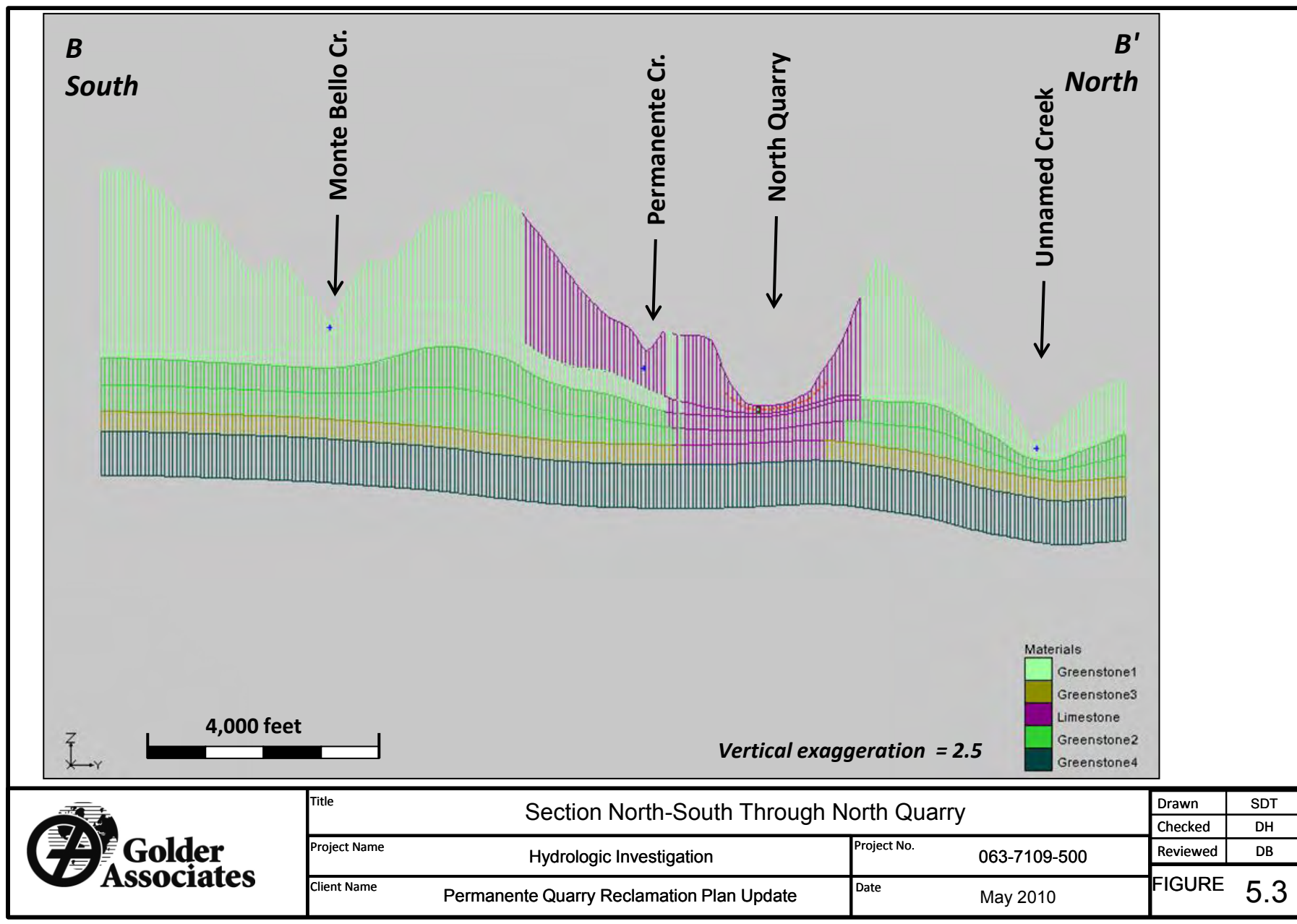


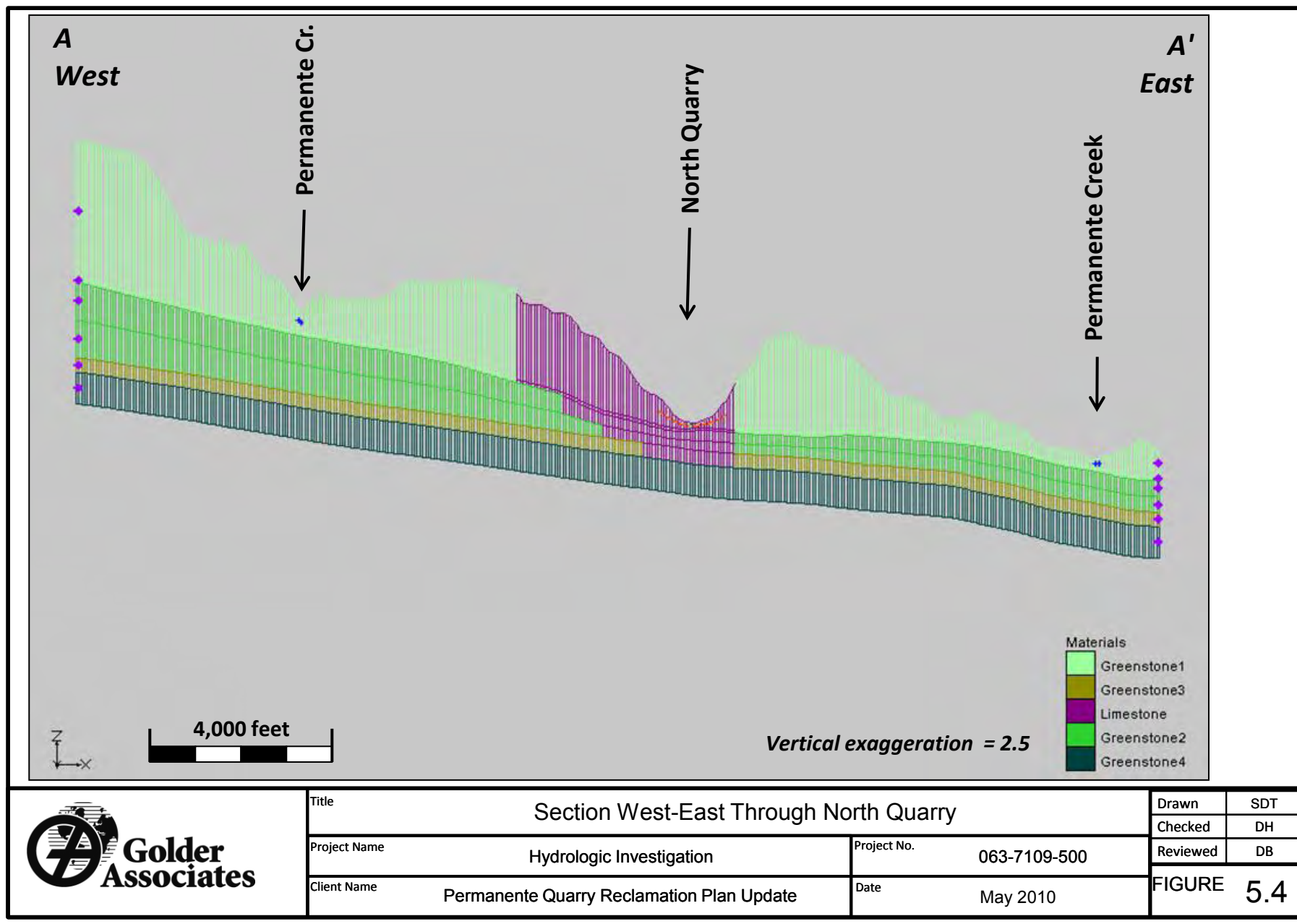
Title North Quarry Water Level and Pumping Rate			Drawn	DH	
			Checked	SDT	
Project Name	Hydrologic Investigation	Project No.	063-7109-500	Reviewed	DB
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010	FIGURE 4.17	

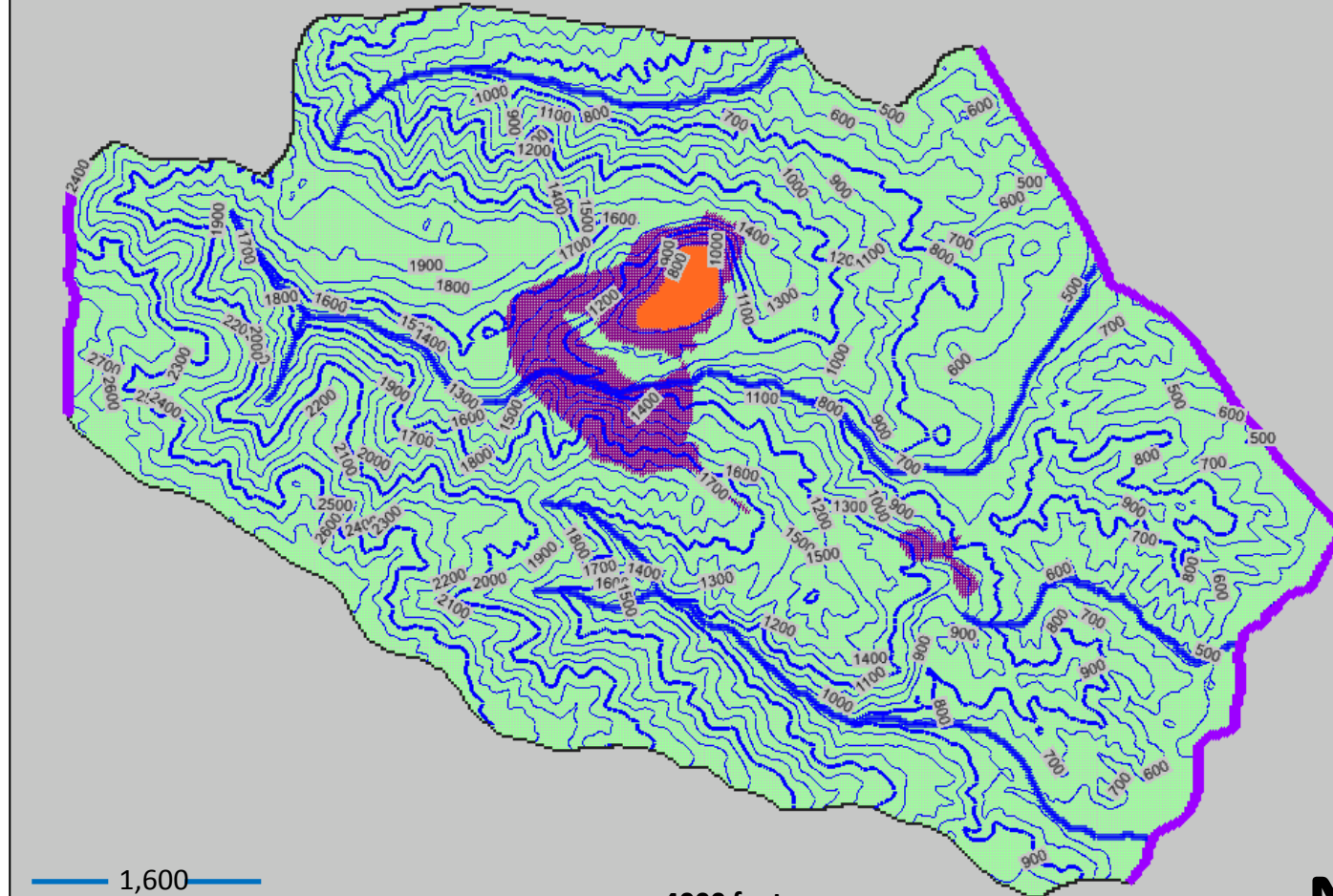












1,600

Topographic elevation (ft amsl)

4000 feet



Title

Model Top Surface - Current Conditions

Project Name

Hydrologic Investigation

Project No.

063-7109-500

Client Name

Permanente Quarry Reclamation Plan Update

Date

May 2010

Drawn

SDT

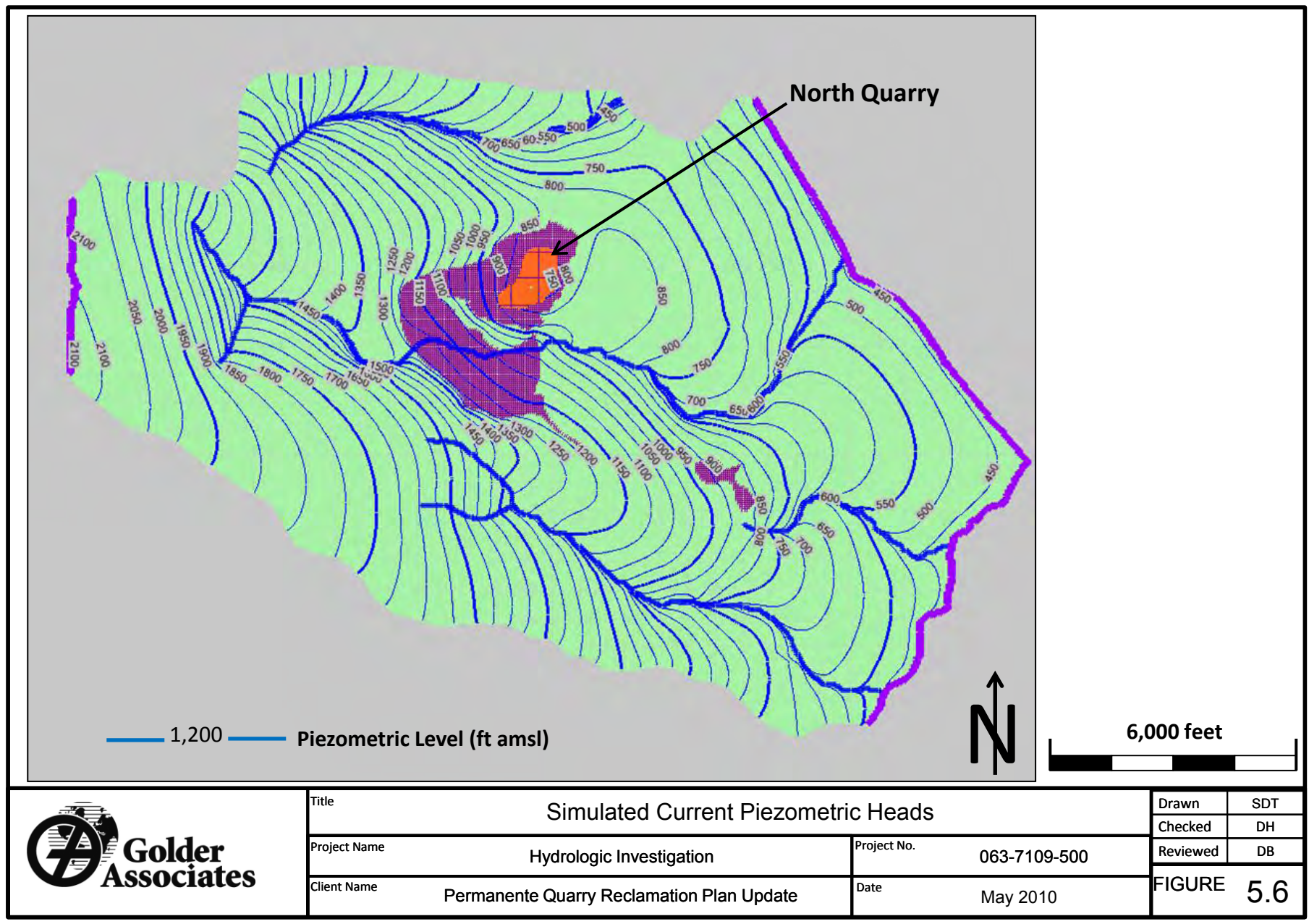
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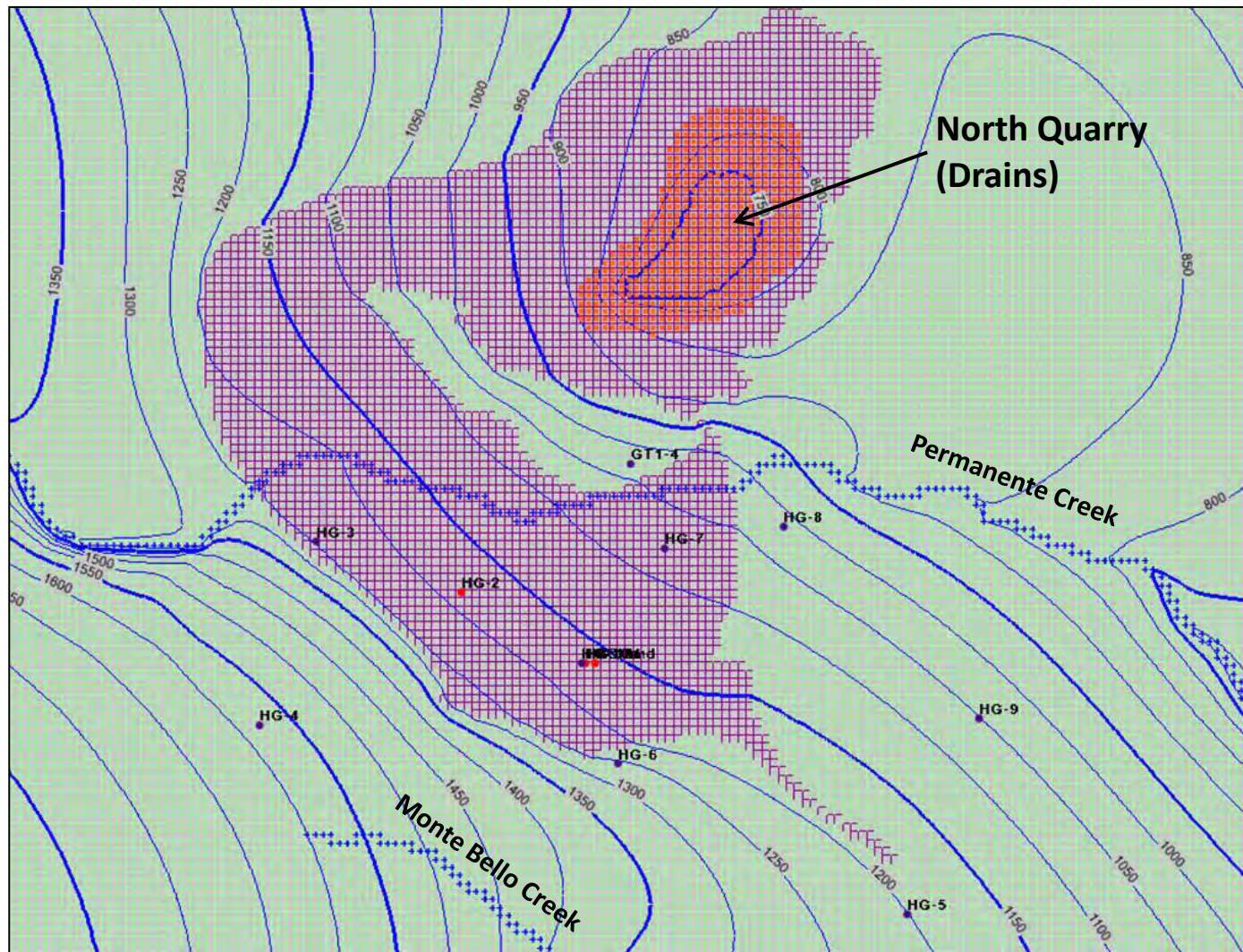
DH

Reviewed

DB

FIGURE 5.5



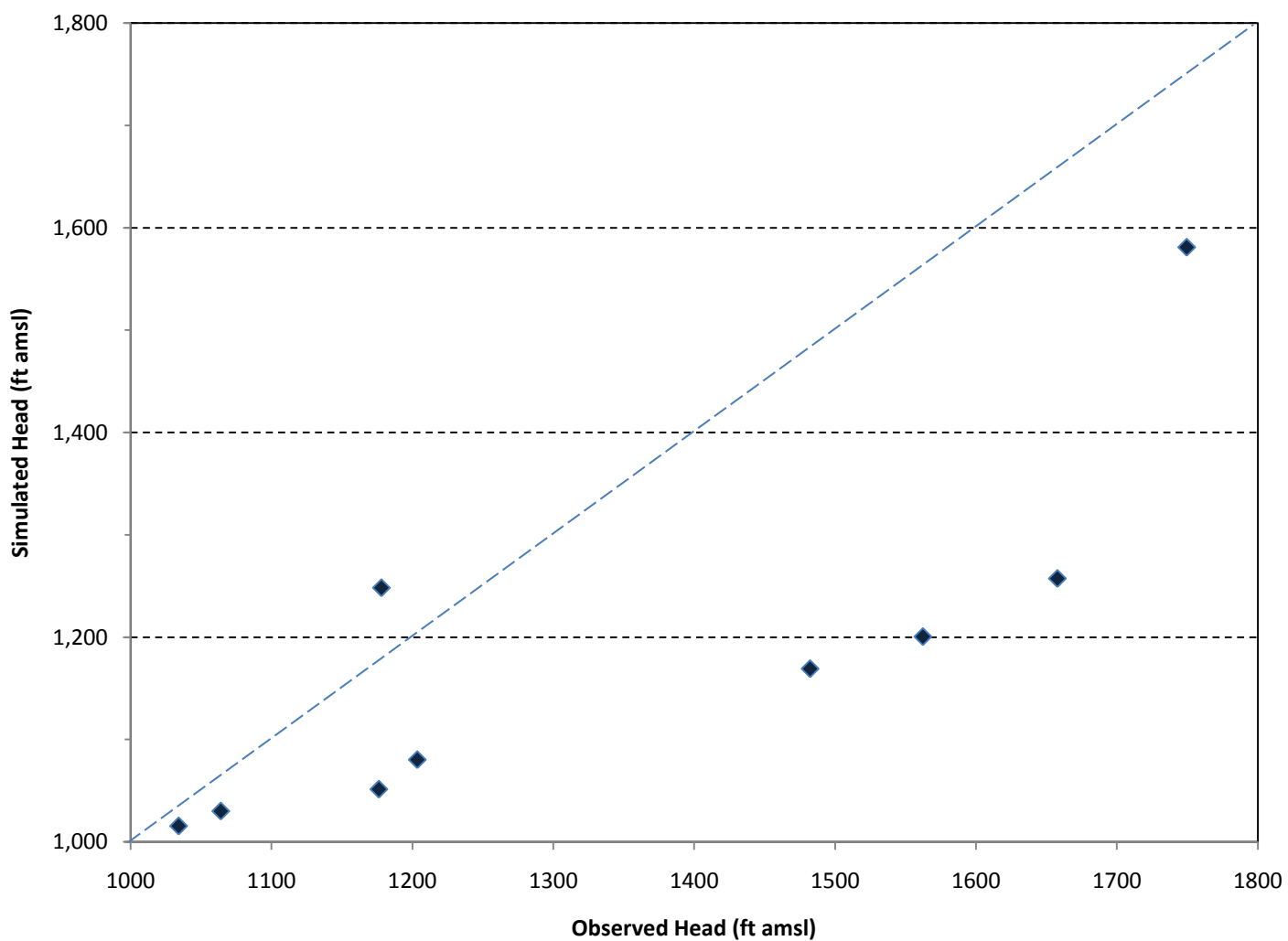


1,200  
Piezometric Level  
(ft amsl)

1,600 feet



Title		Simulated Current Piezometric Heads – Quarry Area		Drawn	SDT
Project Name		Hydrologic Investigation		Checked	DH
Client Name		Permanente Quarry Reclamation Plan Update		Reviewed	DB
		Project No. 063-7109-500		FIGURE 5.7	
		Date May 2010			



Title Calibrated versus Observed heads – October 2009

Project Name Hydrologic Investigation

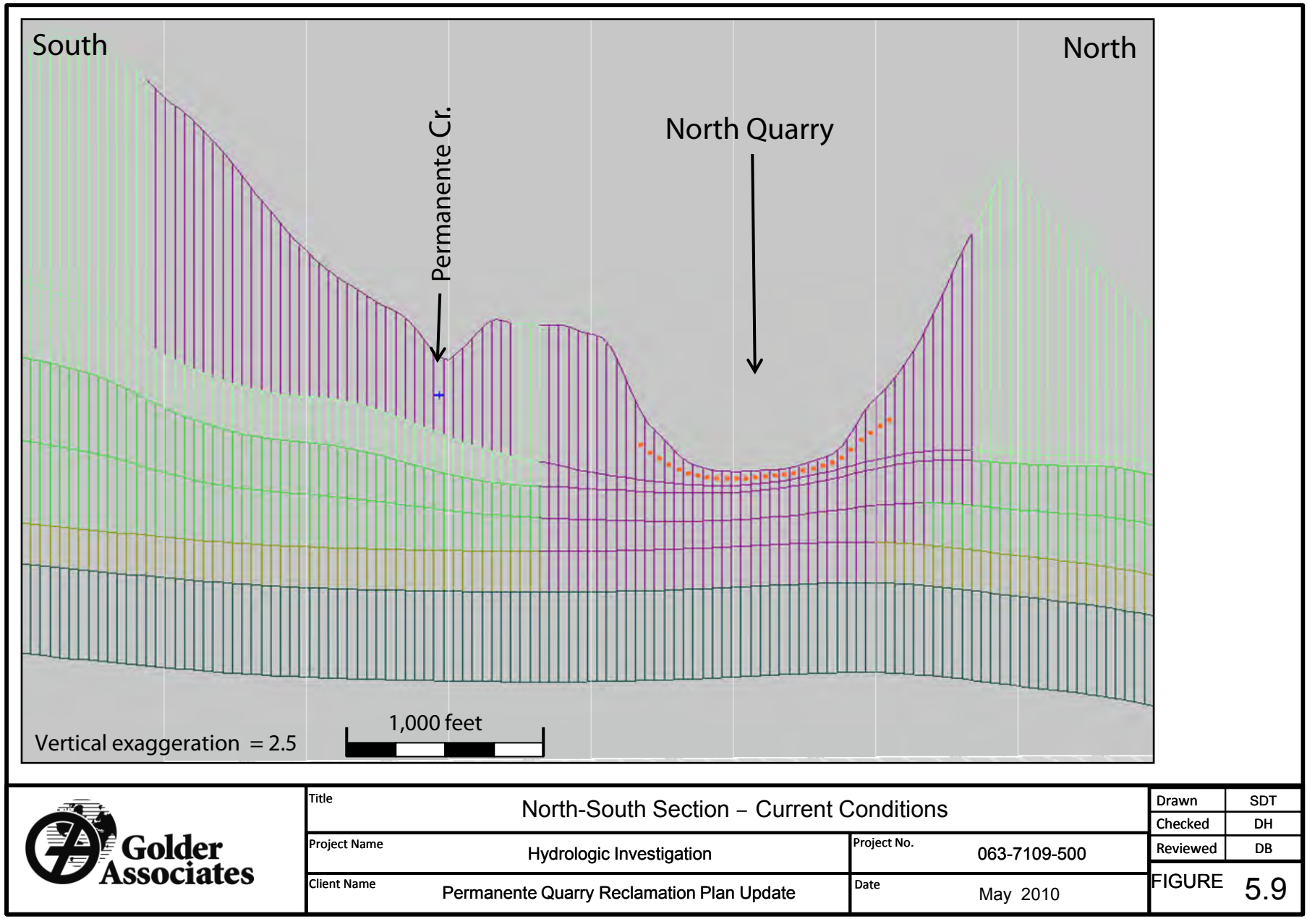
Project No. 063-7109-500

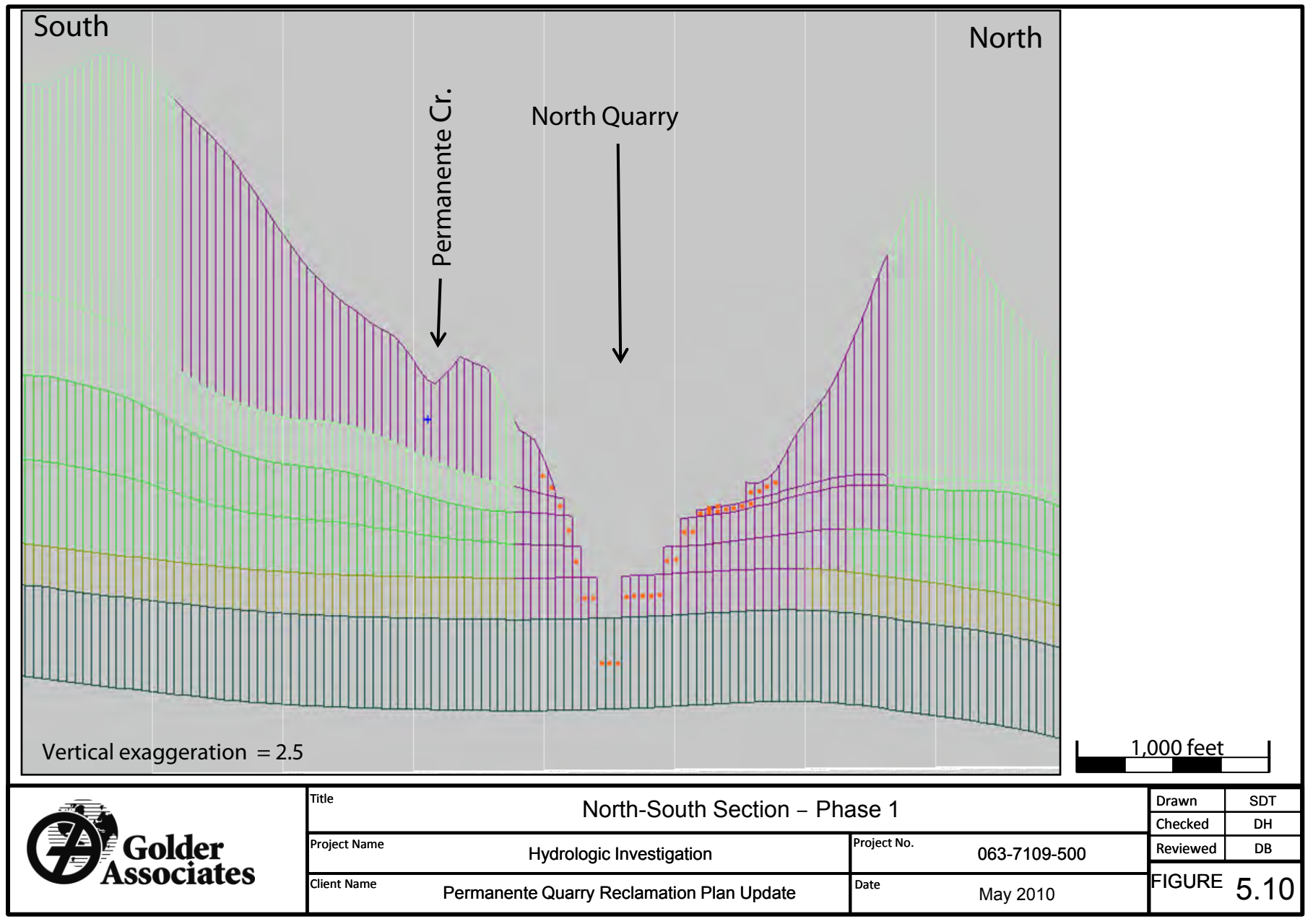
Client Name Permanente Quarry Reclamation Plan Update

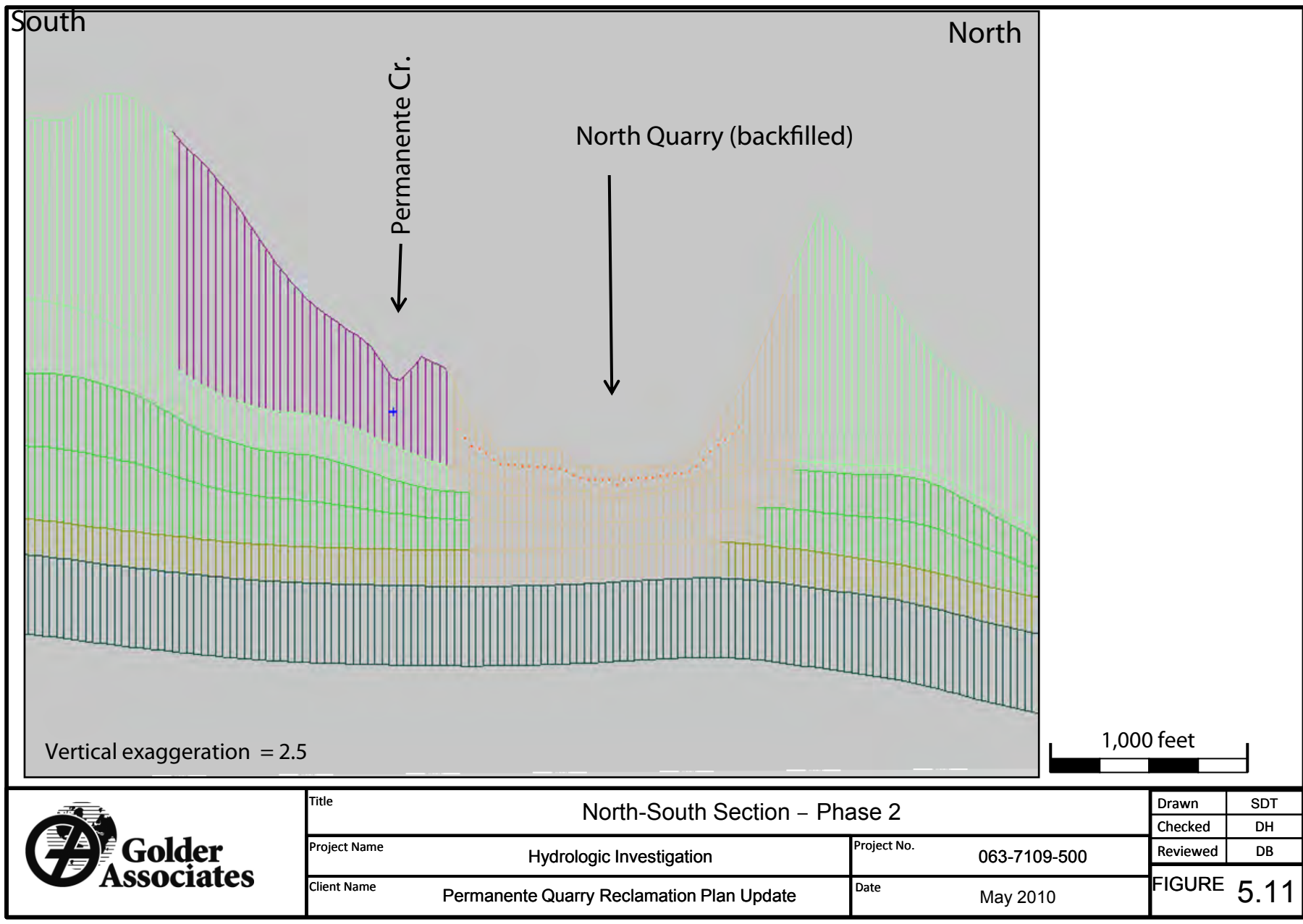
Date May 2010

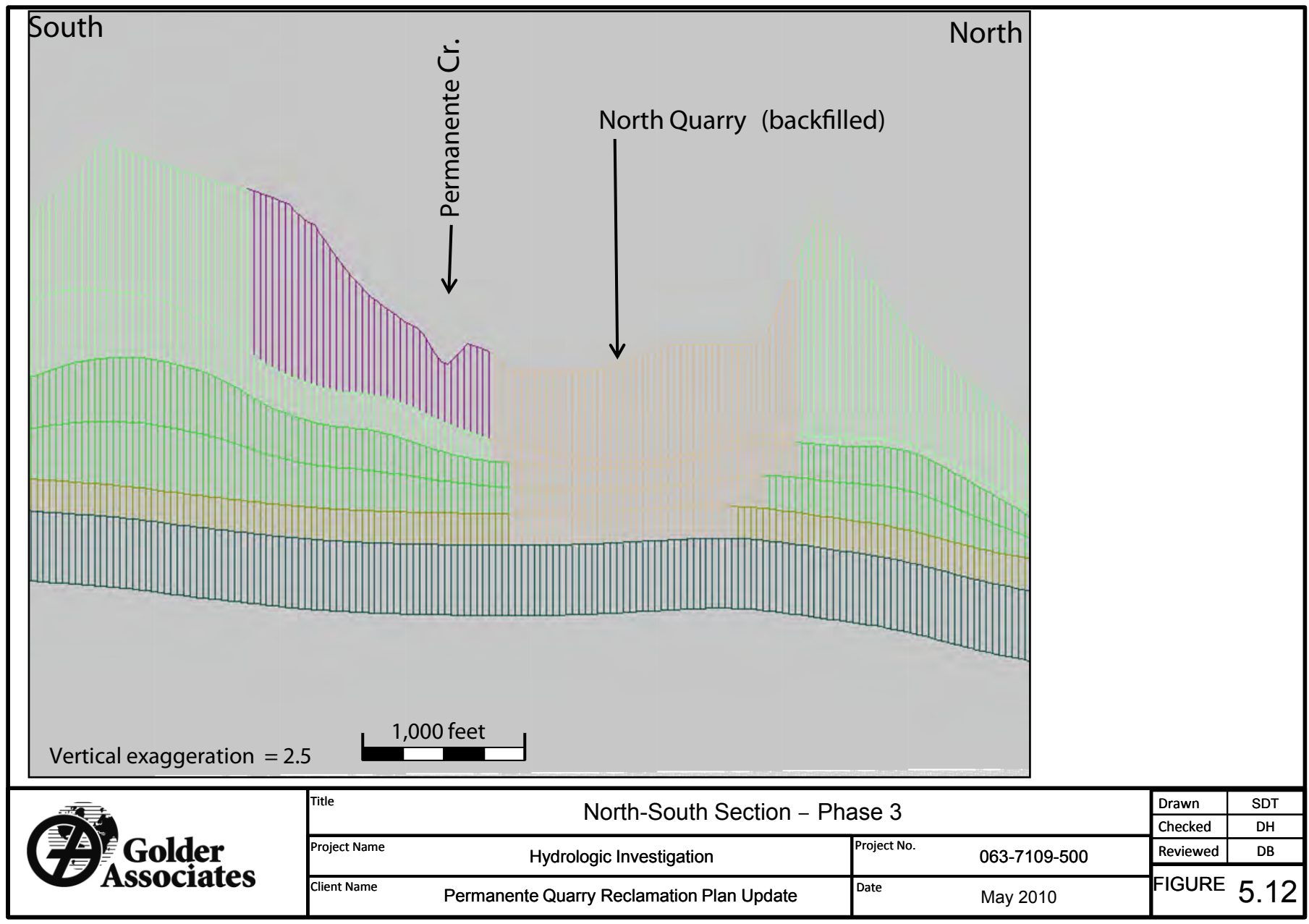
Drawn	SDT
Checked	DH
Reviewed	DB

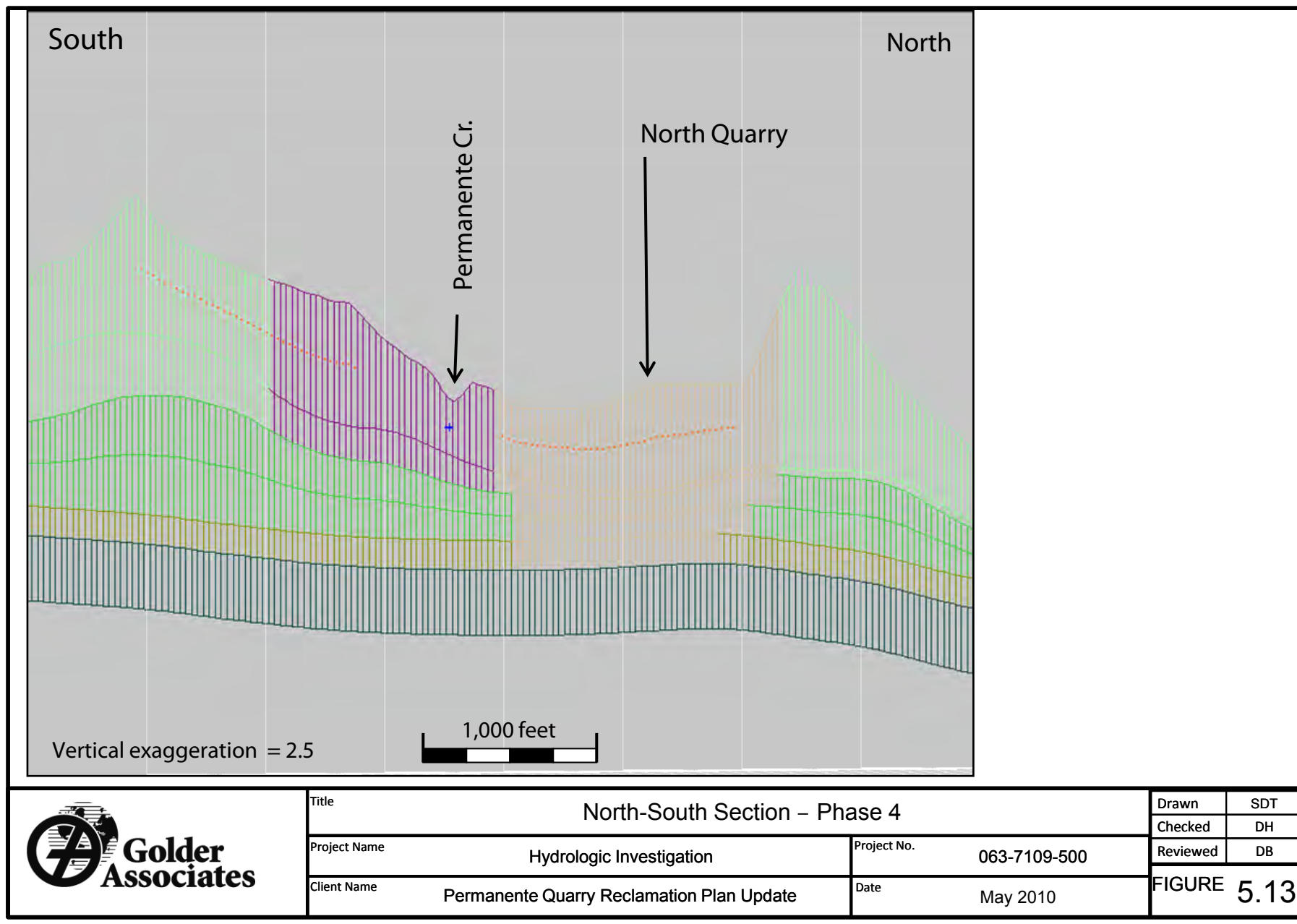
FIGURE 5.8

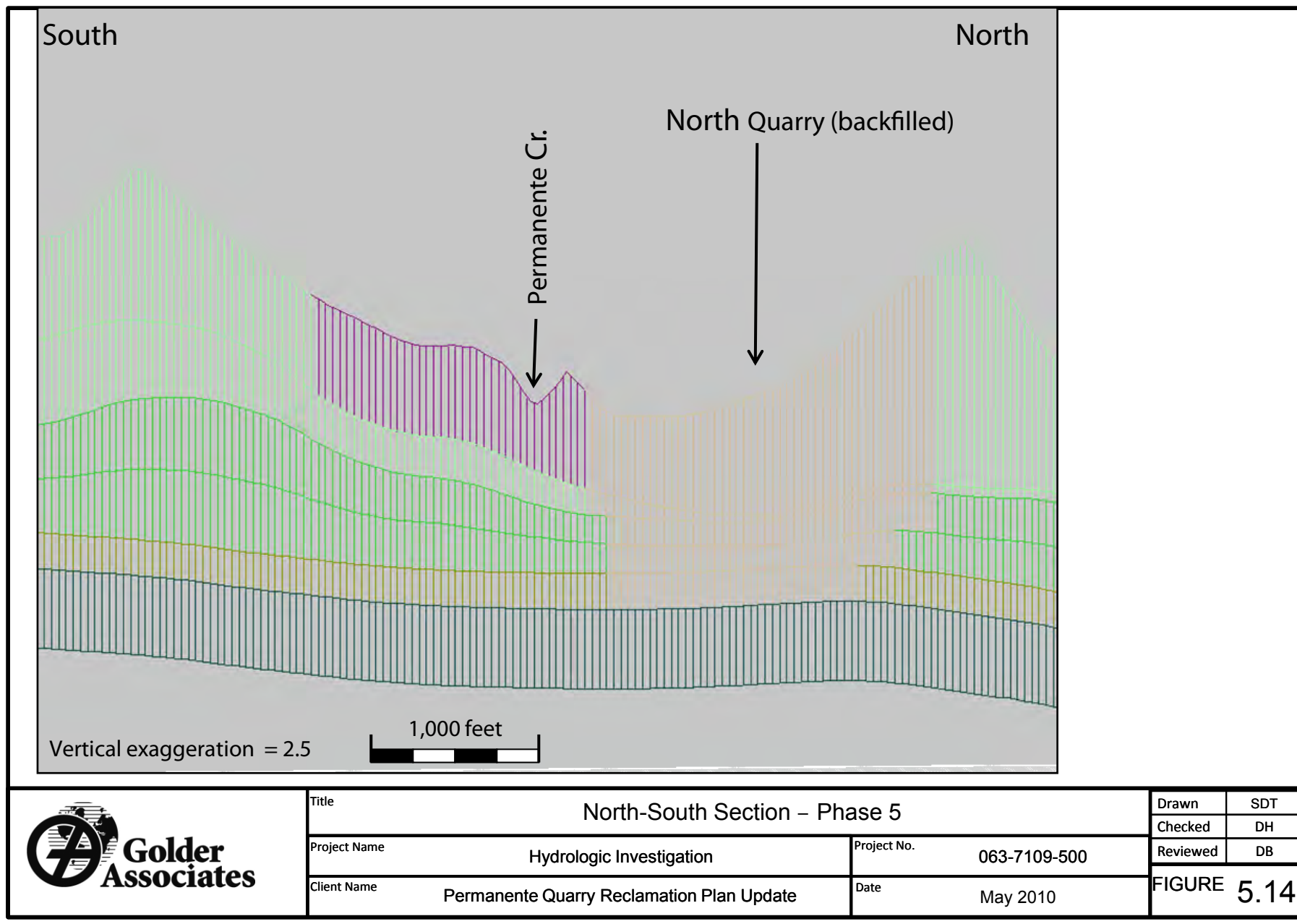


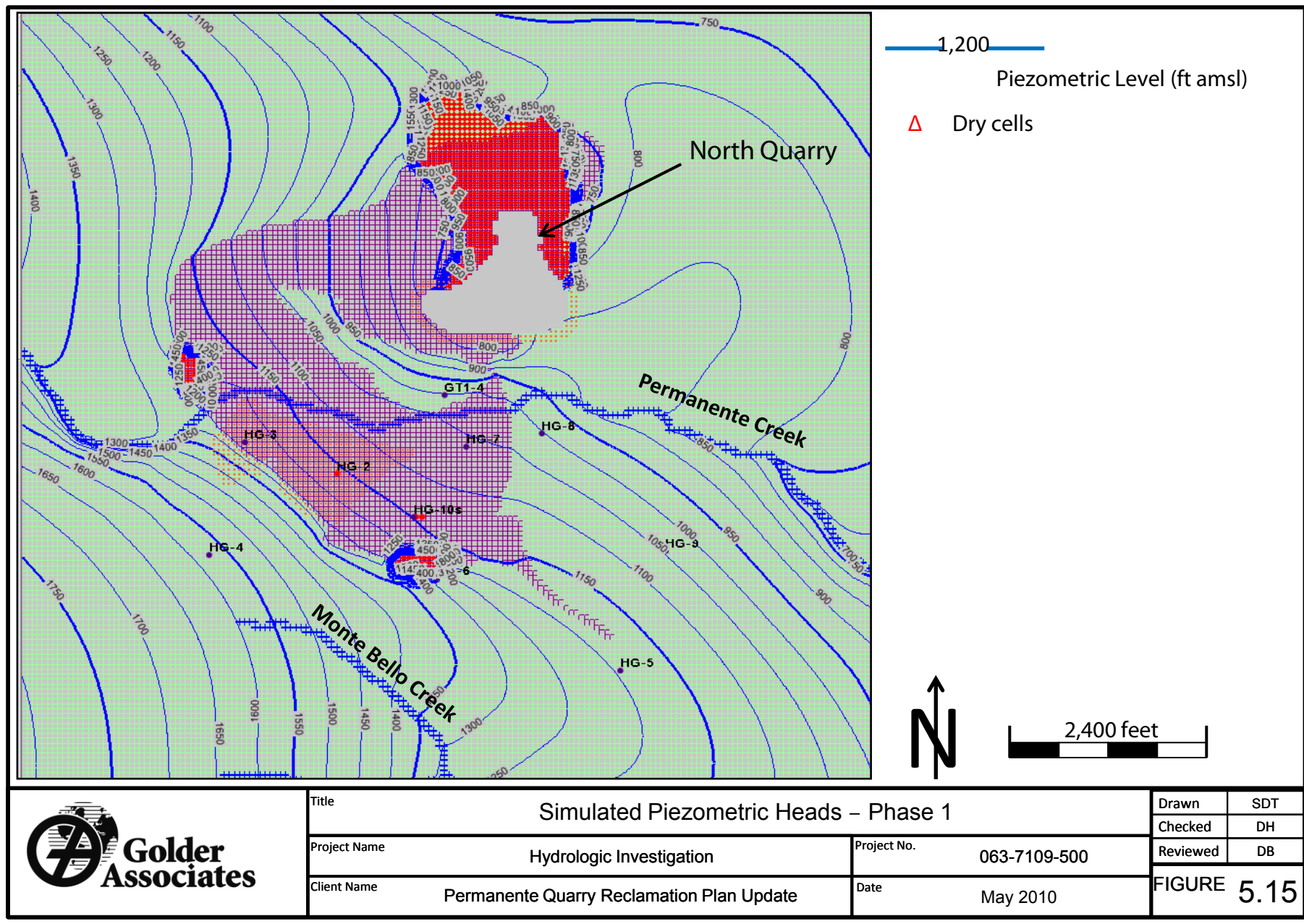


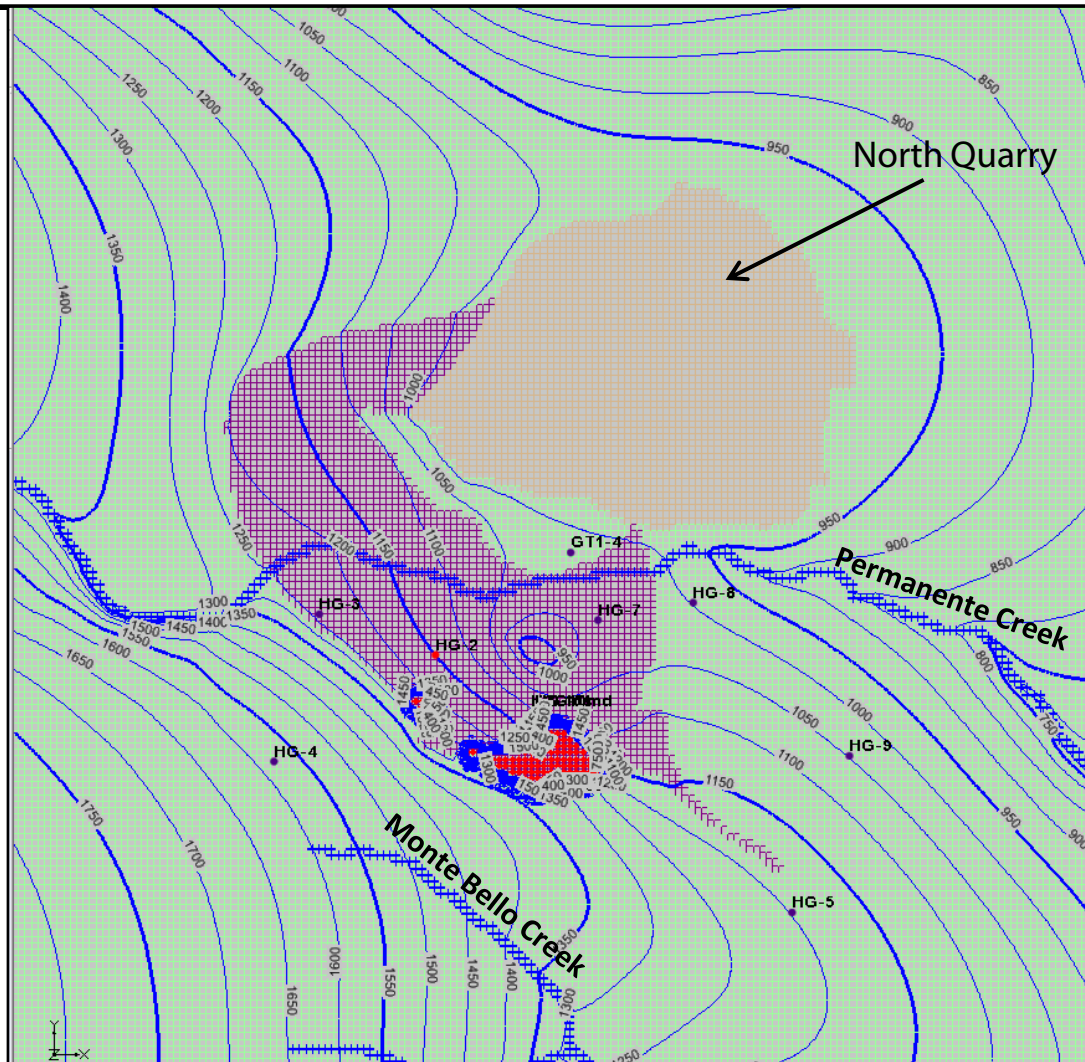












— 1,200 —  
Piezometric Level (ft amsl)

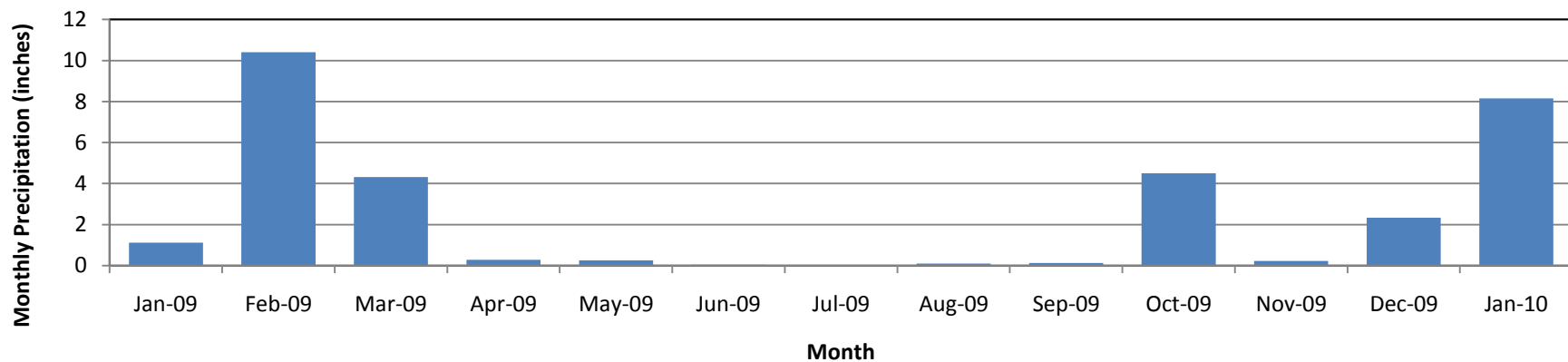
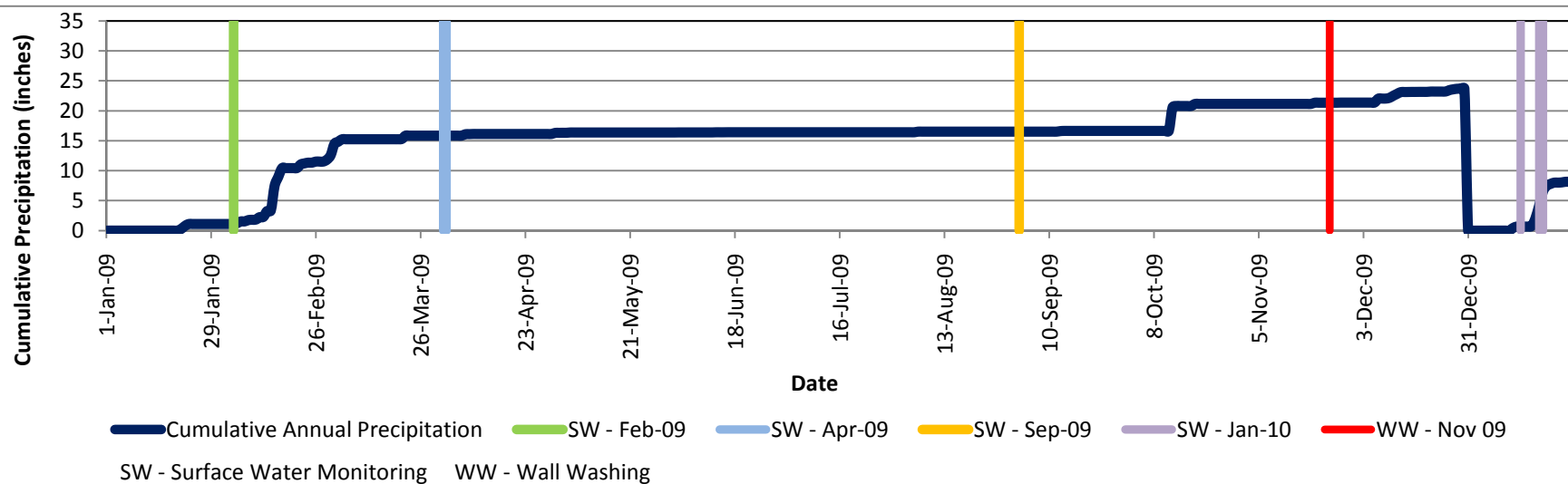
△ Dry cells



2,400 feet

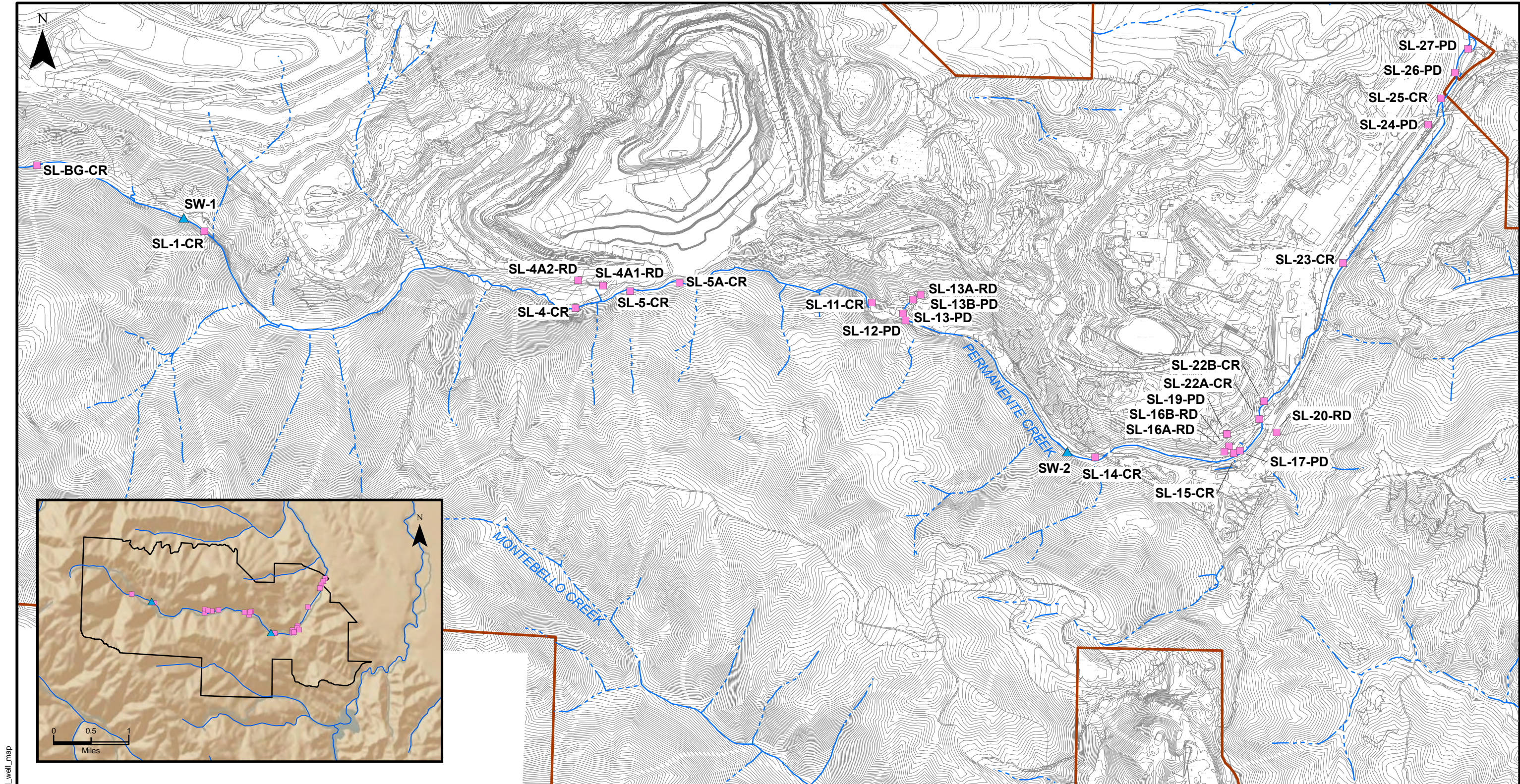


Title Simulated Piezometric Heads – Phase 5				Drawn	SDT
				Checked	DH
Project Name Hydrologic Investigation		Project No. 063-7109-500		Reviewed	DB
Client Name Permanente Quarry Reclamation Plan Update		Date May 2010		FIGURE 5.16	



Title <b>Site Precipitation vs. Surface Water and Wall Washing Sampling Events</b>		Drawn CR
Project Name Hydrologic Investigation	Project No. 063-7109.500	Checked FV
Client Name Lehigh Southwest Cement Company	Date May 2010	Reviewed DB

**FIGURE 6.1**

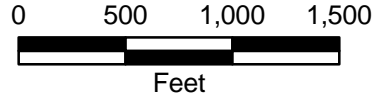


**LEGEND**

- ▲ Surface water sample location (Golder, 2009)
- Storm water sample location (URS Corporation, June 2008)
- Facility boundary

**REFERENCES**

Spatial Reference:  
NAD 1983 StatePlane California III FIPS 0403 Feet



PROJECT		HYDROLOGIC INVESTIGATION PERMANENTE QUARRY RECLAMATION PLAN UPDATE SANTA CLARA COUNTY, CALIFORNIA			
TITLE		STORM WATER SAMPLE LOCATIONS			
		PROJECT No.	063-7109	FILE No.	
		DESIGN	DLM	2/8/2010	SCALE: AS SHOWN
		GIS	DLM	2/8/2010	REV. 0
		CHECK	GW	2/8/2010	FIGURE 6.2
		REVIEW	WLF	2/8/2010	

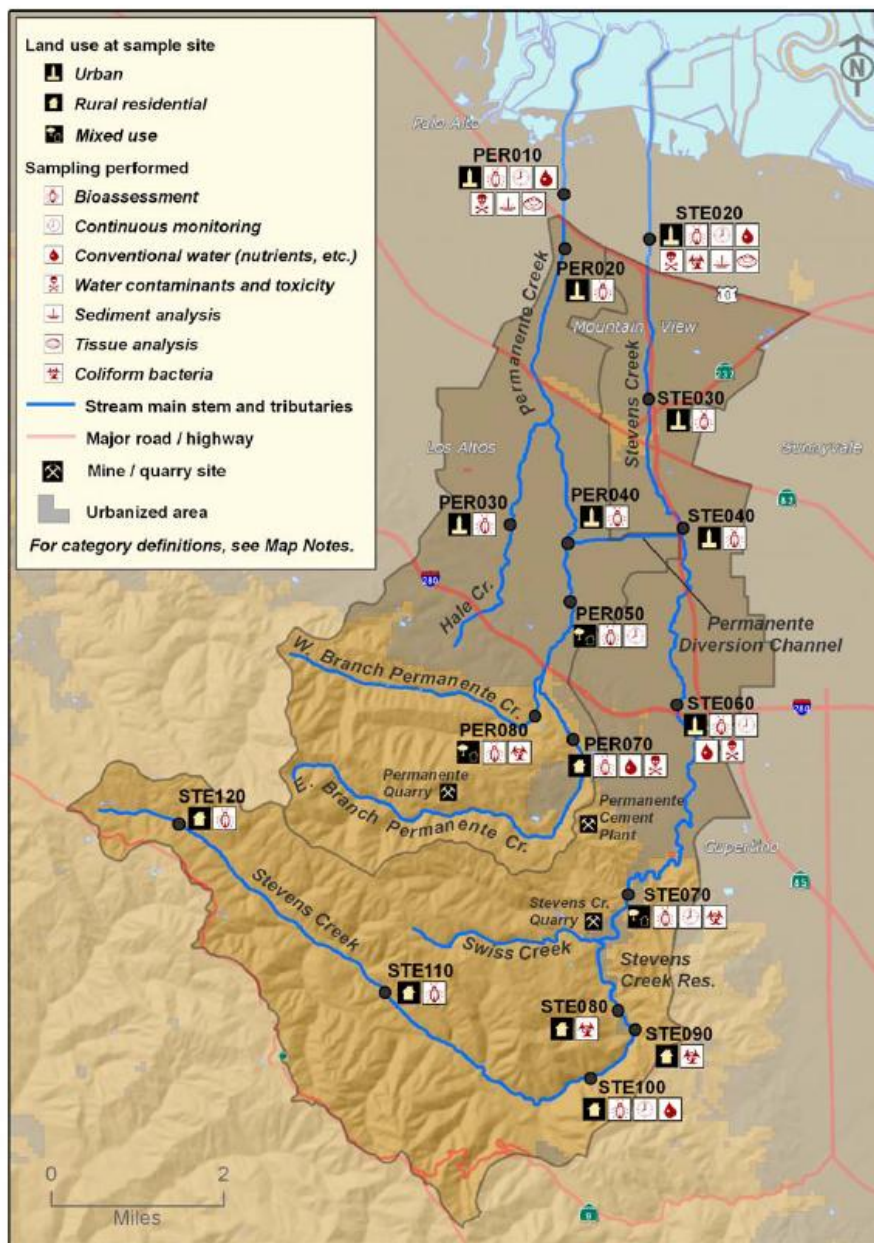



Figure 3-9. Stevens Creek and Permanente Creek watershed

San Francisco Bay Regional Water Quality Control Board  
Surface Water Ambient Monitoring Program (SWAMP)  
Watershed Survey Report 2001-2003

3-19

Source: SFBRWQCB, 2007

	Title Permanente Creek Monitoring Location - PER070 (SFBRWQCB)		Drawn	CR
	Project Name Hydrologic Investigation		Checked	RV
	Project No. 063-7109.500		Reviewed	BF
	Client Name Permanente Quarry Rec Plan Update		Date May 2010	FIGURE 6.3



Title North Quarry - Wall Washing (November 2009)				Drawn	CR
				Checked	FV
Project Name	Hydrologic Investigation	Project No.	063-7109.500	Reviewed	DB/RV
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010	FIGURE 6.4	



Title		Wall Washing - Graywacke (GW-01)	Drawn	CR
Project Name		Hydrologic Investigation	Checked	FV
Client Name		Permanente Quarry Reclamation Plan Update	Reviewed	DB/RV
		Project No.	063-7109.500	FIGURE 6.5
		Date	May 2010	



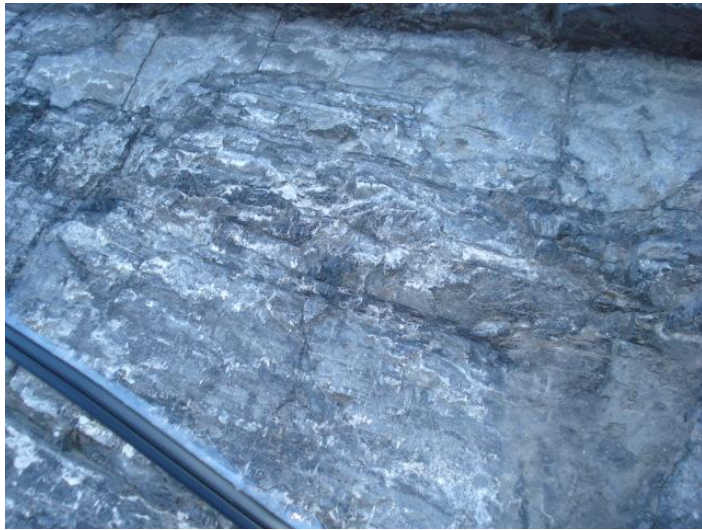
Title		Wall Washing - Chert Sample (CT-01)	Drawn	CR
Project Name		Hydrologic Investigation	Checked	FV
Client Name		Permanente Quarry Reclamation Plan Update	Reviewed	DB/RV
		Project No. 063-7109.500	FIGURE 6.6	
		Date May 2010		



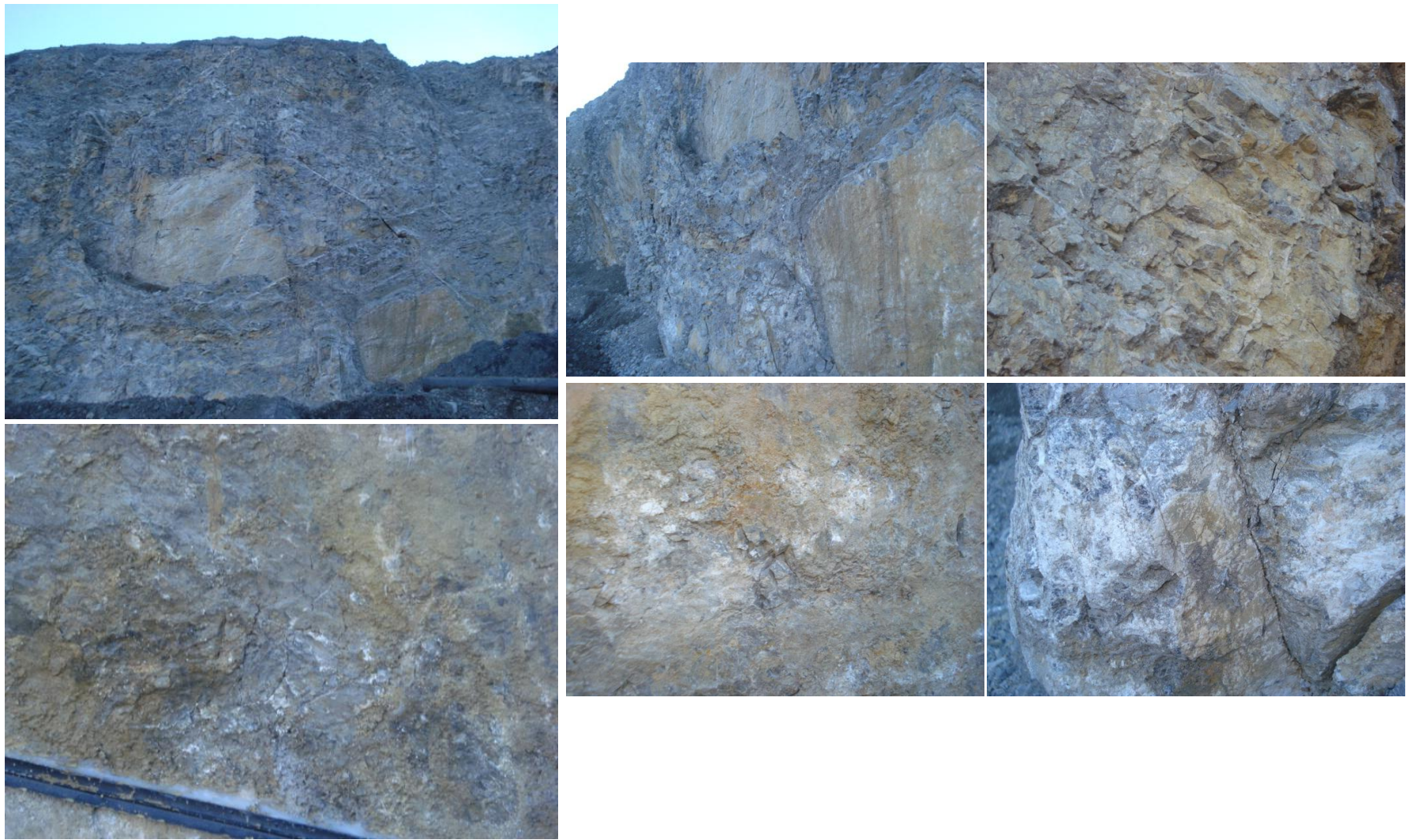
Title Wall Washing - Greenstone (GS-01)			Drawn	CR	
			Checked	FV	
Project Name	Hydrologic Investigation	Project No.	063-7109.500	Reviewed	DB/RV
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010	FIGURE 6.7	



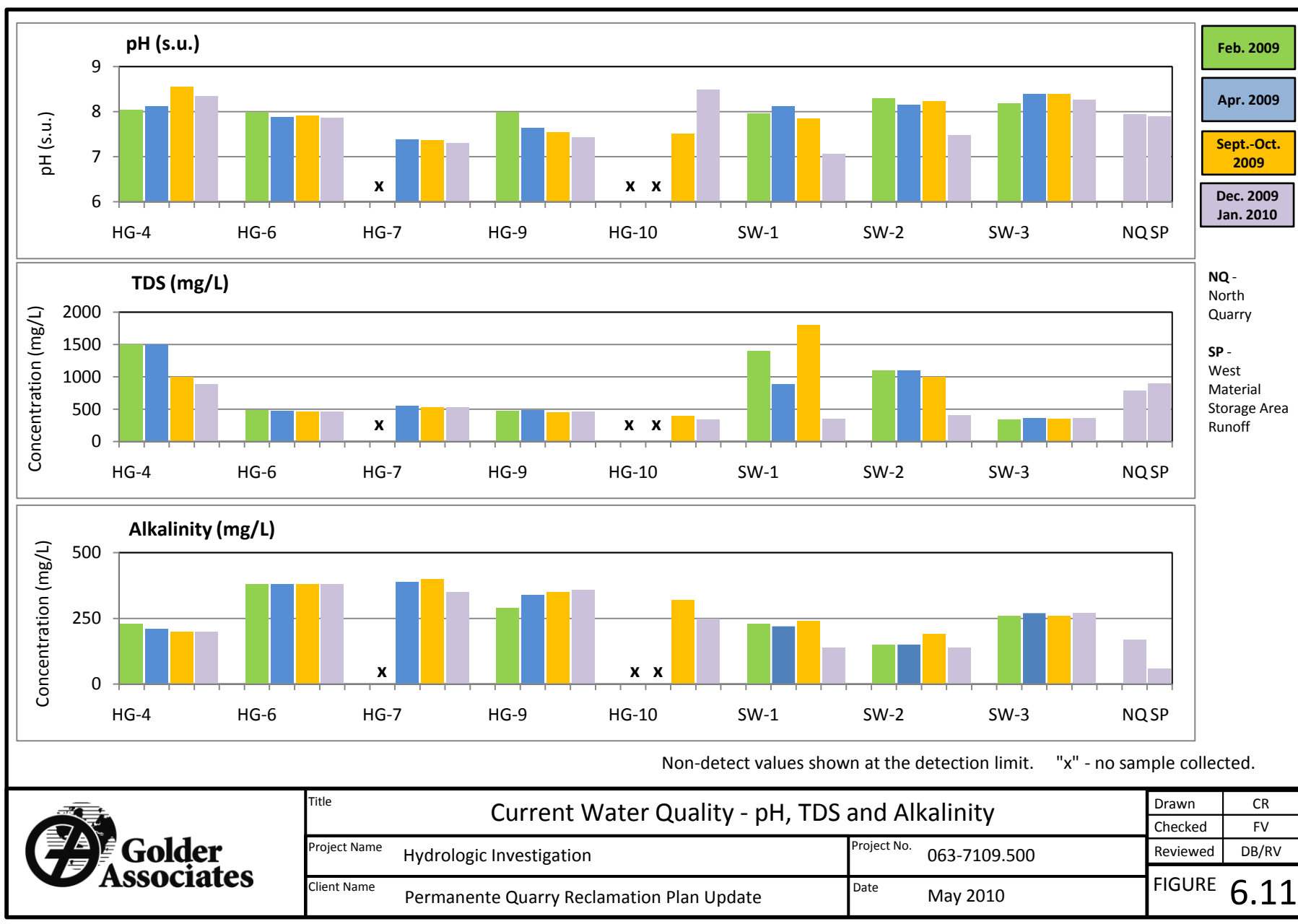
Title		Wall Washing - Limestone - Medium to High Grade (MG-01)		Drawn	CR
Project Name		Hydrologic Investigation		Checked	FV
Project No.		063-7109.500		Reviewed	DB/RV
Client Name		Permanente Quarry Reclamation Plan Update		FIGURE 6.8	
Date		May 2010			

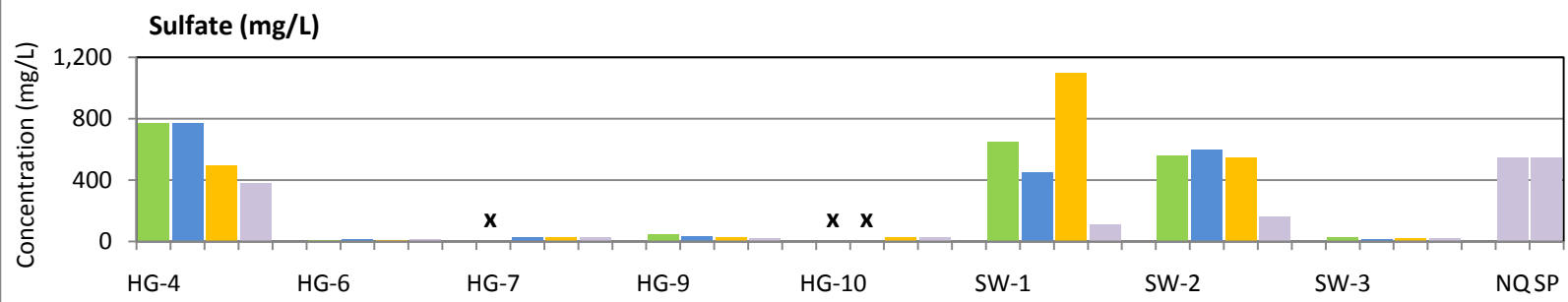


Title Wall Washing - Limestone - High Grade (HG-01)			Drawn	CR	
			Checked	FV	
Project Name	Hydrologic Investigation	Project No.	063-7109.500	Reviewed	DB/RV
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010	FIGURE 6.9	



Title Wall Washing - Limestone - High and Medium/Low Grade (HMG-01)				Drawn	CR
				Checked	FV
Project Name Hydrologic Investigation		Project No. 063-7109.500		Reviewed	DB/RV
Client Name Permanente Quarry Reclamation Plan Update		Date May 2010		FIGURE 6.10	





Feb. 2009

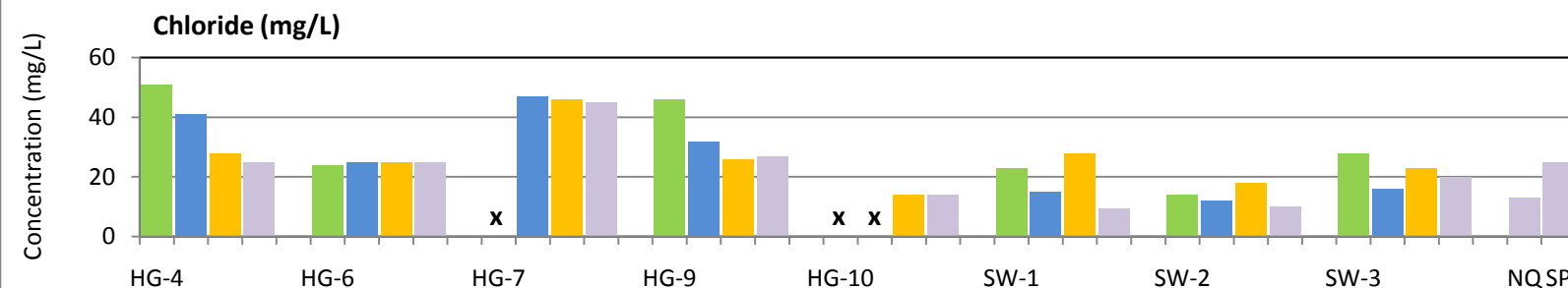
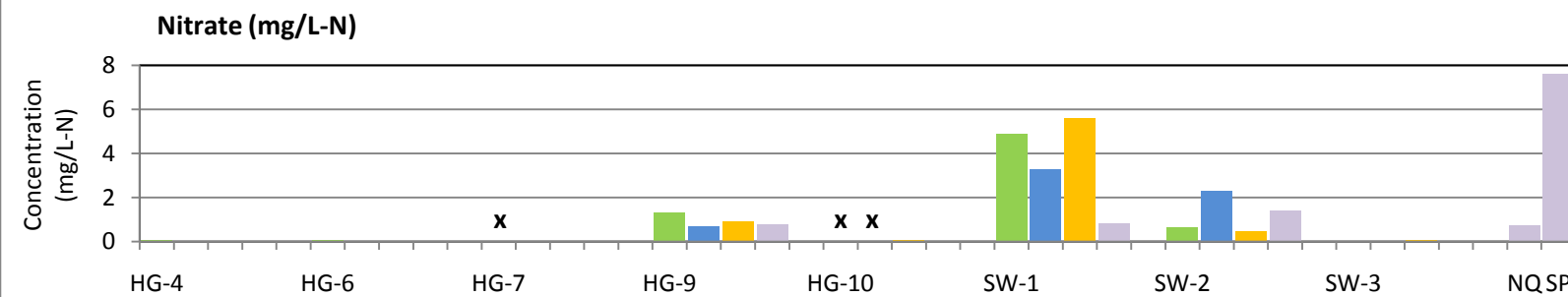
Apr. 2009

Sept.-Oct.  
2009

Dec. 2009  
Jan. 2010

NQ -  
North  
Quarry

SP -  
West  
Material  
Storage Area  
Runoff



Non-detect values shown at the detection limit. "x" - no sample collected.



Title

Current Water Quality - SO<sub>4</sub>, NO<sub>3</sub> and Cl

Project Name

Hydrologic Investigation

Project No.

063-7109.500

Client Name

Permanente Quarry Reclamation Plan Update

Date

May 2010

Drawn

CR

Checked

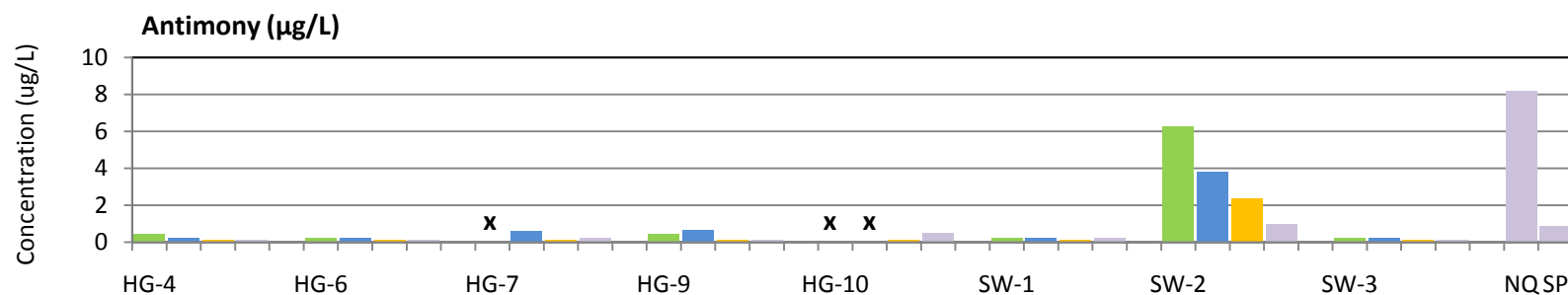
FV

Reviewed

DB/RV

FIGURE

6.12



Feb. 2009

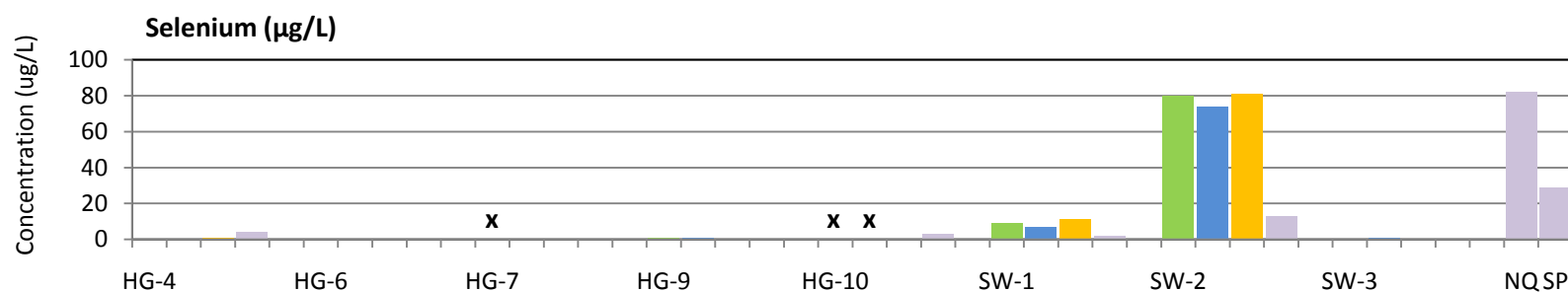
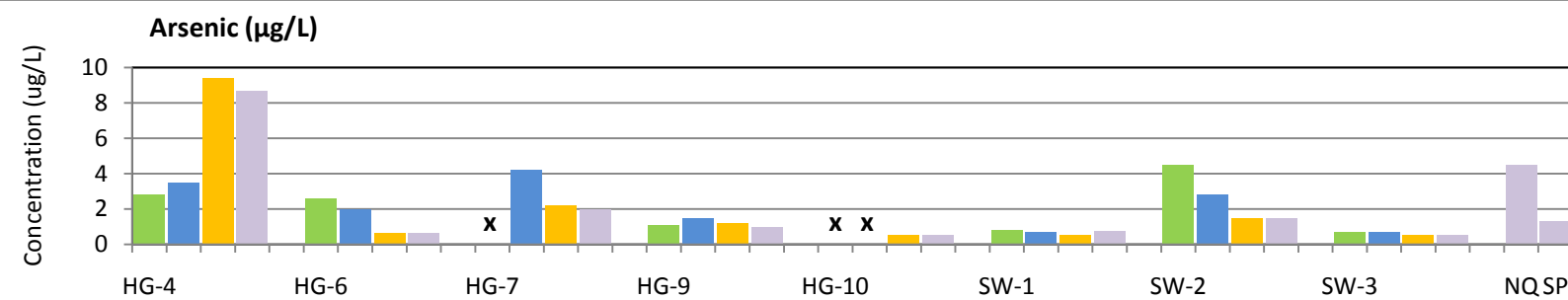
Apr. 2009

Sept.-Oct.  
2009

Dec. 2009  
Jan. 2010

NQ -  
North  
Quarry

SP -  
West  
Material  
Storage Area  
Runoff



Non-detect values shown at the detection limit. "x" - no sample collected.



Title

Current Water Quality - Sb, As and Se

Project Name

Hydrologic Investigation

Project No.

063-7109.500

Client Name

Permanente Quarry Reclamation Plan Update

Date

May 2010

Drawn

CR

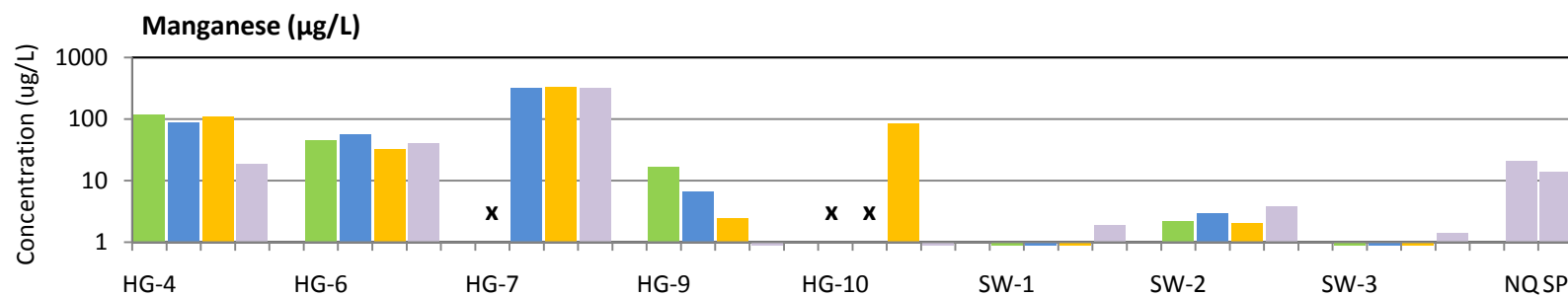
Checked

FV

Reviewed

DB/RV

FIGURE 6.13



Feb. 2009

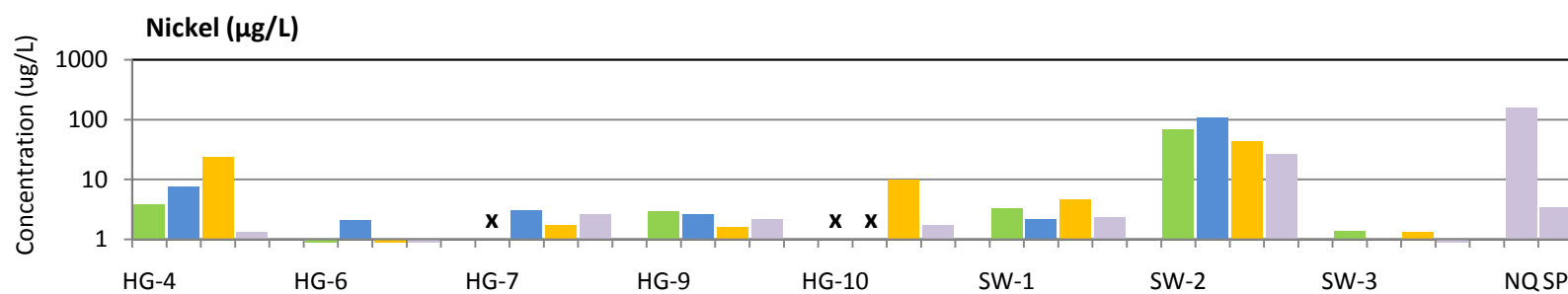
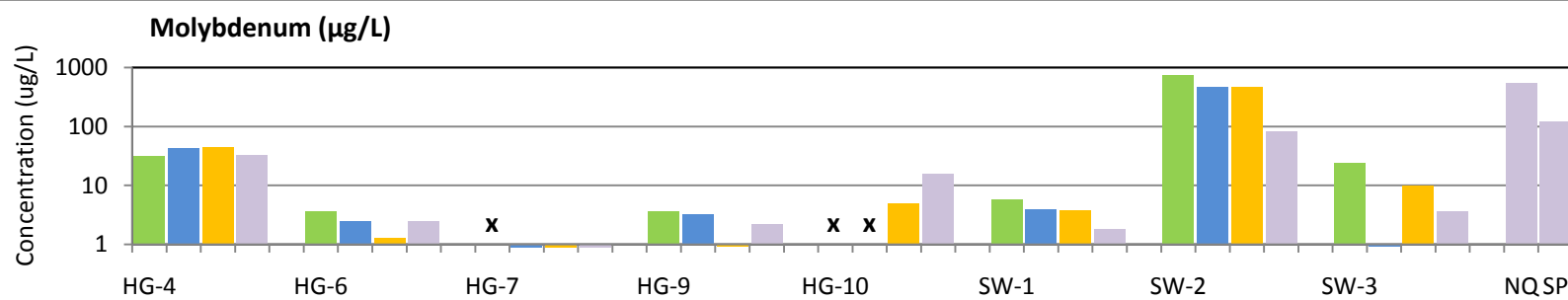
Apr. 2009

Sept.-Oct.  
2009

Dec. 2009  
Jan. 2010

NQ -  
North  
Quarry

SP -  
West  
Material  
Storage Area  
Runoff



Non-detect values shown at the detection limit. "x" - no sample collected.



Title

Current Water Quality - Mn, Ni and Mo

Project Name

Hydrologic Investigation

Project No.

063-7109.500

Client Name

Permanente Quarry Reclamation Plan Update

Date

May 2010

Drawn

CR

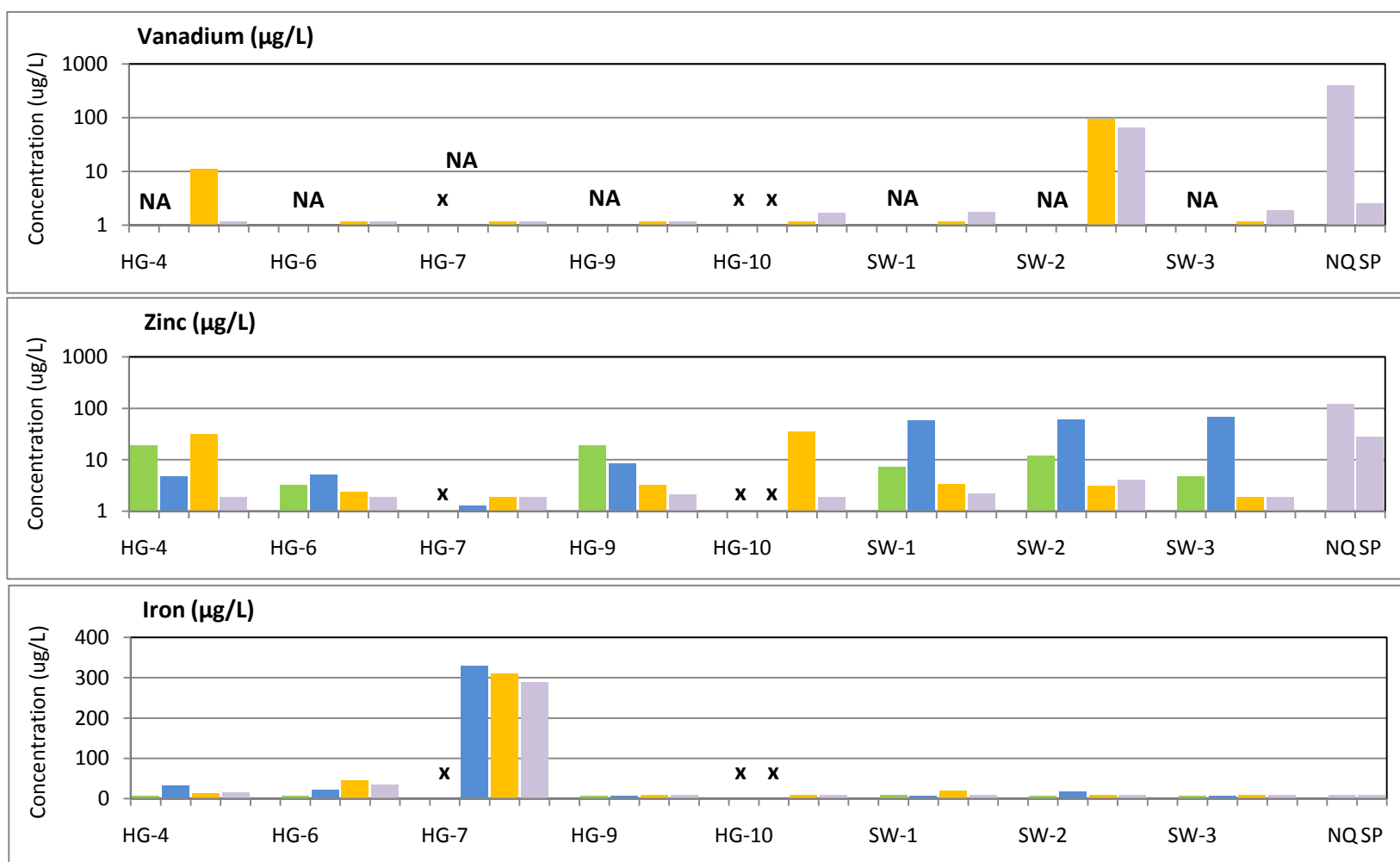
Checked

FV

Reviewed

DB/RV

FIGURE 6.14



Feb. 2009

Apr. 2009

Sept.-Oct. 2009

Dec. 2009

Jan. 2010

NQ - North Quarry

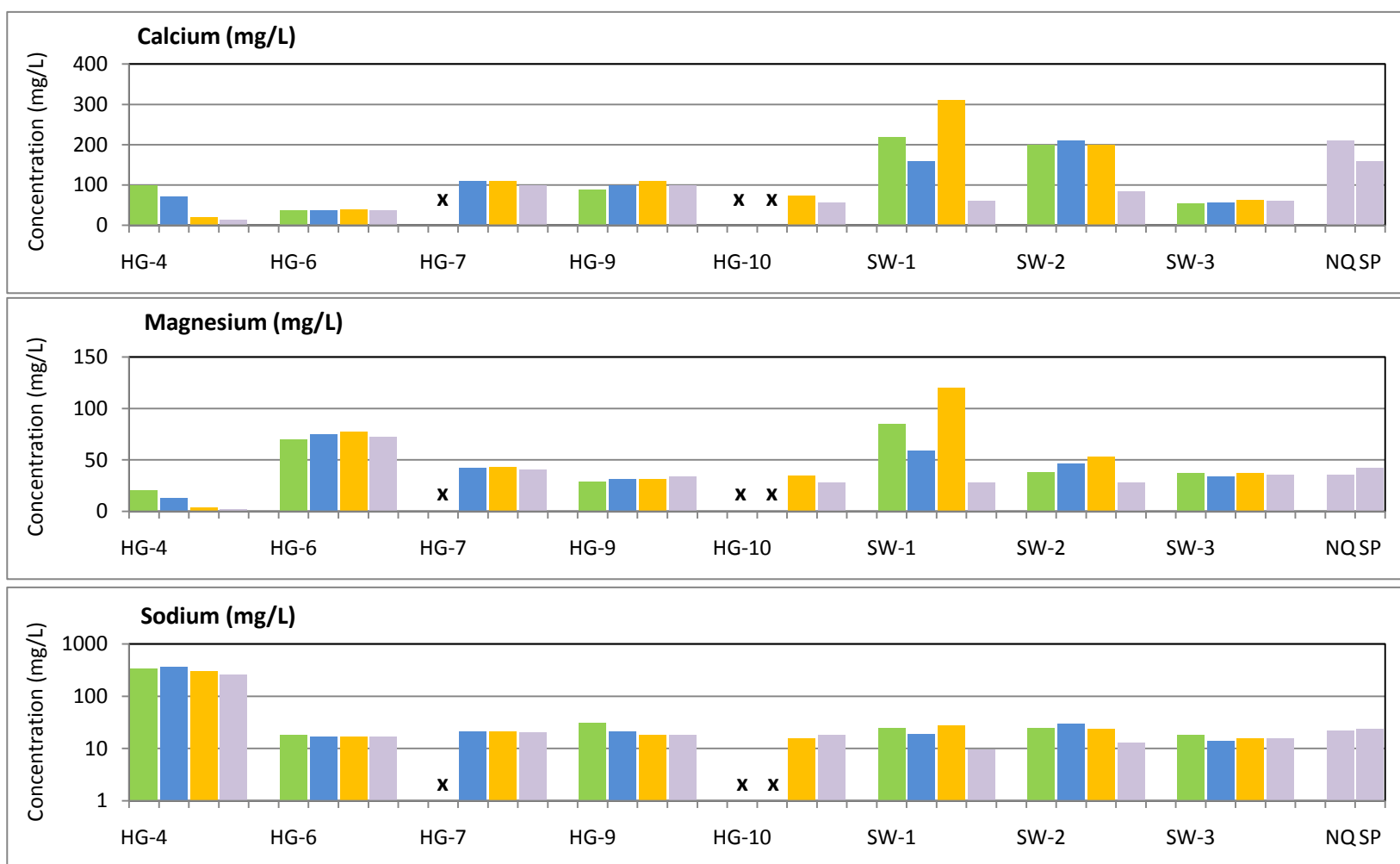
SP - West Material Storage Area Runoff

NA - sample not analyzed for this parameter

Non-detect values shown at the detection limit. "x" - no sample collected.



Title		Current Water Quality - V, Zn and Fe		Drawn	CR
Project Name		Hydrologic Investigation		Checked	FV
Client Name		Permanente Quarry Reclamation Plan Update		Reviewed	DB/RV
		Project No.	063-7109.500	FIGURE 6.15	
		Date	May 2010		



Feb. 2009

Apr. 2009

Sept.-Oct. 2009

Dec. 2009  
Jan. 2010

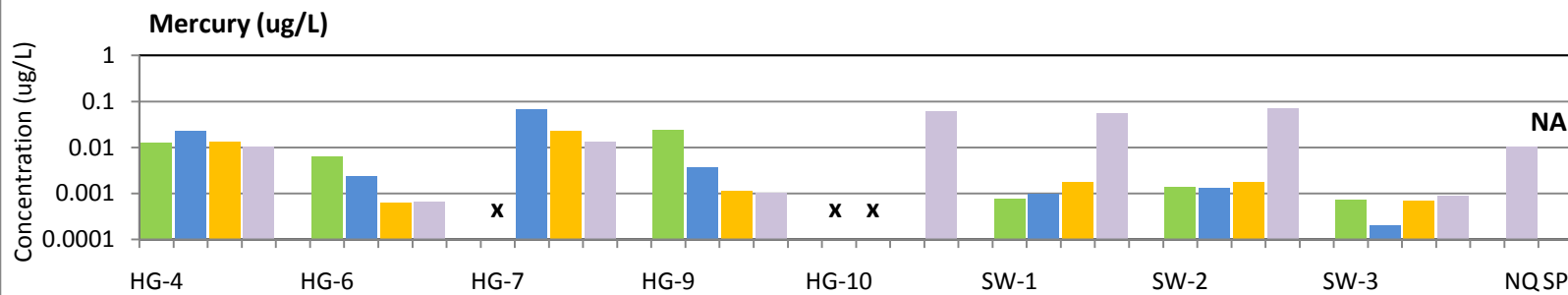
NQ - North Quarry

SP - West Material Storage Area Runoff

Non-detect values shown at the detection limit. "x" - no sample collected.



Title		Current Water Quality - Ca, Mg and Na		Drawn	CR
Project Name		Hydrologic Investigation		Checked	FV
Client Name		Permanente Quarry Reclamation Plan Update		Reviewed	DB/RV
		Project No.	063-7109.500	FIGURE 6.16	
		Date	May 2010		



Feb. 2009

Apr. 2009

Sept.-Oct.  
2009

Dec. 2009  
Jan. 2010

NQ -  
North  
Quarry

SP -  
West  
Material  
Storage Area  
Runoff

NA - sample  
not analyzed  
for this  
parameter

Non-detect values shown at the detection limit. "x" - no sample collected.



Title

Current Water Quality - Hg

Project Name

Hydrologic Investigation

Project No.

063-7109.500

Client Name

Permanente Quarry Reclamation Plan Update

Date

May 2010

Drawn

CR

Checked

FV

Reviewed

DB/RV

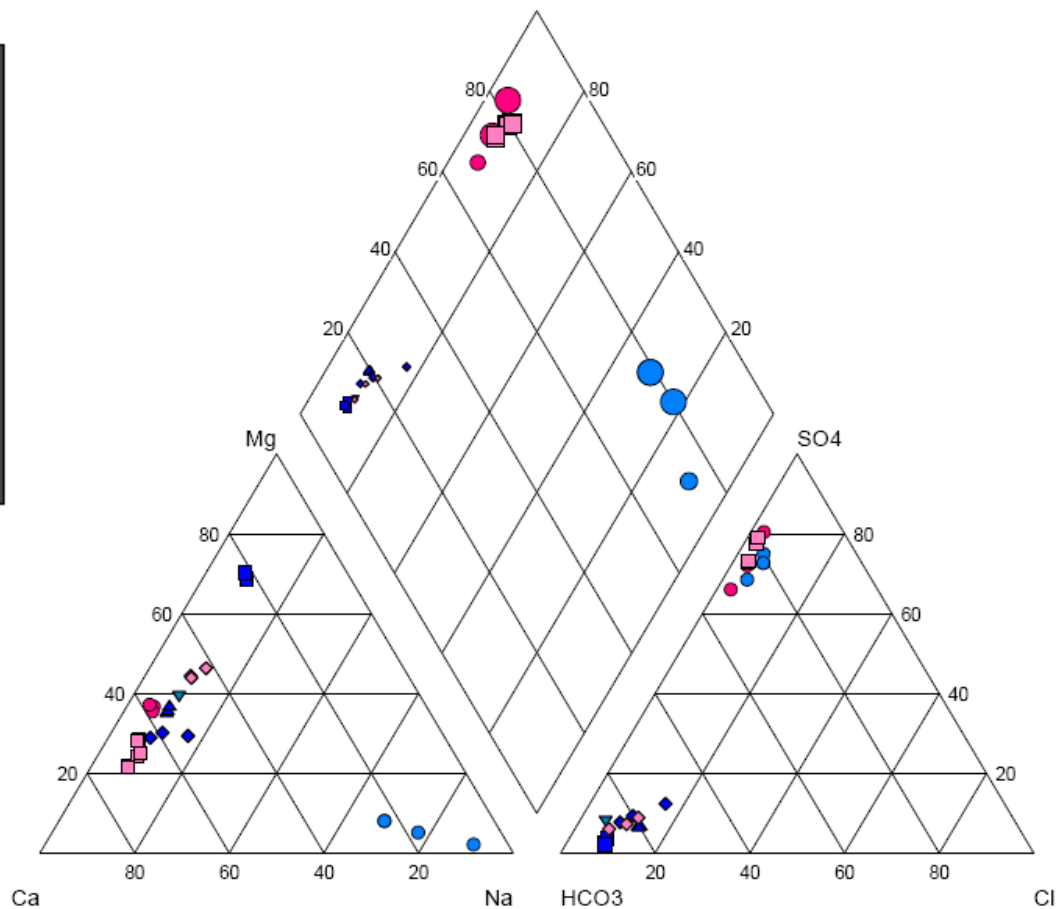
FIGURE 6.17

**Legend:**

- HG-4
- HG-6
- ▲ HG-7
- ◆ HG-9
- SW-1
- SW-2
- ◆ SW-3
- ▼ HG-10S

Scale of radii:  
Proportional to TDS

0  
1500



Water quality results for sampling rounds  
1 to 3 included in Piper Plot.



Title

Groundwater and Surface Water Piper Plot

Project Name

Hydrologic Investigation

Project No.

063-7109.500

Client Name

Permanente Quarry Rec Plan Update

Date

May 2010

Drawn

CR

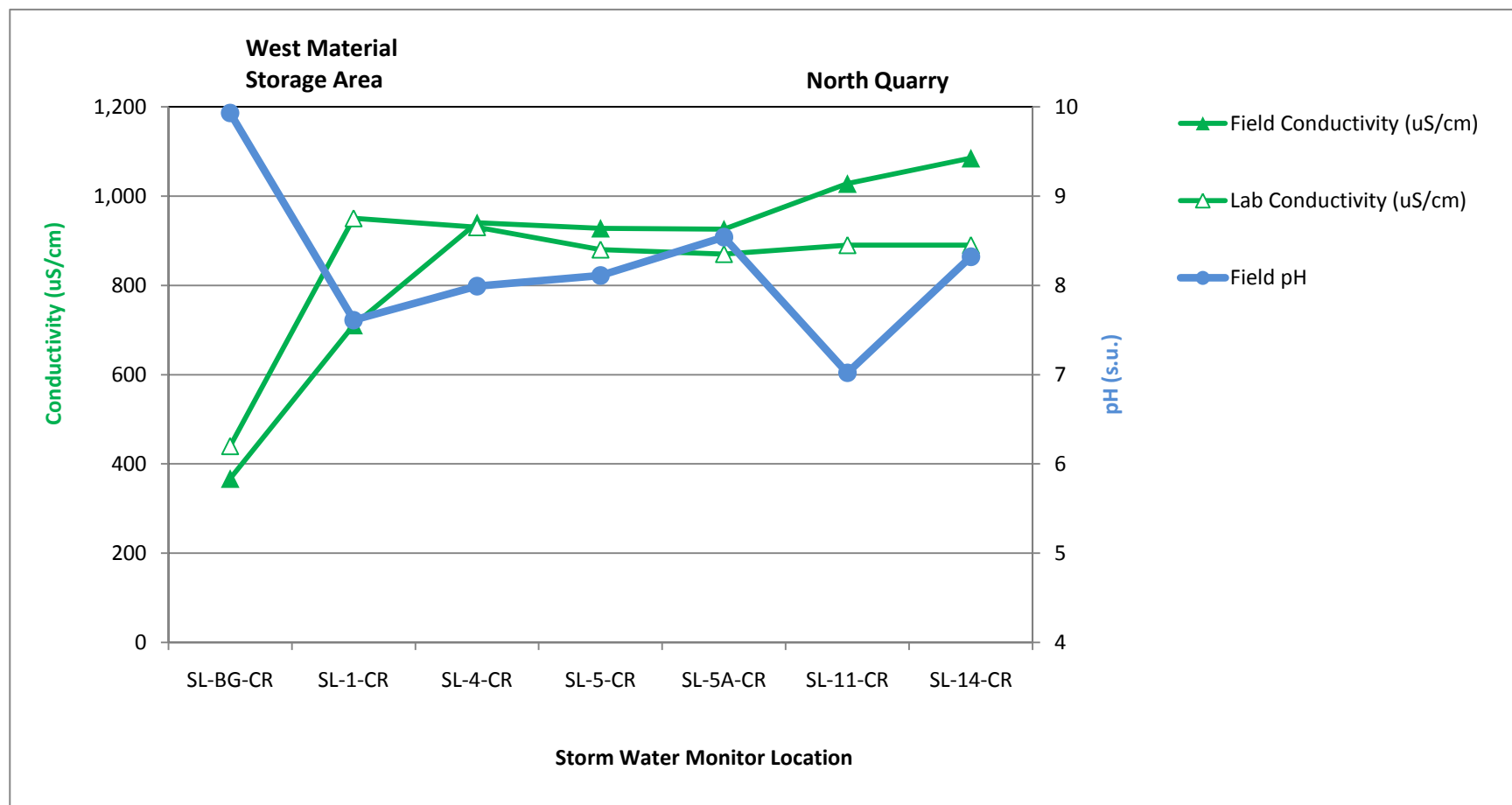
Checked

RV

Reviewed

BF

FIGURE 6.18



Non-detect values shown at the detection limit.



Title **Permanente Creek - Storm Water Monitoring Data (January 18, 2006)**

Project Name **Hydrologic Investigation**

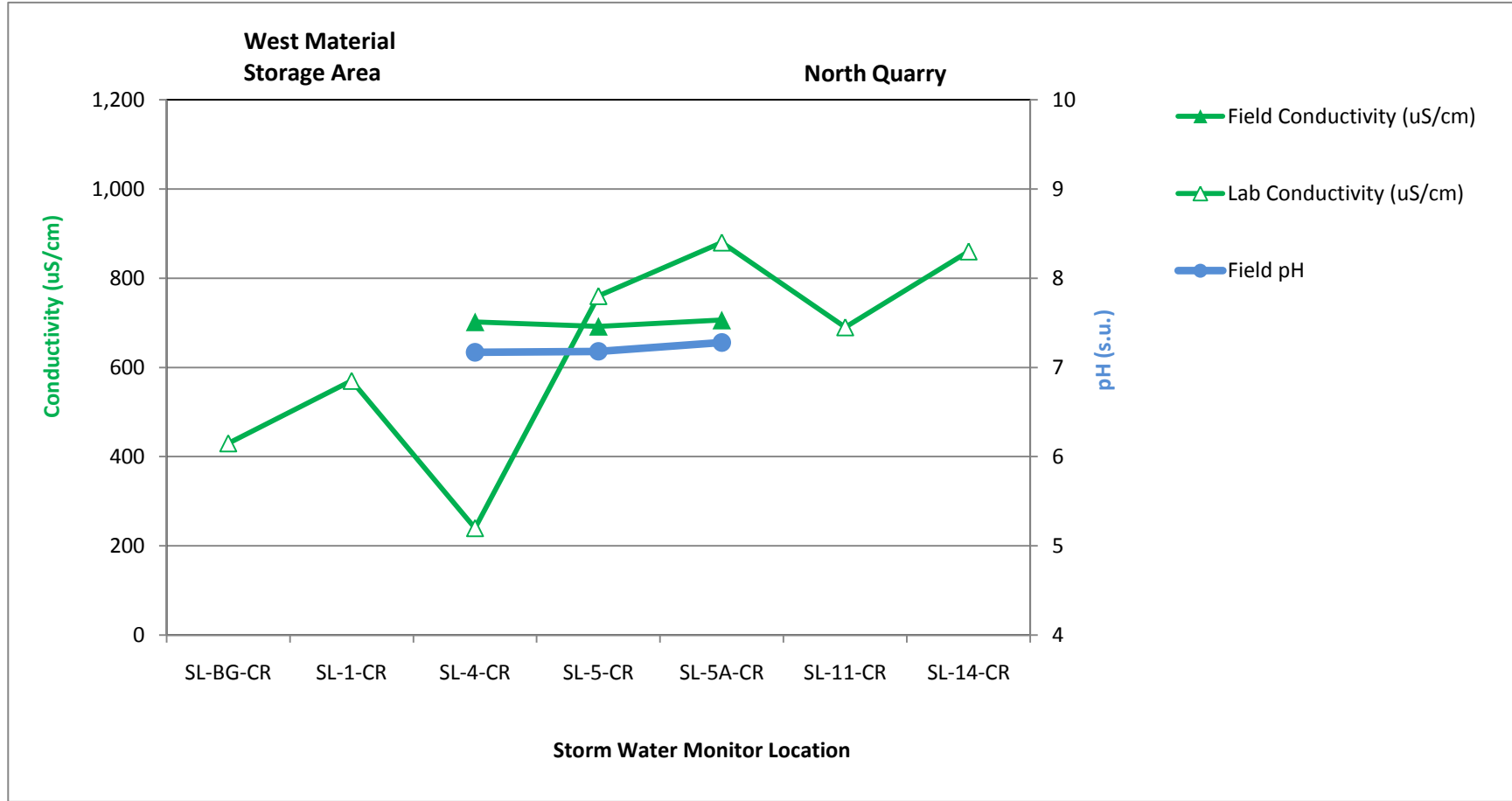
Project No. **063-7109.500**

Client Name **Permanente Quarry Reclamation Plan Update**

Date **May 2010**

Drawn	CR
Checked	FV
Reviewed	DB/RV

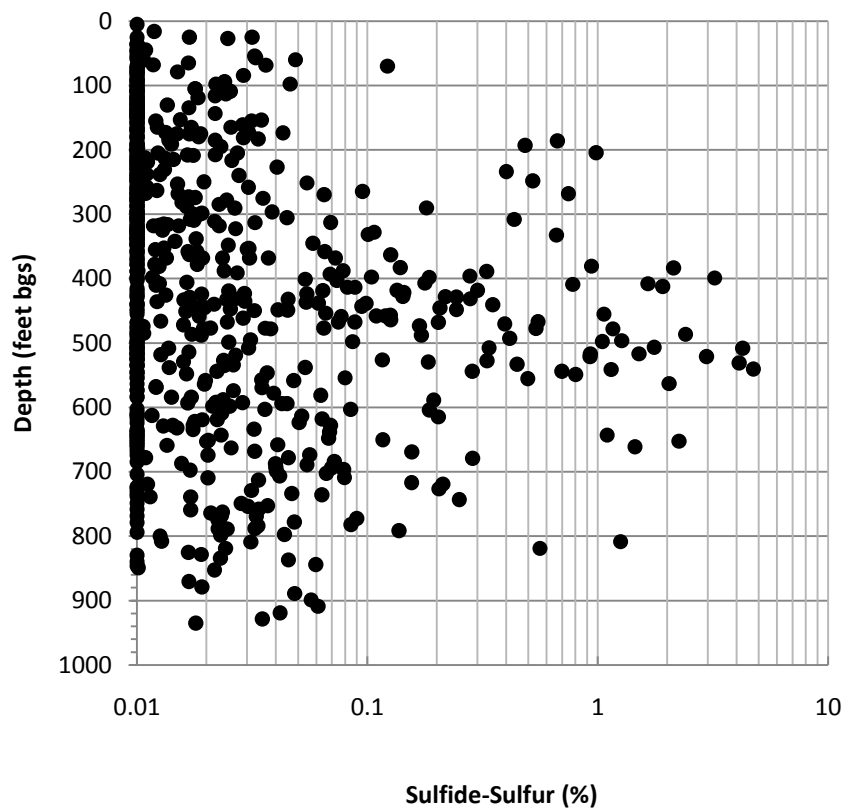
**FIGURE 6.19**



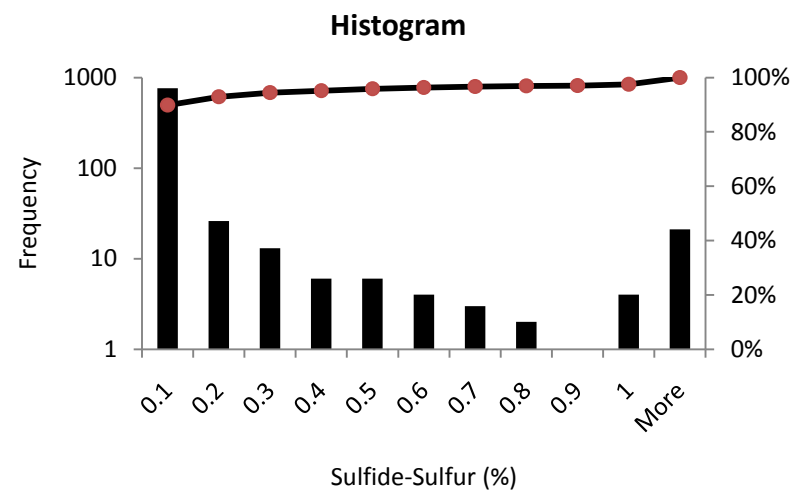
Non-detect values shown at the detection limit.



Title Permanente Creek - Storm Water Monitoring Data (February 27, 2006)		Drawn	CR
Project Name Hydrologic Investigation		Checked	FV
Project No. 063-7109.500		Reviewed	DB/RV
Client Name Permanente Quarry Reclamation Plan Update		Date May 2010	FIGURE 6.20



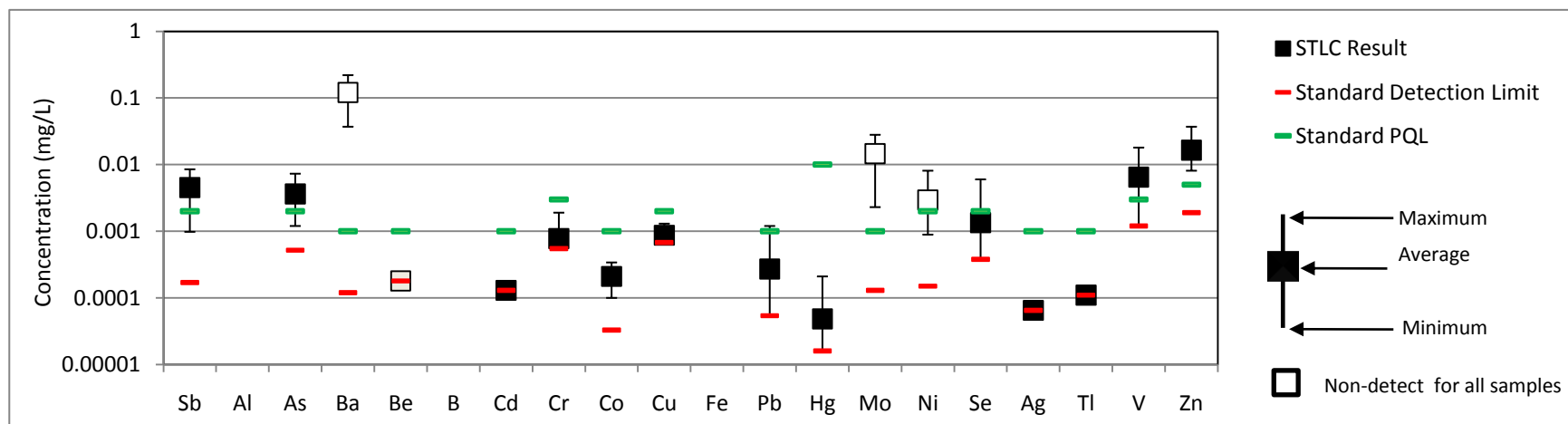
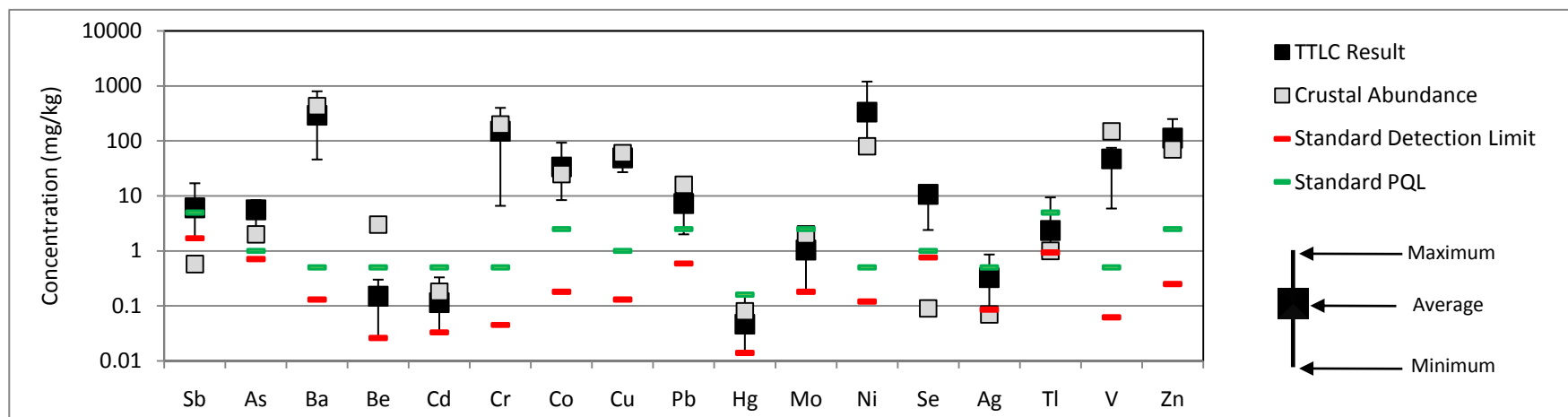
No. of Samples	850
Maximum	4.7%
Minimum	<0.01%
Average	0.09%



Non-detect values shown at the detection limit.



Title Limestone Ore Sulfide-Sulfur Data				Drawn	CR
				Checked	FV
Project Name	Hydrologic Investigation	Project No.	063-7109.500	Reviewed	RV/DB
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010	FIGURE 6.21	



Non-detect values shown at the detection limit and assumed equal to the detection limit in average calculations.

Standard detection limit and practical quantitation limit (PQL) raised for some analytes in one of the six samples analyzed (TTLC analysis).



Title Overburden (Rock) and Ore - TTLC and STLC Results

Project Name Hydrologic Investigation

Project No. 063-7109.500

Client Name Permanente Quarry Reclamation Plan Update

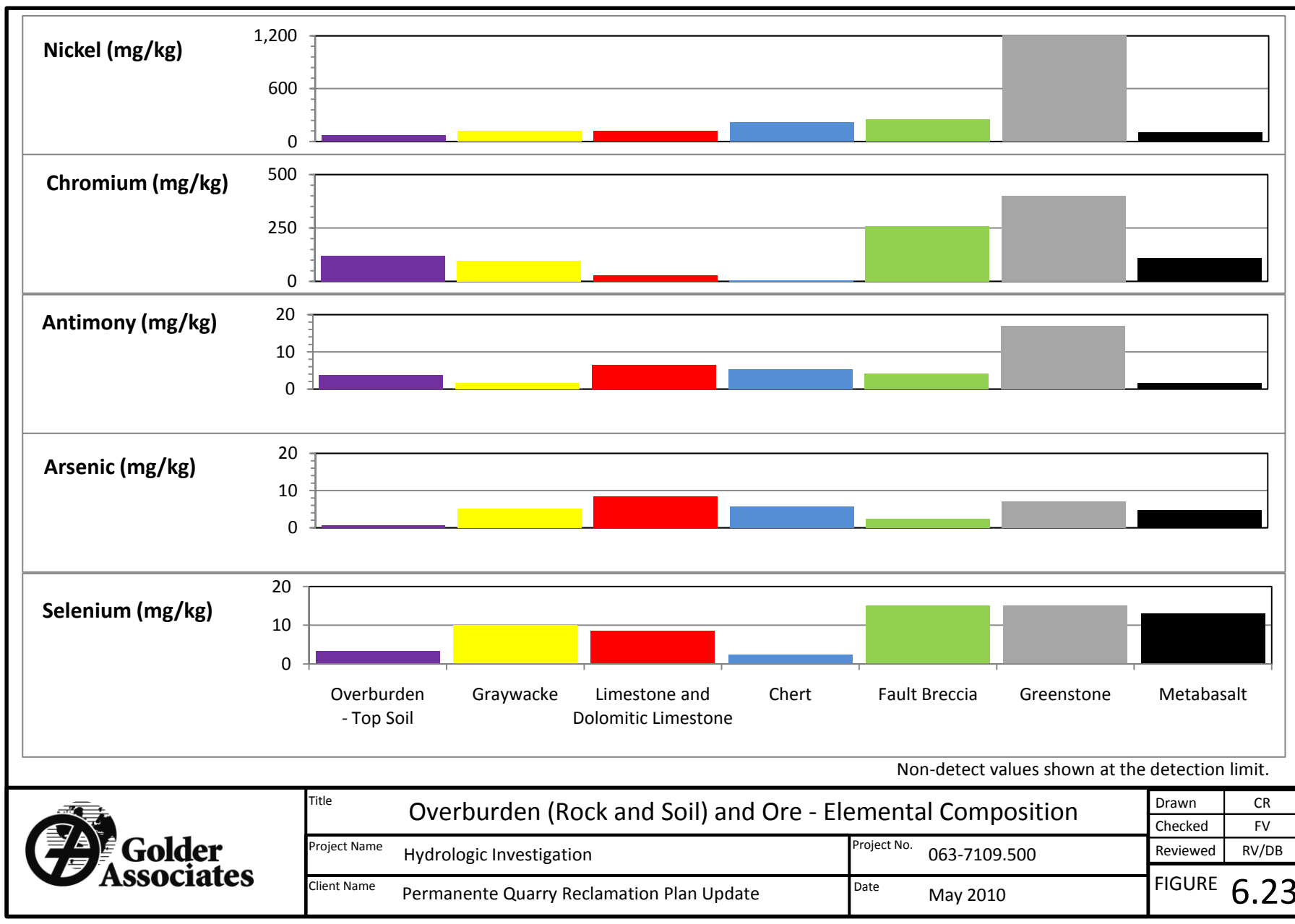
Date May 2010

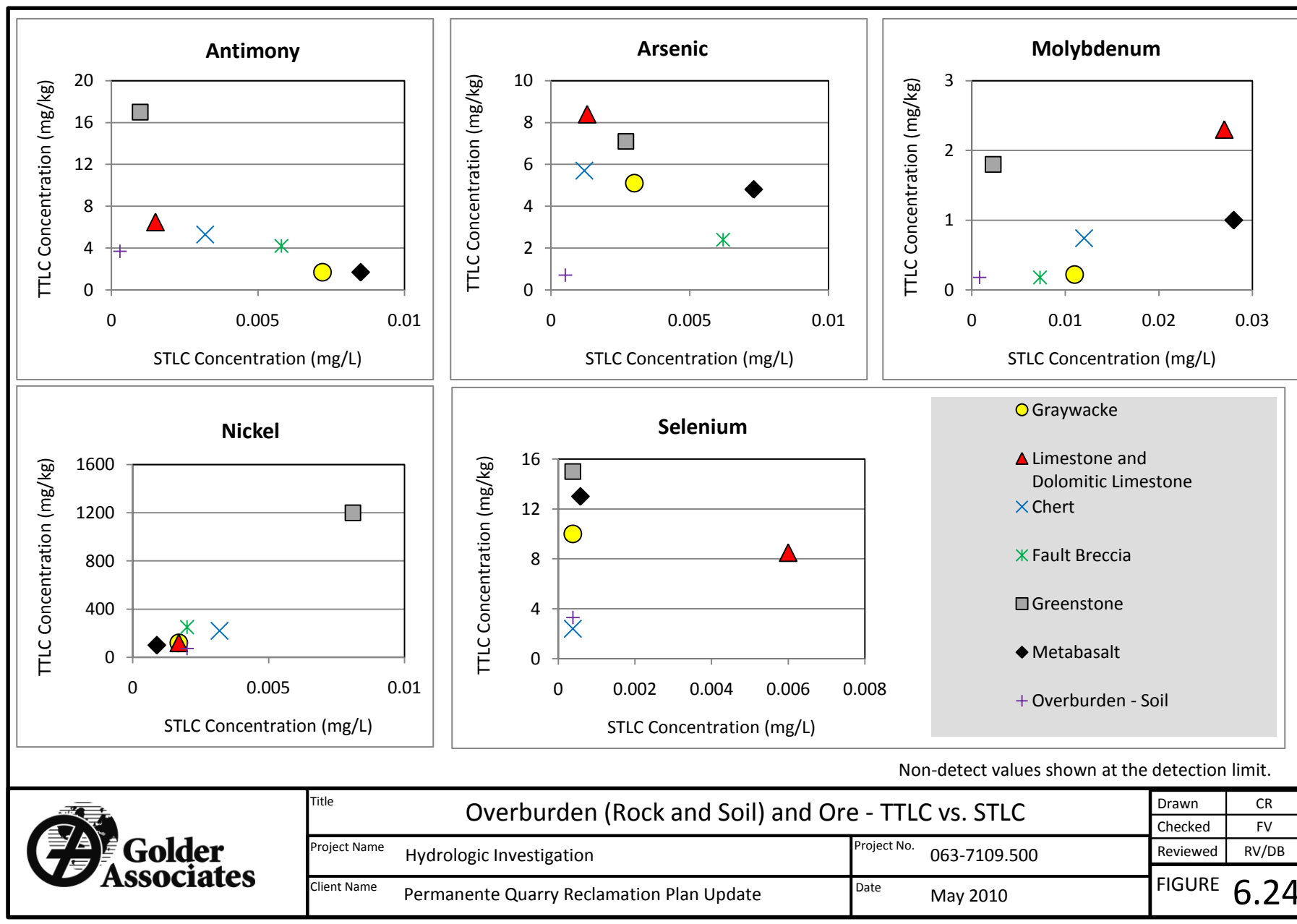
Drawn CR

Checked FV

Reviewed RV/DB

FIGURE 6.22



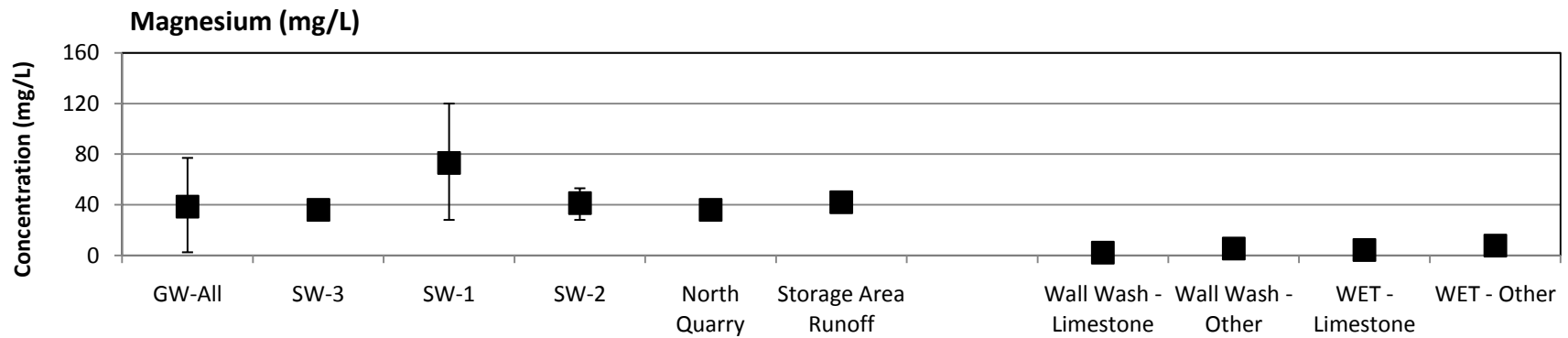
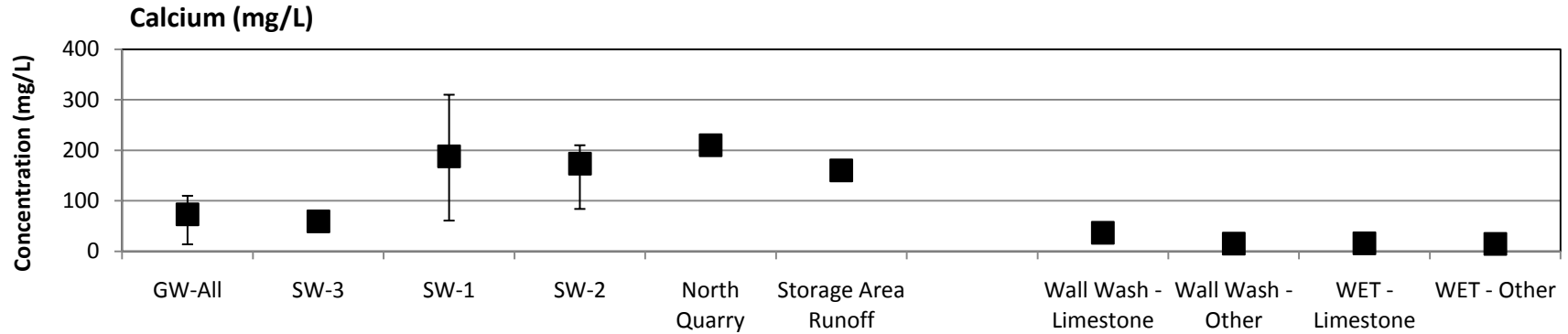




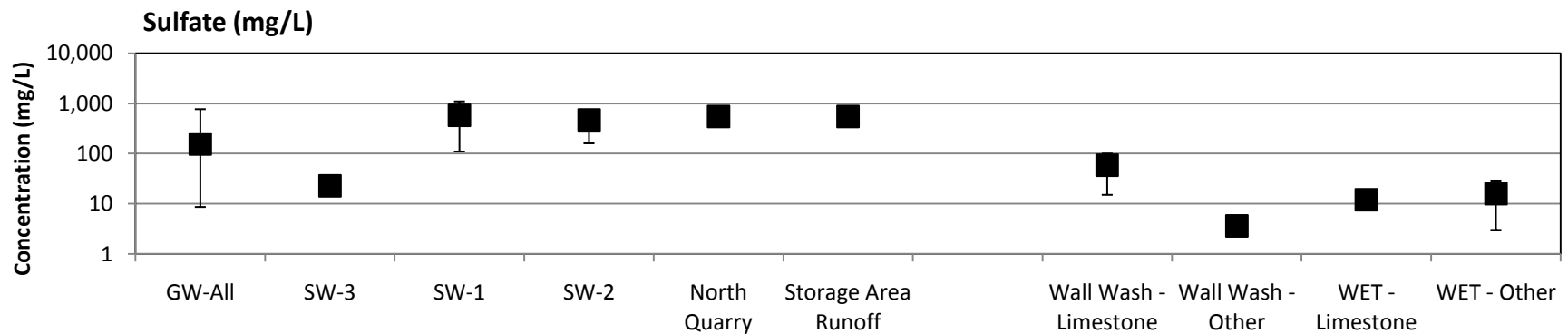
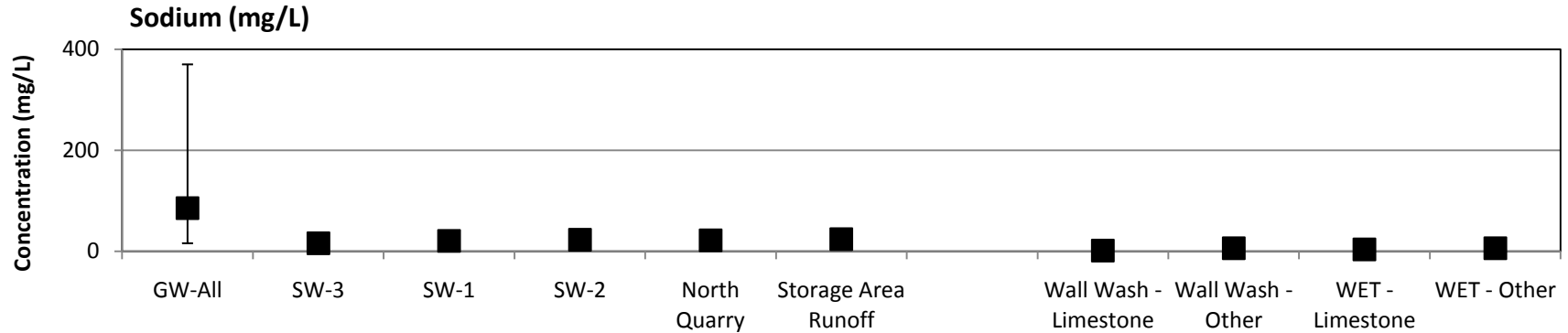
Sample No.	Sample ID	Rock Type
6	HG-01	Limestone - high grade
1	GW-01	Greywacke
3	MG-01	Limestone - medium to high grade
4	CT-01	Chert
5	HMG-01	Limestone - high and med/low grade
2	GS-01	Greenstone
7	FB-01	Field Blank



Title Wall Washing - Samples			Drawn	CR	
			Checked	FV	
Project Name	Hydrologic Investigation	Project No.	063-7109.500	Reviewed	DB/RV
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010	FIGURE	6.25



Title		Water Quality Comparison - Ca and Mg		Drawn	CR
Project Name		Hydrologic Investigation		Checked	FV
Client Name		Permanente Quarry Reclamation Plan Update		Reviewed	RV/DB
		Project No.	063-7109.500	FIGURE 6.26	
		Date	May 2010		



Title

Water Quality Comparison - Na and SO4

Project Name

Hydrologic Investigation

Project No.

063-7109.500

Client Name

Permanente Quarry Reclamation Plan Update

Date

May 2010

Drawn

CR

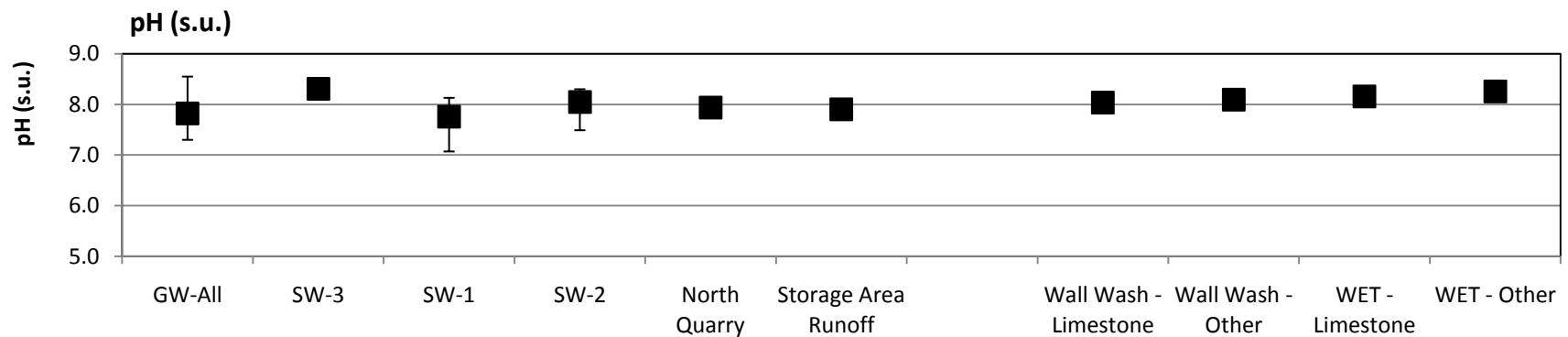
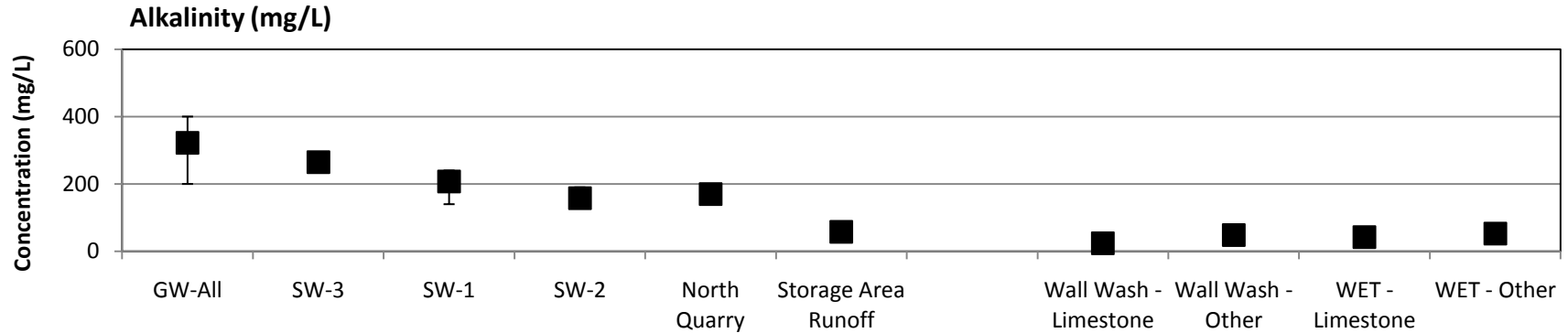
Checked

FV

Reviewed

RV/DB

FIGURE 6.27



Title

Water Quality Comparison - Alkalinity and pH

Project Name

Hydrologic Investigation

Project No.

063-7109.500

Client Name

Permanente Quarry Reclamation Plan Update

Date

May 2010

Drawn

CR

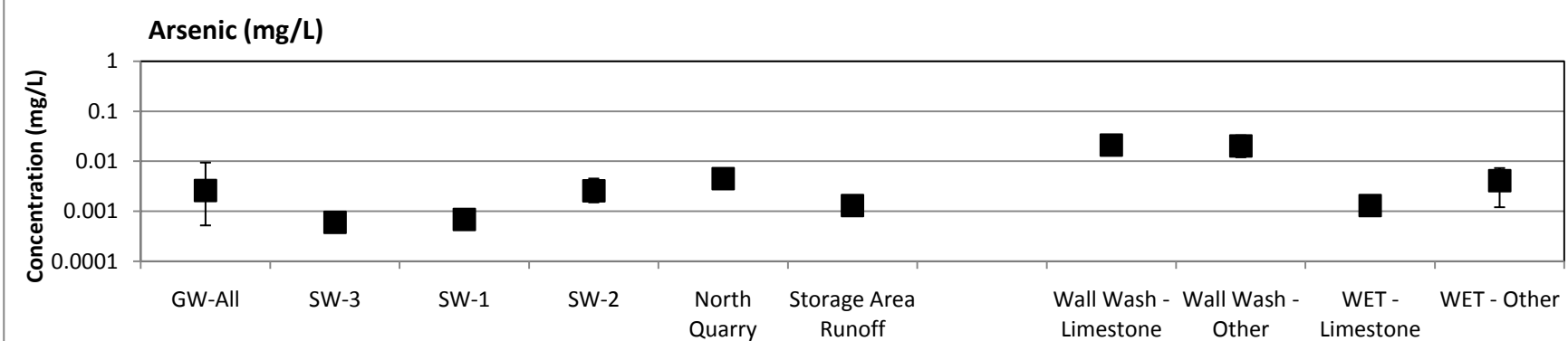
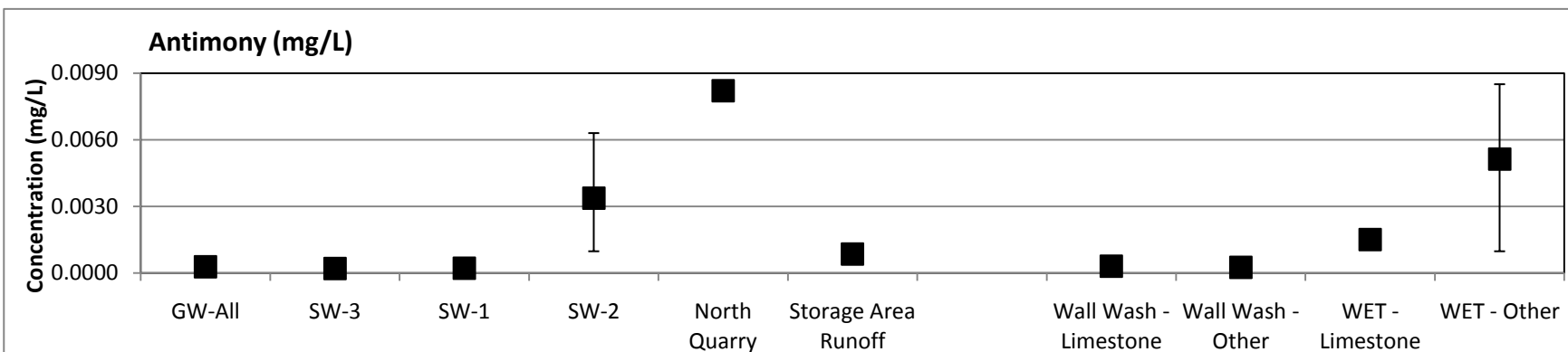
Checked

FV

Reviewed

RV/DB

FIGURE 6.28



Title

Water Quality Comparison - Sb and As

Project Name

Hydrologic Investigation

Project No.

063-7109.500

Client Name

Permanente Quarry Reclamation Plan Update

Date

May 2010

Drawn

CR

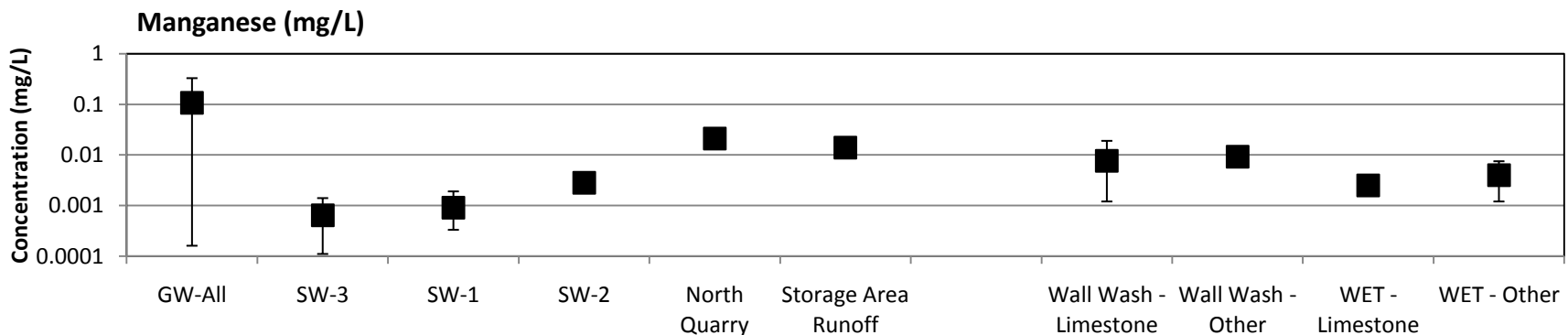
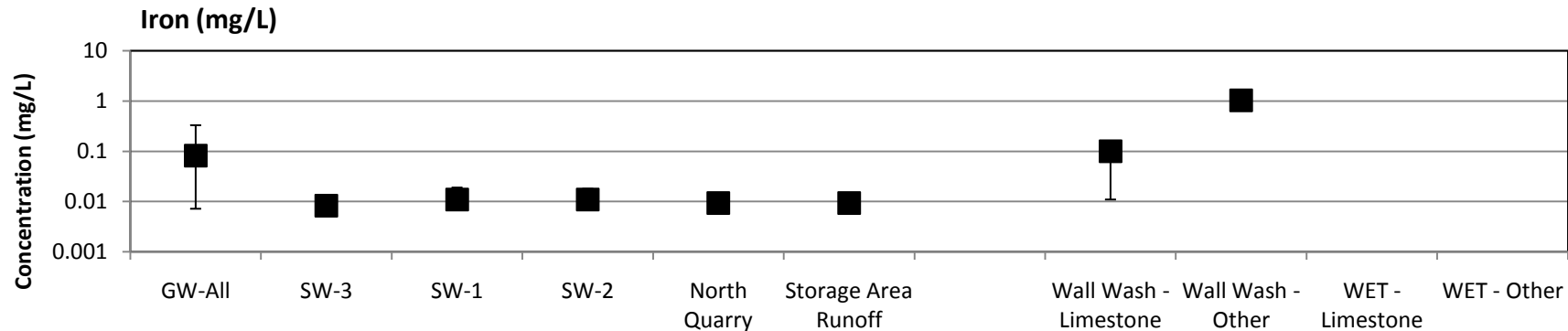
Checked

FV

Reviewed

RV/DB

FIGURE 6.29



Title

Water Quality Comparison - Fe and Mn

Project Name

Hydrologic Investigation

Project No.

063-7109.500

Client Name

Permanente Quarry Reclamation Plan Update

Date

May 2010

Drawn

CR

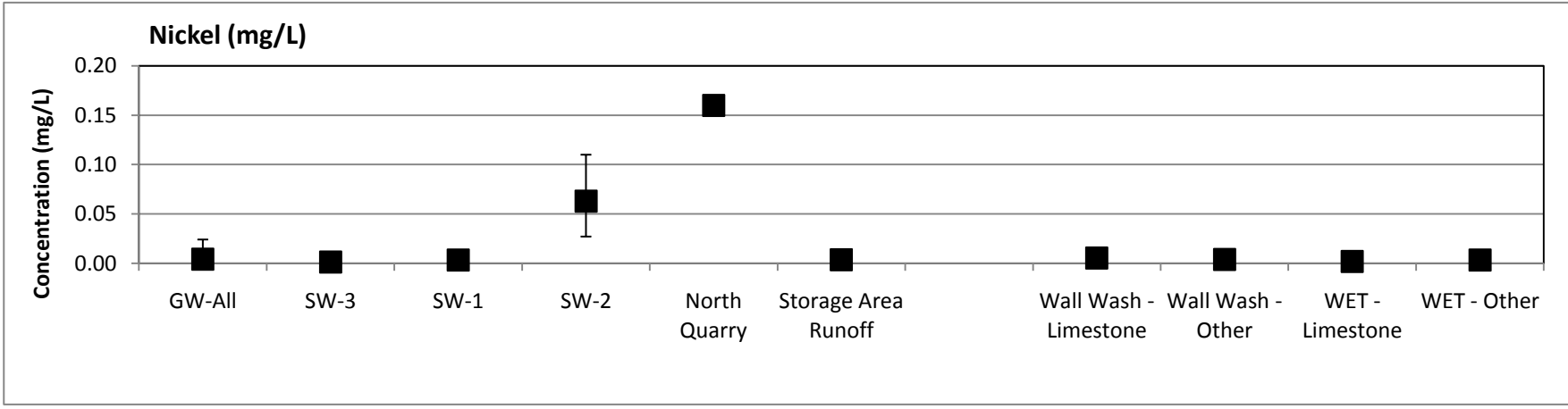
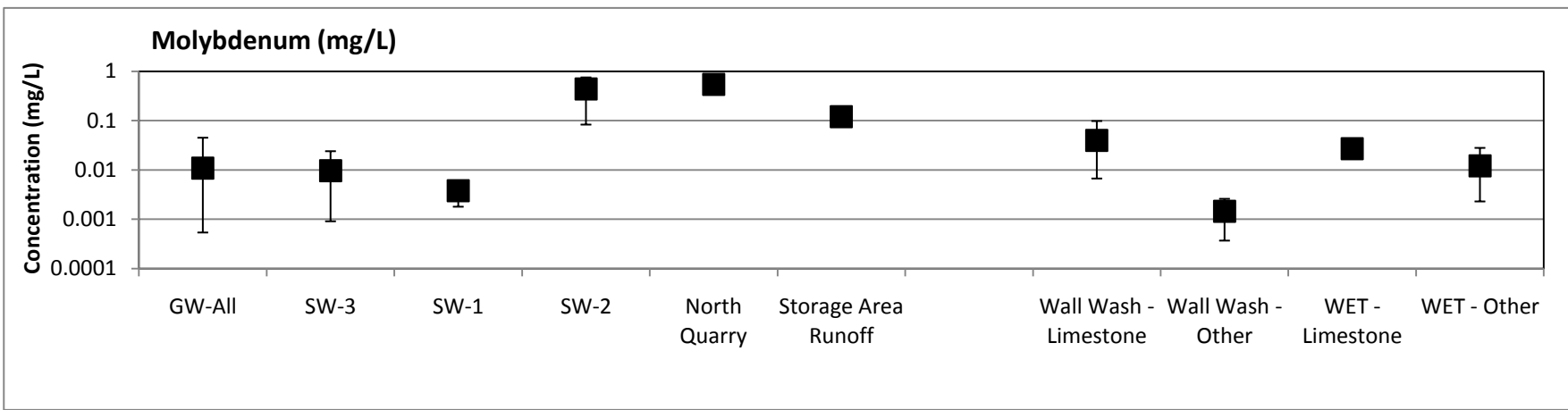
Checked

FV

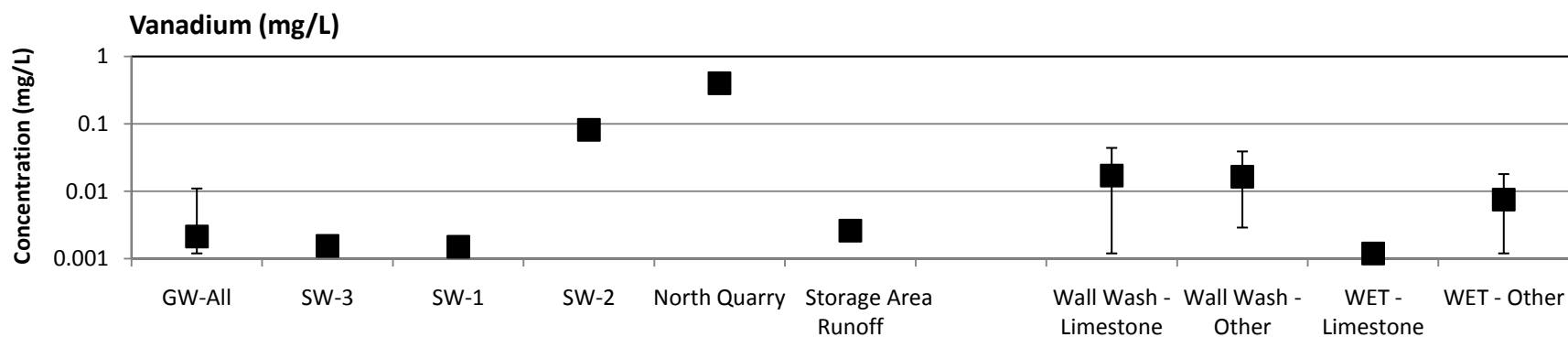
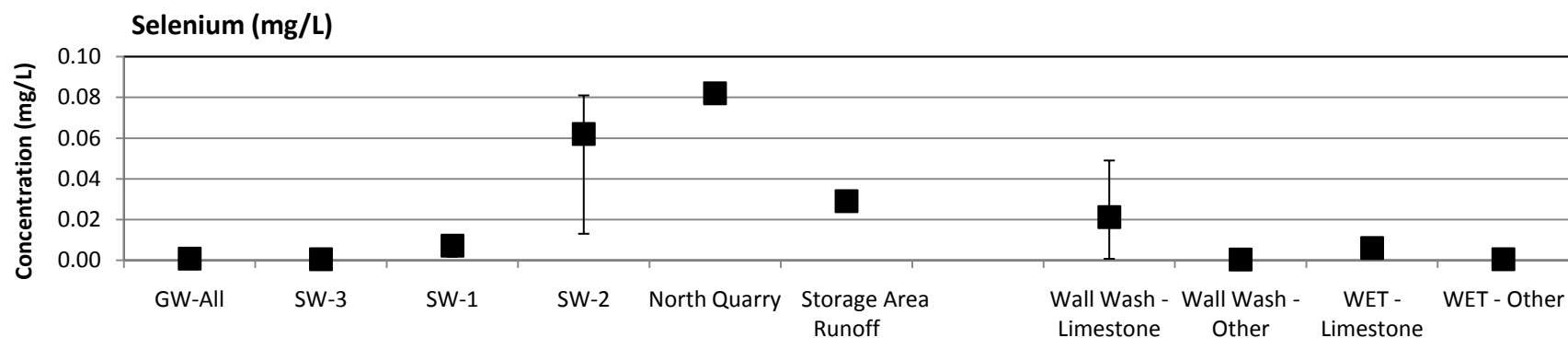
Reviewed

RV/DB

FIGURE 6.30



Title Water Quality Comparison - Mo and Ni				Drawn	CR
				Checked	FV
Project Name	Hydrologic Investigation	Project No.	063-7109.500	Reviewed	RV/DB
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010	FIGURE 6.31	



Title		Water Quality Comparison - Se and V		Drawn	CR
Project Name		Hydrologic Investigation		Checked	FV
Client Name		Permanente Quarry Reclamation Plan Update		Reviewed	-
		Project No.	063-7109.500	FIGURE 6.32	
		Date	May 2010		

**APPENDIX A**  
**BORING LOGS**



Golder Associates  
425 Lakeside Drive  
Sunnyvale, CA 94085  
Telephone: (408) 220-9223  
Fax:

# BORING NUMBER HG-1A

PAGE 1 OF 1

PROJECT NUMBER 0637109.300 phase 2

DATE STARTED 10/26/08

PROJECT NAME Lehigh Permanente

DATE COMPLETED 10/27/08

LOCATION Santa Clara, CA

CASING TYPE/DIAMETER ----

DRILLING METHOD Air Rotary

SCREEN TYPE/SLOT ----

GROUND ELEVATION 1585 ft. MSL

GRAVEL PACK TYPE ----

TOP OF CASING ----

GROUT TYPE/QUANTITY ----

LOGGED BY Ian Thomsen

REMARKS Air rotary drilling to 580 feet using a 6" drill bit.

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
GRAB	10				Clayey mud OVERBURDEN.	
	20					
	30					
	40					
	50					
GRAB	60					60.0
	70				loose limestone/greenstone/chert GRAVEL.	
	80				Water at 73.4 feet.	
	90					100.0
	100					
GRAB	110				GREYWACKE.	
	120					
	130					
	140					
	150					
GRAB	160					
	170					
	180					
	190					
	200					
GRAB	210					220.0
	220				GREYWACKE/GREENSTONE.	
	230					240.0
	240				GREYWACKE.	
	250					
GRAB	260					
	270					
	280					
	290					
	300					
GRAB	310					
	320					
	330					
	340					
	350					
GRAB	360					
	370					
	380					
	390					
	400					400.0
GRAB	410				Brecciated greywacke GOUGE. Very muddy.	
	420					
	430					
	440					
	450					
	460					
	470					
	480					
	490					495.0
	500				Fracture, cherty LIMESTONE with greywacke producing 200gpm of water.	
	510					
	520					
	530					
	540					
	550					
	560					
	570					580.0
	580				Bottom of borehole at 580.0 feet.	



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Sunnyvale, CA 94085  
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# BORING NUMBER HG-2

PAGE 1 OF 1

PROJECT NUMBER 0637109.300 phase 2  
PROJECT NAME Lehigh Permanente  
LOCATION Santa Clara, CA  
DRILLING METHOD Air Rotary  
GROUND ELEVATION 1613 ft. MSL  
TOP OF CASING  
LOGGED BY Jill Dekoekkoek  
REMARKS Air rotary drilling to 560 feet using a 6" drill bit.  
DATE STARTED 10/29/08  
DATE COMPLETED 11/6/08  
CASING TYPE/DIAMETER  
SCREEN TYPE/SLOT  
GRAVEL PACK TYPE  
GROUT TYPE/QUANTITY

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
GRAB	10				OVERBURDEN.	
	20					25.0
	30					
	40				Very Dark-Medium Brown Cherty LIMESTONE with reaction to HCl.	
GRAB	50					
	60					
	70					
	80					
	90					
	100					
GRAB	110					
	120					
	130					
	140					
	150					
GRAB	160					
	170					
	180					
	190					
	200					
GRAB	210					
	220					
	230					
	240					
	250					
GRAB	260					
	270					
	280					
	290					
	300					
GRAB	310					
	320					
	330					
	340					
	350					
GRAB	360	VWT				365.0
	370				Very Dark GREYWACKE with some light brown limestone.	
	380					
	390					
	400					
GRAB	410					
	420					
	430					
	440					
	450					
GRAB	460					
	470					
	480					
	490					490.0
	500				LIMESTONE with chert.	
GRAB	510					
	520					
	530					
	540					
GRAB	550					560.0
	560				Bottom of borehole at 560.0 feet.	



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## BORING NUMBER HG-3

PAGE 1 OF 1

PROJECT NUMBER 0637109.300 phase 2

DATE STARTED 11/8/08

PROJECT NAME Lehigh Permanente

DATE COMPLETED 11/9/08

LOCATION Santa Clara, CA

CASING TYPE/DIAMETER ----

DRILLING METHOD Air Rotary

SCREEN TYPE/SLOT ----

GROUND ELEVATION 1548 ft. MSL






GRAVEL PACK TYPE ----

TOP OF CASING ----

GROUT TYPE/QUANTITY ----

LOGGED BY Jill Dekoekkoek

REMARKS Air rotary drilling to 460 feet using a 5.25" drill bit.

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH	
GRAB	10	VWT			OVERBURDEN.	20.0	
	20				Medium-dark grey LIMESTONE with some chert and trace greenstone/greywacke		
	30						
	40						
GRAB	50						
	60						
	70						
	80						
	90						
GRAB	100						
	110						
	120						
	130						
	140						
	150				Brecciated FAULT GOUGE with calcite veining in the medium grey limestone.	150.0	
GRAB	160						
	170						
	180						
	190						
	200				Dark brown to dark grey LIMESTONE and greywacke. Very low sample recovery.	200.0	
GRAB	210						
	220						
	230						
	240						
GRAB	250						
	260						
	270						
	280						
	290						
	300						
GRAB	310						
	320						
	330						
	340						
	350						
GRAB	360						
	370						
	380						
	390						
	400						
GRAB	410						
	420				GREENSTONE with trace chert, limestone, and calcite.	420.0	
	430						
	440						
GRAB	450						
	460			Bottom of borehole at 460.0 feet.			460.0



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Sunnyvale, CA 94085  
Telephone: (408) 220-9223  
Fax:

# WELL NUMBER HG-4

PAGE 1 OF 1

PROJECT NUMBER 0637109.300 phase 2

PROJECT NAME Lehigh Permanente

LOCATION Santa Clara, CA

DRILLING METHOD Air Rotary

GROUND ELEVATION 1857 ft. MSL

TOP OF CASING 1859.5 ft. MSL

LOGGED BY Jill Dekoekkoek

REMARKS Air rotary drilling to 300 feet using a 6.75" drill bit.

DATE STARTED 11/10/08

DATE COMPLETED 11/12/08

CASING TYPE/DIAMETER Schedule 80 pvc / 2 inches

SCREEN TYPE/SLOT slotted screen / 0.020

GRAVEL PACK TYPE #3 sand

GROUT TYPE/QUANTITY 5% bentonite

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH	WELL DIAGRAM
GRAB	10				OVERBURDEN.		
	20					24.0	
	30				Dark greenish brown BASALT.		
	40						
	50					55.0	
GRAB	60				GREENSTONE.		
	70						
	80						
	90						
	100						
GRAB	110						
	120						
	130						
	140						
	150						
GRAB	160						
	170						
	180						
	190						
	200						
GRAB	210						
	220						
	230						
	240						
	250				Water at 240 feet.		
GRAB	260						
	270						
	280						
	290						
	300				Bottom of borehole at 300.0 feet.	300.0	

5% bentonite  
grout  
2" sch. 80 pvc

Bentonite

#3 sand filter  
pack  
0.020" slotted  
screen



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425 Lakeside Drive  
Sunnyvale, CA 94085  
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# BORING NUMBER HG-5

PAGE 1 OF 1

PROJECT NUMBER 0637109.300 phase 2  
PROJECT NAME Lehigh Permanente  
LOCATION Santa Clara, CA  
DRILLING METHOD Air Rotary  
GROUND ELEVATION 1615 ft. MSL  
TOP OF CASING ----  
LOGGED BY Jill Dekoekkoek  
REMARKS Air rotary drilling to 400 feet using a 6.25" drill bit.  
DATE STARTED 11/20/08  
DATE COMPLETED 11/20/08  
CASING TYPE/DIAMETER ----  
SCREEN TYPE/SLOT ----  
GRAVEL PACK TYPE ----  
GROUT TYPE/QUANTITY ----

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
GRAB	10				OVERBURDEN.	
	20					25.0
	30				GREENSTONE producing ~1/16-1/32 gpm of water after a 1/2 hour air evacuation.	
	40					
GRAB	50					
	60					
	70					
	80					
	90					
	100					
GRAB	110					
	120					
	130					
	140					
	150					
GRAB	160					
	170					
	180					
	190					
	200					
GRAB	210					
	220					
	230					
	240					
	250					
GRAB	260					
	270					
	280					
	290					
	300					
GRAB	310					
	320					
	330					
	340					
	350					
GRAB	360					
	370					
	380					
	390					
	400				Bottom of borehole at 400.0 feet.	400.0



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Sunnyvale, CA 94085  
Telephone: (408) 220-9223  
Fax:

# WELL NUMBER HG-6

PAGE 1 OF 1

PROJECT NUMBER 0637109.300 phase 2

PROJECT NAME Lehigh Permanente

LOCATION Santa Clara, CA

DRILLING METHOD Air Rotary

GROUND ELEVATION 1822 ft. MSL

TOP OF CASING 1825 ft. MSL

LOGGED BY Jill Dekoekkoek

REMARKS Air rotary drilling to 400 feet using a 6.75" drill bit.

DATE STARTED 11/13/08

DATE COMPLETED 11/18/08

CASING TYPE/DIAMETER Schedule 80 pvc / 2 inches

SCREEN TYPE/SLOT slotted screen / 0.020

GRAVEL PACK TYPE #3 sand

GROUT TYPE/QUANTITY 5% bentonite

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH	WELL DIAGRAM
GRAB	10				OVERBURDEN.		
	20					25.0	
	30				Weathered BASALT.		
	40					45.0	
	50				GREENSTONE gouge with trace calcite.		
GRAB	60						
	70						
	80						
	90						
	100						
GRAB	110						
	120						
	130						
	140						
	150						
GRAB	160						
	170						
	180						
	190						
	200						
GRAB	210						
	220						
	230						
	240						
	250						
GRAB	260						
	270						
	280						
	290						
	300						
GRAB	310						
	320						
	330						
	340						
	350						
GRAB	360						
	370						
	380						
	390						
	400				Bottom of borehole at 400.0 feet.	400.0	

5% bentonite  
grout  
2" sch. 80 pvc

Bentonite  
#3 sand filter  
pack  
0.020" slotted  
screen

collapse/slough

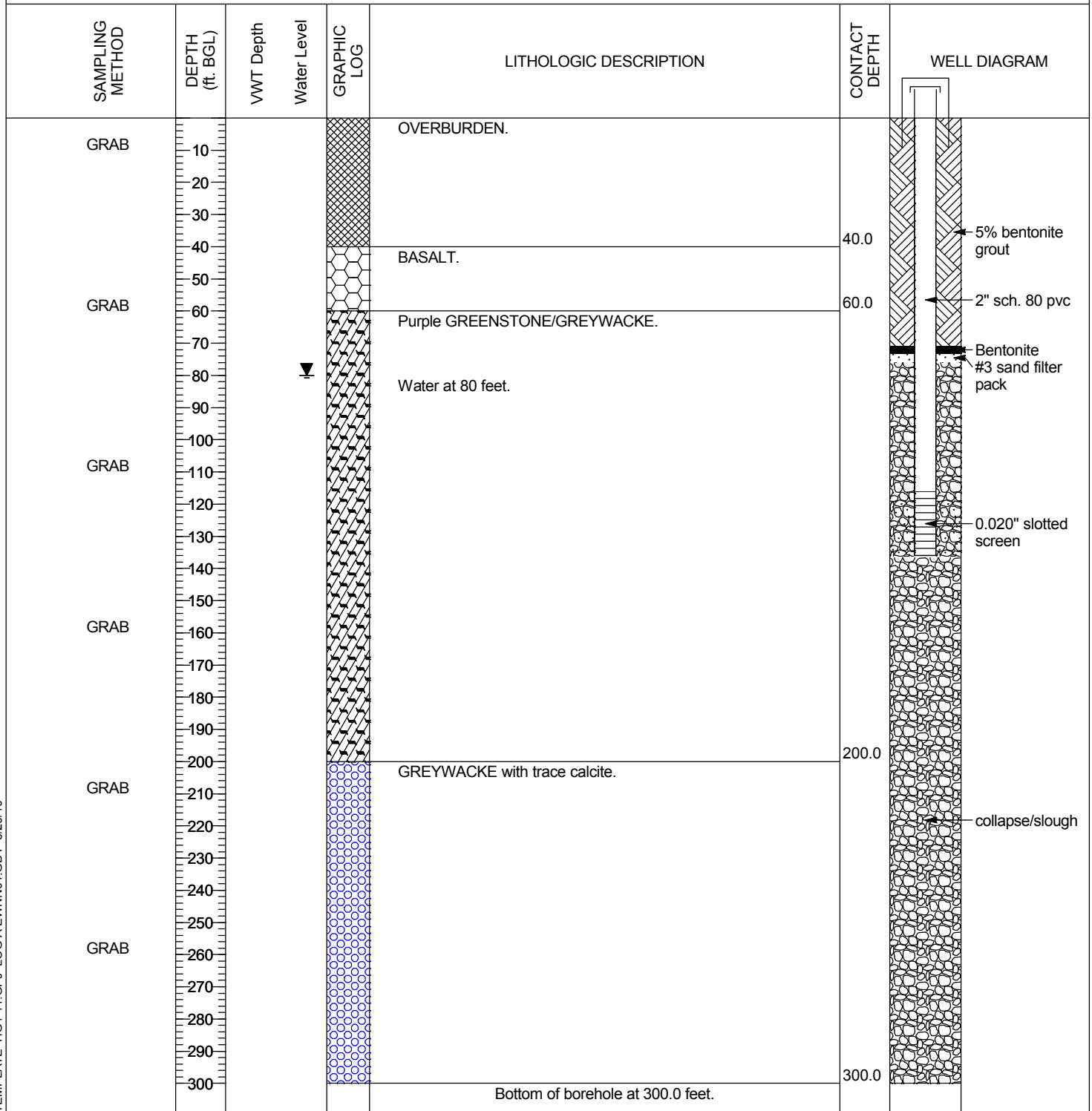


Golder Associates  
425 Lakeside Drive  
Sunnyvale, CA 94085  
Telephone: (408) 220-9223  
Fax:

# WELL NUMBER HG-7

PAGE 1 OF 1

PROJECT NUMBER 0637109.300 phase 2  
PROJECT NAME Lehigh Permanente  
LOCATION Santa Clara, CA  
DRILLING METHOD Air Rotary  
GROUND ELEVATION 1254 ft. MSL  
TOP OF CASING 1257 ft. MSL  
LOGGED BY Jill Dekoekkoek  
REMARKS Air rotary drilling to 300 feet using a 6.75" drill bit.  
DATE STARTED 11/21/08  
DATE COMPLETED 11/22/08  
CASING TYPE/DIAMETER Schedule 80 pvc / 2 inches  
SCREEN TYPE/SLOT slotted screen / 0.020  
GRAVEL PACK TYPE #3 sand  
GROUT TYPE/QUANTITY 5% bentonite





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425 Lakeside Drive  
Sunnyvale, CA 94085  
Telephone: (408) 220-9223  
Fax:

# BORING NUMBER HG-8

PAGE 1 OF 1

PROJECT NUMBER 0637109.300 phase 2  
PROJECT NAME Lehigh Permanente  
LOCATION Santa Clara, CA  
DRILLING METHOD Air Rotary  
GROUND ELEVATION 1148 ft. MSL  
TOP OF CASING ----  
LOGGED BY Jill Dekoekkoek  
REMARKS Air rotary drilling to 200 feet using a 6.75" drill bit.  
DATE STARTED 11/23/08  
DATE COMPLETED 11/23/08  
CASING TYPE/DIAMETER ----  
SCREEN TYPE/SLOT ----  
GRAVEL PACK TYPE ----  
GROUT TYPE/QUANTITY ----

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
GRAB	10				OVERBURDEN.	
	20					
	30					
	40					40.0
GRAB	50				GREENSTONE with greywacke and trace calcite. Producing 2-4gpm of water during evacuation immediately after drilling.	
	60					
	70					
	80					
	90					
GRAB	100					
	110					
	120				Water at 120 feet.	
	130					
	140					
	150	VWT				
GRAB	160					
	170					
	180					
	190					
	200				Bottom of borehole at 200.0 feet.	200.0



Golder Associates  
425 Lakeside Drive  
Sunnyvale, CA 94085  
Telephone: (408) 220-9223  
Fax:

# WELL NUMBER HG-9

PAGE 1 OF 1

PROJECT NUMBER 0637109.300 phase 2

PROJECT NAME Lehigh Permanente

LOCATION Santa Clara, CA

DRILLING METHOD Air Rotary

GROUND ELEVATION 1245 ft. MSL

TOP OF CASING 1248 ft. MSL

LOGGED BY Jill Dekoekkoek

REMARKS Air rotary drilling to 200 feet using a 6.75" drill bit.

DATE STARTED 11/24/08

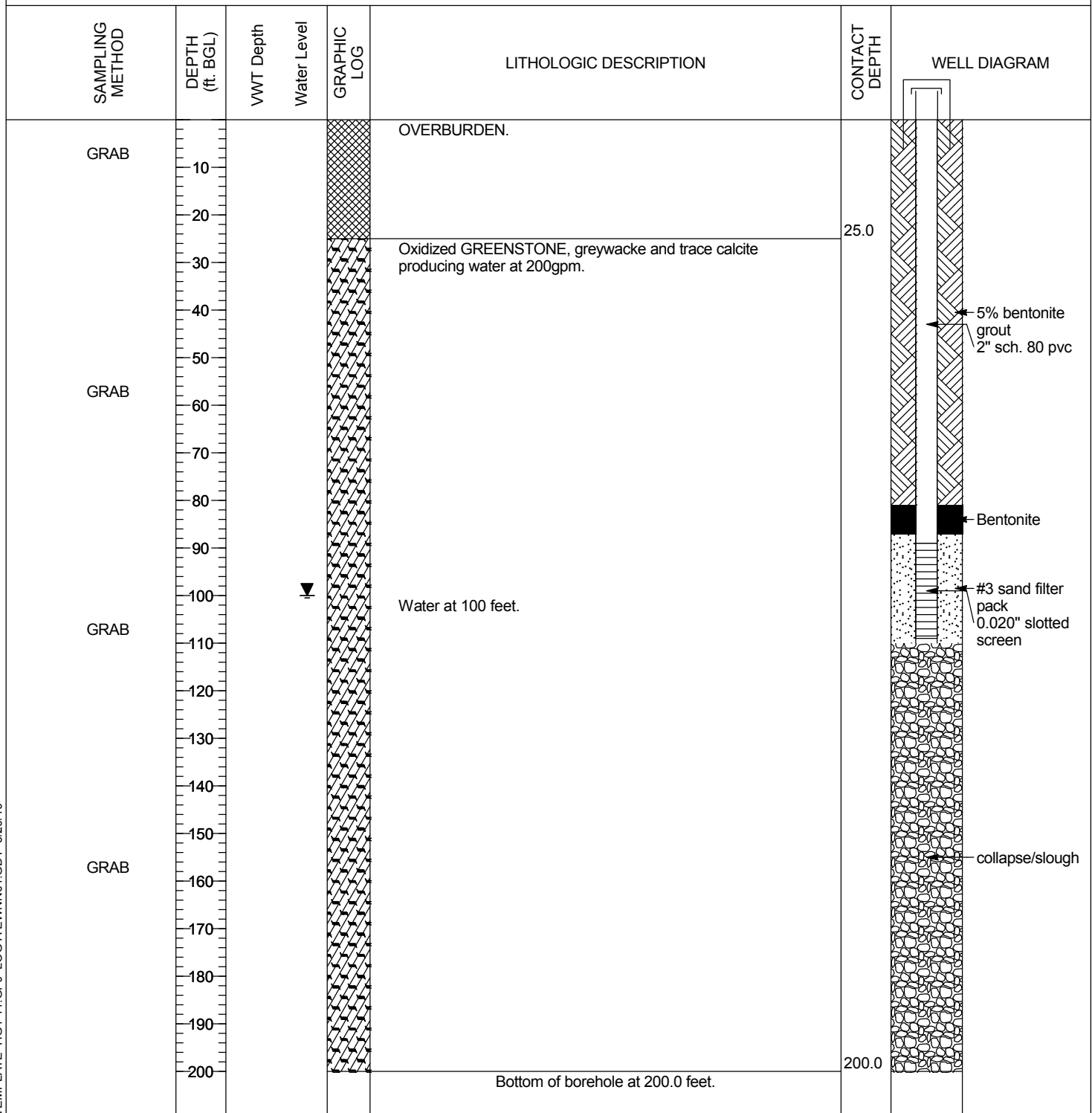
DATE COMPLETED 11/24/08

CASING TYPE/DIAMETER Schedule 80 pvc / 2 inches

SCREEN TYPE/SLOT slotted screen / 0.020

GRAVEL PACK TYPE #3 sand

GROUT TYPE/QUANTITY 5% bentonite





Golder Associates  
425 Lakeside Drive  
Sunnyvale, CA 94085  
Telephone: (408) 220-9223  
Fax:

# WELL NUMBER HG-10S

PAGE 1 OF 1

PROJECT NUMBER 0637109.300 phase 2 DATE STARTED 8/6/09  
PROJECT NAME Lehigh Permanente DATE COMPLETED 10/11/09  
LOCATION Santa Clara, CA CASING TYPE/DIAMETER Schedule 80 pvc / 2 inches  
DRILLING METHOD Air Rotary SCREEN TYPE/SLOT slotted screen / 0.020  
GRAVEL PACK TYPE #3 sand  
GROUND ELEVATION 1585 ft. MSL GROUT TYPE/QUANTITY 5% bentonite  
TOP OF CASING 1587.5 ft. MSL  
LOGGED BY JL/GW  
REMARKS Air rotary drilling to 580 feet using a 6.75" drill bit.

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH	WELL DIAGRAM
GRAB	10				OVERBURDEN with limestone gravel fragments.		
GRAB	20						
GRAB	30						
GRAB	40						
GRAB	50						
GRAB	60						
GRAB	70						
GRAB	80						
GRAB	90					85.0	
GRAB	100				loose GRAVEL containing limestone and trace greenstone/greywacke. Produces 20gpm, very soft.		5% bentonite/cement grout 2" sch. 80 pvc
GRAB	110						
GRAB	120				LIMESTONE with trace greenstone.	120.0	Bentonite chips
GRAB	130						
GRAB	140						
GRAB	150					160.0	#3 sand filter pack 0.020" slotted screen
GRAB	160				GREYWACKE with trace greenstone. Very soft, possibly collapsing in this interval.		
GRAB	170						
GRAB	180						
GRAB	190						
GRAB	200						
GRAB	210					220.0	
GRAB	220				GREENSTONE/GREYWACKE GOUGE. Soft, clayey fault gouge.		
GRAB	230						
GRAB	240						
GRAB	250						
GRAB	260						
GRAB	270						
GRAB	280						
GRAB	290						
GRAB	300					310.0	
GRAB	310				GREYWACKE with trace greenstone and limestone. Increased competence with depth.		
GRAB	320						
GRAB	330						
GRAB	340						
GRAB	350						
GRAB	360						
GRAB	370						slough/collapse
GRAB	380						
GRAB	390						
GRAB	400						
GRAB	410						
GRAB	420						
GRAB	430						
GRAB	440						
GRAB	450						
GRAB	460						
GRAB	470						
GRAB	480						
GRAB	490						
GRAB	500					510.0	
GRAB	510				LIMESTONE. Well indurated, low-grade limestone with very little circulation.		
GRAB	520						
GRAB	530						
GRAB	540						
GRAB	550						
GRAB	560						
GRAB	570					580.0	
GRAB	580				Bottom of borehole at 580.0 feet.		




Golder Associates  
425 Lakeside Drive  
Sunnyvale, CA 94085  
Telephone: (408) 220-9223  
Fax:

# BORING NUMBER HG-10M D

PAGE 1 OF 1

PROJECT NUMBER 0637109.300 phase 2 DATE STARTED 8/6/09  
PROJECT NAME Lehigh Permanente DATE COMPLETED 10/11/09  
LOCATION Santa Clara, CA CASING TYPE/DIAMETER ----  
DRILLING METHOD Air Rotary SCREEN TYPE/SLOT ----  
GROUND ELEVATION 1585 ft. MSL GRAVEL PACK TYPE ----  
TOP OF CASING ---- GROUT TYPE/QUANTITY 5% bentonite  
LOGGED BY JL/GW  
REMARKS Air rotary drilling to 580 feet using a 6.75" drill bit.

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH					
GRAB	10	VWT 10int			See Log for HG-10S						
	20										
	30										
	40										
GRAB	50										
	60										
	70										
	80										
	90										
	100										
GRAB	110	VWT 10int									
	120										
	130										
	140										
GRAB	150										
	160										
	170										
	180										
	190										
	200										
GRAB	210	VWT 10int									
	220										
	230										
	240										
	250										
GRAB	260										
	270										
	280										
	290										
	300										
GRAB	310	VWT 10int									
	320										
	330										
	340										
	350										
GRAB	360										
	370										
	380										
	390										
	400										
GRAB	410	VWT 10int									
	420										
	430										
	440										
	450										
GRAB	460										
	470										
	480										
	490										
	500										
GRAB	510	VWT 10d									
	520										
	530										
	540										
	550										
GRAB	560										
	570										
	580										
Bottom of borehole at 580.0 feet.							580.0				

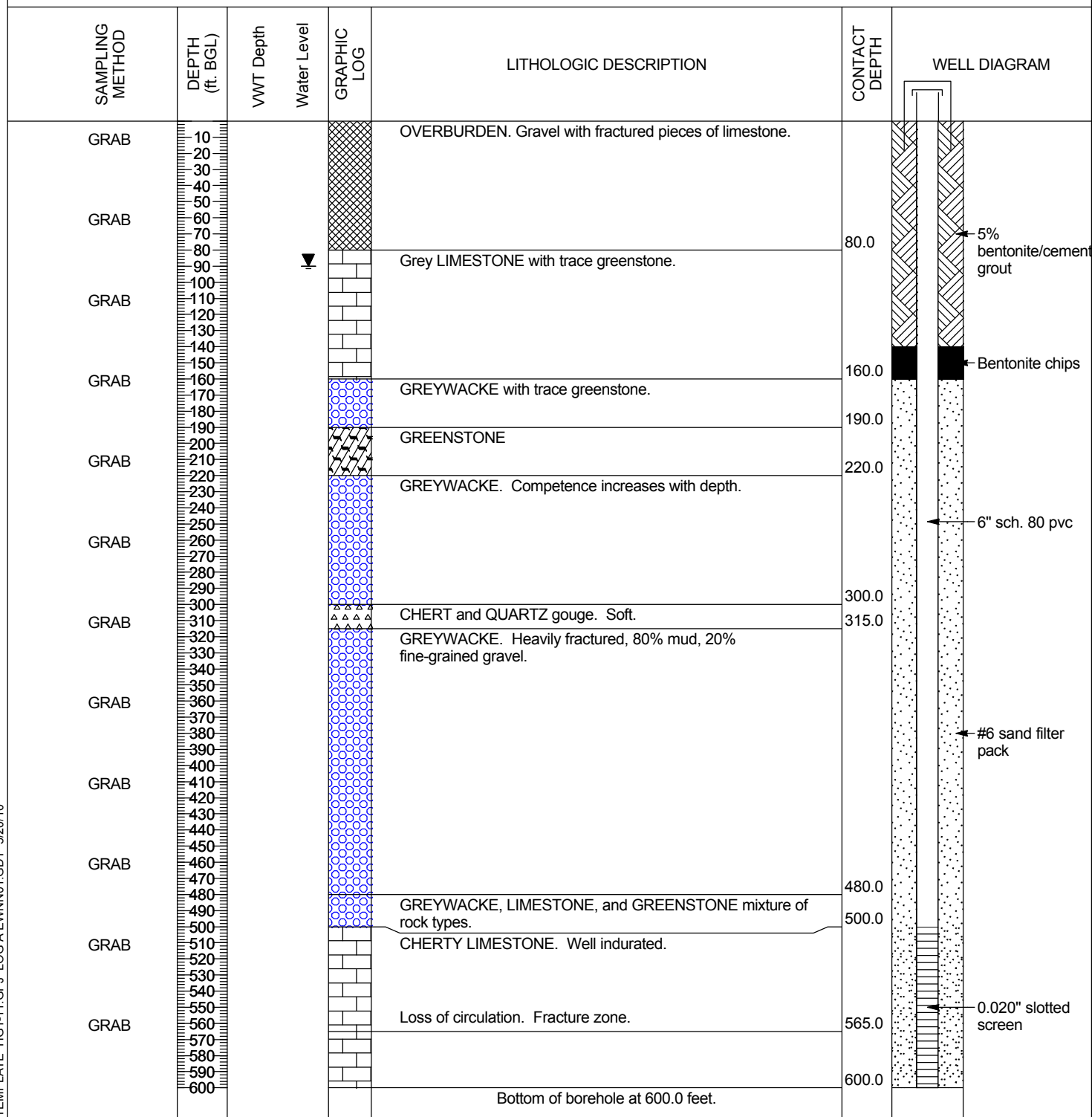


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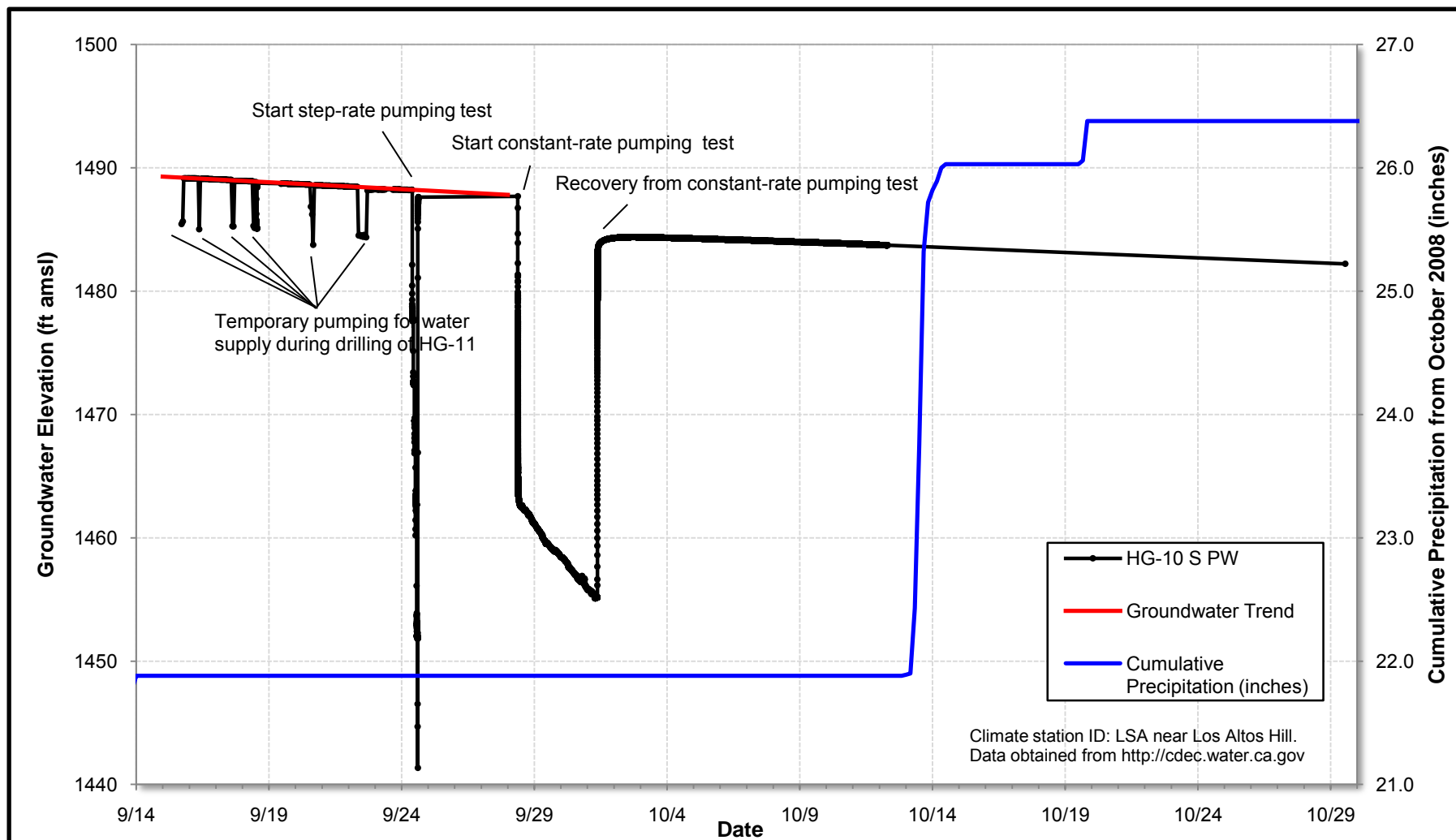
# WELL NUMBER HG-11

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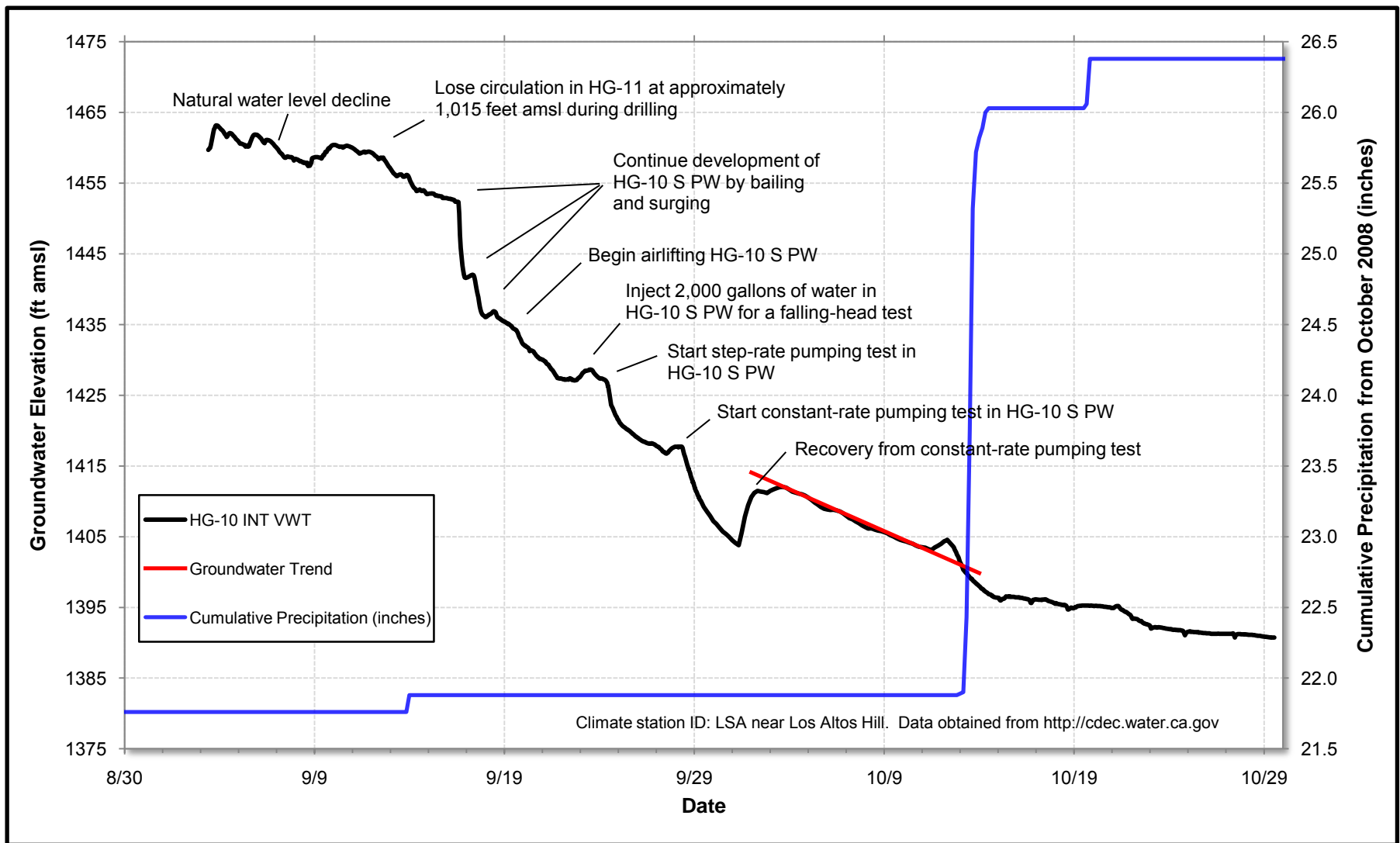
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<b>PROJECT NAME</b> Lehigh Permanente	<b>DATE COMPLETED</b> 9/15/09
<b>LOCATION</b> Santa Clara, CA	<b>CASING TYPE/DIAMETER</b> Schedule 80 pvc / 6 inches
<b>DRILLING METHOD</b> Air Rotary	<b>SCREEN TYPE/SLOT</b> slotted screen / 0.020
<b>GROUND ELEVATION</b> 1585 ft. MSL	<b>GRAVEL PACK TYPE</b> #6 sand
<b>TOP OF CASING</b> 1587.5 ft. MSL	<b>GROUT TYPE/QUANTITY</b> 5% bentonite
<b>LOGGED BY</b> JL/GW	
<b>REMARKS</b> Air rotary drilling from 0-200 feet using 18" drill bit, from 200-600 using a 14" bit.	



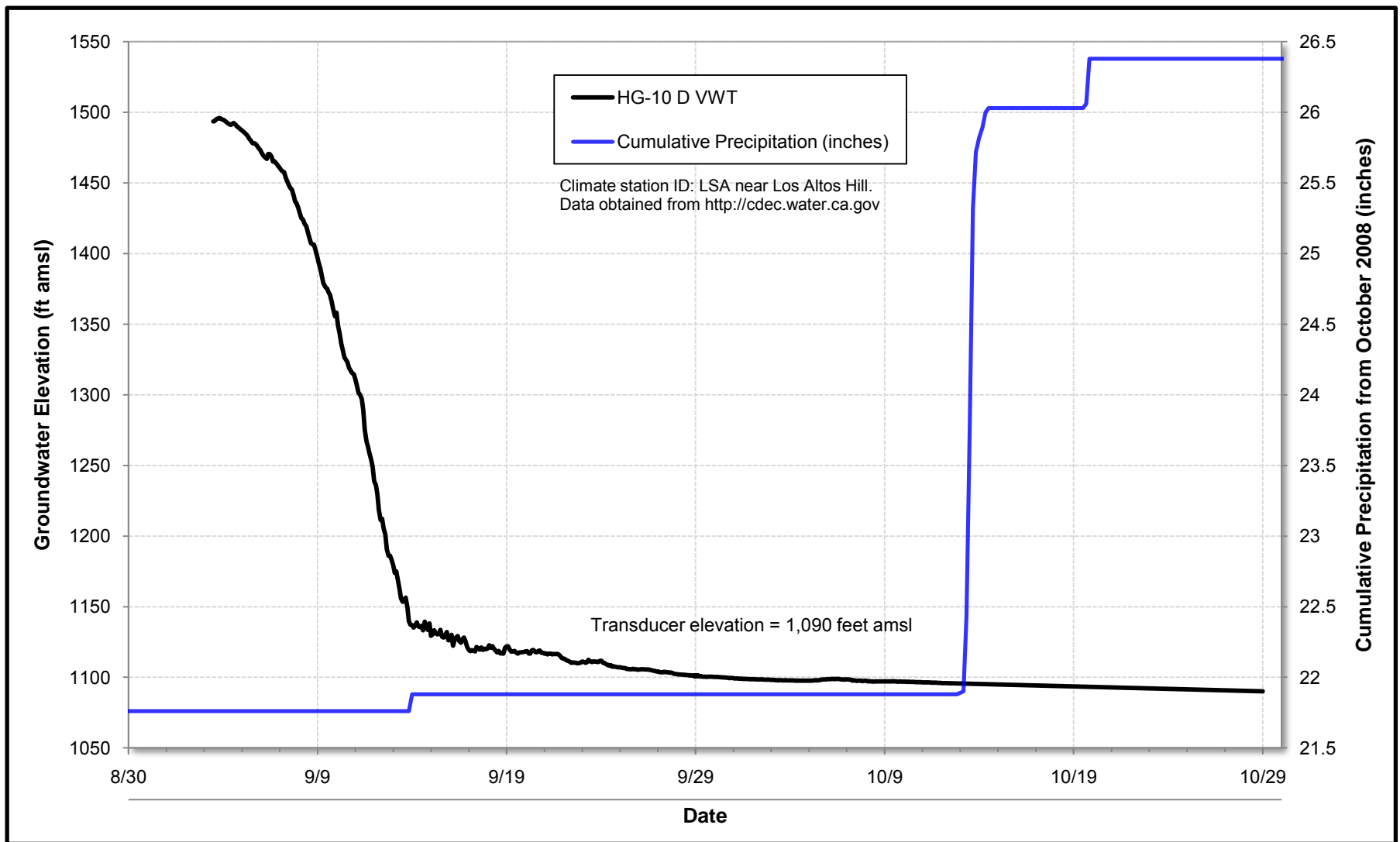
**APPENDIX B**  
**HYDROGRAPHS**



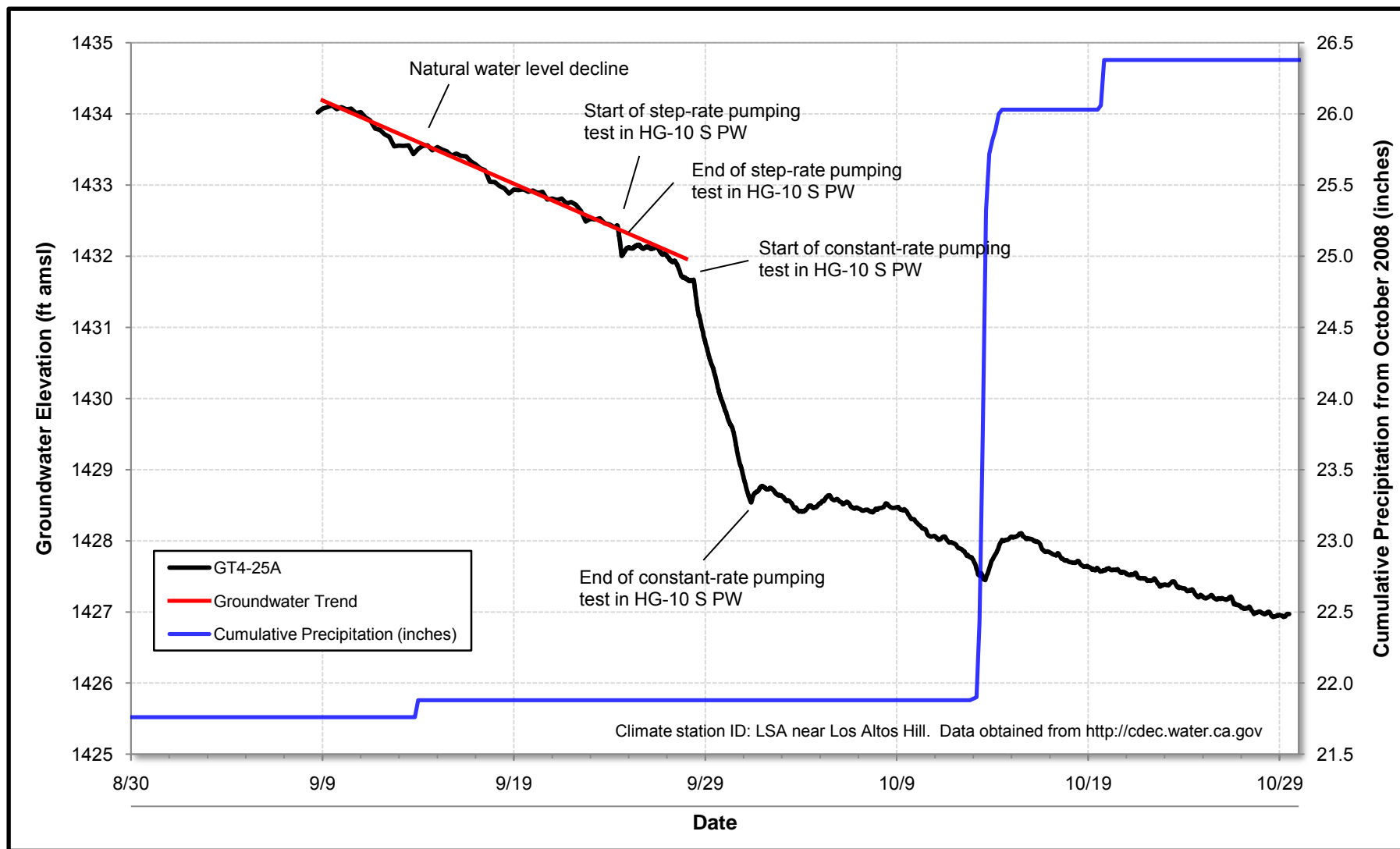
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Project Name	Hydrologic Investigation	Project No.	063-7109-500
		Reviewed	DB
Client Name	Lehigh Permanente	Date	March 2, 2010
		FIGURE C.1	



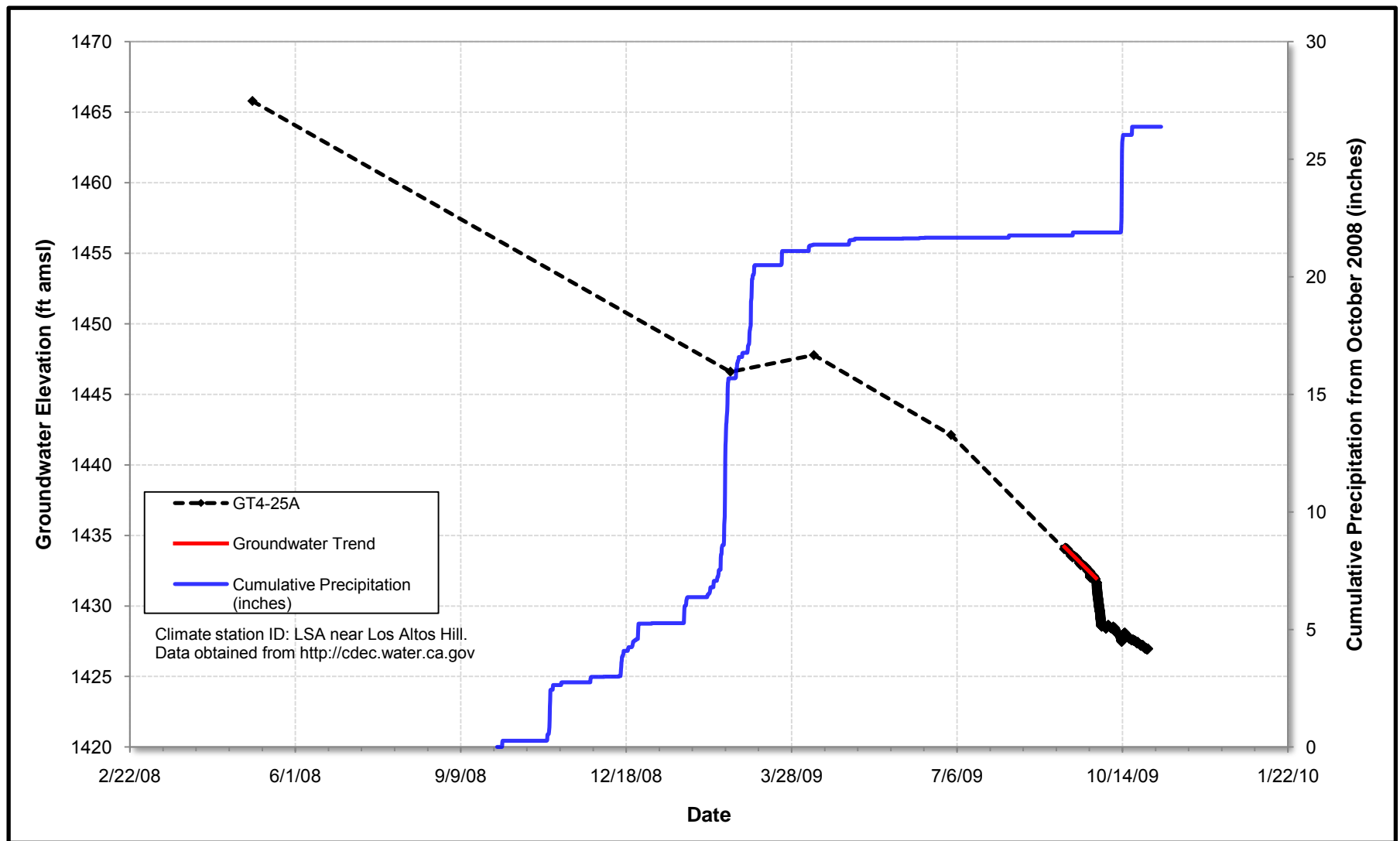
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Project Name		Hydrologic Investigation	Project No.	063-7109-500	Reviewed	DB
Client Name		Lehigh Permanente	Date	March 2, 2010	FIGURE C.2	



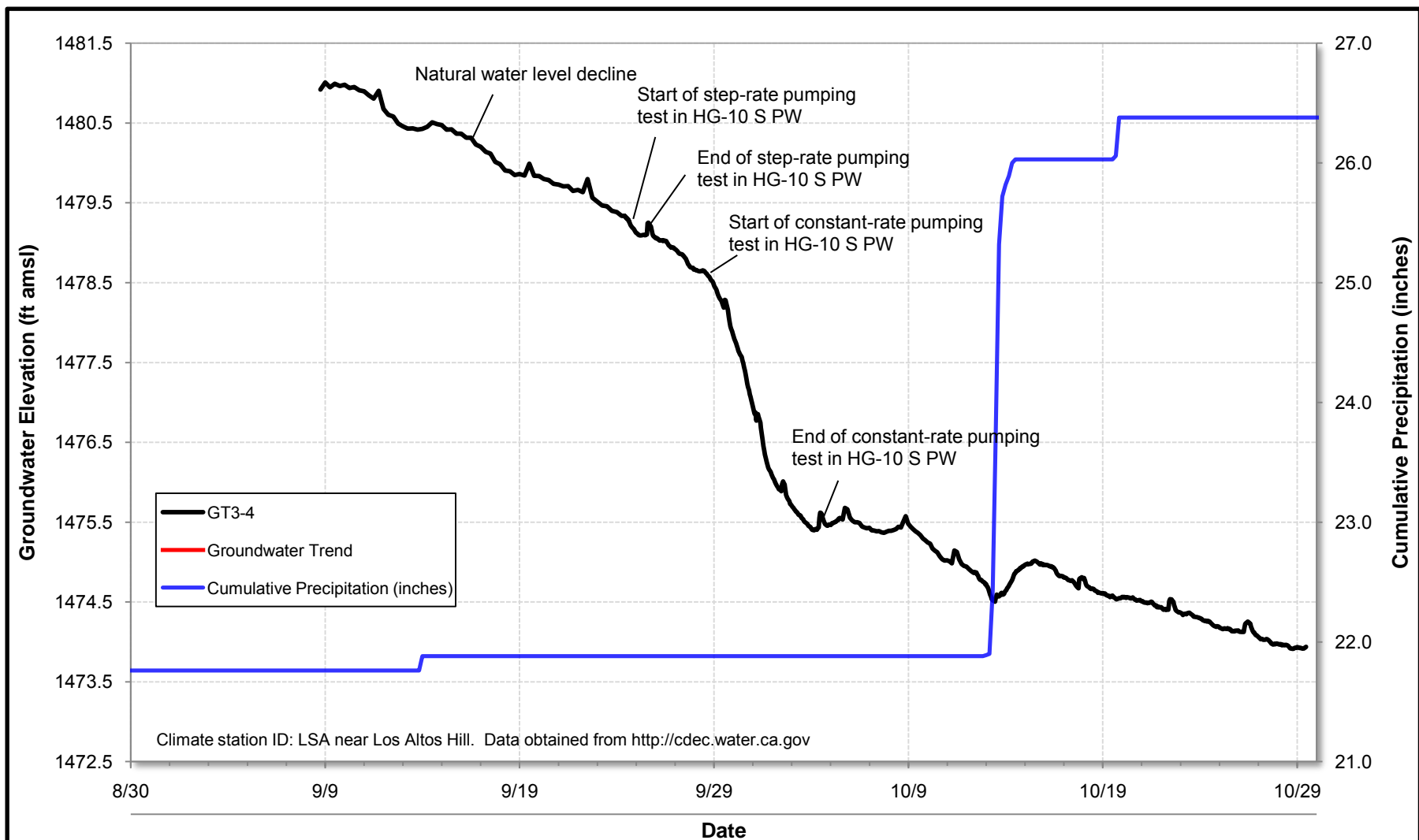
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					Checked	GW	
Project Name		Hydrologic Investigation	Project No.		063-7109-500	Reviewed	DB
Client Name		Lehigh Permanente	Date		March 2, 2010	FIGURE C.3	



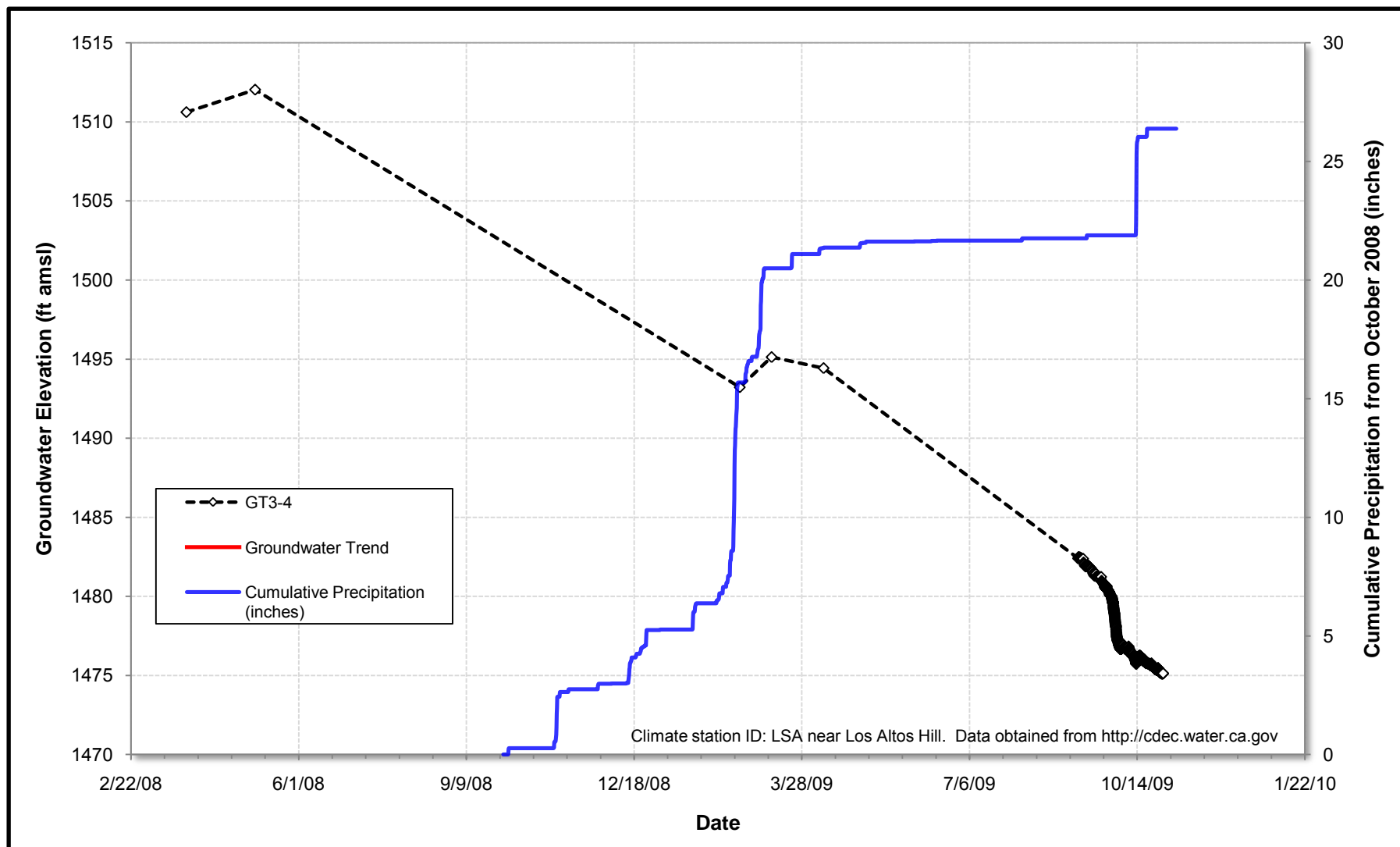
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		Checked	GW
Project Name	Hydrologic Investigation	Project No.	063-7109-500
		Reviewed	DB
Client Name	Lehigh Permanente	Date	March 2, 2010
		FIGURE C.4	



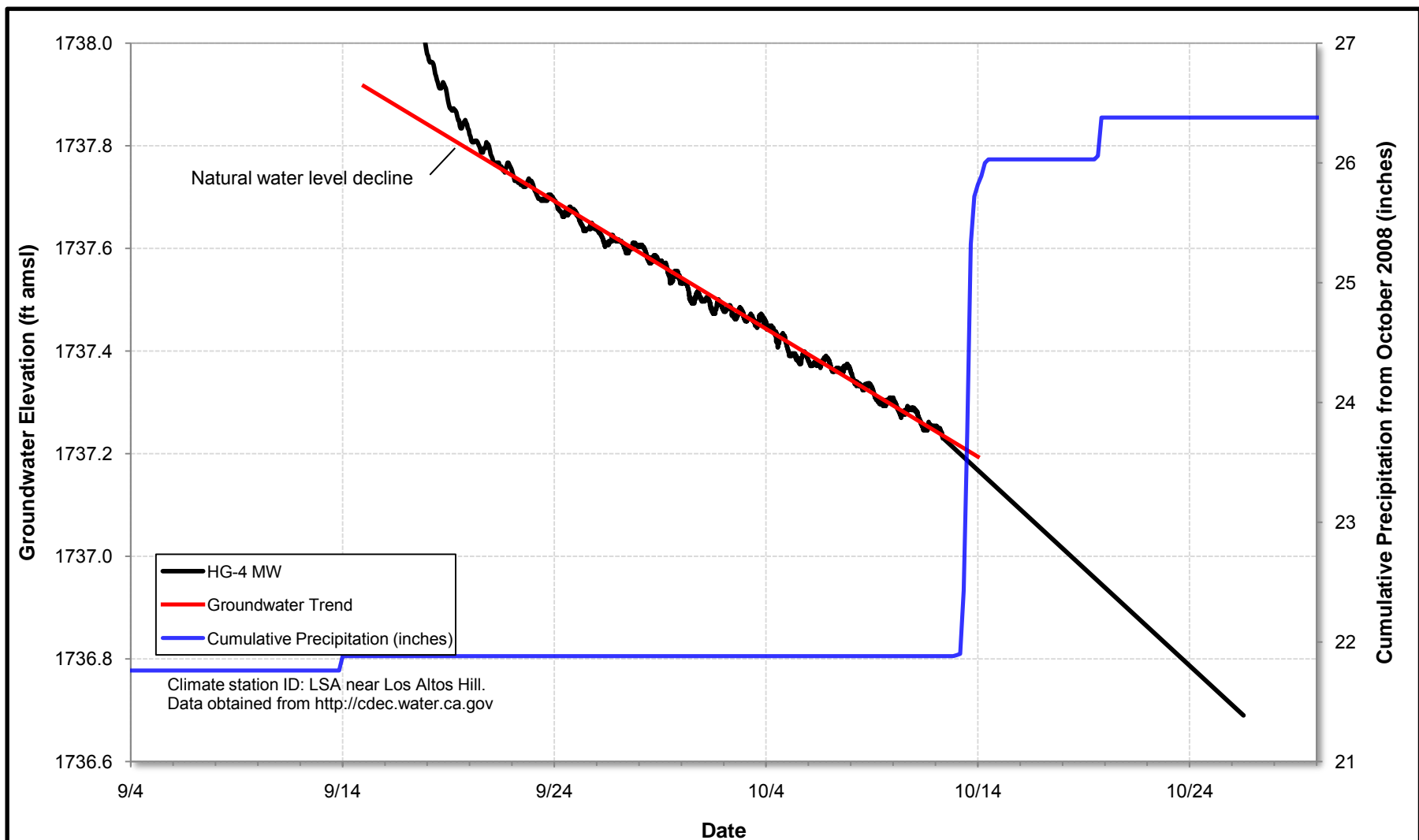
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Project Name		Hydrologic Investigation	Project No.	063-7109-500	Reviewed	DB
Client Name		Lehigh Permanente	Date	March 2, 2010	FIGURE C.5	



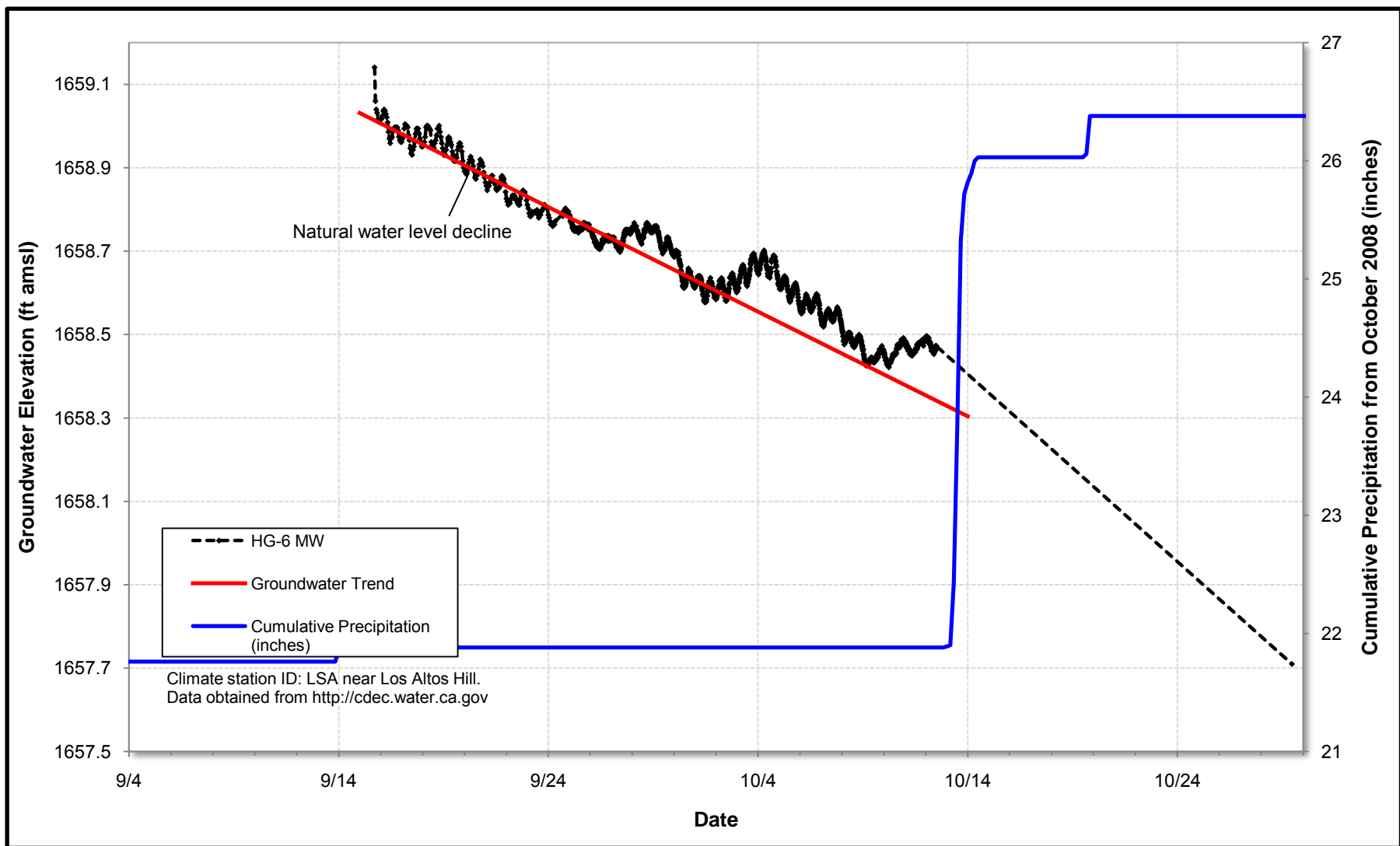
Title GT3-4 VWT Hydrograph			Drawn	DH
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Project Name Hydrologic Investigation		Project No. 063-7109-500	Reviewed	DB
Client Name Lehigh Permanente		Date March 2, 2010	FIGURE C.6	



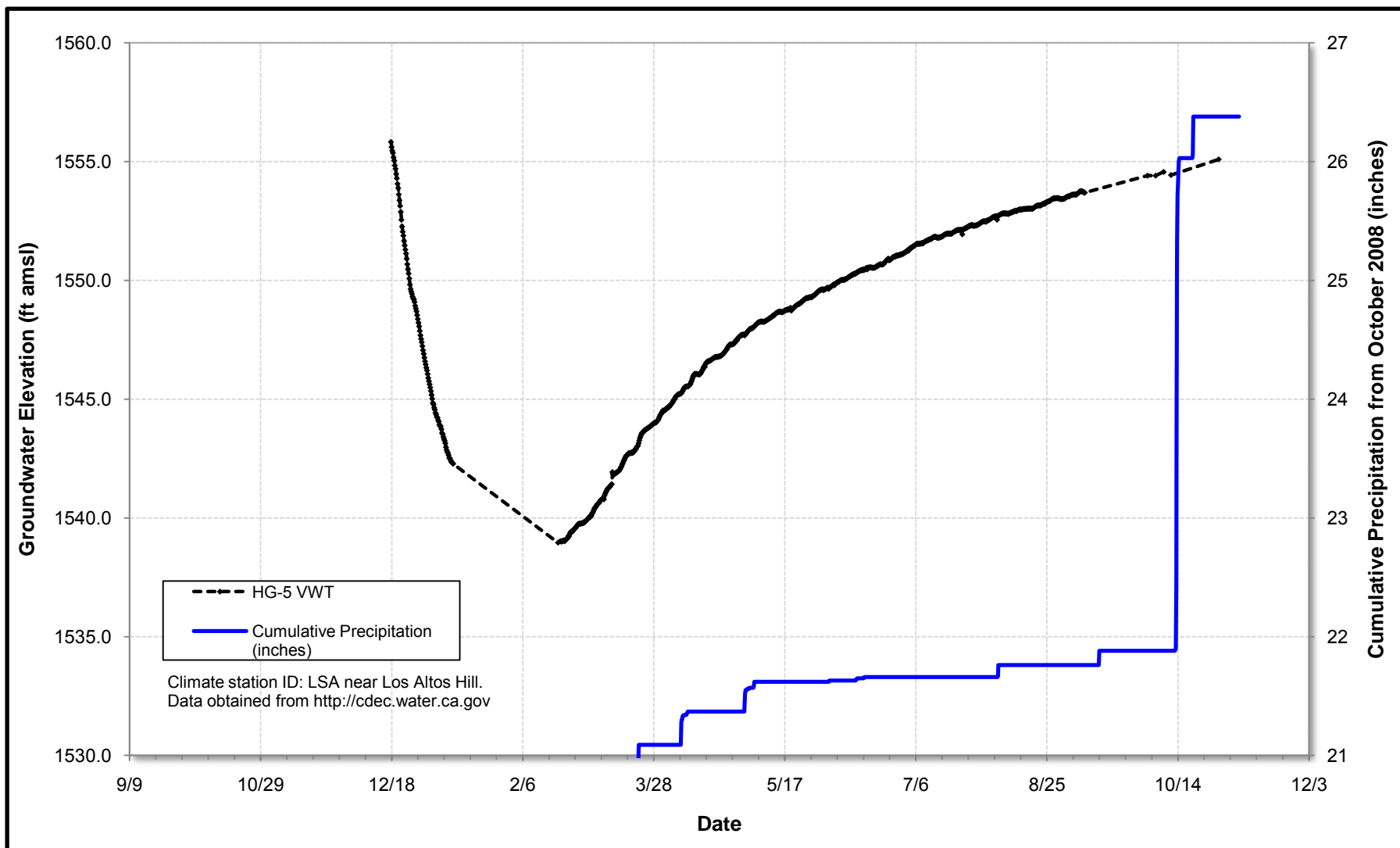
Title GT3-4 VWT Hydrograph			Drawn	DH	
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Project Name Hydrologic Investigation		Project No.	063-7109-500	Reviewed	DB
Client Name Lehigh Permanente		Date	March 2, 2010	FIGURE C.7	



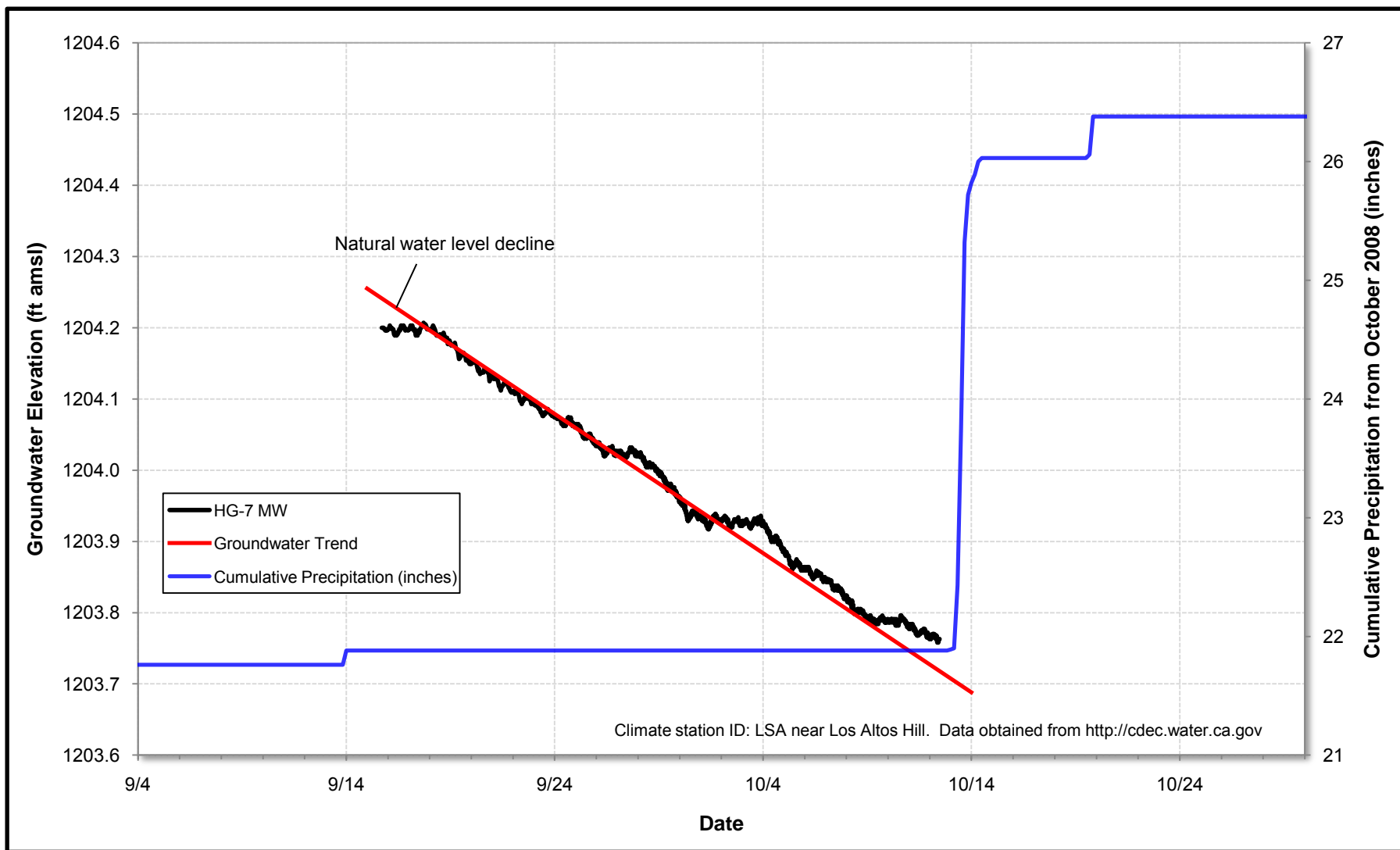
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				Checked	GW
Project Name Hydrologic Investigation		Project No. 063-7109-500		Reviewed	DB
Client Name Lehigh Permanente		Date March 2, 2010		FIGURE C.8	



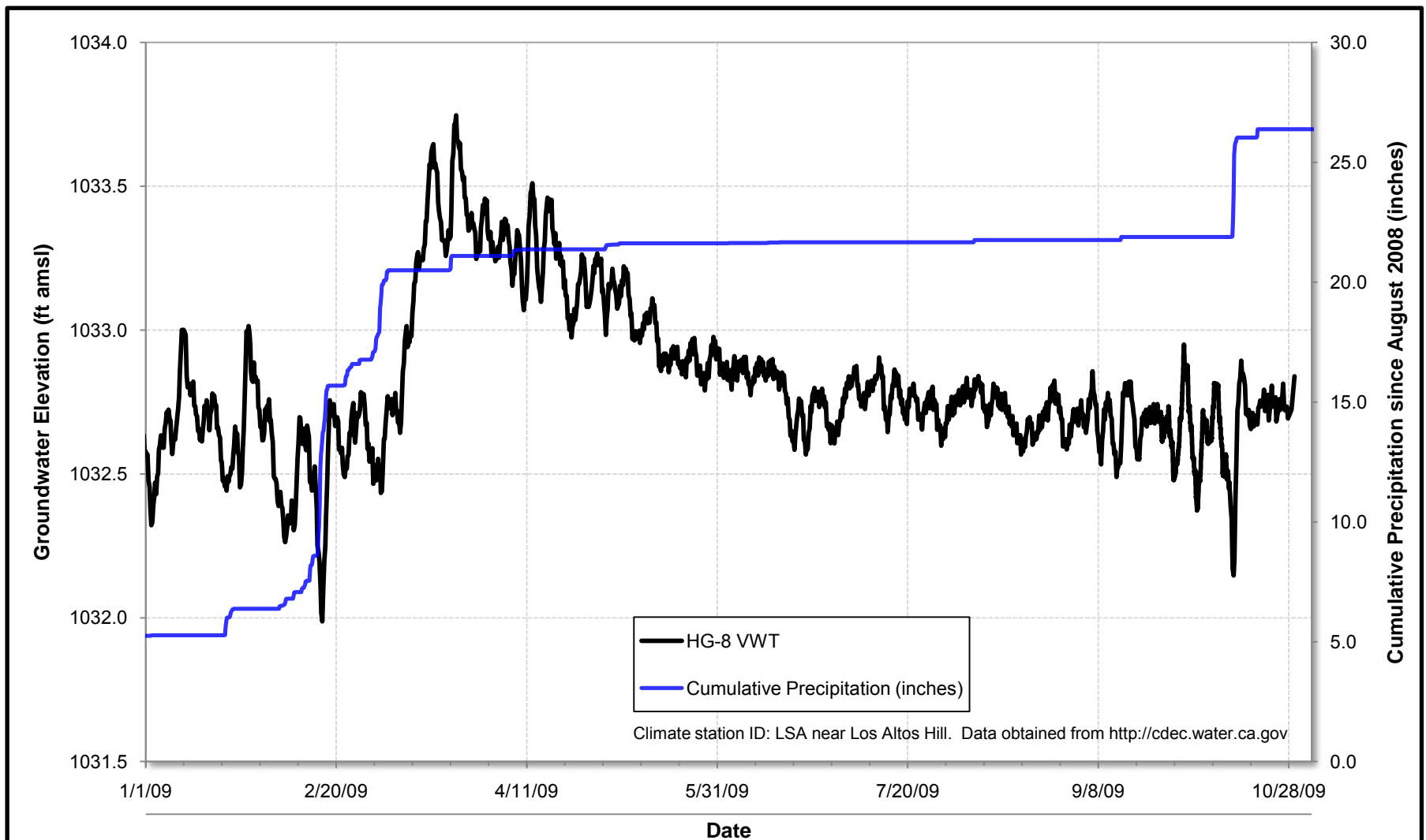
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		Checked	GW
Project Name	Hydrologic Investigation	Project No.	063-7109-500
Client Name	Lehigh Permanente	Date	March 2, 2010
		FIGURE C.10	



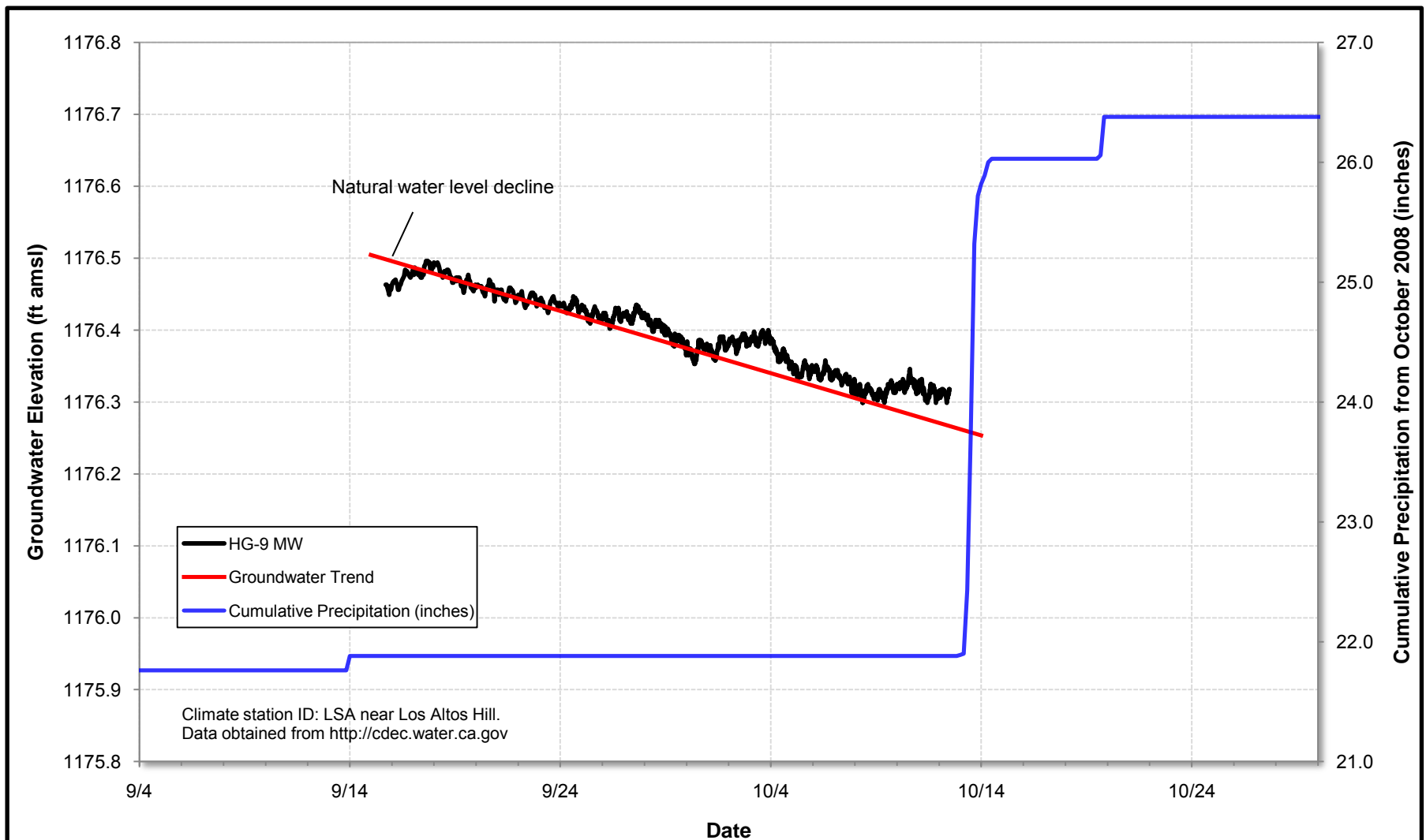
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Project Name Hydrologic Investigation		Project No.	063-7109-500	Reviewed	DB
Client Name Lehigh Permanente		Date	March 2, 2010	FIGURE C.9	



Title				HG-7 MW Hydrograph		Drawn	DH
						Checked	GW
Project Name		Hydrologic Investigation		Project No.		063-7109-500	
						Reviewed	DB
Client Name		Lehigh Permanente		Date		March 2, 2010	
				FIGURE C.11			



Title		HG-8 VWT Hydrograph		Drawn	DH	
				Checked	GW	
Project Name		Hydrologic Investigation	Project No.	063-7109-500	Reviewed	DB
Client Name		Lehigh Permanente	Date	March 2, 2010	FIGURE C.12	



Title		HG-9 MW Hydrograph		Drawn	DH
				Checked	GW
Project Name	Hydrologic Investigation	Project No.	063-7109-500	Reviewed	DB
Client Name	Lehigh Permanente	Date	March 2, 2010	FIGURE C.13	

**APPENDIX C**  
**PACKER TEST RESULTS**



## TECHNICAL MEMORANDUM

*Attorney-Client Confidential Work Product*

**Date:** 3/27/2009

**Project No.:** 0637109

**To:** Bill Fowler

**Company:** Golder Associates

**From:** Rick Booth

**cc:** George Wegmann

**RE: PACKER TEST RESULTS, LEHIGH PERMANENTE QUARRY, CUPERTINO, CA**

---

In October and November 2008, a total of nine (9) boreholes were drilled in order to characterize the geology and hydrogeology of the project area. The borings were drilled to depths ranging from approximately 200 to 500 feet below grade and the cuttings were logged by a Golder geologist. The hydraulic conductivity of the bedrock encountered in borehole was tested using a downhole straddle packer set up. After the completion of the packer tests, four (4) monitoring wells were constructed in four of the boreholes for long term groundwater level and water quality monitoring. Vibrating wire transducers (VWT) were installed in the remaining boreholes except for boring HG-1, which could not be instrumented because of borehole instability. Borehole HG-1 was abandoned by filling with grout. The VWT installations involved attaching the VWTs and their cables to a string of PVC pipe as it was inserted into the borehole; and then fully-grouting the hole, using the PVC string as a tremmie pipe.

A total of fourteen (14) tests were analyzed from boreholes HG-2, HG-3, HG-4, HG-5, HG-8, and HG-9. Tests were conducted in boreholes HG-6 and HG-7; however, the tests could not be analyzed due to packer failure (poor borehole conditions prevented an adequate packer seal) or downhole transducer failure when the tubing could not be filled to surface. Every test consisted of a stabilization period after packer inflation followed by a constant rate injection test and a recovery phase.

Interval transmissivity was estimated using HydroBench. HydroBench is a pressure transient interpretation package developed by Golder Associates using the methodology of the Bourdet derivative (Bourdet et al. 1983), coupled with a library of analytical and reservoir models. The software allows the simultaneous analysis of different hydrogeological test phases such as Constant Rate Injection Tests, Slug – and Pulse Tests. The derivative of pressure (i.e., rate of pressure change) with respect to the natural logarithm of time that has shown to significantly improve the diagnostic and quantitative analysis of slug and constant-rate pumping tests (Spane and Wurstner, 1993).

Hydraulic conductivity was computed by dividing the simulated interval transmissivity by the interval length. This implies the entire test interval length contributes equally to the test transmissivity and does not account for the scenario of a highly conductive feature in a relatively low permeable matrix. This scenario can be interpreted from long duration interference tests, which was not part of this scope of work.



## TECHNICAL MEMORANDUM

*Attorney-Client Confidential Work Product*

Skin effect was encountered in most tests. Skin effect is due to a zone surrounding the borehole that has a lower permeability than the formation at large. This acts as a “skin” around the wellbore, causing a lower apparent transmissivity than the formation represents. This apparent lower transmissivity is reflected in the steady state approximation derived from the Theim equation. The steady state approximation, as shown on Table 1, is consistently up to ½-order of magnitude lower than the transmissivity simulated in HydroBench. HydroBench accounts for the skin effect and removes it from the simulation.

Hydraulic conductivity ranged from 1E-04 m/sec in borehole HG-9 from 66 to 94 feet below ground surface (ft bgs) to 2E-07 m/sec in borehole HG-2 from 421.9 to 450.6 ft bgs. The mean hydraulic conductivity of all tests is 1E-05 m/sec. The HydroBench pressure and derivative curve matches are attached as Figures 1-14. A summary of test results is presented in Table 1.

### *References*

Bourdet, D., Whittle, T.M. Douglas, A.A., Pirard, Y.M., 1983; *A new set of type curves simplifies well test analysis*. World Oil, May 1983. Pp. 95 – 106

Spane, Wurstner, 1993. DERIV: *A Computer Program for Calculating Pressure Derivatives for Use in Hydraulic Test Analysis*. Ground Water, September, 1993.

### *Attachments*

Table 1: Summary of Test Results

Figures 1 – 14: HydroBench Pressure and Derivative Curves

**Table 1**  
**Summary of Test Results**  
**Lehigh Permanente Quarry**  
**Cupertino, CA**  
**March 2009**

	Test Number	Top (ft bgs)	Bottom (ft bgs)	Interval Length (ft)	Packer Setup	Test Type	Analysis Match <sup>1</sup>	Transmissivity (m <sup>2</sup> /sec)	Hydraulic Conductivity <sup>2</sup> (m/sec)	Theim Steady State Approx. <sup>3</sup>		
										Constant Flow Rate (gpm)	dP (psi)	Transmissivity (m2/sec)
HG-1a	No Tests											
HG-2	1	505.35	554	48.65	Single Packer	CRI	Recovery	4.E-05	2.E-06	22.5	76	2.E-05
	2	463.9	492.6	28.7	Double Packer	CRI	Recovery	2.E-05	2.E-06	16.5	243	5.E-06
	3	421.9	450.6	28.7	Double Packer	CRI	Injection	2.E-06	2.E-07	2.4	215	8.E-07
	4	379.9	408.6	28.7	Double Packer	CRI	Recovery	8.E-05	9.E-06	27.0	82	2.E-05
HG-3	1	400	453	53	Single Packer	CRI	Injection	1.E-04	9.E-06	14.0	8	1.E-04
	2	358.9	387.6	28.7	Double Packer	CRI	Recovery	4.E-06	4.E-07	9.0	197	3.E-06
	3	295.89	324.56	28.67	Double Packer	CRI	Injection	2.E-04	2.E-05	15.0	17	6.E-05
HG-4	1	274	296.6	22.6	Single Packer	CRI	Injection	< 5.E-06	< 7.E-07	<2	75	< 2.E-6
	2	211.89	240.56	28.67	Double Packer	CRI	Injection	8.E-06	9.E-07	1.8	48	3.E-06
HG-5	1	337.9	366.5	28.6	Double Packer	CRI	Injection	7.E-06	8.E-07	2.5	60	3.E-06
	2	253.9	283.6	29.7	Double Packer	CRI	Injection	4.E-06	4.E-07	0.8	52	1.E-06
HG-6	No Tests											
HG-7	No Tests											
HG-8	1	149	178	29	Double Packer	CRI	Injection	1.E-05	1.E-06	5.0	56	6.E-06
	2	86	115	29	Double Packer	CRI	Injection	1.E-04	1.E-05	21.0	49	3.E-05
HG-9	1	66	94	28	Double Packer	CRI	Injection	9.E-04	1.E-04	21.4	6	2.E-04

ft bgs feet below ground surface

CRI Constant Rate Injection

gpm Gallons Per Minute

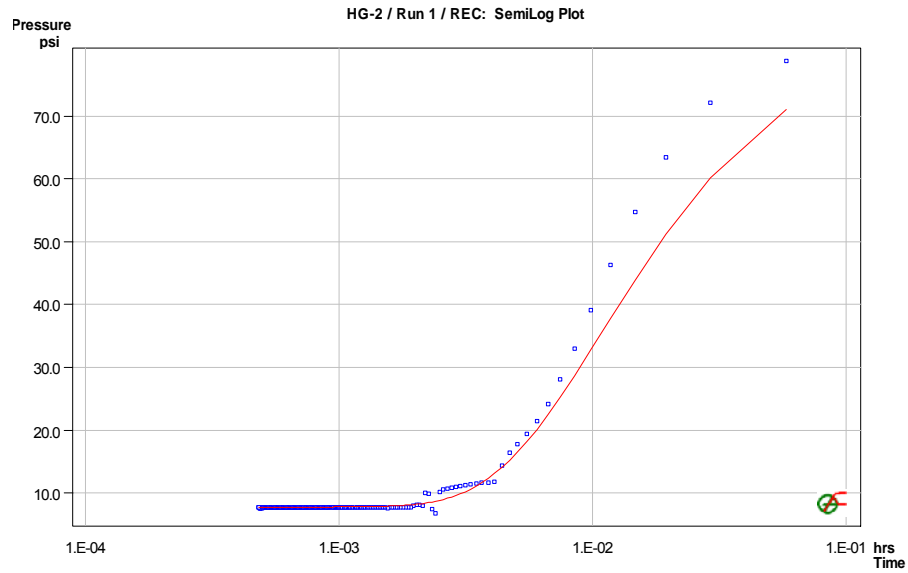
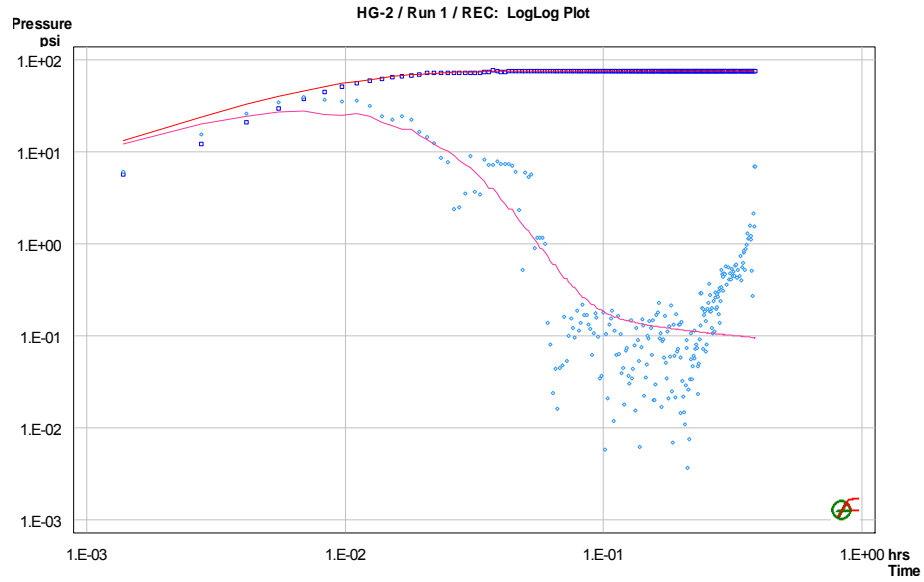
dP Change in pressure induced during the test.

1 Analysis Match refers to the portion of the pressure curve that was used to fit the HydroBench simulation.

2 Conductivity calculated by multiplying the transmissivity by the interval length

3 Theim Steady State Equation:  $T = \frac{Q \cdot \ln(R_i / R_{ew})}{2 \cdot (PI) H}$ , where Q=flow rate, Ri=borehole radius, Rew=radius of influence (assumed 10 meters), H=dP

# HG-2 Test 1 (505.35 to 554 feet)

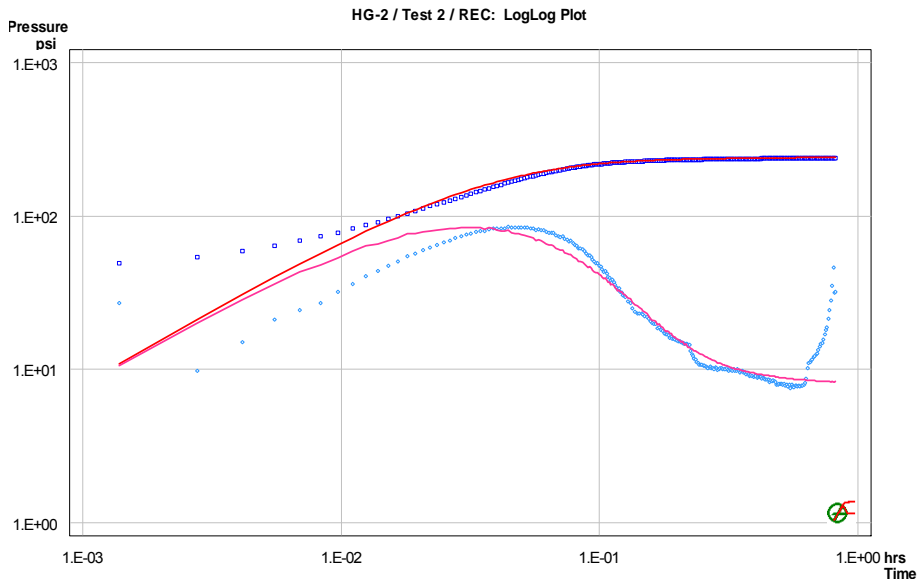
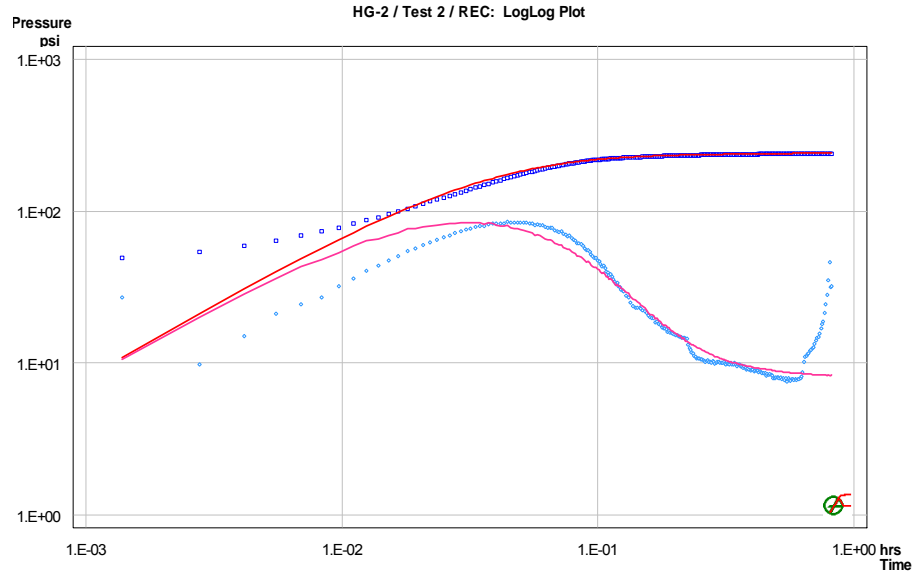


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Static Pressure: 7.69 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	3.509e-05 m <sup>2</sup> /s	1.041e-05	- - m	2.5580
	C (WBS)	Skin		
CRI:	4.625e-08 m <sup>3</sup> /Pa	9.8944		
REC:	4.625e-08 m <sup>3</sup> /Pa	9.8944		

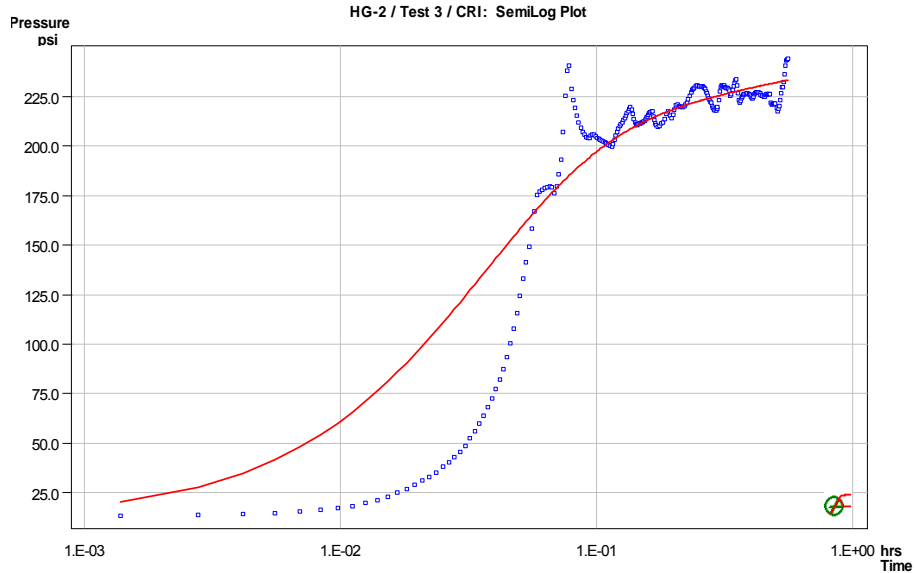
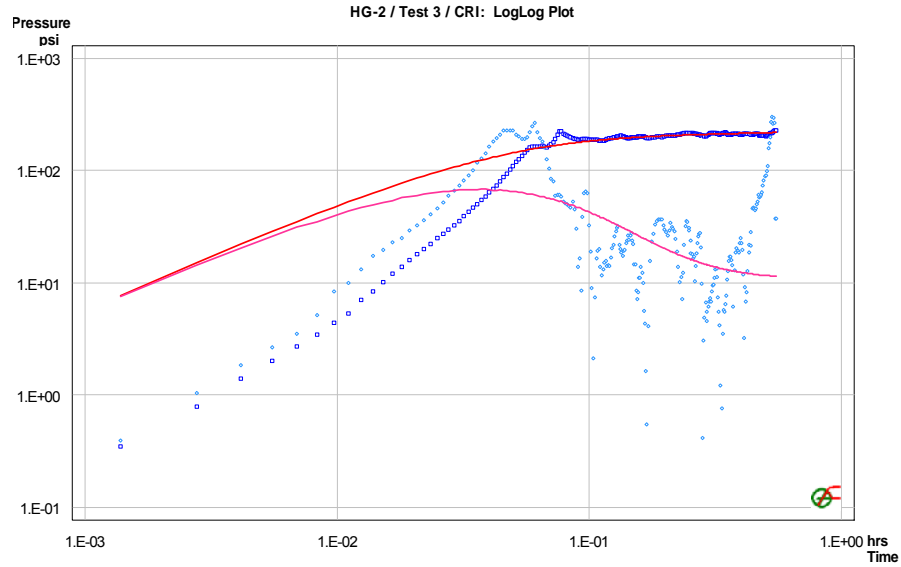
# HG-2 Test 2 (463.9 to 492.6 feet)



Static Pressure: 14.17 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	1.680e-05 m <sup>2</sup> /s	1e-4	-- m	2.0000
	C (WBS)	Skin		
CRI:	2.870e-08 m <sup>3</sup> /Pa	9.7315		
REC:	6.692e-08 m <sup>3</sup> /Pa	9.7315		

# HG-2 Test 3 (421.9 to 450.6 feet)



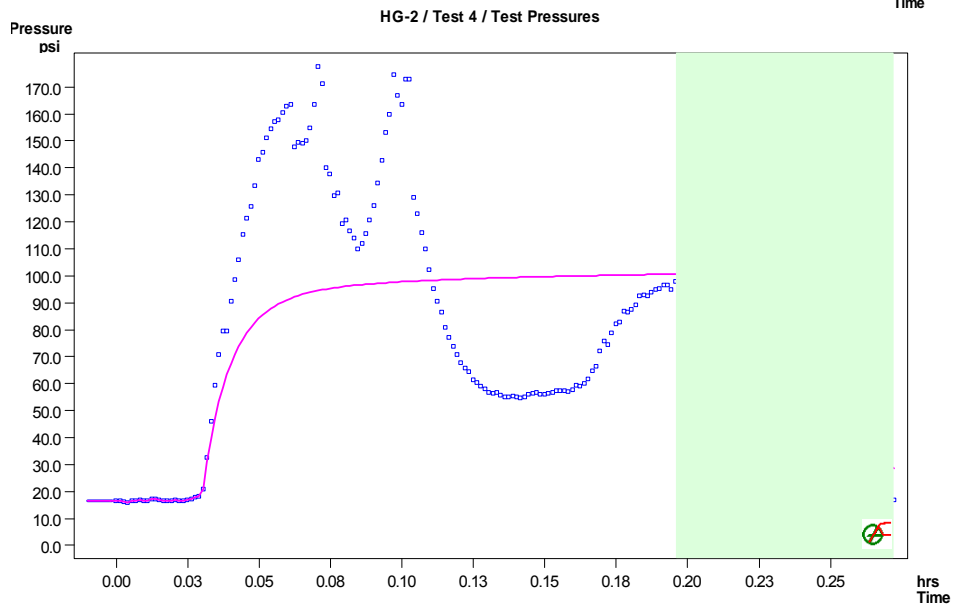
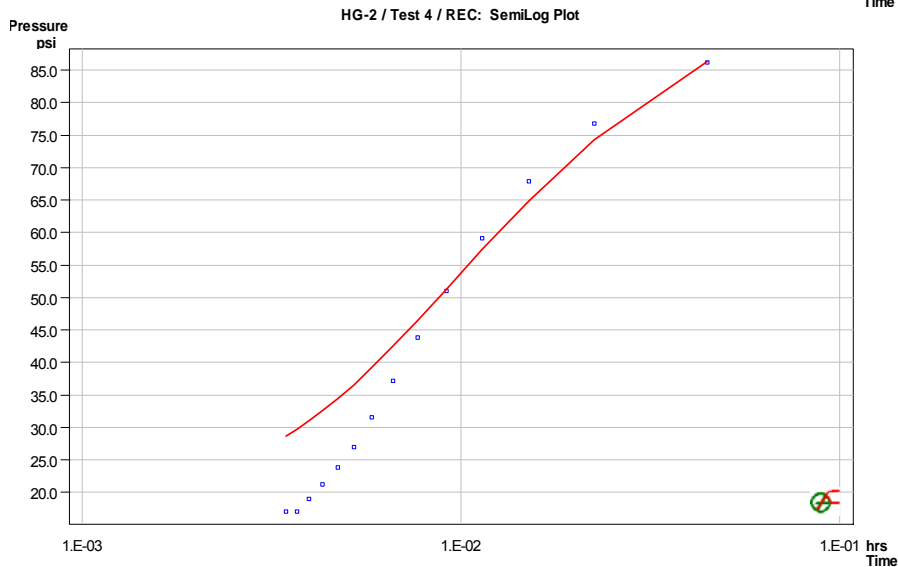
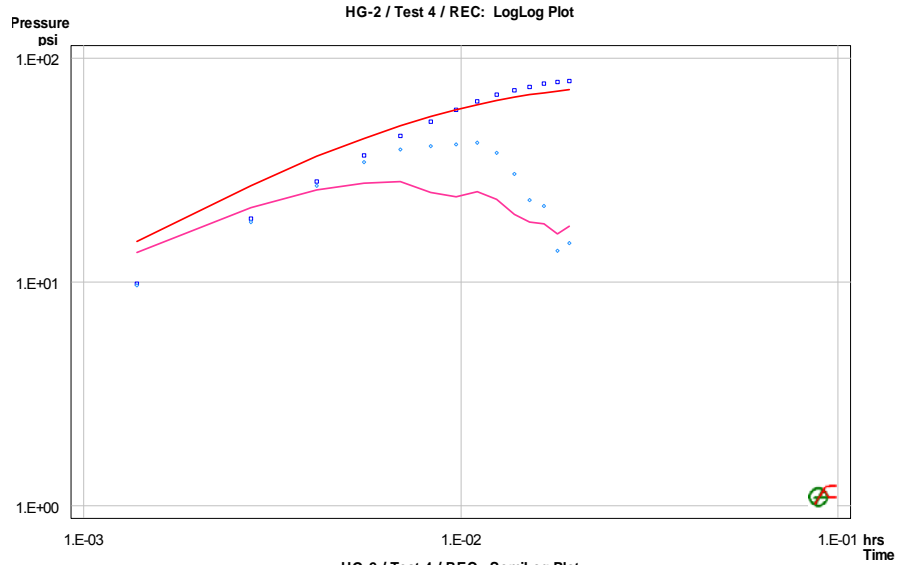
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Static Pressure: 12.49 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	1.717e-06 m <sup>2</sup> /s	1.000e-04	- - m	2.0000
	C (WBS)	Skin		
CRI:	1.330e-08 m <sup>3</sup> /Pa	6.6485		
REC:	9.800e-09 m <sup>3</sup> /Pa	6.6485		

# HG-2

## Test 4 (379.9 to 408.6 feet)



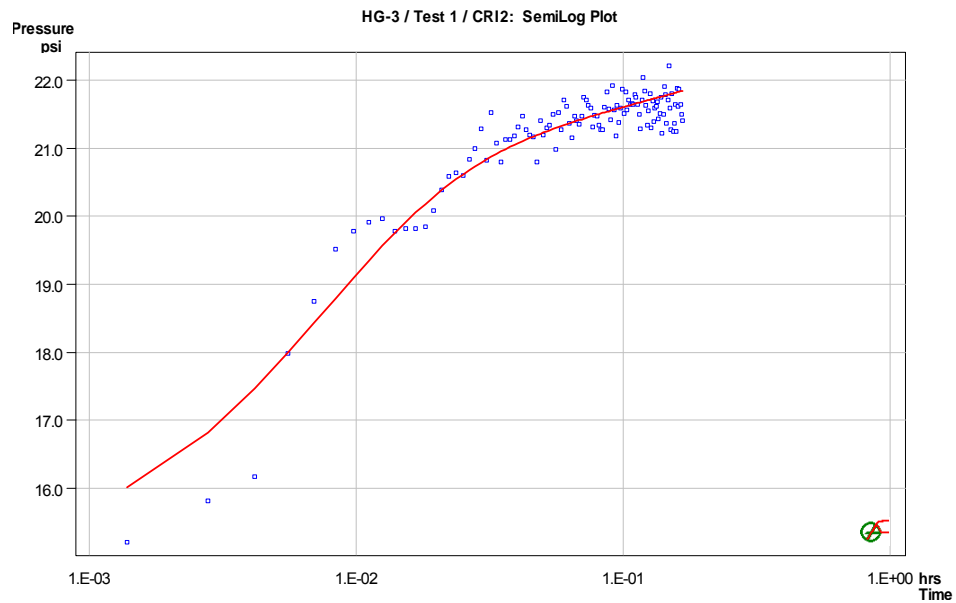
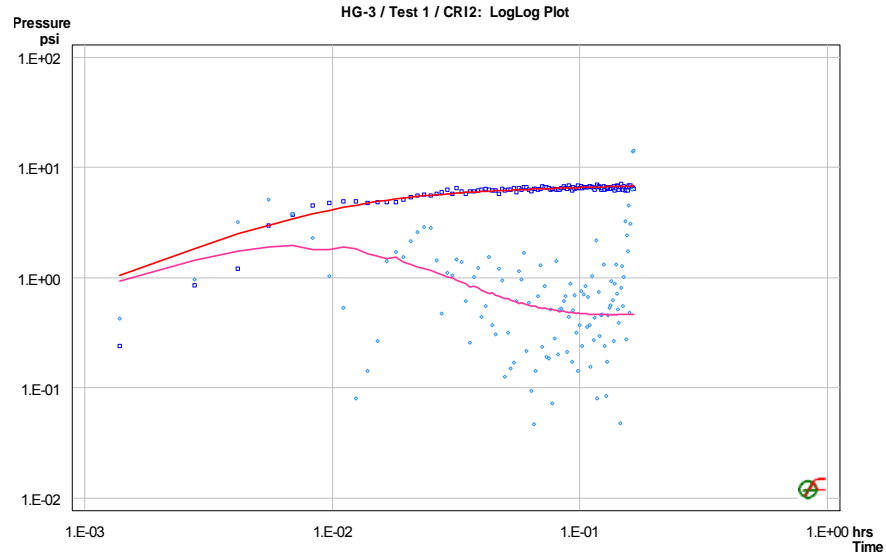
HG-2  
Test 4 (379.9 to 408.6 feet)

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Static Pressure: 16.71 psi

	Transm.	Storativ.	Radius	Flow Dim.
<hr/>				
Shell 1:	7.732e-05 m <sup>2</sup> /s	1e-4	- - m	2.0000
	C (WBS)	Skin		
<hr/>				
CRI:	2.214e-8 m <sup>3</sup> /Pa	9.9976		
REC:	7.159e-08 m <sup>3</sup> /Pa	9.9976		

# HG-3 Test 1 (400 to 453 feet)

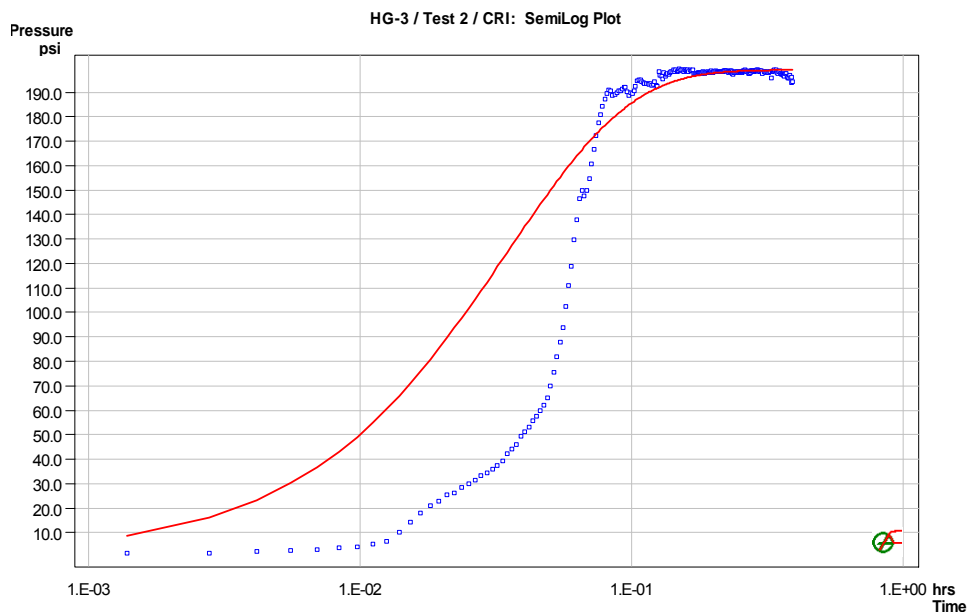
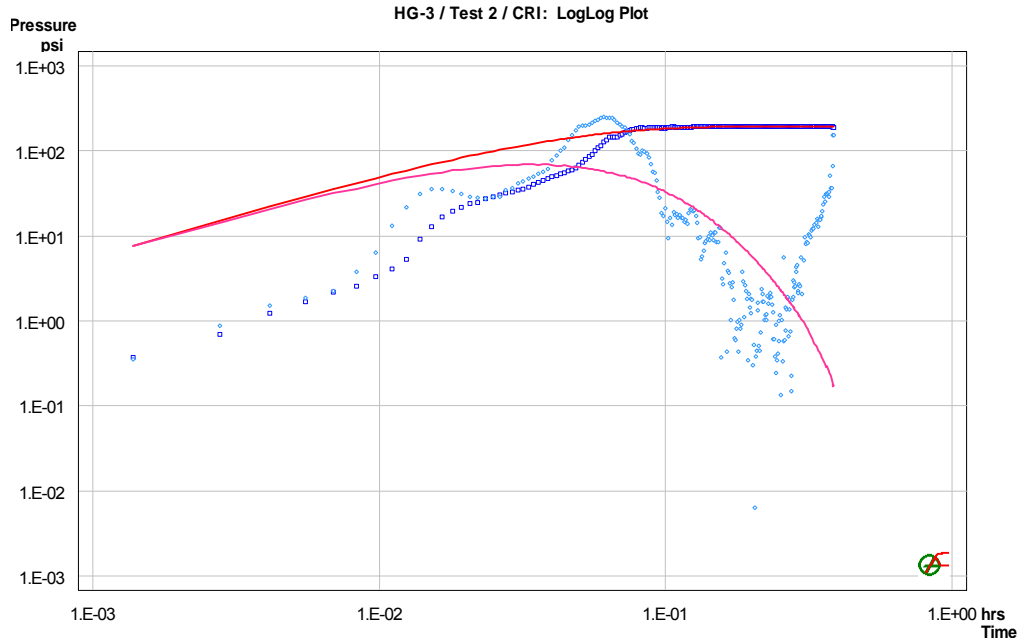


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Static Pressure: 12.38 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	1.377e-04 m <sup>2</sup> /s	1.000e-04	-- m	2.0000
	C (WBS)	Skin		
CR12:	4.406e-07 m <sup>3</sup> /Pa	-0.2314		
REC2:	1.000e-11 m <sup>3</sup> /Pa	-0.2314		

# HG-3 Test 2 (358.9 to 387.6 feet)

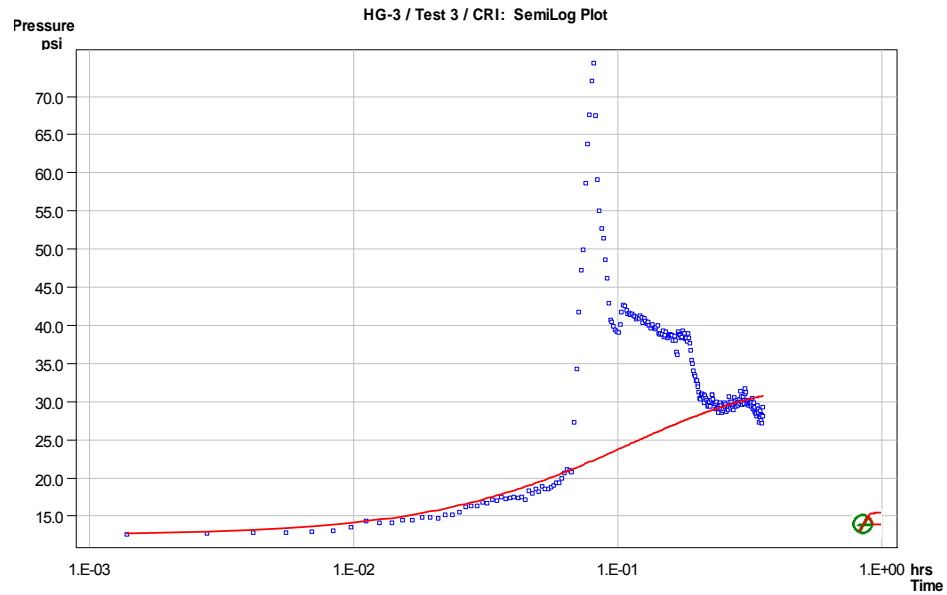
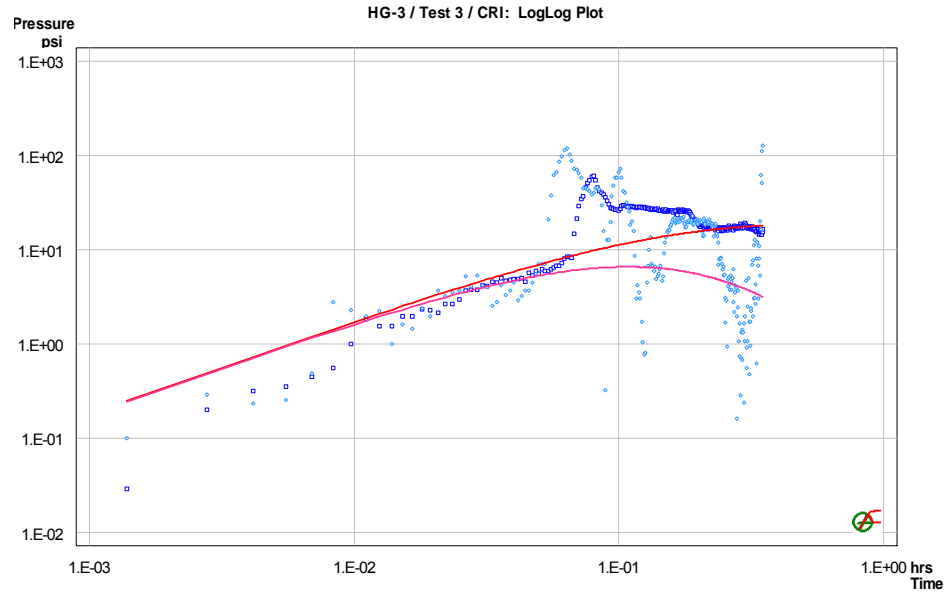


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Static Pressure: 0.80 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	3.667e-06 m <sup>2</sup> /s	1.000e-05	- m	2.0000
	C (WBS)	Skin		
CRI:	5.117e-08 m <sup>3</sup> /Pa	1.6058		

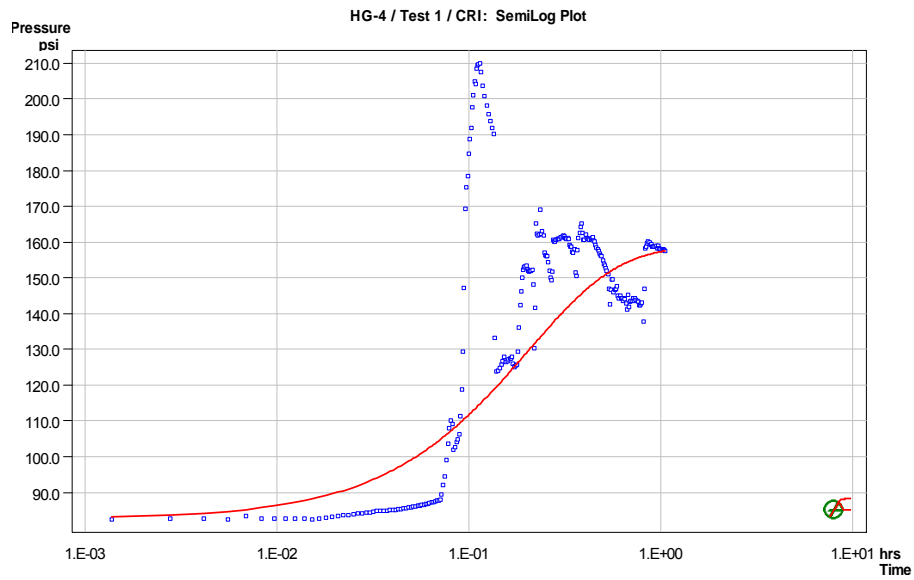
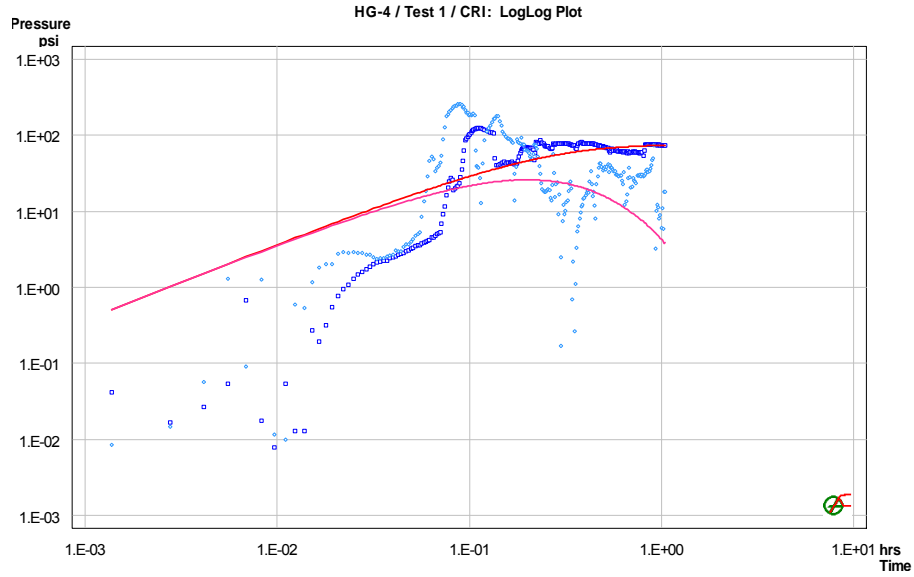
# HG-3 Test 3 (295.89 to 324.56 feet)



Static Pressure: 12.40 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	1.942e-04 m <sup>2</sup> /s	1e-4	-- m	2.0000
	C (WBS)	Skin		
CRI:	2.726e-06 m <sup>3</sup> /Pa	10.0000		
REC:	2.798e-07 m <sup>3</sup> /Pa	10.0000		

# HG-4 Test 1 (274 to 296.6 feet)

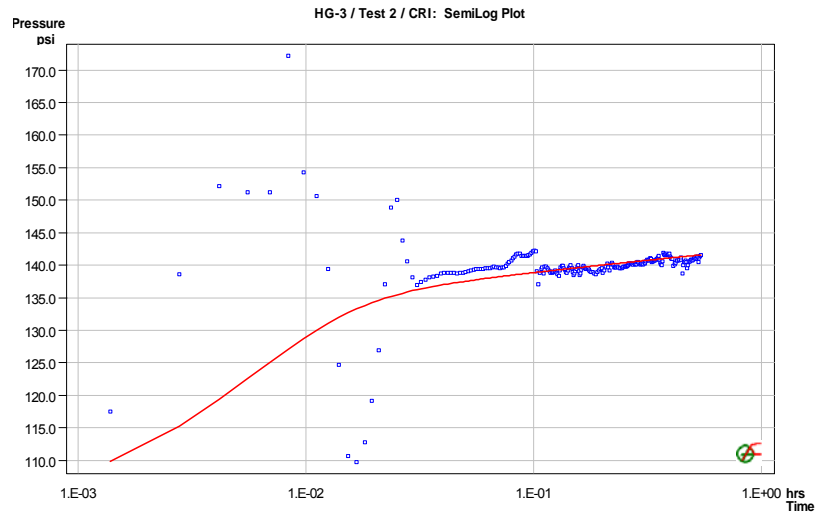
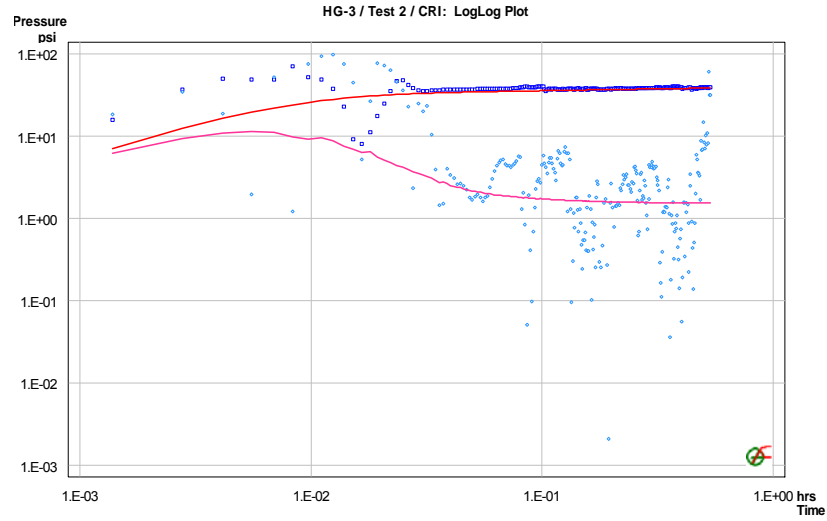


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Static Pressure: 82.67 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	4.861e-06 m <sup>2</sup> /s	1e-4	-- m	2.3435
	C (WBS)	Skin		
CRI:	1.760e-07 m <sup>3</sup> /Pa	9.9931		
REC:	3.370e-09 m <sup>3</sup> /Pa	9.9931		

# HG-4 Test 2 (211.89 to 240.56 feet)

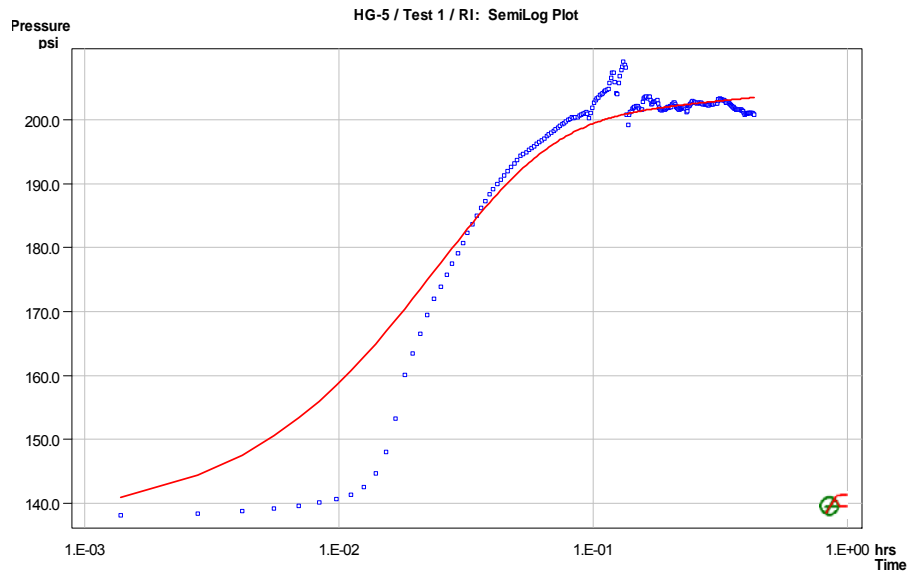
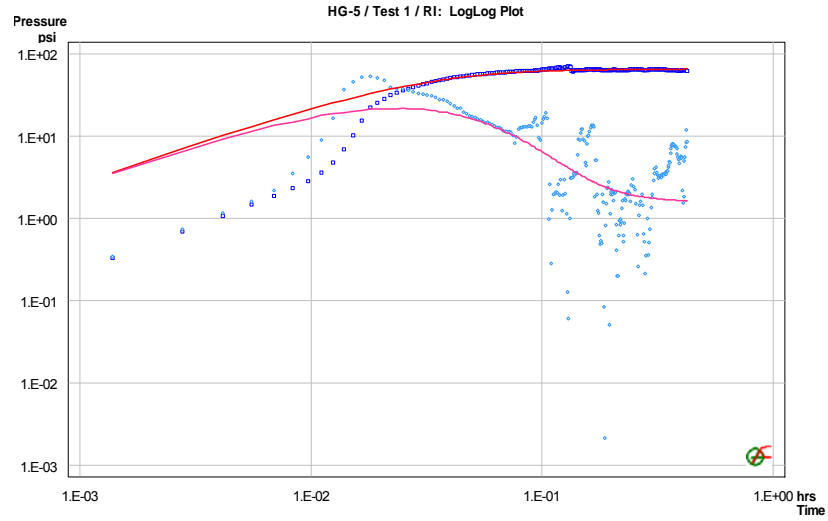


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Static Pressure: 102.81 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	8.195e-06 m <sup>2</sup> /s	1.000e-04	-- m	2.0000
	C (WBS)	Skin		
CRI:	9.637e-09 m <sup>3</sup> /Pa	7.1146		
REC1:	4.313e-08 m <sup>3</sup> /Pa	7.1146		

# HG-5 Test 1 (337.9 to 366.5 feet)



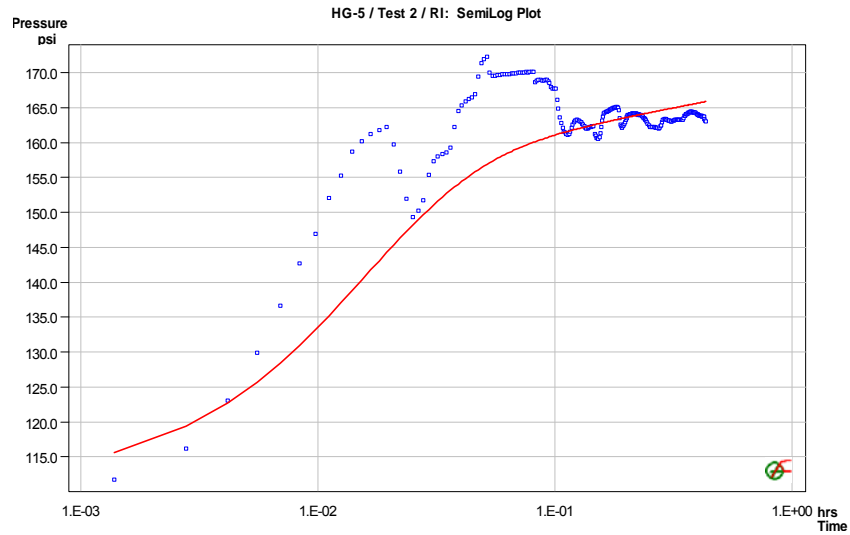
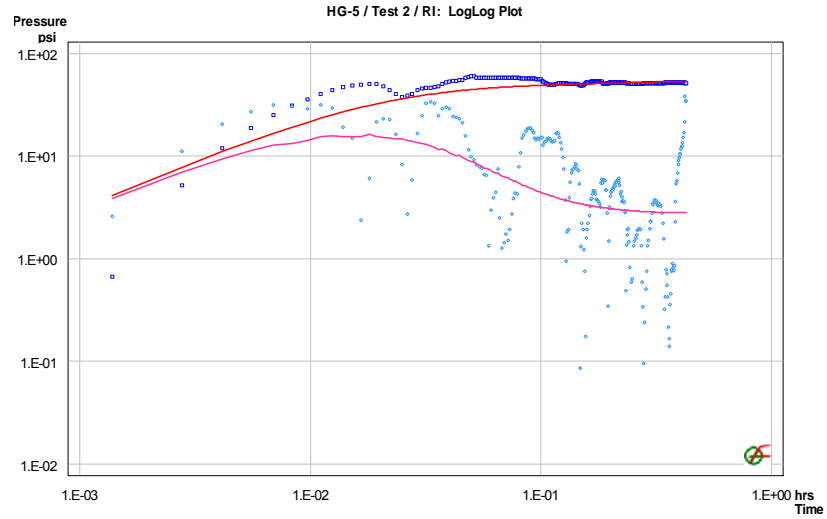
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Static Pressure: 137.5 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	6.659e-06 m <sup>2</sup> /s	8.914e-04	-- m	2.3030
	C (WBS)	Skin		
RI:	2.848e-08 m <sup>3</sup> /Pa	9.6946		
REC:	9.309e-07 m <sup>3</sup> /Pa	9.6946		

# HG-5

## Test 2 (253.9 to 283.6 feet)

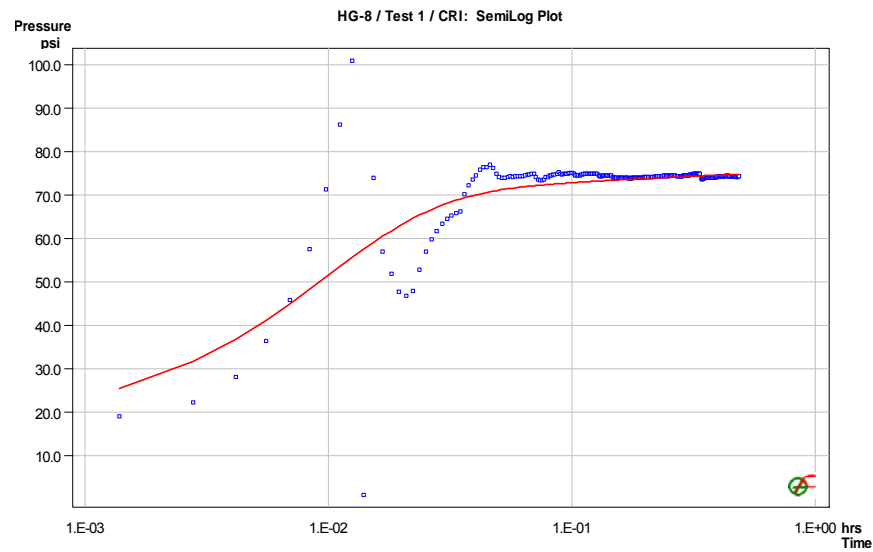
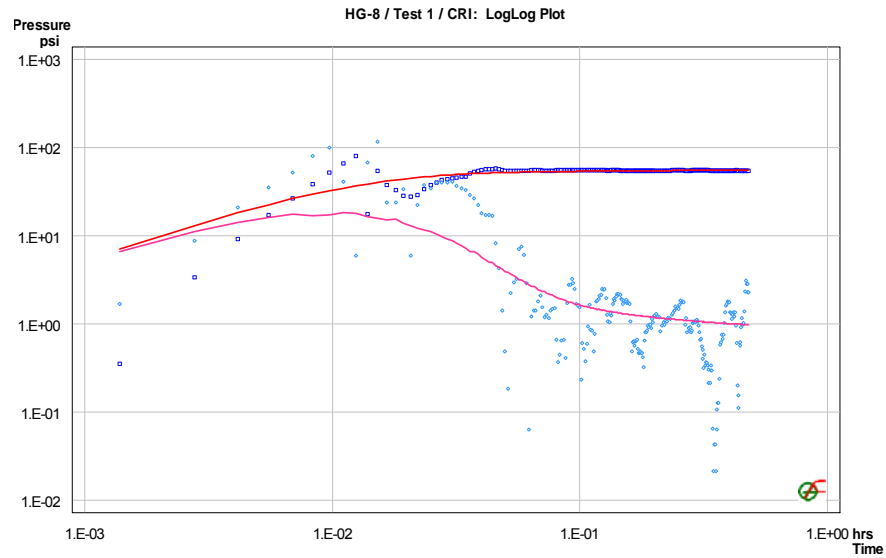


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Static Pressure: 107.28 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	3.543e-06 m <sup>2</sup> /s	1.125e-05	-- m	1.8516
	C (WBS)	Skin		
RI:	7.500e-09 m <sup>3</sup> /Pa	10.0000		
REC:	9.687e-07 m <sup>3</sup> /Pa	10.0000		

# HG-8 Test 1 (149 to 178 feet)

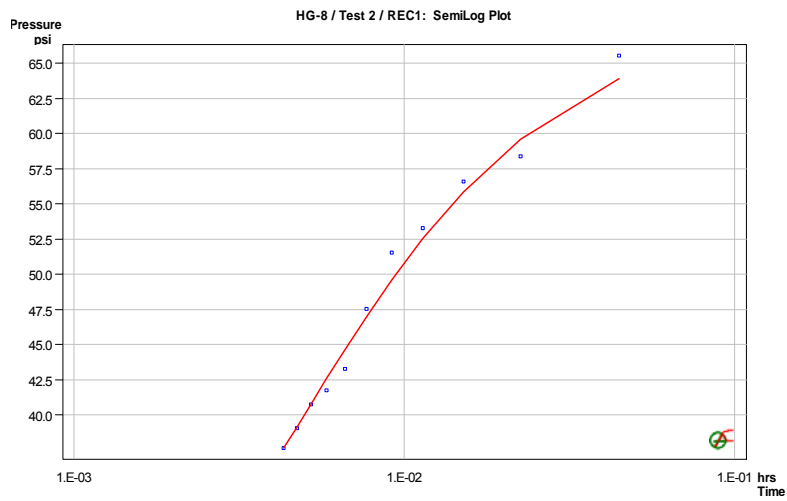
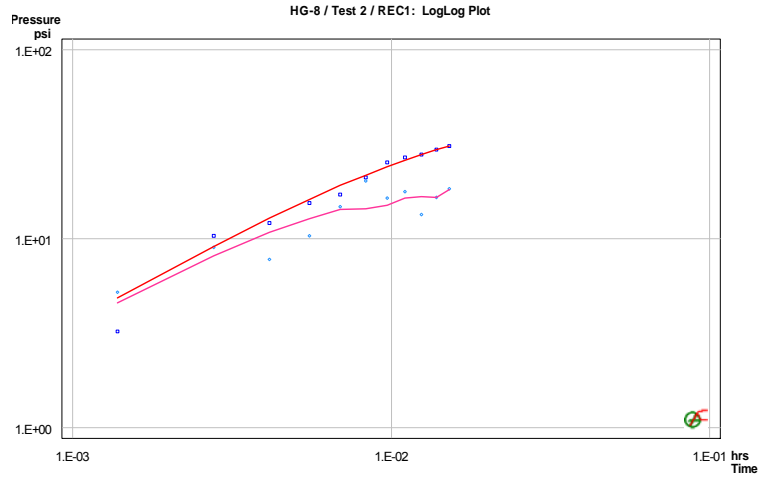


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Static Pressure: 18.4 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	1.015e-05 m <sup>2</sup> /s	1.072e-04	-- m	2.2641
	C (WBS)	Skin		
CRI:	2.907e-08 m <sup>3</sup> /Pa	4.7653		
REC:	1.818e-07 m <sup>3</sup> /Pa	4.7653		

# HG-8 Test 2 (86 to 115 feet)

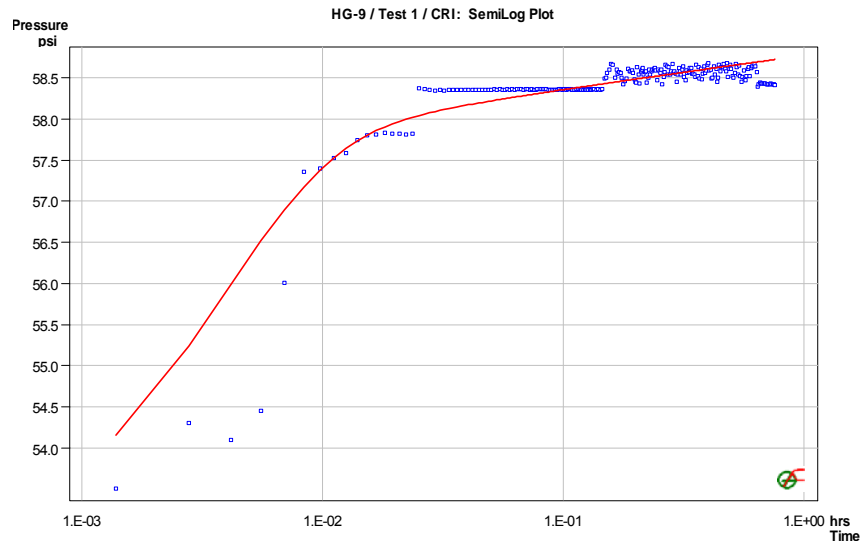
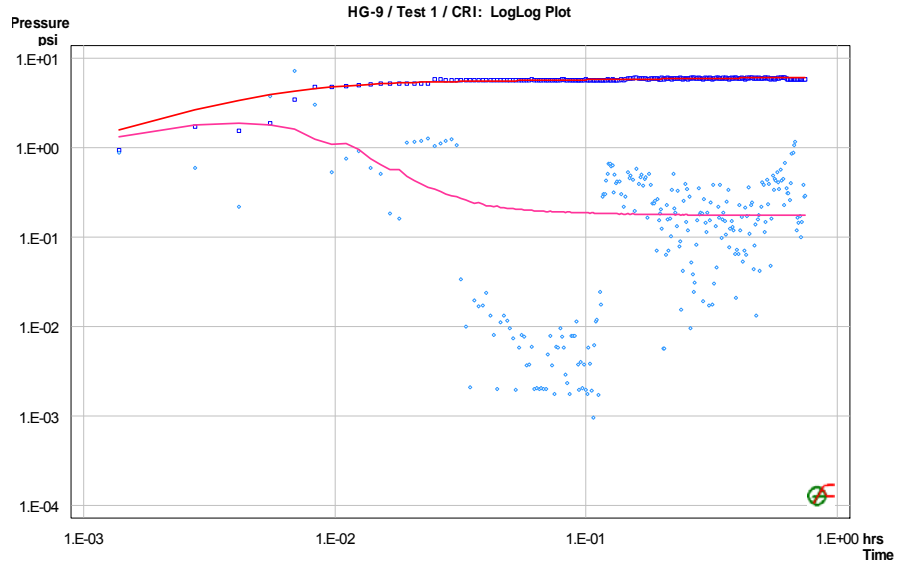


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Static Pressure: 20.25 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	1.015e-04 m <sup>2</sup> /s	9.372e-05	-- m	2
	C (WBS)	Skin		
CRI:	1.570e-07 m <sup>3</sup> /Pa	9.9999		
REC1:	1.834e-07 m <sup>3</sup> /Pa	9.9999		
REC2:	9.974e-07 m <sup>3</sup> /Pa	9.9999		

# HG-9 Test 1 (66 to 94 feet)



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Static Pressure: 52.57 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	8.974e-04 m <sup>2</sup> /s	1.813e-04	- - m	2.0000
	C (WBS)	Skin		
REC:	8.512e-11 m <sup>3</sup> /Pa	10.0000		
CRI:	4.978e-07 m <sup>3</sup> /Pa	10.0000		

**APPENDIX D**  
**GROUNDWATER AND SURFACE WATER QUALITY RESULTS**

TABLE D-1  
Water Quality Monitoring Results

		HG-4	Q	HG-4	Q	HG-4	Q	HG-4	Q	HG-6	Q	HG-6	Q	HG-6	Q	HG-6	Q	HG-7	Q	HG-7	Q	HG-7 DUP	Q	HG-7	Q	HG-9	Q	HG-9	Q
		9-Feb-09		14-Apr-09		26-Oct-09		4-Jan-10		9-Feb-09		14-Apr-09		29-Oct-09		4-Jan-10		15-Apr-09		27-Oct-09		27-Oct-09		29-Dec-09		9-Feb-09		15-Apr-09	
Dissolved Metals																													
Aluminum (Al)	µg/L	<38		<38		<38		<38		<38		<38		<38		<38		<38		<38		<38		<38		<38		<38	
Antimony (Sb)	µg/L	0.43	J	<0.23		0.17	J	<0.17		<0.23		<0.23		<0.17		<0.17		0.62	J	<0.17		<0.17		0.27	J	0.47	J	0.67	J
Arsenic (As)	µg/L	2.8	J+	3.5		9.4	B	8.7		2.6	J+	2.0		0.62	J	0.62	J	4.2		2.2	B	2.4	B	2		1.1	J,J+	1.5	J
Barium (Ba)	µg/L	39		21		14		7.4	B	120		130		240		250	B	120		120		120		110		30		22	
Beryllium (Be)	µg/L	0.064	J,J+	0.061	J	<0.18		<0.18		0.052	J,J+	<0.046		<0.18		<0.18		<0.046		<0.18		<0.18		<0.18		0.064	J,J+	<0.046	
Boron (B)	µg/L	-		250	B	270		260		-		60	B,J,J+	46	J	64	J	27	B,J,J+	<9.7		<9.7		21	J	-		21	B,J,J+
Cadmium (Cd)	µg/L	0.2	J	0.052	J	<0.13		<0.13		0.014	J	0.017	J	<0.13		<0.13		0.013	J	<0.13		<0.13		<0.13		0.053	J	0.040	J
Chromium (Cr)	µg/L	<0.64	B	4.0		20		<0.55		<0.64	B	3.2		<0.55		<0.55		0.94	J	2.1	J	1.4	J	<0.55		0.68	J	1.9	J
Hexavalent Chromium (Cr VI)	µg/L	<0.7		<0.7		<0.70	H	<0.70		<0.7		<0.7		<0.70		<0.70		<0.7		<0.70		<0.70		<0.70		1.4	J	<0.7	
Copper (Cu)	µg/L	3.6		3.1		7.7		0.8	J	0.58	J	0.93	J,J+	<0.68		<0.68		0.43	J,J+	<0.68		<0.68		<0.68		4.0		0.67	J,J+
Iron (Fe)	µg/L	<7.2		33	J,J+	13	J	16	J	<7.2		21	J,J+	46	J	34	J	330		310		310		290		<7.2		<7.2	
Lead (Pb)	µg/L	0.28	J	0.26	J	0.76	J	<0.054		<0.019		0.12	J,J+	<0.054		<0.054		0.038	B,J,J+	<0.054		<0.054		<0.054		<0.019		0.038	B,J,J+
Manganese (Mn)	µg/L	120		90		110		19		46		58		33		41		320		330		320		320		17		6.7	
Mercury (Hg)	µg/L	<0.016		<0.016		-		-		<0.016		<0.016		-		-		<0.016		-		-		-		<0.016		<0.016	
Mercury (Hg) by 1631	µg/L	0.0126		0.0226		0.0135		0.0106		0.00631		0.00234		0.00064	J+	0.00068		0.0677		0.0235		0.0221		0.0135		0.0244		0.00384	
Molybdenum (Mo)	µg/L	31	B	43		45		33		3.6	B	2.5		1.3	J+	2.5		0.74	B,J,J+	0.62	J,J+	0.54	J,J+	0.81	J,J+	3.7		3.2	B
Nickel (Ni)	µg/L	3.8	B	7.7		24		1.3	J	0.86	B,J	2.1		0.54	J	0.47	J	3.1		1.7	J	1.7	J	2.6		2.9		2.6	
Selenium (Se)	µg/L	0.27	B,J	0.32	J	1.1	J	3.9		<0.23	B	<0.23		<0.38		<0.38		<0.23		<0.38		<0.38		<0.38		0.9	J	0.73	J
Silver (Ag)	µg/L	<0.028	B	<0.028		<0.065		<0.065		<0.028	B	<0.028		<0.065		<0.065		<0.028		0.81	J	0.42	J	<0.065		<0.028		<0.028	
Thallium (Tl)	µg/L	0.088	J	0.20	J,J+	0.23	J	<0.11		0.1	J	<0.054		<0.11		<0.11		0.17	J,J+	<0.11		<0.11		<0.11		<0.054		0.19	J,J+
Vanadium (V)	µg/L	-		-		11		<1.2		-		-		<1.2		<1.2		-		<1.2		<1.2		<1.2		-		-	
Zinc (Zn)	µg/L	19	B,J+	4.8	J	32		<1.9	B	3.2	B,J,J+	5.2		2.4	J	<1.9		1.3	B,J	<1.9		3	J	<1.9		19	J+	8.7	B
Calcium (Ca)	mg/L	100		73		21	B	14		37		38		39		37		110		110		110		100		88		100	
Magnesium (Mg)	mg/L	21	B	13		3.8		2.4		70	B	75		77		72		42		43		45		41		29		31	
Sodium (Na)	mg/L	340	B	370		300	B	260		18	B	17		17		17		21		21		21		20		31		21	
Potassium (K)	mg/L	9.6		8.8		7.1		6.3	B	2		1.7		1		1.1	B	0.93	J,J+	0.93	J	0.91	J	0.94	J	3.2		2.4	
Silicon (as SiO <sub>2</sub> )	mg/L	37		33		35		33		59		61		67		62		25		26		26		23		18		22	
Total Metals																													
Total Recoverable Aluminum (Al)	µg/L	6,100		1,800		4,800		3,500		2,900		2,900		230		75		39,000		36,000		47,000		17,000		1,500		750	
Total Recoverable Antimony (Sb)	µg/L	1.1	J	<0.23	B	<0.20		<0.20		0.3	J	<0.23	B	<0.20		<0.20		0.56	J	0.47	J	0.44	J	0.48	J	0.76	J	<0.23	
Total Recoverable Arsenic (As)	µg/L	2.6		3.7		8.4		11		2.5		2.6		<1.1		<1.1		15		9.7		11		5		1.1	J	1.5	J
Total Recoverable Barium (Ba)	µg/L	250	B	27		21		13		180	B	140		270		250		490	B	330		350		250		59		28	B
Total Recoverable Beryllium (Be)	µg/L	0.064	J,J+	<0.060		<0.20		<0.20		<0.060		<0.060		<0.20		<0.20		1.0		0.81	J	0.94	J	0.36	J	0.1	J,J+	<0.060	
Total Recoverable Boron (B)	µg/L	-		260		280		270		-		71	J	60	J	66	J	220	B	12	J	17	J	28	J	-		110	B
Total Recoverable Cadmium (Cd)	µg/L	0.49	J	0.077	J	0.17	J	0.12	J	0.15	J	0.077	J	<0.11		<0.11		0.75	J	0.28	J	0.35	J	0.16	J	0.17	J	0.075	J

TABLE D-1  
Water Quality Monitoring Results

	HG-4	Q	HG-4	Q	HG-4	Q	HG-4	Q	HG-6	Q	HG-6	Q	HG-6	Q	HG-6	Q	HG-7	Q	HG-7	Q	HG-7 DUP	Q	HG-7	Q	HG-9	Q	HG-9	Q
	9-Feb-09		14-Apr-09		26-Oct-09		4-Jan-10		9-Feb-09		14-Apr-09		29-Oct-09		4-Jan-10		15-Apr-09		27-Oct-09		27-Oct-09		29-Dec-09		9-Feb-09		15-Apr-09	
Total Recoverable Chromium (Cr) µg/L	45		14	J+	86		30		22		14	J+	<0.64		<0.64		430		320		360		130		6.5		<1.6	
Total Recoverable Copper (Cu) µg/L	28		4.1	J+	19		7.7		12		4.8	J+	1.3	J	<0.66		51		35		36		14		12		4.1	J+
Total Recoverable Iron (Fe) µg/L	12,000		3,400		9,800		6,400	B	5,800		5,500		460		160		84,000		53,000		69,000		22,000		3,200		1,900	
Total Recoverable Lead (Pb) µg/L	4		0.26	J	1.2		1.3	B	0.96	J	0.18	J	<0.19		0.72	B,J	13		8.3		9		3.2		1.6		0.15	J
Total Recoverable Manganese (Mn) µg/L	290		94	B	180		73	B	160		100	B	44		42	B	1,300	B	1,100		1,200		620		88		41	B,J+
Total Recoverable Mercury (Hg) µg/L	0.042	B,J	<0.016		<0.016		<0.016		<0.016	B	<0.016		<0.016		<0.016		<0.016		0.058	J	0.092	J	0.022	J	0.018	J	<0.016	
Total Recoverable Molybdenum (Mo) µg/L	37		58	B	59		57		2.5		1.8	B,J+	1.4		1.7		2.2	B,J+	1.9		2		1.8		3.9		1.9	B,J+
Total Recoverable Nickel (Ni) µg/L	37		14	B	67		26		15		10	B	1.8	J	1.2	J,J+	420		310		350		120	B	7.8		4.8	J+
Total Recoverable Selenium (Se) µg/L	0.94	J	<0.50		<0.54		1.3	J	<0.50		<0.50		<0.54		<0.54		0.90	J	<0.54		<0.54		<0.54		1.1	J	<0.50	
Total Recoverable Silver (Ag) µg/L	0.5	J	<0.064		<0.088		<0.088		<0.064		<0.064		<0.088		<0.088		0.26	J	0.14	J	0.15	J	<0.088		<0.064		<0.064	
Total Recoverable Thallium (Tl) µg/L	0.15	J	<0.054		<0.11		<0.11		<0.054		<0.054		<0.11		<0.11		0.14	J	0.12	J	0.12	J	<0.11		<0.054		<0.054	
Total Recoverable Vanadium (V) µg/L	-		-		32		11		-		-		<2.6		<2.6		-		91		100		38		-		-	
Total Recoverable Zinc (Zn) µg/L	68		58		40		14	B	32		16	J+	8.7		3.2	B,J	99	B	79		86		35		37		19	B,J+
Total Recoverable Calcium (Ca) mg/L	140		70		27		18		47		44		41		41		120		130		130		120		97		120	
Total Recoverable Magnesium (Mg) mg/L	31		16		11		7.6		82		88		81		80		91		93		110		64		32		35	
Total Recoverable Sodium (Na) mg/L	390		380		320	B	260		19		19		17		17		37	B	24	B	23	B	21		38		23	B
Total Recoverable Potassium (K) mg/L	11		9.3		7.5		6.5		2.2		1.9		1.1		1.1		5.4		5.2		5.7		3.7		3.6		2.8	
Pesticides	ND		ND		-		-		ND		ND		-		-		ND		-		-		-		ND		ND	
PCBs	ND		ND		-		-		ND		ND		-		-		ND		-		-		-		ND		ND	
VOCs																												
Total Trihalomethanes (TTHM)																												
Bromoform µg/L	<0.24		<0.24		-		-		0.48	J	<0.24		-		-		<0.24		-		-		-		1.1		<0.24	
Chloroform µg/L	<0.23		<0.23		-		-		<0.23		<0.23		-		-		<0.23		-		-		-		0.94	J+	0.24	J,J+
Dibromochloromethane µg/L	<0.23		<0.23		-		-		0.4	J	<0.23		-		-		<0.23		-		-		-		2.6		0.41	J
Toluene µg/L	<0.12		0.41	J	-		-		0.34	J	0.24	J	-		-		0.30	J	-		-		-		<0.12		0.48	J
SVOCs																												
bis(2-ethylhexyl)phthalate µg/L	22	J+	4.1	B,J,J+	-		-		31	J+	2.5	B,J,J+	-		-		<1.1	B	-		-		-		16	J+	<1.1	B
General Chemistry																												
Bicarbonate mg/L	280		250		220		230		470		460		470		460		480		480		480		430		360		410	
Carbonate mg/L	<5.0		<2.5		11		6.9		<2.5		<2.5		<2.5		<2.5		<2.5		<2.5		<2.5		<2.5		<2.5		<2.5	
Total Alkalinity (as CaCO <sub>3</sub> ) mg/L	230		210		200		200		380		380		380		380		390		400		390		350		290		340	
Chloride mg/L	51		41		28		25		24		25		25	B	25		47		46		46		45		46		32	
Fluoride mg/L	0.32		0.39		0.55		0.58		0.073		0.080		<0.010		0.13		0.18		0.2		0.2		0.25		0.30		0.37	
Sulfate mg/L	770		770		500		380		11		15		8.6		16		31		31		30		29		48		38	
Hardness (as CaCO <sub>3</sub> ) mg/L	340		240		69		45		380		400		410		390		440		450		460		430		340		390	

TABLE D-1  
Water Quality Monitoring Results

		HG-4	Q	HG-4	Q	HG-4	Q	HG-4	Q	HG-6	Q	HG-6	Q	HG-6	Q	HG-6	Q	HG-7	Q	HG-7	Q	HG-7 DUP	Q	HG-7	Q	HG-9	Q	HG-9	Q
		9-Feb-09		14-Apr-09		26-Oct-09		4-Jan-10		9-Feb-09		14-Apr-09		29-Oct-09		4-Jan-10		15-Apr-09		27-Oct-09		27-Oct-09		29-Dec-09		9-Feb-09		15-Apr-09	
Total Dissolved Solids (TDS)	mg/L	1,500		1,500		1,000		880		490		470		460		460		550		530		580		530		480		490	
Total Suspended Solids (TSS)	mg/L	190		290		840		70		81		91	J+	3.3		2		1,100		840		1,000		400		88		34	
Residual Chlorine	mg/L	<0.10		<0.10		<0.10	H	<0.10	H	<0.10		<0.10	H	<0.10	H	<0.10	H	<0.10		<0.50	H	<0.50	H	<0.10	H	<0.10		<0.10	
Ammonia (as N)	mg/L-N	0.21		0.28		0.28	B	0.17		0.084		0.094	J+	0.064		0.057		0.090	J+	0.18		0.042	J	0.035	J	0.037	J	<0.025	
Nitrate (as N)	mg/L-N	0.068	J	<0.026		<0.026		<0.026		0.051	J	<0.026		<0.026		<0.026		<0.026		<0.026		<0.026		0.026	J	1.3		0.72	
Nitrite (as N)	mg/L-N	0.01	J	<0.0081		0.014	J,J+	<0.0081		0.012	J	<0.0081		0.012	B,J,J+	0.031	J	<0.0081		0.0099	B,J,J+	0.0094	B,J,J+	<0.0081		0.0087	J	<0.0081	
Total Phosphorus	mg/L	0.4		0.37		0.45		0.49		0.12	J+	0.077		<0.016		<0.016		0.64		0.51		0.63		0.21		0.19	J+	0.044	J
Total Sulfide	mg/L	<0.050		0.13	J	0.24		1		<0.050		<0.050		<0.050		<0.050		0.15	J	<0.25		<0.25		<0.050		<0.050		<0.050	
pH	s.u.	8.04		8.12		8.55	H	8.35	H	8.00		7.88		7.92	H	7.87	H	7.38		7.37	H	7.4	H	7.3	H	7.99		7.64	
Electrical Conductivity (@ 25 °C)	umhos/cm	1,900		1,900		1440		1300		740		725		736		708		839		870		871		880		747		753	
Odor	odor units	2		2		2		4		1.0		2.0		none		1		none		none		none		none		1.0		none	
Turbidity	NTU	350		540		140		43		120		56		3.4		2.4		810		210		320		160		210		34	
Cyanide	mg/L	<0.0032		0.017	B,J+	<0.0028		<0.0028		<0.0032		0.021	B,J+	<0.0028		<0.0028		<0.0028		<0.0028		<0.0028		<0.0028		<0.0032		<0.0028	
Dioxins	pg/L	<1.2		<0.78		-		-		<0.82		<0.88		-		-		<0.94		-		-		-		<0.54		<0.80	
Aquatic Toxicity		pass		pass		-		-		pass		pass		-		-		pass		-		-		-		pass		pass	
Asbestos (# of fibers)	# of fibers	ND		ND		-		-		ND		ND		-		-		ND		-		-		-		ND		ND	
Oil and Grease	mg/L	-		<1.2		-		-		-		1.4	J	-		-		<1.2		-		-		-		-		<1.2	

Notes:

- 1 = Baseline criteria from SAN FRANCISCO BAY BASIN (REGION 2) WATER QUALITY CONTROL PLAN (BASIN PLAN), Table 3.4  
For Cd, Cu, Pb, Ni, Ag, Zn are based on hardness values, baseline criteria listed use hardness of 100 mg/L.
- 2 = Environmental Protection Agency (EPA) maximum contaminant level (MCL) for drinking water, Region 9  
SMCL - secondary maximum contaminant level  
bolded value and yellow shading identify California limits that differ from the national limits.
- TT - Treatment technique (a required process intended to reduce the level of a contaminant in drinking water)
- MRDL - maximum residual disinfectant level

Data Qualifiers (Q):

- J = estimated value below laboratory reporting limit - laboratory qualifier
- B = detected in blank sample - laboratory qualifier
- H = holding time exceeded - laboratory qualifier
- J+ = biased high due to detection in field blank or equipment blank

ND - below detectable limits

"-" - not analyzed

TABLE D-1  
Water Quality Monitoring Results

					HG-9	Q	HG-9	Q	HG-10	Q	HG-10	Q	SW-1	Q	SW-1	Q	SW-1	Q	SW-1	Q	SW-2	Q	SW-2 Dup	Q	SW-2	Q	SW-2 Dup	Q	SW-2	Q
					27-Oct-09		29-Dec-09		28-Sep-09		4-Jan-10		4-Feb-09		2-Apr-09		22-Sep-09		19-Jan-10		4-Feb-09		4-Feb-09		2-Apr-09		2-Apr-09		22-Sep-09	
Dissolved Metals																														
Aluminum (Al)	µg/L		<38		<38		<38		<38		<38		<38		<38		<76		<38		<38		<38		<38		<38		<38	
Antimony (Sb)	µg/L		<0.17		<0.17		<0.17		0.48	J	<0.23		<0.23		<0.17		0.26	J	6.3		6.1		3.8		4.0		2.4			
Arsenic (As)	µg/L		1.2	B,J	1	J	<0.52		<0.52	`	0.79	J	<0.67		<0.52		0.74	J,J+	4.5		4.8		2.8		3.4		1.5	J		
Barium (Ba)	µg/L		19		20		150		24	B	34	B	91		63		58		37	B	35		63		66		60			
Beryllium (Be)	µg/L		<0.18		<0.18		<0.18		<0.18		<0.046		<0.046		<0.18		<0.18		<0.046		<0.046		0.059	J,J+	<0.046		<0.18			
Boron (B)	µg/L		10	J	33	J	33	B,J	15	J	-		55	B,J,J+	200	B,J+	51	J	-		-		89	B,J,J+	91	B,J,J+	100	J+		
Cadmium (Cd)	µg/L		<0.13		<0.13		<0.13		<0.13		<0.013		0.022	B,J	<0.13		<0.13		0.098	J	0.14	J	0.055	B,J	0.057	B,J	<0.13			
Chromium (Cr)	µg/L		1.5	J	<0.55		<0.55		15		<0.64		1.5	J	<0.55		<0.55		<0.64		<0.64		<0.64		<0.64		<0.55			
Hexavalent Chromium (Cr VI)	µg/L		<0.70		<0.70		<0.01		1.9	J	0.98	J	<0.7		<0.70		1.2	B,J,J+	0.95	J	1.2	J, H	0.83	J	0.92	J	<0.70			
Copper (Cu)	µg/L		0.86	J	<0.68		1.9	J	2.3		1.2	B,J,J+	1.6	B,J,J+	4.2		3.1		1.3	B,J,J+	1.0	J,J+	1.3	B,J,J+	1.3	B,J,J+	3.3			
Iron (Fe)	µg/L		<9.3		<9.3		<9.3		<9.3		8.1	J	<7.2	B	<19		9.7	J	<7.2		<7.2		18	B,J	<7.2	B	<9.3	B		
Lead (Pb)	µg/L		<0.054		<0.054		0.13	J	<0.054		<0.019		0.029	J	<0.054		<0.054		0.023	J	<0.019		<0.019		<0.019		<0.054			
Manganese (Mn)	µg/L		2.5		0.19	J	85		0.16	J	0.33	J,J+	0.58	J	0.79	J,J+	1.9		2.2		2.1		3.0		3.0		2.1	J+		
Mercury (Hg)	µg/L		-		-		-		-		<0.016		<0.016	B	-		-		<0.016		<0.016		<0.016	B	<0.016	B	-			
Mercury (Hg) by 1631	µg/L		0.00113	J+	0.00105		-		0.0631		0.00078		0.00101		0.00178	J+	0.0547		0.00141		-		0.00133		0.00157		0.00182	J+		
Molybdenum (Mo)	µg/L		0.93	J,J+	2.2		5		16		5.7	B,J+	3.9		3.8	J+	1.8		750	B	740		460		490		470			
Nickel (Ni)	µg/L		1.6	J	2.2		10		1.7	J	3.3		2.2		4.7		2.3		70		-		110		110		44			
Selenium (Se)	µg/L		<0.38		<0.38		<0.38		2.8		8.9		7.1		11		1.7	J	80		79		74		76		81			
Silver (Ag)	µg/L		0.34	J	<0.065		<0.065		<0.065		<0.028		0.063	J,J+	<0.065		<0.065		<0.028		<0.028		<0.028		<0.028		<0.065			
Thallium (Tl)	µg/L		<0.11		<0.11		<0.11		<0.11		<0.054	B	<0.054		<0.11		0.17	J	0.16	B,J	0.085	J	<0.054		<0.054		<0.11			
Vanadium (V)	µg/L		<1.2		<1.2		<1.2		1.7	J	-		-		<1.2		1.8	J	-		-		-		-		97			
Zinc (Zn)	µg/L		3.2	J	2.1	J	35		<1.9	B	7.2	J+	58	B,J+	3.4	J,J+	2.2	B,J	12	J+	-		61	B,J+	71	B,J+	3.1	J,J+		
Calcium (Ca)	mg/L		110		100		74		57		220		160		310		61		200		200		210		200		200	B		
Magnesium (Mg)	mg/L		31		34		35		28		85		59		120		28		38		37		46		46		53			
Sodium (Na)	mg/L		18		18		16		18		25	B	19		28		9.6		25	B	25		30		30		24			
Potassium (K)	mg/L		1.7		1.4		0.6	J	3.5		1.1		1.1	B,J+	1.5		0.88	J	1.1		1.1		1.4	B	1.4	B	1.1			
Silicon (as SiO <sub>2</sub> )	mg/L		23		21		16		6		15		17		17		16		11		11		12		12		17			
Total Metals																														
Total Recoverable Aluminum (Al)	µg/L		160		160		94		38	J	<28		85	J+	62		3,700		32	J	39	J	63	J+	110	J+	<38			
Total Recoverable Antimony (Sb)	µg/L		<0.20		<0.20		<0.20		<0.20		<0.23	B	<0.23		<0.40		<0.20		6.2	B	6.1		4.0		4.0		2.3			
Total Recoverable Arsenic (As)	µg/L		<1.1		<1.1		<1.1		<1.1		<0.82		<0.82		<2.2		<1.1		2.4		1.9	J	2.0		2.1		<1.1			
Total Recoverable Barium (Ba)	µg/L		19		23		170		200		38	B	100	B	61		100		40	B	40		72	B	76	B	60			
Total Recoverable Beryllium (Be)	µg/L		<0.20		<0.20		<0.20		<0.20		<0.060		<0.060		<0.40		<0.20		<0.060		<0.060		<0.060		0.10	J	<0.20			
Total Recoverable Boron (B)	µg/L		16	J	33	J	26	J	15	J	-		60	B,J,J+	290	B,J+	70	J	-		-		90	B,J,J+	85	B,J,J+	110	B,J+		
Total Recoverable Cadmium (Cd)	µg/L		<0.11		<0.11		<0.11		<0.11		<0.051		<0.051		<0.22		<0.11		0.14	J	0.16	J	0.086	J	0.099	J	0.14	J		

## Water Quality Monitoring Results

[illegible]

TABLE D-1  
Water Quality Monitoring Results

		HG-9		Q		HG-9		Q		HG-10		Q		HG-10		Q		HG-10		Q		HG-10		Q		HG-10	
		27-Oct-09		29-Dec-09		28-Sep-09		4-Jan-10		4-Feb-09		2-Apr-09		22-Sep-09		19-Jan-10		4-Feb-09		4-Feb-09		2-Apr-09		2-Apr-09		22-Sep-09	
Total Dissolved Solids (TDS)	mg/L	450		460		400		340		1,400		890		1,800		350		1,100		970		1,100		1,000		1,000	
Total Suspended Solids (TSS)	mg/L	6	J+	5.2		18		7		<2.5		0.75	J	5.2		340		<2.5		2.2		2.0		2.2		5.2	
Residual Chlorine	mg/L	<0.10	H	<0.10	H	<0.10	H	<0.10	H	<0.10		<0.10		<0.10	H	<0.10	H	<0.10		<0.10		<0.10		<0.10		<0.10	H
Ammonia (as N)	mg/L-N	<0.025		<0.025		<0.025		0.026	J	<0.025	B	<0.050		<0.025		0.038	B,J,J+	<0.025	B	<0.025		<0.025		<0.025		<0.025	
Nitrate (as N)	mg/L-N	0.91		0.77		0.05	J	0.029	J	4.9		3.3		5.6		0.81		0.65		0.67		2.3		2.3		0.48	
Nitrite (as N)	mg/L-N	0.0091	B,J,J+	<0.0081		<0.0081		0.021	J	<0.0081		<0.0081		<0.0081		<0.0081		<0.0081		<0.0081		<0.0081		<0.0081		<0.0081	
Total Phosphorus	mg/L	0.067		<0.016		<0.016		0.036	J	<0.012		0.031	J,J+	<0.016		0.26		<0.012		<0.012		0.025	J,J+	0.012	J,J+	<0.016	
Total Sulfide	mg/L	<0.050		<0.050		<0.050		<0.050		<0.050		<0.050		<0.050		<0.050		<0.050		<0.050		<0.050		<0.050		<0.050	
pH	s.u.	7.55	H	7.44	H	7.52	H	8.5	H	7.97		8.13		7.86	H	7.07	H	8.30		8.29		8.15		8.28		8.24	H
Electrical Conductivity (@ 25 °C)	umhos/cm	752		775		662		533		1,500		1,110		2040		515		1,240		1,210		1,210		1,210		1,270	
Odor	odor units	none		none		none		none		none		none		none		4		none		4		none		none		2	
Turbidity	NTU	3.6		1.4		4.6		2.7		0.38	J+	0.24		2.1		120		2.9		2.4		0.44		0.48		1.5	
Cyanide	mg/L	<0.0028		<0.0028		<0.0028		<0.0028		<0.0032		0.0034	B,J,J+	<0.0028		<0.0028		<0.0032		<0.0032		0.0036	B,J,J+	<0.0028	B	<0.0028	
Dioxins	pg/L	-		-		-		-		<0.64		<0.29		-		-		<0.64		-		<1.0		<0.72		-	
Aquatic Toxicity		-		-		-		-		pass		pass		-		-		pass		-		pass		pass		-	
Asbestos (# of fibers)	# of fibers	-		-		-		-		ND		-		-		-		1		-		-		-		-	
Oil and Grease	mg/L	-		-		-		-		-		<1.2	B	-		-		-		-		<1.2	B	1.6	B,J,J+	-	

## Water Quality Monitoring Results

															North Quarry				West Material Storage Area					
		SW-2 Dup	Q	SW-2	Q	SW-2 Dup	Q	SW-3	Q	SW-3	Q	SW-3	Q	SW-3	Q	North Quarry	Q	West Material Storage Area	Runoff	Q	Basin Plan	USEPA		
		22-Sep-09		20-Jan-10		20-Jan-10		4-Feb-09		1-Apr-09		22-Sep-09		14-Jan-10		13-Jan-10		13-Jan-10			Criteria <sup>1</sup>	DW MCL <sup>2</sup>		
Dissolved Metals																								
Aluminum (Al)	µg/L	<38		<38		<38		<38		<38		<38		<38		<38		<38				1,000 200 SMCL		
Antimony (Sb)	µg/L	3.0		0.98	J	0.99	J	<0.23		<0.23		<0.17		<0.17		8.2		0.86	J			6		
Arsenic (As)	µg/L	2.2		1.5	J,J+	1.5	J,J+	<0.67		<0.67		<0.52		<0.52		4.5	J+	1.3	J,J+	150 (4-day) 340 (1 hr)		50		
Barium (Ba)	µg/L	68		43		42		96	B	100		170		110		41		24				1,000		
Beryllium (Be)	µg/L	<0.18		<0.18		<0.18		<0.046		<0.046		<0.18		<0.18		<0.18		<0.18				4		
Boron (B)	µg/L	100	J+	36	J	35	J	-		39	J,J+	67	J,J+	40 J		69	J	31	J					
Cadmium (Cd)	µg/L	<0.13		<0.13		<0.13		0.017	J	<0.013		<0.13		<0.13		0.53	J	<0.13		1.1 (H) (4-day) 3.9 (H) (1 hr)		5		
Chromium (Cr)	µg/L	0.58	J	<0.55		<0.55		<0.64		0.81	J	<0.55		0.63 J		<0.55		<0.55		11 (4-day) 16 (1 hr) Cr (VI)		50		
Hexavalent Chromium (Cr VI)	µg/L	<0.70		1.2	B,J,J+	1.2	B,J,J+	1.4	J	<0.7		<0.70		1.3 J,J+		2.0	J+	-						
Copper (Cu)	µg/L	4.8		1.8	J	2		0.7	B,J,J+	0.6	J,J+	2.2		1.4 J		1.5	J	1.2	J	9 (H) (4-day) 13 (H) (1 hr)		TT 1,000 SMCL		
Iron (Fe)	µg/L	<9.3	B	<9.3		<9.3		<7.2		<7.2	B	<9.3	B	<9.3 B		<9.3		<9.3				300 SMCL		
Lead (Pb)	µg/L	<0.054		<0.054		0.22	J	<0.019		0.026	J	<0.054		<0.054		<0.054		<0.054		2.5 (H) (4-day) 65 (H) (1 hr)		TT Action Level = 15 50 SMCL		
Manganese (Mn)	µg/L	2.8	J+	3.9		4.2		0.11	J,J+	0.31	J	0.73	J,J+	1.4		21		14						
Mercury (Hg)	µg/L	-		-		-		<0.016		<0.016		-		-		-		-		0.025 (4-day) 2.4 (1 hr)		2		
Mercury (Hg) by 1631	µg/L	0.00173	J+	0.070		0.0662		0.00072		<0.00020		0.00069		0.00089 J+		0.0107		-		0.025 (4-day)		2		
Molybdenum (Mo)	µg/L	470		83		84		24	B,J+	0.91	B,J,J+	10	J+	3.6		540		120						
Nickel (Ni)	µg/L	47		27		27		1.4	J	1.0	J	1.3	J,J+	0.87 J		160		3.4		52 (H) (4-day) 470 (H) (1 hr)		100		
Selenium (Se)	µg/L	90		13		13		<0.23		0.7	J	<0.38		0.45 J		82		29		5 (4-day) 20 (1-hour)		50		
Silver (Ag)	µg/L	<0.065		<0.065		<0.065		<0.028		<0.028		<0.065		<0.065		<0.065		<0.065		3.4 (H) (1-hr)		100 SMCL		
Thallium (Tl)	µg/L	<0.11		<0.11		<0.11		<0.054	B	0.1	J	<0.11		<0.11		0.39	J	<0.11				2		
Vanadium (V)	µg/L	110		66		66		-		-		<1.2		1.9 J		400		2.6	J					
Zinc (Zn)	µg/L	4	J,J+	4.1	B,J	4.4	B,J	4.7	J,J+	67	J+	<1.9		<1.9		120		28		120 (H) (4-day) 120 (H) (1 hr)		5,000 SMCL		
Calcium (Ca)	mg/L	210	B	84		79		55		58		64	B	61 B		210		160						
Magnesium (Mg)	mg/L	55		28		26		37		34		37		36		36		42						
Sodium (Na)	mg/L	24		13		12		18	B	14		16		16		22		24						
Potassium (K)	mg/L	0.89	J	2.2		2.1		0.55	J	0.63	J,J+	0.51	J	0.63 J		0.85	J	2						
Silicon (as SiO <sub>2</sub> )	mg/L	17		13		12		18		22		23		19		12		7.4						
Total Metals																								
Total Recoverable Aluminum (Al)	µg/L	<76		4,900		5,200		<28		<28		<76		72		720		87,000				1,000 200 SMCL		
Total Recoverable Antimony (Sb)	µg/L	2.2		1.4	J	1.1	J	<0.23	B	0.29	B,J	<0.20		0.42 J		7.9		1.6	J			6		
Total Recoverable Arsenic (As)	µg/L	1.4	J	2.2		2.3		<0.82		<0.82		<1.1		<1.1		3.7		21				50		
Total Recoverable Barium (Ba)	µg/L	61		180		170		110	B	110		160		110		59		4,200				1,000		
Total Recoverable Beryllium (Be)	µg/L	<0.20		<0.20		<0.20		<0.060		<0.060		<0.20		<0.20		<0.20		1.1				4		
Total Recoverable Boron (B)	µg/L	350	B,J+	52	J	54	J	-		48	J,J+	360	B,J+	39 J		70	J	52	J					
Total Recoverable Cadmium (Cd)	µg/L	0.11	J	0.49	J	0.44	J	<0.051		<0.051		<0.11		0.7 B,J		1.3	B	5.8	B	1.1 (H) (4-day) 3.9 (H) (1 hr)		5		

TABLE D-1  
Water Quality Monitoring Results

														North		West Material Storage Area					
		SW-2 Dup	Q	SW-2	Q	SW-2 Dup	Q	SW-3	Q	SW-3	Q	SW-3	Q	SW-3	Q	Quarry	Q	Runoff	Q	Basin Plan	USEPA
		22-Sep-09		20-Jan-10		20-Jan-10		4-Feb-09		1-Apr-09		22-Sep-09		14-Jan-10		13-Jan-10		13-Jan-10		Criteria <sup>1</sup>	DW MCL <sup>2</sup>
Total Recoverable Chromium (Cr)	µg/L	<0.64		25		25		<1.6		<1.6		1.1	J,J+	1.3	J	6		370			50
																					TT
Total Recoverable Copper (Cu)	µg/L	2.2	J+	14		13		0.67	J	0.78	J	1.3	J,J+	1.2	J	3.3		170			1,000
																					SMCL
Total Recoverable Iron (Fe)	µg/L	<60		8,300		9,000		<16		30	J	<60		150		1,200		160,000			300
																					SMCL
Total Recoverable Lead (Pb)	µg/L	<0.19		2.5	B,J+	2.3	B,J+	<0.053		0.064	J,J+	<0.19		0.2	B,J,J+	0.5	B,J,J+	17	B		TT
																					Action
Total Recoverable Manganese (Mn)	µg/L	3.7		170	B	150	B	0.37	J	0.75	J,J+	1.1		4.5	B,J+	38	B	3,000	B		Level = 15
																					50
Total Recoverable Mercury (Hg)	µg/L	0.058	J,J+	0.032	J,J+	<0.016		<0.016		<0.016	B	0.018	J,J+	<0.016		<0.016		1.5		0.025 (4-day)	2
																					2.4 (1 hr)
Total Recoverable Molybdenum (Mo)	µg/L	450		92		94		16	B	1.3	B,J+	1.1		1.1		630		140			
Total Recoverable Nickel (Ni)	µg/L	43		77	B	73	B	1.3	J	1.0	J,J+	1.5	J,J+	1.4	J,J+	180		460			100
Total Recoverable Selenium (Se)	µg/L	69		13		13		<0.50		0.52	J	<0.54		<0.54		73		33		5 (4-day)	50
																					20 (1-hour)
Total Recoverable Silver (Ag)	µg/L	<0.088		<0.088		<0.088		<0.064		<0.064		<0.088		<0.088		<0.088		0.89	J		100
																					SMCL
Total Recoverable Thallium (Tl)	µg/L	<0.11		0.28	J	0.14	J	<0.054		0.14	J	<0.11		0.13	J	0.24	J	0.79	J		2
Total Recoverable Vanadium (V)	µg/L	86		100		96		-		-		<2.6		<2.6		430		350			
Total Recoverable Zinc (Zn)	µg/L	12		89		85		7.8	J+	6.0	J+	5.9		5.9	B	140	B	600	B		5,000
																					SMCL
Total Recoverable Calcium (Ca)	mg/L	200		100		100		61		66		31		69		230		1000			
Total Recoverable Magnesium (Mg)	mg/L	53		31		33		41	B	39		18		42		40		160			
Total Recoverable Sodium (Na)	mg/L	25		13		13		19	B	16		17		17		23		25			
Total Recoverable Potassium (K)	mg/L	0.89	J	2.7		2.8		0.6	J	0.72	J	0.53	J	0.75	J	1.0		8.2			
Pesticides		-		-		-		ND		ND		-		-		-		-			
PCBs		-		-		-		ND		ND		-		-		-		-			
VOCs																					
Total Trihalomethanes (TTHM)																					80
																					80
Bromoform	µg/L	-		-		-		<0.24		<0.24		-		-		-		-			TTHM
																					80
Chloroform	µg/L	-		-		-		<0.23		<0.23		-		-		-		-			TTHM
																					80
Dibromochloromethane	µg/L	-		-		-		<0.23		<0.23		-		-		-		-			TTHM
																					80
Toluene	µg/L	-		-		-		<0.12		<0.12		-		-		-		-			1,000
SVOCs																					
bis(2-ethylhexyl)phthalate	µg/L	-		-		-		2.3	B,J,J+	<1.1		-		-		-		-			
General Chemistry																					
Bicarbonate	mg/L	230		170		170		320		320		310		330		200		71			
Carbonate	mg/L	<5.0		<2.5		<2.5		<2.5		13		7.1		<2.5		<5.0		<5.0			
Total Alkalinity (as CaCO <sub>3</sub> )	mg/L	190		140		140		260		270		260		270		170		58			
Chloride	mg/L	18	B	10	B	10	B	28	B	16		23	B	20		13		25			250 - 600
																					SMCL
Fluoride	mg/L	0.17		0.13		0.13		0.18		0.14		0.12		0.099		0.14		0.22			1.4 - 2.4 (temp. dependent)
																					SMCL
Sulfate	mg/L	560		160	B	160	B	28	B	18	J+	22		23		550		550			250 - 600
																					SMCL
Hardness (as CaCO <sub>3</sub> )	mg/L	750		320		300		290		290		310		300		673		580			

TABLE D-1  
Water QualityMonitoring Results

																North				West Material Storage Area							
				SW-2 Dup	Q	SW-2	Q	SW-2 Dup	Q	SW-3	Q	SW-3	Q	SW-3	Q	SW-3	Q	North Quarry	Q	Runoff	Q	Basin Plan	USEPA				
				22-Sep-09		20-Jan-10		20-Jan-10		4-Feb-09		1-Apr-09		22-Sep-09		14-Jan-10		13-Jan-10		13-Jan-10		Criteria <sup>1</sup>	DW MCL <sup>2</sup>				
Total Dissolved Solids (TDS)				mg/L	1,000			410		400				340		360		350		360		790		900		500	
Total Suspended Solids (TSS)				mg/L	4			200		190				<2.5		0.86	J	<2.0		<3.3		18		3,600		SMCL	
Residual Chlorine				mg/L	<0.10	H		<0.10	H	<0.10	H			<0.10		<0.10	H	<0.10	H		<0.10	H		<0.10	H	4.0	
Ammonia (as N)				mg/L-N	<0.025			0.15	B,J+	0.07	B,J+			<0.025	B	<0.025		<0.025		0.027	J,J+	<0.025		0.095	J+	MRDL	
Nitrate (as N)				mg/L-N	0.51			1.4		1.4				<0.018		<0.026	J	0.055	J	<0.026		0.73		7.6		10	
Nitrite (as N)				mg/L-N	<0.0081			<0.0081		<0.0081				<0.0081		<0.0081		<0.0081		<0.0081		<0.0081		<0.0081		1	
Total Phosphorus				mg/L	<0.016			0.29		0.59				<0.012		<0.012		0.016	J	<0.016	B	<0.016		1.8	B		
Total Sulfide				mg/L	<0.050			<0.050		<0.050				<0.050		<0.050		<0.050		<0.050		<0.050		-			
pH				s.u.	8.16	H		7.49	H	7.55	H			8.18		8.39		8.39	H	8.27	H	7.94		7.90	H	6.5 to 8.5 within 0.5 of ambient	6.5 - 8.5
Electrical Conductivity (@ 25 °C)				umhos/cm	1250			602		605				577		541		589		596		1,130		1,090		SMCL	
Odor				odor units	2			8		4				2		none		1		none		-		-		3	
Turbidity				NTU	1.9			90		100				0.22	J+	0.36		2.1		0.78	J+	-		-		TT	
Cyanide				mg/L	<0.0028			<0.0028		<0.0028				<0.0032		<0.0032		<0.0028		-		<0.0028		-		0.2	
Dioxins				pg/L	-			-		-				<0.64		<0.31		-		-		-		-			
Aquatic Toxicity					-			-		-				pass		pass		-		-		-		-			
Asbestos (# of fibers)				# of fibers	-			-		-				ND		-		-		-		-		-		7E+6 10 µm fibers	
Oil and Grease				mg/L	-			-		-				-		2.8	J,J+	-		-		-		-			

**TABLE D-2**  
PER070 Water Quality Data

063-7109

Parameter	Unit	Dry	Spring	Wet
		Jun-02	Apr-02	Jan-03
Specific Conductance	mS/cm	1.02	1.01	1.14
Dissolved Oxygen	mg/L	8.92	11.21	10.78
pH	s.u.	8.18	8.33	7.50
Temperature	°C	16.69	13.52	14.01
Turbidity	NTU	2.21	1.4	4.90
Velocity	ft/s	1.02	1.94	
Alkalinity	mg/L as CaCO <sub>3</sub>	202	189	185
Boron	mg/L	0.17	0.06	0.18
Chloride	mg/L	55.8	49.7	42.3
Hardness	mg/L as CaCO <sub>3</sub>	424	498	533
SSC	mg/L	3.5	1.5	9.74
Sulfate	mg/L	336	326	379
TDS	mg/L	720	724	850
Total Ammonia	mg/L as N	0.07	0.07	ND
Nitrate	mg/L as N		1.54	2.11
Nitrite	mg/L as N	0.007	0.007	0.0207
Total Kjeldahl Nitrogen	mg/L	0.37	0.37	0
Orthophosphate	mg/L as P	0.025	0.012	0.014
Total Phosphorus	mg/L as P	0.04	0.04	0.056
Cadmium (T)	µg/L	0.074	0.38	0.95
Cadmium (D)	µg/L	0.071	0.37	1
Copper (T)	µg/L	1.85	1.69	2.26
Copper (D)	µg/L	1.74	1.55	1.68
Lead (T)	µg/L	0.019	ND	0.108
Lead (D)	µg/L	0.008	0.02	0.00478
Nickel (T)	µg/L	2.17	8.71	33.7
Nickel (D)	µg/L	1.6	7.86	30.9
Silver (T)	µg/L	ND	ND	ND
Silver (D)	µg/L	ND	ND	ND
Zinc (T)	µg/L	1.88	1.42	5.27
Zinc (D)	µg/L	1.25	1.11	2.64
Arsenic (T)	µg/L	0.92	1	1.95
Arsenic (D)	µg/L	0.86	1.04	1.94
Chromium (T)	µg/L	0.87	2.72	8.12
Chromium (D)	µg/L	0.46	2.31	6.8
Mercury (T)	µg/L	0.0024	0.00137	0.0156
Selenium (T)	µg/L	5.84	10.3	18.7
Selenium (D)	µg/L	5.84	5.09	18.8
Organic Carbon (D)	mg/L	1.4	5.1	0.7
Organic Carbon (T) (TOC)	mg/L	2	12.9	0.9

**Notes:**

Yellow shading identifies peak concentration.

SSC - suspended sediment concentration

ND - concentration is below detectable limits

**Source:** SFBRWQCB, 2007

**APPENDIX E**  
**QUALITY ASSURANCE / QUALITY CONTROL**

**Date:** March 1, 2010**Project No.:** 063-7109**RE: BASELINE WATER QUALITY AND GEOCHEMICAL DATA – QA/QC REPORT**

---

## 1.0 INTRODUCTION

A primary objective of the baseline water quality data collection effort is to provide analytical data that are of known and defensible quality. This Technical Memorandum presents the results of the quality assurance/quality control (QA/QC) evaluation of the baseline data set.

## 2.0 QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

The QA/QC program for baseline sample collection included the following: (1) collection and analysis of field duplicate water samples; (2) collection and analysis of equipment blank and field blank samples; and (3) calculation of charge balance errors.

### 2.1 Field Duplicate Sample Results

Field duplicate sample results were evaluated following guidelines presented in the U.S. Environmental Protection Agency (USEPA) Contract Laboratory Program Functional Guidelines for Inorganic Data Review (USEPA, 2004). Although the USEPA provides no “required” review criteria for determining the comparability of “field” duplicate analyses, or laboratory duplicate analyses of water samples, a control limit of 20% for the Relative Percent Difference (RPD) is typically applied to original and duplicate sample values that are greater than or equal to five times the Contract Required Quantitation Limit (CRQL). A control limit of 35% is applied for solid phase analysis results. For the current study, the CRQL was assumed equal to the practical quantitation limit (PQL). If the concentration in either the original or duplicate sample is less than five times the CRQL (PQL), a control limit of one times the CRQL is applied. These criteria were applied to assess duplicate results.

The RPD of all duplicate samples greater than five times the CRQL was calculated as follows (Equation 1):

$$RPD(\%) = \frac{|original - duplicate|}{\frac{(original + duplicate)}{2}} \times 100 \quad (\text{Equation 1})$$

### 2.2 Field Blank Sample Results

One field blank or equipment sample was collected and analyzed during each groundwater and surface water sampling event. Equipment blanks are used to verify the adequacy of sampling equipment

decontamination procedures. All samples reporting values less than ten times the reporting limit for any constituent detected in a blank sample were qualified as estimated high (J+ qualifier) (USEPA, 2004).

### 2.3 Charge Balance Errors

Calculation of a charge balance error is a standard practice in assessing the accuracy of a water analysis. Solution electroneutrality means that the sum of cations in solution (expressed in meq/L) should be equal to the sum of anions. A charge balance error of less than 5% to 10% is generally regarded as indicative of a good analysis. Charge balance errors for water samples were calculated as follows:

$$Error(\%) = \frac{(\sum cation - |\sum anion|)}{(\sum cation + |\sum anion|)} \times 100 \quad (\text{Equation 2})$$

Charge balance errors were calculated for speciated solutions using PHREEQC (Version 2.12), an equilibrium speciation and mass-transfer code developed by the United States Geological Survey (USGS) (Parkhurst and Appelo, 1999). Concentrations of constituents reported below detectable limits were assumed equal to the detection limit.

## 3.0 QUALITY ASSURANCE/QUALITY CONTROL RESULTS

### 3.1 Surface Water and Groundwater Samples

One field duplicate sample was collected during each sampling round. Duplicate analysis results are presented in Attachment A. Results are summarized in Table E-1. The results of field duplicate analysis were satisfactory. For each duplicate sample, greater than 94% percent of determinations met the project defined acceptable criteria.

One field blank (FB) or equipment blank (EB) sample was collected during each surface water and groundwater sampling event, respectively. Complete blank sample results are provided in Attachment B. Summaries of only the blank sample detections that resulted in qualification of one or more sample results as biased high (J+ qualifier) are presented in Table E-2 (equipment blanks) and Table E-3 (field blanks). Constituents detected in the blank samples were typically present at concentrations below the PQL. Equipment and field blank samples collected in April 2009 yielded the highest number of detections. A number of constituents were detected in the laboratory blank sample (identified with a "B" qualifier), indicating that laboratory contamination may have been the source.

Constituents detected in 4 or more blank samples are listed below:

- **Molybdenum** – Dissolved molybdenum was often detected in both field and equipment blanks. This result suggests that the filters may introduce low levels of molybdenum into the samples. The maximum concentration measured in a blank sample (11 µg/L) is much lower than the range of concentrations measured at SW-2 (83 to 750 µg/L).

- **Zinc** – Dissolved zinc was often detected in both field and equipment blanks.
- **Nickel** – Total recoverable nickel was detected in five out of eight blank samples. Concentrations were consistently low ( $<1 \mu\text{g/L}$ ).
- **Bis(2-ethylhexyl)phthalate** - Bis(2-ethylhexyl)phthalate was detected in all blank samples in which it was analyzed. This constituent was often detected in the laboratory blank, indicating that the laboratory is a possible source of contamination.

Charge balance error results are shown in Table E-4. All charge balance errors were acceptable. Thirty-two (32) of the 34 water samples reported charge balance errors less than 5%. All samples reported charge balance errors less than 10%.

### 3.2 Mine Water Samples

Duplicate and blank samples were not collected during the mine water (i.e., North Quarry and storage area runoff) sampling event. Charge balance error results are shown in Table E-4. Charge balance errors were acceptable ( $<10\%$ ).

### 3.3 Laboratory Geochemical Testing

Charge balance error results for WET test leachates are shown in Table E-5. Charge balance errors were positive for all samples, indicative of a cation surplus or anion deficit. Charge balance errors ranged from 3% to 17%. The WET leach test is mainly intended to provide information on trace metal leaching. Because the charge balance errors are most likely attributable to inaccurate analysis of major ions, the errors are considered acceptable for the current evaluation.

### 3.4 Field Geochemical Testing – Wall Washing

Wall washing field blank results are presented in Table E-6. Most constituents were below detectable limits in the single blank sample collected. Low level detections of the following constituents resulted in qualification of some sample results as biased high (i.e., assigned a J+ qualifier): dissolved nickel, dissolved zinc and dissolved potassium.

Charge balance error results are shown in Table E-7. Charge balance errors were acceptable for the wall washing rinsates from the three limestone samples (less than 5%). The chert, greywacke and greenstone rinsate samples reported charge balance errors ranging from 15 to 20%. All errors were positive, indicative of a cation excess or anion deficit. It is possible that the poor charge balance results from omission of an analyte. Charge balance errors were calculated using only dissolved phase concentrations. Total phosphorus concentrations for these three samples ranged from 2 to 100 mg/L. Exclusion of dissolved phosphate in the calculation of charge balance errors may in part explain the anion deficit.

## 4.0 SUMMARY

A primary objective of the baseline water quality data collection is to provide analytical data that are of known and defensible quality. This Technical Memorandum presents the results of the QA/QC evaluation of the baseline water quality data set. Based on this evaluation, the data are of acceptable quality for their intended purpose.

## 4.1 References

Parkhurst, D.L., and C.A.J. Appelo, 1999. User's Guide to PHREEQC (Version 2) - A Computer Program for Speciation, Batch-Reaction, One-Dimensional Transport, and Inverse Geochemical Calculations, U.S. Geological Survey Water-Resources Investigations Report 99-4259, Denver, CO.

U.S. Environmental Protection Agency (USEPA), 2004. US EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review – Final. EPA 540-R-04-004, October 2004.

## List of Tables

Table E-1	Field Duplicate Result Summary – Water Quality Monitoring
Table E-2	Summary of Equipment Blank Sample Results – Water Quality Monitoring
Table E-3	Summary of Field Blank Sample Results – Water Quality Monitoring
Table E-4	Charge Balance Errors – Water Quality Monitoring
Table E-5	Charge Balance Errors – WET Test
Table E-6	Field Blank Sample Result – Wall Washing
Table E-7	Charge Balance Errors – Wall Washing

## List of Attachments

TM Attachment A Field Duplicate Results

TM Attachment B Field and Equipment Blank Results

**TABLE E-1**  
**Field Duplicate Result Summary**  
**Water Quality Monitoring**

<b>Location</b>	<b>Date</b>	<b>No. of Determinations</b>	<b>No. of Failures</b>	<b>% Failure</b>
SW-2	4-Feb-09	66	2	3%
SW-2	2-Apr-09	77	3	4%
SW-2	22-Sep-09	69	2	3%
HG-7	27-Oct-09	70	4	6%
SW-2	20-Jan-10	69	2	3%

**TABLE E-2**  
**Summary of Equipment Blank Sample Results – Water Quality Monitoring**

Parameter	Unit	February				April				October				December				Total EB
		EB-1	Q	MDL	PQL	EB-1	Q	MDL	PQL	EB-1	Q	MDL	PQL	EB-1	Q	MDL	PQL	
		9-Feb-09				15-Apr-09				29-Oct-09				29-Dec-09				
Arsenic (As)	µg/L	<b>1</b>	J	0.67	2													1
Beryllium (Be)	µg/L	<b>0.058</b>	J	0.046	1													1
Boron (B)	µg/L					<b>14</b>	B,J	4.9	100									1
Copper (Cu)	µg/L					<b>0.24</b>	J	0.045	2									1
Iron (Fe)	µg/L					<b>8.9</b>	J	7.2	50									1
Lead (Pb)	µg/L					<b>0.019</b>	J	0.019	1									1
Mercury (Hg) by 1631	µg/L									<b>0.00052</b>		0.0002	5E-04					1
Molybdenum (Mo)	µg/L					<b>0.24</b>	J	0.031	1	<b>0.21</b>	J	0.13	1	<b>0.21</b>	J	0.13	1	3
Thallium (Tl)	µg/L					<b>0.058</b>	J	0.054	1									1
Zinc (Zn)	µg/L	<b>3</b>	B,J	0.28	5													1
Potassium (K)	mg/L					<b>0.13</b>	J	0.071	1									1
Total Recoverable Beryllium (Be)	µg/L	<b>0.099</b>	J	0.06	1													1
Total Recoverable Chromium (Cr)	µg/L					<b>4.4</b>		1.6	3									1
Total Recoverable Copper (Cu)	µg/L					<b>1.4</b>	J	0.045	2									1
Total Recoverable Manganese (Mn)	µg/L					<b>5.4</b>	B	0.092	1									1
Total Recoverable Molybdenum (Mo)	µg/L					<b>1.6</b>	B	0.031	1									1
Total Recoverable Nickel (Ni)	µg/L					<b>0.99</b>	B,J	0.065	2					<b>0.56</b>	B,J	0.25	2	2
Total Recoverable Zinc (Zn)	µg/L					<b>3.5</b>	J	1.3	5									1
Chloroform	µg/L	<b>5</b>		0.23	0.5	<b>2.9</b>		0.23	0.5									2
bis(2-ethylhexyl)phthalate	µg/L	<b>6.5</b>		1.5	5.5	<b>2.2</b>	B,J	1.1	4.8									2
Total Suspended Solids (TSS)	mg/L									<b>12</b>		20	20					1
Ammonia (as N)	mg/L-N					<b>0.025</b>	J	0.025	0.05									1
Nitrite (as N)	mg/L-N									<b>0.0089</b>	B,J	0.0081	0.05					1
Total Phosphorus	mg/L	<b>0.025</b>	J	0.012	0.05													1
Cyanide	mg/L					<b>0.0041</b>	B,J	0.003	0.01									1

**Notes:**

MDL - method detection limit

PQL - practical quantitation limit

Laboratory Qualifiers (Q):

J = estimated value below laboratory reporting limit

B = detected in blank sample.

H = holding time exceeded

detected in blank sample - one or more results

**bold** qualified as estimated biased high (J+)

**TABLE E-3**  
**Summary of Field Blank Sample Results – Water Quality Monitoring**

Parameter	Unit	February				April				September				January				Total FB
		FB-1	Q	MDL	PQL	FB	Q	MDL	PQL	FB-1	Q	MDL	PQL	FB	Q	MDL	PQL	
		4-Feb-09				3-Apr-09				22-Sep-09				20-Jan-10				
Arsenic (As)	µg/L													0.64	J	0.52	2	1
Beryllium (Be)	µg/L					0.092	J	0.046	1									1
Boron (B)	µg/L					14	B,J	4.9	100	23	B	0.18	1					2
Hexavalent Chromium (Cr VI)	µg/L													0.81	B,J	0.7	2	1
Copper (Cu)	µg/L	0.25	B,J	0.045	2	0.3	B,J	0.045	2									2
Manganese (Mn)	µg/L	0.064	J	0.025	1					2.4		0.22	2					2
Mercury (Hg) by 1631	µg/L									0.00080				0.00023	J	0.0002	0.0005	2
Molybdenum (Mo)	µg/L	4.5	B	0.031	1	0.32	J	0.031	1	11		0.13	1					3
Nickel (Ni)	µg/L									0.22	J	0.15	2					1
Silver (Ag)	µg/L					0.044	J	0.028	1									1
Zinc (Zn)	µg/L	4.8	J	0.28	5	68	B	0.28	5	18		1.9	5					3
Potassium (K)	mg/L					0.14	B,J	0.071	1									1
Total Recoverable Aluminum (Al)	µg/L					36	J	28	50									1
Total Recoverable Boron (B)	µg/L									190	B,J	24	200					1
Total Recoverable Chromium (Cr)	µg/L									1	J	0.64	3					1
Total Recoverable Copper (Cu)	µg/L					0.33	B,J	0.045	2	0.81	J	0.66	2					2
Total Recoverable Iron (Fe)	µg/L	17	J	16	50													1
Total Recoverable Lead (Pb)	µg/L					0.064	J	0.053	1					0.78	B,J	0.19	1	2
Total Recoverable Manganese (Mn)	µg/L					5.3		0.092	1					0.47	B,J	0.11	1	2
Total Recoverable Mercury (Hg)	µg/L					0.018	B,J	0.016	0.2	0.03	J	0.016	0.2	0.028	J	0.016	0.2	3
Total Recoverable Molybdenum (Mo)	µg/L	1.2	B	0.031	1	0.16	J	0.031	1									2
Total Recoverable Nickel (Ni)	µg/L					0.24	B,J	0.065	2	0.43	J	0.25	2	0.35	B,J	0.25	2	3
Total Recoverable Zinc (Zn)	µg/L	1.7	J	1.3	5	40	B	1.3	5									2
bis(2-ethylhexyl)phthalate	µg/L	3.7	B,J	1.9	7	2.4	B,J	1.1	4									2
Sulfate	mg/L					3.5		0.21	1									1
Ammonia (as N)	mg/L-N													0.065	B	0.025	0.05	1
Total Phosphorus	mg/L					0.13		0.012	0.05									1
Turbidity	NTU	0.1		0.1	0.1									0.18		0.1	0.1	2
Cyanide	mg/L					0.003	B,J	0.003	0.005									1
Oil and Grease	mg/L					3.8	B,J	1.2	6.2									1

**Notes:**

MDL - method detection limit

PQL - practical quantitation limit

Laboratory Qualifiers (Q):

J = estimated value below laboratory reporting limit

B = detected in blank sample.

H = holding time exceeded

detected in blank sample - one or more  
 results qualified as estimated biased high  
 (J+)

**TABLE E-4**  
**Charge Balance Errors – Water Quality Monitoring**

Surface Water		
Location	Date	Charge Balance Error (%)
SW-1	4-Feb-09	-0.1
SW-2	4-Feb-09	-3.9
SW-2 Dup	4-Feb-09	-4.3
SW-3	4-Feb-09	0.1
SW-3	1-Apr-09	0.8
SW-1	2-Apr-09	-3.2
SW-2	2-Apr-09	-1.6
SW-2 Dup	2-Apr-09	-4.5
SW-1	22-Sep-09	-5.7
SW-2	22-Sep-09	-1.6
SW-2 Dup	22-Sep-09	0.2
SW-3	22-Sep-09	5.1
SW-3	14-Jan-10	2.2
SW-1	19-Jan-10	3.7
SW-2	20-Jan-10	5.0
SW-2 Dup	20-Jan-10	1.1

Groundwater		
Location	Date	Charge Balance Error (%)
HG-4	9-Feb-09	-0.8
HG-6	9-Feb-09	-0.4
HG-9	9-Feb-09	0.1
HG-4	14-Apr-09	-0.9
HG-6	14-Apr-09	1.5
HG-7	15-Apr-09	0.6
HG-9	15-Apr-09	-0.2
HG-10	28-Sep-09	-0.9
HG-4	26-Oct-09	-2.2
HG-7	27-Oct-09	0.2
HG-7 DUP	27-Oct-09	2.2
HG-9	27-Oct-09	2.6
HG-6	29-Oct-09	3.5
HG-7	29-Dec-09	2.3
HG-9	29-Dec-09	0.2
HG-4	4-Jan-10	-1.1
HG-6	4-Jan-10	-0.6
HG-10	4-Jan-10	0.2

Mine Water		
Location	Date	Charge Balance Error (%)
Storage Area Runoff	13-Jan-10	-6.7
North Quarry	13-Jan-10	-3.7

**TABLE E-5**  
**Charge Balance Errors – WET Test**

Sample		Charge Balance Error (%)
Composite 1	Graywacke	17
Composite 2	Limestone and Dolomitic Limestone	11
GT1-2-08-213	Chert	11
Composite 3	Fault Breccia	5.4
Composite 4	Greenstone	5.2
Composite 5	Metabasalt	10
CS-01	Overburden	2.6

**TABLE E-6**  
**Field Blank Sample Result – Wall Washing**

Parameter	Unit	FB-01	Q
		24-Nov-09	
Aluminum	µg/L	<38	
Antimony	µg/L	<0.17	
Arsenic	µg/L	<0.52	
Hexavalent Chromium	µg/L	<0.70	
Barium	µg/L	1.2	
Beryllium	µg/L	<0.18	
Boron	µg/L	<9.7	
Cadmium	µg/L	<0.13	
Chromium	µg/L	<0.55	
Copper	µg/L	<0.68	
Iron	µg/L	<9.3	
Lead	µg/L	<0.054	
Manganese	µg/L	<0.11	
Molybdenum	µg/L	<0.13	
Nickel	µg/L	0.18	J
Selenium	µg/L	<0.38	
Silicon as SiO <sub>2</sub>	µg/L	<65	
Silver	µg/L	<0.065	
Thallium	µg/L	<0.11	
Vanadium	µg/L	<1.2	
Zinc	µg/L	2	J
Calcium	mg/L	0.14	
Magnesium	mg/L	<0.029	
Sodium	mg/L	<0.12	
Potassium	mg/L	0.099	J
Total Recoverable Aluminum	µg/L	<38	
Total Recoverable Antimony	µg/L	<0.20	
Total Recoverable Arsenic	µg/L	<1.1	
Total Recoverable Barium	µg/L	0.69	B,J
Total Recoverable Beryllium	µg/L	<0.20	
Total Recoverable Boron	µg/L	<12	
Total Recoverable Cadmium	µg/L	<0.11	
Total Recoverable Chromium	µg/L	<0.64	
Total Recoverable Copper	µg/L	<0.66	
Total Recoverable Iron	µg/L	<30	
Total Recoverable Lead	µg/L	<0.19	
Total Recoverable Manganese	µg/L	0.63	B,J
Total Recoverable Mercury	µg/L	<0.016	
Total Recoverable Molybdenum	µg/L	<0.23	
Total Recoverable Nickel	µg/L	0.84	J
Total Recoverable Selenium	µg/L	<0.54	
Total Recoverable Silver	µg/L	<0.088	
Total Recoverable Thallium	µg/L	<0.11	
Total Recoverable Vanadium	µg/L	<2.6	
Total Recoverable Zinc	µg/L	4.6	J

**TABLE E-7**  
**Charge Balance Errors – Wall Washing**

Sample		Charge Balance Error (%)
HG-01	Limestone - high grade	-0.1
GW-01	Greywacke	15
MG-01	Limestone - med to high	-1
CT-01	Chert	20
HMG-01	Limestone - high and med/low	4
GS-01	Greenstone	15

Parameter	Unit	FB-01	Q
		24-Nov-09	
Total Recoverable Calcium	mg/L	0.18	
Total Recoverable Magnesium	mg/L	<0.038	
Total Recoverable Sodium	mg/L	<0.070	
Total Recoverable Potassium	mg/L	<0.092	
Bicarbonate	mg/L	<5.0	
Carbonate	mg/L	<2.5	
Total Alkalinity (as CaCO <sub>3</sub> )	mg/L	<4.1	
Chloride	mg/L	<0.059	
Fluoride	mg/L	<0.010	
Nitrate as N	mg/L	<0.026	
Sulfate	mg/L	<0.21	
Hardness (as CaCO <sub>3</sub> )	mg/L	0.43	J
pH	pH Units	5.81	H
Electrical Conductivity @ 25 C	umhos/cm	2.2	
Total Dissolved Solids @ 180 C	mg/L	<6.7	
Total Suspended Solids (Glass Fiber)	mg/L	<4.0	
Turbidity	NT Units	0.31	
Residual Chlorine	mg/L	<0.10	H
Ammonia as N	mg/L	<0.025	
Nitrite as N	mg/L	<0.0081	
Total Phosphorus	mg/L	<0.016	

## Notes:

Q - Laboratory qualifiers

B - constituent detected in method blank

J - estimated value

H - holding time exceeded

**TM ATTACHMENT A**

**ATTACHMENT A**  
**Duplicate Analysis Results**

Parameter	Units	MDL	PQL	February 2009		
				SW-2	SW-2 Dup	
				4-Feb-09	4-Feb-09	
Metals						
Aluminum (Al)	µg/L	38	50	<38	<38	+/- PQL
Antimony (Sb)	µg/L	0.23	2	6.3	6.1	+/- PQL
Arsenic (As)	µg/L	0.67	2	4.5	4.8	+/- PQL
Barium (Ba)	µg/L	0.068	1	37	35	6%
Beryllium (Be)	µg/L	0.046	1	<0.046	<0.046	+/- PQL
Boron (B)	µg/L			-	-	
Cadmium (Cd)	µg/L	0.013	1	0.098	0.14	+/- PQL
Chromium (Cr)	µg/L	0.64	3	<0.64	<0.64	+/- PQL
Hexavalent Chromium (Cr VI)	µg/L	0.7	2	0.95	1.2	+/- PQL
Copper (Cu)	µg/L	0.045	2	1.3	1.0	+/- PQL
Iron (Fe)	µg/L	7.2	50	<7.2	<7.2	+/- PQL
Lead (Pb)	µg/L	0.019	1	0.023	<0.019	+/- PQL
Manganese (Mn)	µg/L	0.025	1	2.2	2.1	+/- PQL
Mercury (Hg)	µg/L	0.016	0.2	<0.016	<0.016	+/- PQL
Mercury (Hg) by 1631	µg/L	0.0002	0.0005	0.00141	-	-
Molybdenum (Mo)	µg/L	0.031	1	750	740	1%
Nickel (Ni)	µg/L	0.04	2	70	-	-
Selenium (Se)	µg/L	0.23	2	80	79	1%
Silver (Ag)	µg/L	0.028	1	<0.028	<0.028	+/- PQL
Thallium (Tl)	µg/L	0.054	1	0.16	0.085	+/- PQL
Vanadium (V)	µg/L					
Zinc (Zn)	µg/L	0.28	5	12	-	-
Calcium (Ca)	mg/L	0.019	0.1	200	200	0%
Magnesium (Mg)	mg/L	0.021	0.05	38	37	3%
Sodium (Na)	mg/L	0.049	0.5	25	25	0%
Potassium (K)	mg/L	0.071	1	1.1	1.1	+/- PQL
Silicon (as SiO <sub>2</sub> )	mg/L	0.038	0.2	11	11	0%
Total Recoverable Aluminum (Al)	µg/L	28	50	32	39	+/- PQL
Total Recoverable Antimony (Sb)	µg/L	0.23	2	6.2	6.1	+/- PQL
Total Recoverable Arsenic (As)	µg/L	0.82	2	2.4	1.9	+/- PQL
Total Recoverable Barium (Ba)	µg/L	0.072	1	40	40	0%
Total Recoverable Beryllium (Be)	µg/L	0.06	1	<0.060	<0.060	+/- PQL
Total Recoverable Boron (B)	µg/L					
Total Recoverable Cadmium (Cd)	µg/L	0.051	1	0.14	0.16	+/- PQL
Total Recoverable Chromium (Cr)	µg/L	1.6	3	<1.6	<1.6	+/- PQL
Total Recoverable Copper (Cu)	µg/L	0.045	2	1.4	1.3	+/- PQL
Total Recoverable Iron (Fe)	µg/L	16	50	87	100	+/- PQL
Total Recoverable Lead (Pb)	µg/L	0.053	1	<0.053	<0.053	+/- PQL
Total Recoverable Manganese (Mn)	µg/L	0.092	1	4.8	4.9	+/- PQL
Total Recoverable Mercury (Hg)	µg/L	0.016	0.2	<0.016	<0.016	+/- PQL
Total Recoverable Molybdenum (Mo)	µg/L	0.031	1	770	750	3%
Total Recoverable Nickel (Ni)	µg/L	0.065	2	75	77	3%
Total Recoverable Selenium (Se)	µg/L	0.5	2	87	84	4%
Total Recoverable Silver (Ag)	µg/L	0.064	1	<0.064	<0.064	+/- PQL
Total Recoverable Thallium (Tl)	µg/L	0.054	1	<0.054	<0.054	+/- PQL
Total Recoverable Vanadium (V)	µg/L					
Total Recoverable Zinc (Zn)	µg/L	1.3	5	15	16	+/- PQL
Total Recoverable Calcium (Ca)	mg/L	0.021	0.1	230	230	0%
Total Recoverable Magnesium (Mg)	mg/L	0.019	0.05	43	43	0%
Total Recoverable Sodium (Na)	mg/L	0.053	0.5	27	43	46%
Total Recoverable Potassium (K)	mg/L	0.12	1	1.2	1.2	+/- PQL

**ATTACHMENT A**  
**Duplicate Analysis Results**

Parameter	Units	MDL	PQL	February 2009		
				SW-2	SW-2 Dup	
				4-Feb-09	4-Feb-09	
<b>Pesticides</b>				ND	ND	-
<b>PCBs</b>				ND	ND	-
<b>VOCs</b>						
Total Trihalomethanes (TTHM)						
Bromoform	µg/L	0.24	0.5	<0.24	<0.24	+/- PQL
Chloroform	µg/L	0.23	0.5	<0.23	<0.23	+/- PQL
Dibromochloromethane	µg/L	0.23	0.5	<0.23	<0.23	+/- PQL
Toluene	µg/L	0.12	0.5	<0.12	<0.12	+/- PQL
<b>SVOCs</b>						
bis(2-ethylhexyl)phthalate	µg/L	1.1	4	1.8	-	-
<b>General Chemistry</b>						
Bicarbonate	mg/L	10	10	190	-	-
Carbonate	mg/L	5	5	<5.0	-	-
Total Alkalinity (as CaCO <sub>3</sub> )	mg/L	8.2	8.2	150	150	0%
Chloride	mg/L	0.075	0.5	14	14	0%
Fluoride	mg/L	0.0083	0.05	0.15	0.14	+/- PQL
Sulfate	mg/L	0.26	2	560	560	0%
Hardness (as CaCO <sub>3</sub> )	mg/L	0.1	0.5	650	750	14%
Total Dissolved Solids (TDS)	mg/L	50	50	1100	970	13%
Total Suspended Solids (TSS)	mg/L	2.5	2.5	<2.5	2.2	+/- PQL
Residual Chlorine	mg/L	0.1	0.1	<0.10	<0.10	+/- PQL
Ammonia (as N)	mg/L-N	0.025	0.05	<0.025	<0.025	+/- PQL
Nitrate (as N)	mg/L-N	0.018	0.1	0.65	0.67	3%
Nitrite (as N)	mg/L-N	0.0081	0.05	<0.0081	<0.0081	+/- PQL
Total Phosphorus	mg/L	0.012	0.05	<0.012	<0.012	+/- PQL
Total Sulfide	mg/L	0.05	0.1	<0.050	<0.050	+/- PQL
pH	s.u.	0.05	0.05	8.30	8.29	0%
Electrical Conductivity (@ 25 °C)	umhos/cm	1	1	1240	1210	2%
Odor	odor units	1	1	none	4.0	> +/- PQL
Turbidity	NTU	0.1	0.1	2.9	2.4	19%
Cyanide	mg/L	0.0032	0.005	<0.0032	<0.0032	+/- PQL
Dioxins	pg/L			<0.64	-	-
Aquatic Toxicity				pass	-	-
Asbestos (# of fibers)	# of fibers			1	-	-
Oil and Grease	mg/L			NA	-	-

**Determinations**  
**Failures**  
**% Failure**

66  
2

3%

**ATTACHMENT A**  
**Duplicate Analysis Results**

Parameter	Units	MDL	PQL	April 2009		
				SW-2 2-Apr-09	SW-2 Dup 2-Apr-09	
Metals						
Aluminum (Al)	µg/L	38	50	<38	<38	+/- PQL
Antimony (Sb)	µg/L	0.23	2	3.8	4.0	+/- PQL
Arsenic (As)	µg/L	0.67	2	2.8	3.4	+/- PQL
Barium (Ba)	µg/L	0.068	1	63	66	5%
Beryllium (Be)	µg/L	0.046	1	0.059	<0.046	+/- PQL
Boron (B)	µg/L	4.9	100	89	91	+/- PQL
Cadmium (Cd)	µg/L	0.013	1	0.055	0.057	+/- PQL
Chromium (Cr)	µg/L	0.64	3	<0.64	<0.64	+/- PQL
Hexavalent Chromium (Cr VI)	µg/L	0.7	2	0.83	0.92	+/- PQL
Copper (Cu)	µg/L	0.045	2	1.3	1.3	+/- PQL
Iron (Fe)	µg/L	7.2	50	18	<7.2	+/- PQL
Lead (Pb)	µg/L	0.019	1	<0.019	<0.019	+/- PQL
Manganese (Mn)	µg/L	0.025	1	3.0	3.0	+/- PQL
Mercury (Hg)	µg/L	0.016	0.2	<0.016	<0.016	+/- PQL
Mercury (Hg) by 1631	µg/L	0.0002	0.0005	0.00133	0.00157	+/- PQL
Molybdenum (Mo)	µg/L	0.031	1	460	490	6%
Nickel (Ni)	µg/L	0.04	2	110	110	0%
Selenium (Se)	µg/L	0.23	2	74	76	3%
Silver (Ag)	µg/L	0.028	1	<0.028	<0.028	+/- PQL
Thallium (Tl)	µg/L	0.054	1	<0.054	<0.054	+/- PQL
Vanadium (V)	µg/L					
Zinc (Zn)	µg/L	0.28	5	61	71	15%
Calcium (Ca)	mg/L	0.019	0.1	210	200	5%
Magnesium (Mg)	mg/L	0.021	0.05	46	46	0%
Sodium (Na)	mg/L	0.049	0.5	30	30	0%
Potassium (K)	mg/L	0.071	1	1.4	1.4	+/- PQL
Silicon (as SiO <sub>2</sub> )	mg/L	0.038	0.2	12	12	0%
Total Recoverable Aluminum (Al)	µg/L	28	50	63	110	+/- PQL
Total Recoverable Antimony (Sb)	µg/L	0.23	2	4.0	4.0	+/- PQL
Total Recoverable Arsenic (As)	µg/L	0.82	2	2.0	2.1	+/- PQL
Total Recoverable Barium (Ba)	µg/L	0.072	1	72	76	5%
Total Recoverable Beryllium (Be)	µg/L	0.06	1	<0.060	0.10	+/- PQL
Total Recoverable Boron (B)	µg/L	6.4	100	90	85	+/- PQL
Total Recoverable Cadmium (Cd)	µg/L	0.051	1	0.086	0.099	+/- PQL
Total Recoverable Chromium (Cr)	µg/L	1.6	3	<1.6	<1.6	+/- PQL
Total Recoverable Copper (Cu)	µg/L	0.045	2	1.7	4.2	> +/- PQL
Total Recoverable Iron (Fe)	µg/L	16	50	75	120	+/- PQL
Total Recoverable Lead (Pb)	µg/L	0.053	1	<0.053	<0.053	+/- PQL
Total Recoverable Manganese (Mn)	µg/L	0.092	1	5.5	7.2	27%
Total Recoverable Mercury (Hg)	µg/L	0.016	0.2	0.028	<0.016	+/- PQL
Total Recoverable Molybdenum (Mo)	µg/L	0.031	1	430	180	82%
Total Recoverable Nickel (Ni)	µg/L	0.065	2	120	120	0%
Total Recoverable Selenium (Se)	µg/L	0.5	2	74	75	1%
Total Recoverable Silver (Ag)	µg/L	0.064	1	<0.064	<0.064	+/- PQL
Total Recoverable Thallium (Tl)	µg/L	0.054	1	<0.054	<0.054	+/- PQL
Total Recoverable Vanadium (V)	µg/L					
Total Recoverable Zinc (Zn)	µg/L	1.3	5	12	15	+/- PQL
Total Recoverable Calcium (Ca)	mg/L	0.021	0.1	220	200	10%
Total Recoverable Magnesium (Mg)	mg/L	0.019	0.05	48	44	9%
Total Recoverable Sodium (Na)	mg/L	0.053	0.5	31	30	3%
Total Recoverable Potassium (K)	mg/L	0.12	1	1.2	1.1	+/- PQL

**ATTACHMENT A**  
**Duplicate Analysis Results**

Parameter	Units	MDL	PQL	April 2009		
				SW-2 2-Apr-09	SW-2 Dup 2-Apr-09	
<b>Pesticides</b>				ND	ND	-
<b>PCBs</b>				ND	ND	-
<b>VOCs</b>						
Total Trihalomethanes (TTHM)						
Bromoform	µg/L	0.24	0.5	<0.24	<0.24	+/- PQL
Chloroform	µg/L	0.23	0.5	<0.23	<0.23	+/- PQL
Dibromochloromethane	µg/L	0.23	0.5	<0.23	<0.23	+/- PQL
Toluene	µg/L	0.12	0.5	<0.12	<0.12	+/- PQL
<b>SVOCs</b>						
bis(2-ethylhexyl)phthalate	µg/L	1.1	4	2.1	4.6	+/- PQL
<b>General Chemistry</b>						
Bicarbonate	mg/L	5	10	180	180	0%
Carbonate	mg/L	2.5	5	<2.5	<2.5	+/- PQL
Total Alkalinity (as CaCO <sub>3</sub> )	mg/L	4.1	8.2	150	150	0%
Chloride	mg/L	0.059	0.5	12	12	0%
Fluoride	mg/L	0.01	0.05	0.085	0.10	+/- PQL
Sulfate	mg/L	0.21	2	600	610	2%
Hardness (as CaCO <sub>3</sub> )	mg/L	0.1	0.5	740	690	7%
Total Dissolved Solids (TDS)	mg/L	10	50	1100	1000	10%
Total Suspended Solids (TSS)	mg/L	0.5	1.2	2.0	2.2	+/- PQL
Residual Chlorine	mg/L	0.1	0.1	<0.10	<0.10	+/- PQL
Ammonia (as N)	mg/L-N	0.025	0.05	<0.025	<0.025	+/- PQL
Nitrate (as N)	mg/L-N	0.026	0.1	2.3	2.3	0%
Nitrite (as N)	mg/L-N	0.0081	0.05	<0.0081	<0.0081	+/- PQL
Total Phosphorus	mg/L	0.012	0.05	0.025	0.012	+/- PQL
Total Sulfide	mg/L	0.05	0.1	<0.050	<0.050	+/- PQL
pH	s.u.	0.05	0.05	8.15	8.28	2%
Electrical Conductivity (@ 25 °C)	umhos/cm	1	1	1210	1210	0%
Odor	odor units	1	1	none	none	+/- PQL
Turbidity	NTU	0.1	0.1	0.44	0.48	+/- PQL
		0.0032 /				
Cyanide	mg/L	0.0028	0.005	0.0036	<0.0032	+/- PQL
Dioxins	pg/L			<1.0	<0.72	+/- PQL
Aquatic Toxicity				pass	pass	0%
Asbestos (# of fibers)	# of fibers					
Oil and Grease	mg/L	1.2	5	<1.2	1.6	+/- PQL

**Determinations**  
**Failures**  
**% Failure**

77  
3

4%

**ATTACHMENT A**  
**Duplicate Analysis Results**

Parameter	Units	MDL	PQL	September 2009		
				SW-2 22-Sep-09	SW-2 Dup 22-Sep-09	
Metals						
Aluminum (Al)	µg/L	38	50	<38	<38	+/- PQL
Antimony (Sb)	µg/L	0.17	2	2.4	3	+/- PQL
Arsenic (As)	µg/L	0.52	2	1.5	2.2	+/- PQL
Barium (Ba)	µg/L	0.12	1	60	68	13%
Beryllium (Be)	µg/L	0.18	1	<0.18	<0.18	+/- PQL
Boron (B)	µg/L	9.7	100	100	100	+/- PQL
Cadmium (Cd)	µg/L	0.13	1	<0.13	<0.13	+/- PQL
Chromium (Cr)	µg/L	0.55	3	<0.55	0.58	+/- PQL
Hexavalent Chromium (Cr VI)	µg/L	0.7	2	<0.70	<0.70	+/- PQL
Copper (Cu)	µg/L	0.68	2	3.3	4.8	+/- PQL
Iron (Fe)	µg/L	9.3	50	<9.3	<9.3	+/- PQL
Lead (Pb)	µg/L	0.054	1	<0.054	<0.054	+/- PQL
Manganese (Mn)	µg/L	0.22	2	2.1	2.8	+/- PQL
Mercury (Hg)	µg/L	-	-	-	-	-
Mercury (Hg) by 1631	µg/L	-	-	-	-	-
Molybdenum (Mo)	µg/L	0.13 / 0.26	1 / 2	470	470	0%
Nickel (Ni)	µg/L	0.15	2	44	47	7%
Selenium (Se)	µg/L	0.38	2	81	90	11%
Silver (Ag)	µg/L	0.065	1	<0.065	<0.065	+/- PQL
Thallium (Tl)	µg/L	0.11	1	<0.11	<0.11	+/- PQL
Vanadium (V)	µg/L	1.2	3	97	110	13%
Zinc (Zn)	µg/L	1.9	5	3.1	4	+/- PQL
Calcium (Ca)	mg/L	0.016	0.1	200	210	5%
Magnesium (Mg)	mg/L	0.029	0.05	53	55	4%
Sodium (Na)	mg/L	0.12	0.5	24	24	0%
Potassium (K)	mg/L	0.074	1	1.1	0.89	+/- PQL
Silicon (as SiO <sub>2</sub> )	mg/L	0.065	0.2	17	17	0%
Total Recoverable Aluminum (Al)	µg/L	38 / 76	50 / 100	<38	<76	+/- PQL
Total Recoverable Antimony (Sb)	µg/L	0.2	2	2.3	2.2	+/- PQL
Total Recoverable Arsenic (As)	µg/L	1.1	2	<1.1	1.4	+/- PQL
Total Recoverable Barium (Ba)	µg/L	0.21	1	60	61	2%
Total Recoverable Beryllium (Be)	µg/L	0.2	1	<0.20	<0.20	+/- PQL
Total Recoverable Boron (B)	µg/L	12 / 24	100 / 200	110	350	> +/- PQL
Total Recoverable Cadmium (Cd)	µg/L	0.11	1	0.14	0.11	+/- PQL
Total Recoverable Chromium (Cr)	µg/L	0.64	3	0.93	<0.64	+/- PQL
Total Recoverable Copper (Cu)	µg/L	0.66	2	2.5	2.2	+/- PQL
Total Recoverable Iron (Fe)	µg/L	30 / 60	50 / 100	58	<60	+/- PQL
Total Recoverable Lead (Pb)	µg/L	0.19	1	<0.19	<0.19	+/- PQL
Total Recoverable Manganese (Mn)	µg/L	0.11	1	4	3.7	+/- PQL
Total Recoverable Mercury (Hg)	µg/L	0.016	0.2	0.02	0.058	+/- PQL
Total Recoverable Molybdenum (Mo)	µg/L	0.23	1	470	450	4%
Total Recoverable Nickel (Ni)	µg/L	0.25	2	44	43	2%
Total Recoverable Selenium (Se)	µg/L	0.54	2	71	69	3%
Total Recoverable Silver (Ag)	µg/L	0.088	1	<0.088	<0.088	+/- PQL
Total Recoverable Thallium (Tl)	µg/L	0.11	1	<0.11	<0.11	+/- PQL
Total Recoverable Vanadium (V)	µg/L	2.6	3	93	86	8%
Total Recoverable Zinc (Zn)	µg/L	3.2	5	10	12	+/- PQL
Total Recoverable Calcium (Ca)	mg/L	0.036 / 0.072	0.1 / 0.2	200	200	0%
Total Recoverable Magnesium (Mg)	mg/L	0.038 / 0.076	0.05 / 0.1	52	53	2%
Total Recoverable Sodium (Na)	mg/L	0.07 / 0.14	0.5 / 1	24	25	4%
Total Recoverable Potassium (K)	mg/L	0.092 / 0.18	1 / 2	0.99	0.89	+/- PQL

**ATTACHMENT A**  
**Duplicate Analysis Results**

Parameter	Units	MDL	PQL	September 2009		
				SW-2 22-Sep-09	SW-2 Dup 22-Sep-09	
<b>Pesticides</b>				-	-	-
<b>PCBs</b>				-	-	-
<b>VOCs</b>						
Total Trihalomethanes (TTHM)						
Bromoform	µg/L			-	-	-
Chloroform	µg/L			-	-	-
Dibromochloromethane	µg/L			-	-	-
Toluene	µg/L			-	-	-
<b>SVOCs</b>						
bis(2-ethylhexyl)phthalate	µg/L			-	-	-
<b>General Chemistry</b>						
Bicarbonate	mg/L	10	10	240	230	4%
Carbonate	mg/L	5	5	<5.0	<5.0	+/- PQL
Total Alkalinity (as CaCO <sub>3</sub> )	mg/L	8.2	8.2	190	190	0%
Chloride	mg/L	0.059	0.5	18	18	0%
Fluoride	mg/L	0.01	0.05	0.17	0.17	+/- PQL
Sulfate	mg/L	0.42	2	550	560	2%
Hardness (as CaCO <sub>3</sub> )	mg/L	0.1	0.5	710	750	5%
Total Dissolved Solids (TDS)	mg/L	50	50	1000	1000	0%
Total Suspended Solids (TSS)	mg/L	2	2	5.2	4	+/- PQL
Residual Chlorine	mg/L	0.1	0.1	<0.10	<0.10	+/- PQL
Ammonia (as N)	mg/L-N	0.025	0.05	<0.025	<0.025	+/- PQL
Nitrate (as N)	mg/L-N	0.026	0.1	0.48	0.51	+/- PQL
Nitrite (as N)	mg/L-N	0.0081	0.05	<0.0081	<0.0081	+/- PQL
Total Phosphorus	mg/L	0.016	0.05	<0.016	<0.016	+/- PQL
Total Sulfide	mg/L	0.05	0.1	<0.050	<0.050	+/- PQL
pH	s.u.	0.05	0.05	8.24	8.16	1%
Electrical Conductivity (@ 25 °C)	umhos/cm	1	1	1270	1250	2%
Odor	odor units	1	1	2	2	+/- PQL
Turbidity	NTU	0.1	0.1	1.5	1.9	24%
Cyanide	mg/L	0.0028	0.005	<0.0028	<0.0028	+/- PQL
Dioxins	pg/L			-	-	-
Aquatic Toxicity				-	-	-
Asbestos (# of fibers)	# of fibers			-	-	-
Oil and Grease	mg/L			-	-	-
<b>Determinations</b>						69
<b>Failures</b>						2
<b>% Failure</b>						3%

**ATTACHMENT A**  
**Duplicate Analysis Results**

Parameter	Units	MDL	PQL	October 2009		
				HG-7 27-Oct-09	HG-7 DUP 27-Oct-09	
Metals						
Aluminum (Al)	µg/L	38	50	<38	<38	+/- PQL
Antimony (Sb)	µg/L	0.17	2	<0.17	<0.17	+/- PQL
Arsenic (As)	µg/L	0.52	2	2.2	2.4	+/- PQL
Barium (Ba)	µg/L	0.12	1	120	120	0%
Beryllium (Be)	µg/L	0.18	1	<0.18	<0.18	+/- PQL
Boron (B)	µg/L	9.7	100	<9.7	<9.7	+/- PQL
Cadmium (Cd)	µg/L	0.13	1	<0.13	<0.13	+/- PQL
Chromium (Cr)	µg/L	0.55	3	2.1	1.4	+/- PQL
Hexavalent Chromium (Cr VI)	µg/L	0.7	2	<0.70	<0.70	+/- PQL
Copper (Cu)	µg/L	0.68	2	<0.68	<0.68	+/- PQL
Iron (Fe)	µg/L	9.3	50	310	310	0%
Lead (Pb)	µg/L	0.054	1	<0.054	<0.054	+/- PQL
Manganese (Mn)	µg/L	0.11	1	330	320	3%
Mercury (Hg)	µg/L	-	-	-	-	-
Mercury (Hg) by 1631	µg/L	0.001	0.0025	0.0235	0.0221	6%
Molybdenum (Mo)	µg/L	0.13	1	0.62	0.54	+/- PQL
Nickel (Ni)	µg/L	0.15	2	1.7	1.7	+/- PQL
Selenium (Se)	µg/L	0.38	2	<0.38	<0.38	+/- PQL
Silver (Ag)	µg/L	0.065	1	0.81	0.42	+/- PQL
Thallium (Tl)	µg/L	0.11	1	<0.11	<0.11	+/- PQL
Vanadium (V)	µg/L	1.2	3	<1.2	<1.2	+/- PQL
Zinc (Zn)	µg/L	1.9	5	<1.9	3	+/- PQL
Calcium (Ca)	mg/L	0.016	0.1	110	110	0%
Magnesium (Mg)	mg/L	0.029	0.05	43	45	5%
Sodium (Na)	mg/L	0.12	0.5	21	21	0%
Potassium (K)	mg/L	0.074	1	0.93	0.91	+/- PQL
Silicon (as SiO <sub>2</sub> )	mg/L	0.065	0.2	26	26	0%
Total Recoverable Aluminum (Al)	µg/L	38	50	36000	47000	27%
Total Recoverable Antimony (Sb)	µg/L	0.2	2	0.47	0.44	+/- PQL
Total Recoverable Arsenic (As)	µg/L	1.1	2	9.7	11	+/- PQL
Total Recoverable Barium (Ba)	µg/L	0.21	1	330	350	6%
Total Recoverable Beryllium (Be)	µg/L	0.2	1	0.81	0.94	+/- PQL
Total Recoverable Boron (B)	µg/L	12	100	12	17	+/- PQL
Total Recoverable Cadmium (Cd)	µg/L	0.11	1	0.28	0.35	+/- PQL
Total Recoverable Chromium (Cr)	µg/L	0.64	3	320	360	12%
Total Recoverable Copper (Cu)	µg/L	0.66	2	35	36	3%
Total Recoverable Iron (Fe)	µg/L	30	50	53000	69000	26%
Total Recoverable Lead (Pb)	µg/L	0.19	1	8.3	9	8%
Total Recoverable Manganese (Mn)	µg/L	0.11	1	1100	1200	9%
Total Recoverable Mercury (Hg)	µg/L	0.016	0.2	0.058	0.092	+/- PQL
Total Recoverable Molybdenum (Mo)	µg/L	0.23	1	1.9	2	+/- PQL
Total Recoverable Nickel (Ni)	µg/L	0.25	2	310	350	12%
Total Recoverable Selenium (Se)	µg/L	0.54	2	<0.54	<0.54	+/- PQL
Total Recoverable Silver (Ag)	µg/L	0.088	1	0.14	0.15	+/- PQL
Total Recoverable Thallium (Tl)	µg/L	0.11	1	0.12	0.12	+/- PQL
Total Recoverable Vanadium (V)	µg/L	2.6	3	91	100	9%
Total Recoverable Zinc (Zn)	µg/L	3.2	5	79	86	8%
Total Recoverable Calcium (Ca)	mg/L	0.036	0.1	130	130	0%
Total Recoverable Magnesium (Mg)	mg/L	0.038	0.05	93	110	17%
Total Recoverable Sodium (Na)	mg/L	0.07	0.5	24	23	4%
Total Recoverable Potassium (K)	mg/L	0.092	1	5.2	5.7	9%

**ATTACHMENT A**  
**Duplicate Analysis Results**

Parameter	Units	MDL	PQL	October 2009		
				HG-7 27-Oct-09	HG-7 DUP 27-Oct-09	
<b>Pesticides</b>				-	-	-
<b>PCBs</b>				-	-	-
<b>VOCs</b>						
Total Trihalomethanes (TTHM)						
Bromoform	µg/L			-	-	-
Chloroform	µg/L			-	-	-
Dibromochloromethane	µg/L			-	-	-
Toluene	µg/L			-	-	-
<b>SVOCs</b>						
bis(2-ethylhexyl)phthalate	µg/L			-	-	-
<b>General Chemistry</b>						
Bicarbonate	mg/L	5	5	480	480	0%
Carbonate	mg/L	2.5	2.5	<2.5	<2.5	+/- PQL
Total Alkalinity (as CaCO <sub>3</sub> )	mg/L	4.1	4.1	400	390	3%
Chloride	mg/L	0.059	0.5	46	46	0%
Fluoride	mg/L	0.01	0.05	0.2	0.2	+/- PQL
Sulfate	mg/L	0.21	1	31	30	3%
Hardness (as CaCO <sub>3</sub> )	mg/L	0.1	0.5	450	460	2%
Total Dissolved Solids (TDS)	mg/L	33	33	530	580	9%
Total Suspended Solids (TSS)	mg/L	20	20	840	1000	17%
Residual Chlorine	mg/L	0.5	0.5	<0.50	<0.50	+/- PQL
Ammonia (as N)	mg/L-N	0.025	0.05	0.18	0.042	> +/- PQL
Nitrate (as N)	mg/L-N	0.026	0.1	<0.026	<0.026	+/- PQL
Nitrite (as N)	mg/L-N	0.0081	0.05	0.0099	0.0094	+/- PQL
Total Phosphorus	mg/L	0.04	0.12	0.51	0.63	+/- PQL
Total Sulfide	mg/L	0.25	0.5	<0.25	<0.25	+/- PQL
pH	s.u.	0.05	0.05	7.37	7.4	0%
Electrical Conductivity (@ 25 °C)	umhos/cm	1	1	870	871	0%
Odor	odor units	1	1	none	none	0%
Turbidity	NTU	1	1	210	320	42%
Cyanide	mg/L	0.0028	0.005	<0.0028	<0.0028	+/- PQL
Dioxins	pg/L			-	-	-
Aquatic Toxicity				-	-	-
Asbestos (# of fibers)	# of fibers			-	-	-
Oil and Grease	mg/L			-	-	-
<b>Determinations</b>						70
<b>Failures</b>						4
<b>% Failure</b>						6%

**ATTACHMENT A**  
**Duplicate Analysis Results**

Parameter	Units	MDL	PQL	January 2010		
				SW-2 20-Jan-10	SW-2 Dup 20-Jan-10	
Metals						
Aluminum (Al)	µg/L	38	50	<38	<38	+/- PQL
Antimony (Sb)	µg/L	0.17	2	0.98	0.99	+/- PQL
Arsenic (As)	µg/L	0.52	2	1.5	1.5	+/- PQL
Barium (Ba)	µg/L	0.12	1	43	42	2%
Beryllium (Be)	µg/L	0.18	1	<0.18	<0.18	+/- PQL
Boron (B)	µg/L	9.7	100	36	35	+/- PQL
Cadmium (Cd)	µg/L	0.13	1	<0.13	<0.13	+/- PQL
Chromium (Cr)	µg/L	0.55	3	<0.55	<0.55	+/- PQL
Hexavalent Chromium (Cr VI)	µg/L	0.7	2	1.2	1.2	+/- PQL
Copper (Cu)	µg/L	0.68	2	1.8	2	+/- PQL
Iron (Fe)	µg/L	9.3	50	<9.3	<9.3	+/- PQL
Lead (Pb)	µg/L	0.054	1	<0.054	0.22	+/- PQL
Manganese (Mn)	µg/L	0.11	1	3.9	4.2	+/- PQL
Mercury (Hg)	µg/L	-	-	-	-	-
Mercury (Hg) by 1631	µg/L	-	-	-	-	-
Molybdenum (Mo)	µg/L	0.13	1	83	84	1%
Nickel (Ni)	µg/L	0.15	2	27	27	0%
Selenium (Se)	µg/L	0.38	2	13	13	0%
Silver (Ag)	µg/L	0.065	1	<0.065	<0.065	+/- PQL
Thallium (Tl)	µg/L	0.11	1	<0.11	<0.11	+/- PQL
Vanadium (V)	µg/L	1.2	3	66	66	0%
Zinc (Zn)	µg/L	1.9	5	4.1	4.4	+/- PQL
Calcium (Ca)	mg/L	0.016	0.1	84	79	6%
Magnesium (Mg)	mg/L	0.029	0.05	28	26	7%
Sodium (Na)	mg/L	0.12	0.5	13	12	8%
Potassium (K)	mg/L	0.074	1	2.2	2.1	+/- PQL
Silicon (as SiO <sub>2</sub> )	mg/L	0.065	0.2	13	12	8%
Total Recoverable Aluminum (Al)	µg/L	38	50	4900	5200	6%
Total Recoverable Antimony (Sb)	µg/L	0.2	2	1.4	1.1	+/- PQL
Total Recoverable Arsenic (As)	µg/L	1.1	2	2.2	2.3	+/- PQL
Total Recoverable Barium (Ba)	µg/L	0.21	1	180	170	6%
Total Recoverable Beryllium (Be)	µg/L	0.2	1	<0.20	<0.20	+/- PQL
Total Recoverable Boron (B)	µg/L	12	100	52	54	+/- PQL
Total Recoverable Cadmium (Cd)	µg/L	0.11	1	0.49	0.44	+/- PQL
Total Recoverable Chromium (Cr)	µg/L	0.64	3	25	25	0%
Total Recoverable Copper (Cu)	µg/L	0.66	2	14	13	7%
Total Recoverable Iron (Fe)	µg/L	30	50	8300	9000	8%
Total Recoverable Lead (Pb)	µg/L	0.19	1	2.5	2.3	+/- PQL
Total Recoverable Manganese (Mn)	µg/L	0.11	1	170	150	13%
Total Recoverable Mercury (Hg)	µg/L	0.016	0.2	0.032	<0.016	+/- PQL
Total Recoverable Molybdenum (Mo)	µg/L	0.23	1	92	94	2%
Total Recoverable Nickel (Ni)	µg/L	0.25	2	77	73	5%
Total Recoverable Selenium (Se)	µg/L	0.54	2	13	13	0%
Total Recoverable Silver (Ag)	µg/L	0.088	1	<0.088	<0.088	+/- PQL
Total Recoverable Thallium (Tl)	µg/L	0.11	1	0.28	0.14	+/- PQL
Total Recoverable Vanadium (V)	µg/L	2.6	3	100	96	4%
Total Recoverable Zinc (Zn)	µg/L	3.2	5	89	85	5%
Total Recoverable Calcium (Ca)	mg/L	0.036	0.1	100	100	0%
Total Recoverable Magnesium (Mg)	mg/L	0.038	0.05	31	33	6%
Total Recoverable Sodium (Na)	mg/L	0.07	0.5	13	13	0%
Total Recoverable Potassium (K)	mg/L	0.092	1	2.7	2.8	+/- PQL

**ATTACHMENT A**  
**Duplicate Analysis Results**

Parameter	Units	MDL	PQL	January 2010		
				SW-2	SW-2 Dup	
				20-Jan-10	20-Jan-10	
<b>Pesticides</b>				-	-	-
<b>PCBs</b>				-	-	-
<b>VOCs</b>						
Total Trihalomethanes (TTHM)						
Bromoform	µg/L			-	-	-
Chloroform	µg/L			-	-	-
Dibromochloromethane	µg/L			-	-	-
Toluene	µg/L			-	-	-
<b>SVOCs</b>						
bis(2-ethylhexyl)phthalate	µg/L			-	-	-
<b>General Chemistry</b>						
Bicarbonate	mg/L	5	5	170	170	0%
Carbonate	mg/L	2.5	2.5	<2.5	<2.5	+/- PQL
Total Alkalinity (as CaCO <sub>3</sub> )	mg/L	4.1	4.1	140	140	0%
Chloride	mg/L	0.059	0.5	10	10	0%
Fluoride	mg/L	0.01	0.05	0.13	0.13	+/- PQL
Sulfate	mg/L	0.21	1	160	160	0%
Hardness (as CaCO <sub>3</sub> )	mg/L	0.1	0.5	320	300	6%
Total Dissolved Solids (TDS)	mg/L	20	20	410	400	2%
Total Suspended Solids (TSS)	mg/L	6.2	6.2	200	190	5%
Residual Chlorine	mg/L	0.1	0.1	<0.10	<0.10	+/- PQL
Ammonia (as N)	mg/L-N	0.025	0.05	0.15	0.07	+/- PQL
Nitrate (as N)	mg/L-N	0.026	0.1	1.4	1.4	0%
Nitrite (as N)	mg/L-N	0.0081	0.05	<0.0081	<0.0081	+/- PQL
Total Phosphorus	mg/L	0.016	0.05	0.29	0.59	68%
Total Sulfide	mg/L	0.05	0.1	<0.050	<0.050	+/- PQL
pH	s.u.	0.05	0.05	7.49	7.55	1%
Electrical Conductivity (@ 25 °C)	umhos/cm	1	1	602	605	0%
Odor	odor units	1	1	8	4	>+/- PQL
Turbidity	NTU	0.5	0.5	90	100	11%
Cyanide	mg/L	0.0028	0.005	<0.0028	<0.0028	+/- PQL
Dioxins	pg/L			-	-	-
Aquatic Toxicity				-	-	-
Asbestos (# of fibers)	# of fibers			-	-	-
Oil and Grease	mg/L			-	-	-
<b>Determinations</b>						69
<b>Failures</b>						2
<b>% Failure</b>						3%

**TM ATTACHMENT B**

ATTACHMENT B  
Blank Sample Results

		February				February				April			
		EB-1	Q	MDL	PQL	FB-1	Q	MDL	PQL	EB-1	Q	MDL	PQL
		9-Feb-09				4-Feb-09				15-Apr-09			
<b>Metals</b>													
Aluminum (Al)	µg/L	<38		38	50	<38		38	50	<38		38	50
Antimony (Sb)	µg/L	<0.23		0.23	2	<0.23		0.23	2	<0.23		0.23	2
Arsenic (As)	µg/L	<b>1</b>	J	0.67	2	<0.67		0.67	2	<0.67		0.67	2
Barium (Ba)	µg/L	<b>0.11</b>	J	0.068	1	<b>0.27</b>	B,J	0.068	1	<0.068		0.068	1
Beryllium (Be)	µg/L	<b>0.058</b>	J	0.046	1	<0.046		0.046	1	<0.046		0.046	1
Boron (B)	µg/L									<b>14</b>	B,J	4.9	100
Cadmium (Cd)	µg/L	<0.013		0.013	1	<0.013		0.013	1	<0.013		0.013	1
Chromium (Cr)	µg/L	<0.64	B	0.64	3	<0.64		0.64	3	<0.64		0.64	3
Hexavalent Chromium (Cr VI)	µg/L	<0.7		0.7	2	<0.7		0.7	2	<0.7		0.7	2
Copper (Cu)	µg/L	<0.045		0.045	2	<b>0.25</b>	B,J	0.045	2	<b>0.24</b>	J	0.045	2
Iron (Fe)	µg/L	<7.2		7.2	50	<7.2		7.2	50	<b>8.9</b>	J	7.2	50
Lead (Pb)	µg/L	<0.019		0.019	1	<0.019		0.019	1	<b>0.019</b>	J	0.019	1
Manganese (Mn)	µg/L	<0.025		0.025	1	<b>0.064</b>	J	0.025	1	<0.025		0.025	1
Mercury (Hg)	µg/L	<0.016		0.016	0.2	<0.016		0.016	0.2	<0.016		0.016	0.2
Mercury (Hg) by 1631	µg/L												
Molybdenum (Mo)	µg/L	<b>0.21</b>	B,J	0.031	1	<b>4.5</b>	B	0.031	1	<b>0.24</b>	J	0.031	1
Nickel (Ni)	µg/L	<0.04	B	0.04	2	<0.04		0.04	2	<0.04		0.04	2
Selenium (Se)	µg/L	<0.23	B	0.23	2	<0.23		0.23	2	<0.23		0.23	2
Silver (Ag)	µg/L	<0.028	B	0.028	1	<0.028		0.028	1	<0.028		0.028	1
Thallium (Tl)	µg/L	<0.054		0.054	1	<0.054	B	0.054	1	<b>0.058</b>	J	0.054	1
Vanadium (V)	µg/L												
Zinc (Zn)	µg/L	<b>3</b>	B,J	0.28	5	<b>4.8</b>	J	0.28	5	<0.28		0.28	5
Calcium (Ca)	mg/L	<b>0.2</b>		0.019	0.1	<b>0.12</b>		0.019	0.1	<b>0.092</b>	J	0.019	0.1
Magnesium (Mg)	mg/L	<b>0.068</b>	B	0.021	0.05	<b>0.087</b>		0.021	0.05	<b>0.025</b>	J	0.021	0.05
Sodium (Na)	mg/L	<b>0.3</b>	B,J	0.049	0.5	<b>0.39</b>	B,J	0.049	0.5	<b>0.66</b>		0.049	0.5
Potassium (K)	mg/L	<0.071		0.071	1	<0.071		0.071	1	<b>0.13</b>	J	0.071	1
Silicon (as SiO <sub>2</sub> )	mg/L	<0.038		0.038	0.2	<0.038		0.038	0.2	<b>0.075</b>	J	0.038	0.2
Total Recoverable Aluminum (Al)	µg/L	<28		28	50	<28		28	50	<28		28	50
Total Recoverable Antimony (Sb)	µg/L	<0.23		0.23	2	<0.23	B	0.23	2	<0.23	B	0.23	2
Total Recoverable Arsenic (As)	µg/L	<0.82		0.82	2	<0.82		0.82	2	<0.82		0.82	2
Total Recoverable Barium (Ba)	µg/L	<b>0.096</b>	B,J	0.072	1	<b>0.079</b>	B,J	0.072	1	<b>0.11</b>	J	0.072	1
Total Recoverable Beryllium (Be)	µg/L	<b>0.099</b>	J	0.06	1	<0.06		0.06	1	<0.06		0.06	1
Total Recoverable Boron (B)	µg/L									<b>6.4</b>	J	6.4	100
Total Recoverable Cadmium (Cd)	µg/L	<0.051		0.051	1	<0.051		0.051	1	<0.051		0.051	1
Total Recoverable Chromium (Cr)	µg/L	<1.6		1.6	3	<1.6		1.6	3	<b>4.4</b>		1.6	3
Total Recoverable Copper (Cu)	µg/L	<b>0.09</b>	J	0.045	2	<b>0.05</b>	J	0.045	2	<b>1.4</b>	J	0.045	2
Total Recoverable Iron (Fe)	µg/L	<16		16	50	<b>17</b>	J	16	50	<16		16	50
Total Recoverable Lead (Pb)	µg/L	<0.053		0.053	1	<0.053		0.053	1	<0.053		0.053	1
Total Recoverable Manganese (Mn)	µg/L	<b>0.12</b>	J	0.092	1	<0.092		0.092	1	<b>5.4</b>	B	0.092	1
Total Recoverable Mercury (Hg)	µg/L	<0.016		0.016	0.2	<0.016		0.016	0.2	<0.016		0.016	0.2
Total Recoverable Molybdenum (Mo)	µg/L	<0.031		0.031	1	<b>1.2</b>	B	0.031	1	<b>1.6</b>	B	0.031	1
Total Recoverable Nickel (Ni)	µg/L	<0.065		0.065	2	<0.065		0.065	2	<b>0.99</b>	B,J	0.065	2
Total Recoverable Selenium (Se)	µg/L	<0.5		0.5	2	<0.5		0.5	2	<0.5		0.5	2
Total Recoverable Silver (Ag)	µg/L	<0.064		0.064	1	<0.064		0.064	1	<0.064		0.064	1

ATTACHMENT B  
Blank Sample Results

		February				February				April			
		EB-1	Q	MDL	PQL	FB-1	Q	MDL	PQL	EB-1	Q	MDL	PQL
		9-Feb-09				4-Feb-09				15-Apr-09			
Total Recoverable Thallium (Tl)	µg/L	<0.054		0.054	1	<0.054		0.054	1	<0.054		0.054	1
Total Recoverable Vanadium (V)	µg/L												
Total Recoverable Zinc (Zn)	µg/L	<b>2.4</b>	J	1.3	5	<b>1.7</b>	J	1.3	5	<b>3.5</b>	J	1.3	5
Total Recoverable Calcium (Ca)	mg/L	<0.021		0.021	0.1	<0.021		0.021	0.1	<0.021		0.021	0.1
Total Recoverable Magnesium (Mg)	mg/L	<0.019		0.019	0.05	<0.019	B	0.019	0.05	<0.019		0.019	0.05
Total Recoverable Sodium (Na)	mg/L	<0.053		0.053	0.5	<b>0.12</b>	B,J	0.053	0.5	<b>0.059</b>	J	0.053	0.5
Total Recoverable Potassium (K)	mg/L	<0.12		0.12	1	<0.12		0.12	1	<0.12		0.12	1
Bromoform	µg/L	<0.24		0.24	0.5	<0.24		0.24	0.5	<0.24		0.24	0.5
Chloroform	µg/L	<b>5</b>		0.23	0.5	<b>3.3</b>		0.23	0.5	<b>2.9</b>		0.23	0.5
Dibromochloromethane	µg/L	<0.23		0.23	0.5	<0.23		0.23	0.5	<0.23		0.23	0.5
Toluene	µg/L	<0.12		0.12	0.5	<0.12		0.12	0.5	<0.12		0.12	0.5
<b>SVOCs</b>													
bis(2-ethylhexyl)phthalate	µg/L	<b>6.5</b>		1.5	5.5	<b>3.7</b>	B,J	1.9	7	<b>2.2</b>	B,J	1.1	4.8
<b>General Chemistry</b>													
Bicarbonate	mg/L	<b>5</b>		5	5	<5		5	5	<b>6.9</b>		5	5
Carbonate	mg/L	<2.5		2.5	2.5	<2.5		2.5	2.5	<2.5		2.5	2.5
Total Alkalinity (as CaCO <sub>3</sub> )	mg/L	<b>4.1</b>		4.1	4.1	<4.1		4.1	4.1	<b>5.6</b>		4.1	4.1
Chloride	mg/L	<0.059		0.059	0.5	<0.075	B	0.075	0.5	<b>0.44</b>	J	0.059	0.5
Fluoride	mg/L	<0.01		0.01	0.05	<0.0083		0.0083	0.05	<0.01		0.01	0.05
Sulfate	mg/L	<0.21		0.21	1	<0.13	B	0.13	1	<0.21		0.21	1
Hardness (as CaCO <sub>3</sub> )	mg/L	<b>0.79</b>		0.1	0.5	<b>0.67</b>		0.1	0.5				
Total Dissolved Solids (TDS)	mg/L	<6.7		6.7	6.7	<6.7		6.7	6.7	<b>10</b>		10	10
Total Suspended Solids (TSS)	mg/L	<5		5	5					<b>1</b>	J	0.5	5
Residual Chlorine	mg/L	<0.1		0.1	0.1					<0.1		0.1	0.1
Ammonia (as N)	mg/L-N	<0.025		0.025	0.05	<0.025	B	0.025	0.05	<b>0.025</b>	J	0.025	0.05
Nitrate (as N)	mg/L-N	<0.026		0.026	0.1	<0.018		0.018	0.1	<0.026		0.026	0.1
Nitrite (as N)	mg/L-N	<0.0081		0.0081	0.05	<0.0081		0.0081	0.05	<0.0081		0.0081	0.05
Total Phosphorus	mg/L	<b>0.025</b>	J	0.012	0.05	<0.012		0.012	0.05	<0.012		0.012	0.05
Total Sulfide	mg/L	<0.05		0.05	0.1	<0.05		0.05	0.1	<0.05		0.05	0.1
pH	s.u.	5.86		0.05	0.05	5.66		0.05	0.05	5.95		0.05	0.05
Electrical Conductivity (@ 25 °C)	umhos/cm	<b>2.25</b>		1	1	<b>2.8</b>		1	1	<b>3.77</b>		1	1
Odor	odor units	No Obs Odor		1	1	No Obs Odor		1	1	No Obs Odor		1	1
Turbidity	NTU	<0.1		0.1	0.1	<b>0.1</b>		0.1	0.1	<b>0.11</b>		0.1	0.1
Cyanide	mg/L	<0.0032		0.0032	0.005	<0.0032		0.0032	0.005	<b>0.0041</b>	B,J	0.0028	0.005
Oil and Grease	mg/L									<1.2		1.2	7.6

**Notes:**

Laboratory Qualifiers (Q):  
 J = estimated value below laboratory reporting limit  
 B = detected in blank sample.  
 H = holding time exceeded

**bold** detected in blank sample  
**bold** detect in blank sample - one or more results qualified as J+

ATTACHMENT B  
Blank Sample Results

		April				September				October			
		FB	Q	MDL	PQL	FB-1	Q	MDL	PQL	EB-1	Q	MDL	PQL
		3-Apr-09				22-Sep-09				29-Oct-09			
<b>Metals</b>													
Aluminum (Al)	µg/L	<38		38	50	<38		38	50	<38		38	50
Antimony (Sb)	µg/L	<0.23		0.23	2	<0.17		0.17	2	<0.17		0.17	2
Arsenic (As)	µg/L	<0.67		0.67	2	<0.52		0.52	2	<0.52		0.52	2
Barium (Ba)	µg/L	0.46	J	0.068	1	1.4	J	0.7	2	<0.12		0.12	1
Beryllium (Be)	µg/L	0.092	J	0.046	1	<0.18		0.12	1	<0.18		0.18	1
Boron (B)	µg/L	14	B,J	4.9	100	23	B	0.18	1	<9.7		9.7	100
Cadmium (Cd)	µg/L	<0.013	B	0.013	1	<0.13		9.7	100	<0.13		0.13	1
Chromium (Cr)	µg/L	<0.64		0.64	3	<0.55		0.13	1	<0.55		0.55	3
Hexavalent Chromium (Cr VI)	µg/L	<0.7		0.7	2	<0.70		0.55	3	<0.70		0.7	2
Copper (Cu)	µg/L	0.3	B,J	0.045	2	<0.68		0.68	2	<0.68		0.68	2
Iron (Fe)	µg/L	<7.2	B	7.2	50	<9.3		9.3	50	<9.3		9.3	50
Lead (Pb)	µg/L	<0.019		0.019	1	<0.054		0.054	1	<0.054		0.054	1
Manganese (Mn)	µg/L	<0.025		0.025	1	2.4		0.22	2	<0.11		0.11	1
Mercury (Hg)	µg/L	<0.016	B	0.016	0.2								
Mercury (Hg) by 1631	µg/L					0.00080				0.00052		0.0002	0.0005
Molybdenum (Mo)	µg/L	0.32	J	0.031	1	11		0.13	1	0.21	J	0.13	1
Nickel (Ni)	µg/L	<0.04		0.04	2	0.22	J	0.15	2	<0.15		0.15	2
Selenium (Se)	µg/L	<0.23		0.23	2	<0.38		0.38	2	<0.38		0.38	2
Silver (Ag)	µg/L	0.044	J	0.028	1	<0.065		0.065	1	<0.065		0.065	1
Thallium (Tl)	µg/L	<0.054		0.054	1	<0.11		0.11	1	<0.11		0.11	1
Vanadium (V)	µg/L					<1.2		1.2	3	<1.2		1.2	3
Zinc (Zn)	µg/L	68	B	0.28	5	18		1.9	5	<1.9		1.9	5
Calcium (Ca)	mg/L	0.23		0.019	0.1	0.041	J	0.016	0.1	<0.016		0.016	0.1
Magnesium (Mg)	mg/L	0.086		0.021	0.05	<0.029		0.029	0.05	<0.029		0.029	0.05
Sodium (Na)	mg/L	0.12	J	0.049	0.5	0.2	J	0.12	0.5	0.14	J	0.12	0.5
Potassium (K)	mg/L	0.14	B,J	0.071	1	<0.074		0.074	1	<0.074		0.074	1
Silicon (as SiO <sub>2</sub> )	mg/L	<0.038		0.038	0.2	<0.065		65	200	<0.065		0.065	0.2
Total Recoverable Aluminum (Al)	µg/L	36	J	28	50	<76		76	100	<38		38	50
Total Recoverable Antimony (Sb)	µg/L	<0.23		0.23	2	<0.20		0.2	2	<0.20		0.2	2
Total Recoverable Arsenic (As)	µg/L	<0.82		0.82	2	<1.1		1.1	2	<1.1		1.1	2
Total Recoverable Barium (Ba)	µg/L	1.2	B	0.072	1	<0.21		0.21	1	<0.21		0.21	1
Total Recoverable Beryllium (Be)	µg/L	<0.06		0.06	1	<0.20		0.2	1	<0.20		0.2	1
Total Recoverable Boron (B)	µg/L	17	B,J	6.4	100	190	B,J	24	200	<12		12	100
Total Recoverable Cadmium (Cd)	µg/L	<0.051		0.051	1	<0.11		0.11	1	<0.11		0.11	1
Total Recoverable Chromium (Cr)	µg/L	1.6	J	1.6	3	1	J	0.64	3	<0.64		0.64	3
Total Recoverable Copper (Cu)	µg/L	0.33	B,J	0.045	2	0.81	J	0.66	2	<0.66		0.66	2
Total Recoverable Iron (Fe)	µg/L	<16		16	50	<60		60	100	<30		30	50
Total Recoverable Lead (Pb)	µg/L	0.064	J	0.053	1	<0.19		0.19	1	<0.19		0.19	1
Total Recoverable Manganese (Mn)	µg/L	5.3		0.092	1	0.11	J	0.11	1	<0.11		0.11	1
Total Recoverable Mercury (Hg)	µg/L	0.018	B,J	0.016	0.2	0.03	J	0.016	0.2	<0.016		0.016	0.2
Total Recoverable Molybdenum (Mo)	µg/L	0.16	J	0.031	1	<0.23		0.23	1	<0.23		0.23	1
Total Recoverable Nickel (Ni)	µg/L	0.24	B,J	0.065	2	0.43	J	0.25	2	<0.25		0.25	2
Total Recoverable Selenium (Se)	µg/L	<0.5		0.5	2	<0.54		0.54	2	<0.54		0.54	2
Total Recoverable Silver (Ag)	µg/L	<0.064		0.064	1	<0.088		0.088	1	<0.088		0.088	1

ATTACHMENT B  
Blank Sample Results

		April				September				October			
		FB	Q	MDL	PQL	FB-1	Q	MDL	PQL	EB-1	Q	MDL	PQL
		3-Apr-09				22-Sep-09				29-Oct-09			
Total Recoverable Thallium (Tl)	µg/L	<0.054		0.054	1	<0.11		0.11	1	<0.11		0.11	1
Total Recoverable Vanadium (V)	µg/L					<2.6		2.6	3	<2.6		2.6	3
Total Recoverable Zinc (Zn)	µg/L	<b>40</b>	B	1.3	5	<3.2		3.2	5	<3.2		3.2	5
Total Recoverable Calcium (Ca)	mg/L	<0.021		0.021	0.1	<0.072		0.072	0.2	<0.036		0.036	0.1
Total Recoverable Magnesium (Mg)	mg/L	<0.019		0.019	0.05	<0.076		0.076	0.1	<0.038		0.038	0.05
Total Recoverable Sodium (Na)	mg/L	<b>0.13</b>	B,J	0.053	0.5	<b>0.26</b>	J	0.14	1	<b>0.24</b>	J	0.07	0.5
Total Recoverable Potassium (K)	mg/L	<0.12		0.12	1	<0.18		0.18	2	<0.092		0.092	1
Bromoform	µg/L	<0.24		0.24	0.5								
Chloroform	µg/L	<b>4.9</b>		0.23	0.5								
Dibromochloromethane	µg/L	<0.23		0.23	0.5								
Toluene	µg/L	<0.12		0.12	0.5								
SVOCs													
bis(2-ethylhexyl)phthalate	µg/L	<b>2.4</b>	B,J	1.1	4								
General Chemistry													
Bicarbonate	mg/L	<b>5</b>		5	5	<b>5</b>		5	5	<b>5</b>		5	5
Carbonate	mg/L	<2.5		2.5	2.5	<2.5		2.5	2.5	<2.5		2.5	2.5
Total Alkalinity (as CaCO <sub>3</sub> )	mg/L	<b>4.1</b>		4.1	4.1	<b>4.1</b>		4.1	4.1	<b>4.1</b>		4.1	4.1
Chloride	mg/L	<b>0.19</b>	B,J	0.059	0.5	<b>0.12</b>	B,J	0.059	0.5	<0.059	B	0.059	0.5
Fluoride	mg/L	<0.01		0.01	0.05	<0.010		0.01	0.05	<0.010		0.01	0.05
Sulfate	mg/L	<b>3.5</b>		0.21	1	<b>0.25</b>	J	0.21	1	<0.21		0.21	1
Hardness (as CaCO <sub>3</sub> )	mg/L	<0.1		0.1	0.5	<0.10		0.1	0.5	<0.10		0.1	0.5
Total Dissolved Solids (TDS)	mg/L	<b>10</b>		10	6.7	<6.7		6.7	6.7	<6.7		33	33
Total Suspended Solids (TSS)	mg/L	<0.5		0.5	1.2	<2.0		2	2	<b>12</b>		20	20
Residual Chlorine	mg/L	<0.1		0.1	0.1	<0.10	H	0.1	0.1	<0.10	H	0.5	0.5
Ammonia (as N)	mg/L-N	<0.025		0.025	0.05	<0.025		0.025	0.05	<0.025		0.025	0.05
Nitrate (as N)	mg/L-N	<b>0.047</b>	J	0.026	0.1	<0.026		0.026	0.1	<0.026		0.026	0.1
Nitrite (as N)	mg/L-N	<0.0081		0.0081	0.05	<0.0081		0.0081	0.05	<b>0.0089</b>	B,J	0.0081	0.05
Total Phosphorus	mg/L	<b>0.13</b>		0.012	0.05	<0.016		0.016	0.05	<0.016		0.04	0.12
Total Sulfide	mg/L	<0.05		0.05	0.1	<0.050		0.05	0.1	<0.050		0.25	0.5
pH	s.u.	6.08		0.05	0.05	6.02	H	0.05	0.05	5.72	H	0.05	0.05
Electrical Conductivity (@ 25 °C)	umhos/cm	<b>1.81</b>		1	1	<b>1.7</b>		1	1	<b>2.39</b>		1	1
Odor	odor units	No Obs Odor		1	1	No Obs Odor		1	1	No Obs Odor		1	1
Turbidity	NTU	<0.1		0.1	0.1	<0.10		0.1	0.1	<0.10		1	1
Cyanide	mg/L	<b>0.003</b>	B,J	0.0028	0.005	<0.0028		0.0028	0.005	<0.0028		0.0028	0.005
Oil and Grease	mg/L	<b>3.8</b>	B,J	1.2	6.2								

Notes:

Laboratory Qualifiers (Q):  
J = estimated value below laboratory reporting limit  
B = detected in blank sample.  
H = holding time exceeded

**bold** detected in blank sample  
**bold** detect in blank sample - one or more results qualified as J+

ATTACHMENT B  
Blank Sample Results

		December				January			
		EB-1	Q	MDL	PQL	FB	Q	MDL	PQL
		29-Dec-09				20-Jan-10			
<b>Metals</b>									
Aluminum (Al)	µg/L	<38		38	50	<38		38	50
Antimony (Sb)	µg/L	<0.17		0.17	2	<0.17		0.17	2
Arsenic (As)	µg/L	<0.52		0.52	2	0.64	J	0.52	2
Barium (Ba)	µg/L	<0.12		0.12	1	<0.12		0.12	1
Beryllium (Be)	µg/L	<0.18		0.18	1	<0.18		0.18	1
Boron (B)	µg/L	<9.7		9.7	100	<9.7		9.7	100
Cadmium (Cd)	µg/L	<0.13		0.13	1	<0.13		0.13	1
Chromium (Cr)	µg/L	<0.55		0.55	3	<0.55		0.55	3
Hexavalent Chromium (Cr VI)	µg/L	<0.70		0.7	2	0.81	B,J	0.7	2
Copper (Cu)	µg/L	<0.68		0.68	2	<0.68		0.68	2
Iron (Fe)	µg/L	<9.3		9.3	50	<9.3		9.3	50
Lead (Pb)	µg/L	<0.054		0.054	1	<0.054		0.054	1
Manganese (Mn)	µg/L	<0.11		0.11	1	<0.11		0.11	1
Mercury (Hg)	µg/L	-							
Mercury (Hg) by 1631	µg/L	<0.0002		0.0002	0.0005	0.00023	J	0.0002	0.0005
Molybdenum (Mo)	µg/L	0.21	J	0.13	1	<0.13		0.13	1
Nickel (Ni)	µg/L	<0.15		0.15	2	<0.15		0.15	2
Selenium (Se)	µg/L	<0.38		0.38	2	<0.38		0.38	2
Silver (Ag)	µg/L	<0.065		0.065	1	<0.065		0.065	1
Thallium (Tl)	µg/L	<0.11		0.11	1	<0.11		0.11	1
Vanadium (V)	µg/L	<1.2		1.2	3	<1.2		1.2	3
Zinc (Zn)	µg/L	<1.9		1.9	5	<1.9	B	1.9	5
Calcium (Ca)	mg/L	<0.016		0.016	0.1	<0.016		0.016	0.1
Magnesium (Mg)	mg/L	<0.029		0.029	0.05	<0.029		0.029	0.05
Sodium (Na)	mg/L	<0.12		0.12	0.5	<0.12		0.12	0.5
Potassium (K)	mg/L	<0.074		0.074	1	<0.074		0.074	1
Silicon (as SiO <sub>2</sub> )	mg/L	<65		65	200	<0.065		0.065	0.2
Total Recoverable Aluminum (Al)	µg/L	<38		38	50	<38		38	50
Total Recoverable Antimony (Sb)	µg/L	<0.20		0.2	2	<0.20		0.2	2
Total Recoverable Arsenic (As)	µg/L	<1.1		1.1	2	<1.1		1.1	2
Total Recoverable Barium (Ba)	µg/L	<0.21		0.21	1	<0.21		0.21	1
Total Recoverable Beryllium (Be)	µg/L	<0.20		0.2	1	<0.20		0.2	1
Total Recoverable Boron (B)	µg/L	<12		12	100	<12		12	100
Total Recoverable Cadmium (Cd)	µg/L	<0.11		0.11	1	<0.11		0.11	1
Total Recoverable Chromium (Cr)	µg/L	<0.64		0.64	3	<0.64		0.64	3
Total Recoverable Copper (Cu)	µg/L	<0.66		0.66	2	<0.66		0.66	2
Total Recoverable Iron (Fe)	µg/L	<30		30	50	<30		30	50
Total Recoverable Lead (Pb)	µg/L	<0.19		0.19	1	0.78	B,J	0.19	1
Total Recoverable Manganese (Mn)	µg/L	<0.11		0.11	1	0.47	B,J	0.11	1
Total Recoverable Mercury (Hg)	µg/L	<0.016		0.016	0.2	0.028	J	0.016	0.2
Total Recoverable Molybdenum (Mo)	µg/L	<0.23		0.23	1	<0.23		0.23	1
Total Recoverable Nickel (Ni)	µg/L	0.56	B,J	0.25	2	0.35	B,J	0.25	2
Total Recoverable Selenium (Se)	µg/L	<0.54		0.54	2	<0.54		0.54	2
Total Recoverable Silver (Ag)	µg/L	<0.088		0.088	1	<0.088		0.088	1

ATTACHMENT B  
Blank Sample Results

		December				January			
		EB-1	Q	MDL	PQL	FB	Q	MDL	PQL
		29-Dec-09				20-Jan-10			
Total Recoverable Thallium (Tl)	µg/L	<0.11		0.11	1	<0.11		0.11	1
Total Recoverable Vanadium (V)	µg/L	<2.6		2.6	3	<2.6		2.6	3
Total Recoverable Zinc (Zn)	µg/L	<3.2		3.2	5	<3.2		3.2	5
Total Recoverable Calcium (Ca)	mg/L	<0.036		0.036	0.1	<0.036		0.036	0.1
Total Recoverable Magnesium (Mg)	mg/L	<0.038		0.038	0.05	<0.038		0.038	0.05
Total Recoverable Sodium (Na)	mg/L	<0.070		0.07	0.5	<0.070		0.07	0.5
Total Recoverable Potassium (K)	mg/L	<0.092		0.092	1	<0.092		0.092	1
Bromoform	µg/L								
Chloroform	µg/L								
Dibromochloromethane	µg/L								
Toluene	µg/L								
SVOCs									
bis(2-ethylhexyl)phthalate	µg/L								
General Chemistry									
Bicarbonate	mg/L	<5.0		5	5	<5.0		5	5
Carbonate	mg/L	<2.5		2.5	2.5	<2.5		2.5	2.5
Total Alkalinity (as CaCO <sub>3</sub> )	mg/L	<4.1		4.1	4.1	<4.1		4.1	4.1
Chloride	mg/L	<b>0.4</b>	J	0.059	0.5	<b>0.25</b>	B,J	0.059	0.5
Fluoride	mg/L	<0.010		0.01	0.05	<0.010		0.01	0.05
Sulfate	mg/L	<b>0.36</b>	J	0.21	1	<b>0.22</b>	B,J	0.21	1
Hardness (as CaCO <sub>3</sub> )	mg/L	<0.10		0.1	0.5	<0.10		0.1	0.5
Total Dissolved Solids (TDS)	mg/L	<6.7		6.7	6.7	<6.7		6.7	6.7
Total Suspended Solids (TSS)	mg/L	<2.0		2	2	<2.0		2	2
Residual Chlorine	mg/L	<0.10	H	0.1	0.1	<0.10	H	0.1	0.1
Ammonia (as N)	mg/L-N	<0.025		0.025	0.05	<b>0.065</b>	B	0.025	0.05
Nitrate (as N)	mg/L-N	<0.026		0.026	0.1	<0.026		0.026	0.1
Nitrite (as N)	mg/L-N	<0.0081		0.0081	0.05	<0.0081		0.0081	0.05
Total Phosphorus	mg/L	<0.016		0.016	0.05	<b>0.018</b>	J	0.016	0.05
Total Sulfide	mg/L	<0.050		0.05	0.1	<0.050		0.05	0.1
pH	s.u.	5.63	H	0.05	0.05	5.36	H	0.05	0.05
Electrical Conductivity (@ 25 °C)	umhos/cm	<b>2.33</b>		1	1	<b>2.27</b>		1	1
Odor	odor units	No Obs Odor		1	1	No Obs Odor		1	1
Turbidity	NTU	<0.10		0.1	0.1	<b>0.18</b>		0.1	0.1
Cyanide	mg/L	<0.0028		0.0028	0.005	<0.0028		0.0028	0.005
Oil and Grease	mg/L								

Notes:

Laboratory Qualifiers (Q):  
 J = estimated value below laboratory reporting limit  
 B = detected in blank sample.  
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**bold** detected in blank sample  
**bold** detect in blank sample - one or more results qualified as J+