Attachment F

Hydrologic Investigation

REPORT

HYDROLOGIC INVESTIGATION

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

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Project No. 063-7109

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EXECUTIVE SUMMARY

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

The objective of this report is to provide an overall characterization of the hydrologic conditions of the Site 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: Monte Bello Creek located approximately 700 feet from the South Quarry perimeter; and Permanente Creek situated between the existing North Quarry and South Quarry. Permanente Creek tends to be dry adjacent to the North Quarry in dry months, while surface water flows occur both upstream of and downstream from the North Quarry throughout the year.
- 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 upstream of the South Quarry and 0.14 cfs downstream of the South Quarry.
- 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 amsl and the South Quarry is excavated. Since the South Quarry will be shallower, sustained groundwater inflow into the South Quarry will be up to an estimated 90 gpm, and will not occur until the base of the South Quarry is at its lowest elevation. Similar to the North Quarry, the groundwater inflow rate will decrease as the South Quarry is reclaimed (backfilled) to a minimum elevation of 1,110 ft amsl.
- The simultaneous development of the South Quarry, and the 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 predicted annual average post-mining water elevation in the South Quarry is below the minimum backfill elevation for the South Quarry; therefore, the development of a pit lake is not anticipated based on the available data. The estimated average annual inflow from all sources (groundwater, surface water, and precipitation) to the South Quarry at equilibrium is 26 gpm.
- 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 expansion will have no significant impact to groundwater levels in supply wells located along Monte Bello Ridge, approximately between ¾ and one mile from the center of the South Quarry. Therefore, operation of these wells, or any other nearby wells, will not be adversely affected by the planned quarry expansion and subsequent reclamation.

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 within the proposed South Quarry, 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.

PROFESSIONAL CERTIFICATION

HYDROLOGIC INVESTIGATION

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MAY 2010

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

Prepared By: Golder Associates Inc.
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:

PROFESSIONAL GEOLOGIST
WILLIAM L. FOWLER
No. 1401
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

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

David Banton
Principal/Practice Leader

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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 development and reclamation of the proposed South Quarry, and concurrent reclamation of the existing North Quarry, located at the Lehigh Permanente Quarry (the Quarry) in Santa Clara County, California.

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 proposed mining and 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 scope of work completed for the project is discussed in detail in Section 1.3. The background for the overall reclamation project is discussed in Section 1.2.

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 currently comprises approximately 570 acres of operational areas, which consist of 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 (Figure 1.3). The amendment would incorporate 1,105 acres of Lehigh's 3,510-acre ownership, and address the reclamation of mining activities over approximately the next 20 years. Under the amendment, areas disturbed by mining would be reclaimed for open space uses.

The project also is the approval of a conditional use permit (CUP) for certain mining operations at the Quarry. The CUP would authorize the continuation of mineral extraction in a portion of the planned extraction area south of Permanente Creek known as the South Quarry. Rock mined at the South Quarry would be transported to existing facilities for processing. The South Quarry is included in the proposed reclamation plan amendment and would be reclaimed according to the requirements therein.

The proposed reclamation plan amendment and CUP would result in the following conditions and changes at the Quarry:

- South Quarry: The project would approve a CUP and amend the reclamation plan to provide for concurrent mining and reclamation at the South Quarry. Operations would occur over a period of approximately 20 years, depending on market demands. The South Quarry will be mined in five phases with reclamation following mining within each phase. Mined limestone and greenstone would be transported to existing Quarry facilities for crushing and processing.

- Topsoil Storage Area: The project would amend the reclamation plan to provide for the reclamation of the Topsoil Storage Area, an area located to the south of the Rock Plant. The Topsoil Storage Area would serve to temporarily store topsoil material removed from the South Quarry until such material is needed for reclamation.
- 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 site for overburden and waste rock extracted from the South Quarry. Reclamation activities would establish final slopes and vegetation in the North Quarry consistent with the surrounding topography.
- Central Materials Storage Area (CMSA): The project would amend the reclamation plan to include all planned storage phases for the CMSA, located directly west of EMSA and east of the North Quarry. The proposed reclamation plan amendment would provide final grading contours and revegetation for this area.
- EMSA: The EMSA is expected to be built out and closed to storage prior to project approval, and reclamation would at that time be in progress.
- WMSA: The project would amend the current reclamation plan for the WMSA to reflect the transition of the adjacent North Quarry reclaimed fill slopes and tie in these slopes to the WMSA's east side. The project also would update the current WMSA revegetation design.
- Rock Plant: The project would amend the reclamation plan to provide a reclamation design for the Rock Plant.

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 resource-related coreholes in the South Quarry for planning of subsurface investigations
- 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 in the South Quarry area
- 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 in the South Quarry 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 near the base of the proposed South Quarry
- 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). Cross sections of the South Quarry derived from the TerraSource model are included as Figure 2.5. 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. A more detailed description of the geology within the South Quarry is presented in Section 4.2.

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, 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. WMSA), in areas of proposed overburden fills (i.e., CMSA, EMSA and Topsoil Storage Area), and in the proposed South Quarry area. 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. Along the south flank of Permanente Creek, on the hillside east of the proposed South Quarry, two large landslides are identified by Sorg and McLaughlin (1975) while Rogers and Armstrong (1973) map only one of the landslide features. The possible presence of these landslides does not affect development of the South Quarry.

2.3 Structural Setting

The San Andreas Fault zone is located approximately two miles southwest of the quarry (Figure 2.6). 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 North and South Quarry areas, 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 2.6). 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 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 1×10^{-5} to 1×10^{-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 the South Quarry boundaries. 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 of the South Quarry as shown on Figure 3.1. The boreholes were drilled by using either direct or duel-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 of the South Quarry area.

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 within the vicinity of the proposed South Quarry, 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
	1st Round February 2009	2nd Round April 2009	3rd Round October 2009	4th Round January 2010	November 2009	January 2010
VOCs	x	x				
Metals[1] (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[2]	x	x	x	x	x[3]	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_2, 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 over the past year in accordance with Golder's standard operating procedures (SOPs). The wells were sampled at different times of the year 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 evaluate 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 with approximately 75% of the drainage of proposed South Quarry is to Permanente Creek and 25% to Monte Bello Creek. Current elevations range from 1,990 feet amsl along the ridge in the southwest corner of the South Quarry 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 located south of the proposed South Quarry and 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 and downstream of the proposed South Quarry.

Permanente Creek is situated between the existing North Quarry and proposed South Quarry and is mainly entrenched in limestone. Monitoring station MS-1 is located at elevation 1,330 feet amsl and upstream of the proposed South Quarry and existing North Quarry (Figure 3.1). Monitoring station MS-2 is located at elevation 650 ft amsl and downstream of the proposed South Quarry and existing North Quarry. MS-2 is also located downstream of the North Quarry dewatering discharge point. Permanente Creek is generally dry 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 West Materials Storage Area, 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 South Quarry 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.

4.1.5 Geologic Structure

As noted in Section 2.2.1 and similar to the North Quarry, the rocks appear to occur as an imbricate thrust stack of layered, folded and faulted limestones, greenstones, and metabasalts. Contacts between these units are typically thrust faults (Figure 2.5). This thrust stack is tectonically overlain by continentally-derived graywacke. Two major structures within the South Quarry area consist of a segment of the Northwest Berrocal Fault Strand that strikes west-northwest, just north of Permanente Creek, through the south wall of the North Quarry and a west-northwest offset of the Northwest Berrocal Fault Strand further to the south, which is located along the southern South Quarry boundary and separates the limestone unit from the footwall greenstone/breccia unit. Other large scale structures across the South Quarry area include a series of steeply-dipping faults striking to the north-northeast (Figure 2.5).

A geological model developed by TerraSource for the Quarry grouped the five general rock types in South Quarry coreholes into the following three groups:

- Hanging Wall Graywacke (includes Greenstone and Conglomerate)
- Footwall Fault Breccia (predominately Greenstone)
- Limestone (all grades)

Lehigh geological logging indicates the breakdown of rock types within the model rock masses listed in Table 4.1.

TABLE 4.1

Distribution of Rock Types within Geologic Model Rock Masses

Lithology	Footwall Fault Breccia (Greenstone)		Hanging Wall Graywacke		Limestone	
	Footage	% of Total	Footage	% of Total	Footage	% of Total
Metabasalt	14	0.5%	11	1%	0	0%
Fault Breccia	1,188	40.5%	572	45%	66	2%
Graywacke	24	1%	472	37%	56	2%
Limestone	318	11%	25	2%	2,927	94%
Greenstone	1,364	47%	183	15%	69	2%

The dominant thrust contact in the TerraSource model is the hanging wall contact of the footwall fault breccia (greenstone). The model indicates an overall dip to the northeast for this contact, with sections that dip about 20˚ in the north and south parts of the South Quarry, separated by a steeper section. From the steeper section toward the north, limestone overlies the footwall fault breccia (greenstone).

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 proposed South Quarry 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 noted on Figure 2.5, limestone occurs in blocks that range in thickness from less than 50 feet along the western portion to approximately 600 feet at the center of the proposed South Quarry. Generally, the limestone unit 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 the greenstone footwall 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 (Figure 2.5). 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 (Table 4.1), fault breccia comprises up to 40% of the greenstone unit. The fault breccia usually is highly sheered 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 and is predominately present along the southern portion of the proposed South Quarry and extends south to and under Monte Bello Creek. Greenstone also underlies the limestone unit located within the proposed South Quarry 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 proposed South Quarry as part of the hanging wall associated with the Northwest Berrocal Fault Strand. Based on the geological coreholes (Table 4.1), 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 3×10^{-3} to 1×10^{-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. 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^2/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^2/d, and an estimated storativity (S) of 2.6×10^{-3} to 9.3×10^{-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^2/d and a range of storativity values from 1×10^{-4} to 1×10^{-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 1×10^{-4} to 1×10^{-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 near the proposed South Quarry. 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 the 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 WY 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 and proposed South Quarry and the 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[1]). 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

[1] A water year is from October 1 through September 30.

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 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^3/d]

A is the surface area of the watershed area contributing to the North Quarry [ft^2]

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^3/d]

Q is the pumping rate of water out of the North Quarry [ft^3/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^2), precipitation of 4.2 inches (0.35 ft), and a total change in water storage of 1,738,000 ft^3 (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 in order to estimate the impacts of proposed mining of the South Quarry on Permanente Creek and Monte Bello Creek (discussed in Section 5). 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^3 (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^3 (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^3 (675 acre-ft), with a range of inflows from about 210 gpm (5^{th}-percentile) to 1,480 gpm (95^{th}-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 modeling was performed to evaluate the following issues concerning the development of the South Quarry and continued mining and subsequent reclamation of the North Quarry:

1. Groundwater inflows into the North Quarry as mining in the North Quarry continues to its ultimate depth (at about 440 ft amsl);

2. Groundwater inflows into the South Quarry from Phases 1 through 5;

3. The effect that development and reclamation of the South Quarry and reclamation of the North Quarry will have on the local surface hydrology, in particular, Permanente and Monte Bello Creeks;

4. The effect of development and reclamation of the South Quarry and reclamation of the North Quarry will have on local groundwater supply wells; and

5. The distribution of pore pressures in the pit slopes of the South Quarry to verify geotechnical assumptions relative to slope stability.

The numerical flow model used the United States Geologic Survey (USGS) code *MODFLOW-2000* (Harbaugh et al, 2000). A cross-section flow model (orientated north-south) through the two quarries was developed using the code *SEEP/W (*Geo-Slope, 2001*)* to evaluate the pore pressure distribution within the pit slopes. The two numerical models were 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 in the planned South Quarry area 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 and the planned South 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 at the planned South Quarry is notably shallower, and is contained solely within model layer 1.

5.3.4 Hydraulic Properties

The initial hydraulic properties assigned to the modeled 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.

In the area of the planned South Quarry, the simulated groundwater flow direction is towards the northeast (that is, discharging to Permanente Creek). The simulated heads near the planned South Quarry 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 area being more compartmentalized and heterogeneous than the model is able to simulate without suffering mathematical instability.

Although the largest head residuals occur in the three wells near the ridgeline, the maximum development of the southern wall of the South Quarry will not extend deep enough to intercept the measured water table in this area. Therefore, although the modeled heads are lower than measured, the model is expected to reasonably predict the groundwater seepage rate into the south wall of the South Quarry during mining, as well as predicting effects of 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
	afy	cfs	afy	cfs	afy	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. 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.

The current base of the North Quarry is at approximately 750 ft amsl (Figure 5.9). Under Phase 1, the base of the North Quarry will be deepened a further 310 feet (to elevation 440 ft amsl) while the South Quarry development starts (Figure 5.10). During subsequent phases, the South Quarry will be expanded as the North Quarry is backfilled. The North Quarry will be backfilled to an elevation of 990 ft amsl. The South Quarry will be at its deepest (elevation 925 ft amsl) in Phase 5, at which time the backfilling of the North Quarry will be essentially completed (Figure 5.14). At the conclusion of Phase 5, the South Quarry will be backfilled to a minimum elevation of 1,110 ft amsl. Table 5.4 presents the lowest pit elevation and approximate affected area for the North and South Quarries 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
	North	South	North	South	
Current Conditions	750	-	346	-	Current Conditions
1	440	1,250	346	31	Parts of layers 1-4 were inactivated at the center of North Quarry
2	840	1,250	346	87	
3	990	1,200	346	139	
4	990	1,150	346	160	
5 - Pre-SQ Backfill	990	925	346	179	
5 - Post-SQ backfill	990	1,110	346	179	

The MODFLOW model simulated the hydrologic effects of these phases by a combination of (a) 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. Only for Phase 1 were the model cells at the center the North Quarry 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 whereas the South Quarry will not have been sufficiently developed to intercept groundwater beyond localized perched water. 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). The South Quarry will be at its full development depth (925 ft amsl) and will intercept some groundwater that would otherwise discharge to Permanente Creek.

Table 5.5 presents the average annual changes in groundwater discharge for the North and South Quarries 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	South Quarry	Permanente Creek – upper(1)	Permanente Creek - middle(2)	Monte Bello Creek – upper(3)	Monte Bello Creek – middle(4)
	gpm	gpm	cfs	cfs	cfs	cfs
Current Conditions	310	0	0.40	0.32	0.09	0.14
1	+61	<10	<0.01	-0.09	-0.01	<0.01
2	+60	<10	<0.01	-0.11	-0.01	<0.01
3	+58	+11	<0.01	+0.46	-0.01	<0.01
4	+62	<10	<0.01	+0.46	-0.01	-0.01
5 - Pre-SQ Backfill	-236	+90	<0.01	+0.18	<0.01	<0.01
5 - Post-SQ Backfill	-230	+10	<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.
- Sustained groundwater inflow will not occur into the South Quarry until Phase 5 (up to 90 gpm), when the base of the South Quarry will be at its lowest elevation. Because of the heterogeneous conditions in the quarry area, short-term (seasonal) groundwater inflow will occur as perched zones with isolated groundwater are mined out.
- The simultaneous development of the South Quarry and the reclamation of the North Quarry will have no measurable impact on groundwater discharge to Monte Bello Creek, and to the upper reach (above station MS-1) of Permanente Creek.
- The simultaneous development of the South Quarry and the reclamation of the North Quarry 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. During Phase 2, this decrease in groundwater flow to this reach will be 0.11 cfs.

- 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.
- The predicted annual average post-mining water elevation in the South Quarry is approximately 1,105 ft amsl. This is approximately 5 feet below the backfill elevation and the low-point surface water overflow elevation of approximately 1,110 ft amsl. Therefore, there will be no direct surface water runoff from the post-mining South Quarry to Permanente Creek. However, there will be groundwater discharge from the South Quarry to Permanente Creek. The average annual groundwater discharge from the flooded South Quarry is estimated to be approximately 10 gpm. The post-mining water balance is discussed in Section 5.4.
- 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.
- The modeling results also predict that the planned Quarry expansion will have no significant impact on groundwater levels in the supply wells located along Monte Bello Ridge, located approximately between ¾ and one mile from the center of the South Quarry. Therefore, operation of these wells will not be adversely affected by the planned expansion and reclamation.

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 the two quarries under post-mining (reclaimed) conditions. The main assumptions for this are described below.

The total amount of backfill placed in and water flowing into each quarry was calculated on monthly increments. For the North Quarry, it was assumed that 4 years was required to backfill the quarry to an elevation of 990 ft amsl. For the South Quarry, it was assumed that one year was required to backfill the quarry to an elevation of 1,110 ft amsl. During filling, the water table elevation within each 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 each 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 each 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.

- North Quarry – 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.
- South Quarry - most of the surface runoff within the footprint of the South Quarry will be diverted away from the South Quarry. Therefore, surface runoff will occur from only the very interior 26.4 acres of the South Quarry.

- **Groundwater Inflow -** Groundwater entering each quarry was based on the results of the *MODFLOW* model. The groundwater inflow to the North Quarry ranged from 371 gpm (end of Phase 1) to 80 gpm (Phase 5, post-backfill). Groundwater inflow to the South Quarry ranged from 90 gpm (end of Phase 5, pre-backfill) to less than 10 gpm (Phase 5, post-backfill). The water balance assumed that groundwater inflow declined over time as the quarries backfill filled with water. The groundwater inflow to the North Quarry decreased from 371 gpm at the start of reclamation to 80 gpm when the height of the water table reached elevation of 990 ft amsl. For the South Quarry, the groundwater inflow decreased from 90 to 10 gpm over the filling period.
- **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 and 5.7 summarize the results of the estimated post-mining monthly water balance when the water levels have reached equilibrium for the North and South Quarry, respectively.

The estimated time to flood the North Quarry backfill is approximately 14 years; for the South Quarry, the estimated time is approximately 6 years. For the South Quarry, the estimated total average annual inflow at equilibrium is 26 gpm. For the North Quarry, 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 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 present at the proposed South Quarry, geochemical characterization of 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, to characterize current groundwater and surface water quality within the vicinity of the proposed South Quarry, surface water and groundwater sampling was conducted. 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 within the footprint of the proposed South Quarry: 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 14th, 19th, and 20th, respectively. On January 19th and 20th, 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 downgradient of the WMSA. This water ultimately discharges into the North Quarry. This sample is assumed to be representative of WMSA runoff.

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 polluted 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 within the vicinity of the proposed South Quarry 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 drilled within and adjacent to the proposed South Quarry; review of select core samples from 13 of the 48 borings; and, outcrop reconnaissance within the vicinity of the South Quarry. Geocon identified the following major rock types within the South Quarry exploration area (Geocon Consultants, Inc., 2009a):

- **Graywacke**: Generally medium to dark grey quartzose graywacke comprising grains of quartz, chert, feldspar, and feldsapthic 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^2. 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 μm 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_3 or Mg-Ca-HCO_3 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 is still being flushed from the well. The latter would explain the elevated pH and decline in TDS and chloride.

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 (≤ 1 µg/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 µg/L) to nine micrograms per liter (9 µg/L) (Figure 6.13). Dissolved molybdenum, nickel and zinc groundwater concentrations ranged from less than a microgram per liter (< 1 µg/L) to tens of micrograms per liter (10s µg/L) (Figures 6.14 and 6.15). Maximum dissolved molybdenum (45 µg/L) and nickel (24 µg/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 µg/L). HG-4 selenium concentrations ranged from less than a microgram per liter to 4 µg/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_3). 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 (≤ 2 µg/L): Be, Cd, chromium (Cr), Pb, Hg, Ag and Tl. Dissolved arsenic (As) and antimony (Sb) concentrations were also below detectable limits or low (≤ 1 µg/L) at SW-1 and SW-3. These constituents were detected at part per billion levels (up to 6 µg/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 µg/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 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 mg/L-N) and phosphorus (<0.6 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. 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 $CaCO_3$/t for the rock samples. The metabasalt sample reported a higher NP than the limestone sample (644 kg $CaCO_3$/t). The overburden soil sample yielded the lowest NP value of 23 kg $CaCO_3$/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 $CaCO_3$/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 from the South Quarry 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. For comparison, this table includes average crustal abundance concentrations and regulatory limits for hazardous waste classification. 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 necessary 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 (µg/L) to almost 10 µg/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 µg/L). Mercury was only detected in the limestone and overburden soil sample leachates (0.21 µg/L and 0.19 µg/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 µg/L) and selenium (up to 49 µg/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 µg/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 µg/L) and molybdenum (0.4 to 98 µg/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 µg/L to 33 µg/L. Dissolved arsenic concentrations in the limestone leachates were relatively consistent at approximately

20 µg/L. Dissolved aluminum (0.06 to 1.8 mg/), iron (0.01 to 1.4 mg/L) and manganese (1.2 to 19 µg/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^2/d)	Transmissivity (ft^2/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^2/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
Average	**0.89**	**2.92**	**4.25**	**3.37**	**5.59**	**2.90**	**1.68**	**0.46**	**0.08**	**0.00**	**0.01**	**0.06**	**22.20**

TABLE 4.6
Water Year 2009 Annual Water Balance Summary

		Permanente Creek		Monte Bello Creek	
	Units	MS-1	MS-2	MS-3	MS-4
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
10/1/2038	42	1	80	**123**
11/1/2038	137	3	80	**220**
12/1/2038	200	4	80	**284**
1/1/2039	158	3	80	**241**
2/1/2039	263	5	80	**348**
3/1/2039	136	3	80	**219**
4/1/2039	79	2	80	**160**
5/1/2039	22	0	80	**102**
6/1/2039	4	0	80	**84**
7/1/2039	0	0	80	**80**
8/1/2039	1	0	80	**81**
9/1/2039	3	0	80	**83**

Annual Average Total Steady-State Inflow to North Quarry: 169 gpm

TABLE 5.7 (pg 1 of 2)
Summary of Inflows in South Quarry

Month	Precipitation (gpm)	Surface Runoff (gpm)	Groundwater Inflow (gpm)	Total Pit Inflow (gpm)
1/1/2035	3	5	90	98
2/1/2035	7	8	79	94
3/1/2035	5	4	72	81
4/1/2035	3	2	67	73
5/1/2035	1	1	63	64
6/1/2035	0	0	58	58
7/1/2035	0	0	56	56
8/1/2035	0	0	53	53
9/1/2035	0	0	51	51
10/1/2035	3	1	49	53
11/1/2035	11	3	49	64
12/1/2035	17	5	47	69
1/1/2036	14	4	44	62
2/1/2036	24	6	42	73
3/1/2036	13	3	40	56
4/1/2036	8	2	37	47
5/1/2036	2	1	37	40
6/1/2036	0	0	35	36
7/1/2036	0	0	35	35
8/1/2036	0	0	35	35
9/1/2036	0	0	33	33
10/1/2036	5	1	33	39
11/1/2036	17	3	33	52
12/1/2036	25	4	31	60
1/1/2037	20	3	31	54
2/1/2037	34	5	28	68
3/1/2037	18	3	28	49
4/1/2037	11	2	26	38
5/1/2037	3	0	26	29
6/1/2037	1	0	24	24
7/1/2037	0	0	24	24
8/1/2037	0	0	24	24
9/1/2037	0	0	24	24
10/1/2037	6	1	24	30
11/1/2037	19	3	21	43
12/1/2037	28	4	21	53
1/1/2038	22	3	21	47
2/1/2038	38	5	19	62
3/1/2038	20	3	19	41
4/1/2038	12	1	17	30
5/1/2038	3	0	17	20
6/1/2038	1	0	17	17
7/1/2038	0	0	17	17
8/1/2038	0	0	17	17
9/1/2038	0	0	17	17
10/1/2038	6	1	15	22
11/1/2038	21	3	15	38
12/1/2038	30	4	15	49
1/1/2039	24	3	15	42
2/1/2039	41	5	12	58
3/1/2039	21	2	12	36
4/1/2039	12	1	12	26
5/1/2039	4	0	10	14
6/1/2039	1	0	10	11
7/1/2039	0	0	10	10
8/1/2039	0	0	10	10
9/1/2039	0	0	10	11
10/1/2039	7	1	10	17
11/1/2039	22	2	10	34
12/1/2039	32	3	10	46
1/1/2040	25	3	10	38
2/1/2040	42	5	10	57
3/1/2040	22	2	10	34
4/1/2040	13	1	10	24
5/1/2040	4	0	10	14
6/1/2040	1	0	10	11

TABLE 5.7 (pg 2 of 2)
Summary of Inflows in South Quarry

Month	Precipitation (gpm)	Surface Runoff (gpm)	Groundwater Inflow (gpm)	Total Pit Inflow (gpm)
7/1/2040	0	0	10	10
8/1/2040	0	0	10	10
9/1/2040	0	0	10	11
10/1/2040	7	1	10	17
11/1/2040	22	2	10	34
12/1/2040	32	3	10	46
1/1/2041	25	3	10	38
2/1/2041	42	5	10	57
3/1/2041	22	2	10	34
4/1/2041	13	1	10	24
5/1/2041	4	0	10	14
6/1/2041	1	0	10	11
7/1/2041	0	0	10	10
8/1/2041	0	0	10	10
9/1/2041	0	0	10	11
10/1/2041	**7**	**1**	**10**	**17**
11/1/2041	**22**	**2**	**10**	**34**
12/1/2041	**32**	**3**	**10**	**46**
1/1/2042	**25**	**3**	**10**	**38**
2/1/2042	**42**	**5**	**10**	**57**
3/1/2042	**22**	**2**	**10**	**34**
4/1/2042	**13**	**1**	**10**	**24**
5/1/2042	**4**	**0**	**10**	**14**
6/1/2042	**1**	**0**	**10**	**11**
7/1/2042	**0**	**0**	**10**	**10**
8/1/2042	**0**	**0**	**10**	**10**
9/1/2042	**0**	**0**	**10**	**11**

Annual Average Total Steady-State Inflow to South Quarry: 26 gpm

TABLE 6.1
Groundwater Wells Completion Details and Sulfide Occurrence

Well	Ground Elevation (ft amsl)	Screen Interval (ft bgs)	Screen Interval (ft amsl)	Screen Interval Geologic Unit	Groundwater Elevation (ft amsl)	Sulfide Occurrence
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

Station Name	Description
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

Analysis	Method	Analytes
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_4 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

Sample ID	Lithology	Approximate Exposure Time - Age of Face	Location	Water Applied (L)	Water Collected (L)	Sample Area (m^2)
GW-01	**GRAYWACKE -** light brown, highly weathered, fine-grained, no sulfides visible	> 5 years	access road by office	3.5	1.7	0.69
CT-01	**CHERT** - 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	**GREENSTONE** - dark greenish gray, very soft, slickenslides evident, gouge zone, no sulfides visible	< 1 month fresh face	southwest corner of bench 900	5.0	1.5	0.80
MG-01	**LIMESTONE** - 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	**LIMESTONE** - 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	**LIMESTONE** - 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 [a]							
				TDS	SO_4	NO_3	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	$Na-SO_4-HCO_3$	8.0 - 8.6	1,220	605	<0.1	6	85	38	9	1.4
HG-6	4	$Mg-Ca-HCO_3$	7.9 - 8.0	470	13	<0.1	1	45	3	1	<0.4
HG-7	3	$Mg-Ca-HCO_3$	7.3 - 7.4	537	30	<0.1	3	323	1	3	<0.4
HG-9	4	$Ca-Mg-HCO_3$	7.4 - 8.0	470	36	0.9	1	7	3	2	0.6
HG-10S	2	$Ca-Mg-HCO_3$	7.5 - 8.5	370	30	<0.1	<0.5	43	11	6	1.6
Surface Water											
SW-1	4	$Ca-Mg-SO_4$	7.1 - 8.1	1,110	578	3.6	0.7	0.9	4	3	7
SW-2	4	$Ca-Mg-SO_4-HCO_3$	7.5 - 8.3	903	468	1.2	2.6	3	441	63	62
SW-3	4	$Ca-Mg-HCO_3$	8.2 - 8.4	353	23	<0.1	<0.7	0.6	10	1	0.4

[a] 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 (mg/L)	pH (s.u.)	SO_4 (mg/L)	NO_3 (mg/L-N)	Se (D) (µg/L)	Ni (D) (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 $CaCO_3$/t	23	62	644	94	112	205	867
Acid Potential (AP)	kg $CaCO_3$/t	<0.3	3.8	3.1	2.2	29	<0.3	<0.3
NNP (NP - AP)	kg $CaCO_3$/t	23	58	641	92	83	205	867
NPR (NP/AP)	-	>77	17	206	43	4	>656	>2,774

Golder Associates

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; **scattered pyrite**; 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; **some pyrite**.		
		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, **trace pyrite**.		
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; **some pyrite**.		
		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, greywacke and greenstone with greenstone dominate from 73.4-75.1 feet; some very scattered milky calcite veins; some poorly- to well-developed slickensides; **trace amounts of pyrite**.		
		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; **some pyrite**; 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; **scattered pyrite**; 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; **no visible pyrite**; 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; **no visible pyrite**; 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 LIMESTONE (457.0 - 494.2 feet) - very scattered pyrite
GEO 4-18A-08	None
GEO 4-20A-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 4-22A-08	GREENSTONE (142.9 - 198.2 feet) - scattered pyrite
GEO 4-23A-08	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 FAULT BRECCIA (479.3-496.0) - scattered pyrite
GEO 4-23B-08	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.

GEO 4-26A-08	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 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

GEO 4-38B-08	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 4-40A-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 FAULT BRECCIA: 621.8-654.3 feet - scattered pyrite METABASALT: 654.4-700.0 feet - scattered pyrite
GT 4-33B-08	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 FAULT BRECCIA: 435.3-469.3 feet - scattered pyrite GREENSTONE: 476.0-698.0 feet - scattered pyrite
HG 2	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 LIMESTONE: 395.4-625.0 feet - very scattered grains of pyrite, pyrite content <0.1%
RH 1-1-08	None
RH 1-2-08	None

TABLE 6.11
Overburden and Ore - TTLC and STLC Results

					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	
Parameter		Unit	Detection Limit	PQL	Result	Q[b]	Result	Q[b]	Result	Q[b]	Result	Q[b]	Result	Q[b]	Result	Q[b]	Result	Q[b]
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 (@ $25\,^{\circ}C$)		umhos/cm	1	1	140		160		130		190		160		160		130	
Total Alkalinity		mg/L as $CaCO_3$	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 [c]	0.001/0.1 [c]	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_4	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 [a]	5 [a]	3.7	J	<1.7		6.5		5.3		4.2	J	<17		<1.7	
Arsenic	As	mg/kg	0.71 [a]	1 [a]	<0.71		5.1		8.4		5.7		2.4		<7.1		4.8	
Barium	Ba	mg/kg	0.13 [a]	0.5 [a]	77		60		800		560		180		46		110	
Beryllium	Be	mg/kg	0.026 [a]	0.5 [a]	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 [a]	0.5 [a]	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 [a]	0.5 [a]	120		95		29		6.6		260		400		110	
Cobalt	Co	mg/kg	0.18 [a]	2.5 [a]	29		20		21		8.4		34		93		26	
Copper	Cu	mg/kg	0.13 [a]	1 [a]	63		50		56		27		56		45		62	
Lead	Pb	mg/kg	0.59 [a]	2.5 [a]	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 [a]	2.5 [a]	<0.18		0.22	J	2.3	J	0.74	J	<0.18		<1.8		1	J
Nickel	Ni	mg/kg	0.12 [a]	0.5 [a]	73	B	120		120		220		250		1200		100	
Selenium	Se	mg/kg	0.76 [a]	1 [a]	3.3		10		8.5		2.4		15		15		13	
Silver	Ag	mg/kg	0.086 [a]	0.5 [a]	<0.086		<0.086		0.63		<0.086		0.13	J	<0.86		0.16	J
Thallium	Tl	mg/kg	0.94 [a]	5 [a]	<0.94		<0.94		<0.94		<0.94		0.97	J	<9.4		<0.94	
Vanadium	V	mg/kg	0.062 [a]	0.5 [a]	120		64		15		5.9		75		53		70	
Zinc	Zn	mg/kg	0.25 [a]	2.5 [a]	51	B	250	B	67	B	150	B	75	B	64	B	71	B

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

TABLE 6.12
Wall Washing Results

	Age	Limestone - High Grade	Q	Graywacke	Q	Limestone - med to high	Q	Chert	Q	Limestone - high and med/low	Q	Greenstone	Q		Q
		HG-01		GW-01		MG-01		CT-01		HMG-01		GS-01		FB-01	
		11/24/2009		11/24/2009		11/24/2009		11/24/2009		11/24/2009		11/24/2009		11/24/2009	
		> 5 years		> 5 years		2 months		< 1 month		1 year		< 1 month			
Field Parameters															
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			
Lab Parameters															
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_2	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			
		HG-01		GW-01		MG-01		CT-01		HMG-01		GS-01		FB-01	
		11/24/2009		11/24/2009		11/24/2009		11/24/2009		11/24/2009		11/24/2009		11/24/2009	
	Age	> 5 years	Q	> 5 years	Q	2 months	Q	< 1 month	Q	1 year	Q	< 1 month	Q		Q
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 $CaCO_3$)	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 $CaCO_3$)	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+ - qualitifed as biased high due to detection in field blank.

FIGURES

G:\GIS\Sites\Lehigh_Permanente_Quarry\mxd\SiteLocationMap.mxd

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

Golder Associates

PROJECT No.		063-7109	FILE No.
DESIGN	DLM	1/28/2010	SCALE: AS SHOWN REV. 0
GIS	DLM	1/28/2010	
CHECK	GW	1/28/2010	**FIGURE 1.1**
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)

0 600 1,200 2,400
Feet

N

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

TITLE
PROJECT OVERVIEW

Golder Associates

PROJECT No.		063-7109	FILE No.
DESIGN	DLM	2/1/2012	SCALE: AS SHOWN REV. 0
GIS	DLM	2/1/2012	
CHECK	GW	2/1/2012	**FIGURE 1.2**
REVIEW	WLF	2/1/2012	

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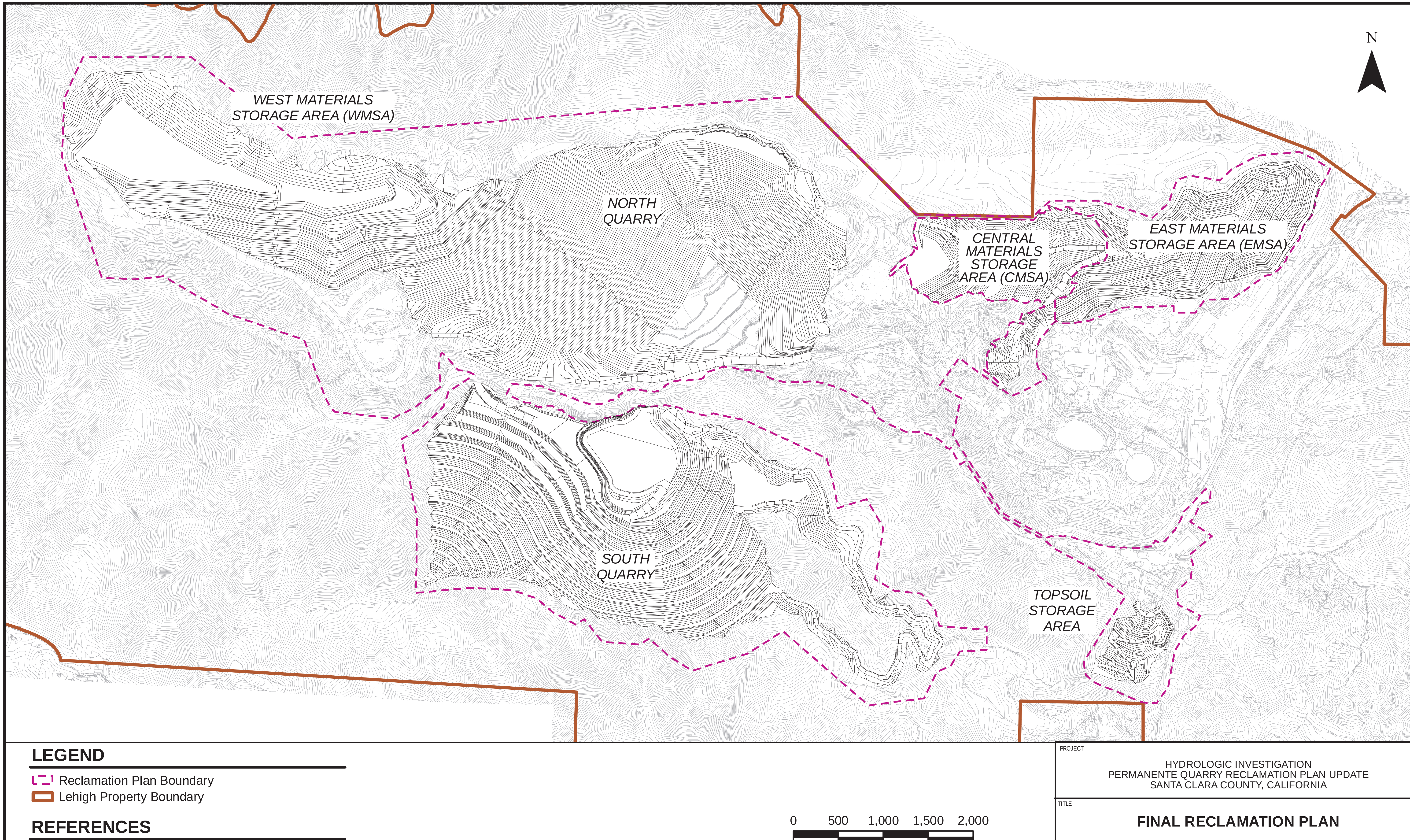

LEGEND

- Reclamation Plan Boundary
- Lehigh Property Boundary

REFERENCES

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

G:\GIS\Sites\Lehigh_Permanente_Quarry\mxd\RP_WC_ultimate

PROJECT

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

TITLE

FINAL RECLAMATION PLAN

Golder Associates

PROJECT No.		063-7109	FILE No.
DESIGN	DLM	2/8/2010	SCALE: AS SHOWN REV. 0
GIS	DLM	2/8/2010	
CHECK	GW	2/8/2010	**FIGURE 1.3**
REVIEW	WLF	2/8/2010	

LEGEND

Facility boundary

REFERENCES

ESRI:World_Shaded_Relief
(http://services.arcgisonline.com/arcgis/services)
Spatial Reference:
NAD 1983 StatePlane California III FIPS 0403 Feet

0 5 10
Miles

PROJECT

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

TITLE

REGIONAL TOPOGRAPHIC SETTING

Golder Associates

PROJECT No.		063-7109	FILE No.
DESIGN	DLM	2/8/2010	SCALE: AS SHOWN REV. 0
GIS	DLM	2/8/2010	
CHECK	GW	2/8/2010	**FIGURE 2.1**
REVIEW	WLF	2/8/2010	

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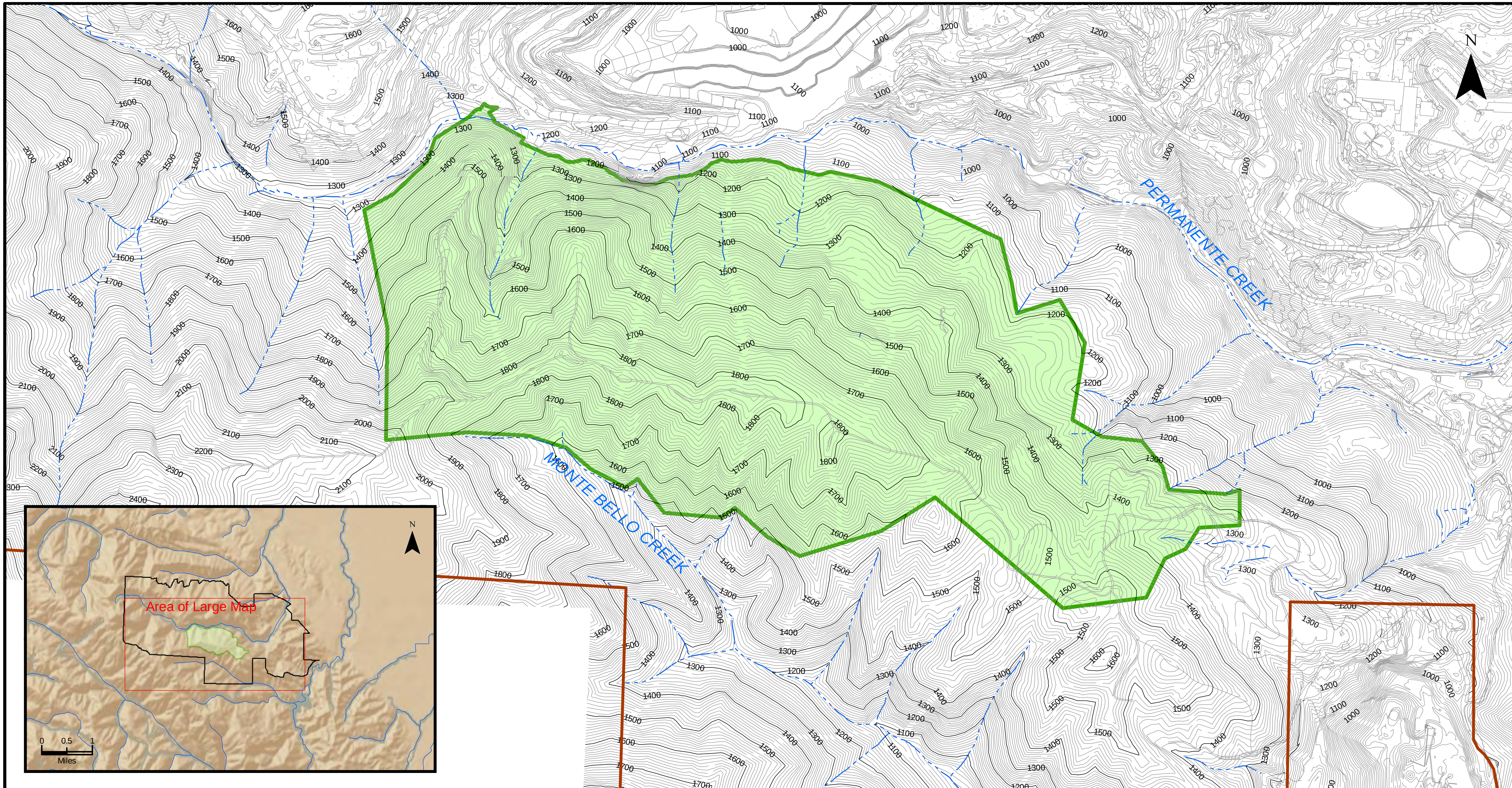


G:\GIS\Sites\Lehigh_Permanente_Quarry\mxd\H_well_map

LEGEND

- Facility boundary
- South Quarry

REFERENCES

Spatial Reference:
NAD 1983 StatePlane California III FIPS 0403 Feet

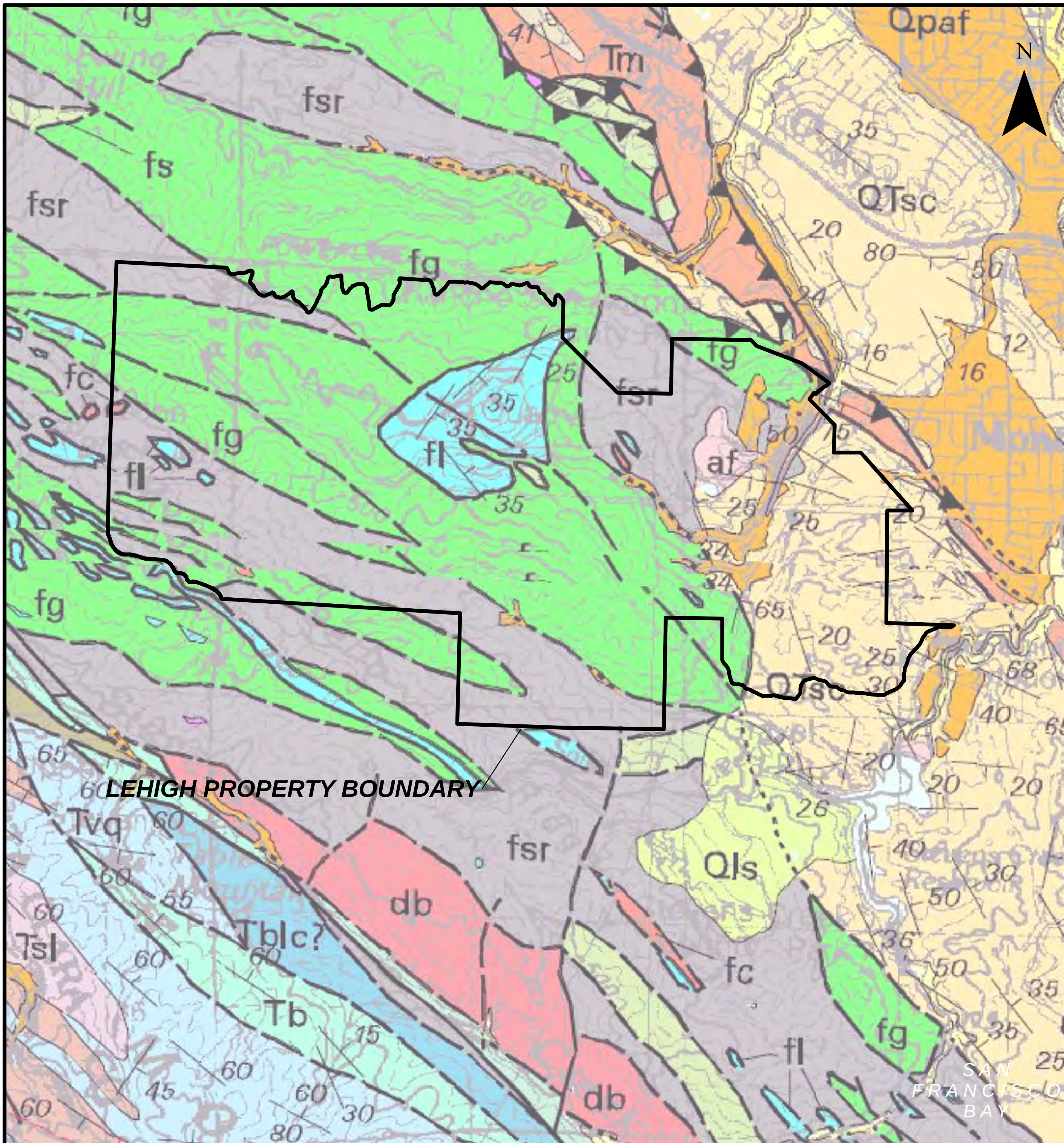
0 500 1,000 1,500
Feet

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

TITLE
LOCAL TOPOGRAPHIC SETTING

Golder Associates

PROJECT No.		063-7109	FILE No.
DESIGN	DLM	2/8/2010	SCALE: AS SHOWN REV. 0
GIS	DLM	2/8/2010	**FIGURE 2.2**
CHECK	GW	2/8/2010	
REVIEW	WLF	2/8/2010	



0 0.5 1
Miles

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.		063-7109	FILE No.
DESIGN	DLM	1/28/2010	SCALE: AS SHOWN REV. 0
GIS	DLM	1/28/2010	
CHECK	GW	1/28/2010	FIGURE 2.3
REVIEW	WLF	1/28/2010	

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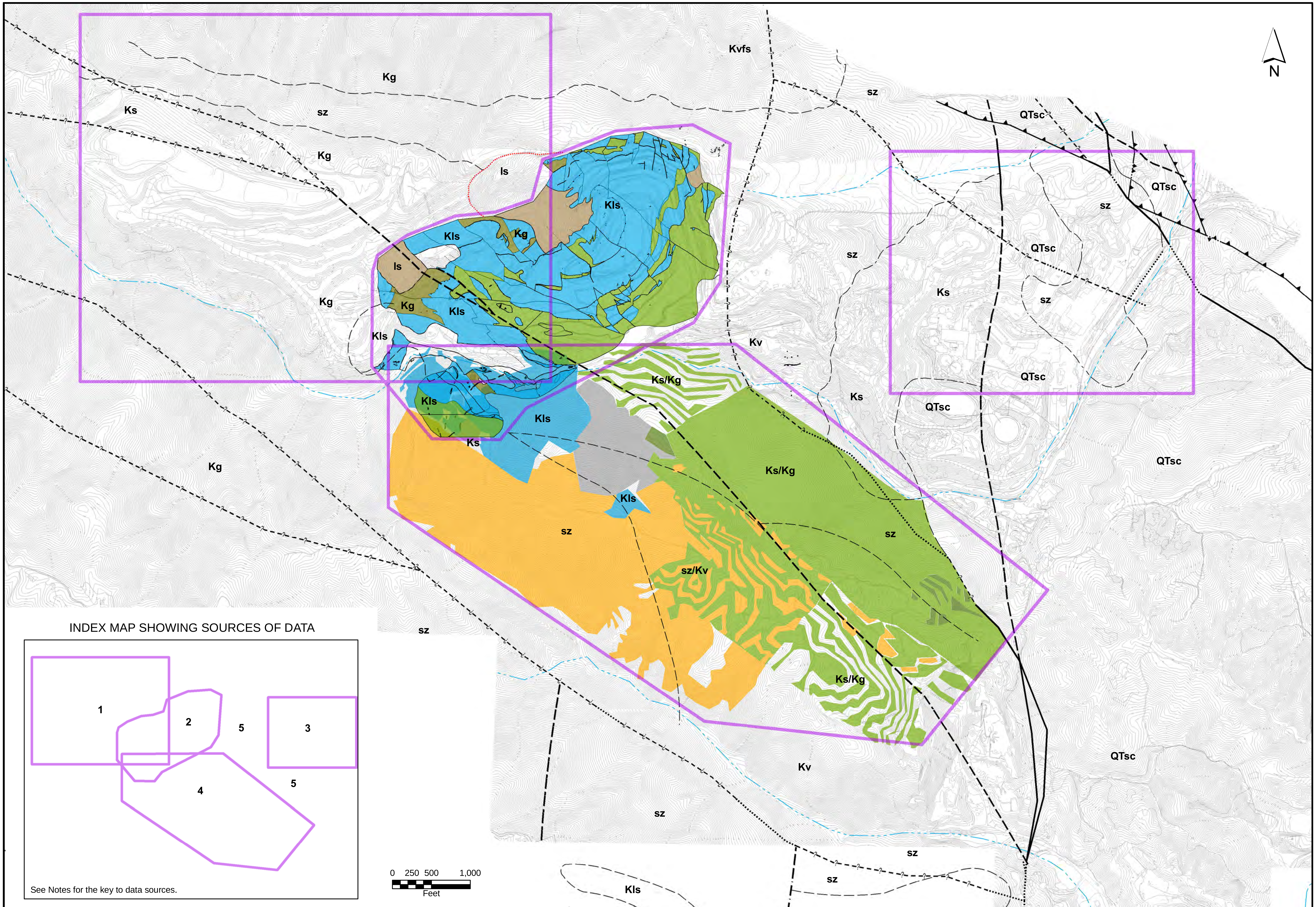

LEGEND

- 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 (ls)
- 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 Agrregate 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

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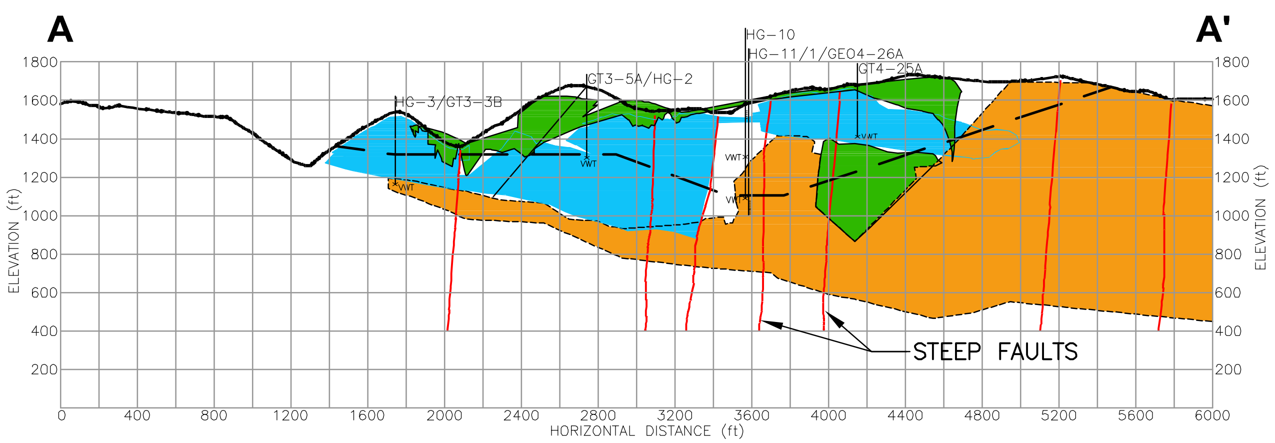
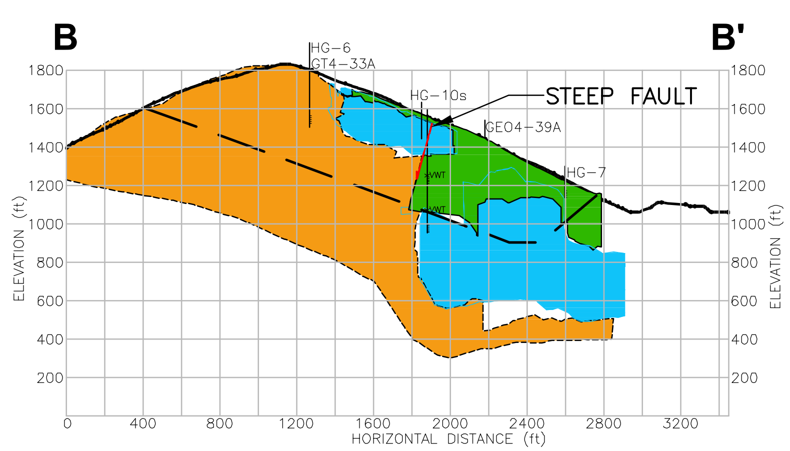


SECTION A-A'

0 500 1000 1500 2000
Feet



SECTION B-B'

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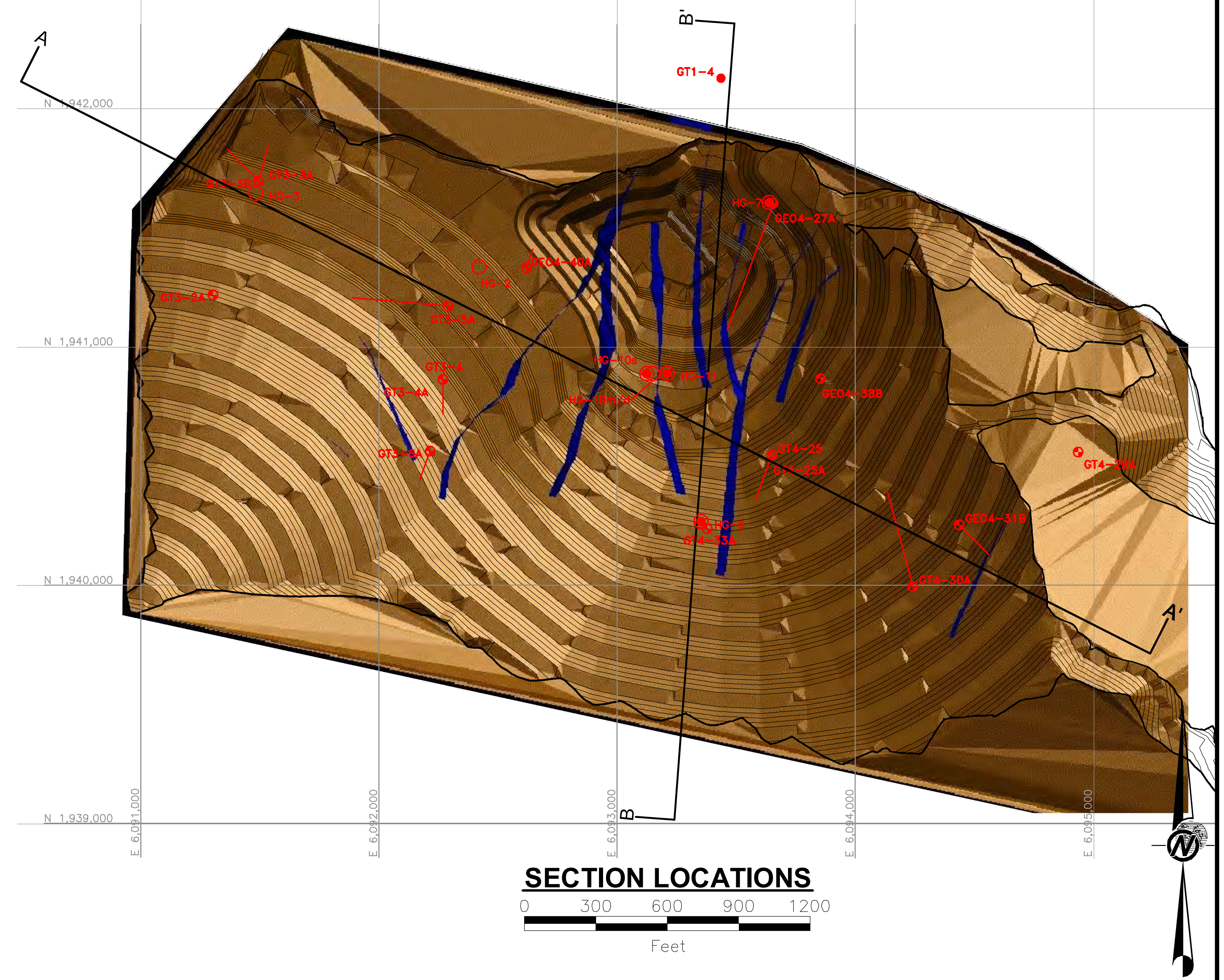
Feet



SECTION LOCATIONS

0 300 600 900 1200
Feet

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

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

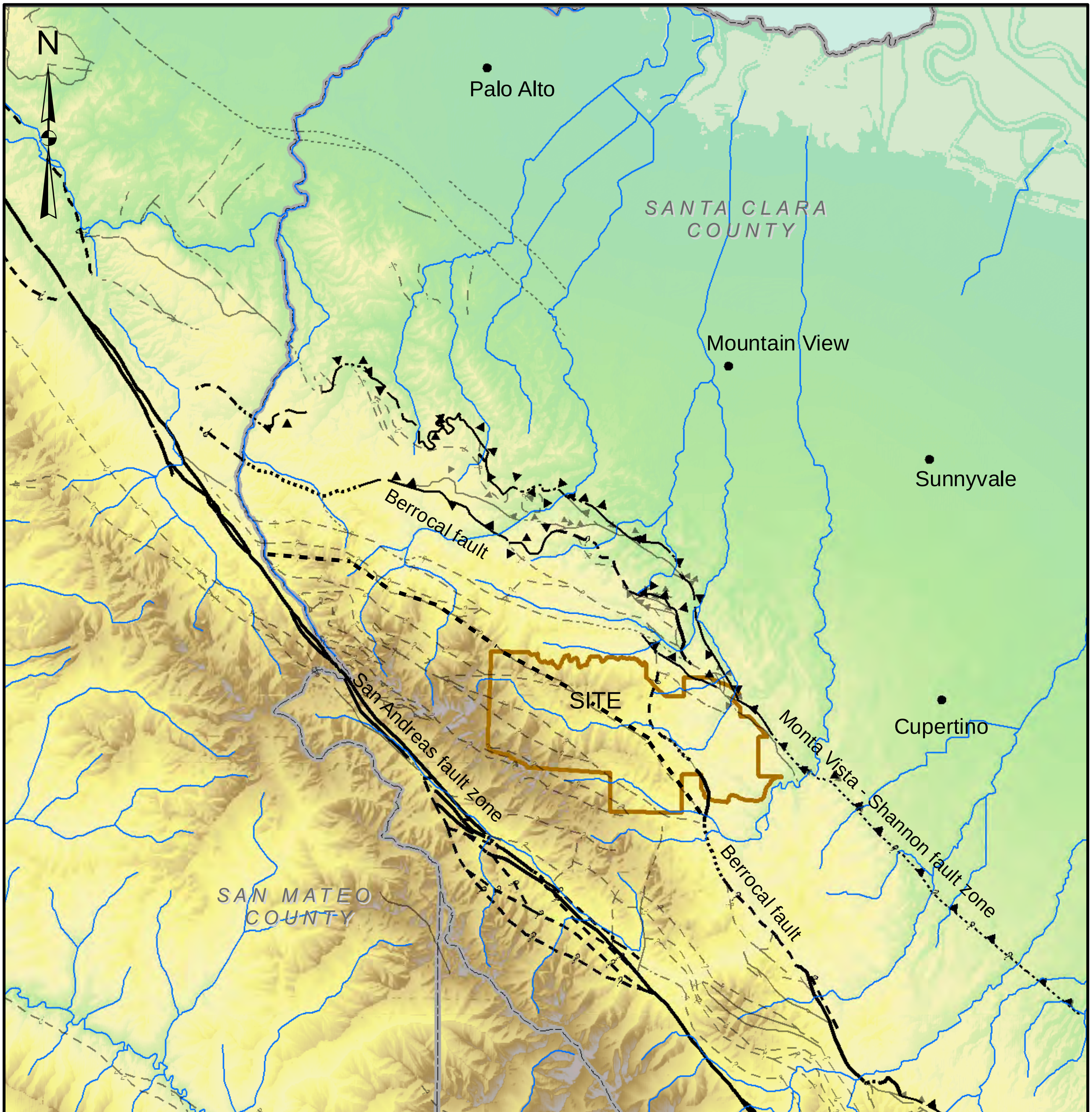
TITLE

GEOLOGICAL CROSS SECTIONS A-A' AND B-B'

Golder Associates

PROJECT No.	063-7109		FILE No.	Figure 2.4
DESIGN	DLM	2/8/2010	SCALE AS SHOWN	REV. 0
CADD	AJS	2/8/2010		
CHECK	GW	2/8/2010	**FIGURE 2.5**	
REVIEW	WLF	2/8/2010		

Thursday, February 18, 2010 – 10:00am FILE: C:\Documents and Settings\ASchaper\Desktop\Figure 2.4.dwg TAB NAME \Figure 4.1



0 1 2 Miles

Legend

- Stream

Fault (surface expression):

- Certain
- Concealed
- Inferred
- Thrust (teeth in dip direction)

Dashed where approx., querried 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

Golder Associates
Sunnyvale, CA

PROJECT No.		063-7109
DESIGN	DLM	3/13/2009
GIS	DLM	3/13/2009
CHECK	WLF	3/25/2009
REVIEW	WLF	3/25/2009

FILE No.

SCALE: AS SHOWN REV. 0

FIGURE 2.6

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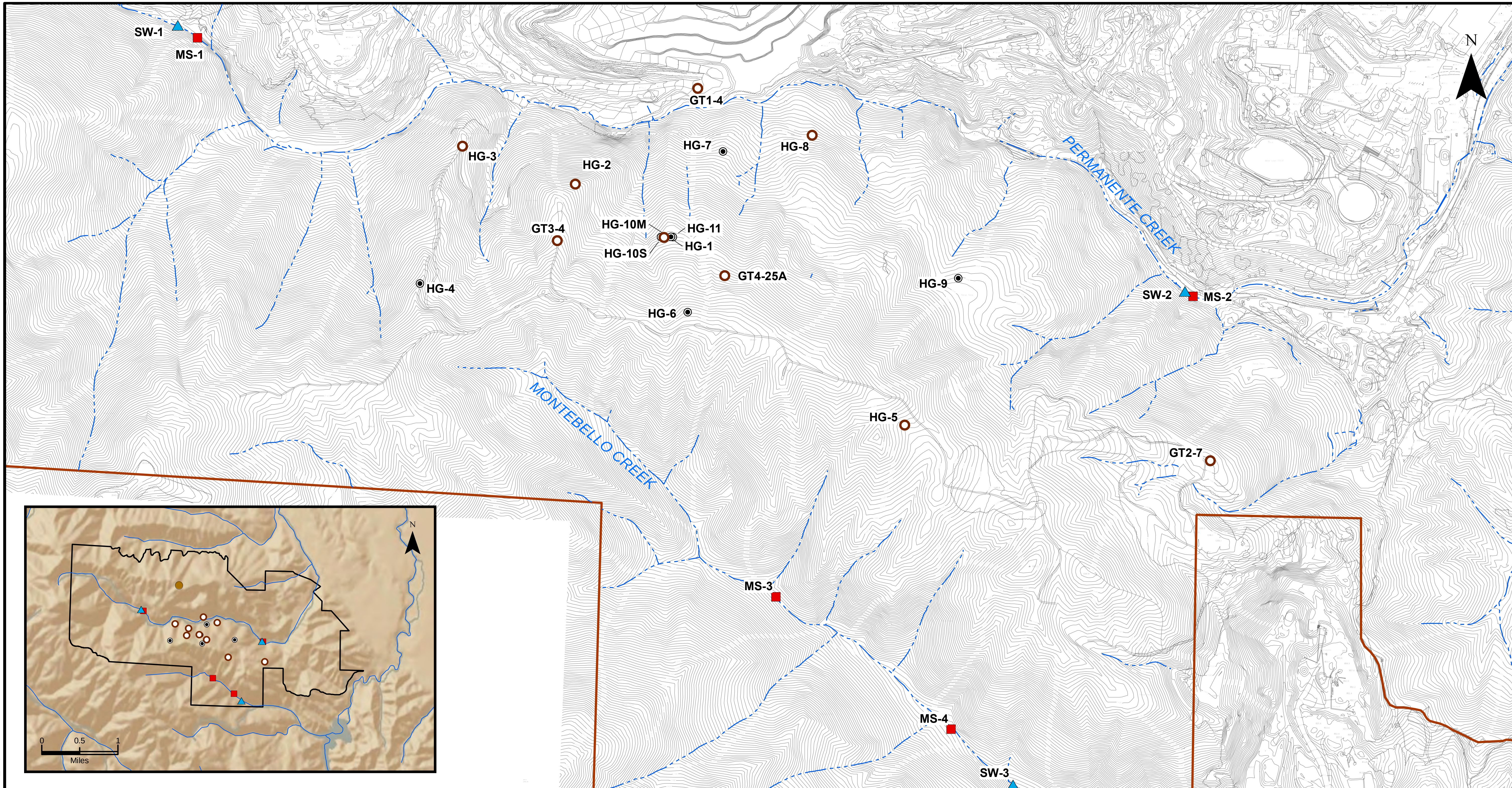


G:\GIS\Sites\Lehigh_Permanente_Quarry\mxd\H_well_map

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

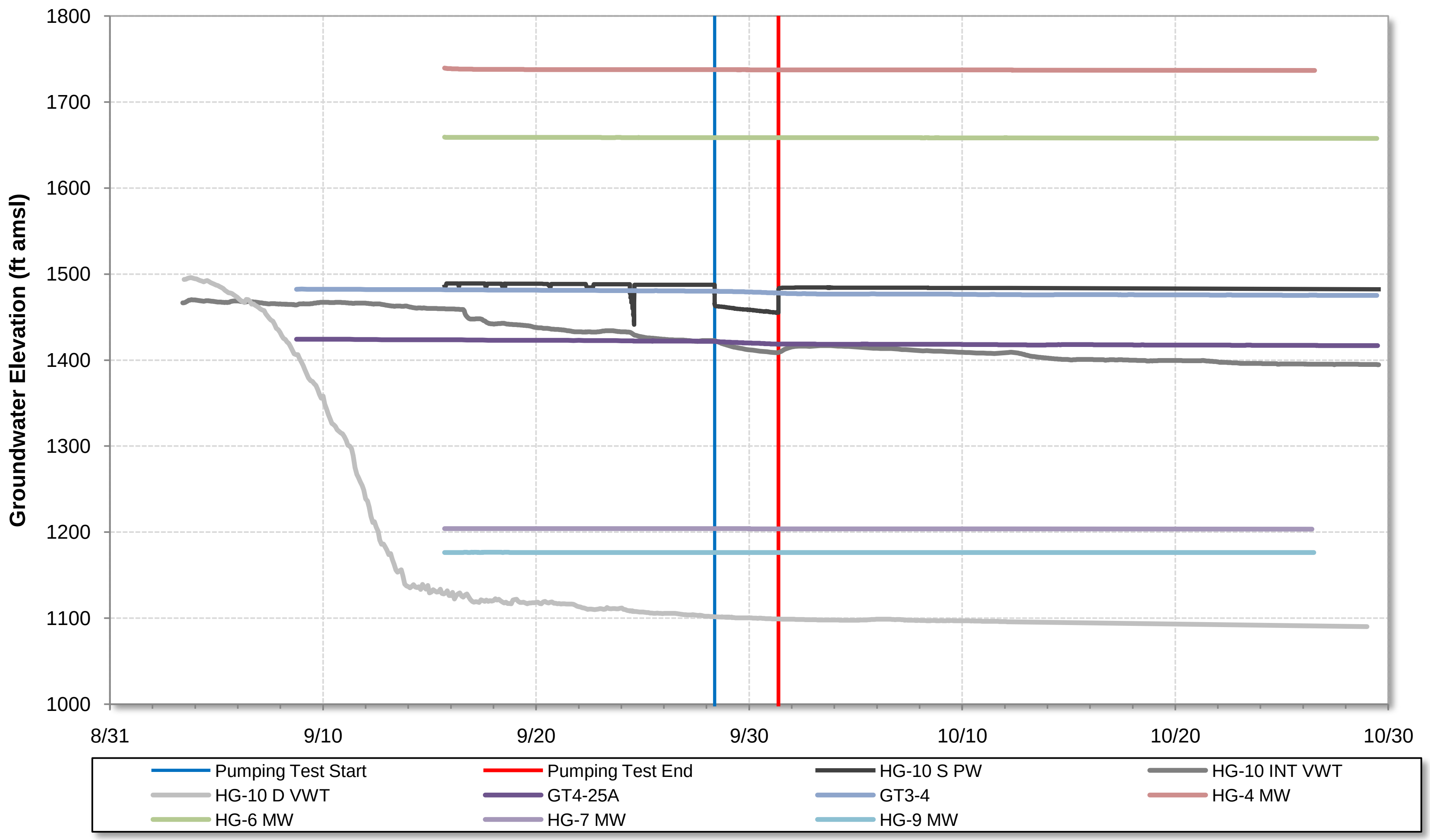
0 500 1,000 1,500
Feet

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

TITLE
MONITORING LOCATIONS

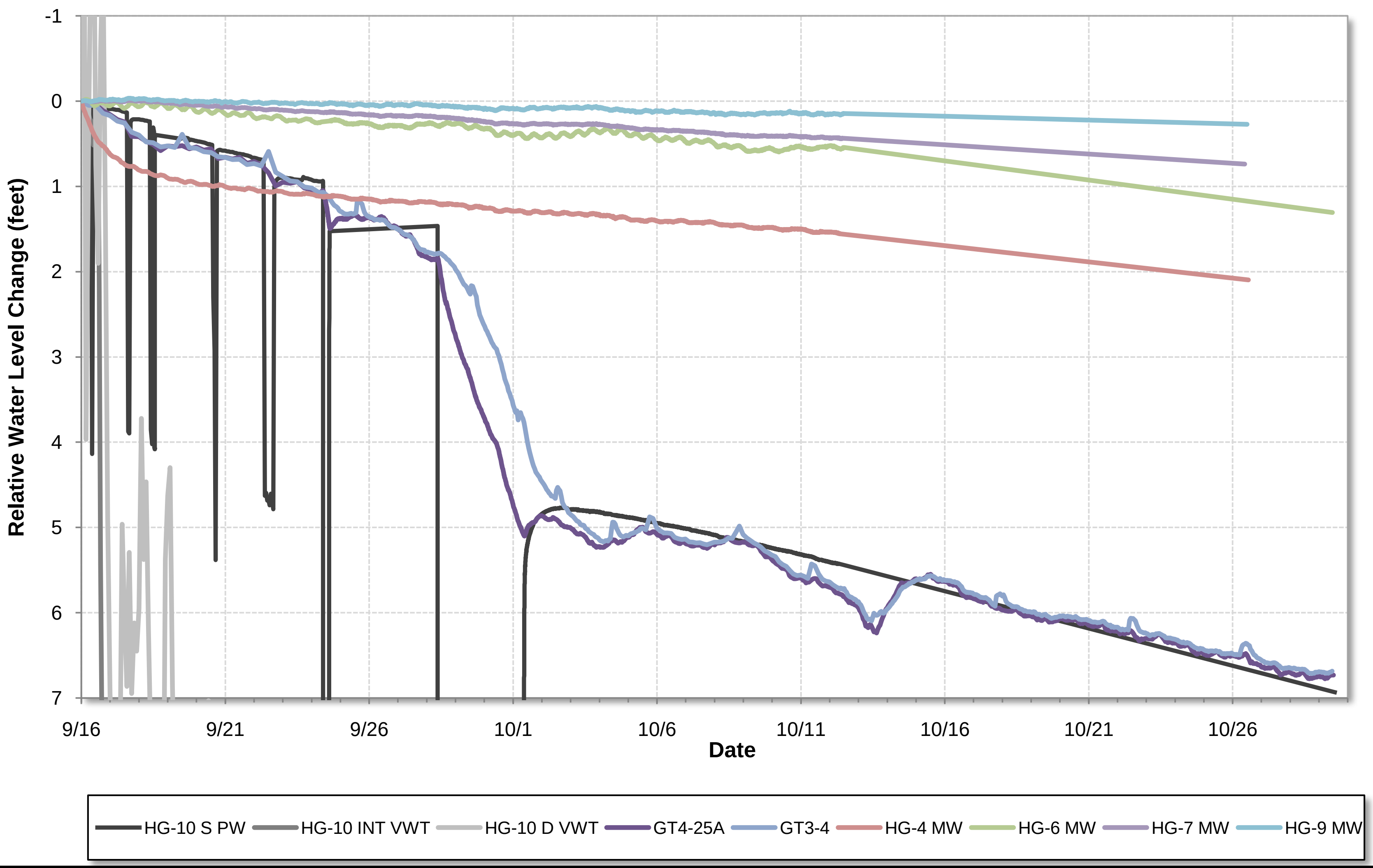
Golder Associates

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

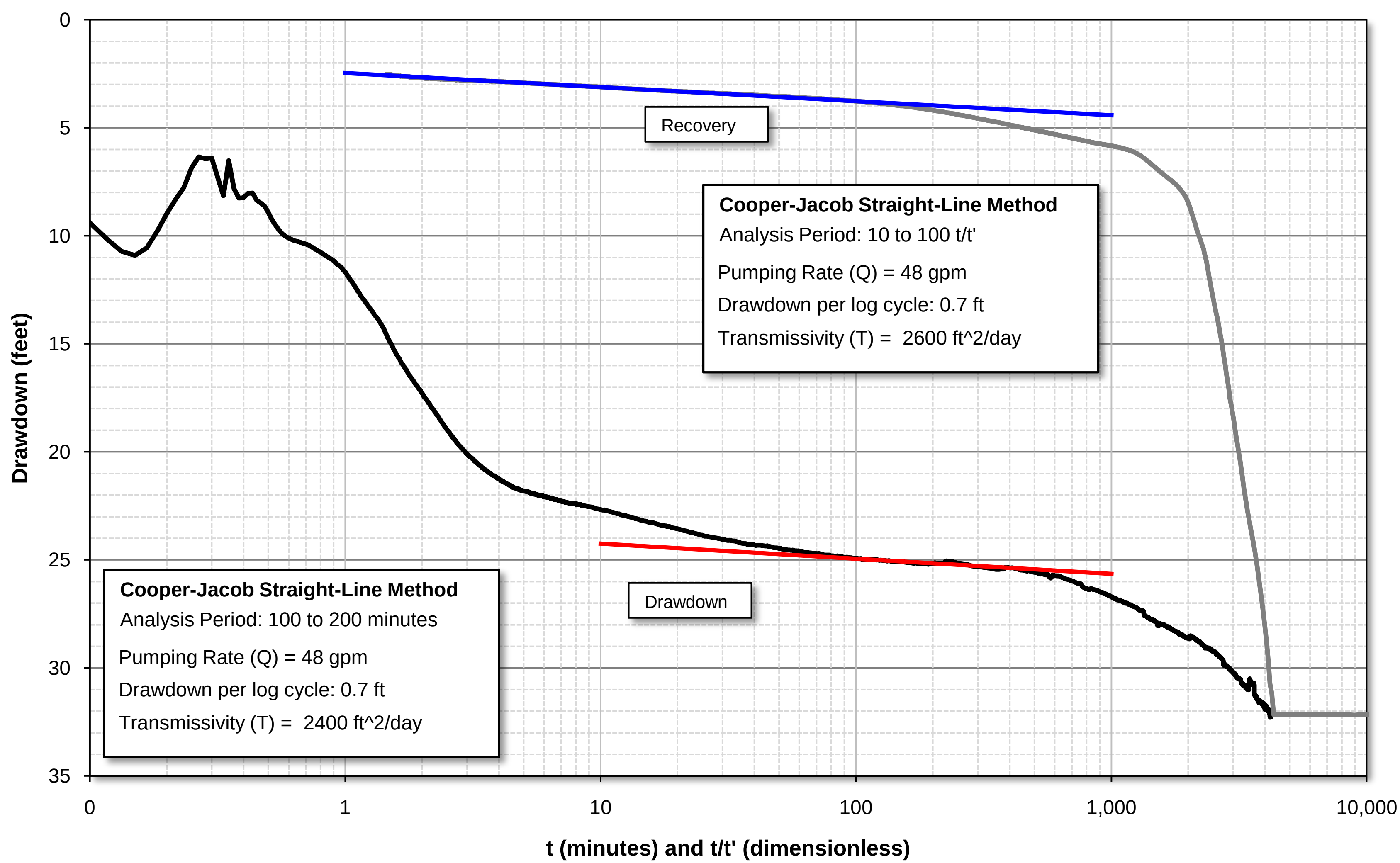


Golder Associates	Title	Groundwater Levels		Drawn	DH
				Checked	SDT
	Project Name	Hydrologic Investigation	Project No. 063-7109-500	Reviewed	DB
	Client Name	Permanente Quarry Reclamation Plan Update	Date May 2010	FIGURE	4.1

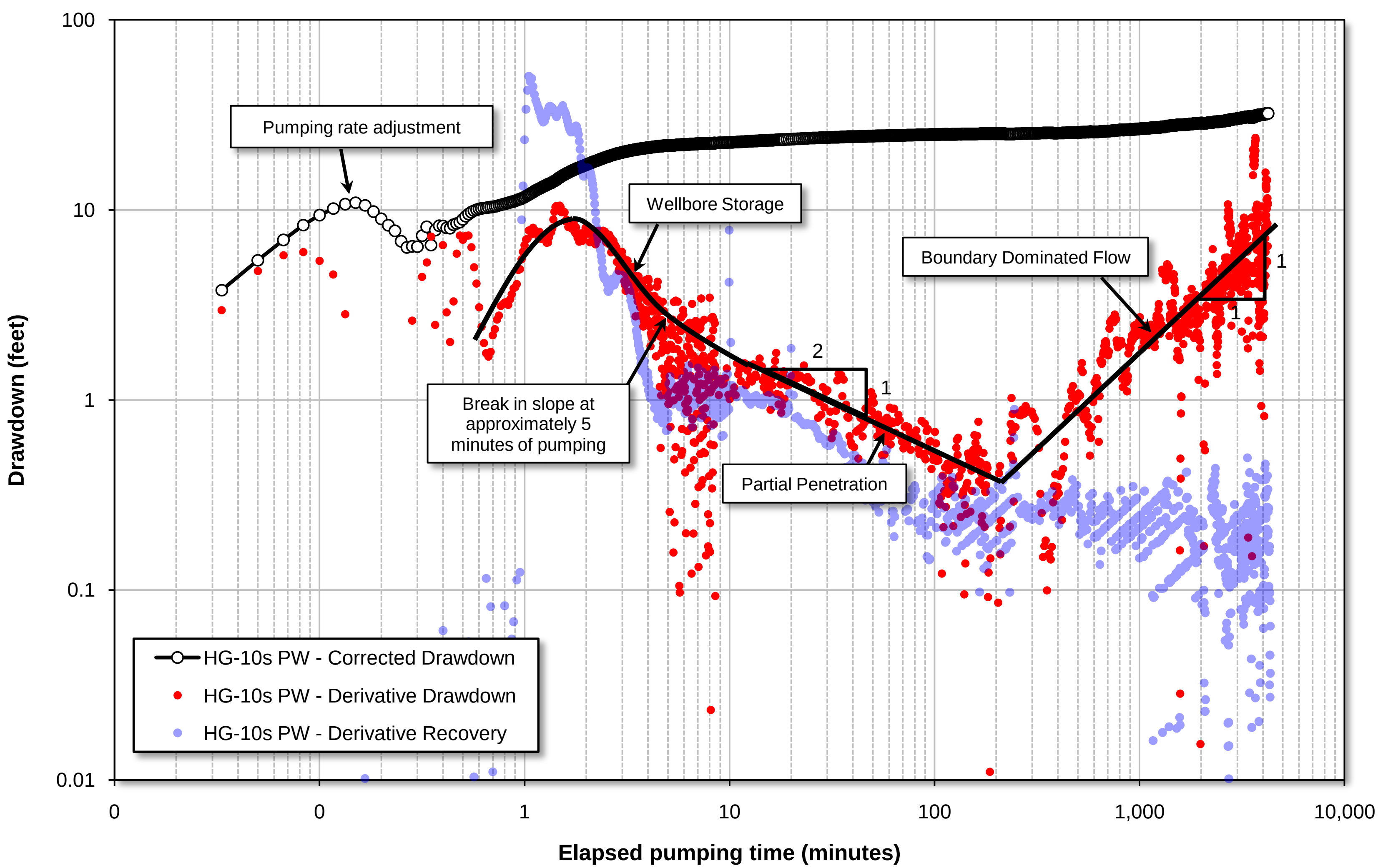
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Phase 6\Redmond 111609\Hydrogeologic Report\Figures\Supporting Files\Section 4 - ALL FIGURES_040710dh.xlsx



Golder Associates	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



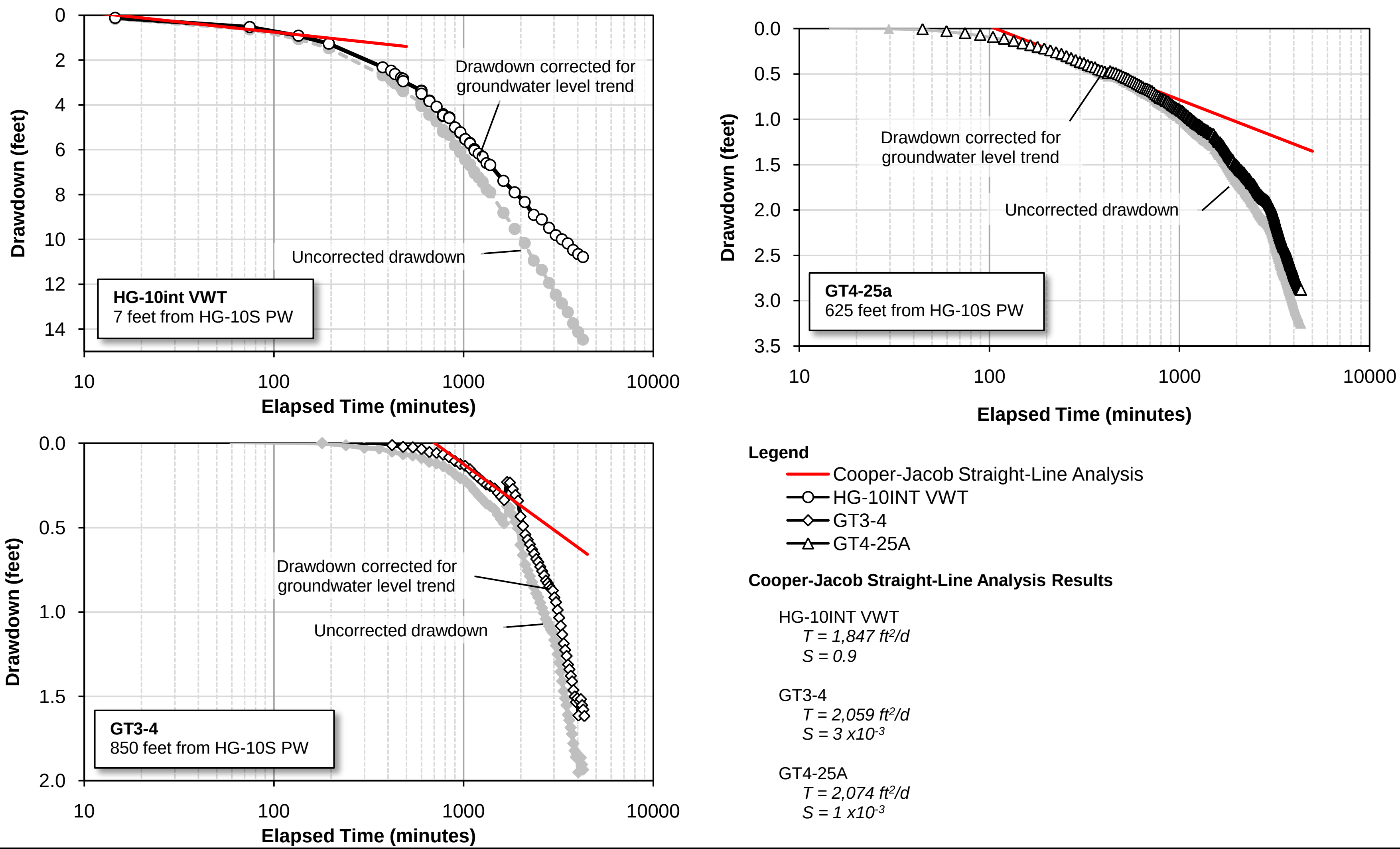
Golder Associates	Title: HG-10S Drawdown and Recovery Semi-Log Plot		Drawn	DH
			Checked	MPK
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500	Reviewed	DB
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE	4.3



Golder Associates

Title	HG-10S Drawdown and Recovery Derivative Log-Log Plot	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	4.4

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Phase 6\Redmond 111609\Hydrogeologic Report\Figures\Supporting Files\Section 4 - ALL FIGURES_040710dh.xlsx

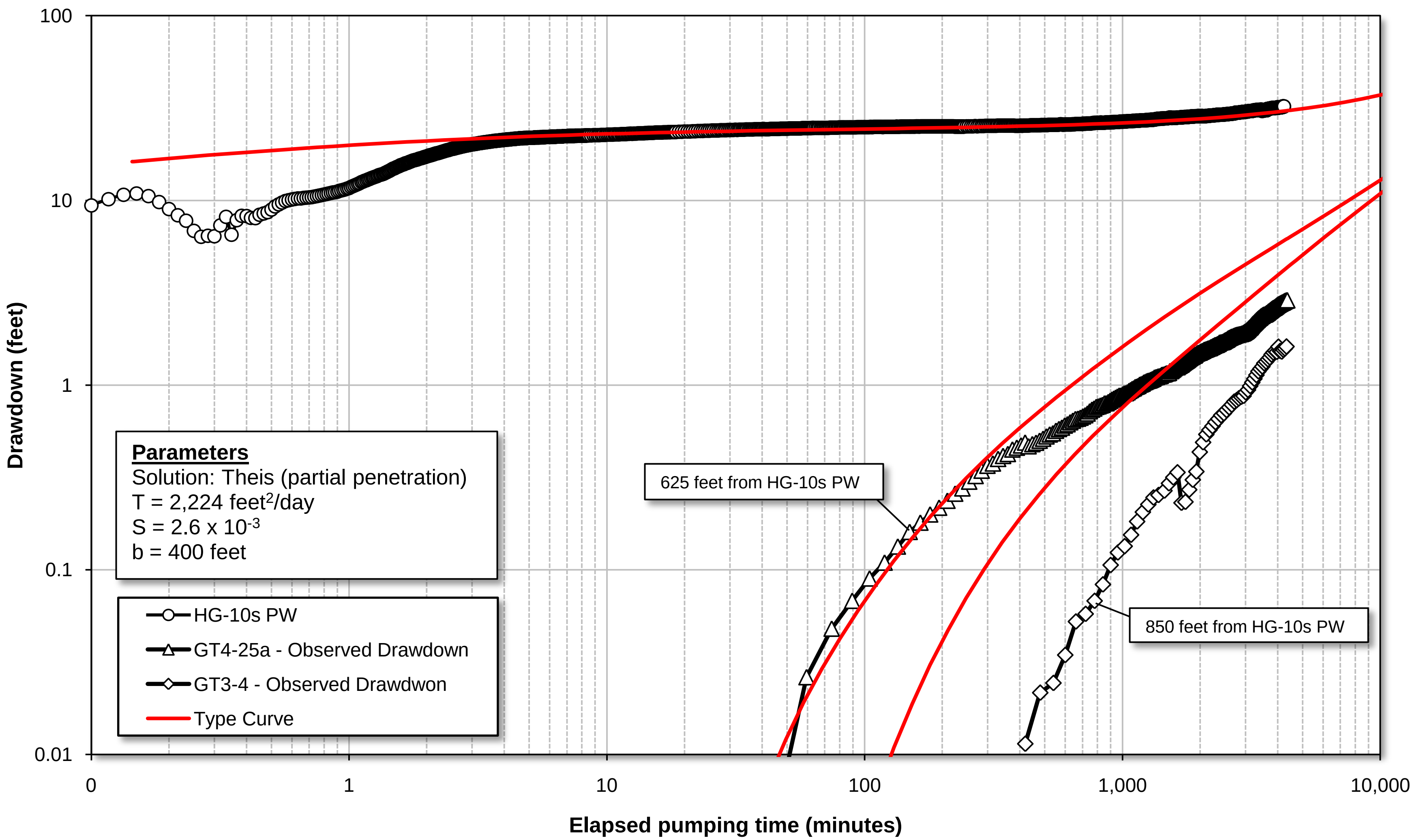


Golder Associates

Title	Corrected Drawdown Hydrographs for Observation Wells		
Project Name	Hydrologic Investigation	Project No.	063-7109-500
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010

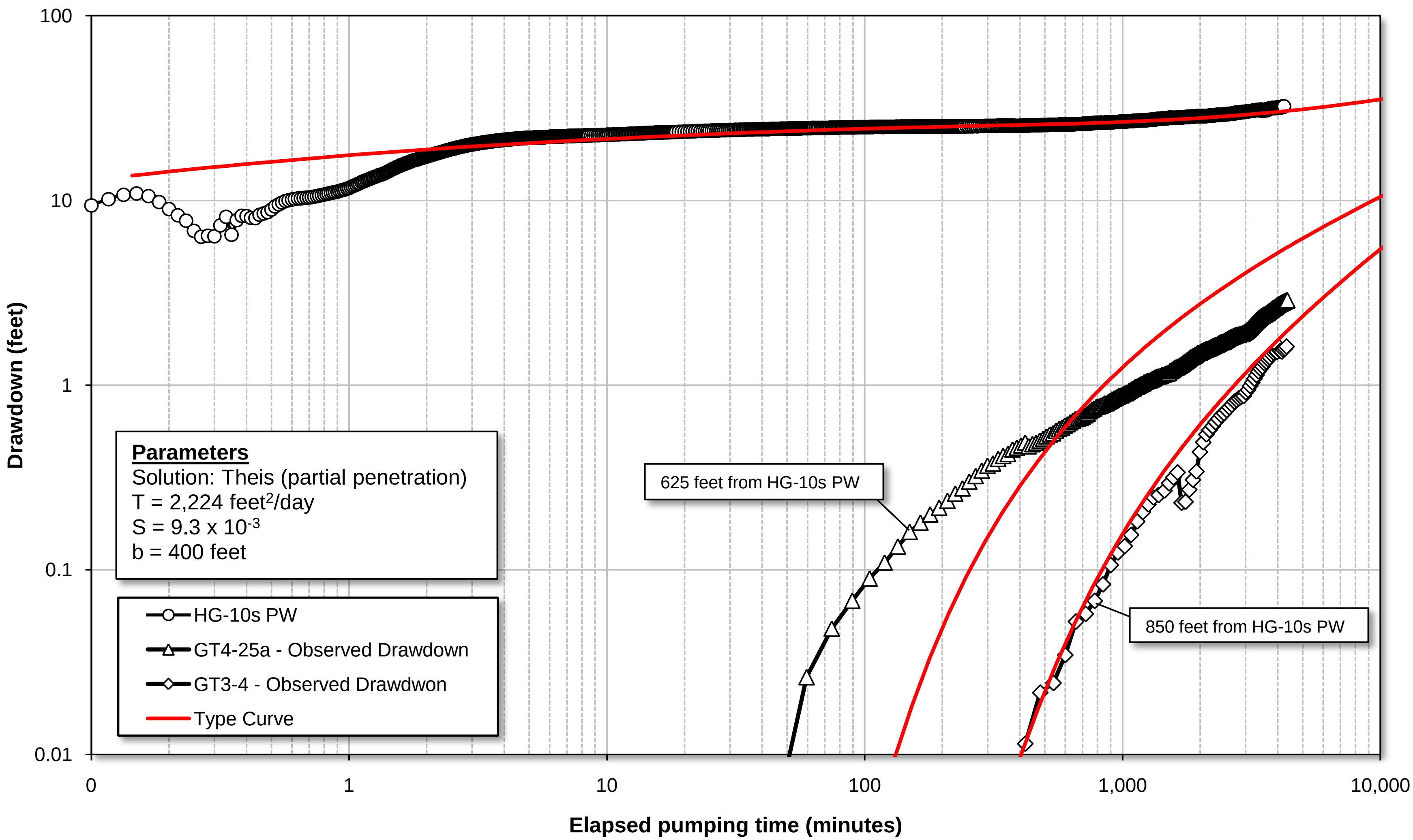
Drawn	DH
Checked	MPK
Reviewed	DB
FIGURE	4.5

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Phase 6\Redmond 111609\Hydrogeologic Report\Figures\Supporting Files\Section 4 - ALL FIGURES_040710dh.xlsx



Golder Associates

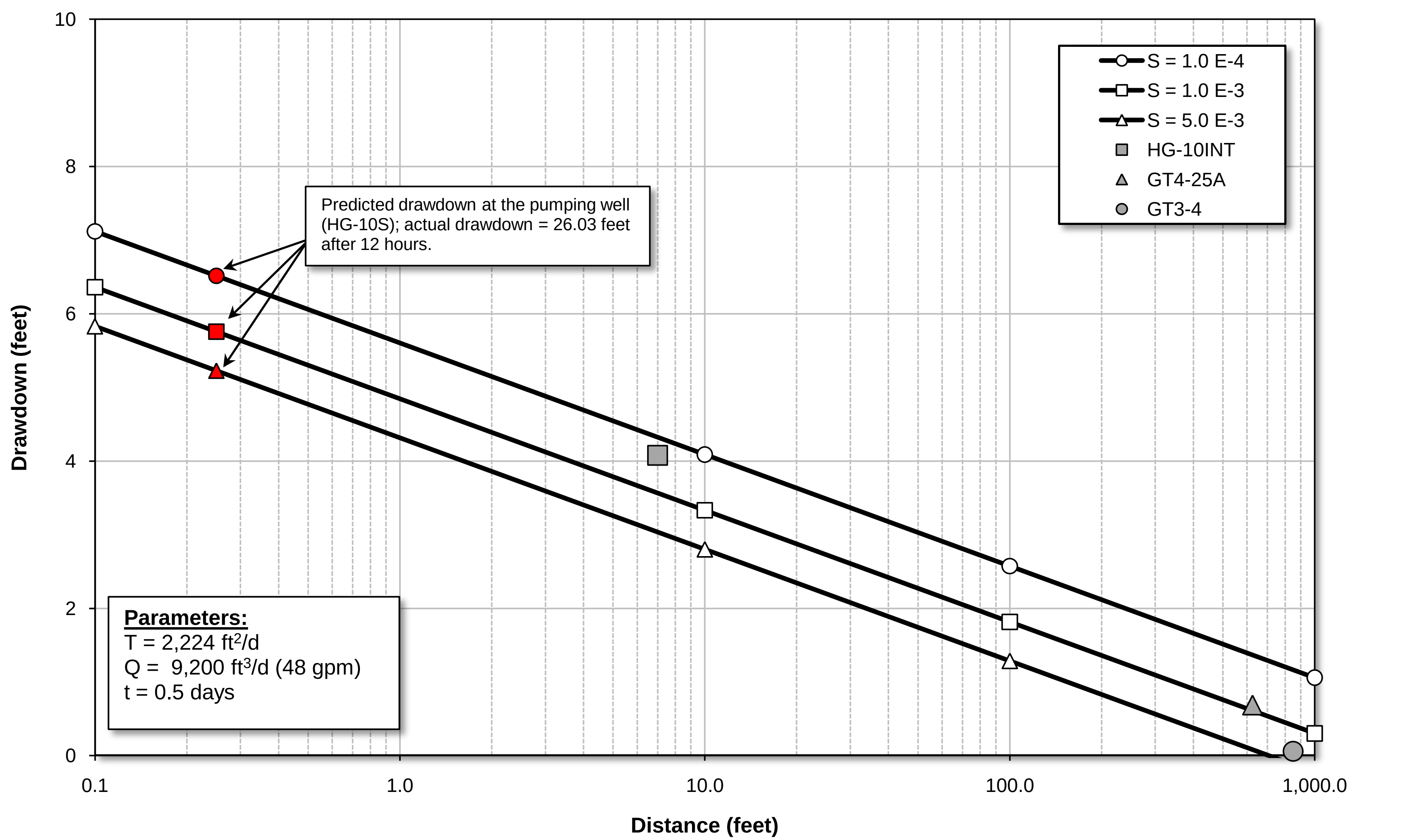
Title	Theis Partial Penetration Analysis Results from AQTESOLV	Drawn	DH
		Checked	MPK
Project Name: Hydrologic Investigation	Project No.: 063-7109-500	Reviewed	DB
Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE	4.6



Golder Associates

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	4.7

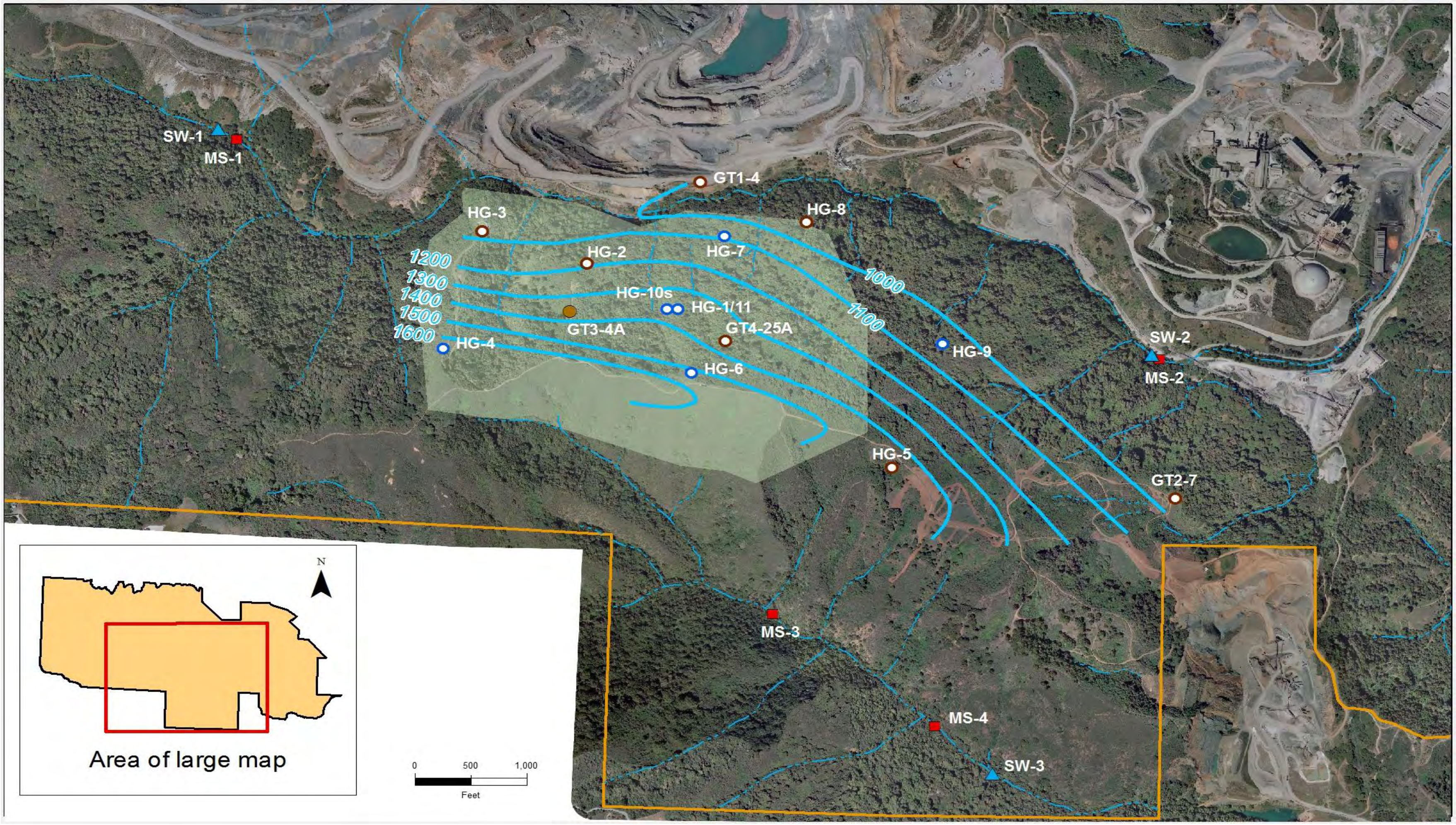
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Phase 6\Redmond 111609\Hydrogeologic Report\Figures\Supporting Files\Section 4 - ALL FIGURES_040710dh.xlsx



Golder Associates

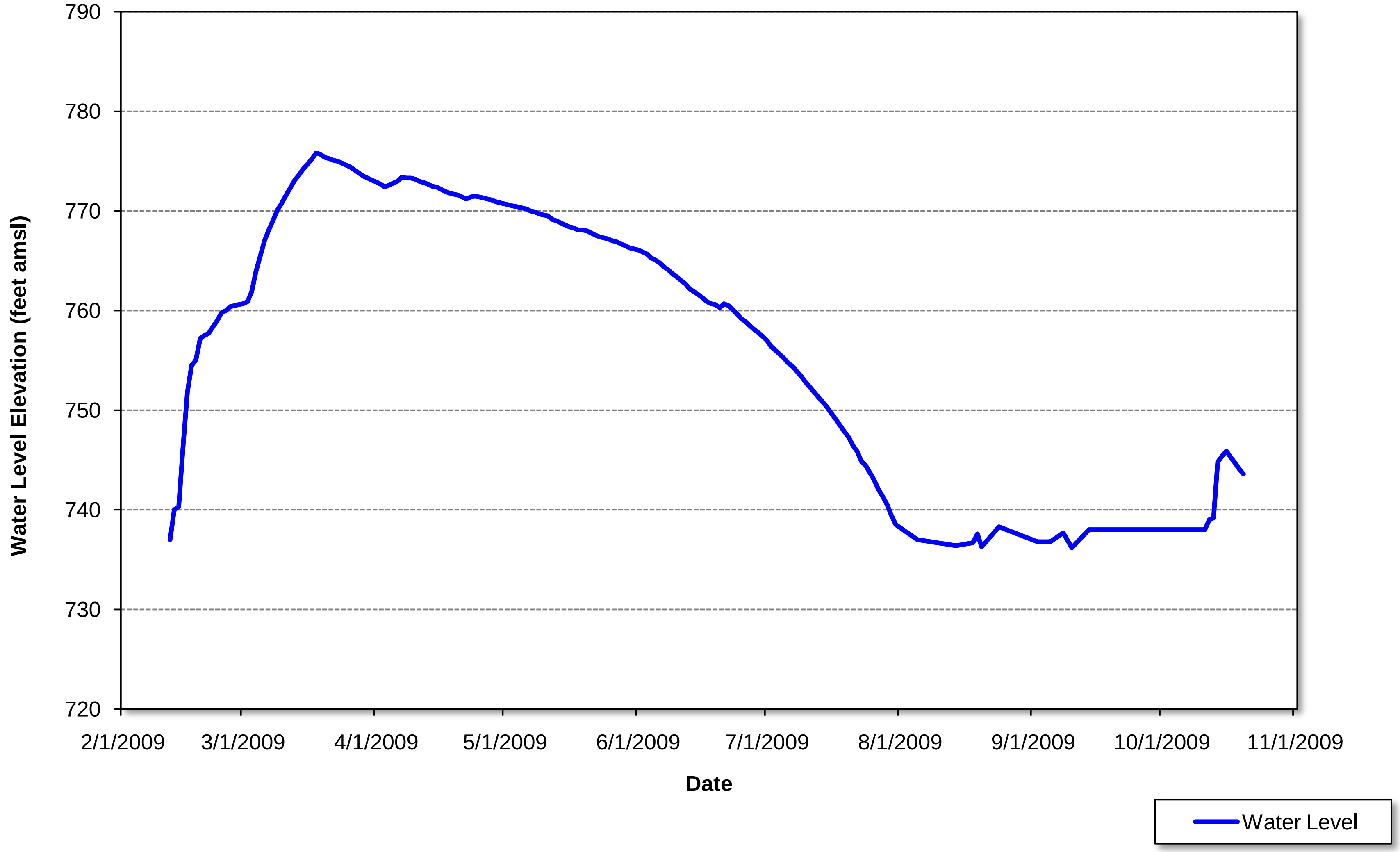
Title	Distance vs. Drawdown Semi-Log Plot	Drawn	DH
		Checked	MPK
Project Name	Hydrologic Investigation	Project No. 063-7109-500	Reviewed: DB
Client Name	Permanente Quarry Reclamation Plan Update	Date May 2010	FIGURE 4.8

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Phase 6\Redmond 111609\Hydrogeologic Report\Figures\Supporting Files\Section 4 - ALL FIGURES_040710dh.xlsx

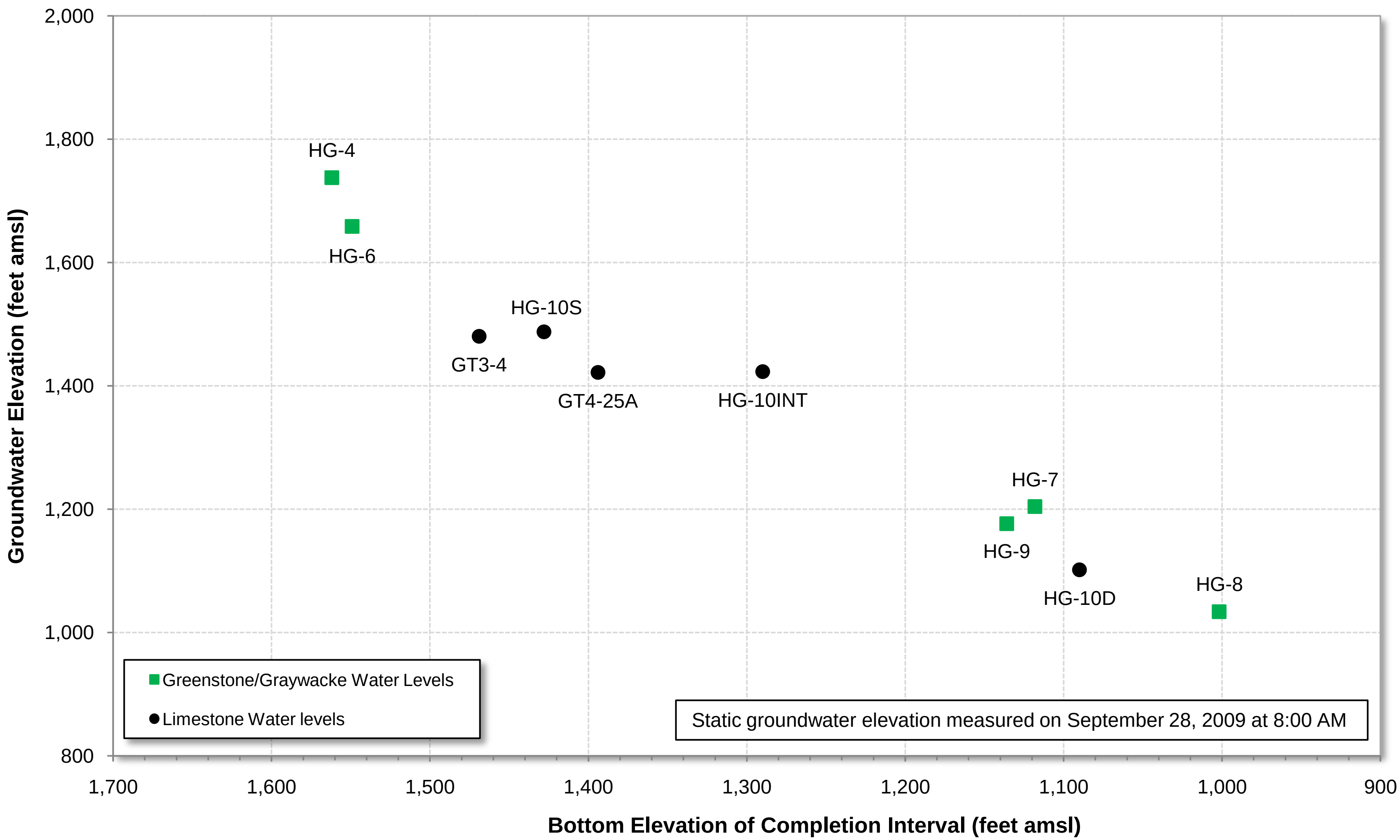


Golder Associates	Title: Groundwater Elevation Contour Map		Drawn: GW
			Checked: DH
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500	Reviewed: DB
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE 4.9

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Phase 6\Redmond 111609\Hydrogeologic Report\Figures\Supporting Files\Section 4 - ALL FIGURES_040710dh.xlsx



Golder Associates	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



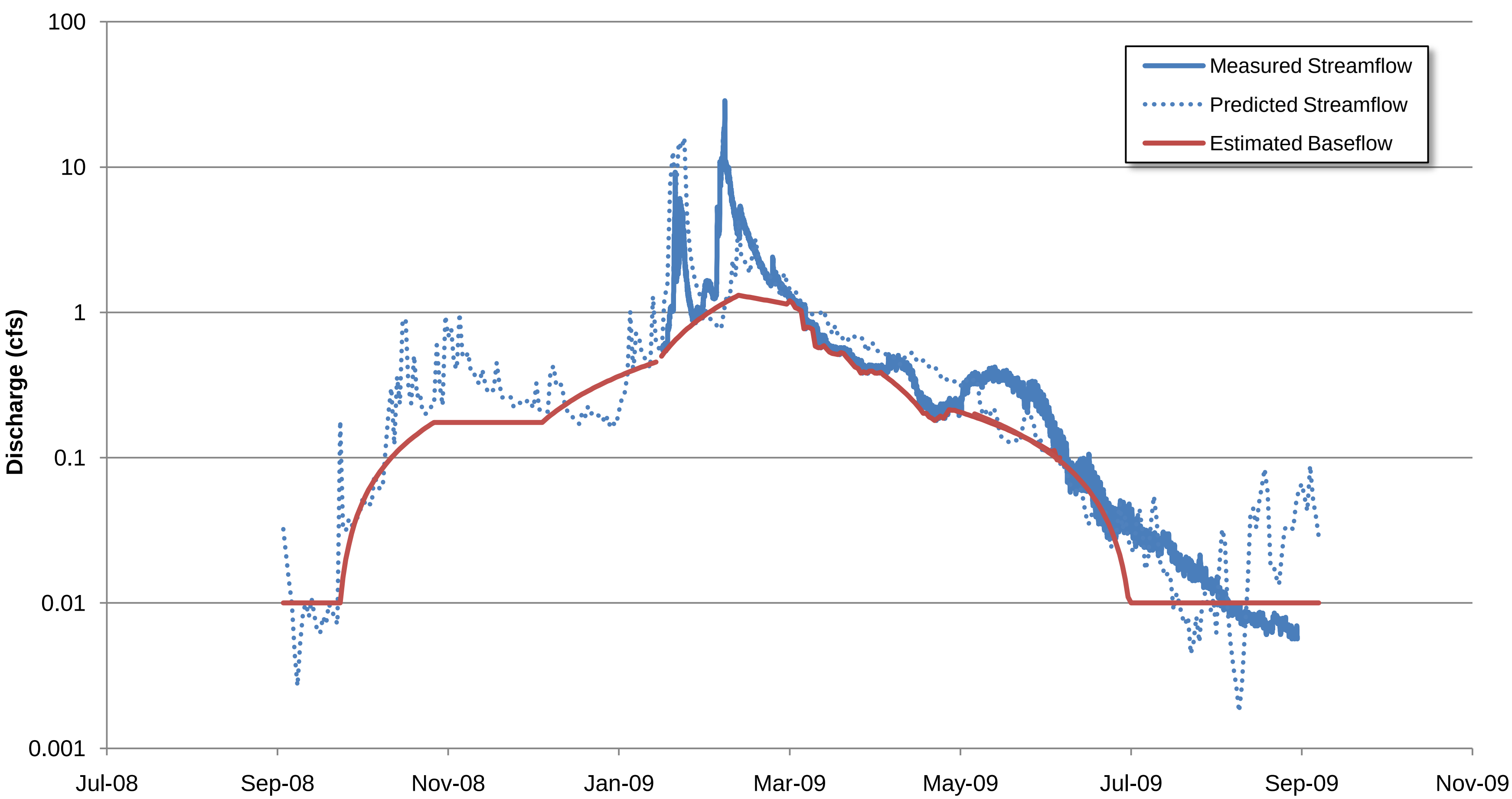
Golder Associates

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

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Phase 6\Redmond 111609\Hydrogeologic Report\Figures\Supporting Files\Section 4 - ALL FIGURES_040710dh.xlsx



Golder Associates

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

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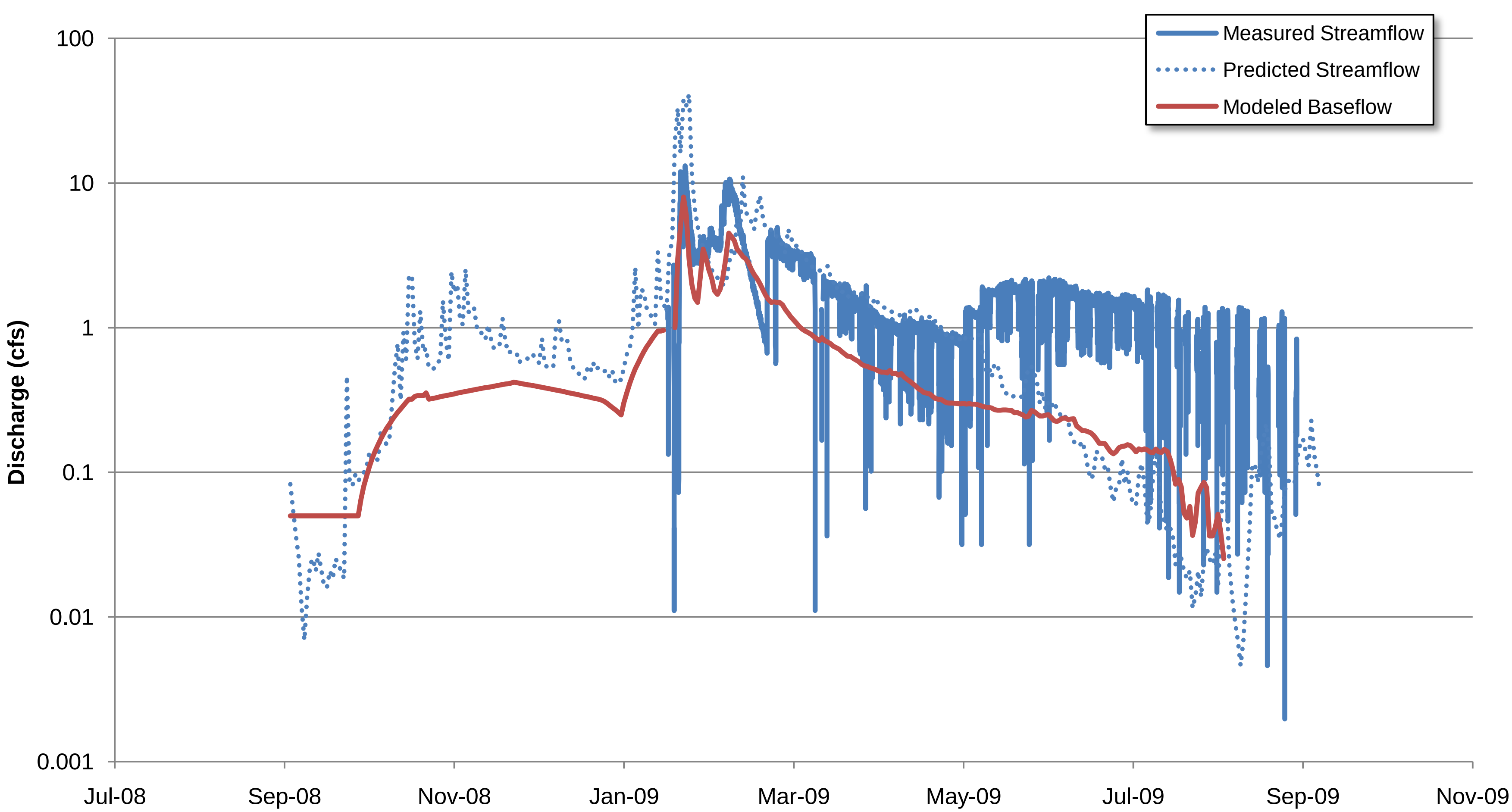
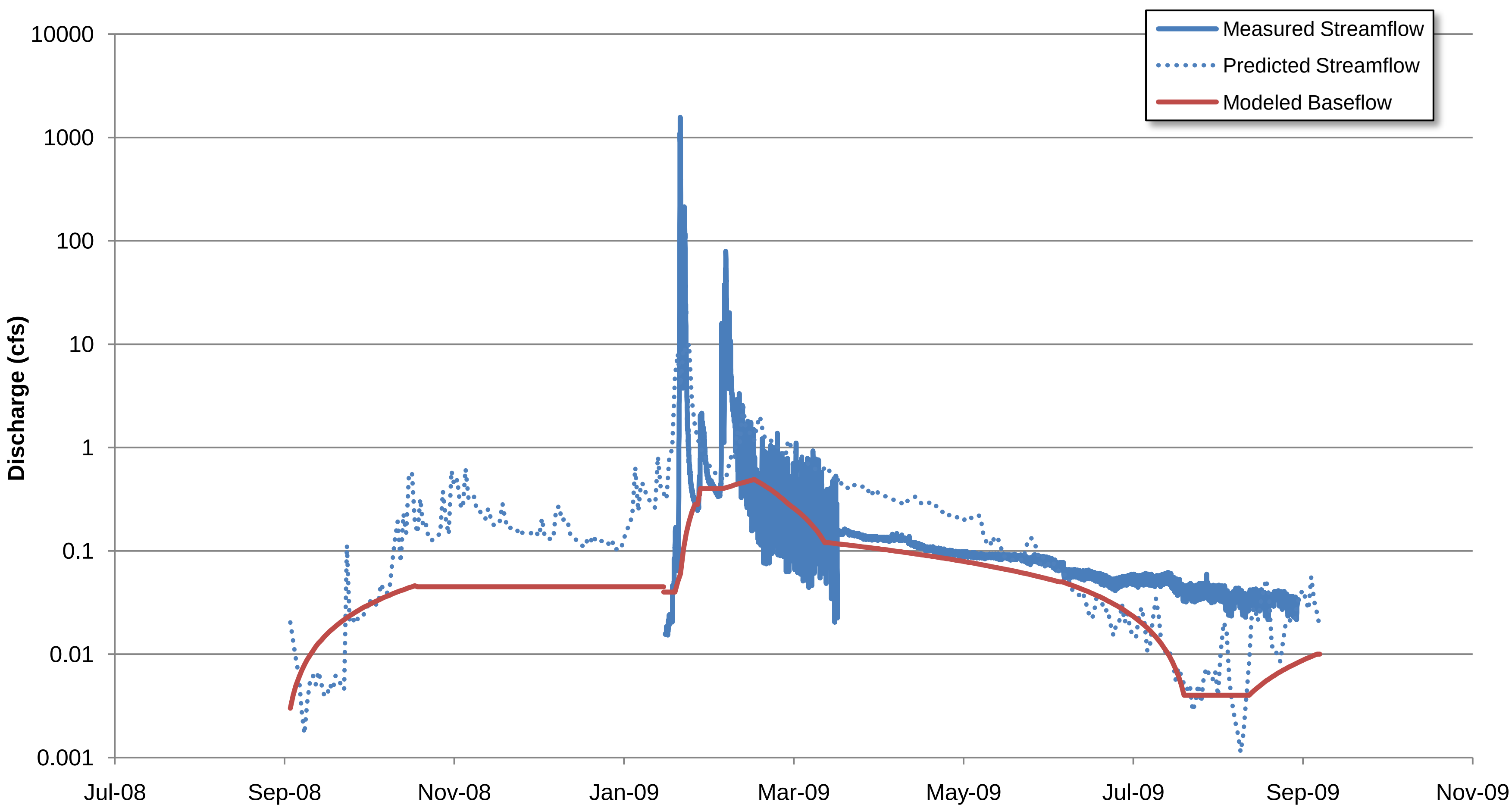
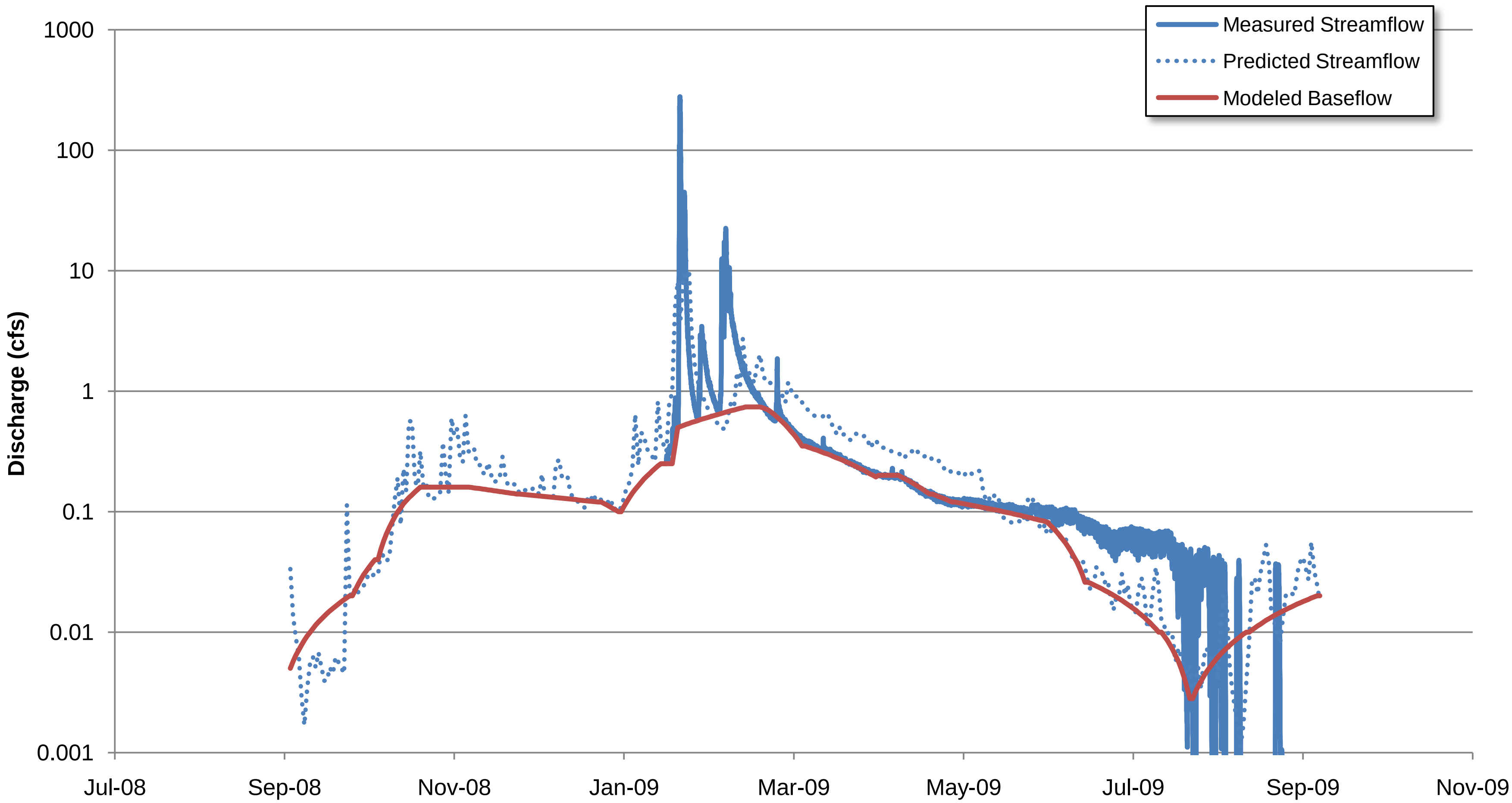


Golder Associates	Title	MS-2 Baseflow Separation Hydrograph		Drawn	JP/DH
				Checked	SDT
	Project Name	Hydrologic Investigation	Project No. 063-7109-500	Reviewed	DB
	Client Name	Permanente Quarry Reclamation Plan Update	Date May 2010	FIGURE	4.13



Golder Associates	Title: MS-3 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	4.14

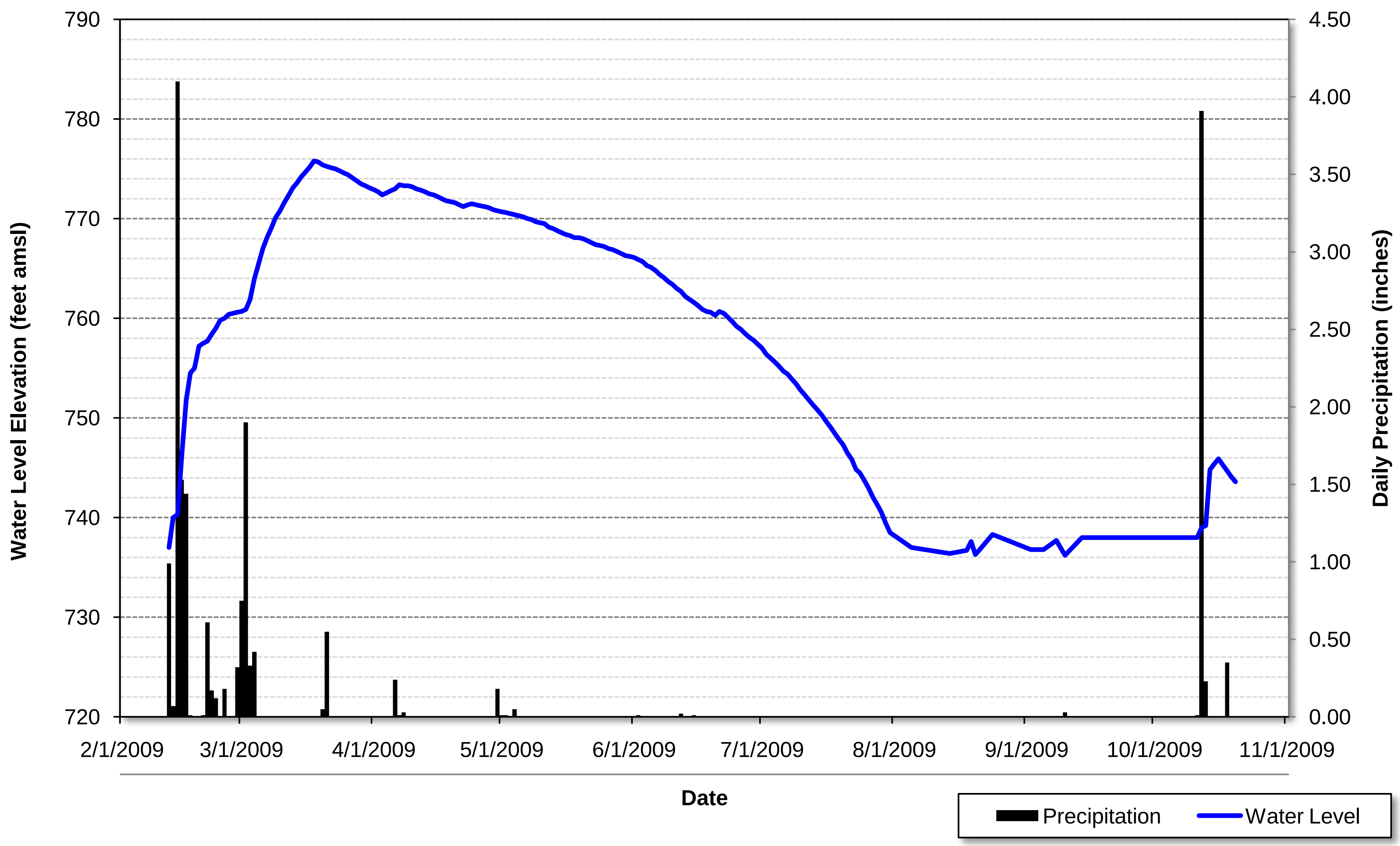


Golder Associates

Title	MS-4 Baseflow Separation Hydrograph		
Project Name	Hydrologic Investigation	Project No.	063-7109-500
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010

Drawn	JP/DH
Checked	SDT
Reviewed	DB
FIGURE	4.15

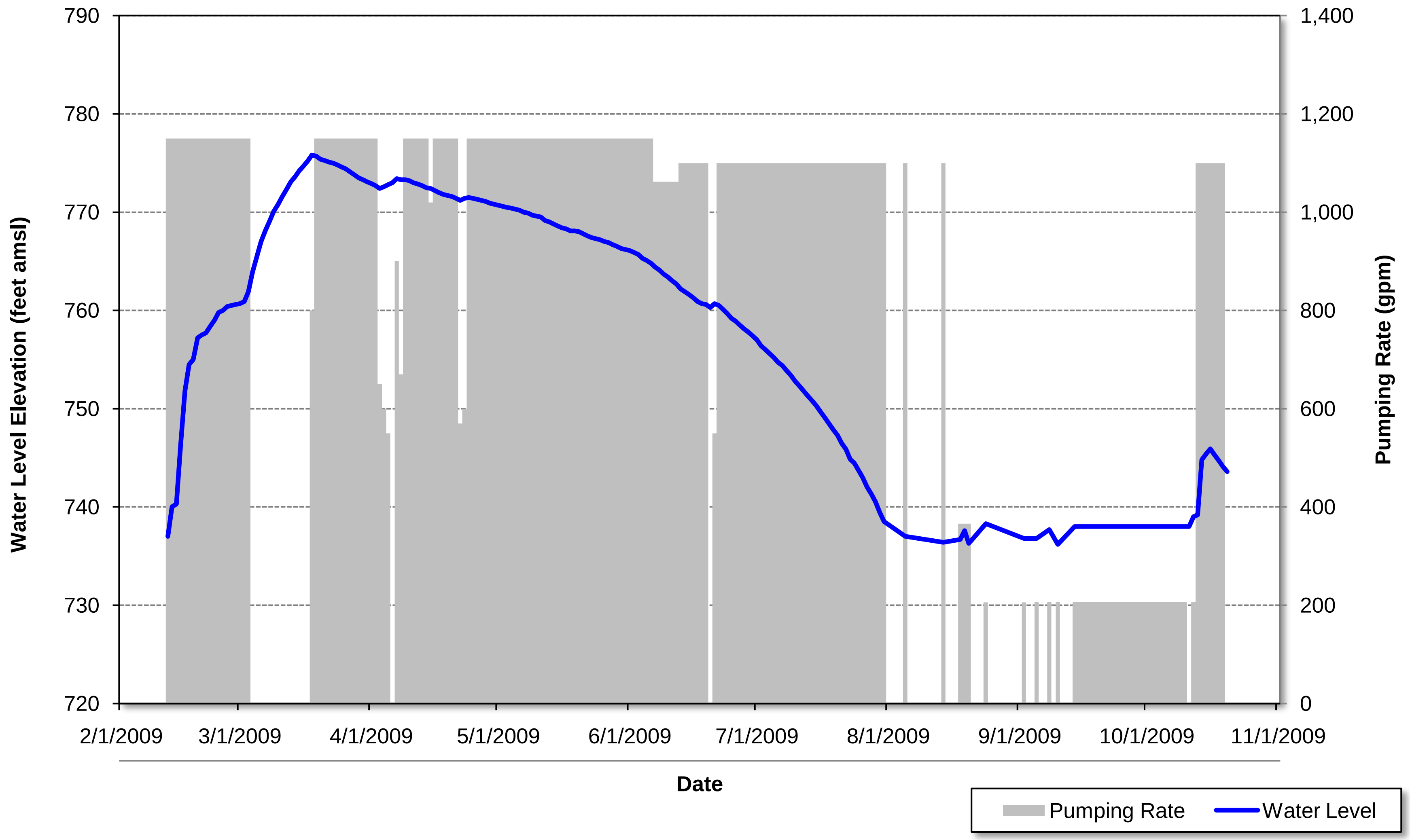
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Phase 6\Redmond 111609\Hydrogeologic Report\Figures\Supporting Files\Section 4 - ALL FIGURES_040710dh.xlsx



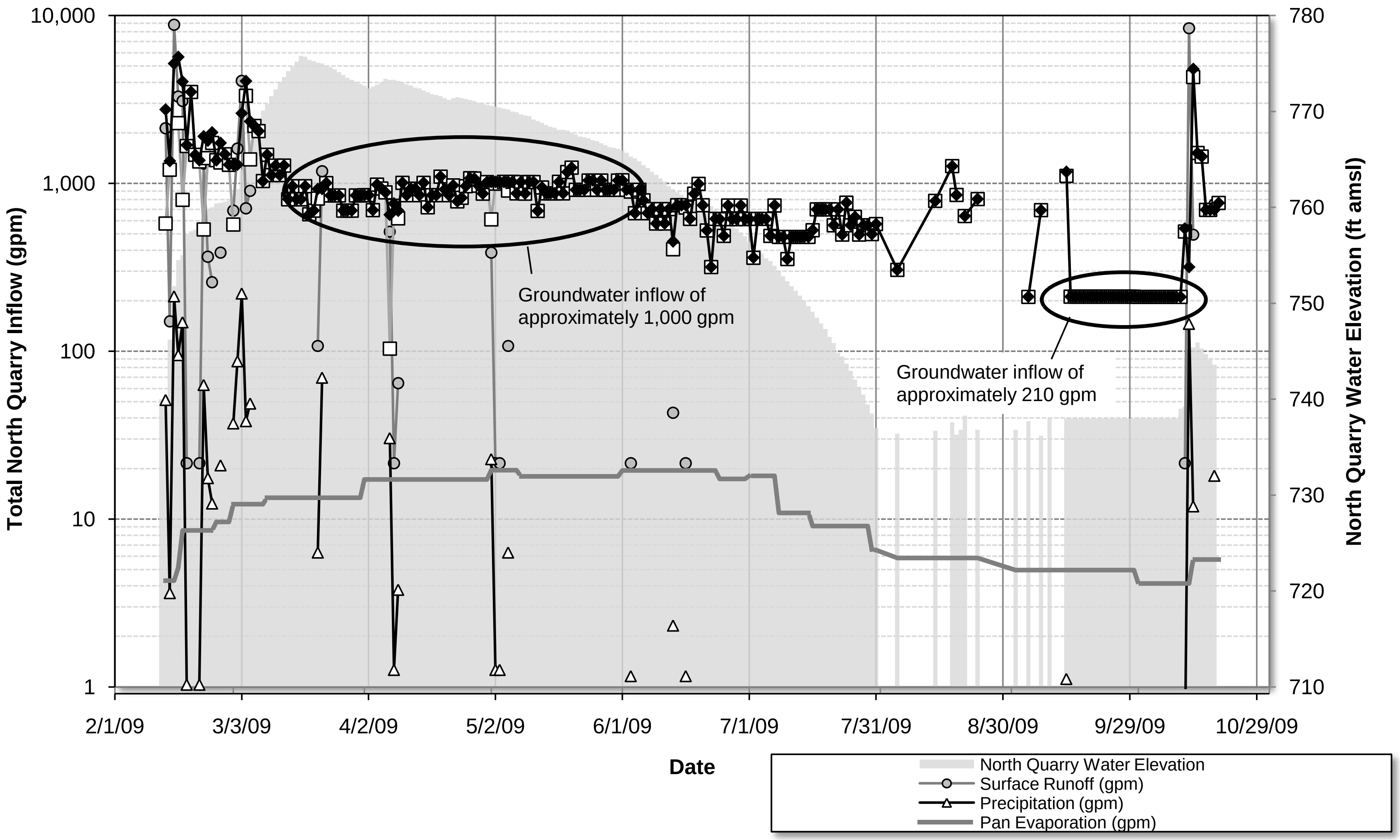
Golder Associates

Title	North Quarry Water Level and Daily Precipitation			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	4.16

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Phase 6\Redmond 111609\Hydrogeologic Report\Figures\Supporting Files\Section 4 - ALL FIGURES_040710dh.xlsx



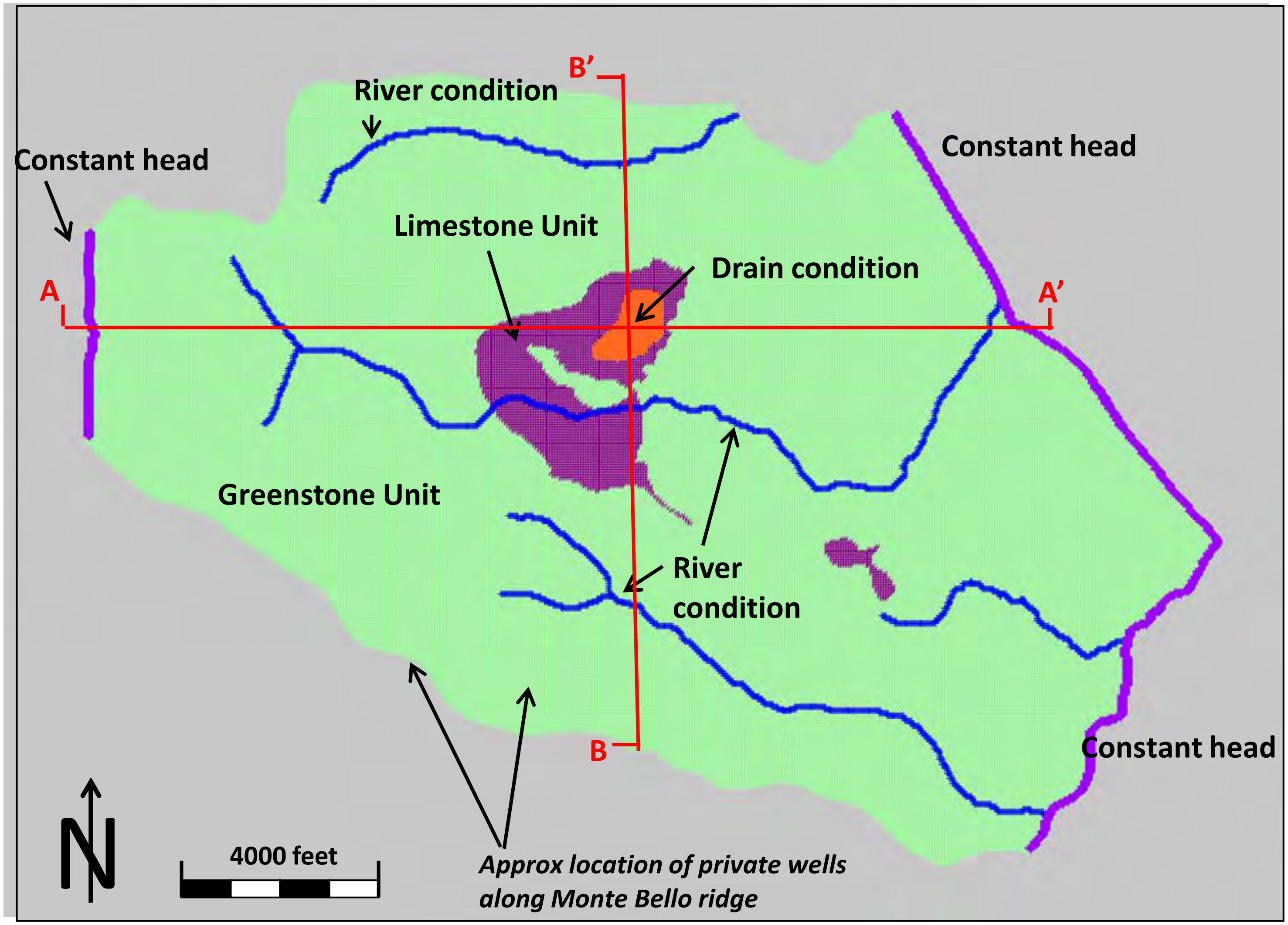
Golder Associates	Title: North Quarry Water Level and Pumping Rate		Drawn: DH / Checked: SDT / Reviewed: DB
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500	
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE 4.17



Title	North Quarry Inflow - Existing Condition			Drawn	DH
Project Name	Hydrologic Investigation	Project No.	063-7109-500	Checked	SDT
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010	Reviewed	DB
				FIGURE	4.18

Golder Associates

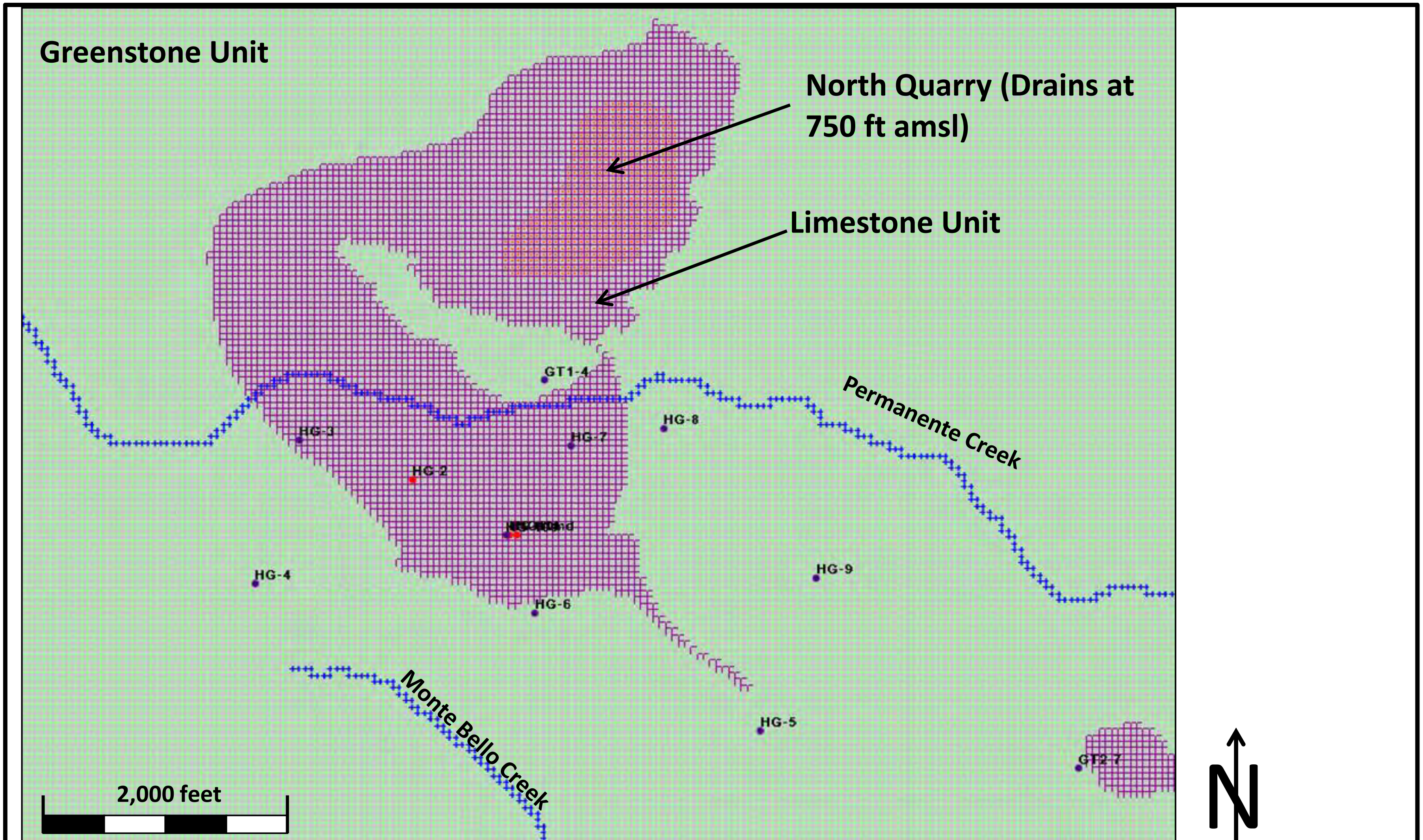
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Phase 6\Redmond 111609\Hydrogeologic Report\Figures\Supporting Files\Section 4 - ALL FIGURES_040710dh.xlsx



A A'

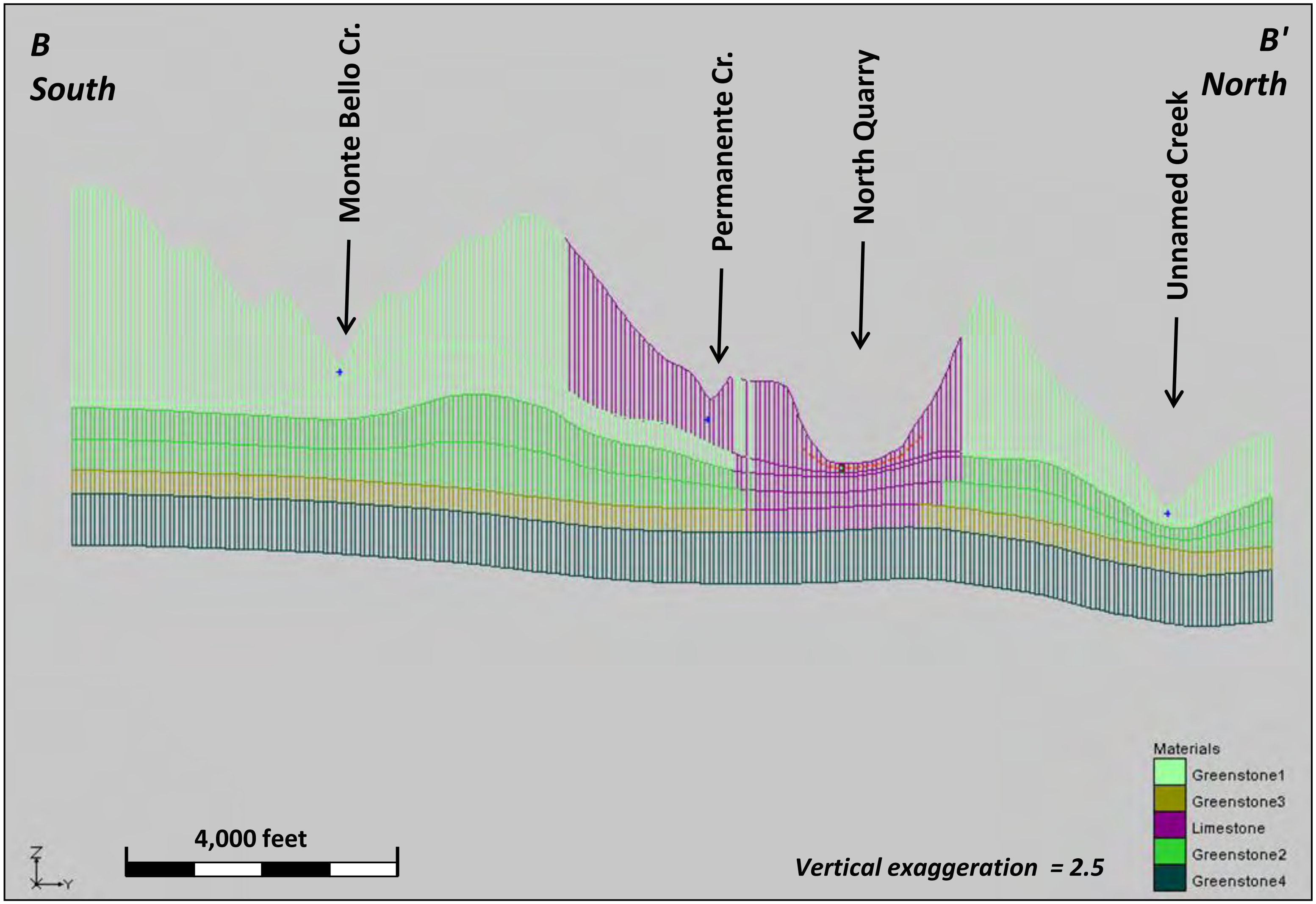
Section Line (see Figs 5.3 and 5.4)

Golder Associates	Title: Model Domain and Boundary Conditions			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	5.1

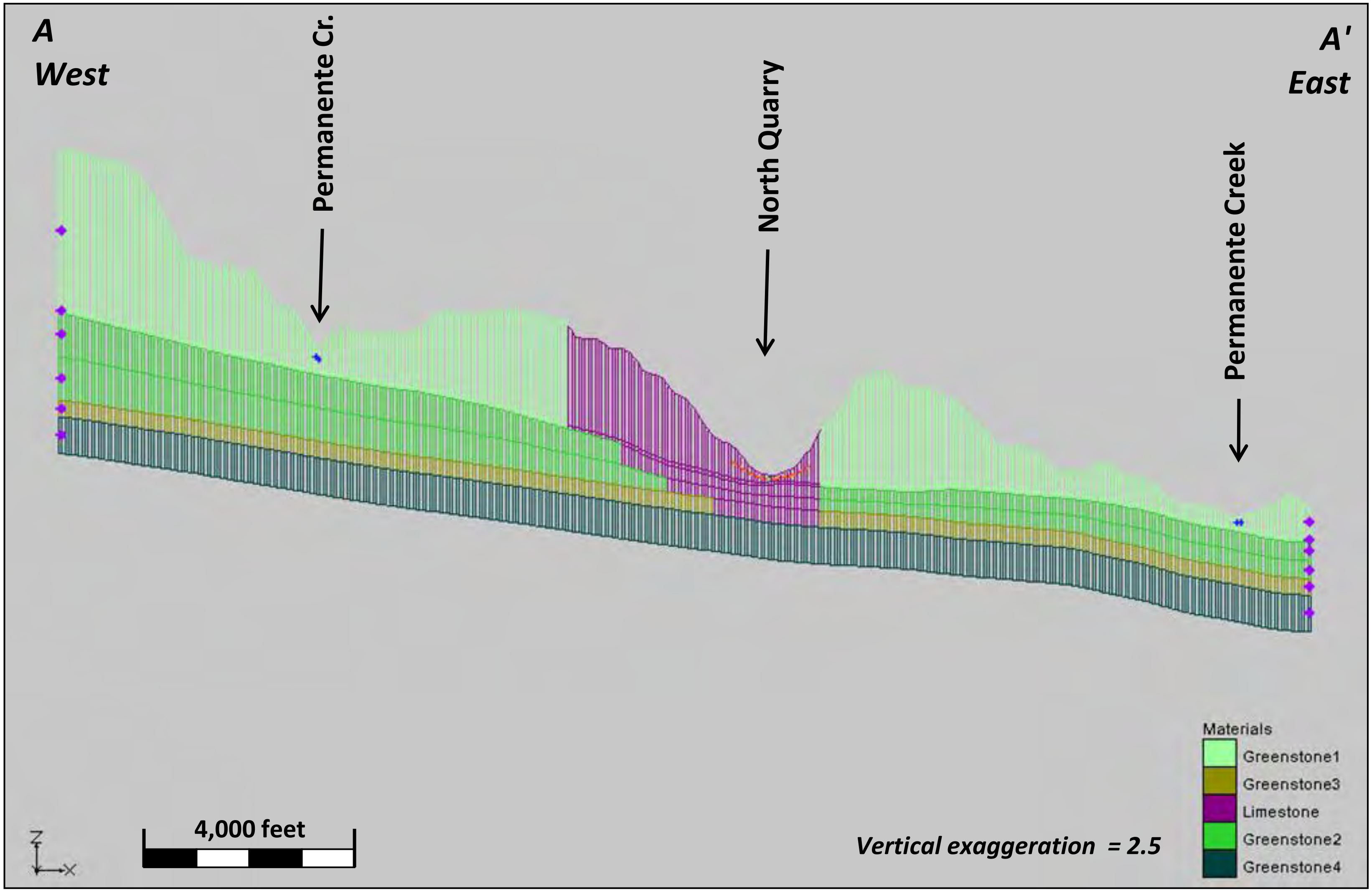


Golder Associates	Title: Model Grid and Boundary Conditions - Quarry Area		Drawn: SDT; Checked: DH; Reviewed: DB
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500	
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE 5.2

Section 5_MODFLOW_plots_041210.xlsx

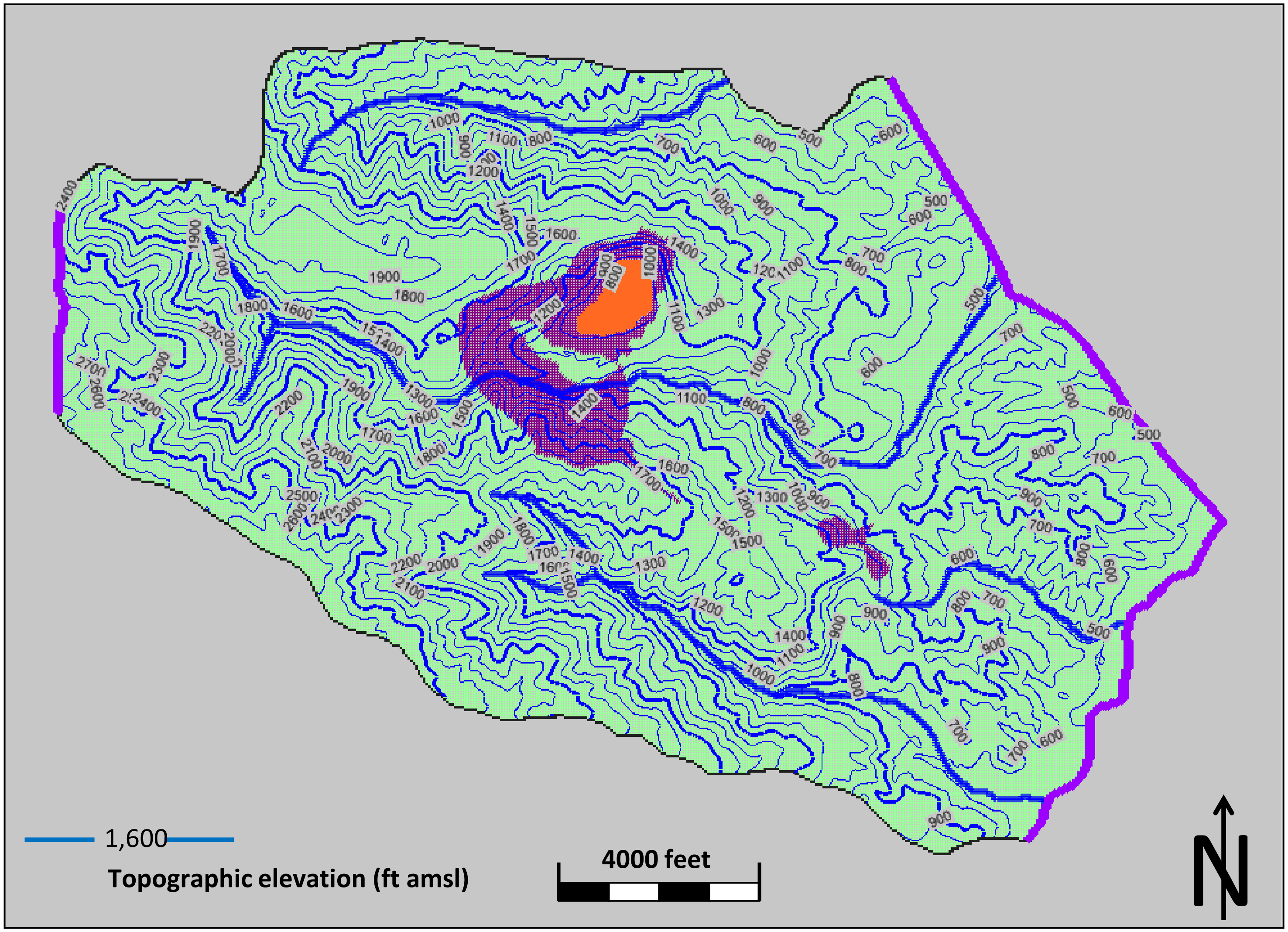


Golder Associates	Title: Section North-South Through North Quarry			Drawn: SDT
				Checked: DH
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500		Reviewed: DB
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010		FIGURE 5.3

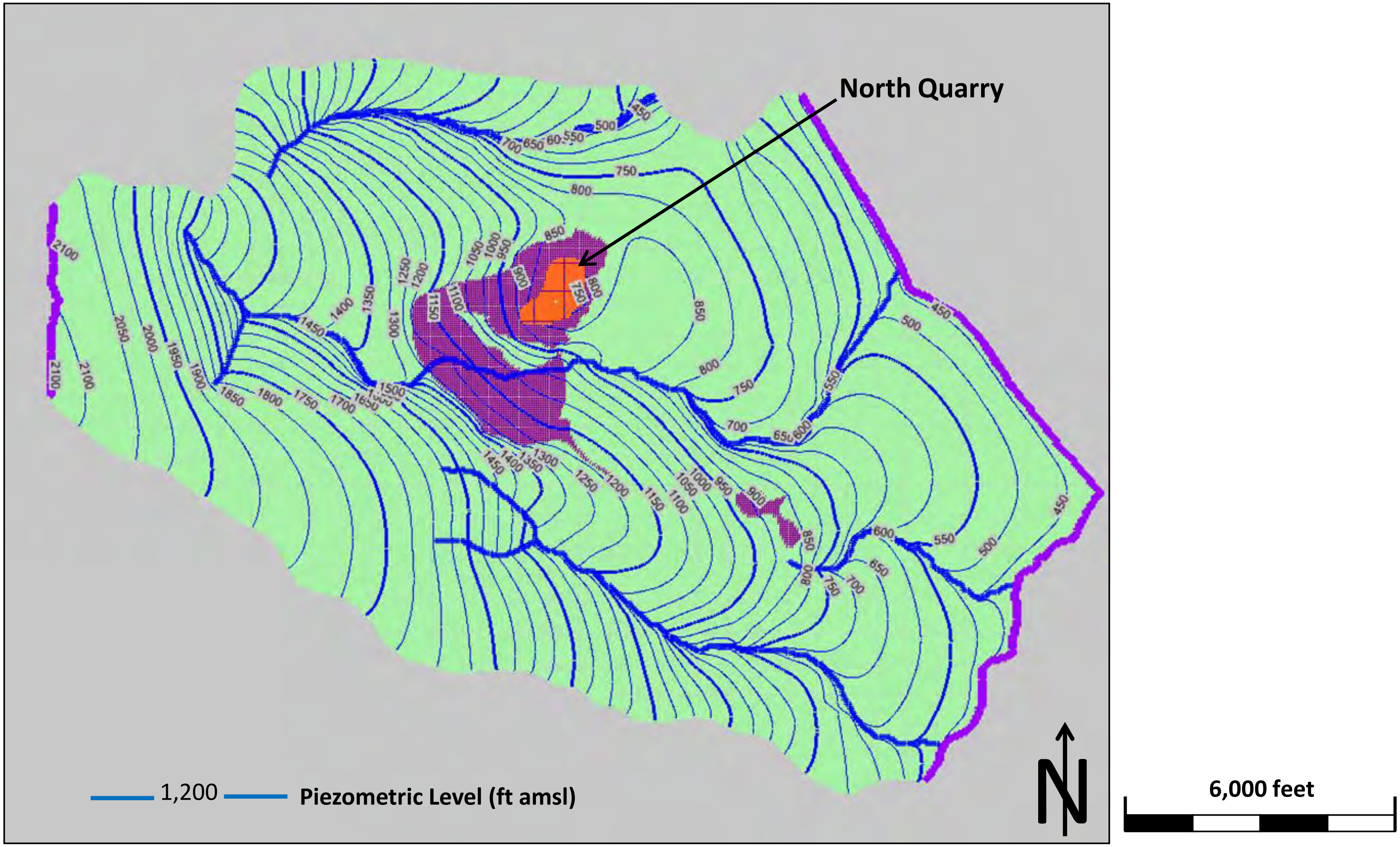


Golder Associates

Title	Section West-East Through North Quarry			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	5.4

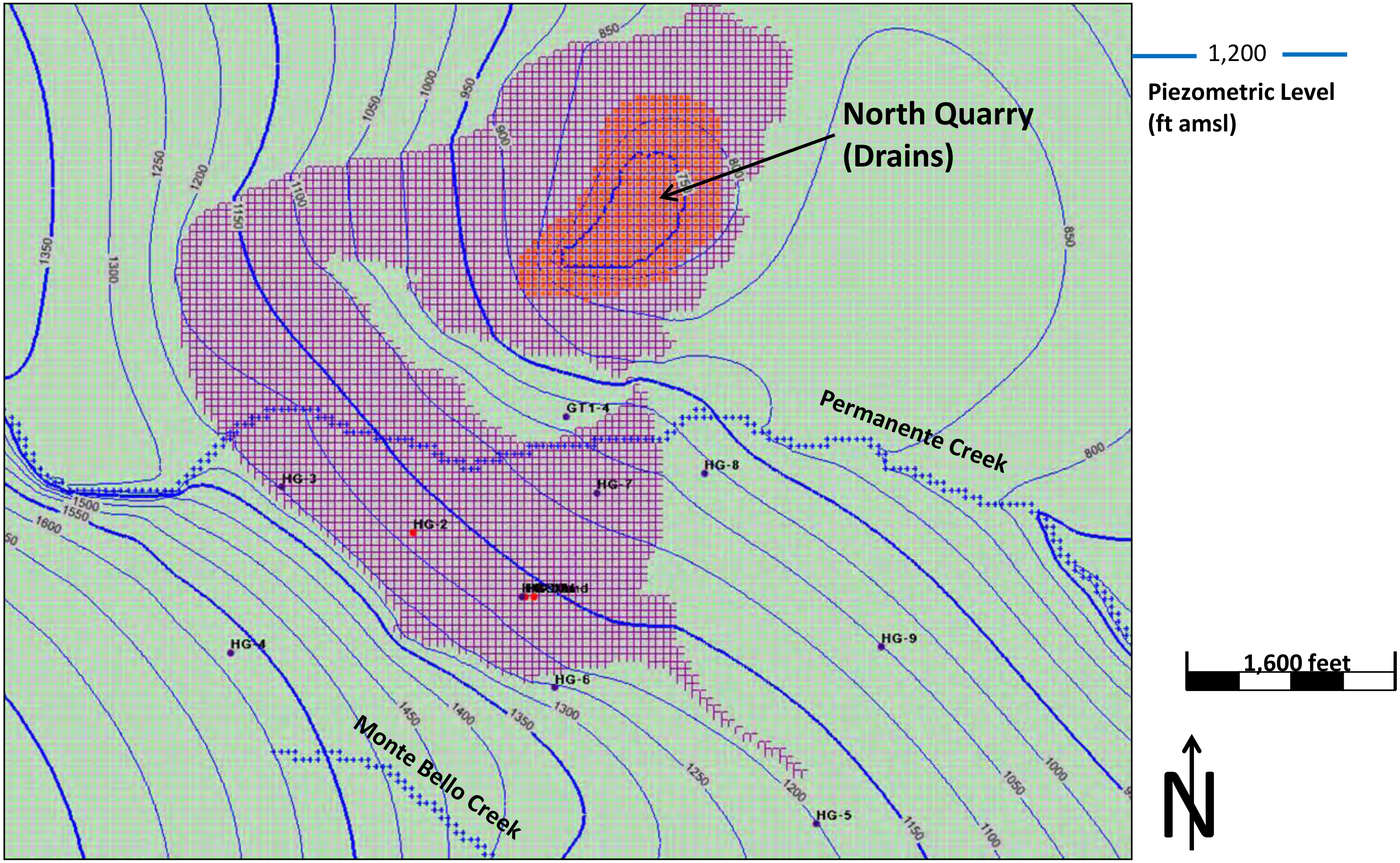


Golder Associates	Title	Model Top Surface - Current Conditions			Drawn	SDT
					Checked	DH
	Project Name	Hydrologic Investigation	Project No.	063-7109-500	Reviewed	DB
	Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010	FIGURE	5.5



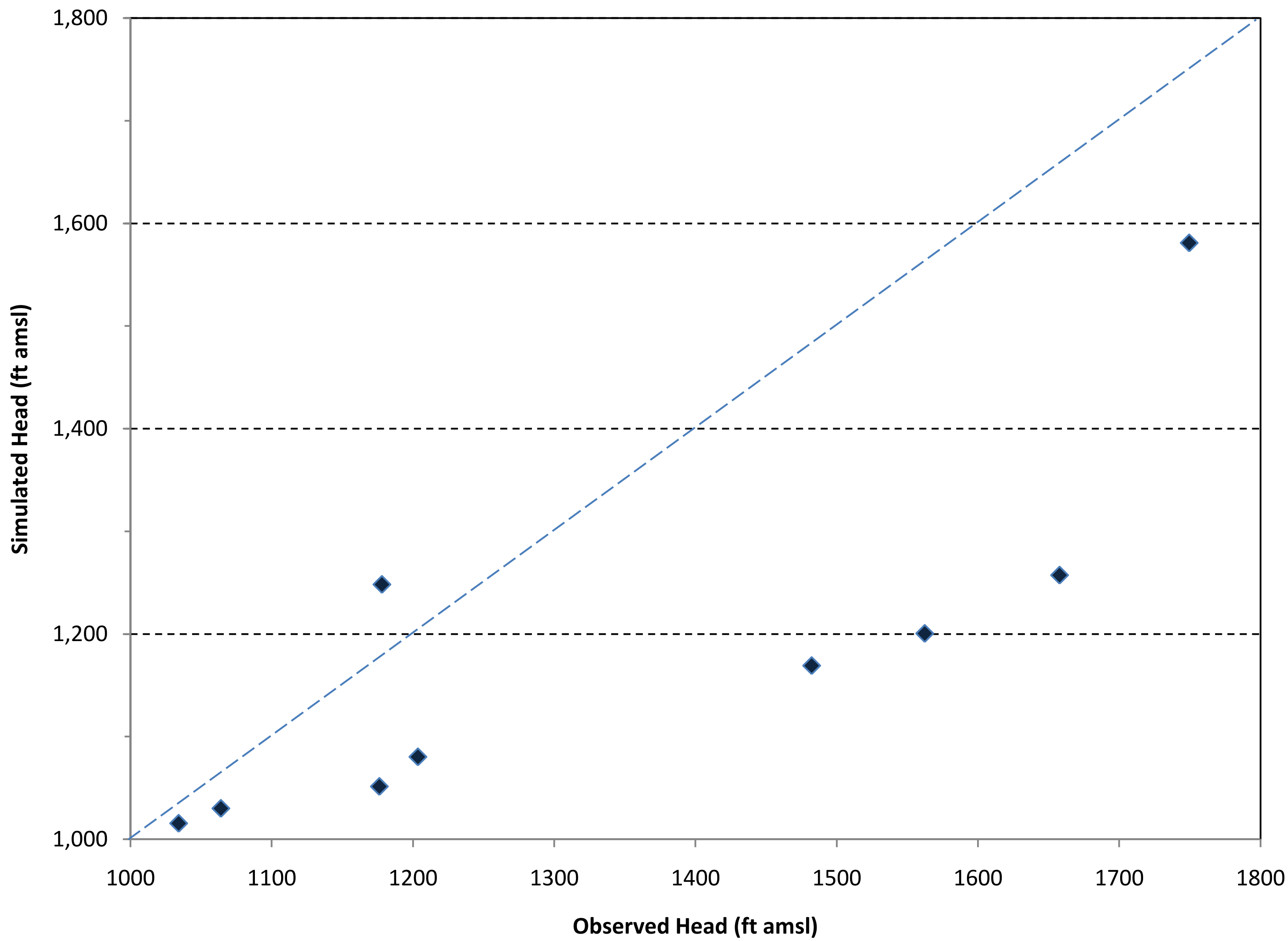
Title	Simulated Current Piezometric Heads	Drawn	SDT
		Checked	DH
Project Name: Hydrologic Investigation	Project No.: 063-7109-500	Reviewed	DB
Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE	5.6

Section 5_MODFLOW_plots_041210.xlsx



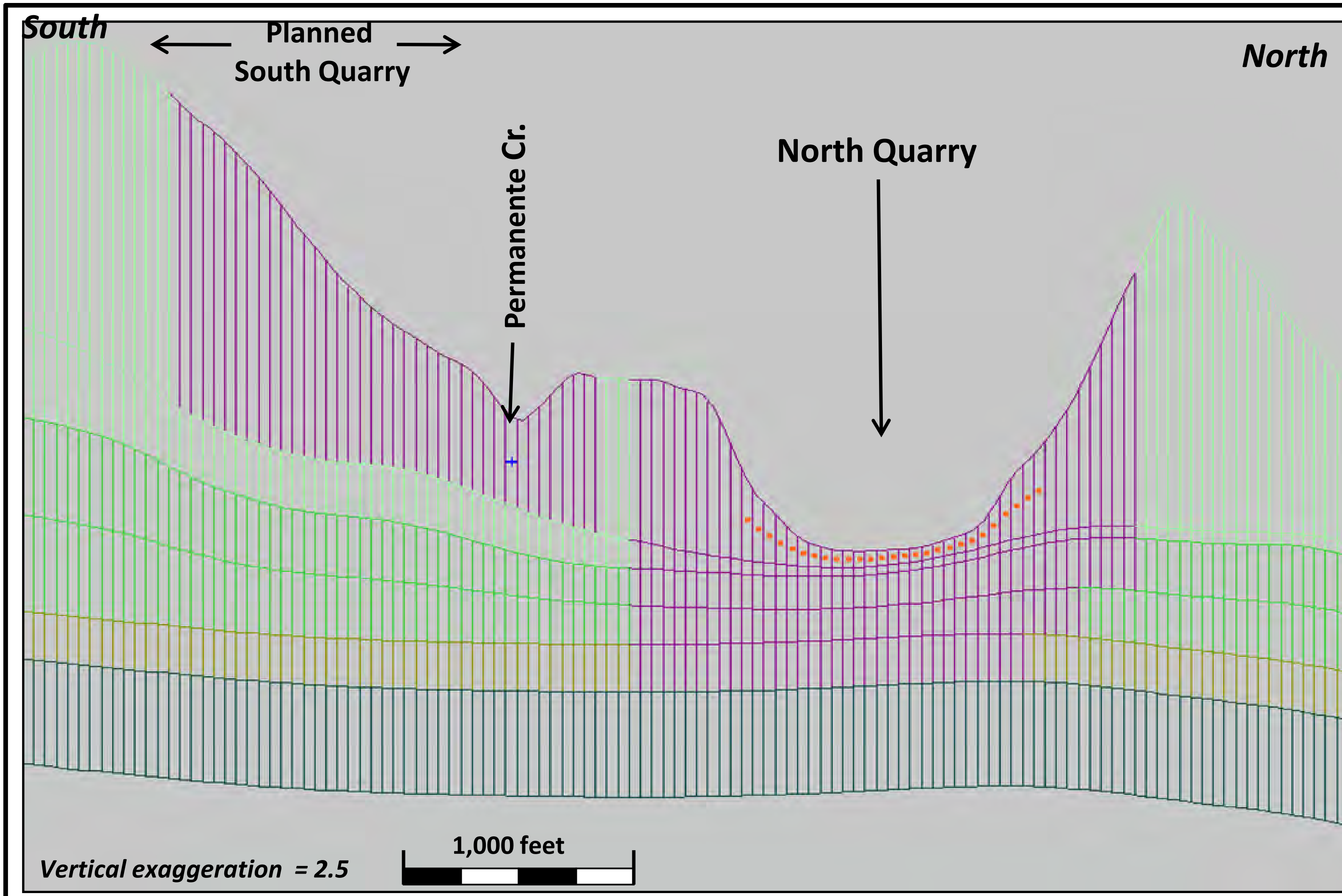
Golder Associates	Title: Simulated Current Piezometric Heads – Quarry Area		Drawn	SDT
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500	Checked	DH
			Reviewed	DB
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE	5.7

Section 5_MODFLOW_plots_041210.xlsx

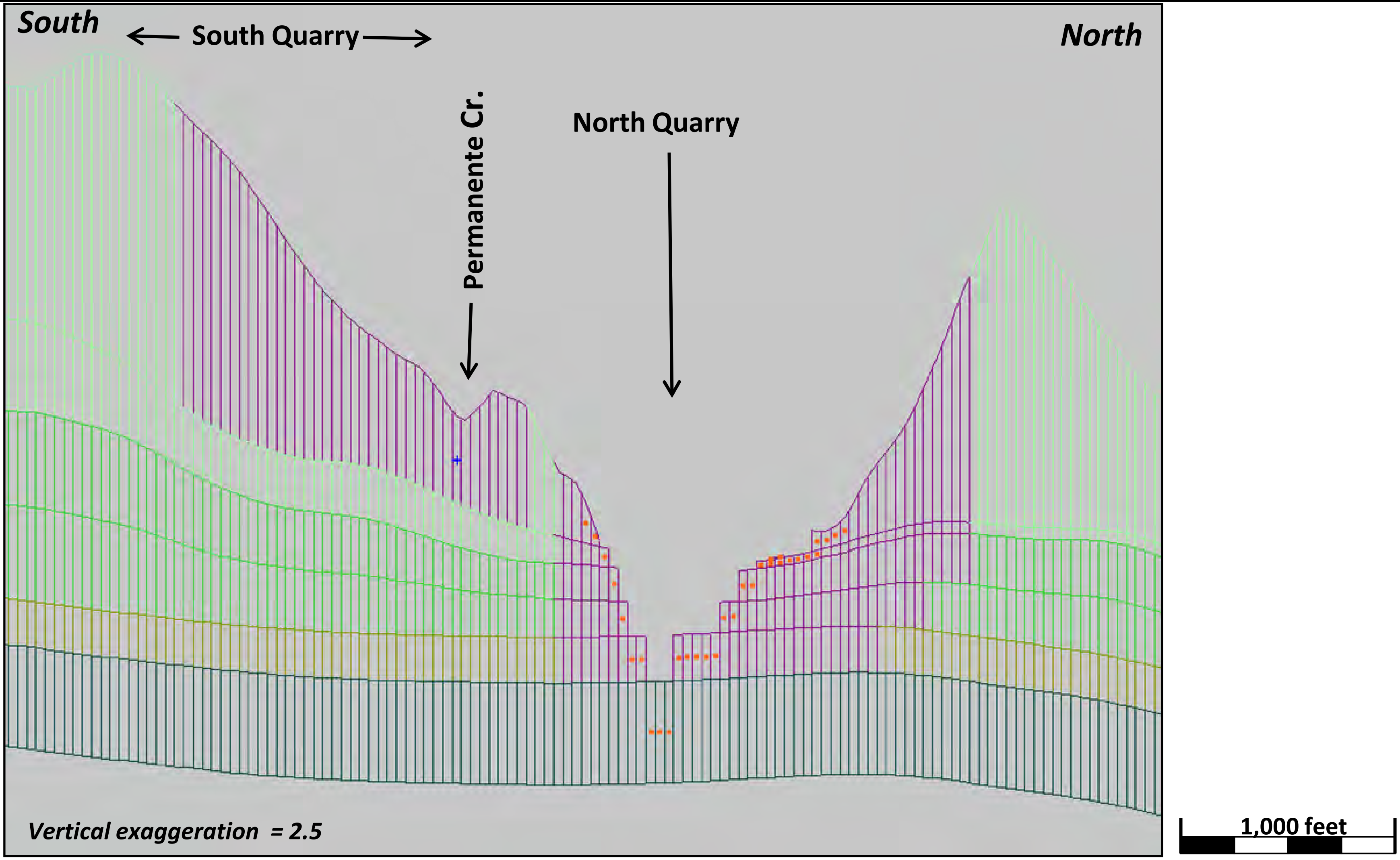


Golder Associates	Title	Calibrated versus Observed heads – October 2009		Drawn	SDT
				Checked	DH
	Project Name	Hydrologic Investigation	Project No. 063-7109-500	Reviewed	DB
	Client Name	Permanente Quarry Reclamation Plan Update	Date May 2010	FIGURE	5.8

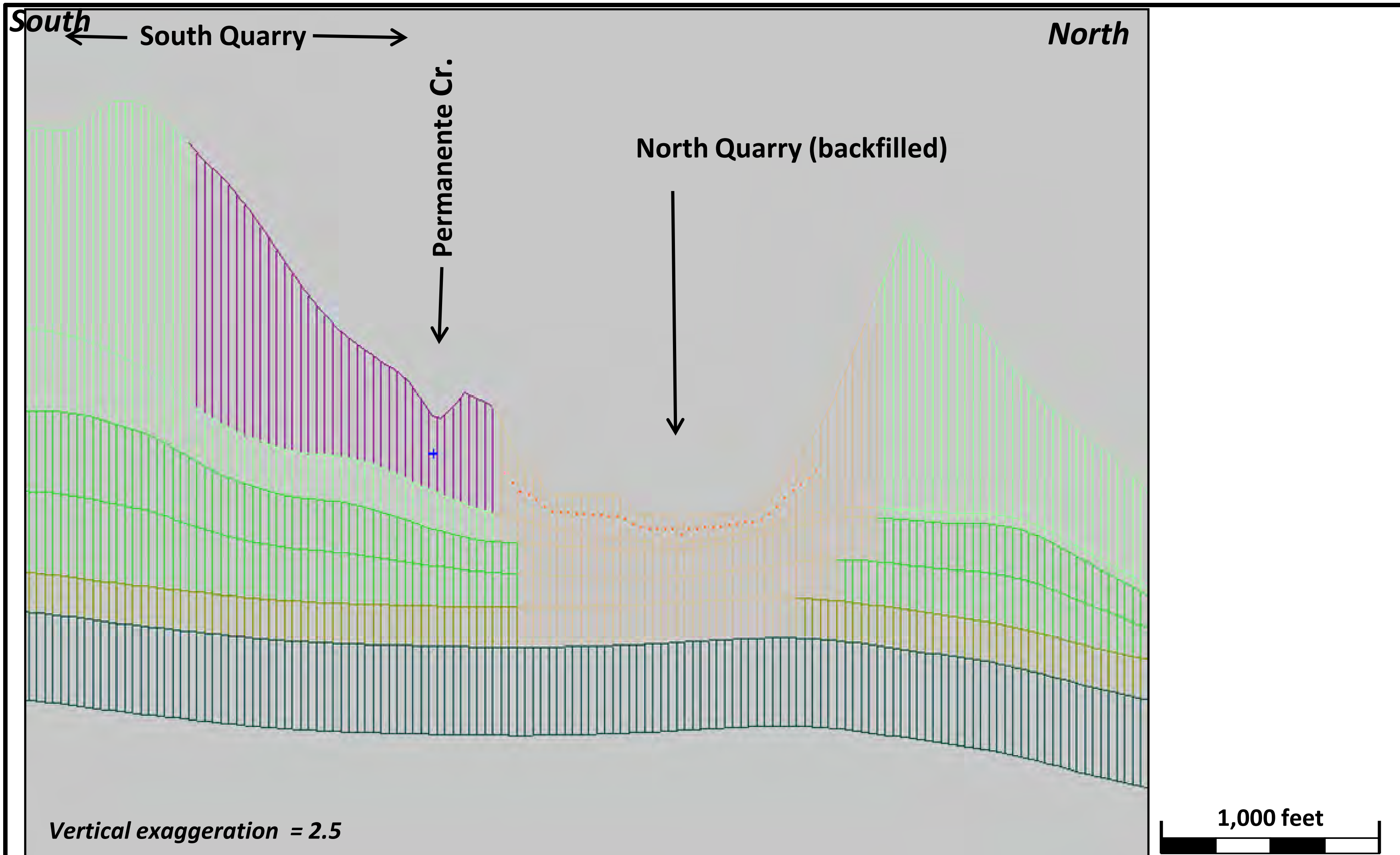
Section 5_MODFLOW_plots_041210.xlsx



Golder Associates	Title: North-South Section – Current Conditions			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	5.9



Golder Associates	Title: North-South Section – Phase 1		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 5.10



Golder Associates	Title: North-South Section – Phase 2		Drawn: SDT
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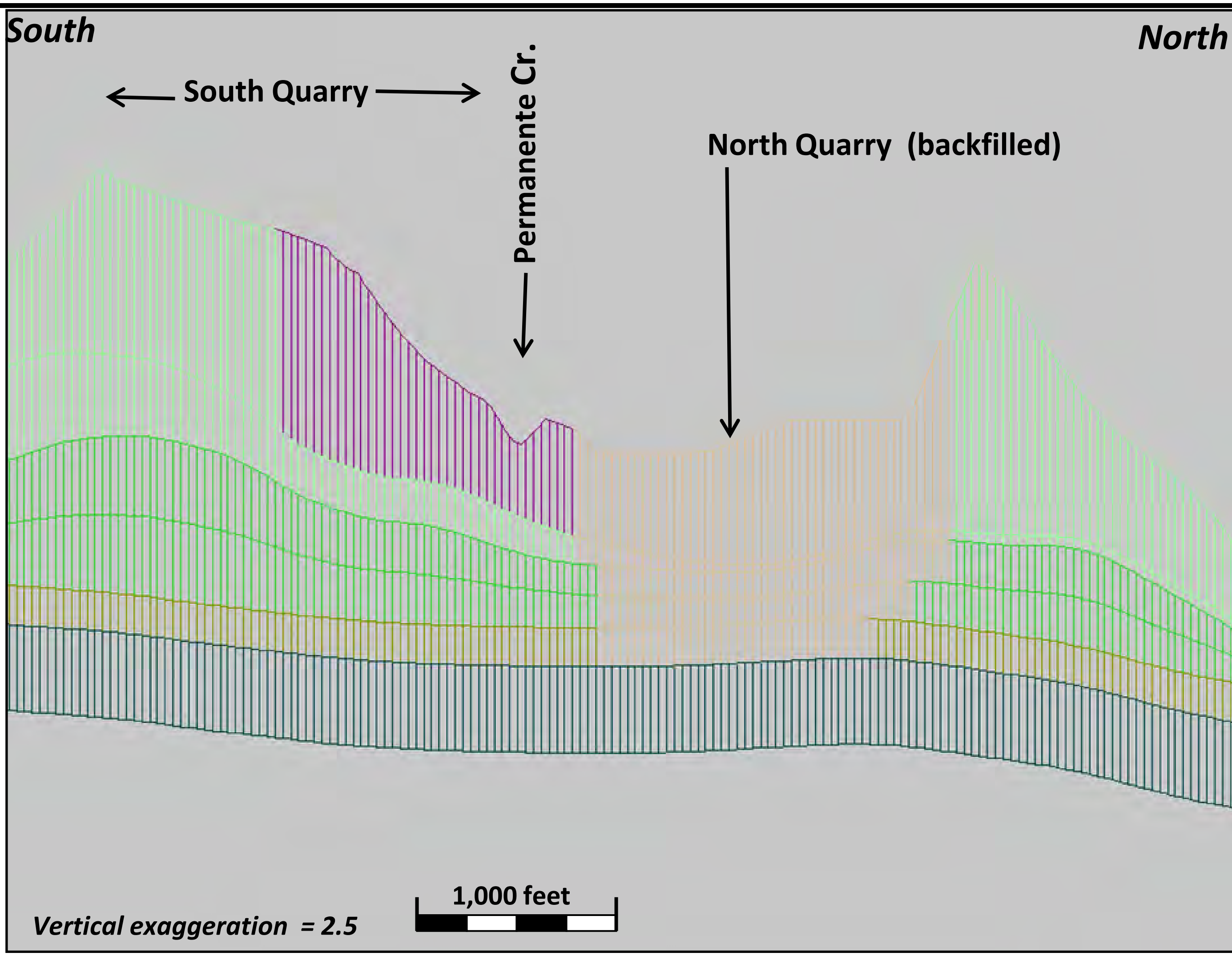
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500	Reviewed: DB
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE 5.11



Golder Associates	Title: North-South Section – Phase 3		Drawn: SDT
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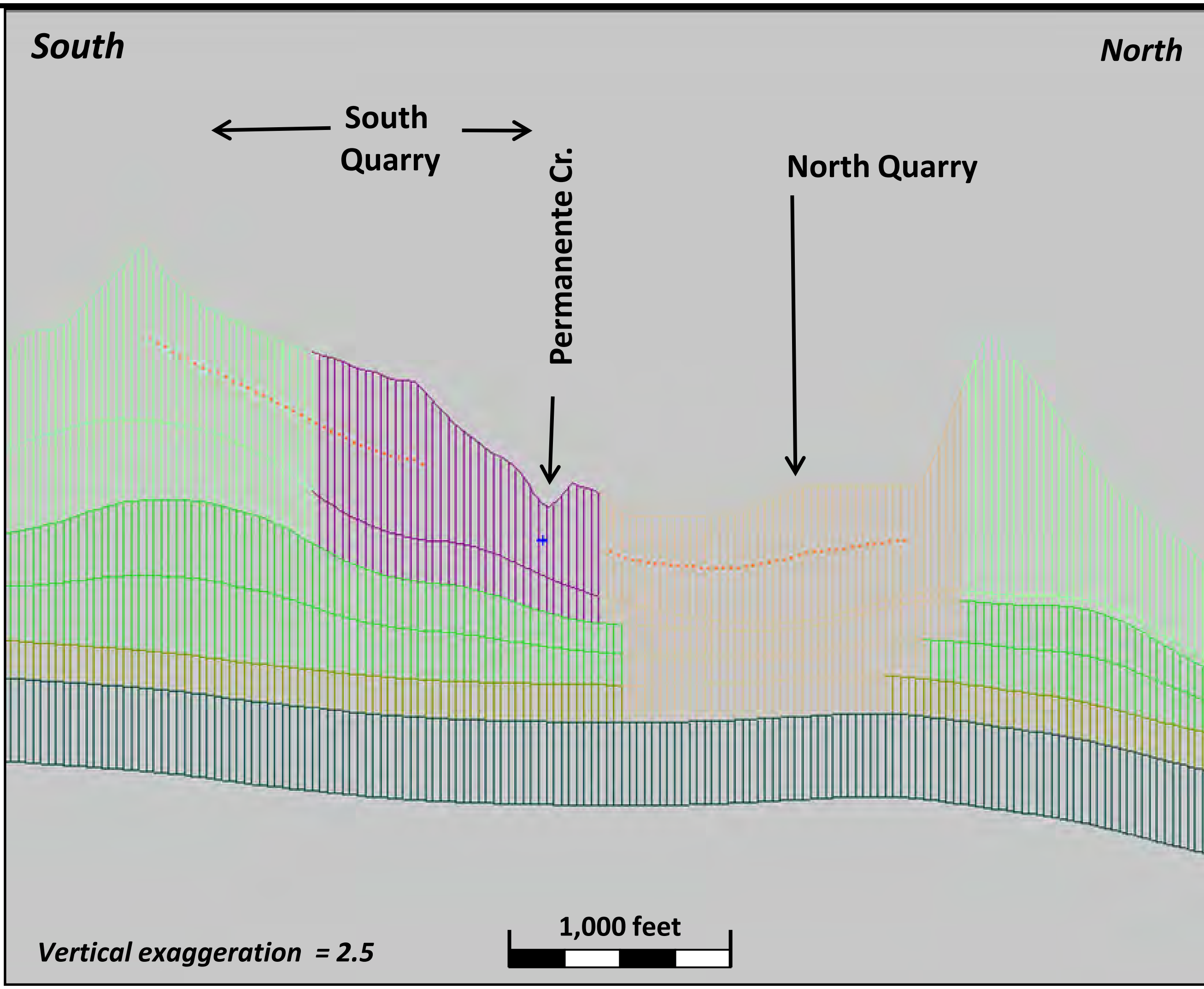
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500	Reviewed: DB
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE 5.12



Golder Associates	Title: North-South Section – Phase 4		Drawn: SDT
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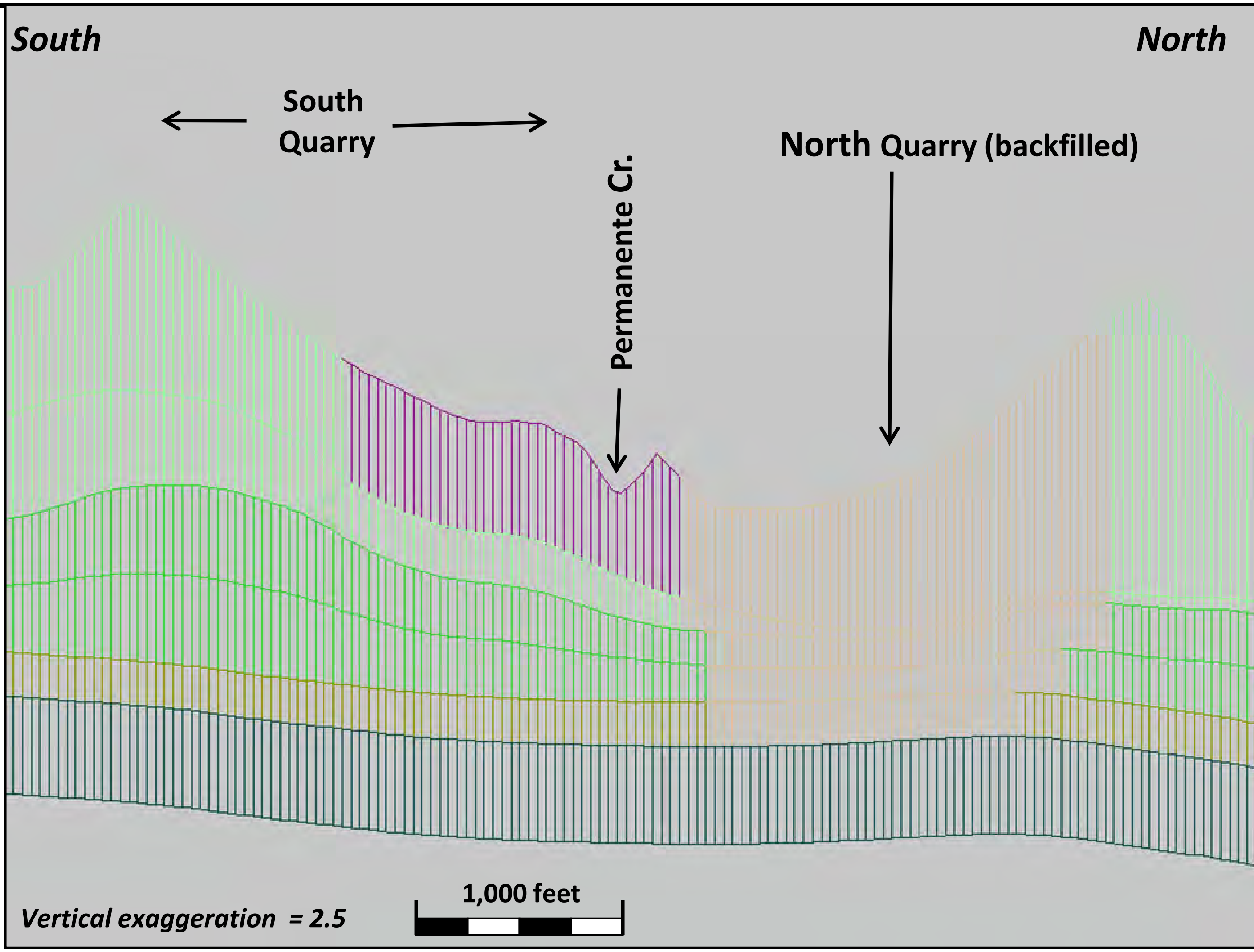
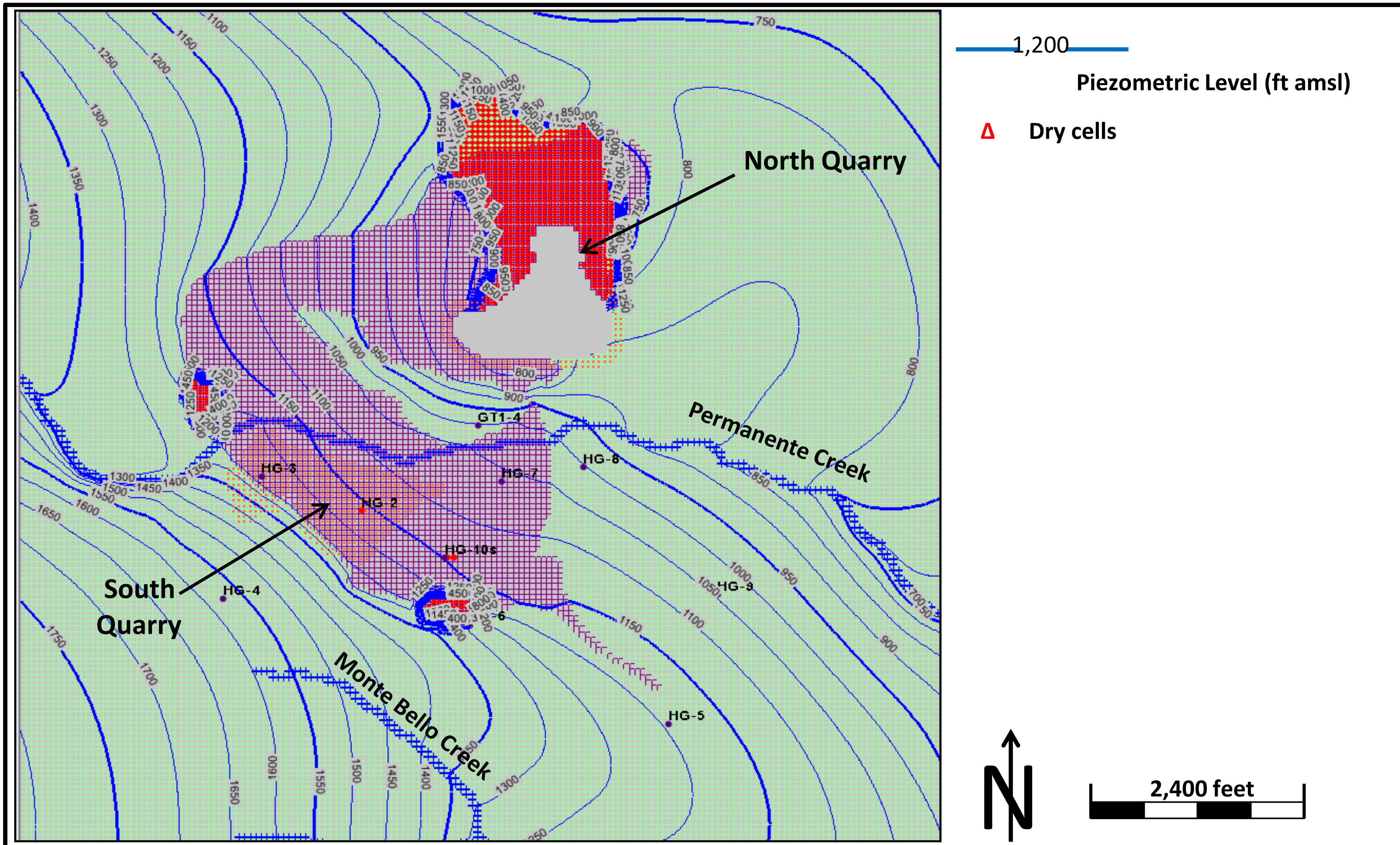
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500	Reviewed: DB
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE 5.13



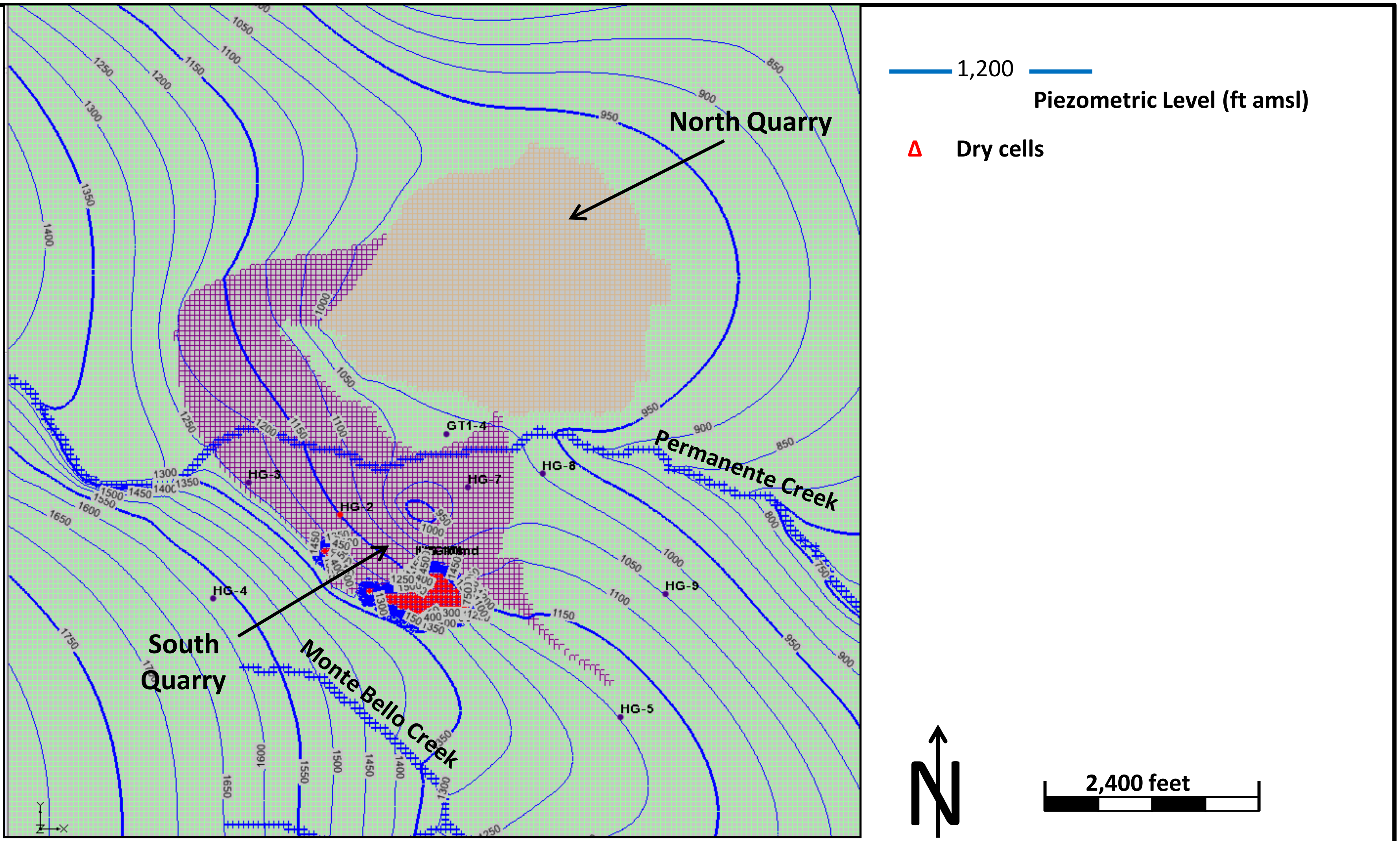
Golder Associates	Title: North-South Section – Phase 5		Drawn: SDT
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500	Checked: DH
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	Reviewed: DB
			FIGURE 5.14



Golder Associates

Title	Simulated Piezometric Heads – Phase 1			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	5.15

Section 5_MODFLOW_plots_041210.xlsx



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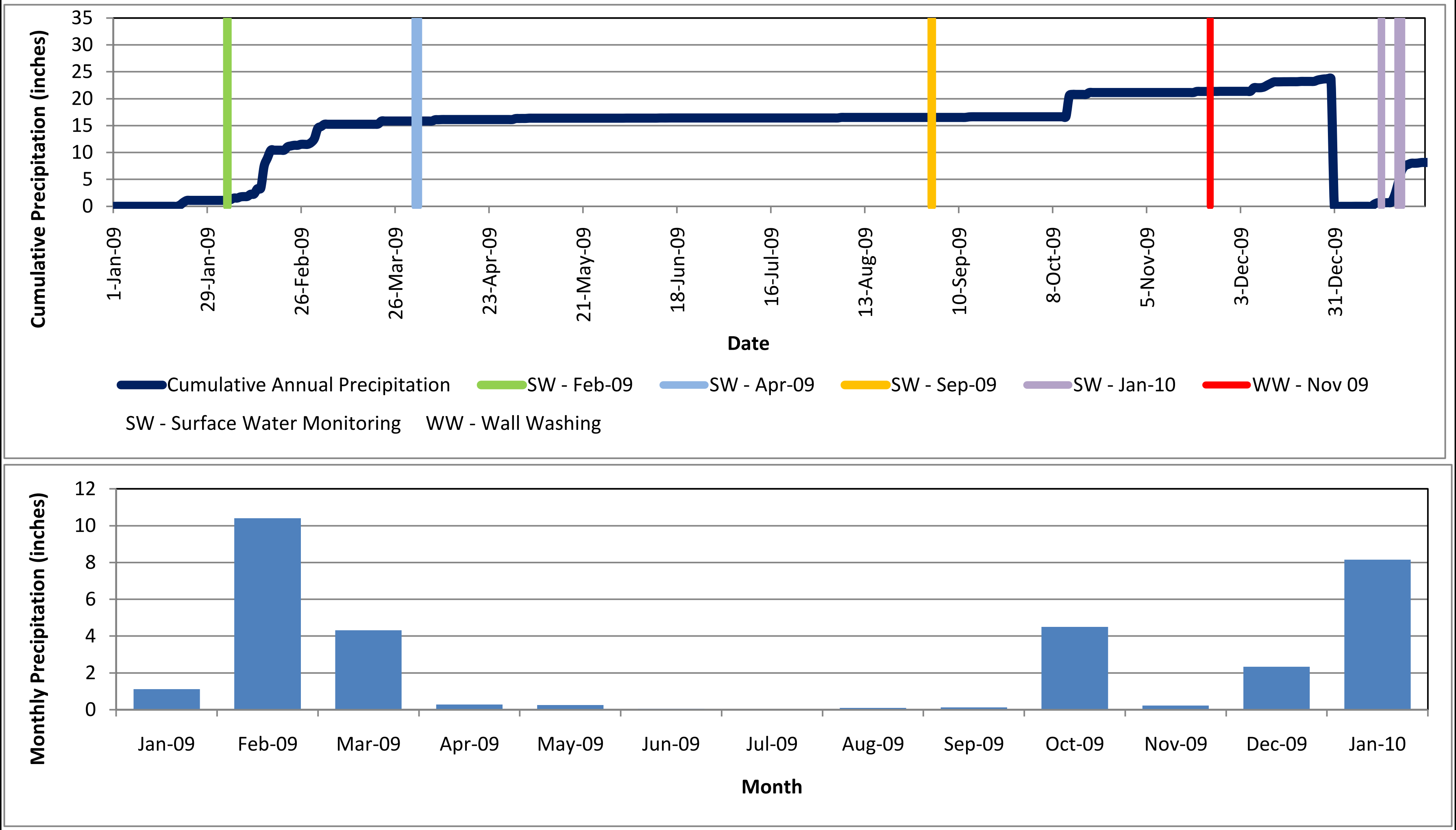
	Project Name	Hydrologic Investigation	Project No. 063-7109-500	Reviewed	DB
	Client Name	Permanente Quarry Reclamation Plan Update	Date May 2010	FIGURE	5.16



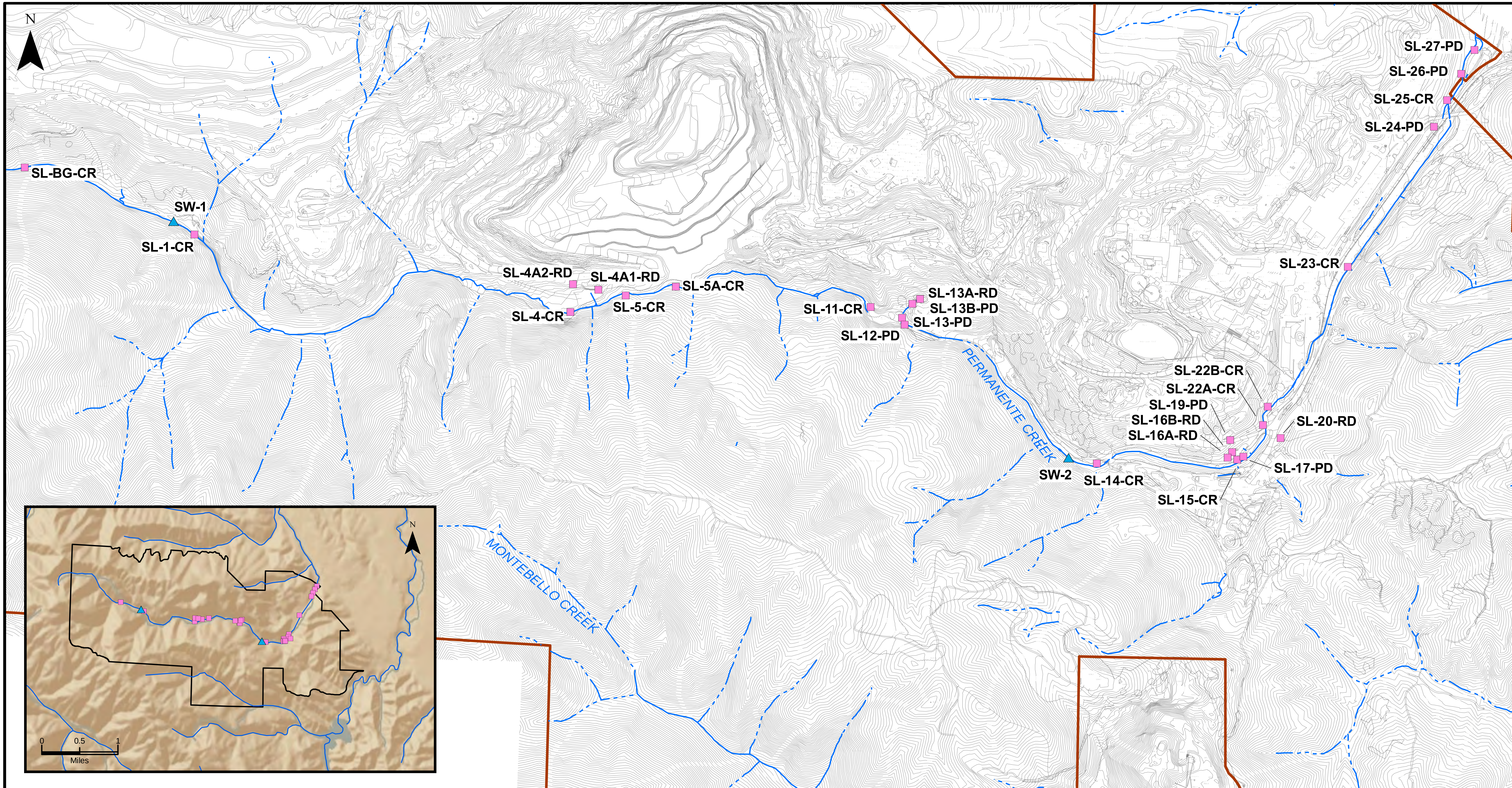
Golder Associates

Title	Site Precipitation vs. Surface Water and Wall Washing Sampling Events		
Project Name	Hydrologic Investigation	Project No.	063-7109.500
Client Name	Lehigh Southwest Cement Company	Date	May 2010

Drawn	CR
Checked	FV
Reviewed	DB

FIGURE 6.1

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Rainfall.xlsx



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

0 500 1,000 1,500
Feet

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

TITLE
STORM WATER SAMPLE LOCATIONS

Golder Associates

PROJECT No.		063-7109	FILE No.
DESIGN	DLM	2/8/2010	SCALE: AS SHOWN REV. 0
GIS	DLM	2/8/2010	
CHECK	GW	2/8/2010	**FIGURE 6.2**
REVIEW	WLF	2/8/2010	

G:\GIS\Sites\Lehigh_Permanente_Quarry\mxd\H_well_map

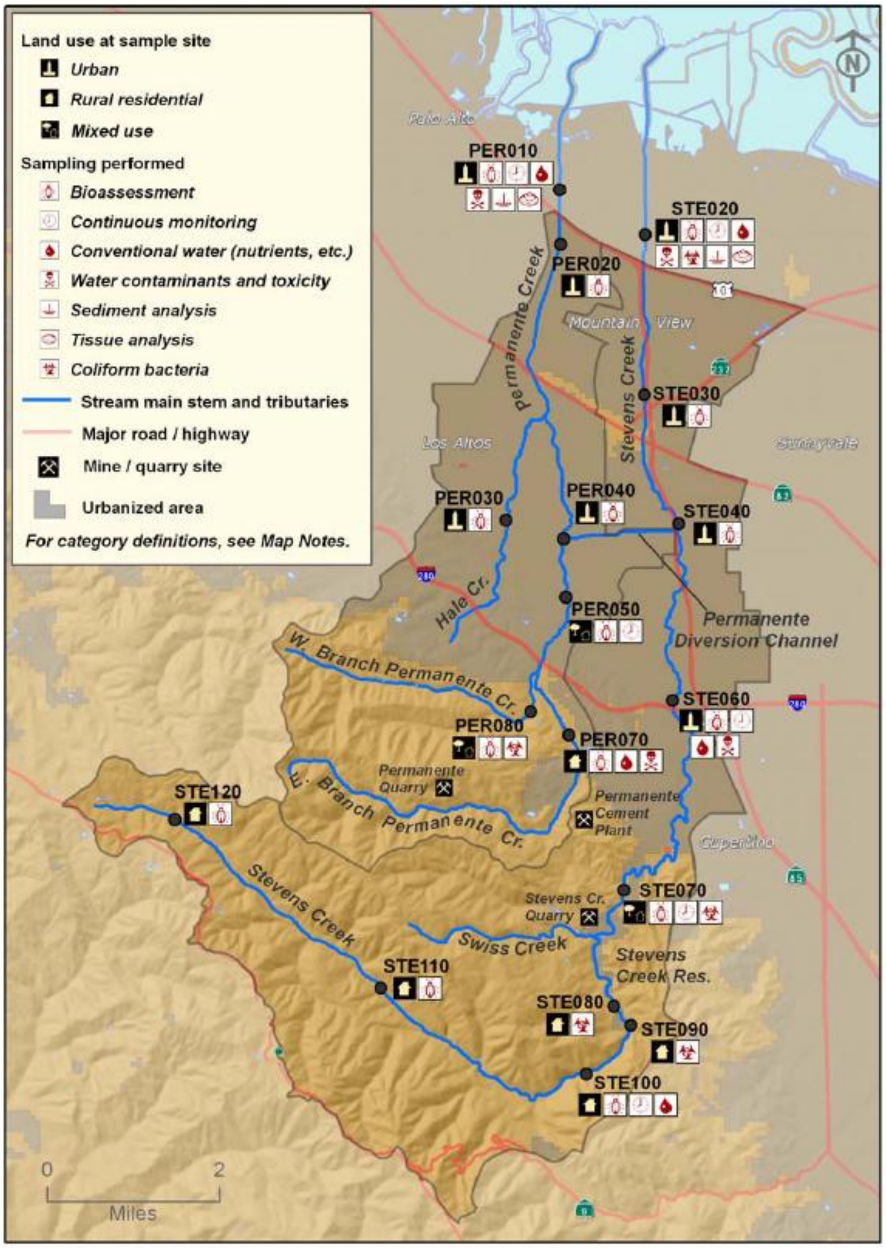


Figure 3-9. Stevens Creek and Permanente Creek watershed

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

3-19

Source: SFBRWQCB, 2007

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

Golder Associates

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

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Wall Washing.xlsx

Golder Associates	Title: Wall Washing - Graywacke (GW-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 6.5

Golder Associates	Title	Wall Washing - Chert Sample (CT-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	6.6

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

Golder Associates

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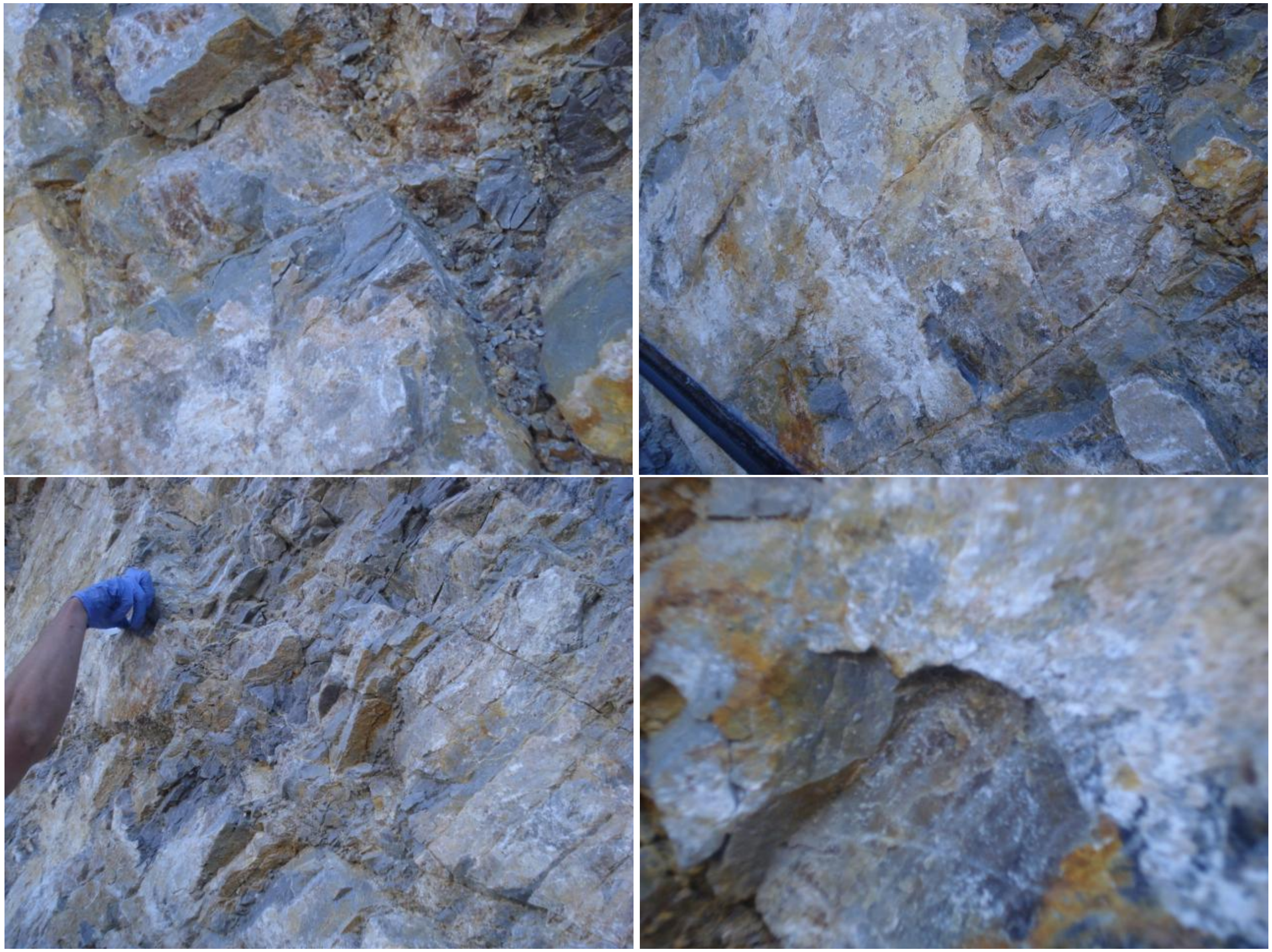


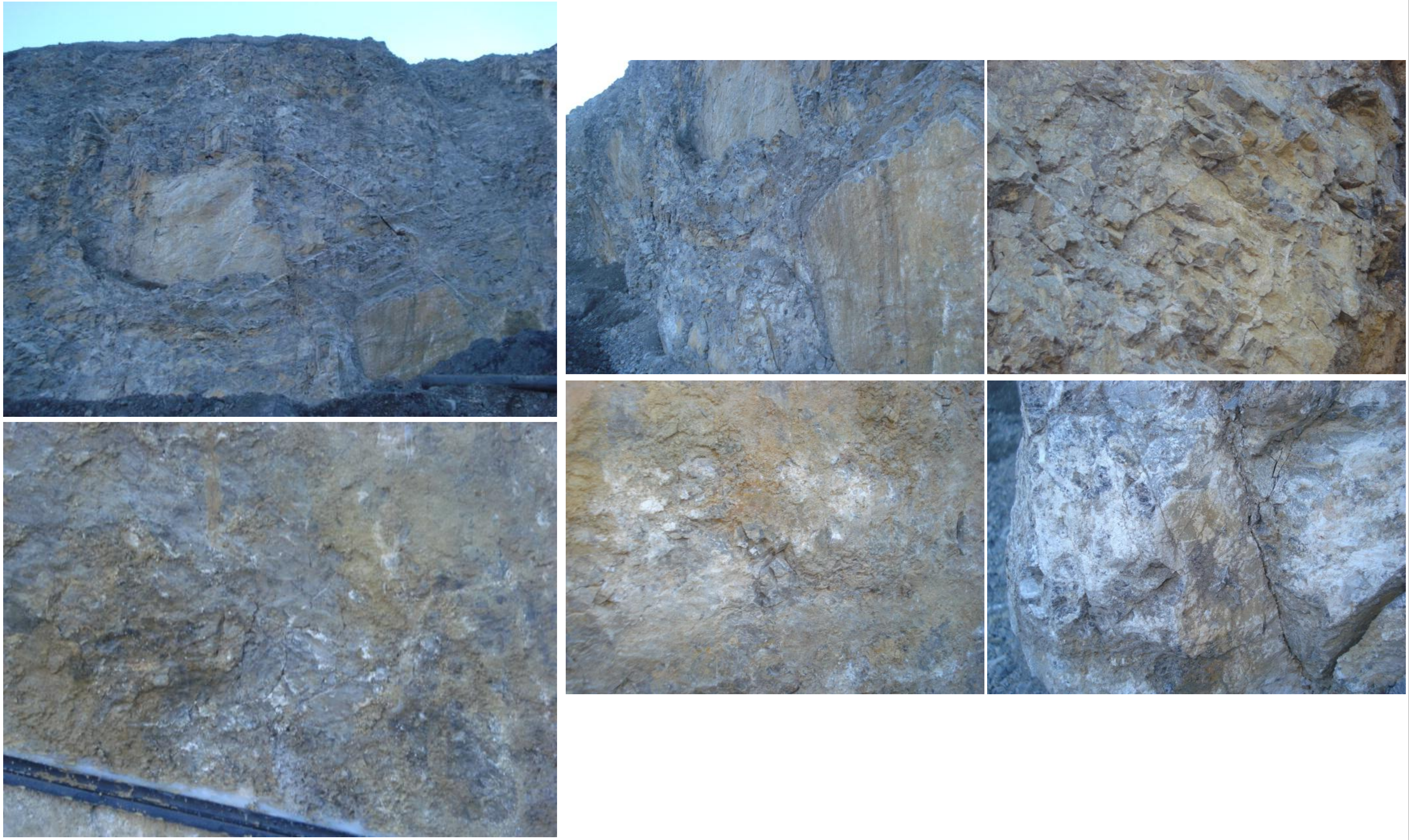
Golder Associates	Title: Wall Washing - Limestone - Medium to High Grade (MG-01)		Drawn: CR
			Checked: FV
	Project Name: Hydrologic Investigation	Project No. 063-7109.500	Reviewed: DB/RV
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE 6.8

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Wall Washing.xlsx

Golder Associates

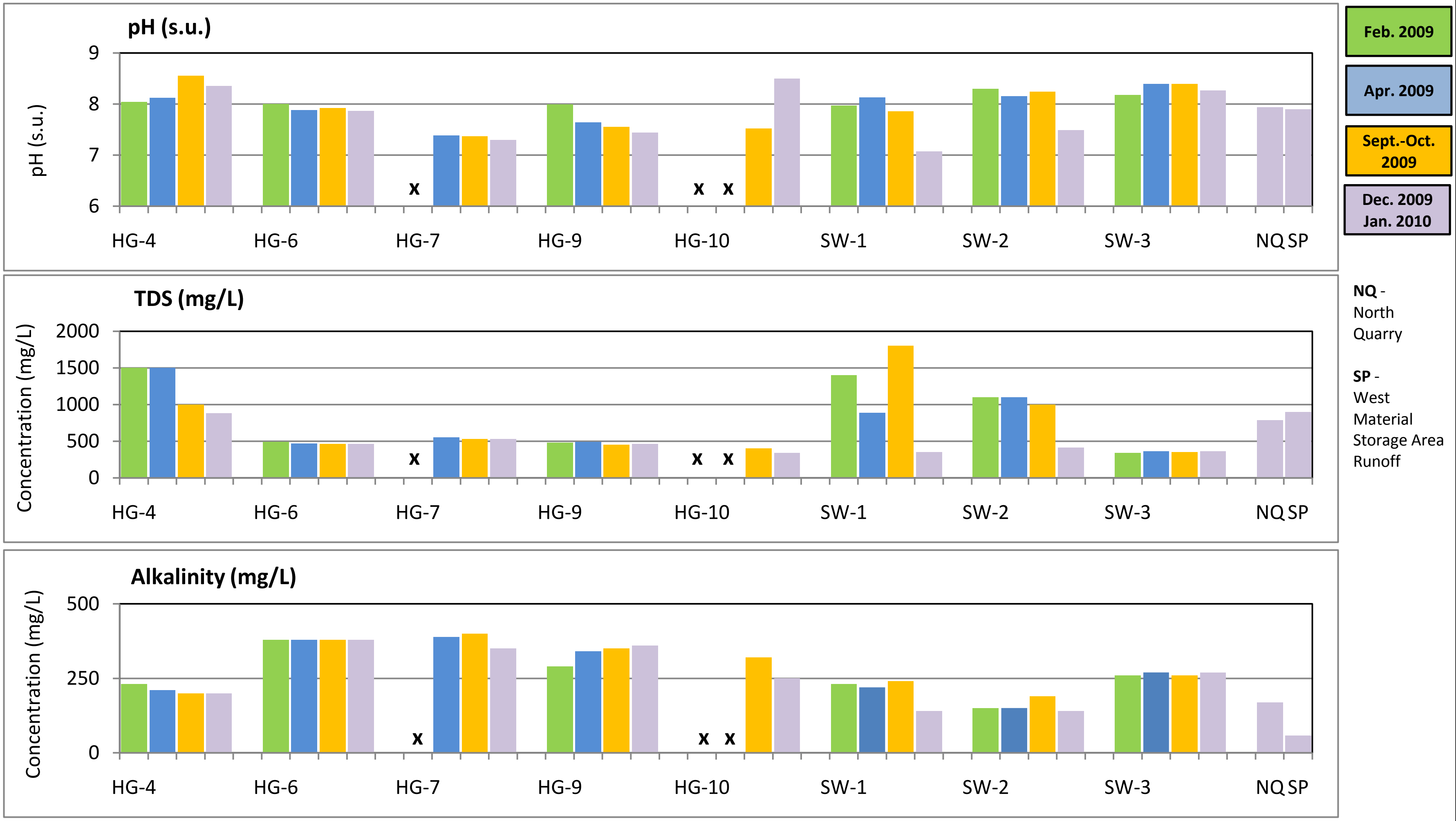
Title	Wall Washing - Limestone - High Grade (HG-01)		
Project Name	Hydrologic Investigation	Project No.	063-7109.500
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010

Drawn	CR
Checked	FV
Reviewed	DB/RV
FIGURE	6.9



Golder Associates

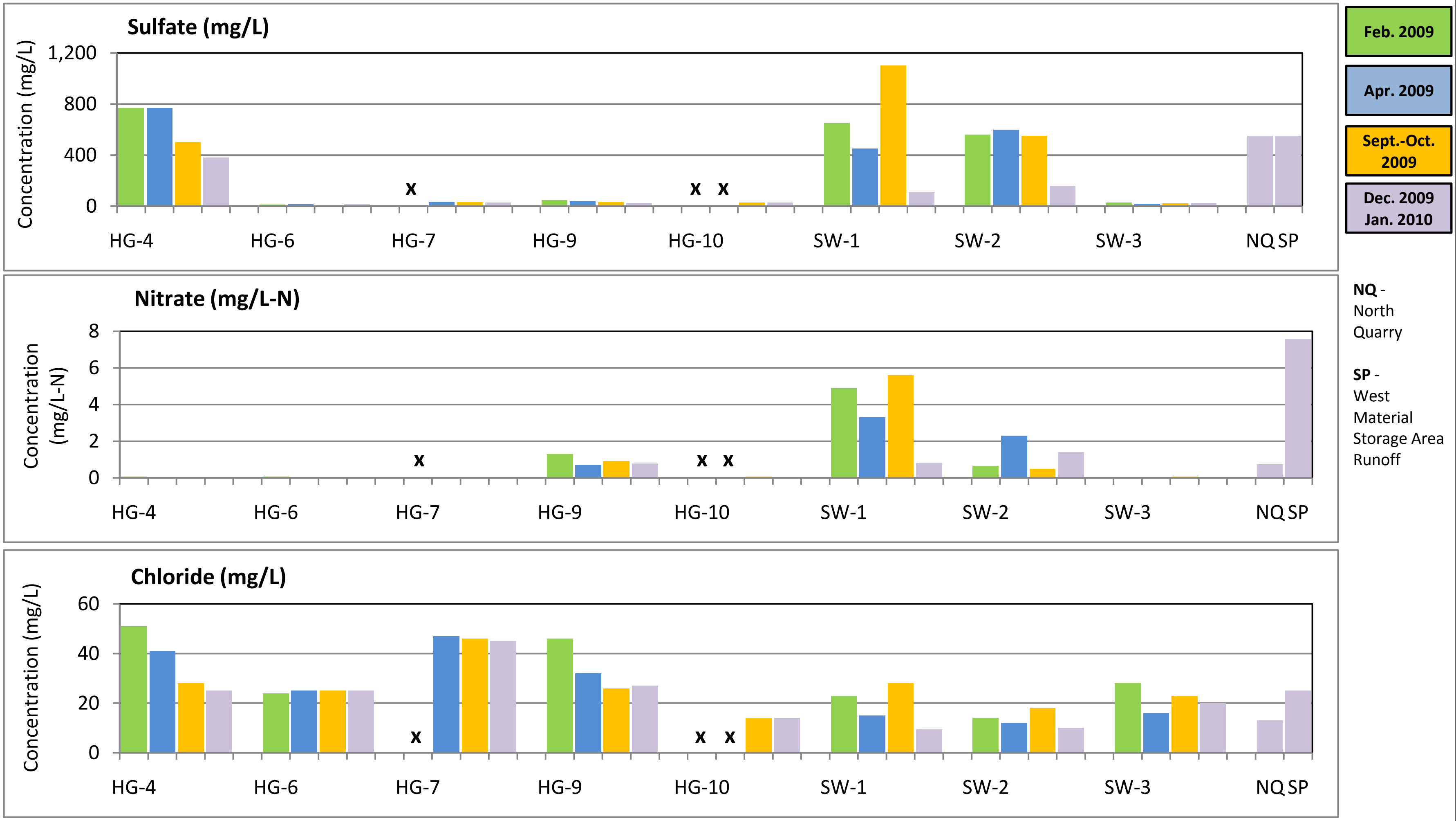
Title	Wall Washing - Limestone - High and Medium/Low Grade (HMG-01)	Drawn	CR
		Checked	FV
Project Name	Hydrologic Investigation	Project No.	063-7109.500
		Reviewed	DB/RV
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010
FIGURE	6.10		



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

Golder Associates	Title: Current Water Quality - pH, TDS and Alkalinity		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 6.11

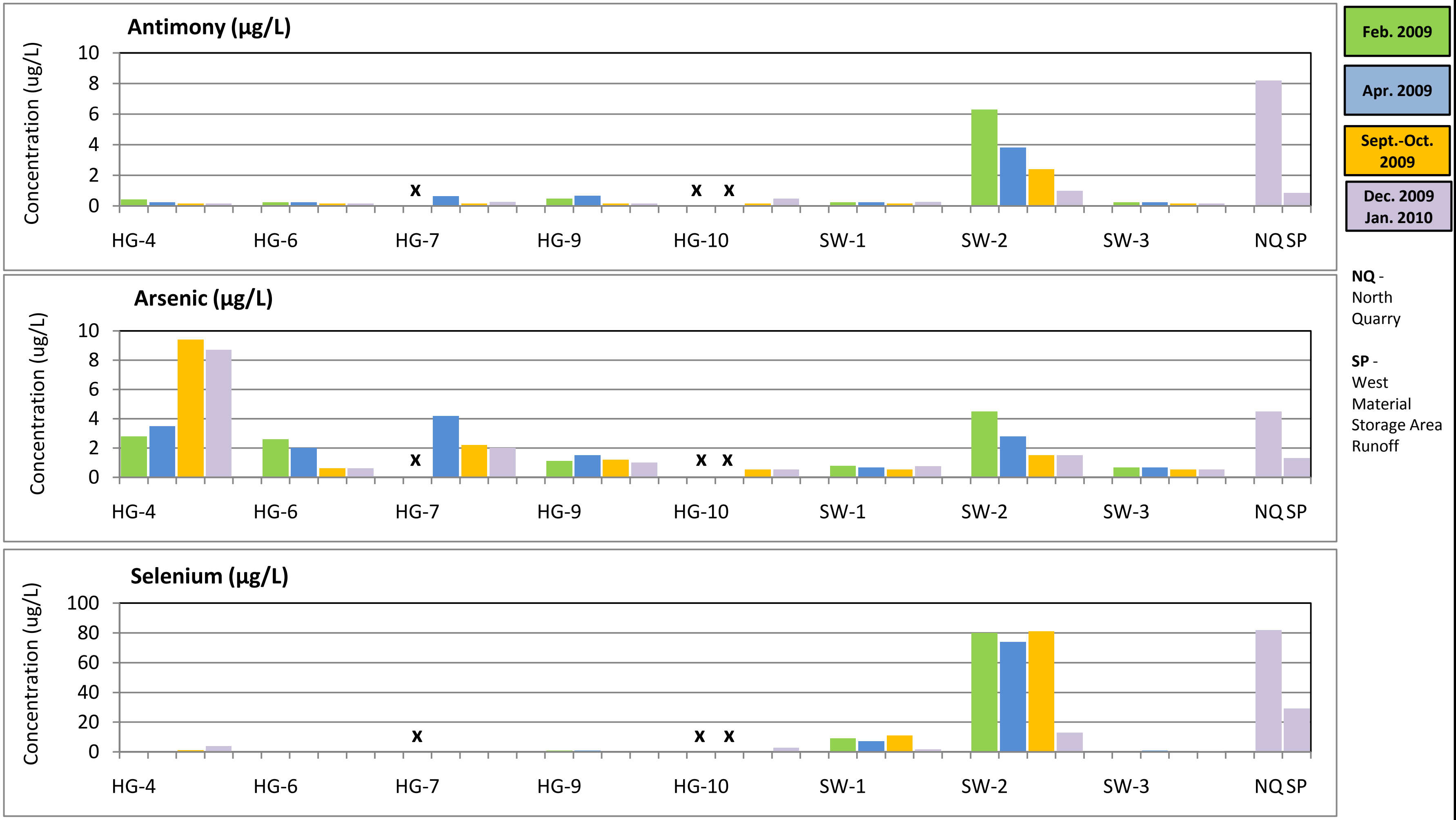
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Water Quality Eval (Feb 2010).xlsx



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

Golder Associates	Title	Current Water Quality - SO4, NO3 and Cl	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 6.12

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Water Quality Eval (Feb 2010).xlsx

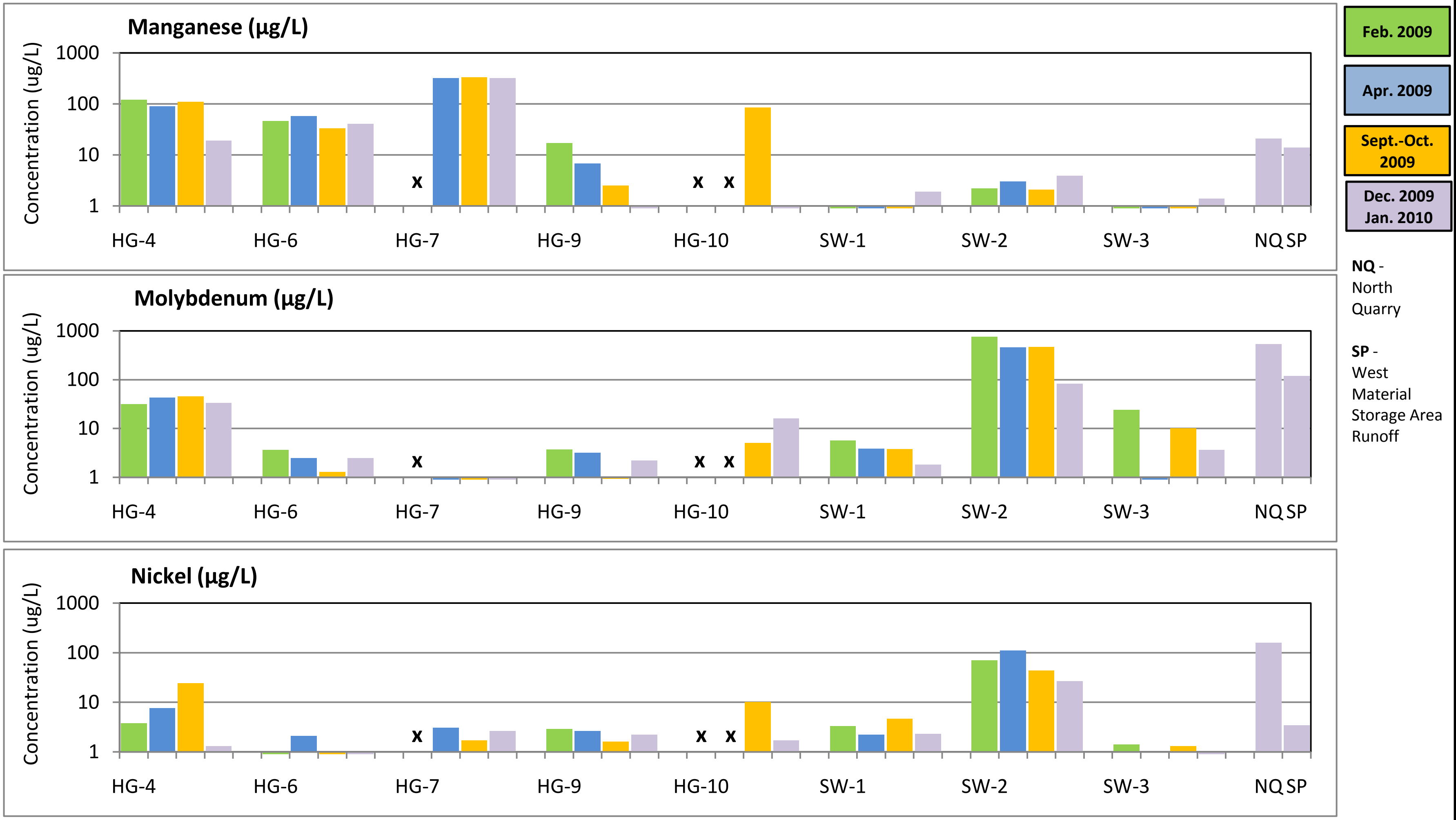


Non-detect values shown at the detection limit. "x" - no sample collected.

Golder Associates

Title	Current Water Quality - Sb, As and Se	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	6.13

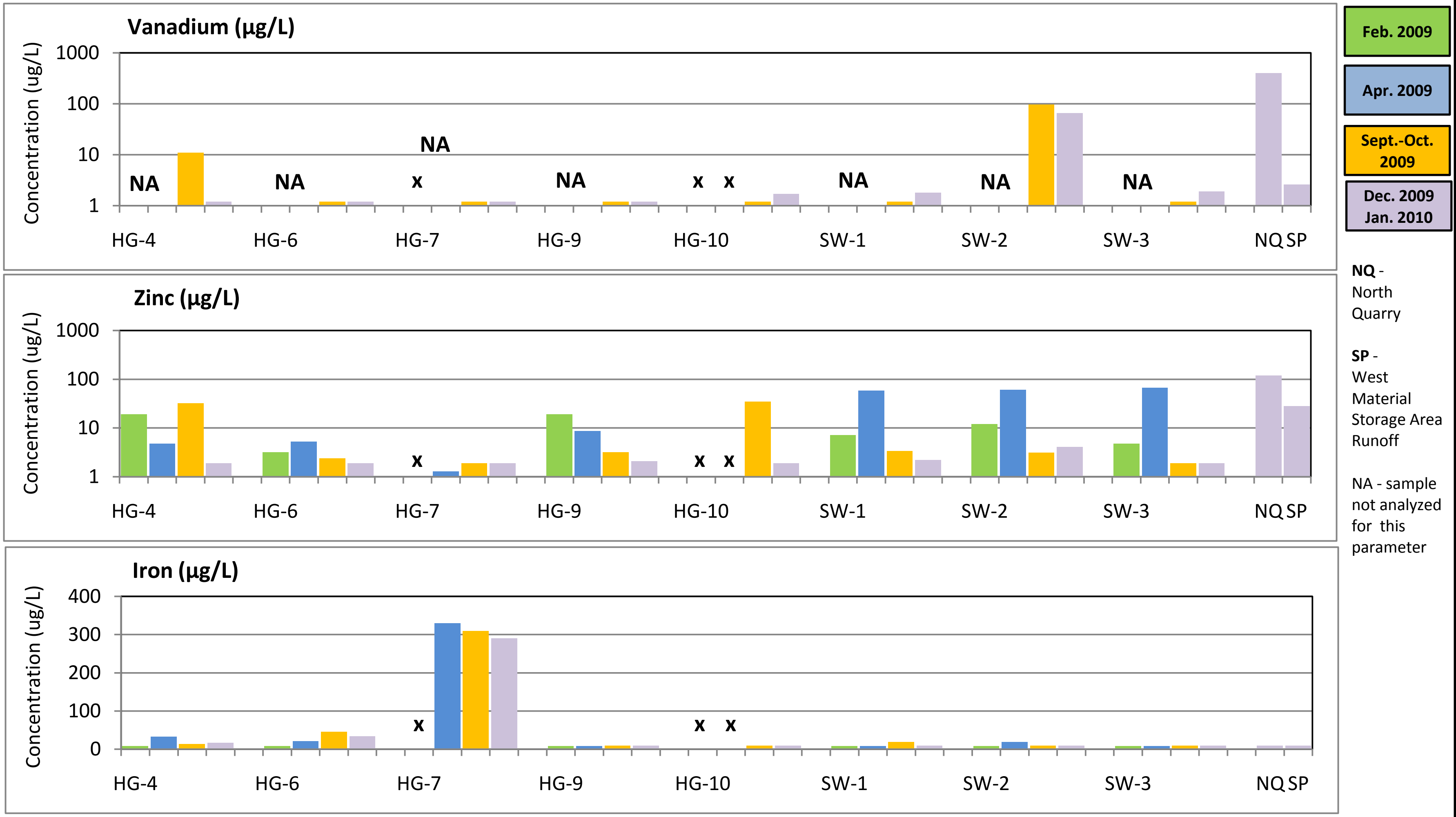
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Water Quality Eval (Feb 2010).xlsx



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

Golder Associates	Title: Current Water Quality - Mn, Ni and Mo		Drawn: CR Checked: FV Reviewed: DB/RV
	Project Name: Hydrologic Investigation	Project No.: 063-7109.500	
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE 6.14

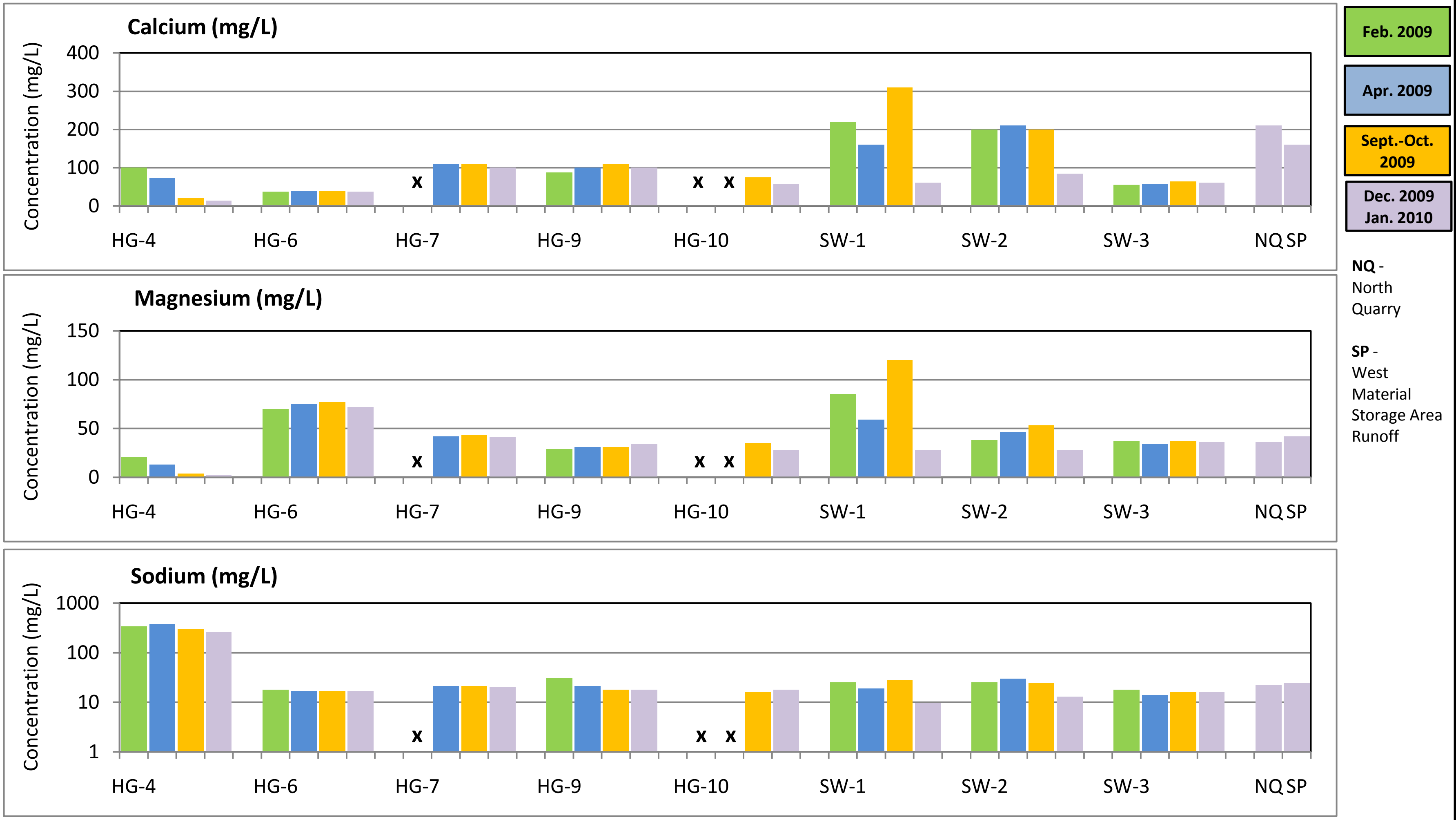
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Water Quality Eval (Feb 2010).xlsx



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

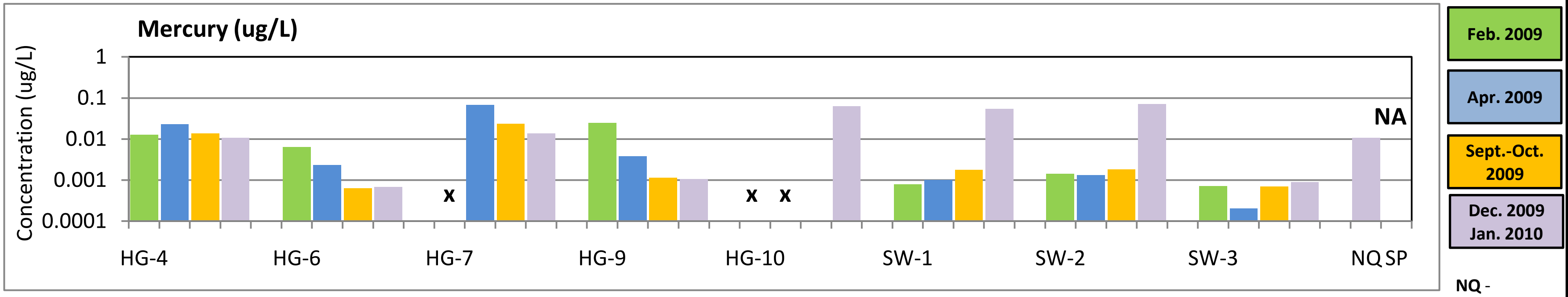
Golder Associates	Title: Current Water Quality - V, Zn and Fe		Drawn: CR
	Project Name: Hydrologic Investigation	Project No.: 063-7109.500	Checked: FV
			Reviewed: DB/RV
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE 6.15

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Water Quality Eval (Feb 2010).xlsx



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

Golder Associates	Title	Current Water Quality - Ca, Mg and Na		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	6.16



NQ - North Quarry

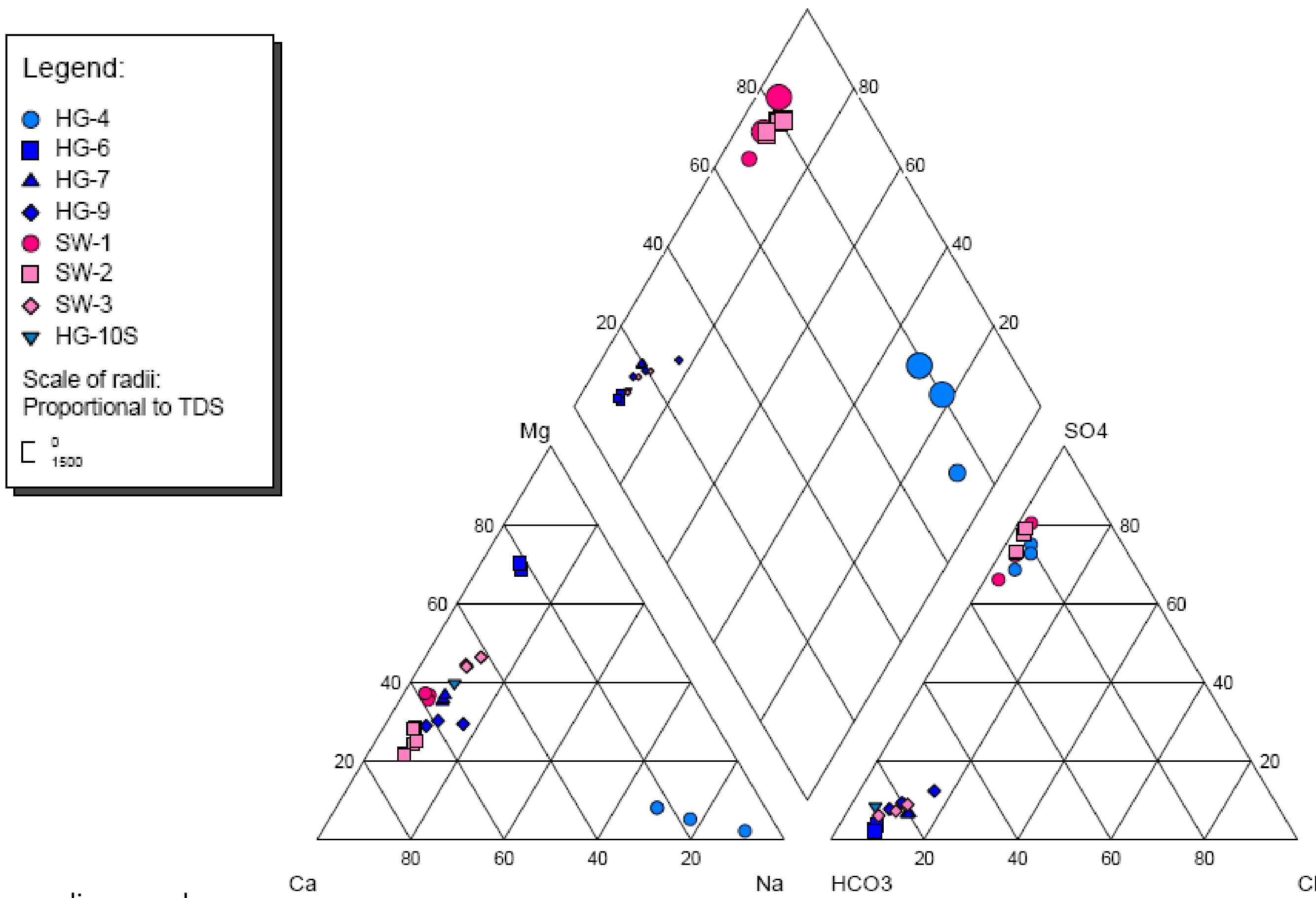
SP - West Material Storage Area Runoff

NA - sample not analyzed for this parameter

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

Golder Associates	Title: Current Water Quality - Hg		Drawn	CR
	Project Name: Hydrologic Investigation	Project No.: 063-7109.500	Checked	FV
			Reviewed	DB/RV
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE	6.17

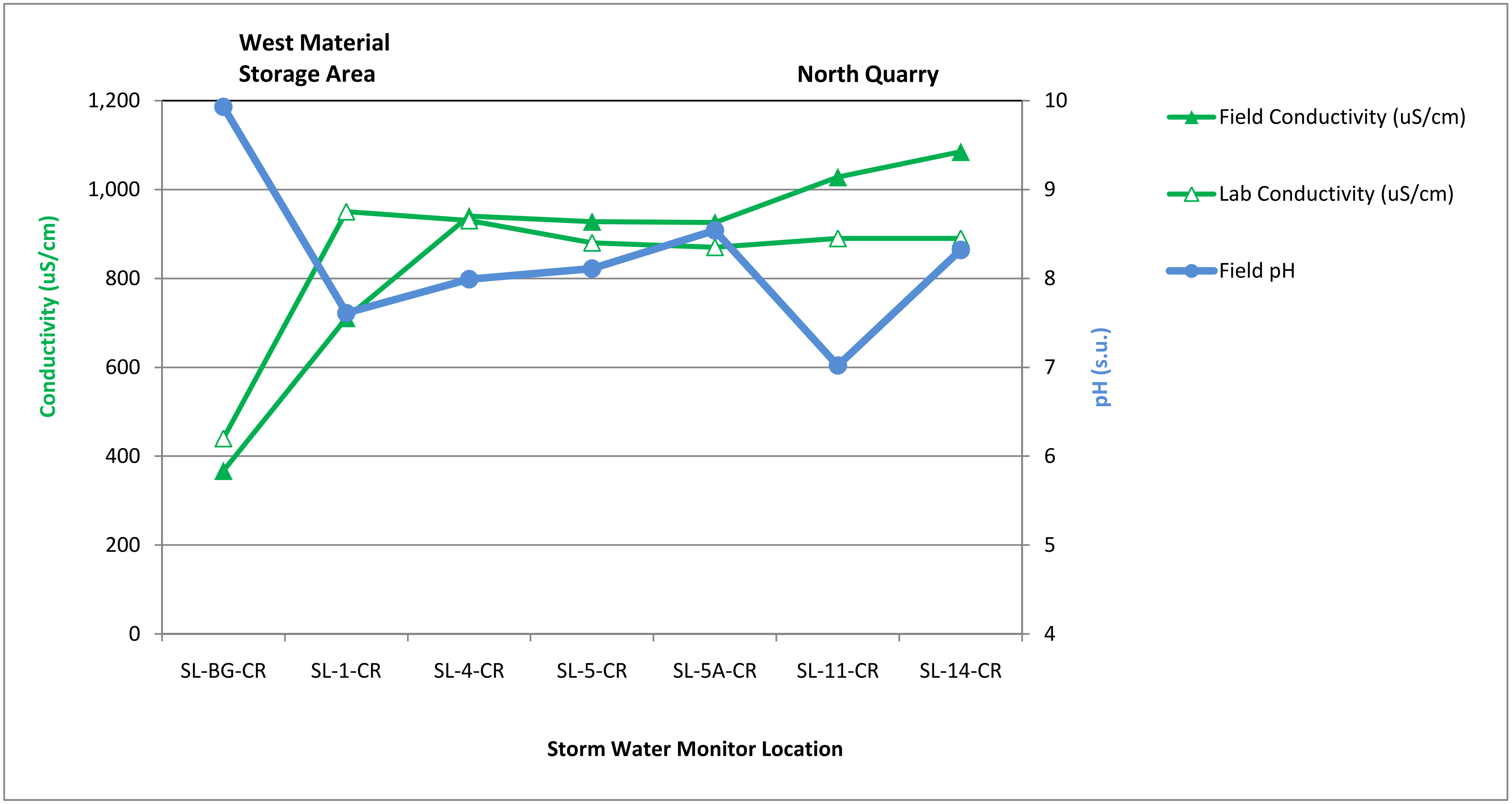
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Water Quality Eval (Feb 2010).xlsx



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

Title	Groundwater and Surface Water Piper Plot			Drawn	CR
				Checked	RV
Project Name	Hydrologic Investigation	Project No.	063-7109.500	Reviewed	BF
Client Name	Permanente Quarry Rec Plan Update	Date	May 2010	FIGURE	6.18

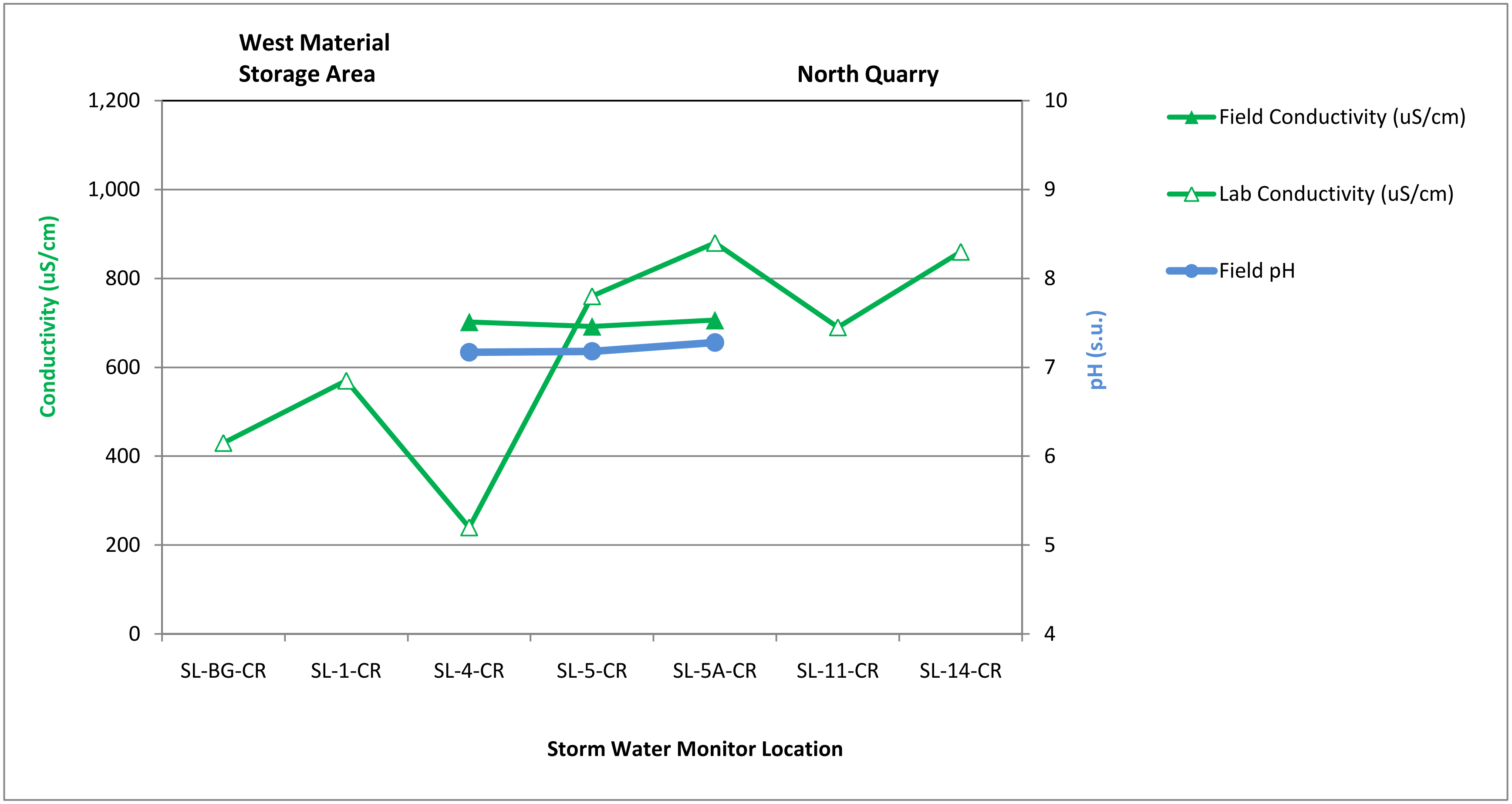
Golder Associates



Non-detect values shown at the detection limit.

Golder Associates	Title: Permanente Creek - Storm Water Monitoring Data (January 18, 2006)		Drawn	CR
	Project Name: Hydrologic Investigation	Project No. 063-7109.500	Checked	FV
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	Reviewed	DB/RV
			FIGURE	6.19

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Stormwater Data.xlsx

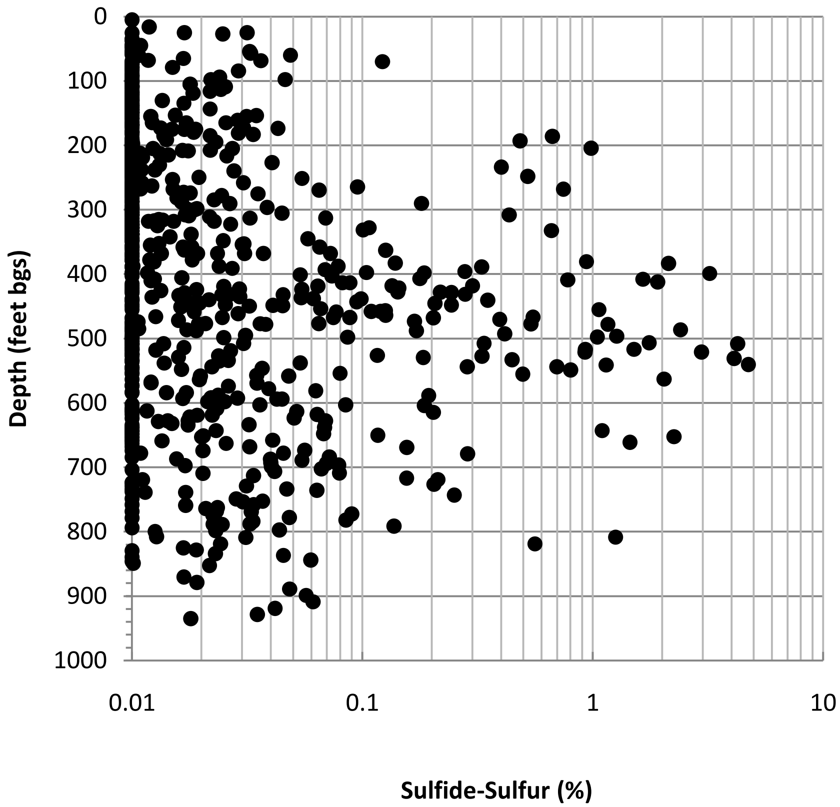


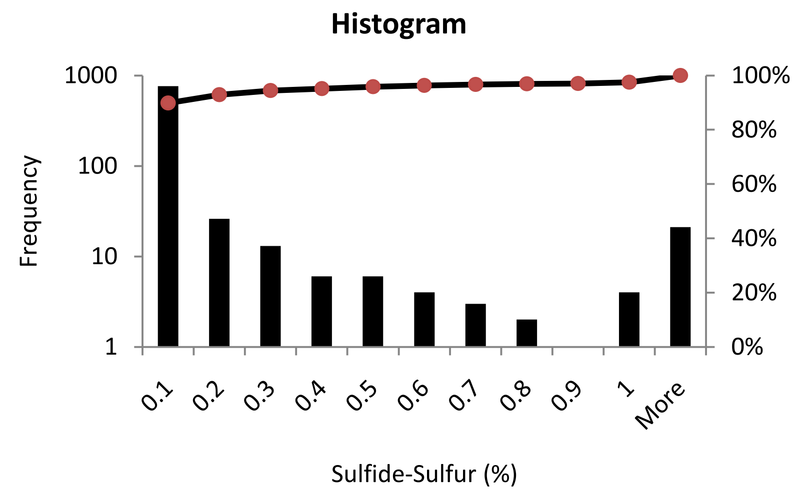
Non-detect values shown at the detection limit.

Golder Associates	Title	Permanente Creek - Storm Water Monitoring Data (February 27, 2006)	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 6.20

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Stormwater Data.xlsx

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





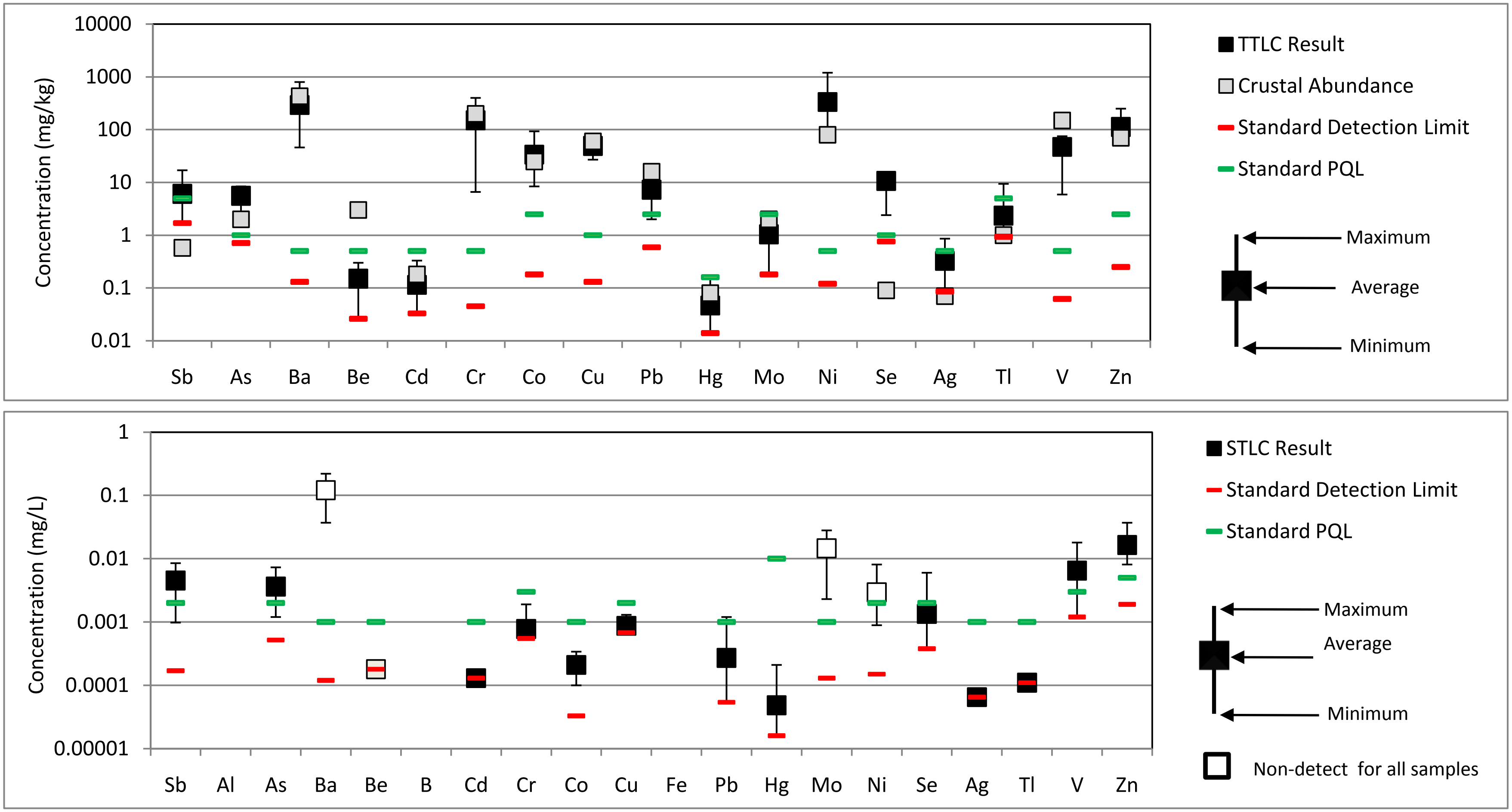
Non-detect values shown at the detection limit.

Golder Associates

Title	Limestone Ore Sulfide-Sulfur Data		
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

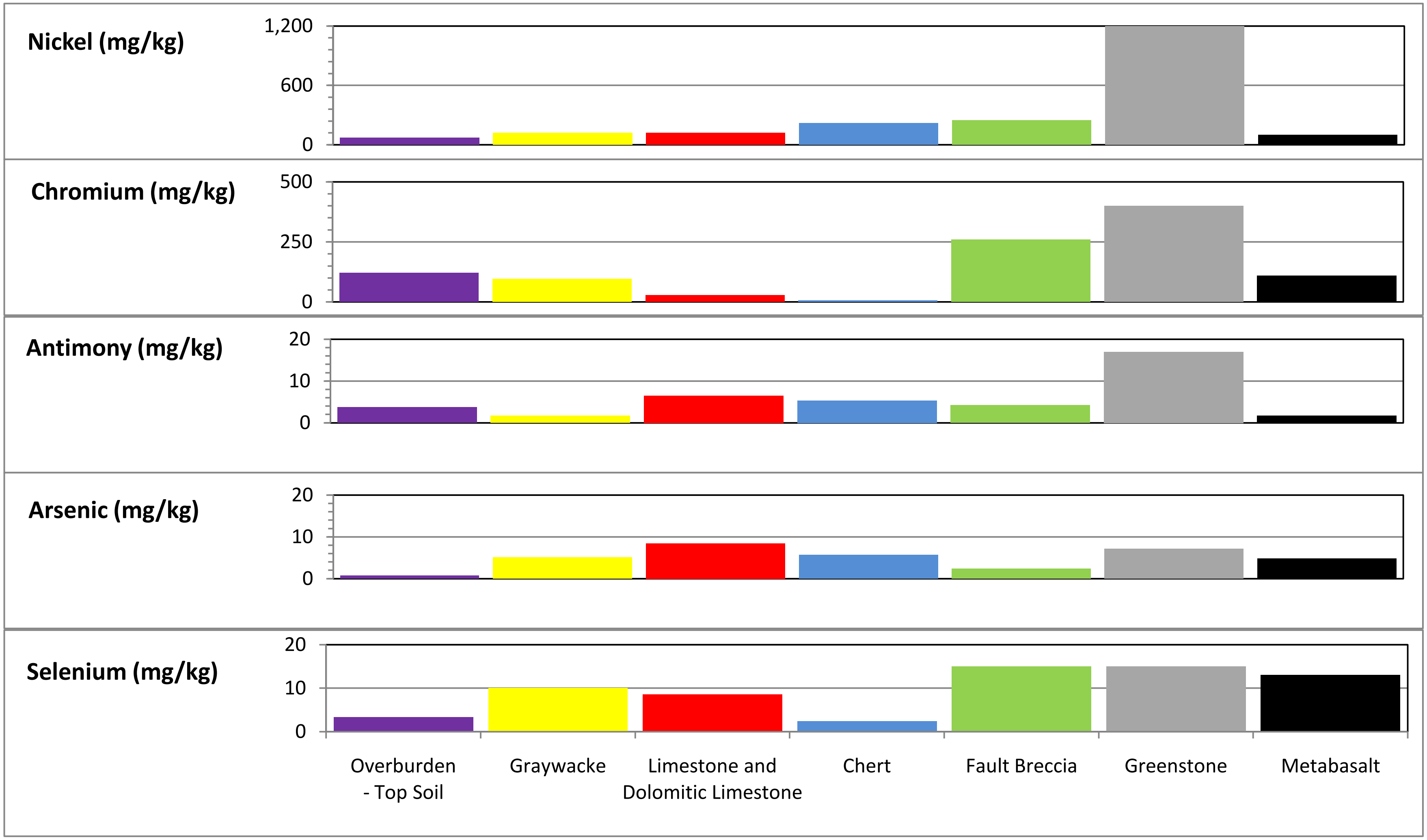
FIGURE 6.21



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).

Golder Associates

Title	Overburden (Rock) and Ore - TTLC and STLC Results			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	6.22

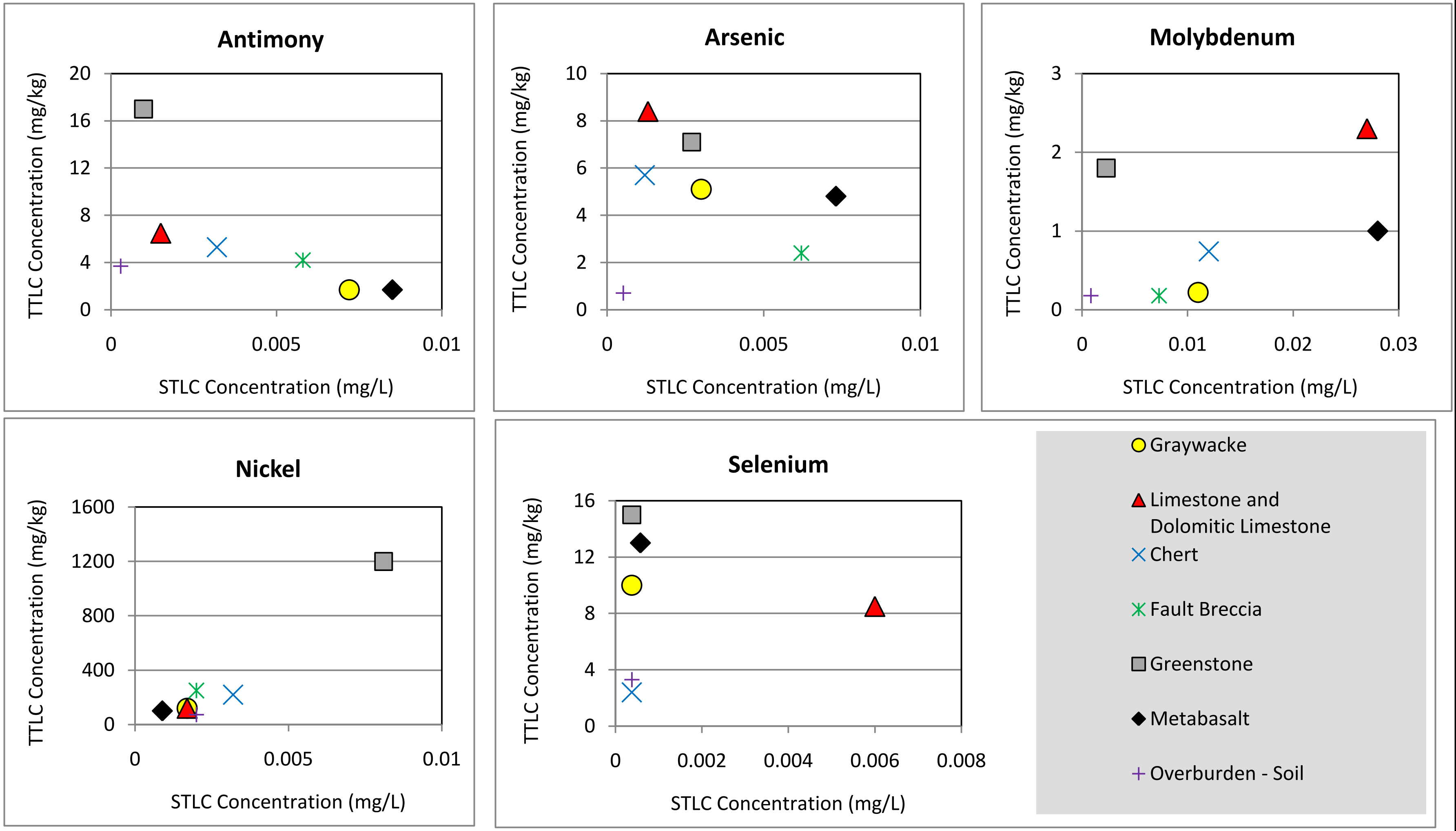


Non-detect values shown at the detection limit.

Golder Associates

Title	Overburden (Rock and Soil) and Ore - Elemental Composition			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	6.23

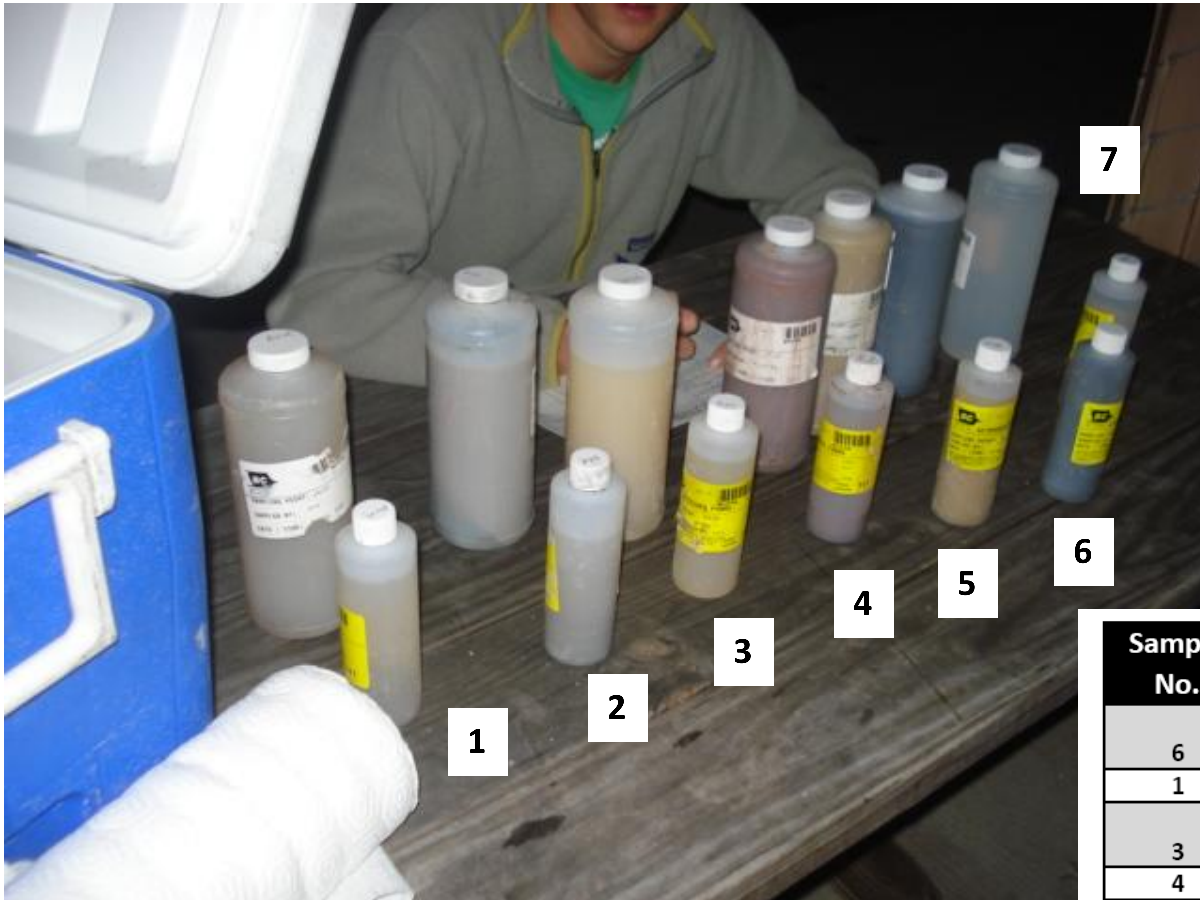
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Waste Rock Data.xlsx



Non-detect values shown at the detection limit.

Golder Associates	Title	Overburden (Rock and Soil) and Ore - TTLC vs. STLC		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	6.24

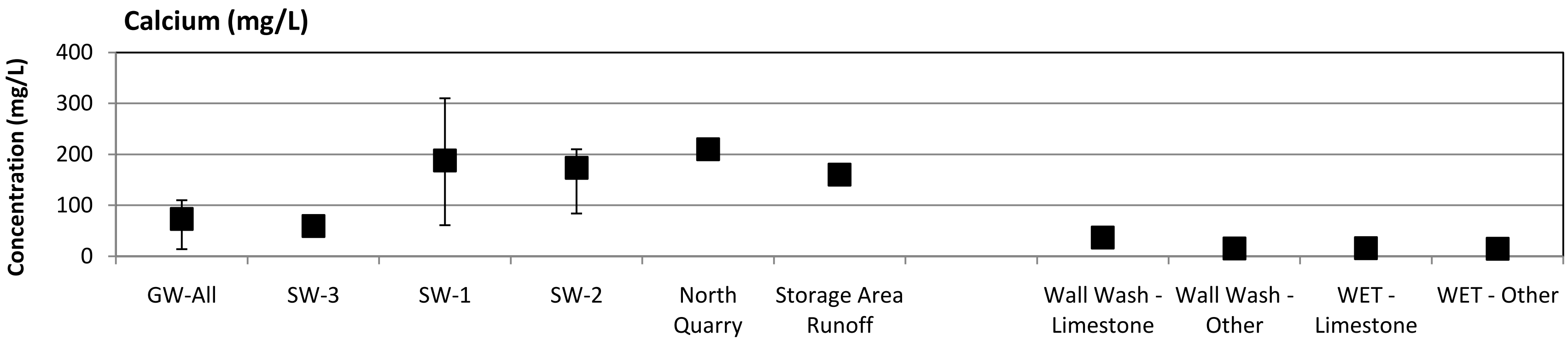
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Waste Rock Data.xlsx

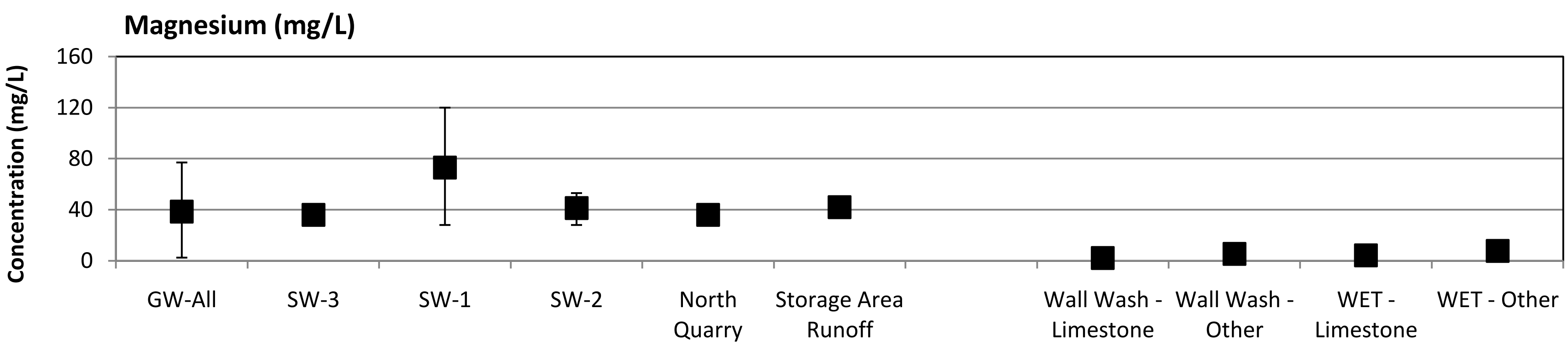


Sample No.	Sample ID	Rock Type
6	HG-01	Limestone - high grade
1	GW-01	Greywacke
3	MG-01	Limestone - medium to high grade
4	CT-01	Chert
5	HMG-01	Limestone - high and med/low grade
2	GS-01	Greenstone
7	FB-01	Field Blank

Golder Associates

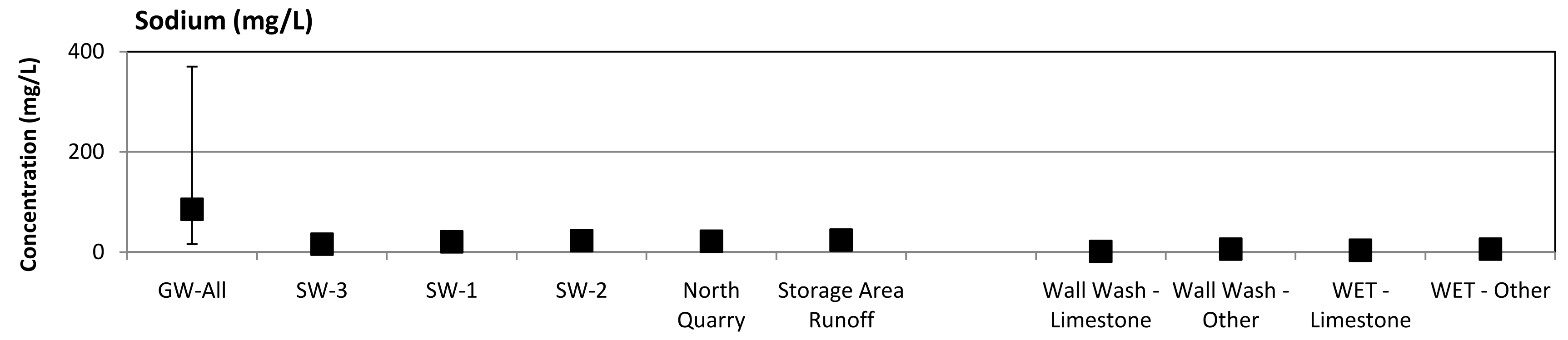
Title	Wall Washing - Samples	Drawn	CR
		Checked	FV
Project Name	Hydrologic Investigation	Project No.	063-7109.500
		Reviewed	DB/RV
Client Name	Permanente Quarry Reclamation Plan Update	Date	May 2010
		FIGURE	6.25

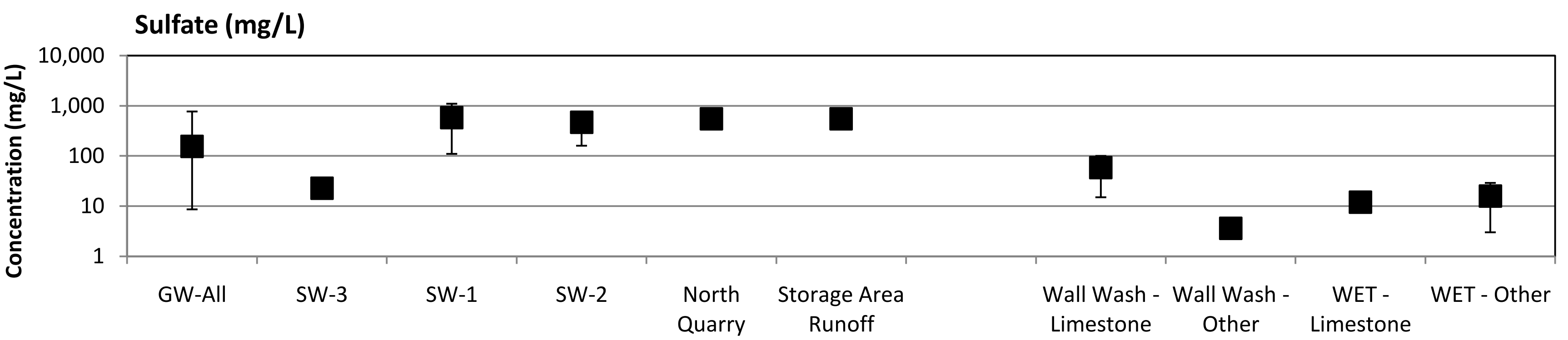




Golder Associates	Title: Water Quality Comparison - Ca and Mg		Drawn: CR / Checked: FV / Reviewed: RV/DB
	Project Name: Hydrologic Investigation	Project No.: 063-7109.500	
	Client Name: Permanente Quarry Reclamation Plan Update	Date: May 2010	FIGURE 6.26

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Water Types.xlsx

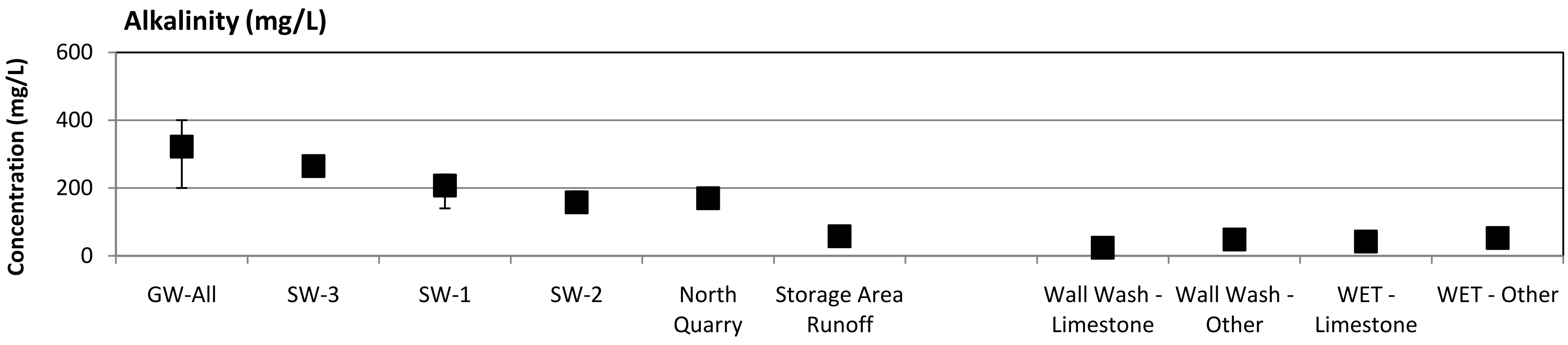


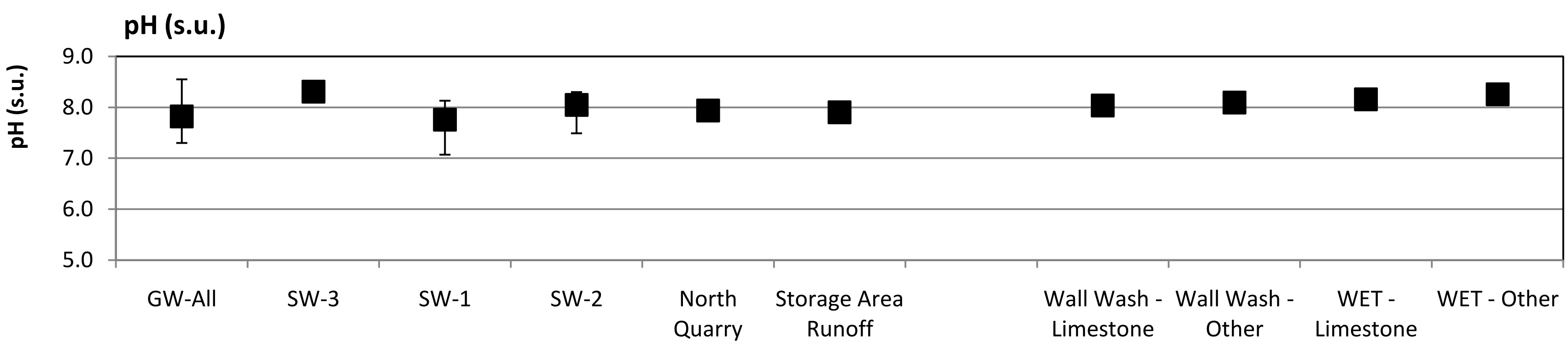


Golder Associates

Title	Water Quality Comparison - Na and SO4	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 6.27

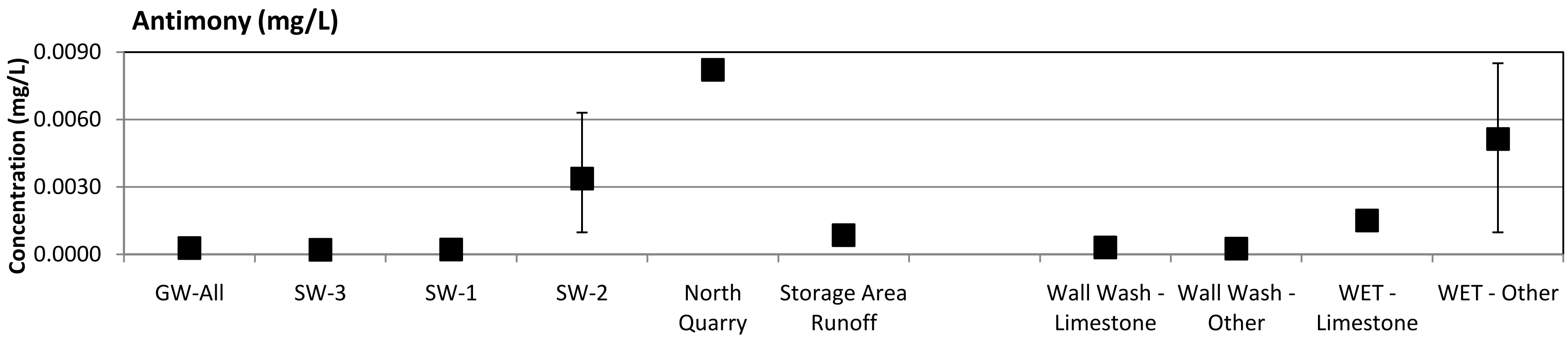
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Water Types.xlsx

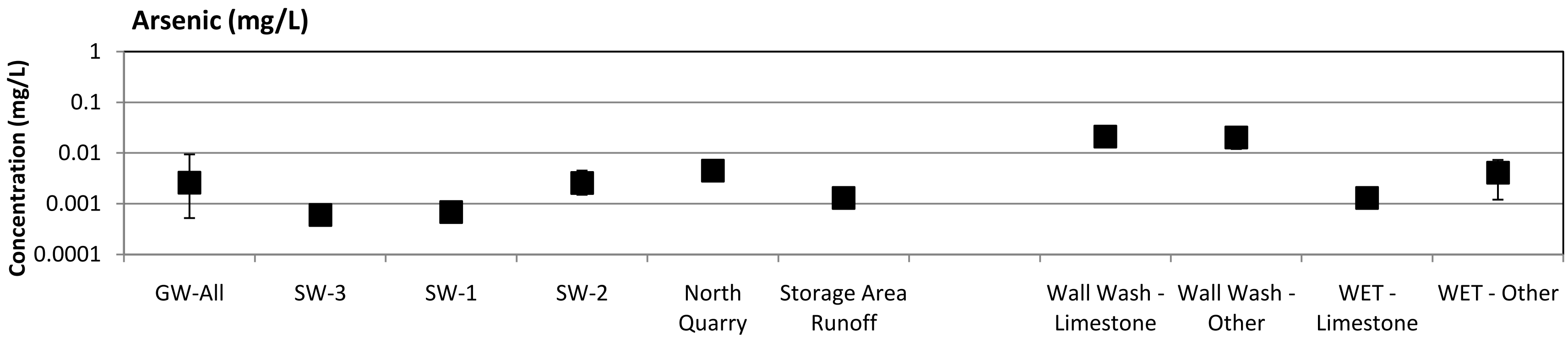




Golder Associates	Title	Water Quality Comparison - Alkalinity and pH		Drawn	CR
				Checked	FV
	Project Name	Hydrologic Investigation	Project No. 063-7109.500	Reviewed	RV/DB
	Client Name	Permanente Quarry Reclamation Plan Update	Date May 2010	FIGURE	6.28

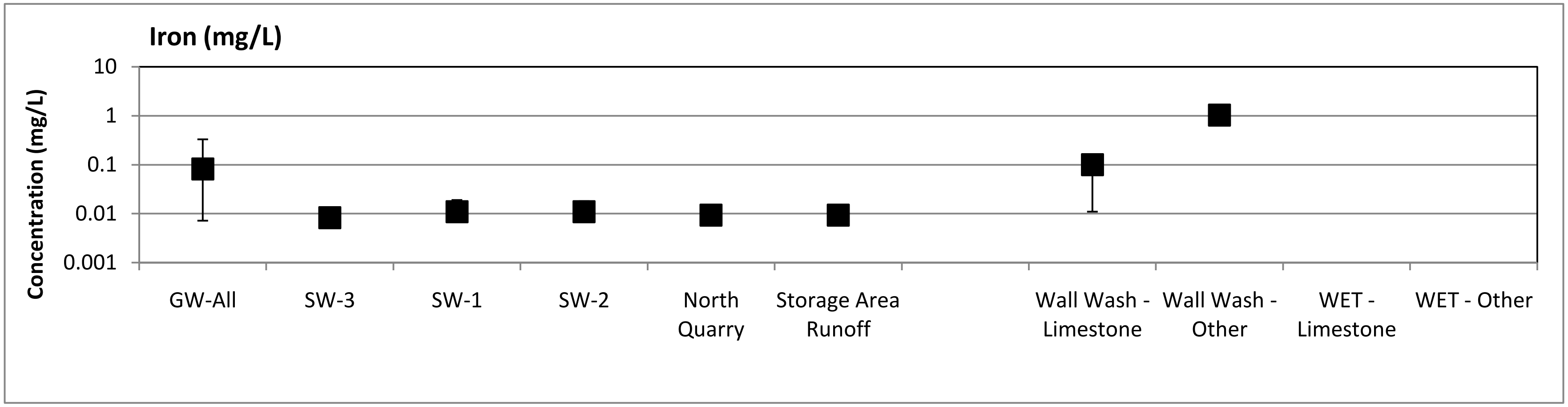
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Water Types.xlsx

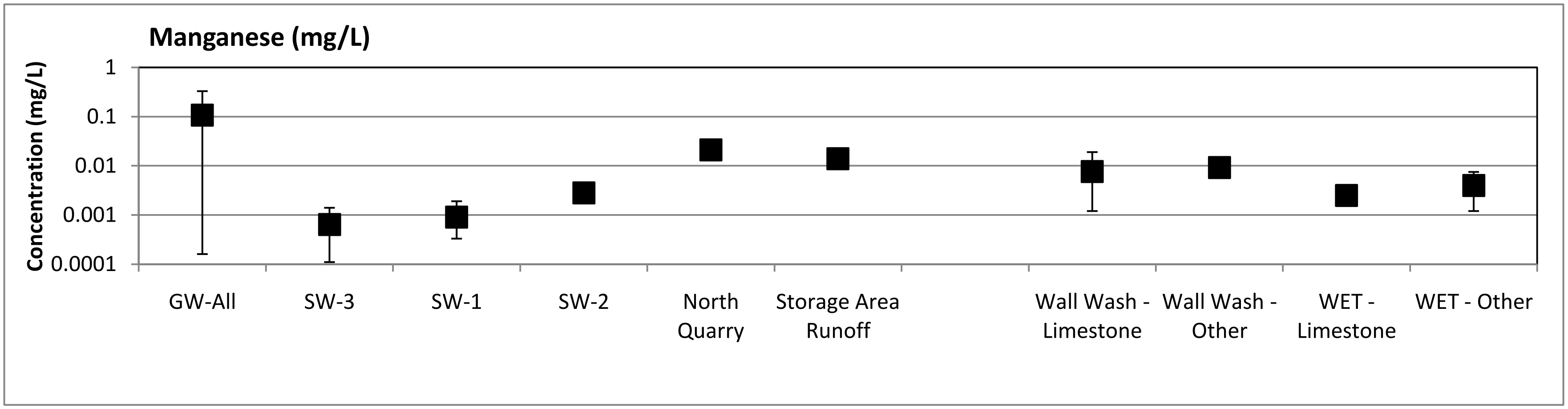




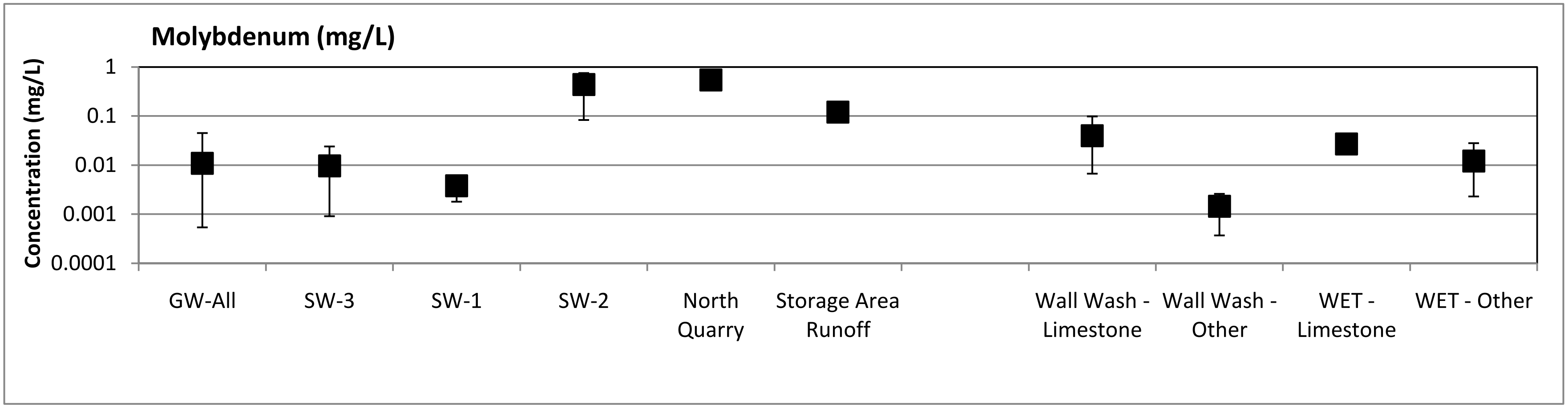
Golder Associates

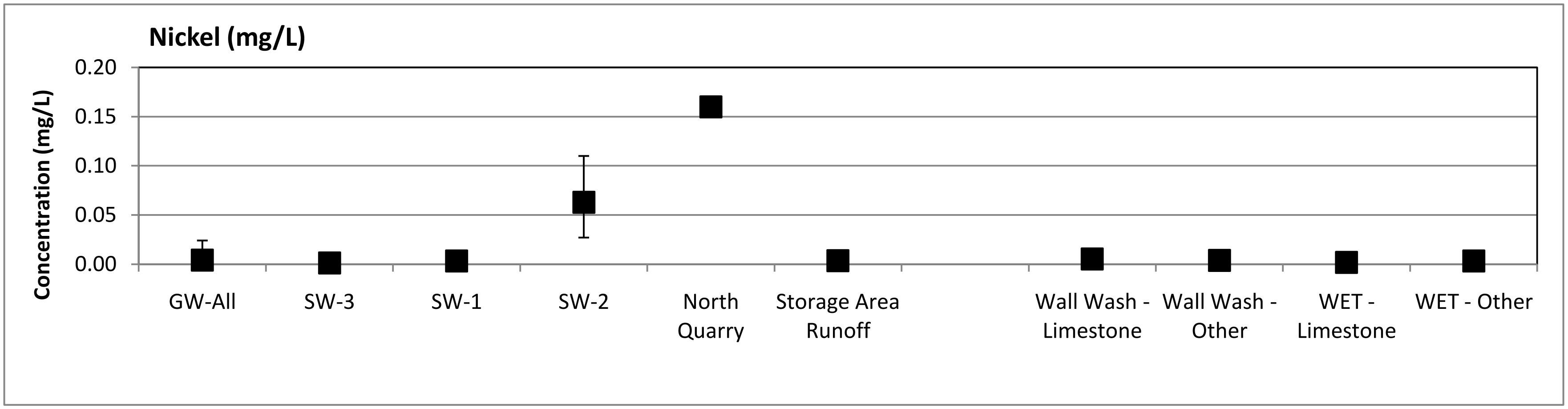
Title	Water Quality Comparison - Sb and As	Drawn	CR
		Checked	FV
Project Name	Hydrologic Investigation	Project No. 063-7109.500	Reviewed RV/DB
Client Name	Permanente Quarry Reclamation Plan Update	Date May 2010	FIGURE 6.29





Golder Associates	Title: Water Quality Comparison - Fe and Mn			Drawn	CR
	Project Name: Hydrologic Investigation	Project No.	063-7109.500	Checked	FV
				Reviewed	RV/DB
	Client Name: Permanente Quarry Reclamation Plan Update	Date	May 2010	FIGURE	6.30

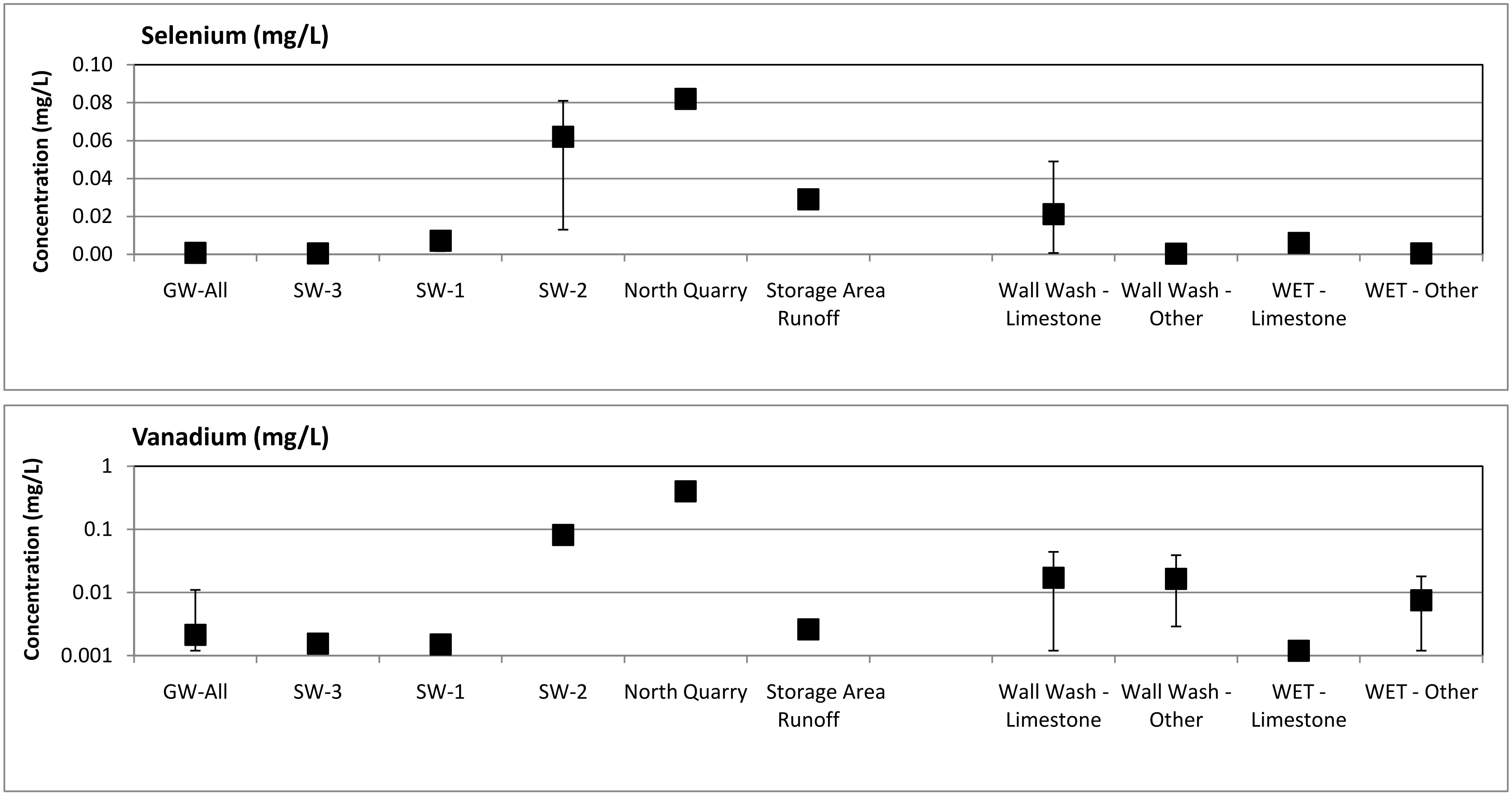




Golder Associates

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

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report\5_Final Revisions (May 21 2010)\Water Types.xlsx



Golder Associates

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

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Geochemistry\Baseline Report (Nov 2009)\Report (Feb 20 2010)\Water Types

APPENDIX A

BORING LOGS

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

BORING NUMBER HG-1A

PROJECT NUMBER 0637109.300 phase 2
PROJECT NAME Lehigh Permanente
LOCATION Santa Clara, CA
DRILLING METHOD Air Rotary

GROUND ELEVATION 1585 ft. MSL
TOP OF CASING ----
LOGGED BY Ian Thomsen

DATE STARTED 10/26/08
DATE COMPLETED 10/27/08
CASING TYPE/DIAMETER ----
SCREEN TYPE/SLOT ----
GRAVEL PACK TYPE ----
GROUT TYPE/QUANTITY ----

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	10–60				Clayey mud OVERBURDEN.	60.0
GRAB	60–100		▼ (73.4)		loose limestone/greenstone/chert GRAVEL. Water at 73.4 feet.	100.0
GRAB, GRAB, GRAB	100–220				GREYWACKE.	220.0
	220–240				GREYWACKE/GREENSTONE.	240.0
GRAB, GRAB, GRAB	240–400				GREYWACKE.	400.0
GRAB	400–495				Brecciated greywacke GOUGE. Very muddy.	495.0
	495–580				Fracture, cherty LIMESTONE with greywacke producing 200gpm of water.	580.0

Bottom of borehole at 580.0 feet.

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

BORING NUMBER HG-2

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

DATE STARTED 10/29/08
DATE COMPLETED 11/6/08
CASING TYPE/DIAMETER ----
SCREEN TYPE/SLOT ----
GRAVEL PACK TYPE ----
GROUT TYPE/QUANTITY ----

REMARKS Air rotary drilling to 560 feet using a 6" drill bit.

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
GRAB	10				OVERBURDEN.	
	20					25.0
	30				Very Dark-Medium Brown Cherty LIMESTONE with reaction to HCl.	
	40					
	50					
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	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					560.0

Bottom of borehole at 560.0 feet.

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

BORING NUMBER HG-3

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**	----
		GRAVEL PACK TYPE	----
GROUND ELEVATION	1548 ft. MSL	**GROUT TYPE/QUANTITY**	----
TOP OF CASING	----		
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	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
GRAB	0–20			OVERBURDEN.	20.0
GRAB, GRAB, GRAB	20–150			Medium-dark grey LIMESTONE with some chert and trace greenstone/greywacke	150.0
GRAB	150–200			Brecciated FAULT GOUGE with calcite veining in the medium grey limestone.	200.0
GRAB, GRAB, GRAB, GRAB, GRAB	200–420	VWT (at approx. 370)		Dark brown to dark grey LIMESTONE and greywacke. Very low sample recovery.	420.0
GRAB	420–460			GREENSTONE with trace chert, limestone, and calcite.	460.0
				Bottom of borehole at 460.0 feet.	

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

WELL NUMBER HG-4

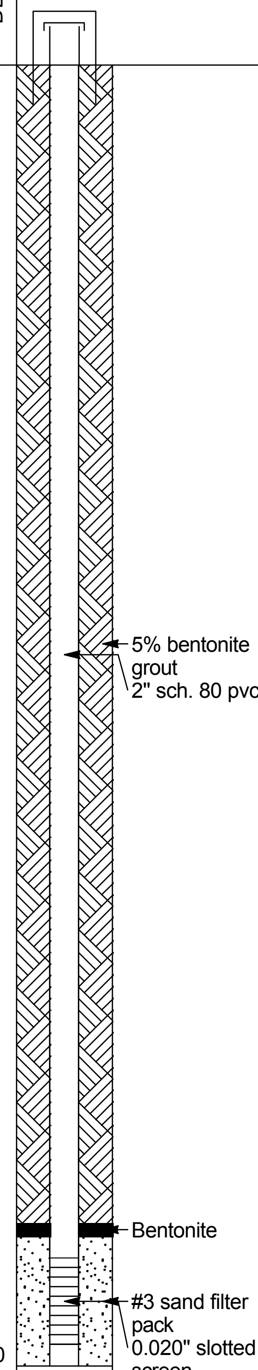
PROJECT NUMBER 0637109.300 phase 2
PROJECT NAME Lehigh Permanente
LOCATION Santa Clara, CA
DRILLING METHOD Air Rotary

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	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
GRAB	0–24			OVERBURDEN.	24.0
	24–55			Dark greenish brown BASALT.	55.0
GRAB (approx. 58, 108, 158, 208, 258 ft)	55–300		▼ 240	GREENSTONE. Water at 240 feet.	300.0
				Bottom of borehole at 300.0 feet.	

WELL DIAGRAM



TEMPLATE HG1-11.GPJ LOG A EWNN01.GDT 5/20/10

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

BORING NUMBER HG-5

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

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					
	50					
GRAB	60					
	70					
	80					
	90					
	100					
GRAB	110					
	120					
	130					
	140					
	150		▼			
GRAB	160					
	170					
	180					
	190					
	200					
GRAB	210					
	220					
	230					
	240	VWT				
	250					
GRAB	260					
	270					
	280					
	290					
	300					
GRAB	310					
	320					
	330					
	340					
	350					
GRAB	360					
	370					
	380					
	390					
	400					400.0
					Bottom of borehole at 400.0 feet.	

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

WELL NUMBER HG-6

PROJECT NUMBER 0637109.300 phase 2
PROJECT NAME Lehigh Permanente
LOCATION Santa Clara, CA
DRILLING METHOD Air Rotary

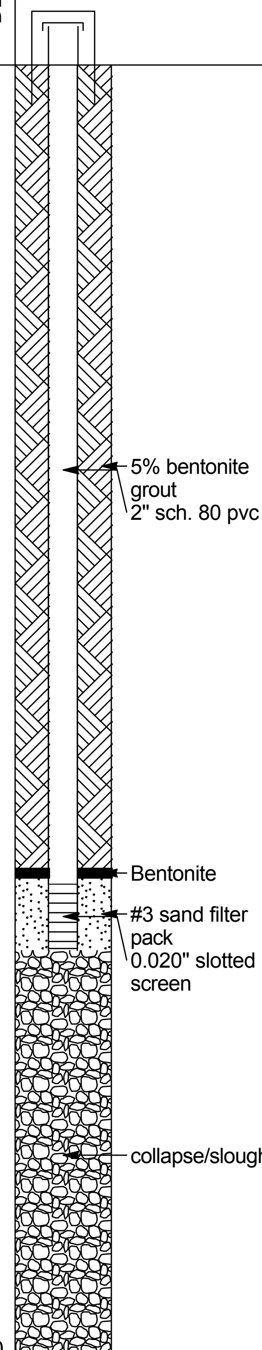
GROUND ELEVATION 1822 ft. MSL
TOP OF CASING 1825 ft. MSL
LOGGED BY Jill Dekoekkoek

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

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

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
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

WELL DIAGRAM



Golder Associates
Golder Associates
425 Lakeside Drive
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Telephone: (408) 220-9223
Fax:

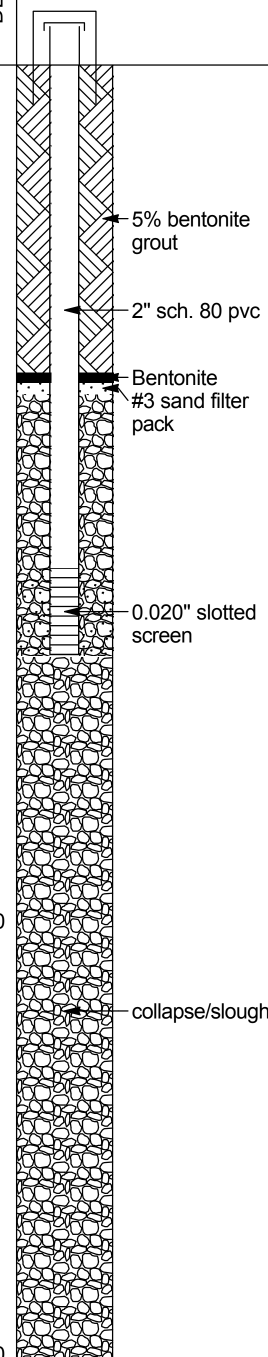
WELL NUMBER HG-7

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

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
GRAB	0–40				OVERBURDEN.	40.0
	40–60				BASALT.	60.0
GRAB, GRAB, GRAB	60–200		▼ 80		Purple GREENSTONE/GREYWACKE. Water at 80 feet.	200.0
GRAB, GRAB	200–300				GREYWACKE with trace calcite.	300.0
					Bottom of borehole at 300.0 feet.	

WELL DIAGRAM



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

BORING NUMBER HG-8

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

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
GRAB	0–40				OVERBURDEN.	40.0
GRAB, GRAB, GRAB	40–200	VWT (~148)	▼ (120)		GREENSTONE with greywacke and trace calcite. Producing 2-4gpm of water during evacuation immediately after drilling. Water at 120 feet.	200.0
					Bottom of borehole at 200.0 feet.	

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

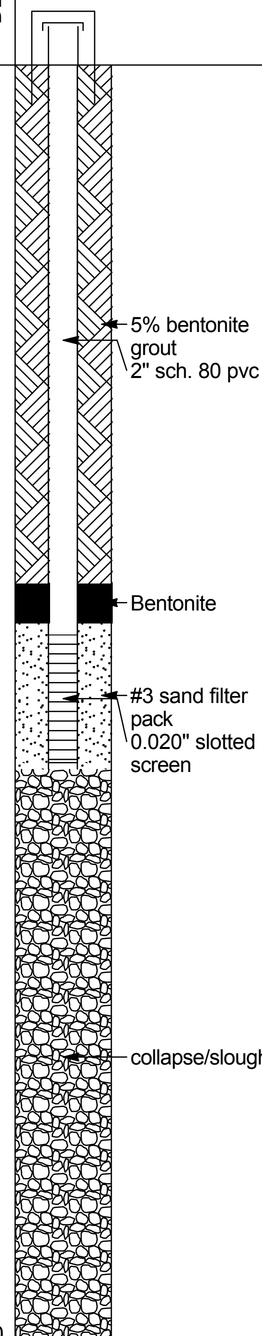
WELL NUMBER HG-9

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

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	GRAPHIC LOG	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
GRAB	0–25				OVERBURDEN.	25.0
GRAB	25–200				Oxidized GREENSTONE, greywacke and trace calcite producing water at 200gpm.	
GRAB	100		▼		Water at 100 feet.	
GRAB	200				Bottom of borehole at 200.0 feet.	200.0

WELL DIAGRAM



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

WELL NUMBER HG-10S

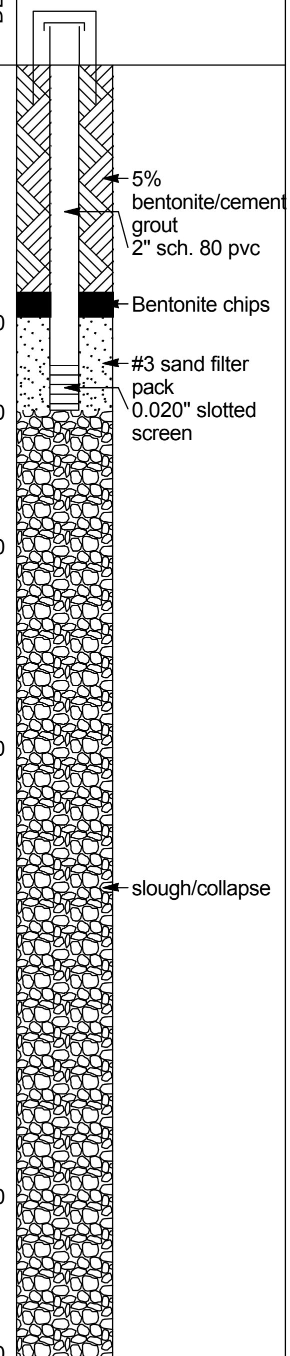
PROJECT NUMBER 0637109.300 phase 2
PROJECT NAME Lehigh Permanente
LOCATION Santa Clara, CA
DRILLING METHOD Air Rotary
GROUND ELEVATION 1585 ft. MSL
TOP OF CASING 1587.5 ft. MSL
LOGGED BY JL/GW

DATE STARTED 8/6/09
DATE COMPLETED 10/11/09
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

REMARKS Air rotary drilling to 580 feet using a 6.75" drill bit.

SAMPLING METHOD	DEPTH (ft. BGL)	VWT Depth	Water Level	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
GRAB	10			OVERBURDEN with limestone gravel fragments.	
GRAB	60				
	90		▼		85.0
GRAB	110			loose GRAVEL containing limestone and trace greenstone/greywacke. Produces 20gpm, very soft.	120.0
	120			LIMESTONE with trace greenstone.	160.0
GRAB	160			GREYWACKE with trace greenstone. Very soft, possibly collapsing in this interval.	220.0
GRAB	210				
	220			GREENSTONE/GREYWACKE GOUGE. Soft, clayey fault gouge.	310.0
GRAB	260				
GRAB	310			GREYWACKE with trace greenstone and limestone. Increased competence with depth.	510.0
GRAB	360				
GRAB	410				
GRAB	460				
GRAB	510			LIMESTONE. Well indurated, low-grade limestone with very little circulation.	580.0
GRAB	560				
	580			Bottom of borehole at 580.0 feet.	

WELL DIAGRAM



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

BORING NUMBER HG-10M D

PROJECT NUMBER 0637109.300 phase 2
PROJECT NAME Lehigh Permanente
LOCATION Santa Clara, CA
DRILLING METHOD Air Rotary
GROUND ELEVATION 1585 ft. MSL
TOP OF CASING ----
LOGGED BY JL/GW
DATE STARTED 8/6/09
DATE COMPLETED 10/11/09
CASING TYPE/DIAMETER ----
SCREEN TYPE/SLOT ----
GRAVEL PACK TYPE ----
GROUT TYPE/QUANTITY 5% bentonite
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				See Log for HG-10S	
	20					
	30					
	40					
	50					
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	VWT 10int				
GRAB	310					
	320					
	330					
	340					
	350					
GRAB	360					
	370					
	380					
	390					
	400					
GRAB	410					
	420					
	430					
	440					
	450					
GRAB	460					
	470					
	480					
	490					
	500	VWT 10d				
GRAB	510					
	520					
	530					
	540					
	550					
GRAB	560					
	570					
	580					580.0
					Bottom of borehole at 580.0 feet.	

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

WELL NUMBER HG-11

PROJECT NUMBER 0637109.300 phase 2
PROJECT NAME Lehigh Permanente
LOCATION Santa Clara, CA
DRILLING METHOD Air Rotary

GROUND ELEVATION 1585 ft. MSL
TOP OF CASING 1587.5 ft. MSL
LOGGED BY JL/GW

DATE STARTED 9/4/09
DATE COMPLETED 9/15/09
CASING TYPE/DIAMETER Schedule 80 pvc / 6 inches
SCREEN TYPE/SLOT slotted screen / 0.020
GRAVEL PACK TYPE #6 sand
GROUT TYPE/QUANTITY 5% bentonite

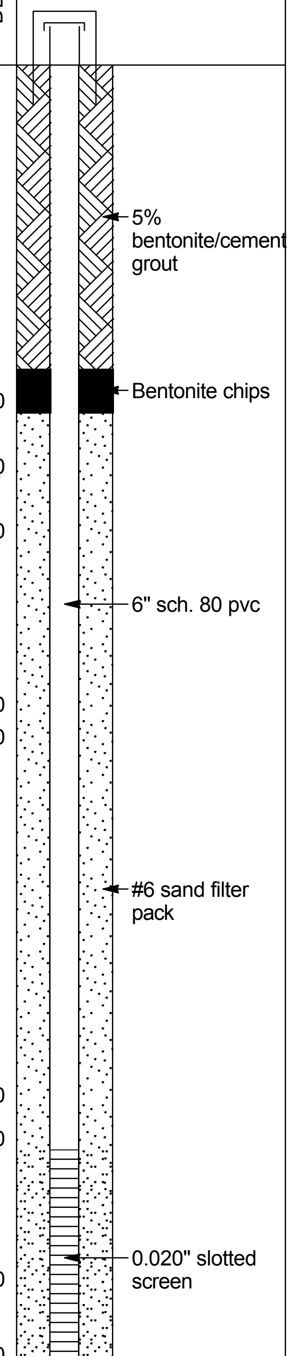
REMARKS Air rotary drilling from 0-200 feet using 18" drill bit, from 200-600 using a 14" bit.

SAMPLING METHOD	DEPTH (ft. BGL)	LITHOLOGIC DESCRIPTION	CONTACT DEPTH
GRAB	0–80	OVERBURDEN. Gravel with fractured pieces of limestone.	80.0
GRAB	80–160	Grey LIMESTONE with trace greenstone.	160.0
GRAB	160–190	GREYWACKE with trace greenstone.	190.0
GRAB	190–220	GREENSTONE	220.0
GRAB	220–300	GREYWACKE. Competence increases with depth.	300.0
GRAB	300–315	CHERT and QUARTZ gouge. Soft.	315.0
GRAB	315–480	GREYWACKE. Heavily fractured, 80% mud, 20% fine-grained gravel.	480.0
GRAB	480–500	GREYWACKE, LIMESTONE, and GREENSTONE mixture of rock types.	500.0
GRAB	500–565	CHERTY LIMESTONE. Well indurated. Loss of circulation. Fracture zone.	565.0
GRAB	565–600		600.0

Water level symbol (▼) at approximately 87 ft.

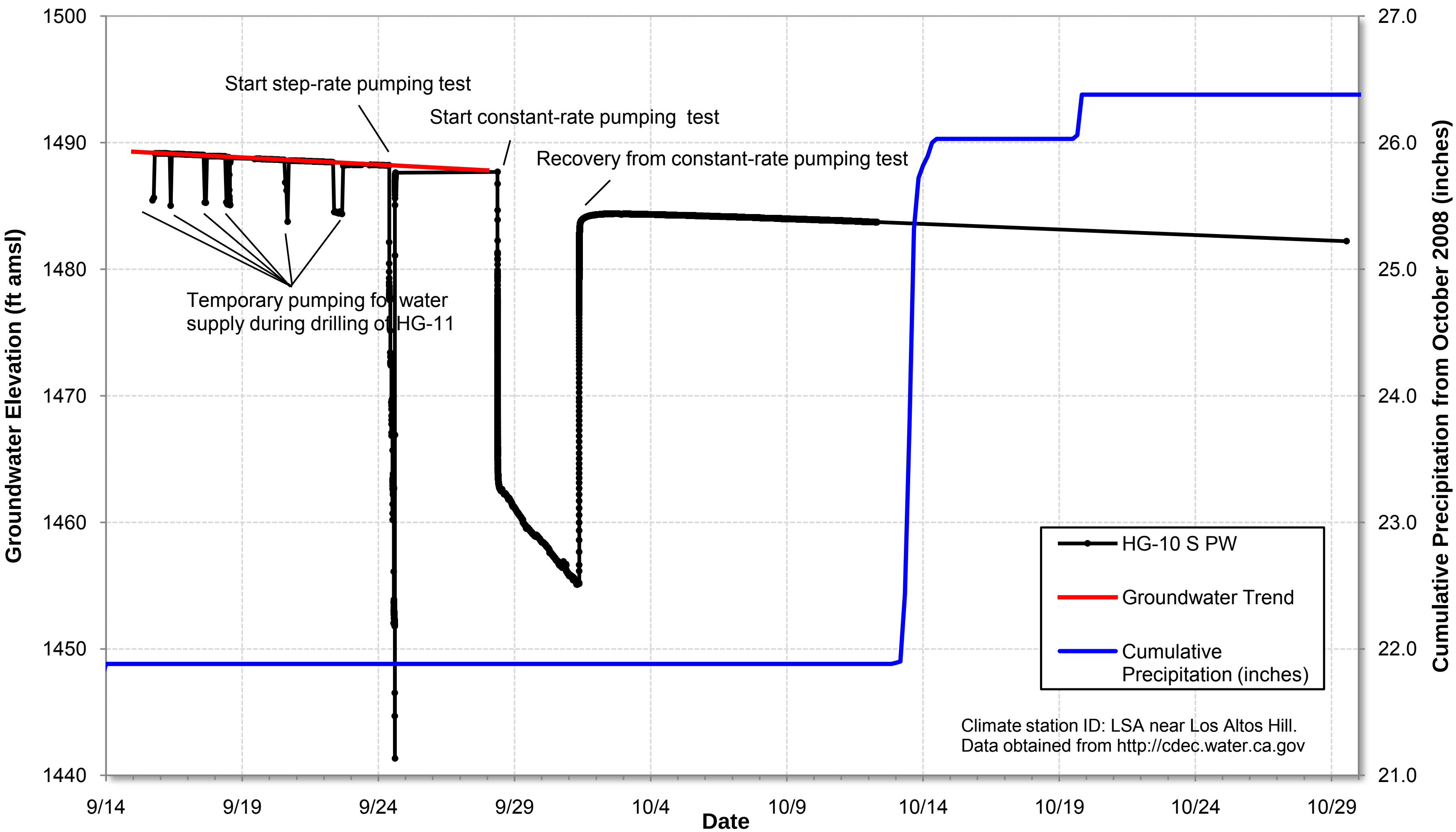
Bottom of borehole at 600.0 feet.

WELL DIAGRAM



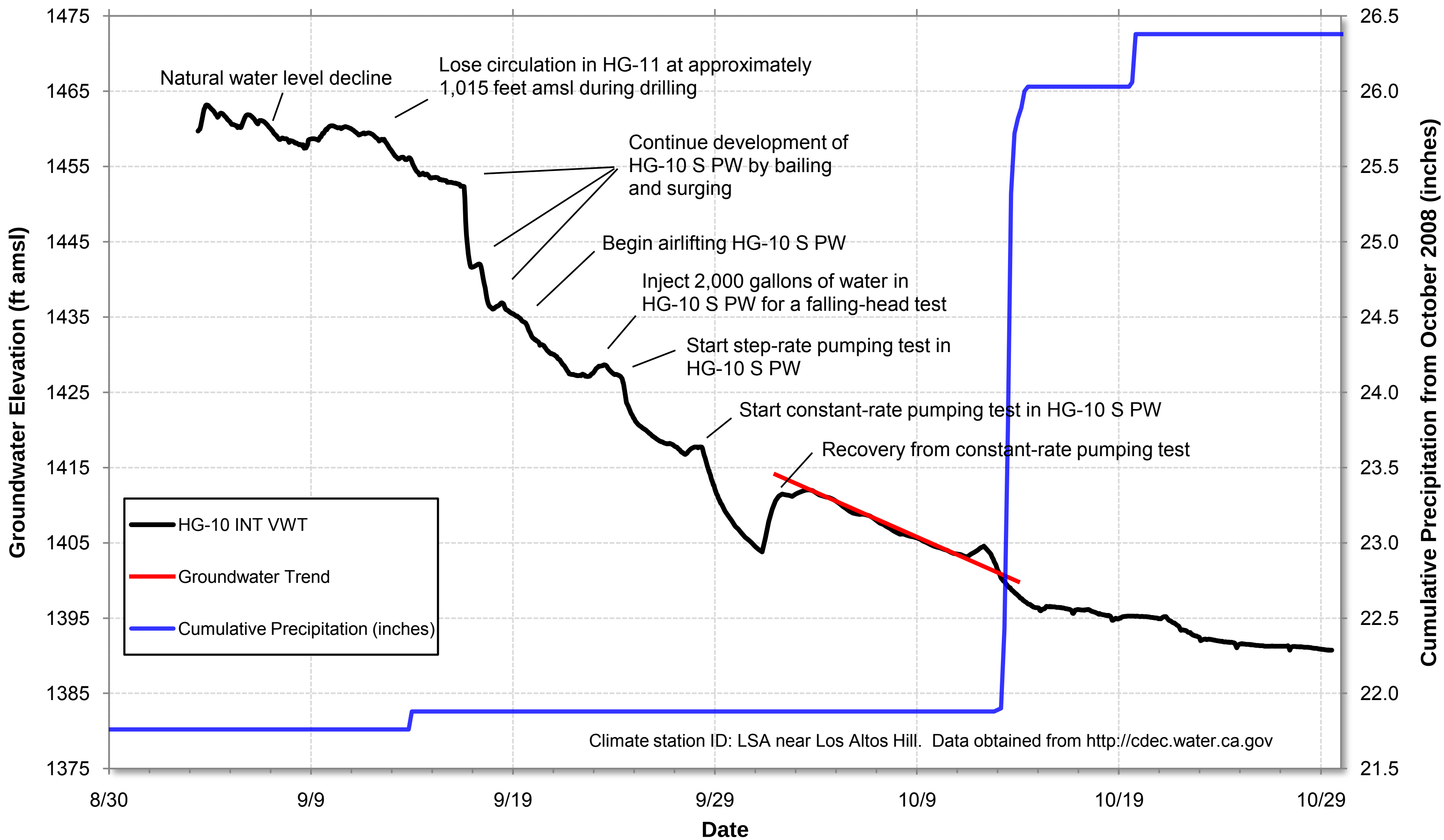
APPENDIX B

HYDROGRAPHS



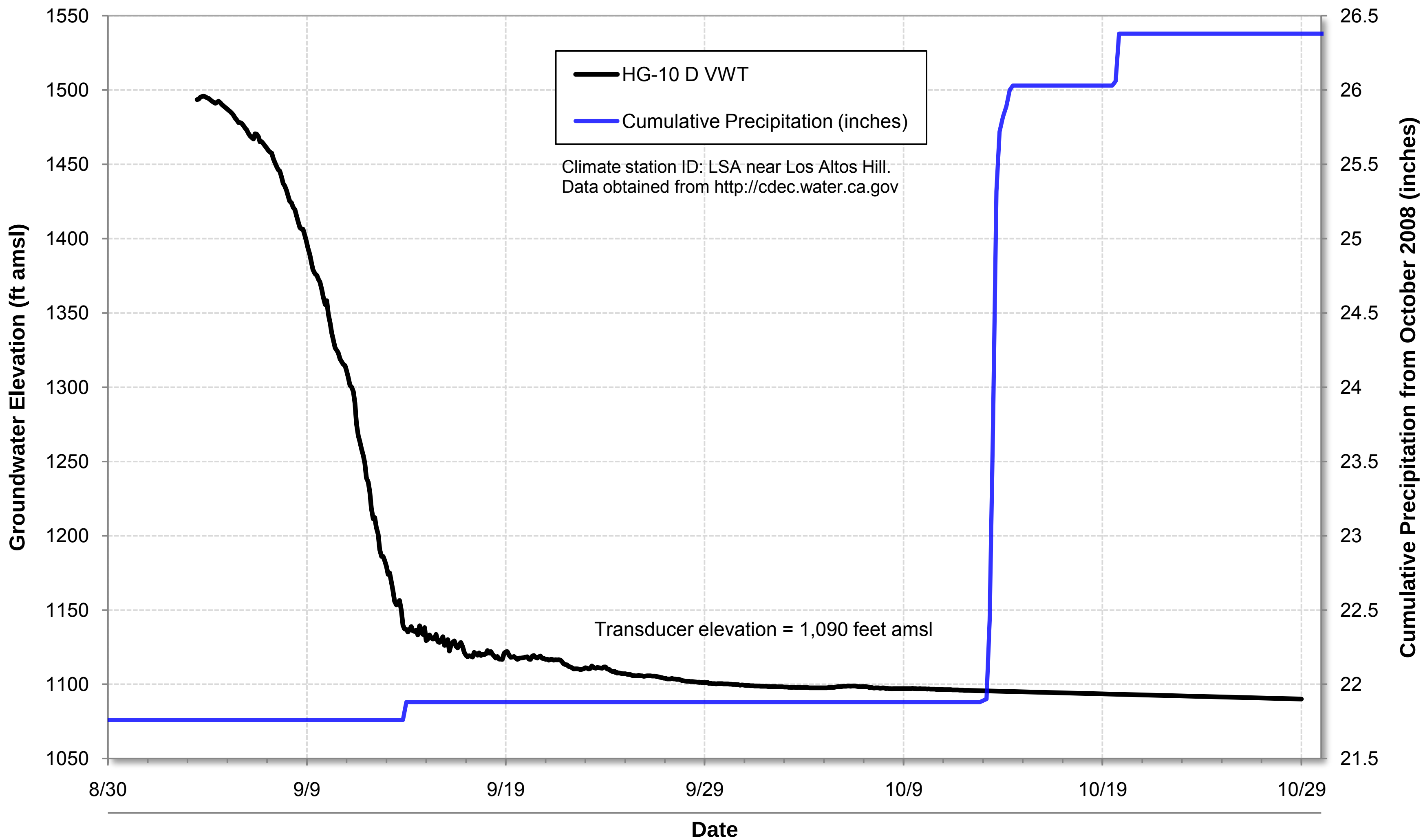
Golder Associates	Title: HG-10 S PW Hydrograph		Drawn: DH / Checked: GW / Reviewed: DB
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500	
	Client Name: Lehigh Permanente	Date: March 2, 2010	FIGURE C.1

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Ext_500\Pumping Test\



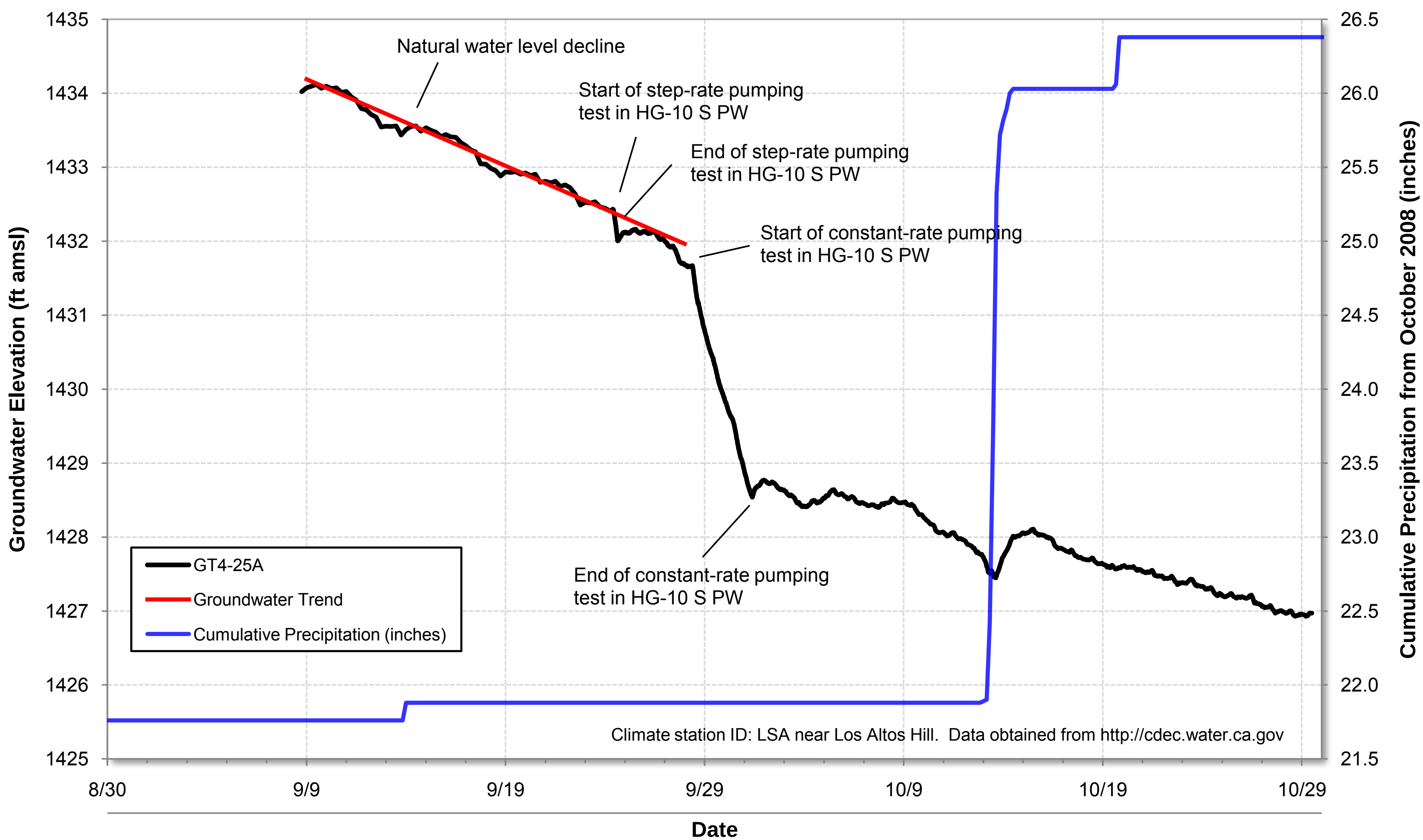
Golder Associates	Title: HG-10 INT VWT Hydrograph		Drawn: DH
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500	Checked: GW
			Reviewed: DB
	Client Name: Lehigh Permanente	Date: March 2, 2010	FIGURE C.2

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Ext_500\



Golder Associates	Title: HG-10 D VWT Hydrograph		Drawn: DH
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500	Checked: GW
			Reviewed: DB
	Client Name: Lehigh Permanente	Date: March 2, 2010	FIGURE C.3

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Ext_500\Pumping Test\

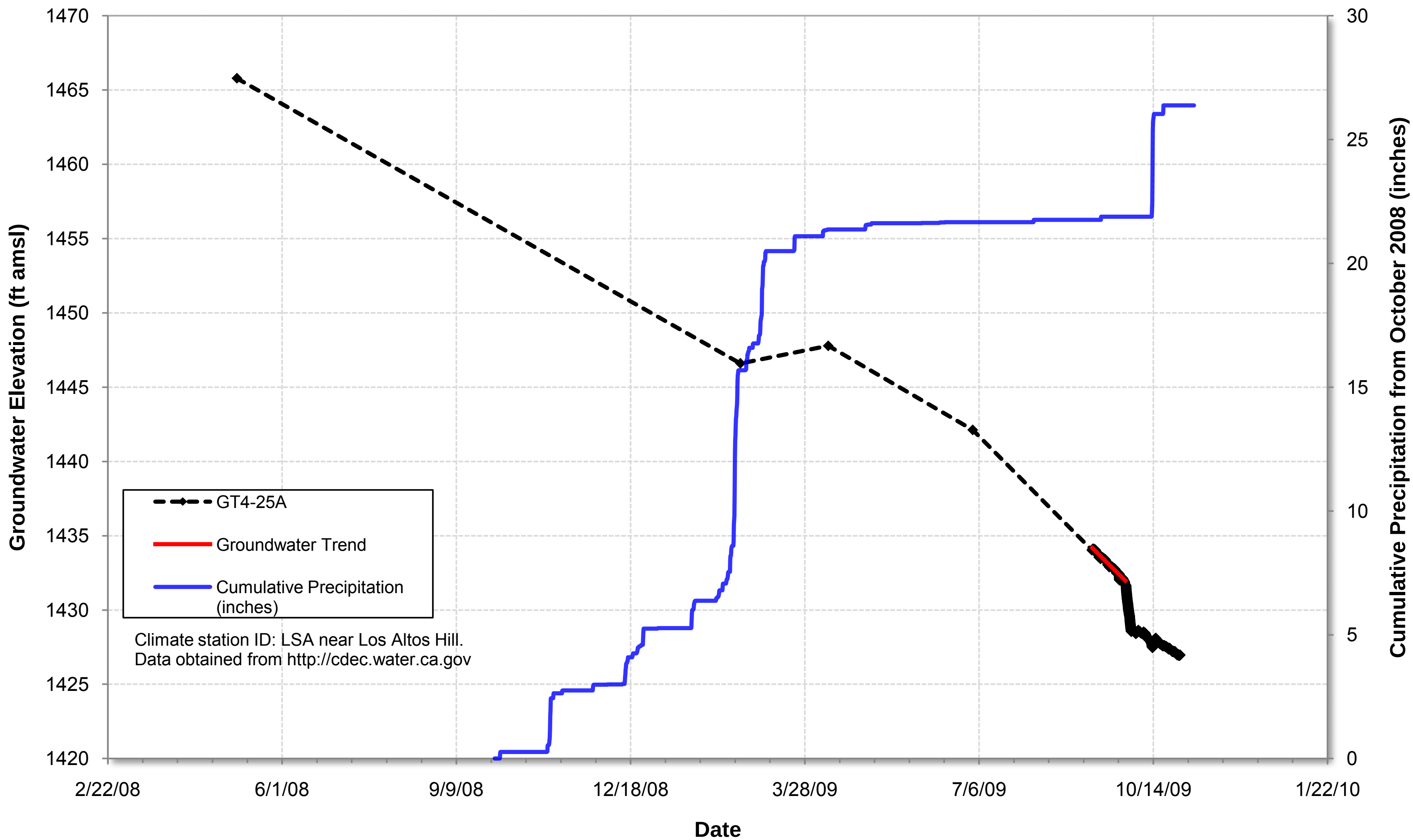


Golder Associates

Title	GT4-25a VWT Hydrograph		
Project Name	Hydrologic Investigation	Project No.	063-7109-500
Client Name	Lehigh Permanente	Date	March 2, 2010

Drawn	DH
Checked	GW
Reviewed	DB
FIGURE	C.4

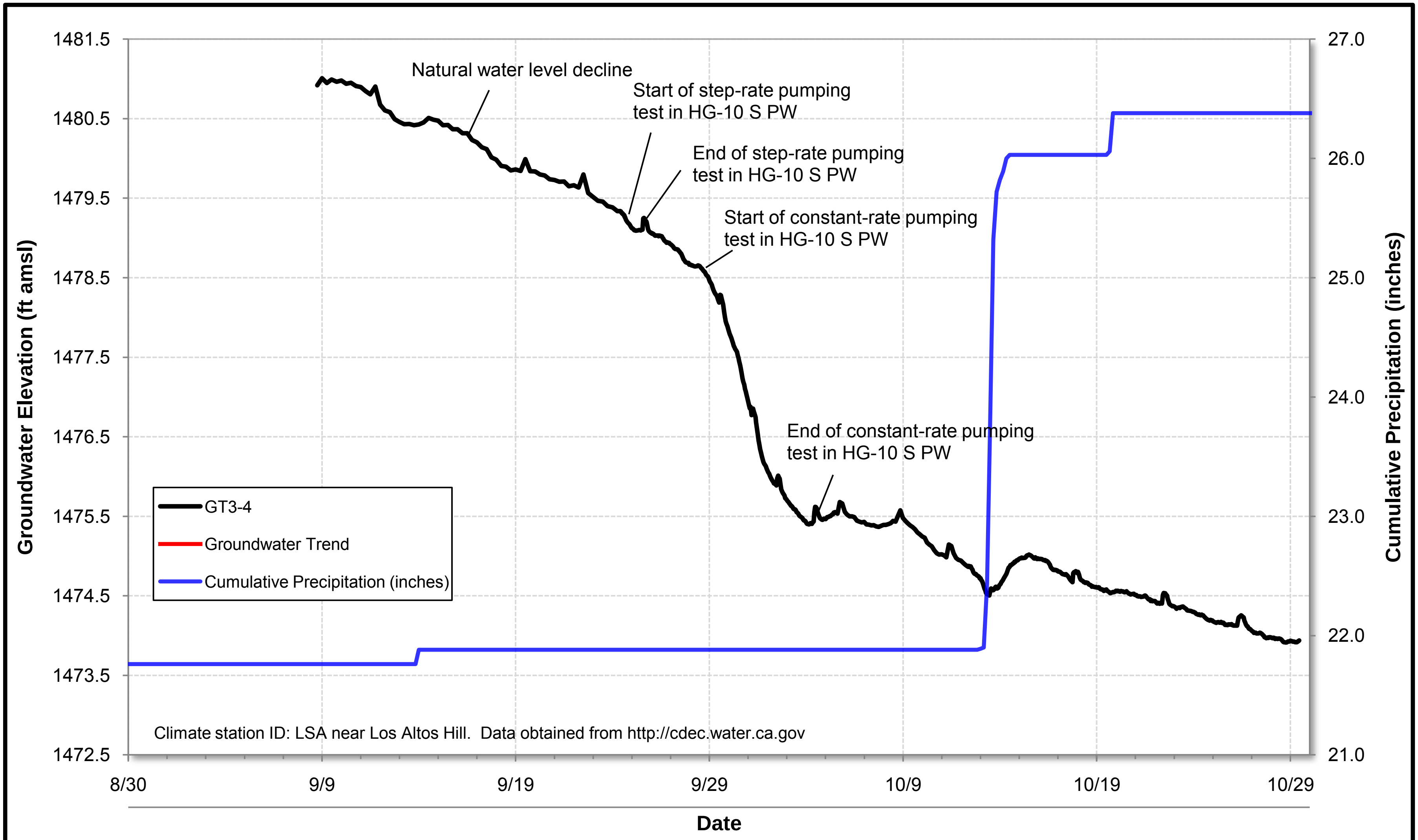
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Ext_500\Pumping Testt



Golder Associates

Title	GT4-25a 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.5

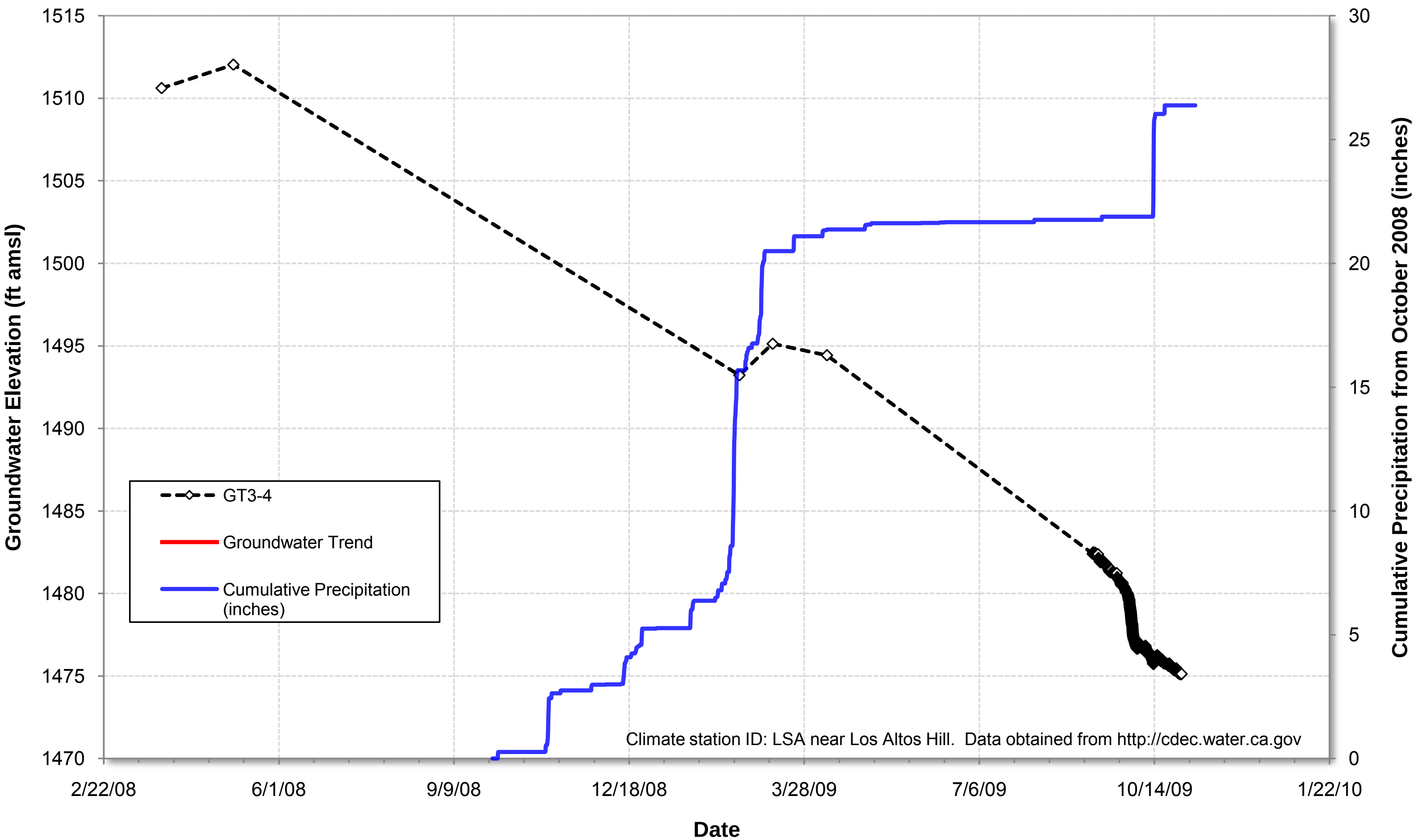
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Ext_500\Pumping Test\



Golder Associates

Title	GT3-4 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.6

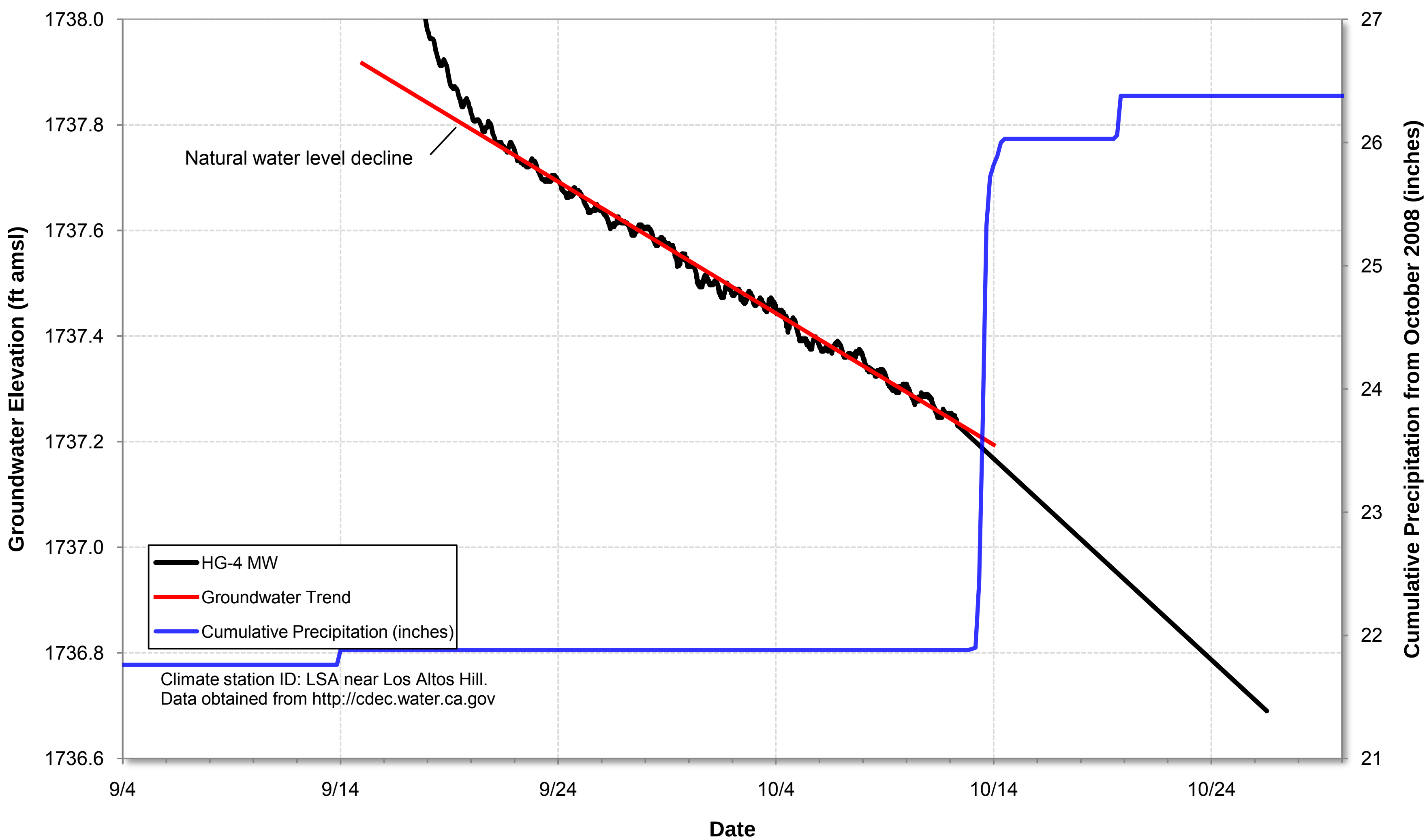
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Ext_500\Pumping Test\



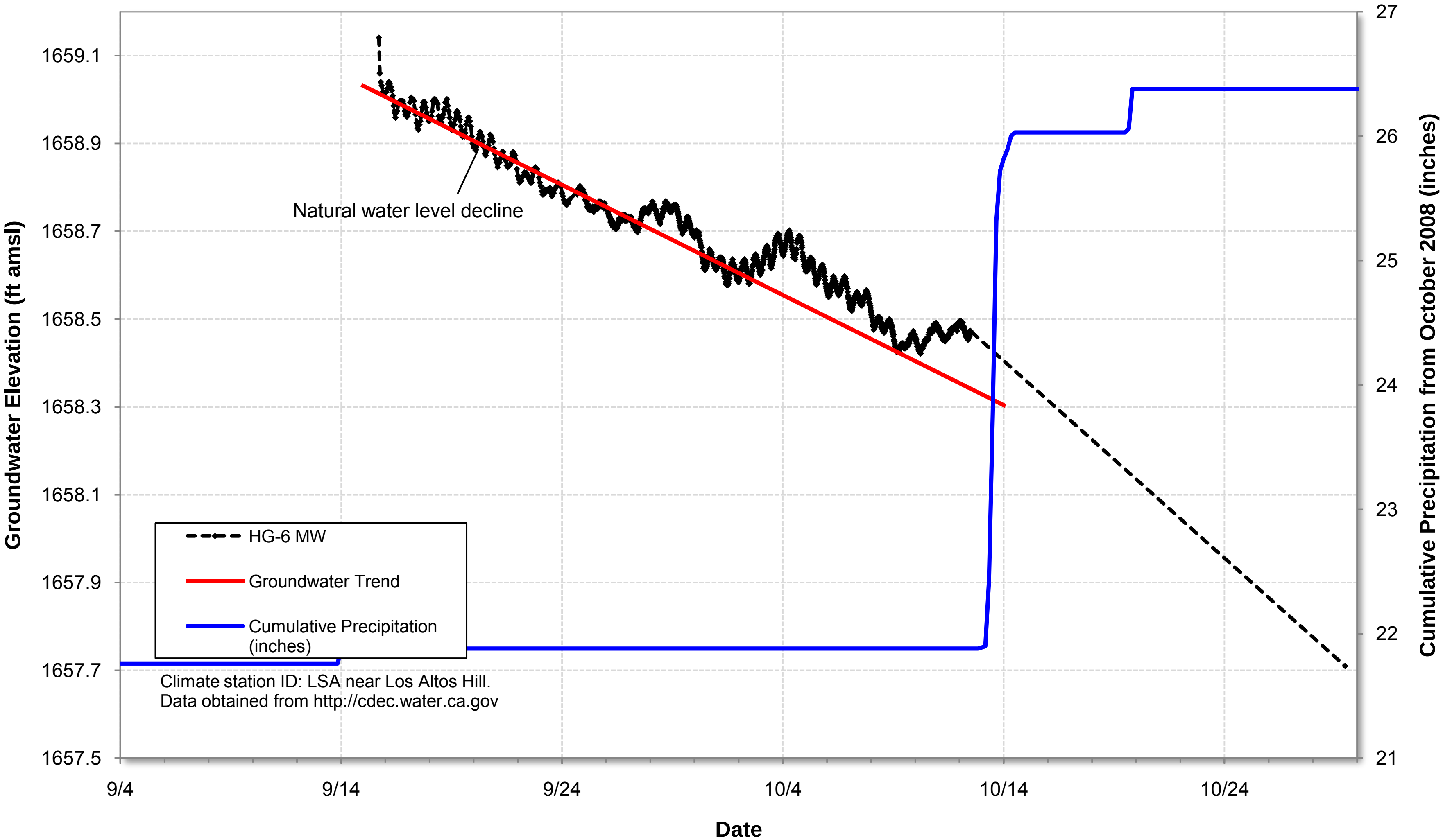
Golder Associates

Title	GT3-4 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.7

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Ext_500\Pumping Test\



Golder Associates	Title	HG-4 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.8



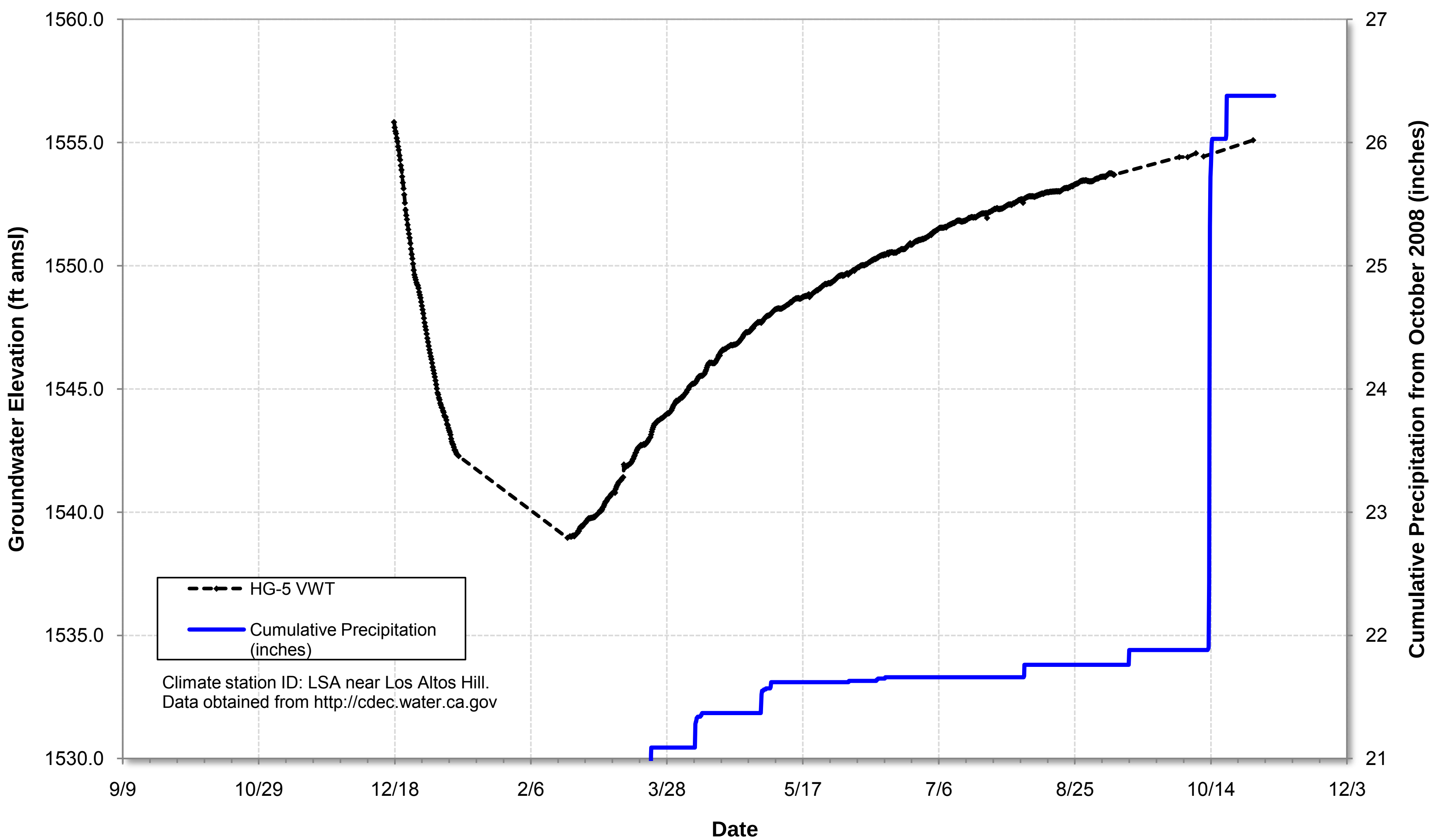
Title	HG-6 MW Hydrograph		
Project Name	Hydrologic Investigation	Project No.	063-7109-500
Client Name	Lehigh Permanente	Date	March 2, 2010

Golder Associates

Drawn	DH
Checked	GW
Reviewed	DB

FIGURE C.10

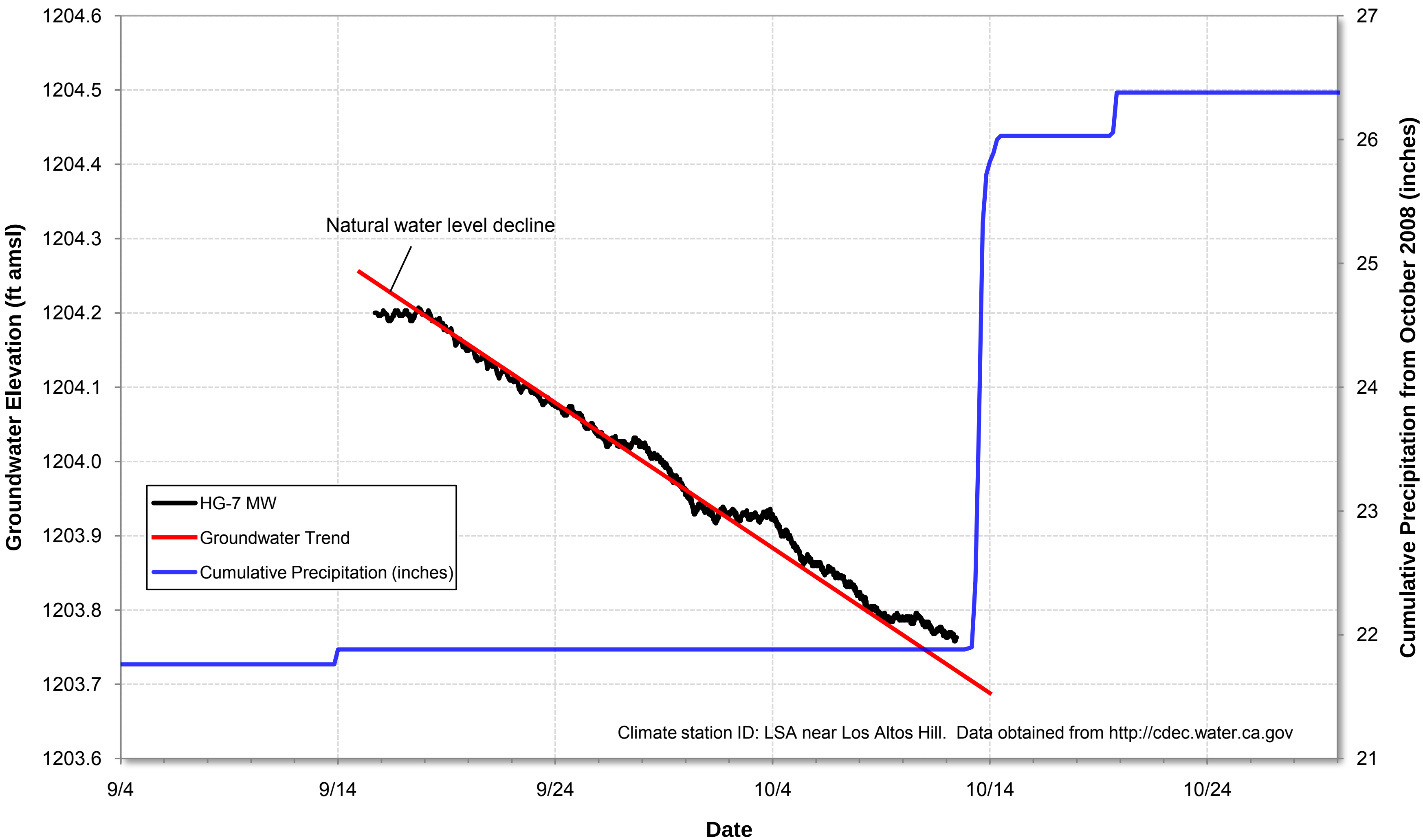
V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Ext_500\Pumping Test\



Golder Associates

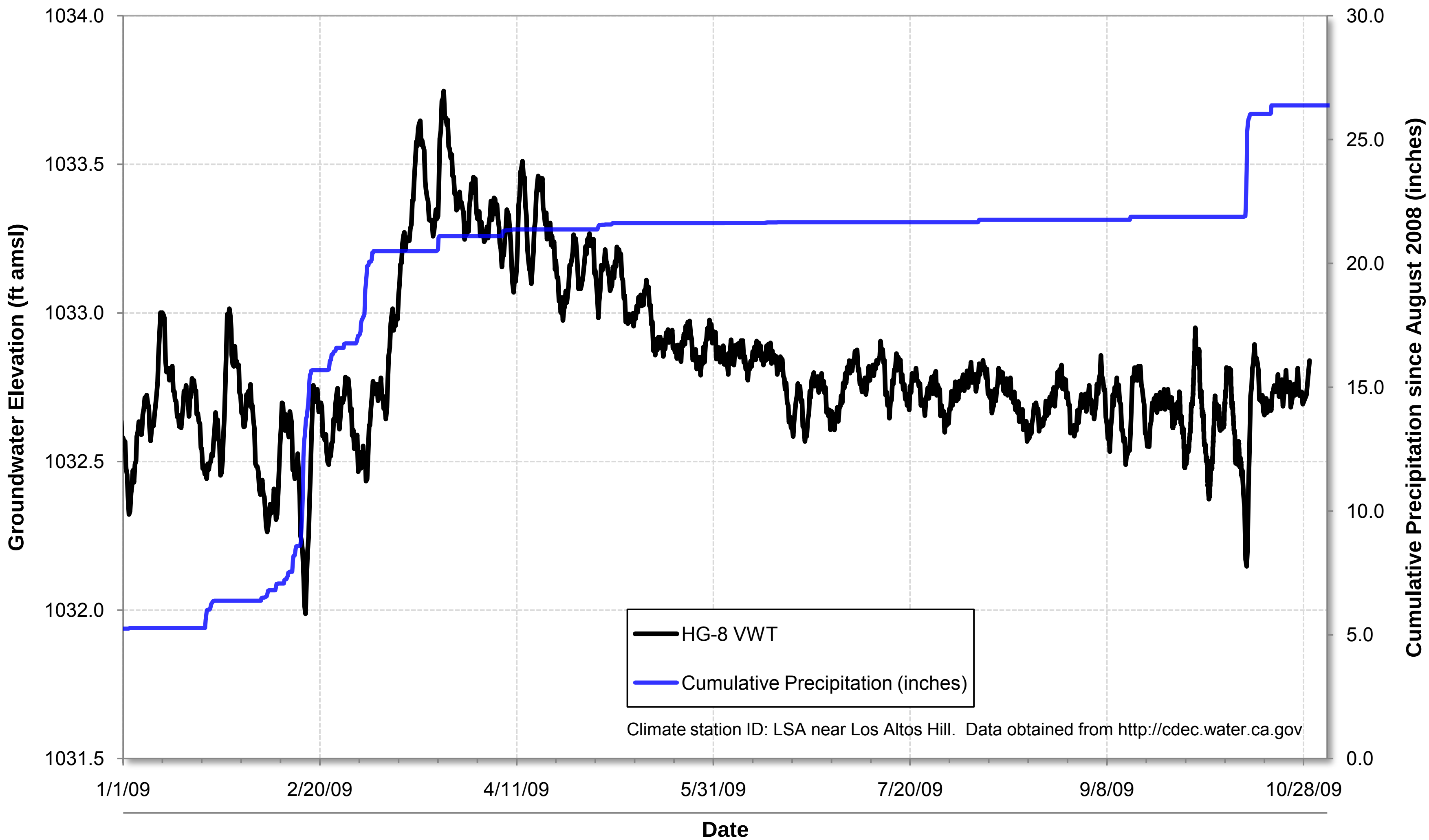
Title	HG-5 VWT Hydrograph	Drawn	DH
		Checked	GW
Project Name: Hydrologic Investigation	Project No.: 063-7109-500	Reviewed	DB
Client Name: Lehigh Permanente	Date: March 2, 2010	FIGURE	C.9

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Ext_500\Pumping Test\



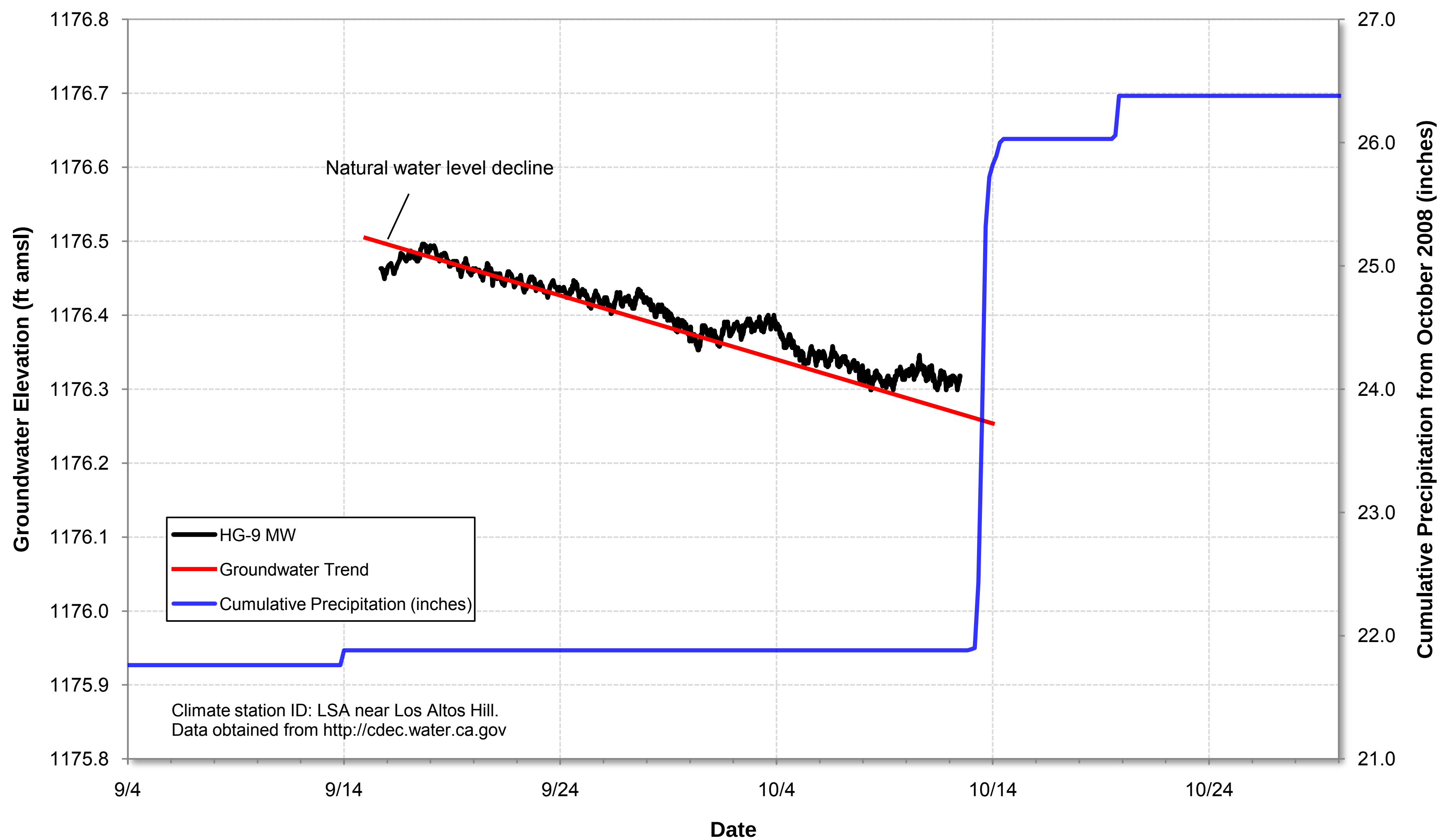
Golder Associates	Title: HG-7 MW Hydrograph		Drawn: DH / Checked: GW / Reviewed: DB
	Project Name: Hydrologic Investigation	Project No.: 063-7109-500	
	Client Name: Lehigh Permanente	Date: March 2, 2010	FIGURE C.11

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Ext_500\Pumping Test\



Golder Associates	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

V:\PROJECTS_2006 PROJECTS\063-7109_Permanente_Quarry\Ext_500\Pumping Test\



Golder Associates

Title	HG-9 MW Hydrograph		
Project Name	Hydrologic Investigation	Project No.	063-7109-500
Client Name	Lehigh Permanente	Date	March 2, 2010

Drawn	DH
Checked	GW
Reviewed	DB
FIGURE	C.13

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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.

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

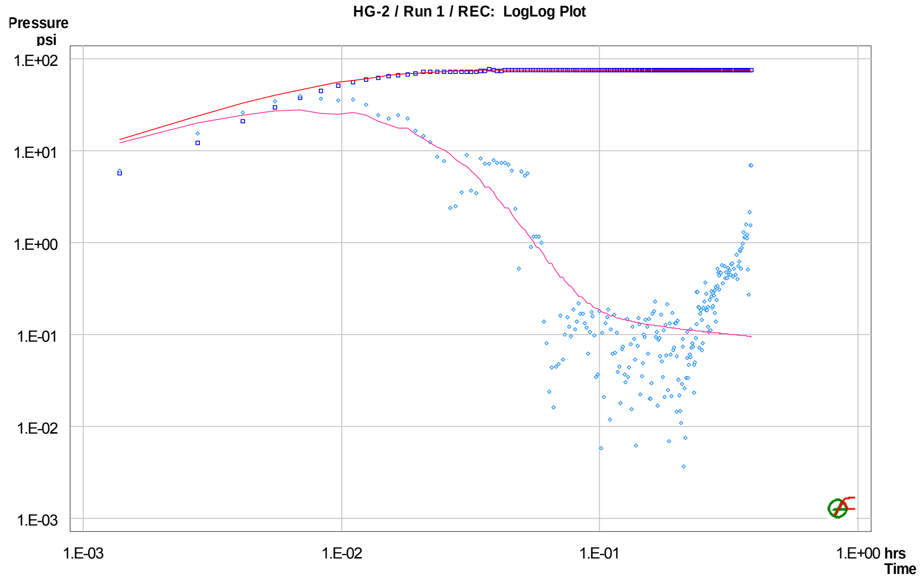
Table 1
Summary of Test Results
Lehigh Permanente Quarry
Cupertino, CA
March 2009

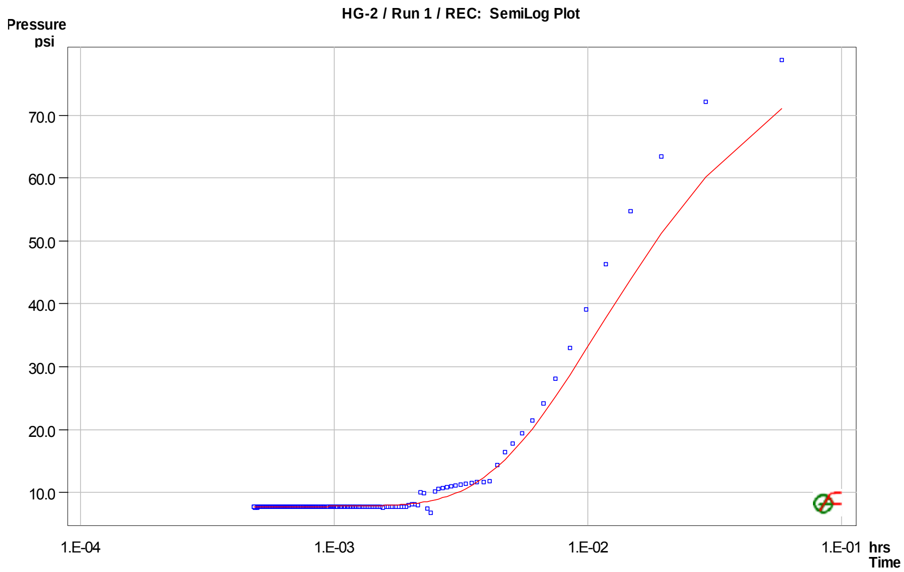
	Test Number	Top (ft bgs)	Bottom (ft bgs)	Interval Length (ft)	Packer Setup	Test Type	Analysis Match[1]	Transmissivity (m^2/sec)	Hydraulic Conductivity[2] (m/sec)	Theim Steady State Approx.[3] Constant Flow Rate (gpm)	dP (psi)	Transmissivity (m2/sec)
HG-1a	No Tests											
HG-2	1	505.35	554	48.65	Single 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=Q*ln(Ri/Rew)/2(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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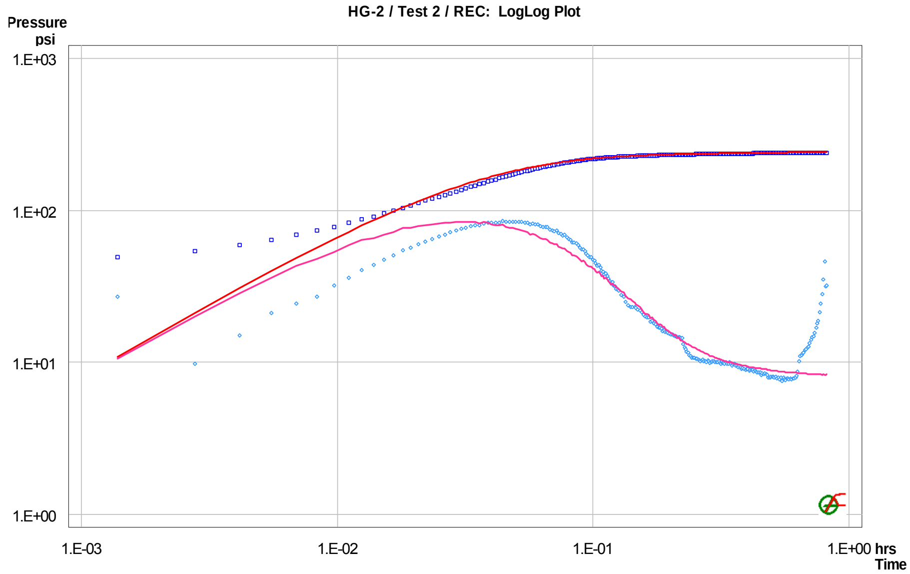
Static Pressure: 7.69 psi

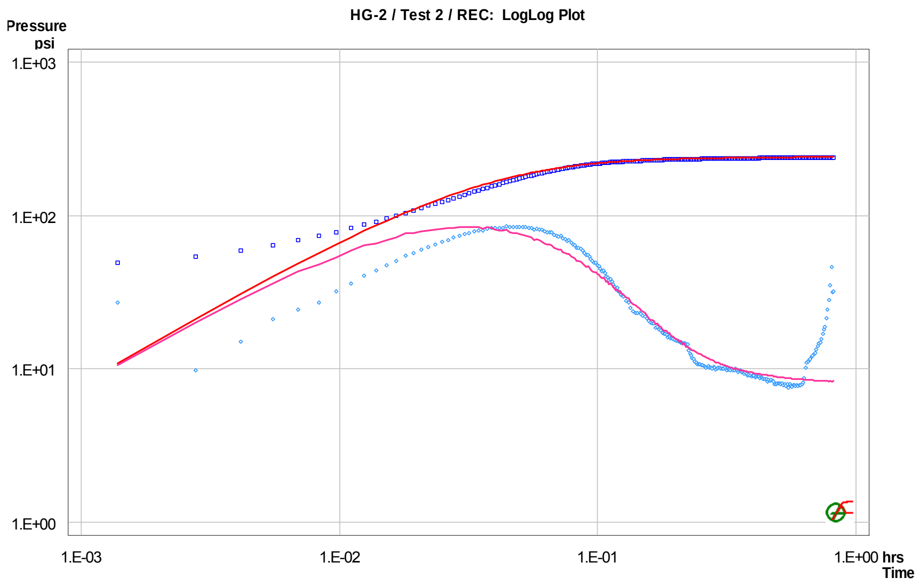
	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	3.509e-05 m^2/s	1.041e-05	- - m	2.5580

	C (WBS)	Skin
CRI:	4.625e-08 m^3/Pa	9.8944
REC:	4.625e-08 m^3/Pa	9.8944

HG-2

Test 2 (463.9 to 492.6 feet)





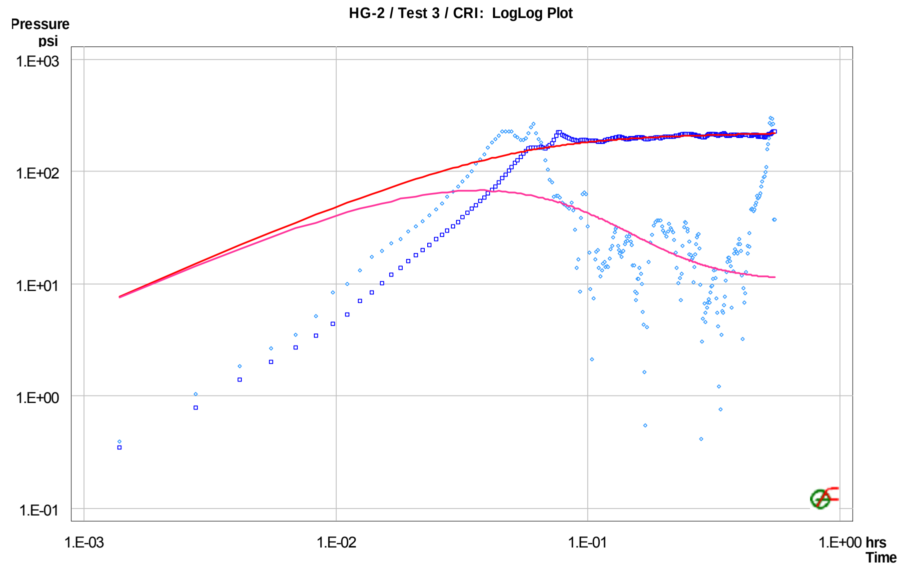
Static Pressure: 14.17 psi

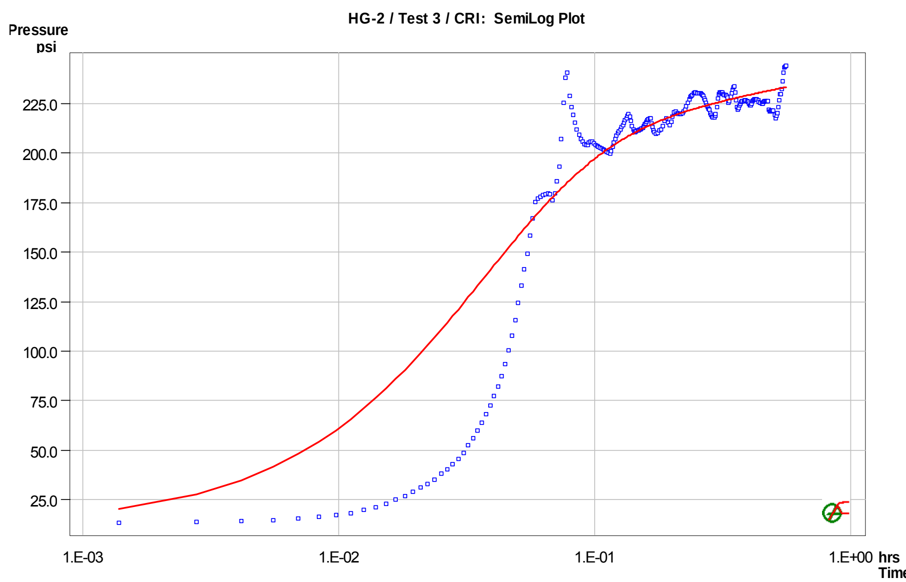
	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	1.680e-05 m^2/s	1e-4	-- m	2.0000

	C (WBS)	Skin
CRI:	2.870e-08 m^3/Pa	9.7315
REC:	6.692e-08 m^3/Pa	9.7315

HG-2

Test 3 (421.9 to 450.6 feet)





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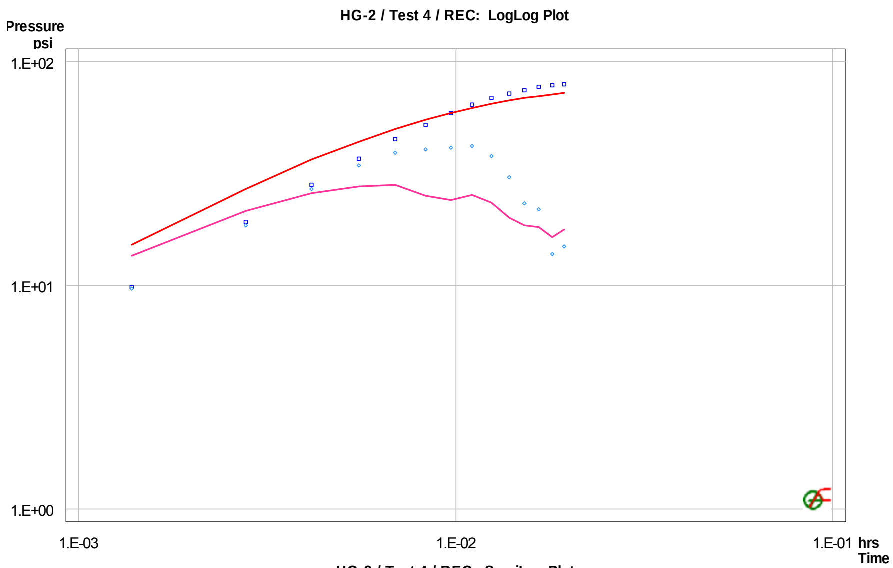
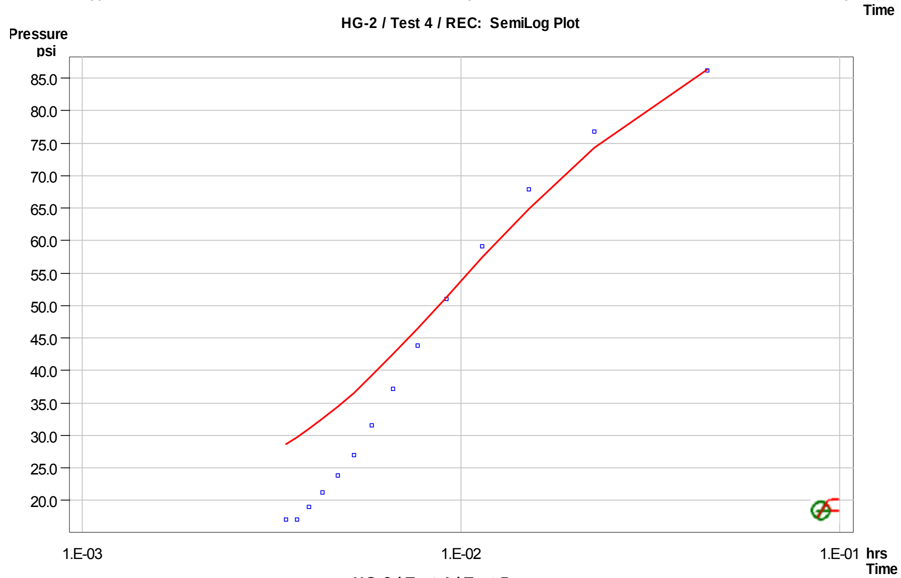
Static Pressure: 12.49 psi

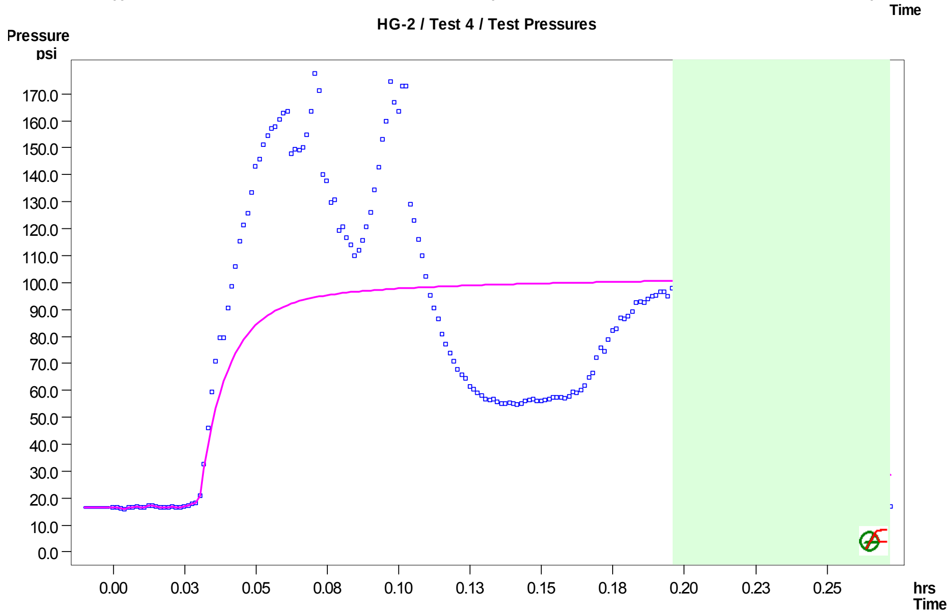
	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	1.717e-06 m^2/s	1.000e-04	- - m	2.0000

	C (WBS)	Skin
CRI:	1.330e-08 m^3/Pa	6.6485
REC:	9.800e-09 m^3/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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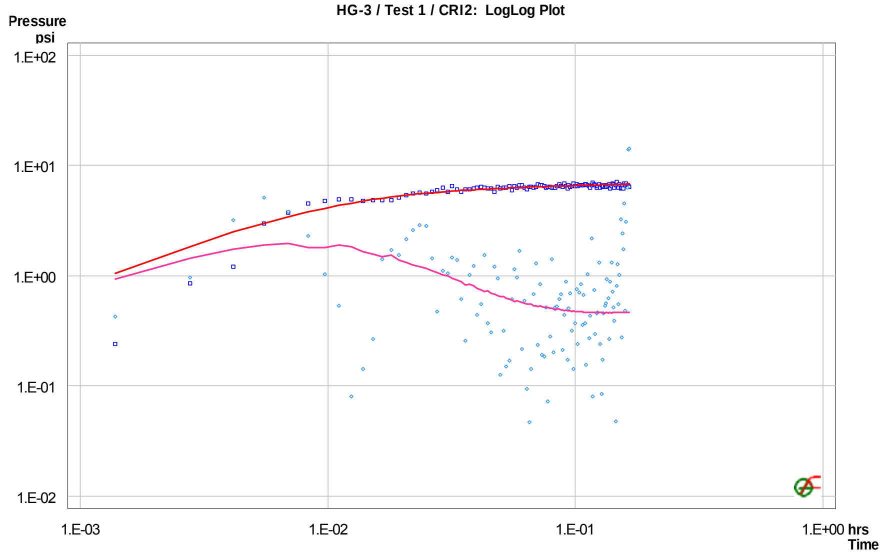
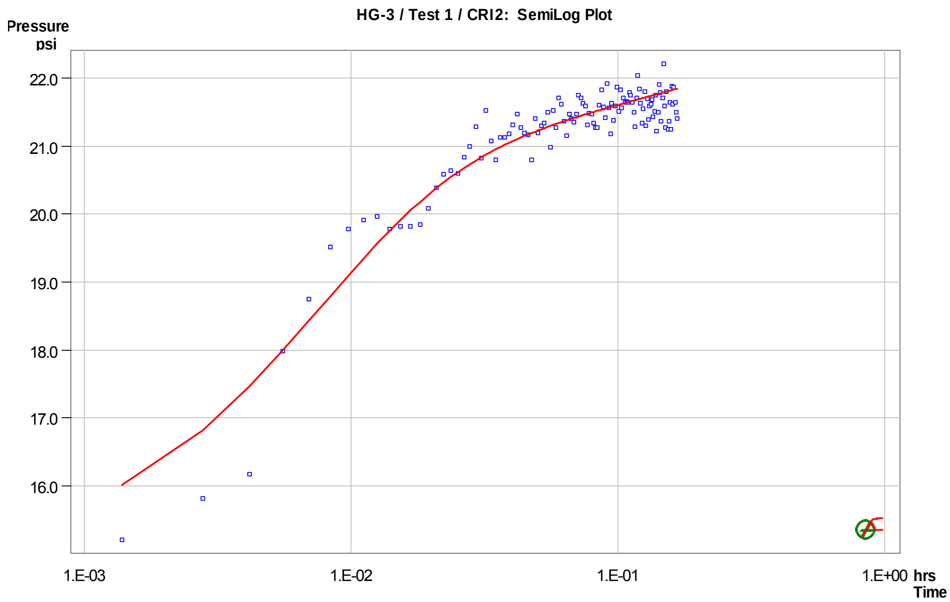
Static Pressure: 16.71 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	7.732e-05 m^2/s	1e-4	- - m	2.0000

	C (WBS)	Skin
CRI:	2.214e-8 m^3/Pa	9.9976
REC:	7.159e-08 m^3/Pa	9.9976

HG-3
Test 1 (400 to 453 feet)





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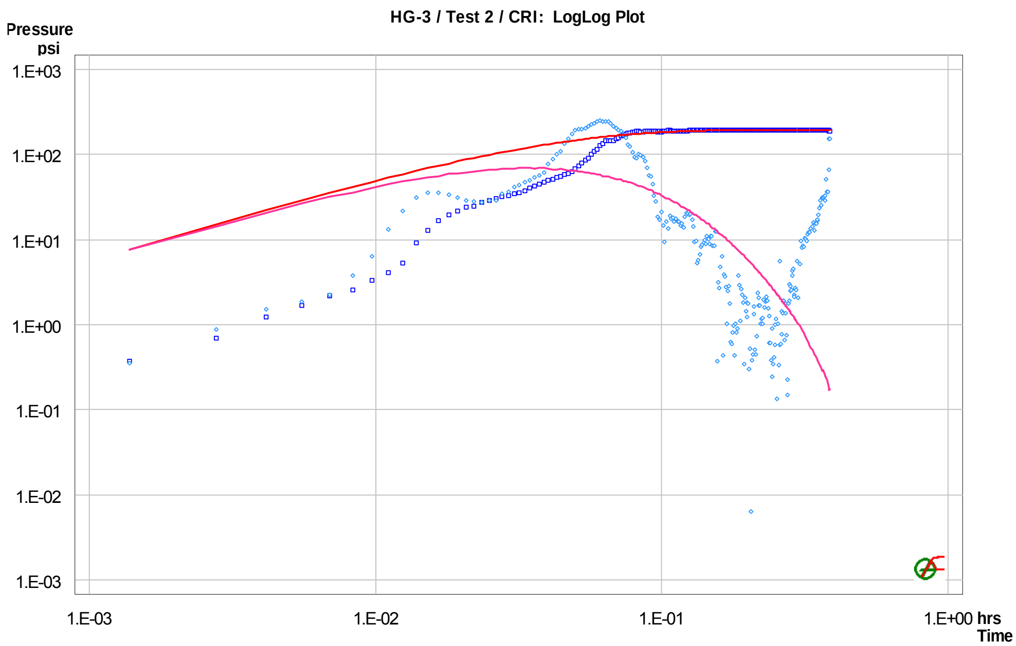
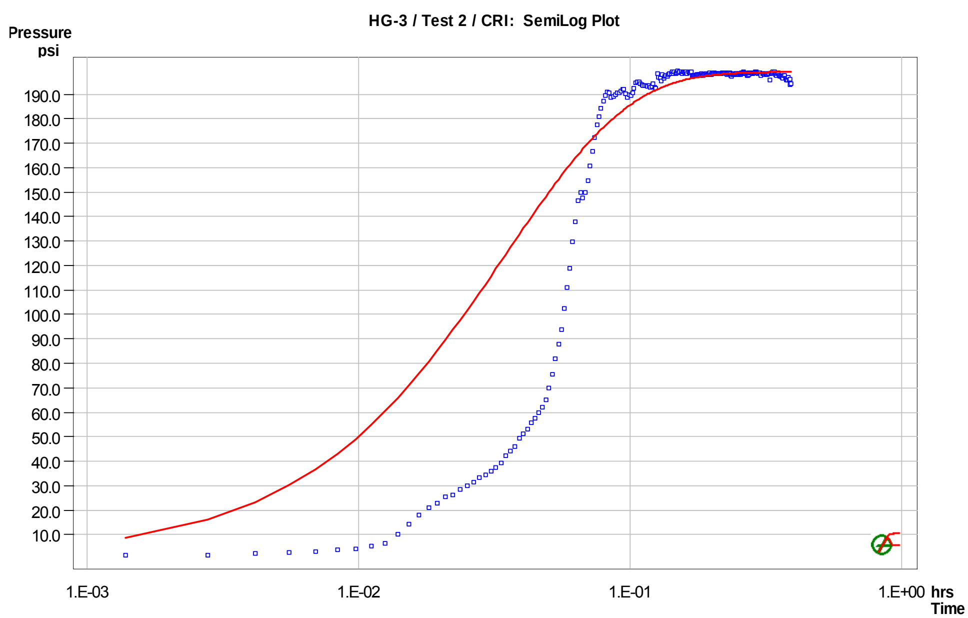
Static Pressure: 12.38 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	1.377e-04 m^2/s	1.000e-04	- - m	2.0000

	C (WBS)	Skin
CRI2:	4.406e-07 m^3/Pa	-0.2314
REC2:	1.000e-11 m^3/Pa	-0.2314

HG-3
Test 2 (358.9 to 387.6 feet)





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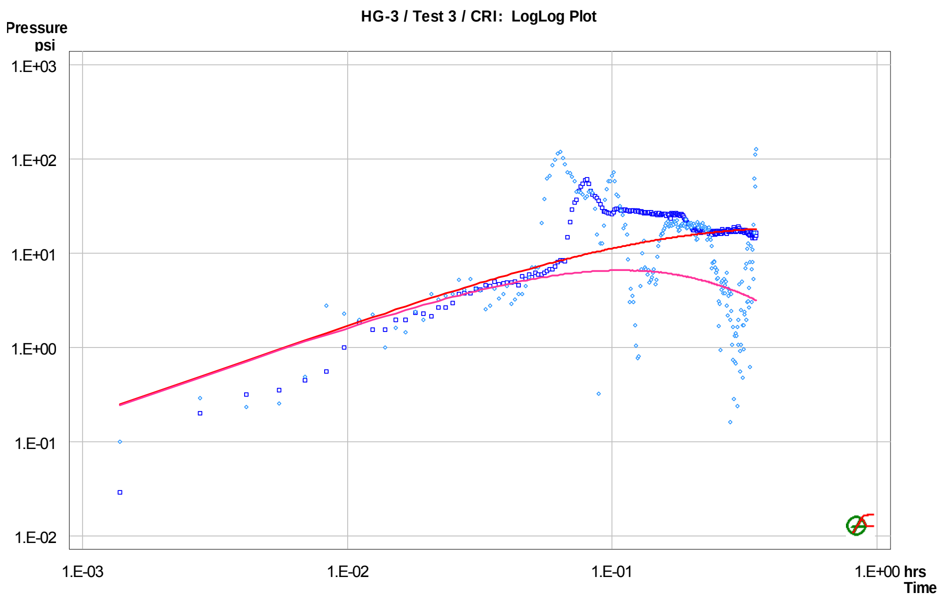
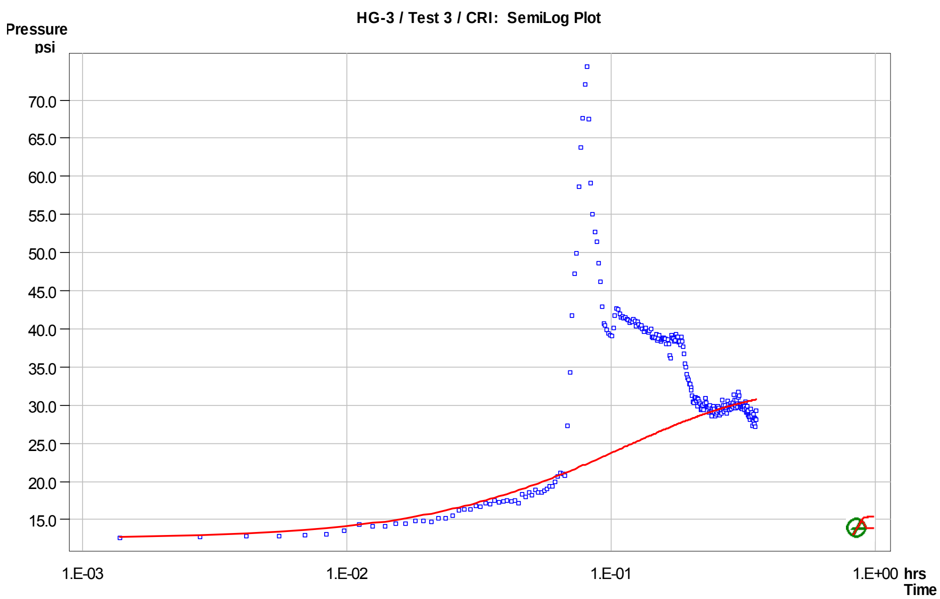
Static Pressure: 0.80 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	3.667e-06 m²/s	1.000e-05	- m	2.0000

	C (WBS)	Skin
CRI:	5.117e-08 m³/Pa	1.6058

HG-3
Test 3 (295.89 to 324.56 feet)



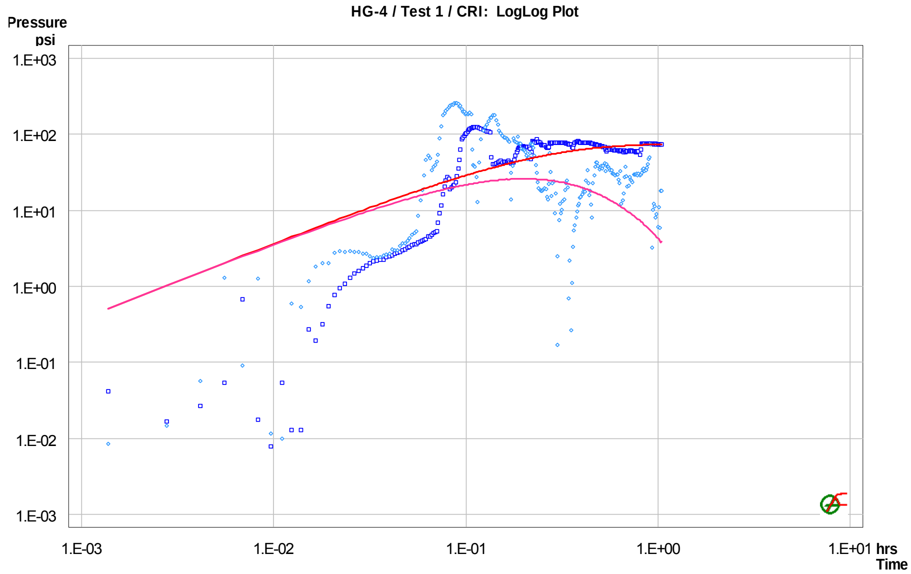


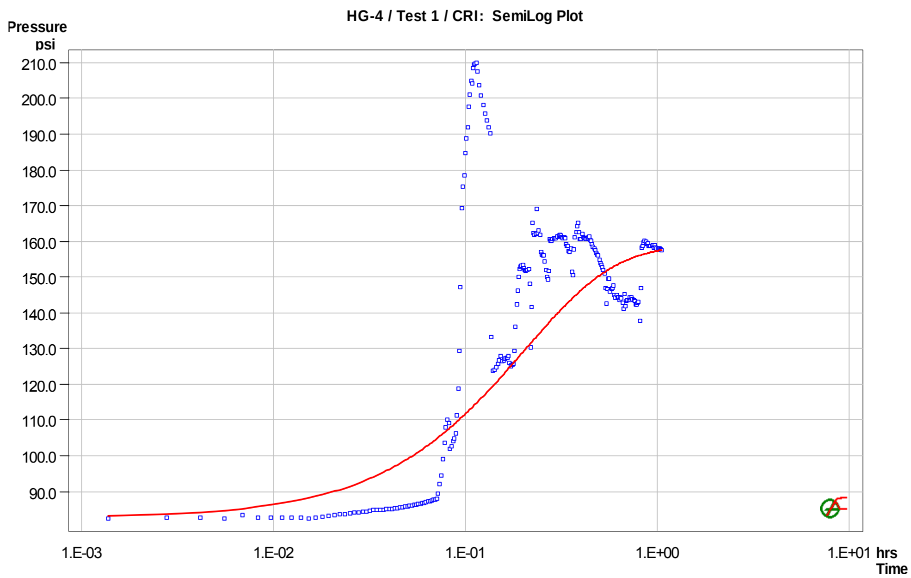
Static Pressure: 12.40 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	1.942e-04 m^2/s	1e-4	-- m	2.0000

	C (WBS)	Skin
CRI:	2.726e-06 m^3/Pa	10.0000
REC:	2.798e-07 m^3/Pa	10.0000

HG-4
Test 1 (274 to 296.6 feet)





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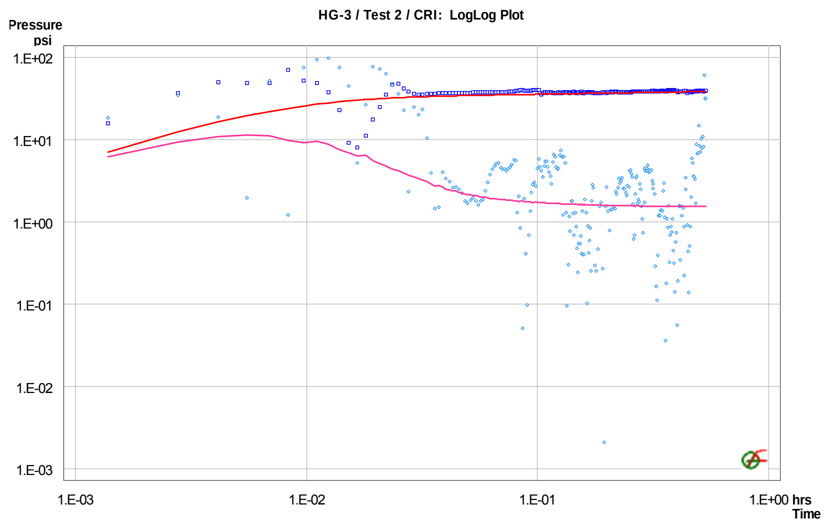
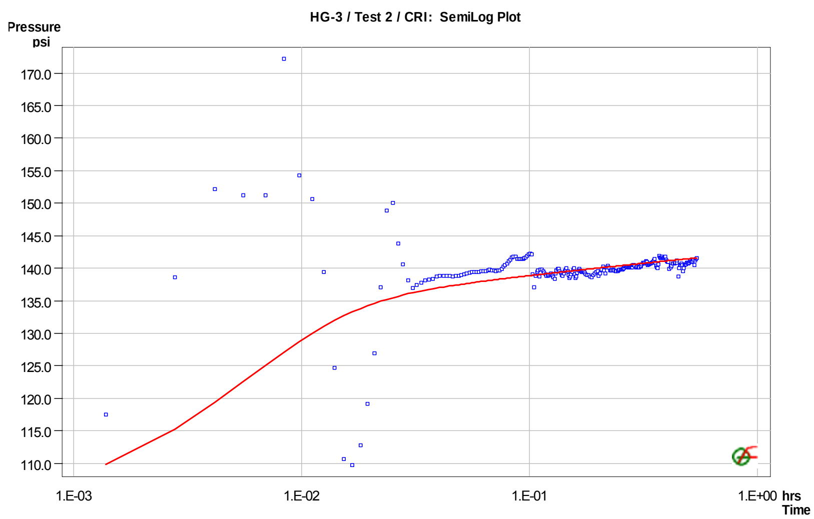
Static Pressure: 82.67 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	4.861e-06 m^2/s	1e-4	-- m	2.3435

	C (WBS)	Skin
CRI:	1.760e-07 m^3/Pa	9.9931
REC:	3.370e-09 m^3/Pa	9.9931

HG-4
Test 2 (211.89 to 240.56 feet)





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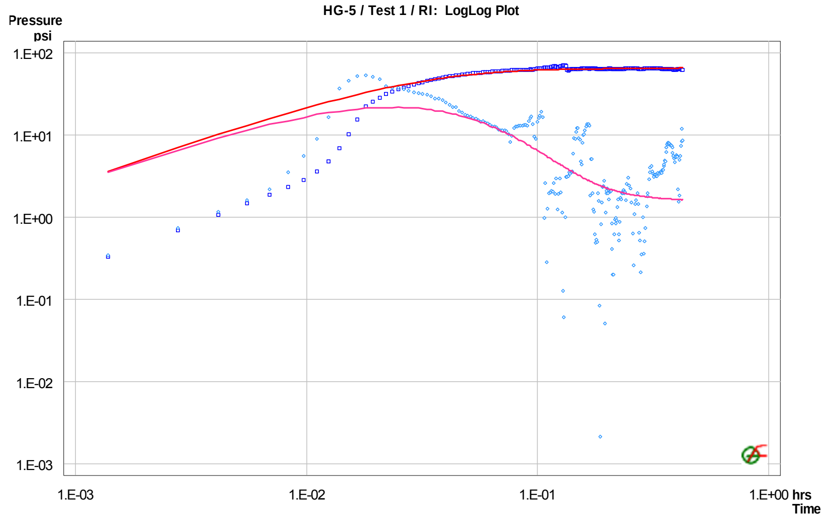
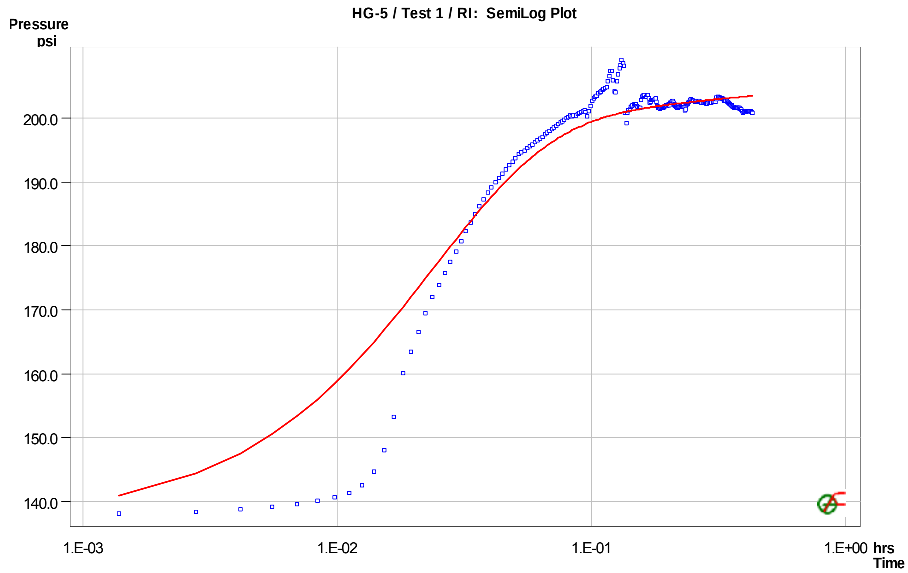
Static Pressure: 102.81 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	8.195e-06 m²/s	1.000e-04	- - m	2.0000

	C (WBS)	Skin
CRI:	9.637e-09 m³/Pa	7.1146
REC1:	4.313e-08 m³/Pa	7.1146

HG-5
Test 1 (337.9 to 366.5 feet)





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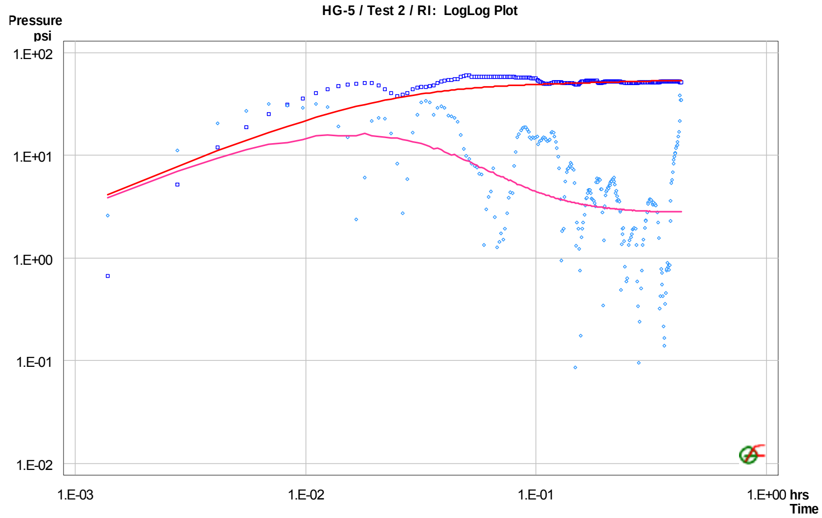
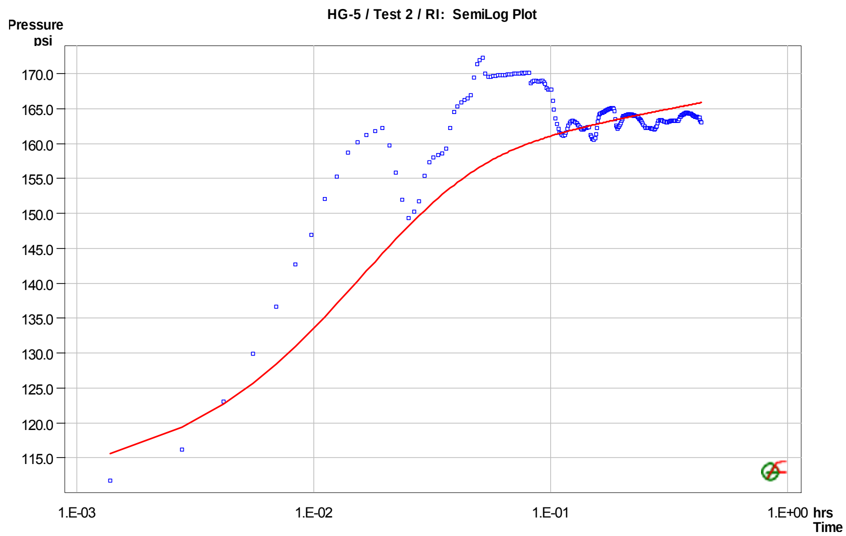
Static Pressure: 137.5 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	6.659e-06 m^2/s	8.914e-04	- - m	2.3030

	C (WBS)	Skin
RI:	2.848e-08 m^3/Pa	9.6946
REC:	9.309e-07 m^3/Pa	9.6946

HG-5
Test 2 (253.9 to 283.6 feet)





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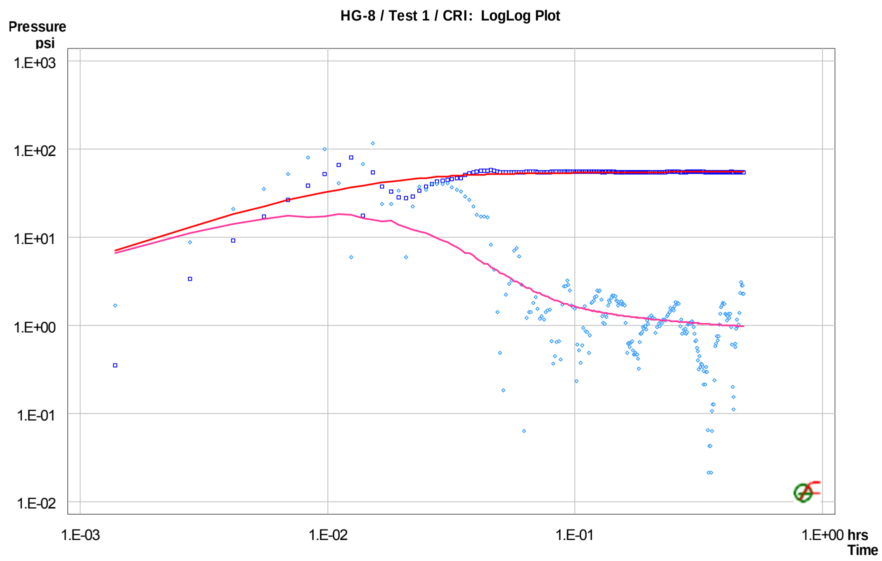
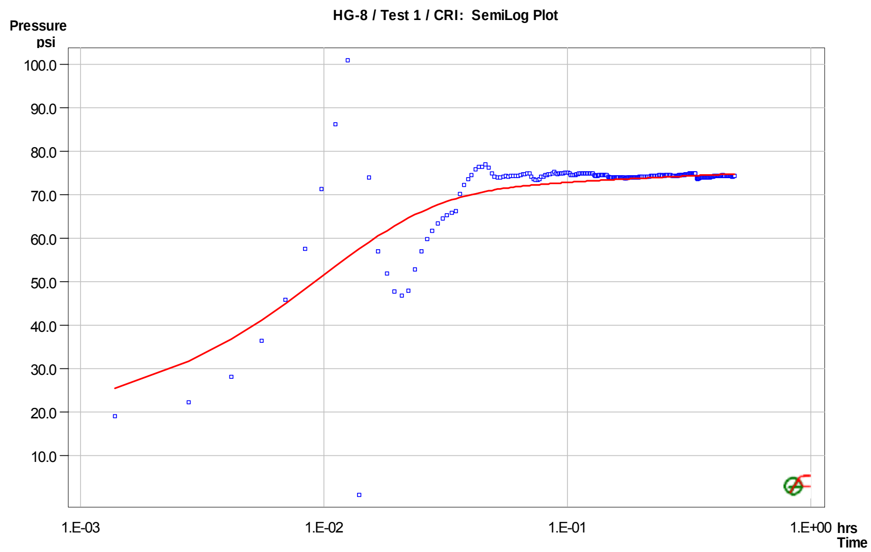
Static Pressure: 107.28 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	3.543e-06 m^2/s	1.125e-05	-- m	1.8516

	C (WBS)	Skin
RI:	7.500e-09 m^3/Pa	10.0000
REC:	9.687e-07 m^3/Pa	10.0000

HG-8
Test 1 (149 to 178 feet)





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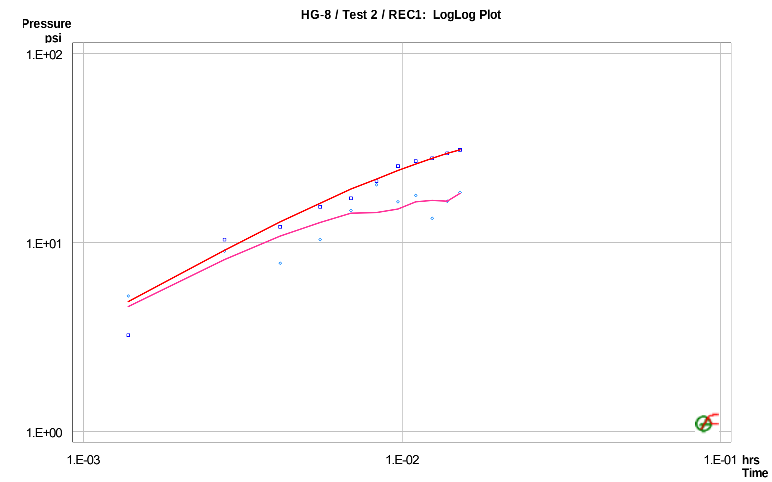
Static Pressure: 18.4 psi

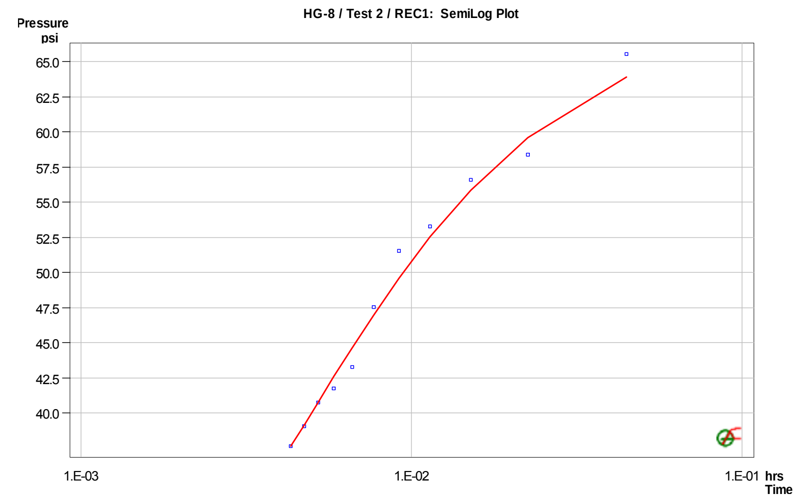
	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	1.015e-05 m²/s	1.072e-04	- - m	2.2641

	C (WBS)	Skin
CRI:	2.907e-08 m³/Pa	4.7653
REC:	1.818e-07 m³/Pa	4.7653

HG-8

Test 2 (86 to 115 feet)





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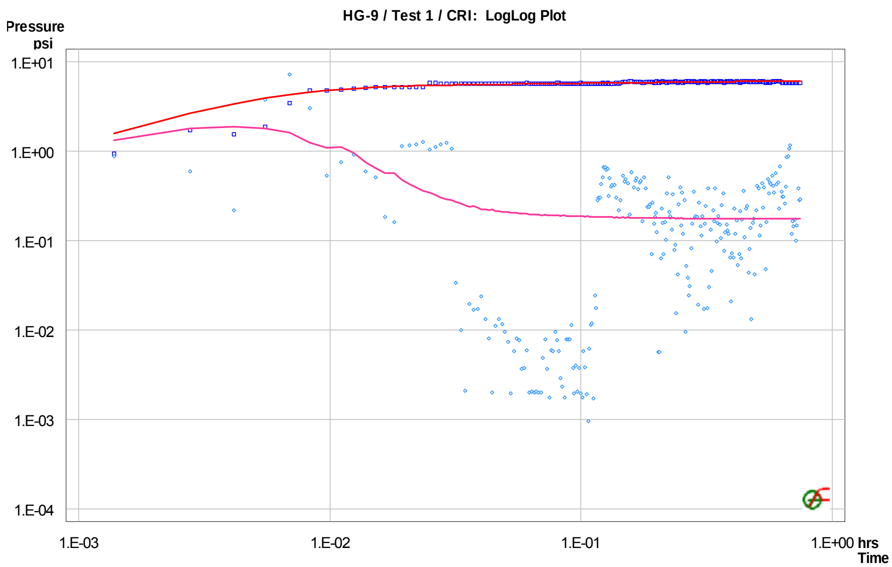
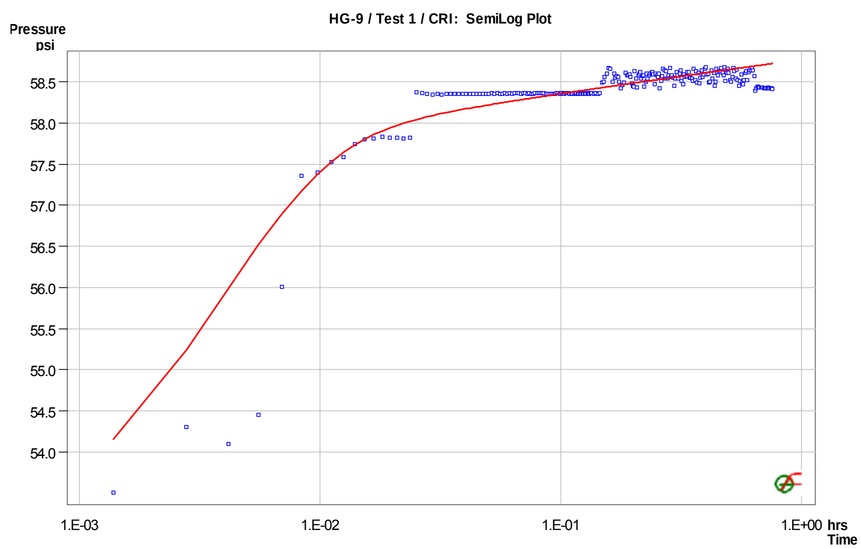
Static Pressure: 20.25 psi

	Transm.	Storativ.	Radius	Flow Dim.
Shell 1:	1.015e-04 m^2/s	9.372e-05	- - m	2

	C (WBS)	Skin
CRI:	1.570e-07 m^3/Pa	9.9999
REC1:	1.834e-07 m^3/Pa	9.9999
REC2:	9.974e-07 m^3/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^2/s	1.813e-04	- - m	2.0000

	C (WBS)	Skin
REC:	8.512e-11 m^3/Pa	10.0000
CRI:	4.978e-07 m^3/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_2)	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
		9-Feb-09		14-Apr-09		26-Oct-09		4-Jan-10	
Total Recoverable Chromium (Cr)	µg/L	45		14	J+	86		30	
Total Recoverable Copper (Cu)	µg/L	28		4.1	J+	19		7.7	
Total Recoverable Iron (Fe)	µg/L	12,000		3,400		9,800		6,400	B
Total Recoverable Lead (Pb)	µg/L	4		0.26	J	1.2		1.3	B
Total Recoverable Manganese (Mn)	µg/L	290		94	B	180		73	B
Total Recoverable Mercury (Hg)	µg/L	0.042	B,J	<0.016		<0.016		<0.016	
Total Recoverable Molybdenum (Mo)	µg/L	37		58	B	59		57	
Total Recoverable Nickel (Ni)	µg/L	37		14	B	67		26	
Total Recoverable Selenium (Se)	µg/L	0.94	J	<0.50		<0.54		1.3	J
Total Recoverable Silver (Ag)	µg/L	0.5	J	<0.064		<0.088		<0.088	
Total Recoverable Thallium (Tl)	µg/L	0.15	J	<0.054		<0.11		<0.11	
Total Recoverable Vanadium (V)	µg/L	-		-		32		11	
Total Recoverable Zinc (Zn)	µg/L	68		58		40		14	B
Total Recoverable Calcium (Ca)	mg/L	140		70		27		18	
Total Recoverable Magnesium (Mg)	mg/L	31		16		11		7.6	
Total Recoverable Sodium (Na)	mg/L	390		380		320	B	260	
Total Recoverable Potassium (K)	mg/L	11		9.3		7.5		6.5	
Pesticides		ND		ND		-		-	
PCBs		ND		ND		-		-	
VOCs									
Total Trihalomethanes (TTHM)									
Bromoform	µg/L	<0.24		<0.24		-		-	
Chloroform	µg/L	<0.23		<0.23		-		-	
Dibromochloromethane	µg/L	<0.23		<0.23		-		-	
Toluene	µg/L	<0.12		0.41	J	-		-	
SVOCs									
bis(2-ethylhexyl)phthalate	µg/L	22	J+	4.1	B,J,J+	-		-	
General Chemistry									
Bicarbonate	mg/L	280		250		220		230	
Carbonate	mg/L	<5.0		<2.5		11		6.9	
Total Alkalinity (as $CaCO_3$)	mg/L	230		210		200		200	
Chloride	mg/L	51		41		28		25	
Fluoride	mg/L	0.32		0.39		0.55		0.58	
Sulfate	mg/L	770		770		500		380	
Hardness (as $CaCO_3$)	mg/L	340		240		69		45	

		HG-6	Q	HG-6	Q	HG-6	Q	HG-6	Q
		9-Feb-09		14-Apr-09		29-Oct-09		4-Jan-10	
Total Recoverable Chromium (Cr)	µg/L	22		14	J+	<0.64		<0.64	
Total Recoverable Copper (Cu)	µg/L	12		4.8	J+	1.3	J	<0.66	
Total Recoverable Iron (Fe)	µg/L	5,800		5,500		460		160	
Total Recoverable Lead (Pb)	µg/L	0.96	J	0.18	J	<0.19		0.72	B,J
Total Recoverable Manganese (Mn)	µg/L	160		100	B	44		42	B
Total Recoverable Mercury (Hg)	µg/L	<0.016	B	<0.016		<0.016		<0.016	
Total Recoverable Molybdenum (Mo)	µg/L	2.5		1.8	B,J+	1.4		1.7	
Total Recoverable Nickel (Ni)	µg/L	15		10	B	1.8	J	1.2	J,J+
Total Recoverable Selenium (Se)	µg/L	<0.50		<0.50		<0.54		<0.54	
Total Recoverable Silver (Ag)	µg/L	<0.064		<0.064		<0.088		<0.088	
Total Recoverable Thallium (Tl)	µg/L	<0.054		<0.054		<0.11		<0.11	
Total Recoverable Vanadium (V)	µg/L	-		-		<2.6		<2.6	
Total Recoverable Zinc (Zn)	µg/L	32		16	J+	8.7		3.2	B,J
Total Recoverable Calcium (Ca)	mg/L	47		44		41		41	
Total Recoverable Magnesium (Mg)	mg/L	82		88		81		80	
Total Recoverable Sodium (Na)	mg/L	19		19		17		17	
Total Recoverable Potassium (K)	mg/L	2.2		1.9		1.1		1.1	
Pesticides		ND		ND		-		-	
PCBs		ND		ND		-		-	
VOCs									
Total Trihalomethanes (TTHM)									
Bromoform	µg/L	0.48	J	<0.24		-		-	
Chloroform	µg/L	<0.23		<0.23		-		-	
Dibromochloromethane	µg/L	0.4	J	<0.23		-		-	
Toluene	µg/L	0.34	J	0.24	J	-		-	
SVOCs									
bis(2-ethylhexyl)phthalate	µg/L	31	J+	2.5	B,J,J+	-		-	
General Chemistry									
Bicarbonate	mg/L	470		460		470		460	
Carbonate	mg/L	<2.5		<2.5		<2.5		<2.5	
Total Alkalinity (as $CaCO_3$)	mg/L	380		380		380		380	
Chloride	mg/L	24		25		25	B	25	
Fluoride	mg/L	0.073		0.080		<0.010		0.13	
Sulfate	mg/L	11		15		8.6		16	
Hardness (as $CaCO_3$)	mg/L	380		400		410		390	

		HG-7	Q	HG-7	Q	HG-7 DUP	Q	HG-7	Q
		15-Apr-09		27-Oct-09		27-Oct-09		29-Dec-09	
Total Recoverable Chromium (Cr)	µg/L	430		320		360		130	
Total Recoverable Copper (Cu)	µg/L	51		35		36		14	
Total Recoverable Iron (Fe)	µg/L	84,000		53,000		69,000		22,000	
Total Recoverable Lead (Pb)	µg/L	13		8.3		9		3.2	
Total Recoverable Manganese (Mn)	µg/L	1,300	B	1,100		1,200		620	
Total Recoverable Mercury (Hg)	µg/L	<0.016		0.058	J	0.092	J	0.022	J
Total Recoverable Molybdenum (Mo)	µg/L	2.2	B,J+	1.9		2		1.8	
Total Recoverable Nickel (Ni)	µg/L	420		310		350		120	B
Total Recoverable Selenium (Se)	µg/L	0.90	J	<0.54		<0.54		<0.54	
Total Recoverable Silver (Ag)	µg/L	0.26	J	0.14	J	0.15	J	<0.088	
Total Recoverable Thallium (Tl)	µg/L	0.14	J	0.12	J	0.12	J	<0.11	
Total Recoverable Vanadium (V)	µg/L	-		91		100		38	
Total Recoverable Zinc (Zn)	µg/L	99	B	79		86		35	
Total Recoverable Calcium (Ca)	mg/L	120		130		130		120	
Total Recoverable Magnesium (Mg)	mg/L	91		93		110		64	
Total Recoverable Sodium (Na)	mg/L	37	B	24	B	23	B	21	
Total Recoverable Potassium (K)	mg/L	5.4		5.2		5.7		3.7	
Pesticides		ND		-		-		-	
PCBs		ND		-		-		-	
VOCs									
Total Trihalomethanes (TTHM)									
Bromoform	µg/L	<0.24		-		-		-	
Chloroform	µg/L	<0.23		-		-		-	
Dibromochloromethane	µg/L	<0.23		-		-		-	
Toluene	µg/L	0.30	J	-		-		-	
SVOCs									
bis(2-ethylhexyl)phthalate	µg/L	<1.1	B	-		-		-	
General Chemistry									
Bicarbonate	mg/L	480		480		480		430	
Carbonate	mg/L	<2.5		<2.5		<2.5		<2.5	
Total Alkalinity (as $CaCO_3$)	mg/L	390		400		390		350	
Chloride	mg/L	47		46		46		45	
Fluoride	mg/L	0.18		0.2		0.2		0.25	
Sulfate	mg/L	31		31		30		29	
Hardness (as $CaCO_3$)	mg/L	440		450		460		430	

		HG-9	Q	HG-9	Q
		9-Feb-09		15-Apr-09	
Total Recoverable Chromium (Cr)	µg/L	6.5		<1.6	
Total Recoverable Copper (Cu)	µg/L	12		4.1	J+
Total Recoverable Iron (Fe)	µg/L	3,200		1,900	
Total Recoverable Lead (Pb)	µg/L	1.6		0.15	J
Total Recoverable Manganese (Mn)	µg/L	88		41	B,J+
Total Recoverable Mercury (Hg)	µg/L	0.018	J	<0.016	
Total Recoverable Molybdenum (Mo)	µg/L	3.9		1.9	B,J+
Total Recoverable Nickel (Ni)	µg/L	7.8		4.8	J+
Total Recoverable Selenium (Se)	µg/L	1.1	J	<0.50	
Total Recoverable Silver (Ag)	µg/L	<0.064		<0.064	
Total Recoverable Thallium (Tl)	µg/L	<0.054		<0.054	
Total Recoverable Vanadium (V)	µg/L	-		-	
Total Recoverable Zinc (Zn)	µg/L	37		19	B,J+
Total Recoverable Calcium (Ca)	mg/L	97		120	
Total Recoverable Magnesium (Mg)	mg/L	32		35	
Total Recoverable Sodium (Na)	mg/L	38		23	B
Total Recoverable Potassium (K)	mg/L	3.6		2.8	
Pesticides		ND		ND	
PCBs		ND		ND	
VOCs					
Total Trihalomethanes (TTHM)					
Bromoform	µg/L	1.1		<0.24	
Chloroform	µg/L	0.94	J+	0.24	J,J+
Dibromochloromethane	µg/L	2.6		0.41	J
Toluene	µg/L	<0.12		0.48	J
SVOCs					
bis(2-ethylhexyl)phthalate	µg/L	16	J+	<1.1	B
General Chemistry					
Bicarbonate	mg/L	360		410	
Carbonate	mg/L	<2.5		<2.5	
Total Alkalinity (as $CaCO_3$)	mg/L	290		340	
Chloride	mg/L	46		32	
Fluoride	mg/L	0.30		0.37	
Sulfate	mg/L	48		38	
Hardness (as $CaCO_3$)	mg/L	340		390	

		HG-4	Q	HG-4	Q	HG-4	Q	HG-4	Q	HG-6	Q	HG-6	Q	HG-6	Q	HG-6	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**	
Total Dissolved Solids (TDS)	mg/L	1,500		1,500		1,000		880		490		470		460		460	
Total Suspended Solids (TSS)	mg/L	190		290		840		70		81		91		3.3	J+	2	
Residual Chlorine	mg/L	<0.10		<0.10		<0.10	H	<0.10	H	<0.10		<0.10		<0.10	H	<0.10	H
Ammonia (as N)	mg/L-N	0.21		0.28		0.28	B	0.17		0.084		0.094	J+	0.064		0.057	
Nitrate (as N)	mg/L-N	0.068	J	<0.026		<0.026		<0.026		0.051	J	<0.026		<0.026		<0.026	
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
Total Phosphorus	mg/L	0.4		0.37		0.45		0.49		0.12	J+	0.077		<0.016		<0.016	
Total Sulfide	mg/L	<0.050		0.13	J	0.24		1		<0.050		<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
Electrical Conductivity (@ 25 °C)	umhos/cm	1,900		1,900		1440		1300		740		725		736		708	
Odor	odor units	2		2		2		4		1.0		2.0		none		1	
Turbidity	NTU	350		540		140		43		120		56		3.4		2.4	
Cyanide	mg/L	<0.0032		0.017	B,J+	<0.0028		<0.0028		<0.0032		0.021	B,J+	<0.0028		<0.0028	
Dioxins	pg/L	<1.2		<0.78		-		-		<0.82		<0.88		-		-	
Aquatic Toxicity		pass		pass		-		-		pass		pass		-		-	
Asbestos (# of fibers)	# of fibers	ND		ND		-		-		ND		ND		-		-	
Oil and Grease	mg/L	-		<1.2		-		-		-		1.4	J	-		-	

		HG-7	Q	HG-7	Q	HG-7 DUP	Q	HG-7	Q	HG-9	Q	HG-9	Q
		15-Apr-09		**27-Oct-09**		**27-Oct-09**		**29-Dec-09**		**9-Feb-09**		**15-Apr-09**	
Total Dissolved Solids (TDS)	mg/L	550		530		580		530		480		490	
Total Suspended Solids (TSS)	mg/L	1,100		840		1,000		400		88		34	
Residual Chlorine	mg/L	<0.10		<0.50	H	<0.50	H	<0.10	H	<0.10		<0.10	
Ammonia (as N)	mg/L-N	0.090	J+	0.18		0.042	J	0.035	J	0.037	J	<0.025	
Nitrate (as N)	mg/L-N	<0.026		<0.026		<0.026		0.026	J	1.3		0.72	
Nitrite (as N)	mg/L-N	<0.0081		0.0099	B,J,J+	0.0094	B,J,J+	<0.0081		0.0087	J	<0.0081	
Total Phosphorus	mg/L	0.64		0.51		0.63		0.21		0.19	J+	0.044	J
Total Sulfide	mg/L	0.15	J	<0.25		<0.25		<0.050		<0.050		<0.050	
pH	s.u.	7.38		7.37	H	7.4	H	7.3	H	7.99		7.64	
Electrical Conductivity (@ 25 °C)	umhos/cm	839		870		871		880		747		753	
Odor	odor units	none		none		none		none		1.0		none	
Turbidity	NTU	810		210		320		160		210		34	
Cyanide	mg/L	<0.0028		<0.0028		<0.0028		<0.0028		<0.0032		<0.0028	
Dioxins	pg/L	<0.94		-		-		-		<0.54		<0.80	
Aquatic Toxicity		pass		-		-		-		pass		pass	
Asbestos (# of fibers)	# of fibers	ND		-		-		-		ND		ND	
Oil and Grease	mg/L	<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

		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		<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_2)	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

		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	
Total Recoverable Chromium (Cr)	µg/L	<0.64		<0.64		3.5		1.2	J	<1.6		<1.6		<1.3		40		<1.6		<1.6		<1.6		<1.6		0.93	J,J+
Total Recoverable Copper (Cu)	µg/L	1.2	J	0.92	J	4.8		11		1.6	J	1.6	B,J,J+	3.2	J,J+	15		1.4	J	1.3	J	1.7	B,J,J+	4.2	B	2.5	J+
Total Recoverable Iron (Fe)	µg/L	350		350		160		57		<16		46	J	99		6,600		87	J+	100	J+	75		120		58	
Total Recoverable Lead (Pb)	µg/L	<0.19		<0.19		0.26	J	0.69	B,J	<0.053		<0.053		<0.38		1.7	B,J+	<0.053		<0.053		<0.053		<0.053		<0.19	
Total Recoverable Manganese (Mn)	µg/L	9.5		8.6		92		5.2	B	0.92	J	3.3	J+	3.2		130	B	4.8		4.9		5.5	J+	7.2	J+	4	
Total Recoverable Mercury (Hg)	µg/L	0.05	J	<0.016		<0.016		0.050	J	<0.016		0.028	B,J,J+	<0.016		<0.016		<0.016		<0.016		0.028	B,J,J+	<0.016	B	0.02	J,J+
Total Recoverable Molybdenum (Mo)	µg/L	1.2		1.1		5.5		6.7		8.2	B,J+	3.3		4.5		2		770	B	750		430		180		470	
Total Recoverable Nickel (Ni)	µg/L	2.1		2.6	B,J+	11		5.4	J+	4.3		3.2	B	5.8		27	B	75		77		120	B	120	B	44	
Total Recoverable Selenium (Se)	µg/L	<0.54		<0.54		<0.54		<0.54		9.2		7.6		9.2		2.3		87		84		74		75		71	
Total Recoverable Silver (Ag)	µg/L	<0.088		<0.088		<0.088		<0.088		<0.064		<0.064		<0.18		<0.088		<0.064		<0.064		<0.064		<0.064		<0.088	
Total Recoverable Thallium (Tl)	µg/L	<0.11		<0.11		<0.11		<0.11		<0.054		<0.054		<0.22		<0.11		<0.054		<0.054		<0.054		<0.054		<0.11	
Total Recoverable Vanadium (V)	µg/L	<2.6		2.8	J	4.3		<2.6		-		-		<5.2		23		-		-		-		-		93	
Total Recoverable Zinc (Zn)	µg/L	9.9		5.5		40		10	B	6.0	J+	8.4	B,J+	8.7		18		15	J+	16	J+	12	B,J+	15	B,J+	10	
Total Recoverable Calcium (Ca)	mg/L	120		100		87		70		240		180		310		71		230		230		220		200		200	
Total Recoverable Magnesium (Mg)	mg/L	33		34		41		32		92	B	64		120		32		43	B	43		48		44		52	
Total Recoverable Sodium (Na)	mg/L	20	B	19		18	B	17		26	B	19	B	30		10		27	B	43		31	B	30	B	24	
Total Recoverable Potassium (K)	mg/L	1.9		1.5		0.62	J	3.7		1.3		0.89	J	1.5		1.1		1.2		1.2		1.2		1.1		0.99	J
Pesticides		-		-		-		-		ND		ND		-		-		ND		ND		ND		ND		-	
PCBs		-		-		-		-		ND		ND		-		-		ND		ND		ND		ND		-	
VOCs																											
Total Trihalomethanes (TTHM)																											
Bromoform	µg/L	-		-		-		-		<0.24		<0.24		-		-		<0.24		<0.24		<0.24		<0.24		-	
Chloroform	µg/L	-		-		-		-		<0.23		<0.23		-		-		<0.23		<0.23		<0.23		<0.23		-	
Dibromochloromethane	µg/L	-		-		-		-		<0.23		<0.23		-		-		<0.23		<0.23		<0.23		<0.23		-	
Toluene	µg/L	-		-		-		-		<0.12		<0.12		-		-		<0.12		<0.12		<0.12		<0.12		-	
SVOCs																											
bis(2-ethylhexyl)phthalate	µg/L	-		-		-		-		2	B,J,J+	3.2	B,J,J+	-		-		1.8	B,J,J+	-		2.1	B,J,J+	4.6	B,J+	-	
General Chemistry																											
Bicarbonate	mg/L	420		440		390		290		280		270		290		170		190		-		180		180		240	
Carbonate	mg/L	<2.5		<2.5		<2.5		8.8		<5.0		<2.5		<5.0		<2.5		<5.0		-		<2.5		<2.5		<5.0	
Total Alkalinity (as $CaCO_3$)	mg/L	350		360		320		250		230		220		240		140		150		150		150		150		190	
Chloride	mg/L	26		27		14		14		23	B	15	B	28	B	9.4	B	14	B	14		12	B	12	B	18	B
Fluoride	mg/L	0.36		0.46		0.14		0.11		0.13		0.11		0.12		0.12		0.15		0.14		0.085		0.10		0.17	
Sulfate	mg/L	31		26		30		29		650	B	450		1,100		110	B	560	B	560		600		610		550	
Hardness (as $CaCO_3$)	mg/L	400		390		330		260		900		650		1,300		270		650		750		740		690		710	

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	
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+	-	

		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[1]	DW MCL[2]
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
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			50 SMCL
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_2)	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

		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[1]	DW MCL[2]
Total Recoverable Chromium (Cr)	µg/L	<0.64		25		25		<1.6		<1.6		1.1	J,J+	1.3	J	6		370			50
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			TT 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 Level = 15
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		50 SMCL
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) 2.4 (1 hr)	2
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) 20 (1-hour)	50
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
Bromoform	µg/L	-		-		-		<0.24		<0.24		-		-		-		-			80 TTHM
Chloroform	µg/L	-		-		-		<0.23		<0.23		-		-		-		-			80 TTHM
Dibromochloromethane	µg/L	-		-		-		<0.23		<0.23		-		-		-		-			80 TTHM
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 $CaCO_3$)	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 $CaCO_3$)	mg/L	750		320		300		290		290		310		300		673		580			

		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[1]**	**DW MCL[2]**
Total Dissolved Solids (TDS)	mg/L	1,000		410		400		340		360		350		360		790		900			500 SMCL
Total Suspended Solids (TSS)	mg/L	4		200		190		<2.5		0.86	J	<2.0		<3.3		18		3,600			
Residual Chlorine	mg/L	<0.10	H	<0.10	H	<0.10	H	<0.10		<0.10		<0.10	H	<0.10	H	<0.10		<0.10	H		4.0 MRDL
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+		
Nitrate (as N)	mg/L-N	0.51		1.4		1.4		<0.018		<0.026		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 SMCL
Electrical Conductivity (@ 25 °C)	umhos/cm	1250		602		605		577		541		589		596		1,130		1,090			
Odor	odor units	2		8		4		2		none		1		none		-		-			3 SMCL
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

Parameter	Unit	Dry Jun-02	Spring Apr-02	Wet 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 $CaCO_3$	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 $CaCO_3$	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
Orthophospate	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):

$$RPD(\%) = \frac{|original - duplicate|}{\frac{(original + duplicate)}{2}} x100 \qquad \text{(Equation 1)}$$

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

Golder Associates Inc.
18300 NE Union Hill Road, Suite 200
Redmond, WA 98052 USA
Tel: (425) 883-0777 Fax: (425) 882-5498 www.golder.com

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:

$$Error(\%) = \frac{(\Sigma cation - |\Sigma anion|)}{(\Sigma cation + |\Sigma anion|)} x100 \qquad \text{(Equation 2)}$$

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 µg/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

List of Attachments

TABLE E-1
Field Duplicate Result Summary
Water Quality Monitoring

Location	Date	No. of Determinations	No. of Failures	% Failure
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	**1**	J	0.67	2													1
Beryllium (Be)	µg/L	**0.058**	J	0.046	1													1
Boron (B)	µg/L					**14**	B,J	4.9	100									1
Copper (Cu)	µg/L					**0.24**	J	0.045	2									1
Iron (Fe)	µg/L					**8.9**	J	7.2	50									1
Lead (Pb)	µg/L					**0.019**	J	0.019	1									1
Mercury (Hg) by 1631	µg/L									**0.00052**		0.0002	5E-04					1
Molybdenum (Mo)	µg/L					**0.24**	J	0.031	1	**0.21**	J	0.13	1	**0.21**	J	0.13	1	3
Thallium (Tl)	µg/L					**0.058**	J	0.054	1									1
Zinc (Zn)	µg/L	**3**	B,J	0.28	5													1
Potassium (K)	mg/L					**0.13**	J	0.071	1									1
Total Recoverable Beryllium (Be)	µg/L	**0.099**	J	0.06	1													1
Total Recoverable Chromium (Cr)	µg/L					**4.4**		1.6	3									1
Total Recoverable Copper (Cu)	µg/L					**1.4**	J	0.045	2									1
Total Recoverable Manganese (Mn)	µg/L					**5.4**	B	0.092	1									1
Total Recoverable Molybdenum (Mo)	µg/L					**1.6**	B	0.031	1									1
Total Recoverable Nickel (Ni)	µg/L					**0.99**	B,J	0.065	2					**0.56**	B,J	0.25	2	2
Total Recoverable Zinc (Zn)	µg/L					**3.5**	J	1.3	5									1
Chloroform	µg/L	**5**		0.23	0.5	**2.9**		0.23	0.5									2
bis(2-ethylhexyl)phthalate	µg/L	**6.5**		1.5	5.5	**2.2**	B,J	1.1	4.8									2
Total Suspended Solids (TSS)	mg/L									**12**		20	20					1
Ammonia (as N)	mg/L-N					**0.025**	J	0.025	0.05									1
Nitrite (as N)	mg/L-N									**0.0089**	B,J	0.0081	0.05					1
Total Phosphorus	mg/L	**0.025**	J	0.012	0.05													1
Cyanide	mg/L					**0.0041**	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

(shaded) 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 4-Feb-09	Q	MDL	PQL	FB 3-Apr-09	Q	MDL	PQL	FB-1 22-Sep-09	Q	MDL	PQL	FB 20-Jan-10	Q	MDL	PQL	
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
bold (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

Golder Associates

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 24-Nov-09	Q
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_2	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 24-Nov-09	Q
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 $CaCO_3$)	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 $CaCO_3$)	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

ATTACHMENT A

ATTACHMENT A
Duplicate Analysis Results

Parameter	Units	MDL	PQL	February 2009 SW-2 4-Feb-09	SW-2 Dup 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_2)	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 4-Feb-09	SW-2 Dup 4-Feb-09	
Pesticides				ND	ND	-
PCBs				ND	ND	-
VOCs						
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
SVOCs						
bis(2-ethylhexyl)phthalate	µg/L	1.1	4	1.8	-	-
General Chemistry						
Bicarbonate	mg/L	10	10	190	-	-
Carbonate	mg/L	5	5	<5.0	-	-
Total Alkalinity (as $CaCO_3$)	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 $CaCO_3$)	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	66
Failures	2
% Failure	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_2)	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	
Pesticides				ND	ND	-
PCBs				ND	ND	-
VOCs						
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
SVOCs						
bis(2-ethylhexyl)phthalate	µg/L	1.1	4	2.1	4.6	+/- PQL
General Chemistry						
Bicarbonate	mg/L	5	10	180	180	0%
Carbonate	mg/L	2.5	5	<2.5	<2.5	+/- PQL
Total Alkalinity (as $CaCO_3$)	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 $CaCO_3$)	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
Cyanide	mg/L	0.0032 / 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	77
Failures	3
% Failure	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_2)	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	
Pesticides				-	-	-
PCBs				-	-	-
VOCs						
Total Trihalomethanes (TTHM)						
Bromoform	µg/L			-	-	-
Chloroform	µg/L			-	-	-
Dibromochloromethane	µg/L			-	-	-
Toluene	µg/L			-	-	-
SVOCs						
bis(2-ethylhexyl)phthalate	µg/L			-	-	-
General Chemistry						
Bicarbonate	mg/L	10	10	240	230	4%
Carbonate	mg/L	5	5	<5.0	<5.0	+/- PQL
Total Alkalinity (as $CaCO_3$)	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 $CaCO_3$)	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			-	-	-

Determinations	69
Failures	2
% Failure	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_2)	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	
Pesticides				-	-	-
PCBs				-	-	-
VOCs						
Total Trihalomethanes (TTHM)						
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	5	480	480	0%
Carbonate	mg/L	2.5	2.5	<2.5	<2.5	+/- PQL
Total Alkalinity (as $CaCO_3$)	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 $CaCO_3$)	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			-	-	-

Determinations	70
Failures	4
% Failure	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_2)	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 20-Jan-10	SW-2 Dup 20-Jan-10	
Pesticides				-	-	-
PCBs				-	-	-
VOCs						
Total Trihalomethanes (TTHM)						
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	5	170	170	0%
Carbonate	mg/L	2.5	2.5	<2.5	<2.5	+/- PQL
Total Alkalinity (as $CaCO_3$)	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 $CaCO_3$)	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			-	-	-

Determinations	69
Failures	2
% Failure	3%

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			
Metals													
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	1	J	0.67	2	<0.67		0.67	2	<0.67		0.67	2
Barium (Ba)	µg/L	**0.11**	J	0.068	1	**0.27**	B,J	0.068	1	<0.068		0.068	1
Beryllium (Be)	µg/L	**0.058**	J	0.046	1	<0.046		0.046	1	<0.046		0.046	1
Boron (B)	µg/L									**14**	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	**0.25**	B,J	0.045	2	**0.24**	J	0.045	2
Iron (Fe)	µg/L	<7.2		7.2	50	<7.2		7.2	50	**8.9**	J	7.2	50
Lead (Pb)	µg/L	<0.019		0.019	1	<0.019		0.019	1	**0.019**	J	0.019	1
Manganese (Mn)	µg/L	<0.025		0.025	1	**0.064**	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	**0.21**	B,J	0.031	1	**4.5**	B	0.031	1	**0.24**	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	**0.058**	J	0.054	1
Vanadium (V)	µg/L												
Zinc (Zn)	µg/L	**3**	B,J	0.28	5	**4.8**	J	0.28	5	<0.28		0.28	5
Calcium (Ca)	mg/L	**0.2**		0.019	0.1	**0.12**		0.019	0.1	**0.092**	J	0.019	0.1
Magnesium (Mg)	mg/L	**0.068**	B	0.021	0.05	**0.087**		0.021	0.05	**0.025**	J	0.021	0.05
Sodium (Na)	mg/L	**0.3**	B,J	0.049	0.5	**0.39**	B,J	0.049	0.5	**0.66**		0.049	0.5
Potassium (K)	mg/L	<0.071		0.071	1	<0.071		0.071	1	**0.13**	J	0.071	1
Silicon (as SiO_2)	mg/L	<0.038		0.038	0.2	<0.038		0.038	0.2	**0.075**	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	**0.096**	B,J	0.072	1	**0.079**	B,J	0.072	1	**0.11**	J	0.072	1
Total Recoverable Beryllium (Be)	µg/L	**0.099**	J	0.06	1	<0.06		0.06	1	<0.06		0.06	1
Total Recoverable Boron (B)	µg/L									**6.4**	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	**4.4**		1.6	3
Total Recoverable Copper (Cu)	µg/L	**0.09**	J	0.045	2	**0.05**	J	0.045	2	**1.4**	J	0.045	2
Total Recoverable Iron (Fe)	µg/L	<16		16	50	**17**	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	**0.12**	J	0.092	1	<0.092		0.092	1	**5.4**	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	**1.2**	B	0.031	1	**1.6**	B	0.031	1
Total Recoverable Nickel (Ni)	µg/L	<0.065		0.065	2	<0.065		0.065	2	**0.99**	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	**2.4**	J	1.3	5	**1.7**	J	1.3	5	**3.5**	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	**0.12**	B,J	0.053	0.5	**0.059**	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	**5**		0.23	0.5	**3.3**		0.23	0.5	**2.9**		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
SVOCs													
bis(2-ethylhexyl)phthalate	µg/L	**6.5**		1.5	5.5	**3.7**	B,J	1.9	7	**2.2**	B,J	1.1	4.8
General Chemistry													
Bicarbonate	mg/L	**5**		5	5	<5		5	5	**6.9**		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 $CaCO_3$)	mg/L	**4.1**		4.1	4.1	<4.1		4.1	4.1	**5.6**		4.1	4.1
Chloride	mg/L	<0.059		0.059	0.5	<0.075	B	0.075	0.5	**0.44**	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 $CaCO_3$)	mg/L	**0.79**		0.1	0.5	**0.67**		0.1	0.5				
Total Dissolved Solids (TDS)	mg/L	<6.7		6.7	6.7	<6.7		6.7	6.7	**10**		10	10
Total Suspended Solids (TSS)	mg/L	<5		5	5					**1**	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	**0.025**	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	**0.025**	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	**2.25**		1	1	**2.8**		1	1	**3.77**		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	**0.1**		0.1	0.1	**0.11**		0.1	0.1
Cyanide	mg/L	<0.0032		0.0032	0.005	<0.0032		0.0032	0.005	**0.0041**	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			
Metals													
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**		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_2)	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	**40**	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	**0.13**	B,J	0.053	0.5	**0.26**	J	0.14	1	**0.24**	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	**4.9**		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	**2.4**	B,J	1.1	4								
General Chemistry													
Bicarbonate	mg/L	**5**		5	5	**5**		5	5	**5**		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 $CaCO_3$)	mg/L	**4.1**		4.1	4.1	**4.1**		4.1	4.1	**4.1**		4.1	4.1
Chloride	mg/L	**0.19**	B,J	0.059	0.5	**0.12**	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	**3.5**		0.21	1	**0.25**	J	0.21	1	<0.21		0.21	1
Hardness (as $CaCO_3$)	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	**10**		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	**12**		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	**0.047**	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	**0.0089**	B,J	0.0081	0.05
Total Phosphorus	mg/L	**0.13**		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	**1.81**		1	1	**1.7**		1	1	**2.39**		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	**0.003**	B,J	0.0028	0.005	<0.0028		0.0028	0.005	<0.0028		0.0028	0.005
Oil and Grease	mg/L	**3.8**	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			
Metals									
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_2)	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 $CaCO_3$)	mg/L	<4.1		4.1	4.1	<4.1		4.1	4.1
Chloride	mg/L	**0.4**	J	0.059	0.5	**0.25**	B,J	0.059	0.5
Fluoride	mg/L	<0.010		0.01	0.05	<0.010		0.01	0.05
Sulfate	mg/L	**0.36**	J	0.21	1	**0.22**	B,J	0.21	1
Hardness (as $CaCO_3$)	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	**0.065**	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	**0.018**	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	**2.33**		1	1	**2.27**		1	1
Odor	odor units	No Obs Odor		1	1	No Obs Odor		1	1
Turbidity	NTU	<0.10		0.1	0.1	**0.18**		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.
H = holding time exceeded

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