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June 30, 2004

Mr. Norman Shopay
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California Department of Toxic Substances Control
Permitting and Corrective Action Branch
700 Heinz Avenue, Suite 200
Berkeley, California 94710-2721

Subject: Draft Background Study Work Plan
PG&E Topock Compressor Station, Needles, California

Dear Mr. Shopay:

This letter transmits the *Work Plan for Assessing Background Metals Concentrations in Groundwater* near Pacific Gas and Electric Company's (PG&E's) Topock Compressor Station. This work plan was originally submitted to the California Department of Toxic Substances Control (DTSC) on April 9, 2004. DTSC and Arizona Department of Environmental Quality (ADEQ) comments on the work plan were forwarded on June 7, 2004. The enclosed work plan reflects changes made in response to DTSC and ADEQ comments as discussed in a conference call on June 9, 2004.

If you have any questions, please do not hesitate to call me.

Sincerely,

Julia J Eakins for Yvonne Meeks

Enclosure

cc: Karen Baker/DTSC
Aaron Yue/DTSC
Alfredo Zanoria/DTSC

Draft

Work Plan for Assessing Background Metals Concentrations in Groundwater, PG&E Topock Compressor Station and Vicinity, Needles, California

Prepared for

Pacific Gas and Electric Company

June 2004

CH2MHILL

Work Plan for Assessing Background Metals Concentrations in Groundwater, PG&E Topock Compressor Station and Vicinity, Needles, California

Prepared for
Pacific Gas and Electric Company

This work plan was prepared under supervision of a
California Registered Geologist

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Brian Schroth, R.G., C.Hg.
Project Hydrogeologist

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Acronyms and Abbreviations

Cr(T)	total chromium
Cr(VI)	hexavalent chromium
GMP	groundwater monitoring program
mg/L	milligrams per liter
PG&E	Pacific Gas and Electric Company
PPE	personal protective equipment
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facilities Investigation
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

1.0 Introduction

This work plan presents the approach, proposed activities, and procedures to assess the range of background concentrations of hexavalent chromium (Cr[VI]),total chromium (Cr[T]), and other metals in groundwater near the Pacific Gas and Electric Company's (PG&E's) Topock Compressor Station, near Needles, California (Topock site) and in the surrounding region.

The background study will measure concentrations of Cr(VI), Cr(T), and other metals in wells outside of the existing groundwater plume, currently defined by the California State drinking water standard maximum contaminant level of 0.05 milligrams per liter (mg/L). Wells selected for the study will be located in areas away from past chromium-containing waste discharge activity or other activities that may have impacted concentrations of chromium and other metals in groundwater. Concentrations of chromium and other metals in samples from these background wells will be used to develop a geochemically- and statistically-based estimate of the background metals concentrations in groundwater at the Topock site.

1.1 Objective

The objective of the background study is to define an upper threshold concentration for total chromium, Cr(VI), and other metals in groundwater at the Topock Site. The upper threshold concentration represents the upper concentration of the constituent not impacted by contamination and is referred to as a background concentration. The background study will be used to:

- Complement the RCRA Facility Investigation (RFI) activities at the Topock site, by allowing appropriate constituents of concern to be selected and evaluated.
- Assist with the Corrective Measures Study (CMS) activities at the Topock site during the development of clean-up concentrations for the Topock site.

1.2 Background

PG&E has operated a natural gas compressor station at the Topock site since 1951. Chromium compounds were used as scale and corrosion inhibitors in cooling towers at the facility. Periodically, the cooling towers were drained, and the spent cooling water was discharged to a percolation bed in Bat Cave Wash (Figure 1). The unlined percolation bed was used for disposal of chromium-containing blowdown water from the cooling towers between 1951 and the mid 1960s. Following this period, the cooling tower blowdown water was treated to remove chromium to less than 1 mg/L. Between the early 1970s and 1985, discharge was redirected to four lined evaporation ponds located to the southwest of the former percolation bed (Figure 1). During the early 1970s, some of the treated wastewater was injected into Well PGE-08. In 1985, PG&E replaced the chromium-based corrosion inhibitor with a phosphate-based corrosion inhibitor in the cooling towers. The lined evaporation ponds (henceforth "former evaporation ponds") were closed in 1989, and new Class II double-lined evaporation ponds (henceforth "active evaporation ponds"), located to the northwest, have been in use since that time (Figure 1). As a result of past disposal practices, elevated concentrations of chromium are found in groundwater near the Topock site.

1.3 Work Plan Structure

This work plan is organized into the following sections:

- Section 1.0 presents the objective of the work plan and site background information;
- Section 2.0 presents an overview of the hydrogeological setting of the site;
- Section 3.0 presents a description of the overall approach to the background study;
- Section 4.0 describes the proposed background monitoring network;
- Section 5.0 presents the sampling and analysis methodology;
- Sections 6.0, 7.0, and 8.0, and detail quality assurance and quality control (QA/QC), health and safety, data analysis and reporting, respectively;
- Section 9.0 presents the schedule for the study, and
- Section 10.0 presents a list of the works cited during the preparation of this document.

2.0 Hydrogeologic Setting

2.1 Site Conceptual Model

Groundwater beneath the Topock site occurs primarily in unconsolidated alluvial deposits derived from the local mountains. The deposits consist mainly of fine-to-coarse sand, with gravel commonly present. Silt and clay beds have been documented on some boring logs, though they are not believed to form continuous confining layers. In the vicinity of the Colorado River, the alluvial deposits grade into river-derived deposits with similar hydraulic properties. Total saturated thickness of unconsolidated deposits is typically in the 80- to –120-foot range. The Red Fanglomerate, a reddish-brown consolidated rock unit, underlies the unconsolidated deposits and yields limited groundwater via secondary fractures. Metamorphic rocks of the nearby Chemhuevi Mountains form the basement unit beneath the Red Fanglomerate.

The Topock Site is situated at the southern end of the Mohave Groundwater Basin, as described in previous reports (Anderson et al. 1992; Anderson and Freethey 1996). The Colorado River runs north to south through this basin, which is a typical basin-and-range alluvial basin surrounded by mountains of older rock. The Colorado River has cut a bedrock canyon (Topock Canyon) to exit the basin to the south. The site represents the southern extent of unconsolidated alluvial aquifer material in the Mohave Basin. Although the river is the major source of groundwater recharge in many areas of the basin, the Topock area is a net groundwater discharge area due to the pinching out of alluvial material. Groundwater flows upward into the river from the east and west in this area, and the river carries this water through Topock Canyon and into the next alluvial basin to the south.

The Colorado River levels are controlled by releases from Davis Dam on Lake Mohave, upstream from the Topock Site. River levels fluctuate by 2 to 3 feet per day from these releases, producing a sinusoidal hydrograph each day. Releases are greatest in the late winter and spring, producing higher river levels during this time (February through May). Groundwater is recharged by the river during this time of year. Beginning in June, releases decrease, producing lower river levels and reversing the groundwater gradient back towards the river. The lowest river levels typically are from October to January.

The small amount of local groundwater flow at the Topock site is partly derived from periodic rainfall in the surrounding hills. Water from these higher elevations recharges the local groundwater by a combination of overland flow and subsurface fracture flow. The remainder of groundwater recharge comes from groundwater flow from the west and northwest along with seasonal recharge from the Colorado River in the floodplain area. Groundwater discharges primarily to the Colorado River during the summer, fall, and winter. Groundwater is also removed via evapotranspiration by plants in the floodplain. As is typical of Lower Colorado River basin discharge areas, average groundwater movement is upward and toward the river. Similarly, groundwater on the Arizona side generally follows the Sacramento (AZ) River drainage westward toward the Colorado River. Due to the dry conditions of this desert environment, groundwater gradients are very small, on the order of 10^{-4} to 10^{-3}. Hydraulic conductivity of the unconsolidated deposits averages around 20 feet/day, and corresponding groundwater velocity is in the range of 1 to 20 feet/year.

2.2 Site-specific Data

The site subsurface consists of unconsolidated alluvial material underlain by the Red Fanglomerate layer, which is underlain by metamorphic bedrock. Because the fanglomerate and bedrock have very low permeability, groundwater movement occurs primarily in the unconsolidated alluvium. Most monitoring wells in the unconsolidated alluvium are screened in the shallow part of the saturated section of this unit. Well clusters, such as those at MW-24, MW-20, and MW-34, also contain wells screened at medium and deep levels of the unconsolidated alluvium. In the floodplain of the Colorado River, the shallow alluvial material interfingers with recent fluvial deposits and dredge spoils. The total saturated thickness of unconsolidated materials around the site area is about 100 feet. A more detailed description of the geology and hydrostratigraphy is provided in the RCRA RFI report for the Topock site (E&E 2004).

Lateral groundwater gradients in the unconsolidated alluvium are relatively flat, on the order of 10^{-4} to 10^{-3} feet per foot. Consequently, average groundwater velocity at the site can be very low, on the order of 1 to 3 feet per year (E&E 2004), but generally range around 20 feet per year in the floodplain area. Gradient directions vary between seasons and years but generally run from the former discharge area to the northeast. An upward vertical gradient has been observed in unconsolidated alluvium well clusters, as well as between bedrock and the unconsolidated alluvium.

Monitoring wells have been installed near and along Bat Cave Wash and to the east of the wash to characterize the Cr(VI) distribution in groundwater. Wells MW-16, MW-17, and MW–18 were designed as background wells in areas not associated with past site chromium use/disposal (E&E 2004). Monitoring wells associated with the current active evaporation ponds (MW-1 and MW-3 through MW-8) were installed as part of the monitoring and reporting program for permitted discharge to the ponds. Discharges to these lined ponds have occurred since 1989, after PG&E ceased the use of chromate as a corrosion inhibitor in the cooling towers. These wells may also be viewed as background wells with respect to the Bat Cave Wash Study.

Figure 2 illustrates the Cr(VI) distribution with data from the December 2003 sampling round. The chromium plume is approximated by the dashed contour representing 0.05 mg/L Cr(VI).

2.3 Geochemistry of Hexavalent Chromium

The alluvial material in the Topock-Needles area is primarily derived from the metadiorite and gneissic rocks comprising the mountains to the south and west. In addition, there are also fluvial deposits from the ancient Colorado River evident in some areas above the current floodplain. These fluvial materials were derived from a large number of sources in the Colorado River basin and were transported to this area in the recent geologic past.

Although chromium is most abundant in ultramafic and mafic rocks such as peridotites, serpentinites, and gabbro (Hem 1985), some occurrence of the element would be expected from pyroxenes and micas contained in the local rocks around the Topock Site. These sources were among those cited in a similar geologic environment in central Arizona (Robertson 1975). That study illustrated that, although ultramafic rocks yielded significantly greater concentrations of Cr(VI) to the local groundwater, these more granitic rocks still contributed Cr(VI). The local environment near the site would be expected to yield modest concentrations of chromium (less than 0.05 mg/L) to groundwater. A regional study has reported background Cr(VI) concentrations between 0.010 and 0.050 mg/L in Sacramento Valley (Arizona)—the groundwater basin immediately to the east of Mohave Valley—in which the Topock site is located (Robertson 1991).

2.4 Definition of the Area to be Monitored for the Background Study

The objective of the background study is to define background concentrations for use at the Topock Site. Ideally, this would involve only sampling wells at the Topock site; however, because of the potential influence of chromium containing wastewater disposal and other site activities on groundwater concentrations at the Topock Site, the background monitoring network will need to include wells outside of the site.

The selection of the extent of the area outside of the Topock site that will be considered for evaluating the background concentrations at the Topock site is based on the conceptual site model and hydrogeological and geochemical conditions outlined above and considered representative of site conditions.

The vertical and lateral extent of the area to be monitored is defined, for the purposes of this background study, as the unconsolidated alluvial aquifer of the Mojave Groundwater Basin stretching from the Topock site in the south to Needles in the north (approximately 15 miles north of the Topock Site) and from the edge of the alluvial aquifer in the west to several miles east of the site in Arizona.

3.0 Approach to Background Study

This section presents the overall approach that will be used to conduct the background study. The approach will consist of the following four steps:

1. Selecting potential background wells
2. Selecting final background wells
3. Calculating background concentrations
4. Reviewing background concentrations

The activities to be performed for each of these steps are discussed in the subsequent sections.

3.1 Selecting Potential Background Wells

The potential list of wells will be generated based on a well search of the site and surrounding region. The first step of screening potential background wells does not involve sample collection, but involves collection and evaluation of location, accessibility, and construction information for potential wells to determine the suitability for inclusion in the background study. During this step, information will be compiled on each of the wells and evaluated to assess the applicability of the well being carried forward into the potential list of wells.

The potential list of wells will be identified based on the following criteria:

- Wells must be hydraulically up or cross-gradient from the chromium groundwater plume at the Topock site. This will be determined by plotting wells on a figure with the chromium plume (Figure 2).
- The wells must be within the Background Zone defined in Section 2.4.
- Chromium and metals concentrations in the groundwater monitored by the wells must not be impacted from anthropogenic activities. This will be evaluated by reviewing past records, reports, aerial photographs, discussions with site personnel , and making site inspections. This task will be completed in conjunction with the Topock Site RFI Report.
- The wells must be accessible for sampling. This will be determined during discussions with the well owner and during site inspections.
- The wells must be screened over similar hydrogeologic conditions as the Topock site (unconsolidated alluvium). This will be evaluated based on geologic and well construction logs for the wells. If geologic and/or well construction logs are not available, the well may still be carried forward into the list of potential wells if other information (e.g., well depth or location) suggest that it could potentially be monitoring

similar geologic conditions. During Step 2, the groundwater geochemistry will be evaluated to check if the well monitors the same groundwater type.

The initial stages of this step have been completed and are discussed in Section 4.0.

3.2 Selecting Final Background Wells

The potential list of wells that meet the criteria outlined for step 1 above will be included in the first rounds of groundwater sample collection in the background study. The first rounds of groundwater sampling will be used to further evaluate the list of wells to determine whether the identified wells meet the criteria of having similar groundwater geochemistry conditions as the Topock site.

In this step, available historic data will be supplemented with additional data collected during two bi-monthly rounds of the background sampling program to determine whether the groundwater is of the same water type. The historic data and first two rounds of sampling data will be evaluated based on techniques such as: (1) Stiff and Piper diagram analysis for detecting groundwater chemistry groupings; (2) map view plots of key field parameters (oxidation-reduction potential, pH, temperature, specific conductance) along with Cr(VI) and Cr(T) concentrations to further aid in geochemical grouping and potential outlier identification; (3) geologic and boring log evaluation that considers natural geochemical variation; (4) scatterplots (i.e., concentrations of individual constituents or ratios plotted against one another); (5) evaluation of isotope data; and (6) potential flowpath reactions and mixing may be simulated using the geochemical code PHREEQC. This tool enables the exploration of groundwater chemistry evolution along local or regional flowpaths using a thermodynamic database and mass balance techniques.

3.3 Calculating Background Concentrations

The list of wells that meet the criteria outlined for steps 1 and 2 above will be used to calculate background concentrations. The background data set will initially be collected over a 1-year period by sampling the selected background wells at bi-monthly intervals (total of six sampling rounds). Details of the sampling, analysis methods and QA/QC procedures are provided in Section 6.0 of this work plan.

After 1 year of analytical data have been collected, statistical tests will be used to calculate a background concentration for the following parameters:

- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Total chromium
- Hexavalent chromium
- Cobalt
- Copper
- Lead

- Mercury
- Molybdenum
- Nickel
- Selenium
- Silver
- Thallium
- Vanadium
- Zinc

Only the data collected during the background study will be used to calculate the background concentrations. Although historic data will be used for identification of background wells, these data will not be used in the calculation of the background concentrations because different analytical methods and detection limits were used during historic sampling events.

The statistical goal of this study is to develop a background threshold value for each constituent that is representative of upper concentrations not impacted by source contamination. This threshold value will be used in comparison with potentially-contaminated samples to determine whether these samples should be considered unusual relative to the background data set. The following sections discuss the statistical issues and protocols involved in calculating these background statistics.

3.3.1 Non-detects

Throughout the analysis of data, the frequency of detects will be considered as decisions are made. A low frequency of detects raises uncertainty differently for different statistical tests, but there are not mathematical techniques that can erase the increased uncertainty. For this study, non-detects should not be a huge issue, since the final goals relate more to the upper end of the concentration distribution. Nevertheless, the presence of non-detects requires attention to possible impacts on conclusions.

In most, or all cases, non-detects will simply be replaced with a proxy value which is half of the detection limit. On plots, the non-detects will be labeled differently (such as an open symbol for non-detects versus a filled-in symbol for detects). In some specific applications, such as the determination of statistical distribution, particularly in outlier analysis, proxy values assigned as random numbers between zero and the detection limit may be assigned, but this will depend on the situation. When a large number of equivalent non-detect proxies are included in a data set, tests of normality usually fail. Any deviations from a simple proxy of half of the detection limit will be discussed in the report.

3.3.2 Outlier Analysis

An outlier analysis will be performed on the data to help determine if individual results appear unusual and should be excluded from the background data set. In addition, if this analysis demonstrates a pattern for specific samples, one or more sample may be excluded altogether from the data. The mathematical outlier test will not be the only criteria in whether or not a result is excluded, but any results identified as mathematical outliers will undergo additional scrutiny and any decision to retain them in the data set will be discussed in the text.

Per United States Environmental Protection Agency (USEPA) guidance (USEPA 2000), the mathematical outlier tests will be chosen depending on the available sample size. For sample sizes of 25 or more, Rosner's test will be applied. If smaller sample sizes are available, Dixon's Extreme Value test will be used. Both tests will be applied to the highest five concentrations for each parameter. While Rosner's handles potential multiple outliers directly, the Extreme Value does not, but it will nevertheless be applied sequentially for each elevated value. (Multiple outliers imply the potential for two or more true outliers to mask their identity as outliers since they are close to one another in concentration.) These outlier tests will be performed with a significance level of 0.05.

Both of these outlier tests are based on an assumption that the remaining concentrations represent a normal distribution (after the potential outlier is excluded). This assumption is often not true in application, based on the Shapiro-Wilk test using a significance level of 0.05. When the tests of normality for the non-outlier concentrations do not support assumptions of normality, the data will be transformed (USEPA 2000) using a variety of transformations. These can include the square root transformation, the cubic root transformation, and the natural logarithmic transformation. The logarithmic transformation is a standard transformation in environmental applications, while the square root and cubic root offer options appropriate for intermediate levels of skewness in the data.

Each transformation will be evaluated for each potential outlier. The transformation offering the greatest p-value for normality will be chosen for each individual case. (Different transformations may be determined for the five highest concentrations tested as potential outliers.) The reported mathematical status as an outlier will be reported based on the transformation of choice.

In addition to the statistical tests, the data will be plotted either as scatter plots or probability plots (or both). Probability plots graph the measured concentrations against those expected if the data (or the transformed data) are normally distributed. As such, the data points tend to form straight lines when the data resembles a normal distribution. Hence, these probability plots can be helpful in understanding whether the data should be evaluated as untransformed or transformed during the statistical evaluations.

3.3.3 Summary Statistics and Background Threshold Calculations

After the outlier analysis is complete and the background data set is established, summary statistics for these data, by constituent, will be calculated. These summary statistics will include the mean, median, standard deviation, frequency of detection, and probabilities for normality and lognormality (via the Shapiro-Wilk test for normality). Also, the primary goal of this study, the background threshold statistic, will be calculated and presented.

The background statistic will be calculated as 95 percent/95 percent background Upper Tolerance Limit (UTL), that is, an upper bound (with 95 percent confidence) of the background 95th percentile. The calculation of the UTLs depends on the distributional assumption. When appropriate, the normal UTL will be calculated using the following equation:

$$UTL = \bar{x} + \left(K \times s\right), \tag{1}$$

where:
$\bar{x}$ is the sample mean.
K is the tolerance factor.
s is the sample standard deviation.

For data sets that appear to be lognormally distributed, a lognormal UTL will be calculated using the following equation:

$$UTL = e^{\bar{y} + \left(K \times s_x\right)}, \tag{2}$$

where:
$\bar{y}$ is the sample mean of the log-transformed sample data.
K is the tolerance factor.
s_x is the sample standard deviation of the log-transformed sample data.

For data sets that do not appear to be normally or lognormally distributed, nonparametric UTLs will be calculated. A nonparametric UTL is computed by first ranking the concentrations and then choosing the lowest-ranked detected concentration that provides a coverage of 95 percent with 95 percent confidence. For data sets with less than 59 concentrations, 95 percent coverage is not possible with 95 percent confidence, even when the maximum concentration is assigned as the UTL. In this study, the estimated percentile (95th or lower) associated with the highest concentration will be reported. This percentile is calculated using the following equation:

$$p = B_{0.95,n,1} \tag{3}$$

where B is a beta distribution defined by n (the number of sample results) and 1 (since the highest ranked concentration is being used).

3.4 Reviewing Background Concentrations

Following the completion of the background concentration calculation, a review of the background concentrations will be performed to:

1) Check for sample independence and data trends through time. Variation in concentrations is expected to exist in concentrations measured from the designated background wells over time. This will either be due to random variation in the data or due to actual shifts in the concentrations over time. The goals of this study rest on the assumption of acquiring independent results. One example of violating this assumption would be to obtain repeat groundwater samples from a given well so frequently that they are essentially field duplicates (since the media being sampled has essentially not changed since the previous sampling event). Thus, it is appropriate to leave sufficient time between sampling events to allow the media to change sufficiently to offer a new independent sample.

   If the groundwater is shifting in concentration over time, it might be expected that differences in measured concentrations between events would be greater than typically observed between field duplicates from the same event. If, however, the groundwater concentrations are not shifting in time, or that shift is small relative to the variation in field duplicate analysis, a variation in concentrations between events greater than typically seen in field duplicates would not be expected. Thus, an analysis of statistical independence is not straightforward, and this issue requires support from knowledge of hydrogeological conditions in the designated groundwater field. Therefore, this evaluation will also consider groundwater gradients and groundwater flow velocities (where the information is available to allow this evaluation).

A parallel concern when studying potential shifts in concentrations with time is whether the background data are appropriate for comparisons into the future. If background data are not collected simultaneously with investigative data, the project must rely on snapshot of background conditions as a comparative statistic. The question arises, how long is that snapshot appropriate?

Data between years, or over a series of sampling events, can be compared via two-sample comparative techniques (such as the nonparametric Wilcoxon Rank Sum test) and trend analysis techniques such as the Mann-Kendall test. Any such analyses of groundwater data should be expected to indicate some significant differences (considering all the constituents being studied), but extensive differences are a signal that limits of the applicability of the background snapshot are evident. This requires some professional interpretation, since the issues of sample independence and significant shifts over time sometimes become difficult to differentiate. These issues, supported by statistical analysis, will be discussed after data for this study become available.

2) Based on the results of the evaluation outlined in #1 above, assess whether additional data needs to be collected and whether background concentrations need to be updated during subsequent years.

3) Compare the background concentrations with findings of other studies carried out in the region (e.g., Robinson, 1975; Robinson, 1991) to establish concentrations of naturally-occurring Cr(VI), Cr(T), and other metals. Caution should be exercised during this comparison by evaluating comparability of methods of sampling, analysis, and general methodology before drawing conclusions.

4.0 Identification of Potential Background Monitoring Network

This section summarizes the initial activities undertaken to identify and select potential background monitoring wells. As outlined in Section 3.1, the potential list of wells generated from a well search will initially be screened using location, accessibility and construction information to evaluate the suitability for inclusion in the first rounds of groundwater sample collection in the background study.

4.1 Well Search

A well search was performed by querying the United States Geological Society well database for the area surrounding the Topock site. From this well search, an initial set of 28 potential background wells have been selected for evaluation. Table 1 lists these wells and summarizes the information gathered for these wells. Further work is required to obtain location, accessibility, and construction information (e.g., well logs, well depth, etc.) on some of these wells.

Additional candidate background wells have been identified during the well search and are being evaluated to determine the well owners and whether these wells are appropriate to include in the list of potential background wells.

4.2 Location Compared to Topock Site Chromium Plume

Each of the wells identified during the well search was evaluated against the extent of the chromium plume at the Topock Compressor Station site. Figure 2 shows the location of the potential background wells located near the site compared to the chromium plume.

To reduce ambiguity in the data obtained, wells immediately adjacent to the plume have been excluded from the background study. Also, monitoring wells MW-14 and MW-15 have been excluded. Though water chemistry data in these wells suggest background conditions, their locations close to Bat Cave Wash (MW-14) and immediately downgradient of the former evaporation pond site (MW-15) potentially link these wells to past site activities that involved chromium.

Topock site monitoring wells MW-16, MW-17, and MW-18 were installed as background monitoring wells for the Topock RFI (E&E 2004). Though not part of the current groundwater monitoring program (GMP) (PG&E 2003), well MWP-12 is located south of the former evaporation ponds and was also designed as a background monitoring well. Under a separate monitoring program, seven monitoring wells surround the active evaporation ponds to the west of the site. The wells (MW-1, MW-3 through MW–8) are used to monitor integrity of the active evaporation ponds. The location of the active evaporation ponds is about 3,000 feet west of Bat Cave Wash, a distance considered sufficient for use in the background study, and in a cross- to upgradient direction from the former discharge area (see Figure 1). The nearest water supply well to the site is the Park Moabi well, located over a mile northwest of the Topock facility in an upgradient/cross-gradient direction. These wells previously have been referred to as background wells and will be compared with other site wells below.

Available data on chromium for these wells show a range in concentration over time (Table 2). There have been no significant long-term or seasonal time trends in these concentrations (see Appendix A). The range in Cr(VI) concentration appears to be from below detection limit to 0.05 mg/L, in general agreement with regional data (Robertson 1991). Based upon available chemistry data from site monitoring wells, the wells appearing to be background candidates have variable chemical composition and Cr(VI) concentrations between non-detect and 0.05 mg/L. As with any natural system, significant variation in chemistry and trace metals is to be expected. The background study will consist of careful monitoring of chemical characteristics of these and other wells over a 1-year period to determine a representative range in natural Cr(VI).

Other wells outside the Topock site area will provide additional information on the range of natural Cr(VI) concentration in the region, as well as general chemistry. Candidates include City of Needles wells to the north and wells to the east of the river in the vicinity of Topock, Arizona. In 1997, PG&E drilled two wells in the floodplain on the opposite side of the river, with the intention of producing a new water supply for the facility. The wells were never used due to high total dissolved solids. Sampling these wells will help to establish background Cr(VI) in the floodplain area. Other Arizona wells include the two wells PG&E currently uses for its facility supply, potentially an additional private supply well at Topock, Arizona, and four wells operated by El Paso Natural Gas Company, located in Arizona several miles to the east.

4.3 Location within Background Monitoring Zone

All of the wells listed in Table 1 fall within the lateral area to be monitored for the background study, as defined in Section 2.4. However, further work is required to locate all geologic and well construction logs to determine if wells are screened within the unconsolidated alluvium and therefore fall within the vertical zone to be monitored for the background study.

4.4 Location Compared to Anthropogenic Impacts on Groundwater

In addition for the need for the background monitoring network to be outside the influence of the chromium plume at the Topock Compressor Station site, the background monitoring network must also be outside the influence of other anthropogenic impacts on groundwater. None of the 28 identified potential background monitoring wells are known to have been impacted from anthropogenic activities. However, additional evaluation is required to identify sources of groundwater contamination in the area and potential impacts on the background monitoring network.

4.5 Well Accessibility

As the background monitroing well network is located outside of PG&E property, access to the wells for sampling must be obtained. PG&E has existing access agreements for wells associated with the active evaporation ponds and/or are part of the ongoing groundwater monitoirng program. However, access will need to be obtained for other wells. PG&E has an outreach program that will be implemented for selected wells prior to sample collection to solicit well owner access.

4.6 Wells Screened Over Same Hydrogeologic Unit as Topock Site

Evaluation of the geologic and well construction logs indicates that many of the proposed background sampling locations are believed to be within unconsolidated alluvium of the Mojave Valley region (eastern California and western Arizona) so that the geological and hydrogeological conditions of the background locations are representative of the Topock site. Available geologic and well construction logs are contained in Appendix B.

If a geologic or well construction log has not yet been located or is known to be unavailable, the well will not be eliminated from the potential background well network at this time, unless other information suggests that the well was not screened over the unconsolidated alluvium. Analytical results from the first two rounds of background sample collection will be used to evaluate the groundwater geochemistry to check whether the well monitors the same groundwater type as the Topock site.

4.7 Proposed Background Wells

Of the 28 wells identified for evaluation after the well search, a total of 26 wells are proposed as potential background wells based on comparison to the selection criteria. Table 3 summarizes the evaluation of the wells against the selection criteria. Monitoring wells MW-14 and MW-15 have been excluded from the potnetial background well list due to their locations close to Bat Cave Wash (MW-14) and immediately downgradient of the former evaporation pond site (MW-15). The potential background well locations are shown on Figure 3, with off-site wells in approximate locations. Eleven site groundwater monitoring wells and one water supply well, located upgradient and cross-gradient of the 0.05 mg/L Cr(VI) plume, are included in this network of wells:

MW-01	MW-05	MW-08	MW-18
MW-03	MW-06	MW-16	MWP-12
MW-04	MW-07	MW-17	Park Moabi Well

The site wells, along with the off-site Park Moabi well, have been monitored for chromium as part of former and ongoing Topock site GMP. Table 2 presents the available historical chromium data from these 12 wells. The remaining 14 wells proposed for the background study include:

- Two domestic water supply wells, one each owned by Mr. Smith and Mr. Sanders.

- Four City of Needles municipal supply wells, located in and around Needles, California, about 11 miles north of the site.
- Two inactive PG&E supply wells, located immediately across the Colorado River from the I-3 monitoring station.
- Two City of Needles production wells supplying water for Topock, Arizona and the PG&E facility, located approximately 1.5 miles east of the compressor station.
- Four water wells operated by El Paso Natural Gas Company and located between 2.5 and 3.5 miles east of the site in Arizona.

PG&E has requested access to the City of Needles and other private wells listed above. Access to these wells for this study is subject to owner permission and final access agreements.

Additional candidate background wells have been identified during the well search and are being evaluated to determine if they are appropriate to be added to this list of potential background wells.

Each of the selected wells will be sampled six times on approximately 2-month intervals. This will provide monitoring data over the course of an entire year. Though historical data are available for some of the wells (as shown in Table 2), the chromium detection limits for many past sampling events are considered elevated. Beginning in June 2002, analysis for Cr(T) was performed using USEPA Method 6020A, with a reporting limit of 0.0056 mg/L. However, instability of this method necessitated a change to USEPA Method 6010B in September 2003, with a detection limit of 0.001 mg/L. Beginning in September 2003, the water supply and background monitoring wells in the GMP have been sampled for Cr(VI) using USEPA Method 7199, providing a detection limit of 0.0002 mg/L.

To correlate the data collected during the background study with the data collected during the ongoing quarterly GMP of other Topock site wells, groundwater samples collected from the GMP wells and river sampling stations will be analyzed for the constituents outlined in Tables 4 and 5 during one sampling event in 2004. This sampling will be in addition to the routine data collection performed as part of the GMP for the Topock site.

4.6 Selection of Final Background Well Network

Table 3 also lists the criteria that will be used to select the final background well network and, where available, information has been entered into this table. Further work is required to collect sufficient data to complete this table and allow the final well network to be selected, as described in Section 3.1.

5.0 Sampling and Analysis Methods

Groundwater sampling for the proposed background study will follow the general methods and procedures used for the current Topock GMP, as described in PG&E's *Draft Sampling and Analysis Plan for Groundwater and Surface Water Monitoring* (Draft SAP) (PG&E 2004a). The subsequent sections also provide general description of the procedures.

This study will be performed under the direction of a California Registered Geologist, Certified Engineering Geologist, or Professional Engineer (herein referred to as Licensed Professional). A qualified technician will collect groundwater samples and coordinate delivery of the samples to a State of California-certified analytical laboratory. The Licensed Professional will oversee the site investigations during all phases of work, including sampling and data analysis and will review the report. Permitting, sampling protocol, chain of custody, health and safety procedures will follow local, county, and state guidelines.

5.1 Analytical Parameters and Methods

The groundwater samples will be analyzed for the metal constituents of concern identified in the Corrective Action Consent Agreement, namely Cr(VI), Cr(T), copper, nickel, and zinc. Additionally, to serve as a comprehensive water quality assessment, other trace metals on the priority pollutant metal list (i.e., CAM 17 list) will be analyzed along with the site constituents of concern to assess background concentrations for the Topock site. In addition, the groundwater samples will be analyzed for the hydrogen and oxygen isotopes, tritium, and ^{18}O. The analytical methods and reporting limits to be used for chromium and metals analyses are listed in Table 4 and described in detail in SW-846 (USEPA 2002).

In addition, a subset of the samples (eight to ten samples) will be analyzed for additional parameters in order to assess potential analytical interferences and verify general water chemistry. These parameters will be analyzed in accordance with the guidelines of SW-846 (Miscellaneous Test Methods), USEPA's Drinking Water Methods for Chemical Parameters (USEPA/600/R-93/100 for chlorides, sulfates), and/or Standard Methods for the Examination of Water and Wastewater (APHA-AWWA 1992, 1995). The analytical methods for the additional parameters are presented in Table 5. Actual reporting limits will be reported by the laboratory.

All groundwater samples will be tested for the following field parameters: temperature, pH, electrical conductivity, dissolved oxygen, oxidation-reduction potential, and turbidity.

5.2 Groundwater Sample Collection

Groundwater samples will be collected from the 26 identified wells using the protocols outlined in the Draft SAP (PG&E 2004a).

The sampling container, preservation, and holding time requirements for the various parameters proposed to be monitored are listed in Table 6 and based on the requirements in

40 CFR 136.3 and SW-846. Precleaned containers, laboratory-prepared with preservative, will be procured from the analytical laboratory.

5.3 Sample Filtration

Samples requiring analysis of dissolved target analytes will be collected and analyzed following the procedures outlined in the Draft SAP (PG&E 2004a). The laboratory will ensure that the filters are free of target analytes of concern by preparing a laboratory blank using the same filters.

5.4 Sample Documentation and Shipment

The sample documentation and shipment procedures outlined in the Draft SAP (PG&E 2004a) will be followed during the background study.

5.5 Decontamination Procedures

Decontamination procedures outlined in the Draft SAP (PG&E 2004a) will be followed during the background study.

5.6 Management of Investigation Derived Waste

Investigation-derived waste associated with this study will consist primarily of wastewater produced from the purging of monitoring wells, used personal protective equipment (PPE), and disposable sampling equipment. Investigation-derived waste will be managed as outlined in the Draft SAP (PG&E 2004a).

6.0 Quality Assurance and Quality Control

Groundwater samples will be submitted to a State of California-certified analytical laboratory for chemical analyses. QA/QC during sampling and analysis will be ensured by following the QA/QC procedures outlined in the Draft SAP (PG&E 2004a) and the *Draft Quality Assurance Project Plan for Groundwater and Surface Water Sampling at the Topock Compressor Station* (PG&E 2004b).

7.0 Health and Safety

Health and safety plans will be required and followed for all personnel working on the Topock site. CH2M HILL has developed site-specific health and safety plans for the Topock site. A copy of the health and safety plans will always be available at the site and are available for review upon request. The necessary PPE and environmental monitoring equipment will be used, as specified in the health and safety plans.

8.0 Data Evaluation and Reporting

CH2M HILL will review and validate bimonthly monitoring data for QA/QC and will maintain the data in the project database.

After two rounds of data have been collected, the data will be geochemically evaluated to check that the groundwater being sampled is geochemically of a similar type to the groundwater at the Topock site using the methods outlined in Section 3.2. A preliminary report will be prepared to summarize the data evaluation and provide the rationale for selection of the background well network. Calculation of the background concentration will not be made based on the two rounds of data and, therefore, will not be included in this report.

After collection of 1 year of background groundwater data (six rounds of data collection), the statistical methods outlined in Section 3.3 will be used to calculate the background concentration for each constituent. The background data set and concentrations will then be reviewed as outlined in Section 3.4. A background study report will be prepared to document the final background monitoring well network, background data, background concentration calculations, and background concentration review.

9.0 Schedule

It is anticipated that the background study sampling will commence in August 2004. Bimonthly sampling will continue through July 2005. The draft background study report for the Topock site is scheduled for release in October 2005.

10.0 References

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Tables

TABLE 1
Wells Evaluated as Potential Background Wells for Chromium and Metals Groundwater Background Study
Work Plan for Assessing Background Metals Concentrations in Groundwater,
PG&E Compressor Station and Vicinity, Needles, California

Well ID	Well Location & Approx. Distance to Bat Cave Wash Discharge Area	Well Owner	Well Use / Remarks	Sampling System / Method	Well Depth	Well Screen Length	Geologic Log	Well Construction Log	Date Installed	Hydrogeologic Unit Monitored	General Chemistry Data Available	Metal Chemistry Data Available	Chromium Chemistry Data Available
MW-01	New Ponds site - 3,300' west	PG&E	New Ponds detection monitoring	ded. sampling pump	211	10	Yes	Yes	Aug-86	Unconsolidated Alluvium	Yes	Yes	Yes
MW-03	New Ponds site - 2,900' west	PG&E	New Ponds detection monitoring	ded. sampling pump	207	18	Yes	Yes	Aug-86	Unconsolidated Alluvium	Yes	Yes	Yes
MW-04	New Ponds site - 2,700' west	PG&E	New Ponds detection monitoring	ded. sampling pump	175	10	Yes	Yes	Aug-86	Unconsolidated Alluvium	Yes	Yes	Yes
MW-05	New Ponds site - 2,800' west	PG&E	New Ponds detection monitoring	ded. sampling pump	185	9	Yes	Yes	Jun-89	Unconsolidated Alluvium	Yes	Yes	Yes
MW-06	New Ponds site - 3,200' west	PG&E	New Ponds detection monitoring	ded. sampling pump	194	9	Yes	Yes	Jun-89	Unconsolidated Alluvium	Yes	Yes	Yes
MW-07	New Ponds site - 3,000' west	PG&E	New Ponds detection monitoring	ded. sampling pump	182	9	Yes	Yes	Jun-89	Unconsolidated Alluvium	Yes	Yes	Yes
MW-08	New Ponds site - 2,700' west	PG&E	New Ponds detection monitoring	ded. sampling pump	178	9	Yes	Yes	Jun-89	Unconsolidated Alluvium	Yes	Yes	Yes
MWP-12	Old Ponds site - 2,100' south	PG&E	Old Ponds site background monitoring	Temporary sampling pump	136	40	No	No	1986	Unknown	Unknown	Unknown	Unknown
MW-14	1,500' northwest	PG&E	RFI background monitoring	Unknown	131	20	Yes	Yes	Jul-97	Unconsolidated Alluvium	Yes	Yes	Yes
MW-15	1,900' west	PG&E	RFI background monitoring	Unknown	201	20	Yes	Yes	Jul-97	Unconsolidated Alluvium	Yes	Yes	Yes
MW-16	New Ponds area - 4,200' west	PG&E	RFI background monitoring	ded. sampling pump	218	20	Yes	Yes	Apr-98	Unconsolidated Alluvium	Yes	Yes	Yes
MW-17	1.0 mile northwest	PG&E	RFI background monitoring	ded. sampling pump	150	20	Yes	Yes	May-98	Unconsolidated Alluvium	Yes	Yes	Yes
MW-18	3,000' northwest	PG&E	RFI background monitoring	ded. sampling pump	105	20	Yes	Yes	Apr-98	Unconsolidated Alluvium	Yes	Yes	Yes
Park	1.6 miles	San	Park Moabi	prod. pump	200	120	Unknown	Unknown	1966	Unknown	Yes	Yes	Yes

TABLE 1
Wells Evaluated as Potential Background Wells for Chromium and Metals Groundwater Background Study
Work Plan for Assessing Background Metals Concentrations in Groundwater,
PG&E Compressor Station and Vicinity, Needles, California

Well ID	Well Location & Approx. Distance to Bat Cave Wash Discharge Area	Well Owner	Well Use / Remarks	Sampling System / Method	Well Depth	Well Screen Length	Geologic Log	Well Construction Log	Date Installed	Hydrogeologic Unit Monitored	General Chemistry Data Available	Metal Chemistry Data Available	Chromium Chemistry Data Available
Moabi	northwest	Bernardino County	facility, active supply well	wellhead port									
Sanders-1	X' east	Resident	Domestic well	Unknown		Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Yes
Smith-1	3,000' east	Resident	Domestic well	Unknown	68	Unknown	Unknown	Unknown	Feb-98	Unknown	Unknown	Unknown	Unknown
Topock-2 (aka GSWC#2)	Topock, AZ - 1.2 miles east	City Needles	active municipal well	prod. pump wellhead port	135	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Topock-3 (aka GSWC#3)	Topock, AZ - 1.2 miles east	City Needles	active municipal well	prod. pump wellhead port	150	65	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
PGE-09-N	river floodplain, AZ - 3,000' east	PG&E	inactive, planned Station supply	ded. prod. pump?	95	69	Yes	Yes	Apr-97	Unconsolidated Alluvium	Unknown	Unknown	Unknown
PGE-09-S	river floodplain, AZ - 3,000' east	PG&E	inactive, planned Station supply	ded. prod. pump?	100	70	Yes	Yes	Apr-97	Unconsolidated Alluvium	Unknown	Unknown	Unknown
Needles-1	Needles, CA area - 15 miles northwest	City Needles	active municipal well	TBD	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Needles-2	Needles, CA area - 15 miles northwest	City Needles	active municipal well	TBD	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Needles-3	Needles, CA area - 15 miles northwest	City Needles	active municipal well	TBD	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown.	Unknown	Unknown.
Needles-4	Needles, CA area - 15 miles	City Needles	active municipal well	TBD	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

TABLE 1
Wells Evaluated as Potential Background Wells for Chromium and Metals Groundwater Background Study
Work Plan for Assessing Background Metals Concentrations in Groundwater,
PG&E Compressor Station and Vicinity, Needles, California

Well ID	Well Location & Approx. Distance to Bat Cave Wash Discharge Area	Well Owner	Well Use / Remarks	Sampling System / Method	Well Depth	Well Screen Length	Geologic Log	Well Construction Log	Date Installed	Hydrogeologic Unit Monitored	General Chemistry Data Available	Metal Chemistry Data Available	Chromium Chemistry Data Available
	northwest												
El Paso-1	Mohave Co., AZ - 3 miles east	El Paso Natural Gas	active supply well	TBD	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown.	Unknown	Unknown.
El Paso-2	Mohave Co., AZ - 3 miles east	El Paso Natural Gas	active supply well	TBD	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
El Paso-3	Mohave Co., AZ - 3 miles east	El Paso Natural Gas	active supply well	TBD	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
El Paso-4	Mohave Co., AZ - 3 miles east	El Paso Natural Gas	active supply well	TBD	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

Notes: TBD = to be determined

TABLE 2
Chromium Concentrations In Potential Background Wells
Work Plan for Assessing Background Metals Concentrations in Groundwater,
PG&E Compressor Station and Vicinity, Needles, California

			Concentration range (mg/ L)		
Well ID	**Well Use/ Location**	**No. of Sampling Events**	**Cr(T)**	**Cr(VI)**	**Percent Detections**
MW-01	New Ponds	31 Cr(T); 5 Cr(VI)	<0.02 – 0.23	<0.01 – 0.0046	65% Cr(T); 20% Cr(VI)
MW-03	New Ponds	29 Cr(T); 5 Cr(VI)	<0.05 – 2.3	<0.01 – 0.0117	93% Cr(T); 80% Cr(VI)
MW-04	New Ponds	30 Cr(T); 5 Cr(VI)	<0.05 – 0.41	0.020 – 0.022	90% Cr(T); 100% Cr(VI)
MW-05	New Ponds	32 Cr(T); 5 Cr(VI)	<0.05 – 0.27	0.010 – 0.020	88% Cr(T); 100% Cr(VI)
MW-06	New Ponds	32 Cr(T); 5 Cr(VI)	<0.01 – 0.09	0.009 – 0.010	50% Cr(T); 100% Cr(VI)
MW-07	New Ponds	32 Cr(T); 5 Cr(VI)	<0.05 – 0.40	0.010 – 0.020	91% Cr(T); 100% Cr(VI)
MW-08	New Ponds	31 Cr(T); 5 Cr(VI)	<0.06 – 0.26	0.020 – 0.0509	97% Cr(T); 100% Cr(VI)
MWP-12	Old Ponds	TBD			
MW-14	Bat Cave Wash	No Data Avail.			
MW-15	Old Ponds	19 Cr(T); 20 Cr(VI)	<0.01 – 0.023	<0.01 – 0.05	79% Cr(T); 55% Cr(VI)
MW-16	Background Monitoring well	17 Cr(T); 18 Cr(VI)	<0.02 – 0.0248	< 0.01 – 0.03	76% Cr(T); 61% Cr(VI)
MW-17	Background Monitoring well	15 Cr(T); 15 Cr(VI)	<0.02 – 0.0051	< 0.01 – 0.0055	20% Cr(T); 13% Cr(VI)
MW-18	Background Monitoring well	18 Cr(T); 19 Cr(VI)	0.022 – 0.0432	< 0.01 – 0.0461	100% Cr(T); 95% Cr(VI)
Park Moabi Well	Park Supply well	18 Cr(T); 19 Cr(VI)	< 0.01 – 0.018J	< 0.01 – 0.01	67% Cr(T); 11% Cr(VI)
Sanders-1	Domestic well , Topock, AZ	1 Cr(T); 1 Cr(VI)	<0.001	0.00019	0% Cr(T); 100% Cr(VI)
Smith-1	55-565878	TBD			
Topock-2	Topock, AZ Muni well	TBD			
Topock-3	Topock, AZ Muni well	TBD			

TABLE 2
Chromium Concentrations In Potential Background Wells
Work Plan for Assessing Background Metals Concentrations in Groundwater,
PG&E Compressor Station and Vicinity, Needles, California

			Concentration range (mg/ L)		
Well ID	**Well Use/ Location**	**No. of Sampling Events**	**Cr(T)**	**Cr(VI)**	**Percent Detections**
PGE-9N	15N/21W3A	TBD			
PGE-9S	15N/21W3B	TBD			
Needles-1	City of Needles Muni well	TBD			
Needles-2	City of Needles Muni well	TBD			
Needles-3	City of Needles Muni well	TBD			
Needles-4	City of Needles Muni well	TBD			
El Paso-1	Supply well	TBD			
El Paso-2	Supply well	TBD			
El Paso-3	Supply well	TBD			
El Paso-4	Supply well	TBD			

Note: [J]Estimated concentration between laboratory method detection limit and reporting limit.

TBD = to be determined

TABLE 3
Rationale for Selection of Potential Background Wells
Work Plan for Assessing Background Metals Concentrations in Groundwater,
PG&E Compressor Station and Vicinity, Needles, California

Selection of Potential Background Wells									Selection of Final Background Well Network	
Well ID	**Wells Hydraulically Up or Cross Gradient of Chromium Plume**	**Sufficient Well Information Available**	**Within Background Zone**	**Is the Well Monitoring the Unconsolidated Alluvium**	**Anthropogenic Impact on Groundwater**	**Well Accessible for Sampling**	**Selected as Potential Background Well**	**Comments**	**Geochemistry Similar to Topock Site**	**Selected in Final Background Well Network**
MW-01	Yes	Yes	Yes	Yes	TBD	Yes	Yes		Yes	TBD
MW-03	Yes	Yes	Yes	Yes	TBD	Yes	Yes		Yes	TBD
MW-04	Yes	Yes	Yes	Yes	TBD	Yes	Yes		Yes	TBD
MW-05	Yes	Yes	Yes	Yes	TBD	Yes	Yes		Yes	TBD
MW-06	Yes	Yes	Yes	Yes	TBD	Yes	Yes		Yes	TBD
MW-07	Yes	Yes	Yes	Yes	TBD	Yes	Yes		Yes	TBD
MW-08	Yes	Yes	Yes	Yes	TBD	Yes	Yes		Yes	TBD
MWP-12	Yes	Unknown	Yes	Unknown	TBD	Yes	Yes		Unknown	TBD
MW-14	No	Yes	Yes	Yes	potentially	Yes	No	Well is located too close to the chromium plume	Yes	TBD
MW-15	No	Yes	Yes	Yes	potentially	Yes	No	Well is located too close to the chromium plume	Yes	TBD
MW-16	Yes	Yes	Yes	Yes	TBD	Yes	Yes		Yes	TBD
MW-17	Yes	Yes	Yes	Yes	TBD	Yes	Yes		Yes	TBD
MW-18	Yes	Yes	Yes	Yes	TBD	Yes	Yes		Yes	TBD
Park Moabi	Yes	Yes	Yes	Unknown	TBD	Yes	Yes		Unknown	TBD
Sanders-1		Yes	Yes	Unknown	TBD	Unknown	Yes		Unknown	TBD
Smith-1	Yes	Unknown	Yes	Unknown	TBD	Unknown	Yes		Unknown	TBD
Topock-2 (aka GSWC#2)	Yes	Unknown	Yes	Unknown	TBD	Unknown	Yes		Unknown	TBD
Topock-3 (aka GSWC#3)	Yes	Unknown	Yes	Unknown	TBD	Unknown	Yes		Unknown	TBD
PGE-09-N	Yes	Unknown	Yes	Yes	TBD	Unknown	Yes		Yes	TBD
PGE-09-S	Yes	Unknown	Yes	Yes	TBD	Unknown	Yes		Yes	TBD
Needles-1	Yes	Unknown	Yes	Unknown	TBD	Unknown	Yes		Unknown	TBD

TABLE 3
Rationale for Selection of Potential Background Wells
Work Plan for Assessing Background Metals Concentrations in Groundwater,
PG&E Compressor Station and Vicinity, Needles, California

			Selection of Potential Background Wells					Selection of Final Background Well Network	
Needles-2	Yes	Unknown	Yes	Unknown	TBD	Unknown	Yes	Unknown	TBD
Needles-3	Yes	Unknown	Yes	Unknown	TBD	Unknown	Yes	Unknown	TBD
Needles-4	Yes	Unknown	Yes	Unknown	TBD	Unknown	Yes	Unknown	TBD
El Paso-1	Yes	Unknown	Yes	Unknown	TBD	Unknown	Yes	Unknown	TBD
El Paso-2	Yes	Unknown	Yes	Unknown	TBD	Unknown	Yes	Unknown	TBD
El Paso-3	Yes	Unknown	Yes	Unknown	TBD	Unknown	Yes	Unknown	TBD
El Paso-4	Yes	Unknown	Yes	Unknown	TBD	Unknown	Yes	Unknown	TBD

TABLE 4
Analytical Methods to be Used for Chromium and Metals
Work Plan for Assessing Background Metals Concentrations in Groundwater, PG&E Compressor Station and Vicinity, Needles, California

Parameter	Analytical Method	Maximum Reporting Limit (mg/L)
Aluminum	SW6010B/SW6020/EPA200.7/EPA200.8	0.05
Antimony	SW6010B/SW6020/SW7000*/EPA200.7/EPA200.8*	0.003
Arsenic	SW6010B/SW6020/SW7000*/EPA200.7/EPA200.8	0.005
Barium	SW6010B/SW6020/EPA200.7/EPA200.8	0.5
Beryllium	SW6010B/SW6020/EPA200.7/EPA200.8	0.001
Boron	SW6010B/EPA200.7	0.2
Calcium	SW6010B/EPA200.7	1
Cadmium	SW6010B/SW6020/SW7000*/EPA200.7/EPA200.8	0.002
Chromium, Hexavalent	SW7199	0.0002
Chromium, Total	SW6010B/SW6020/SW7000*/EPA200.7/EPA200.8	0.001
Cobalt	SW6010B/SW6020/EPA200.7/EPA200.8	0.005
Copper	SW6010B/SW6020/EPA200.7/EPA200.8	0.01
Iron	SW6010B/EPA200.7	0.5
Lead	SW6010B/SW6020/SW7000*/EPA200.7/EPA200.8	0.005

TABLE 4
Analytical Methods to be Used for Chromium and Metals
Work Plan for Assessing Background Metals Concentrations in Groundwater, PG&E Compressor Station and Vicinity, Needles, California

Parameter	Analytical Method	Maximum Reporting Limit (mg/L)
Magnesium	SW6010B/EPA200.7	1
Manganese	SW6010B/SW6020/EPA200.7/EPA200.8	0.5
Mercury	SW7470A/EPA245.1	0.0002
Molybdenum	SW6010B/SW6020/SW7000*/EPA200.7/EPA200.8*	0.005
Nickel	SW6010B/SW6020/SW7000*/EPA200.7/EPA200.8	0.02
Potassium	SW6010B/EPA200.7	1
Selenium	SW6010B/SW6020/SW7000*/EPA200.7/EPA200.8	0.005
Silver	SW6010B/SW6020/SW7000*/EPA200.7/EPA200.8	0.005
Sodium	SW6010B/EPA200.7	1
Thallium	SW6010B/SW6020/SW7000*/EPA200.7/EPA200.8	0.001
Vanadium	SW6010B/SW6020/SW7000*/EPA200.7/EPA200.8	0.005
Zinc	SW6010B/SW6020/EPA200.7/EPA200.8	0.02

Notes:
SM - Standard Methods SW - SW846 Update III.
[1] Actual laboratory reporting limits may be equal to or less than those identified in the maximum laboratory reporting limit column above.

TABLE 5
Analytical Methods to be Used for Additional Parameters
Work Plan for Assessing Background Metals Concentrations in Groundwater,
PG&E Compressor Station and Vicinity, Needles, California

Analyte	Method	Reporting Limits Water (mg/L)
Chloride	EPA 300.0/SW9056	0.5
Fluoride	EPA 300.0/SW9056	0.5
Sulfate	EPA 300.0/SW9056	0.5
Bromide	EPA 300.0/SW9056	0.5
Nitrate	EPA 300.0/SW9056	0.5
Total Alkalinity	EPA310.1	5
Bicarbonate Alkalinity	EPA310.1	5
Specific Conductance	EPA120.1/SW9050	2 μmhos/cm
pH	EPA150.1/SW9040	0.1 pH units
Total Dissolved Solids (TDS)	EPA160.1	10
Total Suspended Solids (TSS)	EPA160.2	10
Turbidity	EPA180.1	0.1 NTU
Carbonate Alkalinity	EPA310.1	5
Hydroxide Alkalinity	EPA310.1	5
Perchlorate	EPA314.0	0.004
Ammonia	EPA350.2	0.5
ortho- Phosphate	EPA365.1	0.02
Sulfide	EPA376.1/2	2
Ferrous Iron (Fe^{+2})	SM3500D	0.2
Total Kjeldahl Nitrogen (TKN)	EPA351.4	0.5
Dissolved Silica	EPA370.1	0.04
Total Organic Carbon	EPA415.2	0.5
Dissolved Organic Carbon	EPA415.2	0.5
Chromium (hexavalent)	SW7199/EPA218.6	0.0002
Chromium (hexavalent)	SW7196A	0.01
Iodide	EPA 300.0MOD	0.2
^{18}O	Laboratory SOP (CF-IRMS)	NA
Deuterium	Laboratory SOP (CF-IRMS)	NA
Tritium	Univ of Miami RSMAS Method	NA

Notes:
SM - Standard Methods SW - SW846 Update III EPA – EPA 600 Series for Chemical Analysis of Water and Wastes.
1 For greater accuracy in determination of ferrous iron, recommendations from the following research publication will be referred: Fredlee, G., and Stumm, W. Journal of the AWWA, Dec. 1966. p 1567-1574.

TABLE 6
Sample Containers, Preservation and Holding Time for Analytes
Work Plan for Assessing Background Chromium and Metals Concentrations in Groundwater,
PG&E Compressor Station and Vicinity, Needles, California

Analyte	Method	Container and Minimum Quantity Water	Preservation	Holding Time
Dissolved Metals*	SW6010B/SW6020/EPA200.7/EPA200.8/SW7000 series methods	1-L/P, G	Laboratory or field filtration. Add nitric acid to pH<2; chill to 4°C.	180 days
Hexavalent Chromium	SW7199/EPA218.6	500-mL/P, G	Laboratory or field filtration. Chill to 4°C. after adding $(NH_4)_2SO_4/NH_4OH$ buffer solution to pH 9-9.5	24 hours
Hexavalent Chromium	SW7196A	500-mL/P, G	Cool to 4°C	24 hours
Ammonia	E350.2	1-L P/G	Add H_2SO_4 to pH<2; chill to 4°C	28 days
Alkalinity (Total, Bicarbonate, Carbonate, Hydroxide)	EPA 310.1	500-mL/P, G	Cool to 4°C	14 days
TDS	EPA 160.1	500-mL/P, G	Cool to 4°C	7 days
TSS	EPA 160.2	500-mL/P, G	Cool to 4°C	7 days
Turbidity	EPA 180.1	500-mL/P, G	Cool to 4°C	48 hrs
Specific Conductance	EPA 120.1/SW9050	500-mL/P, G	Cool to 4°C	28 days
pH	EPA 150.1/SW9040	500-mL/P, G	Cool to 4°C	ASAP
DOC	EPA 415.2	500-mL/P, G or 40ml VOA	Laboratory or field filtration. Add H_2SO_4 to pH<2; chill to 4°C	28 days
TOC	EPA 415.2	500-mL/P, G or 40ml VOA	Add H_2SO_4 to pH<2; chill to 4°C	28 days
Perchlorate	EPA 314.0	500-mL/P, G	Cool to 4°C	28 days
Sulfide	EPA 376.2	500-mL/P, G	Add zinc acetate and NaOH to pH>9, Cool to 4°C.	7 days
Total Kjeldahl Nitrogen (TKN)	EPA 351.4	500-mL/P, G	Add H_2SO_4 to pH<2; chill to 4°C	28 days
Ferrous Iron (Fe^{+2})	SM3500D	500-mL/P, G	Cool to 4°C	24 hours
Dissolved Silica	EPA 370.1/2	500-mL/P only	Cool to 4°C	28 days

TABLE 6
Sample Containers, Preservation and Holding Time for Analytes
Work Plan for Assessing Background Chromium and Metals Concentrations in Groundwater,
PG&E Compressor Station and Vicinity, Needles, California

Analyte	Method	Container and Minimum Quantity	Preservation	Holding Time
		Water		
^{18}O and deuterium	Laboratory SOP(Continuous Flow Mass Spectrometer-CF-IRMS)	100-mL/P or 40ml VOA	Cool to 4°C	None
Anions	SW9056/ EPA300.0/EPA365 .2	125 ml P/G	4°C	Bromide, Chloride, Fluoride, Sulfate, Iodide in 28 days Nitrate and ortho-Phosphate in water 48 hours

Polyethylene (P); glass (G).
* If Boron is a target analyte, a polyethylene bottle must be used for sample collection.

Figures

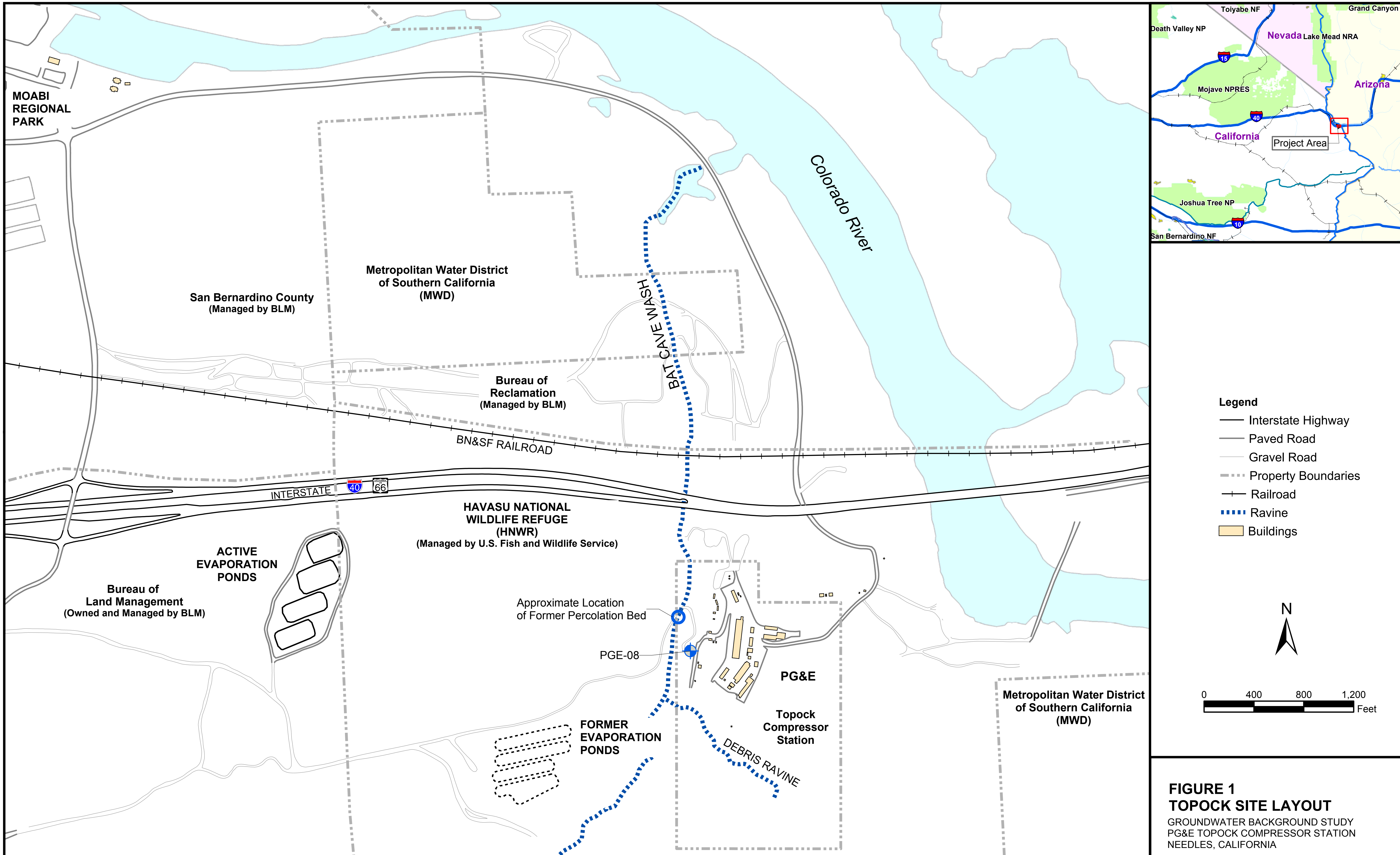


FIGURE 1
TOPOCK SITE LAYOUT
GROUNDWATER BACKGROUND STUDY
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

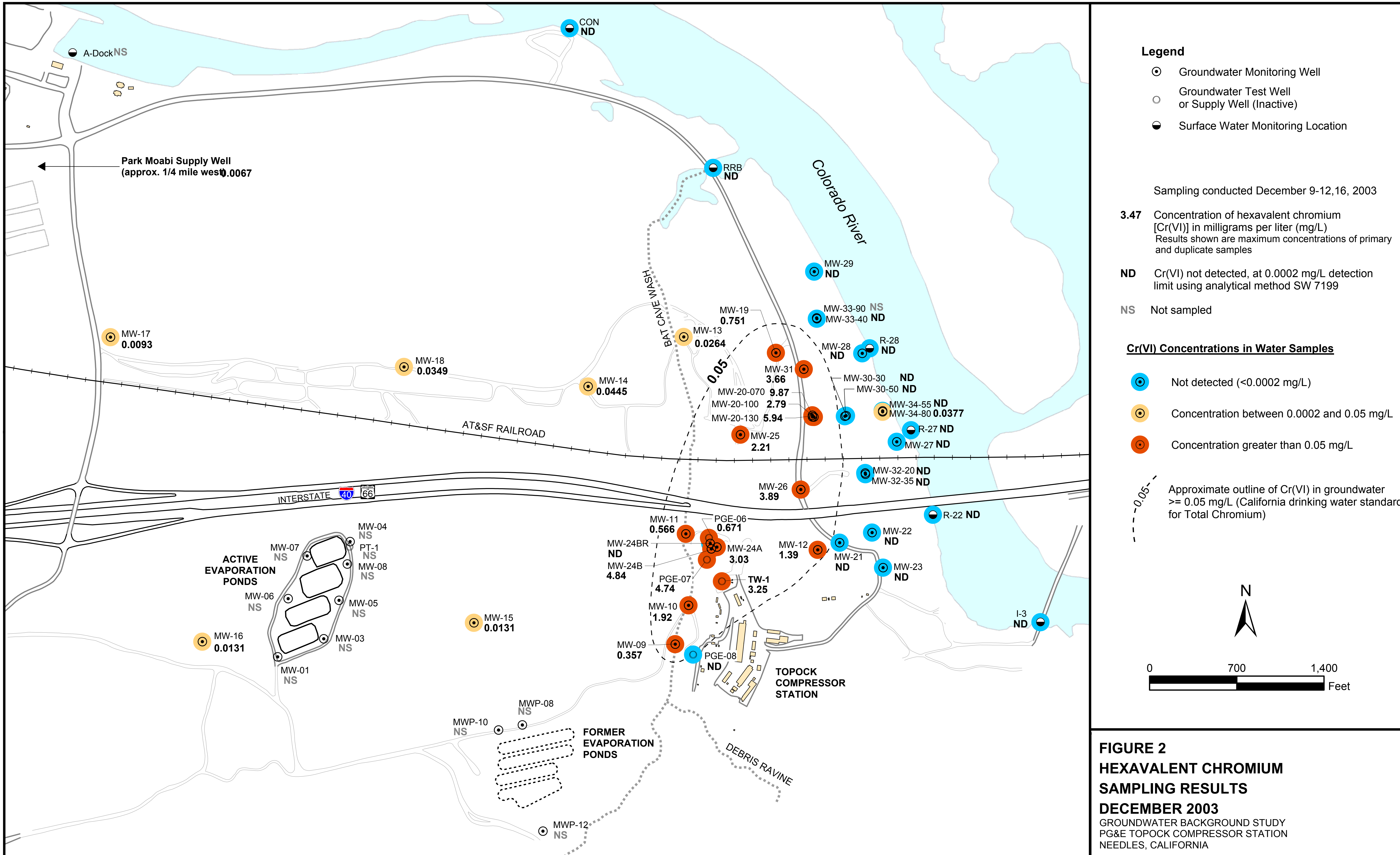


FIGURE 2
HEXAVALENT CHROMIUM SAMPLING RESULTS DECEMBER 2003
GROUNDWATER BACKGROUND STUDY
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

SFO \\CABERNET\PROJ\PACIFICGASELECTRICCO\TOPOCKPROGRAM\GIS\MXD\BACKGROUND_STUDY_RESULTS_CR6_FIG2.MXD BACKGROUND_STUDY_RESULTS_CR6_FIG2.PDF 04/08/2004 17:33:35

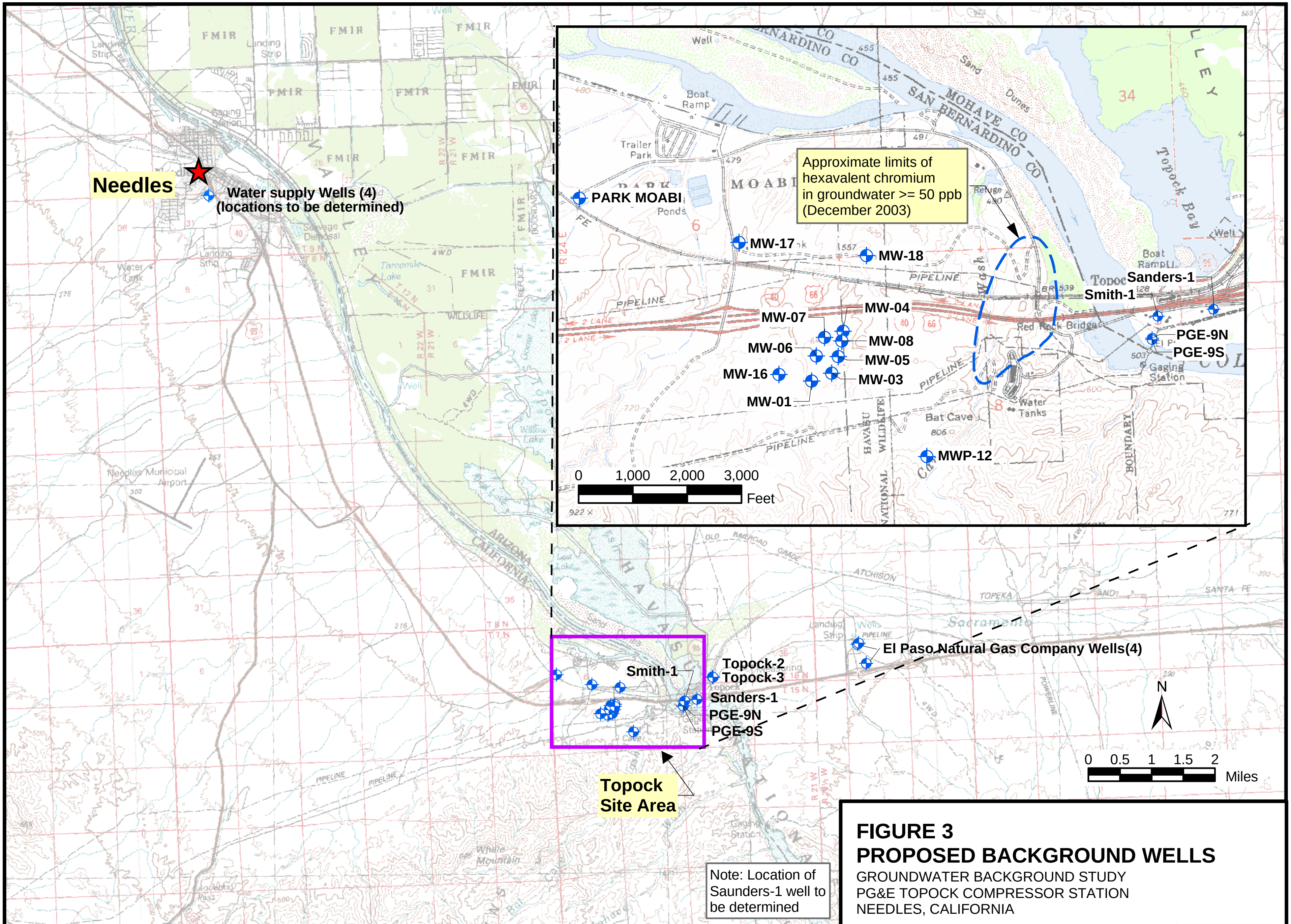


FIGURE 3
PROPOSED BACKGROUND WELLS

GROUNDWATER BACKGROUND STUDY
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

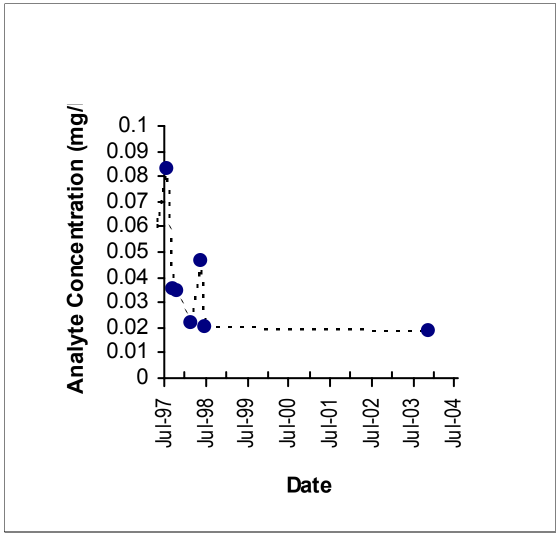
CH2MHILL

SFO \\ZINFANDEL\PROJ\PACIFICGASELECTRICCO\TOPOCKPROGRAM\GIS\MXD\BACKGROUND_STUDY_REGIONAL_MAP_FIG3.MXD BACKGROUND_STUDY_REGIONAL_MAP_FIG8.PDF 06/30/2004 10:24:29

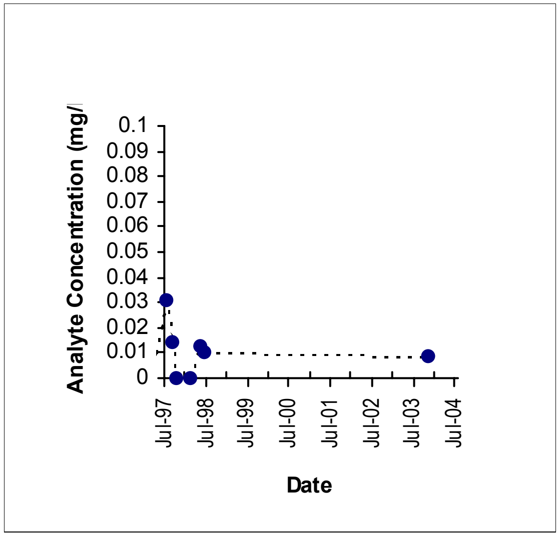
Appendices

Appendix A

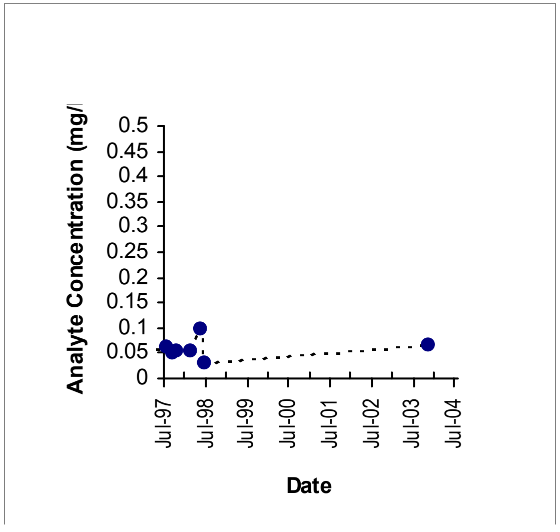
PGE Topock Groundwater Monitoring
Chemical Time Series Plots
Cr(T)



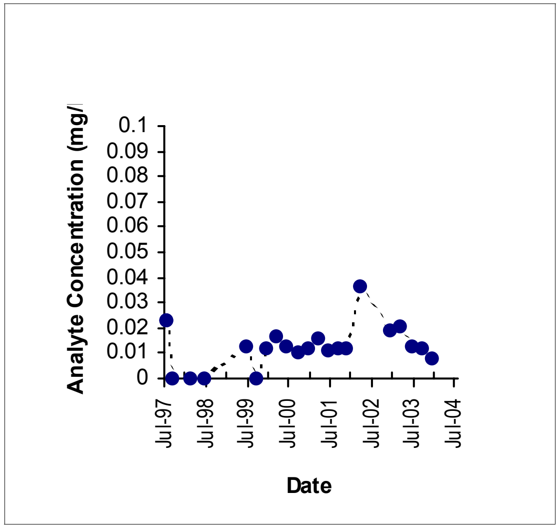
Location: MW-04 Maximum 0.083 mg/L



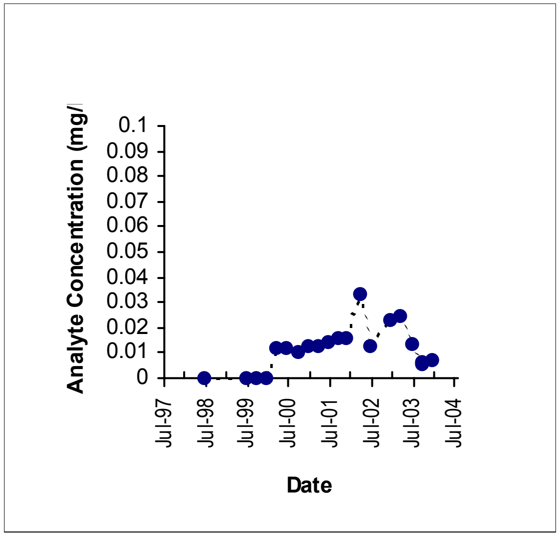
Location: MW-06 Maximum 0.031 mg/L



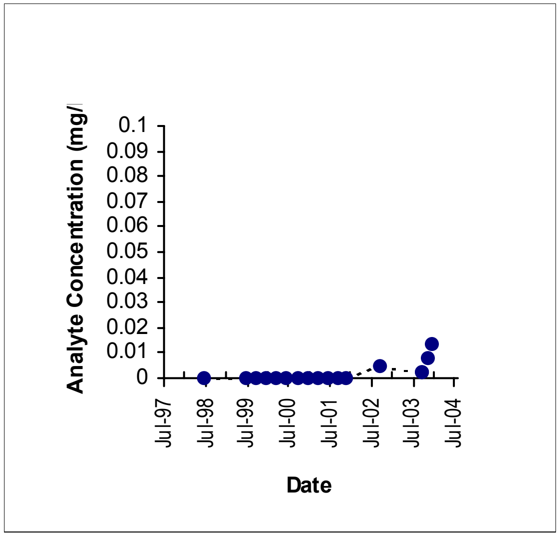
Location: MW-08 Maximum 0.1 mg/L



Location: MW-15 Maximum 0.0368 mg/L



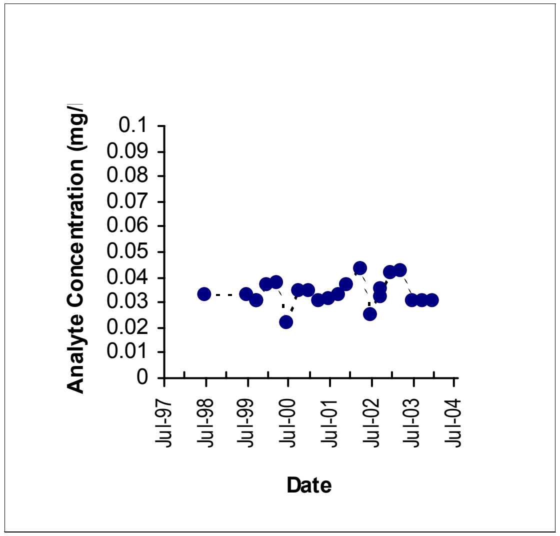
Location: MW-16 Maximum 0.0336 mg/L



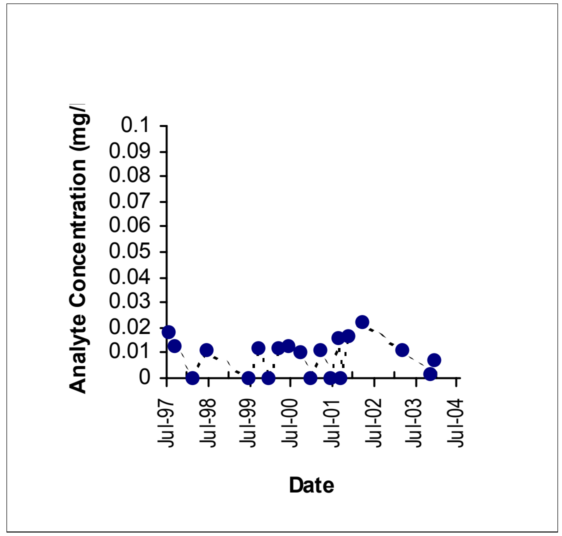
Location: MW-17 Maximum 0.0137 mg/L

Notes: (1) The Reporting Limit for Cr(T) varies from 0.001 to 0.05 mg/L
(2) Concentrations less than reporting limits are plotted as 0 mg/L

PGE Topock Groundwater Monitoring
Chemical Time Series Plots
Cr(T)



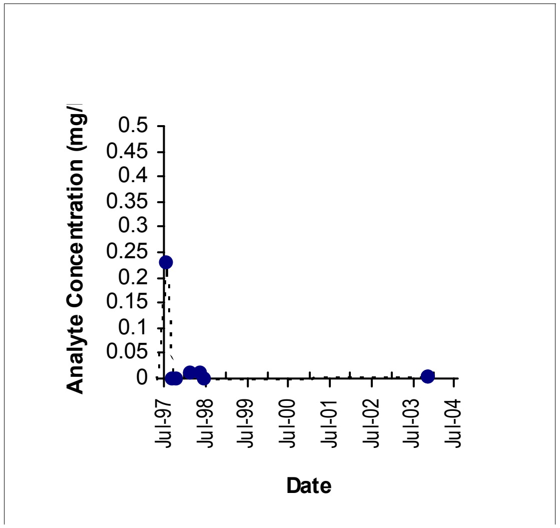
Location: MW-18 **Maximum 0.0434 mg/L**



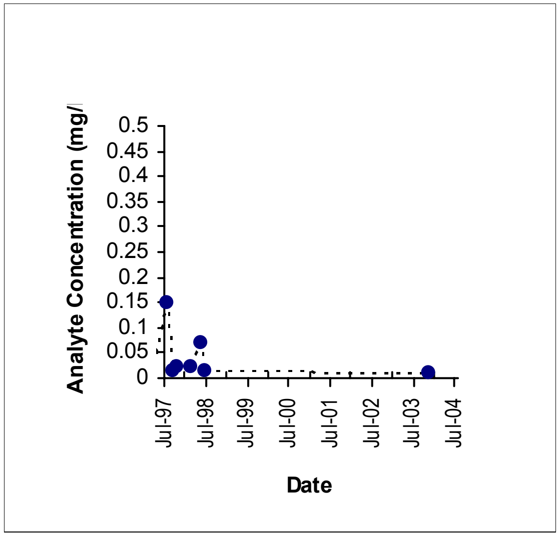
Location: Park-Moabi **Maximum 0.0223 mg/L**

Notes: (1) The Reporting Limit for Cr(T) varies from 0.001 to 0.05 mg/L
(2) Concentrations less than reporting limits are plotted as 0 mg/L

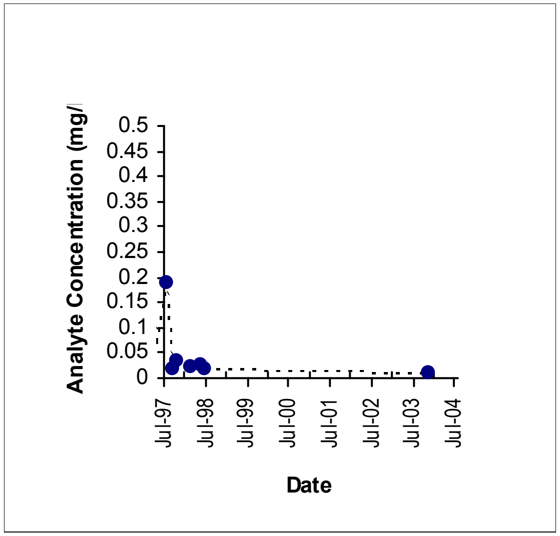
PGE Topock Groundwater Monitoring
Chemical Time Series Plots
Cr(T)



Location: MW-01 **Maximum 0.23 mg/L**



Location: MW-05 **Maximum 0.15 mg/L**

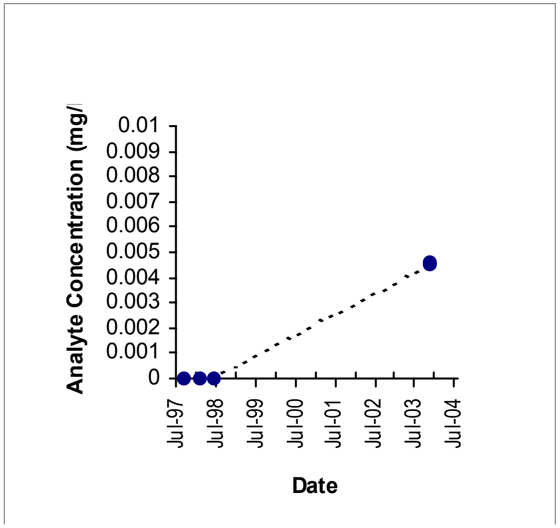


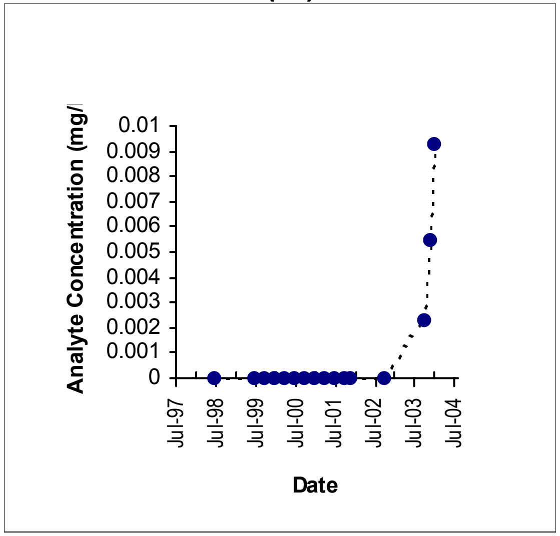
Location: MW-07 **Maximum 0.19 mg/L**

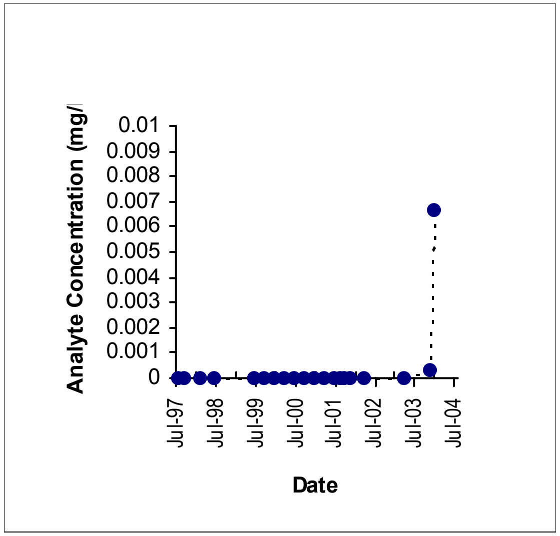
Notes: (1) The Reporting Limit for Cr(T) varies from 0.001 to 0.05 mg/L
(2) Concentrations less than reporting limits are plotted as 0 mg/L

PGE Topock Groundwater Monitoring
Chemical Time Series Plots

Cr(VI)







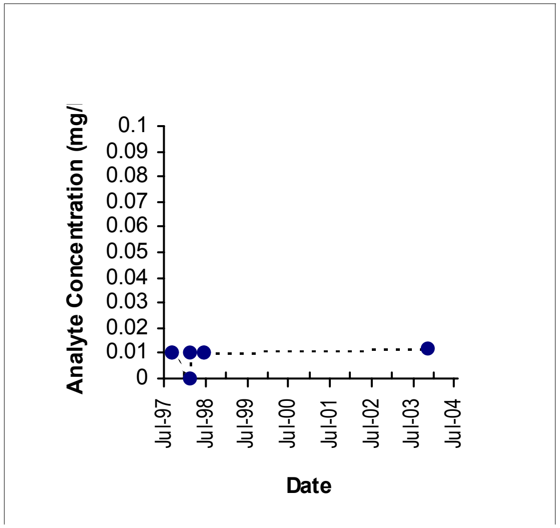
Location: MW-01 Maximum 0.0046 mg/L

Location: MW-17 Maximum 0.0093 mg/L

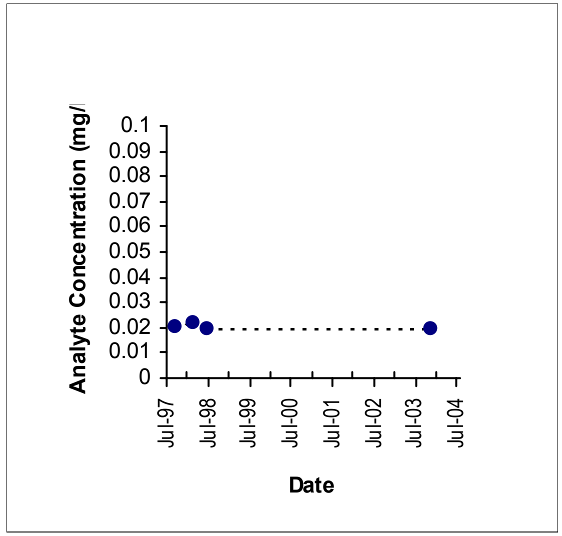
Location: Park-Moabi Maximum 0.0067 mg/L

Notes: (1) The Reporting Limit for Cr(IV) varies from 0.0002 to 0.01 mg/L.
(2) Concentrations less than reporting limits are plotted as 0 mg/L

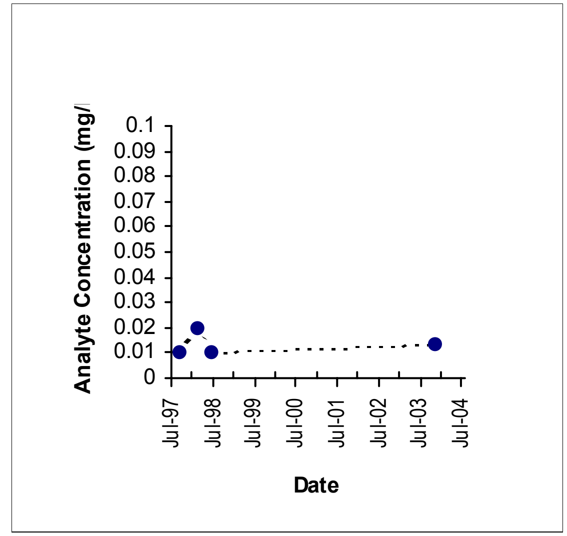
PGE Topock Groundwater Monitoring
Chemical Time Series Plots
Cr(VI)



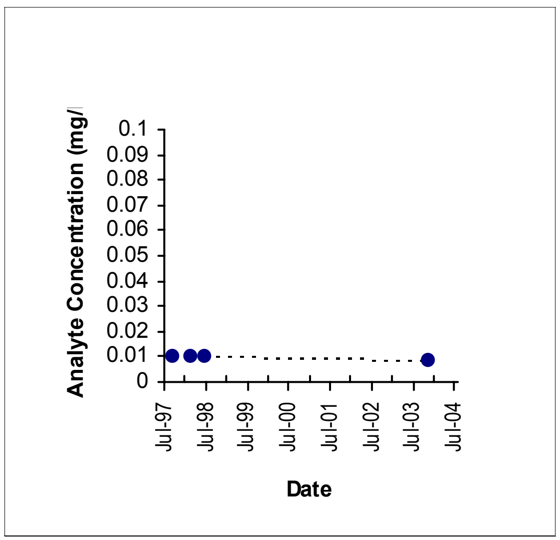
Location: MW-03 Maximum 0.0117 mg/L



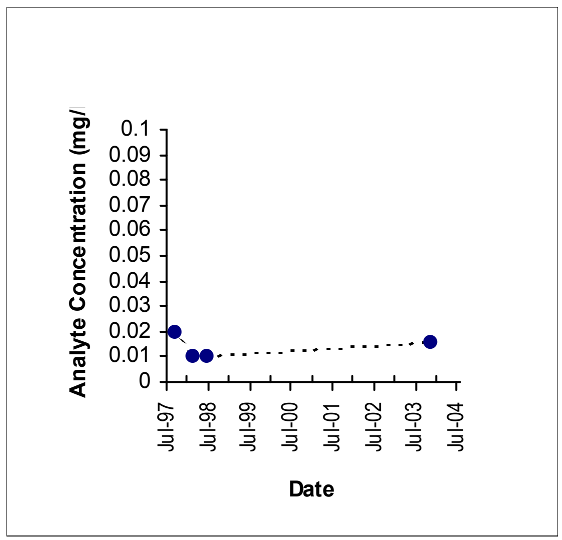
Location: MW-04 Maximum 0.022 mg/L



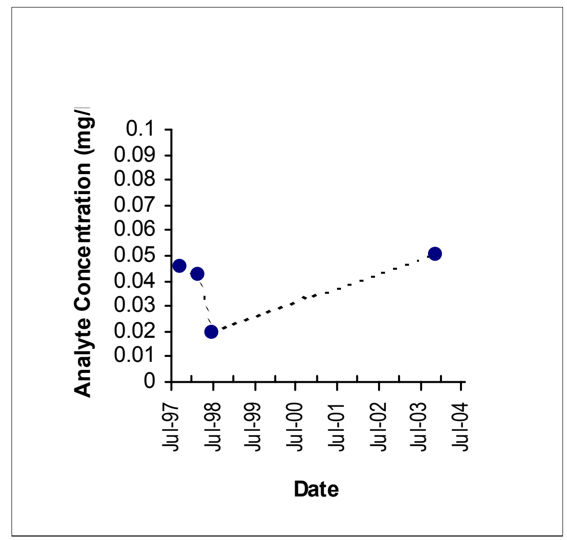
Location: MW-05 Maximum 0.02 mg/L



Location: MW-06 Maximum 0.01 mg/L



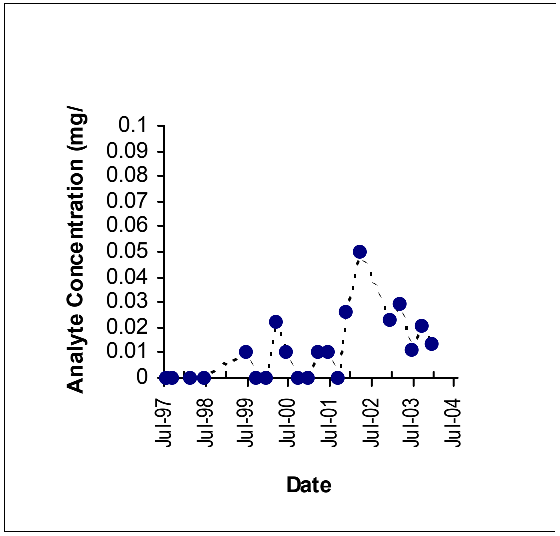
Location: MW-07 Maximum 0.02 mg/L



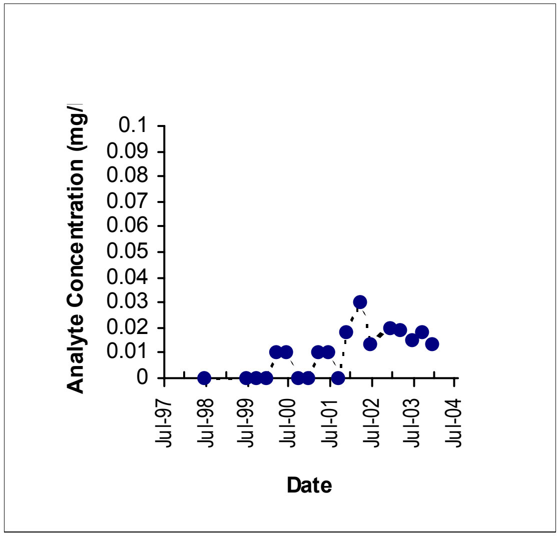
Location: MW-08 Maximum 0.0509 mg/L

Notes: (1) The Reporting Limit for Cr(IV) varies from 0.0002 to 0.01 mg/L.
(2) Concentrations less than reporting limits are plotted as 0 mg/L

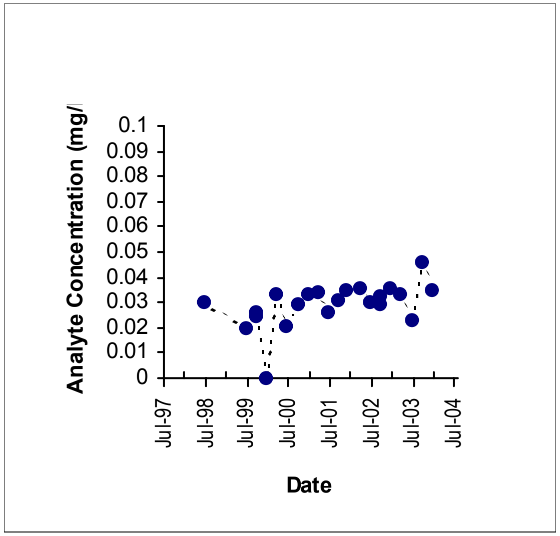
PGE Topock Groundwater Monitoring
Chemical Time Series Plots
Cr(VI)



Location: MW-15 Maximum 0.05 mg/L



Location: MW-16 Maximum 0.03 mg/L



Location: MW-18 Maximum 0.0461 mg/L

Notes: (1) The Reporting Limit for Cr(IV) varies from 0.0002 to 0.01 mg/L.
(2) Concentrations less than reporting limits are plotted as 0 mg/L

Appendix B

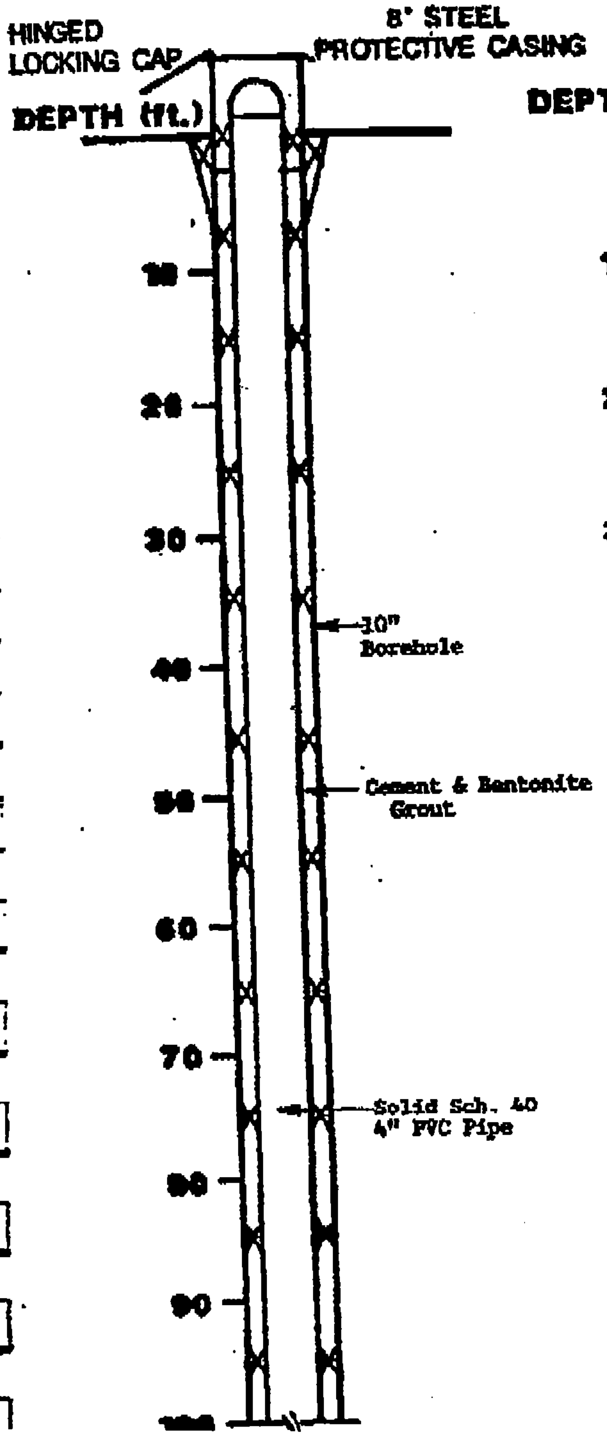
ON 07/08/03 for MW-1
Ground surface = 656.3'
PVC = 661.31'

BOREHOLE LOGS AND WELL CONSTRUCTION RECORD

Topock Compressor Station (NEW POND SITE)

WELL AS BUILT **BORE HOLE** P-1 MW-1

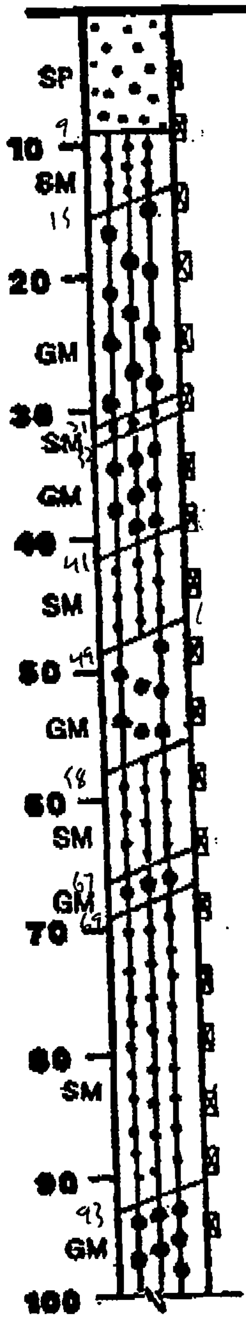
ELEV. TOP OF PVC PIPE: 660.41' DATE STARTED: 8/24/86



DESCRIPTION OF MATERIALS

DATUM: MEAN SEA LEVEL

DEPTH (ft.) SURFACE ELEV. 659.17'



SAND - Pinkish Brn, VF-F gr, dry, subang to subrdd; sparse gravels to ½".

SILTY SAND w/gravel-Brn, dry, calc., metadiorite, gneiss & qtz gravels to 2½". Sand Matrix

SILTY GRAVEL w/sand-Brn, dry, calc., metadiorite, gneiss & qtz gravels to 2½". Sand Matrix

SILTY SAND - As before (Lens)

SILTY GRAVEL w/sand - As before

SILTY SAND w/gravel - Brn, VF-C gr, dry, subang., calc. w/subang gravels to 2"

SILTY GRAVEL w/sand - Brn, ang to subang, dry, calc., to 2½"

SILTY SAND w/gravel - Brn, VF-C gr, dry, subang w/gravels to 2"

- Increasing Gravels -

SILTY SAND w/gravel - as before

- Increasing Gravels -

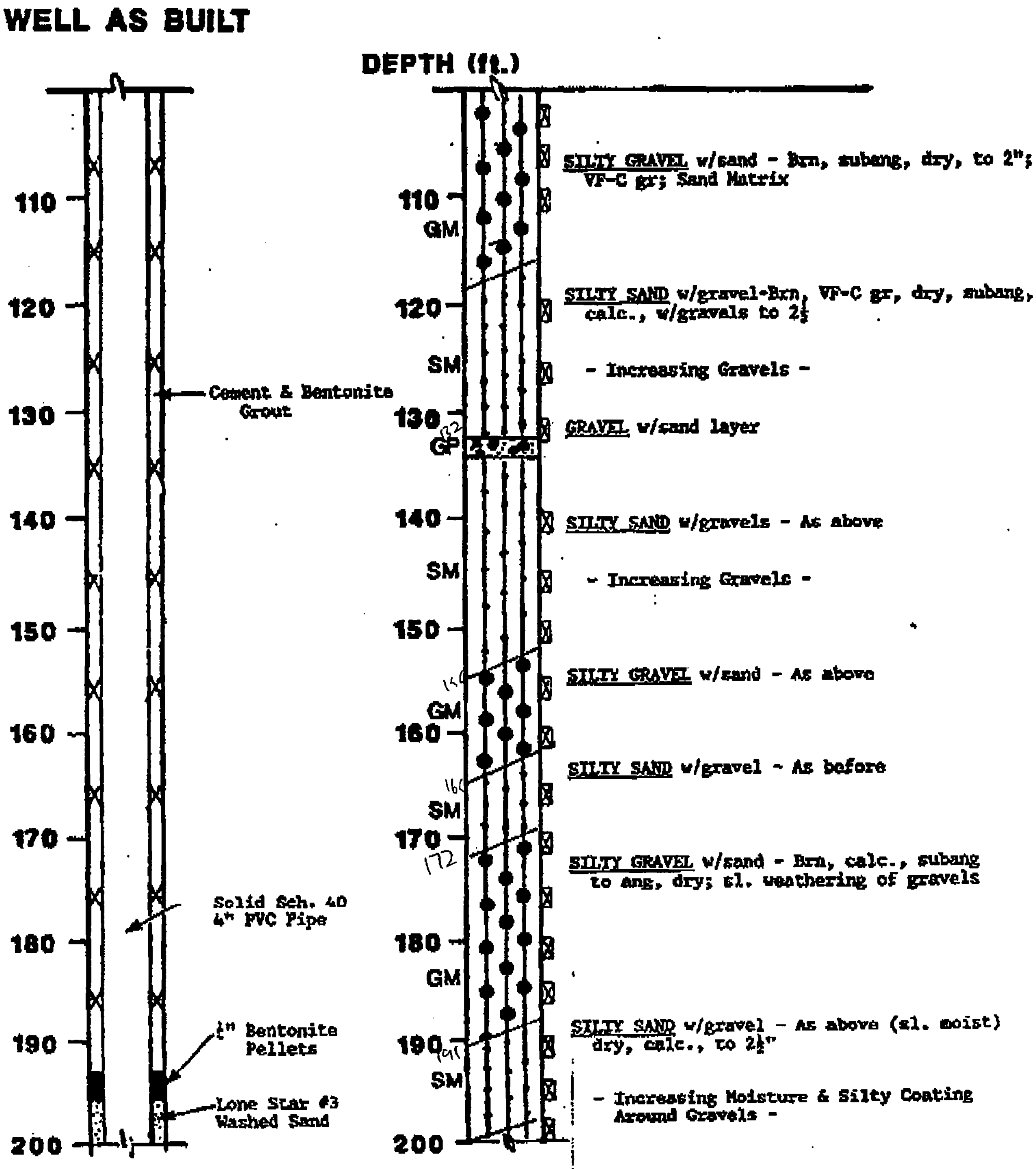
SILTY GRAVEL w/sand - Brn, subang, dry, to 3"

- Calc. Cemented Congl Frags - ?

BOREHOLE LOGS AND WELL CONSTRUCTION RECORD

Topock Compressor Station (NEW POND SITE)

BORE HOLE P-1 Continued

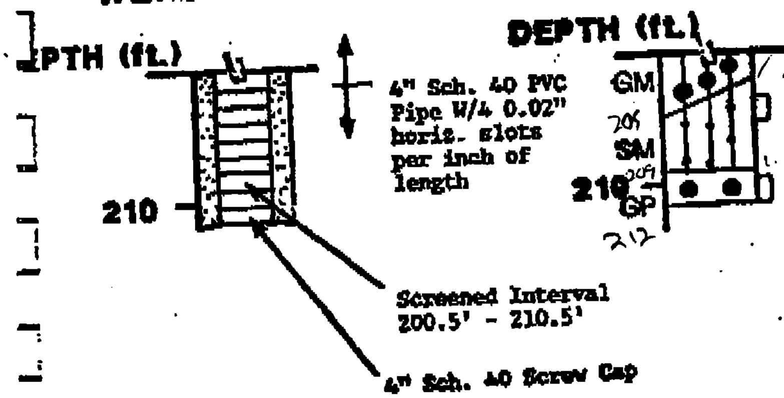


A-7

BOREHOLE LOGS AND WELL CONSTRUCTION RECORD

Topock Compressor Station (NEW POND SITE)

BORE HOLE P-1 Continued



DESCRIPTION OF MATERIALS

Depth to 1st water 204' (8/27/86)

SILTY GRAVEL w/sand

SILTY SAND w/gravel - wet

GRAVEL w/sand - Brn, subang to ang, wet to 2½"

Hole Terminated at 212'

Notes:
1. Hole advanced by Layne-Western's 10" air percussion hammer rig.
2. Borehole logged by L.A. Flora.

ON 07/08/03 for MW-3
GS = 645.30'
PVC = 650.08'

BOREHOLE LOGS AND WELL CONSTRUCTION RECORD

Topock Compressor Station (NEW POND SITE)

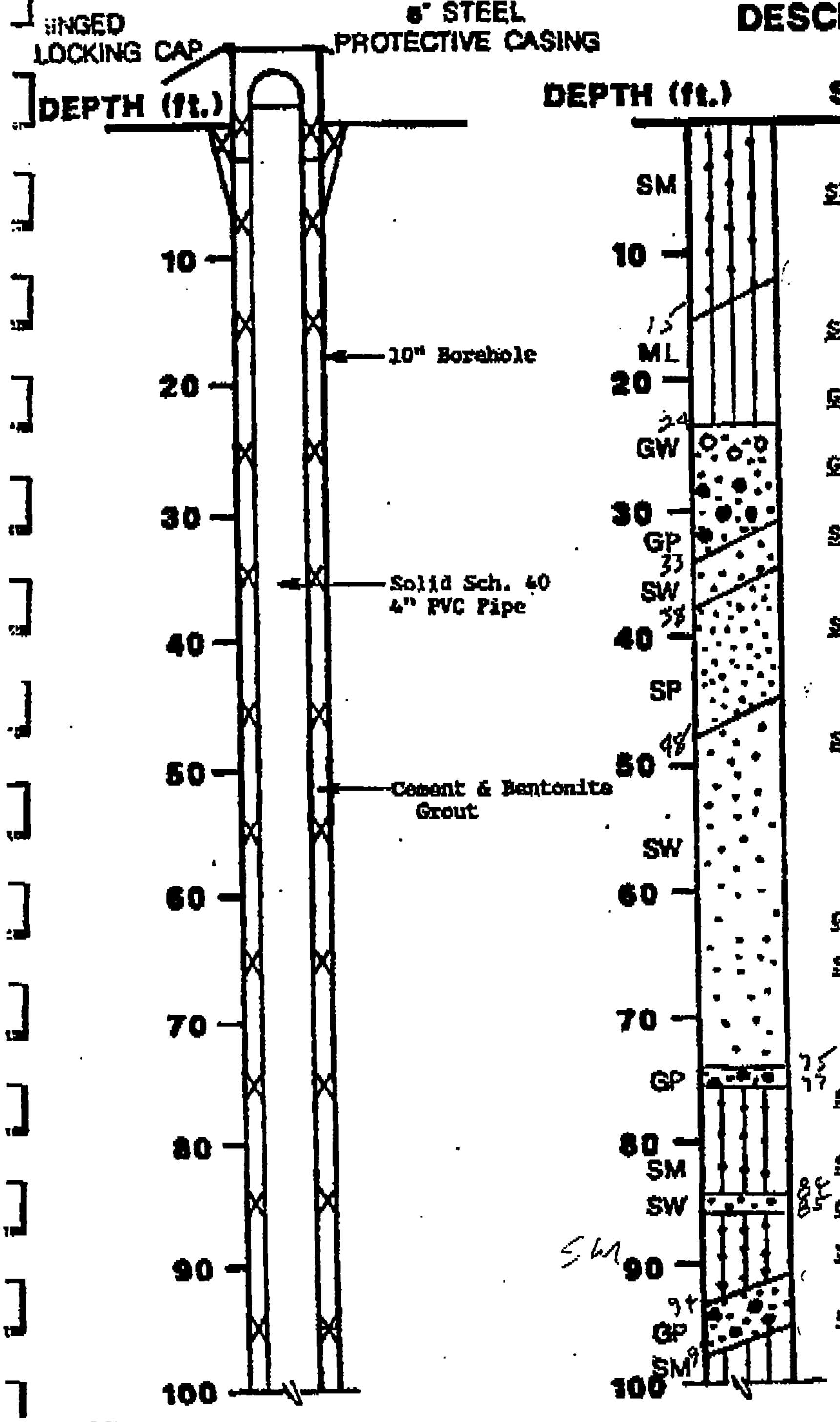
WELL AS BUILT **BORE HOLE** P-3 (MW-3) MW-3

ELEV. TOP OF PVC PIPE: 648.56' **DATE STARTED:** 8/19/86

DESCRIPTION OF MATERIALS

DATUM: MEAN SEA LEVEL

SURFACE ELEV. 647.83'



SILTY SAND - Pinkish Brn., VF gr, calc, dry subang w/sparse gravels to ½".
- increasing gravels -
- blebs of Red silty clay -

SILT w/sand - Pinkish Brn, dry
- decreasing clay blebs -

GRAVEL w/sand & silt - Brn, dry, subang to ang, to 4", fresh

GRAVEL w/sand & silt - As above to 1½"

SAND w/gravel - Brn, VF-C gr, dry; gravels to 1½"

SAND w/gravel - As above, VF-M gr

SAND w/gravel - Brn to Reddish Brn, VF-C gr, dry, calc., subang w/metadiorite & gneissic gravels to 2"; trace silt

GRAVEL w/sand Layer

SILT SAND w/gravel - Grn, VF-C gr, dry, subang to subrdd, w/subang gravels to 2½"
- sparce calc. cemented congl frags. -

SAND - Rd Brn, VF-C gv, sl. moist

SILTY SAND - As above

GRAVEL w/sand - some calc. cemented congl frags

SILTY SAND w/gravel - Rd Brn, VF-C gr, dry calc. w/gravels to 3"

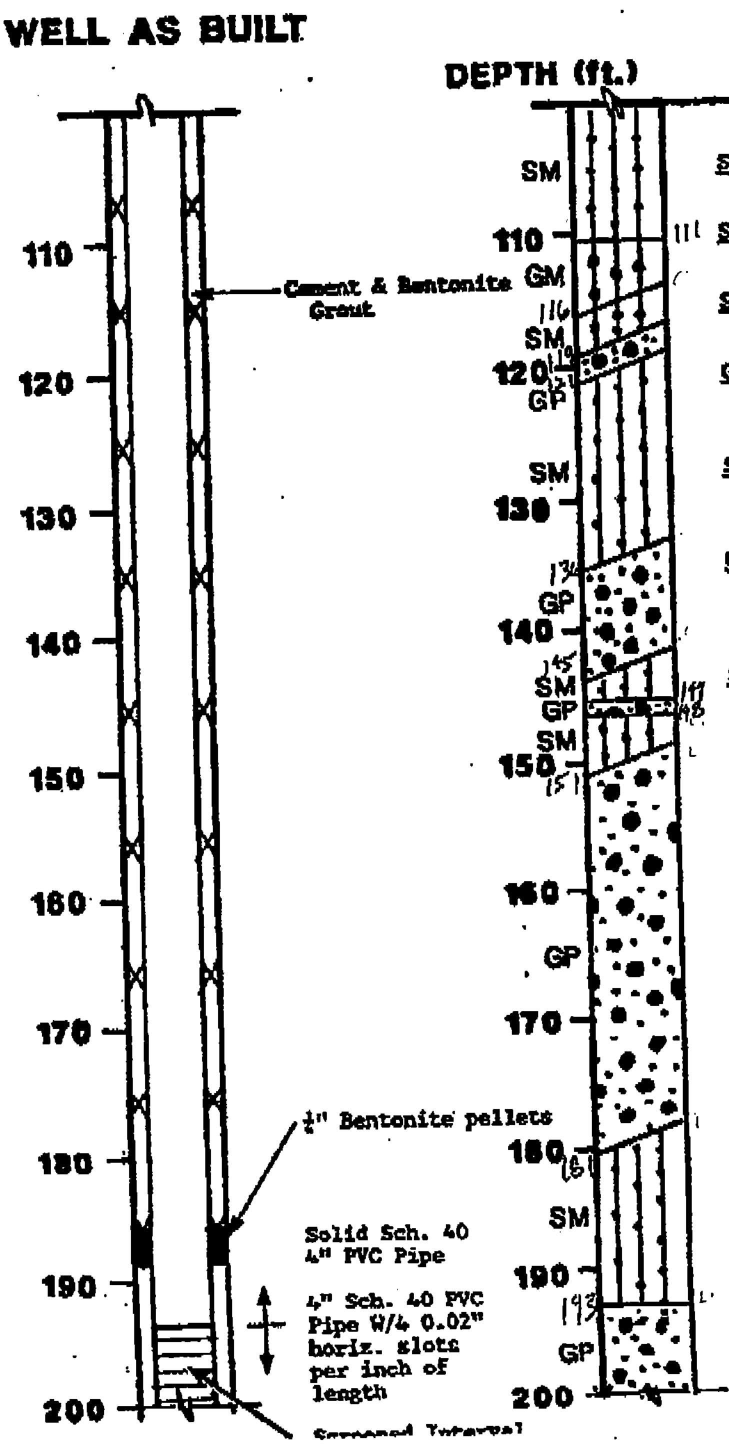
GRAVEL w/sand

BOREHOLE LOGS AND WELL CONSTRUCTION RECORD

Topock Compressor Station (NEW POND SITE)

BORE HOLE P-3 Continued

647.83



SILTY SAND w/gravel - Rd Brn, VF-C gr, dry subang; w/meta gravels & calc cemented congl frags to 4"

SILTY GRAVEL w/sand - As above, more gravel

SILTY SAND w/gravel

GRAVEL w/sand - Dk Gray, fresh to sl, weathered; dry, to 2"

SILTY SAND w/gravel - As above

GRAVEL w/sand & silt - Gray, subang to ang, dry, to 3" w/Sandy - Silty Matrix

SILTY SAND w/gravel - Brn, VF-Cgr, dry, subang. calc., w/gravels to 1½"

GRAVEL w/Sand - Gray, subang, fresh to sl. weathered clasts, to 2½"

- some w/calc. cement coating -

- increased gravels between 171' - 172' -

- Dry -

SILTY SAND w/gravels - Brn, sl. moist, VF-Cgr, subang w/moist coating on gravels

- increasing moisture -

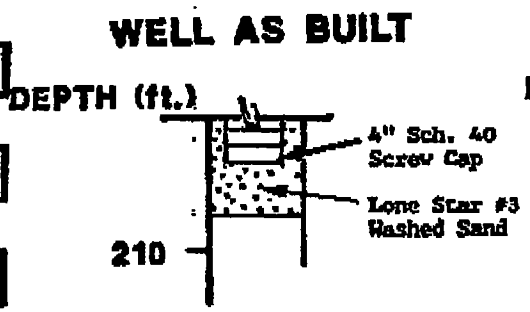
Depth of 1st water
189' (8/20/86) - wet -

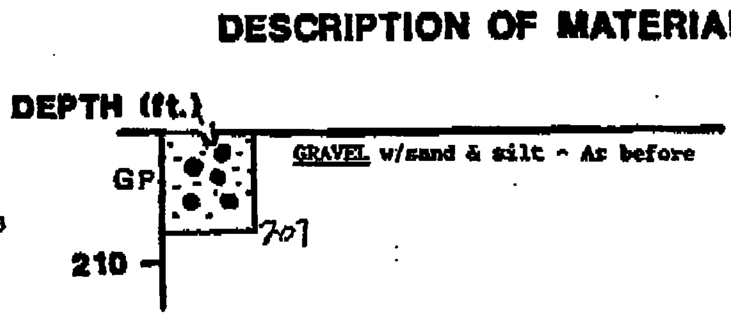
GRAVEL w/sand & silt - Brn, wet, to 3", common silt/sand coatings

BOREHOLE LOGS AND WELL CONSTRUCTION RECORD

Topock Compressor Station (NEW POND SITE)

BORE HOLE P-3 Continued





Hole Terminated at 207'

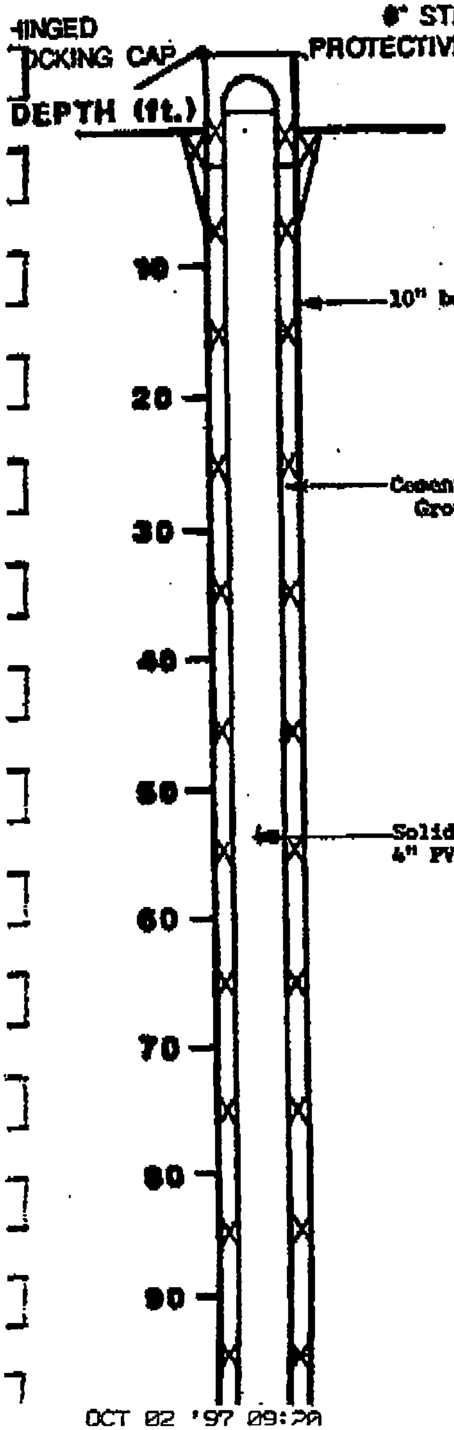
Notes:
1. Hole advanced by Layne-Western's 10" air percussion hammer rig.
2. Borehole logged by L.A. Flora.

BOREHOLE LOGS AND WELL CONSTRUCTION RECORD

Topock Compressor Station (NEW POND SITE)

WELL AS BUILT BORE HOLE P-4 MW-4 MW-4

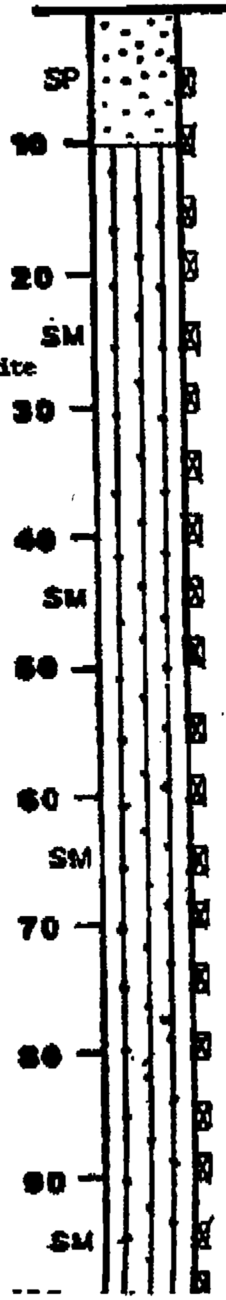
ELEV. TOP OF PVC PIPE: 624.34' DATE STARTED: 8/21/86



DESCRIPTION OF MATERIALS

DATUM: MEAN SEA LEVEL

DEPTH (ft.) SURFACE ELEV. 622.95'



SAND - Pinkish Brn, VF-F gr, dry, subang to ang, uniform; sparse fine gravels

- increasing gravels to 1" -

SILTY SAND w/gravel - Brn, VF-C gr, dry, subang to subrdd, poorly sorted, w/ang metadiorite gravels to 2½"

SILTY SAND w/gravel - As above

- decreasing gravels -

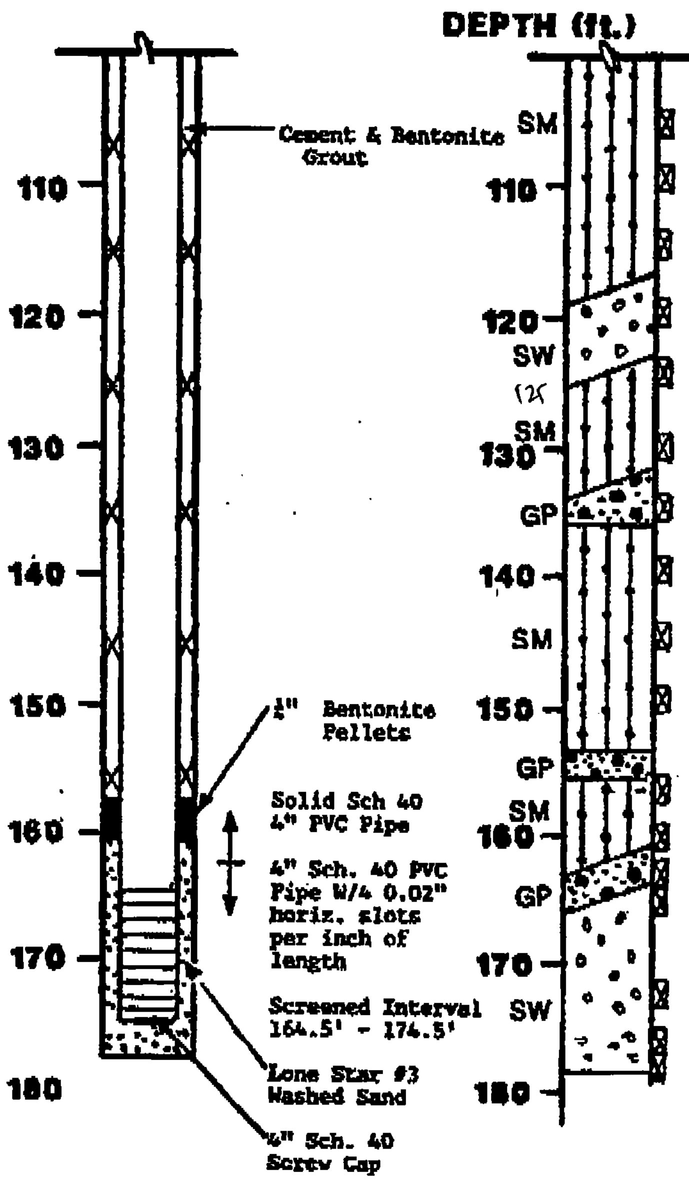
SILTY SAND w/gravel - As above w/calc. cemented congl. frags

BOREHOLE LOGS AND WELL CONSTRUCTION RECORD

Topock Compressor Station (NEW POND SITE)

BORE HOLE (P-4) Continued

WELL AS BUILT



SILTY SAND - Brn, VF-C gv, dry, subang; sparse sl. moist, silt coated gravels to 2"

SAND w/gravel -Brn, VF-C gr, subang, dry to sl. Moist silty coating on some gravels; calc. cemented congl. frags common.

SILTY SAND w/gravel - As before

GRAVEL w/sand - Pinkish Brn, subang to subrdd. to 1½"; Reddish silt-sand sl. moist coatings on some gravels; Sandy Matrix, dry.

SILTY SAND w/gravel - Pinkish Brn, VF-C gr. dry, subang to subrdd; Meta gravels to 2½", sl. moist silty coating on gravels

GRAVEL w/sand - As above

SILTY SAND w/gravel - As before

GRAVEL w/sand - As above

Depth to 1st water 164' (8/21/86)

SAND w/gravel - Brn, moist, VF -C gr, subang, moist to wet gravels to 1"

- increasing moisture -

Wet

Hole Terminated at 180'

Notes:
1. Hole advanced by Layne-Western's 10" air percussion hammer rig.
2. Borehole logged by L.A. Flora.

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-5

Soil Boring Log - Monitoring Well MW-5

El.=632.6
460,601.2N, 3,050,677.8E
6-21-89

Depth,(Ft.)		Sample No.	Description
0	GM	632.6	SILTY GRAVEL WITH SAND
5		5-1	Gray-brown, dry, slightly silty gravel. Subangular to 3" size. Predominantly metadiorite, quartz diorite, and gneiss. Older alluvial fan materials.
10			Slightly humid.
15		617.6 5-2	
15	GW - GM		WELL GRADED GRAVEL WITH SILT AND SAND
20		5-3	Gray-brown, slightly silty gravel.
24	GM	608.6	
25			SILTY GRAVEL WITH SAND
		5-4	Tan, humid, moderately silty gravel.
30		5-5	Gray-brown, humid, silty gravel.
35		597.1	
35.5	GW - GM		WELL GRADED GRAVEL WITH SILT AND SAND
		5-6	Grey brown, humid, slightly less silty gravel.
40			

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-5

Soil Boring Log - Monitoring Well MW-5

Depth,(Ft.)		Sample No.	Description
40	GM - GW	5-7	WELL GRADED GRAVEL WITH SILT AND SAND Tan-brown, moist\humid, silty gravel.
45 / 45.5		587.1	
	SM	5-8	SILTY SAND WITH GRAVEL Slightly reddish brown, humid, medium fine silty sand with gravel.
50 / 50		582.6	
	GM	5-9	SILTY GRAVEL WITH SAND Tan-brown, humid, silty gravel.
55 / 56		5-10 576.6	
60	SM		SILTY SAND WITH GRAVEL Brown, humid, fairly gravelly silty sand. Brown, humid, medium coorse silty sand with occassional coorse gravel to 3" and abundant smaller, subangular gravel.
		5-11	
65		5-12	
69.5		563.1	
70	GM		SILTY GRAVEL WITH SAND Brown, humid slightly silty medium-fine gravel.
72		560.6	
	SM	5-13	SILTY SAND WITH GRAVEL Brown, silty sand with small gravel.
74.5 / 75		558.1	
	GM		SILTY GRAVEL WITH SAND Brown, humid, silty gravel with sand.
80			

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-5

Soil Boring Log - Monitoring Well MW-5

Depth,(Ft.)	Soil	Sample No.	Description
80	GM		SILTY GRAVEL WITH SAND Brown, humid, slightly silty small gravel with sand.
		5-14	
85			
		5-15	
90 90		542.6	
	GM - GW	5-16	WELL GRADED GRAVEL WITH SILT AND SAND Brown, humid, silty gravel with sand.
95		5-17	
			Brown, humid, silty to sandy gravel.
100			
105 105		527.6	
	SM	5-18	SILTY SAND WITH GRAVEL Brown, humid, silty sand with gravel.
106.5		526.1	
	GM - GW		WELL GRADED GRAVEL WITH SILT AND SAND Brown, humid, silty gravel with sand. Gravels to 3" - most 3/4 to 1-1/2".
110			
		5-19	
115			117' - large cobbles.
120			

TOPOCK COMPRESSOR STATION
NEW SURFACE IMPOUNDMENTS

MW-5

Soil Boring Log - Monitoring Well MW-5

Depth,(Ft.)	Soil	Sample No.	Description
120	GM - GW	5-20	WELL GRADED GRAVEL WITH SILT AND SAND
125			
129		503.6	
130	SM	5-21	SILTY SAND WITH GRAVEL Brown, humid, medium coarse slightly silty sand with gravel.
133.5		499.1	
135	GM - GW	5-22	WELL GRADED GRAVEL WITH SILT AND SAND Brown, humid, slightly silty gravel with sand.
140		5-23	
145			
145.5		487.1	
	SM	5-24	SILTY SAND WITH GRAVEL Gray-brown, humid, medium coarse sand with gravel.
150			
155		5-25	Tan, humid, silty sand with sparse gravel. Firm.
160			

TOPOCK COMPRESSOR STATION

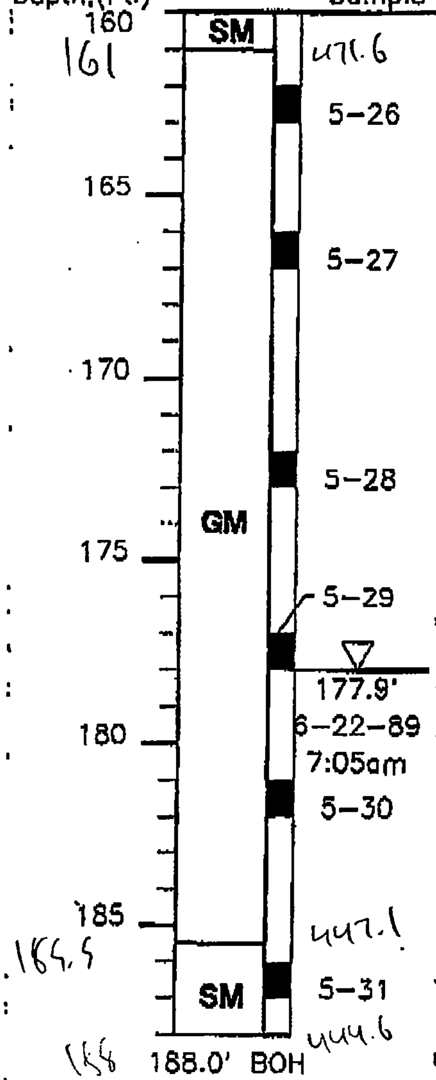
NEW SURFACE IMPOUNDMENTS

MW-5

Soil Boring Log – Monitoring Well MW-5

Sheet 5 of 5

Depth (Ft.) Sample No. Description



5-26 SILTY GRAVEL WITH SAND
Gray–tan, slightly moist sitly gravel with sand. Gravels coated with silt.

5-27 Sandy gravel coated with reddish–brown silt. Somewhat moist. Firm.

5-28 Gray–brown, slightly moist fairly silty gravel with sand. Firm. Gravel silt–coated.

5-29 Gray–brown, moist, silty gravel with sand.

5-30 Gray–brown, moist, silty gravel with sand. Firm.

5-31 SILTY SAND WITH GRAVEL
Gray–brown to brown, moist, slightly silty coarse sand with gravel.

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-6

Soil Boring Log - Monitoring Well MW-6

El.=640.1'
460,614.7N, 3,050,269.5E
6-27-89

Depth,(Ft.)		Sample No.	Description
0	GM	6-1	SILTY GRAVEL WITH SAND Gray-tan, silty gravel with sand. Fill, medium dense, dry.
4.5 5	SP	635.6 6-2	POORLY GRADED SAND WITH GRAVEL. Tan, dry, slightly silty, poorly graded fine sand with gravel. Loose, young alluvial fan deposit.
6 10	GM	6-3 634.1	SILTY GRAVEL WITH SAND Gray, dry silty gravel. Older alluvial fan material. Gravels subangular diorite and metadiorite rock types. Firm, to 4" some larger.
14 15 20 25	GW - GM	6-4 626.1 6-5 6-6 6-7	WELL GRADED GRAVEL WITH SILT AND SAND Gray-brown, humid, less silty gravel with sand.
26 30 35 40	GM	614.1 6-8 6-9 6-10	SILTY GRAVEL WITH SAND Gray-tan, humid, silty gravel with sand. Gravels to 4" Slight silt coating on gravels.

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-6

Soil Boring Log - Monitoring Well MW-6

Sheet 2 of 5

Depth,(Ft.)	Unit	Sample No.	Description
40	GM		SILTY GRAVEL WITH SAND
		6-11	
45 45		595.1	
	GW - GM	6-12	WELL GRADED GRAVEL WITH SILT AND SAND Gray-brown, humid, silty gravel with appreciable sand. Dense.
50			
55		6-13	Gray-brown, humid, silty gravel with appreciable sand. Gravel silt-coated. Dense.
60			
65		6-14	
70		6-15	
73.5		566.6	
75	GM	6-16	SILTY GRAVEL WITH SAND Grayish-brown to brown, humid, silty gravel with sand. Gravel silt coated. Dense.
79.5		560.6	
80			

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-6

Soil Boring Log - Monitoring Well MW-6

Depth,(Ft.)		Sample No.	Description
80	GW-GM	6-17	WELL GRADED GRAVEL WITH SILT AND SAND Gray-brown, humid, fairly silty, well-graded gravel with sand
84 / 85		556.1	
	GM	6-18	SILTY GRAVEL WITH SAND Brown to gray-brown, humid, moderately silty gravel with sand. Dense.
90 / 91		549.1	
95		6-19	WELL GRADED GRAVEL WITH SILT AND SAND Gray-brown, humid (increasing moisture), slightly silty gravel with sand. Moderately dense.
100		6-20	
105	GW-GM	6-21	Tan-brown, humid, fairly silty, well-graded gravel with sand.
		6-22	
110			
		6-23	
115			Gray-brown, humid, slightly silty, well-graded gravel with sand.
		6-24	
120			

TOPOCK COMPRESSOR STATION

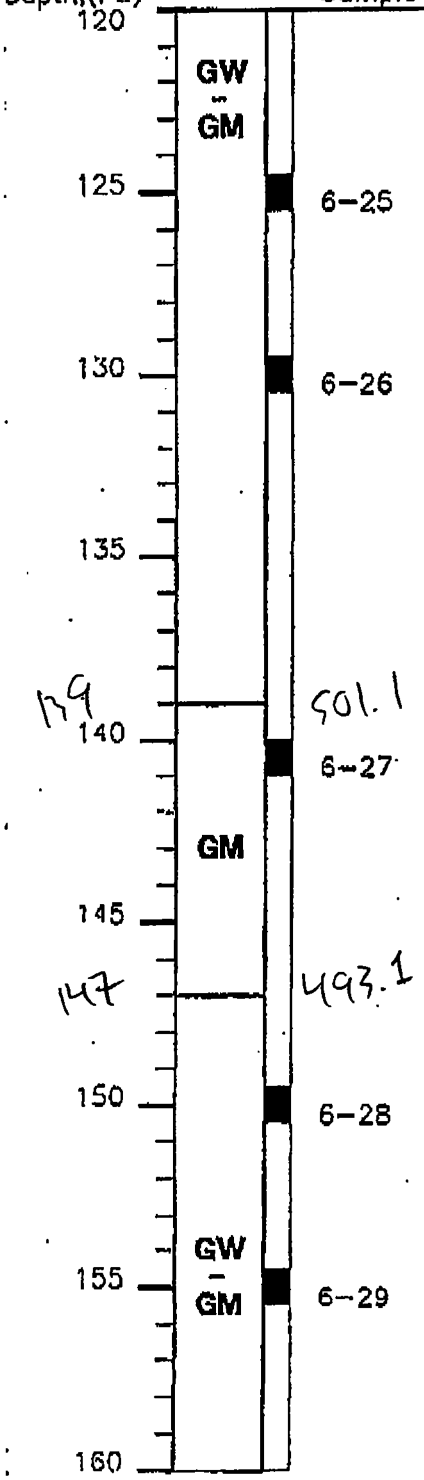
NEW SURFACE IMPOUNDMENTS

MW-6

Soil Boring Log - Monitoring Well MW-6

Sheet 4 of 5

Depth,(Ft.) Sample No. Description



WELL GRADED GRAVEL WITH SILT AND SAND

Gray-brown, humid; slightly silty, well-graded gravel with sand. Dense. Gravels coated with silt.

SILTY GRAVEL WITH SAND

Gray-brown, humid, silty gravel with sand.

WELL GRADED GRAVEL WITH SILT AND SAND

Gray-brown, humid, slightly silty, well-graded gravel with appreciable sand.

Slight suggestion of increasing moisture content.

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-6

Soil Boring Log - Monitoring Well MW-6

Depth,(Ft.)	Soil	Sample No.	Description
160 – 174.5	GW - GM	6-30 6-31 6-32 6-33	WELL GRADED GRAVEL WITH SILT AND SAND Gray-brown, humid, slightly silty, well graded gravel with sand and abundant cobbles. 172.0' - 174.5' cobbly zone.
174.5 – 184	GM	465.6 6-34 456.1	SILTY GRAVEL WITH SAND Tan-brown, slightly damp silty to sandy gravel. Dense. 179.5' -180.5' cobbly zone. 181.5' - 184' cobbly zone.
184 – 185	SM	6-35 455.1	SILTY SAND WITH GRAVEL Brown, moist silty gravel with appreciable sand.
185 – 192	GM	185.7 6-28-89 7:00am	SILTY GRAVEL WITH SAND Very rocky 189.5' - 191.0'. Large cobble 191.0' - 192.2'.
192 – 194	GC	448.1 6-36 446.1	CLAYEY GRAVEL WITH SAND Brown, wet, fairly silty, clayey gravel.

194.0' BOH

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-7

Soil Boring Log - Monitoring Well MW-7

El.=628.1'
460,957.2N, 3,050,421.6E

Depth,(Ft.) 6-25-89 Sample No. Description

0 — GW-GM

7-1 625.1
3 — 7-2 — **WELL GRADED GRAVEL WITH SILT AND SAND**
Gray-brown, humid, silty, sandy gravel. Gravel to subangular 3". Young alluvial fan deposit.

SP
4.5 — 5 — 623.6 — **POORLY GRADED SAND WITH SILT.**
Brown, dry, medium coarse, slightly silty sand with small subangular gravel.

GM
6.5 — 621.6 7-3 — **SILTY GRAVEL WITH SAND**
Brown, humid, moderately silty gravel with sand. Gravels subangular to 2".

SP
9 — 619.1 7-4 — **POORLY GRADED SAND WITH SILT.**
Tan, dry, medium coarse sand with gravel to 1". Loose.

10

15

7-5

20

GM — **SILTY GRAVEL WITH SAND**
Gray-brown, silty gravel. Medium dense older alluvial fan deposit. Gravels silt coated. Gravels to 2-4" size.

25 — 7-6

30

7-7

35

591.1
37 — 7-8

GW-GM — **WELL GRADED GRAVEL WITH SILT AND SAND**
Gray-brown, humid, sandy silt with gravel. Gravels to 2-3".

40

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-7

Soil Boring Log - Monitoring Well MW-7

Sheet 2 of 5

Depth,(Ft.)		Sample No.	Description
40	GW-GM	7-9	WELL GRADED GRAVEL WITH SILT AND SAND
45			
46	GM	582.1 7-10	SILTY GRAVEL WITH SAND Grayish-brown, humid, silty gravel. Moderately dense.
49 50	GW-GM	579.1	WELL GRADED GRAVEL WITH SILT AND SAND Grayish-brown, humid, sandy gravel with silt. Moderately loose.
54.5 55	GM	573.6 7-11 7-12	SILTY GRAVEL WITH SAND Brown, humid to moist, silty gravel with sand, moderately firm.
60 60 65 70 75 80	GW-GM	568.1 7-13 7-14 7-15 7-16	WELL GRADED GRAVEL WITH SILT AND SAND Grayish-brown to brown, humid, sandy gravel with silt, moderately loose.

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-7

Soil Boring Log - Monitoring Well MW-7

Sheet 3 of 5

Depth,(Ft.)	USCS	Sample No.	Description
80	GW - GM		WELL GRADED GRAVEL WITH SILT AND SAND
84		S44.1 7-17	
85	GM		SILTY GRAVEL WITH SAND Grayish-brown, humid, silty gravel with sand. More gravelly and firmer.
		7-18	
			89.5' large boulder.
90			Gray-brown, humid, silty gravel with sand. Medium dense. Gravels silt coated.
		7-19	
95			96.0-96.2; 96.4-96.7' rocky zone.
100			
		7-20	
104		S24.1	
105	GW	7-21	WELL GRADED GRAVEL WITH SAND Grayish-brown, humid gravel with coarse sand and some silt.
110			
		7-22	
115 (115)		7-23	
	GM	S13.1	SILTY GRAVEL WITH SAND Gray-brown to gray, humid, silty gravel with sand.
120			

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-7

Soil Boring Log - Monitoring Well MW-7

Depth,(Ft.)		Sample No.	Description
120			
		7-24	SILTY GRAVEL WITH SAND Gray-brown to gray, humid, silty gravel with sand.
125			123.5 - 124.3' large cobbles
130		7-25	
			131.0 - 131.6' cobble
	GM		Grayish-brown to brown, humid, sandy gravel with silt.
135			
		7-26	
140			139.5 - 139.9' cobble.
		7-27	Brown, damp, humid, sandy silty gravel.
145			
148		480.1	
150		7-28	WELL GRADED GRAVEL WITH SILT AND SAND Gray-brown, humid, slightly silty sandy gravel.
	GW-GM		
155 / 155		473.1	
		7-29	SILTY GRAVEL WITH SAND Gray-brown, humid silty gravel with sand.
	GM		
160			

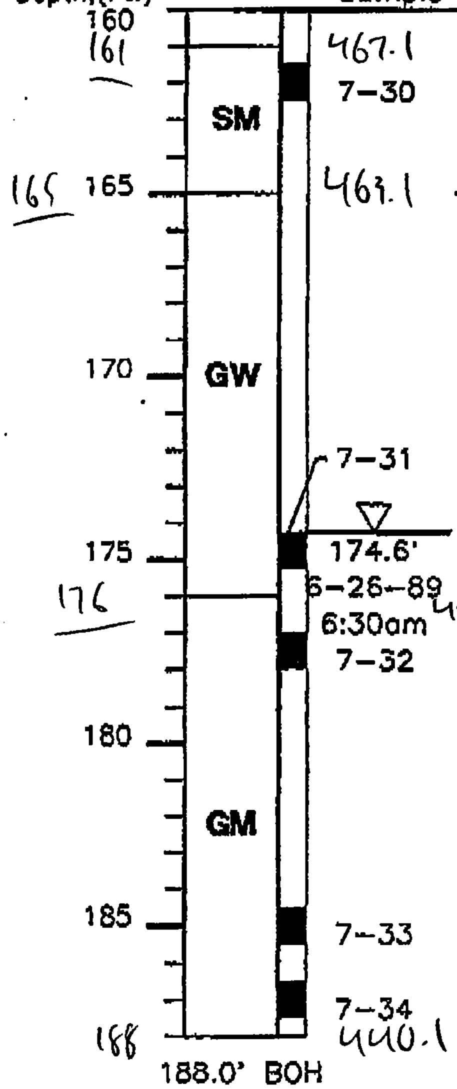
TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-7

Soil Boring Log - Monitoring Well MW-7

Depth,(Ft.) Sample No. Description



SILTY SAND WITH GRAVEL

Tan, humid silty sand with gravel..

WELL GRADED GRAVEL WITH SAND

165.5-169.0' Large cobbles.
Chips of fine grained boulder; fresh diorite.

Chips at 167.8 are gneissic as well. (Two boulders?)

Moist silty gravel and cobbles.

Brown moist, silty gravel with sand.

SILTY GRAVEL WITH SAND

Nested large cobbles

Brown, moist, silty gravel with sand. Very firm.

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-8

Soil Boring Log - Monitoring Well MW-8

El.=624.7'
460,892.0N, 3,050,744.3E

Depth,(Ft.)	6-23-89	Sample No.	Description
0–6	SP	8-1	POORLY GRADED SNAD WITH GRAVEL Light brown, dry, medium sand with gravel to 1". Loose. Young alluvial fan deposit.
6		618.7	
6–9	SM	8-2	SILTY SAND WITH GRAVEL Gray-brown, dry silty sand with gravel to 3".
9		615.7	
9–15.5	GM	8-3	SILTY GRAVEL WITH SAND Gray-brown, dry, silty gravel with sand. Subangular to angular gravels to 3". Metamorphic gneiss and metadiorite. Older alluvial fan material.
15.5		609.2	
15.5–20.5	SM	8-4	SILTY SAND WITH GRAVEL Gray-brown, dry to humid, very gravelly, medium coarse silty sand.
20.5		604.2	
20.5–26	GM	8-5	SILTY GRAVEL WITH SAND Large cobble - metadiorite at 21.3 - 21.5' Gray-brown, dry to humid, fairly silty sandy gravel.
26		598.7	
26–27.5	SW-SM		WELL GRADED SAND WITH SILT AND GRAVEL Gray-tan, humid to dry, gravelly slightly silty medium coarse sand.
27.5		597.2	
27.5–35.5	GM	8-6	SILTY GRAVEL WITH SAND Gray-brown, humid, slightly silty sandy gravel. Gravels to 3-4" maximum.
35.5		589.7	
35.5–40	SW-SM	8-7	WELL GRADED SAND WITH SILT AND GRAVEL Gray-brown, dry, slightly silty gravelly sand.

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-8

Soil Boring Log - Monitoring Well MW-8

Sheet 2 of 5

Depth,(Ft.)		Sample No.	Description
40 41	GM	583.7 8-8	SILTY GRAVEL WITH SAND Gray-brown, humid, silty, sandy gravel.
45 45	GW - GM	579.7 8-9	WELL GRADED GRAVEL WITH SILT AND SAND Brown, humid, slightly silty, quite sandy gravel.
50 50.5	GM	574.2 8-10	SILTY GRAVEL WITH SAND Brown, humid, silty gravel.
54.5 55	SM	570.2 8-11	SILTY SAND WITH GRAVEL Gray-brown, humid, fairly gravelly silty sand.
57.5 60 65	GM	567.2 8-12	SILTY GRAVEL WITH SAND Gray-brown, humid, sandy slightly silty gravel. Gravel to 3"
66	SM	558.7 8-13	SILTY SAND WITH GRAVEL Light brown, humid, slightly silty medium sand with sparse gravel.
70 70.5	GW	8-14	WELL GRADED GRAVEL WITH SAND Gray-brown, humid, slightly silty gravel. Gravel silt-coated.
75 76	SM	8-15	SILTY SAND WITH GRAVEL Brown to gray-brown, humid, silty sand with gravel.
80			

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-8

Soil Boring Log - Monitoring Well MW-8

Depth (Ft.)	Soil	Sample No.	Description
80–88.5	SM	8–16	SILTY SAND WITH GRAVEL Gray–brown, humid, silty sand with gravel. Gravel silt–coated.
88.5–92	GW - GM	8–17	WELL GRADED GRAVEL WITH SILT AND SAND Gray–brown, humid, slightly silty sandy gravel. Gravels silt–coated.
92–94.5	SM	8–18	SILTY SAND WITH GRAVEL Gray–brown, humid, slightly silty coarse sand with gravel.
94.5–105.5	GM	8–19	SILTY GRAVEL WITH SAND Gray–brown, humid, silty gravel. Firm.
105.5–109	SM	8–20	SILTY SAND WITH GRAVEL Gray–brown, humid, medium coarse silty sand with gravel.
109–120	GW - GM	8–21 8–22	WELL GRADED GRAVEL WITH SILT AND SAND Gray–brown, humid, quite sandy silty gravel.

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-8

Soil Boring Log - Monitoring Well MW-8

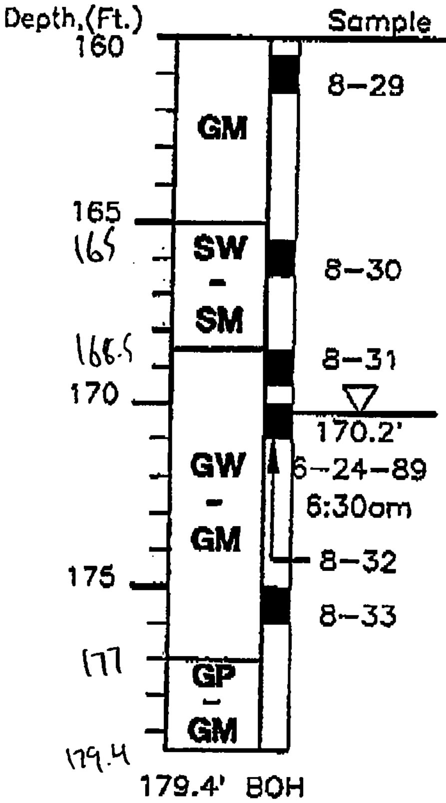
Depth, (Ft.)	USCS	Sample No.	Description
120			
122 – 127 (125)	SM	8-23	SILTY SAND WITH GRAVEL Brown, humid, medium coarse silty sand with gravel.
127 – 135 (130)	GM	8-24	SILTY GRAVEL WITH SAND Brown to gray-brown, humid, silty gravel. Firm.
135 – 139	GW - GM		WELL GRADED GRAVEL WITH SILT AND SAND Gray, humid, very slightly silty, sandy gravel. Firm.
139 – 143 (140)	SW - SM	8-25	WELL GRADED SAND WITH SILT AND GRAVEL. Gray-brown, humid, slightly silty sand with gravel.
143 – 155.5 (145, 150, 155)	GW - GM	8-26 8-27	WELL GRADED GRAVEL WITH SILT AND SAND Tan to gray, humid, slightly silty sandy gravel.
155.5 – 159.5	SM	8-28	SILTY SAND WITH GRAVEL Brown, humid, silty sand with gravel.
160			

TOPOCK COMPRESSOR STATION

NEW SURFACE IMPOUNDMENTS

MW-8

Soil Boring Log - Monitoring Well MW-8



Description

SILTY GRAVEL WITH SAND
Brown, slightly moist to humid silty gravel with sand.

Slightly increasing moisture.

WELL GRADED SAND WITH SILT AND GRAVEL.
Brown, moist to slightly moist, gravelly silty sand.

WELL GRADED GRAVEL WITH SILT AND SAND
Brown, moist, silty gravel. Firm.

171.5–177' large cobbles/boulders.

POORLY GRADED GRAVEL WITH SILT
Brown, moist silty gravel.

LOG OF WELL MW-14

ALISTO PROJECT NO: 10-320-06	DATE DRILLED: 07/14-15/97
CLIENT: Pacific Gas and Electric Co.	
LOCATION: Topock Compressor Station	
DRILLING METHOD: Resonant Sonic, Continuous Coring	
DRILLING COMPANY: Boart Longyear	CASING ELEVATION: 570.54
LOGGED BY: Ted Moise/Ken Simas	APPROVED BY: Dan Salaices

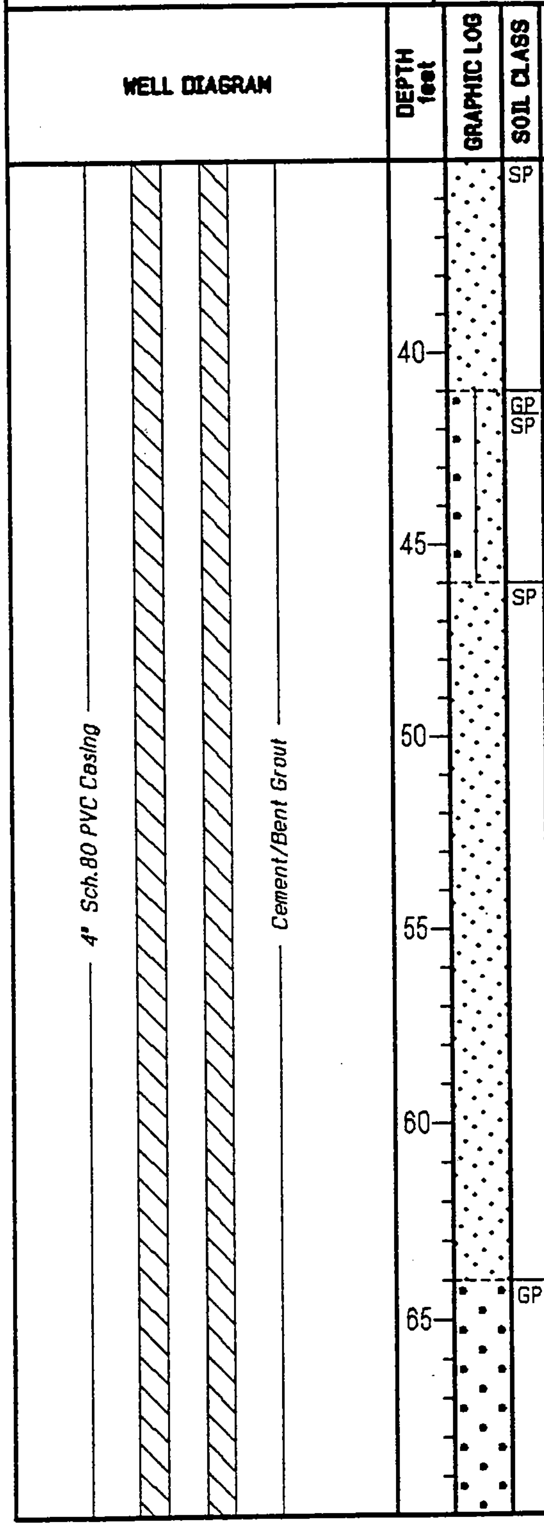
SEE SITE PLAN

WELL DIAGRAM: 4" Sch.80 PVC Casing; Cement/Bent Grout

DEPTH feet	SOIL CLASS	GEOLOGIC DESCRIPTION
0	GP	sandy GRAVEL: grayish orange pink; 70% gravel, 4-75 mm, rounded to subangular; 30% sand, fine to coarse grained; dry.
	SP	gravelly SAND: pale yellowish brown; 80% sand, fine to coarse grained; 20% gravel, 4-50 mm, subangular; dry.
5		
		At 8 feet, 80% sand, fine to coarse grained; 40% gravel, 4-70 mm, subangular.
10		
15	GP	sandy GRAVEL: pale yellowish brown; 80% gravel, 4-35 mm; subangular; 40% sand, fine to coarse grained, dry.
	SP	gravelly SAND: pale yellowish brown; 80% sand, fine to coarse grained; 10% gravel, 4-20 mm, subangular, dry.
20		At 20 feet, 55% sand, fine to coarse grained; 45% gravel, 4-50 mm.
		At 22 feet, color change to light gray; 80% sand, fine to coarse grained; 40% gravel, 4-50 mm, angular to subrounded.
25		At 25 feet, color change to light olive gray; 40% gravel, 4-25 mm, subangular.
30		At 30 feet, color change to pale yellowish brown; 75% sand, fine to coarse grained; 25% gravel, 4-80 mm, subangular; dry.

LOG OF WELL MW-14

SEE SITE PLAN	ALISTO PROJECT NO: *10-320-06* DATE DRILLED: *07/14-15/97*
	CLIENT: *Pacific Gas and Electric Co.*
	LOCATION: *Topock Compressor Station*
	DRILLING METHOD: *Resonant Sonic, Continuous Coring*
	DRILLING COMPANY: *Boart Longyear* CASING ELEVATION: *570.54*
	LOGGED BY: *Ted Moise/Ken Simas* APPROVED BY: *Dan Salaices*



SOIL CLASS	GEOLOGIC DESCRIPTION
SP	At 36 feet, gravel, 4-40 mm, subangular. At 38 feet, color change to light olive gray; 60% sand, fine to coarse grained; 40% gravel, 4-75 mm, subrounded to subangular; dry.
GP SP	sandy GRAVEL/gravelly SAND: Pale yellowish brown; 50% sand, fine to coarse grained; 50% gravel, 4-75 mm, subangular to subrounded; dry.
SP	gravelly SAND: Pale yellowish brown; 70% sand, fine to coarse grained; 30% gravel, 4-75 mm, subangular. At 50 feet, 60% sand, fine to coarse grained; 40% gravel, 4-65 mm, subrounded to subangular; dry. At 54 feet; color change to light gray, 55% sand, fine to coarse grained; 40% gravel, 4-35 mm, subangular to subrounded; 5% fines; dry. At 57 feet, 65% sand, fine to coarse grained; 30% gravel, subangular to subrounded, 4-75 mm; 5% fines.
GP	sandy GRAVEL: light gray; 60% gravel, subangular to subrounded, 4-75 mm; 40% sand, fine to coarse grained.

ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL MW-14

SEE SITE PLAN

ALISTO PROJECT NO: 10-320-08 DATE DRILLED: 07/14-15/97

CLIENT: Pacific Gas and Electric Co.

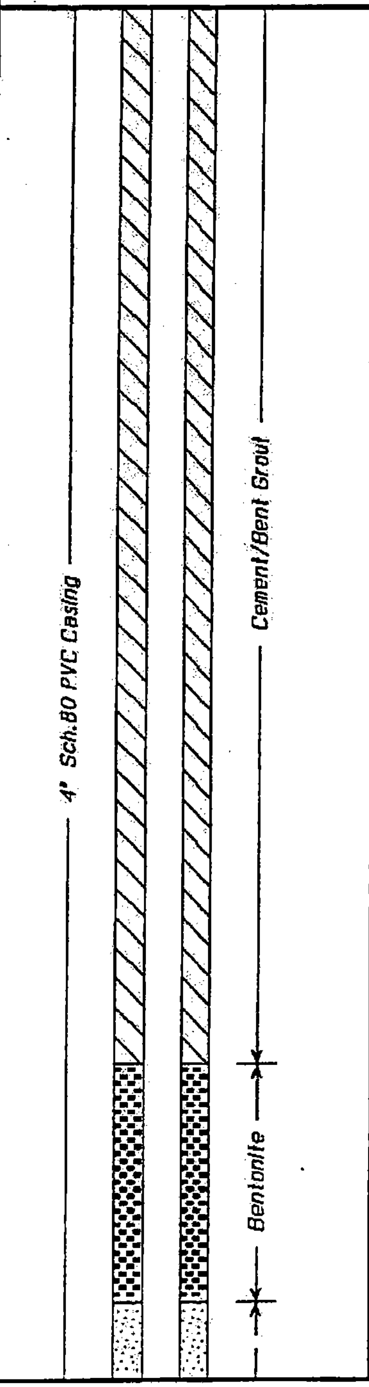
LOCATION: Topock Compressor Station

DRILLING METHOD: Resonant Sonic, Continuous Coring

DRILLING COMPANY: Boart Longyear CASING ELEVATION: 570.54

LOGGED BY: Ted Moise/Ken Simas APPROVED BY: Dan Salaices

WELL DIAGRAM



DEPTH feet	SOIL CLASS	GEOLOGIC DESCRIPTION
	GP	Same
75	SP	gravelly SAND: pale yellowish brown; 80% sand, fine to coarse grained; 40% gravel, 4-50 mm, subangular.
80	GP/SP	sandy GRAVEL/gravelly SAND: light olive brown; 50% sand, fine to coarse grained; 50% gravel, 4-50 mm, subangular. At 79.5 feet, 1.5 foot long boulder core, 8-inches wide. Rock flour is light gray.
85, 90	SP	gravelly SAND: light olive gray; 80% sand, fine to coarse grained; 40% gravel, 4-50 mm, subangular.
95	GP/SP	sandy GRAVEL/gravelly SAND: light olive gray, 50% sand, fine to coarse grained; 50% gravel, 4-50 mm, subangular.
100	SP	gravelly SAND: light gray; 80% sand, fine to coarse grained; 20% gravel, 4-50 mm, subangular.
	GP	sandy GRAVEL: light gray; 75% gravel, 4-50 mm, subangular to subrounded; 25% sand, fine to coarse grained, dry.
	GP/SP	

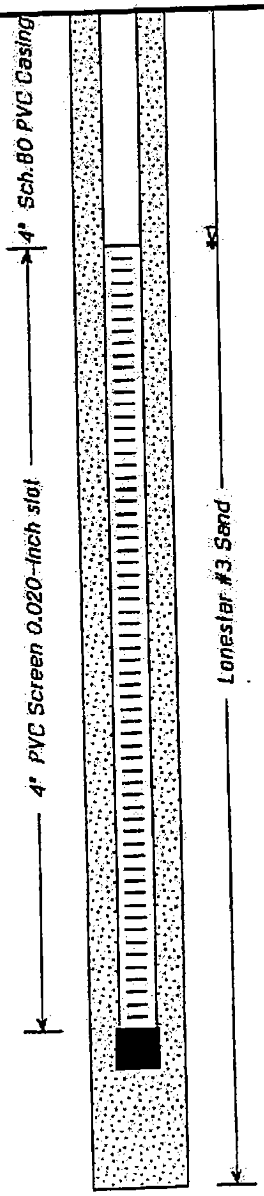
ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL MW-14

ALISTO PROJECT NO: 10-320-06	DATE DRILLED: 07/14-15/97
CLIENT: Pacific Gas and Electric Co.	
LOCATION: Topock Compressor Station	
DRILLING METHOD: Resonant Sonic, Continuous Coring	
DRILLING COMPANY: Boart Longyear	CASING ELEVATION: 570.54
LOGGED BY: Ted Moise/Ken Simas	APPROVED BY: Dan Salaices

SEE SITE PLAN

WELL DIAGRAM



DEPTH feet	SOIL CLASS	GEOLOGIC DESCRIPTION
	GP SP	sandy GRAVEL/gravelly SAND: moderate brown; 50% gravel, 4-75 mm, subrounded to subangular; 50% sand, fine to coarse grained; damp.
	SP	gravelly SAND: light olive brown; 60% sand, fine to coarse grained; 40% gravel, subangular, 4-40 mm; moist to wet.
110	GP	sandy GRAVEL: light olive gray; 60% gravel, subangular to subrounded, 4-75 mm; 40% sand, fine to coarse grained; wet at 111 feet. At 116 feet, color change to light brown; gravel 4-75 mm. At 117.5 feet, 140 mm cobble, light gray rock flour.
115		
120	SP	gravelly SAND: pale yellowish brown; 65% sand, fine to coarse grained, 30% gravel, subangular, 4-75 mm; 5% fines; wet.
125	GP GM	sandy silty GRAVEL: pale yellowish brown; 55% gravel, subangular, 4-50 mm, occasional cobble to 80 mm; 35% sand, fine to coarse grained; 10% fines; wet.
	SP	gravelly SAND: pale yellowish brown; 60% sand, fine to coarse grained; 35% gravel, subangular, 4-20 mm; 5% fines; wet.
130	SM	gravelly silty SAND: pale yellowish brown; 60% sand, fine to coarse grained; 20% gravel, subangular, 4-30 mm; 20% fines; wet.
135	SP	gravelly SAND: light olive gray; 65% sand, fine to coarse grained; 30% gravel, subangular, 4-25 mm; 5% fines; wet.

Total depth of the boring is 135 feet.

ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL MW-15

SEE SITE PLAN

ALISTO PROJECT NO: 10-320-06 DATE DRILLED: 07/10-13/97

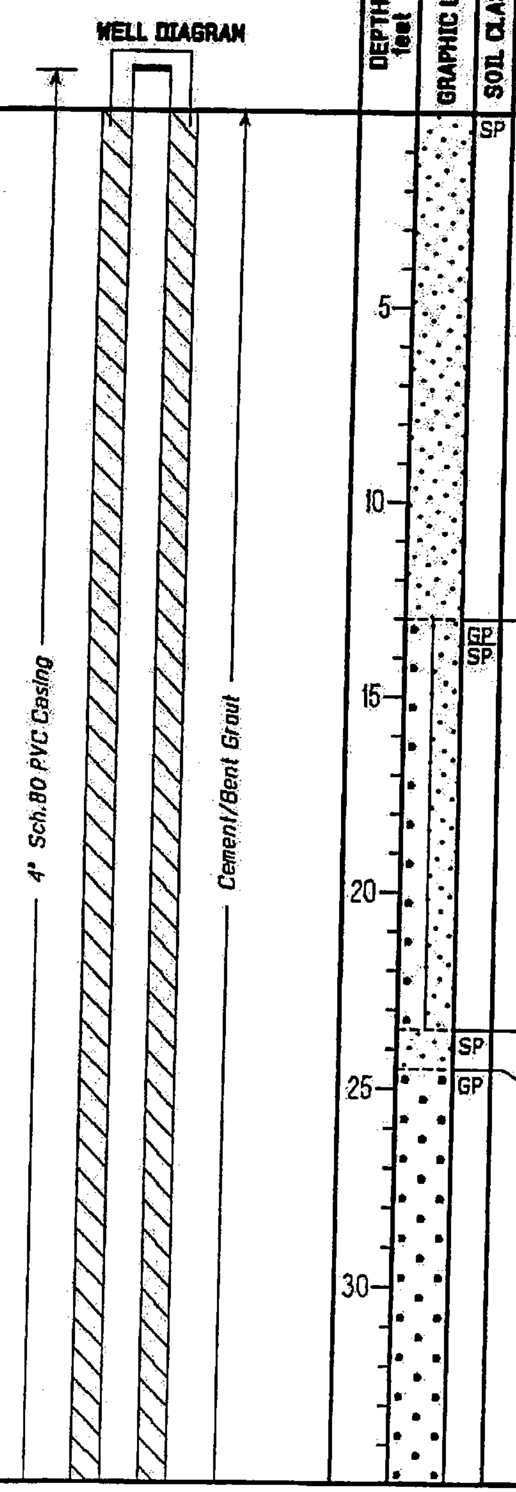
CLIENT: Pacific Gas and Electric Co.

LOCATION: Topock Compressor Station

DRILLING METHOD: Resonant Sonic, Continuous Coring

DRILLING COMPANY: Boart Longyear CASING ELEVATION: 64109

LOGGED BY: Ted Moise/Ken Simas APPROVED BY: Dan Salaices



GEOLOGIC DESCRIPTION

SP — gravelly SAND: pinkish gray; 80% sand, fine grained; 20% gravel, 4-75 mm, subangular; dry.

GP/SP — sandy GRAVEL/gravelly SAND: pale yellowish brown; 50% gravel, 4-70 mm, subangular; 50% sand, fine to coarse grained; dry.

SP — gravelly SAND: pale yellowish brown; 60% sand, fine to medium grained; 40% gravel, 4-30 mm, subangular; dry.

GP — sandy GRAVEL: pale yellowish brown; 60% gravel, 4-80 mm, subangular; 40% sand, fine to medium grained; dry.

At 27.5 feet, sandy GRAVEL: pale yellowish brown; 70% gravel, 4-80 mm, subangular; 30% sand, fine to medium grained; dry.

at 34.5 feet, subrounded gravel.

ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL MW-15

ALISTO PROJECT NO: 10-320-06 DATE DRILLED: 07/10-13/97

CLIENT: Pacific Gas and Electric Co.

LOCATION: Topock Compressor Station

DRILLING METHOD: Resonant Sonic, Continuous Coring

DRILLING COMPANY: Boart Longyear CASING ELEVATION: 641.09

LOGGED BY: Ted Moise/Ken Simas APPROVED BY: Dan Salaices

SEE SITE PLAN

WELL DIAGRAM	DEPTH feet	SOIL CLASS	GEOLOGIC DESCRIPTION
4" Sch.80 PVC Casing; Cement/Bent Grout		GP	Same
	40	SP	gravelly SAND: pale yellowish brown; 60% sand, very fine to medium grained; 40% gravel, subrounded, 4-35 mm, some fractured conglomerate gravels; dry.
		GP	sandy GRAVEL: pale yellowish brown; 60% gravel, subrounded to subangular, 4-150 mm; 40% sand, very fine to medium grained; dry.
	45	GP SP	sandy GRAVEL/gravelly SAND: pale yellowish brown; 50% gravel, subrounded, 4-70 mm; 50% sand, very fine to medium grained; dry.
	50, 55, 60, 65	SP	gravelly SAND: pale yellowish brown; 70% sand, very fine to medium grained; 30% gravel, subrounded and fractured, 4-75 mm; dry. at 51 feet, 60% sand, very fine to coarse grained; 40% gravel, 4-70 mm, subrounded; dry. at 63 feet, 80% sand, very fine to medium grained; 20% gravel, 4-25 mm, subrounded; dry.
		GP	At 67.5 feet, sandy GRAVEL: pale yellowish brown; 60% gravel, subrounded to angular, some conglomerate gravels, 4-75 mm; 40% sand, very fine to medium grained; dry.
		SP	At 69 feet, gravelly SAND: pale yellowish brown; 70% sand, very fine to medium grained; 30% gravel, subrounded, 4-30 mm; dry.
		GP	

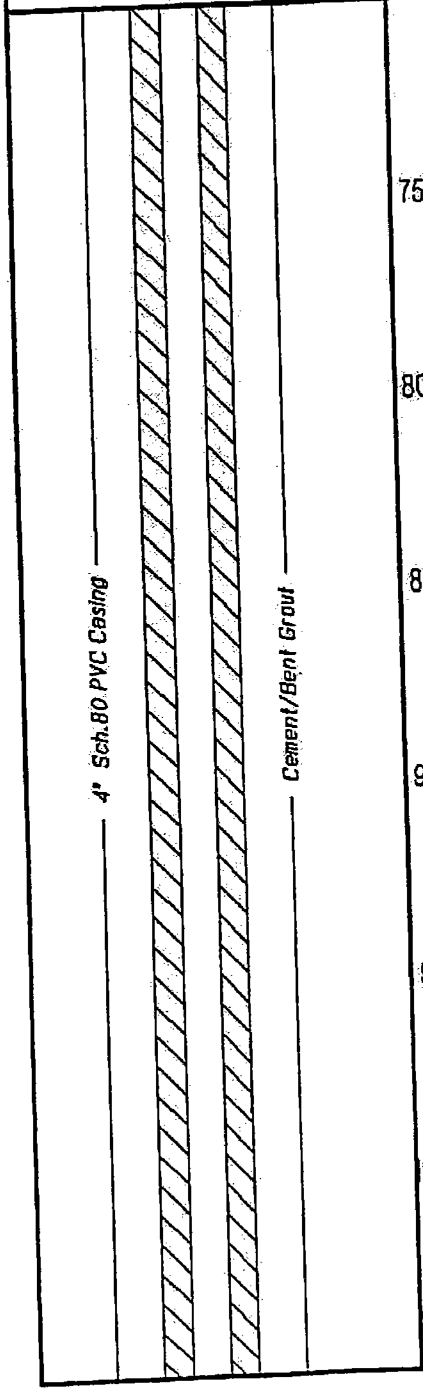
ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL MW-15

SEE SITE PLAN

ALISTO PROJECT NO: 10-320-06 DATE DRILLED: 07/10-13/97
CLIENT: Pacific Gas and Electric Co.
LOCATION: Topock Compressor Station
DRILLING METHOD: Resonant Sonic, Continuous Coring
DRILLING COMPANY: Boart Longyear CASING ELEVATION: 64109
LOGGED BY: Ted Moise/Ken Simas APPROVED BY: Dan Salalces

WELL DIAGRAM



DEPTH feet	SOIL CLASS	GEOLOGIC DESCRIPTION
	GP	sandy GRAVEL: pale yellowish brown; 65% gravel, subrounded and fractured, 4-30 mm; 35% sand, very fine to medium grained; dry.
75	GP SP	sandy GRAVEL/gravelly SAND: pale yellowish brown; 45% gravel, subrounded, 4-40 mm; 5% cobble, subrounded, up to 130 mm; 50% sand, very fine to medium grained; dry.
	SP	gravelly SAND: pale yellowish brown; 60% sand, very fine to medium grained; 40% gravel, subrounded, 4-20 mm; dry.
		COBBLES with sand: 30% sand, very fine to fine grained; 70% cobbles, fractured and subrounded, to 150 mm.
80	SP	gravelly SAND: pale yellowish brown; 60% sand, very fine to medium grained; 40% gravel, 4-40 mm, subrounded and fractured gravel; dry.
		COBBLES with sand: 30% sand, very fine to fine grained; 70% cobbles, fractured and subrounded, to 150 mm.
	SP	gravelly SAND: pale yellowish brown; 60% sand, very fine to medium grained; 40% gravel, 4-40 mm, subrounded and fractured gravel; dry.
85		COBBLES with sand: 30% sand, very fine to fine grained; 70% cobbles, fractured and subrounded, to 150 mm.
	SP	gravelly SAND: pale yellowish brown; 60% sand, very fine to medium grained; 40% gravel, 4-40 mm, subrounded; dry.
		COBBLES with sand: 30% sand, very fine to fine grained; 70% cobbles, fractured and subrounded, to 150 mm.
90	GP SP	sandy GRAVEL/gravelly SAND: pale yellowish brown; 50% sand, very fine to medium grained; 50% gravel, subrounded, 4-70 mm.
	SP	gravelly SAND: pale yellowish brown; 70% sand, very fine to medium grained; 30% gravel, 4-30 mm, subrounded; dry.
95	GP	sandy GRAVEL: pale yellowish brown; 60% gravel, 4-75 mm, subrounded and fractured gravels; 40% sand, fine to medium grained; dry.
100	SP	gravelly SAND: pale yellowish brown; 65% sand, very fine to medium grained; 35% gravel, 4-30 mm, subrounded; dry. At 101 feet, 60% sand, 40% gravel.

ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL MW-15

SEE SITE PLAN

ALISTO PROJECT NO: 10-320-06 DATE DRILLED: 07/10-13/97

CLIENT: Pacific Gas and Electric Co.

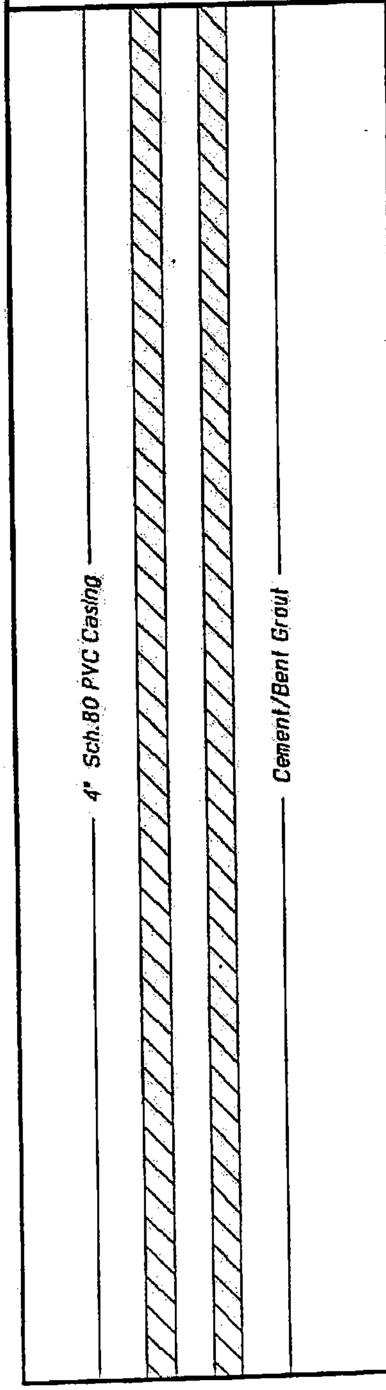
LOCATION: Topock Compressor Station

DRILLING METHOD: Resonant Sonic, Continuous Coring

DRILLING COMPANY: Boart Longyear CASING ELEVATION: 64109

LOGGED BY: Ted Moise/Ken Simas APPROVED BY: Dan Salaices

WELL DIAGRAM

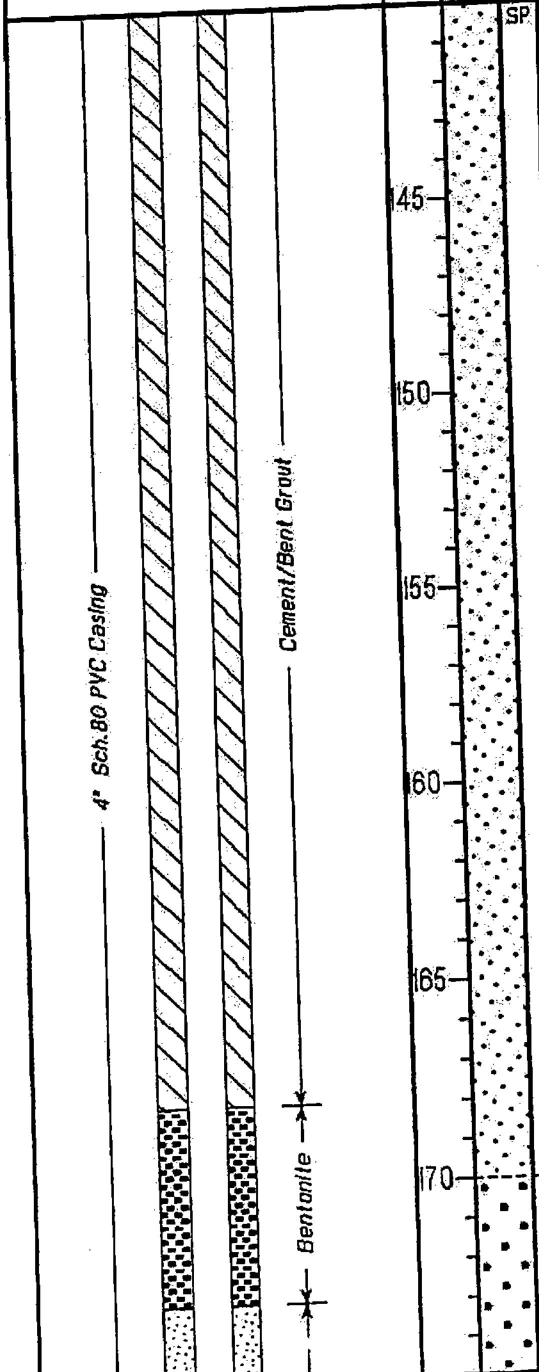


DEPTH feet	SOIL CLASS	GEOLOGIC DESCRIPTION
	SP	Same
	GP	sandy GRAVELS: 60% gravel, 4-75 mm, fractured gravels; 40% sand, very fine to fine sand; dry.
110	SP	gravelly SAND: pale yellowish brown; 80% sand, fine to coarse grained; 20% gravel, 4-40 mm, subrounded; dry.
115		Rock fragments with very fine to fine sand.
	SP	gravelly SAND: pale yellowish brown; 65% sand, fine to coarse grained; 35% gravel, 4-30 mm, subrounded; dry.
120		At 120 feet, 75% sand; 25% gravel, 4-20 mm.
		At 121 and 123.5 feet, 100 mm cobbles.
125		
130	GP	sandy GRAVELS: 60% gravel, 4-70 mm, subrounded and fractured gravel; 40% sand, very fine to medium grained; dry.
	SP	gravelly SAND: pale yellowish brown; 80% sand, very fine to medium grained; 20% gravel, 4-30 mm, subrounded; dry.
		At 133 feet, 65% sand, 35% gravel.
		At 134 feet, 75% sand, 25% gravel.
135		

ALISTO ENGINEERING GROUP WALNUT CREEK, CALIFORNIA	LOG OF WELL MW-15	

SEE SITE PLAN	
	ALISTO PROJECT NO: *10-320-06* DATE DRILLED: *07/10-13/97*
	CLIENT: *Pacific Gas and Electric Co.*
	LOCATION: *Topock Compressor Station*
	DRILLING METHOD: *Resonant Sonic, Continuous Coring*
	DRILLING COMPANY: *Boart Longyear* CASING ELEVATION: *641.09*
	LOGGED BY: *Ted Moise/Ken Simas* APPROVED BY: *Dan Salaices*

WELL DIAGRAM | DEPTH feet | GRAPHIC LOG | SOIL CLASS | GEOLOGIC DESCRIPTION



Depth (feet)	Soil Class	Geologic Description
	SP	
147		At 147 feet, 70% sand, 30% gravel, 4-40 mm.
154		At 154 feet, 80% sand, fine to coarse grained; 40% gravel, 4-80 mm, subangular; dry.
162		At 162 feet, light gray; 70% sand; 30% gravel, 4-75 mm.
170	GP	sandy GRAVEL: light gray; 70% gravel, 4-80 mm; 30% sand, fine to coarse grained.
174.5		At 174.5 feet; 65% gravel; 35% sand.

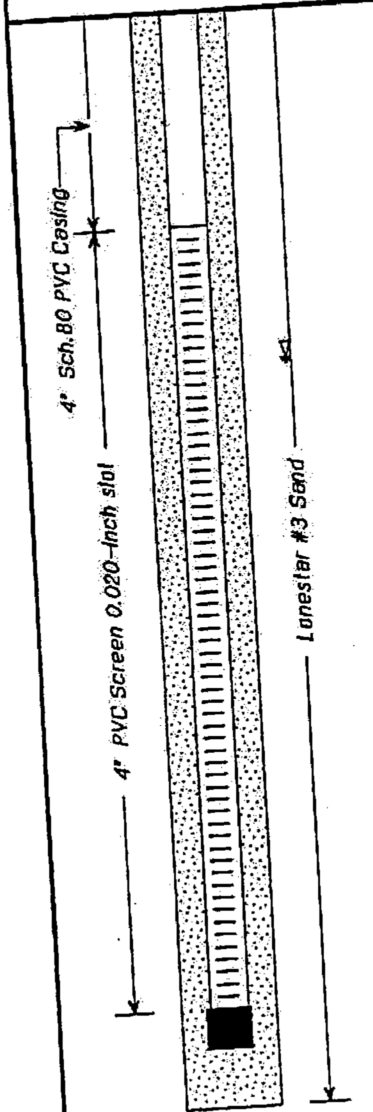
ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL MW-15

ALISTO PROJECT NO: 10-320-06 DATE DRILLED: 07/10-13/97
CLIENT: Pacific Gas and Electric Co.
LOCATION: Topock Compressor Station
DRILLING METHOD: Resonant Sonic, Continuous Coring
DRILLING COMPANY: Boart Longyear CASING ELEVATION: 641.09
LOGGED BY: Ted Moise/Ken Simas APPROVED BY: Dan Salaices

SEE SITE PLAN

WELL DIAGRAM



DEPTH feet	SOIL CLASS	GEOLOGIC DESCRIPTION
	GP	Same
180		At 180 feet, damp to moist.
	SP	gravelly SAND: olive gray; 55% sand, fine to medium grained; 30% gravel, subangular, 4-30 mm; 15% fines; damp to moist.
		At 184 feet, 70% sand, fine to coarse grained; 30% gravel, subangular, 4-25 mm; wet.
185		At 185 feet, 80% sand, fine to medium grained; 30% gravel, subangular, 4-30 mm; 10% fines; wet.
		At 188 feet, 80% sand, fine to coarse grained; 20% gravel, subangular, 4-30 mm; wet.
190	SM	gravelly silty SAND: brownish gray; 80% sand, fine to coarse grained; 25% gravel, subangular, 4-80 mm; 15% fines; wet.
195	SP	gravelly SAND: brownish gray; 75% sand, fine to coarse grained; 25% gravel, subangular, 4-80 mm, wet.
	SM	gravelly silty SAND: brownish gray; 80% sand, fine to coarse grained; 25% gravel, subangular, 4-60 mm; 15% fines; wet.
200		
		Total depth of borehole is 204 feet.
205		

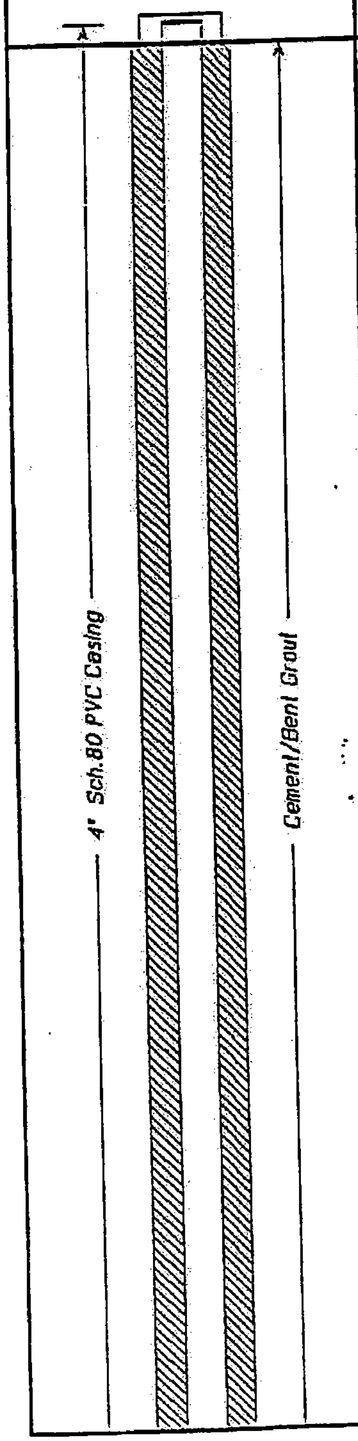
ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL MW-16

ALISTO PROJECT NO: 10-320-08	DATE DRILLED: 04/09-10/98
CLIENT: Pacific Gas and Electric Co.	
LOCATION: Topock Compressor Station	
DRILLING METHOD: Ingersol Rand STRATEX/Air rotary	
DRILLING COMPANY: THF Drilling	CASING ELEVATION:
LOGGED BY: Dan Salaices	APPROVED BY: Dan Salaices

SEE SITE PLAN

WELL DIAGRAM

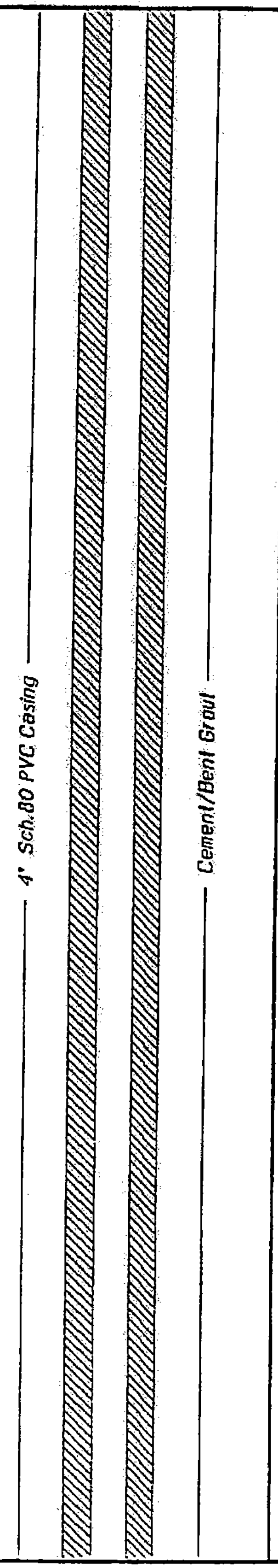


DEPTH feet	SAMPLES	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
0–15			SP	gravelly SAND: light gray; ~80% sand, fine- to coarse-grained; ~40% gravel, subangular, 4-50 mm; dry.
15–70			GP	sandy GRAVEL: light olive-gray to olive-gray; ~80% gravel, subangular to angular (appears to be mechanically fractured); ~20% sand; dry.

Depth scale: 10, 20, 30, 40, 50, 60

LOG OF WELL MW-16

WELL DIAGRAM

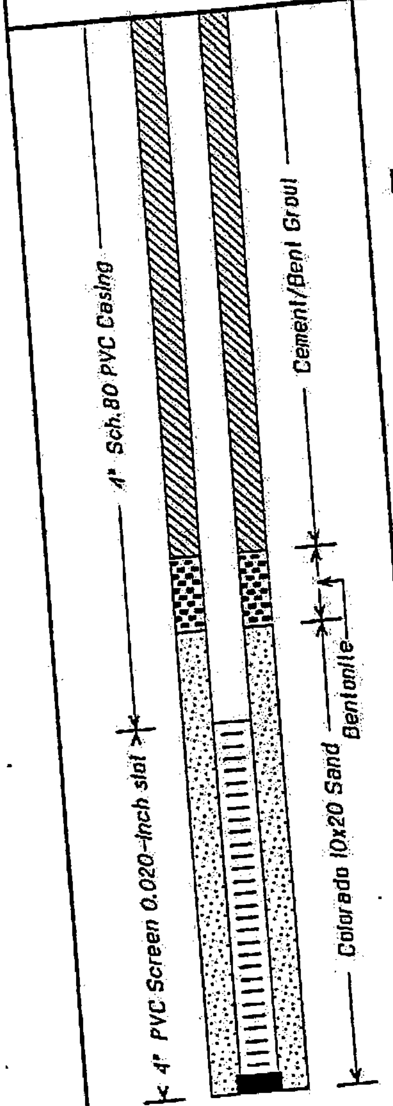


DEPTH feet	SAMPLES	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
80, 90, 100, 110			GP	sandy GRAVEL continued.
120, 130			SP	gravelly SAND: light brownish-gray; ~80-80% sand, very fine- to fine-grained; gravel, light olive-gray, subangular to angular (crushed); dry.
140, 150			GP	sandy GRAVEL: light olive-gray; ~70-80% gravel, subangular to angular (crushed); ~20-30% sand, very fine- to coarse-grained; dry.

LOG OF WELL MW-16

ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

WELL DIAGRAM	DEPTH feet	SAMPLES	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
				GP	sandy GRAVEL continued.
	170				
	180				
	190				
	200				Slight moisture at 200 feet.
				SP	gravelly SAND: olive-gray; ~60-70% sand, fine- to coarse-grained; ~30-40% gravel, subangular, 4-15 mm; wet.
	210				
					Total depth of borehole is 218 feet.
	220				
	230				
	240				



ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL MW-17

ALISTO PROJECT NO: *10-320-08* DATE DRILLED: *05/17-18/95*

CLIENT: *Pacific Gas and Electric Co.*

LOCATION: *Topock Compressor Station*

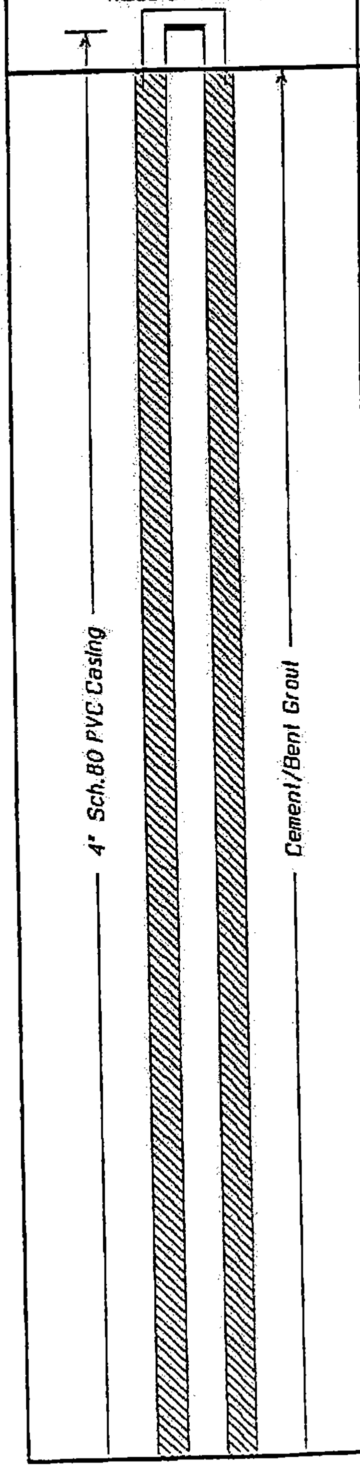
DRILLING METHOD: *Rotosonic*

DRILLING COMPANY: *Boart Longyear* CASING ELEVATION:

LOGGED BY: *Ted Moise* APPROVED BY: *Dan Salaices*

SEE SITE PLAN

WELL DIAGRAM



DEPTH feet	SAMPLES	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
			SP-SM	gravely silty SAND: light brown; ~50% sand, fine- to coarse-grained; ~40% gravel, angular to subrounded, to 20 mm; ~10% fines.
			GP	sandy GRAVEL: light olive-gray; ~55% gravel, angular to subrounded, to 40 mm; ~40% sand, fine- to coarse-grained; ~5% fines.
5			ML	sandy SILT: grayish-orange-pink; ~90% fines; ~10% sand, fine- to coarse-grained; dry.
10			SP	SAND: grayish-orange; fine- to coarse-grained; dry.
15			GP	sandy GRAVEL: grayish-orange-pink to light gray; ~60% gravel, angular to subrounded, to 50 mm; ~40% sand, fine- to coarse-grained; cobble, to 140 mm; dry.
			CL	silty CLAY: light gray.
20				
25				
30				

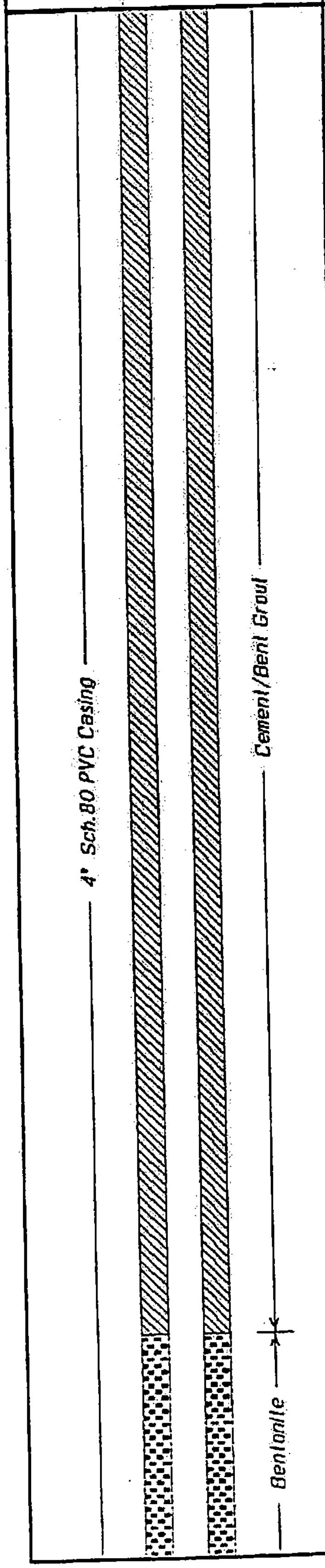
LOG OF WELL MW-17

WELL DIAGRAM: 4" Sch.80 PVC Casing; Cement/Bent Grout

DEPTH feet	SAMPLES	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
			CL	silty CLAY continued.
40				
45				
50				
55			ML	sandy SILT: very pale orange; ~35% sand, fine- to medium-grained; damp.
			GP GM	sandy silty GRAVEL: yellowish-gray; ~50% gravel, angular to subrounded, to 40 mm; ~40% sand, fine- to coarse-grained; 10% fines; dry.
			SP	gravelly SAND: light-gray; ~55% sand, fine- to coarse-grained; ~45% gravel, subangular to rounded, to 50 mm.
60				At 61 feet, Cobble, to 100 mm.
				Color change to pale yellowish-brown at 64 feet.
65			GP	sandy GRAVEL: light gray; ~50 gravel, subangular to subrounded, to 80 mm; ~45% sand, fine- to coarse-grained; ~5% fines.
70				
75				

ALISTO ENGINEERING G[illegible]
WALNUT CREEK, CALIFORNIA

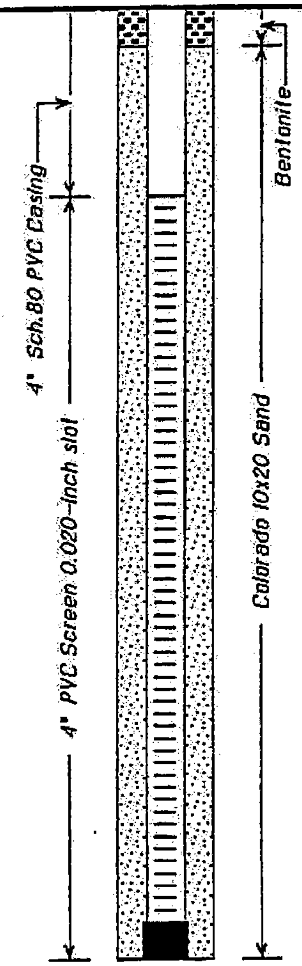
LOG OF WELL MW-17



DEPTH feet	SAMPLES	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
			GP	sandy GRAVEL: light gray; ~65 gravel, subangular to subrounded, to 70 mm; ~30% sand, fine- to coarse-grained; ~5% fines.
85				
			SP/SM	gravelly silty SAND: light gray to pale yellowish-brown; ~55% sand, fine- to coarse-grained; ~35% gravel, subangular to subrounded, to 80 mm; ~10% fines.
90				
95				
100				
			SP	gravelly SAND: light gray to pale yellowish-brown; ~65% sand, fine- to coarse-grained, ~30% gravel, subangular to subrounded, to 50 mm; ~5% fines.
105				gravelly SAND: light gray to pale yellowish-brown; ~55% sand, fine- to coarse-grained, ~40% gravel, subangular to subrounded, to 80 mm; ~5% fines.
110				
			GP	sandy GRAVEL: light gray to pale yellowish-brown; ~50% gravel, subangular to subrounded, to 80 mm; ~45% sand, fine- to coarse-grained; ~5% fines.
115				
120				
			GP/GM	

LOG OF WELL MW-17

WELL DIAGRAM



DEPTH feet	SAMPLES	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
			GP GM	sandy silty GRAVEL: light gray to light brownish-gray; ~55% gravel, subangular to subrounded, to 70 mm; ~35% sand, fine- to coarse-grained; ~10% fines. damp at 129 feet.
130			GP	sandy GRAVEL: light olive-gray; ~30% sand, fine- to coarse-grained; ~65% gravel, angular to subrounded, to 55 mm; ~5% fines; wet.
			SP	gravelly SAND: light olive gray to pale-brown; ~55% sand, fine- to coarse-grained; ~40% gravel, subangular to subrounded, to 55 mm; ~5% fines.
135				
140			GP GM	sandy silty GRAVEL: olive-gray to brownish-gray; ~50% gravel, subangular to subrounded, to 70 mm; ~40% sand, fine- to coarse-grained; ~10% fines.
145				
150				Total depth of borehole is 150.5 feet.
155				
160				
165				

ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL MW-18

SEE SITE PLAN

ALISTO PROJECT NO: 10-320-08 DATE DRILLED: 04/08/98

CLIENT: Pacific Gas and Electric Co.

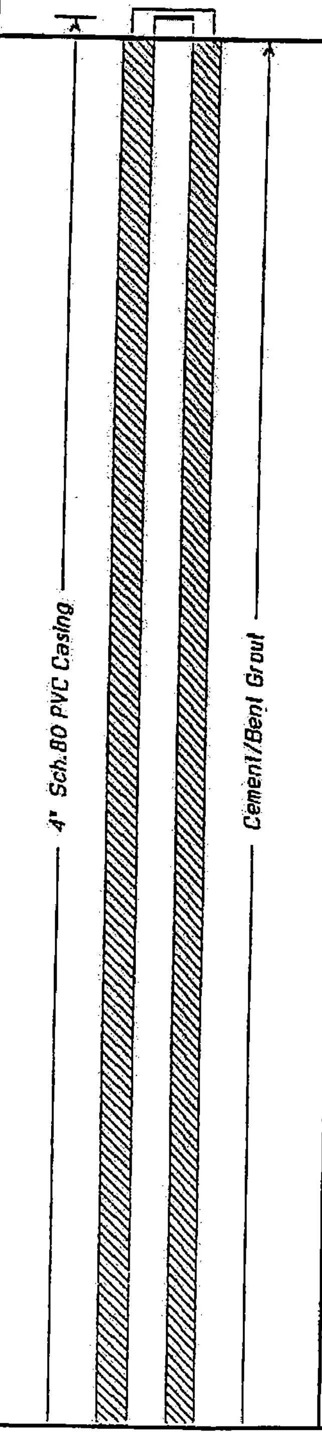
LOCATION: Topock Compressor Station

DRILLING METHOD: Ingersol Rand STRATEX/Air rotary

DRILLING COMPANY: THF Drilling CASING ELEVATION:

LOGGED BY: Dan Salaices APPROVED BY: Dan Salaices

WELL DIAGRAM



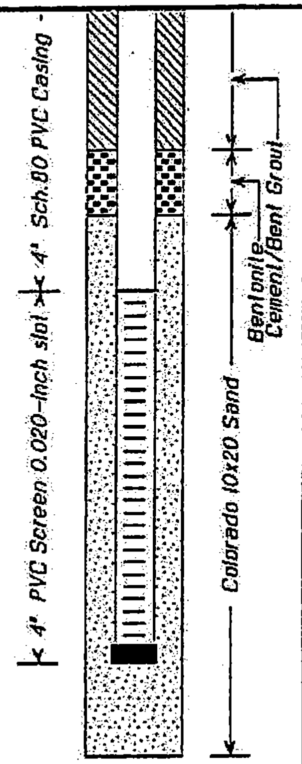
DEPTH feet	SAMPLES	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
0–22			GP	sandy GRAVEL: light greenish-gray to gray; ~80% gravel appears angular and fractured, probably contains 50-150 mm angular clasts which are seen in outcrop; dry.
22–32			SP	gravelly SAND: light greenish-gray to gray; ~80% sand, fine- to coarse-grained; gravel, subrounded, 4-8 mm; dry.
32–42			GP	sandy GRAVEL: light greenish-gray to gray; ~80% gravel appears angular and fractured; dry.
42–			SP	gravelly SAND: light brownish-gray; ~60-80% sand, fine- to coarse-grained; gravel, subrounded to subangular (appears crushed); dry.

Depth scale: 10, 20, 30, 40, 50, 60

ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL MW-18

WELL DIAGRAM



DEPTH feet	SAMPLES	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
80			SP	gravelly SAND continued.
90, 100			GP	sandy GRAVEL; light brownish-gray to gray; ~70% gravel, subrounded to subangular (appears partly crushed), 4-15 mm; ~30% sand, fine- to coarse-grained. Appears moist at 90 feet.
110				Total depth of borehole is 110 feet.
120				
130				
140				
150				

Now ID for db GIS PGE-9N

ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL 15N/21W3A

SEE SITE PLAN

ALISTO PROJECT NO: 10-186-18 DATE DRILLED: 04/22/97

CLIENT: Pacific Gas and Electric

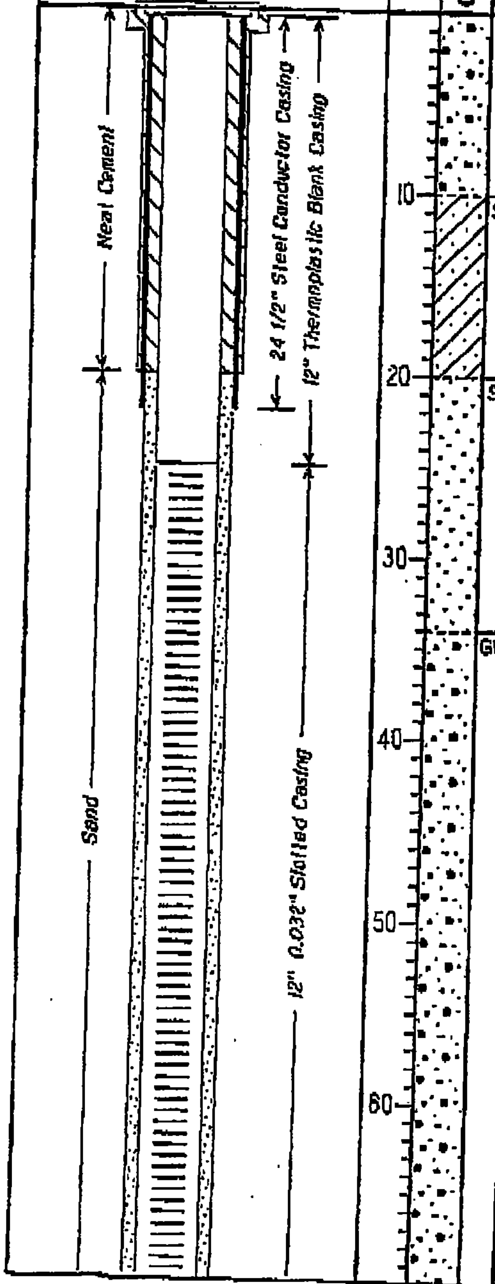
LOCATION: Topock Compressor Station, Topock Arizona

DRILLING METHOD: Mud Rotary, 10" Trilone

DRILLING COMPANY: Howard Pumping CASING ELEVATION: 460

LOGGED BY: Dan Birch APPROVED BY: David Lipnicke

WELL DIAGRAM | DEPTH feet | GRAPHIC LOG



	SOIL CLASS	GEOLOGIC DESCRIPTION
	GW	sandy GRAVEL: brown, wet; fine to coarse gravel, fine sand.
10	SC	clayey SAND: light blue clay; fine sand.
20	SP	gravelly SAND: brown, wet; 75% fine to coarse sand, 20% fine to medium gravel, some clay 5%.
34	GW	sandy GRAVEL: brown, wet; 60% fine to medium gravel, 40% fine to coarse sand.
		Same: with wood.
	SC	

New ID for GIS = PGE-9N

ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL 15N/21W3A

SEE SITE PLAN

ALISTO PROJECT NO: 10-186-18 DATE DRILLED: 04/22/97

CLIENT: Pacific Gas and Electric

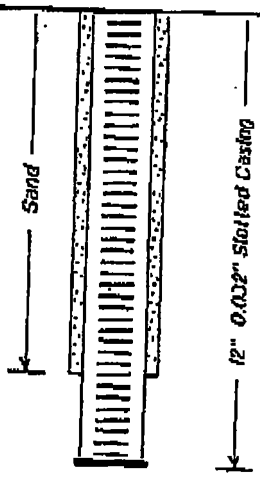
LOCATION: Topock Compressor Station, Topock Arizona

DRILLING METHOD: Mud Rotary, 10" Trilone

DRILLING COMPANY: Howard Pumping CASING ELEVATION: 460

LOGGED BY: Dan Birch APPROVED BY: David Lipnicke

WELL DIAGRAM	DEPTH (feet)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
			SC	clayey gravelly SAND: brown, wet: 25% fine to coarse sand, 70% fine to coarse gravel, some brown clay 5%.
	75		SW	gravely SAND: brown, wet: 80% fine to coarse sand, 40% fine to coarse gravel.
	80			
	90			wood chips at 89' to 90'.
	95			Fanglomerate bedrock at 94'.
				Well terminated at 95 feet.
	100			
	110			
	120			
	130			



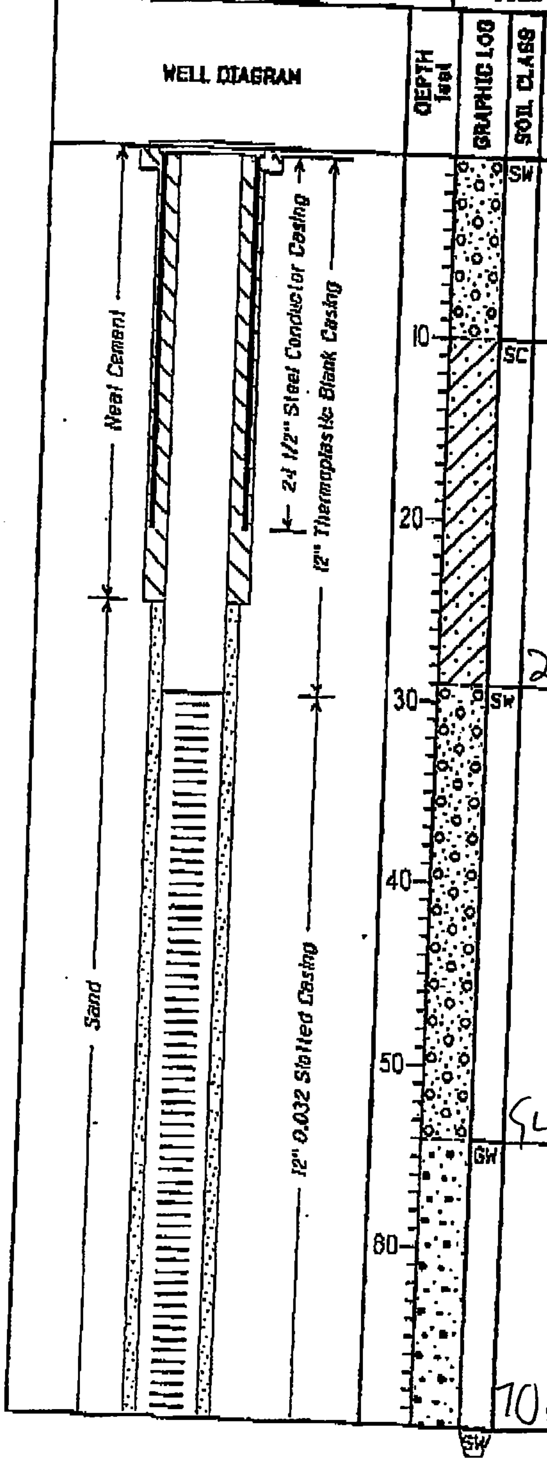
PGE-9N

ALISTO ENGINEERING GROUP
WALNUT CREEK, CALIFORNIA

LOG OF WELL 15N/21W3B

SEE SITE PLAN

ALISTO PROJECT NO: 10-188-18 DATE DRILLED: 04/04/97
CLIENT: Pacific Gas and Electric
LOCATION: Topock Compressor Station, Topock Arizona
DRILLING METHOD: Mud Rotary, 19" Trilone
DRILLING COMPANY: Howard Pumping CASING ELEVATION: 460
LOGGED BY: Dan Birch APPROVED BY: David Lipnicke



DEPTH (feet)	SOIL CLASS	GEOLOGIC DESCRIPTION
0	SW	gravelly SAND: brown, wet; 70% fine to coarse sand, 30% fine to coarse gravel.
10	SC	clayey SAND: blue clay; 70% fine to coarse sand, some burnt wood.
29	SW	gravelly SAND: brown, wet; 70% fine to coarse sand, 30% fine to medium gravel; wood at 29' to 31'.
54	GW	sandy GRAVEL: 80% fine to coarse gravel, 30% fine to coarse sand, 10% clay.
70'	SW	Wood at 69'.

New ID for db GIS PGE-9S

ALISTO ENGINEERING GROUP WALNUT CREEK, CALIFORNIA	LOG OF WELL 15N/21W3B	Page 2 of 2

SEE SITE PLAN

ALISTO PROJECT NO: *10-188-16* DATE DRILLED: *04/04/97*

CLIENT: *Pacific Gas and Electric*

LOCATION: *Topock Compressor Station, Topock Arizona*

DRILLING METHOD: *Mud Rotary, 19" Tricone*

DRILLING COMPANY: *Howard Pumping* CASING ELEVATION: *460*

LOGGED BY: *Dan Birch* APPROVED BY: *David Lipnicke*

WELL DIAGRAM	DEPTH feet	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
			SW	gravelly SAND: brown, wet: 70% fine to coarse sand, 30% fine to coarse gravel color change to reddish-brown at 103'.
	80			
	90			
	100			Color change to reddish-brown at 103'.
	104			Fanglomerate bedrock, red, hard, chips in cuttings refusal of tricon at 104' to 104.5'.
				Well terminated at 104.5 feet.
	110			PGE - 9S
	120			
	130