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December 29, 2006

Mr. Aaron Yue
Project Manager
California Department of Toxic Substances Control
5796 Corporate Avenue
Cypress, CA 90630

Subject: Addendum to Work Plan for California Slant Drilling
PG&E Topock Compressor Station, Needles, California

Dear Mr. Yue:

This letter transmits an addendum to the *Work Plan for Additional Groundwater Characterization Beneath the Colorado River by Slant Boring in California*, submitted to DTSC on October 19, 2006. The Work Plan Addendum is submitted in response to DTSC's December 22, 2006 letter that requested preparation of a supplement to the approved Work Plan.

If you have any questions on this submittal, please do not hesitate to contact me at (805) 234-2257.

Sincerely,

Julie Eakins for Yvonne Meeks

cc. Karen Baker/DTSC
Chris Guerre/ DTSC
John Earle/HNWR
Cathy Wolff-White/BLM
Casey Padgett/DOI

Enclosure

Addendum to Work Plan for Additional Groundwater Characterization Beneath the Colorado River by Slant Boring in California

PG&E Topock Compressor Station, Needles, California

DATE: December 29, 2006

Introduction

On October 19, 2006, PG&E submitted the *Work Plan for Additional Groundwater Characterization Beneath the Colorado River by Slant Boring in California* (Work Plan) (CH2M HILL 2006a), describing proposed additional groundwater investigation using slant boring and well installation at a selected drilling site along the California shoreline of the Colorado River near the PG&E Topock Compressor Station.

On December 22, 2006 PG&E received comments and directives from DTSC regarding the Work Plan in the letter "Work Plan Addendum for California Slant Drilling" (DTSC 2006b). This Addendum to the Work Plan for Additional Groundwater Characterization Beneath the Colorado River by Slant Boring in California (Addendum) provides responses and information to address DTSC's comments and requirements listed in the December 22, 2006 letter.

In addition to addressing DTSC's December 22 requirements letter, this Addendum provides a technical update on the multilevel slant well construction specifications proposed in the Work Plan. Upon DTSC's concurrence, this Addendum (including the updated technical specifications), together with the previously approved Work Plan, will constitute the final work plan for this project.

Responses to DTSC December 22, 2006 Letter

DTSC comments are shown in bold font with responses shown in normal font.

DTSC COMMENT 1. PG&E should make a reasonable attempt to notify and coordinate with DTSC, Federal Agencies, and FMIT representatives if field decisions are necessary during the implementation of the slant drilling activities pursuant to response to General Comment No. 5.

It is anticipated that conference calls will be convened during the well installation work to allow stakeholder input for decisions about placement of well screens and possibly other aspects of the slant boring program. DTSC, Federal Agencies, the Fort Mojave

Indian Tribe (FMIT) and Hargis + Associates will be provided advance notification of these calls.

DTSC COMMENT 2. PG&E shall work with the FMIT to identify qualified tribal monitors and make a reasonable attempt to arrange for their presence during field activities pursuant to the FMIT General Comment No. 6.

PG&E will contact the FMIT to make a reasonable attempt to identify qualified tribal monitors and to arrange for their presence during the field activities.

DTSC COMMENT 3. PG&E shall include additional language in the supplement on the project background respecting the Tribal connection to their sacred landscape pursuant to response to Specific Comment No. 1.

The Topock site and adjacent lands are contained within a larger geographic area that is considered sacred by the Fort Mojave Indian Tribe and by other Native American tribes. In recognition of this, all activities are planned in such a way as to minimize impact to this area. The work will be conducted in a manner which recognizes and respects these resources and the spiritual values of the landscape and the Colorado River. Practices which will be implemented with this objective in mind include: minimizing additional disturbance to the landscape by installing wells in previously disturbed areas where possible; minimizing the size of drilling pads and staging areas; use of all terrain drilling and sampling equipment in areas not served by existing roadways; constructing nested wells with multiple well screens at different depths in a single boring where possible rather than drilling individual borings for each well depth' minimizing the amount of equipment and duration that equipment is present on site; painting wellheads in earth-tone colors; and providing training to all site employees to ensure that they are aware of and respectful of the spiritual value of this landscape and the sacred nature of the land.

DTSC COMMENT 4. PG&E shall provide a chromium plume figure in the supplement pursuant to Specific Comment No. 2 and provide additional discussion on the rationale of this project as it relates to plume definition pursuant to response to Specific Comment No. 6.

Figure 2-2 from PG&E's most recent Quarterly IM Performance Evaluation and Performance Monitoring Report, dated November 30, 2006 is provided as Attachment A to this Addendum in response to this comment. The figure depicts the concentration contours in the deep aquifer zone. The limitations of this depiction are noted on that figure. As noted on the figure, "…there are no data confirming the existence of hexavalent chromium below the Colorado River."

To formulate a final remedy, it is necessary to understand the extent of the plume, which may be beneath the river in some locations. The slant drilling is proposed for an area where there is a relatively shallow bedrock "saddle" beneath the river. Groundwater flowing southward beneath the river must pass over this relatively shallow and narrow saddle between the bedrock outcrops on both sides of the river. Monitor wells drilled at an angle can reach the shallow bedrock beneath the river in the location of this bedrock saddle. At other locations, bedrock occurs at greater depths that would likely be beyond the reach of the angle drilling technology proposed for use. The bedrock outcrops on both sides of the river constrain the river and the groundwater flow beneath the river to

a relatively narrow channel in the area of the bedrock saddle. Because the channel is narrow in this area, relatively few monitoring wells beneath the river can provide coverage of the southward flowing groundwater. Thus, angled monitoring wells installed near the bedrock saddle provide for monitoring of the potential southern extent of the Cr(VI) plume with a minimum number of wells and minimum disturbance of the land surface.

There are plans to drill angled wells on both sides of the river in this area to provide monitoring of the entire width of the bedrock saddle beneath the river. The work plan for angled drilling from the Arizona side is expected to be completed in January 2007. This work plan will also include vertical wells to define the eastern extent of the Cr(VI) plume and determine groundwater flow directions on the Arizona side of the river.

DTSC COMMENT 5. PG&E shall consult with FMIT and the appropriate regulatory agencies on decisions involving restoration of vegetation in accordance with response to Specific Comment No. 5.

PG&E will consult with the land owner, the FMIT, and appropriate regulatory agencies on decisions involving restoration of vegetation. The proposed site restoration plan for the slant drilling location is presented in Section 2.7 of the Work Plan; the restoration plan is consistent with prior revegetation efforts completed at a nearby monitoring well, MW-43. While PG&E welcomes any comments on Section 2.7, any changes to the site restoration plan would ultimately require approval from the Havasu National Wildlife Refuge.

DTSC COMMENT 6. PG&E shall reference the Standard Operating Procedure (SOP) for the drilling, core logging and well installations, and make the SOP available for review pursuant to responses to Specific Comments No. 8 and 12.

The standard operating procedures (SOPs) for drilling, logging, well installation, and groundwater monitoring and sampling activities to be followed during implementation of the California slant drilling project are provided in Attachments B and C to this Addendum.

It should be noted that installation of multiple completion wells in angled boreholes is not a common procedure and there are no standard operating procedures available to cover some aspects of this work. We have engaged the services of BESST, Inc., an equipment manufacturer who has experience installing their BARCAD samplers in angled boreholes. The design for the wells and the methods to complete the wells has been developed based on their prior experience.

DTSC COMMENT 7. PG&E shall present an option to explore leaving non-contaminated investigation-derived wastes on site pursuant to response to Specific Comment No. 13.

The proposed procedures for managing the investigation-derived waste (IDW) are presented in Section 3.1 of the Work Plan. Modifying these procedures to leave non-contaminated investigation-derived wastes on site would require prior approval from DTSC, Havasu National Wildlife Refuge, and other permitting agencies. Approximately 20 cubic yards of soil and approximately 4,000 gallons of water are anticipated to be generated during the well installation field activities.

The option to leave non-contaminated investigation-derived waste on site would require, at a minimum, the following activities:

- Collection of the IDW as defined in the Work Plan (in temporary bins, storage tanks) until characterization of the material has been completed and appropriate approvals have been obtained;
- Characterization of the material through analytical testing, and development of criteria defining the suitability for leaving onsite (e.g., background concentrations);
- Determination of an appropriate location for placement of the material to avoid wetland areas, and to avoid harming sensitive species;
- Notification to and/or approval from agencies including DTSC, Havasu National Wildlife Refuge, the California Regional Water Quality Control Board, and the U.S. Army Corps of Engineers.

Proposed Modification in Well Casing Materials

After further discussion of the well design with representatives of BESST, Inc. (manufacturers of BARCAD sampling devices) and ProSonic (the preferred drilling contractor), we are proposing to change the casing material from 1-inch diameter PVC plastic pipe to 3/8 - inch diameter thick wall stainless steel tubing. The upper 20 to 30 feet of the casings will be constructed of larger, ¾ - inch diameter stainless steel tubing to accommodate the installation of water level transducers.

Stainless steel tubing offers the following advantages over the PVC pipe:

1. Stainless tubing is stronger than PVC pipe and therefore less likely to break or pinch off when the formation collapses as the drive pipe is pulled back.
2. The smaller diameter of stainless steel will allow use of a larger diameter tremmie pipe, which is less likely to plug when in use.
3. The smaller diameter will also allow for the use of a separate tremmie pipe, which will provide a secure conduit for a "tagging rod" needed to sound the depth of gravel pack and grout during construction.
4. The smaller diameter provides more open space in the borehole, which allows for better placement of grout seals.
5. The smaller diameter tubing will result in greatly reduced purge volumes and facilitate sampling with shorter purge times and smaller purge water tanks.

All other well design parameters such as borehole diameter, depth of screened intervals, well head completion details, etc. described in Section 2.5 of the Work Plan remain unchanged. The change in casing materials is proposed primarily to minimize the risk of failure of the well casings and to maximize the ability to accurately place gravel pack and grout materials in the well during installation.

Certification

This Addendum to the Work Plan was prepared by CH2M HILL under the supervision of the professional whose seal and signature appears herein in accordance with currently accepted professional practices. No warranty, expressed or implied, is made.

Paul Bertucci

Paul F. Bertucci
California Certified Engineering Geologist

References

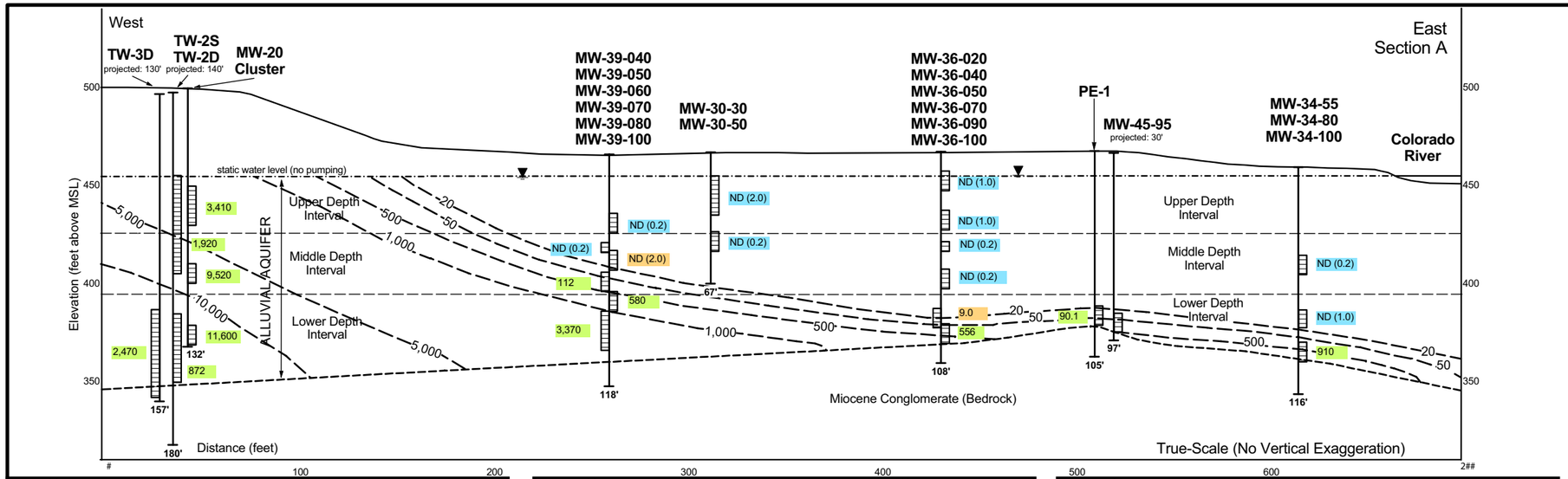
California Department of Toxic Substances Control (DTSC). 2006a. Letter to PG&E providing comments and conditions of approval. "Work Plan for Groundwater Characterization by Slant Boring in California, Pacific Gas and Electric Company, Topock Compressor Station, Needles, California." October 30.

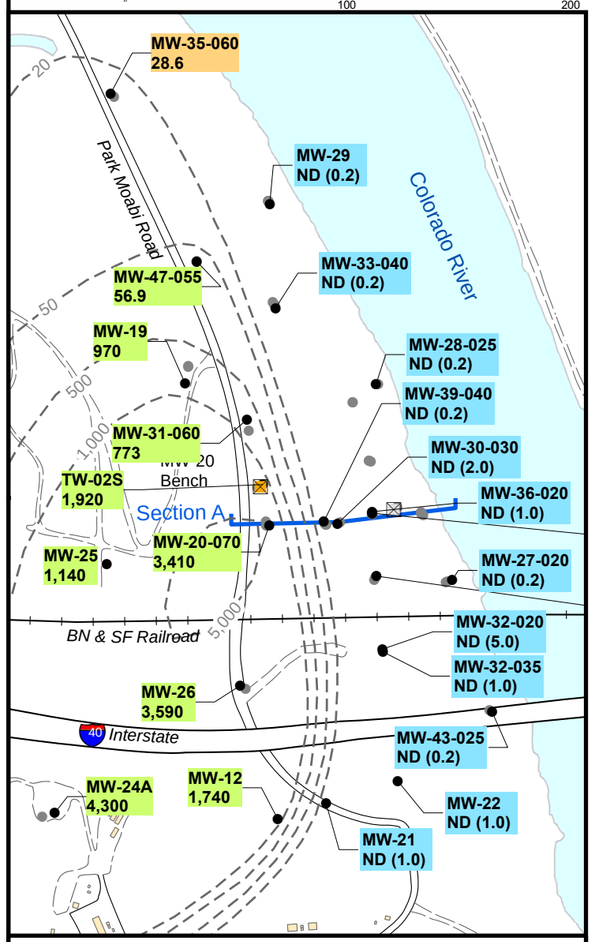
_____. 2006b. Letter to PG&E. "Work Plan Addendum for California Slant Drilling at Pacific Gas and Electric Company, Topock Compressor Station, Needles, California." December 22.

CH2M HILL. 2006a. *Work Plan for Additional Groundwater Characterization beneath the Colorado River by Slant Boring in California. PG&E Topock Compressor Station, Needles, California*. October 19.

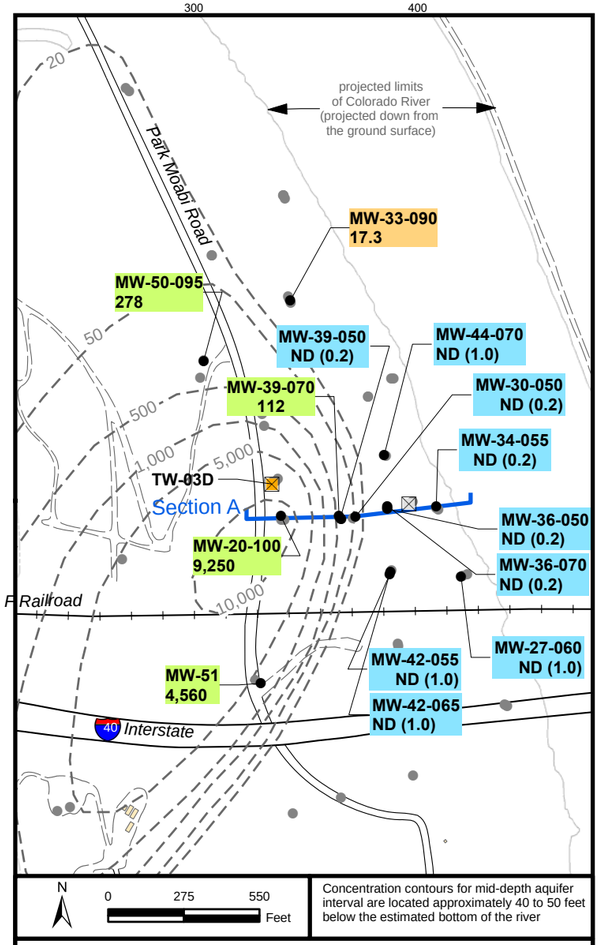
_____. 2006b. *Performance Monitoring Report for October 2006 and Quarterly Performance Monitoring Report, August through October 2006, PG&E Topock Compressor Station, Needles, California*. November 30.

Attachment A
Chromium Distribution Map for IM Performance Monitoring Area



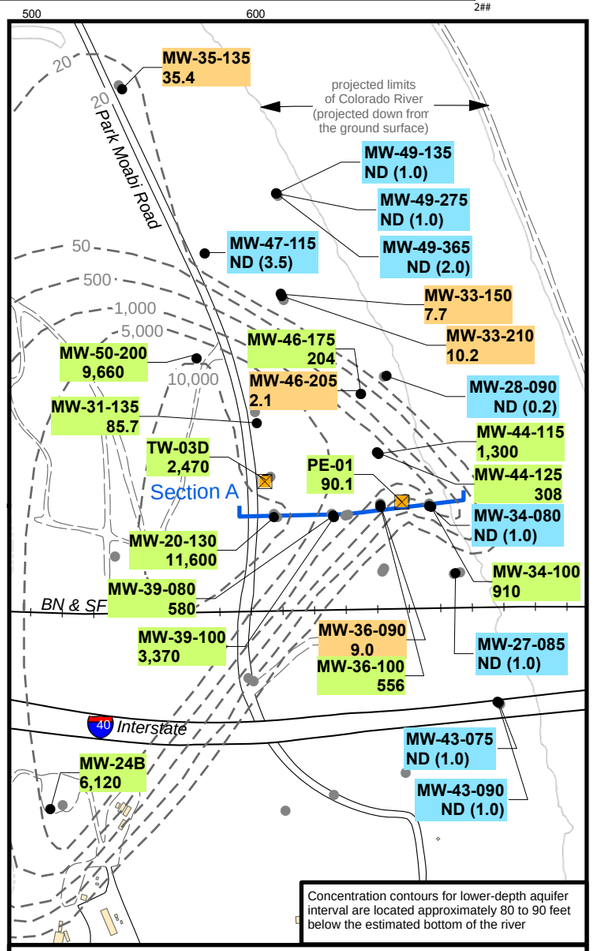


Shallow Wells (Upper Depth Interval)



Concentration contours for mid-depth aquifer interval are located approximately 40 to 50 feet below the estimated bottom of the river

Intermediate Wells (Middle Depth Interval)



Concentration contours for lower-depth aquifer interval are located approximately 80 to 90 feet below the estimated bottom of the river

Deep Wells (Lower Depth Interval)

LEGEND

Maximum Hexavalent Chromium [Cr(VI)] Concentrations in Groundwater, October 2006 Monitoring

Concentrations in micrograms per liter (µg/L)
equivalent to parts per billon (ppb)

ND = not detected at listed reporting limit
J = Concentration estimated by laboratory or data validation

Results are from October 2006 sampling.
Results posted are maximum concentrations from primary and duplicate samples.
See Tables B-1 and B-2 for sampling data and other results.

ND (1) Not detected at listed reporting limit (ppb)

41 Less than 50 ppb

3,810 Greater than 50 ppb

50 Inferred Cr(VI) concentration contour

Hydrogeologic Section A (true-scale) showing aquifer depth intervals, well screens, and Cr(VI) sampling results.

NOTES ON CONTOUR MAPS

1. The Cr(VI) contour maps for 2006 performance monitoring have been revised to incorporate data from new wells and water quality data trends for floodplain area. The revised maps provide additional interpretation of plume limits and do not reflect plume migration during performance monitoring.

2. The locations of the Cr(VI) contours shown for depths 80-90 feet below the Colorado River (east and southeast of well clusters MW-34) are estimated based on hydrogeologic and geochemical conditions documented in site investigations 2004-2006. The actual locations of contours beyond well control points in these areas are not certain, but are inferred using available site investigation and monitoring data (bedrock structure, hydraulic gradients, observed distribution of geochemically reducing conditions and Cr(VI) concentration gradients). There are no data confirming the existence of Cr(VI) under the Colorado River.

FIGURE 2-2
MAXIMUM Cr(VI) CONCENTRATIONS IN ALLUVIAL AQUIFER, OCTOBER 2006

INTERIM MEASURES PERFORMANCE MONITORING
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

Attachment B
Standard Operating Procedures for Drilling, Logging, and Well Installation

SOP-B1

General Guidance for Monitoring Well Installation and Development Standard Operating Procedures for PG&E Topock Program

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This Standard Operating Procedure provides site personnel with a review of well installation procedures. These procedures are to be considered general guidelines only and are in no way intended to supplement or replace the contractual specifications in the driller's subcontract.

REQUIRED DOCUMENTS

1) Event-specific sampling and analysis plan (SAP).
2) Applicable project work plan or monitoring plan. Refer to Topock Program *Sampling, Analysis, and Field Procedures Manual* and *Quality Assurance Project Plan* (Procedures Manual), as required.
3) Topock Program Health and Safety Plan.
4) Well construction logs/specifications.
5) Previous sampling logs or tabular historic field data.
6) Blank sampling logs and field notebook.
7) Blank CH2M HILL Well Completion Diagrams.

EQUIPMENT LIST

- Drilling rig (hollow stem auger, sonic, air hammer, air rotary, or mud rotary).
- Polyvinyl chloride (PVC), Schedule 40, minimum 2-inch-diameter, flush-threaded, blank casing; alternatively, stainless-steel casing.
- PVC, Schedule 40, minimum 2-inch-inside-diameter, flush-threaded, factory-slotted screen; alternatively, stainless-steel casing.
- PVC or stainless-steel centering guides (if used).
- Above-grade well completion: PVC, threaded or push-on type, vented cap.
- Clean silica sand, in-factory-sealed bags, non-reactive, rounded, water-washed for constructing the primary (coarse) filter pack and secondary (fine optional) filter pack. Grain size determined based on sediments observed during drilling, geotechnical tests, or from previous well installations.
- Pure, additive-free bentonite pellets, chips, and/or powder.
- Coated bentonite pellets.
- Portland cement.

- Above-grade well completion: minimum 6-inch-inside-diameter steel pipe with locking cover, diameter at least 2 inches greater than the well casing, painted for rust protection; heavy duty lock; protective posts if appropriate.
- Flush-mount well completion: Morrison 9-inch or 12-inch 519 manhole cover or equivalent; rubber seal to prevent leakage; locking cover inside of traffic-rated box.
- Single- or double-surge block with solid bottom, open top, separated by 2 feet of slotted pipe (double surge block only).
- Well-development pump, pump controller, and steam cleaner.
- Calibrated meter(s) to measure pH, temperature, specific conductance, turbidity, dissolved oxygen, and total dissolved solids (TDS) of purged water during well development.
- Containers (Department of Transportation [DOT]-approved 5-gallon drums or trailer-mounted water tank) for water produced from well.

GUIDELINES

1) Wells will be installed in accordance with standard United States Environmental Protection Agency (USEPA) procedures.
2) The threaded connections will be water-tight.
3) Well screens generally will be constructed of 10-slot or 20-slot Schedule 40 PVC and will be 10 to 20 feet long, depending on the requirements of the well. The exact slot size and length will be determined by the field team supervisor. Stainless steel may be required under certain contaminant conditions.
4) Wells will be surrounded by four concrete-filled, 3-inch-diameter guard posts.
5) A record of the finished well construction will be compiled.
6) All soils and liquids generated during well installations will be placed in lined, roll-off containers pending proper disposal.

WELL TYPES

There are several basic types of monitoring wells: single-cased, double-cased, clustered, nested, and multiple-port wells. The first three are recommended for general use in most hydrogeologic investigations.

Single-cased Wells. A single-cased well consists of a section of slotted well screen connected to a riser pipe that extends to above or just below the ground surface. An artificial filter pack is placed in the annulus between the screen and the borehole to 2 to 3 feet above the top of the well screen. A transitional seal fills the annular space directly above the filter pack, followed by bentonite-cement or sand-cement grout to the ground surface.

Double-cased Wells. Double- or multiple-cased wells are often installed when the aquifer zone to be sampled must be isolated from overlying aquifer zones to prevent cross contamination between aquifer zones. Typically, a large-diameter boring (14 to 16 inches or more in diameter) is drilled into a low-permeability material (clay) immediately below the

zone to be sealed off. Steel conductor casing with welded joints and an outside diameter that is at least 4 inches smaller than the hole diameter is lowered into the borehole, centered, and pushed into the clay up to 10 feet. A bentonite-cement or sand-cement grout is then pumped through a tremie pipe into the annular space, between the conductor casing and the formation from the bottom up to the ground surface.

Clustered Wells. Well clusters consist of two or more wells installed in proximity to one another but screened at different intervals in different boreholes. Single- and double-cased wells may both be included in the well cluster. Well cluster systems allow sampling of groundwater from different aquifers or from different zones within the same aquifer with essentially no risk of cross contamination between the aquifers. Installation procedures for each well in a well cluster are the same as for single- or double-cased wells.

Nested Wells. Nested wells consist of more than one well casing installed in a single borehole. Nested wells allow groundwater sampling and measurement of water levels from two or more different zones or aquifers using one borehole. Each well is screened at a different depth, and seals are placed above and below each well screen.

Multiple-port Wells. Multiple-port wells have multiple screens on the same casing string with sampling ports at different depths separated by inflatable or mechanical packers. This arrangement allows for discrete sampling at different depths across a large vertical extent in one thick aquifer or in several thinner ones.

PROCEDURES

Monitoring Well Installation

This section presents procedures for the installation of the monitoring wells, including discussion of borehole completion; installation of the casing and screen, artificial filter pack, and borehole seals; and surface completion.

1) Monitoring wells in unconsolidated materials will be installed in at least 6-inch-diameter boreholes to accommodate well completion materials in designated locations.

2) Monitoring wells in unconsolidated materials will be constructed of 2-inch-diameter, factory manufactured, flush-jointed, Schedule 40 PVC screen with threaded bottom plug and riser.

3) Screens will be filter packed with a properly-sized, properly-graded, thoroughly-washed, sound, durable, well-rounded basalt or siliceous sand. When using sonic drill casing, the filter pack will be installed by slowly pouring the sand into the annular space while raising the casing in 1 to 3 foot intervals and using a weighted tape to sound for the sand surface.

4) Following each lift of the drill casing, the well casing height will be checked for settling or to see if the casing was pulled up.

5) The primary filter sand pack (typically Monterey #3 or equivalent) will extend from 1 to 2 feet below the base to 2 feet above the top of the screen; for non-sonic drilling methods the filter pack will be allowed to settle and hydrate before final measurement is taken. Alternately, a surge block can be used to agitate the sand and facilitate settling. For sonic drilling, the vibration induced during casing removal serves to properly settle the sand.

For wells that are installed with approved screen lengths longer than 20 feet, the filter pack will be proportionally extended above the top of the screen to allow for settling of the longer pack.

6) A secondary filter sand pack (typically Monterey #30 or equivalent) 1 foot thick will be placed above the primary sand pack.

7) Annular well seals will consist of 2 to 5 feet of pelletized or granular bentonite clay placed above the filter pack. If necessary, the pellets will be hydrated using potable water. For wells drilled using sonic, the bentonite will be poured into the annular space while raising the drill casing in 1- to 3-foot increments and sounding for the top of the bentonite with a weighted tape. The height of the well seal also will be sounded with a weighted tape.

8) The top of the annular seal will be measured after the pellets have been allowed to hydrate and before the grout is applied. The pellets will be allowed to hydrate for at least 30 minutes before work in the well continues.

9) The annular space above the bentonite seal will be filled to grade with a bentonite-cement slurry grout mixture.

10) The grout mixture consists of 94 pounds of cement (1 bag) per 6 gallons of water and 2 to 3 pounds of powdered bentonite per bag of cement to reduce shrinkage.

11) The grout mix will be carefully applied to avoid disturbing the bentonite seal; the method of grout placement must force grout from the bottom of the space to be grouted to the surface.

12) After allowing the grout to settle and set up overnight, additional grout will be added to maintain grade.

13) A protective steel casing equipped with keyed-alike locking caps will be grouted in place for each new well; the casing will extend at least 2 feet above grade and 3 feet below grade and will be painted a bright color.

Well Development

1) New monitoring wells will be developed after the well has been completely installed and the grout has hardened (a minimum of 24 hours following grouting).

2) The well will be developed by bailing, surging, and pumping.

3) Equipment placed in the well will be decontaminated before use.

4) If information is available, the least-contaminated well will be developed first.

5) Initial development will be with a bailer (i.e., stainless-steel, 10-foot-long bailer) to facilitate removal of coarse-grained sediment.

6) The well will subsequently be surged using a surge block across the screened interval. Additional bailing will be performed if significant coarse sediment is still present.

7) Following bailing and surging, a submersible pump will be lowered into the well. Development may include surging the well by abruptly stopping flow and allowing water in the well column to fall back into the well.

8) Pumping will continue until the water produced is free of turbidity (less than 10 NTU) and water quality parameters (i.e., pH, temperature, conductivity, TDS, and dissolved oxygen) have stabilized.

9) Development water will be considered hazardous and placed in sealed 55-gallon DOT-approved steel drums or other approved containers (i.e., lined roll-off bins).

KEY CHECK AND ITEMS

- Ensure that all equipment is properly decontaminated as needed.
- Only new, sealed materials (e.g., screens, risers, and sand) will be used in constructing the well.
- Care will be taken when making downhole measurements to ensure that proper heights of sand, seal, and grout are achieved.
- Fill out CH2M HILL Well Completion Diagram (see Attachment A).
- All materials generated during sampling (debris, PPE, decontamination liquids, etc.) will be placed in approved investigation-derived waste storage containers (i.e., drums or roll-offs) for storage pending analysis and disposal off site.

SOP-B3

Borehole Sampling and Logging of Soil Borings
Standard Operating Procedures for PG&E Topock Program

This standard operating procedure (SOP) provides guidance for sample collection from soil borings during the drilling process, and proper documentation necessary. Detailed guidance for sample collection, preservation and handling is provided in Section 4.0 of the site Quality Assurance Project Plan (QAPP) and in the Topock Program *Sampling, Analysis, and Field Procedures Manual* (Procedures Manual). SOP-B2 provides detailed guidance for soil characterization and logging.

REQUIRED DOCUMENTS

1) Event-specific sampling and analysis plan (SAP), work plan or event-specific field instructions. Planned borehole depth, proposed well construction/specifications, and field sampling summary table, if available.

2) Applicable project work plan or monitoring plan. Refer to the Procedures Manual and QAPP, as required.

3) Topock Program Health and Safety Plan (HSP).

4) Previous sampling, drilling, or well construction logs from other boreholes or wells in the vicinity, if available.

5) Blank sampling log and field notebook.

PREPARATION AND SETUP

1) Review event-specific work plan or event-specific field instructions, previous sampling logs, Procedures Manual, and HSP.

2) Initiate field logbook for sampling activity.

3) Review sampling procedures and equipment, and planned sample depths with drilling contractor and field crew.

Equipment List

- Field logbook
- Borehole log
- Blue or black waterproof or permanent ink pens
- Trash bags
- Plastic sandwich bags
- Paper towels

- Stainless steel sampling equipment (provided by driller)
- Decontamination equipment (Alconox® solution in spray bottle, brushes, buckets, rinse water spray bottle)
- Soil sample containers appropriate for sample analysis and preservation as called for in SAP and QAPP (glass jars, brass sleeves, Encore® containers, sandwich bags, etc.)
- Soil sampling equipment not provided by driller (spatula or putty knife, stainless steel compositing bowl, hand auger, etc.)
- Groundwater sample containers appropriate for sample analysis and preservation as called for in SAP and QAPP (glass jars, VOA vials, plastic jars, etc.)
- Groundwater sample equipment not provided by driller (pump, filters, tubing, power supply, etc.)
- Water quality meters
- Water level indicator
- Distilled water
- Coolers with ice
- Protective waterproof gloves (nitrile or latex)

GUIDELINES

Soil Boring Logs Documentation

Soil boring logs will be completed on the soil boring log forms during the drilling activities at the time of the logging and soil descriptions. Information collected will be consistent with the standard CH2M HILL form (See SOP-B2 attachment A). Sample data may also be documented in the comments section of the boring log.

Items documented on the borehole log include:

1) **Sample Interval:** The top and bottom depth of each sample run should be recorded on the borelog. Sampling includes samples collected for analysis as well as core retrieved for logging purposes.

2) **Sample Type and Number:** Enter the sample type and number consistent with the sampling and analysis plan at the correct depth intervals. An "x" should be placed across the vertical interval where the environmental soil, grab groundwater, or geotechnical sample was collected.

3) **Sample Recovery:** Enter the length of retrieved core to the nearest 0.1 foot of sample recovered, and record the value in feet. Do not count slough or caved material as part of the total recovered length of core. Record total length and percent of sample recovered. If using a 5-foot sample barrel, multiply the total length by 2 and 100 to get a percentage number. Similarly, if using a 2.5-foot sampler, multiply by 4 and 100 to get the percent recovery.

4) **Sampling:** Sampling difficulties shall be noted. Disturbed samples shall be noted on the log as well as the sample recovery. The top of the sample shall be marked on the container.

5) **Water Levels:** Water-level measurements, where groundwater is encountered, are required for each boring. Changes in soil moisture shall be noted and, if there is no water encountered, a note to that effect shall be included on the borehole log. The date and time of water-level measurements shall be documented.

At a minimum, sample identifiers (IDs) should be noted on boring logs at the depth collected. When time and space allows, a summary of analytical sample information can be included. When inclusion of these data prevents documentation of drilling information, sample data should be omitted in order to document drilling.

Borehole Sampling by Drilling—General Procedure

Split-spoon sampling procedures shall be executed in accordance with American Society for Testing and Materials (ASTM) D1586, "Standard Method for Penetration Test and Split-barrel Sampling of Soils" (ASTM 1984). California (2-inch) or Modified California (2.5-inch) split-barrel samplers may also be used.

1) The split-spoon or split-barrel sampler shall be advanced to the top of the sampling interval using a wire-line or sample rods such as A or AW. The larger-diameter samplers may be fitted with three 6-inch-long stainless-steel sleeves. The sampler shall be driven 18 inches or to refusal, with a 140-pound hammer dropping repeatedly 30 inches. Refusal shall be defined as requiring 50 blows with the hammer to advance the sampler less than 6 inches.

2) The number of blows required to drive the sampler each 6 inches shall be recorded on the borelog.

3) As the sample tubes are disassembled, an organic vapor monitor probe shall be inserted into the gap between two sample liners, and the liner exhibiting the highest reading shall be selected for analysis.

4) In general, the middle liner is collected for laboratory analysis, and 10 percent of the bottom liners are collected for quality assurance testing. A sample of the soil in the top liner typically is placed in a re-sealable plastic bag or 8-ounce clear glass jar and left in the sun for approximately 15 minutes to allow any volatile organic compounds (VOC) to volatilize.

5) After the 15 minute volatilization period, the soil vapor in the plastic bag is then measured for VOCs by taking a reading of the headspace. Background VOCs for the bag are determined by monitoring the air in an empty bag.

6) Results of the organic vapor monitoring are recorded on the boring log.

7) Small portions of soil at the ends of the sleeve are scraped off for classification.

Borehole Sampling by Drilling—Split Spoon Sampling

1) Samples collected for laboratory analysis using split spoon sampling device will be separated and transferred from the split-spoon halves into sample jars by clean stainless-steel utensils.

2) Samples for VOCs will be separated and collected first, followed by semivolatile organic compounds samples.

3) For VOC samples, avoid mixing the soil before sampling and sample directly from the split spoon. See SOPs for guidance on homogenizing soil samples and for VOC sampling using EnCore samplers, respectively.

Borehole Sampling by Drilling—Direct-push Sampling

1) Samples collected for laboratory analysis using a direct-push sampling drill rig will be handled by either opening the tube and placing the soil in sample jars or cutting the acetate tube and submitting it the laboratory directly.

2) For samples that will be removed from the acetate tube, the tube will be cut open longitudinally using a double-bladed razor knife.

   - Soil will be inspected and logged prior to removal of soil samples.
   - A short section of soil will be removed from the acetate sleeve using a stainless-steel utensil, homogenized in a clean stainless-steel bowl, and placed in sample jars.
   - Soil collected for VOC analysis will be sampled directly from the split acetate sleeve using EnCore samplers.

3) Alternatively, a short (6-inch) length of liner will be cut from the acetate sleeve and collected directly for laboratory analysis.

   - The section of acetate liner will be removed, capped with Teflon sheeting and plastic end caps at both ends, and taped with clear label or packing tape.
   - Labels shall be affixed to the liners with job designation, time, boring number, sample depth interval, sample number, date sampled, and the initials of the sampler clearly marked.
   - The samples shall then be enclosed in a plastic bag and stored in a cooler maintained at 4˚C.
   - Sample information shall be placed on the chain-of-custody, the borelog, and the field logbook. All samples shall be handled in accordance with *Chain of Custody Procedures*.

Borehole Sampling by Drilling—Split-barrel Sampling

Soil samples can also be collected using a 3-foot-long or 5-foot-long split-barrel sampler. The split-barrel sampler is similar to the split-spoon sampler that is used to hold steel or brass sampling sleeves, but the split-barrel sampler typically is not used to hold sample sleeves.

1) The sampler is lowered to the base of the drill bit and is advanced slightly ahead of the drill bit and augers (or conductor casing). The weight of the drill string and sample barrel along with the drilling and cutting action of the drill bit advances the face of the split-barrel sampler into the formation.

2) Once the desired depth interval is reached, the split-barrel sampler is retrieved using a cable or tool steel sections.

3) The retrieved sampler is unscrewed, and one or both halves are laid on the sample table. The soil typically will form a continuous column of soil in one of the split-barrel halves.

4) The soil column is split longitudinally for soil descriptions using a putty knife or spatula.

5) Samples for VOC analysis are collected immediately directly from the soil column.

6) Other soil samples are collected after the core section has been described and logged. The soil is described following the procedures in the following sections.

Groundwater Sampling

1) Groundwater samples can be collected by hydropunch by bailer or by pumping from an isolated zone. Collection of groundwater by bailing is not an accurate method of collection depth discrete groundwater samples, as the zone sampled is poorly isolated.

2) Hydropunch samples are collected below the bit of the drill stem, in relatively undisturbed soil zone. This method of sample collection may be difficult in fine-textured soils and in very rocky soils. To collect these samples, a point is driven below the depth of the drill bit, then a screen zone is opened within this point and water allowed to flow in. The hydropunch tool must be decontaminated between samples.

Groundwater can also be collected from the open or cased borehole with a bailer. A disposable or decontaminated stainless-steel bailer is lowered into the boring, and water is collected. This method is preferable for collection of groundwater from the water table. Attempts can be made to collect discrete groundwater samples beneath the water table; however, the boring must be cased with watertight, stainless-steel pipe, and the boring must be evacuated prior to collection of samples.

Alternatively, discrete groundwater samples can be collected by isolating a zone with casing and packers. To collect these samples, the borehole is first advanced to the depth at which a sample is required. Then casing is advanced to within 20 feet of the sample zone. Next, a pump and packers are lowered into the hole. The zone from which samples are to be collected is isolated with a packer, and water is pumped directly from the target zone.

Sample Handling

Sample preservation and sampling procedures are detailed in Section 4.0 of the QAPP. Additional information is provided in the Procedures Manual and in the appropriate SAP.

KEY CHECKS AND ITEMS

- Check entries to the soil boring log and field logbook in the field during sampling activities because the samples will be disposed at the end of the fieldwork, confirmation and corrections cannot be made later.

- Check that the sample numbers and intervals are properly specified.
- Ensure that drilling equipment is decontaminated prior to the beginning of work and between each borehole.
- All materials generated during sampling (debris, PPE, decontamination liquids, etc.) will be placed in 55-gallon drums or roll-off bins for storage pending analysis and disposal off site, as outlined in SOP 39, Standard of Practice H-83, and Appendix D of the project *Soil and Groundwater Management Plan*.

ATTACHMENT A

Examples of Soil Bore Logs

CH2MHILL

PROJECT NUMBER	BORING NUMBER SHEET OF

SOIL BORING LOG

PROJECT _____ LOCATION _____

ELEVATION _____ DRILLING CONTRACTOR _____

DRILLING METHOD AND EQUIPMENT _____

WATER LEVELS _____ START _____ FINISH _____ LOGGER _____

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL	NUMBER AND TYPE	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION

SHEET 1 of 9	**PROJECT NUMBER:** 326128.01.16.EN	**BORING NUMBER:** *MW-47*

SOIL BORING LOG - DRAFT FOR DISCUSSION

PROJECT NAME: IMPM Drill Program		**HOLE DEPTH (ft):** 288.0	**DRILLING CONTRACTOR:** Prosonic Corp. Phoenix, AZ	
SURFACE ELEVATION: 482.6 ft. MSL	**NORTHING (CCS NAD 27 Z 5):** 2,103,450.05	**EASTING (CCS NAD 27 Z 5):** 7,615,629.49	**DATE STARTED:** 02/27/2006	**DATE COMPLETED:** 03/13/2006
DRILLING METHOD: Rotosonic			**DRILLING EQUIPMENT:** Sonic AT (track mounted)	
LOCATION: PG&E Compressor Station - Flood Plain, Topock, California			**LOGGED BY:** B. Moayyad, K. Ebel	

DEPTH BGS (feet)	SAMPLE INTERVAL	SAMPLE TYPE/ NUMBER	SAMPLE RECOVERY (ft)	USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS SYMBOL, COLOR, PERCENT COMPOSITION, GRADING, GRAIN SHAPE, MINERALOGY, DENSITY/CONSISTENCY, STRUCTURE, MOISTURE.	COMMENTS DRILLING OBSERVATIONS AND OPERATIONS, DAILY START AND END TIMES , DRILL RATE, REFUSALS, SAMPLING AND TESTING NOTES.
5			6	SP	**POORLY GRADED SAND (SP)** - very lt brn (10YR7/3), =2% fines, 98% f to m lithic quartz sand, subang to subrnd, dry - fine roots, iron staining, some iron oxide coating on grains	Hand augured to 5' bgs
10			10	SP	- slightly moist - dry	Rapid drill rate, no chatter
15						
20			16	SW	**WELL GRADED SAND w/ GRAVEL (SW)** - lt yellowish brn (10YR6/4), 45% gravel up to 7cm, 50% f to m sand, 5% fines, loose, met subang gravel, dry(moist@ 17') - cobble present in slough - one subrnd chert gravel - Possible Fluvially Reworked Alluvium - lt grey (10YR7/2), subang to rnd met gravel up to 9cm, 2% to 5% fines - dk yellowish brn (10YR4/4), mostly c sand subang to ang, met, some Miocene conglomerate gravel	
25				SW	- 65% sand, 30% gravel up to 4cm, 5% fines	
30				SW	**WELL GRADED SAND w/ GRAVEL (SW)** - dk yellowish brn (10YR3/6), 35% gravel up to 4cm, 55% m to c sand, 10% silty fines, met clasts are grain supported some mm siltstone - some oxide staining	
35				SW	**WELL GRADED SAND w/ GRAVEL AND CLAY (SW)** - dk yellowish brn (10YR3/6), 30% subang met gravel up to 7 cm, 55% subrnd to subang m to c sand, 15% clayey fines, m density, moist	Drill rate slowed to clean out 8" pipe

CH2MHILL

PROJECT NUMBER: 326128.01.16.EN

BORING NUMBER: *MW-47*

SOIL BORING LOG - DRAFT FOR DISCUSSION

PROJECT NAME: IMPM Drill Program		**HOLE DEPTH (ft):** 288.0	**DRILLING CONTRACTOR:** Prosonic Corp. Phoenix, AZ	
SURFACE ELEVATION: 482.6 ft. MSL	**NORTHING (CCS NAD 27 Z 5):** 2,103,450.05	**EASTING (CCS NAD 27 Z 5):** 7,615,629.49	**DATE STARTED:** 02/27/2006	**DATE COMPLETED:** 03/13/2006
DRILLING METHOD: Rotosonic			**DRILLING EQUIPMENT:** Sonic AT (track mounted)	
LOCATION: PG&E Compressor Station - Flood Plain, Topock, California			**LOGGED BY:** B. Moayyad, K. Ebel	

DEPTH BGS (feet)	SAMPLE INTERVAL	SAMPLE TYPE/ NUMBER	SAMPLE RECOVERY (ft)	USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS SYMBOL, COLOR, PERCENT COMPOSITION, GRADING, GRAIN SHAPE, MINERALOGY, DENSITY/CONSISTENCY, STRUCTURE, MOISTURE.	COMMENTS DRILLING OBSERVATIONS AND OPERATIONS, DAILY START AND END TIMES , DRILL RATE, REFUSALS, SAMPLING AND TESTING NOTES.
			2.5	SW	**WELL GRADED SAND w/ GRAVEL (SW)** - dr yellowish brn (10YR3/6), 30% gravel, 60% sand, 10% silty fines	Drilling smooth but preceeds less rapidly
40			10	SW	**WELL GRADED SAND w/ GRAVEL (SW)** - 40% subang met gravel up to 6cm, 55% subrnd to ang sand, 5% fines - more gravel below 38' - gravel is mostly fine	
45						
50			10	SW	**WELL GRADED SAND w/ GRAVEL (SW)** - Pale brn (10YR6/3), 30% subang met gravel up to 5cm, 60% subrnd to subang m to c met sand, 10% silty fines, wet	Soil sample collected
				SP	**POORLY GRADED SAND w/ GRAVEL (SP)** - pale brn (10TR6/3), 30% f subang gravel up to 2 cm, 65% mostly c sand, =2% fines	
55				SW	**WELL GRADED SAND w/ GRAVEL (SW)** - yellowish brn (10YR5/4), 40% subang met gravel up to 9cm, 55% f to c met sand, 5% silty fines, clast supported, m density, wet	
60			9.5	GW	**WELL GRADED GRAVEL w/ SILT AND SAND (GW)** - brn (7.5YR5/4), 55% subang to ang met gravel up to 4cm, 25% f to c sand, 20% silty fines, dense, moist to dry - soil dries out	Collected Isoflow sample
65					- lt grey (10YR7/2) and powder dry - moist sandy zone, 55% gravel, 35% sand, 10% fines - dry silty lt grey GW below 65'	Drill rate slows to 2' / min
70				SW	**WELL GRADED SAND w/ GRAVEL (SW)** - yellowish brn (10YR5/4), 35% subang met gravel up to 4cm, 60% subrnd sand, 5% silty fines, loose, moist to wet	Moderate Drill Rate

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PROJECT NUMBER: 326128.01.16.EN

BORING NUMBER: *MW-47*

SOIL BORING LOG - DRAFT FOR DISCUSSION

PROJECT NAME: IMPM Drill Program		**HOLE DEPTH (ft):** 288.0	**DRILLING CONTRACTOR:** Prosonic Corp. Phoenix, AZ	
SURFACE ELEVATION: 482.6 ft. MSL	**NORTHING (CCS NAD 27 Z 5):** 2,103,450.05	**EASTING (CCS NAD 27 Z 5):** 7,615,629.49	**DATE STARTED:** 02/27/2006	**DATE COMPLETED:** 03/13/2006
DRILLING METHOD: Rotosonic			**DRILLING EQUIPMENT:** Sonic AT (track mounted)	
LOCATION: PG&E Compressor Station - Flood Plain, Topock, California			**LOGGED BY:** B. Moayyad, K. Ebel	

DEPTH BGS (feet)	SAMPLE INTERVAL	SAMPLE TYPE/ NUMBER	SAMPLE RECOVERY (ft)	USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS SYMBOL, COLOR, PERCENT COMPOSITION, GRADING, GRAIN SHAPE, MINERALOGY, DENSITY/CONSISTENCY, STRUCTURE, MOISTURE.	COMMENTS DRILLING OBSERVATIONS AND OPERATIONS, DAILY START AND END TIMES , DRILL RATE, REFUSALS, SAMPLING AND TESTING NOTES.
			6	SP	**POORLY GRADED SAND w/ SILT (SP)** - brn (7.5YR4/4), 5% subrnd to subang met gravel up to 4cm, 85% f to c sand, 10% fines, poorly graded, wet, no odor	
145			3	SM	**SILTY SAND W/ GRAVEL (SM)** - brn (7.5YR4/4), 20% subang to subrnd gravel up to 6cm, 60% f to c sand, 20% silty fines, well graded, m consolidated, met, wet, no odor	
150			5	SM	**SILTY SAND w/ GRAVEL (SM)** - dk yellowish brn (10YR4/4), 25% subang to subrnd up to 4cm met gravel, 60% well graded f to c sand, 15% fines, wet, no odor	
155			4	SW	**WELL GRADED SAND w/ SILT AND SAND (SW)** - dr yellowish brn (10YR4/4), 10% subang to subrnd up to 3cm met gravel, 75%well graded f to c sand, 15% fines, moist to wet	
			2	SW	**SILTY SAND (SM)** - brn (7.5YR4/4), 5% ang to subrnd met gravel up to 1.5cm increasing with depth, 85% poorly graded m to c sand, 10% fines, loose, wet	
			2	SM	**SILTY SAND w/ GRAVEL (SM)** - dk yellowish brn (10YR4/4), 15% subang to subrnd up to 2.5cm met gravel, 75% well graded f to c sand, 10% fines, mostly met, trace chert, loose, wet, no odor	Collected Isoflow sample
160			4	SM	**SILTY SAND W/ GRAVEL (SM)** - brn (7.5YR4/4), 25% subang to subrnd gravel up to 6.5cm, 60% m to c sand, 15% silty fines, well graded, m consolidated, met, wet, no odor	Drill rate = 0.75' to 1.5' / min
165			4	SW	**SILTY SAND (SW)** - mottled dk reddish brn (5YR3/4), 10% subang to subrnd gravel up to 2.5cm, 50% well graded f to m sand, 40% silt, metamorphic, dry to damp, no odor, interbedded sandy silt laminations	
170			5.5	SW	**SAND w/ GRAVEL (SW)** - dk reddish brn (5YR3/4), 20% subang to subrnd gravel up to 5cm, 75% f to c sand, 5% fines, well graded, loose, met, wet	
175			2.5	SM	**SILTY SAND w/ GRAVEL (SM)** - brn (7.5YR4/4), 15% subang to subrnd gravel, 70% f to m sand, 15% fines, poorly graded, met,increasingly consolidated, slightly to moderately calcareous, moist to wet	

PROJECT NUMBER:	BORING NUMBER:
326128.01.16.EN	*MW-47*

SOIL BORING LOG - DRAFT FOR DISCUSSION

PROJECT NAME: IMPM Drill Program		**HOLE DEPTH (ft):** 288.0	**DRILLING CONTRACTOR:** Prosonic Corp. Phoenix, AZ	
SURFACE ELEVATION: 482.6 ft. MSL	**NORTHING (CCS NAD 27 Z 5):** 2,103,450.05	**EASTING (CCS NAD 27 Z 5):** 7,615,629.49	**DATE STARTED:** 02/27/2006	**DATE COMPLETED:** 03/13/2006
DRILLING METHOD: Rotosonic			**DRILLING EQUIPMENT:** Sonic AT (track mounted)	
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DEPTH BGS (feet)	SAMPLE INTERVAL	SAMPLE TYPE/ NUMBER	SAMPLE RECOVERY (ft)	USCS CODE	SOIL DESCRIPTION SOIL NAME, USCS SYMBOL, COLOR, PERCENT COMPOSITION, GRADING, GRAIN SHAPE, MINERALOGY, DENSITY/CONSISTENCY, STRUCTURE, MOISTURE.	COMMENTS DRILLING OBSERVATIONS AND OPERATIONS, DAILY START AND END TIMES , DRILL RATE, REFUSALS, SAMPLING AND TESTING NOTES.
285			0	BR	**MIOCENE CONGLOMERATE BEDROCK (BR)** - 60% well graded subang to rnd gravel up to 10cm, 30% well graded sand, 10% fines, very calcareous, well consolidated to mostly hard, mod to very altered locally, mostly met, dry to moist	
					Boring Terminated at 288 ft	

ABBREVIATIONS

cc = continuous core run
brn = brown
lt = light
dk = dark
vf = very fine-grained
f = fine-grained
m = medium-grained
c = coarse-grained
vc = very coarse-grained
ang = angular
subang = subangular
subrnd = subrounded
rnd = rounded
br = bedrock formation
ss = sandstone
conglom = conglomerate
comptd = compacted
qtz = quartz

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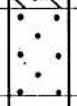
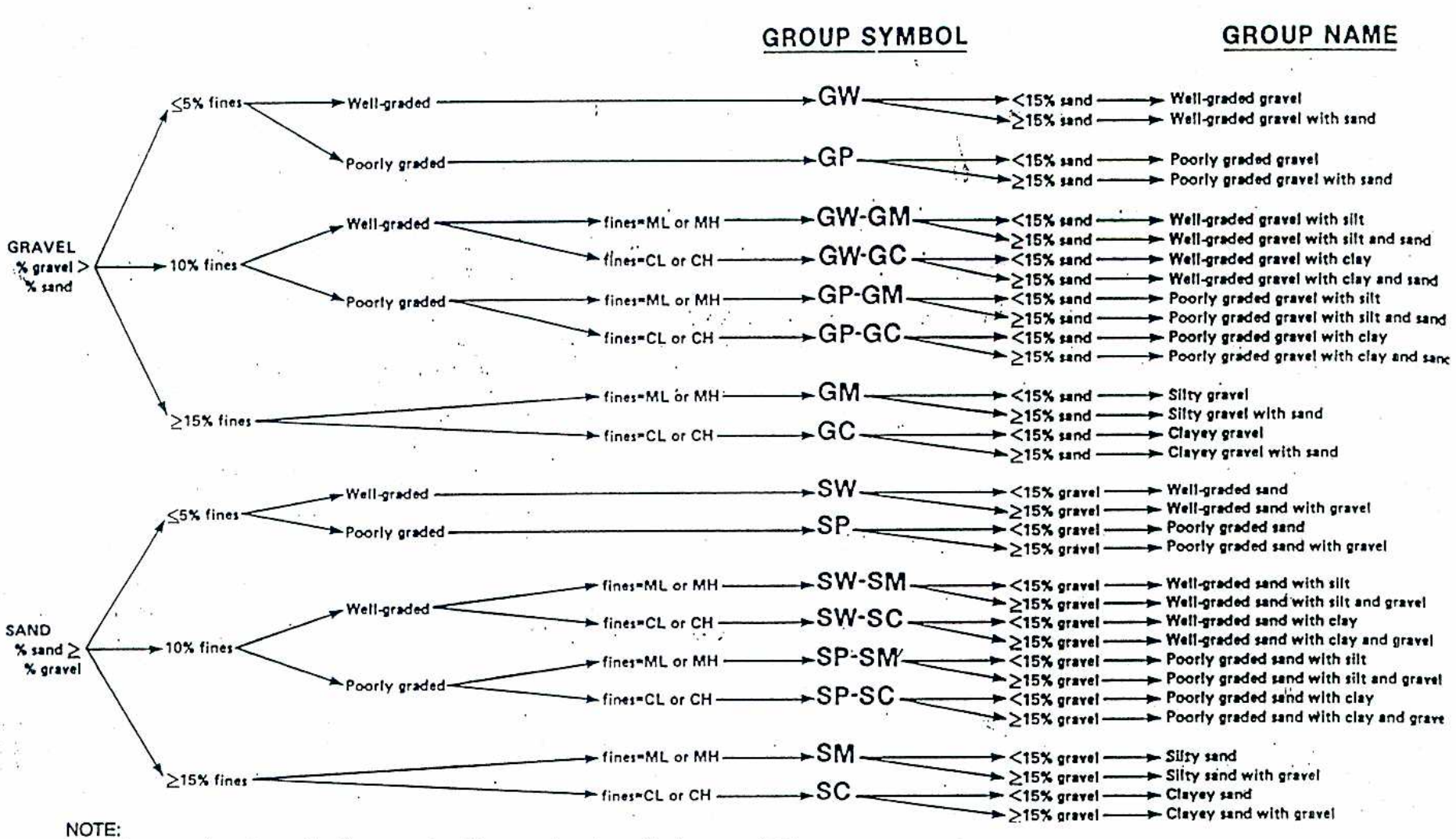
ATTACHMENT B

Unified Soil Classification System and Logging Criteria

GENERAL SOIL CATEGORIES			SYMBOLS		TYPICAL SOIL TYPES
COARSE GRAINED SOILS More than half is larger than No. 200 sieve	GRAVEL More than half coarse fraction is larger than No. 4 sieve size	Clean Gravel with little or no fines	GW		Well Graded Gravel, Gravel-Sand Mixtures
			GP		Poorly Graded Gravel, Gravel-Sand Mixtures
		Gravel with more than 12% fines	GM		Silty Gravel, Poorly Graded Gravel-Sand-Silt Mixtures
			GC		Clayey Gravel, Poorly Graded Gravel-Sand-Clay Mixtures
	SAND More than half coarse fraction is smaller than No. 4 sieve size	Clean sand with little or no fines	SW		Well Graded Sand, Gravelly Sand
			SP		Poorly Graded Sand, Gravelly Sand
		Sand with more than 12% fines	SM		Silty Sand, Poorly Graded Sand-Silt Mixtures
			SC		Clayey Sand, Poorly Graded Sand-Clay Mixtures
FINE GRAINED SOILS More than half is smaller than No. 200 sieve	SILT AND CLAY Liquid Limit Less than 50%		ML		Inorganic Silt and Very Fine Sand, Rock Flour, Silty or Clayey Fine Sand, or Clayey Silt with Slight Plasticity
			CL		Inorganic Clay of Low to Medium Plasticity, Gravelly Clay, Sandy Clay, Silty Clay, Lean Clay
			OL		Organic Clay and Organic Silty Clay of Low Plasticity
	SILT AND CLAY Liquid Limit Greater than 50%		MH		Inorganic Silt, Micaceous or Diatomaceous Fine Sandy or Silty Soils, Elastic Silt
			CH		Inorganic Clay of High Plasticity, Fat Clay
			OH		Organic Clay of Medium to High Plasticity, Organic Silt
HIGHLY ORGANIC SOILS			PT		Peat and Other Highly Organic Soils

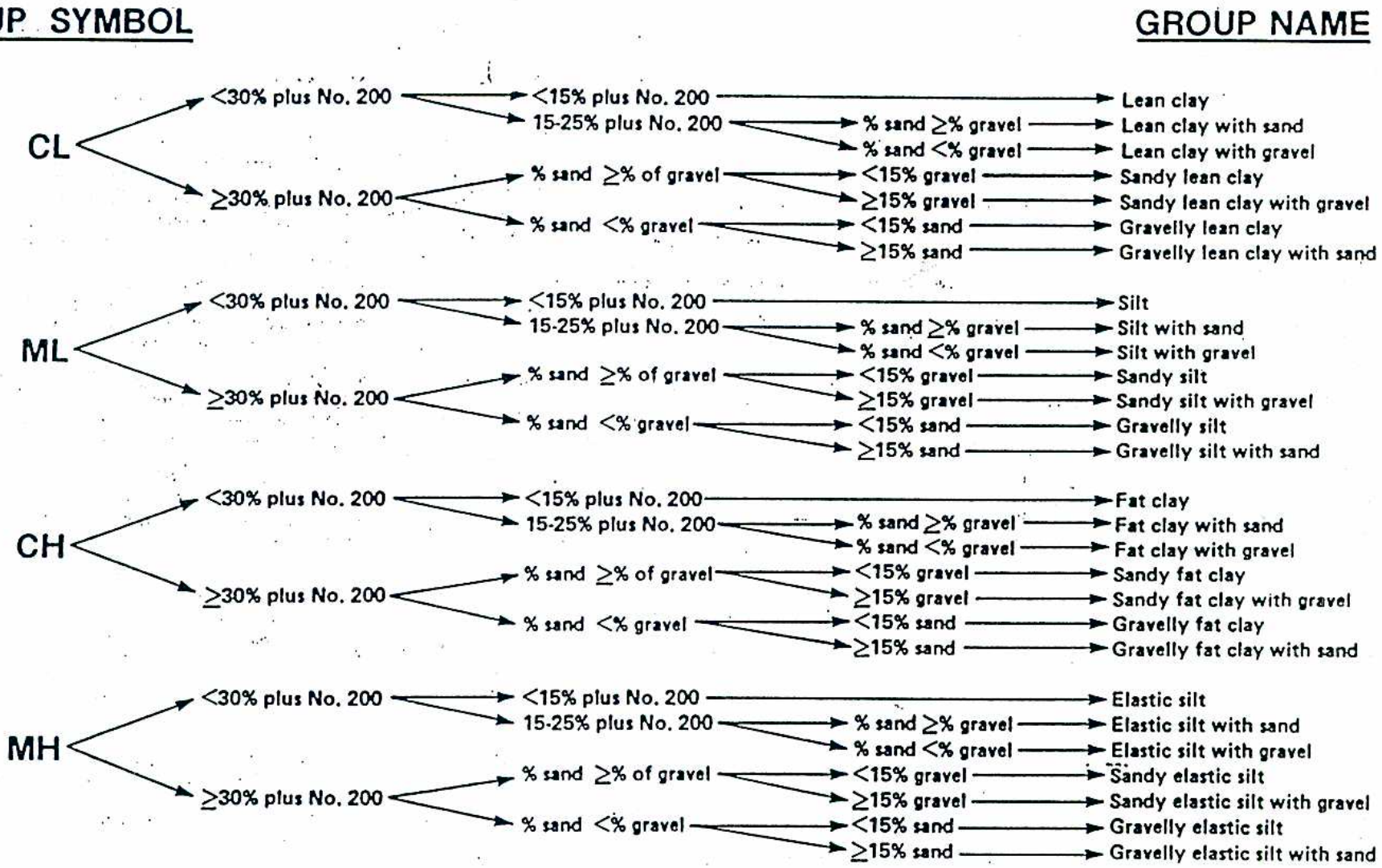
UNIFIED SOIL CLASSIFICATION SYSTEM

		PLATE
JOB NUMBER	DATE APPROVED	



NOTE:
Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5%
(After ASTM Designation D2488 Standard Test Method for Classification of Soils for Engineering Purposes)

Flow Chart for Classifying Coarse-grained Soil
(50% or more retained on No. 200 sieve)
Field Guide for Soil Classification and Logging Procedures



NOTE:
Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5%
(After ASTM Designation D2488 Standard Test Method for Classification of Soils for Engineering Purposes)

Flow Chart for Classifying Fine-grained Soil
(50% or more passing No. 200 sieve)
Field Guide for Soil Classification and Logging Procedures

similar, the material is classified as poorly graded or well sorted. If fines represent less than 5 percent of the total mass, the symbol SP is used for a poorly-graded sand and SW for a well graded sand. If silts and/or clays exceed 12 percent, the symbols GC, SC, GM, and SM are used, respectively.

If the silts and clays are between 5 to 12 percent of the total sample weight, a dual classification with two group symbols is used. The first symbol is GW, GP, SW, or, SP, and the second is GC, GM, SC, or SM. The group name corresponds to the first group symbol plus the modifying words "with clay" or "with silt" to indicate the plasticity characteristics. If the fines plot on the CL-ML range on the plasticity chart (Figure 2-2), possible dual classification group names are:

GW-GM	well graded gravel with silt
GW-GC	well graded gravel with clay
GP-GM	poorly graded gravel with silt
GP-GC	poorly graded gravel with clay
SW-SM	well graded sand with silt
SW-SC	well graded sand with clay
SP-SM	poorly graded sand with silt
SP-SC	poorly graded sand with clay

If silts and clays exceed 12 percent of the total weight of sample, the modifiers "M" and "C" are used, respectively. If a sand or gravel has more than 15 percent of the other coarse-grained constituent, the words "with gravel" or "with sand" are added to the group name. A flow chart for classifying coarse-grained soils is presented in Figure 2-3.

2.2 Fine-grained Soils

Particles passing the No. 200 sieve are silts (M) and clays (C). These soils must undergo testing in order to differentiate between them. Typical tests used are: dry strength, dilatancy, toughness, and plasticity. These terms are further discussed in Tables 2-2 through Table 2-6. Silts have little or no dry strength when dry, while clays have considerable dry strength. Dry strength, dilatancy, and toughness are also used to identify the fine-grained fraction of coarse-grained soils.

TABLE 2-2
Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with the mere pressure of handling.
Low	The dry specimen crumbles into powder with some finger pressure.
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure.
High	The dry specimen cannot be broken with finger pressure. The specimen will break into pieces between the thumb and a hard surface.
Very high	The dry specimen cannot be broken between the thumb and a hard surface.

TABLE 2-3
Criteria for Describing Dilatancy

Description	Criteria
None	There is no visible change in the specimen.
Slow	Water appears slowly on the surface of the specimen during shaking, and does not disappear, or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking, and disappears quickly upon squeezing.

TABLE 2-4
Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.

TABLE 2-5
Identification of Inorganic Fine-grained Soils from Manual Tests

Soil Symbol	Dry Strength	Dilatancy	Toughness
ML	None to low	Slow to rapid	Low or thread cannot form
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	None	High

TABLE 2-6
Criteria for Describing Plasticity

Description	Criteria
Nonplastic	A 1/8-inch (3-mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to read the plastic limit. The thread cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be re-rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier that the plastic limit.

Fine-grained soils are accurately determined in the laboratory using the Atterberg Limits test. This test include liquid limit, plastic limit, and plasticity index measurements. The liquid limit is the water content of a soil at the point of transition from a plastic to a liquid state. The plastic limit is the water content of a soil at the point of transition from a semisolid to a plastic state. The plasticity index is the difference between the liquid limit and the plastic limit.

As shown in the Figure 2-2, five fields have been identified. These include:

- Silty Clays (CL), Organic Silts (OL) or Organic Silty Clays (OL) of low plasticity
- Fat Clays (CH) and Organic Clays (OH)
- Inorganic Silts (ML) and Organic Silty Clays (OL) of low plasticity
- Silts (MH) and Organic Clays (OH) of a high plasticity
- Silty Clays to Clayey Silt (CL-ML) of low plasticity

Fine-grained soils with a liquid limit > 50 are modified by the symbol H (MH or CH), and those with a liquid limit < 50 are modified by the symbol L (ML or CL). Fine-grained soils containing 30 percent or more coarse-grained fraction should be modified by descriptive terms, such as "gravelly" or "sandy." If the coarse fraction is between 15 and 30 percent, the words" with sand and/or gravel" should be added to the group name. A flow chart for classifying fine-grained soils is presented in Figure 2-4.

2.3 Organic Soils

To classify organic soils, the percentage organic material present in the soil as well as the non-organic fines must be estimated. When the organic content ranges from 18 to 36 percent, the material is an organic clay or an organic silt, depending on the nature of the fine-grained constituents. When the organic content is between 36 and 90 percent, the material is designated a muck or peaty muck (OL or OH). A flow chart for classifying organic soil is presented in Figure 2-4. The term "peaty" is added if the organic remains are

SOP-B5

Decontamination of Personnel and Equipment, Well Drilling, and Subsurface Sampling and Investigations
Standard Operating Procedures for PG&E Topock Program

This standard operating procedure provides general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially-contaminated areas.

REQUIRED DOCUMENTS

1) Event-specific sampling and analysis plan (SAP).

2) Applicable project work plan or monitoring plan, which includes a health and safety plan. Refer to Topock Program *Sampling, Analysis, and Field Procedures Manual* and *Quality Assurance Project Plan*, as required.

PREPARATION AND SETUP

1) Initiate field log sampling book for activity.

2) Inspect all equipment necessary to carry out activities detailed in event-specific SAP.

3) Review decontamination guidelines for equipment necessary to carry out activities.

Equipment List

- Demonstrated analyte-free, deionized water (specifically, ASTM Type II water)
- Distilled water
- Potable water; must be from a municipal water supplier, otherwise an analysis must be run for appropriate volatile and semivolatile organic compounds and inorganic chemicals (e.g., Target Compound List and Target Analyte List chemicals)
- 2.5% (W/W) Liquinox® and water solution
- Large plastic pails or tubs for Liquinox® and water, scrub brushes, spray or squirt bottles for Liquinox® solution, and distilled or deionized water, plastic bags, and sheets
- Department of Transportation (DOT)-approved 55-gallon drum for disposal of waste
- Nitrile or latex gloves
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

GUIDELINES

Personnel Decontamination

Decontamination should be performed after completion of tasks whenever personnel come in contact with contaminated (or potentially-contaminated) soils or fluids. Full or emergency decontamination should be performed when contaminant concentrations are not known and when potentially-contaminated fluids come into contact with skin beneath clothing, eyes, nose, or ears.

Procedures for full/emergency decontamination are to:

1) Remove contaminated clothing.

2) Step into containment area (decontamination pad or large pail).

3) Rinse away fluids and soil.

4) Wash skin with Liquinox® solution in such a way as to not abrade skin. (Liquinox® solution should be made with potable water and sufficient detergent to create foamy suds.) Eyes and mucus membranes in contact with contaminants must be washed with eye wash or drinking water continuously for at least 15 minutes.

5) Rinse with potable water.

6) If no other clothes are available, wash affected clothes in Liquinox® solution prior to donning. If other clothes are available, contaminated clothes may be isolated for later wash or disposed of along with personal protective equipment (PPE).

7) Any PPE worn (including disposable latex booties, gloves, and disposable coveralls) should be discarded into DOT-approved 55-gallon drum located at the MW-20 bench.

8) Dispose of wash and rinseate water in an appropriate container with other chromium contaminated fluids. These fluids may be taken to the MW-20 bench for treatment or to a Baker® tank within the PG&E facility for containerization.

9) Replace all appropriate clothing and PPE before resuming work or departing site.

Moist soil or water containing known concentrations of hexavalent chromium less than 50 parts per billion that comes into contact with hands need not require full decontamination. Dry soil containing chromium that comes into contact with clothing can also be decontaminated in an abbreviated manner.

Daily decontamination and minor exposure contact decontamination procedures are to:

1) Wash hands and skin that comes in contact with soils or water that may contain small concentrations of chromium as soon as possible after contact. Wash with Liquinox® solution and rinse with potable water.

2) If contaminated soil or water contacts hands through hole or over lip of gloves, remove gloves and wash hands thoroughly before donning new gloves.

3) Discard gloves into DOT-approved 55-gallon drum located on the MW-20 bench at the end of the day or event.

4) Remove coveralls or dry soils from clothing before leaving site. Clothing contaminated by moist soil or water containing hexavalent chromium should be removed and promptly washed.

5) At the end of the work day, shower entire body, including hair, either at the work site or at hotel.

Sampling Equipment Decontamination—Groundwater Sampling Pumps

Sampling pumps are decontaminated after each use as follows:

1) Don waterproof (nitrile or latex) gloves.

2) Run pump and reusable tubing through with Liquinox® solution (made with potable water) so that the pump and all portions or the tubing have been flushed with the solution for at least 30 to 60 seconds. More time is required if water is present in the tubing. If unsure, run for 2.5 minutes. Outside of the tubing should also be submerged and washed in the solution.

3) Run pump and reusable tubing through first rinse (with potable or distilled water) so that the pump and all portions or the tubing have been flushed with the solution for at least 60 seconds. More time is required if any suds are present in the pump or tubing.

4) Run pump and reusable tubing through second rinse (with distilled water) so that the pump and all portions or the tubing have been flushed with the solution for at least 30 seconds. More time is required if water from first rinse is present in tubing.

5) Equipment blank samples may be taken at this point using ASTM Type II water or distilled water as required by laboratory.

Sampling Equipment Decontamination—Other Equipment

Reusable sampling equipment is decontaminated after each use as follows:

1) Don nitrile or latex gloves.

2) Wash all equipment surfaces that contacted the potentially contaminated soil/water with Liquinox® solution (made from potable water). Water quality meters that are not placed within wells should not be washed with detergent, as this will degrade sensors; these meters should be double-rinsed. Any portion of equipment that is placed inside wells (including cables and pipe) and that comes in contact with moisture should be washed with detergent.

3) Rinse equipment and supplies with potable water, if the equipment is not used to collect groundwater or soil samples. Equipment used to collect samples or take water quality parameters should be rinsed with distilled water.

4) Air dry or towel dry with paper towels.

5) Collect all rinseate and dispose of in Baker® tank within the PG&E facility or Denbeste® tank at the MW-20 bench.

6) Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums if highly contaminated. If not contaminated, equipment can be washed and disposed of in trash.

7) Preserved bottles may need to be washed before being packed or handed without gloves. The outsides of filled bottles should be rinsed and toweled dry to prevent contact with strong acids or based.

Heavy Equipment and Tools

Heavy equipment such as drilling rigs, drilling rods/tools, and the backhoe will be decontaminated upon arrival at the site and between locations as follows:

1) Set up a decontamination pad in designated area.

2) Steam clean heavy equipment until no visible signs of dirt are observed. This may require wire or stiff brushes to dislodge dirt from some areas.

KEY CHECKS AND ITEMS

- Clean with solutions of Liquinox® and potable water. Rinse with distilled or deionized water if equipment is used to collect samples or water readings; otherwise, rinse with potable water.
- Equipment placed within wells should be thoroughly decontaminated and before being placed in a well. All potions of this equipment that come into contact with moisture should be decontaminated.
- Decontaminate filled sample bottles before relinquishing them to anyone.

SOP-B6

Disposal of Waste Fluids and Solids (IDW)
Standard Operating Procedures for PG&E Topock Program

This standard operation procedure (SOP) describes the procedures used to dispose of hazardous fluid and solid materials generated as a result of the site operations. This SOP does not provide guidance on the details of Department of Transportation (DOT) regulations pertaining to the transport of hazardous wastes; the appropriate Code of Federal Regulations (49 CFR 171 through 177) should be referenced. Also, the site investigation-derived waste management plan should be consulted for additional information and should take precedence over this SOP.

REQUIRED DOCUMENTS

1) Event-specific sampling and analysis plan.

2) Applicable project work plan or monitoring plan. Refer to Topock Program *Sampling, Analysis, and Field Procedures Manual* and *Quality Assurance Project Plan*, as required.

3) Topock Program Health and Safety Plan.

PREPARATION AND SETUP

1) For soil and groundwater collection and storage, a subcontractor (either Denbeste Transportation, Inc. or a drilling or sampling contractor) will bring clean, empty drums, roll-off bins, Denbeste® tanks, or Baker® Tanks to the site.

2) Locate the empty drums at the field staging area and move drums to drilling locations as required.

EQUIPMENT LIST

- DOT-approved 55-gallon steel drums, Denbeste® Tanks, Baker® Tanks or roll-off bins
- Portable polytanks for transferring water from well samples locations to tanks or bins
- Tools for securing drum lids
- Funnel for transferring liquid into drum
- Water pump to transfer liquids
- Labels
- Marking pen for appropriate labels
- Seals for 55-gallon steel drums
- Plastic sheets and buckets to catch leaks and drips

PROCEDURES

General Methodology

1) Prior to filling soil bins, determine if plastic sheeting is required for soil disposal bins. Line bins with plastic sheeting as required by disposal contractor and facility. Seal bins and

check for water tightness on soil bins and water tanks. Inventory all bins and tanks by unique identifier.

2) Fill soil bins with drilling and well installation wastes. When three-fourths full, cap or close, and update inventory. The drilling, sampling, or waste disposal subcontractor will move the drums to the on-site drum storage area. Fill tanks with clear water. Muddy water should be allowed to settle out in soil bins or separator tanks prior to transfer to Denbeste® or Baker® Tanks.

3) Separate full drums by waste and media types.

4) As the drums are filled in the field, affix labels indicating that the contents are potentially hazardous. Update bin log with type of waste and locations from which soil is obtained.

5) Drums may be used for temporary storage of soil or water. The drums should be closed and sealed at the end of each work day or when full. Drums used for soil should not be used for clear water storage without decontamination. Drums should be labeled if the contents are not transferred to a tank or bin by the end of the day.

6) Portable polytanks are used to transfer water from wells being sampled or developed to Denbeste® or Baker® tanks. These tanks should be emptied at the end of each day or when full. Sediment that accumulates that the bottom of these tanks should be removed and disposed of with contaminated soil on a regular basis.

7) Soils and groundwater from the site have been characterized for waste disposal. Wastes, which have not been included in the characterization, should be labeled sampled and separated from other wastes.

8) Typically Denbeste Transportation, Inc. should be contacted for disposal of wastes and movement of soil bins and large water tanks. Other contractors may also be involved in waste disposal.

Labeling

1) Label drums and other containers used for storing wastes from drilling, development, and sampling operations when accumulation in the container begins. Labels will include the following minimum information:

   - Container number
   - Container contents
   - Origin (source area including individuals wells, piezometers, and soil borings)
   - Date that accumulation began
   - Date that accumulation ended

2) When laboratory results are received, complete or revise drum labels to indicate the hazardous waste constituents in compliance with 40 CFR, Part 262, Subpart C.

Groundwater and Drilling Fluids

1) Collect water and drilling fluids generated during well sampling and development and during soil boring in polytank or hopper (water-tight bin used to transport cuttings with forklift).

SOP-B9

Drilling--Sonic Method
Standard Operating Procedures for PG&E Topock Program

REQUIRED DOCUMENTS

1) Event-specific sampling and analysis plan (SAP), Work Plan or event-specific field instructions. Planned borehole depth, proposed well construction/specifications, and field sampling summary table, if available.

2) Applicable project work plan or monitoring plan. Refer to Topock Program Sampling, Analysis, and Field Procedures Manual and QAPP (Procedures Manual), as required.

3) Topock Program Health and Safety Plan (HSP)

4) Previous sampling, drilling, or well construction logs from other boreholes or wells in the vicinity, if available

5) Blank sampling log and field notebook

Equipment List:

- Drilling rig (Sonic)
- Drill rods and core barrel

GUIDELINES

PRIOR TO INTRUSIVE ACTIVITIES AT ANY DRILLING LOCATION THE AREA WILL HAVE BEEN CLEARED OF ALL UTILITIES AND THE CLEARANCE RECORDED IN THE FIELD LOGBOOK. It is also the field team leader's responsibility to confirm that all required access permits are in place.

Prior to the start of drilling, the area of site activity will be identified and delineated using stakes and/or flagging. The extent of impact will be mineralized at all times and the delineated area of activity decreased when possible. All sensitive vegetation or habitats will be delineated with stakes and/or flagging and no impact will occur in these areas.

Sampling depths and total depths of holes shall be determined by temporary marking of drill equipment, by reference to standard equipment dimensions (for example, 5-foot hollow-stem auger flights), or by measurement using a fiberglass tape. Final total depth measurements will be confirmed using a weighted fiberglass tape. Observations by the field geologist or engineer shall be recorded directly in the borehole log.

The field borehole log is the standard form used to document subsurface geologic conditions. The borehole log is divided into two areas. One portion contains spaces for noting information on the drilling and sampling methods. The second portion contains space for noting lithologic descriptions. All sheets shall be filled out completely, legibly, and in ink. The borehole log will be filled out in the field at the time of the drilling and sampling. The original logs shall be permanent records, and information on the logs may not be

erased. If corrections are needed, information shall be crossed out with a single line and the correction shall be initialed and dated.

The use of water and drilling fluid to assist in sonic drilling for monitoring well installation will be avoided, unless required for such conditions as running sands or drilling bedrock formations.

Temporary outer casing, drill rods, core barrels, and other downhole drilling tools will be properly decontaminated prior to the initiation of drilling activities and between each borehole location. Core barrels and other downhole soil sampling equipment will also be properly decontaminated before and after each use.

Sonic inner casing (sample tube) will have an inside diameter of at least 3.25 inches. Samples may be collected for chemical analysis. For sonic drilling, these samples are collected in a metal trough. A continuous core is collected and the sample interval is selected from the length of core run.

Surface casing may be installed where soil borings will penetrate a confining layer or when there is risk of eroding soil during the drilling process if water is used.

PROCEDURES

Instructions for Completing Soil Boring Logs

Soil boring logs will be completed in the field log books. Information collected will be consistent with that required for Form D1586 (attached), a standard CH2M HILL form or an equivalent form that supplies the same information. Procedures will follow the SOP "*Soil*

Non-Core Collection Drilling

At locations or depths from which core collection is not required, drilling may proceed without the recovery of soil cores. The drilling will include advancing the larger outer casing and the use of water to facilitate cuttings removal from the boring. The inner casing drill rods may or may not be used, depending on the cuttings recovery when drilling with the larger outer casing.

Continuous Core Drilling

At locations or depths when core collection is required, drilling will proceed using an outer casing and an inner core sample tube. The inner core sampling tube will be advanced first without the use of water. Before removal of the sampling tube, the outer casing will be advanced, using water only as needed for cuttings removal, to the same total depth as the inner casing. The outer casing will stabilize the boring when the sampling tube is removed. The process is repeated in 10 to 20 foot intervals, as the lithology of the boring permits.

The length of each drilling interval should be adjusted depending on the lithology and the quality and recovery percentage of the sample cores retrieved. At locations with very hard drilling (i.e. with large cobbles or hard materials) or when percent recovery decreases, the drilling interval should be decreased until such time that the conditions change.

After retrieval of the inner sampling core tube, the minimally disturbed sample cores will be collected into plastic liner sleeves in intervals of 2 to 3 feet. The plastic sleeves will be

immediately sealed on both ends. The cores will be used for visual descriptions and may be used for analysis for geochemical and geotechnical parameters.

KEY CHECKS AND ITEMS

- Check entries to the soil boring log and field logbook in the field during sampling activities because the cores will be disposed at the end of the fieldwork, confirmation and corrections cannot be made later.
- Check that the sample numbers and intervals are properly specified.
- Ensure that drilling equipment is decontaminated prior to the beginning of work and between each borehole.
- All materials generated during sampling (debris, PPE, decontamination liquids, etc.) will be placed in approved IDW storage containers pending analysis and disposal off site as outlined in SOP-B6, *Disposal of Waste Fluids and Solids (IDW)*.

SOP-B11

Site Clearance and Permitting
Standard Operating Procedures for PG&E Topock Program

This standard operating procedure (SOP) addresses the procedures for site clearance and permitting at the Topock site. This SOP should be used to obtain proper site clearance and permits before any work is performed at a site.

REQUIRED DOCUMENTS

1) Applicable project work plan, event-specific sampling and analysis plan (SAP), and/or Procedures Manual, if applicable.

2) Topock Program Health and Safety Plan (HSP).

3) Site map with work locations identified.

PREPARATION AND SETUP

1) Review applicable project work plan, event-specific SAP, Procedures Manual, and HSP.

2) Identify locations where work will be performed, determine if any subsurface work will be needed.

3) Before the start of any work obtain approval by the appropriate land agencies (such as BLM, USFWS, or the County of San Bernardino). Activities located on PG&E property fall under the jurisdiction of the County; however, approval may also be required from BLM and/or USFWS for activities such as access, waste management, etc.

4) Before the start of any work obtain appropriate approval by the regulatory agencies. These include at a minimum the DTSC. Other regulatory approvals that may be required include, but are not limited to CDFG, USFWS, USACE and RWQCB.

If subsurface work will be involved, follow the following steps:

1) Follow the guidelines of the Southern California Underground Service Alert (USA) agency to mark the edges of the work location as outlined on their web page (http://www.digalert.org). Make sure to:

   - Identify delineated areas with white markings with the requesters company name or logo within the pre-marked zones

   - Delineate the exact area of excavation with white paint through the use of dots or dashes, or a continuous solid line. Limit the size of each dash to approximately 6" in length and 1" width with interval spacing not less that approximately 4 feet. Dots of approximately 1" diameter are typically used to define arcs or radii and may be placed at closer intervals in lieu of dashes. Limit width of lines to 1".

- For point locations (such as a soil boring or well) mark the exact location in the USA box with a stake. Make sure the delineated area around the stake is of adequate radius (50 to 100 feet is appropriate for drilling).

2) Call USA at 1-800-227-2600 at least three working days before the start of work at the identified location and provide them with the information requested on the location request form, shown in Attachment 1. Be ready to give the location in terms of feet relative to I-40 and to Park Moabi Road when calling. You will be assigned a Dig Alert Number, file this number until work at the delineated area is complete. (The number does expire after two weeks and a new number may need to be obtained if work has been delayed.)

3) Mark the Dig Alert Number in the delineated area using white paint as soon as possible after calling USA.

4) If the location is in a developed area, contact a private utility locator and have them perform a sweep of the delineated work area. Util-Locate at (866) 421-5325 is typically used for this service.

5) In some cases the utility companies may need to be contacted directly by CH2M HILL. If the following companies do not respond to the USA ticket or if we are working in their easements, use the following contact information and procedures:

   Southwest Gas: Main contact is Jim Default/702-365-2097 (The required minimum clearance distance from gas pipelines is 18-inches**.** Potholing may need to be performed in advance of design completion Southwest Gas should be called prior to construction activities). If Southwest Gas does not come to the site after the USA call, contact them at their Bullhead City office at (928) 763-7766

   Southern California Gas Co.: Main contact is Frank Castro/818-701-4566; secondary contact is Martin Woodsworth/818-701-4543. If we need to work in their easement, we must provide a letter from BLM giving us permission to be on the property. Southern California Gas Co. also requires advance notification of construction activities. They may also require a copy of the design drawing, potholing activities, and the issuance of a "Non-Interference" letter, if applicable, before work can proceed. One of their representatives may need to be in the field when digging is occurring near their pipeline.

   TransWestern Pipeline Co.: Main contacts are Ron Westbrook (ROW Department)/713-345-3067 and Mike Baxter (Operations)/928-757-3620. They may require potholing if proposed construction activities are near their pipelines. Crossing pipeline requires filling out a simple form.

   Burlington Northern Santa Fe Railroad: Main contact is Greg Rousseau (BNSF)/909-386-4079. Prior to work in their easements submit the proper application with the $250 fee to the Staubach Company.

   City of Needles Utility Dept: Main contact is Ron Myers/760-326-5700 (ext. 7 for the utilities department). Work activities may need to be a minimum of 10 to 15 feet from their utility poles.

6) Do not start subsurface work at the site until the delineated area has been marked or cleared by the appropriate utility agencies.

If the work includes a performing a well installation or abandonment, or drilling a boring:

1) Apply for a San Bernardino County well permit two to three weeks before the start of drilling (one permit per well; cost is /$212.00 per well). Obtain a permit application by calling the Environmental Health Services Department at 1-909-387-4666 (open Monday through Friday, 8:00 a.m. to 5:00 p.m). An example well permit form is shown in Attachment2. The fee schedule for permits is located at http://www.sbcounty.gov/dehs/FEESCHEDULE/feeschedule.htm#wateranchor. Fill out the appropriate permit form and provide it to the California-licensed driller contracted to perform the well installation. The driller is expected to review and file the permit with the San Bernardino County Department of Environmental Health Services (Steve Sesler), address below.

   Environmental Health Services
   385 N. Arrowhead, 2nd Floor
   San Bernardino, CA 92415-0160

2) A well permit needs to be obtained from San Bernardino County for well abandonment by the same procedure described in #11. Check the 'destruction' box on the same permit form used for well installation.

3) A permit also needs to be obtained from San Bernardino County for any boring that reaches to or below the water table, even if a well is not actually installed. The permit process is the same as described in #11.

Attachment C
Standard Operating Procedures for Groundwater Monitoring and Sampling

SOP-A2

Purging and Sampling of 1-inch-diameter Groundwater Monitoring Wells Modified Well-Volume Method Standard Operating Procedures for PG&E Topock Program

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This standard operating procedure (SOP) addresses the procedures and equipment to be used for purging and sampling all groundwater monitoring wells at the Topock site with 1-inch casing diameters. This SOP should be used for sampling groundwater monitoring wells using dedicated tubing and a peristaltic pump (one or two). A well-volume based purging and sampling method will be used for these wells.

REQUIRED DOCUMENTS

1) Event-specific planned sample table (PST).
2) Applicable project work plan or monitoring plan. Refer to Topock Program Sampling, Analysis, and Field Procedures Manual and Quality Assurance Project Plan (QAPP) as required.
3) Topock Program Health and Safety Plan (HSP).
4) Field notebook.
5) Database generated sampling logs.
6) Tabular historic field data if previous results not available on database generated sampling logs.

PREPARATION & SETUP

1) Review event-specific PST or event-specific field instructions, previous sampling logs, Procedures Manual, and HSP.
2) Initiate field logbook for sampling activity.
3) Inspect all equipment and verify that the field water quality (WQ) meters have been calibrated prior to use according to SOP-A9, *Calibration of Field Instruments*.
4) Inventory sample bottles and filters for required analyses, and confirm the lab courier schedule.
5) Prepare bottles for metals analyses that require preservation according to the event specific PST with procedures outlined in SOP-A6, *Sampling Field Filtration and Preservation for Metals Analyses*.
6) Field-check and setup sampling equipment: WL meter, WQ meters, flow-through cell, pump control and power supply, pump discharge/sampling tubing, spill containment equipment, health and safety equipment, etc. Install dedicated tubing and connect to peristaltic pump. Connect peristaltic pump to power supply.
7) Open well protection lid and measure initial static WL according to SOP-A7, *Water level Measurements*. Record WL value on sampling log.

8) If the well is equipped with a transducer and it is necessary to remove transducer from the well for sampling, follow SOP-C1, *Temporary Removal and Replacement of Transducers*

9) Measure total depth of well with a decontaminated weighted tape according to SOP-A11, *Total Depth Measurements*. Record measured total depth of well on sampling log under 'Field measured confirmation of Well Depth'.

PURGING AND SAMPLING PROCEDURES

1) Prepare database generated groundwater sampling log for the well.

2) Use the water level and the measured total depth recorded in the steps 7 and 9 above to calculate the column of standing water in the well (total depth minus water level). Enter the standing water height in the groundwater sampling log.

3) Calculate 3-casing volumes using the following equation:

   3*(SWH*D) = 3 casing volumes

   SWH = standing water height
   D = the volume of water per foot of height for the well's diameter

   The following values are used for D:

   1″ well = 0.04
   2″ = 0.17
   4″ = 0.66
   6″ = 1.5
   8″ = 2.6

   Record purge volume on sampling log.

4) Use the purge rate listed on the PST to determine the target purge rate. Compare the calculated purge volume and purge duration from prior events listed on the PST to the current calculations. If the well has not been previously sampled, estimate the expected purge parameters using previous sampling information from nearby wells. Start purging and measure WL and calculate the purge rate every 2 minutes during the start of purging. Allow 500 milliliters of purge water to pass through the system (approximately 1-system volume), start recording field indicator parameters per sampling sheet.

5) Continue purging, and measure WL and field parameters every 2-3 minutes at a minimum. Decrease the purge rate and measure/record new purge rate if significant drawdown is observed (WL is below the top of the screen) or turbidity increases more than 5-10 NTU's. Record time for all measurements collected. Note and provide qualifying remarks if parameter readings are anomalous or unstable due to instrument problem.

6) Observations on sample appearance and clarity during purging and at sampling are required. For standardization, use a glass jar or clear plastic bottle to collect and record observations of discharge water appearance during purging. Also note characteristics of any odors associated with discharge.

7) Continue purging until **3-casing volumes** have been purged **and** field parameters stabilize. For 1-inch wells the total volume purged is typically 4-6 casing volumes. Indicator parameters are considered stabilized when 3 consecutive readings made several minutes apart fall within the following EPA stabilization criteria:

   - pH ± 0.1 pH units
   - Specific conductance ± 3%
   - ORP ± 10 millivolts
   - Turbidity ± 10% NTU units (when turbidity is >10 NTUs)
   - Dissolved oxygen ± 0.3 mg/L
   - Temperature ± 2° Celsius

8) Collect samples for analyses according to event-specific PST. For all samples, decrease the discharge rate to reduce water turbulence at the pump discharge point. Prepare sample containers and collect gas-sensitive analytes first. The preferred collection order will be volatile organic compounds (VOCs), semi-volatile organic compound (SVOCs), metals (including hexavalent chromium [Cr(VI)] and total chromium [Cr(T)], then general chemistry with stable isotopes last. Sample containers are to be filled by transferring water directly from the pump discharge to the appropriate sample container. Filter and preserve as required for individual samples as outlined in the event-specific PST.

9) Record sample information, final WL, and purge volume data on sampling log.

10) If well was equipped with a transducer, replace transducer according to SOP-C1, *Temporary Removal and Replacement of Transducers*.

11) Close and secure well protection lid.

12) Follow the Field Procedures Manual for sample handing and management, equipment decontamination, and investigation-derived waste (IDW) management.

LOW VOLUME AND POOR RECOVERY WELLS

Some groundwater monitoring wells under the GMP may exhibit slow or poor recovery upon purging. These groundwater monitoring wells may not recover sufficiently during purging and run completely dry without an opportunity to collect the required series of groundwater stabilization parameters, or run dry prior to sampling. The following procedures should be followed for collection representative groundwater samples from wells that go dry during purging activities in preparation for groundwater sampling.

PREPARATION & SETUP

Follow steps in Preparation and Setup above and evaluate the volume of water to be discharged prior to the groundwater monitoring well going dry, if known.

PURGING AND SAMPLING PROCEDURES FOR LOW RECOVERY WELLS

1) Prepare database generated groundwater sampling log for the well.
2) Use the water level and the measured total depth recorded in the steps 7 and 9 above to calculate the column of standing water in the well (total depth minus water level). Enter the standing water height in the groundwater sampling log.
3) Calculate 3-casing volumes and record on sampling log.
4) Use the purge rate listed on the PST to determine the target purge rate. Compare the calculated purge volume and purge duration from prior events listed on the PST to the current calculations. If the well has not been previously sampled, estimate the expected purge parameters using previous sampling information from nearby wells. Start purging at a rate of less than one gallon per minute. Measure WL and confirm purge rate.
5) Continue purging and measuring WL. Begin recording field indicator parameters after 500 milliliters of water has been purged, and every 2-3 minutes at a minimum thereafter. Record time for all measurements collected. Note and provide qualifying remarks if parameter readings are anomalous or unstable due to instrument problem.
6) Observations on sample appearance and clarity during purging and at sampling are required. For standardization, use a glass jar or clear plastic bottle to collect and record observations of discharge water appearance during purging. Also note characteristics of any odors associated with discharge.
7) Continue purging until **3-casing volumes** have been purged **and** field parameters stabilize, or until the well is purged dry. If the well purges dry during the observation period, immediately shut off the pump and collect a final set of water quality parameters (ph, specific conductance, ORP, turbidity, dissolved oxygen, and temperature).
8) Record the final water level, note the time, the volume of water discharged and the elapsed time for the complete discharge of the well.
9) Allow the well to recharge to 80 percent of the original height of the water column. Ideally, this should be the following day - within 24 hours of the well being purged dry. The recovery period to achieve 80 percent of the height of the water column could take longer than 24 hours in some instances.
10) Calculate the volume of water in the well and volume of water needed to fill all of the sample containers. Initiate procedures for the well sampling. Begin to slowly purge the well and collect at least one set of water quality parameters prior to filling the sample containers. Collect samples for analyses according to event-specific PST. Prepare sample containers and collect gas-sensitive analytes first. The preferred collection order will be VOCs, SVOCs, metals, and then general chemistry. If an insufficient volume of water will be generated to fill all of the sample containers, prioritize the sample collection to obtain the critical analytes for the main COCs first, then continue collecting samples until the groundwater supply is exhausted. Verify the critical analyte list with the Project Manager or the Field Task Manager. Sample containers are to be filled by transferring water directly from the pump discharge to the appropriate sample

container. Filter and preserve as required for individual samples as outlined in the event-specific PST.

11) Record sample information, final WL, and purge volume data on sampling log.

12) If well was equipped with a transducer, replace transducer according to SOP-C1, *Temporary Removal and Replacement of Transducers*.

13) Close and secure well protection lid.

14) Follow the Field Procedures Manual for sample handing and management, equipment decontamination, and IDW management.

Project Name PGE Topock GMP
Job Number
Field Team Field Conditions

Sampling Event
Date
Page of

Well/Sample Number **QC Sample ID** QC Sample Time

Purge Start Time Purge Method Ded. Pump

Flow Cell: Y / N Min. Purge Volume (gal)/(L) Purge Rate (gpm)/(mLpm)

Water Level	Time	Vol. Purged gallons / liters	pH	Conductivity mS/cm	Turbidity NTU	Diss. Oxygen mg/L	Temp. oC	Salinity %	TDS g/L	Eh/ORP mv	Comments (See description below
Parameter Stabilization Criteria			+/- 0.1 pH units	+/- 3%	+/- 10% NTU units when >10 NTUs	+/- 0.3 mg/L	NA	NA	NA	+/- 10 mV	
Did Parameters Stablize prior to sampling?							NA				
Are measurements consistent with previous?							NA				

Sample Time Sample Location: pump tubing well port spigot bailer other

Comments:

Initial Depth to Water (ft BTOC): Measure Point: Well TOC Steel Casing WATER LEVEL METER SERIAL NUMBER:

Field measured confirmation of Well Depth (ft btoc):

WD (Well Depth - from database) ft btoc

SWH (Standing Water Height) = WD-Initial Depth

D (Volume as per diameter) 2"= 0.17, 4"= 0.66, 1"=0.041

One Casing Volume = D*SWH

Three Casing Volumes =

Initial DTW / Before Removal		**If Transducer**		
		Approx. 5 min After Reinstallation		Time of Removal
Time	Initial DTW	Time	Final DTW	Time of Reinstallation
Comments:				

Color: clear, grey, yellow, brown, black, cloudy, green **Odor:** none, sulphur, organic, other **Solids:** Trace, Small Qu, Med Qu, Large Qu, Particulate, Silt, Sand

EXAMPLE PLANNED SAMPLE TABLE

Date: December 31, 2006 Event: 2006-GMP-000

								Aqueous Sample Container		250 ml Poly	500 ml Poly		
								Aqueous Preservatives		4'C	HNO3, 4'C		
								Filtered		Lab	Field		
								Lab		TLI	TLI		
								Analysis Holding Time		1	28		
Sample ID	Sample Location	Team	Approx DTW (feet TOC)	Target Purge Rate (gpm)	Est. Total Purge (gal)	Est. Total Purge Duration (min)	Previous CR (VI) µg/L	Sampling System	Sampling Type	CR6 (7199) Lab Filtered	Diss Metals (6010B) Field Filtered Chromium		
EB-GMP	EB-000-1	1							N	10			
MW-10-000	MW-10	1	74.36	5	40	8.00	1610	CD pump	N	10	10		
MW-11-000	MW-11	1	66.31	5	30	6.00	323	CD pump	N	10	10		
MW-12-000	MW-12	1	28.46	3	40	13.33	1250	Temp. pump	N	10	10		

NOTES:

1. Purge and sample in accordance with July 2004 Sample and Analysis Plan and March 2005 Field Procedures Manual.
2. Record the water level and field parameters during purging. Compare parameters with previous (Table 2). Note where anamalous data is suspected and investigate equipment problems
3. Complete the entire field data form and note "NA" where data is not applicable
4. Sample when purge volume is greater than or equal to three casing volumes and stablization criteria have been met
5. Fax Purge forms, COCs, Field notes, and Calibration forms daily to Oakland office (510)-622-9210.
6. Turnaround times stated in analyses columns.

Date Printed:8/28/2006

Example Analyte List

Field Team _____

Project Name PGE Topock GMP

Job Number 338234.GM.02.00

Sampling Event 2006-GMP-000

Date

Well/Sample Number MW-10-000

QC Sample ID NA

Samples Samples are to be collected in the order listed

Lab	Turnaround Time	Analyte	Field Filtered (Y/N)	Share Group	Bottle			Preservative	pH check	Notes
					Material	Size	Number			
TLI	10 days	CR6 (7199) - Lab Filtered	N	Hex Cr	Poly	250 mg/L	1	4'C	NA	
TLI	10 days	Diss Metals (6010B) - Chromium	Y	Metals-DissolvedField	Poly	1000 mg/L	1	HNO3, 4'C	NA	

SOP-A5

Groundwater Sampling from Sonic Drilling Boreholes
Standard Operating Procedures for PG&E Topock Program

This standard operating procedure (SOP) addresses the procedures and equipment to be used for purging and collection of grab groundwater samples from boreholes during sonic drilling. When a pump sampling system (Prosonic "Isoflow") is available and feasible, Isoflow sampling is the preferred method. When Isoflow sampling is not available or not feasible then a bailer method will be used for grab groundwater sampling while drilling.

REQUIRED DOCUMENTS

1) Event-specific sampling and analysis plan (SAP), Work Plan or event-specific field instructions. Planned borehole depth, proposed well construction/specifications, and field sampling summary table, if available.
2) Applicable project work plan or monitoring plan. Refer to Topock Program Sampling, Analysis, and Field Procedures Manual and QAPP (Procedures Manual), as required.
3) Topock Program Health and Safety Plan (HSP)
4) Previous sampling, drilling, or well construction logs from other boreholes or wells in the vicinity, if available
5) Blank sampling log and field notebook

PREPARATION & SETUP

1) Review event-specific Work Plan or event-specific field instructions, previous sampling logs, Procedures Manual, and HSP.
2) Initiate field logbook for sampling activity.
3) Review sampling procedures and equipment, and planned sample depths with drilling contractor and field crew.
4) Inspect all required field equipment and calibrate field water quality (WQ) meters according to SOP-A9, *Calibration of Field Instruments*.
5) Inventory sample bottles, review required analyses, and understand lab courier schedule.
6) Field-check and setup sampling equipment: Decontaminated Isoflow pump or stainless steel bailer, rig hoist, generator, containers for purge water management, water level (WL) meter, WQ meters, flow-through cell, pump control and power supply, pump discharge/sampling tubing, health and safety equipment, etc.

PURGING AND SAMPLING PROCEDURES FOR ISOFLOW SAMPLING FROM BOREHOLE

7) Prepare groundwater sampling log (use field notebook and summarize relevant information on sampling form).

8) Insert the Isoflow into the sonic casing. After the Isoflow is set, retract the sonic casing approximately 10 feet. Record the top and bottom of this open borehole interval and identify the grab groundwater sample as the mid-point of this interval. If possible, a water level measurement can be taken before Isoflow pumping begins. Measure initial static WL according to SOP-A7, *Water level Measurements*. Record WL value on sampling log. Monitor and record Isoflow pumping rate and WL measurements made while pumping. The length of the open borehole interval will be a field decision based on the frequency of Isoflow sampling and the formation conditions. Shorter open borehole intervals (as short as 5 feet) are appropriate for Isoflow sampling frequency of every 20 feet of drilled depth, or in heterogeneous conditions where it is desired to sample from a specific conductive zone. Longer open borehole intervals of up to 20 feet are appropriate if the Isoflow sampling frequency is every 50 to 60 feet of drill depth.

9) Measure water quality parameters using a flow-through cell connected directly to the sampling port. If it is not possible to connect the flow-through cell, a clean 5-gallon bucket may be used by filling the bucket with purge water and inserting the instrument probes directly into the bucket. If the bucket is used, turbulence in the bucket should be minimized to the extent possible. Record time for all measurements collected. Note and provide qualifying remarks if parameter readings are anomalous or unstable due to instrument problems. Record the purge rate. Purge water should be contained in a portable water storage tank, as directed by the Field Team Manager.

10) Observations on sample appearance and clarity during purging and at sampling are required. For standardization, use a clear glass jar to collect and record observations of discharge water appearance during purging. Also note characteristics such as any odors associated with the discharge water. Record the following water quality data on the field data sheet: pH, specific conductance, ORP, turbidity, TDS, and dissolved oxygen, and temperature. Indicator parameters are considered stabilized, and thus sampling may commence, when 3 consecutive readings made several minutes apart fall within the following EPA-recommended stabilization criteria:

- pH +/- 0.1 pH units
- Specific conductance +/- 3%
- ORP +/- 10 millivolts
- Turbidity +/- 10% NTU units (when turbidity is >10 NTUs)
- Dissolved oxygen +/- 0.3 mg/L

However, parameter stabilization is not a requirement for sampling from open boreholes. Typically, TDS is used as a reliable indicator for borehole sampling at the site, given the known increasing concentration with depth across the site.

11) Collect samples for analyses according to event-specific SAP. For all samples, decrease the discharge rate to reduce water turbulence at the pump discharge point. Prepare sample containers and collect gas-sensitive analytes first. The preferred collection order

will be volatile organic compounds (VOCs), semi-volatile organic compound (SVOCs), metals (including hexavalent chromium [Cr(VI)] and total chromium [Cr(T)]), then general chemistry (cations, anions, stable isotopes). Sample containers are to be filled by transferring water directly from the pump discharge to the appropriate sample container.

12) Record sample information, final WL, and purge volume data on field log.

13) Oversee the driller's removal and decontamination of the Isoflow sampling pump.

14) Oversee the driller in resuming drilling and soil sampling.

15) Follow SOPs in Program Procedures Manual for sample handing and management, equipment decontamination, and investigation-derived waste (IDW) management.

PURGING AND SAMPLING PROCEDURES FOR BAILER SAMPLING FROM BOREHOLE

7) Prepare groundwater sampling log (use field notebook and summarize relevant information on sampling form).

8) Collect the grab groundwater sample by bailing the open hole interval below the sonic casing after removing a 10 to 20-foot sonic core run.

9) Sound the bottom of the borehole after removing the core barrel. Measure initial static WL according to SOP-A7, *Water level Measurements*. Record WL value on sampling log.

10) Calculate 1-casing volume using measured WL depth, casing diameter, and total well depth information. Insert the decontaminated stainless steel bailer into the borehole and begin bailing a minimum of one casing volume. Purge water should be contained in a portable water storage tank, as directed by the Field Team Manager.

11) Measure water quality parameters using a clean 5-gallon bucket and inserting the instrument probes directly into the bucket. If the bucket is used, turbulence in the bucket should be minimized to the extent possible. Record time for all measurements collected. Record the following water quality data on the field data sheet: pH, specific conductance, ORP, turbidity, TDS, dissolved oxygen, sample appearance, and odor. Parameter stabilization is not a requirement for sampling from open boreholes. Typically, TDS is used as a reliable indicator for borehole sampling at the site, given the known increasing concentration with depth across the site.

12) Collect samples for analyses according to event-specific SAP. Prepare sample containers and collect gas-sensitive analytes first. The preferred collection order will be volatile organic compounds (VOCs), semi-volatile organic compound (SVOCs), metals (including hexavalent chromium [Cr(VI)] and total chromium [Cr(T)]), then general chemistry (cations, anions, stable isotopes). Sample containers are to be filled by transferring water directly from the bailer to the appropriate sample container. For all samples, handle the bailer with care and decant from the bailer slowly to minimize the potential for aeration and turbulence as containers are filled.

13) Record sample information, final WL, and purge volume data on field log.

14) Follow SOPs in Program Procedures Manual for sample handing and management, equipment decontamination, and IDW management.

SOP-A6

Sample Field Filtration and Preservation for Metals Analyses
Standard Operating Procedures for PG&E Topock Program

This standard operating procedure (SOP) addresses the procedures and equipment to be used for collecting groundwater / surface water samples for field filtered metals analyses at the Topock site. Refer to SOP- A1, A2, A3, or A4 for specific groundwater and surface water sampling methods.

REQUIRED DOCUMENTS

1) Event-specific sampling and analysis plan (SAP).
2) Applicable project work plan or monitoring plan. Refer to Topock Program Sampling, Analysis, and Field Procedures Manual and QAPP (Procedures Manual), as required.
3) Topock Program Health and Safety Plan (HSP)
4) Previous sampling logs
5) Blank sampling logs and field notebook

PREPARATION & SETUP

1) Review event-specific SAP or event-specific field instructions, previous sampling logs, Procedures Manual, and HSP.
2) Initiate field logbook for sampling activity.
3) Inventory sample bottles, required analyses, and lab courier schedule.
4) Field-check and setup sampling equipment: field filters, buffering solution, acid, and sample bottles.

FIELD-FILTRATION AND SAMPLE COLLECTION PROCEDURES FOR GROUNDWATER FROM MONITORING AND EXTRACTION WELLS

1) Follow SOPs A1 and A2.

Sample Collection

1) Once parameters are stabilized and a minimum 3-casing volumes have been removed from the well, disconnect the tubing from the flow-through cell and connect the inline 0.45 micron filter.
2) Allow 500 milliliters to flow through the inline filter. Fill the sample container by transferring water directly from the filter discharge to the appropriate sample container.

Total Chromium and Metals Method SW 6010B

(i) Fill a laboratory provided pre-preserved sample bottle (250 ml poly containing HNO_3) or unpreserved sample bottle (250 mL poly) with the sample to the top of the bottle neck. CARE MUST BE TAKEN NOT TO OVERFILL THE BOTTLE.

(ii) Test the pH of the sample with laboratory provided pH paper.

(iii) If the pH of the sample is greater than 2, add 5 drops of HNO_3. Close the bottle, shake, test pH. Continue adding HNO_3 in 5-drop increments until the pH is less than 2.

(iv) Record the total amount of HNO_3 added to the sample and the pH on the chain of custody and field form. Seal, label, and place the sample on ice.

Hexavalent Chromium Method SW 7196A

(i) Fill a laboratory provided sample bottle (250 mL poly) to the top of the bottle neck.

(ii) Seal, label, and place the sample on ice.

Hexavalent Chromium Method SW 7199

(i) Fill a laboratory provided sample bottle (250 mL poly) to approximately 235 mL, leaving headspace for the addition of buffer solution.

(ii) Add 3 mL of laboratory provided buffer solution using a pipette. Place the lid on the sample bottle and shake gently. Test the pH using laboratory provided pH strips.

(iii) If the pH is less than 9, add ten drops (0.5 mL) of buffer solution, close bottle and shake gently. Test pH using laboratory provided pH strips. If the pH is less than 9, continue adding the buffer solution in 10-drop increments until the pH is between 9 and 9.5 or until 12.5 mL of buffer solution is added.

(iv) If the pH is less than 9 and 12.5 mL of buffer solution has been added, add one drop of 20% NH_4OH, close bottle, gently shake, test pH. Continue until the pH is between 9 and 9.5.

(v) When the pH of the sample is between 9 and 9.5, record the total amount of pH buffer and 20% NH_4OH added to the sample and the pH of the sample on the chain of custody and field form. Seal, label, and place the sample on ice.

3) Discard used pH paper(s) and filter in IDW bin.

4) Record sample information, final WL, and purge volume data on field log.

FILTRATION AND SAMPLE COLLECTION PROCEDURES FOR SURFACE WATER AND GROUNDWATER FROM PRODUCTION WELLS

5) Follow SOP-A4 for surface water and SOP-A3 for production well sampling.

Sample Collection

6) At the support vehicle, use a peristaltic pump to pump collected surface water from the 1-liter laboratory-provided sample container through an inline 0.45 micron filter. 500 milliliters of sample should be passed through the filter prior to sample collection.

7) Sample containers are to be filled by transferring water directly from the filter discharge to the appropriate sample container.

Total Chromium and Title 22 Metals Method SW 6010B

(i) Fill a laboratory provided pre-preserved sample bottle (250 ml poly containing HNO_3) or unpreserved sample bottle (250 mL poly) with the sample to the top of the bottle neck. CARE MUST BE TAKEN NOT TO OVERFILL THE BOTTLE.

(ii) Test the pH of the sample with laboratory provided pH paper.

(iii) If the pH of the sample is greater than 2, add 5 drops of HNO_3. Close the bottle, shake, test pH. Continue adding HNO_3 in 5-drop increments until the pH is less than 2.

(iv) Record the total amount of HNO_3 added to the sample and the pH on the chain of custody and field form. Seal, label, and place the sample on ice.

Hexavalent Chromium Method SW 7196A

(i) Fill a laboratory provided sample bottle (250 mL poly) to the top of the bottle neck.

(ii) Seal, label, and place the sample on ice (no field preservation required).

Hexavalent Chromium Method SW 7199

(i) Fill a laboratory provided sample bottle (250 mL poly) to approximately 235 mL, leaving headspace for the addition of buffer solution.

(ii) Add 3 mL of laboratory provided buffer solution using a pipette. Place the lid on the sample bottle and shake gently. Test the pH using laboratory provided pH strips.

(iii) If the pH is less than 9, add ten drops (0.5 mL) of buffer solution, close bottle and shake gently. Test pH using laboratory provided pH strips. If the pH is less than 9, continue adding the buffer solution in 10-drop increments until the pH is between 9 and 9.5 or until 12.5 mL of buffer solution is added.

(iv) If the pH is less than 9 and 12.5 mL of buffer solution has been added, add one drop of 20% NH_4OH, close bottle, gently shake, test pH. Continue until the pH is between 9 and 9.5.

(v) When the pH of the sample is between 9 and 9.5, record the total amount of pH buffer and 20% NH_4OH added to the sample and the pH of the sample on the chain of custody and field form. Seal, label, and place the sample on ice.

8) Discard used pH paper(s), filter, and initial sample collection bottle in IDW bin.

9) Record sample information on field log.

SOP-A7

Water Level Measurements
Standard Operating Procedures for PG&E Topock Program

This standard operating procedure (SOP) addresses the procedures and equipment to be used for manually measuring the depth to water at surface water locations, groundwater monitoring wells and production wells.

REQUIRED DOCUMENTS

1) Event-specific sampling and analysis plan (SAP).
2) Applicable project work plan or monitoring plan. Refer to Topock Program Sampling, Analysis, and Field Procedures Manual and QAPP (Procedures Manual), as required.
3) Topock Program Health and Safety Plan (HSP)
4) Well construction logs/specifications
5) Previous water level data
6) Blank sampling logs and field notebook

PREPARATION & SETUP

1) Review event-specific SAP or event-specific field instructions, previous sampling logs, Procedures Manual, and HSP.
2) Ensure that the WL meter has been decontaminated (check for label/tag) or decontaminate as needed following SOP-A10 *Decontamination of Water Sampling Equipment.*
3) Initiate field logbook for sampling activity.
4) Inspect all equipment and calibrate water level meters if multiple meters are being used according to SOP-A9, *Calibration of Field Instruments*.
5) If a transducer is present in the well and it is necessary to remove transducer to allow well access, refer to SOP-C1, *Temporary Removal and Replacement of Transducers.*
6) Calibrate wrist-watch to the atomic clock at the Topock Compressor Station.

MEASUREMENT PROCEDURES

7) Prepare groundwater sampling log (use attached form dated March 2005).
8) At the beginning of a sampling event, if a decontamination label is not visible/complete on the water level meter to be used, proceed with decontamination of equipment. If present, remove the tag prior to use.
   During a sampling event, if the water level meter is not noted as decontaminated in the field notes, decontaminate the lower 5 feet of the water level probe before using according to SOP-A10*, Decontamination of Water Sampling Equipment*.

9) Place water level probe into well or from surface water monitoring point and lower until sensor sounds. Shake the line to remove any retained water. Note depth to water (DTW) measurement to mark on well casing, if there is no mark on casing measure to the north. Repeat 3 times and record final DTW to the nearest hundredth of a foot on the sampling log. Record well identification, time, date, DTW, and water level meter number.

10) Compare DTW measurement with previous data and note discrepancies on the sampling form. Repeat step #8 if an unexpected discrepancy is noted.

11) Decontaminate the lower five feet of measuring tape, or any portion of the instrument that came in contact with water, by unwinding the tape and following SOP-A10, *Decontamination of Water Sampling Equipment*. Record decontamination procedures and the serial number of the water level meter in the field book. If the field event is complete, attach a label to the water level meter and note decontamination procedure, initials, and date, and place the water level meter in a clean plastic bag.

SOP-A8

Field Water Quality Measurements Using a Flow-through Cell Standard Operating Procedures for PG&E Topock Program

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This Standard Operating Procedure (SOP) provides general guidelines for using the Horiba® U-22 meter and flow-through cell or similar device for field measurements of pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature of groundwater samples. Additionally addressed are procedures for measuring water sample turbidity using the Hach turbidity meter. The manufacturer's manual should be consulted for detailed calibration and operating procedures.

REQUIRED DOCUMENTS

1) Event-specific sampling and analysis plan (SAP).
2) Applicable project work plan or monitoring plan. Refer to Topock Program Sampling, Analysis, and Field Procedures Manual and QAPP (Procedures Manual), as required.
3) Topock Program Health and Safety Plan (HSP)
4) Manufacturer Manuals
5) Previous sampling logs
6) Blank sampling logs and field notebook

PREPARATION & SETUP

1) Review event-specific SAP or event-specific field instructions, previous sampling logs, Procedures Manual, and HSP.
2) Initiate field logbook for sampling activity.
3) Inspect all equipment : Horiba® U-22 Water Quality Meter with flow-through cell, or similar device; Hach turbidity meter; distilled water in squirt bottle.
4) Prior to each day's use, clean the probes and flow-through cell according to manufacturer's directions and calibrate the field water quality (WQ) meters according to SOP-A9, *Calibration of Field Instruments*.

The Horiba® U-22 meter is capable of measuring the following parameters:

Parameter	Range of Measurement	Accuracy
pH	0 – 14 pH	+/- 0.1 pH units
Specific Conductivity	0 – 100 mS/cm	+/- 3 % full scale
Dissolved Oxygen	0 – 19.9 mg/l	+/- 0.2 mg/l
Temperature	0 – 55 ^{o}C	+/- 1.0 ^{o}C
ORP	-1999 mv - +1999 mv	+/- 15 mV
Salinity	0 - 4 %	+/- 0.3 %
Turbidity	0 – 800 NTU	+/- 5 % full scale

Note: Experience with field instruments indicates the Hach® turbidity meter provides a more consistent and responsive measurement of turbidity compared to the turbidity probe on the Horiba® U-22. Therefore, the Hach® turbidity meter should be used for turbidity measurements when available.

SAMPLE MEASUREMENT PROCEDURES

1) Connect the discharge tubing from the pump to the inlet side (bottom port) of the flow-through cell.

2) Connect the discharge tubing to the outlet side (top port) of the flow-through cell.

3) Place the discharge tube in a purge water collection vessel.

4) Record the time and start the pump.

5) Establish a suitable discharge rate of the pump that is consistent with the SAP and guidance.

6) Allow the well drawdown to stabilize and the temperature of the flow-through cell to equilibrate with the water temperature.

7) Turn the meter on to the measure mode.

8) Record water quality readings at regular intervals every three minutes; however the time interval between successive readings should not be shorter than the recharge time of the flow-through cell. For example, if the volume of the flow-through cell is 375 mL and the stabilized discharge rate is 137 mL/minute, the water quality readings should be at least 3 minutes apart.

9) Fill the sample vial associated with the Hach turbidity meter from the flow-through cell's discharge point. Wipe the vial dry and place in the Hach meter . Close the lid of the Hach meter completely and record the turbidity of the sample by pressing 'Read'. Adjust the range as needed.

10) Record the water quality information, volume of water discharged, the ending water quality characteristics, the ending water level, and the sample time and number in the field logbook and/or field sampling data sheet, if used.

Key Checks and Preventive Maintenance

- Calibrate meter.
- Clean probe with distilled water when done.
- If probes are dirty, rinse with a weak Alconox solution in the flow-through cell. If the device still does not calibrate, rinse with weak Alconox solution, isopropyl alcohol, Alconox, and rinse well with distilled or tap water.
- Store device using tap water. Use of deionized water will ruin the probes.
- Refer to operations manual for recommended maintenance.
- Check batteries, and have a replacement set on hand.

SOP-A10

Decontamination of Water Sampling Equipment
Standard Operating Procedures for PG&E Topock Program

This standard operating procedure (SOP) addresses the procedures and equipment to be used for decontamination of sampling equipment at the Topock site.

Required Documents

1) Event-specific sampling and analysis plan (SAP).
2) Applicable project work plan or monitoring plan. Refer to Topock Program Sampling, Analysis, and Field Procedures Manual and QAPP (Procedures Manual), as required.

Preparation and Setup

1) Initiate field log sampling book for activity.
2) Inspect all equipment necessary to carry out activities detailed in event-specific SAP.
3) Review decontamination guidelines for equipment necessary to carry out activities.

Equipment List:

-Distilled water
-2.5 percent (W/W) Alconox and distilled water solution
-Large plastic pails or tubs for Alconox and distilled water, scrub brushes, squirt bottles for Alconox solution, distilled water, and clean plastic bags.
-Trash pump to transfer used decontamination water from tubs to holding tank for disposal of waste.
-Phthalate-free gloves

Guidelines

Field Equipment

Water-level Indicators

Any portion of a water-level indicator (e.g. probe and/or cable) that contacts the groundwater must be decontaminated by washing with Alconox or Liquinox solution and rinse with distilled water after use.

Probes/Cables
Probes (e.g., pH or specific ion electrodes, geophysical probes, etc..) and/or cables that come into contact with groundwater will be decontaminated using the procedures specified below unless manufacturer's instructions indicate otherwise.
For probes that make no direct contact (e.g.,OVM equipment), the probe will be wiped with paper towels.

Other Sampling Equipment
Other sampling equipment such as surface water sampling containers, spatulas, spoons, or bowls should be decontaminated and cleaned in the manner prescribed in this SOP.

Procedures

Sampling Equipment Decontamination – Groundwater Sampling Pumps

Sampling pumps are decontaminated after each use as follows:

1. Don phthalate-free gloves.
2. Turn off pump after sampling. Remove pump from well and place pump in decontamination tub, making sure that tubing does not touch the ground.
3. Turn pump back on and pump 1 gallon of Alconox solution through the sampling pump.
4. Rinse with a minimum of 1 gallon of distilled water.
5. Keep decontaminated pump in decontamination tub or remove and wrap in clean plastic sheeting or clean plastic garbage bag.
6. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum or holding tank.
7. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

Sampling Equipment Decontamination – Other Equipment

Reusable sampling equipment is decontaminated after each use as follows.

1. Don phthalate-free gloves.
2. Wash all equipment surfaces that contacted the potentially contaminated soil/water with Alconox solution.
3. Rinse with distilled water or triple rinse with potable water.
4. Air dry and wrap exposed areas with plastic sheeting or a clean plastic garbage bag for transport and handling if equipment will not be used immediately.
5. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum or holding tank.
6. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

Key Checks and Items

- Clean with solutions of Alconox and distilled water.
- If necessary, decontaminate the outside of filled sample bottles before relinquishing them to anyone.

- All materials generated during sampling (debris, PPE, decontamination liquids, etc.) will be placed in 55-gallon drums or rolloff bins for storage pending analysis and disposal off site.
- Document all decontamination procedures in the field log book. Prior to use of equipment during a sampling event, check log book to see that equipment was decontaminated, if not proceed with decontamination procedures prior to use. At the end of an event, tag equipment as decontaminated with initials and date. Remove the tag prior to use at the beginning of the next event. If at the beginning of a sampling event this tag is not visible/complete, proceed with decontamination of equipment.
- The effectiveness of field cleaning procedures will be monitored by rinsing decontaminated equipment (i.e. portable pump) with organic-free water and submitting the rinse water in standard sample containers for analysis. The minimum number of equipment blank samples will be at least one per team (per event), per piece of equipment decontaminated, during large-scale field sampling efforts.

SOP-A13

Spill Prevention, Containment, and Control Measures for Monitoring Well Sampling Standard Operating Procedures for PG&E Topock Program

This standard operating procedure (SOP) addresses the procedures and equipment to be used for spill prevention, containment, and control associated with groundwater sampling activities at the Topock site. This SOP applies to containment and control of potential spills of purge and equipment decontamination water generated during the sampling of monitoring wells.

REQUIRED DOCUMENTS

1) Topock Program Health and Safety Plan (HSP).
2) Emergency Notification Binder. Note: This binder will be carried by field crews.

PREPARATION & SETUP

1) Prepare and load required spill containment equipment for use during monitoring well purging
2) Inspect reusable spill containment equipment for damage and report any damage found to the Field Task Manager.
3) Review this SOP and the Emergency Notification Binder.

EQUIPMENT LIST

- Small (4′ by 6′ by 1′ deep) "Throw N′ Go" spill containment basin for ATV trailer-mounted purge water tank, when sampling on floodplain. Containment capacity is 154 gallons on level ground.
- Large (8′ by 23′ by 1′ deep) "Throw N′ Go" spill containment basin for truck bed-mounted purge water tank. Containment capacity is 1,274 gallons on level ground
- Vinyl liner for ATV trailer-mounted purge water tank that fits inside the trailer bed, for sampling in the upload areas.
- Portable work surface (4′ x 4′ Collapse-a-tainer Lite) for 5-gallon purge buckets and smaller equipment such as water quality meters.
- Small spill containment pad (2′ x 2′).
- 5-gallon buckets
- Hydrophilic sorbent material (absorbent pads or mats).
- Hand-operated or other water pump for transferring fluids.
- Plastic sheeting/visqueen
- Shovel and/or other hand tools.
- Plastic bags for storage and disposal of used sorbent material.

GENERAL SPILL PREVENTION PRACTICES

- Do not place wet items or items that have been in the well onto the ground. All items with fluids should be placed on the small spill containment pad as a working surface
- No drops of water should hit the ground. Use either 5-gallon buckets or the small spill containment pad to avoid drops from equipment
- Only use restroom facilities at the GMP trailer or the IM3 facility.

CONTAINMENT SCENARIO 1: SAMPLING ON FLOODPLAIN

For monitoring well sampling on the floodplain, purge water is placed in a 200-gallon ATV trailer-mounted tank. The trailer-mounted tank is situated adjacent to the monitoring well to be sampled. Purge water is pumped directly into the tank via transfer hose at approximately 3 gallons per minute (gpm). Purge water from the Horiba flow cell is contained in a 5-gallon bucket and is manually transferred into the purge water tank.

Potential Spill Scenarios

- Overfill of ATV trailer-mounted purge water tank
- Spills at time of hose disconnection from tank or during manual transfer into tank from bucket
- Disrupted bucket of purge water

Required Equipment

- Small (4′ by 6′) "Throw N′ Go" spill containment basin for ATV trailer-mounted purge water tan
- Vinyl liner for ATV trailer
- Portable work surface
- Small spill containment pad
- Sorbent material
- Hand-operated or other water pump for transferring fluids

Procedures

1) Deploy the ATV trailer-sized "Throw N′ Go" containment basin. Situate ATV trailer with purge water tank inside the containment basin, as close to well head as possible. Secure the transfer hose in the tank opening.

2) Evaluate the remaining capacity of the tank prior to initiating well purging to ensure that there is sufficient capacity to hold the amount of purge water anticipated to be generated during purging of the well.

3) Any buckets for purge water and smaller equipment such as the Horiba must be placed inside the portable work surface prior start of purging.

4) During purging, field staff will remain at the discharge end of the hose and will monitor transfer of water into the purge water tank. If tank approaches being full, discontinue purging.

5) If there are any small drips that arise (i.e. from hose fittings), immediately place the small spill containment pad underneath the drip.

6) At completion of purging, when disconnecting the transfer hose from the tank opening, perform hose disconnection within the containment basin to ensure that any drips or spills of purge water are contained within the basin. If any purge water is present in the containment basin, transfer the water into the purge water tank.

7) Secure purge water tank openings and ensure that the tank is well secured to the ATV trailer. Remobilize to the next well to be sampled.

8) Repeat the preceding steps at the next well to be sampled.

9) When the ATV trailer-mounted purge water tank is full, continue with procedures under Containment Scenario 3.

CONTAINMENT SCENARIO 2: SAMPLING IN NON-FLOODPLAIN AREA

For monitoring well sampling in non-floodplain areas of the site, wells can be accessed by truck, and purge water is placed in a 400-gallon truck bed-mounted tank. Purge water is pumped directly into this tank via transfer hose at rates up to 10 gpm. Purge water from the Horiba flow cell is contained in a 5-gallon bucket and is manually transferred into the purge water tank.

Potential Spill Scenarios

- Overfill of truck bed-mounted purge water tank
- Spills at time of hose disconnection from tank or during manual transfer into tank from bucket
- Disrupted bucket of purge water

Required Equipment

- Large (8′ by 23′) "Throw N' Go" spill containment basin for truck bed-mounted purge water tank
- Portable work surface
- Small spill containment pad
- Sorbent material
- Hand-operated or other water pump for transferring fluids

Procedures

1) Deploy the truck-sized "Throw N' Go" containment basin. Situate truck with purge water tank inside the containment basin, as close to well head as possible. Secure transfer hose in tank opening.

2) Evaluate the remaining capacity of the tank prior to initiating well purging to ensure that there is sufficient capacity to hold the amount of purge water anticipated to be generated during purging of the well.

3) Any buckets for purge water and smaller equipment such as the Horiba must be placed inside the portable work surface prior start of purging.

4) During purging, field staff will remain at the discharge end of the hose and will monitor transfer of water into the purge water tank. If tank approaches being full, discontinue purging.

5) If there are any small drips that arise (i.e. from hose fittings), immediately place the small spill containment pad underneath the drip.

6) At completion of purging, when disconnecting the transfer hose from the tank opening, perform hose disconnection within the containment basin to ensure that any drips or spills of purge water are contained within the basin. If any purge water is present in the containment basin, transfer the water into the purge water tank.

7) Secure purge water tank openings and ensure that the tank is well secured to the truck bed. Remobilize to the next well to be sampled.

8) Repeat the preceding steps at the next well to be sampled.

9) When the truck-mounted purge water tank is full, continue with procedures under Containment Scenario 4.

CONTAINMENT SCENARIO 3: TRANSFER OF PURGE WATER FROM ATV TRAILER-MOUNTED TANK TO TRUCK BED-MOUNTED TANK

When the ATV trailer-mounted purge water tank requires emptying to a truck bed-mounted tank, the following procedures will be used. Purge water is transferred using a sump pump and transfer hose at rates up to 10 gpm.

Potential Spill Scenarios

- Overfill of truck bed-mounted poly tank
- Pump or transfer hose leakage during pumping into tank or at time of hose disconnection

Required Equipment

- Large (8′ by 23′) "Throw N′ Go" spill containment basin for truck bed-mounted purge water tank
- Small (4′ by 6′) "Throw N′ Go" spill containment basin for ATV trailer-mounted purge water tank
- Sorbent material
- Hand-operated or other water pump for transferring fluids

Procedures

1) Ensure that the truck with truck bed-mounted purge water tank is situated within its containment basin.

2) Deploy the ATV trailer-sized containment device. Situate ATV trailer with purge water tank inside the containment basin, as close to the truck as possible.

3) Evaluate the remaining capacity of the truck bed-mounted tank prior to initiating transfer from the ATV trailer-mounted tank, to ensure that there is sufficient capacity to hold the amount of purge water to be transferred.

4) Using sump pump and transfer hose, pump water from the ATV trailer-mounted tank to the truck bed-mounted tank. Field staff will be present during the entire transfer to

monitor the water level in the receiving tank and to ensure no leakage or spills occur. If the tank approaches being full, discontinue transfer operations.

5) At the completion of transfer operations, when disconnecting the transfer hose from the receiving tank opening, perform hose disconnection within the containment basin to ensure that any drips or spills of purge water are contained within the basin. If any purge water is present in the containment basin, transfer the water into the purge water tank.

6) Secure purge water tank openings and ensure that the tank is well secured to the truck bed.

7) When the truck-mounted purge water tank is full, continue with procedures under Containment Scenario 5.

CONTAINMENT SCENARIO 4: TRANSFER OF PURGE WATER FROM TRUCK BED-MOUNTED TANK TO FINAL STORAGE LOCATION

When the truck bed-mounted purge water tank requires emptying, the following procedures will be used. Purge water is transferred into a 5,500-gallon storage tank at the PG&E Topock Compressor Station, at rates up to 20 gpm. The 5,500-gallon tank is located within a permanent containment structure.

Potential Spill Scenarios

- Overfill of tank at final storage location
- Pump or transfer hose leakage during pumping into tank or at time of hose disconnection.

Required Equipment

- Large (8′ by 23′) "Throw N' Go" spill containment basin for truck bed-mounted purge water tank
- Sorbent material
- Hand-operated or other water pump for transferring fluids

Procedures

1) Ensure that the truck with bed-mounted tank is situated within its containment basin.

2) Evaluate the remaining capacity of the receiving tank prior to initiating transfer from the truck-mounted tank, to ensure that there is sufficient capacity to hold the amount of purge water to be transferred.

3) Using pump and transfer hose, pump water from the truck-mounted tank to the receiving tank. Field staff will be present during the entire transfer to monitor the water level in the receiving tank and to ensure no leakage or spills occur. If the receiving tank approaches being full, discontinue transfer operations.

4) At the completion of transfer operations, when disconnecting the transfer hose from the receiving tank opening, perform hose disconnection within the containment basin to

ensure that any drips or spills of purge water are contained within the basin. If any purge water is present in the containment basin, transfer the water into the purge water tank.

5) Secure tank openings on the receiving tank.

SPILL RESPONSE ACTIONS

In the event purge water is spilled outside of containment basins, the field team will take the following actions.

Required Equipment

- Sorbent material
- Plastic sheeting/visqueen
- Hand-operated or other water pump for transferring fluids
- Shovel and/or other hand tools
- 5-gallon buckets
- Plastic bags for storage and disposal of used sorbent material

Procedures

1) To the extent possible, use sorbent material and plastic sheeting/visqueen to contain the spilled purge water.

2) With the exception of the low-impact area of the floodplain, dig a small pit and line with visqueen to serve as a containment area for collection of spilled purge water. Use of this technique will be limited to only those areas where water does not immediately percolate into the ground surface. DO NOT dig into the ground or otherwise disturb the ground surface in the low-impact area of the floodplain.

3) Transfer any contained purge water into the purge water tank.

4) Manually dig up any saturated soil and place in 5-gallon bucket(s) or other appropriate containers. DO NOT dig into the ground or otherwise disturb the ground surface in the low-impact area of the floodplain.

5) Dispose of containerized soil, used sorbent material, and gloves in accordance with SOP-B6, *Disposal of Waste Fluids and Solids (IDW)*.

6) Perform notifications as required in the Emergency Notification Binder. Complete the Notification Documentation Form provided in the Binder.

SOP-A16

Access Routes
Standard Operating Procedures for PG&E Topock Program

This standard operating procedure (SOP) addresses the procedures to be used when accessing wells or other sampling stations at the Topock site. This SOP should be used for all travel to collect data on site. All field personnel and subcontractors are required to read this SOP and sign on the Employee Signoff Form.

OVERVIEW

Figure 1 shows the Topock project groundwater and surface water data collection locations.[1] The map also shows the access routes used for sampling and transducer downloads. These lines indicate vehicle access on existing roads, and indicate where all-terrain vehicle (ATV) or foot access is used at locations where pickup truck access is not possible. Purple lines on the map indicate where either pickup trucks or ATVs are used. Blue lines indicate routes with allowed access by ATV but not by pickup truck. Black dotted lines indicate foot access routes. Where the black dots overlay the blue routes on the floodplain area, the access is on foot during the Southwestern Willow Flycatcher nesting season (May 1st through September 30th), and by ATV outside of nesting season. The access routes with specific mitigation measures or access procedures discussed herein are highlighted in green.

Table 1 summarizes the frequency of the current sampling schedule at each data collection point and the means of access by code. As Table 1 indicates, there are 3 access procedures that are to be followed depending on when fieldwork is to occur:

A = Universal for the site

B = Floodplain during Flycatcher summer nesting season (May 1st through September 30th)

C = Upland close to cultural resources (Year-round)

A work orientation is to be provided to all field personnel regarding cultural and biological resources and the spiritual importance of the geographic area and the river to local tribes. The orientation should emphasize the need to stay within the established, marked access routes and work areas, and to prevent enlargement of previously used areas. It should also include instilling awareness of specific access details.

A SITES ACCESS PROCEDURES – APPLIES TO ALL SITES

Personnel must obey the following procedures when accessing all data collection sites (refer to Figure 1):

[1] Data collection locations do not include boat-based sampling in Colorado River, future well locations, or past or future soil/sediment sampling locations.

- Access by vehicles is restricted to established roads or tracks. For off-road access the number of vehicles used should be minimized (usually one pickup and trailer for SEFS and one pickup or SUV for CH2M HILL).
- All vehicles are to observe a 10-mph speed limit on Historic Route 66 (H-66), drive in the center of H-66 to avoid wear on the H-66 shoulders, and not cut corners when exiting H-66 to access well locations.
- All vehicles are to travel slowly off-road (5 mph speed where possible) to give time to observe and avoid wildlife and minimize noise, dust, and vehicle rutting.
- Most off-road access is to be by low-impact All Terrain Vehicles (ATV's) which carry sampling or data collection equipment and can tow a small trailer for management of groundwater sampling purge water.
- Access beyond the purple lines on the map is by ATV (blue lines) or on foot (dotted black lines). Access follows consistent routes or paths.
- Minimize time near possible wildlife habitat.
- Coordinate with on-site field client representative (FCR) and security patrol to prevent unauthorized access to site areas.

These minimum procedures are followed for all data collection locations. More rigorous procedures are to be used at locations where potential concerns have been identified.

B SITES ACCESS PROCEDURES

Field crews are to follow the following mitigation measures for the floodplain wells as listed below during the Southwestern Willow Flycatcher nesting season, May 1st through September 30th. The universal A sites measures that were outlined above will also apply at these locations. Site B locations include:

- Well locations MW-27, MW-30, MW-34, MW-36, MW-42, MW-45, PE-1, and shoreline location R-27 on the Bureau of Land Management (BLM) managed area
- Well locations MW-22, MW-32, MW-43, and shoreline location R-22 on the Havasu National Wildlife Refuge (HNWR) area

Well sampling, transducer data collection, and any other work activities will not occur during the protocol survey timing for the Flycatcher. Upon completion of the surveys, the onsite biologist will approve/disapprove of work activities depending on the survey results. If a Flycatcher is not detected, then the biologist will permit the activities. If a Flycatcher is detected, then the biologist will not permit the work activities, and the regulatory agencies will be consulted.

Specialized Field Equipment

A 6x6 Polaris ATV with a stealth muffler will be utilized while accessing B sites on BLM property during the nesting season. The larger ATV will minimize noise and enable towing water storage tanks through the sand without getting stuck at low revolutions per minute (RPM). The larger ATV will also be able to trailer a 200-gallon purge tank, which would minimize the number of trips needed to dispose of the purge water from a typical well cluster.

New power supply outlets have been installed at PE-1 and a leak detection vault north of MW-39. By using this power supply to power the groundwater pumps instead of a generator, the sampling operation is virtually noiseless when sampling the following wells near PE-1: MW-27, MW-30, MW-34, MW-36, MW-42, and MW-45 clusters. Using a heavy-gauge extension cord, it is possible to use this power source for sampling at these locations on BLM property.

Approximately 700 feet of 4-inch "lay-flat" hose is to be used to replace the current garden hose used to connect the pumps at the well head to the purge tanks at the staging areas. The lay-flat hose will be rolled out using an ATV, generally before the nesting season when possible. The need to transport the hose prior to each monitoring well would be eliminated by leaving the hose in place after sampling is completed, minimizing the impact in areas of potential Flycatcher habitat. Spill containment will be provided under any hose connections where multiple hose segments are required to reach more distant wells. The hose will be cleared of all water after sampling is completed and left in place until the next sampling event. Clearing water from the hose will be accomplished by lifting the hose to shoulder height to drain the water into the purge water storage tank. Since the area is open to public recreation and the potential for damage to the hose exists, the field crews will carefully inspect the hose before each use.

New dedicated pumps were installed in late 2005 in MW-27, MW-34, and MW-43 well clusters. These new dedicated pumps are in addition to existing dedicated pumps in wells at MW-30, MW-32, and MW-36. Therefore, pumps and decontamination equipment will no longer need to be transported to these wells, decreasing the overall impact associated with sampling at these locations.

Access Procedures for Wells on BLM Property

For wells located on the BLM property, pickup-truck-carried equipment is staged on the graded road approximately 120 feet south of well cluster MW-35 (Figure 1). The pickup-truck is therefore located a minimal distance from the paved road and on an established access route. From that point, 2 ATVs travel south to access monitoring well clusters. One will be a heavy duty 6x6 ATV that transports equipment and tows the water tank trailer, while the other will be a light duty 4x4 ATV that transports personnel. Well clusters MW-30, MW-36, and MW-42 will be accessed directly by ATVs. For sampling MW-34 and MW-45 clusters, the ATV's will park in the staging area at the PE-1 location and field crews will travel and carry equipment by foot to the wells. For sampling the MW-27 cluster and R-27, the ATVs will park in the staging area mid-way between MW-42 and MW-27. Field crews will then carry equipment by foot to the sampling locations. The power source at PE-1 will be used to sample the B site wells on BLM property.

Access Procedures for Wells on HNWR Property

On HNWR property, located to the south of the railroad bridge, pickup-truck-carried equipment is to be staged at the cleared and graded area to the west of well cluster MW-32 (Figure 1). All power equipment and purge water storage tanks are staged at this location. No ATV's will be allowed for work in this area. Only foot traffic along established trails is permitted from the MW-32 staging area to the three well clusters MW-22, MW-32, and MW-43, and shoreline station R-22 located near potential nesting habitat on the HNWR property.

Sampling Procedures for B Site Wells with Dedicated Pumps

The following list summarizes the modified "nesting season" sampling procedures for the B site monitoring wells with dedicated pumps. These modified procedures will be followed each year during May 1st through September 30th:

- A biologist will pre-survey the planned work area for the presence of nesting listed-bird species, and sampling will proceed if the survey results are negative. BLM and DTSC will be contacted and sampling will not proceed if the pre-survey finds nesting listed-bird species.
- New sampling procedures and biological resource sensitivity will be reviewed at each field event kickoff briefing.
- Pickup trucks will stage at the MW-35 area off Park Moabi Road (BLM property) or west of the MW-32 cluster (HNWR property).
- On BLM property, only two ATVs will transport equipment from MW-35 area to the staging areas.

- The ATVs will maintain low speeds and low revolutions per minute to minimize noise. The target speed will be 5 mph on the floodplain, per BLM direction. The ATVs will maintain a reduced speed to the extent possible while avoiding getting lodged or stuck.
- A biologist will accompany the sampling team upon startup of activities and will provide a reconnaissance "sweep" during the sampling event.
- All equipment transported by ATV will be staged at one of the two ATV staging areas.
- Generators will be operated at the staging area where there is no nearby power supply (HNWR). Two 2-kilowatt generators will be operated in parallel to mitigate noise.
- Spill prevention, containment, and control measures outlined in SOP-A13 will be implemented. This includes the use of large plastic spill containment trays under each lay-flat hose connection between the well and the staging area.
- The well purge will be conducted with the dedicated pump and documented.
- When the well purge is complete, samples will be collected.
- After sample bottles are filled, the dedicated pump will be shut down.
- The sample cooler will be carried back to the staging area.
- At all times, conversation noise and abrupt or unnecessary movements will be avoided, and equipment noise will be minimized. Equipment will be muffled or padded during transport and setup to avoid clanging or other impact noises from bottles and metal components.
- A biologist's report of the sampling activities will be completed within a week of the sampling and submitted to DTSC and BLM.

Sampling Procedures for B Site Wells without Dedicated Pumps

For monitoring wells without a dedicated pump installed (MW-27-20 and MW-43-25), an electric submersible pump is carried on foot from the ATV staging area to each well location. From the wellhead, discharge tubing is run along the trails to the purge water holding tanks at the staging area. The distance from the sample location to the staging area is as much as 750 feet. Electrical power cords are also run along the trails from a portable electric generator at the staging area to the pump control box. The pump control box is situated approximately 350 feet from the wellhead. That distance is determined by the maximum length of the motor lead cable that connects the control box to the pump.

The following list summarizes the modified "nesting season" sampling procedures for the B site monitoring wells without dedicated pumps. These modified procedures will be followed each year during May 1st through September 30th:

- A biologist will pre-survey the planned work area for the presence of nesting listed-bird species, and sampling will proceed if the survey results are negative. BLM and DTSC will be contacted and sampling will not proceed if the pre-survey finds nesting listed-bird species.

- New sampling procedures and biological resource sensitivity will be reviewed at each field event kickoff briefing.
- Pickup trucks will stage at the MW-35 area off Park Moabi Road (BLM property) or west of the MW-32 cluster (HNWR property).
- On BLM property, only two ATVs will transport equipment from MW-35 area to the staging areas.
- The ATVs will maintain low speeds and low revolutions per minute to minimize noise. The target speed will be 5 mph on the floodplain, per BLM direction. The ATVs will maintain a reduced speed to the extent possible while avoiding getting lodged or stuck.
- A biologist will accompany the sampling team upon startup of activities and will provide a reconnaissance "sweep" during the sampling event.
- On BLM property, all equipment transported by ATV will be staged at one of the two ATV staging areas.
- Generators will be operated at staging areas where no is no nearby power supply (HNWR). Two 2-kilowatt generators will be operated in parallel to mitigate noise.
- The pump control box will be staged on the established footpath about 350 feet from the well to be sampled (MW-22, MW-45).
- Spill prevention, containment, and control measures outlined in SOP-A13 will be implemented. This includes the use of large plastic spill containment trays under each lay-flat hose connection between the well and the staging area.
- The pump flow rate will be set at the pump control box as the purge is started, and then the control box will be left unattended.
- The well purge will be conducted and documented from the staging areas.
- When the well purge is complete, two people will carry a cooler with sample bottles to the well head and one person will go to the pump control box.
- After sample bottles are filled, the pump will be shut down at the control box, and the pump will be removed from the well.
- The pump and sample cooler will be carried back to the MW-39 or MW-32 staging area.
- The pump and first hose length will be decontaminated and taken to the next well for sampling.
- At all times, conversation noise and abrupt or unnecessary movements will be avoided, and equipment noise will be minimized. Equipment will be muffled or padded during transport and setup to avoid clanging or other impact noises from bottles and metal components.
- A biologist's report of the sampling activities will be completed within a week of the sampling and submitted to DTSC and BLM.

Modified Purging and Sampling Procedures for Wells Without Dedicated Pumps

To minimize the presence of the sampling crew members near the well locations, water quality readings are to be measured from the discharge at the staging area. Typically, the water quality readings are measured at the well head. Field readings are measured using a Horiba U-22 water quality meter with a flow cell. Normally, three consecutive readings taken at least 3 minutes apart must meet the following criteria:

- pH +/- 0.1 pH units
- Specific conductance +/- 3%
- ORP +/- 10 millivolts
- Turbidity +/- 10% NTU units (when turbidity is >10 NTUs)
- Dissolved oxygen +/- 0.3 mg/L
- Temperature +/- 2^{o} Celsius

It is expected that discharged purge water will be heated after traveling across hot sand on the floodplain. For this reason, temperature and dissolved oxygen are eliminated as stabilization criteria at these wells. The revised stabilization criteria include:

- pH +/- 0.1 pH units
- Specific conductance +/- 3%
- ORP +/- 10 millivolts
- Turbidity +/- 10% NTU units (when turbidity is >10 NTUs)

In addition, water level measurements are to be taken at the beginning and end of the purge only. No measurements will be taken during the purge.

Since the water from the discharge hose is expected to be heated, analytical samples will be collected at the wellhead. Once the field parameters are stable and three well volumes have been purged from the well, one crew member will carry an ice chest with sample bottles to the well head and collect the samples in accordance with the SOP. A tee fitting on the sampling hose is to be used for sample collection at the wellhead. After the samples are collected, the pump will be shut down and pulled from the well. Equipment that requires decontamination is to be carried back to the staging area before sampling the next well. Otherwise, equipment will be moved directly to the next well location to be sampled.

A PG&E-designated biologist is to be onsite during sampling to ensure that these measures are adequate to avoid any potential direct or indirect impacts to the Southwestern Willow Flycatcher near the monitoring wells.

Health and Safety

The nesting season of the Southwestern Willow Flycatcher occurs during the hottest part of the year when temperatures can exceed 120 degrees Fahrenheit in the afternoon. Additional health and safety procedures are put in place to address the additional exertion required for the modified sampling procedures while working in the summer heat.

The following procedures are implemented for sampling in hot weather conditions:

- The workday begins at 5:00 a.m. and work ceases no later than 12:00 p.m.

- Crew numbers are at least doubled to allow for crew rotations for rest and rehydration breaks.
- Oral body temperature is monitored to determine if employees are adequately dissipating heat buildup. If an employee's body temperature exceeds 99.6 degrees Fahrenheit, the following work period will be shortened by one-third. If an employee's oral temperature exceeds 100.4 degrees Fahrenheit, he or she will not return to work for the rest of the day.
- Heart rate is measured during each break period. If an employee's heart rate exceeds 100 beats per minute (bpm), or 20 bpm above resting rate, the subsequent work period will be shortened by one-third. If the heart rate exceeds 180 bpm minus the employee's age, then work activities are suspended until the rate returns to resting rate.
- Each individual's weight is measured throughout the day. If weight loss exceeds 1.5 percent of total body weight, the worker will be removed from work until fluids have had time to be absorbed and body weight returns to less than 1.5 percent of loss. If body weight loss exceeds 3 percent, the employee will be removed from work for the day.

C SITES ACCESS PROCEDURES

Field crews are to implement the following mitigation measures for the upland wells listed below to prevent impacts from data collection on cultural or biological resources.

- East Mesa wells (IW-2, IW-3, OW-1, OW-2, and OW-5 well clusters)
- West Mesa wells (OW-3 well cluster)
- Compliance wells (CW-1, CW-2, CW-3, and CW-4 well clusters).
- Monitoring wells MW-14, MW-15, MW-16, MW-18, and MW-25.

The goal of these additional precautions is to prevent any excursion onto areas that were not previously disturbed or are not allowable for access or work area use. Unlike the B sites access procedures that were developed for use on the floodplain only during the summer nesting season, the additional precautions for these upland area C sites will be applied on a year-round basis. The universal A sites measures that were outlined above will also apply at these locations year round.

- Personnel and vehicles are required to stay within the areas that were previously used.
- Use 'inclusive' fencing to mark the boundaries of allowable access routes or work areas to these locations, rather than fencing to exclude specific cultural and biological resources.
- For the less frequent quarterly or semiannual access to wells MW-15, MW-16, MW-18, and MW-25, crews must stay on the clearly defined gravel access roads to each well.
- Use lathe stakes to mark boundaries during construction and well installation, rather than orange plastic fencing. These boundary stakes will be maintained, and if needed a similar marker for both access routes and work area boundaries may be substituted in the future. Any replacement should have limited visual impacts, such as small fiberglass or ABS plastic pole markers often used to mark driveway entrances, topped with a taut rope to prevent travel off existing designated work areas. Specific areas where these boundary markings are maintained include:
  - Access route on and off H-66 and edges of the East Mesa.
  - Access route from H-66 and a turnaround/work area near OW-3 on the West Mesa.
  - Access route from H-66 and a turnaround/work area near CW-4 in the unnamed wash.
  - Access routes past CW-2 and turnaround area at CW-3.
  - Defined access turn-off from H-66 to CW-1 and MW-14.
- Drive one-way on the CW-2 and CW-3 access track and turn vehicles only at the established turnaround at CW-3.
- Drive in only the active channel area of the wash when accessing CW-1.
- Stay on established roads to access MW-15 and MW-16.

TABLE 1
Data Collection Locations, Sampling Frequency and Site Access Codes
SOP-A16 Access Routes
PG&E Topock Site, Needles, California

Well ID	Sampling Frequency [1]	Site Access Code
GMP Monitoring Wells		
MW-9	S	A
MW-10	S	A
MW-11	S	A
MW-12	Q	A
MW-13	Q	A
MW-14	Q	C
MW-15	S	C
MW-16	S	C
MW-17	S	A
MW-18	S	C
MW-19	Q	A
MW-20-70	Q	A
MW-20-100	Q	A
MW-20-130	Q	A
MW-21	Q	A
MW-22	Q	B
MW-23	Q	A
MW-24A	S	A
MW-24B	S	A
MW-24BR	Q	A
MW-25	Q	C
MW-26	Q	A
MW-27-20	Q	B
MW-27-60	Q	B
MW-27-85	M	B
MW-28-25	Q	A
MW-28-90	M	A
MW-29	Q	A
MW-30-30	Q	B
MW-30-50	Q	B
MW-31-60	Q	A
MW-31-135	Q	A
MW-32-20	Q	B
MW-32-35	Q	B
MW-33-40	Q	A
MW-33-90	Q	A
MW-33-150	M	A
MW-33-210	M	A
MW-34-55	Q	B
MW-34-80	M	B
MW-34-100	BW	B
MW-35-60	Q	A
MW-35-135	Q	A
MW-36-20	Q	B
MW-36-40	Q	B
MW-36-50	Q	B
MW-36-70	M	B
MW-36-90	M	B
MW-36-100	M	B
MW-37D	Q	A
MW-37S	Q	A
MW-38D	S	A
MW-38S	S	A
MW-39-40	Q	A
MW-39-50	Q	A
MW-39-60	Q	A
MW-39-70	M	A
MW-39-80	M	A
MW-39-100	M	A
MW-40D	Q	A
MW-40S	Q	A
MW-41D	Q	A
MW-41M	Q	A
MW-41S	Q	A
MW-42-30	Q	B
MW-42-55	Q	B
MW-42-65	Q	B
MW-43-25	Q	B
MW-43-75	M	B
MW-43-90	M	B
MW-44-70	ND	A
MW-44-115	BW	A
MW-44-125	BW	A
MW-45-95a	ND	B
MW-45-95b	ND	B
MW-46-175	BW [2]	A
MW-46-205	ND	A
MW-47-55	ND	A
MW-47-115	ND	A
MW-48	ND	A
MW-49-135	ND	A
MW-49-275	ND	A
MW-49-365	ND	A
MW-50-95	ND	A
MW-50-200	ND	A
MW-51	ND	A
GMP Shoreline Surface Water Sampling Locations		
I-3	M	A
R-22	M	B
R-27	M	B
R-28	M	A
RRB	M	A
CON	M	A
A-Dock	M	A
NR-1	M	A
NR-2	M	A
NR-3	M	A
Test Wells and Extraction Wells		
PE-1	M	B
TW-2S	Q*	A
TW-2D	Q*	A
TW-3D	M	A
TW-4	ND	A
TW-5	ND	A
Water Supply Wells		
PGE-6	2A	A
PGE-7	2A	A
Park Moabi	Q	A

Well ID	Sampling Frequency [1]	Site Access Code
Injection Wells		
IW-2	NS	C
IW-3	NS	C
PGE-8	2A	A
IM3 Observation Wells		
OW-1 (S,M,D)	Q	C
OW-2 (S,M,D)	Q	C
OW-3 (S,M,D)	S	C
OW-5 (S,M,D)	Q	C
IM3 Compliance Wells		
CW-1 (M,D)	S	C
CW-2 (M,D)	S	C
CW-3 (M,D)	S	C
CW-4 (M,D)	S	C
Additional Water Level Measurement Locations		
MWP-08	NS	A
MWP-10	NS	A
MW-01	NS	A
MW-02	NS	A
MW-03	NS	A
MW-04	NS	A
MW-05	NS	A
MW-06	NS	A
MW-07	NS	A

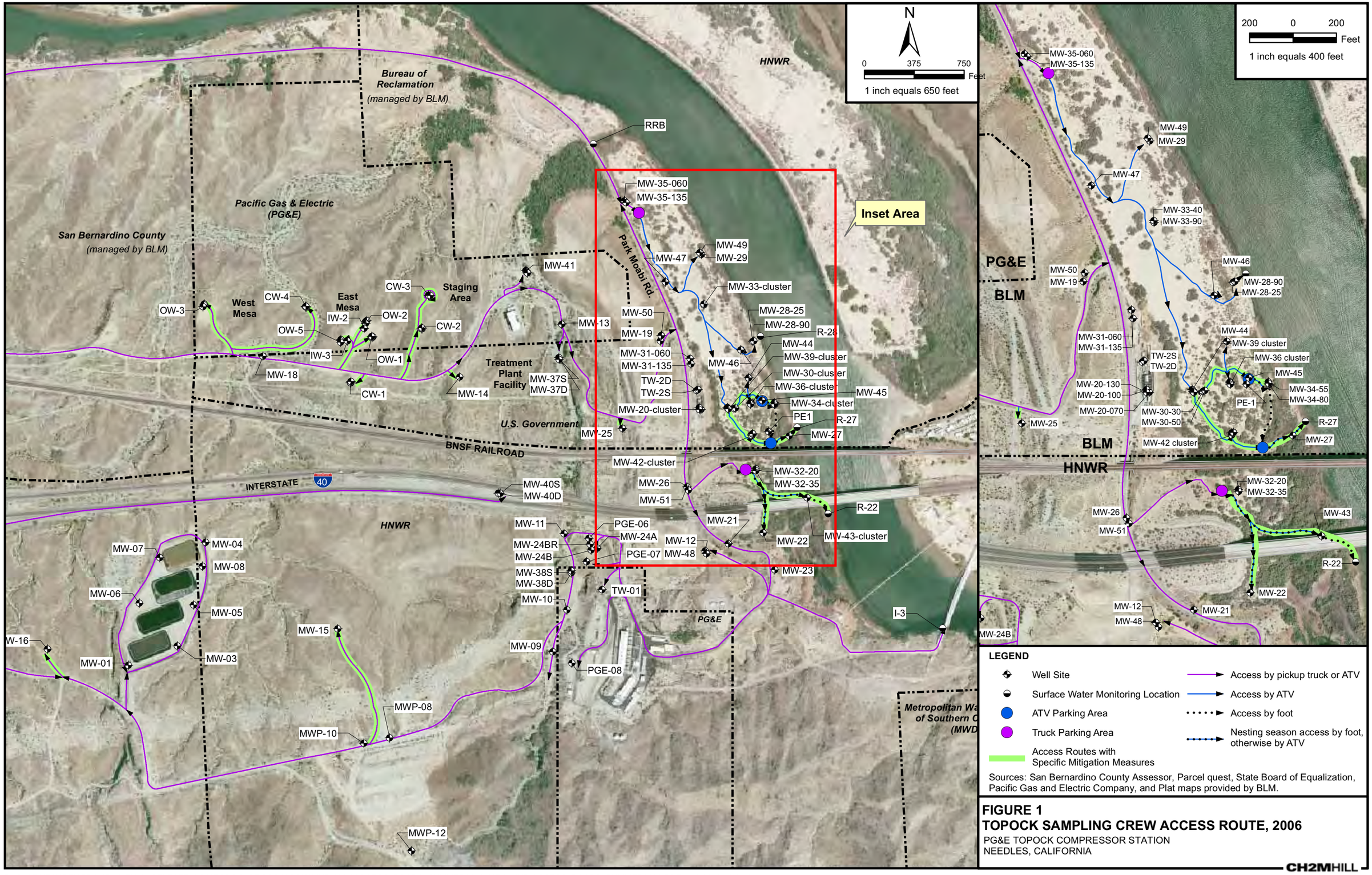
Notes:

W	Weekly
BW	Biweekly
M	Monthly
Q	Quarterly
A	Annual
S	Semi-Annually
2A	Every 2 years
NS	Not sampled routinely
Q*	Revert to Monthly if active
ND	Routine sampling frequency not determined yet

[1] As of May 17, 2006

[2] Through June 2006

Shoreline sampling locations are accessed by foot or by boat from the river.



LEGEND

- Well Site
- Surface Water Monitoring Location
- ATV Parking Area
- Truck Parking Area
- Access Routes with Specific Mitigation Measures
- Access by pickup truck or ATV
- Access by ATV
- Access by foot
- Nesting season access by foot, otherwise by ATV

Sources: San Bernardino County Assessor, Parcel quest, State Board of Equalization, Pacific Gas and Electric Company, and Plat maps provided by BLM.

FIGURE 1
TOPOCK SAMPLING CREW ACCESS ROUTE, 2006
PG&E TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA

CH2MHILL

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EMPLOYEE SIGNOFF FORM

Site Access SOP

The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this SOP, have read and understood it, and agree to abide by its provisions.

Project Name: Topock Projects (GMP, CMP, BKG, IM3, PWSS) **Project Number:** varies by project

EMPLOYEE NAME (Please print)	**EMPLOYEE SIGNATURE**	**COMPANY**	**DATE**