Topock - Proposed Technical Trial for Alternative Sampling Approaches at Selected Monitoring Wells

PREPARED FOR: PG&E

PREPARED BY: CH2M HILL

DATE: August 27, 2012

This memorandum presents a proposed technical trial of alternative sampling approaches at the PG&E Topock Site (Site). This trial would test sampling approaches designed to reduce investigation derived waste, maintain or increase data quality, and reduce the sampling footprint at the Topock site. The results of this trial will be evaluated to determine if alternative sampling techniques are appropriate for compliance and/or process monitoring of the final groundwater remedy. A successful trial would allow for more flexibility in selecting optimum sampling approaches for the remainder of the monitoring program and during the final remedy.

Background

The groundwater monitoring programs at Topock collectively require over 350 well purges per year using the currently accepted sampling approach for Site wells[1]: a minimum three volume purge followed by sample collection after stabilization of groundwater indicator quality parameters. This sampling approach results in a relatively large amount of investigation derived waste (IDW) liquid compared to other sampling approaches proposed herein.

Alternative sampling approaches, including the no-purge HydraSleeve™ (HS) system and minimal draw down purging (low flow purging), can reduce waste generation and IDW management travel on-site, reduce time spent at each well, minimize impact to sensitive biological habitat, and increase project sustainability. With implementation and start-up of the final groundwater remedy approaching, an increase in sampling scope and frequency is anticipated to support both compliance monitoring of the remedy under Applicable or Relevant and Appropriate Requirements and remedy process monitoring. The testing and acceptance of alternative sampling approaches would positively impact the sustainability of remedy monitoring.

Alternative Sampling Approaches

HydraSleeve

The HS sampling system (http://www.hydrasleeve.com/index.php), manufactured by GeoInsight, is an alternative sampling technology that captures a representative sample for

[1] There are a few wells in the Site groundwater sampling program that do not yield adequate volume for a three volume purge prior to sample collection. A modified low yield sampling protocol is used for sample collection at these wells. None of the low yield wells are included in this technical trial of alternative sampling approaches.

most physical and chemical parameters without purging the well. The chief advantages of the HS is that it is an inexpensive disposable sampler that allows for rapid installation and depth-discrete (no mixing) sample collection, does not generate purge water, and provides water samples for all analytical parameters (organics, metals, and general chemistry analytes) necessary for the Site. Physically, the HS sampler consists of a bottom-sealed section of a lay-flat polyethylene sleeve with a polyethylene reed valve incorporated in the top end.

The HS was reviewed in a joint study completed by the U.S. Army Corps of Engineers, the Air Force Center for Environmental Excellence and the Air Force Real Property Agency in 2005 (Parsons, 2005). This study found that sample results for most metals and volatile organic compounds were comparable to three-volume purge sample results. In seven comparison samples using three volume purge sampling, minimal drawdown sampling and HS, hexavalent chromium, concentrations were mostly higher using HS than the other methods. Due to the limited number of samples (seven) available for comparison, the authors did not provide an explanation for this observation.

Minimal Drawdown

The objective of the minimal drawdown approach is to remove a small volume of water at a low flow rate from a specific (or discrete) portion of the screened interval of a well without mixing water and causing minimal stress (drawdown) in the aquifer. The minimal drawdown sampling approach typically uses traditional well purging equipment (i.e. 12-volt electric submersible, peristaltic, or bladder pumps) at purge rates from 0.1 to 0.5 liters per minute to achieve this objective. In wells with high yields, a higher flow rate may be possible with limited drawdown, allowing use of the Grundfos 2-inch submersible pump. There is extensive precedent for this approach of purging at a flow rate that creates minimal drawdown in the well, while monitoring the stabilization of groundwater quality indicator parameters. The U.S. Environmental Protection Agency (USEPA) has published multiple studies and directive documents on this subject. Specifically, guidance on sampling procedures for the minimal drawdown technique is given in the 1996 USEPA paper entitled "Groundwater Issue Paper: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures" (Puls and Barcelona, 1996). Additionally, the 2002 USEPA paper entitled "Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers" (USEPA, 2002) provides current and/or recommended sampling procedures, including the minimal drawdown approach, that minimize disturbance to the aquifer and yield the most representative groundwater samples.

Well List

The monitoring wells proposed for use in this three quarter trial are listed in Table 1. Sample collection for the trial is anticipated to begin in third quarter 2012 and continue through first quarter 2013. Wells were selected to provide a diverse sampling set, considering the following key factors:

- Location within the site, such as 'floodplain' or 'upland'. Upland wells are generally screened in alluvial sediments or in some cases, bedrock and contain a higher salinity than other site wells. Floodplain wells are screened in either fluvial or alluvial sediments and generally have lower salinity than other site wells.

- Aquifer depth zone. The proposed wells include screens in the shallow, mid-depth, deep and bedrock aquifer zones.
- Previous Cr(VI) concentration. Historical Cr(VI) concentrations range from ND to 12,100 micrograms per liter in the proposed monitoring wells.
- Purge Volume and Purge Rate. The proposed wells include a range of casing volumes and a range of yields (sustainable flow rates). The wells selected for this study can be sampled using three volume purge or low flow sampling procedures.

All of the proposed wells will be sampled during each of the three quarterly sampling events, including those wells that are normally sampled with a semiannual sampling frequency, as shown on Table 1. The wells will be sampled using the methods described below.

Field Sample Collection Methods

The HS and minimal drawdown sampling methods will be used in conjunction with the traditional three volume purge during this trial to collect data necessary for comparison of results between these three sampling methods. Three individual samples will be collected at each monitoring well during each sampling "event" in the study. One sample using each method will be collected in the following sequence:

- Remove dedicated pump and pressure transducer (if present).
- Deploy HS sampler and pressure transducer (if present) in well casing at least 1-week prior to removal for sample collection.
- Remove pressure transducer (if present) and HS and collect sample as described in the standard operating procedure (SOP), Attachment 1.
- Install pump following HydraSleeve removal.
- Purge and sample using minimal drawdown SOP, Attachment 2.
- Purge and sample using standard three volume purge SOP, Attachment 3.

Laboratory Analysis

There are no sample volume considerations with the three volume purge or minimal drawdown purge methods, but there are volume considerations with HS sampling. It is anticipated that up to two, 36-inch length (1-liter volume) HS samplers will be used at each well during the trial resulting in an available sample volume of approximately 1.5 liters per well using HS.

Sample collection for the study will include all of the analytes listed below for three volume purge and minimal drawdown sampling. HS sample collection will include the analytes listed below in order of priority. If inadequate sample volume is available, analytes lower on the priority list may not be collected during all sampling events.

1. hexavalent chromium;
2. dissolved metals (chromium, molybdenum, selenium, arsenic, manganese, calcium, magnesium, sodium, and iron);

3. alkalinity and anions (chloride, sulfate, and nitrate).

Results and Reporting

Samples from each of the three approaches will be sent to the same laboratories used for the normal three volume purge samples. Data validation and management will be conducted in accordance with the *Quality Assurance Project Plan* (QAPP), *Addendum to the PG&E Program Quality Assurance Project Plan for the Topock Groundwater Monitoring and Investigation Projects* (CH2M HILL, 2008, 2012)..

Preliminary results of the comparison study will be submitted in tabular form approximately 2 weeks after all validated data are available. Sampling results from the three volume purge will be reported in the appropriate quarterly monitoring report during the trial period. Complete results from the two alternative sampling approaches and analysis of the data against the three volume purge data will be presented in a technical memorandum, submitted under separate cover following the final quarter of the sampling trial.

References

CH2M HILL. 2008. *PG&E Program Quality Assurance Project Plan, Addendum to the PG&E Program Quality Assurance Project Plan for the Topock Groundwater Monitoring and Investigation Projects*. December.

_____. 2012. *PG&E Program Quality Assurance Project Plan, Addendum to the PG&E Program Quality Assurance Project Plan for the Topock Groundwater Monitoring and Investigation Projects*. (In Preparation).

Parsons. 2005. *Results Report for the Demonstration of No-Purge Groundwater SamplingDevices at Former McClellan Air Force Base, California*. Prepared for the U.S. Army Corps of Engineers, Air Force Center for Environmental Excellence, and Air Force Real Property Agency.

Puls, R.W. and M.J. Barcelona. 1996. *GROUNDWATER ISSUE PAPER: Low-Flow (Minimal Drawdown)Ground-Water Sampling Procedures*; U.S. Environmental Protection Agency, EPA/540/S-95/504,12 pp.

Yeskis, D. and B. Zavala, 2002. *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers,* U.S. Environmental Protection Agency, EPA/542/S-02/001, 53 pp.

Table 1
Proposed Well List - Topock Groundwater Sampling Technology Trial

Well	Normal Sampling Frequency	Aquifer Zone / Depth	Screen Length (ft btoc)	Water Column Above Screen (ft)	Site Area	GMP Sampling Frequency	Range of Cr(VI) Results 2011 (µg/L)	Range of Lab SC results 2011 (µs/cm)	Current Sampling Technique
MW-10	Semiannually	Shallow	74-94	-1	Upland	Q	269 - 621	2,600 - 3,000	3-volume purge
MW-12	Quarterly	Shallow	27.5-47.5	-2	Upland	Q	2,000 - 3,000	6,400 - 6,700	3-volume purge
MW-19	Semiannually	Shallow	46-66	0	Route 66	SA	289 - 497	2,000 - 2,200	3-volume purge
MW-20-130	Semiannually	Deep	121-131	72	Floodplain	SA	10,900 - 12,100	10,000 - 12,000	3-volume purge
MW-26	Semiannually	Shallow	51.5-71.5	4	Route 66	SA	1,810 - 2,010	4,000-4,000	3-volume purge
MW-31-60	Semiannually	Shallow	41.5-61.5	-2	Floodplain	SA	304 - 489	3,200 - 3,800	3-volume purge
MW-33-90	Quarterly	Mid-depth	69-89	35	Floodplain	Q	17 - 25	9,600 - 10,000	3-volume purge
MW-36-100	Semiannually	Deep	88-98	70	Floodplain	SA	56 -73	9,700 - 10,000	3-volume purge
MW-44-115	Quarterly	Deep	105-115	86	Floodplain	Q	150 - 240	9,990 - 11000	3-volume purge
MW-44-125	Quarterly	Deep	116-125	97	Floodplain	Q	ND - 65	9,800 - 12,000	3-volume purge
MW-46-175	Quarterly	Deep	165-175	136	Floodplain	Q	34 - 121	16,000 - 17,000	3-volume purge
MW-47-055	Semiannually	Shallow	45-55	15	Floodplain	SA	19 - 25	4,300 - 4,600	3-volume purge
MW-47-115	Semiannually	Deep	105-115	75	Floodplain	SA	17 - 24	12,000 - 14,000	3-volume purge
MW-50-095	Quarterly	Mid-depth	85-95	43	Upland	SA	14 - 18	5,000 - 5,100	3-volume purge
MW-50-200	Quarterly	Deep	190-200	147	Upland	Q	7,800 - 10,200	17,000 - 19,000	3-volume purge
MW-51	Semiannually	Mid-depth	97-112	50	Route 66	SA	4,730 - 4,810	10,000-10,000	3-volume purge
MW-59-100	Quarterly	Shallow	86-101	0	Upland	Q	4,000 - 5,100	9,000 - 10,000	3-volume purge
MW-61-110	Quarterly	Shallow Bedrock	92-112	4	East Ravine	Q	522 - 684	15,000 - 16,300	3-volume purge

The proposed trial period will include third quarter 2012, fourth quarter 2012 and first quarter 2013. All proposed wells will be sampled during each event, including wells designated as having semiannual normal sampling frequency.

ND = non-detect; Q = quarterly; SA = semi-annual

SOP-A1

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

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 casing diameters in excess of 1-inch. This SOP will be used for sampling groundwater monitoring wells using a dedicated electric submersible pump with a single discharge rate, a dedicated electric pump with a controllable discharge rate, or a portable electric pump with a controllable discharge rate. A peristaltic pump or inertial pump (Waterra or similar) can be used if an electrical submersible pump is not appropriate. A well-volume based purging and sampling method will be used for these wells. This SOP does not apply to FLUTe wells, or Blatypus pump equipped wells (MW-58BR). Those wells will be sampled according to the relevant Field Activities Work Plan (available from on-site field coordinator).

REQUIRED DOCUMENTS:

- Event-specific planned sample table (PST).
- Applicable project work plan or monitoring plan. Refer to Topock Program Sampling, Analysis, and Field Procedures Manual and QAPP (Procedures Manual), as required.
- Topock Program Health and Safety Plan (HSP)
- Applicable SOP's
- Well construction logs/specifications
- Mobile Integrated Sample Tracking (MIST) handheld database
- Previous sampling logs or tabular historic field data tables
- Current site access map
- Blank sampling logs, maps, sample labels, chains of custody (COC's), and the designated groundwater sampling field notebook

REQUIRED EQUIPMENT:

- 2 or more (i.e. one is backup) YSI-556 WQ instruments with flow through cells, or equivalent.
- Hach 2100P turbidimeter or equivalent.
- 200 foot (or longer as needed) water level indicator (WLI).
- Trimble Rugged Reader hand held instrument for MIST data collection.
- Two, 200 gallon capacity purge tanks.
- Utility vehicles (UTV's) as necessary.

- Back-up 2-inch pump and controller.
- Honda 2000 watt generator or alternate power source.

PREPARATION & SETUP:

- Review event-specific PST or event-specific field instructions, previous sampling logs, Procedures Manual, HSP, and groundwater sampling supplies and equipment check list. (NOTE: the PST should also be reviewed for required "non-analytical event activities" such as water level measurements or other data collection that is planned in association with the groundwater sampling event).
- Acquire the existing field logbook for groundwater sampling and initiate entries.
- Inspect all equipment and verify that the field water quality (WQ) meters have been calibrated prior to use according to the manufacturer's instructions and SOP-A9, *Calibration of Field Instruments*.
- Inventory sample bottles, build sample sets for the required analytes at each sample location, ensure a sufficient supply of lab de-ionized water for equipment blanks, and confirm the lab courier schedule.
- Field-check sampling equipment and supplies: water level indicator (WLI), WQ meters, flow-through cell, pump controller, power supply, pump discharge/sampling tubing, N-dex gloves, D.I water sprayers, 5 gallon buckets, paper towels, 0.45 micron in-line filters, etc.

FIELD PROCEDURES:

- **Prior to opening any monitor well, remove all pens, lighters, calculators, or any other loose items from vest pockets, or from any other location where they could fall into the well.**
- Upon arrival at the monitoring well, at least 2 members of the sampling team must confirm the well ID. Wells should be clearly marked on the well monument. If the well cannot be positively identified by the marking, measure total depth of the well and compare to the well installation details to confirm the correct location. Report worn or unclear well markings to the on-site field coordinator.
- Place spill containment according to SOP A-13 *Spill Containment.*
- Collect an "EB", equipment blank, ***prior to pump installation*** if necessary according to the PST.
- Open the protective casing lid and, ***prior to moving it***, note the exact configuration of the transducer installation if present. Measure static WL according to SOP-A7, *Water level Measurements,* moving the transducer if necessary, and record WL value in MIST and on the sampling log.
- If the well is equipped with a transducer and does not have a dedicated pump installed, remove the transducer from the well according to SOP-C1, *Temporary Removal and Replacement of Transducers*.

- If the well does not have a dedicated pump installed, but does have dedicated sample tubing, attach the dedicated tubing to the appropriate pump and install decontaminated pump at the same intake/sampling depth as used in prior events. There is a marking on the purge tubing which corresponds with the monitor well top of casing (TOC) to facilitate this requirement. Purge and sample the well as described below.
- If the well does not have a dedicated pump ***or*** tubing, or has not been previously sampled, use new low-density polyethylene tubing and install the pump with the intake 15 feet below the surface of the static water column, or at the depth prescribed by the Project Manager (PM) or Field Team Manager (FTM), and record the intake depth in MIST and on the field data sheet. Purge and sample the well as described below.
- If the well ***does*** have a dedicated pumping system, connect the discharge tubing and purge and sample the well as described below.
- Collect daily equipment blanks and duplicate samples as required by the PST and instructed by the field team leader.

PURGING AND SAMPLING PROCEDURES:

- Prepare the groundwater sampling log. Use the static water level and the total depth provided on the field data sheet and in the PST to calculate the volume of one casing of standing water in the well.
- Calculate 3 casing volumes for the minimum required purge amount and record on sampling log.
- Evaluate previous purge rates, amount of drawdown, stability of field parameters, and total purge volume prior to sample collection from previous sampling records and historical data tables (Appendix B of *Monitoring Plan for Groundwater and Surface Water Monitoring Program*). If the well has not been previously sampled, estimate the expected purge rate using previous sampling information from nearby wells.
- If the pumping rate is in excess of one gpm, install the provided flow splitter so that the pumping rate does not need to be decreased to collect the sample. If the flow rate is at two gpm or above, install a second flow splitter to control the flow through the flow through cell.
- Install the pump as previously described. Immediately after installation, stuff a large trash bag, or place another barrier into the well bore around the pump discharge tubing. This will help to prevent foreign objects from falling into the well.
- Ensure that all tubing connections are properly tightened and then start the pump. Check for any leaks, monitor drawdown, and calculate/set the purge rate. The purge rate can be determined using the fill-time of a graduated container, or using a flow meter if available. The well specific purge rate and pump setting should be available on the previous purge form. Record pump setting (i.e. hertz) on sampling log if available.
- Purge water should be contained in a portable purge water storage tank. If approved by well owner and the governing regulatory agencies, water may be discharged directly to the ground (this presently applies to PM-03 and PM-04 water supply wells), as directed by the FTM.

- Continue purging, measuring WL and field indicator parameters periodically (time, pH, conductivity, turbidity, dissolved oxygen, temperature, salinity, TDS, ORP, appearance, and any odors present). Time the readings such that there are a minimum of 4 sets of data collected over the course of the full purge.
- If significant drawdown is observed or turbidity increases dramatically, decrease the purge rate and measure/record new purge rate. Significant drawdown is considered to be 5 percent of the total height of the water column or to the top of screen. Record time for all measurements collected. Note and provide qualifying remarks if parameter readings are anomalous or unstable due to instrument problems and change out the instrument.
- During the purge, compare the field parameters to historical purge data. If the parameters are significantly different (greater than 50% difference for SC, pH, and/or ORP) re-confirm the ID of the well. If the well ID is re-confirmed by 2 crew members, and the readings continue to be significantly different than prior readings, set up a second WQ instrument in series to confirm readings. If the anomalous readings are confirmed by the second instrument, contact the field coordinator to resolve the issue. If the second WQ instrument produces readings that are comparable to historic values, note an instrument change and use the second instrument's readings.
- Continue purging until ***3-casing volumes*** have been removed ***and*** field parameters stabilize. 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^{o} Celsius

- When the requirements above have been satisfied and the purge cycle is complete, disconnect the flow through cell and prepare to collect samples directly from the pump discharge tubing for analyses according to event-specific PST.
- If flow splitters have been used, do not change the flow rate, and collect the sample from the dedicated sampling port of the first splitter in line.
- 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)]; see SOP-A6), then general chemistry (cations, anions, stable isotopes).
- For filtered samples, attach a 0.45 micron in-line filter to the pump discharge and allow approximately 500 mL of sample to pass through the filter before beginning sample collection in accordance with SOP A-6 *Field filtration* and the QAPP.
- When sample collection is complete, record sample information, final WL, and purge volume data in MIST and on the field sampling log.

- If transient pump previously installed, remove the pump from the well, detach the dedicated tubing and carefully drain any residual water to the purge water tank. Fold both ends of the purge tubing and secure with wire ties as a further deterrent to leakage. Store the dedicated tubing in a sealed, labeled trash bag. Decontaminate the pump according to SOP A-10, *Decontamination of Water Sampling Equipment*.
- If well was equipped with a transducer, replace the transducer in exactly the same configuration in which it was found and in accordance with SOP-C1, *Temporary Removal and Replacement of Transducers*.
- Close and secure well protection lid.
- Follow SOPs in *Program 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 monitoring wells may not recharge sufficiently during purging, and may run completely dry without an opportunity to collect the required series of groundwater stabilization parameters, or requisite samples. The following procedures will be followed for collecting representative groundwater samples from wells that go dry during purging.

PREPARATION & SETUP:

Follow the steps above.

PURGING AND SAMPLING PROCEDURES FOR LOW RECOVERY WELLS:

- Prepare the groundwater sampling log. Use the static water level and the total depth provided on the field data sheet (comparing to the previous values used on the PST) to calculate the volume of one casing of standing water in the well.
- Calculate 3 casing volumes for the minimum required purge amount, and record on purge log.
- Evaluate previous purge rates, amount of drawdown, stability of field parameters, and total purge volume prior to sample collection from previous sampling records and historical data tables (Appendix B of *Monitoring Plan for Groundwater and Surface Water Monitoring Program*). If the well has not been previously sampled, estimate the expected purge rate using previous sampling information from nearby wells.
- Connect the dedicated purge tubing if available or use new tubing if necessary. Install the pump as previously described and start the purge. Monitor drawdown, and calculate/set the purge rate. Record the pump setting (i.e. hertz) on the sampling log if available.
- Continue purging, measuring WL and field indicator parameters periodically (time, pH, conductivity, turbidity, dissolved oxygen, temperature, salinity, TDS, ORP, and any

odors present). Space the readings such that there are a minimum of 4 sets of data collected over the course of the available purge volume.

- During the purge, compare the field parameters to previous purge data. If the parameters are significantly different (greater than 50% difference for SC, pH, and/or ORP) confirm the ID of the well. If the well ID is confirmed by 2 crew members, and the readings continue to be significantly different than prior readings, set up a second WQ instrument in series to confirm readings. If the anomalous readings are confirmed by the second instrument, contact the field coordinator to resolve the issue. If the second WQ instrument produces readings that are comparable to historic values, note an instrument change and use the second instrument's readings.
- Continue purging until ***3-casing volumes*** have been removed ***and*** field parameters stabilize, or until the well purges dry. If 3 casing volumes are removed, sample as described above. If the well runs dry, continue as instructed below.
- If previously installed, remove the pump from the well and decontaminate according to SOP A-10, *Decontamination of Water Sampling Equipment*. The pump may also be left in place to facilitate subsequent purging and sampling.
- Record the final water level, time, the volume of water discharged and the elapsed time for the dewatering of the well.
- Allow the well to recharge to 80 percent of the original height of the water column. Ideally, this should be within 24 hours of the monitoring 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 (MW-48).
- ***At MW-24BR only,*** return to the well the following day and continue purging until a total of 190 gallons have been removed, then sample normally.
- Once recovery has reached 80%, or 48 hours have elapsed (whichever comes first), a bailer can be used for sample collection. Collect samples for analyses according to PST. 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).
- If an insufficient volume of water is available to fill all of the sample containers, first contact laboratory personnel to determine the minimum allowable volumes needed for the required analyses. *(Talk to FTM as the FTM may have already contact lab personnel and may have the instructions for you.)* Then verify the critical analyte list with the PM or the FTM and prioritize the sample collection to obtain the critical analytes for the main contaminants of concern first. Continue collecting samples until all samples have been collected, or the groundwater supply is exhausted. Unfiltered samples are to be filled by transferring water directly from the bailer to the sample container.
- For filtered samples, attach a 0.45 micron in-line filter to the bailer and allow approximately 200 mls of sample to pass through the filter before beginning sample collection in accordance with SOP A-6 *Field filtration*. If gravity flow is insufficient to filter the sample, use a pressurized bailer and filter for sample filtration.

- When sample collection is complete, record sample information, final WL, and purge volume data in MIST and on the field sampling log.
- If well was equipped with a transducer, replace the transducer in exactly the same configuration in which it was found and according to SOP-C1, *Temporary Removal and Replacement of Transducers*.
- Close and secure well protection lid.
- Follow *Procedures Manual* for sample handing and management, equipment decontamination, and investigation-derived waste (IDW) management.

SOP-A17

Sampling of Groundwater Monitoring Wells
HydraSleeve No Purge Method
Standard Operating Procedures for PG&E Topock Program

This standard operating procedure (SOP) addresses the procedures and equipment to be used for sampling all groundwater monitoring wells approved for the Hydrasleeve sampling approach.

REQUIRED DOCUMENTS:

- Event-specific planned sample table (PST).
- Applicable project work plan or monitoring plan. Refer to Topock Program Sampling, Analysis, and Field Procedures Manual and QAPP (Procedures Manual), as required.
- Topock Program Health and Safety Plan (HSP)
- Applicable SOP's
- Well construction logs/specifications
- Mobile Integrated Sample Tracking (MIST) handheld database
- Previous sampling logs or tabular historic field data tables
- Current site access map
- Blank sampling logs, maps, sample labels, chains of custody (COC's), and the designated groundwater sampling field notebook

REQUIRED EQUIPMENT:

- 2 or more (i.e. one is backup) YSI-556 WQ instruments, or equivalent.
- Hach 2100P turbidimeter or equivalent.
- 200 foot (or longer as needed) water level indicator (WLI).
- Trimble Rugged Reader hand held instrument for MIST data collection.
- HydraSleeve samplers (from supplier)
- Pointed plastic discharge tube (included with sampler)
- Polypropylene strapping (from supplier)
- Stainless steel weights
- Small cable ties
- String reel
- Utility knife

- Scissors (stainless steel)
- Well caps with small eyelet on bottom allowing a string to be tied off
- Sample containers, cooler and ice

PREPARATION & SETUP:

- Review event-specific PST or event-specific field instructions, previous sampling logs, Procedures Manual, HSP, and groundwater sampling supplies and equipment check list. (NOTE: the PST should also be reviewed for required "non-analytical event activities" such as water level measurements or other data collection that is planned in association with the groundwater sampling event).
- Acquire the existing field logbook for groundwater sampling and initiate entries.
- Inspect all equipment and verify that the field water quality (WQ) meters have been calibrated prior to use according to the manufacturer's instructions and SOP-A9, *Calibration of Field Instruments.*
- Inventory sample bottles, build sample sets for the required analytes at each sample location, ensure a sufficient supply of lab de-ionized water for equipment blanks, and confirm the lab courier schedule.
- Field-check sampling equipment and supplies: water level indicator (WLI), WQ meters, HydraSleeve supplies, N-dex gloves, D.I water sprayers, 5 gallon buckets, paper towels, 0.45 micron in-line filters, etc.

FIELD PROCEDURES:

- **Prior to opening any monitor well, remove all pens, lighters, calculators, or any other loose items from vest pockets, or from any other location where they could fall into the well.**
- Upon arrival at the monitoring well, at least 2 members of the sampling team must confirm the well ID. Wells should be clearly marked on the well monument. If the well cannot be positively identified by the marking, measure total depth of the well and compare to the well installation details to confirm the correct location. Report worn or unclear well markings to the on-site field coordinator.
- Place spill containment according to SOP A-13 *Spill Containment.*
- Open the protective casing lid and, ***prior to moving it***, note the exact configuration of the transducer installation if present. Measure static WL according to SOP-A7, *Water level Measurements,* moving the transducer if necessary, and record WL value in MIST and on the sampling log.
- If the well is equipped with a transducer and does not have a dedicated pump installed, remove the transducer from the well according to SOP-C1, *Temporary Removal and Replacement of Transducers.*

PURGING AND SAMPLING PROCEDURES:

HydraSleeve Deployment

1. Remove HydraSleeve sampler from package and pinch the top to create an opening. See Attachment 1 for a representation of an unfilled HydraSleeve sampler.
2. Squeeze side fins together at top to bend reinforcing strips outward.
3. Use a cable tie to fasten a looped end of string to the top of the HydraSleeve sampler. Cut off excess cable tie. Alternatively, the string can be attached directly to the HydraSleeve sampler using a knot. If desired, a weight can be attached to the top of the sampler to provide some upper weight. This requires a cable tie to be placed between the length of string and the top of the weight and another to be placed between the weight and the sampler.
4. Fold the two holes at the bottom of the HydraSleeve together and attach a weight using a cable tie. Cut off the excess cable tie.
5. Lower the sampler to the bottom of the well screen by measuring the string during deployment, using caution not to drop the length of string into the well by fastening the loose end of the string to an object such as a well cap.
6. Following placement in the well, fasten the end of the string to the hook on the bottom of the well's locking cap.
7. Record the depth below the well measuring point at which a sampler is hanging in the well in the field logbook.
8. Place cap back onto well.
9. Secure monitoring well and area prior to demobilization.

HydraSleeve Sample Recovery

Once a sufficient period of time has elapsed so that re-equilibration of the water within the well with surrounding groundwater conditions has occurred (typically a minimum of 1-week), the HydraSleeve samplers can be recovered and samples collected for analysis.

For standard HydraSleeve sampler recovery, the following procedures will be performed at each well:

1. Measure the depth to water to the nearest 0.01 foot.
2. Carefully remove the stopper from the well riser and pull the sampler from the well. This can be done by several different methods, depending upon the intended sample interval. The most commonly used method is to pull the HydraSleeve sampler upward continuously from its starting point, at a rate of one to two feet per second or faster, until the sampler is full, which is a vertical distance of 24 to 48 inches for a 24-inch long sampler. If a shorter sampling

interval is desired, the sampler should be pulled upward at the rate of one to two feet per second for the length of the sampler, then allowing the sampler to drop back down to its starting point. Repeat this cycle three to five times. A third option is to cycle the sampler up and down using rapid, short strokes (6-inch cycle at a minimum of one cycle per second) five to eight times. This method provides the shortest sampling interval.

3. The condition of the sampler should be recorded in the field logbook, including the presence of any headspace within the sampler.

HydraSleeve Sample Collection

Samples for chemical analysis will be collected from the HydraSleeve samplers immediately following removal from the well. The following sampling procedures will be used at each well:

1. Identification labels for sample bottles will be filled out for each sample.
2. The sampler will be cut free from its deployment string.
3. Squeeze the full sampler just below its top to expel water resting above the flexible check valve.
4. Push the pointed discharge tube through the outer polyethylene sleeve approximately three to four inches below the white reinforcing strips.
5. Transfer the sample into the desired sample containers. Raising or lowering the bottom of the sampler or pinching the sample sleeve just below the discharge tube will control the flow of the sample. The sample sleeve can also be squeezed, forcing fluid up through the discharge tube, similar to squeezing a tube of toothpaste.
    - 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)]; see SOP-A6), then general chemistry (cations, anions, stable isotopes).
    - For filtered samples, attach a 0.45 micron in-line filter to the HydraSleeve discharge and allow approximately 500 mL of sample to pass through the filter by gravity before beginning sample collection in accordance with SOP A-6 *Field filtration* and the QAPP.
6. If sample volume allows, transfer water into a container to obtain field parameter readings with a YSI-556 WQ or equivalent instrument (note in the field book the results are approximate because a flow-through cell could not be used). Field parameter readings are to be recorded on the groundwater sample form.
7. Excess sampler water will be returned to the monitoring well from which it came.
8. Samples will be preserved and managed as detailed in the QAPP. Time of sampling will be recorded in the field logbook, sample labels, MIST and chains of custody.

9. After the samples have been collected, immediately place the sample bottles in an ice-filled cooler.Before decontamination of field equipment, the well cap will be replaced and locked.

10. If redeployment of a new HydraSleeve sampler is not intended, sampling equipment, except for string, stainless steel weight and rubber stopper, will be discarded as with other PPE trash, and the blank string with weight will be redeployed down the well. However, if deployment of a new sampler is required, the new sampler will be reattached to the existing string and stainless steel weight. The sampler can then be deployed in the well for the next sampling event.

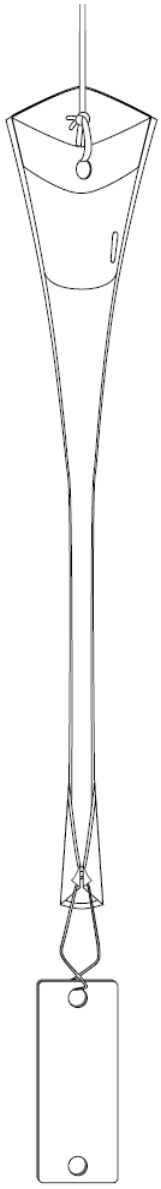
11. If well was equipped with a transducer, replace the transducer in exactly the same configuration in which it was found and in accordance with SOP-C1, *Temporary Removal and Replacement of Transducers*.

12. Prior to leaving the site, field documentation, including the chain-of-custody form, will be completed.

13. Secure monitoring well and area prior to demobilization.

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

Attachment 1
Representation of HydraSleeve Sampler



SOP-A18

Purging and Sampling of Groundwater Monitoring Wells
Minimal Drawdown Method
Standard Operating Procedures for PG&E Topock Program

This standard operating procedure (SOP) addresses the procedures and equipment to be used for purging and sampling all groundwater monitoring wells approved for the minimal drawdown sampling approach. This SOP will be used for sampling groundwater monitoring wells using an adjustable rate, positive displacement pump.

REQUIRED DOCUMENTS:

- Event-specific planned sample table (PST).
- Applicable project work plan or monitoring plan. Refer to Topock Program Sampling, Analysis, and Field Procedures Manual and QAPP (Procedures Manual), as required.
- Topock Program Health and Safety Plan (HSP)
- Applicable SOP's
- Well construction logs/specifications
- Mobile Integrated Sample Tracking (MIST) handheld database
- Previous sampling logs or tabular historic field data tables
- Current site access map
- Blank sampling logs, maps, sample labels, chains of custody (COC's), and the designated groundwater sampling field notebook

REQUIRED EQUIPMENT:

- 2 or more (i.e. one is backup) YSI-556 WQ instruments with flow through cells, or equivalent.
- Hach 2100P turbidimeter or equivalent.
- 200 foot (or longer as needed) water level indicator (WLI).
- Trimble Rugged Reader hand held instrument for MIST data collection.
- Two, 200 gallon capacity purge tanks.
- Utility vehicles (UTV's) as necessary.
- Honda 2000 watt generator or alternate power source.
- Adjustable-rate, positive-displacement pump
- Sample containers, cooler and ice

PREPARATION & SETUP:

- Review event-specific PST or event-specific field instructions, previous sampling logs, Procedures Manual, HSP, and groundwater sampling supplies and equipment check list. (NOTE: the PST should also be reviewed for required "non-analytical event activities" such as water level measurements or other data collection that is planned in association with the groundwater sampling event).
- Acquire the existing field logbook for groundwater sampling and initiate entries.
- Inspect all equipment and verify that the field water quality (WQ) meters have been calibrated prior to use according to the manufacturer's instructions and SOP-A9, *Calibration of Field Instruments*.
- Inventory sample bottles, build sample sets for the required analytes at each sample location, ensure a sufficient supply of lab de-ionized water for equipment blanks, and confirm the lab courier schedule.
- Field-check sampling equipment and supplies: water level indicator (WLI), WQ meters, flow-through cell, pump controller, power supply, pump discharge/sampling tubing, N-dex gloves, D.I water sprayers, 5 gallon buckets, paper towels, 0.45 micron in-line filters, etc.

FIELD PROCEDURES:

- **Prior to opening any monitor well, remove all pens, lighters, calculators, or any other loose items from vest pockets, or from any other location where they could fall into the well.**
- Upon arrival at the monitoring well, at least 2 members of the sampling team must confirm the well ID. Wells should be clearly marked on the well monument. If the well cannot be positively identified by the marking, measure total depth of the well and compare to the well installation details to confirm the correct location. Report worn or unclear well markings to the on-site field coordinator.
- Place spill containment according to SOP A-13 *Spill Containment.*
- If using a transient pump,collect an "EB", equipment blank, ***prior to pump installation*** if necessary according to the PST.
- Open the protective casing lid and, ***prior to moving it***, note the exact configuration of the transducer installation if present. Measure static WL according to SOP-A7, *Water level Measurements,* moving the transducer if necessary, and record WL value in MIST and on the sampling log.
- If the well is equipped with a transducer and does not have a dedicated pump installed, remove the transducer from the well according to SOP-C1, *Temporary Removal and Replacement of Transducers*.
- If the well does not have a dedicated pump installed, but does have dedicated sample tubing, attach the dedicated tubing to the appropriate pump and install decontaminated

pump at the same intake/sampling depth as used in prior events. There is a marking on the purge tubing which corresponds with the monitor well top of casing (TOC) to facilitate this requirement. Purge and sample the well as described below.

- If the well does not have a dedicated pump ***or*** tubing, or has not been previously sampled, use new low-density polyethylene tubing and install the pump with the intake at approximately the midpoint of the well screen. Purge and sample the well as described below.
- If the well ***does*** have a dedicated pumping system, connect the discharge tubing and purge and sample the well as described below.
- Collect daily equipment blanks and duplicate samples as required by the PST and instructed by the field team leader.

PURGING AND SAMPLING PROCEDURES:

- Install the pump in the well. Slowly lower the pump (with the attached tubing and safety line) into the well to the desired depth. The pump will be set near the middle of the well screen, if possible. At a minimum, the pump intake will not be positioned lower than 2 feet from the bottom of the well. The depth to the pump intake will be recorded on the Groundwater Sampling Form. If there is less than 3 feet of available water, the groundwater well will be purged and sampled using a bottom-loading bailer.
- Measure the water level in the well after pump insertion. Leave the water level probe in the well to facilitate continued water level monitoring during purging activities.
- Start purging the well at a low flow rate between 0.2 and 0.5 liters per minute. Measure the purge rate using a container of known volume, and record this information on the Groundwater Sampling Form.
- The water level should be monitored during purging, and ideally, the purge rate should equal the well recharge rate so there is limited drawdown in the well. (The water level should stabilize for the specific purge rate). The purge rate may be increased above 0.2 and 0.5 liters per minute as long as a constant water level in the well can be maintained. There should be at least 1 foot of water over the pump intake. This assures that there is no risk of the pump suction being broken, or of entrainment of air in the sample. Record adjustments in the purge rate and changes in depth to water on the field data sheet. Purge rates should, if needed, be decreased to the minimum capabilities of the pump (0.1 to 0.2 liters per minute) to avoid affecting well drawdown.
- During purging, the water quality parameters will be measured periodically (every 3 to 5 minutes) until the parameters have stabilized as shown below. If parameter stabilization has not occurred after 4 hours, purging activities will be considered complete.
    - 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

- When the requirements above have been satisfied and the purge cycle is complete, disconnect the flow through cell and prepare to collect samples directly from the pump discharge tubing for analyses according to event-specific PST. 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)]; see SOP-A6), then general chemistry (cations, anions, stable isotopes).
- For filtered samples, attach a 0.45 micron in-line filter to the pump discharge and allow approximately 500 mL of sample to pass through the filter before beginning sample collection in accordance with SOP A-6 *Field filtration* and the QAPP.
- When sample collection is complete, record sample information, final WL, and purge volume data in MIST and on the field sampling log.
- If transient pump previously installed, remove the pump from the well, detach the dedicated tubing and carefully drain any residual water to the purge water tank. Fold both ends of the purge tubing and secure with wire ties as a further deterrent to leakage. Store the dedicated tubing in a sealed, labeled trash bag. Decontaminate the pump according to SOP A-10, *Decontamination of Water Sampling Equipment*.
- If well was equipped with a transducer, replace the transducer in exactly the same configuration in which it was found and in accordance with SOP-C1, *Temporary Removal and Replacement of Transducers*.
- Close and secure well protection lid.
- Follow SOPs in *Program Procedures Manual* for sample handing and management, equipment decontamination, and investigation-derived waste (IDW) management.