STANDARD OPERATING PROCEDURE FOR GROUND WATER SAMPLING

The Office of Environmental Measurement and Evaluation
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Revision Page

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1.0 Scope & Application:

1.1 This Standard Operating Procedure is applicable to the collection of representative samples from ground water. It includes samples collected from either temporarily or permanently installed ground water monitoring wells. Samples can also be obtained from pits, dug or drilled holes that contain ground water. Specific procedures for Low Stress (low flow) Purging and Sampling is described in its own SOP.

1.2 The scope of this SOP is limited to field operations and protocols applicable during ground water sample collection.

2.0 Summary of Method:

2.1 Ground water sampling procedures can be split into two tasks, purging and sampling. Purging is the process of removing stagnant water from the location (monitoring well, dug pit or hole) prior to sampling and replacing it with ground water from the adjacent formation. This will enable the sampler to collect a more representative sample of the actual aquifer condition. Thus, the SOP will first discuss appropriate purging methods followed by sampling techniques.

2.2 Purging

2.2.1 Purging and Purge Volume Computation

Monitoring Wells should be purged, at a minimum, the equivalent of three times the well volume of standing water or continue evacuating water until specific conductance, temperature, and pH stabilize. The volume of water present in each well shall be computed based on the length of water column and well casing diameter. The water volume shall be computed using the following formula given below:

$$V = 0.041D^2\left(d_2 - d_1\right)$$

V = Volume in gallons

D = Inside diameter of well casing in inches

d_2 = Total depth of well in feet

d_1 = depth to water surface in feet

Field notes should reflect the single well volume calculations or determinations that clearly identify the purge volume goal. Stabilization should be achieved within 3 well volumes, if not continue until it does or to a maximum of 5 well volumes.

The field project manager should determine when the most representative sample can be obtained based upon available site information. With respect to ground water chemistry the following conditions can generally be used to determine purge stabilization: specific conductance varies no more than 10 percent, and temperature is constant for at least three consecutive readings. During sample collection water chemistry parameters should be measured and recorded.

In some instances a well may be pumped or bailed dry (evacuated). When this occurs, the well can be assumed to be adequately purged and the well can be sampled following sufficient recovery (enough volume to allow filling all sample containers).

Sampling must commence as soon as possible after purging. If there is not an adequate volume available, than sampling should occur as soon as there is. Purging procedures are described below.

2.2.2 Well-Purging Methods

Purging must be performed for all ground water monitoring wells prior to sample collection in order to remove stagnant water from within the well casing and ensure that a representative sample is obtained. Three general types of equipment are used for well purging; bailers, surface pumps, or down-well submersible pumps. In all cases pH, temperature, and specific conductance will be monitored during purging. The data values shall be recorded into the field log book.

2.2.3 Decontamination

The purging equipment shall be decontaminated immediately after use to ensure against cross-contamination from one well to the next well.

Bailers: If a bailer is used to purge the well, use dedicated one time use bailers. If not then: add clean detergent solution to bailer, cover the ends, and slosh solution end to end while rotating the barrel to ensure washing of all interior surfaces. Dump spent detergent solution in a waste collection vessel. Thoroughly rinse exterior surfaces three times with distilled water. Rinse the interior of bailer with distilled water three times. Using a teflon wash bottle designated for use with a specific solvent (typically isopropyl alcohol or methanol), squirt solvent on the inside of the bailer's barrel and rotate the bailer to flush the entire surface, then cover ends and slosh solvent end to end while rotating the barrel of the bailer. Dump spent solvent in a designated waste container. Repeat solvent rinse process three times. Rinse the exterior surface of the bailer with solvent and wipe dry with a chemical resistant wipe. Repeat this process three times as well. Dispose of all wipes and spent solutions in appropriate containers and return them to the laboratory.

Bailer Cord: The wetted or contaminated portion of braided nylon of braided cotton cord can be cut and disposed of.

Pumps: If a pump is used, pump one gallon of distilled water through immediately after use. Wash or wipe the exterior surface of the pump hose with a detergent solution and rinse or wipe three times with distilled water. Thoroughly wash or wipe three times with solvent (typically isopropyl alcohol) and allow to air dry before reuse.

2.3 Sampling

Sampling is the process of collecting, containerizing, and preserving the ground water sample after the purging process is complete. Three devices have been generally accepted to collect ground water samples from most wells. These are Teflon bailer, peristaltic pump/vacuum jug assembly, and a stainless steel and Teflon bladder pump. A description of how to collect a sample using these tools will be described later on in section 8.

3.0 Definitions:

3.1 Bottle Blank: Analyte-free water is collected into a sample container, of the same lot as the containers used for the environmental samples. This evaluates contamination introduced from the sample container(s) from a common lot.

3.2 Equipment/Rinse/Rinsate Blanks: A sample that is collected by pouring over or running analyte-free water through the sample collection equipment after decontamination and before sample collection. The sample is collected in the appropriate sample container with the proper preservative, identical to the samples. This represents background contamination resulting from the field equipment, sampling procedure, sample container, preservative, and shipment.

3.3 Field Blank: In the field, analyte-free water is collected into a sample container with preservatives. The sample containers are the same lot used for the environmental samples. This evaluates contamination introduced from the sample container(s) with applicable preservatives. Field blanks are not used for volatile samples.

3.4 Field Replicates/Duplicates: Two or more samples collected at the same sampling location. Field replicates should be samples collected side by side or by collecting one sample and immediately collecting the second sample. Field replicates represent the precision of the whole method, site heterogeneity, field sampling and the laboratory analysis.

3.5 Field Split Samples: Two or more representative subsamples taken from one environmental sample in the field. Prior to splitting, the environmental sample is homogenized to correct for sample heterogeneity that would adversely impact data comparability. Field split samples are usually analyzed by different laboratories (interlaboratory comparison) or by the same laboratory (intralaboratory comparison). Field splits are used to assess sample handling procedures from field to laboratory and laboratory's comparability.

3.6 Filter Blank: In the field, analyze-free water is passed through a filter and collected into in the appropriate sample container. The filter blank is then preserved. This procedure is identical to the sample collection.

3.7 Laboratory Quality Samples: Additional samples will be collected for the laboratory's quality control: matrix spike, matrix spike duplicate, laboratory duplicates, etc.

3.8 **Proficiency Testing (PT)/Performance Evaluation Sample (PES): A sample, the composition of which is unknown to the laboratory or analyst, provided to the analyst or laboratory to assess the capability to produce results within acceptable criteria.** This is optional depending on the data quality objectives.

3.9 Shipping Container Temperature Blank: A water sample that is transported to the laboratory to measure the temperature of the samples in the cooler.

3.10 Trip Blanks: A sample collected at the laboratory using analyte free water in the appropriate sample container with the proper preservative, taken out to the field, and returned to the laboratory for analysis without being opened. Trip blanks are generally for volatile organic compounds, low level metals, and gasoline range hydrocarbon samples. Used to assess contamination introduced during sample transport.

4.0 Health and Safety Warnings:

4.1 When working with potentially hazardous materials or situations, follow EPA, OSHA, and specific health or safety procedures.

4.2 All proper personal protection clothing and equipment is to be worn.

4.3 When sampling lagoons or surface impoundments containing known or suspected hazardous substances, take adequate precautions. The sampling team member collecting the sample should not get too close of the edge of the impoundment, where bank failure may cause them to lose their balance.

4.4 Physical hazards associated with well sampling:

1. Lifting injuries
2. Use of pocket knives for cutting discharge hose
3. Heat and cold stress
4. Slip, trip, and fall conditions
5. Electrical shock associated with using submersible pumps.

4.5 Some samples may contain biological and chemical hazards. These samples should be handled with suitable protection to skin, eyes, etc.

5.0 Interferences:

5.1 Interference may result from using contaminated equipment, solvents, reagents, sample container, or sampling in a disturbed area.

5.2 Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of the sampling equipment is necessary.

5.3 **All sampling equipment must be routinely demonstrated to be free from contaminants under the conditions of the analysis by running equipment blanks.**

6.0 Personnel Qualifications:

6.1 All field samplers working at Superfund sites are required to take a 40 hour health and safety training course and a refresher course prior to engaging in any field activities.

6.2 The field sampler should be trained by an experienced sampler before initiating the procedure.

6.3 All personnel shall be responsible for complying with all necessary quality assurance/quality control requirements that pertain to their organizational/technical function.

7.0 Equipment and Supplies:

Table 1 listed below identifies the types of equipment which may be used for a range of ground water-sampling applications. From this list, a project- specific equipment list should be selected based upon data quality objectives, the depth to ground-water, purge volumes, analytical parameters and well construction.

Table I. Equipment List

- Purging/Sample Collection : Bailer, Teflon or Stainless Steel, Centrifugal Pump, Submersible Pump, Peristaltic Pump, Water-Level Measurement Equipment

- Sample Preparation/Field Equipment: pH Meter w/ standards, Specific Conductance Meter Thermometer, Chlorine Residual Meter, Filtration Apparatus

Additional equipment to support sample collection and provide baseline worker safety will be required to some extent for each sampling task. The additional materials are separated into two primary groups: general equipment which is reusable and materials which are expendable.

- General: Project-specific sampling program, Decontamination and Cleaning solutions (Distilled-water, isopropyl alcohol* in Telfon wash bottle,Detergent solution, Tap water), Site-specific Health & Safety equipment (gloves, respirators, goggles), Field data sheets and log book, Preservation solutions, Sample containers, and intermediate containers, Coolers and ice and/or ice packs, and First Aid kit

- Expendable Materials: Bailer Cord (braided nylon or braided cotton line, 1/8" diameter or smaller, do not use monofilament fishing line), Respirator Cartridges, Gloves (chemical resistant), Chemical-free paper towels, and Trash containers

* Methanol, Hexane or methylene chloride (in order of preference) may also be used if so noted

8.0 Sample Collection:

8.1 Water-Level Measurement

Prior to obtaining a water-level measurement, create a clean surface area onto which sampling equipment can be positioned and work can be performed. If necessary cut a slit in one side of a plastic bag and slip it over and around the well, to a create a clean space for the sampling equipment. Unlock and/or open the monitoring well. Note and record description of condition of the security system and protective casing at the well site, i.e., cap, lock, base.

8.1.2 Measurement:

After unlocking and/or opening a monitoring well, the first task will be to obtain a water-level measurement. Water-level measurement will be made using an electronic water level detector. Establish a measuring point. Typically, all depth measurements should be made from top (the highest point) of the inner well casing. The measuring point location should be described in the field log book and should be used in all subsequent sampling efforts. Lower the water-level measurement tape and record the depth to water and total depth of the well. Care should be taken to assure that the water-level measurement device hanges freely in the monitoring well and is not adhering to the wall of the well casing. Record into field logbook.

8.1.3 Decontamination:

The measurement device shall be decontaminated immediately after use with either detergent and DI water or an isopropyl alcohol soaked towel. Generally, only that portion of the tape which enters the water table should be cleaned. It is important that the measuring tape is never placed directly on the ground surface.

8.2 GW Sampling:

Determine the appropriate ground water sampling methods: bailers, submersible pumps, and peristaltic pumps. The withdrawal methods selected may depend upon the advantages or disadvantages each device offers relative to the overall data quality objectives. It could be more appropriate to use a combinations of devices to achieve a desired sample. Therefore, careful consideration should be made when choosing the sample device.

8.2.1 Sample Collection Procedures: A positive-displacement type sampling bailer is mostly for collection of volatile organics.

C Place protective plastic material around monitoring well, attach line to a new or clean/decontaminated bailer suitable for the diameter well being sampled.

C Lower bailer slowly and gently into well, do not drop of splash bailer into the water. Stop lowering at desired point adjacent to well screen.

C Carefully (don't hit sides of well, this could cause flaking of material into bailer) withdraw and waste three bailers full of well water prior to collecting sample for analyses. Withdraw a sample from the well, transfer the sample from the bailer directly into the sample container. Preserve and filter according to program methodology requirements or as required by site sampling plan.

C Record sampling information in logbook or sampling data sheets. Label appropriate sampling containers with sampling details and custody information.

C Secure well

8.2.2 Peristaltic Pump Method:

C Using a water level detector, determine the depth to the water table, and depth to the well bottom.

- Measure out the correct length of small diameter tubing based on measured depths. At least 12" of additional tubing should protrude above the well riser. Lower the tubing into the well opening until it reaches the mid point of the well screen.

- Purge at least three well volumes of water before sampling begins, using a water pumping device, such as a peristaltic pump.

- Record sampling information in logbook or sampling data sheets. Label appropriate sampling containers with sampling details and custody information.

- To collect sample, hold the sample container in a slightly tilted position under the well tubing dispenser, and fill to desired amount.

- Repeat step above until the appropriate number of samples is obtained.

- After sampling is complete: disconnect the pump, remove the tubing from the well.

- Secure well

8.2.3 Submersible Pumps:

- Allow well to recharge after purging, keeping the pump just above or at the screen mid section.

- Attach a gate valve to hose if necessary (if not already fitted) and reduce pumping flow rate to allow for proper sample collection and minimal well draw down.

- Record sampling information in logbook or sampling data sheets. Label appropriate sampling containers with sampling details and custody information.

- If there is no gate valve and discharge rate is high, then run water down side of clean jar and fill sample bottles from the jar.

- When sampling is finished, remove pump and assembly and decontaminate prior to next location. Tube can be dedicated to well. When sampling well of varying concentrations its best to start with the least contaminated and finish with the most contaminated.

- Secure well

8.3 Filtration Procedures for Dissolved Inorganics:

8.3.1 Set up procedure:

- Attach filter to sample hose

8.3.2 Filtering:

- Filter approximately 100 ml's of sample through filter and waste.
- Filter sample, replacing filters as needed to obtain sufficient volume.
- Filter sample into clean sample container and preserve immediately according to program methodology requirements.

9.0 Handling, Preservation, and Storage:

9.1 Transfer the sample into a suitable labeled sample container.

9.2 Preserve the sample or use pre-preserved sample bottles, when appropriate.

9.3 Cap the container, use a custody seal if the sample is for enforcement and then place the container in a zip-lock plastic bag.

9.4 Load all the sample containers into cooler(s) ensuring that the bottles are in the ice but not totally immersed in water.

9.5 Record all pertinent data in the site logbook and/or on the field data sheet.

9.6 Complete the chain of custody form.

9.7 Attach the custody seals to the cooler prior to shipment.

9.8 A list for the laboratory's containers and preservatives for the various analytes is located on the EPA Region 1 homepage under OEME.

10.0 Data and Records Management:

10.1 All data and information is to follow the Field Data Management SOP.

10.2 The chain of custody form is signed over to the laboratory. A copy is kept with the sampling records.

10.3 The sampling data is stored at US EPA - NE, 11 Technology Dr, North Chelmsford, MA for at least 3 years.

11.0 Quality Control and Quality Assurance:

11.1 Representative samples are required. The sampler will evaluate the site specific conditions to assure the sample will be representative.

11.2 All sampling equipment must be decontaminated prior to use and after each discrete sample following the General Field Equipment - Cleaning, Preparation, and Decontamination SOP (unless specified differently in SOP or SAP)

11.3 All field QC samples requirements in the SAP or QAPP must be followed. These may involve trip blanks, equipment blanks, field duplicates and the collection of extra samples for the laboratory's quality control.

12.0 Waste Management and Pollution Prevention:

12.1 During field sampling and analysis events there may be hazardous waste produced from the sample collection. The waste must be handled and disposed of in accordance with federal, state, and municipal regulations. Dispose of the hazardous waste produced at the site where the work was performed, if the operating site has proper disposal available. If there is no disposal that meets regulatory requirements, the waste must be transported back to EPA-NE and transferred to the hazardous waste manager for disposal. The sample volume should be minimized to reduce unnecessary waste.

13.0 References: