

**SAMPLING GROUNDWATER MONITORING WELLS**

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**1.0 PURPOSE**

This document establishes the Savannah River Site (SRS) procedure for the collection of groundwater samples from monitoring wells when the samples are intended for chemical and radiological analyses for regulatory compliance purposes. [S/RID] The technical basis for these procedures also establishes a frame of reference for samples collected for other scientific uses. (Reference United States (US) Department Of Transportation (DOT), 49 Code of Federal Regulations (CFR), Transportation, Sections 171 through 177<sup>1</sup>.)

**2.0 SCOPE**

This document is applicable to any department, organization, contractor, or person who collects groundwater samples for regulatory compliance purposes from monitoring wells located within the SRS.

This is a Reference procedure. The user is not required to have this procedure present while performing the activity.

**3.0 GENERAL INFORMATION****3.1 Precautions and Limitations**

Additional hazard analysis may be required to ensure that facility/job specific hazards are identified and that the appropriate actions are taken to eliminate/mitigate the identified hazard(s).

**3.2 Prerequisite Actions**

**SEE** applicable Sections in procedure.

**3.3 Terms/Definitions**

**REFER** to 3Q5 glossary.

**4.0 RESPONSIBILITIES**

Prior to initiating any new compliance groundwater sampling program at SRS, the WSRC Project Manager (PM) or their designee completes the Sampling Mobilization Request form [SMR (located on Lotus Notes)] as determined by the departmental technical representative. **SUBMIT** the completed form for review and mobilization.

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#### **4.0 RESPONSIBILITIES, continued**

If the project is outside of Soil and Groundwater Closure Projects (SGCP), then the completed form/plan shall be submitted to SGCP, Geochemical Monitoring Groundwater Coordinator for review and mobilization.

The sampling personnel (SP) conducting this procedure performs the following; prepares all required documentation verifying that this procedure has been followed, ensures that all sampling equipment is properly maintained and calibrated, ensures that the SRS sample identification numbers are properly used, and records the field data collected during sampling on standard SRS forms or as described in the site specific sampling plan, unless otherwise approved by the site specific project Point of Contact or Technical Representative as identified on the SMR form. The SP shall be familiar with and follow this procedure, Standard Operating Procedures (SOP) as appropriate, project specific sampling guidance, Site Safety procedures, the site- specific health and safety plan when applicable and the special procedures and precautions required in Radiological Areas, and purge water collection of Investigative Derived Waste (IDW), when applicable.

The SP and designated analytical laboratories shall properly maintain the Chain Of Custody (COC) forms for environmental compliance samples (Attachment 1) and return them to SGCP for record keeping under the data management system.

#### **5.0 PROCEDURE**

##### **5.1 Sample Containerization, Preservation, and Analytical Procedures**

The sample containers, preservatives, and holding times shall be appropriate for the parameters based upon the most recent Environmental Protection agency (EPA) approved analytical methods. Specific parameter lists and analytical procedures include those dictated by the regulatory programs under which the sampling is performed [e.g., the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), etc.]. Appropriate containers and sample preservatives are to be included on the COC forms.

##### **5.2 Sample Order**

**COLLECT** the samples and **PLACE** them in the sample containers for analysis in the order specified below, unless instructed otherwise by the site specific sampling plan. In some cases turbidity concerns may warrant collecting metals first. For wells that have a history of pumping dry, the project point of contact may prioritize the sampling order.

- Volatile Organic Compounds (VOCs)
  - Purgeable organic carbon
  - Purgeable organic halogens
  - Metals
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**5.2 Sample Order, continued**

- Total Organic Halogens (TOX)
- Total Organic Carbon (TOC)
- Base/Neutral/Acid (BNA) Extractable organics
- Pesticides/PCBs
- Herbicides
- Radionuclides
- Phenols
- Cyanide
- Sulfate, chloride and fluoride
- Nitrate and ammonia.

**5.3 Sampling Materials and Equipment Required**

The following materials and equipment may be required:

- Alkalinity titration kit
  - Aluminum foil
  - Bailer
  - Batteries, spare battery for pH meter, conductivity meters, temperature meter, water level tape
  - Beakers, polyethylene - two 50-mL, two 600-mL, two 1000-mL
  - Black indelible ink marker and black ball-point pen
  - Bromcresol Green Methyl Red powder pillows (for alkalinity titration)
  - Buffers for calibrations, pH 4, pH 7 and pH 10
  - Calculator
  - COC forms
  - Control box for electric pumps
  - Coolers for sampling kits and samples (if from the laboratories, cleaned of all tape, labels, etc.)
  - Copy of Sampling Procedure
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**5.3 Sampling Materials and Equipment Required, continued**

- Decontamination solvents (see Attachment 3)
  - Deionized water - 1 plus gallons
  - Detergent, phosphate free (Liquinox® or Detergent 8)
  - Dissolved Oxygen meter
  - Eh meter
  - Electric extension cords - two 50' cords
  - Erlenmeyer flask - 250 mL (for alkalinity measurements)
  - Field logbooks (bound with numbered pages, not wire-bound)
  - Electronic data recorder
  - Filtering apparatus with spare O rings (Attachment 2)
  - Filters - .45 micron
  - Fire Extinguisher
  - Generator - 3500 kW, possible 6500 kW (unleaded gas only, for pump sampling)
  - Gloves - suitable for intended use
  - Graduated cylinder (1 liter), for measuring flow rates
  - Ice or Ice Packs - sufficient to cool collected samples. Ice packs should be examined for leakage as this material can produce false positives in analytical results.
  - Isopropanol, pesticide grade
  - Keys - for well locks, access to wells
  - Lockase or equivalent for corroded locks
  - Nylon rope (new, for bailer sampling)
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**5.3 Sampling Materials and Equipment Required, continued**

- Phenolphthalein powder pillows (for alkalinity measurements)
  - Plastic lay down sheeting (4 mil) for each well bailed
  - Plastic tape
  - Preservatives (generally in sample bottles)
  - Personal protective equipment as required
  - Safety glasses
  - Disposable gloves
  - Portable eye wash station
  - Other safety equipment as specified
  - Sample containers
  - Specific conductance and pH meters, calibration standards, buffer solutions, rinse bottle filled with deionized water, beakers, laboratory wipes, etc.
  - Squirt bottles, Teflon™ for pesticide alcohol dispensing
  - Squirt bottles, polyethylene for deionized water (DI) and potable water
  - SRS data forms
  - Stainless steel, Teflon™, or Polyvinyl Chloride (PVC) bailer(s) wrapped in aluminum foil or plastic (for bailer sampling)
  - Suction-lift pump, centrifugal pump, or submersible pump
  - Sulfuric acid cartridges, 0.1600 and 1.600 (for alkalinity measurements)
  - Thermometer for air and water
  - Trash bags or containers
  - Turbidity meter
  - Watches and stop watches (for flow rates)
  - Water level measuring device, calibrated (i.e., metal measuring tape [300 ft] or electric water level indicator).
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## 5.4 Sample Container and Sampling Equipment Preparation

### 5.4.1 Sample Container Preparation

1. **ASSEMBLE** the correct number of sample containers, preservatives (usually in the bottles), and coolers needed to collect samples for each COC form. Sample containers and preservatives should meet the requirements detailed in Attachment 2.
2. **IF** the sample containers are not clean, **THEN**  
  
**DECONTAMINATE** them in accordance with Section 5.4.2.
3. **LABEL** the sample containers with black indelible ink showing the well number, sample date and time of sampling. Additional information, such as sample parameter and preservative, may need to be included if the container labels have not been pre printed by the laboratories.
4. **LINE** the sample cooler(s) with plastic.
5. **PLACE** the empty sample container(s) in the cooler(s).
6. Do not leave the sample bottles unattended unless they are locked within a storage space.
7. **TRANSPORT** sample containers to the sampling site with sufficient ice for cold preservation of the samples.

### 5.4.2 Sampling Equipment Cleaning and Decontaminating

**CLEAN** or **DECONTAMINATE** sampling and associated equipment per Attachment 3 of this procedure.

## 5.5 Sampling Procedure

**FOLLOW** the instructions in Section 5.5.1 if the well has a submersible pump, Section 5.5.2 if the well is to be bailed, or Section 5.5.3 if the well is equipped with a Purge Water Management System (PWMS) tank unit. **FOLLOW** the instructions in Section 5.5.4 if the well is being sampled with a Hydrasleeve<sup>TM</sup>.

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## **5.5 Sampling Procedure, continued**

**MAINTAIN** field documentation. **RECORD** the field data in field logbooks, data forms, electronic data recorder, or as described in the site specific sampling plan. All documentation must be completed in waterproof black ink; corrections must be marked with a single line, dated, and initialed. Serialized documents are not to be destroyed or discarded, even if illegible or inaccurate. Voided entries must be maintained within the project files.

The field logbook is a detailed, daily, handwritten record of specific information relative to the conditions under which a groundwater sample was collected. Field logbooks shall be bound, with sequentially numbered pages made with water resistant paper. All forms are to be completed in the field and originals must be returned to the PM or designee. Entries in the field logbooks must be made in real time. Unused pages or portions of pages must be lined out to prevent entry of additional information at a later date.

Information to be included in the field logbooks or electronic data recorder includes:

- well identification, date and time task started, and the names and organizations of personnel performing the task
- a description of results of any field tests that have been conducted
- a description of samples collected and any splits, duplicates, matrix spikes, blanks and decontamination rinsate samples that were prepared
- comments specific to sampling conditions, observations, well condition and unusual occurrences such as equipment malfunctions
- Data from the electronic recording device will be downloaded electronically into the Environmental Restoration Data Management System (ERDMS).

### **5.5.1 Submersible Impeller Pump Sampling**

1. **CHANGE** gloves for each sampling episode and after handling any tools and equipment to minimize the possibility of cross contamination.
  2. **CALIBRATE** the pH meter at least once daily, using the instructions supplied by the manufacturer. **USE** fresh standard buffer solutions of pH 4, 7, and 10.
  3. **CALIBRATE** the specific conductance meter daily with a standard potassium chloride solution, using the instructions provided by the manufacturer.
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#### 5.5.1 Submersible Impeller Pump Sampling, continued

4. **CALIBRATE** the turbidimeter daily, using the instructions provided by the manufacturer.
5. **PERFORM** the Alkalinity Accuracy Check daily (or whenever values disagree with expected ranges) using the directions in the manufacturer's manual (or Attachment 3).
6. **CALIBRATE** the Oxidation Reduction Potential (ORP) meter daily, using the instructions provided by the manufacturer (when Eh measurements are specified to be collected and **CONVERT** the ORP result to Eh using the conversion factor specified by the manufacturer).
7. **MEASURE** specific conductance prior to other field parameters such as pH, [Eh or Dissolved Oxygen (DO) when specified], alkalinity, turbidity, and temperature, when collecting discrete field measurements as opposed to using a simultaneous measurement device.
8. **MEASURE** the depth to the top of the water in the well prior to purging. Groundwater elevation is measured from the top of the coupling attached to the water liquid level pipe. This reference point must be surveyed for vertical elevation so that water level depths may be converted to datum elevations.

**IF** a coupling is not attached to the water level riser pipe, **THEN**

**MEASURE** elevation from the top of the well seal.

**IF** the well seal is missing, **THEN**

**MEASURE** elevation from the top of the well casing. Any reference point other than the riser pipe coupling should be clearly noted in the appropriate documentation.

9. **CALCULATE** the volume of water to be purged from the well prior to stabilization of indicator parameters and sample collection. For wells equipped with single speed pumps, two well volumes shall be purged prior to establishing indicator parameter stability. For wells equipped with variable speed pumps, two well volumes plus one riser pipe volume shall be purged prior to establishing indicator stability. Sample collection may begin when the appropriate volume has been purged and indicator parameter stability has been achieved. The following measurements and calculations are used to determine the well volume (in gallons) of groundwater in each well as follows:



### 5.5.1 Submersible Impeller Pump Sampling, continued

- a. In order to obtain the height (H) of the groundwater column, **OBTAIN** the well's known effective depth (ED), which is considered the bottom of the screen depth and subtract from measured depth to static water (MSD). Most wells have a water liquid level pipe (also called riser pipe or stand pipe) that is generally 1/2" to 1" in diameter and 2" to 3" above ground surface that is used to measure water levels.

- b. **USE** the following formula to calculate the volume of water in a well or riser pipe:

$$V = 0.041 d^2 h, (x 2 = 2 \text{ well volumes})$$

Where V=volume of water in gallons, d=diameter of well or riser pipe in inches, and h=depth of the water column in feet from top of water column to bottom of casing (or length of riser pipe for calculating riser pipe volumes).

- c. **NOTE** the flow meter reading prior to purging. **MULTIPLY** V x 2 to get two well volumes. **ADD** the total of two well volumes (plus the riser pipe volume if using a variable speed pump) to the meter reading to determine the point at which to begin evaluation of stabilization criteria.

10. Prior to purging the well, **DETERMINE** if the well requires purge water collection.

**IF** required, **THEN**

**PREPARE** containers to collect and dispose of purged water. SGCP maintains a list(s) of monitoring wells that require special purge water disposal and applicable treatment facility acceptance lists.

NOTE: The well must either be listed on an approved well list or be covered by an active Investigation Derived Waste (IDW) Management Strategy<sup>2</sup>. IDW strategies are controlled documents issued by SGCP Waste Management. If purge water is being managed under an IDW strategy then a current working copy must be in the field while work is being conducted.

### 5.5.1 Submersible Impeller Pump Sampling, continued

11. **PURGE** the well as follows:

- a. **PLACE** the generator down wind of the well being sampled.
- b. **OPEN** the gate valve on the well.
- c. **CONNECT** the pump to the appropriate control box and power source.
- d. **TURN** the circuit breaker on the generator to the OFF position.
- e. **START** the generator.
- f. **TURN** the circuit breaker to the ON position.
- g. Periodically **DETERMINE** the rate of purging and the volume purged by checking the flow meter reading. The rate at which the water will be purged and sampled will vary depending on the pump type installed in the well. Lower purge rates generally produce the most representative samples since formation and filter pack stress is reduced, turbulent flow through the well screen is reduced or eliminated, less drawdown is produced thus reducing or eliminating the mixing of overlying stagnant casing water within the screened interval and prevents sample dilution or cross contamination from water being drawn in from outside the zone of concern.

**IF** the flow rate is low enough that water can only be discharged through the sampling port, **THEN**

**DETERMINE** the flow rate by measuring the time it takes to fill a 1 liter graduated cylinder. Higher flow rates can be determined by the time it takes to fill a larger container. Flow rate can then be measured in units of liters per minute (L/min) and, if desired, converted to gallons per minute (conversion factor: 3.785 liters = 1 gallon).

For wells with single speed pumps, **ATTEMPT** to control surging and maintain flow by minimal adjustment of the gate valve. Fluctuations in flow rate during purging should be noted in the field logbook or electronic data recorder. **MEASURE** and **RECORD** the flow rate immediately prior to sampling.

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**5.5.1 Submersible Impeller Pump Sampling, Step 11g, continued**

Wells equipped with variable speed pumps will be purged at a flow rate slow enough that it does not induce surging. For wells with a tendency to pump dry, **ATTEMPT** to reduce the purging flow rate to a level that does not exceed the recharge rate in the screened zone so a steady, low discharge may be maintained. Operator discretion must be used since the optimum purging flow rate may vary from well to well. After two well volumes have been purged, **REDUCE** the flow rate to no more than one liter per minute (1 L/min). **CONTINUE** purging for at least one riser pipe volume and until the indicator parameters have stabilized as defined in Section 5.5.1 Step 11i.

- h.** Thoroughly **RINSE** and **FILL** the field measurement sample cup with purged water.
- i.** After purging two well volumes (and an additional riser pipe volume for variable speed pumps), **MEASURE** and **RECORD** the specific conductivity, pH, turbidity, and temperature of the water being purged. The parameters of pH, specific conductance and turbidity will be used to indicate when stabilization has occurred. **TAKE** a minimum of three successive measurements of specific conductance, pH, temperature and turbidity at no less than three minute intervals. Stabilization has been reached for specific conductance, pH and temperature when the measurements for each parameter vary by no more than 10 percent of each other (i.e. the current measurement must be within +/- 10% of the average of the previous two readings). With respect to turbidity, stabilization has been attained when measurements are within 10 percent as above, or the difference between measurements is no greater than 1 Nephelometer Turbidity Unit (NTU).
- j.** The well is ready to sample when a total of at least two well volumes (and one additional riser pipe volume for variable speed pumps) has been purged and the indicator parameters (specific conductance, pH, turbidity and temperature) have stabilized as defined in Section 5.5.1 Step 11i. Do not collect samples for metals if the stable turbidity value is greater than 15 NTUs unless authorization has been given by the appropriate personnel (well custodian, sampling requestor, point of contact etc.).

**IF** sampling was incomplete **THEN**

**NOTIFY** supervision, **AND**

**NOTE** on the COC form any incompletions encountered during sampling.

- k.** **RECORD** any water color or odor detected.
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- I. **RECORD** final specific conductance, pH, (Eh or DO when specified), alkalinity, turbidity, temperature, flow rate and the amount of water purged prior to sampling.
12. Reasonable effort should be made to prevent pumping the well dry during purging (and sample collection) since this may cause a number of negative effects including chemical change/loss in the formation water due to atmospheric exposure.

**IF** the well goes dry during purging, **THEN**

**RECORD** the amount of water purged just before the well went dry, **AND**

**ALLOW** the well to recover, **AND**

**SAMPLE** within 24 hours. Recovery time will vary depending on the well. Do not purge more than a riser pipe volume prior to collecting the sample, **AND**

**IF** the well goes dry during sampling, **THEN**

**CONTINUE** the sampling process by returning to the well, within 24 hour recovery intervals, until all the sample bottles have been filled.
13. **SAMPLE** the well as follows:
  - a. **ADJUST** the flow rate using the gate valve on the well to achieve non-turbulent flow from the sample port, when evacuation is complete and stability is reached.
  - b. **COLLECT** the samples in the order outlined in Section 5.2. Do not collect samples for metals if the stable turbidity value is greater than 15 NTU unless authorization has been given by the well custodian or sampling requestor. **NOTIFY** supervision and appropriate personnel (well custodian, sampling requestor, point of contact, etc.) that sampling was incomplete. Also, **NOTE** on the COC form any incompleteness encountered during sampling.
  - c. **FILL** the sample containers from the sampling port, being careful to avoid contact between the sample containers and the sampling port.

### 5.5.1 Submersible Impeller Pump Sampling, Step 13, continued

- d. **ENSURE** that samples for VOC or TOX analyses are free of air bubbles. Gently **FILL** the bottles to overflowing, **CAP** tightly, **INVERT**, and **INSPECT**.

**WHEN** a bubble free sample has been obtained, **THEN**

**CHILL** it immediately.

- e. With the exception of samples requiring zero head space, **LEAVE** sufficient air space (ullage; approximately 10% of the volume of the containers) to prevent the liquid contents from completely filling the bottle at 130° F to compensate for any pressure and temperature changes.

- f. In general, the samples collected will be unfiltered. Filtering can bias the sample by filtering out colloids that may contain or bind certain contaminants contained in the groundwater.

**IF** filtration is specified on the COC form, **THEN**

**FILTER** the samples for the specified analyses using an in line disposable filter that is recommended for removing particles larger than at least 0.45um.

After the well has stabilized and field measurements have been taken, **INSTALL** the in line filter directly to the sample port with appropriately sized adapter and tubing.

**WHEN** applicable, **THEN**

**ASSURE** that the flow arrow on the filter is in the correct position, **AND**

**FOLLOW** any available filter manufacturer's instructions. Immediately before beginning sample collection, **PUMP** at least 1 liter of sample water through the filter for cleaning and conditioning.

14. **WHEN** all sample containers are filled, **THEN**

**TURN** the generator circuit breaker to the OFF position, **AND**

**DISCONNECT** the generator from the pump, **AND**

**DRAIN** all lines, **AND**

**CLOSE** the gate valve and the sampling port, **AND**

**REPLACE** the end cap on the sample port, **AND**

**SECURE** the water elevation riser cap, **AND**

**LOCK** the well.

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### 5.5.1 Submersible Impeller Pump Sampling, Step 13, continued

15. In general, preservatives have already been added to the sample containers.  
**IF** they have not, **THEN**  
**PRESERVE** the samples as required, **AND**  
**ENSURE** that they are tightly capped. **SEAL** the sample bottles by wrapping parafilm clockwise around the caps.
16. Appropriately **LABEL** each sample with the sample ID number and the date and time the sample was taken.
17. **PLACE** samples in coolers with sufficient ice/ice packs for cold preservation.
18. **NOTE** the sample ID number, date, and time on the COC form. **DESCRIBE** any exceptions, problems, or incompleteness encountered during sampling in the comments section.
19. **COMPLETE** the Custody Transfer Record on the COC form when the samples are relinquished. **REFER** to Section 5.8.1 for procedures on shipping samples.

### 5.5.2 Bailer Sampling

1. **CHANGE** gloves for each sampling episode and after handling any tools and equipment to minimize the possibility of cross contamination. **DECONTAMINATE** bailer and any of the bailer retrieval line that's contacted the water after sampling completion of each well unless dedicated to individual wells or disposed of after each use. (Some materials used for retrieval lines such as ropes and strings may prohibit the assurance of a proper decontamination).
  2. **CALIBRATE** the pH meter at least once daily, using the instructions supplied by the manufacturer. **USE** fresh standard buffer solutions of pH 4, 7, and 10.
  3. **CALIBRATE** the specific conductance meter daily with a standard potassium chloride solution, using the instructions provided by the manufacturer.
  4. **CALIBRATE** the turbidimeter daily, using the instructions provided by the manufacturer.
  5. **CALIBRATE** the ORP meter daily, using the instructions provided by the manufacturer.  
  
**WHEN** Eh measurements are specified to be collected, **THEN**  
  
**CONVERT** the ORP result to Eh using the conversion factor specified by the manufacturer.
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### 5.5.2 Bailer Sampling, continued

6. **WHEN** collecting discrete field measurements as opposed to using a simultaneous measurement device, **THEN**

**MEASURE** specific conductance prior to other field parameters such as pH, (Eh or DO when specified), alkalinity, turbidity, and temperature.

7. **MEASURE** the depth to the top of the water in the well prior to purging. Groundwater elevation is measured from the top of the coupling attached to the water level riser pipe. This reference point must be surveyed for vertical elevation so that water level depths may be converted to datum elevations.

**IF** a coupling is not attached to the water level riser pipe, **THEN**

**MEASURE** elevation from the top of the well seal.

**IF** the well seal is missing, **THEN**

**MEASURE** elevation from the top of the well casing. Any reference point other than the riser pipe coupling should be clearly noted in the appropriate documentation.

8. **CALCULATE** the well purge volume using the following formula:

$$V = 0.041d^2h \text{ (x } 2 = 2 \text{ well volumes)}$$

where V=volume of water in gallons, d=diameter of well in inches, and h=depth of the water column in feet.

9. **ATTACH** a new nylon rope to the bailer and **PLACE** both on a sheet of plastic (the rope or bailer must not touch the ground).

10. Prior to purging, **DETERMINE** if the well requires purge water collection.

**IF** purge water collection is required, **THEN**

**PREPARE** containers for purged water. SGCP maintains a list(s) of monitoring wells that require special purge water disposal and applicable treatment facility acceptance lists.

<p><b>NOTE:</b> The well must either be listed on an approved well list or be covered by an active Investigation Derived Waste (IDW) Management Strategy. IDW strategies are controlled documents issued by SGCP Waste Management.</p>
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### 5.5.2 Bailer Sampling, continued

11. Since Bailer sampling may introduce bias into the sample results due to agitation of the formation and filter pack, sample aeration and sample contamination due to improper handling at the well head, care should be taken to adhere to proper bailer purging and sampling protocol. **PURGE** the well as follows:
- a. After taking the static water level measurement per Step 7, **CALCULATE** the water column length to the bottom of the well or well screen. This is to track the top of water column during purging and sampling to assure the bailer is gently entered into the water column and not dropped into the bottom sediment.
  - b. Wearing clean gloves, **ATTACH** a clean retrieval line (i.e., nylon sail rope, PTFE coated lined, stainless steel, etc.) pre-cut to the proper length for the well depth, never allowing the retrieval line or bailer to touch the ground or any other possible source of contamination at any time during the installation, purging or sampling process.
  - c. Slowly and smoothly, **LOWER** the bailer gently to the selected depth to lower the top of the bailer below the water surface. **LOWER** and **RAISE** the bailer as slowly and smoothly as possible to keep the surging action to a minimum. This will help reduce the sample turbidity and keep the technique as consistent as possible. After filling, slowly and gently **REMOVE** the bailer from the well. **CONTINUE** these steps as necessary constantly lowering and raising the bailer as gently and smoothly as possible keeping the surging action minimized to reduce agitation of the formation and disturbance of bottom sediments.
  - d. Beginning with the first water purged, **COLLECT** and **RECORD** field measurements. **MEASURE** and **RECORD** (at least once per well volume) the specific conductivity, then the pH, (Eh or DO when specified), turbidity, and temperature of the water being purged. **CONTINUE** to take field measurements at least at well volume intervals.
  - e. **PURGE** a minimum of two well volumes. **KEEP** track of the volume purged.
  - f. The first field measurement is taken from the first bailer. The well is ready to sample when results of pH, temperature and conductivity measurements do not vary by more than ten percent between three successive measurements, taken at well volume intervals.
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### 5.5.2 Bailer Sampling, Step 11f, continued

That is to say, when the current measurement is within +/- 10% of the average of the previous two measurements, with a well volume purged between each measurement. **RECORD** final field measurements [pH, conductivity, turbidity, alkalinity and temperature (Eh or DO when specified)] and the amount of water purged at time of sampling. Turbidity is not used as a stabilization parameter since the agitation caused by bailing creates excessive variability in the turbidity from the well. If the turbidity value is greater than 15 NTUs, the appropriate personnel (well custodian, sampling requestor, point of contact etc.) must approve the collection or shipping of samples for metals analysis.

g. **RECORD** any water color or odor detected.

12. **IF** the well goes dry during purging, **THEN**

**RECORD** the amount of water purged just before the well went dry, **AND**

**ALLOW** the well to recover, **AND**

**SAMPLE** within 24 hours (recovery time will vary depending on the well).

**IF** the well goes dry during sampling, **THEN**

**CONTINUE** the sampling process by returning to the well, within 24-hour recovery intervals, until all the sample bottles have been filled.

13. **SAMPLE** the well as follows:

a. **COLLECT** water samples by slowly lowering until the top of the bailer is below the depth of the top of the screen zone. Trying not to cause any unnecessary disturbance, slowly **REMOVE** the bailer and carefully **TRANSFER** the water to the sample container. Be particularly careful not to agitate samples requiring VOC analyses. Bottom emptying bailers equipped with a flow control tap is recommended.

b. **COLLECT** the samples in the order outlined in Section 5.2. Do not collect samples for metals if the turbidity value is greater than 15 NTUs unless authorization is been given by the appropriate personnel (well custodian, sampling requestor, point of contact etc.). **NOTIFY** supervision that sampling was incomplete. Also **NOTE** on the COC form any incompletions encountered during sampling.

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### 5.5.2 Bailer Sampling, Step 13, continued

- c. **ENSURE** that samples for VOC or TOX analyses are free of air bubbles. Gently **FILL** the bottles to overflowing, **CAP** tightly, **INVERT**, and **INSPECT**.

**WHEN** a bubble free sample has been obtained, **THEN**

**CHILL** it immediately.

- d. With the exception of samples requiring zero head space, **LEAVE** sufficient air space (ullage; approximately 10% of the volume of the containers) to prevent the liquid contents from completely filling the bottle at 130° F to compensate for any pressure and temperature changes.

- e. In general, the samples collected will be unfiltered. However,

**IF** filtration is specified on the COC form, **THEN**

**FILTER** the samples using a pressurized disposable bailer system such as the WATERMARK<sup>®</sup> system or a similar system. These type bailing systems incorporate pressurized bailers, hand operated vacuum/pressure pump and inline disposable filters. **FOLLOW** any available filter manufacturer's instructions.

14. In general, preservatives have already been added to the sample containers.

**IF** they have not, **THEN**

**PRESERVE** the samples as required, **AND**

**ENSURE** that they are tightly capped, **AND**

**SEAL** the sample bottles by wrapping parafilm clockwise around the caps.

15. **WHEN** all sample containers are filled and sampling equipment removed, **THEN**

**SECURE** the water elevation riser cap, **AND**

**LOCK** the well.

16. Appropriately **LABEL** each sample with the sample ID number and the date and time the sample was taken.
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### 5.5.2 Bailer Sampling, continued

17. **PLACE** samples in coolers with sufficient ice packs for cold preservation.
18. **NOTE** the sample ID number, date and time on the COC form. **DESCRIBE** any exceptions, problems or incompletions encountered during sampling in the comments section.
19. **COMPLETE** the Custody Transfer Record on the COC form when the samples are relinquished. **REFER** to Section 5.8.1 for procedures on shipping samples.

### 5.5.3 Sampling Procedure for PWMS Tank Assemblies

There are currently four types of PWMS configurations being used at SRS, a tank type that utilizes a dedicated submersible pump and a tankless type that utilizes a dedicated submersible pump with a packer. The SP shall verify the configuration and use the appropriate procedure. (SEE WSRC Manual C3 Vol. IX - Standard Operating Procedures - Remote Facilities, ER-SOP-037 - Four Inch Well Tankless Operating Procedure, WSRC Manual C3 Vol. I - Standard Operating Procedures, ER-SOP-031 - Purge Water Management System Combined Tank Operations, ER-SOP-038 - QED Micropurge Operating Procedure, and ER-SOP-042 - Packer Assembly Operations.)

### 5.5.4 Hydrasleeve<sup>TM</sup> Sampling

1. **USE** cable ties to connect Hydrasleeve<sup>TM</sup> to pre-measured, weighted tether. (The top of the Hydrasleeve<sup>TM</sup> is the end with a plastic ring.)
  2. **LOWER** the Hydrasleeve<sup>TM</sup> into the well. Try to minimize agitation of water. In most cases, the top of the Hydrasleeve<sup>TM</sup> should be below the top of the screen or sampling interval by a distance equal to 2 times the length of the Hydrasleeve<sup>TM</sup>.
  3. **SECURE** the tether at surface and **ALLOW** the Hydrasleeve<sup>TM</sup> to remain in the well for at least 24 hours.
  4. To sample, **PULL** the tether upward at about 1-2 feet per second for a distance equal to 2 times the length of the Hydrasleeve<sup>TM</sup>. This will fill the Hydrasleeve<sup>TM</sup> and cause the valve to close. **CONTINUE** pulling the Hydrasleeve<sup>TM</sup> to surface at a slower rate (if desired).
  5. **PUSH** the pointed discharge tube through Hydrasleeve<sup>TM</sup>.
  6. **USE** the tube to fill sample bottles. Flow rate can be controlled by raising and lowering the bottom of the tube or by pinching just below the discharge tube.
-

#### 5.5.4 Hydrasleeve™ Sampling, continued

7. **DISCARD** the Hydrasleeve™ and discharge tube along with gloves and other trash.
8. **DEPLOY** a new Hydrasleeve™ for the next sampling event.

#### 5.6 Westbay™ Sampling Procedures

This procedure must be used in conjunction with Attachment 5, "Westbay™ Piezometer Water Level Calculation". The procedure includes instructions for five activities: surface checks, pressure profile, bottle preparation, groundwater sampling, and filling sample containers.

##### 5.6.1 Surface Checks

1. **REMOVE** the MOSDAX Sampler from its storage case. **INSPECT** the probe housing and body for any damage.
  2. **ASSEMBLE** the tripod and counter over the well. **RUN** the cable over the counter.
  3. **INSTALL** vacuum coupling at top of MOSDAX Probe (MP) casing.
  4. **CONNECT** the probe to the cable. Before attaching, **INSPECT** the O-ring at the top of the probe. The O-ring should be clean and intact. **MAKE** sure that the cablehead is aligned with the probe while making the connection to avoid bending the brass pin in the cablehead. **TIGHTEN** the nut hand tight only.
  5. **CONNECT** the two-pin cable from the MOSDAX Probe Controller Interface (MPCI) to the cable reel. With the MPCI OFF, **CONNECT** the three-pin cable from the MPCI to the 12 v power supply.
  6. **CONNECT** the 9 pin cable from computer or hand held controller (HHC) to the MPCI and **TURN** the MPCI ON.
  7. **PERFORM** the following surface checks to ensure that the location arm and the shoe mechanisms are operating normally: Start by pressing <ARM IN>. This puts the location arm to a known initial position and resets the internal position counter. Next, **RELEASE** the location arm. The location arm should extend smoothly. The number of revolutions used to release the location arm is displayed and should be 15 to 16 revolutions.
-

### 5.6.1 Surface Checks, Step 7, continued

**IF** a smaller number of revolutions is reported, **THEN**

**RETRACT** the arm, **AND**

**REPEAT**, **AND**

**PLACE** the probe in the vacuum coupling of the MP casing, **AND**

**ACTIVATE** the shoe. The shoe should extend and hold the probe firmly in the coupling. The display should indicate 16 to 19 revolutions. A reading of 23 revolutions indicates the probe is activated in open air. **RETRACT** the backing shoe and location arm. Before retracting arm, **ENSURE** that cable reel brake is on.

8. **CHECK** that the face plate for sampling and the plastic plunger are installed on the sampler.
9. **CHECK** to make sure that the valve is closed (the LCD on the key pad will indicate <open> or <closed>).

### 5.6.2 Pressure Profile

1. **OBTAIN** the completed MP Casing Log.
  2. At the surface, **READ** and **RECORD** (on the profile sheet) initial atmospheric pressure reading.
  3. **SET** the counter to 0. Using the Collar Detect function of the hand held controller, **LOWER** the probe to the magnetic collar below the lowest measurement port coupling to be sampled (**REFER** to current revision of the Westbay Multilevel Well Installation Information and Port Sampling Data Log, ERD-EN-2005-0113) by releasing the reel brake and using hand crank to gently lower the probe. **USE** the counter to measure the depth. There will be an audible beep when the probe reaches the collar.
  4. **RELEASE** the location arm by pressing the function key.
-

### 5.6.2 Pressure Profile, continued

5. **LOCATE** the probe in the measurement port to be sampled based on its distance above the magnetic collar (**REFER** to current revision of the Westbay Multilevel Well Installation Information and Port Sampling Data Log, ERD-EN-2005-0113) ; generally, the magnetic collar is 1.5 ft below the lowest measurement port in a given screen). **LOWER** the probe slowly until the location arm rests (catches) in the measurement port. The depth indicated on the counter should match the table within 0.2 ft. If not, the following steps should be taken. Using the Collar Detect function of the hand held controller, **LOWER** probe to the magnetic collar below the lowest measurement port coupling to be sampled. Once this magnetic collar is detected by using the value on the counter, **RAISE** the probe about 1.5 ft. to locate the lowest measurement port within that screen zone. Once the lowest port is located the remaining ports are located above that port generally at two foot increments to each other (**SEE** appropriate well schematic).
  6. **READ** and **RECORD** the inside MP casing pressure at the port.
  7. **CALCULATE** the piezometric level according to the attached “Westbay™ Piezometer Water Level Calculation” (Attachment 5). **RECORD** piezometric level on the Westbay™ Piezometric Pressures/Levels Field Data and Calculation Sheet.
  8. **ACTIVATE** the shoe by pressing the function key. The pressure on the display should change to the formation pressure.
  9. **READ** and **RECORD** the outside casing pressure when the reading is stable.
  10. **RETRACT** the shoe by pressing the function key.
  11. **READ** and **RECORD** another inside casing reading. This reading should match the inside casing reading recorded in Step 6.
  12. **IF** a difference is noted (> 5%) between the readings, **THEN**  
  
    **RECORD** the water level inside the MP casing again using the water level tape. (A review of the water level histories should be made to determine if the difference is significantly greater than the normal historical trend).  
  
    **IF** a water level tape is used, **THEN**  
  
    **ENSURE** that the water level tape is completely removed from the well before the sampler probe is moved from port to port.
-

### 5.6.2 Pressure Profile, Step 12, continued

**IF** the water-level tape probe and the Westbay<sup>TM</sup> sampling apparatus become jammed in the well, **THEN**

**RETRIEVE** gently to avoid breaking off the water level probe.

NOTE:	The three pressure readings plus the time and water level constitute a complete set of readings at a measurement port coupling.
-------	---

13. **MOVE** the probe up to the next port you wish to measure and **REPEAT** Steps 4 through 10.
14. After the last measurement, **REMOVE** the probe from the well.
15. **READ** and **RECORD** the final surface atmospheric pressure after removing the probe from the well. This reading should be similar to the reading recorded in Step 2.

### 5.6.3 Bottle Preparation

1. **INSPECT** all components, **CHECK** the O-rings for damage, and **REPLACE** them if necessary.
  2. **INSTALL** the bottom Teflon<sup>TM</sup> filling tube to the top end of the bottle. To attach the tube to the bottle, **PRESS** the tube firmly in the center of the seal holder.
  3. **INSERT** both valved ends into the sample bottle and **SECURE** the nuts hand tight.
  4. **CONNECT** the bottle(s) with interconnect hoses to hand tight. Do not over-tighten.
  5. **ATTACH** the bottle(s) to the sampler.
  6. **ENSURE** that the bottom valve on the bottom bottle is closed and all other valves are open before lowering the sampler into the well. A valve is open when the tab on the valve is parallel to the long axis of the bottle. A valve is closed when the tab is perpendicular to the long axis of the bottle.
  7. **PLACE** the probe in the vacuum coupling in the MP casing.
-

### 5.6.3 Bottle Preparation, continued

8. **PREPARE** the sampler and bottles using Steps 9 through 14.
9. **ACTIVATE** the shoe (with key pad).
10. **CLOSE** the valve (with key pad).
11. **CHECK** vacuum with hand pump by squeezing handle (1 to 2 times) and **VERIFY** that the pressure holds.
12. **OPEN** valve (with key pad).
13. **EVACUATE** container with hand pump to a pressure < 2 psi. **VERIFY** that the pressure holds.
14. **CLOSE** valve (with key pad).

### 5.6.4 Groundwater Sampling

1. **VERIFY** port identification on sample COC form.
2. **NOTE** the counter reading from the Pressure Profile Log created during this sampling event and **COMPARE** to pressure profile in the current revision of the Westbay Multilevel Well Installation Information and Port Sampling Data Log, ERD-EN-2005-0113. **LOWER** probe to the sampling port to be sampled.

**IF** counter does not match within 0.2 ft., **THEN**

**CONTINUE** by following Section 5.6.2, Step 5.

3. **RELEASE** arm. **RAISE** probe ~ 2 ft and **LOWER** it until location arm rests (catches) in measurement port.
4. **RECORD** pressure inside MP casing.
5. **ACTIVATE** the shoe.
6. **RECORD** pressure in sample zone. **COMPARE** it to the Profile Log (generated during Pressure Profile Log created during this sampling event). These numbers should match (within 5%).

**IF** they do not match, **THEN**

**RETRACT** the shoe, **AND**

---



#### 5.6.4 Groundwater Sampling, Step 6, continued

**RAISE** the probe again ~ 2 ft and lower it again until the location arm rests (catches) in the measurement port.

Again, **ACTIVATE** the shoe and **RECORD** the pressure in the sample zone and again, **COMPARE** the pressure to the Profile Log created during this sampling event.

**IF** there is still not a match, **THEN**

**RETRACT** the shoe and do not sample the port. **CALL** the appropriate personnel (well custodian, sampling requestor, point of contact, etc.) to report the situation and **SEEK** technical guidance.

**IF** this personnel is unavailable, **THEN**

**RETRIEVE** the bottle, **AND**

**PROBE**, **AND**

**REPEAT** the bottle preparation steps and Steps 1-5 to sample the next port identified on the sample COC form.

**IF** there is a valid pressure match, **THEN**

**PROCEED** to Step 7.

7. **OPEN** valve (with key pad).
8. **RECORD** zone pressure after it rises to its maximum (following valve opening). It should read the same as the pressure recorded in Step 6.

As in Step 6, **IF** the pressure does not match, **THEN**

**RETRACT** the shoe and do not sample the port, **AND**

**CALL** the appropriate personnel (well custodian, sampling requestor, point of contact, etc.), **AND**

**REPORT** the situation.

**IF** they are unavailable, **THEN**

**RETRIEVE** the bottle, **AND**

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#### 5.6.4 Groundwater Sampling, Step 8, continued

##### PROBE, AND

**REPEAT** the bottle preparation steps and Steps 1-7 to sample the next port identified on the sample COC form.

**IF** there is a valid pressure match, **THEN**

**PROCEED** to Step 9.

9. **CLOSE** valve.

10. **RETRACT** the shoe.

11. **RECORD** pressure in MP casing. The pressure measured in the MP casing should be the same as the pressure measured in Step 4 (before sample bottle filling).

**IF** the pressure does not match the Step 4 pressure, **THEN**

**RECORD** the observation in the comments on the Westbay™ Piezometric Pressures/Levels Field Data and Calculation Sheet, **AND**

**PROCEED** to Step 12.

12. **RETRIEVE** probe and bottle to vacuum coupling.

##### 5.6.4.1 Combining Pressure Profiling and Groundwater Sampling (Alternative Method)

After Section 5.6.2, Step 12 (Pressure Profiling of all ports to be sampled) **LOWER** the probe with bottles attached to desired port and collect groundwater sample after the pressure profile has been verified to ensure correct port location. After sample collection is completed, **PROCEED** to Section 5.6.4, Step 9. **REPEAT** these steps as needed to complete sampling.

---

### 5.6.5 Fill Sample Containers

1. With probe at vacuum coupling, have one sampler hold probe with hands, while second sampler slackens cable. Take care to avoid kinking electronic cable, then **PULL** probe and bottle from MP casing.
2. **CLOSE** all open valves (manually, with valve key).
3. **DETACH** bottle from probe and bottles from one another.
4. **TAKE** one bottle. **OPEN** top valve, then **OPEN** bottom valve. **FILL** VOA vials directly from Westbay™ bottle valve.
5. After filling VOA vials, **USE** remaining water to fill beaker for field parameter measurement.
6. **TAKE** 2nd Westbay™ bottle. **OPEN** top valve, then **OPEN** bottom valve, and **FINISH** filling beaker. Any water remaining in 2nd bottle should be dispositioned according to the IDW management plan for the individual well.
7. **MEASURE** field parameters per Section 5.5.1, Step 11i.
8. After measuring field parameters, **USE** additional bottles to fill containers for other analytes (if applicable) per Section 5.5.
9. **REPEAT** Steps 1 through 8 at the next sampling port, following decontamination of Westbay™ equipment and beaker per Attachment 2.
10. **WHEN** sampling is complete and equipment removed from the well, **THEN**  
  
    **SECURE** the water elevation riser cap, **AND**  
  
    **LOCK** the well.

### 5.7 Field and Laboratory Quality Assurance/Quality Control

When a contract laboratory is used to conduct analyses of environmental samples, the laboratory must ensure that a proper quality assurance/quality control (QA/QC) program is exercised.

Field QC samples include field duplicates, split samples, equipment blanks, trip blanks, and field blanks (defined in the glossary). The frequency of QC samples is included in the Mobilization Report.

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## **5.8 Other Sampling Devices and Sampling Methods**

There is too much available sampling equipment to cover in detail in this procedure and new sampling equipment is constantly coming on the market. In addition, new sampling methodology's are constantly being introduced to the industry, some of which have already been put into use at the SRS. In these cases it is best to use the manufacturer's guidelines and guidance from the manufacturer's technical department until SRS procedures are developed. Some of these sampling devices introduced at the SRS for sampling monitoring wells are:

Bladder Pump	Widely accepted over a broad range of sampling and particularly recommended when VOC's and light hydrocarbons are of concern. Highly recommended for low flow purging and sampling. Limited purge volume since purge amount is based on stabilization parameters instead of a set number of well volume evacuations.
Waterra Hydra-Lift	An inertial pumping device consisting of a riser tube with a one-way valve at the foot and a surface pumping mechanism . The water enters the tubing as the tubing/ foot valve is pushed downward and is retained when the tubing is pulled again, inertia of the water providing the force to push to surface. The water travels in a continuous column, with little disturbance, thus retaining volatiles. It operates to 250+ ft. Will not obtain a high purge rate, maximum about 4 gal/min with 1" diameter tubing.
Hydrasleeve™	A discreet depth sampling device that is useful for low yield wells with relatively low sampling volumes requirements (about 1.5 liters for a 2" diameter well BUT the device can be stacked for more volume). A simple to use no- purge sampling device saves sampling time and generates little or no waste. Care should be taken to not cross contaminate the samples if lowering or raising the device through a LNAPL layer.
Peristaltic Pump	A suction lift vacuum pump that can be used for shallow well sampling where dedicated sampling equipment is not utilized. Depth limitation is about 25 ft. and not generally recommended for collecting samples for VOC analysis. Studies have shown that a significant loss of VOC's and light hydrocarbons occur when using peristaltic pumps at greater than 18-20 fts depths. Tubing length on the discharge end should be as short as possible to limit sample exposure.

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## 5.8 Other Sampling Devices and Sampling Methods, continued

Passive Diffusion Bag	Used for VOC sampling only. A polyethylene bag ( acting as a semi permeable membrane) and filled with analyte-free water that's lowered to depth in the water column and left for 14 days or more to equilibrate. Theoretically VOC's, excluding certain ketones, ethers and alcohols, diffuse through the membrane and reach equilibrium with the water inside the bag. After retrieval the water is removed from the bag into sample vials.
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If the sampling method requires purging, **THEN**

Prior to starting, **DETERMINE** if the well requires purge water collection.

If purge water collection is required, **THEN**

**PREPARE** containers for purged water. SGCP maintains a list(s) of monitoring wells that require special purge water disposal and applicable treatment facility acceptance lists.

NOTE: The well must either be listed on an approved well list or be covered by an active Investigation Derived Waste (IDW) Management Strategy. IDW strategies are controlled documents issued by SGCP Waste Management.

### 5.8.1 Sample Shipping Procedure

Offsite sample shipping must be coordinated with the Hazardous Materials Transportation (HMT) Services organization. Sampling personnel must be able to inform the Hazardous Materials Transportation Representative (HMTR) on the classification of the samples as environmental, hazardous, and/or radioactive. In some cases it may be required to complete preliminary screening(s) before classification and shipping can occur. The samplers shall follow shipping instructions and procedures as provided by the HMTR. Samples should be prepared for shipment by air to offsite laboratories using the procedure outlined in Attachments 6 and 7.

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### 5.8.2 Classification of Non Radioactive Samples

1. **CLASSIFY** non radioactive samples prior to shipping as either environmental or hazardous material samples. In general, environmental samples include drinking water, ambient groundwater and surface water, background/control soils, sediment, treated municipal and industrial wastewater effluents, biological specimens, or any samples not expected to be contaminated with high levels of hazardous materials. The shipment of environmental samples is not regulated by the DOT. However, these samples must be transported in such a manner as to preserve their integrity.

NOTE:	Regulations for packing, marking, labeling, and shipping hazardous materials and wastes are promulgated by the DOT and are described in the Code of Federal Regulations (49 CFR 171 through 177). Samples collected from areas suspected of being highly contaminated may need to be shipped as hazardous material. Also, if a sample is preserved, the amount of preservative (e.g., NaOH pellets, HCL) must not exceed the amount indicated in 40 CFR 136.3, Table 2 (Attachment 2 of this procedure, Page 3 of 3) or the sample may be considered hazardous material and must be shipped as such in accordance with 49 CFR 171 through 177. Guidance for complying with DOT regulations in shipping environmental laboratory samples is given by WSRC HMT Services.
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2. **PREPARE** samples for shipment to offsite laboratories using the procedure outlined in Attachment 7.
3. Offsite laboratories will notify SRS upon receipt of samples, record any irregularities, and return the original completed COC forms to their SRS Subcontract Technical Representative (STR) or STR designated responsible person.

### 5.9 Post Performance Activities

**ENSURE** the applicable Sections of the SMR (located on Lotus Notes) are completed, and **ROUTE** the completed form to the specified Technical Representative and the Project Task Team Lead (PTTL) for review and mobilization.

If the project is outside of SGCP, then the completed form/plan shall be submitted to SGCP, Geochemical Monitoring Groundwater Coordinator for review and mobilization.

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## **6.0 RECORDS**

Records generated as a result of implementing this procedure are processed in accordance with Procedure Manual 1B, Procedure 3.31<sup>3</sup>.

Chain of Custody Form

Sampling Mobilization Request

Mobilization Report

## **7.0 REFERENCES**

<sup>1</sup>US DOT, 49 CFR, Transportation, Sections 171 through 177

<sup>2</sup>Savannah River Site Investigation Derived Waste Management Plan (current revision)

<sup>3</sup>Procedure Manual 1B, Procedure 3.31, Records Management

[S/RID], ANSI/ASQC E4, Part B, Sect. 3.3 (3)

EPA (U.S. Environmental Protection Agency), 1986. Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual, Environmental Services Division, Region IV. April 1

WSRC C3 Vol. 9, Standard Operating Procedures, ER-SOP-305 (current revision), Cleaning of Hazardous Waste Contaminated Debris for Disposal or Reuse

## **8.0 ATTACHMENTS**

- 1 Chain of Custody Form
  - 2 Decontamination of Sampling Equipment and Containers
  - 3 Table Ii - Required Containers, Preservation Techniques, and Holding Times
  - 4 Performing Field Alkalinity Measurements
  - 5 Westbay<sup>TM</sup> Piezometer Water Level Calculation
  - 6 Packaging Radioactive or Hazardous Water Samples for Offsite Shipment
  - 7 Packaging Non Radioactive Water Samples for Offsite Shipment
-

## Chain Of Custody Form

<b>Savannah River Site</b> Environmental Protection Department Building 773-57H Aiken, SC 29808	Well: ABC 14 Date: 3-13-96 Time: 1:31	Sampled By: RCS Corporation COC # Duplicate Id:	Ship To: General Engineering Lab 2040 Savage Road Charleston, SC 29414 Contract: 44071244N-95-7-48C
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[illegible]

Comments\* 14-day rush for radiochemicals and 7-day rush for other samples.  
TAL/TEI with TC library scan (77)  
Sodium (28MS) V04

Contract Line Items
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47 77 1751 1755 1781 1772 1774  
1785 2041 2147 2148

Items	Relinquished By ***	Date	Time	Received By	Reason for Transfer*
1-0	John A. Smi	3/14/98	0800	Barbara P. Risse,	
1-0	Barbara P. Risse,	3/14/98	1330	Andrew John	
1-0	Andrew John	3/14/98	1540	L. Dresse	

Optional



**Attachment 2      Decontamination of Sampling Equipment and Containers****1.0      GENERAL****1.1      Introduction**

The instructions outlined in this attachment, adapted from EPA (1996), are guidelines for cleaning field sampling equipment and sample containers prior to and during use. Alternative field decontamination procedures may be substituted for these procedures depending on the Data Quality Objectives for the project. Deviations from these procedures shall be documented in the study plan, field records, and investigative reports.

**1.2      Use of Safety Procedures During Cleaning Operations**

Always wear safety glasses with side shields or goggles and plastic or neoprene gloves.

Never eat, smoke, drink, chew, or make any hand to mouth contact in the decontamination area.

**1.3      Specifications for Cleaning Materials**

Specifications for standard cleaning materials referred to in this attachment are as follows:

- Soap shall be a standard brand of phosphate free laboratory detergent such as Liquinox® and Detergent 8. Use of other detergent must be justified and documented in the field logbooks or electronic data recorder and inspection or investigative reports.
  - The recommended solvent to be used is pesticide-grade isopropanol. Use of a solvent other than pesticide grade isopropanol for equipment cleaning purposes must be identified in the site specific sampling requirements.
  - Other solvents may be substituted for a particular purpose if required. For example, removal of concentrated waste materials may require the use of either pesticide grade hexane or petroleum ether. After the waste material is removed, the equipment must be subjected to the standard cleaning procedure. Because these solvents are not miscible with water, the equipment must be completely dry prior to use.
  - Tap water may be used from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.
-

**Attachment 2          Decontamination of Sampling Equipment and Containers, continued****1.3      Specifications for Cleaning Materials**

- Analyte free water (deionized water) is tap water that has been treated by passing through a standard deionizing resin column. At a minimum, the finished water should contain no detectable heavy metals or other inorganic compounds (i.e., at or above analytical detection limits) as defined by a standard Inductively Coupled Argon Plasma Spectrophotometer (ICP) (or equivalent) scan. Analyte free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.
- Organic/analyte free water is defined as tap water that has been treated with activated carbon and deionizing units. A portable system to produce organic/analyte free water under field conditions is available. At a minimum, the finished water must meet the analytical criteria of analyte free water and should contain no detectable pesticides, herbicides, or extractable organic compounds, and no volatile organic compounds above minimum detectable levels as determined by the EPA Region IV laboratory for a given set of analyses. Organic/analyte free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.
- Solvents, laboratory detergent, and rinse waters used to clean equipment must be changed between sampling locations. The organic/analyte free water rinse water used for the final rinse (Section 3.1 Step 5) may not be reused between samples or sample locations.

**1.3.1   Handling and Containers for Cleaning Solutions**

Improperly handled cleaning solutions may easily become contaminated. Storage containers must be constructed of the proper materials to ensure their integrity. The following are acceptable materials used for containing the specified cleaning solutions:

- Soap must be kept in clean plastic, metal, or glass containers until used. It should be poured directly from the container during use.
  - Solvent must be stored in the unopened original containers in appropriate chemical storage until used. They may be applied using the low pressure nitrogen system fitted with a Teflon™ nozzle, or using Teflon™ squeeze bottles.
  - Tap water may be kept in clean tanks, hand pressure sprayers, squeeze bottles, or applied directly from a hose.
-

**Attachment 2      Decontamination of Sampling Equipment and Containers, continued**

- Analyte free water must be stored in clean glass, stainless steel, or plastic containers that can be closed prior to use. It can be applied from plastic squeeze bottles.
- Organic/analyte free water must be stored in clean glass, Teflon™, or stainless steel containers prior to use. It may be applied using Teflon™ squeeze bottles, or with the portable system.

<p>NOTE:      Hand pump sprayers generally are not acceptable storage or application containers for the above materials (with the exception of tap water). This also applies to stainless steel sprayers. All hand sprayers have internal oil coated gaskets and black rubber seals that may contaminate the solutions.</p>
---

**1.3.2    Disposition of Decontamination Solutions and Equipment Wash/Rinse Water**

Wash and rinse solutions from cleaning sampling equipment intended for reuse outside of SGCP scope and the SRS Investigation Derived Management Plan must be disposed in accordance with applicable RCRA regulations.

Wash and rinse solutions from scope within SGCP and the SRS Investigation Derived Management Plan must be handled per Manual WSRC-C3, Volume 9, Procedure ER-SOP-305.

**1.4      Marking of Clean Sampling Equipment and Containers**

If decontaminated sampling equipment and containers are to be placed in storage, label them with the date the equipment was cleaned. Also, if there was a deviation from the standard cleaning procedures outlined in this attachment, note this fact on the label.

**1.5      Segregation of Used Field Equipment**

Do not store field equipment and reusable sample containers needing cleaning or repairs with clean equipment, sample tubing, or sample containers. Do not restore field equipment, reusable sample containers, disposable sample containers, and sample tubing that are not used during an investigation without recleaning it, if these materials were taken to a location where herbicides, pesticides, organic compounds, or other toxic materials are present.

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**Attachment 2          Decontamination of Sampling Equipment and Containers, continued****2.0      QUALITY CONTROL FOR DECONTAMINATION****2.1      General**

This section establishes QC guidelines for monitoring the effectiveness of the cleaning procedures for sampling equipment and sample containers outlined in this attachment. Sampling personnel should review QC data upon receipt to identify any abnormalities or contamination of sampling equipment or sample containers. If problems are detected, they should immediately investigate the cause of the problem(s) and institute corrective action.

**2.2      Rinse water**

If required by the SMR or Mobilization Report (MR), the quality of the unused analyte and/or organic/analyte free rinse water may be monitored. Samples of the rinse water are to be placed in pre cleaned sample containers and submitted for analysis. Additionally monitor the organic/analyte free water for low level pesticide, herbicide, extractable, and purgeable compounds. If problems are detected, immediately investigate the cause of the problem(s) and institute corrective action.

**2.3      Sampling Equipment Cleaned in the Field (Rinsate sample)**

The effectiveness of the field cleaning procedure must be monitored if the equipment is to be used at a location that has different contamination (e.g. different RCRA listed waste codes), or recycled. This is accomplished by field cleaning each piece of sampling equipment, collecting a rinsate sample using deionized water, and submitting the rinsate sample in a pre cleaned sample container for analysis. One representative rinsate sample may be taken from a piece of sampling equipment if several pieces are washed in the same container. Analytical results must be non detectable in order to release the sampling equipment for use at a location that does not have similar RCRA listed waste codes, free release offsite, or for recycle. Rinsate samples are not required for sampling equipment listed in Sections 3.2 and 3.3.

**3.0      STANDARD FIELD CLEANING PROCEDURES****3.1      Sampling Equipment Used for the Collection of Trace Organic and Inorganic Compounds**

- 1.      CLEAN** with tap water and soap using a brush if necessary to remove particulate matter and surface films. Equipment may be steam cleaned (soap and high pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. PVC or plastic items should not be steam cleaned.
-

Attachment 2      **Decontamination of Sampling Equipment and Containers, continued**

2.     **RINSE** thoroughly with tap water.
3.     **RINSE** thoroughly with analyte free water.
4.     **RINSE** thoroughly with solvent. Do not solvent rinse PVC or plastic items.
5.     **RINSE** thoroughly with organic/analyte free water. If organic/analyte free water is not available, equipment should be allowed to dry completely. Do not apply a final rinse with analyte (tap) water. Organic/analyte free water can be generated onsite utilizing the portable system.
6.     **COLLECT** a rinsate sample and **ANALYZE** per Section 2.3.
7.     **REMOVE** the equipment from the decontamination area and **COVER** with plastic. Equipment stored overnight should be wrapped in aluminum foil and covered with clean, unused plastic. **TAG** as “Not a Waste – For Reuse (Pending Results)”
8.     **RELEASE** for reuse or recycle if analytical results are non-detectable. Other options are available if the sampling equipment cannot be free released (see ECA for details).
9.     **DOCUMENT** the decontamination noting the time, date, description of sampling equipment, name of personnel conducting the decontamination, and analytical results.

**3.2     Well Sounders or Tapes Used to Measure Groundwater Levels**

Triple **RINSE** all portions of equipment that have contacted the groundwater with deionized water before and after each well. For projects outside of SGCP scope and the SRS Investigation Derived Management Plan (current revision), the rinse water must be disposed in accordance with applicable RCRA regulations.

**WASH** and **RINSE** solutions from scope within SGCP and the SRS Investigation Derived Management Plan (current revision) must be handled per Manual WSRC-C3, Volume 9, Procedure ER-SOP-305 (current revision).

Rinsate samples are not required for this equipment to render available for reuse.

**3.3     Field Measurement Instruments/Probes**

Triple **RINSE** the pH, temperature, specific conductance, turbidity and Eh probes (or any other field measurement instruments that contact the sample) and the sample cups with deionized water prior to and after each well.

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**Attachment 2          Decontamination of Sampling Equipment and Containers, concluded**

For projects outside of SGCP scope and the SRS Investigation Derived Management Plan (current revision), the rinse water must be disposed in accordance with applicable RCRA regulations.

Wash and rinse solutions from scope within SGCP and the SRS Investigation Derived Management Plan (current revision) must be handled per Manual WSRC-C3, Volume 9, Procedure ER-SOP-305 (current revision).

Rinsate samples are not required for this equipment to render available for reuse.

**Attachment 3**

**Table II - Required Containers, Preservation  
Techniques, And Holding Times**

**Page 1 of 3**

Attachment 3 [copied from the Code of Federal Regulations (CFR)] is for reference only and may not be the latest version since the CFR's change without notification. Users may confirm by checking the Code of Federal Regulations on line through the National Registry or by checking the EPA's home at "<http://cfr.counterpoint.com/cfr/40/1997/0731/0007852.html>".

Parameter No./name	Container <sup>1</sup>	Preservation <sup>2,3</sup>	Maximum holding time <sup>4</sup>
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Table IA—Bacteria Tests:

1–4 Coliform, fecal and total	P,G	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>5</sup>	6 hours.
5 Fecal streptococci	P,G	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>5</sup>	6 hours.

Table IA—Aquatic Toxicity Tests:

6–10 Toxicity, acute and chronic	P,G	Cool, 4°C <sup>16</sup>	6 hours.
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Table IB—Inorganic Tests:

1. Acidity	P, G	Cool, 4°C	14 days.
2. Alkalinity	P, G	Do	Do.
4. Ammonia	P, G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days.
9. Biochemical oxygen demand	P, G	Cool, 4°C	48 hours.
10. Boron	P, PFTE, or Quartz.	HNO <sub>3</sub> to pH<2	6 months.
11. Bromide	P, G	None required	28 days.
14. Biochemical oxygen demand, carbonaceous	P, G	Cool, 4°C	48 hours.
15. Chemical oxygen demand	P, G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days.
16. Chloride	P, G	None required	Do.
17. Chlorine, total residual	P, G	Do	Analyze immediately.
21. Color	P, G	Cool, 4°C	48 hours.
23–24. Cyanide, total and amenable to chlorination.	P, G	Cool, 4°C, NaOH to pH>12, 0.6g ascorbic acid <sup>5</sup>	14 days. <sup>6</sup>
25. Fluoride	P	None required	28 days.
27. Hardness	P, G	HNO <sub>3</sub> to pH<2, H <sub>2</sub> SO <sub>4</sub> to pH<2	6 months.
28. Hydrogen ion (pH)	P, G	None required	Analyze immediately.
31, 43. Kjeldahl and organic nitrogen	P, G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days.

Metals: <sup>7</sup>

18. Chromium VI	P, G	Cool, 4°C	24 hours.
35. Mercury 3, 5–8, 12, 13, 19, 20, 22, 26, 29, 30, 32–34, 36, 37, 45, 47, 51, 52, 58–60, 62, 63, 70–72, 74, 75. Metals, except boron, chromium VI and mercury.	P, G	HNO <sub>3</sub> to pH<2	6 months.
38. Nitrate	P, G	Cool, 4°C	48 hours.
39. Nitrate-nitrite	P, G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days.
40. Nitrite	P, G	Cool, 4°C	48 hours.
41. Oil and grease	G	Cool to 4°C, HCl or H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days.
42. Organic Carbon	P, G	Cool to 4°C HCl or H <sub>2</sub> SO <sub>4</sub> or H <sub>3</sub> PO <sub>4</sub> , to pH<2	28 days.

# Hydrogeologic Data Collection Procedures and Specifications

**Manual:** 3Q5  
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**Revision:** 11  
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## Sampling Groundwater Monitoring Wells

### Attachment 3

### Table II - Required Containers, Preservation

Page 2 of 3

Parameter No./name	Container <sup>1</sup>	Preservation <sup>2,3</sup>	Max holding time <sup>4</sup>
44. Orthophosphate	P, G	Filter immediately, Cool, 4°C	48 hours.
46. Oxygen, Dissolved Probe	G Bottle and	None required	Analyze immediately.
47. Winkler	do	Fix on site and store in dark	8 hours.
48. Phenols	G only	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days.
49. Phosphorus (elemental)	G	Cool, 4°C	48 hours.
50. Phosphorus, total	P, G	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days.
53. Residue, total	P, G	Cool, 4°C	7 days.
54. Residue, Filterable	P, G	Do	7 days.
55. Residue, Nonfilterable (TSS)	P, G	Do	7 days.
56. Residue, Settleable	P, G	Do	48 hours.
57. Residue, volatile	P, G	Do	7 days.
61. Silica	P, PFTE, or Quartz.	Cool, 4 °C	28 days.
64. Specific conductance	P, G	Do	Do.
65. Sulfate	P, G	Do	Do.
66. Sulfide	P, G	Cool, 4°C add zinc acetate plus sodium hydroxide to pH>9.	7 days.
67. Sulfite	P, G	None required	Analyze immediately.
68. Surfactants	P, G	Cool, 4°C	48 hours.
69. Temperature	P, G	None required	Analyze.
73. Turbidity	P, G	Cool, 4°C	48 hours.

Table IC—Organic Tests.<sup>8</sup>

13, 18–20, 22, 24–28, 34–37, 39–43, 45–47, 56, 66, 88, 89, 92–95, 97. Purgeable Halocarbons.	G, Teflon-lined septum.	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>5</sup>	14 days.
6, 57, 90. Purgeable aromatic hydrocarbons	do	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>5</sup> , HCl	Do.
3, 4, Acrolein and acrylonitrile	do	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>5</sup> ;	Do.
23, 30, 44, 49, 53, 67, 70, 71, 83, 85, 96. Phenols. <sup>11</sup>	G, Teflon™-lined cap.	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>5</sup>	7 days until extraction, 40 days after
7, 38. Benzidines <sup>11</sup>	do	Do	7 days until
14, 17, 48, 50–52. Phthalate esters <sup>11</sup>	do	Cool, 4°C	7 days until extraction; 40 days after
72–74. Nitrosamines <sup>11,14</sup>	do	Cool, 4°C, store in dark, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>5</sup>	Do.
76–82. PCBs <sup>11</sup> acrylonitrile	do	Cool, 4°C	Do.
54, 55, 65, 69. Nitroaromatics and isophorone <sup>11</sup>	do	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>5</sup> store in dark	Do.
1, 2, 5, 8–12, 32, 33, 58, 59, 64, 68, 84, 86. Polynuclear aromatic hydrocarbons. <sup>11</sup>	do	Do	Do.
15, 16, 21, 31, 75. Haloethers <sup>11</sup>	do	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>5</sup>	Do.
29, 35, 37, 60, 63, 91. Chlorinated hydrocarbons. <sup>11</sup>	do	Cool, 4°C	Do.
87. TCDD <sup>11</sup>	do	Cool, 4°C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> <sup>5</sup>	Do.

Table ID—Pesticides Tests:

1–70. Pesticides <sup>11</sup>	do	Cool, 4°C, pH 5–9 <sup>15</sup>	Do.
Table IE—Radiological Tests:			
1–5. Alpha, beta and radium	P, G	HNO <sub>3</sub> to pH<2	6 months.



**Attachment 3****TABLE II NOTES****page 3 of 3**

<sup>1</sup> Polyethylene (P) or glass (G). For microbiology, plastic sample containers must be made of sterilizable materials (polypropylene or other autoclavable plastic).

<sup>2</sup> Preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

<sup>3</sup> When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO<sub>3</sub>) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

<sup>4</sup> Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that for the specific types of samples under study, the analytes are stable for the longer time, and has received a variance from the Regional Administrator under § 136.3(e). Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability. See § 136.3(e) for details. The term “analyze immediately” usually means within 15 minutes or less of sample collection.

<sup>5</sup> Should only be used in the presence of residual chlorine.

<sup>6</sup> Maximum holding time is 24 hours when sulfide is present. Optionally all samples may be tested with lead acetate paper before pH adjustments to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

<sup>7</sup> Samples should be filtered immediately onsite before adding preservative for dissolved metals.

<sup>8</sup> Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

<sup>9</sup> Sample receiving no pH adjustment must be analyzed within seven days of sampling.

<sup>10</sup> The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

<sup>11</sup> When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6–9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re the requirement for thiosulfate reduction of residual chlorine), and footnotes 12, 13 (re the analysis of benzidine).

<sup>12</sup> If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to benzidine.

<sup>13</sup> Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.

<sup>14</sup> For the analysis of diphenylnitrosamine, add 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> and adjust pH to 7–10 with NaOH within 24 hours of sampling.

<sup>15</sup> The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.

<sup>16</sup> Sufficient ice should be placed with the samples in the shipping container to ensure that ice is still present when the samples arrive at the laboratory. However, even if ice is present when the samples arrive, it is necessary to immediately measure the temperature of the samples and confirm that the 4°C temperature maximum has not been exceeded. In the isolated cases where it can be documented that this holding temperature can not be met, the permittee can be given the option of onsite testing or can request a variance. The request for a variance should include supportive data which show that the toxicity of the effluent samples is not reduced because of the increased holding temperature.

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**Attachment 4      Performing Field Alkalinity Measurements****1.0      PURPOSE**

This document provides instructions for the use of the Hach Digital Titrator Model 16900-01 to measure field alkalinity concentrations that may be then used to determine the carbonate, bicarbonate and hydroxide alkalinity of a groundwater sample.

**2.0      GENERAL**

In sampling a well, follow all of the steps in WSRC 3Q5, Procedure 15.

The Hach Digital Titrator Model 16900-01 is recommended for performing field alkalinity measurements and the following procedure is based on the procedure outlined in the Hach manual.

Phenolphthalein alkalinity is determined by titrating a sample with sulfuric acid to a pH of 8.3. The pH 8.3 endpoint is evidenced by the color change of phenolphthalein indicator added to the sample. The Phenolphthalein alkalinity indicates the total hydroxide concentration and one half the carbonate present. The Total alkalinity is evidence by a color change at a pH of 4.5. The Total alkalinity includes all the carbonate, bicarbonate and hydroxide. The relationship between the carbonate, bicarbonate and hydroxide (shown in Table 2) can be used to calculate the individual concentrations.

**3.0      SAFETY**

**EXERCISE** care in the use and storage of the sulfuric acid cartridges.

**4.0      EQUIPMENT REQUIRED**

- Deionized water
  - Hach Digital Titrator Model 16900-01
  - Sulfuric Acid Titration Cartridges (0.1600 N and 1.600 N)
  - Polypropylene delivery tube
  - Graduated cylinder
  - TenSette Pipette
  - 250 mL Erlenmeyer flask
  - Phenolphthalein Indicator Powder Pillows
  - Bromcresol Green-Methyl Red Indicator Powder Pillows
  - Alkalinity Voluette Ampule Standard, 0.500 N
  - Hach Digital Titrator Model 16900-01 Manual
  - Protective gloves, goggles and clothing
  - List of wells and expected alkalinity ranges
  - Field Log Book
-

**Attachment 4 Performing Field Alkalinity Measurements, continued****5.0 FIELD ALKALINITY MEASUREMENT PROCEDURE**

1. **SELECT** the sample volume and Sulfuric Acid (H<sub>2</sub>SO<sub>4</sub>) Titration Cartridge corresponding to the expected alkalinity concentration as mg/L calcium carbonate (CaCO<sub>3</sub>) from Table 1.

**Table 1**

Range (mg/L as CaCO <sub>3</sub> )	Sample Volume (mL)	Titration Cartridge (N H <sub>2</sub> SO <sub>4</sub> )	Catalog Number	Digit Multiplier
10-40	100	0.16	1438	0.1
40-	25	0.16	1438	0.4
100-	100	1.60	1438	1.0
200-	50	1.60	1438	2.0
500-	20	1.60	1438	5.0
1000-	10	1.60	1438	10.0

2. **USE** historical information (if available) from the well or nearby wells to select the appropriate Sulfuric Acid Titration Cartridge solution (0.1600 N or 1.600 N) and Digit Multiplier (0.10 or 1.0). In the majority of cases, the Sample Volume of 100 mL, Titration Cartridge solution of 0.1600 N, and Digit Multiplier of 0.1 should be used first.
  3. **IF** the expected sample alkalinity concentration is unknown, **THEN**  
  
**START** with the 25 mL sample volume. This will indicate if the sample alkalinity is below 40, between 40 and 160, or above 160 mg/L as CaCO<sub>3</sub>. This information can be used to determine its approximate alkalinity concentration. **RE-TEST** another sample using the appropriate sample size and Sulfuric Acid Cartridge solution.
  4. While wearing rubber gloves, **REMOVE** the polyethylene cap and **INSERT** a red polypropylene delivery tube into the end of the Titration Cartridge. **USE** a straight tube with a hook at the end for hand-held titrations.
  5. **SLIDE** the Titration Cartridge into the titrator receptacle and **LOCK** in position with a slight turn.
-

Attachment 4 Performing Field Alkalinity Measurements, continued

6. To start titrant flowing and flush the delivery tube, **HOLD** the tip of the Titration Cartridge up and turn the delivery knob until air is expelled and several drops of sulfuric acid solution flow from the tip. Then use the counter reset knob to **TURN** the digital counter back to zero and either **TAP** the titrator to remove any sulfuric acid on the delivery tube or **RINSE** the tip of the delivery tube with de-ionized (D.I.) water.
  7. **USE** a clean graduated cylinder or pipette to measure the 100 mL (or alternate) sample volume. **TRANSFER** the sample into a clean 250-mL Erlenmeyer flask. The graduated cylinder and Erlenmeyer flask should be rinsed with D.I. water before each alkalinity measurement.
  8. Determining Phenolphthalein Alkalinity:
    - a. **ADD** the contents of one Phenolphthalein Indicator Powder Pillow and **SWIRL** to mix. **OPEN** the pillow by tearing off the top or cutting it with clippers or scissors. The solution will either turn pink or remain colorless.  
  
**IF** the solution remains colorless, **THEN**  
  
**ENTER** zero for Phenolphthalein Alkalinity in the field log and proceed to Step 9.
    - b. **IF** the color turns pink, **THEN**  
  
**USE** the Sulfuric Acid Titration Cartridge (selected using Table 1) for the expected alkalinity concentration based on historical data of the well or nearby wells. Titrate to a colorless endpoint (pH of 8.3), swirling the flask while titrating with the tip of the delivery tube in the solution.
    - c. **CALCULATE** the Phenolphthalein alkalinity by multiplying the digit multiplier times the number of digits required to reach the colorless endpoint.
    - d. 
$$\begin{array}{rcl} \text{Digits} & \times & \text{Digit} \\ \text{Required} & & \text{Multiplier} \end{array} = \text{mg/L as CaCO}_3 \text{ Phenolphthalein Alkalinity}$$
    - e. **RECORD** the Phenolphthalein Alkalinity in the Field Log Book.
    - f. **PROCEED** with Step 9, continuing the titration to determine the Total Alkalinity.
-

Attachment 4 Performing Field Alkalinity Measurements, continued

9. Determining the Total Alkalinity:

- a. After adding the Phenolphthalein Indicator Powder Pillow in Step 8.a, **ADD** one Bromcresol Green-Methyl Red Indicator Powder Pillow to the flask and swirl to mix.

**IF** the solution turns pink, **THEN**

**RECORD** "zero" for the total alkalinity in the Field Log Book.

**IF** the solution did not turn pink, **THEN**

**PROCEED.**

- b. After the Bromcresol Green-Methyl Red has been added, **TITRATE** with Sulfuric Acid until a light pink (pH of 4.5) color is observed (select a Sulfuric Acid Titration Concentration using Table 1 or continue the titration with the Sulfuric Acid used in Step 8.b). **READ** the total digits on the Digital Counter.

- c. **CALCULATE** the Total Alkalinity using the following equation:

$$\frac{\text{Total Digits Used}}{\text{Multiplier}} \times \text{Digit} = \text{mg/L as CaCO}_3 \text{ Total Alkalinity}$$

- d. **RECORD** the Total Alkalinity in the Field Log Book.

10. The carbonate, bicarbonate, and hydroxide alkalinity concentrations may be calculated individually using the relationships shown in Table 2.

Table 2. Alkalinity Relationships

<b>If Phenolphthalein</b> <b>Alkalinity Result =</b>	<b>then Hydroxide</b> <b>Alkalinity =</b>	<b>then Carbonate</b> <b>Alkalinity =</b>	<b>then Bicarbonate</b> <b>Alkalinity =</b>
0	0	0	Total Alk
< 1/2 Total Alk	0	2(Phen Alk)	Total Alk-2(Phen Alk)
= 1/2 Total Alk	0	2(Phen Alk)	0
> 1/2 Total Alk	2(Phen Alk)-Total Alk	2(Total Alk-Phen Alk)	0
Phen Alk = Total Alk	Total Alk	0	0

**Attachment 4 Performing Field Alkalinity Measurements, concluded**

Example calculation:

The well is new and there is no historical information to use for predicting the sample alkalinity. However, the pH is 9 so the sampler expects measurable Phenolphthalein alkalinity in the sample since the Phenolphthalein endpoint of pH 8.3 is less than a pH of 9. Using Table 1 as a guide, the sampler selects a sample volume of 25 and a Sulfuric Acid Titration Cartridge of 0.1600 N. The sampler collects 25 mL of sample and pours it into a clean 250 mL Erlenmeyer flask. The sampler adds the contents of one Phenolphthalein Indicator Powder Pillow to the sample and swirls to mix. The solution turns pink, so the sampler knows that the total alkalinity is greater than 40 mg/L, as expected. The sampler then titrates (with 0.1600 N Sulfuric Acid solution) until a colorless endpoint is reached, corresponding to a pH of 8.3. To get the Phenolphthalein alkalinity, the sampler notes the number of digits used to reach the endpoint and multiplies the number of digits times the digit multiplier of 0.4 (see Table 1). The sampler records the value in the Field Log Book under Phenolphthalein alkalinity. The sampler then adds one Bromcresol Green-Methyl Red Indicator Powder Pillow to the flask and swirls. The sampler continues titration with the sulfuric acid to reach a light pink color, corresponding to a pH endpoint of 4.5. The sampler then calculates the total alkalinity (mg/L) by multiplying the total digits required (recorded on titrator) by the digit multiplier (0.4, respectively, from Table 1). The sampler records the Total alkalinity in the Field Log Book.

**6.0 EQUIPMENT CALIBRATION**

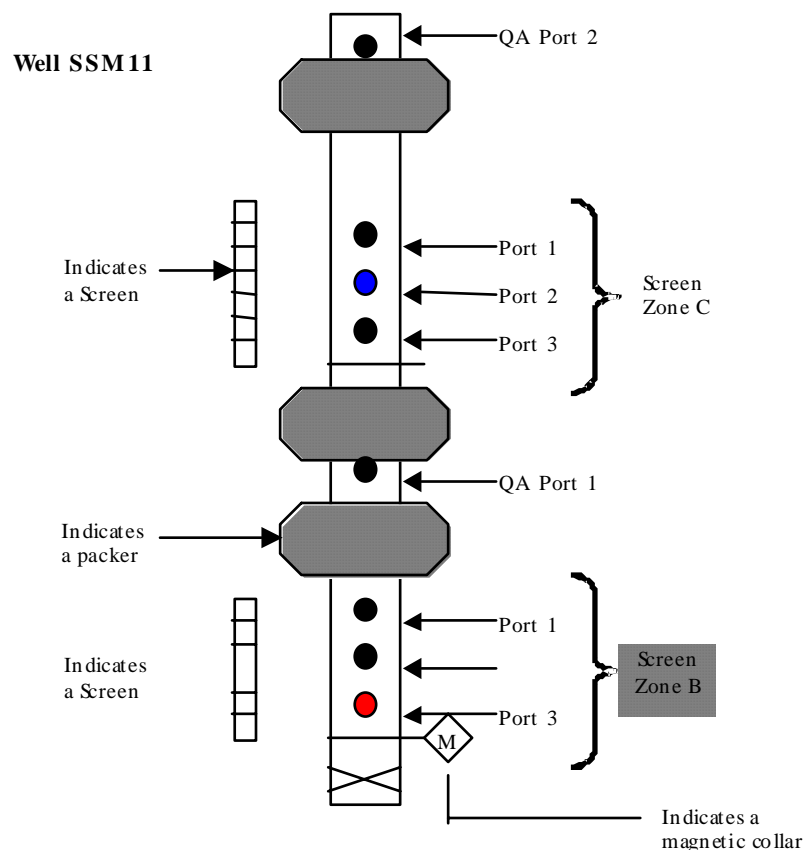
Calibration should be performed daily and should also be performed when interferences are suspected or to verify the analytical technique. To calibrate, **PERFORM** the following procedure.

1. **SNAP** the neck off an Alkalinity Voluette Ampule Standard, 0.500 N.
  2. **USE** a TenSette Pipette to add 0.1 mL of standard to the sample titrated in Section 5.0, Steps 8 and 9. **RESUME** titration back to the same light pink endpoint. Record the number of digits needed.
  3. **REPEAT** twice more, **USE** two more additions of 0.1 mL and **TITRATE** to the endpoint after each addition.
  4. Each 0.1 mL of addition of standard should require 25 additional digits of 1.600 N titrant or 250 digits of 0.1600 N titrant. If these uniform increases do not occur, a problem exists that was caused by either the reagents, the apparatus, the procedure or an interfering substance. To determine the cause, **REFER** to the Accuracy Check and Standard Additions in Appendix A of the Hach Digital Titrator Model 16900-01 Manual (p.113-124).
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Attachment 5 Westbay™ Piezometer Water Level Calculation

Zone #: Well screens for Westbay Wells installed in the M-Area aquifer zone, Lost Lake Aquifer zone and Crouch Branch aquifer zone are typically letter designated similar to screen intervals in conventionally installed wells (i.e., "A" wells are deeper than "B" wells; and "B" wells are deeper than "C" wells etc). However, in contrast, most of the Westbay™ (and conventional) monitoring wells installed in the deeper underlying aquifer unit (formally designated the Tuscaloosa formation) are labeled the opposite.

- Since the Westbay™ wells have multiple ports in multiple screen zones, each screen zone is identified as either "A", "B", or "C" and the ports within each screen zone are designated from bottom to top as 3, 2, or 1.
- Therefore, in the following drawing the lowest port in screen zone "B" is designated SSM 11B3. Likewise, the middle port in screen zone "C" is designated SSM 11C2.



Port Depth: While the Westbay™ reel counter registers in increments of feet and inches, the data are recorded and used in SRS Environmental Reports are expressed using the engineer's scale (10<sup>th</sup>s of feet). The table below is provided to assist SP when translating Port Depth Data in 10<sup>th</sup>s of feet. The port should be located by its distance from the magnetic collar.

**Attachment 5 Westbay™ Piezometer Water Level Calculation, concluded**

The scale would be as follows:

Inches	Decimal of Feet
1	0.08
2	0.17
3	0.25
4	0.33
5	0.42
6	0.50
7	0.58
8	0.67
9	0.75
10	0.83
11	0.92

Inside Casing: The pressure measurement at port location with only the arm out.

Outside Casing: The pressure measurement at port location with arm/shoe out.

Inside Casing: A second measurement at port location with only the arm out.

Temperature: A reading of temperature from the probe.

Time: Time from which the reading was taken

Piezometer Level:

Identity	Symbol
Pressure Outside	P <sub>o</sub>
Ambient Pressure	P <sub>a</sub>
Pressure Constant	2.307
Port Depth in Decimal	PD, as measured from top of casing

- Formula:  $-(P_o - P_a)(2.307) + (PD)$
- Therefore, If SSM 11B2 had a PD of 147'11" (147.92), P<sub>o</sub> of 32.67, and a P<sub>a</sub> of 14.82: It would work out to be:  $-(32.67 - 14.82)(2.307) + 147.92$  or 106.74 Feet.
- 106.74 should be used as the Depth to Water in logbooks, computers, or electronic data recorders, as well as the Water Level Inside MP on the Westbay™ Field Data Sheets. The depth to water is measured from the ground surface.

<b>NOTE:</b> The Piezometer Level should be obtained for all the ports being sampled and only the pressures should be checked for the QA ports.
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**Attachment 6      Packaging Radioactive or Hazardous Water Samples for Offsite  
Shipment**

**1.0      PURPOSE**

This procedure provides instructions for packaging glass and plastic water containers to meet the guidelines in DOT regulations (49 CFR, part 173.421, 173.422) for "radioactive material, excepted package limited quantity of material" prior to shipment from SRS. The DOT guidance for limited quantity is shipment in "excepted packages". There are no specific testing requirements for "excepted packages". Shipments of groundwater samples in this category must be certified as being acceptable for transportation by WSRC Hazardous Materials Transportation (HMT) Services prior to offsite shipment.

**2.0      SCOPE**

This document is applicable to any group or individual who is responsible for the collection, packaging and shipment of groundwater samples to offsite laboratories for analyses.

**3.0      SAFETY**

- **COMPLY** with applicable departmental and SRS safety rules.
- **WEAR** rubber gloves and safety glasses when handling samples.
- **WEAR** leather gloves and safety glasses when handling broken glass.

**4.0      SAMPLE PACKAGING PROCEDURE**

This procedure is for SRS groundwater samples which do not exceed a specific activity of 0.027 mCi/mL **AND** less than 27 mCi total per shipment (DOT threshold for tritiated well water samples). The expected SRS activity was calculated for five possible packaging configurations of sample bottles in coolers with the volumes ranging from 8,000 mL to 29,000 mL. The maximum expected total activity, using an activity limit of 500,000 pCi/mL and a volume of 30,000 mL, was 15 mCi. For the purposes of this procedure, a "package" is defined as a cooler of glass and plastic bottles filled with groundwater packaged using the procedure outlined below.

Attachment 6      Packaging Radioactive or Hazardous Water Samples for Offsite  
Shipment, continued

1.    **USE** coolers supplied by the contract laboratories only if the cooler is listed on the Packaging Approval List (posted on Shrine). **INSPECT** the interior and exterior of each cooler; do not use if it shows any signs of damage. **CLEAN** coolers of all tape, labels, etc. and **PLUG** all cooler drain holes with silicone caulking.
2.    Prior to sample packaging, **LINE** the cooler as appropriate with blue ice (when required for sample preservation), bubble packing and then two heavy duty plastic bags (**PLACE** the second bag inside of the first bag) line the inner bag with absorbent material. When blue ice is required **ADJUST** the total amount according to the outside seasonal temperatures.
3.    With the exception of samples requiring zero head space, **ENSURE** that each container has sufficient air space (ullage) to prevent the liquid contents from completely filling the bottle at 130 degrees Fahrenheit to compensate for any pressure and temperature changes (approximately 10% of the volume of the containers).
4.    **SEAL** the top of each sample container with 1 in. parafilm tape to prevent leakage.
5.    Groundwater sample shipments from SRS will rarely or ever exceed the DOT threshold, but some samples may exceed one or more of the SRS RCO limits, 1.35 pCi/mL (3 d/m/mL) Alpha; 7.207 pCi/mL (16 d/m/mL) Beta-Gamma and 800,000 pCi/mL tritium. In these cases Place an OSR 4-672 "Caution Radioactive Materials" trefoil radioactive sticker on each bottle.
6.    **PACK** all Volatile Organic Compounds (VOC) vials in polyfoam packers, DOT34A, or an equivalent to prevent breakage. **SEAL** each packer with filament tape. **PLACE** "Caution Radioactive Material" tape on the outside of each packer. For shipping 40 mL vials, **INSERT** bubble wrap layers inside the polyfoam packers to ensure the vials do not become dislodged during transport. Completely **WRAP** all other glass bottles with bubble wrap.

NOTE:	1 gallon or ½ gallon milk style plastic containers are <u>not</u> to be used for Hazardous or Radioactive shipments offsite rather a combination of 1 Liter and 2 Liter wide mouth containers will be used as substitutes for the milk style containers.
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Attachment 6      **Packaging Radioactive or Hazardous Water Samples for Offsite  
Shipment, continued**

7.     **PLACE** all of the sample containers in the inner plastic bag.
  8.     **PLACE** a layer of 1 in. bubble packing on top of the samples. **SEAL** the inner bag with tape. **SEAL** the outer bag with tape and **PLACE** "Caution Radioactive Material" tape on the bag.
  9.     **IF** the samples are to be stored overnight, **THEN**  
  
      **SECURE** them such that only the sampling personnel who have custody may have access to them.
  10.    **ENSURE** that the samples are adequately cooled so they arrive at the offsite laboratory at the required temperature.
  11.    **COORDINATE** release of radioactive material for offsite shipment with Radiological Control Operation (RCO) personnel. **TRANSPORT** the coolers to the designated SRS shipping area for release to the courier in ample time to allow the same day shipment. **TRANSPORT** and **RELEASE** samples in accordance with RCO requirements. Release of radioactive material for offsite shipment is permissible from Building 772-7B at the discretion of the Transportation Department.
  12.    **SIGN** the COC form with the date and time the package is released to shipping personnel.
  13.    **MAKE** a photocopy of the COC forms. **RETAIN** one copy for records.
  14.    **SEPARATE** the original COC forms to correspond to each individual cooler. **SEAL** the custody forms in plastic bags and place them inside the appropriate coolers.
  15.    **WEIGH** each cooler separately and **VERIFY** the weight does not exceed the limits posted on the Packaging Approval List (posted on shrine).
  16.    **ENSURE** that RCO personnel inspects the sample packaging and labeling as appropriate (smears and counts will be necessary when SRS RCO limits in #5 are exceeded).
  17.    **SEAL** the cooler lid with 2 in. wide fiberglass tape. Two complete wraps (layers) of fiberglass tape around each end of the cooler are required. **PLACE** tape over the drain plug.
  18.    **PLACE** a custody seal appropriately on each cooler being transported by commercial carrier.
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Attachment 7      **Packaging Non Radioactive or Non Hazardous Water Samples for Offsite Shipment**

**1.0      PURPOSE**

This procedure provides instructions for packaging glass and plastic water containers of non radioactive samples prior to shipment from SRS.

**2.0      SCOPE**

This document is applicable to any group or individual who is responsible for the collection, packaging, and shipment of groundwater samples to offsite laboratories for analyses.

**3.0      SAFETY**

1.      **COMPLY** with applicable departmental and SRS safety rules.
2.      **WEAR** rubber gloves and safety glasses when handling samples.
3.      **WEAR** leather gloves and safety glasses when handling broken glass.

**4.0      SAMPLE PACKAGING**

1.      **USE** insulated coolers, cleaned of all tape, labels, etc.
  2.      Prior to sample packaging, **LINE** the cooler as appropriate with blue ice (when required for sample preservation), bubble packing and then a heavy duty plastic bag in the cooler. When blue ice is required, **ADJUST** the total amount according to the outside seasonal temperatures.
  3.      With the exception of samples requiring zero head space, **ENSURE** that each container has sufficient air space (ullage) to prevent the liquid contents from completely filling the bottle at 130° F to compensate for any pressure and temperature changes (approximately 10% of the volume of the containers).
  4.      **SEAL** the top of each sample container with parafilm to prevent leakage.
  5.      Completely **WRAP** all glass bottles with bubble packing to prevent breakage. **PACK** all VOC vials in bubble packing or place in soft foam packers provided by the analytical laboratories prior to bubble wrapping.
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Attachment 7      Packaging Non Radioactive or Non Hazardous Water Samples for  
Offsite Shipment, continued

6.    **PLACE** all of the sample containers in the plastic bag; place ice packs around the samples.
  7.    **SEAL** the plastic bag with tape.
  8.    **IF** the samples are to be stored overnight, **THEN**  
  
      **SECURE** them such that only the sampling personnel who have custody may have access to them.
  9.    **ENSURE** that the samples are adequately cooled so they arrive at the offsite laboratory at the required temperature.
  10.   **TRANSPORT** the coolers to the designated SRS shipping area for release to the courier in ample time to allow same day shipment.
  11.   **SIGN** the COC form with the date and time the package is released to shipping personnel.
  12.   **MAKE** a photo copy of the COC forms. **RETAIN** one copy for records.
  13.   **SEPARATE** the original COC forms to correspond to each individual cooler. **SEAL** the custody forms in plastic bags and place them inside the appropriate coolers.
  14.   **WEIGH** all of the coolers and **REPORT** the total weight to the shipping department personnel.
  15.   **SEAL** each cooler lid with fiberglass tape. **PLACE** tape over the drain plug.
  16.   **PLACE** a custody seal appropriately on each cooler.
  17.   **WHEN** shipping by air, **THEN**  
  
      **CALL** the appropriate shipping representative, **AND**  
  
      **GIVE** the carrier name, air bill number, number of coolers shipped, and date shipped.
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