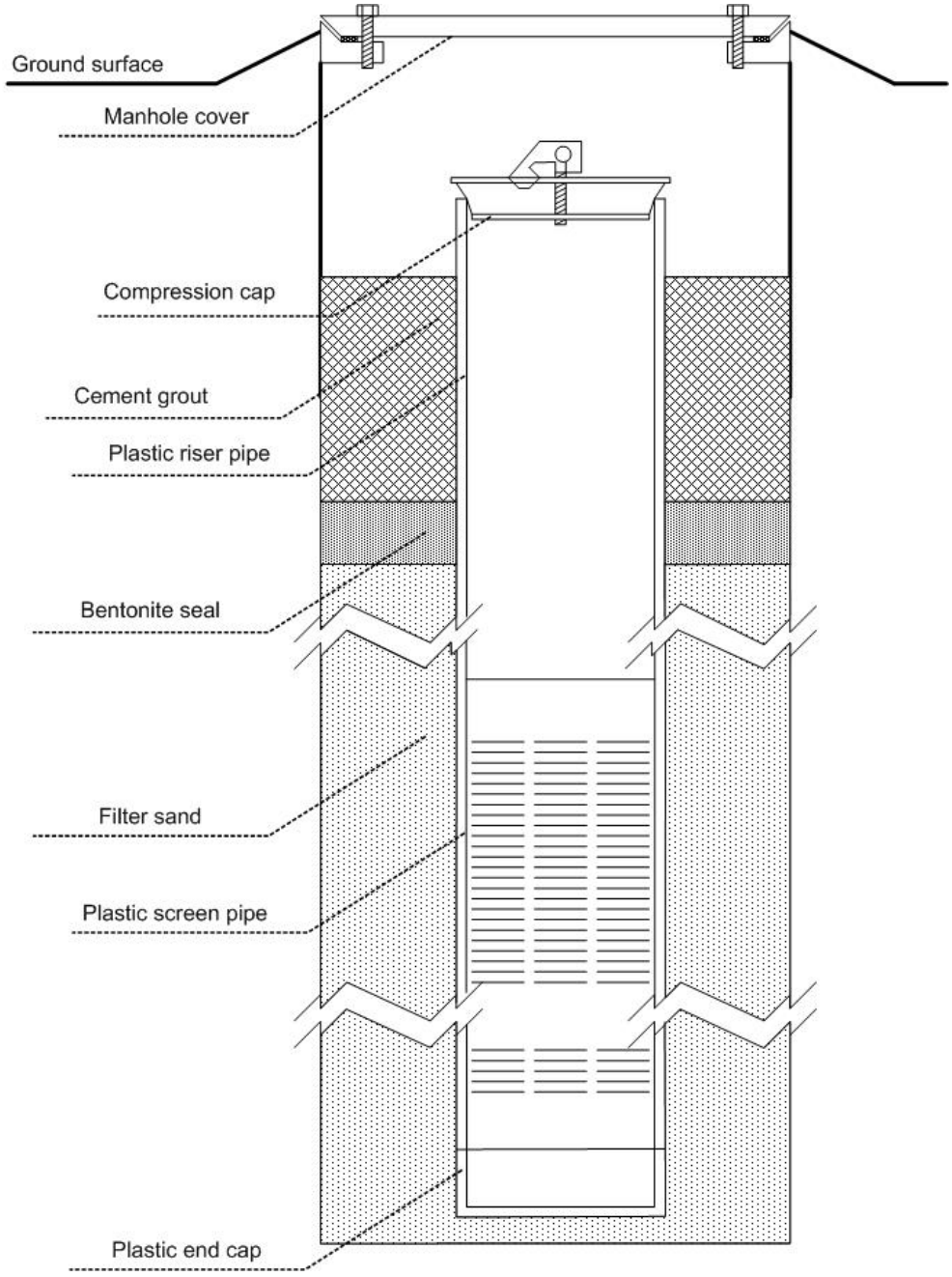
**1. Purpose and Scope**: Groundwater samples are collected to measure the concentration of pesticide in the subsurface environment. This SOP describes how to collect, transport, and store groundwater samples from shallow environmental monitoring wells. Often the monitoring wells sampled by the Program will be a component of an environmental site investigation not associated with APHIS activities. Monitoring wells are different in many ways from potable wells used as drinking water sources and the procedures for collecting a water sample are also different. If the well being sampled is a potable well, contact the Environmental Compliance Team at (301) 851-2345 for instructions and equipment requirements. Any instructions on water sampling and documentation found in the Environmental Monitoring Plan (EMP) for the Program supersedes instructions contained in this SOP.

Environmental monitoring wells provide access to the unconfined aquifer, also called the water table, for sampling and measurement of hydraulic characteristics. Monitoring wells are typically a plastic pipe composed of slotted (screen) and solid (riser) portions. Typically four or two inch diameter plastic pipe is installed into a larger diameter (eight to twelve inch diameter) vertical hole. The area around the plastic pipe (annulus) is filled with filter sand adjacent to the screen. The annulus is sealed with manufactured clay (bentonite) at the riser and cemented to the surface. The top of the plastic pipe will be sealed with a removable compression cap. Access to the plastic pipe is usually protected by either a small manhole or a steel standpipe. Proper maintenance of the bolt down manhole lid gasket, and the compression cap inside the manhole, are important to protect the subsurface environment from the intrusion of sediments and surface water into the well. A schematic of a typical below grade well is presented in Figure 1.

To ensure the water sample collected from the well is representative of the current subsurface conditions, stagnant water resting in the plastic pipe and the annulus filled with filter sand should be purged and allowed to recharge. The procedure to calculate the volume of water that should be purged from the well and measurement of other aquifer characteristics is described in detail in Section 3.

Figure 1 - Below-grade environmental monitoring well.



**2. Supplies Required**: To request sampling supplies, contact the monitoring supplies coordinators, Lisa Mosser (305) 278 4902, or Richard King (305) 278 2905, Center for Plant Health Science and Technology, Miami, or email the Environmental Monitoring Supplies Checklist to lisa.k.mosser@usda.gov or richard.a.king@usda.gov.
(for address see SOP EM - 17, *Packaging and Shipping of Samples*).

2.1 Hammer, screw-driver, pry-bar, socket set

2.2 hand operated bilge pump and sponge

2.3 water level indicator

2.4 field log book and environmental monitoring forms (APHIS Form 2060)

2.5 calculator and *SOP EM-14 Collection of Groundwater Samples*

2.6 disposable weighted bailers (1.5 x 36 inch for two inch diameter wells and 3.0 x 36 inch for four inch diameter wells)

2.7 cotton “jersey” work gloves and nitrile gloves

2.8 nylon rope (3/8 inch thick) and string

2.9 plastic buckets (five gallon) with lids

2.10 pH and temperature meter

2.11 conductivity (specific conductance) meter with a range of 0.0 to 19.99 millisiemens (mS)

2.12 1 gallon, collapsible plastic "cubitainers"*

*NOTE: cubitainers may introduce material that will interfere with the analysis of some compounds. Please check with CPHST when ordering supplies. If the pesticide to be analyzed is among those that might be affected by the cubitainer, then the laboratory will supply glass containers instead.

2.13 sodium sulfate (pre-packaged five gram vials) †

2.14 sulfuric acid (in a plastic squeeze bottle) †

†NOTE: most pesticides used by PPQ are stable in acidic water. However, check with the CPHST- Biloxi when ordering supplies to determine that the acid and buffer specified herein are correct for the pesticide being sampled. If not, the laboratory will provide alternate materials and instructions for stabilizing the sample.

2.15 sample cooler or insulated shipping container from the laboratory

2.16 one gallon resealable plastic "freezer" bags

2.17 15 to 20 pounds of ice (double bagged and sealed with clear packing tape), or frozen blue ice packs, per cooler

2.18 five to ten gallons of distilled water

2.19 dish detergent or cleaning product supplied by the laboratory

2.20 dish brush

2.21 paper towels

2.22 duct and clear packing tape

2.23 overnight courier service shipping labels and account numbers

2.24 55 gallon drums (for temporary storage of purge or decontamination water)

2.25 indelible markers

2.26 100 foot measuring tape or surveyor's measuring wheel

**3. Preparation of the monitoring well**:

3.1 Identify and document the exact location of the monitoring well. Measure the location of the well relative to three or more fixed features on site (utility poles, street curbs, fuel dispenser islands, other monitoring wells). Check your work area for possible hazards and environmental concerns. **Ensure that vehicular traffic is prevented from entering the work area immediately around the well.** Wear all the appropriate personal protective equipment including eye protection and chemical resistant gloves.

3.2 Remove the manhole cover or standpipe lid. Manholes lids are often bolted (9/16 inch socket) down and may need to be pried up with a screw driver. Remove gross amounts of sediment from the lid gasket if present. If surface water is present inside the manhole, use a hand operated bilge pump or sponge to remove the water, until it will not flow into the plastic pipe protected by the compression cap. Remove the compression cap.

3.3 Determine the volume of water in the well (plastic pipe) by measuring the height of the water column and multiplying by the gallons per foot. Use the water level indicator to measure the depth to water (DTW) and the bottom of the well or total depth (TD) from the top of the plastic pipe. Note that the water level indicator measures depth in decimal feet (hundredths) so the measurement hatch marks are not in inches. Subtract DTW from TD to get the water column height (CH) in feet. Multiply the CH by the gallons per foot for the well diameter (WD) to determine the well volume (WV). A four inch diameter well will hold 0.67 gallons of water per foot of CH. A two inch diameter well will hold 0.17 gallons of water per foot of CH. Record the well information in the field book and prepare a purge water data table. An example table is presented in Table 1. Prepare and maintain the sample documentation as described in Section 6 (i.e. APHIS Form 2060).

Table 1 – Example well purge water data.

| Site Name: *Public Works* | | Well Identification: *MW1* | | Date: *Sept-30-09* | |
|---|---|---|---|---|---|
| WD (inches) | TD (feet) | DTW (feet) | CH (feet) | Gal./foot | WV (gal.) |
| *4* | *30.0* | *14.35* | *15.65* | *0.67* | *10.5* |
| Purge start time | Purge stop time | Amount purged (gal.) | Sample identification | Sample time | Recharge DTW (feet) |
| *09:30* | *09:55* | *31.5* | *PW-9/30-MW1* | *10:15* | *18.3* |

| Measurements | pH | Temperature (◦F) | Conductivity (mS) | Turbidity |
|---|---|---|---|---|
| Initial | *5.76* | *61.0* | *865* | *Moderate* |
| 1st WV | *5.88* | *58.9* | *848* | *Moderate* |
| 2nd WV | *5.90* | *56.3* | *856* | *Moderate/slight* |
| 3rd WV | *5.85* | *55.9* | *851* | *Slight* |
| Sample | *5.80* | *55.8* | *855* | *None* |

Comments: *Well purged and sampled with disposable bailer. Light yellow brown turbidity cleared up while purging. Compression cap needs to be replaced. Joe Consultant (BSC Inc.) was on site and collected split samples.*

3.4 Purging four inch diameter monitoring wells requires the lifting of a bailer (approximately 1 gallon = 8.3 pounds) from depths varying from 10 to 40 feet many times. Protect your hands from rope burns and blisters that result from handing saturated rope with thick gloves. A pair of cotton "jersey" gloves covered with a pair of nitrile gloves works well. Change both pairs of gloves often when they become saturated and torn, respectively. Secure an end of the rope to the bailer using a bowline or multiple tight square knots. Lower the bailer to the bottom of the well and secured the above ground portion of rope to an appropriate object (e.g. bucket handle) after a generous amount of additional slack has been laid out.

3.5 Rapidly remove the bailer from the well and pour a small aliquot of water from the top of the bailer into a clear vessel for measurement of the aquifer characteristics. Record the measurements in the field log book including the purge start time. Pour the remaining contents of the bailer into a five gallon bucket. Purge the calculated well volumes (WV) ensuring the last bailer-full of each volume has submerged to the bottom of the well. Record the aquifer characteristics by measuring an aliquot of water from the last bailer removed for each well volume.

3.6 Before, during, and after purging the well volumes, several aquifer characteristics should be measured to determine if the water sample is representative. Measure

the pH, temperature, and conductivity (specific conductance) of the first water drawn from the well, and at the completion of each of the three well volumes purged. This data should be measured when the sample is collected once the groundwater has recharged into the well. In addition, the turbidity should be visually estimated when the aquifer characteristic measurements are collected. Turbidity can be characterized as:

- Heavy – water opaque and sediment settles rapidly to the bottom of the vessel,
- Moderate – water opaque little or no sediment settling apparent,
- Slight – water is transparent,
- None – water is clear of turbidity but may still have discoloration.

3.7 Some wells may not recharge at a rate that will allow three well volumes to be purged. This will be apparent when the bailer does not completely submerge at the bottom of the well. When this condition occurs the purging is complete. Record the aquifer characteristics, the total amount of water removed and the purge stop time. After purging is complete allow the well to recover to static conditions prior to collecting the sample and final aquifer characteristic measurements.

3.8 Dispose of the purge water in a manner appropriate for the monitoring well that is being sampled. In most cases the wells up-gradient from the sources of contamination being investigated will be selected for sampling. Unless otherwise instructed pouring of apparently clean (i.e. no chemical odors or sheens) purge water onto nearby landscaped areas is acceptable. Dedicated 55 gallon steel drums may be present on site for use as temporary storage containers. Follow the instruction of the facilities management or their representative concerning the disposal of purge water.

**4. Collecting a Groundwater Sample**:

4.1 Prepare the sample cooler or an insulated shipping container provided by the laboratory by removing any expired shipping labels and tape. Fill one gallon resealable “freezer” bags half full with ice and expel the excess air before sealing the seams. Seal each of the ice bags into another one gallon resealable bag and adhere clear plastic tape along both sides of the top seam to ensure the seal remains closed. In general the cooler should have equal amounts of ice to water samples by weight. Therefore a laboratory supplied insulated shipping container with three water samples in 1 gallon cubitainers will require 20 pounds of ice in four to six double-bagged pouches. More detailed instructions on how to pack

and ship the water samples to the laboratory are described in SOP EM-17, *Packaging and Shipping of Samples*.

4.2 To prevent introducing turbidity into the sample, gently lower the bailer into the well water and collect the water sample from the top of the water column. Measure the aquifer characteristics at the time when the sample was collected and record data including the sample time in the field log book.

4.3 Remove the cap and inflate the cubitainer by exhaling into the opening of the cubitainer.

4.4 Fill the cubitainer from the top of the bailer while ensuring as little turbidity as possible is transferred from the bailer. Depending on the volume of water required for analysis, this step maybe repeated many times, therefore sampling only the turbidity free water in the top half of the bailer is prefered.

4.5 Check the pH of the sample, adjust if necessary, and add the stabilizer. See Section 5 of this SOP for instructions.

4.6 Collapse the cubitainer containing the stabilized sample to expel most of the air and screw on the cap securely.

4.7 With the indelible marker label the sample container with a unique identifier that will allow the sample to be matched to its documentation. Sample labels provided by the lab will not adhere to the container if it is wet, so the unique identifier should also be written on the container. Seal the labeled container in a resealable plastic bag with the blue copy of the APHIS Form 2060 in another resealable plastic bag and expel the excess air.

4.8 Place the sample in the cooler to keep it chilled until it can be transported from the field and placed in a freezer for storage until shipping.

**5. Adjusting pH and Stabilizing a Water Sample**:

5.1 Measure and record the pH of the water using the pH meter or by dipping one end of a strip of pH paper into the sample.

5.2 Stabilize the water sample by adding three sodium sulfate vials to the water sample container. Cap the sample container and mix by inverting the container until the sodium sulfate is dissolved. (NOTE: most pesticides used by PPQ are

stable in acidic water. But check with CPHST when ordering supplies to determine that the acid and buffer specified herein are correct for the pesticide being sampled. If not, the laboratory will provide alternate materials and instructions for stabilizing the sample.)

5.4 If the pH of the water sample is greater than 5, add three to five drops of sulfuric acid to the sample. (NOTE: Sulfuric acid can cause chemical burns. Flush skin with water if exposure occurs. Reference the Material Safety Data Sheet provided by CPHST with this chemical.) Mix the acid and water, and measure the pH again with a fresh piece of pH paper or the pH meter. Repeat this step as until the pH of the water sample is about 5.

5.5 Record the final pH measured in step 5.4.

**6. Documentation**:

6.1 Complete an APHIS Form 2060 for each water sample.

6.2 Record all observations in the field log book (see SOP EM-12, *Using a Field Log Book*) as described in Section 3.3 of this SOP. Describe difficulties encountered during the sample collection and potential sources of cross-contamination (i.e. poorly maintained monitoring well, surface water infiltration, nearby land-use practices). For groundwater samples, be sure to record the soil type, ground cover, and the topography of the treatment site. For all samples, include GPS coordinates and a sketch of the sample location and its relation to the treatment site and any sensitive site(s) in the vicinity. The sketch should include an approximate scale and a North arrow. Annotated aerial photographs, topographical maps, or photographs of the site in addition to the sketch are useful.

6.3 Retain the pink copy of Form 2060 for your records and distribute the remaining copies as specified in the EMP.

**7. Decontamination**:

7.1 Before moving to another site all the equipment that came into contact with the well pipe and water must be cleaned to prevent the cross contamination of other groundwater monitoring wells. Disposable bailers and ropes should be decontaminated and reused until they become permanently soiled or have chemical odors. Bailers can be cleaned by repeatedly submerging the ball check-valve in a bucket half full of a soapy solution. If needed scrub the outside of the

bailer with a brush to remove residual material. Wash the parts of instruments that contact groundwater or the monitoring well pipe taking care not to submerge display screens or sensitive electronics. Rinse equipment with distilled water from a gallon jug or spray bottle. Catch the rinse water in a bucket and dispose of it in an appropriate manner. Allow the equipment to air dry or wipe the surfaces with paper towels.

7.2 Follow the storage and equipment care instruction provided by the equipment manufacturer. Equipment, instruments, and supplies should be stored in sealable containers (e.g. large plastic storage bins) to prevent contact with common workplace or automotive chemicals.

**8. Packaging and Shipping**:

8.1 Package and ship the water samples to the laboratory as described in SOP EM-17, *Packaging and Shipping of Samples*.