Drinking Water & Wastewater

Guidance for Groundwater Monitoring Well Sampling at Sewage Works

WSA 531

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Water Security Agency

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1 Introduction

1.1 Background

Monitoring wells are essential for assessing impacts to groundwater quality around sewage treatment facilities and lagoons. This monitoring provides information about groundwater contaminants, tracks groundwater movement and ensures compliance with regulations.

Newly constructed or upgraded sewage works (primarily sewage lagoons) as well as some existing sewage works are required to develop and implement a groundwater monitoring program that is approved by the Water Security Agency (WSA). Sampling requirements are typically outlined in the construction permit and/or permit to operate a sewage works.

1.2 Purpose

This document provides guidance to operators to ensure representative samples are collected from monitoring wells at a sewage works, lagoon or similar facility. This document provides a general overview of the common methods and best practices in gathering samples to help promote uniformity, reduce sampling related errors, and produce more meaningful data for decision making. Other methods may be used in addition to this procedure. Please keep detailed records of methods used in operational notes.

2 Sampling

2.1 Sample Plan

Before sampling monitoring wells, it is important to review any available information for the well. For newly constructed monitoring wells, a geo-technical report or similar consultant's assessment can provide information needed to ensure that proper sampling method and materials are utilized. A sample record should be created for each well that includes well location, total depth, depth to the water level and well screen depth. Compare this information to what is observed on-site; if a well has been damaged it may not be appropriate for sampling. See Appendix B for an example of a sampling record.

WSA's sampling requirements for monitoring wells are described in the Permit to Operate a Sewage Works, and each well has a unique WSA station number for identification. Typically, sampling is required between June and August (inclusive) once per year and samples are tested for a Group 1 panel that includes: conductivity at 25°C, chloride, nitrate (NO3), total coliform bacteria, and *Escherichia Coli* bacteria. Contact an accredited laboratory to obtain all appropriate bottles and forms. Follow any directions given by the laboratory related to the collection of samples.

2.2 Sample Apparatus

An appropriate sample apparatus is selected based on the characteristics of the monitoring well being sampled. Well water refill rate and water volume dictates which apparatus is appropriate to minimize turbulence and agitation in the well. For example, a suction lift apparatus would suit a well with low refill and volume characteristics, because of slow, controlled pumping rates. Three common sample apparatuses include a bailer (Figure 1), a suction lift peristaltic pump (Figure 2) and a submersible pump (Figure 3).

A bailer is a hollow tube with a ball/foot valve at the bottom that, when submerged in water, will lift the ball valve and allow water to fill the tube; when removed from water, the ball will drop and seal water in the tube. The bailer is then raised to the surface on a rope or string. Some bailers are single use disposable, while others are reusable.

A suction lift peristaltic pump is connected to suction tubing positioned in the monitoring well and when negative pressure (suction) is applied, water is drawn through the tubing and can be collected at the surface.

A submersible pump is connected to sample tubing, lowered into the well, and submerged in the water. It works by pushing water up through the sample tubing with an impeller to the surface.

Each apparatus is relatively easy-to-use, but the suction lift peristaltic and submersible pump will require a power source. Other sample apparatuses may be considered appropriate based on the monitoring well characteristics. For more information on selecting the appropriate sample apparatus, ask your local environment officer; an external source with more information can be found online: Water sampling – Field equipment and techniques | Alberta.ca.

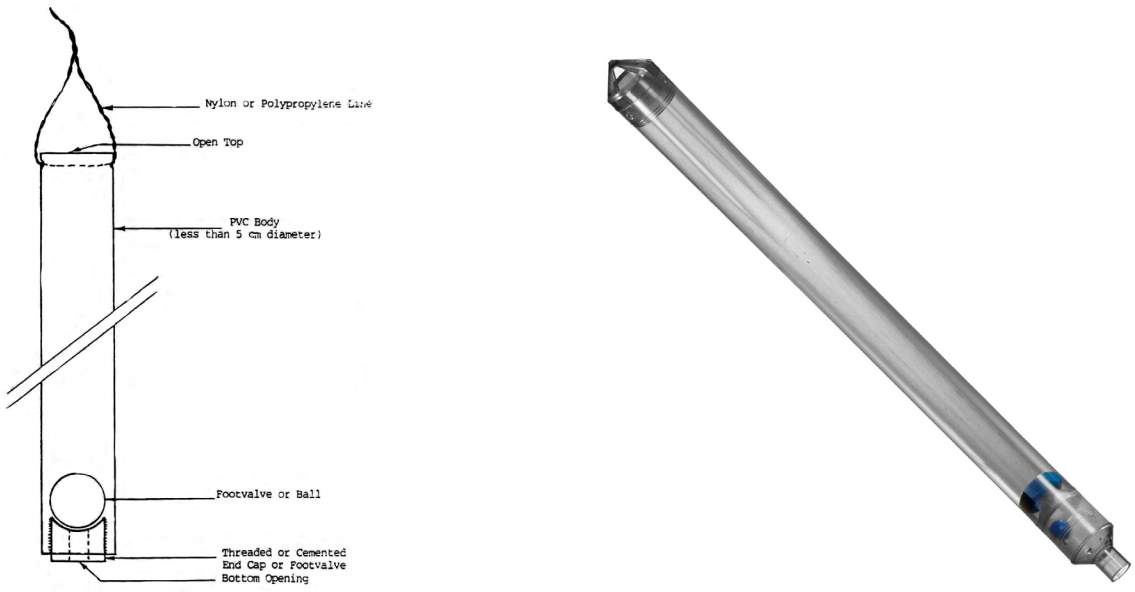

Figure 1. Bailer

Figure 2. Suction Lift Peristaltic Pump

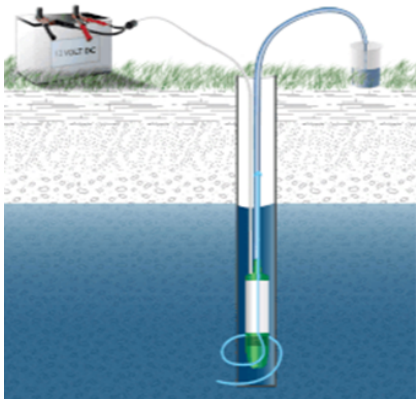

Figure 3. Submersible Pump

2.3 Sample Equipment

- Water level monitoring device
- Weighted measuring tape/rope (if necessary to measure well depth)
- Sample apparatus
- Tubing (if needed) – polyethylene or Teflon is recommended
- Power source or extension cords (if needed)
- Graduated cylinder or bucket
- pH meter or multimeter
- Sample bottles from accredited laboratory
- Well sample record(s)
- Paper towels
- Cooler
- Plastic sheeting
- Rope/twine (if needed)
- Decontamination supplies - distilled water, tap water, non-phosphate soap, cleaning brush and spray bottle, clean buckets or totes

Note: Decontamination is necessary for all water level measuring equipment as well as all sampling equipment before the start of sampling and between sampling wells. See Appendix A for decontamination procedures.

2.4 Water Level Measurement

A water level measurement is needed from the monitor well prior to purging and sampling the well. This information is important for trending groundwater levels around the sewage treatment facility and determining the static water volume in a monitoring well. Using the water level monitoring device and weighted measuring tape/rope (if necessary), measure the initial water level (W_i) in the well and total well depth (W_d). Water level measuring equipment must be decontaminated before use in each monitoring well. Record these measurements on a sampling record and compare them to the corresponding values in the engineering report.

Calculate the height of water in the well (W_h). $W_h = W_d - W_i$

Note: If the total well depth is significantly less than design (i.e., collapsed or obstructed well) or if there is no water in the well, then sampling might not be possible.

2.5 Purging

Well purging is important for removing matter or contamination that is not representative of the groundwater quality, which might be present in the monitoring well after a long period of inactivity. Purging should take place until three (3) consecutive water tests meet the stabilization criteria outlined in Table 1. This is the preferred method for low flow monitoring wells. Alternatively, purge at least 3 static water volumes (SWV) from the monitoring well (see calculation below).

Table 1. Well Stabilization Criteria[1]

Parameter	Stabilization Criteria
pH	+/- 0.1
Conductivity	+/- 3%
Turbidity	+/- 10% or <10 NTU

Note: For wells that can be pumped or bailed dry, do not dewater the well screen interval. Complete the purging steps as refill rates and time allows. **Removing a minimum of one SWV is required for this procedure.** On the sampling record, mark "unable to sample" if sampling cannot be conducted due to insufficient water in the monitoring well.

Step-by-step procedure:

1. Decontaminate any equipment that will be entering the well as per Appendix A.
2. Calculate the static water volume (SWV).

   SWV (Litres) = [(Inner well diameter(metres))/2]^2 x 3.14 x water height(W_h)(metres) x 1,000 (Litres/Metre^3)
3. Mark the well screen depth on the suction hose or bailer rope.
4. Lower sampling equipment into the well to just above the screened section of the well and start collecting water from the well into the graduated cylinder or bucket. Proper disposal of purged water should be considered.
5. Check the selected stabilization criteria after every half SWV.
6. Once three successive readings are within the tolerance range in Table 1, or 3 SWVs have been removed, the purge is complete.
7. If turbidity does not stabilize after purging, let the well(s) rest for 24 hours prior to sampling.
8. Decontaminate all equipment used in the well before utilizing in another well.

[1] USEPA - Groundwater Sampling Guide

2.6 Sample Collection

The monitoring wells that have been successfully purged can be sampled using the same equipment as the well purging steps above. Decontamination of the sample equipment must be conducted prior to sampling if the equipment was previously used in another well. Sampling can occur immediately after well purging unless turbidity did not stabilize during purging, in this case wait 24 hours before sampling. Efforts should be made to sample wells in the order of least contamination to greatest; however, decontamination of equipment is still required between samples.

Note: Clean sampling equipment should not be placed directly on the ground or other contaminated surfaces prior to sampling or during transport or storage.

Step-by-step procedure:

1. Lay plastic sheeting around the well casing to reduce the likelihood of contamination of sampling equipment from the ground.
2. Label sample bottles with the date, location, WSA station number and time.
3. Decontaminate sample equipment if sample collection is not immediately after purging of the same well.
4. Lower the sampling equipment into the well carefully; do not drop.
5. Sampling equipment should be positioned above the well screens and below the water level for sampling.
6. If using a pump, turn the pump on and allow enough time for the flow to become free of gases. The sampling flow rate should be less than the purging rate. Ensure the pump suction does not come out of the water. Alternatively, begin bailing the well.
7. If sampling is not immediately after purging, remove 1 SWV from the well prior to sampling. Monitor the volume of water removed from the well with a graduated cylinder or bucket.
8. Fill the sample bottles with well water and follow all laboratory instructions for submitting samples. Place samples in a cooler for transport.
9. Decontaminate sample equipment once sampling is complete and equipment is removed from well.
10. Record all sampling details on the laboratory's chain of custody and in the well sampling records.
11. Plan to submit all samples as soon as possible as certain tests are time sensitive. Samples must arrive at the lab within 48 hours of collection.

Common errors for this procedure include the following:

- insufficient sample volume collected;
- insufficient development or purging of the monitoring well;
- contaminants are destroyed or decayed during sample storage and handling;
- inappropriate sample collection equipment;
- water quality monitoring equipment is not appropriately calibrated;
- contamination of the sample during collection, handling, storage or analysis; and
- particulate matter in the sample (e.g., silt).

3 References

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Yeskis, Douglas and Zavala, Bernard. (2002). Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. United States Environmental Protection Agency. https://www.epa.gov/sites/default/files/2015-06/documents/gw_sampling_guide.pdf

APPENDIX A

Decontamination Procedures

Prior to entering and once removed from the well, decontamination of all equipment including water level measurement, weighted measuring tape, tubing, sample apparatus and any other sampling equipment should be conducted by scrubbing with a brush and a non-phosphate soapy-water wash, rinsed with tap water, and rinsed with distilled water to help ensure that there is no cross-contamination between wells.

Step-by-step procedure:

1. Submerge or spray all surfaces of the sampling equipment with soapy water. Use a bristle brush and/or paper towel to help remove visible dirt, contaminants, etc. Rinse equipment with tap water then with distilled water.
2. To clean apparatus that includes pump and tubing, pump approximately 2 to 3 gallons of each soapy water, tap water and then distilled water through tubing. Pump at low rate to increase contact time.
3. Try to remove any remaining liquid out of tubing prior to use. If this cannot be done, compressed air may be used to purge tubing. Another option is to install a check valve in the pump line (usually just above the pump head) so that liquid can't run back down the well as the tubing is lowered down the next well.
4. Prior to lowering the equipment down a well, spray the outside with distilled water. Use paper towels to dry.
5. (Optional) If a hydrophobic contaminant is present (e.g., high levels of PCBs), additional rinsing steps may be needed. For example, an organic solvent such as reagent-grade isopropanol alcohol may be added as a first rinse prior to the soapy water rinse.
6. Proper disposal of decontamination liquid and supplies should be considered.

APPENDIX B

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Groundwater Well Sampling Record

Appendix B

Sewage Works: _____ Date: _____

Sampling Personnel: _____

Weather Conditions: _____

Well Information

Well Name:	Station Number:
Well Depth:	Well Diameter:
Depth to Water:	Static Water Volume:
Well Condition:	
Sampling Apparatus:	

Parameters *(during purging)*

Time	Water Level	Volume Pumped	pH	Conductivity	Turbidity	Temperature

Sample

Date: _____ Time: _____

Lab: _____ Sample No. _____

Panel/Parameters: □ Group 1 (includes 1 L & 250 mL sterile bottle)

□ Other: _____

Comments: _____

_____

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_____