



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F303

Groundwater Monitoring Well Sampling

Standard Operating Procedure

SOP Number	SOP-F303
Revision	0.2
Author(s)	Marc Los Huertos
Date	2026-06-26
Organization	EA Program, Pomona College

FOR INTERNAL USE ONLY

This document is the property of the Environmental Analysis Program at Pomona College.
Unauthorized distribution is not permitted.

Table of contents

1 Purpose	2
2 Scope	2
3 Responsibilities	2
4 Definitions	2
5 Safety and Hazards	3
5.1 Required PPE	4
5.2 Emergency Procedures	4
6 Equipment and Materials	4
6.1 Sampling Equipment	4
6.2 Field Documentation	4
7 Procedure	5
7.1 Pre-Sampling Preparation	5
7.2 Water Level Measurement	5
7.3 Pump Placement and Low-Flow Purging	5
7.4 Sample Collection	6
7.5 Post-Sampling Procedures	6
7.6 Decontamination Between Wells	6
8 Sample Preservation and Holding Times	7
9 Quality Control	7
10 References	7
11 Related SOPs	8
12 Training Record	8
13 Appendix A: Groundwater Purge Log	8

1. Purpose

This SOP describes procedures for collecting representative groundwater samples from monitoring wells using the low-flow (minimal drawdown) purging and sampling method. Low-flow sampling minimizes disturbance to the well and surrounding formation, reduces turbidity artifacts, and yields samples that are more representative of in-situ groundwater chemistry than traditional high-volume purge methods (Puls & Barcelona, 1996).

The procedures follow EPA low-flow guidance (Puls & Barcelona, 1996), EPA Region 4 groundwater sampling procedures (U.S. Environmental Protection Agency, Region 4, Science and Ecosystem Support Division, 2017), and Cal-EPA DTSC guidance on representative groundwater sampling.

2. Scope

- **Applies to:** Sampling of existing groundwater monitoring wells with an inside diameter of 2 inches (5 cm) or greater, screened intervals of 3 m (10 ft) or less, and a water level above the top of the screen
- **Does not apply to:** Well installation or development; direct-push (e.g., Geoprobe) sampling; spring or seep sampling; wells requiring high-volume purging for regulatory compliance; wells with water levels below the top of the screen (consult the PI for alternative procedures)
- **Location:** All EA Program groundwater monitoring sites

3. Responsibilities

Role	Responsibility
PI / Project Lead	Approve sampling plan and well selection
Field Lead	Coordinate logistics, maintain well access agreements
Trained Personnel	Purge and sample wells per this SOP
New Students	Complete training before participating in well sampling

4. Definitions

- **Dedicated pump:** A pump permanently installed in a single well and not removed between sampling events; eliminates inter-well cross-contamination and decontamination burden; preferred for long- term monitoring programs.
- **Drawdown:** The decline in water level within a well caused by pumping; in low-flow sampling, drawdown must remain at or below 10 cm to minimize vertical mixing within the screened interval and preserve the representativeness of the sample (Puls & Barcelona, 1996).
- **E-tape (electric tape, water level indicator):** An electronic device consisting of a two-conductor cable with a sensing probe at the tip; when the probe contacts the water surface, an audible alarm sounds; used to measure depth to water from a reference point (typically the top of casing, TOC).

- **Flow-through cell:** A sealed flow cell into which purge water is routed so that a multiparameter probe can measure field parameters continuously without exposure to the atmosphere; prevents degassing of CO₂ and O₂ that would bias pH, DO, and ORP readings.
- **High-volume purge:** The traditional well purging approach in which 3–5 well volumes (or more) are removed before sampling; causes high drawdown, turbulence, and resuspension of fine particles; generally produces less representative samples than low-flow methods (Puls & Barcelona, 1996).
- **Low-flow (minimal-drawdown) sampling:** A groundwater sampling technique in which the pump is set at the mid-screen interval and the flow rate is adjusted to maintain drawdown of 10 cm or less; sampling begins only after field parameters have stabilized (Puls & Barcelona, 1996; Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations, 2021).
- **ORP (oxidation-reduction potential):** A measure of the electron-donating or -accepting capacity of a groundwater sample; expressed in millivolts; sensitive to exposure to atmospheric oxygen; must be measured in a flow-through cell without headspace.
- **Parameter stabilization:** The criterion indicating that the water being pumped from the well is representative of the aquifer rather than stagnant casing water; defined as three consecutive readings within specified limits for pH, temperature, specific conductance, DO, ORP, and turbidity (see §7.3 criteria table).
- **Screen interval (screened interval):** The perforated section of the well casing through which groundwater enters the well from the surrounding aquifer; the pump intake should be positioned at the center of this interval during low-flow sampling.
- **Standing water volume:** The volume of water within the well casing above the bottom of the well screen; calculated as $V = \pi r^2 h$, where r is the inside casing radius and h is the height of the water column; used to determine whether enough water exists for low-flow sampling.
- **TOC (top of casing):** The surveyed reference elevation from which all depth-to-water measurements are taken; must be marked on the well casing with a permanent reference point.
- **Trip blank:** A set of 40 mL VOC sample vials filled with laboratory-grade water in the lab, transported to the field in a sealed cooler alongside field samples, and returned to the lab unopened; detects contamination introduced during transport (APHA et al., 2012).
- **Well volume:** The volume of water stored in the well casing above the screen; typically calculated from well construction records; one well volume is the minimum purge volume before parameter monitoring in high-volume purge methods.

5. Safety and Hazards

Hazards

- **Physical:** Heavy well caps and locks; lifting pumps and equipment; uneven terrain around well pads; potential for back strain when bending over flush-mount wells
- **Chemical:** Groundwater may contain VOCs, metals, or other contaminants. Purge water may require containerization as hazardous waste. Preservative acids in pre-preserved bottles are corrosive.
- **Biological:** Standing water in well vaults may harbor mosquitoes or other vectors
- **Confined spaces:** Flush-mount well vaults may be classified as confined spaces. Do

not enter vaults.

5.1. Required PPE

- ☐ Nitrile gloves (double-glove when handling suspected hazardous groundwater)
- ☐ Safety glasses or chemical splash goggles
- ☐ Closed-toed shoes or field boots

5.2. Emergency Procedures

Refer to [SOP-F001 Field Safety](#) and [SOP-L003 Hazardous Materials Handling](#).

6. Equipment and Materials

6.1. Sampling Equipment

Item	Notes
Low-flow peristaltic pump or bladder pump	Programmable flow rate; 0.1–0.5 L/min
Pump tubing (dedicated or new)	PTFE or polyethylene; appropriate ID for pump
Flow-through cell	With ports for multiparameter probe
Multiparameter probe	pH, temperature, SpC, DO, ORP, turbidity; calibrated per instrument SOP
E-tape (water level indicator)	Metric and/or English gradations
Pre-labeled sample bottles	Per analyte; type and preservative per project QA plan (APHA et al., 2012)
Deionized water	For equipment blanks and rinsing
Well keys	For locked well caps

6.2. Field Documentation

Item	Notes
Well construction logs	Casing depth, screen interval, diameter
Groundwater purge log (Appendix A)	For recording stabilization parameters
Chain of custody (COC) forms	Required for lab submission
Field notebook	
Camera	Photo-document well condition
GPS unit or smartphone	For confirming well locations

7. Procedure

7.1. Pre-Sampling Preparation

1. Review well construction logs for each well: casing material, diameter, total depth, screen interval, and previous water level data.
2. Calculate the volume of standing water in the well casing above the screen using $V = \pi r^2 h$.
3. Calibrate the multiparameter probe per the manufacturer's instructions. Record calibration data on the purge log.
4. Assemble pump, tubing, and flow-through cell. For non-dedicated equipment, decontaminate with deionized water before use at each well.

7.2. Water Level Measurement

1. Remove the well cap. Note the condition of the well (damage, standing water in vault, obstructions).
2. Wipe the e-tape sensor with a clean paper towel.
3. Lower the e-tape slowly until the alarm sounds at the water surface.
4. Record depth to water from the TOC to the nearest 0.3 cm (0.01 ft).
5. Measure well depth from the same reference point (after sampling, to avoid resuspending settled solids).
6. Calculate the water column height and standing water volume.

Tip

Always measure water level before inserting the pump. Lowering the pump displaces water and changes the apparent water level.

7.3. Pump Placement and Low-Flow Purging

1. Slowly lower the pump intake to the center of the screened interval. Avoid dropping the pump or allowing it to contact the bottom of the well.
2. Start the pump at the lowest speed setting and slowly increase until discharge begins. Target a flow rate of 0.1–0.5 L/min (Puls & Barcelona, 1996; Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations, 2021).
3. Check the water level. Drawdown must not exceed 10 cm. If drawdown exceeds 10 cm, reduce the pumping rate.
4. Route discharge through the flow-through cell for continuous monitoring.
5. Record field parameters and cumulative purge volume on the purge log at 3–5 minute intervals.
6. Continue purging until field parameters have stabilized (Puls & Barcelona, 1996):

Parameter	Stabilization Criterion
pH	±0.1 units over three consecutive readings
Temperature	±0.2 °C over three consecutive readings

Parameter	Stabilization Criterion
Specific conductance	±3% over three consecutive readings
Dissolved oxygen	±0.3 mg/L over three consecutive readings
ORP	±10 mV over three consecutive readings
Turbidity	±10% over three readings (or < 10 NTU)

7. Once all parameters are stable, proceed immediately to sample collection. Do not turn off the pump between purging and sampling.

! If the Well Purges Dry

If the well dewateres before stabilization, stop pumping and allow the well to recover. Sample as soon as adequate volume has recovered. Record the dewatering event and recovery time on the purge log. Note that samples from wells purged to dryness may not be representative.

7.4. Sample Collection

1. Disconnect the flow-through cell from the discharge line. Collect samples directly from the pump tubing (U.S. Environmental Protection Agency, Region 4, Science and Ecosystem Support Division, 2017).
2. Maintain the same low flow rate used during purging.
3. Collect samples in this order to minimize bias:
 - a. VOCs (if applicable) – 40 mL glass vials, zero headspace
 - b. Dissolved gases (if applicable)
 - c. Total metals and other unfiltered analytes
 - d. Filtered (dissolved) analytes – attach a 0.45 µm in-line filter
 - e. General chemistry (pH, conductivity, alkalinity, nutrients)
 - f. Bacteria (use sterile bottles)
4. Fill bottles slowly to minimize aeration and turbulence.
5. Cap immediately, label, and place in ice.

7.5. Post-Sampling Procedures

1. Measure and record the final depth to water.
2. Measure the total well depth.
3. Remove the pump and tubing. Replace the well cap and lock.
4. Containerize all purge water per the site waste management plan.
5. Decontaminate non-dedicated equipment and collect an equipment blank.
6. Complete the chain of custody form.

7.6. Decontamination Between Wells

1. Flush the pump and tubing with 1 L of laboratory-grade detergent solution (Alconox or equivalent).

2. Flush with 3 L of deionized water.
3. Change nitrile gloves between wells.
4. Collect one equipment blank per sampling event (APHA et al., 2012).

8. Sample Preservation and Holding Times

Follow preservation requirements specified by your analytical laboratory (APHA et al., 2012). Common groundwater analytes:

Analyte	Container	Preservative	Holding Time
pH	Poly, 250 mL	None; measure in field	15 minutes
Specific conductance	Poly, 250 mL	Refrigerate 4 °C	28 days
Alkalinity	Poly, 250 mL	Refrigerate 4 °C	14 days
Nitrate + nitrite	Poly, 250 mL	H ₂ SO ₄ to pH < 2; 4 °C	28 days
Total metals	Poly, 500 mL	HNO ₃ to pH < 2; 4 °C	6 months
Dissolved metals	Poly, 500 mL	Filter 0.45 µm; HNO ₃ to pH < 2; 4 °C	6 months
VOCs	Glass, 40 mL (×3)	HCl to pH < 2; 4 °C	14 days

9. Quality Control

- **Field blank:** One per event; deionized water at the well site (APHA et al., 2012).
- **Equipment blank:** One per event from the final deionized rinse.
- **Field duplicates:** One per 10 wells sampled.
- **Trip blanks (VOCs only):** One per cooler.

10. References

- Puls & Barcelona (1996)
- U.S. Environmental Protection Agency, Region 4, Science and Ecosystem Support Division (2017)
- (Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations, 2021)
- APHA et al. (2012)

APHA, AWWA, & WEF. (2012). *Standard methods for the examination of water and wastewater* (22nd ed., p. 1360). American Public Health Association.

Puls, R. W., & Barcelona, M. J. (1996). *Low-flow (minimal drawdown) ground-water sampling procedures* (EPA/540/S-95/504). U.S. Environmental Protection Agency, Office of Research; Development. <https://www.epa.gov/sites/default/files/2015-06/documents/lwflw2a.pdf>

Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations, Pub. L. Nos. ASTM D6771-21 (2021). <https://doi.org/10.1520/D6771-21>

U.S. Environmental Protection Agency, Region 4, Science and Ecosystem Support Division. (2017). *Groundwater sampling operating procedure (SESDGUID-301-R4)*. U.S. EPA Region 4 SEDS. https://www.epa.gov/sites/default/files/2017-07/documents/groundwater_sampling301_af.r4.pdf

11. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F007	Field Decontamination	Between-well equipment cleaning
F008	Sample Labeling and COC	Chain of custody
F300	Surface Water Sampling	Preservation and handling
L802	Quality Control and QA	QC requirements

12. Training Record

Before sampling groundwater monitoring wells independently, personnel must:

1. Read this SOP, [SOP-F001](#), and [SOP-F300](#) in full
2. Review well construction logs for the wells to be sampled
3. Demonstrate proper water level measurement technique
4. Observe a trained operator complete a full low-flow purge and sample collection at one well
5. Perform a supervised purge and sampling event achieving stabilization within the criteria in §7.3
6. Demonstrate proper decontamination and chain of custody procedures
7. Be signed off by the PI or field lead

13. Appendix A: Groundwater Purge Log

Print on waterproof paper and complete one form per well.

Site: _____ **Well ID:** _____ **Date:** _____ **Sampler:** _____

Well Construction: Casing diameter: _____ in | Total depth: _____ ft | Screen: _____ to _____ ft below TOC

Pre-sampling water level: _____ ft from TOC **Calculated standing water volume:** _____ L

Elapsed Time (min)	Cum. Vol. (L)	Flow (L/min)	Draw- down (cm)	pH	Temp (°C)	SpC (µS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)
-----------------------	------------------	-----------------	-----------------------	----	--------------	----------------	--------------	-------------	--------------------

Stabilization achieved? Y / N Time: _____

Post-sampling water level: _____ ft from TOC **Total well depth (post-sampling):** _____
ft from TOC