



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F302

Stormwater Sampling

Standard Operating Procedure

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1. Purpose

This SOP describes procedures for collecting stormwater runoff samples from urban and peri-urban watersheds during wet-weather events. Storm runoff is a primary pathway by which sediments, nutrients, metals, bacteria, and other pollutants enter receiving waters. Characterizing stormwater quality is essential for assessing nonpoint source pollution, evaluating the effectiveness of best management practices (BMPs), and supporting compliance with National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit requirements (APHA et al., 2012; California State Water Resources Control Board, 2018).

The procedures described here are consistent with the California State Water Resources Control Board’s Surface Water Ambient Monitoring Program (SWAMP) guidance and the State Water Board’s Stormwater Sampling Guidance Document for construction and industrial general permits.

2. Scope

- **Applies to:** Manual grab and time-composite sampling of stormwater runoff from outfalls, storm drains, open channels, sheet flow, and receiving streams during and immediately following precipitation events
- **Does not apply to:** Dry-weather urban runoff (use [SOP-F300 Surface Water Sampling](#)); automated composite sampling with programmed autosamplers (requires a separate instrument-specific SOP); industrial facility compliance sampling governed by site-specific SWPPPs
- **Location:** All EA Program stormwater monitoring sites in the greater Los Angeles basin and Inland Empire watersheds

3. Responsibilities

Role	Responsibility
PI / Project Lead	Approve sampling plan and storm-event criteria
Field Lead	Monitor weather forecasts, mobilize crew, verify equipment
Trained Personnel	Collect and handle samples per this SOP
New Students	Complete training before participating in storm sampling

4. Definitions

- **Antecedent dry period:** The number of consecutive dry days before a storm event; typically a minimum of 72 hours is required for a storm to qualify as an independent event that will produce a representative first flush; shorter antecedent periods may indicate ongoing, non-independent runoff (California State Water Resources Control Board, 2018).
- **BMP (best management practice):** A structural or operational practice designed to reduce the volume or concentration of pollutants in stormwater runoff; includes detention basins, bioswales, permeable pavement, inlet filters, and street sweeping.

- **Event mean concentration (EMC):** The flow-weighted average concentration of an analyte across the entire storm event; calculated as total analyte load divided by total event runoff volume; the standard metric for characterizing stormwater quality and comparing across sites and storms (U.S. Environmental Protection Agency, 2002).
- **First flush:** The initial pulse of stormwater runoff, which typically carries a disproportionately high load of accumulated pollutants relative to later portions of the storm; occurs most prominently in highly impervious urban catchments.
- **Flow-weighted composite sample:** A sample assembled by combining aliquots that are proportional to instantaneous flow rate at each collection interval; produces a sample whose concentration approximates the event mean concentration (California State Water Resources Control Board, 2018).
- **MS4 (Municipal Separate Storm Sewer System):** A conveyance system owned and operated by a municipality that is designed to collect and convey stormwater separately from sanitary sewage; regulated under NPDES permits.
- **NPDES (National Pollutant Discharge Elimination System):** The federal permit program under the Clean Water Act that regulates point-source discharges of pollutants, including stormwater from MS4s, construction sites, and industrial facilities.
- **Outfall:** A pipe, channel, or other structure through which stormwater is discharged to a receiving water body; a standard sampling location for MS4 compliance monitoring.
- **SWPPP (Stormwater Pollution Prevention Plan):** A site-specific plan required for construction sites and certain industrial facilities under NPDES permits; documents BMPs, monitoring requirements, and inspection schedules.
- **Time-composite sample:** A sample assembled by combining equal aliquots collected at fixed time intervals throughout the storm event; simpler than flow-weighted compositing but does not account for flow variability.

5. Safety and Hazards

Hazards

- **Drowning and flash flooding:** Stormwater channels and storm drains can fill rapidly during precipitation. Water levels can rise without warning. Never enter a storm drain, culvert, or engineered channel during active flow.
- **Slippery surfaces:** Wet concrete, asphalt, and channel banks are extremely slippery.
- **Electrical hazard:** Avoid sampling near downed power lines during storms.
- **Traffic:** Storm sampling often occurs at night or in low visibility. Wear high-visibility vests and use traffic cones. Park away from traffic lanes.
- **Establish an escape route** before approaching any sampling location.
- **Monitor upstream conditions.** If water is rising, retreat immediately.
- If lightning is observed, cease sampling and move to a vehicle or enclosed structure. Wait 30 minutes after the last observed lightning before resuming.

5.1. Emergency Procedures

Refer to [SOP-F001 Field Safety](#) for general emergency response. If a team member is swept into a channel, call 911 immediately. Do not attempt an in-water rescue unless you have swift-water rescue training and equipment.

6. Equipment and Materials

6.1. Sampling Equipment

Item	Notes
Pre-labeled sample bottles	Type and preservative per analyte (see §9)
Polypropylene grab-sample bottles (1 L)	For general chemistry and nutrients
Sterile 100 mL Colilert bottles	With sodium thiosulfate for bacteria
Extension pole with bottle clamp	For sampling from bridges, banks, or above outfalls
Stainless steel or HDPE bucket	For flow-weighted composites
Graduated cylinder or measuring cup	For volumetric aliquots into composites
Deionized water	For equipment blanks and rinsing
Syringe and 0.45 µm filters	For dissolved analyte samples

6.2. Field Documentation and Transport

Item	Notes
Field data sheets (waterproof paper)	Record time, sample ID, conditions
Chain of custody (COC) forms	Required for lab submission
Camera (waterproof)	Photo-document site conditions
Rain gauge (manual or tipping bucket)	For recording on-site precipitation
Coolers with ice	Maintain samples at 4 °C during transport
Custody seals	For sealing coolers before shipment

7. Storm Event Criteria

7.1. Qualifying Storm Events

A qualifying storm event must meet all of the following criteria unless the project sampling plan specifies otherwise (California State Water Resources Control Board, 2018):

- **Antecedent dry period:** At least 72 hours (3 days) of dry weather preceding the storm
- **Minimum rainfall:** At least 2.5 mm (0.1 inches) of total precipitation predicted or observed
- **Duration:** Sufficient to produce runoff at the sampling location

7.2. Storm Tracking and Mobilization

1. Monitor the 3–7 day National Weather Service (NWS) forecast and local radar (e.g., Weather.gov, NWS Doppler) during the October– March wet season.
2. When a qualifying storm is forecast, notify the team at least 24 hours in advance if possible.
3. Pre-position coolers, ice, and sampling supplies in vehicles. Confirm all sample bottles are correct and labeled.
4. Confirm sampling site access (locked gates, private property) before departure.

8. Sample Collection Procedures

8.1. Sampling Time

Attempt to collect at least three samples per event when possible (APHA et al., 2012; California State Water Resources Control Board, 2018):

1. **First flush:** As early as practical after runoff reaches the sampling point; ideally within 30 minutes of runoff initiation
2. **Mid-storm:** Approximately at peak flow
3. **Recession:** During the falling limb, at least 2 hours after peak flow

Record the time, rainfall amount (if a gauge is present), and an estimate of flow conditions (trickle, moderate, high) at each sampling time.

8.2. Outfall and Stormwater Channel Sampling

1. Approach the outfall or channel sampling point from upstream or from above. Never stand downstream of an active outfall.
2. Using the extension pole, position the bottle mouth facing upstream at mid-depth (or as close to mid-depth as safely possible).
3. Fill to the appropriate volume for the analytes being collected.
4. Cap immediately, label, and place in the cooler with ice.

8.3. Sheet Flow Sampling

1. Identify a low point or convergence zone where sheet flow concentrates.
2. Place a clean stainless steel or HDPE tray or shallow pan at ground level to intercept the flow.
3. Transfer collected water to sample bottles using a clean syringe or by pouring directly.
4. Record the contributing area and surface type (impervious, pervious, mixed).

8.4. Time-Composite Sampling

1. At each time interval (e.g., every 30 minutes), collect a grab sample per §6.1 or §6.2.

2. Measure a fixed aliquot volume (e.g., 50–100 mL) using a graduated cylinder.
3. Add the aliquot to the composite bottle. Mix gently.
4. Record the time, flow estimate, and aliquot volume in the field notebook.
5. At the end of the event, transfer the composite to appropriately preserved bottles for each analyte.

9. Sample Preservation and Holding Times

Follow [SOP-F300 Surface Water Sampling](#) §9 for general preservation (APHA et al., 2012). Common stormwater analytes:

Analyte	Container	Preservative	Holding Time
pH	Poly, 250 mL	None; analyze in field	15 minutes
Conductivity	Poly, 250 mL	Refrigerate 4 °C	28 days
TSS / SSC	Poly, 1 L	Refrigerate 4 °C	7 days
Turbidity	Poly, 250 mL	Refrigerate 4 °C	48 hours
Nitrate + nitrite	Poly, 250 mL	H ₂ SO ₄ to pH < 2; 4 °C	28 days
Ammonia	Poly, 250 mL	H ₂ SO ₄ to pH < 2; 4 °C	28 days
Total phosphorus	Poly, 250 mL	H ₂ SO ₄ to pH < 2; 4 °C	28 days
Ortho-phosphate	Poly, 250 mL	Filter 0.45 µm; 4 °C	48 hours
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
Total coliforms / <i>E. coli</i>	Sterile, 100 mL	Na ₂ S ₂ O ₃ ; 4 °C	6 hours
Oil and grease	Glass, 1 L	HCl to pH < 2; 4 °C	28 days

10. Quality Control

- **Field blank:** At least one per event – fill a sample bottle with deionized water at the site and handle identically to field samples (APHA et al., 2012).
- **Field duplicates:** Collect one per 10 samples (or at least one per event).
- **Equipment blanks:** If non-dedicated equipment is used, collect a deionized water rinse blank.
- **Documentation:** Complete the COC form before samples leave the field; photograph site conditions at each sampling location.

11. Data Management

1. Enter field data (times, conditions, flow estimates, sample IDs) into the project database within 48 hours.
2. When laboratory results are received, merge with field data and apply QC flags per [SOP-L802 Quality Control](#).
3. Archive original field data sheets (scan if paper).
4. Version-control all analysis scripts per [SOP-L801 RStudio and GitHub](#).

12. References

- California State Water Resources Control Board (2018)
- California State Water Resources Control Board (2017)
- APHA et al. (2012)
- U.S. Environmental Protection Agency (2002)

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

California State Water Resources Control Board. (2017). *Quality assurance program plan*. Surface Water Ambient Monitoring Program (SWAMP). https://www.waterboards.ca.gov/water_issues/programs/swamp/

California State Water Resources Control Board. (2018). *Storm water sampling guidance document for compliance with California construction and industrial general permits*. https://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/draft_cnst_sample_guidance.pdf

U.S. Environmental Protection Agency. (2002). *Urban stormwater BMP performance monitoring: A guidance manual for meeting the national stormwater BMP database requirements* (EPA-821-B-02-001). Office of Water, U.S. EPA. https://www.epa.gov/sites/default/files/2015-10/documents/2002_10_24_npdes_swbmp_bmpguide.pdf

13. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F300	Surface Water Sampling	Sample collection and preservation
F008	Sample Labeling and COC	Chain of custody
L802	Quality Control and QA	QC flags and data review

14. Training Record

Before collecting stormwater samples independently, personnel must:

1. Read this SOP, [SOP-F001](#), and [SOP-F300](#) in full
2. Review the safety rules in §4 with the field lead
3. Participate in at least one supervised storm sampling event, including mobilization, sample collection, preservation, and COC completion
4. Demonstrate proper grab and composite sampling techniques
5. Be signed off by the PI or field lead