

SAFETY AND ADMINISTRATION

General Safety, Lab Safety, Field Safety, and Administrative Protocols

Environmental Analysis Program
Teaching and Research Laboratories, Seeley G Mudd
Pomona College

Marc Los Huertos

Environmental Analysis Program Coordinator



Pomona College
Claremont, California

SAFETY AND ADMINISTRATION

Safety and Administration

General safety, field safety, lab safety, and administrative protocols

EA Program – Biogeochemistry Lab, Pomona College

Compiled: June 26, 2026

SOP Num- ber	Title
SOP-F001	Field Safety
SOP-F002	Field Equipment Checklist
SOP-F003	Field Notebook Protocols
SOP-F004	Site Access and Permits
SOP-F005	Random Sampling Design
SOP-F006	GPS and Site Navigation
SOP-F007	Field Decontamination Protocols
SOP-F008	Sample Labeling, Chain of Custody, and Transport
SOP-L002	General Laboratory Safety Plan
SOP-L003	Hazardous Materials Handling
SOP-L004	Chemical Spill Response
SOP-L005	Chemical Inventory Management
SOP-L006	Waste Disposal and Hazardous Waste Pickup
SOP-L007	EA Program Equipment and Instrument Inventory
SOP-L010	Laboratory Notebook Recording
SOP-L015	Foreign Soil Handling and Import Permits
SOP-L020	Reagent and Standard Preparation



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F001

Field Safety

Standard Operating Procedure

SOP Number	SOP-F001
Revision	1.3
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 Materials	3
6 Estimated Time	4
7 Field Preparation Checklist	4
7.1 Before Departure	4
7.2 Supply Checklist	4
7.3 On Site	4
8 Hazard-Specific Procedures	5
8.1 Transportation	5
8.2 Weather Hazards	5
8.2.1 Lightning	5
8.2.2 Heat	5
8.2.3 High Wind	5
8.3 Overhead Hazards (Widow-Makers)	5
8.4 Sharp Tools	6
8.5 Biotic Hazards	6
8.5.1 Poison Oak	6
8.5.2 Ticks	6
8.5.3 Stinging Insects	6
8.5.4 Wildlife	6
9 Emergency Response Procedure	6
9.1 Responding to a Medical Emergency	6
9.2 Chronic Conditions	7
9.3 Injury from Equipment	7
9.4 Documenting the Incident	7

10 Stop-Work Conditions	7
11 References	8
12 Related SOPs	8
13 Training Record	8
14 Appendix A: Field Work Planning Form	8

1. Purpose

This SOP covers field-based research activities and class field trips, addressing transportation, weather-based, and biotic hazards. Although we cannot predict all risks and hazards, it is everyone's responsibility to identify and mitigate potential risks associated with field work (Occupational Safety and Health Administration, 2012).

2. Scope

- **Applies to:** All field-based research activities, class field trips, and off-campus data collection
- **Does not apply to:** Laboratory-only procedures (see relevant Lab SOPs)
- **Location:** All field sites used by the EA Program

3. Responsibilities

Role	Responsibility
Instructor / PI	Approve field plans, ensure training compliance
Trained Personnel	Follow this SOP, report deviations and hazards
New Students	Complete training and document review before field work

Anyone conducting research in the field is required to have documented training before commencing field work. Learning about risks and taking the precautions described here is the first step to reducing the risks associated with field work. Anyone working in the field should identify potential risks and attempt to mitigate them.

4. Definitions

- **Field lead:** The trained, designated person responsible for safety decisions during a field outing; authorizes resumption of work after a stop-work condition, maintains communication with the PI, and is the first point of contact in an emergency.

- **Heat illness:** A spectrum of conditions caused by overheating, ranging from heat cramps and heat exhaustion to heat stroke; heat stroke (core temperature above 40 °C, altered mental status) is a life-threatening emergency requiring immediate 911 activation (Occupational Safety and Health Administration, 2012).
- **Incident report:** A written record of any injury, illness, near-miss, or property damage occurring during field work; submitted to the PI and the college risk management office within 24 hours of the event (Pomona College, 2024).
- **Minimum crew size:** Two persons at all times during field work; one person must be capable of summoning help if the other is incapacitated. Solo field work is prohibited unless explicitly waived in writing by the PI for low-hazard, high-visibility situations.
- **PPE (personal protective equipment):** Equipment worn to minimize exposure to field hazards, including closed-toed shoes, long pants, safety glasses, sun protection, and task-specific items such as hard hats and cut-resistant gloves (National Research Council, 2011).
- **Risk assessment:** A structured evaluation of the hazards at a field site and the probability and severity of resulting harm; used to select appropriate control measures and documented on the Field Work Planning Form (Appendix A).
- **Stop-work authority:** The right – and duty – of any crew member to stop field operations without prior approval when they observe an imminent safety hazard. No crew member may be penalized for exercising stop-work authority in good faith (Occupational Safety and Health Administration, 2012).
- **Two-person rule:** See “Minimum crew size” above.
- **Widow-maker:** A dead branch, dead tree, or tree with structural defects that may fall without warning; a leading cause of fatalities in forest work; avoid working beneath or near hazard trees, especially in high wind.

5. Safety and Hazards

General Field Hazards

Reducing risks is one of our main priorities. Like many endeavors in life, field work has certain risks. We can reduce these risks dramatically by understanding our physical limits and how these can be tested by uncontrolled environmental factors.

We rely on each individual to be mindful of their own limitations and to advocate for themselves and others to reduce risk exposure.

5.1. Required Materials

- First Aid Kit (kits are located in EA vehicles; see EA vehicle checklist to document their presence)
- Cell phone(s) with emergency contacts programmed
- Walkie-talkies (optional but recommended for sites with poor cell service)
- Personal Protective Equipment (PPE) appropriate for the site and task

6. Estimated Time

Preparing to go in the field can take a few minutes to several hours of planning and gathering resources. A good rule of thumb is to double the time you think it will take to get ready.

7. Field Preparation Checklist

7.1. Before Departure

- ☐ Check weather report and air quality index
- ☐ Read and understand emergency procedures for the specific site
- ☐ Know locations of emergency equipment (first aid kit, fire extinguisher if applicable)
- ☐ Be aware of any special medical conditions of team members
- ☐ Report departure time and expected return to supervisor
- ☐ Identify the hospital or urgent care facility closest to the field site
- ☐ Develop a transportation plan with a designated driver
- ☐ Complete a risk assessment and safety plan (Appendix A)

7.2. Supply Checklist

- ☐ PPE appropriate for the task (see §8 for task-specific items)
- ☐ Rain gear (if precipitation is forecast)
- ☐ Closed-toed shoes or field boots (no sandals or open-toed shoes)
- ☐ Additional clothing/gear for site conditions (e.g., long sleeves and gaiters for poison oak areas)
- ☐ Sunscreen and sun hat
- ☐ Adequate water (minimum 1 L per person per 2 hours in warm conditions)
- ☐ Rite in the Rain field notebook and waterproof pen
- ☐ Watch or phone for time-stamping field records
- ☐ First aid kit
- ☐ Cell phone with the following numbers programmed:
 - 911 (emergency)
 - Campus safety: (909) 621-8170 (Pomona College)
 - Lab supervisor and/or instructor
 - Field team members

7.3. On Site

- Identify a meeting time and departure plan if the team splits up
- Leave no trace: ensure the environment remains undisturbed
- Field lead ensures that safety procedures are followed
- Report any potential field hazards to the field lead immediately

8. Hazard-Specific Procedures

8.1. Transportation

- All passengers must wear seatbelts at all times
- Designated driver is identified before departure; no impaired driving
- Allow extra time on unpaved or unfamiliar access roads
- Do not drive into flooded washes or roads

8.2. Weather Hazards

8.2.1. Lightning

Follow the 30-30 rule: if the time between a lightning flash and thunder is 30 seconds or less, the storm is within 10 miles – seek shelter immediately. Remain sheltered for 30 minutes after the last flash or thunder (Occupational Safety and Health Administration, 2012).

When lightning threatens:

1. Move away from tall isolated objects (trees, towers, open hilltops)
2. Avoid open fields and water bodies
3. Seek a low-lying area away from individual trees
4. Do not hold metal equipment
5. If no shelter is available, spread the team out (at least 30 m apart) to reduce the risk of multiple casualties

8.2.2. Heat

Southern California field sites can exceed 40 °C. Carry adequate water, take shade breaks, and monitor for heat-related illness. Symptoms of heat exhaustion include heavy sweating, weakness, cold or clammy skin, weak pulse, nausea, and fainting. Heat stroke (hot/dry/red skin, rapid strong pulse, unconsciousness) is a medical emergency: call 911 immediately and cool the person rapidly (Occupational Safety and Health Administration, 2012).

8.2.3. High Wind

Sustained winds above 25 mph (above 20 mph when working near trees or overhead hazards) require stopping work. High winds increase the risk of widow-makers and can topple equipment.

8.3. Overhead Hazards (Widow-Makers)

Before working under or near any tree:

1. Look up and assess the crown for dead branches, leaning limbs, or structural failure
2. Do not work beneath or near hazard trees in high wind

3. Wear a hard hat when working in forested areas with overhead hazard potential
4. If a hazard tree is identified, flag it and report it to the field lead; do not attempt to remove it

8.4. Sharp Tools

When using hand saws, loppers, pruners, or other cutting tools:

- Keep blades sheathed while walking
- Pass tools handle-first; never toss tools
- Never carry open blades through brush
- Wear cut-resistant gloves when operating cutting tools

8.5. Biotic Hazards

8.5.1. Poison Oak

Wear long sleeves, long pants, and gloves when working in potential poison oak habitat. Learn to identify the plant. Wash exposed skin with soap and water as soon as possible after potential contact. Do not burn plant material that may contain poison oak.

8.5.2. Ticks

Wear long pants tucked into socks and long sleeves. Use permethrin- treated clothing or DEET-based repellent in tick habitat. Perform a full-body tick check at the end of every field day. Remove attached ticks promptly with fine-tipped tweezers.

8.5.3. Stinging Insects

Know whether any team member has a history of anaphylaxis. Ensure that at least one team member knows the location of any prescribed epinephrine auto-injectors (EpiPens) in the group. Call 911 immediately if anaphylaxis is suspected.

8.5.4. Wildlife

Do not approach, feed, or attempt to handle wildlife. Report unusual wildlife behavior (particularly in mammals that could indicate rabies) to the field lead.

9. Emergency Response Procedure

9.1. Responding to a Medical Emergency

1. Survey the scene; identify any risks to other team members
2. Do not move the injured person unless they are in immediate danger

3. Call 911; provide the following information:
 - Suspected type of injury or illness
 - Location (GPS coordinates if known; nearest landmark otherwise)
 - Type of assistance required
 - Number of persons injured
4. Identify a location for emergency vehicle access and send someone to meet the vehicle
5. Notify the PI or instructor as soon as possible (Pomona College, 2024)

9.2. Chronic Conditions

Personnel with chronic conditions (epilepsy, diabetes, heart conditions, severe allergies) must inform the field lead before each field outing. The field lead will ensure the team knows relevant first aid steps and the location of any required medications.

9.3. Injury from Equipment

Handle all equipment with caution. Read operating procedures before use. Do not use any equipment you are unsure of how to handle – ask a trained team member first.

9.4. Documenting the Incident

- Record what happened and how the injury or illness occurred in the field notebook
- Complete a formal incident report and submit it to the PI and the college risk management office within 24 hours
- This information is used to eliminate hazards and prevent future incidents (Pomona College, 2024)

10. Stop-Work Conditions

Stop all field operations immediately if any of the following occur:

- Lightning is detected within about 10 miles, or thunder is audible
- Wind is sustained above 25 mph (above 20 mph when working near trees or other overhead hazards)
- A crew member shows signs of heat illness, injury, or allergic reaction
- An unexpected utility or buried line is found within the work zone
- Crew size drops below the two-person minimum

Resume only when the field lead confirms conditions are safe (Occupational Safety and Health Administration, 2012).

11. References

- Occupational Safety and Health Administration (2012)
- National Research Council (2011)
- Pomona College (2024)

National Research Council. (2011). *Prudent practices in the laboratory: Handling and management of chemical hazards* (Updated). National Academies Press. <https://doi.org/10.17226/12654>

Occupational Safety and Health Administration. (2012). *Laboratory safety guidance* (OSHA 3404-11R). US Department of Labor.

Pomona College. (2024). *Emergency instructions*. <http://www.pomona.edu/sites/default/files/emergency-instructions.pdf>

12. Related SOPs

SOP	Title	Relationship
F002	Field Equipment Checklist	Supplies required for safe field work
F003	Field Notebook Protocols	Incident documentation
F004	Site Access and Permits	Site-specific hazard requirements
F100	EA Program Vehicle Use	Transportation safety

13. Training Record

Training is documented in EA Program files. Before conducting independent field work, personnel must:

1. Read this SOP in full
2. Attend a field safety orientation with the PI or field lead
3. Demonstrate understanding of the stop-work conditions and emergency response procedure
4. Be signed off by the instructor or designated trainer

14. Appendix A: Field Work Planning Form

Complete this form before each field outing and retain it in the project file.

Project / Site Name: _____

Date: _____ **Departure time:** _____ **Expected return:** _____

Field Lead: _____

Team Members: _____

Emergency Contacts: _____

Name	Role	Phone
911	Emergency	911
Campus Safety	Pomona College	(909) 621-8170
PI / Instructor		

Nearest Hospital / Urgent Care:

Name: _____ Address: _____ Phone: _____

Location / GPS of field site: _____

Hazards identified at this site:

- ☐ Lightning / thunderstorm risk
- ☐ Extreme heat
- ☐ High wind / overhead hazard trees
- ☐ Poison oak
- ☐ Ticks
- ☐ Stinging insects / known anaphylaxis in team
- ☐ Swift water / drowning risk
- ☐ Wildlife
- ☐ Other: _____

Risk Mitigation Plan: _____

PI / Supervisor Approval: _____ **Date:** _____



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F002

Field Equipment Checklist

Standard Operating Procedure

SOP Number	SOP-F002
Revision	1.2
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	1
2 Scope	1
3 Responsibilities	2
4 Definitions	2
5 References	2
6 Procedure	2
6.1 Before Departure	2
6.2 On Site	2
6.3 After Return	3
6.4 Storage Locations	3
7 Equipment Modules	3
7.1 Core Module (Every Field Outing)	3
7.2 Water Sampling Module	4
7.3 Soil Sampling Module	4
8 Related SOPs	4
9 Training Record	5

1. Purpose

This SOP provides standardized checklists for packing, verifying, and returning field equipment. Using a checklist before every field outing prevents forgotten items, reduces time lost in the field, and ensures that equipment is returned clean, functional, and ready for the next user. This SOP complements the safety and planning procedures in [SOP-F001 Field Safety](#) and the equipment inventory in [SOP-L007 Equipment Inventory](#).

2. Scope

- **Applies to:** All EA Program field outings, including research sampling events, class field trips, and equipment loans

- **Does not apply to:** Laboratory-only procedures; drone operations (see dedicated SOP when available)
- **Location:** Equipment stored in SGM 131, 132, 133, and 134; deployed to all EA field sites

3. Responsibilities

Role	Responsibility
Field Lead	Verify checklist completion before departure; confirm equipment return
Trained Personnel	Pack and check equipment; clean and return after use
New Students	Assist with packing under supervision; learn storage locations

4. Definitions

Not applicable. This SOP covers logistical checklists using standard English equipment names that require no technical definition. For definitions of field measurement terms, consult the method-specific SOPs listed in Section 5 (Equipment Modules).

5. References

6. Procedure

6.1. Before Departure

1. Identify which **activity modules** (Section 5) apply to the planned field work. Most outings require the Core Module plus one or more activity-specific modules.
2. Print or copy the relevant checklists. Check off each item as it is packed.
3. For instruments requiring calibration (Eureka Manta2, pH meter), calibrate in the lab before packing. Record calibration results in the field notebook.
4. Verify that all batteries are charged (Crime-Lite, GPS, walkie-talkies) and that backup batteries are included.
5. Confirm cooler ice or ice packs are frozen and ready.
6. Complete the Field Work Planning Form in [SOP-F001](#), Section 13.
7. The field lead initials the checklist and confirms vehicle reservation per [SOP-F100](#) if applicable.

6.2. On Site

1. Unpack systematically; keep items organized to avoid loss.
2. At the end of the sampling event, re-check the checklist to confirm all items are accounted for before leaving the site.
3. Note any damaged or malfunctioning equipment on the checklist.

6.3. After Return

1. Clean all equipment per the relevant method SOP (rinse sampling equipment with DI water, wipe down instruments, dry sieves).
2. Return every item to its designated storage location (see room assignments below and [SOP-L007](#)).
3. Recharge batteries and replace consumables (sample bottles, filters, preservatives) for the next user.
4. Report any damaged, lost, or malfunctioning items to the field lead or lab manager immediately.
5. File the completed checklist with the field data sheets.

6.4. Storage Locations

Storage Room	Equipment Category
SGM 131	Tapes, sieves, survey scopes, infiltrometers, walkie-talkies
SGM 132	Vehicles, coolers, generators
SGM 133	Sampling bottles, sondes, VanDorn bottles, LiCor sensor, microscope, analytical instruments
SGM 134	DI water system, glassware, vacuum filtration supplies

7. Equipment Modules

7.1. Core Module (Every Field Outing)

This checklist applies to every field trip regardless of activity type.

Item	Storage	Check
Completed Field Work Planning Form (SOP-F001)	–	☐
Field notebook (Rite in the Rain) and pens	SGM 133	☐
Cell phone, charged, with emergency contacts	Personal	☐
First aid kit	In vehicle	☐
Sunscreen and sun hat	Personal	☐
Full water bottles (one per person)	Personal	☐
Nitrile gloves (box)	SGM 133	☐
GPS unit or smartphone with GPS app	SGM 133	☐
Camera (or phone camera)	Personal	☐
Vehicle keys and fuel card	In vehicle	☐
Walkie-talkies (if splitting into groups)	SGM 131	☐
Trash bag (leave no trace)	–	☐
Clipboard	SGM 133	☐

7.2. Water Sampling Module

Use for surface water grab sampling, stormwater sampling, and bacteria sampling. See [SOP-F300](#) and [SOP-F302](#).

Item	Storage	Check
Pre-labeled sample bottles (poly and/or glass, with preservatives)	SGM 133	[]
Cooler with ice packs or ice	SGM 132	[]
Chain of custody (COC) forms	SGM 133	[]
Sample tags	SGM 133	[]
Extension pole with bottle attachment	SGM 133	[]
Sterile 100 mL Colilert bottles	SGM 133	[]
0.45 µm syringe filters and syringes	SGM 134	[]
Deionized water (squeeze bottle)	SGM 134	[]
Paper towels	SGM 134	[]
Field data sheets (water sampling)	SGM 133	[]
VanDorn bottle (if needed)	SGM 133	[]
Wading boots (if entering water)	Personal	[]

7.3. Soil Sampling Module

Use for soil profile description, bulk density, and grab samples. See [SOP-F400](#) and [SOP-F407](#).

Item	Storage	Check
Soil auger or hand trowel	SGM 131	[]
Pre-labeled Ziploc bags or Whirl-Pak bags	SGM 133	[]
Munsell color chart	SGM 131	[]
Soil core rings (bulk density)	SGM 131	[]
Rubber mallet	SGM 131	[]
Field data sheets (soil)	SGM 133	[]
Cooler with ice (perishable samples)	SGM 132	[]

8. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F003	Field Notebook Protocols	Notebook is on checklist
L007	Equipment Inventory	Storage locations
F100	EA Program Vehicle Use	Vehicle reservation

9. Training Record

Before leading a field outing independently, personnel must:

1. Read this SOP in full
2. Identify the correct storage room for each major equipment category
3. Complete a supervised pre-departure checklist for one field outing
4. Be signed off by the field lead or PI



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F003

Field Notebook Protocols

Standard Operating Procedure

SOP Number	SOP-F003
Revision	1.1
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 Notebook Selection and Preparation	3
5.1 Acceptable Notebooks	3
5.2 Front Matter	3
5.3 Page Numbering	3
6 Required Entries for Every Field Visit	4
6.1 Header Block	4
6.2 Time Stamps	4
6.3 Site Observations	4
6.4 Sample and Measurement Records	4
6.5 Equipment and Instrument Notes	5
6.6 Deviations from SOPs	5
6.7 Departure	5
7 Sketches and Diagrams	5
8 Photographs	6
8.1 When to Photograph	6
8.2 Photo Naming and Logging	6
9 Corrections and Errors	6
10 Chain of Custody	6
11 Notebook Archiving	7
12 References	7
13 Related SOPs	7

14 Training Record

7

1. Purpose

This SOP establishes the minimum standards for field documentation in the EA Program. Complete, legible, and contemporaneous field notes are the foundation of defensible environmental data (Kanare, 1985). Notes recorded in the field cannot be reconstructed later from memory; what is not written down at the time is effectively lost. This SOP ensures that every field visit produces a record sufficient for another trained researcher to understand what was done, where, when, by whom, and under what conditions.

For laboratory notebook requirements, see [SOP-L010 Laboratory Notebook Recording](#).

2. Scope

- **Applies to:** All EA Program field activities, including sampling, sensor deployment and retrieval, site reconnaissance, equipment installation, and monitoring visits.
- **Does not apply to:** Laboratory work or purely digital data collection on tablets and phones (though digital entries should follow the same content standards described here).
- **Location:** All EA Program field sites.

3. Responsibilities

Role	Responsibility
Lab PI	Set documentation standards; review notebooks periodically
Field Lead	Ensure all team members record required entries
All Field Personnel	Maintain a field notebook per this SOP
New Students	Read this SOP before their first field outing

4. Definitions

- **Chain of custody (COC):** A documented record of sample possession at every transfer point from collection to laboratory analysis; the COC form number must be cross-referenced in the field notebook entry for the corresponding samples.
- **Contemporaneous record:** An entry made at the time the observation or action occurs, not reconstructed from memory afterward; the defining characteristic of a legally defensible field or laboratory record (Kanare, 1985).
- **Deviation:** Any departure from a written SOP during field activities; must be recorded in the notebook with the reason for the deviation and an assessment of its potential effect on data quality.

- **Field notebook:** A bound, weather-resistant notebook with numbered pages used to record all field observations, measurements, and activities; the primary raw-data record for a field project (Kanare, 1985).
- **Good Documentation Practice (GDP):** A set of principles for creating accurate, legible, contemporaneous, original, and attributable records; the foundation of data integrity in regulated and research laboratories (Broman & Woo, 2018).
- **Header block:** A standardized set of fields (date, time, site, personnel, weather, purpose, SOPs in use) recorded at the top of each field visit entry before any observations or data are logged.
- **Rite in the Rain:** A brand of field notebook and paper products printed on water-resistant stock that can be written on with ballpoint or mechanical pencil even in rain; the preferred notebook format for EA Program field work.
- **Sample ID:** A unique alphanumeric code assigned to each sample at the moment of collection, cross-referencing the field notebook, sample label, COC form, and laboratory data file.
- **Tare mass:** Not applicable in field notebooks – see [SOP-L400 Soil Moisture](#).
- **Time stamp:** The date and time of a discrete field action, recorded in the notebook at the moment of the action; use ISO 8601 format (YYYY-MM-DD HH:MM) or a consistent AM/PM scheme throughout the notebook.

5. Notebook Selection and Preparation

5.1. Acceptable Notebooks

Use a bound, weather-resistant field notebook with numbered pages. Acceptable options include:

- Rite in the Rain (top-spiral or side-spiral, any size)
- Any hardbound notebook with numbered pages (if weather protection is not required for the site)

Do **not** use loose-leaf paper, spiral notebooks with perforated pages, or sticky notes for primary field records (Kanare, 1985).

5.2. Front Matter

On the inside front cover or first page of a new notebook, record:

- Your name, phone number, and email
- “If found, please return to: EA Program, Pomona College, SGM 133”
- Project name(s)
- Date the notebook was put into service

5.3. Page Numbering

If pages are not pre-numbered, number them in ink before going to the field. Never remove pages from a field notebook.

6. Required Entries for Every Field Visit

Every field visit entry must begin with the following header information. Write it before you do anything else on site.

6.1. Header Block

Record at the top of a new page or clearly separated section:

Field	Example
Date	2026-05-18 (ISO format: YYYY-MM-DD)
Time of arrival	08:15 PST
Site name / ID	Bernard Field Station, Plot BFS-03
GPS coordinates	34.0975 N, 117.7125 W (WGS84)
Personnel present	M. Los Huertos, J. Smith
Weather conditions	Clear, ~25 °C, light wind from W, no recent rain
Purpose of visit	Soil sampling for CN analysis; sensor download
SOPs in use	F400, F401, F510

6.2. Time Stamps

Record the time of every discrete action: sample collection, instrument reading, equipment start/stop, calibration check, photo taken. Use 24-hour format or AM/PM consistently throughout the notebook (Broman & Woo, 2018).

6.3. Site Observations

Before beginning work, note anything relevant:

- Visible changes since the last visit (new construction, vegetation removal, standing water, animal activity, vandalism, equipment condition)
- Odors or visual indicators of contamination
- Land use activities in progress nearby (mowing, irrigation, construction)

6.4. Sample and Measurement Records

For each sample collected or measurement taken, record at minimum:

- Sample ID (use the project's established naming convention)
- Time of collection or measurement
- Location (plot, transect position, depth, or other descriptor)
- Value or description (e.g., "pH = 7.2," "soil moist, dark brown, loamy texture")
- Preservation method applied (e.g., "filtered, acidified with HNO₃ to pH < 2")
- Container type and label verification

 Write More Than You Think You Need

Include observations that seem obvious at the time. “Soil was saturated and smelled of sulfide” or “sensor housing had a spider web across the inlet” may be critical for interpreting data months later (Kanare, 1985).

6.5. Equipment and Instrument Notes

Record for every instrument used:

- Instrument ID (serial number or lab asset tag)
- Calibration status (date of last calibration; field check performed?)
- Settings (logging interval, flow rate, method name)
- Any malfunctions, error messages, or anomalies

6.6. Deviations from SOPs

If you deviate from the standard procedure for any reason, record:

- What you did differently and why
- Whether the deviation may affect data quality
- Who authorized the deviation (if applicable)

6.7. Departure

Before leaving the site, record:

- Time of departure
- Summary of work completed and any work left undone
- Disposition of samples (e.g., “cooler with ice, to lab by 12:00”)
- Any follow-up actions needed

7. Sketches and Diagrams

A simple sketch is often more informative than a paragraph of text (Kanare, 1985). Include sketches of:

- Site layout showing sampling locations, landmarks, and compass orientation
- Equipment placement (sensor positions, transect layout, plot boundaries)
- Anything unusual (erosion features, spill boundaries, wildlife sightings relevant to the study)

Label all sketches with a north arrow, approximate scale, date, and your initials.

8. Photographs

8.1. When to Photograph

- At the start of every visit: a general site photo showing conditions
- Each sampling location before and after sampling
- Equipment installations and sensor positions
- Anything unusual or noteworthy (damage, contamination indicators, unexpected conditions)
- Calibration setups

8.2. Photo Naming and Logging

Record in the notebook the photo number or filename and a brief description for every photo taken:

“Photo IMG_4231: Plot BFS-03 looking NE, pre-sampling, 08:22”

Transfer photos to the project folder within 48 hours and rename using the convention:

YYYY-MM-DD_SiteID_Description_PhotoNumber.jpg

Back up photos to the project GitHub repository or shared drive (Broman & Woo, 2018).

9. Corrections and Errors

- Never erase, white-out, or obliterate an entry.
- To correct an error, draw a single line through the incorrect text so it remains legible. Write the correction nearby and initial and date the change.
- If you skip a page or leave blank space, draw a diagonal line through the unused area and initial it to prevent later additions (Kanare, 1985).

10. Chain of Custody

When samples will be submitted to an analytical laboratory (internal or external), complete a Chain of Custody (COC) form. The COC must accompany the samples and include:

- Project name and PI
- Sample IDs matching the field notebook entries
- Date and time of collection
- Number and type of containers
- Analyses requested
- Preservatives applied
- Signatures at each transfer (field to transport, transport to lab)

Record the COC form number in the field notebook entry for cross-reference. See [SOP-F008 Sample Labeling, COC, and Transport](#) for the full chain-of-custody procedure.

11. Notebook Archiving

- At the end of a field season or project, submit completed notebooks to the PI for archiving.
- Notebooks are stored in labeled binders in SGM 133 and must be retained for a minimum of 5 years after project completion.
- Transcribe key data from notebooks to digital spreadsheets within 48 hours of each field visit, following the tidy data principles in
 1. Flag any discrepancies between the notebook and the digital record and resolve them with the field lead.

12. References

- Kanare (1985)
- 1

Broman, K. W., & Woo, K. H. (2018). Data organization in spreadsheets. *The American Statistician*, 72(1), 2–10. <https://doi.org/10.1080/00031305.2017.1375989>

Kanare, H. M. (1985). *Writing the laboratory notebook*. American Chemical Society.

13. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F006	GPS and Site Navigation	Recording GPS coordinates
F008	Sample Labeling and COC	COC cross-referenced in notebook
L010	Lab Notebook Recording	Lab counterpart to this SOP
L801	RStudio and GitHub	Digital data file version control

14. Training Record

Before conducting any field work independently, personnel must:

1. Read this SOP in full
2. Set up a field notebook with correct front matter
3. Complete a practice header block entry under supervision
4. Demonstrate correct error-correction technique (single-line strikethrough, initials, date)
5. Be signed off by the PI or field lead



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F004

Site Access and Permits

Standard Operating Procedure

SOP Number	SOP-F004
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	1
2 Scope	2
3 Responsibilities	2
4 Definitions	2
5 General Principles	3
5.1 Planning Timeline	3
5.2 Permits You May Need Simultaneously	4
5.3 Permit Files	4
5.4 Insurance and Liability	4
6 Agency-Specific Procedures	4
6.1 Robert J. Bernard Biological Field Station (BFS)	4
6.2 California Department of Fish and Wildlife (CDFW)	5
6.3 California Department of Parks and Recreation (State Parks)	5
6.4 University of California Natural Reserve System (UCNRS)	6
6.5 U.S. Fish and Wildlife Service (USFWS)	6
6.6 Bureau of Land Management (BLM)	7
6.7 National Park Service (NPS)	8
6.8 USDA Forest Service (USFS)	8
7 Permit Decision Flowchart	9
8 References	9
9 Related SOPs	10
10 Training Record	10

1. Purpose

This SOP describes the procedures for obtaining site access and research permits for field work conducted by the EA Program. Field research on public or institutional lands almost always requires advance authorization (US Fish and Wildlife Service, 2019). Working without proper permits can

result in fines, confiscation of samples, invalidation of data, and jeopardized relationships with land managers. This document provides an agency-by-agency guide covering the landowners and managers most commonly encountered by EA Program researchers.

2. Scope

- **Applies to:** All EA Program field activities that take place on lands managed by the agencies and institutions listed in this SOP, including class field trips, independent student research, and faculty-led projects
- **Does not apply to:** Laboratory procedures; field work on private land (which requires landowner permission negotiated on a case-by-case basis); marine or offshore research (which may require additional permits from NOAA or the California Coastal Commission)
- **Key principle:** It is the responsibility of the PI (or the supervising faculty member) to determine what permits are required and to obtain all necessary approvals before any field work begins. Students should never assume that their faculty advisor has obtained permits – always confirm.

3. Responsibilities

Role	Responsibility
PI / Faculty	Identify required permits, submit applications, maintain permit files, ensure compliance with all permit conditions
Field Lead	Carry copies of active permits in the field; confirm permit status before each outing
Students	Verify that permits are in place before field work; follow all permit conditions; report any compliance issues to the PI

4. Definitions

- **BFS (Bernard Field Station):** An 86-acre biological reserve of The Claremont Colleges located at 1400 N. Amherst Avenue, Claremont, CA; administered by the BFS Director; all organized access requires an approved Use Request (Robert J. Bernard Biological Field Station, 2024).
- **CESA (California Endangered Species Act):** California state law (Fish and Game Code §2050 et seq.) that protects state-listed threatened and endangered species; take of CESA-listed species requires a separate Memorandum of Understanding from CDFW in addition to a Scientific Collecting Permit (California Department of Fish and Wildlife, 2024).
- **CDFW Scientific Collecting Permit (SCP):** A permit issued by the California Department of Fish and Wildlife authorizing the take or possession of wildlife for scientific, educational, or propagation purposes; required whenever research involves capturing, handling, marking, or collecting wildlife, or when take of sensitive species may occur incidentally (California Department of Fish and Wildlife, 2024).

- **ESA Section 10 permit:** A federal incidental take permit issued by the U.S. Fish and Wildlife Service under Section 10(a)(1)(A) of the Endangered Species Act; required for non-federal activities that involve take of federally listed threatened or endangered species (U.S. Fish and Wildlife Service, 2024).
- **ESA Section 7 consultation:** The formal interagency process under Section 7 of the Endangered Species Act through which a federal agency (e.g., USFS, BLM) consults with USFWS or NMFS to ensure that its authorized activities do not jeopardize listed species or destroy critical habitat.
- **Incidental take:** The unintentional, but not unexpected, harm to a listed species that results from an otherwise lawful activity; must be authorized through a Section 10 permit (private activities) or Section 7 consultation (federal activities).
- **NEPA (National Environmental Policy Act):** Federal law requiring federal agencies to assess the environmental impacts of their proposed actions; complex research proposals on federal lands may trigger NEPA review, substantially extending the permit processing timeline.
- **RAMS (Reserve Application Management System):** The online portal through which researchers and instructors apply for access to University of California Natural Reserve System reserves (University of California Natural Reserve System, 2024).
- **RPRS (Research Permit and Reporting System):** The National Park Service’s online system for submitting research permit applications, reporting annual activities, and communicating with park research coordinators (National Park Service, 2024).
- **Special Use Permit (SUP):** A general-purpose permit issued by federal land management agencies (BLM, USFS) authorizing a specific research project or activity on public lands; may take 60–120 days or more to process (Bureau of Land Management, 2024; USDA Forest Service, San Bernardino National Forest, 2024).
- **Take:** Under California Fish and Game Code §86, to hunt, pursue, catch, capture, or kill, or attempt to do so; under the federal ESA, to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to do so.
- **UC Natural Reserve System (UCNRS):** A network of 41+ reserves managed by the University of California for research, teaching, and public service; access requires an approved RAMS application (University of California Natural Reserve System, 2024).

5. General Principles

5.1. Planning Timeline

Permit processing times vary widely. Submit applications at least 60–90 days before the planned start of field work. Some agencies (particularly federal ones involving NEPA review or listed species) may require 6 months or more. Always confirm the current timeline with the specific office.

Agency / Institution	Typical Lead Time
Bernard Field Station	1–2 weeks
California State Parks	60–90 days
UC Natural Reserve System	2–4 weeks
CDFW (General Use SCP)	60–90 days
CDFW (Specific Use SCP)	3–6 months

Agency / Institution	Typical Lead Time
USFWS (Section 10)	3–12 months
BLM	60–120 days
National Park Service	60–120 days
USDA Forest Service	60–120 days

5.2. Permits You May Need Simultaneously

A single field project can require permits from multiple agencies. For example, sampling macroinvertebrates in a stream within a National Forest may require a USFS Special Use Permit, a CDFW Scientific Collecting Permit, and (if listed species are present) a USFWS Section 10 permit. The land management agency will typically not finalize its own permit until copies of all other required permits are submitted.

5.3. Permit Files

The PI must maintain a digital folder (in the EA Program Google Drive or GitHub repository) containing:

- Copies of all active permits (signed, final versions)
- Copies of all applications submitted
- Copies of annual reports and compliance documents submitted to agencies
- Expiration dates and renewal deadlines

Field leads must carry printed or digital copies of relevant permits during every field outing.

5.4. Insurance and Liability

Several agencies require proof of liability insurance as a condition of permit issuance. Pomona College maintains institutional liability coverage; contact the Office of Risk Management to obtain a Certificate of Insurance naming the specific agency as an additional insured party.

6. Agency-Specific Procedures

6.1. Robert J. Bernard Biological Field Station (BFS)

The BFS is an 86-acre facility of The Claremont Colleges located at 1400 N. Amherst Avenue, Claremont, CA. Access requires advance approval from the BFS Director (Robert J. Bernard Biological Field Station, 2024).

When a permit is needed: All research projects, class field trips, and organized activities on the BFS require a Use Request, even for Claremont Colleges faculty and students. Casual, unaccompanied pedestrian access also requires prior authorization.

How to apply:

1. Contact the BFS Director (Dr. Wallace M. Meyer III, wallace.meyer@pomona.edu, 909-621-8577) to discuss the proposed project
2. Complete the online “Apply to Use” form at <https://bfs.sites.pomona.edu/using-the-bfs/>
3. Allow 1–2 weeks for approval; more complex projects may require additional review

Website: <https://bfs.sites.pomona.edu/using-the-bfs/>

6.2. California Department of Fish and Wildlife (CDFW)

CDFW issues Scientific Collecting Permits (SCPs) for the take or possession of wildlife (mammals, birds, reptiles, amphibians, fish, certain plants, and invertebrates) for scientific, educational, and propagation purposes (California Department of Fish and Wildlife, 2024).

When a permit is needed: Any time your research involves capturing, handling, marking, or collecting wildlife – or when there is potential for incidental take of sensitive species.

Permit types:

- **General Use SCP** – for more common species, non-invasive methods, and areas outside Marine Protected Areas
- **Specific Use SCP** – for focused studies involving prohibited wildlife, more invasive methods, or sensitive locations including MPAs

How to apply:

1. Review the SCP regulations (Title 14, Section 650, CCR) and Standard Conditions at <https://wildlife.ca.gov/Licensing/Scientific-Collecting>
2. Apply online through the Scientific Collecting Permit Portal (SCPP)
3. Pay the required permit fee before issuance

CESA-listed species: Requires a separate CESA Memorandum of Understanding from CDFW in addition to the SCP.

Reporting: Each permit holder must submit a Mandatory Wildlife Report (form DFW 1379a) annually.

Website: <https://wildlife.ca.gov/Licensing/Scientific-Collecting>

6.3. California Department of Parks and Recreation (State Parks)

When a permit is needed: Any scientific research, data collection, specimen collection, or installation of monitoring equipment in California State Park System lands requires written authorization (California Department of Parks and Recreation, 2024).

How to apply:

1. Download and complete form DPR 65 from https://www.parks.ca.gov/?page_id=21557
2. Prepare a full study proposal following the Study Proposal Guidelines for Research in California State Parks
3. Submit the application, study proposal, proof of insurance, and copies of any other required permits (CDFW, USFWS, etc.) to the appropriate State Parks district office; for multi-district projects, submit to the Natural Resources Division in Sacramento at nrd.research@parks.ca.gov
4. Allow 60–90 days for processing

Reporting: A summary report of activities and findings must be submitted to State Parks; renewal is contingent on receipt of this report.

Website: https://www.parks.ca.gov/?page_id=21557

6.4. University of California Natural Reserve System (UCNRS)

The UCNRS manages 41+ reserves across California for research, teaching, and public service (University of California Natural Reserve System, 2024).

When a permit is needed: All research projects and class visits require an approved application through the Reserve Application Management System (RAMS).

How to apply:

1. Contact the reserve director(s) to discuss project requirements
2. Review the NRS Use Guidelines at <https://ucnrs.org/reserve-research-guidelines/>
3. Submit a research application through RAMS at <https://rams.ucnrs.org>
4. Once approved, submit a Reservation for each planned visit through RAMS

Special conditions:

- IACUC approval required if the project involves vertebrate animals
- Additional agency permits (CDFW, USFWS) may be required
- All equipment must be removed and sites restored at project conclusion

Website: <https://ucnrs.org/>

6.5. U.S. Fish and Wildlife Service (USFWS)

USFWS administers permits for activities involving species listed under the federal Endangered Species Act (ESA), migratory birds (Migratory Bird Treaty Act), and wildlife on National Wildlife Refuges (U.S. Fish and Wildlife Service, 2024).

When a permit is needed:

- Take of federally listed threatened or endangered species requires a Section 10(a)(1)(A) recovery permit
- Research involving migratory birds requires a federal Bird Banding Permit and/or Scientific Collecting Permit
- Research on National Wildlife Refuge lands requires a Special Use Permit from the refuge manager

How to apply:

1. For ESA-listed species: submit form 3-200-55 through the USFWS Endangered Species permits portal
2. For migratory birds: apply through the USFWS Bird Banding Laboratory or the federal permits portal
3. For refuge access: contact the specific refuge manager

Key considerations: Section 10 applications are subject to a 30-day Federal Register public comment period; processing times are 3–12 months. Annual reports are required for all active permits.

Website: <https://www.fws.gov/service/apply-permit>

6.6. Bureau of Land Management (BLM)

BLM manages extensive public lands in California, including desert, grassland, and mountain areas where EA Program research may occur (Bureau of Land Management, 2024).

When a permit is needed: Any organized research activity on BLM-managed lands, including specimen collection, installation of monitoring equipment, and systematic surveys.

How to apply:

1. Contact the nearest BLM Field Office at <https://www.blm.gov/office/directory>
2. BLM staff will determine whether a Special Recreation Permit, research authorization, or another approval type is needed
3. Submit required application materials (maps, project description, copies of other agency permits)
4. Allow 60–120 days; complex NEPA projects may take longer

Website: <https://www.blm.gov/learn/science-in-the-blm/conducting-science>

6.7. National Park Service (NPS)

NPS requires a Scientific Research and Collecting Permit for most scientific activities in any unit of the National Park System (National Park Service, 2024).

When a permit is needed: Any study in the natural or social sciences within a national park, monument, seashore, or other NPS unit.

How to apply:

1. Create an investigator account in the Research Permit and Reporting System (RPRS) at <https://irma.nps.gov/rprs/>
2. Locate the park profile in RPRS and contact the research coordinator for park-specific conditions
3. Submit the application through RPRS; allow 60–120 days
4. Annual reports are submitted through RPRS

Website: <https://www.nps.gov/subjects/science/research-and-collecting-permit-overview.htm>

6.8. USDA Forest Service (USFS)

USFS manages National Forest System (NFS) lands through local Ranger District offices (USDA Forest Service, San Bernardino National Forest, 2024).

When a permit is needed: Any organized research activity on NFS lands, including specimen collection, installation of monitoring equipment, and systematic surveys.

How to apply:

1. Contact the Ranger District office for the relevant National Forest (for Southern California: San Bernardino, Angeles, Cleveland, or Los Padres)
2. Download and complete a Research Special-Use Operating Plan/Itinerary from the forest's website and submit it to the district permit coordinator
3. Forest staff will determine whether a full Special Use Permit or a Research Permit Waiver is appropriate
4. Allow 60–120 days; projects requiring NEPA analysis may take longer

Special conditions:

- Projects involving wildlife or threatened/endangered plants may require additional CDFW and/or USFWS authorization
- A summary of findings must be provided to the Forest Service upon completion

Website: <https://www.fs.usda.gov/>

7. Permit Decision Flowchart

Use the following steps to determine what permits you need:

1. **Identify the land manager.** Who owns or manages the land where you will work?
2. **Obtain the land access permit** from the land manager (Sections 5.1–5.8 above).
3. **Will you handle, capture, collect, or disturb wildlife?** If yes, you likely need a CDFW Scientific Collecting Permit (§5.2).
4. **Are any federally listed species present, or could they be incidentally encountered?** If yes, you likely need a USFWS Section 10 permit or ESA Section 7 consultation (§5.5).
5. **Are any state-listed species (CESA) present?** If yes, you need a CESA MOU from CDFW in addition to the SCP (§5.2).
6. **Does the land manager require other agency permits before issuing its own?** If yes, obtain those permits first and submit copies with your land access application.

 When in doubt, ask

If you are unsure whether a permit is required, contact the agency before beginning field work. It is always better to ask in advance than to be stopped in the field or have your data and specimens invalidated.

8. References

- California Department of Fish and Wildlife (2024)
- California Department of Parks and Recreation (2024)
- Robert J. Bernard Biological Field Station (2024)
- University of California Natural Reserve System (2024)
- U.S. Fish and Wildlife Service (2024)
- Bureau of Land Management (2024)
- National Park Service (2024)
- USDA Forest Service, San Bernardino National Forest (2024)
- US Fish and Wildlife Service (2019)

Bureau of Land Management. (2024). *Conducting science on BLM lands*. <https://www.blm.gov/learn/science-in-the-blm/conducting-science>

California Department of Fish and Wildlife. (2024). *Scientific collecting permits*. <https://wildlife.ca.gov/Licensing/Scientific-Collecting>

California Department of Parks and Recreation. (2024). *Scientific research and collecting on state park system lands*. https://www.parks.ca.gov/?page_id=21557

National Park Service. (2024). *Research and collecting permit overview*. <https://www.nps.gov/subjects/science/research-and-collecting-permit-overview.htm>

Robert J. Bernard Biological Field Station. (2024). *Rules for use and apply to use*. <https://bfs.sites.pomona.edu/using-the-bfs/>

University of California Natural Reserve System. (2024). *Reserve research guidelines*. <https://ucnrs.org/reserve-research-guidelines/>

U.S. Fish and Wildlife Service. (2024). *Endangered species act section 10: Incidental take permits*. <https://www.fws.gov/service/apply-permit>

US Fish and Wildlife Service. (2019). *Quality assurance project plan for eDNA monitoring of bighead and silver carps*. USFWS, Midwest Fisheries Center. <https://www.fws.gov/project/environmental-dna-edna>

USDA Forest Service, San Bernardino National Forest. (2024). *Research and collection permits*. <https://www.fs.usda.gov/r05/sanbernardino/permits/research-and-collection-permits>

9. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required reading before any field work
F002	Field Equipment Checklist	Carry permit copies in field kit
F007	Field Decontamination	Required by many agency permits
F610	Macroinvertebrate Sampling	Typically requires CDFW SCP
F700	eDNA Field Sampling	May require CDFW SCP for target taxa

10. Training Record

Before leading field work on any permitted site, personnel must:

1. Read this SOP in full
2. Identify all permits required for their specific project and site
3. Confirm with the PI that all permits are active and in hand
4. Know where to find copies of active permits (digital and/or printed)
5. Understand the reporting requirements for each active permit
6. Be signed off by the PI or designated field lead



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F005

Random Sampling Design

Standard Operating Procedure

SOP Number	SOP-F005
Revision	1.1
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	1
2 Scope	1
3 Responsibilities	1
4 Safety and Hazards	1
4.1 Required PPE	1
4.2 Emergency Procedures	2
5 Definitions	2
6 Required Materials	2
7 Biases and Interferences	3
8 Procedure	3
8.1 Generating Random Numbers	3
8.2 Simple Random Sampling	4
8.3 Grid-Based Random Sampling (Field)	4
8.3.1 Establishing the Baseline Grid	4
8.3.2 Generating Coordinates and Placing Quadrats	5
8.3.3 Recording Data Within Quadrats	5
8.4 Stratified Random Sampling	6
8.5 Map-Based Sampling with Exclusion Zones	6
9 Data Management	6
10 References	7
11 Related SOPs	7
12 Training Record	7

1. Purpose

This SOP provides standardized procedures for designing and executing random sampling in field and laboratory settings. Random sampling ensures that every unit in the target population has an equal and independent probability of selection, eliminating researcher bias and supporting valid statistical inference (Elzinga et al., 1998; Krebs, 1999).

2. Scope

- **Applies to:** Any EA Program study where population estimates are the goal, including vegetation surveys, soil sampling, water quality monitoring, and laboratory subsampling
- **Does not apply to:** Targeted or judgmental sampling designs (e.g., hot-spot investigations); mark-release-recapture studies for mobile organisms (see separate SOP)
- **Sampling types covered:** Simple random sampling, grid-based random sampling, and stratified random sampling

3. Responsibilities

Role	Responsibility
PI / Field Lead	Approve sampling design, review sampling plan
Trained Personnel	Execute random selection, collect and record data
New Students	Complete training before independent fieldwork

4. Safety and Hazards

Hazards

Field sampling involves site-specific hazards including uneven terrain, heat exposure, wildlife encounters, and sharp equipment (stakes, pins). Review site conditions before each sampling event.

4.1. Required PPE

- ☐ Closed-toe shoes or boots
- ☐ Sun protection (hat, sunscreen)
- ☐ Gloves (when handling equipment or samples)

4.2. Emergency Procedures

Refer to [SOP-F001 Field Safety](#). Carry a first aid kit and charged cell phone to all field sites.

5. Definitions

- **Border rule:** A convention for counting organisms that overlap a quadrat edge; the standard rule is to count organisms touching the top and right edges and exclude those touching the bottom and left edges; must be applied consistently within a study to avoid double-counting (Elzinga et al., 1998).
- **Grid-based random sampling:** A method in which a coordinate grid is laid over the study area and quadrat locations are selected using randomly generated X and Y coordinates; the standard approach for quadrat-based ecological surveys (Elzinga et al., 1998).
- **Power analysis:** A calculation to determine the minimum sample size (n) needed to detect a biologically meaningful effect with acceptable Type I error (α) and Type II error (β) probability; should be completed before fieldwork begins (Krebs, 1999).
- **Quadrat:** A square frame of known area (typically 0.25, 0.5, or 1.0 m²) used to delineate sampling units in the field (Elzinga et al., 1998).
- **Sampling frame:** A numbered list or spatial grid that enumerates every unit in the population; units missing from the frame have zero probability of selection and introduce bias (Krebs, 1999).
- **Sampling universe (population):** The complete set of units from which a sample will be drawn; must be explicitly defined before generating a sampling frame (Krebs, 1999).
- **Simple random sampling:** A design in which n units are selected at random from a numbered list (sampling frame) such that every possible combination of n units has an equal probability of selection; appropriate when the population is homogeneous (Krebs, 1999).
- **Stratified random sampling:** A design in which the population is divided into internally homogeneous subgroups (strata) and random samples are drawn independently from each stratum; reduces variance compared to simple random sampling when strata differ from each other (Elzinga et al., 1998; Krebs, 1999).
- **Stratum:** A subdivision of the sampling universe into zones that are internally homogeneous (e.g., by elevation band, vegetation type, or soil moisture class); the basis for stratified random sampling.

6. Required Materials

Item	Notes
Two survey tape measures (20–50 m)	For establishing coordinate grids
Ground pins or stakes	To anchor tape measures
Quadrat frame(s)	Size appropriate to target organisms
Random number generator app or R	See §8.1
GPS unit	To record sampling locations
Field data sheets and waterproof markers	Pre-printed with site and date fields
Compass	For establishing grid orientation
Field identification guides	If sampling vegetation or organisms

7. Biases and Interferences

Representative sampling requires strict adherence to randomized procedures. Common sources of bias include:

- **Incomplete sampling frames.** Any unit missing from the frame has zero probability of selection (Krebs, 1999).
- **Haphazard placement.** Never “throw” a quadrat to choose a location; human throws cluster toward the center of the area, violating equal probability assumptions (Elzinga et al., 1998).
- **Environmental heterogeneity.** If the study area contains distinct gradients, simple random sampling may under-represent one end. Use stratified random sampling instead (§8.4).
- **Edge effects.** Establish and apply a consistent border rule when counting organisms in quadrats (§8.3).

8. Procedure

8.1. Generating Random Numbers

Use a software-based random number generator to produce unbiased selections. Never rely on manual or mental number selection (Krebs, 1999).

In R, generate a set of random integers within a defined range:

```
# Generate 15 random integers between 1 and 100
set.seed(NULL) # ensure a fresh seed each session
random_vals <- sample(1:100, size = 15, replace = FALSE)
sort(random_vals)
```

```
[1] 3 9 12 15 20 35 44 51 59 63 66 75 78 84 100
```

For field use without a computer, a printed random number table is acceptable. Begin at a pre-selected (arbitrary) starting position and read values sequentially. Table 1 provides a reference table of 200 random numbers between 0 and 1000.

Table 1: Reference table of 200 random numbers (0–1000)

1	2	3	4	5	6	7	8	9	10
924.2	634.1	556.0	247.2	144.7	912.8	778.9	886.8	4.8	373.9
537.2	379.9	597.8	374.3	856.6	972.9	414.4	848.9	367.1	208.8
469.2	942.1	197.0	595.3	509.7	56.6	574.1	244.4	943.6	610.2
288.6	755.0	79.2	751.2	920.4	192.6	399.1	194.8	98.3	188.4
770.1	227.6	971.5	722.2	232.8	578.3	91.7	278.5	457.4	21.5
772.8	914.7	509.7	470.0	195.0	28.6	174.7	224.9	523.8	710.5
39.3	620.4	49.7	176.0	152.5	491.3	525.4	49.3	529.7	164.2

Table 1: Reference table of 200 random numbers (0–1000)

1	2	3	4	5	6	7	8	9	10
434.9	319.1	675.4	111.4	165.3	589.5	345.6	973.2	740.5	826.2
472.2	76.3	776.3	616.9	367.0	55.5	827.1	965.7	508.6	166.7
273.8	260.8	753.4	667.2	85.9	0.5	638.3	696.6	490.0	417.1
674.3	883.8	524.8	999.1	866.6	152.6	594.7	998.7	515.1	667.4
2.0	17.5	883.5	690.5	647.1	48.2	198.4	445.5	535.9	512.7
25.1	314.9	348.6	152.1	519.7	942.0	314.5	224.7	833.1	369.5
432.1	211.8	638.2	878.3	543.3	179.5	228.5	574.9	528.1	357.5
499.4	906.2	737.8	973.9	837.4	931.0	700.3	439.8	755.1	90.1
388.7	650.0	287.8	373.8	126.8	600.6	194.7	755.6	212.7	156.0
395.4	129.3	192.8	390.5	820.9	411.9	767.0	731.3	367.1	195.0
715.7	110.4	978.7	523.3	213.6	109.2	442.0	294.0	190.1	783.1
941.0	177.1	539.3	412.3	886.2	366.6	206.3	524.7	367.8	187.4
827.2	533.1	923.0	932.7	174.4	314.6	426.2	43.7	861.6	117.3

8.2. Simple Random Sampling

Use this approach when the population can be enumerated as a list (e.g., lab samples, batch numbers, individual organisms in a database) (Krebs, 1999).

1. Define the target population and compile a complete, numbered sampling frame.
2. Determine the required sample size (n) using a power analysis.
3. Use `sample()` in R to draw n unit numbers without replacement.
4. Document the random seed (if reproducibility is desired), the selected unit IDs, and the date of selection.
5. Collect the data or specimens from the selected units.

8.3. Grid-Based Random Sampling (Field)

Use this approach when the sampling universe is a spatially defined area (Elzinga et al., 1998).

8.3.1. Establishing the Baseline Grid

1. Locate the boundaries of the study site.
2. Drive a stake at the origin point and lay two tape measures at 90 degrees to create X and Y axes.
3. Secure the tapes with ground pins to define a coordinate grid (e.g., 20 m $\times$ 20 m).

8.3.2. Generating Coordinates and Placing Quadrats

4. Generate pairs of random integers within the range of each axis:

```
x_max <- 20; y_max <- 20; n_quadrats <- 15
coords <- data.frame(
  X = sample(0:x_max, size = n_quadrats, replace = TRUE),
  Y = sample(0:y_max, size = n_quadrats, replace = TRUE)
)
coords <- coords[order(coords$X), ]
coords$QuadratID <- seq_len(nrow(coords))
knitr::kable(coords, row.names = FALSE)
```

X	Y	QuadratID
0	2	1
1	7	2
2	4	3
4	17	4
7	4	5
7	11	6
7	3	7
8	8	8
8	10	9
9	18	10
13	0	11
17	18	12
17	1	13
18	0	14
18	16	15

5. Walk along the axes to each coordinate intersection and place the bottom-left corner of the quadrat at that point.
6. Never reposition a quadrat after placement; if a coordinate falls on an obstruction, record the obstruction and sample as-is (Elzinga et al., 1998).

8.3.3. Recording Data Within Quadrats

7. Quantify the target variable using one of three standardized metrics:
 - **Density:** Count every individual within the frame
 - **Percent cover:** Estimate the fraction of ground area covered
 - **Frequency:** Score presence (1) or absence (0)
8. Apply the border rule consistently (§4).
9. Aim to sample at least 5–10% of total grid area, or a minimum of 30 quadrat placements, for adequate statistical power (Krebs, 1999).
10. Calculate the mean count (or cover) per quadrat and extrapolate:

$$\text{Estimated population} = \bar{x}_{\text{quadrat}} \times \frac{\text{Total site area}}{\text{Area of one quadrat}}$$

8.4. Stratified Random Sampling

Use this approach when the study area contains distinct environmental gradients that would increase variance under simple random sampling (Elzinga et al., 1998; Krebs, 1999).

1. Divide the study area into homogeneous strata based on a relevant environmental variable.
2. Within each stratum, establish an independent coordinate grid following §8.3.
3. Generate random coordinates separately for each stratum.
4. Sample each stratum independently; do not pool random selections across strata.
5. Weight stratum means by the proportion of total area each stratum represents when calculating site-level estimates.

8.5. Map-Based Sampling with Exclusion Zones

1. Obtain or create a georeferenced map of the study area.
2. Delineate exclusion zones and calculate the remaining accessible area.
3. Generate random coordinates across the full extent, then discard any that fall within exclusion zones.
4. Continue generating coordinates until the target sample size is met within the accessible area.
5. Record discarded coordinates in the sampling log.

R Implementation

An R script for map-based random sampling with exclusion polygons can be built using the `sf` package. Generate random points with `sf::st_sample()`, then filter against exclusion polygons with `sf::st_difference()`.

9. Data Management

1. Record all sampling metadata (date, site, grid dimensions, random seed or table starting position, personnel) on the field data sheet.
2. Enter field data into the project database within 48 hours.
3. Archive original data sheets (scan if paper).
4. Version-control all analysis scripts per [SOP-L801 RStudio and GitHub](#).

10. References

- Krebs (1999)
- Elzinga et al. (1998)
- 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.

Elzinga, C. L., Salzer, D. W., & Willoughby, J. W. (1998). *Measuring and monitoring plant populations* (BLM Technical Reference 1730-1). Bureau of Land Management.

Krebs, C. J. (1999). *Ecological methodology* (2nd ed.). Benjamin Cummings.

11. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F006	GPS and Site Navigation	Navigate to random points
F603	Vegetation Transect Surveys	Applies this sampling design

12. Training Record

Before designing or executing random sampling independently, personnel must:

1. Read this SOP in full
2. Complete [SOP-F001 Field Safety](#) training
3. Demonstrate proficiency with random number generation in R
4. Participate in a supervised field sampling session using the grid-based procedure
5. Be signed off by the PI or field lead



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F006

GPS and Site Navigation

Standard Operating Procedure

SOP Number	SOP-F006
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	1
2 Scope	2
3 Responsibilities	2
4 Definitions	2
5 Safety and Hazards	3
5.1 Required PPE	3
5.2 Emergency Procedures	3
6 Equipment and Materials	3
7 Procedure	4
7.1 Pre-Field Setup	4
7.2 Recording Waypoints in the Field	4
7.3 Waypoint Naming Convention	4
7.4 Navigating to Existing Waypoints	5
7.5 Post-Field Data Management	5
8 Quality Control	5
9 References	5
10 Related SOPs	6
11 Training Record	6

1. Purpose

This SOP describes standardized procedures for recording geographic coordinates, navigating to field sites, and managing waypoint data. Accurate and consistent location data are essential for linking field observations to spatial analyses, returning to the same sampling points across seasons, and sharing site information among researchers. This SOP covers handheld GPS receivers, smartphone GPS applications, and post-field data management (U.S. Forest Service, 2012).

2. Scope

- **Applies to:** All EA Program field activities that require geographic coordinates, including sample collection, transect establishment, monitoring well location, equipment installation, and site reconnaissance
- **Does not apply to:** High-precision survey-grade GNSS work (sub-centimeter accuracy); drone-based georeferencing (see [SOP-F630](#)); GIS post-processing and spatial analysis (see future SOP-L804)
- **Location:** All EA Program field sites

3. Responsibilities

Role	Responsibility
PI / Field Lead	Approve coordinate system and datum for each project
Trained Personnel	Record waypoints per this SOP, upload data after fieldwork
New Students	Complete training before independent use

4. Definitions

- **Datum:** A mathematical model of the Earth's surface used as the reference for geographic coordinates; the EA Program default is **WGS 84** (World Geodetic System 1984), the datum used by consumer GPS and Google Maps; NAD 83 is nearly identical for most field purposes but must be specified explicitly if used (U.S. Forest Service, 2012).
- **Decimal degrees (DD):** A coordinate format expressing latitude and longitude as a single decimal number (e.g., 34.0975 N, 117.7125 W); the EA Program default format; preferred for data entry in spreadsheets and GIS.
- **GNSS (Global Navigation Satellite System):** The general term for satellite-based positioning systems; includes the US GPS, Russian GLONASS, European Galileo, and Chinese BeiDou constellations; modern receivers use multiple constellations simultaneously to improve accuracy.
- **GPS (Global Positioning System):** The US-operated GNSS constellation of 31+ satellites; provides horizontal accuracy of 3–5 m under open sky with a modern consumer receiver (U.S. Forest Service, 2012).
- **GPX file:** A standard XML-based file format for exchanging GPS waypoints, tracks, and routes between devices and software; the preferred export format for EA Program waypoints.
- **HDOP (Horizontal Dilution of Precision):** A dimensionless number indicating GPS positional uncertainty due to satellite geometry; values below 2 indicate excellent geometry; values above 5 indicate poor geometry and reduced accuracy (U.S. Forest Service, 2012).
- **Offline map:** A map tile set downloaded to a smartphone or device before the field visit, enabling navigation without cellular data; required for EA Program field sites with unreliable coverage.
- **UTM (Universal Transverse Mercator):** A projected coordinate system that divides the world into 60 zones and expresses positions in meters east (easting) and north (northing) of a zone origin; useful for measuring distances directly but requires specifying the UTM zone.

- **Waypoint:** A named, saved geographic location stored in a GPS receiver or smartphone app; defined by coordinates (latitude, longitude, and optionally elevation), a name, and often a description or icon.
- **WGS 84 (World Geodetic System 1984):** The global coordinate datum used by GPS satellites, Google Maps, and most modern consumer GPS devices; the EA Program default (U.S. Forest Service, 2012).

5. Safety and Hazards

Hazards

- **Physical:** Navigating to remote waypoints may involve uneven terrain, dense vegetation, or stream crossings. Do not fixate on the GPS screen while walking.
- **Environmental:** Reliance on GPS in areas with poor satellite coverage (dense canopy, steep canyons) can lead to navigation errors. Always carry a paper map or site sketch as a backup.

5.1. Required PPE

- ☐ Closed-toed shoes or field boots
- ☐ Sun protection (hat, sunscreen)

5.2. Emergency Procedures

Refer to [SOP-F001 Field Safety](#). If lost or disoriented, stop moving, note your last known coordinates, and contact the field lead by phone or walkie-talkie.

6. Equipment and Materials

Item	Notes
Handheld GPS receiver (Garmin or equivalent)	Check battery level; carry spare batteries (Garmin International, 2019)
Smartphone with GPS app	Avenza Maps, Gaia GPS, or similar app with offline map capability (Avenza Systems, 2024)
Backup paper map or site sketch	Annotated with known landmarks and access roads
Field notebook	For recording waypoint IDs and descriptions
USB cable or Bluetooth adapter	For downloading waypoints to a computer
Spare batteries (AA or rechargeable)	Matched to the GPS unit model

7. Procedure

7.1. Pre-Field Setup

1. Confirm the coordinate system and datum for the project. The EA Program default is **WGS 84, latitude/longitude in decimal degrees** (U.S. Forest Service, 2012). If a project requires UTM or NAD 83, configure the device accordingly and note the setting in the field notebook.
2. On a handheld GPS, verify the datum setting: navigate to Setup > Position Format and confirm WGS 84 (Garmin International, 2019).
3. On a smartphone app, enable offline maps for the study area. Do not rely on cellular data for map tiles in the field (Avenza Systems, 2024).
4. Clear or archive old waypoints from the device so the day's data are easy to identify.
5. Pre-load target waypoints if revisiting known sites. Use the naming convention described in §6.3.

7.2. Recording Waypoints in the Field

1. At the sampling location, hold the GPS receiver at chest height in an open area away from dense canopy, cliff faces, and vehicles.
2. Wait until the GPS reports an accuracy of 5 m or better ($\text{HDOP} < 2$ preferred). If accuracy remains above 5 m after two minutes, record the waypoint and note the reported accuracy in the field notebook (U.S. Forest Service, 2012).
3. Save the waypoint using the naming convention in §6.3.
4. In the field notebook, record:
 - Waypoint name
 - Date and time
 - Coordinates (as displayed on the device)
 - Reported accuracy (HDOP or meters, as available)
 - A brief description (e.g., “upstream riffle, transect 3 start”)
5. If using a smartphone, take a screenshot of the GPS display as a backup record.

7.3. Waypoint Naming Convention

Use the following format: `SITE_TYPE_NN`

- **SITE** = three- or four-letter site abbreviation (e.g., BFS, THW, MRW)
- **TYPE** = two-letter code for the point type (see table below)
- **NN** = sequential two-digit number

Code	Point Type	Example
WQ	Water quality sampling	BFS_WQ_01
SO	Soil sampling	THW_SO_03

Code	Point Type	Example
TR	Transect endpoint	MRW_TR_01
WL	Monitoring well	BFS_WL_02
RF	Reference / benchmark	THW_RF_01
GN	General / other	MRW_GN_05

If a project requires a different convention, document it in the project README and field notebook.

7.4. Navigating to Existing Waypoints

1. Load the target waypoint on the GPS receiver or smartphone app.
2. Use the “Navigate” or “Go To” function. Follow the bearing indicator, checking your surroundings periodically.
3. When the GPS indicates you are within the reported accuracy of the waypoint, look for physical markers (flagging, rebar, painted rocks) to confirm the exact location.
4. If the physical marker cannot be found, record a new waypoint at the location you judge to be correct and note the discrepancy in the field notebook.

7.5. Post-Field Data Management

1. Download waypoints from the GPS receiver to the project computer within 48 hours of returning from the field.
2. Export waypoints as a `.gpx` or `.csv` file and save to the project GitHub repository under `data/gps/`.
3. Use the file naming convention: `YYYY-MM-DD_SiteID_waypoints.gpx`
4. Verify that waypoint names match the field notebook entries. Correct any discrepancies before committing the file.
5. Back up the raw GPS file to the lab shared drive.

8. Quality Control

- Compare GPS coordinates against known benchmarks or previously recorded waypoints when revisiting sites. Discrepancies greater than 10 m should be investigated and noted (U.S. Forest Service, 2012).
- At least once per semester, verify the GPS receiver against a known benchmark (e.g., a USGS survey marker or campus reference point).
- Record the GPS model, serial number, and firmware version in the field notebook at the start of each project.

9. References

- Garmin International (2019)
- Avenza Systems (2024)

- U.S. Forest Service (2012)

Avenza Systems. (2024). *Avenza maps user guide*. <https://support.avenzamaps.com>

Garmin International. (2019). *GPSMAP 66 series owner's manual*. <https://www8.garmin.com/manuals/webhelp/gpsmap66st/EN-US/GUID-BF2E4F90-EB9F-4A7D-A94E-52614D3B9D05-homepage.htm>

U.S. Forest Service. (2012). *Field data collection with GPS: A best practices guide* (Gen. Tech. Rep. RMRS-GTR-289). USDA Forest Service, Rocky Mountain Research Station. <https://www.fs.usda.gov/research/treesearch/43085>

10. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F003	Field Notebook Protocols	Waypoint data recorded in notebook
F005	Random Sampling Design	GPS used to navigate to random points

11. Training Record

Before using GPS equipment independently, personnel must:

1. Read this SOP in full
2. Demonstrate proper waypoint recording (datum check, accuracy verification, naming convention) during a supervised field visit
3. Successfully download and export waypoints to the project repository
4. Be signed off by the PI or field lead



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F007

Field Decontamination Protocols

Standard Operating Procedure

SOP Number	SOP-F007
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	1
2 Scope	2
3 Responsibilities	2
4 Definitions	2
5 Safety and Hazards	3
5.1 Required PPE	3
5.2 Emergency Procedures	3
6 Equipment and Materials	3
6.1 Decontamination Supplies	3
6.2 Solution Preparation	4
7 Procedure	4
7.1 Between-Site Decontamination (Field)	4
7.2 Post-Field Decontamination (Laboratory)	5
7.3 Invasive Species of Concern	5
8 Quality Control	5
9 References	6
10 Related SOPs	6
11 Training Record	6

1. Purpose

This SOP describes standardized procedures for decontaminating field equipment between sampling sites and between field outings. Proper decontamination serves two purposes: (1) preventing cross-contamination of samples that would compromise analytical results, and (2) preventing the transfer of invasive species, pathogens, and nuisance organisms between water bodies and field sites (California Department of Fish and Wildlife, 2016; Hosea & Finlayson, 2005). These procedures apply to all equipment that contacts environmental media (water, soil, sediment, biological tissue) or that is transported between sites.

2. Scope

- **Applies to:** All reusable field sampling equipment, wading gear (boots, waders, nets), sampling instruments (sondes, meters), containers, and hand tools used at EA Program field sites
- **Does not apply to:** Disposable, single-use items (e.g., individually packaged sterile Colilert bottles, disposable filter cartridges); laboratory glassware cleaning (see [SOP-L101](#)); drone or camera equipment (wipe with dry cloth only unless visibly contaminated)
- **Location:** Performed at field sites (between-site decontamination) and in the lab (post-field cleaning in SGM 131–134)

3. Responsibilities

Role	Responsibility
PI / Field Lead	Ensure decontamination supplies are on the equipment checklist; verify compliance
Trained Personnel	Decontaminate equipment per this SOP before and after each site visit
New Students	Complete training before independent fieldwork

4. Definitions

- **2% bleach solution:** A dilute sodium hypochlorite solution prepared by adding 200 mL of household bleach (5–8% NaOCl) to 10 L of tap water; the standard decontamination solution for wading gear, nets, and hand tools in the EA Program; must be prepared fresh each field day as bleach degrades within hours (California Department of Fish and Wildlife, 2016).
- **Aquatic invasive species (AIS):** Non-native organisms introduced to a water body where they cause ecological or economic harm; common AIS of concern in Southern California include New Zealand mudsnail, quagga mussel, didymo, and chytrid fungus; transferred between water bodies on wet gear (California Department of Fish and Wildlife, 2016).
- **Chytrid fungus (*Batrachochytrium dendrobatidis*, Bd):** A waterborne pathogenic fungus lethal to many amphibian species; transmitted via contaminated water, soil, and equipment; killed by 2% bleach or thermal decontamination at 60 °C (Hosea & Finlayson, 2005).
- **Cross-contamination:** Transfer of analytes, biological material, or organisms from one sample or site to another via inadequately cleaned equipment; can invalidate analytical results and introduce invasive species.
- **Didymo (*Didymosphenia geminata*):** A freshwater diatom that forms dense mats on stream substrates; tolerates damp conditions for many hours; felt-soled wading boots are a primary vector; killed by 2% bleach or drying for at least 48 hours (California Department of Fish and Wildlife, 2016).
- **Equipment blank:** A sample of deionized water rinsed through decontaminated sampling equipment and collected as a QC sample; analyzed alongside field samples to verify that decontamination removes analytes below detection limits.
- **New Zealand mudsnail (*Potamopyrgus antipodarum*):** An invasive snail less than 5 mm long that survives transit on damp wading gear for up to 28 hours; a significant concern

in Southern California streams; killed by 2% bleach immersion for at least 10 minutes or thermal decontamination at 60 °C (Hosea & Finlayson, 2005).

- **Thermal decontamination:** Application of water at 60 °C to kill aquatic invasive species and pathogens; preferred over bleach for equipment sensitive to sodium hypochlorite (rubber gaskets, sensor membranes) (California Department of Fish and Wildlife, 2016; Hosea & Finlayson, 2005).

5. Safety and Hazards

Hazards

- **Chemical:** Dilute bleach (sodium hypochlorite) is a skin and eye irritant and can damage clothing. Handle with gloves and avoid splashing.
- **Physical:** Hot water (60 °C or above) used for thermal decontamination poses a scald risk. Use insulated containers and pour carefully.
- **Biological:** Equipment that has contacted contaminated water or soil may carry pathogens. Wear gloves during decontamination.

5.1. Required PPE

- ☐ Nitrile gloves
- ☐ Safety glasses (when using bleach solution)
- ☐ Lab coat or field clothing you are willing to bleach-stain

5.2. Emergency Procedures

For bleach splashes to skin or eyes, flush with clean water for at least 15 minutes. Refer to [SOP-F001 Field Safety](#) and [SOP-L003 Hazardous Materials Handling](#).

6. Equipment and Materials

6.1. Decontamination Supplies

Item	Notes
Household bleach (sodium hypochlorite, 5–8%)	For preparing 2% decon solution
Spray bottle (labeled “Decon – Bleach 2%”)	For applying solution in the field
Stiff-bristle scrub brush	For removing visible debris
Bucket (5-gallon, dedicated)	For soaking equipment
Deionized or distilled water	For final rinse of sampling equipment
Tap water (carboy or jug)	For initial rinse in the field
Paper towels or clean rags	For drying

Item	Notes
Garbage bags	For isolating contaminated gear during transport

6.2. Solution Preparation

Prepare a **2% bleach solution** by adding 200 mL of household bleach (5–8% sodium hypochlorite) to 10 L of tap water. Prepare fresh solution each field day; bleach degrades within hours (California Department of Fish and Wildlife, 2016).

For **thermal decontamination** (alternative to bleach), heat water to at least 60 °C. Preferred for equipment that may be damaged by bleach (e.g., rubber gaskets, certain sensor membranes) (Hosea & Finlayson, 2005).

7. Procedure

7.1. Between-Site Decontamination (Field)

Perform the following steps before moving to the next sampling site.

Wading gear (boots, waders, chest packs):

1. Remove from the water body and inspect for visible organisms (snails, plant fragments, mud).
2. Use the scrub brush and tap water to remove all visible debris, paying special attention to boot soles, lace eyelets, and wader seams.
3. Spray all surfaces with 2% bleach solution or immerse boot soles in the bleach bucket for at least one minute (California Department of Fish and Wildlife, 2016).
4. Rinse with tap water to remove bleach residue before entering the next water body.

Nets, sieves, and kick screens:

1. Remove all visible organisms and debris by hand and with the scrub brush.
2. Soak in 2% bleach solution for at least one minute, or pour hot water (60 °C) over all mesh surfaces (Hosea & Finlayson, 2005).
3. Rinse with tap water.

Sampling instruments (sondes, meters, tubing):

1. Rinse the sensor housing and cable with tap water.
2. Wipe external surfaces with a cloth dampened with DI water.
3. Do not immerse sensitive electronics in bleach. If the manufacturer recommends a specific decontamination procedure, follow it instead.

Hand tools (trowels, augers, calipers, measuring tapes):

1. Scrub off visible soil or sediment with tap water and the brush.
2. Spray with 2% bleach solution or rinse with DI water.
3. Dry with paper towels before packing.

7.2. Post-Field Decontamination (Laboratory)

Upon return to the lab, before storing equipment:

1. Unpack all field equipment in the designated cleaning area (SGM 134 sink or outdoor wash area).
2. Repeat the cleaning steps from §6.1, using DI water for the final rinse of any equipment that contacts samples.
3. Allow all equipment to air-dry completely before storing. Incompletely dried equipment promotes mold and bacterial growth.
4. Inspect nets and mesh for tears; report damage to the lab manager.
5. Return all equipment to designated storage locations per [SOP-L007](#).

7.3. Invasive Species of Concern

The following organisms are of particular concern in Southern California watersheds (California Department of Fish and Wildlife, 2016; Hosea & Finlayson, 2005):

Organism	Concern
New Zealand mudsnail (<i>Potamopyrgus antipodarum</i>)	< 5 mm; survives on wet gear up to 28 hours
Quagga/zebra mussel (<i>Dreissena</i> spp.)	Veligers invisible to the naked eye
Didymo (<i>Didymosphenia geminata</i>)	Algal cells survive on damp felt soles
Chytrid fungus (<i>Batrachochytrium dendrobatidis</i>)	Lethal to amphibians; transmitted via water and mud
Invasive aquatic plants (e.g., <i>Arundo donax</i> fragments)	Fragments root easily at new sites

! Important

If sampling in a watershed known to harbor New Zealand mudsnails or quagga mussels, use thermal decontamination (60 °C) rather than bleach, as hot water is more reliably lethal to these organisms (Hosea & Finlayson, 2005). Allow gear to dry completely (at least 48 hours) before using it at another site.

8. Quality Control

- The field lead verifies that decontamination supplies are packed before departure (include on the [SOP-F002 Field Equipment Checklist](#)).
- At the start of each semester, inspect decontamination supplies (bleach expiration, brush condition, spray bottle function) and replace as needed.
- For chemical sampling, submit one equipment blank per sampling event: rinse decontaminated equipment with DI water and collect the rinse as a sample. Analyze alongside field samples to verify that decontamination removes analytes below detection limits.

9. References

- California Department of Fish and Wildlife (2016)
- Hosea & Finlayson (2005)

California Department of Fish and Wildlife. (2016). *Aquatic invasive species decontamination protocol*. California Department of Fish; Wildlife. <https://wildlife.ca.gov/Conservation/Invasives/Aquatic>

Hosea, R. C., & Finlayson, B. (2005). *Controlling the spread of New Zealand mudsnails on wading gear* (Administrative Report 2005-02). California Department of Fish; Game, Office of Spill Prevention; Response.

10. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F002	Field Equipment Checklist	Decon supplies on checklist
F304	Stream Physical Habitat	References invasive species prevention
F610	Macroinvertebrate Sampling	Gear decon between streams
L101	Glassware Cleaning	Lab-side cleaning protocols

11. Training Record

Before performing field decontamination independently, personnel must:

1. Read this SOP in full
2. Demonstrate proper preparation of 2% bleach solution
3. Demonstrate between-site decontamination of wading gear and sampling equipment during a supervised field visit
4. Be signed off by the PI or field lead



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F008

Sample Labeling, Chain of Custody, and Transport

Standard Operating Procedure

SOP Number	SOP-F008
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	1
2 Scope	2
3 Responsibilities	2
4 Definitions	2
5 Safety and Hazards	3
5.1 Required PPE	3
5.2 Required Training	3
6 Equipment and Materials	3
7 Procedure	3
7.1 Sample ID Scheme	3
7.2 Labeling Sample Containers	4
7.3 Completing the COC Form	4
7.4 Sample Transport	4
7.5 Receiving Samples in the Laboratory	4
8 Quality Control	5
9 References	5
10 Related SOPs	5
11 Training Record	5

1. Purpose

This SOP establishes a single, program-wide standard for labeling field samples, completing chain of custody (COC) documentation, and transporting samples from the field to the laboratory (APHA et al., 2012; U.S. Environmental Protection Agency, 2002). Consistent labeling prevents sample mix-ups, and a complete chain of custody ensures that data are legally defensible and scientifically traceable. These procedures apply to all sample types (water, soil, sediment, biological tissue, air filters) collected by the EA Program.

2. Scope

- **Applies to:** All environmental samples collected during EA Program field activities, whether analyzed in-house or submitted to an external laboratory
- **Does not apply to:** Internal laboratory standards and reagents (labeled per [SOP-L005](#)); data files and digital records (see [SOP-L801](#))
- **Location:** All EA Program field sites, vehicles, and laboratory receiving areas (SGM 133, 134)

3. Responsibilities

Role	Responsibility
PI / Project Lead	Approve sample ID scheme for each project; designate receiving personnel
Field Lead	Verify labels and COC forms before leaving the field
Trained Personnel	Label samples and complete COC per this SOP
Receiving Personnel	Accept custody, verify sample condition, log receipt
New Students	Complete training before independent sampling

4. Definitions

- **Chain of custody (COC):** A documented, unbroken record of the collection, transfer, and possession of a sample from the moment of collection through final analysis or disposal; used to demonstrate sample integrity for legal or regulatory purposes (U.S. Environmental Protection Agency, 2002).
- **Holding time:** The maximum elapsed time between sample collection and analysis within which the sample remains chemically stable and analytically valid; analyte- and preservative-specific (e.g., 6 h for *E. coli*, 28 d for nitrate in H_2SO_4) (APHA et al., 2012).
- **Preservative:** A chemical added to a sample container (e.g., H_2SO_4 , HNO_3 , $\text{Na}_2\text{S}_2\text{O}_3$) to prevent biological or chemical degradation of target analytes during transport and storage (APHA et al., 2012).
- **QA/QC sample:** A blank, duplicate, spike, or other quality-control sample collected alongside field samples to assess contamination, precision, and accuracy; documented on the COC form.
- **Sample ID:** A unique alphanumeric code assigned to a sample at the moment of collection; the primary key linking field records, labels, COC forms, and laboratory data.
- **Zero headspace:** A sample container filled completely with no air gap; required for volatile organic compound (VOC) samples to prevent loss of analytes to the headspace.

5. Safety and Hazards

Hazards

- **Chemical:** Some sample containers include chemical preservatives (sulfuric acid, nitric acid, sodium thiosulfate). Handle pre-preserved bottles with care. Refer to [SOP-L003](#).
- **Physical:** Coolers loaded with ice and sample bottles can be heavy. Use proper lifting technique.
- **Biological:** Soil and water samples may contain pathogens. Wear nitrile gloves when handling samples.

5.1. Required PPE

- ☐ Nitrile gloves
- ☐ Safety glasses (when handling preserved bottles)

5.2. Required Training

- [SOP-F001 Field Safety](#)
- [SOP-F003 Field Notebook Protocols](#)

6. Equipment and Materials

Item	Storage	Notes
Pre-labeled sample bottles	SGM 133	Correct preservative per method
Waterproof field labels	SGM 133	Rite in the Rain or equivalent
Permanent markers (fine-tip)	SGM 133	Black; waterproof
Chain of custody forms	SGM 133	One form per cooler
Cooler with ice packs	SGM 132	Pre-chilled to 4 °C
Bubble wrap / packing foam	SGM 133	For fragile glass bottles
Zip-lock bags	SGM 133	Secondary containment for preserved bottles
Sample seals / custody tape	SGM 133	For regulatory submissions

7. Procedure

7.1. Sample ID Scheme

The PI or project lead establishes the sample ID scheme before the first field outing. A standard EA Program sample ID has the structure:

[ProjectCode] - [SiteCode] - [YYYYMMDD] - [SampleType] - [Replicate]

Example: SGMC-US1-20260415-GW-A

Record the scheme in the project metadata file and in the field notebook before the first sampling event.

7.2. Labeling Sample Containers

1. Write the sample ID on the pre-printed label or directly on the container using a waterproof marker.
2. Include the following minimum fields on every label:
 - Sample ID
 - Collection date and time (24 h format)
 - Collector initials
 - Matrix (water / soil / sediment / tissue / air filter)
 - Preservative (if present)
3. For pre-preserved bottles, verify the preservative type is printed or written on the container before field use.
4. For biological samples requiring cold preservation, add an ice temperature indicator sticker.

7.3. Completing the COC Form

1. Start a new COC form for each cooler.
2. Fill in all header fields: project name, project number, field lead, date, field site.
3. Enter each sample in the log: sample ID, matrix, collection date and time, preservative, number of containers, and requested analysis.
4. Include QA/QC samples (field blanks, field duplicates, trip blanks) on the same COC form as the associated samples.
5. Sign and date the form before departing the field.

7.4. Sample Transport

1. Place samples in the cooler with sufficient ice to maintain 4 °C.
2. Separate chemically preserved bottles from unpreserved samples using a zip-lock bag as secondary containment.
3. Verify the cooler temperature on departure and on arrival using a thermometer; record both readings on the COC form.
4. Transport samples promptly; do not leave samples in a hot vehicle.

7.5. Receiving Samples in the Laboratory

1. The receiving person checks the sample count against the COC form.
2. Verify that the number of containers matches the COC listing; note any discrepancies.
3. Check sample temperature with a thermometer placed among the bottles and record on the COC form.
4. Transfer samples to appropriate storage:

- Water samples: refrigerator at 4 °C ([SOP-L106](#))
 - Soil samples: refrigerator at 4 °C (short-term) or freezer (archiving)
 - Biological samples: freezer at -20 °C or -80 °C as required
5. Both the field lead and the receiving person sign and date the COC form to document the transfer of custody.
 6. File the signed COC form with the project records.

8. Quality Control

- The field lead reviews all labels and the COC form before leaving the field site.
- Receiving personnel verify sample count, condition, and temperature upon arrival.
- Any broken, leaking, or incorrectly labeled samples are flagged on the COC form and reported to the PI within 24 hours.
- COC forms are retained for the duration of the project plus a minimum of 5 years.

9. References

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

U.S. Environmental Protection Agency. (2002). *Guidance for quality assurance project plans (EPA QA/G-5)* (EPA/240/R-02/009). U.S. Environmental Protection Agency. <https://www.epa.gov/sites/default/files/2015-06/documents/g5-final.pdf>

10. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F002	Field Equipment Checklist	Labeling supplies on checklist
F003	Field Notebook Protocols	COC recorded in notebook
F300	Surface Water Sampling	Sample-specific preservation
F303	Groundwater Sampling	Well-specific labeling
F400	Soil Sampling	Soil-specific labeling
L802	Quality Control and QA	QC sample requirements

11. Training Record

Before labeling and handling samples independently, personnel must:

1. Read this SOP and [SOP-F003 Field Notebook Protocols](#) in full
2. Demonstrate correct sample labeling using the project ID scheme
3. Complete a COC form correctly during a supervised field outing
4. Be signed off by the field lead or PI



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L002

General Laboratory Safety Plan

Standard Operating Procedure

SOP Number	SOP-L002
Revision	1.1
Author(s)	EA Students, Fall 2015
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 Acknowledgements	2
3.1 Student Contributions	2
4 Responsibilities	2
5 Definitions	3
6 Health and Safety	3
6.1 General Safety Rules	3
6.2 Personal Protective Equipment (PPE)	4
6.3 Emergency Equipment Locations	4
7 Emergency Procedures	4
7.1 Earthquakes	5
7.2 Fires and Evacuation	5
7.3 Medical Emergencies	6
7.4 Chemical Spills	6
7.5 Crime on Campus	6
8 Training Requirements	6
8.1 Required Training for All Researchers	6
8.2 Training Procedure	7
8.3 Annual Requirements	7
8.4 Estimated Time	7
9 Housekeeping	7
10 Ethical Efforts and Contributions	7
11 References	8
12 References	8

13 Appendix A: SOP Training Documentation Form	8
13.1 SOP Training Documentation	8
13.1.1 Agreement	8
13.1.2 SOP Sign-Off Record	8
13.1.3 Pomona College Lab Safety Course (Annual Requirement)	9
13.1.4 Sexual Harassment Policy Acknowledgment	9
13.1.5 Additional Notes	9

1. Purpose

The objective of this SOP is to create a safe operating environment for all researchers in the EA Program laboratories. It establishes general safety rules, emergency procedures, training requirements, and record-keeping procedures.

This Laboratory Safety Plan is a living document and requires ongoing updating, editing, and expansion as incidents occur and lessons are learned.

2. Scope

- **Applies to:** All staff, students, and researchers working in EA Program laboratories and field sites
- **Does not apply to:** Visitors on supervised tours who do not handle materials or equipment
- **Location:** SGM 133 and all associated EA Program spaces

3. Acknowledgements

3.1. Student Contributions

EA030, Fall 2015: Benjamin Schmidt, Kay Garlick-Ott, Marc Los Huertos, Grace Hruska, Juan Jaramillo, Thomas Kelleher, RaSia Khepra, Alexander Landau, Peter Mellinger, Emelia von Saltza, Alexandra Tchaoucheva, Ki'Amber Thompson, Malone Mischke.

4. Responsibilities

Role	Responsibility
Principal Investigator	Ensure all researchers are trained; approve training records
Lab Manager	Conduct training, verify competency, sign off on forms
Chemical Safety Officer	Maintain SOPs, promote safety culture, conduct periodic reviews
All Researchers	Complete required training, follow all SOPs, report hazards

5. Definitions

Laboratory Manager: A student, staff, or faculty member who has been trained and identified as the laboratory manager. The laboratory manager oversees all training and monitors all activities in the laboratory. The current laboratory manager is Assoc. Professor Marc Los Huertos.

Chemical Safety Officer: Assigned annually; responsible for maintaining SOPs, training researchers, and ensuring safe laboratory conditions (see [SOP-L003](#)).

PPE (Personal Protective Equipment): Protective clothing, goggles, gloves, or other garments designed to protect the wearer from injury or infection.

SDS (Safety Data Sheet): A document describing the hazards, safe handling, storage, disposal, and first aid for each chemical used in the lab. The SDS binder is located on the counter next to the east entrance to SGM 133. - **Carcinogen:** A substance capable of causing cancer in living tissue; classified by IARC (Group 1, 2A, 2B) or NTP; requires special handling, documentation, and medical surveillance in many jurisdictions. - **Emergency eyewash station:** A plumbed fixture that delivers a continuous low-pressure flow of water to both eyes simultaneously; located within 10 seconds of any area where corrosive chemicals are used; activate immediately after any eye contact with a hazardous substance and flush for a minimum of 15 minutes. - **Fume hood:** A ventilated enclosure that captures and exhausts chemical vapors, dusts, and fumes away from the work area; the sash must be kept at or below the safe working height marked on the hood. - **Personal protective equipment (PPE):** Wearable protection including safety glasses, splash goggles, face shields, lab coats, nitrile or other chemically appropriate gloves, and closed-toe shoes; selected based on the specific hazards of each procedure. - **Safety Data Sheet (SDS):** A standardized 16-section document (GHS format) describing a chemical's identity, physical and health hazards, safe handling, storage, disposal, and emergency response; must be accessible for every hazardous chemical in the lab. - **Secondary containment:** A tray, cabinet, or outer container that holds spilled liquid if the primary container fails; required under all liquid chemicals stored above bench height and all corrosives.

6. Health and Safety

6.1. General Safety Rules

- Developing a safe and productive environment is key to sustaining a strong scientific ethic; reflect on how you and your colleagues can promote safe conditions
- All personnel must always employ a buddy system, whether working within or outside traditional work hours (8 AM – 5 PM), and on weekends
- You must obtain written permission to work in the lab outside traditional hours
- No work is allowed in the laboratory without expressed permission from the Laboratory Manager
- No food, drink, or cosmetics in the laboratory
- No headphones or earbuds that block auditory hazard warnings
- Long hair must be tied back; loose clothing and dangling jewelry must be secured
- Wash hands thoroughly before leaving the laboratory
- Report all accidents, injuries, and near-misses to the lab manager immediately

6.2. Personal Protective Equipment (PPE)

When entering the lab:

- ☐ Your legs should be covered
- ☐ Wear closed-toed shoes (no sandals)
- ☐ Put on a lab coat as you enter
- ☐ Safety glasses or goggles (when working with chemicals)
- ☐ Nitrile gloves (when handling chemicals or biological materials)
- ☐ Wear a mask when working in the lab with another person (to protect against infectious diseases)

Additional PPE may be required depending on the procedure. Consult the specific SOP and the SDS for each chemical.

6.3. Emergency Equipment Locations

Know the location of the following before beginning any work:

- ☐ Fire extinguisher (near the front entrance)
- ☐ Safety shower (right and left sides of the lab)
- ☐ Eyewash station (right and left sides of the lab)
- ☐ First aid kit
- ☐ Spill kit (mounted on the wall near the PPE shelves, entrance to SGM 133)
- ☐ SDS binder (counter next to the east entrance)
- ☐ Emergency exits
- ☐ Lab contact list (posted in SGM 133; notify the lab manager if it seems out of date)

7. Emergency Procedures

! Emergency Numbers

- **Campus Safety:** (909) 607-2000 (from a campus phone, dial x72000) – open 24/7
- **Emergency:** 911
- **Poison Control:** 1-800-222-1222
- **CUC Student Health Services:** 909-621-8222
- **CUC Environmental Health and Safety:** 909-621-8538

When calling Campus Safety, be ready to provide your name, the location of the emergency, and your contact phone number. Campus Safety will assess the situation and call any necessary services (ambulance, fire department, etc.).

Pomona College On-Call Deans and the Monsour On-Call Counselor are reachable via Campus Safety's emergency number.

7.1. Earthquakes

Earthquakes are common in southern California. Developing an effective strategy before an earthquake strikes is key to laboratory safety.

Indoor response:

1. Move away from windows, filing cabinets, shelves, chemicals, and other heavy objects that may fall
2. “Duck, Cover, and Hold” until shaking stops
3. If not near a table or sturdy desk, crouch against an interior wall and cover your neck and head
4. Once shaking stops, take any necessary items (phone, wallet, medication) and leave the building
5. Go to the nearest Pomona College evacuation site and wait for further instructions
6. Put on shoes as there could be broken debris
7. DO NOT USE ELEVATORS

Outdoor response:

1. Move away from buildings, trees, signs, electrical poles, and wires
2. Protect your head and neck
3. After shaking stops, go to the nearest evacuation site

Aftershocks may occur. Be prepared and follow appropriate evacuation plans if they do.

7.2. Fires and Evacuation

In the case of a small fire, you may attempt to use a fire extinguisher. Remember:

1. Remove people from the area
2. Activate the closest fire alarm
3. Call Campus Safety
4. Extinguish the fire only if safe to do so:
 - Place yourself between the fire and the exit
 - **P**ull the pin
 - **A**im the nozzle toward the base of the fire
 - **S**queeze the handle to release the extinguishing agent
 - **S**weep the base of the fire from side to side
5. Use only one fire extinguisher; if the fire is not controlled after one, leave the room, close the door, and evacuate

If trapped in a building:

1. Call Campus Safety
2. Close all windows and doors
3. Wet and place cloth material around and under the door to prevent smoke from entering

7.3. Medical Emergencies

1. Call Campus Safety; let them know the victim's condition
2. Provide necessary first aid until Campus Safety and/or emergency services arrive (only if trained)
3. Do not move the injured person unless necessary
4. See the campus evacuation map for AED locations

7.4. Chemical Spills

If there is a hazardous chemical spill in the laboratory, do not attempt to clean it up unless trained and equipped to do so. Refer to [SOP-L003 Hazardous Materials Handling](#) for spill response procedures.

- If chemicals get in your eye, flush for 15 minutes at the eyewash station
- If toxic materials are spilled on your body, remove all clothing and stand beneath the lab shower for 15 minutes
- In the event of inhalation, move to fresh air
- If someone is at risk, protect yourself first; only provide assistance if you can do so safely

7.5. Crime on Campus

Active shooter: Exit the building if safe to do so. If not, close and lock the laboratory door, turn off lights, pull down window shades, keep quiet, silence phones, and call Campus Safety.

Bomb threat and utilities failure: Review the Emergency Brochure posted near laboratory exits for detailed procedures.

8. Training Requirements

8.1. Required Training for All Researchers

A researcher is not permitted to use lab equipment until he or she has been appropriately trained. Training is complete only after the Training Documentation Form (Appendix A) has been signed by both the researcher and the lab manager.

Every researcher must complete the following before beginning independent work:

Order	Training Item	SOP Reference
1	General Laboratory Safety (this SOP)	L01
2	Hazardous Materials Handling	L003
3	Foreign Soil Handling (all users, even if not using foreign soils)	L015
4	Field Safety (if conducting field work)	F001

Order	Training Item	SOP Reference
5	Pomona College Lab Safety Course	Annual requirement
6	Pomona College Handbook on Sexual Harassment	Required reading
7	Project-specific SOPs	As assigned by PI

8.2. Training Procedure

1. Read the assigned SOP thoroughly
2. Discuss the SOP with the lab manager, including hazards, mitigation strategies, and emergency procedures
3. Demonstrate competency for any hands-on procedures (if applicable)
4. Sign and date the SOP Training Documentation Form (Appendix A)
5. Obtain the lab manager's signature verifying your training
6. Place the completed form in the SOP Training Binder in the lab

8.3. Annual Requirements

- All researchers must attend the Pomona College Lab Safety Course each year they are working in the lab
- Training sign-offs must be renewed when SOPs are revised to a new version
- The lab manager documents the completion date of the annual safety course

8.4. Estimated Time

Initial safety training (this SOP plus discussion) generally requires approximately 45 minutes.

9. Housekeeping

- When you arrive, look around to identify any safety concerns and report them immediately to the Lab Manager
- Keep work areas clean and organized
- Return all chemicals and equipment to their designated storage locations after use
- Clean up spills immediately using appropriate procedures
- Dispose of waste in the correct containers (chemical waste, sharps, biohazard, general trash)
- Do not block emergency exits, safety showers, or eyewash stations
- Report broken or malfunctioning equipment to the lab manager

10. Ethical Efforts and Contributions

Working in the lab requires thinking carefully about what you are contributing and how others using the lab will find it. Each researcher is expected to leave the lab in better condition than they found it and to contribute to the ongoing improvement of safety documentation.

11. References

12. References

13. Appendix A: SOP Training Documentation Form

Print this form for each researcher. Once completed and signed, place it in the SOP Training Binder in the lab.

13.1. SOP Training Documentation

Researcher Name: _____

Email Address: _____

Expected Graduation Year (NA for non-students): _____

13.1.1. Agreement

By signing each row below, I confirm that I have read and understood the SOP, including all safety hazards, operating procedures, and emergency protocols. I understand that any injuries or equipment damage that occur while I am using laboratory equipment after being trained will be my responsibility. I agree to follow the procedures as written and to report any deviations, incidents, or unsafe conditions to the lab manager.

Initials: _____

13.1.2. SOP Sign-Off Record

SOP No.	SOP Title	Version	Researcher Signature	Date	Lab Manager Signature	Date
L01	General Laboratory Safety					
L02	Hazardous Materials Handling					

SOP No.	SOP Title	Version	Researcher Signature	Date	Lab Manager Signature	Date
F01	Field Safety					
F41	Foreign Soil Handling					

13.1.3. Pomona College Lab Safety Course (Annual Requirement)

Academic Year	Date Completed	Lab Manager Signature
---------------	----------------	-----------------------

13.1.4. Sexual Harassment Policy Acknowledgment

Date Read	Researcher Signature
-----------	----------------------

13.1.5. Additional Notes



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L003

Hazardous Materials Handling

Standard Operating Procedure

SOP Number	SOP-L003
Revision	1.05
Author(s)	EA30-Fall 2015, Virginia Paschal
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	1
2 Scope	1
3 Responsibilities	2
4 Definitions	2
5 Safety and Hazards	2
5.1 Required PPE	2
5.2 Required Training	3
6 General Safe Handling Procedures	3
6.1 Working with Hazardous Materials	3
6.2 Physical Hazards	3
7 Chemical Storage	3
7.1 General Rules	3
7.2 Storage by Hazard Class	3
8 Waste Disposal	4
9 References	4
10 Training Record	4

1. Purpose

This SOP covers the safe use, storage, disposal, and spill treatment of hazardous materials. It applies to staff, students, and researchers who use acid, base, explosive, caustic, and poisonous materials in EA Program laboratories.

This document does not explicitly cover radioactive materials.

2. Scope

- **Applies to:** All staff, students, and researchers handling hazardous chemicals in EA Program laboratories
- **Does not apply to:** Radioactive materials (see separate procedures)
- **Location:** SGM 133 and associated EA Program laboratory spaces

3. Responsibilities

Role	Responsibility
Lab PI	Approve SOP, ensure training compliance
Trained Personnel	Follow this SOP, report deviations
New Students	Complete training before independent use

4. Definitions

- **Caustic chemicals:** Chemicals such as ammonium hydroxide, potassium hydroxide, and sodium hydroxide that are able to burn or corrode organic tissue by chemical action.
- **Combustible liquid:** A liquid with a flashpoint at or above 60 °C (140 °F); can burn at temperatures usually above normal working temperatures.
- **Corrosive chemicals:** Strong acids and bases, dehydrating agents, nonmetal chlorides, and halogens that are health hazards and can damage skin, eyes, and respiratory tissue on contact. Store corrosives under the fume hood on low shelving or in approved storage cabinets. Gas cylinders should not be stored in the same cabinet with corrosive liquids. Segregate acids from bases and oxidizing acids from organic acids; separate nitric acid from all other acids.
- **Flammable liquid:** A liquid with a flashpoint below 60 °C (140 °F) that can ignite easily at normal working temperatures.
- **Hazardous material:** Any substance posing a physical or health hazard as defined by OSHA 29 CFR 1910.1200, including flammables, corrosives, oxidizers, toxins, and carcinogens (Occupational Safety and Health Administration, 1990).
- **Safety Data Sheet (SDS):** A standardized document describing a chemical's hazards, safe handling, storage, disposal, and emergency response procedures; located on the counter near the east entrance and at the PPE shelves in SGM 133.

5. Safety and Hazards

Hazards

- **Chemical:** Acids, bases, flammables, oxidizers, and toxic reagents are used routinely in EA Program labs.
- **Physical:** Glassware breakage, heat from hot plates and ovens, compressed gas cylinders.
- **Biological:** Soil and water samples may contain pathogens.

5.1. Required PPE

- ☐ Safety glasses / goggles
- ☐ Lab coat
- ☐ Nitrile gloves
- ☐ Face shield (concentrated acids and bases)

5.2. Required Training

- [SOP-L002 Laboratory Safety](#) before handling any hazardous chemical

6. General Safe Handling Procedures

6.1. Working with Hazardous Materials

- Read the SDS for every chemical before first use.
- Never work alone when handling concentrated acids, bases, or flammables.
- Use the fume hood when working with volatile, toxic, or corrosive chemicals.
- Cap unused containers immediately; return chemicals to designated storage after use.
- Purchase the smallest quantity needed; order corrosives in plastic-coated containers where available.

6.2. Physical Hazards

Glassware: Inspect glassware for cracks before use. Use extreme care when inserting glass tubing into stoppers. Use heat-resistant gloves near hot glassware.

Burns: Use hot plates or water baths instead of open flames. Tie up loose hair and wear snug-fitting, non-synthetic clothing when possible. Always use a fume hood with volatile organic compounds.

Chemical spills: Read the SDS before working with any hazardous chemical. Always wear PPE, cap unused chemical containers, and use fume hoods. Never work alone.

Mercury spills: Follow the college's emergency instructions for mercury spill response.

Explosions: Develop written protocols for explosive chemicals. Use fume hoods; avoid experiments in closed containers; always wear PPE.

Chemical inhalation: Never breathe deeply from a chemical mixture. Use a fume hood; consider gas monitoring equipment for experiments that generate toxic gases.

7. Chemical Storage

7.1. General Rules

- Store chemicals by hazard class, not alphabetically.
- Never store chemicals on the floor; use low shelves or cabinets with front lips.
- Secure shelves to the wall. Ensure shelves have lips to prevent containers from falling.

7.2. Storage by Hazard Class

Hazard Class	Storage Location
Flammable liquids	Flammable-storage cabinet (yellow, self-closing)
Corrosive acids	Acid cabinet under fume hood (separate from bases)
Corrosive bases	Base cabinet under fume hood (separate from acids)
Oxidizers	Separate from flammables and organics
Toxics / reagents	General chemical shelves, secured
Compressed gases	Chained to wall; away from corrosives
Refrigerated	Lab refrigerator (no food); door labeled

8. Waste Disposal

See [SOP-L006 Waste Disposal](#) for the complete waste classification and disposal procedures. Key rules:

- Segregate waste by chemical compatibility (acids, bases, halogenated solvents, non-halogenated solvents, heavy metals).
- Label every waste container with the chemical name, hazard class, and accumulation start date.
- Never pour hazardous chemicals down the drain without verifying local discharge limits.
- Schedule EH&S pickup when a container reaches 75% capacity or after 270 days of accumulation, whichever comes first.

9. References

Occupational Safety and Health Administration. (1990). *Occupational exposure to hazardous chemicals in laboratories, 29 CFR 1910.1450*. US Department of Labor. <https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1450>

10. Training Record

Training is documented in EA Program files. Before working independently, personnel must:

1. Read this SOP in full
2. Complete [SOP-L002 Laboratory Safety](#) training
3. Review SDS forms for all chemicals to be handled
4. Demonstrate understanding of spill response procedures
5. Be signed off by the PI or Chemical Safety Officer



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L004

Chemical Spill Response

Standard Operating Procedure

SOP Number	SOP-L004
Revision	1.1
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 Emergency Contact Information	2
5 Definitions	3
6 Spill Classification	4
6.1 Minor Spill	4
6.2 Major Spill	4
7 Major Spill Response	4
7.1 If in Doubt, Get Out	4
8 Minor Spill Response	5
8.1 General Procedure	5
8.2 Acid Spills	5
8.3 Base Spills	5
8.4 Flammable Organic Solvent Spills	6
8.5 Toxic or Unknown Chemicals	6
9 Spill Kits	6
10 Body and Eye Exposure Response	6
10.1 Skin Contact	6
10.2 Eye Contact	6
11 Documentation and Reporting	7
12 References	7
13 Related SOPs	7
14 Training Record	7

1. Purpose

This SOP provides step-by-step procedures for responding to chemical spills in EA Program laboratories. It covers how to classify a spill, when to clean it up yourself vs. when to evacuate, how to clean up minor spills by chemical class, and how to document and report the incident. This SOP is designed to be a quick reference during an emergency; read it in advance so the procedures are familiar before you need them (National Research Council, 2011; Occupational Safety and Health Administration, 2012).

For general chemical safety, storage, and waste disposal, see [SOP-L003 Hazardous Materials Handling](#). For general lab emergency procedures (fire, earthquake, medical), see [SOP-L002 Laboratory Safety](#).

2. Scope

- **Applies to:** All chemical spills in EA Program laboratories (SGM 133, 134, 135)
- **Does not apply to:** Radioactive material spills; biological spills (BSL-2 organisms); field spills (handle per [SOP-F001](#) and local regulations)
- **Location:** All EA Program laboratory spaces

3. Responsibilities

Role	Responsibility
All Lab Personnel	Assess the spill, protect themselves, initiate response
Lab Manager	Oversee cleanup of minor spills; report major spills
Lab PI	Ensure training; review incident reports
Campus Safety	Respond to major spills; coordinate with fire department

4. Emergency Contact Information

Post this information near every laboratory phone and exit.

Contact	Number / Method
Campus Safety	x72000 (from campus phone) or 909-621-8170
Pomona College Facilities	x18383
Poison Control	1-800-222-1222
911	For life-threatening emergencies
Lab Manager	<i>TBD – post current contact</i>
Lab PI (Marc Los Huertos)	<i>TBD – post current contact</i>

Refer also to (Pomona College, 2024).

5. Definitions

- **Carcinogen:** A substance capable of causing cancer with repeated or prolonged exposure; minor spills of carcinogens (e.g., acrylamide, formaldehyde, chloroform, benzene) require extra precautions including respiratory protection and disposal as hazardous waste regardless of volume (National Research Council, 2011).
- **Corrosive:** A chemical that causes visible destruction or irreversible alteration of skin, eye, or mucous membrane tissue on contact, or that corrodes steel or aluminum; includes strong acids ($\text{pH} < 2$) and strong bases ($\text{pH} > 12$); neutralized before disposal with appropriate Spill-X material (Occupational Safety and Health Administration, 2012).
- **Emergency eyewash station:** A plumbed or pressurized portable fixture that delivers a continuous flow of clean water to both eyes simultaneously; required to be within 10 seconds of unobstructed travel from any hazardous chemical work area; must be activated for at least 15 minutes for any eye chemical contact (Occupational Safety and Health Administration, 2012).
- **Flammable liquid:** A liquid with a flash point below $60\text{ }^{\circ}\text{C}$ ($140\text{ }^{\circ}\text{F}$); includes common laboratory solvents such as ethanol, methanol, acetone, hexane, and isopropanol; minor spills of flammables must be cleaned up with absorbent pads, not paper towels, and all ignition sources must be extinguished immediately (National Research Council, 2011).
- **Flash point:** The minimum temperature at which a liquid produces sufficient vapor to ignite momentarily in the presence of a flame or spark; the key property for classifying a spilled liquid as a flammable hazard.
- **Major spill:** A spill that cannot be safely managed by lab personnel; any spill meeting the criteria in §5.2 – including spills involving injury, unknown chemicals, large volumes, or highly toxic/reactive materials – requires evacuation and a call to Campus Safety; do not attempt to clean up a major spill.
- **Minor spill:** A small spill of a known chemical with known hazards that trained lab personnel can safely clean up using available PPE and spill control materials; all criteria in §5.1 must be met before treating a spill as minor.
- **Safety Data Sheet (SDS):** A standardized 16-section document describing a chemical's identity, hazards, safe handling, first aid, spill response, and disposal; Section 6 (Accidental Release Measures) is the primary reference for spill response; must be accessible in the laboratory at all times (Occupational Safety and Health Administration, 2012).
- **Secondary containment:** A tray, cabinet, or other physical barrier that holds spilled or leaked chemical if the primary container fails; required under all liquid chemical containers in storage; prevents spills from spreading and simplifies cleanup.
- **Spill-X-A / Spill-X-C / Spill-X-S:** Commercial spill control kits manufactured by Ansul (Johnson Controls): A = acid neutralizer (for strong acids), C = caustic/base neutralizer (for strong bases), S = solvent absorbent (for flammable organic solvents); each kit changes color when neutralization is complete.
- **Universal absorbent:** An inert granular or pad material (e.g., diatomaceous earth, Zorb-All pads) that absorbs chemical spills without reacting; suitable for a wide range of chemicals but does not neutralize acids or bases.

6. Spill Classification

Before responding, classify the spill. Your response depends on the classification (Occupational Safety and Health Administration, 2012).

6.1. Minor Spill

A spill is **minor** if ALL of the following are true:

- The chemical and its hazards are known (you have read the SDS)
- The volume is small (less than approximately 500 mL of liquid or 100 g of solid)
- No one is injured or exposed
- The spill is confined to a small area (benchtop or floor, not spreading)
- You have the proper PPE and spill control materials on hand
- The chemical is not highly toxic, volatile, flammable, or reactive at the spilled quantity

Action: Clean it up yourself using the procedures in Section 7.

6.2. Major Spill

A spill is **major** if ANY of the following are true:

- Someone is injured, contaminated, or experiencing symptoms
- The chemical is unknown
- The volume is large (more than approximately 500 mL or 100 g)
- The spill involves a highly toxic, volatile, flammable, or reactive material at any quantity
- The spill is spreading and cannot be easily contained
- You do not have proper PPE or cleanup materials
- You are unsure whether you can handle it safely

Action: Evacuate and call for help (Section 6).

7. Major Spill Response

7.1. If in Doubt, Get Out

If you are unsure whether a spill is minor or major, treat it as major. Your safety is more important than preventing property damage.

1. Protect yourself and others.

- Alert everyone in the lab. Help anyone who is injured or contaminated only if you can do so without endangering yourself.

- If chemicals are on someone's skin or in their eyes, begin flushing with water immediately (safety shower for body, eyewash for eyes). Continue flushing for at least 15 minutes (Occupational Safety and Health Administration, 2012).
- Remove contaminated clothing while flushing.

2. **Evacuate.**

- Clear all personnel from the room and close (do not lock) doors.
- Activate the building fire alarm if there is a fire risk or if toxic vapors require building evacuation.

3. **Call for help.**

- Call Campus Safety: x72000 or 909-621-8170.
- For life-threatening emergencies: 911.
- Notify the lab manager and PI.

4. **Stay available.**

- Wait near the lab entrance (not inside) to brief first responders.
- Bring the SDS for the spilled chemical to the responders.

8. Minor Spill Response

8.1. General Procedure

1. Put on appropriate PPE before approaching the spill: gloves, safety glasses, lab coat at minimum; add face shield for large acid/base spills (National Research Council, 2011).
2. Inform others in the lab that you are cleaning up a spill.
3. Select the correct cleanup material (Section 7.2–7.4).
4. Apply cleanup material from the outside edge of the spill toward the center to prevent spreading.
5. Allow sufficient time for neutralization (Spill-X-A and Spill-X-C change color when complete).
6. Scoop up the spent absorbent and place in a labeled waste container (hazardous waste).
7. Wipe the area with a damp paper towel; dispose of used paper towels as hazardous waste.
8. Remove PPE carefully; wash hands.
9. Document the spill (Section 9).

8.2. Acid Spills

Use **Spill-X-A** (acid neutralizer). Apply the powder to the spill and mix gently with a spatula. When the color indicator shows neutralization is complete, sweep or scoop into a waste container. For spills involving HF (hydrofluoric acid): treat as a major spill regardless of volume; HF causes deep, potentially lethal burns with delayed onset.

8.3. Base Spills

Use **Spill-X-C** (caustic neutralizer). Apply and mix as for acid spills. Monitor for heat generation; some base reactions with neutralizer can be exothermic.

8.4. Flammable Organic Solvent Spills

1. Extinguish all ignition sources immediately (no open flames, turn off hot plates, do not use electrical switches).
2. Increase ventilation (open sash of fume hood, turn on exhaust fan).
3. Use **Spill-X-S** absorbent pads or granular universal absorbent. Do not use paper towels (can generate static or wick the solvent).
4. Collect all absorbent material in a waste container.
5. If vapors persist, evacuate and call Campus Safety (National Research Council, 2011).

8.5. Toxic or Unknown Chemicals

If the chemical is toxic (acutely hazardous, carcinogenic, or unknown): treat as a major spill and call Campus Safety. Do not attempt to clean up acutely toxic or carcinogenic spills without specific training and proper respiratory protection.

9. Spill Kits

The following spill kits are maintained in each laboratory. Inspect each kit at the start of every semester and after any use. Verify that all items are present and not expired. Replenish as needed and record the check date on the spill kit inspection log.

Kit Type	Location	Contents
Spill-X-A (acid)	SGM 133, fume hood	Neutralizing powder, scoop, bag, PPE
Spill-X-C (base)	SGM 133, fume hood	Neutralizing powder, scoop, bag, PPE
Spill-X-S (solvents)	SGM 133, bench shelf	Absorbent pads, bag, PPE
Universal absorbent	SGM 134	Granular absorbent, scoop, bags

10. Body and Eye Exposure Response

10.1. Skin Contact

1. Remove contaminated clothing immediately.
2. Flush the affected area with large volumes of water for at least 15 minutes (Occupational Safety and Health Administration, 2012).
3. Do not apply neutralizing agents directly to skin.
4. Seek medical attention.

10.2. Eye Contact

1. Immediately go to the eyewash station.
2. Hold eyelids open and flush both eyes continuously for at least 15 minutes.
3. Call Campus Safety or 911; all chemical eye exposures require medical evaluation.

11. Documentation and Reporting

After every spill, including minor ones that were cleaned up successfully:

1. Complete the EA Program Spill/Incident Report Form (posted on the lab shared drive).
2. Record: date, time, location, chemical name and CAS number, volume spilled, who was involved, any exposures or injuries, actions taken, waste disposal method.
3. Submit the form to the PI within 24 hours.
4. The PI submits a report to Pomona College EH&S for any spill that resulted in an exposure or injury, required evacuation, or involved a reportable quantity of a regulated chemical (Pomona College, 2024).
5. Review the incident with the lab group within one week to identify how to prevent recurrence.

12. References

- Occupational Safety and Health Administration (2012)
- National Research Council (2011)
- Pomona College (2024)

National Research Council. (2011). *Prudent practices in the laboratory: Handling and management of chemical hazards* (Updated). National Academies Press. <https://doi.org/10.17226/12654>

Occupational Safety and Health Administration. (2012). *Laboratory safety guidance* (OSHA 3404-11R). US Department of Labor.

Pomona College. (2024). *Emergency instructions*. <http://www.pomona.edu/sites/default/files/emergency-instructions.pdf>

13. Related SOPs

SOP	Title	Relationship
L002	Laboratory Safety	General emergency procedures
L003	Hazardous Materials Handling	Chemical safety, storage, waste
L005	Chemical Inventory Management	Inventory affected by spills

14. Training Record

Before working independently in the lab, all personnel must:

1. Read this SOP in full
2. Complete [SOP-L002](#) and [SOP-L003](#) training
3. Locate all spill kits, the safety shower, and the eyewash station in their assigned lab
4. Walk through a simulated minor spill cleanup with the lab manager
5. Be signed off by the lab manager or PI



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L005

Chemical Inventory Management

Standard Operating Procedure

SOP Number	SOP-L005
Revision	1.1
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	1
2 Scope	2
3 Definitions	2
4 Responsibilities	3
5 Safety Considerations	3
6 The Inventory System	3
6.1 Electronic Inventory	3
6.2 Physical Labels	4
7 Procedures	4
7.1 Receiving New Chemicals	4
7.2 Ordering Chemicals	4
7.3 Storage Assignment	5
7.4 Using and Depleting Chemicals	5
7.5 Disposing of Chemicals	5
7.6 Periodic Audits	6
8 Waste Minimization	6
9 References	6
10 Related SOPs	6
11 Training Record	7

1. Purpose

This SOP establishes the procedures for managing the chemical inventory in EA Program laboratories. A current, accurate inventory is essential for safety (knowing what is on hand in an emergency), regulatory compliance (fire code limits on flammable storage, Pomona College Chemical Hygiene Plan), waste minimization (avoiding duplicate purchases and expired stockpiles), and research efficiency (knowing what is available before ordering) (Occupational Safety and Health Administration, 2012; Standard on Fire Protection for Laboratories Using Chemicals, 2019).

2. Scope

- **Applies to:** All chemicals stored in EA Program laboratories (SGM 133, 134, 135), including reagents, standards, solvents, acids, bases, compressed gases, and prepared solutions
- **Does not apply to:** Common consumables that are not hazardous (Kimwipes, gloves, filter paper, etc.), or chemicals stored exclusively in other departments' spaces
- **Location:** All EA Program laboratory spaces

3. Definitions

- **CAS number (Chemical Abstracts Service Registry Number):** A unique numerical identifier assigned to every chemical substance by CAS; the most reliable identifier for chemicals because, unlike common names, it is unambiguous; required on every inventory spreadsheet row.
- **Chemical Hygiene Plan (CHP):** A written program required by OSHA's Laboratory Standard (29 CFR 1910.1450) describing the safety procedures, equipment, and work practices in place to protect laboratory workers from hazardous chemicals; Pomona College's CHP is maintained by EH&S (Occupational Safety and Health Administration, 2012).
- **Expiration date:** The manufacturer-recommended date after which a chemical's stated purity, concentration, or safety characteristics may no longer be guaranteed; after this date, the chemical must be tested or disposed of.
- **GHS (Globally Harmonized System of Classification and Labelling of Chemicals):** The United Nations system for standardizing chemical hazard communication; governs the content and format of Safety Data Sheets and container labels in the United States under the OSHA Hazard Communication Standard (Occupational Safety and Health Administration, 2012).
- **Hazard class:** A classification of a chemical's primary physical or health hazard (flammable, corrosive, oxidizer, toxic, carcinogen, etc.) per OSHA/GHS criteria; used to assign compatible storage locations and set fire code quantity limits (Standard on Fire Protection for Laboratories Using Chemicals, 2019).
- **NFPA 45:** The National Fire Protection Association standard governing fire protection for laboratories using chemicals; sets maximum allowable quantities (MAQs) of flammable and combustible liquids that may be stored in different lab occupancy types (Standard on Fire Protection for Laboratories Using Chemicals, 2019).
- **Peroxide-forming solvent:** A solvent that can spontaneously form explosive organic peroxides during storage (e.g., diethyl ether, THF, isopropanol); must be tested periodically with peroxide test strips and disposed of before the safe shelf life is exceeded; open-date label required on every container (National Research Council, 2011).
- **Safety Data Sheet (SDS):** A standardized 16-section document (GHS format) describing a chemical's identity, hazards, safe handling, storage, disposal, and emergency response; legally required to be accessible in the workplace for all hazardous chemicals; Section 7 (Handling and Storage) and Section 13 (Disposal) are most relevant to inventory management (Occupational Safety and Health Administration, 2012).
- **Small Quantity Generator (SQG):** A US EPA RCRA designation for facilities generating 100–1,000 kg of hazardous waste per month; Pomona College's classification, which sets specific accumulation time and storage requirements.

- **Surrogate chemical:** A non-hazardous chemical used for training and demonstration purposes in place of a hazardous substance.

4. Responsibilities

Role	Responsibility
Lab PI	Approve purchases; ensure compliance with fire code limits
Lab Manager	Maintain the inventory database; conduct audits
All Lab Personnel	Log new chemicals upon receipt; update inventory when chemicals are consumed or disposed
Chemical Safety Officer	Review inventory for incompatibilities and compliance

5. Safety Considerations

Accurate inventory management is a safety measure (Occupational Safety and Health Administration, 2012; Standard on Fire Protection for Laboratories Using Chemicals, 2019):

- First responders and the fire department use the chemical inventory to assess hazards during emergencies.
- NFPA 45 fire code limits the total quantity of flammable liquids that may be stored outside of approved flammable-storage cabinets (Standard on Fire Protection for Laboratories Using Chemicals, 2019).
- Knowing what is stored and where prevents accidental mixing of incompatible chemicals.
- Expired chemicals (especially peroxide-forming solvents) can become hazardous over time (National Research Council, 2011).

See [SOP-L003](#) for chemical storage, compatibility, and labeling requirements.

6. The Inventory System

6.1. Electronic Inventory

The EA Program maintains a shared Google Sheet (or equivalent spreadsheet) as the master chemical inventory. The spreadsheet is stored on the lab shared drive and accessible to all lab personnel.

Required columns:

Column	Description
Chemical name	Full name (no abbreviations or formulas only)
CAS number	Chemical Abstracts Service registry number
Manufacturer	Supplier name
Catalog number	Supplier catalog/part number

Column	Description
Lot number	Manufacturer lot number
Date received	YYYY-MM-DD
Quantity received	Amount and units (e.g., 500 mL, 100 g)
Current quantity	Updated when significantly depleted
Concentration/purity	If applicable (e.g., “ACS reagent grade, 37%”)
Expiration date	From manufacturer label, or calculated shelf life
Hazard class	Flammable, corrosive, oxidizer, toxic, etc.
Storage location	Room, cabinet/shelf code (e.g., SGM 133, Flam-1)
SDS on file	Yes/No
Owner/project	Who ordered it and for what project
Status	In use / Sealed / Expired / Disposed

6.2. Physical Labels

Every chemical container in the lab must have a label that includes:

- Chemical name (spelled out)
- Concentration (if a prepared solution)
- Hazard warning(s) per GHS
- Date received or date prepared
- Researcher name
- Expiration date (if applicable)

See [SOP-L003, Section 6.4](#) for detailed labeling requirements.

7. Procedures

7.1. Receiving New Chemicals

1. Inspect the container for damage, leaks, or missing labels when the shipment arrives.
2. If the container is damaged or leaking, do not accept it into the lab. Notify the lab manager. Follow spill procedures in [SOP-L004](#) if needed.
3. Add the chemical to the inventory spreadsheet immediately, completing all required columns.
4. Verify that the SDS is on file. If not, download it from the manufacturer’s website and add it to the SDS binder and the electronic SDS folder.
5. Label the container with the date received and the researcher’s name if not already present.
6. Store the chemical in the correct location based on its hazard class (see §5.3).

7.2. Ordering Chemicals

Before ordering a new chemical:

1. Check the inventory spreadsheet to see if the chemical is already in stock.

2. Check with other lab users to see if someone has an open container that can be shared.
3. Order only the quantity needed for the project. Purchasing excess chemicals generates waste and occupies storage space.
4. For highly hazardous chemicals, consult the PI and review the SDS before ordering (National Research Council, 2011).

7.3. Storage Assignment

Assign storage based on hazard class. Chemicals must be segregated by compatibility (Standard on Fire Protection for Laboratories Using Chemicals, 2019):

Hazard Class	Storage Location
Flammable liquids	Flammable-storage cabinet (yellow, self-closing)
Corrosive acids	Acid cabinet (under fume hood) – separate from bases
Corrosive bases	Base cabinet (under fume hood) – separate from acids
Oxidizers	Separate from flammables and organics
Toxics / reagents	General chemical shelves, secured
Compressed gases	Chained to wall or bench; away from corrosives
Refrigerated/frozen	Lab refrigerator or freezer (no food)

! Important

Never store chemicals on the floor. Use low shelves or cabinets with front lips. Ensure shelves are fastened to the wall. See [SOP-L003](#), Section 6.3 for detailed storage rules.

7.4. Using and Depleting Chemicals

- When you open a sealed container for the first time, write the date opened on the label.
- When a container is nearly empty or fully consumed, update the “Current quantity” and “Status” columns in the inventory spreadsheet.
- Return every chemical to its designated storage location after use.

7.5. Disposing of Chemicals

When a chemical is expired, no longer needed, or in poor condition:

1. Update the inventory spreadsheet: change Status to “Disposed” and record the disposal date.
2. Follow the waste disposal procedures in [SOP-L003, Section 8](#): fill out a waste tag, complete the packing manifest, and schedule pickup.
3. Do not pour chemicals down the drain unless explicitly permitted by the SDS and local regulations for that specific chemical.

7.6. Periodic Audits

Conduct a full physical audit of the chemical inventory at least once per year (typically at the start of the fall semester) (National Research Council, 2011):

1. Print the current inventory spreadsheet.
2. Walk through every storage location and physically verify each item.
3. Note discrepancies between the spreadsheet and actual stock.
4. Remove expired chemicals for disposal.
5. Update the spreadsheet to reflect the audit results.
6. File the annotated printout as the audit record.

8. Waste Minimization

- Order the smallest quantity that will meet your needs.
- Share chemicals across projects when possible.
- Prepare only the volume of working solutions needed for an analytical session.
- Substitute less hazardous chemicals when feasible (e.g., replace a halogenated solvent with a non-halogenated alternative).
- Dispose of expired chemicals promptly rather than letting them accumulate.

See [SOP-L003, Section 8.3](#) for additional waste minimization guidance.

9. References

- Occupational Safety and Health Administration (2012)
- National Research Council (2011)
- (Standard on Fire Protection for Laboratories Using Chemicals, 2019)

National Research Council. (2011). *Prudent practices in the laboratory: Handling and management of chemical hazards* (Updated). National Academies Press. <https://doi.org/10.17226/12654>

Occupational Safety and Health Administration. (2012). *Laboratory safety guidance* (OSHA 3404-11R). US Department of Labor.

Standard on Fire Protection for Laboratories Using Chemicals, Pub. L. Nos. NFPA 45 (2019). <https://www.nfpa.org/codes-and-standards/nfpa-45-standard-development/45>

10. Related SOPs

SOP	Title	Relationship
L002	Laboratory Safety	General safety framework
L003	Hazardous Materials Handling	Storage, labeling, waste disposal

SOP	Title	Relationship
L004	Chemical Spill Response	Spill procedures for inventoried chemicals

11. Training Record

Before ordering, receiving, or storing chemicals independently, personnel must:

1. Read this SOP and [SOP-L003](#) in full
2. Demonstrate how to add a new chemical to the inventory spreadsheet
3. Locate SDS binders and the electronic SDS folder
4. Identify the correct storage location for a given hazard class
5. Be signed off by the lab manager or PI



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L006

Waste Disposal and Hazardous Waste Pickup

Standard Operating Procedure

SOP Number	SOP-L006
Revision	0.1
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	1
2 Scope	2
3 Responsibilities	2
4 Definitions	2
5 Regulatory Context	3
6 Waste Classification	3
6.1 Non-Hazardous Solid Waste	3
6.2 Hazardous Chemical Waste	3
6.3 Biological Waste	4
6.4 Sharps	4
6.5 Drain-Disposable Waste	5
7 Procedure	5
7.1 Labeling Waste Containers	5
7.2 Accumulating Waste	5
7.3 Requesting EH&S Pickup	5
7.4 Empty Container Management	6
8 Satellite Accumulation Area (SAA) Management	6
9 Emergency Spill Response	6
10 References	6
11 Related SOPs	7
12 Training Record	7

1. Purpose

This procedure describes the classification, segregation, labeling, storage, and disposal of all laboratory waste generated in EA Program laboratories, with emphasis on hazardous chemical waste

requiring EH&S pickup. It consolidates and expands the waste disposal sections of [SOP-L003 Hazardous Materials Handling](#) (Sections 8.1–8.6) into a standalone reference that can be posted in the waste accumulation area and used during training.

2. Scope

- **Applies to:** All laboratory waste generated in EA Program laboratories (SGM 133, 134, 135), including chemical waste, biological waste, sharps, and non-hazardous solid waste
- **Does not apply to:** Radioactive waste (not generated in EA Program labs); field waste (see [SOP-F001](#)); e-waste and surplus equipment (coordinate with campus surplus property office)
- **Location:** All EA Program laboratory spaces

3. Responsibilities

Role	Responsibility
Lab PI	Ensure compliance with campus and regulatory waste policies; sign manifests as generator
Lab Manager	Coordinate EH&S pickups, maintain satellite accumulation areas, train personnel
All Lab Personnel	Segregate and label waste correctly per this SOP
Campus EH&S	Collect hazardous waste, prepare manifests, arrange off-site disposal

4. Definitions

- **Characteristic hazardous waste:** Waste that exhibits ignitability, corrosivity, reactivity, or toxicity as defined by 40 CFR Part 261; must be managed as RCRA hazardous waste regardless of quantity.
- **EH&S (Environmental Health and Safety):** The Pomona College department responsible for regulatory compliance, hazardous waste pickup scheduling, safety training, and chemical spill response coordination.
- **Hazardous waste manifest:** A shipping document that tracks hazardous waste from the point of generation to the final disposal facility; prepared by EH&S and signed by the PI as generator.
- **Listed hazardous waste:** Waste from specific industrial processes or containing specific chemicals appearing on EPA lists (F, K, P, U lists under 40 CFR Part 261); managed as RCRA hazardous waste.
- **Satellite accumulation area (SAA):** A designated location at or near the point of waste generation where up to 55 gallons of hazardous waste (or 1 quart of acutely hazardous waste) may be accumulated without a time limit; must be under the control of the operator who generates the waste.

- **Small Quantity Generator (SQG):** A US EPA RCRA classification for facilities generating 100–1,000 kg of hazardous waste per month; Pomona College’s status, which sets 270-day accumulation limits and specific storage, training, and emergency planning requirements.
- **Waste stream:** A category of hazardous waste defined by chemical composition and hazard class (e.g., halogenated solvents, non-halogenated solvents, corrosive acids, heavy metal solutions); wastes must be segregated by compatible stream to prevent dangerous reactions during storage and transport.

5. Regulatory Context

Pomona College is classified as a Small Quantity Generator (SQG) of hazardous waste under RCRA (40 CFR Part 262) and California DTSC regulations. Key requirements:

- Hazardous waste may be accumulated in satellite accumulation areas (SAAs) near the point of generation in containers of 55 gallons or less (1 quart for acutely hazardous waste)
- Once full, containers must be moved to the central accumulation area and picked up by EH&S within 3 days
- All containers must be labeled with the words “Hazardous Waste,” the contents, the hazard(s), and the accumulation start date
- The generator (Lab PI) must sign the packing manifest

6. Waste Classification

6.1. Non-Hazardous Solid Waste

Waste Type	Disposal
Paper, packaging, cardboard	Recycling bins
Uncontaminated gloves and wipes	Standard trash
Clean glassware (broken)	Sharps box or wrapped cardboard, then trash
Uncontaminated soil (dried)	Standard trash or return to field site
Used aluminum tins (clean)	Recycle or reuse

6.2. Hazardous Chemical Waste

Any waste that is ignitable, corrosive, reactive, or toxic (per RCRA D-list), or that is a listed waste (F, K, P, or U list), must be collected and disposed as hazardous waste. Common EA Program hazardous waste streams:

Waste Stream	Typical Source SOPs	Container
Acid waste (HNO ₃ , HCl, H ₂ SO ₄)	L410, L411, L403	Poly carboy, labeled “Acid Waste”
Base waste (NaOH, KOH)	Various	Separate poly carboy

Waste Stream	Typical Source SOPs	Container
Halogenated solvent waste (chloroform, DCM)	L409	Amber glass, labeled “Halogenated Solvent Waste”
Non-halogenated solvent waste (acetone, ethanol, hexane)	Various	Separate glass or poly container
Heavy metal solutions (Pb, Cd, Cr, Hg)	L410, L411	Poly carboy, labeled by metal
Formaldehyde solutions	L305 (preservatives)	Glass, labeled “Formaldehyde Waste”
Oxidizer solutions (H ₂ O ₂ , NaClO ₃)	L412	Collect separately; do not mix with organic waste
Used oil (pump oil)	Vacuum pumps	Labeled container

Critical Segregation Rules

- **Never mix** acids with bases, oxidizers with organics, or halogenated with non-halogenated solvents.
- **Never pour** hazardous waste down the drain unless explicitly approved by EH&S for that specific waste stream.
- When in doubt, treat as hazardous and collect for EH&S pickup.

6.3. Biological Waste

Waste Type	Disposal
Non-pathogenic cultures (soil microbes)	Autoclave, then standard trash
Colilert/Quanti-Tray materials (L305)	Standard trash after UV deactivation or autoclave
eDNA extraction waste (bead tubes, filters)	Standard trash (non-infectious after extraction)
Foreign soil waste (L015)	Autoclave per SOP-L015 before disposal

6.4. Sharps

Waste Type	Disposal
Needles, syringes with needles	Sharps container (red)
Broken glass (contaminated)	Sharps container
Razor blades, scalpels	Sharps container
Broken glass (uncontaminated)	Cardboard box labeled “Broken Glass,” then trash
Intact glass vials (uncontaminated)	Rinse and recycle, or trash

6.5. Drain-Disposable Waste

A limited set of aqueous, non-hazardous solutions may be poured down the drain with copious water, **only if approved by EH&S**:

- Dilute (less than 1%) salt solutions (NaCl, KCl, K₂SO₄, Na₂SO₄) at neutral pH
- Dilute sugar or buffer solutions at neutral pH
- Neutralized acid or base solutions (pH 5–9) that contain no metals or other hazardous constituents

! Important

If you are unsure whether a waste can go down the drain, collect it as chemical waste. The default is always to collect, never to drain.

7. Procedure

7.1. Labeling Waste Containers

1. Every waste container in the SAA must have a hazardous waste label (available from EH&S or the lab manager) before any waste is added
2. Fill in: waste description (chemical names and approximate percentages), hazard(s) (corrosive, flammable, toxic, etc.), accumulation start date, and laboratory location
3. Update the label if new constituents are added to the container

7.2. Accumulating Waste

1. Add waste to the appropriate labeled container in the SAA
2. Keep containers closed when not actively adding waste
3. Do not fill containers beyond 80% capacity (leave headspace for thermal expansion and safe handling)
4. Inspect containers weekly for leaks, corrosion, or label degradation

7.3. Requesting EH&S Pickup

1. When a container is full (or the study is complete), notify the lab manager
2. The lab manager contacts campus EH&S to schedule a pickup
3. Prepare a packing manifest listing: container number, contents (chemical names and approximate percentages), volume, hazard class, and generator (PI) name
4. The PI reviews and signs the manifest
5. Move the container to the central pickup area designated by EH&S
6. EH&S collects the waste, provides a manifest copy, and arranges off-site treatment or disposal

7.4. Empty Container Management

1. Triple-rinse empty reagent bottles with the appropriate solvent (water for aqueous chemicals, the same solvent for organic chemicals)
2. Remove or deface the original label
3. Collect rinse liquid as waste (add to the corresponding waste stream)
4. Clean, delabeled glass bottles may be reused for non-critical purposes or recycled
5. Do not reuse containers that held acutely hazardous (P-listed) chemicals; dispose as hazardous waste

8. Satellite Accumulation Area (SAA) Management

- Each SAA is located at or near the point of waste generation (e.g., the fume hood where digestions are performed, the bench where extractions occur)
- Maximum volume in an SAA: 55 gallons of hazardous waste (or 1 quart of acutely hazardous waste)
- Containers in the SAA must be in good condition, compatible with the waste, and kept closed except when adding waste
- Spill containment (secondary tray) is required under all liquid waste containers
- The lab manager inspects SAAs monthly and logs the inspection on the SAA checklist posted in each area

9. Emergency Spill Response

For waste container spills, follow [SOP-L004 Chemical Spill Response](#). Key points:

- Contain the spill using absorbent materials appropriate to the waste type (do not use paper towels for solvent spills; use chemical absorbent pads)
- Contaminated absorbent becomes hazardous waste; bag, label, and include in the next EH&S pickup
- Report all spills to the lab manager and PI; document in the incident log

10. References

- 40 CFR Part 262. *Standards Applicable to Generators of Hazardous Waste*. US EPA.
- California Code of Regulations, Title 22, Division 4.5. *Hazardous Waste Control Law*. California DTSC.
- Pomona College EH&S. *Hazardous Waste Management Guide*. Available from the Campus Safety Office.
- National Research Council. (2011). *Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards* (updated ed.). National Academies Press.

11. Related SOPs

SOP	Title	Relationship
L002	Laboratory Safety	General safety framework
L003	Hazardous Materials Handling	Chemical safety and storage
L004	Chemical Spill Response	Spill cleanup procedures
L005	Chemical Inventory	Tracking chemicals and SDS
L015	Foreign Soil Handling	Autoclave requirements for imported soil

12. Training Record

Before handling laboratory waste independently, personnel must:

1. Read this SOP and [SOP-L003](#) in full
2. Locate the SAAs in each laboratory room and identify the waste streams currently in use
3. Demonstrate proper waste labeling (fill out a hazardous waste label correctly)
4. Demonstrate correct segregation by assigning 5 sample waste items to the correct container
5. Review the spill response procedure in [SOP-L004](#)
6. Be signed off by the lab manager or PI



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L007

EA Program Equipment and Instrument Inventory

Standard Operating Procedure

SOP Number	SOP-L007
Revision	1.1
Author(s)	Neha Vandemeer
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	1
2 Scope	2
3 Definitions	2
4 Responsibilities	2
5 How to Use This Inventory	2
6 Vehicles	3
7 Field Equipment	3
8 Remote Sensing and Drones	3
9 Raspberry Pi and Air Quality Sensors	3
10 Analytical Instruments	4
11 Balances and Measurement	4
12 Laboratory Equipment	4
13 Annual Audit Procedure	5
14 References	5
15 Related SOPs	5
16 Training Record	5

1. Purpose

This document is a living inventory of instruments, equipment, and major supplies maintained by the EA Program. It serves as the central reference for locating equipment, tracking ID numbers, and linking each item to its governing SOP. All personnel should consult this inventory before purchasing duplicate items and should update it whenever equipment is acquired, moved, or decommissioned.

2. Scope

- **Applies to:** All EA Program equipment in SGM 105, 106, 131, 132, 133, 134, and associated field storage
- **Does not apply to:** Consumable supplies (reagents, glassware under \$50 replacement cost), personal equipment, or equipment belonging to other departments
- **Maintained by:** Lab manager, with updates from all trained personnel

3. Definitions

- **Asset tag:** A numbered label affixed to a piece of equipment to uniquely identify it within the EA Program inventory; the number should match the ID# field in this document.
- **Decommissioned:** Status assigned to equipment that has been permanently removed from service (broken beyond repair, surplus, or disposed of); must be logged with the date and reason in the inventory and reported to the lab manager.
- **Equipment:** In this SOP, a durable item with a replacement value above approximately \$50 and an expected service life of more than one year; includes vehicles, instruments, balances, power tools, pumps, and major field gear.
- **ID# (inventory number):** A unique alphanumeric code assigned to each piece of equipment; the EA Program convention is EA-[CATEGORY]-[NNN] (e.g., EA-FLD-001 for field equipment, EA-LAB-001 for laboratory equipment, EA-INS-001 for analytical instruments); items marked *TBD* need numbers assigned at the next audit.
- **Related SOP:** The primary operating procedure associated with a piece of equipment; a dash (–) indicates no dedicated SOP exists yet.
- **TBD (to be determined):** Placeholder in the ID# or Location column indicating that the information needs to be confirmed during the next physical audit.

4. Responsibilities

Role	Responsibility
Lab Manager	Maintain this document; conduct annual audits; assign ID numbers
PI	Approve major equipment purchases; authorize surplus or disposal
All Lab Personnel	Report new acquisitions, moves, or damage to the lab manager promptly

5. How to Use This Inventory

- Items marked *TBD* in the ID# column need to be assigned an inventory number during the next audit.
- Items marked *TBD* in the Location column need to be physically located and recorded.
- The Related SOP column links to the operating procedure for that item; a dash indicates no dedicated SOP exists yet.
- Report discrepancies (missing items, wrong locations) to the lab manager immediately.

6. Vehicles

Item	ID#	Qty	Location	Related SOP
2016 Ford Explorer #1	<i>TBD</i>	1	Garage, EA Slot	F100
2016 Ford Explorer #2	<i>TBD</i>	1	Garage, EA Slot	F100

7. Field Equipment

Item	ID#	Qty	Location	Related SOP
Cooler #1	<i>TBD</i>	1	SGM 132	–
Cooler #2	<i>TBD</i>	1	SGM 132	–
TopCon AT-G4 Survey Scope w/ Tripod & Stadia	<i>TBD</i>	3	SGM 131	–
Meter Tape (10 m)	<i>TBD</i>	2	SGM 131	–
Meter Tape (25 m)	<i>TBD</i>	1	SGM 131	–
Meter Tape (100 m)	<i>TBD</i>	1	SGM 131	–
Infiltrometer	<i>TBD</i>	3	SGM 131	–
VanDorn Bottle (Horizontal)	<i>TBD</i>	1	SGM 133	F300
VanDorn Bottle (Vertical)	<i>TBD</i>	1	SGM 133	F300
LiCor Underwater PAR Sensor	<i>TBD</i>	1	SGM 133	–
Walkie Talkies	<i>TBD</i>	3	SGM 131	–
Honda Field Generator	<i>TBD</i>	1	SGM 132	F101
Ryobi Field Generator	<i>TBD</i>	1	SGM 132	F101
Eureka Manta2 WQ Sonde	<i>TBD</i>	2	<i>TBD</i>	F200
Pygmy Velocity Meter	<i>TBD</i>	1	<i>TBD</i>	F201
Type AA Velocity Meter	<i>TBD</i>	1	<i>TBD</i>	F201
Stop Watches	<i>TBD</i>	10	<i>TBD</i>	–
Alkalinity Test Kit	<i>TBD</i>	3	<i>TBD</i>	L301

8. Remote Sensing and Drones

Item	ID#	Qty	Location	Related SOP
DJI Mavic 3 Pro	<i>TBD</i>	1	SGM 106	–
DJI Mavic 3 Batteries	<i>TBD</i>	3	SGM 106	–
DJI Matrice 100	<i>TBD</i>	1	SGM 210	–
DJI Matrice 100 Batteries	<i>TBD</i>	6	SGM 210	–

9. Raspberry Pi and Air Quality Sensors

Item	ID#	Qty	Location	Related SOP
Raspberry Pi Zero+	NA	16	SGM <i>TBD</i>	–
Raspberry Pi 3+	NA	2	SGM <i>TBD</i>	–
Raspberry Pi 4+	NA	2	SGM <i>TBD</i>	–

10. Analytical Instruments

Item	ID# / Serial	Qty	Location	Related SOP
Thermo Scientific Delta V IRMS	<i>TBD</i>	1	SGM 135	L208
Thermo Scientific Flash IRMS EA	<i>TBD</i>	1	SGM 135	L475
Thermo Scientific GasBench II	<i>TBD</i>	1	SGM 135	L415
PANalytical Axios XRF Spectrometer	<i>TBD</i>	1	SGM 135	L205
Shimadzu TOC-L w/ ASI-L Autosampler	<i>TBD</i>	1	SGM 133	L204 , L407
Shimadzu TNM-L TN Module	<i>TBD</i>	1	SGM 133	L204
Hach DR3900 Spectrophotometer	<i>TBD</i>	1	SGM 133	L303
Hach DR900 Portable Colorimeter	<i>TBD</i>	1	SGM 133	L303
Turner Designs Trilogy Fluorometer	<i>TBD</i>	1	SGM 133	L203
Bio-Rad QX200 ddPCR System	<i>TBD</i>	1	<i>TBD</i>	L701
Picarro G2508 CRDS Analyzer	S/N 2143-JFAADS2048	1	<i>TBD</i>	F504
Eosense eosMX-P Multiplexer	<i>TBD</i>	1	<i>TBD</i>	F504

11. Balances and Measurement

Item	ID# / Serial	Qty	Location	Related SOP
Mettler Toledo XPE205 Delta Range Microbalance	<i>TBD</i>	1	<i>TBD</i>	L102 , L200
Mettler Toledo Balance	<i>TBD</i>	3	<i>TBD</i>	L102
High Capacity Portable Scale (24 x 24 in)	<i>TBD</i>	1	<i>TBD</i>	–
Digital Calipers	<i>TBD</i>	7	<i>TBD</i>	–
Hydrometer	<i>TBD</i>	5	<i>TBD</i>	L401

12. Laboratory Equipment

Item	ID# / Serial	Qty	Location	Related SOP
MilliQ Elix Water Purification System	<i>TBD</i>	1	SGM 134	–

Item	ID# / Serial	Qty	Location	Related SOP
ESCO Laminar Flow Cabinet	<i>TBD</i>	1	SGM 134	L113
Drying Oven	<i>TBD</i>	1	SGM 134	L105
Thermo Fisher Sorvall ST 8R Centrifuge	<i>TBD</i>	1	SGM 133	L109
Thermo Fisher Legend Micro 21 Centrifuge	SN41972616	1	SGM 133	–
Fisher Isotemp Muffle Furnace	<i>TBD</i>	1	SGM 133	L111
WTW OxiTop BOD System	<i>TBD</i>	8	SGM 133	L306
Echo Labs Revolve Microscope	<i>TBD</i>	1	SGM 133	L211

13. Annual Audit Procedure

1. Walk through every room listed in this inventory (SGM 105, 106, 131, 132, 133, 134, 210) and physically verify the presence and condition of each item.
2. Assign an inventory ID number to any item currently marked *TBD*.
3. Update the Location column if any item has been moved.
4. Note any items that are missing, damaged, or decommissioned.
5. Add any newly acquired equipment.
6. Commit the updated file to the GitHub repository with a descriptive commit message.

14. References

This SOP is an internal administrative document. No peer-reviewed external references apply. For related guidance on laboratory inventory and chemical tracking, see [SOP-L005 Chemical Inventory](#).

15. Related SOPs

SOP	Title	Relationship
L005	Chemical Inventory	Companion inventory for reagents
F002	Field Equipment Checklist	Uses this inventory for storage locations
L801	RStudio and GitHub	Version control for this document

16. Training Record

All lab personnel should review this inventory document when joining the EA Program and whenever they are assigned responsibility for a new class of equipment. No formal sign-off is required for this SOP.



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L010

Laboratory Notebook Recording

Standard Operating Procedure

SOP Number	SOP-L010
Revision	1.1
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 Required Notebook Type	3
6 Setting Up a New Notebook	3
7 Writing Instruments	3
7.1 Required	3
7.2 Not Permitted	4
8 Entry Formatting	4
8.1 Every Entry Begins With	4
8.2 Contemporaneous Recording	4
8.3 Level of Detail	4
8.4 Printouts, Graphs, and Attachments	4
8.5 Tables and Calculations	5
8.6 Blank Space and Unused Pages	5
9 Error Correction	5
10 Electronic Data References	5
11 Carbon-Copy Management	6
12 Signature and Witness	6
13 Carbon Copy Storage and Notebook Archiving	6
13.1 Carbon Copies	6
13.2 Full Notebooks	6
14 Common Mistakes	6

15 References	7
16 Related SOPs	7
17 Training Record	7

1. Purpose

This SOP establishes the physical documentation standards for laboratory notebooks in the EA Program. A properly maintained notebook is a legal record that establishes what was done, when, by whom, and what was observed. These standards follow Good Documentation Practice (GDP) principles used in regulated laboratories and ensure that EA Program data are traceable, contemporaneous, and defensible (Kanare, 1985; U.S. Environmental Protection Agency, 2002).

This SOP covers *how* to record. For *what* to record during an analytical session, see [SOP-L802 Quality Control](#), Section 7.1. For field notebook protocols, see [SOP-F003 Field Notebook Protocols](#).

2. Scope

- **Applies to:** All laboratory work performed under EA Program SOPs, including sample preparation, instrument operation, calibration, data reduction, and reagent/standard preparation
- **Does not apply to:** Field notebooks (see [SOP-F003](#)) or purely electronic records in R scripts and Git (see [SOP-L801](#)), though electronic records should meet the same traceability standards (US Food and Drug Administration, 2004)
- **Location:** All EA Program laboratories (SGM 133, 134, 135)

3. Responsibilities

Role	Responsibility
Lab PI	Set documentation standards; review notebooks
Lab Manager	Issue notebooks; maintain archive; verify compliance
All Lab Personnel	Maintain a notebook per this SOP
New Students	Read this SOP before beginning any lab work

4. Definitions

- **Archival ink:** Ink formulated to resist fading, water, and chemical degradation over decades; required for all permanent laboratory notebook entries; ballpoint or pigment-based pens are preferred over roller-ball gel inks (Kanare, 1985).

- **Carbon-copy notebook:** A notebook with interleaved carbonless copy pages that produce a duplicate of each entry; the copy is torn out and stored separately as a backup, while the original remains bound in the notebook.
- **Contemporaneous record:** An entry made at the time the observation or action occurs, not reconstructed from memory afterward; the defining characteristic of a legally defensible laboratory record (Kanare, 1985).
- **GDP (Good Documentation Practice):** A set of principles for creating accurate, legible, contemporaneous, original, and attributable records; the foundation of data integrity in regulated and research laboratories (U.S. Environmental Protection Agency, 2002).
- **Single-strikethrough correction:** The required method for correcting an error in a laboratory notebook: draw a single line through the incorrect entry so it remains legible, write the correct entry nearby, and sign and date the correction; erasing or using white-out is prohibited (Kanare, 1985).
- **Table of Contents (TOC):** A running index of entries, maintained on the first 2 pages of every notebook, linking dates and topics to page numbers; enables rapid retrieval of specific entries.
- **Witness signature:** A second person's signature and date on a notebook entry confirming that they observed or reviewed the work; required for patent-related records and recommended for any significant observation.

5. Required Notebook Type

Use a bound, carbon-copy laboratory notebook with numbered pages (e.g., a 200-page carbonless copy notebook). Do not use spiral-bound notebooks, loose-leaf paper, or stapled pages as primary records. The carbon-copy notebook provides a built-in backup: the copy page is removed and stored separately, and the original remains permanently bound (Kanare, 1985).

Acceptable notebooks are available from the lab manager. Notify the lab manager when you are on the last 20 pages so a replacement can be ordered.

6. Setting Up a New Notebook

1. Write your name, contact information, the notebook serial number (if present), and the start date on the outside spine.
2. On the inside front cover, record: your name, contact information, project name, and the date the notebook was put into service.
3. Reserve the first two pages for a Table of Contents. Update the TOC as you fill the notebook.

7. Writing Instruments

7.1. Required

Write **all** entries in permanent, non-erasable ink (Kanare, 1985). Use a ballpoint pen that produces a clear impression on both the original and the carbon-copy page. Black or dark blue ink is preferred.

7.2. Not Permitted

- Pencil (can be erased)
- Gel ink or felt-tip pens that do not transfer reliably to the carbon copy
- Erasable ink pens

Tip

Test your pen on a spare carbon-copy page before starting a new notebook. Press firmly enough to produce a legible duplicate, but not so hard that you tear the paper.

8. Entry Formatting

8.1. Every Entry Begins With

At the top of each new entry (or new day), record:

1. **Date** in ISO format: YYYY-MM-DD (e.g., 2026-05-18)
2. **Your name** (or initials, if your full name is on the inside cover and you are the sole user)
3. **Purpose** of the work session in one sentence (e.g., “TOC-L calibration and K_2SO_4 extract analysis, Project: BFS Soils”)
4. **SOP(s) in use** with revision numbers

8.2. Contemporaneous Recording

Write entries **at the time the work is performed**, not from memory afterward (Kanare, 1985). If you record a result on a printout, sticky note, or scrap paper during an urgent moment, tape or staple the original into the notebook and initial and date it at the earliest opportunity. Never discard the original note.

8.3. Level of Detail

Write enough detail so that another trained researcher could reproduce your work using only the notebook and the referenced SOP. At minimum, include all items listed in [SOP-L802, Section 7.1](#) (U.S. Environmental Protection Agency, 2002).

8.4. Printouts, Graphs, and Attachments

Tape or staple instrument printouts, chromatograms, calibration reports, or other documents directly into the notebook. Write across the border of the attachment and the notebook page so that it is clear the attachment was placed at that time. Initial and date each attachment.

8.5. Tables and Calculations

- Draw tables with a ruler if practical.
- Show all calculations, including units and intermediate steps, so that results can be verified.
- Circle or box final results for easy identification.

8.6. Blank Space and Unused Pages

- Do not leave large blank areas within an entry. If you finish an entry partway down a page, draw a diagonal line through the remaining blank space and initial and date it. This prevents later additions.
- Never skip pages. If you accidentally skip a page, draw a diagonal line through it, write “INTENTIONALLY LEFT BLANK,” and initial and date it (Kanare, 1985).

9. Error Correction

If you make a mistake in the notebook (Kanare, 1985):

1. Draw a **single horizontal line** through the incorrect text so it remains legible.
2. Write the correct information directly above, below, or beside the crossed-out entry.
3. Write your initials and the date next to the correction.
4. If the error is extensive (e.g., an entire wrong entry), strike through the full section, write “Error – see page XX,” and rewrite the correct entry on the next available page.

! Prohibited Correction Methods

- White-out, correction tape, or liquid paper
- Erasing or scratching out (even when using pencil)
- Tearing out or cutting out pages
- Writing over an existing entry

Any of these actions raises data integrity concerns and may invalidate the record (Kanare, 1985).

10. Electronic Data References

When analysis is performed electronically (R scripts, instrument software, spreadsheets), record in the notebook:

- The name and location of the electronic file (e.g., full file path or GitHub repository URL)
- The date and time the file was created or the analysis was run
- The software version or R version used

Cross-referencing electronic records ensures that the notebook and the digital record are linked and neither stands alone (U.S. Environmental Protection Agency, 2002; US Food and Drug Administration, 2004).

11. Carbon-Copy Management

1. After completing each session, remove the carbon-copy page.
2. Review the copy for legibility. If the copy is not readable, note this on the original and on the copy.
3. Place the copy in the project's designated folder on the lab shared drive or in the physical project file.
4. The original stays bound in the notebook permanently.

12. Signature and Witness

- Sign and date each entry when you complete it.
- If your work produces a significant new observation or result (a new datum, a method validation, a reproducibility test), have a witness (a labmate or the PI) sign and date the entry as well.
- For IP-sensitive work, all entries should be witnessed at the time of writing, not retroactively.

13. Carbon Copy Storage and Notebook Archiving

13.1. Carbon Copies

File carbon copies chronologically in the project file within 48 hours of each session. Label the folder clearly with the project name, PI, and date range.

13.2. Full Notebooks

When a notebook is full:

1. Record the completion date on the outside spine.
2. Update the Table of Contents on the first two pages.
3. File the completed notebook in the **Notebook Archive** (SGM 133, labeled shelf), organized by project and date.
4. Update the Notebook Registry spreadsheet with the completion date.
5. Notebooks are retained for a minimum of **7 years** after the end of the associated project, or longer if required by a funding agency, IRB, or regulatory body.
6. Notebooks are the property of the EA Program and Pomona College. They must not be taken home, discarded, or removed from the archive without PI approval (Kanare, 1985).

14. Common Mistakes

Mistake	Consequence
Using pencil	Entries can be erased; not a permanent record

Mistake	Consequence
Recording data on scratch paper first	Scratch paper gets lost; transcription adds errors
Leaving entries unsigned	Cannot confirm who performed the work
Leaving blank space without striking through	Appearance that data could be inserted later
Using white-out or scribbling over errors	Raises data integrity concerns
Not removing carbon-copy duplicates	Backup is only useful if stored separately
Forgetting to reference electronic files	Data become disconnected from context
Skipping the Table of Contents	Information is hard to locate later

15. References

- Kanare (1985)
- U.S. Environmental Protection Agency (2002)
- US Food and Drug Administration (2004)

Kanare, H. M. (1985). *Writing the laboratory notebook*. American Chemical Society.

U.S. Environmental Protection Agency. (2002). *Guidance for quality assurance project plans (EPA QA/G-5)* (EPA/240/R-02/009). U.S. Environmental Protection Agency. <https://www.epa.gov/sites/default/files/2015-06/documents/g5-final.pdf>

US Food and Drug Administration. (2004). *Guidance for industry: Part 11, electronic records; electronic signatures – scope and application*. US FDA.

16. Related SOPs

SOP	Title	Relationship
L002	Laboratory Safety	Training documentation forms
L801	RStudio Server and GitHub	Electronic data management
L802	Quality Control and QA	What to record (Section 7.1)
F003	Field Notebook Protocols	Field counterpart

17. Training Record

Before beginning independent laboratory work, all personnel must:

1. Read this SOP in full
2. Set up a new notebook correctly (inside cover, Table of Contents, registry entry)
3. Demonstrate a properly formatted entry including: header, data recording, attached printout, error correction, blank-space management, and signature
4. Be signed off by the lab manager or PI



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L015

Foreign Soil Handling and Import Permits

Standard Operating Procedure

SOP Number	SOP-L015
Revision	1.1
Author(s)	Kathryn Hargan
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	3
5 Safety and Hazards	3
5.1 APHIS Quarantine Requirement	3
5.2 Required PPE	4
5.3 Storage Restrictions	4
5.4 Chemical Hazards	4
5.5 Emergency Procedures	4
6 Personnel and Training Requirements	4
7 Required Materials	5
8 Sample Collection and Import	5
8.1 Equipment Decontamination at the Collection Site	5
8.2 Shipping Foreign Soils	6
8.3 Waybills	6
8.4 Hand-Carrying Soils into the United States	6
9 Receiving, Storage, and Logging	7
9.1 Receiving	7
9.2 Logging	7
9.3 Labeling and Storage	7
10 Treatment, Sterilization, and Disposal	7
10.1 Sterilization Method	7
10.2 Disposal	8
11 Mass Accounting and Audit	8
12 Quality Control	8

13 References	8
14 Related SOPs	9
15 Training Record	9
16 Appendix A: Sample Numbering Convention	9

1. Purpose

This SOP outlines the mandatory practices for securely and safely handling, analyzing, and disposing of soils and sediments collected from outside the United States. The importation and movement of untreated foreign soil is classified by the USDA Animal and Plant Health Inspection Service (APHIS) as an extremely high-risk activity (USDA Animal and Plant Health Inspection Service, 2024b). Several levels of review and approval are required before a permit can be issued. This SOP has been written to fulfill the conditions of the EA Program’s APHIS foreign soil permit.

These practices are mandatory for all personnel working with foreign soils in the EA Teaching and Research Laboratory at Pomona College. Additionally, all persons working in the laboratory, even those not directly handling foreign soils, must read this SOP and be aware of standard operations involving quarantine materials so that a safe and secure laboratory environment is maintained.

2. Scope

- **Applies to:** All soils and sediments collected outside the United States and its territories that are imported to or processed in the EA Program laboratory
- **Does not apply to:** Domestic soils (including soils from Hawaii, Puerto Rico, and the U.S. Virgin Islands, which are not foreign countries under APHIS regulations); fully sterilized or commercially prepared soil reference materials
- **Analyses covered:** ICP-MS, EA-IRMS (total C, N, S and stable isotope ratios), texture, organic matter content, and other parameters where soils can be disposed of properly after analysis
- **Location:** Foreign soil storage in SGM 133 (designated cabinet); processing in SGM 134 (dedicated area)

3. Responsibilities

Role	Responsibility
PI (Permit Holder)	Maintain active APHIS permit; ensure compliance
Lab Manager	Oversee quarantine storage; verify sterilization
Trained Personnel	Handle soils per this SOP; log all activity
All Lab Personnel	Read this SOP; understand quarantine protocols even if not handling foreign soils

4. Definitions

- **APHIS (Animal and Plant Health Inspection Service):** The USDA agency responsible for protecting US agriculture from pests and diseases; regulates genetically engineered organisms and administers quarantine regulations; issues permits for importing soil and biological materials that could harbor plant pests or pathogens (USDA Animal and Plant Health Inspection Service, 2024b).
- **Autoclave sterilization:** Treatment of soil at 121 °C and 15 psi for at least 30–60 minutes to inactivate plant pathogens, weed seeds, nematodes, and other regulated organisms; required by USDA APHIS before foreign soil may be used in experiments outside a permitted facility.
- **CBP (U.S. Customs and Border Protection):** The federal agency that clears imported soils and plant material for entry into the United States, working alongside APHIS inspectors at Plant Inspection Stations.
- **Controlled import permit (PPQ Form 588):** A USDA APHIS document authorizing the importation of specified soil or biological material under defined containment and handling conditions; the PI must obtain this before any foreign soil enters the United States (USDA Animal and Plant Health Inspection Service, 2024b).
- **Decontamination:** A procedure that eliminates or reduces microbial contamination to a safe level with respect to transmission of infection; for foreign soils, typically achieved by autoclave or dry-heat sterilization.
- **Foreign soil:** Soil or sediment originating outside the United States and its territories; regulated by USDA APHIS under 7 CFR Part 330 because of the risk of introducing exotic plant pests, pathogens, and invasive species (USDA Animal and Plant Health Inspection Service, 2024b).
- **Permitted facility:** A laboratory or greenhouse that has been inspected and approved by USDA APHIS for work with imported soil or regulated biological materials; must meet physical containment requirements specified in the permit.
- **Plant Inspection Station (PIS):** A USDA/CBP facility at a port of entry where imported shipments are inspected and cleared by APHIS and CBP inspectors before release.
- **PPQ Form 508:** The green and yellow APHIS shipping label required for shipments of 3 lb or less that will be treated at the Plant Inspection Station.
- **PPQ Form 550:** The black and white APHIS shipping label required for shipments routed directly to a USDA-approved permitted facility.
- **Regulated article:** Any soil, plant material, or organism whose importation is controlled by USDA APHIS because of its potential to harbor or transmit plant pests or diseases.
- **ePermits:** The USDA APHIS online system for applying for and managing import permits and requesting shipping labels (USDA Animal and Plant Health Inspection Service, 2024a).

5. Safety and Hazards

5.1. APHIS Quarantine Requirement

Soil is strictly controlled under APHIS quarantine regulations 7 CFR Part 330 because it can readily provide a pathway for introducing dangerous organisms into the United States. Importation of soil from foreign sources is prohibited unless authorized by APHIS under specific conditions, safeguards, and controlled circumstances described in a valid permit and/or compliance agreement.

Noncompliance can result in permit revocation, fines, and legal action (USDA Animal and Plant Health Inspection Service, 2024b).

5.2. Required PPE

- ☐ Standard laboratory coat
- ☐ Nitrile gloves
- ☐ Lab safety goggles
- ☐ Closed-toe shoes

5.3. Storage Restrictions

- Foreign soils must be stored only in the designated quarantine cabinet in SGM 133
- Foreign soils must be processed only in the dedicated area in SGM 134
- Soils must never be opened or processed outside these designated areas

5.4. Chemical Hazards

If chemicals are used during analysis (e.g., acids for digestion), review the Safety Data Sheets before beginning. For isopropyl alcohol used in decontamination, work in a well-ventilated area and keep away from ignition sources.

5.5. Emergency Procedures

Refer to [SOP-L002 Laboratory Safety](#) and [SOP-L003 Hazardous Materials Handling](#). For spills of foreign soil, see §11 (Spill Cleanup).

6. Personnel and Training Requirements

All personnel working with foreign soils must complete the following before handling any quarantine material:

1. Complete [SOP-L002 Laboratory Safety](#) training, including the annual Pomona College lab safety course
2. Read the USDA/APHIS Compliance Agreement (current agreement number on file with the PI)
3. Read the current Foreign Soil Permit (permit number on file with the PI) (USDA Animal and Plant Health Inspection Service, 2024b)
4. Read this SOP in full
5. Complete [SOP-L105 Drying Ovens](#) training (required for sterilization procedures)
6. Be signed off by the PI or lab manager

! All Lab Users

Even personnel who do not work directly with foreign soils must read this SOP so they understand the quarantine protocols in effect in SGM 133 and SGM 134. This is a condition of the APHIS permit.

i APHIS Contact

For questions about the permit, shipping, or compliance, contact the local APHIS Plant Protection and Quarantine office. Verify current contact information with the PI before each import event, as personnel assignments may change.

7. Required Materials

Item	Location	Notes
Drying oven (capable of 250 °C)	SGM 134	See SOP-L105
Foreign Soils Log Book	SGM 133	Stored with quarantine cabinet
Quarantine cabinet (labeled)	SGM 133	Lockable; red “Quarantine Soil” tags
Refrigerator or freezer (if required)	SGM 133	Designated area for foreign soils
Whirl-Pak bags and Ziplock bags	SGM 133	For sample containment
Isopropyl alcohol	SGM 134	For decontamination of surfaces and equipment
Red tags (“Quarantine Soil – Unsterilized”)	SGM 133	
Green tags (“Quarantine Soil – Sterilized”)	SGM 133	
PPQ Form 508 and/or PPQ Form 550 labels	On file	Requested through ePermits (USDA Animal and Plant Health Inspection Service, 2024a) or by email

8. Sample Collection and Import

8.1. Equipment Decontamination at the Collection Site

All field equipment must be thoroughly cleaned and disinfected of all soil residues at the collection site before packing for transport. Acceptable methods:

- Soak in isopropyl alcohol for one hour, or
- Soak and wash in hot water with detergent for 30 minutes

8.2. Shipping Foreign Soils

1. Pack soil and sediment samples in sturdy, leak-proof containers. Declare contents as “Soil samples.”
2. The primary container must be securely closed and watertight.
3. Enclose the primary container in a second, durable, watertight secondary container. Each container must be capable of containing the soil independently.
4. Attach the appropriate APHIS shipping label to the exterior of each shipping package (USDA Animal and Plant Health Inspection Service, 2024b):
 - **PPQ Form 508** (green and yellow): For shipments of 3 lbs or less that will be treated at the PIS
 - **PPQ Form 550** (black and white): For shipments routed directly to the USDA-approved facility (Pomona College)

Label Placement

Packages without APHIS shipping labels on the exterior may be refused entry even if labels are enclosed inside the package.

5. Each label is individually numbered with a distinctive barcode. The permit holder must request the appropriate labels at the time of permit issuance.
6. Additional labels can be obtained through the “My Shipments/Labels” feature in ePermits (USDA Animal and Plant Health Inspection Service, 2024a) or by emailing BlackWhiteGreenYellowlabelrequest@aphis.usda.gov.

8.3. Waybills

- **PPQ Form 508 shipments** require two waybills: one international waybill to direct the shipment to the PIS, and one domestic waybill (placed inside the package) to direct the shipment from the PIS to the permit holder.
- **PPQ Form 550 shipments** require one waybill to direct the shipment to the permit holder.

The waybill must include: carrier account number or postage, permit holder name, permit number, label number, delivery address, and telephone number. If the waybill address does not match the permit address, the package may be refused entry by CBP.

8.4. Hand-Carrying Soils into the United States

Permitted articles may be hand-carried into the U.S. only if (USDA Animal and Plant Health Inspection Service, 2024b):

1. Hand carrying was requested in the permit application and authorized in the permit conditions
2. The permit conditions list the specific steps that must be followed
3. If someone other than the permit holder will hand-carry, that person must be identified on the permit
4. The authorized hand-carrier must follow all permit conditions pertaining to hand-carried shipments

9. Receiving, Storage, and Logging

9.1. Receiving

1. Transport soils directly to the Biogeochemistry Lab quarantine cabinet in SGM 133. Under no circumstances may soils be opened or processed until they reach the quarantine cabinet.
2. Open containers only inside the designated closed room area in SGM 133 or SGM 134. Take all precautions to prevent the escape of any potential pest that may be in the soil.

9.2. Logging

Upon arrival at Pomona College, log every sample in the Foreign Soils Log Book. Each entry must include:

Field	Description
Sample number	Year and consecutive number (e.g., 18-01)
Date of arrival	YYYY-MM-DD
Origin (provenance)	Country, region, site name
Collector name/initials	Who collected the sample in the field
Mass (grams)	As received
Reason for collection	Research project or study name
Storage location	SGM 133 cabinet shelf, refrigerator, or freezer
Sterilization status	Unsterilized (red tag) on arrival

9.3. Labeling and Storage

1. Samples remain sealed in original Whirl-Pak bags within Ziplock bags until processed.
2. Store bags on shelf trays within the closed quarantine cabinet. Samples must not be left on tables or elsewhere when not in use.
3. All stored, unsterilized soils must be labeled with red tags stating “Quarantine Soil – Unsterilized.”
4. Sterilized samples must be labeled with green tags stating “Quarantine Soil – Sterilized.”
5. Any individual sample being processed outside its storage cabinet must also be clearly labeled to indicate sterilization status.

10. Treatment, Sterilization, and Disposal

10.1. Sterilization Method

Soil samples must be sterilized by dry heat treatment at 250 °C for 24 hours, or by one of the other approved methods documented in the Foreign Soils Log Book.

! All Residues Must Be Sterilized

All residues from processing (including ash, rinse water filter residues, and equipment rinse material) must be sterilized using the same methods as the soil itself.

10.2. Disposal

After sterilization, soils may be disposed of in standard solid waste. Document disposal date, mass, and method in the Foreign Soils Log Book.

11. Mass Accounting and Audit

Periodically verify that the sum of all samples used in analyses and the remaining inventory agrees with the original imported mass within 10% (APHA et al., 2012).

i Note

Discrepancies exceeding 10% must be investigated and documented.

12. Quality Control

- Verify that the APHIS Foreign Soil Permit is current and has not expired before any import activity.
- Confirm that APHIS shipping labels match the current permit number.
- Audit the Foreign Soils Log Book at least once per semester to verify all entries are complete and mass accountability is within 10% (APHA et al., 2012).
- Report any anomalies (missing samples, mass discrepancies, permit questions) to the PI immediately.

13. References

- USDA Animal and Plant Health Inspection Service (2024b)
- USDA Animal and Plant Health Inspection Service (2024a)
- 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.

USDA Animal and Plant Health Inspection Service. (2024a). *ePermits: Permits for importing regulated articles*. <https://www.aphis.usda.gov/aphis/ourfocus/planthealth/import-information/permits/epermits>

USDA Animal and Plant Health Inspection Service. (2024b). *Importing soil and earth: Regulations under 7 CFR part 330*. <https://www.aphis.usda.gov/plant-pests-diseases/permits/soil>

14. Related SOPs

SOP	Title	Relationship
L002	Laboratory Safety	Required prerequisite
L003	Hazardous Materials	Chemical spill response
L105	Drying Ovens	Sterilization at 250 °C
L112	Autoclave Sterilization	Alternative sterilization method

15. Training Record

Before handling foreign soils independently, personnel must:

1. Read this SOP in full
2. Complete [SOP-L002 Laboratory Safety](#) training
3. Complete [SOP-L105 Drying Ovens](#) training
4. Read the current APHIS Compliance Agreement and Foreign Soil Permit (copies on file with the PI) (USDA Animal and Plant Health Inspection Service, 2024b)
5. Complete the annual Pomona College lab safety course
6. Demonstrate proper logging, labeling (red/green tags), and sterilization procedures under supervision
7. Be signed off by the PI

16. Appendix A: Sample Numbering Convention

Each sample receives a number consisting of the two-digit year and a consecutive number for that year. For example, 18-34 indicates the 34th sample logged in 2018. The numbering resets to 01 at the start of each calendar year.



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L020

Reagent and Standard Preparation

Standard Operating Procedure

SOP Number	SOP-L020
Revision	0.1
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	3
5.2 Emergency Procedures	3
6 Water Quality	3
7 Procedure	4
7.1 Planning	4
7.2 Weighing Solids	4
7.3 Dissolving and Diluting	4
7.4 Preparing Calibration Standards by Serial Dilution	5
7.5 pH Adjustment (When Required)	5
7.6 Labeling	5
7.7 Storage	6
7.8 Documentation	6
8 Quality Control	6
9 Common Reagent Recipes	6
10 Waste Disposal	7
11 References	7
12 Related SOPs	7
13 Training Record	8

1. Purpose

This procedure describes general best practices for preparing, labeling, storing, and documenting laboratory reagents and calibration standards used across EA Program analytical methods. Individual analytical SOPs specify the exact reagents and concentrations required for each method; this SOP provides the overarching framework for solution preparation that ensures traceability, accuracy, and safety.

2. Scope

- **Applies to:** Preparation of aqueous reagent solutions, extraction solutions, calibration standards, buffer solutions, and indicator solutions used in EA Program laboratory analyses
- **Does not apply to:** Preparation of biological growth media (covered in microbiology SOPs); preparation of molecular biology reagents (master mixes, primers, probes; see SOP-L701 and related SOPs); field reagent preparation (covered in field SOPs)
- **Location:** EA Program laboratory, SGM 133

3. Responsibilities

Role	Responsibility
Lab PI	Approve reagent-grade specifications
Lab Manager	Maintain chemical inventory, order reagents, prepare shared stock solutions
Trained Personnel	Prepare working solutions per this SOP and the relevant analytical SOP
New Students	Complete training before preparing solutions independently

4. Definitions

- **Blank solution:** A solution prepared identically to calibration standards and samples but containing no analyte; used to correct for background signal and verify the absence of contamination in reagents and glassware.
- **Calibration standard:** A solution of known analyte concentration prepared from a primary or secondary standard; used to establish the relationship between instrument signal and concentration.
- **Matrix-matched standard:** A calibration standard prepared in the same solvent or extract matrix as the samples (e.g., 2 M KCl for soil extracts); minimizes matrix effects on instrument response.
- **Primary standard:** A highly pure, chemically stable substance whose mass can be accurately weighed to prepare a solution of precisely known concentration without prior standardization; examples include potassium hydrogen phthalate (KHP) and anhydrous sodium carbonate.

- **Reagent grade:** A chemical purity classification (also called ACS grade) meeting minimum purity specifications set by the American Chemical Society; appropriate for most analytical work; trace-metal-grade or ultrapure-grade reagents are required for trace analysis.
- **Secondary standard (working standard):** A solution prepared from a primary standard or a certified reference material (CRM) and used as the working calibration solution; must be verified against the primary standard periodically.
- **Stock solution:** A concentrated solution of a reagent or standard prepared in bulk and used to prepare working solutions by dilution; labeled with concentration, preparation date, expiration date, preparer's name, and any hazard information.
- **Volumetric dilution:** Dilution performed using Class A volumetric glassware (volumetric flasks, pipettes) to achieve accurate, traceable concentrations; pipette to volume, mix thoroughly, then bring to final volume.

5. Safety and Hazards

Hazards

- **Chemical:** Concentrated acids, bases, and organic solvents used in reagent preparation are corrosive, toxic, and/or flammable. Review the SDS for every chemical before use.
- **Thermal:** Dissolving some solutes (e.g., NaOH, H₂SO₄ dilution) is exothermic. Add solute to solvent slowly, never the reverse for acid dilutions.
- **Glassware:** Volumetric flasks and graduated cylinders can break during mixing. Inspect for cracks before use.

5.1. Required PPE

- ☐ Safety glasses or splash goggles (for concentrated acids/bases)
- ☐ Lab coat
- ☐ Nitrile gloves
- ☐ Fume hood (for volatile or fuming reagents)

5.2. Emergency Procedures

For chemical splashes, flush with water for at least 15 minutes. For spills, follow [SOP-L004 Chemical Spill Response](#).

6. Water Quality

All reagent and standard preparation must use water of appropriate purity:

Water Grade	Source	Use
Type I (18.2 MOhm, ultrapure)	Milli-Q system (see future SOP-L100)	Calibration standards, trace metal work, DOC analysis, molecular biology
Type II (deionized) Tap water	Central DI supply Building supply	General reagent preparation, rinsing Initial glassware rinse only; never for reagent preparation

i Note

Verify Milli-Q resistivity (should read 18.2 MOhm-cm at 25 C) before preparing trace-level standards. If the reading is below 18.0, replace the cartridge or consult the lab manager.

7. Procedure

7.1. Planning

1. Consult the relevant analytical SOP for the exact reagent name, concentration, and grade required
2. Calculate the mass or volume of solute needed using the target concentration and final volume. Document the calculation in the lab notebook.
3. Verify that the chemical in inventory matches the required grade (ACS reagent grade, trace metal grade, molecular biology grade, etc.)

7.2. Weighing Solids

1. Calibrate or verify the analytical balance per [SOP-L200](#)
2. Use a clean, dry weighing vessel (weigh boat or beaker)
3. Tare the vessel on the balance
4. Transfer the required mass of solid reagent using a clean spatula. Record the actual mass to the precision of the balance.
5. Return the reagent bottle cap immediately to prevent contamination and moisture uptake

7.3. Dissolving and Diluting

1. Transfer the weighed solid to a clean beaker and add approximately 75% of the final volume of water. Stir with a magnetic stir bar or glass rod until dissolved.
2. For acid dilutions: always add acid to water (“Do as you oughta, add acid to water”). Stir continuously and allow the solution to cool before adjusting to final volume.
3. Transfer the solution quantitatively to a volumetric flask of the target volume
4. Rinse the beaker and stir bar with small portions of water and add the rinses to the flask
5. Bring to the mark on the volumetric flask at room temperature. Read the meniscus at eye level.
6. Stopper the flask and invert 10 times to mix

7.4. Preparing Calibration Standards by Serial Dilution

1. Prepare or obtain a stock standard of known concentration (certified reference material or gravimetrically prepared stock)
2. Using calibrated volumetric pipettes or micropipettes ([SOP-L103](#)), transfer the calculated aliquot of stock solution into a volumetric flask
3. Dilute to the mark with the appropriate matrix (water, extractant solution, or acid matrix matching the samples)
4. Prepare the full calibration curve (typically 5–7 points plus a blank) in order from lowest to highest concentration to minimize carryover contamination
5. Record all dilution steps, pipette volumes, and flask sizes in the lab notebook

Tip

For trace-level calibration standards (ppb range), prepare fresh daily or per the stability guidance in the analytical SOP. Dilute standards degrade faster than concentrated stocks due to adsorption to container walls.

7.5. pH Adjustment (When Required)

1. After dissolving, measure the pH with a calibrated pH meter per [SOP-L300](#)
2. Adjust to the target pH using the appropriate acid or base (as specified in the analytical SOP), added dropwise with stirring
3. Record the final pH and the volume of acid/base added

7.6. Labeling

Every prepared solution must be labeled with the following information before it leaves the preparation bench:

- Solution name and concentration (e.g., “0.5 M K₂SO₄”)
- Solvent or matrix (e.g., “in DI water”)
- Date prepared
- Expiration date or shelf life (per the analytical SOP or manufacturer recommendation)
- Preparer’s initials
- Hazard warnings if applicable (e.g., “Corrosive,” “Flammable”)

Important

Never use an unlabeled solution. If you find an unlabeled container, do not use it. Dispose per [SOP-L006 Waste Disposal](#).

7.7. Storage

Solution Type	Storage Conditions
Aqueous inorganic standards	Room temperature, dark; amber bottles for light-sensitive analytes
Organic solvent solutions	Flammable cabinet; fume hood if volatile
Buffer solutions	Room temperature or 4 C per the analytical SOP
Concentrated acids and bases	Acid cabinet (acids) or base shelf (bases); never store together
Molecular biology reagents	-20 C (primers, probes, enzymes) or 4 C (buffers) per manufacturer

7.8. Documentation

Record the following in the lab notebook for every prepared solution:

- Reagent name, lot number, manufacturer, and grade
- Calculation showing target concentration and volumes/masses
- Actual mass weighed (to balance precision)
- Final volume and flask size
- Date prepared, preparer's initials
- Expiration date
- Any deviations from the standard procedure

8. Quality Control

- Verify the concentration of each new stock standard by analyzing it against the previous batch or against a certified reference material (CRM). Agreement should be within 5%.
- For critical calibration standards, prepare from a second independent source (different manufacturer or lot) and compare
- Discard solutions past their expiration date; do not extend shelf life without re-verification
- Check volumetric glassware calibration (Class A tolerance) annually by gravimetric verification
- Verify micropipette accuracy quarterly per [SOP-L103](#)

9. Common Reagent Recipes

The table below lists frequently used reagent solutions across EA Program methods. Refer to the source SOP for complete preparation details.

Solution	Concentration	Source SOP	Shelf Life
KCl extraction solution	2 M	L403	6 months
K ₂ SO ₄ extraction solution	0.5 M	L409	6 months
Sodium hexametaphosphate (HMP)	50 g/L	L401	1 month
HNO ₃ (for sample acidification)	2%	L410	Prepare fresh
KHP stock standard (DOC)	1,000 mg C/L	L407	1 month (refrigerated)
KNO ₃ stock standard (TN)	1,000 mg N/L	L407	6 months
NaOH (for pH adjustment)	1 M	Various	6 months
HCl (for pH adjustment)	1 M	Various	6 months
Longmire's buffer (eDNA preservation)	As formulated	F700	6 months (refrigerated)

10. Waste Disposal

Dispose of expired or unwanted reagent solutions per [SOP-L006 Waste Disposal](#). Key points:

- Hazardous reagents (acids, bases, solvents, metal solutions) go to the appropriate waste stream in the SAA
- Dilute, non-hazardous salt solutions at neutral pH may be drained with copious water if approved by EH&S
- Never pour an unknown or unlabeled solution down the drain

11. References

- National Research Council. (2011). *Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards* (updated ed.). National Academies Press.
- Harris, D.C. (2016). *Quantitative Chemical Analysis*. 9th ed. W.H. Freeman.
- APHA, AWWA, WEF. (2012). *Standard Methods for Examination of Water and Wastewater*. 22nd ed. Section 1080: Reagent Water.

12. Related SOPs

SOP	Title	Relationship
L002	Laboratory Safety	General safety framework
L003	Hazardous Materials Handling	Chemical safety
L005	Chemical Inventory	Reagent sourcing and tracking
L006	Waste Disposal	Disposing of expired reagents
L102	Using Balances	Weighing technique
L103	Micropipettes	Volumetric transfers
L200	Balance Calibration	Ensuring mass accuracy

SOP	Title	Relationship
L300	pH and Conductivity	pH verification of prepared solutions

13. Training Record

Before preparing reagents or standards independently, personnel must:

1. Read this SOP and [SOP-L003](#) in full
2. Demonstrate proper use of the analytical balance (SOP-L102/L200) and micropipettes (SOP-L103)
3. Prepare one reagent solution and one set of calibration standards under supervision, demonstrating correct calculation, weighing, dissolving, volumetric dilution, labeling, and documentation
4. Demonstrate correct acid dilution technique (acid to water)
5. Be signed off by the lab manager or PI