DEPARTMENT OF ECOLOGY
State of Washington

Standard Operating Procedure EAP090, Version 1.2

Decontaminating Field Equipment for Sampling Toxics in the Environment

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Purpose of this Document

The Washington State Department of Ecology develops Standard Operating Procedures (SOPs) to document agency practices related to sampling, field and laboratory analysis, and other aspects of the agency's technical operations.

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SIGNATURES AVAILABLE UPON REQUEST

The Washington State Department of Ecology's (Ecology's) Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical and administrative experts. Their primary purpose is for internal Ecology use, although sampling and administrative SOPs may have a wider utility. Our SOPs do not supplant official published methods. Distribution of these SOPs does not constitute an endorsement of a particular procedure or method.

Any reference to specific equipment, manufacturer, or supplies is for descriptive purposes only and does not constitute an endorsement of a particular product or service by the author or by Ecology.

Although Ecology follows the SOP in most instances, there may be instances in which the Ecology uses an alternative methodology, procedure, or process.

SOP Revision History

Revision Date	Revision History	Summary of changes	Sections	Revisers
12/7/2016	1.1	Revised for clarity and updates	All	Jim Medlen
02/02/2017	1.1	Recertified	All	Tom Gries
01/07/2020	1.2	Revised for formatting and clarity	All	Alex Gipe

1.0 Purpose and Scope

1.1 This document is the Environmental Assessment Program (EAP) Toxics Study Unit (TSU) Standard Operating Procedure (SOP) for decontaminating reusable field equipment to be used for sampling toxic chemicals in various environmental media.

1.2 Washington Department of Ecology (Ecology) investigates toxic contaminants in water, sediment, plant, and animal tissues. To obtain accurate, representative samples, sampling equipment must be free from residual contamination. Quality assurance measures as described are to be implemented after cleaning to ensure equipment is sufficiently decontaminated.

2.0 Applicability

2.1 This document was prepared for use by EAP, but it may have a broader scope of application within Ecology and the regulatory community. This procedure is to be followed by EAP personnel conducting scientific studies to determine the occurrence and concentration of toxic chemicals in the environment. This SOP does not eliminate the need to have project specific cleaning protocols to meet specialized objectives or to have an approved Quality Assurance Project Plan (QAPP) on file before sampling begins.

2.2 The cleaning procedures explained in this SOP are intended for use in a clean laboratory setting. These procedures can be adapted for use in the field. Field cleaning procedures are not included in this document.

3.0 Definitions

3.1 ACS - American Chemical Society

3.2 Blank - A sample of clean matrix submitted to the lab which is used to assess potential sources of contamination.

3.3 Deionized water - Water that has had the ions removed, usually by an ion exchange process.

3.4 HPLC – High Performance Liquid Chromatography: An analytical method used to separate, identify, and quantify compounds dissolved in solution.

3.5 Kow – Octanol-water partition coefficient: The ratio of an organic compound's concentration in a known volume of n-octanol to its concentration in a known volume of water at a specified temperature.

3.6 Matrix – All the components of a sample other than the analyte(s) being analyzed.

3.7 Milli-Q water - Specifically, a trademark of Millipore Corporation to describe ultrapure, type 1 water. This term generally is used to describe ultrapure (Type I) water that has been cleaned using many combinations of processes, usually involving deionization and a series of filters. Millipore Milli-Q water is used at MEL for method blanks and can be provided upon request for various project blanks.

3.8 QAPP - Quality Assurance Project Plan

3.9 Reagent – Solvent or compound used in chemical processes or analysis.

3.10 Reagent grade – Of satisfactory purity to be used for chemical processes or analysis.

3.11 Type IV – Water that conforms to the standards of ASTM Type IV Reagent Water specifications. Type IV Reagent water is available in the cleaning room at Ecology Headquarters. The water purifier at Headquarters uses reverse osmosis, adsorption, and de-ionization to produce Reagent Water.

4.0 Personnel Qualifications/Responsibilities

4.1 Because this procedure requires the use of hazardous materials, training is required as described in Section 1 of the Ecology Chemical Hygiene Plan and Hazardous Materials Management Plan (Ecology, 2016) which includes: Responsibility, Laboratory Orientation, Job-Specific Orientation, New Chemicals, Process or Equipment, and Supervisors Conduct Routine Safety Discussions. Section 16 of the Chemical Hygiene and Hazardous Materials Management Plan discusses SOPs for the handling of the class of chemicals typically used at Ecology (Ecology, 2016).

5.0 Equipment, Reagents, and Supplies

5.1 Heavy-duty aluminum foil.

5.2 Personal protective equipment:

5.2.1 Eye protection.

5.2.2 Apron.

5.2.3 Gloves for solvents and acids. See Section 6 of the Ecology Chemical Hygiene Plan and Hazardous Materials Management Plan (Ecology, 2016). Table 4 of this document describes chemical compatibility by solvent for gloves.

5.3 Fume hood.

5.4 Stainless steel bowls for collecting used solvents.

5.5 Glass funnel.

5.6 Empty glass bottles for properly disposing of used solvents. See Section 11 of Chemical Hygiene Plan and Hazardous Materials Management Plan (Ecology, 2016).

5.7 Cleaning brushes.

5.8 Wash bottles for solvents.

5.9 Decontaminating fluids:

5.9.1 Tap water.

5.9.2 Deionized water (DI)

5.9.2.1 The project manager should consider the source and purity of DI. Two types of DI are available to Ecology staff. Type IV water is produced by the water purifier in the cleaning room at Headquarters. Type I, milli-Q water is available by request from MEL. A project manager should decide which type of DI to use depending on the measurement quality objectives of the study. Deionized water testing to assure that no contaminants of concern are present should be performed at the project manager's discretion.

5.9.3 Acetone, Certified ACS HPLC Grade ≥99.5% purity.

5.9.4 Hexane, Certified ACS HPLC Grade ≥99.5% purity.

5.9.5 Isopropanol ACS, Ultrapure ≥99.9% purity.

5.9.6 Methanol, Certified ACS Reagent Grade ≥99.8% purity.

5.9.7 10 % reagent grade nitric acid. Made up by diluting concentrated reagent grade nitric acid with DI water.

5.9.8 Liqui-Nox® (biodegradable, phosphate-free, interfering-residue free, concentrated soap from Valconox®, Inc.).

5.10 Blank rinse water (Milli-Q water can be provided by MEL upon request, this is the same water that MEL uses for method blanks)

5.11 Certified contaminant-free sample containers.

5.12 Sink and drain board.

6.0 Summary of Decontamination Procedures

6.1 To obtain reliable and usable data from investigations of environmental toxics, it is essential to effectively decontaminate sampling equipment to prevent contamination or cross-contamination of samples. Decontamination of sampling equipment should be conducted in a clean environment using verifiably clean solvents, including deionized water (DI), blank rinse water, organic solvents, and nitric acid.

6.2 There are several factors to consider when selecting a cleaning procedure. A project manager must consider the objectives of the study, target analytes, anticipated concentration of analytes, data quality objectives, method detection limits, media to be sampled, composition of sampling equipment, and safety of cleaning procedures.

6.3 Target analytes must be considered in order to select an appropriate method of decontamination. Dilute (10%) nitric or hydrochloric acid is commonly used to decontaminate equipment for inorganic contaminants such as metals. Organic contaminates are removed using organic solvents such as isopropanol, acetone, hexane, or methanol (EPA, 2015; ASTM 2008). The polarity of the cleaning solvent should be matched to the polarity of contaminants (i.e. polar solvent for polar contaminants). The polarity of the recommended solvents is displayed in Table 1. Recommended solvents for decontaminating sampling equipment for analytes of interest are presented in Table 2.

Table 1. Polarity of Recommended Decontamination Solvents

Solvent	Polarity
Methanol	0.762
Isopropanol	0.546
Acetone	0.355
Hexane	0.009

Source: Reichardt, 2003

Table 2. Recommended Solvents for Decontaminating Equipment for Analytes of Interest

Hexane	Isopropyl Alcohol or Acetone	Methanol	10% Nitric Acid
Polycyclic Aromatic Hydrocarbons (PAHs)	Pharmaceuticals	Volatile Organic Compounds	Metals
Polychlorinated Biphenyls (PCBs)	Many Emerging Contaminants	Perfluorinated Compounds	
Non-Polar Pesticides- Organochlorine Pesticides, DDT, Dieldrin, Toxaphene, etc.	Polar Pesticides, Many Herbicides, Some Organophosphate Pesticides		
Dioxins/Furans and Polybrominated Diphenyl Ethers (PBDEs)	Semi-Volatile Organic Compounds		

6.3.1 Starting sampling with cleaner media and progressing towards more contaminated media can reduce cross-contamination of samples. A sample with an expected low level of an analyte will require extremely thorough cleaning as very low levels of contamination on the sampling equipment can drastically affect the results of analysis.

6.3.2 The effectiveness of decontamination procedures is an important factor when establishing data quality objectives during project planning. Equipment rinse blanks can help the project manager assess whether the cleaning procedures have been effective and meet data quality objectives (see section 8.0, Quality Control and Quality Assurance).

6.3.3 The analytical detection limit (DL) for the sampled media can be a factor in deciding the decontamination procedure to be used. An analytical method with a high DL does not imply that less stringent cleaning methods are necessary. The additive effects of residual surface contamination on sampling equipment could lead to analytical results that are biased high.

6.3.4 The type of media being sampled will determine the effort required to clean sampling equipment.

6.3.4.1 Grossly contaminated equipment used to sample concentrated or pure contaminants, fish tissue, oily media, or sediments will require more physical cleaning than equipment used to sample water.

6.3.4.2 Fish tissue should be rinsed off sampling equipment with cold water before decontamination; hot water will cook the tissue to the equipment. Physical removal of surface contaminants with hot water, a surfactant such as Liquinox®, and a clean non-reactive brush will prepare equipment to be effectively decontaminated with the appropriate acids and/or solvents.

6.3.4.3 Some materials can be damaged by the acids and solvents used for cleaning. For example, acetone will damage acrylic sleeves used in sediment traps. Acids may damage some plastics. When there is doubt whether an acid or solvent will damage a piece of equipment, test the decontamination agent on a part of the equipment that does not contact a sample during sample collection. Keep in mind that non-permeable equipment (i.e. stainless steel or glass) will not absorb contaminants, but the contaminants will adsorb to the surface of the equipment. Non-permeable equipment can usually be cleaned and used again. If sampling equipment is constructed of permeable materials that will absorb contaminants while sampling, they will not be able to be cleaned and reused.

6.4 See Figure 1 for a flow chart of recommended decontamination procedures.

6.5 Decontamination procedures are also addressed in section 16.2 of the Ecology Chemical Hygiene Plan & Hazardous Materials Management Plant. Safety protocols are also covered in this document.

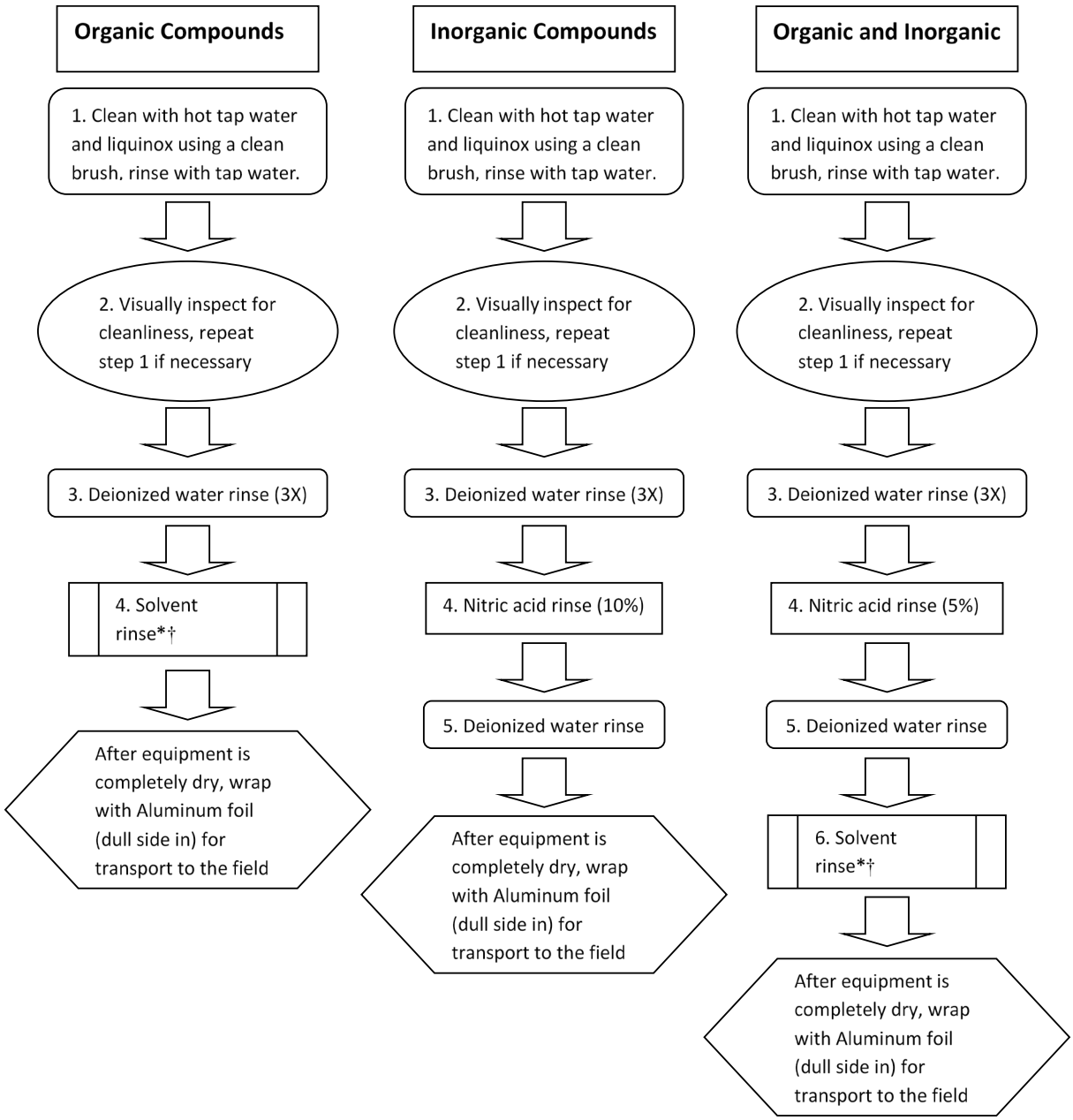

Figure 1. General procedure for decontaminating equipment when sampling for organic or inorganic contaminants.

***Match the polarity of the solvent to the polarity of the contaminant that will be sampled (see section 6.1.1.). Isopropyl alcohol and acetone are effective general cleaning solvents that are mostly polar but also have non-polar characteristics. Hexane is a solvent that works well for desorbing non-polar contaminants. When sampling for perfluorinated compounds, EPA guidance recommends methanol as a cleaning solvent (EPA, 2011).**

†See Table 2 for recommended solvents.

6.6 Detailed Decontamination Procedure

6.7 Start with a clean work area.

6.7.1 Wipe down countertops with a clean sponge to remove dust and other debris.

6.7.2 Cover all surfaces where equipment will be set down (fume hood, drying rack) with new aluminum foil, dull side up.

6.8 Physical removal of surface contaminants is the first step of decontaminating sampling equipment.

6.8.1 Rinse off surface contaminants using tap water. Cold water will work better to remove animal tissue. Hot water will work better for other matrices.

6.8.2 Scrub equipment until clean using a clean brush, Liquinox®, and hot water.

6.8.3 Rinse equipment with hot tap water.

6.8.4 Rinse equipment with deionized water.

6.9 If sampling for inorganics, rinse all surfaces of equipment with 10% reagent grade nitric acid.

6.9.1 Rinse equipment with deionized water (Type IV or better).

6.10 If sampling for organic compounds, a solvent rinse is required.

6.10.1.1 The rinse solvent should be polarity matched to contaminants

6.10.1.2 Polar contaminants include but are not limited to:

- Many pesticides
- Carbamates
- Organophosphates
- Many wastewater related chemicals or emerging contaminants
- Hormones
- Pharmaceuticals
- Personal care products

6.10.1.3 Effective polar solvents include isopropyl alcohol, acetone, and methanol

6.10.1.4 Non-polar contaminants include but are not limited to:

- Polychlorinated biphenyls
- Polybrominated diphenyl ethers
- Polycyclic aromatic hydrocarbons
- Volatile and semi-volatile compounds
- Chlorinated pesticides
- Dioxins and furans

6.10.1.5 Hexane is and effective non-polar decontamination solvent

6.10.1.6 When sampling for extremely low levels of analytes (ppt or smaller), consider using one time use sampling methods such as recyclable transfer jars. This greatly reduces the possibility of sample contamination, which is common when low level analysis is conducted. One time use sampling equipment should be certified by the manufacture to be free of target analytes at project relevant concentrations

6.10.2 Rinse all surfaces of the sampling equipment with the appropriate cleaning solvent.

6.10.2.1 Solvents and solvent wash bottles are located in the corrosive and flammable cabinets in the cleaning room. Use these wash bottles to rinse equipment placed on clean foil inside the fume hood. Collect used solvent and acids and store properly until disposal as described in section 11.0 of the Chemical Hygiene Plan.

6.10.3 If sampling for Volatile Organic Compounds (VOCs), proceed to step 6.10.3.1. If not sampling for these compounds, proceed to 6.10.4.

6.10.3.1 Acetone and isopropanol residues can interfere with high resolution gas chromatography-mass spectrometry analysis of VOCs (personal communication, John Weakland and Alan Rue at Manchester Environmental Laboratory). When cleaning equipment used for sampling matrices to be analyzed for VOCs, use methanol for the solvent rinse.

6.10.4 Let air dry under a fume hood.

6.10.5 After all solvent has evaporated from the equipment, wrap with new aluminum foil, dull side in for transport to the field.

6.11 Links to other Ecology guidance on equipment decontamination can be found in the Appendix of this document.

7.0 Records Management (not applicable)

8.0 Quality Control and Quality Assurance

8.1 Evaluating and documenting the effectiveness of decontamination is essential to obtaining reliable data on environmental toxics. Every toxics QAPP should outline the QA/QC procedures used to ensure effective decontamination. Blank rinses on cleaned equipment will help the project manager to determine if decontamination procedures are sufficient to meet project objectives.

8.2 Analyzing equipment rinse blanks before sampling starts can prevent costly contamination issues during the field component of a project.

8.3 If contaminants of concern are detected in blank water equipment rinses, further investigation will be required to determine the source of contamination.

8.3.1 A more thorough cleaning of equipment may yield a clean equipment rinse blank.

8.3.2 The purity of solvents, including DI water should be analytically verified when analyzing samples for low levels of analyte. Contamination during the cleaning process could affect the outcome of an equipment rinse. Consider using one time use containers to sample low levels of contaminants (see 6.10.1.6).

8.3.2.1 The purity of blank water should be routinely established. Blank samples are collected at appropriate times throughout a series of samples to verify that sample containers are clean, sampling procedures have not introduced contamination, and there are no pollutants that have been introduced during laboratory procedures. If the purity of blank water is not known, it will be difficult if not impossible for a project manager to identify potential sources of contamination. See Table 3 for information about which types of blanks will assess possible sample contamination sources.

Table 3. Types of Blanks and the Contamination Source(s) Potentially Identified

Type of Blank	Potential Origin of Contamination
Method Blank	Lab environment, blank water, and/or analytical instrumentation
Blank Water Blank	Same as method blank
Transfer Blank	Sample containers, and/or field procedures
Transport Blank	Environment during sample transport
Equipment Rinse Blank	Decontamination procedures, and/or lab environment

9.0 Safety

9.1 Decontamination procedures should only be conducted by personnel with previous experience or under the supervision of someone with experience.

9.2 Because this procedure requires the use of hazardous materials (solvents and acid), Ecology personnel must read and understand the safety procedures described in Ecology's Chemical Hygiene Plan & Hazardous Materials Management Plan (Ecology, 2016).

9.3 Chemical Safety Data Sheets (SDSs) for all chemicals used in the procedures outlined in this SOP can be found on the EAP SharePoint site. Also, binders containing SDSs can be found in all field vehicles, vessels, Ecology buildings, or other locations where potentially hazardous chemicals may be handled. EAP staff that follow Ecology SOPs are required to familiarize themselves with these SDSs and take the appropriate safety measures for these chemicals.

9.4 Always follow procedures described in the Chemical Hygiene Plan for the safe and proper use and disposal of solvents and chemicals. Read the appropriate attached Material Safety Data Sheet (MSDS) for the solvents and acid that will be used for decontamination procedures.

9.5 Be sure to use appropriate Personal Protective Equipment and know how to use it. This information is covered in section 6.0 of the Chemical Hygiene Plan. Table 4 displays the effectiveness of various protective gloves when used with the recommended solvents.

Table 4. Protective Gloves and Their Resistance to Cleaning Solvents

Chemical	Neoprene	Natural Latex or Rubber	Butyl	Nitrile Latex	Laminate Film (such as Silver Shield)
Acetone	G	E	E	NR	E
Hexane	E	NR	P	E	E
Methanol	E	E	E	E	E
Nitric Acid 10%	E	G	-	E	E
Nitric Acid 70% (Concentrated)	E	NR	-	NR	E
	E= Excellent	**G=Good**	**F=Fair**	**P=Poor**	**NR= Not Recommended**

Reference: Ansell Chemical Resistance Guide, 2016.

9.6 Understand the chemical spill emergency procedures explained in section 12.0 of the Chemical Hygiene Plan.

9.7 Contact the room custodian and/or the safety officer if any accident occurs, if first aid supplies are inadequate, if chemical spills occur, or for any other need or questions. The names and numbers of the room custodian and the safety officer are posted in the room. In extreme emergency call 911.

10.0 References

10.1 Ansell, 2016. Chemical Resistance Guide http: //www.ansellpro.com/download/Ansell-Chemical-Glove-Resistance-Guide.pdf . Accessed December, 2016.

10.2 ASTM International, 2008. Standard Practice for Decontamination of Field Equipment Used at Waste Sites.

10.3 EPA, 2015. Field Equipment Cleaning and Decontamination at the FEC. SESDPROC-206-R3.

10.4 Fisher Scientific. 2016. Supplier of scientific equipment, supplies, chemicals and furniture. Accessed December, 2016.

10.5 Parker, L. and Ranney, T. Decontaminating Materials Used in Ground Water Sampling Devices: Organic Contaminants, Groundwater Monitoring & Remediation, Volume 20, Issue 1, pages 56–68, February 2000.

10.6 Reichardt, C. Solvents and Solvent Effects in Organic Chemistry, 3rd ed., Wiley-VCH, Weinheim, Germany, 2003.

10.7 Washington State Department of Ecology. 2016. Chemical Hygiene Plan and Hazardous Materials Management Plan. Olympia, WA.

Appendix. Other Ecology Guidance (SOPs) that Outline Cleaning Procedures

EAP003 - Sampling Pesticides in Surface Waters, Anderson, 2015.

EAP007 - Resecting Finfish Whole Body, Body parts or Tissue Samples, Sandvik, 2014.

EAP038 - Collection of Freshwater Core Samples Using a Box or KB Corer, Furl and Meredith, 2015.

EAP040 - Freshwater Sediment Sampling, Blakley, 2016.

EAP 039 - Sampling Marine Sediment, Dutch, 2015.

EAP 041 - Collecting Freshwater Suspended Particulate Matter Samples using In-Line Filtration, Meredith, 2014.

These Ecology SOPs can be found at: http://teams/sites/EAP/QualityAssurance/default.aspx