**COMPARATIVE EVALUATION
OF
THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S AND
THE OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION'S
ENVIRONMENTAL SURVEY AND SITE ASSESSMENT PROGRAM
FIELD SAMPLING PROCEDURES**

Prepared by

T.J. Vitkus, T.L. Bright, and S.A. Roberts

Environmental Survey and Site Assessment Program
Environmental and Health Sciences Division
Oak Ridge Institute for Science and Education
Oak Ridge, Tennessee 37831-0117

Prepared for the

Division of Waste Management
U.S. Nuclear Regulatory Commission

FINAL REPORT

OCTOBER 1997

MASTER

lg
DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

This report is based on work performed under an Interagency Agreement (NRC Fin. No. A-9093) between the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy. The Oak Ridge Institute for Science and Education performs complementary work under contract number DE-AC-05-76OR00033 with the U.S. Department of Energy.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, make any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

**Portions of this document may be illegible
electronic image products. Images are
produced from the best available original
document.**

**COMPARATIVE EVALUATION
OF
THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S AND
THE OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION'S
ENVIRONMENTAL SURVEY AND SITE ASSESSMENT PROGRAM
FIELD SAMPLING PROCEDURES**

Prepared by: Date: 10/16/97
T. J. Vitkus, Survey Projects Manager
Environmental Survey and Site Assessment Program

Prepared by: Date: 10/27/97
T. L. Bright, Health Physics Technician
Environmental Survey and Site Assessment Program

Reviewed by: Date: 10/21/97
R. D. Condra, Technical Resources Manager
Environmental Survey and Site Assessment Program

Reviewed by: Date: 10/17/97
A. T. Payne, Quality Assurance/Safety Manager
Environmental Survey and Site Assessment Program

Reviewed by: Date: 10/17/97
E. W. Abelquist, Assistant Program Director
Environmental Survey and Site Assessment Program

Reviewed by: Date: 10/24/97
W. L. Beck, Program Director
Environmental Survey and Site Assessment Program

TABLE OF CONTENTS

	<u>PAGE</u>
List of Tables	ii
Executive Summary	1
Introduction	3
Objective	3
Documents Reviewed	4
Procedures	8
Discussion	9
Summary	16

LIST OF TABLES

		<u>PAGE</u>
TABLE 1:	EPA and ESSAP Field Sampling Procedures for Surface Soil	17
TABLE 2:	EPA and ESSAP Field Sampling Procedures for Subsurface Soil	20
TABLE 3:	EPA and ESSAP Field Sampling Procedures for Sediment	25
TABLE 4:	EPA and ESSAP Field Sampling Procedures for Surface Water	27
TABLE 5:	EPA and ESSAP Field Sampling Procedures for Groundwater	29
TABLE 6:	EPA and ESSAP Field Sampling Procedures for Vegetation	32
TABLE 7:	EPA and ESSAP Field Sampling Procedures for Stack and Ambient Air	34
TABLE 8:	EPA and ESSAP Field Sampling Procedures for Removable Contamination	40
TABLE 9:	EPA and ESSAP Field Sampling Procedures for Equipment Decontamination	42
TABLE 10:	EPA and ESSAP Procedures for Quality Assurance/ Quality Control	43

**COMPARATIVE EVALUATION
OF THE
U.S. ENVIRONMENTAL PROTECTION AGENCY'S AND
THE OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION'S
ENVIRONMENTAL SURVEY AND SITE ASSESSMENT PROGRAM
FIELD SAMPLING PROCEDURES**

EXECUTIVE SUMMARY

At the request of the U.S. Nuclear Regulatory Commission's (NRC's) Headquarters Office, the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) compared the documented procedures that the U.S. Environmental Protection Agency (EPA) and ESSAP use for collecting environmental samples. The project objectives were to review both organizations' procedures applicable to collecting various sample matrices, compare the procedures for similarities and differences, and then to evaluate the reason for any identified procedural differences and their potential impact on ESSAP's sample data quality. The procedures reviewed included those for sampling surface and subsurface soil, surface and groundwater, vegetation, air, and removable surface contamination.

ESSAP obtained copies of relevant EPA documents and reviewed and prepared a tabulated summary of each applicable procedure. The methods for collecting and handling each type of sample were evaluated for differences, and where these were identified, the significance and effect of the differences on analytical quality were determined.

The results of the comparison showed that, overall, the procedures and methods that EPA and ESSAP use for sample collection are very similar. The number of minor differences noted were the result of restrictions or procedures necessary to ensure sample integrity and prevent the introduction of interfering compounds when samples are to be analyzed for chemical parameters. For most radionuclide analyses, these additional procedures are not necessary. Another item noted was EPA's inclusion of steps that reduce the potential for sample cross-contamination by preparing (dressing) a location prior to collecting a sample or removing a portion of a sample prior to containerization.

Examples such as these are addressed individually in the discussion section for each sample media. The discussions include the reasons for a given procedure; the impact on analytical data if a procedure is not used; and recommendations for clarifications, expansions, or revisions to ESSAP procedures.

The major observed difference between EPA and ESSAP procedures was the level of detail provided for each procedure. EPA procedures are readily available to the general public and, therefore, are written in a very specific format that provides a means for the various EPA regions and industry to implement the procedures consistently. ESSAP's written procedures are controlled documents and prepared in a more generalized format that permits greater flexibility when unique field conditions are encountered.

ESSAP's field staff receive extensive training that addresses procedure specifics and appropriate options during initial certification training, annual recertification training, and on-the-job training. Procedures that may be developed for a specific site are documented in the site-specific survey plan and the project staff are trained in the implementation of the procedure prior to mobilizing to the field. Guidance for the development of unique program procedures is obtained from available industry-wide procedures provided by organizations such as EPA, Environmental Measurements Laboratory (EML), American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI) and other accepted standards organizations. Should field conditions necessitate deviation or alteration of a procedure, then that procedural change must be documented in the site records. Documentation must include the conditions that necessitated the change, a description of the change, and any impacts the change may have on the data quality.

In summary, there were no procedural differences identified that would significantly impact sample data quality and consequently affect the conclusions reached about a site's radiological status. Several recommendations are made for modifications to ESSAP procedures that will provide additional clarification and detail.

**COMPARATIVE EVALUATION
OF THE
U.S. ENVIRONMENTAL PROTECTION AGENCY'S AND
THE OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION'S
ENVIRONMENTAL SURVEY AND SITE ASSESSMENT PROGRAM
FIELD SAMPLING PROCEDURES**

INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC's) Headquarters Office requested that the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education compare field sampling procedures used by ESSAP and those recommended by the U.S. Environmental Protection Agency (EPA). These procedures are provided in various EPA documents and the ESSAP Survey Procedures Manual and survey protocols.

In summary, the project included identifying applicable procedures from those EPA documents referenced in NRC guidance documents, obtaining copies of each EPA document, and reviewing and summarizing those procedures related to the collection of environmental samples. The EPA and ESSAP procedures were compared and evaluated for procedural similarities and differences. In cases where similarities were not found in procedures, factors and technical bases accounting for differences were analyzed, and conclusions were reached as to the significance of the difference, including the potential impact on analytical data quality.

OBJECTIVE

The objective of the review was to compare the field sampling procedures used by ESSAP in support of radiological surveys for the NRC in relation to parallel procedures recommended by the EPA. The information developed was then evaluated to identify potential impacts on ESSAP data quality and, as necessary, recommendations were made for improvements to ESSAP procedures.

DOCUMENTS REVIEWED

The following relevant EPA documents, handbooks, and Standard Operating Procedures were included in the review. A document summary follows each reference.

1. U.S. Environmental Protection Agency. **Compendium of ERT Soil Sampling and Surface Geophysics Procedures**. January 1991.

Serves as a guide for decontamination of sampling equipment, soil sampling procedures, soil gas sampling, and general surface geophysics. Provides a summary of procedures, quality assurance for each procedure, and health and safety considerations. An explanation of interferences and potential problems associated with each procedure is also provided.

2. U.S. Environmental Protection Agency. **Removal Program Representative Sampling Guidance, Volume 1, Soil**. November 1991.

Serves as a guide for obtaining representative soil samples at removal sites.

3. U.S. Environmental Protection Agency. **A Compendium of Superfund Field Operations Methods: Volume 1 & Volume 2**. December 1987.

Focuses primarily on techniques and methods used during the fieldwork phase of a remedial investigation. Other subjects briefly addressed are project planning and management, quality control, decontamination, and health and safety issues.

Sections Reviewed:

Chapter 4:	Sample Control, including Chain-of-Custody
Chapter 8:	Earth Sciences
Section 8.1	Geologic Drilling
Section 8.2	Test Pits and Excavations
Section 8.4.3	Geophysics, Nuclear Logging
Section 8.5	Groundwater Monitoring
Chapter 10:	Surface Water Hydrology
Chapter 11:	Meteorology and Air Quality

Chapter 12:	Biology/Ecology
Chapter 13:	Specialized Sampling Techniques

4. U.S. Environmental Protection Agency. **Description and Sampling of Contaminated Soils, A Field Pocket Guide.** November 1991.

Serves as a companion to EPA's "Guide to Site and Soil Descriptions for Hazardous Waste Site Characterization." Provides a concise, but comprehensive, reference source for methods of describing and analyzing site and soil characteristics in the field that require only visual/tactile observation or very simple equipment.

Sections Reviewed:

Chapter 4, Section 4.1:	Changes in Soil Sampling Procedures
Chapter 4, Section 4.2:	Quality Assurance/Quality Control
Appendix A.1:	General Protocol for Description of Soil Cores
Appendix A.2:	General Protocol for Soil Sample Handling and Preservation

5. U.S. Environmental Protection Agency. **Practical Guide for Groundwater Sampling.** September 1985.

Serves as a companion to the Phase 1 report, "A Guide to the Selection of Materials for Monitoring Well Construction and Ground-Water Sampling" (EPA-600/2-83-024). Provides instructions on minimizing error during laboratory and field testing of sampling materials and sampling mechanisms, particularly for volatile organic compound sampling and analysis.

6. U.S. Environmental Protection Agency. **Importance of Quality for Collection of Environmental Samples. Planning, Implementation, and Assessing Field Sampling Quality at CERCLA Sites.** June 1991.

Explains the importance of adequate planning, implementation, and assessment of field sampling work in the context of the Environmental Protection Agency's Superfund Program.

7. U.S. Environmental Protection Agency, Region IV, Environmental Services Division. **Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual.** February 1991.

Contains the standard operating and field quality assurance procedures to be used by employees during field operations.

Sections Reviewed:

Section 3:	Sample Control, Field Records, and Document Control
Section 4:	Sampling Procedures
4.2	General Considerations
4.3	Definitions
4.6	Specific Sample Collection Quality Control Procedures
4.8	Surface Water and Sediment Sampling
4.9	Ground Water Sampling
4.11	Soil Sampling
4.12.6	Contaminated Surfaces Sampling
Appendix A:	Recommended Sample Containers, Sample Preservation, Sample Holding Times, and Permissible Sample Type
Appendix B:	Standard Cleaning Procedures

8. U.S. Environmental Protection Agency. **Test Methods for Evaluating Solid Waste.** September 1994.

Provides a source of information on sampling and analysis related to compliance with Resource Conservation and Recovery Act (RCRA) regulations. Provides methodology for collecting and testing representative samples of waste and other materials to be monitored.

Sections Reviewed:

Volume 1B:	Laboratory Manual, Physical/Chemical Methods
Chapter 3:	Metallic Analyses
3.1.3	Sample Handling and Preservation
Chapter 4:	Organic Analyses
4.1.2	Sample Handling and Preservation
4.1.4	Cleaning of Glassware

9. **40CFR60, Appendix A, Method 5 and Method 17, Determination of Particulate Emissions from Stationary Sources.** November 1987.

Provides detailed procedures for collecting air samples from stationary sources.

The procedures and methods in the following ESSAP documents were reviewed and compared to the EPA's procedures.

1. **Survey Procedures Manual, Revision 9.** April 30, 1995.

Provides ESSAP's standardized set of procedures that document activities for performing site radiological surveys, applicable to both the DOE and NRC operations.

Sections reviewed:

- Section 8: Sampling Procedures
- Section 9: Integrated Survey Procedures
- Section 10: Health and Safety and Control of Cross Contamination
- Section 11: Quality Assurance and Quality Control

2. **Quality Assurance Manual, Revision 7.** January 31, 1995.

Provides policies and procedures that ensure the validity and quality of the data.

Sections reviewed:

- Section 7: Quality Control
- Section 8: Sample Chain-of-Custody
- Section 11: Records Handling and Storage

3. **Manual of Protocols**

Describes techniques, methods, and considerations as general guidance for site radiological surveys and data acquisition.

PROCEDURES

Applicable EPA documents were reviewed to identify those sections specific to the collection of environmental samples. The sample media types compared included surface and subsurface soil, surface water, groundwater, sediment, vegetation, air, and surface swipe or smear sampling. Where both EPA and ESSAP had specific procedures addressing a given media type, the procedural comparison was performed in the following manner, with all relevant information presented in a tabular format:

1. Each identified EPA document was reviewed, referenced, and relevant sections specified.
2. Related procedures identified in multiple EPA documents were consolidated.
3. A summary was prepared for each procedure and presented in a step-wise format with a direct comparison of the ORISE/ESSAP and EPA procedures for each sample media. Where ESSAP did not have a specific procedure, applicable protocols were used and indicated as such.
4. Commonly encountered field conditions with the potential to affect the sampling procedures or the sample quality were also summarized.

Once each procedure was summarized and compared for significant differences, an evaluation was performed if differences were identified. This evaluation included the following: the technical bases for a given procedure, potential effects on analytical results when the EPA and ESSAP procedure differed, and the significance of any problems that may have been caused as a result of the procedural difference. Finally, specific recommendations for procedural revisions were provided for all cases where observed differences between EPA and ESSAP procedures had the potential for negative impact on the survey data quality generated by ESSAP.

DISCUSSION

SURFACE SOIL

Table 1 provides a summary of surface soil sampling equipment and techniques. Surface soil is defined by ESSAP as 0 to 15 centimeters (cm [0 to 6 inches]) in depth and by the EPA as the top 0 to 3 inches of soil with the extended surface located 0 to 6 inches deeper. ESSAP's definition of surface soil is driven by regulatory agency requirements and guidelines. At sites where atmospheric deposition or other considerations of contaminants is the focus of the ESSAP investigation, then surface soil may be defined differently. Overall, the sample collection procedures as defined by the EPA and ESSAP were comparable.

One difference was noted: ESSAP does not homogenize individual, single-point samples before placing them in the sample containers. Homogenization of a sample in the field is necessary if the entire sample collected is not retained and placed in the sample container. However, the entire sample that ESSAP collects is typically retained and analyzed initially by gamma spectrometry. For radiochemical analysis, where a much smaller sample aliquot is used (10 to 100 grams versus the 800 to 1000 grams sample weight desired for gamma spectrometry), the sample is homogenized in the lab before removing the required aliquot. In many cases, ESSAP personnel will prepare field composites of samples from multiple locations. The method used for these field composites, or when a sample is split with another organization, follows the EPA protocol of homogenizing the sample, dividing the sample into quadrants, placing equal aliquots from each quadrant into the sample container, and repeating the process three times until the sample container has been filled.

The ESSAP procedures manual does not include specific methods for collecting soil samples for volatile organics analysis, where consideration must be given to the avoidance of sample aeration or introduction of trace contaminants, where analytes of concern could be lost, or interfering compounds could be introduced to the sample from sampling equipment. However, such procedures are not applicable to samples for radiological analyses. ESSAP does include a stipulation for the

incorporation of special procedures when samples will be analyzed for nonradiological contaminants or other site-specific considerations. The site-specific procedures ESSAP prepares for investigating chemical contamination follow the recommended EPA approach.

Commonly encountered field conditions that may affect sample integrity and must be considered during sample collection include: high soil moisture, high content of organic matter or clay content, and the presence of bedrock. In situations where high moisture or a clay composition is present, achieving thorough field homogenization of the sample is difficult. Samples with high moisture content may also require secondary containment to reduce the possibility of a sample leaking and possibly cross-contaminating other samples. Collecting representative soil samples in an area in which the bedrock lies near the surface may also require a deviation from the standard sampling procedures, relative to sample depth. Soil samples containing significant organic matter require collection of a larger volume of soil to ensure an adequate sample weight for quantitative analysis following drying and/or ashing.

To summarize, ESSAP's and EPA's surface soil sampling are essentially the same. The definition of surface soil and EPA's recommendation for homogenizing discrete samples were the only significant differences identified, and these differences do not impact ESSAP's sample data quality.

SUBSURFACE SOIL

Subsurface soil sample collection procedures are summarized in Table 2. The most common methods, although not all inclusive, that ESSAP uses to collect subsurface samples are included in the ESSAP manual with generalized descriptions. The EPA procedures include a more detailed description of the various manual and mechanical sample collection techniques. Although not identical, EPA and ESSAP procedure types are very similar.

The first set of procedures—Trenching and Borehole & Downhole Sampling in Table 2—provide a general indication of the depth and stratification of gross contamination during initial site investigations. The ESSAP procedure includes drilling a borehole to a predetermined depth, gamma scanning the borehole, and logging the scan data to identify relative zones of residual activity. These

data are then used to select sample depth locations where soil is scraped from the borehole sidewall. This procedure is similar to the EPA's trench sampling procedure. EPA's procedure involves the excavation of a trench using a backhoe and collecting samples from the side wall of the trench. The only apparent difference in methods is that the EPA specifies "dressing" the surface before sampling. The EPA suggests this step to eliminate contamination that may have been smeared from other depths during trench excavation onto the surface to be sampled. ESSAP's procedure does not include this step when sampling the wall of a borehole.

ESSAP uses the downhole sampling technique primarily as an initial investigation method, where the data generated are used to determine whether or not a site is contaminated and also for general site characterization. The potential exists that as a borehole is being installed, the auger could transfer radioactive materials from contaminated zones (depths) to the borehole wall surface of uncontaminated zones (depths) and result in cross-contamination of a sample. This situation could result in the reporting of elevated levels of radioactive materials at an uncontaminated depth but should not impact the overall assessment of a site's radiological status. It should be noted that when the contamination is a gamma emitter, borehole logging will provide field personnel general information regarding zones of contamination, and it permits sampling in a manner that prevents cross-contamination. Although direct radiation monitoring capabilities provide ESSAP a means of avoiding sample cross-contamination, this is not a conducive approach for all radiological contaminants. To eliminate this potential cross-contamination pathway, ESSAP recommends that the ESSAP procedure be revised to require dressing the borehole wall at each sample location to remove any transferred contamination. Although it is a standard practice in the field, the procedure should also be modified to specify that sampling of the borehole will be initiated at the bottom and proceed toward the surface.

The EPA and ESSAP procedures described for collection of samples using a manual auger or a manual auger in conjunction with a Shelby tube or split-spoon sampler are essentially the same. One noted difference is EPA's specification that the top 1 or 2 inches of the sample core be removed, as this material may represent soil that has collapsed to the bottom of the borehole from other depths. This is a sound practice for eliminating potential cross-contamination and should be specified in the ESSAP procedures. A second item is that ESSAP does not routinely record blow counts when

sampling with a drill rig and split-spoon sampler. ESSAP projects requiring this type of geotechnical data will have these procedures specified in the survey plan and in the drilling subcontracts prepared in support of the project.

The commonly encountered field conditions that may require sampling procedure modifications include boreholes that collapse or fill with water or encountering refusal during drilling operations. When these conditions occur, the appropriate documentation is noted in the field log books and on sampling forms. In addition, ESSAP has integrated specific actions for such situations in their procedures.

SEDIMENT

Table 3 summarizes the sediment sampling procedures. The basic content of the EPA and ESSAP procedures described are virtually identical. The EPA sediment sampling procedures are specific to the type of equipment used. In contrast, ESSAP's manual provides a generalized procedure that is formalized in the site-specific survey plan. Sample collection equipment is determined individually for each site. ESSAP's field staff receive training in the operation of the available sampling equipment and the field conditions that necessitate the use of a particular type of sampling apparatus during annual recertification. ESSAP recommends including more detail on these field conditions and equipment in future manual revisions.

SURFACE WATER

EPA and ESSAP procedures for collecting surface water samples, summarized in Table 4, are similar in the general methodology. Three differences were noted. First, the ESSAP procedure states that the sample is collected into a receptacle and then transferred into a separate container after collection, while the EPA recommends that the sample container itself be used for collection to avoid unnecessary aeration of the sample. However, avoidance of sample aeration is only a concern when sampling for volatile compounds and should not compromise the integrity of a sample for common radiological analyses. For special instances in which ESSAP samples for volatile compounds, the

EPA procedures are used. It should also be noted that when field conditions permit, ESSAP personnel collect the sample directly into the sample container.

Second, the EPA recommends that when using a peristaltic pump, although not a requirement, the system should be purged by allowing several liters of sample to pass through the peristaltic pump system before collecting a sample. ESSAP's procedure does not specify this step, but it is considered a relevant field practice that further ensures sample representativeness. ESSAP recommends specifying this practice in future survey manual revisions. ESSAP sampling procedures also do not describe the sample site selection in detail. However, site selection is addressed in site-specific survey plans based on the type of water (flowing/impounded) and the survey objectives.

Finally, the EPA has various sample preservation requirements. These requirements are analyte-specific and primarily include filtration, pH adjustment, and sample cooling. ESSAP's procedures do not specify preservation for most samples collected for radiological analysis. Rather, these requirements are provided as the need arises in site-specific survey plans, and are based on data quality objectives.

Filtration is performed to separate suspended solids from the sample. The pH adjustment step maintains dissolved metals in solution and prevents metals absorption onto the sample container walls. ESSAP performs these processes either in the field or in the laboratory as required by the analytical procedures and objectives and is dependent upon whether the objective is to determine the total activity in the sample, or to distinguish between the activity present in the suspended or dissolved solids fraction.

Sample cooling minimizes the loss of any volatile analytes and stabilizes the sample from undergoing chemical reactions. For samples that will be analyzed for radioactivity, maintaining the samples at ambient temperatures is not a qualitative or quantitative issue—although exceptions may include the volatile radioiodines, technetium-99, carbon-14, and tritium. When volatile radionuclides are of concern, the site-specific sampling and analytical procedures will specify the necessary procedures to minimize the potential loss of volatile radionuclides.

GROUNDWATER

Table 5 summarizes the groundwater sampling procedures. The basic difference observed between procedures is that ESSAP does not describe monitoring well purging techniques. There are two general bases for this. The procedures as written were used for boreholes that groundwater has percolated into, rather than for established monitoring wells. The samples collected serve only to provide a gross indication of contamination in subsurface water. For surveys requiring groundwater samples from an established well, the property owner is typically responsible for preparing the well for sampling and performing parameter tests (i.e., pH, temperature, dissolved oxygen, etc.), or in some cases, ESSAP personnel will prepare the well. In either case, the EPA procedures for purging are followed and are addressed in the site-specific survey plan and documented in site log books. ESSAP recommends expansion of the procedure for sampling from established groundwater monitoring wells.

Additionally, the sample filtration, pH adjustment, and cooling requirements discussed in the surface water section also apply for groundwater sampling and analysis.

VEGETATION

Table 6 summarizes vegetation sampling procedures. The EPA procedures for vegetation sampling specify collection techniques for each plant structure (i.e., leaves, fruits, roots, stems, etc.). ESSAP procedures are generalized for collection of an entire plant. If project objectives are to determine overall plant uptake of radioactive materials, the entire plant may be analyzed. Project objectives requiring determination of the relative distribution or concentrations of radionuclides in various plant structures would be provided in the site-specific survey plan, and the field sampling procedures would provide details for material collection.

AIR

Table 7 summarizes stack sampling and ambient air sampling procedures. The ESSAP procedures for stack sampling essentially follow the EPA approach, although portions of the procedures have

been modified for program-specific applications. Certain steps also have been generalized because of the wide variety of possibilities that may be encountered in the field. Therefore, the procedure has not been written to address specific or individual systems. Such matters would be addressed in detail in site-specific survey plans.

Ambient air sampling procedures were determined to be unrelated in scope and objective and therefore do not correlate. The EPA procedures reviewed appear to be designed for work zone monitoring. ESSAP's procedures are for general ambient air monitoring for airborne radionuclides.

REMOVABLE SURFACE CONTAMINATION (SWIPE/SMEAR)

Table 8 summarizes procedures for determining the presence of removable surface contaminants. Several discrepancies exist between EPA and ESSAP procedures. While the EPA requires wipes to be handled with tongs, tweezers, or gloves, ESSAP does not. This difference is inherent to the fact that the EPA samples for chemical contaminants and the sample integrity may be compromised if directly handled. ESSAP's method for collecting smear samples using dry smears versus solvent soaked, to identify removable radiological contamination is an industry-accepted practice. The difference in sample collection techniques is based on the different contaminants of concern and data objectives.

Another difference noted was that ESSAP uses envelopes to contain the smears, while the EPA requires the samples to be placed in glass jars because they are saturated with a solvent and to prevent the loss of volatile compounds. When ESSAP collects smear samples for tritium analysis, a similar method is used where a smear is first moistened with deionized water prior to surface smearing, and the smear is then placed into a glass scintillation vial. The final difference noted relates to sample area, which is driven by regulatory requirements and guidelines. ESSAP samples a 100 cm² area versus EPA's recommended 1 m² sampling area.

EQUIPMENT DECONTAMINATION

The ESSAP procedures for equipment decontamination are similar to those of the EPA and are compared in Table 9. Two differences were noted. ESSAP does not require rinsing with nitric acid or pesticide-grade solvent because these steps are necessary for removing trace organic or metallic compounds that may interfere with the chemical analyses. ESSAP also does not require that quality control samples (rinsate samples) be collected when performing equipment decontamination in the field. Special procedures are incorporated into the survey plan for instances where organic compounds are the analytes of interest.

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Table 10 summarizes both organizations' QA/QC procedures. There were no notable differences observed, other than those related to sample handling when volatile organics are a concern. Project documentation requirements are similar, as are the collection of quality control samples.

SUMMARY

At the request of the U.S. Nuclear Regulatory Commission's Headquarters Office, the Environmental Survey and Site Assessment Program compared procedures that EPA and ESSAP use for collecting various types of environmental samples.

Overall, the EPA and ESSAP procedures were similar, but several differences were noted. Each difference was evaluated for any potential effects on the data quality derived from sample analysis. Where procedural differences were noted that could further improve data quality, recommendations were provided for modifying the ESSAP procedure(s). Finally, there were no differences that would significantly impact ESSAP's data quality objectives.

TABLE 1
EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR SURFACE SOIL

EPA	ESSAP
Documents Reviewed	
EPA Documents #1, #2, #4, #7, #8	Survey Procedures Manual Section 8.1
Sampling Strategies	
Surface soil is defined as the top 0-3 in. of soil or as extended surface, defined as 0-6 in. Preliminary survey to identify sampling locations. Random - performed unless evidence of contamination exists. Judgmental (Biased) - performed if evidence of contamination exists (e.g., vegetative stress or staining). Grid-based - performed if sampling over large areas (acres). Grab and Composite Samples Grab - to ID and quantify at a specific location.	Surface soil is defined as the upper 0-15 cm of soil. Special situations, such as to evaluate trends or airborne deposition, determining near surface contamination profiles, and measuring nonradiological contaminants, necessitate special sampling procedures. Preliminary surveys - scanning to identify locations of elevated direct radiation levels. Random - performed for confirmatory or verification surveys when no contamination has been identified in a given area. Biased - performed if evidence of contamination exists based on surface scan results or other factors. Systematic (Grid-based) - performed for characterization surveys. The basic ESSAP grid interval is 10 m (Procedure 6.2). Single-Point and Composite Samples Single-Point - to ID radionuclide concentration at a specific location.

TABLE 1 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR SURFACE SOIL**

EPA	ESSAP
Sampling Strategies (Continued)	
Composite - to characterize average composition of given surface area or interval. A minimum of 4 aliquots from each grid, situated equidistant from the sides of the grid and each other, are recommended for grids measuring up to 100 x 100 ft. One additional aliquot may be collected from the center of each grid, making a total of 5. For grid sizes greater than 100 x 100 ft, 9 aliquots, situated equidistant from the sides of each cell and each other, are recommended.	Composite - 5 samples per 100 m ² area (grid block) are typically collected at the center and 4 points equidistant between the center and grid block corners. Additional samples may be collected to outline areas of elevated activity.
Sampling Equipment	
Spoon Shovel Hand-auger Push-tube Posthole digger	Spoon Shovel Trowel Shelby tube Posthole digger Cup cutter
Sample Collection	
Remove thick, matted root zone if present.	Loosen soil to a depth of 15 cm. Remove large rocks, vegetation, foreign objects. If in an unexcavated area, vegetation plug is removed before sampling.
Remove samples from ground and place in pan and homogenize.	
Fill sample container with soil collected over a surface area of 1 ft ² per sample. A template can be used for marking.	Collect approximately 1 kg of soil (to 15 cm or accessible depth) and place in bag. Seal bag with twist-tie, cap, and tape (or tie bag strings).

TABLE 1 (Continued)

EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR SURFACE SOIL

EPA	ESSAP
<u>Collection of Soil Samples for Purgeable Organic Compounds</u> Collection technique should minimize disturbance of soil. Sample should completely fill container (no head space, if possible) <u>Special Precautions for Trace Contaminant Soil Sampling</u> • Equipment should be stainless steel. • Mixing pans constructed of Pyrex® or equivalent, or glass. • No chromium, cadmium, galvanized plated, or plastic equipment. • Paint and primer removed from equipment.	Not applicable for samples for radiochemical analyses. For activities not covered by the manuals and survey plans, consensus or industry-wide procedures, such as those from EPA, EML, ASTM, ANSI, and other accepted standards organizations, may be used with appropriate approval and documentation.

TABLE 2
EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR SUBSURFACE SOIL

EPA	ESSAP
Documents Reviewed	
EPA Documents #1, #2, #3, #4, #7, #8	Survey Procedures Manual Section 8.2
Sampling Strategies	
Preliminary survey to identify sampling locations. Random - performed unless evidence of contamination exists. Judgmental (Biased)- performed if evidence of contamination exists (e.g., vegetative stress or staining). Grid-based (Systematic)- performed if sampling over large areas (acres). Grab and Composite Samples Grab - to ID and quantify at a specific location. Composite - to characterize average composition of given surface area or interval. A minimum of 4 aliquots from each grid, situated equidistant from the sides of the grid and each other, are recommended for grids measuring up to 100 x 100 ft. One additional aliquot may be collected from the center of each grid, making a total of 5. For grid sizes greater than 100 x 100 ft, 9 aliquots, situated equidistant from the sides of each cell and each other, are recommended.	Preliminary surveys - scanning to identify locations of elevated direct radiation levels. Random - performed for confirmatory or verification surveys when no contamination has been identified in a given area. Biased - performed if evidence of contamination exists based on surface scan results or other factors. Systematic (Grid-based) - performed for characterization surveys. The basic ESSAP grid interval is 10 m (Procedure 6.2). Single-Point and Composite Samples Single-Point - to ID radionuclide concentration at a specific location. Composite - 5 samples per 100 m² area (grid block) are typically collected at the center and 4 points equidistance between the center and grid block corners. Additional samples may be collected to outline area of elevated activity.

TABLE 2 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR SUBSURFACE SOIL**

EPA	ESSAP
Sampling Equipment	
Hand auger (4 in.) Push tube Power auger Drill rig Cone penetrometer rig Backhoe Other	Manual auger Shelby tube Motorized auger Drill rig Split spoon Downhole sampler Trowel or spatula
Sample Collection	
	Required direct radiation measurements are performed by logging the borehole before sample collection to ID gross radiation and determine if special handling is required.
Trenching (EPA)	Borehole & Downhole Sampling (ESSAP)
With a backhoe, dig a trench 3 ft. in width by 1 ft. below the cleared sampling location. Place removed soils on plastic sheets. Dress the surface by removing a 1- to 2-in. layer of soil from the vertical face of the pit using a stainless steel shovel, knife, spatula, or spoon. This is necessary to minimize the effects of cross-contamination due to smearing of material from other levels. Take samples using a trowel, scoop, or coring device at the desired intervals. In many instances, samples can be collected directly from the backhoe bucket.	Applicable to depths of approximately 3 m when boreholes or trenches have been dug and remain uncollapsed or do not contain water. Place a plastic bag liner into the downhole sampler and secure. Lower sampling tool to desired depth. Scrape (borehole or trench wall) with toothed edge of tool until 1 kg of sample is collected.

TABLE 2 (Continued)

EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR SUBSURFACE SOIL

EPA	ESSAP
Hand-Augering	
Hand-augering is the most common manual method used to collect subsurface samples. Powered methods may be used at depths greater than 20 ft. or for resistant materials. Some powered methods are not acceptable for actual sample collection and are used solely to gain easier access to the required sample depth.	Applicable to depths exceeding 3 m and in boreholes where walls do not remain intact or that fill with water.
Clear the sample area of any surface debris. It may be advisable to remove the first 3 to 6 in. of surface soil for an area approximately 6 in. in radius around the drilling location. Using a 4-in. auger-bucket with cutting head or split-spoon sampler, push and twist the auger into the ground. Periodically remove and deposit accumulated soils onto a plastic sheet spread near the hole to prevent loose material from falling back into the borehole. When boring is advanced to the point that a sample is to be taken, slowly and carefully remove the auger.	Drill borehole to the desired sampling depth using auger.
If sampling directly from the auger, collect sample after the auger is removed and proceed to homogenization procedure. If collecting an undisturbed sample, remove auger tip from drill rods and replace with a precleaned thin-wall (Shelby) tube sampler. (This method is preferred for volatile compounds.)	Sample can be collected directly from the bucket auger. Drive Shelby tube sampler beyond augered depth (30 to 60 cm).

TABLE 2 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR SUBSURFACE SOIL**

EPA	ESSAP
Carefully lower the tube sampler down the borehole taking care to avoid scraping the borehole sides. Gradually force the tube sampler into the soil.	
Remove the sampler from the drill rods, then the core from the sampler. Discard the top of the core (app. 1 in.), as this represents material collected before penetration of the layer of concern. Place remaining core into the appropriate labeled sample container. Or, Before lifting the sample, twist the tube to break the bottom of the sample. Clean ½ in. of soil from each end of the tube. Fill any space with a sealing material and then a filler material. Seal the ends of the tube. Mark TOP and BOTTOM so that the orientation is known.	Withdraw collecting device and remove core collected.
Drill Rig with Split-Spoon Sampler	
Using a sledge hammer or well ring, drive the tube. Record the length of the tube used to penetrate the material being sampled and the number of blows required to obtain this depth. Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. Without disturbing the core, transfer it to an appropriate labeled sample container and seal tightly. If volatile organic analysis is to be performed, transfer a portion of the sample directly into an appropriate, labeled sample container. (Mixing should not be performed for volatiles.)	Drive split-spoon sampler beyond augered depth (30 to 60 cm).

TABLE 2 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR SUBSURFACE SOIL**

EPA	ESSAP
Place the remainder of the sample into an appropriate homogenization container (stainless steel, plastic, etc.) and mix thoroughly to obtain a homogeneous sample representative of the entire sampling interval. Place in an appropriate, labeled container and secure the cap tightly.	Transfer plastic bag and sample into container such that leakage and/or cross-contamination do not occur. For cores collected, place the entire core, or a portion of the core, into a container sufficient to ensure moisture leakage and/or cross-contamination does not occur. Seal bag with twist-tie, cap, and tape (or tie bags).
Samples are kept out of direct sunlight to avoid photodegradation of organics and stored at about 4°C until they are shipped to the laboratory.	

TABLE 3
EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR SEDIMENT

EPA	ESSAP
Documents Reviewed	
EPA Documents #3, #7	Survey Procedures Manual Section 8.3
Sampling Equipment	
Peterson dredge Eckman dredge Ponar dredge Corer Scoop BMH-60 sampler	<i>Shallow sediment only:</i> Ponar dredge Garden trowel Post-hole digger Wide-mouth plastic bottle (app. 1L size) Shelby tube
Sample Collection	
Scooping Wade into stream. Face upstream and scoop sample from stream bottom in upstream direction. <i>Note:</i> If stream too deep to wade, collect sample from banks or a boat with steel scoop attached to a piece of conduit. <i>Note:</i> If stream has significant flow and is too deep to wade, BMH-60 sampler suggested. Dredging Peterson dredge suggested when bottom is rocky, in deep water, or high stream velocity. Dredge lowered slowly to avoid displacement of water and keep lighter materials from being missed. Eckman dredge suggested when bottom material very soft (organic sludge or light mud). Should not be used in streams with high velocities.	Collect 1 kg of sediment using collecting tool. Include all material collected; rocks and foreign objects can be discarded during sample preparation, as appropriate. Special requirements may necessitate additional sampling procedures and considerations; these are evaluated and described in detail in site-specific survey plans as the need arises.
Ponar dredge most effective - useful for all types of substrates. Operated as a Peterson dredge.	

TABLE 3 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR SEDIMENT**

EPA	ESSAP
Sample Collection (Continued)	
Coring Coring is recommended for trace organic compounds and metal samples. It is also particularly useful in pollutant monitoring because there is minimal disturbance. <u>Corer specifications</u> • Liners should be constructed of glass or Teflon® to reduce sample contamination (Teflon® preferred to avoid glass breakage). Stainless steel push tubes also acceptable (higher strength, but possible metal contamination). • Tube length of 12 in. for recent deposits, longer for depths greater than 8 in. • Tube diameter larger for mud and clays, smaller for sand and gravel (2 in.). • Tube thickness of 1/3 in. for Teflon® or glass. Push core tube into sediment until 4 in. or less of tube left above surface of substrate. Rotate tube gently to penetrate coarse sediment. Cap tube with Teflon® plug or sheet of Teflon® held by stopper or cork. Extract tube slowly. Cap bottom of core before removing from water.	Special requirements may necessitate additional sampling procedures and considerations; these are evaluated and described in detail in site-specific survey plans as the need arises.
Regardless of the method of collection, sediment samples collected for chemical analysis should be thoroughly mixed (except for purgeable organic compounds analysis) before being placed in the appropriate sample containers.	Place sediment in plastic bottle; tighten cap.

TABLE 4
EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR SURFACE WATER

EPA	ESSAP
Documents Reviewed	
EPA Documents #3, #7	Survey Procedures Manual Section 8.4
Sampling Equipment	
Teflon® Bailers - nondiscrete depths Kemmerer or VanDorn - discrete depths Plastic bucket	Cup, can, pail, or bucket Funnel Plastic container (4L size) with storage box
Sample Collection	
Wade into stream that has a noticeable current, taking care not to agitate sediment. Place sample container opening into the stream current. For water not collected near the shore, a weighted-bottle sampler may be used.	With a cup or can, dip water carefully from the selected location, being careful to avoid collection of bottom sediment or vegetation.
Direct dipping of sample container preferred to avoid adherence of contaminants to the sample transfer container and to reduce aeration of the sample. However, the external surface of each container may need decontamination. Teflon® bailers are used if discrete intervals are not required or to extend sampling reach. Kemmerer or Van Dorn samplers may be used if sampling discrete intervals and Teflon® coated sampler not required.	Using a funnel, transfer the water into a 4L plastic container. Or, Lower the bailer apparatus into the surface or subsurface source of water. Allow water to flow into the bailer (avoiding buildup of sediments). Retrieve the bailer and empty contents through a funnel into a plastic 4L container.
A minimum of 500 mL of sample should be collected. Seal sample container.	Collect a total of 3.8L of sample. Cap the container tightly and place the plastic container in a cardboard box.

TABLE 4 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR SURFACE WATER**

EPA	ESSAP
CONSIDERATIONS: • Bridges and piers alter nature of flow of current. • Wading interrupts sediment concentration in water but acceptable if samples collected directly into bottle (facing upstream) • Boat may be required for sampling in slow-moving water.	
For Use of Peristaltic Pumps	
Install clean tubing in the pump head with sufficient length to reach the required sample depth.	Lower inlet end of tubing until it contacts water surface.
If possible, allow several liters of sample to pass through the system before actual sample collection. Collect the purge volume and return it to the source after the sample aliquot has been collected.	Start pump and collect water in large flask.
Fill necessary sample bottles by allowing pump discharge to flow gently down the side of the bottle with minimal entry turbulence.	Empty flask into sample container. Repeat until 3.8L of sample collected.
Preserve the sample, if necessary. In most cases, preservatives should be placed in sample containers before sample collection to avoid overexposure of samples and overfilling of bottle during collection.	

TABLE 5
EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR GROUNDWATER

EPA	ESSAP
Documents Reviewed	
EPA Documents #3, #5, #7	Survey Procedures Manual Section 8.4
Sampling Equipment	
<u>Purging:</u> Peristaltic Turbine Centrifugal <u>Sampling:</u> Closed top Teflon® bailer Peristaltic pump/vacuum jug Water level indicator pH meter Thermometer Conductivity bridge	Borehole bailer - ESSAP design Submersible, vacuum, or peristaltic pump with power source Plastic container (4L size) with storage box Funnel Large Erlenmeyer flask with two-hole stopper Tygon tubing
Sample Collection	
Wells with In-Place Plumbing (Tap)	
No purge is necessary if the pump runs continuously and the sample can be collected prior to a storage/pressure tank. For intermittently running pumps, determine volume to be purged. Continuously run pump until required volume collected. Sampling techniques for wells with in-place plumbing should be collected directly into appropriate containers from a valve or cold water tap that is located in close proximity to the well.	Open tap. Collect 3.8L of sample in a plastic container directly from the tap.
Groundwater from Wells	
	Note: Not specified as groundwater, but as subsurface water.
A minimum of three wells is required (upgradient of area, middle portion of area, downgradient of area). Existing wells should be used if possible.	Preliminary or scoping survey performed to obtain information to prepare a plan for selecting locations, or well locations may be specified in the Request For Technical Assistance.

TABLE 5 (Continued)

EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR GROUNDWATER

EPA	ESSAP
Determine depth of water using tape measure and rope (or electrical or mechanical water level indicator).	
Purging removes or isolates stagnant H ₂ O that would otherwise bias representative sample. Pump water until well purging parameters stabilize to $\pm 10\%$ over at least two successive well volumes pumped.	
Use a peristaltic pump/vacuum jug, or a closed top Teflon® bailer. Filtration permits determination of soluble constituents and is a form of preservation. It should be done in the field as soon as possible after collection. Filter for trace metals, inorganic anions/cations, and alkalinity. Do not filter for TOC, TOX, volatile organic compound samples, or other organic compounds.	Lower the bailer apparatus into the borehole or other subsurface source of water. Allow water to flow into the bailer (avoid buildup of sediments). Retrieve the bailer and empty contents through a funnel into a plastic 4L container. Repeat procedure until 3.8L of sample have been collected.
Precautions: - Pump used for purging generally should not be used for sample collection. - When sampling for purgeable organic compounds using a peristaltic pump, use a bailer or allow water collected in a Teflon® tube to drain into sample vial. - Place new plastic sheeting around well when bailing to provide clean working area. The nylon rope should be attached to the bailer with a Teflon® coated stainless steel wire.	

TABLE 5 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR GROUNDWATER**

EPA	ESSAP
Refrigeration and protection of samples should minimize the chemical alteration of samples prior to analysis. Note: Use caution to avoid contaminating groundwater. Critical for trace organic or metal samples.	

TABLE 6
EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR VEGETATION

EPA	ESSAP
Documents Reviewed	
EPA Document #7	Survey Procedures Manual Section 8.5
Sampling Equipment	
Not specified	Knife Shears
Sample Collection	
Sample size for vegetation should be approximately 30g for analysis, but the number and type of analyses required will determine how much material must be collected. - Leaves collected for analysis should be clipped at the petiole and allowed to drop directly into the collecting bag. - Plant stems should have removed all flowers, leaves, and other plant growth. Stems are then cut into 3- to 4-in. lengths and allowed to drop directly into the collecting bag. - All leaves, flowers, or cover tissue should be removed from fruits, nuts, or seeds. If this is not possible in the field, the sample label should indicate what part of the sample is to be analyzed.	Collect a total of approximately 1 kg of vegetation. Cut vegetation of desired type from selected location as close as possible to the surface.
- Roots, tubers, or other underground growth: - Underground structures are collected by digging with a trowel or other tool, rather than by pulling the plant out of the ground. - The entire root system is carefully collected, and attached soil is gently removed by shaking or striking. (Some soil will remain, but the laboratory will clean the material prior to analyses). - The root should be cut away from the stem at ground level, and each root placed into a separate bag and labeled.	Sampling protocols require the removal of soil adhering to the subsurface portions of vegetation.

TABLE 6 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR VEGETATION**

EPA	ESSAP
Samples collected are placed in 1-gal. paper bags, labeled, and clipped shut. Several paper bags may be necessary to collect 30g of material. Place the paper bag into a larger plastic bag. Place the plastic bag into a cooler with ice, ice packs, or dry ice, taking care that collected plant material does not come in contact with the cooler water.	Place sample into a plastic bag (if water is to be retained in the vegetation) or burlap bag (if vegetation is acceptably dry).

TABLE 7

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR STACK AND AMBIENT AIR**

EPA	ESSAP
Documents Reviewed	
EPA Documents #3, #9	Survey Procedures Manual Section 8.6
Sampling Equipment	
<u>Sampling Train</u> with the following components: - Probe Nozzle - seamless stainless steel or glass with sharp, tapered leading edge; button-hook or elbow design; size 0.32 to 1.27 cm - Probe Liner-Borosilicate or quartz glass tubing - Pitot tube-Type S-monitors velocity - Differential Pressure Gauge-Incliner manometer - Filter Holder-Borosilicate glass with a glass filter support and a silicone rubber gasket - Filter Heating System - capable of maintaining temperature of app. 1200°C. - Condenser - four impingers connected in series with leak-free ground glass fittings <u>Sample Recovery</u> Wash bottles Glass sample storage containers (polyethylene bottles may be used) Petri dishes	Commercial air sampler (HIVOL, Atomics, Andersen, etc.) Velometer or inclined manometer and pitot tube Sampling apparatus: pumps, pump housings, rotameter nozzles, tygon tubing, filters, filter housings, metal plates, probes, bubblers, etc., as required Petri dishes or other small containers Tweezers Masking tape Thermometer Cleaning equipment

TABLE 7 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR STACK AND AMBIENT AIR**

EPA	ESSAP
<u>Sampling Reagents</u> Glass fiber filters without organic binder Silica gel, 6 to 16 mesh Distilled water Crushed ice Stopcock grease	
For Stack Sampling	
The complexity of this method is such that, in order to obtain reliable results, testers should be trained and experienced with the test procedures.	
Sampling or velocity measurement is performed at a site located at least 8 stack diameters downstream and 2 diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from visible flame.	Select a location in the stack for insertion of sampling probe. Optimum location is a minimum of 8 stack diameters downstream and 2 diameters upstream from any transitions or bends in the stack.
Check filters for irregularities and flaws. Label filters on the back side near the edge. Desiccate the filters at $20 \pm 5.6^{\circ}\text{C}$ and ambient pressure for at least 24 hrs. and weigh at least every 6 hrs. to a constant weight.	
<u>Preparation of Collection Train:</u> The first and second impingers shall contain known quantities of water, the third shall be empty, and the fourth shall contain a known weight of silica gel, or equivalent desiccant. Using a tweezer or clean disposable surgical gloves, place a labeled and weighed filter in the filter holder making sure that it is properly centered. Check the filter for tears after assembly is completed.	
Select a nozzle size based on the range of velocity heads, such that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates.	Calculate appropriate nozzle diameter sizes and flow rates for isokinetic sampling (these rates typically range from 5 to 30 L/min).

TABLE 7 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR STACK AND AMBIENT AIR**

EPA	ESSAP
When glass liners are used, install the selected nozzle using a Viton A O-ring when stack temperatures are less than 2600°C and an asbestos string gasket when temperatures are higher. Set up the train using (if necessary) a very light coat of silicone grease on all ground glass joints, greasing only the outer portion to avoid possibility of contamination by the silicone grease. A pretest leak-check is recommended, but not required.	Drill two 4 cm diameter access holes in the stack wall making them at approximately 90 degree angles to each other. Using a pitot tube and Alnor velometer or inclined manometer, perform duct traverses to determine the velocity distribution.
Select a total sampling time greater than or equal to the minimum total sampling time specified in the test procedures for the specific industry such that (1) the sampling time per point is not less than 2 min., and (2) the sample volume taken will exceed the required minimum total gas sample volume. During the sampling run, maintain an isokinetic sampling rate (within 10% of true isokinetic) and a temperature around the filter of 120 ± 14°C.	
Clean the portholes prior to the test run to minimize the chance of sampling deposited material.	
Verify that the filter and probe heating systems are up to temperature.	Measure temperature and, if appropriate, moisture content of stack gases.
Remove the nozzle cap and ensure that the pitot tube and probe are properly positioned. When the probe is in position, block off the openings around the probe and porthole to prevent unrepresentative dilution of the gas stream.	Attach nozzles and secure plates to probe tubes.
Position the nozzle at the first traverse point with the tip pointing directly into the gas stream.	Adjust nozzle location to the desired sampling position. Insert nozzle the appropriate measured distance into stack with nozzle opening in direct alignment with stack air flow.

TABLE 7 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR STACK AND AMBIENT AIR**

EPA	ESSAP
	Secure metal plates against stacks with rope or bungee cords. Place one probe at a fixed location; reposition a second probe periodically to various predetermined sampling locations within the stack.
Immediately start the pump and adjust the flow to isokinetic conditions.	Start pump and adjust needle valves to obtain the desired flow rate.
If during the sampling run a component change becomes necessary, a leak-check shall be conducted immediately before the change is made. Leak-checks are optional after component changes have been made.	Test system for leakage by blocking intake or pinching hose near intake. If flow rate does not drop to <10% of the initial rate, re-check and tighten connections and components until the system is leak tight. Note and record starting time and flow.
Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse.	During initial sampling, periodically check every 2-4 hrs. the system to ensure that the desired sampling rate is being maintained. Make adjustments as necessary.
A leak-check is mandatory at the conclusion of each sampling run and shall be conducted at a vacuum equal to or greater than the maximum value reached during the sampling run. Results are acceptable if the leakage rate is less than 4% of the average sampling rate. If results are not acceptable, either record the leakage rate and correct the sample volume or void the sample run.	
Carefully remove the filter from the filter holder and place it in its identified petri dish container using tweezers or gloves when handling. If folding the filter is necessary, keep the particulate cake inside the fold. Transfer to the petri dish any matter that adheres to the filter holder gasket. Seal.	Transfer sample collection media to appropriate containers.

TABLE 7 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR STACK AND AMBIENT AIR**

EPA	ESSAP
Into another container, recover particulate matter or any condensate from the probe nozzle, probe fitting, probe liner, and front half of the filter holder by washing with acetone (or distilled water when approved) into a glass container. Take care that dust on the outside of the probe or other exterior surfaces does not get into the sample. Mark the height of the fluid level to determine whether or not leakage occurred during transport. Seal and label.	
	When sampling is complete, remove probe assemblies, and insert expansion plug into stack access hole, if appropriate.
Proper cleanup procedure begins as soon as the probe is removed from the stack at the end of the sampling period. Allow the probe to cool.	Clean equipment before initiating further sampling.
For Ambient Air	
Area sampling stations may be located in various places, as dictated by project and site needs. Areas for consideration are: upwind, support zone, contamination reduction zone, exclusion zone, and downwind.	Select sampling location, based on objective of sampling.
1. For organic vapors: the recommended collection media would be activated carbon, Tenax, Silica gel (polar sorbent material) or Florisil on an industrial hygiene personal sampling pump system with one port or a manifold capable of simultaneously collecting samples on several tubes and analyzed on a GC/MS system.	Select collection media or system, based on contaminants of interest and ambient atmospheric conditions.
2. For inorganic gases: the recommended collection media are silica gel tubes or liquid reagents used with an ion chromatography impinger system.	

TABLE 7 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR STACK AND AMBIENT AIR**

EPA	ESSAP
3. For aerosols: the recommended collection medium is a particulate filter (glass fiber or membrane-type filter) 0.8 μ m pore size used on a system that provides a relatively high flow rate (approximately 2 L/min).	
4. For other types: the recommended collection media are colorimetric detector tubes used with passive dosimeters such as diffusion samplers or permeation devices.	
Meteorological information is an integral part of an air surveillance program. Data concerning wind speed and direction, temperature, barometric pressure, and humidity, singularly or in combination, are needed for the following: • Selecting sampling locations • Calculating air dispersion • Calibrating instruments • Determining population at risk	Measure temperature and, if appropriate, moisture content of stack gases.
When using sorbent tubes, it is wise to check a certain number of traps to ensure that they are not channeled or plugged, which would affect collection efficiency.	Assemble collection system, flow measuring device, and vacuum system. Test system for leakage.
	During initial sampling, periodically check every 2-4 hrs. the system to ensure that the desired sampling rate is being maintained. Make adjustments as necessary. Turn pump off at the previously determined time. Record final time and flow rate. Transfer sample collection media to appropriate containers and label with established procedures.
Personal samplers can be used for personnel monitoring to indicate contaminants at specific locations or for specific work being done. Place on workers, generally within 1 ft. of the mouth and nose (breathing zone).	

TABLE 8

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR REMOVABLE CONTAMINATION**

EPA	ESSAP
Documents Reviewed	
EPA Documents #3 and #7	Survey Procedures Manual Section 8.7
Sampling Equipment	
Filter papers (Whatman 541 or equivalent 15 cm) Solvent to wet filter paper Disposable, chemical-protective gloves	Filter papers (Whatman 50 or equiv. 47 mm diameter, numbered) Glassine or paper envelopes Record forms Counting equipment
Sample Collection	
The terms "wipe", "swipe", and "smear" have all been used synonymously.	
	Direct measurements should be completed before a smear sample is taken.
While wearing a glove, remove a filter paper from the box. (NOTE: A new glove should be used for each sample to avoid cross-contamination of samples.)	Grasp the smear (filter) paper by the edge, between the thumb and index finger.
Moisten the filter with a collection medium selected to dissolve the contaminants of concern. (Typically organic-free water or the solvent used in analysis is used.) The filter should be wet but not dripping.	
Thoroughly wipe app. 1 m ² of the area. Using a 1 m ² stencil will help in judging the size of the wipe area. If the surface is not flat, be sure to wipe any crevices or depressions.	Applying moderate pressure with two or three fingers, wipe the numbered side of the paper over approximately 100 cm ² of the surface.
Fold the filter in half, exposed side in, then fold again to form a 90-degree angle in the center of the filter.	

TABLE 8 (Continued)

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR REMOVABLE CONTAMINATION**

EPA	ESSAP
Place the filter (angle first) into a clean glass jar, replace the top, and seal the jar according to QA requirements.	Place the filter in an envelope.
	Record the smear number, site, date, location of the smear, and name of sample collector on the envelope.
Prepare a blank by moistening a filter to be submitted with other samples.	
	If the initial direct measurement was elevated, the smear should be monitored to determine whether contaminated material was transferred to the smear. If an activity level greater than 250 cpm is detected, the smear envelope should be marked as such. NOTE: Smears having activity levels greater than 2500 cpm should be counted using field instrumentation. If the object of the survey is to determine if radon or thoron daughter products or other short half-life radionuclides are present, the smears should be counted within 1-2 hrs. before significant decay of short-lived radionuclides has occurred. Special considerations for handling removable tritium contamination are made. Moisten smear with deionized water. Wipe the surface as described for removable activity determination. Place smear into LSC vial. Seal and label vial.

TABLE 9

**EPA AND ESSAP FIELD SAMPLING PROCEDURES
FOR EQUIPMENT DECONTAMINATION**

EPA	ESSAP
Documents Reviewed	
EPA Documents #1, #2, #3, #4, #5, #6, #7, #8	Survey Procedures Manual Section 10
Decontamination Procedures	
Physical removal procedures - abrasive and nonabrasive cleaning methods.	Wipe equipment surfaces free of loose material using paper towel.
	Rinse with tap water.
Wash with nonphosphate detergent.	Wash with detergent solution and brush.
Rinse with tap water.	Rinse with tap water.
Rinse with distilled/deionized water.	
Use pesticide-grade solvent rinse (for organic analysis).	
Air dry.	Allow to air dry.
Rinse with distilled/deionized water.	
Cleaning procedures are specific for type of container and type of analyte.	
Any time equipment is cleaned in field, at least one quality control sample shall be collected by rinsing field cleaned equipment with organic-free water and submitting rinse water to the Analytical Support Branch (ASB) for analysis.	

TABLE 10

**EPA AND ESSAP PROCEDURES
FOR QUALITY ASSURANCE/QUALITY CONTROL**

EPA	ESSAP
Documents Reviewed	
EPA Document #7	ESSAP Quality Assurance Manual
Documentation	
All samples immediately sealed upon collection. Waived if field investigator keeps samples in his/her continuous custody until delivery to lab.	A security seal must be placed on sample if sample custody not ensured. An acceptable chain-of-custody is maintained when the sample is under direct surveillance of the assigned individual, the sample is maintained in a tamper-free container; or the sample is within a controlled access facility.
Samples labeled with: • EDS Project Number • Field ID or sample station number • Date/time of collection • Type of sample/description of sample location. Tag numbers. • Signature(s) of sampler or sampling team leader. • Sampling team leader name (when samples collected by more than one team included on same form) • Preserved/unpreserved sample • Types of analyses	Samples labeled with: • Site project number • Grid reference points • Date of collection • Alpha-numeric code to ID each sample, sample collection depth • Sampler initials
A chain-of custody record must be completed for all samples. Separate chain-of-custody records for each final destination. • Total number of sample containers recorded	Chain-of-custody form initiated by sample custodian (in duplicate). • Each sample may be listed as individual entry or a group of samples having common characteristics and originating from same site may be recorded as a single entry (if information describing each sample in group is noted).

TABLE 10 (Continued)

**EPA AND ESSAP PROCEDURES
FOR QUALITY ASSURANCE/QUALITY CONTROL**

EPA	ESSAP
Documents received during investigations for which chain-of-custody required should be placed in large envelopes and sealed. Other physical evidence shall be placed in Zip-Loc® bags or envelopes with custody seal affixed. When samples are split with a facility, state regulatory agency, or other gov. agency, the representative should sign the chain-of-custody record.	- Original copy of chain-of-custody form must contain all signatures and other pertinent information. Must be retained by individual who has custody at any time. - While sample in company of collector, both copies of form remain with sample. When sample is transferred, yellow copy of form is packaged with sample and original remains with sample custodian. - Samples collected by other organizations will have chain-of-custody initiated for them by individual receiving sample.
As few people as possible should handle a sample during inspection/investigation.	
Field investigator is responsible for handling and custody until transferral.	- Project leader or other designated individual responsible for sample accountability. - Individual present during sample collection designated as initial sample custodian. - Sample must always be in custody of sample custodian or under their direct surveillance, or secured in locked vehicle, building, or container.
Branch personnel shall not accept samples from other sources unless sample collection procedures are known to be acceptable, can be documented, and chain-of-custody can be established.	

TABLE 10 (Continued)

**EPA AND ESSAP PROCEDURES
FOR QUALITY ASSURANCE/QUALITY CONTROL**

EPA	ESSAP
Sample Transport	
Samples shall be properly packed for shipment and delivered to the Analytical Support Branch (ASB) or other designated lab. Shipping containers secured with nylon strapping tape and EPA custody seals. Seal signed and dated by field investigator. If sent by mail, package shall be registered with return receipt requested. If sent by common carrier, use Government Bill of Lading or Air bill. Retain receipts as part of documentation. Record air bill number, GBL number, or registered mail serial number in remarks section.	Unsealed samples may be transported by person having custody of sample. Security seals or locks required for transport by mail, check baggage, common carrier, or other mode not controlled by sample custodian.
	Method of transport to be identified on original chain-of-custody record. If sealed samples sent to ESSAP before sample custodian returns, white copy of record may be signed and mailed to ESSAP Lab manager. Lab manager may assume custody.
All samples are accompanied by chain-of-custody record. Place original and one copy of record in a plastic bag inside the secured shipping container. Field investigator or project leader shall retain one copy. Transmit original record to field investigator or project leader.	
	Upon transferral of sample, the individual accepting custody must inspect for tampering. Any evidence of tampering must be noted. Sample collector and receiver must sign form.

TABLE 10 (Continued)

**EPA AND ESSAP PROCEDURES
FOR QUALITY ASSURANCE/QUALITY CONTROL**

EPA	ESSAP
Field Records	
Only bound field notebooks used. Logbook dedicated to individual project. Investigator's name, project name and code entered inside front cover. Entries dated and time recorded. All aspects of sampling recorded in logbook. All sample collection equipment, field analytical equipment, etc. documented in logbooks. All calculations, results, etc. recorded in logbook. All entries dated, legible, and contain accurate documentation of project activities.	Site log books with the following information: • full name of site • project tracking number • funding agency • site contact name and phone number • agency representative name and phone number • directions to the site • brief description of project goal • date of entry • summary of daily project activities • signature of individual completing entry Critical records consist of (but are not limited to) the following: • requests for technical assistance • survey plans • survey plan approval form • field data sheets • calibration data sheets • field drawings • chain-of-custody forms • field certification documentation • source certification sheets • computer files for tracking calibration

TABLE 10 (Continued)

**EPA AND ESSAP PROCEDURES
FOR QUALITY ASSURANCE/QUALITY CONTROL**

EPA	ESSAP
Specific Sample Collection Quality Control Procedures	
A. Experience Requirements: All professional and paraprofessional branch employees shall have equivalent of six months field experience before allowed to select sampling sites. B. Traceability Requirements: All sample collection activities traceable through field records to person collecting sample and to specific piece of sampling equipment.	A. Certification Requirements: All personnel shall observe and assist with performance of a procedure by a trainer and meet all qualifications for certification before being allowed to perform, without assistance, procedures related to program activities. In addition, ESSAP field staff undergo annual recertification and on-the-job-training to discuss updates, general theory, and procedural changes. B. Traceability Requirements: All sample collection activities, including identification of those field staff collecting samples, are traceable through critical records.
C. Measurement of Sample Handling Effectiveness: Monitored by utilizing field blank samples. Should not be picked up by branch personnel earlier than the morning of departure. Samples may be made in field for larger studies, where organic-free water is generated in field. The following field blank samples are required: • water sample VOA trip blank • soil sample VOA trip blank The following blanks prepared in field: • inorganic sample preservation blanks • automatic sampler blanks	C. Not applicable to radiological analyses.

TABLE 10 (Continued)

EPA AND ESSAP PROCEDURES
FOR QUALITY ASSURANCE/QUALITY CONTROL

EPA	ESSAP
Quality Control Samples	
Duplicate grab and/or composite samples shall be collected during all major investigations (more than 20 samples).	To provide evidence of homogeneity on the site (not duplicates).
No more than 10% collected in duplicate.	Collection for systematic sample locations for these media types: soil, sediment, and vegetation.
These samples collected at same time, with same equipment, in identical containers, preserved same as required samples, submitted for same analyses.	Frequency of collection of 10% and/or 1 location for every fraction of 10 samples.
	Collected adjacent to initial sample location.