Bioenvironmental Engineering Reference Document
Surface Sampling

PURPOSE: Provide Bioenvironmental Engineering Flight (BEF) personnel information on surface sampling guidelines.

DESCRIPTION: A complete hazard assessment requires the assessment of surface contamination since personnel may be exposed to these contaminants directly through dermal and ingestion routes, and indirectly through inhalation of contaminants that are disturbed and become airborne (e.g., asbestos, lead). Swipe sampling is an important tool of hazardous assessment. It is useful in categorizing areas for certain types of controls, such as personal protective equipment (PPE) and/or special cleaning and decontamination. Swipe sampling is also useful in evaluating the effectiveness of certain controls. The terms swipe sampling, wipe sampling, and smear sampling are synonymous and describe the techniques used to assess chemical, radiological or biological surface contamination on natural and manmade surfaces. The term "swipe sampling" will be used in this document.

EVALUATION OF SAMPLING RESULTS: The investigator must use professional judgment on a case-by-case basis when evaluating the significance of swipe sampling results. Acceptable surface contamination amounts will vary widely for the same toxic agent depending on the purpose and location of the sample. Any concentration above background is sufficient to identify a problem for some sample locations.

SELECTION OF SWIPE LOCATION. There are a number of approaches for selecting sampling locations. You should determine if your client or technical center (MAJCOM, HQ USAF, Theater CINC, Armstrong Lab, AFCEE, etc.) prefers one approach to the other. If the client does not specify an approach, you must select one based on your best judgment, historical data and/or the site reconnaissance. The collection of representative surface samples may use the same approaches generally used in soil sampling. These approaches include *judgmental, random, systematic grid, systematic random, and transect sampling.* Some of the approaches may be more useful for larger areas of concern. Whatever approach or combinations of approaches you employ make sure to document it so the risk assessors can make appropriate judgments. Table 1 summarizes the acceptability of various sampling approaches based on three sampling objectives.

Judgmental Sampling. Judgmental sampling is the subjective selection of sampling locations at a site, based on historical information, visual inspection, and/or your best professional judgment. Since judgmental sampling has no randomization associated with the approach, statistical interpretation of results cannot be made. Use judgmental sampling to identify contaminants present at areas having the highest concentrations.

Random Sampling. Random sampling is the arbitrary collection of samples within boundaries of the area of concern. Random sampling locations are chosen using a random selection procedure such as a random number table. Randomization is necessary to make probability or confidence statements about sampling results. Random sampling is normally used where contamination is homogeneous throughout the site.

Systematic Grid Sampling. Systematic grid sampling involves subdividing the area of concern by using a square or triangular grid and collecting samples at the node points (intersection of the grid lines). Systematic grid sampling is often used to delineate the extent of contamination and define concentration gradients.

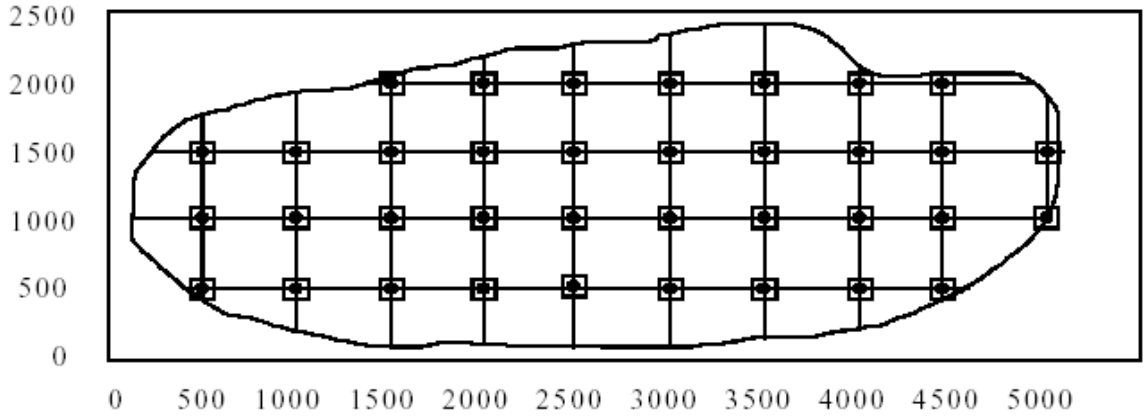

Figure 1. Systematic Grid Sampling (BEE EQS Course Handout #52)

Systematic Random Sampling. Systematic random sampling is a useful and flexible design for estimating the average pollutant concentration within grid cells. Subdivide the area of concern by using a square or triangular grid as discussed above. Then collect samples from within each cell using random selection procedures.

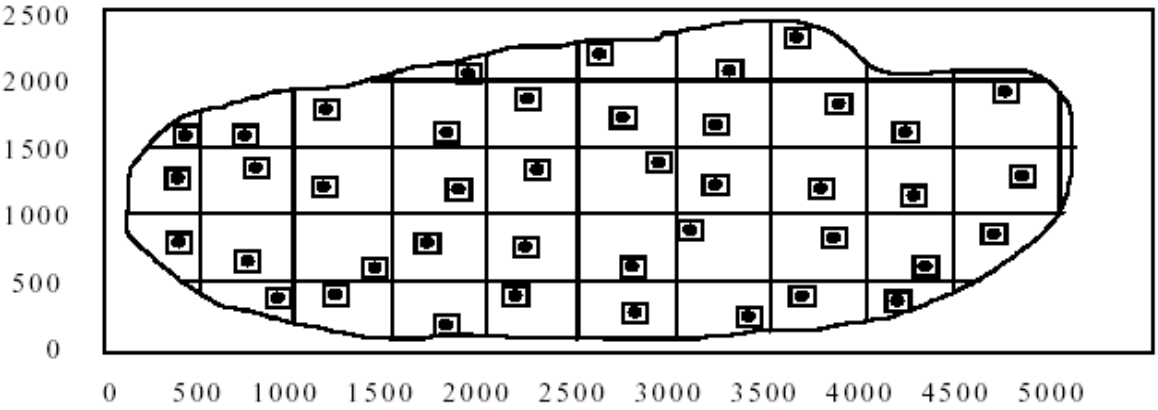

Figure 2. Systematic Random Sampling (BEE EQS Course Handout #52)

Transect Sampling. Transect sampling involves establishing one or more transect lines across the surface of the site. Collect samples at regular intervals along the transect lines. Transect lines may be parallel or non-parallel. A primary benefit of transect sampling over systematic grid sampling is the ease of establishing and relocating individual lines versus entire grids. Transect sampling is often used to delineate the extent of contamination and to define contamination gradients.

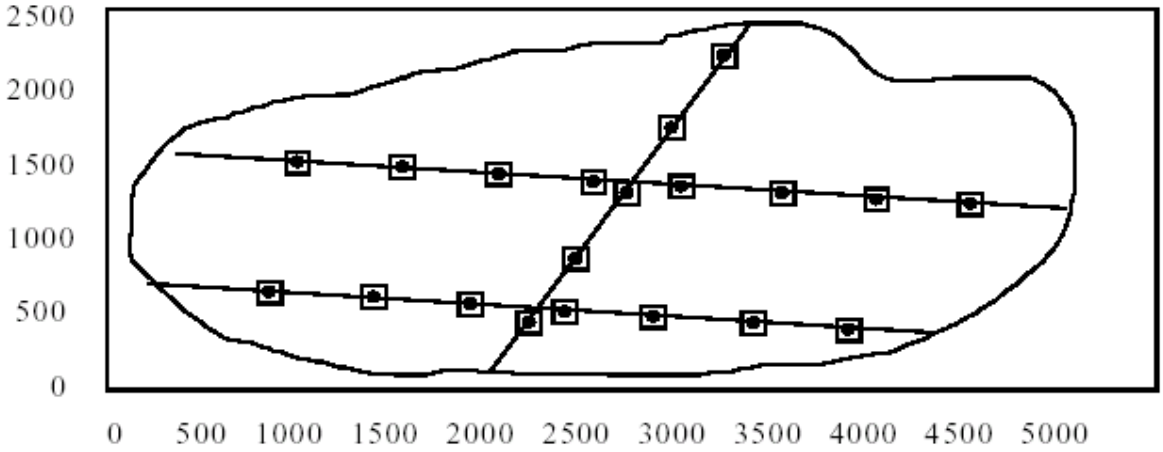

Figure 3. Transect Sampling (BEE EQS Course Handout #52)

MEDIA AND TECHNIQUES FOR SWIPE SAMPLING. Techniques and media for collection of swipe samples from surfaces vary with the agent and purpose of the sample. It is recommended that the analytical laboratory that will be processing the samples be consulted when selecting a sample procedure for a specific chemical or contaminant. Classic swipe sampling techniques involve wiping a surface with a filter, which is then submitted to a laboratory for analysis. Typical media used in surface sampling and the chemicals they are usually used for sampling can be found in . Table 2. Note that this list is not all-inclusive.

General Procedures For Collecting Swipe Samples. Preloading a group of vials or other containers with appropriate filters is a convenient method to carry the sample media to the worksite. (The smear tabs if present should be inserted with the tab end out.) Clean plastic gloves should be worn when handling the filters. The gloves should not be powdered. The following are general procedures for taking swipe samples.

- If multiple samples are to be taken at the site, prepare a rough sketch of the area to be swipe sampled
- A new set of clean, impervious gloves should be used for each sample to avoid contamination of the filter by previous samples (and the possibility of false positives) and to prevent contact with the substance.
- Withdraw the filter from the vial or container with your fingers or clean tweezers. If a damp swipe sample is desired, moisten the filter with the recommended agent (distilled water or other solvent).
- Depending on the purpose of the sample, it may be useful to determine the concentration of contamination using a direct reading instrument such as a radiation detector (e.g., in counts per minute or disintegration per minute of agent per area). For these samples, it is necessary to record the area of the surface wiped (e.g., 100 cm^2). This would normally not be necessary for samples taken to simply show the presence of the contaminant.

- Firm pressure should be applied when wiping.
- Different wiping techniques may be used when collecting the sample. Two commonly used techniques are "S" pattern and the decreasing concentric squares methods.
- "S" pattern - Place filter flat at one end of the sample are and wipe in an "S" pattern over the entire surface. Without allowing the filter to come in contact with any other surface, fold the filter in half with the exposed side in. If possible use the same filter to re-wipe the area at 90º from the first wipe, again using the "S" pattern, then fold it over again. Place the filter in a sample vial or container, cap and place identifying data on the container. Place the same identifying data on the area sketch and sampling form. Include notes with the sketch and sampling form giving any further description of the sample (e.g., "lunch table"; "baseboard").
- Decreasing concentric squares - Start at the outside edge and progress toward the center of the surface area by wiping in concentric squares of decreasing size. Without allowing the filter to come in contact with any other surface, fold the filter with the exposed side in. If possible, use the same filter to repeat sampling of the same area, and then fold it over again. Place the filter in a sample vial or container, cap and place identifying data on the container. Place the same identifying data on the area sketch and sampling form. Include notes with the sketch and sampling form giving any further description of the sample (e.g., "lunch table"; "baseboard").
- Submit control standards and samples (e.g., field blanks, background samples, spike samples, split samples, duplicates, laboratory blanks) as required by the Sampling Plan or analytical laboratory's protocol.
- Samples for some substances should have solvent added to the vial or other container as soon as the swipe sample is placed inside the container. Information on this requirement should be obtained from the analytical laboratory prior to collecting the sample.
- Submit the samples to the analytical laboratory with appropriate documentation, which includes a chain of custody form. (Sample shipment procedures are not covered under this reference document.

Surface Swipes for Radioactive Contamination. Monitoring for removable radioactive contamination should be conducted using conventional swipe techniques for quantitative analyses and, where practicable, large-area swipes for qualitative analyses. Swipes are used to *quantitatively* determine levels of removable activity by wiping a filter paper or equivalent over 100 cm of the surface and counting the collected activity with a smear counter (either located at the facility or sending the sample to a health physics analysis laboratory). Swipes are also used to *qualitatively* detect the presence of removable contamination. Large-area swipes are used to survey areas larger than 1000 cm to promptly assess the presence of low-level loose contamination and to quickly delineate a contamination boundary. Large area swipes are performed by wiping cheesecloth or Masslinn over the surface and counting the swipe with a portable alpha or beta/gamma survey instrument. Smear/swipe surveys are conducted with dry media, even if used for wet surfaces. All wet smears/swipes, except for tritium, should be dry before they are counted. Conventional dry swipe monitoring

techniques may prove to be ineffective in the detection of tritium contamination. If tritium contamination is likely, sampling should be done using wet swipes.
Under certain conditions, radioactive contamination may tend to penetrate the contaminated surface and then return to the surface over an extended period of time. This phenomenon is often encountered when dealing with tritium contamination (off-gassing) and when handling items stored or used under water (leaching). When such conditions are likely, enhanced contamination monitoring methods that are capable of detecting changes in contamination levels as a result of leaching or off-gassing should be used. Monitoring techniques should be developed and documented to ensure that the collected data are representative of the entire surface, with special attention paid to likely points for collection of contamination, such as leakage points, rough surface areas, areas that are infrequently cleaned, current work areas, and high traffic areas.

The presence of radioactive contamination in or on surfaces contaminated with granular solids may present significant challenges to the surface sampling activity. To ensure compliance, an assessment should be performed to determine the likelihood that radioactive contamination may be dispersed from the surface in question to surrounding areas or to items or individuals who may come in contact with the surface. The effectiveness of the swipe sampling techniques discussed in this section may be limited due to the physical conditions and specific characteristics (chemical and radiological) of radionuclides present at some incident/accident sites and in some facilities. Detailed technical guidance for performing monitoring under these conditions is outside the scope of this document and should be sought from your Health Physics Professionals.

Collecting Sterile Surface Swipe Samples for Biological Agents. The following procedures are for use on large, non-porous surfaces such as tabletops, counters, desks, file cabinets, and non-carpeted floors.

- Maintain appropriate chain-of-custody documentation and procedures.
- Don sterile, non-powdered examination gloves over the gloves that are part of the standard PPE.
- Remove a sterile 3" X 3" (or smaller) synthetic (non-cotton) gauze pad (gauze, sterile sponges) from package.
- Moisten the gauze with sterile water, sterile saline, or sterile PBS solution using aseptic technique to prevent cross-contamination. Note: Check with the laboratory that will do the analysis to determine which gauze and solution is preferred.
- Wipe the surface. Recommended wipe area is approximately 1 square foot. Avoid letting the gauze pad dry completely. Suggested sampling technique: make enough vertical S-strokes to cover the entire sample area; fold the exposed side of the pad; make horizontal S-strokes over the same area.
- Place the sampled gauze in a sterile conical vial filled with enough tryptic soy broth to submerse the wipe and cap the vial.
- Label the vial, and place it in a self-sealing bag (Ziploc® bag, Whirlpak®, or similar).

- Document the following items
    - Discrete sample number or identifier
    - Sample location
    - Type of sample
    - Time and date of sample
    - Name of person collecting sample
    - Measured size of the area sampled
    - Map of sample area
- Clean the outside of the sealed bag with a 0.5% to 0.6% sodium hypochlorite solution just prior to leaving the contaminated area. Typical household bleach sold in the United States contains about 5 to 6% sodium hypochlorite. The disinfecting solution is made by adding 1 part household bleach to 1 part white vinegar and 8 parts water. Final solutions should be close to a pH of 7 but not greater.
- Place the cleansed bag in another unused self-sealing bag.
- To collect another sample, repeat all previous steps. Change gloves between samples.
- Prepare samples for shipping according to applicable guidelines and submit the samples to the laboratory for analysis.
- Transport samples to a level B or C laboratory at ambient temperature.

Table 1**081286**

Sampling Approach Comparison (BEE EQS Course Handout #52)

	Sampling Approach				
Sampling Objective	**Judgment**	**Random**	**Systematic Grid**	**Systematic Random**	**Transect**
Establish threat	1	4	2 + A	3	2
Identify sources	1	4	2 + A	3	3
Determine extent of contamination	4	3	1 + A	1	1

1: Preferred approach
2: Acceptable approach
3: Moderately acceptable approach
4: Least acceptable approach
A: Should be used with field screening
B: Preferred only where known trends are present

Table 2

Typical Collection Media and Uses

Collection Media	**Application**

Glass fiber filters (GFF)	Recommended for chemicals analyzed in gas chromatography, or high-performance liquid chromatography
Paper filters	Generally used for collection of metals. Mixed cellulose ester filter discs (AA filters) or smear tabs, or their equivalent, are most often recommended.
Polyvinyl chloride filters	Available for substances unstable on paper-type filters
Gauze squares	May be used for organic substances. More durable than filter media, especially when wiping rough surfaces.
Charcoal-impregnated pads	May be used for collection of volatile solvents from surfaces. Work by trapping solvent on activated charcoal

REFERENCE:

a. Bioenvironmental Engineering Environmental Field Manual, Volume 1, Desktop reference Guide, Section 6, HQ ACC, Langley AFB VA, Feb 2000.

b. OSHA Technical Manual, Section II: Chapter 2 Sampling for Surface Contamination, Occupational Safety & Health Administration, Jan. 20, 1999.

c. Comprehensive Procedures for Collecting Environmental Samples for Culturing Bacillus Anthracis, Centers for Disease Control and Prevention, Revised Apr. 2002.