COVER SHEET
STANDARD OPERATING PROCEDURE

Operation Title: **INCREMENTAL SAMPLE METHODOLOGY FOR SITE INVESTIGATION AND RISK ASSESSMENT**

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DISTRIBUTION;

( ) Division of Remediation………………………..By:______________Date:_______

1.0 APPLICABILITY

This Standard Operating Procedure (SOP) applies to all programs in the Maine Department of Environmental Protection's (MEDEP) Division of Remediation (DR). It is also applicable to all parties that may submit data that will be used by the MEDEP/DR.

This SOP is not a rule and is not intended to have the force of law, nor does it create or affect any legal rights of any individual, all of which are determined by applicable statutes and law. This SOP does not supersede statutes or rules.

2.0 PURPOSE

The purpose of this document is to describe the MEDEP/DR procedure for utilizing Incremental Sampling Methodology (ISM), also known as Multi Incremental Sampling (MIS), for investigation and assessment of chemical concentrations in soil or other media. This document is not intended to comprehensively describe Incremental Sampling Methodology or its applications. MEDEP recommends referencing and adhering to the Interstate Technology and Regulatory Council (ITRC) comprehensive guidance document: Incremental Sampling Methodology (ITRC 2020).

3.0 RESPONSIBILITIES

All MEDEP/DR Staff must follow this procedure when performing this task. All Managers and Supervisors are responsible for ensuring that their staff are familiar with and adhere to this procedure. MEDEP/DR staff reviewing data by outside parties are responsible for ensuring that the procedure (or an equivalent) was utilized appropriately.

4.0 DEFINITIONS

4.1 Decision Unit (DU): The predefined area for which a decision will be made based on an ISM result. The entire area may be sampled or there may be smaller ISM sample units within the DU that are used to make a decision for the entire area.

4.2 DQO: Data Quality Objective

4.3 Exposure Unit (EU): For risk assessment purposes, an area where a receptor is assumed to move randomly across the area and may be exposed to a spatially averaged contaminant concentration.

4.4 Replicate: Additional sample or samples collected from an area using ISM methods; this material is processed and analyzed in the same manner as the original sample; analogous to a field duplicate in discrete sampling.

4.5 SAP: Sampling and Analysis Plan

4.6 Sample Unit (SU): A defined area to be sampled as an individual ISM sample.

5.0 GUIDELINES AND PROCEDURES

5.1 INTRODUCTION

Incremental Sampling Methodology (also referred to as "Multi Incremental Sampling") is a statistically supported sampling method for obtaining a representative mean concentration of a contaminant across a predefined area (area of concern, exposure unit, or decision unit). ISM is typically applied to solid particulate media such as soil and sediment and can include other environmental media such as groundwater or waste. For risk assessment or MEDEP Remedial Action Guidelines (RAGs) risk calculator purposes, if 3 or more replicate ISM samples are completed, then a 95% Upper Confidence Limit (UCL) of the mean can be calculated. Individual values can be directly compared to criteria if the project team agrees to that approach. Use of this technique requires careful planning and project team agreement on DQOs but yields a statistically defensible result to support project decisions.

The methodology described in this document is appropriate for use when an average chemical concentration is required for a predefined site area, and the site sampling is not otherwise outlined in a site-specific Quality Assurance Project Plan (QAPP), Sampling and Analysis Plan (SAP) or other document.

5.2 PLANNING

A well-developed Conceptual Site Model (CSM) is imperative for effective application of ISM. Prior to conducting any sampling event, a SAP should be developed (see MEDEP/DR SOP# RWM-DR-014 - Development of a Sampling and Analysis Plan). Decision Units (DUs) or Exposure Units (EUs) need to be determined based upon the CSM and potential future use of the property. Source areas can be targeted with small DUs and outer areas of a site can be adequately characterized with larger DUs. Replicates should be completed on DUs where a 95% UCL of the mean is needed, where there is uncertainty about the variability of the contamination, and on at least a portion of the site to assess variability in the sampling and analytical methods. The SAP should include specifics regarding DQOs, which are important for determining the number of replicate ISM samples to collect, the number of increments to collect, specific laboratory procedures, and the regulatory criteria that will be used in project decisions.

Prior to sample collection, the project team must agree as to how the data will be used, what criteria will be used for comparison, how replicate analyses will be handled, and whether the average, mean or 95% UCL of the mean or other statistical calculation will be used as a basis for decisions regarding mitigation or cleanup of the site being investigated.

5.3 PROCEDURE

5.3.1 OVERVIEW

Field methodology and laboratory procedures are two significant components to ISM that are designed to limit error inherent in any environmental sample resulting from matrix properties, field sampling methods, and laboratory practices. The field component of the method involves collection of a large number of increments or aliquots that are combined into a single sample. This approach limits the error found in discrete samples, which may hit or miss contamination due to media heterogeneity. The laboratory processing component involves some combination of drying, sieving, grinding, and sub-sampling to reduce the laboratory error related to the selection of the small mass of media that is actually analyzed. The method is easily applied to surficial media but can also be useful in assessing subsurface media using investigative techniques such as hand augers or direct-push technology to obtain subsurface increments, or to install groundwater sampling equipment if desired.

The method is particularly useful where there is a heterogeneously distributed contaminant that limits the value of discrete sampling approaches. Large areas can also be characterized without collecting (and paying for) an excessive number of laboratory samples. For example, the ISM approach may be used on properties where source areas have been targeted for removal and the remaining property needs to be assessed for risk evaluation. ISM can also be applied to environmental sites where a mean value for bulk media is needed to determine if the treatment (e.g., ex-situ, biopile, etc.) has reached project goals. This method is not recommended for sites where limited understanding of the release mechanisms and potential source areas exists, as there would be a potential for missing source areas if DUs are inadequately delineated.

The CSM also is important for determining the number of increments needed for a DU. Generally, 30 is the minimum recommended, with up to 150 for very large areas, or for areas with extremely high contaminant heterogeneity.

5.3.2 PROJECT SPECIFIC CONSIDERATIONS

The project-specific methodology needs to consider factors such as:

- Volatile organics - may be “composited” in a large volume of methanol rather than dried/sieved, etc.
- Semi-volatile compounds - the grinding step may be “pulsed” to avoid overheating the soil and causing losses of compounds of interest.
- Metals – metals such as lead may benefit from grinding the soil, to improve reproducibility of the mean concentration. Metals such as chromium can be artificially elevated by grinding the soil particles, due to contamination introduced by losses from

the stainless steel in puck mill components. Where lab processing is a concern for metals analysis, samples may be dried, homogenized, sieved and subsampled without a grinding step to avoid lab contamination of samples.

ISM can be utilized for PAHs, PCBs, SVOCs, inorganics and VOCs, though the project-specific sample and laboratory methods need to be tailored to the contaminant of interest.

The expected difference between regulatory criteria and the site concentrations is another factor in determining DU size and number of increments. Higher numbers of increments may be warranted where 95% UCL of the mean concentration may be close to project action limits, and greater certainty is required for the data.

Small DUs can be designed to characterize source areas, while peripheral portions of a site where no contamination is expected may be appropriate for larger DUs, if the CSM is well defined. If the DU for a site is very large, a decision can be based on data from smaller sample units (SUs) within the DU. For example, if the DU is a 100-acre parcel, 5 representative 2-acre SUs could be sampled rather than the entire area. If the data are to be used in a risk assessment, one or more DUs may be part of each exposure unit (EU). In these cases, results from multiple DUs or SUs may be combined to obtain a single result for comparison to the project goals or use in risk assessment if the data show units are similar and combining units meets project objectives. Combining DUs is not appropriate where the project objective is to assess a removal action or characterize multiple source areas for evidence of a release.

Details of the theory and basis for the sample method, and “decision-tree” approaches to choosing decision units, number of increments, and project-specific processing methods can be found in ITRC’s 2020 Technical Guidance document, and in the other references listed below.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

DQOs should be stated in the SAP. Quality Assurance/Quality Control (QA/QC) samples may be collected if needed to meet DQOs. Typical types of QA/QC samples that may be collected or prepared at the laboratory include replicate ISM samples to allow determination of a UCL for the DU, laboratory control blank spikes, and analysis of reference material containing known concentrations of the target analytes. All analytical data should be reviewed and assessed to determine if DQOs have been met. If review indicates DQOs have not been met, corrective action will be recommended by the reviewer.

7.0 REFERENCES

Interstate Technology and Regulatory Council. 2020.Technical and Regulatory Guidance, Incremental Sampling Methodology, October 2020. https://ism-2.itrcweb.org/

Recent studies of metals analysis and soil grinding issues have been published by the US Army Corps of Engineers, focused on small arms ranges, but applicable to other site types:

Incremental Sampling Methodology (ISM) for Metallic Residues, ERDC-TR-13-5, August 2013; Cost and Performance Report of Incremental Sampling Methodology for Soil Containing Metallic Residues, ERDC-TR-13-10, September 2013; Demonstration of Incremental Sampling Methodology for Soil Containing Metallic Residues, ERDC-TR-13-9, September 2013; Evaluation of Sampling and Sample Preparation Modifications for Soil Containing Metallic Residues, ERDC-TR-12-1, January, 2012.

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Hawaii Department of Health. 2016. Technical Guidance Manual Subsection 4.2: Use of Multi-increment Samples to Characterize DU's, Interim Final, August, 2016. http://hawaiidoh.org/tgm.aspx?p=0402a.aspx

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