

Environmental Data Collection and Analysis Guidance

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Appropriate characterization of environmental media and use of analytical techniques that achieve appropriate regulatory standards is vital to the evaluation of release-related risks and development of suitable corrective actions. Fulfillment of proper media sampling protocols ensure that data will be of the necessary quality to make these decisions. All proposed environmental media sampling and analysis plans must document how the proposed work will determine the presence or absence of contamination and follow appropriate methodology, including commonly referenced EPA, ASTM, and ITRC guidance documents. The following guidance and reference documents should be incorporated into the site characterization strategies, including sampling and analysis standard operating procedures (SOPs), where applicable. All sampling work plans must follow the requirements of the IRule and be pre-approved by the Secretary.

Site Characterization Strategies:

The objective of all site characterizations is to determine the source, degree, and extent of contamination and identify sensitive receptors. All sites must be characterized in accordance with acceptable industry standard methodologies. Guidance documents are available from EPA, ASTM, and [ITRC](#). SOPs must be available for review if requested by the Secretary.

The SMS strongly encourages the use of integrated site characterization (ISC) techniques. ISC encourages characterization at a sufficient resolution to capture the effects of the heterogeneities that direct contaminant distribution, fate and transport, and remediation effectiveness so that a conceptual site model can be developed ([ITRC, 2011](#)). The specific steps in an ISC process are as follows:

- Define the problem and uncertainties in the Conceptual Site Model (CSM).
- Identify the data gaps and spatial resolution required in the investigation.
- Establish the data collection objectives.
- Prepare the Data Quality Objectives (DQO) to ensure the analytical approaches can meet regulatory standards.
- Design the data collection process.
- Select the appropriate investigative tools.
- Manage, evaluate, and interpret the data.

Although the ISC method can have a higher initial cost than traditional site characterization methods, total costs upon the completion of remedial activities are generally lower since ISC methods provide better identification of the contaminant plume, leading to the most effective remedial strategy. Some ISC characterization techniques include the following:

- Soil gas surveys



- Soil sampling
- Groundwater profiling
- High-resolution characterization tools (e.g. Membrane Interface Probe (MIP))
- Sample collection and data analysis using field labs
- Geological characterization

Environmental Media Sampling:

1. Field Screening

Field screening of environmental media can be valuable during site investigations to inform the onsite environmental contractors and allow decisions to be made in the field, particularly when a flexible work plan is being implemented. It is important to understand the limits of each of these methods and when quantitative data collection is necessary to verify the findings of the field instrument.

There are a number of field-portable instruments and detectors (e.g. photoionization detector (PID), flame ionization detector (FID), water quality multiparameter sensors, colorimetric test kits/immunoassay kits, portable gas chromatograph mass spectrometer (GC/MS), x-ray fluorescence (XRF), etc.) that are available to screen environmental media. The instrument chosen must be capable of detecting the contaminants of concern at the site or other indicator parameters. Field screening efforts are generally not suitable for comparison to regulatory standards. The proposed workplan must provide justification for the selection of field screening instruments based on the judgement of the environmental professional. The workplan must describe how the data will be used to make field decisions. Users must be familiar with and follow the operating instructions recommended by the manufacturer and applicable SOPs.

The most commonly used screening device for volatile organic compounds (VOCs) is the PID. A PID may be used for the direct screening of soil vapor contamination with gasoline, diesel, kerosene and #2 fuel oil. A PID is not sufficient for low volatility petroleum contamination such as #4, #6 or used oil, or for the identification of compound-specific VOCs. If a PID is being used to screen soil samples for VOCs, the same aliquot of soil that is agitated and screened in a Ziploc bag CANNOT be reused for laboratory analysis.

2. Qualitative or Semi-Quantitative Measurements

The use of high-resolution site characterization tools (such as Membrane Interface Probe (MIP) and Laser-Induced Fluorescence (LIF)) during site characterization is accepted and encouraged. These tools can provide rapid generation of high-density data, sometimes of both contaminant levels and lithology. They can also provide a means to identify locations and depths where quantitative data should be collected to improve or complete a conceptual model or allow decision making. If qualitative or semi-qualitative data is collected, environmental media sampling will also be needed to provide quantitative data for comparison to regulatory standards.

The following references are available for guidance, where available:

- https://www.itrcweb.org/dnapi-isc_tools-selection/
- <https://clu-in.org/characterization/>
- ITRC Advanced Site Characterization Tools: <https://asct-1.itrcweb.org/>

3. Soil Sampling

A soil sampling program should be initiated to assess if any contaminants are present in soils above standards during site investigations and post-cleanup confirmatory sampling (if needed). Soil sampling data must be compared to the appropriate soil standards. The appropriate method of soil sampling should be presented in the proposed workplan. Various sample collection approaches are described below.

The following references are available for guidance, where applicable:

- [ITRC-Incremental Sampling Methodology, February 2012](#) (this document will be updated to ISM-2 in late 2020)
- [ASTM-D4547-15 Standard Guide for Sampling Waste and Soils for Volatile Organic Compounds](#)
- [ASTM-D6051-15 Standard Guide for Composite Sampling and Field Subsampling for Environmental Waste Management Activities](#)
- [US EPA Expedited Site Assessment Tools for Underground Storage Tank Sites: A Guide for Regulators \(EPA 510-B-97-001\)](#)

Discrete (or Grab) Samples. Representative of one specific sample site at a specific location. Discrete soil samples are required at Sites to determine the concentrations of the contaminants of concern.

Composite Samples. Non-discrete soil samples composed of more than one specific aliquot collected at various sampling points. May be used for screening for non-volatile contaminants (i.e. PCBs, metals, SVOCs). **Composite samples are not acceptable for VOC sampling or as part of site characterization.** This approach may be acceptable for risk assessment and for waste characterization analysis for proper disposal.

Other Acceptable Soil Sampling Methodologies. Incremental Soil Sampling (ISM) is a structured composite sampling and processing protocol that reduces data variability and provides a reasonably unbiased estimate of mean contaminant concentrations in a volume of soil targeted for sampling. ISM provides representative samples of specific soil volumes defined as decision units (DUs) by collecting numerous increments of soil (typically 30–100 increments) that are combined, processed, and subsampled according to specific protocols. DUs are defined based on an area with a common historical land use or a common proposed reuse. Specific protocols can be found in ITRC's [Incremental Sampling Methodology Guidance](#) document.

Soil Excavations. For soils that are removed for stockpiling and/or treatment, samples of the native material remaining in the ground must be collected and submitted for laboratory analysis in order to demonstrate that the full extent of contamination was removed unless post-excavation sampling is not required as part of the Corrective Action Plan (CAP). This approach will be allowed when the area of soil contamination has been thoroughly characterized and the CAP calls for over excavation of the contaminated soils. The number and locations of post-excavation samples for laboratory analysis will be addressed in the work plan, or the CAP, or through communication with the Secretary. Analytical methodologies will be determined by the contaminant(s) of concern and addressed in the work plan.

4. Groundwater Sampling

Well purging, sampling procedures, and well maintenance. The method of sample collection and materials used will depend on the site conditions and contaminants of concern. The objective is to obtain representative groundwater formation samples (turbidity free) from either temporary well points or monitoring wells for physical and chemical analyses.

The following references are available for guidance, where applicable:

- [ASTM \(D5092M-16\) – Reapproved 2010: Standard Practice for Design and Installation of Groundwater Monitoring Wells](#)
- [ASTM \(D4448-01\) – Reapproved 2013: Standard Guide for Sampling Groundwater Monitoring Wells](#)
- [ASTM \(D6452\) Guide for Purging Methods for Wells Used for Groundwater Quality Investigations](#)
- [ASTM \(D6517\) Guide for Field Preservation of Groundwater Samples](#)
- [EPA Practical Guide for Ground-Water Sampling, EPA/600/2-85/104, US EPA, Dated 1985](#)
- [EPA Low-Flow \(Minimal Drawdown\) Ground-Water Sampling Procedure, April 1996](#)
- [ITRC-Protocol for Use of Five Passive Samplers to Sample for a Variety of Contaminants in Groundwater, February 2007](#)

Metals Analysis. Metals analysis must be for total metals analysis and should follow the EPA Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedure (see reference above).

Well Screens

Monitoring wells as traditionally constructed (i.e. with 10 ft screens) may not be useful as a primary characterization tool because of vertical and volumetric averaging of contaminant concentrations associated with this type of sampling. It is important to understand the site geology and incorporate this understanding into developing an appropriate groundwater characterization plan.

5. Water Supply Sampling

Potentially impacted or threatened drinking water supplies must be sampled to determine the presence of contamination. The sampler must determine where the sample is to be collected, typically closest to the source of the water supply. This is usually at the pressure tank (if a spigot is present), or at the kitchen or bathroom tap, if the pressure tank is not accessible. Volatile organic contaminant concentrations will be reduced throughout the distribution system if a pressure tank is present, therefore it is important to draw fresh water into the tank before sampling.

Always sample prior to water treatment, including sediment filters, if present, and note if treatment was bypassed during sampling.

It is sometimes possible to sample directly from the source when the source is a shallow dug well. Care must be taken to prevent coliform contamination of the water supply from the sampling equipment (example: sampling standing water in a shallow dug well or in a cistern). The next best location is to sample from a faucet or valve after the pump and prior to the pressure tank. In the case of a gravity feed, the first faucet into the house is the next best to sampling the source itself.

Photos should always be collected of all sampled water sources and of the sample location, to include close-up photos and notable features in the surrounding area. Property owners should be interviewed to collect any relevant information related to the well construction, if known. See the attached **Water Supply Field Collection Form** as a guide for collecting relevant water source information.

The following sampling procedures must be utilized, unless approved by the Secretary:

1. If sampling from a faucet in kitchen or bath, remove any filters, aerators, or screens present on faucet. If sampling off of a valve, sample directly into containers. Collect samples directly into appropriate sample bottles. Tap water should be allowed to run for approximately fifteen (15) minutes prior to sampling, or for an appropriate time based on the size of the pressure tank and distribution system. This purges the plumbing system of stagnant water and ensures that representative drinking water is being sampled. Monitoring water quality parameters and temperature during purging is useful to ensure that fresh water is being collected.
2. If sampling from a shallow dug well, utilize the bailer or peristaltic pump if the sampler cannot reach the water supply. Place sample directly into appropriate sample bottles from sampling device. Ensure no contamination from tubing or bottles. Report any deficiencies in water supply protection that may be present (example: door to spring house off of hinges).

6. Vapor intrusion (sub-slab, indoor air, and ambient air)

The potential for VI exists at any site where there has been a release of VOCs near a building and may present a risk for any future buildings constructed above or near a contaminated area. Please see the separate **VTDEC Vapor Intrusion Guidance** for more details.

The following references are available for guidance, where applicable:

- [ITRC Petroleum Vapor Intrusion, October 2014](#)
- [ITRC Vapor Intrusion Pathway: Investigation Approaches for Typical Scenarios, January 2007](#)
- [ITRC Vapor Intrusion Pathway: A Practical Guideline, January 2007](#)
- [OSWER 9200.2-154 Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air](#)
- [EPA 510-R-15-001 Technical Guide for Addressing Petroleum Vapor Intrusion at Leaking Underground Storage Tank Sites](#)

7. Surface Water and Sediments

If a surface water body has been identified as a threatened or impacted sensitive receptor, further characterization may be appropriate. To evaluate the risk to surface water, sampling data should be compared to the Vermont Water Quality Standards. The following reference is available for guidance, where applicable:

- [VT DEC Recommended Guidelines for Evaluating Contaminants to Adversely Affect Aquatic Biota](#)

The contaminants of concern at a site will dictate which analytical method is most appropriate for different media. References to specific laboratory methods are subject to change. EPA Methods referenced below must be used unless an updated or alternative method is approved or requested by the Secretary.

CONTAMINANTS OF CONCERN	ANALYSIS*
VOCs	Initial sampling including petroleum sites: EPA Method 8260 Subsequent petroleum site sampling rounds following Secretary approval: VT Petroleum List** Drinking water supplies: EPA Method 524.2 Soil gas and indoor air: EPA Method TO-15 or 8260
Ethylene Dibromide (EDB)	EPA Method 524.2 when water supplies potentially at risk
SVOCs	EPA Method 8270; SIM
PAHs	EPA Method 8270; SIM
PCBs	EPA Method 8082; EPA Method 1668a Analytical method used will depend on reported parameters, detection limit, media, and potentially degree of weathering.
Dioxins/Furans	EPA Method 8280 or 8290
Metals	EPA SW-846 methods
TPH	Soil analysis ONLY upon approval of the Secretary (see guidance below): EPA Method 8015 DRO or GRO.
PAHs, Arsenic, Lead (Development Soils disposal characterization only)	EPA Method 1312 Synthetic Precipitation Leaching Procedure (SPLP)
Per- and polyfluoroalkyl substances (PFAS)	EPA Method 537.1 for water supplies; Method 537 Modified for other media
1,4 Dioxane	EPA Method 522 (SPE and SIM GC/MS) for groundwater

* For those chemicals not listed, use current EPA approved method

** Vermont Petroleum List: Benzene, toluene, ethylbenzene, xylenes, total trimethylbenzene, naphthalene, MTBE

Guidance on TPH

No soil standard is provided in the IRule for Total Petroleum Hydrocarbons (TPH), therefore analytical data for TPH will not be used directly for risk assessment. TPH data may be collected if the information will help refine the conceptual site model during a site investigation or provide information that will be needed to select remedial options. For example, TPH data can be used to help characterize contaminant mass and distribution, and chromatograms can be useful to determine the type of material present and degree of weathering. THP analysis can also be useful in determining vapor intrusion risk to structures or for some corrective action technologies. Justification for performing TPH analysis must be provided in a work plan. Additional information about evaluating TPH data is available here: <https://tphrisk-1.itrcweb.org/>

Data Quality Objectives (DQOs)

Data Quality Objectives (DQOs) are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. The DQO is a guide for effective collection and analysis of environmental data that ensures the results of the investigation will meet regulatory goals. For detailed

information on the DQO process, refer to the EPA document, “Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4” at:

https://www.epa.gov/sites/production/files/documents/guidance_systematic_planning_dqo_process.pdf.

QA/QC requirements

Minimum QA/QC for a sample delivery group: A trip blank or field blank, a duplicate sample, chain of custody documentation, and documentation of the laboratory’s QA/QC samples analyzed in addition to site specific media samples. Additional QA/QC requirements may be necessary and must be part of an approved work plan.

Reporting

The laboratory method detection limit (MDL) must be below the applicable standard. If the MDL is above a standard, the Secretary may require that additional samples be analyzed using a method providing an MDL below the applicable standard. Non-detect (ND) results must be reported as below test method MDL, with the MDL reported.

Toxicity Equivalence Quotients (TEQ)

The following contaminants must be reported as Toxicity Equivalence Quotients (TEQs):

Polycyclic Aromatic Hydrocarbons (PAHs). Soil analytical results for PAHs must be reported as a TEQ to benzo(a)pyrene. For PAH compounds that are non-detect, a value equal to one half the reported MDL shall be used for calculating the TEQ. Relative potency factors are listed in Appendix F of the IRule. Sediment analytical results for PAHs must be compared to individual PAHs.

Dioxins, furans, and dioxin-like PCBs. Must be reported as a TEQ to 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD). The Toxicity Equivalence Factors (TEF) to be used by the laboratory during analysis are included in Appendix F of the IRule. Laboratory results must include the 2,3,7,8-TCDD values and raw concentrations reported for each individual dioxin-like compound.

Polychlorinated Biphenyls (PCBs). PCBs must be reported as individual congeners, homologs, or Aroclors. The sum of all homologs is also referred to as Total PCBs and can be directly compared to the Vermont Soil Standard. If PCBs are reported as individual congeners, dioxin-like congeners should be segregated; weighted using the TEFs in Appendix F of the IRule; and assessed in conjunction with TCDD-TEQ. The remaining congeners would be summed and assessed as Total PCBs. If results are analyzed as PCB Aroclors, analytical results shall be totaled, and the Total PCBs can be directly compared to the Vermont Soil Standard.

WATER SUPPLY FIELD COLLECTION FORM
PROJECT:

SAMPLE E911 ADDRESS			
SAMPLER(S)		DATE/TIME	
OWNER NAME		E-MAIL	
ADDRESS (IF DIFFERENT)		TELEPHONE	
RENTAL?	YES NO	E-MAIL	
TENANT NAME		TELEPHONE	
WATER SUPPLY TYPE	SPRING OVERBURDEN BEDROCK UNKNOWN	WELL LOCATION (I.E. FRONT YARD, CELLAR...) TAKE A PICTURE OF THE WELL TAG (IF THE WELL HAS ONE)	
DATE OF INSTALLATION			
GPS COORDINATES	LAT:	WELL TAG NUMBER	
	LONG:	DRILLER ID #	
WATER SOFTENER	YES NO TYPE:	ONSITE SEPTIC?	YES NO UNKNOWN
WATER FILTER	YES NO TYPE:	SEPTIC LOCATION	
SAMPLE LOCATION	PRESSURE TANK SPIGOT OUTSIDE SPIGOT KITCHEN FAUCET OTHER: _____	AERATOR REMOVED?	YES NO NONE PRESENT
PURGING TIMES	START: SAMPLE TIME:	ODOR?	YES NO DESCRIBE:
SAMPLE ID:		COLOR?	YES NO DESCRIBE:

SAMPLE AREA INVENTORY/USE:



