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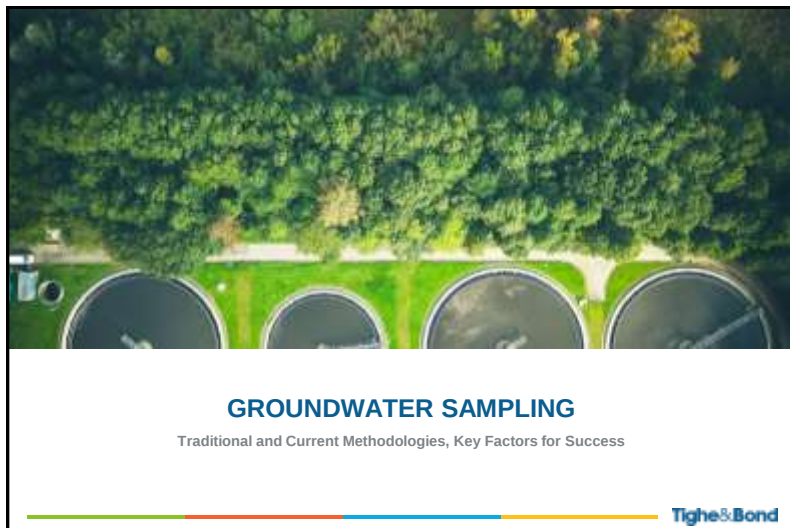


ENVIRONMENTAL SOIL AND GROUNDWATER SAMPLING
Procedures for Collecting Representative Data during Site Assessment Field Work

Nick Guidi Senior Environmental Scientist	Kristi Gagnon Project Environmental Scientist	Nicholas Granata Principal Environmental Scientist
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GROUNDWATER SAMPLING METHODS

Bailers

- Requires removal of 3 well volumes (PVC casing area x water column)
- Disturbs sediments, creating turbid samples

Inertial Check Valves (Waterra)

- Effective for remote locations with deep groundwater (more than 29 feet)
- Can be labor-intensive for high well purge volumes

Electric Submersible Pumps

- Rapid groundwater removal
- Produces non-turbid purge water

Peristaltic Pumps

- Low flow, preferred method for current site assessment practice
- Requires several pieces of equipment, bulky to transport

Bladder Pumps (Submersible, Pneumatic)

- Low flow, preferred method for current site assessment practice
- Requires decontamination between monitoring wells

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GROUNDWATER SAMPLING METHODS

Bailers (Traditional)

- Limited Applicability
- Bail 3X Well Volume
- Disturbs Water Column, Sediments
- Turbid Samples
- Dedicated Equipment for each Monitoring Well

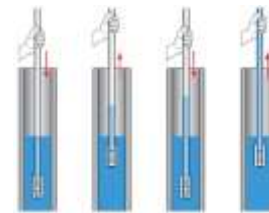
(Campine, 2020)

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GROUNDWATER SAMPLING METHODS

Inertial Check Valves (Waterra)

- Requires Manual Force to Operate
- Easily Transported
- Moderate Groundwater Purge Rates
- No Depth Limitation (Up to 200 feet)
- Dedicated to Each Monitoring Well



(Solinst Canada Ltd., 2020)

(Solinst Canada Ltd., 2020)

(ECT Manufacturing, Inc., 2020)

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EPA LOW STRESS (LOW FLOW) PROCEDURE

Applicability and General Scope

- Standard Approach for Site Assessment/Remediation Industry
- Minimizes Groundwater Disturbance (low turbidity)
- Designed to minimize Hydraulic Stress by Minimizing Drawdown within Monitoring Wells during Purging
- Produces Groundwater Samples More Representative of Aquifer Conditions, Compared to Traditional Methods (Bailer, Inertial Pump)
- Requires an Array of Equipment, including Multi-Parameter Water Quality Meter with Flow-Through Cell and Separate Turbidity Meter, Pump and Accessories (Peristaltic, Bladder or Submersible)
- Geochemical Parameters are Monitored in Purge Water to confirm Equilibrium Conditions between the Monitoring Well Void and the Aquifer
- Adequate for VOCs, SVOCs, Dissolved Gases, Pesticides, PCBs, Metals, other Inorganics or Naturally-Occurring Analytes
- A Current, Detailed EPA Guidance Document Exists for Sampler or Project Manager Reference, which is Periodically Updated by the EPA

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FIELD APPLICATION

Well Development

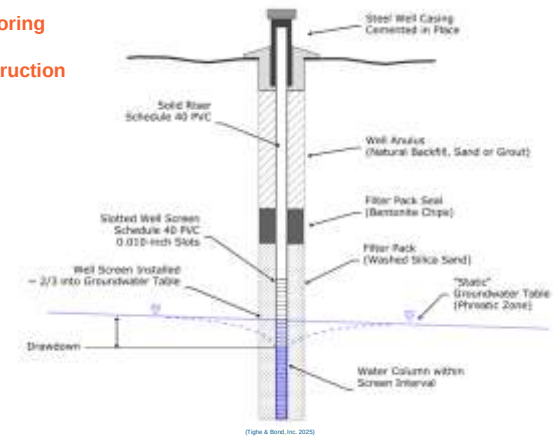


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EPA LOW STRESS (LOW FLOW) PROCEDURE

Monitoring Well Construction



(Tighe & Bond, Inc. 2020)

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FIELD APPLICATION

Temporary Wells



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EPA LOW STRESS (LOW FLOW) PROCEDURE

Materials List

- Padlock Keys, Tools for Opening Well
- Site Plan
- Water Level Meter
- Groundwater Sampling Field Log
- Dedicated Tubing
- Pump and Power Source
- Purge Bucket
- Multiparameter Water Quality Meter and Flow-Through Cell
- Turbidity Meter and T-Valve
- Graduated Vessel
- Laboratory-Supplied Sample Containers and Cooler
- Laboratory Chain of Custody

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EPA LOW STRESS (LOW FLOW) PROCEDURE



(Activated Carbon Dept. 2025)

Water Level Meter

- Water Level Measurements Collected from PVC Rim
- Measurements in 0.01-Foot Increments (1/100th FT)
- Audible Beep and Light when Probe Contacts Water
- Measure Static Water Level, Drawdown, Total Well Depth (After Sampling)



(ENVIRO-EQUIPMENT, INC. 2025)

Interface Meter

- Measure LNAPL or DNAPL
- Audible Solid Beep and Light when Probe contacts product
- Intermittent Beep when Probe Contacts Water

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FIELD APPLICATION

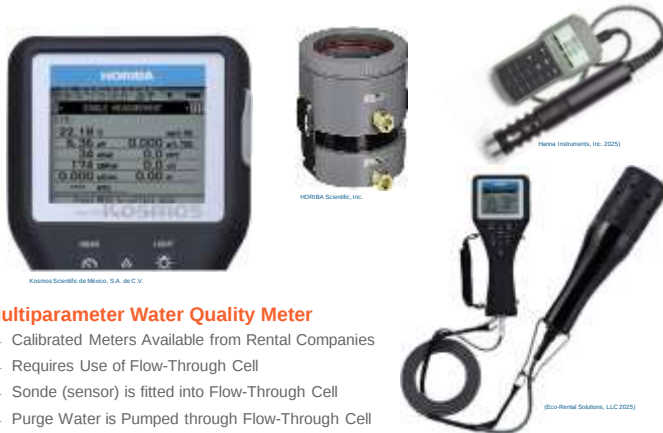
Significant Contamination

- Use Conceptual Site Model (CSM) during field sampling procedures
- Where are the "source" contamination areas?
- Collect groundwater samples from least-contaminated areas to most-contaminated areas



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EPA LOW STRESS (LOW FLOW) PROCEDURE



Multiparameter Water Quality Meter

- Calibrated Meters Available from Rental Companies
- Requires Use of Flow-Through Cell
- Sonde (sensor) is fitted into Flow-Through Cell
- Purge Water is Pumped through Flow-Through Cell

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EPA LOW STRESS (LOW FLOW) PROCEDURE

Peristaltic Pump

- Electrical, Requires 12V DC Battery
- Forces Water Through Tubing via Peristalsis
- Maximum Head Differential of 29 Feet
- Dedicated Tubing, No Need to Decontaminate
- Pump Rate of 50 ml/min to 400 ml/min

Bladder Pump

- Pneumatic
- Can Use Air Cannisters or Electrical Air Pump
- Maximum Head Differential of 180 Feet
- Not Dedicated, Must be Decontaminated
- Pump Rate of 10 ml/min to 600 ml/min



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EPA LOW STRESS (LOW FLOW) PROCEDURE



(ENVIRONMENTAL HOLDINGS PTY LTD 2020)

Electric Submersible Pumps

- Can be Used for Low Flow Sampling, though Less Common in New England (shallow groundwater)
- Requires Decontamination between Monitoring Wells
- High Groundwater Purge Rates
- Requires Generator and Control Box (Vehicle Accessible Applications)
- Pump Rate of 50 ml/min to several L/min

(Pine Environmental Services LLC 2020)



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EPA LOW STRESS (LOW FLOW) PROCEDURE

Groundwater Sampling Field Log

- Static Groundwater Level
- Purge Rates (ml/min) for drawdown equilibrium
- Geochemical Parameters (5 min)
- Three consecutive readings within specified criteria
- Separate Turbidity Readings
- Collect sample following aquifer-well equilibrium

GROUNDWATER SAMPLE DATA COLLECTION

Project Name: _____ Well ID: _____
 Project Number: _____ Date: _____
 Location: _____ Sample Date: _____
 Weather Conditions: _____ Collected By: _____

MOVING (LOW) WELL DATA AND PURGING DETAILS

Reference Point: ☐ PVC ☐ Steel Casing ☐ Concrete Surface
 Diameter of Well: _____ (in)
 Depth to Water: _____ (ft)
 Pump Equipment: _____
 Depth of Water Column: _____ (ft)
 Estimated Equipment: ☐ Yes ☐ No
 1 Pump Volume: _____ (L)
 Volume Pumped: _____ (L)
 Sampling Method: ☐ Tubing ☐ Sucker ☐ Other
 Was Well Purged Dry? ☐ Yes ☐ No
 Time: _____

ESTABLISHED PARAMETERS FIELD DATA

Time (3-5 min)	Depth to Water (ft)	Temp. (°C) (±0.1)	pH (±0.1)	Specific Cond. (µmhos/cm) (±0.1)	DO (mg/L) (±0.1) or Sat. (±0.1)	ORP (mV) (±10 mV)	Turbidity (NTU) (> 0.1 NTU as 0.1 NTU)	Volume Pumped (gallons)

FINAL FIELD DATA

Temperature: _____ (°C) Dissolved Oxygen: _____ (mg/L)
 pH: _____ ORP: _____
 Specific Conductance: _____ (µmhos/cm) Turbidity: _____ (NTU)
 Was the Sample Field Filtered? ☐ Yes ☐ No Filter Pore Size: _____

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EPA LOW STRESS (LOW FLOW) PROCEDURE

Low-Flow (Minimal Drawdown) Ground-Water Sampling

- EPA Guidance Document Available Online
- Last Revised September 2017

QUALITY ASSURANCE
Region 1 Low Stress
(Low Flow) RFP
Previous Version 4
Date July 18, 1999
Revised September 18, 2017
Page 1 of 10

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 1

LOW STRESS (low flow) PURGING AND SAMPLING
PROCEDURE FOR THE COLLECTION OF
GROUNDWATER SAMPLES
FROM MONITORING
WELLS

Quality Assurance Unit
U.S. Environmental Protection Agency - Region 1
11 Technology Drive
North Charleston, SC 29503

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WHAT TO LOOK OUT FOR

Non-Ideal Conditions

- Well purged dry/turbid samples
- Geochemical parameters not equilibrating (practical/time constraints)

Trip Blanks, Equipment Blanks, Duplicate Samples

- Required? Implemented?

Field Filtering

- Private Wells are not filtered!
- "Drinking Water" vs. "Waste" analyses

Laboratory Quality Control Narratives

- Laboratory Log In Sheet
- RCP/MCP CAM Compliance Checklists

Low Flow Tubing

- Teflon/lined recommended for VOCs
- Teflon not recommended for PFAS

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WHAT TO LOOK OUT FOR

Sample Preservation

Table 3
Recommended Containers, Preservation, Storage, & Holding Times
For Water and Wastewater

Description	Method	Matrix	Sample Container ¹	Preservative ²	Prep/Analysis Holding Time	Volumes
Volatiles/Semi-volatile Analysis						
EDB, DBCP	594.1, 8011	H ₂ O	G (B) Tef Sag	Cool (0° C), 75 µL NaOH solution	14 days	40 mL ^{3,12}
Halomeric Acids	553.2	H ₂ O	AG-100 Tef Cap	Cool (5° C, Sigmat)	14 days	250 mL ¹²
GCMS-Parguiles	524.2	H ₂ O	G (B) Tef Sag	Cool (20° C Acetic acid 0.1M, HCl to pH < 2) ¹²	14 days	40 mL ^{3,12}
GCMS-Parguiles	524.2-1119b only	H ₂ O	G (B) Tef Sag	Cool (20° C NaOH solution)	14 days	40 mL ^{3,12}
GCMS-Parguiles	624, 6240C	H ₂ O	G (B) Tef Sag	Cool (20° C HCl to pH < 2) ¹²	14 days ¹²	40 mL ^{3,12}
GCMS-Acrylonitrile, 2-Chloroethylvinyl ether	624	H ₂ O	G (B) Tef Sag	Cool (20° C) ¹²	3 days ¹²	40 mL ^{3,12}
GC-Pesticides	608, 8001B	H ₂ O	AG 100 Tef Cap	Cool (0° C) ^{12,13}	7-90 days ⁹	1L ^{1,8}
GC-PCBs	608, 8002A	H ₂ O	AG 100 Tef Cap	Cool (0° C) ^{12,13}	1 y 01 yr ¹⁰	1L ^{1,8}

(EPA/600/4-91/010)

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WHAT TO LOOK OUT FOR

Data Quality Objectives

- What is the Goal?
- Not All Samples Are the Same!

Assessment

Remediation

Risk Characterization

- Reporting Limits (sensitivity)
- Analytical Methodology
- Sample Collection, Handling, Preservation
- Are you measuring remediation project outcomes?
- Or human exposures?



(Shutterstock.com, 2020)

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WHAT TO LOOK OUT FOR

Sample Log-in Checklist

- Typically provided in laboratory report, near the end
- Identifies common deficiencies in sample preparation, handling and preservation
- Generally indicates overall quality of work by sampler

Client: Tighe & Bond
Job Number: 625-28038-1
Log-in Number: 25626
List Number: 1
List Source: Benthic Rhinoceros Island

Question	Answer	Comment
Reactivity either was not measured or, if measured, is at or below background	N/A	
The cooler is properly used, if present, to meet:	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	N/A	
Samples were received on dry	True	
Cooler Temperature is recorded	True	
Cooler Temperature is recorded	True	
COG is present	True	
COG is filled out in the area required	True	
COG is filled out with all pertinent information	True	
Is the Field Sample's status present in COG?	True	
There are no discrepancies between the Sample ID's and the containers and the COG	True	
Samples are received within holding time (Excluding fields with immediate HPLC)	True	
Samples containers have legible labels	True	
Containers are not broken or leaking	True	
Sample containers / materials are protected	True	
Containers contain samples as noted	True	
Sample bottles are completely filled	True	
Samples Properly sealed / stored	True	
There is sufficient red for all requested analyses, not any requested MINORs	True	
FROM sample used do not have bioindicator or bioindicator (BAP) in duplicate	True	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiple samples are not present	True	

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QUESTIONS?



SOIL SAMPLING

Current Methodologies, ISM, and Key Factors for Success

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CONCEPTUAL SITE MODEL (CSM)

CSM Development

- Physical Setting, Current Uses at and Surrounding Property
- Current and Historical Records Review
- Radius Search (government databases)
- Local, state or county records regarding environmental cleanups
- Municipal File Review
- Site Reconnaissance
- Interviews
- Conclusions

Objectives

- Research upfront
- Build a CSM first
- Site reconnaissance follows current and historical research (know what to look for)
- Interviews follow site visit (know what to ask)
- Analytical data drives further CSM development (Phase II ESA)

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SOIL SAMPLE COLLECTION

Planning for Assessment

- Site Access
- Spatial and Overhead Concerns
- Utility Concerns
- Damage from Equipment Treads
- Sensitive Receptor Areas
- Property Restoration



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SURFACE SOIL SAMPLING

Methods and Equipment

- Soil Sampling Accessibility
 - Utility Concerns
 - Minimal Site Disturbance
 - Precise Soil Sampling
- Bucket Auger
 - Extensions Available
- Dutch Auger
 - Easy collection of soil in heavily rooted areas
 - Good for both hard or wet soils
- Hand Trowel



(HARS, 2022)



(ARMSTRONG, 2022)



(PALMIS Environmental, 2022)

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SUBSURFACE SOIL SAMPLING

Excavators

- Best Visibility Option
- Best Method for Evaluating Fill
- Bladed Bucket versus Toothed Bucket



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SUBSURFACE SOIL SAMPLING

Flush Joint Casing (FJC) Drill Rig (Drive and Wash)

- "Cased" boring advanced with hammer
- Split Spoon Samplers
- 24" Sampler Hammered into the Ground
- Advanced in 6" Increments
- Most Accurate Vertical Sampling
- Indications of soil compaction
 - Low N-values = softer soils
 - Higher N-values = denser soils
- Considerations
 - Time Factor
 - Poor Recovery
 - Height Constraints
- Allows sampling below water table
- Best for deep samples/wells (50 ft +)



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SUBSURFACE SOIL SAMPLING

Hollow Stem Auger (HSA) Drill Rig

- Utilizes a Rotary Cutting Head
- "Screw" motion clears soil when augers are rotated
- Hollow Stem Augers act as Casing
 - Prevents Cave In
 - Limits Cross Contamination
 - Allows for Enhanced Sand Pack for Groundwater Monitoring Wells
- Faster than Flush Joint Casing
- For medium-depth samples/wells (10-50 ft)
- "Running Sands" issue at depths far below groundwater table



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SUBSURFACE SOIL SAMPLING

Direct-Push Tooling (DPT) Drill Rig

- Minimal ground disturbance (~4" holes)
- Quick and Cost Effective
- Minimal Cuttings Generated, Less Investigation-Derived Waste (IDW)
- Uses Dedicated MacroCore sleeves
- OK for shallow borings (30 ft)
- Beware of Compression Factor
 - Using Static Weight and Force which Results in Soil Compression
 - Soil compressed over 4-5 foot intervals
 - Compression as much as 5X
- "Running Sands" are a problem
 - Tooling completely removed from ground after each sample



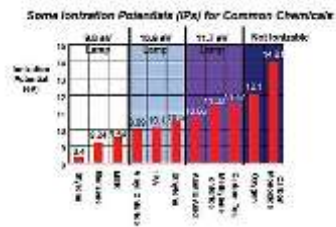
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FIELD SCREENING TOOLS

Photoionization Detector (PID)

- Field/Headspace Screening
- PID Calibration
- Different Bulbs for Different Contaminants
 - Consult your Local Rental Company



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FIELD SCREENING TOOLS

Application and Reporting



Tighe & Bond		Client Information		Project Information		Analysis Information		Reporting Information	
Sample ID	101	Client Name	ABC Company	Project Name	XYZ Project	Analysis Type	GC/MS	Reporting Type	Standard
Sample Location	101	Client Address	123 Main St	Project Address	456 Main St	Analysis Date	5/20/2025	Reporting Date	5/20/2025
Sample Description	101	Client Contact	John Doe	Project Contact	Jane Smith	Analysis Results	10.1	Reporting Results	10.1
Sample Quantity	101	Client Phone	555-1234	Project Phone	555-5678	Analysis Comments		Reporting Comments	
Sample Container	101	Client Email	john.doe@abc.com	Project Email	jane.smith@xyz.com	Analysis Signature		Reporting Signature	
Sample Label	101	Client Website	www.abc.com	Project Website	www.xyz.com	Analysis Initials		Reporting Initials	
Sample Date	101	Client Logo		Project Logo		Analysis Stamp		Reporting Stamp	
Sample Time	101	Client Address	123 Main St	Project Address	456 Main St	Analysis City		Reporting City	
Sample State	101	Client City	New York	Project City	New York	Analysis State		Reporting State	
Sample Zip	101	Client Zip	10001	Project Zip	10001	Analysis Zip		Reporting Zip	
Sample Country	101	Client Country	USA	Project Country	USA	Analysis Country		Reporting Country	
Sample Latitude	101	Client Latitude	40.7128	Project Latitude	40.7128	Analysis Latitude		Reporting Latitude	
Sample Longitude	101	Client Longitude	-74.0060	Project Longitude	-74.0060	Analysis Longitude		Reporting Longitude	
Sample Elevation	101	Client Elevation	100	Project Elevation	100	Analysis Elevation		Reporting Elevation	
Sample Temperature	101	Client Temperature	70	Project Temperature	70	Analysis Temperature		Reporting Temperature	
Sample Humidity	101	Client Humidity	50	Project Humidity	50	Analysis Humidity		Reporting Humidity	
Sample Wind Speed	101	Client Wind Speed	10	Project Wind Speed	10	Analysis Wind Speed		Reporting Wind Speed	
Sample Wind Direction	101	Client Wind Direction	0	Project Wind Direction	0	Analysis Wind Direction		Reporting Wind Direction	
Sample Pressure	101	Client Pressure	1013	Project Pressure	1013	Analysis Pressure		Reporting Pressure	
Sample Visibility	101	Client Visibility	10	Project Visibility	10	Analysis Visibility		Reporting Visibility	
Sample Cloud Cover	101	Client Cloud Cover	0	Project Cloud Cover	0	Analysis Cloud Cover		Reporting Cloud Cover	
Sample Precipitation	101	Client Precipitation	0	Project Precipitation	0	Analysis Precipitation		Reporting Precipitation	
Sample Dew Point	101	Client Dew Point	60	Project Dew Point	60	Analysis Dew Point		Reporting Dew Point	
Sample Frost Point	101	Client Frost Point	30	Project Frost Point	30	Analysis Frost Point		Reporting Frost Point	
Sample Rainfall	101	Client Rainfall	0	Project Rainfall	0	Analysis Rainfall		Reporting Rainfall	
Sample Snowfall	101	Client Snowfall	0	Project Snowfall	0	Analysis Snowfall		Reporting Snowfall	
Sample Icefall	101	Client Icefall	0	Project Icefall	0	Analysis Icefall		Reporting Icefall	
Sample Hailfall	101	Client Hailfall	0	Project Hailfall	0	Analysis Hailfall		Reporting Hailfall	
Sample Sleetfall	101	Client Sleetfall	0	Project Sleetfall	0	Analysis Sleetfall		Reporting Sleetfall	
Sample Drizzle	101	Client Drizzle	0	Project Drizzle	0	Analysis Drizzle		Reporting Drizzle	
Sample Shower	101	Client Shower	0	Project Shower	0	Analysis Shower		Reporting Shower	
Sample Thunderstorm	101	Client Thunderstorm	0	Project Thunderstorm	0	Analysis Thunderstorm		Reporting Thunderstorm	
Sample Tornado	101	Client Tornado	0	Project Tornado	0	Analysis Tornado		Reporting Tornado	
Sample Hurricane	101	Client Hurricane	0	Project Hurricane	0	Analysis Hurricane		Reporting Hurricane	
Sample Earthquake	101	Client Earthquake	0	Project Earthquake	0	Analysis Earthquake		Reporting Earthquake	
Sample Volcano	101	Client Volcano	0	Project Volcano	0	Analysis Volcano		Reporting Volcano	
Sample Asteroid	101	Client Asteroid	0	Project Asteroid	0	Analysis Asteroid		Reporting Asteroid	
Sample Comet	101	Client Comet	0	Project Comet	0	Analysis Comet		Reporting Comet	
Sample Meteor	101	Client Meteor	0	Project Meteor	0	Analysis Meteor		Reporting Meteor	
Sample Supernova	101	Client Supernova	0	Project Supernova	0	Analysis Supernova		Reporting Supernova	
Sample Black Hole	101	Client Black Hole	0	Project Black Hole	0	Analysis Black Hole		Reporting Black Hole	
Sample White Dwarf	101	Client White Dwarf	0	Project White Dwarf	0	Analysis White Dwarf		Reporting White Dwarf	
Sample Red Dwarf	101	Client Red Dwarf	0	Project Red Dwarf	0	Analysis Red Dwarf		Reporting Red Dwarf	
Sample Yellow Dwarf	101	Client Yellow Dwarf	0	Project Yellow Dwarf	0	Analysis Yellow Dwarf		Reporting Yellow Dwarf	
Sample Orange Dwarf	101	Client Orange Dwarf	0	Project Orange Dwarf	0	Analysis Orange Dwarf		Reporting Orange Dwarf	
Sample Red Giant	101	Client Red Giant	0	Project Red Giant	0	Analysis Red Giant		Reporting Red Giant	
Sample Yellow Giant	101	Client Yellow Giant	0	Project Yellow Giant	0	Analysis Yellow Giant		Reporting Yellow Giant	
Sample Orange Giant	101	Client Orange Giant	0	Project Orange Giant	0	Analysis Orange Giant		Reporting Orange Giant	
Sample Red Supergiant	101	Client Red Supergiant	0	Project Red Supergiant	0	Analysis Red Supergiant		Reporting Red Supergiant	
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Sample Orange Supergiant	101	Client Orange Supergiant	0	Project Orange Supergiant	0	Analysis Orange Supergiant		Reporting Orange Supergiant	
Sample Red Hypergiant	101	Client Red Hypergiant	0	Project Red Hypergiant	0	Analysis Red Hypergiant		Reporting Red Hypergiant	
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Sample Orange Hypergiant	101	Client Orange Hypergiant	0	Project Orange Hypergiant	0	Analysis Orange Hypergiant		Reporting Orange Hypergiant	
Sample Red Dwarf Star	101	Client Red Dwarf Star	0	Project Red Dwarf Star	0	Analysis Red Dwarf Star		Reporting Red Dwarf Star	
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Sample Orange Dwarf Planet	101	Client Orange Dwarf Planet	0	Project Orange Dwarf Planet	0	Analysis Orange Dwarf Planet		Reporting Orange Dwarf Planet	
Sample Red Dwarf Moon	101	Client Red Dwarf Moon	0	Project Red Dwarf Moon	0	Analysis Red Dwarf Moon		Reporting Red Dwarf Moon	
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Sample Orange Dwarf Moon	101	Client Orange Dwarf Moon	0	Project Orange Dwarf Moon	0	Analysis Orange Dwarf Moon		Reporting Orange Dwarf Moon	
Sample Red Dwarf Ring	101	Client Red Dwarf Ring	0	Project Red Dwarf Ring	0	Analysis Red Dwarf Ring		Reporting Red Dwarf Ring	
Sample Yellow Dwarf Ring	101	Client Yellow Dwarf Ring	0	Project Yellow Dwarf Ring	0	Analysis Yellow Dwarf Ring		Reporting Yellow Dwarf Ring	
Sample Orange Dwarf Ring	101	Client Orange Dwarf Ring	0	Project Orange Dwarf Ring	0	Analysis Orange Dwarf Ring		Reporting Orange Dwarf Ring	
Sample Red Dwarf Disk	101	Client Red Dwarf Disk	0	Project Red Dwarf Disk	0	Analysis Red Dwarf Disk		Reporting Red Dwarf Disk	
Sample Yellow Dwarf Disk	101	Client Yellow Dwarf Disk	0	Project Yellow Dwarf Disk	0	Analysis Yellow Dwarf Disk		Reporting Yellow Dwarf Disk	
Sample Orange Dwarf Disk	101	Client Orange Dwarf Disk	0	Project Orange Dwarf Disk	0	Analysis Orange Dwarf Disk		Reporting Orange Dwarf Disk	
Sample Red Dwarf Cloud	101	Client Red Dwarf Cloud	0	Project Red Dwarf Cloud	0	Analysis Red Dwarf Cloud		Reporting Red Dwarf Cloud	
Sample Yellow Dwarf Cloud	101	Client Yellow Dwarf Cloud	0	Project Yellow Dwarf Cloud	0	Analysis Yellow Dwarf Cloud		Reporting Yellow Dwarf Cloud	
Sample Orange Dwarf Cloud	101	Client Orange Dwarf Cloud	0	Project Orange Dwarf Cloud	0	Analysis Orange Dwarf Cloud		Reporting Orange Dwarf Cloud	
Sample Red Dwarf Nebula	101	Client Red Dwarf Nebula	0	Project Red Dwarf Nebula	0	Analysis Red Dwarf Nebula		Reporting Red Dwarf Nebula	
Sample Yellow Dwarf Nebula	101	Client Yellow Dwarf Nebula	0	Project Yellow Dwarf Nebula	0	Analysis Yellow Dwarf Nebula		Reporting Yellow Dwarf Nebula	
Sample Orange Dwarf Nebula	101	Client Orange Dwarf Nebula	0	Project Orange Dwarf Nebula	0	Analysis Orange Dwarf Nebula		Reporting Orange Dwarf Nebula	
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Sample Yellow Dwarf Galaxy	101	Client Yellow Dwarf Galaxy	0	Project Yellow Dwarf Galaxy	0	Analysis Yellow Dwarf Galaxy		Reporting Yellow Dwarf Galaxy	
Sample Orange Dwarf Galaxy	101	Client Orange Dwarf Galaxy	0	Project Orange Dwarf Galaxy	0	Analysis Orange Dwarf Galaxy		Reporting Orange Dwarf Galaxy	
Sample Red Dwarf Universe	101	Client Red Dwarf Universe	0	Project Red Dwarf Universe	0	Analysis Red Dwarf Universe		Reporting Red Dwarf Universe	
Sample Yellow Dwarf Universe	101	Client Yellow Dwarf Universe	0	Project Yellow Dwarf Universe	0	Analysis Yellow Dwarf Universe		Reporting Yellow Dwarf Universe	
Sample Orange Dwarf Universe	101	Client Orange Dwarf Universe	0	Project Orange Dwarf Universe	0	Analysis Orange Dwarf Universe		Reporting Orange Dwarf Universe	

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FIELD SCREENING TOOLS



(DEXSIL 2020)

DEXSIL Petroflag Kits

- Test for Total Hydrocarbons in Soil (TPH)
- Real Time Results using Extraction Solvent
- Analyzer Includes Response Factors and Detection Limits for TPH
- Calibration Temperatures are Important!
- Results Above the Upper Limit can be Re-Run with Less Sample Mass
- Potential Low Bias from Water Content
 - Dilution
 - Sample weight bias

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FIELD SCREENING TOOLS

PetroFLAG®
Hydrocarbon Test Kit - Field Data Sheet

Date: 8/26/24 Calibration Time/Date: 10413 / 8/26/24
 Operator: John Cooper Calibration Temperature: 30.0°C
 Location: Highway 201 - Lane

No.	Sample ID	Weight	Time/Date	Reading (ppm)	RF ¹	RF ²	Actual (ppm)	Comments
1	Blank	10g	8/26/24	0				
2	C.V.C.	5g	8/26/24	1000				
3	1.00g soil	1g	8/26/24	1175				Soil 100%
4	1.00g soil	1g	8/26/24	150				Soil 100%
5	1.00g soil	1g	8/26/24	375				Soil 100%
6	1.00g soil	1g	8/26/24	1000				Soil 100%
7	1.00g soil	1g	8/26/24	1000				Soil 100%
8	1.00g soil	1g	8/26/24	1000				Soil 100%
9	1.00g soil	1g	8/26/24	1000				Soil 100%
10	1.00g soil	1g	8/26/24	1000				Soil 100%
11	1.00g soil	1g	8/26/24	1000				Soil 100%
12	1.00g soil	1g	8/26/24	1000				Soil 100%
13	1.00g soil	1g	8/26/24	1000				Soil 100%

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SAMPLING METHODOLOGIES

Representative Sampling

- Site Specific Data Quality Objectives
- Discuss with Project Manager

Considerations

- Non-homogeneity of Soil
 - Contaminants tend to reside in finest fraction of soil particles (silt, clay, organic acids)
- Grab versus Composite Samples
 - Grab samples: single volume of soil homogenized and submitted for analysis
 - Composite samples: multiple volumes of soil (aliquots) homogenized and submitted for analysis
 - Volatile Organic Compound Samples **Never Composited!**
- Judgmental Sampling vs. Systematic Sampling
- Incremental Sampling
- Cross Contamination Issues, Decontamination Procedures

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SAMPLING METHODOLOGIES

Judgmental Sampling

- Informed by the nature of the site, contaminant properties, and observations
- Focused sampling from an obvious release or the mostly likely release mechanism
- Known Conditions vs. Uncertainty
 - Has soil been previously disturbed in the past (e.g. construction activities, filled)
 - Is there existing information that suggests where the location of highest contaminant concentrations are likely?
 - Do contaminant physical properties allow observation of impacted media (odors, staining, field screening)



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SAMPLING METHODOLOGIES

Systematic Sampling

- Used when Contaminant Distribution is Unknown (PCBs, metals, PFAS)
- No odors, staining, point source
- Set up Grid Cells (Letter, Number)
- Helpful to reduce uncertainty about nature, extent, and distribution of contamination at a site
- Number of samples depends on variability of initial data (standard deviation)
 - Source Unknown
 - Soil has been Disturbed
 - Lower potential for “missed” areas with high contaminant concentrations
- Can include composite sampling or grab sampling, or a combination of both



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SAMPLING METHODOLOGIES

Incremental Sampling Methodology (ISM)

- Type of Systematic Sampling
- Structured Composite Sampling Process
- Samples representative of soil throughout a prescribed area/depth called a Decision Unit
- Can have multiple samples (Sampling Units) within a Decision Unit
- Soil non-Homogeneity addressed through “Sub-Sampling” (samples of composite sample)
- Compared to traditional systematic sampling approaches
- ISM yields an accurate estimate of the true mean soil concentration for a given area
- ISM manages micro-scale soil heterogeneity and minimizes potential bias errors



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SAMPLING METHODOLOGIES

Incremental Sampling Methodology (ISM)

- Site is segregated into areas, each called a decision unit (DU)
- Increments (aliquots) collected evenly throughout DU (30 to 100 increments)
 - Can include Sample Units (SU) for varying depths within a DU
- Increments are composited into single composite sample (1 per DU/SU)
- Composite sample is then Sub-Sampled (samples of composite sample)
 - Initial sample is sieved, "slab cake" prepared from finest portions of sample
 - Slab cake is re-sampled as "meta" composite sample
- Final "meta" composite sample is analyzed for contaminants
- Laboratory typically performs ISM processing and analysis
 - Bulk sample volume is a drawback (5-gallon bucket)
 - Can reduce sample bulk by Sub-Sampling in field and discarding initial composite sample

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SAMPLING METHODOLOGIES

Incremental Sampling Methodology (ISM)

Two-Dimensional Slab Cake

- Targets finest soil fraction for analysis
- Sieved composite sample spread in even thickness
- Divided into increments and "sub-sampled"
- Sub-samples are re-composited into "meta" composite sample
- "Meta" composite sample analyzed



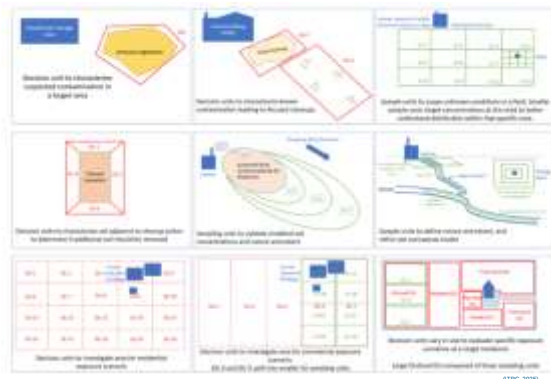
(Mark Bruce, Eurline, 2020/1/16)

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SAMPLING METHODOLOGIES

Incremental Sampling Methodology (ISM)



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LESSONS LEARNED

Non-Homogeneity of Soil is a Challenge

- Hoosac River Assessment
 - Mercury above the industrial hygiene level, reanalysis (from the same jar) showed much lower levels
- Emergency Response Situation in CT
 - Leachable lead concentration issues when analyzed via SPLP and reanalyzed showed different concentrations (some hazardous waste levels, some not)
- Field Screening Should Reflect Analytical Results
 - Sample loses "freshness" during screening
 - Should collect Duplicate Samples for field screening vs. lab analysis
 - Collect one for screening
 - One for lab analysis

Understand CSM, DQOs, Project Objectives before Sample Collection

- Soil sampling can be iterative
- Incorporate data quality issues, access issues, non-homogeneity into subsequent boring/sampling rounds

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QUESTIONS?



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