CT LABORATORIES

delivering more than data from your environmental analyses

Lab Guide for the Field

A quick reference guide for submitting environmental samples

CT Laboratories LLC
1230 Lange Court
Baraboo, WI 53913
608.356.2760

Lab Guide for the Field

Introduction

Think of this Guide as a collection of "cheat sheets" - a quick reference of FAQs and issues that we get calls on all the time:

- What preservation is required for Alkalinity? What is the holding time?
- What's your recommended cooler packing scheme?
- Do I really need to fill out everything on the chain-of-custody (COC) form?
- I ran short on bottles, need additional analyses or am able to obtain only limited sample volumes. What are my options?
- Milligrams per liter, parts per billion, percent: how does that go again?
- What are the differences between various means of sampling soils for VOC analysis?
- What does VOCs stand for? (volatile organic compounds, *see acronyms listing*)
- Should I let the lab know ***if*** …?

As always, if you have any questions or need more information, please contact your CT Laboratories Project Manager. They are here to help.

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1230 Lange Court – Baraboo, WI 53913
608.356.2760
www.ctlaboratories.com

Cooler Packing Tips

The following packing tips can help ensure that your samples arrive at the lab intact, uncompromised and within the 0 to 6°C regulatory temperature range.

Before Packing:

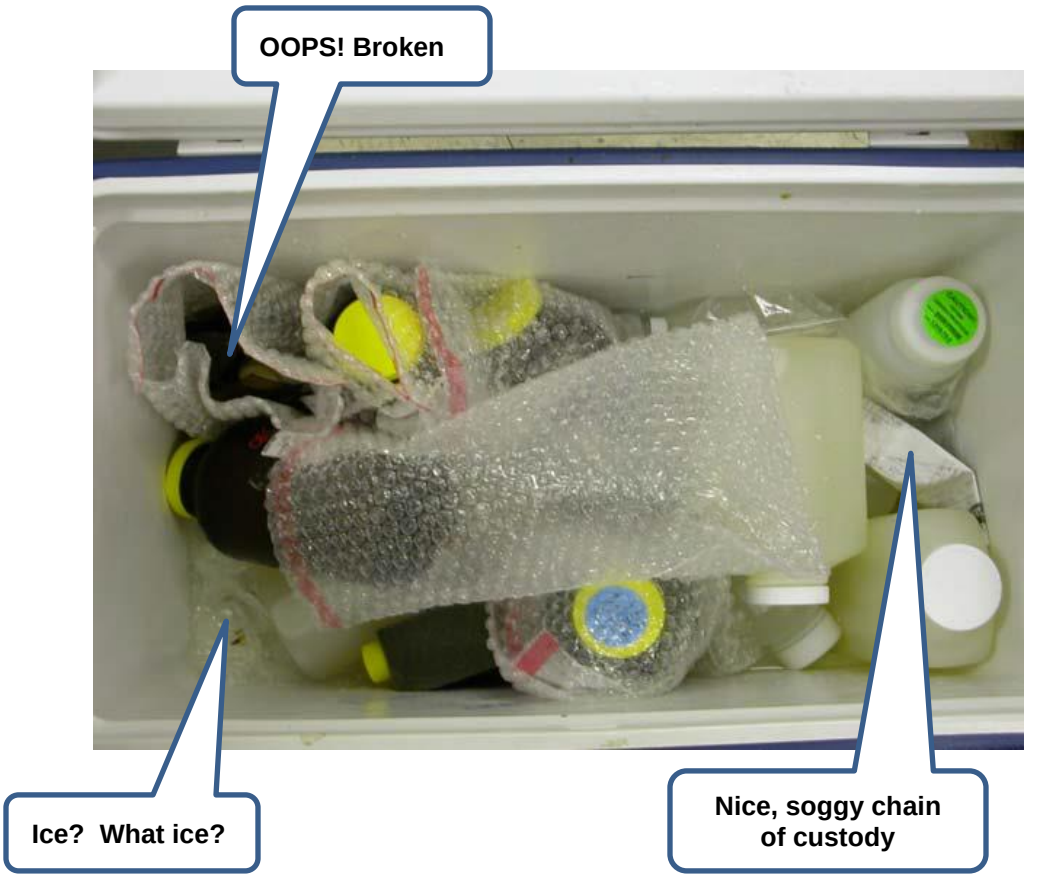
- ✓ For sample labels, please use ballpoint pen – not water-soluble ink (like some felt-tip markers) or pencil, which can rub off or smudge and blur beyond recognition.
- ✓ DO NOT use tape or extra labels on pre-tared bottles or cover up the pre-printed weight on the label.
- ✓ If samples are warm at time of collection, use an ice bath to pre-chill before packing in the cooler, if possible. The cooler's ice then only has to maintain the sample temperature.
- ✓ *Remove or cover up ALL old shipping labels on the cooler* to prevent sorting errors at FedEx/UPS distribution centers

Packing:

3 words: ICE, ICE, ICE

- ✓ At least 1/3 of the cooler should be taken up by ice – about 20-25 lbs. of ice for a large cooler. In warmer months, use more. Remember, *ice is cheaper than resampling*.
- ✓ Use "natural" ice. Never use dry ice – it can freeze the samples solid, compromising the sample integrity and causing containers to break, as well as being a safety hazard. Blue Ice packs don't maintain needed temperature well, and their use is not allowed by some regulatory agencies.
- ✓ Separate the sample containers from direct contact with the ice/melt water. Either bag the ice, bag the samples, or both. Bagged ice helps contain melt water.
- ✓ Sealing samples in ziplock bags or bubble bags helps protect the containers from water intrusion, and cushion them against breakage.
- ✓ Avoid packing materials that absorb water, like paper or peanuts. They don't provide cushioning once they get soggy or start to decompose (and they are a BIG MESS to unpack in that condition).
- ✓ To help avoid breakage, glass containers (particularly larger ones, such as1-Liter ambers) should be packed upright, never laying on their side; and use ice or bubble bags to keep them isolated.
- ✓ The foam blocks we provide are designed to hold VOC vials – they provide cushioning and keep the vials upright.

- ✓ Soil VOC/GRO Terracore kits should be shipped in the foam block provided, inside a ziplock bag and in an upright position.
- ✓ A large plastic/garbage bag (the "liner bag") should be used to contain the cooler contents: samples, ice (melt water). Make sure to twist-tie, knot or otherwise seal it.
- ✓ Suggested packing scheme: Layer for cushioning and chilling. Start with an absorbent layer on the bottom, then your outer bag, then bubble wrap, ice, samples, ice (repeat as necessary).
- ✓ Don't forget to pack your temperature blank along with all the other sample containers.
- ✓ **Place completed chain-of-custody in a ziplock bag to keep dry**. Taping the bag to the underside of the cooler lid is a good idea.



Sample Cooler Handling / Shipping Considerations

- This should go without saying, but please *do not use sample coolers for food storage.* (Yes, we've received someone's lunch by mistake).
- Excessive use of tape to seal coolers is not necessary; if you must use tape, a little will do. Your sealed liner bag will contain the cooler contents, and the buckle strap will keep the lid on (that's what it's there for - ***it is not a carrying handle!***).
- If security is an issue, use custody seals. Using tape to cover or sandwich custody seals protects them and makes it easier for us to remove them intact.
- Do not cover the CT Laboratories' cooler barcode label with tape, shipping labels, etc. ***It contains important, DOT mandated shipping information that must remain visible.***

Overnight Shipping (UPS, FedEx, etc.)

- Standard overnight shipping typically means delivery to the lab by 3:00 PM. Great for samples with no short hold times (remember to use extra ice in hot weather).
- Priority Overnight shipments are generally delivered by 10:30 AM ***Monday - Friday***. Remember: "overnight" packages shipped on Friday means delivery on Monday!
- First Overnight is delivered by 8:30 AM – very few projects are needed that early – save your $.
- For **SATURDAY** deliveries: ***make sure you specify "SATURDAY DELIVERY"*** in your shipping software, on the air bill/label and with a sticker on the cooler. Better safe than sorry.
- We are usually staffed for Saturday **sample receipt**, but ***please inform your PM to expect Saturday delivery.*** If we don't know it's coming, we won't know it's missing when it doesn't show up!
- It is a good idea to email your tracking numbers, etc. to your PM. *This is especially important if you are submitting short hold time samples (Nitrate, Nitrite, Coliform, BODs, Hexavalent Chromium, DI Terracores, etc.) or rush analyses.* Only limited analyses are scheduled for weekend shifts, so we need to arrange staff schedules to accommodate these samples.

Sample Drop-Off

Samples may be dropped off at the lab Monday - Friday 8:00 AM - 5:00 PM with the following exceptions:

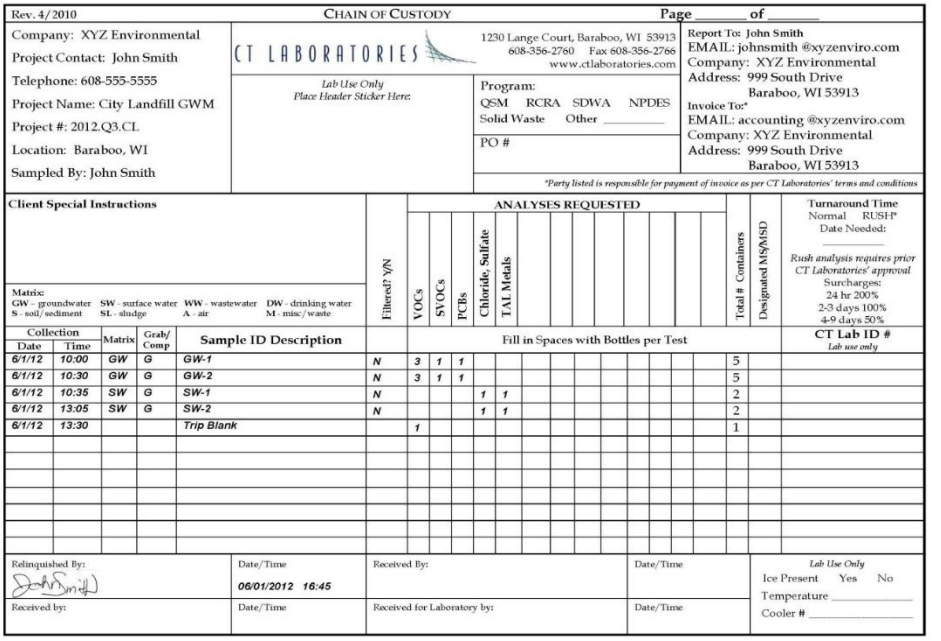
- No BODs or Nitrates after 2:00 PM on Friday's
- No total/fecal Coliforms or Hexavalent Chromium after 12:00 PM on Friday's

Field and Laboratory Quality Control Samples

SAMPLE TYPE	PURPOSE	COLLECTION
Field Blank	To check for cross- contamination during sample collection	Use organic-free, deionized or distilled water (blank water)
Equipment or Rinsate Blank	To check field decontamination procedures	When decontaminating sampling equipment or using a bailer or other sample collection vessel. Use blank water to rinse water into sample containers
Trip Blank	To check contamination during sample handling and shipping	Prepared by the laboratory and shipped with sample bottles
Temperature Blank	Dedicated container to check sample receipt temperature at the laboratory	Either prepared by the laboratory and shipped with sample bottles or prepared in the field
Method Blank	To assess the preparation and analytical batch for potential contamination	Prepared by the laboratory
Matrix Spike (MS)	To assess the effect of sample matrix on precision and accuracy	Collect additional volume for a field sample to be designated as an MS/MSD (sample + MS + MSD = triple volume)
Matrix Spike Duplicate (MSD)	To assess the effect of sample matrix on precision and accuracy	
Field Duplicate	To check reproducibility of field and laboratory procedures. To indicate non- homogeneity	Treat original and field duplicate samples identically
Field Split	To check for inter laboratory reproducibility	Treat original and split samples identically; ship to separate laboratories
Laboratory Duplicate	To check analytical/instrument accuracy and precision	Prepared by the laboratory
Laboratory Spike or Laboratory Control Sample (LCS)	To check the performance of the analytical system	Prepared by the laboratory

Sample Submission Requirements

All samples submitted for analysis must be accompanied by a completed chain-of custody form or letter indicating the required analyses. For your convenience, chain of-custody forms can be obtained from the lab or downloaded from our website at ***www.ctlaboratories.com.*** Following are instructions and an example of a properly completed chain-of-custody form.



Rev. 4/2010 — CHAIN OF CUSTODY — Page _____ of _____

Company: XYZ Environmental
Project Contact: John Smith
Telephone: 608-555-5555
Project Name: City Landfill GWM
Project #: 2012.Q3.CL
Location: Baraboo, WI
Sampled By: John Smith

CT LABORATORIES
1230 Lange Court, Baraboo, WI 53913
608-356-2760 Fax 608-356-2766
www.ctlaboratories.com

Lab Use Only
Place Header Sticker Here

Program:
QSM RCRA SDWA NPDES
Solid Waste Other _____

PO #

Report To: John Smith
EMAIL: johnsmith @xyzenviro.com
Company: XYZ Environmental
Address: 999 South Drive
Baraboo, WI 53913

Invoice To:*
EMAIL: accounting @xyzenviro.com
Company: XYZ Environmental
Address: 999 South Drive
Baraboo, WI 53913

*Party listed is responsible for payment of invoice as per CT Laboratories' terms and conditions

Client Special Instructions

Matrix:
GW - groundwater SW - surface water WW - wastewater DW - drinking water
S - soil/ sediment SL - sludge A - air M - misc/ waste

ANALYSES REQUESTED: Filtered? Y/N; VOCs; SVOCs; PCBs; Chloride, Sulfate; TAL Metals; Total # Containers; Designated MS/MSD

Turnaround Time
Normal RUSH*
Date Needed: _____
Rush analysis requires prior CT Laboratories' approval
Surcharges:
24 hr 200%
2-3 days 100%
4-9 days 50%

Collection Date	Collection Time	Matrix	Grab/ Comp	Sample ID Description	Filtered? Y/N	VOCs	SVOCs	PCBs	Chloride, Sulfate	TAL Metals	Total # Containers	Designated MS/MSD	CT Lab ID # (Lab use only)
						Fill in Spaces with Bottles per Test							
6/1/12	10:00	GW	G	GW-1	N	3	1	1			5		
6/1/12	10:30	GW	G	GW-2	N	3	1	1			5		
6/1/12	10:35	SW	G	SW-1	N				1	1	2		
6/1/12	13:05	SW	G	SW-2	N				1	1	2		
6/1/12	13:30			Trip Blank		1					1		

Relinquished By: John Smith — Date/Time 06/01/2012 16:45 — Received By: — Date/Time —
Received by: — Date/Time — Received for Laboratory by: — Date/Time —

Lab Use Only
Ice Present Yes No
Temperature _____
Cooler # _____

*****Samples for multiple analyses taken at the same time can be written on the same line*****

Company: Name of Company submitting samples.

Project Contact: Person to be contacted if additional information is required.

Telephone: The contact's phone number.

Project Number: Your Project Number (if applicable).

Project Location: Provide location if a separate site or location for a multi-location project.

Sampled by: Name(s) of sampler(s).

Regulatory Program: Indicate the associated regulatory program (if applicable).

Turnaround Time: Indicate the turnaround time desired and due date.

*****Prior arrangements should be made with CT Laboratories if expedited turnaround is needed in order to allocate resources and to determine if desired time frame is feasible*****

Mail to: Name and address to whom the report should be sent.

Invoice to: Name and address to whom the invoice should be sent.

Collection Date/Time: Date and time the sample was collected.

Grab/Comp: (if applicable) Was the sample a grab or composite?

Sample ID Description: Identify sample as it should appear on the analytical test report**.**

Filtered? Y/N: (if applicable) Was the aqueous sample filtered prior to preservation?
(report the parameter as "dissolved")

Matrix: The type of sample: Soil, Air, Sludge, Waste, Groundwater, Surface water, Wastewater, Drinking water.

Analysis Requested: List the analyte(s) and/or Method for each sample on the vertical line. For each sample, enter either an X or the number of bottles for that analysis.

Total # of Containers: Number of containers provided for each sample.

Preservation: Specify preservative used for each analysis requested, leave blank if none were used.

Lab ID #: *For laboratory use only*

Relinquished By: ***IMPORTANT***. Initially, the person collecting the samples should sign and date. This section is used each time the sample is transferred from one party to the next.

Received By: If custody is transferred from one party to the next.

Ice Present/Temperature/Cooler #: *for lab use only*

Soil Sampling for VOCs

The following is a comparison of different VOC soil collection techniques, as a guide in your project planning. Please consult your specific State or program requirements for the appropriate collection or preservation method for your project and share this information with your laboratory PM.

Terra Core® Low Level vs. High Level Analysis

The laboratory offers both low level (generally 5-500 ug/kg) and high level (>500) analysis of VOCs, based on project requirements. If low level is requested, a back-up sample should also be collected for high level analysis. Sampling/preservation options differ between the two.

Terra Core® High Level Kits

Containers:	(2) 40-mL VOA vials with methanol + 1 unpreserved container for % Solids with a plastic bag containing a foam block holding vials, a T-handle and label for sample/description/date/time
Hold Time:	14-days from collection
Benefits:	Includes sampling T and containers; sealed in the field, not opened in the lab
Drawbacks:	To prevent loss of both the preservative and the analytes ***it is critical to wipe container threads before sealing vials and ship upright.***

** Do NOT add additional labels to the vials – you may cover up the tared weight and the extra label weight can skew your results **

Low Level Sample Collection - Terra Core® Low/High Level Kits Option 1

Containers:	(1) 40-mL methanol vial, (2) 40-mL DI water vials + container for % Solids, with a plastic bag containing foam block and T-handle for sample/description/ date/time.
Hold Time:	48-hours to preservation by freezing DI vials (in field or @ lab) – 14 days for methanol
Drawbacks:	Short hold-time to preservation by freezing in field or at the lab. To prevent loss of both the preservative and the analytes, *it is **critical** to wipe container threads before sealing vials and ship upright.*

** Do NOT add additional labels to the vials – you may cover up the tared weight and the extra label weight can skew your results **

Low Level Sample Collection: Terra Core® Low/High Level Kits - Option 2

Containers:	(1) 40-mL methanol vial, (2) 40-mL sodium bisulfate vials + 1 unpreserved container for % solids, with a plastic bag containing a foam block, T-handle for sample/description/date/time.
Hold Time:	14 days from collection
Drawbacks:	Sodium bisulfate can create effervescence (foaming) in carbonate soils, interfering with analysis. Options include high level analysis or DI water kits (Option 1). To prevent loss of preservative and analytes*, it is **critical** to wipe container threads and ship upright.*

** Do NOT add additional labels to the vials – you may cover up the tared weight and the extra label weight can skew your results **

Other Options—High or Low Level – Packed Jar

Containers:	(1) 4 oz amber glass jar with a Teflon lined cap collected with zero headspace
Hold Time:	14 days from collection
Benefits:	Single container; useful for non-homogeneous samples that will not fit into other sampling containers
Drawbacks:	Sample exposed to the air multiple times w/ possible loss of VOCs; container threads must be wiped clean to provide tight seal. Not accepted by many regulatory programs.

Soil Sampling for VOCs

Terra Core® Sampling Procedures

With the plunger seated in the handle, push the TerraCore into freshly exposed soil until the sample chamber is filled. A filled chamber will contain approximately 5 grams of soil.

Wipe all soil or debris from the outside of the TerraCore sampler. The soil plug should be flush with the mouth of the sampler. Remove any excess soil that extends beyond the mouth of the sampler.

Rotate the plunger that was seated in the handle top 90º until it is aligned with the slots in the body. Place the mouth of the sampler into the 40mL VOC vial containing the appropriate preservative and extrude the sample plug by pushing the plunger down. *Only 1 sample plug should be placed in each vial.* Quickly place the lid back on the VOC vial. *When capping the VOC vial, be sure to wipe any soil or debris from the vial threads.*

Repeat for any remaining vials and the % solids container in the kit for that sample point.

***** Do NOT add additional labels to the vials – you may cover up the tared weight and the extra label weight can skew your results *****

Time Saving Tip: It is not necessary to label each container individually. If you place them back into the sponge block and seal in the zip-lock bag provided, you can fill out the single sample label to the outside of the bag.

You must use a new TerraCore handle for each sample point—they are not cleanable or reusable.

Make sure you pack the sponge blocks upright in the cooler.

Please note that CT Laboratories' makes our own Terracore kits, so they can be customized to accommodate VOC + GRO analysis or Michigan-specified requirements (i.e., 10-mL MeOH vs. 5-mL of MeOH).

Aqueous Sampling for VOCs

40-ml clear glass VOA vials with Hydrochloric Acid (HCl)

- Fill the vials in a location which is free from volatile organic analytes. Avoid places with gasoline, cleaning products, or solvents present at the sampling point.
- Fill the vials so there is no air present. This is known as "zero headspace" in the vial.
- The VOC vials contain a strong acid solution, 1:1 HCl, so care should be taken when opening and filling the vials.
- All (3) 40-ml glass vials need to be filled.

If you need to collect a sample from a tap it is best to use the tap nearest the well. Flush the tap for approximately 5 minutes prior to sampling.

Open the tap so that a slow flow comes from the faucet (something just more than a dribble); fill the vial so that the water runs down the glass on the inside of the vial to eliminate the introduction of air bubbles *(Figure 1*).

Fill the vial so that a positive meniscus (a slight overfilling such that the water extends above the edge of the opening) forms at the mouth of the vial *(Figure 2)*. Carefully cap the vial so the cap displaces a slight amount of water, excluding any air. It is critical that the sample vials do not contain any air bubbles once they are capped. Invert the vials to ensure there is no air trapped in the sample vial *(Figure 3)*.

If bubbles are present, open the sample and add additional water to eliminate the bubble. Some sample matrices (such as those high in carbonate or sediment) can cause effervescence and create gas upon contact with the Hydrochloric Acid, which may not allow for the zero-headspace needed to properly analyze the sample. Should this happen, note it on the chain of custody form to ensure proper handling at the lab.

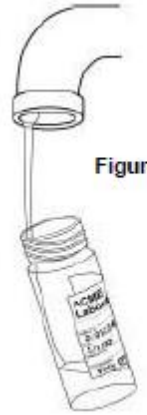


Figure 1

Figure 2

Figure 3

Incremental Soil Methodology (ISM) Sampling

For Method 8330B Explosives / Metals and other analytes

CT Laboratories has extensive experience performing ISM projects with a wide range of project-specific criteria. There are many considerations in designing and implementing an ISM project. It is imperative that you discuss project objectives and options with your client, regulator AND laboratory.

From the lab's perspective, some of the critical choices regarding drying/sieving/grinding include:

- Analytes/methods: explosives, metals, SVOCs, PAHs, PCBs, Pesticides?
- Number of increments and sample mass: individually jarred increments or bulked ziplock bags?
- Air dry or process as is?
- Include or exclude non-sample components: sticks, leaves, rocks, earthworms?
- Sieve to what particle size?
- Grind metals or subsample after sieving?
- Grinding options: puck mill, ball mill, mortar & pestle?
- Grinding blank options: Analyze individually or composite and analyze 1 per batch?
- Rotary sample splitter vs. manual subsampling

Your CT Laboratories PM is available to work with you to define these project components.

Keep in mind that large volume of sediments and other wet samples can take an extended time to dry, which may impact turnaround time.

USDA Soil Sampling Guidelines

USDA regulates the shipping of soils from within certain restricted areas of the country and from outside of the continental United States. Handling of soils from these areas must follow the USDA requirements on both the project's field sampling/shipping side as well as the laboratory's end.

The lab must provide a regulated soil kit (our USDA Permit, Compliance Agreement, and PPQ Form 550) to the client prior to sampling. Field personnel are responsible for the care and custody of the samples until they are properly transferred or dispatched to the lab. Sample labels must be completed for each sample, with sampling location, date, and time.

All sample containers must be accompanied by proper documentation. At a minimum, this documentation includes:

- a properly completed chain of custody (CoC)
- a copy of CT Laboratories' Soil Permit
- a copy of the Compliance Agreement
- PPQ Form 550

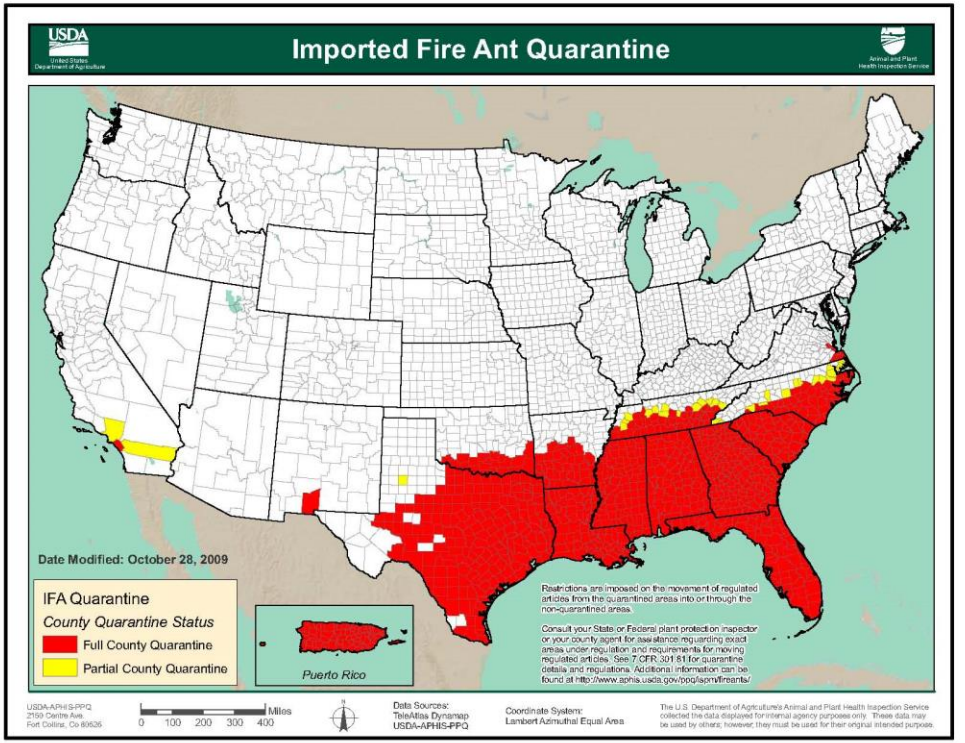
The client's field personnel or other representative must notify CT Laboratories prior to shipment to ensure that the permit holder will be available to take custody of the samples.

Transfer of Custody and Transport/Shipment

Shipping containers must be sturdy and leak-proof to preclude spillage or escape of pests in transit. The container must be secured with a custody seal made in such a manner that visually shows a break, destruction or change in nature if the seal is tampered with. The cooler's shipping label must be addressed exactly as appears on the Soil Permit and Compliance Agreement, and a copy of the PPQ Form 550 must be clearly displayed.

Samples must be properly packaged for shipment. For samples requiring temperature preservations, sufficient ice should surround samples to ensure ice is present when the samples reach the lab. Internal packaging should be in place to ensure container integrity and compliance with shipping regulations.

The original CoC will accompany the samples, with a copy retained by the field personnel. Shipped samples are to be considered restrictive and are shipped via bonded common carriers (UPS, FedEx, etc.). The mode of shipping should be noted in the "remarks" section of the CoC. The person relinquishing the samples signs, dates and note the time in the first "Relinquished by" section of the form. The shipping document (air bill, etc.) will serve as documentation of custody possession. The COC and the Soil Permit should be placed in a waterproof container (ziplock bag, etc.) directly in the cooler.



PPQ Form 550

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE
4700 RIVER ROAD, UNIT 133
RIVERDALE, MD 20737-1236

SOIL SAMPLES
RESTRICTED ENTRY

The material contained in this package is
imported under the authority of 7 CFR 330.300.

For release without treatment if addressee is
Currently listed as a USDA_APHIS inspected facility.

PPQ FORM 550 (APR 2008)

TCLP / SPLP Analysis

Sample matrix (soil, ash, solid, oil, solvent, aqueous or a mixture) as well as the parameters/analyses requested determine the type and number of containers needed for TCLP/SPLP samples.

Solid Matrices: Solid samples (soil, ash, rags, filters, grease, paints, waste oils) will not filter through a 0.6-0.8 um glass fiber filter. What analyses do you need? For Metals only, use plastic containers; for organic analytes (Pesticides, Semivolatiles, Volatiles), you must use glass. Try to submit 300-500 grams of sample (to establish the appropriate extraction fluid and perform the leaching procedure). For additional analyses as part of a Waste Protocol, refer to the ***Container, Preservation and Holding Time Requirements*** tables for minimum sample volumes.

Liquid Matrices: Is it a single or multi-phasic sample? If single phase, is it aqueous? If it is aqueous and contains <0.5% solids, the sample itself becomes the TCLP extract. If non-aqueous with <0.5% solids, it will be analyzed by the appropriate prep and analytical method. Multiphasic samples require each phase to be analyzed separately, with the combined results calculated using the volume ratio of each phase.

*For **known** aqueous samples with no visible solids,* collect:

TCLP Metals = (1) 500-mL HNO_3-preserved plastic bottle
TCLP Organics = (1) 1-Liter unpreserved amber glass bottle
TCLP VOCs = (3) 40-mL HCl-preserved VOA vials with zero-headspace

Aqueous samples with solids present must be evaluated on a sample-by-sample basis. Sufficient volume is needed to meet the liquid and solid portions of the method. Consult your Project Manager.

*For **unknown** liquid samples with no visible solids,* collect:

TCLP Metals = (1) 500-mL unpreserved plastic bottle (if a solvent, use glass jar)
TCLP Organics and/or VOCs = (1) 1-Liter unpreserved amber glass bottle

Other things to consider…
The TCLP Leaching procedure takes a minimum of 20 hours. Once leached, the samples must then go through the standard preparation and analysis process. ***If Rush TAT is needed, advance notice is required.***

The 20X Rule. What is it? Some disposal companies accept regular total (i.e., unleached) analysis. The results are compared to the TCLP Regulatory Limits, and if the total result is less than 20 times the TCLP Limit, it is assumed that a TCLP result would be below the TCLP Limit. *For example:*

The TCLP Regulatory Limit for Lead is 5 mg/L (ppm). A soil sample analyzed for total Lead using the standard digestion and analytical method comes back with a result of 78 mg/kg (ppm). Since the total result of 78 ppm is less than 100 ppm (20 X the TCLP Limit), it is assumed that this sample would not exceed the TCLP Limit if the TCLP Leaching procedure was performed. *Note that if your total value is > 20X the TCLP limit, you will probably need to have a TCLP analysis performed.*

Total Petroleum Hydrocarbons (TPH)

Clients are often confused about what to ask for when they are required to submit a sample for "TPH". There are numerous methods for the quantitation of petroleum hydrocarbons, and they go by many names.

Hydrocarbons are ***generally*** split into two ranges: **GRO** (Gasoline Range Organics or Volatile Hydrocarbons) and **DRO** (Diesel Range Organics or Semivolatile/Extractable Hydrocarbons). *It should be noted that these are merely carbon ranges, and, for example, detection of GRO compounds does not necessarily imply that gasoline is present.* Other ranges include: RRO & ORO. These are usually heavier ranges on the SVOC extraction side. Several states have specific methods that analyze and report the ranges separately, such as Wisconsin, Massachusetts, Alaska, and Washington. Some States or programs analyze and report a total result.

GRO samples are generally analyzed on a purge-and-trap system with a GC that is equipped with a PID/FID in series. The main petroleum hydrocarbon group of interest is gasoline, with emphasis on Benzene, BTEX, or PVOCs (petroleum volatile organic compounds). DRO samples are extracted and analyzed by GC-FID. Many States define what petroleum hydrocarbons can be analyzed as DRO, but generally they range from mineral spirits (early) to "fluids" and "oils" (late).

Reported results are determined in two ways, depending on the method or program requirements. The first involves a calibration curve made directly from petroleum products. Quantitation windows are established for each petroleum hydrocarbon. The area within that window is summed, and a result is calculated using the standard that best matched the sample chromatogram. This method allows gasoline to be quantitated against a gasoline calibration curve, and motor oil to be quantitated against a motor oil curve. The drawback is that petroleum hydrocarbon formulations can differ so there might be a bias when comparing results between laboratories.

The second method uses a specified "component" standard. With this method, the calibration curve will be consistent from lab-to-lab. One example of a component standard is the WI GRO method standard, comprised of 10 individual analytes (MTBE, Benzene, Toluene, Ethylbenzene, m-, p- & o-Xylenes, 1,2,4- and 1,3,5-Trimethylbenzene and Naphthalene). The quantitation window is established 0.1 minutes before the retention time of MTBE and 0.1 minutes after that of naphthalene.

Bottom Line - You need to know your objectives for the data and the requirements of your particular State or regulatory program. Contact your CT Laboratories Project Manager for assistance; they can at least steer you in the right direction.

Container, Preservation & Holding Time Requirements

The tables on the following pages contain information regarding methods commonly employed in performing environmental analysis. It is not intended to be inclusive of all possible analytical methods or matrices. To the best of our knowledge, the information provided is current as of April 2021.

Unless otherwise noted, all samples must be kept refrigerated during storage and iced during transportation.

A note on "other" matrices (sediment, waste, tissue): zip-lock/plastic is acceptable for many parameters; however, glass is required for some. Please consult your project manager regarding your particular project needs.

Minimum Volume or Weight – under certain circumstances, a limited amount/volume of sample may be available during collection. The specified volumes or weights indicate a basic minimum needed to complete the analysis. Collecting a "minimum" amount of sample is not recommended if it can be avoided.

Parameters/Analytes with similar container type/preservation can often be "grouped" in the same container. In certain instances, the container size may need to be larger to accommodate this grouping. For example:

- The nitrogen series (nitrate + nitrite, total kjeldahl nitrogen, ammonia), total phosphorus and COD can be analyzed from a single 125-mL plastic bottle preserved with sulfuric acid.
- BOD, alkalinity and anions can be analyzed from a single 1-liter unpreserved plastic bottle. In certain cases (i.e., high BOD sample), total suspended solids can also be included with this grouping.
- For soil samples: metals, % solids and anions can be analyzed from a single 4-oz plastic unpreserved specimen cup.
- Many semivolatile organic analyses can be performed from one soil sample jar: PAHs, PCBs, Pesticides and TPH can all be analyzed from one 9-oz. glass jar. This only applies to samples with sufficient mass and sample homogeneity. Samples that are "light" (such as ash) will likely require additional containers to meet minimum volumes. Samples with gravel or wood present will be "subsampled" to remove these materials.

Abbreviations:

HCl = Hydrochloric Acid	A = Amber
H_2SO_4 = Sulfuric Acid	Gl = Glass
HNO_3 = Nitric Acid	Pl = Plastic
	L = Liter

Metals

Parameter/Analyte	Method(s)	Matrix	Container/Preservative Minimum volume	Hold Time
Metals (ICP) Aluminum Antimony Arsenic Barium Beryllium Boron Cadmium Calcium Chromium Cobalt Copper Iron Lead Magnesium Manganese Molybdenum Nickel Potassium Selenium Silver Sodium Strontium Sulfur Thallium Tin Titanium Tungsten Vanadium Zinc	EPA 200.7, 6010C, 6010D	Drinking Water	1-L Pl, HNO_3	6 months
		Water	250-mL Pl, HNO_3	
		Solid	4-oz Pl, none	
		Sludge	250-mL Pl, none	
		Wipes	4-oz Gl jar w/ cotton wipe saturated with DI water	
Metals (GFAA) Antimony Arsenic Lead Selenium Thallium	EPA 200.9, 7010	Drinking Water	1-L Pl, HNO_3	
		Water	250-mL Pl, HNO_3	
		Solid	250-mL PL or 4-oz Pl, none	
		Wipes	4-oz Gl jar w/ cotton wipe saturated with DI water	

Parameter/Analyte	Method(s)	Matrix	Container/Preservative Minimum volume	Hold Time
Mercury	EPA 245.1, 7470A	Water	250-mL Pl, HNO_3	28 days
		Drinking water	1-L Pl, HNO_3	
	EPA 7471B	Solid	4-oz Pl cup, none	
Hardness	EPA 6010C, SM 2340B	Water	250-mL Pl, HNO_3	6 months
Hexavalent Chromium	EPA 7196A	Water	125-mL Pl, none **min volume = 50 mL**	24 hours

General Chemistry Analytes

Parameter/Analyte	Method(s)	Matrix	Container/Preservative Minimum volume	Hold Time
Alkalinity (carbonate, bicarbonate)	EPA 310.2, SM 2320B	Water	125-mL Pl, none **min volume = 50 mL**	14 days
Ammonia Nitrogen	EPA 350.1, SM 4500-NH3H	Water	125-mL Pl, H_2SO_4 **min volume – 50 mL**	28 days
	EPA 350.1	Solid	4-oz Pl cup, none **min sample = ~15 g**	28 days
Anions (bromide, chloride, fluoride, nitrate, nitrite, ortho-phosphate, sulfate)	EPA 300.0, 9056A	Water	125-mL Pl, none **min volume = 50 mL**	48 hours to 28 days
	EPA 9056A	Solid	4-oz Pl cup, none **min sample = ~15 g**	28 days
BOD – 5 day (total, soluble, carbonaceous)	SM 5210B	Water	1-liter Pl, none **min volume = 500 mL**	48 hours
Bromide (see also "Anions")	EPA 300.0, 9056A	Water	125-mL Pl, none **min volume = 50 mL**	28 days
Chloride (see also "Anions")	EPA 300.0, 9056A	Water	125-mL Pl, none **min volume = 50 mL**	28 days
	EPA 9056A	Solid	4-oz Pl cup, none **min sample = ~15 g**	28 days
COD	EPA 410.4	Water	125-mL Pl, H_2SO_4 **min volume = 50 mL**	28 days
Coliform (total)	SM 9223	Water	100-mL or 120-mL sterile Pl bottle with or without sodium thiosulfate. Fill above line on bottle.	*State dependent* WI-30 hrs
Coliform (fecal/e.coli)	SM 9222D, SM 9223B	Solid or Water	100-mL Sterile Pl bottle. Fill above line on bottle.	*State dependent* WI-30 hrs
Cyanide (total)	EPA 335.4, 9012A	Water	250-mL Pl, NaOH **min volume = 100 mL**	14 days
Cyanide (reactive)	SW-846 Ch. 7.3	Water	500-mL Pl, none **min volume = 50 mL**	none
	SW-846 Ch. 7.3	Solid	4-oz Pl cup, none	none
Flashpoint	EPA 1010A	Water Solid	250-mL Pl, none 4-oz Pl cup, none	10 days 10 days
Fluoride (see also "Anions")	EPA 300.0, 9056A	Water	125-mL Pl, none **min volume = 50 mL**	28 days
	EPA 9056A	Solid	4-oz Pl cup, none **min sample = ~15 g**	28 days

Parameter/Analyte	Method(s)	Matrix	Container/Preservative Minimum volume	Hold Time
Free Liquids	EPA 9095B	Solid	4-oz Pl cup, none	180 days
Hardness (see also "Metals")	EPA 6010C / SM 2340B	Water	250-mL Pl, HNO_3 **min volume = 75 mL**	6 months
Hexavalent Chromium	EPA 7196A	Water	125-mL Pl, none **min volume = 50 mL**	**24 hours**
Nitrate (see also "Anions")	EPA 300.0, 9056A	Water	125-mL Pl, none **min volume = 50 mL**	**48 hours**
	EPA 9056A	Solid	4-oz Pl cup, none **min sample = ~15 g**	28 days
Nitrite (see also "Anions")	EPA 300.0, 9056A	Water	125-mL Pl, none **min volume = 50 mL**	**48 hours**
	EPA 9056A	Solid	4-oz Pl cup, none **min sample = ~15 g**	28 days
Nitrate + Nitrite	EPA 353.2	Water	125-mL Pl, H_2SO_4 **min volume = 50 mL**	28 days
	EPA 353.2	Solid	4-oz Pl cup, none **min sample = ~15 g**	28 days
Nitrogen, Organic Total	EPA 350.1, 351.2	Water	125-mL Pl, H_2SO_4 **min volume = 100 mL**	28 days
		Solid	250-mL Pl or 4-oz Pl, none	28 days
Nitrogen, Total	EPA 351.2, 300.0	Water	125-mL Pl, H_2SO_4 **min volume = 75 mL**	28 days
	EPA 351.2, 9056A	Solid	250-mL Pl or 4-oz Pl, none	28 days
Nitrogen, Total Kjeldahl	EPA 351.2	Water	125-mL Pl, H_2SO_4 **min volume = 50 mL**	28 days
		Solid	250-mL Pl or 4-oz Pl, none	28 days
Oil & Grease - HEM	EPA 1664A	Water	1-L amber glass, HCl **or** 125-mL amber glass, H_2SO_4 *(RL dependent)*	28 days
Organic Carbon, Total	EPA 415.1, 9060A	Water	125-mL Pl, H_2SO_4 **min volume = 50 mL**	28 days
	Lloyd Kahn / 9060A	Solid	4-oz Pl cup, none **min sample = ~15 g**	28 days (14 days for sediment)
Ortho-phosphate (see also "Anions")	EPA 300.0, 9056A	Water	125-mL Pl, none **min volume = 50 mL**	**48 hours**
pH	EPA 150.1, 9040C, 9041A, SM 4500H+B	Water	125-mL Pl, none **min volume = 50 mL**	ASAP
	9045D	Solid	4-oz Pl cup, none	ASAP

Parameter/Analyte	Method(s)	Matrix	Container/Preservative Minimum volume	Hold Time
Phosphorus	EPA 365.1	Water	125-mL Pl, H_2SO_4 min **volume = 50 mL**	28 days
	EPA 365.4	Solid	4-oz Pl cup, none	28 days
Phosphate	EPA 9056A	Solid	250-mL Pl or 4-oz Pl, none **min sample = ~15 g**	28 days
Residue, Total	SM 2540C	Water	250-mL Pl, none **min volume = 50 mL**	7 days
Solids, Settleable	SM 2540F	Water	1-L Pl, none	7 days
Solids, Total Dissolved	EPA 160.1, SM 2540C	Water	500-mL Pl, none **min volume = 50 mL**	7 days
Solids, Total	SM 2540B	Water	1-L Pl, none **min volume = 50 mL**	7 days
Solids, Percent	EPA 8000C, ASTM D2974-87	Solid	4-oz Pl cup, none **min sample = ~15 g**	7 days
Solids, Total Suspended	SM 2540D	Water	1-L Pl, none **min volume = 500 mL**	7 days
Solids, Total Volatile	EPA 160.4	Water	1-L Pl, none **min volume = 500 mL**	7 days
	SM 2540G	Solid	4-oz Pl cup, none **min sample = ~15 g**	7 days
Solids, Volatile Suspended	EPA 160.2, 160.4, SM 2540D	Water	1-L Pl, none **min volume = 500 mL**	7 days
Specific Gravity	SM 2710F	Water	125-mL Pl, none	none
		Solid	4-oz Pl cup, none	
Sulfate (see also "Anions")	EPA 300.0, 9056A	Water	125-mL Pl, none **min volume = 50 mL**	28 days
	EPA 9056A	Solid	4-oz Pl cup, none **min sample = ~15 g**	28 days
Sulfide (total)	EPA 376.1, 9034	Water	500-mL Pl, NaOH+ZnAc **min volume = 250 mL**	7 days
Sulfide (reactive)	ASTM D4978	Water	500-mL Pl, none **min volume = 250 mL**	none
	ASTM D4978	Soil	4-oz Pl cup, none	28 days

Organic Analytes

Parameter/Analyte	Method(s)	Matrix	Container/Preservative Minimum volume	Hold Time Extraction / Analysis
Petroleum / Fuels Analysis				
Total Petroleum Hydrocarbons (TPH)[1]	EPA 8015C, Mod. 8015, State specific	Water	1-L Amber Gl, none	See TPH notes
		Solid	4-oz Gl jar, none	
Diesel Range Organics (DRO); Oil Range Organics (ORO); Residual Range Organics (RRO)	EPA 8015C	Water	1-L amber Gl, none	7 / 40 days
		Solid	4-oz Gl jar, none	14 / 40 days
DRO – Wisconsin	WDNR DRO	Water	1-L Amber Gl, HCl	7 / 40 days
		Solid	60-mL tared Amber Gl, with 25-35 g unpreserved sample	Add solvent within 10 days / 47 days
Gasoline Range Organics (GRO)	EPA 8015C	Water	(3) 40-mL VOA vials, HCl	14 days
		Solid	Terra core sampler or 4-oz Gl, zero headspace	14 days
GRO – Wisconsin	WDNR GRO	Water	(3) 40-mL VOA vials, HCl	14 days
		Solid	Terra core sampler or 60-mL tared Amber Gl, with 25-35 g sample / methanol	21 days
Volatile Organic Compounds[2] (VOCs)				
VOCs – standard or project specific list	EPA 8260C	Water	(3) 40-mL VOA vials, HCl **or** (3) 40-mL VOA vials, none	14 days 7 days
		Solid	60-mL tared A Gl, Methanol **or** Terra Core sampler **or** 4-oz Gl jar, zero headspace	See VOC notes
VOCs including 2-Chloroethyl vinyl ether	EPA 8260C	Water	(3) 40-mL VOA vials, none	7 days
VOCs including Acrolein and Acrylonitrile	EPA 8260C	Water	(3) 40-mL VOA vials, pH 4-5 (3) 40-mL VOA vials, none	14 days 7 days
VOCs – Low Level Analysis	EPA 8260C	Water	(4) 40-mL VOA vials, HCl **or** (4) 40-mL VOA vials, none	14 days 7 days
		Solid	Terra Core sampler	See VOC notes
VOCs – SDWA List	EPA 524.2	Drinking Water	(3) 40-mL VOA vials, HCl	14 days

Parameter/Analyte	Method(s)	Matrix	Container/Preservative Minimum volume	Hold Time Extraction/ Analysis
BTEX, MTBE, PVOC, Naphthalene	EPA 8260C, WDNR GRO	Water	(3) 40-mL VOA vials, HCl **or** (3) 40-mL VOA vials, none	14 days 7 days
		Solid	60-mL tared A Gl, Methanol **or** Terra Core sampler **or** 4-oz Gl jar, zero headspace	14 days
Semivolatile Organic Parameters				
SVOCs – standard or project specific list	EPA 8270D, 8270D-SIM	Water	1-L Amber Gl, none	7 days / 40 days
		Solid	4-oz Gl, none	14 days / 40 days
Polyaromatic Hydro-carbons (PAHs)	EPA 8270D, 8270D-SIM	Water	1-L Amber Gl, none	7 days / 40 days
		Solid	4-oz Gl, none	14 days / 40 days
1,4-Dioxane	EPA 8270D-SIM	Water	1-L Amber Gl, none	7 days / 40 days
		Solid	4-oz Gl, none	14 days / 40 days
PCBs	EPA 8082A	Water	1-L Amber Gl, none	7 days / 40 days
		Solid	4-oz Gl, none	14 days / 40 days
		Oil	4-oz Gl, none	
		Wipes	4-oz Gl w/ 4x4" gauze pad, moistened w/ Hexane	
Chlorinated Pesticides	EPA 8081B	Water	1-L Amber Gl, none	7 days / 40 days
		Solid	4-oz Gl, none	14 days / 40 days
TCLP Herbicides (2,4-D, 2,4,5-TP)	EPA 8151A	Water	1-L Amber Gl, none	7 days / 40 days
		Solid	4-oz Gl, none	14 days / 40 days

Parameter/Analyte	EPA Method(s)	Matrix	Container/Preservative Minimum volume	Hold Time Extraction/ Analysis
Other Organic Parameters				
Explosives	EPA 8330B	Water	1-L Amber Gl, none	7 days / 40 days
		Solid	4-oz Gl, none	14 days / 40 days
Nitrocellulose	EPA 9056M	Water	1-L Amber Gl, none	28 days
		Solid	4-oz Gl, none	28 days
Nitroguanidine	Lab SOP SV030	Water	(2) 40-mL VOA vials, none	7 days / 40 days
		Solid	4-oz Gl, none	14 days / 40 days
Dissolved Gases – Methane, Ethane, Ethene	RSK-175	Water	(3) 40-mL VOC vials, HCl Shipped inverted	14 days
Dissolved Gases – Carbon Dioxide	Mod. RSK-175	Water	(3) 40-mL VOC vials, none Shipped inverted	7 days

1. Total Petroleum Hydrocarbons (TPH) can refer to numerous test methods and the analysis of many different Petroleum Hydrocarbons and/or boiling point ranges. If you are unsure which TPH range and/or test you need performed, please contact your CT Laboratories Project Manager.

2. Volatile Organic Compounds (VOCs) - There are numerous methods, lists and sampling options associated with VOCs. The required sampling container and hold times will be dependent on the method specified, State in which the sample is collected and/or the regulatory program being followed. If you are unsure which container should be used, please contact your CT Laboratories Project Manager.

Concentration Units Conversion Chart

Liquids

									% w/v
1	ng/L	1	ppt	0.001	ug/L	0.001	ppt	0.0000001	%
1	ug/L	1	ppb	0.001	mg/L	0.001	ppm	0.0000001	%
10	ug/L	10	ppb	0.01	mg/L	0.01	ppm	0.000001	%
100	ug/L	100	ppb	0.1	mg/L	0.1	ppm	0.00001	%
1,000	ug/L	1,000	ppb	1	mg/L	1	ppm	0.0001	%
10,000	ug/L	10,000	ppb	10	mg/L	10	ppm	0.001	%
100,000	ug/L	100,000	ppb	100	mg/L	100	ppm	0.01	%
1,000,000	ug/L	1,000,000	ppb	1000	mg/L	1000	ppm	0.1	%
10,000,000	ug/L	10,000,000	ppb	10,000	mg/L	10,000	ppm	1	%
100,000,000	ug/L	100,000,000	ppb	100000	mg/L	100000	ppm	10	%

Solids

									% w/w
1	ug/kg	1	ppb	0.001	mg/kg	0.001	ppm	0.0000001	%
10	ug/kg	10	ppb	0.01	mg/kg	0.01	ppm	0.000001	%
100	ug/kg	100	ppb	0.1	mg/kg	0.1	ppm	0.00001	%
1,000	ug/kg	1,000	ppb	1	mg/kg	1	ppm	0.0001	%
10,000	ug/kg	10,000	ppb	10	mg/kg	10	ppm	0.001	%
100,000	ug/kg	100,000	ppb	100	mg/kg	100	ppm	0.01	%
1,000,000	ug/kg	1,000,000	ppb	1000	mg/kg	1000	ppm	0.1	%
10,000,000	ug/kg	10,000,000	ppb	10,000	mg/kg	10,000	ppm	1	%
100,000,000	ug/kg	100,000,000	ppb	100000	mg/kg	100000	ppm	10	%

ng	nanogram	ppt	parts per trillion
ug	microgram	ppb	parts per billion
mg	milligram	ppm	parts per million
L	Liter	%	percent
kg	kilogram	w	weight
		v	volume

Acronyms and Abbreviations

°C	Degrees Celsius
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
COC	Chain of Custody
CVA	Cold Vapor Absorption
DOT	Department of Transportation
DRO	Diesel Range Organics
EB	Equipment Blank
EPA	United States Environmental Protection Agency
FB	Field Blank
FLAA	Flame Atomic Absorption
FID	Flame Ionization Detector
GC	Gas Chromatograph
GFAA	Graphite Furnace Atomic Absorption
GRO	Gasoline Range Organics
ICP	Inductively Coupled Plasma
LCS	Laboratory Control Sample
MTBE	Methyl tert-butyl ether
MS/MSD	Matrix Spike/Matrix Spike Duplicate
PAH	Polyaromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PID	Photoionization Detector
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RL	Reporting Limit
SPLP	Synthetic Precipitation Leaching Procedure
SDWA	Safe Drinking Water Act
SVOC	Semivolatile Organic Compounds
TAT	Turnaround Time
TCLP	Toxicity Characteristics Leaching Procedure
TPH	Total Petroleum Hydrocarbons
VOC	Volatile Organic Compounds

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About CT Laboratories

CT Laboratories LLC is an environmental chemistry laboratory located in Baraboo, Wisconsin, with over 30 years' history of providing high quality analytical testing and project management to clients nationwide. The company is classified by SBA as a ***WOSB*** under NAICS Code 541380 – Testing Laboratories and is a Wisconsin certified **WBE**.

Experience should not be overlooked: CT Laboratories' staff is comprised of dedicated, long-term employees. Key personnel including the President, Laboratory Director, Project Managers, Group Leaders and Senior Analysts have an average tenure of over 12 years with the company.

We routinely provide analytical services to numerous commercial and manufacturing clients, environmental consultants and municipal, State and Federal agencies. We hold DoD ELAP accreditation for a wide range of routine and specialty analyses, and maintain multiple NELAP and individual State certifications.

The laboratory offers an extensive list of routine and specialty testing capabilities for a diverse list of sample matrices, including: groundwater, drinking water, wastewater, elutriates and leachates, soil, sediment, oils, sludge, tissue/biota, slag, hazardous waste, building materials, wipes, concrete cores, paint chips and more.

In addition to standard analytical methodologies, CT Laboratories offers new methods and procedures to fulfill client requests and project needs, including method modifications and custom method development.

We believe that communication is the key to every successful project. Each client is assigned an experienced, dedicated Project Manager to handle their testing program. We contact each client up front to discuss their project, making sure that all questions and scenarios are discussed and project documentation, such as QAPPs, are in place before the work arrives. The PMs will input project-specific requirements (special compounds, reporting limits or action levels) into our LIMS. When samples arrive at the laboratory, the client is notified of receipt and condition; any problems are reported immediately. After reports have been completed, the PM is available to answer any questions regarding your data.

The laboratory is a strong proponent of electronic data deliverables (EDDs), which provide great flexibility in how the data can be used. Our EDD format capabilities include, but are not limited to, ERPIMS, EQuIS, SEDD, ADR, ERIS, and various Excel or client-specific formats. Because we send clients analytical results and other reports electronically, we have become virtually paperless in this area. Data is transferred directly from the analytical instruments to the LIMS, then into the specific report format requested by each client. The laboratory provides full data packages, including "CLP-like" Level III and IV containing the QC and raw data necessary for independent review and reconstruction of the analytical results (data validation). Our package is an original file – generated directly from LIMS, not merely a scanned copy (with the exception of chains-of-custody). The PDF file is bookmarked, making it easy to follow a sample or search for specific data.