SUBMISSION INTEGRITY

2018

Sample Submission Integrity

When processing samples for submission to the lab, there are a few items to be mindful of:

1. Sample and data integrity
2. Submission defensibility – legal scrutiny or peer review
3. Regulatory and contract requirements

These items can be impacted in many ways including how the samples are collected, stored & transported, and how the accompanying Chain of Custody is completed.

Let’s discuss the way samples are reviewed at Sample Reception before they are sent into the lab by going through Maxxam’s submission checklist.

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SAMPLE CHECKLIST

#1 – Custody Seal Not Intact

Purpose: Custody seals are used for legal defensibility. A secure seal upon receipt indicates the cooler and samples have not been tampered with during transit.

How to Apply a Custody Seal:

- Sign and date the custody seal and apply so that the seal covers both the lid and the body of the cooler
- For coolers with a hinged lid, 1 seal is sufficient and should be placed over the opening
- For coolers with a lift-off lid, use 2 seals
- Seals should be securely attached with lots of tape - for example, in a “T” shape

For your convenience, Maxxam provides custody seals upon request

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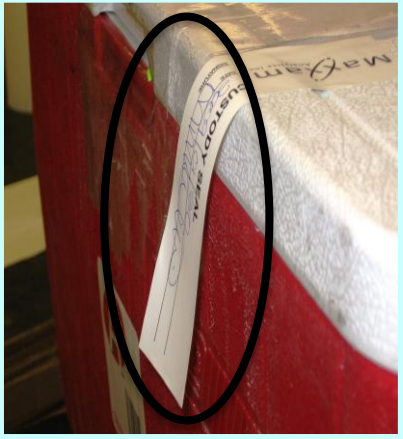
#1 – Custody Seal Not Intact

Here are some examples of improperly applied custody seals on coolers:

Custody Seal Absent

Custody Seal not across opening



Custody Seal not sealed across opening

Custody Seal not intact upon receipt

Custody Seal not signed/dated

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#1 – Custody Seal Not Intact

Process: Custody seals on coolers are not mandatory. Maxxam records the state of the custody seal upon receipt. In cases where seals are broken or appear to be tampered with, the lab contacts you for further direction on how to proceed.

As a reminder, lab supplied Travel Blank samples should also have a custody seal.

- This custody seal is supplied by the lab and applied to the travel blank sample for transport to the customer
- The seal should be intact upon customer receipt
- The seal should remain intact during the entire sampling event including any transit
- The seal should remain intact upon receipt back at the lab

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#2 – Sample Temperature > 10.0°C

Purpose: Samples that are kept cool best resemble the sample at the time of collection. Regulations or methods will often specify the requirement to keep samples cool in order to minimize biodegradation and/or chemical reactions that could impact the integrity of the sample.

How to Keep Samples Cool:

- Best Practice is to use loose ice, double bagged
- Put samples on ice as soon as they are collected
- For packing, distribute ice throughout the cooler (i.e. not localized at the bottom, top or side)
    - Do not recommend the use of ice packs
    - Do not recommend the use of free or loose ice
- Check the local weather forecast and add extra ice, especially during “hot spells”
- Assume there will be delays in transit – pack coolers with extra ice especially when shipping during peak holiday travel times

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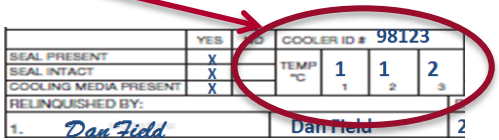
#2 – Sample Temperature > 10.0°C

How is Temperature Taken:

1. Maxxam takes three temperatures from every shipping container/cooler (one located at each end of cooler and middle) using a NIST-certified IR reader.
2. These temperature readings are transcribed onto the COC and the average of the three temperatures is calculated. *This calculated average temperature is applied to all samples in the cooler and is included on the final report.

Average Temperature* Upon Receipt	Temperature Exceedence?
≤ 10.0°C	No
> 10.0°C	Yes
≥ 10.0°C received sameday as samples were collected	No - As long as a reasonable attempt to cool has been made
Frozen Samples	No – Unless it is a microbiological sample



Exceptions:

- Lead (Pb) in Paint
- Summa Canister
- Physical Testing Parameters:
  - Asbestos
  - Particle Size

Samples with an average temperature* ≥ 10.0ºC (as calculated above) will not receive a FLAG. No effort to cool is required if these samples are packaged separately from other chemical and physical tests.

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#3 – Broken Bottle in Transit

Purpose: In addition to the safety concern of broken glass, cracked or broken containers can impact sample integrity in various ways such as:

1. Introducing contamination to the sample
2. Loss of volatile compounds
3. Loss of sample volume

Helpful Packing Tips:

- Provide additional containers of sample where feasible
- Use the bubble wrap provided with the bottle supplies to repackage containers
- Cooler contents should be secured with additional packaging material to prevent movement (horizontal, lateral, vertical) once the cooler is sealed
- If possible, alternate glass and plastic sets of bottles
- Suggest avoid using ice as a packing material, as containers will become mobile once ice has melted

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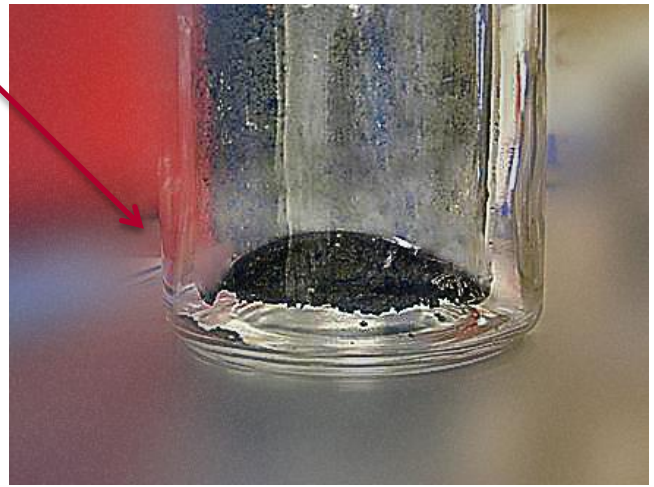
#3 – Broken Bottle in Transit

Process: When additional containers are available, they are used for analysis and the broken container is salvaged (if possible) or discarded.

When no additional containers are available and the lab receives a sample with cracked bottles/lids for volatile analyses and severely cracked bottles requiring taping or transfer, Maxxam contacts the client for approval to proceed with any analysis. A comment appears on the Certificate of Analysis regarding use of the container and it's condition.

In some cases where insufficient volume remains, the lab requests a priority of analyses before processing the samples. All broken and cracked bottles and/or lids will be noted.



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#4 – No Chain of Custody

Purpose: The Chain of Custody (COC) provides legal defensibility and is required in order to maintain the chain of custody of samples. The COC must accompany the samples.

Electronic COC (eCOC):

- Using the eCOC from Maxxam's Customer Portal allows the testing instructions to be submitted electronically. The physical tracking process and chain of custody is maintained by using the Custody Tracking Form which is relinquished by the submitter and accompanies the samples in transit to the lab

Manual COC:

- For multi-cooler shipments, a best practice is to include one COC per cooler. If one cooler is delayed in transit, all other coolers would have accompanying COCs, and the lab could proceed with the received samples
- Remember that multiple COCs can be included in one final Certificate of Analysis. Pack 1 COC per cooler and indicate Page 1 of X, 2 of X, 3 of X etc.

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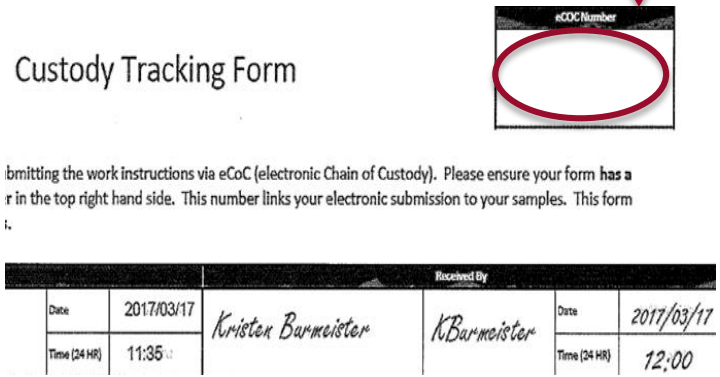
#4 – No Chain of Custody

Process: Maxxam contacts you in cases where samples arrive without a COC. For eCOC submissions, please record the eCOC number on the Custody Tracking Form (this number is the link to the electronic test instructions).



If a COC is accidently forgotten from a shipment, a copy can be emailed to Maxxam. Note that the absence of a COC means there is a break in the chain of custody and the submission is no longer legally defensible.

For multi-cooler shipments, multiple COCs can be included in one final Certificate of Analysis. Pack 1 COC per cooler and indicate Page 1 of X, 2 of X, 3 of X etc.

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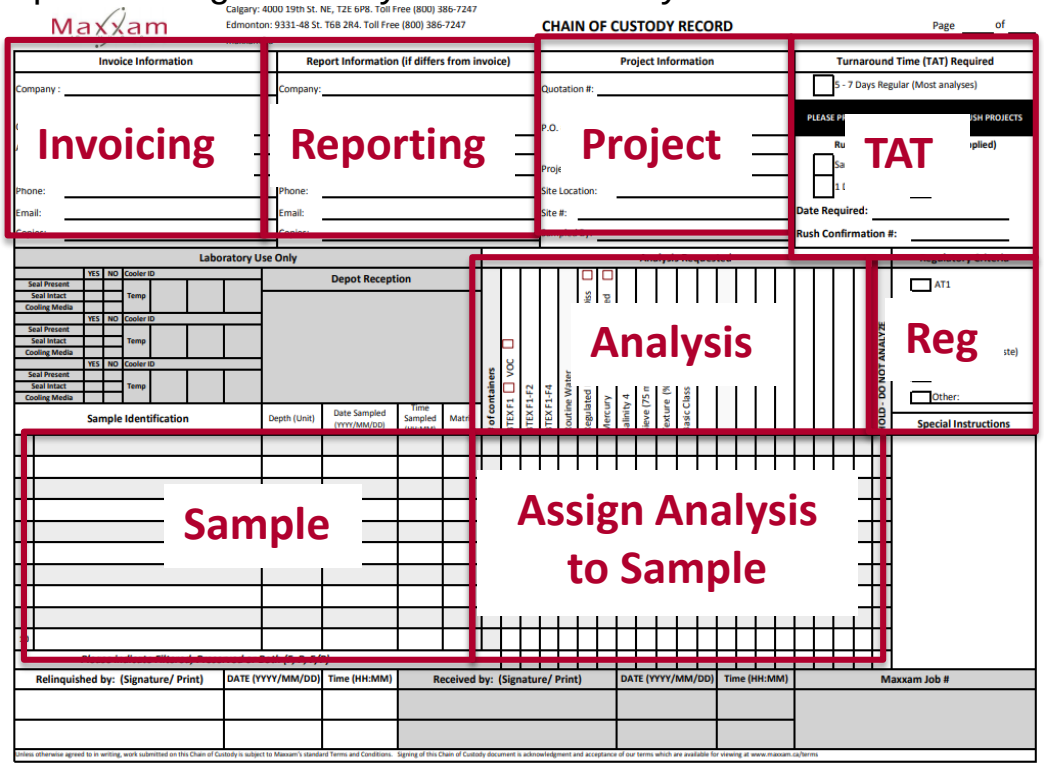
#5 Chain of Custody Information Incomplete

Purpose: The Chain of Custody provides the lab with a specific set of instructions to follow with respect to analytical methods, parameters, RDLs, holding times and billing instructions. It is a legal document that should stand up to peer-review and possible legal scrutiny and so accuracy is critical.

Tips for Filling Out the COC:

- Populate the COC by section
- Have a COC template for field staff to review before submitting a completed COC
- Utilize eCOC:
  - Creates templates for consistent and accurate information over multiple submissions
  - Mandatory fields ensures required information is populated



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#5 Chain of Custody Information Incomplete

Process: The lab reviews the COC to confirm the required information is available to proceed with the requested analysis. If any item is unclear, the lab contacts you for confirmation before proceeding. Some items are critical and will prevent the lab from proceeding until clarification is received (i.e. missing analysis).

Some common tips to remember:

- Include both the sampling date and the sampling time
- Sampling date should be before the relinquish date
- Confirm the matrix listed matches the sample matrix
- Each sample has a corresponding analysis (or Hold) request checked off
- eCOC has mandatory fields and built-in smart logic (example: errors when adding soil tests to a water sample) to assist with accurate COC submissions

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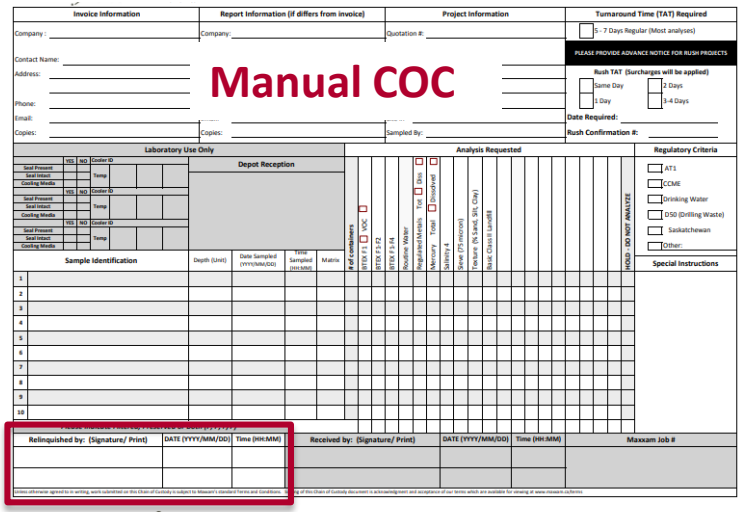
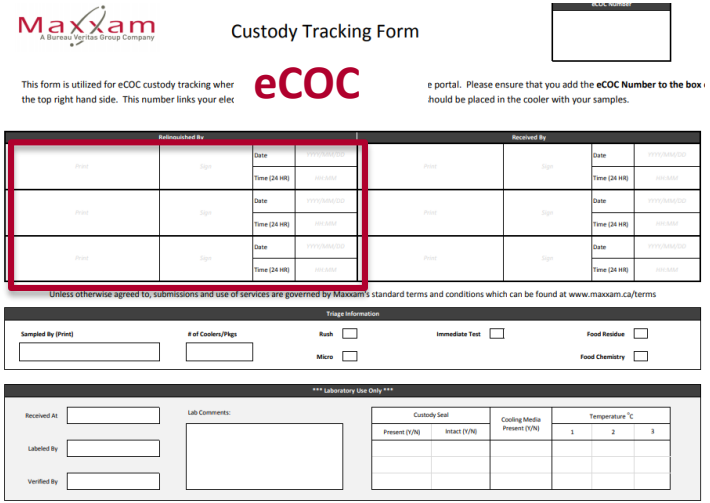
#6 – C of C Not Signed and Dated

Purpose: For legal defensibility and in order to maintain chain of custody of samples, the COC needs to be relinquished when transferring custody to another party (courier, lab, etc.) by signing and indicating the date and time of relinquishment.





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#6 – C of C Not Signed and Dated

Process: Maxxam signs for custody of samples upon receipt and can proceed with analysis of samples that were not relinquished. A notification is provided of the break in custody of the samples.

Helpful Tips:

- Leave the guess work behind - use the date and time of when you are sealing up the cooler for transport
- Include both the date AND the time when relinquishing custody
- For multi-page COC submissions, remember to relinquish all COC pages
- If this is commonly missed, review field practices to see at which part in your process the COC should be relinquished

#8 – Bottles Listed On COC Not In Shipment

Purpose: Recording the number of containers submitted for each sample allows the lab to confirm that all containers have been received. The lab can also confirm if sufficient sample is received for the requested analysis or identify the possibility of delayed shipments (example: only 1 of 2 coolers received)

FIELD SAMPLE ID	MATRIX				# CONTAINERS
	GROUND WATER	SURFACE WATER	SOIL	OTHER	
[1] MW-1	X				4

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#8 – Bottles Listed On COC Not In Shipment

Process: Maxxam reviews the number of containers submitted for each sample against what was received. When there is a bottle missing, you are contacted. In some cases, the analyses can proceed if all required containers were received.

Helpful Tips for Cooler Packing:

- Cross check the number of samples and number of containers that go into the cooler with the COC
- If submitting empty containers (i.e. dry well):
  - Do not include a Sample ID on the container – cross it out
  - Put all empty containers into a separate cooler

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#9 – Bottles In Shipment Not on COC

Purpose: Recording the number of containers submitted for each sample allows the lab to confirm that all containers have been received. The lab can often times determine if an analysis request was missed on the COC based on the containers in the cooler. Also for defensibility, the samples listed on the COC should match those included in the final report.

FIELD SAMPLE ID	MATRIX				# CONTAINERS
	GROUND WATER	SURFACE WATER	SOIL	OTHER	
[1] MW-1	X				2

#9 – Bottles In Shipment Not on COC

Process: Maxxam reviews the number of containers submitted for each sample against what was received. When there is an extra bottle or sample with no corresponding analytical request, you are contacted. In some cases, the extra bottle is a replicate bottle (ex 1 of 3 containers) and the lab can proceed as instructed on the COC.

Helpful Tips for Cooler Packing:

- Cross check the number of samples and number of containers that go into the cooler with the COC
- If submitting QC samples, be sure to list them on the COC
  - Blanks including field and trip blanks
  - Duplicates
- Extra samples for disposal only should be packed separately from samples requiring analysis
- Remember to mark samples on Hold, as an analysis on the COC

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#10 – Analysis Requirements Absent or Unclear

Purpose: In order to ensure you receive the analytical data required by your program, the instructions to the lab need to be clear; EVERY sample should have a corresponding analytical request, including samples submitted for 'hold'. Ambiguous instructions can lead to assumptions of incorrect analysis, RDLs, parameters etc.

Tips for Clear COC Submissions:

- Review the COC to make sure each sample listed has a corresponding analysis
- Contact your Maxxam Project Manager for guidance on how to request non-routine tests
- Use eCOC to select required tests – this pulls directly from Maxxam's database of available tests
- Include the Regulatory requirements – this helps the lab know what detection limits and parameter lists are required

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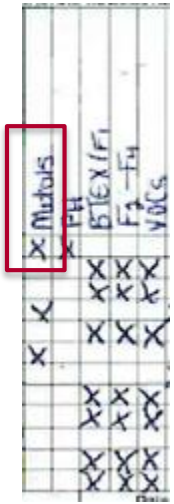
#10 – Analysis Requirements Absent or Unclear

Process: When a COC is received with unclear or absent instructions, the lab contacts you on how to proceed.



Common Ambiguous Requests to Avoid:

- Samples submitted for *both* HOLD and an analysis request
- Samples with no analysis checked off
- Generic requests such as:
  - Metals
  - TCLP
  - Pesticides
- Additional containers submitted which do not have a corresponding instruction
- Unusual filtration requests → Metals sample bottle listed as preserved and unfiltered, requesting dissolved metals

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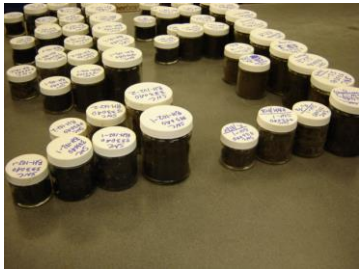
#11 – Labeling Issue (Missing/Incorrect)

Purpose: In addition to maintaining defensibility and traceability of the samples relinquished on the COC, labelling of sample jars allows the lab to confirm that the correct samples as listed on the COC were received. The labels must be legible and only the Sample ID is required – additional information such as project info, sampling date is not mandatory.



Tips for Labelling:

- Soil Jars – when writing the Sample ID on the lid and the label, make sure the ID's match. The Sample ID is only required once on a soil jar
- Truncated ID's are acceptable, so long as the truncated ID can be matched to a full ID on the COC
- Sometimes, less is more! Additional information such as sampling date or project info is not required, however if it is included on the label, it will be checked against the information on the COC

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#11 – Labeling Issue (Missing/Incorrect)

Process: As samples are unpacked at Maxxam, they are reviewed against the COC to confirm all items have been received. If a label is missing, illegible or does not match, the lab contacts you for instruction on how to proceed.

Examples:

- The sampling date on the sample label doesn't match the sampling date on the COC
- The sample ID written on the lid does not match the sample ID written on the label
- There is no sample ID written on the label
- The sample ID has been damaged (ex. water from melted ice or condensation) and is illegible

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#13 – Samples Received After Hold Time

Purpose: analyzing samples past the recommended hold time can compromise the integrity of the sample and the associated results. In some cases, data may be inadmissible for reporting purposes.

Holding Time Information and Tips:

- Review your projects for short holding time tests
- Common short hold time tests include:
  - Anions
  - Microbiology
  - Ferrous and Ferric Iron
  - Formaldehyde
  - Residual Chlorine
  - Turbidity
- Review shipping options for quick delivery to the lab
- Ship samples daily to the lab to allow as much time as possible for transit and analysis

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#13 – Samples Received After Hold Time

Process: The lab contacts you when samples are received past or very close to holding time for approval to proceed with any analysis. In cases where a sampling time is not included on the COC, a sampling time of 4:00pm is assumed for the lab to proceed.

Plan Your Shipping:

- Remote sites are a challenge! Sometimes, it's just not logistically feasible to collect samples and have them arrive at the lab within holding time due to geographic shipping challenges. Some field kits are available to test immediate hold time tests like pH and conductivity
- Courier delays are an uncommon but unfortunate event that can't be predicted or prevented. Ship samples daily to the lab instead of 'stockpiling' samples. Also try to avoid shipping samples with short holding time tests over holiday periods
- When using one of the "large" courier companies, use electronic waybills wherever possible. Service deliveries on manual waybills are not guaranteed and cannot always be immediately tracked in transit

#14 – Wrong Bottle(s)

Purpose: In some cases, regulations or methods dictate container and preservative requirements for particular analyses. In order to obtain the most representative state of the sample, containers and preservatives ‘pause’ the sample at a collection. An incorrect container or preservative could impact the integrity of the sample and the associated results.

Bottle Type Tips:

- Use the containers provided in your Maxxam bottle order, and the packing list for reference. Maxxam proofs containers which provides traceability to a particular lot in the event of contamination
- Reach out to your Maxxam PM if you are unsure of the correct bottle type for a particular analysis
- Keep common bottle types on-hand/in storage for emergency sampling events

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#14 – Wrong Bottle(s)

Process: In some cases, Maxxam may be able to proceed with the analysis based on the type of container used, however in other cases the container may render the sample unviable. You are contacted in these situations to discuss appropriate options (if any) for analysis.

Use of Soil Bags:

- Some regional jurisdictions have approved the use of soil bags in place of soil jars for particular tests. BC, AB, SK, MB, ON*, QC and ATL have approved the use of soil bags for Metals and Inorganics.
- In Ontario, only the following Inorganics can be submitted in soil bags:
  - pH, Grain Size, Moisture Content
  - Metals – including hydride forming metals, HWS Boron and Mercury
  - Electrical Conductivity
  - Sodium Adsorption Ratio (SAR)
  - Chloride
  - Total Chromium
  - Hexavalent Chromium (protect from light)
  - Free Cyanide
  - Total Nitrogen
  - Nitrite/Nitrate

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#15 – Incorrect Preservation or Void Space Present

Purpose: Preservation of samples is based on regulatory or method specific requirements with the intention of maintaining the sample in the same state as the time it was collected – this includes methanol preservation of soil samples. When collecting samples for volatile analysis, **void space** can impact the integrity of the sample and the associated results.

Acceptable Void Space

Significant Void Space

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#15 – Incorrect Preservation or Void Space Present

Preservative Tips:

- Where required by regulation, use methanol preservation for volatiles in soil
- If an unpreserved container is required however only preserved container is on-hand, rinse the container with DI water and additional sample
- Sulphide and Cyanide analysis in water require the preservative to stabilize the sample and cannot be completed accurately in samples collected without preservative

Void Space Tips:

- Do the “shake test” on soil samples – if you hear sample rattling in the jar, there is likely void space
- Turn over water vials to inspect for the presence of air bubbles
- Where possible, try to fill at least one jar with minimal void space. Indicate on the COC if void space is due to:
    1. Insufficient sample volume
    2. Frozen sample
    3. Sample texture/hardness

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#16 – Insufficient # of Bottles/Volume Without Flagging

Purpose: To ensure sufficient volume is available for each test requested on a sample. In cases of limited quantity of sample, the lab may be unable to complete all analyses including corresponding QC samples. RDLs may also be raised impacting the usability of the data when comparing against regulatory criteria.

Where sample recovery is poor, be sure to indicate that on the COC and provide a priority of analysis if multiple tests are required.

	FIELD SAMPLE ID	MATRIX				# CONTAINERS	SAMPLING		FIELD FILTERED & PRESERVED	LAB FILTRATION REQUIRED	BTEX	F1	F2-F4	OIL & GREASE - TO	Poor Recovery
		GROUND WATER	SURFACE WATER	SOIL	OTHER		DATE (YY/MM/DD)	TIME							
1	BH-1 SS-1			X		3	10/04/15	16:00			X	X	X		
2	BH-2 SS-1			X		2	10/04/15	16:30			X	X	X		X

SPECIAL INSTRUCTIONS:

Limited sample available for BH-2 SS-1.
Please analyze BTEX/F1-F4 first and
then pH if enough sample remaining

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#16 – Insufficient # of Bottles/Volume Without Flagging

Process: Completing analysis on samples with insufficient volumes can result in data integrity impacts such as the lab's inability to run QC samples such as a lab duplicate or matrix spike and could result in raised detection limits. When not instructed how to proceed with limited volumes on the COC, the lab confirms prior to analyzing.

Helpful Tips:

- Confirm the # of bottles required with your Maxxam PM
- When dealing with low recoveries, check with the lab to determine absolute minimum volumes required
- Indicate on the COC when samples had low recoveries and the priority of analyses

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#17 – Incorrect or Missing Billing Information

Purpose: This is a customer specific requirement and is linked to customer billing practices. Having the invoicing details accurate on the COC ensures correct rates are applied and that invoices are directed to the appropriate party for payment in a timely manner.

Tips:

- When working with third-parties that will be direct-billed, confirm invoicing requirements and provide the information on the COC
- Set up eCOC templates to have this information included on each submission
- “Pending” can be included on the COC when waiting for this information from third-parties

Process: Maxxam can proceed with the analysis. Occasionally the missing information will not be identified until the invoice is generated or not processed and so requests for required billing info may come after completion of the project.

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#19 – Sample Requiring Filtration Received Preserved

Purpose: Samples that are preserved prior to filtration can no longer be analyzed for dissolved parameters due to data integrity impacts. Preservation begins the digestion/extraction process of dissolved parameters.

Most Commonly Impacts:

- Dissolved Metals! Samples submitted in preserved bottles for dissolved metals cannot be analyzed for dissolved metals as the digestion process will have begun and bias data
- If field filtration is not an option, samples can be lab filtered. Submit the samples in an unpreserved container
- If there is no unpreserved container in the field, rinse the preservative out of a container with DI water and extra sample before filling with sample for submission to the lab

Process: The lab contacts you to confirm how to proceed with the sample.

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#22 – Samples Received Frozen

Purpose: Primarily of concern for microbiology or ecotoxicology samples received frozen as the integrity of the analysis is significantly impacted with frozen samples. In some regions, regulation also requires that all samples must not be received at the lab frozen.

Tips:

- Review the amount of ice used for transporting samples to the lab, particularly in cold winter months
- Pack samples with some additional packaging material to act as insulation and prevent freezing

Process: The lab contacts you to confirm how to proceed with the sample.

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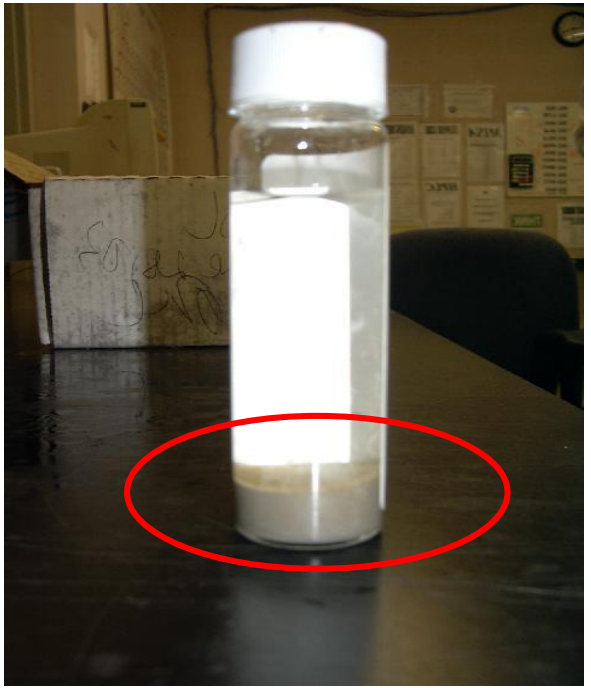
#23 – Sediment in Organics Containers

Purpose: The presence of sediment in organics containers will impact the data. Some regulations will dictate how to treat samples containing sediment however if no regulatory requirement exists, the choice lies with the customer on how to proceed.

Submission Tips:

- Be cautious when submitting field duplicates as sediment levels can impact data
- Note on the COC instructions on how you would like the lab to handle submissions with sediment
- VOCs cannot be decanted and so samples with high sediment levels may not be able to be analyzed



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#23 – Sediment in Organics Containers

Process: Since the presence of sediment is often out of the control of the sampler, the lab will note any sediment levels on the final Certificate of Analysis.

This will be noted for information purposes only and not included in any FLAG reporting.

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#30 – No Quote or Incorrect Quote

Purpose: In order to ensure the correct rates are applied to your invoice, the COC should be filled out with the applicable quote, particularly in the case of third-party billing.

COC Tips:

- For direct-bill submissions, if unsure about a quote number, indicate “Standing Offer” on the COC
- For third-party bill submissions, if unsure about a quote number, indicate the third party customer name on the COC
- When eCOC is used, you will be directed to select a quote from a picklist, ensuring the info is populated for each submission

Process: Maxxam can proceed with the analysis. Occasionally the missing information will not be identified until the invoice is generated or not processed and so requests for required billing info may come after completion of the project.

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So Maxxam Called - What Does it Really Mean?

After reviewing your submission against the checklist, you are contacted by Maxxam for clarification on how to proceed with particular samples.

What does that call mean?

- Collection, Packing and Paperwork requirements are reviewed and details are discussed for clarity
- Provide guidance to the lab on how to process your submission
- Opportunity to quickly ‘course correct’ – often times a field program is more than just one submission to the lab. Having this conversation with your Maxxam contact will assist in facilitating future submissions where Collection, Packing and Paperwork items are accurate and clear.

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A Review of Helpful Tips

To Avoid Breakage During Travel

- Do not overfill coolers, coolers should not exceed 40 lbs
- Evenly distribute soils jars in the cooler

To Avoid High Sample Temperatures

- Ice should be distributed throughout the entire cooler
- Check local weather and add extra ice during “hot spells”
- Assume delays, pack coolers with the assumption that a delay may occur during peak holiday travel times.

To Avoid Missing or Extra Samples

- Always conduct a final layout of the samples and do a count of the number of containers per sample – ensure this number matches what is entered on the COC (also ensures field QC is accounted for)
- Wherever possible, pack all samples contained on the COC in the same cooler – crosschecking with COC as you go to ensure that all samples on the COC have been placed in the cooler, all Label IDs match what is on the COC, and all sample IDs are clearly marked on the COC

To Avoid Incomplete COC or Unclear Analysis

- Use eCOC for submissions to the lab – certain fields are mandatory and built-in “smart logic” assists the user with populating the required information

- Request a Prelog COC from your Maxxam Project Manager where Maxxam will pre-populate certain fields on the COC

- Keep on hand a “complete” COC template to reference in the field. Or create an overlay to highlight where information may be missing

- Give new field techs, or techs that have not been in the field for some time a “test” Chain of Custody to complete properly before they go out in the field

- Fill in COC as day progresses and do a final check of accuracy at the end of the day. Do not rush to log all samples on the COC at the end of the day – this is a major cause of COC errors.

- Always contact your Maxxam Project Manager if you are unsure about what to fill in for a specific analysis

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Safety Tips

- Do not overfill coolers – Lifting heavy coolers is a major strain on your back and can lead to serious back injuries. Always keep coolers < 40lbs and use proper lifting techniques when moving coolers

- Use caution and required PPE when opening coolers; particularly if using a knife to open the cooler, or if breakage of glass containers has occurred. Carefully inspect the contents of the cooler before reaching in – broken glass can result in serious cuts and the appropriate PPE should be used to safely dispose of it.

- Use caution when handling sample bottles containing preservatives. Although present in small amounts, the preservatives are still corrosive and skin contact can cause redness and severe burning

- When on site – if you are using your cooler as a table, make sure you are sitting so that you are facing site activity. Keep as far away from site activity as possible

- Practice the 3-Point Rule to reduce the likelihood of slips and falls by maintaining 3 or 4 points of contact with equipment, stairs, ladders at all times to ensure maximum stability and support

QUESTIONS?