Working with an Environmental Analytical Laboratory

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AEF Conference

October 6, 2016

Objectives When Using a Laboratory:

or

How to Make Good Decisions Based on Good Science

- Obtain Cost Effective Laboratory Results
- Meet Regulatory/Permit Conditions
  - Defensible Results (Cheaper is not always better)
- Obtain Accurate and Precise Laboratory Results
  - Your Entire Work Plan for Environmental Regulatory Compliance, Improvement Projects, Cleanup Projects and Corrective Actions are driven by the site water, soil, and air analytical data.

What We Are Covering Today

- Planning and Managing the Project/Compliance Needs
  - Project/Data Objectives
  - Procedures and Performance Criteria
- What makes Environmental Testing Lab Good?
  - AR Certification overview
  - QA/QC of Sample Collection and Lab Reports
  - Accurate and Precise Results
  - Complete Laboratory Reports and Easy to Understand

What We Are Covering Today – Cont'd

- Explaining Reporting Levels
  - MDL/MQL/RL and why you should care?
- How to Hints
  - Ordering lab analyses, shipping/receiving basics
  - Reviewing the Laboratory Reports

Data Objectives

- Data Quality Objectives (DQO) are project-specific goals that address the generation, assessment, and intended use of the data associated with that investigation. DQOs will be used to determine whether the amount and quality of data associated with the investigation are sufficient and sufficiently accurate to draw the conclusions that will be necessary.

DQO May Be Driven By:

- Permit Limits
- Permit Compliance Schedules
- Cleanup Levels
- Investigations

Planning Procedures and Performance Criteria for Testing

- Field activities
- Laboratory Testing
- Office

Quality Assurance Planning

- Quality Assurance Plans (QAPP, SAP, SOP) document/integrate the planning, procedures, implementation, QA/QC activities, and assessment procedures for a particular project:
  - Project parameters and procedures
  - Sample collection and handled procedures
  - Data management and analysis procedures

QA contd.

- Defines Representativeness of environmental condition or population
- Provides steps to determine the validity of specific sampling or analysis procedures
- Designates both internal and external QC measures
- Defines training and certification of participants
- Data Validation - Proper data documentation

Quality Assurance – External Verification

- Performance audits
- Data Validation of Laboratory Reports
- Split sample analysis
- Replicate (duplicate) sample analysis

What makes A Environmental Testing Lab Good?

- AR Certification
- QA/QC of Sample Collection and Lab Reports
- Accurate and Precise Results
- Complete Laboratory Reports and Easy to Understand Reports
- Turn Around Time - Reasonable

ADEQ Laboratory Certification Program

Information submitted to ADEQ by permittees is required to come from laboratories that ADEQ has certified:

- Labs are certified each year.
- Not all Environmental Testing Labs are Certified for all parameters.
  - 28 labs certified for herbicides (only 4 labs in Arkansas)
  - 8 labs certified for Dioxin (0 in Arkansas)

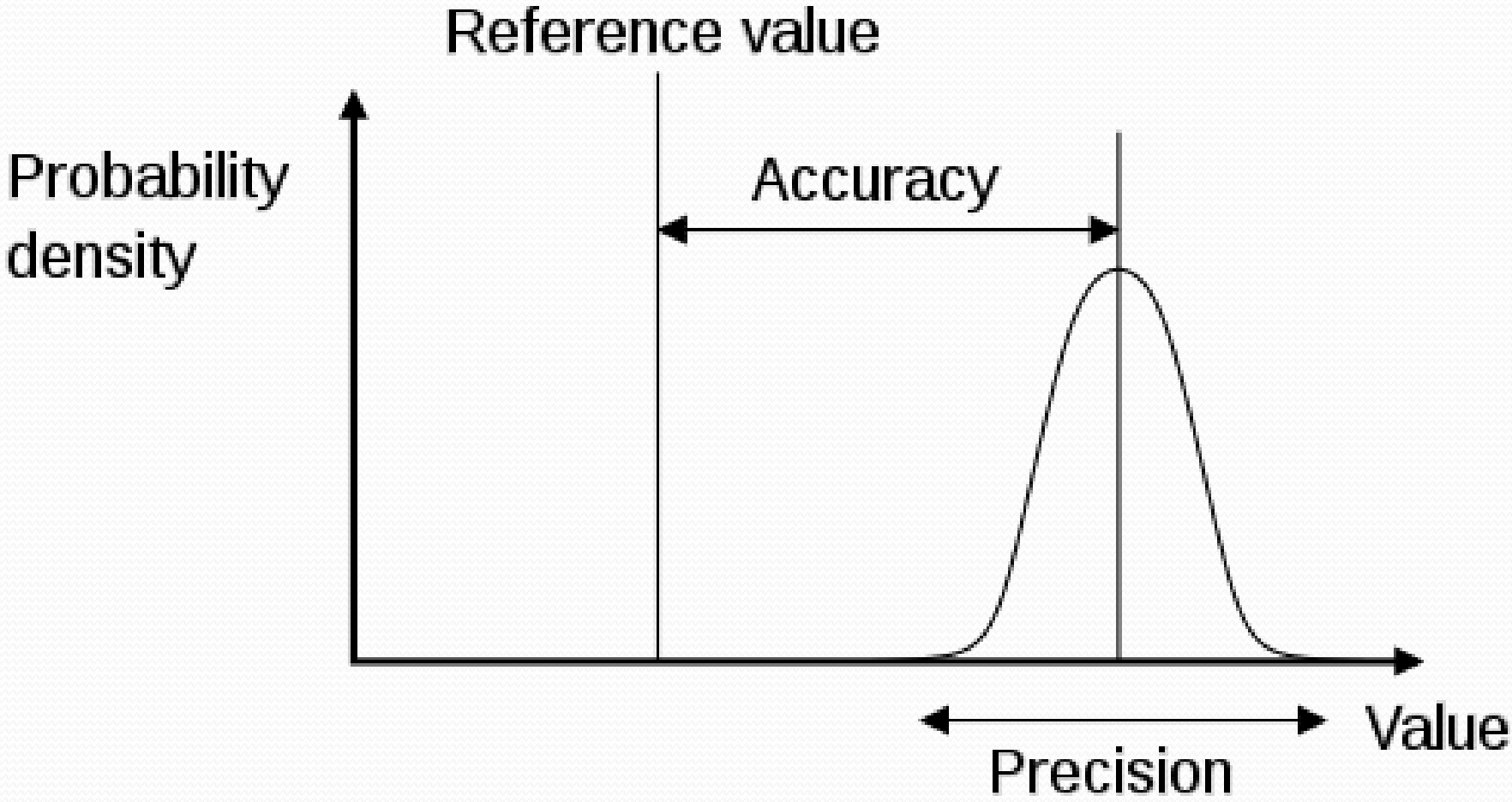
QA/QC of Sample Collection and Lab Reports

- Why do we need QA/QC for environmental measurements?
  - To help prevent errors from happening
  - To identify and correct errors that have taken place
  - Understand data reliability
  - Quantify areas of analytical uncertainty
  - Standardize measurement to allow for repeatable and comparable data across time and place

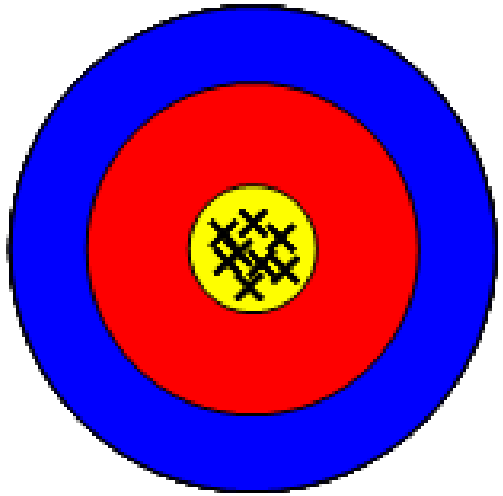
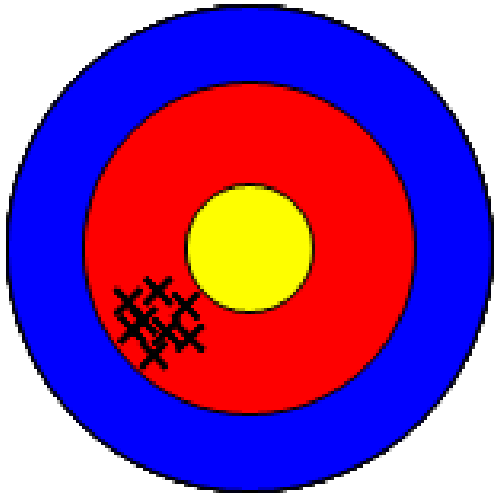
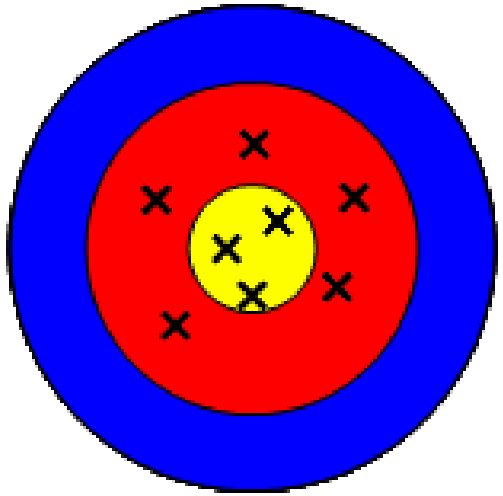
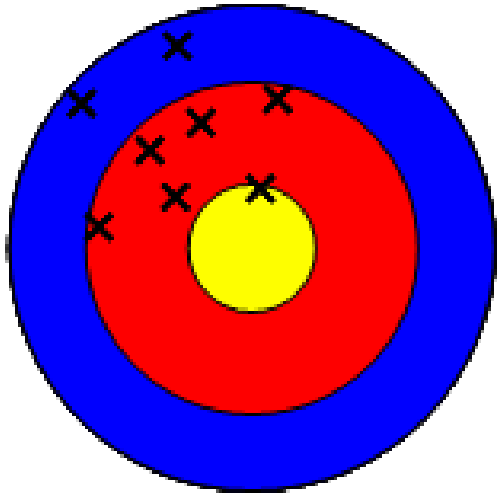
QA/QC Sample cont'd.

- QC is particularly critical in filed data collection
  - Field Sampling is often the most costly aspect of a project
  - Right the first time - data is never reproducible under the exact same condition or setting
- QC is applicable in all aspects of a project including:
  - Field data collection and sampling
  - Laboratory analysis and processing
  - Data evaluation and assessment
  - Reporting and project documentation

Accuracy = true value
Precision = Repeatability

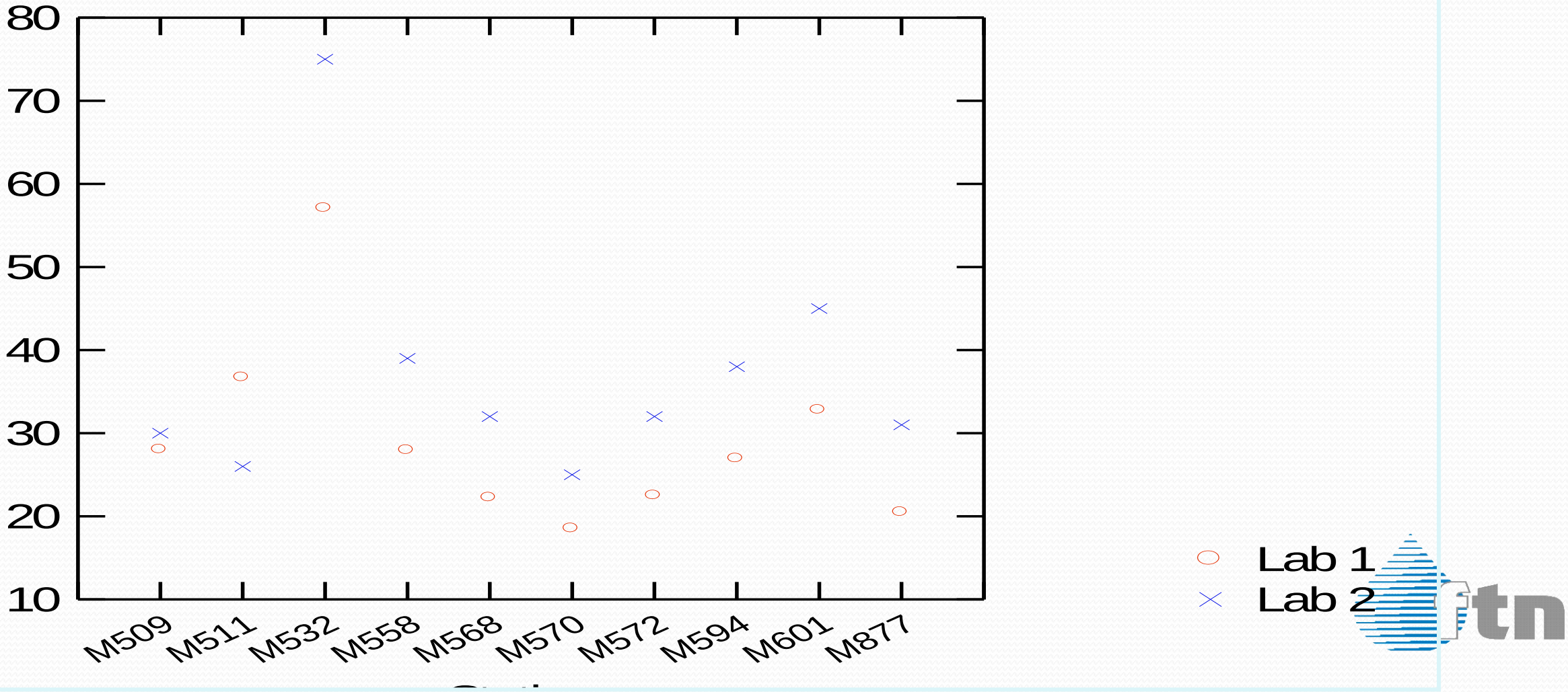


https://en.wikipedia.org/wiki/Accuracy_and_precision

	Accurate	Inaccurate (systematic error)
Precise		
Imprecise (reproducibility error)		

https://www.quora.com/What-is-accuracy-and-how-does-it-differ-from-precision

Different Labs and Methods = Different Results



Explaining Reporting Levels

- **Detection Limit Implications**
  - **Detection Limits Too High – not high enough for reporting requirements, cleanup verification, and project evaluations.**
  - **Detection Limits Too Low – More Expensive Testing, Not Required, may show false problems**
  - **Detection Limit Variable –different detection limits in the same matrix indicate matrix effects/problems**
  - **Detection limit are often used as a real data point by AGENCIES**

Acronyms

CRDL	Contract Required Detection Limit
CRQL	Contract Required Quantitation Limit
EDL	Estimated Detection Limit
EQL	Estimated Quantitation Limit
IDL	Instrument Detection Limit
LLD	Lower Limit of Detection
LLQ	Lower Limit of Quantitation
LOD	Limit Of Detection
LOL	Limit Of Linearity
LOQ	Limit Of Quantitation
MDC	Minimum Detectable Concentration
MDL	Method Detection Limit
MQL	Method Quantitation Limit
PQL	Practical Quantitation Limit
SDL	Sample Detection Limit
SQL	Sample Quantitation Limit
UCL	Upper Calibration Limit
UQL	Upper Quantitation Limit

Detection:

- Method Detection Limit (MDL):
  - “The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence (three times the standard deviation of replicate spiked analyses) that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.”*Lowest concentration that can be detected by an instrument with correction for the effects of sample matrix and method-specific parameters such as sample preparation. MDLs are explicitly determined as set forth in 40 CFR Part 136..

.....Generally these clean-water MDLs (corrected for %moisture, sample size, and dilution) are used for reporting limits, but the laboratory may use MDLs that they have generated. MDLs generated by the laboratory using the sample matrix of interest are the most reliable. If the clean-water MDLs are used, remember that they do not include all of the upward correction necessary to account for the effects of sample matrix

Detection cont'd.

- Minimum Quantitation Limits (EQL, MQL, PQL):
  - Lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. EQLs normally are arbitrarily set rather than explicitly determined. Most organic SW-846 methods give EQLs. The SW-846 EQLs are arbitrarily set at some multiple of typical MDLs for reagent water. Multiplying factors are given for various matrices such as groundwater, wastewater, soil and sludge, etc. Generally, laboratories use the SW-846 EQLs (adjusted for sample size, dilution, and %moisture) for reporting limits, but they may use EQLs that they have generated. SW-846 does not stipulate how to handle organic analytes that are positively identified at a concentration below the SW-846 EQL. Generally, laboratories DO NOT report these as present.
- Report Limit (RL), Detection Limit (DL):
  - These are more general terms that can mix the use of MDL and MQL to help avoid the confusion.

Helpful How To Hints

- Ordering lab analyses, shipping/receiving basics
  - Use COC to order bottles
  - Shipping
- Reviewing the Laboratory Reports
  - Develop a system to review laboratory reports
- Data Management
  - Electronic files from the lab
  - Graph Data as it is reported

Order Lab Analysis and Bottles

- **Chain of Custody Form**
  - Verify sample identification numbers and collection information matches lab report;
  - Verify that there is an acceptance signature for each relinquished signature documenting the delivery of the samples to the laboratory facility. Check for errors in noted dates and times;
  - Correct any errors with a single line cross-out, initial/date and note reason for correction; and,
  - Determine if samples appropriately preserved/refrigerated/iced; and,
  - Determine if samples were received by the laboratory an appropriate temperature.
  - **Sample Preservation and Holding Times Evaluation**

Order Lab Analysis and Bottles cont'd.

- **Sample Containers**
  - Any improper sample container, as described in the applicable analytical method, or a sample container that is not properly sealed or has been otherwise compromised, should be considered to be a significant QC infraction.
- **Sample Preservation**
  - Analytical results from samples that are not preserved in accordance with the requirements of the analytical method should be considered to be a significant QC infraction.

Date	Project Name	Project No.	Project Manager (Print) **Nathan Siria - FTN**	Page 1 of 1

Report / Bill to:	Submitted by: FTN Associates, Ltd. 3 Innwood Circle, Suite 220 Little Rock, AR 72211 (501) 225-7779 • Fax (501) 225-6738
Sampler Signature(s)	Recorded By (Print) Nathan Siria

SAMPLE DESCRIPTION									Parameters (Method Number)										Lab Turn-Around-Time
Sample Identification	Date	Time	Matrix* W	Matrix* S	Matrix* O	No. of Containers	Comp	Grab	TSS, Dissolved Copper (DL <0.004 mg/L)				Total Copper DL <0.004 mg/L)						☐ 24 Hours ☐ 48 Hours ☒ Normal ☐ Other: Due: __/__/__
Outfall 001			X			2		X	X				X						
																			Detection Limits
																			Parameter: Copper Detection Limit: 0.004
						Container Type			P				P						
						Preservative			NO				N						

* Matrix: W = Water S = Soil O = Other
G = Glass P= Plastic V = VOA vials H = HCl to pH2 T = Sodium Thiosulfate
NO = None S = Sulfuric acid pH2 N = Nitric acid pH2 B = NaOH to pH12 Z = Zinc acetate

Relinquished By (Signature)	Print Name	Date Time	Received By (Signature)	Print Name	Date Time
Relinquished By (Signature)	Print Name	Date Time	Received By Laboratory (Signature)	Print Name	Date Time

Sampler Remarks: Please e-mail results to:	Laboratory Remarks: Record: pH: Rainfall Amount: _____Duration_____

Laboratory Report Inspection

- **Read the Narrative identifying QC nonconformance:**
  - **Analysis Holding-time Excursions (total holding time from collection)**
    - Analytical results that are greater than the applicable regulatory criteria can be considered usable, regardless of the holding time, as long as the intended use of the data is to identify locations where concentrations of contaminants exceed those criteria. However, analytical results less than regulatory criteria that were analyzed and/or extracted after more than two times the holding time has passed should not be considered usable unless the investigator can provide the rationale for the use of the data
  - **Shipping Temperature Excursions**
  - **Calibration Issues:**
  - **Significant QC Violations for Specific Analytes:**
    - The following situations are considered to be significant QC violations. If any of the following issues are reported, the investigator is encouraged to contact the laboratory for guidance.

Laboratory Report Inspection cont'd.

- **Analytical results;**
  - Determine that reporting limits (RLs) match DQOs;
  - Check dilution factor to see if a dilution was performed and if so, the RL adjusted accordingly;
  - Determine that RLs are less than, or equal to the regulatory criteria; and,
  - Determine if sample results are provided for the each requested analysis
- **Determine the existence and magnitude of contamination resulting from laboratory or field activities**
  - **Method, Field or Trip Blank Evaluation**
  - **Field Duplicates and Laboratory Duplicates**
  - Laboratory Control Samples (LCS);
  - MS/MSD (when requested); Evaluate accuracy (Matrix Spike) and precision (Matrix Spike Duplicate)
    in the sample matrix.
  - Surrogates (as appropriate for method);

Data Management

- **Laboratory Results Reported**
  - Full Laboratory Finalized Report
  - Electronic Results
- **Factors to be Considered During Data Usability Evaluations**
  - Adjusting analytical results reported by the laboratory based on laboratory QC information is not appropriate. For example, if matrix spike indicate a percent recovery of 150%, you can not adjust the results downward by 50 %.
  - Acceptance criteria is to define a range where data are acceptable as reported. Any data within an acceptable recovery window is appropriate for use.
  - Results from surrogate analytes do not automatically indicate that a QC issue exists for a specific compound. Matrix spikes are used to evaluate the performance of a specific compound on the spiked sample. • Soil and sediment results should be reported on a dry-weight basis. Tissues are reported on a wet-weight basis.

Data Management cont'd.

- Sample heterogeneity issues or RL issues are to be considered when evaluating total results and results following SPLP or Toxicity Characteristic Leaching Procedure (TCLP) extraction. For example, the total sample results of analysis for total VOCs are "ND," while the results for the SPLP or TCLP leachate indicate the presence of VOCs at substantial concentrations.
- It is inappropriate to conclude in all instances that because the matrix spike and matrix spike duplicate results are biased low, the contaminants are bound up in a sample matrix that has not undergone some form of treatment, and therefore the low bias is irrelevant. The investigator should contact the laboratory to determine, if possible, how to overcome such matrix interference issues.
- It is important to work with the laboratory to minimize analytical difficulties or bias. There are several options for sample clean-up and analysis. Typically, sediment samples for pesticides or PCBs need extensive sample clean-up because naturally occurring interferences can cause analytical problems. Should the resultant effect of cleanup be an increase in the RL, the laboratory should contact the investigator and inquire as to how the laboratory is to proceed.

Finally

- Ask the Lab to Notify You When Unusual Conditions Are Encountered
- Ask Their Opinion During the Entire Process

Thanks For Your Time Today!