HOW TOMORROW MOVES

WHAT'S IN A NUMBER?

2014 Railroad Environmental Conference
Urbana-Champaign, Illinois
October 27, 2014

ANN BERNHARDT, AMEC ENVIRONMENT & INFRASTRUCTURE
PAUL KURZANSKI, CSX TRANSPORTATION

HOW TOMORROW MOVES

OVERVIEW- WHAT'S IN A NUMBER?

- Importance of Data Quality
- Project Scoping Sets the Stage
- Laboratory Data Reporting
- Data Review and Validation
- Measurement Uncertainty – A New Factor
- Disputes Involving Data

UNDERSTANDING ANALYTICAL VARIABILITY

IMPORTANCE OF DATA QUALITY

- Questionable detects near the detection limit
- False positive detects
- Holding times and sample preservation issues
- Incorrect method citation versus permit or plan requirements
- CWA versus CERCLA data quality requirements
- Differences between labs, split samples
- Allocation and comingling plumes
- Fraud and gross incompetence

PROJECT DECISIONS REQUIRE QUALITY DATA

IMPORTANCE OF DATA QUALITY

U.S. Environmental Protection Agency
Office of Inspector General

14-P-0270
May 29, 2014

At a Glance

Why We Did This Review

The purpose of this review was to determine the use of procedures by the U.S. Environmental Protection Agency (EPA), other federal agencies and states to manage the communication of and appropriate action on laboratory data determined to be fraudulent. We refer to this as a due diligence process.

The EPA relies on external laboratories to provide environmental testing data and

EPA Has Not Implemented Adequate Management Procedures to Address Potential Fraudulent Environmental Data

What We Found

The EPA lacks a due diligence process for potential fraudulent environmental data. The agency has three policies and procedures that address how to respond to instances of fraudulent data, but they are all out of date or unimplemented. Our survey of EPA regional offices disclosed that a majority of respondents were unaware there was a policy, and approximately 50 percent expressed the need for such policies and

The EPA is not ensuring that fraudulent laboratory environmental data is being communicated to appropriate program offices and data users, reviewed, and analyzed for its impact on human health and the environment.

PROJECT SCOPING SETS THE STAGE

Why is **Project Scoping** Important to Data Quality?

- **Align analytical methodology** with Regulatory Programs
- Develop achievable **Data Quality Objectives**
- **Select a laboratory** best suited for full range of project needs

USABLE DATA STARTS WITH PROJECT PLANNING

LABORATORY ANALYSIS

TAL Metals

Client: AMEC Environment and Infrastructure

Laboratory ID: OG18050-001

Description: MW-01

Matrix: Aqueous

Date Sampled: 07/17/2013 1015

Date Received: 07/18/2013

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	3005A	6010C	1	07/22/2013 2226	CDF	07/19/2013 1500	25459

Parameter	CAS Number	Analytical Method	Result	Q	PQL	MDL	Units	Run
Arsenic	7440-38-2	6010C	0.0097	BJ	0.010	0.0030	mg/L	1
Barium	7440-39-3	6010C	0.011	J	0.025	0.0080	mg/L	1
Cadmium	7440-43-9	6010C	ND		0.0020	0.00060	mg/L	1
Chromium	7440-47-3	6010C	0.0037	J	0.0050	0.0016	mg/L	1
Lead	7439-92-1	6010C	ND		0.010	0.0030	mg/L	1
Selenium	7782-49-2	6010C	ND		0.010	0.0030	mg/L	1
Silver	7440-22-4	6010C	ND		0.0050	0.0016	mg/L	1

Verify Key Information:

1. Verify **sample date and time** information is accurate
2. Verify **parameters, method, reporting limits, and units** match plans
3. Check **result qualifiers** that may affect decision making

LABORATORY ANALYSIS- QC DATA

TAL Metals - MSD

Sample ID: OG18050-001MD
Batch: 25459
Analytical Method: 6010C
Matrix: Aqueous
Prep Method: 3005A
Prep Date: 07/19/2013 1500

Parameter	Sample Amount (mg/L)	Spike Amount (mg/L)	Result (mg/L)	Q	Dil	% Rec	% RPD	% Rec Limit	% RPD Limit	Analysis Date
Arsenic	0.0097	0.40	0.45		1	110	0.57	80-120	20	07/22/2013 2233
Barium	0.011	2.0	2.0		1	102	1.5	80-120	20	07/22/2013 2233
Cadmium	ND	0.40	0.41		1	102	2.1	80-120	20	07/22/2013 2233
Chromium	0.0037	2.0	2.0		1	98	1.0	80-120	20	07/22/2013 2233
Lead	ND	0.40	0.42		1	105	2.7	80-120	20	07/22/2013 2233
Selenium	ND	0.40	0.48		1	119	3.1	80-120	20	07/22/2013 2233
Silver	ND	0.40	0.38		1	96	1.2	80-120	20	07/22/2013 2233

CHECK LABORATORY QC RESULTS:

1. **Matrix Spike % Recovery** results- all are acceptable
2. **% Relative Percent Difference (RPD)** result- all are acceptable
3. Method **Control Limits** are provided for reference
4. Check for flags on results- bias or estimated

LABORATORY ANALYSIS- QUALIFIERS

Common Lab Qualifiers

J = Estimated value. Trace detects, lab QC failures, etc.

B = Blank contaminant, analyte detected in the associated blank

D = Result reported from a dilution

E = Exceeds calibration range of instrument

H = Hold time exceeded

Custom Lab Qualifiers

Labs customize qualifiers for various issues:

- Matrix interference
- Co-eluting compounds that cannot be resolved
- Specific sample problems

MOST QC FAILURES SUGGEST ESTIMATED DATA

DATA VALIDATION

What is Data Validation?

Independent review of the laboratory data to assess limitations to its use. Limitations are expressed as validation qualifiers typically following National Functional Guidelines.

When is Data Validation Required?

Depends on project requirements, regulatory program requirements, the importance of the decision, how much is already known about contaminants present.

What Level of Validation is Required?

Field QC, Lab QC, sample QC, calculation verification, raw data

CLARIFIES BIAS AND SEVERITY OF QC FAILURES

DATA VALIDATION

EPA Data Validation Qualifiers

U = The analyte was analyzed for, but was **not detected** above the level of the reported sample quantitation limit

J = The result is an **estimated quantity**

UJ = The analyte was analyzed for, but was **not detected** and the reported **quantitation limit is approximate**

NJ = The analyte has been **"tentatively identified"** and the associated numerical value is the **estimated concentration**

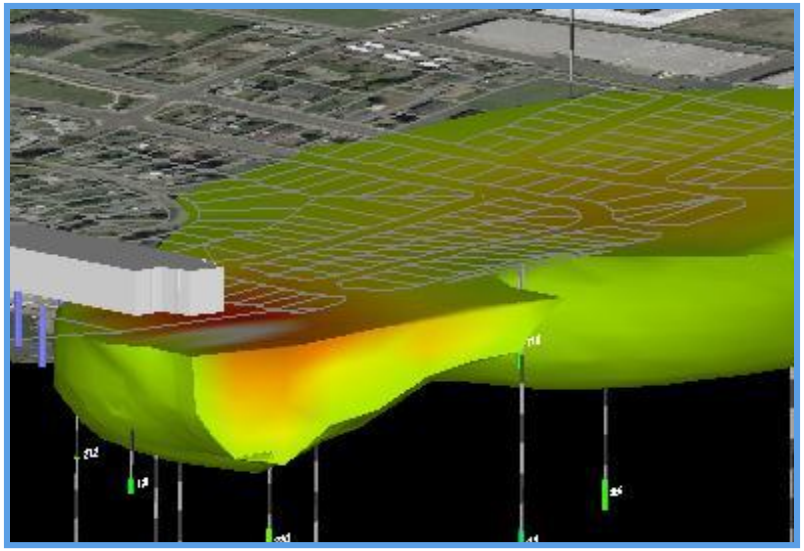
R = The data result is **unusable**. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

DATA ARE USABLE UNLESS REJECTED

ASSESSING DATA USABILITY

Determine if results are usable for decisions

- PARCCS:
  - Precision
  - Accuracy
  - Representativeness
  - Completeness
  - Comparability
  - Sensitivity



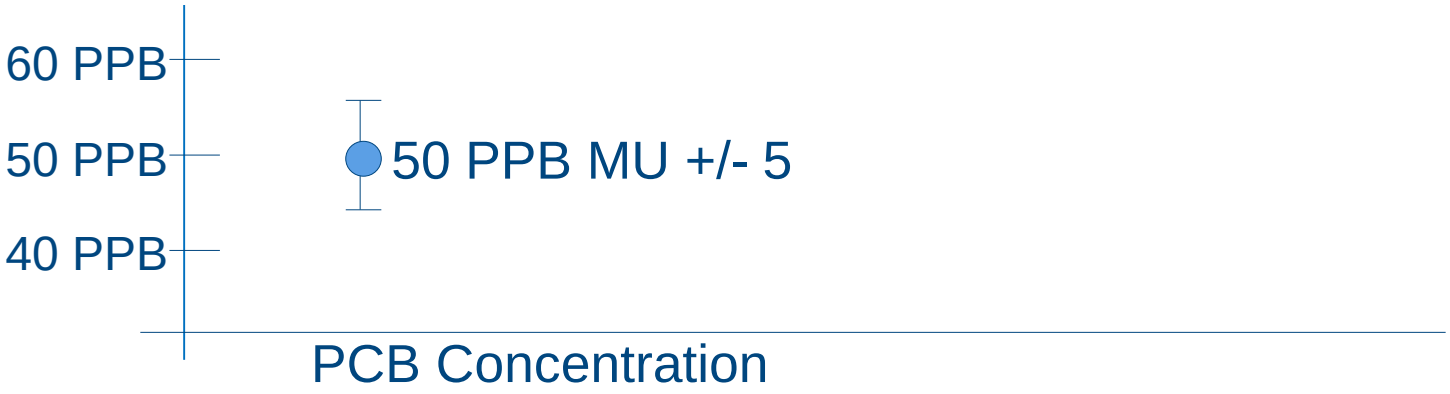
- Assess site conditions and historical data
- Review data against DQOs

DO THE RESULTS MAKE SENSE?

MEASUREMENT UNCERTAINTY

Measurement Uncertainty (MU)

- Definition: Uncertainty of the result of the measurement deviation
- Accounts for systematic and random error in the analysis
- 95% confidence expressed as +/- of reported result
- Does not eliminate uncertainty, but rather defines it numerically
- Not regularly considered by EPA in guidance and regulatory decisions



DEFINES A CONFIDENCE INTERVAL

DISPUTES INVOLVING DATA

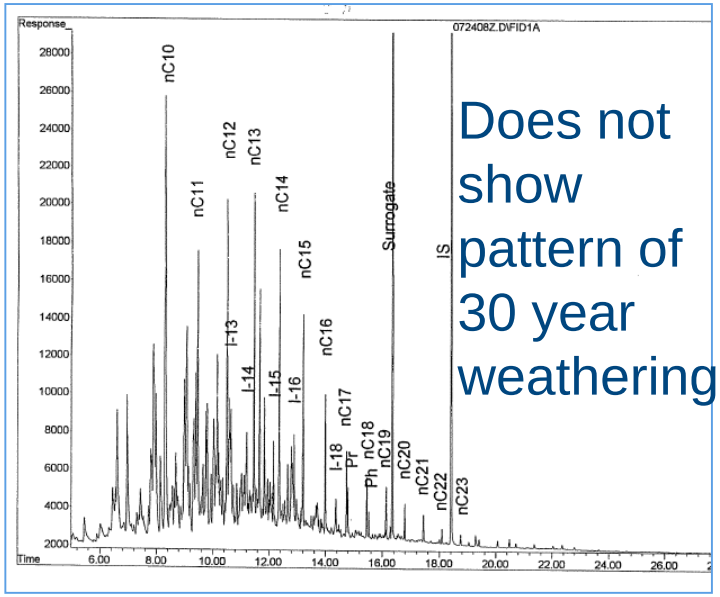
CASE STUDIES

DISPUTES INVOLVING DATA- CASE STUDIES

Historical data supports current decisions

- Property owner contested that derailment in 1976 was cause of hydrocarbons present on their site
- Property owner presented data and fuel chromatograms
- Chromatogram review demonstrated the hydrocarbons were not due to derailment

Recommendation: Pursue multiple lines of evidence in support of data decisions, including historical data.



DATA SHOULD MAKE SENSE

DISPUTES INVOLVING DATA- CASE STUDIES

Pesticide sampling on former agricultural field

- Less experienced laboratory selected as part of state agency program promoting use of HUB-zone businesses.
- Lab reports significant matrix interference causing very low to 0% recoveries of lab QC
- Review of site conditions, soil, and expected results suggest poor laboratory performance as driver
- 2nd laboratory analysis shows fully acceptable lab QC results and usable data for project

Recommendation: If lab results show significant QC issues, it may warrant closer evaluation of lab systems and/or method modifications applied to improve performance

DON'T ASSUME MATRIX INTERFERENCE IS REASON FOR QC FAILURES

DISPUTES INVOLVING DATA- CASE STUDIES

Asbestos results reported as not detected

- Technician collecting sample noted what appeared to be asbestos in layers of material for 10 samples
- Lab reports that all layers as non-detect for asbestos
- 2nd laboratory analysis shows asbestos in all layers of material
- 1st lab reanalyzes samples and confirms detections
- Laboratory issued corrective action - suggests training on proper preparation of materials for analysis and adhering to established QC

Recommendation: Ask lab to redo analysis if results are inconsistent, evaluate possible sources that would cause unexpected results

QUESTION RESULTS THAT ARE INCONSISTENT WITH SITE KNOWLEDGE

DISPUTES INVOLVING DATA- CASE STUDIES

Higher data scrutiny may reveal more significant problems

- Laboratory pre-selected at agency level
- Level II type lab reports show minimal issues
- Validation of Level III type report reveals significant issues and possibly unusable data

Recommendation: Integrate higher levels of data validation and data review to increase confidence in the data.

DATA VALIDATION INCREASES CONFIDENCE IN THE DATA

DISPUTES INVOLVING DATA- CASE STUDIES

Industrial company needing full confidence in data

- 3 labs conducting PCB transformer oil analysis
- Data compared against 3 threshold criteria values at 2, 50, 500 ppm
- Evaluated **measurement uncertainty** to minimize risk of improper/costly decisions
- Discontinued use of 1 lab

Recommendation: Integrate measurement uncertainty for critical and high-risk decisions

MEASUREMENT UNCERTAINTY QUANTIFIES A CONFIDENCE INTERVAL

SUMMARY- WHAT'S IN A NUMBER?

Check laboratory QC results for significant problems

✓Review results versus plans/permits

✓Review result qualifiers and QC failures

✓Ask lab to reanalyze or to explain unexpected results

Integrate **data validation for higher level scrutiny** of data

✓Verify program requirements for data validation

✓Understand limitations to data use or if results are unusable

Consider **measurement uncertainty** in DQOs

✓ Quantify measurement uncertainty for critical decisions

QUESTIONS?

HOW TOMORROW MOVES

REFERENCES

- National Functional Guidelines 2013
- Guidance on Environmental Data Verification and Data Validation, EPA-240-R-02-004, November 2002
- Guidance on Evaluation, Resolution, and Documentation of Analytical Problems Associated with Compliance Monitoring (aka The Pumpkin Book), EPA 821-B-93-001, September 1993
- Solutions to Analytical Chemistry Problems with Clean Water Act Methods (Pumpkin Book Revision), EPA 821-R-07-002, March 2007
- EPA Has Not Implemented Adequate Management Procedures to Address Potential Fraudulent Environmental Data, EPA Office of Inspector General, Report No. 14-P-0270, May 29, 2014
- ILAC 2002 - Introducing the Concept of Uncertainty of Measurement in Testing in Association with the Application of the Standard ISO/IEC 17025, ILAC-G17:2002, International Laboratory Accreditation Cooperation (ILAC), 2002