Evaluating and Interpreting Data

Department of Environmental Protection

Water Quality Standards Program

Aquatic Ecology & Quality Assurance Section

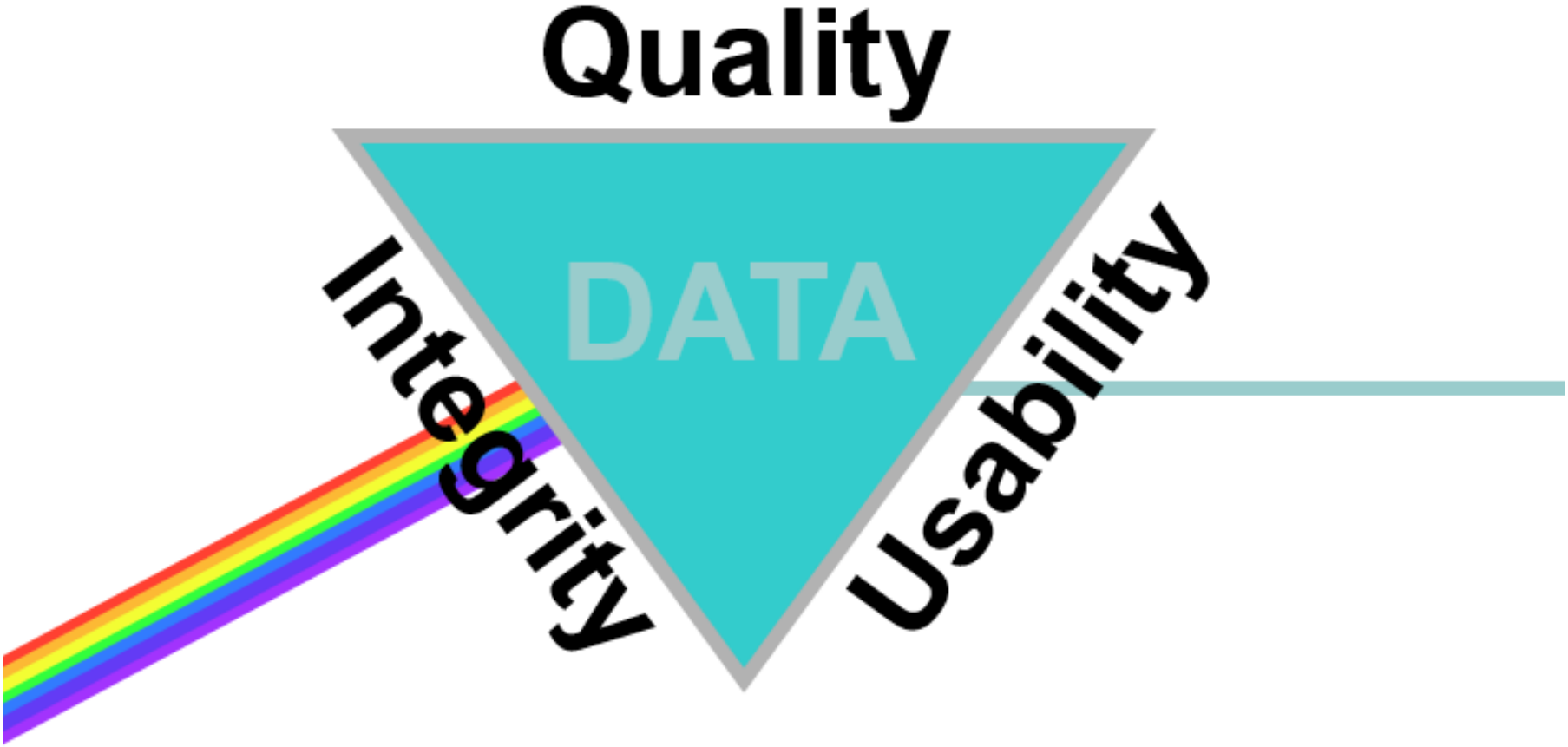
To Ensure the Correct Decision:

- DEP must verify that data are useable.
  - Consistent with Data Quality Objectives and program requirements.

- We have Statutory Authority to reject data.

Data Planning & Review -Philosophy

- Prevent or minimize data quality problems through careful planning, and maximize data usability by understanding the effect of the quality of the data on the environmental decisions to be made
- **Final decisions about data usability belong to decision maker or data user**
- Document usability evaluations (transparency to data user & public)


Quality
DATA
Integrity
Usability

Assumptions – Are they valid?

- The sampler followed the DEP SOPs or other stipulated procedures
- The Lab followed the method, analyzed Quality Control samples and performed some level of review of the analytical and QC Data

Data Usability – Sources for Criteria

- QA Rule 62-160
- DEP-EA-001/07
  - "DEP Process for Assessing Data Usability"
- DEP SOPS
- Other DEP rules
- Permits, contracts, etc.
- Approved analytical methods
- QA plan, Sampling & Analysis Plan, etc.

DEP-EA-001/07

- Describes a process – not an absolute set of criteria
  - Requires data evaluation per use & **context**
  - Defers to project or program DQOs and DQIs
  - Defaults to minimum criteria where applicable
    - NELAC (TNI) lab standards
    - DEP SOPs
    - QA Rule requirements
    - Analytical Method requirements
    - DEP default criteria for specific DQIs

Data Use and Context

- Project management goals
  - Screening, monitoring, research, compliance, assessment, clean-up, etc.
  - Satisfaction of Data Quality Objectives
- Quality Control Results for Data Quality Indicators
  - Frequency & magnitude of failures
  - Impact on individual sample results
- Action or compliance levels
  - Sample concentrations
  - Reported MDLs & PQLs
- Corroborating Data
  - Historical, trend, independent analyses, etc.

Secondary – Use Data (Found Data)

- **Existing Data – Data Review and Data Quality Questions for Secondary Use**
  - What are the minimum requirements for use of these data?
  - Were the data generated in a way that meets the quality criteria for the current use (DQOs)?
    - Is there “metadata” describing the performance per DQIs?

Easy Checks – Data Review

1. Completeness
   - Report of sample data & relevant QC data
     - Sampling & analysis dates and times
     - Report of relevant field information
   - Other Contract Deliverables (if applicable)
2. Lab certification
   - Analytical Methods Used
3. Reported MDL & PQL values
4. Data Qualifiers
   - Holding Time and Preservation
   - Blanks
   - Precision & Spike Recovery
   - MDL & PQL
   - Microbiology

Lab Certification Data Base

- Verify certification for the reported method
  - Search for a lab by name or location
  - Search for a lab that can analyze for a specific method, matrix or analyte
  - Show all **Fields of Accreditation** (FOA) for a specific lab
  - Show the history of an FOA for a specific lab
- DOH certified labs query
  - http://appprod.dep.state.fl.us/labs/cgi-bin/aams/index.asp

Usability Questions - Examples:

- Waste Remediation Site-
  - Cleanup Target Levels - Rule 62-777 FAC
  - Lab used a method with a higher PQL

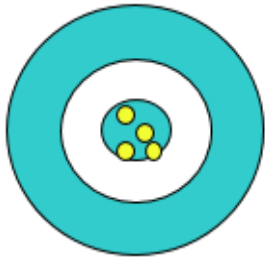
    DATA usable or not?
- Wastewater Effluent Sample - permit compliance
  - Limit is 10ug/L arsenic
  - Sample result was 9.5ug/L
    - Lab LCS recovery 65%, acceptance criteria 75-125%

      DATA usable or not?

Precision and Accuracy

- Accuracy: The ability to measure the “true” value. Overall agreement of a measurement to a known value - includes a combination of random error (precision) and systematic error (bias) in both sampling and analysis operations
- Bias: Systematic or persistent distortion of a measurement process that causes errors in one direction
- Precision: Consistency of measurements. Agreement among repeated measurements under identical, or substantially similar conditions

Precision and Accuracy



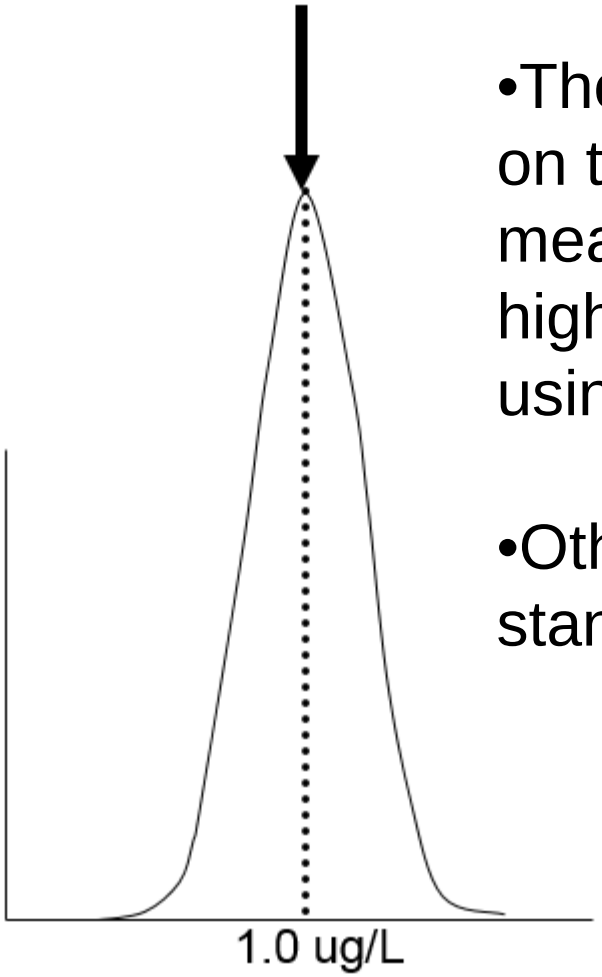
Good precision,
Good accuracy

Good precision,
Poor accuracy

Poor precision,
Good accuracy

Poor precision,
Poor accuracy

Accuracy – Spikes (all types)

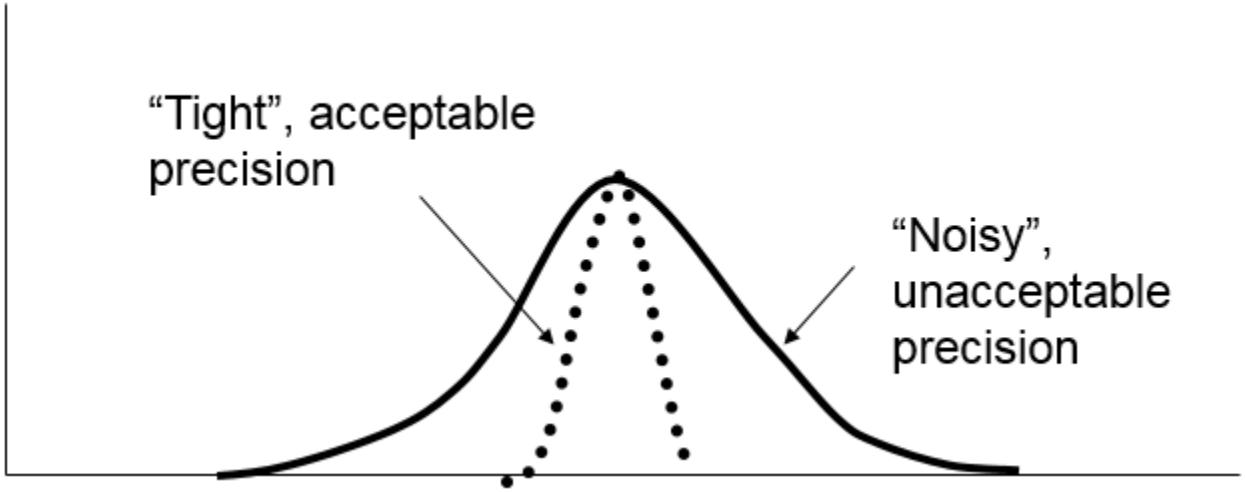


- The true or standard value is based on the central tendency of measurements involving multiple high quality testing laboratories, using exacting NIST procedures.

- Other laboratories purchase standards for calibration and QC.

Precision – Duplicates or Replicates

The relative agreement in values from repeated measures of the same sample (relative standard deviation) during routine testing runs (measurement repeatability).



Analysis Error – Example

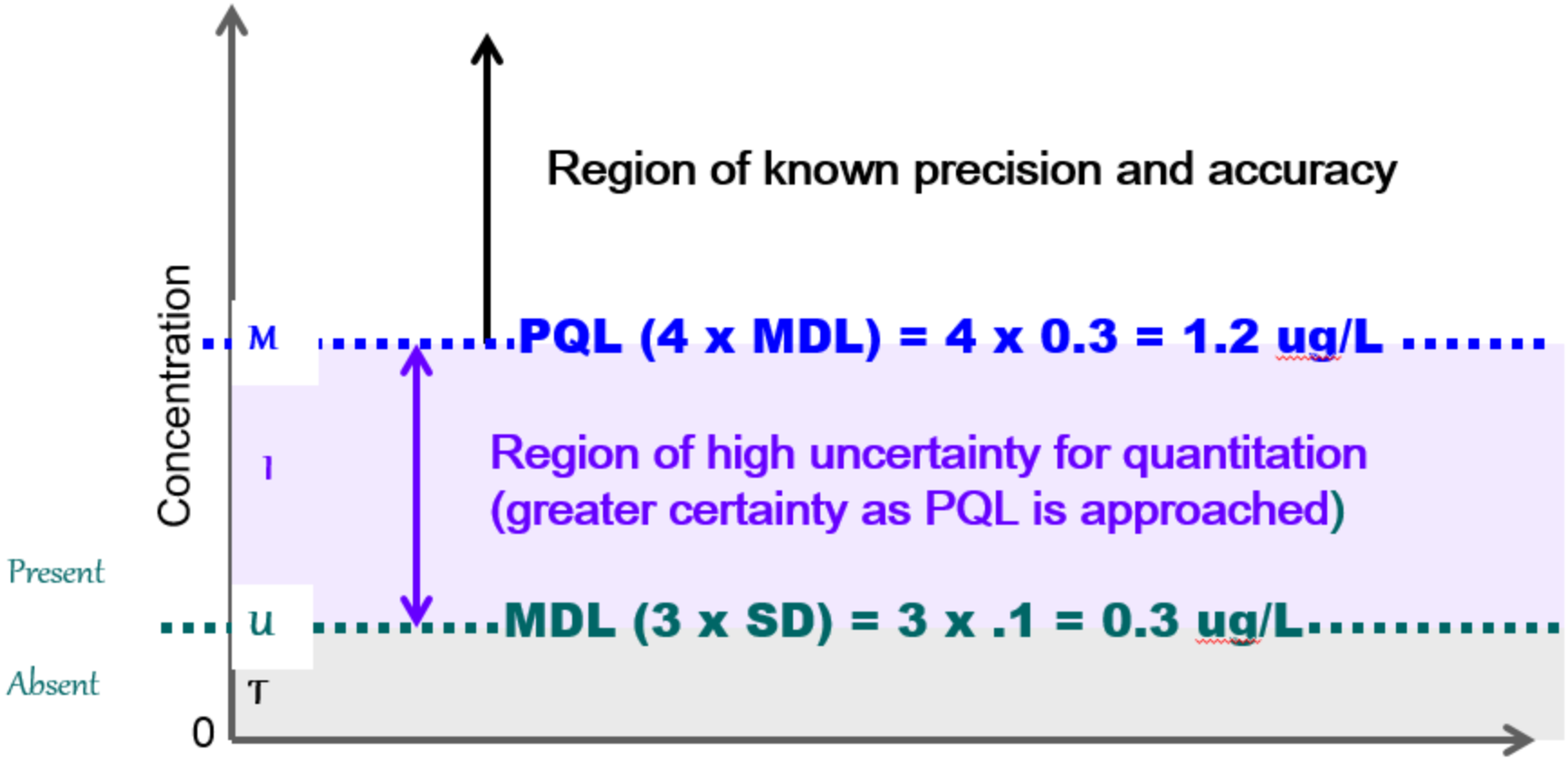
- **Given a reported value of 10 mg/L:**
  - Analytical method measures with 20% low bias (average 80% recovery) and 30% relative standard deviation (RSD) error in precision
  - With 20% bias, result could be 8; including 30% precision error, result could be as low as 5.6.
  - Doesn't include sampling error

*Definitions – MDL & PQL**

- **Method Detection Limit**: (MDL) An estimate of the minimum amount of a substance that an analytical process can reliably detect.
- **Practical Quantitation Limit**: (PQL)The lowest level of measurement that can be reliably achieved during routine laboratory operating conditions within specified limits of precision and accuracy.
- MDLs & PQLs are analyte-and matrix-specific and are laboratory-dependent, determined from the preparation and analysis of a sample in a given matrix containing the analyte.

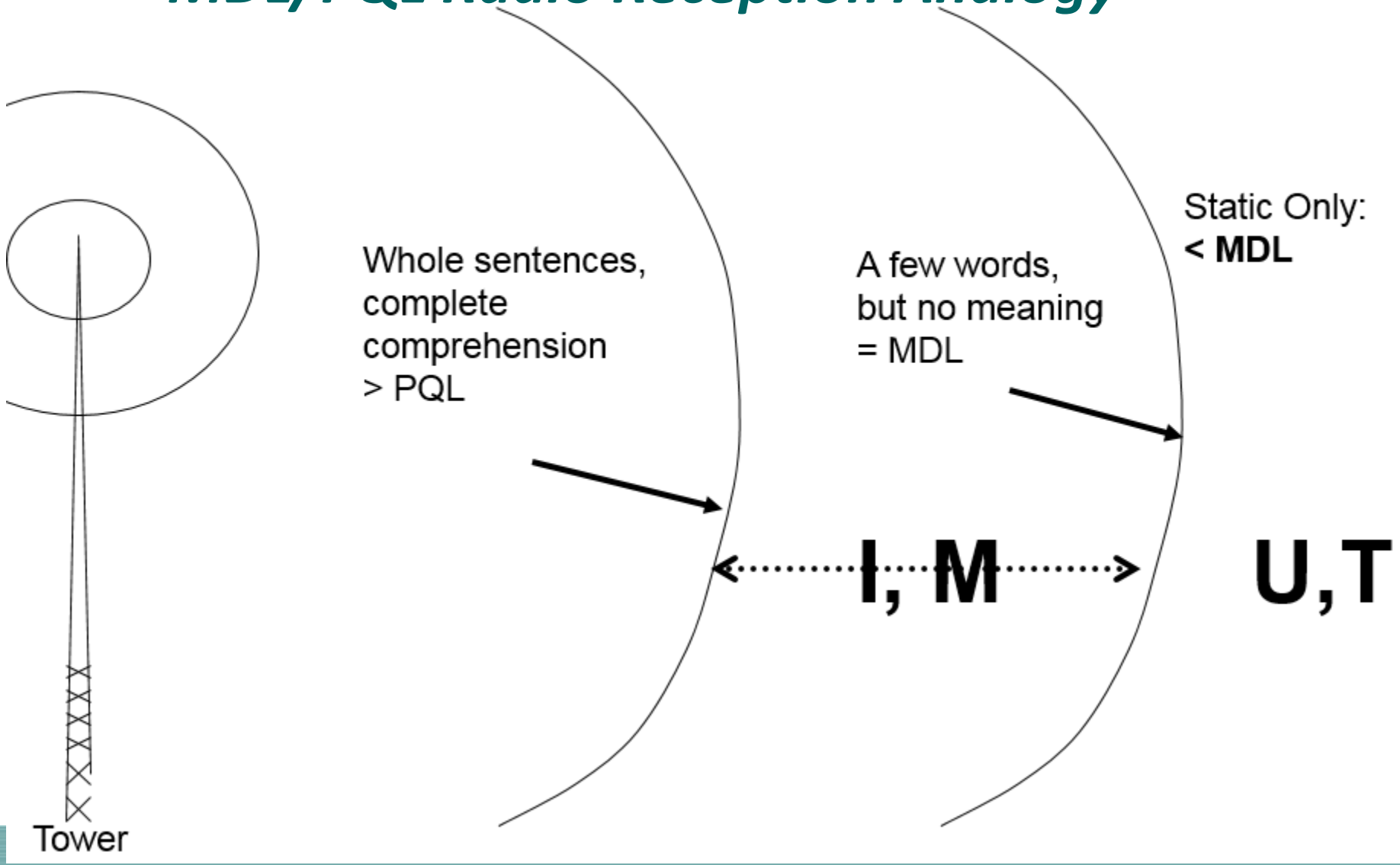
* **"Reporting Limits" can be either of the above... Or something else. Be careful!**

MDL/PQL Relationship



MDL is an Estimate of a Lab's Ability to Detect (not quantitate) at the MDL concentration

MDL/PQL Radio Reception Analogy



Detection & Quantification Qualifiers

- U : Analyte Not Detected in Sample (MDL value reported)
- I : Sample Value is between MDL & PQL (sample value reported)
- M : Sample Value is between MDL & PQL (PQL value reported)
- T : Sample Value is less than MDL (sample result reported)
  - "T" rarely used and should be explained

MDLs & PQLs Problems

- Lab MDL or PQL is too high for intended use
  - Sensitivity not usable for non-detect samples
    - Reported MDL or PQL doesn't meet target
    - Elevated MDL/PQL from unnecessary sample dilutions not usable
- Estimated values for sample results <PQL problematic

DEP Data Qualifiers

- 62-160, Table 1
- Provide Quality Control Information

- A Data Qualifier does not Automatically Signify Unusable Data
  - A failed QC result (a measure of a DQI) does not automatically mean unusable data

When is blank contamination significant?

- Typical blanks reported
  - Lab method blank
  - Field-QC blanks
    - Equipment blank
    - Field blank
    - Trip blank (VOCs)

Lab Method Blank

- Analyte-free water processed as routine sample.
- Result evaluated to determine sources of internal lab contamination.

Blank Evaluation – Data Qualifier Codes

- *Evaluate Blank Detects Relative to Sample Concentrations – OK if:*
  - Blank Concentration ≤ 10% of Sample Concentration
    - If not, flag samples per QA rule DQC table
      - Only applies to affected analytes
      - Usability of sample results must be determined in context

- *Evaluate Field-QC Blanks Like Lab Blanks*

Blanks – Data Qualifier Code conditions for associated samples

- Blanks are Non-Detects (MDL Value with "U")
  - Samples receive no data qualifier codes
- Blanks have analytes detected
  - Samples receive data qualifier codes per "10%" rule
    - "V" - analyte found in Lab Method Blank
    - "J" – analyte found in any other type of lab QC Blank
      - Code comment required
    - "G" - analyte found in field-QC blank
  - Blank values are not typically subtracted from sample results

Holding Time (Q)

Refer to FS 1000, Tables 4 – 11

- Check to see if Required Holding Times Met
  - Hours or days?
  - Sample Preparation (including extracts) or Analysis?
- Exceeded Holding Time: "Q"
  - ➲ *If Exceeded:*
    - ➲ *+/- Estimations Based on Chemical/Biological Properties*

Holding Time (Q) Example

- Data Generated: County surface water monitoring program
  - 15 chlorophyll a samples per 5-year period
  - 48-hour hold time for filtration was not met
  - **Were the data <u>USABLE</u>?**

❑ Lab Records Audit: Data for IWR assessments

- ❑ *Majority of samples analyzed beyond the hold time*
- ❑ *None were qualified with a Q*
- ❑ *Lab Manager –qualifiers purposely suppressed*
- ❑ ***Were the data <u>USABLE</u>?***

Preservation (Y)

Refer to FS 1000, Tables 4 – 11

- Proper Preservation?
  - Temperature control
  - Chemical treatment
  - pH adjustment
- Improper Preservation: Y
  - If Exceeded:
    - +/- Estimations Based on Chemical/Biological Properties
      - Chemical Results may be Lower than the Actual Value

Interpreting Qualifiers

Estimated Values

- "J" – Estimated

➲ *Narrative Explanation Must be Provided*

➲ *Estimate bias if possible*

➲ *Evaluate Based on Explanation*

Examples

- No QC Measures Performed
- QC Failure (e.g., Accuracy, Precision)
- Matrix Interference
- Improper Lab or Field Procedures
- Lab or field calibration failure

Replicate Precision (J)

- Lab Replicates: Lab Precision Criteria
- Field Replicates: Use Lab Precision Criteria as Starting Point for Evaluation
- Unacceptable Precision: "J" (estimated value)
  - ➲ *Evaluate lab replicates based on required criteria*
    - ➲ *Analytical method, project DQO or lab precision limit*
  - ➲ *Evaluate Field Replicates:*
    - ➲ *Does precision exceed lab precision criterion?*
    - ➲ *Site or sampling event issues*
      - ➲ *Sampling Error - Improper Sampling Techniques?*
      - ➲ *Indication that Samples are not Representative?*

Interpreting Qualifiers

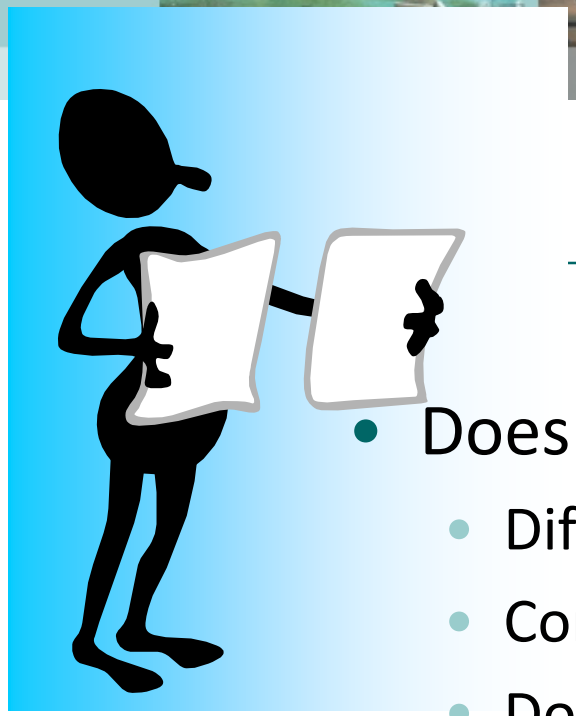
Microbiological

- "B" – Membrane Filter Method Colony Counts Not in Ideal Range
  - If Sample volume = 100 ml & Colony Counts are below method ideal range, "B" is not required
- "Z" – Value Reported is Estimated
  - Colonies are too numerous to count (> 200 colonies)
  - ➲ *Estimate based on "ideal range" per method*
    - ➲ Highest dilution (lowest sample volume) should be used for estimate calculation

"Parts vs. Whole"

- Sum of "Parts" < 120% of Reported "Whole"
  - NO_2 or NO_3 ≤ Total NO_x
  - Total Ammonia ≤ TKN
  - NO_2 + NO_3 + TKN = Total Nitrogen
  - Orthophosphate ≤ Total Phosphorus
  - Dissolved ≤ Unfiltered (Total)

➲ *Value may be due to errors in Reporting, Calculations, Sampling or Analysis*



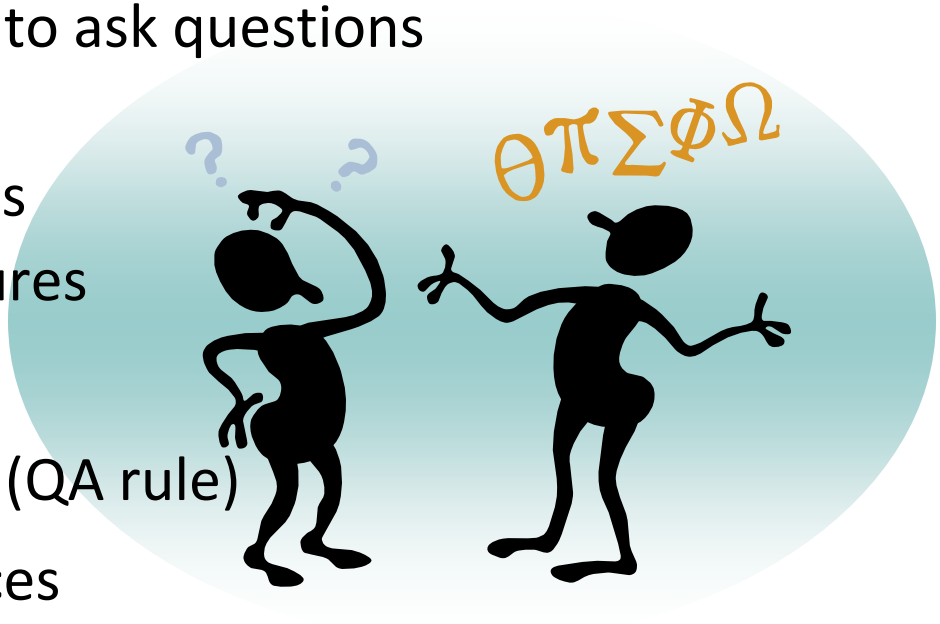
Review Data

- Does it Make Sense?
  - Different from Expected?
  - Consistently the Same Value?
  - Do Parts Add up to Total?
- Are Non-Detects Reported Correctly (“U”)?
- What QC Problems are Reported?
  - Spikes (all types), duplicates, blanks, calibrations
  - Detection and quantitation limit issues

- **Possible Warning Flags**
  - **No QC Problems – <u>Ever!</u>**
  - **Always in Compliance**
  - **MDLs or PQLs are at the Regulatory Limit**

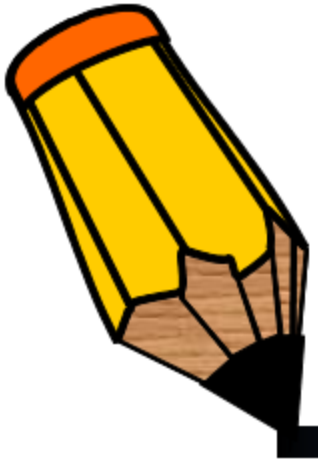
Ask Questions

- You have the authority to ask questions
  - Data report issues
  - Sampling procedures
  - Laboratory procedures
- Be persistent
- Ask for documentation (QA rule)
- Seek other DEP resources
  - Other district staff
  - Aquatic Ecology & Quality Assurance Section
  - Tallahassee laboratories (expert staff for chemistry and biology)



Will DEP Accept The DATA?

Your Goal:
ensure that the results accurately represent the sample source



Bottom Line

Data Review Resources

- DEP-EA-001/07
- QA Rule
- DEP SOPs
- MDL & PQL target lists
  - 62-4.246(4)
  - Waste management rules
- Staff assistance:
  - DEP lab
  - AEQAS