Understanding Analytical Environmental Data
WE FIX EVERYTHING
FROM DAYBREAK TO HEARTBREAK
GARAGE
Complex and Confusing

- Interested in low concentrations of targets
- Heterogeneous samples - variable results
- Matrix interference on analysis
- Regulations don’t address these problems
Complex and Confusing

- What do you need?
- Why do you need it?
- How will you use it?
- Bad or good decisions can come from it?
Complex and Confusing

- All data have error.
- Nobody can afford absolute certainty.
- Tolerable error rates (99 % vs. 95 % certainty)
- Without DQOs, decisions are uninformed.
- Uninformed decisions - conservative and expensive
APPENDIX I FOR DETECTION MONITORING
APPENDIX IA

GENERAL GROUND WATER QUALITY INDICATOR PARAMETERS

CATIONS
MAGNESIUM
SODIUM
POTASSIUM
CALCIUM

ANIONS
CARBONATE
BICARBONATE
CHLORIDE
SULFATE
NITRITE
NITRATE

FIELD PARAMETERS
PH
SPECIFIC CONDUCTIVITY
TEMPERATURE
TOTAL ORGANIC CARBON
Appendix IA Parameters

- Dissolved Anions  Method 300 or 9056 (pay attention to hold times)  
  + Alkalinity Method 310.1  
  - 48 hour hold on NO$_3^-$ and NO$_2^-$ (May need 353.1, 353.2, 353.3)

- Dissolved Cations Method 6010B/6020

- Field Parameters  
  - Specific Conductance Method 160.1  
  - pH Method(s) 150.1 or 9040B  
  - Temperature Method 170.1  
  - TOC (Not field parameter) Lab Method 9060

- Ask for what you want
- Communicate, communicate, communicate
Appendix IA Parameters

- Water is electrically neutral
- Anion-Cation Chemical Equivalence determined by Mass to Charge
- $\text{NO}_3^-$ and $\text{NO}_2^-$
  - Nitrate, one negative charge per $14 + (16 \times 3) = 62/1 = 62 \text{ mEq}$
  - Nitrite, one negative charge per $14 + (16 \times 2) = 46/1 = 46 \text{ mEq}$
- $\text{SO}_4^{2-}$ Sulfate, two neg charges per $32 + (16 \times 4) = 96/2 = 48 \text{ mEq}$

<table>
<thead>
<tr>
<th>CATIONS</th>
<th>mg/L</th>
<th>Meq/L</th>
<th>% Tot Cations</th>
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<td>Sodium</td>
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<td>10.87</td>
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<table>
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<th>Meq/L</th>
<th>% of Tot Anions</th>
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<td>SELENIUM (TOTAL)</td>
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<td>SILVER (TOTAL)</td>
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<tr>
<td>THALLIUM (TOTAL)</td>
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(14) VANADIUM (TOTAL)
(15) ZINC (TOTAL)

ORGANIC CONSTITUENTS:
(16) ACETONE 67-64-1
(17) ACRYLONITRILE 107-13-1
(18) BENZENE 71-43-2
(19) BROMOCHLOROMETHANE 74-97-5
(20) BROMODICHLOROMETHANE 75-27-4
(21) BROMOFORM; TRIBROMOMETHANE 75-25-2
(22) CARBON DISULFIDE 75-15-0
(23) CARBON TETRACHLORIDE 56-23-5
(24) CHLOROBENZENE 108-90-7
(25) CHLOROETHANE; ETHYL CHLORIDE 75-00-3
(26) CHLOROFORM; TRICHLOROMETHANE 67-66-3
(27) DIBROMOCHLOROMETHANE; CHLORODIBROMOMETHANE 124-48-1
(28) 1,2-DIBROMO-3-CHLOROPROPANE; DBCP 96-12-8
(29) 1,2-DIBROMOETHANE; ETHYLENE DIBROMIDE; EDB 106-93-4
(30) O-DICHLOROBENZENE; 1,2-DICHLOROBENZENE 95-50-1
(31) P-DICHLOROBENZENE; 1,4-DICHLOROBENZENE 106-46-7
(32) TRANS-1,4-DICHLORO-2-BUTENE 110-57-6
(33) 1,1-DICHLOROETHANE; ETHYLIDENE CHLORIDE 75-34-3
(34) 1,2-DICHLOROETHANE; ETHYLENE DICHLORIDE 10 7-06-2
(35) 1,1-DICHLOROETHYLENE; 1,1-DICHLOROETHENE; VINYLIDEN CHLORIDE 75-35-4
(36) CIS-1,2-DICHLOROETHYLENE; CIS-1,2-DICHLOROETHENE
Appendix IB Parameters

• Total Elements Method 6010B/6020

• Volatiles
  – Method 8260B
  – Method 624

• Ask for what you want
• Communicate, communicate, communicate
Measurement and Data Acquisition

- Standard Analytical Methods allow for:
  - data comparability, reproducibility
  - understanding of its matrix behaviour
  - Specifying a method specifies complex requirements
  - matrix effects versus lab problems
Precision

“agreement among individual measurements”

absolute error (difference between replicate samples).

| pH₁ − pH₂ | = Absolute Error
| pH 10 − pH 10.5 | = 0.5 standard units
When the magnitude can affect the understanding of precision, the Relative Percent Difference ("RPD") can be employed.

The RPD is the ratio difference to the average of the two replicate samples:

\[
\text{RPD} = \left( \frac{|C_1 - C_2|}{\frac{C_1 + C_2}{2}} \right) \times 100
\]

where:

- \(C_1\) = Measured concentration of the first sample aliquot
- \(C_2\) = Measured concentration of the second sample aliquot
Precision

$$\text{RPD} = \frac{(\text{Result 1} - \text{Result 2})}{(\text{Result 1} + \text{Result 2})/2} \times 100$$

Two cases:

Case 1 - Sample 1 = 3 ppb     Sample 2 = 2 ppb
$$\text{RPD} = \frac{3 - 2}{(3+2)/2} \times 100 = \frac{1}{2.5} \times 100 = 40\%$$

Case 2 - Sample 1 = 30 ppb    Sample 2 = 29 ppb
$$\text{RPD} = \frac{30 - 29}{(30+29)/2} \times 100 = \frac{1}{29.5} \times 100 = 3.4\%$$
Accuracy

“agreement between true and measured value”

“ability to obtain the right result on a “known” sample”

Known samples = Matrix Spikes and LCSs

Accuracy reported as the “Percent Recovery”, or it can be defined as the absolute error.

\[
\text{Recovery} = \%R = \frac{C_s - C_u}{C_n} \times 100
\]

where:

- \(C_s\) = Measured concentration of the spiked sample aliquot
- \(C_u\) = Measured concentration of the unspiked sample aliquot (use 0 for the LCS)
- \(C_n\) = Nominal (theoretical) concentration increase that results from spiking the sample, or the nominal concentration of the spiked aliquot (for LCS)
good accuracy
poor precision

poor accuracy
good precision

good accuracy
good precision
• Bias and Accuracy sometimes used interchangeably

• Bias
  – Defn: consistent over/under estimation of true value due to sampling, handling, and analysis errors
QA/QC QAPP Laboratory Performance on Cadmium

100 ppb Known
DQO Approach: 3 Phases

• Planning
  - Data Quality Objectives (Why sample?)
  - Quality Assurance Project Plan (“QAPP”)

• Implementation
  - Field Data Collection (Sampling)
  - Quality Assurance/Quality Control Activities

• Assessment
  - Data Validation
  - Quality Assurance/Quality Control Activities
DQO Approach: 3 Phases

• Planning
  - Data Quality Objectives (Why sample?)
  - Quality Assurance Project Plan ("QAPP")
  - Planned Quality Assurance/Quality Control
    - Trip Blanks
    - Equipment/Decon Blanks
    - Sampling Precision – Planned duplicates
    - Control Samples (background or Upgradient Wells)
    - Material Blanks (Grout – well annular space) (Filter Pk. Screened interval)
QUALITY ASSURANCE PROJECT PLAN

for

Off the Road Landfill

Pine, Colorado

Draft Document

Prepared By:

Compliance Assistance and Technical Support Unit
Hazardous Materials and Waste Management Division
Colorado Department of Public Health and Environment
1.4.1. Quantitative Quality Assurance Objectives

<table>
<thead>
<tr>
<th>Critical Measurement</th>
<th>Matrix</th>
<th>Method</th>
<th>Reporting Units</th>
<th>PQL</th>
<th>Precision</th>
<th>Accuracy</th>
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<tbody>
<tr>
<td>Total Metals³</td>
<td>Liquid/Solid</td>
<td>6010B</td>
<td>ug/L mg/Kg</td>
<td>Method Specs</td>
<td>&lt;25 %</td>
<td>80-120</td>
</tr>
<tr>
<td>Total Mercury</td>
<td>Liquid/Solid</td>
<td>7470A/7471A</td>
<td>ug/L mg/Kg</td>
<td>Method Specs</td>
<td>&lt;35 %</td>
<td>80-120</td>
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<tr>
<td>Volatiles</td>
<td>Liquid/Solid</td>
<td>8260B</td>
<td>ug/L mg/Kg</td>
<td>Method Specs</td>
<td>&lt;20 %</td>
<td>80-110</td>
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<tr>
<td>Semi-Volatiles</td>
<td>Liquid/Solid</td>
<td>8270C</td>
<td>ug/L mg/Kg</td>
<td>Method Specs</td>
<td>&lt;40 %</td>
<td>40-140</td>
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<td>Organo Chlorine Pests/PCBs</td>
<td>Liquid/Solid</td>
<td>8181A</td>
<td>ug/L mg/Kg</td>
<td>Method Specs</td>
<td>&lt;35 %</td>
<td>60-120</td>
</tr>
</tbody>
</table>

³Precision = Relative % Difference = (Duplicate₁ - Duplicate₂) / (Duplicate₁ + Duplicate₂) x 100

²Accuracy = % Recovery of Laboratory Fortified Blank

³Total Metals = Sb, Al, As, B, Ba, Be, Cd, Co, Cu, Cr, Fe, Pb, Li, Ag, Mn, Ni, Se, Th, V, and Zn

<table>
<thead>
<tr>
<th>Supporting Measurement</th>
<th>Matrix</th>
<th>Method</th>
<th>Reporting Units</th>
<th>PQL</th>
<th>Precision</th>
<th>Accuracy</th>
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</thead>
<tbody>
<tr>
<td>Dissolved Anions⁴</td>
<td>Liquid</td>
<td>300</td>
<td>mg/L</td>
<td>Method Specs</td>
<td>&lt;30 %</td>
<td>60-120</td>
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<tr>
<td>Dissolved Cations⁴</td>
<td>Liquid</td>
<td>6010B</td>
<td>mg/L</td>
<td>Method Specs</td>
<td>&lt;30 %</td>
<td>60-120</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>Liquid</td>
<td>310.1/310.2</td>
<td>mg/l as CaCO₃</td>
<td>Method Specs</td>
<td>&lt;35 %</td>
<td>60-120</td>
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<tr>
<td>pH</td>
<td>Liquid/Solid</td>
<td>9045C</td>
<td>Standard Units</td>
<td>Method Specs</td>
<td>1 +/- 1 S.U.</td>
<td>+/- 0.5 S.U.</td>
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<td>Temperature</td>
<td>Liquid</td>
<td>Manufacturer</td>
<td>Standard Units</td>
<td>Method Specs</td>
<td>&lt; 5 %</td>
<td>95-105 %</td>
</tr>
<tr>
<td>% Lower Explosive Limit</td>
<td>Gas</td>
<td>Manufacturer</td>
<td>% LEL</td>
<td>&lt; 1 % LEL</td>
<td>Method Specification</td>
<td></td>
</tr>
</tbody>
</table>

⁴Dissolved Anions = Ca, K, Na, Mg

⁴Dissolved Cations = Sulfate, Chloride, Nitrate, Nitrite, 0-Phosphate, Fluoride

To determine if positive water samples contain contaminants at concentrations greater than the regulatory thresholds, the Practical Quantitation Limit ("PQL") for the analyte shall be used. The PQL provides a threshold, above which, there is a 95 % confidence that the analyte is present at the reported concentration. The PQL shall meet, or exceed the method specifications.
<table>
<thead>
<tr>
<th>Matrix</th>
<th>Equipment</th>
<th>Preservative</th>
<th>Hold time</th>
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<tbody>
<tr>
<td>Solid for Total Metals</td>
<td>glass/polyethylene</td>
<td>Cool 4 degrees</td>
<td>6 month</td>
</tr>
<tr>
<td>Liquid for Total Metals</td>
<td>glass/polyethylene</td>
<td>Cool 4 degrees, pH&lt; 2 with HNO₃</td>
<td>6 month</td>
</tr>
<tr>
<td>Solid for Total Mercury</td>
<td>glass/polyethylene</td>
<td>Cool 4 degrees, pH&lt; 2 with HNO₃</td>
<td>28 days</td>
</tr>
<tr>
<td>Liquid for Total Mercury</td>
<td>glass/polyethylene</td>
<td>Cool 4 degrees, pH&lt; 2 with HNO₃</td>
<td>28 days</td>
</tr>
<tr>
<td>Liquid for Volatiles</td>
<td>glass PFTE lined, 40 mL vial</td>
<td>Cool 4 degrees, Inverted vial, Segregated</td>
<td>14 days</td>
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<tr>
<td>Solid for Volatiles</td>
<td>glass PFTE lined</td>
<td>Cool 4 degrees, Segregated</td>
<td>14 days</td>
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<td>Semivolatile Organics (Liq/Sol)</td>
<td>Amber glass</td>
<td>Cool 4 degrees</td>
<td>14 days</td>
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<tr>
<td>OrganoCl Pests (Liq/Sol)</td>
<td>Amber glass</td>
<td>Cool 4 degrees</td>
<td>14 days</td>
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<tr>
<td>pH (Laboratory)</td>
<td>glass/polyethylene</td>
<td>Cool 4 degrees</td>
<td>14 days</td>
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<td>Alkalinity</td>
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<td>Dissolved Anions (Liq)</td>
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<tr>
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<td>glass/polyethylene</td>
<td>Cool 4 degrees, Lab Filtered, pH&lt; 2 HNO₃</td>
<td>6 month</td>
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</tbody>
</table>
DQO Approach: 3 Phases

• Implementation
  - Field Data Collection (Sampling)
  - Quality Assurance/Quality Control Activities
    • Blanks
    • Duplicates
    • Paperwork
    • Reports and Results
Success Equals Communication

- Lab must understand what you want
- Document your communications in writing
- Make sure the methods chosen meet DQOs
- Specify methods on Chain of Custody
- Look report over IMMEDIATELY on receipt – call if problems appear
<table>
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<tr>
<th>DATE</th>
<th>TIME</th>
<th>CLIENT ID</th>
<th>NO. OF BOTTLES</th>
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<td>6/29/01</td>
<td>0820</td>
<td>GWMW-1</td>
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<td>6/29/01</td>
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<td>GWMW-2</td>
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<td>6/29/01</td>
<td>1225</td>
<td>GWMW-4</td>
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<td>6/29/01</td>
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<td>Trip Blank</td>
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**COMMENTS**

**MEANS OF DELIVERY**
Client Sample Report

Matrix: Oil

Lab Sample Number: B0307125-01A
Prep Date: 7/22/2003
Analytical Method ID: SW8260B - VOCs by GC/MS - Oil
Prep Method ID: P&TOil
Prep Batch Number: T030724004
Report Basis: As Received
Sample prep wt./vol: 1.00 g

<table>
<thead>
<tr>
<th>Analyte</th>
<th>CASNo</th>
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<th>Flags</th>
<th>Units</th>
<th>PQL</th>
<th>MDL</th>
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<tr>
<td>Bromodichloromethane</td>
<td>75-27-4</td>
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<td>J</td>
<td>mg/Kg</td>
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<td>Bromoform</td>
<td>75-25-2</td>
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<td>mg/Kg</td>
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<td>5.0</td>
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<td>mg/Kg</td>
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<td>31</td>
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<td>Carbon Disulfide</td>
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<td>mg/Kg</td>
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<td>8.2</td>
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Surrogate

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<th>Result</th>
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<th>Units</th>
<th>PQL</th>
<th>MDL</th>
<th>Spike</th>
<th>% Recov</th>
<th>LCL</th>
<th>UCL</th>
<th>Rerun #</th>
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<tbody>
<tr>
<td>1,2-Dichloroethane-d4</td>
<td>17060-07-0</td>
<td>1,000</td>
<td></td>
<td>mg/Kg</td>
<td>200</td>
<td>20</td>
<td>1,000</td>
<td>100</td>
<td>70</td>
<td>130</td>
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<tr>
<td>Dibromofluoromethane</td>
<td>1868-53-7</td>
<td>930</td>
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<td>mg/Kg</td>
<td>40</td>
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<td>93.3</td>
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<td>p-Bromofluorobenzene</td>
<td>460-00-4</td>
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<td>47</td>
<td>1,000</td>
<td>104</td>
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<tr>
<td>Toluene D-8</td>
<td>108-88-3D</td>
<td>990</td>
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<td>mg/Kg</td>
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<td>0.0</td>
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<td>98.8</td>
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<td>130</td>
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</tbody>
</table>

Analysis Date: 7/23/2003 1:39:00PM
Instrument: MS3VOA
File Name: 03072236.D
Dilution Factor: 2,000

Prep Extract Vol: 10.00 ml
Analyst Initials: mu

Report Section: None
Client Sample Name: 3
Collection Date: 7/15/2003 2:00:00PM

Rerun #: 2
Samples were prepared and analyzed according to methods outlined in the following references:


- Methods for the Determination of Inorganic Substances in Environmental Samples, EPA/600/R-93/100, August 1993.


Problems encountered with the analyses are discussed in the following narrative.

SW8260B - VOCs by GC/MS analysis:

The method blank associated with analysis run 7/10/01 had 1.57µg/L of methylene chloride detected. Any samples that had this compound detected in them are denoted with a **B** flag. If the amount present in the sample is 10 times the amount present in the method blank, it is believed to be lab contamination. If the amount detected in the samples are above 10 times the amount detected in the method blank, it is believed to be attributed from the sample.
DATA FLAGS AND DEFINITIONS

The PQL is the Method Quantitation Limit as defined by USACE.
Reporting Limit: Limit below which results are shown as "ND". This may be the PQL, MDL, or a value between. See the report conventions below.

Result Field:
- ND = Not Detected at or above the Reporting Limit
- NA = Analyte not applicable (see Case Narrative for discussion)

Qualifier Fields:
- LOW = Recovery is below Lower Control Limit
- HIGH = Recovery, RPD, or other parameter is above Upper Control Limit
- E = Reported concentration is above the instrument calibration upper range

Organic Analysis Flags:
- B = Analyte was detected in the laboratory method blank
- J = Analyte was detected above MDL or Reporting Limit but below the Quant Limit (PQL)

Inorganic Analysis Flags:
- J = Analyte was detected above the Reporting Limit but below the Quant Limit (PQL)
- W = Post digestion spike did not meet criteria
- S = Reported value determined by the Method of Standard Additions (MSA)

Other Flags may be applied. See Case Narrative for Description
<table>
<thead>
<tr>
<th>Analyte Name</th>
<th>SampResult</th>
<th>LCSRes.</th>
<th>SDRes.</th>
<th>SPLev</th>
<th>SPDLev</th>
<th>Recov</th>
<th>SD Recov</th>
<th>RPD</th>
<th>Recov Lim</th>
<th>RPDLim</th>
<th>Flag</th>
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<tbody>
<tr>
<td>1,3-Dichloropropane</td>
<td>ND</td>
<td>0.0239</td>
<td>0.0263</td>
<td>0.0250</td>
<td>0.0250</td>
<td>95.6</td>
<td>105.2</td>
<td>9.6</td>
<td>80 - 120</td>
<td>20</td>
<td></td>
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<tr>
<td>1,2-Dibromoethane</td>
<td>ND</td>
<td>0.0275</td>
<td>0.0285</td>
<td>0.0250</td>
<td>0.0250</td>
<td>110.0</td>
<td>114.0</td>
<td>3.6</td>
<td>80 - 120</td>
<td>20</td>
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<tr>
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<td>0.0235</td>
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<td>0.0250</td>
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<td>94.0</td>
<td>0.0</td>
<td>80 - 120</td>
<td>20</td>
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<tr>
<td>Ethylbenzene</td>
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<td>0.0253</td>
<td>0.0250</td>
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<td>101.2</td>
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<td>80 - 120</td>
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<tr>
<td>1,1,1,2-Tetrachloroethane</td>
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<td>0.0250</td>
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<tr>
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<td>0.0503</td>
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<td>20</td>
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<tr>
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<td>0.0250</td>
<td>0.0250</td>
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<td>80 - 120</td>
<td>20</td>
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<tr>
<td>Styrene</td>
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<td>0.0256</td>
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<td>102.4</td>
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<td>80 - 120</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Bromoform</td>
<td>ND</td>
<td>0.0319</td>
<td>0.0335</td>
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<td>0.0250</td>
<td>127.6</td>
<td>134.0</td>
<td>4.9</td>
<td>80 - 120</td>
<td>20 high,highdup</td>
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<tr>
<td>Isopropylbenzene</td>
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<td>0.0243</td>
<td>0.0241</td>
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<td>0.0250</td>
<td>97.2</td>
<td>96.4</td>
<td>0.8</td>
<td>80 - 120</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Bromobenzene</td>
<td>ND</td>
<td>0.0245</td>
<td>0.0251</td>
<td>0.0250</td>
<td>0.0250</td>
<td>98.0</td>
<td>100.4</td>
<td>2.4</td>
<td>80 - 120</td>
<td>20</td>
<td></td>
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<tr>
<td>n-Propylbenzene</td>
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<td>0.0224</td>
<td>0.0223</td>
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<td>0.0250</td>
<td>89.6</td>
<td>89.2</td>
<td>0.4</td>
<td>80 - 120</td>
<td>20</td>
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</tbody>
</table>
# QC Recovery Report

*Work Order:* B0106354

## Prep Batch Number: B010702023

<table>
<thead>
<tr>
<th>Base Sample</th>
<th>B0106361-01D</th>
<th>Anal. Method:</th>
<th>SW6010B - ICP - Total</th>
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<tbody>
<tr>
<td>QC Sample</td>
<td>B0106361-01D-MS</td>
<td>Sample Prep Date:</td>
<td>7/2/01 12:00:00AM</td>
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<tr>
<td>QC Duplicate</td>
<td>B0106361-01D-DUP</td>
<td>Analysis Units:</td>
<td>mg/L</td>
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<td>Sample Analysis Date:</td>
<td>7/3/01 4:35:00PM</td>
<td>Matrix:</td>
<td>Aqueous</td>
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<tr>
<td>QC Sample Analysis Date:</td>
<td>7/3/01 4:43:00PM</td>
<td>QC DUP Sample Analysis Date:</td>
<td>7/3/01 4:39:00PM</td>
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### Analyte

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Samp. Result</th>
<th>Spike Result</th>
<th>Dup Res</th>
<th>Spike Conc</th>
<th>Recov</th>
<th>DUPRDP</th>
<th>DUPUCL</th>
<th>LCL</th>
<th>UCL</th>
<th>RPD</th>
<th>DUPFL</th>
<th>Rec Fl</th>
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</thead>
<tbody>
<tr>
<td>Lead</td>
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<td>0.458</td>
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<td>92</td>
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<tr>
<td>Manganese</td>
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<td>94</td>
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<td>Selenium</td>
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<td>Zinc</td>
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<td>75</td>
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<td></td>
</tr>
</tbody>
</table>
DQO Approach: 3 Phases

• Assessment
  – Data Validation
  – Quality Assurance/Quality Control Activities
Assessment and Oversight
Most Common Problems

• Detection limits
• Interfering substances
• Background contamination
• Method failure/ wrong method
• Laboratory failure to execute
• Calibration and Tuning
Data Validation and Usability
Most Common Problems

• Method/sample performance against requirements
• Sampling Bias
• Determinations of precision and accuracy
• Determinations of usability
What should you look for?

- Common Problems
- Permit or Regulatory Requirements
- Comments by the lab (Case Narrative) that may raise issues you need to consider
- QC out of limits (method blanks, LCS, matrix spikes)
- For large jobs, have at least some of the data validated independently
Much Work Remains to be Done before We Can Announce Our Total Failure to Make any Progress
• Implementation
Assessment
Lab Project Management

- Commitment to specific turn-around times?
- Detection limits meet requirements
- Specific reporting package – BATCH QC
  - Level III Report – Blanks, Precision and Accuracy determinants (Duplicates and LCS), Matrix Spikes
  - LIMS
- Written SOP's
What should you look for?

Level III Report

Blanks are “ND”, influences other than lab
(trip blanks and equipment blanks)

Good precision

Good accuracy

Influence of the matrix (MSA and/or Matrix Spikes)
How Can You Choose a Laboratory?

Follow good consumer practices and ask questions about:

- Capabilities (Do they do the methods you need?)
- Service (Provide sample kits, point of contact?)
- Quality Assurance (Can you examine their QA plan)
- Quality Control (Can you examine QC charts, data)
- Inspection (Take a look under the hood, kick the tires)
- Get a written Quotation
Tell the lab what you think

• Labs need feedback
• Do it in writing if you can – otherwise it may not get to the right person
• Do it right away
• Ask for what you want
• Communicate, communicate, communicate