



MAINTAINING DATA QUALITY INDICATORS  
THROUGHOUT THE LIFE OF A PROJECT

National Environmental Monitoring Conference

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# Agenda

SOLUTIONS YOU CAN COUNT ON. PEOPLE YOU CAN TRUST.



Communicating Data Quality



Reporting Data



Data Quality Indicators



Auditing



Storage

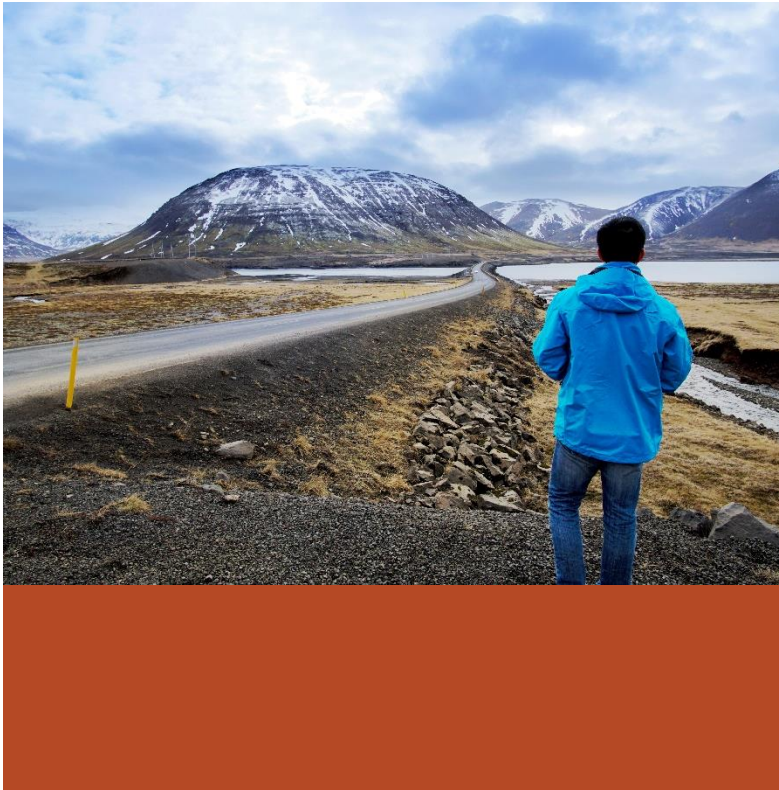


Final Thoughts

# Life of a Project



# What is the point?



- Other than the current intended purpose, how can this data be used in the future?
- What should this data NOT be used for?
- How long is the data usable for?
- What would cause this data to not be usable in the future?

# Data Quality Audience's

LABORATORY



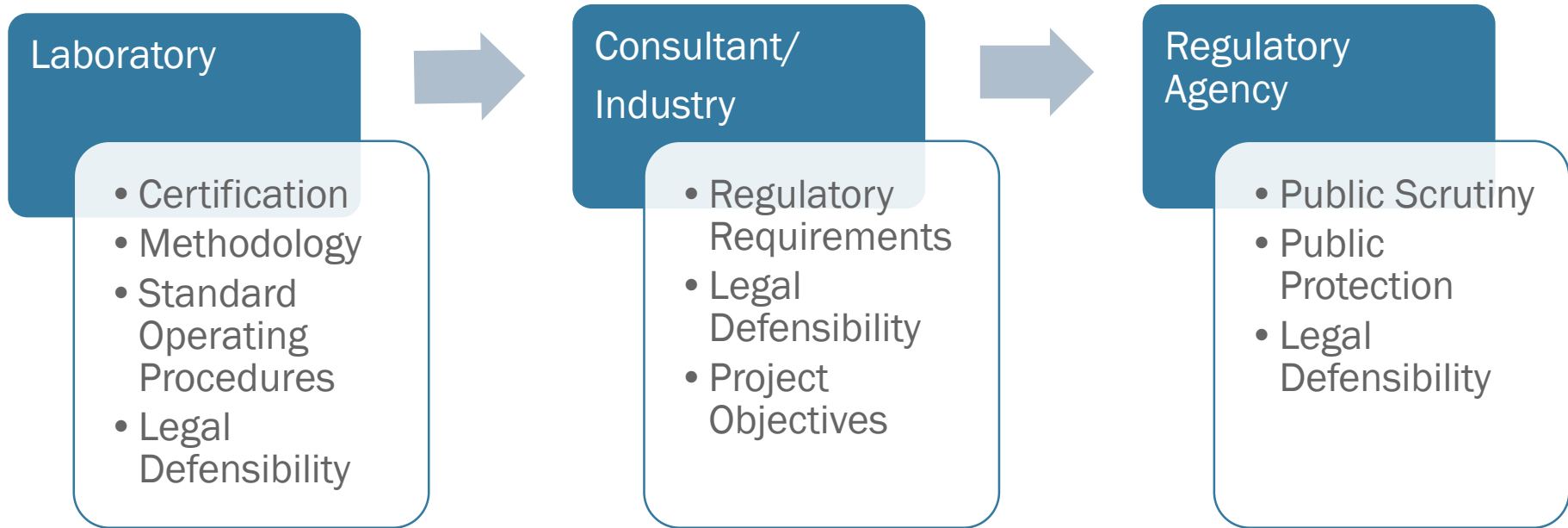
INDUSTRY



REGULATOR



# Why is Data Quality Important?



# What is Data Quality?

Definition

## EPA General Assessment Factors (EPA QA/G-4)



**Soundness:** The extent to which the scientific and technical procedures, measures, methods or models employed to generate the information are reasonable for, and consistent with, the intended application.



**Applicability and Utility:** The extent to which the information is relevant for the Agency's intended use.



**Clarity and Completeness:** The degree of clarity and completeness with which the data, assumptions, methods, quality assurance, sponsoring organizations and analyses employed to generate the information are documented.



**Uncertainty and Variability:** The extent to which the variability and uncertainty (quantitative and qualitative) in the information or the procedures, measures, methods or models are evaluated and characterized.



**Evaluation and Review:** The extent of independent verification, validation, and peer review of the information or of the procedures, measures, methods or models.

# What is Data Quality?

## Laboratory Perspective

Soundness	Data is able to meet certification and audit requirements.
Applicability/Utility	Is useable for the intended purpose. HAPPY CLIENT!
Clarity and Completeness	Easy to read and understandable.
Uncertainty and Variability	Defensible and able to meet certification and audit requirements.
Evaluation and Review	Able to pass audit requirements and be defensible for the client.





# What is Data Quality?

## Industry/Consultant Perspective

Soundness	Meet regulatory and public scrutiny
Applicability/Utility	Usable for the intended purpose.
Clarity and Completeness	Time and Budget Easy to Interpret and Use
Uncertainty and Variability	Regulatory Scrutiny Data Validation/Time and Budget
Evaluation and Review	Regulatory and Public Scrutiny Decision Making



# What is Data Quality?

REGULATOR

## Regulator Perspective

Soundness

Public Scrutiny  
Intended Use of Data

Applicability/Utility

Usability  
Current/Future Use of Data

Clarity and Completeness

Easy to Interpret and Use  
Easy to Explain

Uncertainty and Variability

Public Scrutiny  
Decision Making

Evaluation and Review

Public Scrutiny  
Decision Making



# Data Quality Indicators (DQIs)

Any information that provides an understanding of limitations on the use of data.



# Data Quality Indicator - Field

- Field collection methods (SOPs)
- Weather
- Observations
- Instrumentation logs
- Chain-of-Custody
- Location notes
- Procedure documentation
- Field Audits



# Data Quality Indicator - Lab

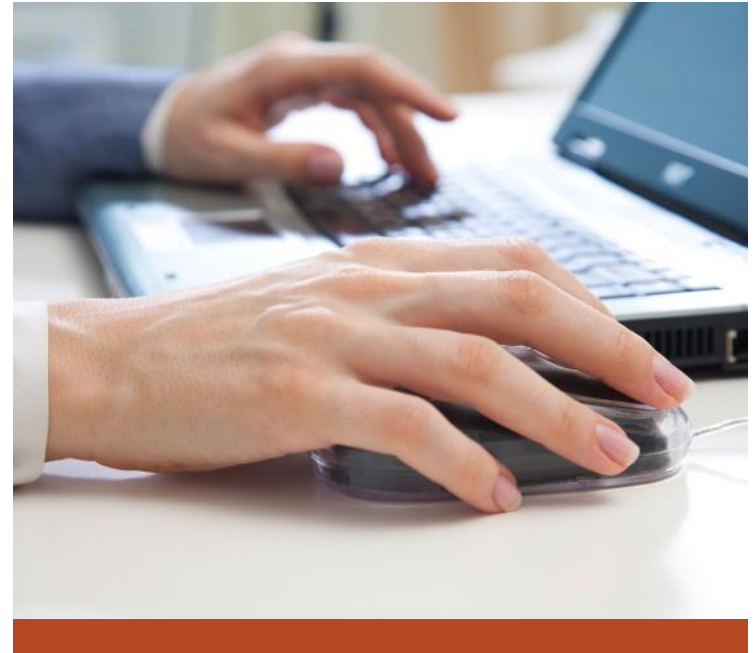
## Laboratory Report

- Control charts
- Standard Operating Procedures
- Bench Notes
- Instrument Calibration
- Qualifiers
- Audit Notes
- PT Sample Results
- Chain-of-Custody



# Data Quality Indicators - Validation

- Qualifiers
- Documentation/Notes
- Bias Indicators
- Reasons for qualification
- Reports



# What do DQI's tell me?

- What do they tell me?
  - Data Bias (J+/J-)
  - Reasons for estimated data
  - Cross Contamination (field or laboratory)
  - Calibration errors
  - Manual Corrections
  - Rejected results – not usable for the intended purpose
  - Other considerations that may affect the data like weather conditions or tampering

# Maintaining Data Quality Indicators





# Storage

- Information to store:
  - Field data
  - Field notes
  - Final signed (legal) laboratory report
  - Final chain-of-custody
  - Final EDD
  - Final data validation
  - Data qualifiers



# Storage Example

Select Site
 Requests
 My Profile
 Support
 Help
 Logout Christina

Demo Project Direct

» TRIHY

Add new Sample Delivery Group
 Save Filters
 Clear Filters
 Clear Colors
 Export to Excel

Update	View Comments	Project Event	Sample Event	SDG	Sample Date	DV Tier	Priority	EDD Received	EDD Uploaded	DV Final	DV Flags Posted	Tier I Report	DV Report	EDD	Standard Lab Report	Expanded Lab Report	Upload EDD to Database	Update	Delete
		Quarterly Monitoring	Q3	O0807024	07/14/2008			08/05/2008	08/29/2008	04/10/2012							08/29/2008		
		Quarterly Monitoring	Q3	O0807025	07/15/2008			08/05/2008	08/29/2008	09/22/2008							08/29/2008		
		Semiannual Monitoring	S1	O0810011	10/06/2008			12/10/2008	12/10/2008	12/11/2008							12/10/2008		
		Quarterly Monitoring	Q1	O0810021	10/12/2008			11/21/2008	12/10/2008	11/21/2008							12/10/2008		
		Quarterly Monitoring	Q1	O0810025	10/13/2008			11/21/2008	12/10/2008	11/21/2008							12/10/2008		
		Quarterly Monitoring	Q2	O0810026	10/14/2008			11/21/2008	12/10/2008	11/21/2008							12/10/2008		
		Quarterly Monitoring	Q2	O0810028	10/15/2008			11/21/2008	12/10/2008	11/21/2008							12/10/2008		
		Quarterly Monitoring	Q3	O0810035	10/20/2008			11/21/2008	12/10/2008	11/21/2008							12/10/2008		
		Quarterly Monitoring	Q3	O0810039	10/21/2008			11/21/2008	12/10/2008	11/21/2008							12/10/2008		
		Quarterly Monitoring	Q4	O0810040	10/22/2008			11/21/2008	12/10/2008	11/21/2008							12/10/2008		
		Quarterly Monitoring	Q4	O0810048	10/26/2008			11/21/2008	12/10/2008	11/21/2008							12/10/2008		
		Semiannual Monitoring	S2	O0901007	01/11/2009			02/02/2009	02/02/2009	02/25/2009							02/02/2009		
		Semiannual Monitoring	S2	O0901009	01/12/2009	2		02/06/2009	02/06/2009	04/10/2012							02/06/2009		
		Semiannual Monitoring	S2	O0901012	01/13/2009			02/02/2009	02/02/2009	02/25/2009							02/02/2009		
		Quarterly Monitoring	Q1	O0904021	04/06/2009	2		04/29/2009	05/29/2009	03/01/2010							05/29/2009		
		Quarterly Monitoring	Q1	O0904022	04/07/2009	2		05/01/2009	05/29/2009	04/10/2012							05/29/2009		
		Quarterly Monitoring	Q3	O0905007	05/03/2009	2		06/06/2009	06/11/2009								06/11/2009		
		Quarterly Monitoring	Q1	O0905016	05/06/2009	2		05/29/2009	05/29/2009	03/01/2010							05/29/2009		
		Quarterly Monitoring	Q1	O0905033	05/11/2009			06/15/2009	06/16/2009	06/16/2009							06/16/2009		
		Semiannual Monitoring	S1	O0905034	05/12/2009			06/15/2009	06/16/2009	06/16/2009							06/16/2009		
		Quarterly Monitoring	Q4	O0905042	05/13/2009			06/15/2009	06/16/2009	06/16/2009							06/16/2009		
		Semiannual Monitoring	S1	O0905050	05/19/2009			06/25/2009	06/25/2009	06/25/2009							06/25/2009		

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64 items in 1 pages

# Resulting Data Qualifiers

- Store qualifiers so that they are used when the data is used
- Store reasons for qualifiers with the final data records
- Make sure that end users can understand why qualifiers were added. It may affect the final use of the data



# Qualification Storage

Select Site
Requests
My Profile
Support
Help
Logout Christina

Demo Project Direct

Select SDG: 1354579
Flags
Flag Reasons
Finalize SDG

**Filters**

Analyte: Barium, Total
 Method: --ALL--
 Matrix: Water
 Field Sample: --ALL--
 Surrogate: --ALL--
 Internal Standards: --ALL--

Apply Filter
Clear Filters

**Set Flags**

Detect: J
 Non-Detect: --Select--
 Flag Reason(s): --Select--
 Preserve Lab Flags: ☐ J ☐ U

Apply Flags

	Flag	Result	Limit	MDL	Units	Field Sampled	Analyte	Method	Lab Sampled	QA Batch Id	Sample Date	Analysis Date	Reason	Lab Flag	Sample Type	Start Depth	End Depth	Dilution
<input type="checkbox"/>		1,880,000	2,000.00	700.00	ug/L	P2RI-56DF-121206	Bicarbonate	2320 B	6886350	12343003105A	12/6/2012	12/9/2012 8:14:00 AM			N	0.00	0.00	1.000000
<input type="checkbox"/>			2,000.00	700.00	ug/L	P2RI-56DF-121206	Carbonate	SM20 2320 B	6886350	12343003105A	12/6/2012	12/9/2012 8:14:00 AM		U	N	0.00	0.00	1.000000
<input type="checkbox"/>		27.10	5.00	.33	ug/L	P2RI-56DF-121206	Barium, Total	SW 6010B	6886350	1.23452E+11	12/6/2012	12/12/2012 3:22:00 PM			N	0.00	0.00	1.000000
<input type="checkbox"/>			5.00	.36	ug/L	P2RI-56DF-121206	Cadmium, Total	SW 6010B	6886350	1.23452E+11	12/6/2012	12/12/2012 3:22:00 PM		U	N	0.00	0.00	1.000000
<input type="checkbox"/>		24,800.00	200.00	64.00	ug/L	P2RI-56DF-121206	Calcium, Total	SW 6010B	6886350	1.23452E+11	12/6/2012	12/13/2012 6:01:00 PM			N	0.00	0.00	1.000000
<input type="checkbox"/>		1.50	15.00	1.10	ug/L	P2RI-56DF-121206	Chromium, Total	SW 6010B	6886350	1.23452E+11	12/6/2012	12/12/2012 3:22:00 PM		J	N	0.00	0.00	1.000000
<input type="checkbox"/>		2.80	5.00	.66	ug/L	P2RI-56DF-121206	Cobalt, Total	SW 6010B	6886350	1.23452E+11	12/6/2012	12/12/2012 3:22:00 PM		J	N	0.00	0.00	1.000000
<input type="checkbox"/>		219.00	10.00	2.10	ug/L	P2RI-56DF-121206	Copper, Total	SW 6010B	6886350	1.23452E+11	12/6/2012	12/12/2012 3:22:00 PM			N	0.00	0.00	1.000000
<input type="checkbox"/>			15.00	5.10	ug/L	P2RI-56DF-121206	Lead, Total	SW 6010B	6886350	1.23452E+11	12/6/2012	12/12/2012 3:22:00 PM		U	N	0.00	0.00	1.000000
<input type="checkbox"/>		13,400.00	100.00	60.60	ug/L	P2RI-56DF-121206	Magnesium, Total	SW 6010B	6886350	1.23452E+11	12/6/2012	12/13/2012 6:01:00 PM			N	0.00	0.00	1.000000
<input type="checkbox"/>		8,590.00	500.00	145.00	ug/L	P2RI-56DF-121206	Potassium, Total	SW 6010B	6886350	1.23452E+11	12/6/2012	12/12/2012 3:22:00 PM			N	0.00	0.00	1.000000
<input type="checkbox"/>		2,910,000	50,000.00	8,350.00	ug/L	P2RI-56DF-121206	Sodium, Total	SW 6010B	6886350	1.23452E+11	12/6/2012	12/13/2012 6:05:00 PM			N	0.00	0.00	50.000000
<input type="checkbox"/>			5.00	1.30	ug/L	P2RI-56DF-121206	Vanadium, Total	SW 6010B	6886350	1.23452E+11	12/6/2012	12/12/2012 3:22:00 PM		U	N	0.00	0.00	1.000000

# Report the Data

- Figures
- Tables
- Reports
- Appendices
- Laboratory Reports
- Data Validation report



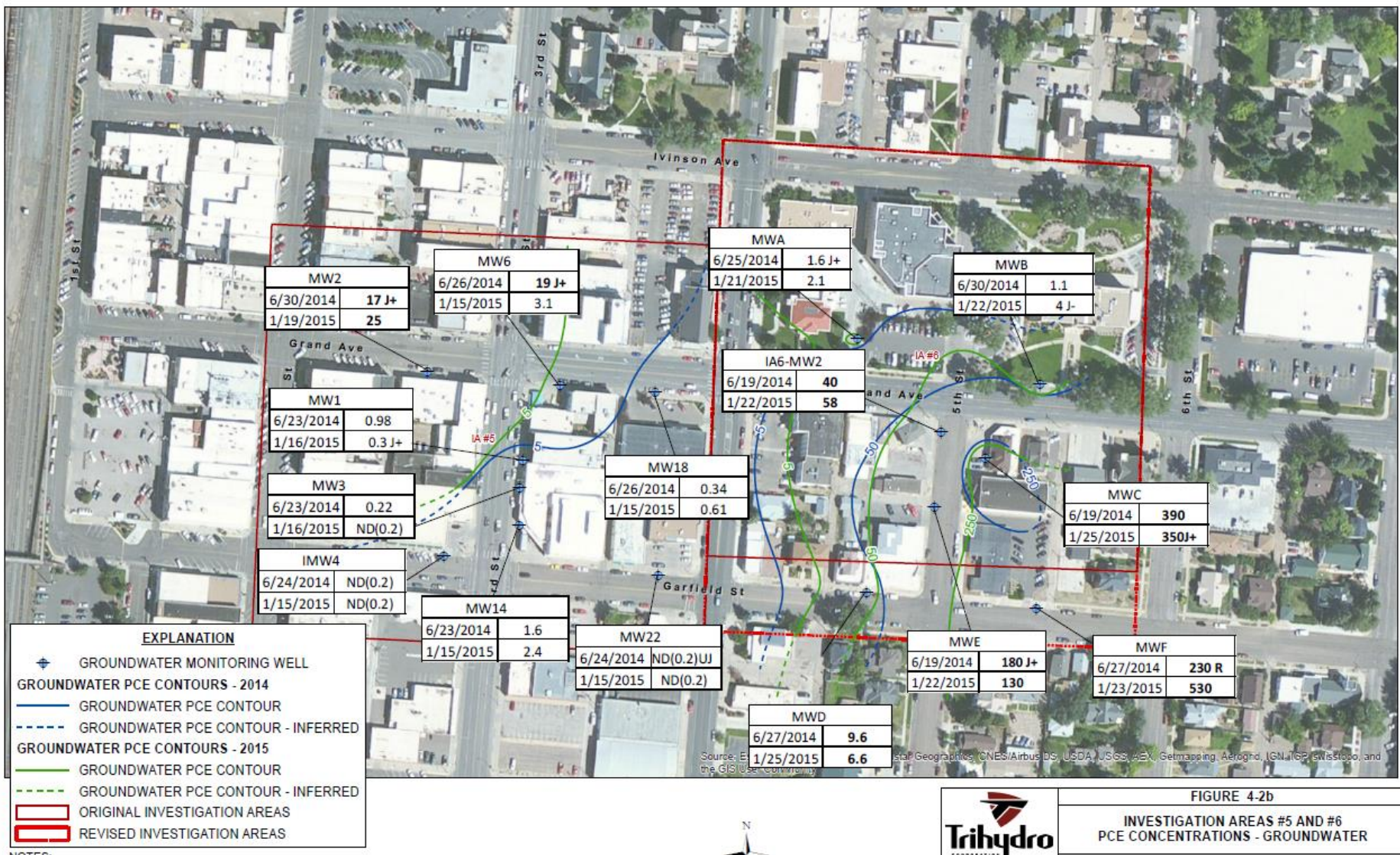


# Analytical Report

TABLE 1. EXAMPLE REPORT

Location ID	Date Sampled	Benzene (mg/L)	1,1-dimethyl- ethanol (ug/L)	Ethyl- benzene (mg/L)	MTBE (mg/L)	Naphthalene (mg/L)	Toluene (mg/L)	Gasoline Range Organics (mg/L)
MW-479	12/21/04	ND(0.005)	--	0.083	0.01	0.041	ND(0.005)	--
	05/16/05	ND(0.005)	--	0.026	ND(0.01)	0.019	ND(0.005)	--
	10/27/05	ND(0.01)	--	0.199	0.031	ND(0.02)	ND(0.01)	--
	04/18/06	ND(0.0025) UJ	--	0.088	0.021	0.045	ND(0.0025)UJ	--
	05/17/07	0.0091	--	0.24	ND(0.005)	ND(0.05)	ND(0.05)	10.2
	05/06/08	0.0027	--	0.1	ND(0.001)	0.0088	0.0036	1.5
MW-479 Dup	05/06/08	0.0028	--	0.1	ND(0.001)	0.0076	0.0031	1.6
MW-479	10/20/08	0.013	--	0.18	ND(0.002)	0.049	0.1	1.6
	04/07/09	0.017 J	--	0.37 JB	ND(0.01)	0.29 JB	ND(0.01)	9.3 JB
MW-481	10/12/93	4	--	ND(0.2)	--	--	ND(0.2)	--
	05/04/94	ND(0.002)	--	ND(0.002)	--	--	ND(0.002) R	--
	12/01/94	2	--	0.0056	--	--	0.0021	--
	11/12/98	1.95	--	0.825	--	--	0.202	--
	05/20/99	0.13	--	0.075 J+	--	--	0.07	--
	11/18/99	0.02	--	0.01	--	--	ND(0.002)	--
MW-481 Dup	06/01/00	0.113 J-	--	0.053 J	--	--	0.003	--
	06/01/00	0.132	--	0.047	--	--	0.003	--
MW-481	11/22/00	0.127	--	0.748	--	--	0.064	--
	05/22/01	0.034	--	0.024	--	--	ND(0.002) UJ	--
	12/28/01	ND(0.002)	--	ND(0.002)	--	--	ND(0.002)	--
	05/31/02	0.008	--	0.004	--	--	ND(0.002)	--
	01/03/03	ND(0.0005)	--	ND(0.0005)	--	--	ND(0.0005)	--
	10/12/93	7.1	--	0.82	--	--	0.75	--
MW-482	12/01/94	4.2	--	1.1	--	--	0.33	--
	06/17/03	0.279	--	0.346	--	--	0.0268 J-	--
	01/01/04	1.86	--	3.144	--	--	1.97	--
	06/22/04	1.246 J	--	3.626	--	--	2.148	--
	12/22/04	0.622	--	2	ND(0.044)	0.269	2.05	--
	12/22/04	0.628	--	2.06	ND(0.044)	0.326	2.06	--
MW-482 Dup	05/16/05	0.429	--	0.47	0.031	0.19	2.18 J+	--
	10/28/05	0.373 J+	--	1.5	0.043 J+	0.218	1.63	--
	04/18/06	0.277	--	2.07	0.037	0.053	1.51	--
	07/18/06	0.365	--	0.269	ND(0.005) UJ	0.312	1.986	53.4
	07/19/06	0.409	--	2.657	ND(0.005)	0.527	1.948	47
	10/10/06	0.514	--	2.454	ND(0.005)	0.53	1.83 J+	48.8
MW-482 Dup	10/10/06	0.587 J-	--	2.866	ND(0.005)	0.219	2.232	59
MW-482	05/17/07	0.161	--	0.857	ND(0.005)	0.222	0.571	23.3
Subsurface Remediation Standard		0.005	NA	0.7	0.04	0.7	1	7.3

Notes:



**FIGURE 4-2b**  
INVESTIGATION AREAS #5 AND #6  
PCE CONCENTRATIONS - GROUNDWATER

# Why Audit??

- Multiple laboratory reports and versioning
- EDDs
- Accidental change
- Validation report and flagging versioning





# How Do We Maintain Quality Over the Life of a Project?

- **COMMUNICATE:** Determine what quality data look like for your project and how is it obtained?
  - Plan for quality data (how will you communicate the quality of the data?)
  - Communicate what quality data will mean field/laboratory/consultant/etc...
  - Predict all and any potential future uses of the data (other than your current intentions)
- **STORAGE:** Keep all of the data evidence together in one place.
  - Field Notes, Data, Laboratory Reports, EDDs, etc...
- **REPORTING:** Maintain qualifications and reasons in figures and tables.

# How Do We Maintain Quality Indicators?

- **AUDITING**: Determine a method to track changes to data and files.
  - Multiple lab reports
  - EDDs
  - Unintentional Changes
  - Data Validations
- **ACCESS**: Make sure that any end-users have access to the data and the qualifications.

# Questions?

WHAT

WHY

WHERE

WHEN

WHO

HOW