DEQ
State of Oregon
Department of
Environmental
Quality

Quality Assurance: Evaluating the Quality of Data

Quality assurance is the plan/procedures for determining data quality

- Why it is important
- Reviewing your data
- Assigning Data Quality Level (DQL)
- Assign DQL’s to an example data set

Evaluating Data for Data Quality

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Evaluating the Quality of Data

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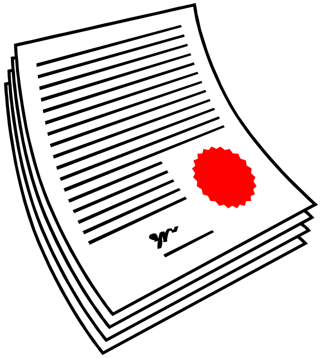
Why evaluate the quality of your data?

- Bad data = Bad decisions
  How data is used: data → information → decisions
- Credibility



- Makes your data more useful to more people
- Identify areas where additional training or new methods/equipment are needed
- Data submission to DEQ

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- Why it is important
- **Reviewing your data**
- **Assigning a DQL**
- **What to do with your DQL**

Reviewing Your Data

Completeness
Meta data, calibration, accuracy checks, results

Not Complete → Find missing pieces
Determine usefulness

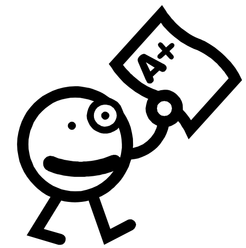
Complete

Reasonableness
Compare to historical data & normal range, professional judgment

Not reasonable → Find supporting data, add comment, discard

Reasonable

Assign Data Quality Levels using the Data Quality Matrix
Calibration records
Accuracy checks
Duplicates
Split samples



Robby the Result gets a grade!

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Data Quality Matrix (DQM) & Data Quality Level (DQL)

A way to classify data from diverse sources into one set of standard, simple, useful categories of quality.

Data Validation Criteria for Water Quality Parameters Measured in the Field

Data Quality Level	Quality Assurance Plan	Water Temperature Methods	pH Methods	Dissolved Oxygen Methods	Turbidity Methods	Conductivity Methods	Bacteria Methods	Data Uses
A+	DEQ QAPP approved by DEQ QA Officer	Thermometer Accuracy checked with NIST standards A ≤ ± 0.5°C P ≤ ± 1.5°C	Calibrated pH electrode A ≤ ± 0.2 S.U. P ≤ ± 0.3 S.U.	Winkler titration or calibrated Oxygen meter A ≤ ± 0.2 mgL^{-1} P ≤ ± 0.3 mgL^{-1}	Nephelometric Turbidity meter A ≤ ± 5% Standard value P ≤ ± 5%	Meter with temp correction to 25°C A ≤ ± 7% of standard value P ≤ ± 10%	DEQ Approved Methods Absolute difference between log-transformed values P ≤ 0.6 log	Regulatory, permitting, compliance (e.g., 303(d) and 305(b) assessments)
A	External QAPP	External Data Thermometer Accuracy checked with NIST standards A ≤ ± 0.5°C P ≤ ± 1.5°C	External Data Calibrated pH electrode A ≤ ± 0.2 S.U. P ≤ ± 0.3 S.U.	External Data Winkler titration or calibrated Oxygen meter A ≤ ± 0.2 mgL^{-1} P ≤ ± 0.3 mgL^{-1}	External Data Nephelometric Turbidity meter A ≤ ± 5% Standard value P ≤ ± 5%	External Data Meter with temp correction to 25°C A ≤ ± 7% of standard value P ≤ ± 10%	External Data DEQ Approved Methods Absolute difference between log-transformed values P ≤ 0.6 log	Regulatory, permitting, compliance (e.g., 303(d) and 305(b) assessments)
B	Minimum Data Acceptance Criteria Met	Thermometer Accuracy checked with NIST standards A ≤ ± 1.0°C P ≤ ± 2.0°C	Any Method A ≤ ± 0.5 S.U. P ≤ ± 0.5 S.U.	Winkler titration or calibrated Oxygen meter A ≤ ± 1 mgL^{-1} P ≤ ± 1 mgL^{-1}	Any Method A ≤ ± 30% P ≤ ± 30%	Meter with temp correction to 25°C A ≤ ± 10% of standard value P ≤ ± 15%	DEQ Approved Methods Absolute difference between log-transformed values P ≤ 0.8 log	Regulatory, permitting, compliance (e.g., 303(d) and 305(b) assessments) with professional judgment
C		A > ± 1.0°C P > ± 2.0°C	A > ± 0.5 S.U. P > ± 0.5 S.U.	A > ± 2 mgL^{-1} P > ± 2 mgL^{-1}	A > 30% P > 30%	A > ± 10% P > ± 15%	Absolute difference between log-transformed values P > 0.8 log	Void data. Not used for 303(d) and 305(b) assessments
D		Missing Data	Missing Data	Missing Data	Missing Data	Missing Data	Missing Data	Missing Data
E	No QAPP provided	No Precision Checks	Any Method No Precision Checks	Any Method No Precision Checks or A ≤ ± 2 mgL^{-1} P ≤ ± 2 mgL^{-1}	Any Method No precision checks	Meter without routine calibration No precision checks	Any Method No precision checks	Informational purposes only
F	See accompanying notes							

What does a data quality level (DQL) mean?

A DQL **is** a general classification of the accuracy and precision of your data.

A DQL **is not** the determinant of whether your data is useful.

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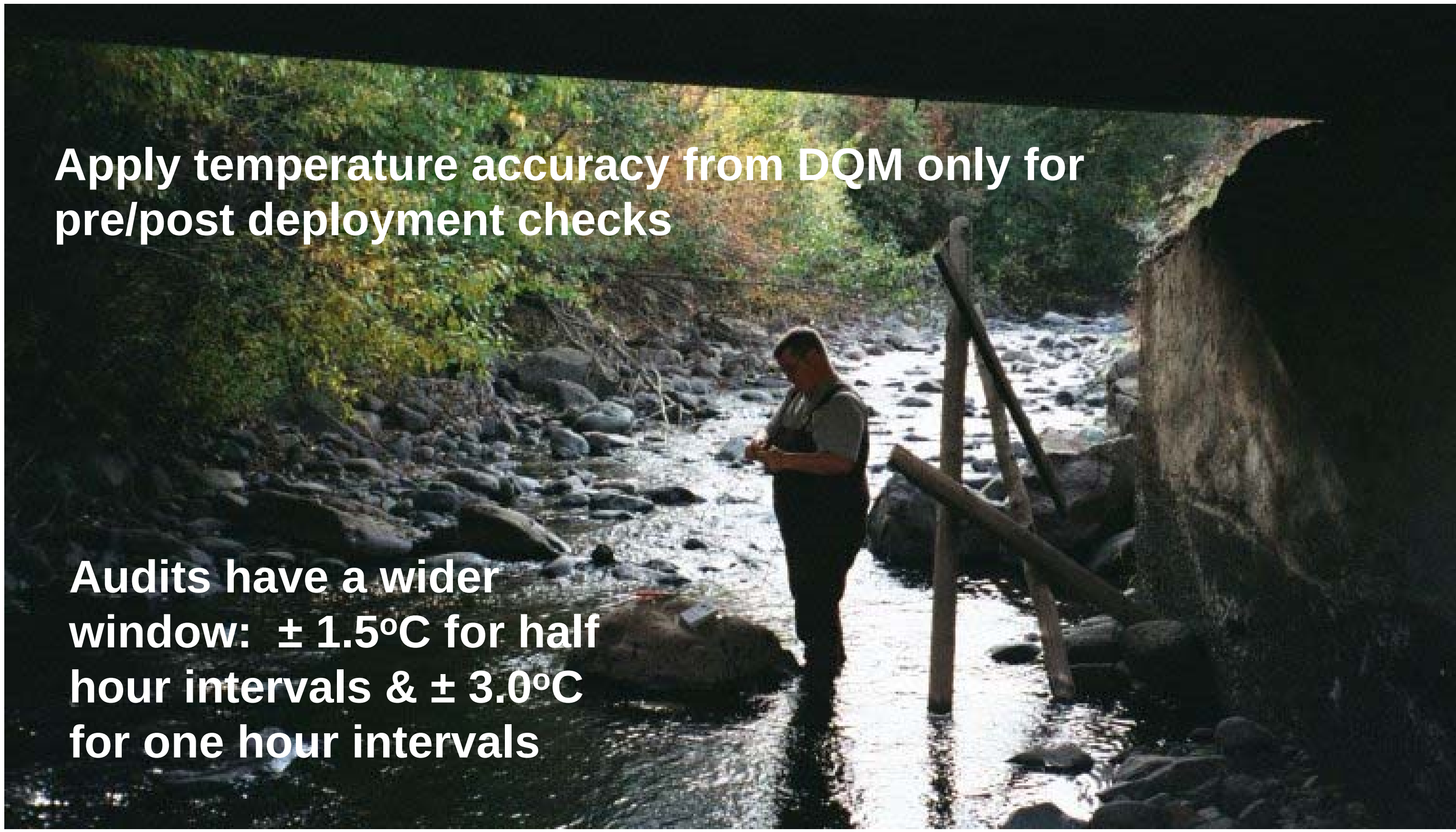
Continuous Temperature Monitors: This data follows slightly different rules.



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Assigning Data Quality Levels

Quality control results are used to determine data quality levels

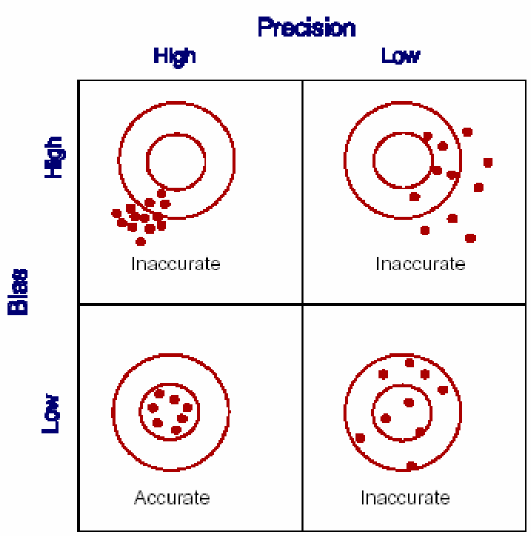
Calibration records- Verify daily calibrations and performance of meters.

Accuracy checks- organize standards checks and compare results to the **Data Quality Matrix (DQM)**

Duplicate samples- determine the difference between duplicates to assign precision and compare to the DQM

Split samples- Compare split results to determine precision and bias.

PRECISION, BIAS, AND ACCURACY



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5 Steps to Assigning Data Quality Levels to Results

1. **Confirm the Quality Assurance Project Plan was followed** and no "oddities" occurred. Check field notebook and comments.
2. **Document Calibration** for all equipment requiring regular calibration.
3. **Calculate Accuracy** by (1) calculating the difference between measured results and standards for accuracy checks before and after the time of sampling, and (2) compare the magnitude of difference to the guidelines for accuracy in the data quality matrix (DQM) to assign the appropriate accuracy data quality level.
4. **Calculate Precision** by (1) calculating appropriate differences between duplicates or split samples, and (2) compare the magnitude of the differences to the guidelines for precision in the DQM and assign the appropriate precision (DQL)
5. **Determine Overall DQL** by selecting the lower level between the accuracy and precision results.

Notes: You will only be able to do steps 3 and 4 for those sites where you have the right kind of quality control results…i.e. you can't calculate precision for a site that doesn't have a duplicate or split.

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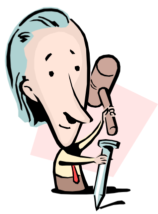

Working With Quality Control Results

To use the values for accuracy and precision ranges from the Data Quality Matrix (DQM) you need to make some basic calculations to determine how different two values are.

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<u>Absolute Difference</u>- (Temp., pH, DO, *E. coli**, and for Turbidity values less than 20 NTU's for accuracy or precision checks)

A.D. = result 1 – result 2

Note: When comparing against standards, like pH buffer, the standard value should be result 2.

Example

pH Notes
Accuracy check 06/15/03 17:35

Buffer	Temp	Reading	Theoretical	Diff
7	25.3	7.19	7.01	+0.18
10	24.9	10.01	10.05	

$$A.D. = 10.01 - 10.05 = -0.04$$

* Note: For bacteria compare the log value of the result

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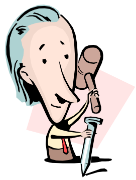

Working With Quality Control Results, cont'd

Percent Difference- (Turbidity and Conductivity accuracy checks or other lab analysis involving checks against a known, standard value)

$$P.D. = 100x\left(\frac{\text{result} - \text{standard value}}{\text{standard value}}\right)$$

Example

Conductivity Notes

Conductivity standard check 06/15/03 17:45

Standard	Temp	Reading	Difference	% Diff
146.7	17.8	150.5	+ 3.8	2.6%
1407	18.0	1447	+ 40	

$$P.D. = 100x\left(\frac{1447 - 1407}{1407}\right) = 100x\left(\frac{40}{1407}\right)$$

$$= 100x0.0284\ldots = 2.8\%$$

Relative Percent Difference- (for comparison of duplicates and split samples of turbidity and conductivity as well as many lab test results)

$$R.P.D. = 100x\left(\frac{\text{result 1} - \text{result 2}}{\text{average of result 1 \& result 2}}\right)$$

Example

Turbidity Results

Turbidity duplicate 11/12/03

Site	Time	Turbidity
1C	11:25	25 NTU
1C (dup)	11:26	28 NTU

$$R.P.D. = 100x\left(\frac{28 - 25}{\frac{28 + 25}{2}}\right) = 100x\left(\frac{3}{26.5}\right)$$

$$= 100x0.1132\ldots = 11\%$$

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Spreading Your Quality Control Results

Data quality levels are “spread” to cover all the data from a day*.

Accuracy for each parameter should be available for the beginning and end of the day, the lowest accuracy DQL is assigned to the entire day.

Precision should be measured once a day at a single site. This precision result is then applied to all the data that day.

Example: *pH accuracy checks*

Morning 8:05 6/15/03

Buffer	Temp	Reading	Theoretical	Diff.	DQL
7	17.8	7.02	7.04	-0.02	A
10	18.0	10.06	10.08	-0.02	A

Evening 18:30 6/15/03

Buffer	Temp	Reading	Theoretical	Diff.	DQL
7	26.3	7.22	7.01	+0.21	**B**
10	26.5	10.12	10.00	+0.12	A

All pH Data for 6/15/03 assigned a B data quality level.

Example: *Conductivity duplicates*

Stream sampling 6/15/03

Station	Time	Temp(C).	Cond	Turb		pH	D.O.
Cow 1	08:50	15.4	152	3		7.6	6.9
Cow 2a	**09:45**	**15.8**	**149**	**39**		**7.7**	**9.2**
Cow 2b duplicate	**09:46**	**15.7**	**151**	**41**		**8.1**	**9.7**
Cow 3	10:30	16.5	149	2	4	7.7	10.1
Cow 4	11:15	17.4	154	4	6	7.8	10.8

Precision:
Temp→ A
D.O. → A
Cond → A
Turb → A
pH → B

* This is the general method for applying quality control results. Alternative methods may work better for a specific program.

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For more information contact:

Steve Hanson
Volunteer Monitoring Coordinator
ODEQ Laboratory Division
2020 SW 4th Ave.
Portland, OR 97201
503.229.5449
hanson.steve@deq.state.or.us