Data Analysis and Attainment Assessment

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Tribal Clean Water Section

*Note these slides have been adapted from a larger set for timing and content purposes. For full original slides, visit https://www7.nau.edu/itep/main/Conferences/confr_tlef19_pres.

Learning Objectives

- Introduce basic approaches of assessing data for specific water quality parameters against typical criteria
- Learn how to interpret data for attainment decisions using an example waterbody
- Receive tips and tools for doing assessments

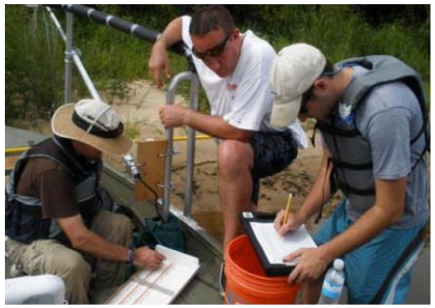
Bottom Line in Assessing Data Quality

- Identify the data being considered for use
  - Tribal (primary)
  - Non-tribal (secondary)
- Collect information on how the data was produced (Sample collection, analysis, reporting procedures)
- Review data quality guidance used in producing the data (e.g. QAPP)
- Screen the data for obvious problems
  - Poor documentation of procedures
  - Values below detection limits, significant outliers, etc.
- Evaluate the usefulness of the data
- Document justifications for data use/non-use

Which datapoints need further review?

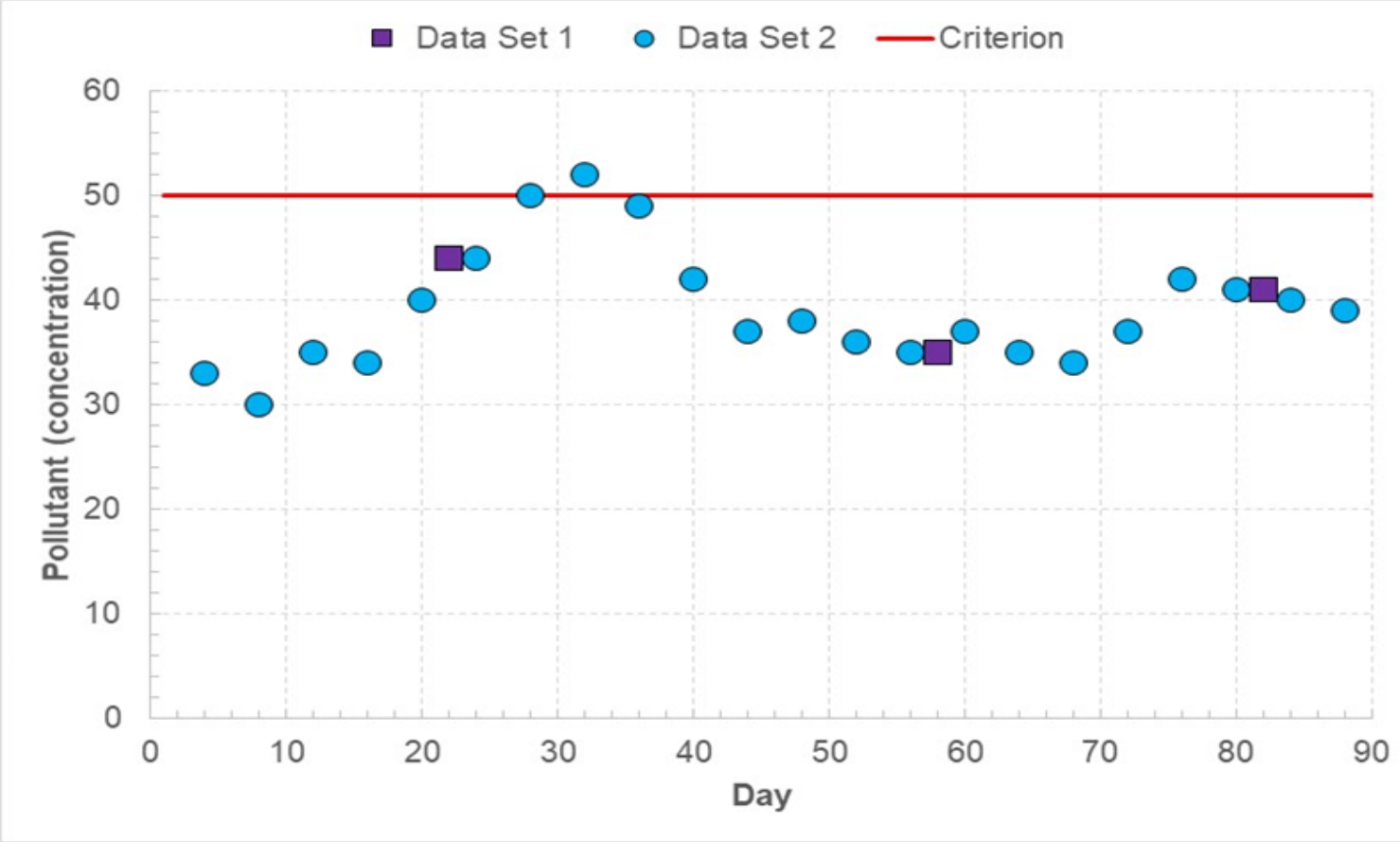
Date	pH (standard units)	Field comment
June 1	6.9	Cloudy
June 14	7.1	
June 23	6.8	Sunny but cool
July 8	5.2	
July 15	7.1	Windy
July 20	7.1	
July 29	7.0	Overcast
August 2	6.9	
August 8	6.8	No pH 7 calibration solution
August 16	7.1	
August 23	8.2	Drizzling
August 31	7.2	

Considerations for Sample Size



- **Sample size should target research questions**:
  - Types of waterbodies to be assessed
  - High/low flow conditions to be considered
  - Parameters of interest & seasonality
- **Number of samples to be taken**
  - A few data points—a greater chance that exceedances will be missed
  - An entire season of data—better coverage, a greater chance that an exceedance will be captured
  - Cost – what your budget is for collecting and processing samples
- **Check your WQS to make sure you have the minimum number of samples**
  - Support / Non-support decisions are based on the WQS
  - Note: Not meeting minimum sample size does not always mean you can't make a decision

Sample Size Example



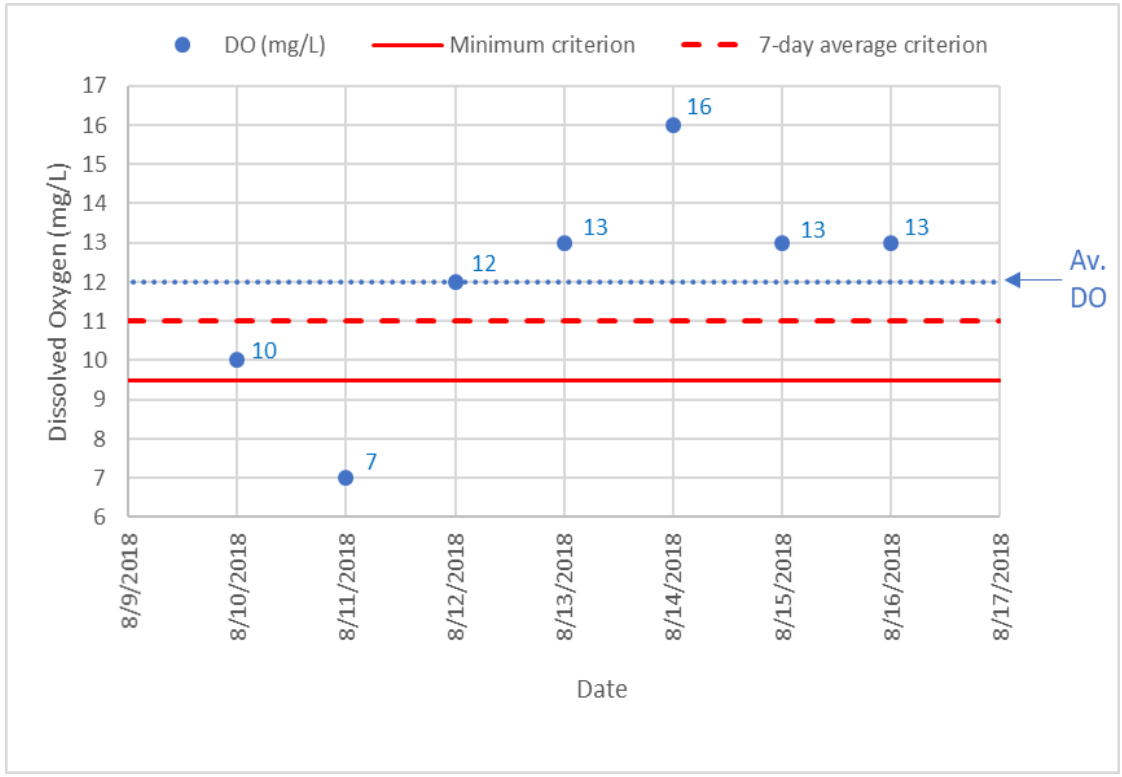
Analysis of Conventional Pollutants

- DO, pH, temperature, turbidity, conductivity
- Relatively easily to measure

https://www.fondriest.com/environmental-measurements/measurements/measuring-water-quality/dissolved-oxygen-sensors-and-methods/

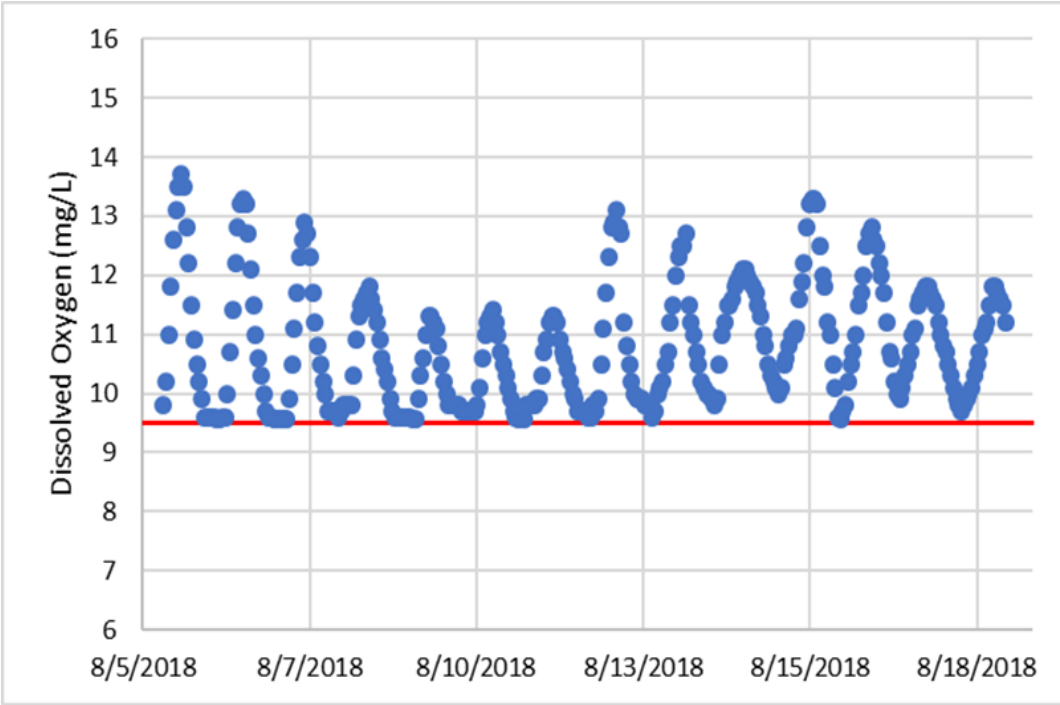
Dissolved Oxygen Assessment

- Salmon and trout spawning water
  - 7-day average of the daily mean dissolved oxygen: 11 mg/L
  - Minimum: 9.5 mg/L
- 7-day average: 12.3 mg/L
- Range 7-16 mg/L



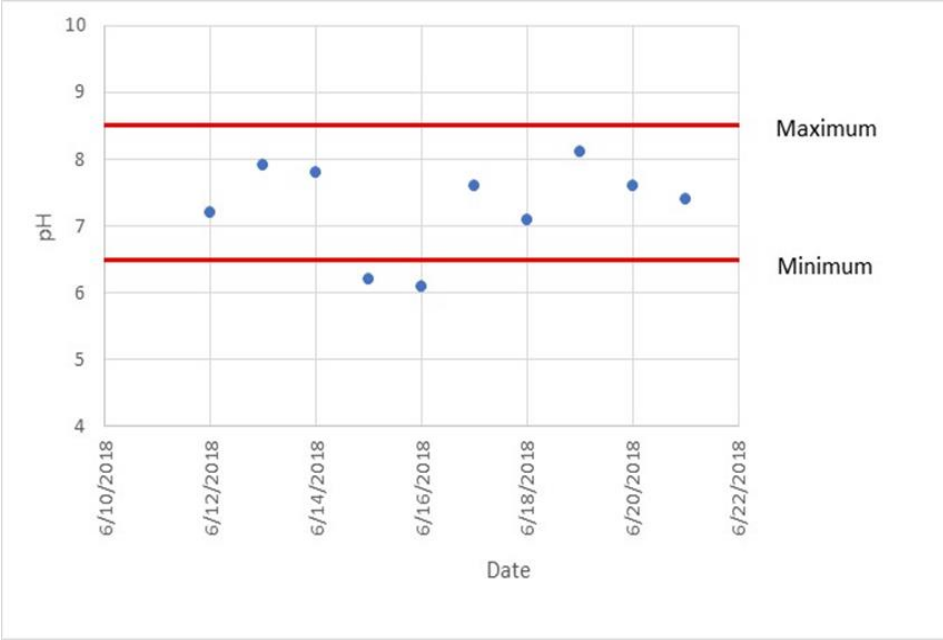
Dissolved Oxygen Assessment

- Salmon and trout spawning water criteria
  - 7-day average of the daily mean dissolved oxygen: 11 mg/L
  - Minimum: 9.5 mg/L



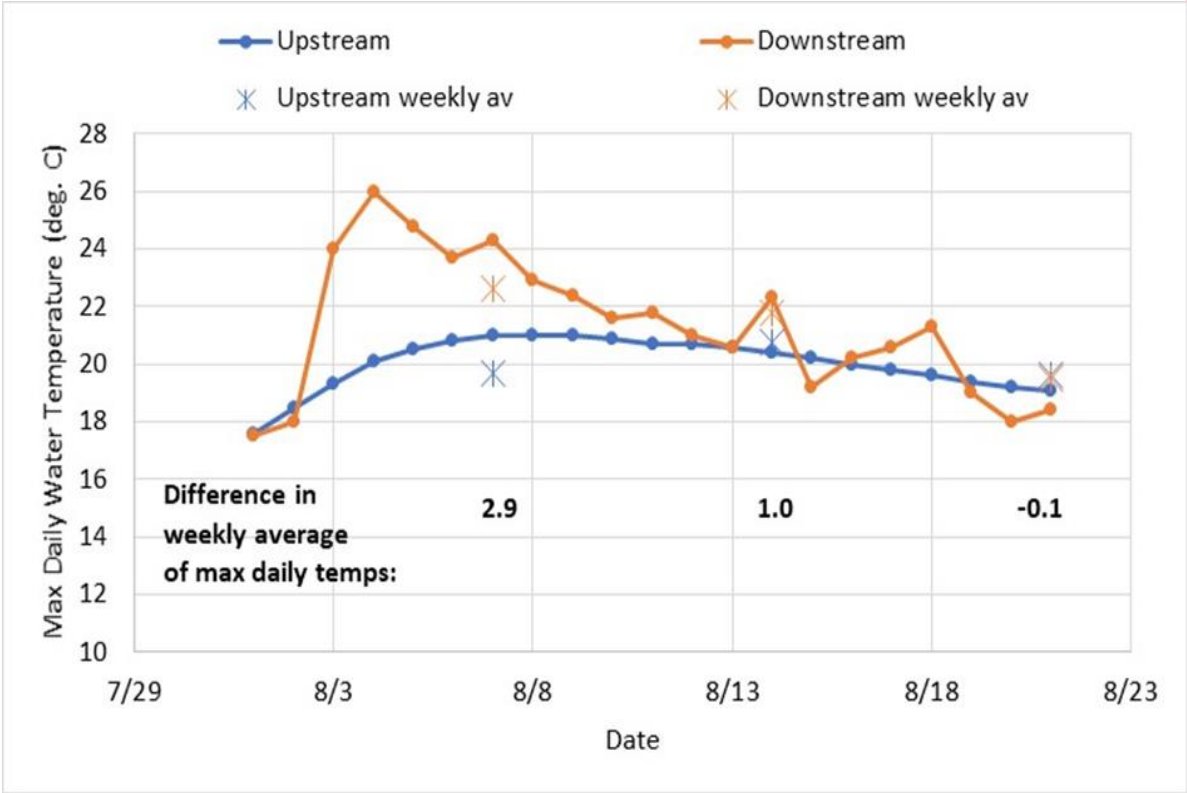
pH Criteria

- A measure of acidity and alkalinity of the water
- Criteria require keeping pH within a specific range
  - To protect human health, the pH must be within the range of 5 to 9
  - To protect aquatic life, the pH must be within the range of 6.5 to 9.0 for freshwater and 6.5 to 8.5 for saltwater



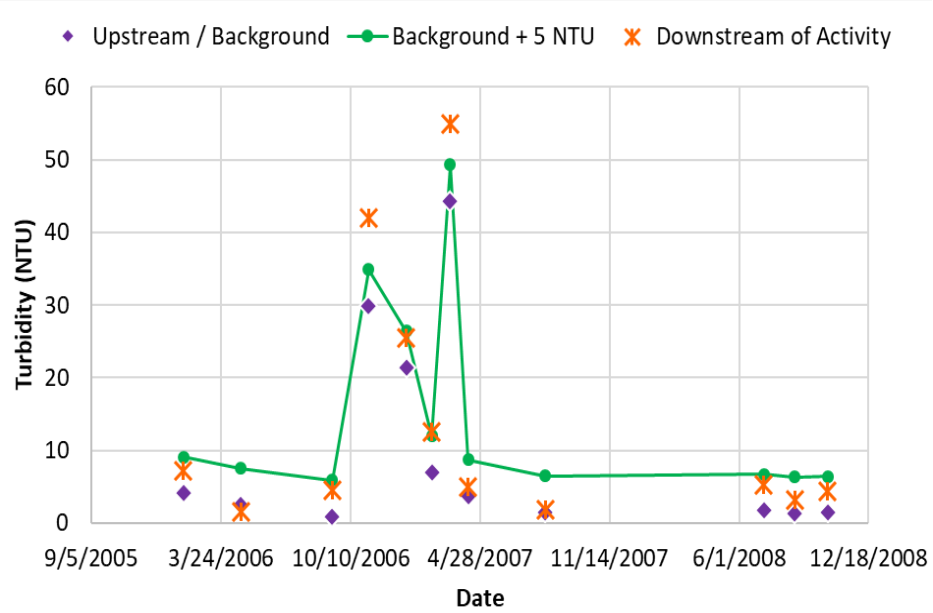
Temperature Example

"No increase in the weekly average of the maximum daily temperature between upstream/ downstream locations that is greater than 2.7° C"



Turbidity: Increase over Background Turbidity Example

- Pueblo of Sandia: “Turbidity shall not exceed 5 NTU over background when background turbidity is 50 NTU or less, with no more than a 10 percent increase when background turbidity is more than 50 NTU. Background turbidity shall be measured at a point immediately upstream of the turbidity-causing activity.”
- Note conditions when criteria is exceeded



Analysis of Biological Parameters

- Macroinvertebrates
- Fish
- Algae
- Habitat
- Trophic state
- Culturally important species (wild rice, salmon, cattails)

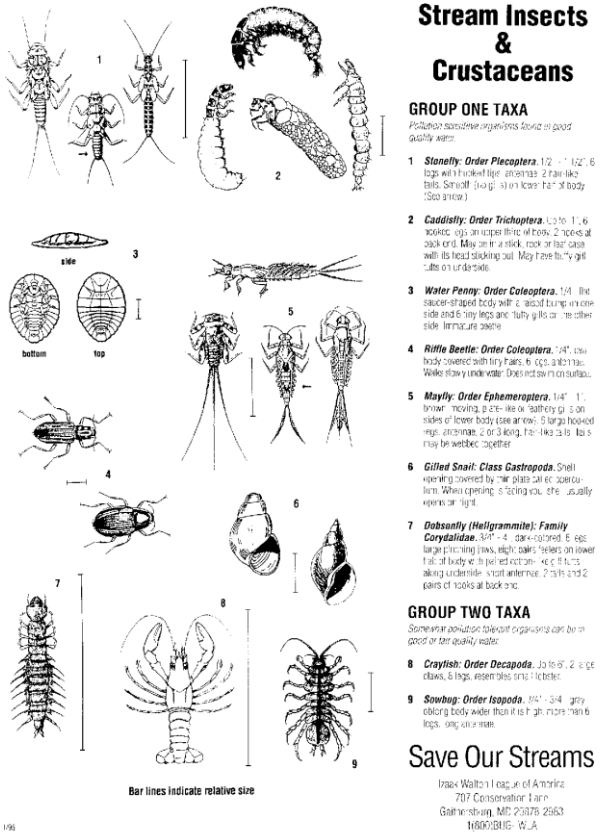
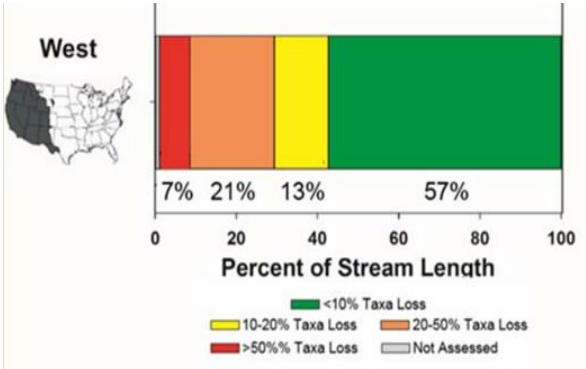


FIG. 1. Save Our Streams organism card. (Reprinted by permission of the Izaak Walton League of America, Gaithersburg, Maryland.)

Macroinvertebrate Multi-Metric Index (MMI)

- Taxonomic richness — number of families or genera within different taxonomic groups
- Taxonomic composition — proportional abundance of certain taxonomic groups
- Taxonomic diversity — distribution of the number of taxa and the number of organisms
- Feeding groups — distribution of filterers, scrapers, grazers, and predators
- Habits/habitats — distribution of macros by how they move and where they live
- Pollution tolerance — distribution of macros by the range of contamination they can tolerate

Find the NARS ecoregional index for your ecoregion at https://www.epa.gov/sites/production/files/2016-03/documents/nrsa_0809_march_2_final.pdf



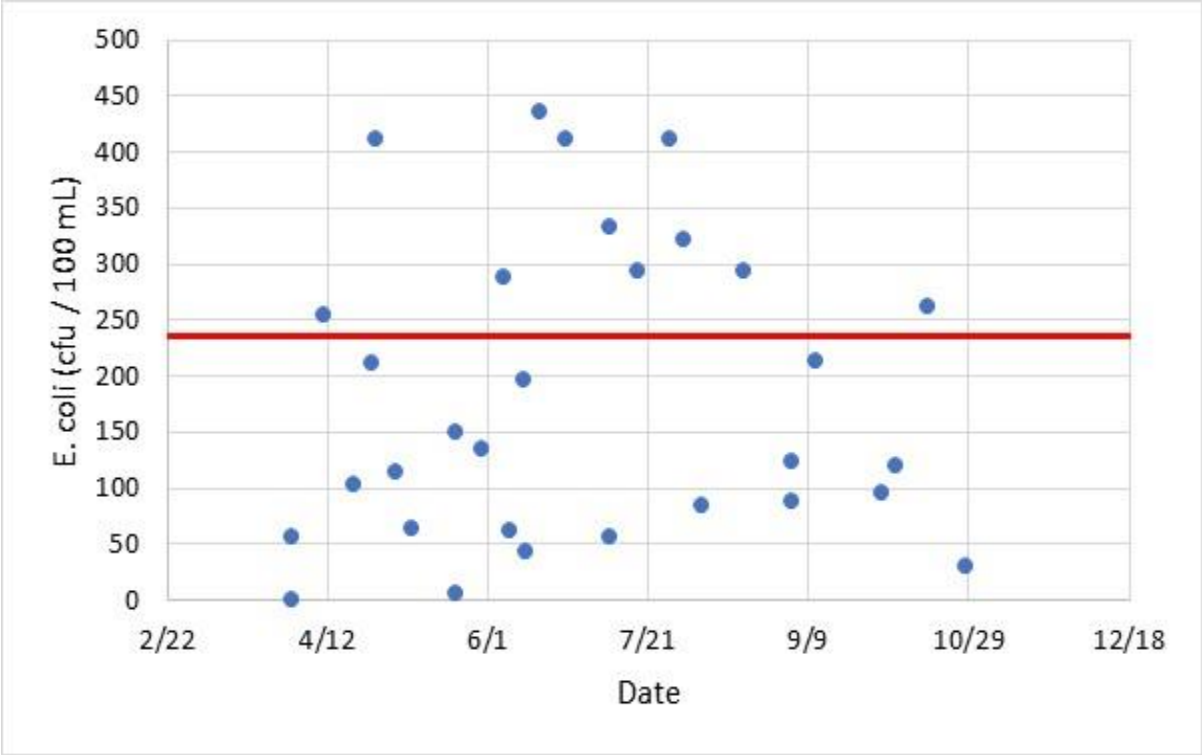
Analysis of Pathogen Parameters: *Escherichia coli* (*E. coli*) and Enterococci

- Geometric mean
- Navajo Tribe *E. coli* criterion: 126 cfu/100 mL as a geometric mean, minimum of 4 samples in 30 days

Month	Monthly Geometric Mean	# of Samples
Apr	71	6
May	62	5
Jun	174	6
Jul	218	4
Aug	199	3
Sep	133	3
Oct	98	4

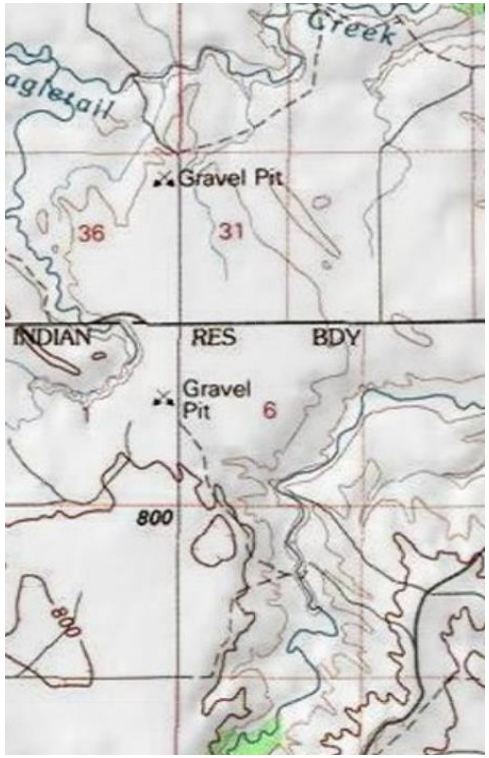
E. coli: Averaging Period and Recurrence Interval

- Single sample maximum
- Navajo Tribe *E. coli* criterion: 235 cfu/100 mL
- 11 out of 31 samples, or 35%, are greater than 235



Making Designated Use Impairment Decisions: Hypothetical Example and Exercise

- Assess water quality at a hypothetical site: Salamander Creek
- Identify the designated uses
- Identify the water quality criteria parameters needed to evaluate each designated use
- Apply the criteria to the water quality data to make a use impairment decision
- Integrate the impairment information into an assessment
- Discuss next steps based on assessment findings



Salamander Creek: Numeric Criteria

Salamander Creek is designated for four uses that have the following numeric criteria:

Parameter	Unit	Type	Statistic	Exceedance	Aquatic Life Other Than Fish	Irrigation Water Supply	Public Drinking Water Source	Warmwater Habitat
Conductivity	uS/cm	Max	Instantaneous	10%	750	2,500	1,000	1,500
Dissolved oxygen	mg/L	Min	Instantaneous	None	5.0	--	--	5.0
Nitrate	mg/L	Max	Average*	None	1.5	100	10*	1.0
pH	SU	Range	Instantaneous	None	6.5<pH<9	--	--	6.5<pH<9
Total phosphorus	mg/L	Max	Average	None	0.1	--	--	0.3

** The nitrate criterion is instantaneous for the public drinking water source.*

Salamander Creek: Aquatic Life Other Than Fish

Aquatic life other than fish has five numeric criteria

Parameter	Unit	Type	Stat.	Exceed.	Criterion
Cond.	uS/cm	Max	Inst.	10%	750
DO	mg/L	Min	Inst.	None	5.0
Nitrate	mg/L	Max	Avg	None	1.5
pH	SU	Range	Inst.	None	6.5 – 9.0
TP	mg/L	Max	Avg.	None	0.1

Ten samples were collected and evaluated

Explicit Value = actual number/magnitude

Date	Cond. (uS/cm)	DO (mg/L)	Nitrate (mg/L)	pH (SU)	TP (mg/L)
May 23	600	10	0.8	7.1	0.08
Jun 9	800	9	0.9	7.0	0.09
Jun 24	1,000	10	1.2	7.0	0.14
Jul 1	600	10	1.6	6.9	0.15
Jul 15	575	9	1.8	6.8	0.19
Jul 29	550	7	1.3	6.7	0.23
Aug 6	450	6	1.7	6.8	0.29
Aug 15	750	6	1.9	6.7	0.32
Aug 23	1,600	7	1.3	6.8	0.35
Sep 3	950	6	0.9	6.9	0.30

Salamander Creek: Irrigation Water Supply

Irrigation water supply has two numeric criteria

Parameter	Unit	Type	Stat.	Exceed.	Criterion
Cond.	uS/cm	Max	Inst.	10%	2,500
Nitrate	mg/L	Max	Avg	None	100

Ten samples were collected and evaluated

Explicit Value = actual number/magnitude

Date	Cond. (uS/cm)	DO (mg/L)	Nitrate (mg/L)	pH (SU)	TP (mg/L)
May 23	600	10	0.8	7.1	0.08
Jun 9	800	9	0.9	7.0	0.09
Jun 24	1,000	10	1.2	7.0	0.14
Jul 1	600	10	1.6	6.9	0.15
Jul 15	575	9	1.8	6.8	0.19
Jul 29	550	7	1.3	6.7	0.23
Aug 6	450	6	1.7	6.8	0.29
Aug 15	750	6	1.9	6.7	0.32
Aug 23	1,600	7	1.3	6.8	0.35
Sep 3	950	6	0.9	6.9	0.30
Avg	***788***	***8***	***1.3***	***6.9***	***0.21***

Salamander Creek: Use Support Summary

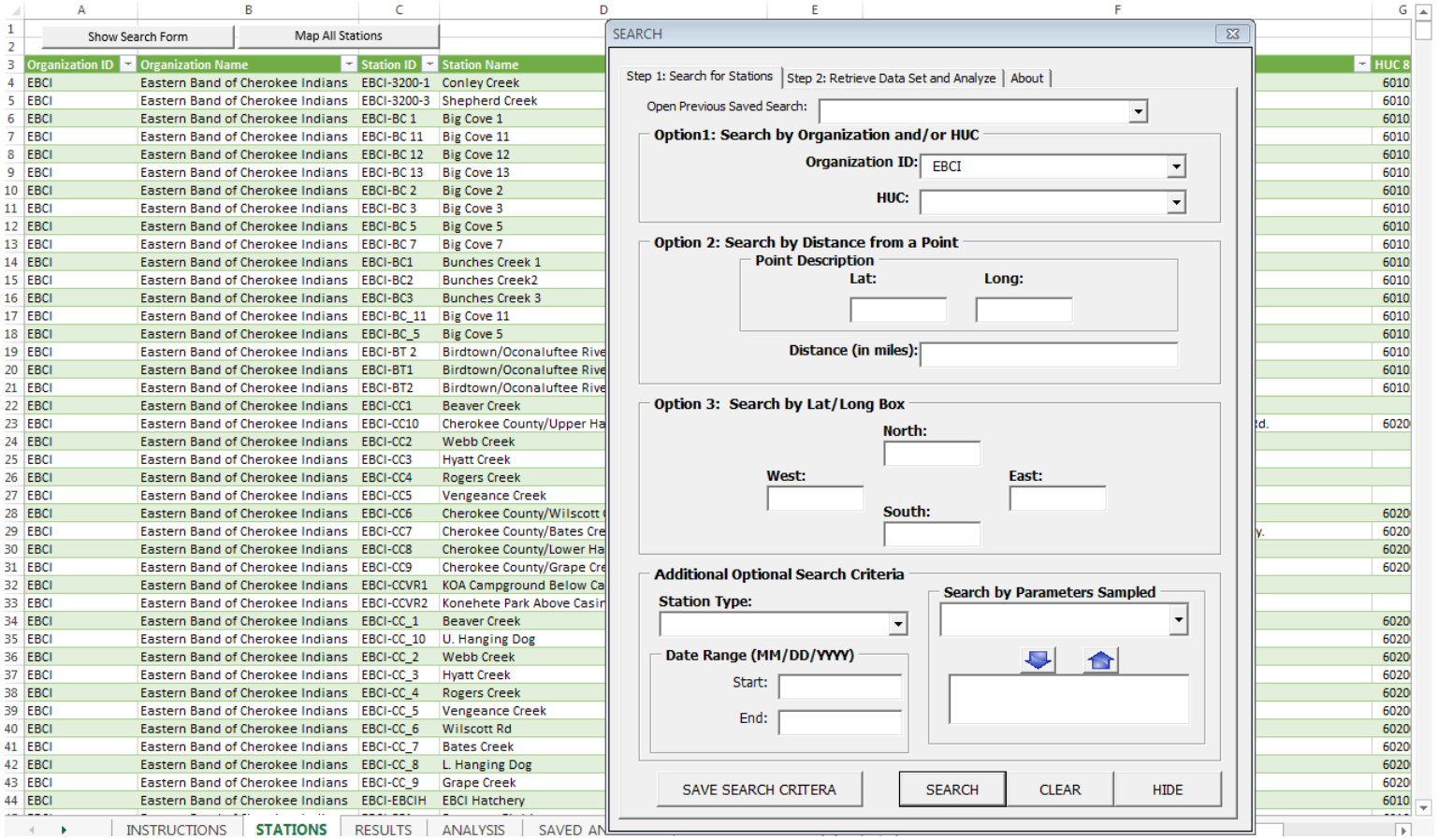
Designated Use	Use Support	Probable Cause of Impairment
Aquatic Life Other Than Fish	Not Supporting	Conductivity and Total Phosphorus
Irrigation Water Supply	Fully Supporting	--
Public Drinking Water Supply	Fully Supporting	--
Warmwater Habitat	Not Supporting	Nitrate

What might be the next steps?

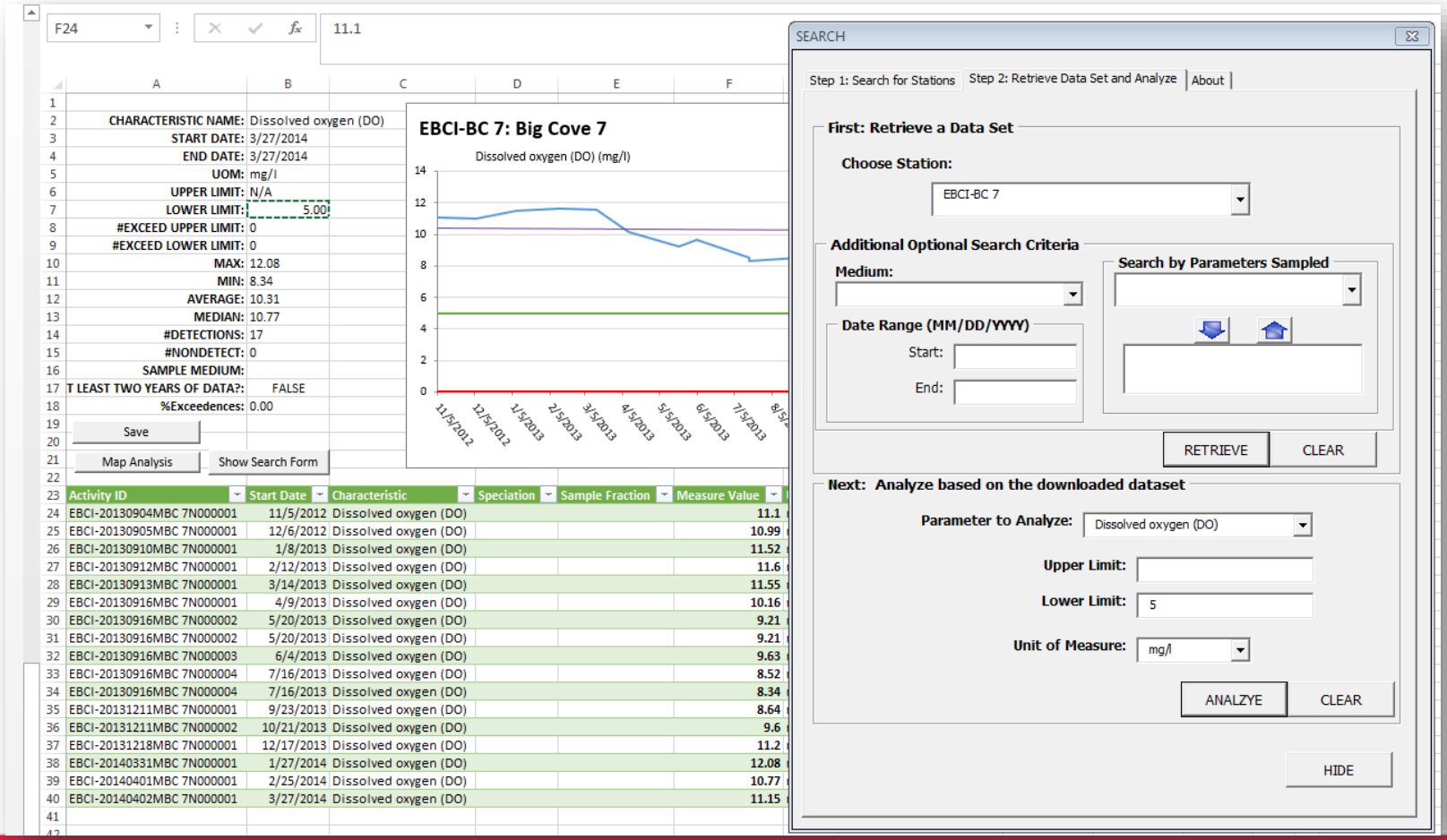
- Two waterbody uses were not met:
  - **Aquatic Life Other Than Fish** – Conductivity and total phosphorus criteria were not met
  - **Warmwater Habitat** – Nitrate criterion was not met
- What should the tribe consider as next steps for:
  - Monitoring strategy – Any changes/refinements needed?
  - Assessing impairment parameters – What should they look for?

EPA Tools for Water Quality Data Assessment

WQX Excel Data Analysis Tool



WQX Excel Analysis Tool

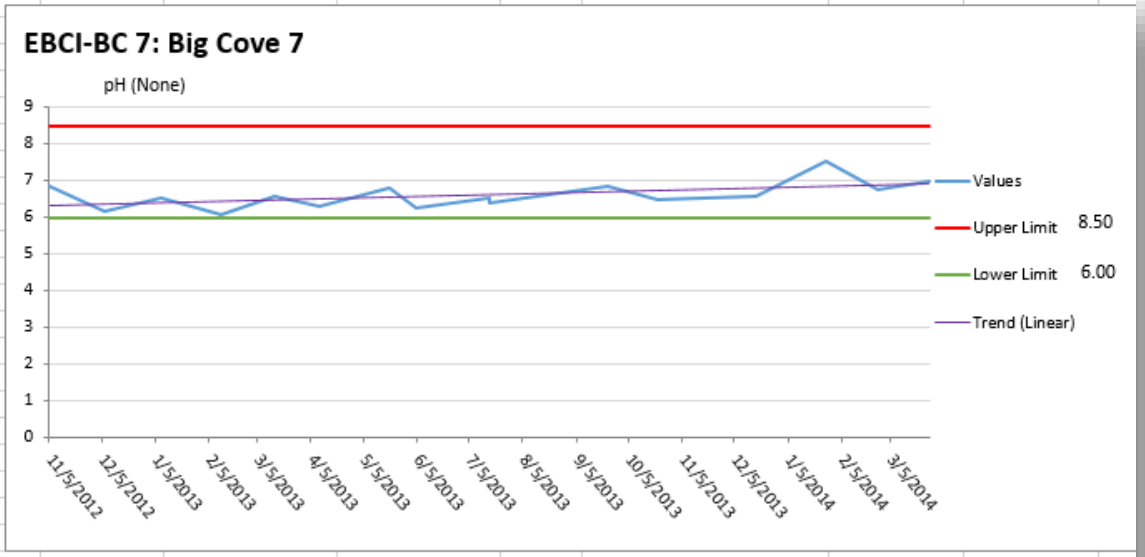


WQX Excel Data Analysis Tool

CHARACTERISTIC NAME:	pH
START DATE:	3/27/2014
END DATE:	3/27/2014
UOM:	None
UPPER LIMIT:	8.50
LOWER LIMIT:	6.00
#EXCEED UPPER LIMIT:	0
#EXCEED LOWER LIMIT:	0
MAX:	7.52
MIN:	6.07
AVERAGE:	6.607647059
MEDIAN:	6.55
#DETECTIONS:	17
#NONDETECT:	0
SAMPLE MEDIUM:	
T LEAST TWO YEARS OF DATA?:	FALSE
%Exceedences:	0.00

Save

Map Analysis | Show Search Form



Activity ID	Start Date	Characteristic	Speciation	Sample Fraction	Measure Value	Units	Detection Condition Text	Upper Limit	Lower Limit
EBCI-20130904MBC 7N000001	11/5/2012	pH			6.85	None		8.50	6.00
EBCI-20130905MBC 7N000001	12/6/2012	pH			6.18	None		8.50	6.00
EBCI-20130910MBC 7N000001	1/8/2013	pH			6.51	None		8.50	6.00
EBCI-20130912MBC 7N000001	2/12/2013	pH			6.07	None		8.50	6.00
EBCI-20130913MBC 7N000001	3/14/2013	pH			6.56	None		8.50	6.00
EBCI-20130916MBC 7N000001	4/9/2013	pH			6.31	None		8.50	6.00
EBCI-20130916MBC 7N000002	5/20/2013	pH			6.81	None		8.50	6.00
EBCI-20130916MBC 7N000002	5/20/2013	pH			6.81	None		8.50	6.00
EBCI-20130916MBC 7N000003	6/4/2013	pH			6.23	None		8.50	6.00

Questions?

Contact Information:

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FAQ: How to do a moving average in excel?