



# 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](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?

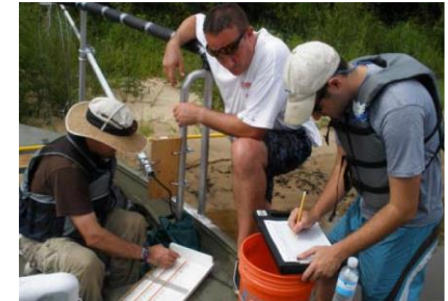
Date	pH (standard units)	Field comment
June 1	6.9	Cloudy
June 14	7.1	
June 23	6.8	Sunny but cool
July 8	5.2	
July 15	7.1	Windy
July 20	7.1	
July 29	7.0	Overcast
August 2	6.9	
August 8	6.8	No pH 7 calibration solution
August 16	7.1	
August 23	8.2	Drizzling
August 31	7.2	





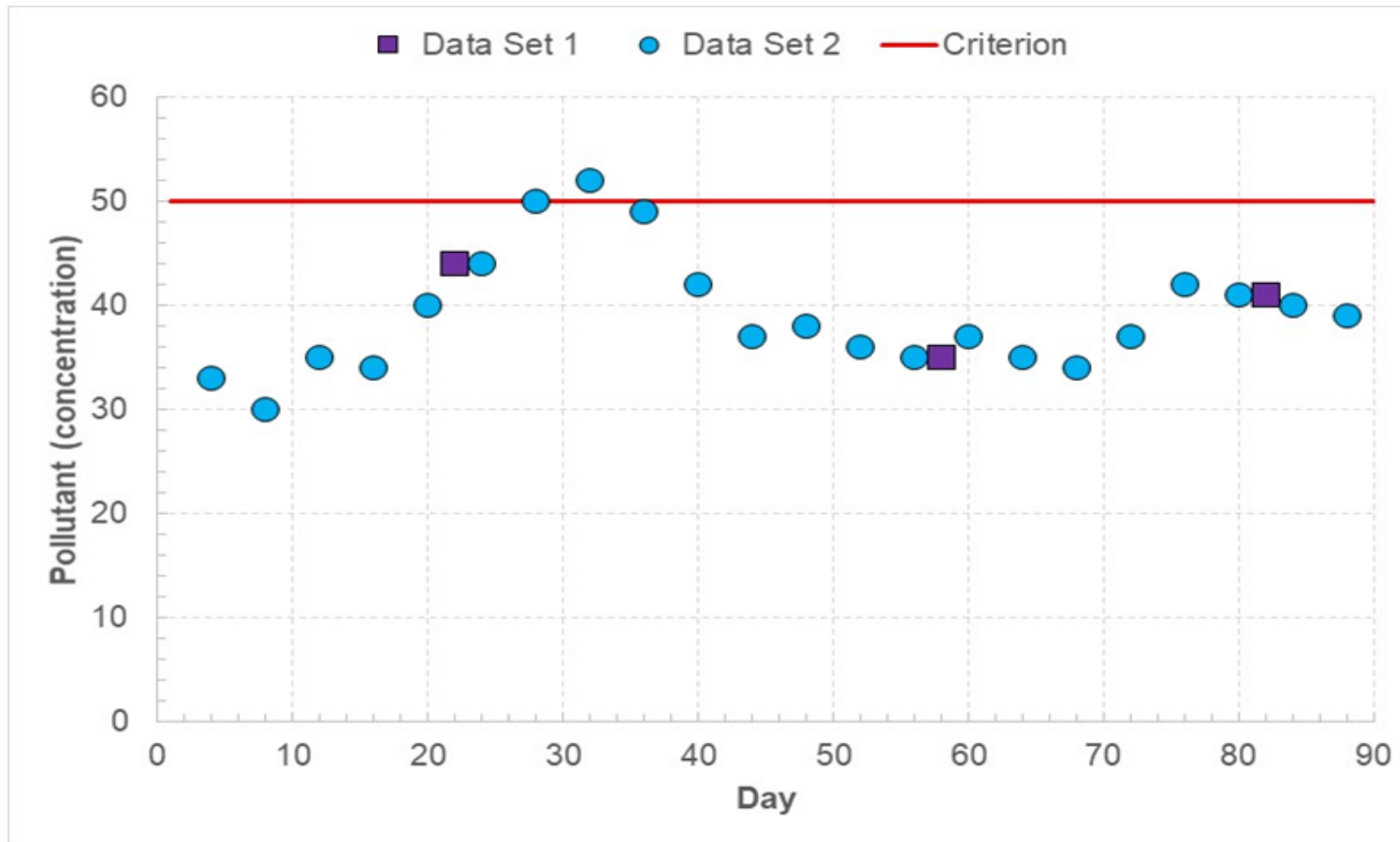
# Considerations for Sample Size

- **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/>

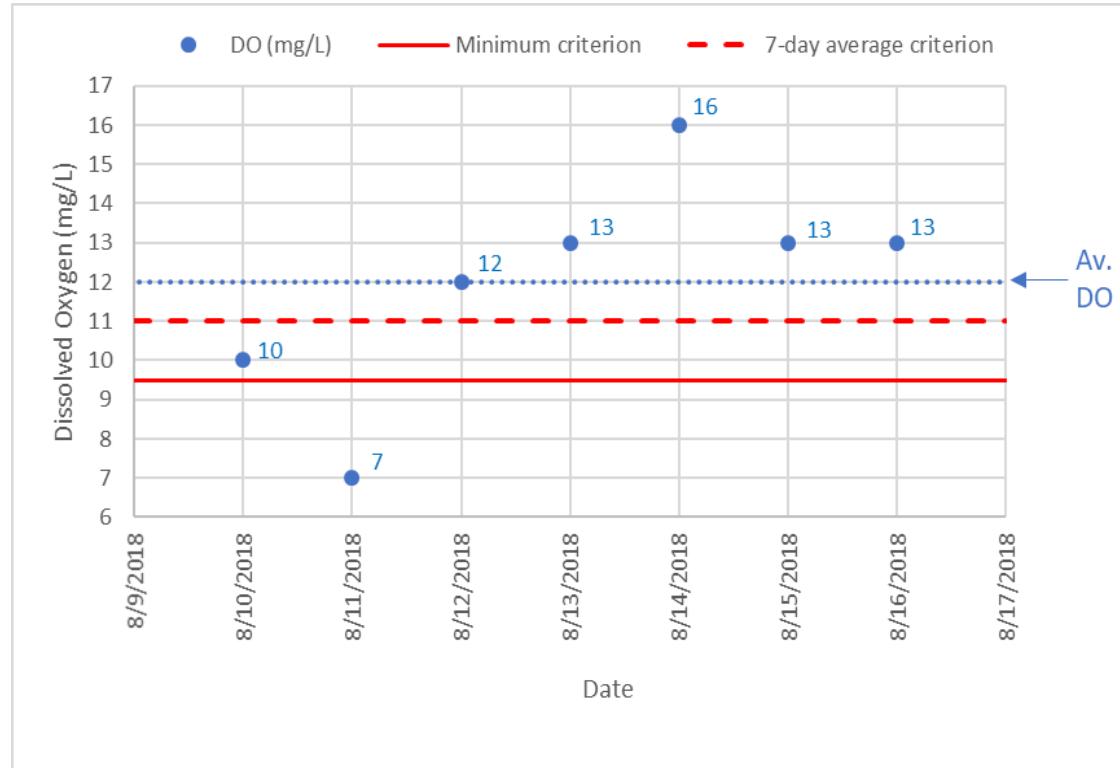






# Dissolved Oxygen Assessment

- 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

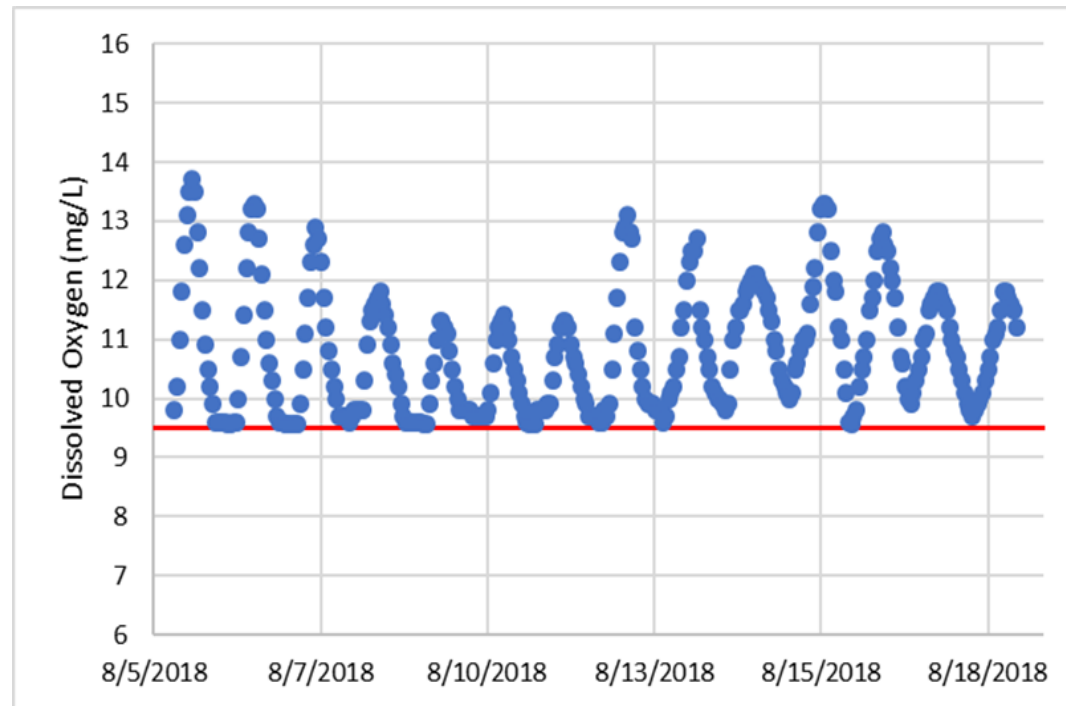






# Dissolved Oxygen Assessment

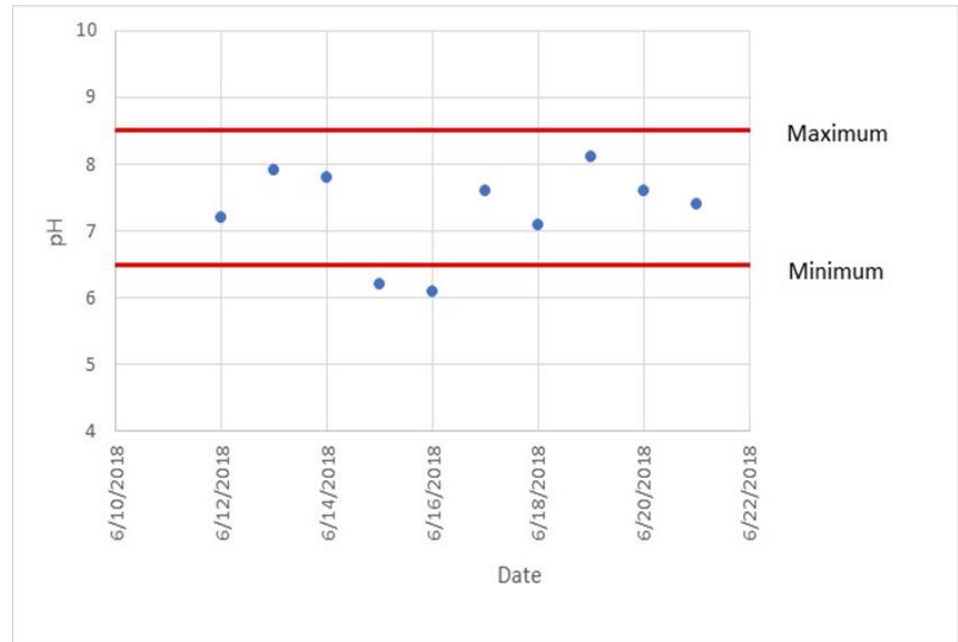
- Salmon and trout spawning water criteria
  - 7-day average of the daily mean dissolved oxygen: 11 mg/L
  - Minimum: 9.5 mg/L





# pH Criteria

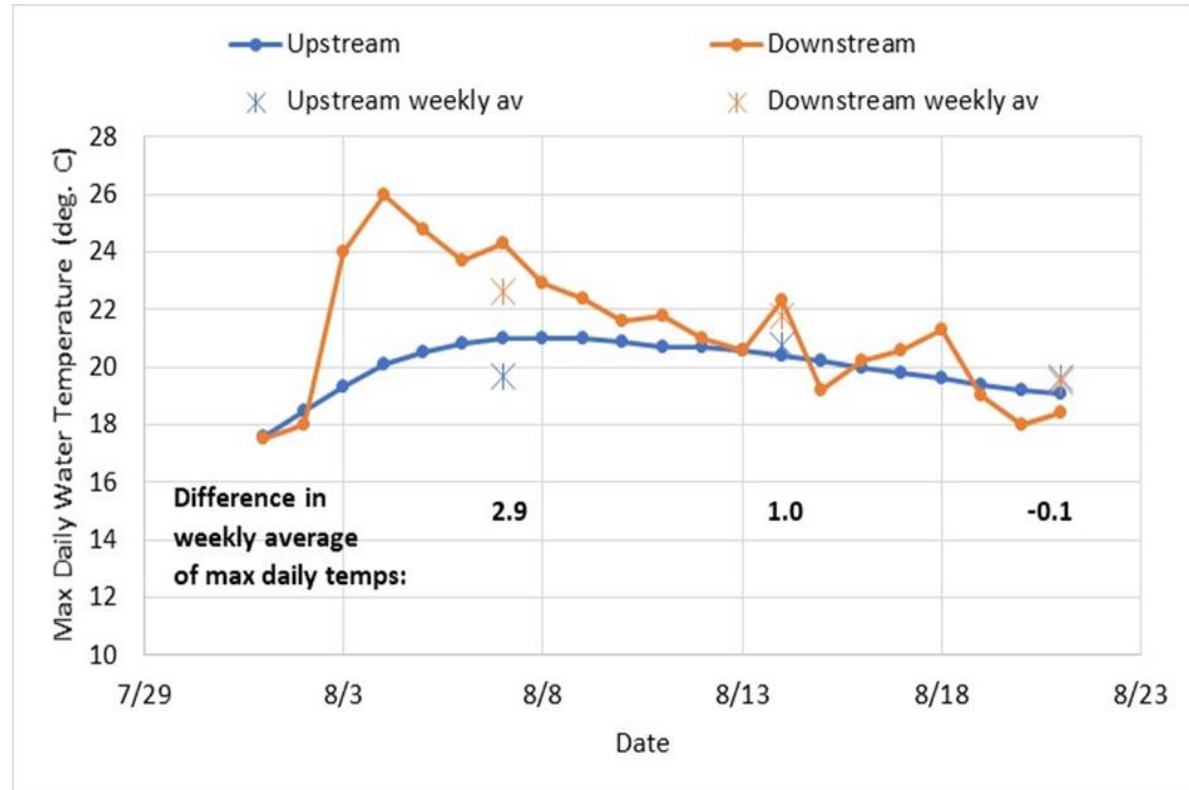
- A measure of acidity and alkalinity of the water
- Criteria require keeping pH within a specific range
  - To protect human health, the pH must be within the range of 5 to 9
  - To protect aquatic life, the pH must be within the range of 6.5 to 9.0 for freshwater and 6.5 to 8.5 for saltwater





# Temperature Example

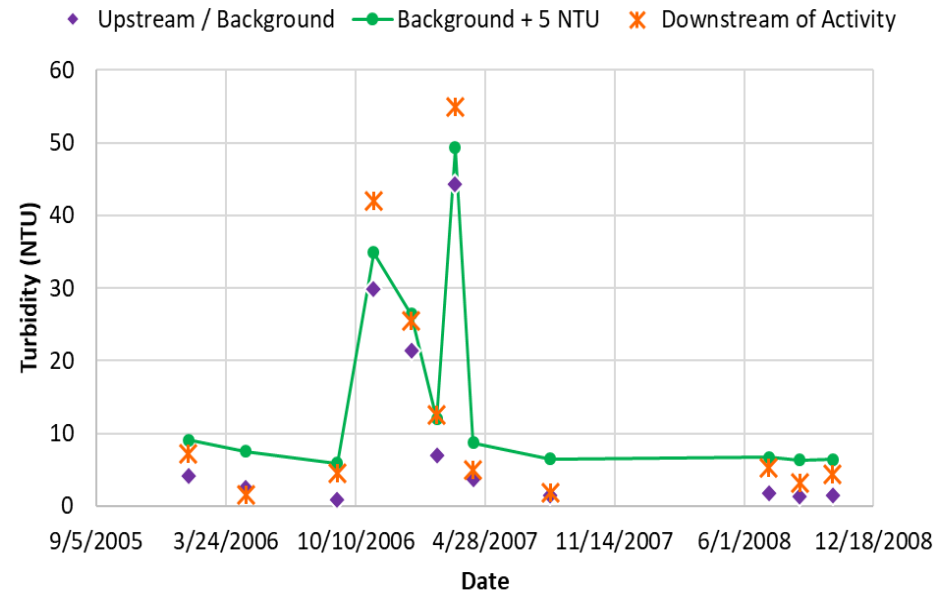
“No increase in the weekly average of the maximum daily temperature between upstream/downstream locations that is greater than 2.7° C”





# 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)

**Stream Insects & Crustaceans**

**GROUP ONE TAXA**  
Pollution sensitive organisms found in good quality water:

- 1 Stonefly: Order Plecoptera.** 1/2" - 1 1/2"; 6 legs with 5 hooked legs; antennae 2; fan-like tails. Small; (wing) 3; 10-15 pairs of body setae. (See arrow)
- 2 Caddisfly: Order Trichoptera.** 1/2 to 1"; 6 legs; eggs in capsule from 2 holes at back end. May be in a stick, rock or leaf case with its head sticking out. May have feathery gill tufts on underside.
- 3 Water Penny: Order Coleoptera.** 1/4". The slender elongated body with 2 spots being on one side and 6 long legs are fully visible on the other side. Larvae are pale.
- 4 Riffle Beetle: Order Coleoptera.** 1/4"; low body covered with many hairs; 6 legs; 2 antennae. Walks slowly underwater. Does not swim on surface.
- 5 Mayfly: Order Ephemeroptera.** 1/4" - 1"; brown; 6 legs; 2 antennae; 3 on sides of lower body case are visible; large hooded eye; antennae 2 or 3 long. Female has 2 long legs may be webbed together.
- 6 Gilled Snail: Class Gastropoda.** Shell opening covered by the plate called operculum. When opening is closed you see usually 2 eyes or 1 eye.
- 7 Dobsonfly (Megaloptera): Family Megaloptidae.** 1 1/2" - 4"; dark-colored; 8 legs; large pincers (jaws, right ones) feelers on lower half of body; 10 pairs of antennae; 4 pairs of legs; walking underside; stout antennae; 2 pairs and 2 pairs of hooks at back end.

**GROUP TWO TAXA**  
Some are pollution tolerant organisms can be in good or fair quality water:

- 8 Crayfish: Order Decapoda.** 1/2 to 6"; 2 large claws, 8 legs, antennae 5 and 10 feelers.
- 9 Sawfly: Order Megaloptera.** 1/2" - 3/4"; grey; oblong body wider than it is high; more than 6 legs; long antennae.

**Save Our Streams**  
Izaak Walton League of America  
707 Conservation Lane  
Gaitheersburg, MD 20878-2953  
1-800-BUG-WA

Bar lines indicate relative size

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

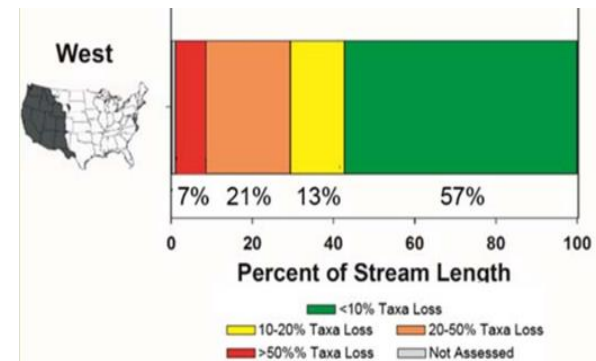




# Macroinvertebrate Multi-Metric Index (MMI)

- 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](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

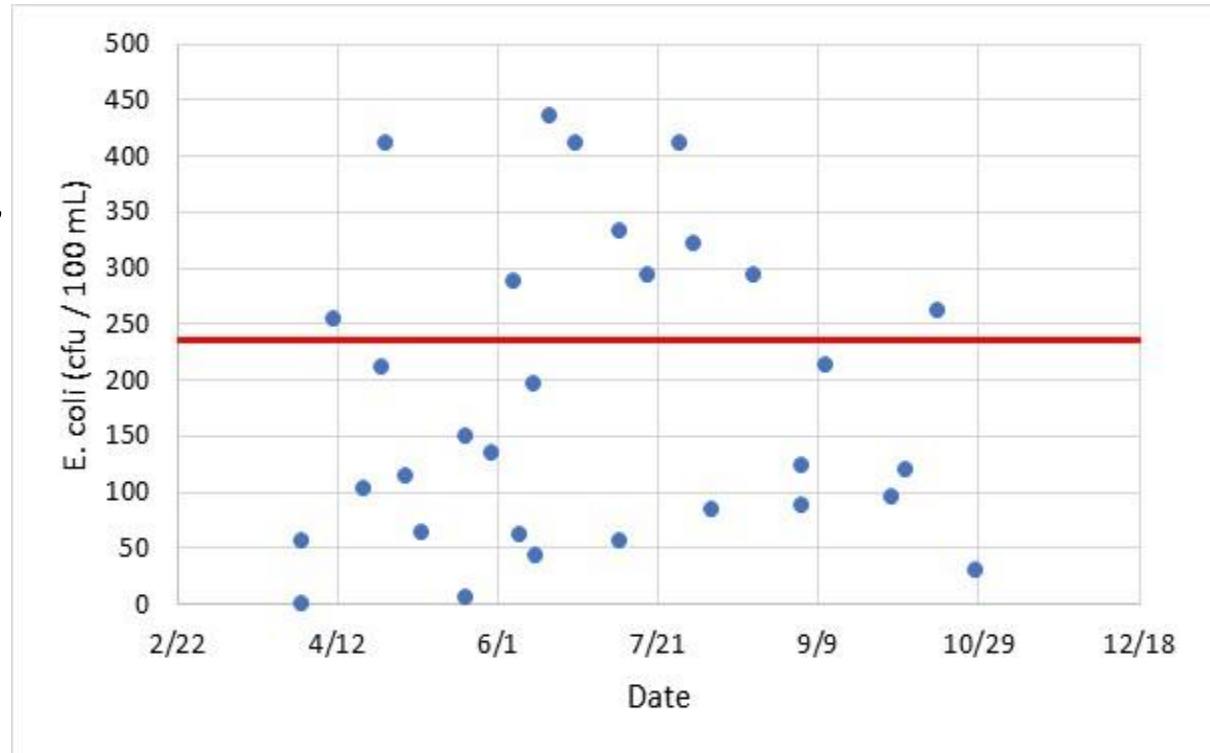






## *E. coli*: Averaging Period and Recurrence Interval

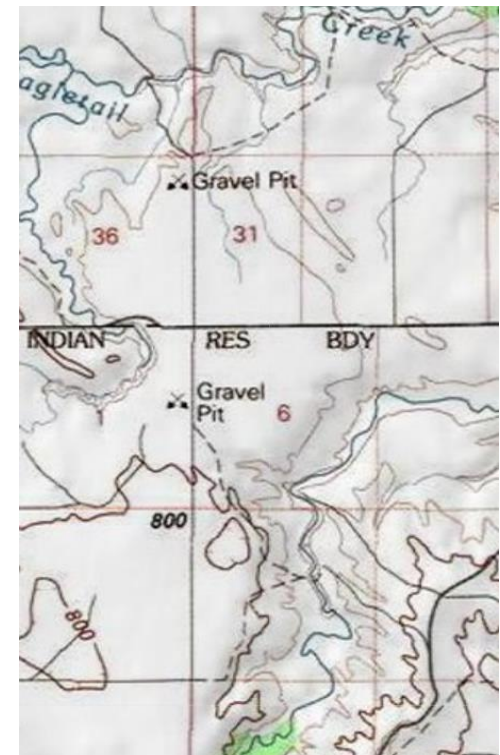
- Single sample maximum
- Navajo Tribe *E. coli* criterion: 235 cfu/100 mL
- 11 out of 31 samples, or 35%, are greater than 235





# 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

Date	Cond. (uS/cm)	Explicit Value (number)	Value = actual (magnitude)	Nitrate (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

Ten samples were collected and evaluated

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

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
<b>Avg</b>	<b>788</b>	<b>8</b>	<b>1.3</b>	<b>6.9</b>	<b>0.21</b>





# Salamander Creek: Use Support Summary

<b>Designated Use</b>	<b>Use Support</b>	<b>Probable Cause of Impairment</b>
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

Organization ID	Organization Name	Station ID	Station Name
EBCI	Eastern Band of Cherokee Indians	EBCI-3200-1	Conley Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-3200-3	Shepherd Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-BC 1	Big Cove 1
EBCI	Eastern Band of Cherokee Indians	EBCI-BC 11	Big Cove 11
EBCI	Eastern Band of Cherokee Indians	EBCI-BC 12	Big Cove 12
EBCI	Eastern Band of Cherokee Indians	EBCI-BC 13	Big Cove 13
EBCI	Eastern Band of Cherokee Indians	EBCI-BC 2	Big Cove 2
EBCI	Eastern Band of Cherokee Indians	EBCI-BC 3	Big Cove 3
EBCI	Eastern Band of Cherokee Indians	EBCI-BC 5	Big Cove 5
EBCI	Eastern Band of Cherokee Indians	EBCI-BC 7	Big Cove 7
EBCI	Eastern Band of Cherokee Indians	EBCI-BC1	Bunches Creek 1
EBCI	Eastern Band of Cherokee Indians	EBCI-BC2	Bunches Creek2
EBCI	Eastern Band of Cherokee Indians	EBCI-BC3	Bunches Creek 3
EBCI	Eastern Band of Cherokee Indians	EBCI-BC_11	Big Cove 11
EBCI	Eastern Band of Cherokee Indians	EBCI-BC_5	Big Cove 5
EBCI	Eastern Band of Cherokee Indians	EBCI-BT 2	Birdtown/Oconaluftee Rive
EBCI	Eastern Band of Cherokee Indians	EBCI-BT1	Birdtown/Oconaluftee Rive
EBCI	Eastern Band of Cherokee Indians	EBCI-BT2	Birdtown/Oconaluftee Rive
EBCI	Eastern Band of Cherokee Indians	EBCI-CC1	Beaver Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-CC10	Cherokee County/Upper Ha
EBCI	Eastern Band of Cherokee Indians	EBCI-CC2	Webb Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-CC3	Hyatt Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-CC4	Rogers Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-CC5	Vengeance Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-CC6	Cherokee County/Wilscott t
EBCI	Eastern Band of Cherokee Indians	EBCI-CC7	Cherokee County/Bates Cre
EBCI	Eastern Band of Cherokee Indians	EBCI-CC8	Cherokee County/Lower Ha
EBCI	Eastern Band of Cherokee Indians	EBCI-CC9	Cherokee County/Grape Cre
EBCI	Eastern Band of Cherokee Indians	EBCI-CCVR1	KOA Campground Below Ca
EBCI	Eastern Band of Cherokee Indians	EBCI-CCVR2	Konehete Park Above Casin
EBCI	Eastern Band of Cherokee Indians	EBCI-CC_1	Beaver Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-CC_10	U. Hanging Dog
EBCI	Eastern Band of Cherokee Indians	EBCI-CC_2	Webb Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-CC_3	Hyatt Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-CC_4	Rogers Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-CC_5	Vengeance Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-CC_6	Wilscott Rd
EBCI	Eastern Band of Cherokee Indians	EBCI-CC_7	Bates Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-CC_8	L. Hanging Dog
EBCI	Eastern Band of Cherokee Indians	EBCI-CC_9	Grape Creek
EBCI	Eastern Band of Cherokee Indians	EBCI-EBCIH	EBCI Hatchery

SEARCH

Step 1: Search for Stations | Step 2: Retrieve Data Set and Analyze | About

Open Previous Saved Search:

**Option 1: Search by Organization and/or HUC**

Organization ID:

HUC:

**Option 2: Search by Distance from a Point**

Point Description

Lat:  Long:

Distance (in miles):

**Option 3: Search by Lat/Long Box**

North:

West:  East:

South:

**Additional Optional Search Criteria**

Station Type:

Date Range (MM/DD/YYYY)

Start:  End:

Search by Parameters Sampled

SAVE SEARCH CRITERIA | SEARCH | CLEAR | HIDE





# WQX Excel Analysis Tool

CHARACTERISTIC NAME:	Dissolved oxygen (DO)
START DATE:	3/27/2014
END DATE:	3/27/2014
UOM:	mg/l
UPPER LIMIT:	N/A
LOWER LIMIT:	5.00
#EXCEED UPPER LIMIT:	0
#EXCEED LOWER LIMIT:	0
MAX:	12.08
MIN:	8.34
AVERAGE:	10.31
MEDIAN:	10.77
#DETECTIONS:	17
#NONDETECT:	0
SAMPLE MEDIUM:	
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
EBCI-20130904MBC 7N000001	11/5/2012	Dissolved oxygen (DO)			11.1
EBCI-20130905MBC 7N000001	12/6/2012	Dissolved oxygen (DO)			10.99
EBCI-20130910MBC 7N000001	1/8/2013	Dissolved oxygen (DO)			11.52
EBCI-20130912MBC 7N000001	2/12/2013	Dissolved oxygen (DO)			11.6
EBCI-20130913MBC 7N000001	3/14/2013	Dissolved oxygen (DO)			11.55
EBCI-20130916MBC 7N000001	4/9/2013	Dissolved oxygen (DO)			10.16
EBCI-20130916MBC 7N000002	5/20/2013	Dissolved oxygen (DO)			9.21
EBCI-20130916MBC 7N000002	5/20/2013	Dissolved oxygen (DO)			9.21
EBCI-20130916MBC 7N000003	6/4/2013	Dissolved oxygen (DO)			9.63
EBCI-20130916MBC 7N000004	7/16/2013	Dissolved oxygen (DO)			8.52
EBCI-20130916MBC 7N000004	7/16/2013	Dissolved oxygen (DO)			8.34
EBCI-20131211MBC 7N000001	9/23/2013	Dissolved oxygen (DO)			8.64
EBCI-20131211MBC 7N000002	10/21/2013	Dissolved oxygen (DO)			9.6
EBCI-20131218MBC 7N000001	12/17/2013	Dissolved oxygen (DO)			11.2
EBCI-20140331MBC 7N000001	1/27/2014	Dissolved oxygen (DO)			12.08
EBCI-20140401MBC 7N000001	2/25/2014	Dissolved oxygen (DO)			10.77
EBCI-20140402MBC 7N000001	3/27/2014	Dissolved oxygen (DO)			11.15

### EBCI-BC 7: Big Cove 7

Dissolved oxygen (DO) (mg/l)

SEARCH

Step 1: Search for Stations | Step 2: Retrieve Data Set and Analyze | About |

**First: Retrieve a Data Set**

Choose Station:

**Additional Optional Search Criteria**

Medium:

Date Range (MM/DD/YYYY)

Start:

End:

Search by Parameters Sampled:

RETRIEVE CLEAR

**Next: Analyze based on the downloaded dataset**

Parameter to Analyze:

Upper Limit:

Lower Limit:

Unit of Measure:

ANALYZE CLEAR

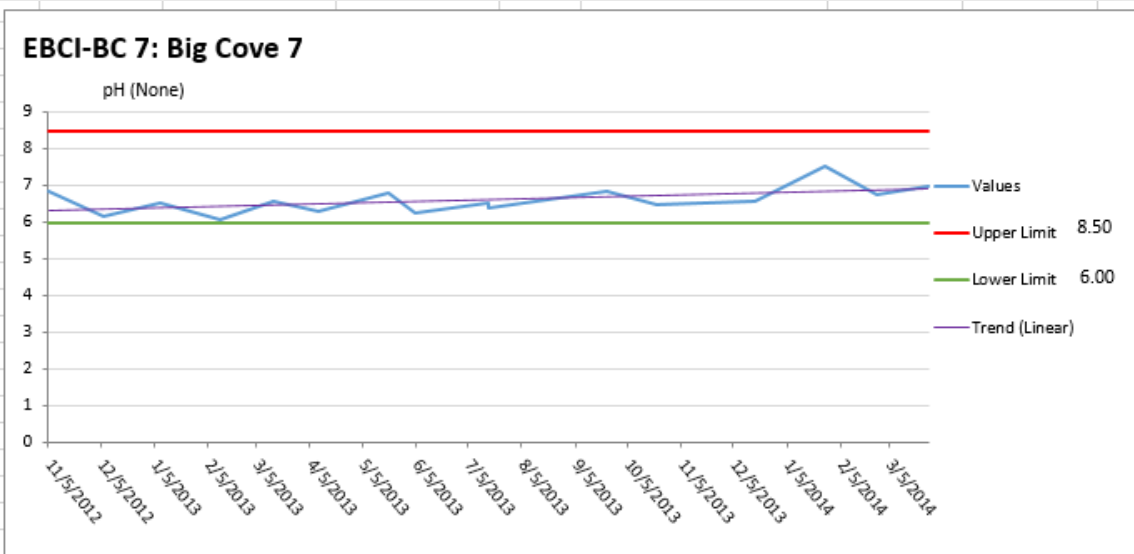
HIDE





# WQX Excel Data Analysis Tool

1	
2	CHARACTERISTIC NAME: pH
3	START DATE: 3/27/2014
4	END DATE: 3/27/2014
5	UOM: None
6	UPPER LIMIT: 8.50
7	LOWER LIMIT: 6.00
8	#EXCEED UPPER LIMIT: 0
9	#EXCEED LOWER LIMIT: 0
10	MAX: 7.52
11	MIN: 6.07
12	AVERAGE: 6.607647059
13	MEDIAN: 6.55
14	#DETECTIONS: 17
15	#NONDETECT: 0
16	SAMPLE MEDIUM:
17	T LEAST TWO YEARS OF DATA?: FALSE
18	%Exceedences: 0.00
19	<input type="button" value="Save"/>
20	<input type="button" value="Map Analysis"/> <input type="button" value="Show Search Form"/>
21	
22	
23	Activity ID ~ Start Date ~ Characteristic ~ Speciation ~ Sample Fraction ~ Measure Value ~ Units ~ Detection Condition Text ~ Upper Limit ~ Lower Limit ~
24	EBCI-20130904MBC 7N000001 11/5/2012 pH 6.85 None 8.50 6.00
25	EBCI-20130905MBC 7N000001 12/6/2012 pH 6.18 None 8.50 6.00
26	EBCI-20130910MBC 7N000001 1/8/2013 pH 6.51 None 8.50 6.00
27	EBCI-20130912MBC 7N000001 2/12/2013 pH 6.07 None 8.50 6.00
28	EBCI-20130913MBC 7N000001 3/14/2013 pH 6.56 None 8.50 6.00
29	EBCI-20130916MBC 7N000001 4/9/2013 pH 6.31 None 8.50 6.00
30	EBCI-20130916MBC 7N000002 5/20/2013 pH 6.81 None 8.50 6.00
31	EBCI-20130916MBC 7N000002 5/20/2013 pH 6.81 None 8.50 6.00
32	EBCI-20130916MBC 7N000003 6/4/2013 pH 6.23 None 8.50 6.00





# Questions?

Contact Information:

Kate Pinkerton, US EPA Region 9

[Pinkerton.kate@epa.gov](mailto:Pinkerton.kate@epa.gov), 415-972-3662





# FAQ: How to do a moving average in excel?

