TURBIDITY

What is it?

What does it Mean for Stream Health?

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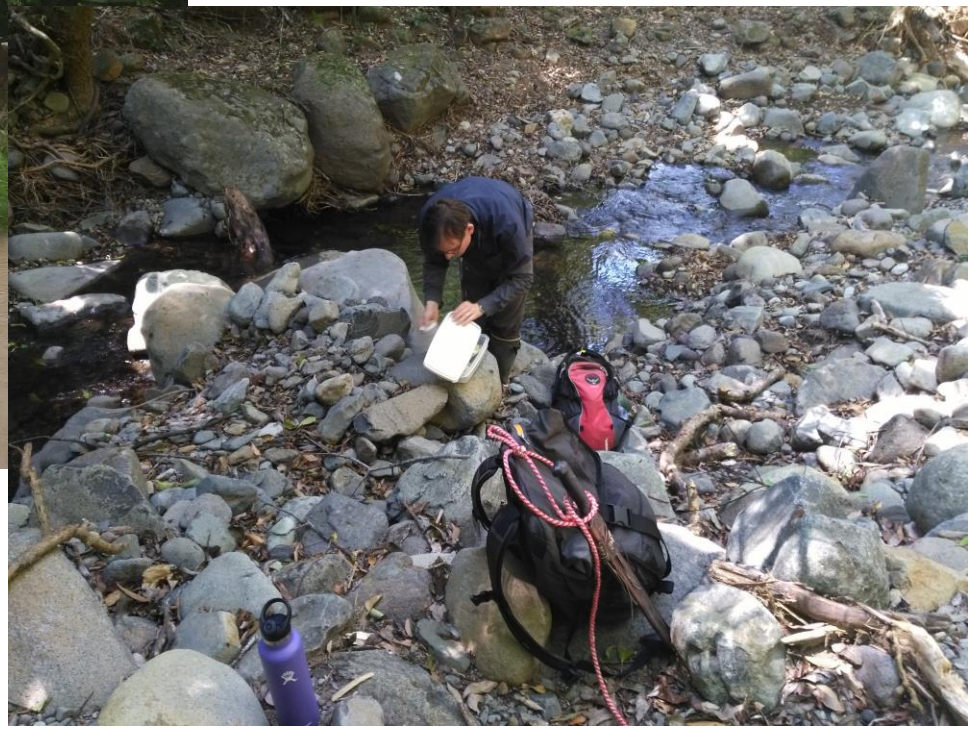
Assistant Director, Research Scientist

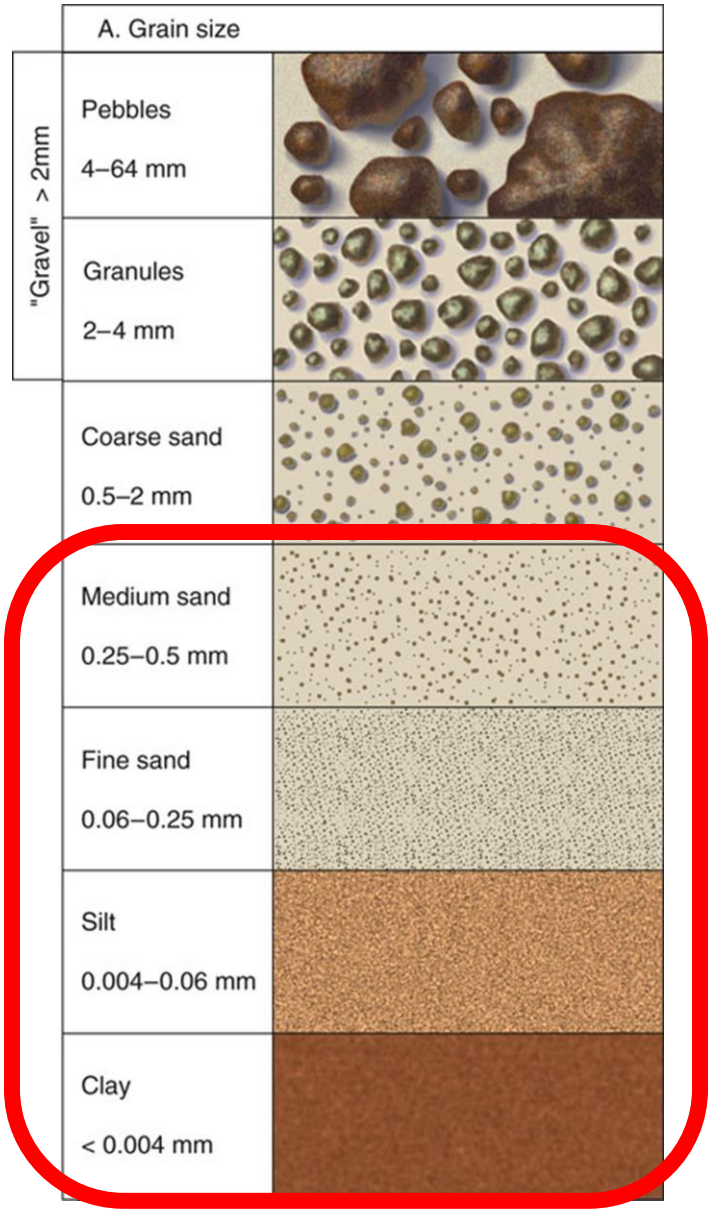
Understanding turbidity starts with understanding sediment

muddy-looking water caused by suspended sediment

cobbles and boulders also become bedload sediment during events



Most of the inorganic sediment in our streams is clay, silt, and sand



https://www.geography-fieldwork.org/gcse/coasts/coastal-processes/fieldwork/

What does suspended sediment look like?

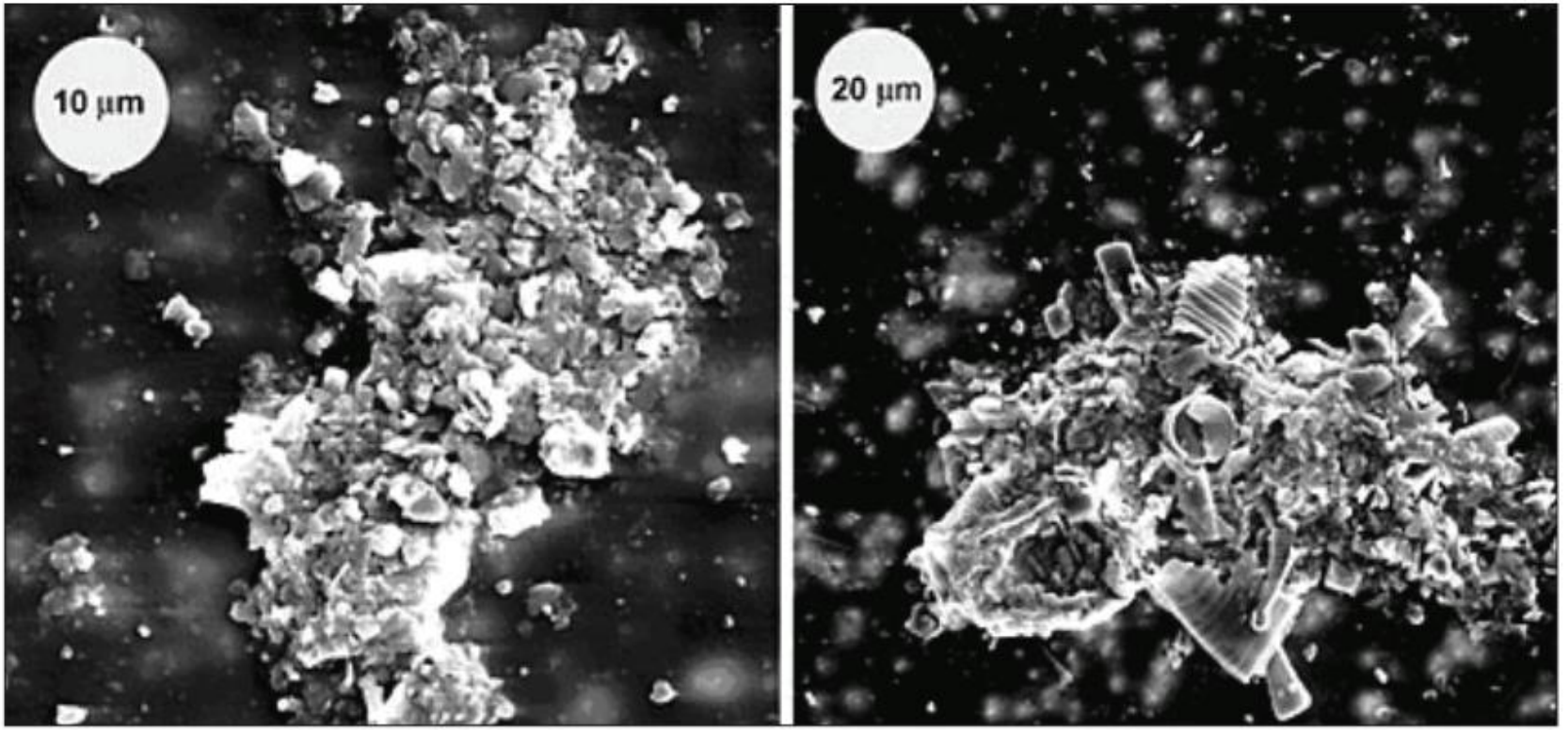


Photo courtesy of GFS Chemicals.

Figure 2. SEM images shows the huge diversity of particle size and shape encountered in re

https://s.campbellsci.com/documents/us/technical-papers/obs_ssc-turbidity.pdf

How do you measure suspended sediment?

suspended sediment concentration (SSC)

total suspended solids (TSS)

Why measure suspended sediment?

to compare the values to a regulatory or biological threshold

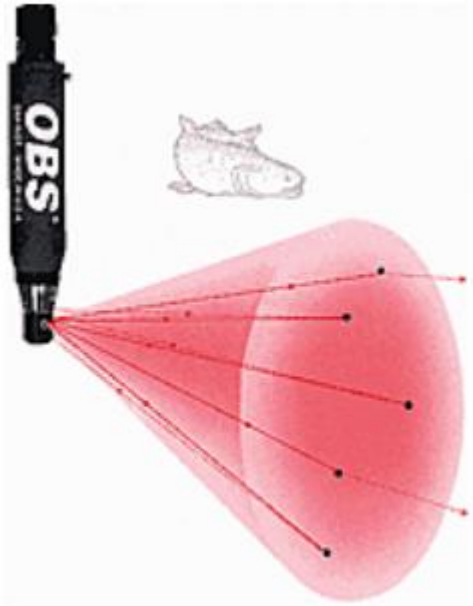
to understand sediment source, transport, deposition, and erosion

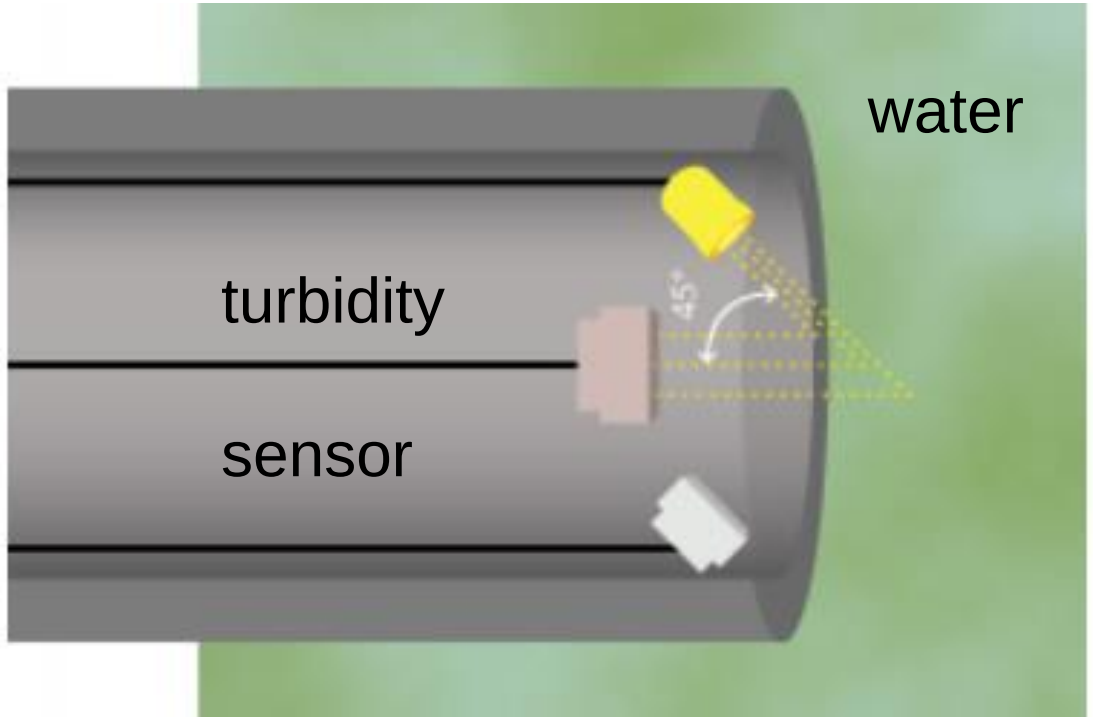
to compare loads upstream and downstream of something

Suspended sediment is a lot of work
Is there a shortcut?

NO… but there is turbidity.

Pros: cheap, easy, continuous
Cons: the units have no inherent meaning





https://www.fondriest.com/environmental-measurements/measurements/measuring-water-quality/turbidity-sensors-meters-and-methods/
https://s.campbellsci.com/documents/us/technical-papers/obs_basics.pdf

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How does turbidity affect plants, invertebrates, fish, and humans?

Blocks sunlight that aquatic plants (algae) need

Clogs stream bottom habitat for invertebrates and fish

Clouds the vision of fish seeking prey

Gives a ride to chemical hitch-hikers (like phosphorus)

Looks trashy (to people)

Elevated risk of water-borne bacteria (to people)

What are the regulatory limits for turbidity in surface water?

Pennsylvania (Neshaminy only): 100 NTU for PWS, WWF, MF, and 40 NTU May – September (100 NTU otherwise) for CWF.

New Jersey

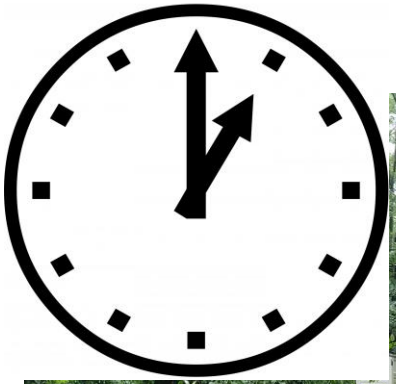
- FW2, SE3 waters: maximum 30 day average of 15 NTU, a maximum of 50 NTU at any time
- SE1, SE2 waters: maximum 30 day average of 10 NTU, maximum of 30 NTU at any time
- SC waters: not to exceed 10 NTU

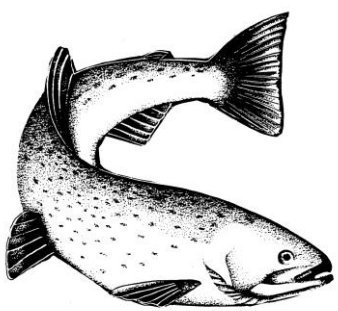
DE: Not to exceed 10 NTU above natural levels

NY: In Class AA Special Fresh Surface Waters, no increase that creates a visible contrast to natural conditions.

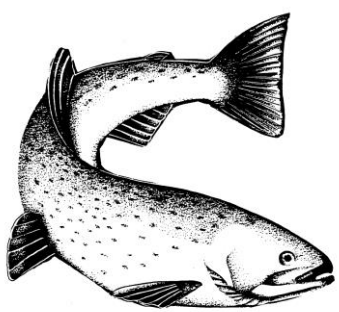
EPA: no standard, but our region's reference condition is 1 to 2 NTU

Length of turbid conditions is critical





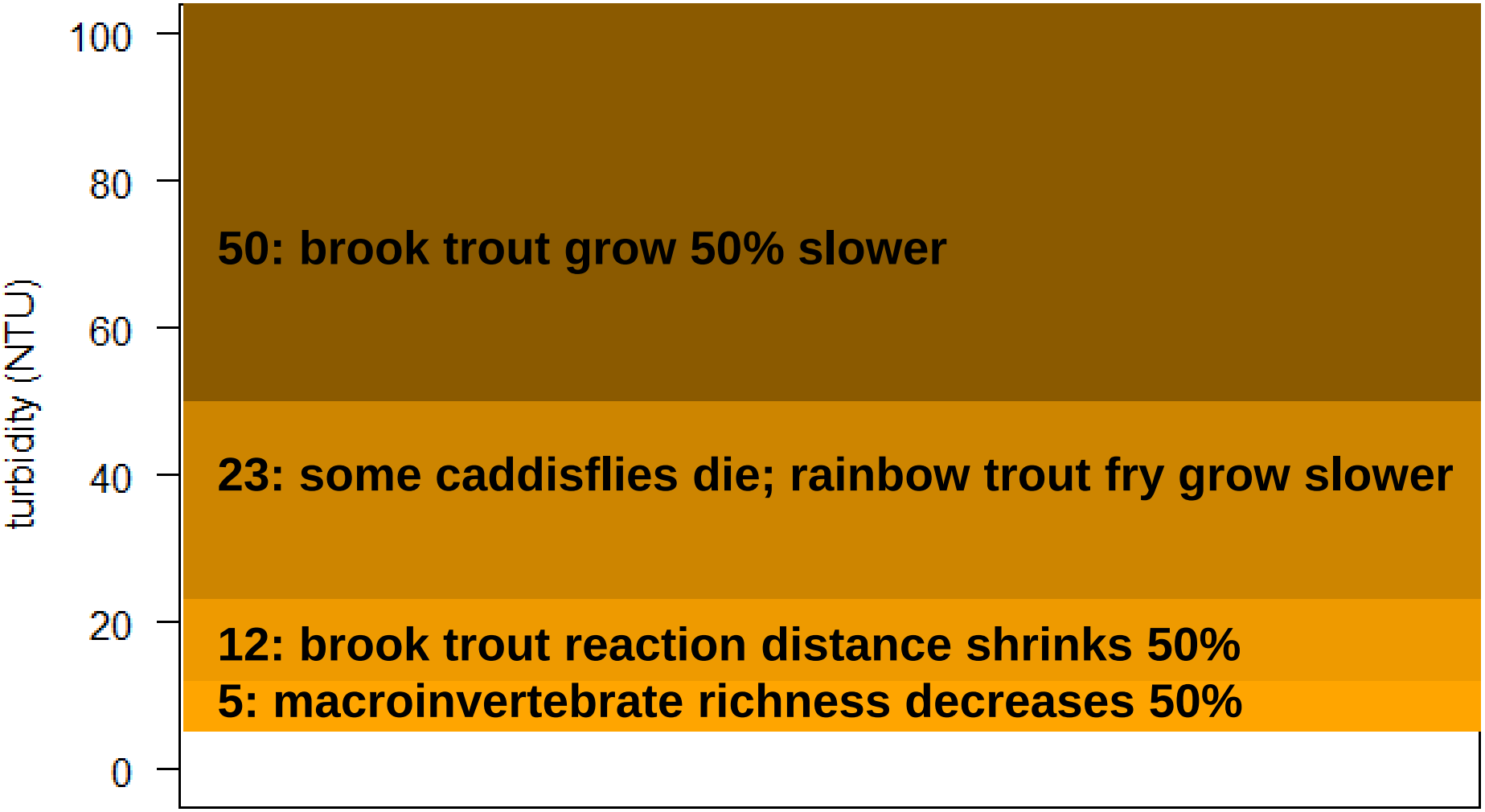
effects on organisms may be the same



Summary of 2018-2019 DRWI turbidity data exploring magnitude and comparisons

1. chose data collected less than 1 week from sensor cleaning
2. discard outlier data
3. smooth the data to reduce high frequency variation
4. split data into “events” and normal conditions
5. average all non-event data
6. extract the peak turbidity during events

Layering thresholds helps put turbidity into perspective: how much is too much ?



Turbidity is higher downstream of prior milldam on Ridley Creek

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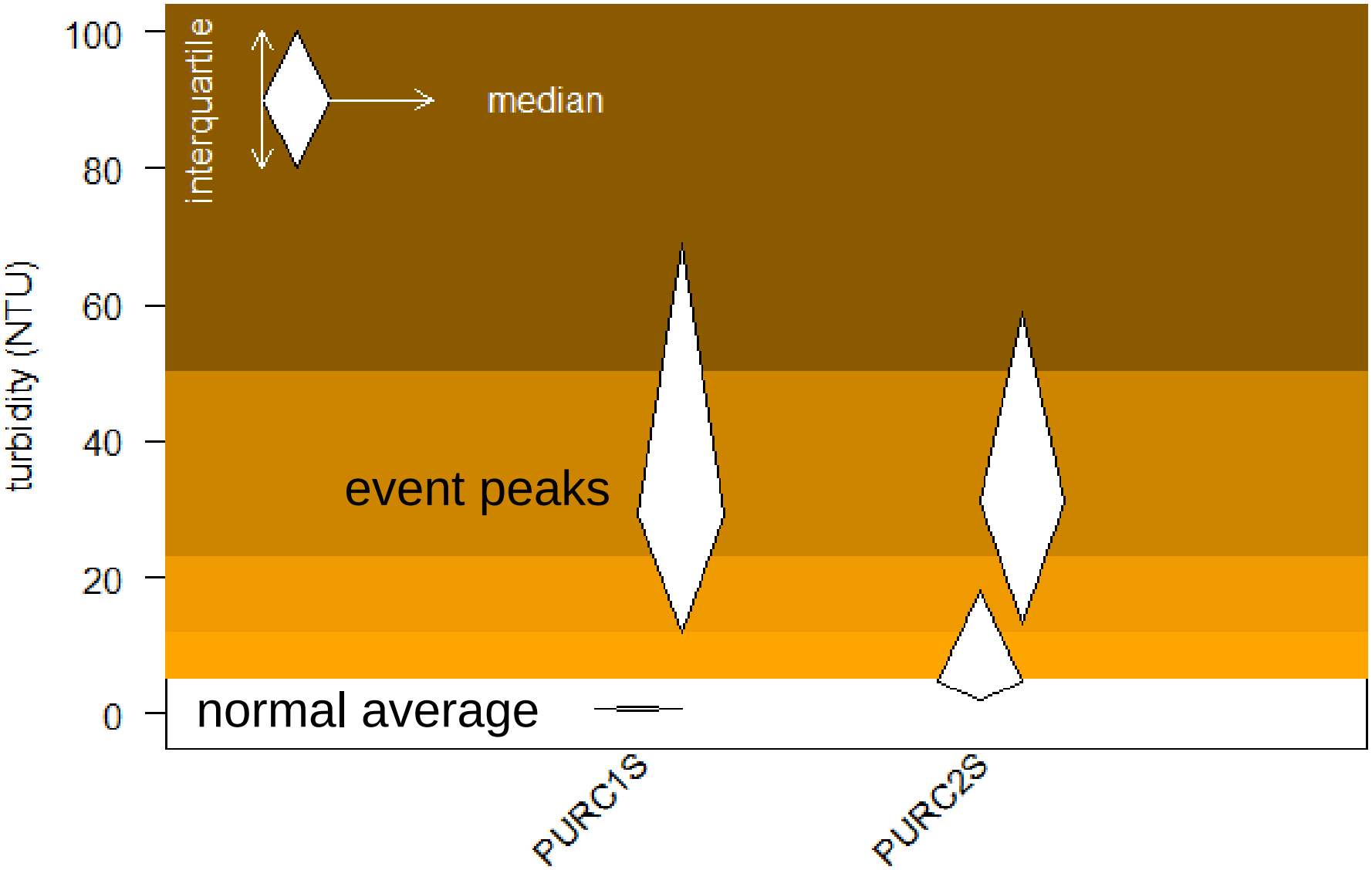
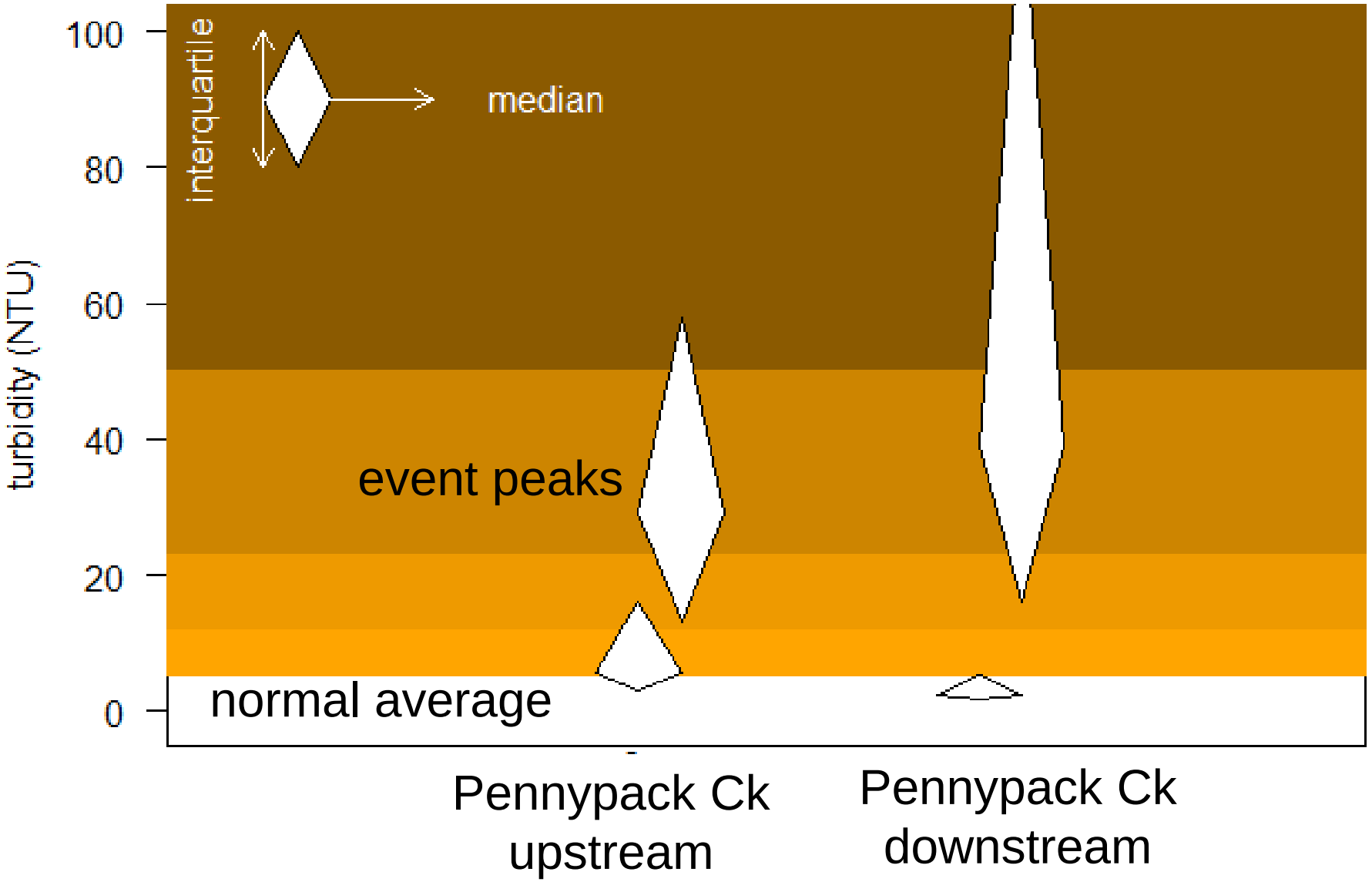
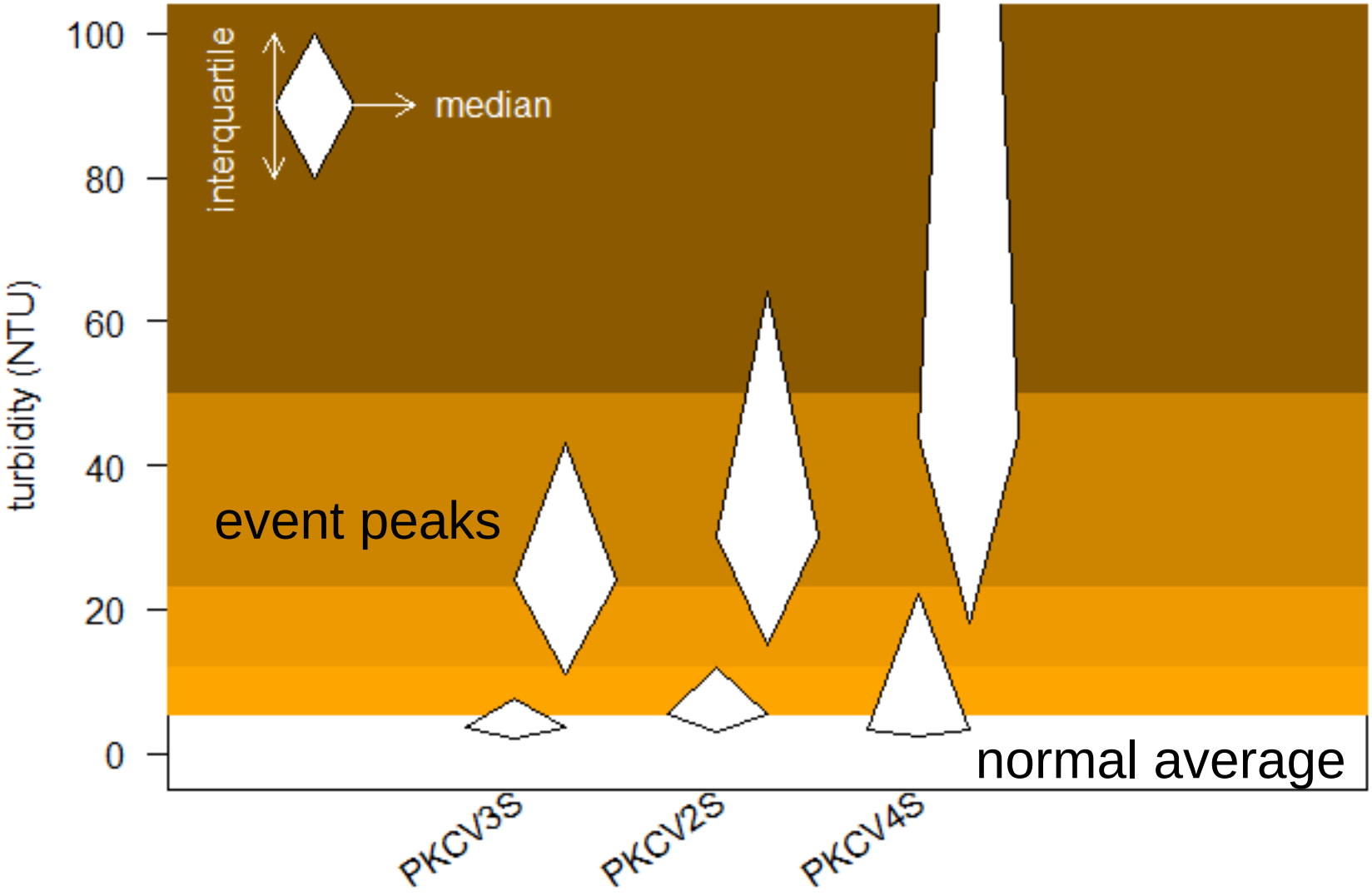


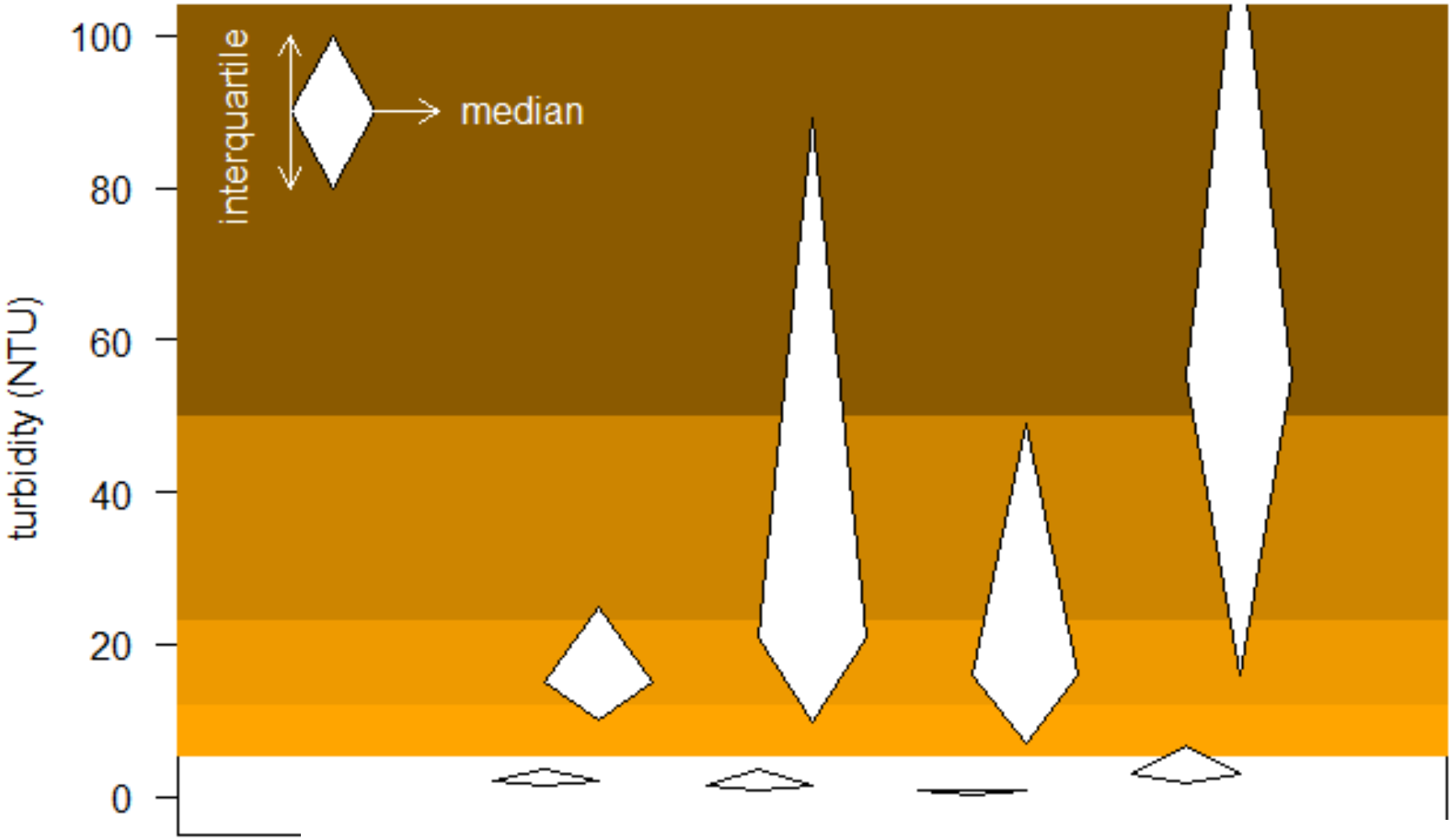
Is Northhampton Creek increasing turbidity of Pennypack during storms?



What explains this trend on Cherry Creek?



How do trout streams compare with a pristine stream?



How do we use turbidity to assess stream health?

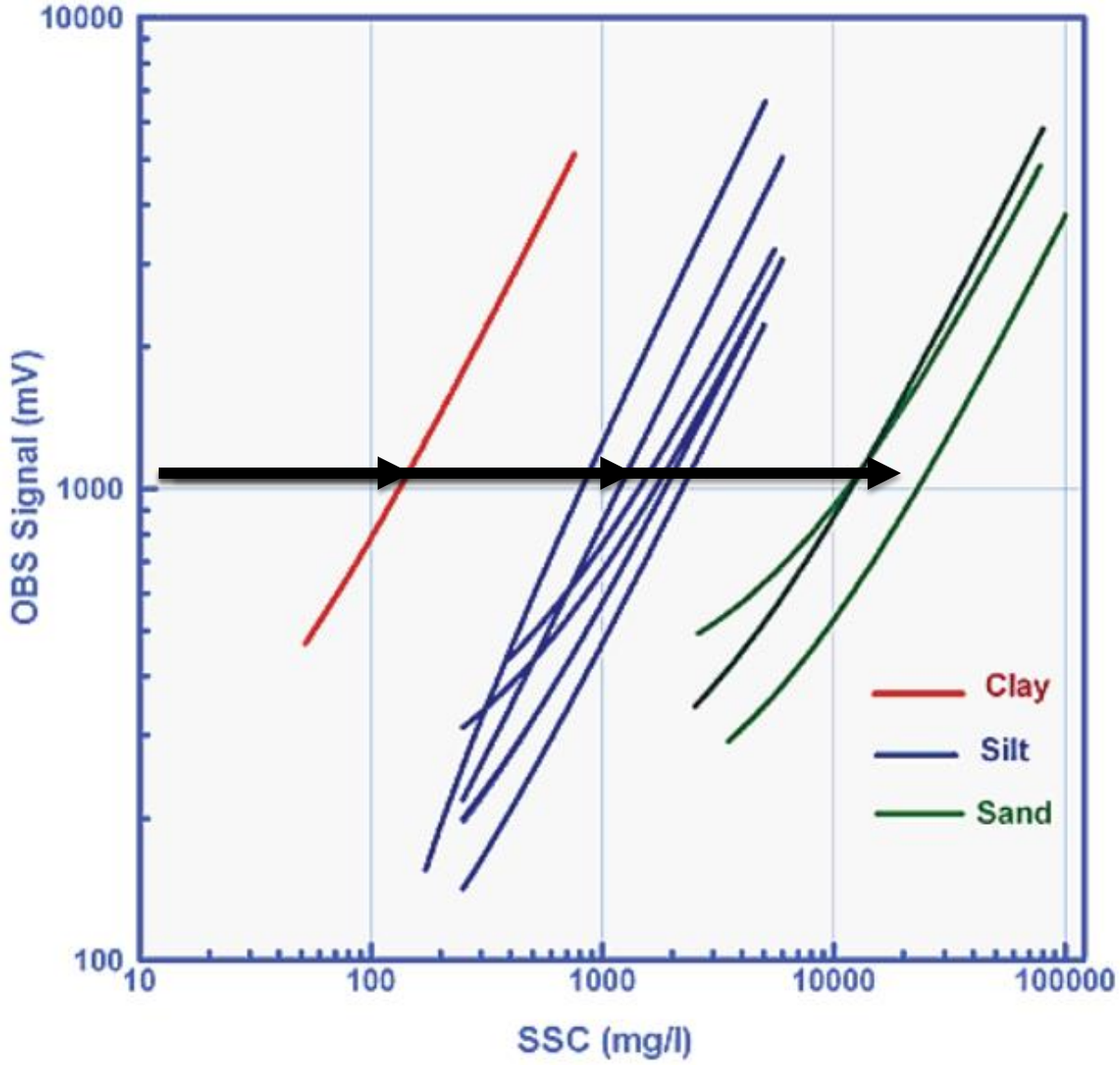
to compare the values to a threshold of biological impact

or, convert to SSC/TSS and:

evaluate sediment source, transport, deposition, and erosion

compare loads upstream and downstream of something

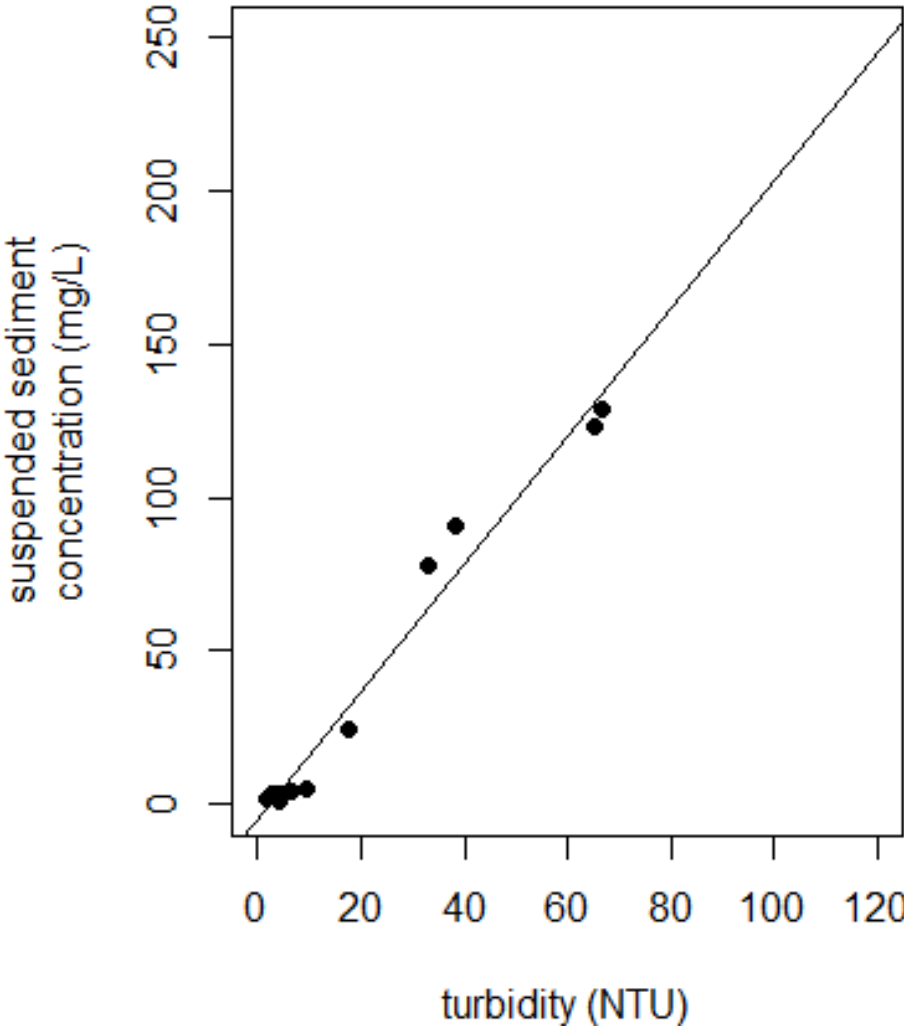
Turbidity is related to suspended sediment concentration, but…



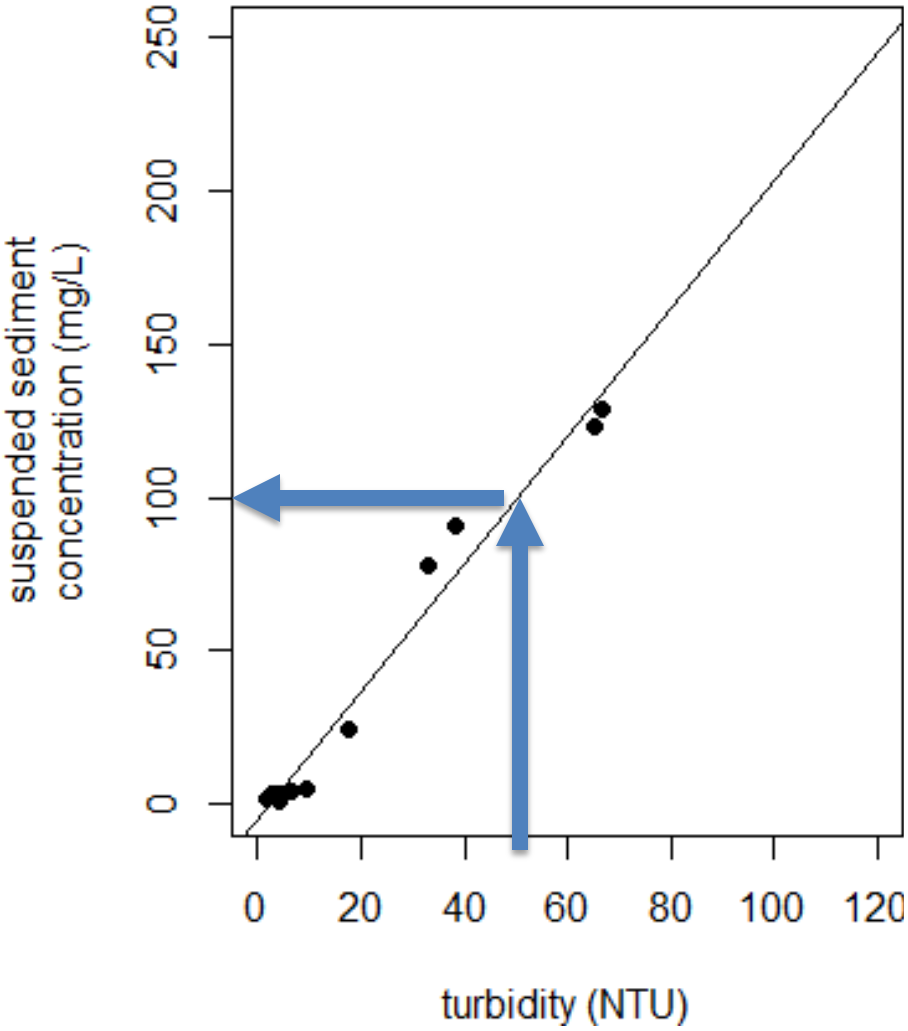
your stream has a combination of clay, silt, and sand!

https://s.campbellsci.com/documents/us/technical-papers/obs_sediment_size.pdf

Estimate SSC by first measuring turbidity and SSC simultaneously

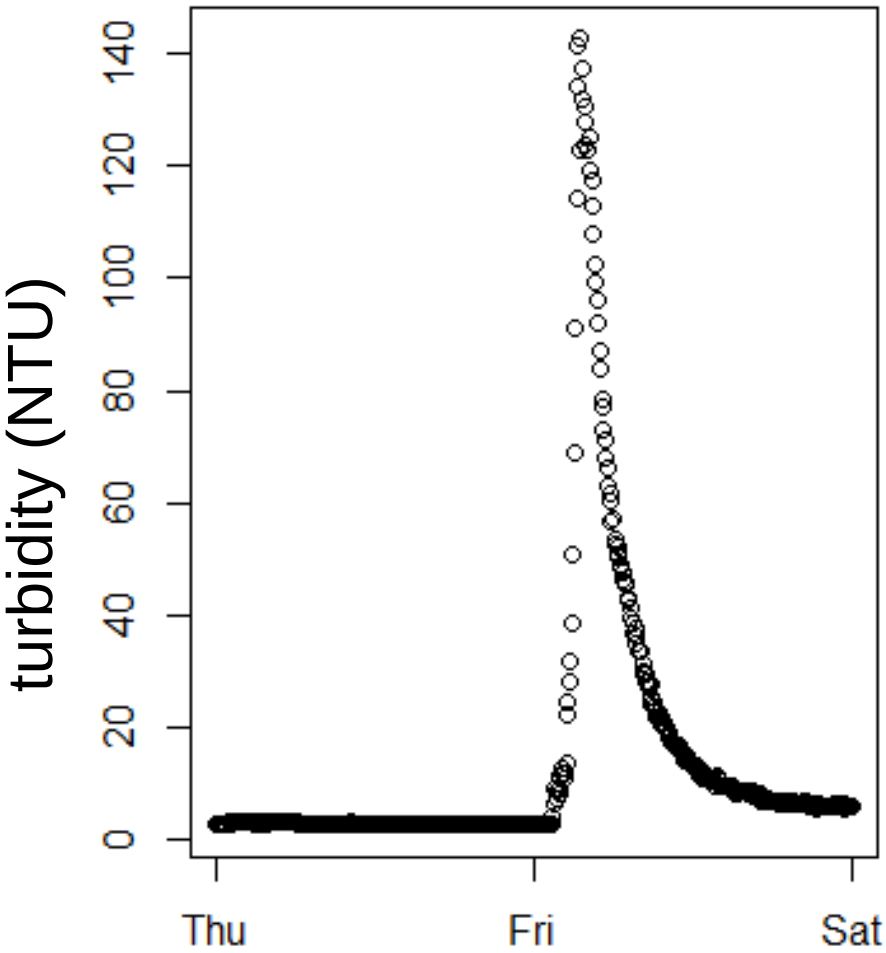


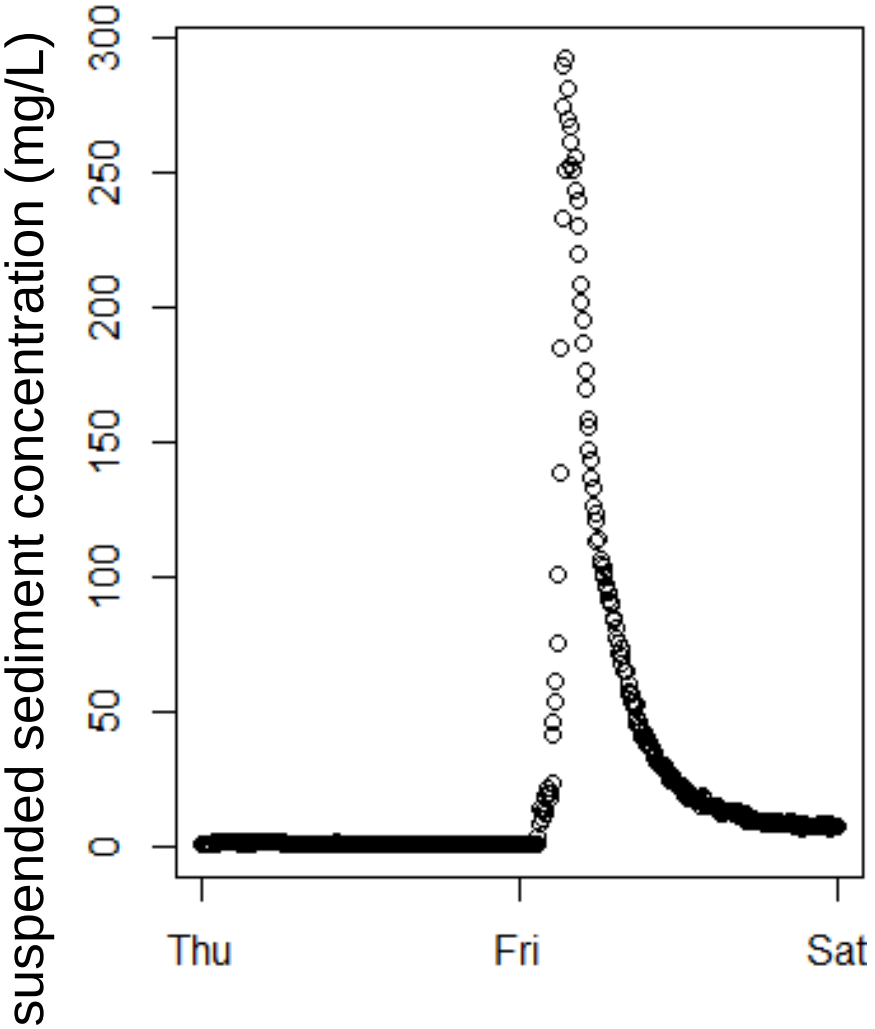
Next, develop a formula to predict suspended sediment concentration from turbidity



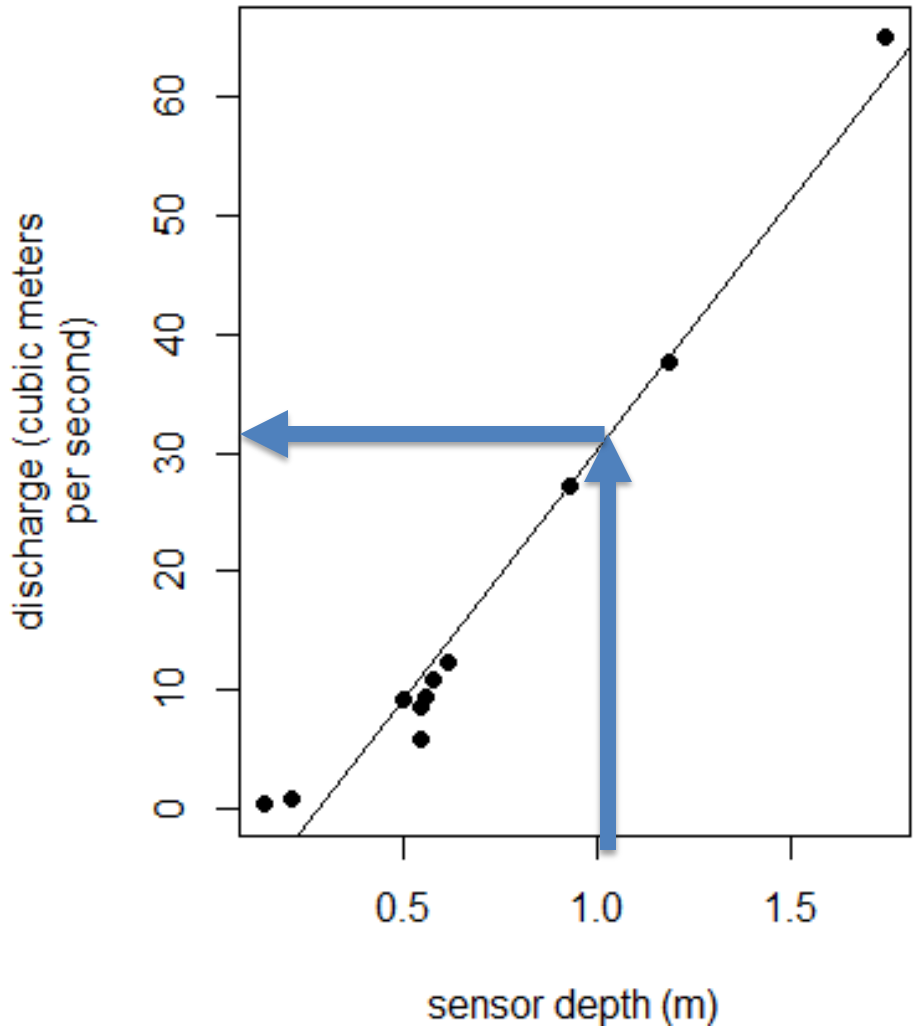
SSC = slope X turbidity + intercept

Then apply the formula to the turbidity sensor measurements

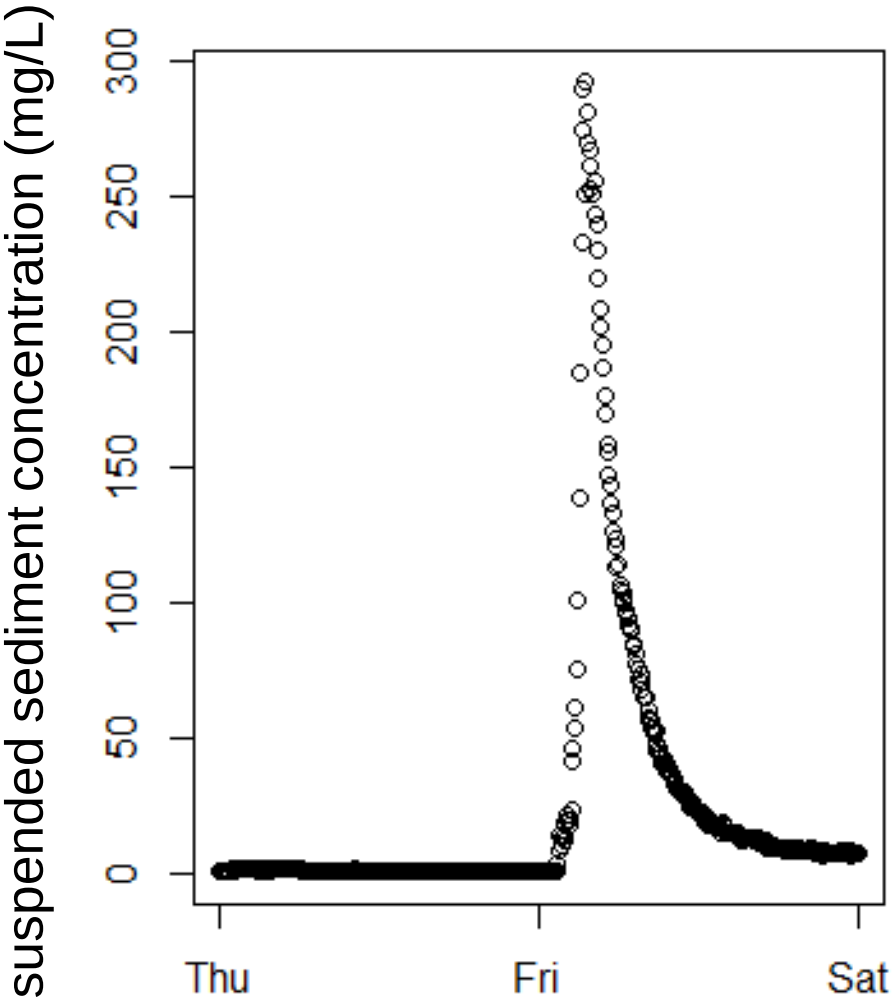


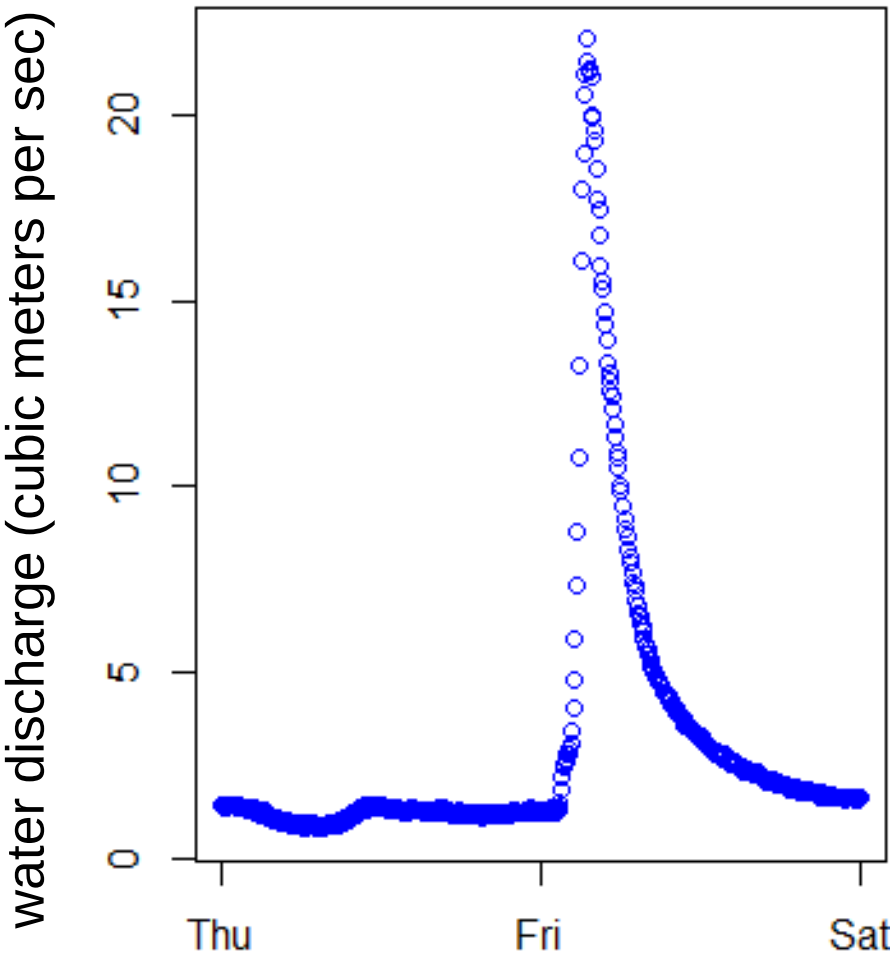


Follow the same process to predict discharge from sensor depth



Concentration X discharge = sediment load (47,304 ±16,731 kilograms)





But our formulas aren't perfect; sediment load can vary by 35% given these data!

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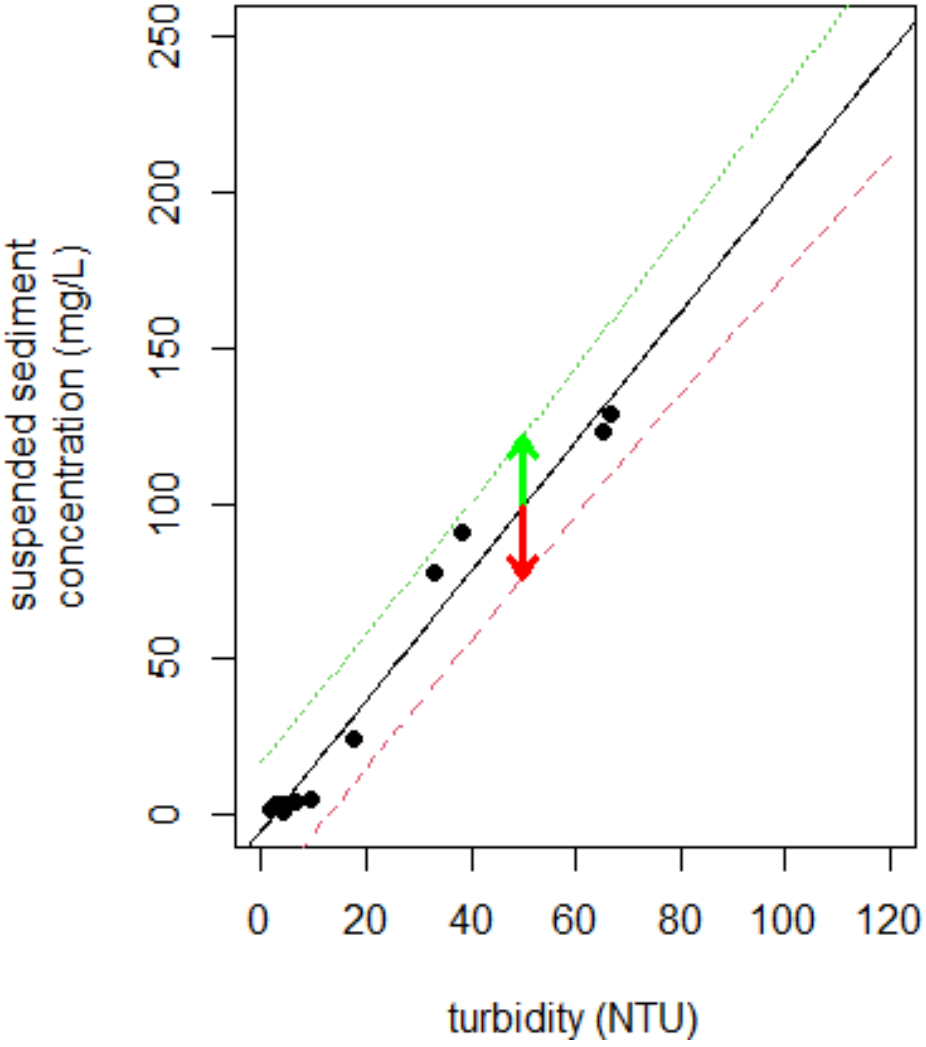

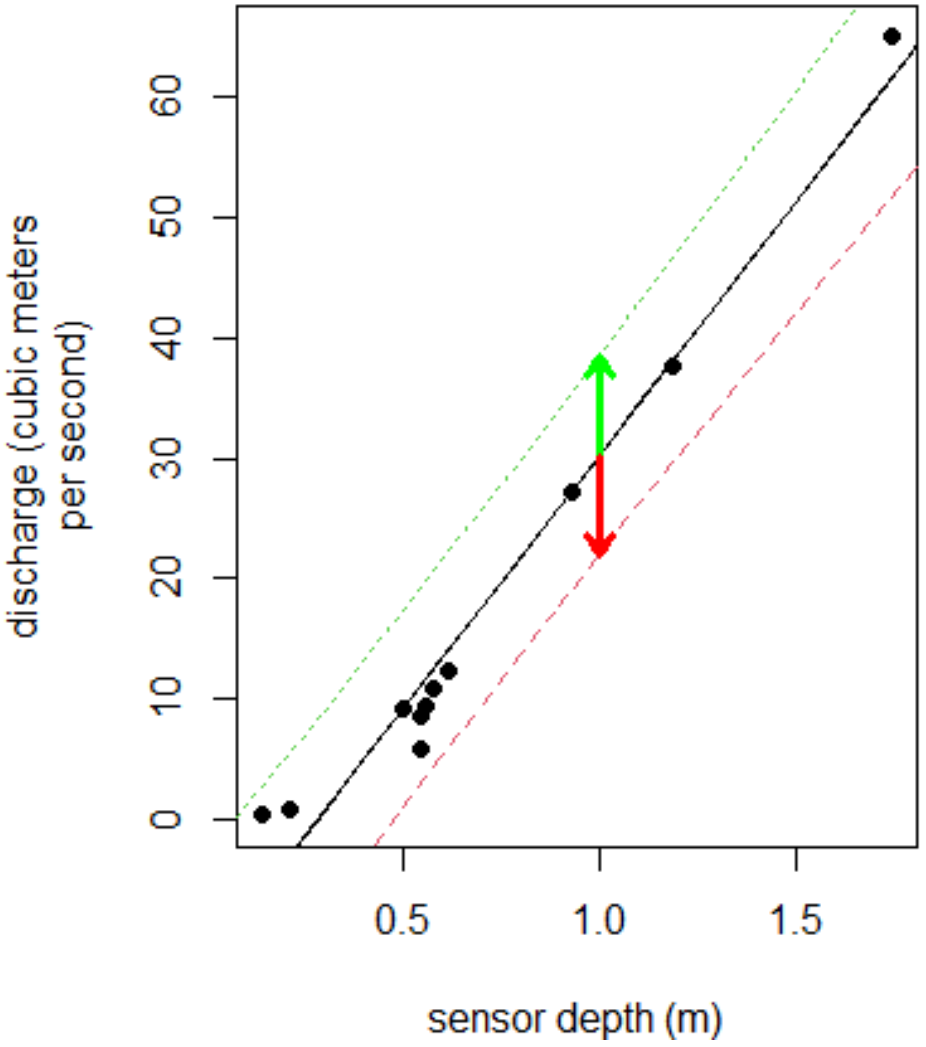

Next month we'll talk about how YOU can:

1. improve your turbidity measurements
2. analyze your turbidity data
3. better accomplish your monitoring goals.