Darby Creek Valley Association's Watershed 101, Online Seminar

April 11, 2020

Introduction to Water Quality Data

David Bressler, Stroud Water Research Center

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Overview

- Describe what we mean by “data”
- Introduce new monitoring project for the headwaters of Darby Creek
  - Collaboration between DCVA/WCT/Stroud Center
  - Lauren McGrath will go into further detail
- **Take a look at the types of Water Quality Data to be collected**
  - **Brief definition and description of the data types**
  - **Why each data type is important to understand**

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Learning Objectives

- Better understanding of “data”

- Better understanding of how to understand the health of streams/watersheds
  - **What’s important to look for in data**
  - **What different types of data tell us about a stream**
  - **How to develop a picture of a watershed and its health**

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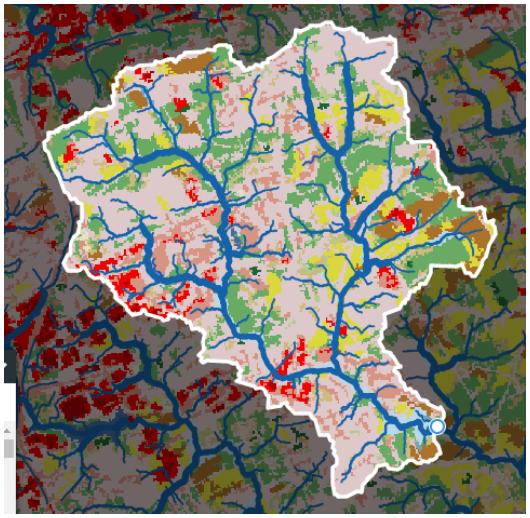
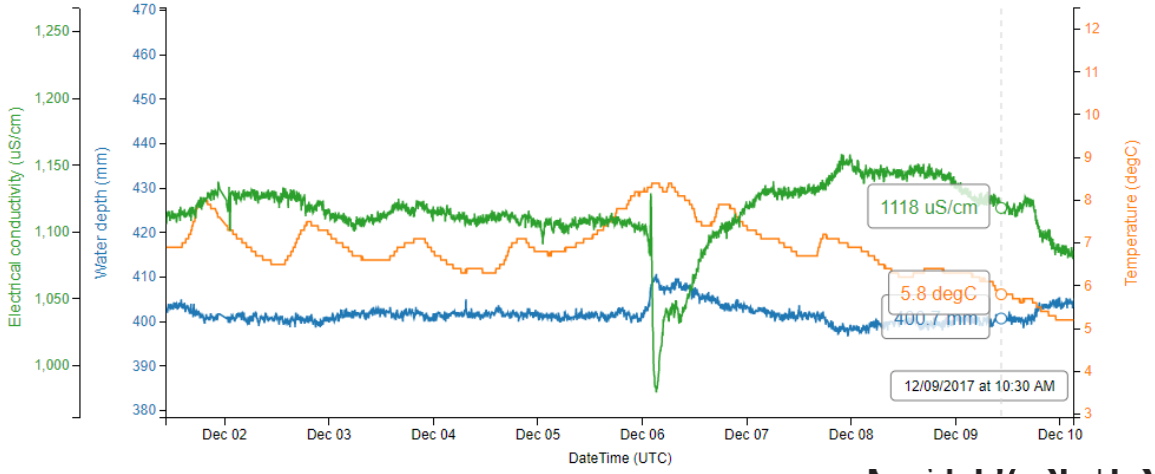
What *is* data? What *are* data?

- Numbers?
- Maps?
- Photos?
- Narratives?
- Information?

Conductivity, Winter 2019-2020	
Arithmetic Mean	840.55
Geometric Mean	106.15
Maximum	1603.20
Minimum	571.20
Standard Deviation	77.39
10%	746.80
25%	786.80
Median, 50%	818.50
75%	874.00
90%	916.50
Number of Observations	25,217





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What is the purpose of data?

IT ALL DEPENDS ON:

- **WHAT YOUR INTENTIONS ARE**
- **WHAT QUESTION(S) YOU ARE INTERESTED IN ANSWERING**
- **WHAT YOU ARE TRYING TO UNDERSTAND**

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What is the purpose of data?

- Whoever you are, scientist, volunteer for watershed group, concerned citizen:
  - It's ultimately about forming a **story/picture** about the stream/watershed
  - Lots of different types of information can be gathered to do this
    - And again, it's entirely dependent on what you want to know

What information (i.e., data) can be gathered?

- **Samples and Measurements**
  - Water Chemistry
  - Stream physical conditions
  - Water quantity
  - Biology

- Landscape Conditions – watershed boundaries, land uses, road crossings, point sources

- First-hand experiential information - with your eyes, walking, biking, driving, boating,

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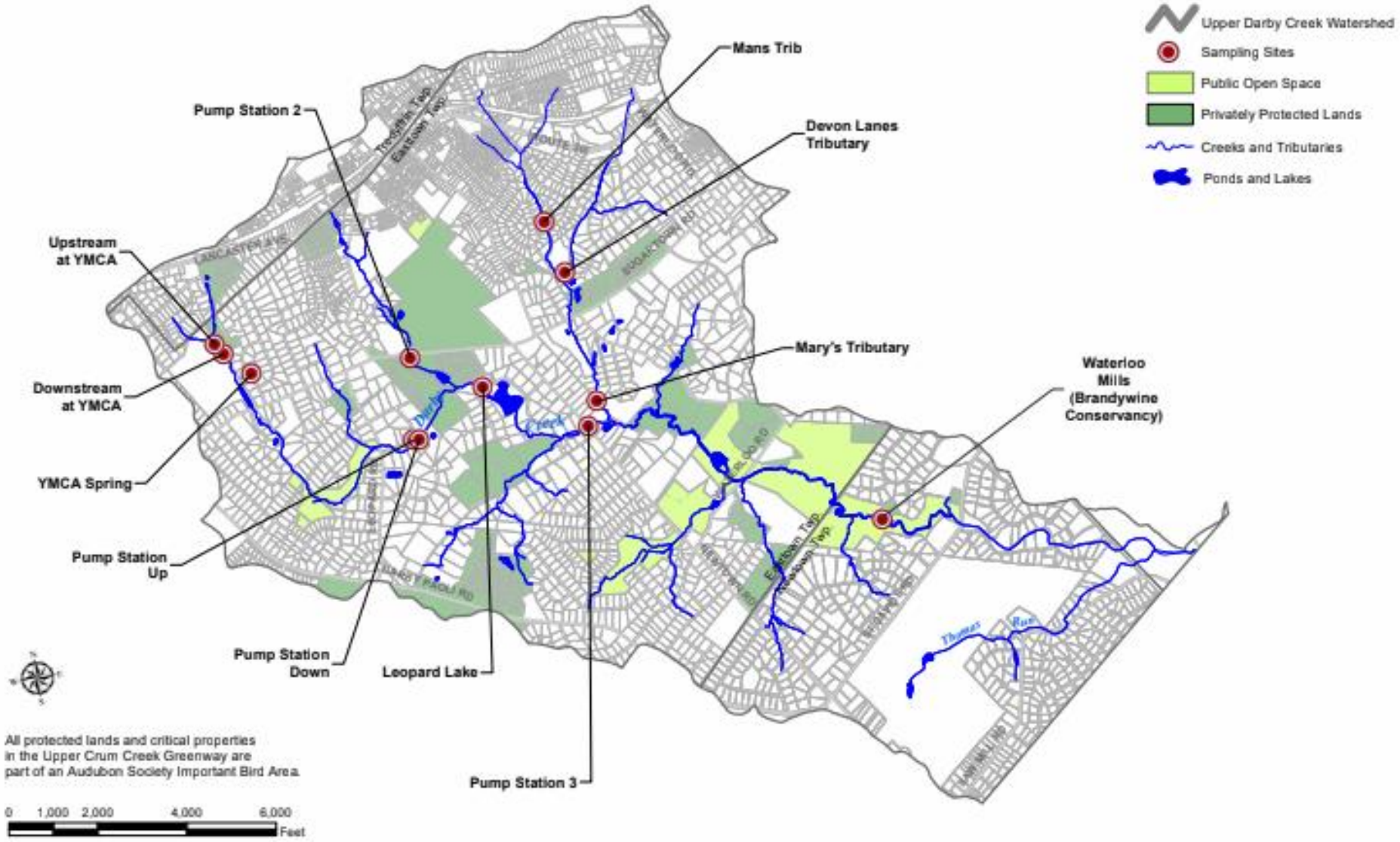
DCVA/WCT - Darby Creek Headwaters Monitoring Project



DCVA/WCT - Darby Creek Headwaters Monitoring Project

- Purpose is to get a picture of what the Darby Creek headwaters looks like. These are the data that will be collected:
  - Conductivity
  - Temperature
  - pH
  - Water depth (discharge)
  - Total Suspended Solids and Turbidity
  - Macroinvertebrates and Fish
  - Landscape conditions

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What I’m going to do now

- Describe each of these parameters in simple terms
- Show graphs, photos, and other information to support understanding of how each of these parameters relate to stream health

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Conductivity

- Electrical Conductivity is a measure of how well water conducts electricity
  - Directly related to concentration of ions and salts **dissolved** in the water
    - Natural dissolved minerals picked up by water on/in land
    - Pollution, for instance, road salt, sewage, nutrients, pesticides

Type	Electrical Conductivity (µS/cm)
Pure Water	0.05
Distilled Water	1
Rain or Snow	2 - 100
Surface / Ground Water	50 - 50,000
Seawater	50,000

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Conductivity

- Why is it important?
  - Serves as a coarse indicator of stream health
  - Can be a red flag for pollution
  - Some scientists say “If there was only one thing I could measure to tell me about a stream it would be conductivity”

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Conductivity

- Conductivity is HIGH in areas with lots of human activity (cities, housing developments, etc)
- Conductivity is LOW in areas with minimal human activity (forests, wetlands, etc.)
- **These are general patterns but are not always true*

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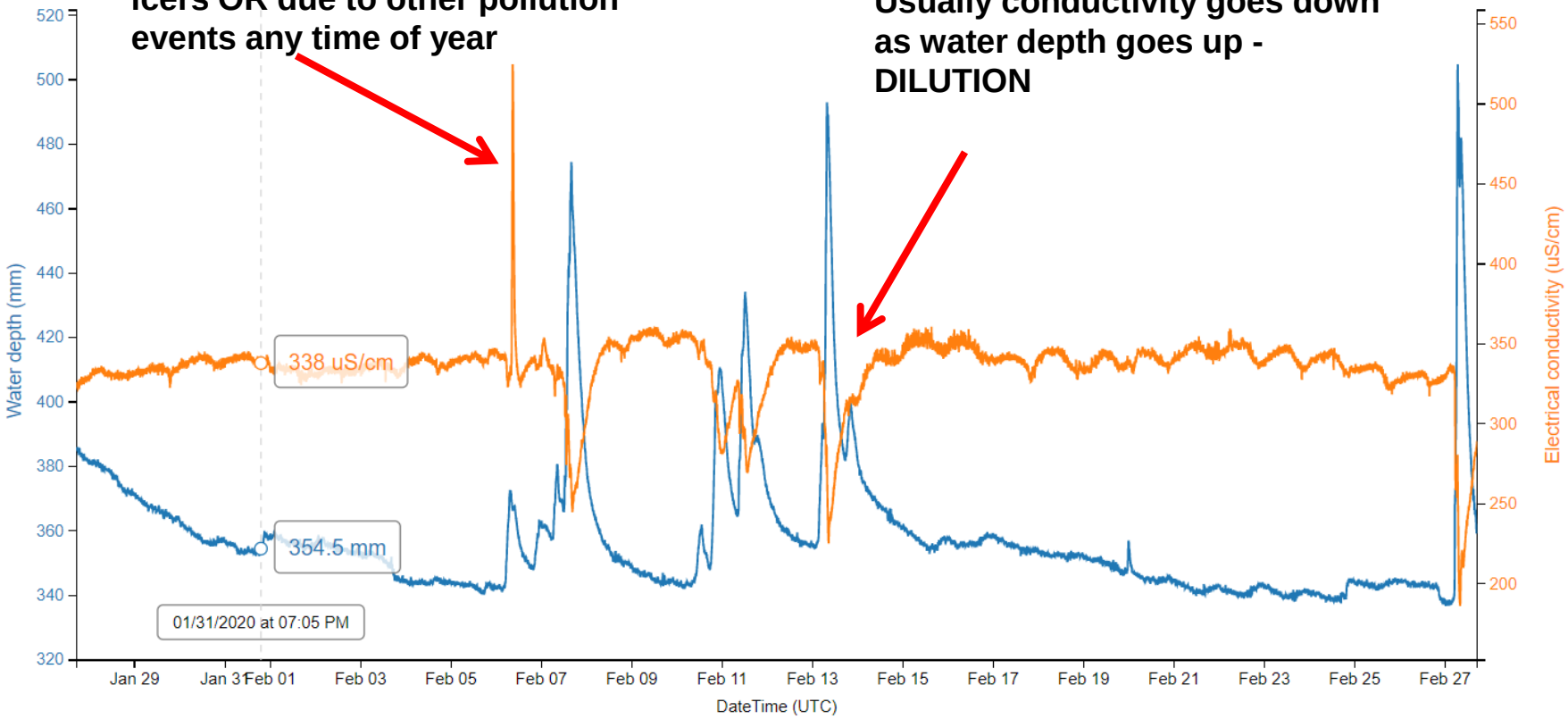
Conductivity

Conductivity can spike in winter due to flushes of road salt/de-icers OR due to other pollution events any time of year

Usually conductivity goes down as water depth goes up - DILUTION



Site Code: MSAC2S
Site Name: Angelica Creek, Berks Nature, downstream of The Nature Place

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Conductivity

- Naturally, minerals from rocks/soil dissolve in groundwater

Punches Run in Nolde State Forest

Average conductivity <u>120 uS/cm</u>

Conductivity range <u>50-150 uS/cm</u>

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Conductivity

- Human activity introduces salt and other pollutants to stream water

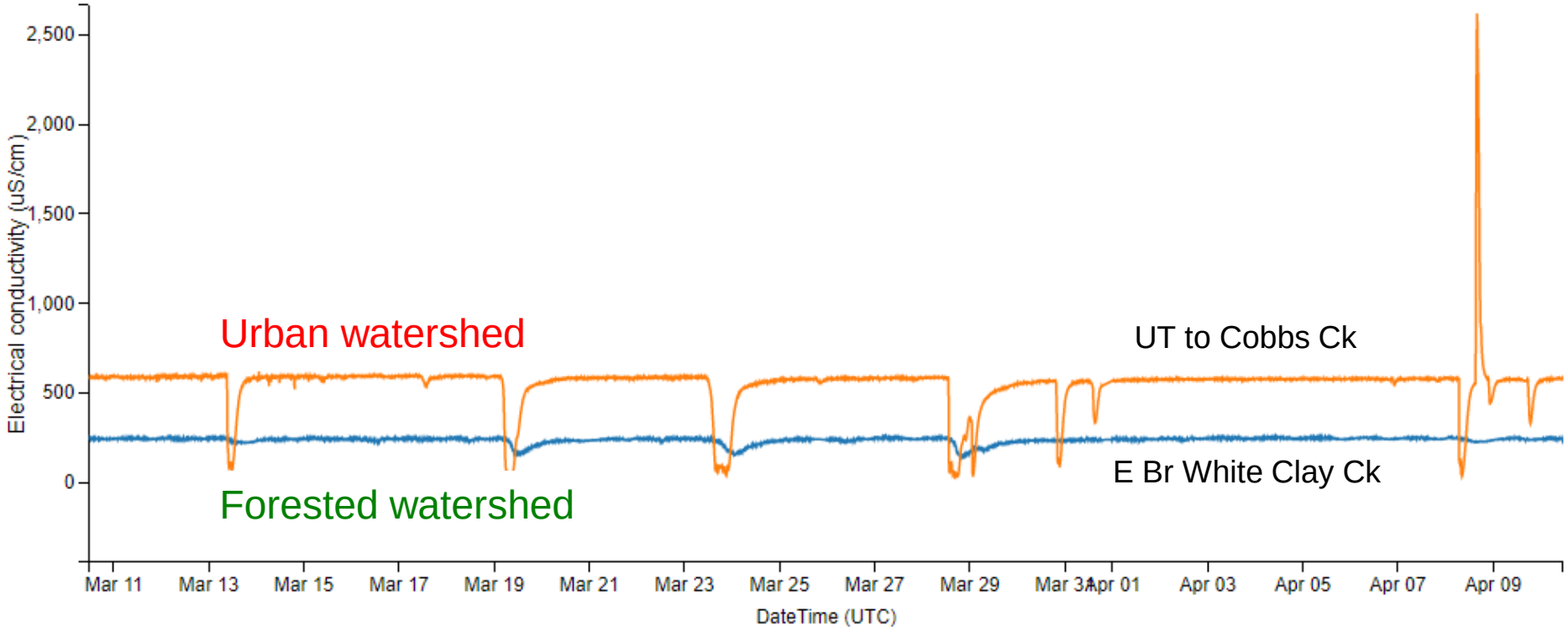
Rocky Run at Concord Mall, DE

Average conductivity <u>1100 uS/cm</u>

Conductivity range <u>300-45,000 uS/cm</u>

Conductivity

- Streams surrounded by roads, buildings, parking lots, etc usually have higher conductivity than streams in natural settings



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Conductivity

- Road salt and de-icers are prominent issue in developed watersheds, “freshwater salinization syndrome”

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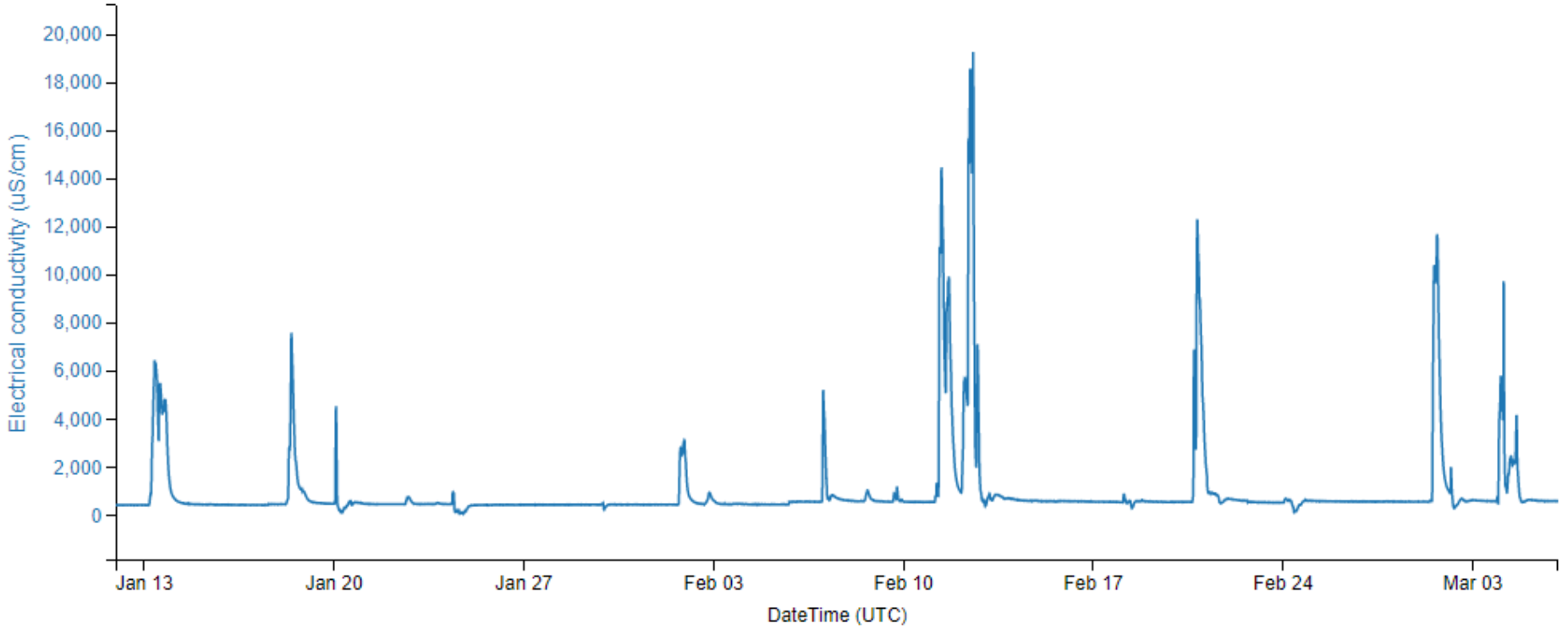
Conductivity

- Road salt and de-icers are prominent issue in developed watersheds, “freshwater salinization syndrome”



UT to Cobbs at McCall Golf Course, 2019

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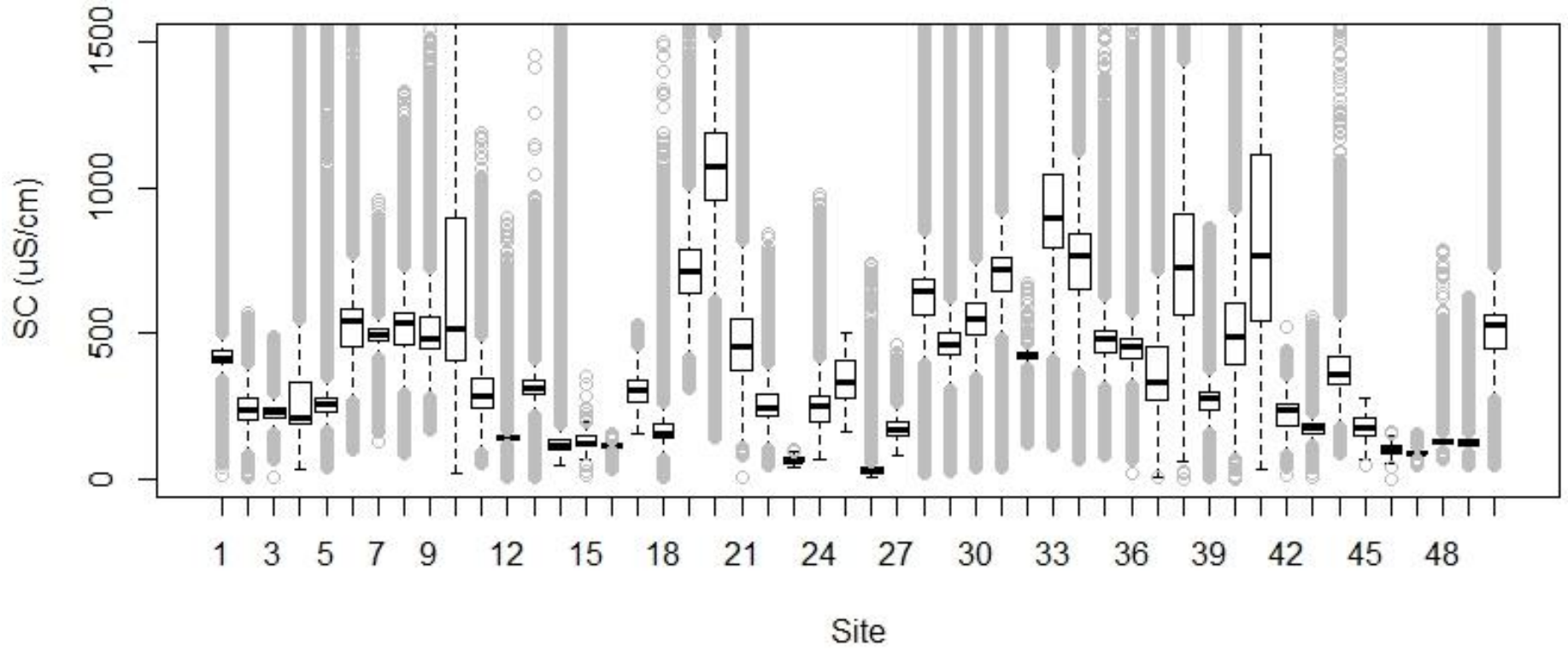
Conductivity

Conductivity in streams across the Delaware River Basin



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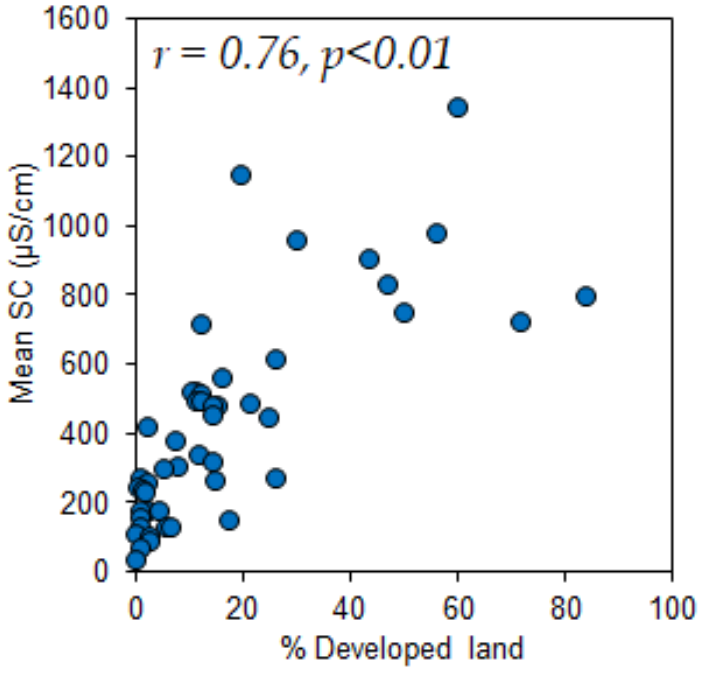
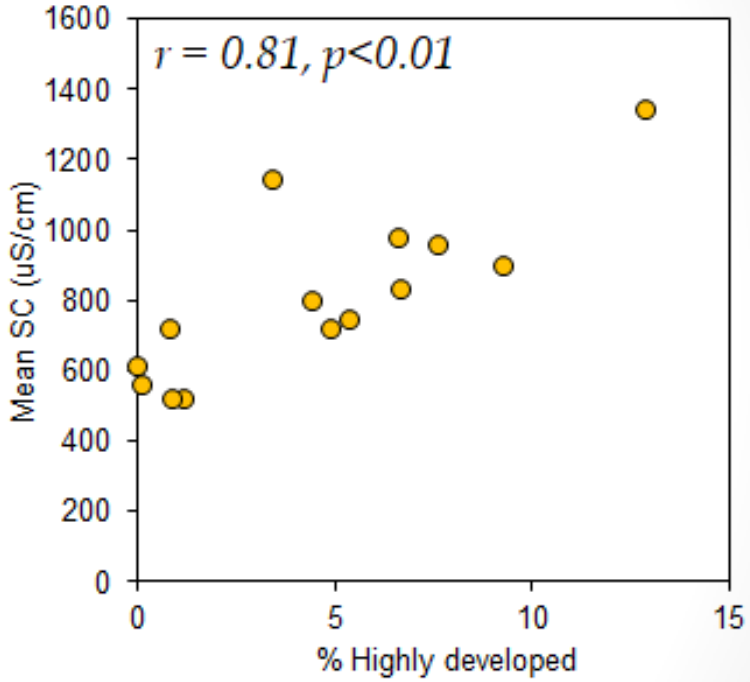
Conductivity

Specific conductivity and land use





- % developed land in the WS was the best land-use predictor of mean SC across the study period
- For sites with highest mean SC, it was best explained by % highly developed land-use

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Water Temperature

- Why is it important?
  - Affects biology – fish, macroinvertebrates
    - Dissolved Oxygen (DO) in water decreases as Water Temperature increases
    - Warmer temps increase toxicity of pollutants
    - Can serve as a coarse indicator of watershed conditions

Trout need cold water!

Less than 70 degF

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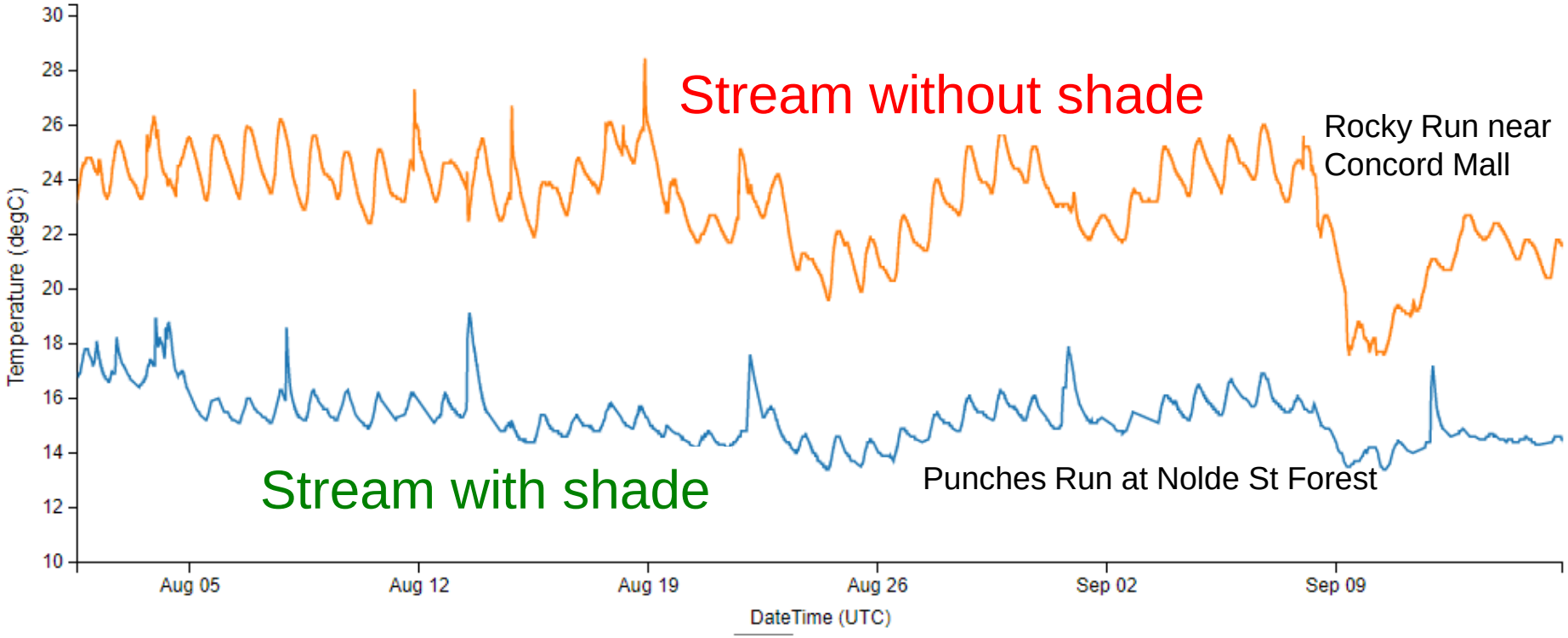
Water Temperature

- Streams with trees are generally cooler than streams without trees



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Water Temperature

Colder

Warmer

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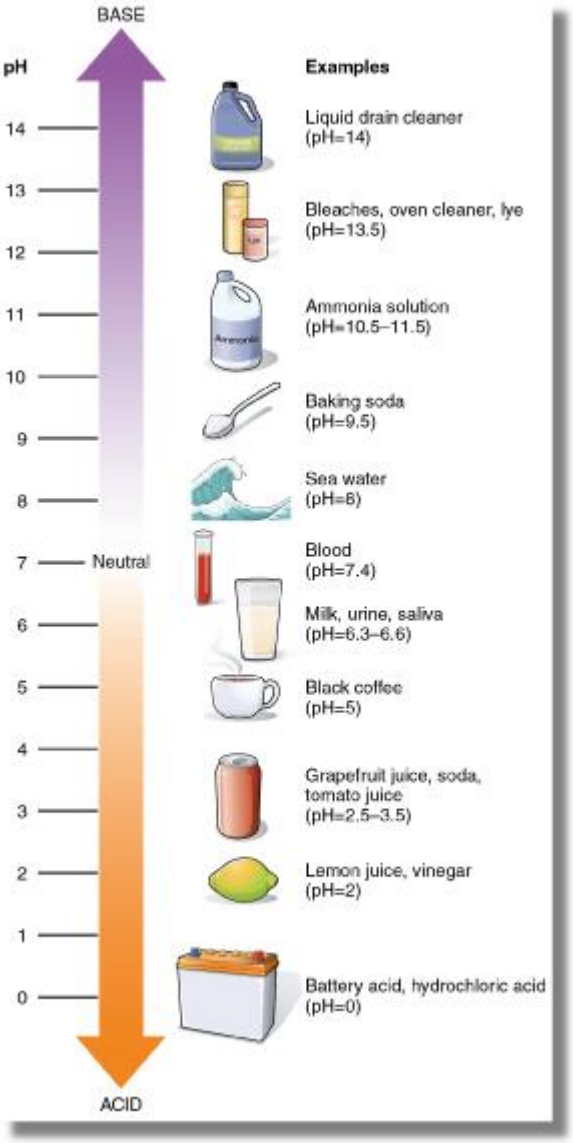
pH

- pH = Concentration of Hydrogen ions in water
  - More H^+ means lower pH (acidic)

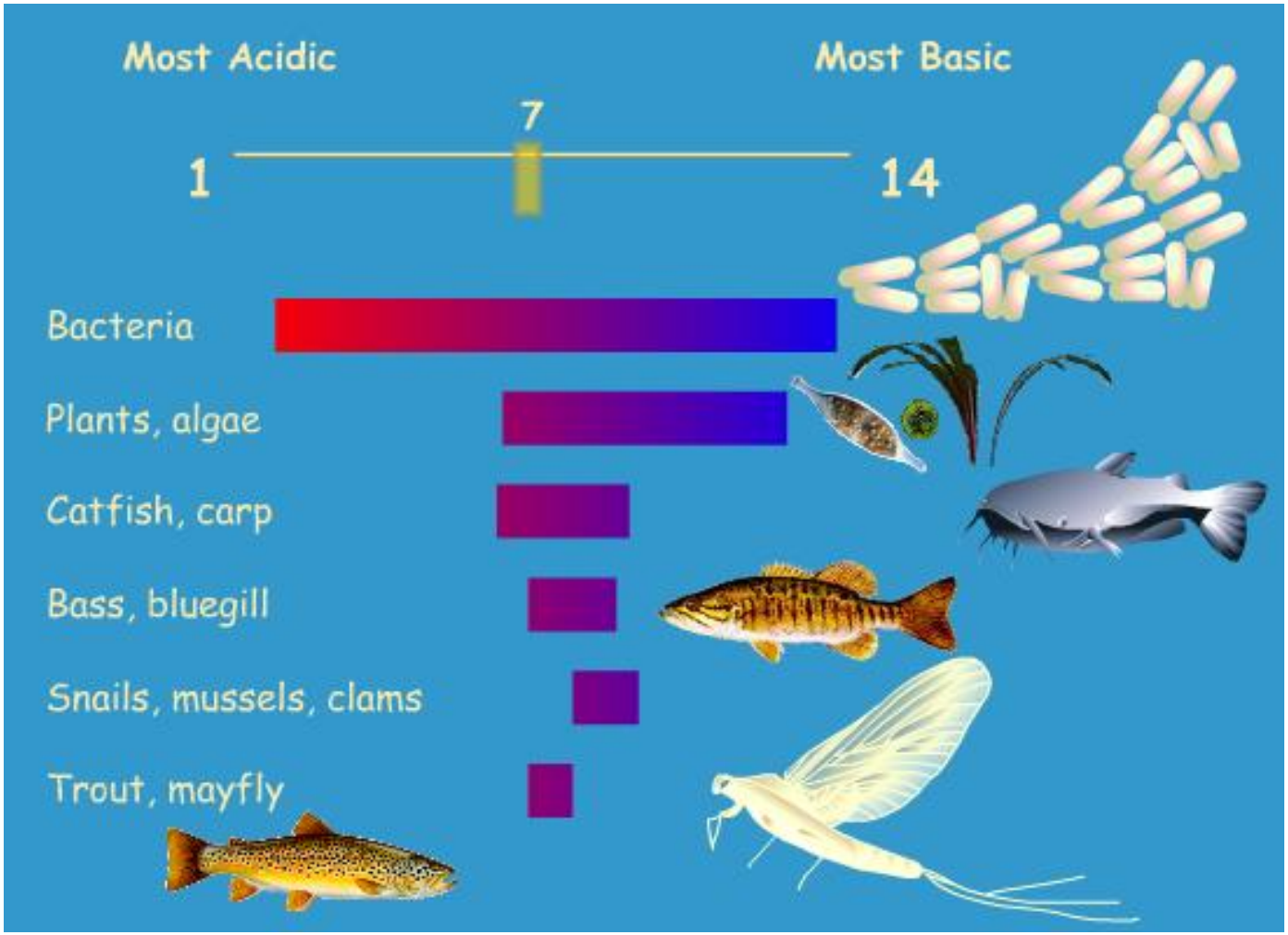
- pH of streams is generally **6.5-8.5**



pH

- Why important?
  - Affects drinking water, acid corrosion, hard/basic water causes deposits on pipes
  - Acidic conditions harmful to aquatic life
  - Affects metabolism and usage of nutrients
  - Metals and other pollutants tend to be more toxic at lower pH because they are more soluble

pH



http://techalive.mtu.edu/meec/module05/pH.htm

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Water Depth (Discharge or Stream Flow)

- Why important?
  - Flooding issues, flashy stream flow – lots of water at one time
  - High stream flow can hurt the stream banks, habitat, and streamside vegetation
  - Low stream flow can reduce habitat, warm water, reduce oxygen
  - Storm water carries a lot pollutants
    - Understanding how much water there is can help understand how much pollution there is

Water Depth (Discharge or Stream Flow)

- Impervious surfaces = hard surfaces that don't allow water to get into the ground
  - Causes flooding and destruction of stream habitat, banks, and riparian zones

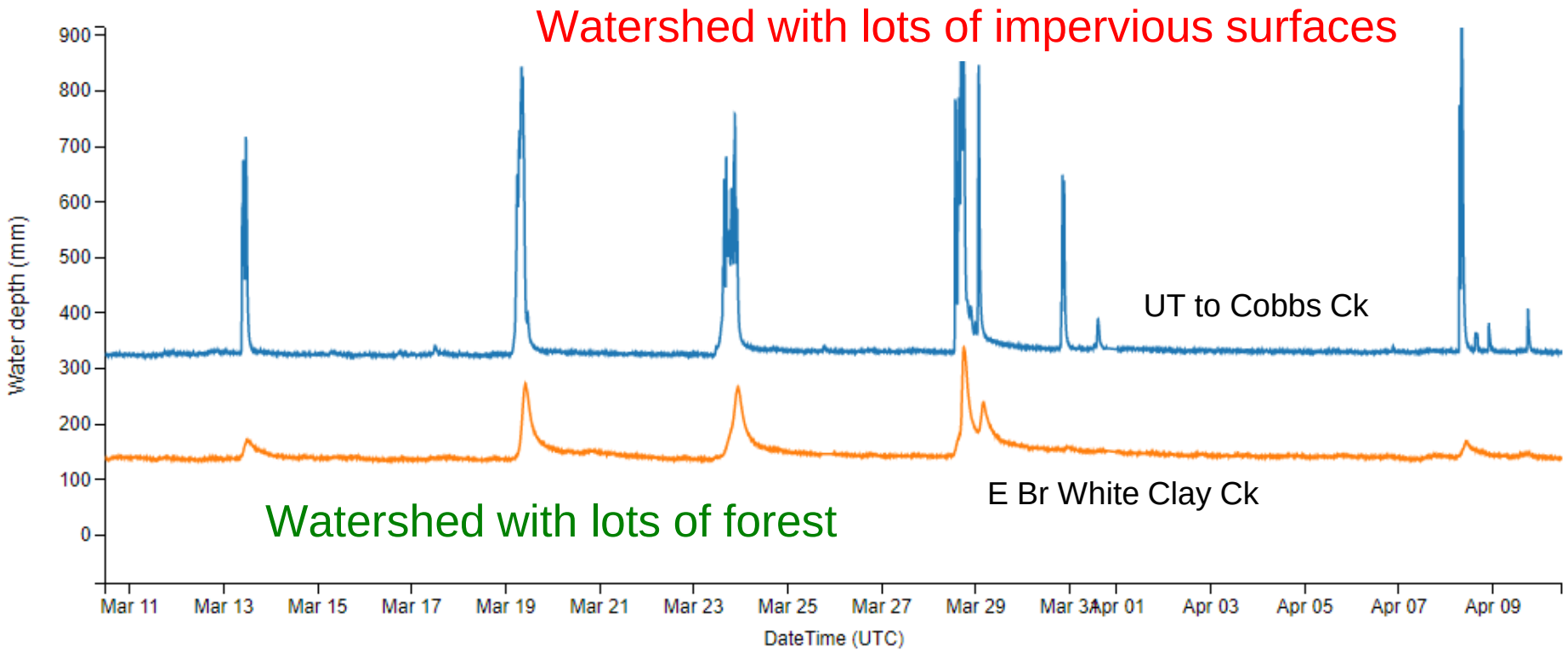
- Typical impervious surfaces
  - Roads
  - Parking lots
  - Roofs
  - Agricultural fields (to some extent)
  - Lawns (to some extent)

Water Depth

Impervious surfaces don't allow water to enter the ground – instead rain water quickly runs into a storm drain or across the land and into the nearest stream

Water Depth (Discharge or Stream Flow)

- Stream flow is more extreme, flashier, more flooding in urban than forested watersheds



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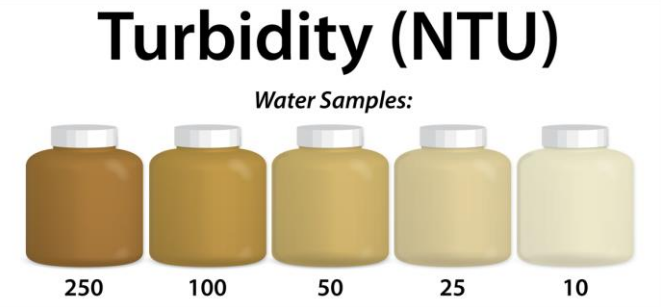
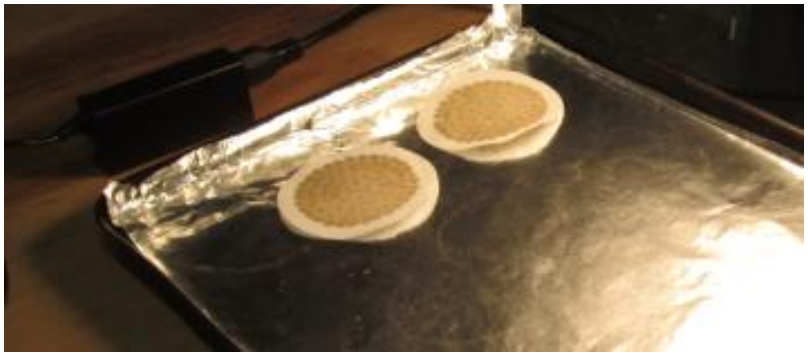
Turbidity and Total Suspended Solids

- Turbidity = how clear/muddy the water is (measured in Nephelometric Turbidity Units, NTU)



- Total Suspended Solids (TSS) = concentration of non-dissolved particles (e.g., silt, sand) in the water (measured as milligrams per liter, mg/L)



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Turbidity and Total Suspended Solids

- Why important?
  - Sediment is a stressor – clogs macroinvertebrate habitat, affects fish spawning and respiration
  - Agriculture loses a lot of soil to water erosion – sediment from farms carried into nearby streams
  - Pollutants (e.g., nutrients, metals) can attach to sediment particles and get carried into streams

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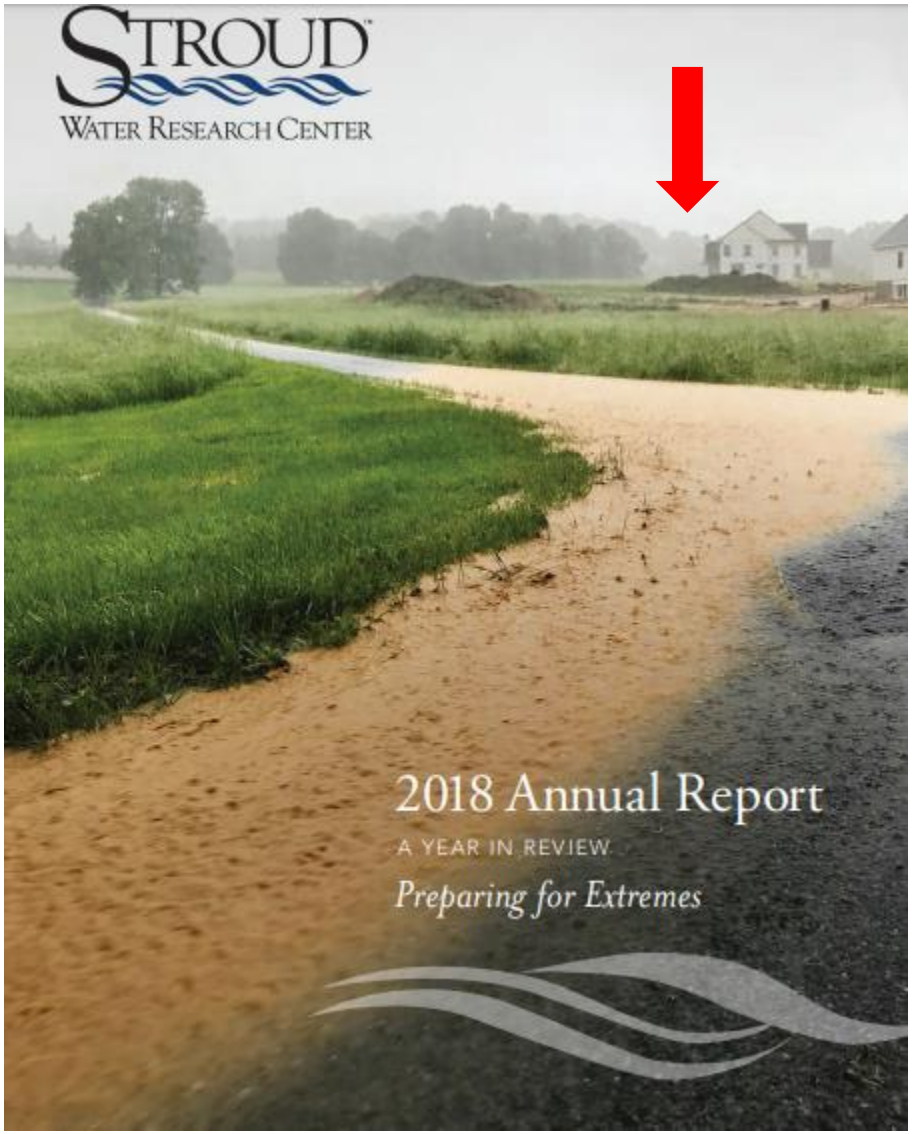
Turbidity and Total Suspended Solids



Sediment washes into streams from any exposed soil

- Construction sites
- Agriculture
- Pasture
- Erosion of stream banks

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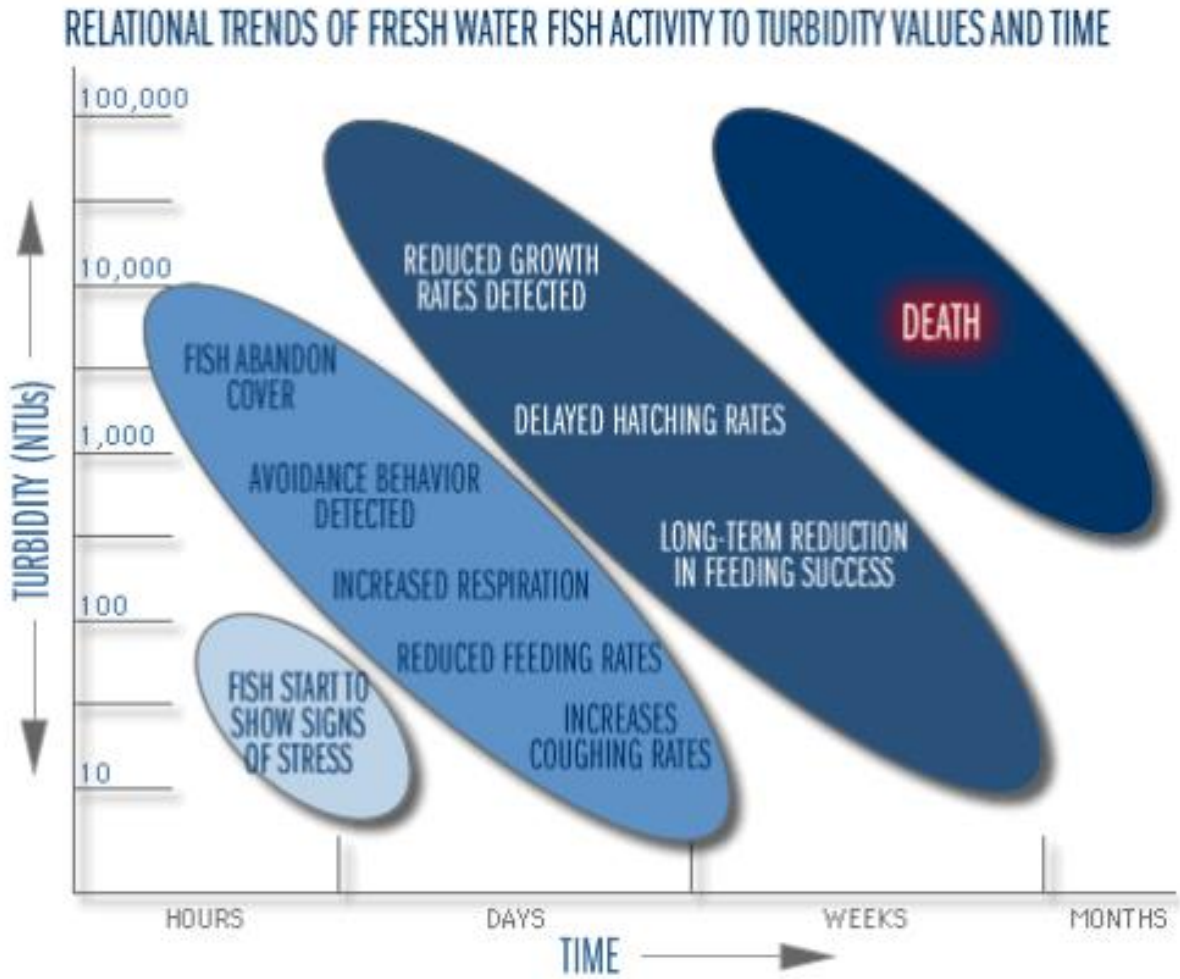
Turbidity and Total Suspended Solids



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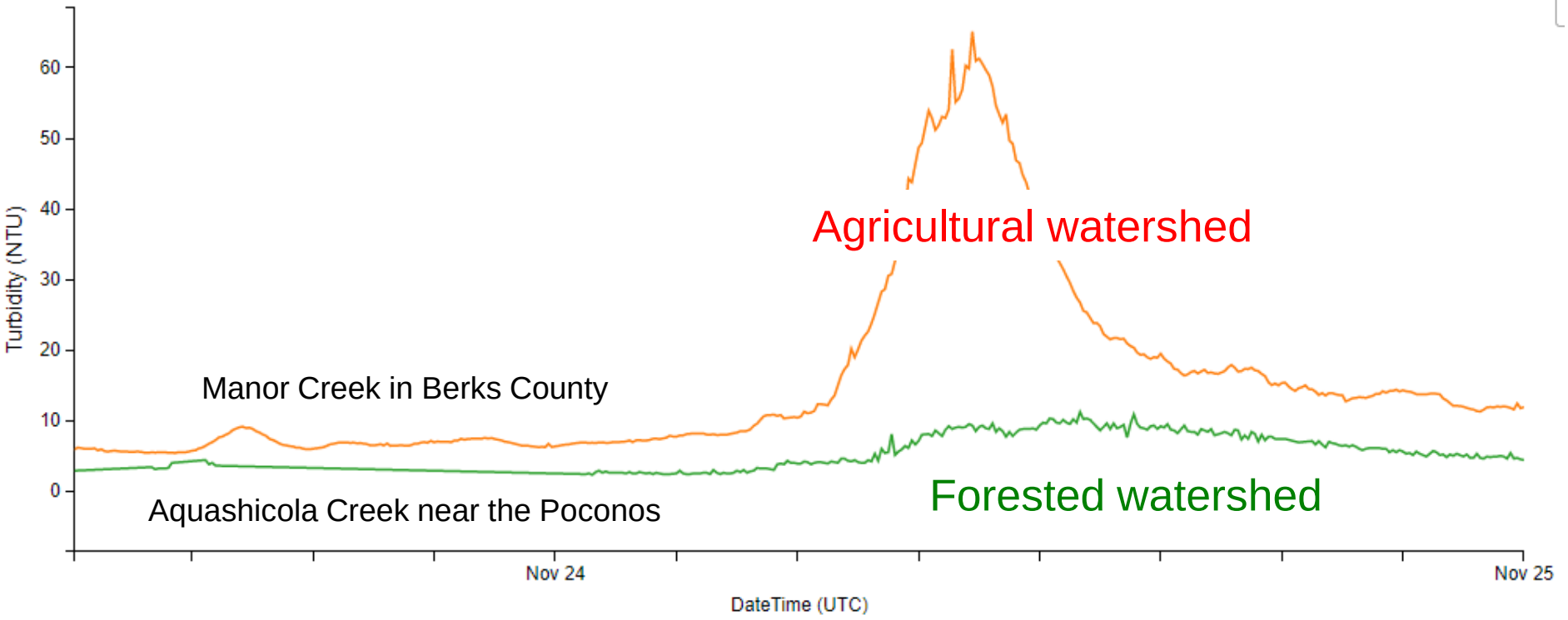
Turbidity and Total Suspended Solids

- Runoff carries sediment from exposed soil into nearby streams causing elevated turbidity (and TSS)



2019

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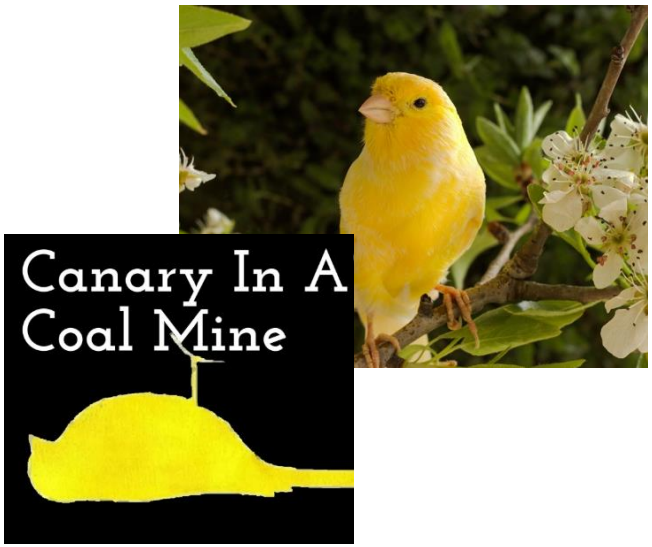
Biology – macroinvertebrates and fish

- All types of animals and plants are affected by their environment
- Macroinvertebrates and fish are often used as indicators of stream health
  - Higher diversity = better stream health
  - Presence of sensitive species = better stream health

Biology – macroinvertebrates

- Key macroinvertebrate indicators of pollution, “EPT” species:
  - Mayflies (**E**phemeroptera)
  - Stoneflies (**P**lecoptera)
  - Caddisflies (**T**richoptera)



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Mayflies, Stoneflies, and Caddisflies in a Stream

https://www.petbarn.com.au/petspot/bird/look-canary-care-food/
https://www.stitcher.com/podcast/canary-in-a-coal-mine

https://www.macroinvertebrates.org/

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Biology – macroinvertebrates

- Mayfly, Stonefly, and Caddisfly larvae live in the stream
- Adults are terrestrial – see them flying around, on streamside rocks, in bushes and trees

Mayfly | **Stonefly** | **Caddisfly**

Larva

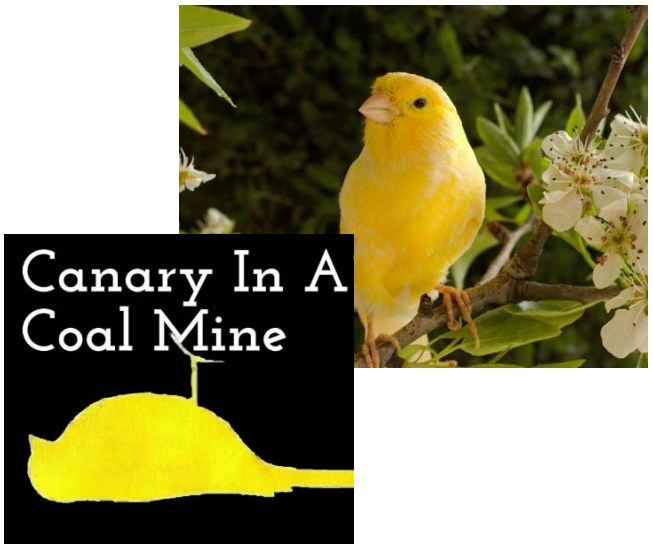
Adult

https://bugguide.net/node/view/840513

https://bugguide.net/node/view/401912

Biology - fish

- Trout and other species of fish can serve as pollution indicators



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Examples of pollution sensitive fish

Brook Trout

Longnose Dace

Brown Trout

American Brook Lamprey

Rainbow Trout

Shield Darter

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Biology - fish

Brook Trout – The only *native* non-migratory trout in eastern North America

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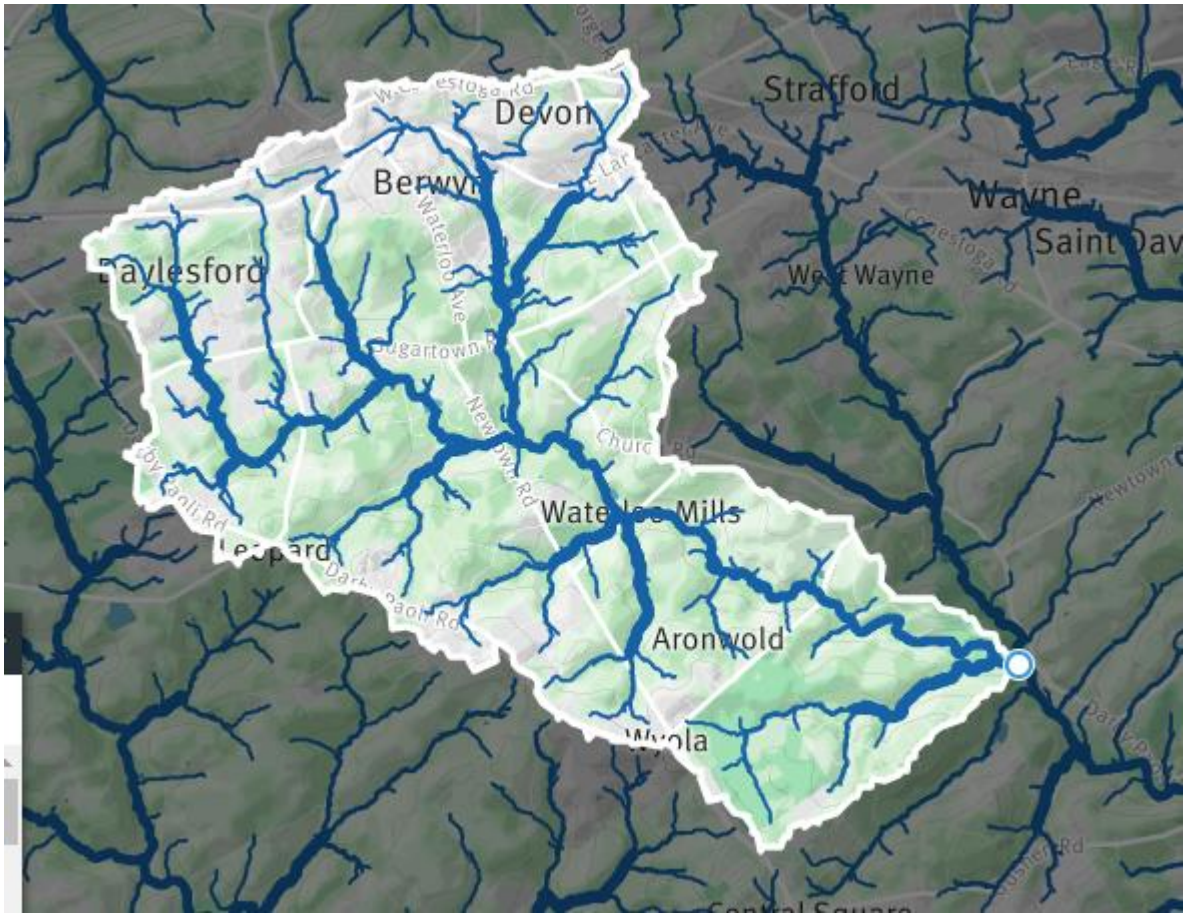
Landscape Conditions

Watershed boundary



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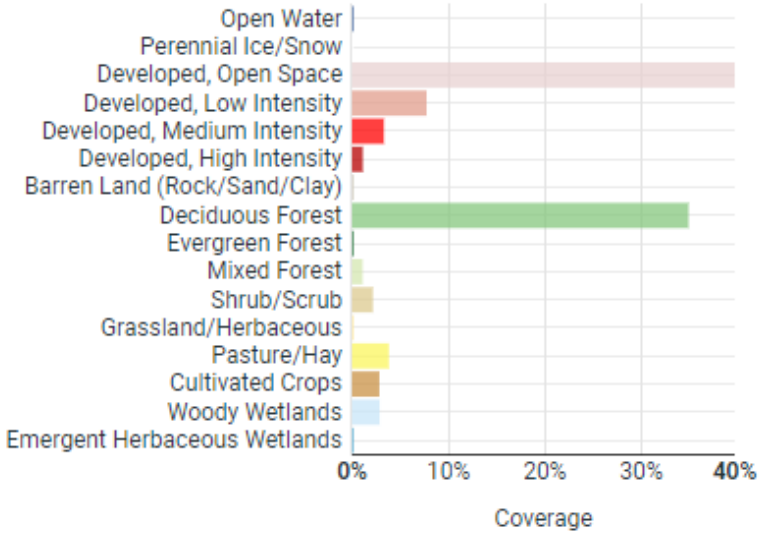
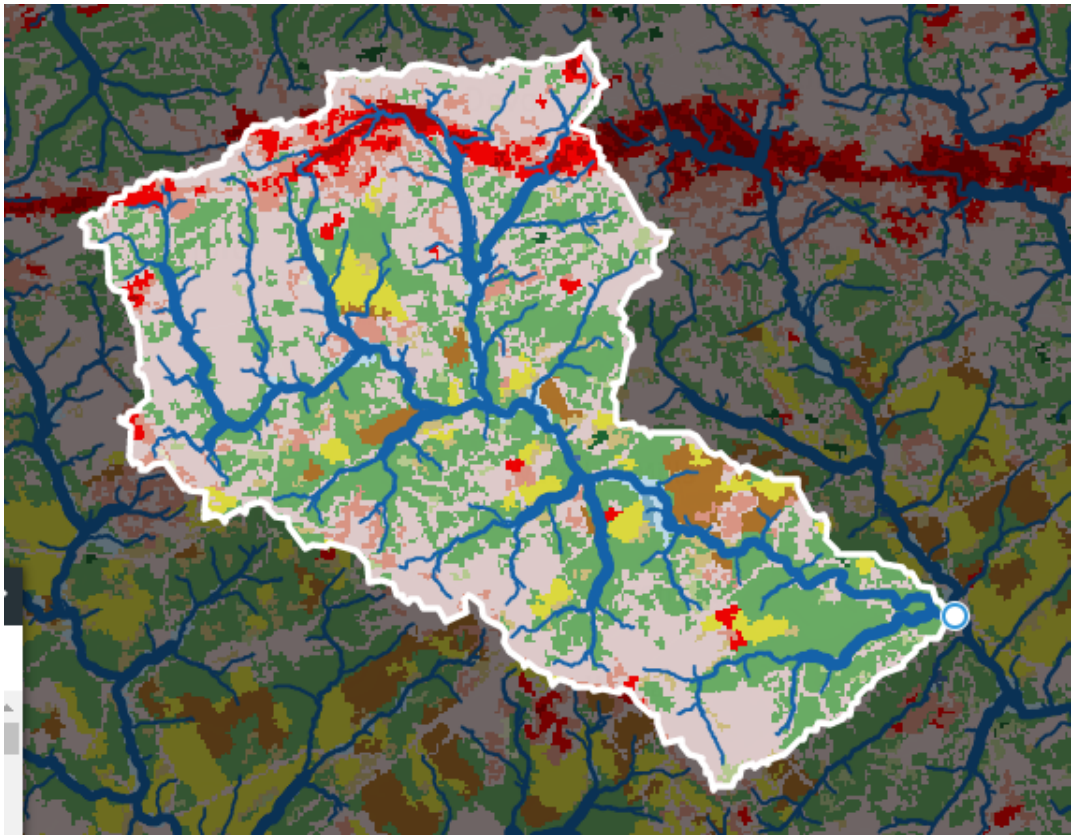
Landscape Conditions

Land Use/Land Cover





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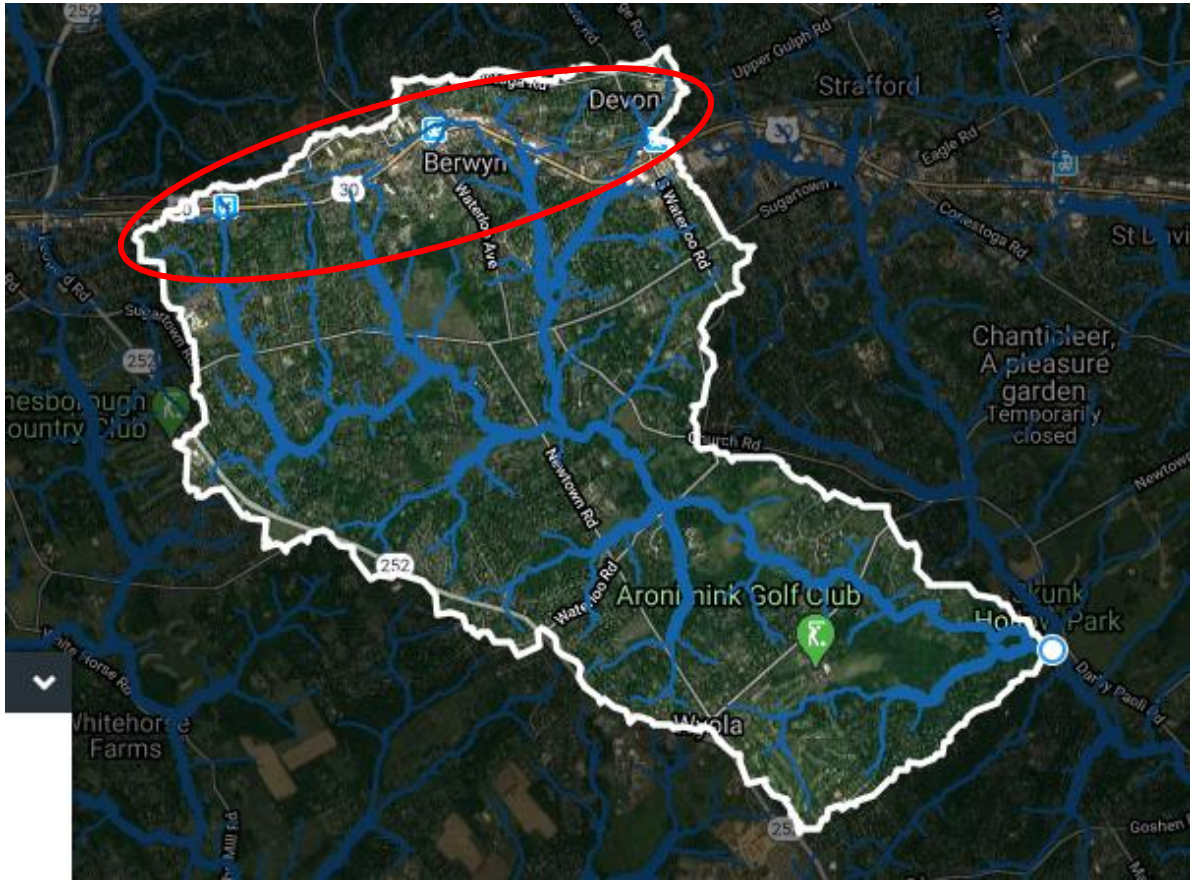
Landscape Conditions

Areal maps



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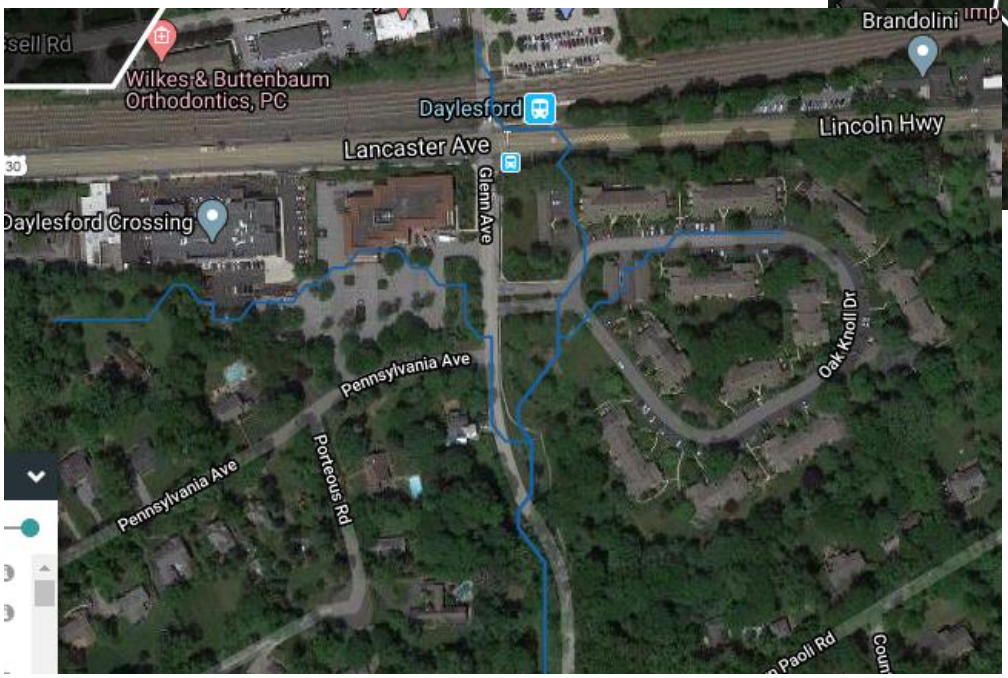
Landscape Conditions

Aerial maps



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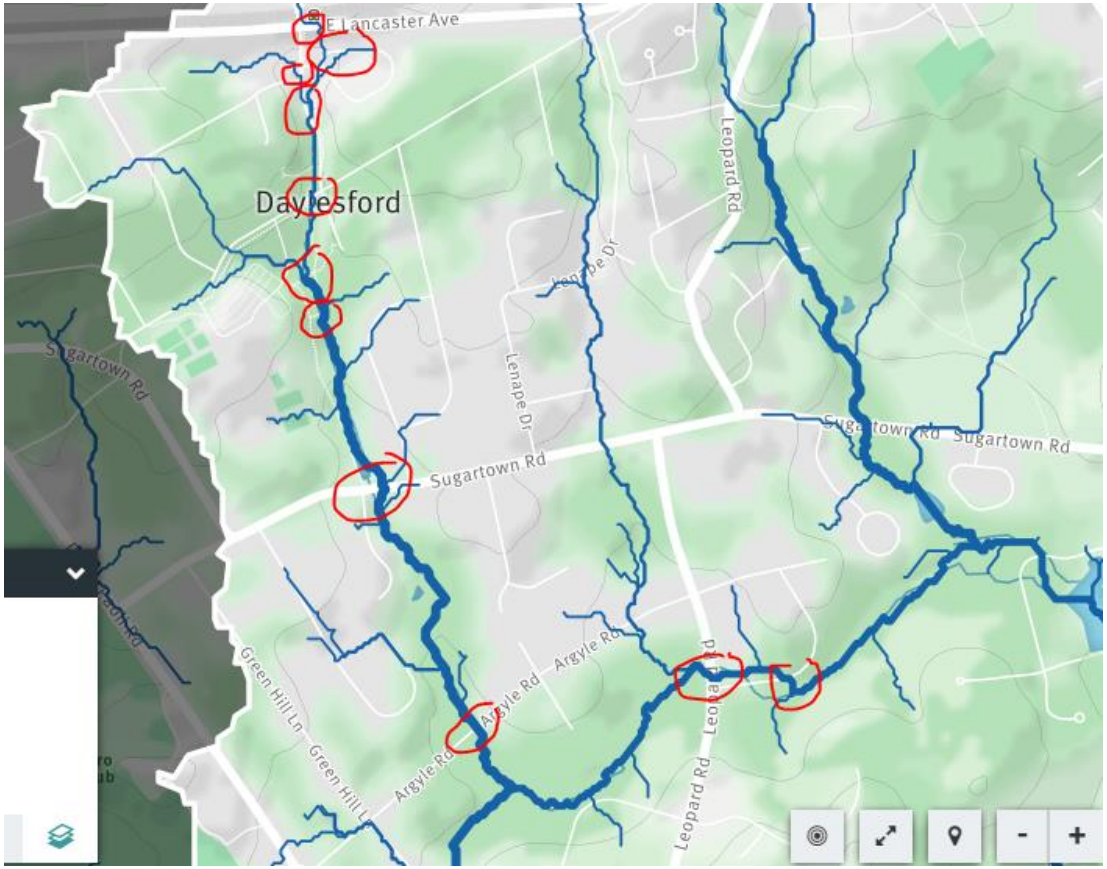
Landscape Conditions

Road crossings



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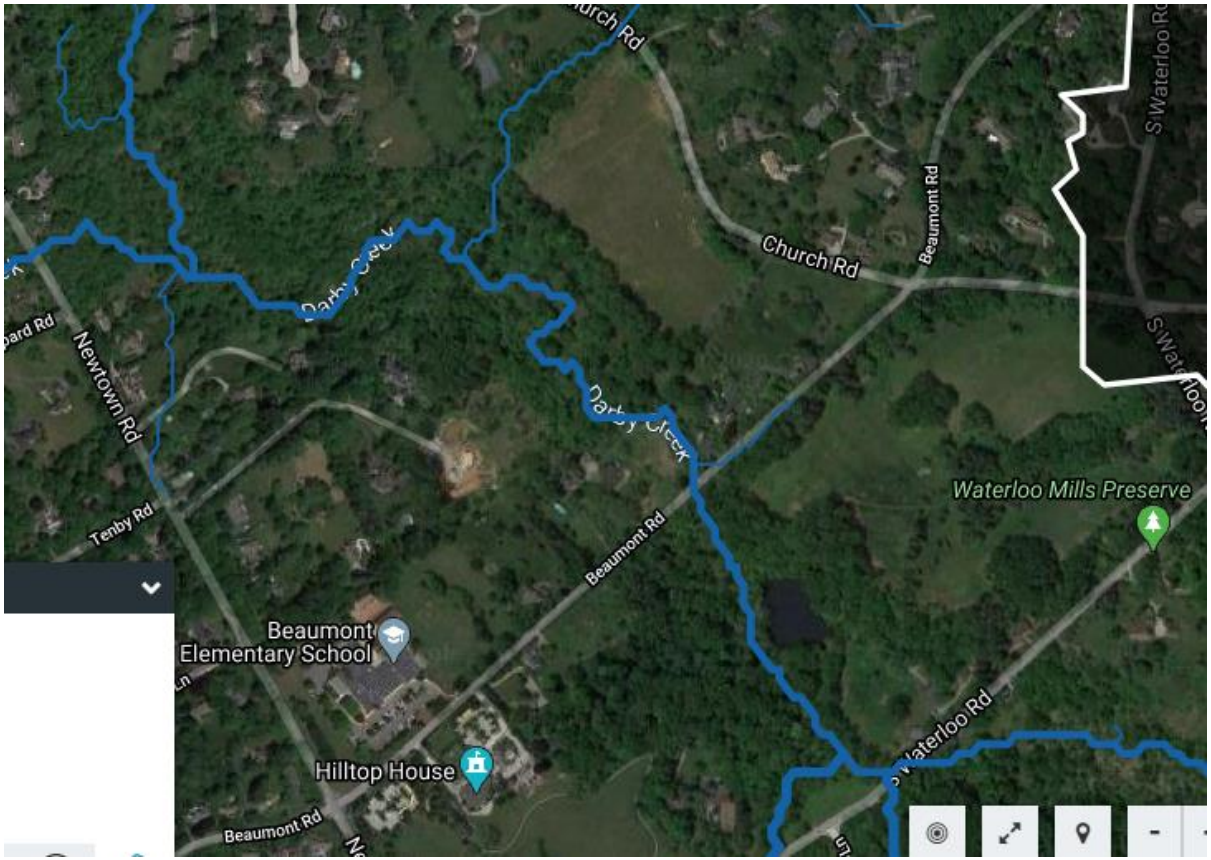
Landscape Conditions

Natural/forested areas



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What about just looking and seeing?

- Go out and look around, explore the watershed, walk the stream, check out road crossings, investigate pipes and discharges, investigate areas where things are changing, turn over rocks in the stream, take clear photos
  - Connecting what's happening on the land to what's happening in the stream
  - Keep your mind open and just look at what's there and see what questions arise
  - Use maps to focus your efforts and guide your path
  - Resources and organizations are available to provide information and support

**Derron LaBrake will be leading stream walks in Darby Creek headwaters!*

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Using your eyes and your feet

What's happening on LAND and in the WATER?

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Using your eyes and your feet

What's happening on LAND and in the WATER?

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Using your eyes and your feet

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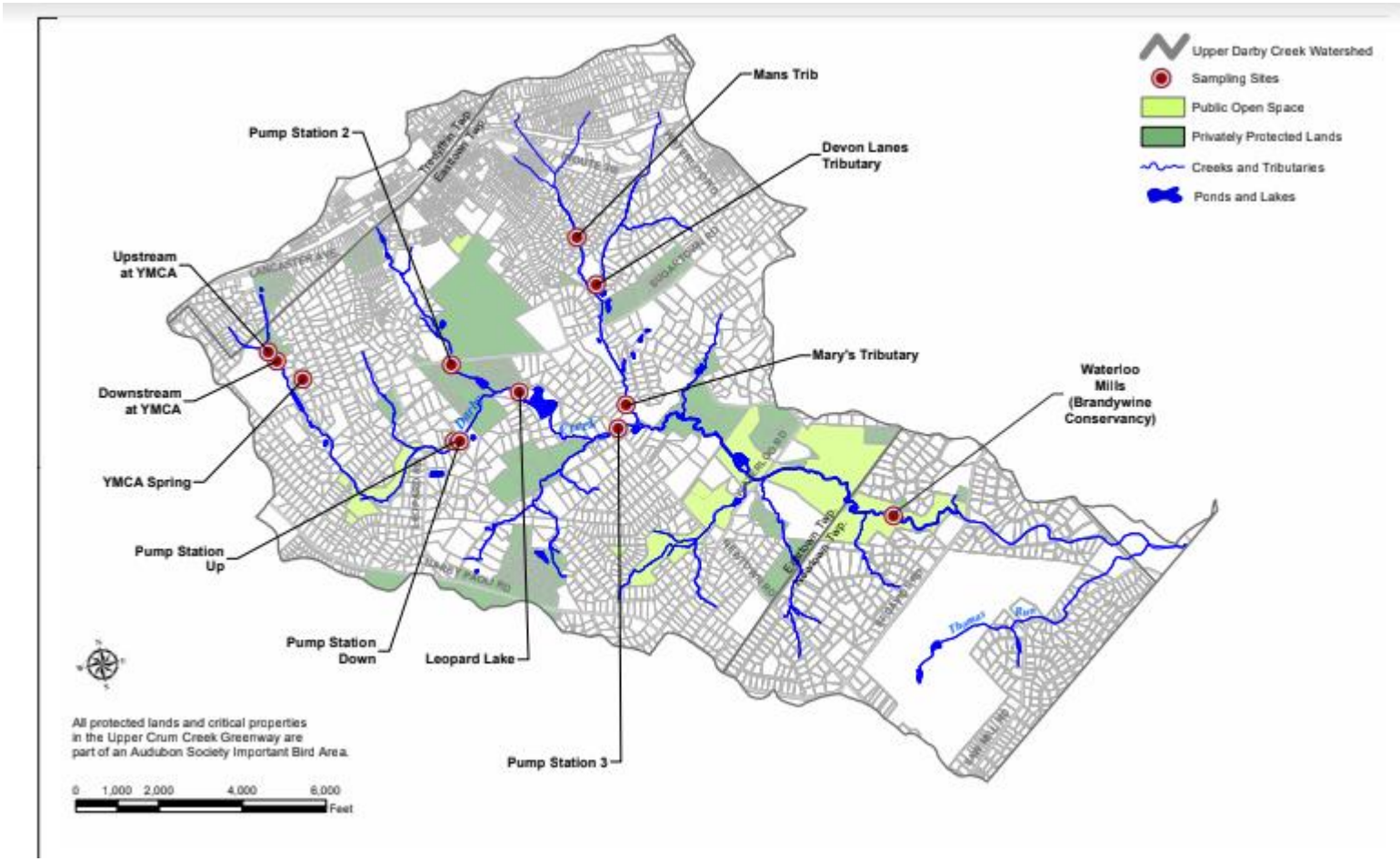

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Thanks!

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