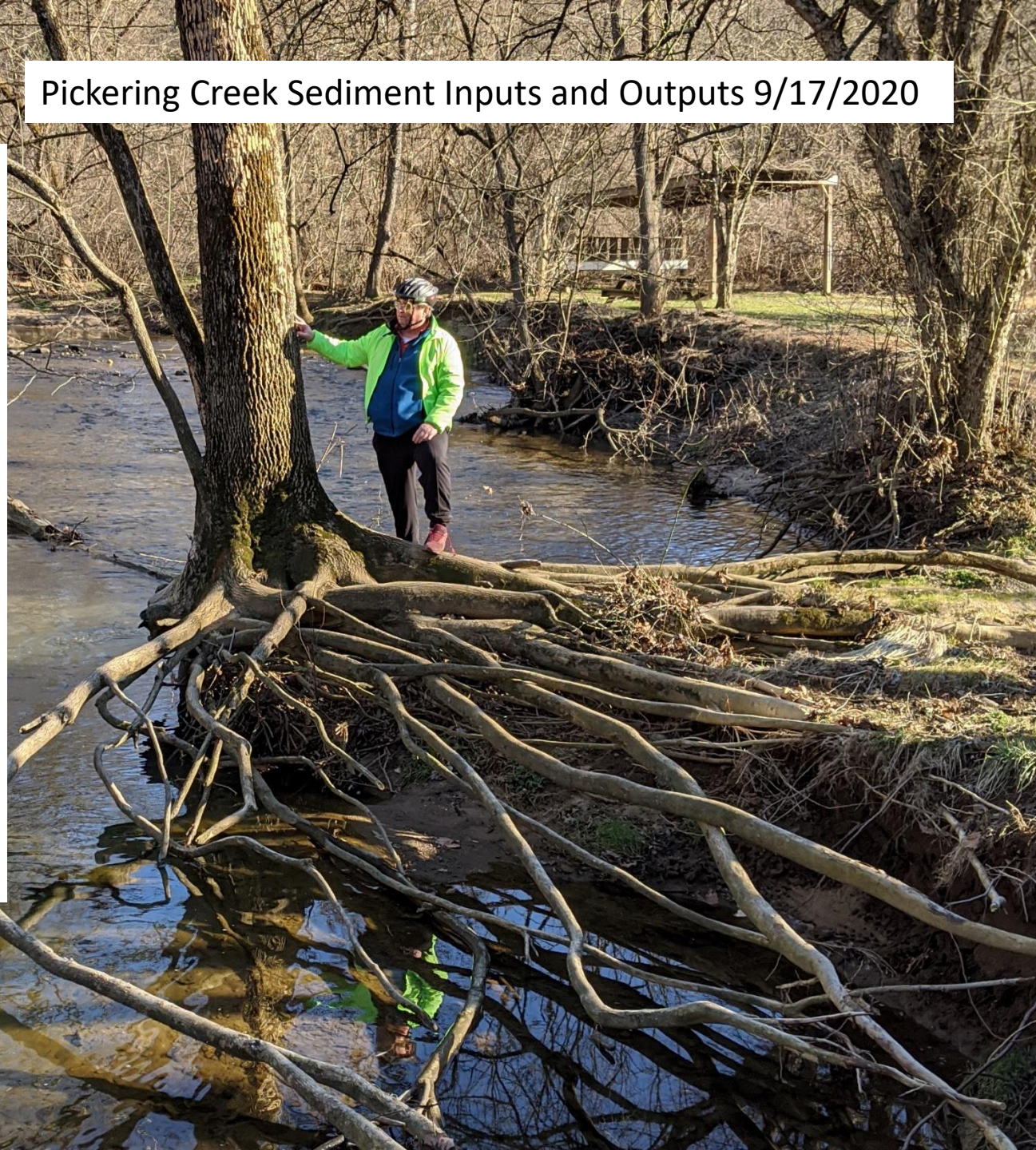
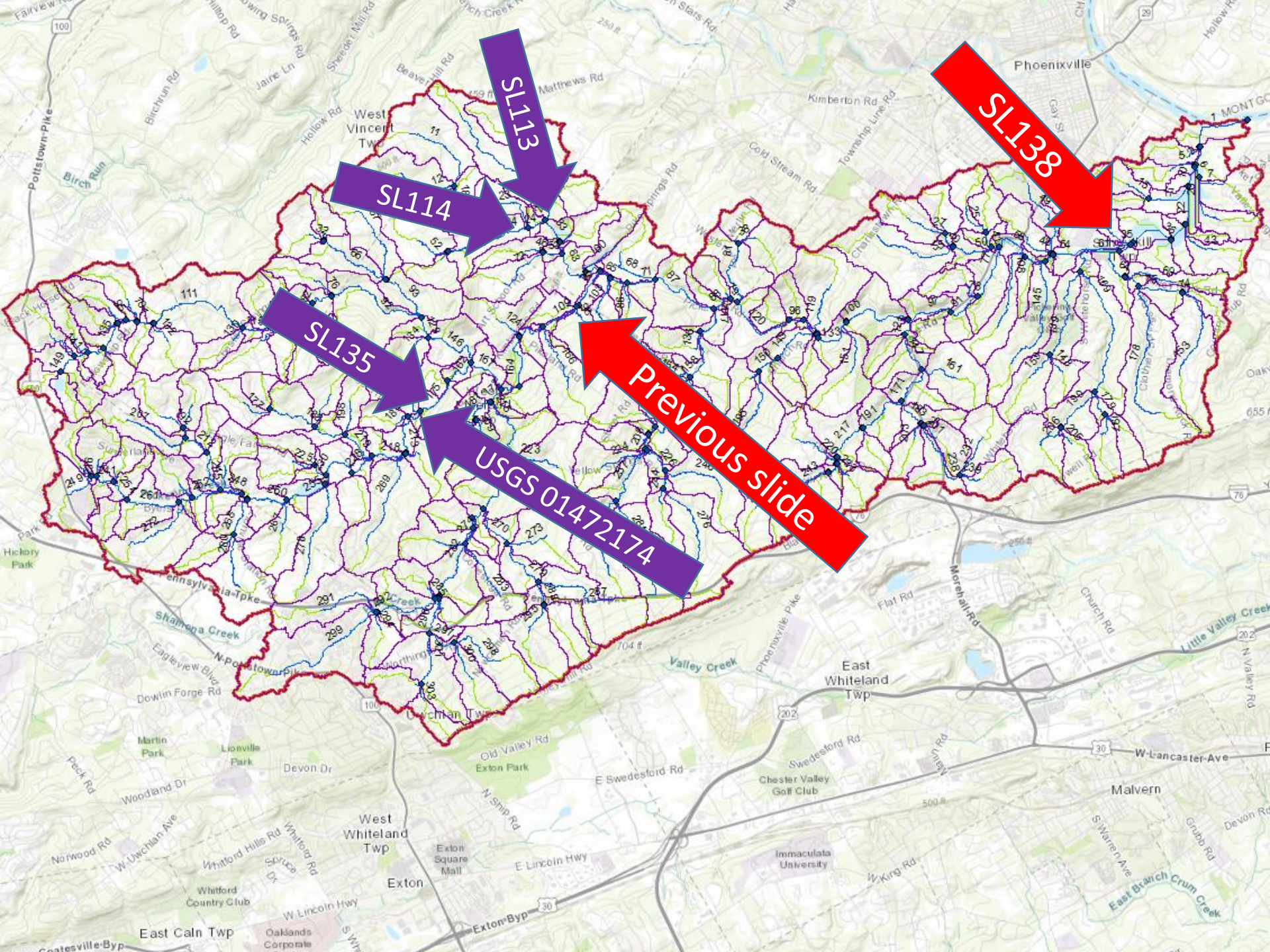


Pickering Creek Sediment Inputs and Outputs 9/17/2020

GVWA's example of processing Mayfly logs

- Work with data from SL138 and focus on the period of 3/2018 to 12/3018
- Technique to clean up turbidity data leveraging modeled flow and runoff data
- Integrate turbidity and flow over time to find sediment loading
- Compare with known sediment sources up stream



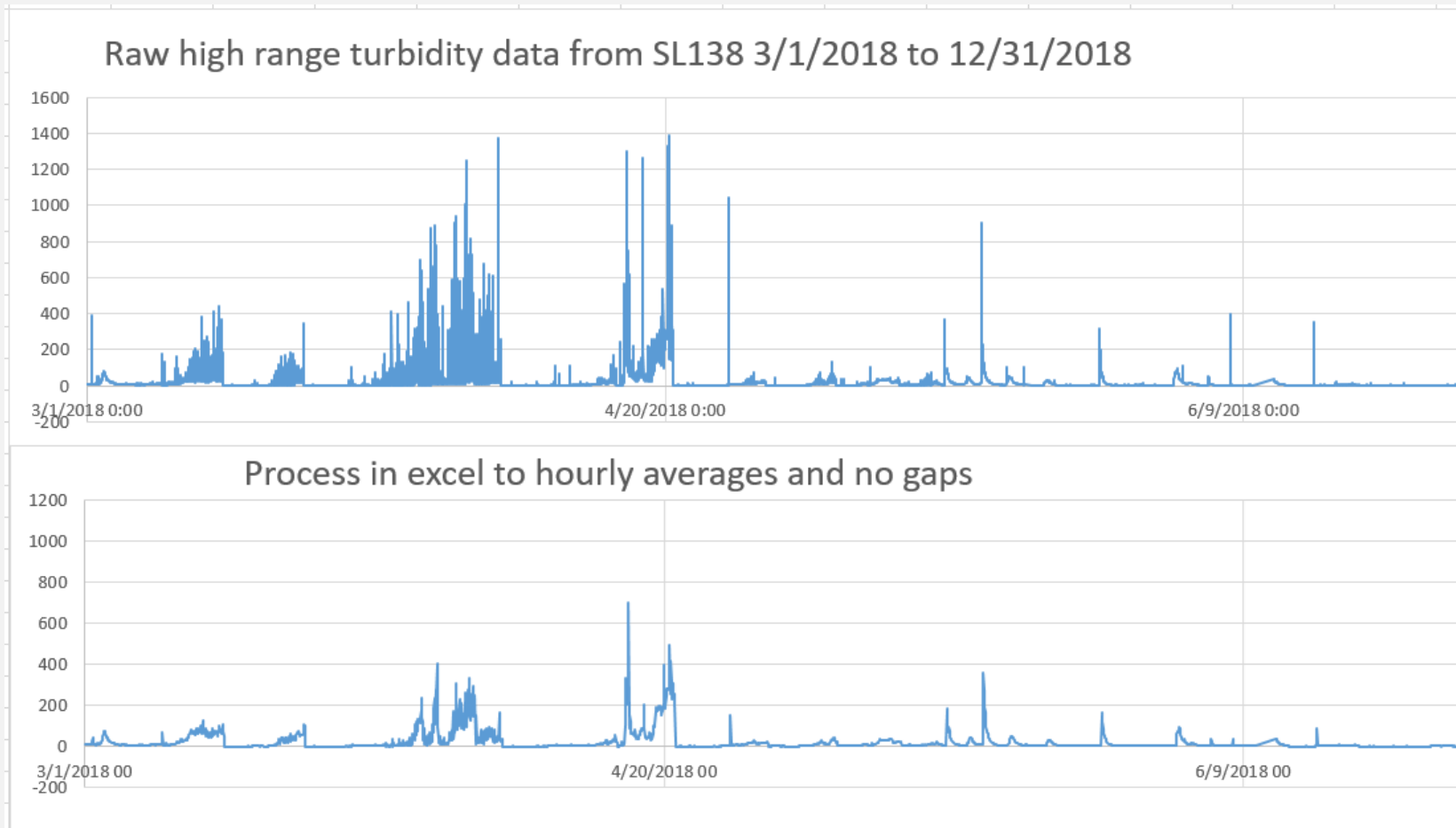




Brook trout (stocked) catch and release photo: Josh Carr.

Raw high range turbidity data from SL138 3/1/2018 to 12/31/2018

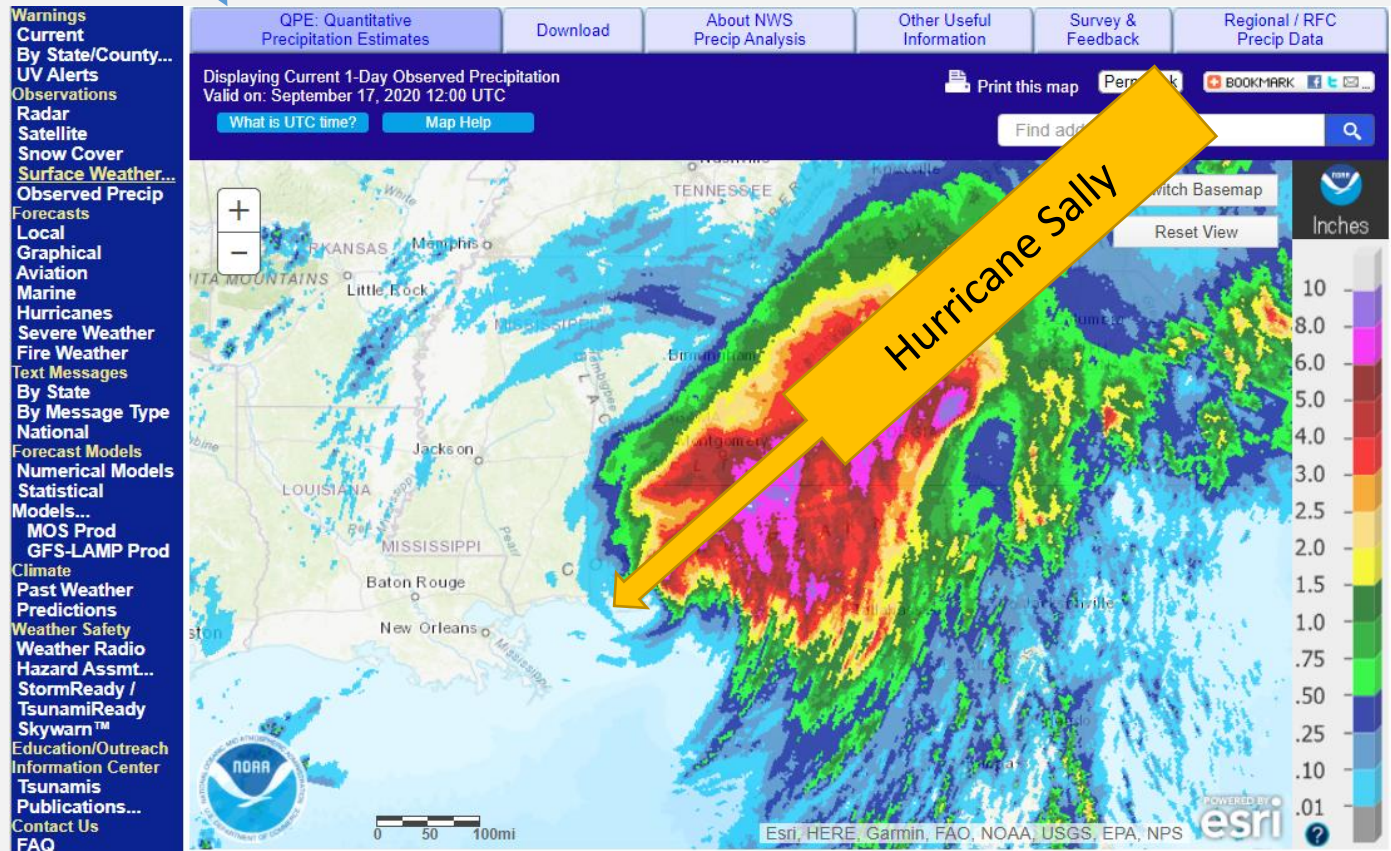
- 5 minute intervals but gaps of any size may be present
- Process in excel to hourly averages and no gaps
- Missing hourly data should be filled as #NA (for graphing in Excel)



We know some of the > 10 turbidity data is from sensor fouling; **we need to filter out turbidity data collected during baseflow conditions.**

- Leverage additional data sources available for the watershed above the SL138
- Data available:
 - Precipitation
 - Solar radiation
 - Wind
 - Humidity
 - Temperature
 - Soils
 - Land Cover
 - Topography

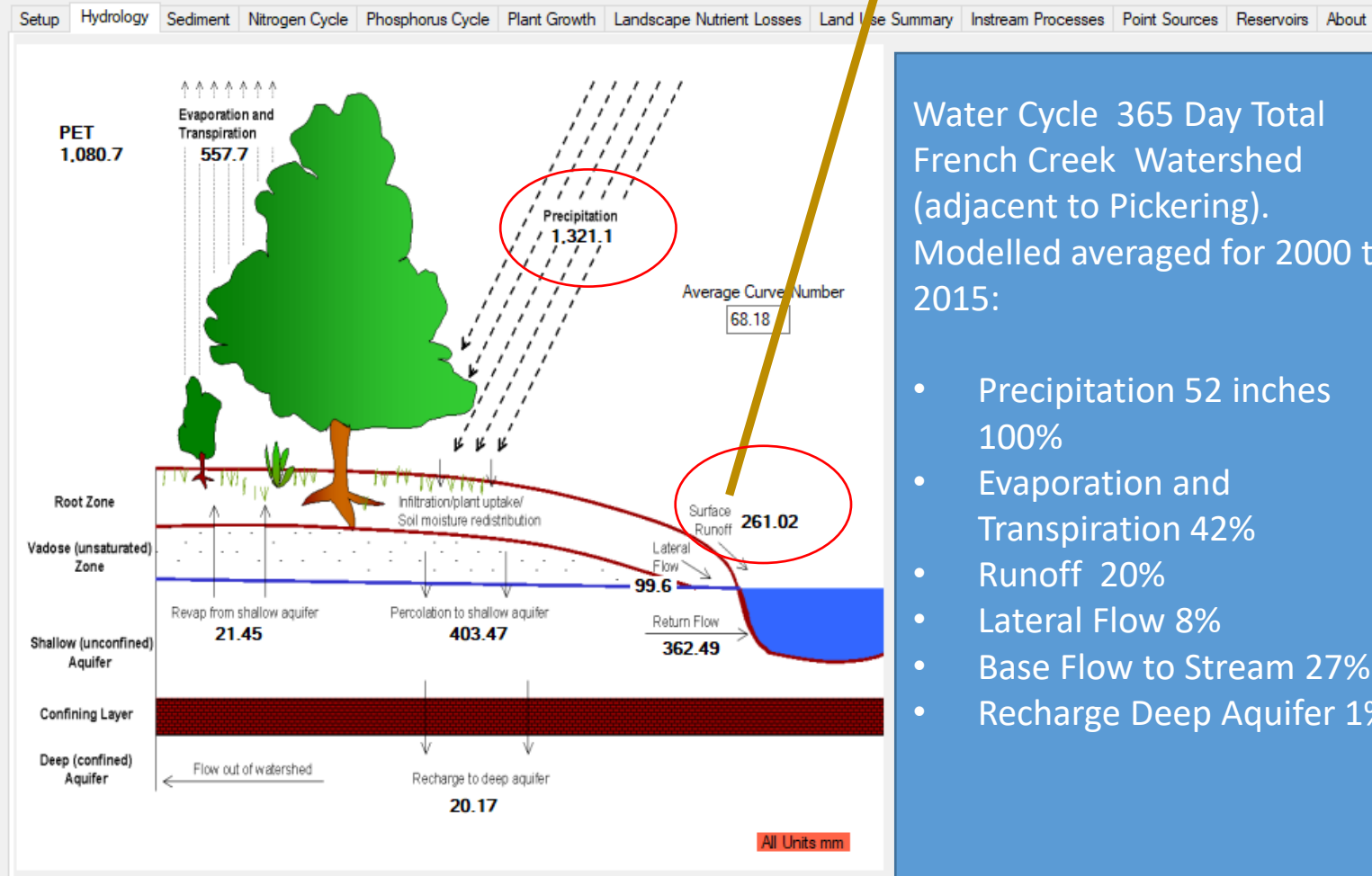
Quantitative
Precipitation
Estimates
combine
surface data
and Nexrad
radar to
provide high
resolution
precipitation
data



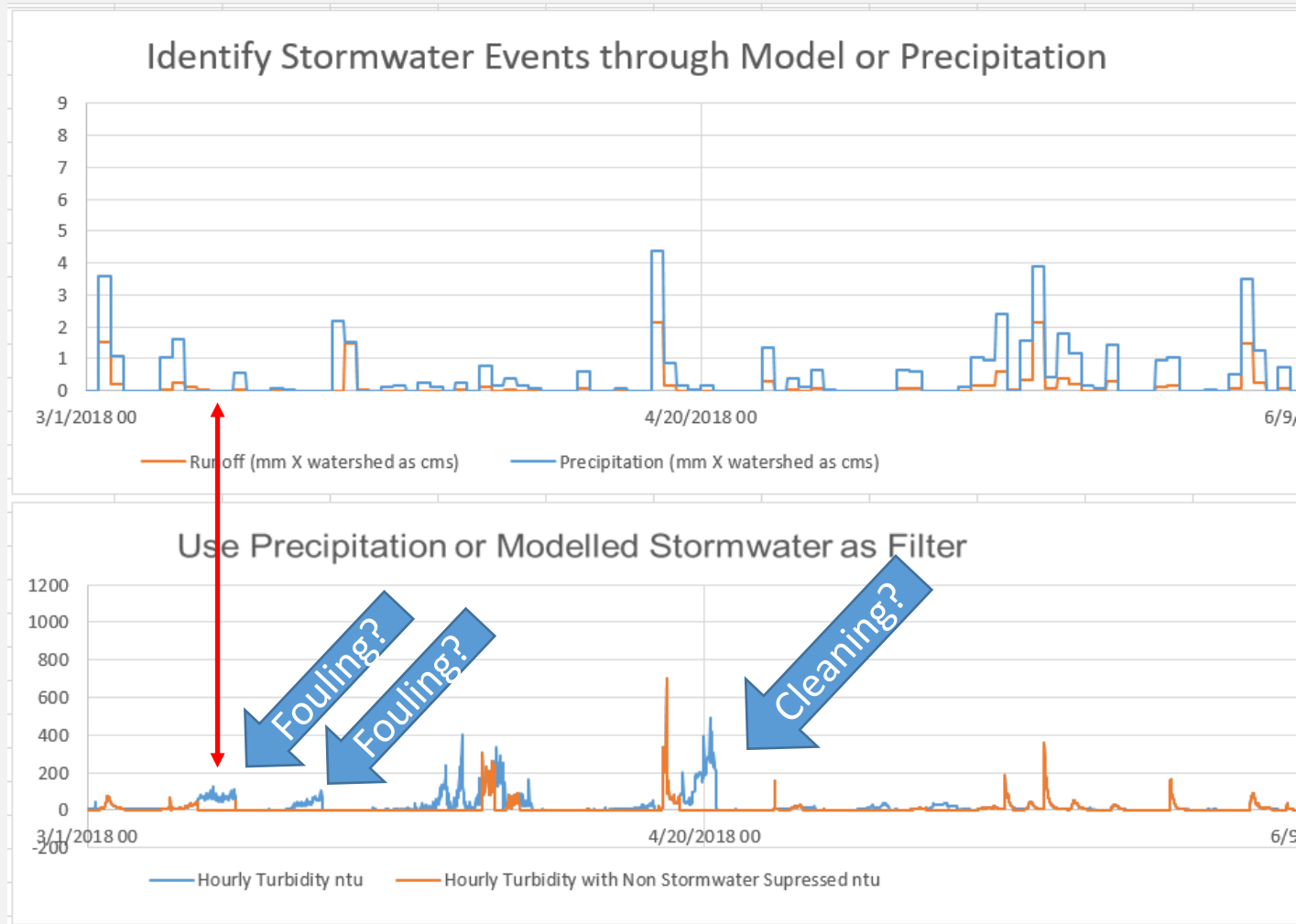
Use SWAT model to process this “outside the stream” data into daily and hourly outputs for

- Water yield to stream channel--includes stormwater
- Surface runoff to stream channel—stormwater
- Groundwater flow to stream channel
- Shallow aquifer flow to stream channel
- Evapotranspiration

Model provides daily and hourly runoff data--use this as filter. Many other filter approaches available

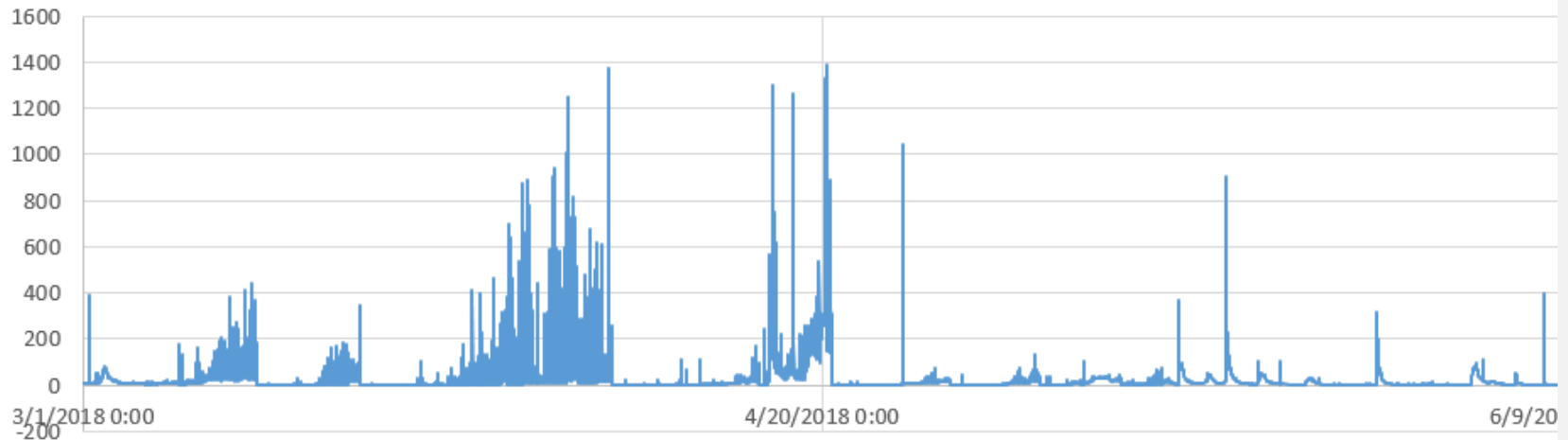


Use modelled stormwater flow as a filter—suppress turbidity data from baseflow conditions. Other approaches are to use precipitation in watershed or process the hydrograph for baseflow. Need to develop QA/QC for applying filter.

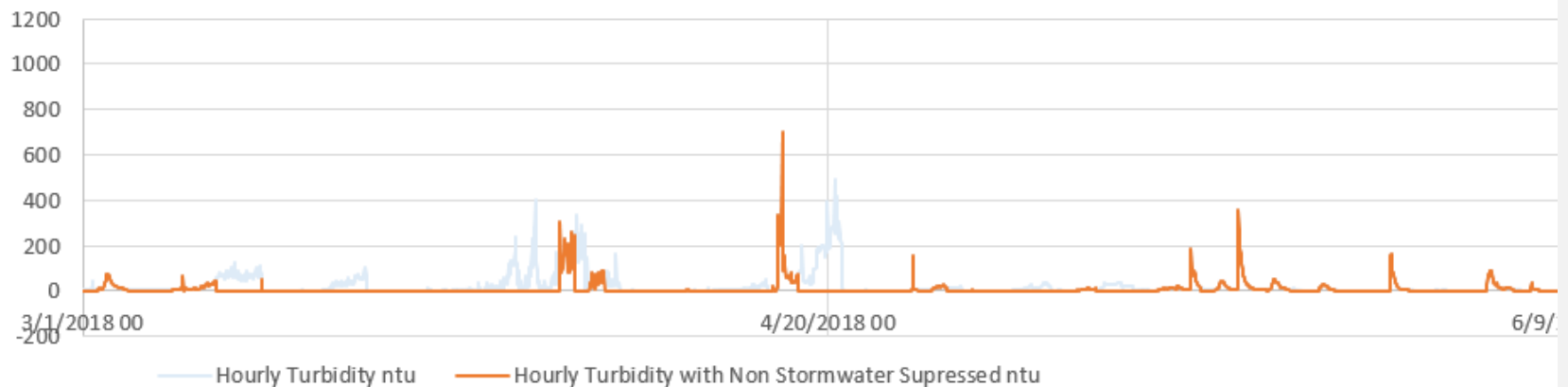


Comparison of raw 5 minute turbidity data to filtered hourly data

Raw high range turbidity data from SL138 3/1/2018 to 12/31/2018

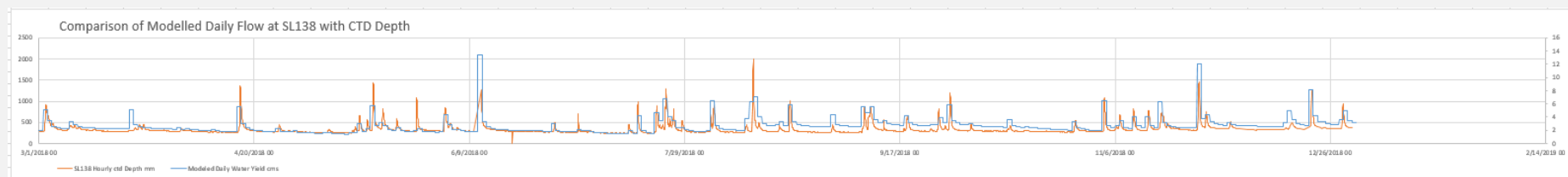
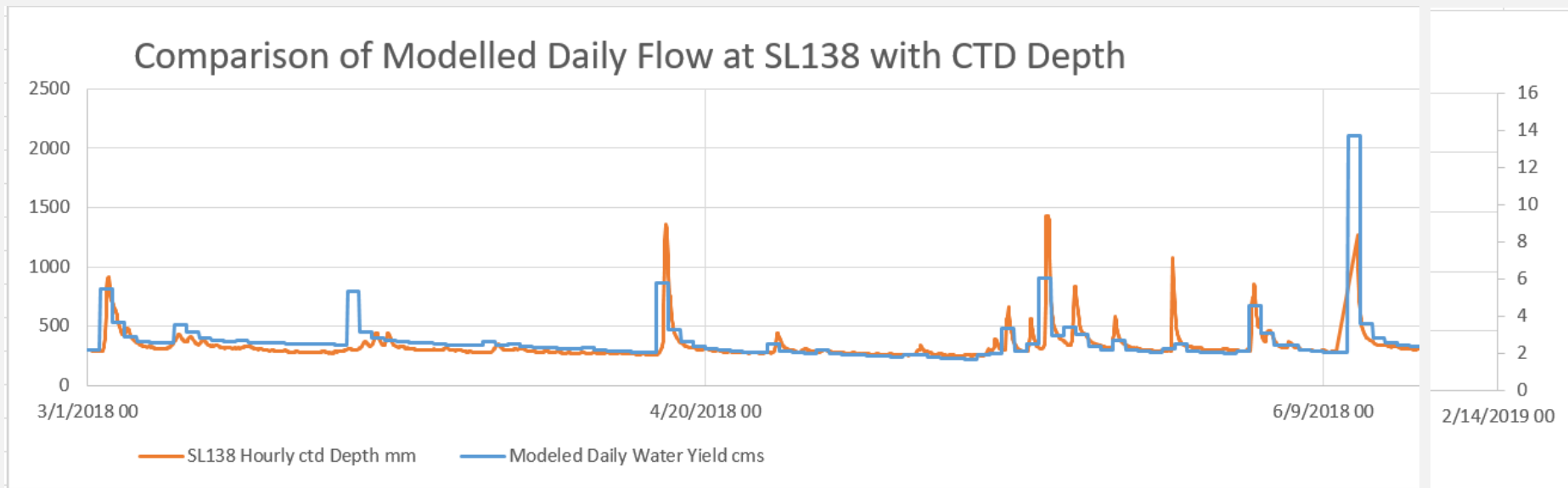


Use Precipitation or Modelled Stormwater as Filter



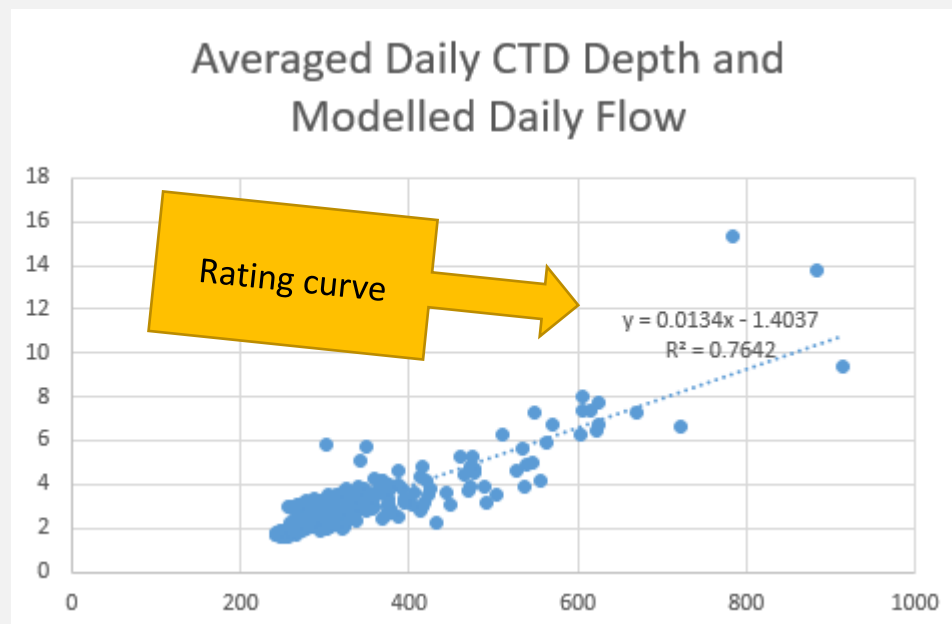
Integrate turbidity and flow over time to find sediment loading

- concentration X volume = mass
- Concentration is proportional to turbidity. Assume for this example that 1 ntu = 2 mg/l total suspended solids (@ 105 C). *Lots of caveats—should be using curve.*
- Need hourly flow, and this will typically come from rating curves developed and updated at the gauge station.
- For this example, using modelled flow and CTD depth to develop rating curve
- Time period of 3/1/2018 to 12/31/2018 was chosen for apparent stability in stream channel depth at SL138.

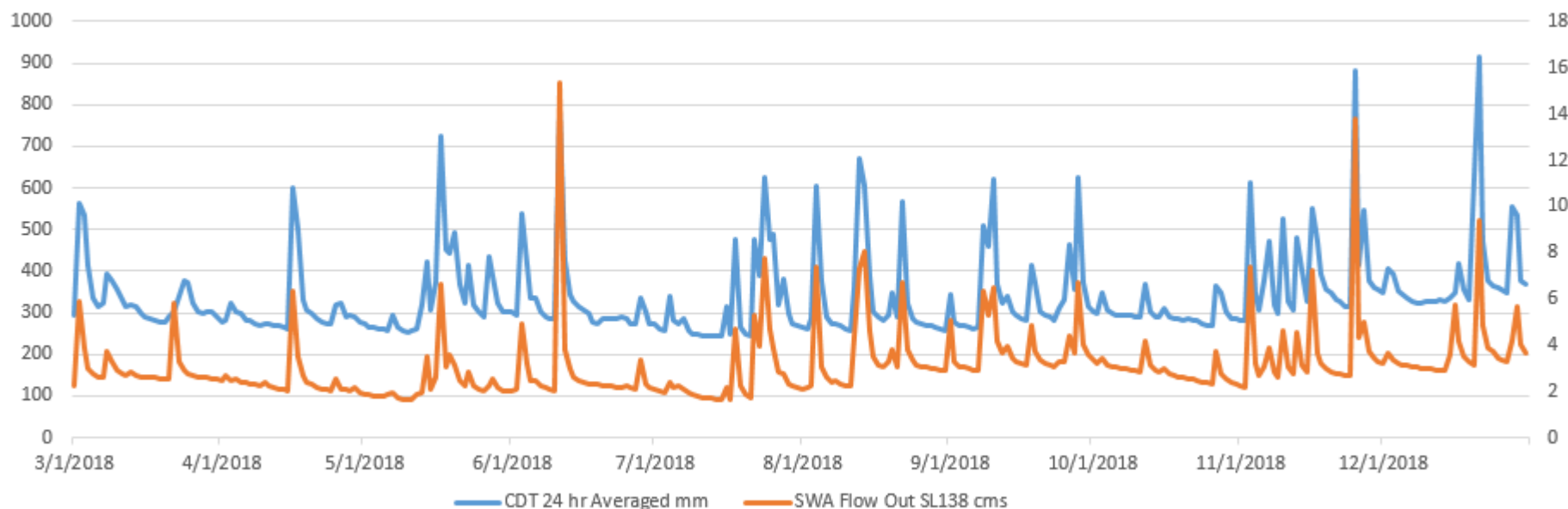


Make a Rating Curve

For this example, rating curve was developed from averaged daily CTD depth and modelled daily flow—NOT FIELD MEASUREMENTS. Caution, averaging the CTD depth to 24 hour intervals introduces errors; the rating curve should be developed at hourly or sub hourly frequency. SWAT data is daily.

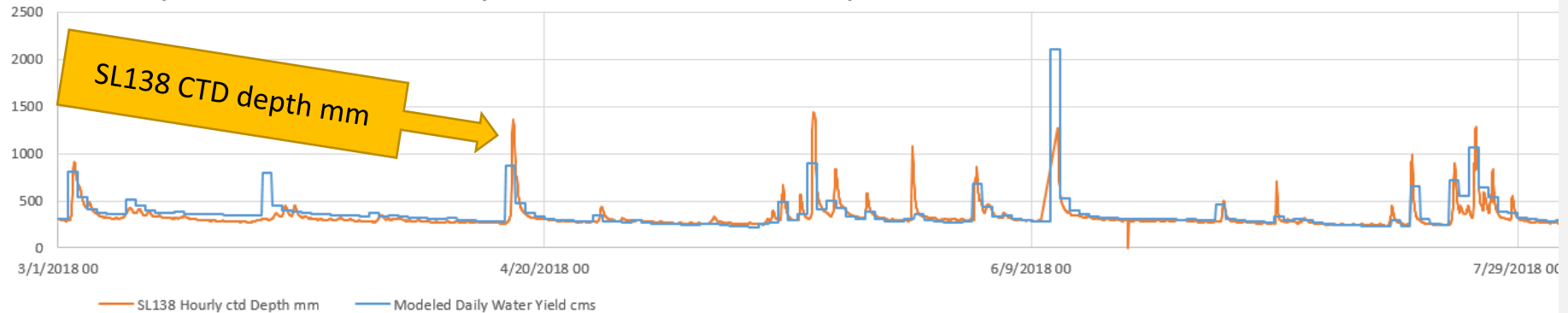


Comparison of Averaged Daily CTD Depth and Modelled Daily Flow

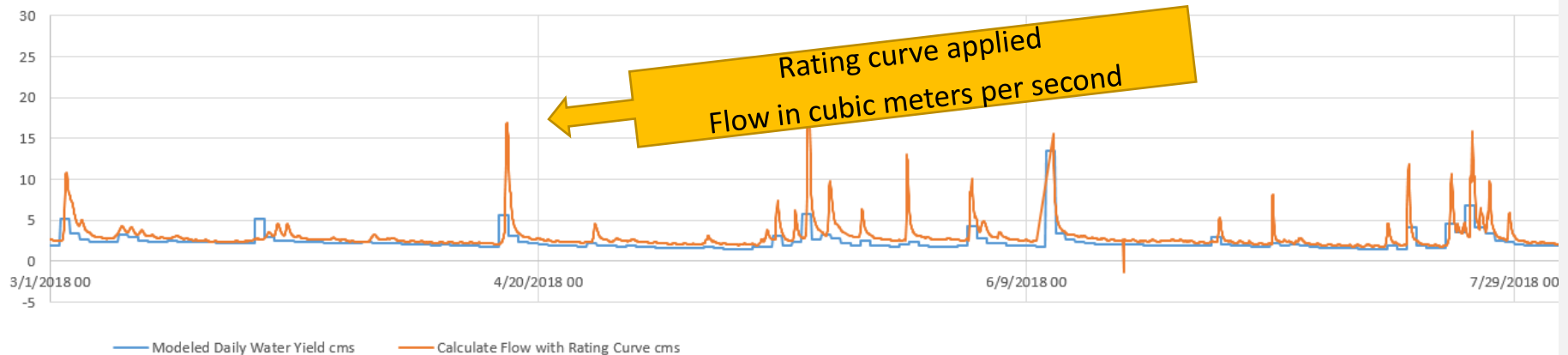


CTD depth in mm upper figure, flow in cubic meters per second lower figure.
Hourly time step.

Comparison of Modelled Daily Flow at SL138 with CTD Depth



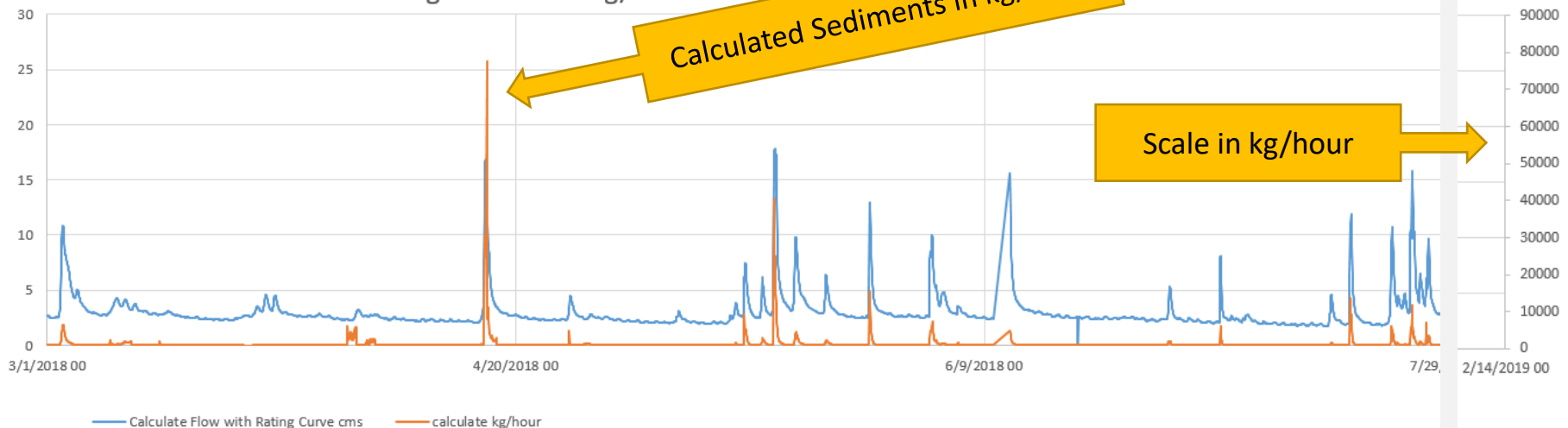
Comparison of Modelled Daily Flow and Hourly Flow from CTD Depth with Rating Curve Applied



Integrate turbidity and flow over time to find sediment loading

- concentration X volume = mass
- TSS mg/l convert to TSS/cubic meter water (cm)
- TSS/cm X flow cubic meters per second = mg TSS/second
- Convert to kg/hour
- Total calculated TSS 6,900,000 kg or 6,900 metric tons 10 months
- This example indicates ~8000 metric tons/year at SL138.
- Many caveats about this example analysis
- Next step is to try other turbidity filters and develop QA/QC for their application

Calculated TSS Loading at SL138 in kg/hour



Go to story map <https://arcg.is/08r5ba0> see tabs for M04 and M22

Stream Bank Sediment Sources

Mills of French and Pickering Creeks

A Story

Mill Survey

Detection Limits

M04

MO4 LIDAR to UAV

M36

M36UAV

M50 Sequential LIDAR

M50 UAV to UAV

M56

M56UAV

M16

M18

M19

M22

M53

Historical Resources

Charlestown Ham

Loudoun Pl



Erosion rate analysis comparing an aerial image from 1958 to a high resolution hillshade model from 2014 data. After carefully aligning the aerial image to the relatively accurate hillshade model, the stream banks from both times are drawn. The yellow area is the difference between the two bank lateral positions

Zooming in will first remove the yellow area, then the 1958 aerial.

The area in yellow is 10,000 square meters.

This site was dammed in 1898 to create an ice pond for the commercial production of ice blocks. The dam breached in 1942. The sediment accumulation here is relatively recent, as is the subsequent breach and erosion.

1958_bank

2014_LIDAR_bank

Icedam Bank Lateral Change 1958 to 2014_WFL1 -
stream_banks_loss_1958_2014

French and Pickering Creeks Watersheds Extent

1958_Aerial

aerial1958.tif

sanminuspasHR1.tif

-2.34655553 - -2.1

-2.099999999 - -1.8

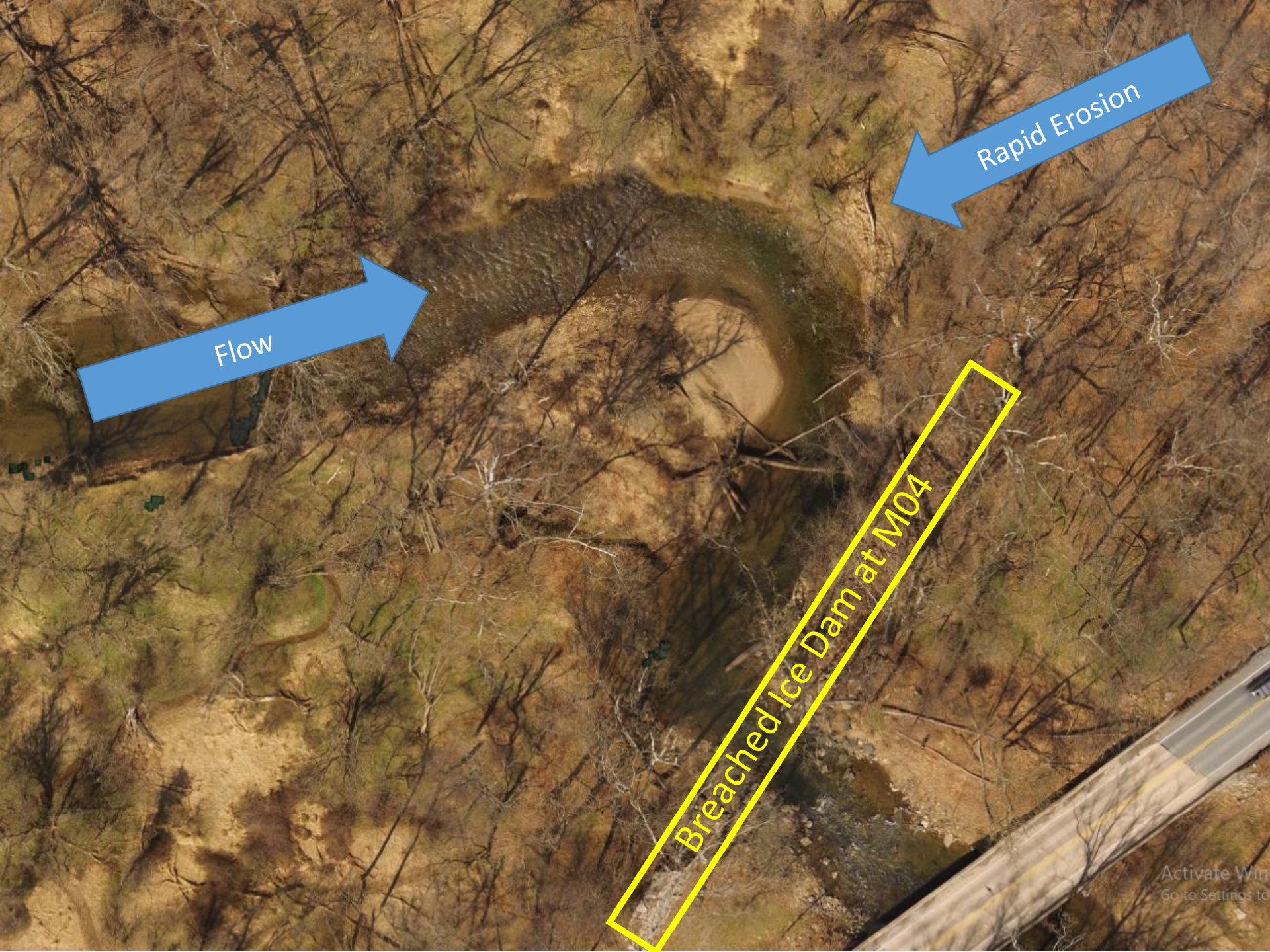
-1.799999999 - -1.5

-1.499999999 - -1.2

-1.199999999 - -0.9

At M04, 10,000 square meters bank loss over 66 years with average 2 meters depth is ~600 metric tons of sediment/year.

The calculated TSS at SL138 is ~8000 metric tons/year



Flow

Rapid Erosion

Breached Ice Dam at M04

Stream bank erosion



3d model of stream bank at M04



SL113