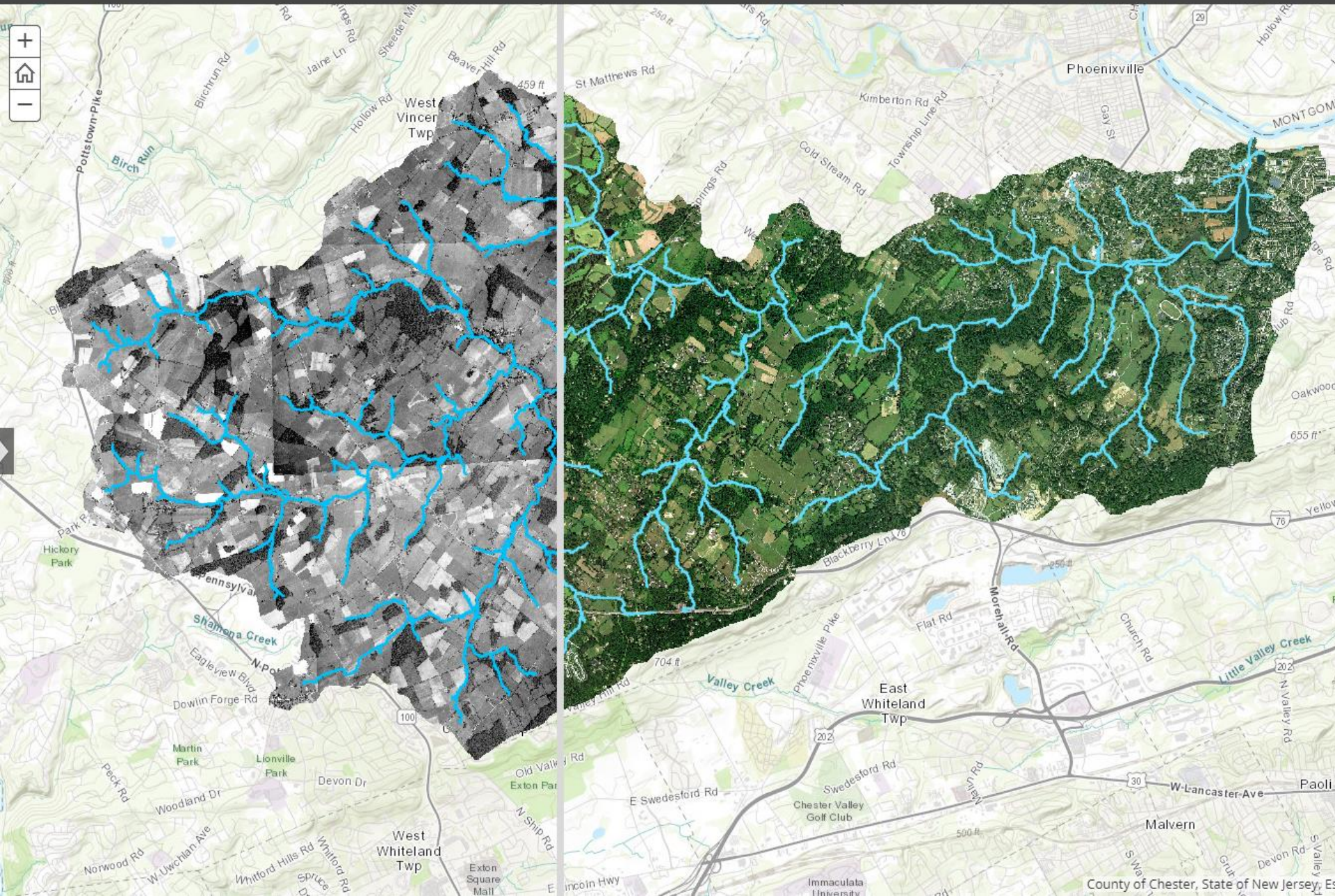
# Quantifying Sediment Sources in the Pickering Creek

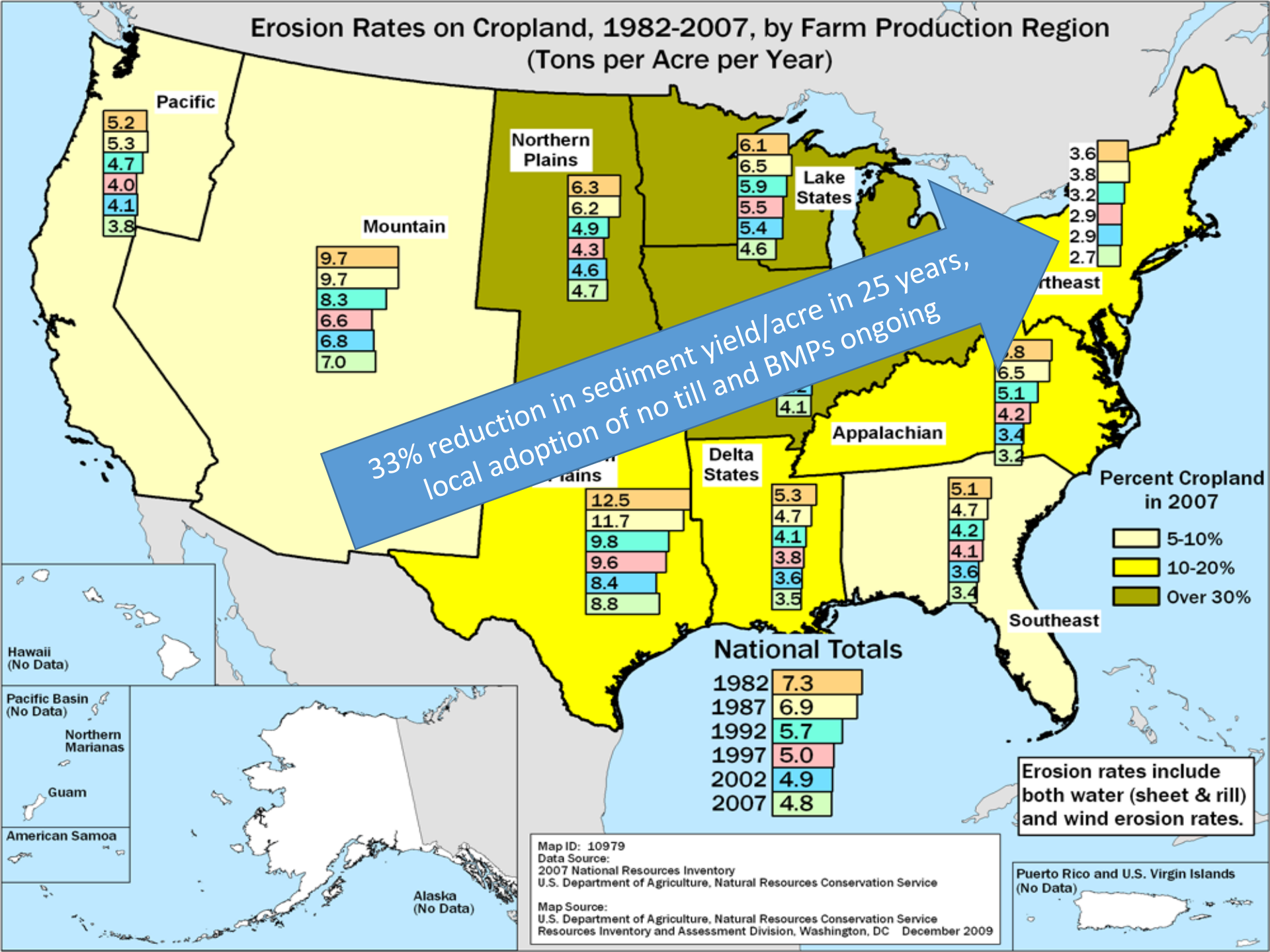
Stormwater at SL113

Pickering 1937 Aerial Imagery

Pickering 1937 Aerial Imagery

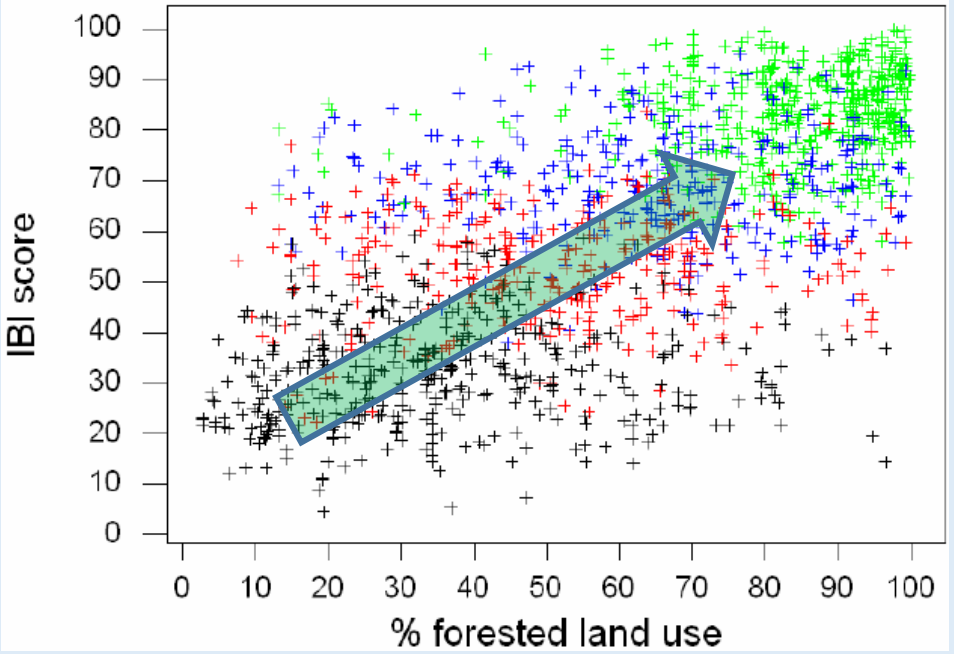
(leave ppt, switch to [live view of story map]

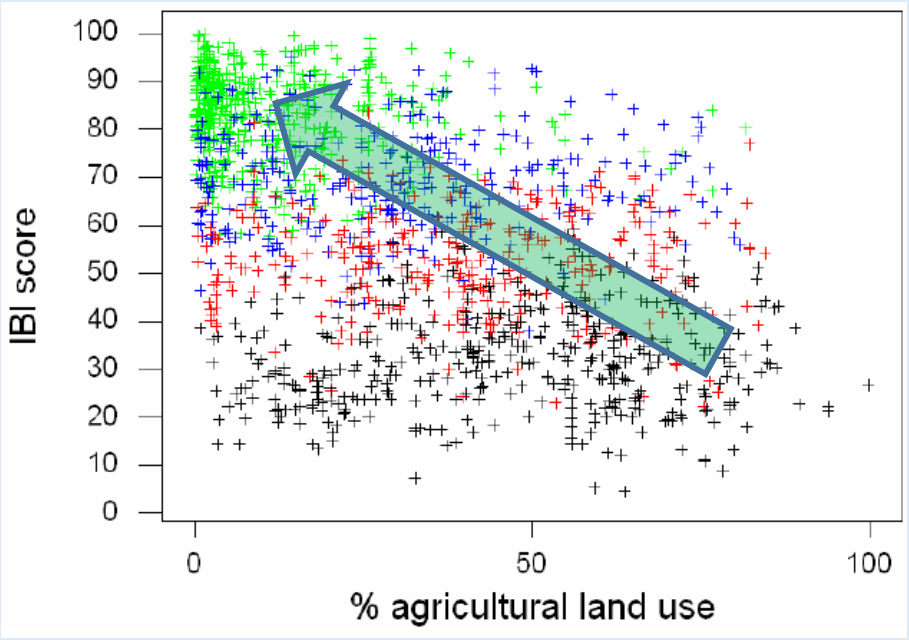



Erosion Rates on Cropland, 1982-2007, by Farm Production Region
(Tons per Acre per Year)
Pacific
5.2
5.3
4.7
4.0
4.1
3.8
Mountain
9.7
9.7
8.3
6.6
6.8
7.0
Northern Plains
6.3
6.2
4.9
4.3
4.6
4.7
Lake States
6.1
6.5
5.9
5.5
5.4
4.6
3.6
3.8
3.2
2.9
2.9
2.7
33% reduction in sediment yield/acre in 25 years, local adoption of no till and BMPs ongoing
4.1
Appalachian
6.5
5.1
4.2
3.4
3.2
Delta States
12.5
11.7
9.8
9.6
8.4
8.8
5.3
4.7
4.1
3.8
3.6
3.5
5.1
4.7
4.2
4.1
3.6
3.4
Southeast
Percent Cropland in 2007
5-10%
10-20%
Over 30%
National Totals
1982 7.3
1987 6.9
1992 5.7
1997 5.0
2002 4.9
2007 4.8
Hawaii (No Data)
Pacific Basin (No Data)
Northern Marianas
Guam
American Samoa
Alaska (No Data)
Erosion rates include both water (sheet & rill) and wind erosion rates.
Map ID: 10979
Data Source:
2007 National Resources Inventory
U.S. Department of Agriculture, Natural Resources Conservation Service
Map Source:
U.S. Department of Agriculture, Natural Resources Conservation Service
Resources Inventory and Assessment Division, Washington, DC December 2009
Puerto Rico and U.S. Virgin Islands (No Data)

Multiple trends in the Pickering are driving changes in water quality over the past 50 years

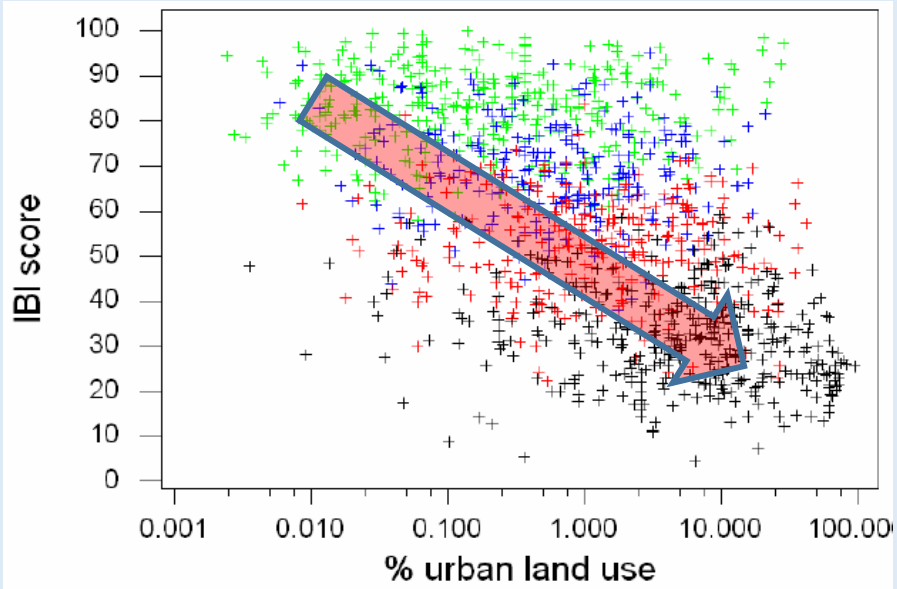
Increasing forest cover acres, increase in riparian forest, and increase in forest biomass per forest acre




Decreasing ag lands acres *and* decreasing soil loss *per* acre

Increasing urban and suburban development




Figures from A Benthic Index of Biotic Integrity for Wadeable Freestone Riffle-Run Streams In Pennsylvania, PADEP, 2009

# The Biological Condition Gradient: Biological Response to Increasing Levels of Stress

## Levels of Biological Condition

**Level 1.** Natural structural, functional, and taxonomic integrity is preserved.

**Level 2.** Structure & function similar to natural community with some additional taxa & biomass; ecosystem level functions are fully maintained.

**Level 3.** Evident changes in structure due to loss of some rare native taxa; shifts in relative abundance; ecosystem level functions fully maintained.

**Level 4.** Moderate changes in structure due to replacement of some sensitive ubiquitous taxa by more tolerant taxa; ecosystem functions largely maintained.

**Level 5.** Sensitive taxa markedly diminished; conspicuously unbalanced distribution of major taxonomic groups; ecosystem function shows reduced complexity & redundancy.

**Level 6.** Extreme changes in structure and ecosystem function; wholesale changes in taxonomic composition; extreme alterations from normal densities.

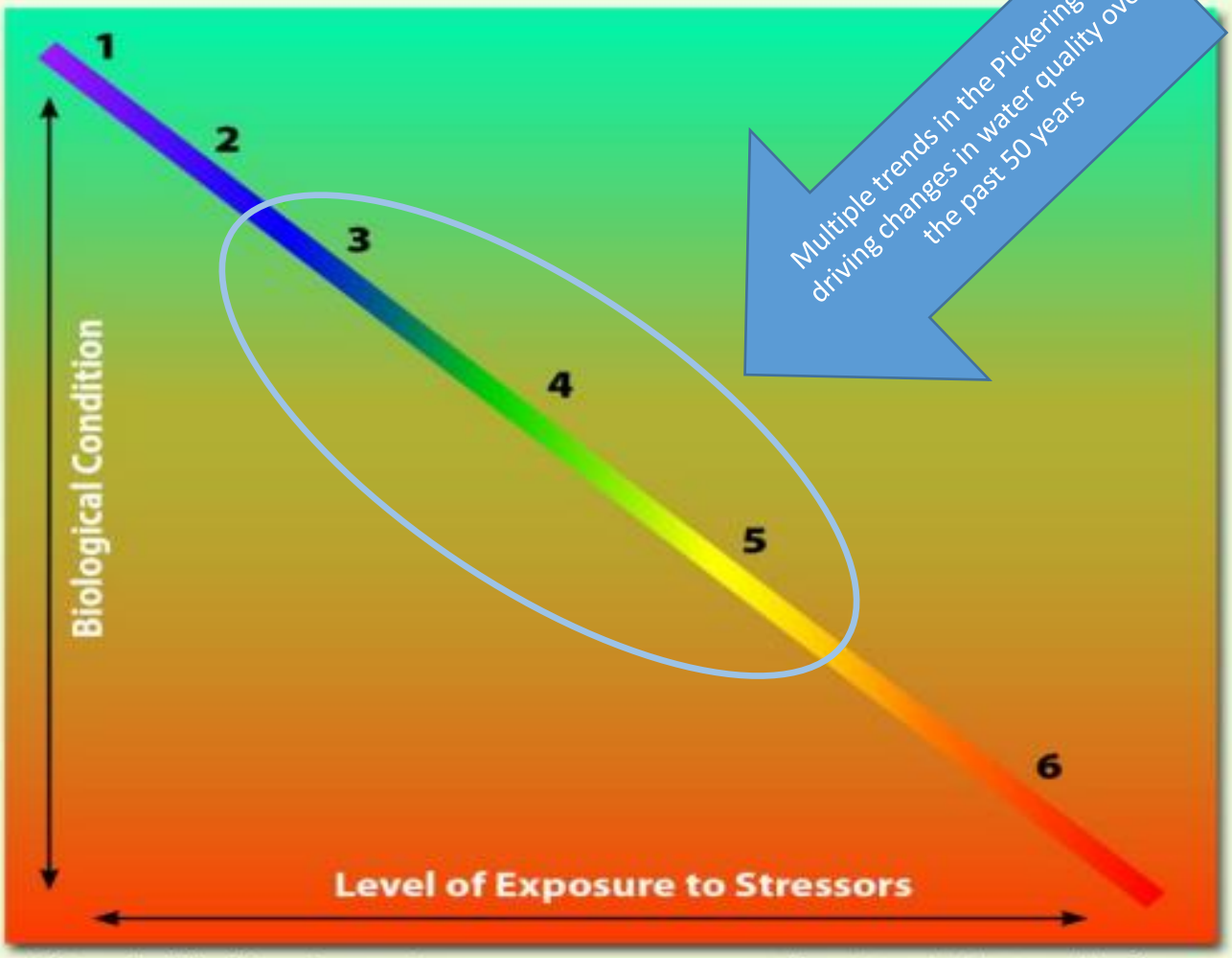
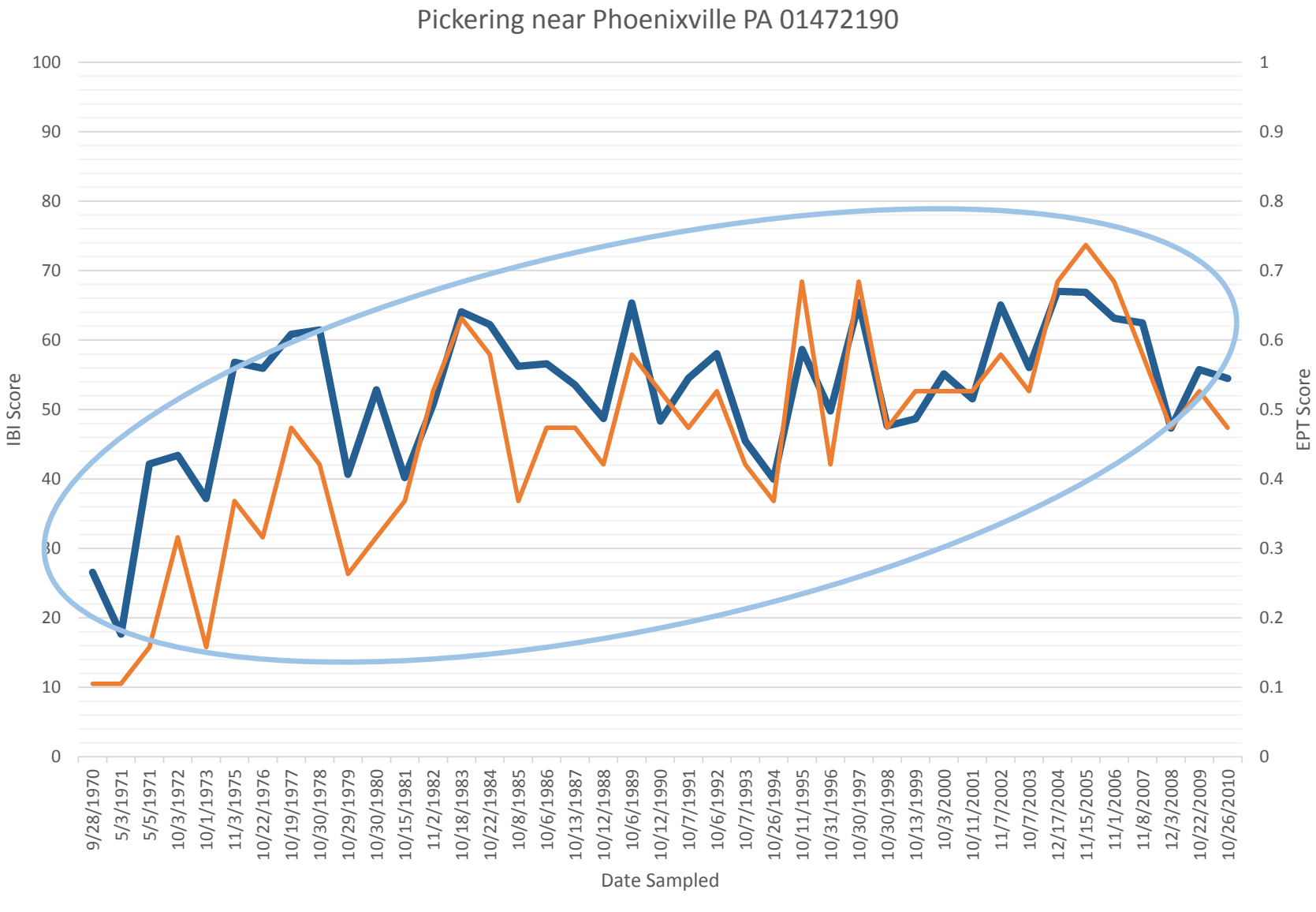



Figure from The Biological Condition Gradient – a conceptual model depicting stages of biological condition responses to an increasing stressor gradient –Davies and Jackson (2006)

# Multiple trends in the Pickering are driving changes in water quality over the past 50 years



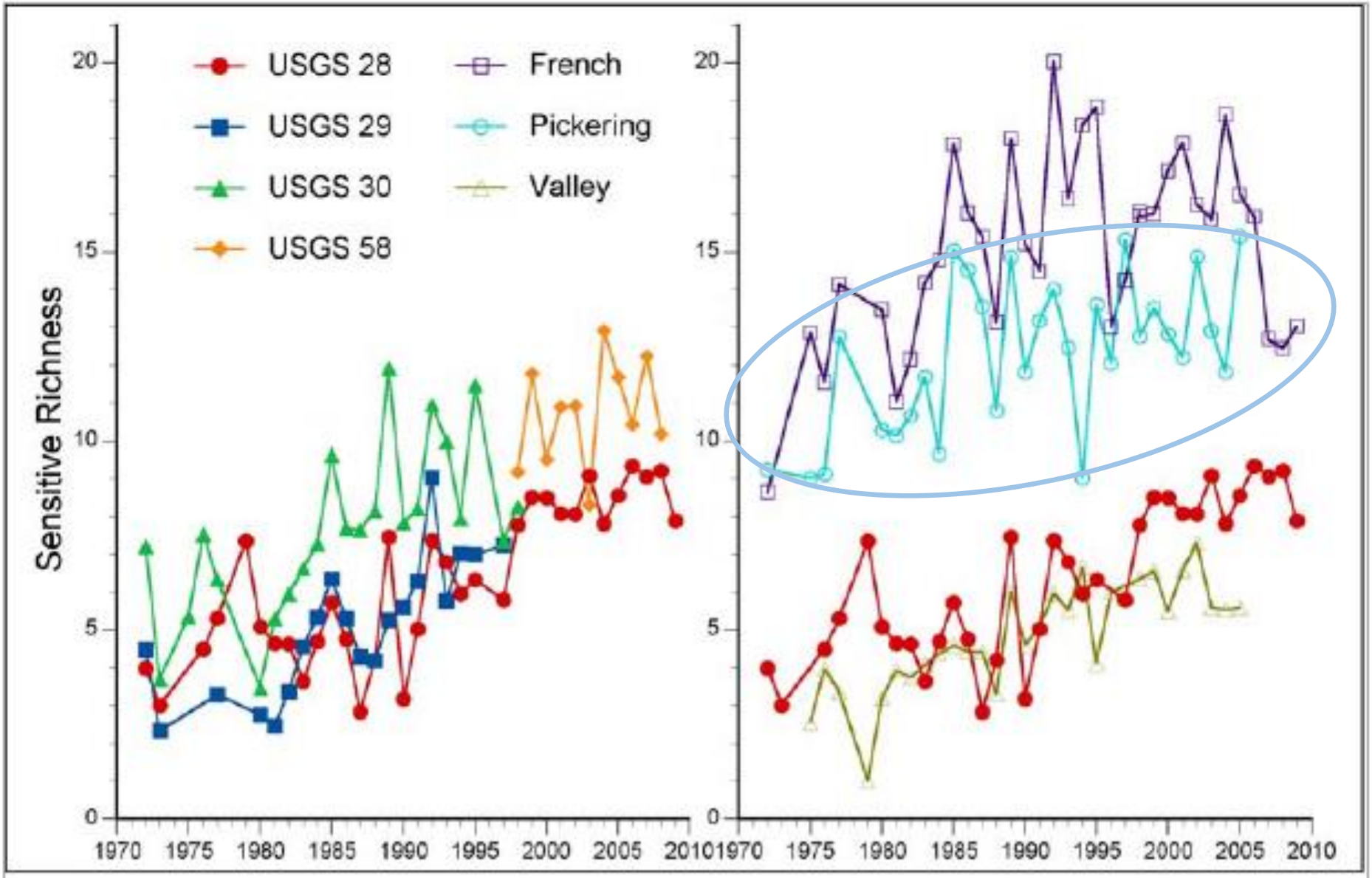



Figure source: Stream Watch Report by the Stroud Water Research Center Stroud Contribution 2010010

# What are the main stressors? What data should we be collecting?

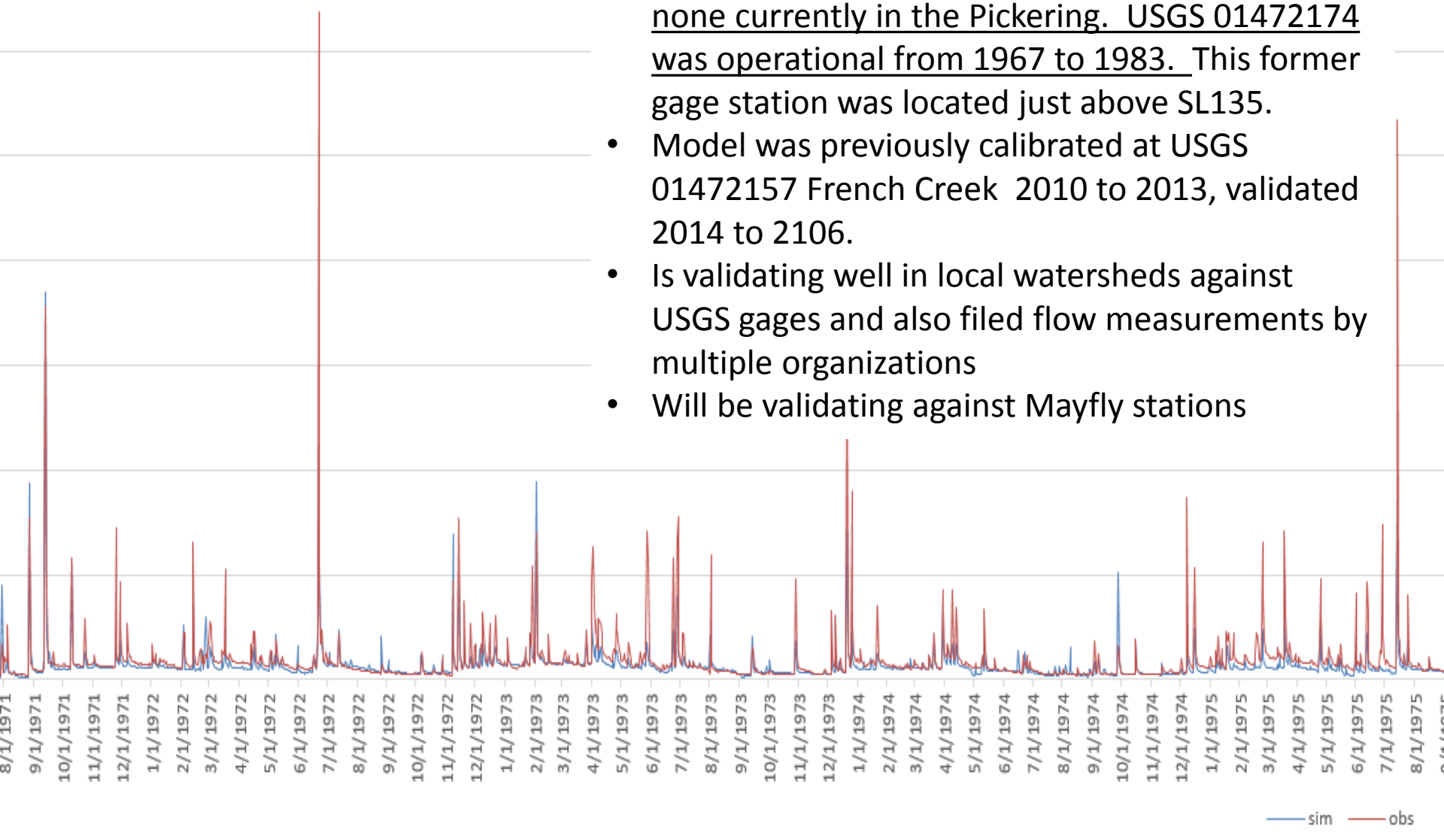
- Stormwater flows from runoff are a strong departure from reference condition.
- Sediment from stream bank erosion—aka legacy sediments
- Sediment in runoff
- Other NPS in runoff, including de-icers, present but poorly understood.
- Temperature increases from poor riparian coverage and decreased ground water flows.
- Not WWTP. Permitted treatment plant discharges into the Pickering are essentially absent.

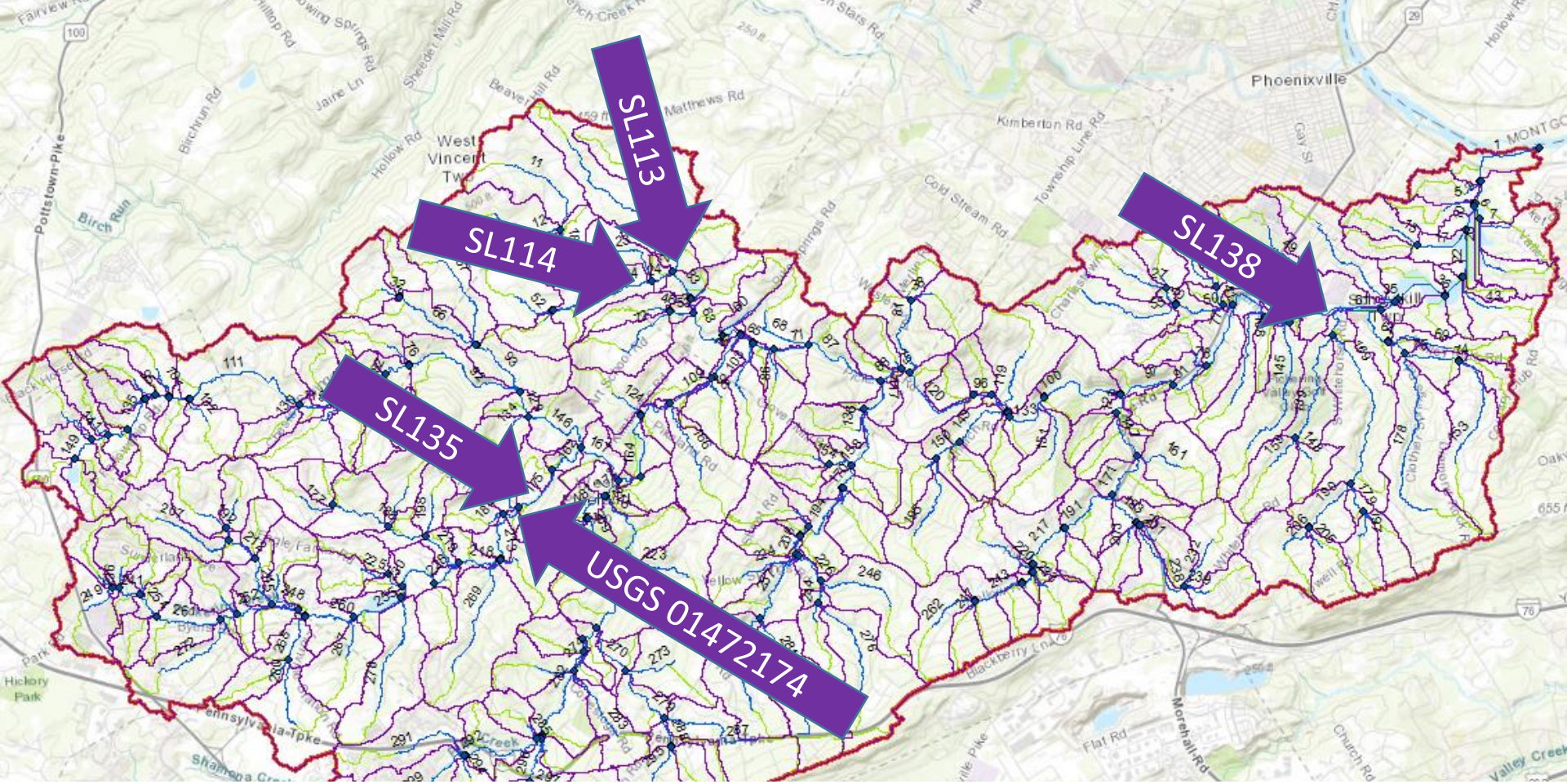
*Mayfly is very cost effective for collecting good quality data at watershed outlets.*

# Simulated versus Observed at USGS 01472174

SWAT modeled flow versus observed for Pickering.

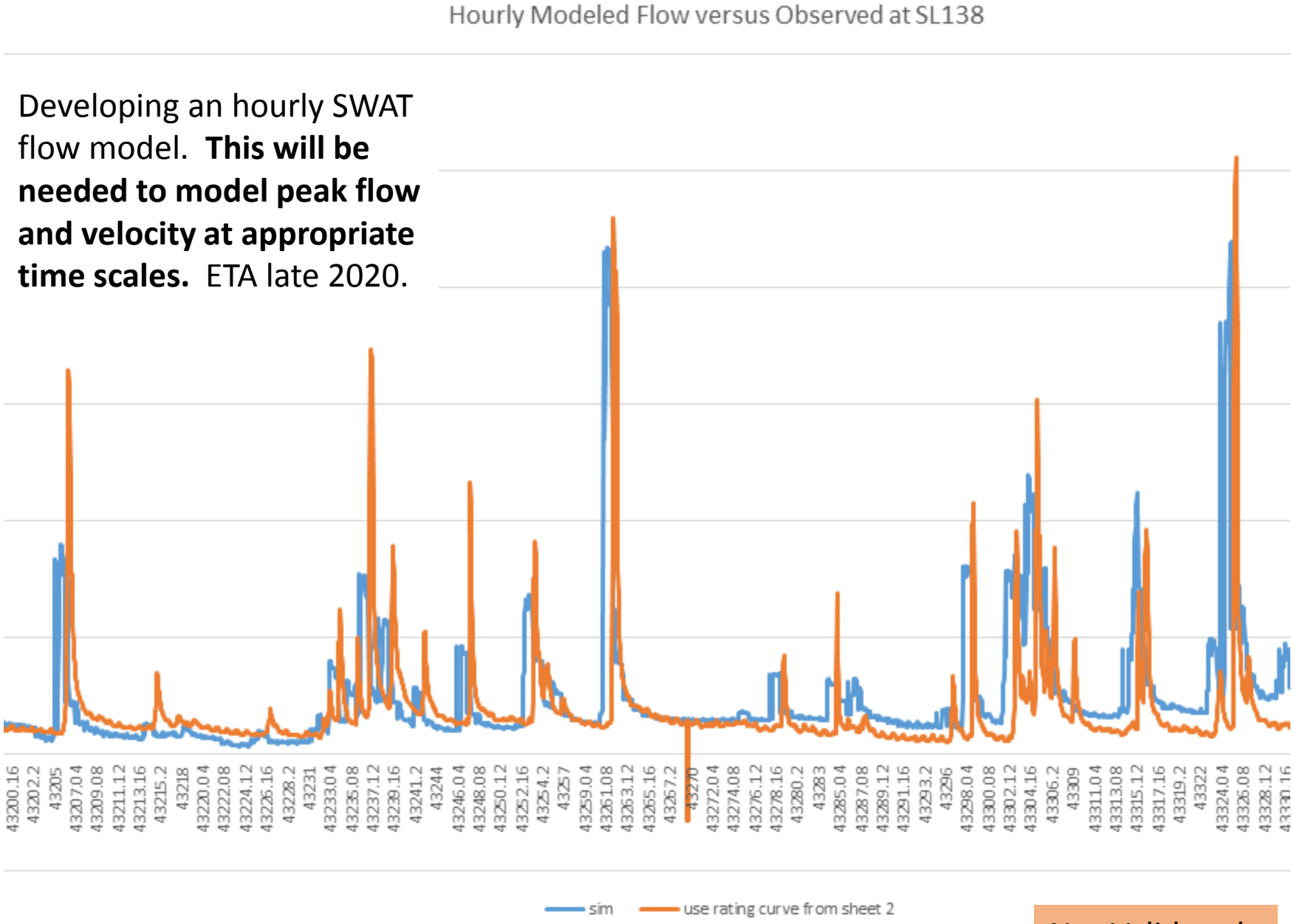
- Usually validating against USGS gages; however none currently in the Pickering. USGS 01472174 was operational from 1967 to 1983. This former gage station was located just above SL135.
- Model was previously calibrated at USGS 01472157 French Creek 2010 to 2013, validated 2014 to 2106.
- Is validating well in local watersheds against USGS gages and also filed flow measurements by multiple organizations
- Will be validating against Mayfly stations



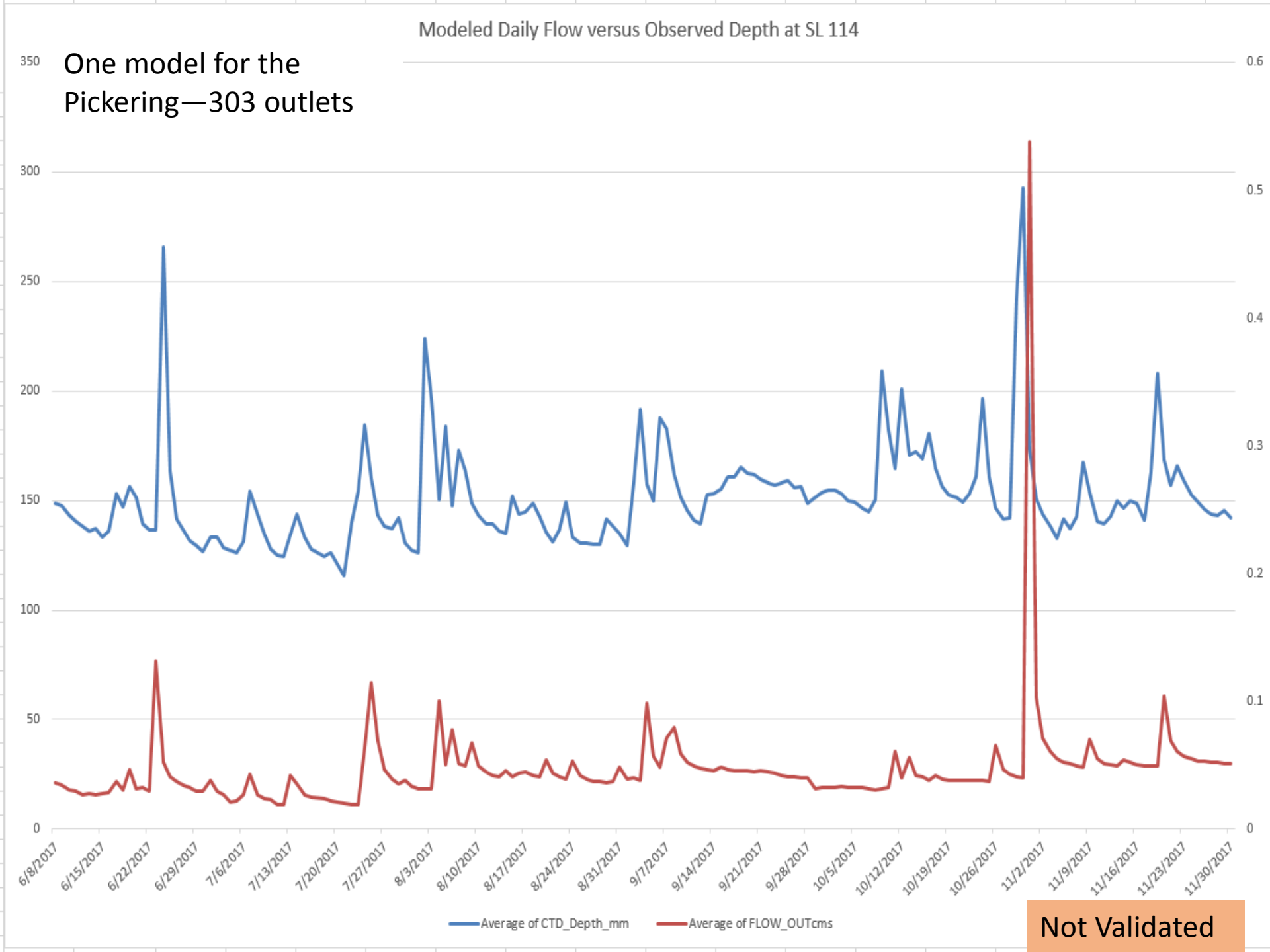



- High resolution model for Pickering with 303 subbasins and outlets. Four outlets are instrumented.
- First order watersheds are mostly correct—the smallest tribs are time consuming to identify and delineate.
- Flow calibration is believe to be good but will be validated at Mayfly and multiple other sites in the watershed.
- Model is a framework for connecting Mayfly data to the rest of the watershed and for explaining observed conditions: flow, turbidity, temperature, conductivity.

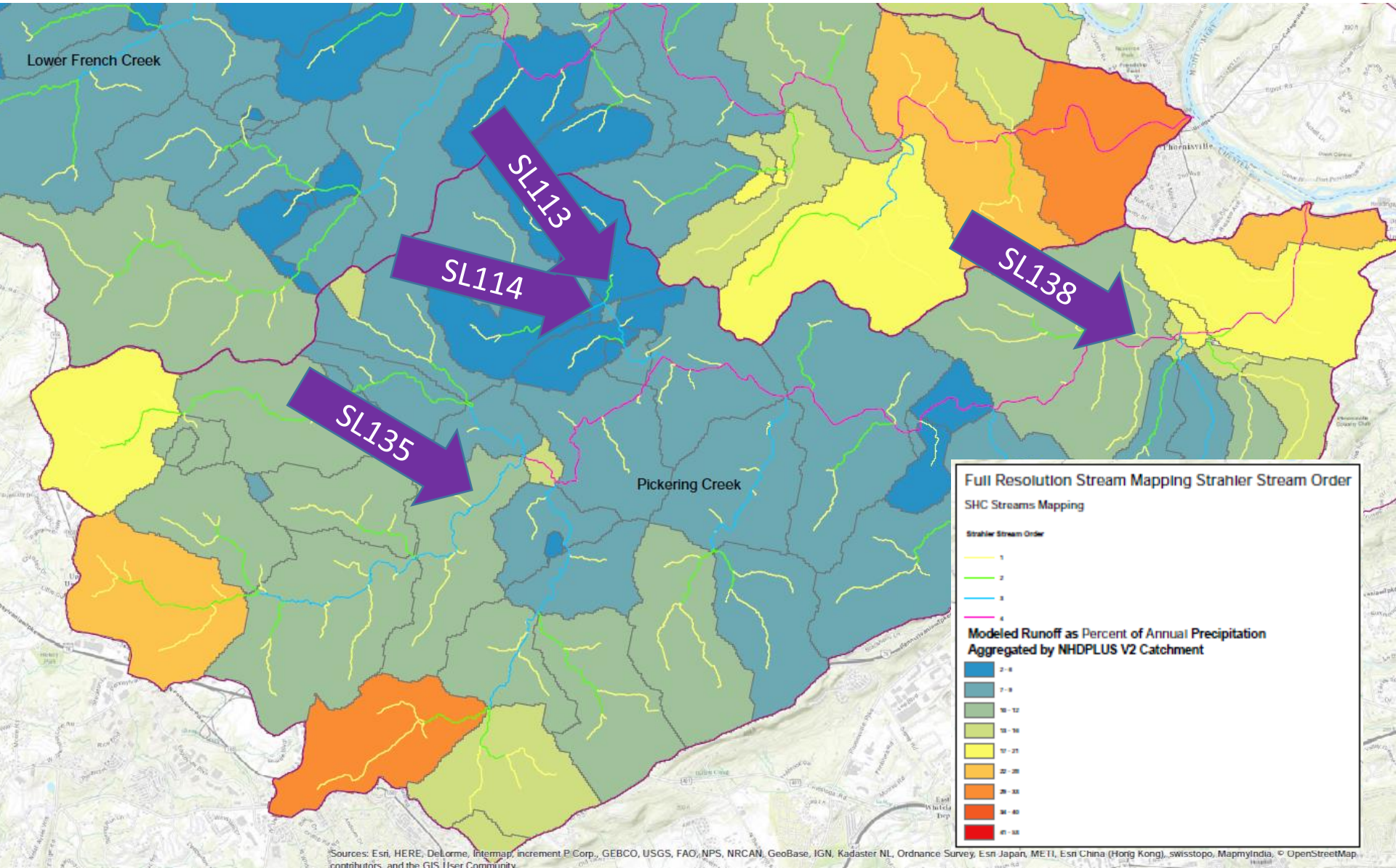
Developing an hourly SWAT flow model. **This will be needed to model peak flow and velocity at appropriate time scales.** ETA late 2020.



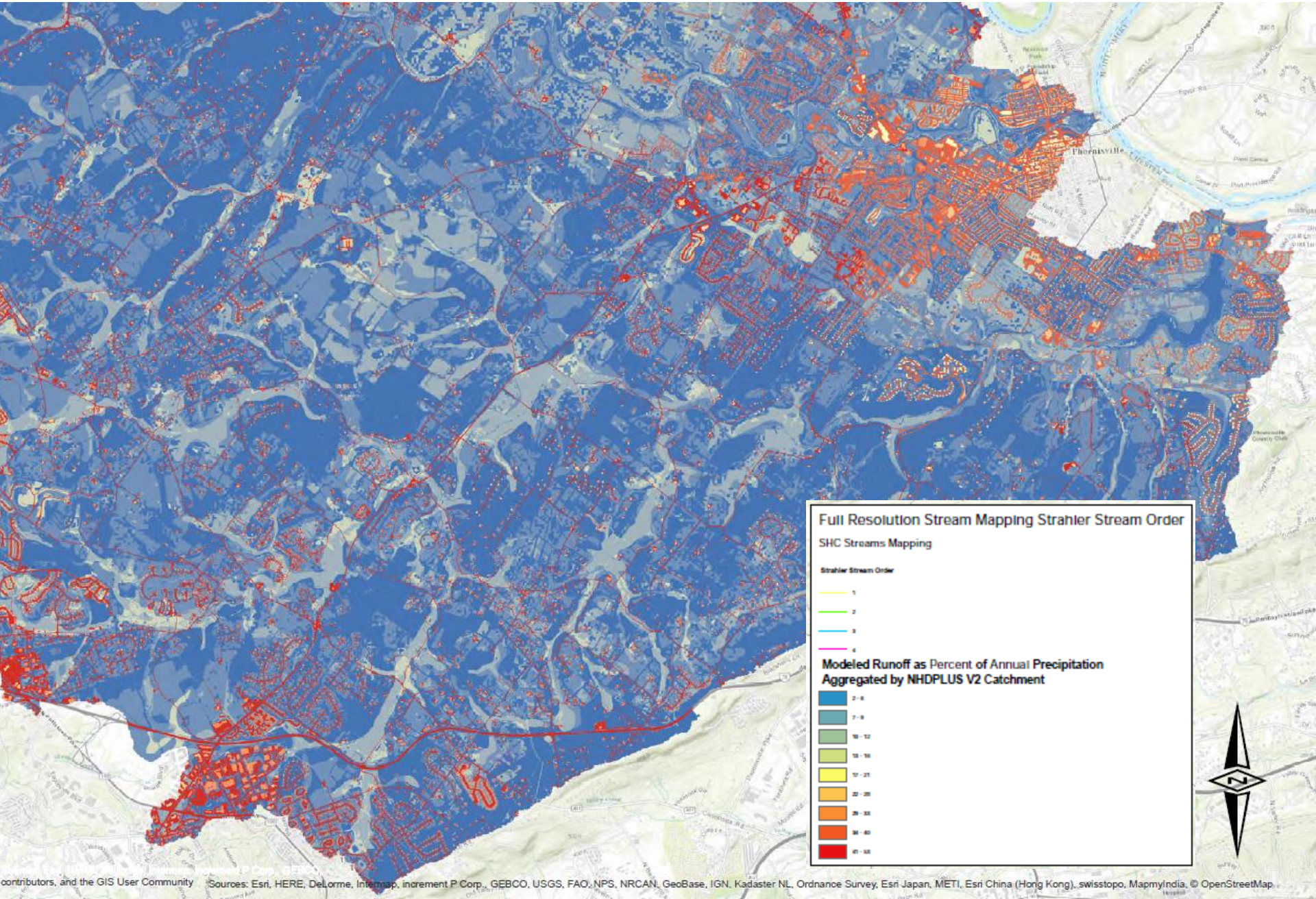

Not Validated

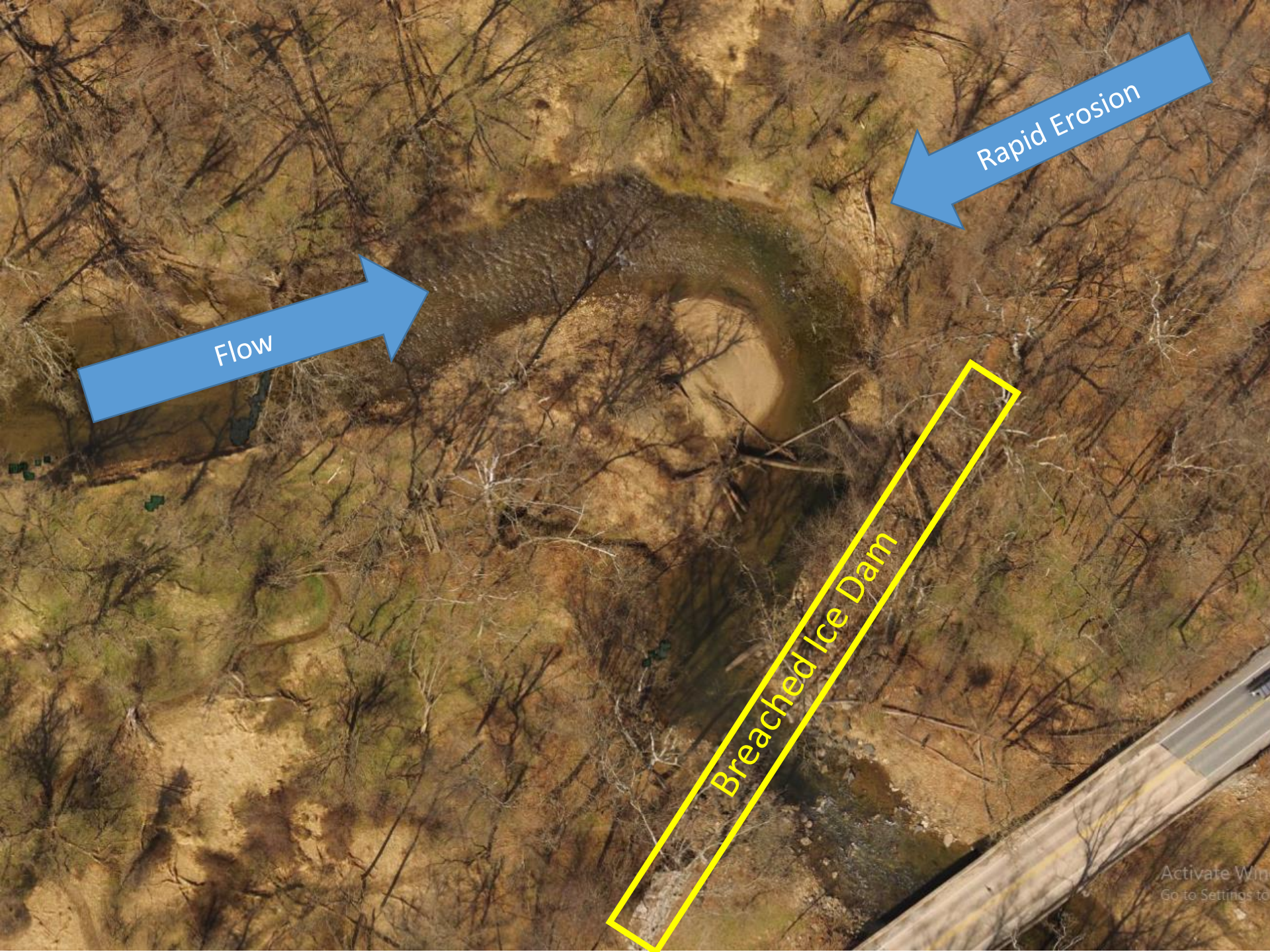

Modeled Daily Flow versus Observed Depth at SL 114
One model for the Pickering—303 outlets
350
300
250
200
150
100
50
0
0.6
0.5
0.4
0.3
0.2
0.1
0
6/8/2017
6/15/2017
6/22/2017
6/29/2017
7/6/2017
7/13/2017
7/20/2017
7/27/2017
8/3/2017
8/10/2017
8/17/2017
8/24/2017
8/31/2017
9/7/2017
9/14/2017
9/21/2017
9/28/2017
10/5/2017
10/12/2017
10/19/2017
10/26/2017
11/2/2017
11/9/2017
11/16/2017
11/23/2017
11/30/2017
Average of CTD_Depth_mm
Average of FLOW_OUTcms
Not Validated

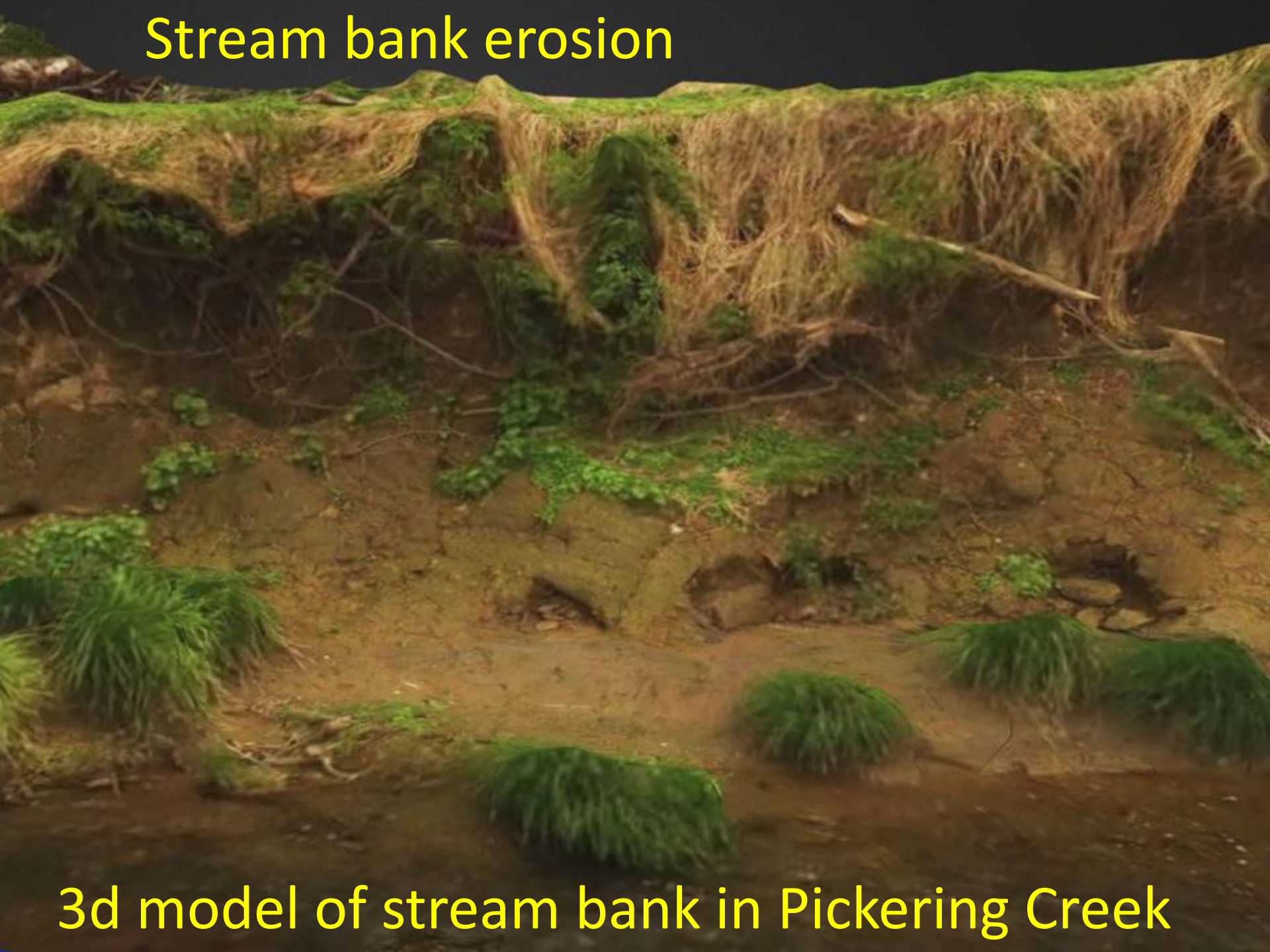
# Modeled stormwater flows from runoff



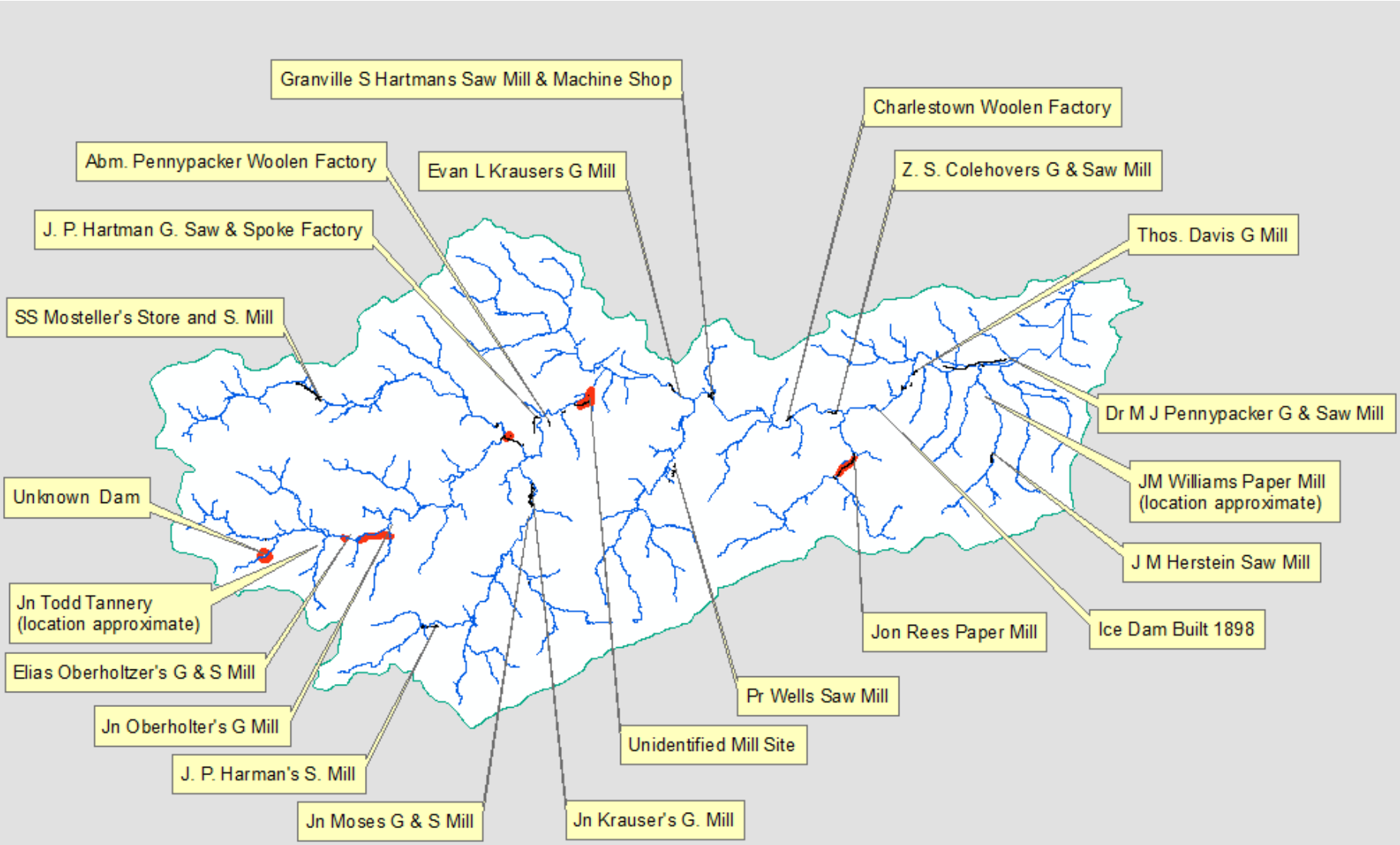
# Modeled stormwater flows from runoff with 1 meter UVM-SAL LULC




Rapid Erosion
Flow
Breached Ice Dam

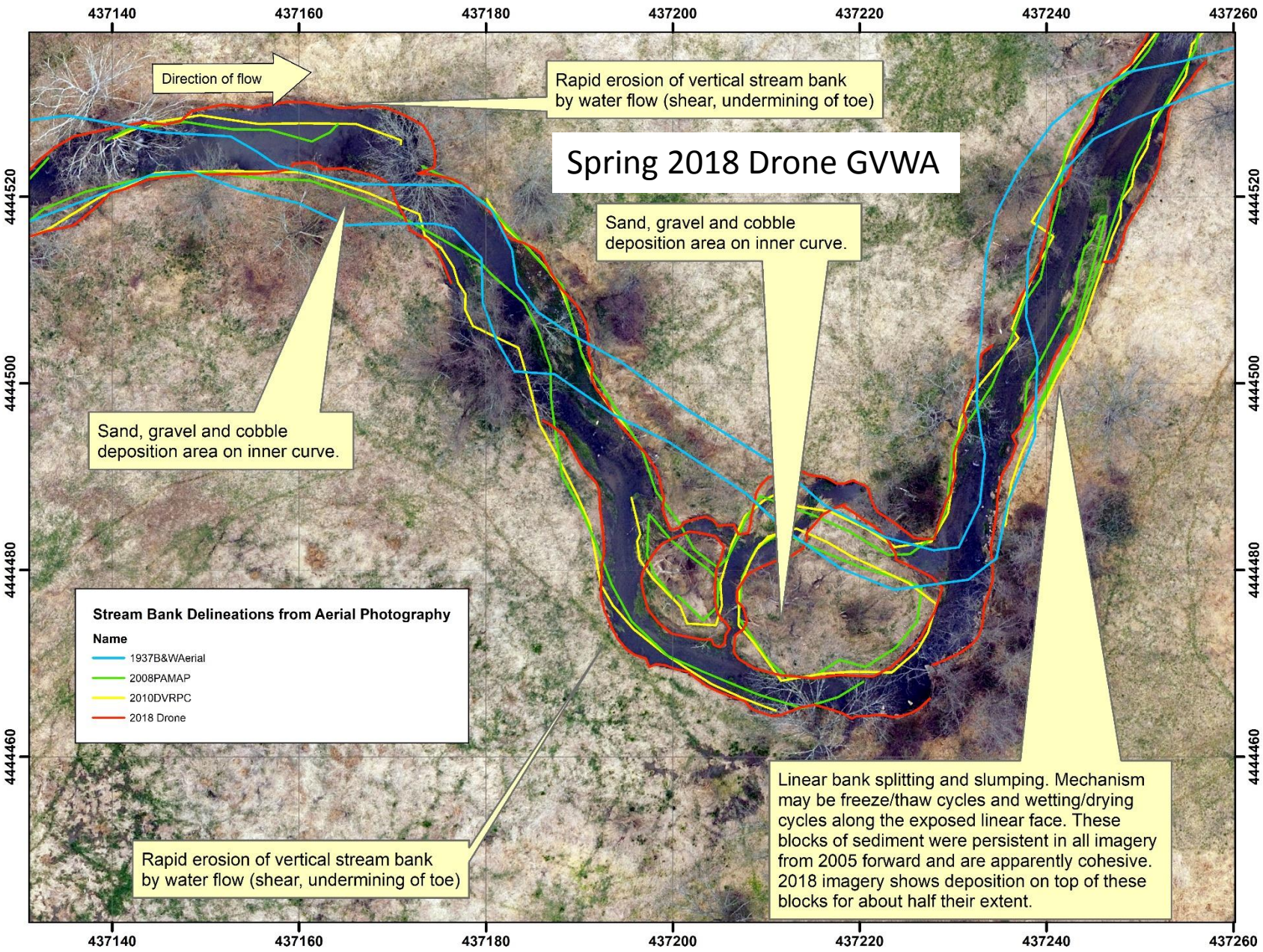

Stream bank erosion
3d model of stream bank in Pickering Creek

Former Mill Dams are common in the Pickering. These are large stores of legacy sediments

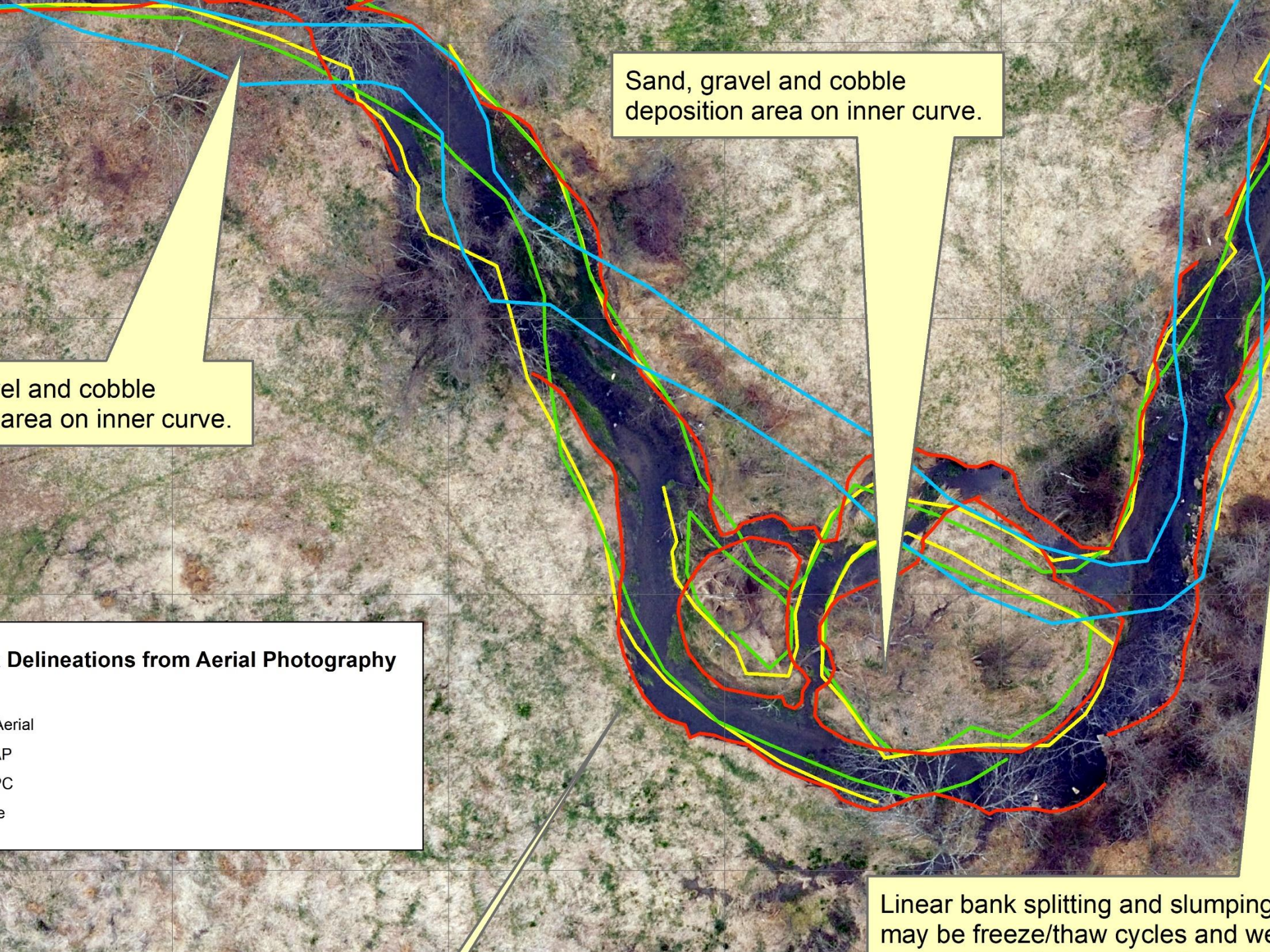


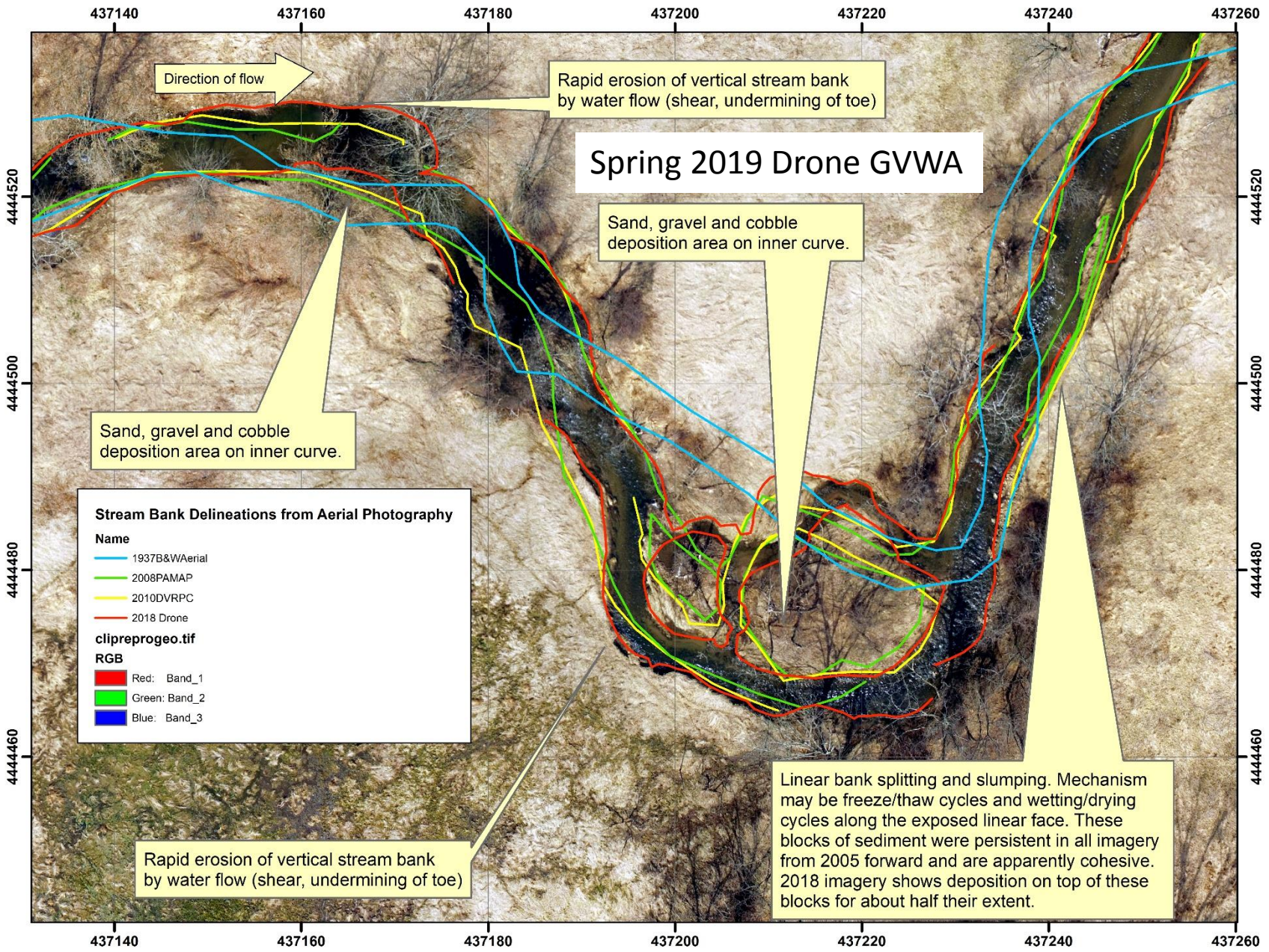
# Quantifying Sediment Sources in the Pickering --Experimental Design

- Basic framework:
  - Quantify Inputs of suspended sediments
  - Measure Outputs of suspended sediments-Turbidity sensors
  - Compare.
  - Inputs should equal outputs!
- Quantifying inputs is challenging—very short lived events
- Across a large watershed the individual events smooth out into a consistent output signal
  - Modeled versus observed sediment is reasonable
- At reach scale, signal is less smooth




Coordinate System NAD 1983 (2011) UTM Zone 18N
Units: Meters


Sand, gravel and cobble deposition area on inner curve.
el and cobble
area on inner curve.
Delineations from Aerial Photography
Aerial
AP
PC
e
Linear bank splitting and slumping
may be freeze/thaw cycles and we

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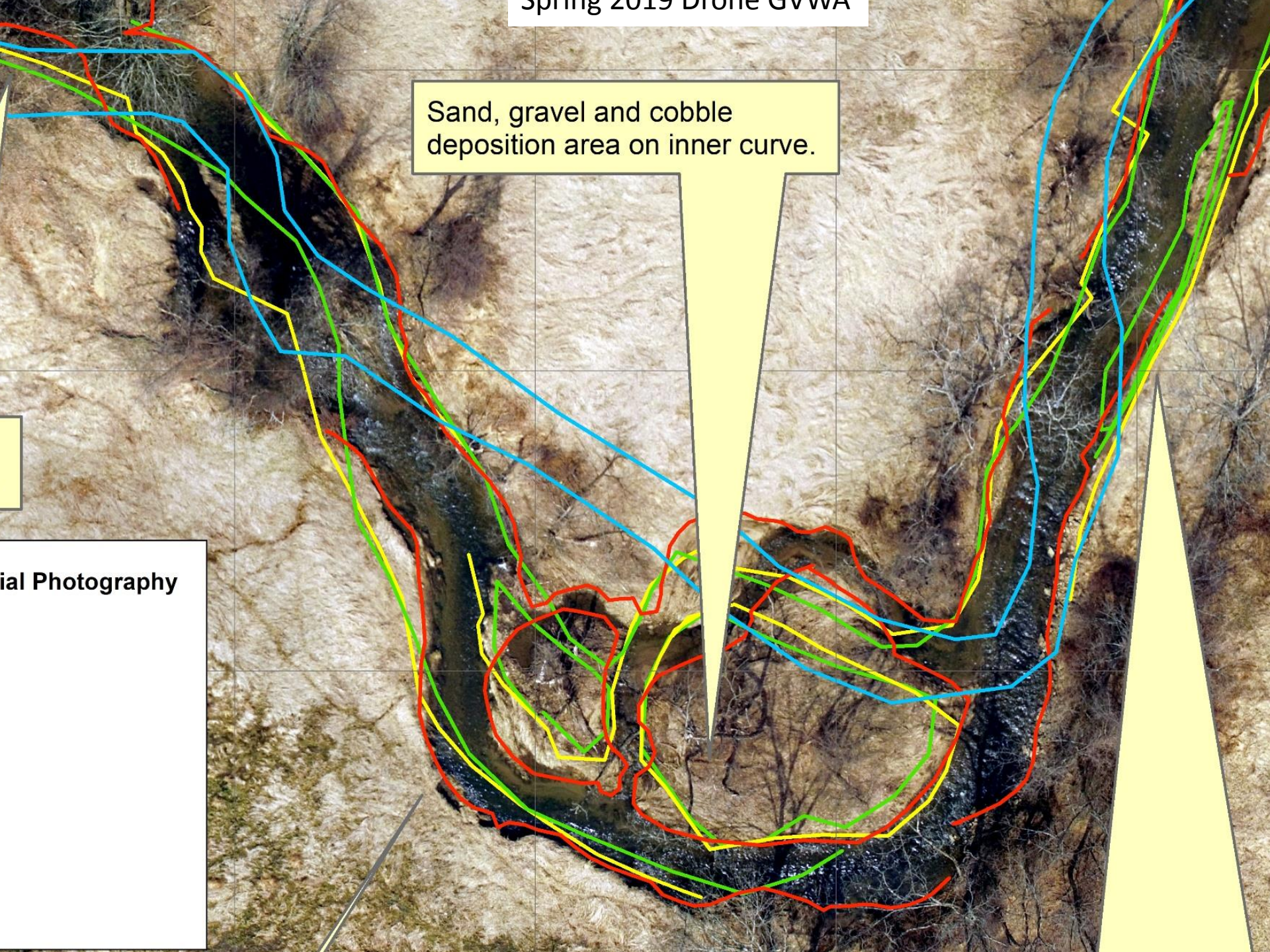
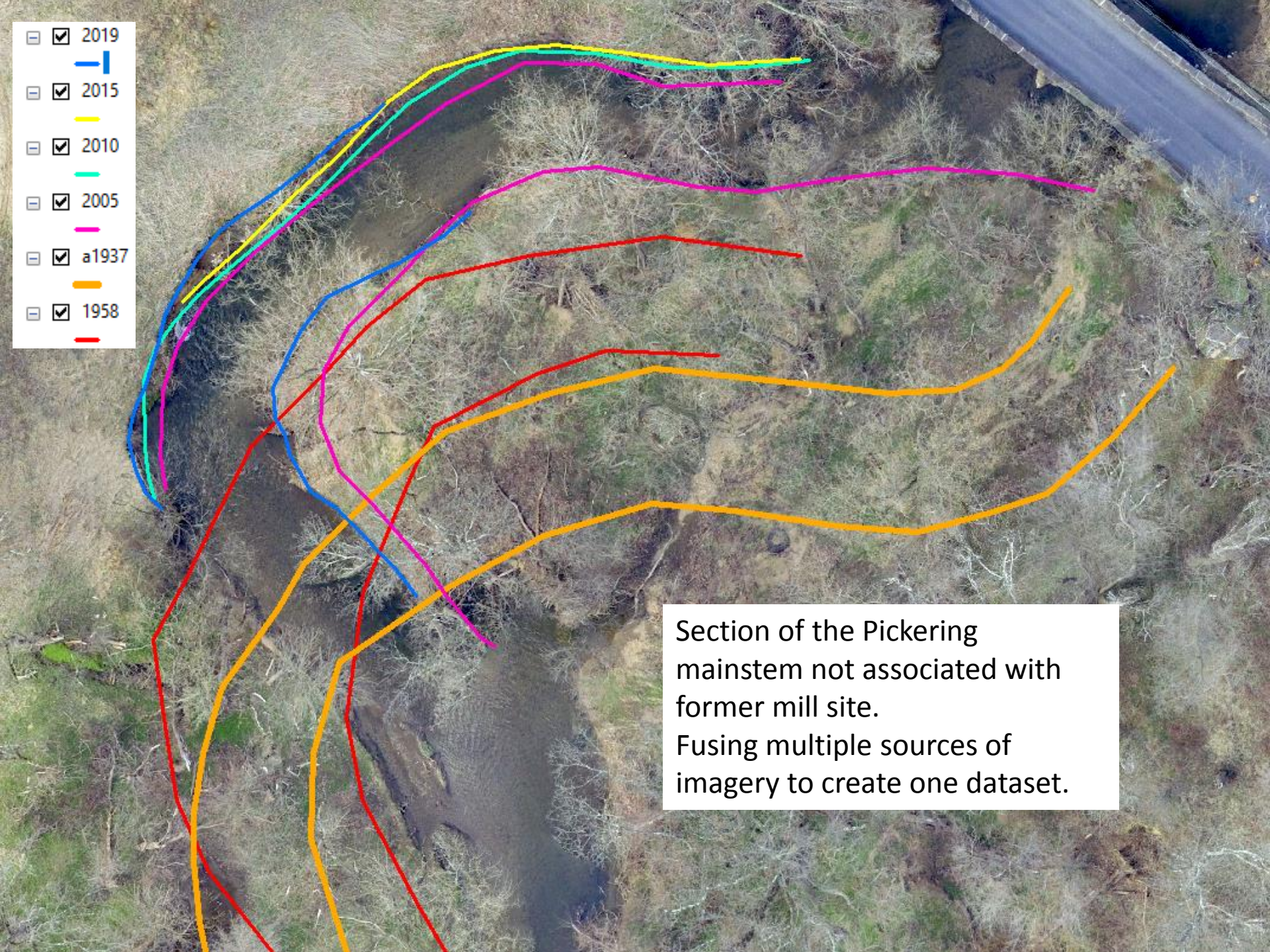
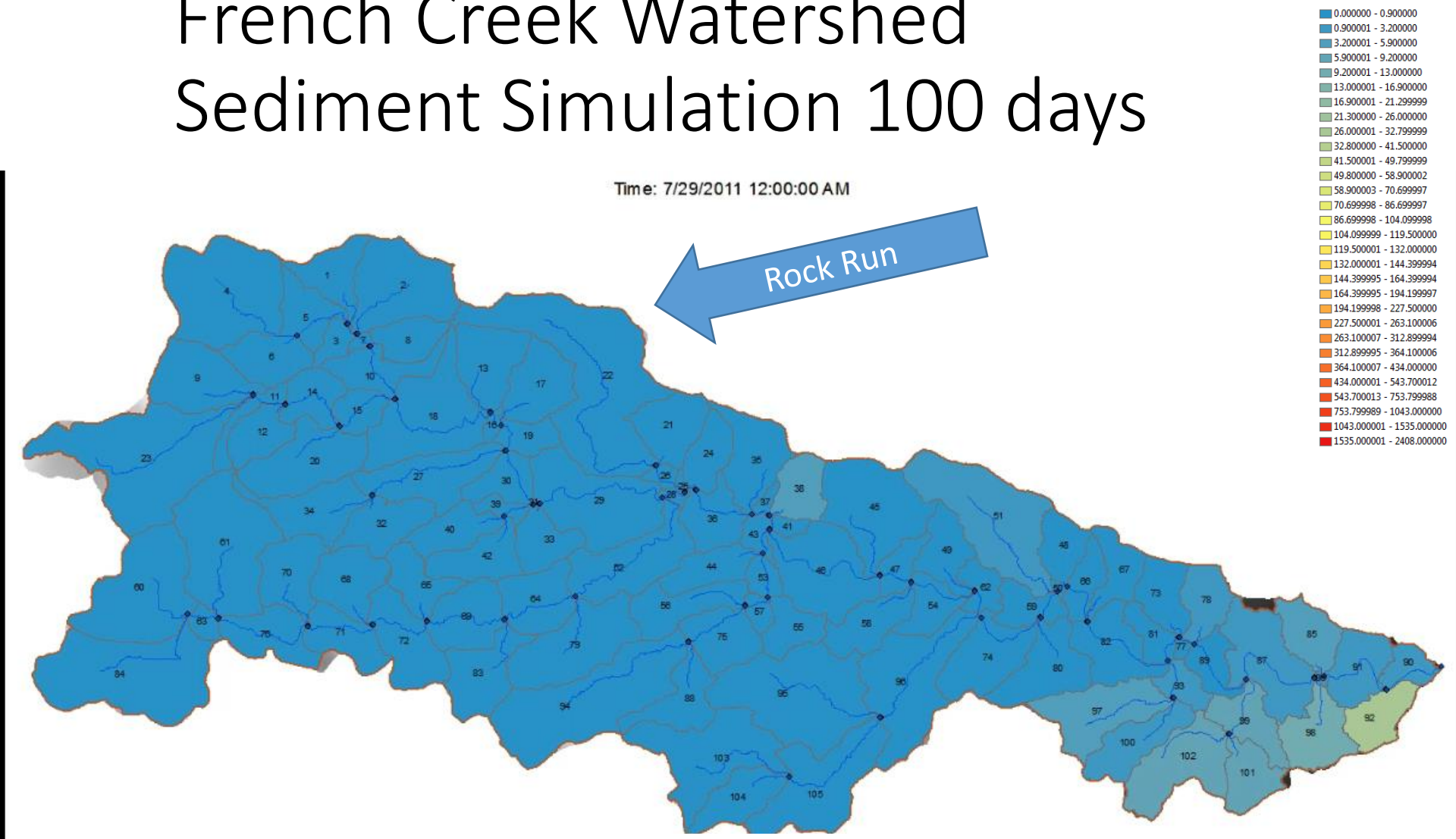

Spring 2019 Drone GVWA
Sand, gravel and cobble deposition area on inner curve.
ial Photography


2019
2015
2010
2005
a1937
1958
Section of the Pickering mainstem not associated with former mill site.
Fusing multiple sources of imagery to create one dataset.

# French Creek Watershed Sediment Simulation 100 days




Example of simulated daily sediment concentration. Built 9/2013—superseded by more recent sediment models. Similar simulation for the Pickering could be compared against observed sediment at Mayflys.

SL113