Streambank Stabilization Techniques using Natural Channel Design

Gian Dodici
US Fish & Wildlife service
Cortland, NY

Where to Begin?

East Branch Delaware

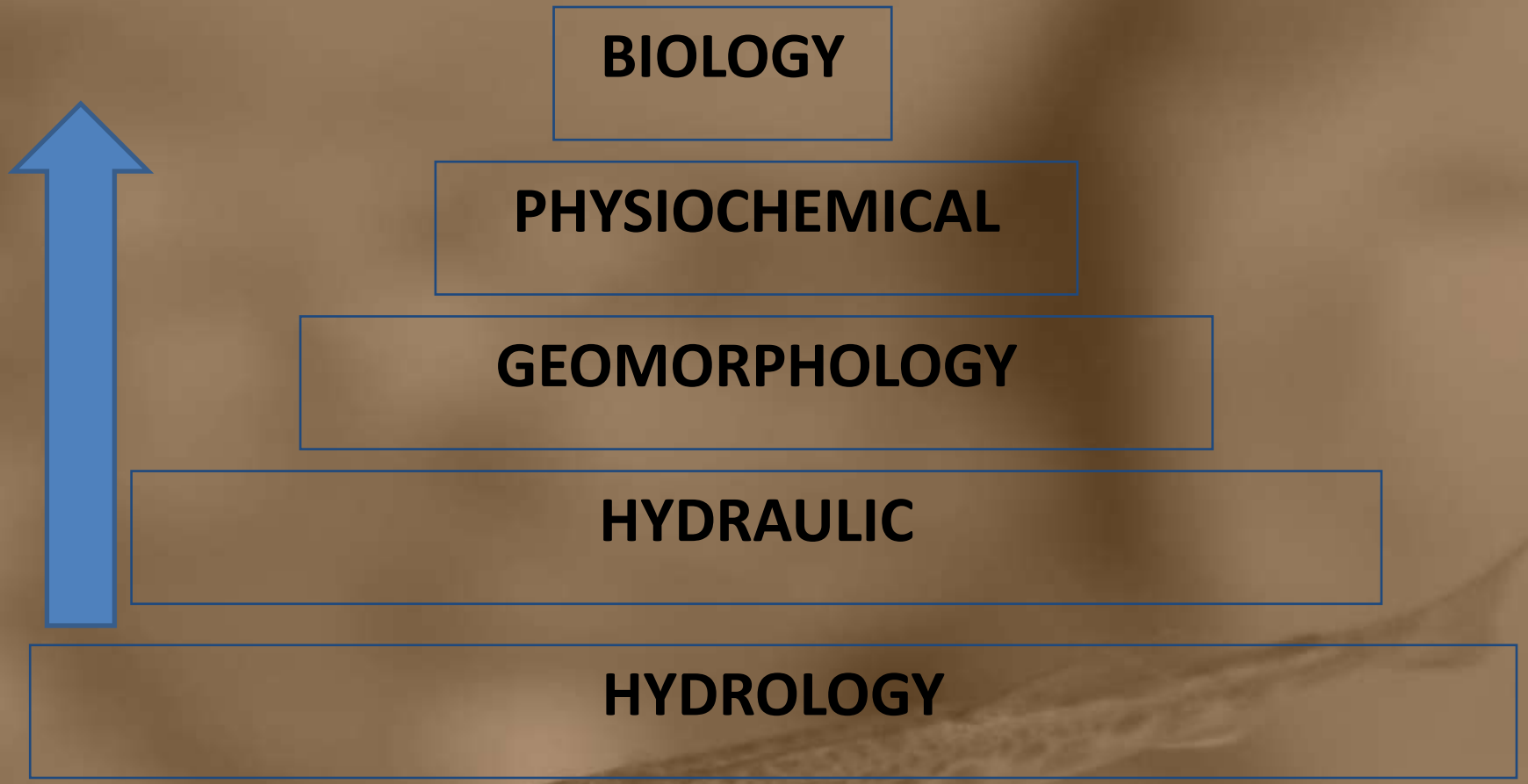
Natural Channel Design

Create a dimension, pattern, and profile that transports water and sediment.

Restoration of Pattern, Dimension and Profile

Restoration of Function

Stream Functions Pyramid



1. HYDROLOGY

- Transport of water from the watershed to the channel
  - Precipitation/ Runoff
  - Channel Forming Discharge
  - Flood Frequency
  - Flow Duration

Owasco Inlet, Cayuga County

2. HYDRAULIC

- Transport of water in the channel, on the floodplain and through sediments
  - Velocity
  - Shear Stress
  - Stream Power
  - Bank Height Ratio
  - Entrenchment Ratio
  - Rating Curves
  - Groundwater / Surface Water Exchange

Geneganstlet Creek, Chenango County

3. GEOMORPHOLOGY

- Transport of wood and sediment to create diverse bedforms and dynamic equilibrium
  - **Sediment transport capacity**
  - Channel Evolution
  - **Streambank erosion rates**
  - Riffle & Pool spacing
  - Depth variability
  - Substrate distribution
  - **Large Woody Debris Transport & Storage**
  - Riparian Vegetation density & composition

Cattaraugus Creek, Cattaraugus County

4. PHYSIOCHEMICAL

- Temperature and Oxygen regulation; processing of organic matter and nutrients
  - Dissolved Oxygen
  - **Temperature Regulation**
  - pH
  - Conductivity
  - Nutrient processing
  - Organic processing
  - Turbidity

5. BIOLOGY

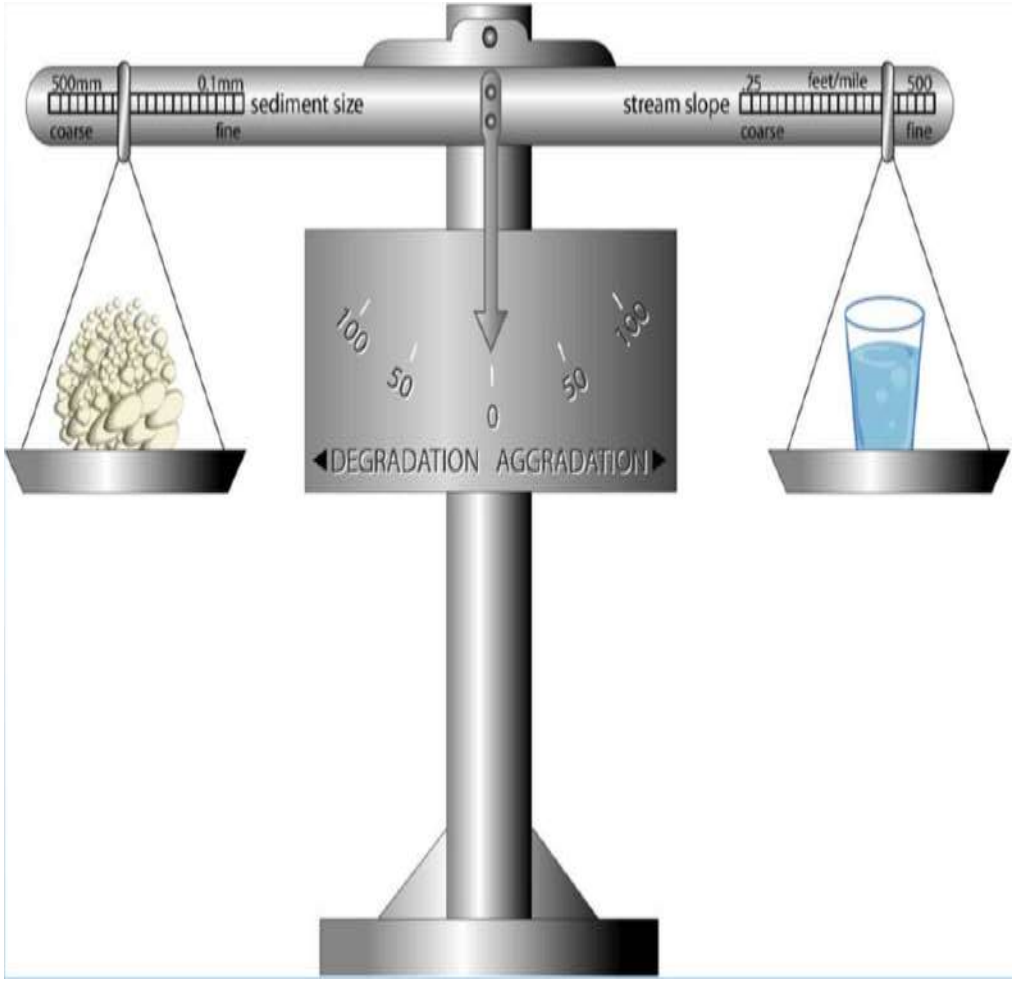
- Biodiversity and Life Histories of aquatic and riparian life
  - **Primary and Secondary production**
  - Macroinvertebrate communities
  - Fish communities
  - Riparian Communities

Streambank protection: Geomorphic Issues

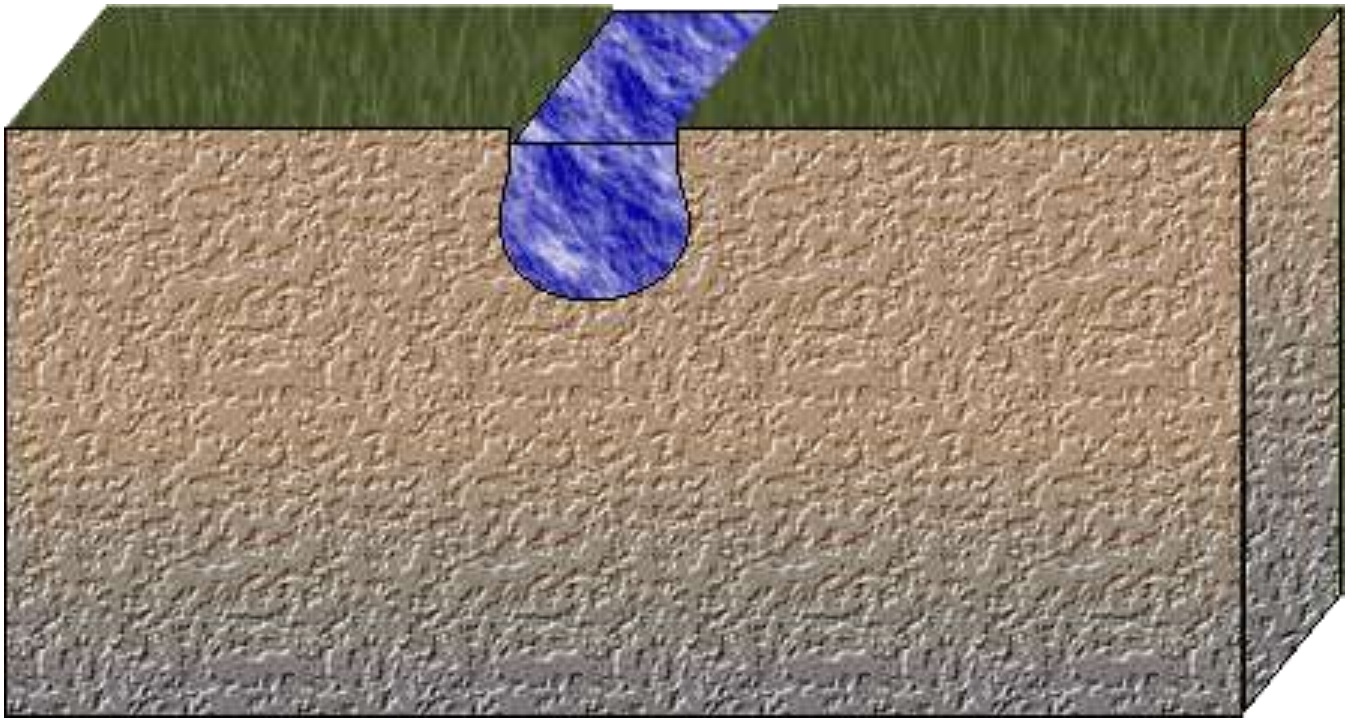
- Channel Type
- Natural & Historic migration rates
- Lateral migration processes and ecological function
  - LWD & Bedload transport
- Channel vertical stability (incision vs. aggredation)
- Riparian Zone

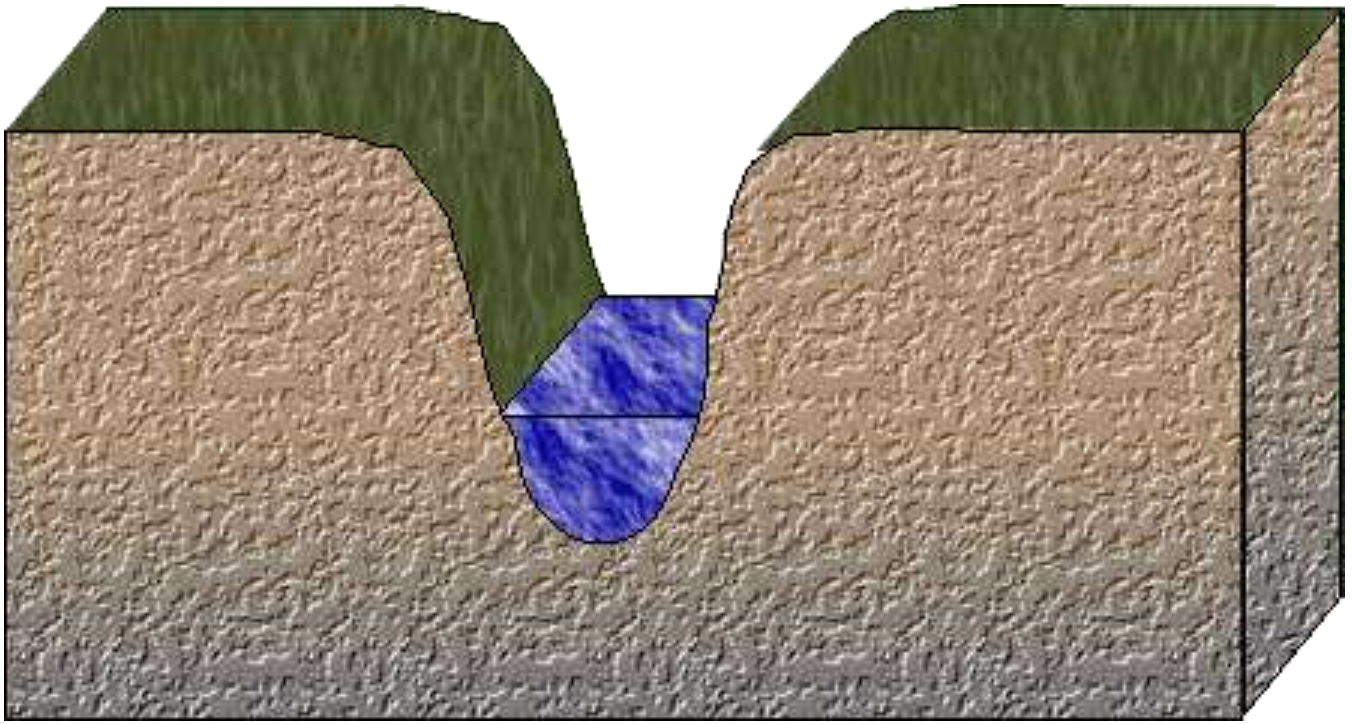
Channel Evolution

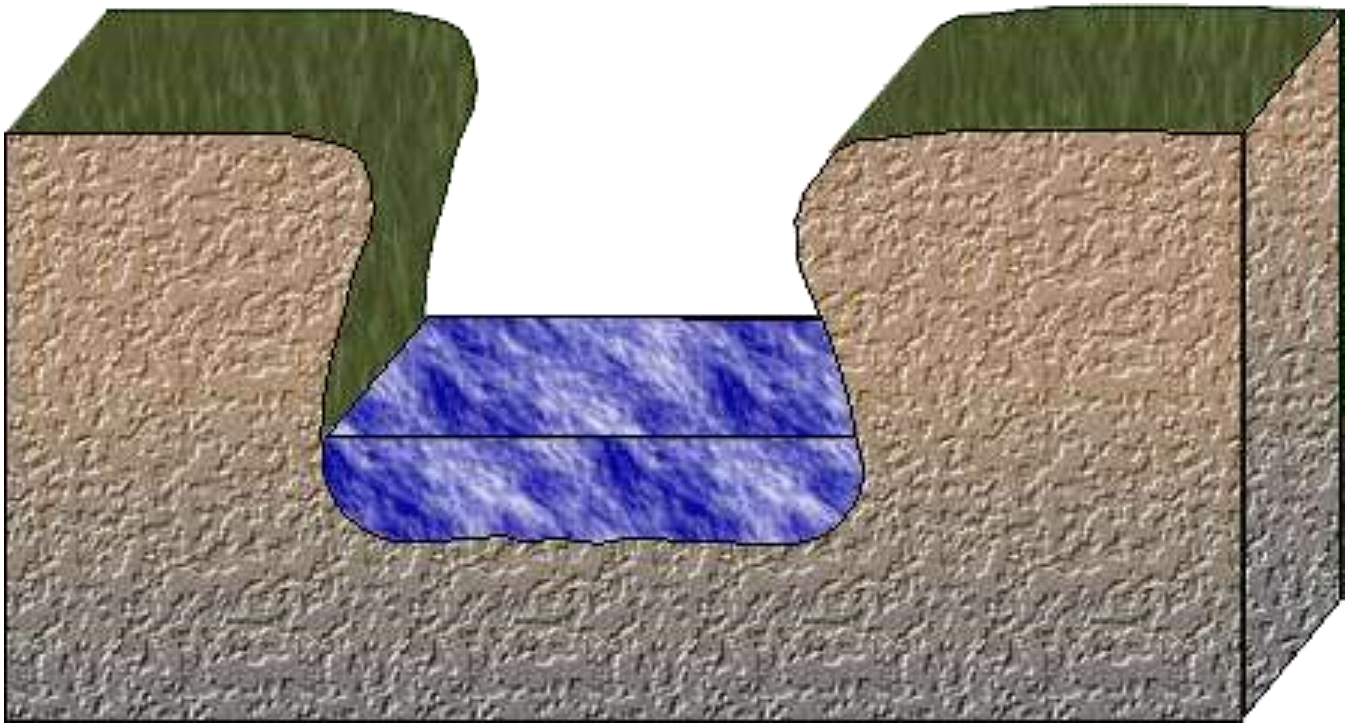
- Changes in stream power (slope & discharge) or stream work (sediment transport) result in channel adjustment

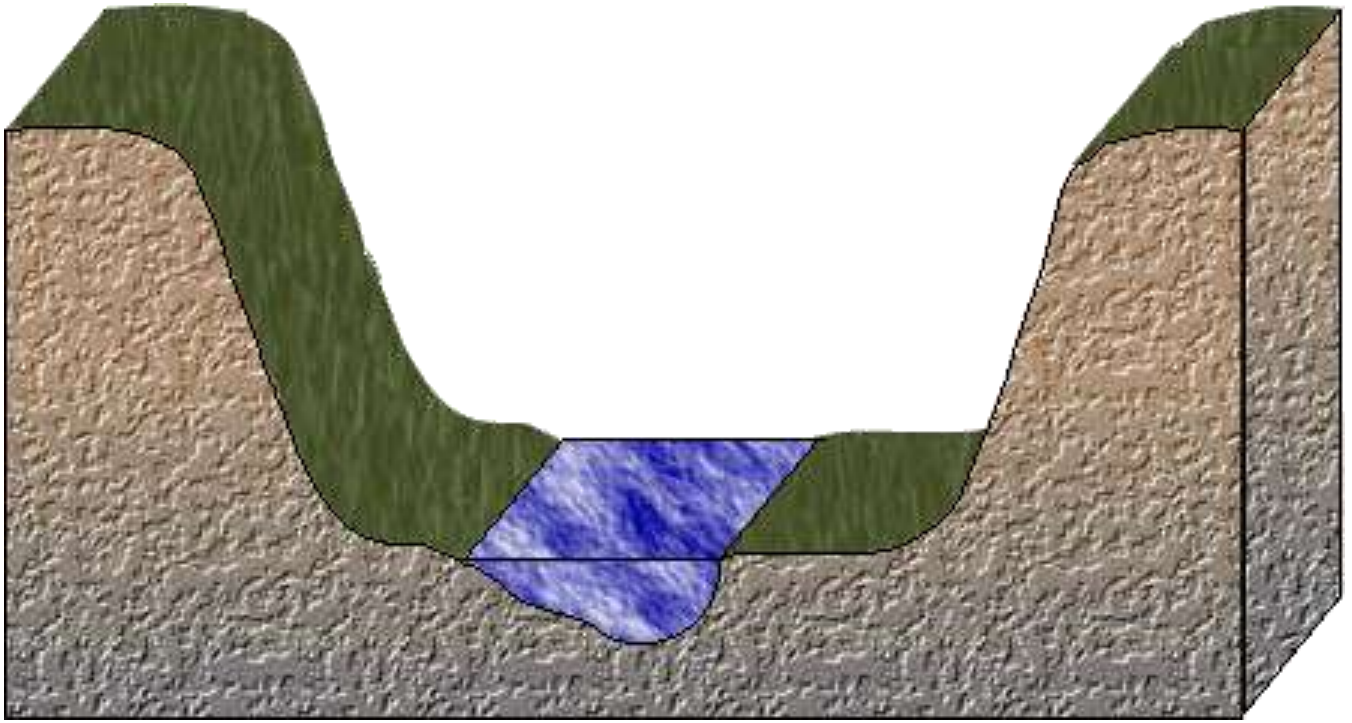


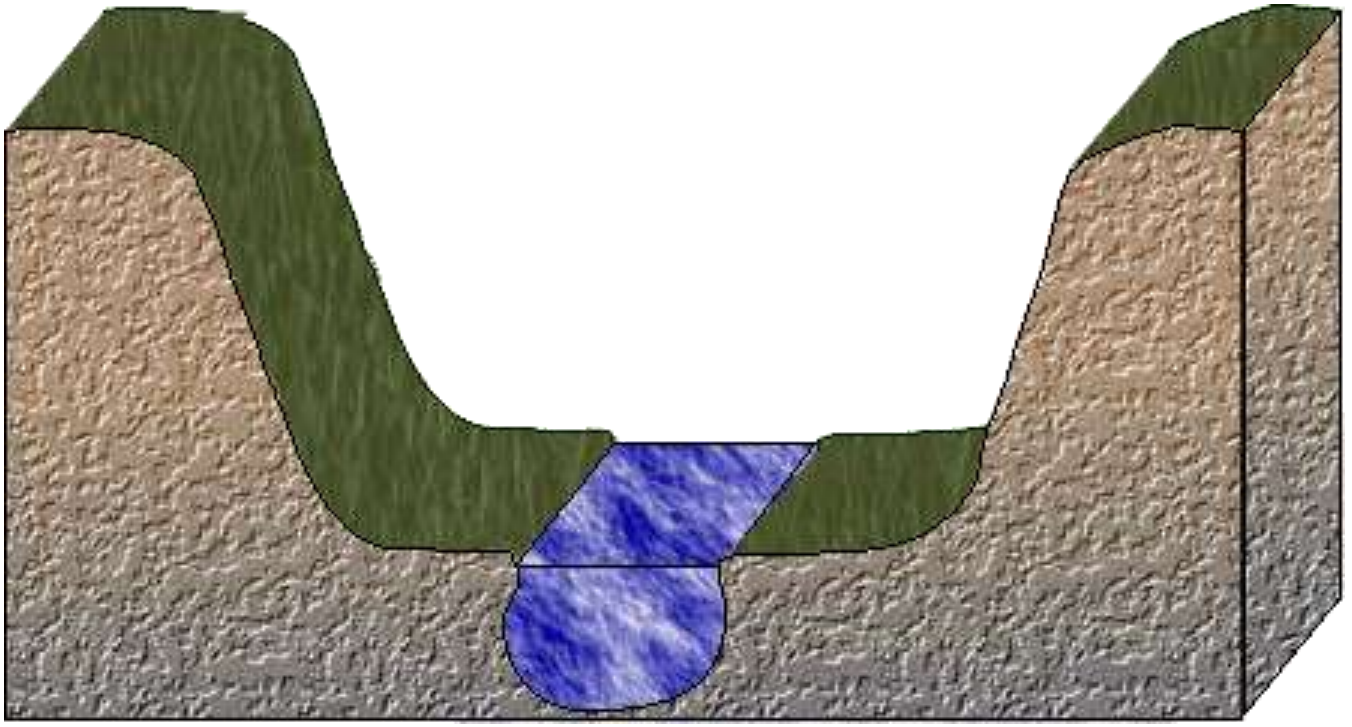
Channel Evolution



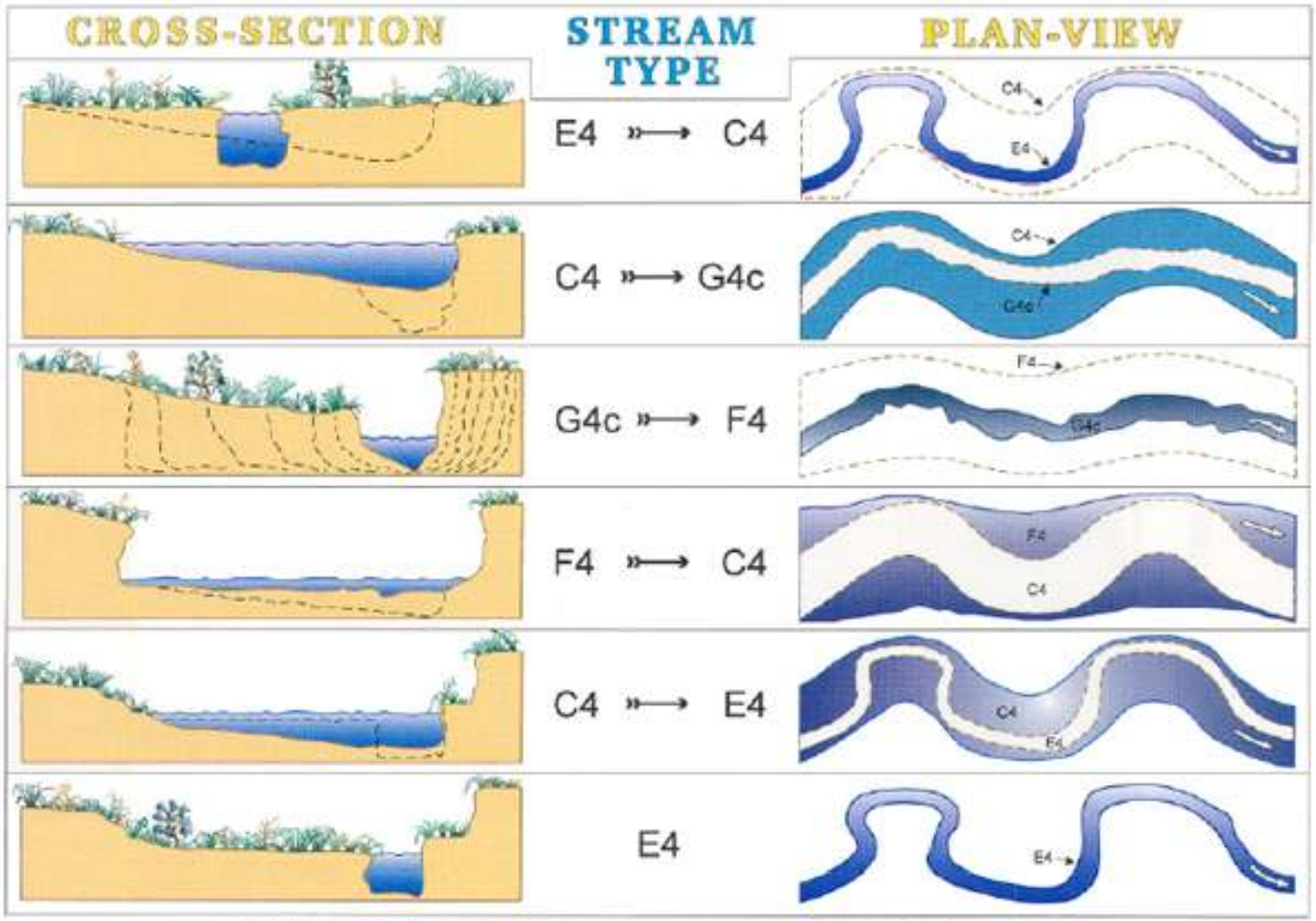








Channel Evolution Model



Adjustments of channel cross-section and plan-view patterns as stream types change or shift through an evolutionary cycle (Rosgen 1996)

Causes of streambank instability

changes in
land or stream
corridor use

changes in
geomorphology
and hydrology

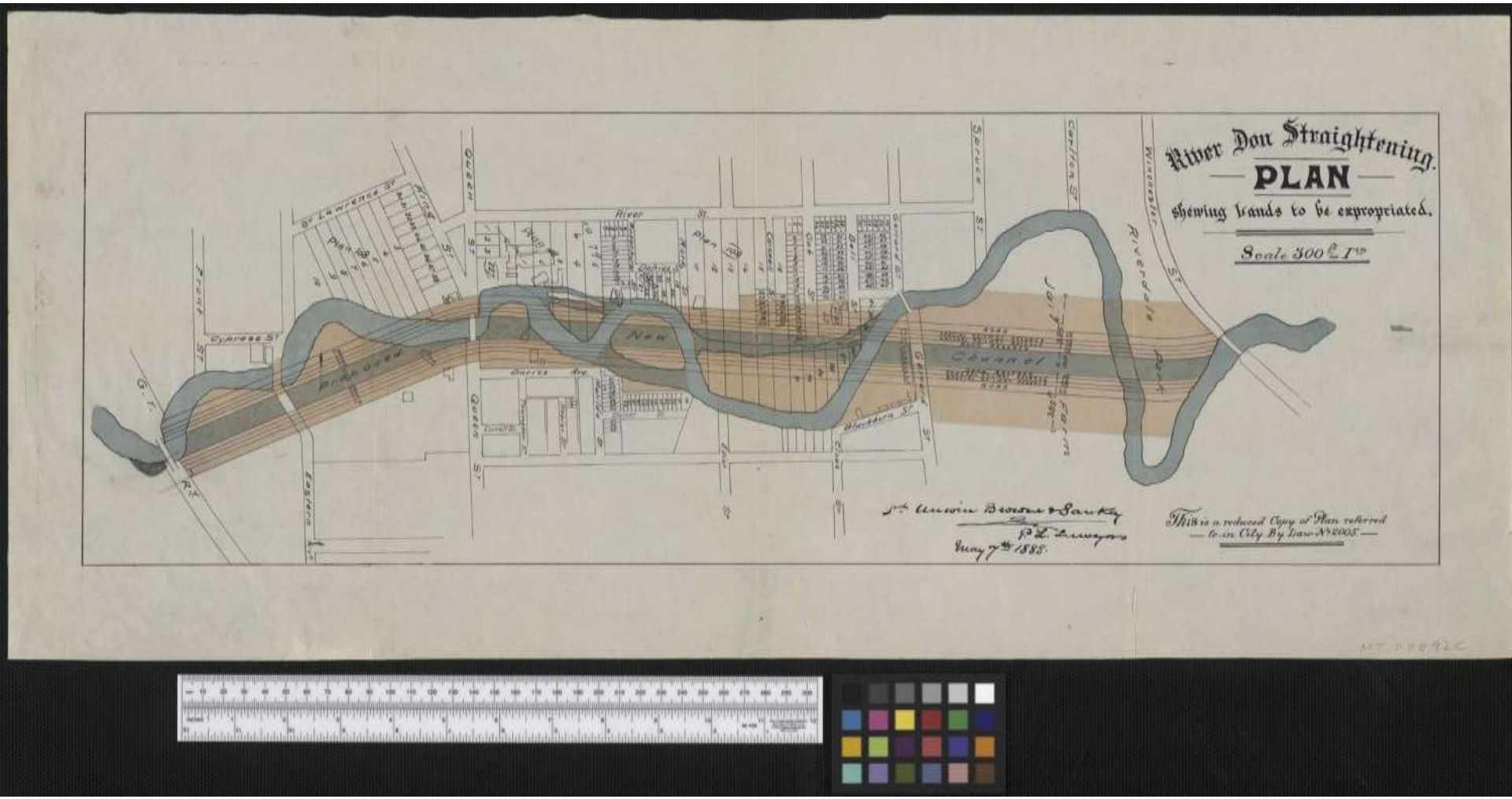
changes in
stream
hydraulics

changes in function
such as habitat,
sediment transport,
and storage

1. Change in Hydrology

2. Change in Hydraulics

River Don Straightening Plan (Toronto, Canada), 1888



http://hdl.handle.net/10315/1210

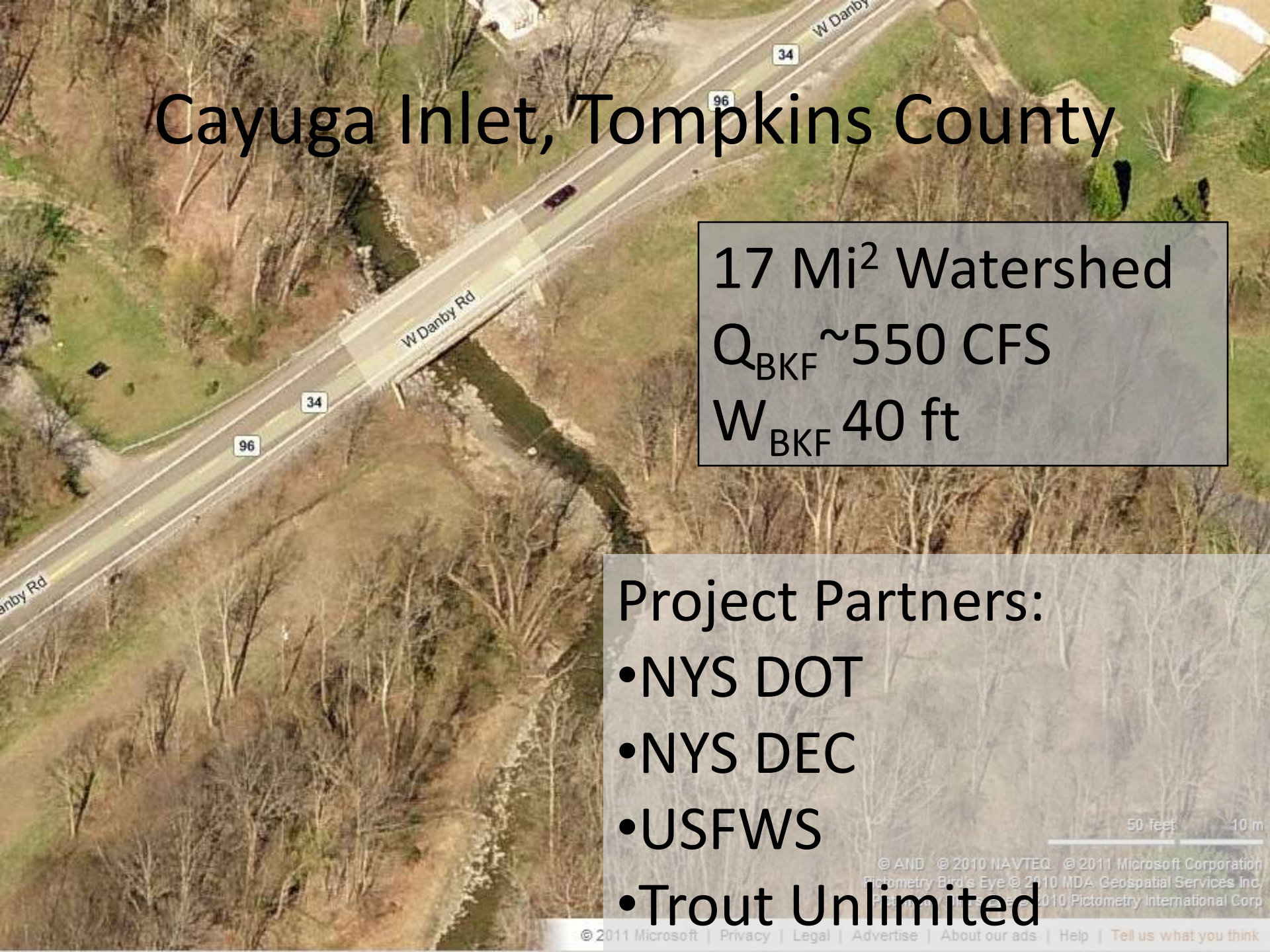
3. Change in Geomorphology

Tributary to Otselic River, Cortland County

Four Keys to a low-maintenance stream project

- Floodplain connectivity
- Bed form diversity
- Lateral stability
- Riparian Community

Cayuga Inlet, Tompkins County



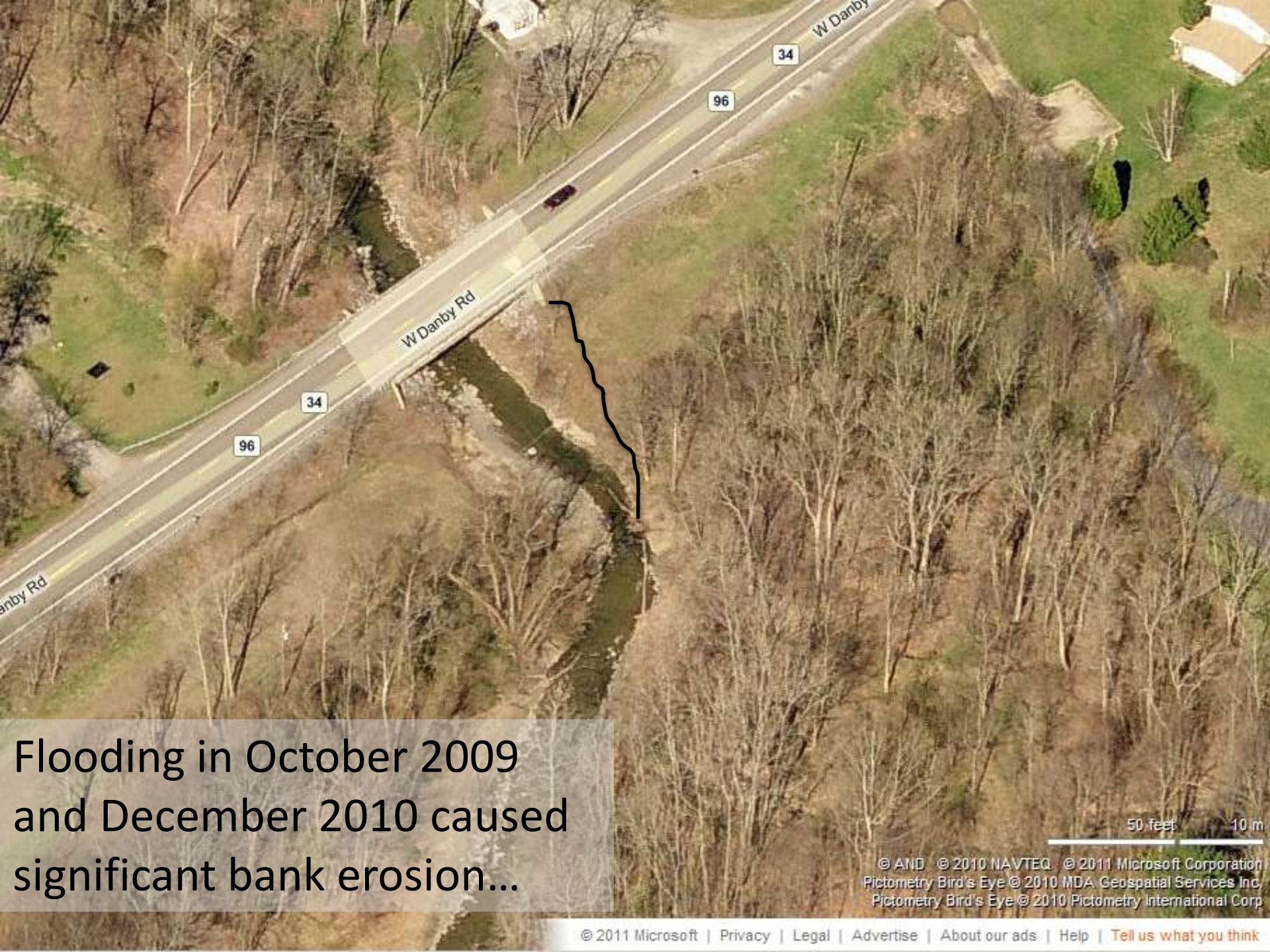
17 Mi^2 Watershed

Q_{BKF}~550 CFS

W_{BKF} 40 ft

Project Partners:

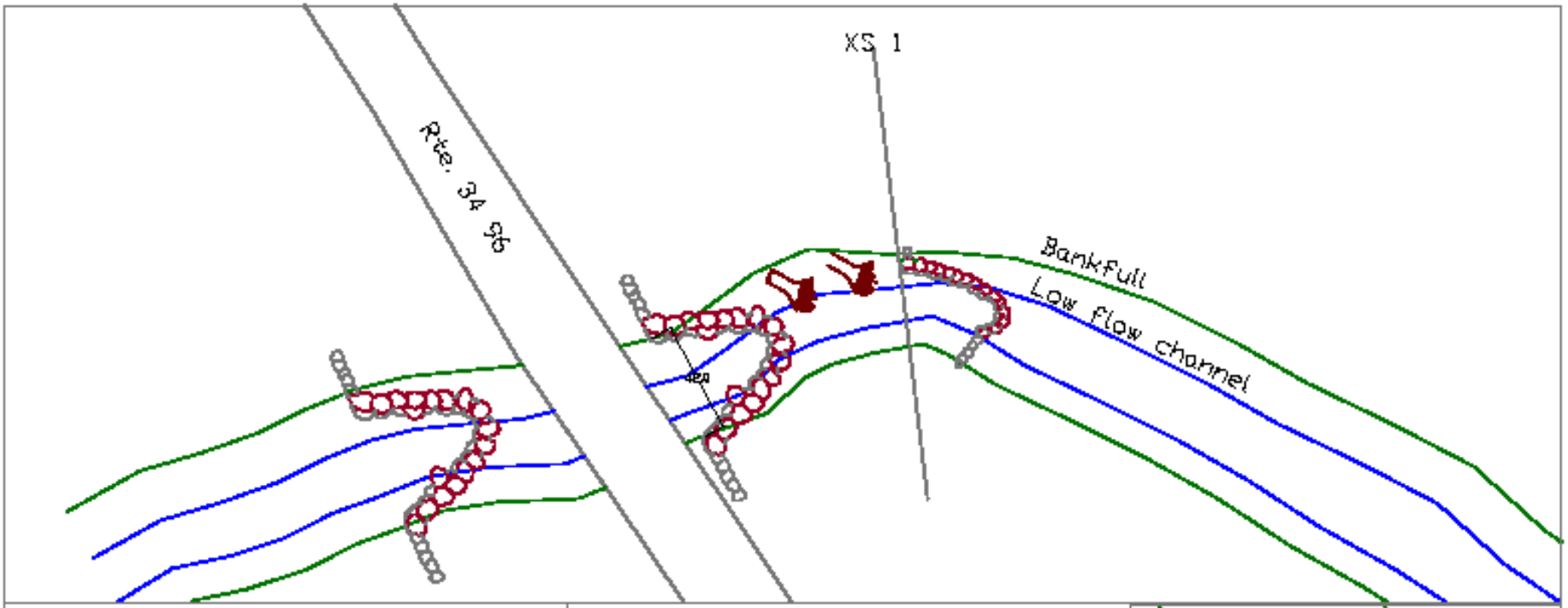
- NYS DOT
- NYS DEC
- USFWS
- Trout Unlimited

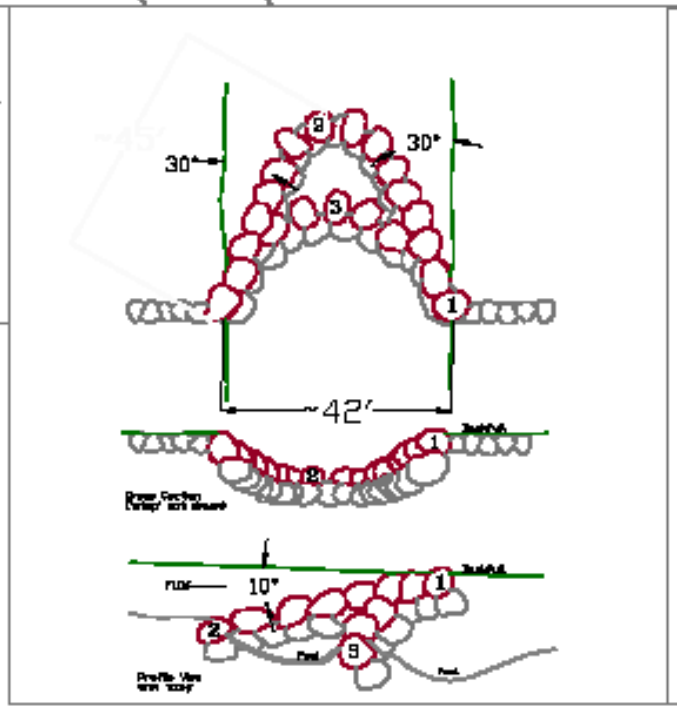


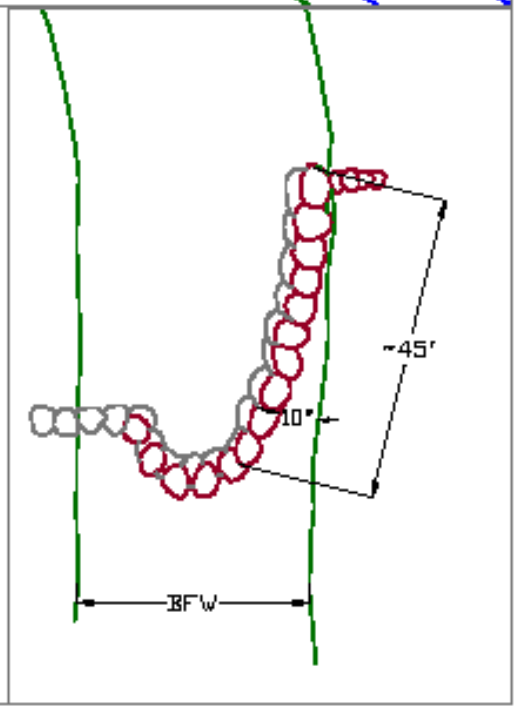
Flooding in October 2009 and December 2010 caused significant bank erosion…


January 11, 2011


January 11, 2011







Cayuga Inlet at Rte. 34 / 96 bridge, Town of Newfield

U.S. Fish & Wildlife Service
New York Field Office


January 27, 2011


March 3, 2011

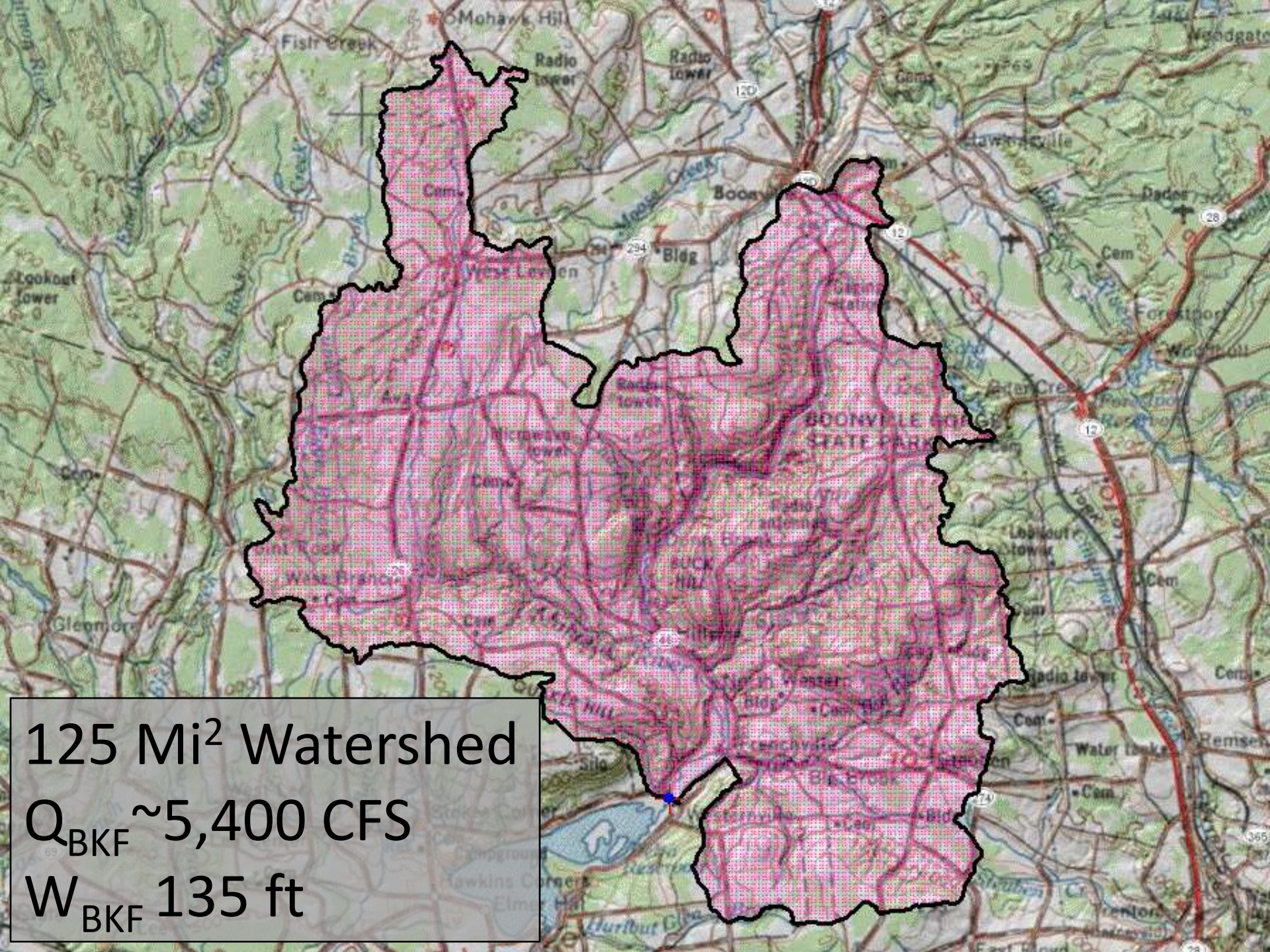

July 12, 2011


November 9, 2011

Mohawk River, Oneida County

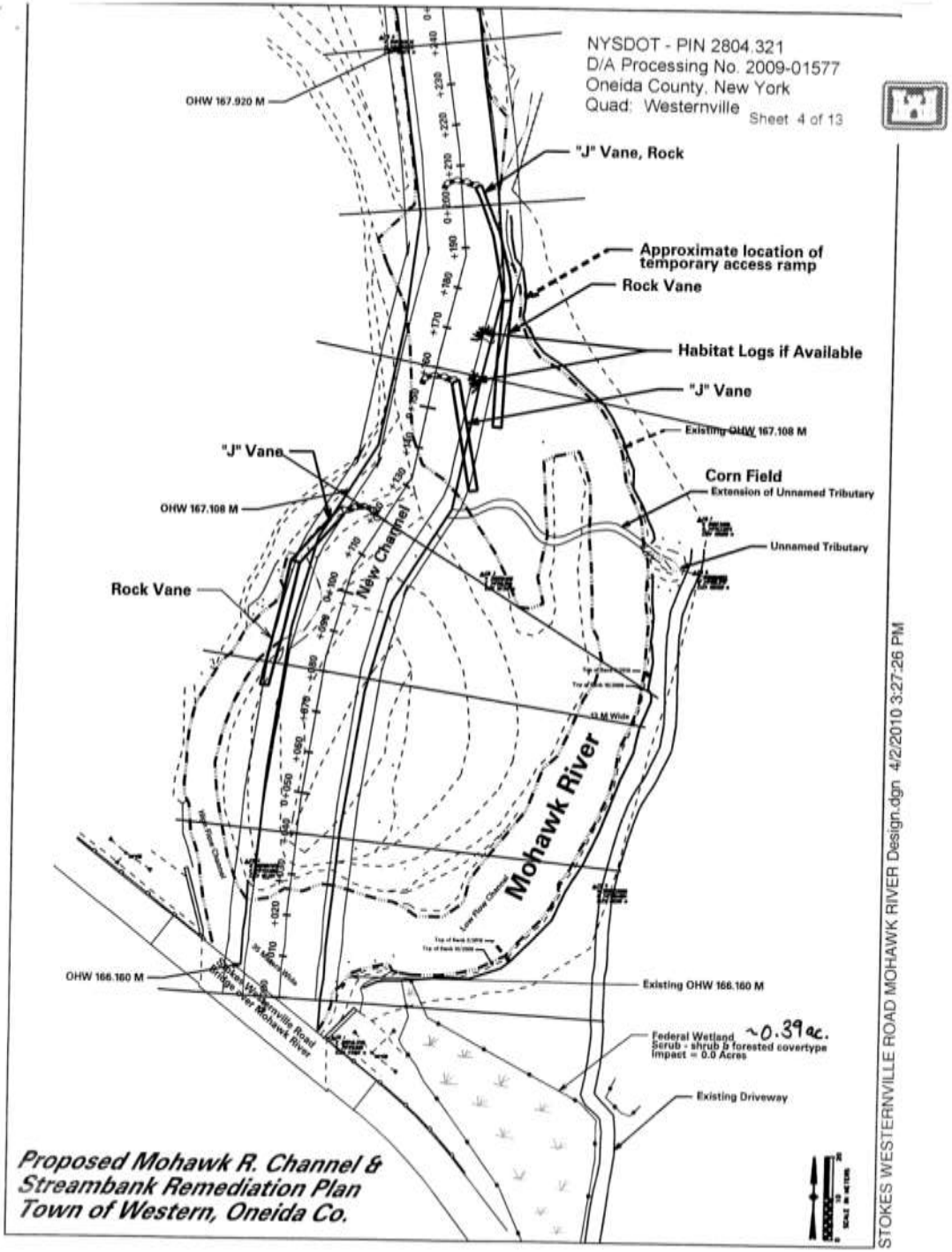
Project Partners:

- NYS DOT
- NYS DEC
- NYS Thruway - Canals
- USFWS
- Trout Unlimited


125 Mi² Watershed
Q_{BKF}~5,400 CFS
W_{BKF} 135 ft


09/21/2009


09/21/2009


NYSDOT - PIN 2804.321
D/A Processing No. 2009-01577
Oneida County, New York
Quad: Westernville
Sheet 4 of 13
OHW 167.920 M
"J" Vane, Rock
Approximate location of temporary access ramp
Rock Vane
Habitat Logs if Available
"J" Vane
Existing OHW 167.108 M
"J" Vane
OHW 167.108 M
Corn Field
Extension of Unnamed Tributary
Unnamed Tributary
Rock Vane
New Channel
Mohawk River
Low Flow Channel
OHW 166.160 M
Existing OHW 166.160 M
Federal Wetland
Scrub - shrub & forested covertype
Impact = 0.0 Acres
~0.39 ac.
Existing Driveway
Proposed Mohawk R. Channel &
Streambank Remediation Plan
Town of Western, Oneida Co.
STOKES WESTERNVILLE ROAD MOHAWK RIVER Design.dgn 4/2/2010 3:27:26 PM


March 9, 2011

- Pictures taken 3/11/2011 from John Hallock cell phone


October 25, 2011