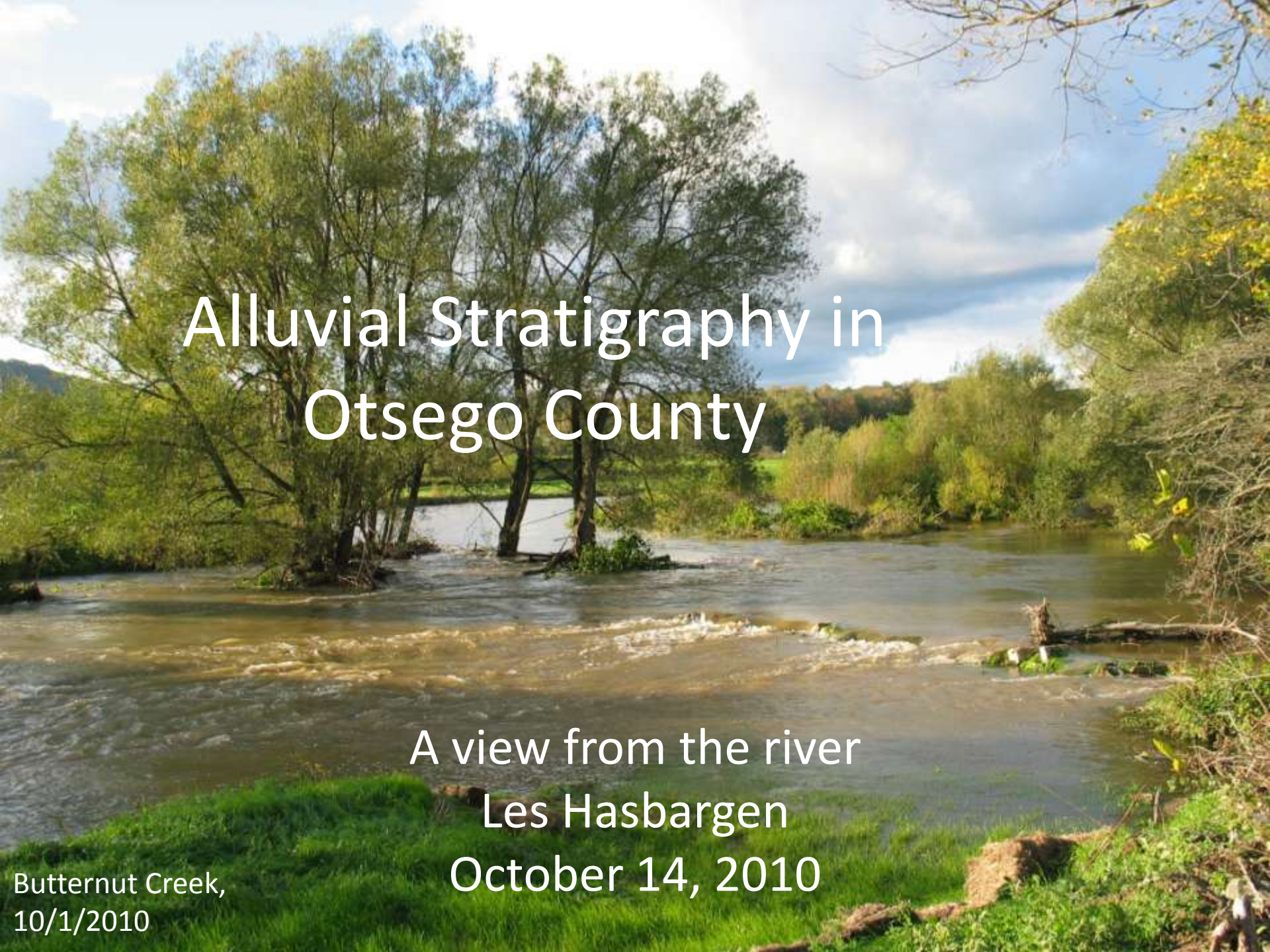


Alluvial Stratigraphy in Otsego County

A view from the river

Les Hasbargen

October 14, 2010

Butternut Creek, 10/1/2010

Overview

- Acknowledgements: Damon Matteson, Emily Carroll, Cindy Klink, Emmon Johnson
- Models for floodplain stratigraphy
- Observations from GPR in local floodplains
- The view from the river: modern processes and the story in the banks

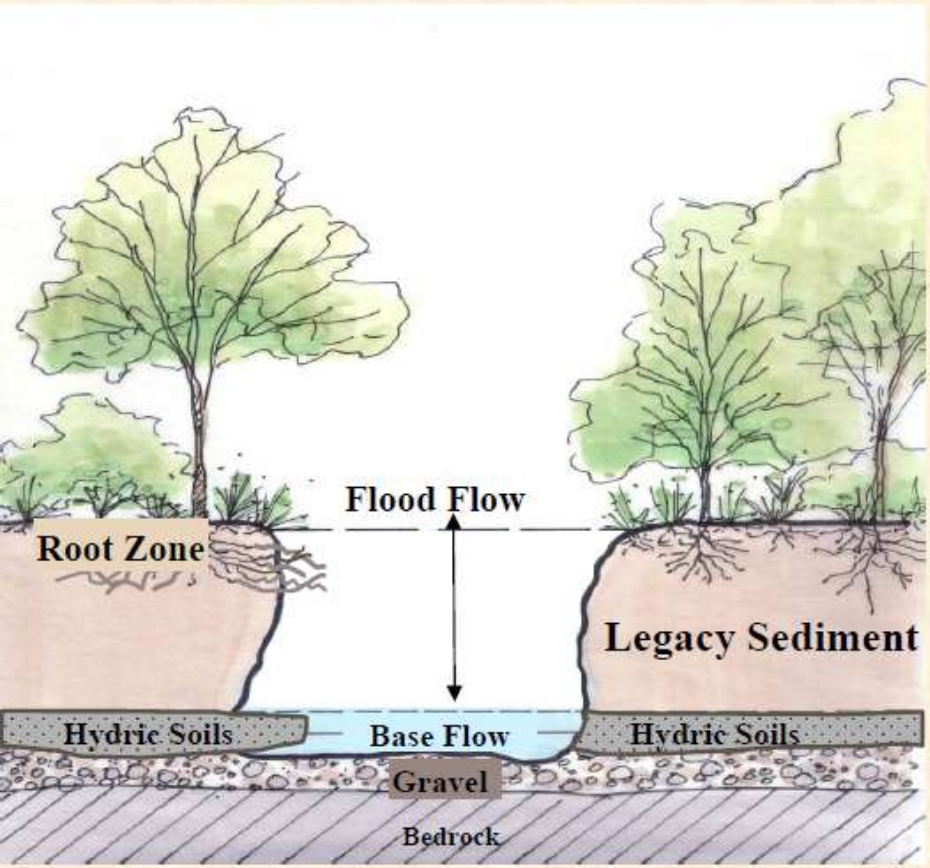
Floodplain stratigraphy

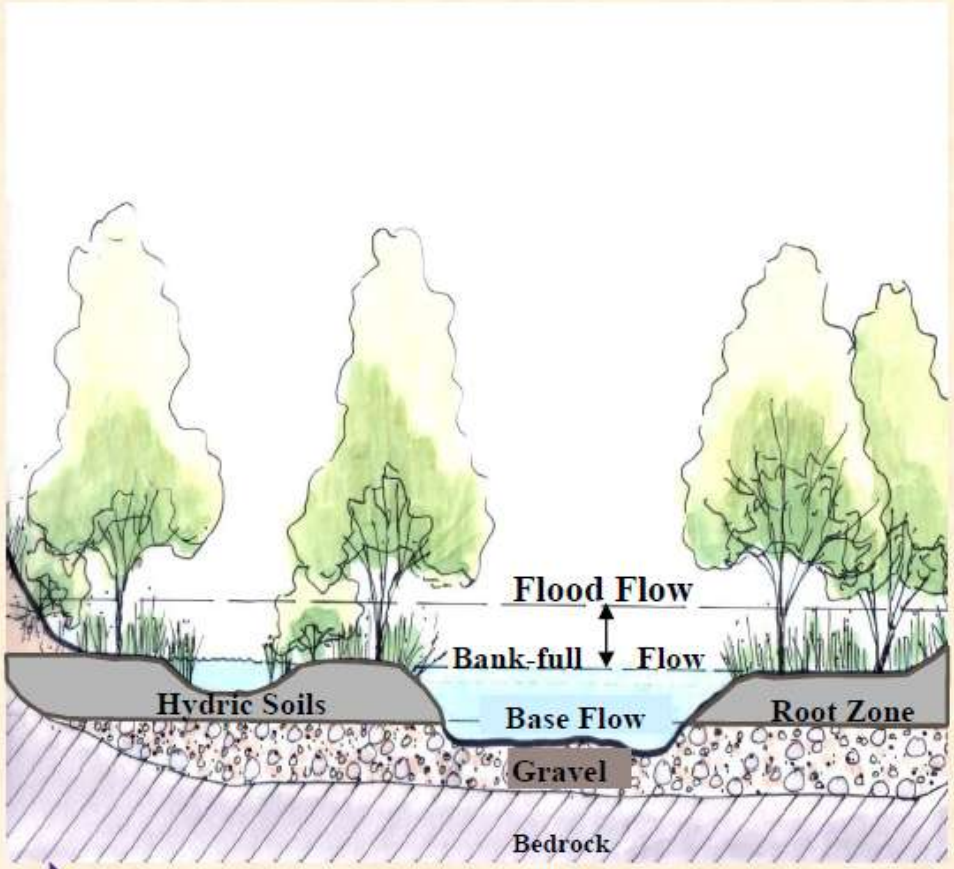
- Models for floodplain development
  - Channel lag and overbank fines
  - Exponential decay of upward growth of floodplain
  - Lateral migration, cutoffs, bar hopping, and channel avulsion
  - Legacy sediment model
  - Toward a local model: reaches with beaches and reaches without
- GPR study at Pine Lake: a lesson in the subsurface
- Questions:
  - Temporal continuity of strata?
  - How laterally continuous are layers?
  - Is there evidence for an historic depositional event? Can we date alluvial sediments?
  - Is the present like the past?
  - Can we discriminate between models?

Floodplain and Riparian Wetland Restoration BMP

Conceptual Design

Existing Condition ⇨ **Proposed Restoration**

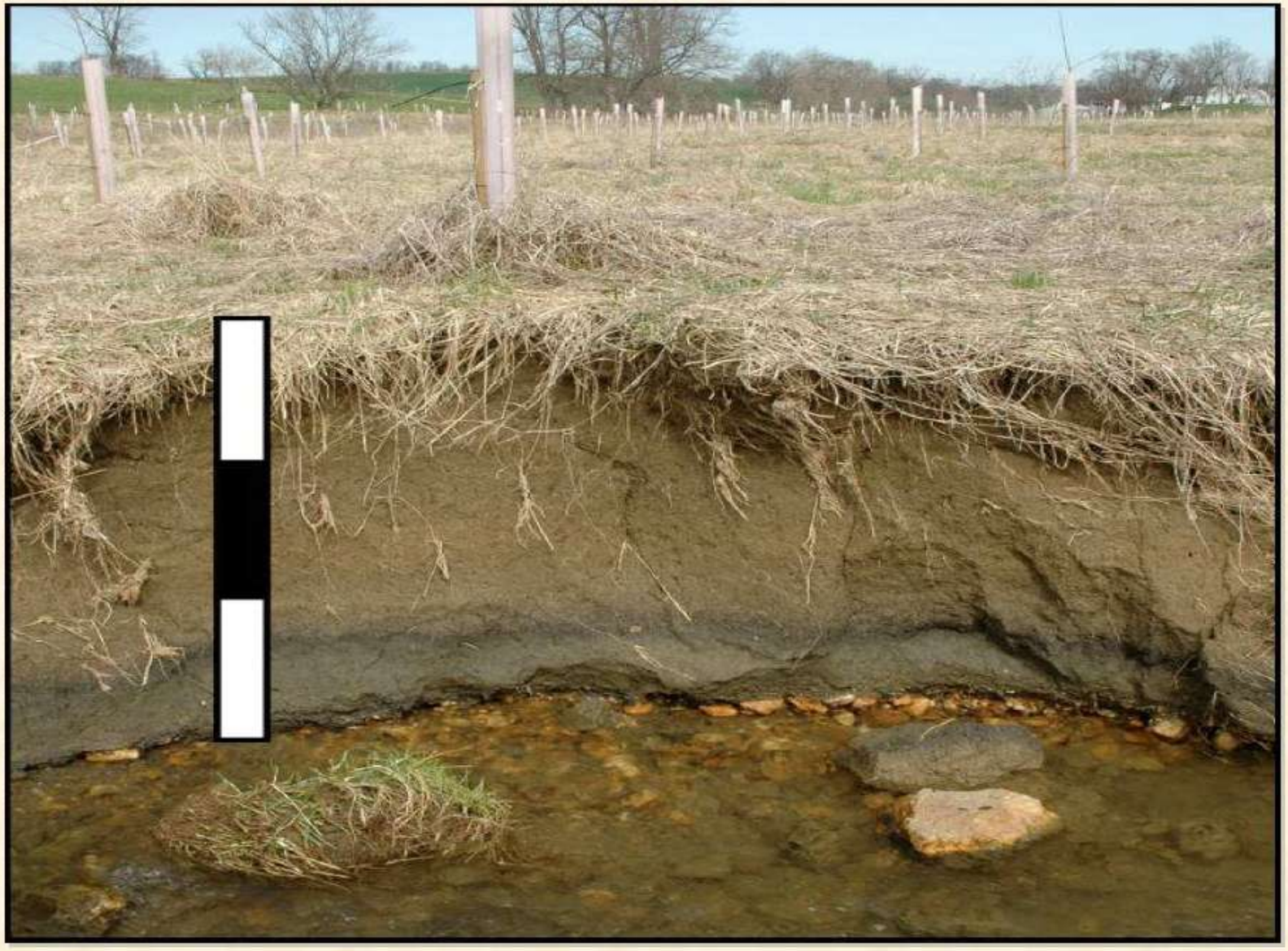




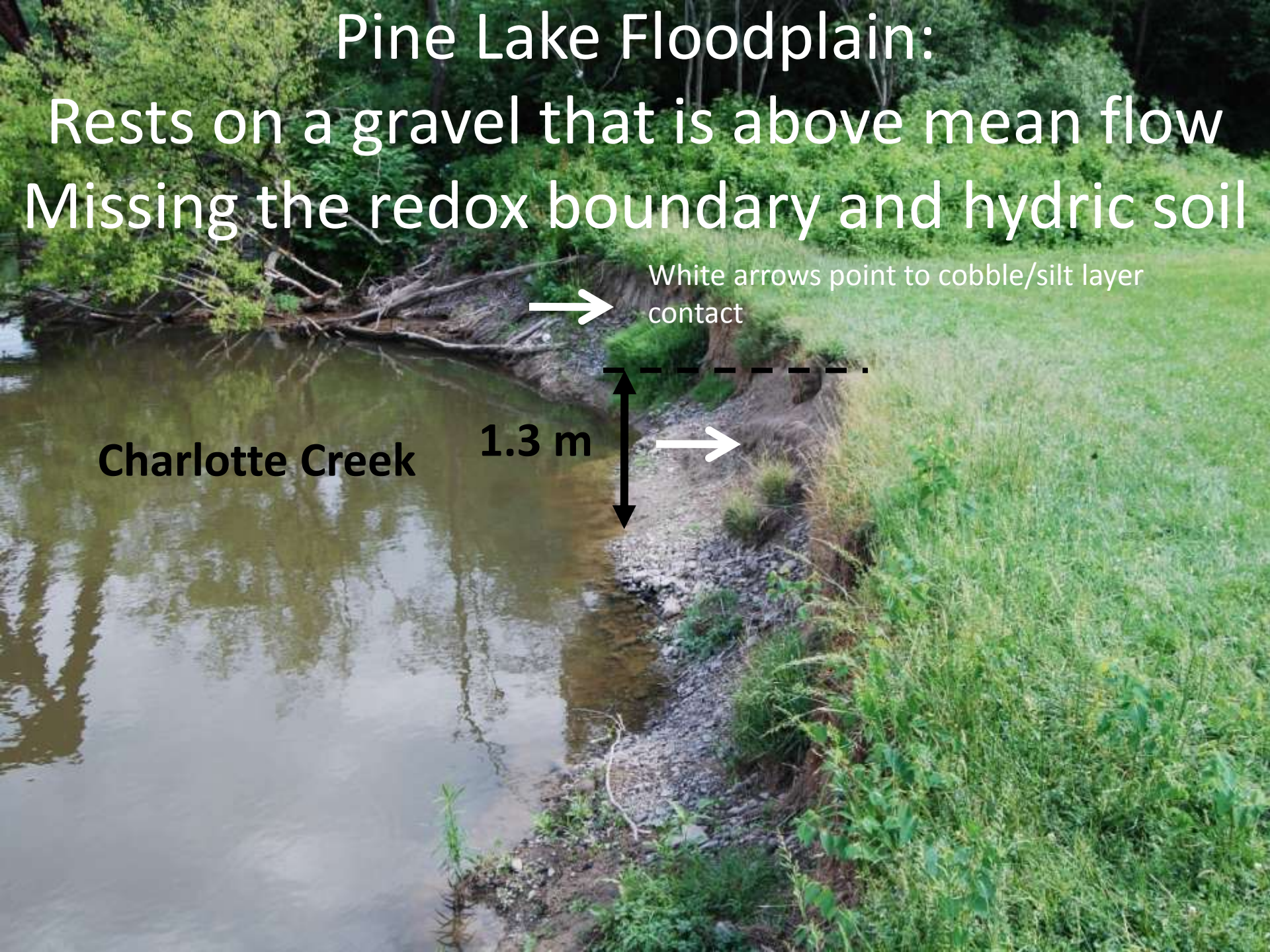
Jeffrey Hartranft, ***US EPA's Principles for Ecological Restoration of Aquatic Resources and a New and Innovative Best Management Practice To Address Legacy Sediment Impairments*****, PA DEP, 2009.**

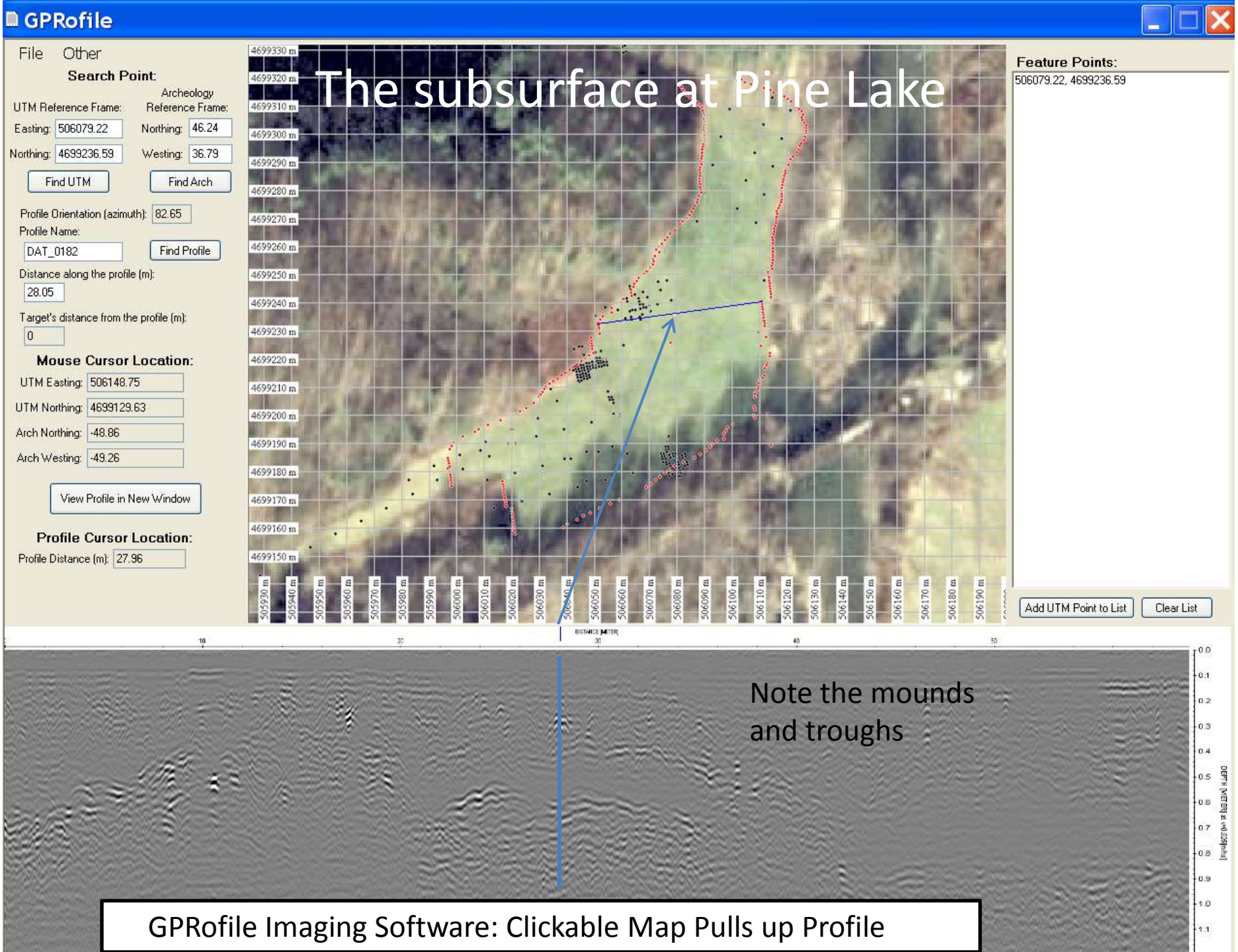
⇨ **Natural Condition**

Big Spring Run - Type Section

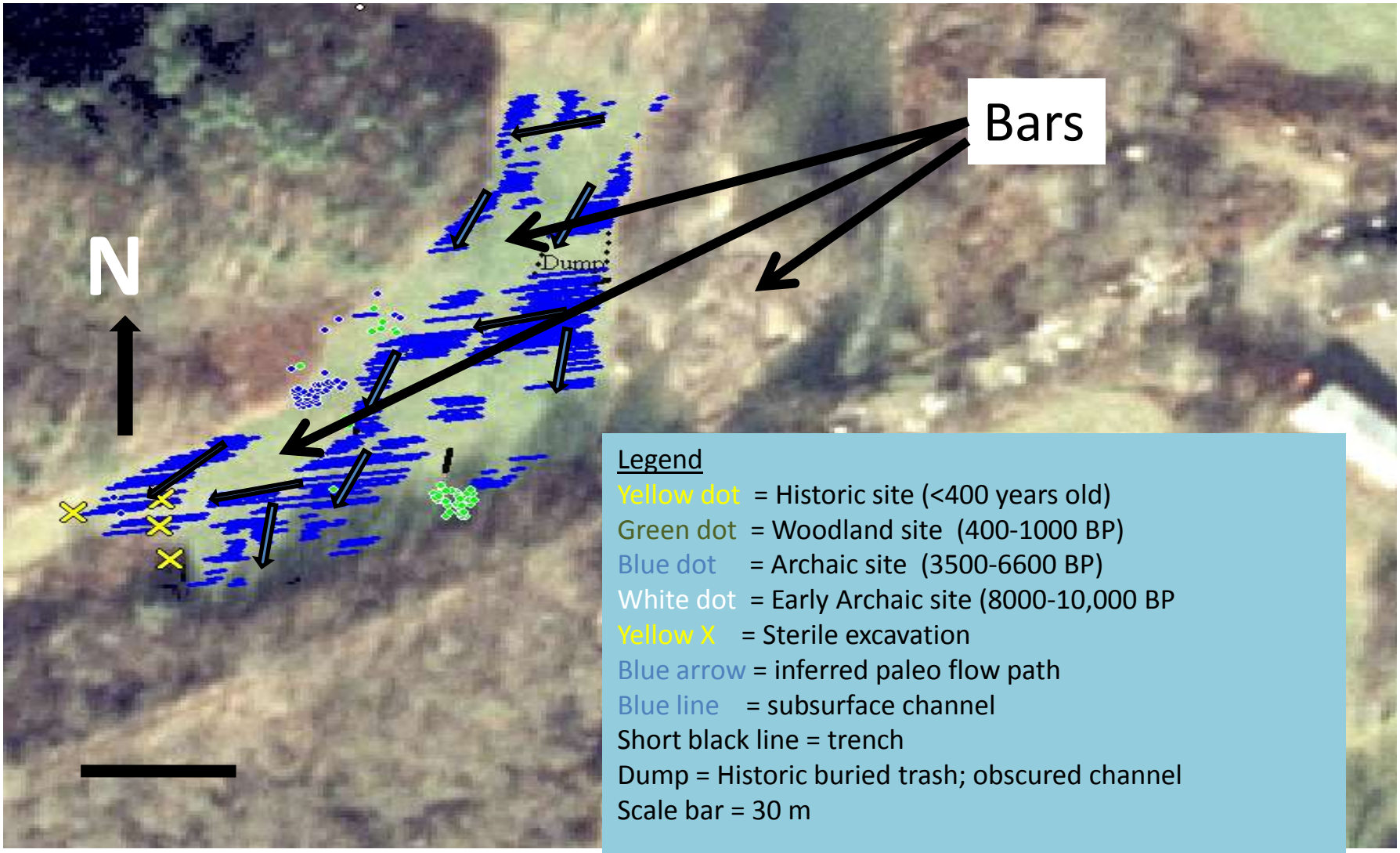


Courtesy Franklin & Marshall College


Pine Lake Floodplain:
Rests on a gravel that is above mean flow
Missing the redox boundary and hydric soil
White arrows point to cobble/silt layer contact
1.3 m
Charlotte Creek


GPRofile
File
Other
Search Point:
UTM Reference Frame:
Archeology Reference Frame:
Easting: 506079.22
Northing: 46.24
Northing: 4699236.59
Westing: 36.79
Find UTM
Find Arch
Profile Orientation (azimuth): 82.65
Profile Name:
DAT_0182
Find Profile
Distance along the profile (m):
28.05
Target's distance from the profile (m):
0
Mouse Cursor Location:
UTM Easting: 506148.75
UTM Northing: 4699129.63
Arch Northing: -48.86
Arch Westing: -49.26
View Profile in New Window
Profile Cursor Location:
Profile Distance (m): 27.96
The subsurface at Pine Lake
Feature Points:
506079.22, 4699236.59
Add UTM Point to List
Clear List
Note the mounds and troughs
GPRofile Imaging Software: Clickable Map Pulls up Profile

Map view of buried channels



Legend
Yellow dot = Historic site (<400 years old)
Green dot = Woodland site (400-1000 BP)
Blue dot = Archaic site (3500-6600 BP)
White dot = Early Archaic site (8000-10,000 BP
Yellow X = Sterile excavation
Blue arrow = inferred paleo flow path
Blue line = subsurface channel
Short black line = trench
Dump = Historic buried trash; obscured channel
Scale bar = 30 m

The view from the river

- Cutbanks expose deposits of the past
- Modern channel patterns and processes
  - Depositional features (longitudinal bars, point bars, mud bars, mud pools, LWD pools)
  - Erosional features (scours, flood channels, and cutbanks)
  - Vertical accretion? (the thick tan layer)
  - Lateral accretion? Bar hopping and dipping mud layers
  - Down channel variation in reach “type”
    - Still water runs deep
    - Bars, riffles, pools

Floodplain growth
Butternut Creek, Oct. 1, 2010


Otego Creek at Bankfull
March 2010

One source of gravel bars: tributaries!

Unnamed tributary to Butternut Creek

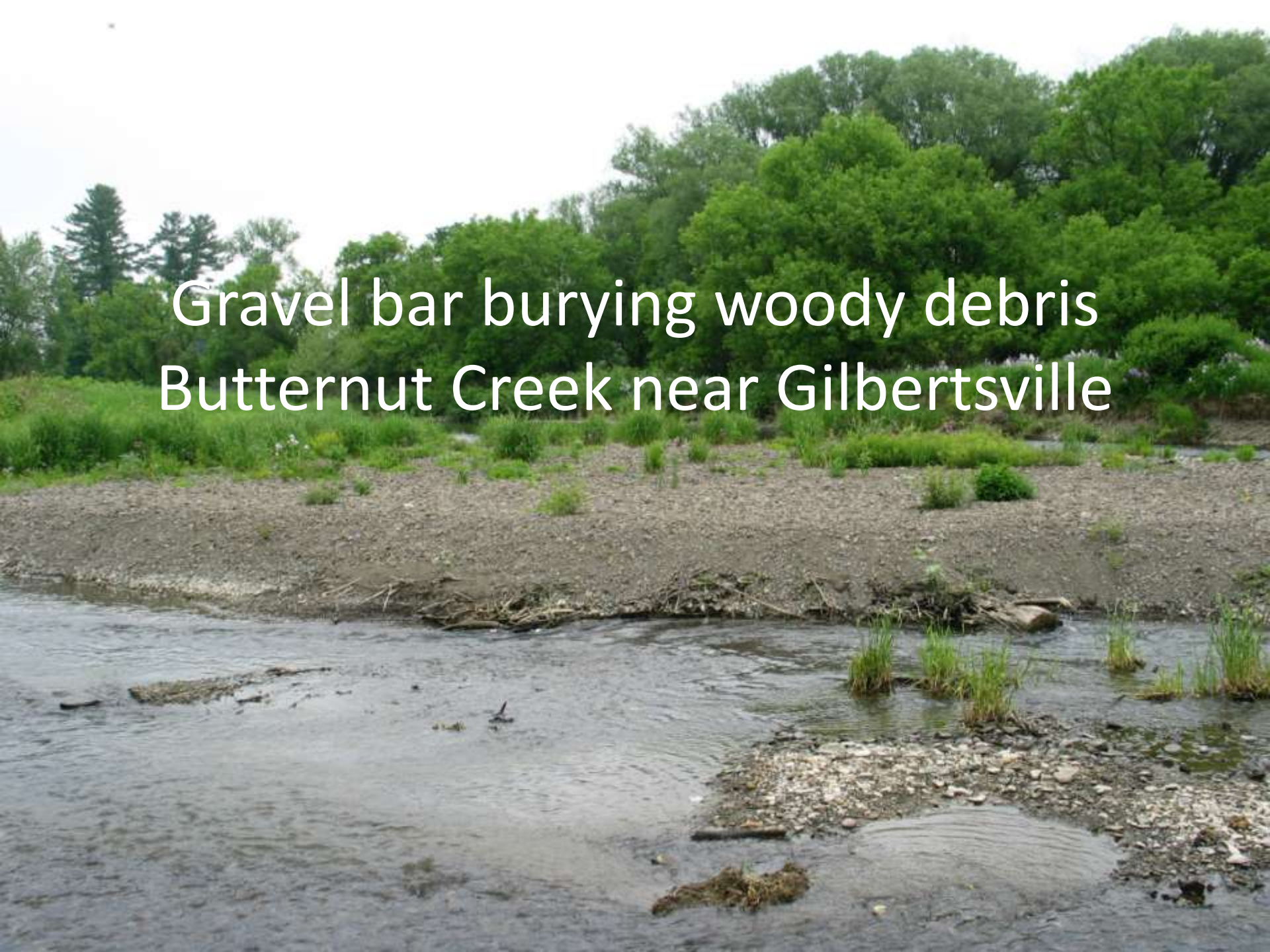

Tributary Delta
Butternut Creek


Incipient flood channel with fresh gravel over a muddy substrate (crevasse splay)
(LWD) off-screen at left

Bank collapse from 10/1/2010 event


Gravel and fines interfinger
Off screen to left—rapids!


Riffle-pool reach
Butternut Creek near Gilbertsville
Note the bank collapse


Gravel bar burying woody debris
Butternut Creek near Gilbertsville


Quiet Deep Reaches with high muddy banks
Butternut Creek
Summer 2010


Gravel delta at a tributary junction
Otego Creek


Gravel Delta


Massive peat Otego Creek


Close up of Peat/Clay


Signs of lateral accretion

Floodplain fines over gravel
Unadilla River near New Berlin

Image courtesy of Damon Matteson

Gravel below dark gray carbon-rich layer overlain by massive muddy layer—looks like Legacy

Unadilla River near New Berlin

Image courtesy of Damon Matteson

Surprises to me

- Low gradient doesn’t mean no activity
- Dipping mud layers (lateral accretion deposits)
- Organic material gets buried a lot!
- Channel perimeters are very active: lose up to a meter/yr in bank erosion, and can bury trees, tractor tires, golf balls in a hurry
- Vertical accretion dominates slow deep reaches; lateral and vertical common in riffle-pool reaches
- LWD is common, as are huge maples, willows, and walnuts along the banks: the trees have a story to tell

The meaning of the basal peat…

- Clearly an oxic/anoxic boundary (orange to red and gray-brown-black zones; see bag)
- Is it a buried floodplain?
- Are they just local woody debris mats buried by lateral accretion?
- Does the water table dictate soil redox zones and preservation of organics?
- Are soil forming processes capable of smearing entire floodplain deposits in 100-200 yrs?

Our next steps

- Date the base of the massive floodplain deposits
  - Everywhere young = legacy sediment model validated
  - Large age range discounts legacy model=>
- Working toward a conceptual framework to understand local rivers
  - Geologically young and low gradient (deglacial setting)
  - Riffle-pool and deep run reaches characterize local channels (***reaches with beaches and reaches without***)
  - Unstable banks are everywhere
  - Is current level of activity characteristic for the Holocene?

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