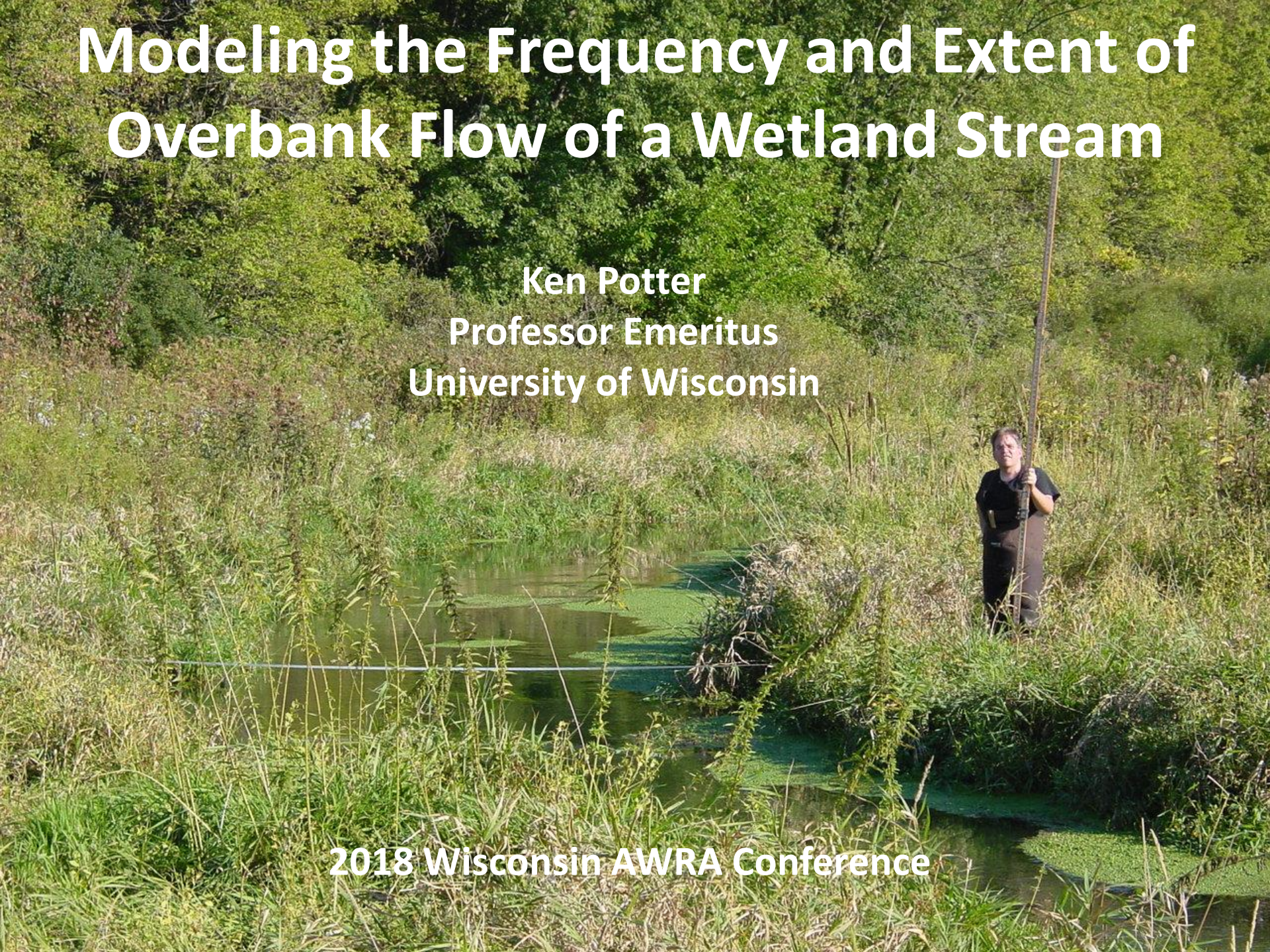
Modeling the Frequency and Extent of Overbank Flow of a Wetland Stream

Ken Potter
Professor Emeritus
University of Wisconsin



2018 Wisconsin AWRA Conference

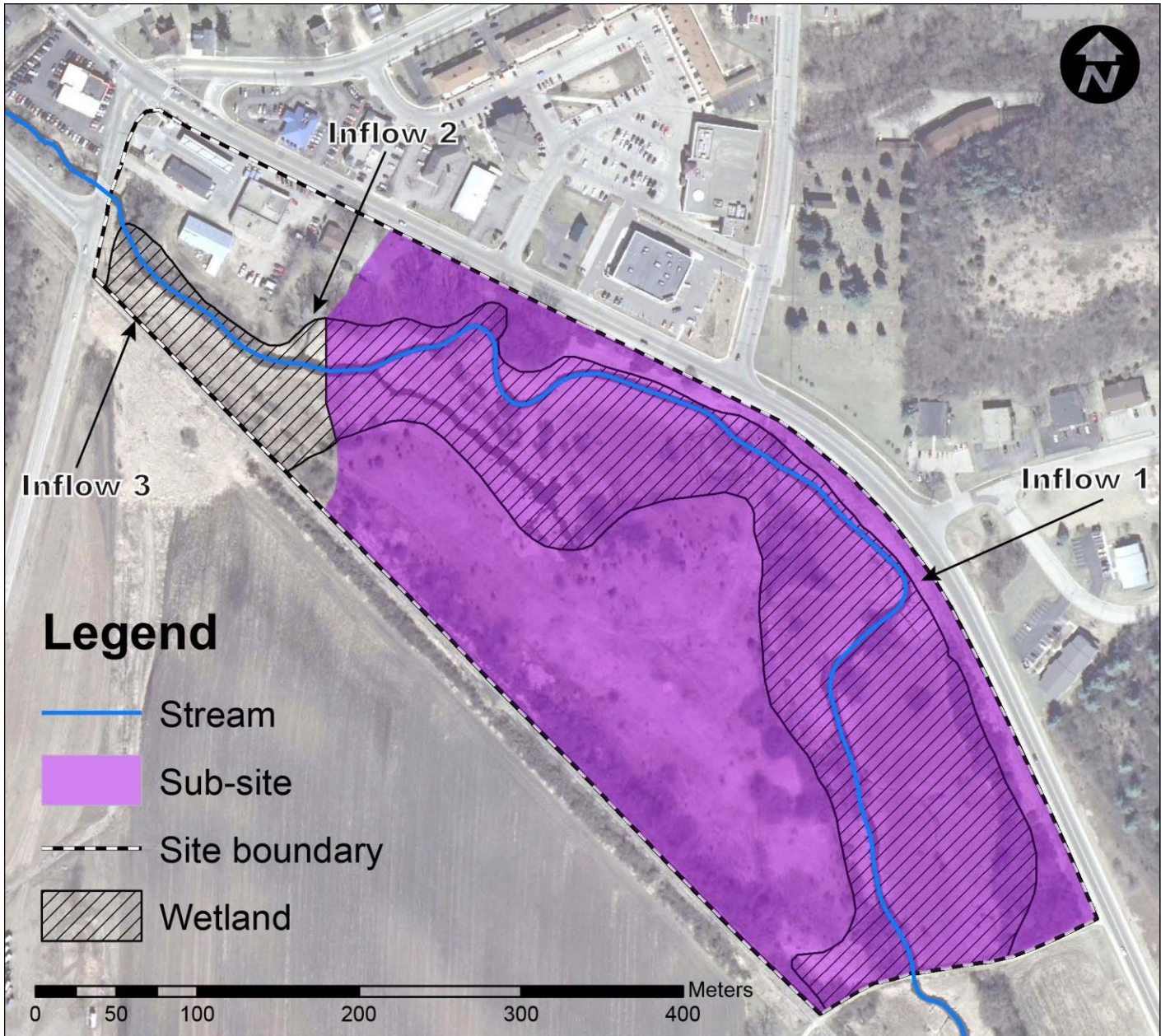
Black Earth Creek at Cross Plains

DA = 38 km²

14 hectare floodplain

6.3 hectare wetland

5.5 hectares in subsite



Topographic Analysis

- Constructed a 3-meter DEM supported by over 3000 surveyed elevation measurements

- Surveyed 50 evenly spaced stream cross sections, 37 in subsite.

Hydraulics Analysis

- Used 1-dimensional hydraulic modeling to estimate bankfull discharge at each cross section.

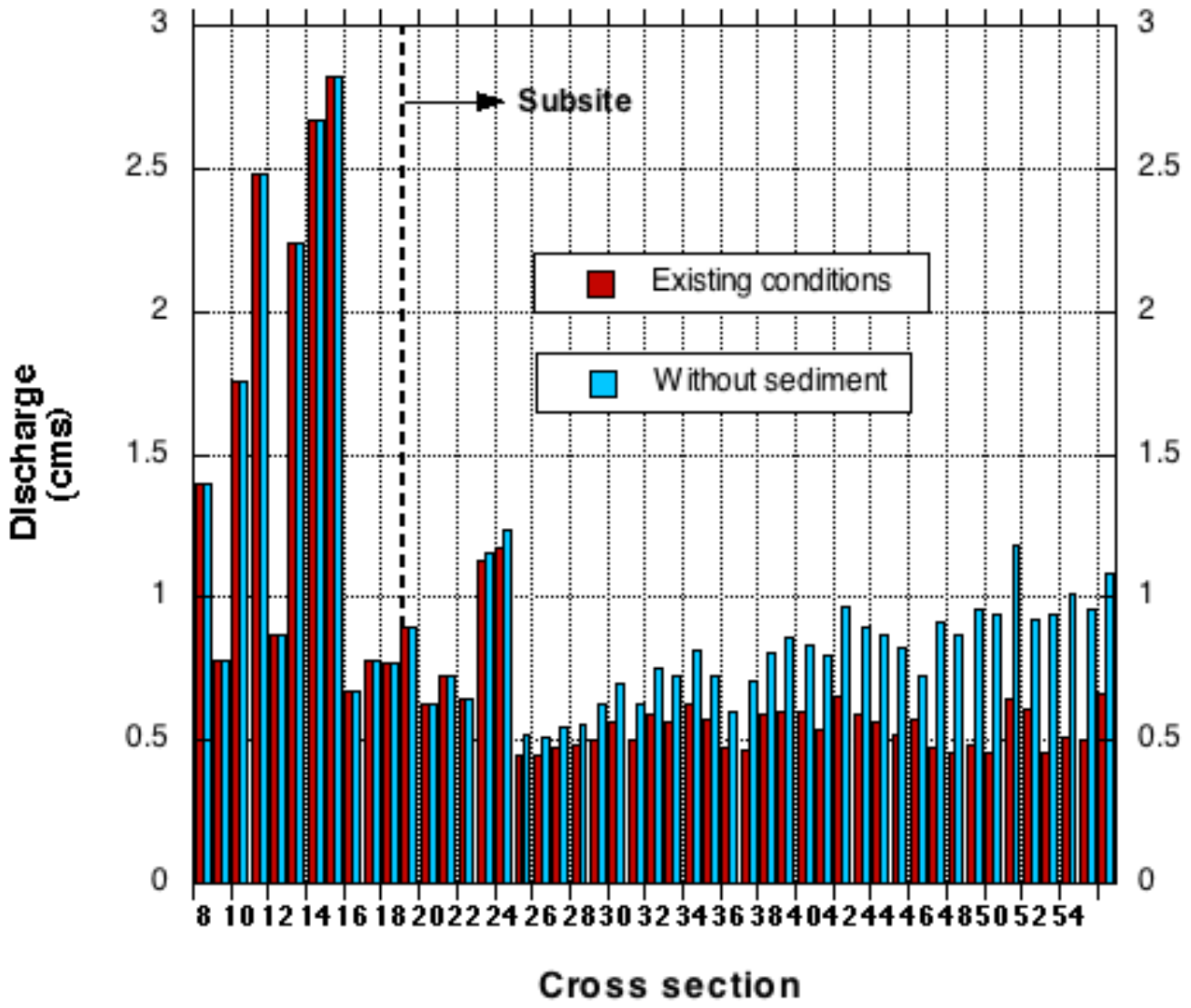
- Used 2-dimensional hydraulic modeling to quantify the extent of wetland inundation.

Hydrologic Analysis

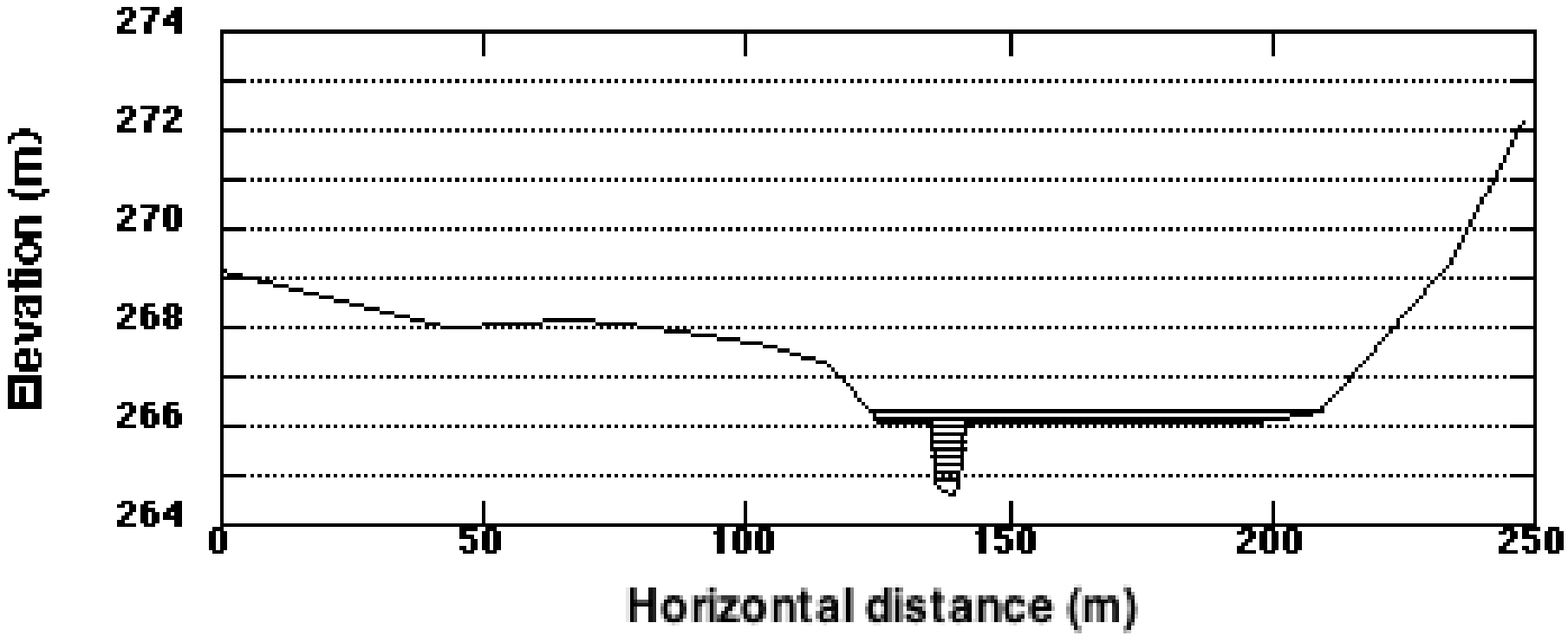
- Constructed a flow-duration relationship based on 13 years of discharge data from two (non-overlapping) USGS gages, one in the site and one just downstream.

- Used the flow-duration relationship to quantify the frequency of inundation occurrences at each cross section and of wetland area inundated.

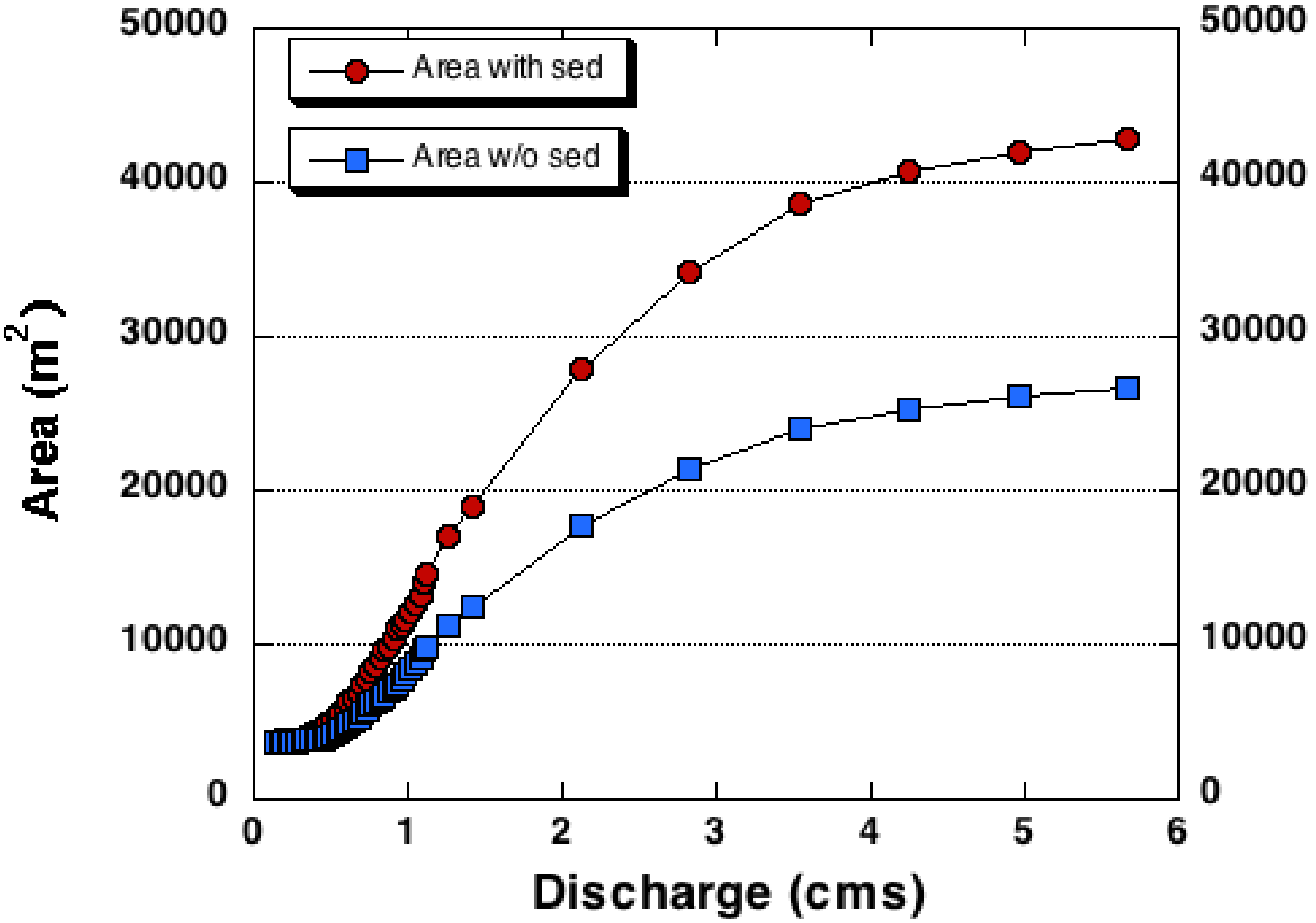
Overbank Discharge



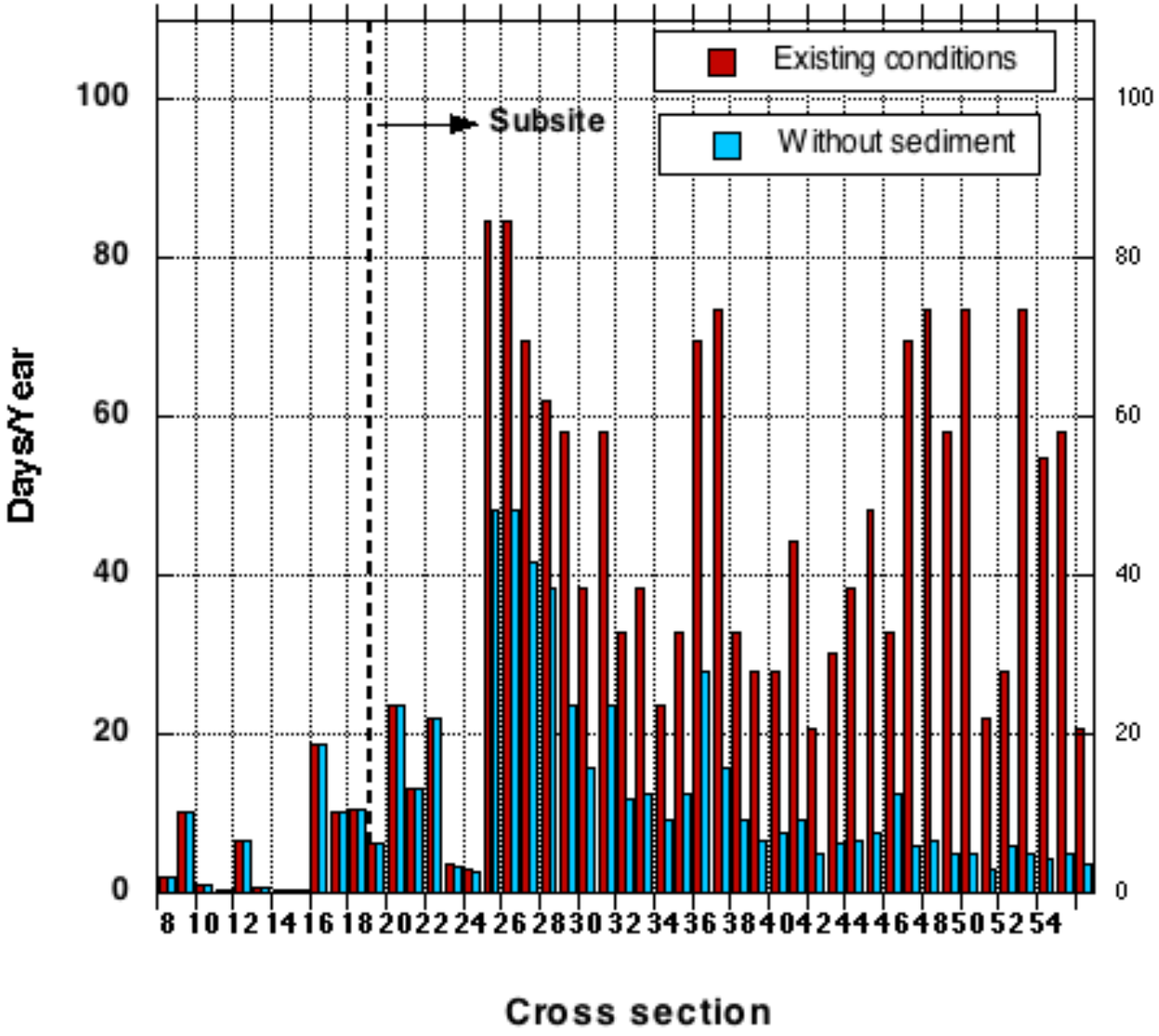
Cross Section Through Subsite



Inundation Area vs. Discharge



Days Exceeding Bankfull



Max = 85 & 45 days/yr

Min = 23 & 2.6 days/yr

Mean = 43 & 14 days/yr

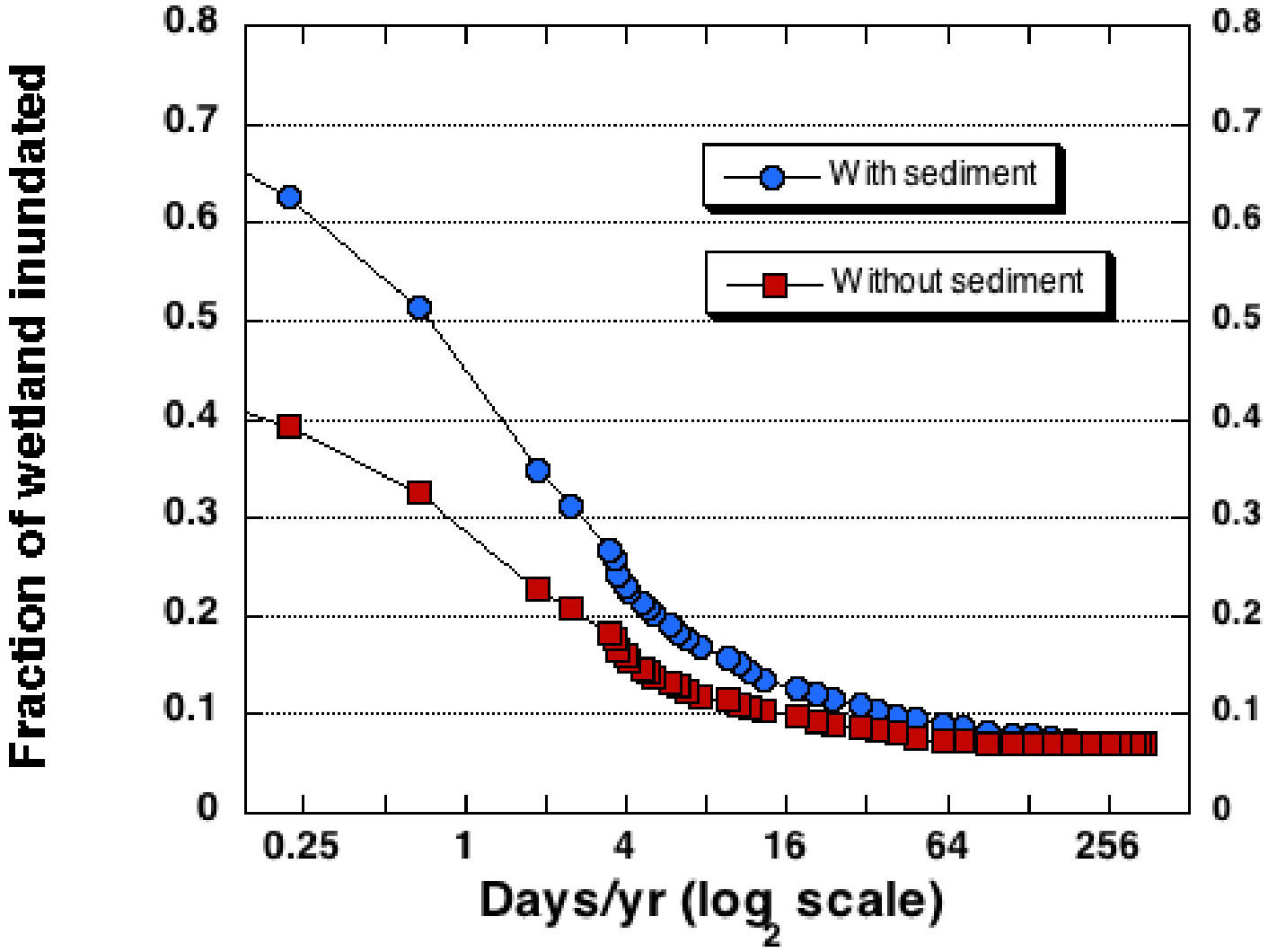
Comparisons

- Hauke and Clancy (2011)
  - BEC just downstream: **0.3 days per year**
  - BEC at 118 km: **1.1 days per year**

Comparisons

- Endreny (2007)- 56 gaged sites in MD, NC, and NY (may include some wetland streams)
  - Mean bankful exceedance frequency = **2.0 days per year**
  - Max = **12.5 days per year**
  - Min = **0.7 days per year**

Inundation Area Frequency



Amount of Water Reaching Floodplain

- Based on a hydrological analysis, Boyington estimated that less than 1% of the water flowing past this site reaches the floodplain.

- Due to shallow inundation depth.

Sediment in Channel?

How permanent are the stream sediments?

- Sediment was present throughout study (2005-2010)

- The sediment is present today, though it is not known whether it is in the same configuration.

Why is the wetland flooded so often?

- Alluvial floodplains are constructed by lateral migration or overbank deposition.
- There has been no lateral migration over last 100+ years.
- There are no point bars.

Why is the wetland flooded so often?

- Wetlands immediately upstream may be capturing much of the sediment in the stream.
- It is likely that the overbank flows do not carry sediment, due to flat gradient (.001) and shallow overbank depth.
- The pre-settlement flows and sediment transport were much lower.

This is not an alluvial floodplain!

Questions?