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 km$^2$

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.
Cross Section Through Subsite
Inundation Area vs. Discharge
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

![Graph showing the fraction of wetland inundated against days per year on a log scale. The graph compares inundation with and without sediment accumulation.]
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?