Stream & Wetland Restoration Through the Lens of MS4 Compliance and the Chesapeake Bay TMDL: Can We Get There Without It?

Anne Arundel County
WATERSHED
Protection & Restoration
PROGRAM

Erik Michelsen

Anne Arundel County's Regulatory Mandates

* Municipal Separate Storm Sewer System (MS4) Permit (issued by MDE).
  * 5-year cycle, current permit was issued in February 2014.
  * Requires treatment of 20% of the untreated impervious area in the county during the 5-year permit cycle.
  * **Approximate restoration cost to comply - $250 million+**
* Chesapeake Bay Total Maximum Daily Load (TMDL)
  * A "recommended annual intake" of pollution required by the Clean Water Act.
  * Requires reductions in nitrogen, phosphorus, and sediment.
  * **Approximate stormwater restoration cost to comply - $900 million+**

TABLE 3

SEDIMENTATION AT SELECTED HISTORIC TOWNS
UPPER CHESAPEAKE BAY REGION

Town or Location	Founded	River or Creek	Approximate Time Sedimentation Recorded	Amount of Downstream Migration of Head Navigation (Miles)	Approximate Reduction In Depth, Ft.	Years
Bladensburg, Md.	1742	Anacosta	1875	2	3	1875-1937
Piscataway, Md.	1634	Piscataway	1807	1	3	1863-1945
Georgetown, Washington, D.C.	1751	Potomac	1804	20 (No Dredge)	9-25	1783-1837
Mt. Vernon	1752	Potomac	1793	——	1 to 4	1863-1904
Dumfries, Va.	1748	Quantico	1787	1.7	4	1796-1905
Iron Factory	1734	Neabsco	——	0.75	——	1734-1872
Port Tobacco	1658	Port Tobacco	1700	1	6	1800-1882
Upper Marlboro	1706	Patuxent	1733	8	7	1859-1944
Elk Ridge near Baltimore	1650	Patapsco	Before 1898	7	15 at Hanover St.	1845-1924
Joppa Town	1707	Gunpowder	1750	2.5	10	1750-1897

From the Proceedings of the Governor's Conference on Chesapeake Bay (1968).

“Anne Arundel County is much freer from tidal marshes than are many regions of the Coastal Plain. Several of the larger rivers the Magothy, Severn, and South River have no marshes of large extent. “ - *The Geology and Mineral Resources of Anne Arundel County (1917)*

North River from Rt

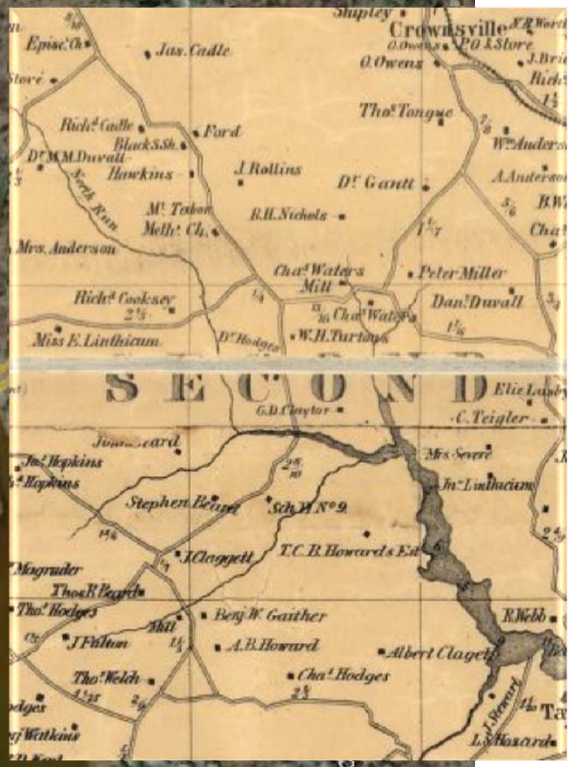
"Long after the colonial period, local farmers continued to ship their tobacco by water. William P. Doepkens recalls seeing barges loading tobacco in the North River (South Run) near the intersection of Route 450 and Rutland Road as recently as the 1920s." – From Sotweed to Suburbia

Bacon Ridge Branch

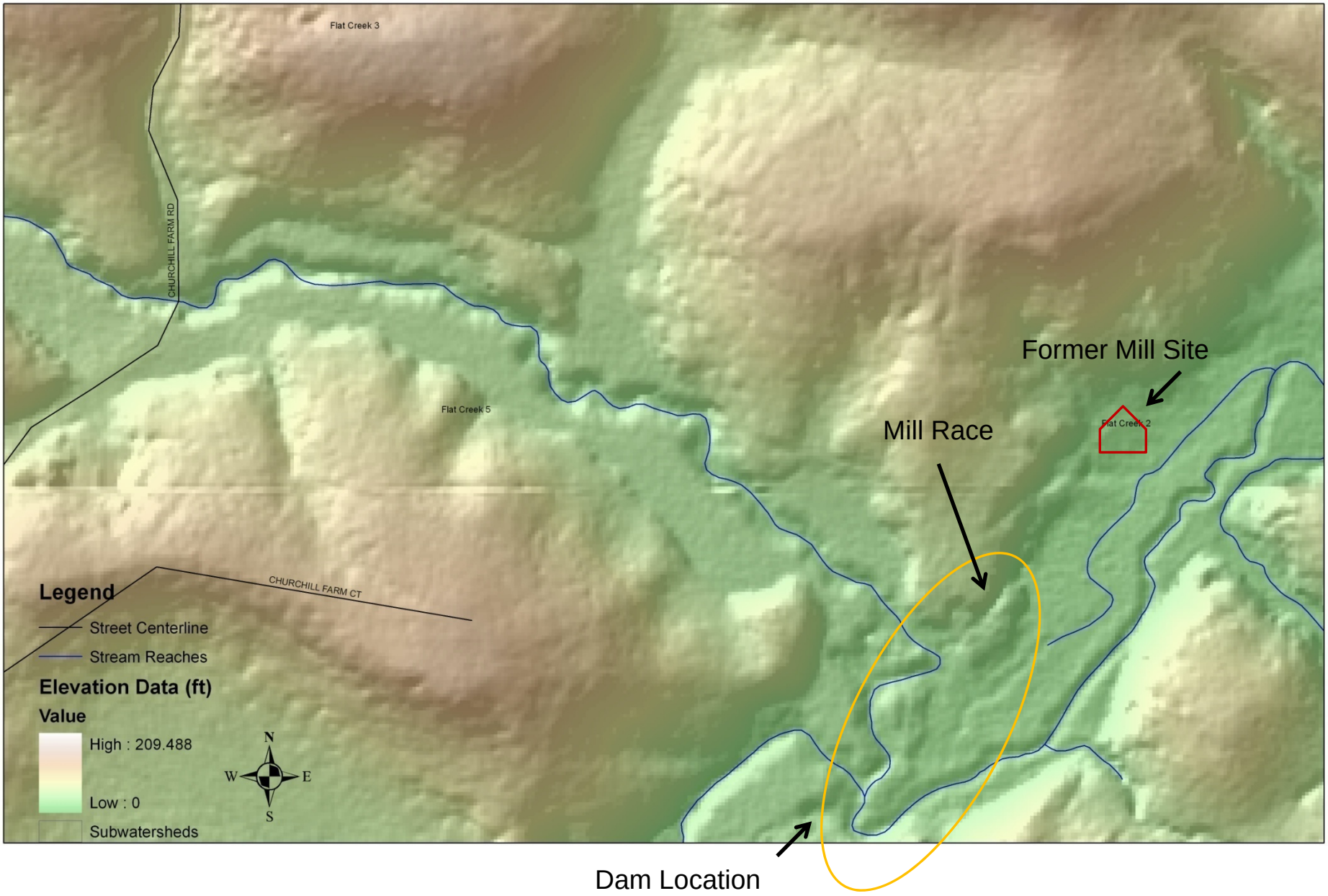
3000'

North River

Marshes have filled in ~9 % or 20 hectares of the 230 hectare area of the estuary present above Riva Bridge in 1846. (Marcus & Kearney, 1991)



Imagery Date: Apr 2005 38°59'03.97" N 76°36'42.54" W elev 112 ft Eye alt 7193 ft


Flat Creek 3
CHURCHILL FARM RD
Flat Creek 5
Former Mill Site
Flat Creek 2
Mill Race
CHURCHILL FARM CT
Legend
Street Centerline
Stream Reaches
Elevation Data (ft)
Value
High : 209.488
Low : 0
Subwatersheds
N
W
E
S
Dam Location

Otter Point Creek (Harford County)

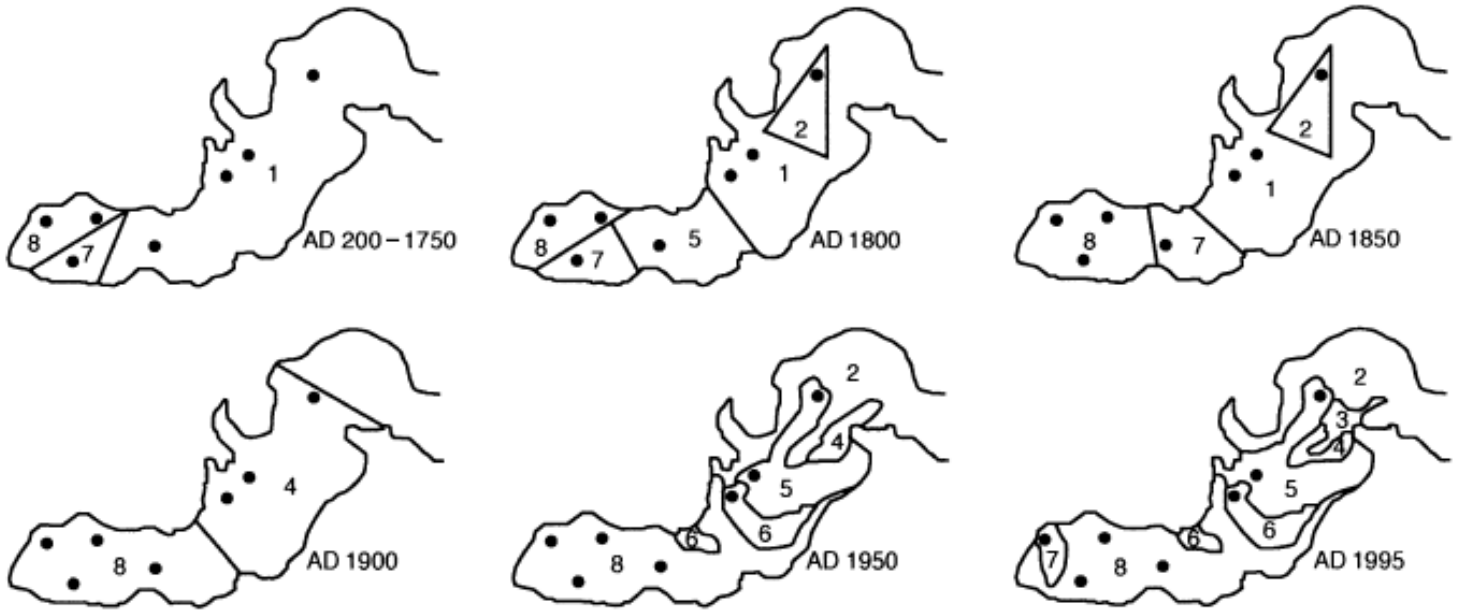
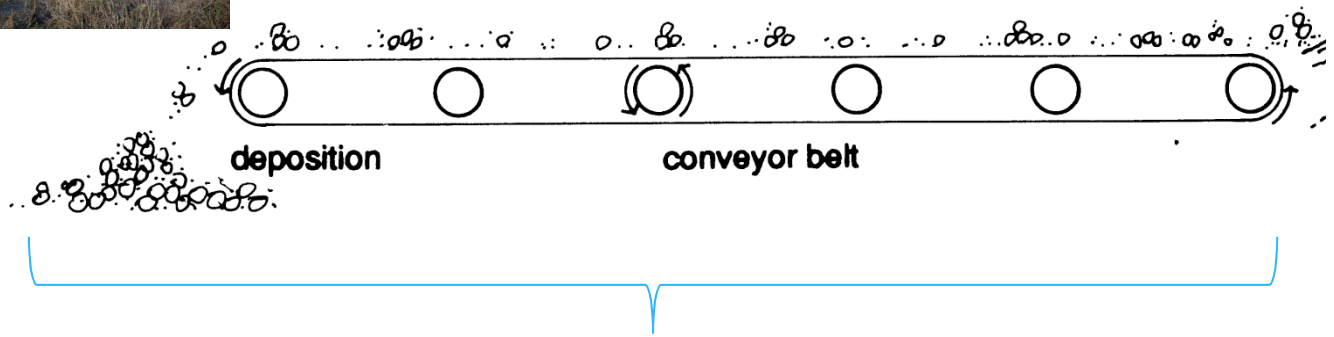


Figure 9 Spatial habitat distribution within the OPC wetland for pre-European period (AD 200 to AD 1750) and 50-yr increments since 1750. Dots represent coring locations. Habitats numbers follow Figure 6 and Table 1: 1, subtidal; 2, pioneer mudflat; 3, floating leaf; 4, low marsh; 5, middle marsh; 6, high marsh; 7, shrub marsh; 8, riparian forest

Our Broken Stream Systems Function as Major Sources & Conveyors of Sediment & Phosphorus



Adapted from Kondolf, M. (1997). Environmental Management, 21, 533-551.

The Currencies of Restoration

Nitrogen &
Phosphorus

Sediment

Impervious Acres

Comparative Cost Effectiveness of Various Stormwater Practices

Comparing LID and Stream Restoration -
Medina & Curtis, 2011 (Fairfax Co, VA)

Practice	Pollutant	$/Unit Reduced	Avg Additional Cost
LID	Nitrogen	$14-23 k/lb	$6 k/lb
Stream Restoration	Nitrogen	$5-19 k/lb	
LID	Phosphorus	$70-122 k/lb	$54 k/lb
Stream Restoration	Phosphorus	$17-67 k/lb	
LID	Sediment	$224-358 k/ton	$258 k/lb
Stream Restoration	Sediment	$13-53 k/ton	

"[S]tream restoration can confer additional benefits, such as aquatic ecosystem restoration and reconnection of streams with their floodplains."

Comparative Cost Effectiveness of Various Stormwater Practices

Costs of Stormwater Management Practices in Maryland Counties – King & Hagan, 2011

Practice	Pollutant	$/Unit Reduced
Bioretention Retrofit	Impervious Acre	$187k
Dry Pond Retrofit	Impervious Acre	$73k
Stream Restoration	Impervious Acre	$65k

Montgomery County, MD - 2016

Practice	Pollutant	$/Unit Reduced
LID	Impervious Acre	$200-280k
Stormwater Pond	Impervious Acre	$75k
Stream Restoration	Impervious Acre	$47k

Is That All?

No, Unfortunately, It's Not

Stream channel sources provide between 33-66% of sediment yield – Smith & Wilcock, 2015

"Analysis of MS4 data suggests between 20-80% of sediment is coming from stream bed or bank erosion and resuspension" – CWP, 2014

"Streambank sediment yields constituted 70% of the estimated average Piedmont watershed yields" – Donovan, Miller, Baker, & Gellis , 2015

And the Bay Program Watershed Model gets an update in 2017

But Wait, There's More

Nitrate isotope data suggests that around 55% of the nitrate in urban streams could be from leaky sanitary sewers (during baseflow) – Pennino et al, 2016

The relatively high concentrations of TN in the control stream during small storm events reveal a potentially strong groundwater source in these headwater streams, which is diluted during large rain events. – Filoso, 2013

Opportunities to cooperate between bureaus for better overall outcomes and cost share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Questions?

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Watershed Protection and Restoration Program

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