INTEGRATION OF SEDIMENT BUDGET AND DYNAMICS RESEARCH WITH REGIONAL SEDIMENT MANAGEMENT (RSM) IN THE DELAWARE ESTUARY

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Abstract

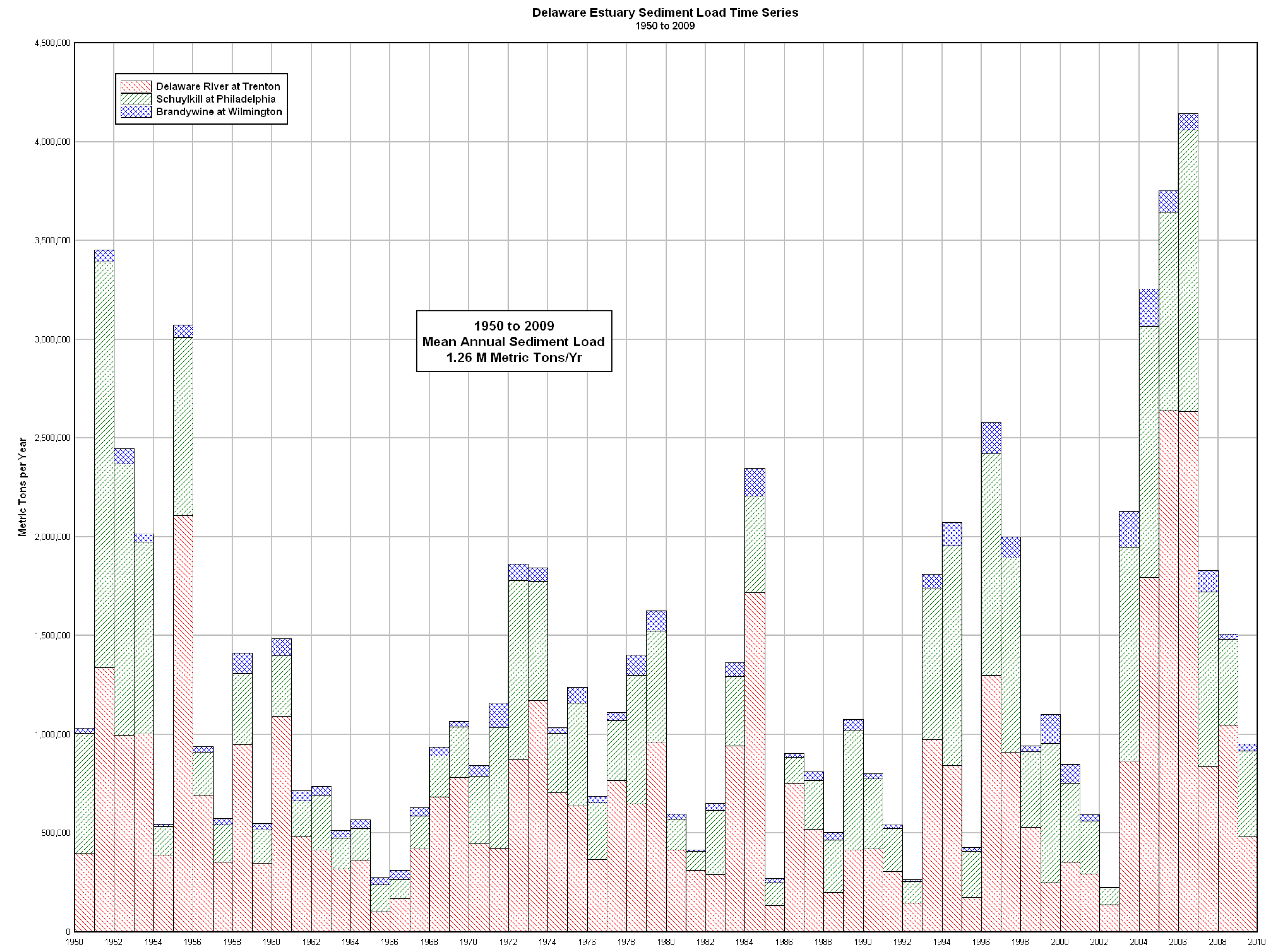
The sediment budget of the Delaware estuary, along with the dynamical processes that affect it, have been the subject of renewed interest and research within the Estuary science community over the past decade. At the same time, the US Army Corps of Engineers has adopted Regional Sediment Management (RSM) as a planning and project management objective for its water resources management program. This has led to several initiatives that address both the specific issue of sediment budget/dynamics, as well as the broader topic of RSM within the Delaware Estuary.

This poster presents an overview of the present state-of-knowledge of several components of the Estuary sediment budget. Some are relatively well understood quantitatively, and others are not. In-progress findings from an ongoing project by the Philadelphia District - "Sediment Sources and Sinks in the Delaware Estuary: A Synthesis for Regional Sediment Management Planning" – are summarized in the poster. When it is complete, this project will:

- **Identify what is known about the major sediment sources and sinks of the estuary**
- **Describe and quantify the principal sediment transport mechanisms and pathways**
- **Identify deficiencies in the present understanding of the sediment system and improve awareness of ecological processes so as to implement workable, successful applications of RSM within the Delaware estuary**

The information has been developed as an activity of the "Delaware Estuary RSM Workgroup" initiated in 2009 with representation from government agencies as well as academic and non-profit organizations involved with various aspects of RSM. The broad goal of this workgroup is to "optimize opportunities to effectively manage sediments in a manner to achieve a sustainable balance between ecological and economic activities". The ultimate goal of the group is to develop an RSM Plan that addresses the economic benefits and long-term needs of sediment quality and quantity, dredged material management, and beneficial use in the Delaware Estuary, and provides recommendations for the development of new policies, procedures, and management practices in RSM.

Upland Sediment Input



Sediment Accumulation in Tidal Marshes

Table 2. Surface areas and spatially averaged mass accumulation rates for the three marsh subregions in Delaware Estuary.

Marsh subregion	Surface area (m^2)	Total accumulation ($kg/m^2/yr$)	Inorganic accumulation ($kg/m^2/yr$)	Organic accumulation ($kg/m^2/yr$)	Inorganic mass burial (tons/yr)
Tidal Fresh	73,548,338	2.6	2.0	0.6	1.5×10^5
Estuarine	469,459,977	1.7	1.4	0.3	6.6×10^5
Saline Fringe	268,796,838	1.5	1.0	0.5	2.7×10^5
TOTALS	**811,805,154**	**5.8**	**4.4**	**1.4**	**1.1×10^6**

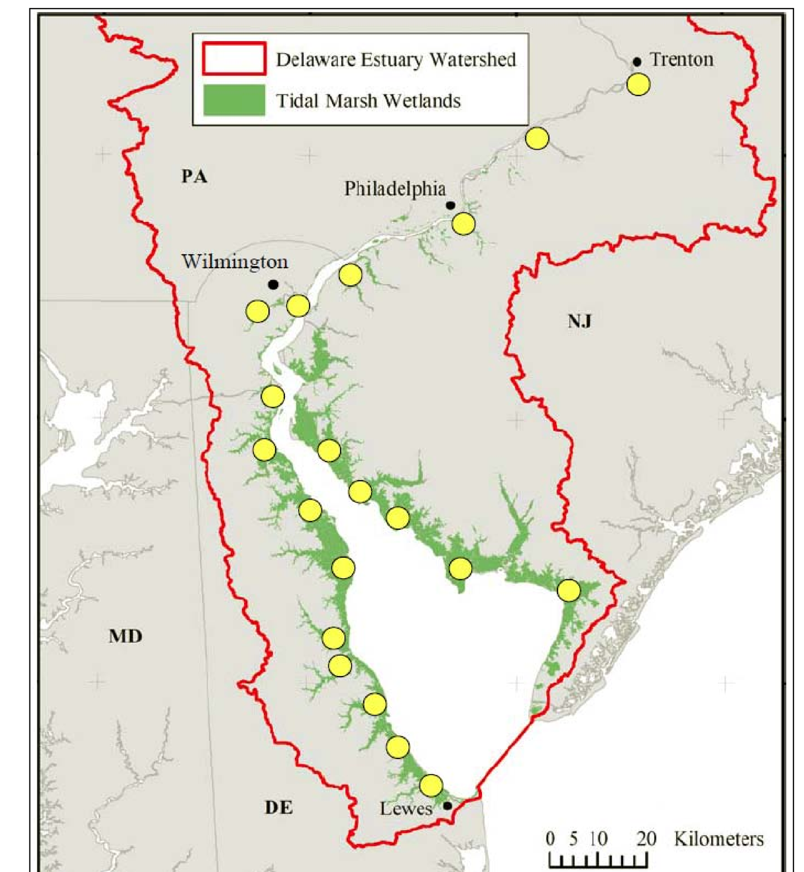
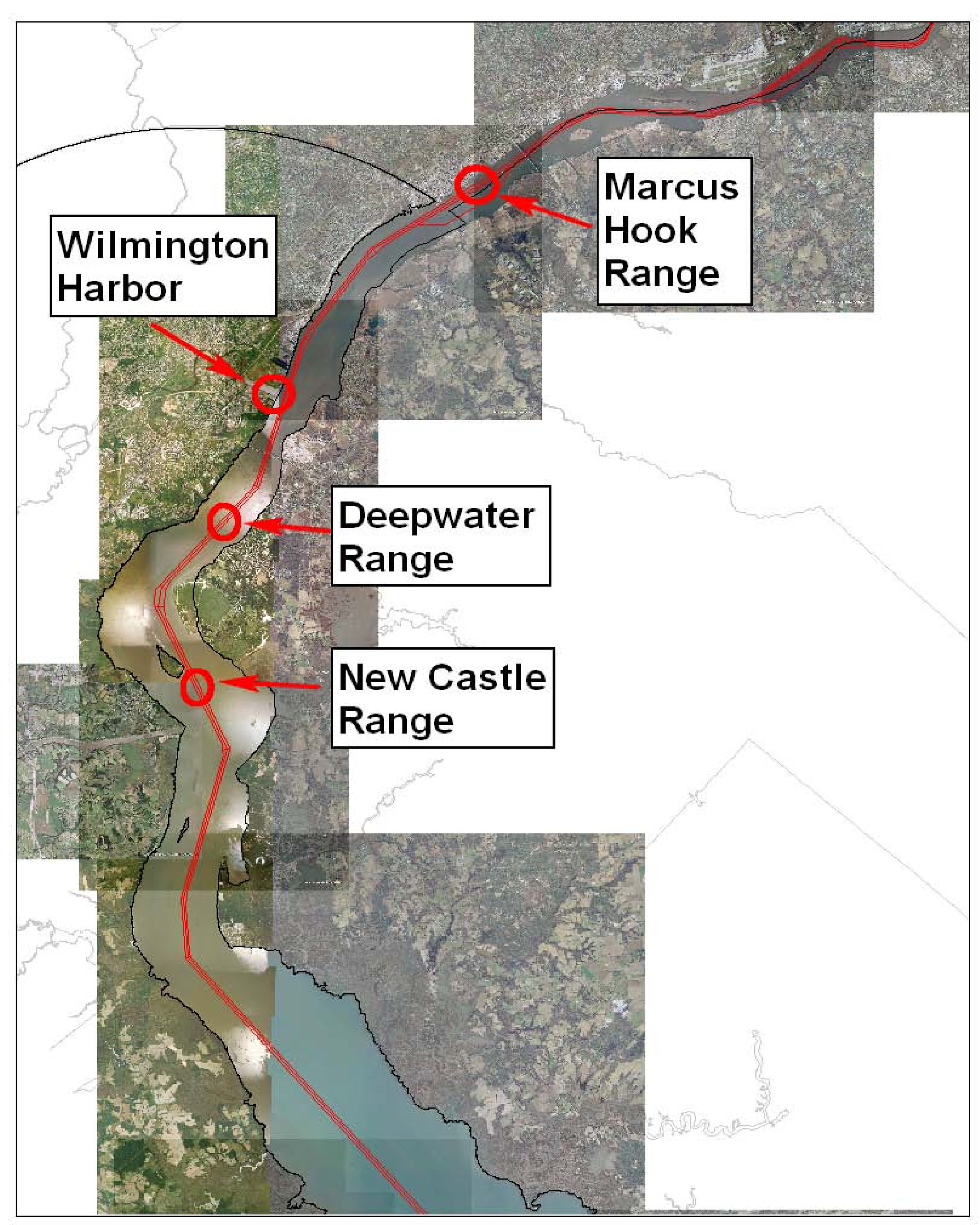


Figure 1. Location map showing the locations of core-sampling sites along the tidal wetland coast of Delaware Estuary. Multiple cores were collected and analyzed at each of the sites shown.

High Maintenance Dredging Areas



About 80% of all dredging in Delaware estuary occurs in these four areas . This zone of the estuary is where the Estuary Turbidity Maximum (ETM) is typically located.

Resident Suspended Load

Table 2. Resident suspended-sediment load and average residence time in the estuary.

Estuary segment	Minimum (tons)	Maximum (tons)	Mean (tons)
Lower bay	1,750	192,500	22,750
Upper bay	1,800	285,000	43,200
Lower estuary	31,875	940,315	146,625
Upper estuary	225	41,250	6,000
Tidal river	105	11,550	1,995
Totals	**35,755**	**1,470,615**	**220,570**
Residence time (days)	**10**	**413**	**62**

*Mean residence time of suspended sediment in the estuary based on the long-term mean annual influx of river sediment (1.3×10^6 tons/yr) determined for TASK 1.

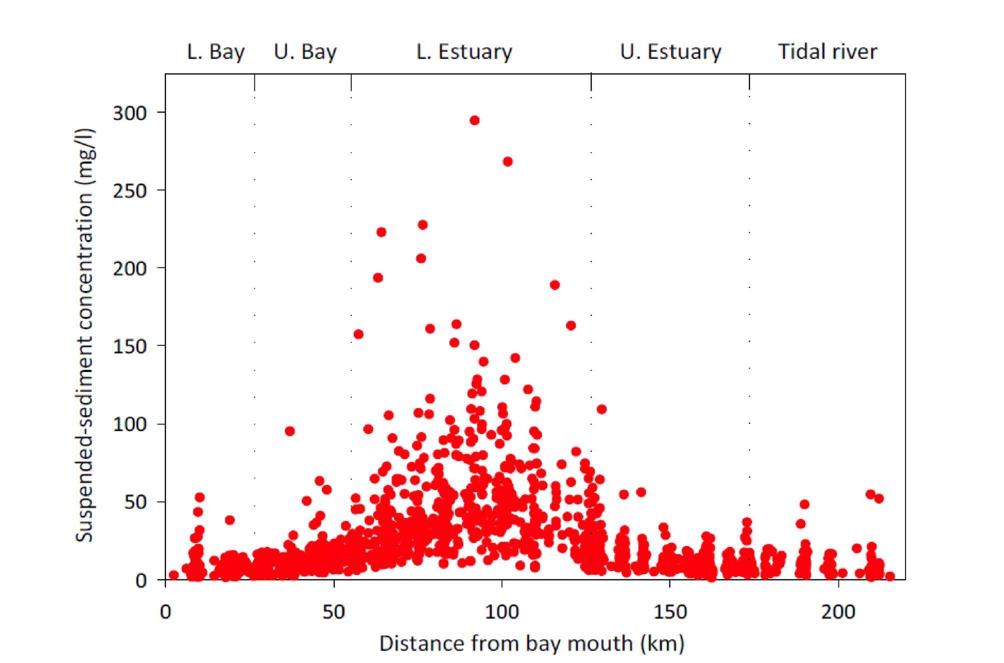


Figure 1. Spatial distribution of suspended-sediment concentration along the axis of Delaware Estuary. The five zones used to compute the total resident sediment load are shown.

Fringing Tidal Marsh Loss

Lateral Retreat Rate of Marsh Shoreline (m/yr)			
ZONE	1880 to 1970 (90 years)	1970 to 2000 (30 years)	1880 to 2000 (120 years)
Estuarine Marsh	1.1	2.1	1.3
Saline Fringe Marsh	1.0	2.2	1.2

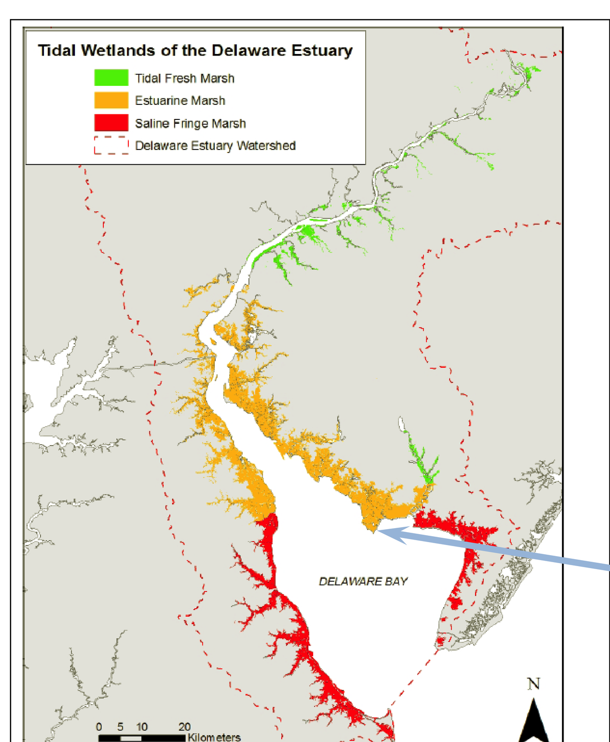
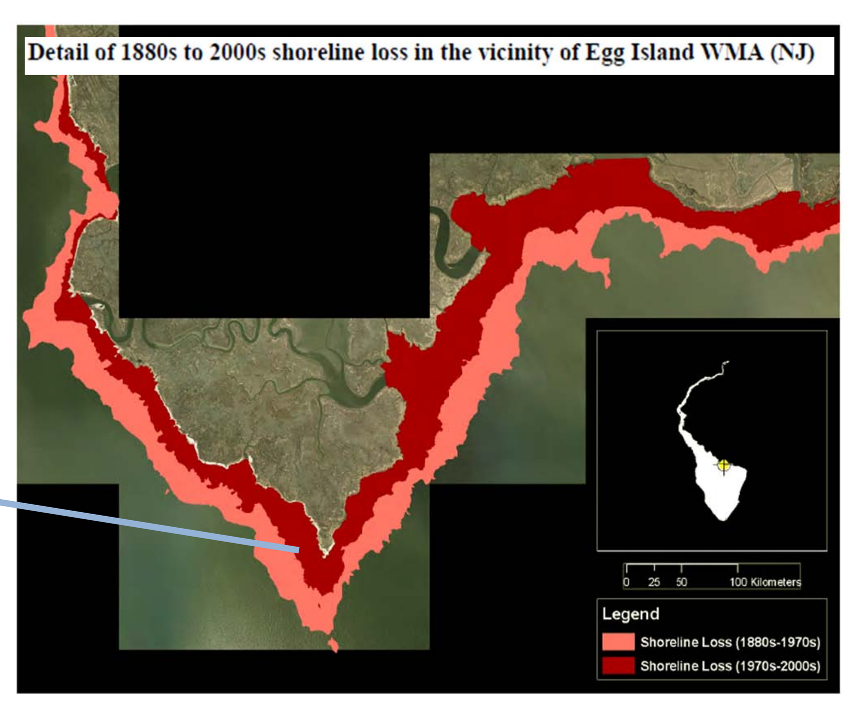


Figure 2. Tidal wetlands of Delaware Estuary subdivided into three subregions according to salinity range.



The most recent quantitative sediment budget for the estuary compiled by UD

1950-1985 Estuary Sediment Mass Balance			
SOURCES		SINKS	
Bottom erosion	3.4	Dredging	2.8
Rivers	1.3	Marshes	2.1
Phytoplankton	0.23	Subtidal shoals	0.63
Waste/industrial	0.17		
TOTAL SOURCES	5.1	TOTAL SINKS	5.5

Note: Sources and sinks shown in millions of metric tons per year

(source: Walsh 2004, Anthropogenic Influences on the Morphology of the Tidal Delaware River and Estuary: 1877–1987)

All quantities above are being reevaluated as part of the Delaware Estuary RSM program