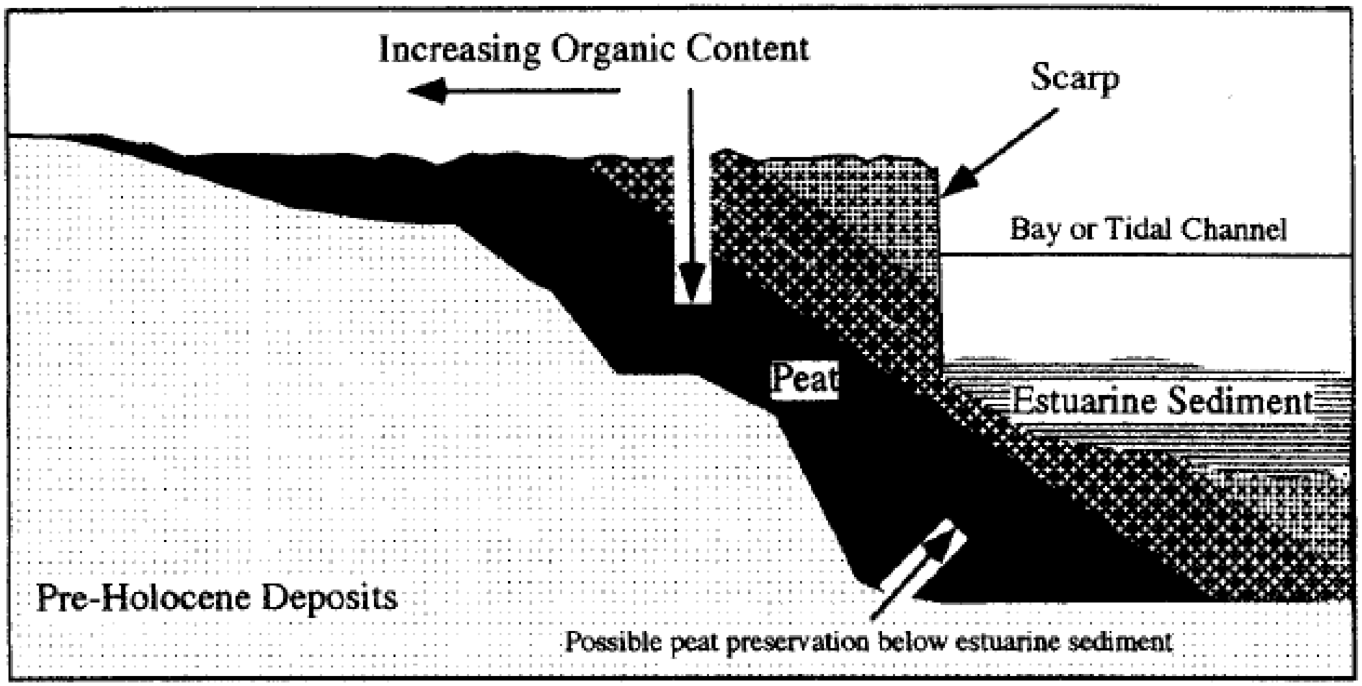
Irregularly Flooded Brackish MHW Marsh Restoration –

Some Considerations for Engineering Drainage Density and Configuration

Irregularly Flooded Salt Marsh

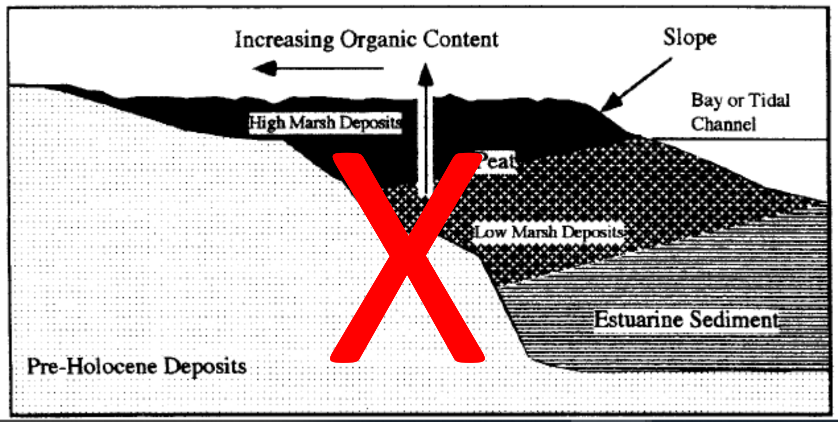
a) Davis and Johnson: Peat organic-content decreasing upwards. Marsh surface at mean high water. No distinct low or high marsh.



New marsh forms on landward edge, marsh accretes tracking MHW, erodes on bayside edge

Regularly Flooded Salt Marsh

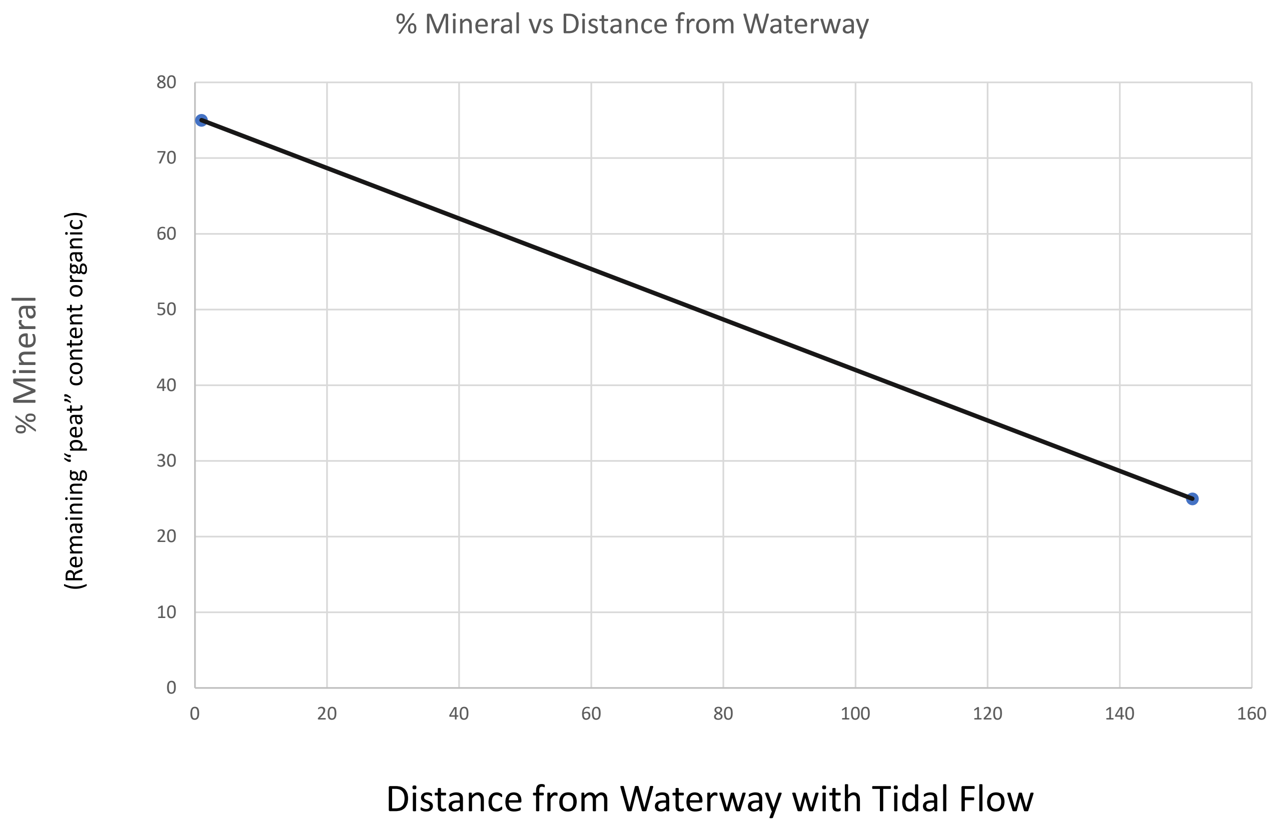
b) Shaler and Redfield: Peat organic-content increasing upwards. Vegetated marsh surface ranges from mean high water to mean water.



New marsh forms on landward and bayward edge, high marsh accretes tracking MHW, low marsh MW to MHW

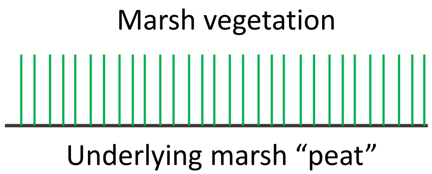
(Note: Runnels are Creating Low Marsh in Irregularly Flooded Marsh. Runnels Not Considered Further in Presentation.)

“Peat” surface interval samples

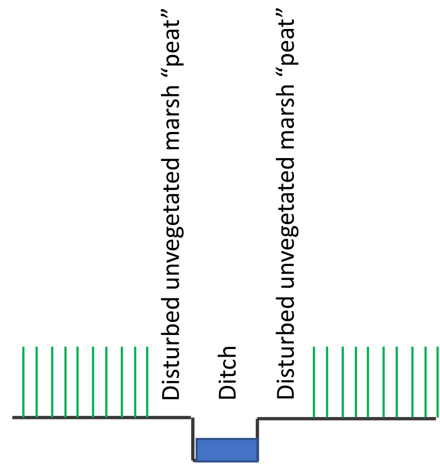


Effect of marsh canopy interception of tidal-borne sediment

Pre-Ditch



Immediate Post-Ditching



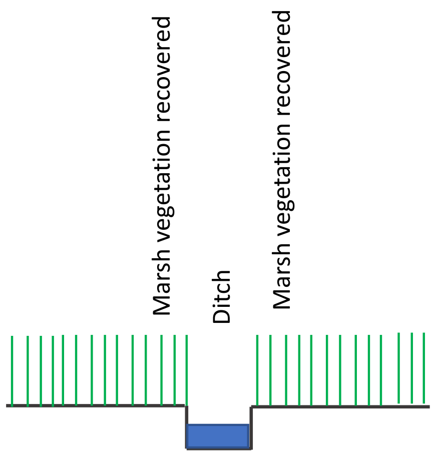
Note: lateral drainage maintained for mosquito control

Marsh ditching for mosquito control

(in areas of where mineral surface underlying "peat" not intercepted)

USFWS. "Is Historic Ditching a Major Contributor to Spartina patens Marsh Loss?"
https://gcc02.safelinks.protection.outlook.com/?url=https://youtu.be/72eY20U7PX8&&data=05|01|rich_mason@fws.gov|d53a2430e5c34ade274908daee5fc45c|0693b5ba4b184d7b9341f32f400a5494|0|0|638084392325682662|Unknown|TWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0=|3000|||&&sdata=uOn95zzlWonT0zVwHlu14QlP5Azg2DpZ2l0gwQRtgUk=&&reserved=0

Several Years Post-Ditching



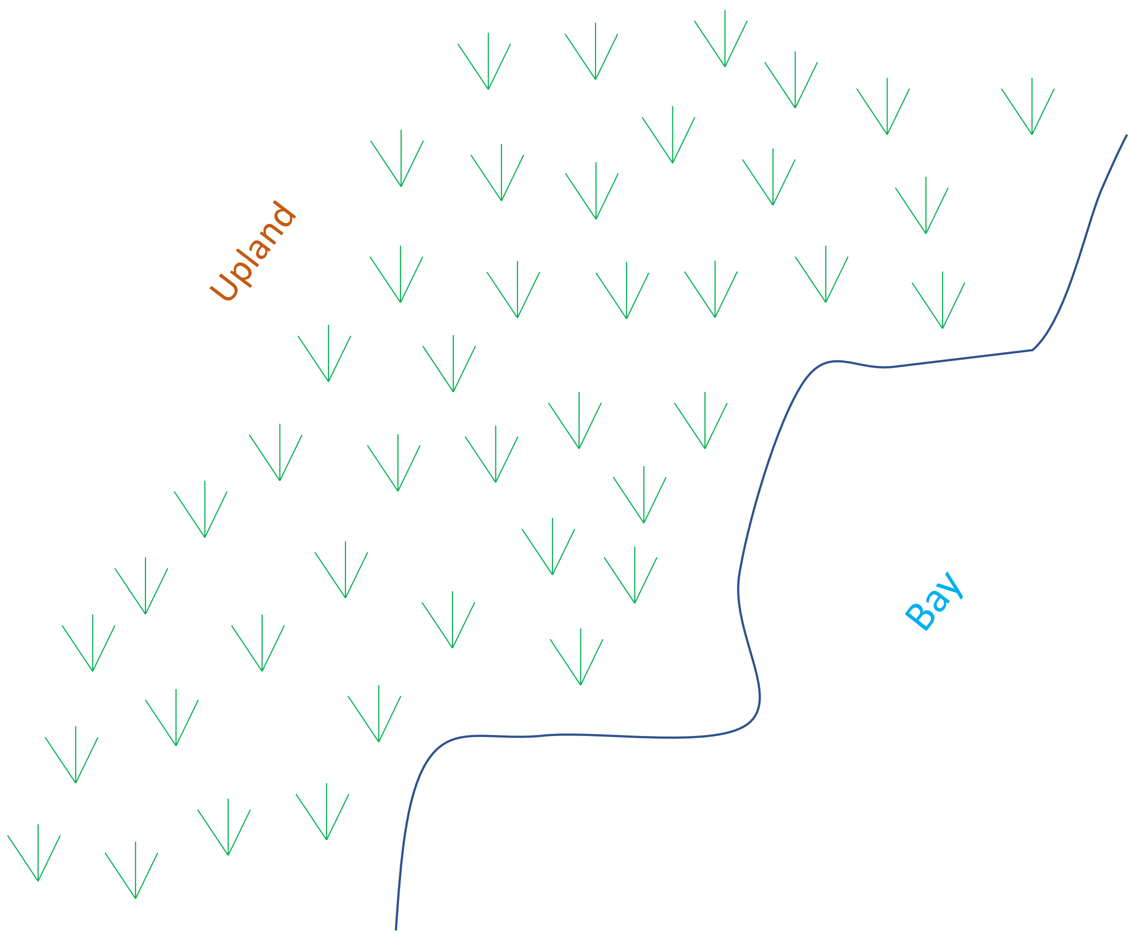
Decades Post-Ditching

(See Plan Views)

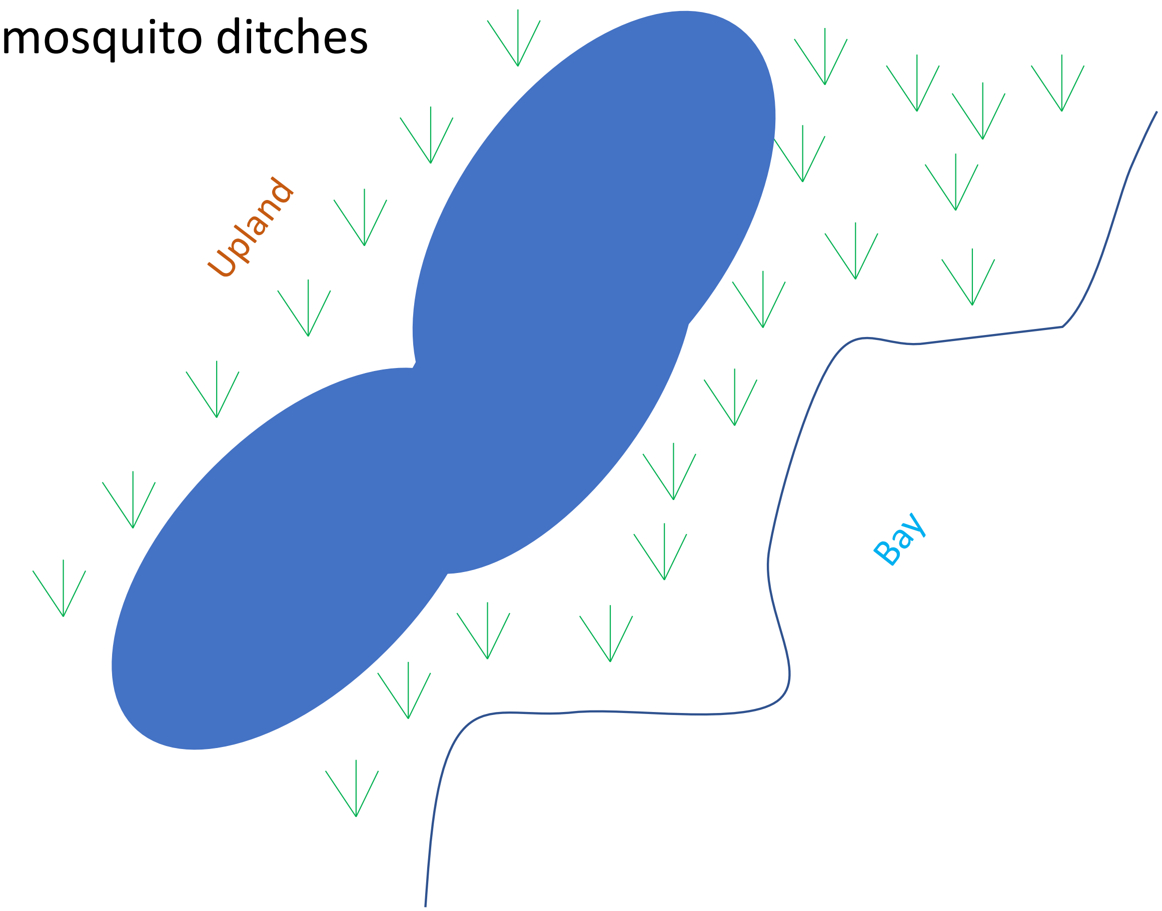
Marsh after mosquito ditching

(in areas of where mineral surface underlying “peat” not intercepted)

Historic Mainland Fringe Irregularly Flooded Brackish Marsh

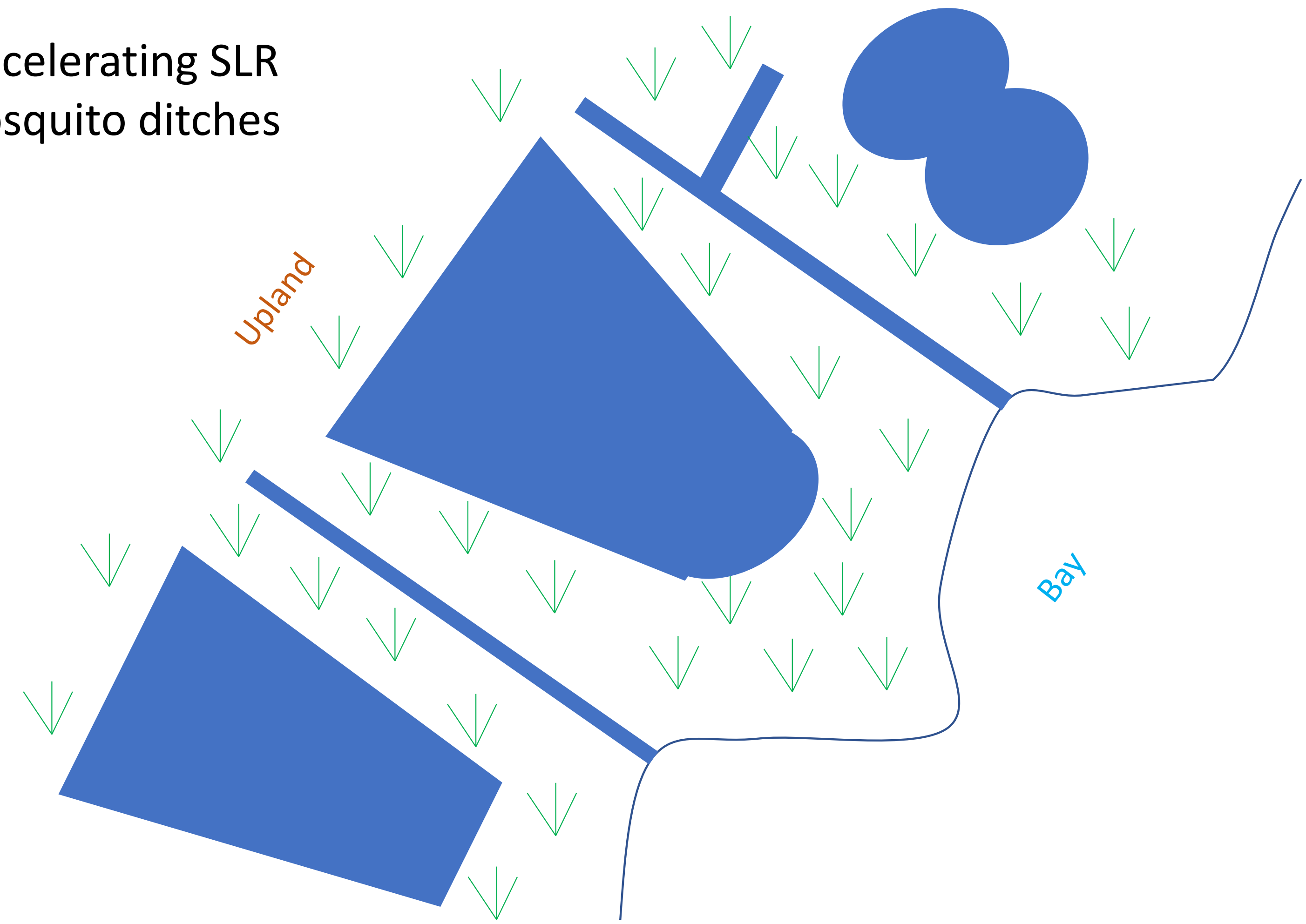


2020 - continuously accelerating SLR
(now ~ 5 mm/yr), no mosquito ditches



Interior areas remote from tidal waterways converting to open water.
Marsh survives on bay shoreline via overwash deposits.
New marsh forming along mainland on drowned upland soils.

2020 with continuously accelerating SLR
(now ~ 5 mm/yr), with mosquito ditches



Interior areas remote from natural or manmanmade tidal waterways converting to open water.
Marsh survives on bay shoreline via overwash deposits and along tidal ditches via ditch tidal flow fine sediment input.
New marsh forming along mainland on drowning upland soils.

Mosquito-Ditched and Non-Ditched Brackish Marsh in Close Proximity. Google Earth most recent imagery, April 2023

Lower Eastern Shore, Daugherty Creek Area, S of Crisfield.

Lower Eastern Shore, Big Annemessex River, NE of Crisfield.

Forsythe NWR Mullica River/Great Bay. Mosquito-Ditched and Non-Ditched Brackish Marsh in Close Proximity.
Google Earth most recent imagery, April 2023

MD Coastal Bays, Application 2023-60234. Note marsh condition along 1st order (Strahler) ditches that don't form box/grid. Google Earth most recent imagery, April 2023

Optimizing for Surface Stability in MHW Marsh- Critical Variables That Can be Engineered:

Tidal Waterways. Mosquito ditches offer unintentional design guidelines

-Optimal waterway spacing closer than in natural marshes

-Need branching pattern/widths that promote "strongest you can get" tidal flow

Interior ponds. Formation in drowning marsh offers anti-design guideline

-Interior ponds reduce upstream mineral sediment delivery (also dampen tidal range and when large create local higher wave energy within pond (promotes interior shoreline erosion)

-Minimize/avoid interior ponds

(I think we can increase MHW surface geomorphic stability to buy some extra years of project life, but not sure how many years …)

(Would restore marsh at MHW [NOT low marsh like runnels], not sure how this would meet habitat requirements of saltmarsh sparrow…)

Other variables:

"Peat" character

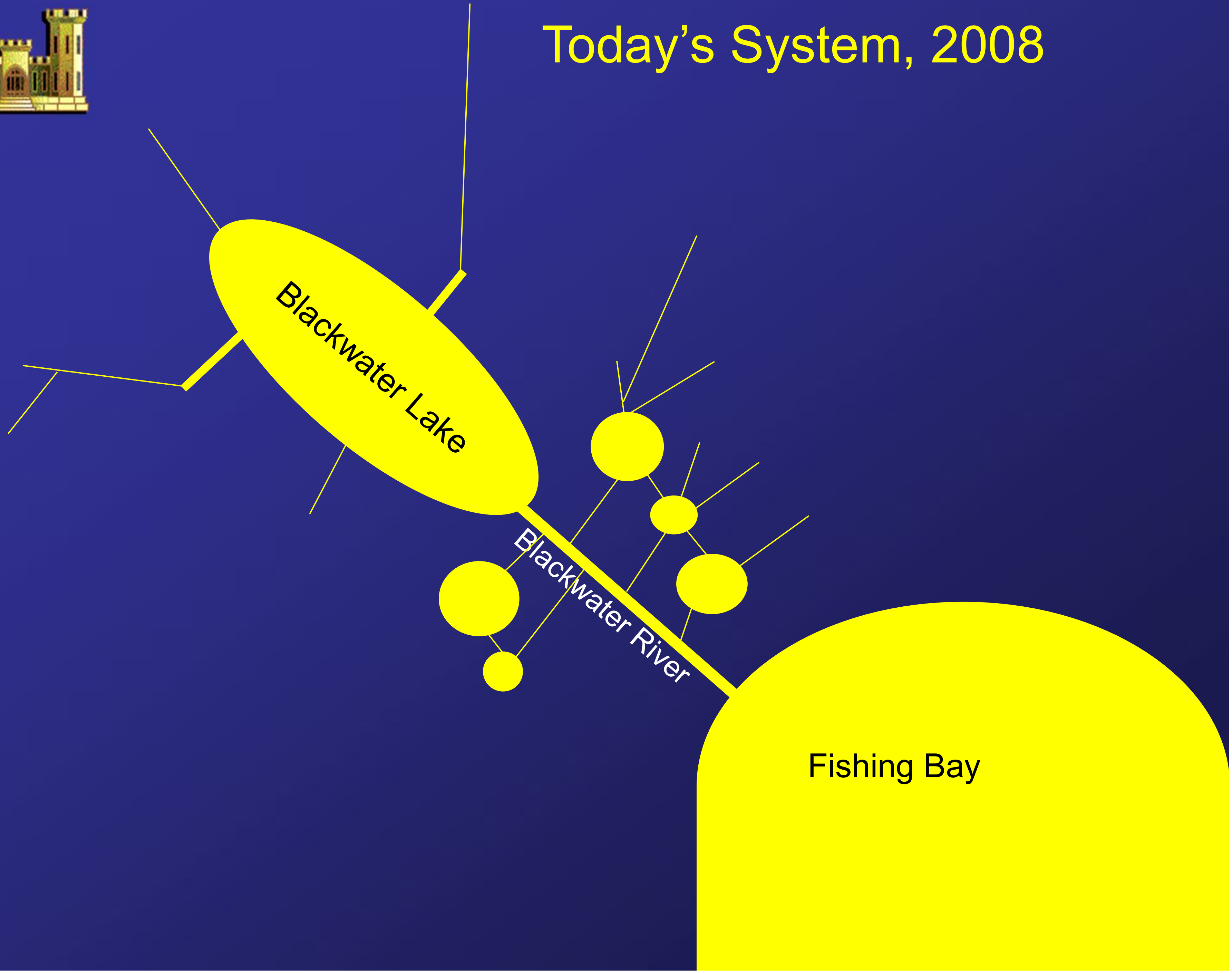
-Thickness (function of subsurface topography, such as Carolina Bays under brackish marsh, generally the thicker the more vulnerable to autocompaction)

-Organic vs mineral content (the more mineral, the more stable)

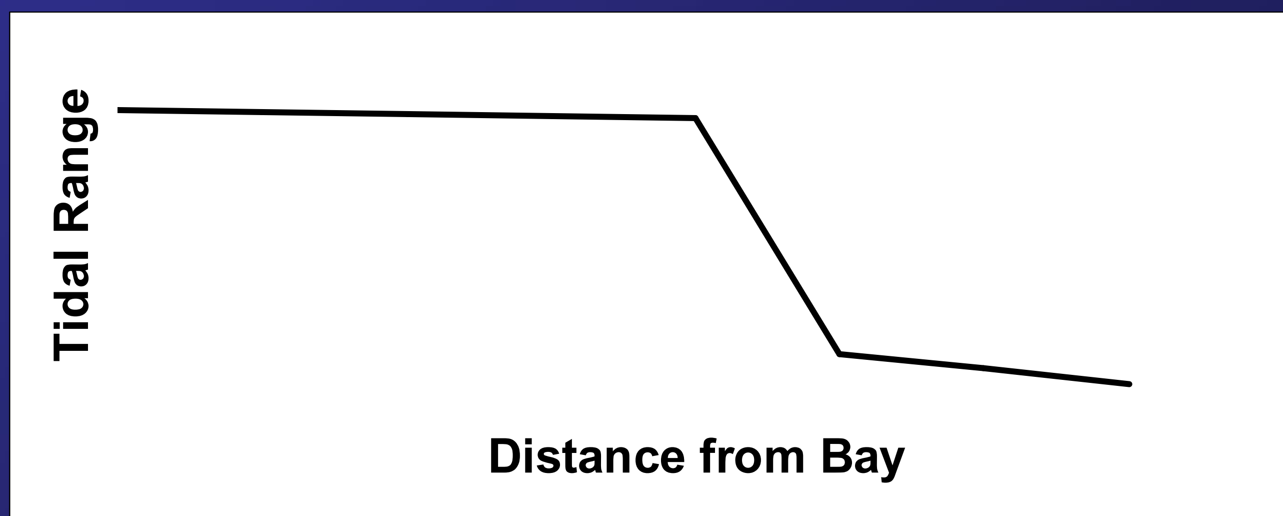
Tidal range

-Inlet proximity (with accelerating SLR, eventually new inlets through Assateague Island?) (Blackwater NWR Example)

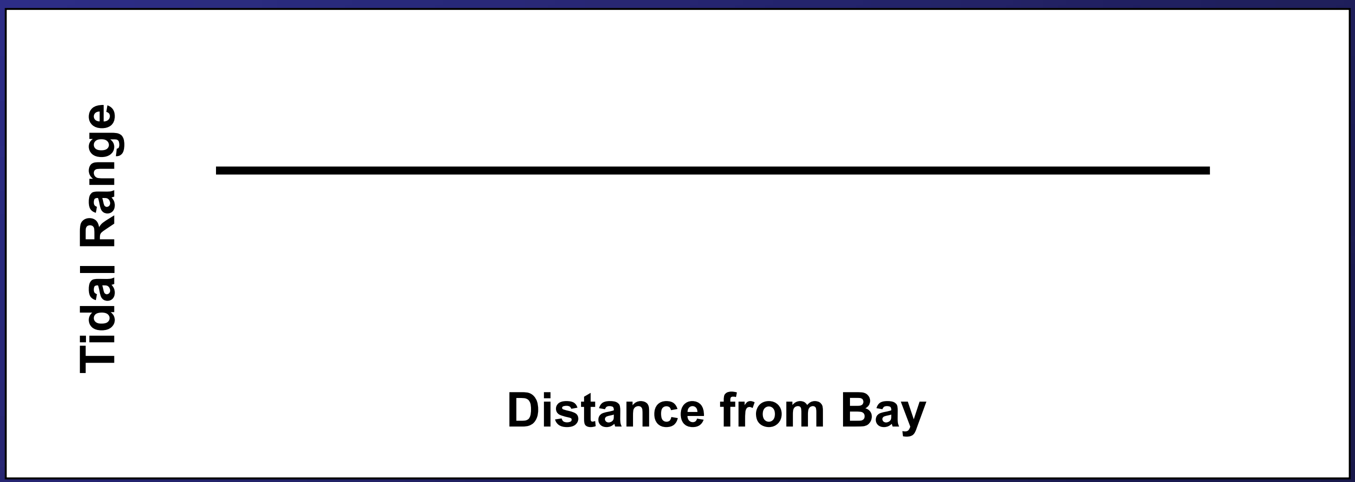
Today's System, 2008



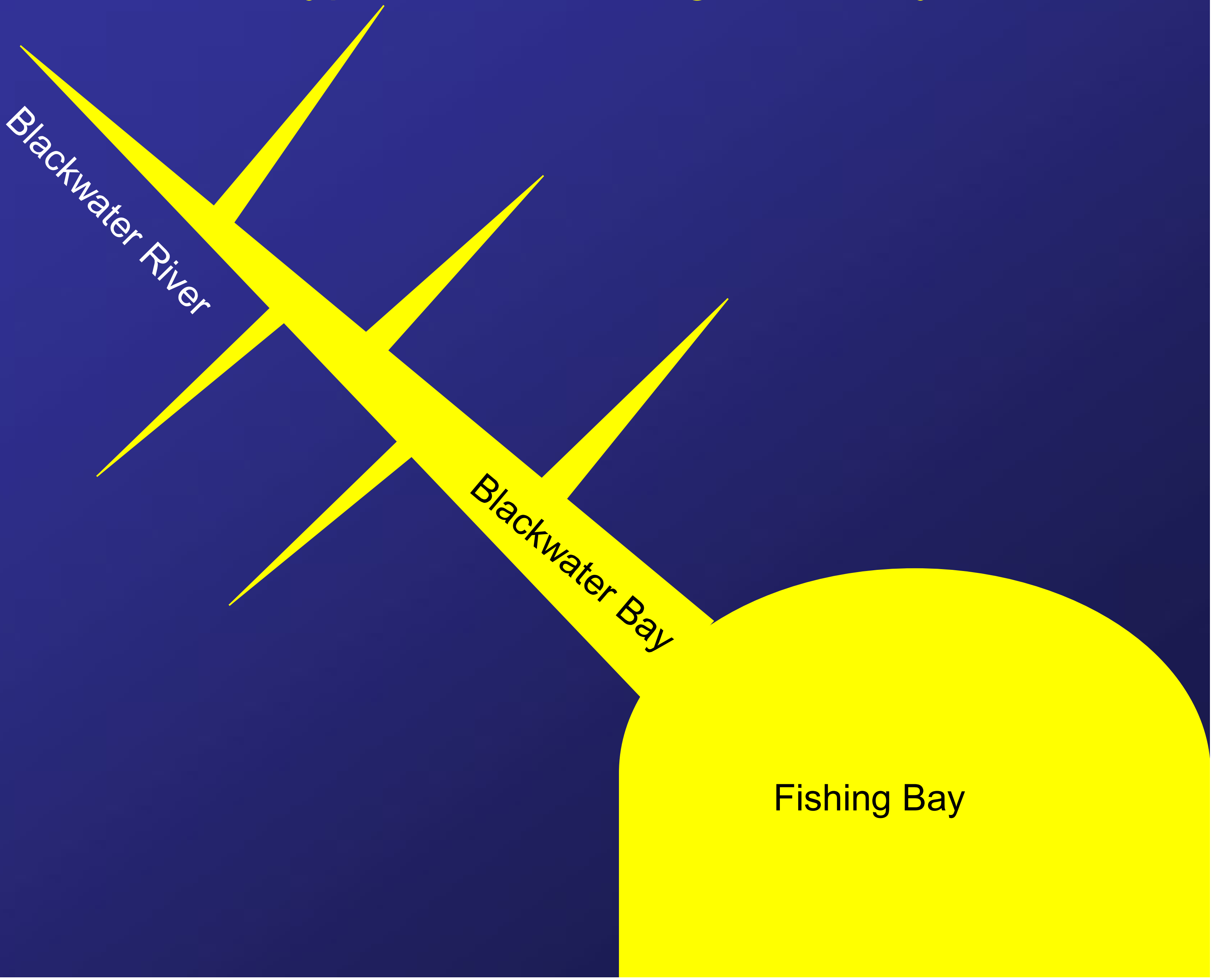
Today's System

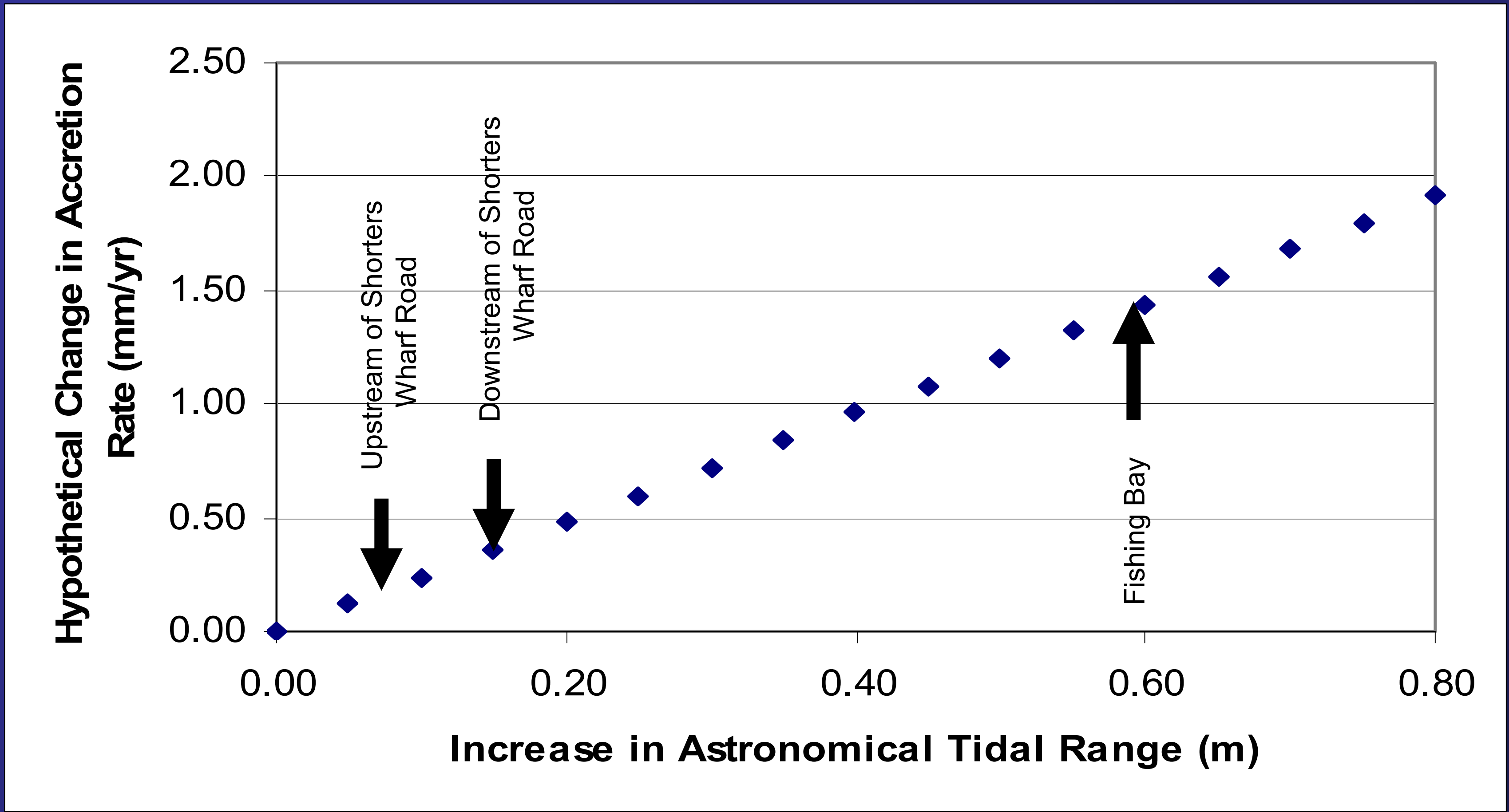


Hypothetical Re-engineered Tidal Waterway, Optimized for Accretion



Hypothetical Re-engineered system, 2035





Non-riverine marshes (Stevenson and others, 1986).

Accretion Balance (mm/yr) = 2.4*(mean tidal range) - 2.1.