Coastal wetland management: Bridges, culverts, and tidal restrictions - Amanda Santoni

Tidal restrictions are structures that disrupt natural flow between habitats that experience tides. Examples include undersized bridges or culverts; road causeways; and water control structures such as tide gates, weirs, levees, dikes, berms, and dams. These restrictions are prevalent in coastal areas and can create unique challenges in coastal management. Alteration of tidal exchange can lead to direct loss of tidal wetlands or their function. According to the 2020 U.S. Environmental Protection Agency Tidal Restriction Synthesis Review, data on the location and severity of tidal restrictions data in the U.S. are limited. To address this gap, The EPA partnered with the Federal Highway Administration to develop The Tidal Restriction Prioritization Protocol for the Restoration of Tidal Wetlands for New York, New Jersey, Puerto Rico and the U.S. Virgin Islands. The protocol was developed through virtual meeting and in-person workshops with regional stakeholders. The result is a screening tool that allows coastal managers to evaluate tidal restrictions and take actions to restore tidal wetland habitat and functions. The Protocol can be used to help focus coastal management resources on implementable projects that rehabilitate, remove or replace tidally restrictive structures and provide restorative benefits to tidally influenced wetlands and built infrastructure.

Fireplace Neck: Tidal Wetland Restoration through Small Scale Hydrologic Chages - Barbara Barnes

Fireplace Neck appears to be a well-established functioning marsh system in the Town of Brookhaven, NY. The approximately 108 acre New York State Department of Environmental Conservation property is dominated by low marsh habitat. However, forty years ago, this same complex was primarily high marsh.

Fireplace Neck is a grid ditched marsh exhibiting water logging, changes in marsh vegetation over time, and an increase of invasive species cover. It is showing signs of habitat degradation as high marsh transitions to low marsh and eventually to mudflat and open water. Over the last 100 years substantial changes to site hydrology occurred through the implementation of extensive ditching, to support salt hay farming and later mosquito control. These interventions, exacerbated by other influences like sea-level rise and modified sediment sources, has altered site hydrology and vegetation patterns resulting in slowly degrading marsh function.

While many restoration projects complete extensive site re-grading, importation of fill material to raise grades, and replanting, the goal of this project was to identify smaller scale restoration techniques that could be implemented to limit further degradation and encourage tidal hydrology. Increasing circulation reduces the high salinity levels and low dissolved oxygen levels seen in mudflat areas, allowing for revegetation of these areas. This work was accomplished by widening existing tidal channels, removing vegetation growth from primary ditches, installing runnels, and adding and removing ditch plugs to better size the drainage area to the widened channels. Work was completed in 2023 and early monitoring showed positive results.

Maine's CoastWise Approach for Tidal Crossing Design - Performance Criteria for Ecological Resilience - Matt Shultz

The CoastWise Approach provides a set of best practices for building safe, resilient, and ecologically supportive road crossings in the tidal environment. In support of this new guidance the CoastWise Steering Committee sponsored an analysis to evaluate performance criteria for tidal road crossings, identify preferred metrics, and provide recommendations. The intent is to provide streamlined guidance for road crossing sizing to support upstream wetland function and resilience. We analyzed eleven (11) selected tidal road crossing project sites located in Maine utilizing new/updated hydraulic modeling performed using various model types (0-D, 1-D, and 2-D).

We assessed the applicability of hydraulic head differential (HHD) and the timing of peak high tides (phase lag) as potential performance metrics for tidal crossing structures. We then validated the effectiveness and appropriate target criteria for these performance metrics in order to provide unrestricted tides to the upstream tidal basin, ensuring ecological resilience (for present-day and future design tides with sea level rise).

Primary study conclusions included that 1) a combination of criteria be evaluated when sizing a crossing structure (both HHD- and phase-based), 2) a set of performance criteria can be met for most sites, however, the criteria may need adjustment based on the project objectives, limitations, or feasibility, 3) the selected hydraulic model type can affect the ability to meet performance criteria; the selected model should be able to represent the complexity of the marsh/tidal crossing system, 4) correlations exist between certain site characteristics and the structure spans selected using different metrics/performance criteria.

Tidal wetland restoration through barrier removal from east to west - Michael Burke

Commonly, tidal wetland restoration involves work to remove barriers represented by roads, levees, railroads, dams, and other features. In doing so, the aim is to improve tidal connectivity enabling tidal hydrologic exchange, but also to enable a suite of companion ecological processes including aquatic organism passage, nutrient and sediment cycling, marsh migration, storm buffering, and other similar benefits. Additionally, estuary habitat restoration on both the east and west coasts is sensitive to human communities in coastal areas, considering infrastructure, ecological values, recreation, and history. Despite this broad array of common objectives, locally-influenced factors refine site-specific objectives in different regions. This presentation contrasts locally-varying objectives and approaches to tidal wetland restoration between the Columbia River Estuary (CRE) and the estuaries of Downeast Maine, two regions where effective tidal wetland restoration is regarded as essential to recovery of ESA-listed salmon species native to each region. Although there is varying local focus on direct endangered salmonid species habitat restoration, projects emphasize community and infrastructure resiliency while also supporting wetland sustainability and resiliency in the face of sea level rise, holistically supporting the coastal ecosystems that are co-evolved with salmon, and that are critical to the regional economies. While regional ecosystems, funding, programs,

and sometimes even language can differ, restoration values are often more similar than different. Estuary restoration practitioners learn as we go – integrating lessons from implemented projects to new ones. Our presentation uses multiple project examples to share lessons learned across the continent.

Hydrodynamic and Salinity Modeling to Inform Culvert Replacement Design and Ecosystem Restoration in the Pamet River Estuary, Truro MA. - Grace Medley

The Pamet River Estuary is in the Town of Truro on Cape Cod (Massachusetts) and has historically been divided into a saltwater-dominated and freshwater-dominated marsh at a gate/culvert structure at the Truro Center Road crossing. This crossing, along with sills and channel blockages due to phragmites, acts to maintain the eastern (upstream) portion of the estuary as an entirely freshwater system. During a powerful Nor'easter in March of 2018, the structure at the crossing was damaged, and the upstream freshwater marsh was inundated with saline storm surge for nearly two weeks, causing degradation of the ecosystem and flooding to property owners. The Town of Truro has made it a priority to re-design the culvert system at Truro Center Road with infrastructure improvements to achieve drainage efficiency, climate resilience (sea level rise) and ecosystem (saltmarsh) restoration goals upstream of the crossing. A 2-dimensional hydrodynamic modeling approach using the Environmental Fluid Dynamics Code (EFDC) was implemented to simulate tidal exchange, flow and salt fluxes to provide insight into how the system changes under a series of alternatives being considered as part of the culvert re-design process. A total of 5 alternatives were tested, including an open estuarine restoration, a clear span bridge, and multiple culvert configurations to analyze changes in salinity, water surface elevations and hydroperiod. The results of the analysis were utilized to inform restoration and improvements associated with each alternative, which aided in the selection of a preferred restoration design alternative.