Marsh Adaptation Scenarios

The protection and restoration marsh adaptation scenarios are based on the <u>NOAA Landscape</u> <u>Scale Marsh Resilience Framework</u> marsh resilience categories and a decision matrix developed by USGS (Ganju et al. 2023), which correlates elevation and the Unvegetated to Vegetated Ratio (UVVR) in a <u>geospatial analysis</u> to <u>guide marsh actions</u>. While not shown here, the USGS is also developing a marsh lifespan calculator that will estimate how long the marsh could persist, which could inform future marsh adaptation decisions.

Protection Scenario: Use data to identify *healthy marshes* that are susceptible to sea level rise (SLR) and have the potential to migrate.

| Indicator for Marsh Adaptation | Data Layers |
|---|---|
| High Marsh Integrity – Good Condition | UVVR (less than 0.15) |
| High Vulnerability to Sea Level Rise | Existing Tidal Marsh Layer NOAA Sea Level Rise Scenarios (2050 and 2090 Intermediate and Intermediate High) |
| High Adaptive Capacity | Marsh Migration Corridor Envelope (MMCE) - Model synthesis indicating marsh migration potential MD Wetland Adaptation Areas Protected Lands |

Restoration Scenario: Use data to identify *degraded marshes* that are susceptible to SLR and have the potential to migrate.

| Indicator for Marsh Adaptation | Data Layers |
|--|--|
| Low Marsh Integrity – Degraded Condition | UVVR (greater than 0.15) |
| High Vulnerability to Sea Level Rise | Existing Tidal Marsh Layer NOAA Sea Level Rise Scenarios (2050 and 2090 Intermediate and Intermediate High) |
| High Adaptive Capacity | Marsh Migration Corridor Envelope (MMCE) - Model synthesis indicating marsh migration potential Protected Lands |

Wicomico River, MD Regional Focus Area- Maps and Summaries

Maps were generated by the Project Team (Skeo, MD Department of Natural Resources, and the Climate Resiliency Workgroup) to support the Chesapeake Bay Program's Goal Implementation Team (GIT)-funded project sponsored by the Climate Resiliency Workgroup (CRWG). This project is ongoing and aims to support partnership building and identification of marsh adaptation projects. Each map has a corresponding JPG file. The following maps represent the Wicomico Regional Focus Area, which was selected with guidance from a Steering Committee.

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Marsh Adaptation Strategies based on Marsh Health and Potential Marsh Migration

These maps display available data related to sea level rise vulnerability, marsh health, and marsh migration potential.

Map 1—Existing Marshes and Wicomico Regional Focus Area

Purpose: Showcase opportunities for large-scale marsh adaptation

Location of existing tidal marshes (blue) in the Wicomico Regional Focus Area from the <u>National</u> <u>Wetland Inventory</u>, which showcases the potential for existing large-scale marsh adaptation.



Existing Marshes and Wicomico Regional Focus Area

Map 2—Marsh Migration Corridor Envelope (2') and NOAA SLR Int-High (2050) Purpose: Identify protection needs to facilitate marsh migration

The Marsh Migration Corridor Envelope (MMCE) combines outputs from three marsh migration models to determine areas of potential marsh migration to future sea level rise (SLR) scenarios in Chesapeake Bay based on the <u>methodology</u> developed by the Virginia Institute of Marine Science (VIMS; Mitchell et al., 2023). Models included are the Sea Level Affecting Marshes Model 5.0 (SLAMM), a modified Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST), and the Marsh Migration Mapping Method of the NOAA Sea Level Rise Viewer (NOAA). Existing tidal wetlands and impervious surfaces were removed from the MMCE.

Protection Scenario: The mapped data shows significant potential for future migration under various 2 ft. sea level rise scenarios (pink area; labeled as Multiple Models – 2 ft. Sea Level Rise) adjacent to land projected to be below sea level in 2050 (blue area; based on <u>NOAA SLR</u> <u>Intermediate-High scenario</u>). The marsh migration corridors (in pink) could be areas to target land conservation efforts to allow vulnerable marshes to migrate.



Marsh Migration Corridor Envelope (2') & NOAA SLR Int-High (2050)

[Map 2]

Map 3—Marsh Health (UVVR) and Marsh Migration Corridor Envelope (2') *Purpose: Identify restoration and/or protection potential of existing marshes*

The unvegetated to vegetated ratio (UVVR) was developed by the USGS and is broadly an indicator of marsh health and stability. A smaller number indicates greater marsh stability. A UVVR threshold greater than 0.15 indicates disintegration of the wetland complex making it less resilient to sea level rise. Restoration efforts that maintain a 0.15 or lower UVVR will allow for increased likelihood for marsh persistence.

Protection Scenario: Based on the UVVR data, significant areas of stable marsh (beige area; labeled as Healthy/Stable Conservation) exist adjacent to potential marsh migration corridors under various 2 ft. sea level rise scenarios (see description of the marsh migration corridor envelope in Map 2). Protecting those marshes can help prolong marsh persistence and facilitate migration as sea level rises.

Restoration Scenario: Smaller marshes that are less stable (red and burgundy) adjacent to potential marsh migration areas highlight opportunities for restoration and shoreline protection efforts. Slowing down marsh degradation (i.e., decreasing the UVVR value) allows for the greater likelihood of increasing marsh persistence compared to taking no action. Additionally, increasing marsh health allows from the greater likelihood of marsh migration success in the

future. In some cases where marsh migration is limited, restoration of existing marshes may still need to be considered for short-term community protection measures. Local input is imperative to ground truth mapped data.



Marsh Health (UVVR) & Marsh Migration Corridor Envelope (2')

[Map 3]

Marsh Adaptation—Land Use and Community Social Vulnerability Considerations

Maps 4-7—Marsh Health (UVVR) and Marsh Migration Corridor Envelope (2'), Land Use (Impervious Surface, Forested, and Agriculture), MD Wetland Adaptation Areas with MD Protected Lands, FEMA Risk Index, and NOAA SLR Int-High (2050 & 2090)

Purpose: Identify protection potential of existing marshes and identify opportunities that account for current protected lands, land-use (e.g., agriculture, forest, impervious), and development; assess vulnerability of communities adjacent to the Wicomico River as sea level rises and land transitions.

Protection Scenario: Marshes that are within protected lands offer opportunities for faster largescale action in protecting and restoring marsh condition given their ownership. A significant amount of marsh within the protected lands (Map 4) is unstable or at the lower end of the stability threshold based on UVVR data (see Map 3 for UVVR description). The protected lands adjoin areas with extensive healthy marsh and potentially suitable migration corridors (see Map 2 for Marsh Migration Corridor Envelope description). These adjacent lands are privately owned and are either largely undeveloped or agricultural (Map 5). While this region has relatively low population density, there is significant risk to agricultural lands because of coastal and riverine

flooding and extreme events like hurricanes. The opportunity to facilitate marsh migration on undeveloped tracts through easements, partnerships or land acquisition can support long-term coastal resilience. There are further opportunities to work with private landowners to support natural land transition as future sea level rise affect agricultural lands. The Maryland Wetland Adaptation Areas (Map 6) indicate regions that will be transitioning from uplands to wetlands by 2100 (assuming 4.3 ft. of sea level rise).

Social Vulnerability: Marsh migration corridors adjacent to the Wicomico River present potential opportunity to increase protection for adjacent communities particularly as sea level rises (Map 4). Land use of the area adjacent to Wicomico River also indicates a unique opportunity to consider marsh migration strategies in an undeveloped area and natural transition from agricultural land to marshes to increase coastal protection of nearby population centers (Map 5).

The Wicomico Regional Focus Area is shown as Relatively High Risk (Map 7) with the <u>FEMA</u> <u>Risk Index</u>. The equation behind the FEMA Risk Index includes three components: a natural hazards component (Expected Annual Loss), a consequence-enhancing component (Social Vulnerability), and a consequence-reduction component (Community Resilience). The projected SLR data for 2050 and 2090 shows that regions surrounding the Wicomico River on all sides and into the Chesapeake Bay are at high risk (Map 7). As sea level rise extends inland from the Wicomico River, communities along the river and along the Chesapeake Bay and agricultural lands (Map 5) will be more exposed to coastal climate change impacts and land transitions from upland regions to wetlands (Map 6). Enhancing the longevity of the land could slow down the displacement of people and support coastal protection for highly vulnerable communities and economically important agricultural land.



Marsh Health (UVVR) & Marsh Migration Corridor Envelope (2') with MD Protected Lands



Land Use- Impervious Surface, Agriculture, Forested

[Map 5]

Maryland Wetland Adaptation Areas (Uplands to Wetlands 2100)



[Map 6]



FEMA Risk Index, NOAA SLR Int-High (2050 & 2090)

[Map 7]

Linking Marsh Resiliency Opportunities with Funding Priorities

In light of recent federal infrastructure funding opportunities, resulting from the Inflation Reduction Act and Bipartisan Infrastructure Law, the mapper provides a means of identifying targeted sites for marsh resilience efforts that align with funding priorities. Below are a few mapping scenarios to highlight how this mapper can assist in linking marsh resilience projects with funding priorities to bolster project proposals.

Connection to Living Resource Funding Opportunities

Example: The National Oceanic and Atmospheric Transformational Habitat Restoration and Coastal Resilience Grants

The principal objective of this solicitation is to support transformational habitat restoration projects that restore marine, estuarine, coastal, or Great Lakes ecosystems, using approaches that enhance community and ecosystem resilience to climate hazards. Funding will prioritize habitat restoration actions that: demonstrate significant impacts; rebuild productive and sustainable fisheries; contribute to the recovery and conservation of threatened and endangered species; promote climate-resilient ecosystems, especially in tribal, indigenous, and/or underserved communities; and improve economic vitality, including local employment.

Maps 8 and 9- Fish Habitat Scores:

The Atlantic Coastal Fish Habitat Partnership (ACFHP) developed both the diadromous fish habitat (Map 8) and the estuarine analysis (Map 9) <u>scores</u>. These scores ranged from 0-80 with

higher scores representing better fish habitat (e.g., exposed to less stressors). Metrics for the diadromous fish habitat scoring included impervious surface, point and nonpoint source pollution, riparian buffers, species access, flow alteration, local fragmentation, and Endangered Species Act (ESA) critical habitat. Metrics for the estuarine analysis scoring included seagrass and oyster reef habitat, wetland habitat, water-vegetation edge, proximity to protected habitat, proximity to development, water quality, hardened shoreline, and habitat fragmentation. The suggested conservation actions are based on the final score: above 60 (greens and blues) = area of excellent fish habitat for protection; 20-60 (yellows and oranges) = restoration opportunity area for fish habitat; below 20 (reds) = degraded areas of opportunity.

The Wicomico Regional Focus Area has diadromous scores ranging from 40-60 across most of the areas and estuarine analysis scores ranging from 0-70 with higher inland from the regions along the coast of the Bay.









Wicomico Regional Focus Area & Fish Habitat Estuarine Scores

[Map 9]

Connection to Community Resiliency Funding

Example: NCCOS National Coastal Resilience Fund

The National Coastal Resilience Fund restores, increases and strengthens natural infrastructure to protect coastal communities while also enhancing habitats for fish and wildlife. Established in 2018, the National Coastal Resilience Fund invests in conservation projects that restore or expand natural features such as coastal marshes and wetlands, dune and beach systems, oyster and coral reefs, forests, coastal rivers and floodplains, and barrier islands that minimize the impacts of storms and other naturally occurring events on nearby communities.

Maps 10 and 11- MD EJ Scores & NOAA SLR (2050 & 2090), FEMA Floodplains & Impervious Surface:

Maryland's Environmental Justice Screening (MD EJ Screen) tool assists in identifying communities that have been potentially underserved or overburdened by calculating a score based on four primary indicators (i.e., pollution burden exposure, pollution burden environmental effects, sensitive populations, and socio-economic and demographic indicators). The higher the scores can indicate communities that might be particularly vulnerable to environmental impacts. The Wicomico Regional Focus Area is adjacent to regions classified as more vulnerable to these four primary indicators, with scores ranging from the 50th to 100th percentiles (Map 10); furthermore, these communities are likely to be impacted by the effects of sea level rise in both the near term (2050) and long term (2090) (Map 10). Currently communities living within this focus area reside within regions that have a higher likelihood of experiencing annual flooding, per the FEMA Floodplains data layer (Map 11). The higher social vulnerability coupled with the opportunities to implement marsh adaptation strategies that were highlighted above align with the NCCOS National Coastal Resilience Fund objectives.



MD EJ Score, NOAA SLR Int-High (2050 & 2090)

[Map 10]

FEMA Floodplains & Impervious Surface



[Map 11]