

**Dashboard - Progress Implementing the [2021 Saltwater Intrusion Adaptation Plan](#) (Plan)**

As of: January 31, 2022

Adaptation Measures recommended now (p. 7 of the Plan)

<i>Resource/Land Type - Recommendation</i>	<i>Progress</i>	<i>Next Steps</i>
<b>Farmers/Agricultural Land</b>		
<p>Develop a report that presents specifics for how to establish and implement conservation easements in Maryland that facilitate transitional land uses (e.g., saltmarsh) for salt-impacted farmland.</p>	<p>2020 - DNR pilot project underway using a Wetland Adaptation Buffer and Coastal Resilience Management Plan, funded by Program Open Space. Planning facilitated and participated in discussions between DNR and University of Maryland researchers on possible components of coastal resiliency. Planning presented to ARWG in November 2020 to gather feedback.</p> <p>2021 - DNR obtained additional feedback on the project using Mentimeter from the ARWG in February 2021. DNR and MDE (Kelly Neff) discussed the possibility of finding opportunities for combining mitigation with the pilot. <a href="#">MDA MACS program</a> now funds 100% (no cost-share) wetland creation on farms.</p>	<p>Analyze the results of the Mentimeter feedback to propose possible changes to the pilot project.</p> <p>Determine any obstacles remaining to implement the pilot project and work on solutions to overcome the obstacles.</p> <p>Once the pilot project is developed, create the report called for in the Plan.</p> <p>Identify how resources and education programming will reach historically marginalized farmers.</p> <p>Establish a CBP expert panel for a tidal wetland BMP, since this could provide another incentive in support of this type of conservation easement.</p> <p>Continue to discuss with DNR the potential for integrating wetland mitigation within the coastal resiliency easement pilot and discuss with MDOT opportunity to reuse dredge material at the easement</p>

		<p>site (could help fund wetland restoration opportunities).</p> <p>Establish criteria for prioritizing potential coastal resilience easements for action. Evaluate how the proposed statewide wetland adaptation plan goals can be used to inform criteria.</p> <p>Develop coastal resilience easement scorecard for internal decision making and BPW presentations.</p> <p>A sub-conversation about invasive species management, particularly phragmites, would be necessary because phragmites management/removal may be a disincentive to farmers if it's required for easements. EQIP has previously helped with phragmites control, so that is one option to help.</p> <p>Over time, identify metrics to evaluate the success of the projects (e.g., acres of wetland migration area conserved or under management on the farm). Revisit protected properties every 10 years to evaluate conditions and make management plan adjustments.</p>
<i>Resource/Land Type - Recommendation</i>	<i>Progress</i>	<i>Next Steps</i>
Establish additional education	2020 - Planning facilitated discussions among	Salt salinity monitoring (in soil and

<p>and assistance for farmers to address and prepare for salinization.</p>	<p>researchers and subject matter experts to share updates on current research projects and identify opportunities to assist each other.</p> <p>2021 - Maryland/Delaware agricultural researchers held stakeholder meeting with Eastern Shore farmers to share research updates and to gather feedback on current on-the-ground farming challenges. USDA Climate Hub finalized its <a href="#">Salinization on Working Lands</a> manual. Planning facilitated discussion between University of Maryland and Maryland Sea Grant regarding survey efforts to farmers to identify responses to salt-impacted farmland.</p> <p>2022 - Tully/Modal/Miller/Gedan academic group are implementing a NFWF grant project in collaboration with the Hughes Center to evaluate native grass species ability in salt impacted fields to provide ecosystem services.</p>	<p>groundwater) is needed as a first step (consider use of mobile app to assist with this - data connected with MGS/MDA).</p> <p>Academics will continue research (e.g., Tully/Modal/Miller/Gedan group) to identify current salt-impacted farmland, predict future areas of salt-impacted farmland, identify alternative crops, and identify best methods for establishing saltmarsh on salt-impacted land.</p> <p>Keep track of academic research efforts to ensure this information can be shared with farmers as soon as possible.</p> <p>MDSG will provide a summary from their <a href="#">Coastal Farmer virtual Workshops</a> (manuscript for journal publication will be submitted January 2022).</p>
<p><i>Resource/Land Type - Recommendation</i></p>	<p><i>Progress</i></p>	<p><i>Next Steps</i></p>
<p>Promote the use of more sophisticated water control structures to prevent the inflow of saline waters into field drainage systems.</p>	<p>2021 - Several Maryland state agencies participated in U.S. Climate Alliance discussions with other states in the region regarding how farmers are contending with salt-impacted land and whether they are creating barriers to wetland migration. Through these discussions, we learned that North Carolina farmers especially are making use of water control structures to combat salinization, but the technology does not seem applicable for Maryland's Eastern Shore. <a href="#">MDA MACS program</a> now funds 100% (no cost-share) structures for water control. Also, counties are installing tidal-based weirs to</p>	<p>MDA could expand eligible practices under MACS. Consult with NRCS regarding research findings that would demonstrate an environmental benefit. Consider other MDA funding sources or pursue other grant funding.</p> <p>MDA continue to spread the word about this issue.</p>

	control tidal flooding - some might help with this issue.	
<b>Wetlands</b>		
Develop a statewide wetland adaptation plan, which would include identifying opportunities for migration of coastal wetlands, and in some cases, measures to make high priority wetlands more resilient.	<p>2020 - Planning facilitated discussion among subject matter experts at DNR and with the state agency saltwater intrusion workgroup to develop overarching goals. Planning presented the statewide wetland adaptation plan goals to the ARWG in November 2020 to gather feedback.</p> <p>2021 - DNR obtained guidance from the ARWG regarding necessary components for a statewide wetland adaptation plan using Mentimeter from the ARWG in February 2021. DNR <a href="#">EESLR research project</a> continued and will inform the plan. CBP Climate Resiliency Workgroup obtained GIT funding for a Marsh Adaptation Workshop, to be developed.</p> <p>2022 - "Facilitating Healthy, Just and Community-Supported Marsh Migration in Maryland" - DNR/TNC selected as host for NOAA's 2022-2024 class of Digital Coast Fellows. Fellowship start date August 1, 2022.</p>	<p>Analyze the results of the Mentimeter feedback to guide development of the plan.</p> <p>CBP Climate Resiliency Workgroup Marsh Adaptation Workshop - keep track of status and work to gain impetus and support from the workshop.</p>
<b>Coastal Forests</b>		
Facilitate alternative uses for inundated forest land, such as promoting sika deer or duck hunting.	<p>2021 - DNR/Morgan State PEARL laboratory effort (from Spring newsletter): "Support from the Maryland Department of Natural Resources Wildlife and Heritage Service for PEARL social scientists to explore recreational hunter effort, management preferences, and regional economic impacts related to Sika Deer on Maryland's Eastern Shore. Sika deer are a non-native species with established</p>	<p>Maryland Sea Grant may have some additional alternatives for discussion from its workshops. This is a good template. Several thoughts that came up in Sea Grant agricultural workshops that might be relevant for coastal forests too: 1) explore how farmland might be evolved to marsh or other salt tolerant crops that</p>

	populations in marshlands and coastal areas of the lower Eastern Shore. The survey will target resident and non-resident Sika Deer hunters to generate information about hunter preferences, behaviors, and spending in Maryland.”	might sequester carbon and be a market for farmers - e.g. the mitigation possibilities of alternative farm land uses; 2) explore policies affecting farmer adaptations to wetter and saltier land; 3) changes to federal legislation in the "Farm Bill" which might meet some of the goals of the MD saltwater intrusion adaptation plan.
<i>Resource/Land Type - Recommendation</i>	<i>Progress</i>	<i>Next Steps</i>
Establish additional education and assistance for forest landowners to address and prepare for salinization, including development of a landowners’ outreach program.	2021 - USDA Climate Hub finalized its <a href="#">Salinization on Working Lands</a> manual.	Inform MOU between Critical Area Commission and DNR Forestry through determining the state of the science regarding the benefit of coastal forests and the incremental impact of losing them.  DNR indicates that if there is a very narrow aspect of the ghost forest/timber harvest questions that we can identify, we could try to get an intern through the DNR/MSU partnership to tackle some literature research, compilation, etc. over the summer.

Adaptation Measures that Could be Explored Further to Determine Feasibility and Utility in Maryland (p.9 of the Plan)

<i>Resource/Land Type - Recommendation</i>	<i>Progress</i>	<i>Next Steps</i>
<b>Aquifers and Surface Water Users</b>		

Apply a proven, sound scientific approach to create a hydraulic barrier against saltwater intrusion.	2021 - Anne Arundel County is working towards piloting an aquifer recharge program using potable water as a test. Worcester County is actively managing for saltwater intrusion with treated wastewater by maximizing infiltration into surficial aquifers with increasing spray irrigation and infiltration tools.	Prioritize several water-related needs, including injection of treated wastewater into the groundwater aquifer. Need to understand and work to address possible public concerns.
Create recharge basins to replenish surficial aquifer with freshwater.		
<b>Farmers/Agricultural Land</b>		
Find and then use salt-tolerant crops (e.g., sorghum) that have market potential.	Dr. Dixit, UMES, is pursuing research on this topic.	

Near-Term Research Needs

<i>Resource/Land Type - Recommendation</i>	<i>Progress</i>	<i>Next Steps</i>
<b>Aquifers - Near Term (0-2 years) Research Needs (p. 27)</b>		
<i>Assess available data.</i> There are many data sets in existing governmental (federal, state, and local) and academic databases that can be obtained and analyzed. Obtaining and assessing the data would help identify knowledge gaps.	2020 - Work begun by Maryland Geological Survey (MGS) in five Coastal Plain Counties adjacent to the Bay to compile chloride data (in groundwater) from federal, state, and county datasets. Academic databases not accessed.	Continue groundwater quality data compilation efforts in other Coastal Plain counties.  Create a plan for developing a database with a consistent and compatible format.  Funding for developing a database needs

<p>Compiling the data (both groundwater and surface water) into a single database would be helpful.</p>		<p>to be secured.</p> <p>Up-to-date groundwater sampling for comparison to older datasets is needed - work with county health departments in order to sample new wells.</p>
<p><i>Resource/Land Type - Recommendation</i></p>	<p><i>Progress</i></p>	<p><i>Next Steps</i></p>
<p><i>Assess potential vulnerability.</i> To identify vulnerable aquifers, consider an assessment of withdrawal by sector, initial estimates of hydraulic gradients, and a study of recharge rates. To identify vulnerable water users of the surficial aquifer, overlay groundwater appropriation permits and locations of domestic wells, which must be estimated using water service areas from county water/sewer plans and data on improved parcels, with sea level rise inundation areas. Problem areas such as improperly constructed or improperly abandoned wells also could be identified. Conduct status and trends analyses.</p>	<p>2020 – Hydraulic gradients for five confined aquifers surrounding the Bay have been mapped using 2019 groundwater-level data.</p>	<p>MDE Water Supply Program assesses vulnerability of domestic wells when they approve large Groundwater Appropriation Permits. Talk to MDE permit writers about areas with vulnerabilities.</p> <p>Work with county health departments to identify well construction issues.</p> <p>Identify source of funding to perform systematic vulnerability analysis (data compilation and GIS spatial analysis).</p>

<i>Resource/Land Type - Recommendation</i>	<i>Progress</i>	<i>Next Steps</i>
<p><i>Identify areas where more research and data is needed.</i> Based on an assessment of the available data, areas and aquifers where more information is required could be targeted, as well as knowledge gaps in the aquifer framework, processes of saltwater intrusion, and forecasting.</p>	<p>2020 - Assessment of groundwater quality data coverage has to some extent been accomplished by MGS in Anne Arundel, Kent, Somerset, Wicomico, and Worcester Counties.</p> <p>2020-2023 - Coastal Plain aquifer framework is currently being revised and enhanced by MGS with new data as part of an update to the Aquifer Information System (funded by MDE).</p>	<p>Continue groundwater quality data compilation and assessment in other Coastal Plain counties surrounding the Bay.</p> <p>Create plans for targeted research in areas of vulnerability or data gaps. This should include collecting well-water samples from areas with detectable historical chloride levels to discern trends over time.</p>
<p><i>Develop study plans.</i> Detailed study plans are suggested to effectively and efficiently design and target research and quantify required resources (funding, staffing, etc.).</p>	<p>2020 - Initial plans have been developed for specific grant proposals. No comprehensive plans have been developed yet.</p>	
<p><i>Strengthen the partnership with county health departments and offer technical assistance with existing local databases.</i> Local health department databases house volumes of information and local program managers have a working knowledge of water issues. Local health departments can use additional funding and support to export local information effectively. Disparate formats among county</p>	<p>MDE in partnership with MDH is developing technical tools to facilitate data display and data sharing between local health departments and state agencies. This effort is in its early stages with a business analyst hired to map business processes and record where and how data is stored so that an RFP can be developed to implement new technology for public health information.</p>	<p>Planning could facilitate a discussion between MGS and local health departments through meetings of MDE's local environmental health liaison group.</p> <p>County level leadership is needed to develop comprehensive water and sewer plans (and/or local comprehensive plans) that recognize SWI and other climate limitations (<a href="#">new Water Resource Element guidance</a> could help). Decisions about infrastructure investment today needs to drive a livable future with freshwater and</p>



health department databases should be standardized to allow for more effective data export and compilation.		managed wastewater.
<i>Resource/Land Type - Recommendation</i>	<i>Progress</i>	<i>Next Steps</i>
<b>Surface Waters - Near-Term (0-2 years) Research Needs - pp. 33-34</b>		
<i>Identify currently vulnerable water users.</i> Map the locations of intake pipes (surface water appropriation permits) relative to the current freshwater-saltwater transition zone.		Obtain from MDE the x/y locations (or maps) of intake pipes for surface water appropriation permits; obtain current freshwater-saltwater transition zone within surface waters (from CBP? MGS?)
<i>Identify and catalog ditches.</i> Having high-resolution geographic data on the location, depth and extent of ditches (agricultural, wetland, etc.) could help researchers better estimate and understand the upstream movement of saltwater within Maryland surface waters.	2021 - CBP staff (Peter Claggett) communicated that “land-cover datasets will be translated into three, 58-class, land-use datasets using a variety of local (e.g., tax parcels) and regional (e.g., soils and roads) ancillary datasets. <i>To complement these data, the development of hydrography data consisting of 1-meter resolution (1:2400-scale) fluvial features such as channels, gullies, and ditches are also being developed.</i> ”	Determine from CBP when the ditch data will become available, then share with agricultural researchers as a first step.
<i>Review system-wide approach for monitoring surface water salinity to detect long term changes.</i> This could include a statistical review of the experimental design of any necessary supplemental		What is the CBP doing in this regard, in conjunction with DNR monitoring efforts?

<p>monitoring, and will also allow for model calibration and validation. Conduct status and trends analyses using this information.</p>		
<p><i>Resource/Land Type - Recommendation</i></p>	<p><i>Progress</i></p>	<p><i>Next Steps</i></p>
<p><b>Agriculture - Near-Term (0-2 years) Research Needs - p. 37</b></p>		
<p><i>Improve maps of past, current, and future salinization.</i> Determining current and forecasting future salinization will help farmers better evaluate what land is of higher value, and what land is or will be of lesser value for farming.<sup>66</sup> Assess the vulnerability of Maryland's farms and overall coastal ecosystems to saltwater intrusion via surficial drainage networks by developing a SIVI.</p>	<p>2020-2021: Agricultural researchers in Maryland, Delaware and Virginia are collaborating and working on developing and perfecting methods for identifying areas of current and future salt-impacted farmland.</p>	<p>A research need is a state or region wide economic and ecosystem service impact analysis of lost and converted lands. Farm-scale economic analysis would also be valuable. DNR plans to do the ecosystem service portion of this as part of the EESLR project and there possibly is some work being done at UMCES (or maybe DNREC?) on the farm-scale economic analysis (Dr. Stephen Tubene at UMES also is interested in this).</p> <p>Continue to stay in contact with agricultural researchers to determine when maps could be developed, and discuss with MDA and others the best approach for sharing this information without hurting property values.</p> <p>The ditch data being developed by CBP could be used to inform the development of a Saltwater Intrusion Vulnerability Index (SIVI), but before doing so we need to determine the benefits of the SIVI as a</p>

		forecasting tool in comparison to the methods currently being developed by local agricultural researchers. Consider the 2017 Salisbury University <a href="#">thesis</a> on agricultural ditches.
<i>Track salinity shifts in wells and streams.</i> Track the link between sea level rise and the landward migration of saltwater. Conduct status and trends analyses using this information.		Follow-up with Scott Andres at the Delaware Geological Survey regarding his efforts concerning this. Identify how this work could support the work being completed by agricultural researchers and future MGS work.
<i>Resource/Land Type - Recommendation</i>	<i>Progress</i>	<i>Next Steps</i>
<b>Wetlands - Near-Term (0-2 years) Research Needs - pp. 41-42</b>		
<i>Determine how sea level rise and saltwater intrusion will change the types and amounts of wetlands in Maryland.</i> DNR completed an assessment in 2011 of future wetland loss due to sea level rise using the Sea Level Affecting Marshes Model (SLAMM); see the Sea Level Rise Vulnerable Wetlands layer in the Maryland Coastal Atlas. The total loss and change in type of wetlands due to sea level rise or saltwater intrusion should be reevaluated and the risk assessed. The state could	<p>2022 - DNR EESLR grant project will result in an updated SLAMM forecast.</p> <p>2020-2021 - U.S. Climate Alliance-funded project indicates expected amounts of wetland loss versus potential for wetland migration, resulting in a net loss of wetlands, and where migration is expected to happen (or is expected to be blocked by other land uses).</p> <p>Ongoing - beneficial reuse projects (Poplar Island) to improve near-term resiliency of wetlands and vulnerable coastlines.</p>	2022 - Updated SLAMM results utilizing the 2018 State SLR Projections are available internally at decadal timescales. Once the SLAMM forecast is updated, finalize metadata, select data for sharing on Maryland iMap, and complete communication/messaging.

<p>update its 2011 analysis of the loss of wetlands due to sea level rise, and could perform a similar and additive analysis on the loss and change in type of wetlands due to saltwater intrusion. In the Blackwater 2100 plan, the SLAMM model was used to identify future changes in tidal wetland area and habitat type within Blackwater National Wildlife Refuge. Other factors that might not be taken into account sufficiently by the SLAMM model could be considered as well: (e.g., understanding the relationship between saltwater intrusion and saltmarsh elevation change (saltmarsh accretion rate) is important, given that a lower rate of elevation change in tidal freshwater wetlands would mean they may more quickly become inundated due to sea level rise).</p>		
<p><i>Resource/Land Type - Recommendation</i></p>	<p><i>Progress</i></p>	<p><i>Next Steps</i></p>
<p><i>Identify priority existing wetlands at risk and adaptation actions.</i></p>	<p>See statewide wetland adaptation plan effort (under Adaptation Recommendations).</p>	

<p>Once vulnerable wetlands are identified, the state could update its 2009 study that prioritized which of Maryland’s coastal wetlands to target for protection or restoration – see <a href="http://mde.maryland.gov/programs/Water/WetlandsandWaterways/AboutWetlands/Pages/prioritizingareas.aspx">mde.maryland.gov/programs/Water/WetlandsandWaterways/AboutWetlands/Pages/prioritizingareas.aspx</a> – incorporating new knowledge regarding ecosystem service values of particular areas in Maryland – see <a href="http://dnr.maryland.gov/ccs/Pages/Ecosystem-Services.aspx">dnr.maryland.gov/ccs/Pages/Ecosystem-Services.aspx</a> – and which of these wetlands may be able to migrate further inland (if migration corridors exist) or to be lost or transformed to saltmarsh.</p>		
<p><i>Resource/Land Type - Recommendation</i></p>	<p><i>Progress</i></p>	<p><i>Next Steps</i></p>
<p><b>Coastal Forests - Near-Term (0-2 years) Research Needs - p. 48</b></p>		
<p><i>Collect data on the degradation of coastal forests to help quantify the rate of increase in “ghost forests.” Partner with other organizations to identify appropriate techniques for managing the land to optimize woodland health; evaluate forest</i></p>	<p>MDA Forest Pest Management has periodically conducted aerial surveys to identify salt-impacted coastal forests.</p>	<p>2022 - work with MDA Forest Pest Management to make all years of the aerial survey data public.</p>

management for balance of forest services, wetland migration and other ecosystem services.		
<i>Examine existing land cover change analyses available from researchers.</i> Compile existing information and identify areas where changes to coastal forests have already occurred.		Determine if upcoming CBP land cover data analyses will show loss of coastal forests to open water or to wetlands. DNR SLAMM model results might show this as well.
<i>Resource/Land Type - Recommendation</i>	<i>Progress</i>	<i>Next Steps</i>
<i>Conduct status and trends analyses using existing land cover data to determine coastal forest conditions, identify historical changes and determine the rate of conversion from coastal forest to “ghost forest.”</i>		
<i>Develop a vulnerability index for forests prone to salinization.</i> Building upon the existing land cover change and trend analyses, develop a vulnerability index to assist property owners in determining management options and opportunities.		

**Infrastructure - Near-Term (0-2 years) Research Needs - p. 51**

<p><i>Identify facilities that currently use surface waters based on their location in the watershed. Whether used for water treatment, in manufacturing operations, cooling systems, etc., determine the potential of impacts to systems.</i></p>		<p>Ask for assistance from MDE water supply permitting (e.g., MDE Water Appropriation and Use Permits).</p>
<p><i>Resource/Land Type - Recommendation</i></p>	<p><i>Progress</i></p>	<p><i>Next Steps</i></p>
<p><i>Identify existing underground infrastructure within the coastal plain (i.e., wells, natural gas, energy transmission lines, internet, wastewater and water systems).</i></p>	<p>See comments about local health departments...new technology will seek to capture/visualize wells (with depth) and onsite wastewater.</p> <p>MDE permitting database and mapping tool exists for wetlands and waterways records all the natural gas energy transmission, water etc...under wetlands: <a href="#">Wetlands And Waterways Permits Interactive Search Portal</a></p>	