CLIMATE ACTION FACT SHEET

Protect, preserve, and restore wetlands and buffer areas

PROTECT EXISTING WETLANDS FROM CONVERSION, PRESERVE WETLAND FUNCTIONS, AND RESTORE DEGRADED WETLANDS TO THEIR NATURAL STATE

Natural Resources & Working Lands

Description and purpose of strategy: Wetlands serve important environmental and economic functions. They naturally sequester carbon, provide an essential habitat for wildlife, deliver water quality benefits, and offer protection from flooding and storm surge. Cape Cod's wetlands also provide a variety of recreational opportunities. The protection, preservation, and restoration of wetlands is a prominent strategy for both combating climate change and protecting communities from climate impacts.

Content of fact sheet: Overview of the economic and equity implications of protecting, preserving, and restoring wetlands, including the current state of the practice, a case study from Wellfleet, and steps for implementation.

Implementation support: This fact sheet expands upon strategies and actions from the Climate Actions Database, which can be found at: capecodcommission.org/climate.

BENEFITS

- ☑ Greenhouse gas (GHG) emissions reductions or sequestration
- ☐ Health improvement from reduced pollutants
- ☑ Increased recreation
- ☐ Lower maintenance/operational costs
- ☑ Environmental enhancement/protection
- ☑ Less damage to infrastructure
- ☐ Higher property values
- ☑ Increased resilience
- ☑ Job and economic growth

COSTS

- ☑ Higher capital costs
- ☑ Higher maintenance costs
- ☐ Higher operational costs
- ☑ Additional time for municipal staff to implement

KEY FINDINGS

Equity: Wetlands protection, preservation, and restoration could improve economic opportunities by creating new jobs and protecting the livelihoods of local businesses that rely on the health of coastal and lowland ecosystems. Decreased exposure to risk from coastal hazards can also reduce personal and economic losses, which can be particularly burdensome for vulnerable communities.

Financial benefits: The capital costs associated with wetlands protection, preservation, and restoration typically outweigh the direct financial benefits. The cost per unit of carbon sequestered is high relative to the costs for other mitigation options.

Non-market benefits: There are many non-market benefits associated with wetlands protection, preservation, and restoration, including carbon sequestration, climate resilience, sedimentation and erosion control, water quality, groundwater recharge, wildlife preservation, and recreation. They may outweigh the high up-front costs.

GHG reductions: Healthy wetlands are effective carbon sinks, absorbing and sequestering more carbon per unit area than terrestrial forests. Although wetlands are collectively responsible for roughly one-third of global methane emissions, saline coastal wetlands produce negligible methane emissions. Restoring the natural tidal exchange to impounded coastal wetlands can reduce methane emissions.

Ease of implementation: Implementation approaches may vary significantly based on the type of project and wetland, ranging from passing regulations for wetlands protection and landward migration to launching construction projects to restore degraded wetlands.

BENEFIT COST ANALYSIS

The capital costs incurred by a municipality for a wetlands project are typically higher than the direct economic benefits. However, there are many indirect, or "non-market," benefits associated with wetlands protection, preservation, and restoration that accumulate over time and are often difficult to quantify.

Benefits

- **Direct economic benefits:** Wetlands projects—particularly restoration projects—can yield direct economic benefits to residents in the form of temporary job creation.
- **Climate mitigation benefits:** Wetlands can absorb and sequester impressive quantities of carbon per unit area compared with other ecosystems, storing most of it in sediments rather than vegetative biomass. Estimates suggest that Massachusetts' wetlands store six times more soil organic carbon per acre than forests (EEA, 2022). Because wetlands maintain anoxic conditions for extended periods, they can continue to sequester carbon for thousands of years, creating thick layers of organic matter. Conversely, when wetlands are drained or soil is degraded, rapid soil carbon loss can occur, and large quantities of GHG that took centuries or millennia to store can be released in a few decades. While estimates of long-term carbon burial capacity in wetland sediments are highly variable, research (Mcleod et al., 2011) suggests the following rates:
    - Salt marshes: 73 to 6,900 kilograms of carbon per acre per year
    - Seagrasses: 180 to 770 kilograms of carbon per acre per year

  While wetlands are collectively responsible for roughly one-third of global methane emissions, emissions rates vary significantly across wetland types and conditions. Saltwater wetlands produce negligible methane emissions due to regular inundation with sulfate-rich seawater. Recent studies conducted in Wellfleet and Falmouth by the Woods Hole Coastal and Marine Science Center suggests that restoring natural tidal exchange to impounded saltwater wetlands can significantly reduce methane emissions (Sanders-DeMott et al., 2022).
- **Climate resilience benefits:** Wetlands can act as buffers against storm surge and sea level rise. While difficult to quantify, benefits can be significant; one study suggests that U.S. saltwater wetlands provide more than $3,000 per acre on average per year in storm protection (Moomaw et al., 2018). During Hurricane Sandy alone, tidal marshes prevented an estimated $625 million in storm damage (Narayan et al. 2017). Wetlands also provide sedimentation and erosion control.
- **Water quality benefits:** Wetlands can recharge groundwater and improve water quality by removing pollutants from surface waters.
- **Commercial benefits:** Restoring wetlands strengthens ecosystems and promotes biological diversity. Many industries—including commercial fishing and cranberry production—derive benefits or generate products that are dependent on wetlands.
- **Recreation benefits:** Wetlands provide many recreational benefits including recreational fishing, swimming, boating, hiking, bird watching, and photography. The overall economic impact of recreational fishing in the U.S. is estimated at over $100 billion, and wetlands play a crucial role in the life cycle of up to 90% of fish caught recreationally (EPA, 2006).

Costs

- **Capital costs:** The costs of wetlands restoration can vary widely depending on the size and complexity of the site. Salt marsh restoration projects across the U.S. vary in cost between $3,300 and $15,550 per acre (Cape Cod Commission, 2021). The Massachusetts Division of Ecological Restoration estimates that freshwater wetlands cost $20,000 per acre to restore (EEA, 2022). The economic costs of restoring wetlands per unit of carbon sequestered are high relative to costs for other mitigation strategies. A study commissioned by the State of Maine found that

restoring salt marshes and eelgrass cost well over $1,000 per metric ton of CO_2 sequestered. However, these options become much more cost-effective when they are sited to maximize other ecosystem services, such as flood protection (State of Maine, 2020).

The following table presents the results of a recent cost-benefit analysis conducted for two priority wetlands restoration sites in Barnstable County: Parkers River in Yarmouth and Pamet River in Truro.

COSTS AND BENEFITS OF CAPE COD RESTORATION PROJECTS (IN THOUSANDS OF 2020$)

SITE	ACRES	RESTORATION COST	DIRECT ECONOMIC BENEFIT	CARBON SEQUESTRATION BENEFIT*	NITROGEN REMOVAL BENEFIT	FISHERIES BENEFIT	BENEFIT COST RATIO 2021–2030	BENEFIT COST RATIO 2021–2050
Parkers River	60	$1,050	$422	$4.0–7.0/year	$148–267/year	$14.2/year	2.0–3.2	5.2–8.3
Pamet River	158	$3,170	—	$10.7–18.4/year	$390–705/year	$37.4/year	1.4–2.4	4.2–7.2

* The carbon sequestration benefit was calculated in terms of the social cost of carbon at 2030.
Source: Cape Cod Commission, (2021).

EQUITY

The protection, preservation, and restoration of wetlands can result in a variety of outcomes that strengthen equity and reduce burdens on vulnerable populations. Potential benefits include:

- **Enhanced economic opportunity.** Wetlands conservation may protect or improve livelihoods for populations throughout coastal communities that rely on the health of marine ecosystems for economic security (e.g., fishing, restaurants, other businesses that sell marine products). Temporary job creation from the "restoration economy" could benefit those who are unemployed or under-employed, particularly if accessible training and job programs are developed in parallel.
- **Decreased risk from climate hazards.** Impacts from climate hazards such as flooding and storm surge are often particularly burdensome for underserved and under-resourced communities and can result in considerable economic losses and damage. Wetlands serve as an important bulwark against climate hazards; they can act as buffers from flooding and storm surge, absorb stormwater, and provide shoreline stabilization.

Optimizing Equity During Implementation

Along with the benefits mentioned above, wetland conservation can have equity-related impacts on communities. For instance, it will be important to consider equity in the citing of any wetland projects to avoid displacement. In addition, planners should consider potential long-term project impacts to adjacent communities, including any indirect impacts to property values and taxes that could stem from community improvements.

CASE STUDY: HERRING RIVER, WELLFLEET, MA

In 2023, the Town of Wellfleet and the Cape Cod National Seashore broke ground on the Herring River Restoration Project—the largest tidal restoration project in New England. The project aims to restore healthy estuarine function to over 800 acres of former salt marsh. Expected benefits include improved water quality, habitat restoration, and substantial climate benefits resulting from decreased methane production. The project is largely funded by grants from the U.S. Department of Agriculture Natural Resource Conservation Service and the Massachusetts Department of Fish and Game's Division of Ecological Restoration.

Photo: Chequessett Neck Road bridge and tidal gates, Mary Ann Bragg/Provincetown Banner

STATE OF PRACTICE

General State of Practice

There is an estimated 590,000 acres of wetlands in Massachusetts, representing 14% of the state's land area. An estimated 82% of these wetlands are freshwater; the rest are salt marshes and coastal resource areas such as beaches, dunes, and tidal flats. Between 1990 and 2017, wetlands in Massachusetts had an estimated net gain of 4,188 acres for freshwater wetlands and 737 acres for coastal wetlands. Although human activity was responsible for 1,548 acres of wetland resource loss and 2,733 acres of wetland resource gain during this period, the greatest overall increase to wetland resources was due to natural causes, primarily beaver activity (MassDEP, 2019).

Wetlands can be lost due to natural stressors (e.g., erosion, droughts, coastal storms, sea level rise) or more commonly due to human intervention (e.g., filling, draining). Efforts to prevent wetlands losses can either be regulatory or voluntary and are directed primarily by programs. The Massachusetts Department of Environmental Protection (MassDEP) oversees the administration of the Wetlands Protection Act (Massachusetts General Laws Chapter 131 § 40), which protects wetlands and other resource areas such as riverfront area, salt ponds, and fish runs. The Massachusetts Office of Coastal Zone Management (CZM) oversees the protection of coastal resources including salt marshes, eelgrass, and other habitats.

Cape Cod Context

Wetlands—including freshwater wetlands, salt marshes, intertidal areas, and other coastal resources such as beaches and dunes—represent 1 out of every 4 acres on Cape Cod. Recognizing their importance: the Cape Cod Regional Policy Plan established the Wetlands Resources Goal: "protect, preserve, or restore the quality and natural values and functions of inland and coastal wetlands and their buffers." The Goal includes objectives to protect wetlands and their buffers from vegetation and grade changes, protect wetlands from changes in hydrology, protect wetlands from stormwater discharges, and promote the restoration of degraded wetland resource areas. With narrow exceptions, development on Cape Cod must not alter the vegetation, grade, or hydrology of wetland resources or their 100-foot buffer areas.

IMPLEMENTATION

The following are recommended actions for planning and implementing wetlands projects. Specific approaches may vary based on the type of project (protection, preservation, restoration) and wetland type and function (freshwater/saltwater, tidal/non-tidal, etc.).

1. **Understand the potential.** Understand the natural potential of watersheds—including the historical range of conditions—and the ongoing causes of degradation.
2. **Incorporate wetlands into Open Space and Recreation Plans (OSPRs).** Consider including wetlands and actions for wetlands protection in municipal OSPRs.

REQUIRED EXPERTISE

Internal: Town planner, conservation commission, grant writer

External: Wetland scientist

3. **Secure funding.** Apply for grants to restore wetlands, such as the Environmental Protection Agency (EPA) Wetland Program Development Grants and other federal and state grants.
4. **Draft or modify bylaws and regulations.** Look for opportunities to incorporate local bylaws and regulations for wetlands protection and landward migration (i.e., the movement of coastal wetlands landward into adjacent ecosystems in response to environmental changes).
5. **Prioritize projects.** Focus on projects that are feasible, self-sustainable, and rely on natural fixes.
6. **Track progress.** Monitor restoration progress over time, document results, and modify practices as necessary.

Resources that may assist with implementation of wetlands conservation are provided below.

FINANCIAL AND TECHNICAL SUPPORT	
MassDEP Grants and Financial Assistance: Watersheds and Water Quality	Grant programs focused on nonpoint source pollution, management, planning, and stormwater.
CZM Coastal Resilience Grant Program	Information on Massachusetts CZM grants to advance local efforts to address coastal flooding, erosion, and sea level rise.
CZM Coastal Habitat and Water Quality Grants	Information on the Coastal Habitat and Water Quality Grants, which provide financial resources for projects that assess and treat stormwater impacts and support comprehensive habitat restoration planning activities.
Massachusetts Division of Ecological Restoration (DER) Wetlands Restoration	Information on the Massachusetts DER wetlands restoration program.
Federal Funding for Wetlands	Information on EPA and other federal agency sources of funding that can be used to support state and tribal programs as well as voluntary restoration.
Cape Cod Regional Policy Plan Wetlands Technical Bulletin	Provides technical guidance on how wetlands projects can meet the goals and objectives of the Wetlands Resources Goal set by the Cape Cod Commission's 2018 Regional Policy Plan.
2018 Regional Policy Plan Data Viewer	Interactive GIS data organized according to the Cape Cod Regional Policy Plan Technical Bulletins.
Cape Cod Coastal Planner	A communication and decision support tool to educate users on the climate change hazards impacting Cape Cod's coastline, the adaptation strategies available to address them, and implications for local infrastructure and ecosystems.

ADDITIONAL INFORMATION	
Model Coastal Resiliency Bylaw	A model coastal resiliency bylaw developed by the Cape Cod Commission, which identifies strategies to mitigate and adapt to coastal changes.
Nashua River Communities Resilient Lands Management Project	A project implemented by the Towns of Clinton and Bolton, Massachusetts, to develop place-based land use and land management strategies that can enhance the potential of forests, open spaces, and wetlands. Contains recommendations for wetlands regulations.
Massachusetts Association of Conservation Commissions	A Massachusetts nonprofit 501(c)(3) organization dedicated to protecting wetlands, open space, and biological diversity through education and advocacy.
2021 Cape Cod Pond and Lake Atlas	An update to the 2003 Cape Cod Pond and Lake Atlas; examines the Cape's freshwater bodies, include pond ecology, water quality, threats, and strategies to restore pond health.
Cape Cod Freshwater Initiative	A science-based, information-driven planning process to engage stakeholders and enable action to protect and restore Cape Cod's freshwater resources.
Cape Cod Natural Resources Assessment	A report developed by the Association to Preserve Cape Cod that documents and maps the current status of sensitive natural resource areas on Cape Cod and documents unprotected areas that remain at risk from development.
Principles of Wetland Restoration	A list of principles developed by EPA's Office of Wetlands, Oceans and Watersheds that have been critical to the success of a wide range of aquatic resource restoration projects.
Economic Benefits of Wetlands	Fact sheet developed by EPA summarizing the national and local economic benefits of wetlands.

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Additional climate change information and resources can be found at capecodcommission.org/climate.