

A Programmatic Framework for Considering Climate Change Impacts in Coastal Habitat Restoration, Land Acquisition, and Facility Development Investments

Background: In August 2007 the Government Accountability Office (GAO) issued *Climate Change: Agencies Should Develop Guidance for Addressing the Effects on Federal Land and Water Resources*, calling for federal agencies to consider climate change impacts more systematically when implementing relevant programmatic activities. In response, a NOAA team began a multi-year project in 2009 to incorporate climate change considerations into a Framework for program planning and decision making. The project team initially surveyed relevant NOAA programs, and found despite having a wide range of coastal investments there were no NOAA programs with formal agency guidance to consider climate change impacts that could be used as the starting point for the Framework. The team also conducted a literature review, and found some climate change impacts are widely agreed upon as key factors and therefore worth considering in planning and implementing NOAA's coastal investments. These include changes in: Relative sea and Great Lake levels; Air temperature; Ocean temperature and circulation patterns; Precipitation patterns (amount, timing, intensity); Air and ocean chemistry (acidification); Tropical storm intensities/frequencies; and Species abundance and distribution.

The results of this initial work led to a decision from NOAA leadership to narrow the scope of the Framework, based on the complexity of the task, on the resources currently available for the project, and on the feasibility for a timely completion of the effort. The scope was concentrated on three programs because of their highly relevant coastal missions, and capabilities to implement the recommendations for a selected subset of coastal "investments". These investments are products of 3 NOAA programs that are administered within the National Marine Fisheries Service's Office of Habitat Conservation, and the National Ocean Service's Office of Ocean and Coastal Resource Management. The investments focus on habitat restoration, land acquisition, and facility construction. The project's overall goal was to safeguard these investments from expected impacts of climate change, and where feasible, use these investments to enhance ecosystem resilience or mitigate the adverse impacts of climate change in an integrated manner across various NOAA coastal offices.

Status: The first project phase produced the Framework document. The next phase (ongoing) is developing regional (geographic or ecosystem scale) or program-specific guidance that can be used to: (1) assess the sensitivity of coastal investments to expected climate changes and, where sensitive, identify best practices to avoid or minimize expected adverse impacts; (2) identify restoration or acquisition strategies and opportunities that could enhance ecosystem resilience; and (3) identify green designs and best practices to reduce or offset greenhouse gas emissions from facility operations. The NOAA programs involved will develop the technical guidance in consultation with other relevant NOAA offices, federal and state agencies, non-government organizations, and academic institutes. A workshop was completed in September 2010 for coastal resource planners in New England, to consider effects of sea level rise on infrastructure design and habitat restoration, and a technical guidance document is currently in preparation based on the workshop's findings and summary of its recommendations. Additional planning efforts in other regional areas are being considered and will hopefully be completed to the extent funding and staff are available.

The Framework contains:

- **Recommended actions outlining how NOAA's Office's of Habitat Conservation and Ocean and Coastal Resource Management will evaluate and revise** management of their relevant restoration, acquisition, and facility development projects and programs, to incorporate considerations of climate change to safeguard these investments.

- **General recommendations, applicable to all three program/project types.** Areas addressed include assessing sensitivity of projects to climate change impacts, considering ecosystem resilience, and project monitoring; and recommendations applicable specifically to coastal habitat restoration, land acquisition, or facility development programs, respectively. Factors to be considered include project identification, selection, design, and long-term monitoring. Operational considerations to mitigate the impacts of climate change by reducing greenhouse gas emissions are also included in facilities design and construction.

- **Strategies and guidelines that would allow restoration and acquisition investments to be used** to help natural and human communities become more resilient to the impacts of climate change, and meet original program objectives.

- **Additional guidance, information, and programmatic support needed by programs** to fully implement the Framework, including region-specific technical guidance on how to consider climate change impacts; methodologies to assess ecosystem resilience opportunities, strategic habitat and restoration planning; training; long-term monitoring and land management plan; and funding sources. In many cases, new and more effective agency capabilities will be required to address these needs.

Key Relationships

Adaptation Principles/Key Recommendations

- **Prioritize Connectivity of Habitat:** Focus on activities that connect habitats to allow for habitat and species migration as climate changes.

- **Reduce Existing Stressors:** In the absence of accurate site-specific forecasts of climate change impacts or ecosystem responses, focus on reducing existing stressors (e.g., pollution, habitat fragmentation) that hinder the ability of species or ecosystems to withstand climatic events.

- **Protect Key Ecosystem Features:** Focus management protection strategies on structural characteristics, organisms, or areas that represent important "keystones" of the overall system.

- **Maintain Diversity:** Identify and conserve a diversity of habitat and species within an ecosystem to provide resilience and a source for recovery.

KEY RELATIONSHIPS TO INFORM RESTORATION CONSIDERATIONS ¹						
HABITAT RESTORATION	CHANGES DUE TO CLIMATE					Sensitivity
	Changes in Precipitation Patterns	Changes in Air Temperature	Changes in Ocean Temperature and Circulation	Changes in Relative Sea and Great Lakes Water Levels	Changes in Air/Water Chemistry	
PROJECT TYPE by prevalence	Sensitivity	Sensitivity	Sensitivity	Sensitivity	Sensitivity	Sensitivity
Tidal Wetlands	high	low/medium	medium/high	high	high	low
Adjacent Coastal Buffer (beaches, dunes, riparian upland)	high	low/medium	low/medium	high	high	low
Shellfish Beds	medium/high	low	med/high	medium	medium	low
Submerged Aquatic Vegetation	high	low	high	low/medium	low	low
Mangroves	high	low/medium	low	high	high	low
Other Coastal Wetlands	high	low/medium	low/medium	high	high	low
Benthic Substrate	medium/high	low	low/medium	low	low	low
Coral Reefs	medium/high	low	high	low/medium	high	high
Kelp and Other Macroalgae	low	low	medium/high	low	low	low
Water Column	high	medium/high	low	low	medium	medium
Coastal Shoreline	high	medium/high	high	high	high	high
Average Sensitivity	med/high	low/medium	medium	medium	medium	low/medium

Table 1 is intended to be used by program offices/project proponents as a quick reference to identify climate change impacts of concern and their anticipated influence on habitat restoration projects with various conservation objectives; however these impacts are considered in isolation. While this table may serve as a general guide, the specific characteristics of the restoration site (e.g., location, size) and objectives will determine how it may be affected by climate change.

¹ The relative sensitivity to impacts depicted in Table 1 (i.e., high, medium, low, none) represents a consensus of informed, qualitative opinions, but is nonetheless, a subjective effort.

KEY RELATIONSHIPS TO INFORM LAND ACQUISITION CONSIDERATIONS ¹						
PROJECT OBJECTIVES	CHANGES DUE TO CLIMATE					Sensitivity
	Changes in Precipitation Patterns	Changes in Air Temperature	Changes in Ocean Temperature and Circulation	Changes in Relative Sea and Great Lakes Water Levels	Changes in Air/Water Chemistry	
LAND ACQUISITION	Priority	Priority	Priority	Priority	Priority	Priority
Protect important coastal habitats such as wetlands and streams, marshes, islands and peninsulas, maritime forests, coastal prairies and savannahs, beaches and other water-fronting habitats	high	high	medium/high	high	medium	medium
Protect habitat for important coastal species	high	high	high	high	medium	medium
Protect drinking water supplies	high	medium/high	none/low	medium/high	high	high
Conserve lands with geological significance	low	low	low	medium	low/none	low/none
Conserve buffers, hubs, in holdings, corridors	high	high	low	medium/high	low	low
Provide public access and recreation	low	low	high	medium/high	low	low
Provide aesthetic/scenic vistas	low	none/low	none/low	medium	high	low
Prevent hazards	high	medium	low	high	none/low	none/low
Preserve historic/cultural resources	low	low	low	medium	none/low	none/low
Enhance research and education opportunities, such as acquiring sites to construct research/education facilities	low	low	low	low	low	low
Average Priority	medium/high	medium	low/medium	medium/high	low/medium	low/medium

Table 2 is intended to be used by program offices/project proponents as a quick reference to identify climate change impacts of concern and their anticipated influence on acquisition projects with various conservation objectives. While this table may serve as a general guide, the specific characteristics of the land to be acquired (e.g., location, existing stressors, adjacent land features, etc.) will determine how it may be affected by climate change.

¹ The relative sensitivity to impacts employed in Table 2 (i.e., high, medium, low, none) represent a consensus of informed, qualitative opinions but is nonetheless, a subjective effort. It is also important to note that the Table considers impacts mostly in isolation.

KEY RELATIONSHIPS TO INFORM FACILITY DEVELOPMENT CONSIDERATIONS ¹						
Facility Development	CHANGES DUE TO CLIMATE					Sensitivity
	Changes in Precipitation Patterns	Changes in Air Temperature	Changes in Ocean Temperature and Circulation	Changes in Relative Sea and Great Lakes Water Levels	Changes in Air/Water Chemistry	
Facility Development	medium	low	none	high	none	none
Siting of buildings or other structures on the property	high	low	none	high	low	low
Infrastructure planning (roads, stormwater management facilities, etc.)	high	high	none	medium	none	none
Construction—building design, orientation, construction materials	high	low	none	high	none	none
Coastal public access improvements: dune walkovers, boardwalks, fishing piers, beach rest areas, parking lots, etc.	high	low	none	high	none	none
Waterfront redevelopment revitalization	high	none	none	high	none	none
average sensitivity	medium/high	low/medium	medium	medium/high	low/medium	low/medium

Table 3 is intended to be used by program offices/project proponents as a quick reference to identify climate change impacts of concern and their anticipated influence on facility development projects. While this table may serve as a general guide, the specific characteristics of the facilities to be developed will determine how they may be affected by climate change.

¹ The relative sensitivity to impacts employed in Table 3 (i.e., high, medium, low, none) represent a consensus of informed, qualitative opinions but still are considered a subjective effort to develop a quantitative comparison. It is also important to note that the Table considers impacts mostly in isolation.

May 2010. For a copy of the Framework go to: <http://collaborate.csc.noaa.gov/climateadaptation/Lists/Resources/DispForm.aspx?ID=298>.

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