CAPE COD
COMMISSION

Cape Cod Ocean Management Plan

October 13, 2011



COUNTY OF BARNSTABLE
MASSACHUSETTS

Cape Cod Ocean Management Plan
Approved October 13, 2011 by the Cape Cod Commission

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Cape Cod Ocean Management Plan

Table of Contents page

SECTION 3: SAND MINING AND CABLE AND PIPELINE INSTALLATIONS

MAPS

APPENDICES

SECTION 1: PLAN OVERVIEW AND CONTEXT

1A: INTRODUCTION

On December 31, 2009, the Commonwealth of Massachusetts promulgated the Ocean Management Plan (OMP). The OMP sets forth uses and activities allowed within the state's jurisdictional waters, and establishes performance standards for siting and permitting those uses. The OMP and the amendments to activities allowed in the Ocean Sanctuaries Act mandate that the Regional Planning Agencies determine appropriate scale of renewable energy projects within their jurisdiction, and with reviewing wind turbines proposed within the OMP planning area as Developments of Regional Impact. The purpose of the Cape Cod Ocean Management Plan (CCOMP) is to provide the Cape Cod Commission's definition of appropriate scale for renewable energy projects, as well as provide policy guidance and technical support for regional level discussions and the enactment of additional minimum performance standards to be applied as part of the Development of Regional Impact review process. To ensure broad community participation, a Policy Committee was assembled that consisted of elected officials representing each of the region's 15 towns (plus four ex officio members). In addition, Technical Workgroups in the areas of natural resources, visual considerations and renewable energy were created to explore specific topics relevant to the CCOMP. A stakeholders group was invited to participate and comment on the work of the Policy Committee and Technical Workgroups throughout the planning process.

Following over a year of public meetings, workshops, and forums, the Policy Committee adopted specific recommendations directed at protecting resources and activities critical to Cape Cod. The Cape Cod Commission incorporated the Policy Committee recommendations into this plan to guide future decisions about appropriate development activities in Cape Cod's ocean waters.

1A.1 - Barnstable County Ocean Management Planning DCPC –Procedural History

On December 16, 2009, the Barnstable County Commissioners nominated the Ocean Management Planning area of Cape Cod for designation as a District of Critical Planning Concern (DCPC). Through the Cape Cod Commission Act, the DCPC tool provides a one-year planning period to examine opportunities and constraints within a designated district, and to implement regulations that are consistent with the goals of the district. Following an extensive public hearing process, the Cape Cod Commission recommended designation of the district to the Assembly of Delegates (Assembly). The Assembly held a public hearing and voted unanimously to designate the DCPC by ordinance at their April 21, 2010 meeting.

The DCPC designation document (the "ordinance") defined the purposes of the district, and established guidelines on which the planning process should focus. The full text of the designation ordinance is provided in Appendix 1.

Pursuant to Section 4(1a) of the Cape Cod Commission Act, as the Cape Cod Commission has both the power and the responsibility to put forth an Ocean Management Plan, the Commission initiated a year-long planning effort to build consensus around development potential and resource limitations within the District. The Commission appointed a Policy Committee comprised of one chief elected official from each of Cape Cod's 15 towns, plus four ex-officio members representing neighboring regional planning

agencies. In addition, the Commission convened a Technical Working Group of specialists in the fields of marine biology and coastal processes, renewable energy, and visual assessments to provide technical assistance and guidance through the planning process. Stakeholders were also invited to participate during each step of the planning process. Following a year of workshops, meetings, and forums, the Policy Committee voted to forward recommendations for ensuring that the District's critical resources are protected while allowing for appropriately scaled development. On July 21, 2011, the Cape Cod Commission unanimously voted to recommend implementing regulations for activities within the District for consideration by the Assembly. The Cape Cod Commission found the proposed regulations consistent with the DCPC Guidelines. At their September 21, 2011 meeting, the Assembly failed to approve the proposed regulations and they were not enacted by ordinance. The full content of the proposed regulations is provided as Appendix 2.

1A.2 - Goals and Objectives

Under the Ocean Sanctuaries Act, and as revised by the Ocean Act of 2008, a defined, limited set of activities may occur within Massachusetts' ocean waters. These activities include renewable energy development, aquaculture, sand mining for beach nourishment, cables, and pipelines (and other limited activities). The objectives for this plan are a subset of the OMP objectives, and include:

- Distinguish between areas that may be suitable for siting wind turbines and areas that are clearly unsuitable due to resources or interests present. The OMP allocates 24 turbines to the Cape Cod regional planning area. Future revisions to the OMP may authorize more than 24 turbines. Other possible facilities include meteorological towers, service platforms, and other as yet unknown renewable energy technologies.
- Define appropriate scale for renewable energy projects within Barnstable County, and recommend regulations for the review of wind turbines and other uses and activities allowed under the Oceans Act of 2008;
- Distinguish between areas that may be suitable for sand and gravel mining and areas where sand and gravel mining is clearly unsuitable due to resources or interests present;
- Identify preferred cable and pipeline routes, connection points, if possible, and identify areas that are clearly unsuitable due to resources or interests present;
- Protect unique natural, cultural and other values and balanced economic development;
- Consider impacts to the natural resources and ecosystems in the planning area;
- Consider impacts to the historic, tribal and community character resources in this area;
- Consider impacts to the ocean resources that currently, or may in the future, support the regional economy;
- Identify means for supporting appropriate use of ocean resources that drive the regional economy;
- Involve the community in identifying appropriate locations and scale for such an investment;
- Explore and clarify possible hazards, and develop recommendations to address use conflicts.

1A.3 - Description of the Planning Area

Cape Cod Ocean Management Planning District location and Boundary

The planning area is comprised of the ocean environment offshore of Cape Cod, or Barnstable County (see Map 1). The boundary of the planning area starts 0.3 nautical miles seaward of mean high water, and extends to 3 nautical miles from MHW, or the state jurisdictional boundary, whichever is farther from the shore. The area is coincident with the planning area for the Massachusetts Ocean Management Plan, and excludes the Cape Cod Canal and many of the bays, harbors and embayments as shown on the attached map.

Relationship to Larger Jurisdictions

State Jurisdiction

The Commonwealth of Massachusetts promulgated the Ocean Management Plan (OMP) on December 31, 2009. The OMP sets forth uses and activities allowed within the state's jurisdictional waters, and establishes performance standards for siting those uses. Through the MEPA process, the suitability of offshore sites for particular development types is examined against standards and criteria, and the scope of regulatory review is established. Following MEPA review, the state permitting agencies (DEP, etc.) examine the specific impacts of projects sited in the ocean against regulations or performance standards. Many of these regulations have yet to be promulgated.

The OMP establishes three broad management areas within the state planning area; the Prohibited Area, Renewable Energy Areas, and the Multi-Purpose Area.

- The Prohibited Area is coincident with the Cape Cod Ocean Sanctuary, and activities that may be permitted elsewhere are expressly prohibited in this area, consistent with the Ocean Sanctuaries Act and the Oceans Act of 2008.
- The OMP establishes two Wind Energy areas and three Provisional Areas within the state's planning area. Only a small portion of one of the Provisional Areas is located within the planning area. The Renewable Energy Areas are so designated based on the screening process conducted through the OMP planning process, and are considered to have few significant environmental constraints. The Provisional Areas similarly passed the screening process, but have other constraints that may preclude renewable energy development in the near future (readiness of available technology).
- The Multi-Purpose Area constitutes the vast majority of both the state planning area and the Cape Cod planning area. Renewable energy development, sand and gravel mining, cable and pipeline installations, as well as other allowed activities as defined in the Ocean Sanctuaries Act, may be located within the Multi-Purpose Area based on siting and performance standard criteria.

Through the OMP, the state established that certain defined, mapped habitat areas ("special, sensitive, and unique" or SSU), comprising core habitat areas for key species, should be exclusionary areas for certain kinds of development within the Multi-Purpose Area. The state presumes that development located outside of these defined exclusionary

areas represents a less environmentally damaging practical alternative (LEDPA). The presumption that a project is located in an SSU may be overcome by: 1) a clear demonstration that either no LEDPA exists or that the project will cause no significant alteration of the resource, or 2) a demonstration of clear and convincing evidence that the SSU area maps do not accurately characterize the resource or use. In the absence of regulations indicating how this standard may be applied to individual projects, commenters on the OMP, including the Cape Cod Commission, expressed concern that the OMP may not adequately protect the sensitive habitats in the exclusionary areas from future development.

Recognizing that Regional Planning Agencies, particularly the Cape Cod Commission and the Martha's Vineyard Commission which have regulatory authority within their jurisdictions, were concerned about impacts to their special character that could result from inappropriately sited offshore development, the state legislature specifically mandated that those regional planning agencies shall define the appropriate scale of offshore renewable energy facilities and review these facilities as Developments of Regional Impact (MGL Chapter 132A §15(2)). Review of projects as Developments of Regional Impact is defined within the Cape Cod Commission Act and its Enabling Regulations Governing Review of Developments of Regional Impact. Contained within the Commission's Regional Policy Plan are performance standards for reviewing Wind Energy Conversion Facilities as Developments of Regional Impact.

Federal Jurisdiction

Beyond the state jurisdictional area (3 nautical miles from MHW), federal jurisdiction extends to 200 nautical miles. The newly organized Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE, formerly the Minerals Management Service) has recently convened an intergovernmental group, comprised of federal, Massachusetts, Rhode Island, regional, tribal and other interests for the purposes of examining offshore sites for renewable energy development. Planning for renewable energy development off the Massachusetts and Rhode Island coasts is on-going. In December 2010, the BOEMRE issued a Request for Information to initiate the environmental review process for industrial scale wind energy projects on the Outer Continental Shelf, Massachusetts. This 2,224 square mile area is located approximately 12 miles south of Martha's Vineyard. The area was later significantly reduced in size in response to comments.

The Cape Wind Renewable Energy Project is located within federal waters between Cape Cod and Martha's Vineyard. The project has been reviewed by many agencies at all levels of government, including review by MMS and the Massachusetts Energy Facility Siting Board. The project has received permits for 130 turbines, and a cable landfall in Yarmouth.

1A.4 – Planning Process

As noted previously, in response to the OMP mandate to define appropriate scale for renewable energy facilities, the Cape Cod Commission appointed a committee of chief elected officials from each of the Cape's fifteen communities to actively participate in the planning process and provide policy guidance on balancing development potential with resource protection. The work of this Policy Committee was crucial toward building consensus around policy direction in the plan to protect the Cape's regional interests. Members of the Policy Committee include:

Policy Committee

Frederick Chirigotis	Town Council President	Barnstable
Coreen Moore	Town Planner	Bourne
Edward Lewis	Selectman	Brewster
Leonard Sussman	Selectman	Chatham
Wayne Bergeron	Selectman	Dennis
Martin McDonald	Selectman	Eastham
Melissa Freitag	Selectman	Falmouth
Edward McManus	Selectman	Harwich
Mike Richardson	Selectman	Mashpee
Sims McGrath, Jr.	Selectman	Orleans
Francis Santos	Selectman	Provincetown
Jim Pierce	Selectman	Sandwich
Curtis Hartman	Selectman	Truro
Ira Wood	Selectman	Wellfleet
Suzanne McAuliffe	Selectman	Yarmouth
Paul Niedzwiecki	Executive Director	Cape Cod Commission
Mark London	Executive Director	Martha's Vineyard Commission
Andrew Vorce	Planning Director	Nantucket Planning and EDC
Nancy Durfee	Senior Planner	SRPEDD
Vacant		Old Colony Planning

The Commission also established a technical working group to provide technical expertise and guidance through the planning process. Many of these individuals played an invaluable role in the development of the plan:

Technical Advisory Workgroup

Visual Assessments

Rick Smardon, RLA, SUNY Syracuse
Sue Leven, Brewster Town Planner
Rex Peterson, Truro Town Administrator
Lauren McKean, National Seashore Planner
Charles Orr, Hutker Architects
Robert Brattvet, Brattvet Architects
Sharon Rooney, Chief Planner, CCC
Phil Dascombe, Senior Community Design Planner, CCC
Sarah Korjeff, Historic Preservation Specialist, CCC

Natural Resources
Pat Hughes, Provincetown Center for Coastal Studies
Graham Giese, Provincetown Center for Coastal Studies
Karen Stamieszkin, Provincetown Center for Coastal Studies
Steve McKenna, Coastal Zone Management
Jo Ann Muramoto, Barnstable County Coastal Resources Committee
Megan Tyrrell, Cape Cod National Seashore
Walter Barnhardt, USGS
John Ramsey, Applied Coastal
Woods Hole Group
Heather McElroy, Natural Resources Specialist, CCC
Andy Walsh, Coastal Resources Specialist, CCC

Renewable Energy
Nils Bolgen, Mass Clean Energy Center
Dan MacDonald, UMass Dartmouth
Geoff Cowles, UMass Dartmouth
Joe Soares, Senior Power Supply Planner, Cape Light Compact
Joe Feraci, Interconnection Specialist, NSTAR
Jack Wiggin, UMass Boston
Ryan Christenberry, Planner, CCC

Meetings

The planning process included many meetings to develop understanding of the issues, provide opportunities for public comment and feedback, and for the Policy Committee and Cape Cod Commission to deliberate on the issues and ultimately make recommendations for the plan. Below is a listing of the publically posted meetings:

Policy Committee
7/29/10
8/12/10
2/4/11
2/18/11
5/11/11
4/1/11
6/22/11
7/13/11

Regional Forums
6/1, 6/6, and 6/8/2011

Boards of Selectmen presentations
6/20/11 Brewster
6/21/11 Yarmouth

Joint CCC Planning/Regulatory Committee meetings
4/25/11
6/17/11
7/7/11

7/11/11
7/14/11
9/26/11
10/6/11

Cape Cod Commission meeting
7/21/11

Stakeholders Forum
11/10/10

1A.5 – Balancing Priority Resources and Activities

The purpose of this plan is to examine the potential for a limited, defined set of activities within the planning area, and where possible, facilitate appropriately scaled renewable energy development while ensuring that the unique resources which characterize Cape Cod are adequately protected.[1] This section identifies the specific conservation and human use objectives that this plan strives to balance and address.

Priority Natural Resources

All of the SSU resources are found in whole or part in the planning area. This plan incorporates each of the SSU spatial extents (mapped areas) as defined and delineated by the OMP. The state's OMP describes how these resources were identified (appendix 4 of the OMP), and what data sets were used to define their spatial boundaries. Map 3 shows the spatial extent of these resources. The SSUs include:

- North Atlantic Right Whale Habitat
- Fin Whale Core Habitat
- Humpback Whale Core Habitat
- Roseate Tern Core Habitat
- Special Concern Tern Core Habitat
- Leach's Storm Petrel Important Habitat
- Long-tailed Duck Important Habitat
- Colonial Waterbirds Important Nesting Habitat
- Areas of hard/complex seafloor
- Eelgrass
- Intertidal flats
- Important fish resource areas

[1] The Cape Cod Commission Act establishes that the purpose of the Commission is to further "the conservation and preservation of natural undeveloped areas, wildlife, flora and habitats for endangered species; the preservation of coastal resources including aquaculture; the protection of groundwater, surface water and ocean water quality, as well as the other natural resources of Cape Cod; balanced economic growth… and the preservation of historical, cultural, archaeological, architectural, and recreational values."

The spatial extent of the SSUs may change over time, as better or revised data becomes available. The OMP calls out eelgrass and hard/complex seafloor as two resources that may likely change; eelgrass beds migrate, and data for the hard/complex seafloor requires higher resolution data for project siting purposes. However, with those "data-reliability" exceptions considered, the SSUs are recognized as significant habitat resources which may be incompatible with certain types of development. The specific resources that are incompatible with renewable energy development, sand and gravel mining, or cables or pipelines are also specifically identified in the OMP, and may be seen in Maps 4 - 10.

Continuation of Existing Activities

Numerous activities currently take place in the ocean. People work, play, and relax in and around the ocean. On Cape Cod, our economy and the reasons people choose to live or visit here are often dependent on the ocean. The integration of ocean, economy and quality of life will consequently play a large role in the decisions we make about new activities in the ocean.

Existing activities that are recognized by spatial representations of their extent (maps) in the OMP include:

- Areas of high commercial fishing effort and value
- Areas of concentrated commerce and commercial fishing traffic
- Areas of concentrated recreational fishing
- Areas of concentrated recreational activity

Additional activities that occur in or over the ocean that are considered in this plan include:

- Commercial flights in and out of Cape Cod Airports
- Sight Seeing Flights
- Ferries

The spatial extent of these human use activities is illustrated in Maps 11 & 12.

As noted in 1B.3, land-based uses or activities may be affected by development in the ocean as well. The range of activities catalogued through the visual impact assessment of the planning area, even though occurring largely outside of it, were considered through the planning process.

Potential New Activities

Renewable Energy

The development of renewable energy technologies in the ocean is an opportunity to harness a plentiful renewable resource, found in abundance in the waters around Cape Cod, and to generate clean energy that may reduce our dependence on fossil fuels. The benefits of renewable energy development may be debated, but can include an overall reduction in the emission of greenhouse gases which contribute to the warming of our atmosphere and oceans, resulting in sea-level rise, and other changes to our climate. Cape Cod, shaped by the forces of weather and erosion, is particularly vulnerable to projected changes in climate, thermal expansion of our ocean waters and relative sea-level rise (see Section 1B.5).

Sand and Gravel Mining

Changes in sea-level, storm frequency and intensity, and resulting shore-side impacts from increased erosion and flooding may threaten public infrastructure. Threats to roads, bridges, stormwater management systems, and other public infrastructure may force land managers to consider adaptation or mitigation actions to protect public investments. One of the "development" activities allowed through the OMP is the extraction of sand and gravel from the planning area for the purpose of beach nourishment. Beach nourishment may be one of the management approaches that can protect existing human interests from the impacts of sea-level rise and increased storminess. Pressure to extract sand from the ocean, an as-yet untapped resource, may rise precipitously should predictions for sea-level rise and erosion of our coastal resources be realized.

Cables and Pipelines

The installation of cables and pipelines are also allowed uses within the planning area. Renewable energy development will require connections to existing power infrastructure through cables; other cable installations may be needed to increase other infrastructure capacity, such as fiber optic cables, etc. Pipelines may be needed for other resource delivery; however, at present, wastewater outfall is prohibited in the Cape Cod ocean sanctuaries by the Ocean Sanctuaries Act and the Oceans Act of 2008.

SECTION 1 PLAN OVERVIEW AND CONTEXT
1B: AFFECTED ENVIRONMENT

The ocean waters of Massachusetts have been examined and described in the Massachusetts Ocean Management Plan (OMP). This Cape Cod Ocean Management Plan (CCOMP) examines a subset of the OMP planning area, as described in Section 1A.3 - Description of the Planning Area. Consequently, the resources of interest and concern for the planning area are a subset of the resources examined in the OMP. The CCOMP relies heavily on the inventory and data analysis found in the OMP, particularly data and methodologies discussed in Volume 2 of the OMP. The CCOMP provides summary descriptions of the resources affected, but the OMP is the reference document for the resources present, why they are considered significant, and where they may be found within the planning area.

In addition to the resources addressed through the OMP, this plan addresses the "culturally significant environment" and visual resources of the Cape through a seascape inventory identifying those aspects, qualities, or specific locations on Cape Cod that could be adversely impacted by development.

The following sections discuss the "affected environment" and the underlying reasons for the planning effort.

1B.1 - General site description

Glacial History

The surficial geologic features of Massachusetts, including the planning area, were largely shaped by the late Pleistocene glaciation and the fluctuations in sea level that followed melting of the glacial ice. During the glacial maximum around 21,000 years ago, the ice sheet extended across Cape Cod and south to the islands of Martha's Vineyard and Nantucket. Three glacial lobes occupied the present sites of Buzzards Bay, Cape Cod Bay, and the Great South Channel, located east of Cape Cod. Prominent moraine ridges on Martha's Vineyard and Nantucket mark the southernmost extent of the ice sheet (Oldale, 2001; Uchupi et al., 1996).[2,3] As the glacier retreated, vast quantities of sediment were deposited as outwash plains that form much of Cape Cod, and large, temporary, ice-dammed lakes formed in Nantucket Sound and Cape Cod Bay. Recessional moraines were created where the ice advanced slightly during its overall retreat. Between 11,000 and 8,000 years ago, local sea-level was 20-40 meters (66-130 ft.) lower than present, and large areas seaward of present-day Cape Cod were exposed land (Oldale, 2001). Tundra-like conditions existed on this emerged landscape which may have supported Paleo-indians following their arrival to the area between 11,000-8,000 years ago. Sea-level rise from roughly 6,000 years ago to present has been the dominant process shaping the region's coastal and nearshore zones.

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[2] Oldale, R.N. 2001. The Geologic Story: Cape Cod, Martha's Vineyard, and Nantucket. On Cape Publications, Yarmouth Port, MA.

[3] Uchupi, E., G.S. Giese, D.G. Aubrey, and D.J. Kim. 1996. The Late Quaternary construction of Cape Cod, Massachusetts—a reconsideration of the W.M. Davis model: Geological Society of America Special Paper 309.

Seafloor Composition and Bathymetry

The vast quantities of sediments deposited during the late Pleistocene glaciation form the underpinnings of Cape Cod and the seafloor beneath its surrounding waters. Bedrock beneath Cape Cod is buried by thick deposits of glacial sediments and does not outcrop anywhere on the Cape (Oldale, 2001). Tidal currents, wind and waves, storms, and ongoing sea-level rise have reworked the glacial sediments, forming the contemporary coastal and marine environments of Cape Cod and its surroundings. At the present time, only the general character of the ocean bottom in the planning area is known. The seafloor of Cape Cod Bay is a relatively featureless expanse with large regions of sand and mud in the central area (EEA, 2009).[4] Stronger currents in the open ocean east of the outer Cape have winnowed finer sediments, leaving a seabed dominated by coarse, unstratified glacial till. In Nantucket and Vineyard Sounds, large shoals and sand waves are dominant, while Buzzards Bay is characterized by sand and mud with rocky outcrops.

The U.S. Geological Survey (USGS), in cooperation with the Massachusetts Coastal Zone Management (MCZM), National Oceanic and Atmospheric Administration (NOAA), and other partners are conducting ongoing geologic mapping to characterize the surface and subsurface geologic framework of the seafloor offshore of Massachusetts, including sections of the planning area. The mapping project will produce high resolution maps that will contribute to a better understanding of the type, distribution, and quality of subtidal marine habitats in Massachusetts' coastal ocean. CZM, DMF, USGS, and other partners are actively examining the next steps in moving the seafloor mapping data toward an integrated seafloor habitat classification.[5] Mapping completed within the planning area to date includes northern Cape Cod Bay and part of Buzzards Bay (see Map 2).

The bathymetry of the planning area is varied and includes: the broad, relatively flat sea-bottom of Cape Cod Bay, the complex sand ridge and shoal fields of Nantucket and Vineyard Sounds, and the comparatively steeply sloping near- and offshore zones of the Atlantic Ocean just east of outer Cape Cod. Cape Cod Bay ranges from less than 30 ft. (10 m) deep near the bay margins to waters over 130 ft. (40 m) deep at the northern edge of Cape Cod Bay.[6] Most of the planning area south of Cape Cod (Nantucket and Vineyard Sounds) is within the 30 ft. (10 m) depth contour due to shoaling, but increases locally to depths of 20 meters (65 ft.) or more in swales between sand ridges. The bathymetry of the Atlantic Ocean just east of outer Cape Cod reaches depths of over 330 ft. (100 m) within roughly 10 miles of shore. The deep water and unlimited fetch in this area creates conditions for the largest wave heights in the planning area (Map 1 shows bathymetry within the planning area).

Oceanographic Conditions

The planning area is located at the intersection of two major biogeographic regions: the Gulf of Maine and the Southern New England-New York Bight. These two regions are generally distinguished by different physical and oceanographic settings, which, in turn, support characteristic biological communities. Waters north of Cape Cod are influenced by relatively cold Gulf of Maine currents, while the waters south and east of Cape Cod are influenced by the New England Shelf and occasionally warm core rings spun off the Gulf Stream. The waters of Nantucket Sound and Buzzards Bay are warmer in the summer

[4] Energy and Environmental Affairs, 2009. Massachusetts Ocean Management Plan, Vols. 1 & 2)
[5] EEA, 2008. Ocean Planning Habitat Workgroup Report.
[6] Oldalde, Robert N., 2001. Cape Cod, Martha's Vineyard & Nantucket – The Geologic Story.

than Cape Cod Bay and colder in the winter, but this is more a function of the relatively shallow depths than the influence of source water. Since New England shelf waters are affected by the Gulf of Maine, the two biogeographic regions are not mutually exclusive.

From 2001 to 2008, the Massachusetts Bay "A" buoy (42°31'21"N, 70°33'57"W), located north of the planning area, recorded an average wave height of 3.3 ft. (1.0 m), with a range between (0.13 ft. (0.04 m) and 32.6 ft. (9.95 m) (EEA, 2009). The wave period at the A buoy varied between 4.3-9.3 seconds, with an average period of 7.2 seconds. Wave data collected at a scientific measuring devices station (SMDS) in Nantucket Sound between April 2003 and September 2004 indicated a maximum recorded significant wave height of 6.6 ft. (2.0 m), while the maximum wave height reached 8.2 ft. (2.5 m) (MMS, 2009).[7] The majority of waves had a significant wave height between 1.0 ft. (0.3 m) and 1.3 ft. (0.4 m). Wave periods varied depending on whether wind-generated waves (2-6 seconds) or swell (6-12.8 seconds) determined the shape of an individual wave spectrum. Most of the ocean water around Cape Cod (except east of outer Cape Cod) is fetch limited due to surrounding landforms such as Cape Cod, Monomoy, Nantucket and Martha's Vineyard. Therefore, point sources of wave data provide an incomplete picture of average wave conditions in the planning area (e.g., sites in the northern reaches of Nantucket Sound are sheltered from the strong northwest winds in late fall to early spring, along with occasional northeast wind events).

The waters of Cape Cod Bay experience a semi-diurnal tidal range of up to 13.4 ft. (4.1 m), while in Nantucket Sound, typical tide heights are approximately 1-4 ft. (0.3-1.2 m) (MMS, 2009). Ocean currents in Cape Cod Bay are typically weak except during high freshwater runoff when coastal currents in Massachusetts Bay can extend into Cape Cod Bay. On a more local scale, surface currents in the bay are likely to be driven by storm, wind and tidal currents. Nantucket Sound is mostly influenced by currents and wind due to the lack of significant riverine inputs. Tidal currents in the planning area range from less than1 knot in Buzzards Bay to 4.5 knots near Woods Hole (MMS, 2009). In Vineyard Sound, tidal currents average 1.6 knots, with maximum currents reaching 3.9 knots. Tidal flow and circulation in Nantucket Sound generate complex currents. The velocity of tidal currents on Horseshoe Shoals (outside the planning area) are up to 2 knots (MMS, 2009). Near the shore, current speeds are less and are oriented by local bathymetry and shorelines. The mixing of ocean waters by internal waves or the upwelling of nutrients along ocean fronts promote primary and secondary productivity and concentrate filter-feeding marine organisms.

Due to the location of Cape Cod at the juncture of two major ocean biogeographic regions, different sea surface temperature regimes exist on either side of the Cape (GoMOOS, 2008). Surface temperatures average over 2°F higher south of the Cape relative to waters to the north in Massachusetts Bay.[8] Seasonal shifts in ocean water characteristics also occur as sea and air temperatures change. For example, stratification of the seawater column becomes more pronounced during the summer, affecting nutrient levels, phytoplankton biomass, and dissolved oxygen levels. Wind, waves, upwelling, and the seasonal decrease in sea surface temperatures in the fall causes stratification to break down. While many pelagic species (e.g., nekton, marine mammals, etc.) are actively mobile in the water column, free-floating organisms (e.g., plankton) are completely dependent upon ocean currents for horizontal movement

[7] Minerals Management Service, 2009. Cape Wind Energy Project, Final Environmental Impact Statement. Minerals Management Service, U.S. Dept. of the Interior. January 2009. Volumes 1-3.

[8] Gulf of Maine Ocean Observing System (GoMOOS). 2008. Historical Data.

(many planktonic organisms have the ability to control vertical positioning to take advantage (or not) of favorable ocean currents).

1B.2 - Biological Resources

Marine Wildlife (Marine Mammals, Sea Turtles, Seabirds)

Massachusetts' waters, including the planning area, serve a crucial role in the survival and health of a wide range of marine mammal, sea turtle, and seabird species (EEA, 2009). All of the marine mammal and sea turtle species are either protected under the Marine Mammal Protection Act or are listed as threatened or endangered under the Endangered Species Act. Many are also listed under the Massachusetts Endangered Species Act. Cape Cod lies within the Atlantic Flyway, one of four major American flyways used by migratory birds as they travel seasonally between breeding and wintering ranges. Although considerable information exists for some species (e.g., whales), significant data gaps exist relative to potential development impacts to these sensitive species. Information about the distribution and habitat use of sea turtles in the planning area is one such critical data gap.

Marine Mammals
The endangered North Atlantic Right Whale is common in Cape Cod Bay from February to early May (although sightings have been made year-round) when they feed on abundant zooplankton in the bay waters (Hamilton and Mayo, 1990; Nichols, et al., 2008).[9,10] Between 20% and half of the North Atlantic Right Whale population (approximately 400 whales) visits Cape Cod Bay annually. Since the bay is an important aggregation and feeding area, most of Cape Cod Bay is federally designated as Right Whale Critical Habitat under the Endangered Species Act. The overall status of the North Atlantic Right Whale population is uncertain due to significant anthropogenic threats to its survival (Kraus and Rolland, 2007).[11] Fin Whale and Humpback Whale, both state and federally endangered, and the Minke Whale (not listed) feed later in the season (April to December) in Cape Cod Bay and in the waters near Race Point (CETAP, 1982).[12] Fewer humpbacks and fin whales feed in Nantucket Sound since prey species are not as plentiful. Although the waters of Stellwagen Bank (north of the planning area) are not ideal habitat for the endangered Blue Whale, they have been spotted a few times. The endangered Sei whale also tends to be sporadic, and their presence is likely related to abundance of their prey (copepods, krill and small, schooling fish).

Several other marine mammals not listed under the Endangered Species Act but protected by the Marine Mammal Protection Act are found in the planning area, including Harbor Porpoise, Atlantic White-sided Dolphin, Gray Seal and Harbor Seal.

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[9] Hamilton, P.K. and C.A. Mayo. 1990. Population characteristics of right whales (*Eubalaena glacialis*) observed in Cape Cod and Massachusetts Bays, 1978-1986. pp. 203-208. In Hammond, P.S., S.A. Mizroch, and G.P. Donovan (eds.). Individual Recognition of Cetaceans. Rept. of the Int. Whal. Commn. Special Issue No. 12.
[10] Nichols, O.C., R.D. Kenney, and M.W. Brown. 2008 Spatial and temporal distribution of North Atlantic right whales (*Eubalaena glacialis*) in Cape Cod Bay, and implications for management. Fish. Bull. 108: 270-280.
[11] Kraus, S.D. and R. M. Rolland (Eds.) 2007. The Urban Whale: North Atlantic Right Whales at the Crossroads. Harvard University Press. Cambridge, Massachusetts.
[12] Cetacean and Turtle Assessment Program (CETAP) 1982. A characterization of marine mammals and turtles in the mid- and north-Atlantic areas of the U.S. outer continental shelf. University of Rhode Island.

Each of these species depends on habitat in the planning area for all or part of their life cycles. Atlantic White-sided Dolphins occur in the northern North Atlantic only, with the U.S. population concentrated in the Gulf of Maine. They may move inshore in the summer and offshore in winter following prey.[13] The Harbor Porpoise is the only porpoise common to waters of Cape Cod. It is primarily an inshore species, which becomes less common during the winter months. Harbor Seals are generally seasonal residents and migrate north to breed in the summer (though they can occur year-round in Cape Cod waters), while Gray Seals are now year-round residents on the Cape. Harp Seal and Hooded Seal are found only sporadically, but with increasing frequency.[14]

Sea Turtles

Five species of sea turtles, including Loggerhead, Leatherback, Green, Kemp's Ridley, and Hawksbill sea turtles are found seasonally in the planning area (EEA, 2009). The Leatherback, Hawksbill and Kemp's Ridley turtles are classified as endangered under the federal and state Endangered Species Acts. Loggerhead and Green sea turtles are classified as threatened under both federal and state law. The International Union for Conservation of Nature (IUCN) Red List categorizes Loggerhead and Green sea turtles as endangered, and the Leatherback, Kemp's Ridley and Hawksbill as "critically endangered".[15]

Leatherback and Loggerhead sea turtles are generally found north of Cape Hatteras (including Cape Cod waters) from May-June into October, and are believed to overwinter in southern waters (Wynne and Schwartz, 1999).[16] Leatherbacks are the most commonly reported turtle in Massachusetts waters, including both Nantucket Sound and Cape Cod Bay, when they often arrive in the late summer on their way south from feeding areas further north. August is the peak month for both sightings and strandings of leatherbacks off Cape Cod. The leatherback is known to feed in Massachusetts waters, and groups of hundreds of individuals have been observed in August and September south of Cape Cod and in Cape Cod Bay (NMFS 1992). Leatherbacks feed primarily on jellyfish and gelatinous zooplankton, and utilize the entire water column while feeding. Loggerheads are bottom feeders, foraging in coastal waters on crustaceans and mollusks. Based on satellite tagging of leatherbacks from 2007-2009, high use areas within the planning area include Cape Cod Bay (especially the inner coastline) and eastern Nantucket Sound.[17] Leatherbacks are also known to either migrate through or forage in Buzzards Bay based on sightings and strandings data. The presence and residence time of leatherbacks is highly dependent on prey abundance and distribution, which is likely to vary on an annual basis. However, certain areas within the planning area (eastern Nantucket Sound and Cape Cod Bay) appear to consistently provide important foraging habitat for an unknown number of leatherbacks.

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[13] http://www.capecodstranding.net/site/c.ciJJLVPDKpG/b.958085/k.7ED1/Atlantic_WhiteSided_Dolphin.htm

[14] Provincetown Center for Coastal Studies website (http://www.coastalstudies.org)

[15] Leeney, R.H., Nichols, O.C., Sette, L., Wood LaFond, S. and Hughes P.E.2010. Marine Megavertebrates and Fishery Resources in the Nantucket Sound - Muskeget Channel Area: Ecology and Effects of Renewable Energy Installations. Report to Harris Miller Miller & Hanson Inc., September 2010. Provincetown Center for Coastal Studies, Provincetown, MA, USA. 88 pp.

[16] Wynne, Kate and Malia Schwartz 1999. Guide to Marine Mammals and Turtles of the U.S. Atlantic and Gulf of Mexico, Rhode Island Sea Grant. 114pp.

[17] K. Dodge, personal communication, May 5, 2011

Green, Hawksbill and Kemp's Ridley turtles are more southern and tropical species. However, juveniles and some adults of these three species are found in Cape Cod waters, particularly in the fall in Cape Cod Bay. A portion of the juvenile population of Kemp's Ridley turtles wander out of the Gulf of Mexico and into the Gulf Stream, with some carried as far as Cape Cod where they feed on crabs, shrimp and mollusks in shallow nearshore waters. Juvenile green turtles feed on jellyfish as well as benthic crustaceans and mollusks, and are less commonly observed than Kemp's Ridley. Hawksbill turtles, which are rarely observed, feed on sponges and benthic invertebrates.

Sea turtle sightings collected by Massachusetts Audubon Society demonstrate the presence of sea turtles in waters around the Cape in July and August, with most sightings in Buzzards Bay and Vineyard Sound.[18] Turtle strandings occur most frequently in the fall or early winter presumably due to cold stunning from prolonged exposure to lower water temperatures. The most endangered of the sea turtles, the Kemp's Ridley, is the species that strands in greatest numbers on the Cape, and generally on the shores of Cape Cod Bay.[19] All five species of sea turtles are also susceptible to collisions with boats and entanglement with fishing gear.

Summary of Sea Turtle Species in Cape Cod Ocean Management Planning District

Sea Turtle Species	Seasonality*	Regional Ecology
Leatherback	May to October	- Pelagic feeders (e.g., jellyfish, salps, zooplankton) - Probably the most commonly observed sea turtle in region
Loggerhead	May to November	- Primarily bottom feeders, omnivorous, foraging in shallow or coastal waters
Green	May to October	- Feed mainly on algae and seaweed - Typically not observed until late summer; susceptible to cold stunning

[18] Sea Turtle Sighting Hotline for Southern New England Boaters (http://www.seaturtlesightings.org/monthmap.html)

[19] Massachusetts Audubon Society website (http://www.massaudubon.org/PDF/sanctuaries/wellfleet/seaturtles/ seaturtlestrandings2010.pdf)

Kemp's Ridley	Summer to late fall	- Forage in shallow, coastal waters of Vineyard Sound, Buzzards Bay - Feed mainly on crabs, but also mollusks and shrimp - Mostly juveniles found around Cape Cod - Strand in late fall on north and east shores of Cape Cod
Hawksbill		- Rare visitor (only 3 records in Massachusetts) - Adults feed on sponges along the coast
Diamondback terrapin**	Year-round	- Salt marshes are important foraging areas - Feed on gastropods, crabs, mollusks, etc.

* Presence of turtles during the year dependent on water temperatures.
** The diamondback terrapin lives in brackish waters, and is not a sea turtle, but occupies habitat transitional between oceanic sea turtles and terrestrial/aquatic turtles.

Birds

The varied coastal environments of Cape Cod, such as beaches, marshes, rocky outcrops, islands, and shoals, as well as the surrounding ocean waters, provide valuable breeding, resting, and foraging habitat for resident and migratory bird species. While many of these habitats lie outside the planning area, access to these sites by birds is impossible without traversing the open waters of Cape Cod. In addition, Cape Cod's peninsula setting within one of the major North American flyways (Atlantic flyway) increases the region's value to the thousands of migrating waterfowl, shorebirds, predatory birds, and songbirds which pass through the area (EEA, 2009). The majority of the North American population of endangered Roseate Terns use Buzzards Bay and Cape Cod (Monomoy) sites for nesting, post-breeding staging habitat, foraging and/or resting before returning to their overwintering range in South America (EEA, 2009). Roseate Terns, in addition to Common Terns, Forster's Terns and Black Terns, move widely within the ocean waters of the planning area during the July-September staging period.

Many shorebird species pass through the planning area during their annual spring and fall migrations, including several species that fly thousands of miles (EEA, 2009). The Piping Plover, a state- and federally-threatened species, is among the few shorebirds that nest on Cape Cod. A significant proportion of the Piping Plover population breeds in Massachusetts. Monomoy National Wildlife Refuge/South Chatham and several sites on the Cape Cod National Seashore are among the key stopover sites along the Massachusetts coast that provide shorebirds the resources needed to replenish their fat reserves. . Monomoy Island is nationally recognized as a critical staging area for many species of shorebirds. Pelagic seabirds, such as storm petrels, Northern Gannet,

shearwaters, and jaegers, spend most of their lives at sea. Shearwaters and petrels can be seen in the planning area in late summer and into the fall. Gannets are regularly seen in the late fall and winter months, especially in Cape Cod Bay.

From late summer to mid to late fall, large numbers of waterfowl migrate through the planning area, many of which rest and feed in the Cape's many coves, coastal ponds, and estuaries. Large numbers of coastally migrating sea ducks, such as eiders, scoters, and Long-tailed ducks, arrive in mid- to late fall. The waters around Nantucket likely support the densest aggregations of Long-tailed Ducks in the world, and the largest aggregations of eiders and scoters have been documented overwintering in the waters near Nantucket and Martha's Vineyard (EEA, 2009).

Other Wildlife Species

Large numbers of migrating landbirds pass over Nantucket Sound in the spring and fall (April-May and September-October, respectively) (MMS, 2009). Although much lower than the number of birds migrating over the mainland to the northwest, the number of landbirds traversing Nantucket Sound is estimated to be in the millions (MMS, 2009). Fall migrating songbirds occasionally pushed into the planning area by northwest winds following cold fronts, may be affected by a combination of winds and lighted structures (e.g., wind turbines, lighthouses). Several species of migratory raptors follow the coast, including rare and declining species, such as the Northern Harrier and American Kestrel.

There is currently little information about the migratory patterns of bat species known to pass through the area and the potential impacts of ocean development on these winged mammals. Although bats inhabit islands in Nantucket Sound, little is known about the frequency with which bats fly over surrounding water bodies (MMS, 2009). Of the seven bat species occurring in the region, the Silver-haired Bat, Eastern Red Bat, and Hoary Bat are long distance migrants, and are most likely to be traveling over Cape Cod waters. The other four species (Big Brown Bat, Little Brown Myotis, Northern Myotis, Eastern Pipistrelle) have been documented on Martha's Vineyard and thus also cross saltwater, but these species tend not to travel long distances between their hibernacula and summer ranges.

Fisheries

There are over 200 species of fish inhabiting Massachusetts' waters, many of which occur in the planning area. Fish play a key role in food web dynamics as predators and as a food source for other fish, marine mammals, birds, and humans. Analyses of 30 years of state trawl survey data were used in developing the MOMP to determine the relative abundance of 22 commercially and recreationally valuable fish species and to identify areas "important" to fisheries resources in Massachusetts' waters (EEA, 2009). Several important caveats accompany analysis of these multi-season, multi-year fishery resource datasets including selective species capture (many pelagic species and shellfish species are not vulnerable to capture), the timing and seasonality of the surveys, and undersampling of specific habitats (e.g., complex topography, shallow water).

The results of the trawl survey, as well as other research conducted by Mass. Division of Marine Fisheries, identify the waters of Nantucket Sound to be important fisheries resource areas. Winter flounder are known to spawn within and just outside of the estuaries open to Nantucket Sound. The state's Division of Marine Fisheries recommends prohibiting dredging activity in the waters south of Cape Cod, in Buzzards Bay and around the Islands from Jan. 15 to May 31**.** Large areas of Cape Cod Bay, the remaining areas in Nantucket and Vineyard sounds and Buzzards Bay are ranked as having medium importance for fisheries resources. But even areas ranked as having

lower importance may have resources not found elsewhere and may be vulnerable to impacts from human activities. For example, all life stages of cod are found in Cape Cod Bay (Lough 2004),[20] and the Bay is a particularly important habitat for newly settled age-0 and age-1 fish (Howe *et al.* 2002).[21]

Commercial and recreational fisheries are an important element of the regional economy. Mobile gear (e.g. trawls and dredges) and fixed gear (e.g., longlines, weirs, pots, and gill nets) fisheries are conducted in the planning area. Commercial fisheries in Cape Cod Bay are diverse, targeting many species of fish, including cod, haddock, whiting, and other groundfish, flounders, skates, tuna, striped bass, black sea bass, as well as invertebrates such as lobsters, surf clams, sea scallops, and other shellfish. In Nantucket Sound, commercial fishermen target some of these same species in addition to squid, conch, quahog, bluefish, and Atlantic mackerel. Diving is employed in some areas for harvesting lobsters, surf clams, and sea scallops.

All waters within the District are important to commercial and recreational marine fisheries. Based on DMF fishermen catch reports, Standard Atlantic Fisheries Information System dealer transaction reports, and National Marine Fisheries Service vessel trip reports, areas in the District identified as being high commercial fishing by effort and value activity are Wellfleet Harbor, an area offshore of CCNS in Wellfleet and Truro, Vineyard Sound, and an area in Nantucket Sound immediately west of Monomoy Island. Buzzards Bay, much of Nantucket Sound, areas offshore of the lower Cape, and offshore areas from Yarmouth west to Wellfleet in Cape Cod Bay are identified as having "medium" importance to commercial fisheries activity.

Recreational fishing areas in the District ranked as "high importance" are distributed throughout the District based primarily on landings data and interview-based surveys[22]Approximately half of Cape Cod Bay is considered of "high importance" to recreational fisheries. Other recreational fishing areas of high importance include most of the waters offshore of the lower Cape and around Monomoy Island, the waters south of the mid-Cape, and a relatively smaller proportion of Vineyard Sound and Buzzards Bay[23]Recreational fisheries in the waters of the District are diverse, targeting a wide range of species from charter, party and private vessels. The District's striped bass fishery is world-renowned and is a valuable contribution to the local tourist economy. Recreational fishermen also target bluefish, flounders, black sea bass, tautog, tuna, and other finfish.

[20] Lough, R. G. 2004. Essential fish habitat source document: Atlantic cod, *Gadus morhua*, life history and habitat characteristics. NOAA Technical Memorandum NMFS-NE-190. 94 pp.

[21] Howe, A. B., S. J. Correia, T. P. Currier, J. King, and R. Johnston. 2002. Spatial distribution of ages 0 and 1 Atlantic cod (*Gadus morhua*) off the eastern Massachusetts coast, 1978-1999, in support of 'Habitat Area of Special Concern'. Massachusetts Division of Marine Fisheries Technical Report TR-12. 35 pp.

[22] Commonwealth of Massachusetts. 2009. Massachusetts Ocean Management Plan. December 2009. Online: http://www.env.state.ma.us/eea/mop/final-v1/

[23] Ibid.

Summary of Fisheries in Cape Cod Ocean Management Planning District

Species	Fishery*	Status (√ = overfished)	
Alewife	F		- Spawns inshore and upstream in spring - Declining
American plaice	C		- Demersal - Egg to juvenile stages common in Cape Cod Bay - Largest commercially fished concentrations are found from ~90-180 m depth
Atlantic butterfish			- Pelagic, migrate inshore in spring
Atlantic cod	C,R		- Demersal - All life stages in Cape Cod Bay; bay especially important habitat for newly settled age-0 and age-1 fish - Overfishing may be occurring
Atlantic mackerel	C,R		- Juvenile and adults seasonally present in District waters
Atlantic menhaden	F		- Juvenile development in estuaries - Important forage species for numerous commercial and recreational finfish
Atlantic sea herring			- Migrate to southern New England waters in winter - Important prey of demersal fish, marine mammals, large pelagic fish, and seabirds
Black sea bass	C,R		- Spawning in coastal habitats in April to June; migrates offshore in fall/early winter - Prefers hard bottom
Bluefin tuna	C,R	√	- Juveniles and adults in District waters

* F = forage species; C = commercial fishery; R = recreational fishery

Although not a commercially exploited fish in U.S. waters, basking sharks are found in District waters. The second largest fish in the world (over 9 m total length), basking sharks are listed as "vulnerable" globally and "endangered" in the Northeastern Atlantic by the IUCN[24] Sightings off the northeast U.S. typically occur from May to August. Massachusetts Division of Marine Fisheries scientists, in cooperation with other scientists, tagged and tracked 25 basking sharks off of Cape Cod. They found that basking sharks travel from the coast of southern New England to the coast of South America, traveling at depths of 600 to 3,000 feet (200 to 1,000 m) for several weeks or months (Skomal et.al. 2009)[25]. Data are lacking on population structure and size of this species, but its long lifespan, slow growth, and low fecundity renders it vulnerable to reductions in population. Ocean sunfish, another non-commercial species, also occurs in District waters. As with the basking shark, the lack of data makes an assessment of its conservation status difficult.

Several species of shellfish are important contributors to the Cape Cod ocean ecosystem and its commercial fisheries. Oysters, clams, mussels and other shellfish are prey for certain fish, birds, and marine mammals (as well as humans) and are predators of other marine organisms. They also play particularly important roles in the uptake and recycling of energy and nutrients, filtering seawater and mixing sea-bottom sediments. Massachusetts currently lacks a statewide shellfish resource assessment; however, there are shellfish suitability maps showing the distribution of potential habitat for certain shellfish species in Cape waters. Extensive suitable habitat for sea scallops, surf clams and quahogs are mapped in Cape Cod Bay; the area west of Monomoy is mapped as suitable for quahogs.

The shellfish aquaculture industry in Massachusetts is exclusively bivalve molluscan farming, primarily oysters and quahogs, and generally occurs in the coastal zone outside of the planning area. Aquaculture in the region has been steadily growing by 10% per year over the last decade. The only aquaculture leases within the planning area occur in Wellfleet Harbor, which contains 47 licensed sites as of 2006.

The shellfish species of greatest importance to the commercial fishery are surf clams, ocean quahogs, and sea scallops. Scallop and lobster approach 50% of the total landed value of all commercial species statewide (MA DMF, 2009)[26]. Shellfish resources within the planning area that may be more vulnerable or at greater risk of impact from development include populations of quahogs in Nantucket Sound, and ocean quahogs and sea scallops in Cape Cod Bay (EEA, 2009). Another important resource in the planning area are horseshoe crabs, which have historically been harvested in Massachusetts waters for bait, are also harvested for biomedical use. Horseshoe crab eggs are a significant food source for migrating shorebirds. The Atlantic States Marine Fisheries Commission (ASMFC) developed a horsehoe crab management plan that incorporates bird conservation targets. Horseshoe crabs live offshore in deep waters, but come to shore on sandy beaches and in estuaries to spawn. While horseshoe crab

[24] Leeney, R.H., Nichols, O.C., Sette, L., Wood LaFond, S. and Hughes P.E.2010. Marine Megavertebrates and Fishery Resources in the Nantucket Sound - Muskeget Channel Area: Ecology and Effects of Renewable Energy Installations. Report to Harris Miller Miller & Hanson Inc., September 2010. Provincetown Center for Coastal Studies, Provincetown, MA, USA. 88 pp.
[25] Skomal et al., Transequatorial Migrations by Basking Sharks in the Western Atlantic Ocean, Current Biology (2009), doi:10.1016/j.cub.2009.04.019
[26] Massachusetts Division of Marine Fisheries (MA DMF) 2009. Fisheries statistics project.

spawning habitats may lie outside of the planning area, activities conducted inside the planning area which mobilize sediment (e.g., offshore sand mining) may have deleterious effects on spawning horseshoe crabs.

Major habitat features of critical importance to marine fisheries resources in the planning area include: cobble/boulder/ledge environments, submerged aquatic vegetation and kelp beds, deep water channels and depressions, upwellings, estuaries, shell habitat, frontal boundaries, tide rips, and muddy bottom (shallow water environments are also critical, but typically occur outside of the planning area boundary). Efforts are currently underway by Massachusetts resource management agencies and others to couple biological (life history needs of species) and physical (sediment characteristics) parameters to better predict and map where particular species or species groups are located.

Benthic Communities

Benthic communities are a diverse group of marine invertebrates and plants living on the seafloor that are structured by major physical parameters such as water depth, flow, oxygen level, and various sediment characteristics. Studies of benthic environments in Massachusetts are generally few (e.g., Deer Island Treatment Plant outfall in Massachusetts Bay, U.S. EPA's Environmental Monitoring and Assessment Program (EMAP), National Coastal Assessment (NCA) projects, Cape Wind). Eelgrass and hard bottom communities have been studied most intensively due to their relatively greater importance for marine life.

Sand, mud, and other fine-grained substrates (soft bottom community types) comprise much of the sea-bottom environment within the planning area, with sand the dominant bottom substrate. Dynamic, sandy substrates profoundly influence the structure and abundance of benthic communities in Nantucket Sound. Organisms living in mobile sedimentary environments are well adapted for movement and settlement in sand, and for recovery from natural burial.

Hard bottom substrates, characterized by scattered boulders, cobble and gravel, are much less common than soft-bottom substrates in the planning area. Encrusting and emergent infauna and epifauna, including algae, bryozoans, sponges, and sea anemones, colonize hard bottom substrates (Maciolek et al., 2008).[27] These habitats are also important for many fish species. Some fishes, such as cod, lobster, cusk, and wolfish, exhibit a high dependence on structured seafloor for survival and reproduction. Areas of hard/complex seafloor are few and scattered in Cape Cod Bay and Nantucket Sound, with relatively greater number of occurrences seaward of the Cape's outer shore. Hard bottom benthic communities covers approximately 10% of the Cape Wind project site in Nantucket Sound (located outside of the planning area) (MMS, 2009).

Benthic organisms live on or beneath the seafloor and include macrobenthic organisms (greater than 0.5 mm in length), such as polychaete and oligochaete worms, clams, snails, crustaceans, seastars, sand dollars, and other large invertebrates (MMS, 2009). Crustaceans and mollusks comprise the most abundant benthic taxa in Nantucket Sound, followed by polychaete worms (Avery et al., 1996).[28] Meiofauna are small benthic

[27] Maciolek, N.J., S.A. Doner, D.T. Dahlen, R.J. Diaz, B. Hecker, C. Hunt, and W.K. Smith. 2008. Outfall benthic monitoring interpretive report: 1992–2007 results. Boston: Massachusetts Water Resources Authority. Report 2008-20.

[28] Avery D. E., J. Green, and E. G. Durbin, 1996. The distribution and abundance of pelagic gammarid amphipods on Georges Bank and Nantucket Shoals. Deep Sea Research II 43 (97-8):1521-32.

organisms (0.045 mm-0.5 mm in length) that can number in the tens to hundreds of thousands per square meter, but are seldom represented in general environmental surveys due to their small size. They are represented by numerous phyla including *Gnathostomulida* (jaw worms), *Kinorhyncha* (small marine pseudocoelomate invertebrates) *Loricifera* (small sediment dwelling animals), etc. Benthic abundance and productivity in North Atlantic subtidal marine waters is typically highest in the spring and early summer (Rudnick, et al., 1985).[29] The spring-early summer peak in abundance and diversity is attributed specifically to a combination of warming temperatures and increased availability to diatomaceous detritus, a major food source for many macro- and meiofaunal taxa (Rudnick, et al., 1985). Recruitment success during this spring-early summer period is critical in maintaining the patterns of benthic community structure over time in the region. The distribution and abundance of most species comprising the benthos in the planning area is not known. Nantucket Sound has generally been reported as highly productive for benthic invertebrates, although benthic diversity (i.e., number of species and number of individuals per species) may be lower than diversity in the rest of the Southern New England Shelf (Theroux and Wigley, 1998).[30]

Eelgrass, an important structural component of the benthic zone, has declined sharply from its estimated historical coverage. Eelgrass beds are highly productive plant communities that provide nursery and/or feeding habitat for many fish, waterfowl and invertebrate species. Loss of eelgrass can result in significant shifts in marine fauna, including commercial and recreational species. The degradation of eelgrass beds in the 1930s from an outbreak of wasting disease caused bay scallop stocks to crash and brant geese population numbers to plummet. Eelgrass is highly sensitive to pollution (e.g., nitrogen loading) and serves as an ideal indicator of water quality changes. Loss of eelgrass habitat has been most pronounced south of the Cape and in Buzzards Bay where eelgrass has declined by more than half since 1988 (Costa, 2003).[31]

Alterations to sea-bottom habitats by anthropogenic activities can profoundly affect life history processes of benthic species, weaken or break food webs, and potentially result in the displacement of native species by exotic invasive species, further changing ecosystem dynamics. Areas of submerged aquatic vegetation (e.g., eelgrass), shellfish beds, and hard bottom habitats are among the most vulnerable habitats to disturbance (Johnson et al., 2008).[32] Marine habitat restoration efforts are expensive and often fail to replicate the original habitat. Numerous invasive marine species are known to occur in the low intertidal to shallow subtidal waters of Cape Cod. However, little is known about the distribution of these introduced organisms in the planning area, although given their aggressive nature it is likely many could inhabit or impact the planning area. High-resolution seafloor mapping currently underway in the Cape Cod region by USGS (Map

[29] Rudnick, D. T., R. Elmgren, and J. B. Frithsen, 1985. Meiofaunal prominence and benthic seasonality in a coastal marine system. Ecologia 67(2):157-68.

[30] Theroux, R.B. and R.L. Wigley. 1998. Quantitative composition and distribution of the macrobenthic invertebrate fauna of the continental shelf ecosystems of the northeastern United States. U.S. Dept. Commerce, NOAA Tech Rep. NMFS 140, 240 pp.

[31] Costa, J. 2003. Historical changes of eelgrass in Buzzards Bay. Buzzards Bay National Estuary Program. Wareham, MA. http://www.buzzardsbay.org/eelgrass-historical.htm. Accessed 11/21/08.

[32] Johnson, M.R., Boelke, C., Chiarella, L.A., Colosi, P.D., Greene, K., Lellis-Dibble, K., Ludemann, H., Ludwig, M., McDermott, S., Ortiz, J., Rusanowsky, D., Scott, M., and Smith, J. 2008. *Impacts to Marine Fisheries Habitat from Nonfishing Activities in the Northeastern United States*. NOAA Technical Memorandum NMFS-NE-209.

2) will contribute to broad scale assessment of benthic habitats, ecosystem uniqueness, vulnerability, and resiliency.

1B.3 - Visual Resources and Characteristics

Cape Cod has a wide variety of visual and scenic resources, each exhibiting a character of their own and all contributing to the Cape's unique sense of place. These visual resources can broadly be defined as the visible features that make up the landscape and seascape. The Cape's visual resources vary in their scenic quality, value and ability to absorb changes. Visual and scenic resources in Barnstable County play a significant role in people's enjoyment of the area and are vital to the continued economic strength of the region.

A landscape is an interaction of natural and cultural components of the environment and how they are perceived by people. People's perception of the land, including the views, feelings, memories or associations with the land, and the pattern arising from the influence of natural and man-made factors create a landscape's character. Cape Cod's character is defined by its villages, structures, and its landscapes encompassing and surrounded by water. The character of the region reflects both natural and human history, and is a result of the interaction of many factors including geology, landforms, vegetation, soils, land use and settlement. Particular combinations of these factors create the character that give the Cape its sense of place.

The region's rural character and historic villages are consistently ranked as important factors influencing people's decisions to move to, visit, or live on Cape Cod. The 2005 Cape Cod Residents Survey results report that, of respondents who did not grow up on the Cape, 68 percent said the region's historic character was an important or very important factor in their decision to live here.

The Cape's natural environments and geomorphology consisting of generally low-lying topography, salt-marsh systems, barrier beaches, dune systems and pitch-pine forests, interspersed with kettle ponds, all contribute to the Cape's character and popularity as a destination. The Cape's human history is expressed in the region's traditional development pattern of densely developed village centers surrounded by more sparsely developed outlying areas. The buildings, neighborhoods, working waterfronts, and cultural landscapes that tell the Cape's story are both historically significant and critical to maintaining the unique character that draws so many people to the region.

View of north shore of Cape Cod from Scargo Tower, Dennis

View from Gray's Beach boardwalk, Yarmouth toward Sandy Neck and Cape Cod Bay

Prior to the CCOMP, no comprehensive assessment of the region's scenic resources had been completed; nor was there an objective means of evaluating the degree to which these resources can accommodate change resulting from development. Furthermore, the OMP did not address visual or scenic resource impacts. Therefore, the Cape Cod Commission explored techniques that could be employed through the Commission's Development of Regional Impact process to assist in the evaluation of visual and scenic impacts from this type of development. The Commission established a technical group consisting of Commission staff, a panel of professionals with experience with experience in visual analysis and Dr. Richard Smardon, a professor at SUNY with extensive experience in conducting visual impact assessments. Two major efforts were undertaken as part of this planning process. First, the Commission developed a Visual Impact Assessment (VIA) process that is intended to be used in the application of performance standards by the Cape Cod Commission as part of the DRI review. The technical group provided valuable input on this process throughout, and this VIA process is discussed further in Section 2D. Second, the Cape Cod Commission undertook an inventory of the region's visual and scenic resources in order that this information would be used as a baseline for the impact analysis conducted as development came forward. This inventory process is described more fully below.

Establishing Seascape Units

As an initial step in identifying the Cape's visual and scenic resources, the region has been divided into "seascape units", consisting of the coastal landscape and adjoining areas of open water. Each seascape has three components: an area of sea (seaward component), a length of coastline (coastline component), and an area of land (landward component)[33].

Within the planning area, four regional seascape units were identified.

Regional seascape units are subdivisions of the coastline defined by major regional headlands, islands or coastal features extending from the seaward planning area boundary to the high point on the land surrounding the seascape unit (e.g. the moraine ridge that extends along Cape Cod in many places).

Within the four regional seascape units, local seascape units that nest within the regional seascape units were also identified. These smaller divisions are defined by smaller coastal features, or areas of similar character or form and also extend seaward to the planning areas boundary in the ocean.

The regional and local seascape units established for the planning area are illustrated in Figure 1-1.

[33] DTI. 2005. **Guidance on the Assessment of the Impact of Offshore Wind Farms: Seascape and Visual Impact**. Report of the Dept. of trade and Industry Publication 80666 UK

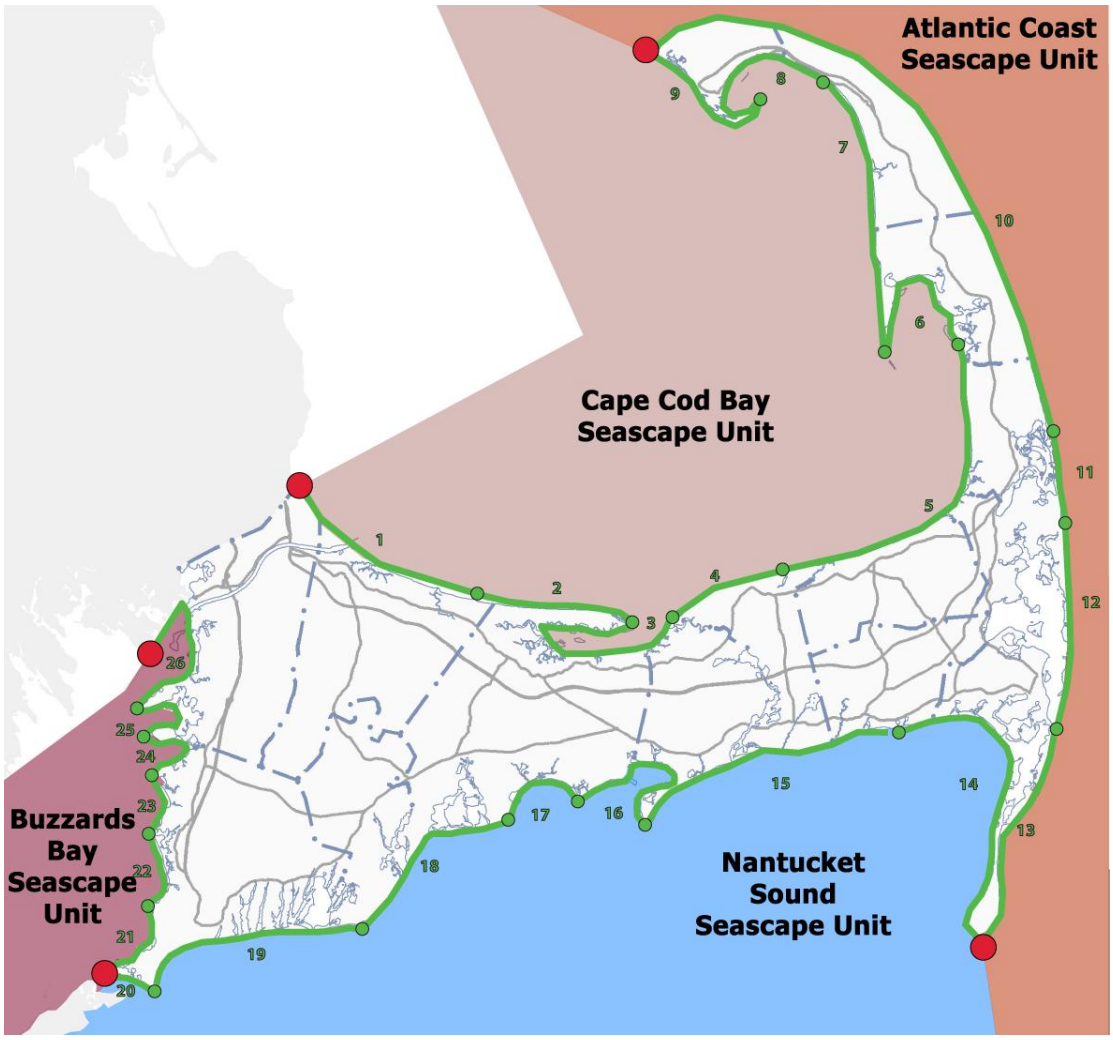

Figure 1-1: Seascape Units

Identifying visual resources
Many of the region's visual and landscape resources are potentially sensitive to changes in the environment. Although the degree of sensitivity varies greatly depending on the resources and development in question, it is important that these resources be identified and characterized. The region's visual and scenic coastal resources include, but are not limited to, the following:

- Barrier beaches
- Intertidal flats
- Coastal dunes
- Maritime forests
- Coastal plain ponds
- Sandplain grasslands
- Estuarine intertidal marshes
- Wildlife habitat
- Public beaches
- State/Federally designated parks

- Parks and recreation areas
- Harbors and marinas
- Historic structures
- Historic districts and villages
- Cultural landscapes
- Scenic roads, and roads with views to the ocean

Scenic resources need not be formally designated and can include any publicly accessible area that can be visited for the purpose of enjoying its visual quality and valued for its natural character, cultural importance or uniqueness. However, there are scenic resources officially designated on Cape Cod including, but not limited to:

- National and State Parks, e.g. the Cape Cod National Seashore and Nickerson State Park.
- Property listed, or eligible for listing, on the National or State Register of Historic Places, e.g. Old King's Highway and other Historic Districts, Nobska Light and other individual properties.
- Wildlife Refuges such as Mashpee Wildlife Refuge.
- Scenic Roadways, e.g. Bridge Road, Eastham.
- Scenic vistas or viewpoints, e.g. scenic canal overlooks in Bourne.

As the landscape character is partly a function of the relationship between people and place, it is also important to identify the groups of people that are interacting with their surroundings and their reasons for valuing different landscapes. For example, users may value their landscape based on: aesthetics and beauty; wildlife habitat; economy or commerce; tourism or recreation; and culture and history to name a few. Also, many of these users and activities taking place in the landscape may be seasonal in nature. The types of users, amenities and activities that occur in the landscape or seascape, include but are not limited to:

Users
- Resident usage
- Visitor usage
- Transient visitors (people travelling through the region to other areas)
- Beach users (including surfing beaches, fishing, walking, exercising, sunbathing, Off-road vehicle use)

Activities
- Sailing activities (including recreational, commercial, transit)
- Fishing activities
- Hiking activities
- Wildlife observation
- Recreational Activities (canoeing, kayaking, windsurfing)

Amenities
- Parking amenities
- Resort amenities
- Accommodation facilities

- Recreational amenities (e.g. golf courses)
- Marinas and boat ramps

Identification of Landscape Similarity Zones

The seascape characterization undertaken for the ocean planning area and described below is intended to define the key characteristics and defining elements that show how one area is distinct from another. To accomplish this, the region's landward components have been grouped into four categories or "Landscape Similarity Zones" (LSZ) by utilizing the methodology outlined in the US Army Corps of Engineers Visual Resource Assessment Procedure (VRAP)[34]. These LSZs broadly reflect landforms, features and environments with similar characteristics and provide a general indication of the degree of transparency (or views) that may be offered from these locations. The four categories are described as follows:

1. Developed/Built Areas: Includes structures, roadways, parking lots, and other "infrastructure" as primary visual characteristics where visual transparency is limited by structures and/or mature vegetation. This category may be further divided into historic village areas, commercial/industrial areas, municipal areas, and suburban or residential areas.

2. Wooded Landscapes: Natural lands that are predominantly forested or characterized by dense vegetation that blocks visual access to lands beyond. These areas may include some roadways, trails, and limited parking areas.

[34] Smardon, R.C., J. F. Palmer, J. Knopf and K. Grinde with J. E. Henderson and L.D. Peyman-Dove. 1988. **Visual Resource Assessment Procedures for US Army Corps of Engineers**. Instruction Report EL-88-1, USACOE waterways Exp. Stn, Vicksburg, Miss.

3. Open Landscapes: Natural lands that have predominantly low vegetation such as heath landscapes, agricultural fields, and mown areas and where visual access to lands beyond is un-obstructed and transparency is very high. This may include some roadways, trails, and limited parking areas. This category may be further divided into natural, managed and disturbed areas.

4. Coastal Landscapes: Areas adjacent to salt water, including beaches, dunes, marshes and their associated waterways with open views to the ocean, and may also include parking areas. Landscape features in this area include water, sand, and low-growing vegetation and a general absence of structures and tall vegetation resulting in high transparency and visibility. This grouping may be further subdivided into natural and developed areas.

The LSZ map was developed using a combination of aerial photography, site visits and a variety of GIS data layers, including topography, vegetation and land use classifications from McConnell Land Use Data and Department of Environmental Protection wetlands classifications. The LSZ map provides a broad analysis of the general visual transparency of the landscape. For example, where woodland is the dominant landscape type affected, views to the ocean are expected to be more limited, whereas where open landscapes are affected, views to the ocean are likely to be more expansive. At a regional scale, the LSZ map illustrates that generally the most expansive views to the ocean are found at the immediate coast (coastal landscape zones) and a limited number of open or cleared locations inland.

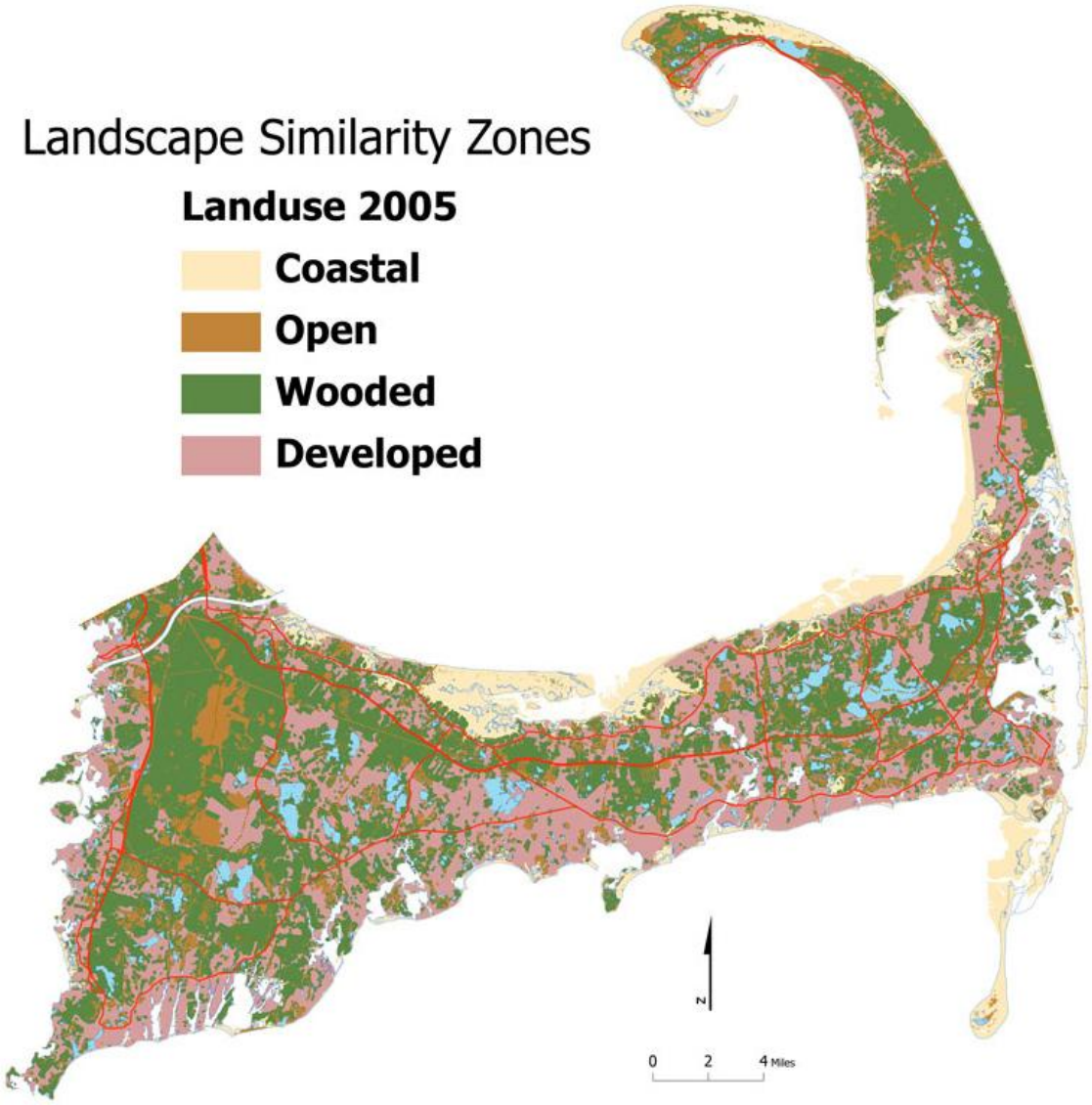

Figure 1-2: Landscape Similarity Zones

Baseline Inventory of scenic viewpoints
In order to make an assessment of the Cape's visual resources, an initial baseline inventory of the Cape's seascapes was conducted at thirty-six locations. These locations were selected as they were representative of views for the local seascape unit, were publicly accessible and were areas of high usage. A map identifying the locations which were inventoried is shown in Figure 1-3.

An inventory form was developed, and with reference to best practice guidance of DTI[35], Hill et al.[36], and the US Corps of Engineers VRAP procedures[37], to ensure that

[35] DTI. 2005. **Guidance on the Assessment of the Impact of Offshore Wind Farms: Seascape and Visual Impact**. Report of the Dept. of trade and Industry Publication 80666 UK

information was consistently collected at each location. The form was used to gather information about each local seascape unit, including an inventory of elements in the seascape and supported by photographs, sketches and maps of the vicinity.

The Massachusetts Ocean Management Plan prohibited development along the Atlantic Coast, and the presence of resource constraints in Buzzards Bay (including rare species habitat) severely limits development there in the short term. Therefore, the baseline inventory work focused on the Nantucket Sound and Cape Cod Bay seascape units. It is anticipated that the Buzzard's Bay and Atlantic Coast seascape units will be inventoried at a later date, and that additional inventory work will be conducted throughout, as resources allow.

Information about the physical form of the sea, coastal and landward components at each location were recorded, including land form, coastal form, coastal aspect, physical features and land use. The inventory form also includes a summary description and key characteristics, as well as information about the users of that location based on local knowledge and state maps, and the relative quality of the visual resources present in the viewshed.

Figure 1-4: Views at Corporation Beach and Barnstable Harbor

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[36] Hill, M.; J. Briggs, P. Minto, D. Bagnall, K. Foley and A. Williams. 2001. **Guide to Best Practice in Seascape Assessment**. Countryside Commission of Wales, Brady Shipman Marsh and University College, Dublin

[37] Smardon, R.C., J. F. Palmer, J. Knopf and K. Grinde with J. E. Henderson and L.D. Peyman-Dove. 1988. **Visual Resource Assessment Procedures for US Army Corps of Engineers**. Instruction Report EL-88-1, USACOE waterways Exp. Stn, Vicksburg, Miss.

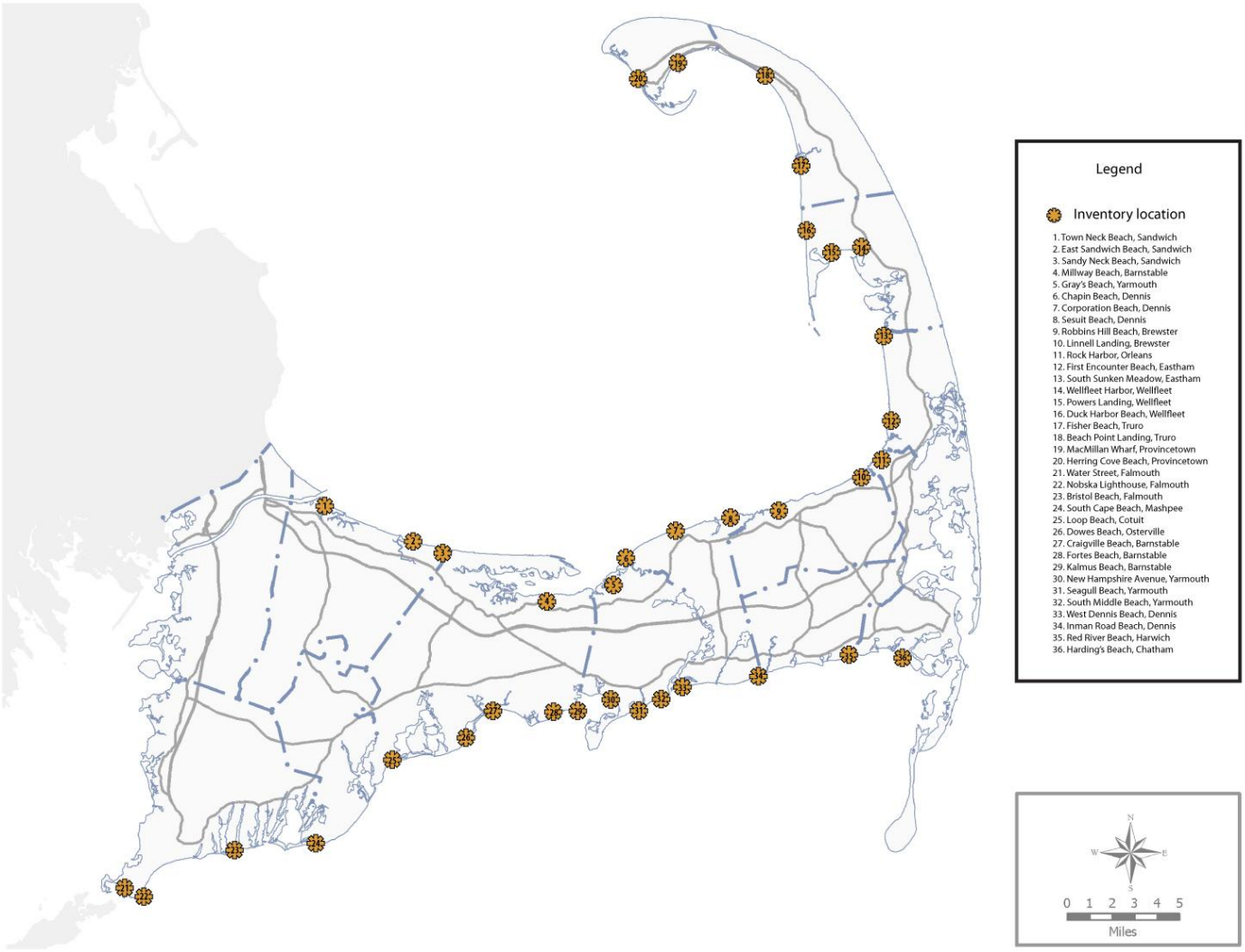

Figure 1-3: Inventory points (May 1, 2011).

1B.4 – Archaeological Resources

Submarine Archaeological

The maritime heritage of the Cape Cod region is reflected not only in the well known cultural resources of the coast (e.g., lighthouses, ship captains' homes), but in the bays and sounds surrounding the Cape. Native American sites, historic shipwrecks, aircraft crash sites, submerged aids to navigation, etc. are all critical elements of the region's maritime heritage. These cultural resources have not been fully inventoried.

Native People, or American Indians may have arrived in the Cape Cod region between 11,000 and 8,000 years ago based on archaeological research. At that time, sea-level was over 50 feet below its present level. The varied coastal environments and abundant flora and fauna present at the time would have yielded a landscape attractive for human occupation. Given that the highest density of terrestrial archaeological sites in Massachusetts, both ancient and historic, are located in coastal settings, it is likely that other sites may exist in areas now submerged by the sea. While only a few Paleo-Indian

artifacts have been discovered in the region's coastal waters to date, the potential for other underwater archaeological sites must be considered.

Many of these resources, in the form of paleosols,[38] may contain information about Native American activity, and should be evaluated on a case-by-case basis. Reliable mapped site location data for the bottom-lands of Massachusetts is nearly non-existent. There are only a handful of known submerged Native American sites in Massachusetts waters. Some submerged and buried intact ancient landscapes have been identified through core sampling and exposing forest features. Such landscape features are strongly suggestive of the possible existence of ancient Native American archaeological sites, but these features are not necessarily archaeological sites. Consequently, the identification of ancient Native American sites must occur on a site-by-site evaluation basis.

European colonization of the Americas ushered in over four centuries of ship and boat traffic engaged in the exploitation of the marine environment and its resources. Vessels were inevitably lost during this age of exploration and exploitation in the region. Research indicates the presence of more than 3,000 shipwrecks in Massachusetts' waters, including many in the planning area. Although documentation exists for many shipwreck sites, the quality of descriptive information and precise locational data is typically lacking. In addition, a strong bias may exist to have recorded only those that posed a significant hazard to navigation, involved human tragedy, or carried valuable cargo. The probability that many other sunken artifacts may exist in the Cape Cod region should be considered.

The state OMP has mapped only some of the known archaeological resources, including more recent shipwrecks. The most commonly available data set, NOAA NOS Automated Wreck and Obstruction Information System, is intended for identifying hazards to navigation, and not all shipwrecks. Additionally, it contains mostly modern steel vessels and its locational precision is generally in miles (not feet). This data may be reliable enough for generalized planning purposes, but not for mapped-based planning aimed at zoning out certain uses from known sensitive resource areas.

In support of the MOMP, the Massachusetts Board of Underwater Archaeological Research (MBUAR) developed rough site potential sensitivity maps for both historic period and ancient Native American sites. These maps represent untested predictive models; they can be suggestive of the probability of site occurrence, but would not eliminate the need for an archaeological investigation on a project-by-project basis. Consequently, they may be useful for generalized marine spatial planning purposes, but not as a site level screening tool for project development. (personal communication 2010, Victor Mastone, MBUAR).

It should also be noted that the Keeper of the National Register of Historic Places determined that Nantucket Sound is eligible for listing in the National Register as a traditional cultural property and as an historic and archaeological property. The area was found to be eligible under four separate criteria: A) for its associations with the ancient and historic period Native American exploration and settlement of Cape Cod and the Islands, and with the central events of the Wampanoags' stories of Maushop and Squant/Squannit; B) for its association with Maushop and Squant/Squannit; C) as a significant and distinguishable entity integral to Wampanoags' folklife traditions, practices, cosmology, religion, material culture, foodways, mentoring, and narratives; and D) for the important cultural, historical, and scientific information it has yielded

[38] Paleosols are ancient, buried soils whose composition may reflect a climate significantly different from the climate now prevalent in the area where the soil is found.

and/or may be likely to yield through archaeology, history, and ethnography about access to resources, patterns of settlement, mobility, and land use prior to and after 6,000 years ago as a result of the inundation of the Sound. It is also important for the significant information it provides and can provide about the cultural practices and traditions of the Native Americans of Cape Cod and the Islands in relationship with other peoples since ancient times.[39]

1B.5 - Climate Change

Climate change over the next century is expected to profoundly affect coastal and marine environments both globally and locally. Average temperatures in New England are projected to rise 2.5 to 4 degrees Fahrenheit in the winter and 1.5 to 3.5 degrees Fahrenheit in the summer over the next several decades.[40] These temperature changes, combined with sea-level rise, rising sea surface temperatures, changes to ocean and atmospheric circulation (including increasing storm frequency and intensity), and acidification of ocean waters will fundamentally change many aspects of life on Cape Cod that are dependent upon local climate.

The effects of on-going sea-level rise in Massachusetts are already being detected and include: flooding of low-lying areas, increased inundation during storms, and accelerating shoreline erosion. A warming trend in winter sea surface temperatures of approximately 1.5°C (2.7 °F) has been observed in Woods Hole (Falmouth) from 1965-2005 (Nixon et al., 2004).[41] Changes in surface temperatures may influence the abundance and distribution of marine species (e.g., increase in abundance of more southerly species) as well as their ecology (e.g., timing of breeding, spawning, migration, and the formation of plankton blooms). Accelerated warming of the ocean is projected to increase the intensity of extreme storm events (and likely their frequency), such as hurricanes and allow them to travel further into high latitude regions. These severe and more frequent storm and precipitation events are likely to exacerbate stormwater management challenges the region already faces, as well as saltwater inundation of public water supplies.

Not only are human populations on the coast at risk from extreme storms, but the performance capabilities of offshore structures could be affected. Changes in wind patterns due to ocean warming will influence wind-generated currents, which, in turn, may cause shifts in ocean and estuarine circulation and alterations in upwelling processes. Increased absorption of carbon dioxide (the primary greenhouse gas) in seawater will increase ocean acidity, which may have negative consequences for marine organisms with calcium carbonate shells or exoskeletons (e.g., quahogs, scallops, lobsters). The local economic impacts from a deterioration of these resources both within and adjacent to the planning area could be profound.

Onshore connections, or infrastructure where cable landfalls are made, should also take into consideration the potential effects of sea-level rise. Siting choices should take into consideration changing velocity and flood zones during storm events as well as the long-term viability of infrastructure investments near the coast. Any wind turbine and

[39] Carol Shull, Keeper of the National Register, letter determining eligibility of Nantucket Sound, dated 1/4/10.
[40] Northeast Climate Impacts Assessment, 2008.
[41] Nixon, S.W., S. Granger, B.A. Buckley, M. Lamont, and B. Rowell. 2004. A one hundred and seventeen year coastal water temperature record from Woods Hole, Massachusetts. Estuaries 27: 397-404.

associated service platform (or other relevant structures) sited in Cape Cod ocean waters have an approximate life expectancy of 20 – 25 years and would likely need to account for worst case scenario sea-level rise in that timeframe during the planning and permitting stage. For instance, the distance between blade swept areas from surface water would likely need to be more conservative to account for rising sea-levels, particularly during extreme weather events when surface swells may be higher than normal. A recent study of offshore wind in the Great Lakes region suggest a minimum distance of 75 feet between blade swept area and surface water for wind turbines. [42]

It is important to note that siting of wind turbines or other renewable energy facilities within the planning area will not prevent the projected near term impacts from Climate Change for our region. However, responsible mitigation measures combined with regional adaptation policies may provide for enhanced resiliency to Climate Change impacts over the long term.

[42] Michigan Great Lakes Wind Council Input on Offshore Wind Energy Legislation (2010).

SECTION 1 PLAN OVERVIEW AND CONTEXT

1C: Definitions

Act: An Act establishing the Cape Cod Commission, Chapter 716 of the Acts of 1989, as amended.

Adverse Visual Impact: Where the degree of change in the scenic quality resulting from an activity is expected to unreasonably alter the public's enjoyment or appreciation of a scenic resource or otherwise unreasonably alter the character, setting or quality of a scenic resource.

Associated Wind Energy Facility Infrastructure: Cables, pipelines, conduits, and other structures or equipment accessory to one or more Wind Energy Conversion Facilities and necessary for the transmission and distribution of electricity.

Beach Nourishment: The placement of clean sediment, of a grain size compatible with existing beach sediment, on a beach to increase its width and volume for purposes of storm damage prevention, flood control, or public recreation. The seaward edge of the nourished beach shall not be confined by any structure.

Cable/Pipeline Prohibited Areas: The areas delineated on the *Cape Cod Ocean Management Plan Cable/Pipeline Prohibited Areas Map,* attached as Map 16 and incorporated by reference. The resources identified on this map include North Atlantic Right Whale Core Habitat, Fin Whale Core Habitat, Humpback Whale Core Habitat, and the Cape Cod Ocean Sanctuary, all as defined in the OMP.

Clerk: Clerk of the Cape Cod Commission.

Core Habitat: defined more specifically in Appendix 4 of the Massachusetts Ocean Management Plan, but generally, those areas defined by concentrations of presence/abundance of a given species. The Commonwealth of Massachusetts defined core habitats for North Atlantic Right whales, Fin whales, Humpback whales, Roseate terns, Least terns, Common terns, and Arctic terns.

Critical Habitat: (1) specific areas identified by the Natural Heritage and Endangered Species Program (NHESP) within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the NHESP determines that the area itself is essential for conservation.

Cultural Landscape: A geographic area (including both cultural and natural resources and the wildlife or domestic animals therein) associated with an historic event, activity, or person, or exhibiting other cultural or aesthetic values. There are four general types of Cultural Landscapes, not mutually exclusive: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes.

CZM: Massachusetts Office of Coastal Zone Management

Development: any of the following undertaken by any person: any building,

construction, renovation, mining, extraction, dredging, filling, excavation, or drilling activity operation; any material change in the use or appearance of any structure in the land itself; any activity that alters a shore, beach, seacoast, river, stream, lake, pond, canal, marsh, dune area, woodland, wetland, endangered species habitat, aquifer, or other resource area, including coastal construction or other activity in Barnstable county within the jurisdiction limits of Barnstable county; demolition of a structure; or the deposit of refuse, solid or liquid waste or fill on a parcel of land or in any water area. Developments include, but are not limited to, Sand and Gravel Mining or Sand Mining operations, Wind Energy Conversion Facilities, Wave Energy or Tidal Energy Facilities, and the installation of pipelines, cables, and other conduits.

Dredging: removal of materials including, but not limited to, rocks, bottom sediments, debris, sand, refuse, plant or animal matter, in any excavating, cleaning, deepening, widening or lengthening, either permanently or temporarily, of any flowed tidelands, rivers, streams, ponds or other waters of the Commonwealth. Dredging shall include Improvement Dredging, Maintenance Dredging, excavating and backfilling or other dredging and subsequent refilling.

Exclusionary Areas: Special, sensitive or unique areas ("SSUs") that (a) comprise one or more of the following, as delineated generally in Figures 2-2 or 2-13 of the OMP or delineated more specifically through the provision of scientifically reliable evidence to the extent available: North Atlantic Right Whale Core Habitat, Fin Whale Core Habitat, Humpback Whale Core Habitat, Roseate Tern Core Habitat, Special Concern Tern Core Habitat, Leach's Storm-Petrel Important Habitat, Long-tailed Duck Important Habit, Colonial Waterbirds Important Nesting Habitat, Areas of Hard/Complex Seafloor, Eelgrass, Intertidal flats, and Important Fish Resource Areas; or (b) comprise expanded North Atlantic Right Whale Habitat as delineated on the map attached hereto as Map 14. To the extent an Exclusionary Area overlaps a Prohibited Area, it shall be treated as a Prohibited Area.

Executive Committee: A standing committee established by the Cape Cod Commission on April 25, 1990.

Executive Director: The Executive Director of the Cape Cod Commission.

Hard/Complex Bottom or Hard/Complex Seafloor: Seafloor characterized by any combination of the following: 1) areas of exposed bedrock or concentrations of boulder, cobble, or other similar hard bottom distinguished from surrounding unconsolidated sediments, 2) a morphologically rugged seafloor characterized by high variability in bathymetric aspect and gradient, or 3) man-made structures, such as artificial reefs, wrecks, or other functionally equivalent structures that provide additional suitable substrate for development of hard bottom biological communities.

Hazardous Waste: Any Hazardous Waste, Universal Waste or Waste as defined in the Massachusetts Hazardous Waste Regulations, 310 CMR 30.010 resulting from construction, testing, maintenance and decommissioning of all project related structures and equipment.

Hearing Officer(s): A person(s) designated to take testimony, open, close and continue hearings and to accept letters of withdrawal.

Historic Landscape: See Cultural Landscape

Host Community: Any one of the region's 15 municipalities where the WECF is proposed to make landfall.

Impacted Community: Any one (or more) of the region's 15 municipalities where either any part of the proposed WECF and Associated WECF Infrastructure falls within a municipal jurisdiction, or any one (or more) of the region's 15 municipalities that is located within 10 miles of the WECF and has a coastline in the same Regional Seascape Unit.

Improvement Dredging: any dredging in an area which has not been previously dredged or which extends the original dredged width, depth, length, or otherwise alters the original boundaries of a previously dredged area for the purposes of improving navigation or flushing of an embayment or harbor.

Locally Owned: – A business or manufacturer that:

a) is responsible for its own decision-making regarding marketing, operations, and legal proceedings; and

b) if a corporation, has a majority of its outstanding shares beneficially owned by individuals who are residents of Barnstable County; or

c) if a partnership, its partners owning a majority beneficial interest in the partnership are residents of Barnstable County; or

d) if an individual or a sole proprietor, he or she is a resident of Barnstable County.

MBUAR: Massachusetts Board of Underwater Archaeological Resources

Maintenance Dredging: Dredging in accordance with a license or permit in any previously authorized dredged area which does not extend the originally dredged depth, width, or length.

MEPA: Massachusetts Environmental Policy Act, M.G.L. Chapter 30, Sections 61-62H.

MHC: Massachusetts Historical Commission

MORIS: Massachusetts Ocean Resources Information System

Ocean Management Plan, or OMP: The plan promulgated by the Executive Office of Energy and Environmental Affairs of the Commonwealth of Massachusetts entitled, "Massachusetts Ocean Management Plan," dated December 2009, comprising two volumes (Volume 1 – Management and Administration, and Volume 2 – Baseline Assessment and Science Framework)

Planning Committee: A standing committee established by the Cape Cod Commission on April 25, 1990

Priority habitat: As codified under the Massachusetts Endangered Species Act, means the geographic extent of Habitat for state-listed species as delineated by the Division of Fisheries and Wildlife pursuant to 321 CMR 10.12, where habitat is defined as an area which, due to its physical or biological features, protects or provides important elements

for the growth and survival of plants or animals such as food, shelter, or living space, and includes without limitation, breeding, feeing, resting, migratory, or overwintering areas. Physical or biological features include, but are not limited to: structure and composition of the vegetation; faunal community; soils; water chemistry and quality; and geologic, hydrologic, and microclimatic factors.

Prohibited Areas: Areas that are Wind Energy Conversion Facility Prohibited Areas, Sand and Gravel Mining Prohibited Areas, or Cable/Pipeline Prohibited Areas, with the exception of cables attached to a Cape Cod Commission approved WECF that is not within a Cable Prohibited area or WECF Prohibited area, and is in a Provisional or Exclusionary area as defined by these regulations.

Provisional Areas: Areas within the District that are not identified specifically as Prohibited Areas or Exclusionary Areas.

Regional Community: The fifteen towns that comprise Barnstable County.

Regional Seascape Units: Subdivisions of the coastline defined by major regional headlands, islands or coastal features that extend seaward to the boundary of the DCPC in the ocean, and to the highest landside topographical contour reached inland from the coast. Regional Seascape Units are depicted graphically on Exhibit F.

Regulatory Committee: A standing committee established by the Cape Cod Commission on April 25, 1990.

Sand and Gravel Mining or Sand Mining: Activities involving the removal of material from the ocean floor for the purposes of Beach Nourishment, but not including Maintenance Dredging activities that include a Beach Nourishment component.

Sand and Gravel Mining Prohibited Areas: The areas delineated on the *Cape Cod Ocean Management Plan Sand and Gravel Mining Prohibited Areas Map,* attached as Map 15 and incorporated by reference. The resources identified on this map include North Atlantic Right Whale Core Habitat, Fin Whale Core Habitat, Humpback Whale Core Habitat, and the Cape Cod Ocean Sanctuary, all as defined by the OMP.

Scenic Road: A public road that has one or more of the following characteristics:

(1) Passes through an area of outstanding natural environmental features providing views of scenic elements such as salt marshes, rivers, bays, dunes and the ocean;

(2) Provides outstanding views of rural, agricultural landscapes including scenic elements such as panoramic or distant views, cropland, pastures, fields, streams, ponds, hedgerows, stone or wooden fences, farm buildings and farmsteads;

(3) Follows historic road alignments and provides views of historic resources;

(4) A large proportion of the road provides frontage for properties that are in a historic district or subject to perpetual or long-term agricultural, environmental or historic easements.

(5) Is designated by a municipality as a scenic road.

Scenic Resources: Public locations or areas that are recognized and enjoyed for their visual and scenic qualities and whose features, patterns, and characteristics contribute to a distinct sense of appreciation of the natural and cultural environment.

Solid Wastes: Any useless, unwanted, and/or discarded material, including but not limited to any material that is intended to be disposed or being disposed, or that is stored, treated or transferred pending such disposal resulting from construction, testing, maintenance and decommissioning of any project related structures and equipment.

TOY: Time of Year.

Visual Impact: The degree of change in scenic quality resulting from an activity.

Wind Energy Conversion Facility or WECF: any electrical generating plant, facility, or unit designed to produce, manufacture, or otherwise generate electric energy in whole or in part by wind, together with any other facilities and equipment located at the same site, whether or not directly related to the production of electric energy through wind. As used herein, the term "Wind Energy Conversion Facility" shall include any portion of a Wind Energy Conversion Facility or its Associated Wind Energy Conversion Facility Infrastructure. This includes, but is not limited to, all transmission, storage, collection and supply equipment, substations, transformers, site access, and machinery associated with the use. A Wind Energy Conversion Facility may include one or more wind turbines.

Wind Energy Conversion Facility Prohibited Areas: The areas comprising (a) the areas extending from the landward boundary of the district seaward 2 nautical miles (nm); and (b) the areas delineated on the *Cape Cod Ocean Management Plan Map of Wind Energy Conversion Facility Prohibited Areas,* attached as Map 13 and incorporated by reference. Resources identified on this map include North Atlantic Right Whale Core Habitat, Fin Whale Core Habitat, Humpback Whale Core Habitat, Long-tailed Duck, Roseate Tern, Special Concern Tern species (Arctic, Least, and Common Terns), important nesting habitats of colonial waterbirds and Leach's Storm Petrel, High Effort and Value Commercial Fishing Areas, Concentrated Commercial Fishing Traffic Lanes, Concentrated Commercial Traffic lanes, and the Cape Cod Ocean Sanctuary, all as defined by the OMP.

SECTION 2: OFFSHORE RENEWABLE ENERGY

2A: OVERVIEW – CAPE COD

One of the primary goals of this plan is to address the potential development of the Cape's ocean waters for renewable energy. The Renewable Energy Technical Advisory Workgroup (RE Workgroup) was assembled to provide the Policy Committee with recommendations toward meeting the goal of defining appropriate scale and location for the development of 24 wind energy conversion facilities as authorized by the OMP, and to address the suitability and feasibility for other types of renewable energy development within the planning area.

The purposes of the planning process, specific to renewable energy, are to identify appropriate areas within the planning area that may support wind power generation after considering both existing and future resources and uses. An extensive analysis of the resources and uses contained within the planning area is essential to this process and was recently undertaken through the OMP. The RE Workgroup agreed to use the OMP natural resources and use analysis as the baseline for the planning process, noting and refining missing or incomplete data where possible. The RE Workgroup acknowledged through the planning process the importance of visual considerations for wind turbines in the ocean waters surrounding Cape Cod, which was not considered in the state's OMP. Utilizing the OMP's list of mapped resources within the planning area as a baseline and including additional data layers for consideration, such as bathymetry and wind resources, the CC OMP provides determination of appropriate scale as well as recommendations on the most appropriate location and scale for offshore wind energy development and other potential forms of renewable energy within the planning area. The following facts and analysis were used to guide informed public policy decisions regarding wind energy development in Cape Cod's ocean waters.

There are presently three forms of offshore renewable energy technology capable of harnessing power on a commercial scale; wave, wind and tidal. All are in various stages of technological development with wind being the most advanced and readily deployable. The impacts of the three primary technologies within this report are varied and somewhat unknown for wave and tidal. The potential impacts from wind turbines have become increasingly understood, although some uncertainties remain. An in-depth discussion of wind turbine siting needs, constraints and potential impacts is addressed in Section 2C after the following overview on the status and potential for wave and tidal energy technologies within the planning area.

Wave Energy

In general, the East coast of the United States does not present as promising a region for the development of wave energy as the West coast, due to the wide extent of relatively shallow continental shelf waters off of the east coast, compared to a very narrow shelf associated with the Pacific coast. These shallow waters slowly draw off energy through frictional interaction with the seafloor as they propagate inshore from the deep ocean, reducing wave height in the process. However, it is still estimated that energy densities ranging seasonally from 5-30 kW per meter of shoreline are associated with the incoming waves (EPRI, 2004). This corresponds to approximately 300 – 1800 MW across a 60 km length of the outer Cape, of which only a fraction could be realistically converted to electricity.

Wave energy technology exists today primarily in the research and development stage, and the state of the technology is commonly considered to be one to two decades behind the development of wind energy. Although wave energy research has been ongoing for the past several decades, primarily in the United Kingdom, little funding has been available for such research in the United States. Even in Europe, wave energy research has lagged significantly behind wind energy due to funding and other political constraints. At the present time, there are no commercially operating wave energy facilities in the world, with the exception of the Pelamis wave energy converter (WEC) off the coast of Portugal, which has had limited commercial scale implementation.

There are many approaches to wave energy conversion currently being tested in research facilities around the world. In general, these can be separated into several broad classes of devices:

- *Oscillating Water Columns* – these devices utilize an enclosed box with its bottom open to the ocean. Water entering the box associated with the crest of the wave pushes air out through a small conduit which is used to drive a turbine producing electricity.
- *Overtopping Devices* – these devices allow incoming waves to break over the top edge of the device leaving water trapped in a small reservoir. As the water drains, it turns a turbine, creating electricity.
- *Point Absorbers* – these are moored devices, or buoys, that move up and down on the water surface. There are several methods of converting the up and down motion of the point absorber to electricity.
- *Oscillating Wave Surge Converters* – these can be thought of us submerged flappers that move back and forth as a wave passes. This flapping motion is then converted to electricity through a variety of methods. Sometimes the motion is used to pump seawater to shore where the electrical generating process takes place.
- *Submerged Pressure Differential Devices* – similar to the surge converters, these devices use pressure differences on the seafloor as a wave passes to pump seawater which can then be used to drive a turbine.
- *Attenuators* – these devices float at the surface with a number of joints. As the device flexes due to surface wave action, pistons within the joints drive high pressure oil through hydraulic motors which then drive turbines to produce electricity. The Pelamis system, operating off the coast of Portugal, is an example of attenuator technology.

As research on these various technologies progresses, certain methods will prove to be more feasible, both technologically and economically. Eventually, the field will settle out with one, or a few, industry standards, but it is difficult to predict at the present time which of these technologies might survive. Thus, it is not clear what a potential wave energy conversion system off the shores of Cape Cod might look like, including visual impacts, impacts to the environment, or even how the energy might be transported to shore (e.g. electrical cables vs. flowing seawater). There are now a number of small start-up companies investing in wave energy research, as well as other industrial and university research. With favorable incentives for green energy R&D, and the development of ocean-scale research infrastructure, it is likely that some of these questions may be answered within the next one to two decades.

Locations identified as suitable for wave energy pilot projects, both by the Electric Power Research Institute (EPRI, 2004) and researchers at the UMass Dartmouth Marine

Renewable Energy Center[1], are beyond the boundaries of the planning area. A more likely long-term planning scenario for commercial wave energy technology will revolve around the transmission cables needed to connect the facility with its landfall location.

Tidal Energy

Interest in generating power from tides has undergone a recent resurgence. Traditional methods employed a barrage approach whereby an embayment of water is trapped following flood tide and the resulting head difference is used to drive flow through one or more turbines, effectively converting potential energy into electrical. This approach requires a significant engineering undertaking and has considerable environmental impact. Modern approaches employ devices that convert the kinetic energy of the fluid into electrical and as such are similar to wind turbines. These devices are commonly known as marine hydrokinetic (MHK) devices. Compared with the barrage, this approach has considerably less impact both visually and environmentally. The MHK devices can be broadly separated into three classes:

- Horizontal Axis Turbines: These turbines feature a rotary device that has an axis of rotation that is parallel to the local flow direction. They may be ducted to increase the flow velocity over the blades.
- Crossflow Turbines: Crossflow turbines have an axis of rotation that is normal to the flow. An example of such is the Gorlov turbine. The design employed by Ocean Renewable Power Company, incorporates stacks of horizontally-oriented crossflow turbines in the water column.
- Oscillating Devices: These devices use moving hydrofoils to generate power. The angle of attack is modified mechanically to maintain lifting forces on both the upstroke and downstroke.

The power extracted by MHK devices is proportional to the cube of the flow velocity and thus return on investment is quite sensitive to the local tidal velocities. At present, a typical threshold speed for commercial viability is a 1.5 m/s flood and ebb peak velocity. The tidal kinetic energy resource in Massachusetts waters was evaluated in a 2006 study by EPRI (Hagerman and Bedard, 2006) using historically available measurements of currents. Using the threshold of 1.5 m/s, the authors identified Muskeget Channel, the Cape Cod Canal, Woods Hole, and Vineyard Sound as candidate locations. None of these locations lie within the planning area. A modeling-based resource assessment supported by the MIT Sea Grant was conducted in 2010 to examine the spatial variability of the resource agreed with the conclusions of EPRI with one other potential location being south of Monomoy Island in the east entrance to Nantucket Sound (Cowles and Churchill, 2010). Although the resource may be sufficient, technological and other exclusion constraints have not been evaluated. In addition, due to existence of strong tidal eddies, the energy field at this site is quite complex and the mobility of the bed would likely have to be studied in great detail before any equipment could be installed.

Tidal currents in the inlets connecting the Cape's embayments and harbors with adjacent waters rarely exceed 1 m/s. Several of these inlets were studied as part of the Massachusetts Estuaries Project (MEP, 2003). These inlets are in hydrodynamic quasi-equilibrium in terms of their morphodynamic stability. Velocities in juvenile inlets such as New Inlet in Chatham, created in 2007, may feature greater tidal velocities due to the tidal phase difference between ocean and embayment. However, these inlets are not yet

[1] A 'wetlab' could put Mass. in the lead in ocean energy race" Kirsner, September 19, 2010, Boston.Com.

in equilibrium and as such would not be good candidates for the emplacement of fixed structures. If a candidate site in a Cape embayment is found, it will likely be one where manmade structures are maintaining an artificial flow constriction.

At present, in Massachusetts, preliminary permits have been issued by the Federal Energy Regulatory Commission (FERC) to the Town of Edgartown to evaluate the tidal resource in Muskeget. They are in the process of working with technology partner Ocean Renewable Power Company (ORPC) to submit a pilot permit enabling installation of up to 5 MW of capacity. A preliminary permit filed by Cape Cod Tidal Energy for the Cape Cod Canal was filed on Aug 9, 2010 and is pending approval by FERC.

If a site within the planning area were identified, it is critical that the potential impact of the turbines be evaluated. Due to the removal of momentum, turbines can influence the sediment transport and local hydrodynamics including flushing rates of adjacent estuaries. Currently, a DOE-funded study is supporting the potential impacts of MHK devices to sediment transport and marine mammals in Muskeget Channel.

In the future, improvements of device efficiency, reduction of construction costs, and increases in electricity prices from fossil fuel power plants will all contribute to drive down the threshold velocity needed for economic viability of tidal kinetic energy extraction. However, for MHK devices the upper limit on efficiency is bounded by Betz law and as the power is proportional to the cube of the current speed it is not likely that tidal energy extraction will be viable in the planning area at a commercial scale at any point in the near future.

Data Gaps

The pilot projects discussed in both the wave and tidal energy studies previously discussed occur outside the planning area, but would require cables within it. Most notable is the wave energy pilot project beyond the Cape Cod Ocean Sanctuary (a Prohibited zone as defined by the OMP). It is unclear whether there are existing easements, as referenced in the study, which would permit a cable across the sanctuary and landfall access to support this type of offshore renewable energy development in the "prohibited" area.

Wind Energy

Wind turbines represent the most technologically advanced and deployable form of renewable energy development within the planning area. Average wind speeds in the planning area range from 6 – 8.5+ m/s (meters per second, measured at 50 meters asl), which represents optimal conditions for harnessing wind energy for all potential locations within the planning area. Additionally, the vast majority of the planning area has a water depth of less than 40 meters, which is desirable (in terms of cost effectiveness) for off-shore wind turbine development.

The determination of appropriate scale for the 24 turbines takes into consideration the many factors specific to the economics of off-shore wind and the unique characteristics of associated impacts from wind turbines, including; capital costs, transmission, net metering, spatial configurations, noise and flicker, hazardous materials, seabed geology, water depth, and need as defined by our region's current and projected demand for electricity. Appropriate scale also considers the abundance of natural resources within the planning area, as identified by the OMP, and by additional resource considerations identified in the planning process. Section 2C-9 and -10 provides a general framework of economic considerations for off-shore wind energy conversion facilities.

SECTION 2 OFFSHORE RENEWABLE ENERGY

2B: POTENTIAL RESOURCE IMPACTS

2B.1 - Seabed Impacts

Impacts to the seabed from the construction and operation of wind energy projects include temporary and permanent impacts associated with initial geotechnical investigations, construction vessels, wind turbine and transmission cable installation, maintenance activities, and decommissioning (MMS, 2009).[2] Geotechnical investigations, such as borings and test pits to sample sea-bottom sediments, would likely have only minor, local impacts to the benthic environment. Seabed impacts associated with boats during the construction and maintenance phases of a project may be temporary or of a more permanent nature depending on the substrate, but generally they are limited in area. Prop wash from vessels operating in shallow water may contact the sea-bottom and cause scour, sediment re-suspension, and a local increase in turbidity that may adversely affect benthic organisms. Large construction vessels and barges used during construction and routine maintenance would likely be supported by hydraulic legs or utilize spuds for positioning,[3] causing direct impacts to the seabed. Anchors and attached chains, which also disturb the seafloor (anchor sweep), may also be used for positioning. The extent of disturbance is limited and dependent on substrate type.

The installation of monopiles will directly impact the seabed and the associated sedentary infauna, while non-sedentary marine organisms would be displaced (Gill, 2005). The susceptibility of species and their resilience, as well as the processes determining community recovery after disturbance, is important in understanding the full ecological consequences of offshore wind energy development. The installation of foundations or transmission cables, for example, will disturb bottom sediments that may smother some benthic organisms as suspended sediments re-settle on the seafloor (CRMC, 2010).[4] The eggs and larvae of fish and other species may be especially vulnerable to burial. Turbidity generated by sediment disturbance may also affect the filtering mechanisms of certain species. The placement of wind turbines, especially in large arrays, may also alter tidal current patterns around the structures, which could affect the distribution of eggs and larvae. However, a study of turbines in Danish water found that the change in hydrodynamic regimes around the turbines had little to no impact on native benthic communities and sediment structure (DONG Energy et al., 2006).[5] Embedding submarine power cables by jet plowing or horizontal directional

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[2] Minerals Management Service, 2009. Cape Wind Energy Project, Final Environmental Impact Statement. Minerals Management Service, U.S. Dept. of the Interior. January 2009. Volumes 1-3.

[3] A spud barge is a vessel that uses heavy timber or pipe as a means by which to moor. The timber or pipe is located in a well at the bottom of the boat, and acts in the same function as would an anchor.

[4] Coastal Resources Management Council, 2010. Rhode Island Special Area Management Plan.

[5] DONG Energy, Vattenfall, The Danish Energy Authority, and The Danish Forest and Nature Agency. 2006. *Danish Offshore Wind: Key Environmental Issues*. November 2006. Available from: www.ens.dk

drilling also causes temporary impacts to the sea-bottom. Cables are typically buried in trenches 2 meters (6.6 ft.) wide and up to 3 meters (9.8 ft.) deep (OSPAR, 2008).[6]

The recovery of seafloor communities from disturbance appears to vary depending on substrate type and recruitment. Disturbance of coarse sand habitats, which are generally dynamic in character, recover more quickly than more stable communities where physical and biological recovery is slow (Hiddink et al., 2006).[7] Rock or other hard substrates with sessile (attached) species are more vulnerable to disturbance (BERR, 2008),[8] while clay, sand, and gravel habitats are generally less affected. Studies of dredging found recovery times of 6-8 months in estuarine muds, 2-3 years for sand and gravel substrates, and up to 5-10 years for coarser substrates (Newell et al., 1998).[9] In deeper waters, where disturbance of the seabed occurs with less frequency, recovery to a stable benthic community may take longer (sometimes years) than in shallow waters. The burial or removal of eggs and larvae of fish species during construction or decommissioning of a project, may delay recolonization of the affected area for months or years (Gill, 2005).[10] A study of the effects of sediment displacement from cable-laying found that macro-algae and benthic fauna were still recovering two years after the activity had ceased (DONG Energy et al., 2006).

Monopiles installed into the seabed by pile driving or vibratory hammer will generate noise and vibrations that are transmitted within the sediment column (as well as within the water column). Once in place, scour will occur around the monopile foundations depending on local sediment transport conditions. To mitigate for erosion impacts, scour control mats or rip-rap may be placed around the foundation, resulting in additional direct habitat impacts to the seabed. Direct habitat loss from the installation of turbines is estimated to be only 2-5% of the total area of a wind farm (Fox et al., 2006).[11] However, the effects of turbines may be greater if the underwater structures change current flows and patterns, causing seafloor scouring or burial of important habitat.

Sea ducks, including scoters, Common Eider, and Long-tailed Duck, which feed on benthic invertebrates (mollusks, crustaceans) and fish, are among the species most sensitive to direct seafloor habitat loss. These species overwinter in large flocks in the region, and typically feed in waters 10-65 ft. deep, although Long-tailed Ducks are capable of diving to depths of 200 ft. (60 m).[12,13] Optimal sea duck foraging locations are

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[6] OSPAR Commission. 2008. *Assessment of the Environmental Impact of Offshore Wind Farms.* Biodiversity Series. Available online at: www.ospar.org.

[7] Hiddink, J.G., Hutton, T., Jennings, S., and Kaiser, M.J. 2006. Predicting the effects of area closures and fishing effort restrictions on the production, biomass, and species richness of benthic invertebrate communities. *ICES Journal of Marine Science*, 63: 822- 830

[8] BERR (U.K. Department for Business Enterprise and Regulatory Reform). 2008. Review of Cabling Techniques and Environmental Effects Applicable to the Offshore Wind Industry. Technical Report 2008.

[9] Newell, R.C., Seiderer, L.J., and Hitchcock, D.R. 1998. The impact of dredging works in coastal waters: A review of the sensitivity to disturbance and subsequent recovery of biological resources on the sea bed. *Oceanography and Marine Biology: An Annual Review*, 36: 127-178.

[10] Gill, A.B. 2005. Offshore renewable energy: ecological implications of generating electricity in the coastal zone. *Journal of Applied Ecology, 42*: 605-615.

[11] Fox, A. D., M. Desholm, J. Kahlert, T. K. Christensen, and I. K. Petersen. 2006. Information needs to support environmental impact assessment of the effects of European marine offshore wind farms in birds. Ibis 148: 129-144.

[12] http://www.ducks.org/conservation/waterfowl-biology/diving-ducks-into-the-deep/page2 (Diving Ducks: Into the Deep (John M. Coluccy, Ph.D., and Heather Shaw)

generally restricted to water less than 164 ft. (50 m) deep, but are typically less than 31 ft. (10 m) (MMS, 2009). A Denmark study failed to find any evidence that the distribution of eiders was affected by turbines, but was correlated to changes in bivalve distributions (Guillemette and Larsen, 2002).[14] The impacts of habitat modification on sea ducks would likely be dependent on the location of the turbines in relation to suitable feeding locations.

In general, the significance of direct seafloor impacts from turbine installations to the larger ocean ecosystem appears to be comparatively low and localized relative to the impacts of wind energy development to the water column and the airspace above the water. In addition, although the monopiles and scour protection structures will displace some seafloor habitat, they will create hard-surface habitat. These artificial reefs will have a significant effect on local species composition and biological structure (Petersen and Malm, 2006),[15] attracting fish and other marine organisms that favor hard substrates. Colonization of introduced structures will cause a fundamental shift in the overall food web dynamics of the ecosystem, possibly resulting in further shifts in benthic diversity, biomass, and organic matter recycling (Gill and Kimber, 2005).[16] The smooth surfaces of monopile foundations, however, lack the structural complexity of natural rocky substrates which help protect resident organisms from predators and shield them from high velocity currents and scour. Organisms that attach to similar (smooth) surfaces, such as navigation buoys or pier pilings, include algae, sponges, tunicates, anemones, bryozoans, barnacles and mussels. Although the reef effect of new structures will result in local ecological changes, benthic and fish communities will likely not change significantly due to the comparatively minor change in the proportion of new hard-surface habitat and existing natural substrates. However, changes in abundance and species composition could degrade other components on the ecosystem (e.g., vulnerable or endangered species) through loss of habitat, increased predation, or increased competition for prey.

2B.2 - Water column Impacts

The installation of wind turbines and submarine power cables will introduce new structures to the marine environment along with noise, vibrations and electromagnetic fields associated with their operation and electricity production (Deese and Schmitt, 2010; Gill and Taylor, 2001)[17],[18]. Little is currently known about how these physical perturbations will affect the variety of undersea life including whales, seals, fish, lobsters and invertebrates.

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[13] http://www.avianweb.com/longtailedduck.html

[14] Guillemette, M., and J. K. Larsen, 2002. Post development experiments to detect anthropogenic disturbances: the case of sea ducks and wind parks. Ecological Applications 12:868-877.

[15] Petersen, Jens Kjerulf, and Torleif Malm, 2006. Offshore Windmill Farms: Threats to or Possibilities for the Marine EnvironmentAmbio Vol. 35, No. 2, March 2006.

[16] Gill, A.B., Kimber, J.A. 2005. The potential for cooperative management of elasmobranchs and offshore renewable energy development in UK waters. *Journal of the MarineBiological Association of the United Kingdom, 85*: 1075-1081.

[17] Deese, Heather, and Catherine Schmitt, 2010. Fathoming: What are the marine impacts of offshore wind turbines? The Working Waterfront, February-March 2010.

[18] Gill, Andrew B., and Helen Taylor, 2001. The potential effects of electromagnetic fields generated by cabling between offshore wind turbines upon Elasmobranch Fishes. Research Project for Countryside Council for Wales. CCW Science Report No. 488

The potential for noise disturbance from construction and operation of wind energy development is significant given the many species of whales, seals, fishes, and crustaceans that interact acoustically for communication, echolocation, finding mates or prey, and/or avoiding predators (Gill, 2005). Underwater sound effects associated with construction will mainly originate from pile drivers used to install the monopiles and noise from vessel traffic transporting supplies, materials, and workers. Noise generated by monopile construction (up to 260 decibels) may cause damage to the acoustic systems of species within 100 meters of the source, and are expected to displace mobile organisms (Nedwell, Langworthy and Howell 2004)[19]. The use of jet plows to install sub-bottom cables produce no audible sounds other than the noise of water exiting the nozzles which is only heard when close by (MMS, 2009).

Pile driving and other activities that generate intense pulses of noise during construction are likely to disrupt marine mammal behavior at a distance of many kilometers, and potentially induce hearing impairment at close range (Madsen et al., 2006).[20] Harbor porpoises reacted to pile driving operations up to 20 km from the sound source (Tougaard, 2009)[21]. Fish have shown startle and alarm responses when encountering a loud noise. Research also suggests fish can detect pile driving noise over large distances, and that the noise may affect intra-specific communication or cause injury or mortality at close range (Popper et al, 2003)[22]. The reported noise levels of operating wind turbines, on the other hand, are low and are unlikely to cause impaired hearing in marine mammals. The impact zones for marine mammals from operating wind turbines depend on several factors including the low frequency hearing abilities of the species in question, sound-propagation conditions, and the presence of other noise sources such as shipping. The significance of these disturbances to marine organisms will strongly depend on their frequency, intensity, and duration in relation to the sensitivity of the organisms and their ability to habituate to the noise. Noise impacts on marine mammals are more severe during the construction of wind farms than during their operation (Madsen et al., 2006).

Construction and operational noise associated with turbines could affect mating, migration, feeding, and mother-calf interactions of whales inhabiting the planning area, including the endangered Humpback Whale, Finback Whale, and Northern Right Whale (Deese and Schmitt, 2010). More important than the behavioral impact, however, is whether the behavioral change affects the long-term fitness of the individual animals and the local population as a whole (Bejder et al., 2006).[23] Habitat avoidance of the construction area during monopile installation (pile driving) and high vessel traffic may

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[19] Nedwell, J., Langworthy, J. & Howell, D., 2004. Assessment of Sub-Sea Acoustic Noise and Vibration from Offshore Wind Turbines and its Impact on Marine Wildlife; Initial Measurements of Underwater Noise during Construction of Offshore Windfarms, and Comparison with Background Noise. Subacoustech Report 544R0424 to COWRIE. The Crown Estate, London, UK.

[20] Madsen, P.T., et al., 2006. Wind turbine underwater noise and marine mammals: implications of current knowledge and data needs. Marine Ecology Progress Series, Vol. 309: 279–295, 2006

[21] Tougaard, J. et al., 2009. Pile driving zone of responsiveness extends beyond 20 km for harbor porpoises (*Phocoena phocoena* (L.)) (L). J. Acoust. Soc. Am. 126 (1), July 2009

[22] Popper, A.N., Fewtrell, J., Smith, M.E. & McCauley, R.D., 2003. Anthropogenic sound: effects on the behavior and physiology of fishes. Marine Technology Society Journal, 37, 35–40.

[23] Bejder, L., Samuels, A., Whitehead, H., and Gales, N., 2006. "Interpreting short-term behavioural responses to disturbance within a longitudinal perspective," Animal Behavior. 72, 1149–1158.

result in temporary habitat loss for marine mammals and reptiles but would not be expected to cause permanent changes in prey abundance and distribution (MMS, 2009).

Mitigation measures currently being considered to reduce construction noise impacts to marine mammals include bubble curtains or fixed screens that act as sound barriers around the piles as they are being installed.[24] A recent report, however, recently found that bubble curtains were not very effective in areas with significant tidal currents but that fixed screens could be effective. Pingers, seal-scarers, or other Acoustic Deterrent Devices designed to repel marine mammals and keep them sufficiently far away from damaging noise sources (e.g., pile driving) that may cause physical injury have met with varying degrees of success. Deterrents using noise may work well for cetaceans who use vocalizations and echolocation for communication and exploration. However, the use of acoustic noise devices adds to the overall noise levels in the ocean and animals can become habituated to these devices.[25]

It is unlikely that increased vessel traffic during construction would significantly contribute to the risk of vessel strikes of whales or sea turtles, since boats moving at slower speeds (e.g., construction vessels) are less likely than faster moving vessels to cause collisions. Construction impacts to marine species that are seasonally present (such as some cetaceans and sea turtles) may be avoided or reduced if construction is scheduled during times of year when these species are absent.

High voltage cables that transmit power between offshore wind farms and the mainland have the potential to interact with aquatic animals that are sensitive to electric and magnetic fields (e.g., migratory fish, elasmobranchs, mammals, chelonians and crustaceans). The electrosensitivity of fish, especially sharks, skates and rays, has been found to influence statistically significant changes in behavior around submarine power cables (Gill, 2005). Magnetic fields may affect marine mammals that use the Earth's magnetic field to navigate. While the sensitivity of American lobster to magnetic fields is unknown, other invertebrates, such as the spiny lobster, are known to be magneto-sensitive. Whether there is any link between these organisms and the magnetic fields associated with offshore wind energy infrastructure is unknown (Gill, 2005).

2B.3 - Impacts to Birds and Bats

Wind turbines can impact birds and bats in several ways including direct mortality from collisions, displacement due to disturbance and/or a "barrier effect," and direct habitat loss (Drewitt and Langston, 2006; Fox et al, 2006; Exo et al., 2003).[26,27] These impacts can cause changes in foraging and flight behavior resulting in increases in energy expenditure, decreased breeding success, or increased mortality. The additional stress to birds from wind turbines, combined with existing stressors faced by avifauna, has the potential to place certain bird populations, such as peregrine falcons, at a greater risk.

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[24] IFAW, 2008. Ocean Noise: Turn it down. June 2008

[25] Cox, et al., 2001. Will harbor porpoises (Phocoena phocoane) habituate to pingers? Journal of Cetacean Research and Management 3:81-86.

[26] Drewitt, Allan L., and Rowena H.W. Langston, 2006. Assessing the impacts of wind farms on birds. Ibis, 148, 29–42

[27] Exo, K. M., O. Huppop, and S. Garthe. 2003. Birds and offshore wind farms: a hot topic in marine ecology. Wader Study Group Bulletin 100: 50-53.

Collisions can occur either with the tower, the rotating blades, or the birds can be forced to the water by the vortex created by the moving rotors. Although there is little data available on bird collisions with offshore structures, there is documentation of birds colliding with lighthouses, offshore oil rigs, and offshore marine facilities (Huppop et al., 2006).[28] Weather conditions can affect the altitude of flight and many birds in good weather fly at altitudes well above turbines. For example, it is generally accepted that nocturnally migrating passerines generally fly at high altitudes (Mabee et al., 2004)[29] except during poor weather (e.g., fog, drizzle). Conditions of low cloud cover and strong head winds may force birds to fly much lower altitudes and potentially at turbine height (Drewitt and Langston 2006). Radar surveys of diurnal and nocturnal flight activity during four migration seasons in Nantucket Sound were conducted to determine passage rates and flight heights (MMS, 2009). Average flight heights during the day were generally lower than at night across all seasons and years. In addition, a greater percentage of birds were observed flying at altitudes below the proposed maximum turbine height (440 ft.) during the day than at night, probably reflecting the day migration of waterbirds and migrating neotropical songbirds that typically fly at higher altitudes at night. The attraction of birds to illuminated structures, especially during overcast, foggy or drizzling weather conditions, is well documented (Drewitt and Langston 2006; Fox et al. 2006). Birds (or bats) that collide with offshore turbines are placed at greater risk than those that collide with structures in terrestrial settings, since they are more likely to die by drowning.

Some groups of birds, such as sea ducks and geese, expend additional energy by avoiding wind farms during daily movements and migration. This "barrier effect," or loss of habitat through avoidance, is highly variable and depends on species, season, local wind patterns, and many other site-specific conditions. Displacement can lead to overcrowding and competition at alternative feeding sites and ultimately result in mortality of more vulnerable species (MMS, 2009). Sea ducks, including Long-tailed Duck, Common Eider, and Black Scoter, are among the most vulnerable bird species to wind farms due to avoidance behavior and consequent habitat loss. In contrast, the flight patterns of gulls and terns appear to be less affected by the barrier effect (Everaert and Stienen, 2006).[30] To date, no evidence of population-level effects due to displacement by wind turbines has been demonstrated, although impacts may be significant if a turbine array blocked flight paths between breeding and feeding areas (Drewitt and Langston, 2006). Birds that exhibit avoidance have a lower probability of collision mortality.

Birds can also be displaced during construction and operation by noise and vibration of the turbines, or by maintenance activities. For species that are not displaced by turbines, research suggests that the longer a wind farm has operated the greater the decrease in bird abundance (i.e., wind farms could cause declines in sea duck abundance over decades) (Stewart et al., 2007).[31] Food availability for piscivorous (fish eating) birds may be diminished if the vibrations of the turbines influence fish distributions. As mentioned

[28] Huppop, O., J. Dierschke, K. M. Exo, E. Fredrich, and R. Hill. 2006. Bird migration studies and potential collision risk with offshore wind turbines. Ibis 148: 90-109.

[29] Mabee, T.J., B.A. Cooper, and J.H. Plissner, 2004. Radar study of nocturnal bird migration at the proposed Mount Storm Power Development, W. Va., Fall 2003. Final Report.

[30] Everaert, J., and E. W. M. Stienen. 2006. Impact of wind turbines on birds in Zeebrugge (Belgium). Biodiversity and Conservation: DOI 10.1007/s10531-006-9082-1.

[31] Stewart, G. B., A. S. Pullin, and C. F. Coles. 2007. Poor evidence-base for assessment of windfarm impacts on birds. Environmental Conservation 34: 1-11.

above, however, underwater structures may act as artificial reefs, increasing fish density and consequently the number of piscivorous birds (i.e., only those not avoiding the wind farm).

Wind turbines may also be a significant hazard to bats, especially during migration (Kunz et al. 2007, Arnett et al. 2007).[32,33] Although bats inhabit islands in Nantucket Sound, little is known about the frequency with which bats fly over surrounding water bodies (MMS, 2009). Of the seven bat species occurring in the region, the Silver-haired Bat, Eastern Red Bat, and Hoary Bat are long distance migrants, and are most likely to be traveling over Cape Cod waters. The other four species (Big Brown Bat, Little Brown Myotis, Northern Myotis, Eastern Pipistrelle) have been documented on Martha's Vineyard and thus also cross saltwater, but these species tend not to travel long distances between their hibernacula and summer ranges. In addition to direct strikes, bats can die from pulmonary lesions caused by pressure changes around turbine blades (Baerwald, 2008).[34] More information is needed to assess bat occurrence and flight behavior in the planning area, as well as the potential for turbines to attract bats as potential roost sites or the potential noise interference of turbines to bat acoustical detection (MMS, 2009).

2B.4 – Impacts to Visual Resources

With 24 ocean wind turbines allocated to the region under the State Ocean Management Plan, and the potential for more in the future, development has the potential to alter the character and impact the Cape's scenic resources. These impacts could occur during both construction/decommissioning and operation. Construction/decommissioning impacts are likely to be more temporary in nature as equipment is moved between individual turbines sites, service platform locations or along cable routes. The operational impacts on scenic resources in the region is potentially great due to the size, scale and characteristics of this kind of development such as the large moving parts, color, lighting, etc. Structures of such scale in the ocean environment are likely to be visible from large stretches of the Cape's coastline, however, the magnitude of any visual impact will be dependent on a number of factors. These include the extent a development is visible, the duration it is visible, the nature, scale and proximity of the development to the view or viewer, and, the context in which they are being viewed (i.e. the character and type of landscape at the viewpoint).

Visibility

Several factors affect the visibility of a turbine facility, each of which are briefly discussed below.

Curvature of the earth

The curvature of the earth has the potential to obscure objects placed large distances away from a viewpoint, however, objects that extend above the water level will

[32] Kunz, T. H., E. B. Arnett, B. A. Cooper, W. I. P. Erickson, R. P. Larkin, T. Mabee, M. L. Morrison, J. D. Strickland, and J. M. Szewczak. 2007. Assessing impacts of wind energy development on nocturnally active birds and bats. Journal of Wildlife Management 71:2449–2486.

[33] Arnett, E. B., K. Brown, W. P. Erickson, J. Fiedler, B. L. Hamilton, T. H. Henry, A., Jain, G. D., Johnson, J., Kerns, R. R. Kolford. 2008. Patterns of fatality of bats at wind energy facilities in North America. Journal of Wildlife Management. 72: 61–78.

[34] Baerwald, E., G. D'Amours, B. Klug, R. Barclay. 2008. Barotrauma is a significant cause of bat fatalities at wind turbines. Current Biology 18: 695-696.

appear visible under clear conditions well beyond the horizon, depending on the height of the structure. This principle is illustrated in the following diagram.

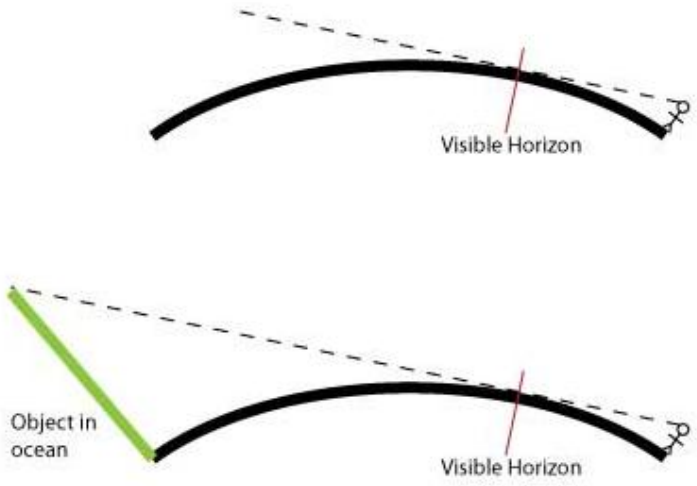

Figure 2-1: Effect of the curvature of the earth on visibility

It is possible to calculate the outer limit that a structure may be theoretically visible before being obscured behind the horizon[35]. This distance was calculated from sea level (representing the lowest elevation) and from 306 feet (representing the highest land elevation on Cape Cod (Pine Hill, Bourne)). The results are illustrated in the table below.

Observer Point	Height above sea level	Distance to horizon (miles)	Distance away a 450ft structure would have to be in order to be invisible beyond horizon.
Sea Level	0	2.89	28.87
Pine Hill	306	21.62	47.59

It is important to emphasize that this illustrates the "theoretical" distance at which structures of this size could be visible and represents the outer limits of any potential viewshed for ocean turbines in the planning area. For comparative purposes, at its widest the planning area is approximately 50 miles from east to west (west of Falmouth in Buzzards Bay to East of Wellfleet) and approximately 50 miles from north to south (north of Provincetown to south of Monomoy).

Although this data indicates that an ocean turbine is potentially visible throughout the region and beyond, this data alone does not indicate whether there is a visual impact due to its dominance or prominence in the viewshed.

[35] Formula for calculating distance to the visible horizon(d): $d=\sqrt{(h(D+h)}$ (D=diameter of the earth (7918 miles), h=eye height of observer above sea level (in miles)). To calculate the distance an object can be seen, calculate the distance to the visible horizon for both the observer, and a point at the top of the object, and add the two together.

Atmospheric conditions

The main atmospheric conditions that affect visibility are: weather conditions (including rain, clouds and fog), air quality and the angle of the sun. These elements tend to obscure distant objects, alter their color and sharpness and hinder the observer's ability to judge distance and scale (Hill et al.). These affects are ephemeral or seasonal in nature and therefore difficult to demonstrate and measure in the field. However, it is important to establish the degree to which they may affect visibility in the region for comparative purposes.

Data concerning the visibility in the region is available from the Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA). Also, the Interagency Monitoring of Protected Visual Environments (IMPROVE) program gathers information concerning air quality. IMPROVE is a partnership program of several federal and state agencies including NOAA, EPA, National Park Service, Forestry Service, Bureau of Land Management and others (a full list of committee members can be found at: http://vista.cira.colostate.edu/IMPROVE/improve_steering_committee.htm.

In a 1976 study, the EPA identified that median visibility in our region ranges between 15 and 25 miles both annually and in the summer. The study included isopleths maps that illustrated these levels, as shown in Figure 2-2.

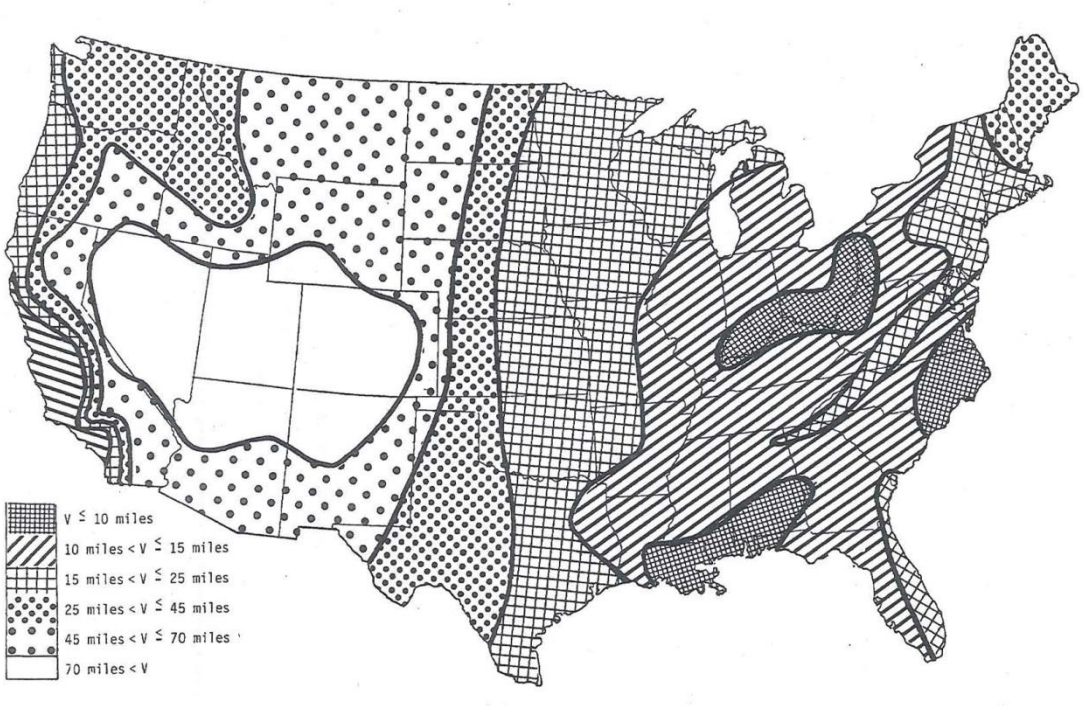

Figure 2-2: Shaded isopleth map of yearly visibilities, Trijonis 1976

More recently, the IMPROVE program has published information relating to the types of particles in the atmosphere and their effects on visibility.

This information is shown in Figure 2-3. The map shows haziness and visibility in terms of deciviews (dv), which is a measure developed by scientists to account for perceived changes in visibility over all atmospheric conditions. The lower the deciview value, the greater the visibility. For our region, and converting deciviews to miles, visibility ranges between 40 and 49 miles.

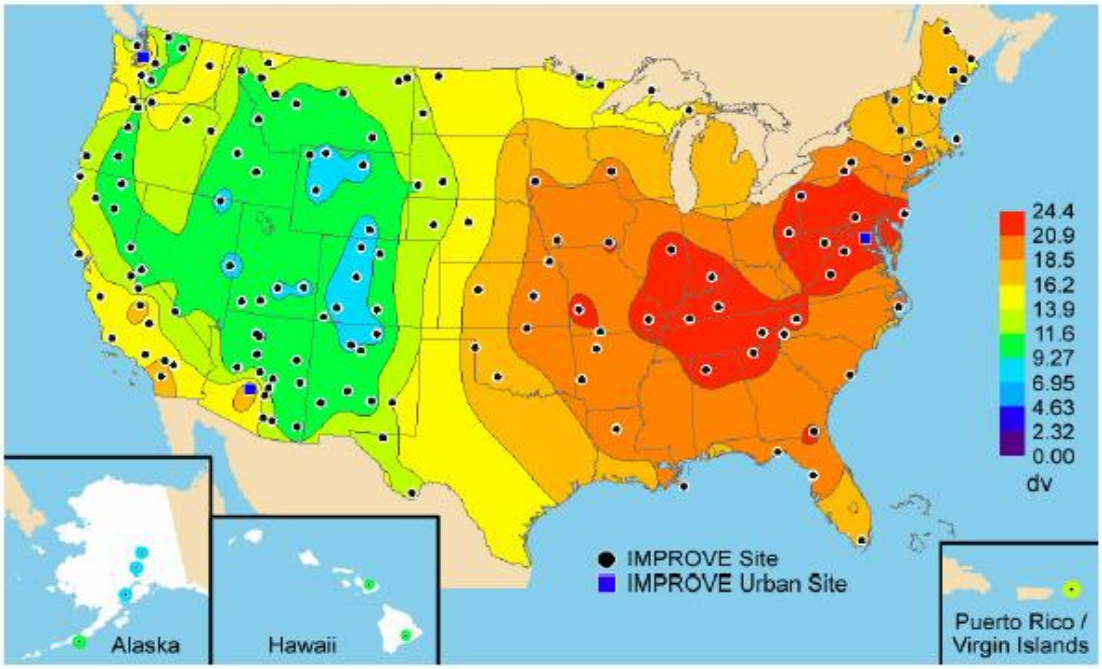

Figure 2-3: Five year average (2000-2004) deciviews, Debell 2006

In addition to this data, hourly visibility records have been provided by NOAA, Northeast Regional Climate Center at Cornell University for three locations on Cape Cod: Chatham Municipal Airport; Provincetown Airport; and, Barnstable Municipal Airport. The data collected includes hourly visibility records for 2009, which was grouped based on the visibility reported. For each location, the percentage of the total was calculated for each of the distance categories (shown in the table below). The data shows that for each of these three locations the visibility range is in excess of 3 miles approximately 90% of the time, and between 80% and 85% of the time is greater than 6 miles. To provide some context, 85% of the planning area is less than 6 miles from the coast. Therefore, the vast majority of the time development in most locations in the planning area would potentially be visible and not obscured from view by atmospheric conditions.

	0-0.4 m	0.41-1.5 m	1.51-3 m	3.1-6 m	6.1 m and more
Hyannis	1%	4%	5%	7%	82%
Provincetown	1%	4%	4%	6%	85%
Chatham	1%	5%	5%	6%	80%

Scale, distance, texture, color and contrast

As the ocean environment is roughly of the same appearance, it offers few clues to help judge how far away a point in the water lies, or the size of an object in the ocean. As noted above, atmospheric factors also affect people's ability to judge scale and distance of objects in the ocean. Where views include other objects or landforms, i.e. a headland, or structures, scale and distance may be more easily judged but this will depend on the proximity of the structures to these objects.

The contrast of an object with its background will be a factor in determining the visibility to the human eye. Contrast can be described as the difference in brightness between two objects. The brightness of an object is dependent on the number of molecules in the atmosphere that reflect and scatter the light; the more molecules the light passes through, the whiter the sky will appear (Scott, et al.). At the horizon, the sky is lightest and as bright as it can be because the light travels through more air mass.

Wind turbines that are light colored will be less visible on a clear day where the sky color is light/bright, however, the same color turbines will have a much greater contrast with a stormy or cloudy sky. The degree to which turbines contrast is also dependent on whether land is visible as a background, a background landmass appearing dark and contrasting with lighter turbines. Similarly, the degree to which objects are front-lit or back-lit will also affect the contrast with their background. The color of background objects, including vegetation and rock color, also play a role in the degree to which there is contrast between a structure and its surroundings.

A 2007 study by Bishop and Miller assessed wind turbine visibility and their impact at different distances from the viewer, different lighting and atmospheric conditions, and with moving or stationary blades. From this study, the authors concluded that distance and visual contrast were found to be very good predictions of perceived impact. The study also highlighted that there was significant difference in impact between simulations with moving versus stationary blades, with moving blades being more positively viewed.

Opinion Poll

Opinions about visual impacts resulting from wind turbine development varies significantly due to the subjective and personal nature of these visual experiences and the difficulty in visualizing potential alterations in the landscape. The result is often a divisive and contentious review of development proposals.

As part of this planning process, the Cape Cod Commission conducted an opinion poll to attempt to gauge public preference for the siting of wind turbines in the ocean and to supplement the baseline inventory data collected. The Commission developed visual simulations of different turbine array configurations at different distances from shore to assess people's reactions to scale and distance thresholds. These simulations were accompanied by a brief opinion poll that was conducted at a variety of public places in the summer and fall of 2010. The images presented arrays of 24 turbines set at different distances from the viewer (at 0.3, 1.5, 3 and 5 nautical miles from the viewer). Three

settings were used to test people's reaction to the scale and distance of the turbine array: a harbor setting, a marsh setting and a beach setting. The respondents were asked to identify how many turbines they could see in the image, and to rate the impact of the turbines on their view from "very positive" from "very negative".

Figure 2-4: Sample of opinion poll image, harbor setting with turbines located 0.3 nautical miles from viewer.

Preliminary results from the poll indicated that there was no statistical difference in respondents' attitudes to wind turbines between the three settings illustrated, nor was there a statistical difference between responses from visitors or residents. However, there was a trend in the attitudes of respondents as distance increased, with respondents generally reacting more favorably to turbines located further away. Although these findings are not statistically significant, the results do support other studies consulted throughout the planning process supporting distance as a key variable in people's attitudes toward wind turbines. The results show that if turbines were placed at the outer limits of the planning area (i.e. at 5 miles), opinions about the turbines were more positive than opinions concerning turbines located closer, but that opinions remained divided. At 1.5 miles away, the majority of the opinions were either negative or very negative. A more detailed methodology for the development of these images, the locations the poll was conducted, and a sample survey form and images are attached in Appendix 4.

SECTION 2 OFFSHORE RENEWABLE ENERGY

2C: Requirements and Constraints for Offshore Wind Energy Development

2C.1 - Introduction

Offshore wind turbines range in scale from 2 – 5 MW of installed capacity (i.e the maximum output of a wind turbine at optimum wind speeds), although larger machines (10+ MW) are currently in the planning and design stages. Generally, with greater scale comes improved cost-effectiveness, primarily because larger turbines are configured with a much larger rotor diameter (or "blades") resulting in a greater swept area for improved power output.

It is important to note the distinction between installed capacity and power output, expressed as capacity factor. Capacity factor is represented by a ratio of the actual energy produced in a given period to the hypothetical maximum possible. For instance, if a 2 MW turbine was in operation at full power 24 hours a day, 365 days a year under a consistent wind speed, over 17 million kilowatt hours of electricity could be generated. Wind, however, is an intermittent resource and wind speeds are variable. A 25% capacity factor may be considered average for land-based wind in our region, which may only result in that same 2 MW turbine generating approximately 7 million kilowatt hours a year[36]. Capacity factors for off-shore installations are projected to be greater than 30% due to better wind resources and larger turbines, which may result in greater power output. These power output calculations are modeled for a given site based on wind speed measurements and installed capacity, and weigh heavily in any project cost analysis.

2C.2 - Transmission

Generally, the shorter the transmission distance the more cost effective the project (assuming suitable landfall interconnection). Similarly, economies of scale are achieved through proposals for larger facilities (i.e multiple turbines) with one-time capital and infrastructure costs to maximize cost effectiveness.

2C.3 - Net Metering

The Massachusetts Green Communities Act, 2008 (GCA) established net metering, or the process of measuring the difference between electricity delivered by a Distribution Company and electricity generated by a Class I, Class II, Class III or Neighborhood Net Metering Facility and fed back to the Distribution Company (MA 220 CMR 18.00). Net metering facilities are classified as follows:

- "Class I" Net Metering Facility (e.g wind turbine) means a plant or equipment that is used to produce, manufacture, or otherwise generate electricity and that is not a transmission facility with a design capacity of 60 kilowatts or less. 220 CMR: DEPARTMENT OF PUBLIC UTILITIES
- "Class II" Net Metering Facility means an Agricultural Net Metering Facility, Solar Net Metering Facility, or Wind Net Metering Facility with a generating

[36] Renewable Energy Research Laboratory, University of Massachusetts at Amherst. **W**ind Power: Capacity Factor, Intermittency, and what happens when the wind doesn't blow?

capacity of more than 60 kilowatts but less than or equal to one megawatt; provided, however, that a Class II Net Metering Facility owned or operated by a Customer which is a municipality or other governmental entity may have a generating capacity of more than 60 kilowatts but less than or equal to one megawatt per unit.

- "Class III" Net Metering Facility means an Agricultural Net Metering Facility, Solar Net Metering Facility, or Wind Net Metering Facility with a generating capacity of more than one megawatt but less than or equal to two megawatts; provided, however, that a Class III Net Metering Facility owned or operated by a Customer which is a municipality or other governmental entity may have a generating capacity of more than one megawatt but less than or equal to two megawatts per unit.

The current cap for all net metering projects statewide for NSTAR is approximately 50 MW, which was 1% of NSTAR's peak demand when the GCA was signed. Since the GCA was signed, this cap has been raised to 3%.

2C.4 - Spatial Considerations

Choices about spacing between wind turbines reflect engineering considerations to optimize energy conversion of the wind resource and minimize turbulence in the blade swept area; however, spacing choices may also reflect consideration of other uses and resources within the planning area. The spatial configuration proposed by the Cape Wind project positions turbines in a grid ranging from a half mile apart by third mile apart (800 – 500 meters). The greater distance is perpendicular to the prevailing wind to account for wind turbulence and array effects that may result in operating inefficiencies. Common siting distances between turbines in the European Union commonly range between 500 and 1,000 metres.[37] Grid configurations are only necessary for groups of turbines, smaller number of turbines may also be arranged in a single row, cluster or other configuration that may reduce the spatial extent of the development.

2C.5 - Noise and Flicker

Computer generated noise models, based on ambient sound level measurements, are a widely practiced method for addressing potential noise impacts during the permitting process for wind turbines. However, these models can be somewhat problematic as to the actual impacts post-construction given the type of noise generated by turbines, the variability of different individuals' sensitivity to noise, and the noise regulations in place. The MassDEP Noise Policy (310 CMR 7.10) states that increases in broadband sound level cannot exceed 10 dB(A) over ambient, or produce a pure tone condition. The application of this noise policy to the permitting of land-based wind turbines has been difficult in some areas, as noise impacts persist even though the project appears to be in compliance with the regulation. One explanation for this is that the MassDEP Noise Policy does not address the intermittency, low frequency (infrasound), and vibration characteristics described in sound complaints made by those living in close proximity to commercial scale (1 MW or greater) wind turbines. While there is considerable debate around the appropriate setbacks to protect against these impacts -- due to complicated site specific factors of topography, wind direction and speed, atmospheric conditions, and seasonal factors -- the further the distance between a commercial scale wind turbine

[37] Greening Blue Energy: Identifying and managing the biodiversity risks and opportunities of off shore renewable energy, Dan Wilhelmsson *et al*, 2010.

and sensitive receptors, the greater the potential for a reduction in noise (and associated sound) impacts from wind turbines.

While sound travels more efficiently over water than land, due to less topographic interference (among other factors), there is some uncertainty over the distance at which potential noise impacts from off-shore wind turbines becomes a concern. Additional study in this area will be useful for establishing appropriate and informed regulations for siting offshore wind turbines.

Flicker, or shadow flicker to which it is often referred, occurs typically on land when the position of the turbine and blades falls between the setting or rising sun and a sensitive receptor, such as abutting residences. Topography and tree canopy are contributors to mitigating potential impacts for land-based turbines; however potential impacts of flicker across open water are unknown, and impacts from distances both near and far should be modeled during any regulatory review process. The turbine blades' ability to catch light and reflect it in a flicker effect when rotating should also be modeled.

2C.6 - Hazardous Materials

Utility scale wind turbines (i.e greater than 1 MW) contain large quantities of petroleum-based lubricants within the nacelle of the turbines. Quantities typically range from 400 – 500 gallons per turbine and increase proportionate to scale. Additionally, large quantities of hazardous materials are present during construction and decommissioning, contained within cranes, service platforms and shipping vessels. Similar to the Commission's water resources protection practices for proposed land based development a, Spill Prevention, Control and Countermeasures Plan is essential as part of any proposed development to address these unknowns on a project specific basis.

2C.7 - Seabed Geology

As has been previously discussed in the Natural Resources section, bedrock beneath Cape Cod is buried by thick deposits of glacial sediments and does not outcrop anywhere on the Cape (Oldale, 2001). Tidal currents, wind and waves, storms, and ongoing sea-level rise have reworked the glacial sediments, forming the contemporary coastal and marine environments of Cape Cod and its surroundings. At the present time, only the general character of the ocean bottom in the planning area is known.

Of the various foundation types presently available for offshore installations, gravity foundations, monopile foundations, and tripod and jacket foundations are the most feasible. Of these, monopiles are the most likely technology to be used within the planning area (up to depths of 30 meters). Monopile installation relies on sandy, muddy, or gravelly substrate, which is consistent with what we know about the seabed geology within the planning area.[38]

2C.8 - Water Depth

The bathymetry of the planning area is varied and includes: the broad, relatively flat sea-bottom of Cape Cod Bay, the complex sand ridge and shoal fields of Nantucket and Vineyard Sounds, and the comparatively steeply sloping near- and offshore zones of the Atlantic Ocean just east of outer Cape Cod. Cape Cod Bay ranges from less than 10 meters (30 ft.) deep near the bay margins to waters over 40 meters (130 ft.) deep at the

[38] Greening Blue Energy: Identifying and managing the biodiversity risks and opportunities of off shore renewable energy, Dan Wilhelmsson *et al*, 2010

northern edge of Cape Cod Bay. Most of the planning area south of Cape Cod (Nantucket and Vineyard Sounds) is within the 10 meters (30 ft.) depth contour due to significant shoaling, but increases locally to depths of 20 meters (65 ft.) or more in swales between sand ridges.

The National Renewable Energy Laboratory (NREL)[39] notes optimal water depths of up to 30 meters as the most cost effective for off-shore wind energy development, while also acknowledging that emerging technological advances in mooring systems may in the future support deepwater (60+ meters) floating wind turbine structures. For the purposes of the planning process, water depths between 20 and 30 meters are considered optimal areas for wind turbine development. Areas less than 20 meters are critical diving duck habitat (see bathymetry on Map 1). It is therefore recommended these areas be removed from initial consideration for preferred sites. This natural resource consideration is discussed in more detail in Section 2B.

2C.9 - Current and Future Regional Electrical Demand

Forecasted demand for the Southeastern Massachusetts region (SEMA as defined by ISO-NE) is provided for context.

SEMA 50/50 Summer Peak Forecast (MW) [40]			SEMA 90/10 Summer Peak Forecast (MW) [41]		
	2010 Forecast	2009 Forecast		2010 Forecast	2009 Forecast
2010	2,875	2,970	2010	3,095	3,170
2011	2,925	3,010	2011	3,145	3,215
2012	2,970	3,050	2012	3,200	3,260
2013	3,010	3,085	2013	3,240	3,300
2014	3,050	3,120	2014	3,285	3,340
2015	3,100	3,165	2015	3,340	3,385
2016	3,135	3,205	2016	3,385	3,425
2017	3,175	3,240	2017	3,425	3,465
2018	3,210	3,270	2018	3,465	3,505
Average Annual Change	42	38	Average Annual Change	46	42
Compounded Annual Growth rate	1.4	1.2	Compounded Annual Growth rate	1.4	1.3

[39] Large-Scale Offshore Wind Power in the United States, Executive Summary, NREL. September, 2010.
[40] The 2010 Forecast is the ISO New England Forecast for SEMA produced on April 2010.
[41] The 2009 Forecast is the ISO New England Forecast for SEMA produced on April 2009.

Note: 50/50 means that there is a 50% chance of exceeding the forecast and a 50% chance of being less than the forecast. 90/10 means there is a 10% chance of exceeding the forecast and a 90% chance of being less than the forecast.

A hypothetical framework for considering these numbers could be 24 turbines x 3.5 MW = 84 MW of installed capacity, which is 2.7% of the SEMA 90/10 Summer Peak Forecast for 2010 (before capacity factor is considered).

2c.10 - Economics of Wind[42]

The primary challenge to offshore wind energy development is cost reduction. Developing the necessary support infrastructure requires one-time costs for customized vessels, port and harbor upgrades, new manufacturing facilities, and workforce training. Typically, capital costs for offshore wind projects are twice as high as land-based installations, but this may be partially offset by potentially higher energy yields—as much as 30% or more. In general, three primary cost categories for off-shore wind energy conversion facilities are the most relevant to the siting questions addressed in this plan; the turbine, foundations and substructure, and transmission infrastructure. Additional costs pertaining to construction, insurance, operation and maintenance, and decommissioning are uncertain and discussion of these factors at this stage would be speculative. (To offer a frame of reference on potential project cost, a recent financial assessment for an off-shore wind facility in Hull, MA consisting of four 3 – 5 MW turbines estimated a total project cost of between $45 and $53 million.[43])

To make offshore wind energy more cost effective, some manufacturers are designing larger wind turbines capable of generating more electricity per turbine, such as 10-MW turbine designs. These turbines may be 500 – 600 ft in height. In general, capital costs increase as distance from land and water depth increases, and decrease as the size of a project (number of turbines or total MW) increases, as a result of economies of scale. As the technology matures, prices are expected to decline.

Project developers must analyze projects in terms of their initial installed capital cost (ICC) as well as their life-cycle costs, also known as the levelized cost of energy (LCOE). Projections of either ICC or LCOE costs for the U.S. market are difficult because of the many regulatory and technical uncertainties and the lack of U.S. market experience. The ICC has been increasing over time. Costs jumped approximately 55% between 2005 and 2007, leading to an estimated average capital investment of $4,250 per kW for an offshore wind project in 2010; the wind turbine itself contributes 44% of this total.

At this time, it is difficult to ascertain a detailed cost framework for development within the planning area due to uncertain development timeframes, scale and project location. As part of a comprehensive permitting program, detailed financial assessments should be developed on a site-specific basis for any proposed project to better understand the economic conditions in place at the time a project is proposed.

2c.11 - Cable Connections

Cables are required to connect individual turbines within a wind energy installation, and then when bundled together, to transmit that energy to the coast. While cables may be buried, there may remain constraints on other activities (e.g. trawling) within an

[42] The National Renewable Energy Laboratory, Large-Scale Offshore Wind Power in the United States, Executive Summary, September 2010.

[43] Hull Offshore Wind Financial Assessment, LaCapra Associates. February 4, 2010.

installation area. Similarly, cables transmitting energy between a generating facility and the coast require connections at the coast that may or may not require disturbance of land-based resources, including construction of a structure to accommodate the cable connection to the existing electric transmission network. For the purposes of both contemplated and planned future wave, tidal and wind energy conversion facilities beyond the planning area, as well as wind energy conversion facilities within the planning area, the location of cables and their associated impacts become an important component of infrastructure planning for the planning area. There may be an opportunity to coordinate cable connections between different types of energy projects, and/or to limit cable landfalls in order to manage impacts to coastal resources.

2c.12 - Renewable Energy Decommissioning

Additional information is needed regarding decommissioning of wind facilities. Depending on installation method, wind facilities may create foundations in the ocean floor that may be difficult to remove without additional damage to the environment. Complete removal of foundations may require blasting that can harm marine life. With complete removal of wind installations potentially more environmentally damaging than partial removal, abandoned foundations within shallow waters may become permanent hazards to navigation or fishing efforts.[44]

Given that the life span of an average offshore wind farm is estimated to be 25 years, little evidence has been collected on the issue of decommissioning. Several reports suggest experiences from the oil and gas sector can be adapted for off shore wind farms. In a manner similar to oil rigs, decommissioned wind turbines can be disassembled and recycled or, discarded to landfill, or be reconditioned and reused. There are three primary approaches to decommissioning; complete removal, toppling (i.e leave the sub-structure in place and remove the top), and continual upgrades.[45] Given the data gap around decommissioning, public safety concerns should best be addressed on a case-by-case basis.

Decommissioning plans that include bonding should be required as part of any regulatory framework that will allow wind energy development within the planning area. Additional considerations for decommissioning in the event that turbines become inoperable or disabled for more than an extended period of time should also be examined as part of a regulatory framework. This will help maintain the public trust by providing surety for timely decommissioning, as well as promote responsible operation and maintenance of wind energy conversion facilities within the planning area.

[44] Wilhelmsson, D. Greening Blue Energy. IUCN 2010.
[45] Greening Blue Energy: Identifying and managing the biodiversity risks and opportunities of offshore renewable energy, Wilhelmsson et al., 2010.

SECTION 2 OFFSHORE RENEWABLE ENERGY
2D: FACTORS IN DETERMINING APPROPRIATE SCALE

2D.1 - Introduction

The legislature directs the Cape Cod Commission to define the appropriate scale for wind turbines within Cape Cod Bay, Nantucket Sound, Buzzards Bay, and the Cape Cod Ocean Sanctuary[46]. Furthermore, it also directs that the Cape Cod Commission review offshore renewable energy facilities as Developments of Regional Impact. To that end, the Cape Cod Commission within this Ocean Management Plan defines appropriate scale for Cape Cod as directed by its Policy Committee and Joint Regulatory/Planning Committee and the cumulative public process over the last 2 years. This determination of appropriate scale for Cape Cod shall be taken into consideration in conjunction with its Development of Regional Impact review process, as its appropriate scale determinations inform DRI review. To address that charge, the Policy Committee examined several factors that play a role in determining appropriate scale. The following section analyzes the criteria that were considered in making this determination for renewable energy development in Cape Cod's ocean waters, and makes recommendations for balancing the protection of sensitive resources with the potential for wind energy development.

2D.2 - Management Considerations

Community Scale Wind projects are the only renewable energy projects which are likely to move forward in the planning area within the next five to ten years. The only location that may support commercial scale renewable energy projects that the state identified in the OMP and which is also within the planning area is the Provisional Area P3 in Cape Cod Bay. Commercial Scale wind projects may become viable within the next ten years and beyond.

The CCOMP utilized the state designated SSUs (core habitats for critical species) and existing human activity areas to define the Community Scale and Provisional Wind Energy Areas. As a result of additional data, analysis and local discussions, the CCOMP definition of appropriate scale has refined the state's management areas and the activities that are permitted within them, specifically to address Cape Cod resources and interests. Recommendations are made for delineating specific areas (marine spatial planning) where wind energy conversion facilities should not be located, and for performance standards that may further regulate the location, design, and impacts of these facilities. The following is a summary of each factor used in determining appropriate scale utilizing recommendations made by both the Policy Committee and the Cape Cod Commission in their deliberations. The final definition of appropriate scale is detailed in Section 2E.

Protection of the Public Trust

The public trust doctrine derives directly from Roman civil law codified by the Emperor Justinian. In Massachusetts, any lands lying seaward of mean high water are "held in trust for the common benefit of the public, including commerce, fishing, and other

[46] "…2(iii) in municipalities where regional planning agencies have regulatory authority, a regional planning agency shall define the appropriate scale of offshore renewable energy facilities and review such facilities as developments of regional impact." M.G.L. c.132A §15(2)(iii)

activities in which all citizens are free to engage."[47] Protection of the public trust requires ensuring that resources that we share and benefit from as a region are not unduly impacted by development within the planning area, now or into the future. The State OMP indicates that the criteria for excluding renewable energy projects from certain areas was identified in part to address protection of the public trust rights, "in reasonable balance with the siting requirements of renewable energy." By incorporating the mapped OMP data layers for renewable energy into this plan, public trust rights receive an initial level of protection, as renewable energy is not allowed within certain areas (e.g. tidelands), and must meet performance standards to avoid impacts in others (e.g. high commercial fishing areas and recreational areas). Additional performance standards may be appropriate to ensure that the impacts from development, particularly cumulative impacts, are adequately addressed.

Recommendations

Following analysis of options for enhancing protection of the public trust, because the state legislature and the Department of Environmental Protection are authorized to administer protection of the public trust, addressing this appropriate scale factor must rely on state review processes through MEPA, and state agency permitting.

Protection of Public Safety

Appropriate planning, standards, and zoning are needed to ensure public safety from potential adverse impacts from renewable energy development in Cape Cod's ocean waters. Management techniques should ensure that wind energy conversion facilities and their associated infrastructure (such as service platforms) are adequately set-back from shore to avoid use conflicts within the actively used nearshore area. Existing human uses that were considered included beach and water-sheet recreational areas, recreational and commercial fishing activities within the nearshore area, and active recreational boating areas. In addition, standards are needed to ensure that hazardous materials are managed properly, that ongoing turbine operations are safe and properly maintained, and that emergency response procedures are adequately detailed in advance of any emergency. Standards that include mitigation measures and decommissioning should also be developed to protect natural resources and avoid conflict with existing human activities.

Recommendations

Following discussions in meetings of the Policy Committee and Cape Cod Commission, several specific recommendations for protecting public safety were made:

1. Adopt a no-build buffer of 2 nm from the landward edge of the planning area seaward in order to protect public safety.
2. Ensure that WECFs are not located within established ferry routes, navigational channels, commercial shipping lanes and their buffers.
3. Adopt performance standards requiring operations and maintenance plans, emergency response plans, and decommissioning plans.

[47] Ducsik, Dennis Massachusetts CZM, Coastlines 2008.

Compatibility with Existing Uses

Many activities presently take place in the waters offshore of Cape Cod. The state has mapped high-use areas by the type of activity (shown Map 11). The state OMP determined that wind energy development within the planning area would significantly conflict with certain kinds of activities, and consequently the state designated the mapped extent of these activities as "avoid" areas when siting renewable energy projects.

Aside from the state's work in determining existing uses within Cape Cod ocean waters, Cape Codders would generally consider the range and spatial extent of activities occurring throughout the planning area significant. There are likely few areas within the Cape's ocean waters that aren't actively enjoyed or utilized in one fashion or another. Through the planning process, the Policy Committee determined that prohibiting WECF development in all areas identified as significant human use activity areas would result in prohibiting WECFs entirely within the planning area. Consequently, the CCOMP recommends prohibiting WECFs within a subset of these high-use activity areas, and recommends adoption of additional performance standards to evaluate the appropriateness of projects that may be proposed in Provisional Areas.

In addition, cumulative impacts from WECF development were considered. Over the short term planning horizon (5 – 10 years), there are limitations on the number of wind turbines that may be sited within the planning area. This plan examines planning considerations for the 24 turbines presently allocated to the Cape region through the OMP. However, additional turbines may be allocated to Cape Cod in future revisions to the OMP, or by local request to the state. There may be impacts that accrue to resources in the planning area as a result of multiple projects that might be sited in the future, or from community scale projects larger than 24 turbines, or from potential commercial projects that could be located within the provisional area P3 identified on maps in the OMP. Cumulative impacts may also result from the installation of different kinds of development over time (e.g. wind energy conversion facilities, other renewable energy projects, sand mining projects, cable installations, etc.)

Recommendations

The CCOMP makes the following recommendations to ensure that WECFs are compatible with existing uses:

1. Prohibit WECFs within a no-build buffer of 2 nm from the landward edge of the planning area seaward in order to avoid use conflicts.
2. Prohibit WECFs within High Effort and Value Commercial Fishing areas.
3. Ensure that WECFs are not located within established ferry routes, navigational channels, commercial shipping lanes and their buffers.
4. Ensure that the cumulative impacts of WECF development throughout the planning area result in benefits that outweigh the impacts to resources protected under the Act.

Community Benefit

The OMP requires a finding of community benefit for projects approved through the state review process. Cape Codders also clearly wish to ensure that any WECF development that may occur within the Cape's ocean waters provides a clear and

significant benefit to the regional community. To address the economic, environmental and resource protection interests of Cape Cod, the planning process determined that community benefit should be assessed using the following criteria;

- Energy Import Substitution
- Local Fiscal Benefit (and the manner in which that benefit is dispersed to multiple communities)
- Regional Ownership
- Public Facilities Benefit
- Local Labor and Service Providers, and
- Diverse Employment Opportunity.

As a result of extensive discussions, the CCOMP makes some preliminary recommendations for determining the community benefit from a WECF project. Measuring the community benefits from a project requires assessing both the positive outcomes and impacts of each assessment criteria resulting from an off-shore wind energy development at the local and regional scales. Accordingly, the planning process decided the allocation of benefits and impacts should be distributed across three different scales; Host Community, Impacted Community and Regional Community, as reflected in the matrix below. Participants in the planning process determined that regional ownership is a significant component of community benefit. In addition, WECFs should demonstrate that the energy generated from the project would otherwise be imported into the region. A Local Fiscal Benefit and a Public Facilities Benefit (i.e opportunities for distributed generation) were also deemed necessary to demonstrate WECF project benefits to both the Host Community and the Impacted Community(s). These 4 criteria represent the minimum requirements, and that both benefits and impacts should be allocated within the region, for all WECFs under Commission jurisdiction.

The planning process further determined that two additional criteria, *Utilizing Local Labor and Service Providers* and offering *Diverse Economic Opportunities*, were criteria a WECF proponent could elect to provide as additional project benefits.

Allocation of Benefits	Energy Import Substitution	Local Fiscal Benefit	Regional Ownership	Public Facilities Benefit
Host Community		√+		√
Impacted Community		√		√
Regional Community	√		√	

Recommendations

Demonstration of Community Benefit does not lend itself to map-based planning, but will rely on performance standards to ensure that WECFs deliver benefits to the community.

1. Benefits of the project to the community should be considered in any Development of Regional Impact review. Commission members may consider these recommendations during its Development of Regional Impact review and when weighing the probable benefits of a project versus it's probably detriments.
2. Performance standards should be adopted that require that WECFs demonstrate compliance with the community benefit criteria discussed above.

Proximity to Shoreline

As described in section 1B.3, the region has a wide range of visual and scenic resources, some officially designated because of their scenic quality, others not designated. Through the CCOMP process, the Cape Cod Commission has conducted a baseline analysis of some of these resources, and additional resources will be supplemented in the future.

Furthermore, as renewable energy projects can vary greatly in their scale and that the degree of visual impact that these facilities have on the region's visual resources will be strongly influenced by their location, it is most appropriate to establish the visual impact of projects on a case-by-case basis. As such, a Visual Impact Assessment (VIA) process has been created to provide a consistent framework within which the visual impact of development in the ocean can be established. The VIA is intended to be used in the application of performance standards for Wind Energy Conversion Facilities and the Cape Cod Commission concludes that the VIA process shall be used to evaluate the WECF's visual impact through the Development of Regional Impact review process. The VIA process, and all associated guidance to developers, will be provided in a Technical Bulletin.

Recommendations

1. The CCOMP recommends establishment of a 2 mile prohibited area for the protection of public trust, public safety and for the compatibility with existing uses. This prohibited area ensures that turbines are placed a minimum of 2 miles from shore, an area in which their visual impact would likely be greatest.
2. For locations outside of the prohibited areas, WECFs are not of an appropriate scale unless the development is sited and designed to avoid Adverse Visual Impacts to the Cape's scenic and cultural/historic resources, including structures listed or eligible for listing on the National or State Register of Historic Places and Historic or Cultural Landscapes.
3. The 2009 Regional Policy Plan (RPP) currently includes a standard that allows the Commission to require a visual impact assessment for projects (HPCC2.3). This standard requires that new development be sited and designed to avoid adverse visual impacts to visually sensitive areas, including historic resources and cultural landscapes.
4. A Visual Impact Assessment (VIA) should be required for any WECF proposed within the ocean planning area as part of the Development of Regional Impact review process.
5. In order to determine the visual impact of proposed WECFs on the Cape's scenic and historic resources, the CCOMP recommends the Cape Cod Commission

adopt a Technical Bulletin to guide proponents through the process of completing a VIA for any WECF proposed within the planning area. Such technical bulletin should include but not be limited to the following: appropriate material that should be provided in support of a development application; suggested design, siting, layout and mitigation strategies that can be incorporated in the project design to avoid or minimize visual impacts; requirements for simulations and visualizations; and, guidance on the completion of additional analysis and inventory work.

6. The Commission should continue to prepare an inventory and/or analysis of scenic and visual resources in the region.

Appropriateness of the Technology and Scale

OMP defines "appropriateness of technology and scale" as a facility that may be sited such that 1) public trust rights are protected, 2) public safety is protected, 3) significant incompatibilities with existing uses are avoided, 4) proximity to shoreline is appropriate (minimizes visual impacts), and 5) impacts to environmental resources are avoided, minimized, and mitigated.

Within the current planning horizon (5 – 10 years), wind turbine technology is the most viable form of renewable energy development for the planning area. However, over the long-term, the potential for other forms of renewable energy capture, such as wave and tidal technologies, may become viable. The Renewable Energy Technical Advisory Workgroup suggests that presently there are no suitable sites for wave or tidal capture within the planning area; however, as these technologies evolve over time this is an area that should be revisited for consideration in a future iteration of this Plan.

A key consideration for the determination of appropriate scale is how the scale of a wind energy conversion facility fits into the existing context; does it protect public safety and public trust rights, does it minimize impacts to existing resources or activities within the planning area, and are impacts to visual resources minimized? Taken together, these factors should inform the determination of appropriate technology, and at what scale.

Recommendations

1. Prohibit WECFs within a no-build buffer of 2 nm from the landward edge of the planning area seaward in order to avoid use conflicts.
2. Prohibit development in core North Atlantic Right Whale habitat and important Fin Whale and Humpback Whale habitat.
3. Prohibit development in expanded NARW habitat based on new data demonstrating the significant presence of NARWs in this area.
4. Prohibit WECF development in all Wind Energy SSUs, except eelgrass and hard/complex bottom.
5. Prohibit WECFs within High Effort and Value Commercial Fishing areas.
6. Prohibit WECFs within Commercial Fishing Traffic Lanes.
7. Prohibit WECFs within Commercial Traffic Lanes.

8. Prohibit development within the Cape Cod Ocean Sanctuary.

9. Apply minimum performance standards in the Regional Policy Plan to the review of wind energy conversion facilities as Developments of Regional Impact.

Environmental Protection

The development of offshore renewable energy facilities has generated concerns over the potential impacts on biodiversity including habitat loss, collision risks, noise, and electromagnetic fields (Inger et al., 2009). These factors have generally been assumed as having potentially important negative environmental effects. Offshore wind energy construction, operation, and maintenance in the planning area may directly and/or indirectly impact marine species and habitats on the seafloor (e.g., benthic organisms, demersal fish), in the water column (e.g., pelagic fish, whales, sea turtles), and/or above the water surface (e.g., seabirds, bats). Some research suggests that if appropriately managed and designed, offshore energy structures may increase local marine biodiversity and potentially benefit the wider marine environment (Inger et al., 2009, MMS, 2009). Much of the literature describing offshore wind farm impacts is based on existing projects in Europe.

During the course of workshops and meetings to discuss impacts to the marine environment, the Policy Committee and the Cape Cod Commission determined that many resources could be protected through a map-based approach. However, they determined through the planning process that existing data for some resources, such as biologically productive benthic habitats, does not lend itself to map-based prohibitions on development. In addition, resources such as eelgrass and sea turtles may shift or expand in their spatial extent from year to year, or day to day. These kinds of resources may receive better protection through performance standards that examine proposed impacts on a case-by-case basis.

In addition, concerns over protection of the critically endangered North Atlantic Right Whale (NARW) led to recommendations that would prohibit WECF development within areas that expand upon the state's designated NARW core habitat area, as well as performance standards to ensure no adverse impacts to whales that may "stray" from these designated core habitats.

Recommendations

In general, the CCOMP recommends prohibiting development within SSUs that the state determined to be exclusionary for WECF development. The Policy Committee and the Cape Cod Commission make the following recommendations:

Marine mammals:

1. Prohibit development in core North Atlantic Right Whale habitat and important Fin Whale and Humpback Whale habitat.
2. Prohibit development in expanded NARW habitat based on new data demonstrating the significant presence of NARWs in this area
3. Protect whales in other areas from impacts of construction and decommissioning.
4. Impose speed restrictions on construction and maintenance vessels in known whale habitat.

5. Adopt mitigation techniques to limit impacts of construction noise to marine life (pingers, etc.)

Birds, bats:

1. Avoid siting turbines in waters less than 20 meters in depth.
2. Avoid siting turbines in important sea duck feeding, resting, or staging areas, and in known flight pathways between resting and feeding areas.

Sea turtles:

1. Ensure protection of sea turtles through turtle protection plans during construction and decommissioning.

Fisheries:

1. Protect significant habitat of important commercial fish species and declining/rare species as determined by Division of Marine Fisheries (Summary of Marine Fisheries Resource Recommendations for Municipal Maintenance Hydraulic Dredging Activities on Cape Cod and the Islands, July 2010.
2. Prohibit WECF development in areas of designated high effort and value commercial fisheries activity.

Benthic habitat:

1. Avoid direct and indirect adverse impacts on seagrass and biologically productive benthic habitats.
2. Minimize turbidity during construction (cable laying, etc.) through best construction practices

General:

1. Prohibit WECF development in all Wind Energy SSUs, except eelgrass and hard/complex bottom.
2. Manage construction noise

SECTION 2 OFFSHORE RENEWABLE ENERGY
2E: DEFINITION OF APPROPRIATE SCALE

2E.1 - Introduction

The Oceans Act of 2008 amended the Ocean Sanctuaries Act to allow the development of renewable energy facilities "of appropriate scale," provided that the renewable energy facility is otherwise consistent with an ocean management plan. The Oceans Act identifies seven factors to be used in the definition of appropriate scale. The legislature also charges those regional planning agencies with regulatory authority with defining the appropriate scale of wind turbine projects within their jurisdiction. Through the planning process, the Policy Committee provided direction for the definition of appropriate scale, with due consideration for each of the following factors:

1. Protection of public trust rights
2. Protection of public safety
3. Compatibility with existing uses
4. Proximity to the shore line considers existing uses and visual impacts
5. Impacts to the environment are avoided, minimized, and mitigated to the maximum extent practicable
6. Benefit to the community is demonstrated
7. Technology and scale are appropriate to the proposed location

2E.2 - Definition of Appropriate Scale for Renewable Energy Facilities within the Ocean Waters of Barnstable County

As mandated by the legislature, the Cape Cod Commission herein defines the appropriate scale of Renewable (Wind) Energy Facilities located within an area comprised of all the ocean waters (comprising approximately 521,552.3 acres of open water) and land below and air above within Barnstable County, starting from a line drawn 0.3 nautical miles seaward from Mean High Water (MHW) around Barnstable County and extending to 3 nautical miles from MHW, or the state jurisdictional boundary, whichever is farther from the shore, not to include the waters of Plymouth County, as shown on map 1. This area is coincident with the planning area as defined in the Massachusetts Ocean Management Plan and excludes the Cape Cod Canal and many of the bays, harbors and embayments as shown on Map 1.

Renewable Energy Facilities of appropriate scale are defined as those consistent with all of the following parameters/criteria:

Public Safety

- Wind Energy Conversion Facilities (WECF) and their associated infrastructure are not of appropriate scale unless located outside buffers to established ferry routes, navigational channels and commercial shipping lanes, including but not limited to routes delineated by MORIS at the Massachusetts CZM website http://www.mass.gov/czm/mapping/index.htm .

- WECFs are not of appropriate scale unless sited outside an area extending from the landward boundary of the planning area seaward 2 nautical miles (nm), due to the active recreational and commercial use of the area.

Compatibility with Existing Uses

- WECFs are not of appropriate scale unless sited outside High Effort and Value Commercial Fishing Areas, as defined by the OMP (see Map 5).

- WECFs are not of appropriate scale unless sited outside Concentrated Commercial Fish Traffic Areas, as defined by the OMP (see Map 5).

- WECFs are not of appropriate scale unless sited outside Concentrated Commercial Traffic lanes, as defined by the OMP (see Map 5).

- WECFs are not of appropriate scale unless sited outside an area extending from the landward boundary of the planning area seaward 2 nautical miles (nm), due to the active recreational and commercial use of the area.

Community Benefit

- WECFs are not of appropriate scale unless they provide direct and indirect benefits such as energy import substitution, regional/local ownership, job creation, and a local fiscal benefit in the form of a percentage of electrical generation paid annually to the host and impacted communities.

Proximity to Shore & Appropriateness of Technology and Scale

- WECFs are not of appropriate scale unless sited outside an area extending from the landward boundary of the planning area seaward 2 nautical miles (nm) due to the presence of natural resources (such as seagrass, intertidal flats, herring runs, tern habitat), commercial and recreational uses, and due to Adverse Visual Impact to scenic and historic resources and cultural landscapes.

- WECFs are not of appropriate scale unless sited outside the Cape Cod Ocean Sanctuary.

- WECFs are not of appropriate scale unless the development is sited and designed to avoid Adverse Visual Impacts to the Cape's scenic and cultural/historic resources, including structures listed or eligible for listing on the National or State Register of Historic Places and Historic or Cultural Landscapes.

- WECFs are not of appropriate scale unless sited outside of, and avoid all adverse impacts to, known archaeological sites or sites with high archaeological sensitivity as identified by the Massachusetts Board of Underwater Archaeological Resources and/or the Massachusetts Historic Commission.

Environmental Protection

- WECFs are not of appropriate scale unless sited outside of Core Habitats for North Atlantic Right Whale, Fin Whale and Humpback Whale, as defined by the OMP (see Map 3).

- WECFs are not of appropriate scale unless sited outside of Expanded North Atlantic Right Whale Habitat, as delineated on the Cape Cod Ocean Management Plan Map of Exclusionary Areas (see Map 14).

- WECFs are not of appropriate scale unless sited outside of High Effort and Value Commercial Fishing Areas, as defined by the OMP (see Map 5).

- WECFs or associated infrastructure that adversely impacts the vulnerable life stages (i.e. specific times of year) of species or groups of species as determined by Division of Marine Fisheries (Summary of Marine Fisheries Resource Recommendations for Municipal Maintenance Hydraulic Dredging Activities on Cape Cod and the Islands, July 2010[48]), are not of appropriate scale.

- WECFs or associated infrastructure that cause long-term, adverse impacts to mapped shellfish suitability areas, as delineated by MORIS at the Massachusetts CZM website http://www.mass.gov/czm/mapping/index.htm, are not of appropriate scale.

- WECFs that adversely affect Priority Habitat, Core Habitat, or local populations of rare animals and plants are not of appropriate scale.

- WECFs are not of appropriate scale unless sited outside of, and avoid all adverse impacts to, seagrass beds (eelgrass and widgeon grass).

- WECFs are not of appropriate scale unless sited outside of, and avoid all adverse impacts to, areas of biologically productive benthic habitats (hard/complex bottom) as defined by the OMP.

- WECFs are not of appropriate scale unless sited outside of, and avoid all adverse impacts to, areas of mapped intertidal habitats as defined by the OMP (see Map 3).

- WECFs are not of appropriate scale unless sited outside of, and avoid all adverse impacts to, Core Habitat or nesting/staging areas for Roseate Tern, Special Concern Tern Habitat, and Important Habitat for Long-tailed Duck, Leach's Storm Petrel, and Important colonially nesting waterbird habitat, as defined by the OMP (see Map 3).

[48] Massachusetts Division of Marine Fisheries, 2010. Summary of Marine Fisheries Resource Recommendations for Municipal Maintenance Hydraulic Dredging Activities on Cape Cod and the Islands. Version 1.1. July 2010

Cumulative Impact

- WECFs may be deemed to be of appropriate scale when the public benefits of the project outweigh the cumulative adverse impacts of all WECF development within the region to resources protected under the Cape Cod Commission Act.

SECTION 3: SAND MINING AND CABLE AND PIPELINE INSTALLATIONS

3A: SAND MINING

3A.1 - Sand and Gravel Mining Potential

The Cape Cod coastline is shaped by the natural forces of wind and wave action. Erosion of the coastline and shifts in the geomorphology of the coast are a continual process where wind and waves move sediment with gradual or sometimes dramatic results. The presence of natural and man-made features affects how and where shifting sands rest. As private property development along the coastline has increased over the last several decades, property owners have sought to protect their homes and property from the reach of storms and erosion through engineered shore protection projects, including bulkheads, seawalls, revetments, etc. As sea level rise and coastal erosion brings the ocean closer to our roads and other public infrastructure, towns and other public entities will continue to seek to protect public property, safety, and interests through shoreline protection projects. The nourishment of beaches and dunes with clean, compatible sand may prove to be an effective means for temporarily managing flooding and erosion in select areas. Commonwealth and local policies and regulations that encourage the use of non-structural methods of erosion control have resulted in an increase in beach nourishment projects in Massachusetts.[1] Since there are limited quantities of historic upland sources and compatibly-sized sediment from navigational channel dredging to meet the needs of beach nourishment projects, coastal managers may increasingly look for compatible sand from offshore locations.

Beach nourishment projects can provide other economic and community benefits in addition to shore protection, including widening recreational beaches and enhancing coastal access. Properly designed beach nourishment projects may have positive environmental benefits by restoring sediment to downdrift coastal landforms, such as beaches, dunes and salt marshes, which rely on continuous sediment input to maintain their integrity during storms and/or ongoing sea-level rise. The restoration of sediment to a coastal system may benefit rare species by enhancing nesting habitat or restoring shorebird habitat.

Although sand and gravel deposits exist in water depths 30 feet (9 m) and shallower (i.e., nearshore zone),[2] dredging in shallow nearshore areas may result in significant impacts to the shore due to wave focusing and alteration in shoreline erosion patterns. Significant sand and gravel deposits also exist in offshore waters, but dredging and transfer of sediments becomes more costly at greater depths and from borrow sites located further offshore. Sand and gravel resources in water depths between 30 and 100 feet (9 – 30 m) are considered the most viable resource sites for potential beach

[1] Assessing Potential Environmental Impacts of Offshore Sand and Gravel Mining (Draft). Prepared by Applied Coastal Research and Engineering, Inc. and Continental Shelf Associates, Inc. May 2000.

[2] The nearshore zone extending seaward from the low water line well beyond the surf zone; it defines the area influenced by the nearshore or longshore currents. The nearshore zone extends somewhat further seawards than the littoral zone

replenishment and storm protection projects.[3] With the advances in marine mining and "at sea" processing, aggregate extraction can occur in waters in excess of 130 feet.[4]

The CCOMP examines the potential effects associated with sand and gravel mining within the planning area for the purposes of shoreline protection projects. (Note: in the discussion below, the terms mining, dredging and excavation are used interchangeably.)

3A.2 - Potential Resource Impacts

The mining of sand and gravel in offshore locations can have a variety of potential environmental impacts, ranging from beneficial to detrimental, direct to indirect, and short term to long term. Offshore sand mining is usually conducted with hydraulic dredges by vacuuming or, in some cases, by mechanical dredging with clamshell buckets in shallow water mining sites. Mechanical dredges can have a more severe but localized impact on the seabed and benthic biota, whereas hydraulic dredges may result in less intense but more widespread impacts.[5] Potential physical and biological impacts include 1) disturbance of benthic and demersal habitats and species, 2) changes in the geomorphology (shape) of the seafloor, 3) impacts to pelagic species habitat during construction (i.e., turbidity in the water column), 4) changes to wave action and sediment transport patterns along the shore resulting in land-based impacts, 5) impacts to marine mammals, migrating fish and other marine life during construction/mining operations, and 6) possible impacts to archaeological resources. Specific impacts associated with changes to the seafloor resulting from sand mining will have to be examined on a case-by-case basis.

Physical Impacts

Offshore sand mining in nearshore and offshore areas can affect the stability of shoals or reduce sediment transport to regions down-current of the borrow site. Borrow sites located shallower than the "depth of closure" (the water depth at which no appreciable movement of sediments by wave action occurs) can focus wave energy and alter sediment transport processes and associated coastal erosion patterns. To limit potential physical impacts to beaches, borrow sites should be located in water depths greater than 30 feet, if possible. How borrow site excavation will change nearshore sediment transport processes is an important aspect in the site evaluation process.

Likely borrow sites within Cape Cod Bay, Vineyard and Nantucket Sounds, and Buzzards Bay may have water depths less than 50 feet. Therefore, caution is needed in selecting borrow sites to ensure that dredging would not significantly alter wave or tidal current patterns. However, the Cape's geographic configuration and presence of nearby islands afford relatively greater protection in many areas from open ocean conditions, reducing the impacts of dredging on the local wave climate.

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[3] Assessing Potential Environmental Impacts of Offshore Sand and Gravel Mining (Draft). Prepared by Applied Coastal Research and Engineering, Inc. and Continental Shelf Associates, Inc. May 2000.

[4] Minerals Management Service. 2005a. Marine Minerals Program, offshore energy and minerals management. Herndon (VA): MMS, [updated 2007 Jun 28; cited 2007 Dec 21].

[5] Pearce JB. 1994. Mining of seabed aggregates. In: Langton RW, Pearce JB, Gibson JA, editors. Selected living resources, habitat conditions, and human perturbations of the Gulf of Maine: environmental and ecological considerations for fishery management. Woods Hole (MA): NOAA Technical Memorandum. NMFS-NE-106. p 48-50.

The reallocation of sand within the coastal environment (i.e., from borrow pit to beach nourishment site) can have significant effects (positive and/or negative) for coastal properties within a given littoral cell (coastal sediment unit). Understanding regional sediment budgets is necessary to determine whether and where nourishment is appropriate within the littoral zone, and to identify areas from which sand can be extracted.

A primer on sediment budgets

– Graham Giese, Provincetown Center for Coastal Studies

On open sandy coasts exposed to vigorous wave action, the erosion, transportation and deposition of sediment are essential geological processes. The form, and changes in form, of beaches, bluffs, dunes, marshes and estuaries, i.e, of a region's basic physical systems, are dependent on the regional sedimentological processes. And the physical systems, in turn, determine the structure underlying and sustaining the local coastal ecosystems and human infrastructure.

Such natural coastal systems include both sediment sources and sediment sinks. Over extended time periods, equilibrium-seeking systems develop forms and undergo changes in form such that the supply and loss of sediment move toward a balance. As a result, the long-term (or net) direction and rate of sediment transport along natural coasts tend to stabilize.

In contrast, interruptions to regional sedimentation processes, those that change the supply and loss of sediment or the rate of sediment movement along a coast, can destabilize a coast, causing rapid deposition and/or erosion. Such changes in landforms or habitats can have unexpected consequences for associated ecosystems or infrastructure.

Because of the natural tendency toward stability of open sandy coasts, it is useful to quantify, through observation, the long-term sources, sinks and associated flows of sediment within specific regions. Sediment sources might include river discharge, coastal bank erosion and seaward migrating dunes. Examples of common sinks are offshore loss, estuarine inflow and dune formation. Mass balance concepts allow for calculation of the fluxes of sediment linking the regional sources and sinks.

Knowledge of sediment budgets for specific regions of sandy coasts provides managers with a critical tool for evaluating potential sedimentological impacts of projects that could alter the character of local sediment sources, sinks or fluxes. There are many examples of unfortunate and unintended sediment-related consequences of activities that seemed to have an overall benefit when initially planned (with more narrow goals in mind): Jetty construction to assist tidal inlet navigation that resulted in barrier beach erosion; beach replenishment that produced shoaling of critical navigation channels; and seawall construction that contributed to loss of adjacent coastal habitats are common examples.

On a cost-benefit basis, the preparation of a regional sediment budget is often a wise choice for managers of exposed sandy coasts where large-scale or significantly increasing coastal engineering activities are anticipated.

Biological Impacts

The primary impacts of offshore sand and gravel mining on living marine resources and their habitats include: 1) direct removal of benthic and demersal habitat (substrate) for fish and invertebrates; 2) conversion of seabed to less productive or uninhabitable sites such as anoxic depressions or highly hydrated clay/silt substrates; 3) resuspension of sediment (turbidity); 4) modification of hydrologic conditions causing adverse impacts to desirable habitats, and 5) release of harmful or toxic materials from mining activities or accidental releases from mining equipment.[6] Noise from offshore mining operations is also a consideration.

A principal concern is the impact of offshore mining on critical spawning and juvenile fish habitat for commercial fish species. Of particular concern are those species with demersal eggs (e.g., Atlantic herring [*Clupea harengus*] and sand lance [*Ammodytes marinus*]).[7] Dredging results in the removal of herring eggs, resulting in lost production to the stock. Gravel and coarse sand appear to be the preferred substrate for Atlantic herring eggs on Georges Bank and in coastal waters of the Gulf of Maine.[8] Dredging can increase turbidity in the water column in the vicinity of the borrow site by re-suspending sediments during and sometimes after dredging. Turbidity can adversely affect marine life, especially less motile organisms such as shellfish, tunicates, and sponges. Generally, the severity of turbidity and sedimentation impacts is greatest for early life stages and for adults of some highly sensitive species (e.g., Atlantic herring). [9] (Note: additional information concerning the potential impacts of offshore mining on fish habitat will be forthcoming.)

Seabed alteration from mining can also fragment habitat, reduce habitat availability, and disrupt predator/prey interactions, resulting in negative impacts to fish and shellfish populations. The disposal of mining residues (or "tailings") from offshore mining can convert sea-bottom substrates to less biologically productive sites, altering habitat function which can then alter the survival and growth of marine organisms. Tailings are often fine-grained and highly hydrated and accumulate in low energy depositional areas. Highly hydrated sediments are of limited utility to colonizing benthic organisms, and benthic dwelling flatfishes and crabs have been observed to persistently avoid sediments comprised of mine tailings.[10,11] The rate of infilling of a borrow area and reestablishment of a stable sediment structure is dependent upon the ability of bottom currents to transport sediments to the mining site.

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[6] U.S. Dept. of Commerce, NOAA, NMFS, 2008. Impacts to Marine Fisheries Habitat from Nonfishing Activities in the Northeastern United States. NOAA Technical Memorandum NMFS-NE-209

[7] International Council for the Exploration of the Sea. 1992. Report of the ICES working group on the effects of extraction of marine sediments on fisheries. Copenhagen (Denmark):ICES Cooperative Research Report # 182.

[8] Stevenson D.K., and M.L. Scott, 2005. Essential fish habitat source document: Atlantic herring, *Clupea harengus*, life history and habitat characteristics (2nd ed). Woods Hole (MA): NOAA, NMFS, Northeast Fisheries Science Center. NOAA Technical Memorandum NMFS-NE-192. [cited 2008 Jul 22]. 94 p.

[9] Wilber D.H., Clarke D.G., 2001. Biological effects of suspended sediments: a review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. North American Journal of Fisheries Management 21(4):855-75.

[10] Johnson S.W., Stanley D.R., Moles D.A., 1998a. Effects of submarine mine tailings disposal on juvenile yellowfin sole (*Pleuronectes asper*): a laboratory study. Marine Pollution Bulletin 36(4):278-87.

[11] Johnson SW, Stone RP, Love DC. 1998b. Avoidance behavior of ovigerous Tanner crabs (*Chionoecetes bairdi*) exposed to mine tailings: a laboratory study. Alaska Fishery Research Bulletin 5:39-45.

Sand and gravel mining can disrupt or eliminate biological communities for several years. The volume and frequency of sediment removal from a borrow site will dictate the severity of biological impacts and recovery times. Infilling and subsequent benthic recovery of borrow sites may take from 1-15 years, depending upon current velocity, sediment characteristics, and the stock of colonizing species and their immigration distance.[12] Although the abundance and diversity of benthic fauna may return to levels comparable to pre-excavation conditions, species composition may be altered in areas where substrates characteristics have been altered.[13] Dredge pits that have been excavated to depths much greater than the surrounding bottom often have very slow infill rates and can be a sink for fine-grained sediments. Deep pits can also have seasonally low oxygen levels that limit their habitat value for fish and invertebrates.[14]

The mining of offshore sand and gravel deposits typically does not result in the release of high levels of contaminants. Coarse-grained sediments typically targeted for mining tend to be found in high-energy environments which are not depositional areas for fine-grained material containing pollutants, and most offshore deposits do not have significant nearby sources of contaminants.

Noise impacts from offshore mining operations may also affect marine organisms. However, there is currently little information regarding the specific impacts of noise generated by offshore mining on the feeding, reproduction, and migratory behavior of marine mammals and finfish, or its importance relative to other sources of anthropogenic ocean noise. The greater depth of offshore mining operations may result in propagation of noise for greater distances than in more confined nearshore areas.[15] Reductions in Atlantic herring catches on the Finnish coast were hypothesized to be due to disturbance to the herring movement patterns by noise and activity associated with sand and gravel mining activities.[16]

Although dredging can negatively impact the sea-bottom, it may create a more biologically productive substrate than pre-existing conditions. For example, removal of a layer of fine-grained material can expose an underlying hard substrate favored by colonizing marine organisms, increasing local biological diversity.[17] Some borrow pits also provide refugia during seasonally fluctuating water temperatures for some pelagic and demersal species [e.g., alewife (*Alosa pseudoharengus*), tautog (*Tautoga onitis*)].

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[12] International Council for the Exploration of the Sea. 1992. Report of the ICES working group on the effects of extraction of marine sediments on fisheries. Copenhagen (Denmark):ICES Cooperative Research Report # 182.

[13] Johnson, R.O. and W.G. Nelson, 1985. Biological effects of dredging in an offshore borrow area. Florida Scientist 48: 166-188.

[14] Pacheco A., 1984. Seasonal occurrence of finfish and larger invertebrates at three sites in Lower New York Harbor, 1981-1982. Final report. Sandy Hook (NJ): NOAA/NMFS. Special report for USACE, New York District. 53 p.

[15] Hildebrand J., 2004. Sources of anthropogenic sound in the marine environment. In: Vos E, Reeves RR, editors. Report of an international workshop: policy on sound and marine mammals; 2004 Sep 28-30; London, England. Bethesda (MD): Marine Mammal Commission. [cited 2008 Jul 21]. 129 p.

[16] Stewart P.L., Arnold S.H., 1994. Environmental requirements Atlantic herring (*Clupea harengus harengus*) in eastern Canada and its response to human impacts. Dartmouth (Nova Scotia): Canadian Technical Report of Fisheries and Aquatic Sciences 2003: ix + 37p.

[17] National Research Council, 1995. Beach Nourishment and Protection. National Academy Press, 334 pp.

However, these benefits are unlikely to outweigh the persistent adverse affects of borrow pits.

"Classifying the seafloor environment into discrete geologic and habitat units is an ongoing effort in Massachusetts. CZM, DMF, USGS, and other partners are actively examining the next steps in moving acoustic seafloor mapping data, in combination with detailed examination… of the ecology of the seafloor, toward an integrated seafloor habitat classification."[18] EEA will be undertaking additional habitat assessments and incorporating them into a use and management plan. Additional site-specific SCUBA surveys will be a key component for permitting sand and gravel mining projects. (seafloor mapping is discussed in more detail in Section 2 of the plan.)

3A.3 – Requirements/Constraints for Sand Mining

Mapped Resources

The State OMP identifies several resource areas as exclusionary for sand and gravel mining, including fin, humpback, and North Atlantic Right Whale core habitat areas, Roseate Tern core habitat, areas of hard/complex seafloor, eelgrass, intertidal flats, and important fish resource areas. The Technical Advisory Workgroup found that these SSUs should be incorporated into the CCOMP (see Map 6). Based on the availability of more recent North Atlantic Right Whale observations (2006 – 2010, Provincetown Center for Coastal Studies), the plan finds it appropriate to expand protected areas for North Atlantic Right Whales.

However, some of the data layers for sand and gravel mining may require some refinement if they are to be incorporated into a regulatory framework. As discussed in other sections of this plan, the hard/complex bottom data layer, which generally represents areas of higher quality benthic habitat, is presently relatively coarse. The data may be used for planning purposes, but regulatory limitations on development should be based on surveys of the ocean bottom conducted at the time of a proposed project.

As noted in Section 1, the current USGS mapping of the seafloor off the coast of Massachusetts may provide better quality data for projects proposed in certain sections of the planning area. Details of their project can be seen at http://woodshole.er.usgs.gov/project-pages/coastal_mass/
As noted on the website, "Accurate depictions of seafloor geology are an important first step toward understanding the type, distribution, and quality of subtidal marine habitats in the Massachusetts coastal ocean."

Like hard/complex bottom, the eelgrass data layer should be used for planning purposes as eelgrass beds may shift in response to changing environmental conditions. The distribution of eelgrass beds for project planning should rely on surveys at the time of permitting a project. Historic eelgrass bed sites should also be considered for their potential to be recolonized by eelgrass if site conditions change (e.g., water quality improvement).

In addition to the natural resource considerations for sand mining, the State OMP identifies areas of concentrated human activity as areas to avoid when siting sand and gravel mining. These areas include concentrated recreational fishing and areas of high

[18] EEA, 2008. Ocean Planning Habitat Workgroup Report.

commercial fishing effort and value (other important uses like shipping lanes, existing cables, should be added), and are shown on Map 7 as the spatial extents defined by the OMP.

Sand Mining Considerations

The demand for clean, compatible sand for managing coastal erosion, or for other beach nourishment purposes, is likely to increase as public infrastructure is increasingly threatened by coastal erosion compounded by ongoing sea-level rise. The number of critical facilities and public infrastructure sites across Cape Cod which are vulnerable to erosion is currently unknown. In addition, many private property owners may be interested in beach nourishment to protect their valuable shorefront assets. In order to better understand the demands or impacts of beach nourishment on regional sediment budgets, additional research and analysis is needed to identify possible future nourishment sites. For example, recent regional studies of longshore sediment transport on Cape Cod may provide invaluable information regarding how beach nourishment will affect adjacent shorelines.[19]

Generally speaking, towns have not sought to nourish beaches as a preventative measure, but have used local beaches as sites to place compatible sands from channel dredging projects. 'Beneficial reuse' of dredged materials is an economical means for disposing of beach-compatible dredging material. Where private coastal development has sought beach nourishment, either to voluntarily improve a beach or as mitigation for a coastal construction project, such projects typically turn to upland sources. With demand to date having been met by upland sand sources or sediments from channel dredging projects, offshore sand sources have not been investigated.

There are several potential barriers to offshore sand mining. Permitting of offshore sand borrow sites require extensive review of existing resources in order to evaluate environmental impacts to fisheries and other marine resources, as well as the physical impacts to the ocean floor and changes to waves and currents that might result. There is also considerable expense associated with mobilizing the necessary barges and dredging equipment, much of which is not readily available in New England and must travel long distances to a project site. Individual towns typically do not have the means to initiate the necessary analysis, permitting, monitoring, and construction costs associated with an offshore mining project.

Within the last ten years, the Minerals Management Service conducted several pilot planning projects to examine regional management of offshore sand mining. These pilot projects, located in New Jersey and Texas, may serve as a model for future sand mining planning on Cape Cod. These projects took a regional approach to evaluating the needs, potential, and limitations of sand mining to benefit coastal environments. Stakeholders at all levels of government were engaged to identify beach nourishment priorities and coordinate efforts to identify appropriate borrow sites. Several possible benefits could result from a coordinated approach to sand mining and beach nourishment, including savings in permitting and construction costs, a potentially smaller impact footprint if few, larger borrow sites are identified rather than several smaller sites, and potentially easier permitting if regulatory agencies know that a discrete number of carefully sited borrow sites are proposed to meet regional demand. Identifying regional borrow sites is consistent with recommendations in the state's OMP.

[19] Woods Hole Sea Grant Program and Cape Cod Cooperative Extension, 2011. Longshore Sediment Transport, Cape Cod, Massachusetts.

3A.4 - Management Considerations

Revisions to the Oceans Act of 2008 provided for a new activity, sand mining for beach nourishment purposes, within the state's ocean sanctuaries. While the OMP provided regional planning agencies with the ability to influence the siting and scale of renewable energy facilities, the OMP provides no comparable protection for regulating sand mining. Due to the potential for significant and unquantified adverse impacts to resources within the planning area, it is critically important that regulations be promulgated to ensure the protection of many resource interests on Cape Cod. The implementing regulations proposed through the DCPC process would have addressed these concerns; this plan recommends adopting the map data layers proposed as sand mining prohibited areas in the implementing regulations, and adoption of the sand mining regulations as minimum performance standards within the Regional Policy Plan.

State Management Framework

As discussed more thoroughly in Section 2D.2, the OMP establishes three broad management areas within the state planning area; the Prohibited Area, Renewable Energy Areas, and the Multi-Purpose Area. Sand and Gravel mining is allowed within the Multi-Purpose Area, contingent upon siting and performance standard criteria. These OMP standards include performance standards for projects in SSUs, and standards to avoid, minimize, and mitigate impacts to existing uses.

Sand mining would trigger state thresholds for MEPA review (filing an Environmental Notification Form (ENF)) when dredging more than 10,000 cy of material not for navigational purposes, or alteration of land under the ocean greater than a 0.5 acre in extent. These thresholds are likely adequate to ensure environmental review of projects having a significant impact on regional resources in coastal waters. Large, complex, "improvement" (new) dredging projects will likely be required to prepare an Environmental Impact Report (EIR), and an Environmental Impact Statement by the Army Corps of Engineers.[20] Projects meeting an EIR threshold for MEPA review must demonstrate consistency with both the Siting and Performance Standards for sand and gravel mining in the OMP. A project required to file an EIR is also required to be reviewed as a Development of Regional Impact by the Cape Cod Commission.

Sand mining, especially in the nearshore zone, has the potential to significantly impact coastal processes in ways that we do not yet fully understand. At the same time, the demand for clean, compatible sand to nourish Cape Cod beaches is likely to grow in the near future. The potential for mining and beach nourishment that the Oceans Act enabled requires a far greater understanding of local and regional sediment processes and dynamics (e.g., transport, sources, erosion rates, sediment budget, influence of coastal structures causing scour, etc) before large scale projects are considered. An in-depth examination of the Cape's sites vulnerable to erosion and shoaling, the demand for sand, and regional sand budgets is needed to evaluate the sustainability of any mining project. In addition, impacts to sensitive resources (e.g., fisheries, shellfish and eelgrass beds) should be well understood before sand mining projects are considered. And, as has been mentioned by others in comments on the state OMP, a management plan that

[20] "Draft Assessing Potential Environmental Impacts of Offshore Sand and Gravel Mining" prepared by Applied Coastal Research and Engineering and Continental Shelf Associates, May 2000.

examines the relevant coastal processes and habitat characteristics of our coastline will be crucial prior to identifying possible mining sites.[21]

Sediment management on Cape Cod requires both regional and local approaches. Sediment (or sand) management plans should characterize sediment processes, identify and prioritize resources to protect, provide guidelines for beach management, and set goals to alleviate and reduce coastal flooding and storm damage. Some towns may have already developed sediment management plans; in addition, municipal FEMA Hazard Mitigation Plans or climate adaptation plans may provide valuable elements for a sediment management plan.

While it may be appropriate to incorporate some of the MOMP's core habitat SSUs as prohibited areas within the planning area, areas of hard/complex seafloor and seagrass should be addressed differently, as the data for hard/complex bottom is inexact or too coarse for planning purposes, or in the case of eelgrass, is a shifting resource that may be better evaluated on a case-by-case basis during permitting.

If the additional studies and analysis recommended here provide evidence of the need for, and the ability to sustainably manage regional sand borrow sites, economies of scale may be realized if such sites are examined. The Cape Cod towns, by pooling their resources, may be able to identify one, two, or three regional sand borrow sites that may provide compatible beach nourishment sands for priority projects across the region. Importantly, such sites should be pursued with the goal of minimizing impacts on the environment. Efforts to identify regional sites should be coordinated with state planning and mapping efforts toward this end. The county could pursue funding for developing regional sediment budgets to quantify the volume of sediment and the active zone of on- and off-shore movement and its direction, as well as means to inventory possible/likely nourishment sites and to identify possible nourishment sources.

Recommendations

Ensuring that the natural resources within the planning area are protected from development impacts requires both a map-based and a performance-based approach, depending on the resource interests. As discussed above, the Cape Cod Commission should utilize the language proposed within the implementing regulations (Appendix 2) as a basis for the submission of sand and gravel mining minimum performance standards of the Regional Policy Plan to the Assembly of Delegates for adoption. Within these minimum performance standards, the following recommendations of the Policy Committee and Cape Cod Commission should be included.

Marine Mammals:

1. Prohibit sand mining in the state OMP-defined data layers for North Atlantic Right Whale (NARW) core habitat, important Fin and Humpback whale habitat, and the Cape Cod Ocean Sanctuary.

[21] Paraphrased from Graham Giese's comments on the draft MOMP: "Development of a companion coastal management plan would provide information on relevant physical processes and habitat characteristics for the many varied Massachusetts coastal reaches. Wave climate and tidal characteristics would be included, as would the rate and direction of net littoral sediment transport. Also the geological and sedimentological characteristics of those areas, including erosion and accretion rates and natural sources and sinks of sediment, would be needed. Then, too, information should be provided concerning coastal engineering structures or activities that would be required for decisions on specific beach nourishment projects."

2. Prohibit development in expanded NARW habitat based on new data demonstrating the significant presence of NARWs in this area.
3. Protect whales in other areas from impacts of construction and decommissioning.
4. Impose speed restrictions on construction and maintenance vessels in known whale habitat.
5. Adopt mitigation techniques to limit impacts of construction noise to marine life (pingers, etc.)

Birds:

1. Avoid siting mining projects in waters less than 20 meters in depth.
2. Avoid siting mining projects in important sea duck feeding, resting, or staging areas, and in known flight pathways between resting and feeding areas.

Sea turtles:

1. Ensure protection of sea turtles through turtle protection plans during construction.

Fisheries:

1. Protect significant habitat of important commercial fish species and declining/rare species as determined by Division of Marine Fisheries (Summary of Marine Fisheries Resource Recommendations for Municipal Maintenance Hydraulic Dredging Activities on Cape Cod and the Islands, July 2010..

Benthic habitat:

1. Avoid direct and indirect adverse impacts on seagrass and biologically productive benthic habitats.
2. Minimize turbidity during construction through best construction practices.
3. Regulations should ensure the protection of regional marine resources by requiring monitoring of the recovery of borrow sites, and restoration of borrow sites to baseline natural resource conditions, to the maximum extent feasible.

Cultural resources:

1. Archaeological sites, shipwrecks, and paleosols should be protected.

Physical impacts:

1. Avoid physical sea bottom alterations that cause changes to local wave or current conditions or sediment transport that will affect coastal landforms, infrastructure, and private property.
2. Sand mining should not result in changes to ocean currents or wave conditions that will adversely impact existing coastal landforms, infrastructure, and public or private property.
3. Regulations should ensure that Sand Mining does not result in saltwater intrusion into freshwater lenses.
4. A regional study of the Cape's sediment processes and sediment budgets should be conducted, and a Regional Sediment Management Plan should be prepared. Detailed sediment budgets should be prepared on a case-by-case basis. A County-

wide Beach Nourishment and Sand Needs Assessment should be conducted as part of a Regional Sediment Management Plan.

5. Towns should be encouraged to develop sediment management plans, coordinated with similar efforts in neighboring towns and with the regional sediment management plan.
6. The potential for regional off-shore borrow sites should be assessed, including the pros and cons of siting/permitting many smaller borrow sites vs. fewer larger sites.

Public Safety:

1. Sand Mining should not result in the mobilization of hazardous materials into the water column.
2. Regulations should ensure that Sand Mining operations are sited with adequate buffers to existing uses.
3. Primary navigation routes should be protected.

Community Benefit:

4. Materials extracted from Sand Mining within the planning area should be applied to beaches within Barnstable County. Sand Mining regulations should consider the direct and indirect impacts of beach nourishment conducted as part of a Sand Mining operation.
5. Given the potential sensitivity of resources impacted by ocean mining and possible related onshore impacts, only projects with clear public benefits should be permitted.
6. Sand mining operations should demonstrate a significant benefit to public resources and coastal ecosystems.

General:

7. Regulations for Sand Mining should be reviewed every five years, at a minimum, and revised as necessary to respond to new or improved data, information, or technology.
8. Regulations should ensure consideration of the cumulative impacts of development activities in the planning area, and possible changes in the type or quantity of development activities allowed within the Cape's ocean waters.

SECTION 3: SAND MINING AND CABLE AND PIPELINE INSTALLATIONS

3B: CABLES AND PIPELINES

3B.1 - Cable and Pipeline Potential

Cables and pipelines are infrastructure components that make connections between places (fiber optic cable to the Islands) or between offshore energy generation facilities and the users on land. Energy generated offshore needs to be brought onshore by cable connections, but those connections may be directed or coordinated through planning. Pipeline installations within the planning area, based on current technologies, may be limited, as wastewater outfalls are presently prohibited within the planning area (all ocean sanctuaries comprising the waters around Cape Cod).

3B.2 - Potential Resource Impacts

Environmental impacts resulting from the installation of cables and pipelines on or under the seafloor are similar in many ways to the impacts associated with sand mining. Please refer to Section 3A.2 for a more comprehensive discussion of the potential resource impacts associated with disturbing the seafloor. Additional considerations specific to the installation of cables and pipelines are summarized below.

Seafloor impacts

The installation of cables and pipelines under the seafloor may result in temporary impacts to the seafloor. Cables and pipelines may be installed either by directional drilling, resulting in minimal physical impacts to the seafloor, or via jet plow or plow and cover techniques that have a temporary impact on the seafloor. Temporary impacts may have a lasting effect where they disturb sensitive resources, like eelgrass or shellfish resource areas. Cable and pipeline installations under the seafloor can disturb benthic sediments and the viability of habitat for benthic organisms. Installations through hard bottom areas requiring blasting can permanently alter productive habitats. Directional drilling is limited by the length of the installation, and thus may not be feasible in all applications.

Cables or pipelines laid on the surface of the seafloor may cause erosion and scour around the pipes, and may interfere with the use of certain fishing gear (e.g., draggers). Installations on the surface of the seafloor can also disturb the migrations or movement of benthic invertebrates, particularly lobsters. As mentioned elsewhere, more information is needed to adequately classify the habitat significance of the seafloor within the planning area. “Classifying the seafloor environment into discrete geologic and habitat units is an ongoing effort in Massachusetts. CZM, DMF, USGS, and other partners are actively examining the next steps in moving acoustic seafloor mapping data, in combination with detailed examination… of the ecology of the seafloor, toward an integrated seafloor habitat classification.” (EEA Ocean Planning Habitat Workgroup Report, 2008) EEA will be undertaking additional habitat assessments and incorporating them into a use and management plan.

Pelagic species may be impacted long term by changes in food sources due to habitat disturbances, or short term from the impacts of construction while cables and pipelines are installed. Dredging activity resulting from jet plow or plow and cover installations can result in sediment in the water column, creating water quality concerns for diving birds, fish, and marine mammals.

The electromagnetic fields (EMF) generated by electrical distribution cables may adversely impact marine life, though current research is inconclusive (refer to Section 2B.2). It may be appropriate to take a conservative approach in the siting of electrical cables outside of sensitive species habitats until more is understood about the effects of EMF.

3B.3 – Requirements/Constraints for Siting Cables and Pipelines

The OMP identifies several SSU resources that would be significantly adversely impacted by the installation of cables or pipelines, and has identified these SSUs as exclusionary areas for cables and pipelines. They include: fin, humpback, and North Atlantic Right whale core habitats, Roseate tern core habitat, areas of hard/complex seafloor, eelgrass beds, inter-tidal flats, and for pipelines, important fish resource areas. The Technical Advisory Workgroup found that the SSUs identified as exclusionary areas for cables and pipelines should be incorporated into this CC OMP (see Maps 8 and 10).

Once a cable or pipeline makes landfall, it needs to tie in with the existing infrastructure. Cables bringing electrical power will need to tie in to portions of the electrical grid that can accommodate the power. A structure at the landfall site may also be needed to make the connection, and where that structure is located could impact resources protected under the Cape Cod Commission Act.

The OMP identifies areas of concentrated recreational fishing and areas of high commercial fishing effort and value as areas to avoid when siting pipelines. These resources, as defined by the OMP, are shown on Map 9. Additional considerations may include areas presently maintained by municipalities or others as navigational channels, or other areas that may be dredged for navigational purposes on a regular basis.

3B.4 – Management Considerations

State MEPA review thresholds pertain to the length of pipeline proposed for energy projects. Pipeline carrying municipal waste would be reviewed by MEPA based on gallons of wastewater generated, or other thresholds, including disturbance of land under the ocean. However, the Oceans Act of 2008 appears to prohibit municipal discharge of treated wastewater within the planning area.[22]

At present, only projects required to prepare an EIR would be reviewed by the Cape Cod Commission as a Development of Regional Impact. While the Oceans Act of 2008 allows for the installation of cables and pipelines within the Cape's ocean sanctuaries, it does not specifically provide for regional review and regulation of cable and pipeline

[22] "Except in the Cape and Islands Ocean Sanctuary, the Cape Cod Ocean Sanctuary, and the Cape Cod Bay Ocean Sanctuary, nothing in this act is intended to prohibit municipal wastewater treatment discharges and municipal wastewater treatment facilities if such discharge into the ocean sanctuary is the only feasible alternative to existing water pollution problems if it is consistent with the intention and purposes of this chapter, and it is approved and licensed by appropriate federal and state agencies…" from the Oceans Act of 2008.

installation. Due to the potential for significant adverse impacts to resources within the planning area, it is critically important that regulations be promulgated to ensure the protection of many resource interests on Cape Cod. The implementing regulations proposed through the DCPC process would have addressed these concerns; this plan recommends adopting the map data layers proposed as cable and pipeline prohibited areas in the implementing regulations, and adoption of the cable and pipeline regulations as minimum performance standards within the Regional Policy Plan.

Ensuring that the natural resources within the planning area are protected from development impacts requires both a map-based and a performance-based approach, depending on the resource interests. As discussed above, the Cape Cod Commission should utilize the language proposed within the implementing regulations (Appendix 2) as a basis for the submission of cable and pipeline minimum performance standards of the Regional Policy Plan to the Assembly of Delegates for adoption. Within these minimum performance standards, the following recommendations of the Policy Committee and Cape Cod Commission should be included.

Marine Mammals:

1. Prohibit cable and pipeline installations in the state OMP-defined data layers for North Atlantic Right Whale (NARW) core habitat, important Fin and Humpback whale habitat, and the Cape Cod Ocean Sanctuary.
2. Prohibit development in expanded NARW habitat based on new data demonstrating the significant presence of NARWs in this area.
3. Protect whales in other areas from impacts of construction and decommissioning.
4. Impose speed restrictions on construction and maintenance vessels in known whale habitat.
5. Adopt mitigation techniques to limit impacts of construction noise to marine life (pingers, etc.)

Birds:

1. Avoid cable and pipeline installations in waters less than 20 meters in depth.
2. Avoid cable and pipeline installations in important sea duck feeding, resting, or staging areas, and in known flight pathways between resting and feeding areas.

Sea turtles:

1. Ensure protection of sea turtles through turtle protection plans during construction.

Fisheries:

1. Protect significant habitat of important commercial fish species and declining/rare species as determined by Division of Marine Fisheries (Summary of Marine Fisheries Resource Recommendations for Municipal Maintenance Hydraulic Dredging Activities on Cape Cod and the Islands, July 2010.

Benthic habitat:

1. Avoid direct and indirect adverse impacts on seagrass and biologically productive benthic habitats.
2. Minimize turbidity during construction through best construction practices.

Cultural resources:

1. Archaeological sites, shipwrecks, and paleosols should be protected.

Physical impacts:

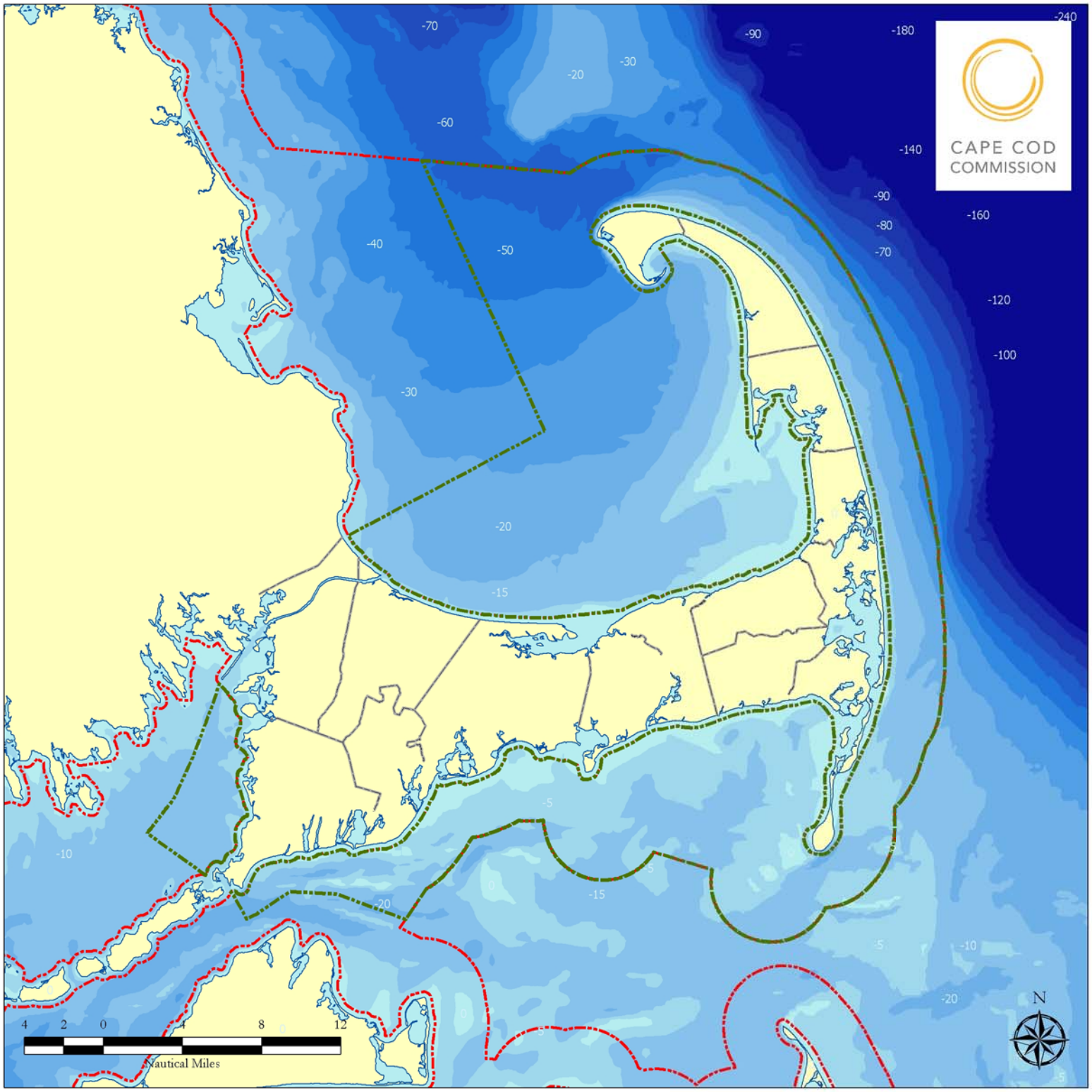
1. Avoid physical sea bottom alterations that cause changes to local wave or current conditions or sediment transport that will affect coastal landforms, infrastructure, and private property.
2. Cable and pipeline installations should not result in changes to ocean currents or wave conditions that will adversely impact existing coastal landforms, infrastructure, and public or private property.

Public Safety:

1. Cable and pipeline installations should not result in the mobilization of hazardous materials into the water column.
2. Regulations should ensure that cable and pipeline installations are sited with adequate buffers to existing uses.
3. Primary navigation routes should be protected.

General:

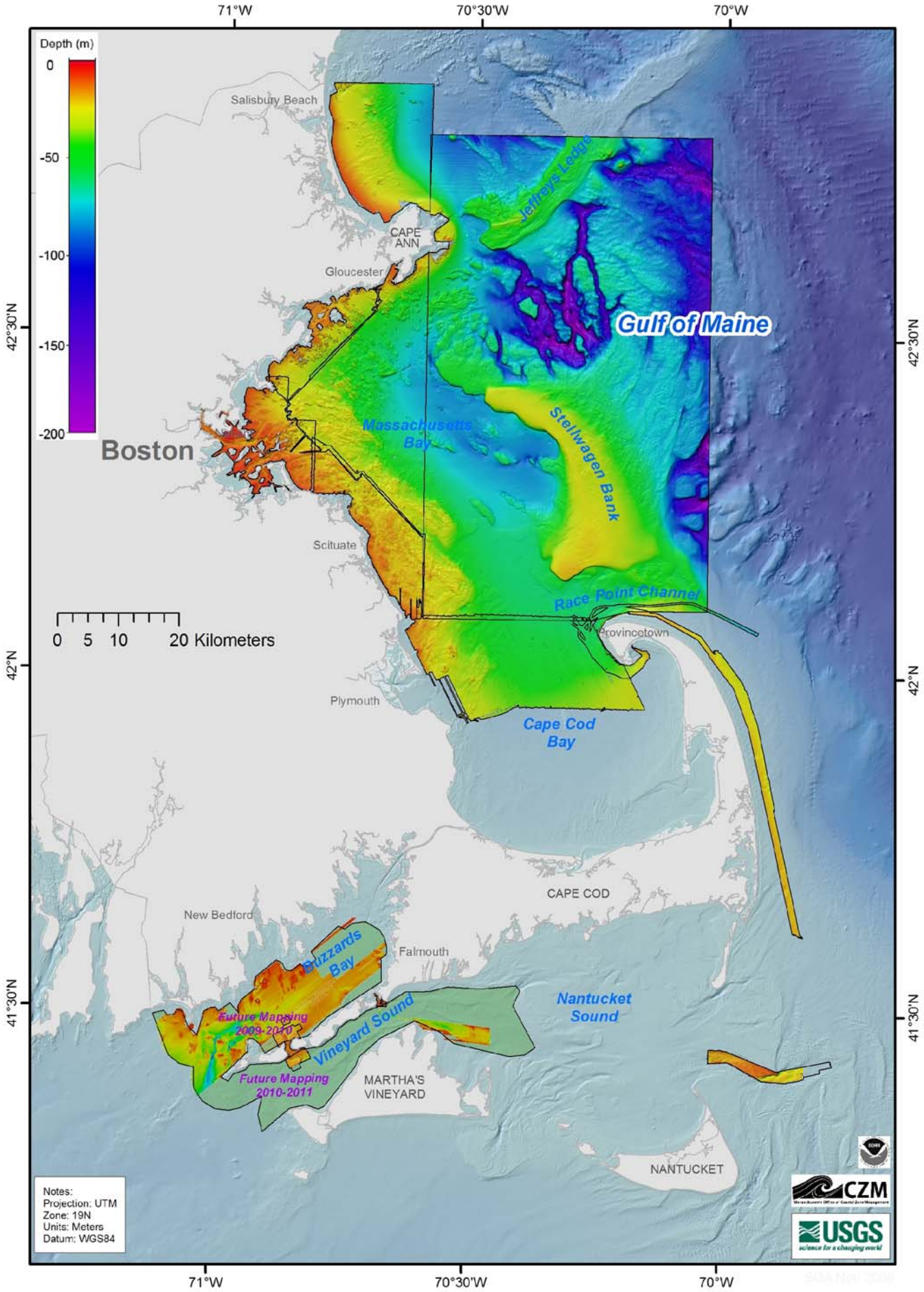
1. Regulations should ensure consideration of the cumulative impacts of development activities in the planning area, and possible changes in the type or quantity of development activities allowed within the Cape's ocean waters.
2. Regulations for Cable and Pipeline installations should address the impacts to coastal resources of the conduit landfall and landside connections, including transition vaults.
3. Cable and Pipeline installation routes should be coordinated with existing routes to the extent feasible.
4. Cable and Pipeline installations should not adversely affect the economic vitality of the host community.



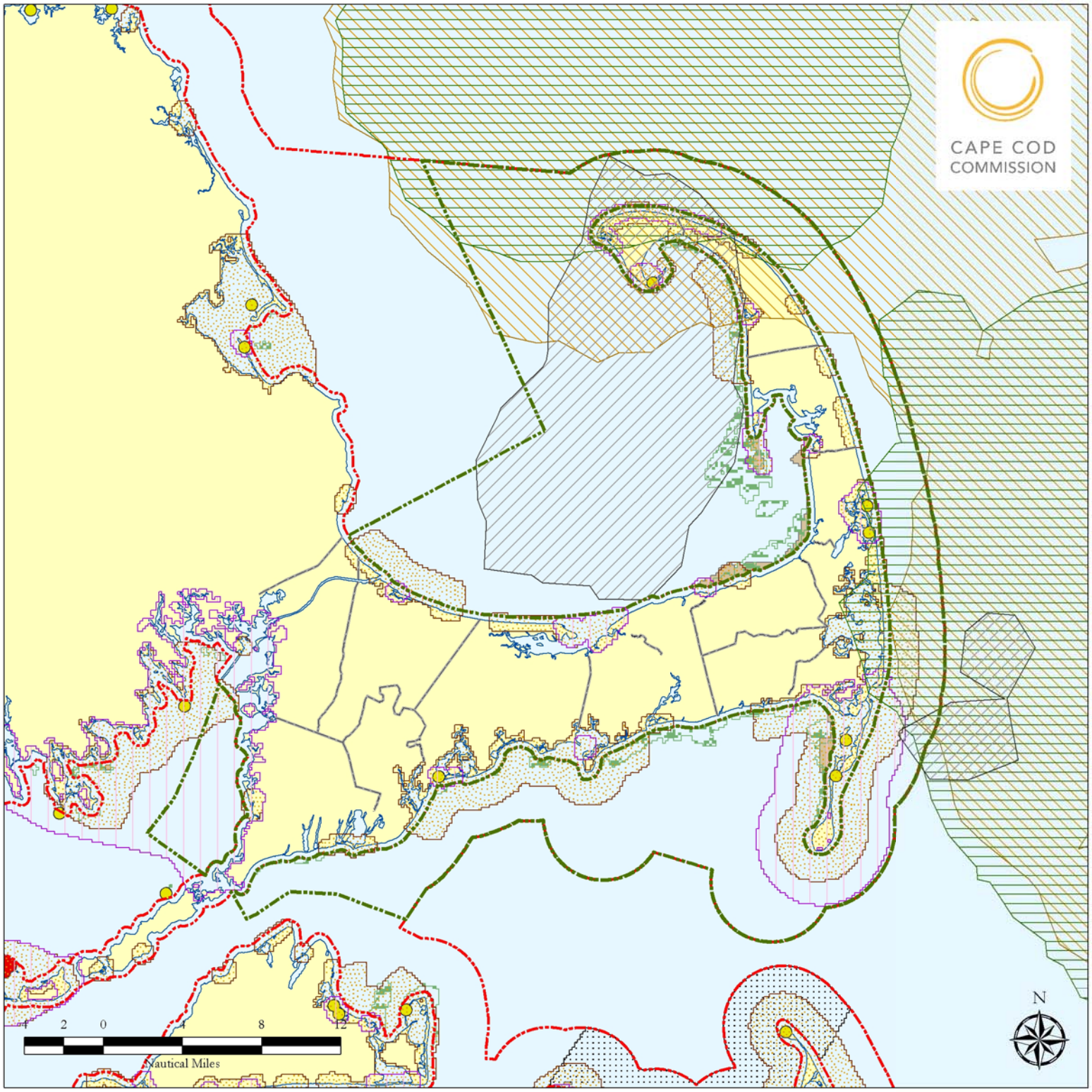
Map 1: Cape Cod Ocean Management Plan
Map of Planning Area

Legend

- Cape Cod OMP
- Massachusetts OMP Area Boundary
- Town Lines
- Land



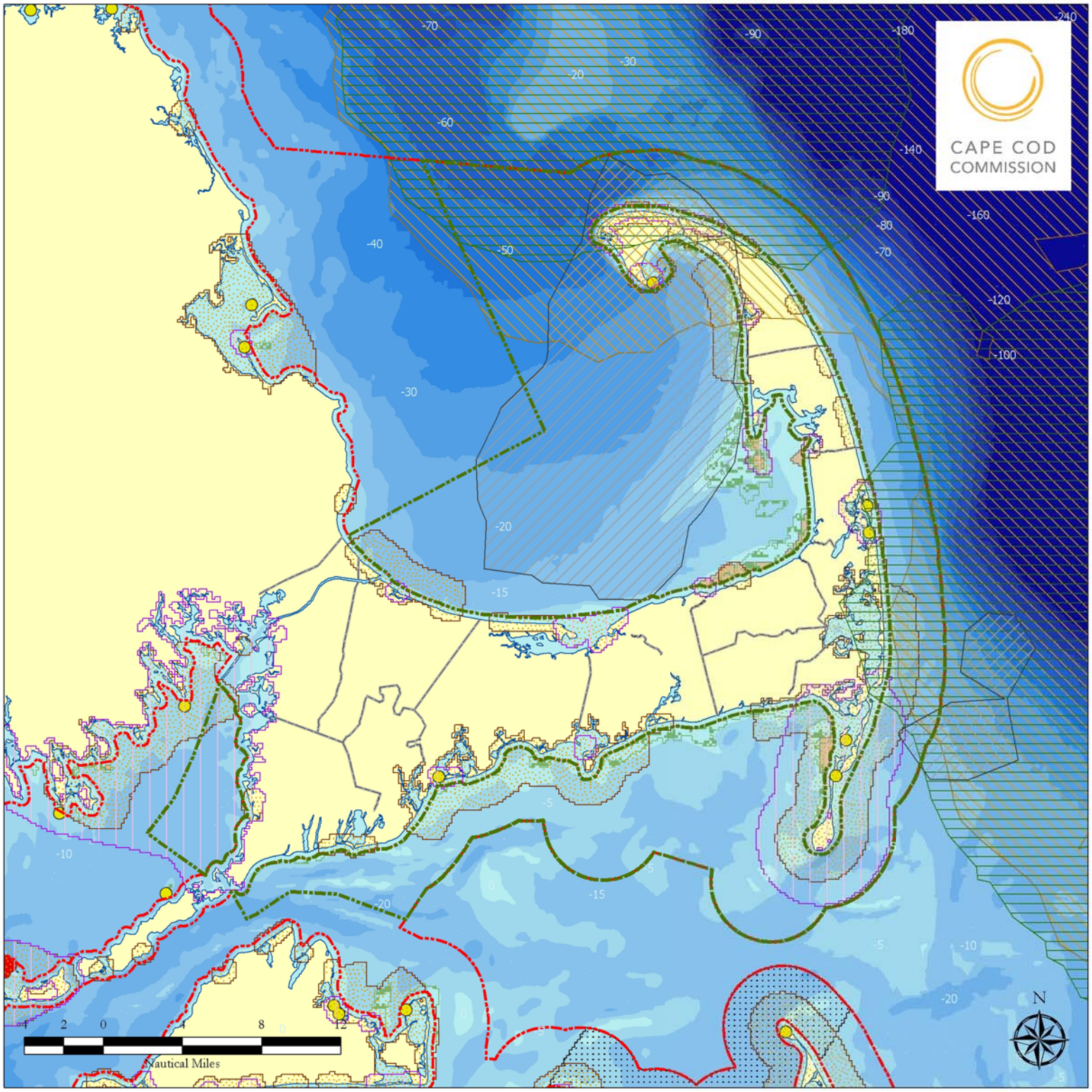
Map 2: Cape Cod Ocean Management Plan
Map of USGS Bathymetrical Mapping of Cape Cod and Environs



Map 3: Cape Cod Ocean Management Plan
Map of Special, Sensitive, and Unique (SSU) Core Habitat Areas

Legend

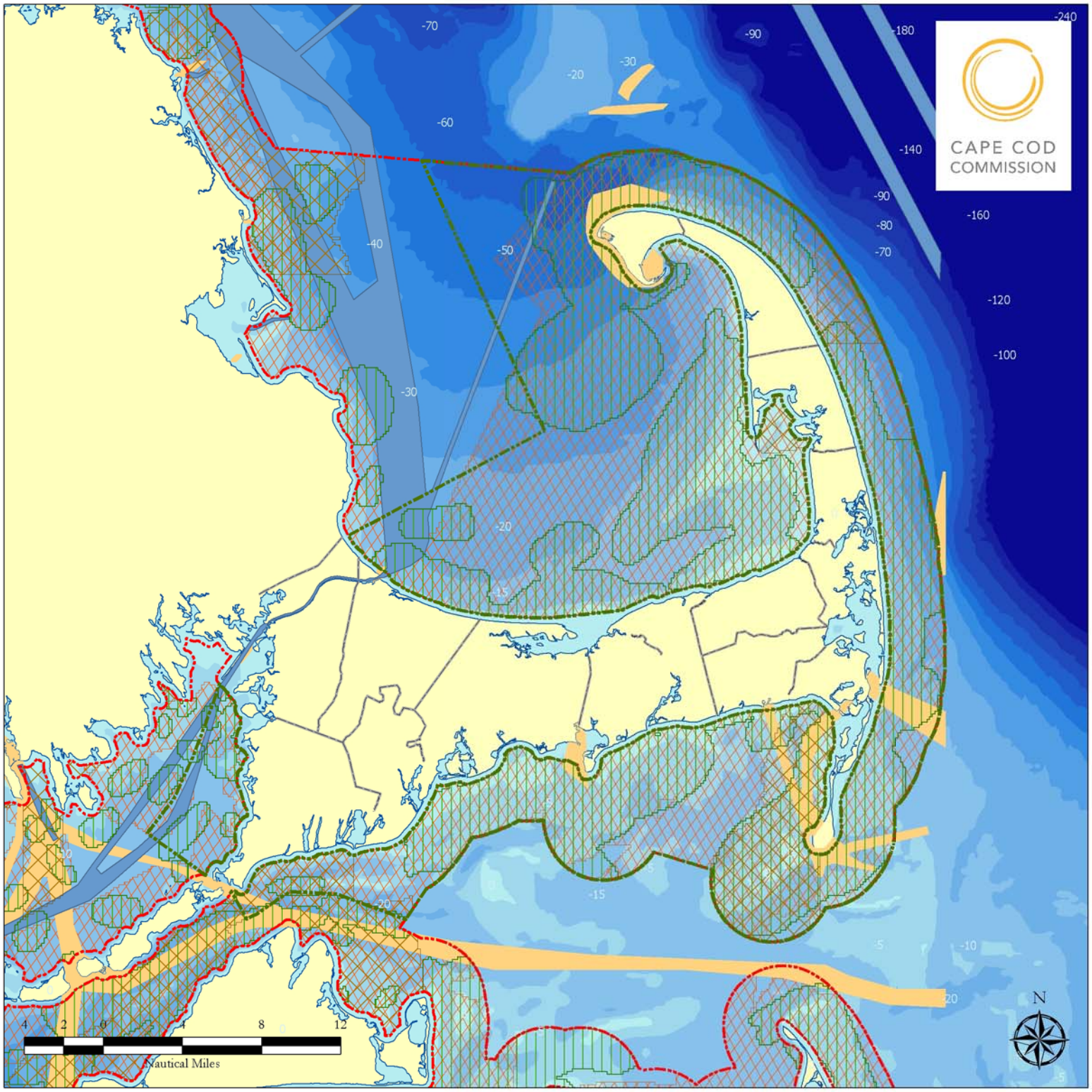
- Cape Cod OMP
- Massachusetts OMP Area Boundary
- Town Lines
- Land
- North Atlantic Right Whale Core Habitat
- Humpback Whale Core Habitat
- Fin Whale Core Habitat
- Roseate Tern Core Habitat
- Special Concern Tern Core Habitat
- Long-tailed Duck Core Habitat
- Leach's Storm-Petrel Important Nesting Habitat
- Colonial Waterbirds Important Nesting Habitat
- Eelgrass
- Intertidal Flats



Map 4: Cape Cod Ocean Management Plan
Map of Mass. OMP Wind Energy Exclusionary Areas

Legend

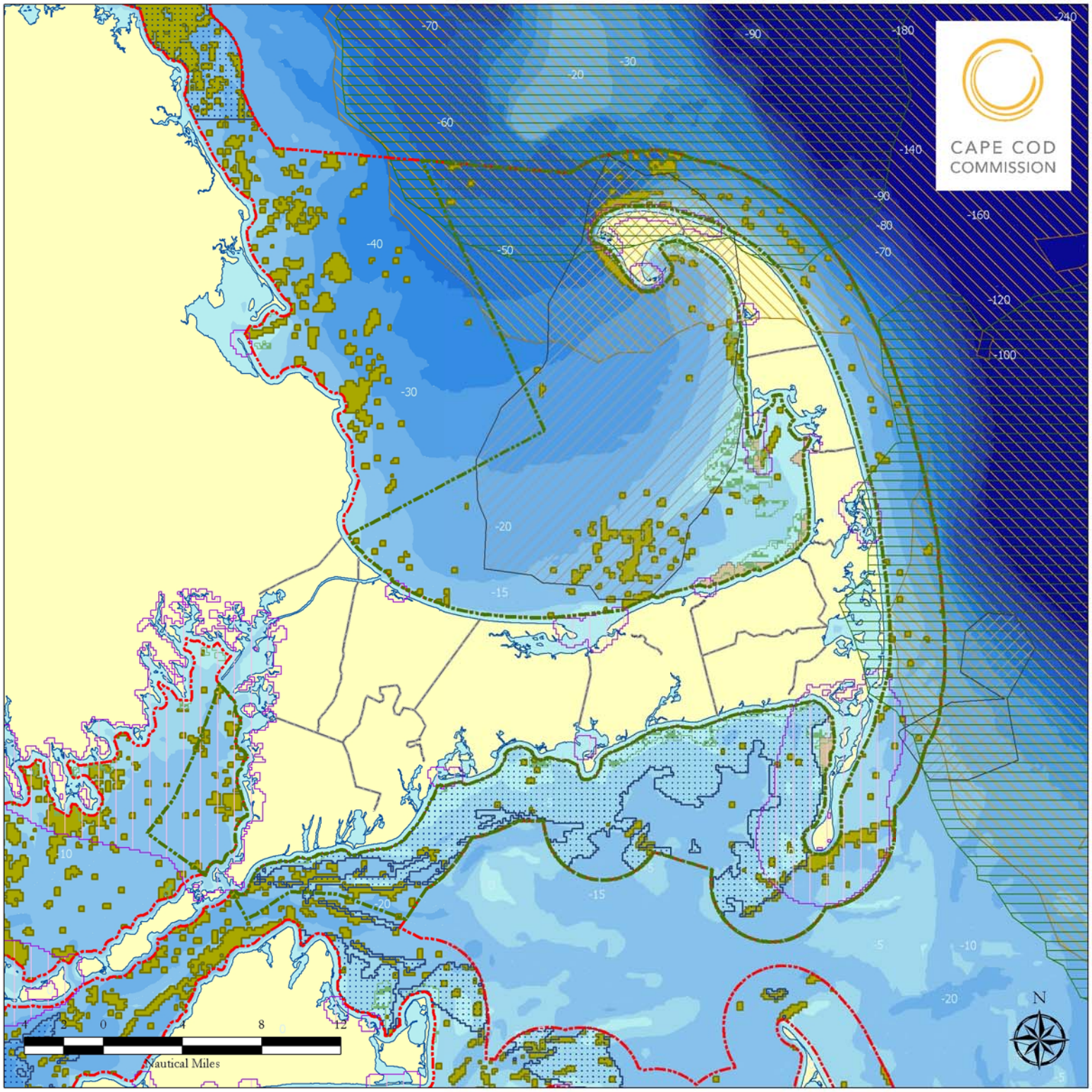
- Cape Cod OMP
- Massachusetts OMP Area Boundary
- Town Lines
- Land
- North Atlantic Right Whale Core Habitat
- Humpback Whale Core Habitat
- Fin Whale Core Habitat
- Roseate Tern Core Habitat
- Special Concern Tern Core Habitat
- Long-tailed Duck Core Habitat
- Leach's Storm-Petrel Important Nesting Habitat
- Colonial Waterbirds Important Nesting Habitat
- Eelgrass
- Intertidal Flats



Map 5: Cape Cod Ocean Management Plan
Map of Mass. OMP Wind Energy Avoidance Areas

Legend

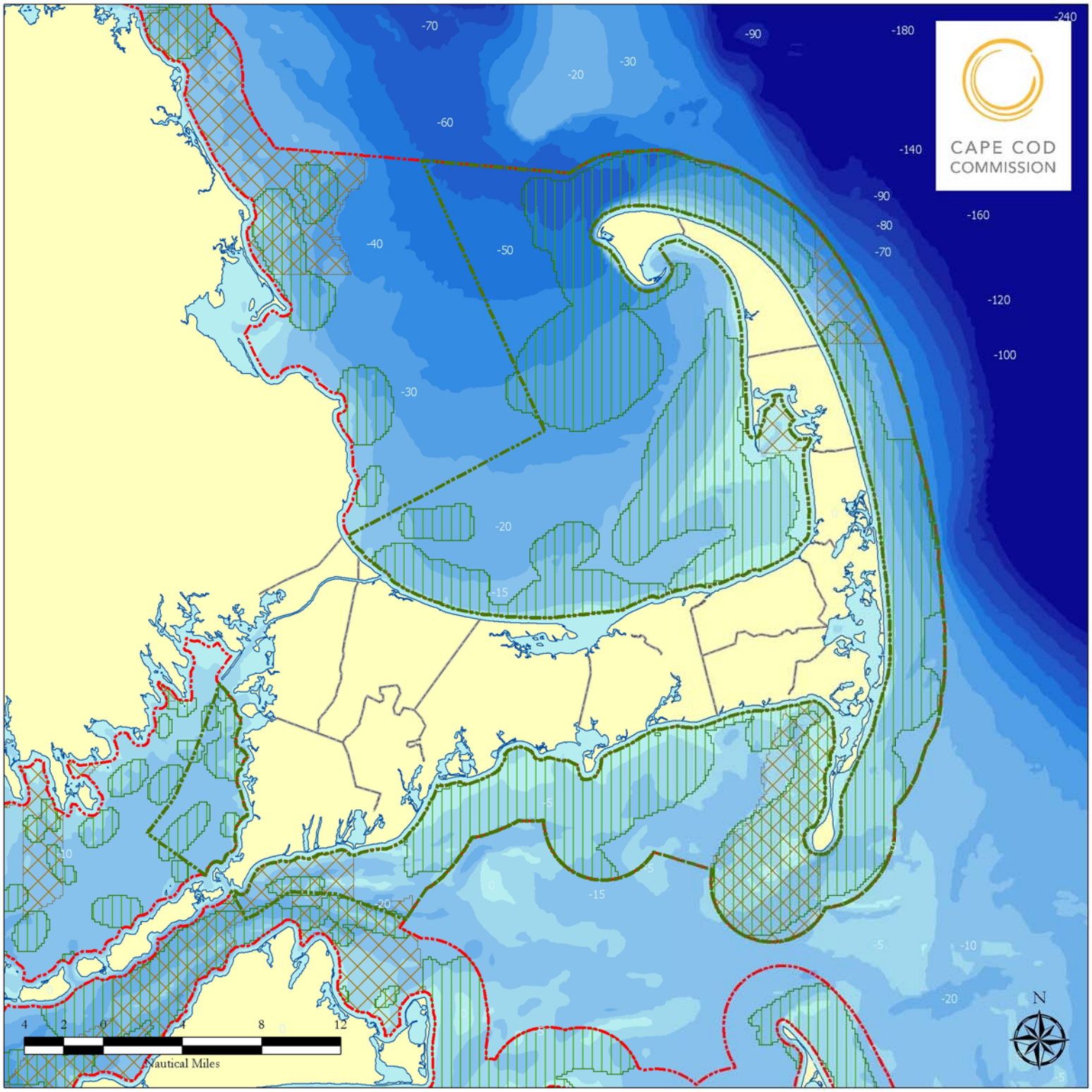
- Cape Cod OMP
- Massachusetts OMP Area Boundary
- Town Lines
- Land
- High Effort and Value Commercial Fishing
- Concentrated Recreational Fishing
- Concentrated Commercial Traffic
- Concentrated Commercial Fishing Traffic
- Concentrated Recreational Boating Activity



Map 6: Cape Cod Ocean Management Plan
Map of Mass. OMP Sand and Gravel Exclusionary Areas

Legend

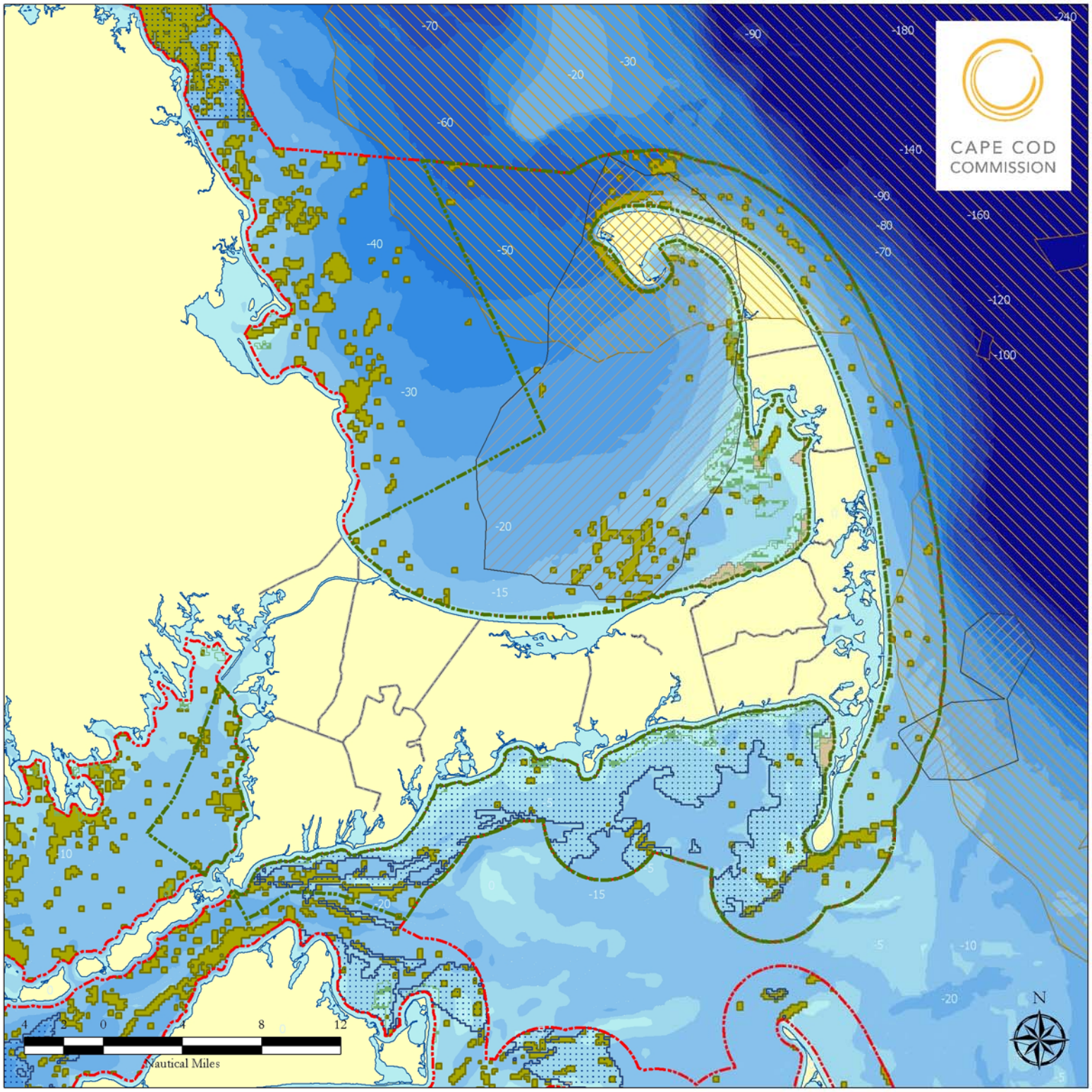
- Cape Cod OMP
- Massachusetts OMP Area Boundary
- Town Lines
- Land
- Humpback Whale Core Habitat
- North Atlantic Right Whale Core Habitat
- Fin Whale Core Habitat
- Roseate Tern Core Habitat
- Important Fish Resources
- Eelgrass
- Hard/Complex Seafloor
- Intertidal Flats



Map 7: Cape Cod Ocean Management Plan
Map of Mass. OMP Sand and Gravel Avoidance Areas

Legend

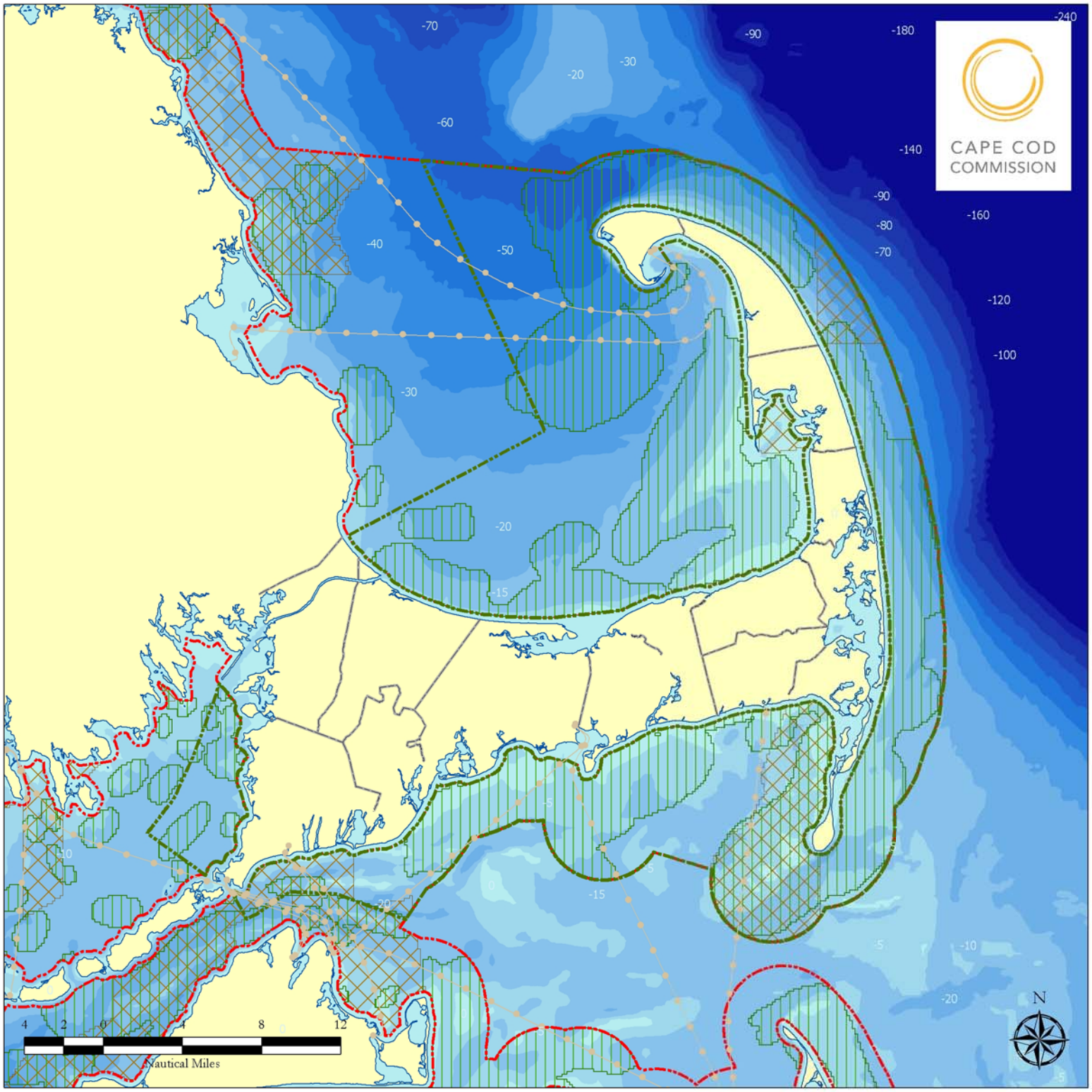
- Cape Cod OMP
- Massachusetts OMP Area Boundary
- Town Lines
- Land
- Concentrated Recreational Fishing
- High Effort and Value Commercial Fishing



Map 8: Cape Cod Ocean Management Plan
Map of Mass. OMP Pipeline Exclusionary Areas

Legend

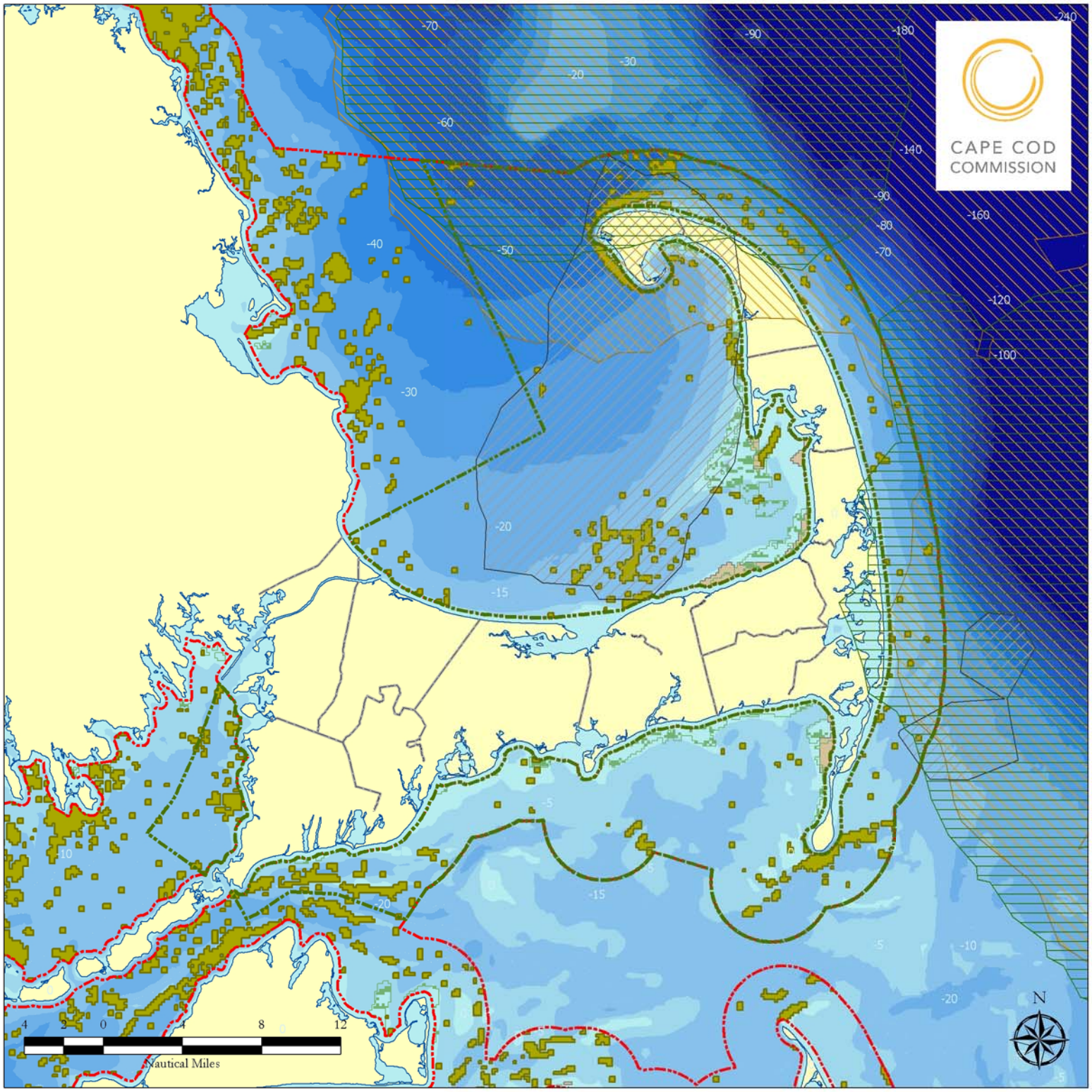
- Cape Cod OMP
- Massachusetts OMP Area Boundary
- Town Lines
- Land
- North Atlantic Right Whale Core Habitat
- Fin Whale Core Habitat
- Important Fish Resources
- Eelgrass
- Hard/Complex Seafloor
- Intertidal Flats



Map 9: Cape Cod Ocean Management Plan
Map of Mass. OMP Pipeline Avoidance Areas

Legend

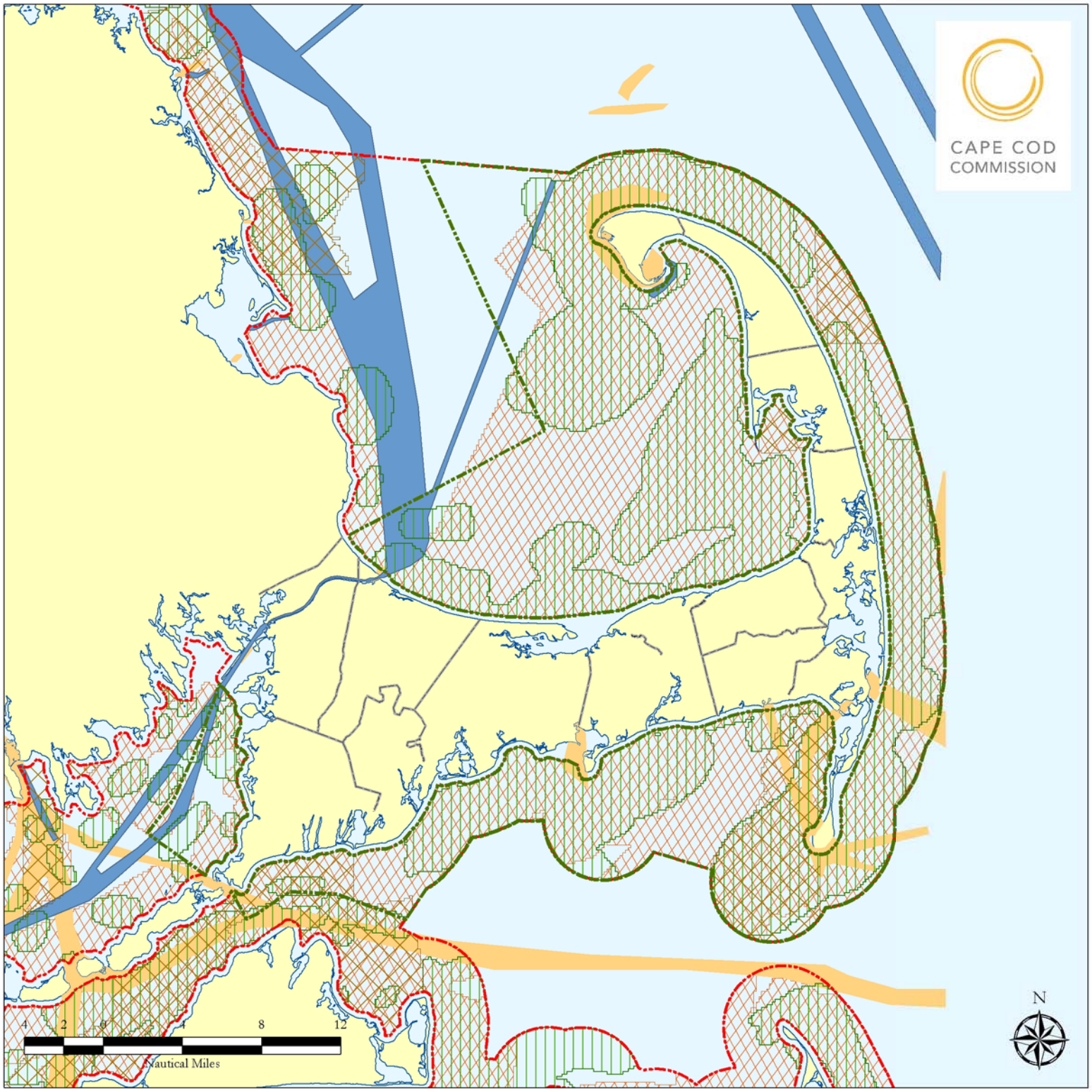
- Cape Cod OMP
- Massachusetts OMP Area Boundary
- Town Lines
- Land
- Ferry Routes
- Concentrated Recreational Fishing
- High Effort and Value Commercial Fishing



Map 10: Cape Cod Ocean Management Plan
Map of Mass. OMP Cable Exclusionary Areas

Legend

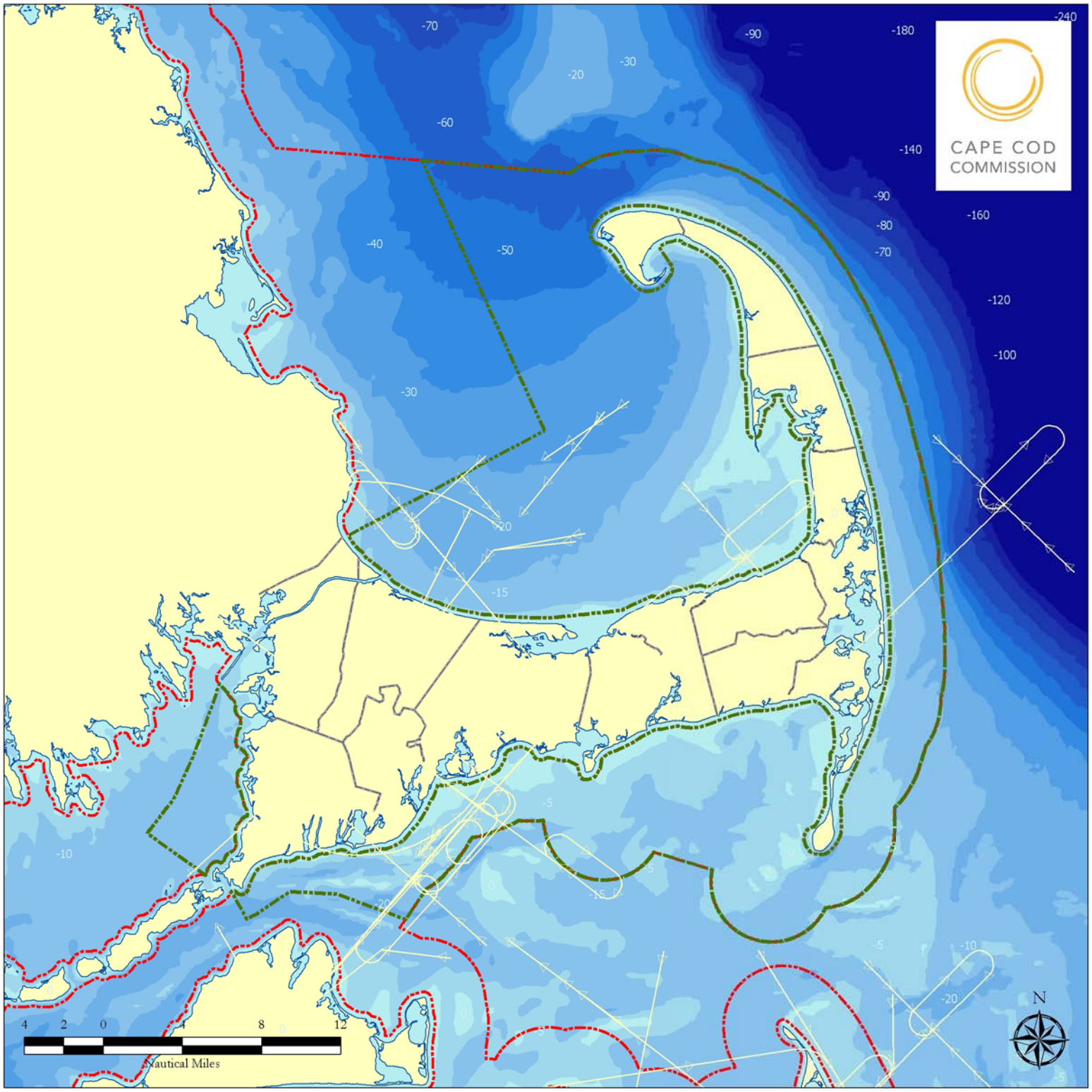
- Cape Cod OMP
- Massachusetts OMP Area Boundary
- Town Lines
- Land
- Humpback Whale Core Habitat
- North Atlantic Right Whale Core Habitat
- Fin Whale Core Habitat
- Eelgrass
- Hard/Complex Seafloor
- Intertidal Flats



Map 11: Cape Cod Ocean Management Plan
Map of Mass. OMP High Use/Activity Areas

Legend

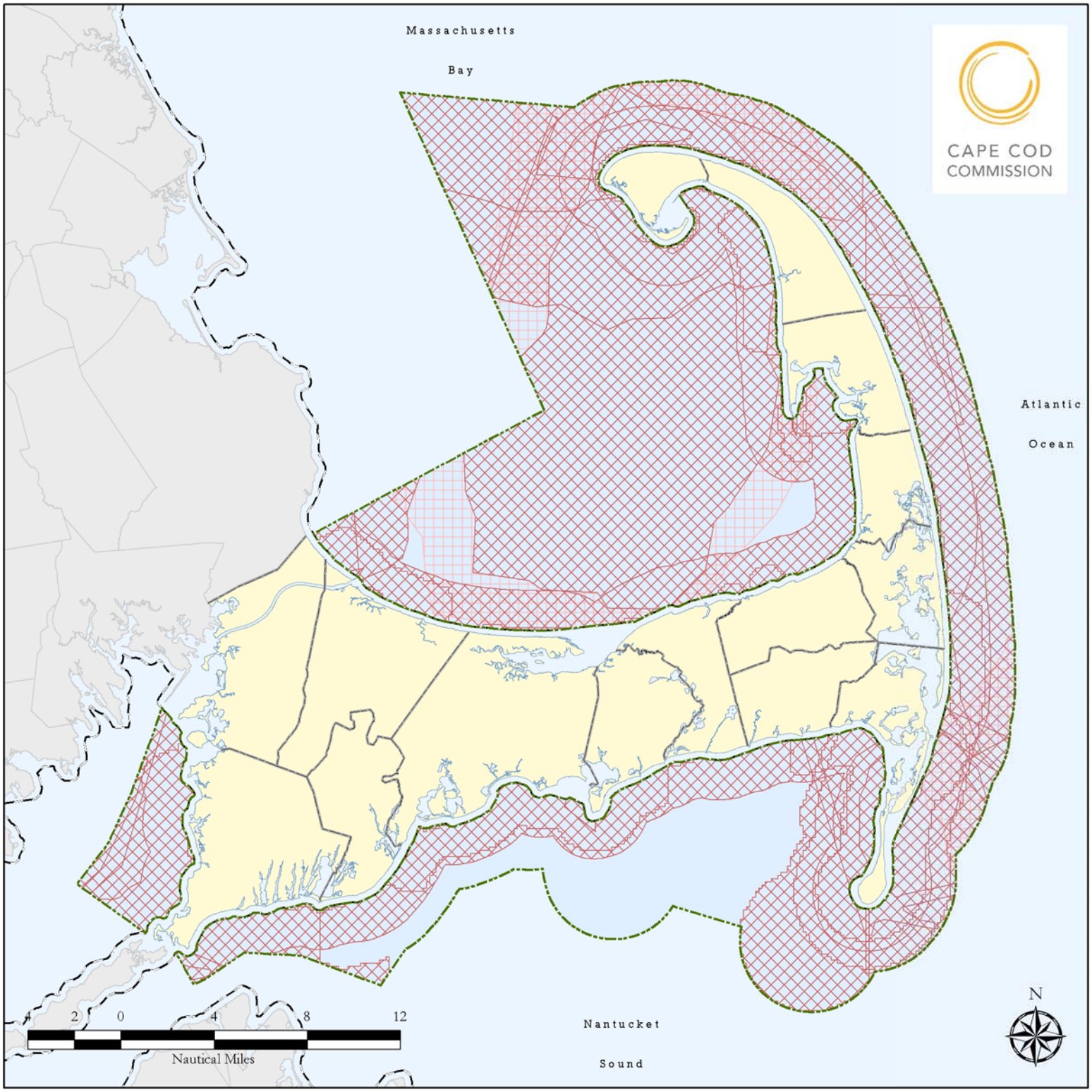
- Cape Cod OMP
- Massachusetts OMP Area Boundary
- Town Lines
- Land
- High Effort and Value Commercial Fishing
- Concentrated Recreational Fishing
- Concentrated Commercial Traffic
- Concentrated Commercial Fishing Traffic
- Concentrated Recreational Boating Activity



Map 12: Cape Cod Ocean Management Plan
Map of Schematics of Commercial Flights In and Out of Cape Cod Airports

Legend

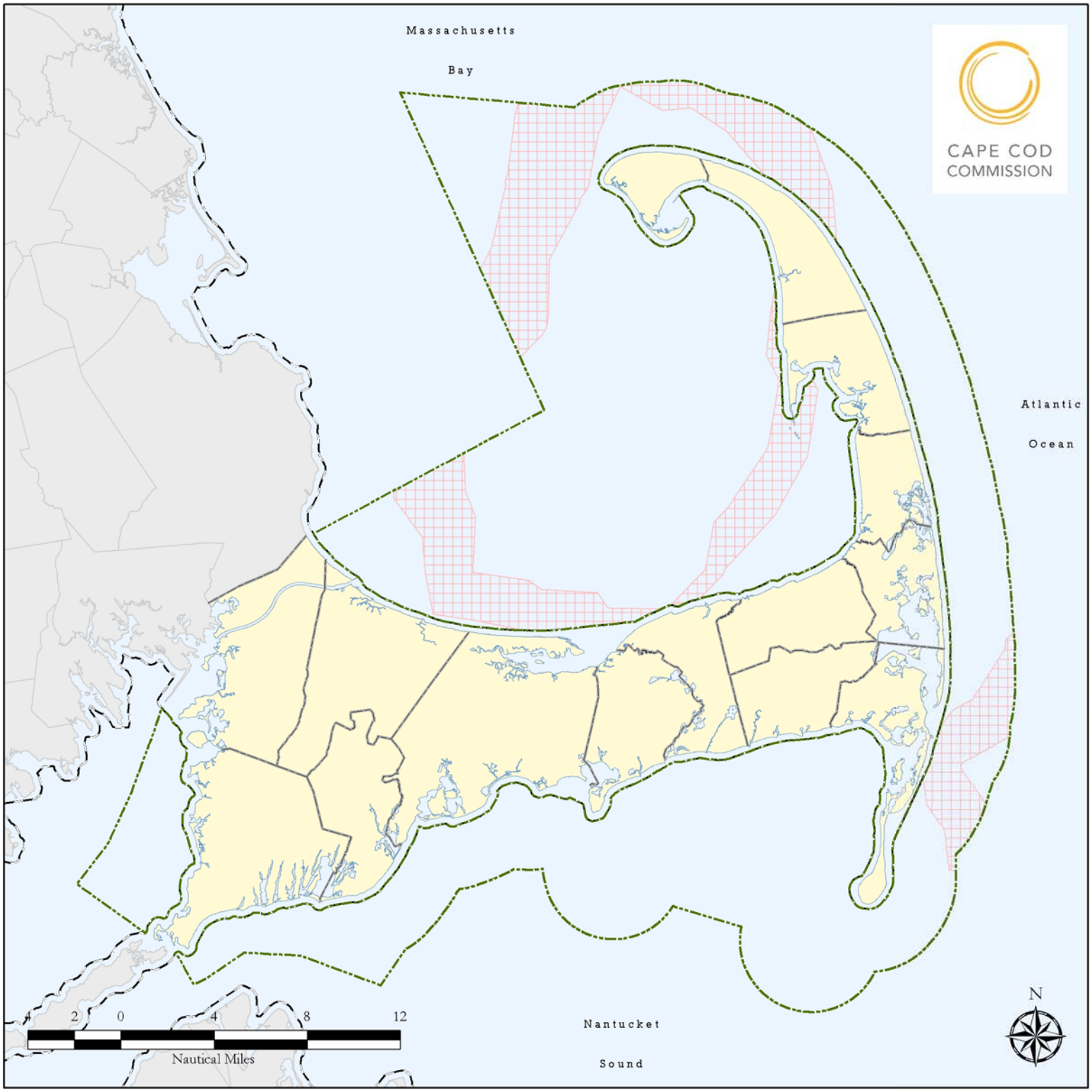
- Cape Cod OMP
- Massachusetts OMP Area Boundary
- Town Lines
- Land
- Airport Approaches



Map 13: Cape Cod Ocean Management Plan
Map of Wind Energy Facility Prohibited Areas

Legend

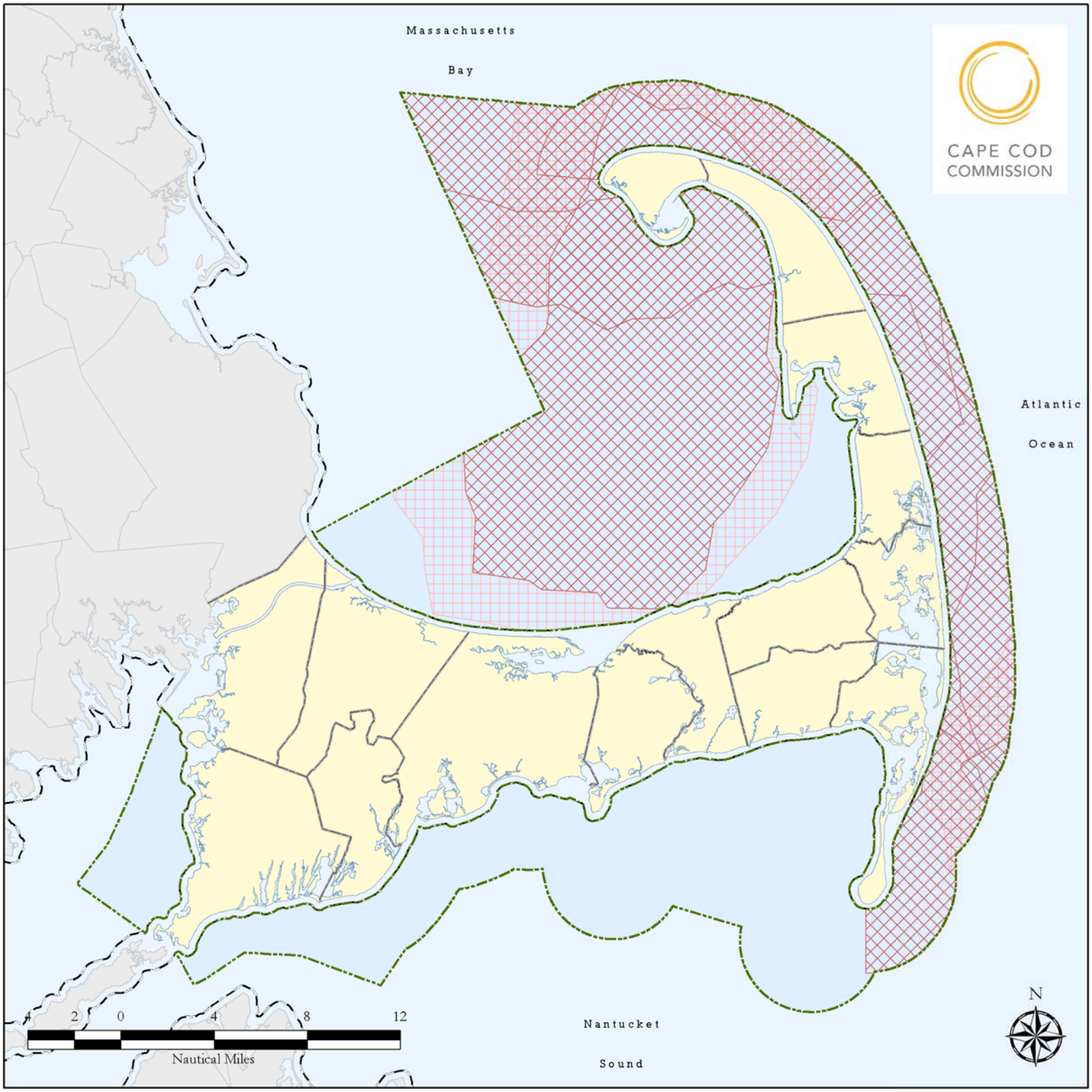
- Cape Cod OMP
- Nearshore Mass. Ocean Management Plan Boundary
- Prohibited Areas
- Exclusionary Areas
- Provisional Areas



Map 14: Cape Cod Ocean Management Plan
Map of Exclusionary Areas

Legend

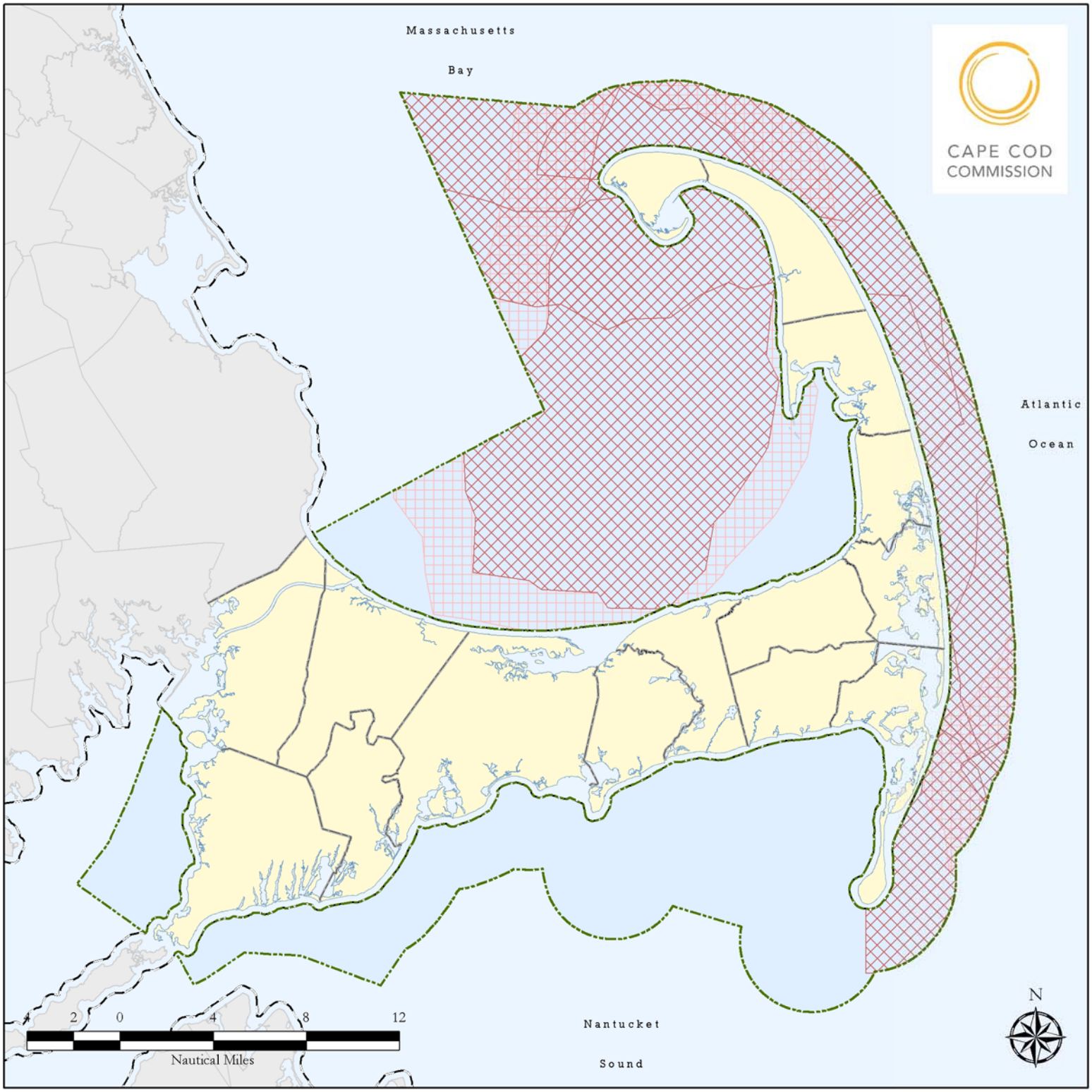
- Cape Cod OMP
- Nearshore Mass. Ocean Management Plan Boundary
- Exclusionary Areas



Map 15: Cape Cod Ocean Management Plan
Map of Sand and Gravel Mining Prohibited Areas

Legend

- Cape Cod OMP
- Nearshore Mass Ocean Management Plan Boundary
- Prohibited Areas
- Exclusionary Areas
- Provisional Areas



Map 16: Cape Cod Ocean Management Plan
Map of Cable and Pipeline Prohibited Areas

Legend

- Cape Cod OMP
- Nearshore Mass. Ocean Management Plan Boundary
- Prohibited Areas
- Exclusionary Areas
- Provisional Areas

BARNSTABLE COUNTY

In the Year Two Thousand and Ten

Ordinance No. 10-03

To establish a District of Critical Planning Concern pursuant to the Cape Cod Commission Act (the "Act") in the ocean waters off Barnstable County, Massachusetts.

BARNSTABLE COUNTY hereby ordains:

SECTION 1.0 Source of Authority and General Purposes

As authorized by Section 10 of the Cape Cod Commission Act, the Barnstable County Assembly of Delegates hereby proposes the Ocean Management Planning District as hereinafter described, for designation as a District of Critical Planning Concern ("District" or "DCPC"). The designation of this district was proposed by the Barnstable County Commissioners. The purpose of the district is to evaluate and establish criteria for determining appropriate scale for renewable energy projects within Barnstable County, and for establishing procedures and regulations for the review of wind turbines and other uses and activities allowed under the Oceans Act of 2008 within the district, including: 1) the installation or development of activities and facilities associated with the generation, transmission and distribution of electric power, 2) the laying of cables, 3) channel and shore protection projects, 4) sand and gravel extraction for shore protection or beach restoration, 5) projects authorized under Chapter 91 and deemed to be of Public Necessity and Convenience, and 6) other related activities not specifically prohibited by the Oceans Sanctuaries Act. The five DCPC types designated and outlined in Section 4 of this ordinance pertain to the charges of determining appropriate scale and regulating wind, and relate to the broader charges of the Commission under the Act, namely to protect unique natural, cultural and other values and to ensure balanced economic development.

SECTION 2.0 Effective Date

The Ordinance shall take effect upon the effective date of this ordinance or upon recording of this Ordinance at the Barnstable County Registry of Deeds, whichever occurs later.

SECTION 3.0 Written Description of the Area

The area nominated for District designation is as follows:

The proposed district is comprised of all the ocean waters and land below and air above within Barnstable County, starting from a line drawn 0.3 nautical miles seaward from Mean High Water (MHW) around Barnstable County and extending to 3 nautical miles from MHW, or the state jurisdictional boundary, whichever is farther from the shore, not to include the waters of Plymouth County, as shown on the attached map. This area is coincident with the planning area as defined in the Massachusetts Ocean Management Plan and excludes the Cape Cod Canal and many of the bays, harbors and embayments as shown on the attached map. Where the bounds of Falmouth, Mashpee, and Bourne's municipal corporations intersect with the bounds of

Wareham, Marion, Mattapoisett, Fairhaven, Gosnold, West Tisbury, Tisbury, or Oak Bluffs' municipal corporations, the district boundary ends with the municipal corporation boundary.

The boundaries are shown on the map attached herein as Exhibit A and incorporated by reference.

The proposed district encompasses 521,552.3 acres of open water.

The land and water within the proposed Ocean Management Planning District reasonably belong within the District because, among other things: 1) they comprise ecological communities which are both distinct and intersect, comprising a whole, 2) the district contains resources of value for their intrinsic qualities as natural living systems, 3) the district contains resources which support or have the potential to support human endeavors, specifically the Cape Cod regional economy, 4) the district comprises a continuous scenic landscape that provides a setting and backdrop for historic villages, and recreational and other day to day activities, providing scenic views both to and from the water, 5) a portion of the area is part of contiguous area mapped as habitat according to the Natural Heritage and Endangered Species Program, 6) the district has the potential to support major public, or commercial investments of utility infrastructure that may benefit the Cape Cod community, and 7) the district contains resources or features that may pose conflicts between uses, or create hazards. The Commission also found that the waters within the District form a critical coherent whole and this area needs further protection afforded by the Act.

SECTION 4.0 Type of District/Reasons for Designation

The proposed Ocean Management Planning District as described above qualifies under Section 10(a) of the Cape Cod Commission Act for designation as a District due to the following factors:

a) The presence of significant wildlife, natural, ecological, archaeological, economic and recreational resources, as well as values of regional, statewide and national significance as described below.

As the Barnstable County Commissioners identified, this area is designated as the following:

1. Wildlife, Natural, Scientific, or Ecological Resource District
2. Cultural, Historic, or Archaeological Resource District
3. Economic and Development District
4. Hazard District
5. Major Public Investment District

SECTION 5.0 Reasons and Purposes for the District's Designation

The ocean waters comprising the district are of critical concern to the region for several reasons, including: the inherent natural resource and scenic qualities the ocean provides; the role of the ocean as a scenic and economic backdrop to the development of Cape Cod as a place where people have wanted to live, work, and play for centuries; the sensitive natural resources, resources of economic value, and cultural and archaeological resources.

There is the potential for development within the district which may adversely impact significant resources and interests protected by the Cape Cod Commission Act. The state's Ocean Management Plan allows for the development of certain structures or uses, including wind turbines, other renewable energy facilities, cables, pipelines, sand and gravel mining, and other activities that could impact natural or economic resources within the district. The potential exists for up to 24 wind turbines to be sited within the planning area. Opportunities exist to identify appropriate locations for renewable energy facilities, to determine the appropriate scale of these facilities, and to streamline permitting. The resources of the district will be better protected if development proceeds in a more controlled manner.

The intent of the proposed district is to preserve and maintain values and resources intended to be protected by the Act. Planning for development within the proposed Ocean Management Planning District is important for balancing the protection of natural, coastal, scientific, cultural, historic, and archaeological resources with other economic resource values. Planning and regulatory tools are available which could be effective in protecting or otherwise meeting the objectives of the District. Current regulatory mechanisms are not adequate to control growth and development in a manner that would protect the resources within the proposed District. Specifically, criteria for determining appropriate scale of renewable energy projects need to be developed for the Cape community to adequately review and regulate energy projects that may be proposed. Identifying areas that may be appropriate for major public investment, like community scaled wind energy projects, could help streamline permitting for those projects.

Set forth below are the reasons why the area is of critical concern to the region, the problems associated with uncontrolled or inappropriate development, and the advantages to be gained by additional planning and regulatory controls.

SECTION 5.1 Natural Resources

The Ocean Planning District contains extensive and diverse natural resources of high ecological, wildlife and scientific value of local, regional, statewide, and in some cases national significance. Marine plants, finfish, shellfish, marine mammals, and seabirds occupy different areas in varying concentrations within the district. The district includes critical habitat in Cape Cod Bay for federally endangered whales (Northern Right Whale, Fin Whale, Humpback Whale) and sea turtles. Habitats within the district also support endangered seabirds such as the Roseate Tern, large, seasonal concentrations of sea ducks, and important finfish and shellfish populations (lobster, sea scallop, horseshoe crab, etc.). Extensive beds of eelgrass, an important subtidal habitat for a variety of marine organisms, occur within the district. The district's diverse natural resources provide scientific research opportunities that will provide a better understanding not only of the Cape's marine ecology but also how the ocean's resources can be sustainably used into the future. The designation of this area as a Wildlife, Natural, Scientific and Ecological Resource District will allow the Cape Cod Commission and the Cape towns to plan for development and develop regulations to address impacts to the natural resources and ecosystems in the district.

The Ocean Management Plan has established management areas within the district including the Prohibited Area (coincident with the Cape Cod Ocean Sanctuary), Renewable Energy Areas (two locations off Martha's Vineyard and the Elizabeth Islands), and the Multi-Use Area which

encompasses the vast majority of the district. The Multi-Use Area is provisionally open to all uses, activities and facilities allowed under the Ocean Sanctuaries Act, including cables and pipelines, sand and gravel extraction for beach nourishment, and community scale wind energy facilities and wave and tidal energy facilities of appropriate scale. The OMP identifies siting and performance standards for each of these activities to avoid or minimize impacts to Special, Sensitive, or Unique Marine and Estuarine Life and Habitat (SSU), Commercial Fishing and Recreational Fishing, and Areas of Concentrated Recreational Activity. The siting and performance standards for the allowed activities are designed to protect or mitigate impacts to specific SSU and to minimize use conflicts with commercial and recreational uses identified in the OMP. However, the OMP does not address local concerns associated with the allowed activities.

The Cape Cod Commission Act specifies among the purposes of the Cape Cod Commission, "the preservation of coastal resources including aquaculture; the protection of … ocean water quality." However, the Commission's Regional Policy Plan does not contain sufficient performance standards for regulating activities in ocean waters around the Cape, such as of renewable energy facilities. The OMP specifically leaves the regional planning agency to define the "appropriate scale" of renewable energy facilities in the district. Community scale wind projects are allowed in the Multi-Use Area with up to 24 turbines allocated for the Cape Cod region.

Activities allowed by the OMP may pose potential risks to the Cape's wildlife and marine ecology. The installation of turbines may result in noise, vibrations, and induced magnetic and electric fields around submarine cables that directly or indirectly affect marine life. Bottom-mounted turbines may impact sensitive sea-bottom habitat (e.g., feeding, spawning, etc.) of marine species by directly impacting the sea-bottom or by shifting sediment transport patterns that change existing benthic ecology. The impacts of new structures in, on and over the ocean on the behavior, communication, physiology of animals (e.g., whales, seals, lobsters, groundfish, birds, bats, etc.) are still being studied. For example, construction and operational noise from energy generation facilities could affect the behavior of whales, including the critically endangered Northern Right Whale, possibly complicating mating, migration, feeding, and mother-calf interactions, as well as communication. The magnitude of impacts will likely depend on the size, number, and design of structures. In addition, the exclusion of some types of fishing around structures may change the composition of fish populations with potential effects on local marine ecology. Conversely, offshore structures will create hard-surface habitat (similar to pilings under a pier), attracting fish and other marine life and locally enhancing marine diversity. Other activities allowed by the OMP, such as sand and gravel extraction, will also directly and indirectly affect benthic marine organisms and their habitat.

The activities allowed by the OMP, especially energy facilities and sand and gravel mining, may create hazards and use conflicts. Sand and gravel extraction in nearshore areas could create hazards by changing wave and current dynamics and shoaling patterns, endanger recreational boaters and other users. For example, shifting nearshore dynamics could also potentially impact coastal properties (e.g., shore erosion). Improperly sited seafloor structures (e.g., bottom-mounted turbines) could shift currents and sediment transport patterns, causing shoaling or other hazards. Energy generation installations will likely have commercial and recreational fishing

and boating exclusion zones to protect the structures and limit liability. Use conflicts may also arise between energy facilities and use of the ocean environment for scientific research.

SECTION 5.2 Community Character/Historic/Archaeological Resources

The proposed ocean DCPC encompasses areas that form the setting of numerous land-based historic districts, historic structures, and cultural landscapes. The historic buildings, neighborhoods, working waterfronts, and cultural landscapes that tell the Cape's story are both historically significant and critical to maintaining the unique character that draws so many people to the region. In many cases, the ocean is a distinctive component of the setting of these resources and of scenic areas, and significant changes to the setting may affect the historic integrity of the region's resources. On Jan. 4, 2010, the National Park Service/US Dept of the Interior determined that Nantucket Sound is eligible for listing on the National Register of Historic Places for its associations with Wampanoag settlement, stories, and folklife, and also for the cultural, historical and scientific information it may yield about land use prior to and after 6,000 years ago as a result of the inundation of the Sound.

Underwater archaeological resources exist on and beneath the ocean floor in the district. These resources comprise both historic shipwreck sites and also paleosols or intact land masses that have been submerged and are believed to hold information about Native American land use prior to their submersion. Nantucket Sound has been determined eligible for listing on the National Historic Register due in part to the significance of these archaeological resources. These resources have not been fully inventoried. While the Ocean Management Plan acknowledges the presence of these archaeological resources, it does not clearly limit sand mining and other developments that would disturb the ocean bottom. The designation of this area as a cultural, historic and archaeological resource district will allow the Cape Cod Commission and the Cape Towns to plan for development and develop regulations to address impacts to the historic, tribal, and community character resources in this area.

SECTION 5.3 Economic Development Resources and Potential

The proposed district contains many resources of vital economic interest to the Cape, the Commonwealth, and beyond. The district contains extensive fish and shellfish resources, areas of significant commercial fisheries activity, and resources which contribute to the tourist economy on Cape Cod, including areas of significance for recreational fishing and boating. The scenic ocean backdrop also draws visitors to the Cape, providing a seasonal boost to the local and regional economy. The health of the marine environment benefits the marine industry and the rest of the Cape economy.

At the same time, the ocean waters surrounding Cape Cod are rich with potential for ocean energy development. As offshore wind, tidal and wave energy technologies advance, Cape Cod has an opportunity to be in the vanguard of this emerging clean energy sector. This fact, together with a renewed global focus on energy independence and sustainable, environmentally friendly energy sources, has made areas with strong wind resources such as Cape Cod a prime consideration for the expansion of wind energy production.

The opportunity for ocean energy development in Cape Cod's ocean waters is rich with economic development and workforce development opportunities that could establish Cape Cod as a leader in offshore energy development. Before this can happen a regulatory framework is needed to balance economic opportunity with other concerns such as the protection of natural living systems; preservation of historic villages and scenic landscapes; and protection of fishing and recreational boating resources to name a few, as these resources already underpin Cape Cod's economy. The goal is to establish a planning and regulatory framework that leads to appropriate scale renewable energy development in the waters around the Cape.

SECTION 6.0 Regulatory Framework

The principal existing regulatory framework within the district consists of the Massachusetts Ocean Management Plan and the Massachusetts Environmental Policy Act and regulations. There are no local regulations that apply within the district, and few minimum performance standards under the Regional Policy Plan that apply.

SECTION 6.1 Suggested Guidelines for Development

The following guidelines shall serve as the basis for future establishment of implementing regulations to be adopted by the county and towns pursuant to Section 11 of the Cape Cod Commission Act to manage development within the Ocean Management Planning District.

SECTION 6.2 Introduction to General Guidelines

Towns and other stakeholders shall develop Implementing Regulations in conjunction with the Cape Cod Commission consistent with the Guidelines described herein. Implementing Regulations for the District may take the form of zoning bylaws or ordinances, regulations, management initiatives, planning tools, or other means identified, which help to achieve the goals and interests of the District. Commission staff will assist the Cape towns in drafting appropriate regulations.

The towns shall propose Implementing Regulations for the District to the Cape Cod Commission. In order to be approved, Implementing Regulations adopted by the towns must be found by the Commission to be consistent with these Guidelines, pursuant to Section 11(d) of the Act.

Upon the adoption of certified Implementing Regulations, the local permitting previously stayed by the DCPC nomination may proceed consistent with the newly adopted Implementing Regulations.

SECTION 6.3 Goals and Interests

Based on concerns articulated in the nomination, the objective of the district is to ensure protection of the following goals and interests through the establishment of implementing regulations by the towns through the Cape Cod Commission:

- Evaluate and establish criteria for determining appropriate scale for renewable energy projects within Barnstable County, and establish procedures and regulations for the review of wind turbines and other uses and activities allowed under the Oceans Act of 2008;
- Protection of unique natural, cultural and other values and balanced economic development;
- Plan for development to consider impacts to the natural resources and ecosystems in the district;
- Plan for development to consider impacts to the historic, tribal and community character resources in this area;
- Plan for development to consider impacts to the ocean resources that currently, or may in the future, support the regional economy;
- Identify means for supporting appropriate use of ocean resources that drive the regional economy;
- Involve the community in identifying appropriate locations and scale for such an investment, while defining the regulatory review process for renewable energy or other public investment projects;
- Explore and clarify possible hazards, and to develop regulations to address use conflicts.

SECTION 6.4 Guidelines

Based on the concerns and opportunities articulated in the resource sections above, and consistent with the goals and interests, the Commission adopts the following guidelines to serve as the basis for implementing regulations to be forwarded on behalf of the towns and County to the Assembly of Delegates to manage development within the Ocean Management Planning District.

6.4.1 Implementing regulations should allow for the continuing use of ocean resources for renewable energy generation and other activities which support the regional economy, so long as those uses are consistent with the other goals and purposes of this DCPC.

6.4.2 Development of thresholds should be considered and established as appropriate for the regional regulatory review of renewable energy projects. Factors to consider should include but are not limited to height, energy generation, or number of individual turbine supports within a project.

6.4.3 Implementing regulations should be developed which determine appropriate scale for renewable energy projects. Factors to consider in defining appropriate scale include, but are not limited to the factors identified in the Ocean Management Plan; 1) protection of the public trust, 2) public safety, 3) compatibility with existing uses, 4) proximity to the shoreline, 5) environmental protection, 6) community benefit, and 7) appropriateness of technology and scale.

6.4.4 Prior to submission of implementing regulations to the Commission the following issues should be considered:

a. the protection of SSU's (special, sensitive, unique resources), commercially and recreationally important fishery resources, and general ecosystem health over the long term;

b. the impacts of seafloor disturbances from development resulting in storm, wave or tidal impacts to the shore, or which result in changes in sediment transport, or which impact significant benthic habitat;
c. water quality protection from wastewater discharges from allowed uses in the district;
d. offshore dumping, or use of the seafloor for burial of waste;
e. the protection of habitat provided above the water surface, specifically for waterfowl, shorebirds, bats, and other avian wildlife that utilize the air for fishing/hunting, mating, and migration, from potential development within the district;
f. the protection of historic districts and historic resources whose setting and historic integrity would be impacted by above-water structures within the Ocean DCPC;
g. viewsheds from significant cultural landscapes, wild or natural areas, including federal and state owned parks and wildlife refuges, and traditional cultural properties that would be impacted by above-water structures within the Ocean DCPC;
h. the protection of underwater archaeological resources from ground-disturbing activities;
i. possible use conflicts between allowed uses that may pose hazards;
j. potential cumulative impacts of renewable energy on resources;
k. co-location of technologies or multiple uses of sites; and
l. decommissioning of renewable energy structures.

SECTION 7.0 Review of Developments of Regional Impact (DRI) within the DCPC

The regulations adopted pursuant to these Guidelines in no way alter the process for the referral and review of the Developments of Regional Impact according to the Act and Regulations of the Cape Cod Commission.

Adopted by the Assembly of Delegates on April 21, 2010.

_____
Thomas Keyes, Deputy Speaker
Assembly of Delegates

Approved by the Board of Regional Commissioners _____ at _____
Date Time

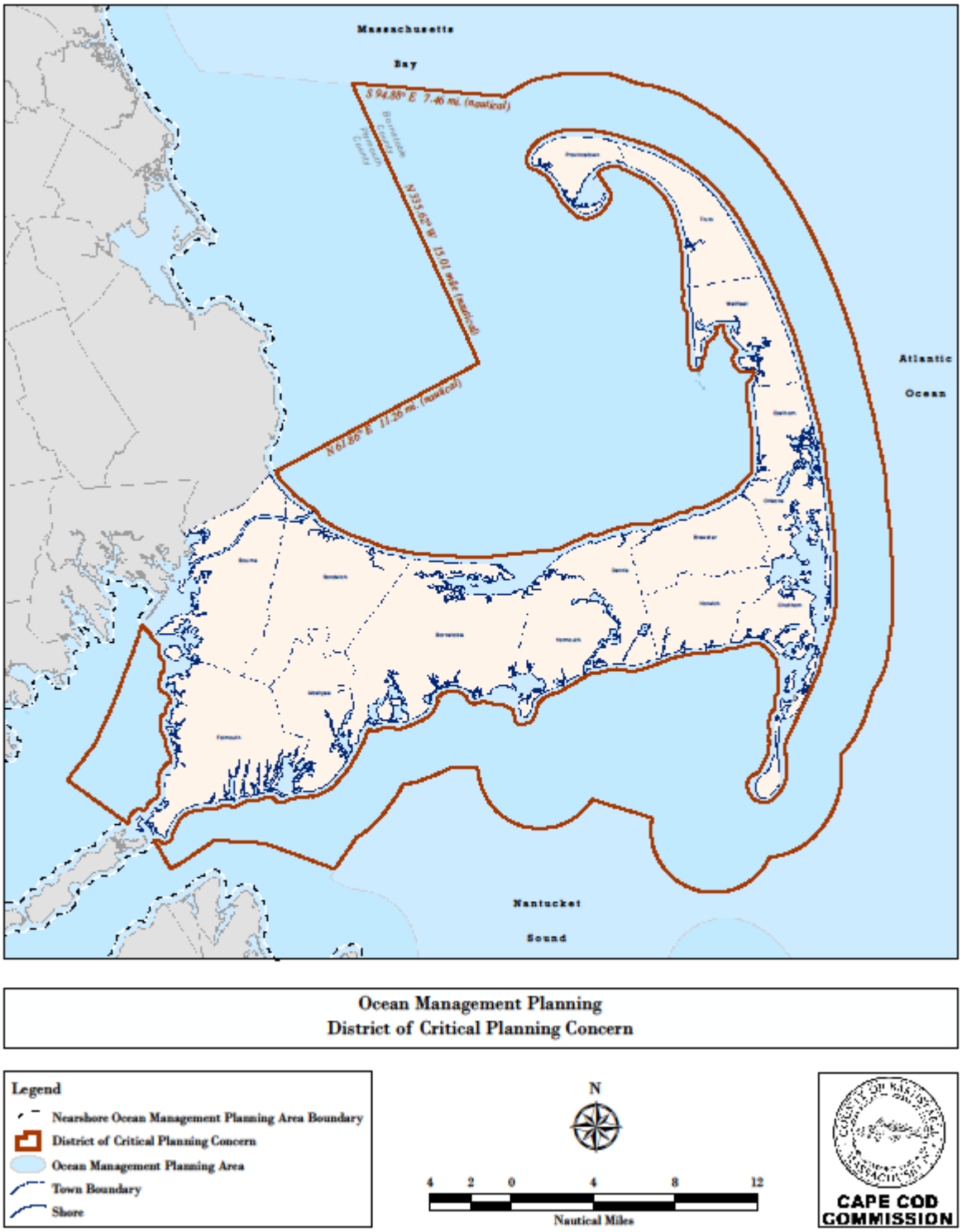
_____
Mary Pat Flynn

_____
William Doherty

_____
Sheila Lyons

APPENDIX 1

Exhibit


Massachusetts
Bay
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N 33.62° W 15.01 mi. (nautical)
N 61.86° E 11.26 mi. (nautical)
Atlantic
Ocean
Nantucket
Sound
Ocean Management Planning
District of Critical Planning Concern
Legend
Nearshore Ocean Management Planning Area Boundary
District of Critical Planning Concern
Ocean Management Planning Area
Town Boundary
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CAPE COD
COMMISSION

A

BARNSTABLE COUNTY

In the Year Two Thousand and Eleven

Ordinance No. XXX

To establish implementing regulations for the Ocean Management Planning District of Critical Planning Concern pursuant to the Cape Cod Commission Act.

BARNSTABLE COUNTY hereby ordains:

Chapter I of the Code of Cape Cod Commission Regulations of General Application

Ocean Management Planning District of Critical Planning Concern Implementing Regulations

SECTION 1 General Provisions

(a) Source of Authority

These regulations concern the regulation of Development within the Ocean Management Planning District of Critical Planning Concern ("Ocean DCPC" or "District") established by Barnstable County Ordinance No. 10-03 and are adopted pursuant to Section 11(f) of the Cape Cod Commission Act, Chapter 716 of the Acts of 1989, as amended.

(b) Function and Purpose

The Commission and the Assembly of Delegates for Barnstable County have determined that the ocean waters and land below and air above, all of which comprise the District, are of critical concern to the region for several reasons, including but not limited to: the ocean's inherent natural resource and scenic qualities; the ocean's role as a scenic and economic backdrop to the development of Cape Cod as a place where people have wanted to live, work, and play for centuries; and the sensitive natural resources, resources of economic value, and cultural and archaeological resources. The areas within the District are all ocean sanctuaries as defined in M.G.L. c. 132A, § 13. If not controlled, Development within the District could adversely impact the significant resources and interests protected by the Act.

These regulations establish the requirements and criteria for Development activities within the Ocean DCPC. The purpose of these regulations is two-fold. The first purpose

is the creation of implementing regulations to serve the purposes of the Ocean DCPC as required by Section 11 of the Act. The second purpose is to establish, through the Ocean DCPC, the process and criteria for determining the "appropriate scale" of renewable energy projects, as set forth in the December 2009 Massachusetts Ocean Management Plan (the "OMP"). The OMP requires that regional planning authorities such as the Commission define the appropriate scale of any wind energy and other renewable energy projects located within waters of those municipalities that are subject to the jurisdiction of such regional planning authorities. The determination of appropriate scale pursuant to these implementing regulations exists apart from any review of an appropriately-scaled renewable energy facility as a development of regional impact pursuant to Section 14 of the Act.

In setting criteria for determining appropriate scale for renewable energy projects within Barnstable County, the Commission was mindful of seven appropriate scale factors set forth in Table 2-2 of the OMP. These factors are (1) the protection of the public trust; (2) public safety; (3) compatibility with existing uses; (4) proximity to the shoreline; (5) environmental protection; (6) community benefit; and (7) appropriateness of technology and scale. Except insofar as only the Commonwealth may act to protect public trust rights, the Commission weighed these factors in combination with the purposes and factors set forth in Sections 1, 10, and 11 of the Act in devising these implementing regulations. The regulations not only establish criteria for determining the appropriate scale of renewable energy projects such as wind turbines, but also for regulating other uses and activities described in the Oceans Act of 2008, including but not limited to: (1) the installation or Development of activities and facilities associated with the generation, transmission and distribution of electric power; (2) the laying of cables; (3) channel and shore protection projects; (4) sand and gravel extraction for shore protection or beach restoration; (5) projects authorized under Chapter 91 and deemed to be of Public Necessity and Convenience; and (6) other related activities not specifically prohibited by the Oceans Sanctuaries Act.

(c) Effective Date

The regulations set forth herein shall be effective following passage as an ordinance and upon recording of the ordinance with the Barnstable County Registry of Deeds.

(d) Definitions

The definitions contained in Section 2 of the Act and the definitions contained herein shall apply to these regulations.

> Act: An Act establishing the Cape Cod Commission, Chapter 716 of the Acts of 1989, as amended.

Adverse Visual Impact: Where the degree of change in the scenic quality resulting from an activity is expected to unreasonably alter the public's enjoyment or appreciation of a scenic resource or otherwise unreasonably alter the character, setting or quality of a scenic resource.

Associated Wind Energy Facility Infrastructure: Cables, pipelines, conduits, and other structures or equipment accessory to one or more Wind Energy Facilities and necessary for the transmission and distribution of electricity.

Beach Nourishment: The placement of clean sediment, of a grain size compatible with existing beach sediment, on a beach to increase its width and volume for purposes of storm damage prevention, flood control, or public recreation. The seaward edge of the nourished beach shall not be confined by any structure.

Cable/Pipeline Prohibited Areas: The areas delineated on the *Cape Cod Ocean Management Plan Cable/Pipeline Prohibited Areas Map,* attached as Exhibit D and incorporated by reference. The resources identified on this map include North Atlantic Right Whale Core Habitat, Fin Whale Core Habitat, Humpback Whale Core Habitat, and the Cape Cod Ocean Sanctuary, all as defined in the OMP.

Clerk: Clerk of the Cape Cod Commission.

Critical Habitat: (1) specific areas identified by the Natural Heritage and Endangered Species Program (NHESP) within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the NHESP determines that the area itself is essential for conservation.

Cultural Landscape: A geographic area (including both cultural and natural resources and the wildlife or domestic animals therein) associated with an historic event, activity, or person, or exhibiting other cultural or aesthetic values. There are four general types of Cultural Landscapes, not mutually exclusive: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes.

CZM: Massachusetts Office of Coastal Zone Management

Development: any of the following undertaken by any person: any building, construction, renovation, mining, extraction, dredging, filling, excavation, or drilling activity operation; any material change in the use or appearance of any structure in the land itself; any activity that alters a shore, beach, seacoast, river, stream, lake, pond, canal, marsh, dune area, woodland, wetland, endangered species habitat, aquifer, or other resource area, including coastal construction or other activity in Barnstable county within the jurisdiction limits of Barnstable county; demolition of a structure; or the deposit of refuse, solid or liquid waste or fill on a

parcel of land or in any water area. Developments include, but are not limited to, Sand and Gravel Mining or Sand Mining operations, Wind Energy Facilities, Wave Energy or Tidal Energy Facilities, and the installation of pipelines, cables, and other conduits.

Dredging: removal of materials including, but not limited to, rocks, bottom sediments, debris, sand, refuse, plant or animal matter, in any excavating, cleaning, deepening, widening or lengthening, either permanently or temporarily, of any flowed tidelands, rivers, streams, ponds or other waters of the Commonwealth. Dredging shall include Improvement Dredging, Maintenance Dredging, excavating and backfilling or other dredging and subsequent refilling.

Exclusionary Areas: Special, sensitive or unique areas ("SSUs") that (a) comprise one or more of the following, as delineated generally in Figures 2-2 or 2-13 of the OMP or delineated more specifically through the provision of scientifically reliable evidence to the extent available: North Atlantic Right Whale Core Habitat, Fin Whale Core Habitat, Humpback Whale Core Habitat, Roseate Tern Core Habitat, Special Concern Tern Core Habitat, Leach's Storm-Petrel Important Habitat, Long-tailed Duck Important Habit, Colonial Waterbirds Important Nesting Habitat, Areas of Hard/Complex Seafloor, Eelgrass, Intertidal flats, and Important Fish Resource Areas; or (b) comprise expanded North Atlantic Right Whale Habitat as delineated on the map attached hereto as Exhibit E. To the extent an Exclusionary Area overlaps a Prohibited Area, it shall be treated as a Prohibited Area.

Executive Committee: A standing committee established by the Cape Cod Commission on April 25, 1990.

Executive Director: The Executive Director of the Cape Cod Commission.

Hard/Complex Bottom or Hard/Complex Seafloor: Seafloor characterized by any combination of the following: 1) areas of exposed bedrock or concentrations of boulder, cobble, or other similar hard bottom distinguished from surrounding unconsolidated sediments, 2) a morphologically rugged seafloor characterized by high variability in bathymetric aspect and gradient, or 3) man-made structures, such as artificial reefs, wrecks, or other functionally equivalent structures that provide additional suitable substrate for development of hard bottom biological communities.

Hazardous Waste: Any Hazardous Waste, Universal Waste or Waste as defined in the Massachusetts Hazardous Waste Regulations, 310 CMR 30.010 resulting from construction, testing, maintenance and decommissioning of all project related structures and equipment.

Hearing Officer(s): A person(s) designated to take testimony, open, close and continue hearings and to accept letters of withdrawal.

Historic Landscape: See Cultural Landscape

Host Community: Any one of the region's 15 municipalities where the WEF is proposed to make landfall.

Impacted Community: Any one (or more) of the region's 15 municipalities where either any part of the proposed WEF and Associated WEF Infrastructure falls within a municipal jurisdiction, or any one (or more) of the region's 15 municipalities that is located within 10 miles of the WEF and has a coastline in the same Regional Seascape Unit.

Improvement Dredging: any dredging in an area which has not been previously dredged or which extends the original dredged width, depth, length, or otherwise alters the original boundaries of a previously dredged area for the purposes of improving navigation or flushing of an embayment or harbor.

Locally Owned: – A business or manufacturer that:

a) is responsible for its own decision-making regarding marketing, operations, and legal proceedings; and

b) if a corporation, has a majority of its outstanding shares beneficially owned by individuals who are residents of Barnstable County; or

c) if a partnership, its partners owning a majority beneficial interest in the partnership are residents of Barnstable County; or

d) if an individual or a sole proprietor, he or she is a resident of Barnstable County.

MBUAR: Massachusetts Board of Underwater Archaeological Resources

Maintenance Dredging: Dredging in accordance with a license or permit in any previously authorized dredged area which does not extend the originally dredged depth, width, or length.

MEPA: Massachusetts Environmental Policy Act, M.G.L. Chapter 30, Sections 61-62H.

MHC: Massachusetts Historical Commission

MORIS: Massachusetts Ocean Resources Information System

Ocean Management Plan, or OMP: The plan promulgated by the Executive Office of Energy and Environmental Affairs of the Commonwealth of Massachusetts entitled, "Massachusetts Ocean Management Plan," dated December 2009, comprising two volumes (Volume 1 – Management and Administration, and Volume 2 – Baseline Assessment and Science Framework)

Ocean Management Planning District of Critical Planning Concern, or Ocean DCPC, or the District: All the ocean waters (comprising approximately 521,552.3 acres of open water) and land below and air above within Barnstable County, starting from a line drawn 0.3 nautical miles seaward from Mean High Water (MHW) around Barnstable County and extending to 3 nautical miles from MHW, or the state jurisdictional boundary, whichever is farther from the shore, not to include the waters of Plymouth County, as shown on the attached map, Exhibit A. This area is coincident with the planning area as defined in the Massachusetts Ocean Management Plan and excludes the Cape Cod Canal and many of the bays, harbors and embayments as shown on the attached map. Where the bounds of Falmouth, Mashpee, and Bourne's municipal corporations intersect with the bounds of Wareham, Marion, Mattapoisett, Fairhaven, Gosnold, West Tisbury, Tisbury, or Oak Bluffs' municipal corporations, the district boundary ends with the municipal corporation boundary. The boundaries are shown on the map attached herein as Exhibit A and incorporated by reference. The Ocean Management Planning District of Critical Planning Concern is also referred to as the "Ocean DCPC" or the "District."

Planning Committee: A standing committee established by the Cape Cod Commission on April 25, 1990

Prohibited Areas: Areas that are Wind Energy Facility Prohibited Areas, Sand and Gravel Mining Prohibited Areas, or Cable/Pipeline Prohibited Areas, with the exception of cables attached to a Cape Cod Commission approved WEF that is not within a Cable Prohibited area or WEF Prohibited area, and is in a Provisional or Exclusionary area as defined by these regulations.

Provisional Areas: Areas within the District that are not identified specifically as Prohibited Areas or Exclusionary Areas.

Regional Community: The fifteen towns that comprise Barnstable County.

Regional Seascape Units: Subdivisions of the coastline defined by major regional headlands, islands or coastal features that extend seaward to the boundary of the DCPC in the ocean, and to the highest landside topographical contour reached inland from the coast. Regional Seascape Units are depicted graphically on Exhibit F.

Regulatory Committee: A standing committee established by the Cape Cod Commission on April 25, 1990.

Sand and Gravel Mining or Sand Mining: Activities involving the removal of material from the ocean floor for the purposes of Beach Nourishment, but not including Maintenance Dredging activities that include a Beach Nourishment component.

Sand and Gravel Mining Prohibited Areas: The areas delineated on the *Cape Cod*

Ocean Management Plan Sand and Gravel Mining Prohibited Areas Map, attached as Exhibit C and incorporated by reference. The resources identified on this map include North Atlantic Right Whale Core Habitat, Fin Whale Core Habitat, Humpback Whale Core Habitat, and the Cape Cod Ocean Sanctuary, all as defined by the OMP.

Scenic Road: A public road that has one or more of the following characteristics:

(1) Passes through an area of outstanding natural environmental features providing views of scenic elements such as salt marshes, rivers, bays, dunes and the ocean;

(2) Provides outstanding views of rural, agricultural landscapes including scenic elements such as panoramic or distant views, cropland, pastures, fields, streams, ponds, hedgerows, stone or wooden fences, farm buildings and farmsteads;

(3) Follows historic road alignments and provides views of historic resources;

(4) A large proportion of the road provides frontage for properties that are in a historic district or subject to perpetual or long-term agricultural, environmental or historic easements.

(5) Is designated by a municipality as a scenic road.

Scenic Resources: Public locations or areas that are recognized and enjoyed for their visual and scenic qualities and whose features, patterns, and characteristics contribute to a distinct sense of appreciation of the natural and cultural environment.

Solid Wastes: Any useless, unwanted, and/or discarded material, including but not limited to any material that is intended to be disposed or being disposed, or that is stored, treated or transferred pending such disposal resulting from construction, testing, maintenance and decommissioning of any project related structures and equipment.

TOY: Time of Year.

Visual Impact: The degree of change in scenic quality resulting from an activity.

Wind Energy Facility or WEF: any electrical generating plant, facility, or unit designed to produce, manufacture, or otherwise generate electric energy in whole or in part by wind, together with any other facilities and equipment located at the same site, whether or not directly related to the production of electric energy through wind. As used herein, the term "Wind Energy Facility" shall include any portion of a Wind Energy Facility or its Associated Wind Energy Facility Infrastructure. This includes, but is not limited to, all transmission, storage, collection and supply

equipment, substations, transformers, site access, and machinery associated with the use. A Wind Energy Facility may include one or more wind turbines.

Wind Energy Facility Prohibited Areas: The areas comprising (a) the areas extending from the landward boundary of the district seaward 2 nautical miles (nm); and (b) the areas delineated on the *Cape Cod Ocean Management Plan Map of Wind Energy Facility Prohibited Areas,* attached as Exhibit B and incorporated by reference. Resources identified on this map include North Atlantic Right Whale Core Habitat, Fin Whale Core Habitat, Humpback Whale Core Habitat, Long-tailed Duck, Roseate Tern, Special Concern Tern species (Arctic, Least, and Common Terns), important nesting habitats of colonial waterbirds and Leach's Storm Petrel, High Effort and Value Commercial Fishing Areas, Concentrated Commercial Fishing Traffic Lanes, Concentrated Commercial Traffic lanes, and the Cape Cod Ocean Sanctuary, all as defined by the OMP.

SECTION 2 Jurisdictions – Projects Subject to the Ocean DCPC Implementing Regulations

These regulations shall apply to any Development or project, including an expansion, extension, or alteration of an existing Development or project, that satisfies the following criteria:

(a) the proposed Development or a portion or component thereof is located partially or entirely within the Ocean DCPC

(b) the proposed Development or a portion or component thereof includes one or more WEFs, the installation of cables or pipelines or similar conduit-type structures, or sand and gravel mining or the use of wave energy or tidal energy to produce, manufacture, or otherwise generate electric energy.

(c) the proposed Development requires one of the following: (i) with respect to WEFs and cables, pipelines, or similar conduit-type structures, an Environmental Notification Form ("ENF") pursuant to the Massachusetts Environmental Policy Act, G.L. c. 30, § 61 *et seq.* ("MEPA"); or (ii) with respect to sand and gravel mining, an Environmental Impact Report ("EIR") pursuant to MEPA.

SECTION 3 Procedure for Reviewing Projects or Developments

(a) Referral; Review

Any municipal agency that receives an application for a permit, license or other authorization for a proposed Development subject to these regulations shall notify the Commission. No such Development shall commence until the Commission has issued a decision pursuant to these regulations and all applicable appeal periods have passed without an appeal having been taken or, if an appeal has been taken, until a final judgment on the Commission's decision has been entered by a court of competent jurisdiction.

(b) Notice

Upon receipt by the Commission of a notice pursuant to subsection (a) above, or upon the filing of an application pursuant to this section, the Commission shall notify, by certified mail, the applicant (except where the Development is brought to the Commission's attention by the filing of an application) and the town clerk for each municipality in Barnstable County.

(c) Contents of Application

All applications shall include (i) the application form on file with the Clerk, (ii) the appropriate filing fee, (iii) a true copy of the deed(s) or other instrument(s) of record showing ownership or control of the property that is site of the proposed Development, and (iv) such additional application materials as are required by the section of these regulations relevant to the type of Development proposed (e.g., WEF, sand and gravel, or cables/pipelines), and as are required in Section 7, General Regulations Applicable to all Projects or Development within the District.

(d) Completeness Review; Scheduling and Notice of Public Hearing

[1] Upon receipt of an application the Executive Director or his/her designee will review the application for completeness. In order to be complete, an application shall contain all of the items identified in subsection (c) above, unless waived by the Executive Director or his/her designee. If additional data or analysis is necessary to assess the impact of the proposed Development, Commission staff may schedule a meeting with the applicant to discuss the additional information required to facilitate Commission review.

[2] A public hearing shall not be scheduled until an application is complete. Failure to submit a complete application in a timely manner may result in a procedural denial.

[3] Once an application is determined to be complete, a public hearing will be scheduled and Commission staff shall review the application for its consistency with these regulations. The regulations and associated technical bulletins applicable to the Commission review of the proposed Development shall be those in effect at the date of the first public hearing

[4] The Commission shall hold the first public hearing within 60 calendar days of the date an application is deemed complete.

[5] All public hearings will be noticed as provided below:

(a) by publication in a newspaper of general circulation throughout Barnstable County, once in each of two successive weeks, the first publication to be not less than 14 calendar days before the day of the hearing;

(b) by posting notice in a conspicuous place in the Commission's offices not less than 14 calendar days before the day of the hearing;

(c) by mailing notice at least 14 calendar days before the day of the hearing to the Assembly of Delegates, County Commissioners, and the town clerk for each municipality in Barnstable County;

(d) by mailing notice at least 14 calendar days before the day of the hearing to the applicant;

(e) if the proposed Development includes work on land above the present mean high water mark, as defined in 310 CMR 9.00, by mailing notice at least 14 calendar days before the day of the hearing to all abutters to the parcel of land on which work is proposed, based on a list of abutters provided by the applicant and certified by the tax assessor of the municipality or municipalities in which such parcel of land is located. Abutters shall include owners of land directly opposite on any public or private street or way and owners of land located within 300 feet of any boundary of the land on which work is proposed as part of the Development.

[6] The applicant shall ensure that copies of all documents subject to notice and hearing are available for public inspection at the Commission's office as of the first date on which notice is published. The Commission will make such copies available for public inspection during normal business hours.

(e) Conduct of Public Hearing

[1] Subcommittee. The Commission may appoint the Regulatory Committee, a

Subcommittee or Commission staff member to serve as hearing officers to conduct the Public Hearing, to hear and report the evidence and testimony, and to assemble and report the record with a recommended decision for consideration by the Commission. The Commission will hold a public hearing following receipt of the recommendations of the Subcommittee or its designee.

[2] Prehearing Conference. The Subcommittee or its designee may order the applicant to attend a prehearing conference to narrow and define the issues and to consider any other matters that may aid in the orderly and efficient conduct of the public hearing and the disposition of the application.

[3] Information and Papers. Applicants shall provide requested information and file and serve papers in a timely manner. A timely manner means that information must be submitted to the Commission at least 14 calendar days in advance of a meeting or hearing. The Commission or its designee may postpone consideration of information submitted less than 14 calendar days prior to a scheduled meeting or hearing. Computation of any time period referred to herein shall begin on the first day following the act which initiates the running of the time period. The last day of the time period is included unless it is a Saturday, Sunday or legal holiday, in such case the period shall run until the close of the next business day. Failure by the applicant to provide information in a timely manner may result in cancellation of a meeting or hearing or in a procedural denial.

[4] Administrative Record. The Subcommittee, the Commission and/or its designee shall make a record of their public hearings which shall consist of any materials filed with the Subcommittee and/or Commission during the time period within which the Subcommittee and/or Commission is accepting materials from the public and/or the applicant.

SECTION 4 Wind Energy Facilities

(a) Prohibited Areas

WEFs or their associated infrastructure shall be located outside of the Wind Energy Facility Prohibited Areas.

(b) Application Requirements for Provisional and Exclusionary Areas

[1] All applicants for a WEF shall provide evidence of filing status with the Federal Aviation Administration, including but not limited to provision of the Notice of Proposed

Construction or Alteration, as required for projects subject to CFR Title 14 Part 77.9.[1]

[2] All applicants for a WEF shall provide a site map demonstrating the provision of adequate buffers to established ferry routes, navigational channels and commercial shipping lanes in accordance with Ocean Resources Maps available through MORIS at the Massachusetts CZM website.

[3] All applicants for a WEF shall provide:

- An Operations and Maintenance Plan, which shall include a detailed Operation and Maintenance Schedule for the life of the WEF and associated infrastructure, including applicable TOY restrictions and/or other natural resource restrictions. Contingency plans for unforeseen maintenance, for instance, in the wake of damage incurred from inclement weather events, or collision, shall be addressed.

- An Emergency Response Plan which identifies responsible parties for first response and ongoing disaster management from events including, but not limited to, fire, mechanical failure (such as blade throw or collapse), collision, catastrophe, oil spills, or other hazardous materials leaks. Applicants shall provide contractual agreements with all federal, state, and local officials and private contractors that will be responsible in the event of an emergency. Such agreements shall confirm that those responders are adequately capitalized.

- A Decommissioning Plan which includes; a commitment and plan to remove all components of the project and restore the site to pre-construction conditions unless doing so would constitute greater harm to the environment, a decommissioning schedule responsive to TOY restrictions, and any security or bonding provisions associated with the project, including those parties responsible

[1] **FAA Obstruction Evaluation / Airport Airspace Analysis (OE/AAA) (new rules as of April 29, 2011); https://oeaaa.faa.gov/oeaaa/external/searchAction.jsp?action=showWindTurbineFAQs**

In administering Title 14 of the Code of Federal Regulations CFR Part 77, the prime objectives of the FAA are to promote air safety and the efficient use of the navigable airspace. To accomplish this mission, aeronautical studies are conducted based on information provided by proponents on an FAA Form 7460-1, Notice of Proposed Construction or Alteration.

CFR Title 14 Part 77.9 states that any person/organization who intends to sponsor any of the following construction or alterations must notify the Administrator of the FAA:

- any construction or alteration exceeding 200 ft above ground level
- any construction or alteration:
  - within 20,000 ft of a public use or military airport which exceeds a 100:1 surface from any point on the runway of each airport with its longest runway more than 3,200 ft
  - within 10,000 ft of a public use or military airport which exceeds a 50:1 surface from any point on the runway of each airport with its longest runway no more than 3,200 ft
  - within 5,000 ft of a public use heliport which exceeds a 25:1 surface
- any highway, railroad or other traverse way whose prescribed adjusted height would exceed the above noted standards
- when requested by the FAA
- any construction or alteration located on a public use airport or heliport regardless of height or location.

for such securities. The costs for decommissioning shall be adjusted annually using the Consumer Price Index, as more specifically detailed in Chapter A, Enabling Regulations of the Code of Cape Cod Commission Regulations of General Application.

- A plan to address mitigating the impacts of construction noise on marine life. The plan should include an assessment of the construction noise impacts on marine life, a monitoring plan for tracking marine wildlife entering the construction zone, and a mitigation plan to avoid or minimize construction noise impacts on marine wildlife.

[4] All applicants for a WEF shall provide a locus map and plans drawn at an appropriate scale and stamped by a registered engineer including, but not limited to, the following: location of all WEF components, existing conditions, turbine locations, transmission network, cable routes and landfall, associated structures, elevations, details, sections and specifications.

(c) Performance Standards for Provisional and Exclusionary Areas

[1] WEFs shall have buffers to established ferry routes, navigational channels and commercial shipping lanes with adequate width to prevent accidents or irreconcilable conflict between different uses.

[2] WEFs shall not eliminate or significantly impair the current and future function of working waterfronts, harbors, and fishing grounds for fish, shellfish, and crustaceans.

[3] The Operations and Maintenance Plan shall identify the party(ies) responsible for ensuring (a) that the WEF and associated infrastructure is maintained in sound condition so as not to constitute a significant threat to the public health and safety and the environment; (b) that adequate capital or insurance exists to make necessary repairs, including repairs on account of accidents and natural disasters; and (c) that all performance standards set forth herein will be met. Such Operations and Maintenance Plan shall include provisions for regular review by the Commission, and the Commission shall require a Certificate of Compliance to ensure reporting is submitted in a timely manner.

[4] The Emergency Response Plan shall ensure the timely and competent response to accidents or disasters so as to minimize to the greatest extent practicable threatened or actual harm to the public and damage to the environment.

[5] The Decommissioning Plan shall ensure that (a) the capital necessary to remove any structures and restore disturbed areas to their natural condition exists and is secure; and (b) the removal of structures and restoration of natural areas will take place within a time period and in a manner that minimizes to the greatest extent possible the risk of harm to the public health and safety and damage to the environment, including observation of TOY restrictions. The Cape Cod Commission shall require a Certificate of Compliance to ensure the provisions of the plan are met.

Community Benefit

[6] Applicants for WEFs shall demonstrate the project's benefit to the community through compliance with the following criteria:

Allocation of Benefits	Energy Import Substitution	Local Fiscal Benefit	Regional Ownership	Public Facilities Benefit
Host Community		√+		√
Impacted Community		√		√
Regional Community	√		√	

Community Benefit Criteria

1. Energy Import Substitution - Applicants for WEFs shall demonstrate through a statement of need that energy generated from the project would otherwise be imported into the region.

2. Local Fiscal Benefit - Applicants for WEFs shall contribute a percentage, in accordance with Technical Bulletin ___, of the WEFs electrical generation capacity to Host and Impacted Communities on an annual basis for the life of the WEF.
   2a). Disbursement of Benefit - Majority share shall be disbursed to the Host Community; remainder disbursed to Impacted Community, or Communities.

3. Regional Ownership - A share of a proposed WEF shall be owned or controlled by a public, or quasi-public regional entity, in accordance with Technical Bulletin ___.

4. Public Facilities Benefit - Applicants for WEFs shall provide, in part or in full, the energy generated by the WEF directly to a public facility(s).

[7] The Commission shall find an additional community benefit for projects where applicants demonstrate compliance with either of the following criteria:

1. Local Labor and Service Providers - Applicants for WEFs shall employ a majority of local businesses in the construction and ongoing operational phases of the project.

2. Diverse Employment Opportunity - Applicants for WEFs shall employ or directly benefit residents with disabilities or minority residents, and/or hire minority, veteran-, and women-owned firms for the construction and ongoing operational phases of the project.

Community Character

[8] WEFs shall be sited and designed to avoid Adverse Visual Impacts to the Cape's scenic and cultural/historic resources, including structures listed or eligible for listing on the National or State Register of Historic Places and Historic or Cultural Landscapes. In order to determine the Visual Impact of a WEF, a Visual Impact Assessment (VIA) shall be required for any Development in the Ocean DCPC in accordance with the Technical Bulletin __.

Archaeological and Historical Resources.

[9] Where Development is proposed on or adjacent to known archaeological sites or sites with high archaeological sensitivity as identified by the MBUAR and/or the MHC, it shall be configured to protect such resources. A predevelopment investigation of such sites shall be required early in the site planning process to serve as a guide for layout of the Development.

Natural Resources

[10] Construction and/or decommissioning of WEFs and their associated infrastructure shall not be permitted from January to May in North Atlantic Right Whale Critical Habitat (Cape Cod Bay).Construction and/or decommissioning activities anywhere in the District shall immediately cease if North Atlantic Right Whale(s) are observed within two (2) miles of WEF construction and/or decommissioning area, until such time that the National Marine Fisheries Service (NMFS), Massachusetts Division of Marine Fisheries, and/or a NMFS approved environmental monitor determine that construction and/or decommissioning activities may resume.

[11] To reduce the potential for vessel harassments or collisions with listed whales and sea turtles, all vessel and aircraft captains and project managers associated with the construction, operation/ maintenance and/or decommissioning of the WEF facility shall be familiar with the NOAA Fisheries Northeast Regional Viewing Guidelines, as updated, and MMS Gulf of Mexico Region's Notice to Lessee (NTL) No. 2007-G04 - Vessel Strike Avoidance and Injured/Dead Protected Species Reporting guidelines, http://www.nero.noaa.gov/prot_res/mmv/regs.html

[12] WEF Development shall avoid water depths less than 20 meters to protect sea duck habitat. The applicant may overcome the presumption that a location less than 20 meters water depth provides habitat for sea ducks by providing site surveys that demonstrate that the site does not provide important feeding, resting, staging, or overwintering habitat for

sea ducks.

[13] WEFs shall be sited and designed to avoid avian or bat migratory routes. Alternatively, where such routes are not known, an applicant shall demonstrate that a WEF can be operated to ensure bird and bat safety during significant migratory events through monitoring equipment and an operations plan.

[14] Construction and/or decommissioning of WEFs or their associated infrastructure shall ensure the protection of sea turtles. The applicant shall provide a species protection plan for review and approval when Development is proposed within sea turtle habitat or during times of year when turtles are present. The Commission may consult with the NHESP in review and approval of a species protection plan.

[15] Construction of WEFs or associated infrastructure areas shall protect important fish resources and habitat as classified by the Division of Marine Fisheries, including diadromous fish runs and shellfish. WEFs may be permitted only if the presumption of a site's importance to fish resources and habitat may be overcome where the applicant demonstrates through a site assessment that the resources do not exist, or the site is not significant to important fish resources and habitat.

[16] Construction of WEFs or their associated infrastructure shall not have any direct impacts on eelgrass beds or other biologically productive benthic habitats (e.g. hard/complex seafloor). The burden of proof shall be on the applicant to demonstrate through field surveys that the resources are not present, and/or will not be adversely impacted. WEFs shall avoid impacts to areas of historic eelgrass beds to the maximum extent feasible, regardless of whether eelgrass is found in the historic eelgrass bed at the time of application.

[17] Applicants for WEFs proposed within 500 feet of eelgrass or other biologically productive benthic habitats (e.g. hard/complex seafloor) shall provide an analysis of anticipated sediment dispersion resulting from construction. The results of the sediment dispersion modeling shall be used to ensure that the design and siting of WEF and associated infrastructure avoids indirect impacts (e.g. turbidity) to eelgrass and other biologically productive benthic habitats (e.g. hard/complex seafloor). The 500 ft buffer may be extended in cases where currents or wave activity are anticipated to increase sediment dispersion and negatively impact eelgrass or other biologically productive benthic habitats. The areal extent and health of eelgrass beds within 500 feet of construction activity shall be monitored to detect indirect impacts to sensitive benthic habitats.

[18] The Commission will consult with the Massachusetts Division of Marine Fisheries in determining whether restrictions shall be placed on the timing or methods of WEF construction and decommissioning to avoid temporary or permanent impacts to critical life history stages (e.g., spawning, and egg, embryo, and juvenile development) of marine species. Best management practices shall be employed during WEF construction and decommissioning to minimize turbidity and sedimentation impacts to sensitive benthic

habitats, including eelgrass and hard/complex bottom. The applicant shall provide a monitoring plan for Commission review and approval to monitor turbidity, suspended particulates, light penetration, dissolved oxygen and nutrient conditions during construction and decommissioning. The report shall identify sensitive marine resources in the vicinity of the WEF site, any changes in the areal extent and health of the sensitive marine resources, and contingency plans if turbidity conditions exceed identified thresholds.

[19] Development associated with WEFs within critical animal and plant habitat areas shall submit the Development proposal to the Massachusetts Natural Heritage and Endangered Species Program for review and comment. Development that would adversely affect habitat of local populations of rare animals and plants shall not be permitted. Development may be permitted where the proponent can demonstrate that such Development will not adversely affect such habitat. An animal and plant habitat management plan may be required as a condition of approval when Development or redevelopment is permitted in critical animal and plant habitat areas.

[20] Construction noise shall be limited at all times to levels shown to have no material adverse effect on marine life. An acoustic monitoring and response plan, including time-of-year (TOY) restrictions on construction and decommissioning, shall be provided to the Commission for review and approval.

Cumulative Impacts

[21] As part of an application for Development within the District, the cumulative impacts of existing or permitted WEFs, sand and gravel mining operations, and cables and pipelines within the District shall be considered. Applicants shall identify on a map all of the existing or permitted WEFs, Sand Mining operations, or cable or pipeline installations within the District, and the Commission shall determine whether the public benefits of the project outweigh the cumulative adverse impacts to resources protected under these regulations..

(d) Additional Performance Standards for Exclusionary Areas. In addition to the Performance Standards above for Provisional and Exclusionary Areas, projects or Developments proposed for Exclusionary Areas must satisfy the following Performance Standard.

[1] WEFs may only be sited within Exclusionary Areas that comprise expanded North Atlantic Right Whale habitat provided the applicant can demonstrate through the provision of clear and convincing evidence that North Atlantic Right Whales have not been present in the Exclusionary WEF area for the prior five year period.

SECTION 5 Sand and Gravel Mining

(a) Prohibited Areas

Sand and Gravel Mining operations shall be located outside of Sand and Gravel Mining Prohibited Areas.

(b) Application Requirements

[1] All applicants for a Sand Mining operation shall provide a site map demonstrating the provision of adequate buffers to established ferry routes, navigational channels and commercial shipping lanes in accordance with Ocean Resources Maps available through MORIS at the Massachusetts CZM website.

[2] All applicants for a Sand Mining operation shall provide:

- An Operations and Maintenance Plan, which shall include a detailed Operation & Maintenance Schedule for the life of the project and associated infrastructure, including applicable TOY restrictions and/or other natural resource restrictions. Contingency plans for unforeseen maintenance, for instance, in the wake of damage incurred from inclement weather events, or collision, shall be addressed.

- An Emergency Response Plan which identifies responsible parties for first response and ongoing disaster management from events including, but not limited to, fire, collision, catastrophe, oil spills, other hazardous materials leaks, or poor water quality or sedimentation resulting from mining operations. Applicants shall provide contractual agreements with all federal, state, and local officials and private contractors that will be responsible in the event of an emergency. Such agreements shall confirm that those responders are adequately capitalized.

- A plan to address mitigating the impacts of construction noise on marine life. The plan shall include an assessment of the construction noise impacts on marine life, a monitoring plan for tracking marine wildlife entering the construction zone, and a mitigation plan to avoid or minimize construction noise impacts on marine wildlife.

[3] Applicants for Sand Mining projects shall submit:

(a) a report documenting the potential impacts of the proposed project on sediment transport patterns and regional sediment budgets of both the borrow and placement sites, and the adjacent areas

(b) a local hazard mitigation plan which includes climate adaptation strategies for the affected communities (may be the Regional Multi-Hazard Mitigation Plan where a local plan has not been adopted), and

(c) evidence that the proposed Sand Mining project for Beach Nourishment purposes results in a substantial benefit to public resources and the coastal ecosystem, and sediments derived from the borrow site will be used locally or regionally (not exported outside the region).

[4] All applicants for a Sand Mining project shall provide a locus map and plans drawn at an appropriate scale and stamped by a registered engineer including, but not limited to, the following: location of Sand Mining activities, existing conditions, footprint, depth of excavation, a physical and chemical analysis of sediment samples sufficient to represent the overall size and depth of the proposed mining area, details, sections and specifications.

[5] The applicant shall conduct an assessment of the environmental impacts of Sand Mining activities prior to permitting. Components of a physical impact assessment shall include, but are not limited to: a pre- and post-construction analysis of local ocean currents and wave conditions and their effects on sediment transport rates and patterns, impacts to existing coastal landforms, infrastructure, and public/private property; pre- and post-construction analysis of impacts to marine species, communities, and habitats; assessment of sand infill rates of borrow pits, and the effects of the project on the adjacent seabed, shore erosion, regional sand budgets, and landward freshwater resources.

[6] The applicant shall provide a post-construction restoration and monitoring plan that ensures restoration of the borrow site(s) to productive natural resource conditions to the maximum extent feasible. The Commission shall require a Certificate of Compliance to ensure the provisions of the plan are met.

(c) Performance Standards for Provisional and Exclusionary Areas

[1] Developments or projects shall have buffers to established ferry routes, navigational channels and commercial shipping lanes with adequate width to prevent accidents or irreconcilable conflict between different uses.

[2] Developments or projects shall not eliminate or significantly impair the current and future function of working waterfronts, harbors, and fishing grounds for fish, shellfish, and crustaceans.

[3] The Operations and Maintenance Plan shall identify the party(ies) responsible for ensuring (a) that the Sand Mining operation is operated and maintained so as not to constitute a significant threat to the public health and safety and the environment; (b) that adequate capital or insurance exists to make necessary repairs, including repairs on account of accidents and natural disasters; and (c) that all performance standards set forth herein will be met. Such Operations and Maintenance Plan shall include provisions for regular review by the Commission, and the Commission shall require a Certificate of Compliance to ensure reporting is submitted in a timely manner.

[4] The Emergency Response Plan shall insure the timely and competent response to accidents or disasters so as to minimize to the greatest extent practicable threatened or actual harm to the public and damage to the environment.

Community Character

[5] Sand Mining operations shall be sited and designed to avoid Adverse Visual Impacts to the Cape's scenic and cultural/historic resources, including structures listed or eligible for listing on the National or State Register of Historic Places and Historic or Cultural Landscapes. In order to determine the Visual Impact of a Sand Mining operation, a Visual Impact Assessment (VIA) shall be required for review for any Development associated with Sand Mining that exceeds 12 months in duration during any calendar year in the Ocean DCPC in accordance with the Technical Bulletin __.

Archaeological and Historical Resources.

[6] Where Development is proposed on or adjacent to known archaeological sites or sites with high archaeological sensitivity as identified by the MBUAR and/or the MHC, it shall be configured to protect such resources. A predevelopment investigation of such sites shall be required early in the site planning process to serve as a guide for layout of the Development.

Physical Assessment

[7] Sand Mining shall not change ocean currents or wave conditions that result in adverse effects on existing coastal landforms, infrastructure, and public/private property, including saltwater intrusion on landward freshwater resources.

Natural Resources

[8] Sand Mining shall not be permitted from January to May in North Atlantic Right Whale Critical Habitat (Cape Cod Bay).

Construction and/or decommissioning activities anywhere in the District shall immediately cease if North Atlantic Right Whale(s) are observed within two (2) miles of Sand Mining operations, until such time that the National Marine Fisheries Service (NMFS), Massachusetts Division of Marine Fisheries, and/or a NMFS approved environmental monitor determine that mining operations may resume.

[9] To reduce the potential for vessel harassments or collisions with listed whales and sea turtles, all vessel and aircraft captains and project managers associated with the Sand Mining operation shall be familiar with the NOAA Fisheries Northeast Regional Viewing Guidelines, as updated, and MMS Gulf of Mexico Region's Notice to Lessee (NTL) No. 2007-G04 - Vessel Strike Avoidance and Injured/Dead Protected Species Reporting guidelines, http://www.nero.noaa.gov/prot_res/mmv/regs.html

[10] Sand Mining shall not be permitted where Sand Mining operations would adversely impact the core habitats of Long-tailed Duck, Roseate Tern, Special Concern Tern species (Arctic, Least, and Common Terns), and important nesting habitats of colonial waterbirds and Leach's Storm Petrel, all as delineated by the OMP. Development may be permitted where the proponent can demonstrate that such Development will not adversely affect the habitat of these species. A species protection plan may be required as a condition of approval when Development is permitted in these core habitats.

[11] Sand Mining operations shall avoid water depths less than 20 meters to protect sea duck habitat. The applicant may overcome the presumption that a location less than 20 meters water depth provides habitat for sea ducks by providing site surveys that demonstrate that the site does not provide important feeding, resting, staging, or overwintering habitat for sea ducks.

[12] Sand Mining shall ensure the protection of sea turtles. The applicant shall provide a species protection plan for review and approval when Development is proposed within sea turtle habitat or during times of year when turtles are present. The Commission may consult with the NHESP in review and approval of a species protection plan.

[13] Sand Mining operations shall protect important fish resources and habitat as classified by the Division of Marine Fisheries, including diadromous fish runs and shellfish. Sand Mining operations may be permitted in Exclusionary or Provisional areas, provided that the presumption of a site's importance to fish resources and habitat is overcome where the applicant demonstrates through a site assessment that the resources do not exist, or the site is not significant to important fish resources and habitat. Sand Mining operations shall also avoidlicensed commercial fishing or aquaculture installations (e.g. fish weirs, aquaculture pens, rafts, floats, etc.)

[14] Sand Mining operations shall not have any direct impacts on eelgrass beds or areas of other biologically productive benthic habitats (e.g. hard/complex seafloor) . The burden of proof shall be on the applicant to demonstrate through field surveys that the resources are not present, and/or will not be adversely impacted. Sand Mining operations shall avoid impacts to areas of historic eelgrass beds to the maximum extent feasible, regardless of whether eelgrass is found in the historic eelgrass bed at the time of application.

[15] Applicants for proposed Sand Mining operations located within 500 feet of eelgrass beds or other biologically productive benthic habitats (e.g. hard/complex seafloor) shall provide an analysis of anticipated sediment dispersion resulting from Sand Mining activities. The results of the sediment dispersion modeling shall be used to ensure that the design and siting of Sand Mining operations avoids indirect impacts (e.g. turbidity) to eelgrass and other biologically productive benthic habitats (e.g. hard/complex seafloor).

[16] The Commission will consult with Massachusetts Division of Marine Fisheries in determining whether restrictions shall be placed on the timing or methods of sand mining operations to avoid temporary or permanent impacts to critical life history stages (e.g.,

spawning, and egg, embryo, and juvenile development) of marine species. Best management practices shall be employed during Sand Mining operations to minimize turbidity and sedimentation impacts to sensitive benthic habitats, including eelgrass and other biologically productive benthic habitats (e.g. hard/complex seafloor). The applicant shall provide a monitoring plan for Commission review and approval to monitor turbidity, suspended particulates, light penetration, dissolved oxygen and nutrient conditions in the proposed area for Sand Mining, in addition to a buffer zone that extends to the furthest boundary of the potentially affected adjacent area (as determined by current/wave modeling). The report shall identify sensitive marine resources in the vicinity of the dredge site, any changes in the areal extent and health of the sensitive marine resources, and contingency plans if turbidity conditions exceed identified thresholds.

[17] Applicants for Sand Mining operations within critical animal and plant habitat areas shall submit the Development proposal to the Massachusetts Natural Heritage and Endangered Species Program for review and comment. Development that would adversely affect habitat of local populations of rare animals and plants shall not be permitted. Development may be permitted where the proponent can demonstrate that such Development will not adversely affect such habitat. An animal and plant habitat management plan may be required as a condition of approval when Development or redevelopment is permitted in critical animal and plant habitat areas.

[18] Construction noise shall be limited at all times to levels shown to have no material adverse effect on marine life. An acoustic monitoring and response plan, including time-of-year (TOY) restrictions on construction and decommissioning, shall be provided to the Commission for review and approval.

Community Benefit

[19] Applicants for Sand Mining shall demonstrate that the project results in a substantial benefit to local or regional public resources or the coastal ecosystem, and that the sediments derived from the offshore borrow site are utilized locally or within Barnstable County.

Cumulative Impacts

[20] As part of an application for Development within the District, the cumulative impacts of existing or permitted WEFs, sand and gravel mining operations, and cables and pipelines within the District shall be considered. Applicants shall identify on a map all of the existing or permitted WEFs, Sand Mining operations, or cable or pipeline installations within the District, and the Commission shall determine whether the public benefits of the project outweigh the cumulative adverse impacts to resources protected under these regulations.

(d) Additional Performance Standards for Exclusionary Areas. In addition to the Performance Standards above for Provisional and Exclusionary Areas, projects or

Developments proposed for Exclusionary Areas shall satisfy the following Performance Standard.

[1] Sand Mining operations shall not be permitted from January to May in the Exclusionary Areas that comprise expanded North Atlantic Right Whale habitat. Sand Mining operations may be permitted in these Exclusionary Areas at other times provided the applicant can demonstrate through the provision of clear and convincing evidence that the activity will not cause direct or indirect impacts to North Atlantic Right Whales.

SECTION 6 Cables, Pipelines, And Other Conduits

(a) Prohibited Areas

Cable or Pipeline Installation shall be located outside of Cable/Pipeline Prohibited Areas.

(b) Application Requirements

[1] All applicants for a Cable or Pipeline Installation shall provide a site map delineating adequate buffers to established ferry routes, navigational channels and commercial shipping lanes, or evidence that the proposed installation will not adversely impact these established uses.

[2] All applicants for a Cable or Pipeline Installation shall provide:

- An Operations and Maintenance Plan, which shall include a detailed Operation & Maintenance Schedule for the life of the project and associated infrastructure, including applicable TOY restrictions and/or other natural resource restrictions. Contingency plans for unforeseen maintenance, for instance, in the wake of damage incurred from inclement weather events, or collision, shall be addressed.

- An Emergency Response Plan which identifies responsible parties for first response and ongoing disaster management from events including, but not limited to, fire, collision, catastrophe, oil spills, other hazardous materials leaks, or poor water quality or sedimentation resulting from conduit installation. Applicants shall provide contractual agreements with all federal, state, and local officials and private contractors that will be responsible in the event of an emergency. Such agreements shall confirm that those responders are adequately capitalized.

- A plan to address mitigating the impacts of construction noise on marine life. The plan shall include an assessment of the construction noise impacts on marine life, a monitoring plan for tracking marine wildlife entering the construction zone, and a mitigation plan to avoid or minimize construction noise impacts on marine wildlife.

[3] All applicants for a cable or pipeline installation shall provide a locus map and plans

drawn at an appropriate scale and stamped by a registered engineer including, but not limited to, the following: location of conduit installation, existing conditions, footprint, depth of excavation, installation method, a physical and chemical analysis of sediment samples sufficient to represent the areas subject to disturbance from construction, details, sections and specifications.

[4] The applicant shall thoroughly assess the physical and biological impacts of cable or pipeline installations prior to permitting. The impact assessment shall include, but not be limited to:

(a) A marine route survey along the proposed cable/pipeline route to acquire project-specific information on seafloor conditions, including bathymetry, seafloor geology/sediment types, sediment thickness, grain size and sediment classes to characterize fisheries/benthic habitat, location of sensitive marine resources, and potential underwater archaeological sites. Sidescan sonar, sub-bottom profiling, multi-beam bathymetry, grab samples, sediment profile imagery, and other technologies and data collection efforts shall be used to acquire high resolution data.

(b) Modeling of the project's affects on erosion, sedimentation, scouring on the adjacent seafloor.

(c) A pre- and post-construction analysis of the impacts to benthic species, communities, habitats, structure and function, finfish and shellfish, mobility of lobsters, horseshoe crabs, and other migratory species.

(d) An evaluation of construction noise impacts on marine wildlife

(c) Performance Standards

[1] Developments or projects shall have buffers to established ferry routes, navigational channels and commercial shipping lane with adequate width to prevent accidents or irreconcilable conflict between different uses.

[2] The Operations and Maintenance Plan shall identify the party(ies) responsible for ensuring (a) that the cable or pipeline is maintained in sound condition so as not to constitute a significant threat to the public health and safety and the environment; (b) that adequate capital or insurance exists to make necessary repairs, including repairs caused by collisions and natural disasters; and (c) that all performance standards set forth herein will be met. Such Operations and Maintenance Plan shall include provisions for regular review by the Commission, and the Commission shall require a Certificate of Compliance to ensure reporting is submitted in a timely manner.

[3] The Emergency Response Plan shall ensure the timely and competent response to accidents or disasters so as to minimize to the greatest extent practicable threatened or

actual harm to the public and damage to the environment.

Archaeological and Historical Resources

[4] Where a Development or project is proposed on or adjacent to known archaeological sites or sites with high archaeological sensitivity as identified by the MBUAR and/or the MHC, it shall be configured to protect such resources. A predevelopment investigation of such sites shall be required early in the site planning process to serve as a guide for layout of the Development.

Physical Resources

[5] Cable and pipeline installations shall not result in adverse impacts to benthic communities, including finfish, shellfish, and migratory species through sedimentation, erosion, scour, or barriers to migration.

Natural Resources

[6] Cable and pipeline installations shall not be permitted from January to May in North Atlantic Right Whale Critical Habitat (Cape Cod Bay).

Construction activities anywhere in the District shall immediately cease if North Atlantic Right Whale(s) are observed within two (2) miles of the construction area, until such time that the National Marine Fisheries Service (NMFS), Massachusetts Division of Marine Fisheries, and/or a NMFS approved environmental monitor determine that construction activities may resume.

[7] To reduce the potential for vessel harassments or collisions with listed whales and sea turtles, all vessel captains and project managers associated with construction shall be familiar with the NOAA Fisheries Northeast Regional Viewing Guidelines, as updated, and MMS Gulf of Mexico Region's Notice to Lessee (NTL) No. 2007-G04 - Vessel Strike Avoidance and Injured/Dead Protected Species Reporting guidelines, http://www.nero.noaa.gov/prot_res/mmv/regs.html

[8] The core habitats of Long-tailed Duck, Roseate Tern, Special Concern Tern species (Arctic, Least, and Common Terns), and important nesting habitats of colonial waterbirds and Leach's Storm Petrel shall be protected. Development may be permitted where the proponent can demonstrate that such Development will not adversely affect the habitat of these species. A species protection plan may be required as a condition of approval when Development is permitted in these core habitats.

[9] Cable or pipeline installation shall ensure the protection of sea turtles. The applicant shall provide a species protection plan for review and approval when Development is proposed within sea turtle habitat or during times of year when turtles are present. The Commission may consult with the NHESP in review and approval of a species protection

plan.

[10] Cable or pipeline installation areas shall protect important fish resources and habitat as classified by the Division of Marine Fisheries including diadromous fish runs and shellfish. Cable or pipeline installation may be permitted in the Exclusionary or Provisional areas, provided that the presumption of a site's importance to fish resources and habitat is overcome where the applicant demonstrates through a site assessment that the resources do not exist, the site is not significant to important fish resources and habitat, or that the impact is temporary or insignificant. Cable or pipeline installations shall also avoid licensed commercial fishing or aquaculture installations (e.g. fish weirs, aquaculture pens, rafts, floats, etc.).

[11] Cable or pipeline installation shall not have any direct impacts on eelgrass beds or areas of other biologically productive benthic habitats (e.g. hard/complex seafloor). The burden of proof shall be on the applicant to demonstrate through field surveys that the resources are not present. Cable or pipeline installation shall avoid impacts to areas of historic eelgrass beds to the maximum extent feasible, regardless of whether eelgrass is found in the historic eelgrass bed at the time of application.

[12] Applicants for cable or pipeline installations located within 500 feet of eelgrass beds or other biologically productive benthic habitats (e.g. hard/complex seafloor) shall provide an analysis of anticipated sediment dispersion resulting from cable or pipeline installation. The results of the sediment dispersion modeling shall be used to ensure that the design and siting of cable or pipeline installation avoids indirect impacts (e.g. turbidity) to eelgrass and other biologically productive benthic habitats (e.g. hard/complex seafloor),. Best construction practices (e.g directional drilling) shall be used to the extent feasible.

[13] The Commission will consult with the Massachusetts Division of Marine Fisheries in determining whether restrictions shall be placed on the timing or methods of cable or pipeline installations to avoid temporary or permanent impacts to critical life history stages (e.g., spawning, and egg, embryo, and juvenile development) of marine species. Best management practices shall be employed during cable or pipeline installation to minimize turbidity and sedimentation impacts to sensitive benthic habitats, including eelgrass and other biologically productive benthic habitats (e.g. hard/complex seafloor. The applicant shall provide a monitoring plan for Commission review and approval to monitor turbidity, suspended particulates, light penetration, dissolved oxygen and nutrients conditions in the proposed area for cable or pipeline installation, in addition to a buffer zone that extends to the furthest boundary of the potentially affected adjacent area (as determined by current/wave modeling). The report shall identify sensitive marine resources in the vicinity of the dredge site, any changes in the areal extent and health of the sensitive marine resources, and contingency plans if turbidity conditions exceed identified thresholds.

[14] Cable or pipeline installations within critical animal and plant habitat areas shall submit the development proposal to the Natural Heritage and Endangered Species

Program for review and comment. Development that would adversely affect habitat of local populations of rare animals and plants shall not be permitted. Development may be permitted where the proponent can demonstrate that such Development will not adversely affect the habitat of these species. An animal and plant habitat management plan may be required as a condition of approval when Development or redevelopment is permitted in critical animal and plant habitat areas.

[15] Construction noise shall be limited at all times to levels shown to have no material adverse effect on marine life. An acoustic monitoring and response plan, including time-of-year (TOY) restrictions on construction and decommissioning, shall be provided to the Commission for review and approval.

Cumulative Impacts

[16] As part of an application for Development within the District, the cumulative impacts of existing or permitted WEFs, sand and gravel mining operations, and cables and pipelines within the District shall be considered. Applicants shall identify on a map all of the existing or permitted WEFs, Sand Mining operations, or cable or pipeline installations within the District, and the Commission shall determine whether the public benefits of the project outweigh the cumulative adverse impacts to resources protected under these regulations.

[17] Applicants shall coordinate conduit installations with existing cable or pipeline routes to the maximum extent feasible in order to minimize harm to the environment.

(d) Additional Performance Standards for Exclusionary Areas. In addition to the Performance Standards above for Provisional and Exclusionary Areas, projects or developments proposed for Exclusionary Areas must satisfy the following Performance Standard.

[1] Cable or pipeline installation shall not be permitted from January to May in the Exclusionary Areas that comprise expanded North Atlantic Right Whale habitat. Cables and pipelines may be permitted in these Exclusionary Areas at other times provided that the applicant can demonstrate through the provision of clear and convincing evidence that the activity will not cause direct or indirect impacts to North Atlantic Right Whales.

SECTION 7 General Regulations Applicable to All Projects or Developments Within The District

(a) Application Requirements

[1] All applicants for a project shall submit to the Commission a written plan to handle, store and dispose of Solid Wastes from construction, testing, maintenance and decommissioning of all project related structures and equipment,. This plan or plans shall address:

1. The types and quantities of Solid Wastes to be generated.

2. The methods for storage, handling and transport to land of the Solid Wastes generated.

3. The facilities to be used for disposal and/or recycling of Solid Wastes.

[2] All applicants for a project shall submit to the Commission a written plan to handle, store and dispose of Hazardous Wastes from all project related construction, testing, and maintenance and from construction and maintenance of support structures and equipment,. This plan or plans shall address:

1. The types and quantities of Hazardous Wastes to be generated.

2. The methods for storage, handling and transport to land of the Hazardous Wastes generated.

3. The facilities to be used for disposal of Hazardous Waste.

[3] All projects shall file a project notification form with the Massachusetts Board of Underwater Archaeological Resources and Massachusetts Historical Commission as part of the application requirements.

[4] Development projects shall provide a traffic management plan that includes: identification of land and water transportation routes; timing and scheduling of construction traffic (mobilization/demobilization plan); traffic control; number of trips generated; size of vehicles including marine vessels and home port location; vessel speeds; pedestrian concerns; and coordination with local officials.

(b) Performance Standards

[1] Re-fueling of vessels and other watercraft associated with regulated activities in the District are prohibited within the District to avoid adverse impacts to water quality.

[2] Development that involves the use of a work force on the waters for the construction and operation of their project shall provide a plan for sanitary waste that will achieve the requirements of a no-discharge zone.

[3] The storing, handling, transportation, and disposal of Solid Wastes and Hazardous Wastes shall not adversely impact water quality or harm marine life.

Coastal Resources

[4] Development and redevelopment in the District shall not interfere with existing legal public access and historic public rights of way along the shore.

[5] Activities or Development within the District shall not impede the landward migration of coastal resources, such as salt marshes, coastal beaches, tidal flats, or coastal floodplain. The landward migration of coastal resources in response to relative sea-level rise shall be incorporated into the location, design, and construction of structures and other activities proposed. In addition, the cumulative impacts of development in conjunction with other accelerating anthropogenic stressors (climate change impacts such as increased storm intensity, increased nutrient inputs), shall be considered as part of this process.

[6] Wherever feasible, clean, compatible dredged material shall be used on public beaches. When infeasible, dredged material shall be reused within the same littoral cell to enhance storm damage prevention provided that public access is afforded in accordance with other standards.

[7] Improvement Dredging shall be prohibited in the District except when necessary to accomplish a substantial public benefit and where no feasible alternative exists.

[8] All projects proposed as Maintenance Dredging shall provide prior permitting authorities, permit numbers, dates of issuance and re-issuance, and documentation that clearly demonstrates the location, width, depth and length of the previously permitted project.

[9] Beneficial reuse, within Barnstable County, of clean dredged materials associated with any dredging project in the District shall be required.

Transportation

[10] Regardless of project traffic generation, Development shall not degrade safety for pedestrians, bicyclists, or motor vehicle operators or passengers.

SECTION 8 Decisions, Noticing, and Appeals

(a) Standard of Review

The Commission shall review proposed Developments for their consistency with the Ocean DCPC and these implementing regulations. The Commission shall approve a Development if it finds that the Development is entirely consistent with the Ocean DCPC and these regulations. The Commission may, in its discretion, approve a Development with conditions if it finds that the conditions are necessary to make a finding that the Development is consistent with the Ocean DCPC and these regulations.

(b) Decisions

[1] Delegation, Recommended Decisions. The chairman of the Commission may delegate to the Regulatory Committee or other subcommittee or Commission staff as a hearing officer the responsibility to review the proposed Development, assemble the record, and make a recommendation to the Commission. Following the public hearing, the Subcommittee or its designee shall provide the Commission and the parties with its recommended decision, clearly setting forth its factual findings and the reasons for its recommendations.

[2] Final Decision. If the Commission delegates to a subcommittee the responsibility to make a recommendation decision, the Commission will hold a public hearing within 45 days after the date on which the recommended decision is made by the subcommittee, regulatory committee or hearing officer. After the close thereof, the Commission will deliberate and vote. The Commission may reject the recommended decision, adopt the recommendation decision in part or with revisions or with conditions, adopt the recommendation decision as proposed, or remand the decision back to the subcommittee or designee for further study and report. Every final decision shall be in writing and shall contain a statement of the reasons therefore, including determinations of fact or law necessary to the decision.

[3] Procedural Denial. Failure to submit a completed and accurate application form, to provide all application materials required by these regulations, or to pay the required filing fee may result in a determination that the application is incomplete and an issuance of a procedural denial. No public hearing needs to be held to determine that an application is incomplete and must be procedurally denied. All procedural denials shall be without prejudice against the applicant, who shall be entitled to submit a completed application subsequent to such procedural denial.

(b) Filing and Recording of Final Decisions

[1] The Commission shall file its final written decision with the Clerk and shall send the decision by certified mail to the applicant and the town clerks of all municipalities within Barnstable County. The written decision may include a copy of the plan of the proposed Development that was the subject of a decision of the Commission.

[2] Notice of the final decision shall be published in a newspaper of general circulation in Barnstable County, including a brief summary of the contents of the decision and a statement that copies of the decision are available for public inspection at the Commission's office during normal business hours. In addition, the Commission shall publish notice of its written decisions in its official publication, The Reporter.

[3] The Commission shall issue its written final decision in a form suitable for recording in the Barnstable County registry of deeds. The decision shall be recorded in the Barnstable County registry of deeds after the appeal period has elapsed and no

appeal has been filed or, if such appeal has been filed, after it has been dismissed or denied. The Commission shall retain proof of such recording, including the recording information (either book and page or instrument number, date, and time). No Development shall begin until the final decision has been recorded. The applicant shall bear the expense of recording and shall provide to the Clerk all information necessary to effectuate the recording of the decision.

(c) Appeals

Any person aggrieved by a Commission decision under these regulations may appeal the Commission's decision to the Barnstable county superior court within sixty days after the Commission has sent the applicant written notice, by certified mail, of its decision and has filed a copy of its decision with the town clerk of any municipality in which the proposed Development is located. Notice of the appeal shall be served within such sixty days on the town clerk for the municipality in which the proposed Development is located and the Commission.

The complaint shall seek relief in the nature of certiorari pursuant to M.G.L. c. 249, § 4. Review shall be limited to the record on which the commission based its decision. The foregoing remedy shall be exclusive. All issues in any proceeding under this section shall have precedence over all other civil actions and proceedings.

SECTION 9 Filing Fees And Outside Consultant Fees

(a) Outside Consultant Fees

For all projects and Developments, in addition to the filing fee outlined below, if the Executive Director of the Commission determines that review of the Development will require the services of an outside consultant or other additional resource to assist in any aspect of the project evaluation, the Executive Director shall provide the applicant with an estimate of the cost of these services and the applicant shall deposit with the Commission an amount of money to cover 100% of this estimate. If this initial estimate is insufficient to adequately review the application, the applicant will provide the additional funds necessary. Any funds not expended at the conclusion of the review will be returned to the applicant.

(b) Filing Fees

Filing fees shall be made in accordance with the Schedule as enumerated by Chapter A, Enabling Regulations of the Code of Cape Cod Commission Regulations of General Application, Section 16: Schedule of Fees.

Adopted by the Assembly of Delegates on September XXX, 2011.

Ronald Bergstrom, Speaker
Assembly of Delegates

Approved by the Board of Regional Commissioners _____ at _____
Date Time

Mary Pat Flynn

William Doherty

Sheila Lyons

Exhibits:

Exhibit A: Ocean DCPC

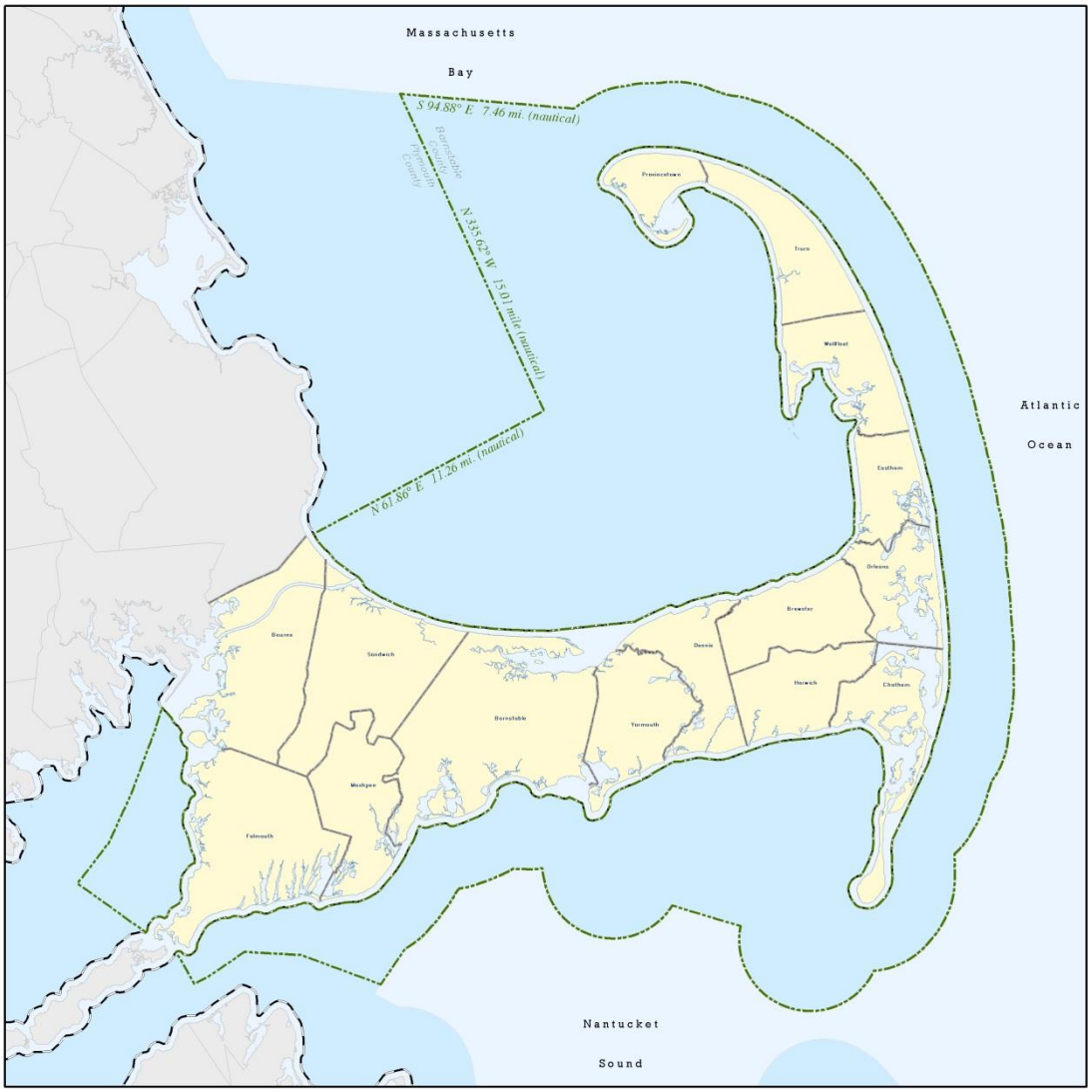

Exhibit A: Cape Cod Ocean Management Plan
District of Critical Planning Concern Boundary Map

Legend
- Cape Cod OMP and Ocean DCPC Boundary
- Nearshore Mass. Ocean Management Plan Boundary
- Ocean Management Planning Area

N

4 2 0 4 8 12
Nautical Miles

CAPE COD COMMISSION

Exhibit B: Cape Cod Ocean Management Plan Map of Wind Energy Facility Prohibited Areas

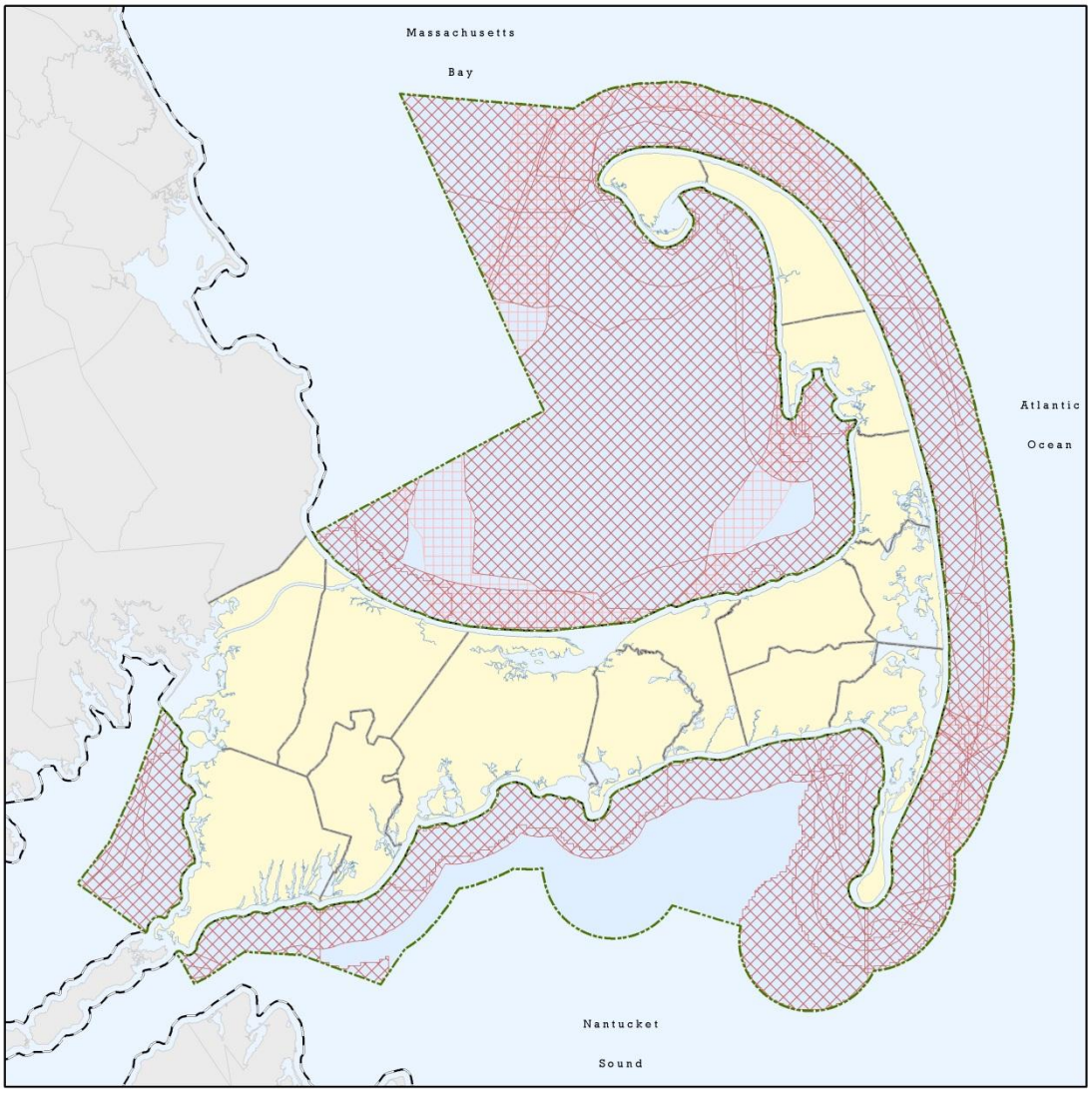

Exhibit B: Cape Cod Ocean Management Plan
Map of Wind Energy Facility Prohibited Areas

Legend
Cape Cod OMP and Ocean DCPC Boundary
Nearshore Mass. Ocean Management Plan Boundary
Prohibited Areas
Exclusionary Areas
Provisional Areas

N

4 2 0 4 8 12
Nautical Miles

CAPE COD COMMISSION

Exhibit C: Cape Cod Ocean Management Plan Sand and Gravel Mining Prohibited Areas Map

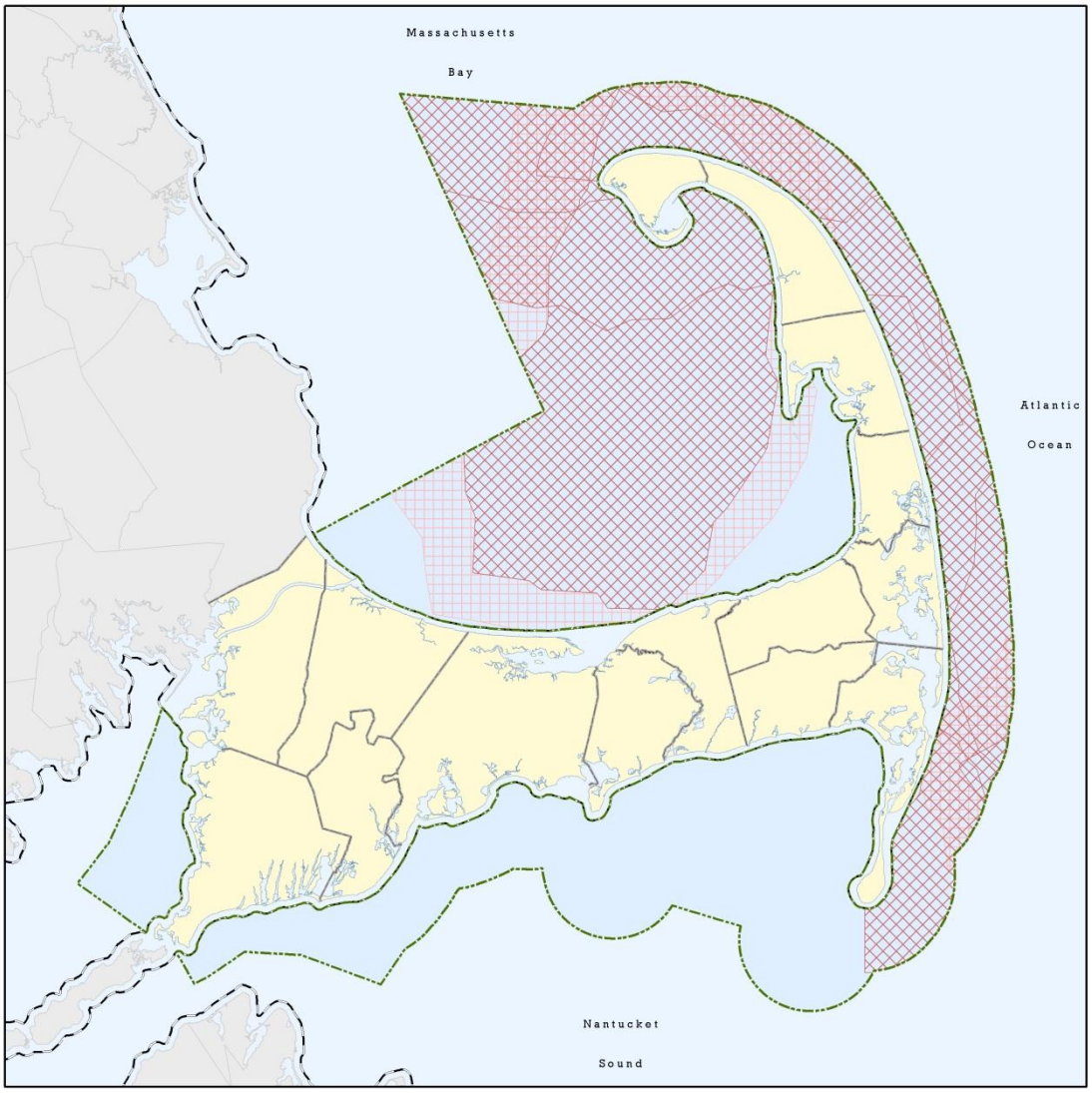

Exhibit C: Cape Cod Ocean Management Plan
Map of Sand and Gravel Mining Prohibited Areas

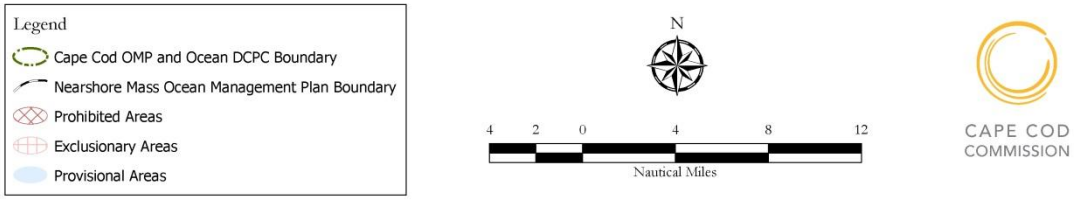

Exhibit D: Cape Cod Ocean Management Plan Cable/Pipeline Prohibited Areas Map

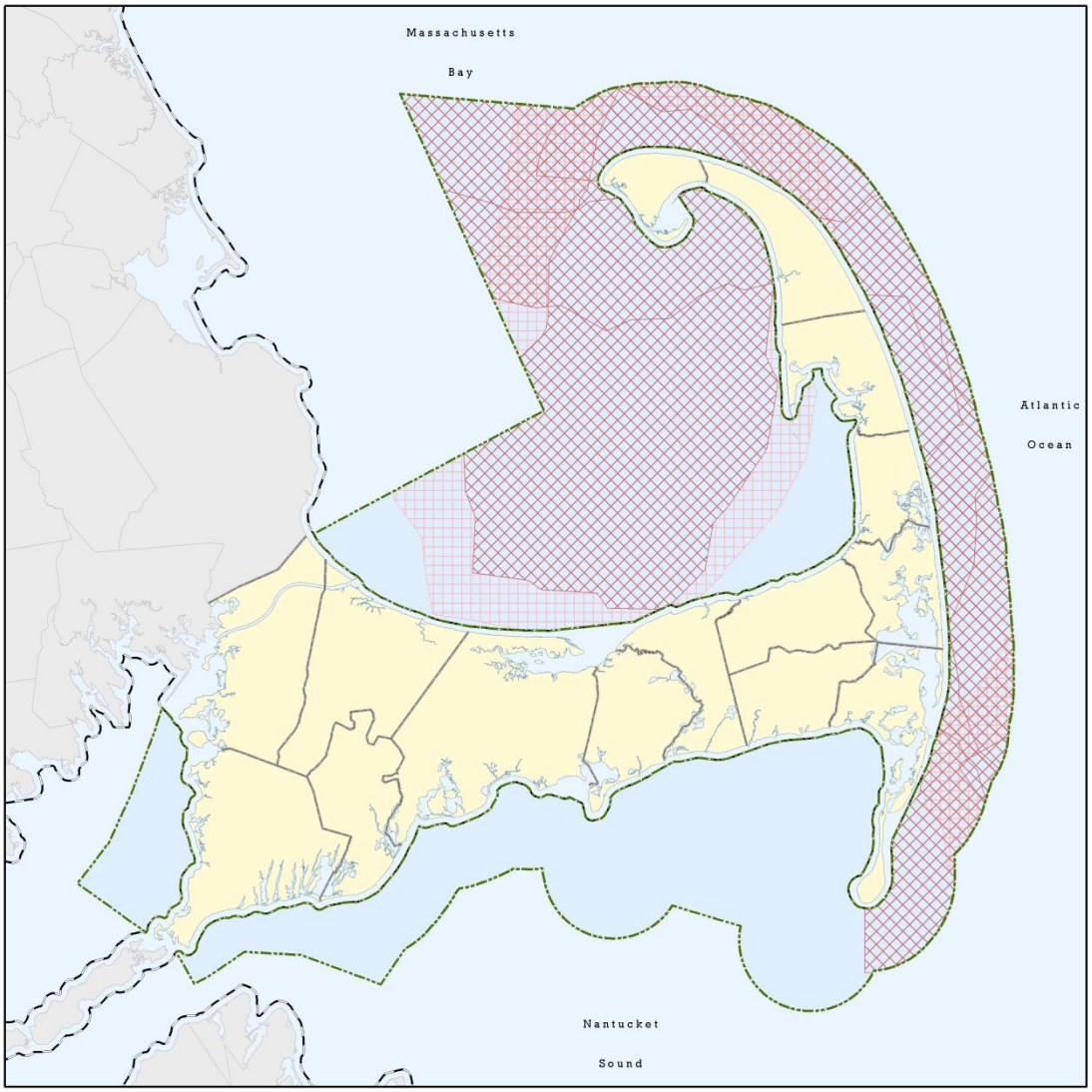

Exhibit D: Cape Cod Ocean Management Plan
Map of Cable and Pipeline Prohibited Areas

Legend
- Cape Cod OMP and Ocean DCPC Boundary
- Nearshore Mass. Ocean Management Plan Boundary
- Prohibited Areas
- Exclusionary Areas
- Provisional Areas

N

4 2 0 4 8 12
Nautical Miles

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Exhibit E: Expanded North Atlantic Right Whale Habitat.

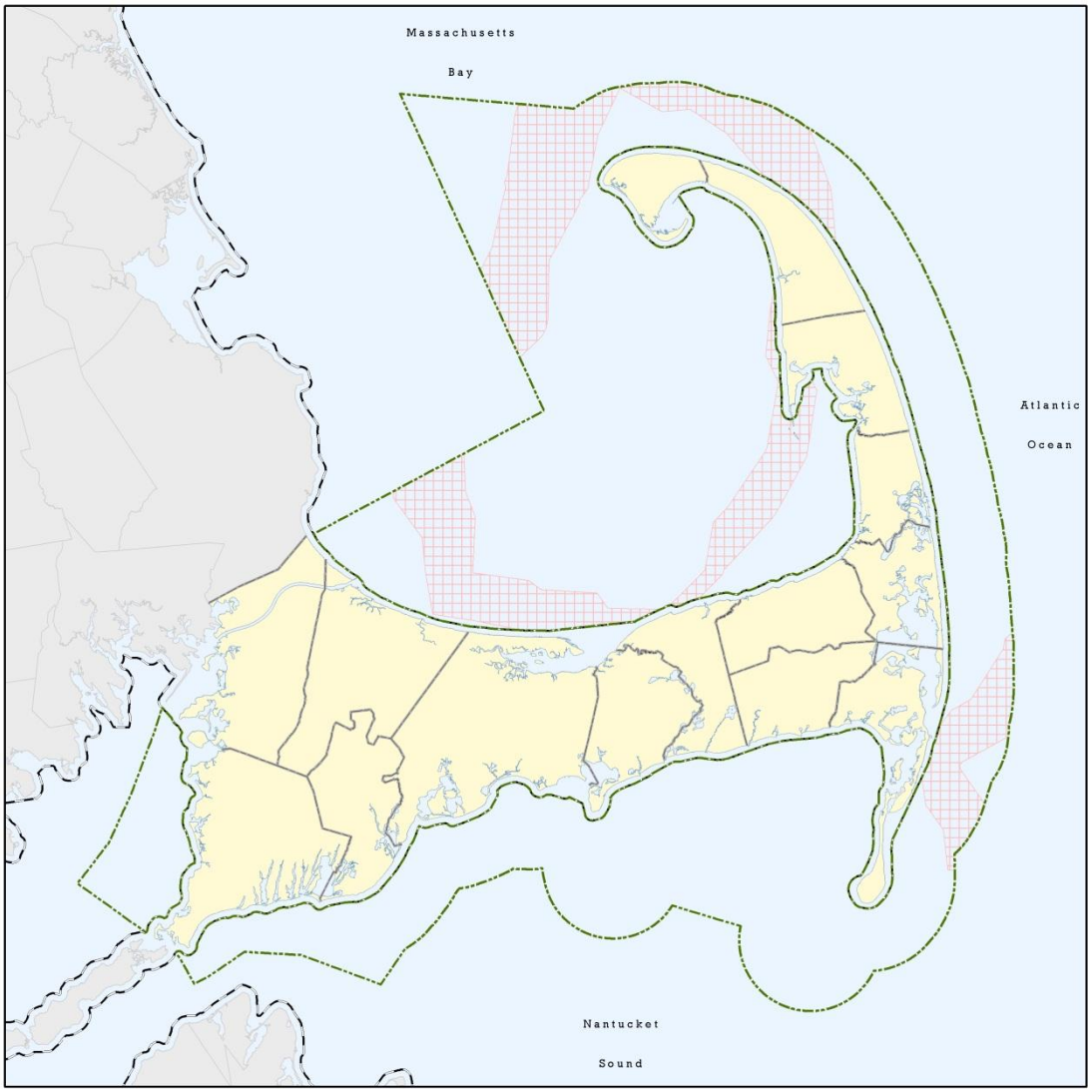

Exhibit E: Cape Cod Ocean Management Plan
Map of Exclusionary Areas

Legend
Cape Cod OMP and Ocean DCPC Boundary
Nearshore Mass. Ocean Management Plan Boundary
Exclusionary Areas

N

4 2 0 4 8 12
Nautical Miles

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Exhibit F: Regional Seascapes Units Map

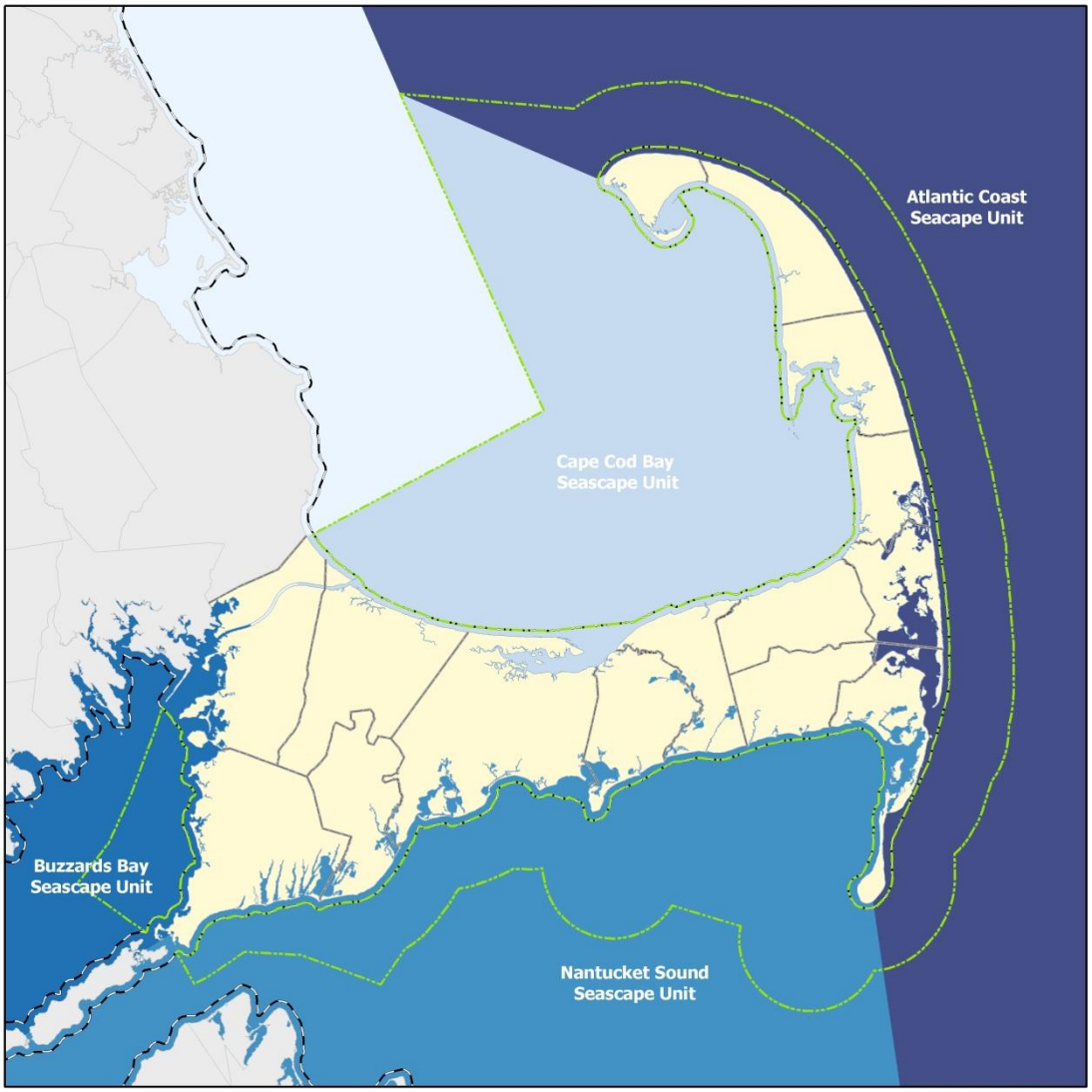

Exhibit F: Cape Cod Ocean Management Plan
Map of Regional Seascape Units

Legend
Cape Cod OMP and Ocean DCPC Boundary
Nearshore Mass. Ocean Management Plan Boundary

N

4 2 0 4 8 12
Nautical Miles

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COMMISSION

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CAPE COD COMMISSION

OCEAN MANAGEMENT PLANNING DCPC

POLICY COMMITTEE RECOMMENDATIONS
Wind Energy Facilities
Voted June 22, 2011

In order to ensure the protection of many resources significant to the Cape Cod Region, and in order to define, in part, the appropriate scale of offshore Wind Energy Facilities (WEFs) within the Cape Cod region, a map establishing areas where WEFs shall be prohibited, based on the presence of several sensitive resources, shall be adopted as an implementing regulation. An expanded area of North Atlantic Right Whale habitat shall be designated an exclusionary area, where WEFs are not strictly prohibited, but where the habitat is presumed significant for the protection of the federally endangered North Atlantic Right Whale.

Cape Cod Ocean Management Plan Map of Wind Energy Facility Prohibited Areas

The areas included as prohibited for WEF development include:

North Atlantic Right Whale core habitat area
Fin Whale core habitat area
Humpback Whale core habitat area
Roseate Tern core habitat area
Special Concern Tern core habitat area (Arctic, Least, and Common Terns)
Long-tailed Duck core habitat area
Leach's Storm Petrel Important nesting habitats
Colonial Waterbird Important nesting habitats
High Effort and Value Commercial Fishing areas
Concentrated Commercial Fishing Traffic lanes
Concentrated Commercial Traffic lanes
Cape Cod Ocean Sanctuary
2 nm from MHW

With the exception of 2nm from MHW, the mapped extents of all the resource areas are taken from the Massachusetts Ocean Management Plan (MOMP).

The area included as exclusionary for WEF development includes:

North Atlantic Right Whale expanded habitat area from the MOMP

COUNTY OF BARNSTABLE MASSACHUSETTS

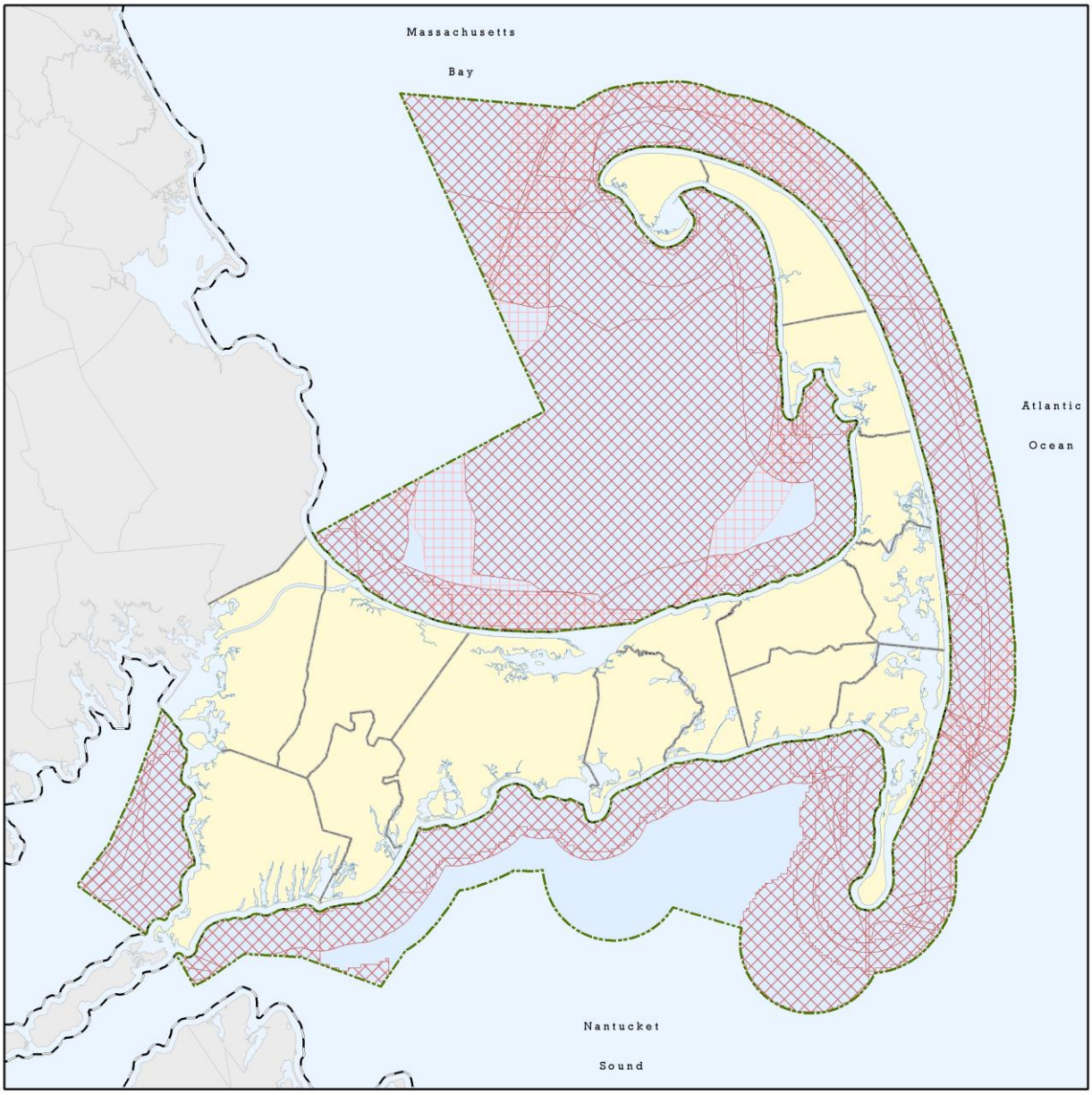

Exhibit B: Cape Cod Ocean Management Plan
Map of Wind Energy Facility Prohibited Areas

Legend
- Cape Cod OMP and Ocean DCPC Boundary
- Nearshore Mass. Ocean Management Plan Boundary
- Prohibited Areas
- Exclusionary Areas
- Provisional Areas

N

4 2 0 4 8 12
Nautical Miles

CAPE COD COMMISSION

COUNTY OF BARNSTABLE MASSACHUSETTS

Additional implementing regulations to define appropriate scale of WEFs should be adopted. The Policy Committee recommends the following:

Recommendation:	**Recommendation addresses the following factors for determining appropriate scale of WEFs:**
Marine and air navigation to/from Cape Cod should be protected.	Public safety Compatibility with existing uses
Regulations should ensure that WEFs are sited with adequate buffers to existing uses, are safely operated and maintained, have emergency response procedures in place, and have bonding and procedures for decommissioning.	Public safety Compatibility with existing uses Environmental protection
Regulations should ensure that WEFs do not adversely affect recreational or commercial fishing.	Public safety Compatibility with existing uses
Regulations should require that projects demonstrate at least 3 community benefit criteria, including but not limited to direct job creation, local ownership, contribution toward energy conservation or education, and energy import substitution.	Community benefit
WEFs should not be sited closer than 2 nm from MHW to avoid conflict with existing uses, to protect public safety, and to protect the scenic and recreational qualities of the coastline.	Public safety Compatibility with existing uses Proximity to shore
WEFs should not be sited such that they adversely impact sensitive shoreside landscapes.	Compatibility with existing uses Proximity to shore
Regulations should ensure regulatory review of all wind energy facilities within the planning area.	Appropriateness of technology and scale Public safety Compatibility with existing uses Proximity to shore Community benefit Environmental protection (All Factors)

Recommendation:	Recommendation addresses the following factors for determining appropriate scale of WEFs:
WEFs should be located outside of the spatial extents of all the sensitive resource areas delineated on the Cape Cod Ocean Management Plan Prohibited Areas map (see above).	Appropriateness of technology and scale Public safety Compatibility with existing uses Proximity to shore Community benefit Environmental protection (All Factors)
Protect whales, terns, and other highly sensitive species habitats through designation of no-build zones in core habitat areas as identified by OMP.	Environmental protection
Protect whales and sea turtles during construction and decommissioning through TOY restrictions, vessel speed restrictions, and other mitigation actions	Environmental protection
Protect known fish spawning habitat, including diadromous fish runs, through TOY restrictions	Environmental protection
Protect eelgrass beds and hard/complex bottom from alteration	Environmental protection
Protect seaduck habitat, including areas less than 20 m depth.	Environmental protection
Protect birds and bats through restricted operations during migrations and storm events	Environmental protection
Minimize turbidity during construction through best construction practices	Environmental protection

Recommendation:	Other Issues:
Ensure that shipwrecks, archaeological sites, and paleosols are not adversely impacted	Cultural considerations
Future iterations of the Cape Cod Ocean Management Plan should consider the cumulative impacts of development activities that have occurred, and possible changes in the type or quantity of development activities allowed within the district.	Cumulative impacts

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CAPE COD COMMISSION

OCEAN MANAGEMENT PLANNING DCPC

POLICY COMMITTEE RECOMMENDATIONS
Sand and Gravel Mining
Voted July 13, 2011

In order to ensure the protection of many resources significant to the Cape Cod Region, a map establishing areas where Sand and Gravel Mining shall be prohibited, based on the presence of several sensitive resources, shall be adopted as an implementing regulation. An expanded area of North Atlantic Right Whale habitat shall be designated an exclusionary area, where Sand and Gravel Mining is not strictly prohibited, but where the habitat is presumed significant for the protection of the federally endangered North Atlantic Right Whale.

Cape Cod Ocean Management Plan Map of Sand and Gravel Mining Prohibited Areas

The areas included as prohibited for Sand and Gravel Mining development include:

North Atlantic Right Whale core habitat area
Fin Whale core habitat area
Humpback Whale core habitat area
Cape Cod Ocean Sanctuary

The mapped extents of all the resource areas are taken from the Massachusetts Ocean Management Plan (MOMP).

The area included as exclusionary for Sand and Gravel Mining development includes:

North Atlantic Right Whale expanded habitat area from the MOMP

The Policy Committee makes the following additional recommendations for implementing regulations to address Sand and Gravel Mining:

1	Sand Mining operations should be located outside of the spatial extents of the whale core habitat areas, and the Cape Cod Ocean Sanctuary as delineated on the Cape Cod Ocean Management Plan Sand and Gravel Mining Prohibited Areas map.
2	Whales, terns, and other highly sensitive species and their habitats should be protected through designation of no-build zones in core habitat areas (as identified by OMP), through TOY restrictions, or through performance standards.
3	Whales, sea turtles, and their habitats should be protected during mining operations through TOY restrictions, vessel speed restrictions, and other mitigation actions. TOY restrictions should be coordinated with existing state-wide restrictions, including the "*Summary of Marine Fisheries Resource Recommendations for Municipal Maintenance Hydraulic Dredging Activities on Cape Cod and the Islands*".
4	Important fish resource areas, including diadromous fish runs and shellfish, should be protected.
5	Regulations should ensure that Sand Mining operations do not adversely affect recreational or commercial fishing, including aquaculture.
6	Eelgrass beds and other biologically productive benthic habitats (e.g., hard/complex bottom) should be protected from alteration.
7	Sea duck habitat, including areas less than 20 m depth, should be protected.
8	Turbidity impacts to sensitive marine resources should be minimized during sand mining through best construction practices (e.g., turbidity/sedimentation monitoring) and TOY restrictions.
9	Regulations should ensure that shipwrecks, archaeological sites, and paleosols are not adversely impacted.
10	Sand mining should not result in changes to ocean currents or wave conditions that will adversely impact existing coastal landforms, infrastructure, and public or private property.
11	Designated navigation routes should be protected.
12	Regulations should ensure that Sand Mining operations are sited with adequate buffers to existing uses.
13	Regulations should ensure consideration of the cumulative impacts of development activities in the District, and possible changes in the type or quantity of development activities allowed within the district.
14	Sand mining operations should demonstrate a significant benefit to public resources and coastal ecosystems.

15	Sand Mining operations should not be sited such that they adversely impact seascapes.
16	Regulations should ensure that Sand Mining does not result in saltwater intrusion into freshwater lenses.
17	Materials extracted from Sand Mining within the district should be applied to beaches within Barnstable County. Sand Mining regulations should consider the effects of beach nourishment conducted as part of a Sand Mining operation.
18	Sand Mining should not result in the mobilization of hazardous materials into the water column.
19	Regulations for Sand Mining should be reviewed every five years, at a minimum, and revised as necessary to respond to new or improved data, information, or technology.
20	Regulations should ensure the protection of regional marine resources by requiring monitoring of the recovery of borrow sites, and restoring borrow sites to productive natural resource conditions, to the maximum extent feasible.

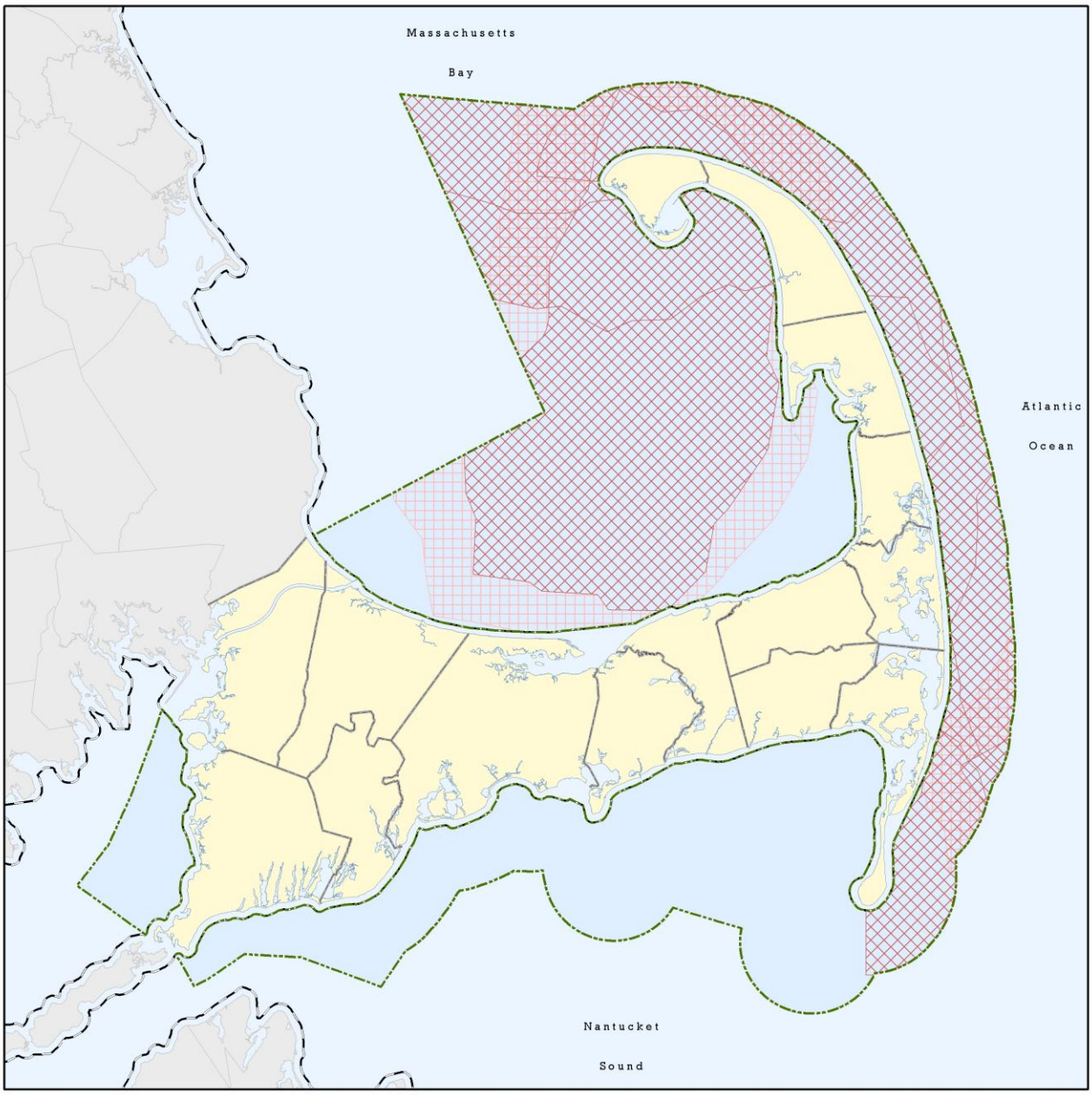

Exhibit C: Cape Cod Ocean Management Plan
Map of Sand and Gravel Mining Prohibited Areas

Legend
- Cape Cod OMP and Ocean DCPC Boundary
- Nearshore Mass Ocean Management Plan Boundary
- Prohibited Areas
- Exclusionary Areas
- Provisional Areas

N

4 2 0 4 8 12
Nautical Miles

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CAPE COD COMMISSION

OCEAN MANAGEMENT PLANNING DCPC

POLICY COMMITTEE RECOMMENDATIONS
Cables and Pipelines
Voted July 13, 2011

In order to ensure the protection of many resources significant to the Cape Cod Region, a map establishing areas where Cable and Pipeline installations shall be prohibited, based on the presence of several sensitive resources, shall be adopted as an implementing regulation. An expanded area of North Atlantic Right Whale habitat shall be designated an exclusionary area, where Cable and Pipeline installations are not strictly prohibited, but where the habitat is presumed significant for the protection of the federally endangered North Atlantic Right Whale.

Cape Cod Ocean Management Plan Map of Cable and Pipeline Prohibited Areas

The areas included as prohibited for Cable and Pipeline development include:

- *North Atlantic Right Whale core habitat area*
- *Fin Whale core habitat area*
- *Humpback Whale core habitat area*
- *Cape Cod Ocean Sanctuary*

The mapped extents of all the resource areas are taken from the Massachusetts Ocean Management Plan (MOMP).

The area included as exclusionary for Cable and Pipeline development includes:

- *North Atlantic Right Whale expanded habitat area from the MOMP*

The Policy Committee makes the following additional recommendations for implementing regulations to address Cable and Pipeline installations:

1	Cables and Pipelines should be located outside of the spatial extents of the whale core habitat areas, and the Cape Cod Ocean Sanctuary delineated on the Cape Cod Ocean Management Plan Cables and Pipelines Prohibited Areas map.
2	Whales, terns, and other highly sensitive species and their habitats should be protected through designation of no-build zones in core habitat areas (as identified by OMP), through TOY restrictions, or through performance standards.
3	Whales, sea turtles, and their habitats should be protected during Cable and Pipeline installations through TOY restrictions, vessel speed restrictions, and other mitigation actions. TOY restrictions should be coordinated with existing state-wide restrictions, including the "*Summary of Marine Fisheries Resource Recommendations for Municipal Maintenance Hydraulic Dredging Activities on Cape Cod and the Islands*".
4	Important fish resource areas, including diadromous fish runs and shellfish, should be protected.
5	Regulations should ensure that Cable and Pipeline installations do not adversely affect recreational or commercial fishing, including aquaculture.
6	Eelgrass beds and other biologically productive benthic habitats (e.g., hard/complex bottom) should be protected from alteration.
7	Sea duck habitat, including areas less than 20 m depth, should be protected.
8	Turbidity impacts to sensitive marine resources should be minimized during cable and pipeline installations through best construction practices (e.g., turbidity/sedimentation monitoring) and TOY restrictions.
9	Regulations should ensure that shipwrecks, archaeological sites, and paleosols are not adversely impacted.
10	Cable and Pipeline installations should not result in changes to ocean currents or wave conditions that will adversely impact existing coastal landforms, infrastructure, and public or private property.
11	Designated navigation routes should be protected.
12	Regulations should ensure that Cable and Pipeline installations are sited with adequate buffers to existing uses.
13	Regulations should ensure consideration of the cumulative impacts of development activities in the District, and possible changes in the type or quantity of development activities allowed within the district.
14	Regulations for Cable and Pipeline installations should address the impacts to coastal resources of the conduit landfall and landside connections, including transition vaults.

15	Cable and Pipeline installation routes should be coordinated with existing routes to the extent feasible.
16	Cable and Pipeline installations should not result in the mobilization of hazardous materials into the water column.
17	Cable and Pipeline installations should utilize the best technology available to minimize impacts to existing resources (e.g. directional drilling).
18	Cable and Pipeline installations should not adversely affect the economic vitality of the host community.

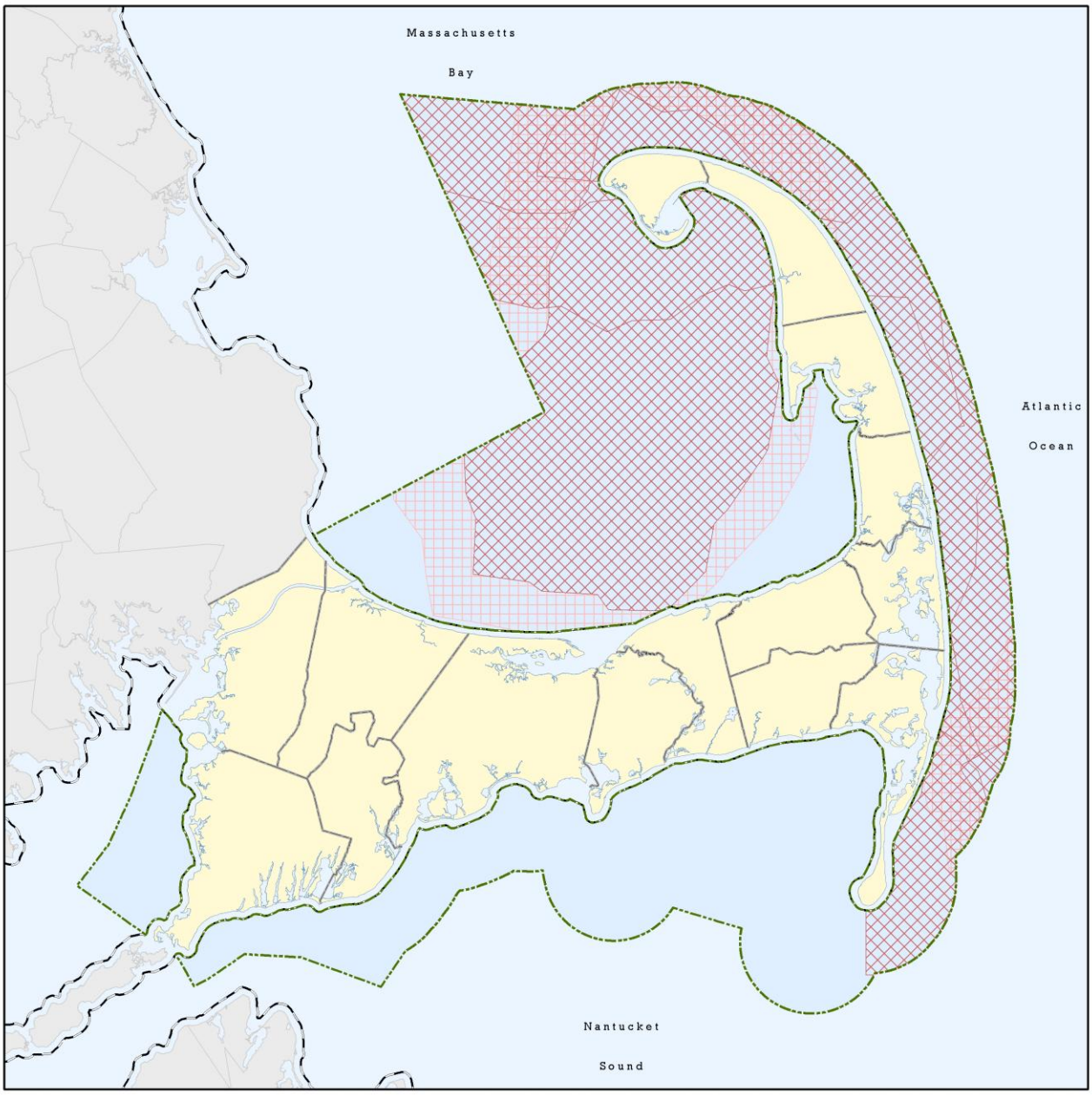


Exhibit D: Cape Cod Ocean Management Plan
Map of Cable and Pipeline Prohibited Areas

Legend
- Cape Cod OMP and Ocean DCPC Boundary
- Nearshore Mass. Ocean Management Plan Boundary
- Prohibited Areas
- Exclusionary Areas
- Provisional Areas

N

4 2 0 4 8 12
Nautical Miles

CAPE COD COMMISSION

COUNTY OF BARNSTABLE MASSACHUSETTS

Public Opinion Poll Methodology and Results

Poll Images

As part of the planning process, the Cape Cod Commission conducted an opinion poll over the summer/fall of 2010 to establish people's reactions to a 24-wind-turbine array when viewed at varying distances. The purpose of the opinion poll is to establish whether there is a perceived change in visual impact that can be identified based on the level of contrast of the turbines in a range of settings and the distance from viewer. After conducting multiple site visits to the shoreline and known viewpoints with vistas (i.e. high points), three settings were chosen which represent typical coastal views on the Cape: a beach environment; a marsh environment; and, a harbor environment. Each view is created entirely with computer software (not a photograph) and is not intended to represent a particular location, although the view includes elements typically seen at coastal locations on Cape Cod (e.g. docks, breakwaters and boats). Preparing the images using this approach allowed the use of the images at multiple locations and ensured that people's emotional attachment to a specific location would not influence their responses.

For each setting, five images were created:

- The setting without any turbines
- The same setting with a 24 turbine field consisting of 3 rows of 8 turbines, with the nearest row to the camera placed at 0.3 nautical miles (1,822 ft) from the viewer.
- The same setting with a 24 turbine field consisting of 3 rows of 8 turbines, with the nearest row to the camera placed at 1.5 nautical miles (9,114 ft) from the viewer.
- The same setting with a 24 turbine field consisting of 3 rows of 8 turbines, with the nearest row to the camera placed at 3 nautical miles (18,228 ft) from the viewer.
- The same setting with a 24 turbine field consisting of 3 rows of 8 turbines, with the nearest row to the camera placed at 5 nautical miles (30,380.5 ft) from the viewer.

The turbine specifications used for the simulation were based on the Siemens 3.5 MW machine, which according to the Siemens website has a 174 ft (53 meter) rotor length, 262 ft (80 meter) hub height and a combined overall height to tip of blade of 436 feet (133 meters). These turbines were chosen as they currently represent the upper end of the size range for ocean applications, thus representing the worst case scenario for scale. For this exercise, the position of the blades was randomly selected to avoid a uniform appearance. The position of the viewpoint was assumed to be at eye level of an average person, and representative of a photograph taken from that location (rather than representative of a human field of view). As a simulation of a photograph, the settings of the "camera" for this image used 35mm equivalent lens and show a horizontal field of view of 39.6 degrees and a vertical field of view of 25.4 degrees.

A three-dimensional model was created for each of the scenes. *SketchUp* and *Vue* software were used to create some of the model elements and *Vue* software was used to render and compose the scene. Within *Vue*'s three-dimensional model, the sun was positioned to illuminate the scene from either in front of the turbine array or behind, and fog and haze settings adjusted to minimize the effect of these atmospheric elements on the view. Reduced size versions of the images used are reproduced at the end of this section, the actual size of the images for the opinion poll were produced with an image of 10.5" by 16.5".

Poll

The Commission developed a brief poll form to accompany the images that was used to gather people's reactions and the degree to which they thought the view was affected by the contrast and proximity of the turbines. Respondents were completed a poll for a series of images for one of the prototypical views and were given an image of the setting without any turbines for comparison purposes. Respondents were allowed to complete a poll for each of the other settings if desired. For each image in a series, the respondent was asked:

1. to identify how many turbines could be seen in the view, either none, 1-5, 6-10, 11-15, 16-20, or 21 or more. This question was intended as an indicator as to how well people understood the images.
2. how the turbines affect their view, ranging from "very positive", "positive", "no effect", "negative", or "very negative".

Respondents were instructed to hold the image at arms length to roughly approximate the perspective of a view to turbines in the ocean from shore. In addition, for each poll, the respondent was asked if they were a resident, visitor or second-home owner on Cape Cod, their age range, and the State or country of residence. A sample poll form is provided below.

The opinion poll was conducted by Cape Cod Commission staff at the following locations:

1. Gray's Beach, Yarmouth
2. Rock Harbor, Orleans
3. West Dennis Beach, Dennis
4. Sandwich Boardwalk, Sandwich
5. Skaket Beach, Orleans
6. Wellfleet Harbor, Wellfleet
7. Menauhant Beach, Falmouth

In addition, the poll was conducted at various public meetings attended by Cape Cod Commission staff in fall 2010. The aim was to have responses in relatively equal numbers from visitors and residents, and relatively equal numbers of responses for each setting.

Analysis
The information and results from the poll were analyzed to identify trends in people's perception of the turbines based on the distance or setting from which they were viewed, and as to whether there was any difference in attitude between visitors and residents.

The histograms below illustrate the number of respondents by response type ranging from a very negative opinion concerning the image (column one), to a very positive opinion concerning the image (column five). A score of three indicates no effect.

Image B: 0.3 Miles

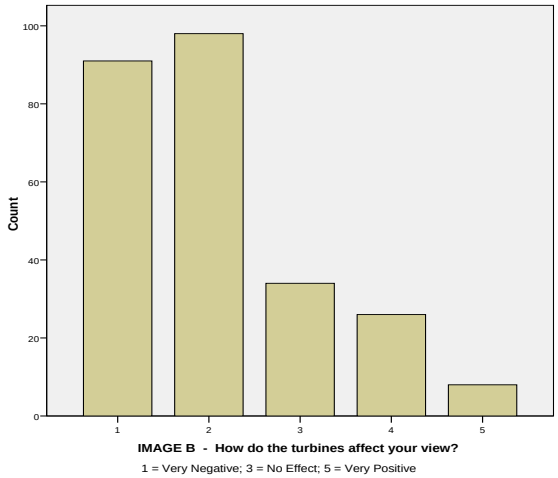


Image C: 1½ miles

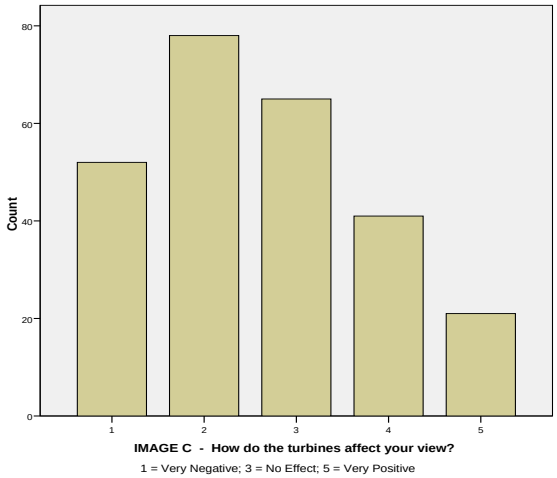


Image A: 3 Miles

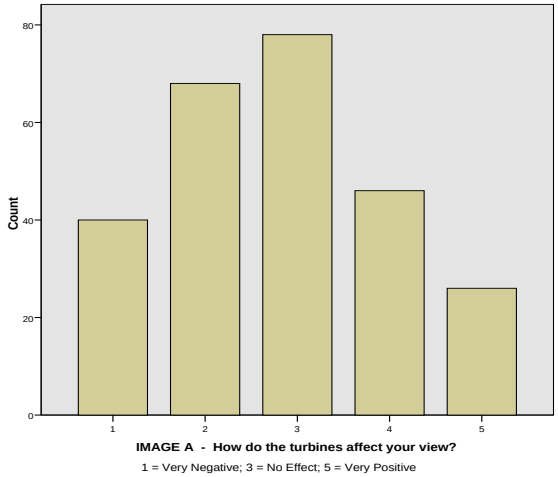
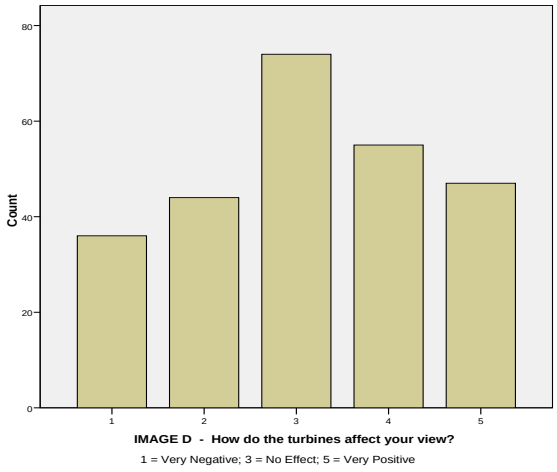


Image D: 5 miles



Results by Type of Respondents: Respondents could classify themselves as residents, visitors, or second-home owners. Eight people left this response blank. Of the remaining two hundred and fifty-two respondents, 43.3% were residents; 44.8% were visitors and the remaining 11.9% were second-home owners. A comparison of means test was performed that indicated no statistical difference in the responses of each type of respondent. In other words, all respondents were as likely to have a similar response to the different images regardless of whether they were residents, visitors, or second-home owners.

Results by Type of Location: Respondents looked at a series of images in three different settings – a harbor view, a salt marsh view, and a beach view. Each setting represented approximately one-third of the total responses. A comparison of means test indicated no statistical difference in the responses for each type of location. In other words, all respondents were likely to respond in a similar way to the images regardless of whether it was a harbor, salt marsh, or beach view.

Results by Distance. Although not statistically significant, there was a clear overall trend in the results that indicated that the respondent opinions became less negative as the distance between the shore and the turbines increased. This trend is illustrated in Table 1.

Survey Results

Distance	Negative (incl. very negative and negative)	Neutral	Positive (incl. very positive and positive)
0.3 nm	73.5%	13.2%	13.2%
1.5 nm	50.6%	25.3%	24.2%
3 nm	41.9%	30.2%	27.9%
5 nm	31.3%	28.9%	39.9%

Harbor Setting: turbines at 0.3 n.m.

Harbor Setting: turbines at 1.5 n.m.

Harbor Setting: turbines at 3 n.m.

Harbor Setting: turbines at 5 n.m.


Marsh Setting: turbines at 0.3 n.m


Marsh Setting: turbines at 1.5 n.m


Marsh Setting: turbines at 3 n.m


Marsh Setting: turbines at 5 n.m

Beach Setting: turbines at 0.3 n.m

Beach Setting: turbines at 1.5 n.m

Beach Setting: turbines at 3 n.m

Beach Setting: turbines at 5 n.m

VISUAL PREFERENCE OPINION POLL:

Wind Turbine Siting in Cape Cod's Ocean Waters

INSTRUCTIONS

The opinion poll will take about 5 minutes and is completely anonymous. If you do not complete the poll, no data are recorded, so you can stop at any time.

Please hold up one image at a time and answer the following questions:

IMAGE A

1. How many wind turbines can you see in the image?
❑ None ❑ 1–5 ❑ 6–10 ❑ 11–15 ❑ 16–20 ❑ 21 or more

2. How do the turbines affect your view?
❑ Very Positive ❑ Positive ❑ No Effect ❑ Negative ❑ Very Negative

IMAGE B

1. How many wind turbines can you see in the image?
❑ None ❑ 1–5 ❑ 6–10 ❑ 11–15 ❑ 16–20 ❑ 21 or more

2. How do the turbines affect your view?
❑ Very Positive ❑ Positive ❑ No Effect ❑ Negative ❑ Very Negative

IMAGE C

1. How many wind turbines can you see in the image?
❑ None ❑ 1–5 ❑ 6–10 ❑ 11–15 ❑ 16–20 ❑ 21 or more

2. How do the turbines affect your view?
❑ Very Positive ❑ Positive ❑ No Effect ❑ Negative ❑ Very Negative

IMAGE D

1. How many wind turbines can you see in the image?
❑ None ❑ 1–5 ❑ 6–10 ❑ 11–15 ❑ 16–20 ❑ 21 or more

2. How do the turbines affect your view?
❑ Very Positive ❑ Positive ❑ No Effect ❑ Negative ❑ Very Negative

<<OVER>>

Next, please provide some basic information about yourself:

1. Are you a Cape Cod...
   ❑ Resident ❑ Visitor ❑ Second-home owner

2. Age
   ❑ under 18 ❑ 30–39 ❑ 50–59 ❑ 70 or older
   ❑ 18–29 ❑ 40–49 ❑ 60–69

3. State or country of residence (if outside U.S.) _____

Thank you for taking the time to complete this survey. Your responses are an important contribution to this project.

If you wish to make any comment about this opinion poll, please use the blog on the Cape Cod Commission web site: www.capecodcommission.org/oceanplanning

Use the same address to obtain more information about the outcome of this survey.

CAPE COD COMMISSION

The Cape Cod Commission is the regional planning agency for Barnstable County, which encompasses all 15 towns on Cape Cod.