THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS
OFFICE OF COASTAL ZONE MANAGEMENT
251 Causeway Street, Suite 800, Boston, MA 02114-2136
(617) 626-1200 FAX: (617) 626-1240

May 22, 2020

Vineyard Wind Project
c/o Rachel Pachter, Chief Development
Officer Vineyard Wind LLC
700 Pleasant Street, Suite 510
New Bedford, MA 02740

Re: CZM Federal Consistency Review of the Vineyard Wind Project – Bureau of Ocean Energy Management Action, U.S. Army Corps of Engineers Action.

Dear Ms. Pachter:

The Massachusetts Office of Coastal Zone Management (CZM) has completed its review of the proposed project to build, operate, and decommission an ~800 megawatt (MW) wind energy project within the Bureau of Ocean and Energy Management (BOEM) Lease Area OCS-A 0501. The project consists of offshore Wind Turbine Generators (WTGs) (each placed on a foundation support structure), Electrical Service Platforms (ESPs), an onshore substation, offshore and onshore cabling, and onshore operations & maintenance facilities. The project will be located in the northern portion of the over 675 square kilometers (km2) (166,886 acre) Lease Area (referred to as the Wind Development Area or WDA), approximately 14 miles south of Martha's Vineyard.

To inform our federal consistency review, CZM reviewed the Environmental Notification Form (ENF), Draft Environmental Impact Report (DEIR), Supplemental Draft Environmental Impact Report (SDEIR), and Final Environmental Impact Report (FEIR) developed pursuant to the Massachusetts Environmental Policy Act; the Construction and Operations Plan, Draft Environmental Impact Statement (DEIS), and the Preliminary Supplemental Environmental Impact Statement (SEIS) developed pursuant to the National Environmental Policy Act; and, pursuant to the Coastal Zone Management Act, the federal consistency certification, applicable state permits/licenses, the U.S. Army Corps of Engineers (USACE) Clean Water Act Section 404/Section 10 permit application, and lease/easement/right-of-way application to BOEM under the Outer Continental Shelf Lands Act. Over the course of the state and federal review process, CZM has received the data and information necessary to make a consistency determination. In our role as a designated cooperating agency, CZM will continue to review and comment on future BOEM submissions including the SEIS and the Final Environmental Impact Statement (FEIS), scheduled for release later in 2020.

In addition to the above-referenced necessary data and information, Vineyard Wind, with the oversight of CZM and input from key stakeholders has developed the Massachusetts Fisheries Compensatory Mitigation Plan (the "Plan"). Pursuant to the Plan, Vineyard Wind has entered into an agreement with the Massachusetts Executive Office of Energy and Environmental Affairs (EEA) to establish two funds totaling $20,935,016 over the life of the project. The agreement outlines two funds: the Compensatory Mitigation Fund and the Fisheries Innovation Fund. The Compensatory Mitigation Fund ($19,185,016) will be used to offset potential direct, indirect, and cumulative economic impacts to Massachusetts fishing businesses and the Fisheries Innovation Fund ($1,750,000) will facilitate innovation that supports the co-existence of the fishing and wind sectors in the offshore environment. The Memorandum of Agreement regarding these funds is attached.

Based on our review, all aspects of the project, including those project elements located in federal waters, and the project's effects on resources and uses in the Massachusetts coastal zone, we concur with the certification that the activity as proposed is consistent with the CZM enforceable program policies.

If the above-referenced project is modified in any manner, including any changes resulting from permit, license or certification revisions, including those ensuing from an appeal, or the project is noted to be having effects on coastal resources or uses that are different than originally proposed, it is incumbent upon the proponent to notify CZM, submit an explanation of the nature of the change pursuant to 15 CFR 930, and submit any modified state permits, licenses, or certifications. CZM will use this information to determine if further federal consistency review is required.

Thank you for your cooperation with CZM.

Sincerely,

Lisa Berry Engler

Lisa Berry Engler
Director

RLB/pb
CZM# 17853

cc:
Mary Boatman, Bureau of Ocean and Energy Management, US Department of the Interior
Michelle Morin, Bureau of Ocean and Energy Management, US Department of the Interior
Brian Krevor, Bureau of Ocean and Energy Management, US Department of the Interior
Christine Jacek, U.S. Army Corps of Engineers
Barbara Newman, U.S. Army Corps of Engineers
Dennis Deziel, US Environmental Protection Agency
Tim Timmermann, U.S. Environmental Protection Agency
Chris Boelke, National Marine Fisheries Service, National Oceanic and Atmospheric Administration
Susan Tuxbury, National Marine Fisheries Service, National Oceanic and Atmospheric Administration
Wendi Weber, US Fish & Wildlife Service
Kathleen Theoharides, MA Executive Office of Energy and Environmental Affairs
Stephanie Moura, MA Department of Environmental Protection
Millie Garcia-Serrano, MA Department of Environmental Protection
David Wong, MA Department of Environmental Protection
Dave Hill, MA Department of Environmental Protection
Dan McKiernan, MA Division of Marine Fisheries
Kathryn Ford, MA Division of Marine Fisheries
Matthew Nelson, Energy Facilities Siting Board
Town of Nantucket Conservation Commission
Town of Barnstable Conservation Commission
Cape Cod Commission

AGREEMENT
REGARDING THE ESTABLISHMENT AND FUNDING OF THE MASSACHUSETTS FISHERIES INNOVATION FUND

This Agreement Regarding the Establishment and Funding of the Massachusetts Fisheries Innovation Fund (the "Fund"), dated as of May 21, 2020, is made between Vineyard Wind, LLC ("Vineyard Wind") and the Massachusetts Executive Office of Energy and Environmental Affairs ("EEA") (collectively the "Parties"). The Massachusetts Office of Coastal Zone Management ("Massachusetts CZM") will implement this agreement on behalf of EEA.

WHEREAS, Vineyard Wind holds a federal Commercial Lease of Submerged Lands for Renewable Energy Development with the U.S. Bureau of Ocean Energy Management ("BOEM"), OCS-A-0501 (the "Lease"), pursuant to the Outer Continental Shelf Lands Act ("OCSLA"), located in federal waters approximately 14 miles south of Martha's Vineyard, Massachusetts;

WHEREAS, the Lease grants Vineyard Wind the exclusive right to submit to BOEM a Construction and Operations Plan ("COP") for a wind energy project and to conduct the activities described in the COP if approved by BOEM;

WHEREAS, on December 19, 2017, Vineyard Wind submitted a COP to BOEM proposing to construct an 800 MW wind energy project in the northern portion of its lease area (the "Project");

WHEREAS, Vineyard Wind's export cable traverses Massachusetts state waters within the Massachusetts Ocean Planning Management Area, which is described in the Massachusetts Ocean Management Plan ("Ocean Plan");

WHEREAS, the Ocean Plan reflects the importance of commercial and recreational fishing to the State and identifies areas of high commercial fishing activity and concentrations of recreational fishing activity;

WHEREAS, Section 307(c)(3) of the Coastal Zone Management Act, 16 U.S.C. 1451 et seq., ("CZMA"), as amended, requires that an applicant for a federal license or permit activity in or outside the coastal zone or an outer continental shelf plan affecting any land or water use or natural resource of a state coastal zone certify that the proposed activities comply with the enforceable policies of the state's approved program and that such activities will be conducted in a manner consistent with the program;

WHEREAS, the enforceable policies of the Massachusetts Coastal Zone Management Program require, to the maximum extent practicable, the avoidance, minimization, and mitigation of impacts to areas of high concentrations of existing water-dependent uses specified in the Ocean Plan, which include commercial and recreational fishing;

WHEREAS, by letter dated March 3, 2020 to Massachusetts CZM, Vineyard Wind detailed its efforts and commitments to avoid, minimize, and mitigate potential project impacts to commercial and recreational fishing within both state and federal waters (attached hereto as Exhibit A);

WHEREAS, pursuant to BOEM requirements under the OCSLA and as set forth in its letter dated March 3, 2020, Vineyard Wind will separately establish a direct compensation fund to compensate Massachusetts fisheries for any claims of direct, downstream, and cumulative impacts to Massachusetts vessels or Massachusetts fisheries in the project area (the "Compensatory Mitigation Fund");

WHEREAS, as set forth in Vineyard Wind's Massachusetts Fisheries Compensatory Mitigation Plan ("Compensatory Mitigation Plan") submitted to BOEM and to Massachusetts CZM in its letter dated March 3, 2020 the Compensatory Mitigation Fund will total $18,426,366 over the life of the Project;

WHEREAS, the Project schedule has been delayed by two years, Vineyard Wind has updated its Compensatory Mitigation Plan to account for payments to the Compensatory Mitigation Fund beginning in 2021, which under the methodology presented in the March 3, 2020 letter increases the Compensatory Mitigation Fund to a total of $19,185,016 over the life of the Project (the updated tables of the Fisheries Compensatory Mitigation Plan were submitted to Massachusetts CZM in a supplemental filing on May 15, 2020, which is included with Exhibit A);

WHEREAS, as required by BOEM, Vineyard Wind will separately establish the Compensatory Mitigation Fund in accordance with the Vineyard Wind Fisheries Mitigation Plan, the terms of which are summarized in Exhibit B hereto;

WHEREAS, Massachusetts CZM will reference Vineyard Wind's Compensatory Mitigation Plan in its federal consistency concurrence letter as a means by which the Parties agree satisfies the enforceable policies of the Massachusetts Coastal Zone Management Program;

WHEREAS, Vineyard Wind, as the first utility scale wind energy project in the United States, desires to provide additional funds to support and promote the compatibility of the offshore wind and commercial and recreational fishing interests;

WHEREAS, as also set forth in Vineyard Wind's Compensatory Mitigation Plan, Vineyard Wind will provide funds to the Fisheries Innovation Fund totaling $1,750,000 prior to the end of the construction of the project and according to the schedule described in Exhibit B; and

WHEREAS, through the establishment of the Fisheries Innovation Fund, Vineyard Wind will support programs and projects that ensure safe and profitable fishing continue as Vineyard Wind and future offshore wind projects are developed in Northern Atlantic waters.

NOW THEREFORE, the Parties agree as follows:

Purpose and Funding of the Compensatory Mitigation Fund

1. The purpose of the Compensatory Mitigation Fund is to compensate for any claims by Massachusetts fishing businesses for impacts resulting in economic losses during any phase of the Vineyard Wind 1 project.

2. In accordance with BOEM's approval of Vineyard Wind's COP, Vineyard Wind will provide for a total of $19,185,016 in funding to the Compensatory Mitigation Fund according to the schedule and parameters set forth in Exhibit B.

Purpose of the Fisheries Innovation Fund

3. The purpose of the Fisheries Innovation Fund is to support programs and projects that ensure safe and profitable fishing continue as Vineyard Wind and future offshore wind projects are developed in Northern Atlantic waters. The Fund will provide support to programs and projects through grants to conduct studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries as well as provide grants for technology and innovation upgrades for fishery participants (and vessels) actively fishing within a wind energy area. These programs and projects may include, but are not limited to, studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries, improvements in fishing vessels and gear, development of new technology to improve navigation in and around the wind farm area, the development of alternative gear and fishing methods, optimization of vessel systems, technology and innovation upgrades for fishery participants (and vessels) actively fishing within a wind energy area, and general fishing vessel safety improvements.

4. There are no restrictions on the use of the funds provided they fulfill the purpose of the Fisheries Innovation Fund.

Establishment of the Fisheries Innovation Fund

5. The Fisheries Innovation Fund will be created by EEA in accordance with Massachusetts law either within the existing DMF Expendable Trust ("Marine Mammals and Fisheries Research and Conservation Trust") or as a separate expendable trust dedicated to these matters. The fund shall be established to receive funds on a schedule described in the Vineyard Wind Fisheries Mitigation Plan (Exhibit B).

6. The Fisheries Innovation Fund will also receive unspent funds rolled over from the Compensatory Mitigation Fund, as set forth in the Vineyard Wind Fisheries Mitigation Plan (Exhibit B).

7. The DMF Director will serve as trustee of the expendable trust, and will chair an Offshore Wind Fisheries Research, Innovation, and Science advisory panel which will advise the Director on any expenditures from the Fund. All approved expenditures from the Fund shall follow all applicable Commonwealth procurement and finance laws, regulations, and guidelines.

8. EEA will use best efforts to ensure that the Fisheries Innovation Fund is established at least 60 days before Vineyard Wind's financial close. EEA will notify Vineyard Wind when the Fisheries Innovation Fund has been established.

Payments to the Fisheries Innovation Fund

9. Vineyard Wind will provide a total of $1.75 million prior to the end of the Project's construction phase, according to the schedule set forth below, with $1 million in funding to be paid when Vineyard Wind 1 achieves financial close[1]. In the event that the Fisheries Innovation Fund is not established within the time prescribed in Paragraph 8, Vineyard Wind will pay the first installment, and, if necessary, any future installments, to another financial vehicle that is agreed upon by both parties until such time as the Fisheries Innovation Fund is established.

Payment Schedule for Fisheries Innovation Fund

	At Financial Close	**One Year After Financial Close**	**Two Years After Financial Close**	**Three Years After Financial Close**
Vineyard Wind Payments	**$1,000,000**	**$250,000**	**$250,000**	**$250,000**
TOTAL Payments over life of the Project (nominal): $1,750,000				

Precedent Conditions

10. This Agreement is contingent on Vineyard Wind achieving financial close for the Project. Vineyard Wind will notify EEA of the financial close date once it is established. If Vineyard Wind fails to reach financial close for the Project, it shall have no further obligations under this Agreement.

11. This Agreement is contingent upon the Massachusetts CZM concurring with Vineyard Wind's consistency certification on or before May 22, 2020.

Dispute Resolution

12. If either Party alleges that there exists a dispute or disagreement regarding the matters covered by this Agreement, it shall notify in writing the other Party of such alleged dispute or disagreement ("Dispute Notice"). The Parties shall attempt to resolve the alleged dispute or disagreement through good faith negotiations. If the Parties fail to resolve the alleged dispute or disagreement within sixty (60) days of the Dispute Notice, the Party alleging the dispute or disagreement may enforce this only by specific performance, injunctive relief or a declaratory judgment action pursuant to the laws of the Commonwealth of Massachusetts. The remedies of specific performance, injunctive

[1] For the purposes of this Agreement, financial close means the date upon which all project and financing documentation for the Project has been executed and becomes effective.

relief and declaratory judgment shall be cumulative of all other rights and remedies at law or equity of the parties under this Agreement.

Governing Law

13. This Agreement shall be construed in accordance with and all disputes hereunder shall be controlled by the laws of the Commonwealth of Massachusetts without regard to its conflict of laws principles. Massachusetts shall be the forum state for all forms of dispute resolution, including but not limited to judicial actions to enforce the Agreement.

Entire Agreement

14. This Agreement, including the attached exhibits constitutes the entire agreement of the parties as to the subject matter of mitigation for potential impacts to the Massachusetts fishing industry, and supersedes any and all prior oral or written agreements of the parties relating to this subject matter; in particular, this Agreement does not supersede the agreement regarding the payment of the Ocean Development Mitigation Fee. This Agreement cannot be changed or modified except in a written instrument mutually agreed-upon and signed by both parties.

Successors and Assigns

15. This Agreement shall be binding upon and inure to the benefit of the Parties and their respective successors and assigns.

Severability

16. If any part of this Agreement is found to be unenforceable, the rest will remain in full force and effect and shall be interpreted so as to give full effect to the intent of the parties.

Execution in Counterparts

17. This Agreement may be executed in counterparts and by the different parties hereto on separate counterparts, each of which when so executed and delivered shall be an original, but all counterparts shall together constitute one and the same instrument. This Agreement may be delivered by the exchange of signed signature pages by facsimile transmission, electronic signatures, or by attaching a pdf copy to an e-mail, and any printed or copied version of any signature page so delivered shall have the same force and effect as an originally signed version of such signature page.

Term; Termination

18. The term of this Agreement shall start as of the date of this Agreement and shall expire upon Vineyard Wind's payment of the final installment to the Fisheries Innovation Fund as set forth in Paragraph 3 or to the Compensatory Mitigation Fund as set forth in Paragraph 2 herein, whichever is later, unless otherwise provided for in BOEM's approval of the COP or as mutually agreed to in writing by the Parties.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed as of the date first written above.

VINEYARD WIND, LLC

DocuSigned by:

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Lars Pedersen
Chief Executive Officer

MASSACHUSETTS EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS

Kathleen A. Theoharides
Secretary

OCS-A 0501 MASS USA
VINEYARD WIND

March 3, 2020

Robert Boeri
Acting Assistant Director
Executive Office of Energy and Environmental Affairs
Office of Coastal Zone Management
251 Causeway Street, Suite 800
Boston, MA 02114-2136

Re: CZM Federal Consistency Review of the Vineyard Wind Project – Bureau of Ocean Energy Management

Dear Mr. Boeri:

In a letter dated June 13, 2019, you requested additional information necessary for the Massachusetts Office of Coastal Zone Management ("CZM") to determine the consistency of the Vineyard Wind 1[1] (the "Project") with the enforceable program policies of the Massachusetts coastal management program. We appreciate the opportunity to provide this additional information by way of this letter and its attachments. During the time since your initial request we have been able to receive and incorporate more information and guidance, particularly from fishermen, and have further developed important elements of the Project in regard to fisheries mitigation and turbine layout.

This letter provides information regarding avoiding and minimizing impacts from the Project to commercial fisheries through the site selection and project design processes. The letter also (a) describes measures undertaken by Vineyard Wind to avoid and minimize impacts to fisheries beyond the site selection and design process, (b) provides information on the economic exposure of the Project to Massachusetts fisheries, and (c) describes a proposed fisheries compensatory mitigation program, which incorporates comments from fisheries stakeholders. The compensatory mitigation program is designed to mitigate for potential impacts that cannot otherwise be avoided or mitigated through measures other than direct compensation (payment). This letter also details

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[1]Vineyard Wind, LLC ("Vineyard Wind") is proposing an ~ 800 megawatt (MW) wind energy project within Bureau of Ocean Energy Management ("BOEM") Lease Area OCS-A 0501, consisting of offshore wind turbines (each placed on a foundation support structure), electrical service platforms, an onshore substation, offshore and onshore cabling, and onshore operations & maintenance facilities (these facilities will hereafter be referred to as the "Project"). The Project will be located in the northern portion of the over 675 square kilometers (km^2) (166,886 acre) Lease Area OCS-A 0501 (referred to as the "Wind Development Area" or "WDA").

Vineyard Wind's engagement with Massachusetts fishermen in the development of the proposed compensatory mitigation program. Finally, this letter briefly addresses other aspects of the Project related to safe navigation and potential impacts to fish and benthic organisms.

I. Avoiding and Minimizing Impacts to Fisheries

Site Selection by a Public, Intergovernmental Task Force Avoided and Minimizes Impacts

The site for the Project was determined through an approximately six-year, public process led by BOEM and relying on a Task Force with representatives from local, state, tribal, and federal agencies, including fisheries agencies and coastal zone agencies for Massachusetts and Rhode Island. This Task Force was focused specifically on identifying appropriate wind development areas off the coast of Massachusetts and Rhode Island; other tasks forces were formed to consider locations on other parts of the East Coast.

The result of this Task Force process, detailed below, was to establish a broad Wind Energy Area ("WEA") offshore Massachusetts and Rhode Island, anywhere within which was deemed appropriate for offshore wind development. BOEM then divided this WEA into four lease areas (later adjusted to five), for wind development companies to acquire through a public auction process for wind project development. Vineyard Wind acquired Lease Area OCS-A 0501 through such an auction in 2015, and thereupon began conducting offshore studies and other work necessary to design and permit the project now being reviewed for CZM consistency. As a result, the Vineyard Wind 1 site was selected through a multiyear, public, transparent process with considerable input from fishermen and other stakeholders.

As an initial step in the Task Force process in 2009, BOEM engaged the Department of Energy's National Renewable Energy Laboratory to evaluate areas along the Atlantic coast with respect to their potential suitability for offshore wind development via a public stakeholder and desktop screening process.

As a result of this initial planning and consultation, BOEM published a Request for Interest ("RFI") on December 29, 2010 for a preliminary Massachusetts ("MA") WEA of approximately 7,628 km^2 (1,884,920 acres), referred to as the "RFI Area." This RFI requested expressions of commercial interest from potential wind energy developers, as well as any information from the public relevant to determining the suitability of the RFI area for offshore wind development. After the initial round of responses to the RFI, BOEM announced a second public comment period, which closed on April 18, 2011. A total of 260 public comments were received, in addition to comments from 10 wind development companies.

The Task Force also relied on information and input from both a Fisheries Working Group ("FWG"), comprised of active fishermen, fisheries scientists, and others representing fishing interests in the area, and a Habitat Working Group, comprised of scientists with expertise in relevant disciplines as well as environmental protection advocacy groups. These working groups were formed by the Executive Office of Energy and Environmental Affairs and the Massachusetts Clean Energy Center, and augmented and supported the Task Force by engaging directly with key stakeholders with the intention of minimizing and avoiding impacts to the marine environment. Early meetings of the FWG provided critically important information regarding the relative value or level of fishing activity in various offshore areas by different gear types, transiting issues, compounding effects created by fishing license/permit requirements, available fisheries science and data, and other considerations important to fishermen. Both working groups continue to meet to address issues on an on-going basis and provide important information to Vineyard Wind in designing the Project and mitigation plan, and are expected to continue to be an important venue for information exchange as the Project moves through construction and into the operational phase. Vineyard Wind intends to remain an active participant in both working groups, to the extent invited to do so by the conveners.

After careful consideration of the public comments, working groups, as well as input from the Massachusetts-BOEM Task Force, BOEM extensively modified the RFI Area to address stakeholder concerns. For example, BOEM decided to exclude certain areas identified as important habitats that could be adversely affected if ultimately used for offshore wind energy development. BOEM also excluded an area of high fisheries value so as reduce potential conflict with commercial and recreational fishing activities, as well as an area of high sea duck concentration. The distance from the WEA to the nearest shore was also extended, in order to further reduce any possible viewshed impacts. These extensive revisions resulted in the revised Massachusetts ("MA") WEA being reduced in size, as compared to the preliminary RFI area, by approximately 40%.

On February 6, 2012, BOEM published a "Call for Information and Nominations" ("Call") for areas within the revised MA WEA (the "Call Area"). The Call for Information and Nominations requested the submission of a nomination for a lease by those interested in potentially obtaining a commercial lease for the "Call Area" and also allowed interested and affected parties to provide comments about site conditions, resources, or uses within the Call Area. That same month, BOEM also published a Notice of Intent to prepare an Environmental Assessment ("EA") for leasing and site assessment activities within the Call Area." The EA was made available for public review on November 12, 2012. Among other issues, the EA considered potential impacts to the endangered North Atlantic Right Whales (*Eubalaena glacialis*) and potential effects on viewsheds. Comments on the EA were considered and the revised EA for the WEA was issued on June 4, 2014. As a result of the analysis presented in the revised EA, BOEM issued a "Finding of No Significant Impact" which concluded that reasonably foreseeable environmental effects associated with the commercial wind lease issuance and related activities would not significantly impact the environment.

On June 17, 2014, BOEM and Massachusetts announced that 3,002 km^2 (742,000 acres) comprising the MA WEA would be made available for commercial wind energy leasing. On January 29, 2015, BOEM held a competitive lease sale, conducted as an auction, for the lease areas within BOEM's MA WEA. Prior to the competitive lease sale, Vineyard Wind entered into a Community Benefits Agreement with the local, community-based non-profit cooperative, Vineyard Power. This first of a kind partnership was intended to lead the way for offshore wind project development to be undertaken alongside stakeholders, with active engagement and participation of local communities. Vineyard Wind subsequently won Lease Area OCS-A 0501 in the auction.

Measures Undertaken by Vineyard Wind to Avoid and Minimize Impacts to Fisheries Beyond the Site Selection Process

After securing Lease Area OCS-A-501, Vineyard Wind began collecting information on the area and incorporated this information into the design of Vineyard Wind 1. This design was then described in a Construction and Operations Plan ("COP") submitted to BOEM, as well as provided to other local, state and federal agencies for various reviews and approvals. Consultations with fishermen and other stakeholders continued up until finalization of the COP prior to submission, and these consultations have continued through the permitting and review process.

Since then, Vineyard Wind has implemented, and will continue to implement, multiple measures to avoid and minimize impacts to fisheries, including:

Fisheries Communication Program

Vineyard Wind has established a robust fisheries communication protocol to ensure effective communication with the fishing industry through all stages of the Project. This protocol is outlined in a fisheries communication plan, which is a "living" document that is updated regularly based on lessons learned and feedback from fisheries stakeholders. The fisheries communication plan is always available on Vineyard Wind's website (https://www.vineyardwind.com/fisheries).

Vineyard Wind's fishery communication is conducted through several roles, including Fishery Liaisons (FL) and Fishery Representatives ("FR"). Vineyard Wind employs two FLs, Crista Bank and a deputy, Caela Howard. At the time of this writing, five FRs are engaged, most of them based in Massachusetts. FLs work on behalf of Vineyard Wind, representing the company's interests in communicating with FRs and others. The FRs do not work on behalf of Vineyard Wind or represent Vineyard Wind's interests, but rather represent their respective fishing communities to Vineyard Wind and provide direct two-way feedback to and from the project, through the FL, with their represented fishery. Vineyard Wind was the first offshore wind farm developer to hire a FR, in Jim Kendall, principal at New Bedford Seafood Consulting and Board Member of the MA Fishermen's Partnership. In addition to Mr. Kendall, Vineyard Wind has engaged the following additional FRs: the New Bedford Port Authority (Ed Washburn, Director), the MA Lobstermen's Association (Beth Casoni, Executive Director), the Martha's Vineyard Fishermen's Preservation Trust (Shelley Edmundson, Executive Director), and the Responsible Offshore Development Alliance (Annie Hawkins, Executive Director).

Fisheries Science Program and Support for Long-term, Regional Studies

Supporting a strong fisheries science program, so as to both inform regulatory decisions as well as better enable fisheries and wind to grow together in the long-term, is a top priority.

A summary description of Vineyard Wind's fisheries science program is provided as Attachment 1. At the time of this writing, Vineyard Wind is supporting a wide variety of fisheries science programs at the amount of more than $2 million/year and anticipates continuing at this level for the foreseeable future.

As part of this, Vineyard Wind is working with the University of Massachusetts Dartmouth's School for Marine Science and Technology and local stakeholders to implement a pre-, during, and post-construction fisheries monitoring program to measure the project's potential effects on fisheries resources. Pre-construction sampling commenced in Spring 2019. In addition, Vineyard Wind is consulting with the New England Aquarium and recreational fishermen in the region to develop monitoring protocols for Highly Migratory Species. The Company is also a founding member of the Responsible Offshore Science Alliance, in order to further support a long-term regional approach to fisheries science related to offshore wind.

Vineyard Wind also believes in a collaborative research approach with agencies. BOEM and the National Oceanic and Atmospheric Administration ("NOAA") have acknowledged that some of the current NOAA survey methodologies may need to change due to future construction of offshore wind farms within the broader WEA, which includes several lease areas besides just the Vineyard Wind lease area. BOEM and NOAA are working collaboratively to design appropriate surveys, or changes in survey methodologies, that can generate comparable information. It is expected that this collaboration will allow NOAA to make informed management decisions. One aspect of the collaboration between BOEM and NOAA may include having individual leaseholders use survey methods that align with NOAA survey methods to facilitate data integration where feasible, and Vineyard Wind is willing and prepared to engage in this process.

Additional Key Initiatives

Vineyard Wind has also engaged in key initiatives to minimize and avoid impacts to fisheries based on consultations with the fishing industry and members of the FWG. These include, but are not limited to:

- Providing thumb drives for electronic charts, showing our lease area and areas of offshore survey work to area fishermen.
- Including Loran navigation lines and closed areas on project charts to facilitate discussion of fishing activities in the area.
- Agreeing with other developers to orient wind turbines in a widely spaced grid pattern across the Massachusetts/Rhode Island WEAs to allow fishing and safe transit in multiple directions, e.g., N-S, E-W, NW-SE.
- Committing to east/west alignment for future projects.

- Selecting the largest commercially available turbine in order to reduce the overall area of Vineyard Wind 1.
- Removing turbine locations along the 20-fathom contour.
- Installing AIS on turbines and electrical service platforms to improve navigation and safety.
- Creating protocols for project vessels to adhere to when encountering fishing activity.
- Dedicating a page on Vineyard Wind's website for fishermen (www.vineyardwind.com/fisheries) to find the latest information on surveys and construction, and sign up to receive email or text message alert updates.
- Maintaining regular, direct communications with fishermen through email, texts, social media mass messaging, as well as regular check-in calls with individual fishermen
- Use of Mariner Updates to notify fishermen and other mariners of vessel activity related to the Project
- Coordinating with other lease holders in the region to enable more efficient communication between fishermen and the wind industry. Initiatives being undertaken include a uniform gear loss claim reporting form and process, a single website and other platforms to access all relevant information in one place, and coordinating meetings so as to minimize time fishermen would need to spend to learn more about wind activities.

II. Economic Exposure of the Project to Massachusetts Fisheries

CZM requested that Vineyard Wind provide an assessment of the potential economic impacts of the Project on the water-dependent uses of Massachusetts, in particular addressing the potential economic exposure of the Massachusetts commercial fishing industry to Vineyard Wind's development of offshore wind. In response, attached is an economic report that was prepared by expert fisheries economist Dr. Dennis King, titled *Economic Exposure of Massachusetts Commercial Fisheries to the Vineyard Wind Project* (referred to herein as the "King Report" and attached as Attachment 2). Dr. Dennis King, who earned his Ph.D. in Marine Resource Economics from the University of Rhode Island, has 40 years-experience teaching, researching and consulting on fisheries, aquaculture, ocean-based industries and markets, seaports, and shipping.

The King Report was developed to provide baseline estimates of economic exposure for the Massachusetts commercial fishing industry from development within Lease Area OCS-A 0501, located within federal waters, and along with the Offshore Export Cable Corridor ("OECC") located within state and federal waters. The baseline estimates of the King Report, which represent the upper bound of theoretical impacts to commercial fisheries from the Project, demonstrate that the potential impacts to commercial fisheries industry in Massachusetts (and the region) are modest in the context of the large scale of the fishery industry. This finding is consistent with the studies, analysis, and feedback received during the Task Force process described above, studies conducted by others[2], as well as anecdotal information from fishermen received through Vineyard Wind's on-going fisheries outreach. The King Report is notable in that it addressed fisheries values for all known targeted species in one comprehensive report, and so included species such as lobster and Jonah crab that were not included in other studies.

The King Report builds on studies conducted by others, in particular BOEM, NOAA, and the Rhode Island Department of Environmental Management ("RI DEM"). In developing the King Report, Dr. King reviewed all available fishing value data and, in the end, decided to rely on fishing value estimates presented in RI DEM 2017 and RI DEM 2018, which were based on an integrated analysis of VTR, VMS, and state and federal landings records. As such, the King report uses the best available data (which includes five years of data from 2011 to 2016) regarding historical fishing revenues generated in the WDA and along the OECC to estimate the economic exposure.[3] The values calculated in the King Report are essentially the same as the landings values reported by NOAA[4] in their DEIS comment letter, which they directed BOEM to use.

It is important to note that the King Report is a study of fisheries values, and as such provides an estimate of fishery-related economic exposure to potential impacts. The King Report is not a projection of anticipated impacts. Nor is the King Report an assessment of how potential changes in ecological or market conditions or fish population dynamics that could occur in the future might result in impacts. There is no scientific or economic research indicating that, as a result of constructing and operating the Project, conditions affecting fishing values in the future will be significantly different than what they were in the recent past. Therefore, the best basis for estimating future fishing values in the WDA are recent year fishing values from the area. While potential impacts of changes in market conditions, fish populations, regulations, fishing practices

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[2] *See, e.g.*, NOAA/SSRC (2018). NOAA, Social Science Research Center (NOAA/SSRC); special report prepared for Vineyard Wind that used vessel trip report ("VTR") data to estimate annual fishing revenue density for Lease Area OCS-A 0501 for years 1996-2017; S*ee also* RI-DEM (2017). Massachusetts Department of Environmental Management, Division of Fisheries, Spatiotemporal and Economic Analysis of Vessel Monitoring System ("VMS") Data within Wind Energy Areas in the Greater North Atlantic.

[3] Please note that there was an early version of the RI-DEM 2017 report (also known as the Livermore 2017 study) which contained typographical errors that have caused some confusion. BOEM drew on that earlier version of the Livermore 2017 study in preparing the Draft Environmental Impact Statement ("DEIS") for Vineyard Wind 1, which resulted in the values reported in Table 3.4.5-3 of the DEIS. NOAA's comments correctly referenced that the values in that table were lower than what they should have been. Livermore had earlier issued a corrected version of that study, and we have confirmed with BOEM that they are aware of the issue and will adjust the FEIS to reflect this correction. Also, for the avoidance of confusion, please note that Table 3.4.5-3 in the DEIS reports values of five ports located in four states, whereas the King Report focuses on all landings in Massachusetts.

[4] As noted in the King Report: "A recent (March, 2019) report by NOAA commenting on BOEM's DEIS for the Vineyard Wind project provided confidence in the fishing values developed in this [King] report which were based primarily on RI-DEM (2017). Based on 2011-2016 data the average annual value of landings from the VWLA used in this [King] report, excluding lobster and Jonah crab, is estimated to be $857,548 (See Table 4a). There is only a 3% difference between this value estimate and the $830,722 in annual landings values for the VWLA estimated based on NOAA's separate analysis for the same period."

or technologies, etc., on future fishing values are obviously very important to fishermen, they do not affect historic fishing values or the validity of using historic fishing values as the most reliable basis for predicting future fishing values. Similarly, speculation as to how constructing and operating the Project might impact fisheries is not relevant to an assessment of recent fisheries values.

The King Report defines economic exposure as:[5]

> "potential economic impacts, not predicted or expected economic impacts. BOEM, for example, defines it as 'the potential for an impact from WEA development if a harvester opts to no longer fish in the area and cannot capture that income in a different location.' In the DEIS, BOEM further adds that 'revenue exposure does not account for mitigation measures nor the potential for continued fishing to occur' (BOEM 2018)."

The King Report found that between 2011 and 2016, the estimated average value of Massachusetts landings from the WDA ($196,621) represent about 0.03% of Massachusetts's average annual commercial landings ($605.2 million).[6] Along the OECC, the King Report estimates that economic exposure to the Project will be under $5,000 and limited to a two month window during Project's construction phase. This very limited exposure is due to several factors: fishing activity along the OECC is low; the period of potential disruption is limited to the two month cable installation construction window; time of year restrictions will restrict construction activities to lower fishing intensity months; and cable burial avoid impacts during the Project's operations phase.[7]

III. Proposed Fisheries Compensatory Mitigation Program

Considerable effort was and will continue to be made to avoid and minimize impacts to fisheries, as described above. While these avoidance and minimization measures are considered to be highly effective, a compensatory (payment) mitigation program is also being proposed to further mitigate any potential economic impacts to Massachusetts (and other states') fisheries from the Project. This program relies on the landing values and analysis provided in the King Report.

Vineyard Wind 1's Massachusetts fisheries compensatory mitigation program will consist of two funds: a Direct Compensation Fund and a Fisheries Innovation Fund. The Direct Compensation Fund will provide assurance that if a fishermen, company (whether fishing or onshore processing), or vessel has a claim of economic loss due to the presence of the Project, funds will be available to compensate for those loses for the duration of the Project. The Fisheries Innovation Fund is

[5] Economic exposure is presented in nominal dollars rather than inflation-adjusted values, which Dr. King concluded provides the most appropriate characterization, as explained in the response from Dr. King to the comments submitted by Tom Sproul (herein the "King Addendum") (Attachment 3).
[6] These landing values from the King Report were used as the basis for a fisheries compensatory mitigation program for Vineyard Wind 1 as further described in this letter.
[7] The King Addendum provides further explanation for how each of the following considerations are accounted for: side impacts, costs for detouring around the WEA and cable laying area, life safety issues, and electromagnetic fields.

intended to fund programs that better enable fishing and offshore wind industries can thrive alongside each other indefinitely, and is not intended to compensate for losses per se. These programs are further detailed in Attachment 4.

Vineyard Wind has made substantial financial commitments to provide compensatory mitigation funds for Massachusetts fishermen for the potential impacts of the Project on fishermen and shoreside business revenues. The compensatory mitigation program addresses: direct impacts to fishing vessels; indirect impacts to shoreside businesses; and cumulative impacts.

The principles upon which the fisheries compensatory mitigation program is based include:

1. Conservative assumption of lost fishing area: The program design makes a conservative assumption that no fish are caught from within the area of any one project starting with the year in which the project begins construction, and then for the life of the project. Even though fishermen will likely be fishing in other areas outside of the project area and possibly catching as much fish as they would have otherwise, as well as continuing to fish within the project area to some extent, this program design assumes that the presence of the project results in lost revenue as if fishermen could only catch a certain amount of fish in the project area but were prevented from doing so. However, it is expected that much activity will in fact continue within the project area, given comments from fishermen related to fishing among the turbines.

2. Direct Impacts: Fishing vessel revenue applied to fixed costs and profit: Of the total landings value of a vessel (ex-vessel value), about 50% goes to trip costs such as fuel, crew pay, and supplies. The balance of the ex-vessel value goes to pay for fixed costs such as insurance, and for vessel profit. This is consistent with, for example, NOAA's Fisheries Contingency Fund that offshore oil and gas operators are required to pay into. By paying 50% of ex-vessel value, a vessel owner can be assured of an amount of revenue to cover fixed costs and gross earnings as if a fishing trip occurred, even if no such trip occurred.

3. Shoreside Impacts: Catching fish also generates shoreside economic activity: Landing, processing, and selling fish caught generates additional economic activity, which is expressed as a "downstream" multiplier applied to ex-vessel landings value. The "downstream" economic multiplier expresses economic activity related to the fish caught, for example processing and selling the fish caught, and other value add activities. This downstream effect is dependent on how much fish is caught. In order to account for possible impacts to this economic activity in a hypothetical scenario of all landings from a project area being lost, a mitigation amount can be calculated using the downstream multiplier.

4. Cumulative impacts on fishing effort (activity): Vineyard Wind's compensatory mitigation program takes into account potential cumulative impacts to the fishing industry as the offshore wind industry develops beyond the initial Vineyard Wind project. This approach better accounts for potential impacts related to shoreside economic activity, such as fish

processing. In addition to assuming that all fishing activity will be lost from the project area, Vineyard Wind's cautious approach for compensatory mitigation conservatively assumes that even though Vineyard Wind's current project only takes up a small percentage (<10% of the total acreage for offshore wind lease areas), it will compensate initially as if 50% of the lease areas had been built-out, with the compensation amount increasing over time as more of the lease areas are built out.

Direct Compensation Fund

The Direct Compensation Fund will compensate fishermen and fishery interests (i.e. others in the fishing industry aside from fishermen, such as vessel owners and onshore companies) for claims of direct impacts associated with the construction, operations, and decommissioning of the project. Direct impacts or losses for which claims may be filed include, but are not necessarily limited to, lost revenues related to the project's interference with fishing activities (if any). If a captain determines they are unable to fish because of the presence of the turbines, and can demonstrate a loss of income (or higher expenses for the same income due to the wind farm) as a result of this decision, then compensation would be available through the Direct Compensation Fund. However, each vessel captain is responsible for the safety of their vessel and Vineyard Wind will not insure fishing vessel accidents.

Lost or damaged gear associated with fishing within the WDA will be compensated directly, through a separate process and with funding aside from the Direct Compensation Fund and paid on an as-needed basis.

The Fund will be held in escrow accounts and managed by one third-party administrator selected by Vineyard Wind in consultation with CZM. Vineyard Wind will, in consultation with state agencies and fishing organizations, establish a claims review and decision process that will govern the payment of claims from the funds. Fishermen, fishing companies, and companies that support fishing interests can submit claims of direct impacts or losses during any phase of the project (construction, operation, decommissioning) to the claims administrator.

Once the claims process is established, the procedures for filing a claim will be posted on Vineyard Wind's website and otherwise be made available through Vineyard Wind's FLs and as further specified in the fisheries communication plan. Claims that are accepted and paid will be accompanied by a release of liability for any future claims arising out of the same facts and circumstances that gave rise to the paid claim. This means that once Vineyard Wind pays a claim, Vineyard Wind, its parents, affiliates, and successors will have no further obligations with respect to that specific claimed loss. However, fishermen could make claims for subsequent losses, if warranted.

Because the mitigation program is funded at a level in excess of total landings value in the area, the only way the funding would be exhausted would be if the fund over-paid (incorrectly) on claims made.

Fisheries Innovation Fund

The Fisheries Innovation Fund will support programs that ensure safe and profitable fishing continue as Vineyard Wind and future offshore wind projects are developed in Northern Atlantic waters. Programs and projects supported by the Innovation Fund will focus on safe, profitable fishing now and in the future. These programs and projects may include the development of alternative gear, optimization of vessel systems, and general fishing vessel safety improvements. The Fisheries Innovation Fund will be hosted and administered by the Massachusetts Executive Office of Energy and Environmental Affairs pursuant to a Memorandum of Agreement entered into by the parties.

IV. Engagement with Massachusetts Fishermen

The proposed fisheries compensatory mitigation program was developed with significant input from Massachusetts fishermen and other stakeholders. Among other things, Vineyard Wind provided updates on the Project and presented preliminary mitigation proposals at two FWG meetings on March 29 and May 15, 2019. Each FWG meeting was attended by over 25 fishermen from various ports and fishery interests across the Commonwealth. Fishing industry representatives from both Rhode Island and New York were also in attendance. The presentations made at each meeting are attached as Attachments 5 (March 29) and Attachment 6 (May 16).

At both the March and May FWG meetings, Vineyard Wind presented the methodology and findings of the King Report. As described during the presentations, the King Report made use of best available data and input from stakeholders, including the Massachusetts Division of Marine Fisheries, to estimate the total dockside value of commercial landings from the Project over its anticipated 30-year life.

During the May 15 meeting, Vineyard Wind presented its proposed fisheries compensatory mitigation program for Massachusetts commercial fishermen. Examples of comments heard and incorporated include those related to “up-front” payment, in order to ensure sufficient funds availability and to account for the fact that any impacts are likely to occur mostly during construction and in early years of the Project’s operation.

V. Potential Impacts to Navigation

Vineyard Wind has taken several steps to assess and mitigate potential impacts to navigation. This includes preparing a detailed navigational risk assessment and a supplementary navigational risk assessment. These studies determined that levels of vessel traffic within the WDA were relatively low and that the spacing between turbines is adequate for two-way fishing vessel traffic, trawling, and turning to occur. These studies also reviewed twenty potential risks and determined that, after proposed mitigation measures were implemented, all impacts were considered negligible or minor, except for one risk associated with trawling activity that was considered moderate. The risk to trawling activity was classified as moderate as there will need to be an adjustment in trawling and dredging operations due to the presence of the turbines, but trawling and dredging can still take place.

Vineyard Wind has also agreed with other offshore wind leaseholders to orient wind turbines in a grid pattern across the Massachusetts/Rhode Island WEAs to allow fishing and safe transit in multiple directions. This agreement was memorialized in a November 1, 2019 letter sent by Vineyard Wind, Equinor Wind US, Eversource Energy, Mayflower Wind, and Orsted North America to the US sent a letter to the US Coast Guard ("USCG") (Attachment 5). The letter outlines a proposal for a uniform 1 by 1 nautical mile wind turbine layout for offshore wind projects developed in response to feedback from key stakeholders, including the region's fisheries and maritime users.

As the letter notes, the proposal to the USCG addresses four principal concerns: (1) navigation safety; (2) the fisheries community's request for uniform and consistent spacing between turbines throughout the Massachusetts/Rhode Island WEAs; (3) creation of distinct transit corridors; and (4) the facilitation of search and rescue operations conducted by both vessel and aircraft. Along with the letter, a report prepared by W.F. Baird & Associates analyzing the uniform layout proposal using international vessel safety guidelines was submitted. W.F. Baird & Associates Ltd. is a leading vessel and port safety consultant. Their analysis finds, among other things, that the uniform layout proposal would facilitate safe navigation through the Massachusetts/Rhode Island WEAs without the need for additional designated transit corridors.

The letter was sent to the USCG in connection with the on-going Massachusetts and Rhode Island Port Access Route Study, which is evaluating ways to enhance navigational safety in the Massachusetts/Rhode Island WEAs. In a draft report released for public comment on January 29, 2020, the USCG, consistent with the letter, recommended the that wind turbine layout in the Massacshusetts/Rhode Island WEAs "be developed along a standard and uniform grid pattern with at least three lines of orientation and standard spacing to accommodate vessel transits, traditional fishing operations, and search and rescue operations."[8] The USCG notes that in the event uniform grid pattern for wind turbine layouts is adopted by BOEM, it would not pursue vessel routing measures through the Massachusetts/Rhode Island WEAs at this time.

VI. Potential Impacts to Fish and Benthic Organisms

The Project's COP contains a detailed assessment of potential impacts to fish and benthic organisms and concluded that impacts would primarily be short-term and localized, with no anticipated population-level impacts. As noted in the COP, the wind turbines are widely-spaced, such that all project components only occupy 0.5% of the WDA, leaving a huge portion of the

[8] USCG (2020). The Areas Offshore of Massachusetts and Rhode Island Port Access Route Study at 38. USCG-2019-0131. January 22, 2020.

WDA undisturbed. No information was identified that shows wind turbines affect fish migration routes.

Vineyard Wind also conducted acoustic modeling to estimate the noise propagation of pile driving (with a target of approximately 12dB noise reduction) in relation to thresholds of mortality and recoverable injury for fish with different hearing structures (based on thresholds in Popper et al., 2014). Modeling results indicated that cumulative sound levels causing mortality or injury to the most sensitive fish species may occur within 200-351 meters ("m") (656-1,152 feet ["ft"]) from the source. Recoverable injury for the most sensitive fish species could occur between 451-691 m (1,480-2,267 ft) from the source. Piles from the project will be installed at distances from the areas mapped by NOAA (using observer data) as having high concentrations of longfin squid egg bycatch that are at least ten times greater (approximately 7,000 m [22,966 ft] or more) than could cause potential injury or mortality. The company will also use soft-start procedures that will allow fish to exit the area before pile driving begins.

VII. Conclusion

Vineyard Wind has undertaken a substantial effort to site and design an offshore wind project in a manner that minimizes potential impacts to commercial fisheries and is responsive to stakeholder concerns. Beyond site selection and design, Vineyard Wind has adopted a number of measures that further limit potential impacts and keep Massachusetts fishermen informed. To the extent potential impacts are unavoidable, Vineyard Wind has developed a fisheries compensatory mitigation program to provide financial payments to Massachusetts fishermen who experience economic loss resulting from the construction and operation of Vineyard Wind 1. For these reasons, and as evidenced by the COP for Vineyard Wind 1 as well as this letter and associated attachments, the Project is consistent with the enforceable program policies of the Massachusetts coastal management program.

Thank you for taking this additional information into consideration with respect to your evaluation of the Project. We stand ready to provide any further information or assistance that you may require.

Respectfully submitted,
Vineyard Wind LLC

By: Rachel Pachter
Title: Chief Development Officer

Attachment 1

Vineyard Wind Fisheries Science Program

Fisheries Science Program

Overview

Vineyard Wind understands how important science and research is to the fishing community. This is one of the primary reasons why Vineyard Wind created a fisheries studies program for the nation's first commercial scale offshore wind project—Vineyard Wind 1 (the "Project").

Beyond supporting the successful development of the Project, including efforts to avoid and minimize fishery-related impacts, Vineyard Wind 1's fisheries studies program prioritizes:

- Establishing relationships with academic institutions that engage in cooperative fisheries research;
- Defining research objectives and scope with input from fisheries stakeholders;
- Supporting a regional approach to fisheries research for offshore wind; and
- Making data easily accessible and publicly available.

Vineyard Wind currently provides more than $2 million in annual funding to the fisheries studies program, making it the largest offshore wind developer supported programs in the US.

Fisheries Monitoring For Vineyard Wind 1

Vineyard Wind has entered into an agreement with UMass Dartmouth's School for Marine Sciences and Technology (SMAST) to develop and implement a pre- and post-construction fisheries monitoring program for Vineyard Wind 1 (Monitoring Plan). Vineyard Wind took this approach to designing the pre- and post-construction fisheries studies so that those who work directly in the fishing industry — most importantly fishermen but also regulators and academics — would have a lead role in identifying the issues to be addressed through the studies, and methods used.

To develop the monitoring framework for Vineyard Wind 1, SMAST sought input from fisheries stakeholders. Among other things, SMAST held a total of six workshops-four for fishermen and two additional workshops with state and federal regulators-in Massachusetts and Rhode Island in November and December 2018 to identify priority areas for fisheries and ecological impact assessment. Just over 100 people attended the workshops, including more than 75 active fishermen. Based on the feedback from the fishing industry, and state and federal regulators, SMAST produced a report for Vineyard Wind in early 2019.[1]

The report recommended a number of fisheries monitoring and research methods, including the following surveys:

- Benthic "drop camera" surveys that will monitor habitat and squid egg mops;
- Trawl surveys to monitor finfish and squid;
- Trap surveys to monitor black sea bass, lobster, and Jonah crab; and
- Plankton larval sampling surveys.

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[1] The complete report is available at https://www.vineyardwind.com/document-room (listed under Fisheries/Fisheries Studies).

In April 2019, Wind announced it would implement all SMAST recommendations to guide fisheries monitoring during project construction and initiate longer-term studies as part of a regional approach to fisheries studies. SMAST-led surveys are already underway with studies initiated in Q2 2019. Drop camera surveys to observe benthic invertebrates and habitat are being conducted twice a year. These surveys emulate SMAST's previous and ongoing drop camera survey design to allow comparison with regional and baseline sampling.

Under the Monitoring Plan, sampling will be conducted before, during and after construction in the project area and control areas to support a "beyond BACI" analysis (e.g., sampling at multiple control sites at multiple periods before and after impact). Sampling will be conducted at least four times: pre-construction (to assess baseline conditions); during construction; and at two different intervals during operation (i.e. one year after construction and then post-construction). Each of these four assessment periods will capture all four seasons of the year. The Monitoring Plan is designed to be "nested and modular", so as to support long-term, regional studies. That is, the studies utilize the methodologies and protocols of other on-going regional studies, so that results can be readily compared and compiled to add to a growing long-term data set that covers a wide, regional area including much of the East Coast in some aspects.

Based on feedback from the fishermen workshops, SMAST also recommended that a consultation committee of fishermen will be organized so that representatives of the fishing community can be updated directly by SMAST while the studies are underway. This committee will also provide guidance as to how the study might be best managed given early findings and any methodological issues that might arise, as well as interpretation of results. This committee is currently being organized.

Overall, the SMAST studies seek to further public understanding of the effects of offshore wind development and inform future permitting and public policy decisions regarding wind energy facility siting. The studies will contribute to and help establish a body of knowledge to the benefit of the US offshore wind industry and fishing community.

Highly Migratory Species

Shortly after Vineyard Wind announced it would implement all of SMAST's recommendations, recreational fishermen raised concerns that highly migratory species (HMS) were not addressed in the SMAST research recommendations. Vineyard Wind reached out to recreational fishing groups and individual fishermen to understand their concerns and brainstorm what could be done to better understand recreational fishing in the area and potential impacts.

This led to partnering with the New England Aquarium Anderson Cabot Center for Ocean Life to initiate a study to document highly migratory species presence across the Massachusetts/Rhode Island Wind Energy Areas with help from the pelagic recreational fleet. Through extensive outreach with key members of the HMS recreational fishing community in southern New England, information will be collected on past and current fishing activity in the wind energy lease areas, and mechanisms will be established to monitor recreational fishing effort during and after the construction activities. The result of this effort will be publicly available through Vineyard Wind's website and include maps of HMS distribution and recreational fishing effort, and testimonials from HMS fishermen.

Additional information is available at: https://www.vineyardwind.com/survey-for-south-of-the-vineyard-fishermen.

Regional Studies

The need for a regional science approach to offshore wind development is important to better understand how this new industry may be affecting fisheries and the environment. The current lack of a regional science framework has made it challenging for developers and concerned stakeholders to design appropriate studies that can provide consistency across all lease areas. The recently created non-profit organization Responsible Offshore Science Alliance (ROSA) is an attempt to fill that void and bring developers, fishing industry, state, and federal agencies together to develop a regional science framework.[2]

Vineyard Wind is a founding board member of ROSA and has committed to both start-up and on-going funding support of that organization. ROSA's mission is to provide for and advance regional research and monitoring of fisheries and offshore wind interactions in order to:

- Increase salient and credible data on fisheries and wind development; and
- Increase understanding of the effects of wind energy development on fisheries and their coastal and ocean ecosystems.

Vineyard Wind is also participating in regional science efforts on concerns other than fishing – with a specific focus on avian and marine mammal species. A Regional Science Entity (RSE) group is in the early stages of formation with participation from state and federal governments, offshore wind developers, and environmental non-governmental organization to advance the regional understanding of these species and their relationship with offshore wind projects.

Data Sharing

The survey and monitoring work Vineyard Wind will conduct for the Project will generate a substantial body of environmental, fisheries, and other data, all of which will be available in the public domain in a manner consistent with other academic research. Much of the data is publicly available through the federal and state permitting process, as well as reports or academic publications that may come out of the survey or monitoring work. Vineyard Wind also plans to make all fisheries monitoring data generated by the Project publicly available on its website. For all other environmental and fisheries data, Vineyard Wind will explore cost-effective and appropriate ways to store and make data publicly available and easy to access. Through ROSA and RSE, Vineyard Wind will work with stakeholders and neighboring developers to find ways to streamline and standardize available data across all offshore efforts.

[2] ROSA's framework agreement is available at: https://rodafisheries.org/wp-content/uploads/2019/10/ROSAFramework_9-2-19_FINAL.pdf.

Attachment 2

King Report

Economic Exposure of Massachusetts Commercial Fisheries to the Vineyard Wind Project

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Executive Summary

EXECUTIVE SUMMARY

Overview

This report develops estimates of the **economic exposure** of Massachusetts commercial fisheries to offshore wind energy development in Vineyard Wind Lease Area OCS-A 0501 (VWLA). **Economic exposure** refers to potential economic impacts, not predicted or expected economic impacts. Estimates of economic exposure developed here can be used as a baseline for establishing a fishermen compensation fund that will allow Massachusetts commercial fishermen to be reimbursed fairly for actual economic losses attributable to the project.

Estimates of the **economic exposure** of commercial fishing in the VWLA are based on data related to historical fishing revenues generated in the VWLA. The best available data show that during 2011-2016 the average annual value of all commercial landings from the VWLA was $1,078,208, and Massachusetts landings from the VWLA were $581,154. The value of Massachusetts landings of all species other than lobster and Jonah crab in the VWLA was estimated to be $462,302 and the average annual value of Massachusetts landings of lobster and Jonah crab in the VWLA was estimated to be $79,438.

The portion of the VWLA where 84 wind turbines will be installed and operated is a 245 square kilometer (km^2) area in the northern part of the VWLA that is known as the 84 Turbine Wind Development Area (WDA-84). The size of WDA-84 is 245 km^2 so it comprises 36.3% of the VWLA which is 675.4 km^2. Massachusetts fishermen who currently operate in the WDA-84 are exposed to potential economic losses because fishing will be precluded in parts of the WDA-84 during construction, the abundance or availability of fish may be temporarily displaced during construction, and fishing activities may be potentially altered after construction.

Fishing revenue data specific to the WDA-84 are not available. Based on the assumption that fishing revenues within the VWLA are uniformly distributed, average annual fishing values in the WDA-84 are estimated to be 36.3% of the values for the VWLA.

Massachusetts Department of Marine Fisheries (MA-DMF) conducted a professional review and provided useful feedback on an earlier report that focused on Rhode Island fishing values in the VWLA. That review was used in preparing this report which responds to all MA-DMF's comments on the earlier report, with one exception. MA-DMF criticized the assumption that fish revenues are uniformly distributed within the VWLA because ecologically "species are not evenly distributed across time or space." However, specific data are not available that could be applied to adjust the analysis to reflect differences in fishing revenues within the VWLA. Therefore, while MA-DMF may be correct that fishing values are not be evenly distributed within the VWLA, and for some species may be higher in the northern part of the VWLA, it is not possible to reliably allocate fishing values estimated for the VWLA by the Bureau of Ocean Energy Management (BOEM), the National Oceanic and Atmospheric Administration (NOAA), and the Rhode Island Department of Environmental Management

(RI-DEM) to sub-areas within the VWLA. Any such adjustments will need to be made at a later date if fishing revenue data specific to the VWLA become available.

Findings– Economic Exposure in WDA-84

Based on the best available data, during 2011-2016 fishing vessels from Massachusetts accounted for 53.9% of fishing revenues from the VWLA associated with landings of all species other than lobster and Jonah crab. Based on federal fishing permit data, Massachusetts vessels accounted for 36.0% of all permitted pots in Lobster Management Area 2 (LMA-2), which includes the VWLA. This report assumes shares of lobster and Jonah crab landings in the VWLA are proportional to numbers of permitted pots in LMA-2.

Section 3.3 of the report shows that based on 2011-2016 catch and landings data the value of landings from the VWLA of species other than lobster and crab is estimated at $857,548. A 2019 report by NOAA commenting on BOEM's DEIS for the Vineyard Wind project provided confidence in this value by presenting estimates of annual landings values for the VWLA based on a separate analysis that averaged $830,722 for the same period, just 3% lower than the estimate developed and used in this report.

Massachusetts' 53.9% share of that landed value is estimated to be $462,218. Based on it's relative size the WDA-84 is estimated to account for 36.3% of those landings. Therefore, the value of Massachusetts landings of species other than lobster and Jonah crab from the WDA-84 is estimated to be $167,785.

Accounting for lobster and Jonah crab landings is difficult because vessels that fish exclusively for those two species are not required to file vessel trip reports (VTRs). In the Rhode Island analysis, economic exposure associated with lobster and Jonah crab was estimated based on the assumption that annual per-pot revenues in the VWLA were the same for pots fished by vessels that do not file VTRs as for vessels that do file VTRs. In response to MA-DMF comments, for this report it is assumed that vessels that fish exclusively for lobster and Jonah crab, and therefore do not file VTRs, have 25% more active pots, deploy 25% more of their active pots in the VWLA, and generate 25% more revenues per pot. These assumptions result in the 28,558 pots permitted to fish in LMA-2 by vessels that fish exclusively for lobster and Jonah crab and do not file VTRs averaging 95.3% more revenues per pot in the VWLA than the 36,558 pots permitted to vessels that file VTRs.

As described in Section 3.3, based on these assumptions, the total average annual value of lobster and Jonah crab landings in the VWLA is $220,660 and the total average annual value of lobster and Jonah crab landings in the WDA-84 is $80,100. Based on Massachusetts fishermen accounting for 36% of these revenues the economic exposure of Massachusetts-based lobster and Jonah crab fishing in the WDA-84 is estimated to be $28,836. Based on the fishing value estimates presented above and described in Section 3.2 of this report the average annual value of Massachusetts landings of all species from the WDA-84 is estimated to be $196,621.

Economic Impacts along the Offshore Export Cable Corridor

The Offshore Export Cable Corridor (OECC) is a 59.4 km (~37 mile) underwater corridor where two cables buried below the ocean bottom will deliver electric power from the WDA-84 to a shore-based power station on Cape Cod's southern shore. As described in Section 4.3, based on the best available data, annual fishing revenues along the OECC over its entire length are estimated to be $110,194, or an average of $9,183 per month. Along nearly all of the OECC cables will be buried beneath the seafloor at a target depth of 5 to 8 feet. Cable installation is expected to take place during a period of approximately 2 months during one year and construction will take place on only a portion of the OECC at any given time. And, based on Time of Year restrictions agreed upon with MA-DMF construction will take place during lower fishing intensity months. Based on the analysis presented in Section 3.2 and summarized above it is reasonable to expect that economic exposure of Massachusetts fishermen to the OECC during construction will be under $5,000.

It is Vineyard Wind's priority to bury all of the export cable however, if the target depth cannot be reached cable protection may need to be installed on the ocean floor. This results in some potential economic exposure after OECC construction because of the possibility that bottom fishing gear could snag on cable protection. Vineyard Wind will establish a lost/damaged fixed gear protocol to address such incidents. Therefore, while this does contribute to overall economic exposure it is not likely to result in any net economic impacts.

Potential Fishing Congestion Impacts

Concern has been raised that the Vineyard Wind project may result in adverse commercial fishing impacts outside the WDA-84 and along the OECC because of fishing vessels being precluded from fishing or choosing not to fish in these areas and shifting fishing effort to other areas that are already being fished. With respect to the OECC, it is not reasonable to expect that the small geographic area and short duration of cable installation will result in shifts in fishing effort that will create any fishing congestion impacts. With respect to the WDA-84, there may be shifts in fishing effort that could cause fishing congestion impacts. However, these shifts involve changes in fishing locations by vessels already operating in fisheries in and around WDA-84 rather than any overall increase in fishing effort. For example, research summarized in Section 3.2 indicates that 87% of revenues earned on fishing trips with tows that transect the WDA-84 are generated outside the WDA-84. Fishing effort that generates the estimated $391,390 in annual fishing revenues from the WDA-84, even if it were all diverted to other fishing areas frequented by Massachusetts fishermen, would represent a very small increase in fishing effort in those areas. Also, after WDA-84 construction is complete, much of the fishing effort diverted from the WDA-84 during construction can be expected to return to the WDA-84. The available evidence indicates that there will not be enough diversion of fishing effort from the WDA-84 or the OECC during or after construction to add significantly to fishing congestion outside those areas or generate any related economic impacts.

Shore-side Indirect and Direct Impacts

Concern has been raised that project-related reductions in Massachusetts fish landings will result in significant shore-side impacts. This possibility can be assessed by considering two distinct pathways by which changes in fisheries generate indirect and induced shore-side impacts. Backward-linked impacts are associated with fixed input purchases (e.g., vessel financing, insurance, dock fees, etc.) which take place whether a vessel fishes or not and also variable input costs (e.g., trip expenses) which are affected by whether a vessel fishes or not. However, neither type of input purchases is affected by the value of fish a vessel lands. In other words, backward-linked shore-based impacts associated with purchases by a vessel operator only occurs if the vessel stops fishing. Since it is not likely that WDA or OECC development will result in Massachusetts-based fishing vessels not fishing it can be expected that they will continue to generate indirect and induced shore-side economic impacts and that their purchases from businesses that support them will remain about the same. While declines in fishing revenues can directly affect vessel profits and crew-shares, under most circumstances they do not result in reduced purchases of fishing inputs from fishery support businesses.

Forward-linked indirect and induced economic impacts are associated with reductions in sales, incomes, and jobs in businesses that purchase seafood products from Massachusetts fishermen who may face supply shortages or higher prices and therefore be forced to cut back on production or increase their prices. However, Massachusetts seafood wholesalers and processors and restaurants have a nearly infinite source of alternatives to the $196,621 in annual Massachusetts ex-vessel landings exposed to potential direct impacts in the WDA-84 area. These potentially impacted Massachusetts landings represent a nearly insignificant share (0.03%) of the $605.3 million in annual ex-vessel value of Massachusetts seafood landings in 2016 (NOAA, 2018). And, it represents an insignificant share (0.008%) of all seafood supplies available to Massachusetts seafood processors, wholesalers, retailers and restaurants which, in 2017, included $2.2 billion in Massachusetts seafood imports (U.S. Dept. of Commerce, 2018). It is not reasonable to assume that changes in the small amount of Massachusetts fish landings exposed to potential impacts by WDA-84 and OECC development will have any significant indirect or induced effects in Massachusetts seafood markets, or result in any significant loss of sales, incomes, or jobs in related shore-based industries in Massachusetts.

Other Potential Impacts

Concern has been expressed that wind turbines may function as fish aggregation devices (FADs) and attract fish to the WDA-84 and make them less accessible to commercial fishing. While this is possible, it is expected that after WDA-84 construction is complete fishing will continue or resume in the WDA-84 and that fish in the WDA-84 will be accessible to commercial fishing.

Concern has also been expressed that development of the WDA-84 could affect fish population dynamics and result in a permanent decline in the abundance of fish in the WDA-84. Other studies of the Vineyard Wind project (BOEM, COP, DEIS) indicate that potential biological impacts are not significant. However, this report is focused on developing estimates of economic exposure that are based on the assumption that all revenues from fishing in the WDA-84 will be lost and not replaced by fishing effort shifting from the WDA-84 to other fishing areas. This means that economic exposure, as defined by BOEM and measured in this report, is not affected by the abundance or availability of fish in the WDA. It is based on the assumption that whatever fish is in the WDA-84 will not be caught. This does not imply that potential biological impacts of the project are not important. It only means that estimates of economic exposure, which are estimates of maximum potential economic losses and are based on the assumption that no fish will be harvested in the WDA-84 is not affected by potential project impacts on the abundance or availability of fish in the WDA-84.

Section 1.0

Introduction

1.0 INTRODUCTION

1.1 Context

Commercial fishing is a historically, culturally, and economically important part of life in Massachusetts (MA). In 2017, 242.1 million pounds of fish with a dockside value of $605.3 million were landed at MA ports, and 2017 was the eighteenth straight year that the port of New Bedford, the largest fishing port in MA, ranked # 1 among all U.S. ports with $389.5 million in landings, (NOAA, 2018) Other nationally ranked MA fishing ports include Gloucester, Provincetown/Chatham, and Boston with 2017 landings valued, collectively, at $103.7 million, and there are many smaller MA fishing ports that have supported Massachusetts's ocean economy for centuries. In 2016, shellfish, especially sea scallops, account for 82% of the value of MA commercial landings and finfish, especially cod, haddock, and flounders, accounted for the other 18%.

The types and sizes of fishing vessels and the species composition of landings differ significantly among MA ports, and there can be significant fluctuations in annual landings at MA ports due to changes in the abundance and availability of fish, fishing regulations, seafood markets, and weather and ocean conditions. Nonetheless, the overall value of commercial landings at MA ports has been fairly stable over the past ten years at around $500 million. These landings generate significant shore-side economic multiplier impacts associated with fishing support and seafood processing and marketing activities. In 2016, for example, $550,7 million in MA commercial landings generated indirect and induced shore-side economic impacts that included over $2 billion in business sales, over $850 million in household income, and over 55,000 full-time-equivalent jobs. (NOAA, 2018)

1.2 Overview

This report provides estimates of the ***economic exposure*** of Massachusetts commercial fisheries to offshore wind energy development in Vineyard Wind Lease Area OCS-A 0501 (VWLA). MA-DMF provided a professional review of a similar analysis that focused on Rhode Island-based fishing in the VWLA, and commented on several assumptions that were used in that analysis. All of those comments have been addressed in this report.

Economic exposure refers to potential economic impacts, not predicted or expected economic impacts. BOEM, for example, defines it as "the potential for an impact from WEA development if a harvester opts to no longer fish in the area and cannot capture that income in a different location." BOEM further adds that "revenue exposure does not account for mitigation measures nor the potential for continued fishing to occur." DEIS (2018)

Estimates of economic exposure provided in this report are based on the best available data and provide a reasonable basis to:

- Determine the potential economic impacts on Massachusetts commercial fisheries from offshore wind energy development in the VWLA; and,

- Establish a basis for a compensatory mitigation program that will allow Massachusetts commercial fishermen to be reimbursed fairly for potential or actual economic losses attributable to the project.

1.3 Format

The report's economic analysis is presented in three sections as follows:

Section 2.0: Focus

Section 2.0 summarizes results from previous research reports that characterize possible project effects on fish resources and fishing activity (BOEM, 2017, COP, 2018, and DEIS, 2018). This section also explains why Section 3 and Section 4 of the report focus on economic exposure related to potential project impacts on fishing activity, not potential project impacts on fish resources.

Economic exposure is assessed with respect to commercial fishing in two distinct areas which are referred to as the Wind Development Area (WDA) and the Offshore Export Cable Corridor (OECC) (See Figure 1):

The WDA is in the northern part of the VWLA where wind turbine generators (WTGs) are currently proposed to be constructed and is approximately 245 km2, or 36.3% of the VWLA.

The OECC is a 59.4 km (~37 mile) underwater corridor where two cables buried 5 to 8 feet below the ocean bottom will deliver electric power from wind turbines in the WDA to a shore-based power transmission station located in the town of Barnstable on Cape Cod's southern shore.

Section 3.0: Baseline Fishing Values and Economic Exposure

As discussed in BOEM (2017) economic exposure refers to potential economic impacts, not expected or actual economic impacts. As described in BOEM (2017) and the DEIS (2018) and demonstrated in this report, it is highly likely that expected or actual economic impacts will be significantly lower than estimates of exposed fishing values developed in Section 3.0

Section 3.0 uses the best available data regarding historical fishing revenues generated in the WDA and along the OECC to estimate the economic exposure. This analysis builds on studies conducted by others, in particular the Bureau of Ocean Energy Management (BOEM), the National Oceanic and Atmospheric Administration (NOAA), and the Rhode Island Department of Environmental Management (RI DEM).

Section 4.0: Economic Impacts

Section 4.0 describes how expected fishery-related economic impacts can be estimated based on the economic exposure estimates from Section 3.0 and information about how fishing activity is likely to adapt during and after WDA and OECC development. This may involve resumed fishing in these areas and/or shifts in fishing effort from these areas to other nearby areas. These responses can be expected to result fishing revenues losses that are lower than the economic exposure estimates developed in Section 3.0. They may be offset by fishing revenue losses or increased costs if fishing effort shifting out of the WDA or OECC results in increased fishing congestion outside these areas.

For purposes of assessing economic impacts these changes in fishing activity can be characterized using the following measures:

- Percent decline in fishing values during and after construction due to impaired fishing within the WDA and in the vicinity of the OECC.
- Percent decline in fishing values during and after construction as a result of vessels being precluded from fishing in the WDA or around the OECC, or fishermen choosing not to fish in these areas;
- Percent increase in fishing values outside these areas that will result from displaced fishing effort shifting to other fishing areas; and,
- Percent decline in fishing values outside the WDA and OECC caused by increased fishing congestion resulting from fishing vessels relocating fishing effort from these areas to other fishing areas.

Section 4.0 also includes an assessment of potential indirect and induced changes in shore-side economic activity associated with MA businesses that support MA commercial fishing and buy, process and market MA commercial landings.

Section 5.0: Summary and Conclusions

This final section of the report presents a summary of results from previous sections and draws conclusions about the economic exposure of MA fishermen and related shore-side businesses to the Vineyard Wind project.

Section 2.0

Focus

2.0 FOCUS

There are two sources of potential fishery-related economic impacts from the Vineyard Wind project, those associated with construction and operation of up to 100 wind turbine generators (WTGs) and up to two Electrical Service Platforms (ESPs) in the WDA, and those associated with the construction and use of two submarine cables within the offshore export cable corridor (OECC) that will deliver electric power from the WDA to a Landfall Site located on the south shore of Cape Cod. (See Figure 1)

Based on established fishery economic theory, project-related activities in both of these areas could result in potential fishery-related economic impacts along two distinct pathways: (1) effects on **fish resources**, in particular effects that reduce the abundance, availability, or catchability of fish; and (2) effects on **fishing activity**, in particular effects that result in changes in fishing time, steaming time, searching time, idle time, fishing locations, or increases fishing congestion and potential gear-specific space-use conflicts.

Recent government reports related to the Vineyard Wind project contain details about potential project impacts on both **fish resources** and **fishing activity** in both the WDA and the OECC both during and after construction. (BOEM, 2017; COP, 2018; DEIS, 2018). These reports indicate that impacts on **fish resources** during construction will be moderate, and that after construction project impacts on fish resources are not expected to be significant. These reports also conclude that potential project impacts on fishing activity in the WDA and around the OECC during construction will be moderate, but that mitigation and compensation programs could reduce expected fishing-related economic impacts to be minor.

The distinction between potential project impacts on fish resources and fishing activity is important for identifying sources and types of potential economic impacts, determining how to reduce or avoid them, and developing mitigation compensation programs to offset them. However, this distinction is not important when estimating ***economic exposure*** as it is defined by BOEM and others and used in this report. That is because estimates of economic exposure are based on maximum potential economic impacts which, in this report, means assuming that all fishing revenues from the WDA and OECC will be lost and not replaced by fishermen shifting fishing effort to other areas. Estimates of economic exposure developed in Section 3.0 of this report are based on estimates of the economic value of fish normally harvested in the WDA or around the OECC that is assumed to be lost, These estimates are not affected by the abundance or availability of fish resources in those areas or anywhere else or how they may be affected by the project.[1]

[1] Potential project impacts on the abundance and availability of fish resources will affect estimates of expected or actual economic impacts by influencing how much fishing revenues presumed to be lost in the WDA or OECC (economic exposure) will either not be lost because of continued or resumed fishing in those areas or will be recouped as a result of fishing effort shifting to nearby areas. The point here is not that biological project impacts do not affect economic impacts, but that economic exposure, as estimated in Section 3, is based on no fish being harvested in the WDA or the OECC which is not influenced by project-related changes in fish abundance or availability of fish in these areas. Because changes in fish abundance and availability will affect how much fishing revenues will not be lost or will be replaced it does influence how close expected or actual economic impacts will be to measures of economic exposure, as described in Section 4.

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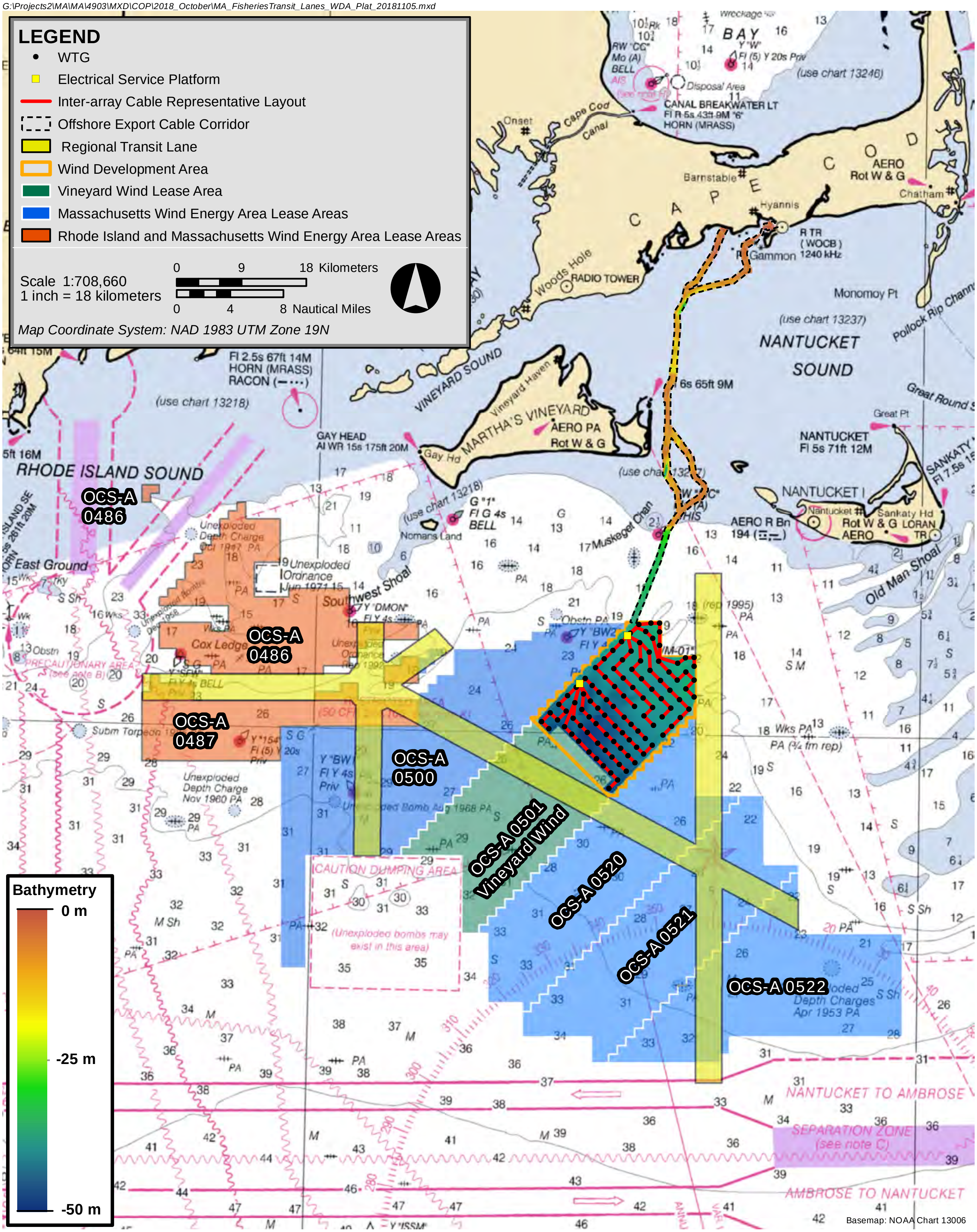

Vineyard Wind Project

VINEYARD WIND

Figure 1

Offshore Location Plat with Regional Transit Lanes

2.1 Estimating Economic Exposure: Data and Assumptions

Because of the complexity and interaction of commercial fishing operations it is necessary to decide what thresholds or minimum standard of exposure to use when determining what fishing activities "may be impacted."[2] For example, BOEM (2017) and RI-DEM (2017) use estimates of the average annual ex-vessel value of fish harvested from the VWLA as a measure of **economic exposure**. On the other hand, RI-DEM (2018) takes a much broader view and defines **economic exposure** as all revenue from all fishing trips that include at least one tow that at least partially intersects the VWLA.[3] This broader approach that assumes all trip revenues on these trips are "derived" from the VWLA and are at risk from VWLA development results in estimates of economic exposure that are significantly higher than more conventional estimates based on the value of harvests from the impact area. The RI-DEM 2018 report acknowledges that true economic exposure is likely to be less than the trip revenues reported in that study. Section 3.0 of this report presents analysis showing that the trip values estimate in RI-DEM, 2018 are based primarily on harvests outside the VWLA, with over 87% of revenues generated outside the WDA, and do not provide a valid basis for measuring economic exposure in the WDA.

This report develops economic exposure estimates based on fishing revenues from the WDA as developed in previous studies by BOEM, NOAA, and RI-DEM, and also estimates of fishing revenues around the OECC based on NOAA/VTR records. It also examines potential economic exposure related to fishing congestion outside the WDA or OECC, In the final analysis estimates of economic exposure that are used are based primarily on the average annual ex-vessel value of landings from the VWLA and the WDA as reflected in RI-DEM (2017) and NOAA (2018) and the annual value of landings around the OECC based on NOAA VTR data. (

Uniform vs non-uniform Fishing Values in the VWLA

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[2] For example, if fishing in a wind energy development area is displaced to other fishing areas it may cause increased fishing congestion that will impact all vessels operating in those areas. The broad definition of fishing activities that "may be impacted," therefore, could include all fishing activities in all potential alternative fishing areas. Congestion impacts in many of these fishing areas may be so improbable or insignificant or so impossible to measure that they need to be ignored.

[3] A more recent version of that report, referred to in the reference section of this report as RI-DEM (2019) takes an even broader view and estimates economic exposure and economic impacts based on the loss of all revenues on all trips with at least one tow that partially intersects either the WDA or within 1 or 2 miles to the north or south of the WDA. The methodology used in that study was not fully described and the economic assumptions used were too extreme and unreasonable for results of that study to be considered a source of useful data for this report.

Feedback from MA-DMF indicated that the assumption of a uniform distribution of fishing revenues within the VWLA was not valid because more fishing revenues are likely generated in the northern part of the VWLA, where the WDA is located, than in the southern part of the VWLA. While this may be the case, data are not available to estimate what portion of VWLA fishing revenues estimated by BOEM, NOAA, and RI-DEM are generated in the northern part of the VWLA or specifically within the WDA.

Using Average Values versus Trends

Feedback from MA-DEM also indicated that annual trends in landings and values may be a better basis for estimating economic exposure than average annual fishing values. An examination of available time series of landings and fishing revenue data for the VWLA and nearby areas do show significant annual fluctuations and some possible long-term trends. However, they differ significantly in direction and magnitude from one species to another. A steady decline in annual lobster landings in Lobster Management Area 2, where the WDA is located, is generally viewed as representing a long-term downward trend induced by ocean warming. At this time there is no basis for determining if increases in the annual value of longfin squid landings from the northern part of the VWLA during certain years may be the start of a trend or a short-term fluctuation. Because of time and data limitations it was not practical to attempt to use trend analysis rather than the averages of recent observations as predictors of economic exposure, BOEM (2017) also recommends using recent year data rather than long-term trends to predict economic exposure and economic impacts.[4]

For these reasons, this analysis relies on recent year average fishing values from the VWLA to estimate economic exposure of commercial fishing.

2.2 Potential Exposure from WDA Development

The location and size of the MA WEA, and the VWLA and WDA are shown in Figure 2. For reference purposes, Figure 2 displays these areas on the most recent year (2015) NOAA fishing footprint chart for the region. This chart shows average annual fishing revenues generated in these areas and surrounding areas measured in dollars per 0.25 square kilometer [km^2]. NOAA refers to these measures as estimates of Fishing Revenue Density (FRD) and bases them on data from NOAA Vessel Trip Reports (VTRs).

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[4] Empirical results from RI-DEM (2019) were determined to be unusable for purposes of the analysis presented in this report (See footnote 4). With regards to trends, however, it is worth noting that the report described research that included an Auto-Regressive Integrated Moving Average (ARIMA) model that was used to try to detect trends in fishing values in the WDA and that "resulting trends were largely flat given the variance in the data and the length of the time series."

Figure 2 shows that during 2015 nearly all of the VWLA and all of the WDA are ranked in the lowest FRD category. This is in contrast to the relatively high FRDs shown for nearby areas just to the north and west of the VWLA.

Figure 3 presents NOAA fishing footprint charts for the prior four years (2011-2014) which show that the geographic distributions of fishing revenues within and outside the VWLA were similar in those years to those shown for year 2015 in Figure 2. The FRD data summarized in these five NOAA charts provide context for the analysis presented in the rest of this report by confirming three observations:

- The VWLA does not include high value fishing areas;
- The VWLA is surrounded by several high value fishing areas; and,
- There is a fairly uniform distribution of fishing revenues within the VWLA.

Figure 2 and Figure 3 also confirm why estimates of fishing revenues from the WDA that are presented later in this report are relatively low with respect to fishing revenues from other nearby areas. Relatively low fishing value estimates were a primary consideration when BOEM designated the MA-WEA, which includes the VWLA, as an area highly suitable for wind energy development.[5] Besides having sufficient wind to provide a reliable energy supply, the location of the MA WEA was selected for two reasons related to fishing. First, the area has relatively low fish biomass, which limits expected project impacts on individual organisms. Second there is high abundance and diversity of fish resources in surrounding areas, which will allow fish populations in the MA WEA to recover quickly following any project-related disturbances (BOEM, 2017). Fish abundance is highly correlated with fishing revenues. Figure 2 and Figure 3, which show low fishing values within the VWLA and high fishing values in nearby areas, help confirm both of BOEM's findings about the MA-WEA and the VWLA.

[5]After considering comments submitted in response to BOEM's Call for Information and Nominations, BOEM excluded from offshore wind energy leasing certain areas identified as including important fish habitats or fishing areas that could be adversely affected by the installation and operation of wind turbine generators. Specifically, BOEM excluded areas with high value fisheries to reduce conflicts between offshore wind energy and commercial and recreational fishing.

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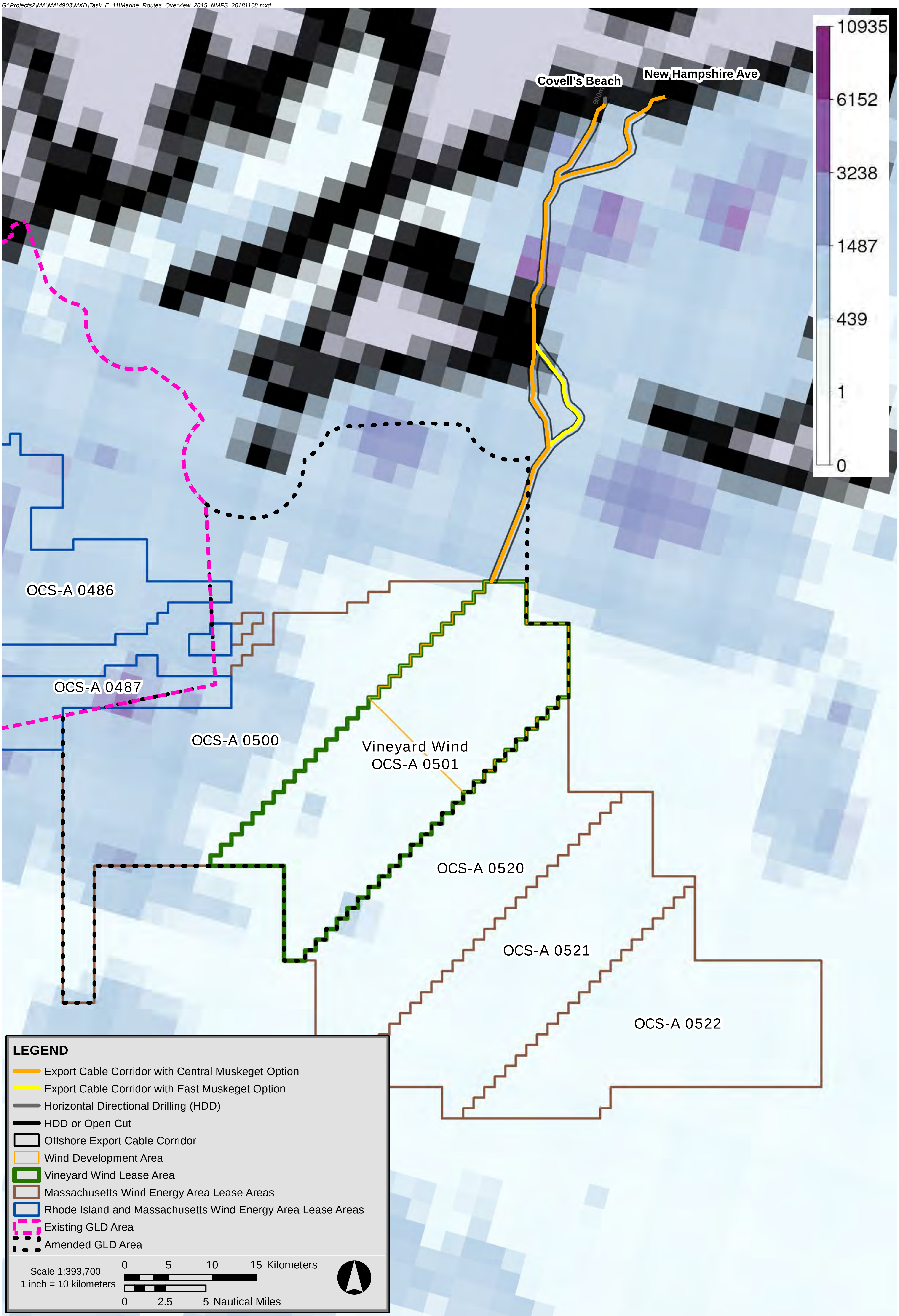

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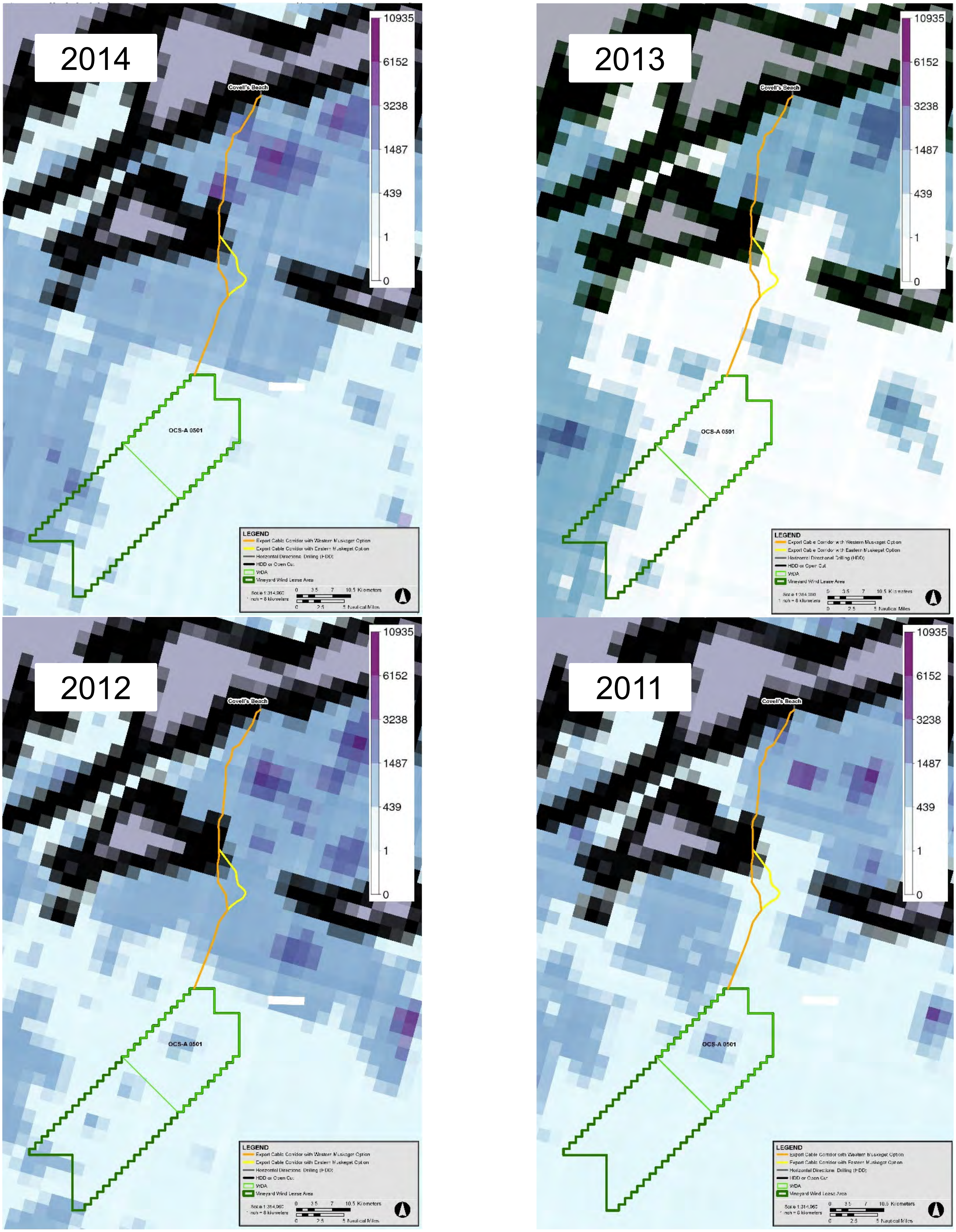
Vineyard Wind Project

VINEYARD WIND

Figure 2

Fishing Revenue Density ($ per km2) - 2015 NMFS Fishing Footprints All Species



Vineyard Wind Project

VINEYARD WIND

Figure 3
Fishing Revenue Density ($ per km2) – 2011-2014 NMFS Fishing Footprints All Species

2.3 Potential Exposure along the OECC

Information in BOEM (2017), COP (2018), and DEIS (2018) explain why potential impacts of the OECC on fish resources and fishing activity are expected to be relatively minor, short-term and localized. This is attributed in those reports to the following factors:

- OECC construction will take place during a period of approximately two months during one year.
- At any given time during OECC construction, fishing will be impaired or precluded only in the vicinity of ongoing construction activity.
- Vineyard Wind has agreed to schedule cable laying activity to take place when commercial fishing and fish spawning activity are not taking place in or around the OECC.

Based on NOAA VTR data it appears that annual fishing revenues along the OECC over its entire length are approximately $110,194, or an average of $9,183 per month. Cable laying is expected to take place during about 2 months of one year and, per agreements with Mass DMF/CZM, will take place during low fishing intensity months. And, as mentioned above, at any given time, only a short segment of the narrow OECC will be under construction and result in fishing being impaired or precluded. Based on this information it is reasonable to expect that economic exposure from the OECC during construction will be under $ 5,000.

Based on information in BOEM (2017), COP (2018), and DEIS (2018), economic exposure in the OECC after construction will be limited to the potential that bottom fishing gear could snag on segments of the OECC where bottom conditions prevent full burial of cables and require cable protection on the seafloor.

It is not possible at this time to assess the likelihood or potential magnitude of gear damage or lost fishing time associated with bottom gear snags along the OECC after construction. However, it is reasonable to expect that it will be rare and to assume that fishermen will be fully compensated for any related economic losses as part of a fishermen compensation program. It is also reasonable to assume that fishermen will be compensated for lost fishing income that could result from disruptions in the scheduling of OECC construction and/or shifts in the distribution or concentration of fish in the vicinity of the OECC that result in unexpected losses in fishing revenues.

Section 3.0

Baseline Fishing Values

3.0 BASELINE FISHING VALUES

Revenues from commercial fishing can vary significantly from year to year due to changes in the abundance and distribution of fish and changes in ocean, weather, market conditions, and fishery regulations. However, it is well established that analyzing data related to the economic value of commercial landings from an area in a set of recent years is the most reliable basis for assessing the annual economic exposure of commercial fishing in that area to impacts from proposed non-fishing activities in the area.

3.1 Sources

Four recent studies provide useful data for assessing fishing value exposure within the WDA because they provide estimates of fishing values for study areas that include the WDA. These studies are described in Table 1 and are cited in the text as follows:

Source 1	RI-DEM (2017) http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/RIDEM_VMS_Report_2017.pdf
Source 2	BOEM (2017) Volume 1: http://www.data.boem.gov/PI/PDFImages/ESPIS/5/5580.pdf Volume 2: http://www.data.boem.gov/PI/PDFImages/ESPIS/5/5581.pdf
Source 3	NOAA-VTR Data (2018) Available Upon Request.
Source 4	RI-DEM Addendum (2018) http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/RIDEM_VMS_Report_2017.pdf

3.2 Preliminary Estimates of Fishing Values for the WDA

Table 2 shows how fishing values presented in each of the four sources were scaled to provide estimates of fishing values in the WDA. This involved two steps: Step 1, divide the estimate of average annual dollar value of landings provided for each study area by the size of the study area (km^2) to generate a measure of fishing revenue density (FRD) for the study area; Step 2, multiply these FRDs by the size of the WDA (245.00 km^2) to generate preliminary estimates of fishing values in the WDA based on the assumption that fish and fishing are uniformly distributed across the study area.

Note that annual economic exposure estimates for the WDA based on Source 1 through Source 3 are very similar, ranging from $247,205 to $330,750, and are much lower than the $995,925 estimate of economic exposure based on the RI-DEM Addendum (Source 4). However, FRD and fishing value estimates based on the RI-DEM Addendum (Source 4) are not comparable to those based on the other three sources. This is because RI-DEM Addendum (Source 4) estimates fishing values "derived" from the WDA based on potential lost fishing under the assumption that "every trip that fished in part within the lease area was prevented" (Source 4). That is, Source 4 measured fishing values at risk in the WDA as the sum of all revenues from all trips that included at least one tow that at least partially intersected the VWLA. The assumption used in that report is that these trips would not occur at all with all revenues lost, as opposed to these trips being modified and continuing to generate fishing revenues. This is not justified based on economic logic. In economic analysis, for example, it is standard to assume that a business will continue to operate as long as expected revenues (e.g., ex-vessel value of trip landings) exceed operating costs (e.g., trip expenses). For this reason, the assumption on which Source 4 is based - that fishing vessels will remain in port and generate no revenues rather than continue to fish and generate revenues - is not realistic. In meetings related to the Vineyard Wind project fishermen themselves acknowledge that fishing will likely continue in and around offshore wind farms.

The methodology of RI DEM Addendum (Source 4) also results in overestimating total exposure across a region because the full value of a trip that occurred over many study areas (e.g. lease areas) is attributed separately to each of the study areas.

Although the results presented in RI DEM Addendum (Source 4) are not used in this report to assess economic exposure they do provide some useful insights into how close actual economic impacts will be to estimates of economic exposure. Analysis presented in Section 4.0, for example, shows that results presented in the 2018 RI-DEM Addendum (Source 4) confirm that there are much higher fishing values outside of the VWLA than inside the VWLA. In fact, 69% of fish revenues from the trips analyzed in 2018 RI-DEM Addendum (Source 4) is generated by fishing outside the VWLA and 87% of those trip revenues are generated by fishing outside the WDA. This supports the expectation that economic impacts will be less than economic exposure because there are nearby, productive and familiar fishing area alternatives. It also indicates that any diversion of fishing effort from the WDA to areas outside the WDA will not involve a very significant increase in fishing effort and fishing congestion in those areas.

For reasons described above, results from Source 4 will not be used in this report to estimate economic exposure.

Fishing values estimated for the WDA based on BOEM (2017) (Source (2)) are reliable and were similar to those developed based on Source 1 and Source 3. However, results from Source 1 and Source 3 were determined to be more reliable for purposes of this report for two reasons. First, the study area of Source (2) was the entire MA-WEA which is an area of over 3,000 km^2 across which significant variability in fishing success is to be expected.

Second, the fishing revenue estimates provided in BOEM (2017) (Source (2)) are from 2007-2012 and are several years older than those provided Source (1)) and Source (3).

RI-DEM (2017) (Source 1) and NOAA VTR Data (2018) (Source 3) provide particularly useful fishing value data for assessing economic exposure in the WDA because they both provide fishing value estimates specifically for the VWLA. Another useful aspect of RI-DEM (2017) (Source 1) is that it provides estimates of fishing values in the VWLA by state, including those based specifically on Massachusetts landings.

A recent (March, 2019) report by NOAA commenting on BOEM's DEIS for the Vineyard Wind project provided confidence in the fishing values developed in this report which were based primarily on RI-DEM (2017). Based on 2011-2016 data the average annual value of landings from the VWLA used in this report, excluding lobster and Jonah crab, is estimated to be $857,548 (See Table 4a), There is only a 3% difference between this value estimate and the $830,722 in annual landings values for the VWLA estimated based on NOAA's separate analysis for the same period,

Before being used to estimated economic exposure the fishing values presented in Table 2 based on Source 1 and Source 3 need to be adjusted because they do not account for landings of American lobster (lobster) and Jonah crab. This is because federal regulations that require commercial fishing vessels to file VTRs that identify where landings were harvested do not apply to vessels that harvest only lobster and Jonah crab. As a result, it is understood that most data related to the location of lobster and Jonah crab harvests are based on VTR records from fishing vessels that catch lobster and Jonah crab and are required to file VTRs because they also harvest other species, which must be reported.

3.3 Adjustments for Lobster and Jonah Crab

Determining the landed value of lobster and Jonah crab harvested from a particular area, such as the VWLA and the WDA, is difficult because vessels that fish exclusively for these two species are not required to file Vessel Trip Reports (VTRs). VTR data showing the location of lobster and Jonah crab harvests are only available for harvests by vessels that fish those two species in addition to other species and are required to include landings of those two species in VTRs.

Two types of data are available to estimate the value of lobster and Jonah crab landings from the WDA: (1) landings in the VWLA reported to NOAA by vessels that file VTRs and (2) federal fishing permit data that show how many pots are permitted to fish for lobster and Jonah crab in Lobster Management Area 2 (Area 2), which includes the VWLA by vessels that file VTRs and by vessels that do not file VTRs.

Federal fishing permit data for 2017 show that 137 vessels, accounting for 65,091 pots, are permitted to harvest lobster in Area 2, and that 64 of those vessels, accounting for 28,533 pots, or 43.8% of all pots possess only Area 2 permits to fish for these two species. These are the vessels that are not required to file VTRs. The remaining 73 vessels, accounting for 36,558 permitted pots or 56.2% of all permitted pots in Area 2, fish for species other than lobster and Jonah crab and therefore file VTRs which include their landings of lobster and Jonah crab.

NOAA VTR Data (2018) (Source 3) show that during 2011-2016 the landed value of lobster and Jonah crab from the VWLA by vessels that filed VTRs averaged $36,567 for lobster and $50,844 for Jonah crab; a total of $87,411 for both species. These are measures of the value of landings by vessels with 36,558 pots permitted to fish in Area 2, as described above. That is an average of $2.39 in landed value in the VWLA per pot permitted to fish in Area 2.

Feedback from MA-DFM indicated that, in general, vessels that fish exclusively for lobster and Jonah crab and do not file VTRs, when compared with vessels that fish for multiple species including lobster and Jonah crab and file VTRs vessels, are likely to have: (a) a higher percent of permitted pots actively fished; (b) a higher percent of active pots fishing in the VWLA, and (c) higher revenues per active pot.

For that reason, the value of lobster and Jonah crab landings in the VWLA by the 43.8% of pots permitted to vessels that do not file VTRs was estimated based on fishing revenues from the 56.2% of pots permitted to vessels that do file VTRs based on the following assumptions: 25% more pots permitted to non-VTR reporting vessels are active, 25% more of those pots are fished in the VWLA, and they generate 25% more fishing revenues. In effect, these assumptions result in an estimate of fishing revenues generated in the VWLA per pot permitted to vessels that do not file VTRs of $4.67 (1.25 X 1.25 X 1.25 X $2.39)

As described above, vessels that file VTRs had 36,558 pots permitted to fish in Area 2 and landed $87,411 worth of lobster and Jonah crab annually in the VWLA. Based on the simple assumptions listed above the average annual value of lobster and Jonah crab landings from the lease area during that period by the 28,533 permitted pots fished by vessels that do not file VTR reports was $133,249. The average annual value of all landings of lobster and Jonah crab from the Vineyard Wind Lease Area during 2011-2016 was $220,660 (that is, $87,411 + $133,249). The WDA accounts for 36.3% of the VWLA so the value of annual lobster and Jonah crab landings from the WDA is estimated to be $80,100 (that is 36.3% of $220,660).

The federal fishing permit data referred to above show that in 2017 Massachusetts-based vessels account for 23,433 pots permitted to fish in Area 2, or 36.0% of all pots permitted to fish in the area. Based on the assumptions listed above, therefore, the initial estimate of the average annual value of lobster and Jonah crab harvested from the WDA by vessels based in Massachusetts is $28,836 which is 36.0% of $80,100.

As described in the previous section, MA-DEM feedback indicated that lobster and Jonah crab and other fish species are not uniformly distributed in the VWLA, with more species abundance in the northern part of the VWLA than in the southern part. However, no additional data have become available to refine the estimates shown above which were used to adjust total fishing revenues estimated in RI-DEM (2017) (Source (1)) and NOAA-VTR, 2018 as shown in Table 3.

The unexpectedly low estimates of lobster and Jonah crab harvests in the Vineyard Wind Lease Area and the WDA were confirmed by other sources of data that show where fishing effort by pots and traps targeting these two species takes place in and around the VWLA. Figure 4, for example, displays pot and trap fishing effort by vessels submitting VTRs for 2011 to 2015 and confirms that little of this fishing effort took place in the VWLA during those years, and nearly none in the WDA (MARCO, 2018).

These results are at least partly explained by well-documented scientific evidence that rising ocean temperatures are affecting the location and productivity of lobster populations along the U.S. Atlantic coast. As shown in Figure 5, lobster populations have exhibited a significant northward shift away from areas south of Cape Cod as water temperatures in southern New England exceed their biological tolerances, while the warming of waters in northern New England has increased their abundance and productivity in those regions (NCA, 2018). These trends are also reflected in the NOAA commercial harvest statistics for lobster which show that between 2000 and 2016 the volume of annual lobster landings at ports south of Cape Cod declined by 49.2% and increased by 172% at ports in Maine (NOAA, 2017).

3.4 Final Estimates of Economic Exposure

3.4.1 Overall Economic Exposure

Table 3 provides estimates of overall economic exposure and Massachusetts based economic exposure based on Source (1)) and Source (3) that take account of landings of all species, including lobster and Jonah crab. Based on these two sources and data for years 2011-2016, the average annual economic exposure of all commercial fishing in the WDA is shown in Table 3 to be $391,390.

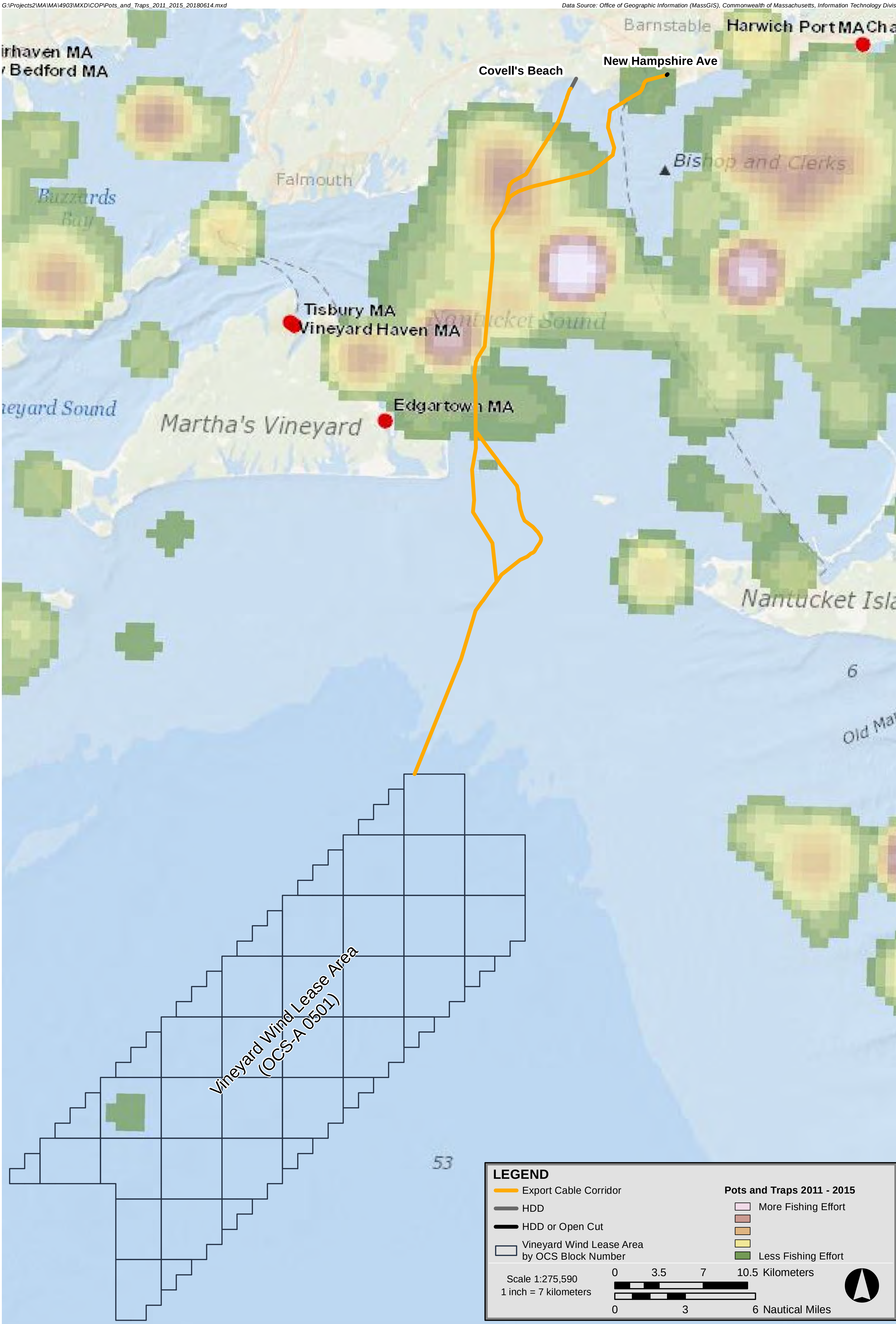
3.4.2 Massachusetts Economic Exposure

Based on RI-DEM (2017) (Source 1), Massachusetts fishermen account for 53.9% of the value of fish harvested in the VWLA other than lobster and crab and pot permit data indicate that Massachusetts fishermen account for 36% of lobster and Jonah crab values. These percentages are used in Table 3 as the basis for estimating the portion of fishing revenues in the WDA that accrue to Massachusetts fishermen and their economic exposure in the WDA. Based on the average of fishing values estimated from RI-DEM (2017) (Source 1) and NOAA VTR Data (2018) (Source 3), the annual economic exposure of Massachusetts based commercial fishing in the WDA between 2011 and 2016 was $196,621.

As noted above, Massachusetts's annual commercial landings during this period averaged more than $605.2 million. This means the economic exposure of all Massachusetts-based commercial fishing to development of the WDA accounts for approximately 0.03% of the overall value of the Massachusetts commercial harvest. As described above, the average annual economic exposure of MA fishermen associated with lobster and Jonah crab harvests in the WDA is $28,836, or about 0.04% of the $72.9 million in annual Massachusetts harvest of those two species (NOAA, 2018).

G:\Projects2\MA\MA\4903\MXD\COP\Pots_and_Traps_2011_2015_20180614.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

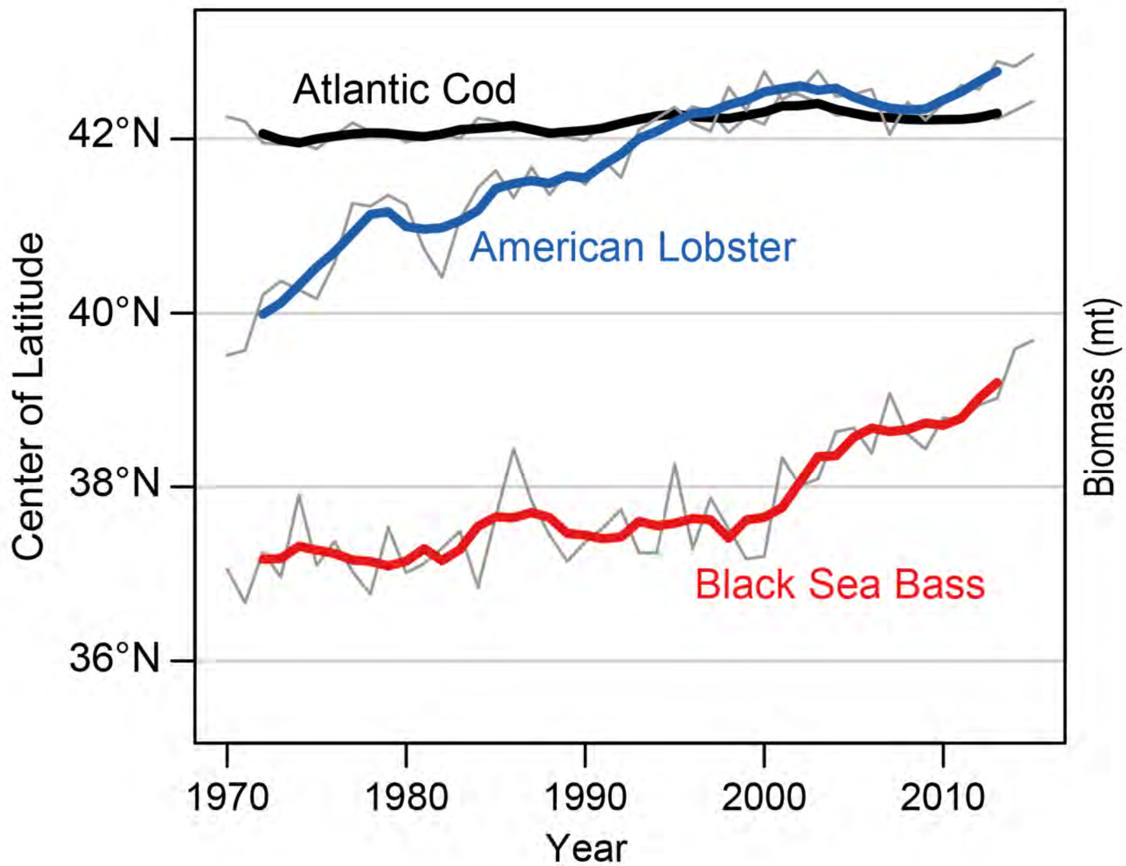


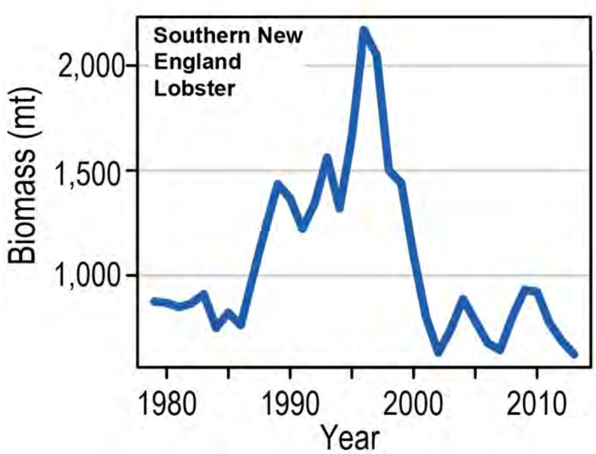
Vineyard Wind Project

VINEYARD WIND

Figure 4

VTR - Pots and Traps 2011 - 2015 (MARCO, 2015)





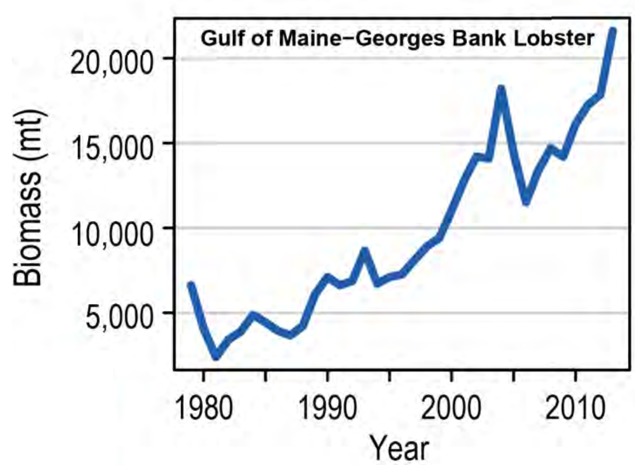


Figure 5

Changes in Distribution and Abundance of Marine Species (NCA, 2018)

Section 4.0

Fishery-Related Economic Impacts

4.0 FISHERY-RELATED ECONOMIC IMPACTS

The economic exposure estimates developed in Section 3.0 represent potential fishery-related economic impacts from WDA development. They do not represent estimates of expected fishery-related economic impacts from WDA development. Under most types of changes in fishing activity that may result because of WDA development (e.g., impaired fishing in the WDA, fishing effort displaced from the WDA, temporary or partial closures of the WDA, etc.), economic impacts can be expected to be lower than estimates of economic exposure developed in Section 3.0. That is because potential or actual impacts on fishing inside the WDA will cause changes in fishing activity that can be expected to offset those impacts.

It is not possible at this time to predict how changes in fishing activity might reduce the economic impacts of WDA development below the estimates of economic exposure developed in Section 3.0. However, comparing RI-DEPs estimates of landings-based fishing values (Table 4a) and trip-based fishing values (Table 4b) provide useful insights into how close actual fishery-related economic impacts will be to estimates of economic exposure presented in Table 3.[6]

(1) Based on RI-DEM (2017) (Source 1), the adjusted average annual value of fish harvested **inside** the Vineyard Wind Lease Area during 2011-2016 was **$1,078,208**.

(2) Based on RI-DEM Addendum (2018) (Source 4), the adjusted average annual value of fish harvested **inside and outside** the Vineyard Wind Lease Area on trips with tows that transected the Vineyard Wind Lease Area during 2011-2016 was $**2,966,447.**

(3) The difference between (2) and (1), which is the average annual value of fish harvested **outside** the Vineyard Wind Lease Area on trips that transected the Vineyard Wind Lease Area which was **$1,888,239**, or 64% of fishing revenues on those trips reported in Source 4.

(4) The WDA accounts for 36.3% of the Vineyard Wind Lease Area. That means approximately 36.3% of the trips with tows that at least partially transect the VWLA transect the WDA; and approximately **$391,389** or 13% of the annual value of landings from trips that transect the VWLA are harvested in the WDA.

(5) That means the average annual value of landings **outside the WDA** on trips that "transect" the Vineyard Wind Lease Area (including landings from outside the VWLA

[6] RI-DEM 2018 (Source 4) is not used in this report to assess the economic value of fishing in the VWLA or the WDA because the trip values presented in that report were generated primarily outside of those areas. Those results are useful here for the same reason. They show that fishing areas are available near the VWLA and the WDA and already account for most of the revenue on fishing trips that transect these areas

and inside the VWLA, but outside the WDA) is $2,442,309 or 87% of revenues from those trips.

To interpret the results presented above and shown in Table 6 in terms of economic exposure and expected economic impacts from WDA development it is useful to compare them using the following definitions from BOEM (2017):

> *"Exposure measures quantify the amount of fishing that occurs in and near individual WEAs and therefore represent the total fishing activity that may be impacted by energy development in the WEAs.*
>
> *Exposure measures ...should not be interpreted as a measure of economic impact or loss. Economic impacts also depend on a vessel's ability to adapt by changing where it fishes. For example, if alternative fishing grounds are available nearby and may be fished at no additional cost, the economic impact will be lower."*

Results presented in RI-DEM (2017) (Source 1) and the RI-DEM Addendum (2018) (Source 4) indicate clearly that in the case of the WDA "alternative fishing grounds are available nearby and may be fished at no additional cost." In fact, those results show that fishing areas immediately adjacent to the WDA already account for most of the fishing revenues from fishing trips with tows that transect the WDA. This means that impacts would be lower than economic exposure even if a vessel's "ability to adapt" was limited to avoiding fishing in the WDA altogether. In fact, for most vessels the "ability to adapt" can also involve modifying specific tows to avoid them transecting the WDA, or continuing to fish in the WDA and fishing only in adjacent or nearby areas. None of these are costly options such as cancelling fishing trips or steaming to less familiar or less productive fishing grounds.

As pointed out in BOEM (2017) (Source 2), it is generally accepted that "if alternative fishing grounds are available nearby and may be fished at no additional cost, the economic impact will be lower" than estimated economic exposure. The trip revenue estimates presented in the RI-DEM Addendum (Source 4) therefore, provide strong indicators that economic impacts of WDA development will be significantly lower than economic exposure estimates developed in Section 3.0. Those were based on all fishing revenues from fishing inside the WDA being lost and not replaced.

4.1 Economic Impacts during WDA Development

Part or all of the WDA may be closed to fishing during periods of construction, which means potential economic losses in commercial fishing revenues up to the economic exposure estimates presented in Section 3.0. However, during those periods some percentage of those potential economic losses will be offset by vessels that normally fish within the WDA shifting fishing effort or simply modifying tows to focus on fishing areas adjacent to the WDA. During construction in the WDA, therefore, it is reasonable to assume that fishery-related economic losses, even with temporary fishing closures in the WDA, will be significantly less than 100% of the annual fishing value exposure estimates presented in Table 6.

4.2 Economic Impacts after WDA Development

Once construction activity in the WDA is complete, the area will be fully open to commercial fishing. At that time, fishermen will decide to either continue or resume fishing in the WDA or not to fish in the WDA.

It is reasonable to assume that fishing values associated with some types of fishing in the WDA will be lower after WDA development than before. However, any lost fishing values associated with fishing in the WDA after development cannot be expected to approach 100% of the exposed fishing values estimated from RI-DEM (2018).

It can be expected that fishermen who decide not to fish in the WDA after construction will continue fishing and generating fishing values outside the WDA. Fishing values associated with this displaced fishing effort may be adversely affected if displaced fishermen must operate in fishing grounds that are less familiar to them or less productive than those in the WDA. However, that does not seem to be the case. As Figure 2, Figure 3, and fishing value information presented in Section 3.0 indicate, there are many highly productive fishing areas near the WDA. In fact, based on RI-DEM Addendum (2018) (Source 4), these nearby and adjacent areas account for most revenues on fishing trips that intersect the WDA. As a result, fishing value losses experienced by fishermen who choose not to fish in the WDA will never approach 100% of the exposed fishing values estimated from RI-DEM (2018).

Overall economic impacts on Massachusetts fishermen can be expected to be below the estimates of annual economic exposure presented in Section 3.0 ($196,621 based on Source 1 and $ 207,183 based on Source 3). However, individual fishermen who earn proportionally more fishing income from the WDA could experience a higher share of these impacts. A section below describe potential congestion impacts fishermen displaced from the WDA may face in fishing areas outside the WDA.

4.3 Economic Impacts along the OECC

As described in Section 4.3, based on the best available data it appears that annual fishing revenues along the OECC over its entire length are approximately $110,194, or an average of $9,183 per month. Cable laying is expected to take place during about 2 months of one year and, per agreements with MA-DMF/CZM, will take place during low fishing intensity months. Also, at any given time, only segments of the 59.4 km (~37 mile) OECC will be under construction which will result in fishing being precluded. Based on this information it is reasonable to expect that economic impacts from the OECC during construction will be under $5,000.

Based on information in BOEM (2017), COP (2018), and DEIS (2018) OECC economic impacts after construction will be limited to the potential that bottom fishing gear could snag on segments of the OECC where bottom conditions prevent full burial of cables and require cable protection on the seafloor. These conditions are possible along approximately 10% of the OECC.

It is not possible at this time to assess the likelihood or potential magnitude of gear damage or lost fishing time associated with gear snags along the OECC. However, it is reasonable to expect that such snags will not be frequent and to assume that fishermen will be fully compensated for any related economic losses as part of a fishermen compensation program established by Vineyard Wind. It is also reasonable to assume that fishermen will be compensated for lost fishing income resulting from any disruptions in the scheduling of OECC construction and/or shifts in the distribution or concentration of fish in the vicinity of the OECC that result in the OECC causing unexpected losses in fishing income.

Overall, it is reasonable to expect that economic exposure during cable burial activities in OECC which will be limited to approximately 2 months during one year will be extremely low. It is also reasonable to expect that economic exposure related to the OECC after construction will also be extremely low. And, since a fishermen compensation fund will be established to compensate fishermen for any economic losses resulting from the OECC expected economic impacts from the OECC can be expected to be minimal.

4.4 Fishing congestion impacts outside the WDA

Concern has been raised that the Vineyard Wind project may result in adverse commercial fishing impacts outside the WDA and OECC as a result of fishing vessels being precluded from fishing or choosing not to fish in these areas and shifting fishing effort to other areas that are already being fished. The analysis presented in Section 3.4 indicates that levels of fishing effort that could potentially be diverted from the WDA and OECC are relatively small. However, the possibility that shifting fishing effort could cause fishing congestion impacts outside these areas deserves attention.

In fishery economics the term "congestion externalities" refers generally to increases in fishing costs or losses of fishing revenues experienced by some vessels that result when other vessels increase fishing effort in an area. This could be caused when new vessels that enter an area: (a) harvest fish that would have been taken by vessels already operating in that area; (b) reduce CPUE by depleting fish stocks; (c) result in fishing quotas or season closures being reached sooner; or (d) cause space/use conflicts that cause other vessels to lose fishing time or operate less efficiently.

In general, the likelihood that new fishing in an area will result in fishing congestion impacts depends on the size of the fishing area, the level and concentration of existing fishing effort in the area, the amount of new fishing effort entering the area, and whether fleet-wide fish harvests from the area are limited by fish stock abundance or fishing regulations or both.

There are examples of extreme fishing congestion in U.S. commercial fisheries. The most frequently cited and most often depicted example involves Bristol Bay Alaska salmon fisheries where each year large numbers of permitted vessels deploy drift and set gillnets in very tight fishing areas during a very short fishing season.

At the other extreme are most open ocean fisheries where fishing areas and allowable harvests are large enough for moderate increases in the level of fishing effort in an area does not generate significant or even measurable congestion impacts.

With respect to WDA and OECC development it is important that fishing effort that might be diverted to nearby fishing areas actually involves a shift in fishing effort within a fishery rather than new fishing effort entering a fishery. It is not reasonable to expect that the small area and short duration of project activity along the OECC will result in shifts in fishing effort that will result in congestion impacts. With respect to the WDA it is worth noting that research by RI-DEM that was summarized in Section 3.2 indicates that 87% of revenues earned on fishing trips that transect the WDA are generated outside the WDA. That is, fishing activity that takes place in the WDA already involves fishing mostly outside the WDA and is already concentrated mostly areas outside the WDA. Fishing effort that generates the estimated $391,390 in annual fishing revenues from the WDA represents a small portion of the fishing effort that generates fishing revenues from near-shore fishing areas around the WDA. The available evidence indicates that there will not be enough diversion of fishing effort from the WDA or the OECC to add significantly to fishing congestion outside those areas or any related economic impacts.

4.5 Shore-side Indirect and Induced Impacts

Concern has been raised that project-related reductions in MA fish landings will result in significant shore-side impacts. The economic exposure of shore-based Massachusetts fishing support and seafood businesses can be characterized in terms of what can be called backward-linked and forward-linked impacts. The sections below explain why the direct impacts of WDA development on fishing activity are not expected to have significant indirect or induced forward-linked or backward-linked economic impacts.

Backward-linked indirect and induced impacts in commercial fisheries are associated with fishermen purchasing fishing inputs from shore-based businesses and thereby generating sales, incomes and jobs in those businesses and the businesses that supply them, and so on. Some of these fishermen purchases are fixed and take place whether a vessel fishes or not (e.g., vessel financing, insurance, dock fees, etc.). Others are variable and are affected by whether a vessel fishes or not (e.g., trip expenses). It is important, however, that neither type of input purchases is affected in any significant way by the value of fish a vessel lands. Therefore, based on the reasonable assumption that fishing vessels will continue to fish regardless of WDA and OECC development, it should be expected that fixed and variable input purchases by Massachusetts-based fishing vessels from shore-side businesses that support them will remain about the same. Any decline in fishing revenues will directly affect fishermen income via vessel profits and crewshares, but should not be expected to generate significant indirect and induced impacts via reduced purchases of inputs from fishery support industries.

Forward-linked indirect and induced economic impacts are associated with reductions in sales, incomes, and jobs in businesses that purchase seafood products from Massachusetts fishermen facing supply shortages or higher prices and therefore being forced to cut back on production or increase their prices. However, the $196,621 in annual ex-vessel landings exposed to potential direct impacts in the WDA area (See Table 7) is nearly an insignificant share (0.03%) of the $605.2 million in annual ex-vessel value of Massachusetts seafood landings in 2016 (NOAA, 2018). And, it represents an insignificant share (0.007%) of all seafood supplies available to Massachusetts seafood processors, wholesalers, retailers and restaurants which, in 2017, included $2,12 billion in Massachusetts seafood imports (U.S. Dept. of Commerce, 2018). It is not reasonable to assume that changes in the small amount of Massachusetts fish landings exposed to impacts by WDA and OECC development will have any significant indirect or induced effects in Massachusetts seafood markets, or result in any significant loss of sales, incomes, or jobs in related Massachusetts-based industries.

Section 5.0

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Attachment 1

Tables

Table 1 Sources of Fishing Value Data Related to the Vineyard Wind Lease Area

Source (1): Rhode Island Department of Environmental Management (RI_DEM), 2017
http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/RIDEM_VMS_Report_2017.pdf

Fishing value data presented in this study were developed by the Massachusetts Department of Environmental Management in response to concerns by the Massachusetts fishing industry that the fishing values developed by BOEM (Source (3) below) were underestimated. Vessel Monitoring System (VMS) data, Vessel Trip Reports (VTR) data, and commercial landings data for years 2011-2016 were used to develop annual estimates of fishing revenues for the MA-WEA and for specific wind lease areas within the MA-WEA, including the Vineyard Wind Lease Area. The study did not account for lobster or crab landings. The WDA constitutes 45.3% of the Vineyard Wind lease area which is one of the focus areas of this study.

Source (2): Bureau of Ocean Energy Management (BOEM), 2017
Volume 1: http://www.data.boem.gov/PI/PDFImages/ESPIS/5/5580.pdf
Volume 2: http://www.data.boem.gov/PI/PDFImages/ESPIS/5/5581.pdf

This study was funded by BOEM and conducted by NOAA's Northeast Fisheries Center, Social Science Research Branch. It focuses on many socio-economic issues and characterizes commercial fishing and fishing revenues generated by federally permitted fishermen operating in the U.S. Atlantic. Making use of VTR data, spatial data from the Northeast Fisheries Observer Program database (NEFOP), and VMS data, the study provides estimates of the average economic value of the commercial fish harvest during 2007 and 2012 by location, species caught, gear type, and port group. Using haul locations recorded by observers from 2004-2012, researchers were able to model the area associated with reported VTR points and identify the proportions of catch that are sourced from within the MA-WEA from any VTR record, or groups of VTR records. This methodology produced an estimate of revenue "exposure" within discrete geographic areas, including the MA-WEA. This study accounted only for lobster and crab landings that were entered into VTRs. The WDA constitutes 10.2% of the MA-WEA study area.

Source (3): National Oceanic and Atmospheric Administration (NOAA) Vessel Monitoring System (VMS) data, 2018 *Available Upon Request*

NOAA uses VTR data to produce annual fishing footprint charts that show annual fishing revenues per 0.25 km^2 (referred to as fishing revenue densities or FRDs) by species and by gear type. During 2018 NOAA provided Vineyard Wind with the results of a similar VTR data analysis that focused on estimates of the annual value of landings from the Vineyard Wind lease area by species for years 1996-2017. These landing values include lobster and crab harvested by vessels that file VTRs because they hold permits to harvest other species. They do not include the value of lobster and crab landings by vessels that fish exclusively for those two species and are therefore not required to file VTRs. The WDA constitutes 45.3% of the Vineyard Wind lease area which was the focus of this analysis.

Source (4) RI-DEM Addendum, 2018
http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/RIDEM_VMS_Report_2017.pdf

This Addendum to Source (2) above provides estimates of annual revenues from all commercial fishing trips during 2011-2016 that involved at least one tow that intersected the Vineyard Wind lease area. These are presented as estimates of the upper bounds of the economic exposure of commercial fishing to development of the Vineyard Wind lease area, and fishing value estimates presented in Source (2) above are characterized as lower bounds. The addendum states that "…the true economic exposure is likely between the two."

Table 2 Estimates of Commercial Fishing Economic Exposure in Vineyard Wind's Lease Area and 84 Turbine Wind Development Area (WDA-84), excluding Lobster and Jonah crab

Source*	Study Period (Years)	Study Area	Basis of Fishing Values*	Size of Study Area (km^2)	Value of Harvest (all years)	Average Annual Value of Harvest	High Annual Value of Harvest	Low Annual Value of Harvest	Ave. Annual Value per km^2	$ Value in WDA-84 (245 km^2)	WDA as % of Study Area
RI-DEM (2017)	2011-2016	VW Lease Area	All landings	675.4	$5,145,290	$857,548	$2,085,025	$208,209	$1,270	$311,150	36.3%
BOEM (2017)**	2007-2012	MA-WEA	All landings	3003.0	$18,180,000	$3,030,000	n/a	n/a	$1,009	$247,205	8.2%
NOAA VTR Data (2018)	2011-2016	VW Lease Area	All landings	675.4	$5,469,182	$911,530	$1,832,405	$561,283	$1,350	$330,750	36.3%
RI-DEM Addendum (2018)	2011-2016	VW Lease Area	Trip Revenues	675.4	$16,474,722	$2,745,787	$5,514,805	$992,233	$4,065	$995,925	36.3%

* *Fishing values do not reflect landings of lobster or Jonah crab.*

** *Does not provide sufficient data to calculate high/low value of Lease Area*

WDA-84 Landings, Massachusetts+

Source*	Study Period (Years)	Average Annual Value	High Annual Value	Low Annual Value	MA % of Lease Area Landings++
RI-DEM (2017)	2011-2016	$167,785	$407,950	$40,738	53.9%
NOAA VTR Data (2018)	2011-2016	$178,347	$358,523	$109,819	53.9%

\+ *BOEM (2017) does not provide sufficient date to allocate value by state; RI-DEM (2018) is not included because exposure estimates are not reliable for this analysis*

++ *State allocation per RI-DEM (2017)*

Table 3 Estimates of Commercial Fishing Economic Exposure in Vineyard Wind's Lease Area and 84 Turbine Wind Development Area (WDA-84), including Lobster and Jonah crab*

All Commercial Landings from the Vineyard Wind Lease Area	Average	Low	High
RI-DEM (2017), adjusted for lobster/Jonah crab	$1,078,208	$2,305,685	$428,869
NOAA VTR Data (2018), adjusted for lobster/Jonah crab	$1,132,190	$2,053,065	$781,943
Average	$1,105,199	$2,179,375	$605,406
All Commercial Landings from WDA-84**	**Average**		**High**
RI-DEM (2017)	$391,390	$836,964	$155,680
RI-DEM (2018)	$410,985	$745,263	$283,846
Average	$401,188	$791,114	$219,763
Massachusetts Landings from the Wind Development Area***	**Average**	**Low**	**High**
RI-DEM (2017)	$196,621	$436,786	$69,574
NOAA VTR Data (2018)+	$207,183	$387,359	$138,655
Average	$201,902	$412,073	$104,115

* *Includes VTR-reported and non-VTR reported landings of lobster and Jonah crab as described in Section 2*

** *WDA-84 accounts for 36.3% of landings from Vineyard Wind Lease Area.*

*** *MA fishing ports account for 53.9% of the economic exposure in the Vineyard Wind Lease Area (RI-DEM, 2017, Table 3)*

\+ *State allocation per RI-DEM (2017)*

Table 4a Economic exposure of commercial fishing in the Vineyard Wind Lease Area and 84 Turbine Wind Development Area (WDA-84) (Using landings estimates from RI-DEM (2017))*

**Values do not reflect the value of lobster and Jonah crab landings*

STATE	2011	2012	2013	2014	2015	2016	Total Landings	Ave. Annual Value, Lease Area	Ave. Annual Value, WDA**	% of total
CT	$35,943	$23,680	$36,764	$19,297	$0	$51,531	$167,216	$27,869	$12,627	3.2%
MA	$112,425	$987,431	$551,972	$199,070	$247,676	$675,235	$2,773,810	$462,302	$209,462	53.9%
NJ	$0	$4	$0	$499	$19,336	$49,532	$69,370	$11,562	$5,238	1.3%
NY	$3,440	$13,966	$26,489	$674	$10,819	$166,146	$221,533	$36,922	$16,729	4.3%
RI	$56,401	$53,036	$159,041	$257,133	$245,169	$1,142,581	$1,913,361	$318,893	$144,486	37.2%
Total Landings	$208,210	$1,078,116	$774,267	$476,672	$523,000	$2,085,024	$5,145,289	$857,548	$388,542	100.0%

***WDA-84 is 36.3% of Vineyard Wind Lease Area.*

	2011	2012	2013	2014	2015	2016	Annual Average All Years
Lease Area Landings per km^2	$308	$1,596	$1,146	$706	$774	$3,087	$1,270
WDA Annual Landings Value	$94,337	$488,478	$350,809	$215,973	$236,963	$944,693	$388,542
MA Annual Landings Value from WDA-84	$40,748	$358,233	$200,189	$72,301	$89,885	$245,046	$167,649

	2011	2012	2013	2014	2015	2016	Annual Average % All Years
MA % of Annual Value from Lease Area	54.0%	91.6%	71.3%	41.8%	47.4%	32.4%	53.9%

Table 4b Economic exposure of commercial fishing in the Vineyard Wind Lease Area and 84 Turbine Wind Development Area (WDA-84) (Using landings estimates from RI-DEM (2018))*

**Values do not reflect the value of lobster and Jonah crab landings*

STATE	2011	2012	2013	2014	2015	2016	Total All Years	Lease Area	WDA*	% of WDA Landings
CT	$111,919	C	$132,648	C	$0	$233,073	$477,640	$79,607	$36,069	2.9%
MA	$274,093	$1,789,724	$1,194,244	$796,423	$641,740	$1,605,656	$6,301,880	$1,050,313	$475,881	38.3%
NJ	$0	C	$0	C	$90,548	$87,846	$178,394	$29,732	$13,471	1.1%
NY	C	C	$296,932	C	$253,454	$515,623	$1,066,009	$177,668	$80,499	6.5%
RI	$606,221	$789,006	$1,429,130	$1,226,021	$1,327,814	$3,072,607	$8,450,799	$1,408,467	$638,155	51.3%
Total	$992,233	$2,578,730	$3,052,954	$2,022,444	$2,313,556	$5,514,805	$16,474,722	$2,745,787	$1,244,075	100.0%

(C) = confidential landings. Confidential landings are treated as $0, however, there is no confidential data for MA.

	2011	2012	2013	2014	2015	2016	Annual Average All Years
Lease Area Landings per km^2	$1,469	$3,818	$4,520	$2,995	$3,426	$8,166	$4,066
WDA Annual Landings Value	$449,566	$1,168,384	$1,383,248	$916,339	$1,048,237	$2,498,675	$1,244,075
MA Annual Landings Value from WDA	$99,334	$649,175	$432,993	$289,011	$232,438	$582,124	$381,455

	2011	2012	2013	2014	2015	2016	Annual Average % All Years
MA % of Annual Value from Lease Area	27.6%	69.4%	39.1%	39.4%	27.7%	29.1%	38.3%

Attachment 2

Dennis M. King, Ph.D., Curriculum Vitae

CURRICULUM VITAE

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EDUCATION

Ph.D. Marine Resource Economics, University of Rhode Island, 1977
M.A. Food and Natural Resource Economics, University of Massachusetts, 1973
B.B.A. Corporate Finance/Economics, University of Massachusetts, 1970

CAREER PROFILE

1991 to present: *Managing Owner*, **King and Associates, Incorporated**
Marine resource economic research and consulting
1991 to present: **University of Maryland, Center for Environmental Science**
Research professor (1991 to 2014); Visiting Professor (since 2014)
1989 to 1990: *Director of Resource Economics*, **ICF International, Washington, D.C.**
1979 to 1988: *Managing Owner*, **King and Associates,** Inc.
Adjunct Professor, **University of California, San Diego,** Economics Dept.,
Adjunct Professor, **Scripps Institution of Oceanography**, La Jolla, CA
1977 to 1979 *Senior Economist*, **U.S. Dept. of Commerce**, NOAA, Oceanic Division, La Jolla, CA
1975 to 1976: *Assistant Professor,* **University of New Hampshire**, Marine resource economics

CAREER OVERVIEW

Forty years of research and consulting experience in marine resource economics, with strong emphasis on fisheries, aquaculture, seafood markets, coastal and ocean resource management, seaports, and shipping. Recent research focuses on impacts of emerging technologies on ocean and water dependent industries and markets, and related investment opportunities and regulatory challenges.

Author of over one hundred reports, papers, and book chapters dealing with economic, business, and trade issues associated with environmental/economic linkages and related policies and regulations. Project manager on over one hundred interdisciplinary science/policy research projects dealing with economic aspects of complex scientific/engineering issues. Advisor to national and international environmental protection and natural resource development agencies, non-government organizations, insurance and financial institutions, small and large businesses, and seaport administrations. Expert witness before U.S. and state congressional committees, at administrative law judge hearings, and in more than forty cases involving private litigation related to fisheries, seafood markets, and environment-based economic losses. Served on scientific committees of the U.S. National Research Council and U.S. National Academies of Science, and as senior economic consultant to the United Nations, The World Bank, and other international organizations, and as technical advisor to U.S. congressional committees and various industry/government councils.

Developed and pioneered practical applications of widely used ecosystem valuation methods and economic tools to assess and compare environmental restoration and mitigation projects and invasive species problems, and resolve coastal fishing-oil industry conflicts. Created widely used analytical method, Habitat Equivalency Analysis (HEA), for assessing and comparing gains and losses in ecosystem services and values for settling natural resource damage claims, and managing environmental trading and banking programs. Developed fishery-related risk assessment methods for Lloyd's of London. Ltd and other global insurers, and GIS- based global fishing fleet allocation/decision-support models for H.J. Heinz (Starkist), Van Camp (Chicken of the Sea), and other global seafood companies. Developed fishery management models, tax programs, and foreign fishing access and rental agreements for individual Pacific Island nations and for regional Pacific island multinational fishery management organizations. Developed and applied award-winning tools for assessing environmental/economic tradeoffs associated with multi-billion dollar investments in environmentally beneficial uses of dredged material, and for performing incremental cost analysis (ICA) to justify them. Developed economic tools for assessing and comparing ballast water treatment technologies and for evaluating alternative ballast water regulatory and compliance monitoring and enforcement programs. Led innovative project addressing economics of enforcement and compliance in U.S. commercial fisheries, and contributed to similar international studies.

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Location and Wetland Values: Some Pitfalls of Offsite Wetland Mitigation in the Chesapeake Watershed, (with Curtis C. Bohlen). In Toward a Sustainable Coastal Watershed: The Chesapeake Experiment, edited by Steve Nelson and Paula Hill, Chesapeake Research Consortium, Edgewater, Maryland, 1994

A Technical Summary of Wetland Restoration Costs in the Continental United States, (with Curtis C. Bohlen). A report prepared for the EPA, Office of Policy Analysis, CEES Contribution # UMCEES– CBL–94–048, June, 1994

Watershed Management and Wetland Mitigation: A Framework for Determining Compensation Ratios, (with Curtis C. Bohlen and Kenneth J. Adler). A report prepared for the EPA, Office of Policy, Planning and Evaluation; Washington, D.C., July, 1993

The Economics of Wetland Mitigation Markets, (with Leonard Shabman and Paul Scodari). A report prepared for the U.S. Army Corps of Engineers, Water Resources Institute, Fort Belvoir, VA. (Preliminary report released August, 1992)

The Use of Economic Incentives for Environmental Protection in Developing Nations, (with Pierre Crosson and Jason Shogren). Winrock Environmental Alliance, Morrilton, Arkansas and O.E.C.D., Paris, October, 1992

Can We Justify Sustainability: New Challenges Facing Ecological Economics. In Ecological Economics, Volume II, Proceedings of 2nd Meeting of the International Society for Ecological Economics, Stockholm, August, 1992

The Economics of Ecological Restoration. In Natural Resource Damage Assessment: Law and Economics, edited by John Duffield and Kevin Ward, John Wiley Publishers, New York, April 1992

Wetland Mitigation Banks - Avoiding Another Taxpayer Bailout. In The National Wetland Newsletter, Volume 9 Number 1, Washington, D.C., January 1992

Scientifically Defensible Compensation Ratios for Wetland Mitigation, (with Kenneth A. Adler). EPA Office of Policy Analysis, Washington, D.C., March 1992

Costing Out Restoration. In Restoration and Management Notes, the Journal of the Society for Ecological Restoration, University of Wisconsin, Summer, 1991 (pp 21)

Wetland Creation and Restoration: An Integrated Framework for Estimating Costs, Expected Results, and Compensation Ratios. EPA, Office of Policy Analysis, Washington, D.C., April, 1991 (pp 79)

Sea Level Rise and Wetlands: Economic Modeling of Impacts and Response Strategies. In Climate Change and Ocean Processes: What Are the Consequences, edited by Gary D. Sharp; Texas Institute of Oceanography, February, 1991

A Method to Estimate Compensation Ratios for Wetland Mitigation Projects. EPA, Office of Policy Analysis; Washington, D.C., May, 1990 (pp 7)

Methods to Value the Aesthetic Impacts of Marine Debris on the Beach. EPA, Office of Policy Analysis; Washington, D.C., January, 1989 (pp 13)

The Economics of Global Billfish Fisheries. In Proceedings of the Second International Billfish Symposium, National Coalition for Marine Conservation, Honolulu, 1989, (pp. 33)

Toward a More Abundant Ocean: Improving Fisheries Management in California, (with Robert Knecht and Biliana Cicin-Sain). National Coalition for Marine Conservation, San Diego, April, 1988. (pp. 189)

Economic Impacts and Net Economic Values Associated with Washington State Salmon and Sturgeon Fisheries. State of Washington, Department of Community Development, Olympia, March, 1988 (pp 71)

U.S. Tuna Markets - A Pacific Island Perspective. In Development of Tuna Fisheries in the Pacific Islands Region, (D. Doulman, editor), University of Hawaii, East-West Center, April, 1987 (pp. 22)

Global Tuna Markets - A Pacific Island Perspective. In Tuna Issues in the Pacific Island Region, (D. Doulman Editor), East-West Center, University of Hawaii, Honolulu. April, 1987 (pp. 88)

Recent Problems in the U.S. Tuna Industry and an Outlook. 37th Annual Tuna Conference, Lake Arrowhead, California, August, 1986

Global Tuna Markets and Hawaii Aku. U.S. Dept. of Commerce, Southwest Fisheries Center Administrative Report H-86-12C, Honolulu, August, 1986

The Economic Impact of Recent Changes in the U.S. Tuna Industry, (with Harry A. Bateman). Sea Grant

Working Paper Number P-T-47, Scripps Institution of Oceanography, La Jolla, August, 1985

The Economic Structure of California's Commercial Fisheries, (with Virginia G. Flagg). Sea Grant Publication Number P-T-32, Scripps Institution of Oceanography, La Jolla, March, 1985

An Economic Impact Calculator for California Fisheries. Sea Grant Publication Number P-T-41, Scripps Institution of Oceanography, La Jolla, March, 1985

Evaluating the Payoff From Fishery-Related Research and Development Projects. Sea Grant Working Paper, Scripps Institution of Oceanography, La Jolla, January, 1984

Fishing Effort and the Production by Individual Vessels. Sea Grant Working Paper, Scripps Institution of Oceanography, La Jolla, January, 1984

The Economic Structure of California Seaports, (with James Liedke-Konow). Sea Grant Technical Report P-T-42, California Sea Grant College Program, La Jolla, 1984

Seaport Impacts: A Broader Basis for Analysis. Sea Grant Working Paper P-T-33, Center for Marine Studies, California State University, San Diego, 1983

Alternative Products and Markets for West Coast Mackerel Landings, (with Harry A. Bateman). West Coast Fisheries Development Foundation Technical Report, 1983

A Review of Products and Markets for California Market Squid, (with Harry A. Bateman). West Coast Fisheries Development Foundation Technical Report, 1983

The International Market for Shrimp, (with Robin Rackowe). Food and Agriculture Organization of the United Nations, Fisheries Division, Rome, 1982

A Forecasting Model for U. S. Tuna Markets. Proceedings of the Thirty-Third Annual International Tuna Conference, Lake Arrowhead, California, 1982

An Interindustry Analysis of California Fisheries, (with Kenneth L. Shellhammer). Sea Grant Technical Report Number P-T-5, California Sea Grant, Institute for Marine Resources, La Jolla, 1982

An Economic Impact Calculator for California Fisheries and Seafood Industries, (with Kenneth L. Shellhammer). Sea Grant Technical Report Number P-T-6, California Sea Grant, Institute for Marine Resources, La Jolla, 1982

A Game-Theoretic Bargaining Model of Tuna Fishing in the South Pacific: Island Nations vs. Multinational Corporations, (with Fred Galloway). Proceedings of the Western Economic Association Annual Meeting, San Francisco, 1981

Trading-off Specification and Measurement Error in Bio-economic Fishing Models. Proceedings of the Western Economic Association Annual Meeting, San Francisco, 1981

Evaluating Capital Requirements in Developing Fisheries. Center for Marine Studies Technical Report, San Diego State University, San Diego, California, 1981

International Management of Highly Migratory Species: A Reply. Journal of Marine Policy, Volume 4, Number 3, July, 1980

Projecting U.S. Consumer Demand for Tuna. Center for Marine Studies Technical Report 80-3, San Diego State University, San Diego, California, February, 1980

Global Tuna Fisheries: Status, Trends and International Outlook. National Academy of Sciences, Ocean Policy Paper, August, 1980

The Development of the Papua New Guinea Tuna Fishery. United Nations, FAO Publication WS/N7173, Food and Agriculture Organization Technical Cooperation Program, Rome, Italy, 1980

International Management of Highly Migratory Species: Centralized vs. Decentralized Economic Decision-Making. Journal of Marine Policy, Volume 3, Number 4, October, 1979

An Economic Evaluation of Alternative International Management Schemes for Highly Migratory Species. S.W.F.C. Administrative Report MS293, San Diego, California, 1978

Measuring the Economic Value of the Eastern Tropical Pacific Tuna Fishery. Proceedings of the Western Division Meetings of the American Fisheries Society, July, 1978

The Economic Theory of Natural Resources Applied to Global Tuna Fisheries. Transient Tropical Tuna, Center for Public Economics, San Diego State University, San Diego, California, 1978

The Application of Polynomial Distributed Lag Models to Problems in Fish Population Dynamics. Proceedings of the Twenty-Eighth Annual Tuna Conference, Lake Arrowhead, California, October, 1977

The Economic Impact of 1978-1980 Tuna/Porpoise Regulations. W.F.C. Admin. Report LJ-77-27, San Diego, California, 1977

The Use of Polynomial Distributed Lag Functions and Indices of Surface Water Transport in Fishery Production Models with Applications for the Georges Bank Ground Fishery. Published Ph.D. Dissertation, University of Rhode Island, University Microfilms International, Ann Arbor, Michigan, 1977

Offshore Fisheries and the 200-Mile Limit. Proceedings of the Marine Science and Ocean Affairs Program, University of New Hampshire, Durham, New Hampshire, 1976

The Use of Economic-Environmental Input-Output Analysis for Coastal Planning, (with D. A. Storey). Special Report Number 40, University of Massachusetts, Water Resources Center, Amherst, Massachusetts, 1974

CLIENTS/PROJECTS

(Sorted by Private Sector, Public Sector and Non-profit sector, from most recent to least recent)

Private Sector

Southwest Florida Joint Wetlands Joint Venture, Prepared a report submitted to the Army Corps of Engineers that challenged certain historical and ongoing applications of the “King equation” to assign credits to Florida-based wetland mitigation banks and form the basis for the Army Corps of Engineers allowing them to be sold as legitimate offsets to wetland impacts.

American Commodities, Incorporated, Expert consultant to plaintiff in litigation involving ”breach of contract” and “fraud” associated with the overpricing and mislabeling of China-produced frozen shrimp products that were imported to the U.S.A. as products of Malaysia in order to avoid U.S. anti-dumping duties on Chinese shrimp.

Glosten Engineering, Serving as head economist on a study funded by the Delta Stewardship Council to determine the technical, logistical, and economic feasibility of shore-based ballast water treatment at California seaports.

Hausfeld Law Offices, Expert consultant to plaintiffs (USA Direct buyers) in price fixing lawsuit involving USA sales of canned tuna and other processed seafood products by the three large foreign-based seafood companies.

EA Engineering/NOAA Managed preparation of economic sections of Programmatic Environmental Impact Statement (PEIS) for gulf coast restoration projects related to the 2010 BP Deepwater Horizon oil spill.

EA Engineering, Inc./NOAA Managed economic analysis and drafting of report to form the basis of NMFS Section 4(b)(2) Report on impacts of proposed Endangered Species Act critical habitat designation for the South Atlantic and Carolina distinct population segments of Atlantic Sturgeon.

Integrated Statistics, Inc./NOAA Managed economic analysis and drafting of report to form the basis of NMFS Section 4(b)(2) Report on impacts of proposed Endangered Species Act critical habitat designation for three northern distinct population segments of Atlantic Sturgeon.

Avatar Environmental. EPA-funded project to develop an integrated ecological risk assessment and ecosystem valuation database to allow users to find studies that can be combined using common end points.

Weston Solutions, Inc. Environmental/economic analysis of dredged material placement options, including NER (National Ecosystem Restoration) analysis to prioritize options and establish Federal cost sharing.

Oil Spill Class Action. Lead economic expert for property owners, businesses, and commercial fishermen in lawsuit for natural resource damages resulting from the April, 1999 Pepco Chalk Point Power Station Oil Spill in the Patuxent River, Maryland

Scientific Certification Systems, Oakland, California. Development of guidelines and protocols for answering production and chain of custody questions to support global seafood certification and labeling programs of the newly formed Marine Stewardship Council.

Fuji Bank, Tokyo. Analysis of competitive forces in global fisheries and fish markets, and assessment of long-term investment risks in Asian and Latin American seafood industries.

Bumblebee Seafoods, Thailand. Analysis of competitive conditions in global tuna markets and evaluation of alternative strategies for expansion and diversification of U.S. and Thai operations.

Asian Development Bank, Manila. Prepared report on tuna export opportunities for Pacific Island nations. Included price forecasts by product, type, and fish size and an assessment of most promising joint-venture strategies in the Pacific basin.

H.J. Heinz and Co., (Star-Kist, International), Pittsburgh, Pennsylvania. Analysis of international and domestic markets for raw/frozen and canned tuna and the impact of market changes on: 1) the financial performance of various national fishing fleets and seafood processing industries and 2) long-term investment and production strategies.

Lloyd's of London, Ltd. Retained four years (1980-1984) as lead consultant and expert witness evaluating risks, estimating losses, developing settlement offers, and supporting legal proceedings related to claims of lost earnings from high-seas fisheries and related losses in fish processing sectors.

Castle and Cooke, Inc., San Francisco, California. Analysis of recent changes in global fisheries and markets and their short-term and long-term impacts on various segments of Asian, Latin, and Pacific seafood industries.

Worldcom Corp. Use regional economic "input-output" models to estimate state-level impacts on business sales, household income, jobs, taxes, and value added if Worldcom/MIC was not allowed to restructure and come out of bankruptcy.

Zapata-Haine Corporation, Mexico City. Evaluation of investments in high seas fisheries and global fish canning facilities and assessment of trends in international seafood markets.

Asian Development Bank/United Nations. Analysis of world shrimp demand and forecast of international shrimp markets through 1985. Report supported successful expansion of global shrimp aquaculture industry during the 1980's.

Booz–Allen, Hamilton, Inc., Los Angeles. Optimization of global fish harvesting, processing, and distribution operations by Fortune 100 firm; integrated management of seafood, fishmeal, fish oil production systems.

Exxon Company, USA, California. Forecast impacts of offshore oil development on seven central California commercial fisheries. Provided basis for cash payments to fishermen for temporary fishing area preclusions.

Banpesca (National Fisheries Development Bank of Mexico). Development of a National Tuna Development Plan and financial/economic models to evaluate investment, production and financing decisions and joint venture and marketing proposals related to global tuna fisheries.

Van Camp Seafood, P.T. Mantrust, Indonesia. Analysis of global tuna fleet allocation and tuna procurement strategies using linear programming and other computerized decision models.

Exxon Company, USA, California. Post-project analysis of economic losses to commercial fishing operations from a three-year offshore oil development project in central California. Provided basis for final settlements with seven commercial fishing fleets for temporary fishing area preclusions.

Florida Wetlandsbank, Inc. Evaluation of Florida Mitigation Banking Review Team debit/credit guidelines and related methodologies, and an evaluation of their potential financial impacts on wetland mitigation ventures in Florida.

Fishermen's Cooperative Association of San Pedro. A study of alternative products and international markets for California market squid.

Southern California Investment Bank. Forecasts of risk and economic performance for selected U.S. commercial aquaculture industries.

Bechtel Group, Inc. San Francisco. Economic/financial analysis of fishery-oil conflicts associated with potential offshore/onshore facilities in Central California.

Cities Service Oil and Gas Corp. San Francisco. Economic/financial analysis of fishery-oil conflicts associated with potential offshore/onshore facilities in Central California.

Non-profit Sector

Fishermen Defense Fund (USA), Prepared paper assessing local and national economic impacts of Amendment 28 to the Gulf of Mexico Reef fish management plan which would reallocate less annual quota to commercial fishers and more to recreational fishers.

Harry R. Hughes Center for Agro–ecology, Inc. Prepare and present economic analysis of county Watershed Implementation Plans (WIPs) at 5 regional workshops in Maryland.

Maryland Environmental Services. Environmental economic analysis of dredged material placement options and GIS-based assessments of aesthetic and other localized impacts of placement alternatives.

UMCES/Campbell Foundation. Development of optimization model for prioritizing oyster restoration in the Chesapeake Bay and examining the opportunity costs of high risk oyster restoration investments.

Canaan Valley Institute. Assessment of environmental restoration alternatives in the mid-Atlantic Highlands region and develop criteria for prioritizing sites and identifying opportunities to develop export- oriented regional industries to provide ecosystem restoration materials, equipment, and skills.

Pennsylvania Environmental Council. Consultant to the PEC and local partnership organizations on projects to develop a registry, scoring criteria, and trading protocols for a prototype water quality credit trading system for the Conestoga River watershed to be used, eventually, in the Susquehanna River and Chesapeake Bay watersheds.

Florida Southwest Water Management District. Evaluation of proposed rules for sector-based water use restrictions during moderate, extreme, and severe droughts.

Civil Engineering Research Foundation (CERF) and International Institute for Energy Conservation (IIEC). Review of international experiences with the use of economic incentives for phasing lead out of gasoline, and recommendations for developing the least-cost strategy for effectively phasing lead out of gasoline in South Africa.

National Science Foundation. Develop indicators and decision-support flow charts and prototype software to help focus wetland conservation/restoration initiatives. (through University of Rhode Island).

Canaan Valley Institute. County-level assessment of ecosystem restoration opportunities and related business opportunities and economic impacts.

Center for International Environmental Law. Applications of geographic information system to prioritize and support enforcement of environmental laws.

Resources for the Future. Legally defensible non-monetary indicators of ecosystem services and values based on site/landscape characteristics.

Winrock International, Inc. Development of carbon sequestration supply function for U.S. forest and agricultural lands to support future greenhouse gas trading.

Resources for the Future, Washington, D.C. Assessing boundary and scale issues in the development of community, regional, and national environmental and economic indicators.

Organization for Economic Cooperation and Development, Paris. Evaluate current applications of economic incentives for environmental protection in developed nations and assess potential in less developed nations.

Center for International Environmental Law. Applications of geographic information system to prioritize and support enforcement of environmental laws.

Environmental Law Institute. Economics of controlling agriculture-based nonpoint source pollution, and estimates of compliance costs for various regulatory alternatives.

World Wildlife Fund/Marine Stewardship Council. Guidelines for using non-government initiatives and industry and market-based incentives to encourage sustainable world fisheries.

East-West Center, Pacific Island Development Program, Honolulu. Prepared publication describing international trade in tropical Pacific fishery products, trade opportunities for central/western Pacific Island nations, and the role of multinationals in markets for Pacific seafood.

Pacific Fisheries Development Foundation, Honolulu, Hawaii. A benefit-cost and cost-effectiveness study of eleven fisheries and aquaculture research and development projects including: Micronesia - Port Development in Truk and Ponape; Guam - Transshipping Facilities; Saipan - High-seas Fisheries; Palau - Cold Storage/Transshipping Facilities; Samoa - Near-shore Fisheries; Tinian - Transhipping Facilities.

South Pacific Forum, Solomon Islands. Feasibility studies for tuna fishery support facilities, tuna fleet development and local cold storage and transshipping operations.

World Wildlife Fund, Washington, D.C. Development and testing of criteria for certifying that seafood products were harvested in fisheries that are sustainable and well managed.

Joint Fishing-Oil Industry Committee, Santa Barbara, California. Study of fishing industry-oil industry interactions in central California area and economic impact of OCS development on financial performance of commercial fishing operations in Santa Barbara Channel and Santa Maria Basin.

South Pacific Forum, Solomon Islands. Development of computerized databases to monitor foreign fishing in 200 mile fishing zones of seventeen member nations, and bio-economic vessel budget simulators to estimate appropriate access fees for various types of fishing vessels.

West Coast Fisheries Development Foundation, Portland, Oregon. Economic potential of alternative product forms and markets for U.S.-caught Pacific and jack mackerel.

National Coalition for Marine Conservation, Pacific Region. Conduct study of alternative ocean management policies for the state of California with consideration of recreational and non-consumptive uses of the marine environment as well as commercial ocean uses.

National Academy of Sciences, National Research Council, Washington, D.C. Analysis of global tuna fisheries, international tuna markets and the role of multinational corporations in high-seas fishery development.

Pacific Marine Fisheries Commission, Portland, Oregon. Prepared report describing the economic impacts of changing global patterns of tuna harvesting and processing and documented methodology for use in studies of changes in other fisheries.

Scripps Institution of Oceanography, Office of Sea Grant, La Jolla, California. Development of regional input-output models and economic multipliers for 19 coastal communities in California using the U.S. Dept. of Agriculture "IMPLAN" economic modeling system.

Scripps Institution of Oceanography, Office of Sea Grant. 1980/1981 Development of California Interindustry Fisheries (CIF) model. Bio-economic extension of 1980/1981 California Interindustry Fisheries (CIF) model. Financial/economic analysis of California seaports and harbors.

Environmental Law Institute, Washington, D.C. Prepare information for the revision of the 1987 "Cost of Environmental Protection Report" under contract to the EPA, Office of Policy Analysis.

President's Council on Sustainable Development. Application of natural resource accounting to evaluate alternatives for sustainable watershed management in the Upper Mississippi River Basin.

Environmental Business Council of the U. S., Boston, MA. Prepared a report for environmental industry trade organizations evaluating the legal, institutional, and technical barriers to increasing U.S. environmental technology exports.

Environmental Business Council of the U.S., Boston, MA. Analysis of technical, institutional, and market barriers to the export of U.S.-based environmental technologies.

Environmental Defense Fund, Washington, D.C. Profile conceptual and practical problems with applying Benefit-Cost Analysis to the environment.

Greenpeace, International, Amsterdam. Analysis of global high seas fishing industries and related markets and their relationships to the incidental kill of marine mammals. Strategy development for promoting “dolphin-safe” canned tuna label in U.S. markets and similar labeling initiatives in Europe and Asia.

Public Sector

Maryland Port Administration. Integrated economic and environmental analysis of environmentally beneficial dredge material placement options, including applications to protect and restore wetlands and create island habitats in the Chesapeake Bay.

Maryland Port Administration. Economic analysis of current U.S. and pending International Maritime Organization (IMO) ballast water regulations and emerging global markets for ballast water treatment technologies and other methods to manage harmful marine invasive species.

U.S. Department of Agriculture, (USDA) Lead Economist on 5 year/$5 million study of innovative applications of wireless moisture sensor networks to guide irrigation and nutrient management decisions in the production of specialty crops and in other intensive agricultural practices.

Maryland Department of the Environment. Development of a full cost accounting framework for urban stormwater best management practices including spreadsheets to determine planning level unit cost estimates for implementing stormwater BMPs in MD counties.

Maryland Port Administration. Integrated economic and environmental analysis of environmentally beneficial dredge material placement options, including applications to protect and restore wetlands and create island habitats in the Chesapeake Bay.

U.S. Dept. of Transportation, Maritime Administration. Assess economic feasibility of converting MARAD ships and ships involved in maritime trade to use alternative fuels and establishing supply chains for providing alternative fuels to selected U.S. seaports.

Maryland Port Administration. Economics of ballast water treatment technologies for marine invasive species.

Mid-Atlantic Regional Coastal Ocean Observing System (MARCOOS). Assessing the value of physical ocean observations to users along several pathways involving fishing, fishery management, search and rescue, shipping, offshore energy, weather predictions, etc.

U.S. Department of Commerce, NOAA. Managing economic component of the Chesapeake Inundation Prediction System (CIPS), a new NOAA storm-generated flooding prediction system for the Chesapeake Bay.

Maryland Environmental Services. Environmental economic analysis of dredged material placement options and GIS-based assessments of aesthetic and other localized impacts of placement alternatives.

NOAA, Office of Habitat Protection. Development of formulae and related guidebook and software for developing science-based and legally-defensible wetland mitigation (compensation) ratios; prepare workshops for NOAA field staff on east coast (Silver Spring, MD) and west coast (Seattle, WA).

NOAA, Office of Habitat Protection. Integrated environmental/economic analysis of derelict fishing gear (ghost traps) in the Chesapeake Bay and cost/risk/benefit analysis of alternative gear identification and retrieval systems.

USDA, Economic Research Service. Develop cost/risk profiles associated with invasive weeds using Cheatgrass in the Columbia River Basin as a case study. Use cost, risk, benefit data to test potential of innovative "risk-optimizer" software to prioritize responses on agricultural and natural lands.

EPA, Regional ecosystem Vulnerability Assessment (ReVA). Use of regional environmental risk/vulnerability indices and other landscape and land use data to guide cross-media and out-of-kind environmental trades, with illustrations for North Carolina and South Carolina.

EPA, Regional ecosystem Vulnerability Assessment (ReVA). Use of landscape indicators and other measures of geographic and socio-economic heterogeneity to develop rules to guide cross-media/inter-state environmental trading involving air and water credits in 15 counties in NC and SC in the vicinity of Charlotte, NC.

NOAA, Office of Habitat Protection. Guidelines for using economic analysis to prioritize and manage habitat protection and restoration strategies.

NOAA, Office of the Administrator. Prepare report on supply and demand conditions and other economic aspects of proposed water quality credit trading programs with special focus on the Chesapeake Bay region.

U.S. Department of Agriculture, APHIS. Development of Cost/Risk and Cost/Benefit Protocols to prioritize and manage spending to control harmful invasive plants on uncultivated land (natural habitats).

U.S. EPA, Office of Atmospheric Programs, (through Stratus Consulting, Inc.). Develop a standard method to “score” carbon sequestration credits and illustrate it using a sample of early U.S.-based carbon sequestration trades.

U.S. Environmental Protection Agency, Office of Air. Economic assessment of voluntary carbon sequestration trading in the United States – comparing cost, performance, and credits under alternative “scoring” systems.

U.S. Army Corps of Engineers, Waterways Experiment Station. The development of wetland indicators to guide national/regional wetland mitigation programs and to debit /credit wetland mitigation banking trades.

Environmental Protection Agency, Office of Policy Analysis. Economic Potential of Carbon sequestration in national and international carbon trading markets: practical methods of verifying and debiting and crediting trades that involve changes in land use and farm and forest management practices.

U.S. Department of Agriculture, Economic Research Service. Develop and test a general analytical framework for assessing the economic effects of agricultural nutrient policies on fisheries and related coastal industries.

U.S. Department of Agriculture, Forest Service and Economic Research Service. An integrated cost-risk- benefit framework for prioritizing and developing response protocols related to noxious weed threats.

U.S. Department of Agriculture/NRCS. Development of an ecosystem benefit website for field office staff; including methods and examples of related to absolute (dollar-abased) and relative (non-dollar) ecosystem value estimates to guide environmental investments and to assess and compare mitigation trades.

U.S. Department of Justice, Washington, D.C. Development of ecosystem valuation methods to facilitate the settlement of natural resource damage claims; expert witness on specific cases involving coastal oil spills.

U.S. Department of Commerce, NOAA. Methods of comparing ecosystem functions, services and values and performing habitat equivalency analysis under Jan. 5, 1996 NRDA - Final Rule (15 CFR Part 990).

U.S. Army Corps of Engineers, Water Research Institute. Wetland location and watershed values: economic and environmental equity issues associated with off-site wetland mitigation banking.

U.S. Environmental Protection Agency, Office of Policy Analysis. Framework for assessing the benefits and costs of vegetative riparian buffers: with case studies for three Chesapeake Bay area sub-watersheds.

U.S. Environmental Protection Agency, Office of Policy Analysis. Relocating wetlands–the hidden costs of wetland mitigation: including case studies for the Chesapeake Bay and San Francisco Bay watersheds.

U.S. Department of Agriculture, Economic Research Service. A framework for evaluating the costs and benefits of managing noxious weeds, prioritizing problem areas, and selecting among weed management alternatives.

Government of Thailand. Economic assessment of proposed changes in U.S. tariffs and quotas related to imported processed seafood products.

Government of Papua New Guinea. Evaluation of export markets and joint venture pricing policies for shrimp, lobster and tuna.

Federated States of Micronesia. Financial feasibility and economic impact of proposed port and fishery development projects.

U.S. Dept. of Commerce, NMFS, Honolulu. Development of Linear Economic Models to analyze the potential economic impacts of statewide Limited Entry programs applied in a multifishery context (groundfish, lobster, shrimp, tuna).

U.S. Dept. of Interior, Office of Territorial Affairs, Washington, D.C. Evaluation of joint venture and marketing arrangements involving U. S. Trust Territories and multinational corporations.

U.S. Farm Credit Bank, Pacific Region, Sacramento, California. Phase I: Financial/economic analysis of fish processing and fishery-related joint venture opportunities in Asia, Europe and Latin America. Initial negotiation with potential joint venture partners for production. Phase II: Evaluation of raw/frozen and canned tuna markets in U.S., Japan and Europe; evaluation of trading opportunities and initial discussions with marketing joint venture partners.

U.S. Dept. of Commerce, NMFS, Honolulu. Prepared report describing economics of Hawaii skipjack tuna industry and identified fishery development strategies and global market opportunities.

Federal Trade Commission, Bureau of Economics, Washington, D.C. Analysis of market and non-market barriers to entering the U.S. food processing industry.

U.S. Dept. of Commerce, NMFS, Seattle. Detailed financial analysis of U.S. high seas fishing operations including bio-economic analysis based on different resource/fishing conditions and delivery/market systems at locations around the world.

U.S. Dept. of Commerce, NMFS, La Jolla, California. Survey and analysis of financial performance for west coast salmon/albacore trollers.

Federated States of Micronesia. Evaluation of U.S. and Japanese investment proposals for new port facilities and investments in national fishing industries.

United Nations, Food and Agriculture Organization, Rome, Italy. Preparation of global fisheries chapter for "U.N. Report on State of Food and Agriculture, 1980-1985."

United Nations, Food and Agriculture Organization, Rome, Italy. Evaluation of port development and seafood industry development alternatives in the southwest Pacific.

United Nations, Food and Agriculture Organization, Rome, Italy. Evaluation of proposed food processing and marketing investments in Solomon Islands and Papua New Guinea.

United Nations, Technical Assistance Program, Rome, Italy. Assessment of financial feasibility and economic impacts of alternative industrial complexes proposed for western Pacific island nations by U.S. and Japan-based multinational corporations.

U.S. Army Corps of Engineers, Water Resources Institute. Development of decision tree framework for identifying and comparing environmental restoration alternatives.

U.S. Dept. of Commerce, NOAA, NMFS. Analysis of economic data for west coast fishing industries.

U.S. Dept. of Commerce, NOAA, NMFS. A cost and earnings study of selected fish harvesting and processing industries.

Government of Solomon Islands. Evaluation of infrastructure requirements and logistical systems to support development of high seas and coastal fishing operations and seafood processing industries.

Government of Kiribati, (Gilbert Islands). Evaluation of joint-venture, fleet acquisition and fish marketing opportunities for newly formed national fisheries corporation.

State of Washington. Economic Impacts of Alternative Fishery Management Policies Related to Salmon and Sturgeon Fisheries. Conducted analysis, prepared report, and testified at Congressional and Senate hearings.

U.S. Dept. of Commerce, NMFS, Terminal Island, California. Survey and analysis of west coast shrimp and groundfish trawlers and development of economic database for vessel budget simulators.

U.S. Interstate Commerce Commission, Washington, D.C. Study of economic impacts of proposed abandonment of Eel River Line by Northwest Pacific Railroad and assessment of transportation alternatives for Humboldt County industries.

U.S. Department of Transportation, FHWA, Environment Division, Washington, D.C. Evaluate the cost and performance of wetland mitigation and mitigation banking alternatives related to highway projects.

U.S. Department of Energy; Pittsburgh Energy Technology Center. Evaluate the costs and cost-effectiveness of wetland creation, restoration, and enhancement projects associated with mitigation for wetland impacts related to offshore oil development.

U. S. Environmental Protection Agency, Office of Policy Analysis, Washington, D.C. Integrated ecological-economic analysis of stream restoration. Evaluation of site selection criteria and the cost-effectiveness of engineered and bio-engineered alternatives.

Agency for International Development. Evaluate potential of environmental economic tools for applications involving development-environment problems in sub-Saharan Africa.

U.S. Army Corps of Engineers, Water Resources Institute. Economics of Wetland Mitigation Banks. Evaluation of economic factors affecting supply and demand for wetland mitigation credits using four case studies.

U. S. Environmental Protection Agency, Region IX (San Francisco). Regional economic profile of wetland creation and restoration activities.

U. S. Environmental Protection Agency, Region IV (Atlanta). Economics of wetland restoration and development of methodologies for estimating appropriate mitigation "compensation ratios" for wetland regulations.

U.S. Bureau of Mines. Development and testing of a training program on the economics of ecological restoration.

U.S. Department of Interior, Minerals Management Service. Estimation and valuation of potential wetland impacts from 5-year OCS oil and gas leasing program (1992-1996) in 26 OCS lease areas.

U.S. Environmental Protection Agency, Office of Policy Analysis. Development of an environmental benefits database and an analytical framework for estimating environmental protection costs.

U.S. Department of Justice, Environment Division, Washington, D.C. Develop procedures for tracing and measuring ecological-economic linkages and estimating ecosystem values to support natural resource damage claims; provide support for related litigation.

U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. Prepared economic analysis for benefits chapter of Regulatory Impact Analysis (RIM) of proposed revision to regulations governing EPA's Spill Prevention Control and Countermeasures program for oil. Project included development of market and non-market benefits associated with fishing, hunting, boating, beach-use, and tourism.

U.S. Environmental Protection Agency, Office of Radiation Programs, Radon Division. Economic analysis of user fees for training and testing of radon professionals. Project required cost and market analysis for regional programs to certify contractor proficiency in the design and use of radon testing equipment.

U.S. Environmental Protection Agency, Office of Policy Planning and Evaluation. Assessment of how offshore oil development affects coastal tourism. Project involved a comprehensive review of literature and comments received at public hearings and the development of a work plan for quantifying adverse impacts on visitations and use of coastal recreation facilities.

U.S. Environmental Protection Agency, Office of Solid Waste. Development of methods to evaluate impacts of potentially catastrophic releases of hazardous waste on wetland functions and values in order to develop location standards.

U.S. Environmental Protection Agency, Office of Policy Analysis. Development of cost/performance guidelines for evaluating wetland creation and restoration projects.

U.S. Environmental Protection Agency, Office of Policy Analysis. Assessment of methods to value economic losses associated with the aesthetic impacts of plastic debris wash-ups on U.S. beaches.

U.S. Environmental Protection Agency, Office of Air and Radiation. Economic analysis federal indoor radon measurement training and proficiency testing program.

U.S. Environmental Protection Agency, Office of Policy Analysis. Assessment of the economic impacts of medical waste tracking systems in ten Eastern States.

U.S. Environmental Protection Agency, Office of Solid Waste. Development of rapid-response economic impact and screening tools to assess the significance and incidence of industry-specific regulatory compliance costs.

State of California, Commercial Salmon Limited Entry Review Board, Sacramento. Analysis of interim salmon management regulations and evaluation of alternatives for permanent California salmon management legislation.

Attachment 3

King Addendum

November 14, 2019

Addendum to:

Economic Exposure of Massachusetts Commercial Fisheries to the Vineyard Wind Project (King, 2019)

Focus: Responses to Criticisms by Dr. Thomas Sproul in his May 31, 2019 Letter to the Massachusetts Office of Coastal Zone Management

Prepared by:
Dennis M. King, Ph.D.

Introduction

This Addendum addresses comments on my report, "Economic Exposure of Massachusetts Commercial Fisheries to the Vineyard Wind Project," received in a May 31, 2019 letter from Dr. Thomas Sproul submitted to the Massachusetts Office of Coastal Zone Management (MA-CZM) on behalf of the Massachusetts Fishermen's Partnership.

The comments contained in Dr. Sproul's letter fall into two general categories:

1. Criticisms related to the approach used in the analysis (e.g., not taking account of inflation); and,

2. Criticisms related to potential economic losses that were ignored (e.g., the possibility that the Vineyard Wind Project (the Project) might cause fisheries to collapse, or that the placement of wind turbines in the Wind Development Area (WDA) will increase the likelihood of fishing vessel collisions and vessels and lives being lost).

The sections below summarize my responses to specific criticisms in each of these two categories. Two attachments provide more technical details related to the treatment of shore-side economic impacts (Attachment A) and transit cost impacts (Attachment B).

General Responses

The Project is the first industrial-scale offshore wind energy project in New England. The wind turbine generators (WTGs) will be located in the northern portion of Vineyard Wind Lease Area OCS-A 0501 (the "Lease Area"); this northern portion is referred to as the "Wind Development Area" (WDA).[1] The purpose of my report was to provide baseline estimates of potential economic exposure to support the development of a fisheries mitigation program for this specific Project.

Many of Dr. Sproul's criticisms reflect misunderstandings about the purpose of my report and the sources of data I used to prepare it. Other criticisms are based on my report not accounting for entirely hypothetical scenarios that Dr. Sproul speculates may develop in the future, but are not supported by available science (e.g., the Project will cause changes in fish migrations and spawning areas or the collapse of the squid fishery).

Further, many of Dr. Sproul's other criticisms are not related specifically to my report or the Project and are based on his speculations about potential long-term cumulative impacts of offshore wind energy development in general. For example, Dr. Sproul states that "…as each new wind development comes online over a decade or more, who is to say that the squid don't eventually learn to spawn elsewhere, leading to a collapse of the fishery?" He qualifies this by adding "…science does not say this will happen." However, he does not indicate on what basis these hypothesized impacts on squid population dynamics could be assessed or incorporated into an analysis related to a specific project in the absence of any underlying scientific support. In fact, studies of offshore wind farms in Europe indicate that while squid exhibit avoidance behavior and relocate away from windfarms during construction, they return after construction with no significant changes in their abundance or age distribution (Vandendriessche et al., 2013; Rumes et al., 2013).

My report was not intended to provide comprehensive economic assessment of all conceivable changes in regional fisheries that could take place in the future and, hypothetically, could be influenced by or attributed to offshore wind energy development. For that reason, it seems best not to respond to many of Dr. Sproul's speculative comments about potential fishery impacts that have no scientific basis and/or are not related specifically to the Vineyard Wind Project. After all, there is no defensible method to assign economic values to these hypothetical impacts, and there is no justification or basis for including them in baseline estimates of what might constitute fair compensation to fishermen for Project impacts.

Dr. Sproul's letter contains estimates of potential lost fishing revenues from WDA development that are significantly higher than those presented in my paper. That is not because he used different sources of data; we both relied on data from the Rhode Island-Department of Environmental Management (RI-DEM). They are significantly higher because they are based on assumptions about Project impacts on fishing operations that are both illogical and conflicting.

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[1] The term "WDA" refers to the original WDA included in the Project's Construction and Operations Plan, which included up to 106 WTG positions. The size of the WDA was subsequently reduced after larger WTGs were selected, such that only 84 WTG positions are needed. The reduced-size WDA is referred to as the "WDA-84."

In my paper, for example, estimates of economic exposure are based on historical statistics regarding fishing revenues from the WDA. These figures are presented as estimates of maximum potential economic losses because they are based on the very conservative assumptions that fishing will be totally precluded from the WDA, and that none of that fishing will be diverted from the WDA to other fishing areas where it will generate offsetting fishing revenues. These maximum potential economic losses are not equivalent to expected economic losses because, in fact, fishing will not be precluded from the WDA during most periods and any fishing effort that is precluded in the WDA will likely be diverted to adjacent areas.

In contrast, estimates of potential fishing revenue losses presented by Dr. Sproul are based on the following three contradictory and unsupported assumptions:

1. Annual fishing revenue losses include all fishing revenues generated on all fishing trips with at least one tow that transects the WDA or a one or two-mile buffer zone around the WDA. This assumes a much larger impact area than will actually occur and implies all of these trips will be cancelled entirely rather than simply modified.

2. Annual economic losses associated with the loss of vessels and lives inside the WDA will result from an increased likelihood of allision with WTGs or collision with other fishing vessels for fishing vessels continuing to fish in the WDA.

3. Annual economic losses associated with the loss of vessels and lives outside the WDA will result from fishing vessels shifting fishing effort from the WDA to other areas, thereby increasing fishing vessel congestion and collision risks outside the WDA.

Each of these assumed impacts contradict one another since they cannot all simultaneously occur at the same time. Therefore, to assume all of these impacts will generate economic losses together is an unreasonable premise in the first instance.

Moreover, Dr. Sproul's estimates of economic exposure based on these three assumptions are not valid even when applying each assumption individually. For example, it is not reasonable to assume that impaired or prohibited fishing in the WDA will result in the cancellation of all fishing trips with even one tow that transects the WDA or a one or two-mile buffer zone around it, with all revenues from those trips being lost. A basic tenet of economics is that businesses will continue operating as long as expected revenues (trip revenues) exceed operating costs (trip expenses) so continued operation will generate at least some income that can contribute to fixed costs (vessel ownership costs). Data presented below show that in recent years over 84% of fishing revenue earned on trips that transect the WDA is generated outside the WDA. It is not reasonable to assume that vessels will stay in port and lose revenues on those trips rather than simply shift the fishing effort that generates just over 15% of their fishing revenues from the WDA to adjacent areas if that becomes necessary.

After assuming that all revenues on trips that transect the WDA will be lost, it is not reasonable to then further assume that fishermen will experience additional economic losses associated with the loss of vessels and lives resulting from (1) increased vessel crowding in the WDA caused by vessels continuing to fish in the WDA; and (2) increased vessel crowding outside the WDA caused by vessels shifting fishing effort from WDA to other areas. Furthermore, as described later, the estimates of allision and collision risks and associated costs presented in Dr. Sproul's letter are not valid. As confirmed by a recent review of the "Life and Vessel Risk" section of Dr. Sproul's letter presented in Baird (2019b), these loss estimates are based on a selection of vessel failure models related to global shipping, not fishing, and shipping-related accident statistics from the 1960s and 1970s that are no longer relevant. Comparisons between the shipping-based accident statistics used by Dr. Sproul and recent U.S. fishing vessel accident statistics indicate that his estimates of allision and collision risks in and around the WDA and their associated economic costs are over-inflated and not reasonable.

The sections below respond to most of Dr. Sproul's specific criticisms and describe why the assumptions he uses to support those criticisms, and the enormous economic losses he estimates based on those assumptions, are not valid. As noted above, I do not respond to some of his more speculative comments about theoretical possibilities which are not supported by scientific research. These theoretical possibilities are best dealt with in real terms, on a case by case basis, if they occur, with compensation paid through claims against Vineyard Wind's compensation fund or through insurance claims or legal proceedings.

Responses to Specific Comments

General Approach

1. <u>Adjusting for Inflation</u>

Dr. Sproul is correct that, for most purposes, estimates of current and future economic values that are based on similar values observed in the past should be adjusted to account for inflation. However, for purposes of estimating baseline economic losses to support negotiations over a fisheries compensation program, there are some significant advantages to using nominal dollar values and disadvantages to using inflation-adjusted dollar values. This is especially true when the basis and timing of compensation payments have not been established, as is the case with the Vineyard Wind project.

A general advantage of presenting nominal as opposed to inflation-adjusted values to support these negotiations is to maintain consistency and improve understandability. Government-published fishing values and all previously released fishing values related to the Vineyard Wind project (e.g., BOEM, COP, NOAA, RI-DEM) are presented in nominal, not inflation adjusted dollars. Using nominal values from these sources, without adjusting them, makes it easier for readers to confirm sources of value estimates and confirm that the estimates of value being used are correct.

Also, at the time my report was written, Vineyard Wind was considering making up front compensation payments for potential fishing revenue losses in future years. Dr. Sproul concluded that taking account of inflation "the numbers in the King Report should be adjusted upward by roughly 9.36%." However, accounting for inflation when compensation payments are made in advance of future economic losses would involve <u>discounting</u> estimates of future economic losses, not <u>inflating</u> them.

In fact, "discount rates" for adjusting the value of payments made before they are due typically account for both inflation (a dollar paid before it is due being worth more than when it is due) and foregone interest earnings (a dollar paid before it is due could have been put into a riskless investment, such as a short-term government bond, until it is due). During 2019, the annual Consumer Price Index (CPI) percent change ranged from 1.5% to 1.9%, the annual rate of one-year U.S. treasury notes ranged from 1.6% to 2.6%, and the Federal Reserve Bank's recommended discount rate for 2019 is 3% (BLS, 2019; DoT, 2019; Federal Reserve Bank, 2019).

It is not important here to determine what discount rate might be used to adjust early Fisheries Compensatory Mitigation Program payments. It is only important to note that if the Vineyard Wind compensation program took account of inflation and forgone interest earnings to adjust early payments for future economic losses, fishermen would lose far more than 9.36% of the nominal fishing values presented in my paper. Under most compensation schemes being considered, fishermen would most certainly prefer, and be better off, receiving compensation payments up-front in the nominal dollar values presented in my paper than in inflation-adjusted (discounted) dollar values recommended by Dr. Sproul.

Additionally, there are other important reasons why it is in the best interest of fishermen (and not Vineyard Wind) to keep baseline estimates of economic losses simple and leave adjustments to be made based on negotiations. In my report, for example, I use annual fishing revenues from the WDA as measures of potential economic loss and a basis for establishing the Fisheries Compensatory Mitigation Program. It is logical to argue that a more proper measure of potential economic loss would be expected losses in net vessel earnings; that is, lost fishing revenues less fishing costs saved. Fishing costs have been estimated by NOAA to average about 50% of fishing revenues; these costs are not incurred if a vessel is not fishing. That is the reason why NOAA's fishermen compensation program compensates vessel owners for lost fishing time at 50% of estimated losses in fishing revenues. Of course, fishing vessels that lose fishing revenues from not fishing in the WDA can be expected to continue to fish elsewhere and to continue to incur fishing costs. In that case, however, they can be expected to recoup at least some fishing revenues lost from the WDA by generating fishing revenues from other areas.

In my report, estimates of potential fishery-related economic losses are based on fishing revenues lost from not fishing in the WDA. My estimates are not adjusted on the assumption that vessels experiencing those lost fishing revenues in the WDA will continue fishing elsewhere (generating offsetting revenues) or the assumption that they will not fish elsewhere (saving fishing costs). However, adjusting estimates of economic loss based on either of these assumptions would result in significantly lower estimates of expected economic losses than those reported in my paper.

In summary, Dr. Sproul recommends that if fishing revenues from the WDA in recent years are used to measure potential economic losses in 2019, they should be adjusted upward by 9.36% to account for inflation. However, making this adjustment would have far less impact on baseline compensation estimates than making other just as logical and much more significant adjustments based on fishing costs saved, alternative fishing revenues generated, or the use of inflation and the time value of money to discount advanced payments of fishermen's compensation.

Note: Attachment A to this Addendum presents estimates of annual fishing revenue losses from the WDA, adjusted to 2019 dollar values, as the basis for developing estimates of potential shore-side multiplier impacts from WDA development.

2. Disregarding Small Changes

Dr. Sproul criticizes the analysis used in the report for "disregarding small changes." I do not fully understand what he is referring to with this comment, as he doesn't specify or reference any particular section of my report or provide examples or information sources to explain what he means.

However, regardless of what Dr. Sproul might have had in mind with this criticism, it would not seem justified since the purpose of my analysis, as described earlier, was to provide baseline estimates of economic exposure. It was not to provide a comprehensive estimate of all potential "small changes" that could result in economic losses under some possible scenarios, no matter how small their probability or likely impact. In fact, the paper did focus on what might be considered low probability worst case impacts (e.g., all landings value from the WDA are lost and not replaced). It did not attempt to address worst case impacts of very low probability events identified by Dr. Sproul that involve pure speculation (e.g., the placement of wind turbines in the WDA will result in the collapse of the entire squid fishery and economic losses due to loss of vessels and fishermen's lives).

Finally, as a practical matter, the criticism by Dr. Sproul that my analysis ignored many possible small changes, regardless of their likelihood, is irrelevant because Vineyard Wind's fisheries compensation program is designed to compensate fishermen (and shore-side interests) in the future for any economic losses resulting from either large or small changes that can be shown to be attributable to the Vineyard Wind project.

3. Assuming Changes are Evenly Distributed

The analysis presented in the report did not assume that changes or impacts are evenly distributed. The report relied on historical Vessel Trip Reports (VTRs), Vessel Monitoring System (VMS) data, state-specific landings and ex-vessel price data, and previous analysis by RI-DEM, NOAA, and BOEM to distribute estimates of economic exposure (potential lost fishing revenues) among states. These sources represent the best available data for allocating potential economic impacts.

Because of data limitations, the report did not attempt to describe how potential lost fishing revenues within each state are likely to affect individual fishing fleets or ports.

As discussed further below, it is reasonable to assume that some fishing fleets and ports rely more than others on harvests from the WDA and may be more impacted by reduced landings from the WDA. As mentioned previously, however, my report provided baseline values to guide the establishment of a fisheries compensation program and ensure an appropriate level of funding is available for that program. It did not assume impacts are evenly distributed or address how compensation payments should be allocated.

4. Reliance on Vessel Trip Report (VTR) Data

This criticism reflects a fundamental misunderstanding of the data used in the analysis presented in the report. As the report indicates, I reviewed all relevant fishing value data and, in the end, decided to rely on fishing value estimates for the Lease Area presented in RI-DEM (2017) which were based on an integrated analysis of VTR, VMS, and state and federal landings records. In fact, the RI-DEM (2017) study that generated most of the fishing value estimates used in my analysis is one of the two studies Dr. Sproul himself cites in his letter as providing evidence that VTR data alone do not provide a reliable basis for estimating fishing values. I agree with Dr. Sproul and the author of RI-DEM's (2017) report that VTR data alone do not provide a reliable independent basis for estimating fishing values. That is why I did not rely solely on them. It is worth noting, however, that I did use NOAA's VTR-based fishing revenue database to cross-check the more broadly-based estimates of fishing values I was using from RI-DEM (2017). It is noteworthy that this crosscheck showed that apart from lobster and Jonah crab landings(which were included in my analysis), fishing values from the Lease Area estimated both ways were very similar for most years.

The estimates of annual landings values from the WDA presented in my report are intended to serve as measures of fishing values at risk that can provide a baseline for negotiations over compensatory mitigation funds. Comparable estimates presented by Dr. Sproul in his letter are significantly higher even though we both used the same source of fishing revenue data (RI-DEM). That is because his estimates were based on a very different set of assumptions that are unusual and unreasonable.

As noted above, the measures of fishing values from the Lease Area in my report were based on estimates of annual fishing revenues generated <u>in the Lease Area</u> during 2011-2016, as presented in RI-DEM (2017). In his letter, Dr. Sproul presents estimates of fishing values for the Lease Area that are based on a subsequent study by RI-DEM (RI-DEM, 2019)[2] which includes the assumption that <u>all</u> fishing revenues on <u>al</u>l fishing trips that intersect either the WDA or a 1 to 2 nautical mile (NM) buffer zone to the north and south of the WDA are fishing values that are attributable to the WDA. This would constitute a measure of potential lost fishing values only under the unreasonable assumption that owners of all vessels that make such trips will choose to keep their vessels in port, generating no fishing revenues, rather than to simply modify their fishing trips (or even just adjust individual tows) in order to continue fishing and generating fishing revenues.

A basic tenet of economics is that businesses will continue operating as long as expected revenues (trip revenues) exceed operating costs (trip expenses), so continued operation will generate at least some income that can contribute to fixed costs (vessel ownership costs). There is no economic justification for presenting estimates of fishing values at risk by assuming that fishermen will be economically irrational and cancel all trips that transect even a portion of the WDA. Furthermore, many statements by the Rhode Island Fisheries Advisory Board ndicate that 1 NM spacing between turbine rows (oriented west-to-east) is needed in order to allow fishing to continue within the WDA. That implies it is unreasonable to assume that all fishing revenues will be lost on all trips that transect a 1 NM or 2 NM buffer around the WDA.

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[2] Rhode Island, Department of Environmental Management (RI-DEM) generated three reports dealing with fishing values in the Vineyard Wind Lease Area. RI-DEM (2017) estimated annual fishing values for the Lease Area based on reported harvests in the Lease Area during 2011-2016. RI-DEM (2018) used the same study period to estimate annual fishing values for the Lease Area based on all fishing revenues reported on all fishing trips during which a vessel transected the lease area. RI-DEM (2019) employed the same approach as RI-DEM (2018) but applied it to all fishing trips during which a vessel transected either the Lease Area or a 1 nautical mile or 2 nautical mile buffer to the north and south of the Lease Area. For unexplained reasons Dr. Sproul chose to use results from RI-DEM (2019) as the basis of the analysis of landing values presented in his letter.

The study that Dr. Sproul uses to base his economic loss estimates, RI-DEM (2019), estimates that fishing values for the WDA based on revenues on trips that transect a 1 or 2 NM buffer zone around the WDA over the thirty-year life of the Project will be $30.6 million with a 1 NM buffer and $35.7 million with a 2 NM buffer. Dr. Sproul uses results from that RI-DEM report, rather than earlier RI-DEM reports that employed more reasonable assumptions, to estimate that annual landings by vessels from Rhode Island and Massachusetts within the WDA are $726,298 with a 1 NM buffer and $829,994 with a 2 NM buffer. The next section compares estimates of fishing revenues generated in the WDA with estimates of fishing revenues generated on trips that transect the WDA to illustrate why Dr. Sproul's approach does not make sense.

<u>**Fishing Revenues on Trips that Transect the WDA**</u>

Based on RI-DEM (2017), the average annual value of landings from within the WDA during 2011-2016 (not including lobster or Jonah crab) was $388,542. Based on RI-DEM (2018), the average annual value of all landings on all trips that transected the WDA during these years (not including lobster or Jonah crab) was $1,244,075. That indicates that $855,533, or 69% of revenues on trips that transect the WDA, is generated <u>outside</u> the WDA. A similar comparison was reported in King (2018) based on trip revenues for Rhode Island-based vessels only, which showed that only 15.8% of fishing revenues on trips by Rhode Island fishing vessels that transect the Lease Area were generated inside the WDA. The remaining 84.2% of fishing revenues on those trips was generated either entirely outside the Lease Area, or inside the Lease Area, but outside the WDA.

Such comparisons confirm what is generally known from VTR, VMS, and AIS data, which is that the WDA is a relatively unproductive commercial fishing area surrounded by relatively productive fishing areas. It also provides evidence that the assumptions used in RI-DEM (2019), which formed the basis of Dr. Sproul's analysis of fishing values at risk, are not valid. It makes no sense to assume that all fishing trips that transect the WDA (or a 1 or 2 NM buffer to the north and south of it) will be cancelled with all trip revenues lost.

Potential Losses Not Estimated

5. <u>Where Scientific Consensus is Lacking</u>

Dr. Sproul introduces this section by stating: "in my opinion, the lack of scientific consensus does not translate into lack of risk imposed on the fishing industry." That is certainly true and, in fisheries, there is always some lack of scientific consensus. However, there is significant scientific consensus about fishery-related issues related to the Vineyard Wind project. Multiple published reports, for example, indicate broad consensus among government, university, and consulting private sector fishery scientists who have contributed to various Vineyard Wind project permitting documents about the Project's expected impacts on fish population dynamics (see BOEM, 2017; COP, 2018; DEIS, 2019). At this time, that consensus, generally, is that Project impacts on fish stocks will occur primarily during construction and decommissioning, and will be relatively minor, localized, and short-term.

The most concrete example Dr. Sproul presents to illustrate where a lack of scientific consensus may involve hidden risks to the fishing industry is not related to the Vineyard Wind project itself, but to potential long-term impacts of offshore wind energy development in general. He states, for example, that "…as each new wind development comes online over a decade or more, who is to say that the squid don't eventually learn to spawn elsewhere, leading to a collapse of the fishery? While science does not say this will happen, I think you would be hard pressed to find anyone interested in insuring this loss."

Dr. Sproul is correct in stating that "…science does not say this will happen…." In fact, as noted previously, studies of offshore wind farms in Europe indicate that while squid exhibit avoidance behavior and relocate away from windfarms during construction, they return after construction with no significant changes in their abundance or age distribution (Vandendriessche et al., 2013; Rumes et al., 2013).

The available science at this time does not provide a basis for addressing the hypothetical possibility that cumulative offshore wind energy development impacts may include the collapse of the squid fishery. There is certainly no basis for considering such a possibility in baseline compensation estimates for a single project. If Dr. Sproul's point here is that it would be worthwhile to develop a better-informed scientific consensus about potential cumulative effects of New England offshore wind development on the population dynamics of squid, I certainly agree with him. In his letter, however, he asserts that my assessment of fishermen's compensation associated with the Vineyard Wind project should have addressed a hypothetical and unsubstantiated outcome: the collapse of the squid fishery. He provided no justification for why this should have been done, or indication of how it could have been done, in the absence of any scientific support.

6. Impacts on Shore-Side Businesses

In my report, I concluded that shore-side impacts from the loss of Massachusetts landings from the WDA would be negligible. In this section of his letter, Dr. Sproul criticizes this conclusion and presents his estimates of these impacts. Below I will summarize the basis of my conclusions about shore-side impacts and why they differ from those reached by Dr. Sproul. Attachment A provides additional supporting details for assessing and comparing the differences in estimated shore-side economic impacts. Attachment A also provides an update to the analysis of shore-side impacts that I prepared for Vineyard Wind in August 2019, which is based on assumptions other than those used in my report. Differences between these updated estimates of shore-based impacts and those presented in my initial report and by Dr. Sproul are described below.

My treatment of shore-side impacts in the initial report was partially based on the limited contribution of Massachusetts fish landings from the WDA to overall Massachusetts landings and to Massachusetts seafood supplies. During 2011-2016, for example, annual Massachusetts commercial landings from the WDA averaged $196,621 (including lobster and Jonah crab), which represented 0.04% of the $558.7 million in average annual Massachusetts landings during those years. In 2016, Massachusetts landings from the WDA, $305,939 (including lobster and Jonah crab), were higher than average and represented 0.02% of the $1.257 billion in fish purchased by Massachusetts seafood suppliers in that year, which includes all purchases of Massachusetts landings plus fish delivered to Massachusetts from other states and overseas.

Because of the relatively small contribution of the WDA to Massachusetts landings and seafood supplies it was reasonable to base my initial assessment of potential shore-side impact on two assumptions.

1. The development of the WDA will not result in Massachusetts fishing vessel operators cancelling fishing trips and purchasing fewer fishing inputs. As a result, there will be no significant shore-based "upstream" (or backward-linked) economic multiplier impacts; and

2. The development of the WDA will not result in Massachusetts seafood purchasers and processors significantly reducing their economic activity because of limited supplies of fish from the WDA. Because the supply of fish from the WDA is so small, and buyers have so many sources of substitute fish, there will be no significant "downstream" (or forward-inked) multiplier impacts.

Based on these two assumptions, my report estimates that Massachusetts shore- side multiplier impacts (indirect and induced effects) from an average annual decline of $196,621 in Massachusetts landings from the WDA (the direct effect) would not be significant. This seemed especially reasonable since fishing will not be totally precluded in the WDA and fishing that is diverted to other areas will continue to supply fish to Massachusetts buyers and generate shore-side impacts.

Dr. Sproul criticizes this assessment and presents an analysis that is based on a fishery impact model he developed for the state of Rhode Island (Sproul and Michaud, 2018). That model assumes:

1. All declines in fish landings are a result of declines in fishing effort and, therefore, will result in proportional (linear) declines in purchases of fishing inputs and upstream (or backward-linked) impacts; and

2. Seafood buyers will not find substitute sources of fish to replace a potential $196,621 decline in Massachusetts landings from the WDA, which will result in proportional (linear) downstream (or forward-linked) losses in seafood business sales and related multiplier impacts.

Based on his Rhode Island model, Dr. Sproul recommends using an economic multiplier of 0.98 to estimate the indirect and induced Massachusetts impacts based on direct losses of Massachusetts landings from the WDA. The model Dr. Sproul developed for Rhode Island and the assumptions on which it is based are reasonable in some instances, such as when significant changes in landings are a result of significant changes in fishing effort. This would be the case, for example, when fishing regulations, such as quotas or closed fishing seasons, prevent vessels from fishing and landing fish. In fact, as shown in Attachment A, NOAA uses a fishery economic impact model for estimating shore-side impacts of fishing regulations which employs Massachusetts-based "upstream" and "downstream" fishery economic impact multipliers of 0.827 and 0.737, respectively. The combined value of these two NOAA-based multipliers for Massachusetts, 1.564, is comparable to the 0.98 multiplier estimate for Rhode Island by Dr. Sproul.

Based on Dr. Sproul's Rhode Island model (0.98 multiplier) and NOAA's Massachusetts model (1.564 multiplier), a loss of $196,600 in Massachusetts landed values from the WDA results in indirect and induced shore-side impacts of $193,000 and $307,428, respectively (if one accepts that the assumptions used in those models are valid in this application).

This comparison indicates that, if one accepts the idea that applying multipliers in this situation is reasonable, it is reasonable to accept or even increase the 0.98 shore-side multiplier used by Dr. Sproul. The problem with Dr. Sproul's approach is that he uses this 0.98 multiplier to estimate indirect and induced shore-side impacts by applying it to the highly exaggerated estimates of direct impacts (losses of landed value) that he developed based on RI-DEM (2019) (see above descriptions of why RI-DEM [2019] results are not valid and grossly overstate direct impacts).

Dr. Sproul's use of highly exaggerated direct impacts results in the use of his 0.98 multiplier generating an estimate of annual shore-based economic exposure of $454,394. As described above, applying Dr. Sproul's multiplier estimate of 0.98 to a more reasonable estimate of direct impacts would result in an estimate of shore-side multiplier impacts of under $200,000. More details about shore-side impact estimates are provided in Attachment A.

I do agree with Dr. Sproul's last point in this section. A possibility exists, however small, that shore-side businesses in some Massachusetts ports may be particularly dependent on fish harvested in the WDA and may have limited access to substitute sources of fish, and therefore, may experience significant localized "downstream" (or forward-linked) shore-side impacts from a decline in fish landings from the WDA. However, it is important to put this possibility in perspective by noting all sources of local shore-based impacts caused by the Project. For example, Vineyard Wind's fishermen's compensation program will be compensating fishermen who typically land fish from the WDA for lost fishing income based on the full landed value of fish harvested in the WDA. Because these compensation payments will not be adjusted for fishing costs, fishermen will actually have more income to spend locally under this compensation program than they would have earned from fishing in the WDA. As a result, shore-side spending by fishermen will likely be higher and generate more shore-side multiplier impacts under the Vineyard Wind compensation program than if the Project had no impacts on fishing in the WDA. While spending of compensatory funds by fishermen will generate shoreside multiplier impacts, fishing businesses may not realize the benefit of that spending activity. That being said those fishing businesses would themselves be eligible to receive compensatory mitigation.

Lastly, it is important to note that in addition to receiving compensation from Vineyard Wind on the basis of the full value of expected landings from the WDA, it is highly likely that the full value of those landings and related shore-based economic impacts will not be lost. Fishermen will continue to land fish, either from continuing to fish in the WDA or by shifting fishing effort from the WDA to other areas. That on-going fishing activity will generate at least some continued shore-side multiplier impacts in the fishing and seafood processing sectors at the same time that compensatory mitigation funds will generate other shore-side multiplier impacts. In the final analysis, therefore, even if there is a net decline in fish landings in some WDA dependent ports as a result of the Project, the combination of shore-side spending based on fishermen's compensation payments, additional compensation paid to onshore fishing businesses, residual landings from the WDA, and replacement landings from increased fishing in other areas can be expected to result in positive "downstream" (or forward-linked) economic impacts. These positive impacts can be expected to replace - if not exceed - any negative economic impacts related to lost landings from the WDA.

7. Economic Impacts from Disruptions in Recreational Fishing

Dr. Sproul starts his criticism in this section by stating: "Recreational fishing is largely not mentioned in the King Report." However, the title of the paper is "Economic Exposure of Massachusetts ***Commercial*** Fisheries to the Vineyard Wind Project" (emphasis added). Because the focus of the paper is commercial fishing, not recreational fishing, it is true that recreational fishing is not mentioned at all in the report.

This would require no further response except that Dr. Sproul's letter asserts that expected annual economic exposure of recreational fisheries during WDA construction and decommissioning will be $3.4 million per year, and overall economic exposure of Massachusetts-based recreational fisheries to WDA development over 30 years is $761.2 million. Dr. Sproul presents no analysis or data to support the notion that these estimates of the overall economic value of recreational fisheries in Massachusetts should be viewed as potential Massachusetts-based economic losses resulting from the Project. As a result, there is no basis for responding to them other than to point out that they are not consistent with any analyses of recreational fishing impacts presented in various environmental reviews prepared for Project permitting purposes, or what is generally known about the effects of constructing and operating wind farms on recreational fishing.

For example, research results indicate that wind turbine construction and decommissioning activities will result in the temporary displacement of fish and limited fish mortality (such as to immobile egg and larval life stages) within the construction footprint, but that there will be no long-term impacts on fish population dynamics (COP, 2018). Other research indicates that recreational fishing that usually takes place in areas where offshore wind projects are developed will shift temporarily to other areas during construction and decommissioning and then return (COP, 2018).

In fact, other than these temporary adverse impacts to fish and recreational fishing during construction and decommissioning, permitting documents related to the Vineyard Wind Project and other sources suggest that offshore wind development can provide significant benefits to recreational fishing. For example, wind turbines have been shown to function as fish aggregation devices (BOEM, 2017, Appendix A). In recognition of the benefits wind turbine foundations bring to recreational fishing, groups such as "Anglers for Offshore Wind" have formed to support responsible development of offshore wind power (seehttp://www.anglersforoffshorewind.org).

8. Increases in Transit Costs for Commercial Fishing Vessels

Dr. Sproul criticizes my report because it did not address potential increases in fishing vessel transit costs. His letter provides estimates that WDA development will result in Massachusetts and Rhode Island fishing vessels experiencing fleet-wide increases in annual transit costs of $45,444 and $30,805, respectively. This section describes why it was reasonable not to address potential transit cost increases in my initial report. It also summarizes an "Updated Transit Cost Analysis" that I undertook in August 2019 at the request of Vineyard Wind because additional information had become available about numbers of annual transits through the WDA. Attachment B provides more details about the updated transit cost analysis summarized below and compares it with the analysis presented in Dr. Sproul's letter. Based on assumptions described in Attachment B it is not unreasonable to accept Dr. Sproul's estimates that fleet-wide annual increases in transit costs for Massachusetts fishing vessels will be $45,444.

There were three reasons why I did not address increased transit costs in my initial Massachusetts report:

1. At the time the report was developed, the only available analysis of transit cost impacts associated with the Vineyard Wind project was in the Project's Construction and Operations Plan (COP) (Section 7.6.3.2, Impacts to fishing activities outside the WDA). That analysis included GIS-based comparisons of steaming distances, times, and costs between major fishing areas as well as between those fishing areas and major fishing ports in Massachusetts, Rhode Island, and New York, based on the most direct (no project) route and the shortest route around the initially configured WDA (306 sq. km). Results presented in the COP (2018) showed that the WDA is not on the direct route between most combinations of ports and fishing areas and, where direct routes did transect the WDA, detouring around the WDA resulted in an average distance increase of less than a few nautical miles (e.g., between about 0.05 NM and 2.5 NM for the routes analyzed). For example, for fishing vessels transiting between Montauk, New York and Asia Rip, transiting around the WDA would increase steaming distance by 0.6 NM and was estimated "…to increase round trip costs by an average of $18.00" (COP, 2018). Based on the COP (2018), WDA impacts on per transit costs were extremely low.

2. At the time the report was developed, I could find no analyses of VMS, VTR, or AIS data that estimated the number of annual transits through the WDA, which is mentioned in the report. I also indicated that because available estimates of potential increases in costs per transit were small and there were no data indicating that the number of transits affected was large, I did not address transit costs in my estimates of baseline economic losses.

3. At the time the report was developed, Vineyard Wind was in the process of reducing the size of the WDA from 306 sq. km to 245 sq. km (making it 20% smaller). Vineyard Wind was also actively engaged in discussions with Rhode Island and Massachusetts fishermen regarding navigation options through the WDA. Updating available transit cost estimates from the COP (2018) to reflect the reduced size of the WDA and fishing vessels having as yet unspecified options for steaming through the WDA, rather than around it, would have made already small estimates of increases in costs per transit even smaller.

Updated Transit Cost Analysis

Since the initial report was prepared in April 2019, new estimates of the typical number of annual fishing vessel transits through the WDA have been developed using AIS and VMS data and can be used to improve estimates of transit cost increases.

Attachment B summarizes an updated transit cost analysis I prepared for Vineyard Wind in August 2019 based on that new data. It also compares transit cost estimates based on two different sets of estimates of annual fishing vessel transits through the WDA: those based on AIS data (Baird, 2019a) and those estimated using 2016 VMS data by RI-DEM, as used in Dr. Sproul's analysis.[3]

Estimates of increases in annual transit costs can be based on two factors: the average increase in costs per transit and the average annual number of transits. Two estimates of the number of annual transits are available. Based on Baird (2019a), an analysis of AIS data indicate that the average annual number of fishing vessel transits through the WDA during 2012-2016 was 989 (excluding vessels that are not equipped with AIS). This is very similar to the second estimate that was used by Dr. Sproul based on a RI-DEM analysis of 2016 VMS data which showed 1,100 annual transits through the WDA by vessels from Massachusetts and Rhode Island (excluding vessels that fish exclusively for lobster and Jonah crab).

Two estimates of average annual fleet-wide increases in fishing vessel transit costs are compared in Attachment B. The first is based on an estimated average cost of $15 per NM from the COP (2018), the number of vessel transits from Baird (2019a), and the average three NM detour per transit estimated in Sproul (2019). This, results in $45 in increased costs per transit. The second is based on Dr. Sproul's estimate of average costs per transit, the number of vessel transits estimated by RI-DEM, and Dr. Sproul's estimates of transits for vessels that fish exclusively for lobster and Jonah crab. As described in Attachment B, the first method results in an estimated increase of $44,505 in annual fleet-wide fishing vessel transit costs (excluding vessels not equipped with AIS); the second method, as reported by Dr. Sproul, results in an estimate of $76,249 in annual fleet-wide fishing vessel costs for Rhode Island and Massachusetts fishing vessels. When Dr. Sproul's estimate is adjusted to include CT, NY, and NJ vessels, as described in Attachment B, the second method results in an overall fleet-wide estimate of $83,699 in increased fishing vessel transit costs per year.

According to Baird (2019a), it is reasonable to conservatively assume that AIS-equipped vessels represent 30% to 50% of the overall fishing fleet operating in WDA-84. Therefore, the estimate of $44,505 in increased transit costs based on Baird (2019a) and COP (2018) may only represent increased transit costs for 30% to 50% of the overall fishing fleet. This may explain why the estimate based on Baird (2019a) and COP (2018) is approximately 53% of the $83,699 in increased fleet-wide transit costs estimated by Dr. Sproul (adjusted to include CT, NY, and NJ-based vessels). For this reason, it is not unreasonable to accept Dr. Sproul's estimate that WDA development will result in fishing vessels from Massachusetts experiencing a fleet-wide increase in average annual transit costs of $45,444.

9. Life and Vessel Safety Risks

Dr. Sproul criticizes my report because it does not attempt to estimate economic losses associated with increased "life and safety risks" associated with two factors: navigational hazards and vessel crowding. He then presents estimates of these economic losses. Below I respond to these criticisms and to his estimates of dollar costs associated with his prediction of vessels and lives that will be lost as a result of

[3] To my knowledge the RI-DEM analysis of 2016 transits through the WDA using VMS data that was cited in Dr. Sproul's letter has not been published.

Project development. Based on the available evidence, expected increases in life and vessel safety risks associated with the Project are not significant and are too small to be measurable and monetized in advance, as Dr. Sproul attempts to do in order to support increases in compensatory mitigation funds.

Before reviewing the approach and data Dr. Sproul uses to monetize life and vessel safety risks based on navigational hazards and vessel crowding, it is important to point out that accepted methods for assessing accident risks in maritime industries are extremely complex, and that actuarial data for applying those methods are constantly being reinterpreted as new vessel safety technologies evolve and are installed on vessels to comply with evolving vessel safety laws or to maintain vessel insurability. For example, as new navigation aids (e.g., GPS and AIS) have evolved and been employed on more ships, accident risks associated with collisions and allisions have declined significantly (Lutzen and Hansen, 2003).

Navigational Hazards

By "navigational hazards," Dr. Sproul is referring to the presence of wind turbines in the WDA, and by "life and safety risks," he is referring to the likelihood that fishing vessels will allide with wind turbines in the WDA or collide with other fishing vessels, resulting in vessels being lost or damaged and fishermen fatalities.

Conceptually, of course, the placement of 84 wind turbines in the WDA where none now exist does create a non-zero risk that a vessel operating in the WDA will run into one. In addition, the presence of turbines may affect radar, an important navigational tool, by potentially creating false targets and clutter on radar displays. However, as discussed in Baird (2019a), upgrades and modifications to fishing vessels' radar systems and/or advanced training of radar operators can mitigate these impacts, and compensatory mitigation funds are available for both of these purposes. Nevertheless, Dr. Sproul is correct that the potential economic costs associated with the risk that fishing vessels will allide with turbines, including the possibility that such risk may be reflected in insurance premiums paid by fishermen or insurance-based restrictions on fishing in the WDA, were not addressed in my report.

Dr. Sproul develops a "vessel traffic/life/safety risk model" and uses it to predict the dollar value of vessels and lives lost as a result of allisions with wind turbines in the WDA and increases in collisions involving fishing vessels inside and outside the WDA. The following section describes the problems with Dr. Sproul's model and the data he used to apply it. It also explains why the likelihood of such accidents is extremely low and why economic damages associated with such rare accidents will be significantly lower than those predicted by Dr. Sproul and should be addressed on a case-by-case basis if and when they occur.

Dr. Sproul's Estimate of Navigation Hazard Costs

In his letter, Dr. Sproul outlines a "vessel traffic/life/safety risk model" he developed and uses it to generate fleet-wide estimates of the current dollar value of expected life and safety risks associated with potential accidents involving fishing vessels and wind turbines in the WDA over a thirty-year period.

Dr. Sproul does not fully explain his model in the letter, so it is difficult to assess how various assumptions fit together. However, it is clear from what information is provided that the model is driven by two factors: his use of a fishing vessel "loss of control rate of 0.005 per hour" which he develops into a fishing vessel control "failure rate of 0.84% per passage through the project area"; and his conclusion that "conditional on loss of control, the probability of impact [between a transiting fishing vessel and a wind turbine] is 1.92%." However, it appears that the loss of control rate of 0.005 per hour, which was derived from Kristiansen (2013), is overly conservative and may not be representative of modern fishing vessels. As described in Baird (2019b), the loss of control used by Dr. Sproul is based on a grounding incidents involving large commercial ships and is 22 to 31 times higher than the other failure rate estimates provided in Kristiansen (2013).

He then predicts that there will be "0.154 vessels lost per accident and 0.087 fatalities per accident" and then, using $750,000 as the cost per lost vessel and $6.5 million as the statistical value of a life saved (SVLS), he concludes that the expected annual economic losses experienced over 30 years by Massachusetts and Rhode Island fishermen as a result of fishing vessels and lives lost in the WDA due to the presence of wind turbines will be $64,741 and $96,203, respectively.

It is not possible from Dr. Sproul's letter to reproduce or trace his analysis, and I have not seen or undertaken any similar analysis. However, before considering Dr. Sproul's results, it is worth noting that they are driven mostly by his determination that fishing vessels will experience "a failure rate of 0.84% per passage through the area" causing accident risk. Since this is not affected by whether wind turbines exist in the area or not, it should be possible to judge whether this number makes sense based on data or vessel logs that reveal how frequently fishing vessels currently experience losses of control in and around the WDA.

For example, as described in the previous section, both Baird (2019a) and RI-DEM (2019) estimate that, on average, there are roughly 1,000 annual fishing vessel transits through the WDA (excluding vessels not equipped with AIS or filing VTRs). Given a failure rate of 0.84% per WDA transit, as predicted by Dr. Sproul, records of those transits should show an average of about 8 vessels per year experiencing a "loss of control" during the 1 to 2 hours it takes most fishing vessels to transit the WDA.

I have not examined any data to assess whether an average of eight fishing vessels per year lose control during their brief transit through the WDA. However, it seems highly unlikely. I expect that interviews with fishing vessel owners and operators and an examination of vessel logbooks will show that the average annual number of fishing vessels that lose control while transiting the WDA is closer to zero.

<u>Dr. Sproul's Assessment of Vessel Crowding Risks</u>

Vessel crowding, in some situations, can be an important source of collision risk and potential economic loss. As described earlier, however, the WDA is a relatively inactive fishing area, and most of the fishing revenues on trips that transect the WDA are generated from fishing that takes place in areas adjacent to the WDA. In open-ocean fisheries, fishing vessels are constantly shifting fishing effort from one area to another in response to changes in fishing, weather, market, and regulatory conditions. Any slight shift in fishing effort resulting from WDA development is likely to have far less impact on vessel crowding than other changes that take place routinely in New England fisheries, such as new fishing permits being issued or fishing regulations (such as quotas, closed areas, or closed seasons) forcing fishing effort from one area to another. As research summarized below indicates, fishing vessel density and accident rates in New England fisheries are not correlated; vessel crowding is not a problem in New England ocean fisheries and significant increases in fishing density in these fisheries has not resulted in increases in vessel collision risk.

Dr. Sproul's letter does not present the model of vessel crowding he used to quantify the dollar value of his estimate of "safety costs due to crowding." However, he does indicate that they are based on certain rules of thumb presented in Kristiansen (2003), which are based on "decades of maritime risk literature dating back to publications from 1971." Dr. Sproul states that these rules of thumb include: "the probability of loss of control is 0.005 failures per hour" and "vessel accidents increase proportionally to the square of the number of vessels" such that "a 1% increase in vessels leads to a 2% increase in conflict, and therefore accidents" (Kristiansen, 2003). On that basis, which he calls "percent displacement," he generates a table that shows WDA development will result in Massachusetts and Rhode Island commercial fishermen facing annual safety costs due to crowding of $62,509 and $45,045, respectively.

To put the validity of this analysis in perspective, consider the results of a study of historical fishing vessel densities and vessel accidents in New England fisheries performed by fishery economists at NOAA and Woods Hole Oceanographic Institution (WHOI) and presented in a 2005 article in the journal *Safety Science* (Jin and Thunberg, 2005). Based on USCG data for years 1981-2000 they examined the effects of potential vessel crowding caused by fishing regulations (e.g., quotas, closed fishing areas, limited fishing seasons) on annual accident rates for fishing vessels operating in fishing areas off the Northeastern United States, including the Vineyard Wind Lease Area. Results showed that in the twenty years between 1981 and 2000, vessel accident rates in those fisheries declined from 1.9933 per thousand days at sea to 0.2906 per thousand days at sea (a decline of 85.4%), while the number of annual vessel-days, measured as 24 hours at sea, increased from 153,013 to 333,771 (an increase of 118.1%). As the density of vessels in these fisheries has increased, accident rates in these fisheries have decreased.

It is reasonable to assume that accident rates in New England fisheries, as in most fisheries, declined during the period of that New England fishery study because of technological advances that improve vessel and navigational safety. It is also reasonable to expect that accident rates in New England fisheries have continued to decline since that study and will continue to decline in the future as a result of new technologies being installed on more vessels, increasingly stringent vessel safety regulations, and vessel insurance requirements.

This research on New England fisheries indicates that the "rule of thumb" used by Dr. Sproul ("a 1% increase in vessels leads to a 2% increase in conflict, and therefore accidents"), which is based on historical global maritime industry statistics, is not valid when applied to modern New England fisheries.

Vessel Crowding in the WDA

As my report indicates, annual fishing revenues generated in the WDA during 2011-2016 averaged $391,390 (nominal, including lobster and Jonah crab). This relatively low level of fishing revenues is consistent with a relatively low level of fishing effort and a low likelihood of vessel crowding associated with fishing in the WDA.

A recent study of vessel traffic within the WDA (Baird, 2019a) provides additional evidence that there is little chance of fishing vessel crowding in the WDA. That study concluded:

> "Historical traffic levels within the [WDA] are relatively low. The vessel traffic is seasonal in nature with approximately 1 vessel every two days on average in the winter months to a peak of 9.3 vessels per day on average in the month of August. An evaluation of vessel proximity indicated that two or more vessels are present within the WDA simultaneously for only 123 hours per year on average (1.4% of the year). Overall, based on this historical level of traffic, the risk of collision between vessels is relatively low."

These measures of limited vessel traffic and fishing activity in the WDA provide evidence that vessel crowding in the WDA is not a meaningful cause of life and vessel safety risks and related economic losses.

Vessel Crowding outside the WDA

As earlier sections indicated, vessels that currently fish in the WDA also fish in adjacent fishing areas and, in fact, many of them fish inside the WDA and in adjacent waters on the same trip. This is important when considering the possibility of vessel crowding from fishing effort shifting from the WDA to other areas. My initial report showed that, of the $2,901,322 in average annual fishing revenues on fishing trips that transect the WDA during 2012-2016, only $459,000, or 15.8%, was generated inside the WDA. The other $2,442,322, or 84.2%, was generated in waters either outside the Lease Area or inside the Lease Area, but outside the WDA. This implies that any shift in fishing effort from the WDA to adjacent and nearby fishing areas will mostly involve fishing vessels that are already operating in those fishing areas shifting slightly more of their fishing effort from the WDA to those other fishing areas.

Overview of Vessel Crowding Risk

Concepts such as "vessel crowding risk" and "fishing congestion externalities" are relevant in some fisheries and can be a significant source of concern in some circumstances. However, for the reasons enumerated above, they do not seem relevant when assessing effects of WDA development on the allocation of fishing effort inside or outside the WDA. The COP (2018), and more recently Baird (2019a), indicate that vessel traffic impacts associated with the Project, including the placement of WTGs in the WDA, will not contribute significantly to navigational risks.

Summary and Conclusions

The purpose of my report, "Economic Exposure of Massachusetts Commercial Fisheries to the Vineyard Wind Project," was to provide baseline estimates of potential economic exposure of Massachusetts *commercial* fisheries to the Vineyard Wind project to support the development of a fisheries mitigation program for this specific Project. The report was not intended to provide a comprehensive economic assessment of all conceivable changes in regional fisheries that could be attributed to offshore wind energy development. My report did address what might be considered low probability worst case impacts (e.g., all landings value from the WDA are lost and not replaced); it did not attempt to address hypothetical scenarios that Dr. Sproul speculates may develop in the future, but are not supported by available science (e.g., the placement of wind turbines in the WDA will result in the collapse of the entire squid fishery and economic losses due to loss of vessels and fishermen's lives). Most of the theoretical possibilities listed by Dr. Sproul as potential sources of fishery economic losses are best dealt with in real terms, on a case-by-case basis, if they occur, with compensation paid through claims against Vineyard Wind's compensation fund or through insurance claims or legal proceedings.

Dr. Sproul's letter listed some criticisms that are based on general principles that may be useful for some purposes, but are not useful when applied to the focus of my report. For example, Dr. Sproul asserts that my report should have expressed fishing values in inflation-adjusted rather than nominal dollars. However, as explained above and in Attachment A, there are significant advantages to using nominal dollar values and disadvantages to using inflation-adjusted dollar values when the basis and timing of compensation payments for fishing value losses have not been established, as is the case with the Vineyard Wind project. Dr. Sproul also criticizes what he characterizes as my reliance on one type of fishery data. However, the fishing value estimates in my report were based on an integrated analysis of VTR, VMS, and state and federal landings records, not just one data type. Dr. Sproul posited that additional mitigation funds are required to pay for economic losses associated with life and safety risks associated with WDA development. However, his assumptions about life and safety risks associated with vessel crowding and vessels alliding with wind turbines are not supported by the available literature. For example, Dr. Sproul's assessment of vessel crowding risks based on global shipping accident data conflicts with findings from a recent study of vessel traffic risks within the WDA (Baird, 2019a). That study confirms that there is very limited vessel traffic and fishing activity in the WDA. Baird (2019b) indicates that Dr. Sproul's estimates of allision and collision risk are derived from his use of vessel failure models and input data that are based on global shipping, not fishing, and significantly over-inflate the frequency of allisions and collisions and their associated economic costs.

Dr. Sproul's estimates of potential lost fishing revenues from WDA development are significantly higher than those presented in my paper even though we both relied on data from RI-DEM. That is because Dr. Sproul's analysis of that data is based on illogical and conflicting assumptions. For example Dr. Sproul assumes that all fishing trips with at least one tow that intersects the WDA or a one or two-mile buffer zone around the WDA will be canceled (resulting in the loss of all revenues from those trips). At the same time, he assumes that fishermen will experience additional economic losses associated increased vessel crowding in the WDA (from continued fishing the WDA) and outside the WDA (caused by vessels shifting fishing effort from WDA to other areas). Each of these assumed impacts contradicts the other since they cannot all simultaneously occur at the same time. Therefore, to assume all of these impacts will apply together is an unreasonable premise.

The analysis presented in my report was based on the best available data using logical assumptions about how WDA development will impact commercial fisheries. The data and results presented in the report confirm what is generally known from all previous analysis of VTR, VMS, and AIS data, state and federal landings data, and all other Project permitting documents, which is that the WDA is a relatively unproductive commercial fishing area surrounded by relatively productive fishing areas. Based on the analysis and results presented in my report, Vineyard Wind has developed a comprehensive Fisheries Compensatory Mitigation Program to account for potential impacts of the Project.

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Attachment A

Updated Assessment of
Shore-side Impacts from the Vineyard Wind Project

Prepared by Dennis King (November 14, 2019)

This Attachment develops estimates of shore-side economic multiplier impacts from Vineyard Wind's 84 turbine offshore wind project in the northern portion of Vineyard Wind Lease Area OCS-A 0501 (referred to as the "Wind Development Area 84" [WDA-84]) based on assumptions that differ from those employed in King (2019). The multiplier impacts estimated here are based on the assumption that fishing effort will be totally precluded from WDA-84, and will not be replaced by increased fishing effort in other areas. The reduction in fishing effort in WDA-84 and the loss of fish landings from WDA-84 are treated as direct economic impacts of WDA-84 development which generate indirect and induced shore-side economic impacts. State-specific estimates of shore-side multipliers and associated economic impacts are developed for Massachusetts (MA), Rhode Island (RI), Connecticut (CT), New York (NY), and New Jersey (NJ).

WDA-84 Fishing Revenues

Estimates of annual fishing revenues from the entire Lease Area, by state, during 2011-2016 for all species other than lobster and Jonah crab are presented in Table 3 of Rhode Island Department of Environmental Management (RI-DEM, 2017). In Table 3 of King (2019), average annual MA fishing revenues from the Lease Area for those years were adjusted upward to include the estimated value of lobster and Jonah crab harvests.

Table 1, below, presents average annual statewide fishing revenues from the Lease Area for MA, RI, CT, NY, and NJ, including lobster and Jonah crab, for years 2011-2016 based on the approach used in King (2019). To respond to Dr. Sproul's criticism that these values should be adjusted to account for inflation, Table 1 also shows average annual fishing revenues from the Lease Area from 2011-2016 adjusted upward by 7.7% to reflect their values in 2019 dollars. Table 1 also shows these annual fishing values adjusted upward to account for inflation adjusted downward to reflect the fact that WDA-84 occupies only 36.3% of the Lease Area.

Table 1: Estimates of Commercial Fishing Economic Exposure in 84 Turbine Wind Development Area (WDA-84)

State	Percent of Fishing Revenue from Vineyard Wind Lease Area (2011-2016)	Dollar Value of Fishing Revenue from Vineyard Wind Lease Area (Annual Average, 2011-2016)	Dollar Value of Fishing Revenue from Vineyard Wind Lease Area, Adjusted to 2019 Dollars	Dollar Value of Fishing Revenue from WDA-84 (36.3% of Lease Area), Adjusted to 2019 Dollars
MA	53.9%	$581,154	$625,903	$227,203
RI	37.2%	$401,093	$431,978	$156,808
CT	3.2%	$34,503	$37,159	$13,489
NY	4.3%	$46,363	$49,933	$18,126
NJ	1.4%	$15,095	$16,257	$5,901
Total	100.0%	$1,078,208	$1,161,230	$421,526

Shore-side Multiplier Impacts

There are two types of economic multipliers associated with commercial fishing. Upstream (or backward-linked) multipliers are generated when commercial fishers purchase inputs (e.g., fuel, ice, equipment, supplies). Downstream (or forward-linked) multipliers are associated with the value-added processing and distribution of fish after it is landed (e.g., cleaning, freezing, cooking, packing, transporting, etc.).

The National Oceanic and Atmospheric Administration (NOAA) provides two ways of estimating state-wide upstream and downstream commercial fishing multipliers. One approach is to use the “advanced query” feature of NOAA’s web-based “Seafood Industry Impacts” tool. A second approach is to calculate multipliers based on statewide economic impact tables presented in NOAA’s *Fishery Economics of the United States* (FEUS) report, last published in 2018. Both approaches rely on widely used state-specific inter-industry input-output models and, at least in recent years, both approaches yield nearly identical results. The “advanced query” feature of NOAA’s web-based fishery economic impact model (at www.st.nmfs.noaa.gov/apex) was used to generate the state multipliers presented below in Table 2.

Table 2 Shore-based Economic Multipliers for Commercial Fisheries*

State	Direct Impact	Indirect and Induced Multipliers		Commercial Fishing Multipliers - Total Direct, Indirect, and Induced (Harvesters and Processors)
		Upstream (Harvesters)	Downstream (Processors)+	
MA	1.0	0.827	0.737	2.564
RI	1.0	0.726	0.595	2.321
CT	1.0	0.773	0.570	2.343
NY	1.0	0.789	0.600	2.389
NJ	1.0	0.993	0.606	2.599

*Based on NOAA's web-based Seafood Impact Estimator

+ Includes the Primary dealers/processors sector and the Secondary wholesalers/distributors sector.

Table 3 uses the inflation-adjusted state fishing revenue values for WDA-84 presented in Table 1 and the state multipliers presented in Table 2 to generate annual shore-side economic impact estimates for each state.

Table 3 Shore-based Economic Impacts of WDA-84 Commercial Fish Landings*

State	Direct Impact	Indirect and Induced Impacts		Total Shore-side Economic Impacts – Direct, Indirect, and Induced (Harvesters and Processors)
		Upstream (Harvesters)	Downstream (Processors)	
MA	$227,203	$187,897	$167,449	$582,548
RI	$156,808	$113,843	$93,301	$363,951
CT	$13,489	$10,427	$7,689	$31,605
NY	$18,126	$14,301	$10,876	$43,303
NJ	$5,901	$5,860	$3,576	$15,337
Total	$421,526	$332,328	$282,891	$1,036,745

*Values in 2019 dollars

Refinements to Shore-based Impact Analysis

It is important to note that the estimates of shore-side multiplier impacts presented in Table 3 are based on the assumption that all commercial fishing will be eliminated from WDA-84 and will not be diverted to other fishing areas where it will continue to generate fish landings and shore-based impacts. However, it is expected that some fishing will continue in WDA-84 and some reduced fishing in WDA-84 will be replaced by increased fishing outside WDA-84. That means shore-based impacts are expected to be less than those shown in Table 3.

A simple approach to adjusting shore-based impacts presented in Table 3 to reflect more realistic assumptions is to use data or best professional judgement to determine the most probable values of two variables, X and Y, where:

> X= the portion of fishing effort eliminated from WDA-84 that will be diverted to other fishing areas rather than being lost altogether; and,
>
> Y= the portion of fishing revenues lost from WDA-84 that will be recouped by whatever fishing effort is diverted to other fishing areas.

The shore-based impacts presented in Table 3, in effect, are based on the assumption that X and Y are both 0.0 and, therefore, should be considered extreme upper bound estimates of direct, indirect, and induced economic impacts. Logical values of X and Y, which reflect some fishing effort diverted from the WDA-84 to other areas (X > 0) and a portion of fish landings and fishing revenue lost in WDA-84 being recouped by increased fishing elsewhere (Y > 0) would generate shore-side multiplier impacts significantly lower than those presented in Table 3.

When considering the cumulative impacts of multiple offshore wind energy projects, it will be useful to examine how realistic values of X and Y for any given project may or may not decline as more projects are implemented.

Attachment B

Updated Assessment of Vineyard Wind Project Impacts on Fishing Vessel Transit Costs

Prepared by Dennis King (November 14, 2019)

This Attachment outlines the results of my review of recently available vessel transit data to estimate annual increases in fishing vessel steaming costs to detour around Vineyard Wind's 84 wind turbine generators in the northern portion of Vineyard Wind Lease Area OCS-A 0501 (referred to as the "Wind Development Area 84" [WDA-84]). It also describes why I have concluded that Dr. Sproul's estimates of $45,444 in increased annual transit costs for Massachusetts (MA) fishing vessels and $30,805 for Rhode Island (RI) vessels are reasonable.

This attachment also describes how I increased Dr. Sproul's estimate of $76,249 in transit costs for MA and RI vessels to $83,699 to include estimated transit costs for fishing vessels from Connecticut (CT), New York (NY), and New Jersey (NJ). It also describes how using estimates of numbers of fishing vessel transits based on Automatic Identification System (AIS) data from Baird (2019a) and transit cost estimates generated from data presented in the Vineyard Wind Construction and Operations Plan (COP) (2018) results in an overall estimate of $44,505 in increased annual transit costs, which is lower than the $83,699 estimate presented in Dr. Sproul's letter likely because the AIS data from Baird (2019a) may not include fishing vessels less than 65 feet in length.

<u>Numbers of Potentially Impacted Vessel Transits</u>

Baird (2019a) contains estimates of the number of fishing vessel transits through WDA-84[4] during 2016-2018 based on AIS records. Using a speed-based filter and the assumption that vessels traveling at over 4 knots are transiting an area whereas vessels travelling at or below 4 knots are engaged in fishing, the number of annual fishing vessel transits through WDA-84 was estimated in Baird (2019a) to be 802 during 2016, 837 during 2017, and 1,328 during 2018. That results in an average of 989 annual transits during 2016-2018.

A second set of vessel transit estimates are reported in Sproul (2019), based on Vessel Monitoring System (VMS) data for 2016 provided by Rhode Island Department of Environmental Management (RI-DEM)[5]. That analysis also used a 4 knot speed filter to distinguish transiting vessels from fishing vessels

[4] The "WDA-84" refers to Vineyard Wind's Wind Development Area (WDA) containing 84 wind turbine generators (WTGs) and is smaller than the WDA included in the Construction and Operations Plan (COP), which includes 106 WTG positions. Note that the Baird report refers to the "WDA-84" as the "LT WDA."

[5] To my knowledge the RI-DEM analysis of 2016 transits through the WDA using VMS data that was cited in Dr. Sproul's letter has not been published.

and resulted in an estimate of 1,100 transits through the WDA-84 by fishing vessels from MA and RI during 2016. Note that this is only 11% higher than the 989 average number of transits estimated for all states during 2016-2018 in Baird (2019a) using AIS data.

These are rough estimates of the number of annual transits through the WDA because: (1) the AIS data used by Baird (2019a) does not necessarily include some vessels less than 65 feet in length which are not required to have AIS equipment onboard; and (2) the VMS data used by RI-DEM do not include records of fishing vessels that fish exclusively for lobster and Jonah crab.

Estimates of Increased Vessel Transit Costs

There are three sources of information about potential increases in vessel transit costs associated with detours required by development of WDA-84. Each source is summarized below.

Vineyard Wind Construction and Operations Plan

Section 7.6.3.2 of the COP prepared by Vineyard Wind in 2017 and revised in 2018 compares direct route distances between prime commercial fishing areas in the vicinity of the WDA as well as between those prime fishing areas and selected fishing ports in MA, RI, and NY to distances between those locations using routes that require detours to avoid passing through the WDA[6].

Although that analysis examined only a few important combinations of ports and fishing areas, it demonstrated that (a) most transits between fishing ports and fishing areas and transits between fishing areas do not transect the WDA; and (b) those that do transect the WDA would experience relatively small increases in steaming distances from rerouting around the WDA (e.g., between about 0.05 NM and 2.5 NM for the routes analyzed).

At the time the COP was being prepared and revised there was very little information available about the sizes or types of fishing vessels that might be impacted. As a result, estimates of increased transit costs were based on general assumptions that impacted vessels have an average steaming speed of 10 knots and burn 50 gallons of marine diesel per hour (gph) when steaming, which at $3.00 per gallon, results in transit costs of $150 per hour or $15 per nautical mile (NM) travelled. Recognizing the limits to the available data regarding the number of potential transits and the likely range of transit costs for different types of vessels, the COP (2018) concluded that “more detailed assessment…would be required to determine potential fleet-wide steaming cost impacts.”

[6] The term “WDA” refers to the original WDA included in the Project’s Construction and Operations Plan, which included up to 106 WTG positions. The size of the WDA was subsequently reduced after larger WTGs were selected, such that only 84 WTG positions are needed. The reduced-size WDA is referred to as the “WDA-84.”

Draft Environmental Impact Statement (DEIS)

The Bureau of Offshore Energy Management (BOEM) released the Draft Environmental Impact Statement (DEIS) for the Vineyard Wind project in December 2018. Table 3.4.5.9 of that report contains data regarding Total Costs by Trip Duration for Vessels in three size classes (Large, >85 ft; Medium, 40 – 85 ft; and Small, < 40 ft). It also indicates that fishing vessels in any of these three size categories may have their transit costs increased by WDA development. However, the DEIS provides only qualitative information about how trip duration and trip costs might increase and trip revenues and vessel profits might decrease as a result of vessels needing to detour around the WDA. After describing the many factors that might impact the magnitude of increases in transit costs, the DEIS concluded that "BOEM expects that potential changes to vessel transit corridors and chosen fishing locations as a result of the Proposed Action would have a **moderate** effect on commercial fisheries and for-hire vessels."

Sproul (2019)

The letter sent to the Massachusetts Office of Coastal Zone Management (CZM) by Dr. Thomas Sproul included an analysis of increased transit costs for Massachusetts and Rhode Island-based commercial fishing vessels that he concludes will result from WDA development. That analysis is based partly on RI-DEM estimates of 1,100 transit-only trips through the WDA. However, because that RI-DEM analysis did not address transits by vessels that fish exclusively for lobster and Jonah crab, Dr. Sproul made separate inquiries which resulted in him estimating that 15 RI-based vessels that fish for lobster and Jonah crab were not included in the RI-DEM analysis and that those RI vessels make an average of 40 annual round-trip transits each through the WDA. That results in 600 round-trip transits or 1,200 one-way transits through the WDA by RI vessels fishing exclusively for lobster and Jonah crab. Dr. Sproul then estimated the number of transits through the WDA by MA-based vessels fishing exclusively for lobster and Jonah crab based on the ratio of lobster landings for the port of New Bedford (882,463 lbs. in 2016) to lobster landings in Rhode Island (2,260,346 lbs. in 2016)[7]. This estimate yields an additional 234 round-trips or 468 one-way transits by MA vessels fishing exclusively for lobster and Jonah crab and brings Dr. Sproul's estimate of the number of annual one-way fishing vessel transits through the WDA to 2,768 (1,100 transits by fishing vessels other than lobster and Jonah crab and 1,668 transits by RI and MA lobster and Jonah crab fishing vessels[8]).

The details of Dr. Sproul's analysis of detour distances and costs are not presented in his letter to CZM. However, the conclusions stated in that letter are: (1) "the average detour per trip per year is 3.025 nm" and (2) "Estimated Additional Costs Due to Re-Routing average $45,444 for MA fishing vessels and $30,805 for RI vessels." That totals $76,249 in estimated increases in annual transit costs for both states.

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7 By using this ratio to estimate transits of MA vessels fishing exclusively for Jonah crab and lobster, Sproul (2019) assumes that the only MA lobster/Jonah crab landings affected are for the port of New Bedford and that the ratio of lobster landings between New Bedford and Rhode Island is comparable to the ratio of Jonah crab landings.

8 The estimate of annual transits by vessels fishing lobster and Jonah crab presented by Dr. Sproul include only vessels from RI and MA and do not account for a small number of possible transits by vessels fishing lobster and Jonah crab that are based in CT, NY, and NJ.

Acknowledging that Dr. Sproul's calculations could not be fully re-created or verified, to arrive at an overall estimate of potential increases in transit costs, I used Dr. Sproul's estimate of increased transit costs for RI and MA vessels to estimate additional re-routing costs for fishing vessels from states other than MA and RI based on their relative share of fish harvested in the WDA (CT, 3.2%; NY, 4.3%; and NJ, 1.4%). That results in estimated transit cost increases for CT, NY, and NJ of $2,679, $3,599, and $1,172, respectively, and yields an overall increase in annual transit costs for fishing vessels from all states (MA, RI, CT, NY, and NJ) of $83,699.

Comparing Results

As described above, some general assumptions were used in the COP (2018) to estimate that average costs per nautical mile of steaming distance is $15. Applying that estimate to the average 3 NM detour per transit estimated in Sproul (2019), which conservatively aligns with the upper bound of increased steaming distances from COP (2018), results in $45 in increased costs per transit. Applying an increase of $45 per transit to the average annual number of transits estimated in Baird (2019a) (989 for 2016-2018) results in $44,505 as an overall estimate of increased annual transit costs.

However, the estimates of annual transits in Baird (2019a) are based on AIS data that may not include fishing vessels less than 65 feet in length. According to Baird (2019a), based on analysis of permitted fishing vessels at New Bedford and Point Judith in 2017 compared to AIS data, it is reasonable to conservatively assume that AIS-equipped vessels represent 30% to 50% of the overall fishing fleet operating in WDA-84. Therefore, the estimate of $44,505 in increased transit costs based on Baird (2019a) and COP (2018) may only represent increased transit costs for 30% to 50% of the overall fishing fleet, which may explain why the estimate based on Baird (2019a) and COP (2018) is approximately 53% of the $83,699 in increased fleet-wide transit costs estimated by Dr. Sproul.

Conclusions

I estimated that an increased fleet-wide transit cost of $44,505 would occur based on the number of fishing vessel transits provided in Baird (2019a) and assumptions on trip costs provided in the COP (2018). As noted in Baird (2019a), the number of transits through the WDA are based on data from AIS-equipped vessels that may represent 30 to 50% of the overall fishing fleet, so transit costs for the overall fishing fleet could be about double my estimate. On that basis, it appears that the estimate of $83,699 in increased annual transit costs resulting from WDA-84 development based on Sproul (2019) is reasonable.

Attachment 4

Massachusetts Compensatory Fisheries Mitigation Plan

VINEYARD WIND

Massachusetts Fisheries Compensatory Mitigation Plan for Vineyard Wind 1

March 3, 2020

Submitted by
Vineyard Wind LLC
700 Pleasant Street, Suite 510
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I. Overview

The Massachusetts Fisheries Compensatory Mitigation Plan (the "Plan") described herein was developed by Vineyard Wind LLC ("Vineyard Wind" or the "Company") for Vineyard Wind 1 (the "Project").[1] Vineyard Wind 1 is an 800 megawatt ("MW") offshore wind project that Vineyard Wind intends to construct within the northern portion of Bureau of Ocean Energy Management ("BOEM") Lease Area OCS-A 0501.

The Plan briefly reviews non-compensatory mitigation measures that Vineyard Wind has or intends to employ to avoid or minimize potential impacts from the Project to Massachusetts fishing businesses. The Plan also details the compensatory mitigation program that Vineyard Wind has developed to address potentially unavoidable fishery-related economic impacts from the construction, operation, and decommissioning of Vineyard Wind 1.

The compensatory mitigation program is structured as two funds totalling more than $20 million[2], as shown in Table 1, over the life of the Project. The funding will be used to offset potential direct, indirect, and cumulative economic impacts to Massachusetts fishing businesses and facilitate innovation that better supports the co-existence of the fishing and wind sectors in the offshore environment.

Table 1. Vineyard Wind Compensatory Mitigation Funds

Fund	Amount
Direct Compensation Fund	$18,426,366
Fisheries Innovation Fund	$1,750,000
TOTAL Payments over the life of the Project (nominal): $20,176,366	

The Direct Compensation Fund will be administered by a third-party administrator that will be selected by Vineyard Wind in consultation with the Massachusetts Office of Coastal Zone Management. The Fisheries Innovation Fund will be hosted and administered by the Massachusetts Executive Office of Energy and Environmental Affairs. Payments to both funds will be made on an annual basis with first payments due when Vineyard Wind 1 achieves financial close.[3]

The funding levels for the compensatory mitigation program were determined based on the economic exposure estimates indicated in the Plan. These estimates rely on best available information and serve as a starting point for assessing potential fishery-related economic impacts from Vineyard Wind 1. Taking a cautious and conservative approach, Vineyard Wind used these economic exposure estimates to determine the maximum level of potential fishery-related economic impacts and designed a compensatory mitigation program that ensures funds will be available to cover impacts above-and-beyond those that are reasonably expected to occur over the life of the Project.

[1] This Plan will be reviewed as part of the federal consistency review of Vineyard Wind 1 that the Massachusetts Office of Coastal Zone Management is undertaking pursuant to the Coastal Zone Management Act (15 C.F.R. part 930, subpart E) and associated regulations.
[2] All dollar values indicated in this document are nominal values.
[3] For the purposes of this Plan, financial close means the date upon which all relevant project and financing documentation for the Project has been executed and become effective

II. Introduction

Commercial fishing is a historically, culturally, and economically important part of life in Massachusetts. Vineyard Wind is committed to working with this sector so that both the wind and fishing industries can grow and thrive together offshore. The Plan, which reflects that commitment, was designed in consultation with the Massachusetts Fisheries Working Group, Vineyard Wind's fisheries representatives, officials from the Commonwealth of Massachusetts, and individual fishermen, among others. It comes only after Vineyard Wind and federal policymakers have expended considerable effort to avoid and minimize potential impacts to fisheries resources and fishing businesses at the outset.

This Plan addresses potential direct economic impacts to fishing vessels, indirect economic impacts to shoreside businesses, and potential cumulative economic impacts from Vineyard Wind 1 as well as future offshore wind projects likely to be constructed in the Massachusetts/Rhode Island Wind Energy Areas ("WEAs"). In Vineyard Wind's view, the Plan's success is assured not only because it relies on best available information, but also because Vineyard Wind has applied a cautious approach in formulating the compensatory mitigation program in order to ensure—at any point in time—sufficient funds are available to address potential fishery-related economic impacts from the Project.

Vineyard Wind suggests that the compensatory mitigation program outlined in this Plan serve as a basis for a uniform mitigation approach that would apply to all offshore wind projects moving forward. This would ensure a fair, transparent, and consistent approach that considers both the estimated fisheries value exposed to a particular project alongside the development of the entire offshore wind industry along the East Coast at any given time. In line with this, Vineyard Wind is proposing the same structure for fishermen potentially impacted by Vineyard Wind 1 in other states, in particular Connecticut, New York, and New Jersey.[4]

III. Non-Compensatory Mitigation: Avoiding and Minimizing Impacts

A. Site Selection and Project Design

Vineyard Wind's approach to fisheries mitigation prioritizes careful siting of offshore wind projects so they avoid potential impacts, to the greatest extent possible, from the outset. The Massachusetts WEA, where the Project will be located, is an environmentally superior location to build an offshore wind project in terms of avoiding harm and minimizing potential impacts, including fisheries impacts. The MA WEA was developed and refined by BOEM through an approximately six-year public stakeholder planning process aimed at identifying wind energy development areas with the least amount of potential impacts to the marine environment. Siting choices associated with this process were the first step in avoiding and minimizing potential impacts to fisheries resources, habitats, and commercial fishing.

[4] Potential impacts to Rhode Island fishermen have previously been addressed in an agreed compensatory mitigation program with the Rhode Island Coastal Resources Management Council as part of Rhode Island's consistency review process for the Project.

Vineyard Wind has sought to further avoid and minimize potential fisheries-related impacts via careful siting of wind turbines within Lease Area OCS-A 0501, adjusting the Project's layout and design elements based on stakeholder input, and refining the proposed cable route and micro-siting informed by survey data and fishermen input. Specific measures incorporated into the Project's design include, but are not limited to, the following:

- Reducing the Project's overall footprint by using the largest commercially available turbine model;
- Designing turbine row orientation to facilitate fishing activities for the fishing type with the largest value in the region;
- Agreeing with other developers to orient wind turbines in a grid pattern across the Massachusetts/Rhode Island WEAs to allow fishing and safe transit in multiple directions, e.g., N-S, E-W, NW-SE.
- Removing turbine locations along the 20-fathom contour within the Vineyard Wind 1 project area;
- Committing to a target cable burial depth sufficient to allow fishing activities to continue over the Project's inter-array and export cables, and to implement a long-term monitoring program to ensure continuous burial; and
- Installing AIS on turbines and electrical service platforms to improve navigation and safety.

B. Measures Beyond Site Selection and Project Design

1. Fisheries Communication Program

Vineyard Wind currently employs two Fisheries Liaisons and has developed a robust fisheries communication protocol to ensure effective communication with the fishing industry through all Project phases. This protocol is outlined in the Company's fisheries communication plan, which is updated regularly based on lessons learned and feedback from fisheries stakeholders. The fisheries communication plan is a public document available on Vineyard Wind's website (https://www.vineyardwind.com/fisheries).

The Company has established formal relationships with five fishery representatives in Massachusetts—New Bedford Seafood Consulting, New Bedford Port Authority, Massachusetts Lobstermen's Association, Martha's Vineyard Fishermen's Preservation Trust, and Responsible Offshore Development Alliance—who represent a variety of fishing gear types and home ports. Vineyard Wind is also an active member and/or participant in the following technical working groups and advisory boards:

- Massachusetts Fisheries Working Group on Offshore Wind Energy
- Massachusetts Habitat Working Group on Offshore Wind Energy
- Rhode Island Fisheries Advisory Board meetings
- New York State Energy Research and Development Authority Fisheries Technical Working Group
- New York State Energy Research and Development Authority Environmental Technical Working Group
- Responsible Offshore Development Alliance Joint Industry Task Force
- Responsible Offshore Science Alliance (ROSA) (Board Member)

These measures, along with other stakeholder outreach initiatives, allow Vineyard Wind to maintain regular contact and productive working relationships with fishing businesses in Massachusetts and across the region, and will facilitate implementation of this Plan.

2. Fisheries Science Program

Vineyard Wind understands how important science and research is to the fishing community. This is one of the primary reasons why the Company created a fisheries science program for Vineyard Wind 1. Beyond supporting the successful development of the Project, including efforts to avoid and minimize fishery-related impacts, the fisheries science program prioritizes:

- Establishing relationships with academic institutions that engage in cooperative fisheries research;
- Defining research objectives and scope with input from fisheries stakeholders;
- Supporting a regional approach to fisheries research for offshore wind; and
- Making data easily accessible and publicly available.

Vineyard Wind currently funds over $2 million dollars each year in fisheries studies and monitoring, and anticipates supporting fisheries research at similar levels for the foreseeable future. As part of this, Vineyard Wind is working with the University of Massachusetts Dartmouth's School for Marine Science and Technology and local stakeholders to implement a pre-, during, and post-construction fisheries monitoring program to measure the Project's potential effects on fisheries resources. Vineyard Wind is also consulting with the New England Aquarium and recreational fishermen in the region to develop monitoring protocols for Highly Migratory Species. The Company is also a founding member of ROSA, in order to further support a long-term regional approach to fisheries science related to offshore wind.

3. Additional Key Initiatives

Vineyard Wind has also implemented several initiatives to minimize and avoid impacts to fisheries based on consultations with and feedback from fisheries stakeholders, including, but not limited to:

- Providing thumb drives for electronic charts, showing our lease area and areas of offshore survey work to area fishermen;
- Including Loran navigation lines and closed areas on project charts to facilitate discussion of fishing activities in the area;
- Creating protocols for project vessels to adhere to when encountering fishing activity;
- Dedicating a page on Vineyard Wind's website for fishermen (www.vineyardwind.com/fisheries) to find the latest information on surveys and construction, and sign up to receive email or text message alert updates; and
- Coordinating with other lease holders in the region to enable more efficient communication between fishermen and the wind industry. Initiatives being undertaken include a uniform gear loss claim reporting form and process, a single website and other platforms to access all relevant information in one place, and coordinating meetings so as to minimize time fishermen would need to spend to learn more about wind activities.

IV. Compensatory Mitigation: Offsetting Potentially Unavoidable Economic Impacts

Compensatory mitigation is appropriately considered once all avoidance and minimization measures have been fully explored. Vineyard Wind acknowledges that, even with the non-compensatory mitigation measures outlined in the previous section, economic impacts to Massachusetts fishing businesses[5] from the construction, operation, and decommissioning of Vineyard Wind 1 may be unavoidable. More specifically, Massachusetts fishermen who currently operate in the Vineyard Wind 1 project area are exposed to potential economic losses because fishing will be precluded in portions of the Vineyard Wind 1 project area during construction, the abundance or availability of fish may be temporarily displaced during construction, and fishing activities may be potentially altered after construction. As a result, Massachusetts fishing businesses may experience negative economic impacts from the Project, as well as future offshore wind projects, that can be offset through compensatory mitigation.

The Plan divides potential fishery-related economic impacts to Massachusetts fishing business into three categories:

- **Direct effects**: A reduction in fishermen's earnings due to reduced fishing activity in the Vineyard Wind 1 project area relative to historic levels, i.e. lost profits or income for commercial fishermen. The value of direct effects is less than the landings value because fishing vessels have expenses that would need to be paid from the revenue from dockside sales. These expenses would not be incurred if the fishermen were not fishing, and so it is not appropriate to include them in estimates of direct effects.
- **Downstream effects:** Assuming fishermen are unable to maintain catch value at historic levels by fishing in other areas, there will be a negative impact on shoreside downstream economic activity associated with Massachusetts business that support Massachusetts fishing and buy, process, and/or market commercial landings.
- **Upstream effects**: To the extent continued build-out of offshore wind capacity in the Massachusetts/ Rhode Island WEAs leads to lower fishing activity generally in the state due to cumulative impacts, there will be a negative economic impact on shoreside upstream activity associated with fuel and supply procurement, boat repair, and other activities.

Relying on best available information, confirmed through consultations with the National Marine Fisheries Service ("NMFS") and state fisheries programs, this Plan employs a cautious approach to determine the potential magnitude of economic impacts. As described below, conservative assumptions and "cautious approach multipliers" ensure available funding covers impacts above-and-beyond what can reasonably be expected to occur.

Based on the results of these calculations, Vineyard Wind is providing more than $20 million in funding for compensatory mitigation over the 30-year life of the Project.[6] The funding will be used to address the potential economic impacts described above as well as facilitate innovation that better supports the co-existence of the fishing and wind sectors in the offshore environment.

[5] For the purposes of this Plan, "Massachusetts fishing businesses" is defined broadly to include not only fishermen but shoreside businesses that provide goods and services to the fishing industry.
[6] The 30-year "life of the Project" includes two years of construction, 25 years of operation, one to two years of decommissioning, and one to two years added as a buffer.

The compensatory mitigation program is structured as two funds:

- **Direct Compensation Fund:** Approximately $18.4 million; and
- **Fisheries Innovation Fund:** $1.75 million (plus any funds not used for above mitigation).

The Direct Compensation Fund is designed to offset potential direct, indirect, and cumulative impacts of the Project. As described below, this funding is comprised of approximately $10.5 million for potential direct and downstream effects and approximately $7.9 million for potential cumulative effects. An additional $1.75 has been allocated the Fisheries Innovation Fund. Payments to both funds will be made on an annual basis with first payments due when Vineyard Wind 1 achieves financial close**.** Any unused funds from the Direct Compensation Fund will be allocated to the Fisheries Innovation Fund at the end of the 30-year life of the Project. An overview of funding levels and indicative payment schedules are provided in Section VI and Appendix 1.

The funds provided through this Plan will only be available to Massachusetts-based fishermen and businesses. This reflects Vineyard Wind's state-based approach to compensatory mitigation, which ensures the needs of each state's fishing community are properly understood and concerns are adequately addressed.

V. Compensatory Mitigation Methodology

Vineyard Wind has worked extensively with federal and state partners and resource agencies, commercial fisheries stakeholders, academia, and industry economists to develop comprehensive methodologies for quantifying fishing activities and assessing the potential economic exposure of the fishing industry to the construction, operation, and decommissioning of Vineyard Wind 1. The following section further describes the methodology Vineyard Wind utilized to assess potential fishery-related economic impacts to Massachusetts fishing businesses from the Project and the associated level of financial compensation to offset those impacts.

A. Massachusetts Fisheries Economic Exposure and Impact Estimates

As a first step, the Plan establishes an economic exposure estimate for Massachusetts commercial fishermen likely to be exposed to the "Vineyard Wind 1 project area" based on an analysis conducted for Vineyard Wind by King and Associates (the "King Report").[7] The Vineyard Wind project area is defined as the 245 square kilometer (km^2) portion of Lease Area OCS-A 0501 where the Project's wind turbines will be installed, and is referred to as the "WDA-84" in the King Report. This area comprises 36.3% of the 675 km^2 available for offshore wind development in Lease Area OCS-A 0501.[8]

The fisheries values (i.e. ex-vessel values) in the King Report are derived from data related to historical fishing revenues generated in Lease Area OCS-A 0501. As noted in the Kind Report, even though revenues from commercial fishing can vary significantly from year to year, "it is well established that analyzing data related to the economic value of commercial landings from an area in a set of recent years is the most reliable basis for assessing the annual economic exposure of commercial fishing in that area to impacts from proposed non-fishing activities in the area."[9]

[7] King, D. (2019a). Economic Exposure of Massachusetts Commercial Fisheries to the Vineyard Wind Project. King and Associates, Inc., Plymouth, Massachusetts. April 12, 2019.
[8] This does not include the Offshore Export Cable Corridor for Vineyard Wind 1. As noted in the King Report, potential economic impacts would be under $5,000 and limited to a 2-month period during the construction phase. *Id.* at 2-9.
[9] *Id*. at 3-1.

The fisheries values data included in the King Report are largely drawn from reports compiled by the Massachusetts and Rhode Island marine fisheries divisions. These values are very close to, but higher than, values reported by NMFS; the data were also supplemented with input and data solicited directly from fishermen, including vessel tracking data and anecdotal descriptions of the types of fishing practices used in the Vineyard Wind 1 project area.

As noted in the King Report, the most recent best available data for commercial fisheries values in Lease Area OCS-A 0501 cover the period 2011 to 2016. As fishing revenue data specific to the Vineyard Wind 1 project area were not available, the King Report assumes that fishing revenues within Lease Area OCS-A 0501 are uniformly distributed. As such, average annual fishing values in the Vineyard Wind 1 project area were estimated to be 36.3% of the values for Lease Area OCS-A 0501.[10] Best available data indicates that Massachusetts commercial fishermen account for 53.9% of total commercial fisheries values in Lease Area OCS-A 0501 on average, excluding lobster and Jonah crab.[11] Massachusetts fishermen are assumed to account for 36%, on average, of commercial landings for lobster and Jonah crab.[12]

Given this approach, the King Report estimates the average annual economic exposure of Massachusetts-based commercial fishermen in the Vineyard Wind 1 project area between 2011 and 2016 was $196,621 (2016 dollars) for all species, as shown in Table 2.[13]

Table 2. Average Economic Exposure Estimate for Massachusetts Fishermen (2011-2016)

	Average annual landings - Lease Area OCS-A 0501	Average annual landings in Vineyard Wind 1 project area	Portion attributable to Massachusetts fishermen
Fish values other than lobster and Jonah crab	$857,548	$311,290	$167,785
Lobster and Jonah crab values	$220,660	$80,100	$28,836
TOTAL	**$1,078,208**	**$391,390**	**$196,621**

The King Report notes that during the same period, Massachusetts's annual commercial landings, excluding lobster and Jonah crab, averaged more than $605.2 million.[14] This means that the economic exposure of Massachusetts-based commercial fishing to Vineyard Wind 1 accounts for approximately 0.03% of the overall value of the Massachusetts commercial harvest.[15] The average economic exposure of Massachusetts fishermen associated with lobster and Jonah crab harvests, with average commercial landings during this period of $72.9 million, amounts to 0.04% of the overall value.[16]

To update the King Report's annual average economic exposure estimate for the Plan, Vineyard Wind conservatively assumed that total catch values within the Vineyard Wind 1 project area had increased by 2.5% per year since 2016, and would continue to do so over the 30-year life of the

[10] Vineyard Wind acknowledges that fishing values may not be evenly distributed within Lease Area OCS-A 0501 but it is not possible to reliably allocate currently available data on fishing values to sub-areas within Lease Area OCS-A 0501.
[11] *Id*. at 3-5.
[12] *Ibid*.
[13] *Ibid.*
[14] *Ibid.*
[15] *Ibid.*
[16] *Id.* at 3-6.

Project.[17] As shown in Table 3, applying the 2.5% escalation rate to the 2011-2016 annual average value yields an assumed $211,739 (2019 dollars) economic exposure estimate for Massachusetts fishermen within the Vineyard Wind 1 project area in 2019.

Table 3. Economic Exposure Estimate for Massachusetts Fishermen (2.5% annual escalation)

2011-2016	2017	2018	2019
$196,621	$201,537	$206,575	$211,739

It's important to note that economic exposure estimates refer to potential economic impacts rather than predicted or expected economic impacts. As such the economic exposure estimates provided in the King Report, and used as the starting point for the development of Vineyard Wind 1's compensatory mitigation program, are not estimates of the Project's expected fishery-related economic impacts. Nevertheless, reflecting Vineyard Wind's cautious approach, to determine the maximum level of potential fishery-related economic impacts for Massachusetts fishing businesses over the life of the Project, Vineyard Wind has very conservatively assumed that potential fishery-related economic impacts are equivalent to the economic exposure estimate set forth in the King Report.

Put another way, for the purposes of this Plan, Vineyard Wind has assumed that ***all*** historic fishing activity in the Vineyard Wind 1 project area would cease beginning at the start of offshore construction and not resume until after the Project is decommissioned. In doing so, Vineyard Wind presumes that Massachusetts commercial fishermen will not adapt or be able to successfully co-exist with the Project over the next 30 years even though all evidence and experience would indicate that commercial fishing activities will be able to continue to a certain degree, and potentially to the same degree.

B. Compensatory Mitigation Estimates

As noted above, Vineyard Wind's compensatory mitigation program is structured as two funds aimed at addressing the following three elements: Direct and Downstream Mitigation, Cumulative Impacts, and Fisheries Innovation. The methodology Vineyard Wind employed to determine financial compensation levels for the first two elements is described in greater detail below.

1. Direct and Downstream Mitigation

As a first step, Vineyard Wind used the very cautious assumption that the Project would result in a total cessation of historic fishing activity in the Vineyard Wind 1 project area to estimate direct and downstream economic impacts. Vineyard Wind then derived appropriate "multipliers" for the direct and downstream effects impact categories and applied them to the ex-vessel value landings to determine potential impacts on fishing-related economic activity from the Project (example provided in Table 4).[18,19]

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[17] As a comparison, average annual inflation in the United States has increased by 1.8% (year-over-year) between 2010 and 2018.

[18] Multipliers are a standard practice approach used to translate ex-vessel values into the economic loss that fishing businesses would experience from a reduction or cessation of historic fishing activity due to other activities, such as offshore wind project development.

[19] Landing, processing, and selling fish caught generates additional economic activity, which is expressed as a "downstream" multiplier applied to ex-vessel landings value. The "downstream" economic multiplier expresses economic activity related to the fish caught, for example processing and selling the fish caught, and other value add activities. This downstream effect is dependent on how much fish is caught. In order to

Table 4. Annual Direct and Downstream Impacts to Massachusetts Fishing Business (2019)

Impact Category	Mass. Fisheries Value (2019)	Multiplier	Economic Impact
Direct Effects	$211,739	0.50[20]	-$105,870
Downstream Effects	$211,739	0.42[21]	-$91,048

Vineyard Wind then calculated the potential direct and downstream economic impacts for every year of the Project to arrive at the required minimum level of compensatory mitigation funding for Direct and Downstream Mitigation, as summarized in Table 5.

Table 5. Annual Direct and Downstream Impacts (assuming no fishing in Vineyard 1 project area)

Direct and downstream impact assuming no fishing in the project area during the full lifetime of project	2019	2020	2021	...	2048
Direct	$ 105,870	$ 108,516	$ 111,229		$ 216,652
Downstream	$ 91,048	$ 93,324	$ 95,657		$ 186,321
Total (direct + downstream)	$ 196,918	$ 201,840	$ 206,887		$ 402,974
Total payments over lifetime of project (nominal)	**$ 8,645,213**				

Finally, continuing with a cautious approach, Vineyard Wind included an additional $1 million in funding—an amount equivalent to approximately four years of average ex-vessel value landings—to the first year payment to ensure that sufficient funds will be available to address inter-year fluctuations in fishing activity. The Company also applied a "cautious approach multiplier" of 10% to each annual payment to create additional buffer for the total funding required.[22] This results in a total of $10,509,734 in Direct and Downstream Mitigation funding provided over the life of the Project, as summarized in Table 6.

Table 6. Direct and Downstream Mitigation Funding (cautious approach)

Direct and downstream mitigation	2019	2020	2021	...	2048
Direct	$ 105,870	$ 108,516	$ 111,229		$ 216,652
Downstream	$ 91,048	$ 93,324	$ 95,657		$ 186,321
Total (direct + downstream)	$ 196,918	$ 201,840	$ 206,887		$ 402,974
Extraordinary, initial funding	$ 1,000,000				
Cautious approach multiplier	1.10	1.10	1.10		1.10
Total annual direct + upstream payments (cautious approach)	**$ 1,216,609**	**$ 222,025**	**$ 227,575**		**$ 443,271**
Total payments over lifetime of project (nominal)	**$ 10,509,734**				

account for possible impacts to this economic activity in a hypothetical scenario of all landings from a project area being lost, a mitigation amount can be calculated using the downstream multiplier.

[20] It is generally established that of landings value of a vessel (ex-vessel value), about 50% goes to trip costs such as fuel, crew pay, and supplies. The balance of the ex-vessel value goes to pay for fixed costs such as insurance, and for vessel profit. This is consistent with, for example, NOAA's Fisheries Contingency Fund (https://www.fisheries.noaa.gov/national/funding-and-financial-services/fishermens-contingency-fund-program) that offshore oil and gas operators are required to pay into. By paying 50% of ex-vessel value, a vessel owner can be assured of an amount of revenue to cover fixed costs and gross earnings as if a fishing trip occurred, even if no such trip occurred.

[21] Based on both NOAA's (2018) Fishery Economics of the United States and an "advanced inquiry" using NOAA's online Fishery Economic Impacts Tool, the "downstream" sales multiplier for the Massachusetts commercial fishing sector is 1.42. That is, every dollar of commercial landings (ex-vessel value) in Massachusetts generates $0.42 in additional Massachusetts "downstream" impacts (see Appendix 2).

[22] Vineyard Wind established a "cautious approach multiplier" as part of this calculation to further support the Company's cautious approach to determining appropriate levels of funding for the compensatory mitigation funding.

Vineyard Wind will annually pay the calculated amounts to mitigate potential direct and downstream impacts into the Direct Compensation Fund, described in Section VI.

2. Cumulative Impact Mitigation

Vineyard Wind's cautious approach to cumulative impact mitigation provides financial compensation throughout every Project phase that far exceeds the level of potential impacts that can reasonably be expected to occur. This ensures sufficient funding will be available for Massachusetts fishing businesses for upstream effects as offshore wind project development proceeds in the Massachusetts/Rhode Island WEAs.

As with direct and downstream impacts, Vineyard Wind first used a cautious assumption that the Project would result in a total cessation of historic fishing activity in the Vineyard Wind 1 project area to estimate upstream impacts. To do this, Vineyard Wind again derived an appropriate "multiplier" for upstream impacts and applied it to the ex-vessel value landings to determine potential lost profits and loss of economic activity from the Project (example in Table 7).[23]

Table 7. Annual Cumulative Impacts to Massachusetts Fishing Business (2019)

Impact Category	Mass. Fisheries Value (2019)	Multiplier	Economic Impact
Upstream Effects	$211,739	0.83[24]	-$175,744

As a next step, Vineyard Wind developed a build-out scenario for the Massachusetts/Rhode Island WEAs. This scenario assumes cumulative impacts based on the percentage of available acreage occupied by offshore wind projects, including Vineyard Wind 1. For example, Vineyard Wind 1 will occupy 6.6% of the available acreage in the Massachusetts/Rhode Island WEAs, which the build-out scenario accounts for as a 7% impact. For all projects in the build-out scenario, Vineyard Wind assumed conservative acreage (i.e. wide spacing between turbines) and aggressive construction timelines based on known projects and future state-sponsored solicitations for offshore wind. According to the scenario, 100% of the available acreage in the Massachusetts/Rhode Island WEAs will be built-out by 2039.

To ensure that funding for cumulative impact mitigation was provided in excess of potential upstream effects, according to the build-out scenario, a "cumulative impacts multiplier" was then applied to the upstream economic impacts. The cumulative impacts multiplier starts at 0.50 on the assumption that 50% of the Massachusetts/Rhode Island WEAs is built-out when Vineyard Wind 1 starts construction in 2020, which is well above the 6.6% of available acreage the Project will occupy. The multiplier increases by 0.25 every five years until it reaches 1.00 when an estimated 68% of the

[23] "Upstream" shoreside economic activity relates to the economic activity generated by fishermen going out to fish such as vessel maintenance, fuel, crew payroll, or purchasing nets and gear. The value of this economic activity is expressed as a multiplier applied to the landings value. However, so long as fishermen go out and fish, this upstream multiplier is realized, regardless of how many fish are caught on any trip. Given this, the upstream multiplier applied to landings values can be used to derive an economic exposure of total cumulative impacts of diminished fishing effort due to increasing build out of wind energy areas. This exposure value can then be applied to an index of the actual state of development of offshore wind in the region, for example, multiplied by 50% if 50% of the total regional wind energy area is developed.

[24] Based on both NOAA's (2018) Fishery Economics of the United States and an "advanced inquiry" using NOAA's online Fishery Economic Impacts Tool, the "upstream" sales multiplier for the Massachusetts commercial fishing sector is 1.83. That is, every dollar of commercial landings (ex-vessel value) in Massachusetts generates $0.83 in additional Massachusetts "upstream" impacts (see Appendix 2).

Massachusetts/Rhode Island WEAs acreage is occupied by offshore wind projects.[25] From there, the multiplier increases to 1.25 when 100% of the available acreage is built-out in 2039, according to the scenario. That is, to be cautious, it is assumed that even more area is built out beyond the Massachusetts/Rhode Island WEAs, for example to account for build-out in other WEAs. This multiplier is held constant from 2039 through the end of the Project's life in 2048.

As shown in Table 8, the cumulative impacts multiplier ensures that funding will be substantially higher than potential total impacts, based on the total acreage that is likely to be impacted, throughout the life of the Project and results in $7,916,632 in funding for cumulative impacts mitigation.

Table 8. Funding Schedule for Cumulative Impacts Mitigation (cautious approach)

Cumulative impacts							
		2019	**2024**	**2029**	**2039**	**...**	**2048**
Upstream	$	175,744	$ 198,838	$ 224,967	$ 287,976		$ 359,643
Agressive scenario for build-out [% of total lease areas]		0%	21%	60%	100%		100%
Cautious multiplier		**0.50**	**0.75**	**1.00**	**1.25**		**1.25**
Total annual cumulative impact payments (cautious approach)	**$**	**87,872**	**$ 149,128**	**$ 224,967**	**$ 359,970**		**$ 449,554**
Total payments over lifetime of project (nominal)	**$**	**7,916,632**					

Vineyard Wind will annually pay the calculated amounts to mitigate potential cumulative impacts into the Direct Compensation Fund, described in Section VI.

VI. Compensatory Mitigation Fund Administration

A. Direct Compensation Fund

The direct, downstream, and cumulative impacts mitigation payments described in the previous section will annually be paid into a Direct Compensation Fund. Vineyard will, in consultation with state agencies and fishing organizations, establish a claims review and decision process that will govern the payment of claims from the Direct Compensation Fund. Massachusetts fishing businesses will be able to submit claims of direct impacts of losses during any phase of the Project to the claims administrator.

Claims for direct impacts or losses for which claims may be filed include, but are not necessarily limited to, lost revenues to the Project's interference with fishing activities (if any). If a captain determines they are unable to fish safely because of the presence of the turbines, and can demonstrate a loss of income (or higher expenses for the same income) as a result of this decision, then compensation would be available through the Direct Compensation Fund. However, each vessel captain is responsible for the safety of their vessel and Vineyard Wind will not insure fishing vessel accidents. Lost or damaged gear associated with fishing within the Vineyard Wind 1 project area will be compensated directly, through a separate process and with funding aside from the Direct Compensation Fund and paid on an as-needed basis.

The documentation required to support a claim will be established by the third-party administrator, but will likely include a demonstrated history of fishing within the project area, as well as historic earnings of the claimant as a proportion of total relevant fisheries landings, against which claims for lost revenues can be measured. Claims can be documented on the basis of a statistical loss, and not necessarily a specific incident or event. For example, a vessel that historically fished in the Vineyard

[25] Vineyard Wind established the "cumulative impacts multiplier" to ensure funding for potential cumulative impacts would exceed actual potential cumulative impacts. The multiplier does this by assuming offshore wind build-out occurs at a highly accelerated rate and ultimately occupies 125% of the acreage available for build-out.

Wind 1 project area could document that their catch value as a proportion of any year's total catch value declined concurrently with their lack of fishing in the WDA after the project was completed. This proposed process for evaluating claims is based on processes used by a number of other similar funds, for example in the oil and gas industry.

Once the claims process is established, the procedures for filing a claim will be posted on Vineyard Wind's website and otherwise be made available through Vineyard Wind's fisheries liaisons, and as further specified in the fisheries communication plan. Claims that are accepted and paid will be accompanied by a release of liability for any future claims arising out of the same facts and circumstances that gave rise to the paid claim. This means that once Vineyard Wind pays a claim, Vineyard Wind, its parents, affiliates, and successors will have no further obligations with respect to that specific claimed loss. However, fishermen could make subsequent claims or on-going claims, if warranted.

First payment to the Direct Compensation Fund will be made upon Vineyard Wind 1's financial close; total payments of approximately $18.4 million will be made over the life of the Project. An indicative schedule of payments into for the Direct Compensation Fund, over the first 10 years of the Project's life, is provided as Table 9. The payments made by Vineyard Wind will be held in escrow and managed by one third-party administrator that will be selected by Vineyard Wind in consultation with the Massachusetts Office of Coastal Zone Management.

Table 9. Indicative Payment Schedule for Direct Compensation Fund

Year	Direct and Downstream Impacts Mitigation Payment	Cumulative Impacts Mitigation Payment	Total Annual Payment
2019	$1,216,609	$87,872	$1,304,481
2020	$222,025	$90,069	$312,094
2021	$227,575	$92,320	$319,895
2022	$233,265	$94,628	$327,893
2023	$239,096	$96,994	$336,090
2024	$245,074	$149,128	$394,202
2025	$251,200	$152,857	$404,057
2026	$257,480	$156,678	$414,158
2027	$263,917	$160,595	$424,512
2028	$270,515	$164,610	$435,125
2029	$277,278	$224,967	$452,245
TOTAL Payments over the life of the Project (nominal)	**$10,509,734**	**$7,916,632**	**$18,426,366**

B. Fisheries Innovation Fund

The Fisheries Innovation Fund will support programs and projects that ensure safe and profitable fishing continue as Vineyard Wind and future offshore wind projects are developed in Northern Atlantic waters. Programs and projects supported by the Fisheries Innovation Fund will focus on safe, profitable fishing now and in the future. These programs and projects may include the development of alternative gear, optimization of vessel systems, and general fishing vessel safety improvements.

Table 10. Indicative Payment Schedule for Fisheries Innovation Fund

Innovation Fund						
	2019	2020	2021	2022	...	2048
Vineyard Wind contributions	$ 1,000,000	$ 250,000	$ 250,000	$ 250,000		$ -
Total payments over lifetime of project (nominal)	**$ 1,750,000**					

The Fisheries Innovation Fund will be hosted and administered by the Massachusetts Executive Office of Energy and Environmental Affairs ("EEA"). Vineyard Wind and EEA will enter into a Memorandum of Agreement regarding payments to the Fund. Vineyard Wind will provide a total of $1.75 million prior to the end of the Project's construction phase, according to the indicative schedule included as Table 10, with $1 million in funding to be allocated when Vineyard Wind 1 achieves financial close.

VII. Conclusion

Vineyard Wind has taken steps to design an offshore wind project that avoids and minimizes potential impacts to Massachusetts fishing businesses to the greatest extent practicable. Recognizing that certain fishery-related economic impacts may be unavoidable, Vineyard Wind has designed a compensatory mitigation program for Vineyard Wind 1 that delivers substantial financial support over the 30-year life of the Project, as summarized in Table 11.

Table 11. Vineyard Wind Compensatory Mitigation Funds

Fund	Amount
Direct Compensation Fund	$18,426,366
Fisheries Innovation Fund	$1,750,000
TOTAL Payments over the life of the Project (nominal): $20,176,366	

The bulk of the more than $20 million in funding provided will be used to address potential economic impacts to Massachusetts fishing businesses; the remaining funds will be used to foster innovation that supports the successful co-existence of the fishing and wind sectors in the offshore environment. As this compensatory mitigation program detailed in this Plan was designed prior to the Project's delay, final payment amounts and schedules will need be needed to reflect the Project's revised construction and operation schedule.

Appendix 1—Vineyard Wind 1 Compensatory Migration Program Funding Overview

Table 1. Vineyard Wind 1 Compensatory Migration Program Funding Overview

Direct and downstream mitigation					
	2019	**2020**	**2021**	**...**	**2048**
Direct	$ 105,870	$ 108,516	$ 111,229		$ 216,652
Downstream	$ 91,048	$ 93,324	$ 95,657		$ 186,321
Total (direct + downstream)	$ 196,918	$ 201,840	$ 206,887		$ 402,974
Extraordinary, initial funding	$ 1,000,000				
Cautious approach multiplier	1.10	1.10	1.10		1.10
Total annual direct + upstream payments (cautious approach)	**$ 1,216,609**	**$ 222,025**	**$ 227,575**		**$ 443,271**
Total payments over lifetime of project (nominal)	**$ 10,509,734**				

Cumulative impacts						
	2019	**2024**	**2029**	**2039**	**...**	**2048**
Upstream	$ 175,744	$ 198,838	$ 224,967	$ 287,976		$ 359,643
Agressive scenario for build-out [% of total lease areas]	0%	21%	60%	100%		100%
Cautious multiplier	**0.50**	**0.75**	**1.00**	**1.25**		**1.25**
Total annual cumulative impact payments (cautious approach)	**$ 87,872**	**$ 149,128**	**$ 224,967**	**$ 359,970**		**$ 449,554**
Total payments over lifetime of project (nominal)	**$ 7,916,632**					

Innovation Fund						
	2019	**2020**	**2021**	**2022**	**...**	**2048**
Vineyard Wind contributions	$ 1,000,000	$ 250,000	$ 250,000	$ 250,000		$ -
Total payments over lifetime of project (nominal)	**$ 1,750,000**					

Vineyard Wind grand total contribution for MA fisheries over lifetime of project	**$ 20,176,366**

Appendix 2—Economic Multipliers for New England Commercial Fisheries

KING AND ASSOCIATES LLC
24 Trillium Rise • Plymouth, MA 02360

DATE: July 20, 2019

TO: Erich Stephens, Vineyard Wind, LLC

FROM: Dennis King, King and Associates, LLC

SUBJECT: Economic multipliers for New England commercial fisheries

Economic multipliers in commercial fisheries can be associated with both "upstream" impacts related to fishing activity and "downstream" impacts associated with seafood processing and other value added activities.

Based on both Fishery Economics of the United States, NOAA, 2018 and an "advanced inquiry" using NOAA's on-line Fishery Economic Impacts Tool, the "upstream" sales multiplier for the MA commercial fish harvesting sector is 1.83 and the "downstream" sales multiplier is 1.42. That is, every dollar of commercial landings (ex-vessel value) in MA generates $0.83 in additional MA "upstream" sales impacts and $0.42 in additional MA "downstream" impacts. This results in an overall sales multiplier of 2.25 for the MA commercial fisheries.

Attachment 1 shows the basis of statewide commercial fishery multipliers (direct, indirect, and induced sales) for MA, CT, RI, ME, and NH. Upstream multipliers associated with Harvesters range from 1.73 (RI) to 1.92 (ME). Downstream multipliers associated with Primary Dealers & Processors range from 1.36 (ME) to 1.75 (NH). Overall sales multipliers range from 2.15 (CT) to 2.50 (NH)

These economic multipliers are based on models that assume a linear relationship between inputs and outputs; that is, an X% change in the value of outputs is assumed to be the result of a corresponding X % change in the value of inputs used.

This assumption is not always valid in fisheries where changes in the ex-vessel value of commercial landings (Outputs) can be a result of changes in fishing effort (Inputs) or as a result of changes in the abundance, availability, or catchability of fish which determines catch per unit fishing effort (CPUE).

Applying these economic multipliers to declines in the ex-vessel value of fish landed in a particular area (e.g., the WDA) is also not valid if the declines are a result of fishing effort shifting from that area to other areas with similar CPUEs where offsetting increases in ex-vessel fish values and multiplier effects can be expected.

Attachment 1
New England Commercial Fishery Impacts from NOAA's online Seafood Industry Impact Tool (Harvesters and Primary dealers/Processors)

Seafood Industry Impacts - Fixed Report Results

Year	Region	State	Impact Categories	Sector	Direct (In Thousands)	Indirect (In Thousands)	Induced (In Thousands)	Total Impacts
2012	NEW ENGLAND	CT	Sales Impacts (in thousands of $)	Harvesters	20,608	11,642	4,295	36,545
2012	NEW ENGLAND	MA	Sales Impacts (in thousands of $)	Harvesters	618,247	333,576	177,576	1,129,399
2012	NEW ENGLAND	ME	Sales Impacts (in thousands of $)	Harvesters	448,544	296,799	115,612	860,955
2012	NEW ENGLAND	NH	Sales Impacts (in thousands of $)	Harvesters	23,176	12,599	4,873	40,648
2012	NEW ENGLAND	RI	Sales Impacts (in thousands of $)	Harvesters	80,787	37,992	20,631	139,410

Seafood Industry Impacts - Fixed Report Results

Impa

Help

Year	Region	State	Impact Categories	Sector	Direct (In Thousands)	Indirect (In Thousands)	Induced (In Thousands)	Total Impacts
2012	NEW ENGLAND	CT	Sales Impacts (in thousands of $)	Primary dealers/processors	3,895	2,195	1,821	7,910
2012	NEW ENGLAND	MA	Sales Impacts (in thousands of $)	Primary dealers/processors	116,849	71,602	68,292	256,743
2012	NEW ENGLAND	ME	Sales Impacts (in thousands of $)	Primary dealers/processors	83,600	37,600	38,257	159,457
2012	NEW ENGLAND	NH	Sales Impacts (in thousands of $)	Primary dealers/processors	8,843	4,628	3,925	17,396
2012	NEW ENGLAND	RI	Sales Impacts (in thousands of $)	Primary dealers/processors	15,269	9,009	8,518	32,796

row(s) 1 - 5 of 5

Attachment 5

Fisheries Working Group Presentation (March 29, 2019)

OCS-A 0501 MASS USA

VINEYARD WIND

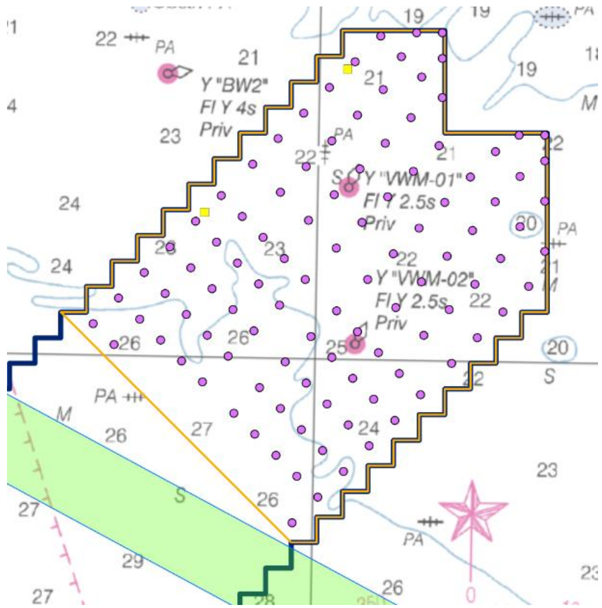
Massachusetts Fisheries Working Group

March 29, 2019

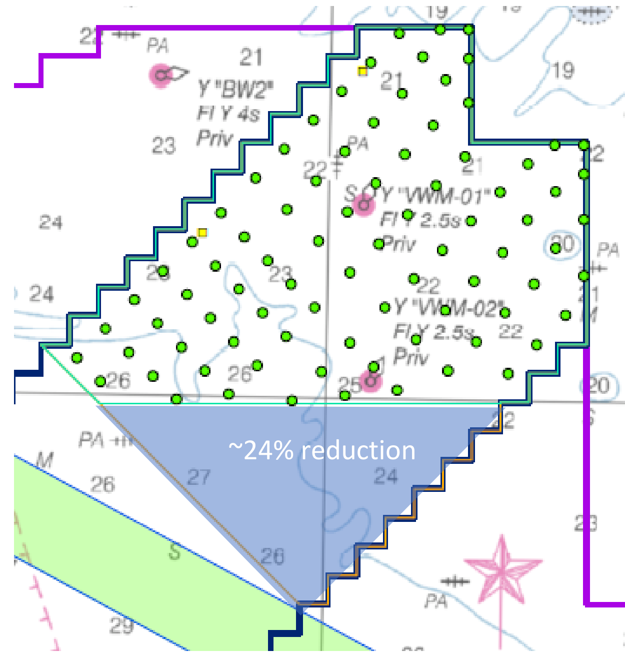
PROJECT UPDATE
WIND DEVELOPMENT AREA – 800 MW

- **106 turbines reduced to 84**
  - MHI Vestas 9.5MW
  - Largest available turbine reduces footprint and number of structures
- **Only 1 Electric Service Platform (ESP)**
  - Original permit 2-4 ESP
- **Monopiles >90%**
  - Jacket foundations reduced from up to 50% to up to 10% (minimizes footprint)
- **Committed to east-west alignment for future development**

106 Turbines



84 Turbines



PERMIT UPDATE

FEDERAL – BOEM Lead Federal Agency

- Draft Environmental Impact Statement (DEIS) released and public comments period closed in February 2019.
- Final Environmental Impact Statement (FEIS) expected June 2019
- RI issued federal consistency determination

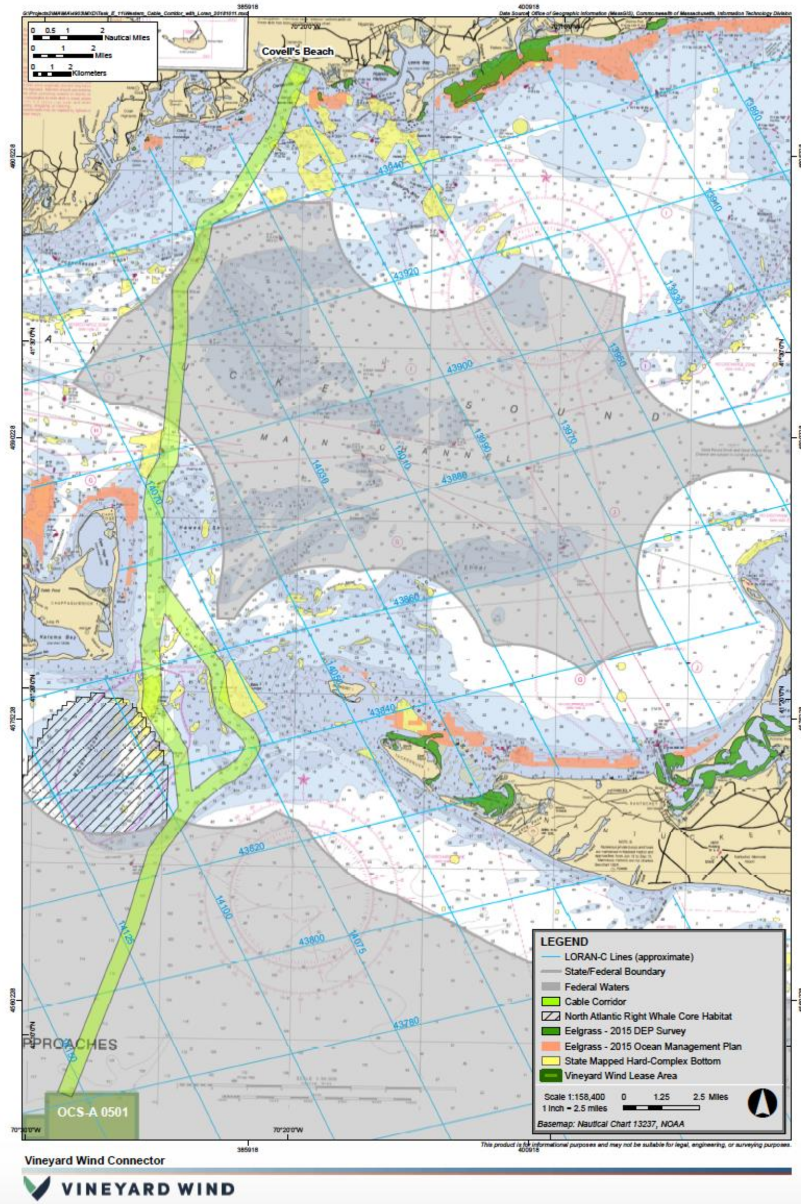
STATE

- Massachusetts Environmental Policy Act (MEPA)
    - Issued Certificate for Final Environmental Impact Report (FEIR) in February 2019
- State and Local Permitting ongoing

RIGHT WHALE PROTECTION

- Agreement with Environmental Groups
- Seasonal restrictions, vessel speed restrictions, acoustic and visual monitoring
- Noise reduction measures during pile driving

PROJECT UPDATE
CONSTRUCTION TIMELINE



Onshore work – Barnstable

- Starts fall 2019

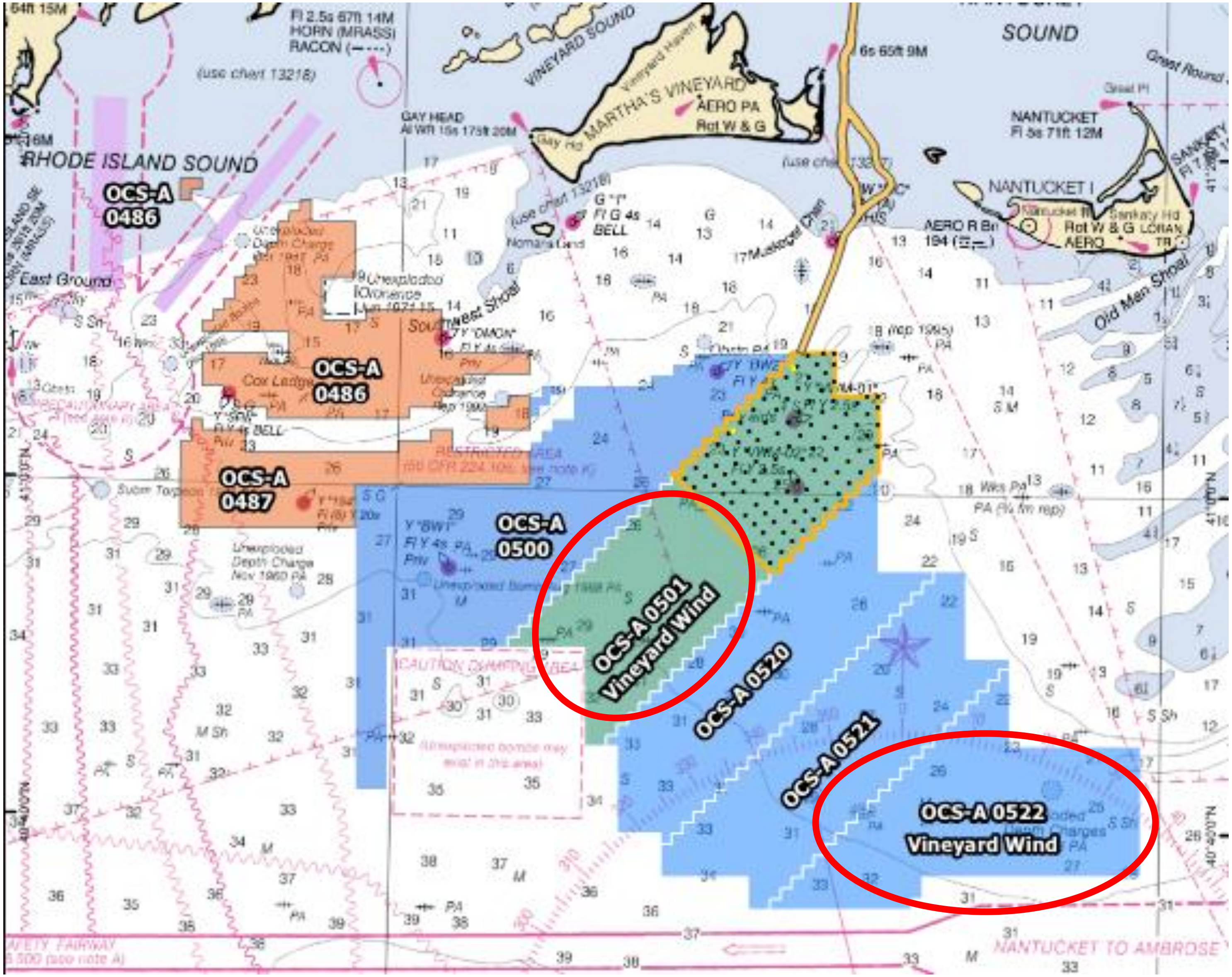
Offshore work

- Starts late summer 2020

Cable Route

- Fall 2020 most of Nantucket Sound
- Early spring 2021 southern Nantucket Sound to wind farm

UPCOMING SURVEYS – 501S & 522



FISHERY REPRESENTATIVES

Vineyard Wind is looking to expand our network of Fishery Representatives

- Represent the fishermen, port, fishery, sector, organization; provide feedback into the project

Existing Representatives

- New Bedford Port Authority
- Jim Kendall
- Martha's Vineyard Fishermen's Preservation Trust
- Massachusetts Lobstermen's Association

Please contact Crista Bank (cbank@vineyardwind.com) if interested

CONTACT DETAILS

Crista Bank – Fishery Liaison

Cbank@vineyardwind.com

phone: 508-525-0421

To sign up for updates and see the latest notices/information please visit www.vineyardwind.com/fisheries

Attachment 6

Fisheries Working Group Presentation (May 16, 2019)

FISHERIES WORKING GROUP

May 16, 2019

- Updates:
  - Fisheries studies
  - Geological survey
- Recreational fishing
- Proposed compensatory mitigation program

FISHERIES STUDIES

Trawl Vessels Needed

Recommended:

- Boat Length: 70 – 90’
- Engine horsepower: 400 – 850 HP

Required:

- Ability to house 3 scientists for overnight accommodation
- Ample deck space to work up the catch
- No recent fisheries violations
- Vessel safety check

If interested, please contact:
Dr. Pingguo He (fish@umassd.edu)

Gear Needed

66" Thyboron Type 4 doors

Rent or buy

Storage Space Needed for

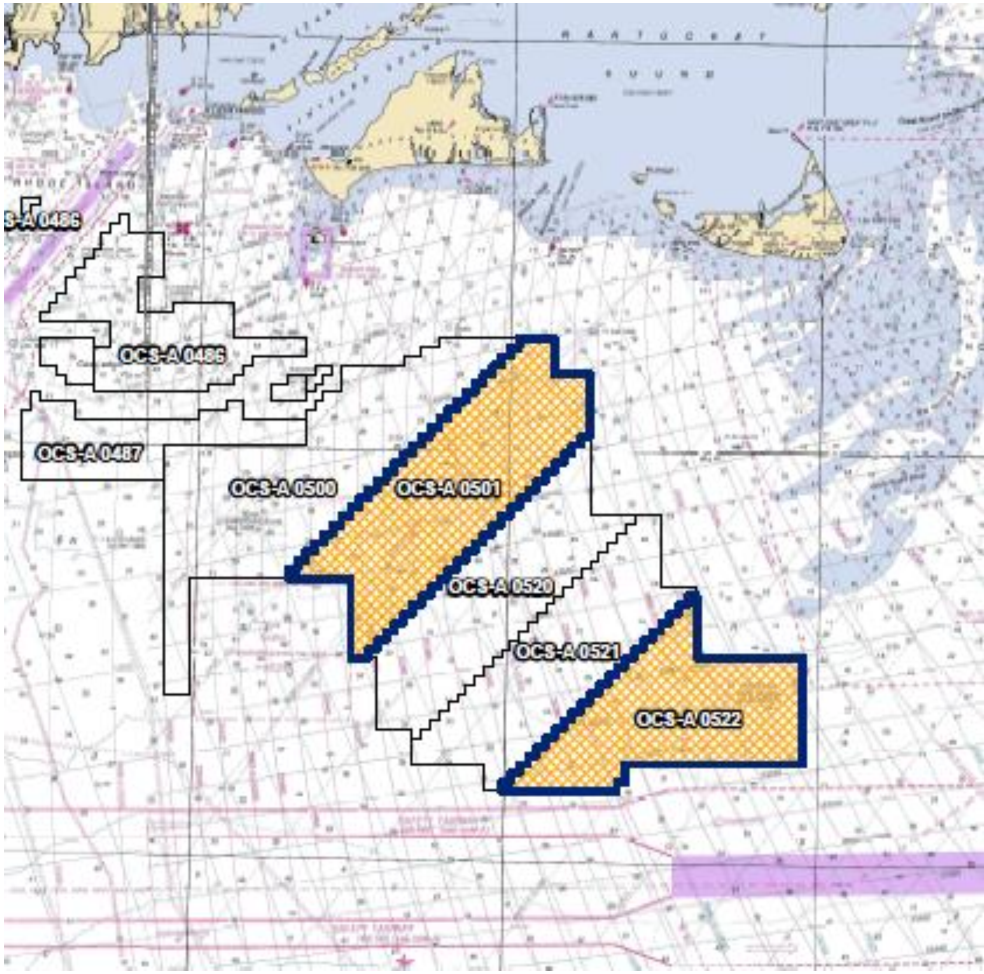
Lobster gear: ~ 5,000 sq feet

Inside storage for extra net and doors

2019 GEOLOGICAL SURVEYS

Surveys will take place in VW lease areas 501 and 522

- Surveys beginning on or around May 22nd
- Initial vessels on survey:
  - MV Neptune
  - MV Gerry Bordelon
- Other vessels to be deployed later, notifications to be made at that time
- Survey will gather data on seabed and subfloor conditions
- Seeking contact with fishermen who are or may be working in the survey area



RECREATIONAL FISHERIES

- Limited information to support quantifying impacts to recreational fisheries, if any
- Evidence that some types of recreational fisheries may benefit
- Lack of specific information / data to quantify impacts
- Vineyard Wind organizing research regarding large pelagics
- Meanwhile, Vineyard Wind proposing to allow recreational fishing businesses to be eligible for direct compensatory mitigation fund

MITIGATION PAID TO TWO FUNDS

Direct compensation fund:

- Funding amount based on average annual value of Massachusetts landings of all species from the project area, estimated to be $196,621/year
- For compensation of direct losses (gear loss, lost revenue, etc)
- Funds held in escrow (trust)
- Requirements for receiving compensation payment established by a panel of fishermen, regulators, and Vineyard Wind
- Claims evaluated and paid by an independent administrator
- This is a typical arrangement for other types of compensatory programs

Innovation fund:

- Funding additional to direct compensation amount
- Funds programs and projects to ensure safe, profitable fishery future alongside offshore wind
- Held by state agency or a separate trust from the direct compensation escrow account
- Vineyard Wind will not be involved in determining how funds are deployed

PAYMENT MECHANISM

Direct Compensation Fund

- Annual payment to fund:
  - $ 196,621 per year, inflated 2.5% each year
  - First year front-loaded X 2 ($393,242)
  - 30 years of payment
- Starting in 2019: year before in-water construction starts

Innovation Fund

- Annual payment to fund:
  - $100,000 per year, inflated 2.5% each year
  - First year front-loaded X 2 ($200,000)
  - 10 years of payment
- Every year after first, unused Direct Compensation funds in excess of $196,621 are moved to Innovation Fund

Total proposal value: $10,049,153

Attachment 7

Proposal for a Uniform Wind Turbine Layout for New England Offshore Wind

November 1, 2019

RE: Proposal for a uniform 1 X 1 nm wind turbine layout for New England Offshore Wind

Mr. Michael Emerson, Director
Marine Transportation Systems (CG-5PW)
US Coast Guard, Stop 7501
Washington DC 20593-751

By email: Michael.D.Emerson@uscg.mil

Dear Mr. Emerson:

We, the five New England offshore wind leaseholders, propose a collaborative regional layout for wind turbines across our respective BOEM leases, and urge the Coast Guard, BOEM, and other regulators and stakeholders to support adoption of this 1 x 1 nautical mile (nm) uniform turbine layout with no additional designated transit corridors. For the purpose of this letter, the combined area encompassed by the seven leases is referred to as the New England Wind Energy Area (NE WEA). Under this proposal each turbine would be spaced 1 nautical mile (nm) apart in fixed east-to-west rows and north-to-south columns to create the 1 nm by 1 nm grid arrangement preferred by many stakeholders, including fishermen operating in the region. This 1x1 nm layout has also been confirmed through expert analysis to allow for safe navigation without the need for additional designated transit lanes. This proposed layout will provide a uniform, wide spacing among structures to facilitate search and rescue operations.

Enclosed please find a report prepared by W.F. Baird & Associates Ltd., a leading vessel and port safety consultant, which describes historic vessel transit patterns in the region and analyzes the 1x1nm layout using international vessel safety guidelines. Baird's analysis is based on AIS data between 2017 and 2018. The key findings include:

- Most traffic in the general region is transiting around, or along the outside edges, of the NE WEA;
- Most of the transiting vessels are fishing vessels, and they follow a wide range of transit paths through the NE WEA as they are coming from several different ports and heading to a variety of fishing grounds;
- Vessels up to 400' length can safely operate within the proposed 1x1 nm layout, and historic transit data shows vessels over this length tend to follow existing Traffic Separation Schemes already outside the NE WEA;
- Given the 1x1nm layout, there does not appear to be a need for designated transit corridors through the WEA.

We respectfully invite the Coast Guard to incorporate this proposal and the enclosed study in the ongoing Massachusetts and Rhode Island Port Access Route Study. Given the many advantages of the proposed 1x1 nm regional layout, the New England Leaseholders are proud to be working together to present a collaborative solution that we believe accommodates all ocean users in the region.

Advantages of a 1 x 1 nm uniform layout

There are four main advantages of the proposed 1x1nm uniform turbine layout:

- Navigation safety
- Responsive to fishermen's request for 1 nm turbine spacing and east-west rows
- Creates 231 transit corridors, in four cardinal directions
- Facilitates search and rescue operations

Navigation Safety

The Coast Guard has consistently expressed its desire that the potential wind energy facilities in then NE WEA preserve mariners' ability to transit from one end of the NE WEA to the other while maintaining a relatively steady course and speed. The Coast Guard was concerned that dissimilar array layouts may present a veritable obstacle course through which mariners must navigate. The solution jointly proposed here would address both Coast Guard issues and preserve navigation safety.

Responsive to requests from fishermen

Commercial fishermen working in the region have consistently advocated for turbines to be oriented in E-W rows, to accommodate long-standing practices designed to minimize conflict between fixed and mobile fishing gear. Considerable written and oral public comments have urged adoption of 1 nm spacing between turbines so as to better facilitate fishing operations among the turbines. Fishermen have also asked that turbine layouts be consistent across lease areas so as to avoid changing their operations as they pass from one lease area into the next.

Members of the Rhode Island Fisheries Advisories Board, the Massachusetts Fisheries Working Group, fisheries groups that serve as representatives to the Leaseholders, fishing fleet operators, and fish processing companies, as well as the National Marine Fisheries Service, have all expressed support for one or all of the following design elements: a uniform layout across the entire NE WEA, E-W rows, and at least 1 nm spacing being turbines. The 1x1nm turbine layout proposed here would provide each of these requested design elements, precisely as requested by the fishing industry.

Creates 231 transit corridors serving four cardinal directions

The proposed 1x1 nm turbine layout accommodates safe transiting through the region by creating 231 transit corridors in four cardinal directions. The existence of numerous corridors, in multiple directions, consistently across all lease areas, would be preferable to having a restricted number of designated transit lanes.

Because most of the vessel traffic in the NE WEA are fishing vessels, as noted in the Baird report, and fishing vessels utilize a wide variety of transit paths, having the ability to safely transit in any of four cardinal directions from any point within the NE WEA best accommodates the largest number of vessels operating in the area.

As shown in Figure 1, the uniform turbine layout would create 231 corridors of uniform width that cross from east-west (E-W), north-south (N-S), NW-SE, and SW-NE. These 231 corridors will be available for mariners no matter where they cross into the NE WEA. The corridor width in the E-W and N-S direction would be 1 nm. In the NW-SE and SW-NE directions the corridors would be 0.7 nm wide for the purpose of maintaining a constant heading, however the closest distance between any two turbines on either side of a vessel using a NW-SE or SW-NE corridor would be 1.4 nm

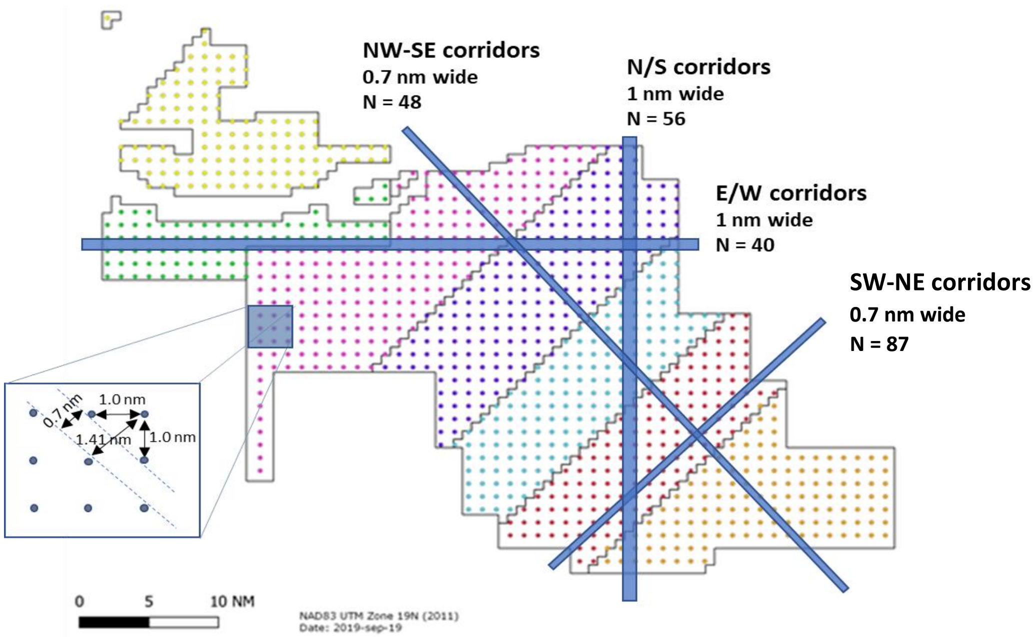


Figure 1: A full 1 X 1 nm E-W, N-S grid creates the equivalent of 231 transit lanes in four different key directions: E-W, NW-SE, N-S and SW-NE.

The AIS data that Baird analyzed, indicates that most of the vessels transiting the region currently choose to navigate outside of the NE WEA even when no turbine structures are present. And of those vessels transiting the NE WEA, many are just inside the edge of the NE WEA.

Of the vessels transiting the NE WEA, most are commercial fishing vessels. These vessels originate from several ports that are generally to the north and northwest of the NE WEA, heading to fishing grounds located generally to the southeast and south of the NE WEA. Consequently, a single transit corridor would still require many vessels to modify their traffic patterns, given the wide variety of origins and destinations to accommodate the wide variety of fishing vessel homeports and practices.

Baird's analysis demonstrates that for all but the very largest vessels transiting in the region — and for fishing vessels of all sizes— the wide spacing of 1 nm between turbines would allow for safe navigation among the turbines. This conclusion applies to vessels that might be passing or overtaking each other, and considers the need to make emergency turns, even with fishing gear deployed.

Facilitates search and rescue operations

Our proposal of a uniform grid turbine layout, with turbines no closer than 1 nm, would afford an even greater level of flexibility and safety for SAR operations, by both vessel and aircraft.

1 x 1 nm layout best accommodates all maritime stakeholders, allowing offshore wind to deliver its benefits to the U.S.

Given the many advantages of the proposed 1x1 nm turbine layout, the New England Leaseholders are proud to be working together to propose a collaborative solution to concerns that have been raised by stakeholders about the full-build out scenario of the NE WEA. We respectfully invite the Coast Guard to incorporate this proposal and the enclosed study in the Massachusetts and Rhode Island Port Access Routing Study. As detailed above, this proposed layout responds to input and requests from many stakeholders and creates an opportunity that we believe accommodates all ocean users. We appreciate your continued consideration for how to safely ensure continued coexistence of all ocean users in the region, including offshore wind.

Christer af Geijerstam, President
Equinor Wind US

Leon Olivier, Executive Vice President Enterprise Energy Strategy
Eversource Energy

John Hartnett, President
Mayflower Wind

Thomas Brostrøm, President
Orsted North America

Lars Thaaning Pedersen, CEO
Vineyard Wind LLC

CC: Walter Cruickshank, Director, Bureau of Ocean Energy Management

Enclosure: Baird Study "Vessel Navigation Through the Proposed Rhode Island/Massachusetts and Massachusetts Wind Energy Areas", October 31, 2019

Vessel Navigation Through the Proposed Rhode Island/Massachusetts and Massachusetts Wind Energy Areas

October 31 2019 | 13057.301.R1.RevD

Baird.
Innovation Engineered.

baird.com

Vessel Navigation Through the Proposed Rhode Island/Massachusetts and Massachusetts Wind Energy Areas

Prepared for:

Epsilon Associates Inc.
3 Mill & Main Place, Suite 250
Maynard, Massachusetts 01754

Prepared by:

W.F. Baird & Associates Ltd.

For further information, please contact
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dscott@baird.com
www.baird.com

13057.301.R1.RevD

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Revision	Date	Status	Comments	Prepared	Reviewed	Approved
A	06 Sep 2019	Draft	For client review	RDS	DT	RDS
B	24 Sep 2019	Draft		RDS	DT	RDS
C	07 Oct 2019	Draft		RDS	DT	RDS
D	31 Oct 2019	Draft		RDS	DT	RDS

Table of Contents

Tables

Figures

Acronyms

AIS	Automatic Identification System
AtoN	Aids to Navigation
BOEM	Bureau of Ocean Energy Management
COLREGS	International Regulations for Preventing Collisions at Sea
COP	Construction and Operations Plan
DWT	Deadweight Tonnage
EMF	Electromagnetic Field
ESP	Electrical Service Platform
Ft	feet
GPS	Global Positioning System
Hz	Hertz
IALA	International Association of Lighthouse Authorities
IPS	Intermediate Peripheral Structures
kts	Knots - vessel speed in nautical miles per hour
LOA	length overall
m	meter
MHHW	Mean Higher High Water
MLLW	Mean Lower Low Water
MSL	Mean Sea Level
NM	nautical mile
NOAA	National Oceanic and Atmospheric Administration
NTM	Notice to Mariners
PAtoN	Private Aids to Navigation
RACON	Radar Transponder
Ro-Ro	Roll-on roll-off vessel
SAR	Search and Rescue
SPS	Significant Peripheral Structure

TSS	Traffic separation scheme
USCG	US Coast Guard
VHF	Very High Frequency Radio
WEA	Wind Energy Area
WTG	Wind Turbine Generator

1. Introduction

In January 2019, Baird completed a Supplementary Analysis for Navigational Risk Assessment of the Vineyard Wind project. That study, documented in Baird (2019), focused on analysis of an Automated Identification System (AIS) data set of vessel traffic in the vicinity of the Vineyard Wind project covering the period from 2017 to 2018. The analyses and risk assessment completed by Baird were focused on the navigation risk during the operational phase of the Vineyard Wind project.

Since that time, guidance has been provided that a uniform wind turbine layout with an East-West orientation should be assumed over the entire Rhode Island/Massachusetts and Massachusetts Wind Energy Area (referred to herein as the WEA) as shown in Figure 1.1. The proposed layout has a 1 nautical mile (nm) wind turbine generator (WTG) spacing in both the East-West (E-W) and North-South (N-S) directions, providing corridors 1 nm wide in both the N-S and E-W orientations. This uniform layout also inherently creates 0.7 nm wide corridors on the diagonal in the Northwest-Southeast (NW-SE) and Southwest-Northeast (SW-NE) directions. As may be seen in Figure 1.1, these corridors exist across the entire WEA, not just through selected designated fairways.

This uniform WTG layout will allow vessels to transit through the turbines on a constant heading track along N-S, E-W, NW-SE and SW-NE corridors at all locations in the WEA.

This study has examined the potential impact of the proposed WTG layout on vessel navigation through the WEA. A first step was to conduct an analysis of historical vessel traffic using Automatic Identification System (AIS) data and the methods presented in Baird (2019). Subsequently an assessment of the influence of the WTG arrangement and transit corridors on vessel navigation was conducted using international design guidance.

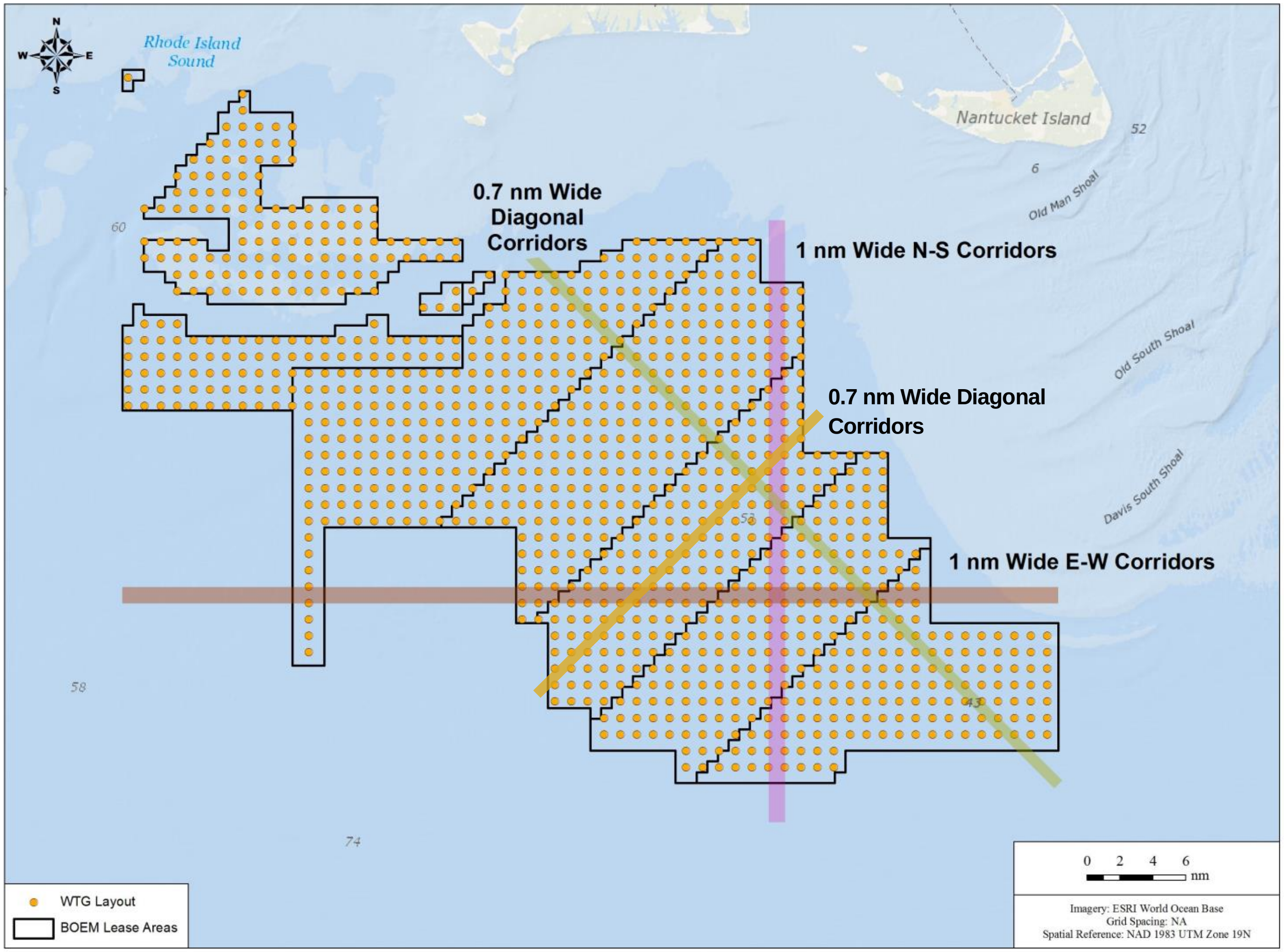

Figure 1.1: RI/MA and MA Wind Energy Areas (WEA) – Uniform Turbine Layout (1 nm E-W; 1 nm N-S; 0.7 nm NW-SE; 0.7 nm SW-NE spacing)

2. Summary of Historical Vessel Traffic

Historical vessel traffic patterns for the years 2017 and 2018 were examined using AIS data. All tracks for vessels transiting within the perimeter of the WEA were extracted from the AIS dataset. The analysis focused on the following vessel types as identified by their AIS reporting codes:

- Cargo;
- Tankers;
- Passenger;
- Military;
- Sailing and Pleasure vessels; and
- Fishing.

Table 2.1 presents a summary of the AIS vessel traffic through the WEA by vessel type. Fishing vessels are the dominant vessel type based on number of AIS data points (pings), unique transits identified in Baird's analysis, and unique vessels. Fishing vessels represent over 70% of the AIS data. The size of fishing vessels is typically 70 ft length overall (LOA) up to a maximum of 195 ft, while vessel beam is typically 25 ft, up to a maximum of 49 ft. Cargo and tanker vessels represent approximately 11% of vessel position data and those vessels typically exceed 600 ft LOA, with the largest vessels between 900 and 1000 ft. There are very few military vessels that transit the WEA (0.3% of total traffic) with only seven unique vessels per year on average. Note the "Other" category has been excluded from the statistics as it is comprised of survey vessels that were operating in the WEA (thus, not normal traffic) as well as vessels that were missing the AIS category data.

Table 2.1: Summary of AIS Vessel Traffic through WEA: 2017 and 2018.

Vessel Type	LOA (ft)		Beam (ft)		% AIS data points – All Data	Unique Vessels (per year)*		Unique Tracks (per year)*	
	Mode^	Max	Mode^	Max		Count	%	Count	%
Fishing	70	195	25	49	71.2%	348	38.7%	3,259	69.4%
Military	105	465	20	55	0.3%	7	0.8%	19	0.4%
Passenger	570	960	105	145	0.7%	16	1.8%	41	0.9%
Cargo	660	990	105	155	7.0%	94	10.4%	252	5.4%
Tanker	600	900	105	155	4.3%	59	6.6%	185	3.9%
Sailing and Recreational	45	300	15	80	16.5%	376	41.8%	941	20.0%
Not Included in Normal Vessel Traffic									
Other#	225	600	35	95	-	48	N/A	453	N/A

* Average of 2017 and 2018 data

Includes survey vessels which operated in the WEA in 2017 and 2018 as well as uncategorized vessels (incomplete AIS data)

^ Mode is the most common LOA or beam of the specified vessel type

2.1 Consideration of Vessels Without AIS

It is important to recognize that AIS is only required on vessels 65 feet and longer and, as a result, not all vessels, particularly fishing vessels, are equipped with AIS equipment. In Baird (2019), a comparison was made between the permitted fishing vessels and those equipped with AIS equipment for two of the larger fishing ports (New Bedford and Point Judith). It was concluded that AIS-equipped fishing vessels appear to represent a relatively large percentage (estimated at about 40% to 60%) of the fishing vessels operating in the area. And while the AIS data does not capture all the fishing vessel traffic which transits the WEA, the AIS data represents the largest fishing vessels by length and beam. Length and beam are two of the more important vessel characteristics considered in the assessment of navigational safety, given the more limited maneuverability of larger vessels and the tendency of larger vessels to travel faster than smaller vessels.

2.2 Summary of Vessel Traffic Through the WEA

Figure 2.1 presents vessel track density plot for all AIS vessels (excluding research and survey vessels) which transited near and through the WEA between 2017 and 2018. The highest density of vessel traffic (shown in grey contours) transits outside the WEA. There are three designated Traffic Separation Schemes (TSS) adjacent to the WEA that can be readily identified by traffic density in the figure (using numbers shown on Figure 2.1):

1. The Narragansett Bay Traffic Lanes that run north-south to the west of the WEA.
2. The Buzzard Bay Traffic Lanes that run in a northeast-southwest orientation and are located northwest of the WEA.
3. The Nantucket-Ambrose Traffic Lanes located to the south of the WEA.

The following report sections (2.3 to 2.5) focus on the three groups of vessels that comprise much of the traffic in the area:

- Cargo, tanker and passenger vessels (grouped together due to size and vessel characteristics)
- Pleasure and sailing vessels
- Fishing vessels

The majority of the AIS vessel traffic through the WEA are fishing vessels (see Table 2.1, 69% of the vessel transits through WEA are fishing vessels) and it is therefore appropriate to focus on the characteristics of the fishing vessel traffic through the WEA and the potential navigation impacts to that group of vessels.

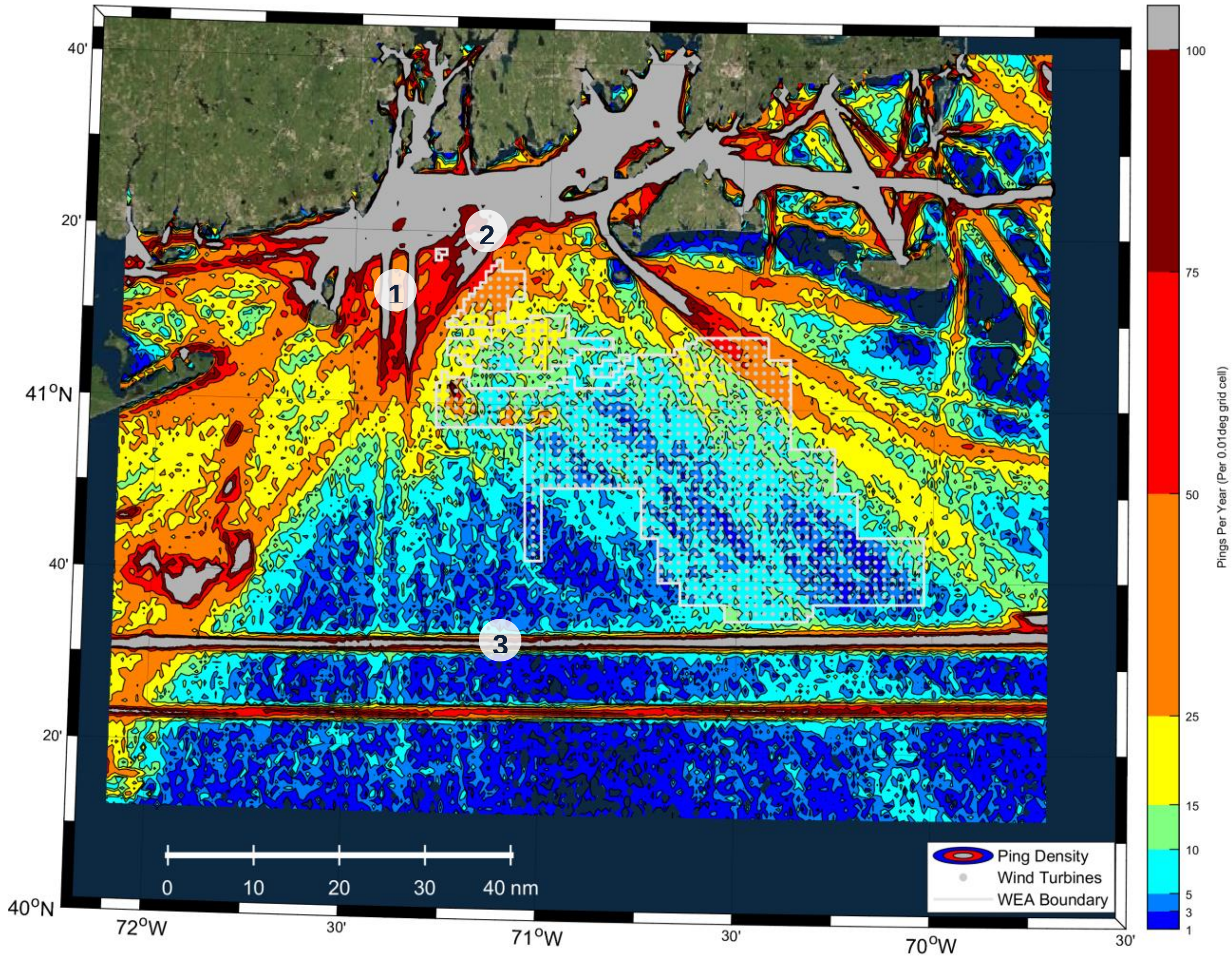

Figure 2.1: All AIS Vessel Traffic Through WEA Vessel Traffic Density: 2017 and 2018 (excluding survey and research vessels).
Note: Numbers indicate designated traffic lanes (TSS).

2.3 Cargo, Tanker and Passenger Vessel Traffic through the WEA

Figure 2.2 presents unique vessel tracks for passenger, cargo and tanker vessels. Based on Table 2.1, most of these vessels are 550 ft or longer (LOA) and they are typically transiting through the NW-SE axis of the WEA, or along the southwestern margins of the WEA. Vessel speeds through the WEA are relatively high, ranging from 8 to 16 knots. Many of these vessels are travelling to and from the Narragansett Bay Traffic Lanes and the Nantucket-Ambrose Traffic Lanes . The feasibility of those ships navigating through the WEA with a uniform turbine layout is discussed later in this report.

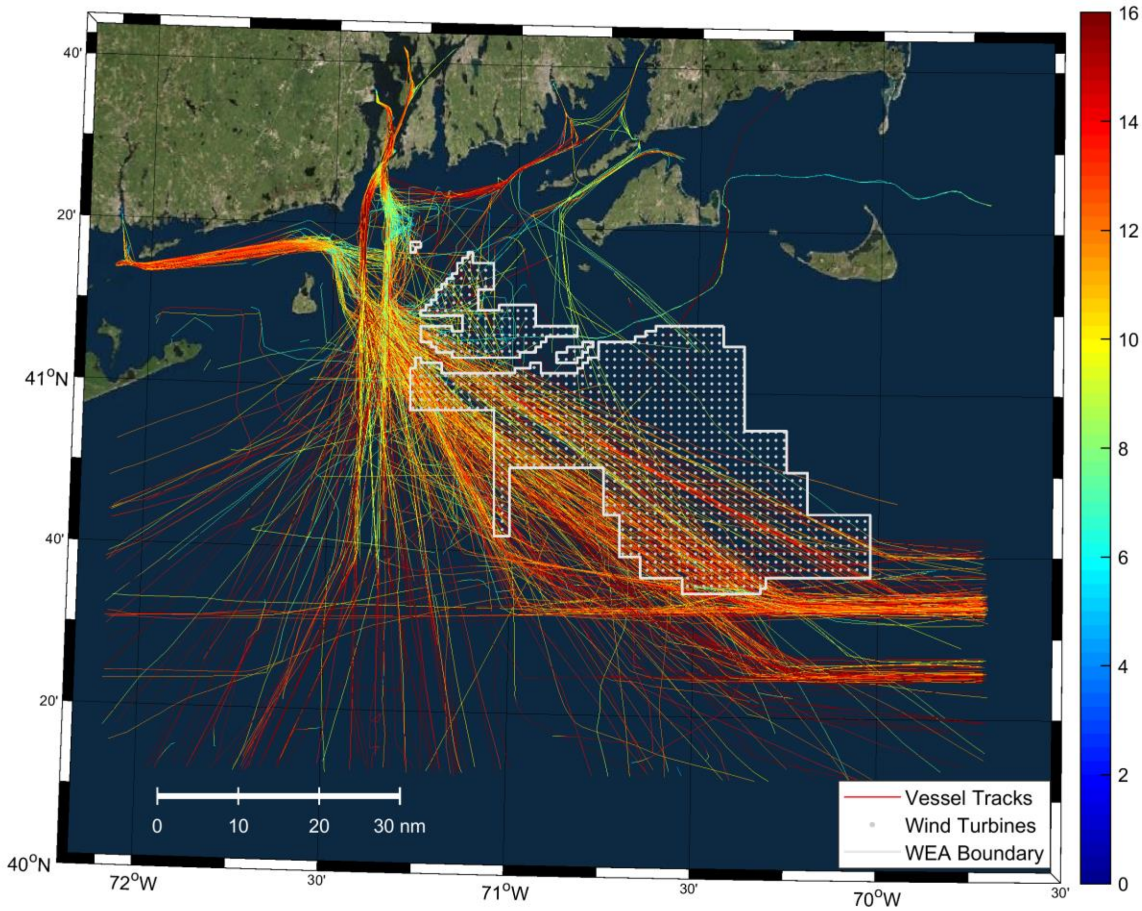

Figure 2.2: Cargo, Tanker and Passenger Vessel Tracks: 2017 and 2018

While a track plot, such as Figure 2.2, provides an indication of the range of historical vessel transits, it is difficult to evaluate the relative volume of vessel traffic as the tracks tend to overlie each other on the busier transit routes. To better understand the traffic volume, "vessel track density plots" were prepared that give an indication of the number of AIS data points ("pings") per specified area (0.01 degrees) annually. The greater the number of data points, the greater the traffic volume. Figure 2.3 presents such a vessel track density plot for cargo, tanker and passenger vessels which transit near and through the WEA. It may be noted in Figure 2.3 that many vessels transit around the WEA. For the vessels that do transit through the WEA the most common transit route is between points 1 and 2 indicated on Figure 2.2.

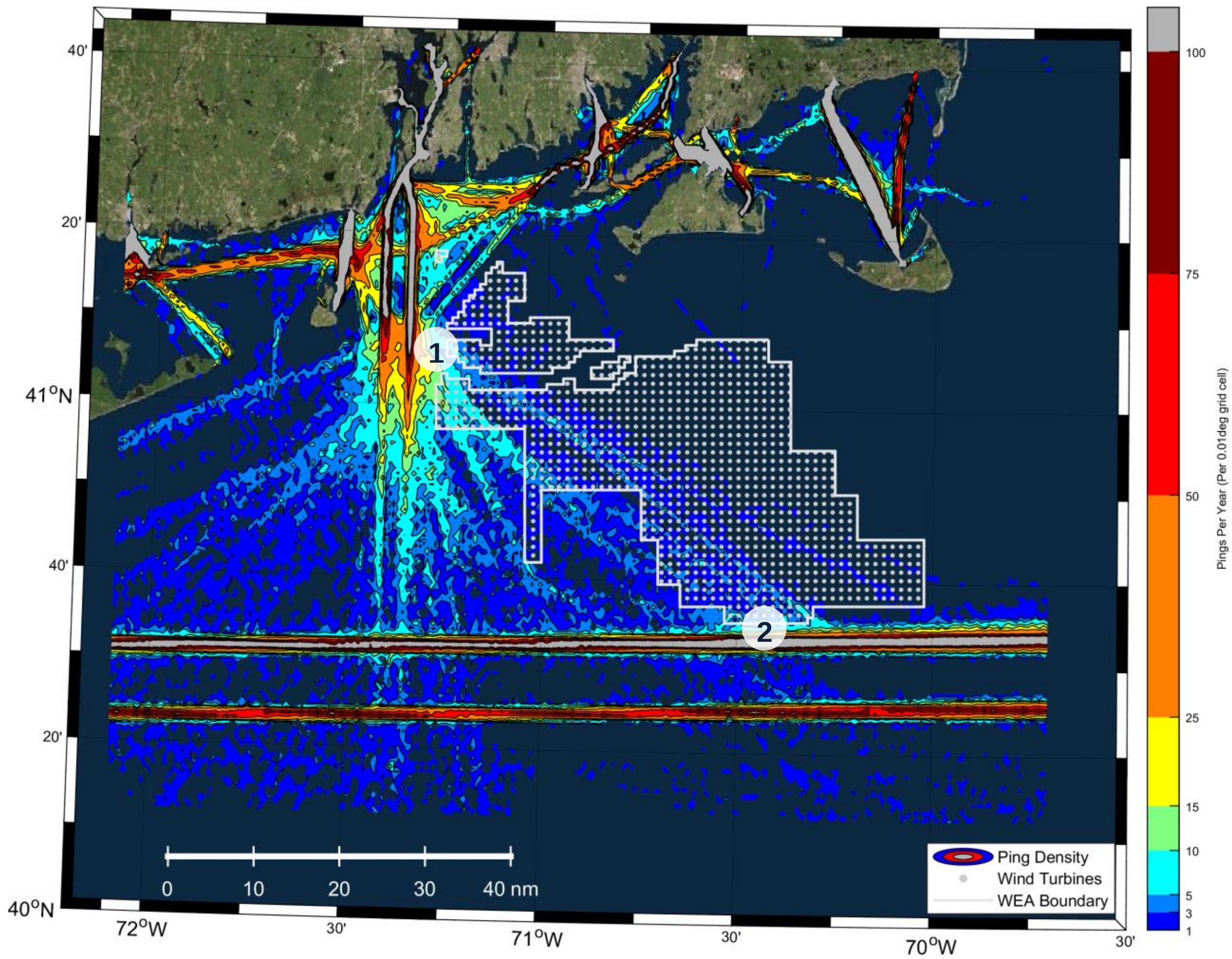

Figure 2.3: Cargo, Tanker and Passenger Vessel Traffic Density: 2017 and 2018

2.4 Pleasure and Sail Vessels

Pleasure and sail vessels represented 16% of the AIS vessel traffic navigation through and near the WEA. Figure 2.4 presents a plot of pleasure and sail vessel traffic for 2017 and 2018 which indicates a reasonable density of traffic through the WEA across a series of NW-SE transit routes. Vessel speeds through the WEA show considerable variability, typically ranging from 8 to 10 knots, but can be as slow as 6 knots or fast as 14 knots. Figure 2.5 presents a traffic density plot which highlights some of the preferred sailing routes. Based on vessel length, all of the vessels transiting through the WEA in 2017 and 2018 could also maneuver through the uniform turbine layout. However, certain very large sail craft do have mast heights that exceed the air draft limits of the turbines due to their blades, and operators of these vessels would need to aware of this limitation. Such vessels would need to be in close proximity to the turbine base for a turbine blade strike to be possible.

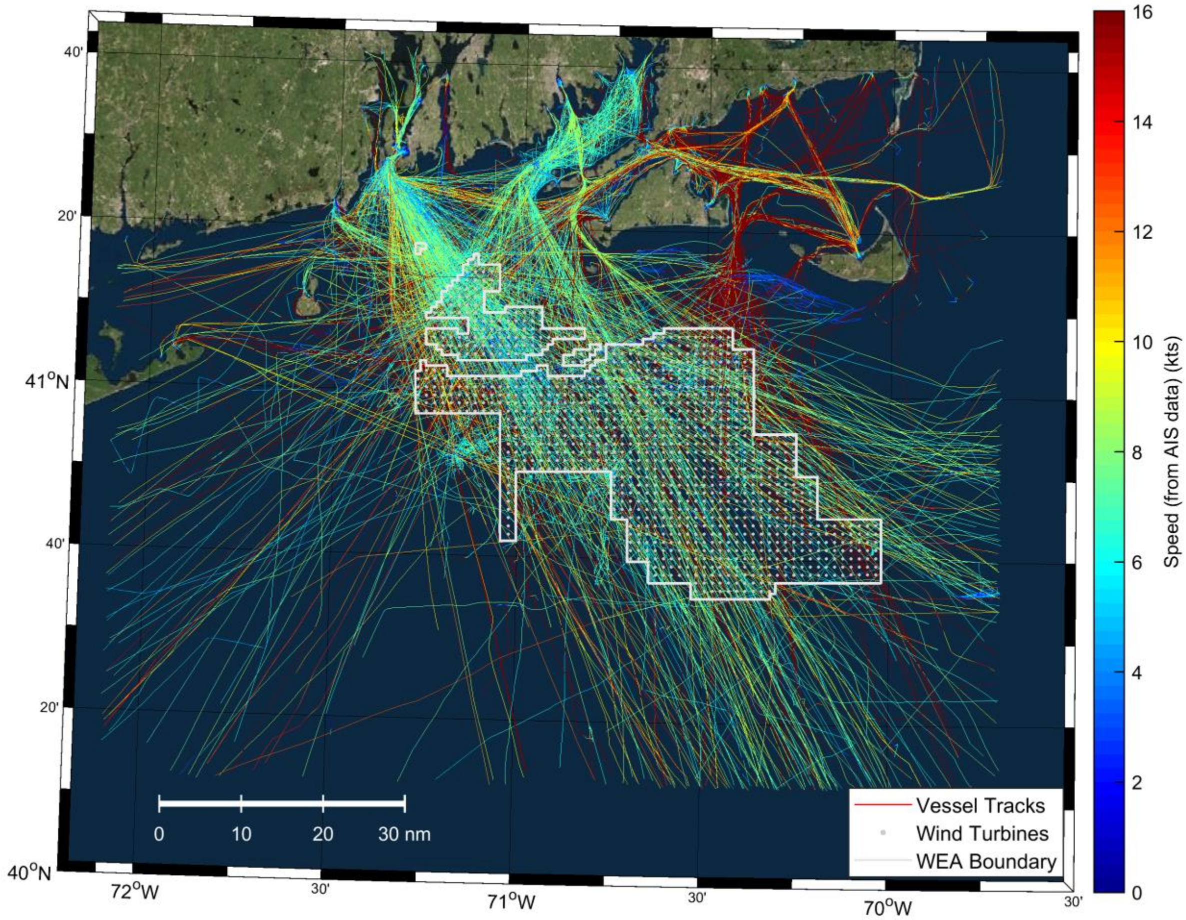

Figure 2.4: Pleasure and Sail Vessel Tracks: 2017 and 2018

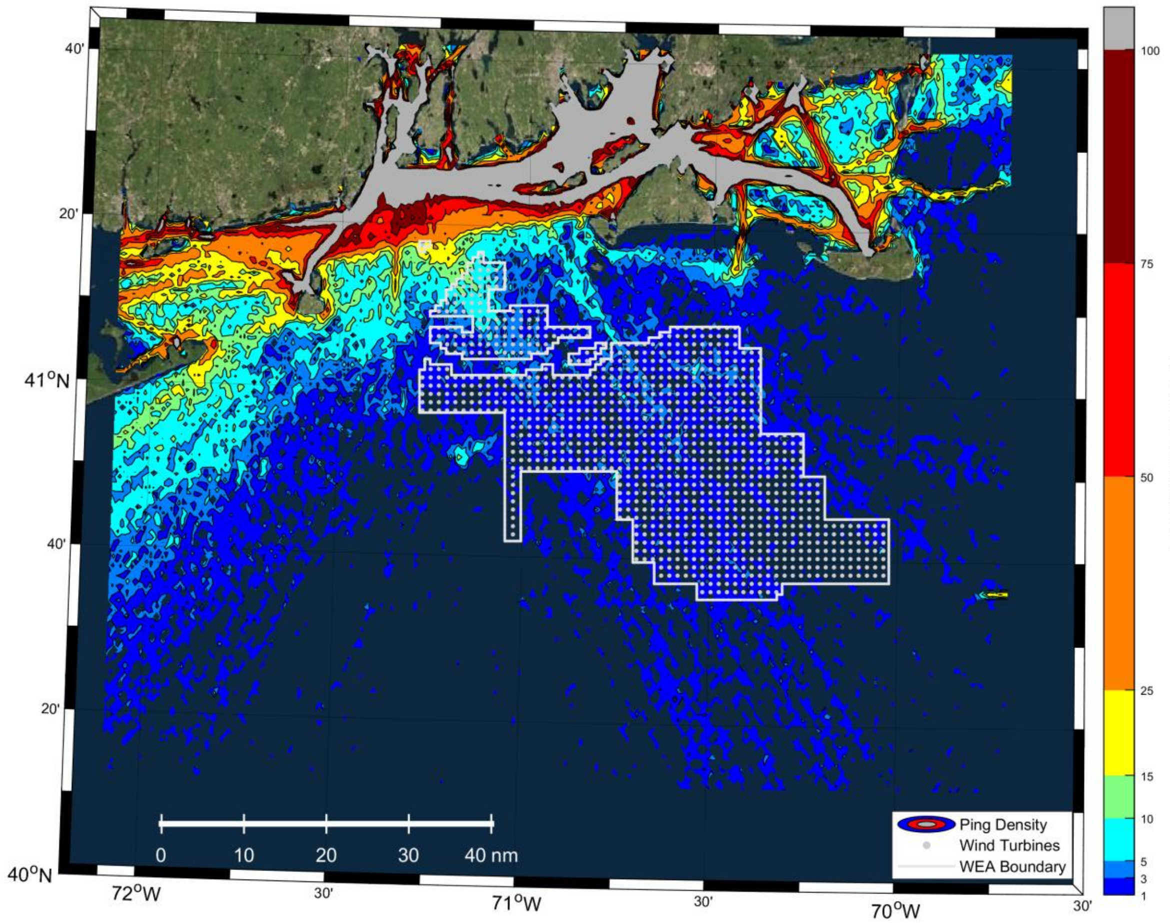

Figure 2.5: Pleasure and Sail Vessel Traffic Density: 2017 and 2018

2.5 Fishing Vessel Traffic through the WEA

The fishing vessel traffic was specifically analyzed based on unique track plots and track density through and around the WEA for the 2017 and 2018 data set, as shown in Figure 2.6 and Figure 2.7. Note that only fishing vessels travelling faster than 4 knots were considered; it was assumed that slower vessels were fishing (trawling) and not transiting. It may be seen in the figures that fishing vessels transit through the WEA with a wide range of track orientations depending on the port of origin and the intended fishing grounds. The typical transit speed of fishing vessels through the WEA is in the order of 6 to 8 knots.

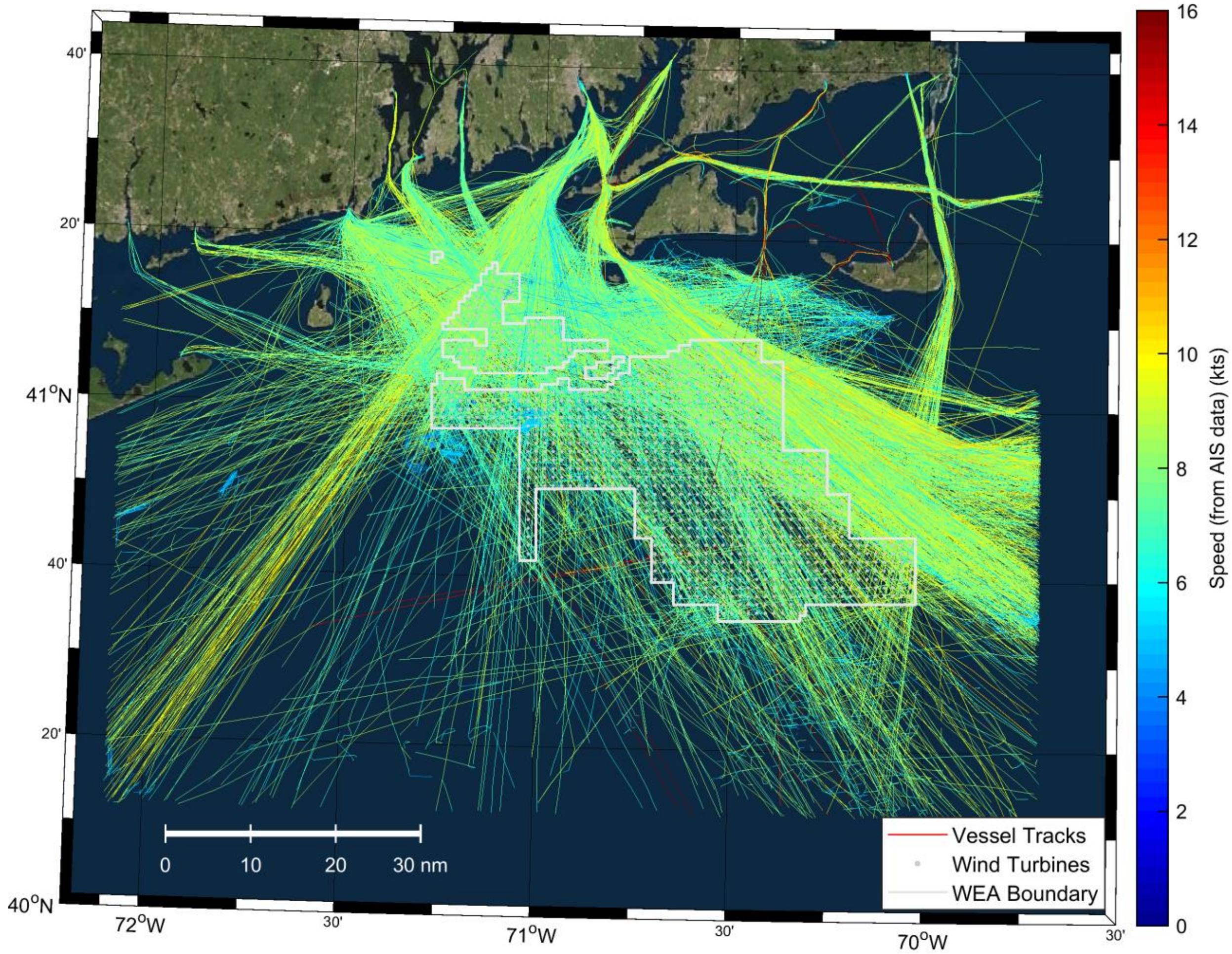

Figure 2.6: Fishing Vessel Traffic Tracks (>4 kts): 2017 and 2018

Figure 2.7 presents the fishing vessel traffic density through and surrounding the WEA. Overall, much of the fishing vessel traffic either skirts the WEA or intersects with perimeter areas of the WEA. The volume of traffic transiting through the middle of the WEA is limited.

Of the vessel traffic that did enter the WEA, the following observations were noted (using the numbers shown on Figure 2.7):

1. There is a concentration of fishing vessel traffic along a SW-NE corridor near the northwestern edge of the WEA.
2. Along the northeastern boundary of the WEA, there are two notable traffic corridors along a NW-SE corridor that intersects the northeastern boundary of the WEA.
3. Through the center of the WEA, there is a moderate density of traffic along a NNW-SSE corridor.

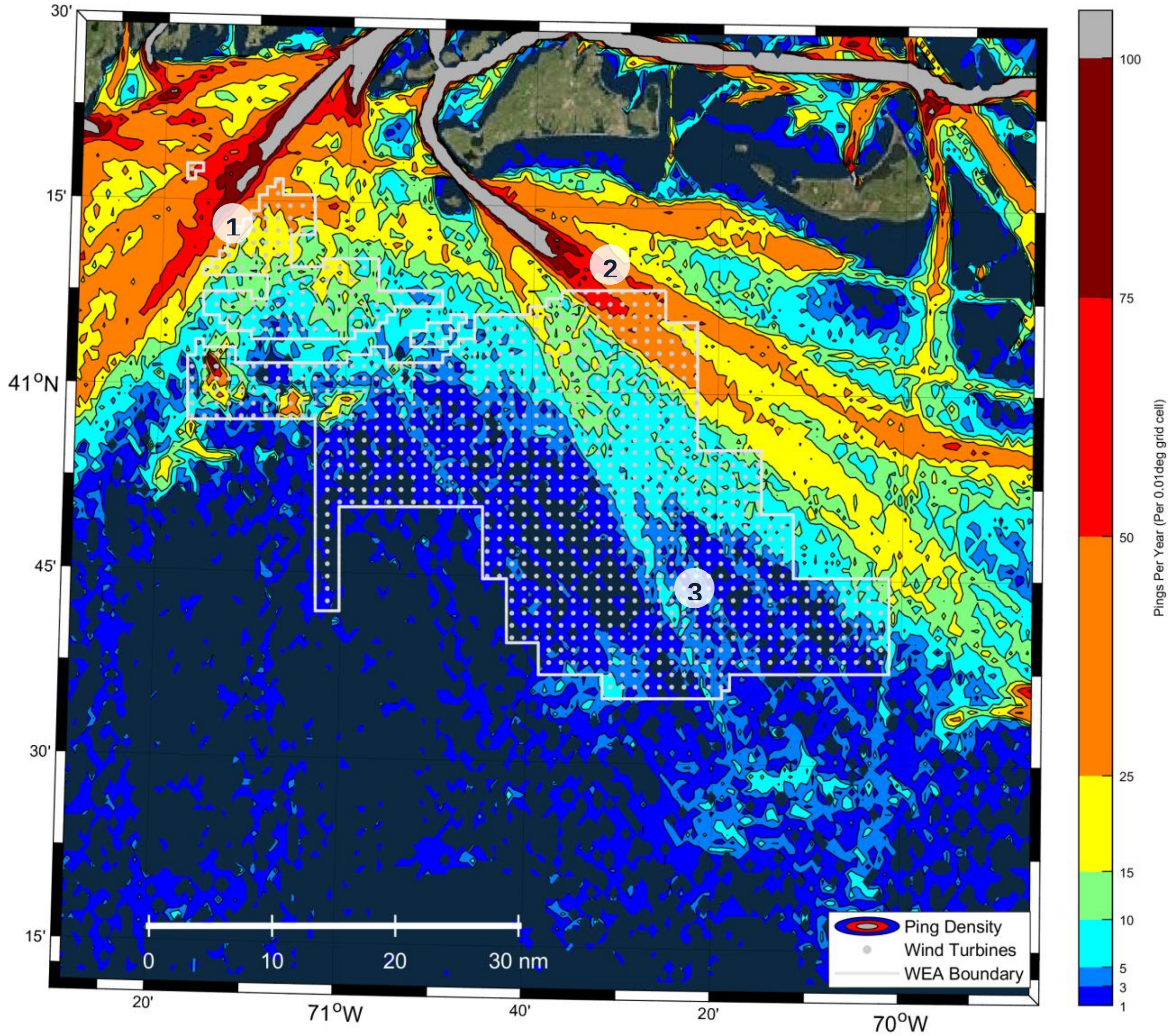

Figure 2.7: Fishing Vessel Traffic Density (> 4 kts): 2017 and 2018

Vineyard Wind has provided Baird with anecdotal information collected by the Vineyard Wind's fisheries liaison that links the Port of Origin and the fishing ground locations frequented by vessels from that port. Table 2.2 indicates the Port of Origin, Fishing Destination and Target Species that were provided to Baird. Based on the 2017 and 2018 AIS vessel traffic data, it has been noted whether the AIS data showed transits between the identified port and fishing destination.

Figure 2.8 is a conceptual schematic indicating the linkages between the destination fishing grounds for the fishing fleets at various ports of origin in the region based on Table 2.2. The lines linking the ports and fishing grounds in the figure do not indicate the relative volume or specific routes of vessel traffic but simply show that a particular fishing practice is being undertaken by certain vessels of a particular port. It is also important to recognize that the fishing grounds do not represent a specific location but rather a general fishing area.

Table 2.2: Fishing Vessel Transits – Ports of Origin and Approximate Destinations

Port of Origin	Fishing Destination	Visible in AIS Data	Type of Catch
Chatham	Veatch Canyon, Atlantis Canyon	Yes	Monkfish
	The Dump	No	Monkfish
New Bedford	South of Nantucket / Martha's Vineyard	Yes	Squid
	Nantucket Lightship Closed Area	Yes	Scallop,
	Great South Channel / Georges	Yes	Scallop, groundfish
	Block Canyon	Yes	Monkfish
	The Dump	No	Monkfish, Lobster
	Munson Canyon	Yes	Whiting, squid
Westport	East side of Atlantis Canyon to the west	No	Lobster, monkfish
Sakonnet	West Atlantis Canyon	Yes	Monkfish
	Mid-way between Atlantis and Block Canyons	No	Monkfish, Lobster
Newport	Atlantis to Hydrographer Canyons	Yes	Lobster
Point Judith	South of Nantucket / Martha's Vineyard	Yes	Squid
	Nantucket Lightship Closed Area	Yes	Scallop
	Lydonia, Munson, Nygren Canyons	Yes	Squid, whiting
	South of the dump	No	Jonah crab (fall)
Montauk	South of Nantucket / Martha's Vineyard	Yes	Squid
	Nantucket Lightship Closed Area	No	Scallop
	Lydonia Canyon	No	Squid, whiting, butterfish
Stonington	South of Nantucket / Martha's Vineyard then to areas further south	Yes	Squid, whiting, butterfish

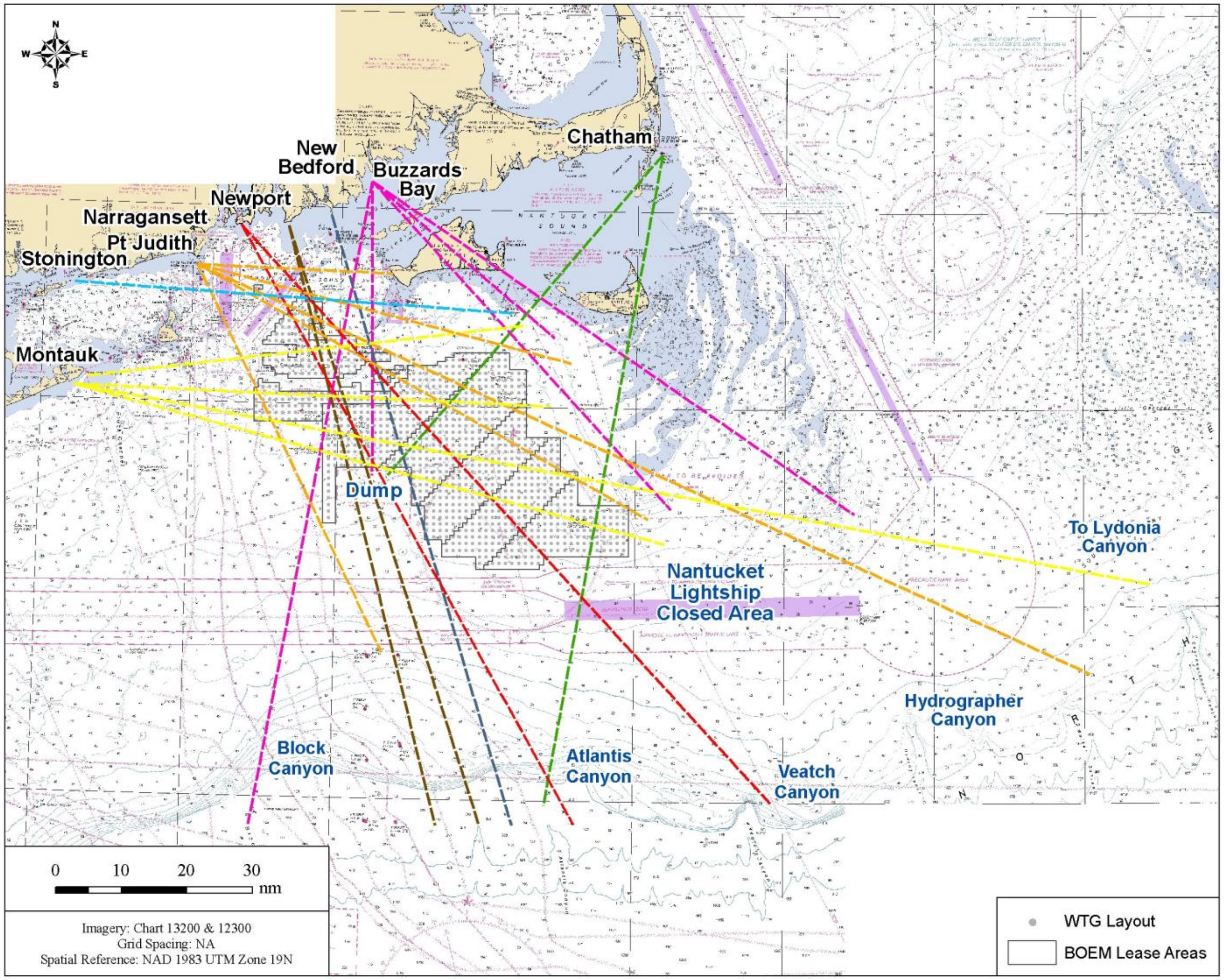

Figure 2.8: Key Fishing Ports Relative to Fishing Ground Locations

Many of the fishing grounds are located south of the WEA at the various canyons where there is a steep drop off in water depths. Other vessels target fishing within the Nantucket Lightship Closed Area, which is located east of, and overlapping with, the most easterly lease area (OCS-A 0522). Vessels from a variety of ports (New Bedford, Point Judith, Montauk, and Stonington) travel to squid trawling grounds located between Nantucket and Martha's Vineyard Islands and the WEA. Vessels from certain ports (Chatham, New Bedford) fish in an area called the "Dump", where unexploded ordnance is identified on hydrographic charts (no wind energy development is planned for this area).

A comparison of Figure 2.6, Figure 2.7 and Figure 2.8 indicates that:

- Vessels transiting to the canyons south of the leases have a wide range of destinations in the general fishing area and are coming from a number of different origination ports, and therefore are transiting over a wide range of tracks and do not follow any specific path.
- Fishing vessels from New Bedford and Buzzards Bay heading to the more easterly fishing grounds travel around the southern end of Martha's Vineyard then follow a southeasterly track along the northern edge of the WEA. Some of the vessels out of Point Judith follow similar tracks. A number of these vessel tracks cross the northeastern edge of the WEA.
- Figure 2.7 shows that a number of fishing vessels travel through the WEA along a NNW-SSE path, starting from the vicinity of Nomans Land Island, and headed towards Veatch Canyon region (Location 3).
- There are fishing grounds, such as the Dump and the Nantucket Lightship Closed Area, where no transits are evident in the AIS plots suggesting that those areas are fished by vessels that are not AIS-equipped.

3. Vessel Navigation Through the WEA

3.1 Navigation Calculations

The Supplementary Analysis for Navigational Risk Assessment of the Vineyard Wind project (Baird, 2019), reported on various analyses of vessel navigation conducted using the international design guidance given in PIANC (2014, 2018). These calculations have been repeated in this study for the WEA vessel traffic. The PIANC analyses are based on the maximum vessel lengths and beams given in Table 2.1.

For the purposes of the analyses, it was been assumed that a navigational lighting and marking plan similar to that proposed by Vineyard Wind (2019) for its current project proposal located in the northern portion of lease area OCS-A 0501 would be implemented over the entire WEA.

In terms of navigational safety when operating vessels within the WEA, there are three important considerations:

1. Sufficient width for two-way traffic (both directions) within a turbine field corridor when transiting or trawling in a straight line.
2. Ability to turn safely to avoid a vessel collision.
3. Ability to turn a trawler within a 1.0 nm corridor (it has been assumed that the trawlers will generally operate on an E-W alignment).

To address item 1 with respect to required channel width, calculations were carried out using the guidance provided by PIANC (2014). This document provides calculation procedures and recommendations for the design of vertical and horizontal dimensions of harbor approach channels of all types. The channel width calculation takes into consideration a range of factors, such as maneuverability of the vessel, the prevailing winds, the magnitude and direction of currents and waves, water depth and the bottom surface characteristics. The channel width is defined relative to the maximum vessel beam width, B.

Table 3.1 summarizes the results of the PIANC (2014) calculations. It was assumed that the transiting vessels (such as cargo or fishing) were of moderate maneuverability while a trawler with gear fully deployed is of poor maneuverability, which is the reason the beam factor differs for the two fishing vessel categories. A fishing trawler (also potentially transiting) of beam 35 feet with two outriggers each having a length of 70 feet was assumed as in Baird (2019). This gave an effective beam of 175 ft. For the purposes of this analysis, this effective beam was also assumed for transiting vessels (giving a conservative result).

Table 3.1: Minimum Two-Traffic Requirements for Vessels in a Straight Channel

	Transiting Cargo / Tanker Vessel	Transiting Fishing Vessels	Trawling
Required Channel Width, Beam Factor	10.8B	11.4B	11.0B
Assumed Maximum Vessel Beam	155 ft	175 ft*	175 ft*
Required Minimum Channel Width	1,674 ft (0.28 NM)	1,995 ft (0.33 NM)	1,925 ft (0.32 NM)

* Note: Effective vessel beam as described in the text above.

Table 3.1 provides the minimum required width for two-traffic in a straight channel for safe operations. As may be noted, the required widths are significantly less than the 0.7 nm width of the NW-SE and SW-NE corridors created by the 1 x 1 nm layout, as described in the introduction. Thus, it is safe for vessels to move within the turbine corridors without restrictions on speed and/or direction provided they are not larger than the assumed vessels. This would apply equally to both overtaking and passing vessels, and to fishing vessels with and without gear deployed. Moreover, these corridors widths are notional (not actual corridors with physical limits at the 0.7nm width), and the actual distance between any two turbines when navigating in these directions is 1.4 nm, see Figure 3.1.

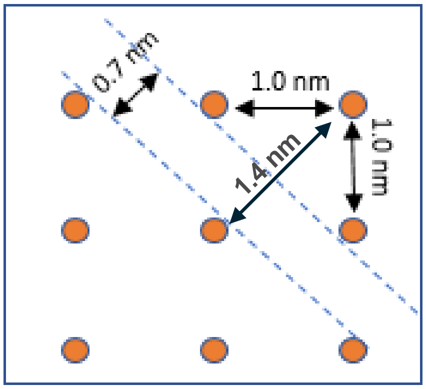

Figure 3.1: Distances Between Turbines When Considering a 0.7 nm Corridor

With respect to item 2 above, in an emergency situation such as an imminent collision, vessels may be required to execute a very rapid turn. Merchant vessels are designed to turn within a tactical turn diameter of 5 times the length of the vessel, while an allowance of 6 times vessel length (LOA) is often used for design purposes (PIANC, 2018). Based on this criterion and assuming a vessel travelling down the center of the minimum corridor width (0.7 nm), a vessel up to 350 to 400 feet LOA (length overall) can safely enter the WEA. Such a vessel executing a rapid turn in the 1 nm corridors would have additional buffer room on either side of the corridor.

The spacing required to turn a trawler between the turbine rows was examined in Baird (2019). It was estimated that a large trawler in this area can change headings by 180° within a lateral distance of 0.7 nm with gear fully deployed, well within the 1.0 nm spacing between turbines in the E-W rows. The required lateral distance would be much smaller if the gear were retrieved before turning then redeployed.

Overall, it was concluded that:

- The limiting constraint for vessel movements through the WEA based on PIANC (2018) will be vessel length. Based on collision avoidance criteria, it is recommended that vessels greater than 400 ft in length should transit around the WEA. In 2017 and 2018, there were no fishing vessels and approximately 27% of the non-fishing vessels with a length exceeding 400 ft.
- The minimum 0.7 nm nominal corridor width is sufficient for two-way transit of fishing or other vessels (up to 400 ft LOA) based on PIANC (2014, 2018) guidelines, allowing vessels to safely pass and overtake in opposite directions.
- The minimum 1.0 nm turbine separation is sufficient for all fishing activities including trawling, as even trawling vessels with gear fully deployed were estimated can change headings by 180° within a lateral distance of 0.7 nm.

It is important to recognize that the above analyses make the inherent assumption that the turbine corridors have a “hard” channel limit. That is, it is assumed that the vessel cannot cross the turbine row alignments that separate the corridors. In reality, the turbines are spaced 1 nm apart and there is room for the vessel to maneuver between the turbines.

3.2 Available Transit Corridors

As noted in Section 1, the proposed uniform layout across the WEA has a 1 nm WTG spacing in both the E-W and N-S directions. This uniform layout also inherently creates 0.7 nm wide corridors on the diagonal in the NW-SE and SW-NE directions. In the case of the diagonal corridors (NW-SE, SW-NE), the turbines are offset from each other in the direction of travel, such that the closest distance between two opposite turbines when navigating in the direction of the corridor is 1.4 nm. Figure 3.2 provides an illustration of the E-W, N-S and diagonal SE-NW transit corridors provided by the uniform 1 nm x 1 nm turbine layout. Illustrations of the available transit corridors are provided in detail in the following:

- Figure 3.3: 40 E-W transit corridors;
- Figure 3.4: 56 N-S transit corridors; and
- Figure 3.5: 48 NW-SE transit corridors.

There are also 87 transit corridors in the SW-NE orientation although the AIS data showed that there is little vessel traffic that transits in this direction.

As may be noted in the AIS data plots shown in Section 2, much of the existing vessel traffic transits the WEA in a NW-SE orientation.

3.3 Designated Transit Corridors

The results of this analysis indicate that sufficient corridor width for vessel maneuvering can be maintained within the WEA without the need for dedicated transit lanes assuming the application of a uniform spacing across the entire WEA and a suggested limit of 400 ft vessel length. The proposed turbine arrangement would accommodate the wide range of ports, destinations, and routes and headings observed by fishing vessels. Additionally, there is a high degree of flexibility available to the US Coast Guard (USCG) to configure the transit corridors outlined in Figure 3.2 to Figure 3.5, should designated or specially corridors be deemed desirable. For example, in each direction, it would be possible to designate marked one-way transit corridors, with a potential separation corridor between opposite directions of transit. Designating specific transit corridors will tend to concentrate the vessel traffic, potentially increasing the number of vessel interactions.

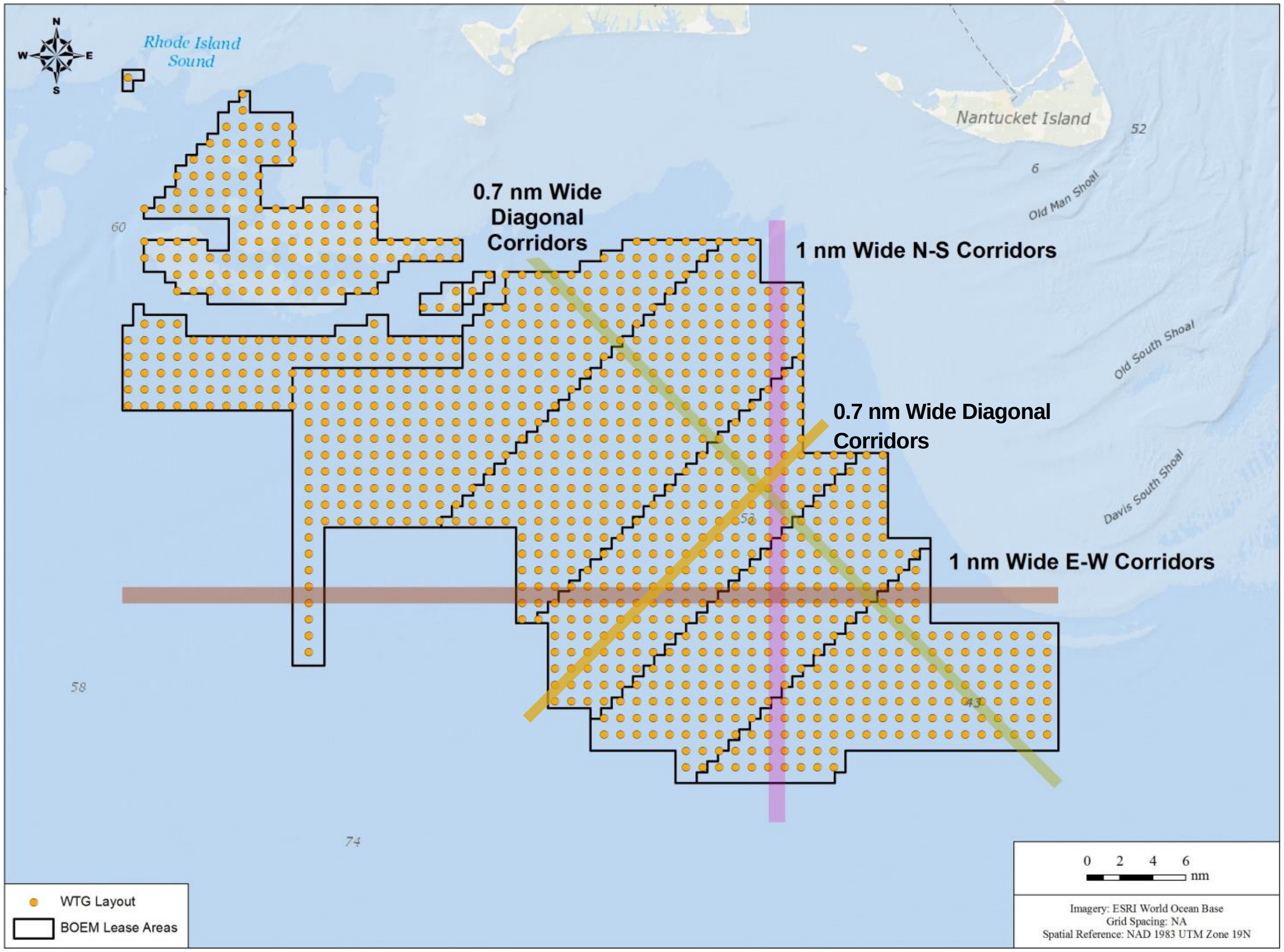

Figure 3.2: Overview of E-W, N-S, NW-SE and SW-NE Transit Corridors provided by 1 nm turbine layout.

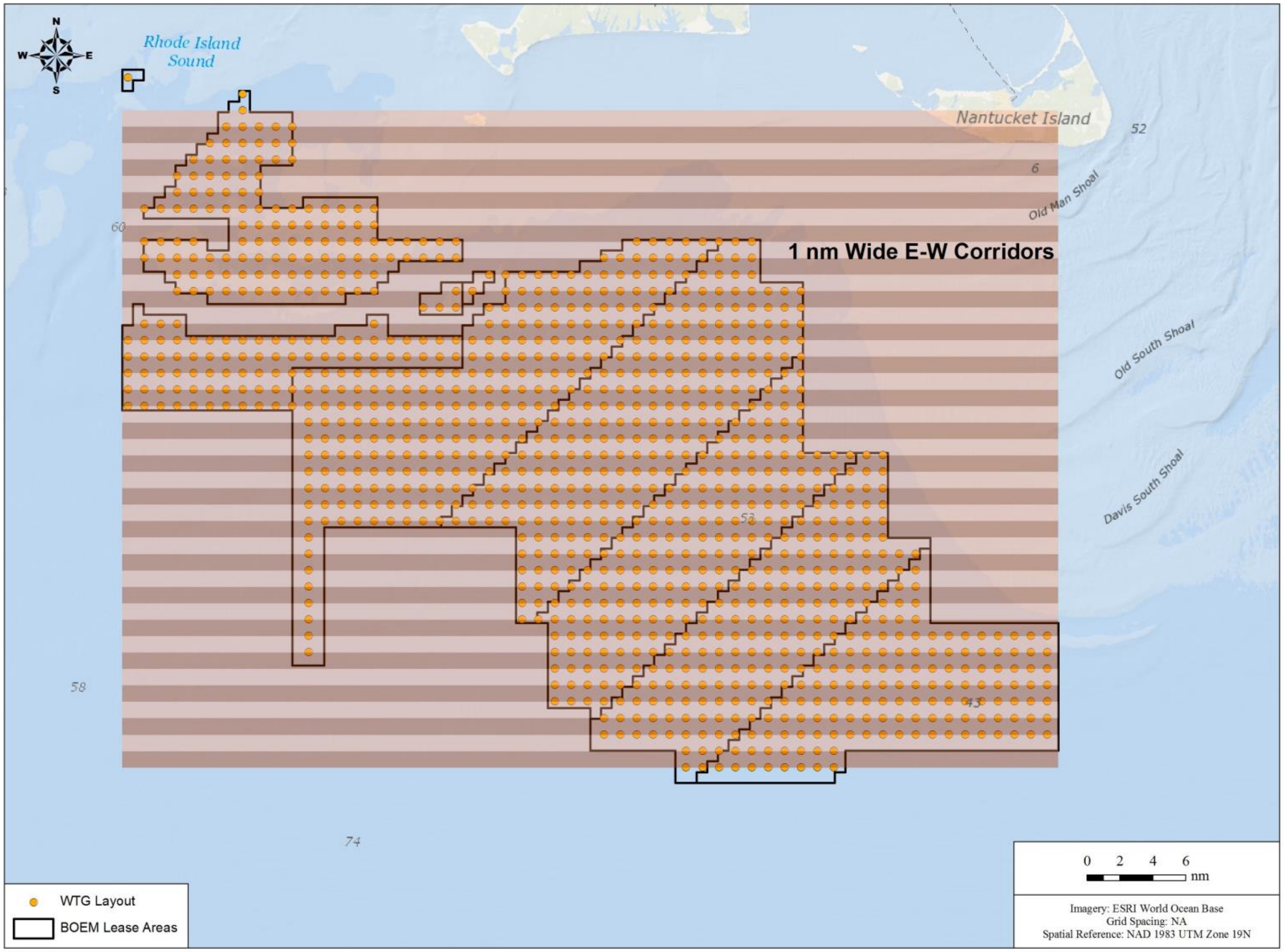

Figure 3.3: 40, 1 nm wide E-W Transit Corridors provided by 1x1 nm turbine layout.

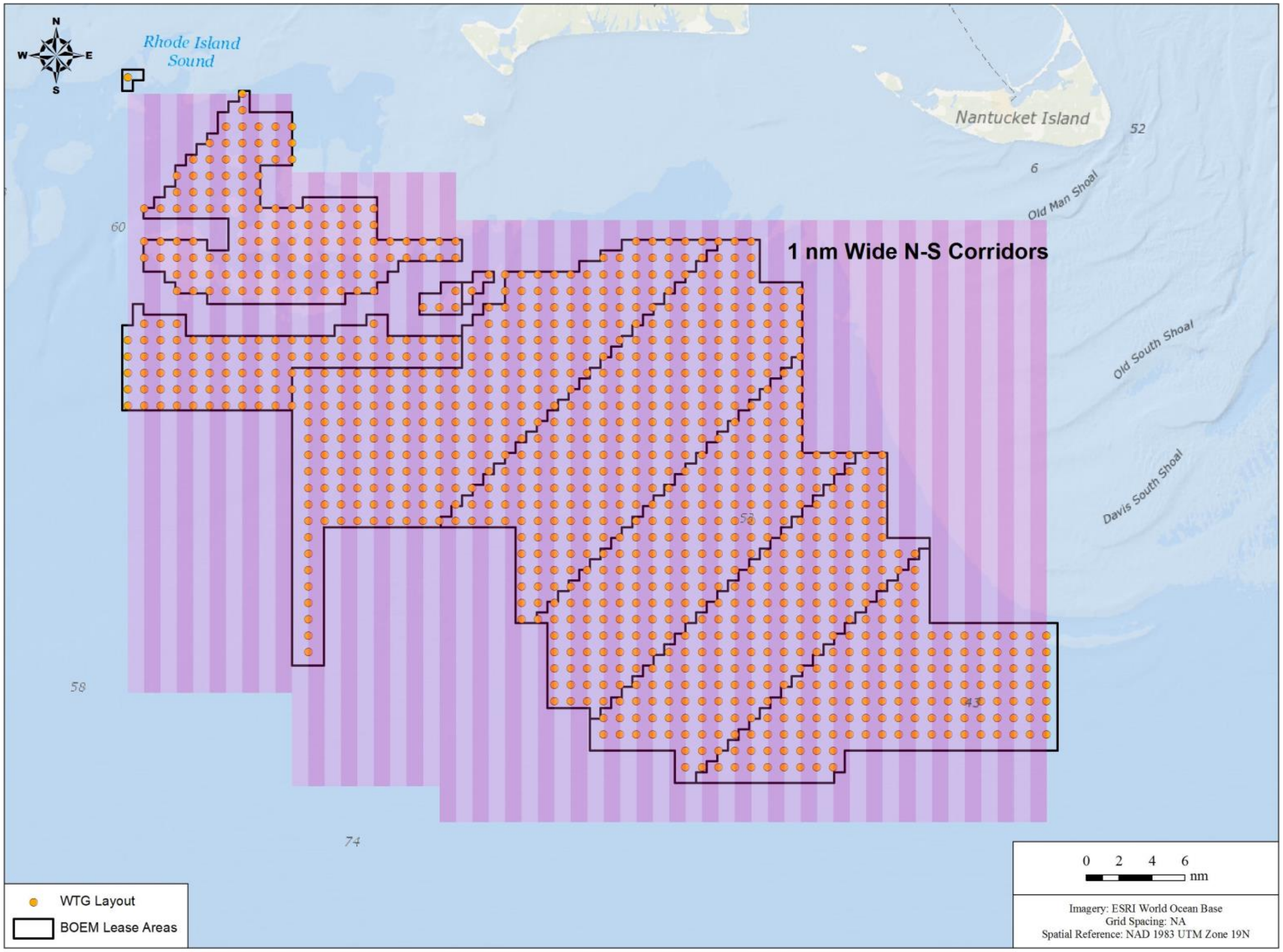

Figure 3.4: 56, 1 nm wide N-S Transit Corridors provided by 1x1 nm turbine layout.

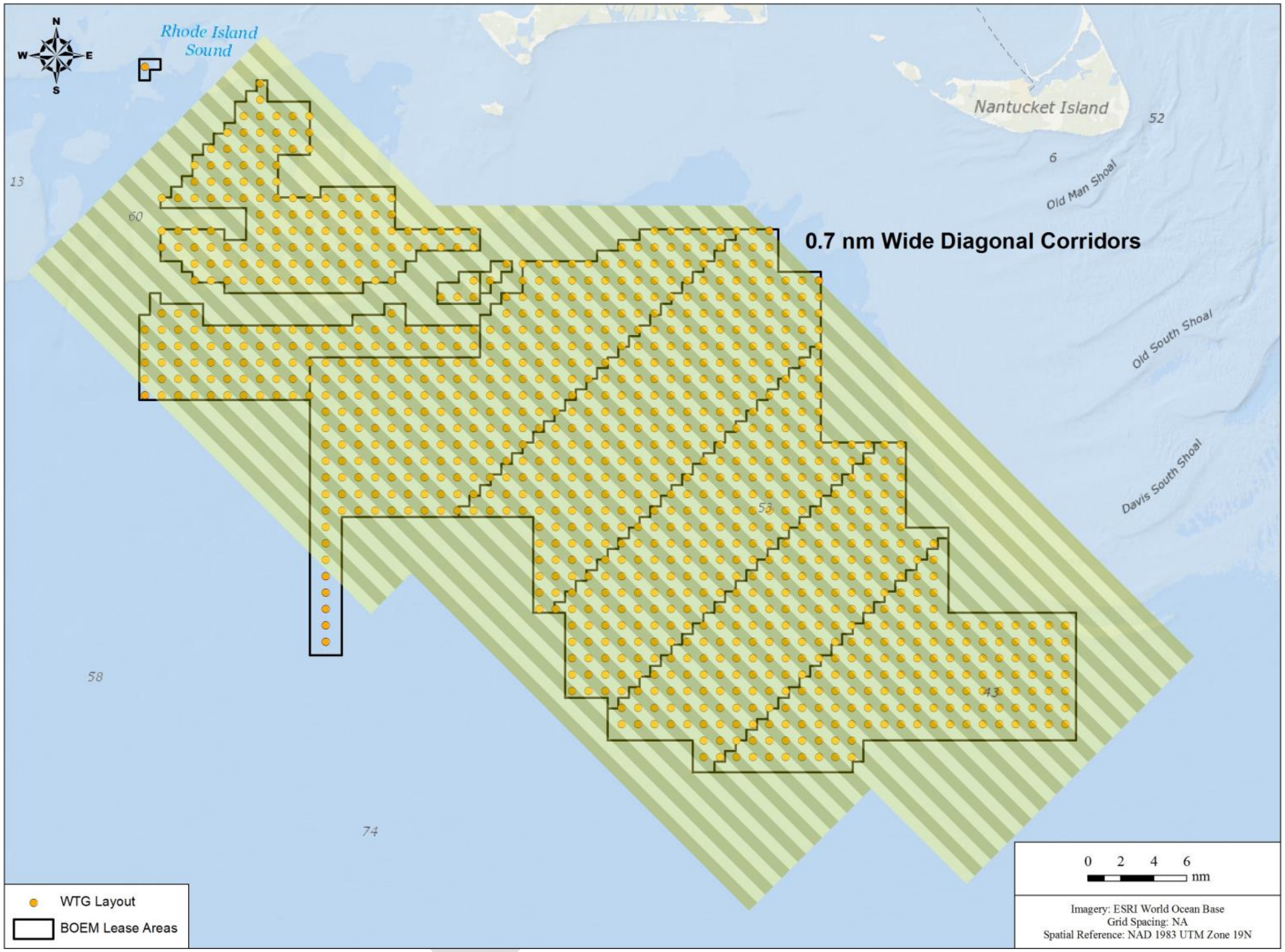

Figure 3.5: 48, 0.7 nm wide SE-NW Diagonal Transit Corridors provided by 1x1 nm turbine layout.

4. Vessel Traffic Around the WEA

Given the turbine layout assumed for this analysis, it is expected that vessels greater than 400 ft LOA or that exceed the air draft limits of the turbine blades will transit around the WEA. This would include many of cargo, tanker, and larger passenger vessels but not fishing vessels (as all observed had a length of less than 400 ft). For the cargo, tanker and passenger vessels identified in Figure 2.2 and Figure 2.3, which presently transit the southwestern margin of the WEA (see between Points 1 and 2 on Figure 2.3), it is expected that to skirt the western edge of the WEA will add approximately 10 nm to the transit distance. Based on average speed through the WEA, the additional transit time for vessels is estimated as the following:

- Passenger vessels: 40 minutes;
- Tanker vessels: 60 minutes; and
- Cargo vessels: 70 minutes.

Given the size, purpose, and transit track of these vessels, many of these larger commercial vessels may be making lengthy trips to or from points well beyond the general region of the WEA. For these vessels, the additional transit time to go around the WEA may be a small part of the overall trip duration. Passenger, tanker and cargo vessels represent approximately 10.2% of the vessel traffic transiting the WEA. As noted in Section 2.2, there are existing TSS that could accommodate the transit of those vessels around the WEA. Much of this traffic is transiting to/from the Narragansett Bay and Nantucket-Ambrose TSS.

Fishing vessels will be able to transit through the WEA (see Section 3.0) and also have the option to transit around the WEA. Figure 2.6 indicates that a significant portion of the AIS fishing vessels are transiting to the west of the WEA, and to the north or near the northern-eastern boundary of the WEA. Those fishing vessels that choose to transit around the WEA are expected to have no or small impacts, of 30 minutes at most, in transit times by avoiding the WEA.

5. Conclusions and Recommendations

A summary of the conclusions and recommendations with respect to vessel navigation through the WEA is as follows:

- There does not appear to be a need for designated transit corridors through the WEA if a uniform turbine layout with 1 nm corridors E-W and N-S and 0.7 nm corridors NW-SE and SW-NE is adopted. This layout would accommodate the wide range of ports, destinations, and routes observed by fishing vessels, which makes up most of the traffic going through the WEA, as well as the majority of observed vessel tracks through the WEA, thereby by accommodating the wide range of reported fishing practices in the region. This arrangement would effectively create 40 corridors in the E-W direction; 56, N-S; 48, NW-SE; and 87 SW-NE.
- If the USCG identifies the need to have designated transit corridors, then certain of the available corridors within the uniform turbine layout could be designated as one-way transit corridors. For example, in each direction, it would be possible to designate one-way transit corridors, with a potential separation corridor between opposite directions of transit.
- Based on considerations of collision avoidance, it is recommended that vessels exceeding 400 feet should transit around the WEA. Vessels of this size were observed to be tanker, cargo, passenger or military vessels. Transiting around the WEA may also provide a suitable option for much of the existing fishing vessel traffic, since the majority of fishing vessel traffic skirts the northwest and northeast boundaries of the WEA and results in little (less than 30 minutes) or no increase in transit times for these vessels.
- It was assumed in the analysis that the navigational lighting and marking plan for the entire WEA will be similar to that proposed by Vineyard Wind for its current project proposal (Vineyard Wind, 2019).

6. References

Baird (2019). Vineyard Wind - Supplementary Analysis for Navigational Risk Assessment. Prepared for Epsilon Associates Inc. Ref: 13057.201.R2.Rev0. January 23, 2019.

PIANC (2014). Harbour Approach Channels Design Guidelines. Report No. 121 – 2014.

PIANC (2018). Interaction Between Offshore Wind Farms and Maritime Navigation. MarCom WG Report No. 161 – 2018. March.

Vineyard Wind (2019). Vineyard Wind LLC - Lighting and Marking Requirements. Rev 4, 8 May 2019.

VINEYARD WIND

ADDENDUM:

Massachusetts Fisheries Compensatory Mitigation Plan for Vineyard Wind 1

May 15, 2020

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ADDENDUM

This document is provided as an update to the Massachusetts Fisheries Compensatory Mitigation Plan (the "Plan") submitted by Vineyard Wind to the Massachusetts Office of Coastal Zone Management ("CZM") on March 3, 2020. The Plan was developed by Vineyard Wind to provide financial payments to Massachusetts fishing businesses that experience economic loss resulting from the construction and operation of Vineyard Wind 1, an 800 megawatt offshore wind project that Vineyard Wind has proposed for the Outer Continental Shelf in Bureau of Ocean Energy Management Lease Area OCS-A 0501. Pursuant to the federal Coastal Zone Management Act, CZM is reviewing Vineyard Wind 1 to determine its consistency with the enforceable polices of the Massachusetts coastal management program.

The compensatory mitigation program detailed in the Plan is structured as two funds – Direct Compensation Fund and Fisheries Innovation Fund – totalling more than $20 million[1] over the life of the Project. The Plan originally assumed that payments would begin in 2019 after Vineyard Wind 1 achieved financial close. However, a federal permitting delay has moved the Vineyard Wind 1 timeline back by approximately two years with financial close now expected in 2021. As a result of the federal permitting delay, payments from Vineyard Wind into the two funds detailed in the Plan will commence in 2021.

The two-year delay in the start of the compensatory mitigation program requires updates to the payment amounts and schedule for the Direct Compensation Fund as the Plan increases the economic impact values that serve as the basis for the payment amounts by 2.5% per year. This 2.5% annual escalation rate is applied under the assumption that average catch values within the Vineyard Wind 1 project area will increase in by that amount every year over the life of the Project. With the first-year payment occurring in 2021 instead of 2019, the compensatory mitigation program will include Direct Compensation Fund payments by Vineyard Wind of $19,185,016 over the life of the Project compared to $18,426,366 as originally anticipated. This increase includes the 2.5% annual escalation in the economic impact values for direct, downstream, and cumulative impacts mitigation for each year of Vineyard Wind 1's federal permitting delay.

This document contains the sections of the Plan that required table and/or text updates in order to reflect the revised payment amounts and schedule for the Direct Compensation Fund. These revised sections are intended to replace the same sections included in the March 3, 2020 version of the Plan submitted to CZM. A summary of the updates made to the Plan in the sections that follow is provided below:

- **Section I** – Updates to Table 1 to reflect Vineyard Wind's higher total payment amount into the Direct Compensation Fund.
- **Section IV** – Update to the bulleted text at the top of page 7 to reflect Vineyard Wind's higher total payment amount into the Direct Compensation Fund.
- **Section V.B.1** – Updates to Tables 6 and 8 to provide the revised funding schedules for Direct and Downstream Mitigation Funding and Cumulative Impacts Mitigation as well as text updates to reflect the revised funding amounts.

[1] All dollar values indicated in this document are nominal values.

- **Section VI.A** – Updates to Table 9 to provide a revised indicative payment schedule for the Direct Compensation Fund and a text update to reflect the higher total payment amount into the Direct Compensation Fund.
- **Section VII** – Updates to Table 11 to reflect Vineyard Wind's higher total payment amount into the Direct Compensation Fund and removal of the following text: "As this compensatory mitigation program detailed in this Plan was designed prior to the Project's delay, final payment amounts and schedules will need be needed to reflect the Project's revised construction and operation schedule."
- **Appendix 1** – Updates to Table 1 to provide the revised funding schedules and payment amounts for direct and downstream mitigation and cumulative impacts mitigation funding.

I. Overview

The Massachusetts Fisheries Compensatory Mitigation Plan (the "Plan") described herein was developed by Vineyard Wind LLC ("Vineyard Wind" or the "Company") for Vineyard Wind 1 (the "Project").[2] Vineyard Wind 1 is an 800 megawatt ("MW") offshore wind project that Vineyard Wind intends to construct within the northern portion of Bureau of Ocean Energy Management ("BOEM") Lease Area OCS-A 0501.

The Plan briefly reviews non-compensatory mitigation measures that Vineyard Wind has or intends to employ to avoid or minimize potential impacts from the Project to Massachusetts fishing businesses. The Plan also details the compensatory mitigation program that Vineyard Wind has developed to address potentially unavoidable fishery-related economic impacts from the construction, operation, and decommissioning of Vineyard Wind 1.

The compensatory mitigation program is structured as two funds totalling more than $20 million[3], as shown in Table 1, over the life of the Project. The funding will be used to offset potential direct, indirect, and cumulative economic impacts to Massachusetts fishing businesses and facilitate innovation that better supports the co-existence of the fishing and wind sectors in the offshore environment.

Table 1. Vineyard Wind Compensatory Mitigation Funds

Fund	Amount
Direct Compensation Fund	$19,185,016
Fisheries Innovation Fund	$1,750,000
TOTAL Payments over the life of the Project (nominal): $20,935,016	

The Direct Compensation Fund will be administered by a third-party administrator that will be selected by Vineyard Wind in consultation with the Massachusetts Office of Coastal Zone Management. The Fisheries Innovation Fund will be hosted and administered by the Massachusetts Executive Office of Energy and Environmental Affairs. Payments to both funds will be made on an annual basis with first payments due when Vineyard Wind 1 achieves financial close.[4]

The funding levels for the compensatory mitigation program were determined based on the economic exposure estimates indicated in the Plan. These estimates rely on best available information and serve as a starting point for assessing potential fishery-related economic impacts from Vineyard Wind 1. Taking a cautious and conservative approach, Vineyard Wind used these economic exposure estimates to determine the maximum level of potential fishery-related economic impacts and designed a compensatory mitigation program that ensures funds will be available to cover impacts above-and-beyond those that are reasonably expected to occur over the life of the Project.

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[2] This Plan will be reviewed as part of the federal consistency review of Vineyard Wind 1 that the Massachusetts Office of Coastal Zone Management is undertaking pursuant to the Coastal Zone Management Act (15 C.F.R. part 930, subpart E) and associated regulations.

[3] All dollar values indicated in this document are nominal values.

[4] For the purposes of this Plan, financial close means the date upon which all relevant project and financing documentation for the Project has been executed and become effective

IV. Compensatory Mitigation: Offsetting Potentially Unavoidable Economic Impacts

Compensatory mitigation is appropriately considered once all avoidance and minimization measures have been fully explored. Vineyard Wind acknowledges that, even with the non-compensatory mitigation measures outlined in the previous section, economic impacts to Massachusetts fishing businesses[5] from the construction, operation, and decommissioning of Vineyard Wind 1 may be unavoidable. More specifically, Massachusetts fishermen who currently operate in the Vineyard Wind 1 project area are exposed to potential economic losses because fishing will be precluded in portions of the Vineyard Wind 1 project area during construction, the abundance or availability of fish may be temporarily displaced during construction, and fishing activities may be potentially altered after construction. As a result, Massachusetts fishing businesses may experience negative economic impacts from the Project, as well as future offshore wind projects, that can be offset through compensatory mitigation.

The Plan divides potential fishery-related economic impacts to Massachusetts fishing business into three categories:

- **Direct effects**: A reduction in fishermen's earnings due to reduced fishing activity in the Vineyard Wind 1 project area relative to historic levels, i.e. lost profits or income for commercial fishermen. The value of direct effects is less than the landings value because fishing vessels have expenses that would need to be paid from the revenue from dockside sales. These expenses would not be incurred if the fishermen were not fishing, and so it is not appropriate to include them in estimates of direct effects.
- **Downstream effects:** Assuming fishermen are unable to maintain catch value at historic levels by fishing in other areas, there will be a negative impact on shoreside downstream economic activity associated with Massachusetts business that support Massachusetts fishing and buy, process, and/or market commercial landings.
- **Upstream effects**: To the extent continued build-out of offshore wind capacity in the Massachusetts/ Rhode Island WEAs leads to lower fishing activity generally in the state due to cumulative impacts, there will be a negative economic impact on shoreside upstream activity associated with fuel and supply procurement, boat repair, and other activities.

Relying on best available information, confirmed through consultations with the National Marine Fisheries Service ("NMFS") and state fisheries programs, this Plan employs a cautious approach to determine the potential magnitude of economic impacts. As described below, conservative assumptions and "cautious approach multipliers" ensure available funding covers impacts above-and-beyond what can reasonably be expected to occur.

Based on the results of these calculations, Vineyard Wind is providing more than $20 million in funding for compensatory mitigation over the 30-year life of the Project.[6] The funding will be used to address the potential economic impacts described above as well as facilitate innovation that better supports the co-existence of the fishing and wind sectors in the offshore environment.

[5] For the purposes of this Plan, "Massachusetts fishing businesses" is defined broadly to include not only fishermen but shoreside businesses that provide goods and services to the fishing industry.
[6] The 30-year "life of the Project" includes two years of construction, 25 years of operation, one to two years of decommissioning, and one to two years added as a buffer.

The compensatory mitigation program is structured as two funds:

- **Direct Compensation Fund:** Approximately $19.2 million; and
- **Fisheries Innovation Fund:** $1.75 million (plus any funds not used for above mitigation).

The Direct Compensation Fund is designed to offset potential direct, indirect, and cumulative impacts of the Project. As described below, this funding is comprised of approximately $11 million for potential direct and downstream effects and approximately $8.2 million for potential cumulative effects. An additional $1.75 has been allocated the Fisheries Innovation Fund. Payments to both funds will be made on an annual basis with first payments due when Vineyard Wind 1 achieves financial close**.** Any unused funds from the Direct Compensation Fund will be allocated to the Fisheries Innovation Fund at the end of the 30-year life of the Project. An overview of funding levels and indicative payment schedules are provided in Section VI and Appendix 1.

The funds provided through this Plan will only be available to Massachusetts-based fishermen and businesses. This reflects Vineyard Wind's state-based approach to compensatory mitigation, which ensures the needs of each state's fishing community are properly understood and concerns are adequately addressed.

V. Compensatory Mitigation Methodology

B. Compensatory Mitigation Estimates

As noted above, Vineyard Wind's compensatory mitigation program is structured as two funds aimed at addressing the following three elements: Direct and Downstream Mitigation, Cumulative Impacts, and Fisheries Innovation. The methodology Vineyard Wind employed to determine financial compensation levels for the first two elements is described in greater detail below.

1. Direct and Downstream Mitigation

As a first step, Vineyard Wind used the very cautious assumption that the Project would result in a total cessation of historic fishing activity in the Vineyard Wind 1 project area to estimate direct and downstream economic impacts. Vineyard Wind then derived appropriate "multipliers" for the direct and downstream effects impact categories and applied them to the ex-vessel value landings to determine potential impacts on fishing-related economic activity from the Project (example provided in Table 4).[7,8]

Table 4. Annual Direct and Downstream Impacts to Massachusetts Fishing Business (2019)

Impact Category	Mass. Fisheries Value (2019)	Multiplier	Economic Impact
Direct Effects	$211,739	0.50[9]	-$105,870
Downstream Effects	$211,739	0.42[10]	-$91,048

Vineyard Wind then calculated the potential direct and downstream economic impacts for every year of the Project to arrive at the required minimum level of compensatory mitigation funding for Direct and Downstream Mitigation, as summarized in Table 5.

[7] Multipliers are a standard practice approach used to translate ex-vessel values into the economic loss that fishing businesses would experience from a reduction or cessation of historic fishing activity due to other activities, such as offshore wind project development.

[8] Landing, processing, and selling fish caught generates additional economic activity, which is expressed as a "downstream" multiplier applied to ex-vessel landings value. The "downstream" economic multiplier expresses economic activity related to the fish caught, for example processing and selling the fish caught, and other value add activities. This downstream effect is dependent on how much fish is caught. In order to account for possible impacts to this economic activity in a hypothetical scenario of all landings from a project area being lost, a mitigation amount can be calculated using the downstream multiplier.

[9] It is generally established that of landings value of a vessel (ex-vessel value), about 50% goes to trip costs such as fuel, crew pay, and supplies. The balance of the ex-vessel value goes to pay for fixed costs such as insurance, and for vessel profit. This is consistent with, for example, NOAA's Fisheries Contingency Fund (https://www.fisheries.noaa.gov/national/funding-and-financial-services/fishermens-contingency-fund-program) that offshore oil and gas operators are required to pay into. By paying 50% of ex-vessel value, a vessel owner can be assured of an amount of revenue to cover fixed costs and gross earnings as if a fishing trip occurred, even if no such trip occurred.

[10] Based on both NOAA's (2018) Fishery Economics of the United States and an "advanced inquiry" using NOAA's online Fishery Economic Impacts Tool, the "downstream" sales multiplier for the Massachusetts commercial fishing sector is 1.42. That is, every dollar of commercial landings (ex-vessel value) in Massachusetts generates $0.42 in additional Massachusetts "downstream" impacts (see Appendix 2).

Table 5. Annual Direct and Downstream Impacts (assuming no fishing in Vineyard 1 project area)

Direct and downstream impact assuming no fishing in the project area during the full lifetime of project					
	2019	2020	2021	…	2048
Direct	$ 105,870	$ 108,516	$ 111,229		$ 216,652
Downstream	$ 91,048	$ 93,324	$ 95,657		$ 186,321
Total (direct + downstream)	$ 196,918	$ 201,840	$ 206,887		$ 402,974
Total payments over lifetime of project (nominal)	**$ 8,645,213**				

Finally, continuing with a cautious approach, Vineyard Wind included an additional $1 million in funding—an amount equivalent to approximately four years of average ex-vessel value landings—to the first year payment to ensure that sufficient funds will be available to address inter-year fluctuations in fishing activity. The Company also applied a "cautious approach multiplier" of 10% to each annual payment to create additional buffer for the total funding required.[11] This results in a total of $10,991,165 in Direct and Downstream Mitigation funding provided over the life of the Project, as summarized in Table 6.

Table 6. Direct and Downstream Mitigation Funding (cautious approach)

Direct and downstream mitigation						
	2021	2022	2023	…	…	2050
Direct	$ 111,229	$114,010	$ 116,860			$227,620
Downstream	$ 95,657	$ 98,049	$ 100,500			$195,754
Total (direct + downstream)	$ 206,887	$212,059	$ 217,360			$423,374
Extraordinary, initial funding	$ 1,000,000					
Cautious approach multiplier	1.10	1.10	1.10			1.10
Total annual direct + upstream payments (cautious approach)	**$ 1,227,575**	**$233,265**	**$ 239,096**			**$465,711**
Total payments over lifetime of project (nominal)	**$10,991,165**					

Vineyard Wind will annually pay the calculated amounts to mitigate potential direct and downstream impacts into the Direct Compensation Fund, described in Section VI.

2. Cumulative Impact Mitigation

Vineyard Wind's cautious approach to cumulative impact mitigation provides financial compensation throughout every Project phase that far exceeds the level of potential impacts that can reasonably be expected to occur. This ensures sufficient funding will be available for Massachusetts fishing businesses for upstream effects as offshore wind project development proceeds in the Massachusetts/Rhode Island WEAs.

As with direct and downstream impacts, Vineyard Wind first used a cautious assumption that the Project would result in a total cessation of historic fishing activity in the Vineyard Wind 1 project area to estimate upstream impacts. To do this, Vineyard Wind again derived an appropriate "multiplier" for upstream impacts and applied it to the ex-vessel value landings to determine potential lost profits and loss of economic activity from the Project (example in Table 7).[12]

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[11] Vineyard Wind established a "cautious approach multiplier" as part of this calculation to further support the Company's cautious approach to determining appropriate levels of funding for the compensatory mitigation funding.

[12] "Upstream" shoreside economic activity relates to the economic activity generated by fishermen going out to fish such as vessel maintenance, fuel, crew payroll, or purchasing nets and gear. The value of this economic activity is expressed as a multiplier applied to the landings value. However, so long as fishermen go out and fish, this upstream multiplier is realized, regardless of how many fish are caught on any trip. Given this, the upstream multiplier applied to landings values can be used to derive an economic exposure of total cumulative impacts of diminished fishing effort due to increasing build out of wind energy areas. This exposure value can then be applied to an index of the actual state of development of offshore wind in the region, for example, multiplied by 50% if 50% of the total regional wind energy area is developed.

Table 7. Annual Cumulative Impacts to Massachusetts Fishing Business (2019)

Impact Category	Mass. Fisheries Value (2019)	Multiplier	Economic Impact
Upstream Effects	$211,739	0.83[13]	-$175,744

As a next step, Vineyard Wind developed a build-out scenario for the Massachusetts/Rhode Island WEAs. This scenario assumes cumulative impacts based on the percentage of available acreage occupied by offshore wind projects, including Vineyard Wind 1. For example, Vineyard Wind 1 will occupy 6.6% of the available acreage in the Massachusetts/Rhode Island WEAs, which the build-out scenario accounts for as a 7% impact. For all projects in the build-out scenario, Vineyard Wind assumed conservative acreage (i.e. wide spacing between turbines) and aggressive construction timelines based on known projects and future state-sponsored solicitations for offshore wind. According to the scenario, 100% of the available acreage in the Massachusetts/Rhode Island WEAs will be built-out by 2039.

To ensure that funding for cumulative impact mitigation was provided in excess of potential upstream effects, according to the build-out scenario, a "cumulative impacts multiplier" was then applied to the upstream economic impacts. The cumulative impacts multiplier starts at 0.50 on the assumption that 50% of the Massachusetts/Rhode Island WEAs is built-out when Vineyard Wind 1 starts construction in 2020, which is well above the 6.6% of available acreage the Project will occupy. The multiplier increases by 0.25 every five years until it reaches 1.00 when an estimated 68% of the Massachusetts/Rhode Island WEAs acreage is occupied by offshore wind projects.[14] From there, the multiplier increases to 1.25 when 100% of the available acreage is built-out in 2039, according to the scenario. That is, to be cautious, it is assumed that even more area is built out beyond the Massachusetts/Rhode Island WEAs, for example to account for build-out in other WEAs. This multiplier is held constant from 2039 through the end of the Project's life in 2048.

As shown in Table 8, the cumulative impacts multiplier ensures that funding will be substantially higher than potential total impacts, based on the total acreage that is likely to be impacted, throughout the life of the Project and results in $8,193,851 in funding for cumulative impacts mitigation.

Table 8. Funding Schedule for Cumulative Impacts Mitigation (cautious approach)

Cumulative impacts	2021	2026	2031	2041	...	2050
Upstream	$ 184,641	$208,904	$ 236,356	$302,555		$377,850
Agressive scenario for build-out [% of total lease areas]	0%	21%	60%	100%		100%
Cautious multiplier	**0.50**	**0.75**	**1.00**	**1.25**		**1.25**
Total annual cumulative impact payments (cautious approach)	**$ 92,320**	**$156,678**	**$ 236,356**	**$378,194**		**$472,312**
Total payments over lifetime of project (nominal)	**$ 8,193,851**					

[13] Based on both NOAA's (2018) Fishery Economics of the United States and an "advanced inquiry" using NOAA's online Fishery Economic Impacts Tool, the "upstream" sales multiplier for the Massachusetts commercial fishing sector is 1.83. That is, every dollar of commercial landings (ex-vessel value) in Massachusetts generates $0.83 in additional Massachusetts "upstream" impacts (see Appendix 2).

[14] Vineyard Wind established the "cumulative impacts multiplier" to ensure funding for potential cumulative impacts would exceed actual potential cumulative impacts. The multiplier does this by assuming offshore wind build-out occurs at a highly accelerated rate and ultimately occupies 125% of the acreage available for build-out.

Vineyard Wind will annually pay the calculated amounts to mitigate potential cumulative impacts into the Direct Compensation Fund, described in Section VI.

VI. Compensatory Mitigation Fund Administration

A. Direct Compensation Fund

The direct, downstream, and cumulative impacts mitigation payments described in the previous section will annually be paid into a Direct Compensation Fund. Vineyard will, in consultation with state agencies and fishing organizations, establish a claims review and decision process that will govern the payment of claims from the Direct Compensation Fund. Massachusetts fishing businesses will be able to submit claims of direct impacts of losses during any phase of the Project to the claims administrator.

Claims for direct impacts or losses for which claims may be filed include, but are not necessarily limited to, lost revenues to the Project's interference with fishing activities (if any). If a captain determines they are unable to fish safely because of the presence of the turbines, and can demonstrate a loss of income (or higher expenses for the same income) as a result of this decision, then compensation would be available through the Direct Compensation Fund. However, each vessel captain is responsible for the safety of their vessel and Vineyard Wind will not insure fishing vessel accidents. Lost or damaged gear associated with fishing within the Vineyard Wind 1 project area will be compensated directly, through a separate process and with funding aside from the Direct Compensation Fund and paid on an as-needed basis.

The documentation required to support a claim will be established by the third-party administrator, but will likely include a demonstrated history of fishing within the project area, as well as historic earnings of the claimant as a proportion of total relevant fisheries landings, against which claims for lost revenues can be measured. Claims can be documented on the basis of a statistical loss, and not necessarily a specific incident or event. For example, a vessel that historically fished in the Vineyard Wind 1 project area could document that their catch value as a proportion of any year's total catch value declined concurrently with their lack of fishing in the WDA after the project was completed. This proposed process for evaluating claims is based on processes used by a number of other similar funds, for example in the oil and gas industry.

Once the claims process is established, the procedures for filing a claim will be posted on Vineyard Wind's website and otherwise be made available through Vineyard Wind's fisheries liaisons, and as further specified in the fisheries communication plan. Claims that are accepted and paid will be accompanied by a release of liability for any future claims arising out of the same facts and circumstances that gave rise to the paid claim. This means that once Vineyard Wind pays a claim, Vineyard Wind, its parents, affiliates, and successors will have no further obligations with respect to that specific claimed loss. However, fishermen could make subsequent claims or on-going claims, if warranted.

First payment to the Direct Compensation Fund will be made upon Vineyard Wind 1's financial close; total payments of approximately $19.2 million will be made over the life of the Project. An indicative schedule of payments into for the Direct Compensation Fund, over the first 10 years of the Project's life, is provided as Table 9. The payments made by Vineyard Wind will be held in escrow and managed by one third-party administrator that will be selected by Vineyard Wind in consultation with the Massachusetts Office of Coastal Zone Management.

Table 9. Indicative Payment Schedule for Direct Compensation Fund

Year	Direct and Downstream Impacts Mitigation Payment	Cumulative Impacts Mitigation Payment	Total Annual Payment
2021	1,227,575	92,320	1,321,916
2022	233,265	94,628	329,915
2023	239,096	96,994	338,113
2024	245,074	99,419	346,517
2025	251,200	101,904	355,129
2026	257,480	156,678	416,184
2027	263,917	160,595	426,539
2028	270,515	164,610	437,153
2029	277,278	168,725	448,032
2030	284,210	172,943	459,183
2031	291,315	236,356	529,702
TOTAL Payments over the life of the Project (nominal)	**3,840,925**	**1,545,172**	**5,408,383**

VII. Conclusion

Vineyard Wind has taken steps to design an offshore wind project that avoids and minimizes potential impacts to Massachusetts fishing businesses to the greatest extent practicable. Recognizing that certain fishery-related economic impacts may be unavoidable, Vineyard Wind has designed a compensatory mitigation program for Vineyard Wind 1 that delivers substantial financial support over the 30-year life of the Project, as summarized in Table 11.

Table 11. Vineyard Wind Compensatory Mitigation Funds

Fund	Amount
Direct Compensation Fund	$19,185,016
Fisheries Innovation Fund	$1,750,000
TOTAL Payments over the life of the Project (nominal): $20,935,016	

The bulk of the more than $20 million in funding provided will be used to address potential economic impacts to Massachusetts fishing businesses; the remaining funds will be used to foster innovation that supports the successful co-existence of the fishing and wind sectors in the offshore environment.

Appendix 1—Vineyard Wind 1 Compensatory Migration Program Funding Overview

Table 1. Vineyard Wind 1 Compensatory Migration Program Funding Overview

Direct and downstream mitigation						
	2021	2022	2023	...	...	2050
Direct	$ 111,229	$ 114,010	$ 116,860			$ 227,620
Downstream	$ 95,657	$ 98,049	$ 100,500			$ 195,754
Total (direct + downstream)	$ 206,887	$ 212,059	$ 217,360			$ 423,374
Extraordinary, initial funding	$ 1,000,000					
Cautious approach multiplier	1.10	1.10	1.10			1.10
Total annual direct + upstream payments (cautious approach)	**$ 1,227,575**	**$ 233,265**	**$ 239,096**			**$ 465,711**
Total payments over lifetime of project (nominal)	**$ 10,991,165**					

Cumulative impacts						
	2021	2026	2031	2041	...	2050
Upstream	$ 184,641	$ 208,904	$ 236,356	$ 302,555		$ 377,850
Agressive scenario for build-out [% of total lease areas]	0%	21%	60%	100%		100%
Cautious multiplier	0.50	0.75	1.00	1.25		1.25
Total annual cumulative impact payments (cautious approach)	**$ 92,320**	**$ 156,678**	**$ 236,356**	**$ 378,194**		**$ 472,312**
Total payments over lifetime of project (nominal)	**$ 8,193,851**					

Innovation Fund				
	2021	2022	2023	2024
Vineyard Wind contributions	$ 1,000,000	$ 250,000	$ 250,000	$ 250,000
Total payments over lifetime of project (nominal)	**$ 1,750,000**			

Vineyard Wind grand total contribution for MA fisheries over lifetime of project	**$ 20,935,016**

Exhibit B: Vineyard Wind Fisheries Mitigation Plan

Related to Vineyard Wind's 800MW project located in the northern-most portion of BOEM Wind Lease Area OCS-A-501

Fisheries Mitigation Plan Overview

Vineyard Wind 1 (the "Project") is an 800-megawatt ("MW") offshore wind project that Vineyard Wind intends to construct within the northern portion of Bureau of Ocean Energy Management ("BOEM") Lease Area OCS-A 0501. The compensatory mitigation program is structured as two funds totaling more than $20 million, over the life of the Project. The funding will be used to offset potential direct, indirect, and cumulative economic impacts to Massachusetts fishing businesses and to facilitate innovation that supports the long-term co-existence of the fishing and wind sectors in the offshore environment.

Mitigation Funds	**Amount**
Compensatory Mitigation Fund	$19,185,016
Fisheries Innovation Fund	$1,750,000
TOTAL Payments over the life of the Project: $20,935,016	

I. Compensatory Mitigation Fund

Structure of the Compensation Mitigation Fund

a.) Funds to be held in escrow by agreement with a third party to compensate for any claims by Massachusetts fishing businesses for impacts resulting in economic losses during any phase of the Vineyard Wind 1 project.

b.) Lost or damaged gear associated with fishing within the Vineyard Wind 1 project area will be compensated directly by Vineyard Wind, through a separate process and with funding separate from the Compensatory Mitigation Fund and paid on an as-needed basis.

c.) Vineyard Wind will make annual funding payments to the escrow account as follows:
   a. First payment to the Compensatory Mitigation Fund will be made upon Vineyard Wind's financial close.[1]
   b. Total payments of $19,185,016 will be made over the life of the Project according to the schedule below and contained in the Compensatory Mitigation Plan included in a letter to the Massachusetts Office of Coastal Zone Management (CZM) dated March 3, 2020 and as updated in supplemental filing to CZM dated May 15, 2020. [2] Total payments shall not exceed $19,185,016 unless changes to the construction timeline warrant updates to the total amount and payment schedule and as mutually agreed to by all parties.
   c. Payments will be paid in accordance with the schedule below. Should the Project be decommissioned prior to its expected life, Vineyard Wind's obligation to fund the Compensatory Mitigation Fund will be terminated. Any outstanding claims will be paid in accordance with the agreement with the third-party administrator.

[1] For the purposes of this Agreement, financial close means the date upon which all project and financing documentation for the Project has been executed and becomes effective.

[2] The life of the Project is 30 years, which includes 25 years of operations and the time necessary for construction and decommissioning of the project.

Compensatory Mitigation Fund Payment Schedule

Year	Direct and Downstream Impacts Mitigation Payment	Cumulative Impacts Mitigation Payment	Total Annual Payment
2021	1,227,575	92,320	1,319,895
2022	233,265	94,628	327,893
2023	239,096	96,994	336,090
2024	245,074	99,419	344,493
2025	251,200	101,904	353,104
2026	257,480	156,678	414,158
2027	263,917	160,595	424,512
2028	270,515	164,610	435,125
2029	277,278	168,725	446,003
2030	284,210	172,943	457,153
2031	291,315	236,356	527,671
2032	298,598	242,265	540,863
2033	306,063	248,321	554,384
2034	313,715	254,529	568,244
2035	321,558	260,892	582,450
2036	329,597	267,415	597,012
2037	337,837	274,100	611,937
2038	346,283	280,953	627,236
2039	354,940	287,976	642,916
2040	363,813	295,176	658,989
2041	372,908	378,194	751,102
2042	382,231	387,649	769,880
2043	391,787	397,340	789,127
2044	401,582	407,274	808,856
2045	411,621	417,455	829,076
2046	421,912	427,892	849,804
2047	432,459	438,589	871,048
2048	443,271	449,554	892,825
2049	454,353	460,793	915,146
2050	465,712	472,312	938,024
TOTAL Payments over the life of the Project (nominal)	**10,991,165**	**8,193,851**	**19,185,016**

d.) The escrow account will be administered by a third party selected by Vineyard Wind in consultation with the Executive Office of Energy and Environmental Affairs (EEA).

   a. Administrative costs associated with managing the fund, establishing a claims procedure, reviewing claims, and, dispersing financial compensation will be paid by Vineyard Wind directly and not deducted from the escrow funds.

   b. Massachusetts fishermen, Massachusetts fishing companies, and companies that support Massachusetts fishing interests can submit claims of direct impacts or losses (other than gear loss claims) during any phase of the Vineyard Wind I project (construction, operating, decommissioning) within the project area to the third-party administrator.

   c. Vineyard Wind, in consultation with the third-party administrator and with EEA will establish a claims review and decision process that will govern the payment of claims from the Compensatory Mitigation Fund.

   d. Claims that are accepted and paid will be accompanied by a release of liability for any future claims arising out of the same facts and circumstances that gave rise to the paid claim.

   e. Funds remaining after making claims payments for any given year will be rolled over to the following year for future claims.

   f. After five years of commercial operations, the third-party administrator will evaluate the claims history against the fund and make reasonable projections regarding future claims. The third-party administrator will use his/her best professional judgement as to whether the balance of the fund and future payments to the fund exceed the amounts necessary to pay anticipated claims. If the third party administrator determines that the balance of the fund exceeds an amount deemed necessary to pay future claims, the administrator may transfer the excess funds, in an amount as determined by the administrator, to the Massachusetts Fisheries Innovation Fund to be used in accordance with the purposes of the Fund. The third-party administrator will conduct this assessment every five years thereafter and transfer funds accordingly. Upon completion of decommissioning, any funds remaining after all claims are paid will be transferred to the Massachusetts Fisheries Innovation Fund to be used in accordance with the purposes of the Fund.

II. Massachusetts Fisheries Innovation Fund

Purpose of the Fisheries Innovation Fund

The purpose of the Fisheries Innovation Fund is to support programs and projects that ensure safe and profitable fishing continue as Vineyard Wind and future offshore wind projects are developed in Northern Atlantic waters. The Fund will provide support to programs and projects through grants to conduct studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries as well as provide grants for technology and innovation upgrades for fishery participants (and vessels) actively fishing within a wind energy area. These programs and projects may include, but are not limited to, studies on the impacts of offshore wind development on fishery resources and the recreational and commercial fishing industries, improvements in fishing vessels and gear, development of new technology to improve navigation in and around the wind farm area, the development of alternative gear and fishing methods, optimization of vessel systems, technology and innovation upgrades for fishery participants (and vessels) actively fishing within a wind energy area, and general fishing vessel safety improvements.

Structure of the Fisheries Innovation Fund

a.) EEA will establish a dedicated expendable trust entitled “Offshore Wind Fisheries Research, Innovation, and Science Fund” (“the Fund”) within the existing Division of Marine Fisheries (DMF) Expendable Trust (“Marine Mammals and Fisheries Research and Conservation Trust”) or another expendable trust dedicated to these matters, to receive funds from Vineyard Wind including funds rolled over from the Compensatory Mitigation Fund.

b.) Vineyard Wind will make four payments into the Fisheries Innovation Fund with the first payment of $1 million at financial close of Vineyard Wind I and the next three payments of $250,000 each on the anniversary date of financial close of the Vineyard Wind I project.

c.) The Director of DMF will serve as trustee of the expendable trust, and will chair an Offshore Wind Fisheries Research, Innovation, and Science Advisory Panel (“the Panel”).

d.) The specific programs and activities supported by the Fund will be decided by the Director in consultation with the Panel. The panel shall advise the Director on spending of funds allocated to Fisheries Research, Innovation, and Science regarding the co-existence of offshore wind development and marine fisheries.

e.) The Panel shall be appointed by the Commissioner of the Department of Fish and Game (DFG) with input from CZM and consist of at least 9 members including two members of the Marine Fisheries Advisory Commission, and 7 members of the public at large, all of whom shall have specific expertise and background in the conduct and management of marine fisheries. Representatives shall include one representative of the lobster trap fishery, one representative of the mobile gear fishery, one representative of a Commercial Fishery Advocacy Organization, one representative of the hook-and-line fishery, one representative of the for-hire fishery, one representative of wholesale seafood dealers, and one representative of offshore wind developers. The Panel members shall serve for terms not to exceed 3 years. Any member shall be eligible for reappointment.

f.) All approved expenditures from the Fund shall follow applicable Commonwealth procurement and finance laws, regulations, and guidelines.

g.) DMF will maintain a registry of projects supported by the Fund. An annual reporting of fund expenditures will be provided to Vineyard Wind and EEA.

h.) The Panel shall meet at least annually and shall also meet at the request of the Director or the Commissioner. A simple majority of the members (5) shall constitute a quorum and the affirmative vote of a majority of members present at a duly called meeting where a quorum is present shall be necessary for any action to be taken by the panel.