MEMORANDUM OF AGREEMENT
AMONG
THE BUREAU OF OCEAN ENERGY MANAGEMENT,
THE MASSACHUSETTS STATE HISTORIC PRESERVATION OFFICER,
VINEYARD WIND, LLC, AND
THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
REGARDING THE VINEYARD WIND 1
OFFSHORE WIND ENERGY PROJECT,
LEASE AREA OCS-A 0501, OFFSHORE MASSACHUSETTS

April 26, 2021

TABLE OF CONTENTS

ATTACHMENTS

ABBREVIATIONS AND ACRONYMS

Acronym	Definition
§	Section
AC	Advisory Circular
Ac	acres
ACHP	Advisory Council on Historic Preservation
ADLS	Aircraft Detection Light System
AGL	Above ground level
AMS	Accelerator Mass Spectrometry
APE	area of potential effect
ASD	Atlantic Shipwreck Database
ATR	Airport Technology Research and Development Branch
AWOIS	Automated Wrecks and Obstructions Inventory System
BITE	Built-in test equipment
BOEM	Bureau of Ocean Energy Management
Cal BP	Calibration to years before present
C.F.R.	Code of Federal Regulations
CMR	Code of Massachusetts Regulations
COP	Construction and Operations Plan
CPT	Cone Penetration Testing
CV	Curricula vitae
CRM	Cultural Resources Manager
CSDGM	Content Standard for Digital Geospatial Metadata
DGPS	Digital Global Positional System
EIS	Environmental Impact Statement
ENC	Electronic navigation charts
EO	Executive Order
ESP	electrical service platform
ESRI	Environmental Systems Research Institute
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
Fed. Reg.	Federal Register
FEIS	Final Environmental Impact Statement
FGDC	Federal Geographic Data Committee
ft	feet
GE	General Electric
GHLAB	Gay Head Light Advisory Board
GIS	Geographic Information System
GPS	global positioning system
GRAD	Dual magneometers
HDD	horizontal directional drilling
HDPE	high-density polyethylene
HRG	High Resolution Geophysical
IP	Internet Protocol
km	kilometers
km^2	square kilometers
kV	kilovolt
Lease Area	Lease Area OCS-A 0501
m	meters
Massachusetts	Commonwealth of Massachusetts
MAG	Single magnetometer
MARA	Marine Archaeological Assessment
MASHPO	Massachusetts State Historic Preservation Officer
MBES	Mutlibeam echosounder
m bsb	meters below seabed
MBUAR	Massachusetts Board of Underwater Archeological Resources
MHC	Massachusetts Historical Commission
MLLW	mean lower low water
MOA	Memorandum of Agreement
MW	megawatt
NA	not applicable
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NHA	Nantucket Historical Association
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NM	Nautical mile
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRHP	National Register of Historic Places
OCME	Office of the Chief Medical Examiner
OCS	Outer Continental Shelf
OECC	Offshore Export Cable Corridor(s)
OECR	Onshore Export Cable Route
OLC	Terma Obstruction Light Control System
PA	Project Archaeologist
PAL	Public Archaeology Laboratory, Inc
PD	Project Director
PDE	Project Design Envelope
POC	Point of Contact
Project	Vineyard Wind 1 Offshore Wind Energy Project
Proponent	Vineyard Wind 1 LLC
PSR	Primary Surveillance Radar

ABBREVIATIONS AND ACRONYMS

Acronym	Definition
QGIS	Open Source Geographic Information System
QMA	Qualified Marine Archaeologist
RIHPHC	Rhode Island Historical Preservation and Heritage Commission
ROW	right-of-way
SBP	Subbottom profiler
SCADA	Supervisory Control and Data Acquisition
SCS	Single channel seismic
SHPO	State Historic Preservation Office
SEIS	Supplement to the Draft EIS
SM	Statute mile
SOI	Secretary of Interior
SSS	Side scan sonar
TCP	Traditional Cultural Property
THPO	Tribal Historic Preservation Officer
TWRA	Tehachapi Wind Resource Area
UDP	Unanticipated Discovery Plan
USDA	US. Department of Agriculture
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USCG	U.S. Coast Guard
USGS	U.S. Geologic Survey
UTM	Universal Transverse Mercator
VIA	Visual Impact Assessment
Vineyard Wind	Vineyard Wind 1 LLC
WDA	Wind Development Area
WTG	wind turbine generator

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REGARDING THE VINEYARD WIND 1 OFFSHORE WIND ENERGY PROJECT,
LEASE AREA OCS-A 0501, OFFSHORE MASSACHUSETTS

April 26, 2021

WHEREAS, the Bureau of Ocean Energy Management (BOEM) plans to approve with conditions the Construction and Operations Plan (COP) submitted by Vineyard Wind, LLC (Vineyard Wind; undertaking) for the project known as Vineyard Wind 1, pursuant to the Renewable Energy Regulations at 30 Code of Federal Regulations (C.F.R.) Part 585; and

WHEREAS, the undertaking consists of BOEM's conditional approval of the COP, which includes the construction, operation, and eventual decommissioning of an up to 800-megawatt (MW) wind energy project located approximately 14 miles from the southeast corner of Martha's Vineyard and a similar distance from the southwest side of Nantucket. The project includes wind turbine generators (WTGs), electrical service platforms (ESPs), an onshore substation, offshore and onshore cabling, and onshore operations and maintenance facilities, as illustrated and discussed in Attachment 3A (Turbine Specifications). The undertaking is more specifically defined as a combination of the assessed National Environmental Policy Act (NEPA) alternatives that are likely to be approved, comprising Alternatives C, D2, and E as described in the Final Environmental Impact Statement (FEIS). Conditional approval of the undertaking would allow up to 84 WTGs (as opposed to up to 100 included in the COP [BOEM 2021]), to be installed within the 106 proposed positions (Alternative E); would exclude the installation of WTGs in six positions in the northernmost portion of the project area (Alternative C); and would require that the WTG layout be arranged in an east-west orientation with all the WTGs in the north-south and east-west direction having a minimum spacing of 1 nautical mile (nm) between them (Alternative D-2). Finally, the undertaking includes the use of the General Electric (GE) Haliade X WTG, a 13MW turbine. Vineyard Wind provided the most recent updates to the COP on September 30, 2020; and

WHEREAS, On December 1, 2020, Vineyard Wind withdrew the COP to conduct additional reviews associated with the inclusion of the GE Haliade-X Wind Turbine Generator into the final Project design. In response to Vineyard Wind's December 1, 2020, letter, BOEM published a notice on December 16, 2020, informing the public that "preparation of an Environmental Impact Statement" for the COP was "no longer necessary" for the sole reason that "the COP ha[d] been withdrawn from review and decision-making" (85 Fed. Reg. 81486 [December 16, 2020]). Accordingly, BOEM "terminated" the "preparation and completion" of the Environmental Impact Statement (EIS). BOEM notified the consulting parties that its National Historic Preservation Act (NHPA) Section 106 review was also discontinued; and

WHEREAS, On January 22, 2021, Vineyard Wind notified BOEM via letter that it had completed its review and had concluded that inclusion of the Haliade-X turbines did not warrant any modifications to the COP. Accordingly, Vineyard Wind informed BOEM that it was rescinding its temporary withdrawal and asked BOEM to resume its review of the COP. After conducting an independent review of the information provided by Vineyard Wind, BOEM confirmed that: (1) the Haliade-X turbines fall within the design envelope analyzed in the June 2020 Supplement to the Draft EIS (SEIS); (2) Vineyard Wind's already-submitted COP contains all the necessary information to complete the Final Environmental Impact Statement (FEIS); and (3) an additional SEIS is not needed under 40 C.F.R. § 1502.9. BOEM notified the consulting parties that its NHPA Section 106 review would resume from where it was previously discontinued, and scheduled and held an additional consultation meeting on February 16, 2021; and

WHEREAS, BOEM has defined the undertaking's area of potential effects (APE) as the depth and breadth of the seabed potentially impacted by any bottom-disturbing activities, constituting the marine archaeological resources portion of the APE; the depth and breadth of terrestrial areas potentially impacted by any ground disturbing activities, constituting the terrestrial archaeological resources portion of the APE; the viewshed from which renewable energy structures, whether located offshore or onshore, would be visible, constituting the viewshed portion of the APE; and any temporary or permanent construction or staging areas, both onshore and offshore, which may fall into any of the above portions of the APE. The APE is more specifically described in Attachment 1 (Description of the Area of Potential Effects); and

WHEREAS, throughout this document the term 'Tribe,' has the same meaning as 'Indian Tribe,' as defined at 36 CFR § 800.16(m); and

WHEREAS, BOEM has consulted with the Delaware Tribe of Indians, Mohegan Tribe of Indians of Connecticut, Narragansett Indian Tribe, Shinnecock Indian Nation, and the Wampanoag Tribe of Gay Head-Aquinnah, for which the Chappaquiddick Island Traditional Cultural Property (TCP), Vineyard Sound and Moshup's Bridge TCP, and the identified submerged ancient landforms that are contributing elements to the Nantucket Sound TCP or to a broader traditional cultural landscape have historic, religious, and cultural significance; and

WHEREAS, BOEM has consulted with the non-Federally recognized historic Massachusetts Chappaquiddick Tribe of the Wampanoag Nation, the Alliance to Protect Nantucket Sound, the Cape Cod Commission, the Gay Head Light Advisory Board, the Massachusetts Board of Underwater Archaeological Resources, the Massachusetts Commission on Indian Affairs, the Nantucket Conservation Foundation, the Nantucket Historical Association (NHA), the National Park Service (NPS), Preservation Massachusetts, the Rhode Island Historical Preservation & Heritage Commission, The Trustees of Reservations, the U.S. Army Corps of Engineers (USACE), and Vineyard Power Cooperative, regarding the effects of the undertaking on historic properties, as more specifically described in Attachment 2 (List of Consulting Parties); and

WHEREAS, in accordance with 36 C.F.R. § 800.6(a)(1), BOEM has notified the Advisory Council on Historic Preservation (ACHP) of its adverse effect determination with specified documentation, and the ACHP has chosen to participate in the consultation pursuant to 36 C.F.R.§ 800.6(a)(1)(iii); and

WHEREAS, BOEM has completed the identification and evaluation of historic properties within the terrestrial archaeological and viewshed portions of the APE for the undertaking as documented in the revised Finding of Adverse Effects (November 2020) and the Supplement to the Finding of Adverse Effects (March 2021); and

WHEREAS, BOEM has determined that the identification and evaluation of historic properties within the marine archaeological portion of the APE for the undertaking will be conducted through a phased approach, pursuant to 36 C.F.R. § 800.4(b)(2), where the final identification of historic properties may occur after the COP is approved due to the likely selection of a combination of NEPA alternatives that differs from that proposed in the COP and previously surveyed for historic properties; and

WHEREAS, BOEM has determined that the undertaking will have a direct adverse effect on the Gay Head Light (GAY.900) and the Nantucket Historic District National Historic Landmark (NAN.C/D), which are listed in the National Register of Historic Places, and has consulted with the Massachusetts State Historic Preservation Officer (MASHPO) at the Massachusetts Historical Commission (MHC) (hereafter, MASHPO) pursuant to 36 C.F.R. Part 800, the regulations implementing Section 106 of the National Historic Preservation Act (NHPA) (54 United States Code [U.S.C.] § 306108); and

WHEREAS, BOEM has determined that the undertaking will have a direct adverse effect on the Nantucket Sound TCP (BRN.9072, CHA.938, DEN.930, EDG.907, FAL.973, HRW.918, MAS.916, NAN.939, OAK.902 and TIS.904) or a broader traditional cultural landscape, specifically on 19 formerly sub-aerially exposed ancient landform features with the potential to contain pre-contact period archaeological resources within and outside the boundaries of the Nantucket Sound TCP; that these ancient landform features hold historic, religious, and cultural significance to the consulting Tribes, the non-Federally recognized historic Massachusetts Chappaquiddick Tribe of Wampanoag Nation; and has consulted with them and the MASHPO pursuant to 36 C.F.R. Part 800, the regulations implementing Section 106 of the NHPA (54 U.S.C. § 306108); and

WHEREAS, BOEM has determined that the undertaking will have a direct adverse effect on the Chappaquiddick Island TCP, which is eligible for listing on the National Register of Historic Places (NRHP), and has consulted with the non-Federally recognized historic Massachusetts Chappaquiddick Tribe of the Wampanoag Nation, and the MASHPO pursuant to 36 C.F.R. Part 800, the regulations implementing Section 106 of the NHPA (54 U.S.C. § 306108); and

WHEREAS, BOEM has determined that the undertaking will have a direct adverse effect on the Vineyard Sound and Moshup's Bridge TCP, which is eligible for listing on the NRHP, and has consulted with the Mashpee Wampanoag Tribe and the Wampanoag Tribe of Gay Head (Aquinnah), both Federally recognized Tribes, and the MASHPO pursuant to 36 C.F.R. Part 800, the regulations implementing Section 106 of the NHPA (54 U.S.C. § 306108); and

WHEREAS, BOEM considered all consulting party recommendations for measures to resolve the adverse effects, as documented in the revised Finding of Adverse Effects (November 2020); virtual meetings/calls with the consulting parties on July 8, 2020, July 20, 2020, August 18, 2020, and February 16, 2021; and written comments received after the February 16, 2021 meeting on the revised Finding of Adverse Effect and the Supplement to the Finding of Adverse Effects (March 2021). The agreed-to approaches to resolve the adverse effects are documented in this Memorandum of Agreement (MOA). The agreed-to measures and methods that will be utilized are listed below and described in more detail in the Stipulations of this MOA as well as Attachment 4 (Gay Head Light Treatment Plan), Attachment 5 (Chappaquiddick Island Traditional Cultural Property Treatment Plan), Attachment 6 (Vineyard Sound and Moshup's Bridge Traditional Cultural Property Treatment Plan), Attachment 7 (Summary of Avoidance and Mitigation Measures for Submerged Ancient Landform and Archaeological Features), and Attachment 8 (Treatment Plan for Submerged Ancient Landform Features with the Potential to Contain Pre-Contact Period Archaeological Sites) to this MOA; and

WHEREAS, BOEM has consulted regarding the effects of the undertaking on historic properties and measures to avoid, minimize, and mitigate the undertaking's effects with MASHPO, who is a signatory to this MOA; and

WHEREAS, BOEM has consulted with Vineyard Wind in its capacity as applicant for approval of the COP, and, because they have responsibilities under the MOA, BOEM has invited them to be a signatory to this MOA; and

WHEREAS, BOEM will invite the Tribes, the non-Federally recognized historic Massachusetts Chappaquiddick Tribe of the Wampanoag Nation, the Gay Head Light Advisory Board, and the Massachusetts Board of Underwater Archaeological Resources to concur with this MOA; and

NOW, THEREFORE, BOEM, the MASHPO, Vineyard Wind, and the ACHP agree that the undertaking will be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on historic properties.

STIPULATIONS

BOEM will ensure that the following measures are required as conditions of its approval of the Vineyard Wind 1 COP and are implemented by Vineyard Wind, unless otherwise specified:

I. ACTIONS TO RESOLVE ADVERSE VISUAL EFFECTS TO IDENTIFIED HISTORIC PROPERTIES

A. Design Requirements. BOEM will include the following as conditions of approval of the Vineyard Wind 1 COP:

1. Vineyard Wind will install no more than 84 WTGs as described in Attachment 3A (Turbine Specifications).

2. Vineyard Wind will paint the wind turbines an off white/grey color (no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey) to reduce visual contrast during daylight hours on historic properties as described in Attachment 3A (Turbine Specifications). The turbines must be painted in this manner prior to commencing commercial operation.

3. Vineyard Wind will exclude the six northeastern most turbine placement locations in the proposed layout closest to Martha's Vineyard, Nantucket, and adjacent islands as shown in Figure 2.1-2 of the FEIS (BOEM 2021) (the Proposed Action Alternative A).

4. Vineyard Wind will install an Aircraft Detection and Lighting System (ADLS) as described in Attachment 3B (ADLS Technical Specifications and Design Information) to reduce nighttime lighting. The system must activate aviation warning lights only when an aircraft is in the vicinity of the Wind Development Area (WDA), resulting in nighttime visibility of the project from adversely affected historic properties, which is estimated to be less than four (4) hours annually, or 0.1 percent of annual nighttime hours. The ADLS must be installed and operational prior to commencing commercial operation.

B. Gay Head Light Restoration and Stabilization. BOEM will include the following as conditions of approval of the Vineyard Wind 1 COP:

1. Vineyard Wind will fund and conduct, at a cost not to exceed $137,500, a restoration and stabilization project for the Gay Head Light to address the advanced state of corrosion of the lantern curtain wall as described in Attachment 4 (Gay Head Light Treatment Plan). Vineyard Wind will fund and commence the restoration and stabilization project prior to initiation of construction of any offshore project elements within the WDA on the Outer Continental Shelf (OCS) included as part of this undertaking.

2. Vineyard Wind will develop the mitigation project consistent with the Secretary of the Interior's Standards and Guidelines for Rehabilitation (36 C.F.R. Part 67).

3. Vineyard Wind will submit proposed scopes of work, draft text, design specifications, and any other associated materials to the Gay Head Lighthouse Advisory Board and the MASHPO for review and comment as they are developed, and no less than 30 days prior to commencement of the work. The MASHPO will review and approve the mitigation project under the terms of the Preservation Restriction (PR) (M.G.L Chapter 184, Section 31-33).

4. Vineyard Wind will develop the mitigation project such that it achieves the following objectives: to learn exactly how the curtain wall was designed and how many components will require replacement versus repair, as well as to perform as much repair work as possible without exceeding the allocated funding of $137,500. Vineyard Wind will develop the mitigation project in such a way as to ensure that it is designed to

investigate the degree of deterioration and to assess conditions in order to better understand components involved in a future complete restoration. The signatories understand that to achieve this set of objectives, a selective disassembly or "probe" into the existing construction will be necessary. Additionally, the signatories understand that repairs needed in excess of the allotted funding will not be undertaken as part of this mitigation, but that this mitigation's documentation will be essential to supporting future restoration work.

5. Vineyard Wind will submit a final assessment report, including all obtained engineering drawings, to the Town of Aquinnah and to MASHPO to be used for future restoration considerations conducted outside of this mitigation.

C. Chappaquiddick Island TCP Ethnographic Study and NRHP Nomination. BOEM will include the following as conditions of approval of the Vineyard Wind 1 COP:

1. Vineyard Wind will fund and conduct at a cost not to exceed $150,000 an ethnographic study and prepare a NRHP nomination package for the Chappaquiddick Island TCP, as further described in Attachment 5 (Chappaquiddick Island Traditional Cultural Property Treatment Plan). Vineyard Wind will fund and commence the study prior to initiation of construction of any offshore project elements within the WDA on the OCS included as part of this undertaking.

2. Vineyard Wind will ensure that the NRHP Nomination describes the relationship of the TCP and other appropriate TCPs, including the Nantucket Sound TCP, within the Wampanoag homeland.

3. Vineyard Wind will ensure that the Chappaquiddick Island TCP NRHP Nomination is produced by qualified historic preservation consultant(s) working with the non-Federally recognized historic Massachusetts Chappaquiddick Tribe of the Wampanoag Nation and the Trustees of Reservations.

D. Vineyard Sound and Moshup's Bridge TCP Ethnographic Study and NRHP Nomination. BOEM will include the following as conditions of approval of the Vineyard Wind 1 COP:

1. Vineyard Wind will fund and conduct at a cost not to exceed $150,000 an ethnographic study and prepare a NRHP nomination package for the Vineyard Sound and Moshup's Bridge TCP, as described in Attachment 6 (Vineyard Sound and Moshup's Bridge Traditional Cultural Property Treatment Plan). Vineyard Wind will fund and commence the study prior to initiation of construction of any offshore project elements within the WDA on the OCS included as part of this undertaking.

2. Vineyard Wind will ensure that the NRHP Nomination describes the relationship of the TCP and other appropriate TCPs, including the Nantucket Sound TCP and Nantucket

Island within the Wampanoag homeland. The NRHP Nomination will also include re-naming of the TCP in accordance with the preferences of the Wampanoag Tribe of Gay Head (Aquinnah) and the Mashpee Wampanoag Tribe.

3. Vineyard Wind will ensure that the Vineyard Sound and Moshup's Bridge TCP NRHP Nomination is produced by qualified historic preservation consultant(s) working with the Wampanoag Tribe of Gay Head (Aquinnah) and the Mashpee Wampanoag Tribe.

II. ACTIONS TO RESOLVE ADVERSE PHYSICAL EFFECTS TO IDENTIFIED HISTORIC PROPERTIES

A. Avoidance of Shipwrecks and Potentially Significant Debris Fields. BOEM will include the following as conditions of approval of the Vineyard Wind 1 COP. Vineyard Wind will avoid identified shipwrecks and potentially significant debris fields previously identified during marine archaeological surveys of the WDA and Offshore Export Cable Corridor (OECC) by a distance of no less than 300 meters from the known extent of the resource, unless the buffer would preclude the installation of facilities at their engineered locations, but in no event would the buffer be less than 100 meters from the known extent of the resource.

B. Avoidance of Submerged Ancient Landform Features. BOEM will include the following as conditions of approval of the Vineyard Wind 1 COP. Vineyard Wind will avoid by micro-siting all submerged ancient landform features previously identified during marine archaeological surveys of the WDA and OECC, as indicated in Attachment 7 (Summary of Avoidance and Mitigation Measures for Submerged Ancient Landform and Archaeological Features).

C. Mitigation of Unavoidable Submerged Ancient Landform Features. BOEM will include the following as conditions of approval of the Vineyard Wind 1 COP. Vineyard Wind will fund additional investigations of the 19 submerged ancient landforms previously identified during marine archaeological surveys of the WDA and offshore export cable corridor that remain in the APE and cannot be avoided due to the undertaking's design constraints in accordance with Attachment 8 (Treatment Plan for Submerged Ancient Landform Features with the Potential to Contain Pre-Contact Period Archaeological Sites) and the following:

1. Vineyard Wind will assemble a research team that meets the qualifications of the Secretary of Interior (SOI) and 950 Code of Massachusetts Regulations (CMR) 70.10(1) to undertake the work;

2. Vineyard Wind will collect up to two additional vibracores in each of the unavoidable submerged landform features;

3. Vineyard Wind will perform laboratory analyses of subsamples collected from the cores where terrestrial soils were identified (e.g. Carbon 14 dating, bulk geochemical analysis of nitrogen, pollen analysis, and microdebitage analysis, as applicable);

4. Upon completion of the fieldwork, Vineyard Wind will prepare a professional report of results suitable for technical audiences and submit it to BOEM and MASHPO for a review period of no less than 30 days. This report will comply with regulation 312 CMR 2.09:3, will meet the standards for technical reporting in 950 CMR 70.14, and will also meet the standards described in the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation;

5. Vineyard Wind will provide Tribal representatives with the opportunity to be present for all stages of work, including core collection, core opening, and core sub-sampling. Vineyard Wind will send formal invitations to the consulting Tribes with schedules for the mitigation study activities. In the interest of collaboration, a communication matrix will be distributed for key team members who are available all the time for consultation, questions, and information requests. Vineyard Wind will hold these meetings in person unless public health or safety considerations warrant remote meetings. The specific timeframe for the consultation process will be defined in the future, but will include a study kickoff meeting, a pre-field planning meeting, a field mobilization vessel tour, a post-field program core sample review, and a study results meeting;

6. Vineyard Wind will develop educational and documentary materials including a detailed PowerPoint presentation prepared with input from the Tribes for a non-technical audience that provides a description of how the submerged landform study was performed and its results; compile a digital geodatabase for use in open source Geographic Information System (QGIS; freeware) documenting the landform features and the study activities (known boundaries of landforms, core locations); provide assistance to Tribes in configuring their own GIS software on their own computers; and prepare an in-person presentation on the study prepared for non-technical audiences;

7. Vineyard Wind will fund and commence these measures prior to initiation of any offshore ground disturbing project elements included as part of this undertaking, and Vineyard Wind will collect the cores prior to any construction disturbance within 500 meters of the 19 unavoidable submerged ancient landform features in question. All aspects of the treatment plan as described in Attachment 8 (Treatment Plan for Submerged Ancient Landform Features with the Potential to Contain Pre-Contact Period Archaeological Sites) will be completed within five (5) years of the execution of this MOA;

8. Vineyard Wind will submit the final data and results to BOEM, the consulting Tribes, and MASHPO; and

9. If archaeological resources are identified, Vineyard Wind will treat them as a post-review discovery, in accordance with Attachment 10 (Offshore Post Review Discoveries Plans) and Stipulation VII.

III. PHASED IDENTIFICATION AND EVALUATION WITHIN THE MARINE ARCHAEOLOGY APE

BOEM has determined that the identification and evaluation of historic properties within the marine archaeological portion of the APE for the undertaking will be conducted through a phased approach, pursuant to 36 C.F.R. § 800.4(b)(2), where the final identification of historic properties may occur after the COP is approved due to the likely selection of a combination of NEPA alternatives that differs from that proposed in the COP and previously surveyed for historic properties. The only portion of the marine archaeology APE that has not been fully surveyed is located within the WDA on the OCS outside of Massachusetts state waters. The entirely of the OECC has been fully surveyed. To complete the identification and evaluation, BOEM will include the following as conditions of approval of the Vineyard Wind 1 COP:

A. Completion of Identification and Evaluation. Vineyard Wind will complete the identification and evaluation of historic properties of all portions of the marine archaeological APE not previously surveyed, and prepare a marine archaeological resources assessment report, in accordance with BOEM's Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 C.F.R. Part 585. Vineyard Wind will submit the report and data to BOEM and the report to MASHPO for a review period of no less than 30 days.

B. Avoidance or Additional Investigations of Potential Archaeological Resources and Submerged Ancient Landform Features. Vineyard Wind will either avoid or investigate any potential archaeological resources or submerged ancient landform features identified as a result of the completion of marine archaeological resource identification surveys that will be performed in all portions of the marine archaeological resources APE not previously surveyed. The avoidance or additional investigations will be performed according to the following:

1. Avoidance of Potential Archaeological Resources. Where feasible, Vineyard Wind will avoid any *potential archaeological resource* (i.e., one or more geophysical survey anomalies or targets with the potential to be an archaeological resource, as determined by BOEM) identified as a result of future marine archaeological resource identification surveys by a distance of no less than 300 meters from the known extent of the resource, unless the buffer would preclude the installation of facilities at their engineered locations, but in no event would the buffer be less than 100 meters from the known extent of the resource.

2. Additional Investigation of Potential Archaeological Resources. If Vineyard Wind determines that avoidance of the *potential archaeological resource* is not possible, the

anomaly or target will be investigated and assessed to BOEM's and MASHPO's satisfaction using acceptable methodologies that meet industry standard ground truthing techniques to determine whether it constitutes an identified archaeological resource.

a) Vineyard Wind will submit its investigation methodology to both BOEM and MASHPO with a review period of no less than 30 days, and will incorporate any BOEM and MASHPO feedback on the investigation methodology until BOEM and MASHPO no longer object to the methodology. If either BOEM and MASHPO do not respond within 30 days to either the original or any resubmission of the investigation methodology, Vineyard Wind may assume that entity has no further objection to the methodology.

b) Vineyard Wind will prepare a technical report to document the results of the investigation and assessment and submit it to BOEM and MASHPO with a review period of no less than 30 days. The technical report will be prepared in accordance with any direction provided by MASHPO, either in published guidance or as communicated during review of the investigation methodology.

c) BOEM and MASHPO will review the technical report within 30 days and BOEM will consult with MASHPO on the eligibility of the archaeological resource. If BOEM and MASHPO do not agree, or if the ACHP so requests, BOEM will obtain a determination of eligibility from the Keeper of the National Register pursuant to 36 C.F.R. Part 63.

(1) If BOEM, in consultation with MASHPO, determines that the potential archaeological resource is, in fact, a confirmed archaeological resource eligible for the National Register that would be adversely affected, Vineyard Wind will resolve the adverse effect to the resource by means of avoidance, minimization, or mitigation, in that order. If either BOEM or MASHPO do not respond within 30 days, Vineyard Wind may assume that entity concurs with the findings and recommendations of the report.

(2) If Vineyard Wind cannot avoid the archaeological resource, Vineyard Wind will perform additional investigations to determine eligibility for listing in the National Register of Historic Places. In consultation with the MASHPO, BOEM will plan for involving the public in accordance with 36 C.F.R. § 800.3(e) of the Section 106 review process. BOEM will identify other consulting parties as provided under 36 C.F.R. § 800.3(f), which may include means such as notifications, requests for comments, existing renewable energy task forces, contact with the MASHPO, and communications for these proposed actions.

3. Avoidance of Submerged Ancient Landform Features. Vineyard Wind shall evaluate and determine the feasibility of avoiding *submerged ancient landform features* with the

potential to contain archaeological resources identified as a result of future marine archaeological resource identification surveys, and will avoid as many features as possible unless the avoidance would preclude the installation of facilities at their engineered locations. Vineyard Wind will report its evaluation(s) and determination(s) in accordance with Stipulation III.A.

4. Mitigation of Submerged Ancient Landform Features. If Vineyard Wind determines that avoidance of the *identified submerged ancient landform features* with the potential to contain archaeological resources is not possible, the feature will be subjected to additional mitigations to resolve the adverse effect pursuant to 36 C.F.R. § 800.6. Vineyard Wind will perform the same mitigation that will be used to resolve effects to the 19 known unavoidable submerged landform features, to include conducting additional investigations and development of educational and documentary materials, as discussed in Stipulation II.C, above, and in accordance with Attachment 8 (Treatment Plan for Submerged Ancient Landform Features with the Potential to Contain Pre-Contact Period Archaeological Sites), and the following:

    a) Vineyard Wind will assemble a research team that meets the qualifications of the Secretary of Interior (SOI) and 950 Code of Massachusetts Regulations (CMR) 70.10(1) to undertake the work;

    b) Vineyard Wind will collect up to two additional vibracores in each of the unavoidable submerged landform features;

    c) Vineyard Wind will perform laboratory analyses of subsamples collected from the cores where terrestrial soils were identified (e.g. Carbon 14 dating, bulk geochemical analysis of nitrogen, pollen analysis, and microdebitage analysis, as applicable);

    d) Upon completion of the fieldwork, Vineyard Wind will prepare a professional report of results suitable for technical audiences and submit it to BOEM and MASHPO for a review period of no less than 30 days. This report will comply with regulation 312 CMR 2.09:3, will meet the standards for technical reporting in 950 CMR 70.14, and will also meet the standards described in the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation;

    e) Vineyard Wind will provide Tribal representatives with the opportunity to be present for all stages of work, including core collection, core opening, and core sub-sampling. Vineyard Wind will send formal invitations to the consulting Tribes with schedules for the mitigation study activities. In the interest of collaboration, a communication matrix will be distributed for key team members who are available all the time for consultation, questions, and information requests. Vineyard Wind should hold these meetings in person unless public health or safety considerations warrant remote meetings. The specific timeframe for the consultation process will be

defined in the future, but will include a study kickoff meeting, a pre-field planning meeting, a field mobilization vessel tour, a post-field program core sample review, and a study results meeting;

f) Vineyard Wind will develop educational and documentary materials including a detailed PowerPoint presentation prepared with input from the Tribes for a non-technical audience that provides a description of how the submerged landform study was performed and its results, compile a digital geodatabase for use in open source Geographic Information System (QGIS; freeware) documenting the landform features and the study activities (known boundaries of landforms, core locations), provide assistance to Tribes in configuring their own GIS software on their own computers, and prepare an in-person presentation on the study prepared for non-technical audiences;

g) Vineyard Wind will fund and commence these measures prior to initiation of any offshore ground disturbing project elements included as part of this undertaking, and Vineyard Wind will collect the cores prior to any construction disturbance within 500 meters of the 19 unavoidable submerged ancient landform features in question. All aspects of the treatment plan as described in Attachment 8 (Treatment Plan for Submerged Ancient Landform Features with the Potential to Contain Pre-Contact Period Archaeological Sites) will be completed within five (5) years of the execution of this MOA;

h) Vineyard Wind will submit the final data and results to BOEM, the consulting Tribes, and MASHPO; and

i) If archaeological resources are identified, Vineyard Wind will treat them as a post-review discovery, in accordance with Attachment 10 (Offshore Post Review Discoveries Plans) and Stipulation VII.

C. Mitigation of National Register Eligible Archaeological Resources. For any archaeological resources *determined eligible for listing on the National Register* (i.e., historic properties) under Stipulation III.A, above, Vineyard Wind will complete a Phase III Archaeological Data Recovery mitigation, pursuant to 36 C.F.R. § 800.6. Vineyard Wind will fund and complete these measures prior to initiation of construction of any project elements within 500 meters of the identified resource.

IV. ONSHORE CABLE ROUTE CORRIDOR MONITORING

Vineyard Wind will ensure that a qualified archaeologist performs terrestrial archaeological monitoring during all ground disturbing activities in areas of moderate to high archaeological sensitivity, to include construction activities within the staging areas for the horizontal directional drill or open trenching in the landfall area and during installation of upland cable within the identified zones of high and moderate

archaeological sensitivity along existing roads, as defined by the Vineyard Wind's cultural resource consultant.

A. Vineyard Wind will ensure that their qualified archaeologist for terrestrial archaeological monitoring meets the minimum professional qualifications in archaeology as defined in the *Secretary of the Interior's Standards and Guidelines Professional Qualification Standards* (36 C.F.R. Part 61) and in the Code of Massachusetts Regulations (950 CMR 70.10).

B. Vineyard Wind will perform the archaeological monitoring under a Massachusetts State Archaeologist's Permit pursuant to the 950 CMR 70.00.

C. If previously undiscovered cultural resources are identified during monitoring, Vineyard Wind and/or the qualified archaeologist will implement the post-review discoveries plan in Stipulation VII. Upon completing the archaeological monitoring, Vineyard Wind's cultural resources consultant will draft a technical report, as required by the Massachusetts State Archaeologist's Permit and aligned with the reporting standards described in 950 CMR 70.14. The report will be submitted to the MASHPO for review, comment, and approval. The review period will be no less than 30 days.

V. PROFESSIONAL QUALIFICATIONS

A. Secretary's Standards for Archaeology and Historic Preservation and for Rehabilitation. Vineyard Wind will ensure that all work carried out pursuant to this MOA will meet the Secretary of the Interior's Standards for Archaeology and Historic Preservation (SOI's Standards; https://www.nps.gov/history/local-law/arch_stnds_7.htm), taking into account the suggested approaches to new construction in the SOI's Standards for Rehabilitation.

B. Secretary's Professional Qualification Standards. Vineyard Wind will ensure that all work carried out pursuant to this MOA is performed by or under the direction supervision of historic preservation professionals who meet the Secretary of the Interior's Professional Qualifications Standards. A "qualified professional" is a person who meets the relevant standards outlined in SOI's Standards; https://www.nps.gov/history/local-law/arch_stnds_9.htm. BOEM, or its designee, will ensure that consultants retained for services pursuant to the MOA meet these standards.

C. The Chappaquiddick Island TCP Ethnographic Study and NRHP Nomination

1. Vineyard Wind will ensure that the ethnographic study will be carried out by a professionally qualified cultural anthropologist working in collaboration with THPOs and respective Tribal community members of the consulting Tribes, as well as the non-Federally recognized historic Massachusetts Chappaquiddick Tribe of the Wampanoag Nation in recognition of the fact that they are the cultural bearers of their oral history. Pursuant to the 950 CMR 70.10(1), an interdisciplinary research team should be

developed and include qualified professionals with relevant previous experience in similar projects in Massachusetts and the New England Region. A "qualified professional" is a person who meets the relevant standards outlined in the Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines [As Amended and Annotated] (http://www.nps.gov/history/loca-law/arch_stnds_9.htm)

2. Vineyard Wind will ensure that the NRHP Nomination is prepared by a qualified historic preservation consultant. In the preparation of the nomination, the consultant will solicit and incorporate the views of the consulting Tribes, the non-Federally recognized historic Massachusetts Chappaquiddick Tribe of the Wampanoag Nation, and the Trustees of Reservations. All work will be conducted in a collaborative effort with Tribal representatives participating in the process.

D. The Vineyard Sound-Moshup's Bridge TCP Ethnographic Study and NRHP Nomination

1. Vineyard Wind will ensure that the ethnographic study will be carried out by a professionally qualified cultural anthropologist working in collaboration with THPOs and respective Tribal community members of the consulting Tribes, in recognition of the fact that they are the cultural bearers of their oral history. Pursuant to the 950 CMR 70.10(1), an interdisciplinary research team should be developed and include qualified individuals with relevant previous experience in similar projects in Massachusetts and the New England Region. A "qualified professional" is a person who meets the relevant standards outlined in the Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines [As Amended and Annotated] (http://www.nps.gov/history/loca-law/arch_stnds_9.htm)

2. Vineyard Wind will ensure that the NRHP Nomination is prepared by a qualified historic preservation consultant. In the preparation of the nomination, the consultant will solicit and incorporate the views of the Wampanoag Tribe of Gay Head (Aquinnah) and the Mashpee Wampanoag Tribe into the NRHP Nomination. All work will be conducted in a collaborative effort with Tribal representatives participating in the process.

E. Investigations of Submerged Ancient Landform Features. Vineyard Wind will ensure that the additional investigations of submerged ancient features will be conducted and reports and other materials produced by one or more qualified marine archaeologists and geological specialists who meet the Secretary of the Interior's Professional Qualifications Standards (48 FR 44738- 44739) and has experience both in conducting High Resolution Geophysical (HRG) surveys and processing and interpreting the resulting data for archaeological potential, as well as collecting, subsampling, and analyzing cores.

VI. DURATION

This MOA will expire at the earlier of (1) the cessation of commercial operations in the lease area, as defined in Vineyard Wind's lease with BOEM (Lease Number OCS-A 0501) or (2) 33-years from the date of COP approval. Prior to such time, BOEM may consult with the other signatories to reconsider the terms of the MOA and amend it in accordance with Stipulation X below.

VII. POST-REVIEW DISCOVERIES

A. Implementation of Post-Review Discoveries Plans. If resources are discovered that may be historically significant or unanticipated effects on historic properties are found, Vineyard Wind and BOEM will implement the appropriate post-review discovery plan included as Attachment 9 (Onshore Post Review Discoveries Plan) or Attachment 10 (Offshore Post Review Discoveries Plans) of this MOA.

1. The signatories acknowledge and agree that it is possible that additional historic properties may be discovered during implementation of the undertaking, despite the completion of a good faith effort to identify historic properties throughout the APE.

2. The signatories further acknowledge and agree that potential archaeological resources and submerged ancient landform features identified as a result of phased identification and evaluation activities conducted under Stipulation III, above, are not post-review discoveries.

3. The term 'archaeological materials,' as used throughout this stipulation, includes specimens consisting of all relics, artifacts, remains, objects, or any other evidence of a historical, prehistorical, archaeological, anthropological, or paleontological nature 150 years old or more which may be found below or on the surface of the earth, and which have scientific, historical or archaeological value, including but not limited to objects of antiquity, aboriginal, colonial or industrial relics, and archaeological or paleontological samples (950 CMR 70.04).

4. The term 'archaeological site,' as used throughout this stipulation, is defined as the geographic locus of the material remains of human activity and include any aboriginal mound, fort, earthwork, village, location, burial ground, historic or prehistoric ruin, quarry, cave or other location one hundred and fifty years old or more, which is or may be the source of valuable archaeological data. This data may be significant to national, state or local historical or prehistorical research (950 CMR 70.04).

B. All Post-Review Discoveries. In the event archaeological materials or archaeological sites are encountered prior to or during construction, operation, or decommissioning of the facilities, Vineyard Wind will do the following:

1. Immediately halt all ground-disturbing activities within the area of discovery;

2. Notify BOEM in writing via report within 72 hours of its discovery;

3. Keep the location of the discovery confidential and take no action that may adversely affect the archaeological resource until the BOEM or its designee has made an evaluation and instructs Vineyard Wind on how to proceed; and

4. Conduct any addition investigations as directed by BOEM or its designee to determine if the resources is eligible for listing in the NRHP (30 C.F.R. § 585.802(b)). BOEM will do this if: (1) the site has been impacted by the Vineyard Wind's project activities; or (2) impacts to the site or to the area of potential effect cannot be avoided. If investigations indicate that the resource is potentially eligible for listing the NRHP, BOEM will tell the Vineyard Wind how to protect the resource or how to mitigate adverse effects to the site. If BOEM incurs costs in protecting the resource, under Section 110 (g) of the NHPA, BOEM may charge Vineyard Wind reasonable costs for carrying out preservation responsibilities under the OCS lands Act (30 C.F.R. § 585.802 (c-d)).

C. Onshore Discoveries: In the event of onshore discovery of archaeological materials, Vineyard Wind will ensure that the procedures described in Attachment 9 (Onshore Post-Review Discoveries Plan; The Public Archaeology Laboratory, Inc., 2021) are executed in the event of a potential discovery of archaeological resources.

D. Offshore Discoveries: If Vineyard Wind discovers a potential archaeological resource such as the presence of a shipwreck (e.g. sonar image or visual confirmation of an iron, steel, or wooden hull, wooden timbers, anchors, concentrations of historic objects, piles of ballast rock), prehistoric artifacts, and/or submerged ancient landforms, etc., Vineyard Wind also will ensure that the procedures described in Attachment 10 (Offshore Post-Review Discoveries Plan) are executed.

VIII. MONITORING AND REPORTING

Each year, beginning one year following the execution of this MOA until 5 years from execution of the MOA, Vineyard Wind will provide the signatories to this MOA a summary report detailing work undertaken pursuant to its terms. Such report will include any scheduling changes proposed, any problems encountered, and any disputes and objections received in Vineyard Wind's efforts to carry out the terms of this MOA. Vineyard Wind can satisfy this stipulation by providing the relevant portions of the annual compliance certification required under 30 CFR § 585.633.

IX. DISPUTE RESOLUTION

Should any signatory to this MOA object to any actions proposed under this MOA, or the manner in which the terms of this MOA are implemented, BOEM will consult with such party to resolve the objection. If BOEM determines that such objection cannot be resolved, BOEM will:

A. Forward all documentation relevant to the dispute, including BOEM's proposed resolution, to the ACHP. The ACHP will provide BOEM with its advice on the resolution of the objection within thirty (30) days of receiving adequate documentation. Prior to reaching a final decision on the dispute, BOEM will prepare a written response that takes into account any timely advice or comments regarding the dispute from the ACHP, signatories, and concurring parties, and provide them with a copy of the written response. BOEM will then proceed according to its final decision.

B. If the ACHP does not provide its advice regarding the dispute within the thirty (30) day time period, BOEM may make a final decision on the dispute and proceed accordingly. Prior to reaching such a final decision, BOEM will prepare a written response that takes into account any timely comments regarding the dispute from the signatories and concurring parties to the MOA, and provide them and the ACHP with a copy of such written response.

C. BOEM's responsibility to carry out all other actions subject to the terms of this MOA that are not the subject of the dispute remain unchanged.

X. AMENDMENTS

This MOA may be amended when such an amendment is agreed to in writing by the signatories. The amendment will be effective on the date a copy signed by all of the signatories is filed with the ACHP.

XI. TERMINATION

If any signatory to this MOA determines that its terms will not or cannot be carried out, that party will immediately consult with the other signatories to attempt to develop an amendment per Stipulation X, above. If, within thirty (30) days (or another time period agreed to by the signatories), an amendment cannot be reached, then any signatory may terminate the MOA upon written notification to the other signatories.

Once the MOA is terminated, and prior to work continuing on the undertaking, BOEM will either (a) execute an MOA pursuant to 36 C.F.R. § 800.6 or (b) request, take into account, and respond to the comments of the ACHP under 36 C.F.R. § 800.7. BOEM will notify the signatories as to the course of action it will pursue.

XII. SUBMISSION OF DOCUMENTATION TO MASHPO

All submittals to the MASHPO must be in paper format and delivered to the MASHPO's office by U.S. Mail, delivery service, or by hand. Plans and specifications submitted to the MASHPO must measure no larger than 11"x17" paper format (unless another format is agreed to in consultation). Pursuant to 36 C.F.R. § 800.3(c)(4), the MASHPO must review and comment on all adequately documented submittals within 30 calendar days of the receipt.

XIII. USE OF THIS MEMORANDUM OF AGREEMENT BY OTHER FEDERAL AGENCIES TO MEET THEIR SECTION 106 OBLIGATIONS

In the event that another federal agency not initially a party to or subject to this MOA receives an application for funding/license/permit for the undertaking as described in this MOA, that agency may fulfill its Section 106 responsibilities by stating in writing it concurs with the terms of this MOA and notifying BOEM, MASHPO, ACHP, and Vineyard Wind that it intends to do so. Such agreement will be evidenced by their signature on the agreement, filing with the ACHP, and implementation of the terms of this MOA.

XIV. ANTI-DEFICIENCY ACT

Pursuant to 31 U.S.C. §1341(a)(1), nothing in this Agreement will be construed as binding the United States to expend in any one fiscal year any sum in excess of appropriations made by Congress for this purpose, or to involve the United States in any contract or obligation for the further expenditure of money in excess of such appropriations.

Execution of this MOA by BOEM, the MASHPO, and the ACHP, and implementation of its terms evidence that BOEM has taken into account the effects of this undertaking on historic properties and afforded the ACHP an opportunity to comment.

[SIGNATURES COMMENCE ON FOLLOWING PAGE]

SIGNATORIES:

Bureau of Ocean Energy Management

AMANDA LEFTON Digitally signed by AMANDA LEFTON Date: 2021.04.29 12:32:19 -04'00' Date

Amanda Lefton, Director

Massachusetts State Historic Preservation Officer

Brona Simon Date May 4, 2021

Brona Simon, State Historic Preservation Officer

Vineyard Wind, LLC

Date May 4, 2021

Rachel J. Pachter
Chief Development Officer

Advisory Council on Historic Preservation

 Date May 7, 2021

Reid Nelson, Acting Executive Director

ATTACHMENT 1 – DESCRIPTION OF THE AREA OF POTENTIAL EFFECT

1.0 Introduction

Bureau of Ocean Energy Management (BOEM) defines the area of potential effect (APE) for approval of the Construction and Operations Plan (COP) to include the following geographic areas:

- The depth and breadth of the seabed potentially impacted by any bottom-disturbing activities, constituting the marine archaeological resources portion of the APE;
- The depth and breadth of terrestrial areas potentially impacted by any ground disturbing activities, constituting the terrestrial archaeological resources portion of the APE;
- The viewshed from which renewable energy structures, whether located offshore or onshore, would be visible, constituting the viewshed portion of the APE; and
- Any temporary or permanent construction or staging areas, both onshore and offshore, which may fall into any of the above portions of the APE.

These are described below in greater detail with respect to the proposed activities.

2.0 Marine Archaeological Resources APE

The depth and breadth of the seabed potentially impacted by any bottom-disturbing activities, constituting the marine archaeological resources portion of the APE, includes a conservative project design envelope (PDE) that can accommodate a number of potential designs, whether monopile or jacketed foundations are used, installed by one or two heavy lift or jack-up vessel(s). This PDE includes a maximum expected vertical depth of disturbance for each wind turbine generator (WTG) and/or electric service platform (ESP) monopile structure of approximately 20 to 45 meters (m) (66 to 148 feet [ft]), with a diameter of approximately 7.5 to 10.3 m (25 to 34 ft). The seabed surface would have an additional scour protection radius of approximately 22 to 26 m (72 to 85 ft) around the base of each WTG foundation. A jacketed WTG structure would penetrate the seabed approximately 30 to 60 m (98 to 197 ft), have a footprint of approximately 18 to 35 m (59 to 148 ft), and have a scour protection radius of approximately 20 to 24 m (65 to 79 ft). A jacketed ESP structure would penetrate the seabed approximately 30 to 75 m (98 to 246 ft), have a footprint of approximately 18 to 45 m (59 to 148 ft), and have a scour protection radius of approximately 20 to 28 m (65 to 92 ft) (BOEM 2021).

During construction of the WTGs and ESPs, jack-up vessels may be employed. The horizontal APE is a diameter around the implanted structure that may be disturbed and is anticipated to be between 200 and 250 m (656 and 820 ft). The vertical depth of disturbance is considered to be less than the monopile and jacketed foundation depth described above. Anchoring activities, if required, would be confined within the Offshore Export Cable Corridor (OECC), which is typically 810 m (2,657 ft) wide but ranges up to 1,000 m (3,280 ft) wide in some areas where more maneuverability may be required. Anchored vessels will not be employed as primary construction and installation vessels in the Wind Development Area (WDA). Any anchoring activities that take place within the WDA will be confined to the APE and any disturbance to the seabed floor from vessel anchors is expected to be limited to 3 m or less (Epsilon Associates, Inc. 2019). The vertical disturbance to the seabed from vessel anchors is expected to be less than 3 m (10 ft). Many deep-water operations are anticipated to make use of dynamically positioned

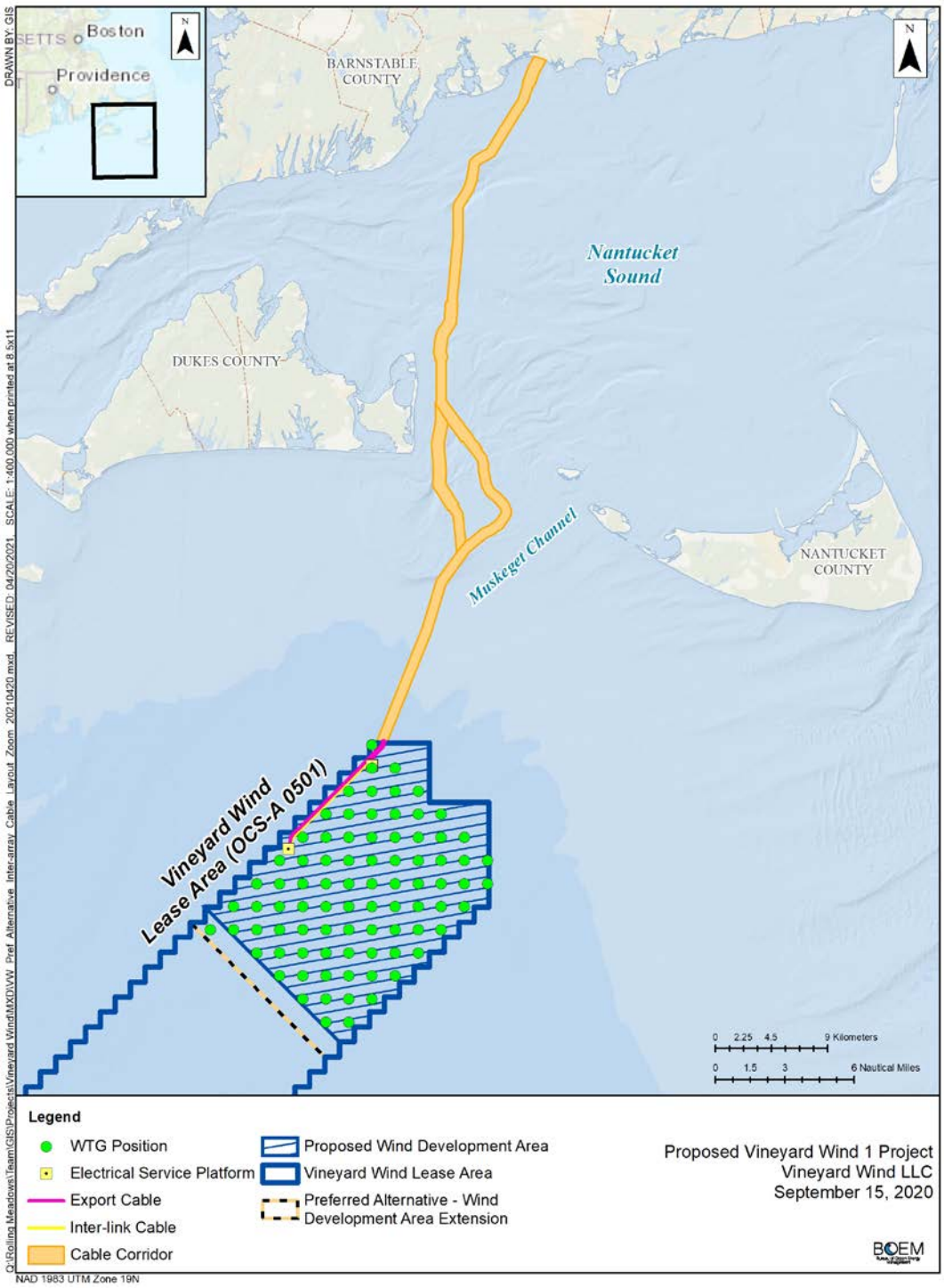
vessels with no anticipated seabed or subsurface impact. Figure 1 depicts the marine archaeological resources APE for activities within the WDA portion of the lease area.

Cabling of the proposed Project is expected to use two or more methods with different bottom disturbances, including installation by jet plow, as well as by a vertical injector installation tool in most locations, which has a narrower width of disturbance than a jet plow, and thus reduces seabed impacts. The primary vertical impact from the cable installation occurs over a 1 m (3.3-ft) wide cable installation trench projected to range between 1.5 and 2.5 m (5 and 8 ft) deep. Minor disturbance may occur from up to 1 to 2 m (3.3-6.6 ft) wide from the tracks or skids of the cable installation equipment. A dredge/ trenching device is included in the COP for some sections of the route but is not expected to be necessary given the planned use of the vertical injector (Epsilon Associates, Inc. 2020, Volume I). If used, the dredge may excavate a 20 m (66 ft) wide corridor to a depth of 4.5 m (14.7 ft) prior to cable installation and cast dredged material within the OECC. If used, it is anticipated that dredging would occur along the OECC until the hopper was filled to an appropriate capacity. The dredging device would then sail several hundred meters away (while remaining within the 810 m [2,657 ft] corridor) and bottom dump the dredged material. In areas with difficult seabed conditions where full cable burial is hard to achieve, cable protection (such as concrete mattresses, rock placement or half-shell pipes [or similar]) may overlay the cable. The maximum dimensions of the protective covering are expected to be a 9 m (29.5 ft) swath, 4.5 m (15 ft) to each side of the cable. Figure 2 depicts the marine archaeological resources APE for activities within the cable route.

According to 30 C.F.R. Part 585 and other BOEM requirements, Vineyard Wind would be required to remove or decommission all installations and clear the seabed of all obstructions created by the proposed Project. All facilities would need to be removed 15 ft (4.6 m) below the mudline (30 C.F.R. § 585.910(a)). Under these requirements, Vineyard Wind would have to complete decommissioning within 2 years of termination of the lease and either reuse, recycle, or responsibly dispose of all materials removed.

3.0 Terrestrial Archaeological Resources APE

The APE for terrestrial archaeological resources includes areas potentially impacted by any ground disturbing activities associated with the construction and operation of the proposed Project. The APE is presented as a conservative PDE and includes the landfall site, underground cable routes, the substation site, and equipment laydown areas. The depth and breadth of potential ground disturbing activities is described below for each location. Figure 3 depicts the terrestrial archaeological resources APE for the landfall site in detail. Figure 4 depicts the terrestrial archaeological resources for the landfall site, onshore cable route, and onshore substation site.



Note: The final inter-array cable layout and location of the cables would be located within the approved PDE. The up to 84 WTGs would be located within 100 of 106 locations presented as part of the Vineyard Wind PDE, and the cable route from the WDA to Covell's Beach would follow one of two options through Muskeget Channel.

Figure 1. Marine Archaeological Resources APE for Activities within the Lease Area

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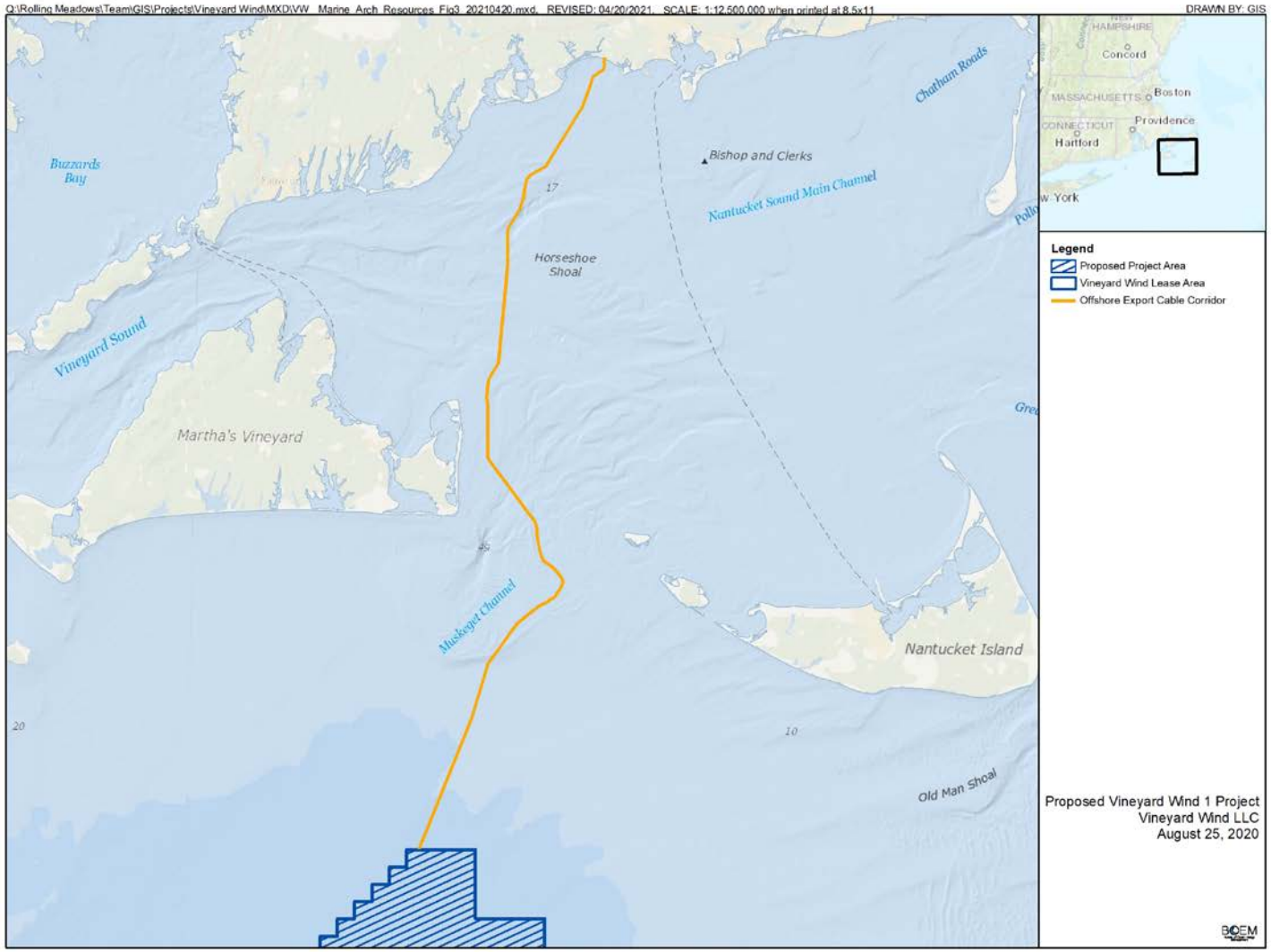
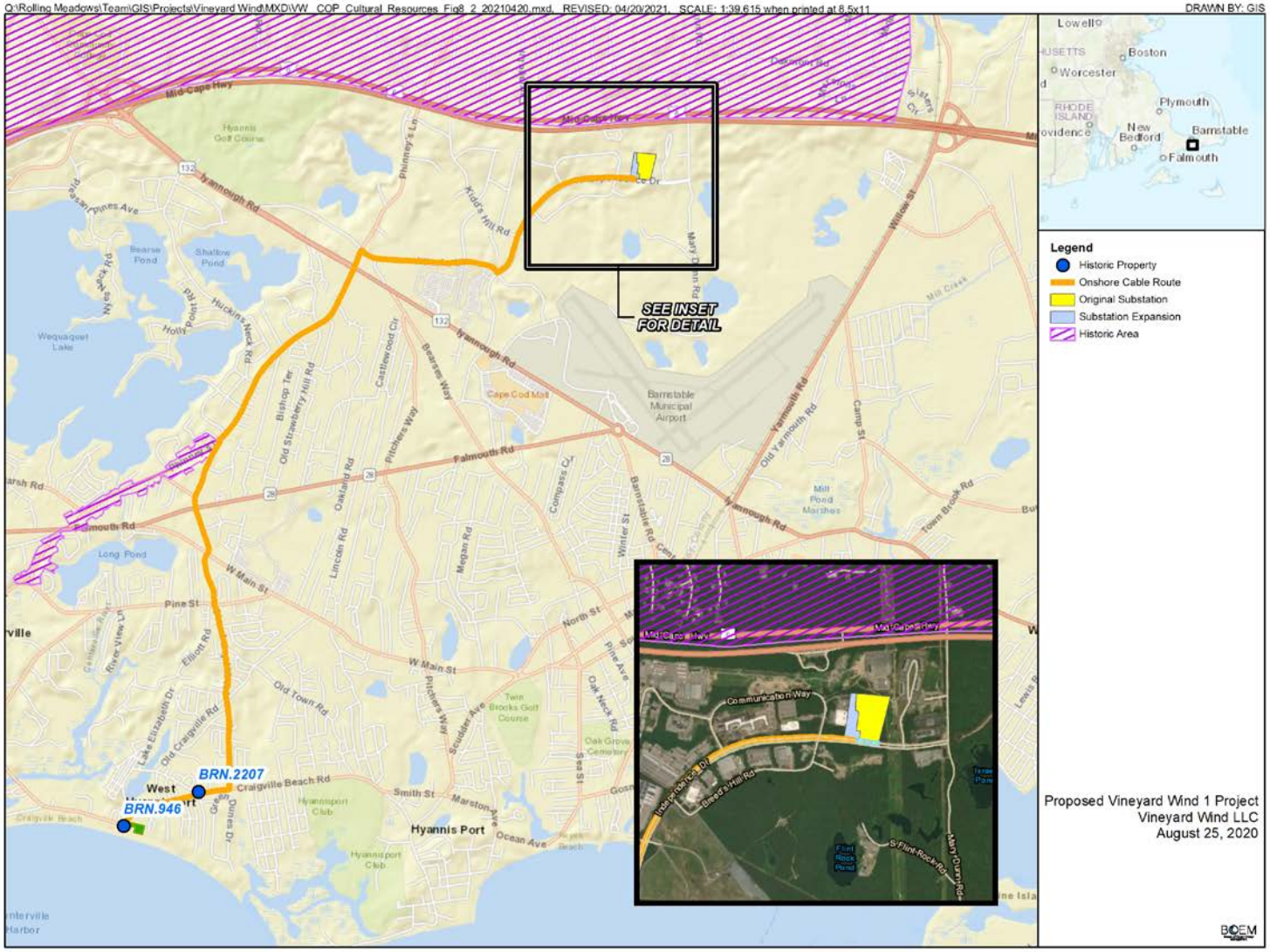


Figure 2. Marine Archaeological Resources APE for Activities within the Cable Route

Figure 3. Terrestrial Archaeological Resources APE for Covell's Beach Landfall Site



Note: Archaeological resources are not depicted as that information is privileged and confidential.

Figure 4. Overview of Terrestrial Archaeological Resources APE

3.1 Covell's Beach Landfall Site

The APE for the Covell's Beach landfall site is specified as follows. At the Covell's Beach landfall site, the horizontal directional drilling (HDD) rig and its supporting equipment would occupy approximately 0.8 acre of the paved staging area in the eastern end of the 2-acre Covell's Beach parking lot. The following proposed Project elements would require excavation into the parking lot:

- At the upper end of the parking lot, two transitional cable joint bays (one per landfall power cable), each approximately 6 m wide by 18.9 m long (20 ft wide by 62 ft long) by 2 m (6.5 ft) deep.
- Immediately adjacent to each joint bay, two fiber optic cable vaults (one fiber optic cable per landfall power cable), each approximately 1.8 m (6 ft) long by 1.2 m (4 ft) wide by1.5 m (5 ft) deep.
- Approximately 9.1 m (30 ft) from the seaward edge of the parking lot, two HDD entry pits (one per landfall cable duct), each approximately 1.5 m (5 ft) wide by 1.5 m (5 ft) long by 1 m (3.3 ft) deep.
- From each temporary HDD entry pit, a 46 to 76 centimeters (cm) (18 to 30 inches) diameter high-density polyethylene (HDPE) pipe with a ground-disturbance diameter of 91 cm (36 inches) would be installed via HDD for use in housing the export cables, which would intersect with the onshore cable route. HDPE conduits would run beneath the parking lot, beach, and intertidal zone, emerging at an exit point approximately 305 m (1,000 ft) offshore. The HDD conduit would be approximately 6.7 m (22 ft) beneath the middle of the beach. At its deepest point, the conduit would be approximately 9.1 m (30 ft) below the seafloor.
- Between the HDD entry pit and the joint bay, the two export cables would be installed in open trenches measuring approximately 1.8 m (6 ft) in depth, 1.2 m (4 ft) in width at the bottom, and 2.4 m (8 ft) in width at the top.

After the export cables leave the two joint bays, they would be housed inside the proposed concrete encased duct bank of eight ducts in a 4 x 2 array (six for cables + two spares). Overall, concrete duct bank width would be 1.5 m (5 ft) and overall duct bank height would be 0.8 m (2.5 ft). The duct bank leaving Covell's Beach would be installed with 0.9 m (3 ft) of cover in an open trench with approximate trench depth of 1.7 m (5.5 ft) and approximate trench width (at the top) of 3 m (10 ft). The duct bank would leave the paved parking area and cross a short segment of unpaved area between Craigville Beach Road and the northwest corner of the parking lot. The duct bank would then follow roadways; the dimensions would be as described below under the sections discussing the onshore cable routes.

3.2 Onshore Cable Route

The APE for the onshore cable route associated with the Covell's Beach landfall site is the Town of Barnstable right-of-way (ROW) along the proposed onshore cable route. As described further below, the disturbance within the ROW would be 3.4 m (11 ft) wide and 2.4 m (8 ft) deep for the typical trench width to install the duct bank, or up to 4.3 m (14 ft) wide and 3.7 m (12 ft) deep where splice vaults are necessary. Both the duct bank and the splice vaults may be installed anywhere within the Town of Barnstable ROW; therefore, the entire ROW along the Onshore Export Cable Route (OECR) is considered the APE, although only a portion of the ROW would actually be disturbed.

The proposed underground cable route would be installed within HDPE or polyvinyl chloride pipes or sleeves encased in concrete duct banks connecting from the Covell's Beach Landfall site to the substation site. The proposed duct banks would be formed using cast-in-place concrete installed in open trenches measuring approximately 2.4 m (8 ft) in depth, 1.8 m (6 ft) in width at the bottom, and 3.4 m (11 ft) in width at the top. Existing conditions within paved roadways would dictate the orientation of the duct bank, which would be either 0.8 m (2.5 ft) wide by 1.5 m (5 ft) deep or 1.5 m (5 ft) wide by 0.8 m (2.5 ft) deep. In locations where splice vaults are necessary, the excavated area would be larger, approximately 4.3 m (14 ft) wide by 15.2 m (50 ft) long and 3.7 m (12 ft) deep, to accommodate pre-cast concrete splice vaults, which typically are 2.9 m (9.5 ft) wide by 10.8 m (35.5 ft) long and up to 2.9 m (9.5 ft) deep (outer dimensions). Thus, the maximum extent of disturbance within the APE (the Town of Barnstable ROW along the onshore cable route) is 4.3 m (14 ft) wide and 3.7 m (12 ft) deep.

3.3 Substation Site

The APE for the substation site is 8.1 acres of the total 8.6-acre site with a maximum ground disturbance of 4.6 m (15 ft) below the high peak of existing grade for the entirety of the roughly 8.1-acre area. Approximately 8.1 acres of the substation site would be cleared and graded; this proposed land clearing is limited only to what is needed to accommodate the substation. To complete finished site grades and to balance earth cuts and fills, several retaining walls would be required and excavation for and construction of these walls would be required as part of completing the site grading effort.

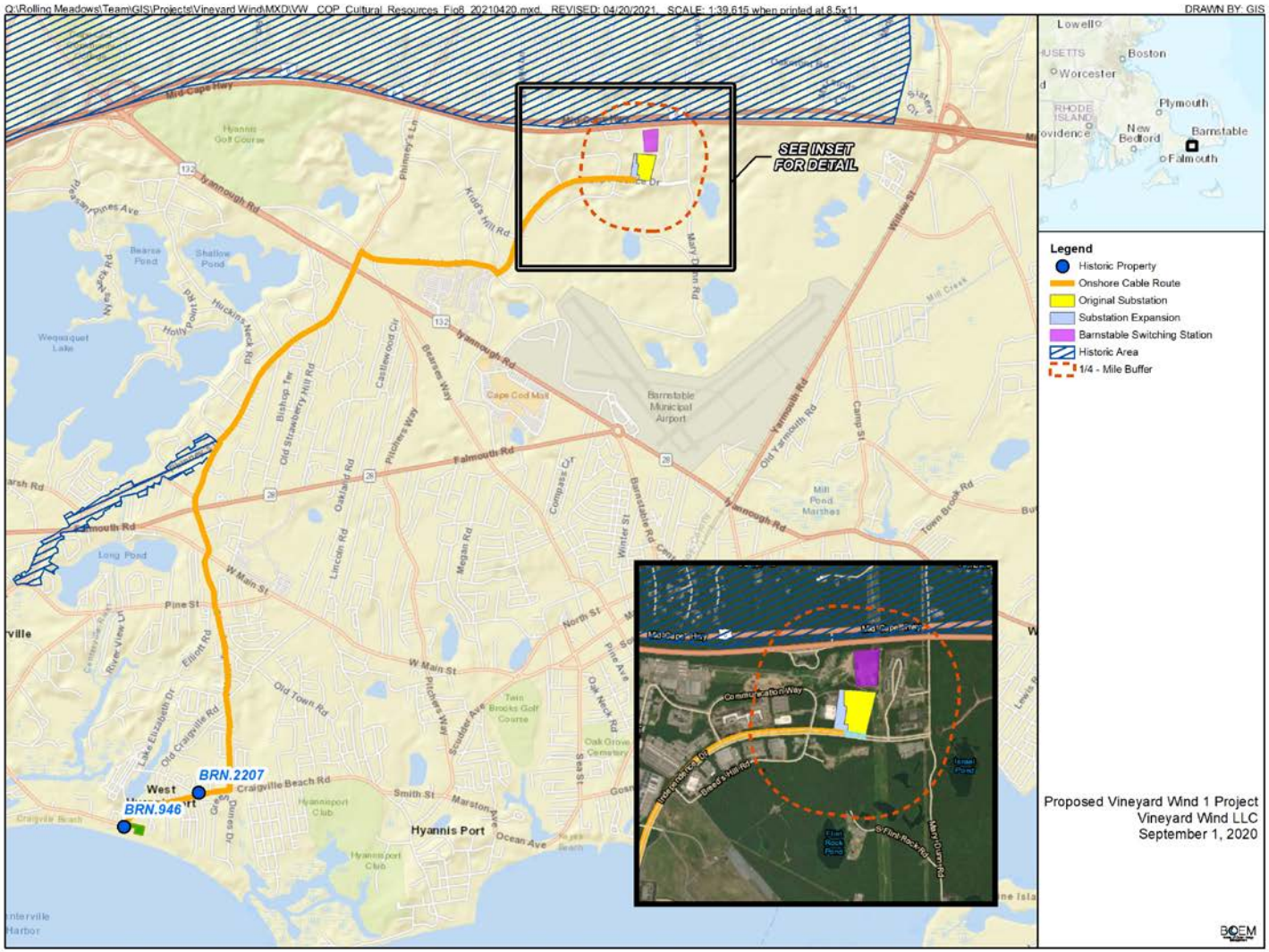
Construction at the substation site would also require excavation of areas required for major component foundations/footings and full volume containment, excavation of the drainage swales and basins required for site drainage, and excavation of the trench for the portions of the duct bank within the substation site.

3.4 Equipment Laydown and Staging Areas

Equipment laydown and staging areas would be set up along the proposed routes. As mentioned previously, for the Covell's Beach landfall site, the HDD rig and its supporting elements would be set up using an approximately 0.8-acre staging area in the eastern end of the 2-acre paved Covell's Beach parking lot. Additional staging areas may be necessary along the OECR. Any additional staging areas would either be paved or, if unpaved, would be at previously established, well-known staging areas that are already used to support construction projects. Within these established staging areas, no excavation or vegetation clearing would be required. It is expected that if additional staging areas are used, they would temporarily store items such as typical roadway construction equipment (excavators, backhoes, dump trucks, etc.), lengths of pipe, framing/support materials, etc. Any additional unpaved staging areas used would be existing, previously established staging areas that are used for multiple projects. Therefore, these staging areas would not be considered part of the terrestrial archaeological resources APE for the Project.

4.0 Viewshed APE

The viewshed from which renewable energy structures—whether located offshore or onshore—would be visible, constitutes the viewshed portion of the APE. Onshore, the viewshed APE includes a 0.25 mi boundary around the proposed onshore substation site (Figure 5); all other elements would be underground and would not be visible.



Note: MACRIS data shown as of August 20, 2020, only historic properties within the APE.

Figure 5. Onshore viewshed APE, Including 0.25-mile Boundary around Proposed Substation Site

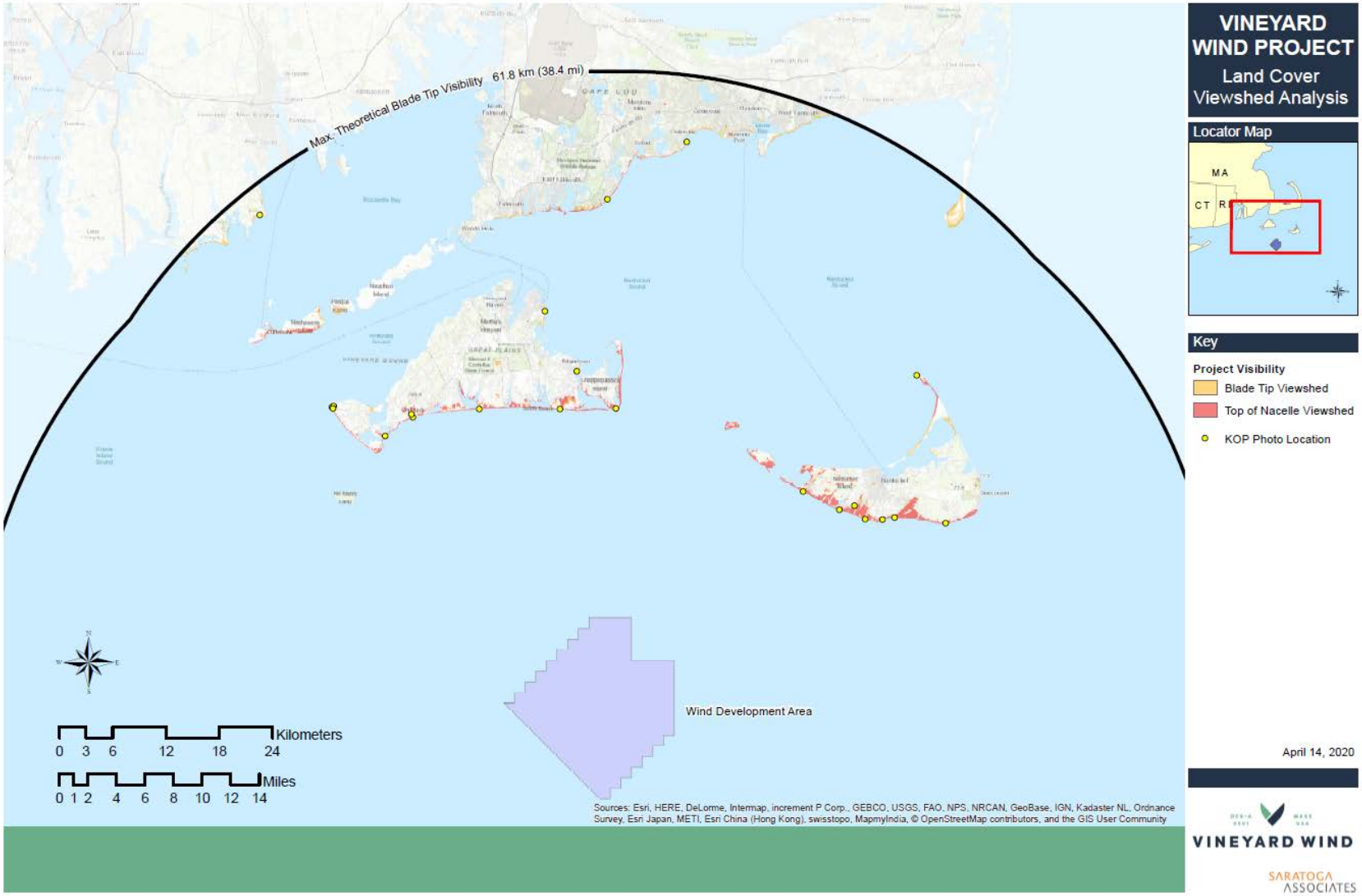
Offshore, the viewshed APE (Figure 6) includes a boundary of 61.8 km (38.4 mi) around the WDA, conservatively determined as the distance at which no part of the WTGs would be visible due to the Earth's curvature and horizon line. This was based on an undertaking that uses 57, 14 MW WTGs, each of which with a maximum height of the blade tip of approximately 255 m (837 ft) and a 1.8 m (6 ft) observer height at the shoreline. At 61.8 km (38.4 mi), a target height of 255 m (837 ft) would be below the horizon line. At 1.8 m (6 ft) in height, an observer at the shoreline would perceive the horizon at 4,828 m (3 mi). With the height of 255 m (837 ft), a 61.8 km (38.4 mi) radius would ensure the entirety of the offshore structures would be below the horizon line.

In January 2021, Vineyard Wind selected the General Electric (GE) Haliade X WTG for this undertaking. As such, the maximum WTG tip height designed specifically for this undertaking will be less than the 255 meters (m; 837 ft]) examined for the viewshed analysis, and reduced to 247.5 m (812 ft) above mean low water line at the maximum vertical extension of the WTG blade (Figure 1). Each GE Haliade-X for this Project has a nameplate capacity of 13MW, and the Project would consist of up to 84 GE Haliade-X WTGs.

Environmental conditions such as wave height, fog, rain, haze, and other factors were not considered in this calculation, but would serve to further limit visibility. The more visually substantial elements of the assemblies (the tower and nacelle) would extend to 496 ft (151 m) above mean low water line; these elements would be entirely below the horizon line at a distance of approximately 48.8 km (30.3 mi) for an observer situated on the shoreline.

The APE was refined for island coastal areas through Geographic Information System (GIS) viewshed analysis, and is shown on Figures 3, 4, 5, and 6 herein. These areas of potential visibility "were then generated using a [GIS] viewshed calculation, which identifies the geographic area where a direct line of sight exists to the blade tip considering the curvature of the earth (with atmospheric refraction) and accounting for obstructions including topography, built, structures, and vegetation." It is important to note that the Historic Properties Visual Impact Assessment (VIA) (Epsilon Associates, Inc. 2020, COP Volume III, Appendix III-H.b) area of impact identifies where there is a theoretical line of sight to the Project and does not identify the degree to which the Project may be visible, if at all, or the number of WTGs that may be visible from any affected location. "The VIA area of impact also does not consider the mitigating factors of atmospheric visibility, the limits of visual acuity, and ocean waves, or the reduction in apparent size of the WTG over increasing distance" (Epsilon Associates, Inc. 2020, COP Volume III, Appendix III-H.b).

As described above, the undertaking would allow for up to 84 WTGs to be installed in the 106 originally proposed positions, would eliminate six of the potential WTG positions in the northern-most portion of the Project area, and would require that the WTG layout be arranged in an east-west orientation with all WTGs spaced at a minimum of 1 nm apart. The undertaking would reduce the visual impact of the Project as well as the potential conflicts with existing ocean uses that include navigation and commercial fishing. Although the undertaking would allow up to 84 WTGs, the evaluation of visual effects is based on an undertaking that uses the tallest (and therefore the most potentially visually impactful) WTGs proposed by Vineyard Wind: 57, 14 MW WTGs.



(Epsilon Associates, Inc. 2020)

Figure 6. Offshore Viewshed APE and Distance from Various Landmarks

ATTACHMENT 2 – LIST OF CONSULTING PARTIES

The following is a list of consulting parties to the National Historic Preservation Act (NHPA) Section 106 review of the Vineyard Wind 1 Project. Some of the parties consulted over the course of the NHPA Section 106 review have voluntarily withdrawn from further participation in the consultation, as indicated by the withdrawal date in parenthesis for each of those parties.

- Advisory Council on Historic Preservation
- Alliance to Protect Nantucket Sound
- Cape Cod Commission
- Non-Federally Recognized Historic Massachusetts Chappaquiddick Tribe of the Wampanoag Nation
- Delaware Tribe of Indians
- Gay Head Light Advisory Board
- Maria Mitchell Association (Dark Skies Initiative) (withdrew August 27, 2020)
- Mashantucket Pequot Tribal Nation
- Mashpee Wampanoag Tribe
- Massachusetts Board of Underwater Archaeological Resources
- Massachusetts Commission on Indian Affairs
- Massachusetts Historical Commission
- Mohegan Tribe of Indians of Connecticut
- Nantucket Conservation Foundation
- Nantucket Historical Association
- Nantucket Historical Commission (withdrew September 10, 2020)
- Nantucket Historic District Commission (withdrew September 10, 2020)
- Nantucket Planning and Economic Development Commission (withdrew September 10, 2020)
- Nantucket Preservation Trust (withdrew August 27, 2020)
- Narragansett Indian Tribe
- National Park Service
- Preservation Massachusetts
- Rhode Island Historical Preservation & Heritage Commission
- Shinnecock Indian Nation
- Town and County of Nantucket (withdrew August 27, 2020)
- The Trustees of Reservations
- US Army Corps of Engineers
- Vineyard Power Cooperative

Vineyard Wind Construction and Operations Plan Offshore Massachusetts Memorandum of Agreement, Attachment 2

- Vineyard Wind, LLC
- Wampanoag Tribe of Gay Head-Aquinnah

ATTACHMENT 3A – TURBINE SPECIFICATIONS

1.0 Introduction

In its Construction and Operations Plan (COP), Vineyard Wind LLC (Vineyard Wind) is proposing the construction, operation, and eventual decommissioning of an up to 800-MW wind energy project consisting 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 and maintenance facilities (Epsilon Associates, Inc. 2020, Volume I). The description of the undertaking remains unchanged from and is described in greater detail with respect to the proposed activities in Bureau of Ocean Energy Management's (BOEM) Finding of Adverse Effect, available at: https://www.boem.gov/sites/default/files/documents/oil-gas-energy/Vineyard-Wind-Finding-of-Adverse-Effect.pdf.

On January 22, 2021, Vineyard Wind resubmitted its COP to BOEM, along with detailed design information concerning their selected General Electric (GE) Haliade-X WTG. In its letter, Vineyard Wind asserted that the selected WTG parameters fall within the PDE analyzed in the Supplement to the Draft Environmental Impact Statement (SEIS) (BOEM 2020a), the Section 106 Finding of Adverse Effects (BOEM 2020b), and the COP, along with its supporting materials. These include, but are not limited to, viewshed assessments and visual simulations, a Visual Impact Assessment (VIA), and multiple terrestrial and marine archaeological resources assessment reports. Vineyard Wind requested that BOEM resume its environmental review of the COP on that basis. Additional information on the Vineyard Wind 1's undertaking is available at: https://www.boem.gov/vineyard-wind.

BOEM has independently reviewed the submitted information and has concluded that the relevant parameters of the Vineyard Wind 1 GE Haliade-X, as documented in Vineyard Wind's letter, fall within the parameters of the previously assessed PDE as presented in the SEIS and in the Finding of Adverse Effects. Although GE's website depicts maximum possible tower height parameters for the Haliade-X, the design that would be used for this particular undertaking does not utilize the maximum tower height. The maximum WTG tip height designed specifically for this undertaking will be reduced from 255 meters (m; 837 ft]) to 247.5 m (812 ft) above mean low water line at the maximum vertical extension of the WTG blade (Figure 1). Each GE Haliade-X for this Project has a nameplate capacity of 13MW, and the Project would consist of up to 84 GE Haliade-X WTGs.

BOEM has required Vineyard Wind to include three design measures to help mitigate Vineyard Wind 1's effects to historic properties. These are discussed below:

1.1 Turbine Placement

BOEM is requiring Vineyard Wind to install no more than 84 WTGs and omit the instillation of six of the northeastern most turbine locations in the proposed layout, in order to reduce visual impacts on the Nantucket National Historic Landmark (NHL; NAN.C/D). Although the impact significance level would

not be changed, not using these turbine placement options would marginally reduce the Vineyard Wind 1's overall visual impacts on the Nantucket NHL (NAN.C/D).

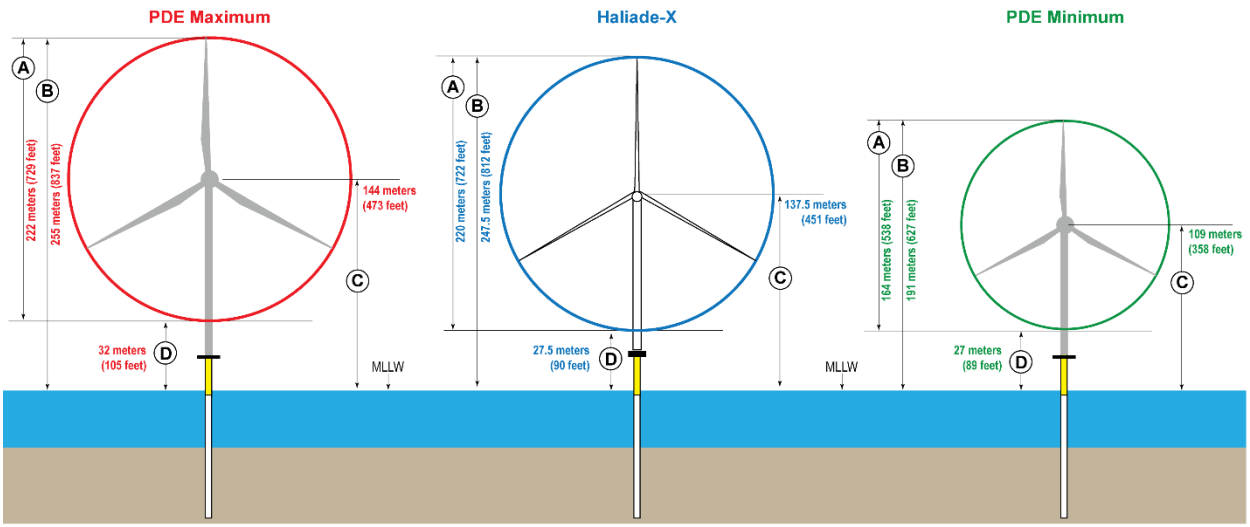
1.2 Lighting

Vineyard Wind has agreed to install an Aircraft Detection Light System (ADLS) to reduce nighttime lighting. The system would activate aviation warning lights only when an aircraft is in the vicinity of the Wind Development Area (WDA), lessening the expected minor long term impacts on the Nantucket NHL (NAN.C/D) and Gay Head Light (GAY.900) by reducing the amount of time WTGs would be visible at night (estimated less than four (4) hours annually, or 0.1 percent of annual nighttime hours).

1.3 Color Scheme

Vineyard Wind has committed to paint the wind turbines an off white/grey color (no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey) to reduce visual impacts during daylight hours on historic properties.

This will not change the impact significance level, but will aid in reducing contrast against the sky for Nantucket NHL (NAN.C/D), Gay Head Light (GAY.900), and Vineyard Sound and Moshup's Bridge Traditional Cultural Property.



	PDE Maximum	Haliade-X	PDE Minimum
A = Rotor Diameter	222 meters (729 feet)	220 meters (722 feet)	164 meters (538 feet)
B = Total Blade Tip Height above MLLW	255 meters (837 feet)	247.5 meters (812 feet)	191 meters (627 feet)
C = Hub Height above MLLW	144 meters (473 feet)	137.5 meters (451 feet)	109 meters (358 feet)
D = Tip Clearance during Operation Above MLLW	32 meters (105 feet)	27.5 meters (90 feet)	27 meters (89 feet)

Figure 1: Schematic comparing dimensions and parameters of the assessed PDE with the dimensions and parameters of the selected Vineyard Wind 1 GE Haliade-X turbine

ATTACHMENT 3B - AIRCRAFT DETECTION LIGHTING SYSTEM TECHNICAL SPECIFICATIONS AND DESIGN INFORMATION

Please refer to the attached document for the proposed aircraft detection lighting system technical specifications and design information.

VINEYARD WIND

Aircraft Detection Lighting System Technical Specifications and Design Information

Table of Contents

VINEYARD WIND

Aircraft Detection Lighting System Technical Specifications and Design Information

Prepared by Vineyard Wind

September 16, 2020

Revised April 20, 2021 (To Include Aviation Obstruction Lighting Plans)

The Federal Aviation Administration (FAA) has approved Aircraft Detection Lighting Systems (ADLS) from multiple vendors. Vineyard Wind has worked closely with FAA-approved ADLS technology supplier Terma and provides the following information.

ADLS uses radar surveillance systems to track aircraft transiting in proximity to the Wind Development Area (WDA). Terma's proposed ADLS for the Project included two radars using an 18 ft high gain (HG) antenna mounted on the transition piece of two WTGs (see the schematic and technical drawing provided as Attachment 1). An example layout for the radars is provided as Attachment 2. If an aircraft is detected by the radar within a predetermined range from the WDA, the ADLS activates the WTG's FAA aviation obstruction lights. As described in Vineyard Wind's Construction and Operations Plan (COP) Volume I and the Historic Properties Visual Impact Assessment (Appendix III-H.b), per FAA guidance, the aviation obstruction lighting system will consist of two synchronized FAA "L-864" red flashing lights (2,000 candelas) mounted on top of the nacelle of each constructed WTG and the ESPs (if needed). Since the WTGs' total tip height is 699 ft or higher, there will be up to four additional low intensity L-810 flashing red lights (25 candelas) at a point approximately midway between the top of the nacelle and sea level. Design plans for the aviation obstruction lighting on the WTGs and ESP are provided in Attachment 3. If approved by BOEM and the FAA, the lights will flash 30 times per minute. Once the aircraft has departed the area, the lights are deactivated by the system. As previously noted, nighttime air traffic across the project area is extremely low and therefore the ADLS is expected to activate less than 4 hours a year.

Failures of the ADLS are expected to occur very infrequently. Terma's performance specifications indicate that the system is expected to be operational 99.93% of the time or more and, on average, a repair is expected to take one hour. Per FAA guidance, if the ADLS fails, the ADLS would turn on the flashing aviation obstruction lights (either all lights or only the lights specifically affected by the component failure) until the system's functions are restored. Terma's fail-safe backup systems are further described in FAA's *Performance Assessment of the Terma Obstruction Light Control System as an Aircraft Detection Lighting System* (see Attachment 4, page 4).

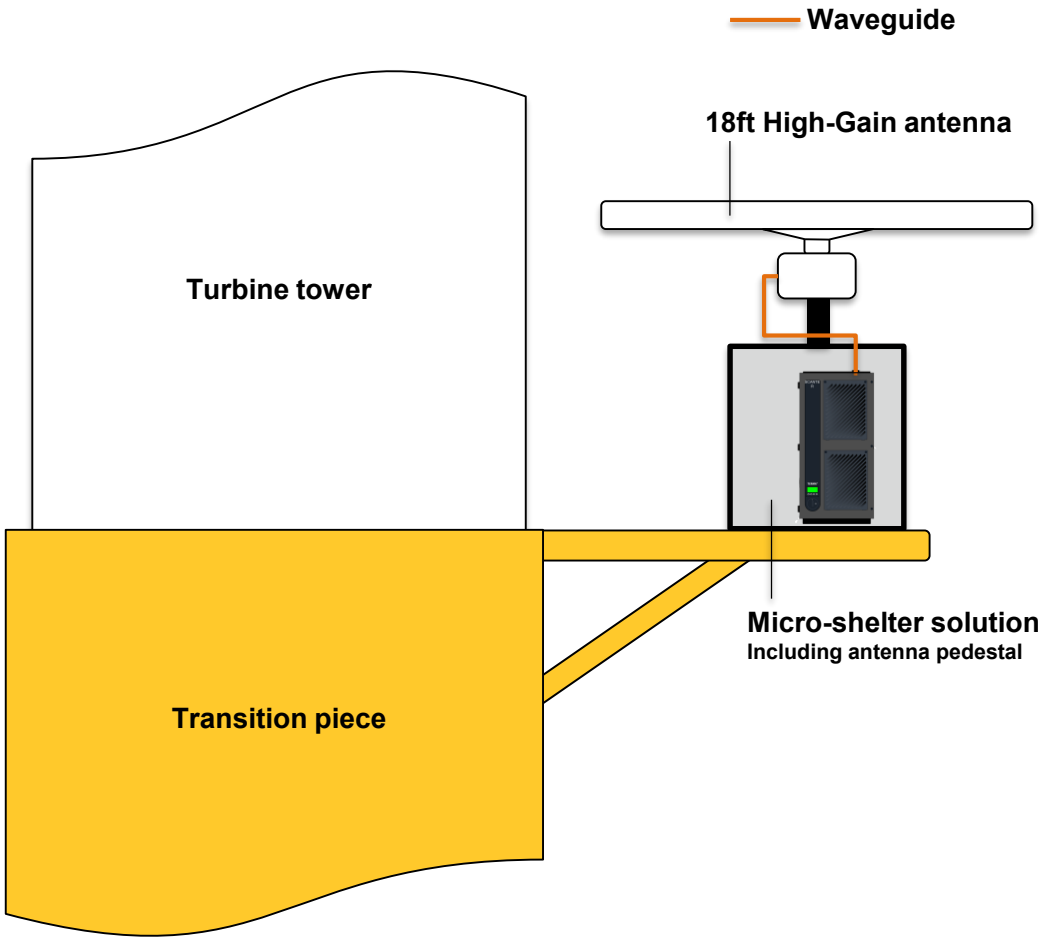
Vineyard Wind's technicians will monitor the status of the system 24 hours a day, seven days a week. If a failure occurs, Vineyard Wind's WTG technicians will perform the repairs during their daily trips to the WDA. Vineyard Wind will store most frequently used spares for the system so that they are readily available if a failure occurs. Overall, Vineyard Wind expects to be able to readily resolve the very limited system failures. Whether the lighted wind turbines will be visible during a failure will depend upon the number of lights affected by the failure, the location of the observer, and the visibility based on weather. Nevertheless, with a 99.93% operational rate, the overall contribution of any failure to the total hours the lights would be on is minimal.

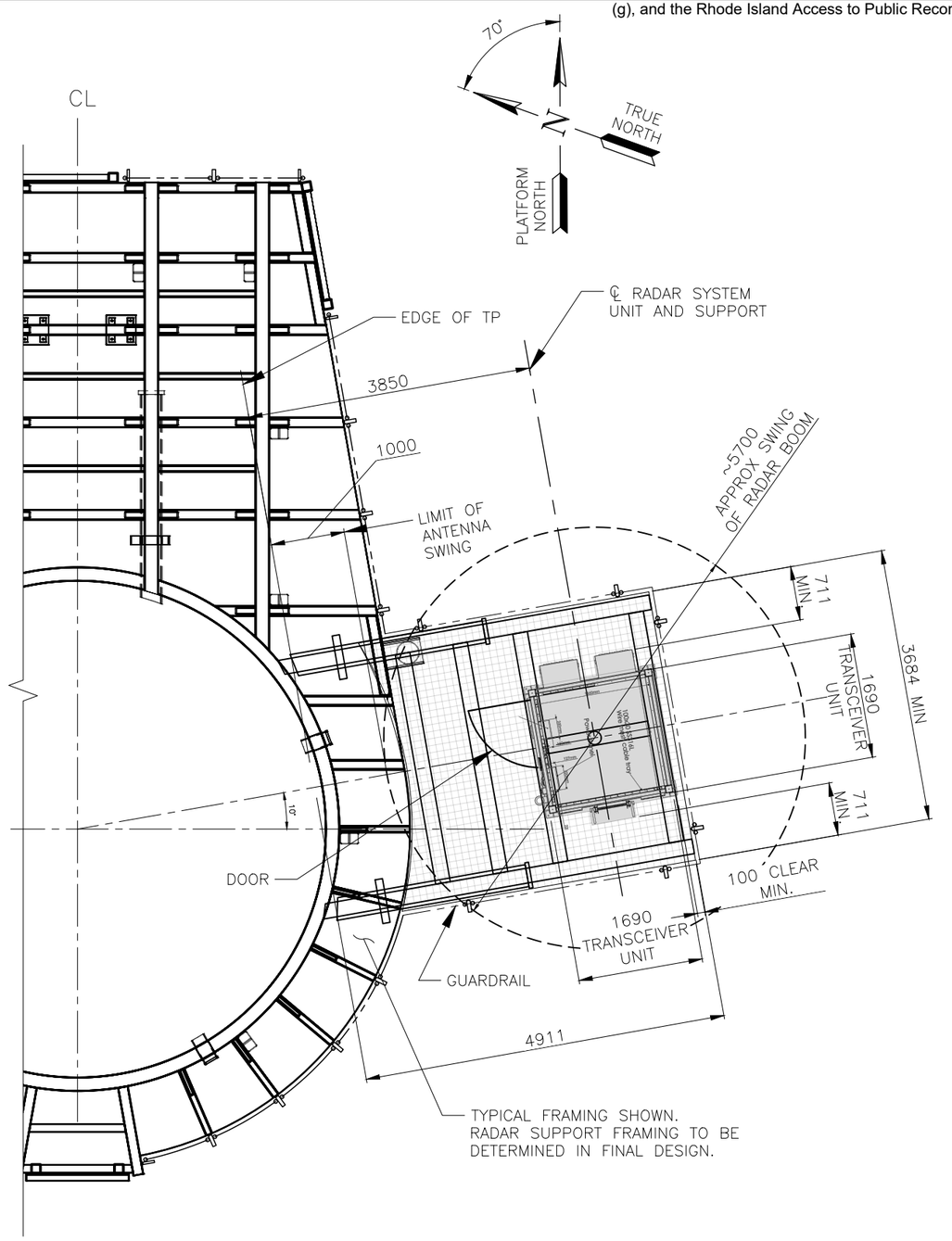
VINEYARD WIND

Attachment 1 Example ADLS Schematic and Technical Drawing

ADLS Transceiver and Antenna

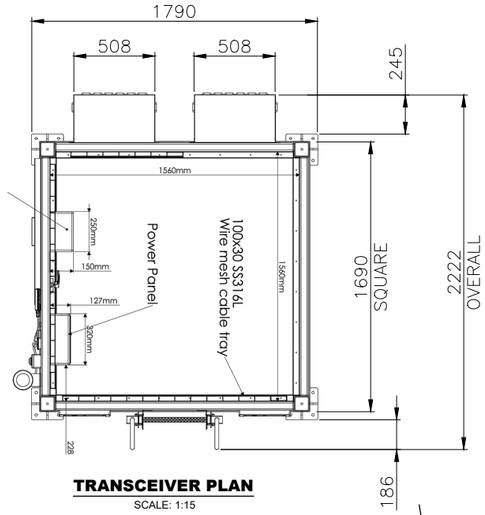
September 16, 2020
Prepared by The Terma Group





EXTERNAL PLATFORM RADAR\ANTENNA FRAMING PLAN - LOCATION I

SCALE: 1:30



TRANSCEIVER PLAN

SCALE: 1:15

EXTERNAL PLATFORM RADAR\ANTENNA FRAMING PLAN - LOCATION II

SCALE: 1:30

1 RADAR PER PLATFORM.
2 TOTAL FOR WIND FARM.

FOR DISCUSSION PURPOSES ONLY
NOT FOR CONSTRUCTION
APRIL 4, 2019

VINEYARD WIND

Attachment 2 Example ADLS Coverage Diagram

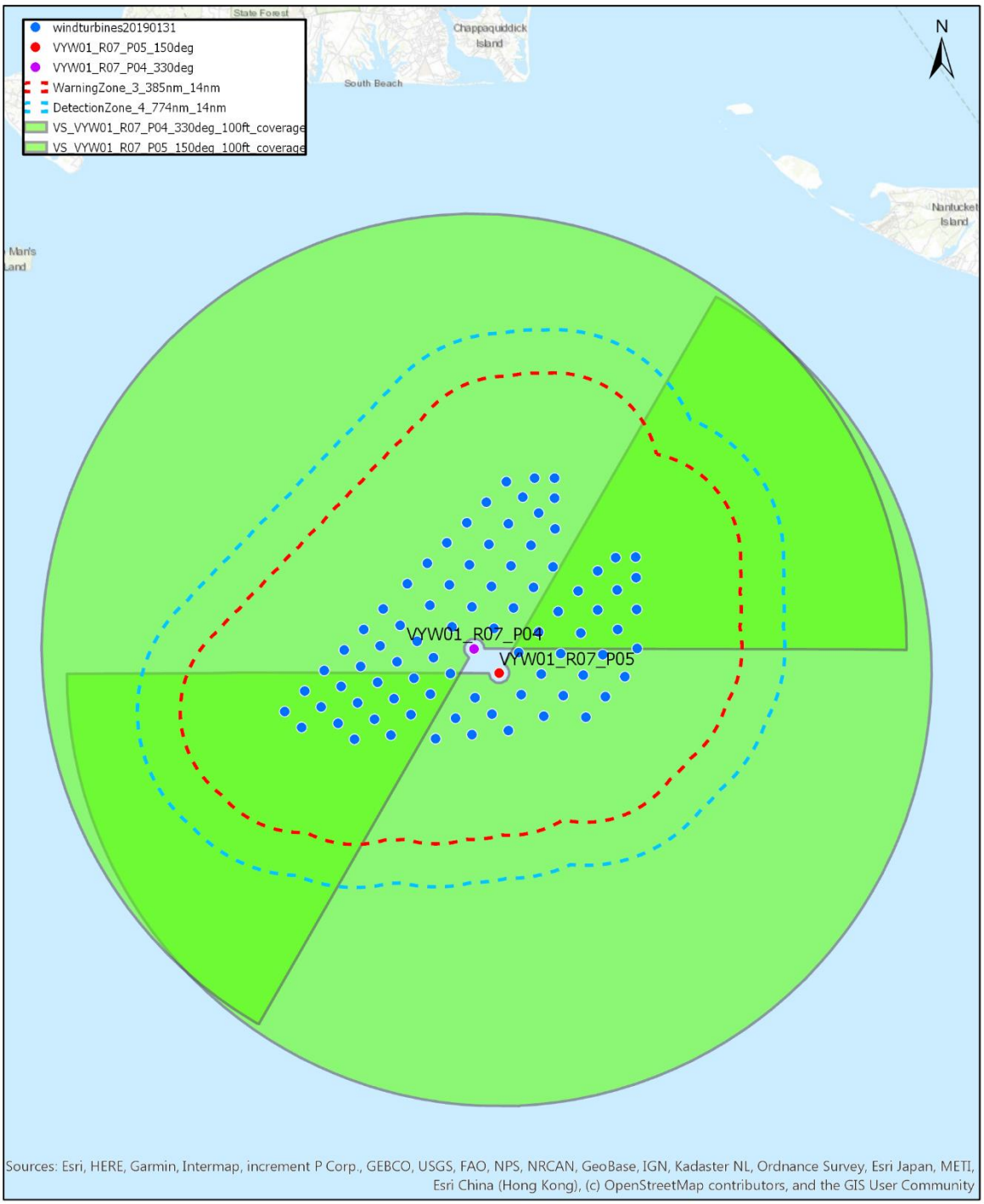
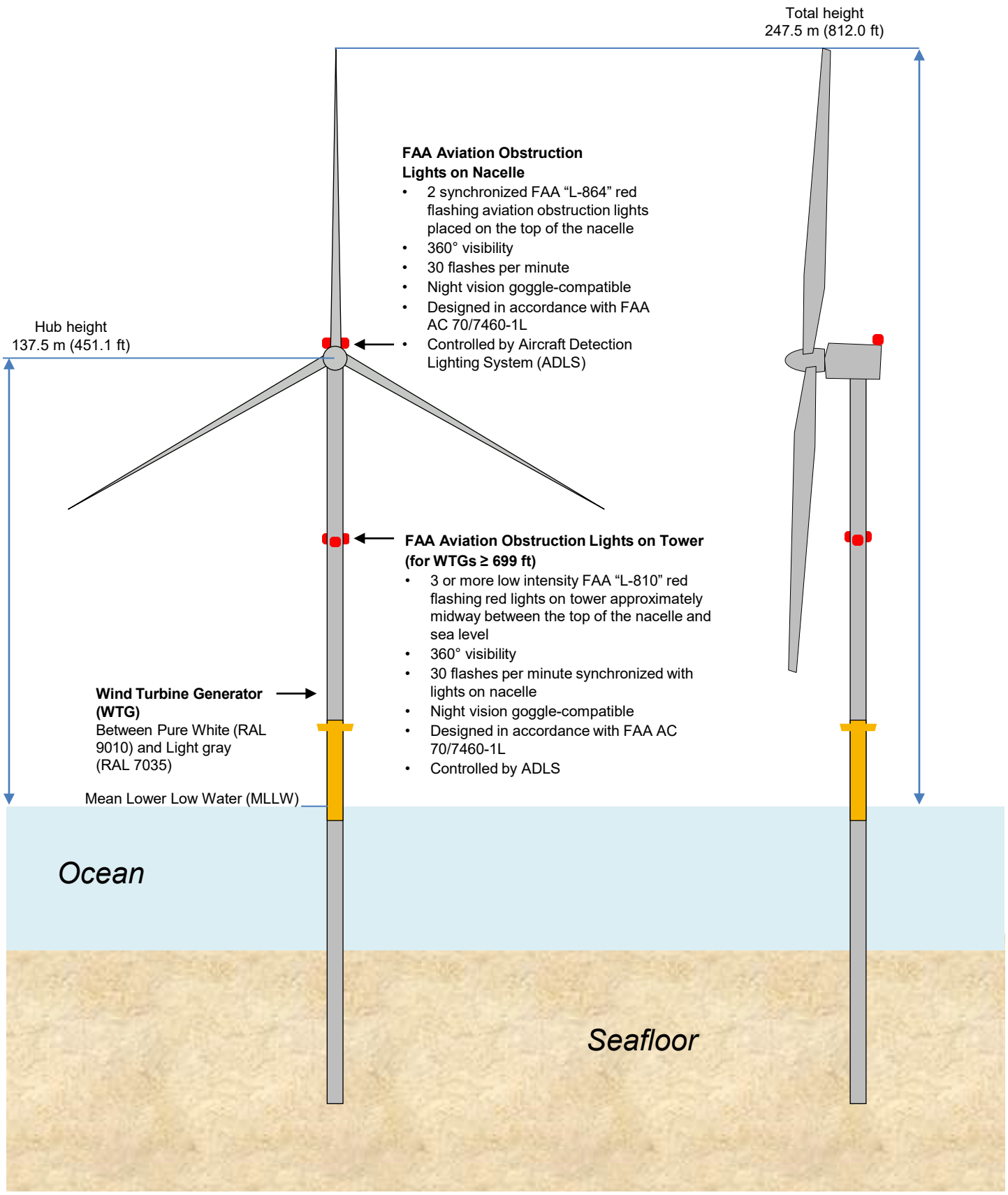


Figure 1 Sample ADLS Coverage for Vineyard Wind 1

Attachment 3 WTG and ESP Aviation Obstruction Lighting Design Plans


Total height
247.5 m (812.0 ft)
FAA Aviation Obstruction Lights on Nacelle
• 2 synchronized FAA "L-864" red flashing aviation obstruction lights placed on the top of the nacelle
• 360° visibility
• 30 flashes per minute
• Night vision goggle-compatible
• Designed in accordance with FAA AC 70/7460-1L
• Controlled by Aircraft Detection Lighting System (ADLS)
Hub height
137.5 m (451.1 ft)
FAA Aviation Obstruction Lights on Tower (for WTGs ≥ 699 ft)
• 3 or more low intensity FAA "L-810" red flashing red lights on tower approximately midway between the top of the nacelle and sea level
• 360° visibility
• 30 flashes per minute synchronized with lights on nacelle
• Night vision goggle-compatible
• Designed in accordance with FAA AC 70/7460-1L
• Controlled by ADLS
Wind Turbine Generator (WTG)
Between Pure White (RAL 9010) and Light gray (RAL 7035)
Mean Lower Low Water (MLLW)
Ocean
Seafloor

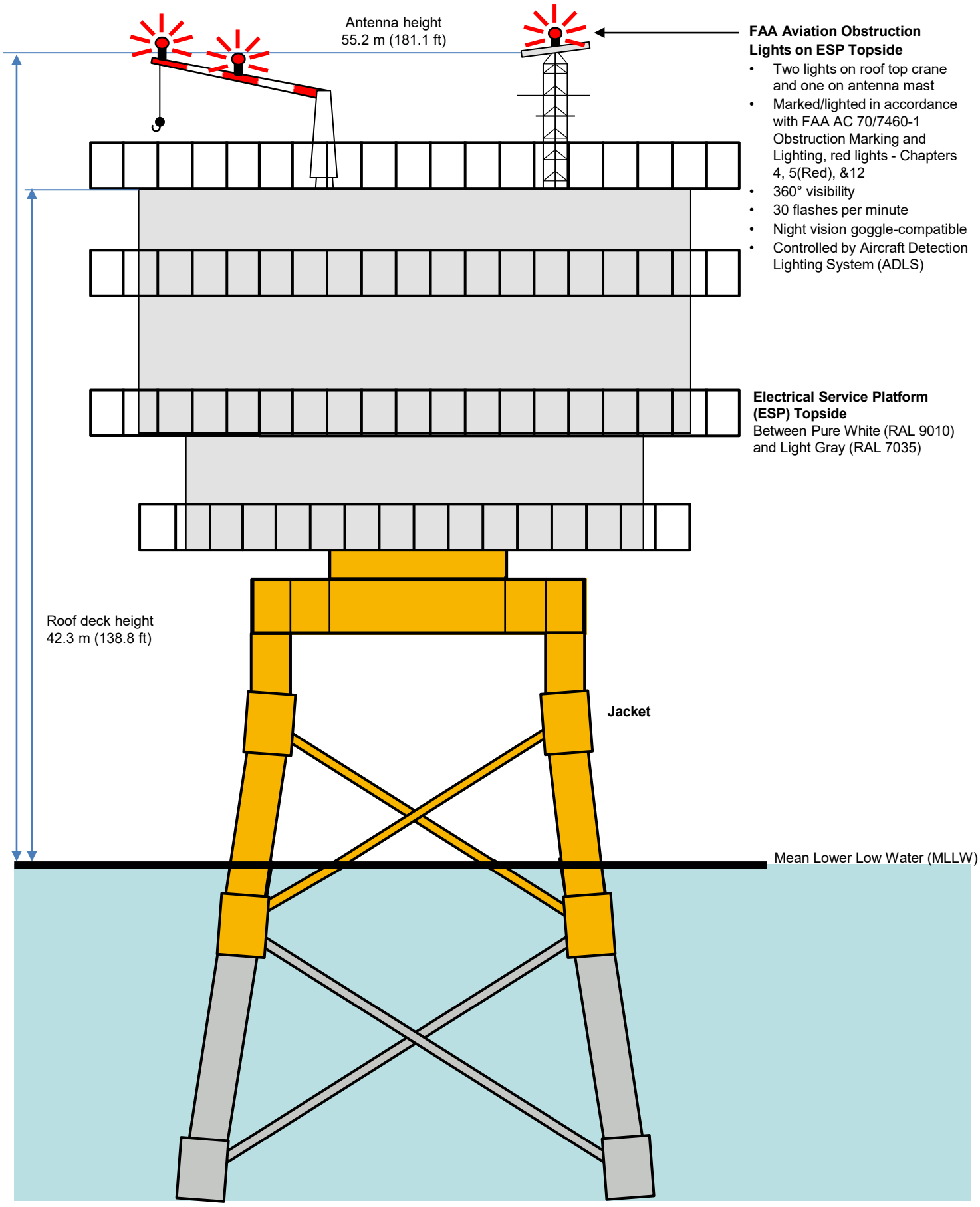


Figure Not to Scale

Vineyard Wind Project

VINEYARD WIND

Attachment 4
FAA's (2016) Performance Assessment of the Terma Obstruction Light Control System as an Aircraft Detection Lighting System

technical note tech note

Performance Assessment of the Terma Obstruction Light Control System as an Aircraft Detection Lighting System

June 2016

DOT/FAA/TC-TN16/41

U.S. Department of Transportation

Federal Aviation Administration

NOTICE

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7. Author(s)	8. Performing Organization Report No.
James Patterson, Jr.* and Garrison Canter**	

9. Performing Organization Name and Address		10. Work Unit No. (TRAIS)
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15. Supplementary Notes

Mike DiPilato, of CSRA International Inc., provided technical support during this performance assessment.

16. Abstract

Federal Aviation Administration (FAA) Airport Technology Research and Development Branch (ATR) personnel conducted a performance assessment of the Terma Obstruction Light Control (OLC) System. The purpose of this assessment was to determine if the Terma OLC system meets the aircraft detection lighting system requirements specified in FAA Advisory Circular (AC) 70/7460-1L, "Obstruction Marking and Lighting," Chapter 14 Aircraft Detection Lighting Systems.

FAA ATR personnel assessed the Terma OLC at the Tehachapi Wind Resource Area, located near Mojave, California. This performance assessment, consisting of demonstrations, flight testing, and data analysis was conducted on April 15, 2015. In the performance assessment, a series of flight patterns were flown against the Terma OLC system to demonstrate whether it could meet the FAA performance requirements specified in AC 70/7460-1L. The Terma OLC system performed according to the manufacturer's specifications and met the performance requirements identified in AC 70/7460-1L.

17. Key Words	18. Distribution Statement
Aircraft Detection Lighting System, Obstruction light control, Obstruction lighting, Terma, ADLS	This document is available to the U.S. public through the National Technical Information Service (NTIS), Springfield, Virginia 22161. This document is also available from the Federal Aviation Administration William J. Hughes Technical Center at actlibrary.tc.faa.gov.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	44	

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

AC	Advisory Circular
ADLS	Aircraft detection lighting system
AGL	Above ground level
ATR	Airport Technology Research and Development Branch
BITE	Built-in test equipment
CFR	Code of Federal Regulations
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
GPS	Global positioning system
IP	Internet protocol
NM	Nautical mile
OLC	Obstruction light control
PSR	Primary surveillance radar
SCADA	Supervisory control and data acquisition
SM	Statute mile
TWRA	Tehachapi Wind Resource Area

EXECUTIVE SUMMARY

Federal Aviation Administration (FAA) Airport Technology Research and Development Branch (ATR) personnel conducted a performance assessment of the Terma Obstruction Light Control (OLC) system. The purpose of this assessment was to determine if the Terma OLC system meets the aircraft detection lighting system (ADLS) requirements specified in FAA Advisory Circular (AC) 70/7460-1L, "Obstruction Marking and Lighting," Chapter 14 – Aircraft Lighting Detection Systems.

Aircraft detection lighting systems continuously monitor the airspace around an obstruction or group of obstructions for aircraft; and when the detection system detects an aircraft in its airspace, the system sends an electronic signal to the lighting control unit, which turns on the lights. Once the aircraft clears the obstruction area and there is no longer a risk of collision, the detection system turns off the lights and the system returns to standby mode.

The United States has experienced a steady increase in the number of applications for construction of telecommunication towers and wind turbines. Any temporary or permanent structure, including telecommunication towers and wind turbines, that exceeds an overall height of 200 feet (61 meters) above ground level or exceeds any obstruction standard contained in Title 14 Code of Federal Regulations Part 77, "Safe, Efficient Use, and Preservation of the Navigable Airspace," should be marked and/or lighted with FAA-approved paint markings or lighting fixtures to ensure that they are visible to pilots at night. Due to the number of existing telecommunication towers and wind turbines, combined with expected future construction, the number of obstructions that have these required lighting fixtures has greatly increased. As a result, it has created a light pollution nuisance to residents living near these obstructions. Using an ADLS could have a positive impact on this problem, while still providing a sufficient level of safety for pilots operating at night in the vicinity of these obstructions.

FAA ATR personnel assessed the Terma OLC system at the Tehachapi Wind Resource Area, located near Mojave, California. This performance assessment, consisting of demonstrations, flight testing, and data analysis was conducted on April 15, 2015. In the performance assessment, a series of flight patterns were flown against the Terma OLC system to demonstrate whether it could meet the FAA performance requirements specified in AC 70/7460-1L. The Terma OLC system performed according to the manufacturer's specifications and met the performance requirements identified in AC 70/7460-1L.

INTRODUCTION

PURPOSE.

Federal Aviation Administration (FAA) Airport Technology Research and Development Branch (ATR) personnel conducted a performance assessment of an aircraft detection lighting system (ADLS) developed by Terma, referred to herein as Terma obstruction light control (OLC) system. The purpose of this assessment was to determine if the Terma OLC system meets the ADLS requirements specified in Chapter 14 of FAA Advisory Circular (AC) 70/7460-1L, "Obstruction Marking and Lighting." [1]

BACKGROUND.

In recent years, several companies have developed detection systems that monitor the airspace around an obstruction or group of obstructions to automatically turn the obstruction lighting on or off as needed. Such systems continuously monitor the airspace around their location; and when the detection system detects an aircraft in its airspace, the system sends an electronic signal to the lighting control unit, which turns on the lights. Once the aircraft clears the obstruction area and there is no longer a risk of collision, the ADLS turns the lights off and the system returns to standby mode. These detection systems are typically (1) mounted directly on the obstruction, (2) positioned on a dedicated tower close to the obstruction, or (3) mounted on a stand-alone structure located in the vicinity of the obstruction at an optimized vantage point to ensure that the sensor can cover the entire volume of airspace around the obstruction. In addition to controlling the obstruction lighting, some vendors have suggested using supplemental warning tools, such as an audible warning message or supplemental lighting that catches the pilot's attention, thereby providing an additional warning to the pilot that they are operating in close proximity to an obstruction.

The United States has experienced a steady increase in the number of applications for construction of telecommunication towers and wind turbines, partially because of government mandates to improve the nation's emergency communication network and to increase the amount of renewable energy generation. These telecommunication towers and wind turbines have begun to heavily occupy almost every corner of the country. Projections show that the accelerated rate of construction will continue well into the next decade. Any temporary or permanent structure, including these telecommunication towers and wind turbines, that exceeds an overall height of 200 ft (61 m) above ground level (AGL) or exceeds any obstruction standard contained in Title 14 Code of Federal Regulations (CFR) Part 77, "Safe, Efficient Use, and Preservation of the Navigable Airspace," [2] should be marked and/or lighted with FAA-approved paint markings or lighting fixtures to ensure that they are visible to pilots. Due to the number of existing telecommunication towers and wind turbines, combined with the expected construction of new structures, the number of obstructions that have FAA-required light fixtures has greatly increased. As a result, it has created a light pollution nuisance to residents living near these obstructions. Using an ADLS could have a positive impact on this problem, while still providing a sufficient level of safety for pilots operating at night in the vicinity of these obstructions.

From 2011 to 2015, ATR personnel have worked closely with several ADLS vendors to better understand the technologies, their capabilities, and the level of performance that would be

necessary to safely integrate this concept into the National Airspace System. One major milestone achieved during the ADLS standards development was to enable the sensors to detect aircraft beyond the required 3 nautical miles (NM) from the obstruction, which would ensure that the lighting was on and the pilot was able to visually acquire the lights 3 NM away from the obstruction. The 3-NM visibility requirement is important because it ties directly to the inflight visibility requirements for a flight conducted under Visual Flight Rules. In 2013, ATR personnel first developed standards for ADLS that were based on technical reviews, discussions, and flight tests of ADLS in the United States and Canada. These ATR-developed standards have since been used by the FAA as the baseline to which new ADLSs, like the Terma OLC system, were tested against. The ATR-developed standards have since been integrated into AC 70/7460-1L as Chapter 14, titled "Aircraft Detection Lighting Systems," which was published in December 2015 [1].

OBJECTIVES.

The overall objective of this assessment was to conduct a performance assessment of the Terma OLC system according to the requirements and standards for ADLSs in Chapter 14 of AC 70/7460-1L. This technical note describes the performance assessment of the Terma OLC system conducted at the Tehachapi Wind Resource Area (TWRA), located near Mojave, California.

RELATED DOCUMENTATION.

The guidelines that have been in place for obstruction marking and lighting have remained mostly unchanged for the last 10 to 20 years and have proved to be sufficient for warning pilots of the presence of an obstruction. The recent update of AC 70/7460-1L does, however, include new material that is designed to improve safety, and at the same time, attempts to reduce the impact of obstruction lighting on nearby communities and wildlife. The introduction of ADLS suggests that the traditional obstruction lights remain the same in intensity, flash rate, and performance, but that the lights can be controlled by an automatic radar-activated monitoring system.

The following FAA documents provide a significant amount of information and guidance pertaining to the lighting of obstructions:

- AC 150/5345-43, "Specification for Obstruction Lighting Equipment."

  This document specifies the lighting equipment and fixtures that should be used for lighting obstructions. The color of the light, flash rate, intensity, and various electrical and performance requirements are all addressed in this document.

  Obstruction lights are given "L" type designations, which are described in this AC. The performance characteristics for the particular lights mentioned in this assessment are as follows:

- L-864—Red flashing obstruction light, 2000 peak Candela, a minimum 750 Candela, with a 3-degree vertical beam spread, flashing at a rate between 20 and 40 flashes per minute. This light is required on wind turbines.

- FAA Technical Note DOT/FAA/TC-TN12/9, "Evaluation of New Obstruction Lighting Techniques to Reduce Avian Fatalities," James W. Patterson, Jr., May 2012.

  This document describes research conducted by FAA ATR personnel in which researchers evaluated a proposal to omit or flash the normally steady-burning red obstruction lights as a way to mitigate their impact on birds, due to their unique color and flash pattern.

AIRCRAFT DETECTION LIGHTING SYSTEM STANDARDS

Based on the result of research efforts conducted by FAA ATR personnel, Chapter 14 of AC 70/7460-1L is the first fully comprehensive set of standards for ADLSs that has been published worldwide. Earlier research efforts in Canada and the United States led to the development of a few sets of very ambiguous descriptions of the technology, but it did not provide any specific guidance on the required range, coverage area, detection target size, or operational requirements for the technology. The following are the key ADLS operational requirements introduced in Chapter 14 of AC 70/7460-1L [1], which is included in its entirety in appendix A.

1. The system should be designed with sufficient sensors to provide complete detection coverage for aircraft that enter a three-dimensional volume of airspace, or coverage area, around the obstruction(s) (see figure 1), as follows:

   a. Horizontal detection coverage should provide for obstruction lighting to be activated and illuminated prior to aircraft penetrating the perimeter of the volume, which is a minimum of 3 NM (5.5 km) away from the obstruction or the perimeter of a group of obstructions.

   b. Vertical detection coverage should provide for obstruction lighting to be activated and illuminated prior to aircraft penetrating the volume, which extends from the ground up to 1000 ft (304 m) above the highest part of the obstruction or group of obstructions, for all areas within the 3-NM (5.5-km) perimeter defined above.

2. The ADLS should activate the obstruction lighting system in sufficient time to allow the lights to illuminate and synchronize to flash simultaneously prior to an aircraft penetrating the volume defined above. The lights should remain on for a specific time period, as follows:

   a. For ADLSs capable of continuously monitoring aircraft while they are within the 3-NM/1000-ft (5.5-km/304-m) volume, the obstruction lights should stay on until the aircraft exits the volume. In the event detection of the aircraft is lost while being continuously monitored within the 3-NM/1000-ft (5.5-km/304-m) volume, the ADLS should initiate a 30-minute timer and keep the obstruction lights on

until the timer expires. This should provide the untracked aircraft sufficient time to exit the area and give the ADLS time to reset.

b. For ADLSs without the capability of monitoring aircraft targets in the 3-nm/1000 ft (5.5-km/304-m) volume, the obstruction lights should stay on for a preset amount of time, calculated as follows:

i. For single obstructions: 7 minutes.

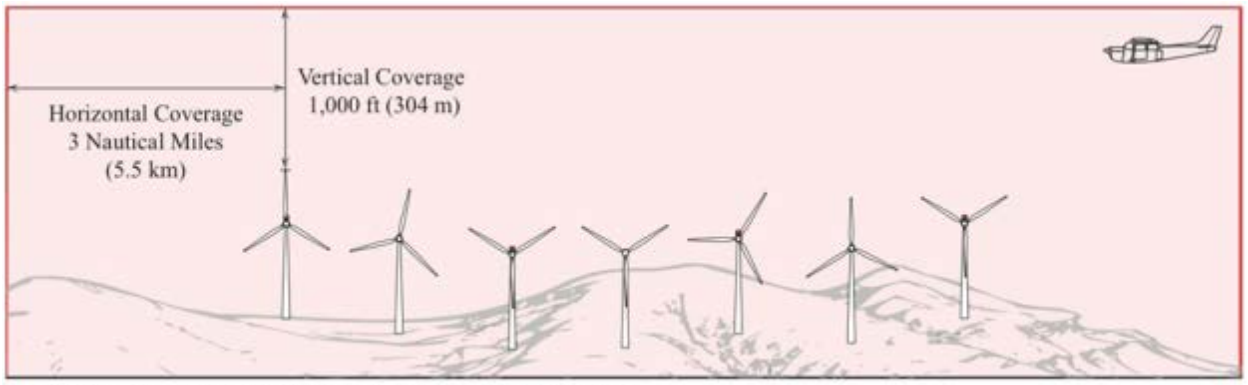
ii. For groups of obstructions: (the widest dimension in nautical miles + 6) x 90 seconds equals the number of seconds the light(s) should remain on.

3. In the event of an ADLS component or system failure, the ADLS should automatically turn on all the obstruction lighting and operate in accordance with AC 70/7460-1L as if it was not controlled by an ADLS. The obstruction lighting must remain in this state until the ADLS and its components are restored.

4. In the event that an ADLS component failure occurs and an individual obstruction light cannot be controlled by the ADLS, but the rest of the ADLS is functional, that particular obstruction light should automatically turn on and operate in accordance with AC 70/7460-1L as if it was not controlled by an ADLS, and the remaining obstruction lights can continue to be controlled by the ADLS. The obstruction lighting will remain in this state until the ADLS and its components are restored.

5. The ADLS's communication and operational statuses shall be checked at least once every 24 hours to ensure both are operational.

6. Each ADLS installation should maintain a log of activity data for a period of no less than the previous 15 days. This data should include, but not be limited to, the date, time, duration of all system activations/deactivations, track of aircraft activity, maintenance issues, system errors, communication and operational issues, lighting outages/issues, etc.



* System above shown in active mode with aircraft in coverage area

Figure 1. Required ADLS Detection Coverage [1]

In 2014, FAA ATR personnel completed an ADLS assessment, with the objective of validating the ADLS standards in AC 70/7460-1L. This assessment is described in FAA Technical Note DOT/FAA/TC-TN15/54, "Performance Assessment of the Laufer Wind Aircraft Detection System as an Aircraft Detection Lighting System." This technical note concluded the following:

> …the performance requirements provided in AC 70/7460-1L for ADLSs remain valid and provide for a technology that offers a satisfactory level of safety for the flying public, while at the same time, reduces the impact of obstruction lights on nearby communities and migratory bird populations. [3]

Chapter 14 of AC 70/7460-1L also contains language that allows for ADLSs to have an optional voice/audio feature that transmits a low-power, audible warning message over an aviation frequency licensed by the Federal Communications Commission (FCC) in the MULTICOM/UNICOM frequency band to provide pilots additional information on the obstruction they are approaching. The Terma OLC system does not offer this option, so these requirements do not apply to this assessment.

TERMA OLC SYSTEM CHARACTERISTICS AND SPECIFICATIONS

The Terma OLC system uses a SCANTER 5202 primary surveillance radar (PSR) to detect aircraft within range of a wind farm or obstruction area and follows the general description provided in AC 70/7460-1L. For instance, when there are no aircraft in the vicinity of the wind turbine farm or obstruction, the warning lights remain off. When aircraft are detected in the vicinity, the lights are activated (turned on). When all aircraft have safely left the vicinity, the lights are deactivated (turned off). The Terma OLC system allows wind turbine farm warning lights to remain safely off at night when aircraft are not in the area.

As shown in figure 2, Terma's OLC system concept consists of one or more SCANTER 5202 PSR system, including an antenna and a global positioning system (GPS) synchronized light control connected via a supervisory control and data acquisition (SCADA) internet protocol (IP) network [4].

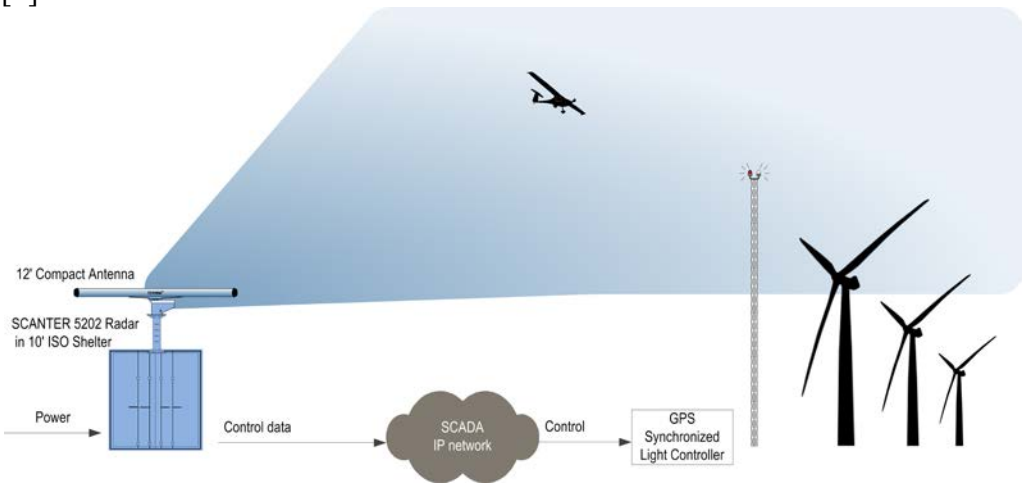


Figure 2. Terma OLC System Concept [4]

TERMA OLC SYSTEM OPERATIONAL DESCRIPTION.

The Terma OLC system operates as follows:

1. Prior to reaching the light activation perimeter of the warning zone (3-NM/1000-ft (5.5-km/304-m) volume), aircraft are detected and tracked by the SCANTER 5202 PSR(s).

2. The PSR sends a signal through the SCADA IP network to the GPS Synchronized OLC system when the aircraft reaches the light activation perimeter of the warning zone.

3. The OLC system turns on the obstruction light(s).

4. The PSR tracks the aircraft until it exits the warning zone light activation perimeter (3-NM/1000-ft (5.5-km/304-m) volume).

5. The OLC system determines when to turn the lights off after verifying that no aircraft are within the warning zone.

TERMA OLC SYSTEM RADAR DESCRIPTION.

Terma's SCANTER 5202 PSR, illustrated in figure 3, is a solid-state X-band radar. SCANTER 5000 series PSRs are in use throughout the world in a variety of applications, including airport surface movement surveillance [4]. These PSRs utilize a combination of technologies, such as solid-state power amplifiers; multiple transmission frequencies (i.e., frequency diversity); pulse-compression; coherent integration; and signal processing, designed to detect and track very small cooperative and noncooperative targets in high-clutter environments, under a variety of weather conditions (e.g., heavy rain and fog), and within and around a wind farm despite the turbulence and clutter created by the wind turbines themselves. Using high spatial resolution, high dynamic range, and side lob suppression the system can filter out noise caused by the spinning turbine blades. Airborne targets are primarily tracked using Doppler-processed signals [4]. These are supplemented by normal radar signals to follow targets with minimal radial velocities, such as helicopters. Terma states that the system has a range of 18 km (approximately 11.18 statute miles (SM)), with a total coverage of up to 1000 km^2 [5]. Therefore, Terma has proposed their OLC system for use at larger wind farms and wind farms with varied layouts. Appendix B contains additional information provided by Terma regarding this system.

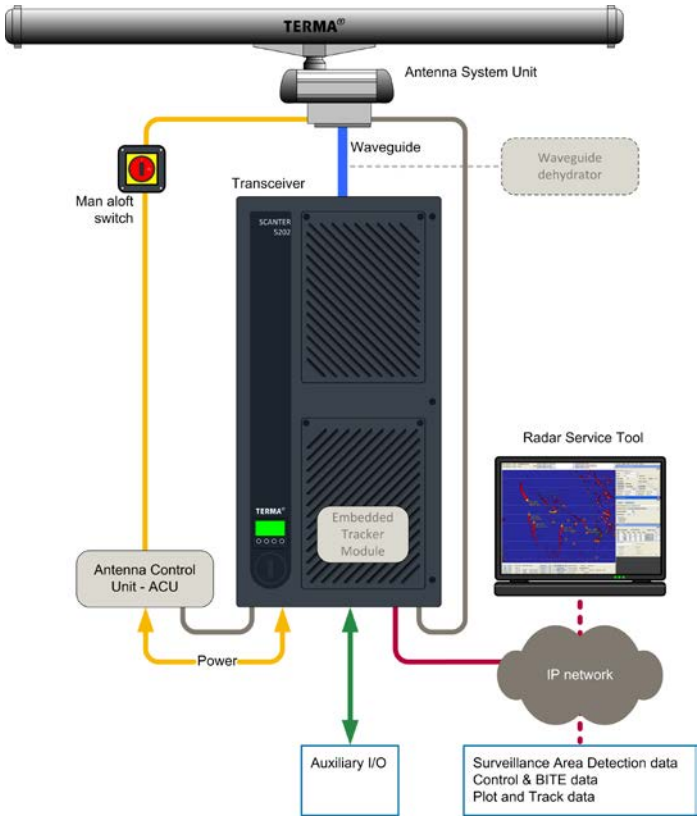


Figure 3. Terma OLC System Radar Configuration [4]

TERMA OLC SYSTEM PERIMETERS.

Terma's OLC system includes three zones to ensure adequate identification of obstructions and compliance with AC 70/7460-1L:

- Outer Detection Zone: Aircraft are detected and tracked by radar in this area, but the obstruction lights are not turned on until one of the aircraft enters the warning zone.

- Inner Warning Zone: Lights in the Obstruction Area are activated when aircraft enter this zone, and the lights remain lit while any aircraft is within this area. This zone will be located a minimum of 3 NM (5.5 km) away from the obstruction or the perimeter of a group of obstructions.

- Obstruction Area: This is a broadly defined area that includes lighted obstruction(s), such as a wind farm.

TERMA OLC SYSTEM FAIL-SAFE DESIGN.

The Terma OLC system includes multiple self-testing functions to provide fail-safe protection. When a failure occurs, the obstruction lights are turned on until the Terma OLC system and its components functions are restored [6]. Built-in test equipment (BITE) in the Terma OLC system provides continuous system status monitoring. The BITE monitors mains-on time, solid-state

power amplifier status, forward power, noise figure, internal voltages and temperatures, turning unit status, and other parameters. Diagnostic tests are performed when the system starts up, including the following [6]:

- Module presence test
- Data link test
- Memory test of all circuits

The BITE also reports the following when monitoring the system during operation [6]:

- BITE errors/warnings
- Signal activity and processes
- Connectivity to OLC system
- Internal supply voltages
- Noise figure, internal voltages, and temperatures
- Forward power
- Reverse power
- Status from motor, gear, and optional inputs providing antenna status
- Temperatures
- Internal power supplies

The status of each BITE parameter is assessed automatically to ensure consistent operation. If any parameter is detected outside of normal operating specifications, error messages are automatically sent through the IP network interface and all obstruction lights are activated. Error records are stored automatically by the system in a log for future inspection [6].

TERMA OLC SYSTEM INSTALLATION DESCRIPTION AT THE TWRA

Terma installed its OLC system at the TWRA, located near Mojave, California. The TWRA is a large wind turbine farm on and around the Tehachapi Mountains containing a mix of turbines manufactured by different vendors. Examples of the wind turbines installed in the TWRA are shown in figure 4. This is a challenging radar coverage environment due to the mountainous terrain and ground clutter caused by the quantity of wind turbines. For example, figure 5 shows the locations of individual wind turbines in the vicinity of the assessment site, which are represented by colored points. The position of the radar is indicated by a red rectangle. It should be noted that for this assessment, the dimensions of the warning zone did not meet the requirement of extending at least 3 NM from the obstruction area as called for in AC 70/7460-1L. This was due to the assessment focusing on the system's ability to activate an indicator lamp when an aircraft was detected in a given area, rather than monitoring the activation of lighting on a specific obstruction or group of obstructions.

Figure 4. Wind Turbines at the TWRA

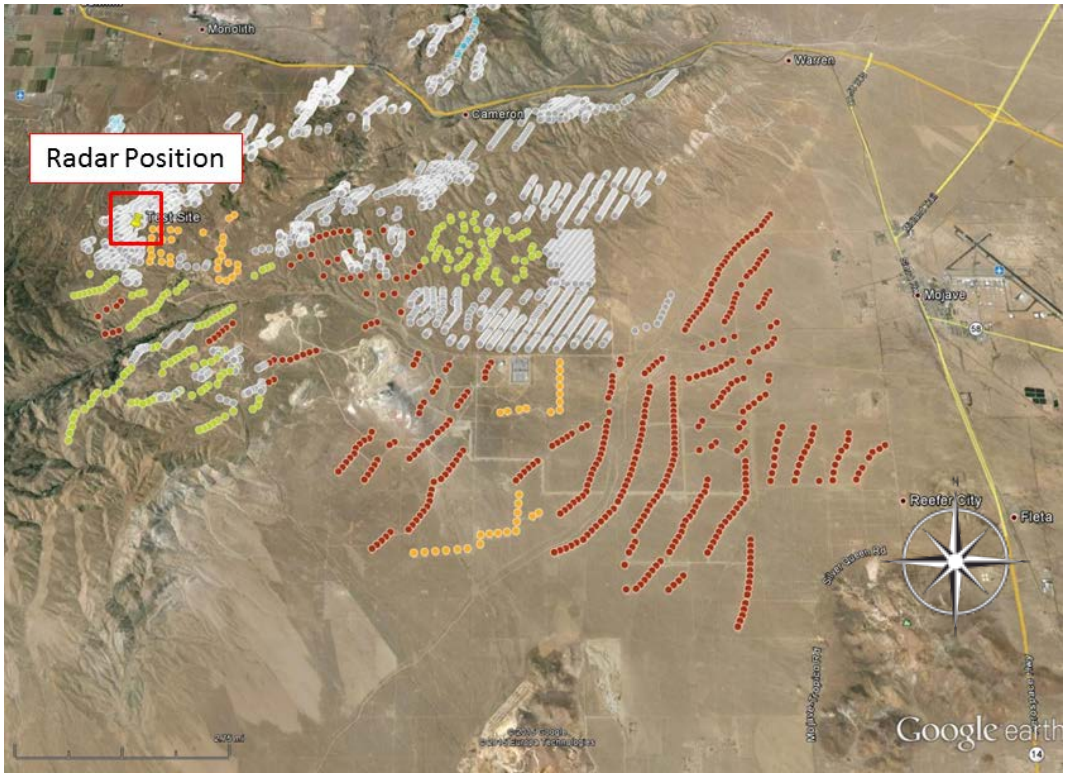


Figure 5. Google Earth Map Showing Ground Clutter Around TWRA Assessment Site (The colored points indicate wind turbine locations.)

The Terma OLC system installation at TWRA utilized one SCANTER 5202 PSR. This radar was mounted on the top of a specially designed shipping container. The radar mounting configuration is shown in figure 6.

Figure 6. Terma SCANTER 5202 PSR Installed at TWRA

Because the Terma OLC system had not yet been connected to obstruction lighting in the wind farm, the OLC system was instead connected to the indicator lamp shown in figure 7. This indicator lamp provided a visual indication to ATR personnel observing the system that the OLC system could activate the light at the appropriate times when the aircraft entered and exited the warning zone airspace.

Figure 7. The OLC System Indicator Lamp Used in Assessment

The yellow polygon shown in figure 8 depicts the perimeter of the warning zone used for the assessment. This warning zone was 2 SM long and 1 SM wide, and the center of the zone was located approximately 4.5 NM southeast of the radar position. Although the size of this warning zone did not meet the 3-NM (5.5-km) perimeter requirement of AC 70/7460-1L, Terma's engineers indicated that the perimeter could be expanded as needed to fully encompass the required airspace volume. The reduced size of the warning zone allowed ATR personnel to conduct performance assessments with greater efficiency due to there being less distance to cover when flying through the zone. Table 1 provides the coordinates of Terma OLC system radar position and four corners of the warning zone used for the assessment.

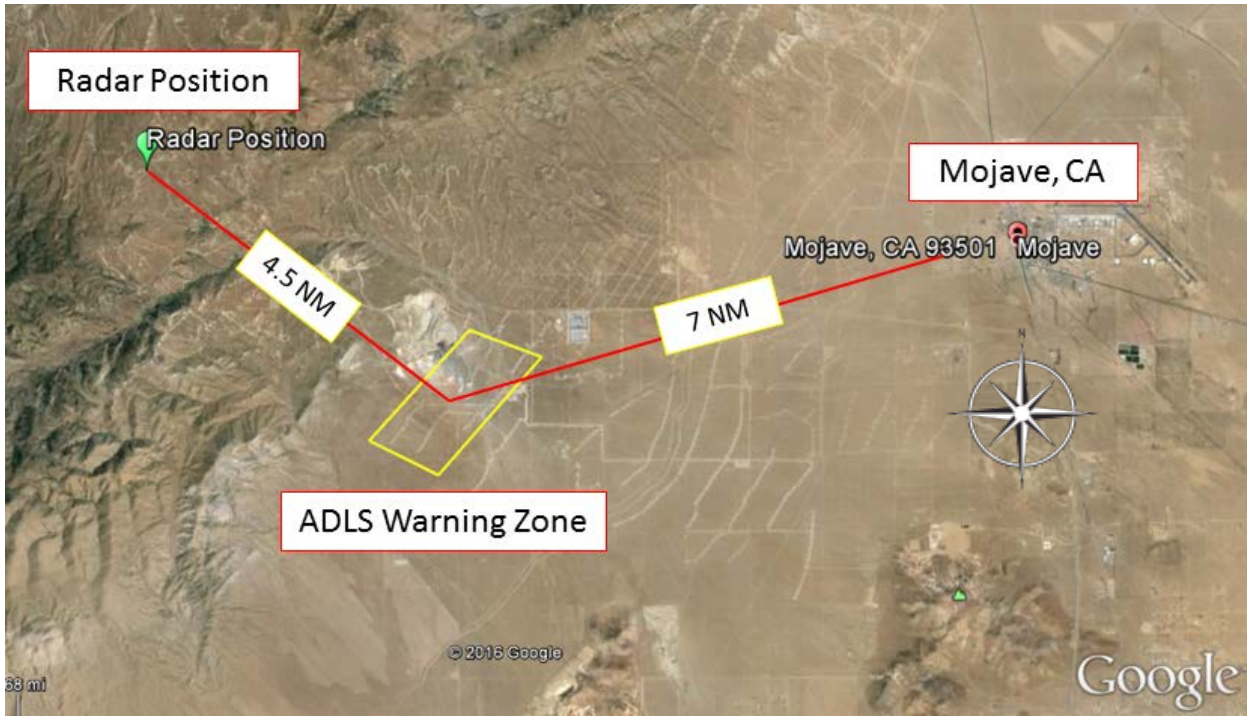


Figure 8. Relative Position of Warning Zone to Terma OLC System Radar

Table 1. The GPS Coordinates of Terma OLC PSR and Warning Zone at TWRA

Location	Latitude	Longitude
Terma OLC PSR SCANTER Radar	35°03'56.03"N	118° 23'02.96"W
Warning Zone – North Corner	35°02'05.39"N	118° 18'25.55"W
Warning Zone – East Corner	35°01'45.22"N	118° 17'23.33"W
Warning Zone – South Corner	35°00'21.07"N	118° 18'53.02"W
Warning Zone – West Corner	35°00'45.85"N	118° 19'53.01"W

THE FAA ASSESSMENTS OF THE TERMA OLC SYSTEM AT THE TWRA

THE FAA FLIGHT ASSESSMENT.

To properly assess the performance of the Terma OLC system, ATR personnel developed a series of flight patterns to assess the system's response to aircraft operating around the warning zone at various altitudes, flight paths, speed, etc. These flight patterns were based on similar ones conducted during a previous FAA ADLS assessment [3]. Each pattern was designed to assess a specific parameter of the ADLS to determine if the system meets the requirements in AC 70/7460-1L. Two flights were conducted, during which these six specific flight patterns were flown, in some cases multiple times. The six flight patterns are described below:

1. The aircraft flew through the center of the warning zone and exited the other side.

2. The aircraft flew inside the warning zone adjacent to its outer edge.

3. The aircraft flew over the radar site, and then flew directly to the warning zone after radar contact was lost.

4. The aircraft completed several tight circles inside the warning zone, and then exited the zone at a different heading from the entry heading.

5. The aircraft flew toward and over the warning zone at least 1500 ft AGL, and then steeply descended into the warning zone.

6. The aircraft flew toward the warning zone from a location where terrain masked the aircraft from initially being detected by the ADLS. The intent of this pattern was to identify how quickly the Terma ADLS could detect the aircraft without the benefit of early detection.

ATR personnel used the Piper PA-22 Tri-Pacer, shown in figure 9, to conduct the flight patterns. A notable characteristic of this aircraft is the outer skin of its wings and sections of fuselage is made of fabric rather than metal. The aircraft was owned and flown by a pilot with a commercial pilot certificate. All flights were operated out of the Mojave Air and Space Port, which was located approximately 20 SM southeast of the Terma OLC system installation. Figure 10 shows a Google Earth map image overlaid with the flight tracks (shown in blue) recorded by a GPS unit on board the aircraft.

Figure 9. Piper Tri-Pacer Used for Assessment

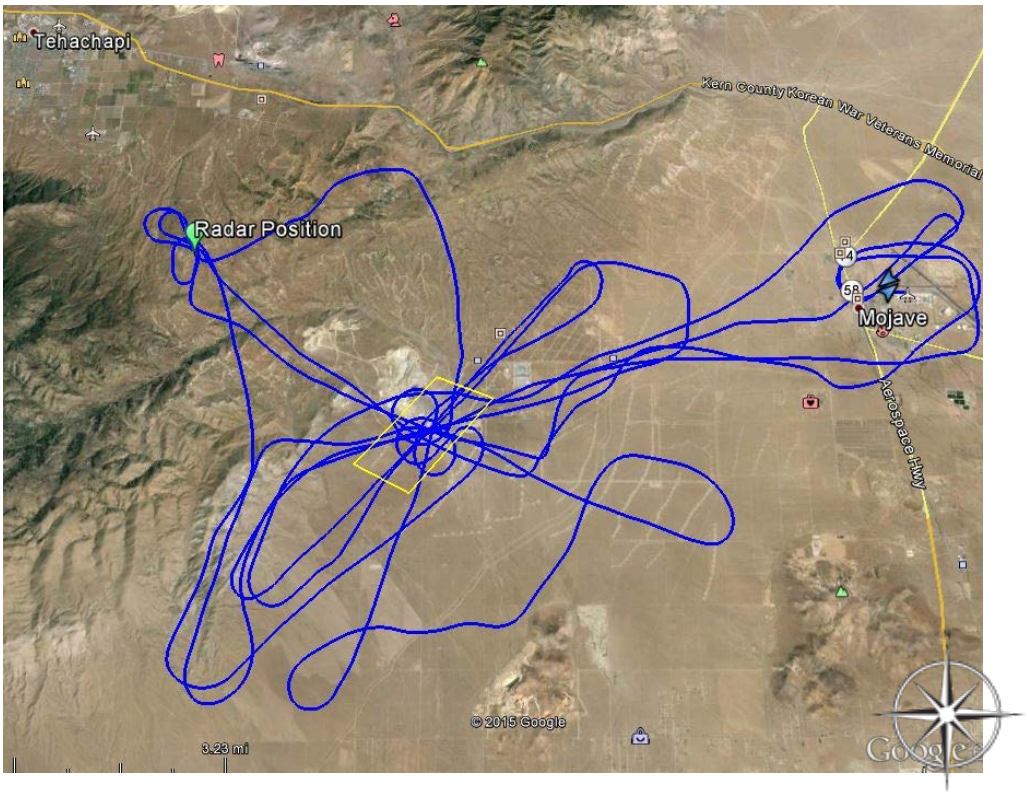


Figure 10. The GPS Flight Track Data From the Aircraft

THE FAA COMPONENT FAILURE ASSESSMENT.

ATR personnel were unable to directly assess the Terma OLC system's fail-safe mechanisms, which activate the obstruction lighting in the event of a component failure. However, Terma engineers did provide documentation of the fail-safe capabilities of the OLC system to ATR personnel. A comprehensive assessment of these features is planned to be conducted at a later date by ATR personnel once Terma's OLC system is connected to an obstruction lighting system and becomes fully operational.

RESULTS

The performance assessment of the Terma OLC system was based on the specifications and criteria provided in AC 70/7460-1L. AC 70/7460-1L lists specifications for basic functions, detection performance, and system output. The following sections document the performance of the Terma OLC system along with the data collected during the performance assessment and discuss how it relates to the AC 70/7460-1L performance specifications.

BASIC FUNCTION ASSESSMENT.

Prior to the assessment flight, the Terma OLC system was turned on, and ATR personnel verified that the system was up and running. ATR personnel verified that, without any aircraft present in the area, the system continuously scanned the area and kept the indicator lamp off. Before beginning the scheduled flight patterns, ATR personnel confirmed that the system was standing by and was not tracking any other aircraft in the area. With the system ready and the indicator lamp off, ATR personnel proceeded to evaluate the Terma OLC system's detection performance.

ATR personnel at the radar site monitored the Terma OLC system monitor and communicated with the ATR personnel on board the aircraft via a two-way radio. Figure 11 shows a screenshot of the flight track as it appeared on this monitor during the assessment. When the aircraft entered the warning zone, ATR personnel confirmed the indicator lamp connected to the OLC system was activated and stayed lit while the aircraft was in the zone. Conversely, when the aircraft exited the warning zone, ATR personnel confirmed the indicator lamp had deactivated.

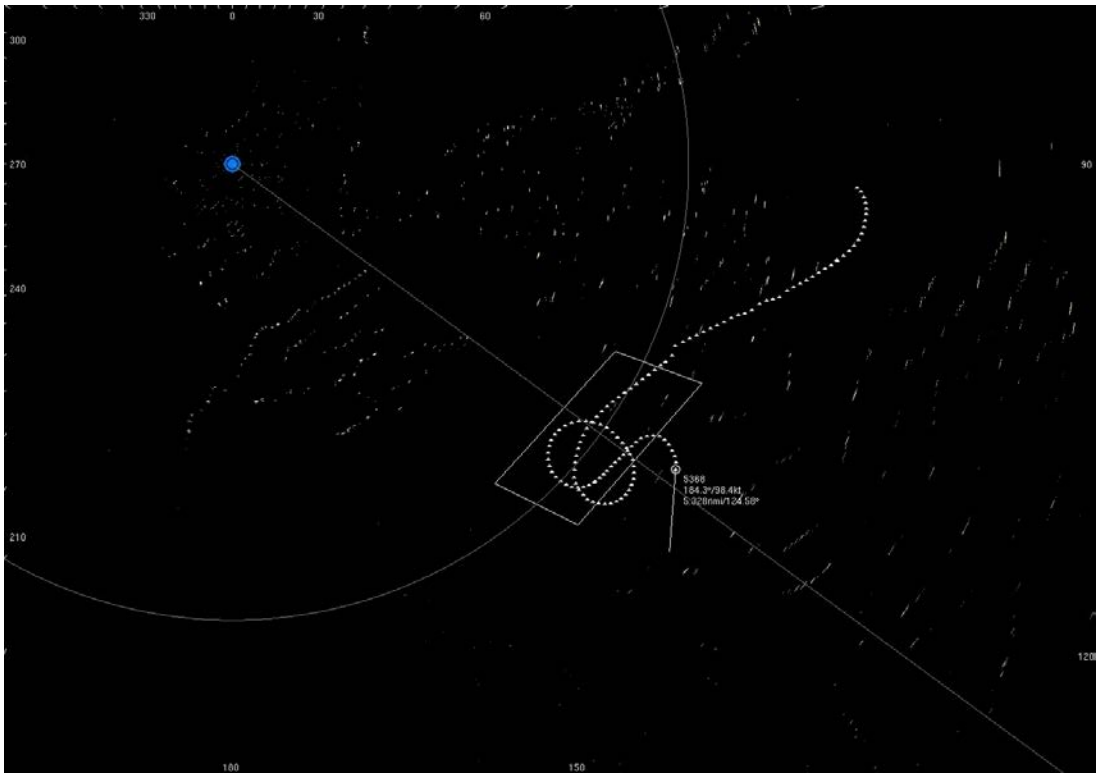


Figure 11. Flight Assessment as Observed on Terma OLC System Monitor

During the assessment flights, the Terma OLC system recorded radar tracks for all airborne targets operating within the vicinity of the system while the performance assessment was being conducted. These radar tracks were exported as Keyhole Markup Language files viewable in Google Earth. Figure 12 shows a record of the entire FAA assessment flight pattern. The dotted magenta lines represent the real-time tracks produced from the Terma SCANTER OLC PSR, and the solid blue lines represent the tracks recorded by the GPS on board the aircraft.

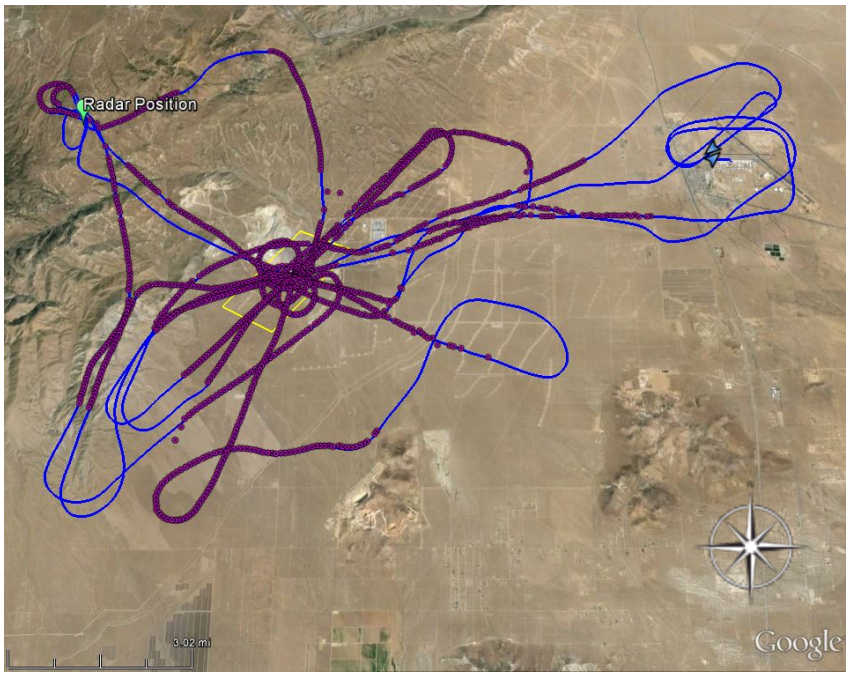


Figure 12. Terma OLC System Cumulative Radar Tracks Overlaid on the FAA Aircraft's GPS Track

DETECTION PERFORMANCE ASSESSMENT.

To demonstrate that the Terma OLC system was able to meet the detection performance requirements for an ADLS, ATR personnel developed and conducted a series of flight maneuvers designed to assess the system's detection capabilities. Descriptions of the maneuvers and the results of the Terma OLC system's detection capability are as follows:

- Flight Inside the Warning Zone Adjacent to its Outer Edge

  The Terma OLC system detected the aircraft 4.3 NM from the warning zone perimeter and activated the indicator lamp when the aircraft entered the warning zone. The indicator lamp deactivated as the aircraft exited the warning zone heading southwest. Figure 13 shows events 1-4 for this flight pattern.

- Flight Directly Through the Center of the Warning Zone and Exiting the Other Side

  The Terma OLC system detected the aircraft 1.2 NM outside the warning zone perimeter and activated the indicator lamp when the aircraft entered the zone, flying toward the northeast. Figure 14 shows events 5-8 for this flight pattern.

- Completion of Several Tight Circles Inside the Warning Zone, Then Exiting the Zone at a Different Heading From the Entry Heading

  The Terma OLC system maintained radar contact with the aircraft at a range of 2.75 NM from the warning zone and activated the indicator lamp as the aircraft entered the

warning zone. The system tracked the aircraft even as it conducted a series of steep circling maneuvers within the warning zone. As the aircraft exited and re-entered the zone at random headings during these turns, the Terma OLC system recognized it as the same aircraft that had entered the perimeter and activated the indicator lamp as required. Figures 15 and 16 show events 9-15 for this flight pattern.

- Flight Over the Radar Site, Then Flying Directly Through the Warning Zone After Radar Contact is Lost

  The Terma OLC system lost contact with the aircraft as it flew directly over the radar site; however, this is typical of all radar systems, which are not designed to detect aircraft above the radar antenna. This gap is known as the cone of silence. Terma's OLC system was able to re-acquire the aircraft within 1.1 NM as it flew toward the warning zone perimeter, activating the indicator lamp when the aircraft entered the perimeter. The Terma OLC system then deactivated the indicator lamp as the aircraft left the zone heading southeast. Figure 17 shows events 16-19 for this flight pattern.

- Flights to the Warning Zone From a Location Where Terrain Masked the Aircraft From Initially Being Detected by the ADLS

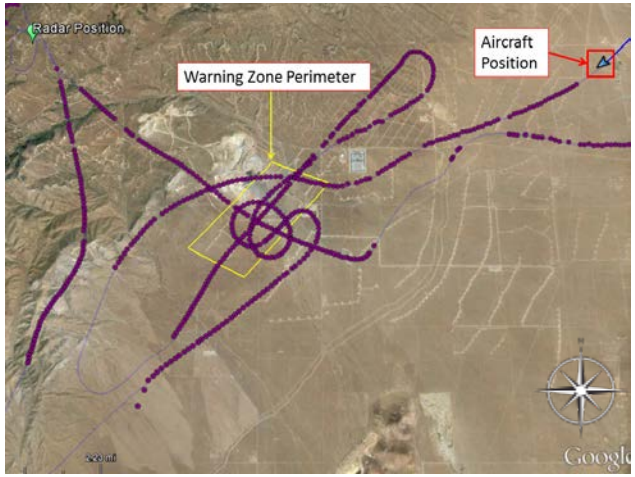
  On two separate flights manuevers, the Terma OLC system successfully detected the aircraft as soon as it appeared from behind a mountain on the west of the warning zone. As soon as the Terma OLC system detected the aircraft (still outside the warning zone perimeter), the system continued to monitor the aircraft's track and activated the indicator lamp when the aircraft entered the warning zone perimeter. After the aircraft flew through the warning zone and exited the area, the Terma OLC system deactivated the indicator lamp, as required. Figures 18 and 19 show events 20-26 for these flight patterns.

- Circling Flight Over the Warning Zone (second flight)

  During a second flight, the Terma OLC system again detected and maintained contact with the aircraft as it circled inside the warning zone, activating and deactivating the indicator lamp as required when the aircraft exited and re-entered the zone. Figures 20 and 21 show events 27-32 for this flight pattern.

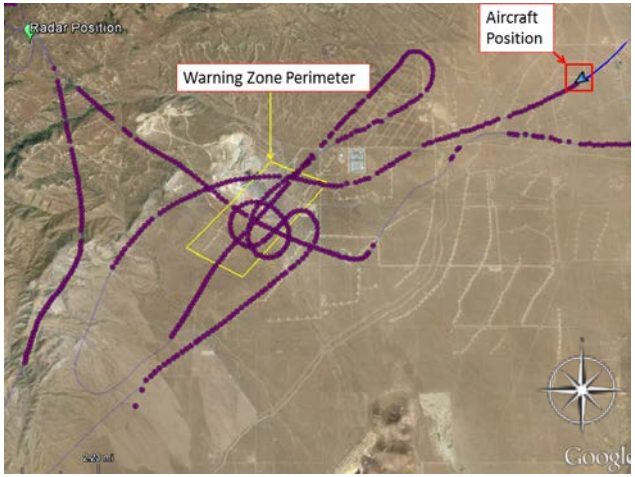
- Flight to and Over the Radar Site, Then Steeply Descending Into the Warning Zone

  Although contact with the aircraft was lost as it flew directly over the radar site and steeply descended behind mountains as it approached the warning zone, the Terma OLC system detected the aircraft with enough time to activate the indicator lamp as it entered the warning zone perimeter. After the aircraft completed the descent and exited the area, the Terma OLC system deactivated the indicator lamp as required. Figure 22 shows events 33-36 for this flight pattern.



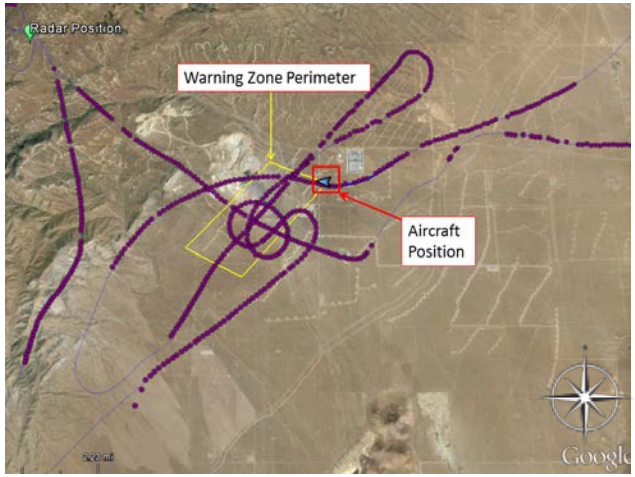
Event 1:

- Aircraft approaches the warning zone from the northeast.
- Indicator lamp is off.



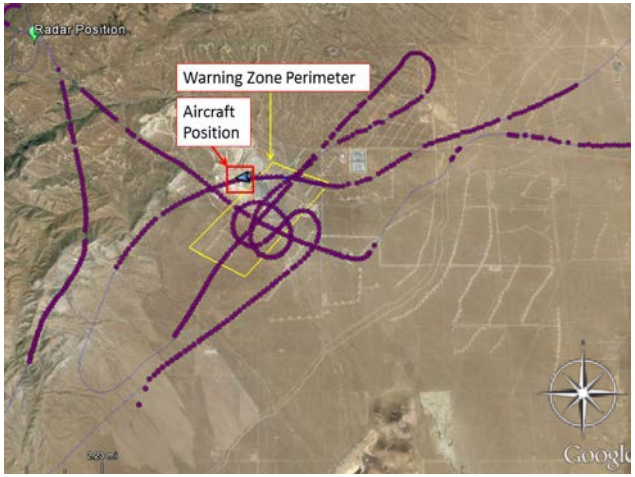
Event 2:

- Aircraft is detected and tracked by radar prior to reaching the warning zone.
- Indicator lamp is off.



Event 3:

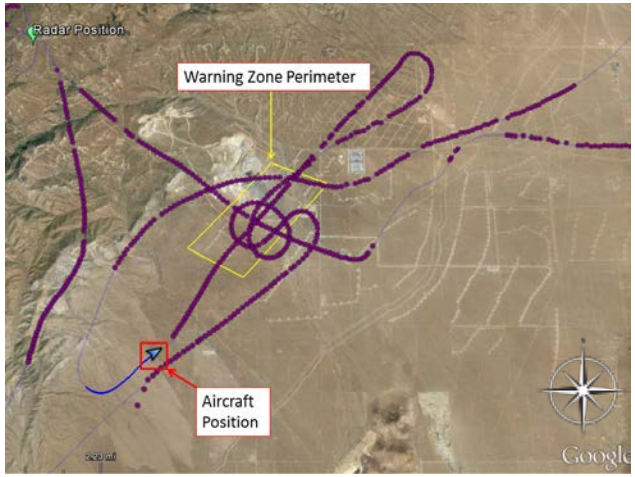
- Aircraft penetrates the warning zone perimeter heading west.
- Indicator lamp is on.
- Aircraft is continuously monitored within the warning zone.



Event 4:

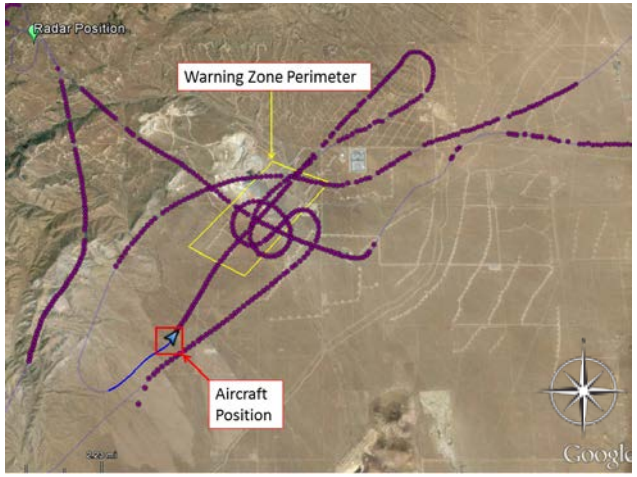
- Aircraft exits the warning zone to the west.
- Indicator lamp is off.

Figure 13. Flight Adjacent to North Edge of Warning Zone (events 1-4)



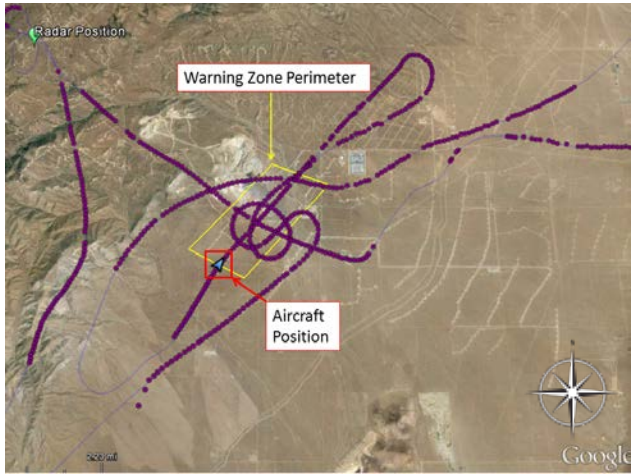
Event 5:

- Aircraft approaches the warning zone from the southwest.
- Indicator lamp is off.



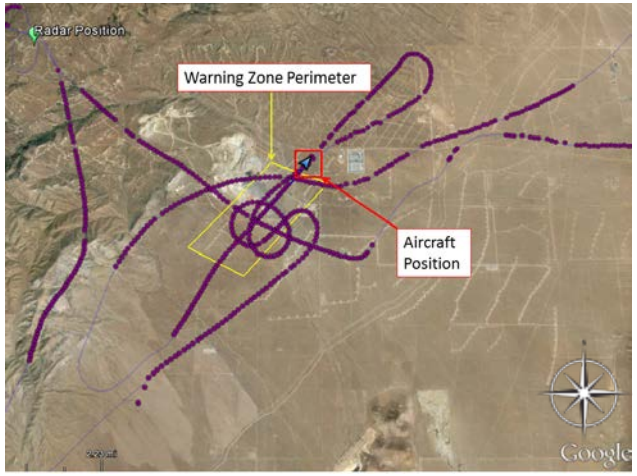
Event 6:

- Aircraft is detected and tracked by radar prior to reaching the warning zone.
- Indicator lamp is off.



Event 7:

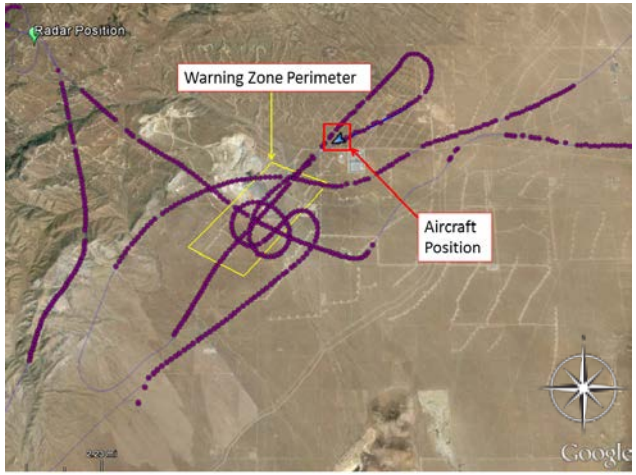
- Aircraft penetrates the warning zone perimeter heading northeast.
- Indicator lamp is on.
- Aircraft is continuously monitored within the warning zone.



Event 8:

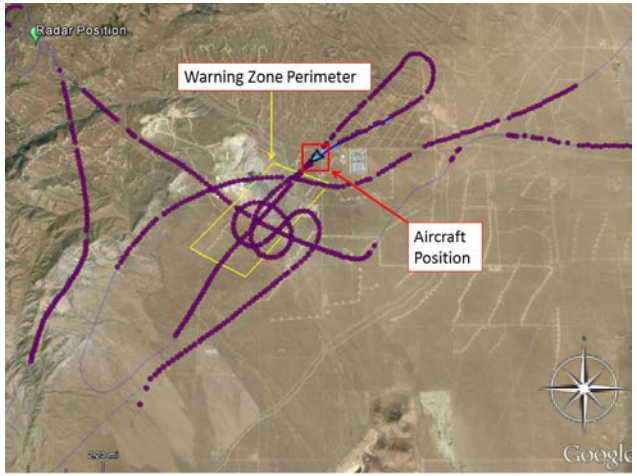
- Aircraft exits the warning zone to the northeast.
- Indicator lamp is off.

Figure 14. Flight Directly Through the Warning Zone to the Northeast (events 5-8)



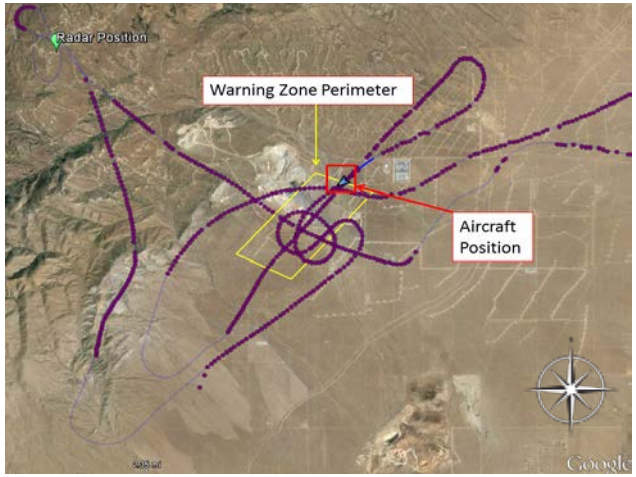
Event 9:

- Aircraft approaches the warning zone from the northeast.
- Indicator lamp is off.



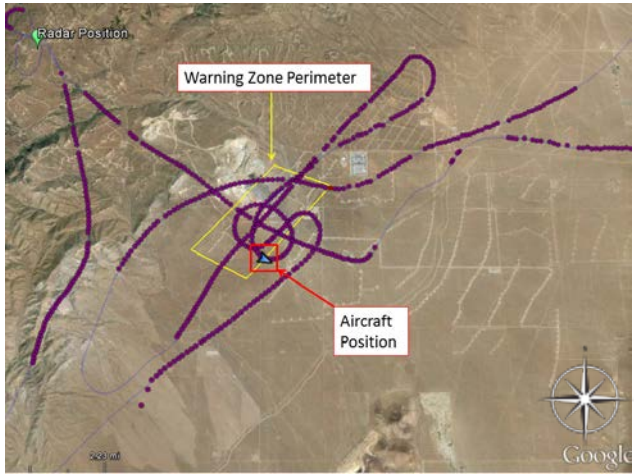
Event 10:

- Aircraft is detected and is tracked by radar prior to reaching the warning zone.
- Indicator lamp is off.



Event 11:

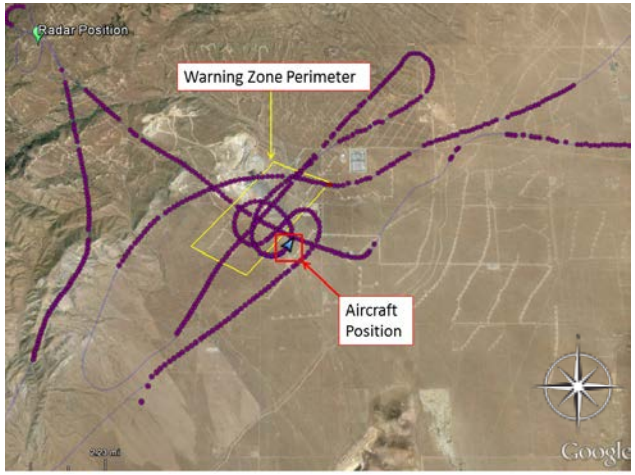
- Aircraft penetrates the warning zone perimeter heading to the southwest.
- Indicator lamp is on.
- Aircraft is continuously monitored within the warning zone.



Event 12:

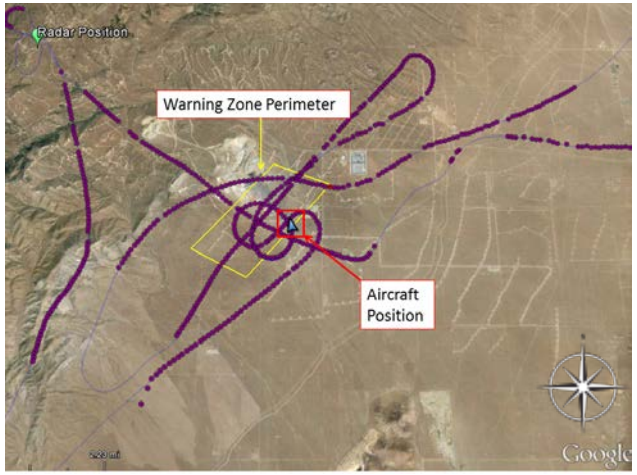
- Aircraft initiates a 540° left turn, exiting the warning zone to the southeast.
- Indicator lamp is off.

Figure 15. Circling Flight Over the Warning Zone (events 9-12)



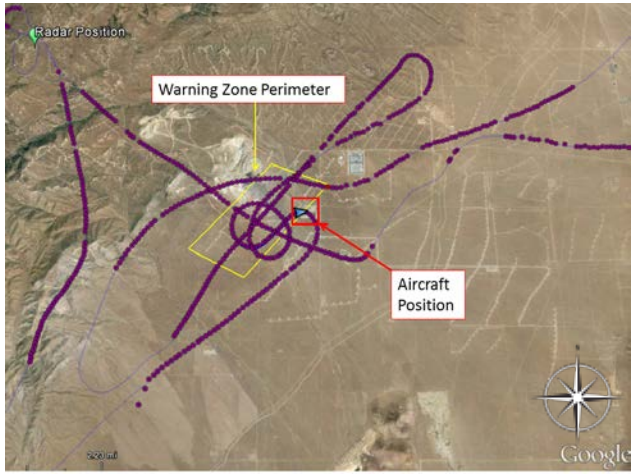
Event 13:

- Aircraft continues its left turn outside the warning zone.
- Indicator lamp is off.



Event 14:

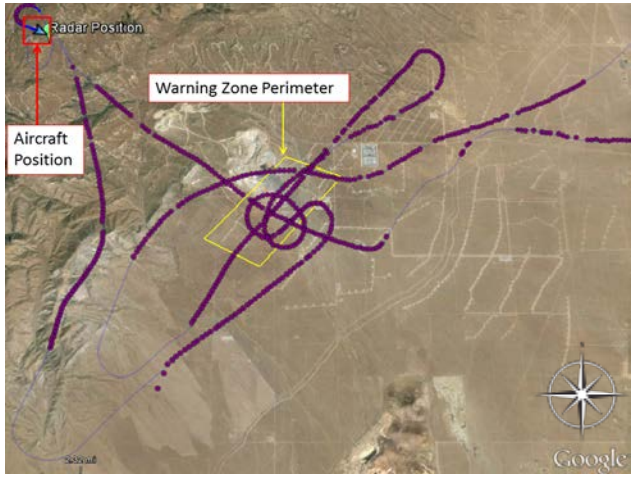
- Aircraft penetrates the warning zone perimeter and continues its 540° left turn inside the warning zone.
- Indicator lamp is on.
- Aircraft is continuously monitored within the warning zone.



Event 15:

- Aircraft begins a right turn, exiting the warning zone to the east.
- Indicator lamp is off.

Figure 16. Continuation of Circling Flight Over the Warning Zone, Then Exit to the East (events 13-15)

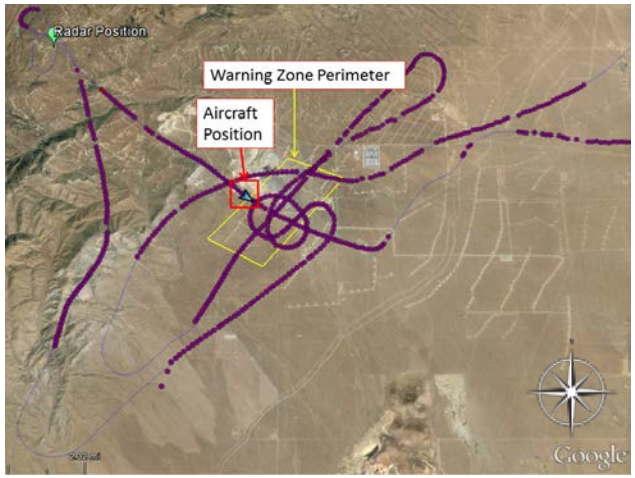


Event 16:

- Aircraft flies directly over the radar site, makes a 180° turn and begins to approach the warning zone from the northwest.
- Indicator lamp is off.

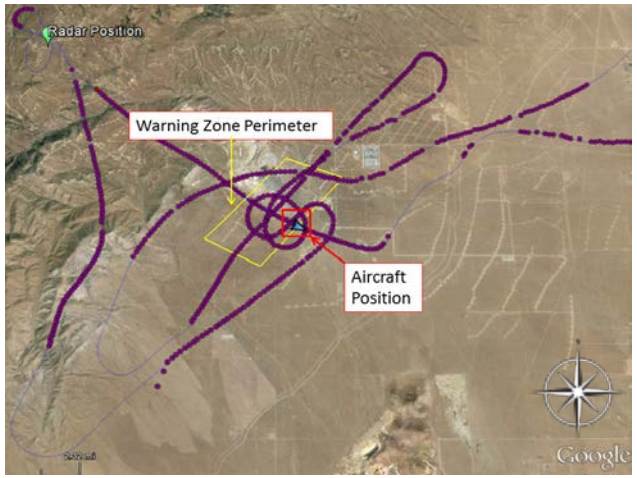
Event 17:

- Aircraft is reacquired and tracked by radar prior to reaching the warning zone.
- Indicator lamp is off.



Event 18:

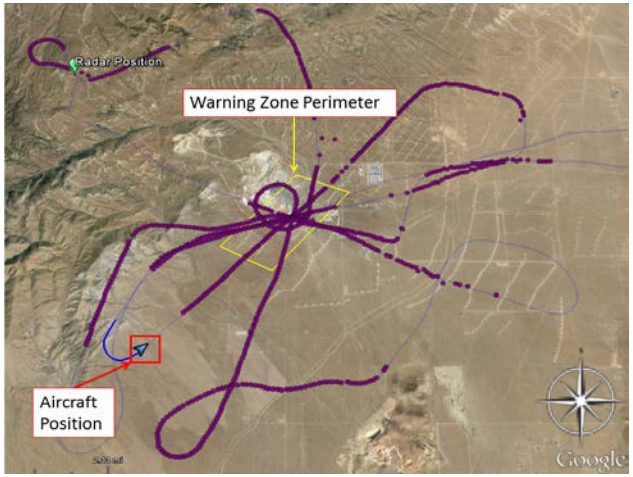
- Aircraft penetrates the warning zone perimeter heading southeast.
- Indicator lamp is on.
- Aircraft is continuously monitored within the warning zone.



Event 19:

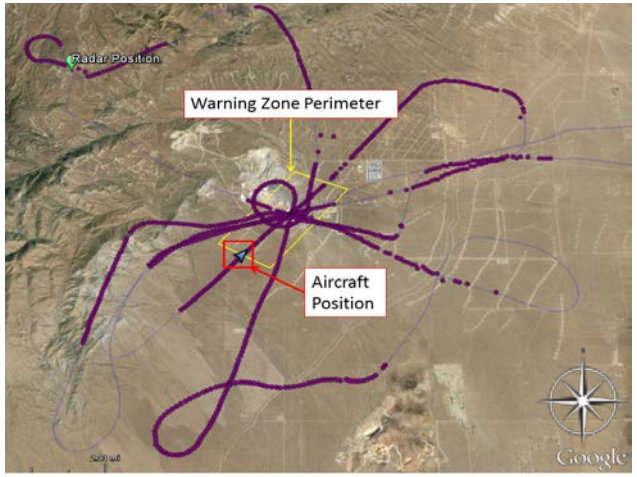
- Aircraft and exits the warning zone to the southeast.
- Indicator lamp is off.

Figure 17. Flight Over Radar Site, Then Directly to the Warning Zone (events 16-19)



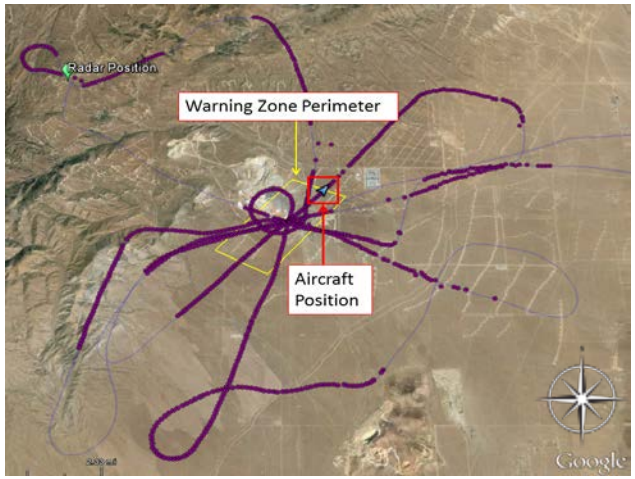
Event 20:

- Aircraft approaches the warning zone from the southwest then suddenly appears from behind the mountain.
- Indicator lamp is off.



Event 21:

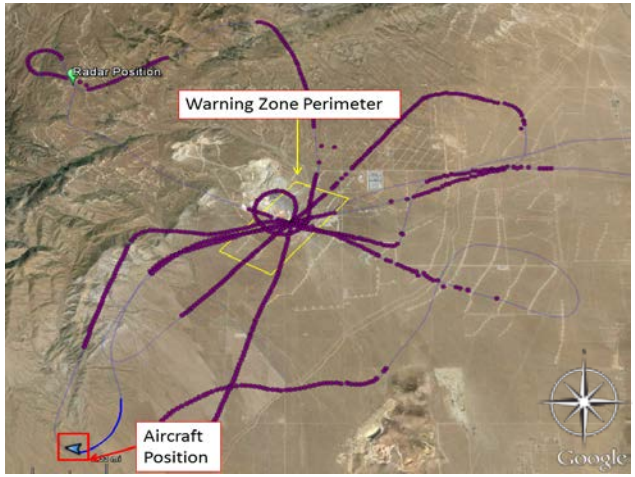
- Aircraft is detected and is tracked by radar shortly before entering the warning zone.
- Aircraft penetrates the warning zone perimeter heading northeast.
- Indicator lamp is on.



Event 22:

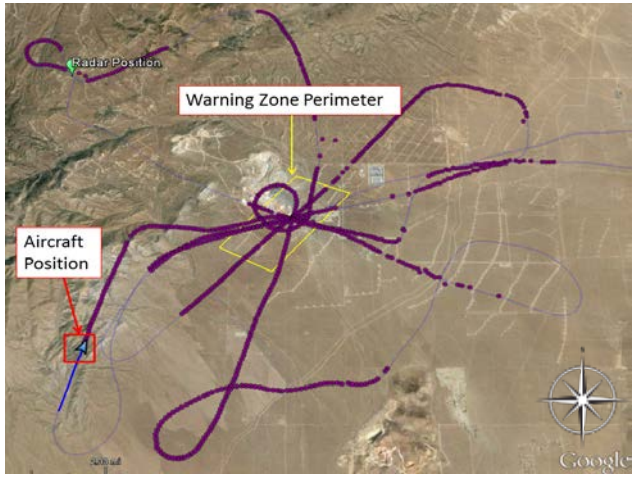
- Aircraft is continuously monitored within the warning zone.
- Aircraft exits the warning zone to the northeast.
- Indicator lamp is off.

Figure 18. Flight to the Warning Zone With Aircraft Initially Hidden Behind a Mountain (events 20-22)



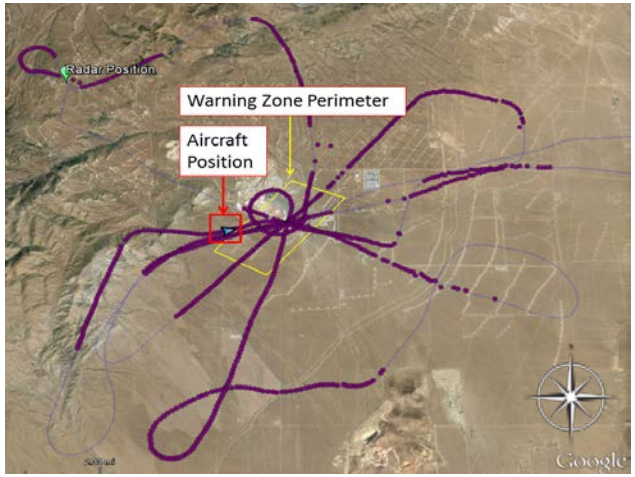
Event 23:

- Aircraft approaches the warning zone from the southwest then suddenly appears from behind the mountain.
- Indicator lamp is off.



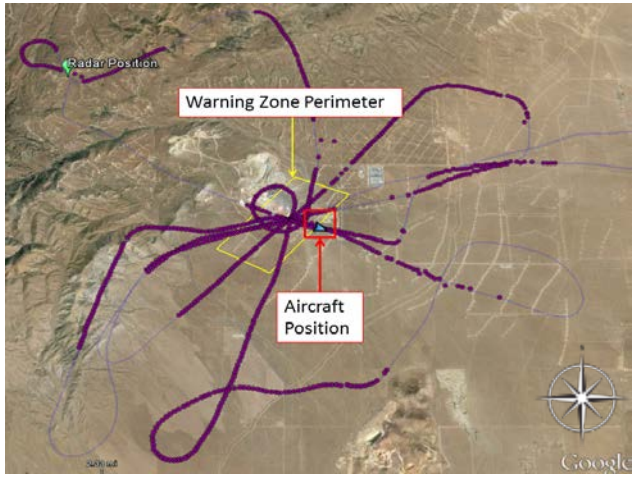
Event 24:

- Aircraft is detected and is tracked by radar.
- Indicator lamp is off.



Event 25:

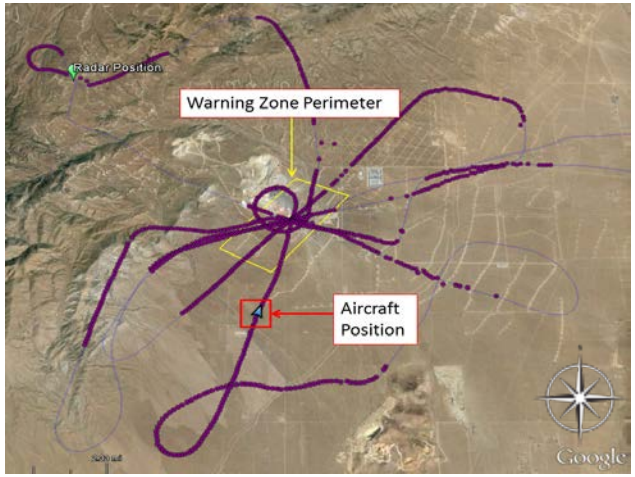
- Aircraft penetrates the warning zone perimeter.
- Indicator lamp is on.
- Aircraft is continuously monitored within the warning zone.



Event 26:

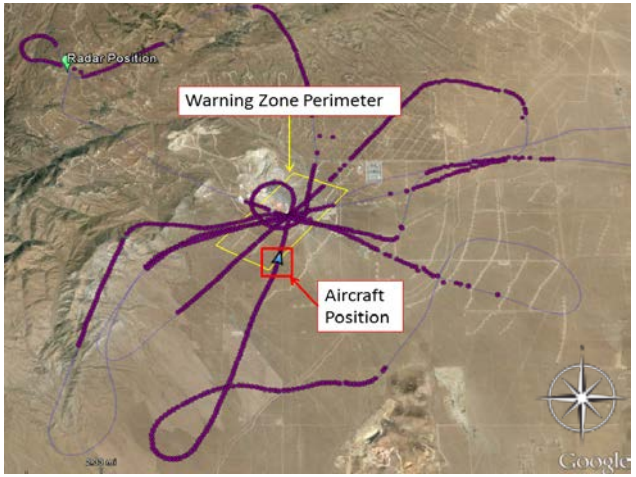
- Aircraft exits the warning zone to the southeast.
- Indicator lamp is off.

Figure 19. Second Flight to Warning Zone With Aircraft Initially Hidden Behind a Mountain (events 23-26)



Event 27:

- Aircraft approaches the warning zone from the south.
- Aircraft is detected and is tracked by radar.
- Indicator lamp is off.

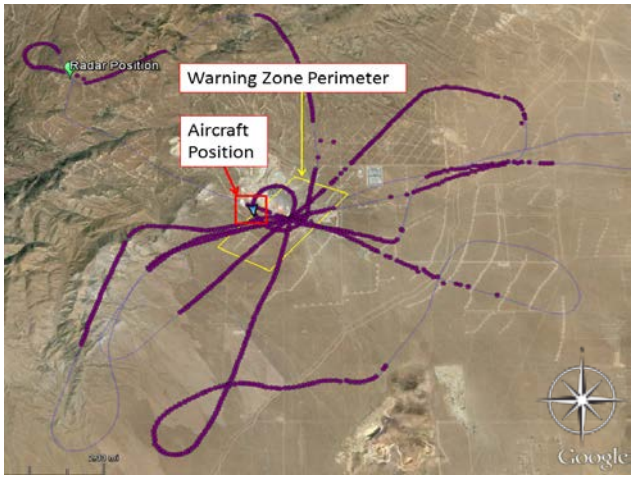


Event 28:

- Aircraft penetrates the warning zone perimeter heading north.
- Indicator lamp is on.
- Aircraft is continuously monitored within the warning zone.

Event 29:

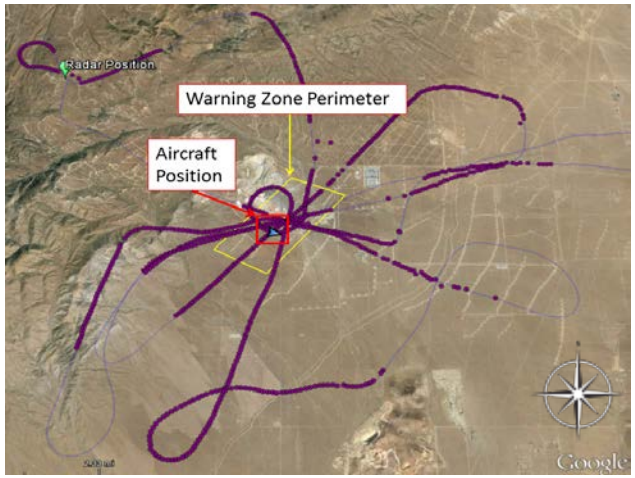
- Aircraft exits the warning zone heading northwest.
- Aircraft begins a 270° left turn towards the warning zone, approaching from the northwest.
- Indicator lamp is off.



Event 30:

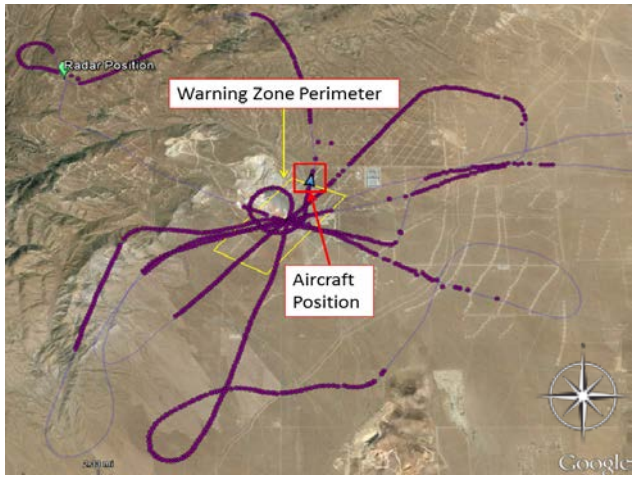
- Aircraft continues its turn and penetrates the warning zone perimeter heading southeast.
- Indicator lamp is on.

Figure 20. Second Circling Flight Over the Warning Zone (events 27-30)



Event 31:

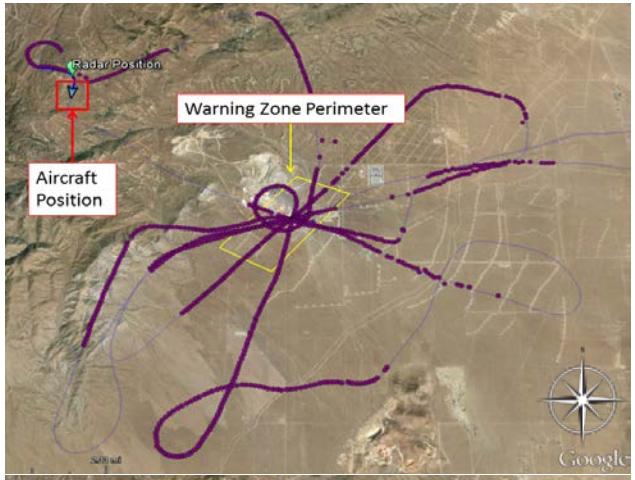
- Aircraft continues the 270° left turn inside the warning zone.
- Aircraft is continuously monitored within the warning zone.
- Indicator lamp is on.



Event 32:

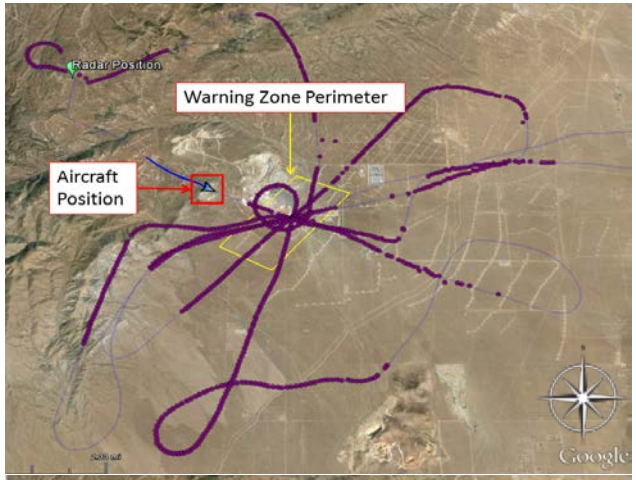
- Aircraft exits the warning zone to the north.
- Indicator lamp is off.

Figure 21. Continuation of Second Circling Flight Over the Warning Zone (events 31-32)



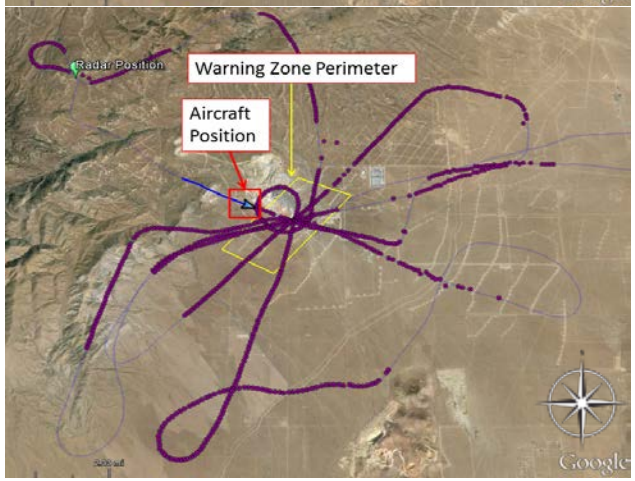
Event 33:

- Aircraft flies over the radar site.
- Radar contact is lost.
- Indicator lamp is off.



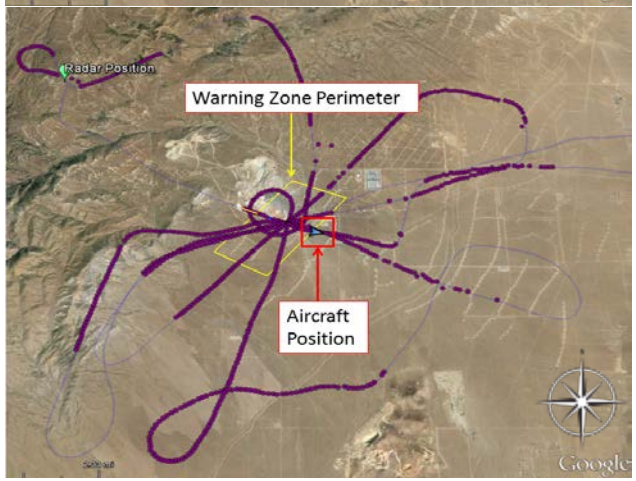
Event 34:

- Aircraft approaches warning zone from the northwest.
- Aircraft is not yet detected by radar.
- Indicator lamp is off.



Event 35:

- Aircraft is detected by radar prior to reaching warning zone.
- Aircraft descends into the zone from 1500 ft AGL heading southeast.
- Indicator lamp is on.



Event 36:

- Aircraft exits the warning zone to the southeast
- Indicator lamp is off.

Figure 22. Descending Flight Into the Warning Zone (events 33-36)

COMPONENT FAILURE ASSESSMENT.

To demonstrate that the Terma OLC system was able to meet the component failure requirements for an ADLS, ATR personnel conducted a series of activities designed to test the system's component failure responses. Descriptions of the activities and the results of the Terma OLC system's failure response are as follows:

- Individual Component and Obstruction Light Control Failure

  These functions were unable to be assessed due to the limited installation at the site. However, Terma engineers did provide the documentation of the fail-safe capabilities of the OLC system to ATR personnel.

- Communication and Status Monitoring

  ATR personnel verified that the Terma OLC system communication and operational status were checked at least once every 24 hours to ensure both are operational.

- Target Size

  ATR personnel confirmed that the Terma OLC system could detect an object with a cross-sectional area of 1 square meter or more within the detection area. This was accomplished by flying an aircraft straight toward the Terma OLC system radar unit, which resulted in the system detecting the narrow profile of the aircraft.

- Activity Log

  The Terma indicated that the data could be stored for an indefinite amount of time, depending on the user's requirement, which satisfies the 15-day requirement of AC 70/7460-1L.

- FCC Part 15 Compliance

  Based on the documentation provided to the ATR personnel by the Terma engineers, it was verified that the Terma OLC system components do not use FCC Part 15 devices [7].

- Audio/Voice Option

  The Terma OLC system does not currently offer a voice/audio option; therefore, this was not evaluated. As stated in AC 70/7460-1L, this is not a required ADLS component.

CONCLUSIONS

The Federal Aviation Administration (FAA) Airport Technology Research and Development Branch evaluated the Terma Obstruction Light Control (OLC) system at the Tehachapi Wind Resource Area, located near Mojave, California. A performance assessment, consisting of demonstrations, flight testing, and data analysis was conducted on April 15, 2015. In this performance assessment, a series of flight patterns were flown against the Terma OLC system to

demonstrate that it could meet the FAA's performance requirements for aircraft detection lighting systems. The Terma OLC system performed according to the manufacturer's specifications and met the performance requirements identified specified in FAA Advisory Circular (AC) 70/7460-1L, "Obstruction Marking and Lighting."

REFERENCES

1. Federal Aviation Administration, "Obstruction Marking and Lighting," Advisory Circular (AC) 70/7460-1L, December 4, 2015.

2. U.S. Federal Register, Title 14 Code of Federal Regulations, Part 77, "Safe, Efficient Use, and Preservation of the Navigable Airspace," Government Printing Office, Washington DC.

3. Patterson, James, Jr., "Performance Assessment of the Laufer Wind Aircraft Detection System as an Aircraft Detection Lighting System," FAA technical note DOT/FAA/TC-TN15/54, September 2015.

4. Terma, "Coverage Report for OLC Demo, California," March 2015.

5. Terma, "SCANTER 5000 Radar Series Radar-Based Obstruction Light Control," 2015.

6. Terma, "SCANTER 5202 System Features: Built-in Test Equipment," 2015.

7. U.S. Federal Register, Title 47 Code of Federal Regulations, Part 15, "Radio Frequency Devices," Government Printing Office, Washington, DC.

APPENDIX A—ADVISORY CIRCULAR 70/7460-1L, CHAPTER 14, AIRCRAFT DETECTION LIGHTING SYSTEMS [1]

CHAPTER 14. AIRCRAFT DETECTION LIGHTING SYSTEMS

14.1 Purpose.

Aircraft Detection Lighting Systems (ADLS) are sensor-based systems designed to detect aircraft as they approach an obstruction or group of obstructions; these systems automatically activate the appropriate obstruction lights until they are no longer needed by the aircraft. This technology reduces the impact of nighttime lighting on nearby communities and migratory birds and extends the life expectancy of obstruction lights.

14.2 General Standards.

14.2.1 The system should be designed with sufficient sensors to provide complete detection coverage for aircraft that enter a three-dimensional volume of airspace, or coverage area, around the obstruction(s) (see Figure A-27 in Appendix A), as follows:

1. Horizontal detection coverage should provide for obstruction lighting to be activated and illuminated prior to aircraft penetrating the perimeter of the volume, which is a minimum of 3 NM (5.5 km) away from the obstruction or the perimeter of a group of obstructions.

2. Vertical detection coverage should provide for obstruction lighting to be activated and illuminated prior to aircraft penetrating the volume, which extends from the ground up to 1,000 feet (304 m) above the highest part of the obstruction or group of obstructions, for all areas within the 3 NM (5.5 km) perimeter defined in subparagraph 14.2.1 1 above.

3. In some circumstances, it may not be possible to meet the volume area defined above because the terrain may mask the detection signal from acquiring an aircraft target within the 3 NM (5.5 km) perimeter. In these cases, the sponsor should identify these areas in their application to the FAA for further evaluation.

4. In some situations, lighting not controlled by the ADLS may be required when the 3 NM (5.5 km) perimeter is not achievable to ensure pilots have sufficient warning before approaching the obstructions.

14.2.2 The ADLS should activate the obstruction lighting system in sufficient time to allow the lights to illuminate and synchronize to flash simultaneously prior to an aircraft penetrating the volume defined above. The lights should remain on for a specific time period, as follows:

---

[1] Federal Aviation Administration, "Obstruction Marking and Lighting," Advisory Circular (AC) 70/7460-1L, December 4, 2015.

1. For ADLSs capable of continuously monitoring aircraft while they are within the 3 NM/1,000 foot (5.5 km/304 m) volume, the obstruction lights should stay on until the aircraft exits the volume. In the event detection of the aircraft is lost while being continuously monitored within the 3 NM/1,000 foot (5.5 km/304 m) volume, the ADLS should initiate a 30-minute timer and keep the obstruction lights on until the timer expires. This should provide the untracked aircraft sufficient time to exit the area and give the ADLS time to reset.

2. For ADLSs without the capability of monitoring aircraft targets in the 3 nm/1,000 foot (5.5 km/304 m) volume, the obstruction lights should stay on for a preset amount of time, calculated as follows:

a. For single obstructions: 7 minutes.

b. For groups of obstructions: (the widest dimension in nautical miles + 6) x 90 seconds equals the number of seconds the light(s) should remain on.

14.2.3 Acceptance of ADLS applications will be on a case-by-case basis and may be modified, adjusted, or denied based on proximity of the obstruction or group of obstructions to airports, low-altitude flight routes, military training areas, or other areas of frequent flight activity. It may be appropriate to keep certain obstructions closest to these known activity areas illuminated during the nighttime hours, while the remainder of the group's obstruction lighting is controlled by the ADLS.

14.2.4 Project sponsors requesting ADLS use should include in their application maps or diagrams indicating the location of the proposed sensors, the range of each sensor, and a visual indication showing how each sensor's detection arc provides the full horizontal and vertical coverage, as required under paragraph 14.2.1. In the event that detection coverage is not 100 percent due to terrain masking, project sponsors should provide multiple maps or diagrams that indicate coverage at the affected altitudes. A sample diagram is shown in Figure A-27 in Appendix A.

14.2.5 Types of ADLS Component or System Failure Events.

1. In the event of an ADLS component or system failure, the ADLS should automatically turn on all the obstruction lighting and operate in accordance with this AC as if it was not controlled by an ADLS. The obstruction lighting must remain in this state until the ADLS and its components are restored.

2. In the event that an ADLS component failure occurs and an individual obstruction light cannot be controlled by the ADLS, but the rest of the ADLS is functional, that particular obstruction light should automatically turn on and operate in accordance with this AC as if it was not controlled by an ADLS, and the remaining obstruction lights can continue to be controlled by the ADLS. The obstruction lighting will remain in this state until the ADLS and its components are restored.

3. Complete light failure should be addressed in accordance with Chapter 2 paragraph 2.4.

14.2.6 The ADLS's communication and operational status shall be checked at least once every 24 hours to ensure both are operational.

14.2.7 The ADLS should be able to detect an aircraft with a cross-sectional area of 1 square meter or more within the volume, as required in subparagraphs 14.2.1 1 and 14.2.1 2.

14.2.8 Each ADLS installation should maintain a log of activity data for a period of no less than the previous 15 days. This data should include, but not be limited to, the date, time, duration of all system activations/deactivations, track of aircraft activity, maintenance issues, system errors, communication and operational issues, lighting outages/issues, etc.

14.2.9 Operational Frequencies.

1. Unlicensed devices (including FCC Part 15) devices cannot be used for this type of system.

2. Any frequency used for the operation of ADLS must be individually licensed through the FCC.

14.3 Voice/Audio Option.

14.3.1 ADLS may include an optional voice/audio feature that transmits a low-power, audible warning message to provide pilots additional information on the obstruction they are approaching.

14.3.2 The audible transmission should be in accordance with appropriate FAA and FCC regulations.

14.3.3 The audible transmission should be over an aviation frequency licensed by the FCC and authorized under the Code of Federal Regulations Title 47- Part 87.483 (excluding 121.5 MHz).

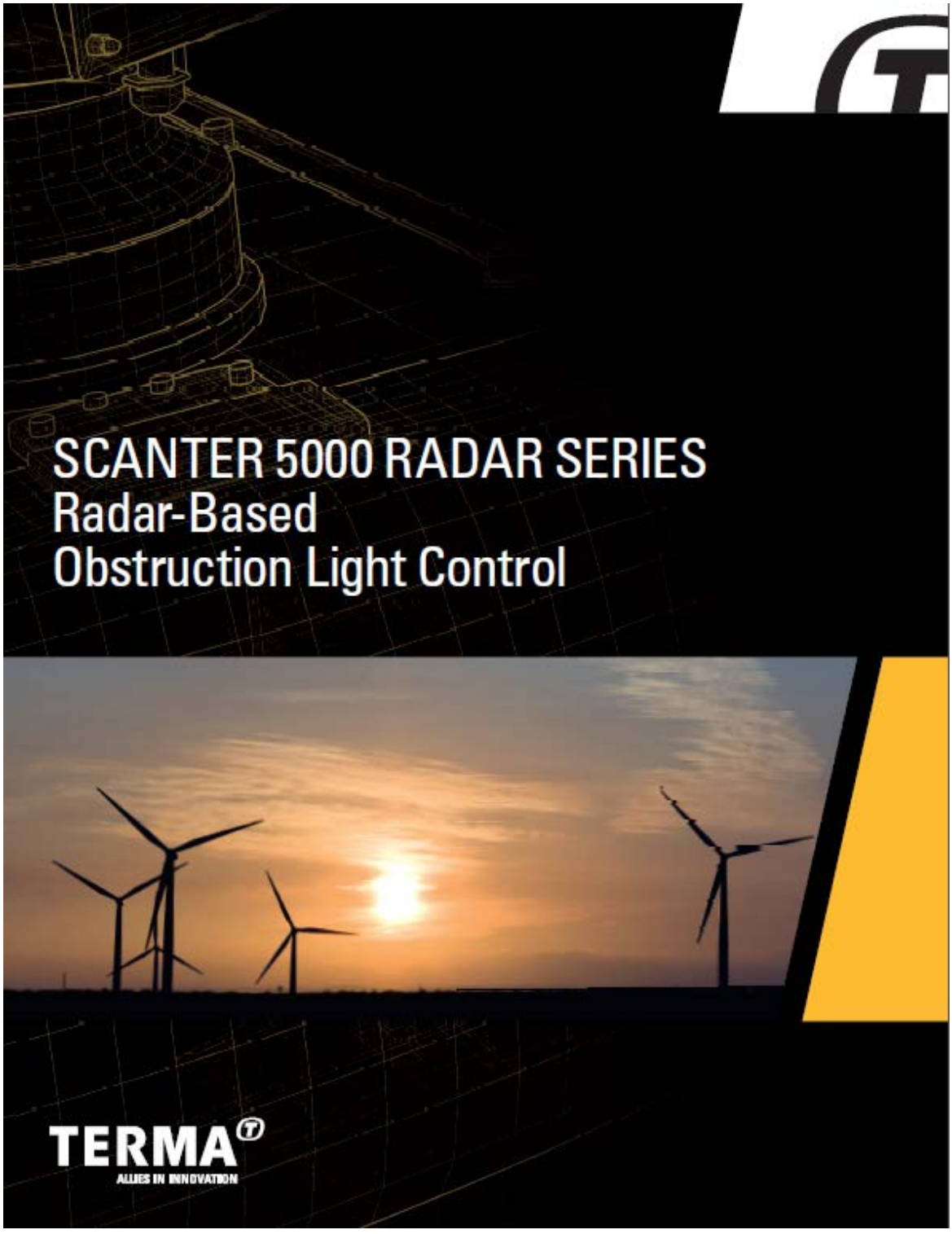
Note: Using air traffic control frequencies in the 117.975-MHz to 137-MHz frequency band is prohibited for this operation.

14.3.4 The audible message should consist of three quick tones, followed by a verbal message that describes the type of obstruction the system is protecting. Appropriate terms to be used include tower(s), wind turbine(s), or power line(s).

14.3.5 The audible message should be repeated three times or until the system determines the aircraft is no longer within the audible warning area defined in the following paragraph.

14.3.6 The audible message should be considered as a secondary, final warning and should be activated when an aircraft is within 1/2 NM (926 m) horizontally and 500 feet (152 m) vertically of the obstruction. The use of, or variation to, the audible warning zone may occur, depending on site-specific conditions or obstruction types.

APPENDIX B—TERMA OBSTRUCTION LIGHT CONTROL SYSTEM INFORMATION



Radar-Based Obstruction Light Control

The increasing size of wind turbines are creating safety and societal challenges for the wind industry, the authorities, and the surrounding municipalities when it comes to obstruction lighting and marking of wind turbines to comply with air traffic regulations. As wind turbines grow taller and enter the lower airspace, high intensity obstruction lights are needed. The high intensity lights required for higher wind turbines can appear very intrusive to wind farm neighbors and to an otherwise pristine night sky. The high intensity lights cause a growing number of delays and cancelations of wind farms due to complaints from neighbors and municipalities near planned wind farms. These problems can be overcome by turning the obstruction lights on only when necessary, i.e. when there is an aircraft in the vicinity of the wind farm. Terma's Obstruction Light Control (OLC) vastly improves the success rate of wind farm deployments, contributing to national climate objectives and at the same time greatly reducing light pollution caused by wind farms.

SOLUTION CAPABILITIES

Terma's radar-based OLC integrates seamlessly with existing infrastructure, aviation obstruction lights, obstruction lights monitoring, control equipment, and lighting from leading vendors.

Combined with Terma's professional services, our turn-key solution is the preferred choice for wind turbine generator manufacturers and wind farm developers.

APPROVALS

Terma has an extensive track record with approval authorities providing documentation, standard safety cases, and support. Terma's knowhow and domain leadership can be of great benefit in the approval process for planning and operational permits. Working with Terma is a long-term partnership from the approval process through to deployment or retrofit of the wind farm.

PRODUCT CHARACTERISTICS

Terma's SCANTER 5000 radar series is part of a larger family of Terma radar products, which have all benefitted from the introduction of fully digital signal processing and Solid State technology, providing extremely clear radar images with low probability of false alarms. The past 5 years of committed field testing governed by independent international aviation authorities has resulted in superior wind farm mitigation capabilities, enabling the radars to truly co-exist with wind turbines without the need for blanking out wind farm areas.

Terma's SCANTER 5000 radar series provides:

- True wind farm mitigation capabilities
- Solid State Power Amplifier (SSPA) ensuring high reliability and availability
- X-Band-based system
- Small target detection capability
- Detection of non-cooperative targets
- Open architecture – integrates via TCP/IP network protocol

SCALABILITY

Terma's radar sensor has a range of 18 km yielding in a total coverage of up to 1,000 km2, making the system ideal for larger wind farms and wind farms with a scattered layout. The exceptional range of the sensor also enables future developments and expansions of the wind farm.

PRODUCT SUSTAINMENT

The Terma SCANTER radar family has proven its performance, reliability, and sustainability in security applications all over the world. Based on Terma's vast knowhow and best-in-class hardware and software technology, the SCANTER 5000 series provides our clients with a proven platform ensuring high availability (High Mean-time Between Failure).

SERVICE & SUPPORT

At Terma, we know the importance of keeping the blades spinning. That is why we offer Global Support & Service Agreements for up to 25 years, supporting long time sustainability and obsolescence management of our SCANTER products throughout the life time of the wind farm.

A WORLD LEADER IN DETECTION TECHNOLOGIES

Terma has more than 60 years of experience in developing and manu-facturing radars, and more than +2,200 radar systems are installed worldwide. Terma provides radar sensors to Vessel Traffic Services (VTS), Coastal Surveillance Radar (CS), and Surface Movement Radar (SMR) segments. More than 85% of all major airports around the world and 65% of all coastal shores rely on Terma's sensor technology.

Terma's OLC is based on proven and reliable technology, ensuring continuous operation and low maintenance costs. Combined with our global service and maintenance capability, you obtain a high-performance system with very low risk.

KEY BENEFITS

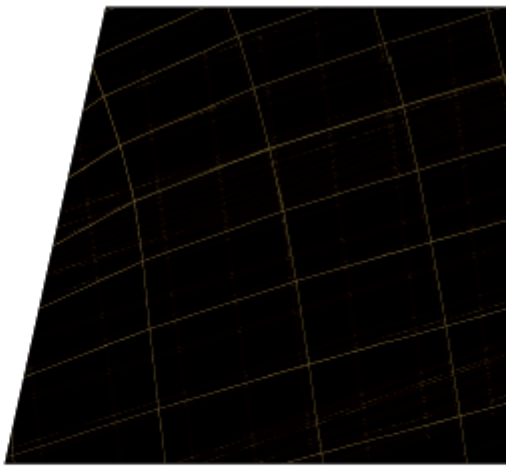
- **Wind Turbine Generator (WTG) manufacturer independent** – Terma's OLC integrates with existing infrastructure and lighting from leading WTG vendors.
- **Scalability / Deployment flexibility** – for larger wind farms that typically have a scattered layout, the Terma sensor capabilities and deployment offerings enable flexible solutions, bringing down the total cost.
- **Extensive track record with approval authorities (SME capabilities)** – each OLC installation typically requires a country-dependent, site-specific approval. Terma has an extensive track record with approval authorities, providing documentation, standard safety cases, and support.
- **Extended instrumented radar range ensures increased collision avoidance capabilities** – extended range provides more 'on time' for collision lighting, thus providing the pilot with an extended warning period beyond legal minimum requirement.

Operating in the aerospace, defense, and security sector, Terma supports customers and partners all over the world. With more than 1,100 committed employees globally, we develop and manufacture mission-critical products and solutions that meet exacting customer requirements.

At Terma, we believe in the premise that creating customer value is not just about strong engineering and manufacturing skills. It is also about being able to apply these skills in the context of our customers' specific needs. Only through close collaboration and dialog can we deliver a level of partnership and integration unmatched in the industry.

Our business activities, products, and systems include: command and control systems; radar systems; self-protection systems for ships and aircraft; space technology; and advanced aerostructures for the aircraft industry.

Headquartered in Aarhus, Denmark, Terma has subsidiaries and operations in The Netherlands, Germany, India, UAE, UK, Singapore as well as a wholly-owned U.S. subsidiary, Terma North America Inc. Terma North America Inc. is headquartered in Arlington, in the Wasington D.C. area, with other offices in Georgia, Texas, Alabama and Virginia.



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ATTACHMENT 4 – GAY HEAD LIGHT TREATMENT PLAN

1.0 Introduction

The Gay Head Light (GAY.900) is a National Register of Historic Places (NRHP) listed property that was determined to be significant under Criteria A and C and a historic maritime structure and aid to navigation.

The mitigation funding from the Vineyard Wind Project to the Town of Aquinnah for the adverse effect to the Gay Head Light shall be used to fund a restoration and stabilization project.

1.1 Proposed Repairs

Vineyard Wind will fund, conduct, and administer in an amount not to exceed $137,500 a mitigation plan to resolve impacts on the Gay Head Light. This will address the advanced state of corrosion of the lantern curtain wall. The mitigation plan will investigate the degree of deterioration to assess conditions in order to better understand components involved in a future complete restoration. To achieve this purpose a selective disassembly or “probe” into the existing construction will be necessary. In addition, the mitigation will, at least temporarily, stabilize the lantern curtain wall so that further damage is prevented, and fully (permanently) restore as much as possible of the curtain wall within the budget.

Specifically, the restoration work will involve the replacement costs for the ladder rail brackets and rail; new stiles with designed connections; glazing batons/bars; cast iron exterior sills; sections of lantern Kick plate; sections of hand-holds/mullions; complete lantern deck railing and stanchions; mid-level mullions; partial Lantern stile ends restoration of outermost ridge of the stiles; pre-formed metals; and replenishment on the edge and construct the 12 bold-in stile ends that mimic the existing edge.

Two of the sixteen sections of the curtain wall are targeted for complete disassembly. These sections are specifically those with components exhibiting the greatest degree of deterioration and include the cast-iron stiles, rails, head jamb, bottom plate and vent and one other, bay which is in the best apparent condition. At these locations, the existing glass will be removed and replaced with new laminated glass panes as necessary. The stiles, sills, and horizontal mullions will be stripped clean of all coatings. Stripped metals will be replenished as necessary utilizing a Belzona system. The deteriorated stiles can be temporarily repaired or replaced with something similar. All components and lantern walls are to be scanned with LIDAR, documented, and converted into AutoCAD for future castings or fabrication/machining as necessary.

Upon completion of temporary repairs, the entire curtain wall is to be leak tested and inspected for adequate sealant. Where necessary, it will receive new sealant and as many as six broken or cracked panes of glass are to be replaced, secured, and sealed to the extent that the budget allows. The exterior ironwork on all sills, stiles and mullions are to receive a corrosion resistant coating to help stabilize and preserve the existing components for future restorations.

In summary, the goal will be to learn exactly how this curtain wall was designed, how many components will require replacement vs. repairs, and perform as much repair work that the allocated funding allows. A

final assessment report, including all obtained engineering drawings, shall be submitted to the Town of Aquinnah to be used for future restoration considerations.

2.0 Standards

The project will require the mobilization of a qualified field crew that is fully experienced in historic restorations of this particular nature. The services of a consulting structural engineer and draftsman will also be needed. The Gay Head Light Advisory Board (GHLAB) reserves the right to review the qualifications of all contractors. The Gay Head Light Advisory Board must approve and supervise all mitigation project work for The Town of Aquinnah. All work is to be approved and supervised by the GHLAB.

The mitigation projects must be developed consistent with the Secretary of the Interior's Standards and Guidelines for Rehabilitation (36 CF 67). Proposed scopes of work, draft text, project plans, and design specifications, should be submitted to the Massachusetts State Historic Preservation Officer (MASHPO) at the Massachusetts Historical Commission (MHC) for review and comment as they are developed. Mitigation projects must be reviewed and approved by MASHPO under the terms of the Preservation Restriction (PR) (M.G.L Chapter 184, Section 31-33).

ATTACHMENT 5 - CHAPPAQUIDDICK ISLAND TRADITIONAL CULTURAL PROPERTY

1.0 Introduction

The Chappaquiddick Island Traditional Cultural Property (TCP) has been determined potentially eligible for listing on the National Register of Historic Places (NRHP) as a traditional cultural property, with significance under Criterion A for its association with and importance in maintaining the continuing cultural identity of the Wampanoag people; Criterion B for its association with Moshup, Squant, and Cheepi; Criterion C as a distinguishable and significant component to Wampanoag folklife traditions; and Criterion D for its potential to yield valuable information pertaining the prehistory and history of the region through archaeology, ethnography, and ethnohistory. The entire island, as well as Norton Point on Martha's Vineyard and Katama Bay, are part of the TCP.

The TCP includes eight contributing elements: The Chappaquiddick Lots (North Neck-Silver Lots); Chappaquiddick Lots (Town of Edgartown)/Woodland Reservation Lots; Katama Bay; Norton Point; Poucha Pond; Sampson Hill; and Wasque Point. Sampson Hill is not located within the viewshed area of potential effects (APE).

Bureau of Ocean Energy Management (BOEM) determined the TCP's traditional viewshed, including the viewshed from the seven contributing elements within the viewshed APE, would be adversely affected by the undertaking because of the introduction of manmade structure where no structures had previously existed.

As mitigation of the undertaking's adverse effect to the Chappaquiddick Island TCP VW must fund and conduct in an amount not to exceed $150,000 an ethnographic study and NRHP nomination package. More specific details of these are described below.

2.0 Ethnographic Study

The Ethnographic Study shall include review of historical records and interviews with knowledgeable tribal members to gather pertinent information on the non-Federally recognized historic Massachusetts Chappaquiddick Tribe of the Wampanoag Nation, present cultural practices, their historic presence on Chappaquiddick Island as well as current cultural ties to and activities on Chappaquiddick Island. The study shall also include mapping and no more than two site visits to the island to locate important activity areas (with Tribal members, if available) and conduct research and photography. No archaeological fieldwork shall be conducted as part of the study. Specific study research areas are:

1. Origin and historic settlement of Chappaquiddick Island
2. Distinctive cultural aspects and/or historical events
3. The location and description of important cultural activity areas
4. Location and description of extant significant buildings and structures
5. Oral history on the daily life and important historical events
6. Continuing present day cultural practices on Chappaquiddick Island

3.0 Traditional Cultural Property National Register Nomination

With the background information compiled in the Ethnographic Study, the applicant shall prepare a National Register Nomination in accordance with the National Park Service Bulletin 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties as well as other relevant National Register bulletins and guidance. The National Register Nomination will include background research to support the National Register listing.

The non-Federally recognized historic Massachusetts Chappaquiddick Tribe of the Wampanoag Nation as the knowledgeable authority on its history, cultural practices and sensitive information shall review the Nomination and, after reviewing any edits, will be presented with a final draft.

4.0 Professional Standards

1. All work carried out pursuant to this Memorandum of Agreement (MOA) must meet the Secretary of the Interior's (SOI) Standards for Archaeology and Historic Preservation (SOI's Standards; http://www.nps.gov/history/local-law/arch_stnds_9.htm), taking into account the suggested approaches to new construction in the SOI's Standards for Rehabilitation.
2. Vineyard Wind must ensure that all work carried out pursuant to this MOA must be done by or under the direction supervision of historic preservation professionals who meet the Secretary of the Interior's Professional Qualifications Standards. BOEM, or its designee, must ensure that consultants retained for services pursuant to the MOA meet these standards. In addition, the ethnographic study shall be carried out by or under the supervision of a professionally qualified cultural anthropologist in collaboration with THPOs and respective Tribal community members, as the Tribal representatives are the cultural bearers of their oral history. Pursuant to the Code of Massachusetts Regulations (950 CMR 70.10(1)) an interdisciplinary research team should be developed and include qualified individuals with relevant previous experience in similar projects in Massachusetts and the New England Region. A “qualified professional” is a person who meets the relevant standards outlined in the Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines [As Amended and Annotate] (http://www.nps.gov/history/loca-law/arch_stnds_9.htm)
3. The Chappaquiddick Island TCP NRHP Nomination must be produced by a qualified historic preservation consultant. The consultant must solicit and incorporate the views of the non-Federally recognized historic Massachusetts Chappaquiddick Tribe of the Wampanoag Nation and other local interested stakeholders, such as the Trustees of Reservations. All work will be conducted in a collaborative effort with Tribal representatives participating in the process.

ATTACHMENT 6 - VINEYARD SOUND AND MOSHUP'S BRIDGE TRADITIONAL CULTURAL PROPERTY

1.0 Introduction

Vineyard Sound and Moshup's Bridge Traditional Cultural Property (TCP)[1], as it is currently referred to, is considered eligible for listing on the National Register of Historic Places (NRHP) under Criterion A for its association with Native American exploration and settlement, Criterion B for its association with Moshup, Criterion C as a significant component of Aquinnah and Mashpee Tribal nations' lifeways, cosmology, economies, traditions, beliefs and cultural practices transcending pre-contact and historic time periods, and Criterion D for its potential to yield information significant to understanding the Native American settlement, economies, land use, and cultural practices prior to and after the inundation of Vineyard Sound.

The Vineyard Sound and Moshup's Bridge TCP is not limited to meeting National Historic Preservation Act (NHPA) criterion and is to be considered under Executive Order (EO) 13007 and the American Indian Religious Freedom Act , and the National Environmental Policy Act (NEPA) review process. EO 13007, "Indian Sacred Sites" (61 FR 26771-26772 (1996)), directs federal land managing agencies to accommodate access to, and ceremonial use of, Indian sacred sites by Indian religious practitioners and to avoid adversely affecting the physical integrity of such sacred sites. Bureau of Ocean Energy Management's (BOEM) management actions within the Outer Continental Shelf may not directly affect Indian sacred sites. However, BOEM recognizes Outer Continental Shelf (OCS) undertakings could affect the physical integrity or ceremonial use of Indian sacred sites located on federal lands. On June 26, 1998, the Director of the Minerals Management Service (since reorganized to BOEM) signed a statement of BOEM's basic policy and procedures to ensure full compliance with the intent of EO 13007.

Though the final boundaries of the TCP have yet to be determined, designation of the area as a TCP is a way of grouping and/or looking at the cultural resources to emphasize the place's value and cultural significance relating to the Mashpee and Aquinnah communities. The Vineyard Sound and Moshup's Bridge area are potentially part of a larger Traditional Cultural District that includes Nantucket and Nantucket Sound, and is associated with the traditional beliefs of collective Wampanoag origins. The TCP is eligible for listing because it is substantiated by Wampanoag cultural, traditions, historical ties to the integrated natural environment, patterns of land use reflective of thousands of years of occupation and habitation. As long-term residents the Wampanoag have performed ceremonial activities within these areas in accordance with traditional cultural rules of practice.

In order to resolve impacts, BOEM is requiring Vineyard Wind to fund mitigation. To fulfill the requirement, Vineyard Wind will fund and conduct in an amount not to exceed $150,000 an ethnographic study to document the TCP, as well as completing a documentation package to nominate the TCP for the NRHP. BOEM's requirements for the studies are be strictly limited to ethnographic and historical

[1] This newly identified property is currently referred to as the Vineyard Sound and Moshup's Bridge TCP, but is subject to change upon further study. The Tribes will name the TCP so as to be more inclusive of the whole area.

information, and will not include any additional archaeological fieldwork related to the TCP. Additional details are provided below:

2.0 Ethnographic study

The Ethnographic Study must include review of historical records and interviews with knowledgeable Wampanoag Tribal members to gather pertinent information on Moshup and his history and importance to the Wampanoag people, including the creation of Moshup's Bridge, Martha's Vineyard/Noepe as well as existing features attributed to Moshup. The study must also include mapping and site visits to the island to locate important features (with Tribal members, if available) and conduct research and photography. Tribal members must be present for mapping in order to ensure proper location and cultural associations. No more than two site visits are required. No archaeological fieldwork is required as part of the study. The study must include, but not be limited to, the following information to support the eligibility of Moshup's Bridge for listing on the National Register of Historic Places as a Traditional Cultural Property:

1. The origin story of Moshup and his arrival at Martha's Vineyard/Noepe, including information on the creation of the island, Vineyard Sound, Moshup's Bridge, Moshup's Den, Aquinnah Cliffs, Elizabeth Islands, and Nomans Island. Information gathered shall include Wampanoag oral histories, traditions, and investigation will confirm whether all of these locations are to be included within the TCP boundaries.
2. Distinctive cultural aspects and/or historical events attributed to Moshup including the creation of existing landforms within the eligible TCP.
3. The location and description of existing features on the Martha's Vineyard/Noepe as well as activity areas including hunting, fishing, and ceremonial locations (that are acceptable for inclusion due to cultural sensitivities) attributed to Moshup. Such information will be important to determine the boundaries of the TCP for National Register purposes.
4. History of the role Moshup plays in relation to the Peoples and information on aspects of Wampanoag cultural attributed to him. In addition, information pertinent to history of Moshup's wife Squant and Cheepi, who are important to the oral history and Wampanoag cultural traditions, will be included in the study.
5. The association of the Wampanoag's cultural beliefs and practices in relation to Moshup and how such continuing practices on Martha's Vineyard/Noepe are important to maintaining the cultural identity of the Wampanoag.

It should be noted that the above components to be included in the ethnographic study are merely suggested areas of specific interest to meet NHPA designation criteria and in no way limit or diminish the actual areas of focus.3.0 Traditional Cultural Property National Register Nomination

With the background information compiled in the Ethnographic Study, the applicant must prepare a National Register Nomination in accordance with the National Park Service Bulletin 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties as well as other relevant National Register bulletins and guidance. The National Register Nomination must be completed for Moshup's Bridge, as a

Traditional Cultural Property for the Wampanoag. The boundaries of the property must be informed by information gathered from the Ethnographic Study as well as additional historical and archaeological research and may or may not include the entirety of the initial bounded eligible area as appropriate. Consultation shall also be conducted with other relevant property managers and interested parties, such as the U.S. Coast Guard (USCG), Town of Gosnold, and individual property owners, regarding the Elizabeth Islands. The nomination must include a history of the role of Moshup in the Wampanoag tradition. The nomination must also include extant resources including landscape features, applicable archaeological sites, as well as important activity areas and ceremonial locations as provided by the Wampanoag.

The Wampanoag Tribe of Gay Head (Aquinnah) and Mashpee Wampanoag Tribe, as the knowledgeable authorities on their history, cultural practices, and sensitive information shall review the Nomination and, after reviewing any edits, will be presented with a final draft.

4.0 Professional Standards

1. All work carried out pursuant to this Memorandum of Agreement (MOA) must meet the Secretary of the Interior's (SOI) Standards for Archaeology and Historic Preservation (SOI's Standards; http://www.nps.gov/history/local-law/arch_stnds_9.htm), taking into account the suggested approaches to new construction in the SOI's Standards for Rehabilitation.
2. Vineyard Wind must ensure that all work carried out pursuant to this MOA must be done by or under the direction supervision of historic preservation professionals who meet the Secretary of the Interior's Professional Qualifications Standards. BOEM, or its designee, must ensure that consultants retained for services pursuant to the MOA meet these standards. In addition, the ethnographic study shall be carried out by or under the supervision of a professionally qualified cultural anthropologist in collaboration with THPOs and respective Tribal community members, as the Tribal representatives are the cultural bearers of their oral history. Pursuant to the Code of Massachusetts Regulations (950 CMR 70.10(1)) an interdisciplinary research team should be developed and include qualified individuals with relevant previous experience in similar projects in Massachusetts and the New England Region. A "qualified professional" is a person who meets the relevant standards outlined in the Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines [As Amended and Annotate] (http://www.nps.gov/history/loca-law/arch_stnds_9.htm).
3. The Vineyard Sound-Moshup's Bridge TCP NRHP Nomination must be produced by a qualified historic preservation consultant. The consultant must solicit and incorporate the views of the Wampanoag Tribe of Gay Head (Aquinnah) and the Mashpee Wampanoag Tribe into the NRHP Nomination. All work will be conducted in a collaborative effort with Tribal representatives participating in the process.

ATTACHMENT 7 - SUMMARY OF AVOIDANCE AND MITIGATION MEASURES FOR SUBMERGED ANCIENT LANDFORM AND ARCHAEOLOGICAL FEATURES

In order to resolve impacts any submerged ancient landform features that are a contributing element to the Nantucket Sound Traditional Cultural Property (TCP) or to a broader traditional cultural landscapes that cannot be avoided by the project, BOEM will require Vineyard Wind to either avoid the feature or, if it is unavoidable, to apply the mitigation treatment plan described in Attachment 8 (Treatment Plan for Submerged Ancient Landform Features with the Potential to Contain Pre-Contact Period Archaeological Sites).

The tables below provide additional details concerning the identified submerged ancient landform features that are a contributing element to the Nantucket Sound TCP or to a broader traditional cultural landscape, as well as other potential archaeological features identified in the Area of Potential Effects (APE). Table 1 provides additional information for the 31 identified submerged landform features and 7 shipwrecks identified, including their avoidance status, mitigation measures, and their status in relation to the Nantucket Sound TCP or a broader traditional cultural landscape. Table 2 notes the types of disturbance within the APE, vertical disturbance depth, disturbance width, and scour protection radius.

In any case where the proposed avoidance distance in this attachment differs from that in the main body of the MOA, the avoidance distance in the MOA takes precedent and will be the avoidance distance Vineyard Wind will be required to observe.

TABLE 1: SUMMARY OF AVOIDANCE AND MITIGATION MEASURES FOR IDENTIFIED SUMBERGED ANCIENT LANDFORM AND ARCHAEOLOGICAL FEATURES							
Feature ID[1,2]	Depth (m bsb)[3]	Radiocarbon Age (Cal BP)[4]	Associated Vibracore/Boring with Terrestrial Sediments	Traditional Cultural Property (TCP)[5,6,7]	Contributing Element to TCP?	Expected Avoidance Status	Proposed Avoidance and Mitigation Measures[8]
OFFSHORE EXPORT CABLE CORRIDOR (OECC)							
OECC Paleochannel Groups							
Channel Group 8	1-10	NA	NA	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 9	1-4	NA	NA	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 10	1-10	NA	Vibracores 41, 126, 141, 142, 144, 145	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 11	3-10	NA	Vibracores 128 & 129	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 12	2-10	NA	NA	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged

TABLE 1: SUMMARY OF AVOIDANCE AND MITIGATION MEASURES FOR IDENTIFIED SUMBERGED ANCIENT LANDFORM AND ARCHAEOLOGICAL FEATURES							
Feature ID[1,2]	Depth (m bsb)[3]	Radiocarbon Age (Cal BP)[4]	Associated Vibracore/Boring with Terrestrial Sediments	Traditional Cultural Property (TCP)[5,6,7]	Contributing Element to TCP?	Expected Avoidance Status	Proposed Avoidance and Mitigation Measures[8]
							landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 13	3-9	NA	NA	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 14/ Lake 1	3-10	NA	NA	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Lake 2	3-10	NA	N	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 15	2-8	NA	Vibracore 166	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)

TABLE 1: SUMMARY OF AVOIDANCE AND MITIGATION MEASURES FOR IDENTIFIED SUMBERGED ANCIENT LANDFORM AND ARCHAEOLOGICAL FEATURES							
Feature ID[1,2]	Depth (m bsb)[3]	Radiocarbon Age (Cal BP)[4]	Associated Vibracore/Boring with Terrestrial Sediments	Traditional Cultural Property (TCP)[5,6,7]	Contributing Element to TCP?	Expected Avoidance Status	Proposed Avoidance and Mitigation Measures[8]
Channel Group 16	1-10	NA	Vibracores 168 & 169	Landscape	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 17	1-6	NA	NA	Landscape	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 18	2-10	NA	NA	Landscape	Yes	Avoided	Export cables will avoid this feature by not using the Western Muskeget Option
Channel Group 19	2-10	NA	NA	Landscape	Yes	Avoided	Export cables will avoid this feature by not using the Western Muskeget Option
Channel Group 20	2-8	NA	NA	Landscape	Yes	Avoided	Export cables will avoid this feature by not using the Western Muskeget Option
Channel Group 21	1-10	NA	NA	Landscape	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 22	4-8	NA	NA	NA	NA	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource*

TABLE 1: SUMMARY OF AVOIDANCE AND MITIGATION MEASURES FOR IDENTIFIED SUMBERGED ANCIENT LANDFORM AND ARCHAEOLOGICAL FEATURES							
Feature ID[1,2]	Depth (m bsb)[3]	Radiocarbon Age (Cal BP)[4]	Associated Vibracore/Boring with Terrestrial Sediments	Traditional Cultural Property (TCP)[5,6,7]	Contributing Element to TCP?	Expected Avoidance Status	Proposed Avoidance and Mitigation Measures[8]
							Mitigation for Submerged Landforms Vineyard Wind 1 Project)
OECC Vibracores with Terrestrial Sediments not Associated with Channel Groups							
Vibracore 170	2.05	6,237	NA	Landscape	Yes	Avoided	Export cables will avoid this feature by micro-routing; recommended avoidance buffer of 50 m
Vibracore 171	0.86	14,060	NA	Landscape	Yes	Avoided	Export cables will avoid this feature by micro-routing; recommended avoidance buffer of 50 m
OECC Potential Shipwrecks							
PSW-1/OECC KP 25.45	0	NA	NA	Landscape	No	Avoided	Export cables will avoid this feature by micro-routing around the 40 x 90 m debris field; recommended avoidance buffer of 100 m from target boundary
PSW-2/OECC KP 27.5	0	NA	NA	Landscape	No	Avoided	Export cables will avoid this feature by micro-routing around the 14 x 37 m area; recommended avoidance buffer of 100 m from target boundary
PSW-3/NHAL KP 1.0	0	NA	NA	Nantucket Sound TCP	No	Avoided	Export cables will avoid this feature by not using the New Hampshire Avenue Option; New Hampshire Avenue is no longer included in the undertaking
PSW-4/ NHAL KP 2.9	0	NA	NA	Nantucket Sound TCP	No	Avoided	Export cables will avoid this feature by not using the New Hampshire Avenue Option; New Hampshire Avenue is no longer included in the undertaking
PSW-5/NHAL KP 3.5	0	NA	NA	Nantucket Sound TCP	No	Avoided	Export cables will avoid this feature by not using the New Hampshire Avenue Option; New Hampshire Avenue is no longer included in the undertaking
WIND DEVELOPMENT AREA (WDA)							

TABLE 1: SUMMARY OF AVOIDANCE AND MITIGATION MEASURES FOR IDENTIFIED SUMBERGED ANCIENT LANDFORM AND ARCHAEOLOGICAL FEATURES							
Feature ID[1,2]	Depth (m bsb)[3]	Radiocarbon Age (Cal BP)[4]	Associated Vibracore/Boring with Terrestrial Sediments	Traditional Cultural Property (TCP)[5,6,7]	Contributing Element to TCP?	Expected Avoidance Status	Proposed Avoidance and Mitigation Measures[8]
WDA Paleochannel Groups[9,10]							
Channel Group 23	1.0-2.1	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by micro-routing
Channel Group 24	1.6-6.5	NA	NA	NA	NA	Not Avoided	Inter-array cable may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)[6]
Channel Group 25	1.9-6.7	NA	NA	NA	NA	Not Avoided	Inter-array cable and jack-up vessel may not be able to avoid this feature (adjacent to WTG); Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)[6]
Channel Group 26	1.3-6.8	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by micro-routing
Channel Group 27	2.0-4.9	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by shallower (1.5 m) burial
Channel Group 28	2.3-6.5	NA	Boring 18T033	NA	NA	Avoided	WTG will not be installed at this location
Channel Group 29	1.2-2.6	NA	NA	NA	NA	Not Avoided	WTG and inter-array cable may not be able to avoid this; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource*

TABLE 1: SUMMARY OF AVOIDANCE AND MITIGATION MEASURES FOR IDENTIFIED SUMBERGED ANCIENT LANDFORM AND ARCHAEOLOGICAL FEATURES							
Feature ID[1,2]	Depth (m bsb)[3]	Radiocarbon Age (Cal BP)[4]	Associated Vibracore/Boring with Terrestrial Sediments	Traditional Cultural Property (TCP)[5,6,7]	Contributing Element to TCP?	Expected Avoidance Status	Proposed Avoidance and Mitigation Measures[8]
							Mitigation for Submerged Landforms Vineyard Wind 1 Project)[6]
Channel Group 30	1.6-5.3	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by micro-routing
Channel Group 31	1.3-5.2	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by micro-routing
Channel Group 32	0.8-3.5	NA	NA	NA	NA	Not Avoided	Inter-array cable and jackup rig may not be able to avoid this feature (adjacent to WTG); Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)[6]
Channel Group 33	2.2-5.3	NA	NA	NA	NA	Avoided	Inter-array cables can avoid by shallower (1.5 m) burial
Channel Group 34	2.3-5.3	NA	NA	NA	NA	Avoided	Inter-array cables can avoid by shallower (1.5 m) burial
Channel Group 44	1-10	NA	Vibracore 309	NA	NA	Not Avoided	Inter-array cable may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)[6]
Channel Group 45	2-5	NA	Vibracore 309	NA	NA	Not Avoided	Inter-array cable may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource*

TABLE 1: SUMMARY OF AVOIDANCE AND MITIGATION MEASURES FOR IDENTIFIED SUMBERGED ANCIENT LANDFORM AND ARCHAEOLOGICAL FEATURES							
Feature ID[1,2]	Depth (m bsb)[3]	Radiocarbon Age (Cal BP)[4]	Associated Vibracore/Boring with Terrestrial Sediments	Traditional Cultural Property (TCP)[5,6,7]	Contributing Element to TCP?	Expected Avoidance Status	Proposed Avoidance and Mitigation Measures[8]
							Mitigation for Submerged Landforms Vineyard Wind 1 Project)[6]
Channel Group 46	1-8	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by micro-routing and shallower (1.5 m) burial
WDA Borings with Terrestrial Sediments not Associated with Channel Groups							
Boring 18S2	2.65-2.95	NA	NA	NA	NA	Avoided	Inter-array cables can avoid by shallower (1.5 m) burial; ESP will not be installed at this location
WDA Vibracores with Terrestrial Sediments not Associated with Channel Groups							
Vibracore C010	1.14-1.18	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by micro-routing
Vibracore 313	2.65	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by shallower (1.5 m) burial
Vibracore 333	2.05-2.10	14,060	NA	NA	NA	Avoided	Inter-array cable can avoid by shallower (1.5 m) burial
Vibracore 400	1.95-1.97	12,045	NA	NA	NA	Avoided	Inter-array cable can avoid by shallower (1.5 m) burial
Vibracore 407	2	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by shallower (1.5 m) burial
WDA Shipwrecks							
SW-1	0	NA	NA	NA	NA	Avoided	8 x 26 m area on edge of cable corridor. Recommended avoidance buffer of 50 m from target boundary.
SW-2	0	NA	NA	NA	NA	Avoided	11 x 22 m area outside survey area. Recommended avoidance buffer of 50 m from target boundary.

Notes:

1. Table includes features within and outside of the Area of Potential Effect (APE).

2. Table excludes OECC Paleochannel Groups 1 through 7, which were along the OECC variant to New Hampshire Avenue and are no longer part of the undertaking.
3. Depth (m bsb) = depth in meters below the seabed to the feature
4. Calibration to years Before Present (Cal BP)
5. Although the exact boundary of the Nantucket Sound TCP is not precisely defined, it is roughly bound by Vineyard Sound, Cape Cod, Martha's Vineyard, and Nantucket.
6. Although the Chappaquiddick TCP does not have specific boundaries, it roughly encompasses the Island of Chappaquiddick, Norton Point in Edgartown, and Katama Bay. OECC Paleochannel Groups 16, 17, and 21, which may not be avoided by the export cables, may be within a traditional cultural landscape.
7. None of the Project's facilities will be physically located within the Vineyard Sound and Moshup's Bridge TCP.
8. Recommended buffer zones around features designated by the Project's Qualified Marine Archaeologist:
    - 50 m from the edge of a shipwreck target boundary (presumed historic if no visual inspection conducted) and 100 m for potential shipwrecks; avoidance buffers are from the maximum visible extent of the shipwreck site
    - 50 m radius from isolated points including vibracores and borings containing paleo-soils
    - 5 m surrounding a paleo-channel depth contour within the vertical APE
9. The current estimate of six unavoidable channel groups may be updated if BOEM selects an alternate layout and new inter-array cable routes are developed.
10. Sixteen WDA Paleochannel Groups (Channel Groups 35 through 43 and Channel Groups 47 through 53) are deeper than the APE and will not be impacted. Thus, these WDA Paleochannel Groups are not included in the table above.

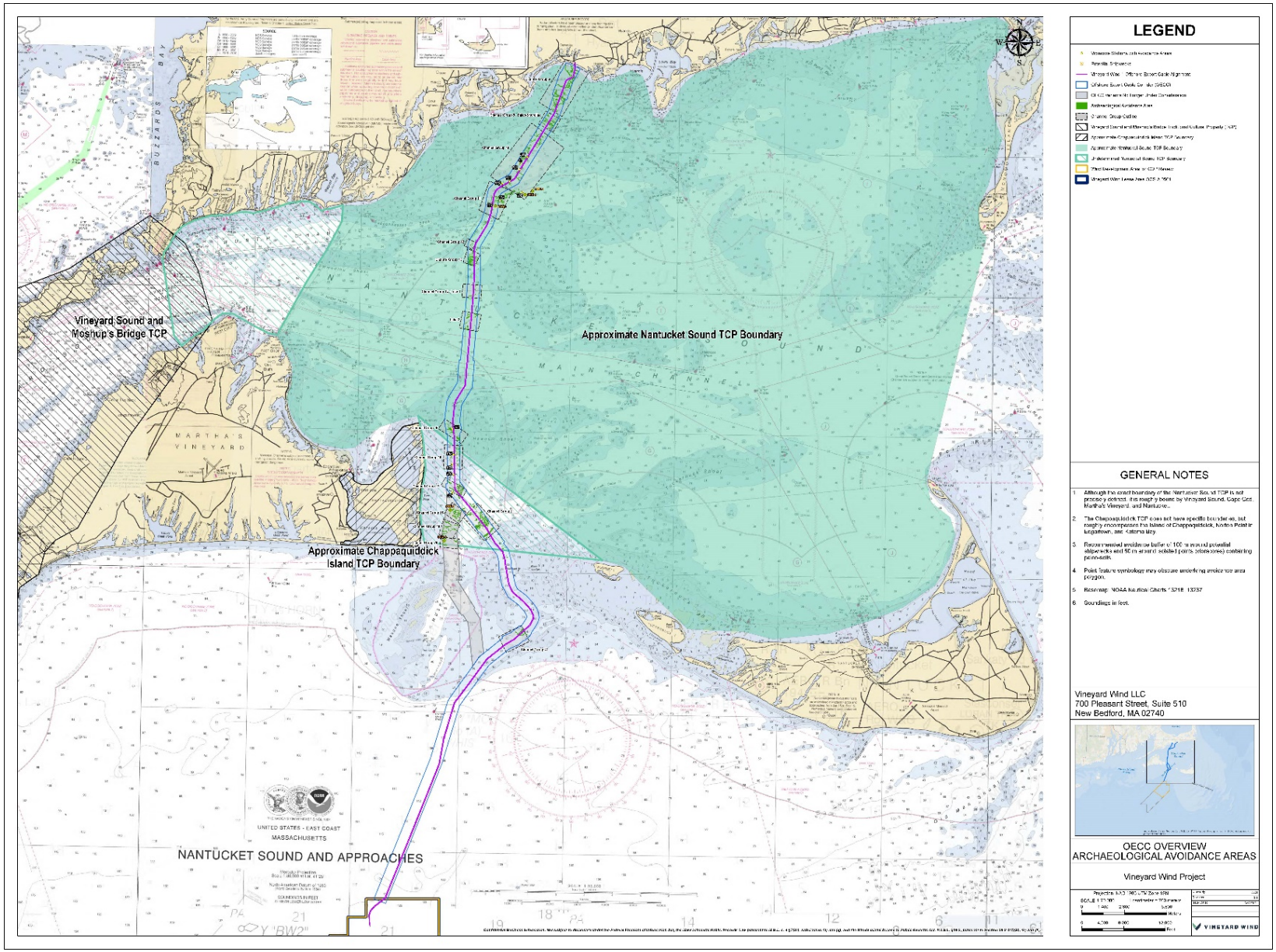
Vineyard Sound and Moshup's Bridge TCP
Approximate Nantucket Sound TCP Boundary
Approximate Chappaquiddick Island TCP Boundary
NANTUCKET SOUND AND APPROACHES
LEGEND
GENERAL NOTES
Vineyard Wind LLC
700 Pleasant Street, Suite 510
New Bedford, MA 02740
OECC OVERVIEW
ARCHAEOLOGICAL AVOIDANCE AREAS
Vineyard Wind Project

TABLE 2: DISTURBANCE INFORMATION			
APE Disturbance Type	Vertical Disturbance Depth	Disturbance Width	Scour protection radius
Monopile WTG	20–45 m (66–148 ft)	7.5–10.3 m (25–34 ft)	22–26 m (72–85 ft)
Jacketed WTG	30–60 m (98–197 ft)	18–35 m (59–115 ft)	20–24 m (66–79 ft)
Jacketed ESP	30–75 m (98–246 ft)	18–45 m (59–148 ft)	20–28 m (65–92 ft)
OECC and WDA anchors	Up to 3 m (10 ft)	Est. 0.5–1.5 m (1.6–4.9 ft)	NA
Inter-array cable[1]	Up to 1.5–2.5 m (4.9–8.2 ft)	1–2 m (3.2–6.5 ft)	NA
OECC cable[1]	Up to 1.5–2.5 m (4.9–8.2 ft)	1–2 m (3.3–6.6 ft)	NA
OECC Dredging[2]	Up to 8 m (26.2 ft)	20 m (66 ft) total; includes cable trench	NA

WTG-wind turbine generator; ESP-electrical service platform; OECC-offshore export cable corridor; WDA- wind development area; m-meters; ft-feet; NA-not applicable

1. Impacts from inter-array or export cable installation will include a cable installation trench of up to 1-m (3.3-ft) wide and a 1–2-m (3.3–6.6-ft) wide temporary disturbance zone to take into account the skids or tracks of the cable installation equipment, which will slide over the seafloor.
2. Where dredging is required, dredging will occur first, then the cable will be installed at the target burial depth below the dredged seafloor.

ATTACHMENT 8 – TREATMENT PLAN FOR SUBMERGED ANCIENT LANDFORM FEATURES WITH THE POTENTIAL TO CONTAIN PRE-CONTACT PERIOD ARCHAEOLOGICAL SITES

Please refer to the attached document for the treatment plan for submerged ancient landform features with the potential to contain pre-contact period archaeological sites.

PROPOSED CULTURAL RESOURCE MITIGATION FOR SUBMERGED LANDFORMS

Vineyard Wind 1 Project

Section 106 Consultation

Prepared For:

VINEYARD WIND

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TABLE OF CONTENTS

DEFINITIONS OF KEY TERMINOLOGY

Term/Acronym	Definition
Area of potential effects (APE)	The APE is defined in 36 CFR § 800.16 as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist." For marine archaeology, the APE represents the horizontal and vertical areas where disturbance of the seabed is expected from Project construction.
Avoidance areas	Archaeologically sensitive shallow areas within the APE that may represent intact landforms that have been recommended for avoidance, if possible, by the Qualified Marine Archaeologist.
Geophysical Surveys	Survey of the submarine geology and seafloor conditions using acoustic and other remote sensing methods; includes side scan sonar, subbottom profiling, magnetometry, bathymetry, etc.
Geotechnical Surveys	Surveys that collect submarine sediment samples or *in situ* (in place) measurements of sediment and rock mechanics and physical properties; includes vibracores, boreholes, and cone penetration testing (CPTs)
Holocene transgression	Refers to the major sea level rise that occurred over the last 18,000 years, which eroded and submerged formerly exposed land surfaces on the continental shelf as the ocean moved landward
microdebitage analysis	Microscopic analysis of lithic (stone) fragments generated by the manufacturing of stone tools
OECC	Offshore export cable corridor
Palynological analysis	Microscopic analysis of pollen particles that can reveal evidence of past ecological and climate conditions
QMA	Qualified Marine Archaeologist
Ravinement surface	The physical interface/horizon created during the sea level transgression (rise) that separates older intact, undisturbed sediment layers below from more recent reworked, disturbed sediments above
Submerged / buried landforms	Former land features (rivers, streams, channel banks, peninsulas, shorelines, etc.) that were first submerged by sea level rise then buried under reworked and recent sediments
terrigenous	Made of material eroded from the land
WDA	Wind Development Area

PROPOSED CULTURAL RESOURCE MITIGATION FOR SUBMERGED LANDFORMS
Vineyard Wind 1 Project
Section 106 Consultation

1.0 INTRODUCTION

Vineyard Wind, LLC (Vineyard Wind) is proposing an 800-MW wind energy project within Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0501 (Lease Area), consisting of offshore wind turbine generators, electrical service platforms, an onshore substation, offshore and onshore cabling, and onshore operations & maintenance facilities (all collectively referred to as the "Vineyard Wind 1 Project" or the "Project") (Figure 1-1). The 800-MW Project will be located in the northern portion of the over 675-square kilometers (km^2) (166,886-acre [ac]) Lease Area (referred to as the "Wind Development Area" [WDA]) and is linked to the south shore of Cape Cod via two offshore export cables that will be placed within the approximately 62-km (33-nautical mile) long and 800 to 1,000 m (2,657 to 3,280 feet) wide Offshore Export Cable Corridor (OECC).

The specific footprint of the Project's WDA is still to be determined with input from the federal government on the final wind turbine generator (WTG) layout. Alternatives to the proposed layout submitted in the Construction and Operations Plan (COP) are being considered. The Project will include 57-100 WTGs, depending on the layout and configuration as well as the size (energy output) of the WTGs. The offshore export cables will be within the OECC, as mapped in Figure 1-1. The precise location of the final cable alignments will generally align along the center of this corridor, with micro-routing (as described further in Section 3.1) to minimize adverse effects to the identified cultural resources, where feasible.

This Project is an undertaking under Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA; 54 U.S.C. 300101 et seq). This mitigation plan has been prepared in accordance with Section 106 of the NHPA and its implemented regulations, (36 CFR § 800). The lead agency for the undertaking is the BOEM. The Area of Potential Effects (APE) for this Project is located on the Outer Continental Shelf (OCS), federal property managed by BOEM, and extends into the waters of the Commonwealth of Massachusetts, where cultural resources are managed by the Massachusetts Board of Underwater Archaeological Resources (MBUAR) and the Massachusetts Historical Commission (MHC). The APE includes the horizontal and vertical extent where disturbance of the seabed is expected from Project construction, operation, and decommissioning.

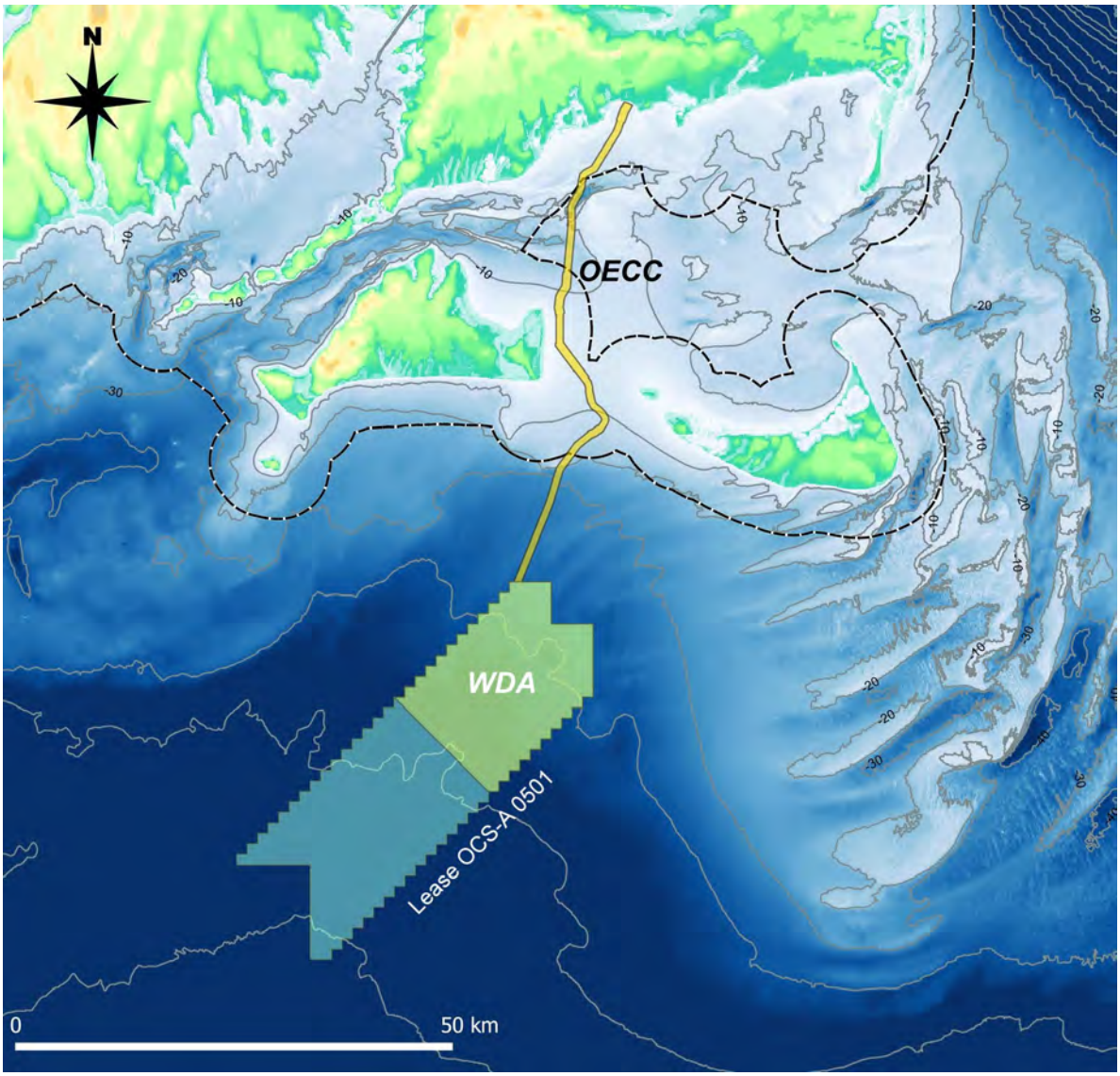

Figure 1-1. Location map of the Vineyard Wind 1 Project.

1.1 Project Background

Between 2016 and 2018, Gray & Pape, Inc. (Gray & Pape) completed a marine archaeological assessment (MARA) of geophysical and geotechnical survey data collected for Vineyard Wind 1, within the proposed WDA and OECC areas in support of their Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (Lease OCS-A 501) (Tuttle et. al 2019). The purpose of the assessment was to identify submerged archaeological resources, or potential archaeological resources, that may be affected by seabed-disturbing Project activities, including site characterization surveys, and the construction, operation, and/or decommissioning of Project facilities.

The assessment was conducted to satisfy the federal regulatory requirements as outlined in the BOEM Offshore Renewable Energy Program's Guidelines on Providing Archaeological and Historic Property Information (2017). Consistent with BOEM guidelines, Vineyard Wind 1 will seek to avoid archaeological resources and potential archaeological resources during Project development, construction, operation, and decommissioning, where feasible. To accommodate alternate locations for turbine placement or cable routing required to avoid affecting potentially significant cultural resources, survey efforts included an area larger than the designed footprint of the WDA and OECC.

Geophysical survey trackline spacing occurred at 30-m intervals in federal waters and 15-m intervals in state waters, with all systems run on every line. Systems included multibeam echosounder (MBES), side scan sonar (SSS), single (MAG) and dual magnetometers (GRAD), subbottom profiler (SBP), and single channel seismic (SCS). Data were processed, analyzed, and interpreted by the survey contractors who generated charts of subsurface features for archaeological review, analyses, and assessment. For example, SSS data provides an image of the seafloor to show the current conditions and visible debris; magnetic data were used to evaluate the potential presence of significant submerged metal cultural resources including, but not limited to shipwrecks; and SBP and SCS data were used to provide an image of sediment layers below the seafloor to look for ancient landforms that are now submerged. Primary features of interest included buried landforms such as channels, channel banks, levees, lakes/ponds, and relict shorelines that were identified, in addition to the Holocene ravinement surface (the Holocene ravinement surface separates older intact, undisturbed sediment layers below from more recently reworked, disturbed sediments above). SBP and SCS data and subsurface feature charts were analyzed and interpreted to identify buried landform features.

Shallow geotechnical data in the form of vibracores and cone penetration testing (CPTs) were acquired at a nominal 300- to 500 m-interval along the proposed OECC. A wider spacing was utilized in the WDA due to the homogeneity of the surface sediments. The core samples and CPT results provided physical samples of the sediments and were used to ground truth the SBP and SCS profiles and further provide evidence of lithologies associated with the identified buried landforms, where sampled. In other words, the core and CPT samples provided physical samples of sediment layers, which were then matched to the reflectors observed on the SBP and SCS profiles. Sample locations were strategically placed to recover sediments from above and below specific horizons noted on the seismic profiles (e.g. channel banks, ravinement). Deep geotechnical data from borings and downhole CPTs were also reviewed.

Following a final decision from BOEM on the Project and the WTG layout, final geophysical and geotechnical surveys will be completed for the revised APE to cover areas of disturbance, which include square areas around each WTG and electrical service platform position and corridors covering the inter-array cable routes. Many of these areas will already have geophysical and geotechnical coverage from previous survey years. The new data will be processed, analyzed, interpreted, mapped, and presented to BOEM and tribal stakeholders as part of the final data and results submission.

2.0 MARINE ARCHAEOLOGICAL RESOURCE ASSESSMENT

In 2019, Gray & Pape, Inc. completed the MARA in support of the COP submission (Tuttle et. al 2019). The archaeological assessment for potential submerged resources included archival (background) research, geophysical (remote sensing) survey, geotechnical investigations, and laboratory analyses of sediment samples collected from the proposed Vineyard Wind 1 corridor and WDA. Archaeological investigations and laboratory analyses were conducted in coordination with six federally recognized Native American tribes. The methods and results of the integrated research are summarized below.

2.1 Archival Research

Background research included a review of historical documents, previous research reports, state site files, shipwreck inventories (automated wrecks and obstructions inventory system [AWOIS], electronic navigational charts [ENC], and BOEM's Atlantic Shipwreck Database [ASD]), and historical maps. Archives at the Rhode Island Historical Preservation and Heritage Commission (RIHPHC) and the MBUAR were consulted to identify information on shipwrecks. Relevant geological and paleoenvironmental sources were reviewed to assist in the effort to reconstruct environmental conditions during periods of potential pre-contact land use within the Project area. These studies found that during the last glaciation of the region and for several thousands of years after the ice retreated sea levels were much lower, exposing portions of the wind farm and export cable as dry land. Terrestrial landscapes existed in portions of the proposed wind farm between approximately 24,000 and 10,000 years ago and may have been occupied by Native American people.

2.2 Geophysical Surveys

Field investigations included a High Resolution Geophysical (HRG) marine survey utilizing magnetometer/gradiometer, side scan sonar, multibeam echo-sounder, and both shallow and medium penetration sub-bottom profilers. This instrument array provided data on objects and seabed features exposed on the sea floor and the characteristics of buried sediments that may be affected by the Project. The total area surveyed between the 2016 and 2018 field investigations over 2,597 nautical miles (4,810 kilometers [km]) of tracklines and over 2,878 nautical miles (5,330 km) of tracklines were run along the OECC.

Magnetic data were collected, saved, edited, processed, and plotted, and anomalies tabulated according to: magnetic intensity (total deviation of the magnetic background measured in gammas); pulse duration (detectable signature duration); signature characteristics (monopolar, or dipolar); and location. There were 2,839 anomalies of 5 gamma or greater were identified during the 2016 to 2018 geophysical surveys within the OECC, and 240 in the WDA. Of the 3,079 magnetic anomalies identified in the Project APE, eight are correlated with five distinct sonar contacts and are likely associated with possible shipwreck sites; five possible shipwrecks in the OECC (PSW-1 through PSW-5) and two shipwrecks in the WDA (SW-1 and SW-2). All other anomalies likely represent articles of ferrous debris that are either buried below the seabed or too small to be acoustically detected and are likely associated with prior construction activities or passing ship traffic. Other sources of the unidentified anomalies may be lost fishing gear.

The side scan sonar data for the seabed in the OECC and WDA were generally unremarkable, with the exception of numerous boulders and areas of sand ripples. The sonar data were collected at a 15-30-m (49.2-98.5-ft) transect spacing, with a range of 50-m (164-ft) per channel, 100-m (328-ft) swath width throughout, to achieve a coverage pattern of well over 300 percent. Side scan files were presented to the QMA from the marine surveyors for review. Each line file was examined for cultural material, structures, linear forms and other indications of human activity. An examination of the side scan sonar records from the 2016 through 2018 geophysical surveys indicate that there are 6,681 above- or on-seabed targets with a resolution of 0.5 m (1.6 ft) that are not interpreted as boulders or other natural features within the OECC and 186 within the WDA. Sixteen targets are associated with five possible shipwrecks and two definitive shipwrecks. The other side scan sonar contacts were not considered to be significant. Of the other side scan sonar contacts that appear to be cultural, most are small and rectangular in shape. It is believed that these contacts represent fishing gear, lobster traps, cable sections, isolated debris and other isolated objects.

Two types of sub-bottom profilers were used and provided two different types of data. The Chirp subbottom profiler (SBP) was deployed on all survey lines. The Chirp model exhibited that the sound energy was absorbed in the near-surface area. The seafloor in many areas is made up of highly compact sands and fine gravels, that absorb/disperse the acoustic energy of the Chirp SBP and do not allow for sufficient penetration to adequately distinguish sub-seafloor reflectors. The medium penetration system (MPS) generally utilized a lower frequency than the Chirp and provided resolution of deeper subbottom features. Sparker data were collected on all survey lines; with single channel data collected at 15-30-m (49.2-98.5-ft) spacing and multi-channel data collected at 150 m (492 ft) spacing.

The geophysical seismic profile data on and paralleling offshore cable route centerlines were used to produce plan view mapping of the most recent marine transgressive ravinement surfaces and interpreted paleochannel features identified within the OECC and the WDA. The most recent marine transgressive ravinement surfaces can be used as generalized proxy for the pre-submergence terrestrial paleolandscape and were reviewed for the possible presence of an identifiable paleolandscape and discrete paleolandforms. Paleochannels are a discrete landform that represent the past location of the physical presence of a stream. Paleochannels, as identified by the geophysical seismic data, are interpreted here to include not only the channel in which the streams used to exist, but all extant features within the relict valley in which the stream once ran. As such, these paleochannels are more accurately paleo-stream valley landscapes. These paleo-stream valley landscapes may contain an actual paleochannel landform as well as other landforms that are commonly associated with alluvial valleys (e.g. floodplains, terraces, levees, fans, etc.). As it is assumed that portions of these paleo-stream valleys would have been the mouth of the stream at points over the periods they individually experienced sea level rise, other paleolandforms related to stream mouth and coastal landscapes may also be present in these paleo-stream valley landscapes. It is possible that at least a portion of these paleo-stream valley features are, in fact, stream channel banks and channels with a thalweg. Comparison of the relative width of these paleo-stream valley features appear to be similar in width to small and

medium order streams on nearby Cape Cod, which appears to support the characterization of these as paleo-stream valleys rather than paleochannels.

Individual paleo-stream valley segments were grouped together and numbered Channel Groups 1-53. Interpreted paleo-stream valley and other identified paleolandscape or paleolandforms have been considered potentially archaeologically sensitive based on the geophysical and geotechnical data acquired to date; no archaeological deposits or resources have been identified to date.

While the Holocene transgression typically erodes the shoreface and coastal land surface during sea level rise, reworking and redistributing materials and thereby reducing the probability of encountering intact cultural artifacts, data from the geotechnical survey (analysis of core sample stratigraphic profiles combined with radiocarbon dating) indicates that such erosion has not removed all sediments from the former terrestrial landscapes or landforms within the Project APE. Identifying such intact terrestrial landscapes or landforms was the main objective of the archaeological review of the geotechnical data, as intact landscape features may have the potential to hold intact archaeological deposits. Intact terrestrial landscapes or landforms were primarily identified on the basis of the presence or absence of paleosols or other sedimentological or stratigraphic indication that samples represented formerly terrestrial environments.

Based on known archaeological evidence from regionally defined cultural periods, the likelihood of finding evidence of past human occupation increases closer to bodies of water, either moving or still-water. Subbottom profiler data was initially consulted to identify potential landscape features that may have once been subaerial stream valleys, ponds, or lakes. The geophysical data was then used to help ground truth the interpretation of these sub-bottom features. Ground truthing data provided by the geotechnical survey, indicates that landscapes that may be interpreted as interfluvial (between stream drainages) have been more consistently eroded and exhibit little to no intact terrestrial landforms, at least not within the limits of the APE. In contrast, such ground truthing data indicates that areas near or within landscape features identified as paleo-stream valleys in the geophysical data have a much higher probability of exhibiting intact terrestrial sediments and landforms that may intersect with the APE. The study only found strong evidence of intact terrestrial landscapes in conjunction with such paleo-stream valley features. While not all of the paleo-stream valleys or lakes were ground truthed, the combined geophysical and geotechnical data results makes it reasonable to assume that areas with the highest potential for archaeological sensitivity exist within the mapped paleo-stream valley landscape features and some of the ravinement surfaces directly associated with them. These criteria, therefore, make up the foundation of the recommendation of the avoidance of landscape features, as mapped.

The combined results of the geophysical and geotechnical data acquired to date have been used to identify potentially historically significant resources. To the extent possible, resources will be avoided. Where avoidance is not possible, this mitigation plan is proposed to address any adverse effects. Table 1 in Appendix A summarizes the project avoidance and mitigation measures.

3.0 PROJECT EFFECTS

Following correlation of all data and an analysis of the geographic distribution and trends of the submerged features, the buried landforms were divided into "Channel Groups" that were recommended for avoidance. The Vineyard Wind 1 team assessed the locations of these features against the APE to determine if avoidance was or was not feasible.

3.1 WDA

Overall, seabed and shallow subsurface conditions in the WDA are not very conducive to subbottom profiling. The deeper water and more recent depositional environment may contribute to the homogenous nature of the upper seabed. Seismic reflectors and features are weakly represented and discontinuous across the area. Thus, any channel features present cannot be traced over longer distances to see orientation and trends. As shown in Table 1 in Appendix A, 21 avoidance areas were recommended within the WDA. This included Channel Groups (n=15) and individual borings or vibracores where an organic-rich soil of likely terrestrial origin was recovered (n=6) (Tuttle et al. 2019).

The Vineyard Wind 1 team determined that most of the Channel Groups were avoidable by either (1) small, isolated avoidance areas along inter-array cable routes that can be micro-sited around or (2) shallower burial of the cables (1.5 m) that provides enhanced avoidance of features buried below the APE (>2 m). Figure 3-1 shows an example of a lateral adjustment to cable position. Such micro-routing will occur during the final engineering of the cable route, prior to the start of cable installation. Figure 3-2 shows how a change in burial depth helps avoid impact to the buried landforms. These two measures (micro-siting and shallower burial) have been incorporated into the initial cable routing process to determine which features can or cannot be avoided. After incorporating these measures, as shown in Table 1 in Appendix A, nine of the 15 Channel Groups were avoided, while six Channel Groups could not be avoided. All six individual borings or vibracores where an organic-rich soil of likely terrestrial origin was recovered were avoided.

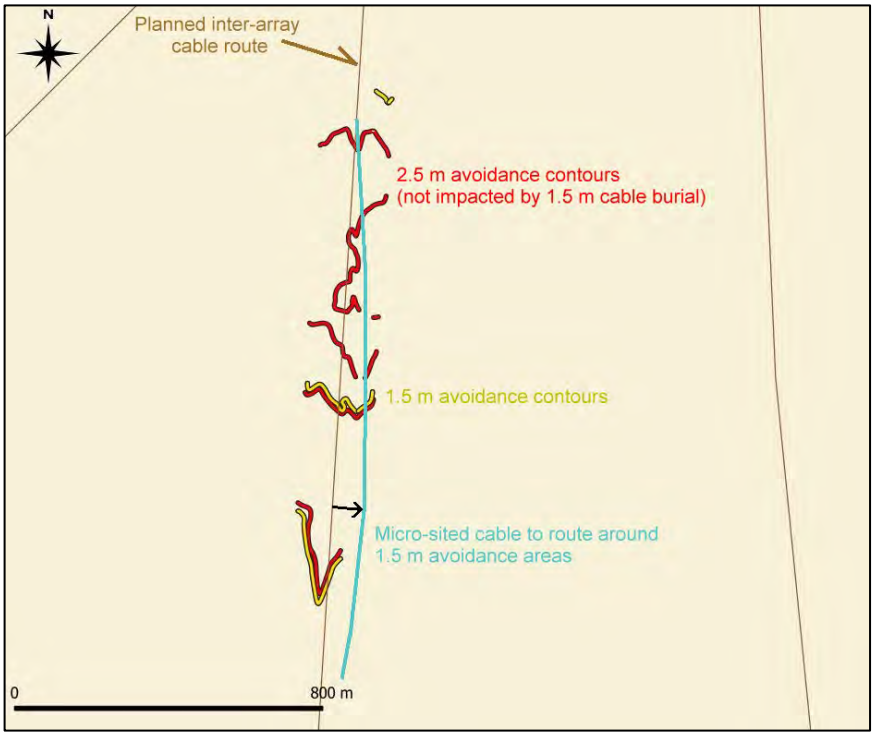

Figure 3-1. Example of how lateral adjustment of cable position (micro-siting) reduces impact to buried landforms.

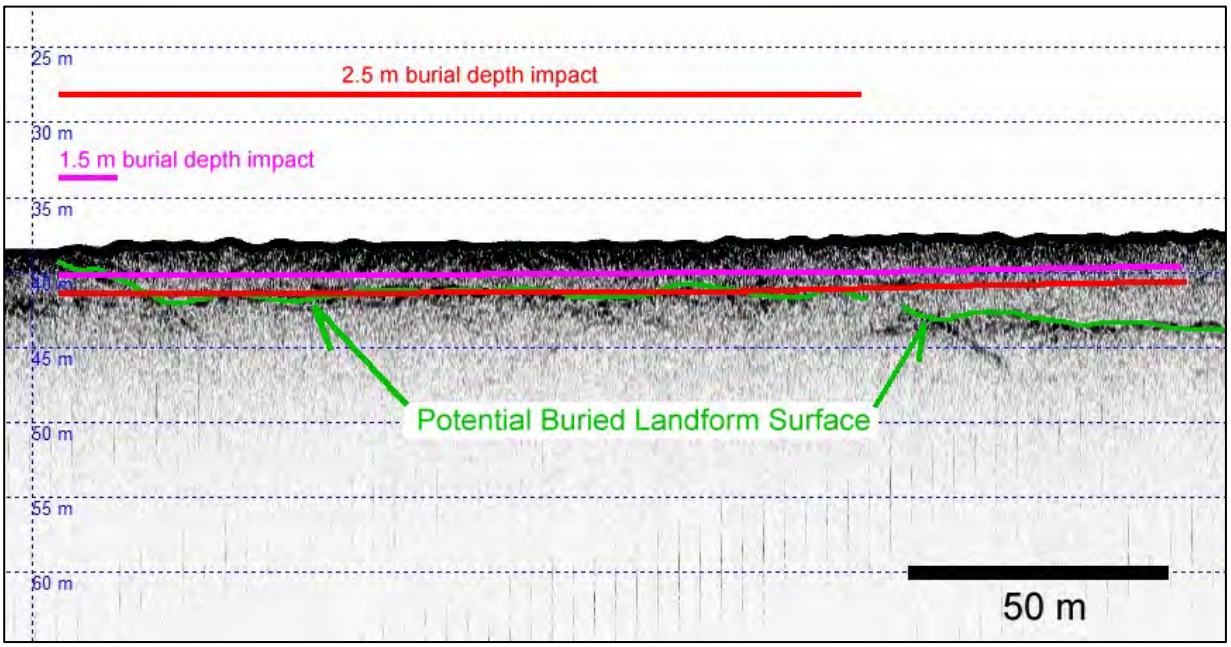

Figure 3-2. Example of how a reduction in cable burial depth minimizes impact to buried landforms. Red line represents length of impact from 2.5 m burial depth; pink link represents length of impact from 1.5 m burial depth. See horizontal scale bar for reference.

***Important to note**: these quantities of recommended avoidance areas are for the original WTG layout presented in the Vineyard Wind COP submittal. However, due to the site conditions offshore and likely results to be obtained from any additional surveying, a similarly low number of unavoidable features is anticipated from any subsequent data.

Avoidance and Minimization Applied To-Date:

- Inter-array cables micro-sited around features
- Cable burial reduced to 1.5 meters
- One previous WTG removed (original layout)
- Same will be done for any alternate layouts approved

3.2 OECC

The offshore export cable corridor transits through Nantucket Sound, a dynamic shallow water environment dominated by strong tidal currents. The variation in water depths and geomorphology of the seafloor in the Sound equate to what would have been islands and peninsulas over the past 12,000 years during periods of lower sea levels. The subbottom profiles and associated vibracore samples indicate there are some laterally extensive submerged landforms, many of which cover the full width of the OECC. As shown in Table 1 in Appendix A, a total of 18 avoidance areas were recommended in the OECC, which included 16 Channel Groups and two individual borings or vibracores where peat deposits and possible terrestrial soils were identified.

Similar to the WDA, many of the buried features are below the APE and will not be disturbed by the Project. Many of the Channel Groups have multiple subsurface features that appear to be connected and cross the full extent of the OECC, meaning that they cannot be fully avoided. However, most of these features are also located below the APE, with only the channel banks and higher elevation portions of the features within the APE. In other words, only a small portion of the buried feature will be disturbed. It is further noted that Vineyard Wind plans on using a specialized installation tool within state waters and all of Nantucket Sound that is known as a vertical injector, which will minimize impact to the seabed. The use of the vertical injector tool eliminates the need for a separate dredging tool and minimizes the area of disturbance from a greater than 20-m (65.6-ft) wide dredge corridor[1] to a less than 1-m (3.3-ft) wide cable installation trench. (If Vineyard Wind utilized a standard jet plow in this area, dredging would be required.) The vertical injector also does not have skids or tracks that pass over the seafloor. Within federal waters (i.e., south of Nantucket Sound and south of the Muskeget Channel), dredging is not required, therefore a standard jet plow will be used, which will also have a less than 1-m (3.3-ft) wide cable installation trench as well as a shallow 1-2 m (3.3-6.6-ft) wide impact from where the skids or tracks pass over the seafloor. Figure 3-3 illustrates the difference in impact to the seabed from the vertical injector versus the dredge equipment that would be required if a standard jet plow were used.

[1] The dredge corridor is approximately 20 m wide at the bottom and an additional width will be disturbed due to the need for sideslopes. The width of the sideslopes depends on the depth of dredging. For a depth of 2.5 m, the sideslopes are 15 m, for a total width of disturbance of m.

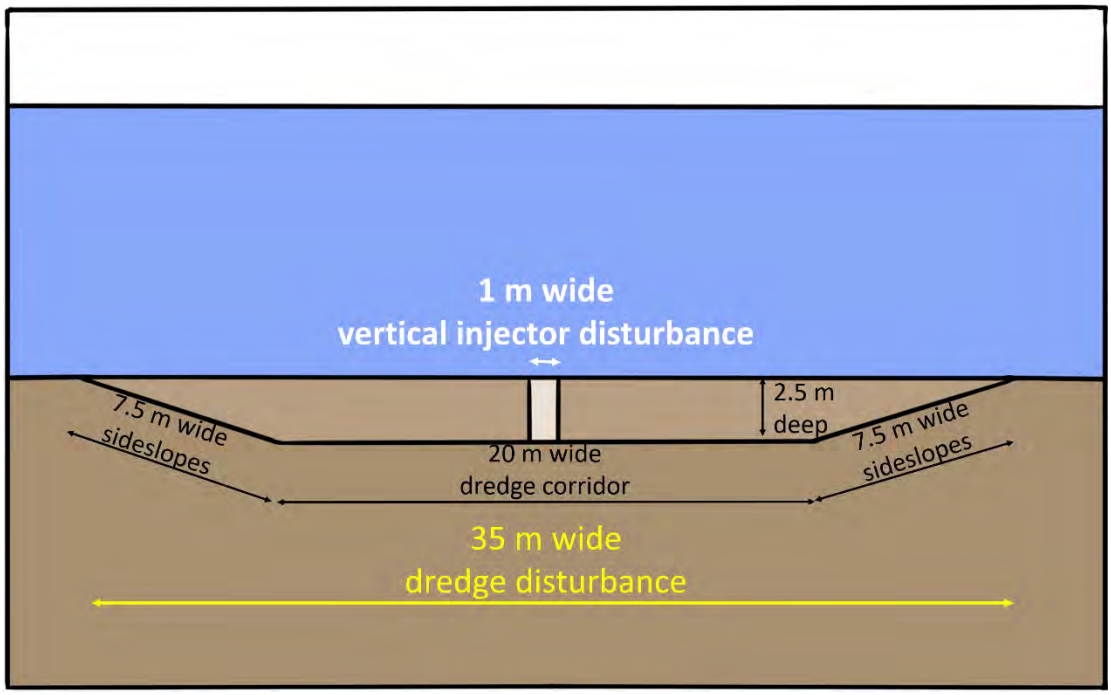

Figure 3-3. Schematic comparing width of seabed disturbance between vertical injector and dredge equipment for 2.5 m depth

Avoidance and Minimization Applied To-Date:

- Export cables to be micro-sited around features where possible
- Cable burial up to 2.5 m below ambient seafloor, avoids deeper features in most areas (deeper burial may be required in sand waves)
- Use of narrow impact cable installation tool

3.3 Adverse Effect to Historic Properties

Given the Project engineering constraints, there are 13 submerged landforms associated with buried coastal features in the OECC and six submerged landforms associated with the WDA that cannot be avoided by the Project (the number of unavoidable submerged landforms within the WDA may be updated if BOEM selects an alternate layout and new inter-array cable routes are developed). These submerged landforms are considered to be significant for their potential to aid in our understanding of pre-Contact settlement along the OCS. BOEM has determined the Project will have an adverse effect to these landforms. In accordance with 36CFR800, this mitigation plan proposes actions to mitigate the adverse effect.

4.0 PROPOSED MITIGATION OF SUBMERGED LANDFORMS

It is important to note that the mitigation discussed herein is for interpreted buried and submerged landforms that have been altered by sea level rise. To date, these landforms have not yielded archaeological materials nor do they constitute an archaeological site. This is a result of the methods used in the marine archaeological resource assessment, which represent best practices for identifying areas of cultural sensitivity. Identifying such areas "first requires the identification and characterization of that landscape", (Robinson et al. 2020:143-144). Given the absence of documented archaeological sites, this mitigation plan is not an archaeological data recovery program, but rather an alternative mitigation proposal to acquire landscape-level information within the APE, consistent with Advisory Council on Historical Preservation (ACHP) Section 106 consultation guidance.

The proposed work outlined herein will be conducted in concert with feedback from various stakeholders throughout the process. The proposed methods for this undertaking consider the Project effects as well as BOEM's *Developing Protocols for Reconstructing Submerged Paleocultural Landscapes and Identifying Ancient Native American Archaeological Sites in Submerged Environments* (Robinson et. al 2020).

To date, archaeologists have documented over 12,500 years of human settlement in the terrestrial terrain of New England, with some of the oldest occupations identified in Southern New England (e.g. Brian D. Jones Paleo-Indian site in Avon, Connecticut and the Sands of the Blackstone in Uxbridge, Massachusetts). Archaeological data from Paleoindian sites in New England have yielded caribou, beaver, and bison, as well as charred floral remains including nuts and berries, and are consistent with the hypothesis that Paleoindians subsisted on migratory game and maintained a seasonably available diet. Sea level rise models show the OCS was far more expansive than it is today, with our present landscape reached around 3,000 years before present. It is probable that many Paleoindian, Archaic, and Woodland period occupations were situated on the now inundated OCS. Archaeological sites may exist within small upland areas associated with accessible water and as resource extraction and exploitation sites within upland areas and coastal setting. The preservation of these sites is dependent on site burial and geological processes following occupation and sea level rise. While no archaeological sites have been identified within the Project APE to date, ancient submerged landforms have been interpreted, primarily from geophysical data (as outlined above in Section 3.0). The objective of this mitigation plan is to acquire additional environmental and archaeological data to refine our understanding of the paleoenvironmental landscape and archaeological sensitivity of the OCS within the Project APE and to establish a study that provides baseline data that can be used by future offshore projects and aid in landscape management.

4.1 Theoretical Background on Identifying Buried and Submerged Archaeological Sites

4.1.1 Submerged Landscapes and Middle-Range Theory

The search for buried and submerged sites is based on contextual archaeology, which, as defined by Butzer (1982:7), relies less on the discovery of artifacts than on examining sites as an expression of human agency, or decision-making. This is an important analytical tool used to more specifically delineate areas where submerged pre-Contact landscapes are most likely to be found on the Atlantic Outer Continental Shelf (OCS). When examined as part of a network within the human ecosystem, the location of archaeological sites becomes somewhat predictable, based on the presence of various factors required to sustain a given population. A contextual approach to submerged pre-Contact archaeology is necessary because the formerly exposed surfaces on which sites were created were buried by sediment before being inundated by rising sea-levels, making the identification of artifacts extremely unlikely. Using a predictive model for human preferences within the landscape (Lothrop et al. 2011, Oswald et al. 2018), contextual archaeology then relies on empirical methods of physical geography applied to middle-range theory.

Typically used in temporal studies, middle-range theory may be applied spatially to translate what is known about pre-Contact site patterns and interactions from a given time period on land to the OCS as a way to model where sites would have been located (as detailed in Evans 2016). Perceived archaeological indices have been identified through previous research on pre-Contact landscape occupation and exploitation patterns, resulting in indices for landscape identification that can be observed through geophysical survey. In other words, by identifying locations that pre-Contact people preferred to occupy and resources that were selectively exploited on land, archaeologists can extend those behavioral patterns spatially to areas that are now underwater.

The search for submerged and buried pre-Contact archaeological landscapes is predicated on an accurate assessment of the landscape from the point in time when it could have been occupied to the present. The synchronic reconstruction of the landscape, or reconstruction of a specific place at a given point in time, provides information about exploitable resources that would have been necessary to support populations, and discrete areas within the landscape where evidence of past occupation is most likely to be found. Diachronic reconstruction of that same place provides information about changes to the site over time that influence preservation of any archaeological materials from their time of deposition and influence secondary site formation processes.

4.1.2 Contextual Archaeology and the "Real" Environment

Archaeologists study past human behavior and build patterns by up-scaling data observed at the micro-scale, or site, to the regional, cultural, or temporal scales. An archaeological site is defined differently depending on the purpose, but generally is defined as a spatially-delimited accumulation of cultural material that has sufficient quantity and quality to allow inferences to be made about behavior occurring at that location (Butzer 1982:259). Sites are critical to reconstructing past human behavior, but non-sites or data occurrences may still provide information needed to inform patterns of available resources (Butzer 1982:260). This is an essential point of understanding to the current study, because pre-Contact artifacts are unlikely

to be identified on acoustic profiling data, whereas environments can be recorded and reconstructed from geophysical data.

In geography, environments may have both a real and a perceived character. Real environments are composed of three elements: the geographical environment, the operational environment, and the modified environment (Butzer 1982:253). The geographical environment, or the physical landscape, is that which is available for occupation and exploitation by a human population (Butzer 1982:253). The operational environment consists of the resources available for subsistence within the overall geographical environment (Butzer 1982:253). The modified environment is defined by Butzer (1982:253) as the space where "frequent or effective activity results in tangible modification" of the landscape. Without knowledge of the real environment, it is difficult, if not impossible, to explore the human dimensions of a place, including motives, preferences, and traditions (Butzer 1982:254). The perceived environment consists of elements from the geographical and operational environments that a human population may or may not be aware of, and which influence decisions. Real and perceived environments are not diametrically opposed, but do not completely overlap. It is not possible, however, to make inferences about the perceived environment without knowledge of the real environment.

4.1.3 "Real" Environments on the Atlantic OCS

The physical landscape of the OCS is not static but has experienced significant change since the Last Glacial Maximum. The MARA used geophysical data to identify three specific types of environment that are presently submerged on the OCS, as they relate to possible pre-Contact archaeological sites: the geographical environment, the operational environment, and the modified environment. The geographical environment that was subaerially exposed during the Last Glacial Maximum presents a largely unexplored (archaeologically) landscape that could have been exploited by pre-Contact populations. The identification of operational and modified environments allows archaeologists to narrow down possible areas of human occupation within the context of the OCS. This mitigation effort proposes to use coring and sediment sampling to collect direct physical evidence to verify the conclusions drawn from the remote sensing.

4.2 Research Questions

Coring and sediment sampling can transform the relative stratigraphic interpretation of acoustic data into a reconstruction of subsurface stratigraphy and environmental conditions at a given point offshore grounded by absolute dating and illustrated by grain size, pollen, macrobotanical, micro-debitage, and/or or point-count analysis. This information can be used to create a better understanding of the geographical, operational, and modified environments as described in the research questions below.

4.2.1 The Geographical Environment

The geographical environment, the physical landscape, has been at least partially documented by the acoustic data as buried coastal features and/or the ravinement surface in the shallow subsurface. However, the data collected to date do not demonstrate that the physical landscape

at these locations was available for human occupation. That is to say, this landscape might have existed at a time prior to potential for human occupation.

Research Question 1. What is the chronological setting of the landform?

This research question will be addressed by C14 dating of organic material recovered from vibracores.

4.2.2 The Operational Environment

As noted above, the operational environment consists of the resources available for human use in the environment. Resources may include plants, animals, minerals, and water. Generally, it is possible to paint a broad picture of the paleoenvironment based on palynological evidence.

Research Question 2. What was the paleoenvironmental setting at the time the landform was exposed?

This question will be addressed through the analysis of palynological samples within terrestrial-originating deposits. Pollen are relatively durable in sediments and will provide information on the past vegetation of the area and may even identify food or medicinal sources for past occupations

4.2.3 The Modified Environment

The modified environment is one that shows direct evidence of human use. This evidence may include actual artifacts created by humans, or chemical changes to the soil resulting from human occupation.

Research Question 3. Is there evidence of human modification of the environment?

This research question will be addressed through bulk geochemical analysis of nitrogen, and screening of the vibracore samples to collect any microdebitage present.

4.2.4 Nantucket Sound Paleoenvironment

The additional work proposed herein has the ability to contribute information on the environmental history of Nantucket Sound and offshore waters south of the islands.

Research Question 4. How do the results of the additional archaeological mitigation investigation fit within the broader geomorphological and paleoenvironmental context of Nantucket Sound?

This research question will be addressed during the planned review and synthesis of existing data and through a comparison of the results of the proposed mitigation activities with results from geological studies in available literature as outlined in Section 5.4 below.

4.3 Overview of Proposed Mitigation

4.3.1 WDA

Resource Conditions:

- Deep water, short term coastal environment
- Older sediments, many pre-date known human occupation
- Subaerial during early cultural time period (Paleo-Indian)
- Discontinuous buried features
- Minimal avoidance areas recommended
- Development activities can avoid the majority of the avoidance areas
- Low impact to pre-contact properties

Proposed Mitigation for Adverse Effects within the WDA:

Vineyard Wind 1 proposes to conduct an additional archaeological investigation on the submerged landforms. This work will be consistent with an archaeological mitigation-level effort to recover additional information on the landform features to better ascertain their chronological setting, cultural-historical association, their environmental setting, and whether evidence of human habitation exists within them. As such, additional vibracores will be conducted within the upper three meters of the seabed. The exact number of cores per channel area and their placement will be selected with input solicited from Tribal representatives, following a review of all of the available geophysical and geotechnical data, and specifically for their ability to provide data that will address the research questions outlined in this mitigation plan. Sub-sampling analyses will be conducted with the sediments, including C14, geochemical analyses of the soil for nitrogen, palynological analysis, and microdebitage analysis. The cores will be collected by a geotechnical survey team and transported to the Gray & Pape office in Providence, where they will be split, analyzed, and sampled. All work will be conducted in a collaborative effort with Tribal representatives participating in the process. Tribal representatives will be invited to be present during core splitting and sub-sampling and provide feedback in the reporting process.

The following would be incorporated into the study design:

a) Approximately two vibracores collected from each unavoidable channel group (it is noted that the current estimate of six unavoidable channel groups may be updated if BOEM selects an alternate layout and new inter-array cable routes are developed)

b) Vibracores to be positioned near the proposed cable installation alignment; actual locations will be selected following a review of all previously acquired data

c) Lab analyses include: C14 dating (Research Question 1), palynological analysis (Research Question 2), bulk core geochemical analysis of nitrogen (Research Question 3), and microdebitage analysis (Research Question 3). C14 samples will be analyzed to assess the age of the landform and to bracket its earliest and latest manifestation within the core. If multiple landforms are identified within a single core, these will all be sampled. Palynological analysis will provide information to allow for reconstruction of the paleoenvironment. Bulk core geochemical analysis

of nitrogen will aid in determining the presence or absence of landform use by humans and will be conducted within each identified landform as will palynological analysis. Microdebitage analysis will occur once all other samples are collected as this will destroy the remaining sample; note that the second half of the core will be archived to allow for future testing or study. This will determine the presence or absence of microdebitage left behind by human production of stone tools. The specific parameters analyzed for each core will depend on what is identified in each core. Please see "Study Plan" section below for more details on the lab analyses.

d) Fieldwork to take place prior to cable installation

e) All results delivered to the Tribes, BOEM, MBUAR, MHC and any other relevant stakeholders in the form of a technical report

f) Tribal representatives have the opportunity to be present for all stages of work

4.3.2 OECC

Resource Conditions:

- Shallow water, long term coastal environment
- Middle age to younger sediments
- Subaerial during all cultural time periods (Paleo-Indian, Archaic, Woodland)
- Prominent and laterally extensive buried features
- Frequent avoidance areas recommended
- Construction activities cannot avoid some features
- Minimal impact to pre-contact properties but more common due to the abundance of features

Proposed Mitigation for Adverse Effects within the OECC:

Using the same approach as for the WDA, Vineyard Wind 1 proposes to conduct an additional archaeological investigation on the submerged landforms in the OECC. This work will be consistent with an archaeological mitigation-level effort to recover additional information on the landform features to better ascertain their chronological setting, cultural-historical association, their environmental setting, and whether evidence of human habitation exists within them. As such, additional vibracores will be conducted within the upper three meters of the seabed. The exact number of cores per channel area and their placement will be selected following a review of all of the available geophysical and geotechnical data, and specifically for their ability to provide data that will address the research questions outlined in this mitigation plan; MBUAR and Tribal representatives will be given the opportunity to review and comment on proposed core locations and their input incorporated into the coring plan. Sub-sampling analyses will be conducted with the sediments, including C14, geochemical analyses of the soil for nitrogen, palynological analysis, and microdebitage analysis. The cores will be collected by a geotechnical survey team and transported to the Gray & Pape office in Providence, where they will be split, analyzed, and sampled. All work will be conducted in a collaborative effort with MBUAR, MHC, and Tribal representatives participating in the process. MBUAR. MHC, and Tribal representative

will be invited to be present during core splitting and sub-sampling and provide feedback in the reporting process.

The following would be incorporated into the study design:

a) Approximately two vibracores collected from each of the 13 unavoidable channel groups, consisting of a minimum of 26 cores and possibly up to 32 cores total (landforms will be sampled to better understand the paleoenvironment, thereby some features will necessitate more, or less, testing than others; a range of 2-6 cores may be strategically positioned at each channel group, but not to exceed the maximum total of 32)

b) Vibracores to be positioned near the proposed cable installation alignment; actual locations will be selected following a review of all previously acquired data, and in coordination with MBUAR, Tribal representatives, and MHC

c) Lab analyses include: C14 dating (Research Question 1), palynological analysis (Research Question 2), bulk core geochemical analysis of nitrogen, and microdebitage analysis (Research Question 3). Cores will be split in half, with one half to undergo lab analyses and the remaining half to be preserved. C14 samples will be analyzed to assess the age of the landform and to bracket its earliest and latest manifestation within the core. If multiple landforms are identified within a single core, these will all be sampled. Palynological analysis will provide information to allow for reconstruction of the paleoenvironment. Bulk core geochemical analysis of nitrogen will aid in determining the presence or absence of landform use by humans and will be conducted within each identified landform as will palynological analysis. Microdebitage analysis will occur once all other samples are collected as this will destroy the remaining sample. This will determine the presence or absence of microdebitage left behind by human production of stone tools. The specific parameters analyzed from each core will be dependent upon what is identified in each core. For further information on lab analyses, please see Section 5.0 Schedule and Study Plan below.

d) Fieldwork to take place prior to cable installation

e) All results delivered to the Tribes, BOEM, MBUAR, MHC, and any other relevant stakeholders in the form of a technical report

f) Tribal representatives have the opportunity to be present for all stages of work

Regarding Tribal involvement, as Vineyard Wind 1 has done in the past through all Project stages, formal invitations will be sent to the consulting Tribes with schedules for the mitigation study activities. The events below include the major tasks we envision that will occur as the Project progresses, but we actually would appreciate collaboration throughout the entire study. A communications matrix will be distributed for key team members who are available all the time for consultation, questions, and information requests. The status of the Covid-19 pandemic at the time these activities are undertaken will determine whether these meetings are remote or in-person. A general schedule is included in Section 5 below, and a more detailed timeline of

activities will be distributed once BOEM has issued approvals and critical decisions regarding the Vineyard Wind 1 Project.

- Study Kickoff Meeting
- Pre-Field Program Planning Meeting
- Field Mobilization Vessel Tour
- Post-Field Program Core Sample Review
- Study Results Meeting

1. Development of educational and documentary materials

Using the submerged landform study results and previous Vineyard Wind 1 Project data and results, the following resources will be made available to support a variety of Tribal objectives:

a) A detailed PowerPoint presentation will be generated to describe the scientific method and processes undertaken as part of the offshore pre-construction surveys and archaeological assessment to document the buried and submerged landforms in Nantucket Sound.

   This will be a technical and descriptive visual document to record all aspects of how the submerged landform study was performed and describe the results that were obtained. Input from the Tribes will help shape the background and supporting material that is desired for inclusion. (This is not meant to serve as a story board/map or include tribal history.)

b) Digital database in the form of a Geographic Information System (GIS) project to document the geographic location and vertical placement of submerged and buried landform features.

   Results of the submerged landform data analysis and mapping will be assembled in a digital format for use by the Tribes. A number of different geographical mapping software packages could be used for this, but we envision specifically interfacing the data in QGIS (freeware) with the Tribes.

c) Assistance getting the GIS software configured on a computer (provided by the Tribes) and the database loaded and operational. Tutorial on software use and guidance on viewing the information provided.

   Following on from Item B above, the Vineyard Wind team will setup one workshop for each Tribe to provide hands-on training for the use of QGIS. This is powerful mapping software that allows users to import and create digital projects, charts, figures, and export all of the above for external use.

d) Option of having a special in-person presentation of the submerged landform study results to the tribal representatives and community.

The Vineyard Wind team would appreciate the opportunity to present the findings of the submerged landform study to the Tribes and support an active dialogue of the results, future work, and options for the inclusion of other study results.

One presentation for each Tribe could be planned for a number of different type community gatherings focusing on the topic of the offshore environment and submerged landscapes. For example, a meeting of the tribal leaders and historic preservation office personnel, a presentation to high school level students, or a collaborative presentation at one of the national tribal meetings. These events offer an opportunity to share the knowledge that has been gained by the submerged landscape study specific to the Vineyard Wind 1 Project and also showcase this mitigation effort as a model for other offshore renewable energy projects to follow. Vineyard Wind 1 will develop these resources and provide an opportunity for MHC and MBUAR to participate and comment on draft materials where feasible.

5.0 SCHEDULE AND METHODS

The following schedule is a preliminary estimate based on the current anticipated government timeline for Project approval. More detail is not possible at this time due to unknown Project parameters and the uncertainty of available survey contractor resources and schedules. This mitigation proposal is not intended as a scope of work. A scope of work and request for proposal will be developed with a subsequent tendering process to identify these resources early in 2021.

Summer 2021	Geophysical data acquisition in the revised inter-array cable corridors and the interpretation and assessment by the QMA of buried landforms mapped via this process.
Summer-Fall 2021	Submerged landform study field work (vibracore collection)
Winter 2021	Submerged landform study lab work and data analysis
Spring-Summer 2022	Reporting of results from the submerged landform study
Spring-Summer 2022	Development of the educational materials

Mitigation Study Plan

The following planned approach for the mitigation study will be implemented, applying survey industry best practices and the extensive experience and lessons learned by the Vineyard Wind team from prior field campaigns and data analysis. This is a general summary of the proposed methods and techniques that will allow the study objectives to be achieved. All work outlined below will be performed under a MBUAR Special Use Permit (SUP) as outlined under 312 CMR 2.0-2.15.

1. Pre-Field Program Planning

A review of existing geological, geophysical, and geotechnical data, as well as the specific buried landform mappings of the OECC and WDA, will inform placement of study vibracore samples. Gray & Pape will coordinate with MHC, MBUAR, NOAA, USGS, Woods Hole Oceanographic Institute, Harvard University (Harvard Forest), and the Massachusetts Office of Coastal Zone Management to acquire relevant files and information useful to determining placement of the cores as well as paleoenvironmental interpretation of the Project APE. New cores will be strategically positioned to sample key horizons interpreted on the subbottom profiles that may be indicative of shallow estuarine or terrestrial deposits of an intact nature below the ravinement surface and to address the research questions outlined in Section 4. Samples will be positioned to the greatest extent practicable where buried landforms are within the vertical APE.

2. Shallow Geotechnical Field Program

The shallow geotechnical program will include the collection of 3-m long vibracore samples of the seabed. Approximately 38-44 vibracores are planned for recovery as part of this study; a minimum of 26 cores in the OECC (but possibly up to 32 total, as specified in Section 4.3.2) and 12 in the WDA (two samples at six stations). The number of planned cores exceeds or is consistent with previous individual research campaigns (Robinson et al. 2020).

One or more vessels will be utilized to perform the investigation, dependent upon water depths at the proposed core stations. The vessel and core rig will be positioned using a Digital Global Positioning System (DGPS) or equivalent navigation system to locate the samples within less than 1 m of the intended station. A pneumatic style (driven by compressed air) vibratory corer will be used to extract relatively undisturbed sediment samples from the upper 3 m. The pneumatic systems are industry best practice and allow penetration and recovery of coarser deposits as compared to other types of sampling rigs. Cores will be cut into 1 m lengths onboard the vessel, section ends photographed, capped, taped securely shut, labeled, and stored vertically. Once back to the dock, the cores will be transported to the lab facility for processing.

3. Vibracore Analysis

Once the cores arrive at Gray & Pape's laboratory, the sections will be cut open and split vertically in half, then logged and photographed by the Project QMA and team (including a geoarchaeologist). Half of the core will undergo a geoarchaeological investigation while the other half is expected to be archived for future reference. The purpose of the geoarchaeological investigation of the vibracore samples is to identify elements of the preserved environments, as specified in the research questions (Section 4). Analysis will be focused on descriptive aspects that may be helpful in identifying whether a sample represented a marine sedimentary deposit or a coastal and/or terrestrial sedimentary deposit.

Terrestrial-originating deposits, representing glacially or postglacially deposited sediments, will be identified based on observed characteristics, including evidence of soil formation and/or remnant soil horizons; a structure other than single grained or massive; lack, or near lack, of marine shell; and the presence of organic materials of a possible terrestrial origin. Marine sediments, representing reworked glacially deposited sediments, will be identified by characteristics, including a lack of evidence of soil formation; a single grained or massive structure; the presence of marine shells; and the lack, or near lack, of organic materials of a possible terrestrial origin.

Descriptions of the core samples will follow set standards in accordance with USDA terminology discussed in the Soil Survey Manual (Soil Survey Staff, 1993, 2010). Descriptions of the samples will be recorded while the soil is in a moistened condition and will include (when possible) soil horizon, Munsell color, texture, mottling, soil structure, ped coatings, sedimentary structure and bedding characteristics, moisture consistency, boundary type, and inclusions, such as organic material or cultural artifacts. These descriptions will be recorded in accordance with the observed master horizons (with suitable subdivisions), noting any possible lithologic discontinuities (Stafford, 2004; Stafford & Creasman, 2002). This information will provide context to the sample and, possibly, to the type of landform (marine or terrestrial) from which the sample originated.

Once the geomorphology is described, subsamples will be taken from each core, including up to 38 samples for C14 dating, bulk core geochemical analysis of nitrogen, palynological analysis, and microdebitage analysis. The locations of these samples will be dependent upon what is identified in each core, as documented by the QMA and geoarchaeologist. Specifically, these subsampling techniques will occur within identified terrestrial-originating deposits. C14 sampling may include direct dating of larger fragments of carbon, or bulk carbon of the sediments themselves depending on the availability of carbon within the identified soil horizons. The subsamples for testing will be strategically positioned in the cores to gain a better understanding of the chronological framework of the sediments. These samples will aid in determining the age of the landform, including its uppermost and lowermost depositional ages. Gray & Pape will collect these samples and supply them to Beta Analytic Testing Laboratory for Accelerator Mass Spectrometry (AMS) dating or a similarly qualified facility.

Gray & Pape will also collect soil samples for bulk core geochemical analysis of nitrogen within the cores. These samples will then be sent to Keck Paleoenvironmental & Environmental Stable Isotope Laboratory at the University of Kansas for processing using a Peripheral-Mass spectrometer (ostech 4010 Elemental Analyzer connected to Thermofinnigan MAT 253) or a similarly qualified facility. Human activity modifies soil's chemical characteristics by altering the amount of carbon, phosphorus, nitrogen, or carbonates within the deposits, typically increasing the ratios of carbon and nitrogen. Ultimately, bulk core geochemical analysis of nitrogen will aid in determining the presence or absence of landform use by humans (geochemical analysis of nitrogen is routinely used as an indicator of anthropogenic activity).

Gray & Pape will also collect palynological samples within terrestrial-originating deposits. Pollen are relatively durable in sediments and will provide information on the past vegetation

of the area and may even identify food or medicinal sources for past occupations. Palynological analysis of core sediments, where necessitated by radiocarbon dates, will aid in the identification of floral species that would have been present in the subaerial environment surrounding the sampled paleolandform and available for exploitation by extant populations. Additionally, pollen data will supplement environmental reconstructions of the landform in question (e.g., low-energy freshwater species, brackish salt-tolerant species). Samples will be sent to the Paleo Research Institute or a similarly qualified facility for processing and analysis.

Microdebitage analysis will occur once all other samples are collected as this will destroy the remaining sample. This will determine the presence or absence of microdebitage left behind by human production of stone tools. Gray & Pape will sort the remaining soils of the core through a geological sieve in search of lithic material related to the reduction stages of stone tool making. Microdebitage measures less than 1 mm in size and can be abundant on archaeological sites around tool-making areas. Microdebitage will be viewed using light microscopy and scanning electron microscopy methods, as available, to better identify their characteristics. One half of each core (split longitudinally) will be archived for future research by other parties if desired, and curation of materials from the analyses will be performed.

It is important to note, the quantity of subsamples and lab testing discussed above is entirely dependent upon the sediments recovered in the vibracores, with a reasonable level of effort included for refinement of paleo-landscape environmental properties. Appropriate sediments for testing may not be recovered in every core, thus the distribution of subsamples and testing will naturally follow the evidence obtained and be determined with input from the consulting parties.

In the unlikely event that an archeological resource(s) is found in the cores, Gray & Pape will discuss arranging permanent curation or other appropriate next steps for the archaeological resource(s) with MBUAR and MHC for portions of the Project within state waters, and BOEM and the Tribes for both state and federal waters.

4. Lab Results and Interpretation

Following receipt of the lab test results, the QMA will review and synthesize the data which will begin to reveal a story of the environmental history of Nantucket Sound and offshore waters south of the islands. Gray & Pape will compare the results amongst available literature, including archaeological testing in the submerged landscapes in the Atlantic Outer Continental Shelf as well as regional studies to provide a greater context to the results. These findings will allow Gray & Pape to provide scientific findings that address the research questions regarding preserved subaerial environments, ultimately allowing for a refined paleo-landscape reconstruction. It may also provide sufficient evidence of the presence or absence of archaeological resources within the direct testing locations.

5. Study Findings

Results of the study will be thoroughly documented in a technical report and presented in a variety of formats discussed in Section 4.0, in consult with the Tribes. Descriptive text and

figures will be generated to explain the entire study process from pre-survey planning to the product development. Digital files of all data and reports will be distributed to the Tribes and other stakeholders as necessary.

This study is envisioned as an opportunity for all engaged stakeholders to actively participate and voice their opinions on how it is completed and the goals we are trying to achieve. Vineyard Wind looks forward to collaborating with the Tribes to develop this potential model study that could be used as a template by other offshore renewable projects as well.

A technical report of finding will be submitted upon completion of the fieldwork. This report will comply with regulation 312 CMR 2.09:3, will meet the standards for technical reporting in 950 CMR 70.14, and will also meet the standards described in the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation.

The report format will include:

- Report Cover with the Project name, project proponent, and author(s);
- Table of contents, figures and tables;
- Abstract prepared according to the State Archaeologist's guidelines;
- Introduction detailing the Project, relevant legislation, Project area/APE description, personnel involved, and acknowledgements;
- Figures detailing the Project location and specific testing locations on Project plans and USGS quadrangle(s), photographs of the Project area/APE and of visible cultural features or structures, and relevant historical maps;
- Maps of the specific testing locations;
- A comprehensive environmental and cultural context for the Project utilizing available resources and tied to the Project history;
- A summary of documentary background research and historical contexts as they relate to Nantucket Sound and Project waters;
- A summary of previous investigations including the date, organization, and reference;
- A description of the Project research, field, and laboratory methodology, including a description and justification of the research design and the method and intensity of the investigation;
- A quantitative and qualitative summary of the field survey results including artifacts and features recovered during the field investigations, and their known or potential research value, as well as, the sites spatial, contextual, and structural characteristics, and the present condition of the site;
- A list of the references cited; and
- Appendices with the relevant agency communication and paperwork, curation documents outlining preserved cores and samples, and artifact catalogs (if artifacts are recovered).

GIS layers created by Gray & Pape for the investigation or the technical report will conform to Federal Geographical Data Committee (FGDC) Standards. Geospatial data will

be delivered in a geo-referenced GIS format (feature-based file structures with one-to-one cardinality between spatial records and attribute records) which would include Environmental Systems Research Institute's (ESRI) shapefile and geodatabase formats. Each GIS data set shall be accompanied by metadata conforming to FGDC's Content Standard for Digital Geospatial Metadata (CSDGM). All data will be provided in the Universal Transverse Mercator (UTM) project in the appropriate zone and will have a datum of WGS84.

Gray & Pape will submit two (2) final copies of the report that address MHC's comments on the draft; a CD-ROM containing a word processing file with the report author(s) names, date, title, page count and an archaeological abstract prepared in accordance with the State Archaeologist's report abstracting guidelines; and any MHC inventory forms, attached to which would be USGS locus maps with the archaeological site clearly bounded, and smaller scale site maps showing the boundaries of the site in relation to archaeological testing.

Curation
Upon project completion, preserved cores and untested samples will be curated at Gray & Pape's Providence, Rhode Island Laboratory facilities. These will be available for access to future researchers including, but not limited to, archaeological researchers, universities, THPOs, SHPOs, and MBUAR.

If artifacts are recovered, they will be curated with the Public Archaeology Laboratory (PAL Inc.), an approved facility that meets the standards identified in 36 CFR 79.9.

Gray & Pape maintains hard copy and digital records of all project materials. Digital and paper copies of records accompany the project materials to the permanent curation facility. The digital data will be provided to the curation facility on CD, and long-term contact information will also be provided for questions and as a failsafe should any degrading of the digital data occur. In addition, duplicate copies of the paper and digital project records are maintained at the Providence office, supported by an automatic server backup procedure. Further, duplicate records of all Providence records are also backed up at the corporation headquarters in Cincinnati.

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APPENDIX A: Mitigation Summary Table

Table 1: Summary of Potential Archaeological Features and Project Avoidance and Mitigation Measures

Feature ID[1,2]	Depth (m bsb)[3]	Radiocarbon Age (Cal BP)[4]	Associated Vibracore/Boring with Terrestrial Sediments	Traditional Cultural Property (TCP)[5,6,7]	Contributing Element to TCP?	Expected Avoidance Status	Proposed Avoidance and Mitigation Measures[8]
OFFSHORE EXPORT CABLE CORRIDOR (OECC)							
OECC Paleochannel Groups							
Channel Group 8	1-10	NA	NA	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 9	1-4	NA	NA	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 10	1-10	NA	Vibracores 41, 126, 141, 142, 144, 145	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 11	3-10	NA	Vibracores 128 & 129	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 12	2-10	NA	NA	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 13	3-9	NA	NA	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 14/ Lake 1	3-10	NA	NA	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Lake 2	3-10	NA	N	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 15	2-8	NA	Vibracore 166	Nantucket Sound TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 16	1-10	NA	Vibracores 168 & 169	Potentially Nantucket Sound TCP or Chappaquiddick TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 17	1-6	NA	NA	Potentially Nantucket Sound TCP or Chappaquiddick TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 18	2-10	NA	NA	Potentially Nantucket Sound TCP	Yes	Avoided	Export cables will avoid this feature by not using the Western Muskeget Option

Feature ID[1,2]	Depth (m bsb)[3]	Radiocarbon Age (Cal BP)[4]	Associated Vibracore/Boring with Terrestrial Sediments	Traditional Cultural Property (TCP)[5,6,7]	Contributing Element to TCP?	Expected Avoidance Status	Proposed Avoidance and Mitigation Measures[8]
				or Chappaquiddick TCP			
Channel Group 19	2-10	NA	NA	Potentially Nantucket Sound TCP or Chappaquiddick TCP	Yes	Avoided	Export cables will avoid this feature by not using the Western Muskeget Option
Channel Group 20	2-8	NA	NA	Potentially Nantucket Sound TCP or Chappaquiddick TCP	Yes	Avoided	Export cables will avoid this feature by not using the Western Muskeget Option
Channel Group 21	1-10	NA	NA	Potentially Nantucket Sound TCP or Chappaquiddick TCP	Yes	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
Channel Group 22	4-8	NA	NA	NA	NA	Not Avoided	Export cables may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)
	OECC Vibracores with Terrestrial Sediments not Associated with Channel Groups						
Vibracore 170	2.05	6,237	NA	Potentially Nantucket Sound TCP or Chappaquiddick TCP	Yes	Avoided	Export cables will avoid this feature by micro-routing; recommended avoidance buffer of 50 m
Vibracore 171	0.86	14,060	NA	Potentially Nantucket Sound TCP or Chappaquiddick TCP	Yes	Avoided	Export cables will avoid this feature by micro-routing; recommended avoidance buffer of 50 m
	OECC Potential Shipwrecks						
PSW-1/OECC KP 25.45	0	NA	NA	Potentially Nantucket Sound TCP or Chappaquiddick TCP	No	Avoided	Export cables will avoid this feature by micro-routing around the 40 x 90 m debris field; recommended avoidance buffer of 100 m from target boundary
PSW-2/OECC KP 27.5	0	NA	NA	Potentially Nantucket Sound TCP or Chappaquiddick TCP	No	Avoided	Export cables will avoid this feature by micro-routing around the 14 x 37 m area; recommended avoidance buffer of 100 m from target boundary
PSW-3/NHAL KP 1.0	0	NA	NA	Nantucket Sound TCP	No	Avoided	Export cables will avoid this feature by not using the New Hampshire Avenue Option; New Hampshire Avenue is no longer included in the undertaking
PSW-4/ NHAL KP 2.9	0	NA	NA	Nantucket Sound TCP	No	Avoided	Export cables will avoid this feature by not using the New Hampshire Avenue Option; New Hampshire Avenue is no longer included in the undertaking
PSW-5/NHAL KP 3.5	0	NA	NA	Nantucket Sound TCP	No	Avoided	Export cables will avoid this feature by not using the New Hampshire Avenue Option; New Hampshire Avenue is no longer included in the undertaking

Feature ID[1,2]	Depth (m bsb)[3]	Radiocarbon Age (Cal BP)[4]	Associated Vibracore/Boring with Terrestrial Sediments	Traditional Cultural Property (TCP)[5,6,7]	Contributing Element to TCP?	Expected Avoidance Status	Proposed Avoidance and Mitigation Measures[8]
WIND DEVELOPMENT AREA (WDA)							
	WDA Paleochannel Groups[9,10]						
Channel Group 23	1.0-2.1	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by micro-routing
Channel Group 24	1.6-6.5	NA	NA	NA	NA	Not Avoided	Inter-array cable may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)[6]
Channel Group 25	1.9-6.7	NA	NA	NA	NA	Not Avoided	Inter-array cable and jack-up vessel may not be able to avoid this feature (adjacent to WTG); Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)[6]
Channel Group 26	1.3-6.8	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by micro-routing
Channel Group 27	2.0-4.9	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by shallower (1.5 m) burial
Channel Group 28	2.3-6.5	NA	Boring 18T033	NA	NA	Avoided	WTG will not be installed at this location
Channel Group 29	1.2-2.6	NA	NA	NA	NA	Not Avoided	WTG and inter-array cable may not be able to avoid this; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)[6]
Channel Group 30	1.6-5.3	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by micro-routing
Channel Group 31	1.3-5.2	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by micro-routing
Channel Group 32	0.8-3.5	NA	NA	NA	NA	Not Avoided	Inter-array cable and jackup rig may not be able to avoid this feature (adjacent to WTG); Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)[6]
Channel Group 33	2.2-5.3	NA	NA	NA	NA	Avoided	Inter-array cables can avoid by shallower (1.5 m) burial
Channel Group 34	2.3-5.3	NA	NA	NA	NA	Avoided	Inter-array cables can avoid by shallower (1.5 m) burial
Channel Group 44	1-10	NA	Vibracore 309	NA	NA	Not Avoided	Inter-array cable may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)[6]
Channel Group 45	2-5	NA	Vibracore 309	NA	NA	Not Avoided	Inter-array cable may not be able to avoid this feature; Vineyard Wind will perform an additional submerged landform study (see the *Proposed Cultural Resource Mitigation for Submerged Landforms Vineyard Wind 1 Project*)[6]
Channel Group 46	1-8	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by micro-routing and shallower (1.5 m) burial
WDA Borings with Terrestrial Sediments not Associated with Channel Groups							
Boring 18S2	2.65-2.95	NA	NA	NA	NA	Avoided	Inter-array cables can avoid by shallower (1.5 m) burial; ESP will not be installed at this location

Feature ID[1,2]	Depth (m bsb)[3]	Radiocarbon Age (Cal BP)[4]	Associated Vibracore/Boring with Terrestrial Sediments	Traditional Cultural Property (TCP)[5,6,7]	Contributing Element to TCP?	Expected Avoidance Status	Proposed Avoidance and Mitigation Measures[8]
WDA Vibracores with Terrestrial Sediments not Associated with Channel Groups							
Vibracore C010	1.14-1.18	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by micro-routing
Vibracore 313	2.65	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by shallower (1.5 m) burial
Vibracore 333	2.05-2.10	14,060	NA	NA	NA	Avoided	Inter-array cable can avoid by shallower (1.5 m) burial
Vibracore 400	1.95-1.97	12,045	NA	NA	NA	Avoided	Inter-array cable can avoid by shallower (1.5 m) burial
Vibracore 407	2	NA	NA	NA	NA	Avoided	Inter-array cable can avoid by shallower (1.5 m) burial
WDA Shipwrecks							
SW-1	0	NA	NA	NA	NA	Avoided	8 x 26 m area on edge of cable corridor. Recommended avoidance buffer of 50 m from target boundary.
SW-2	0	NA	NA	NA	NA	Avoided	11 x 22 m area outside survey area. Recommended avoidance buffer of 50 m from target boundary.

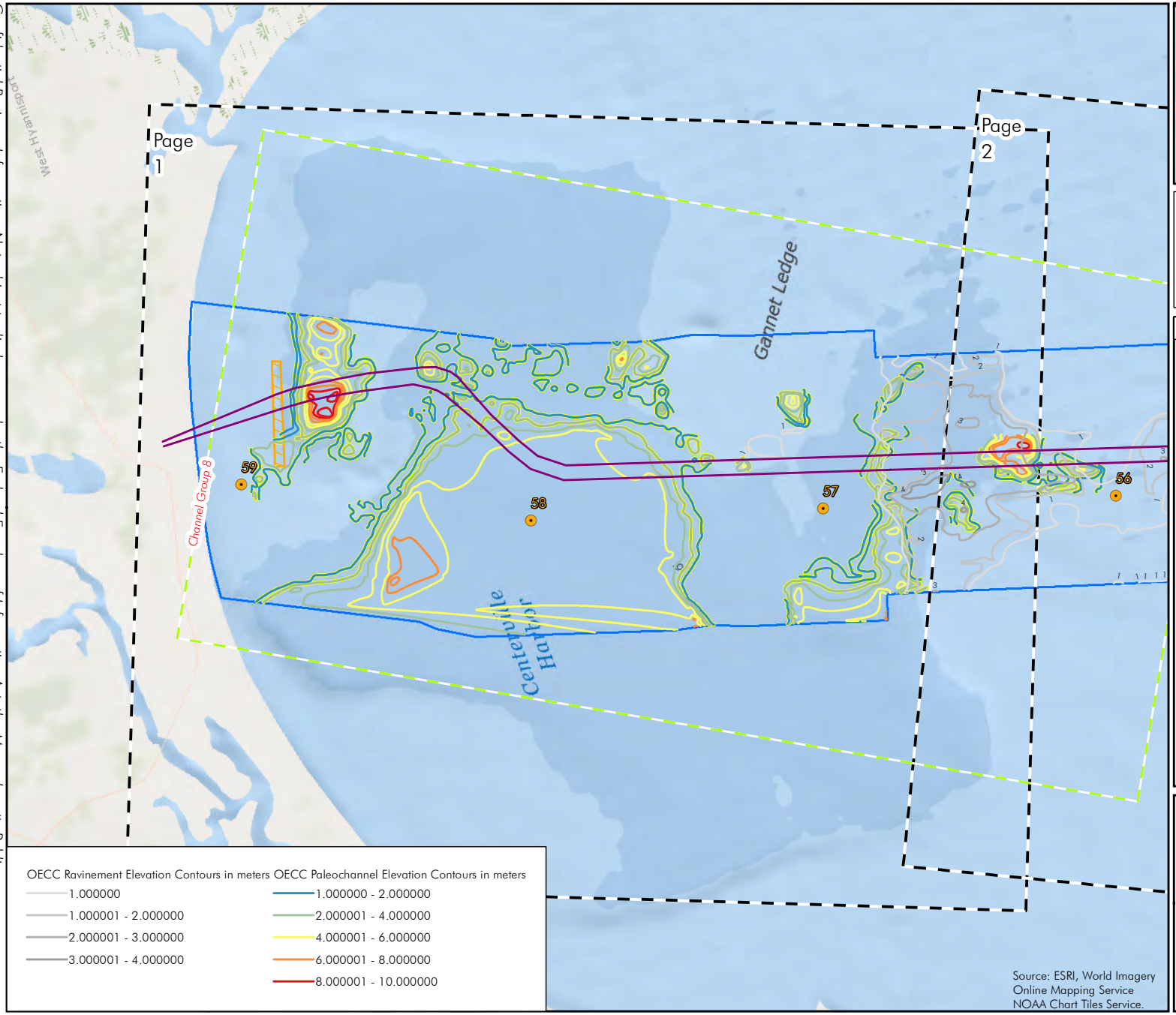
Notes:

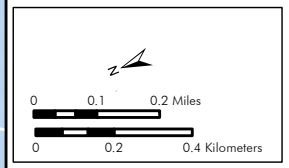
1. Table includes features within and outside of the Area of Potential Effect (APE).
2. Table excludes OECC Paleochannel Groups 1 through 7, which were along the OECC variant to New Hampshire Avenue and are no longer part of the undertaking.
3. Depth (m bsb) = depth in meters below the seabed to the feature
4. Calibration to years Before Present (Cal BP)
5. Although the exact boundary of the Nantucket Sound TCP is not precisely defined, it is roughly bound by Vineyard Sound, Cape Cod, Martha's Vineyard, and Nantucket.
6. Although the Chappaquiddick TCP does not have specific boundaries, it roughly encompasses the Island of Chappaquiddick, Norton Point in Edgartown, and Katama Bay. OECC Paleochannel Groups 16, 17, and 21, which may not be avoided by the export cables, may be within the Chappaquiddick TCP.
7. None of the Project's facilities will be physically located within the Vineyard Sound and Moshup's Bridge TCP.
8. Recommended buffer zones around features designated by the Project's Qualified Marine Archaeologist:
    - 50 m from the edge of a shipwreck target boundary (presumed historic if no visual inspection conducted) and 100 m for potential shipwrecks; avoidance buffers are from the maximum visible extent of the shipwreck site
    - 50 m radius from isolated points including vibracores and borings containing paleo-soils
    - 5 m surrounding a paleo-channel depth contour within the vertical APE
9. The current estimate of six unavoidable channel groups may be updated if the Bureau of Ocean Energy Management (BOEM) selects an alternate layout and new inter-array cable routes are developed.
10. Sixteen WDA Paleochannel Groups (Channel Groups 35 through 43 and Channel Groups 47 through 53) are deeper than the APE and will not be impacted. Thus, these WDA Paleochannel Groups are not included in the table above.

APPENDIX B: Archaeological Avoidance Areas Mapping

OECC GEOARCHAEOLOGICAL RECOMMENDATIONS MAPS

(MAPS 1-32)





LEGEND

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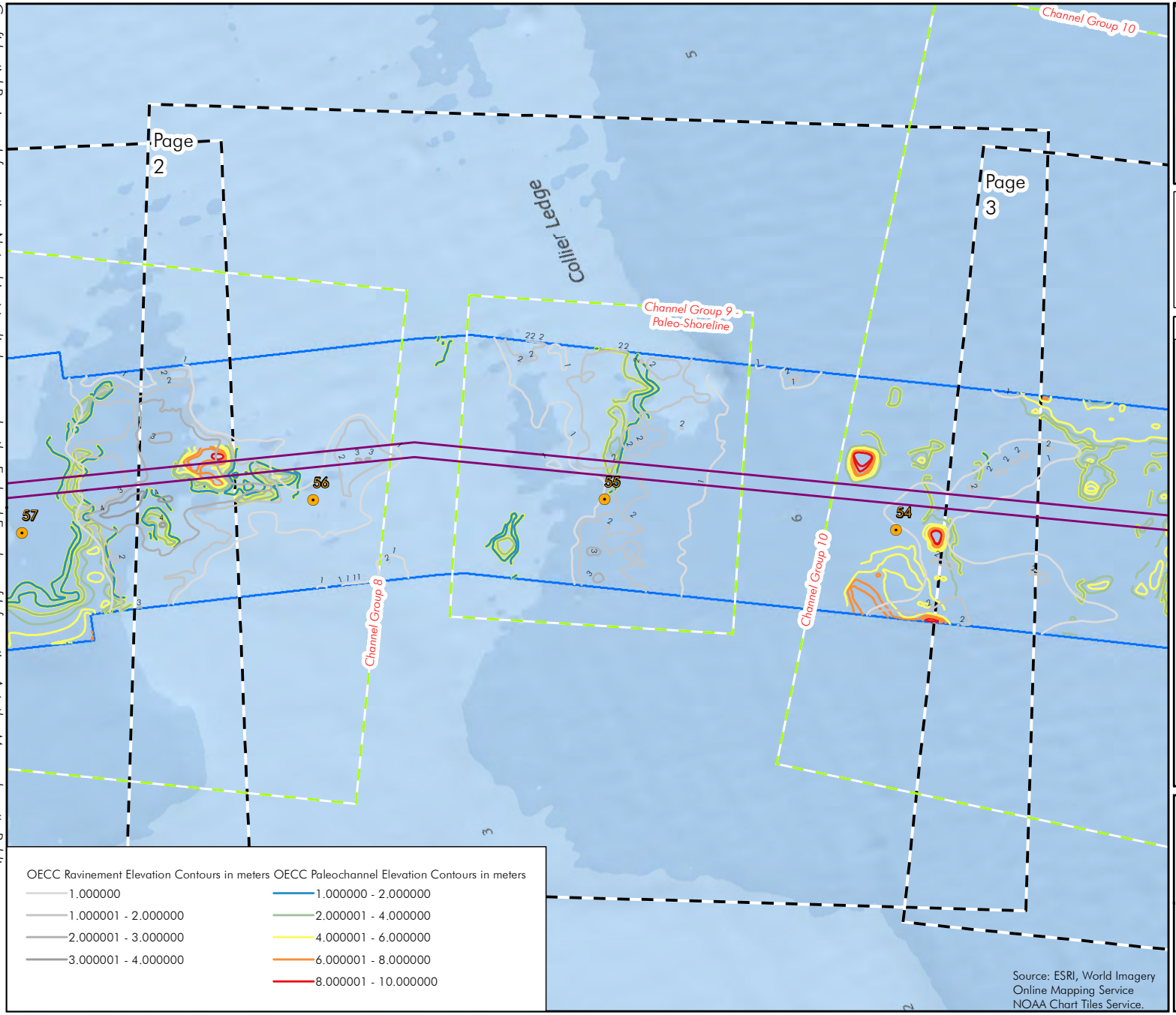
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Not Avoided
- Possible Dredge Areas
- Strip Map
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



0 0.1 0.2 Miles
0 0.2 0.4 Kilometers

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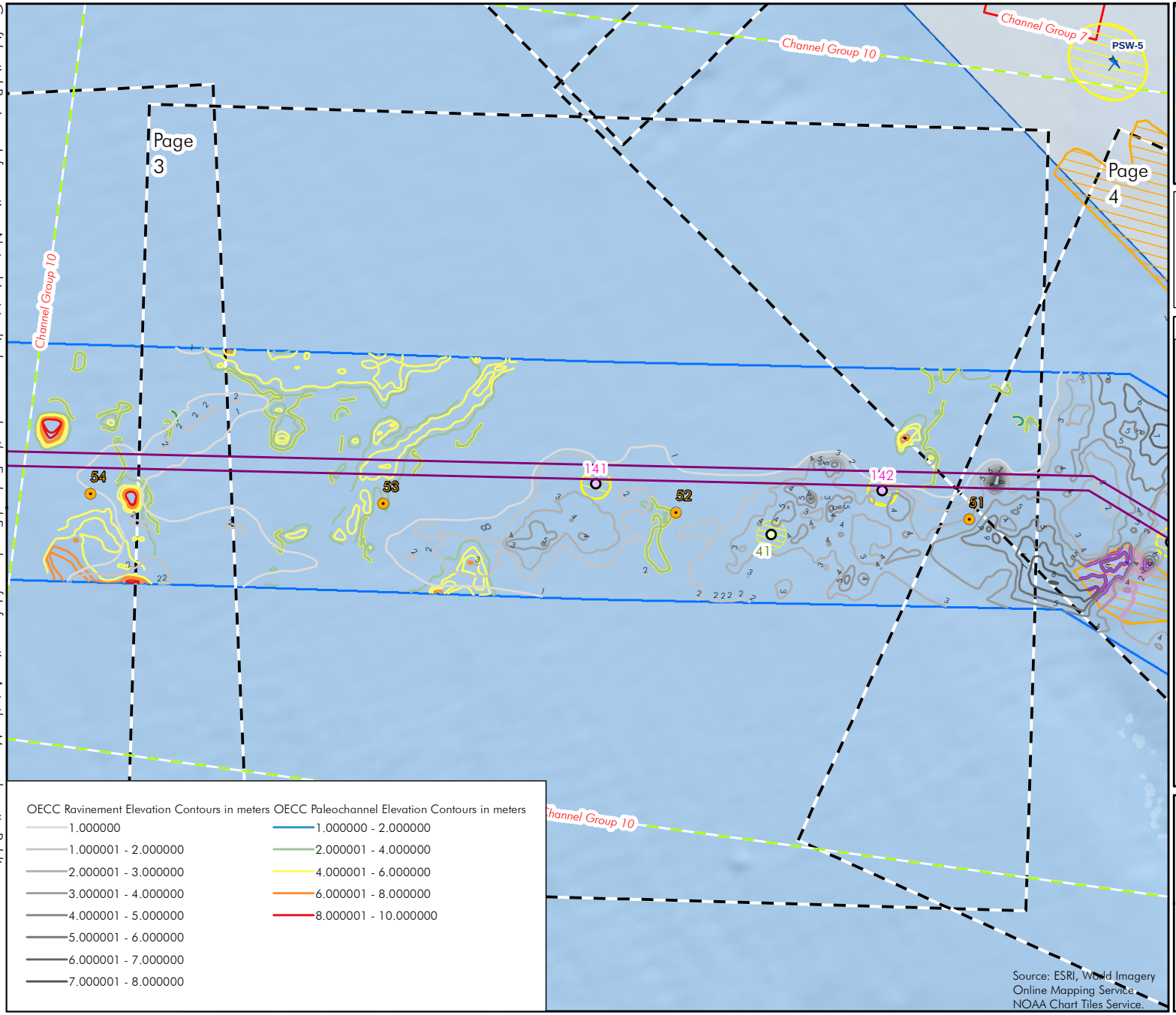
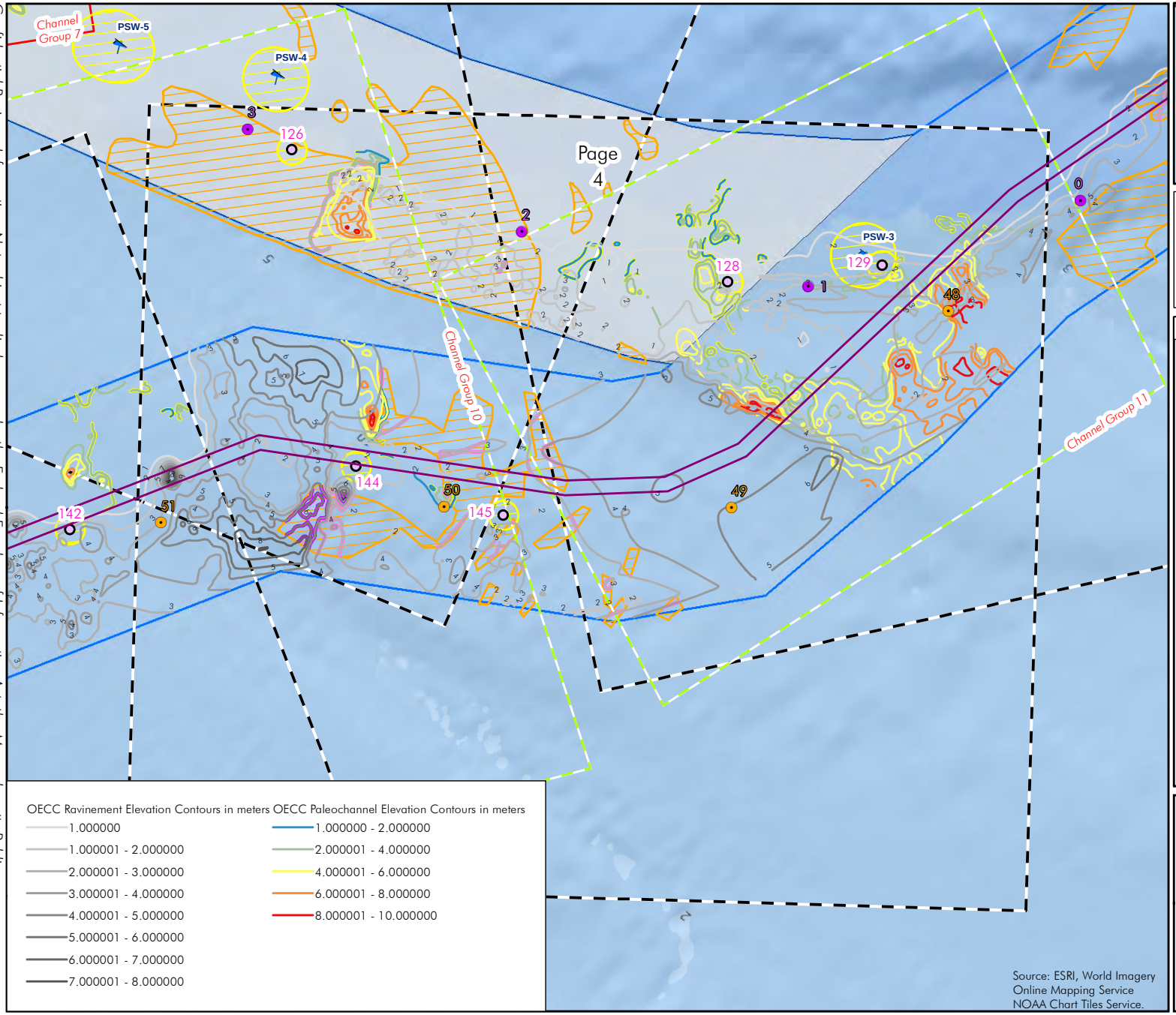
GRAY & PAPE HERITAGE MANAGEMENT



Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



0 0.1 0.2 Miles

0 0.2 0.4 Kilometers

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- 2018_Alpine_OECC_CulturalCo...
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- OECC Paleolandscape Features Dredge Avoidance Areas Between 4.5-8m Below Seafloor
- Avoidance Areas to 4.5m Below Seafloor
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
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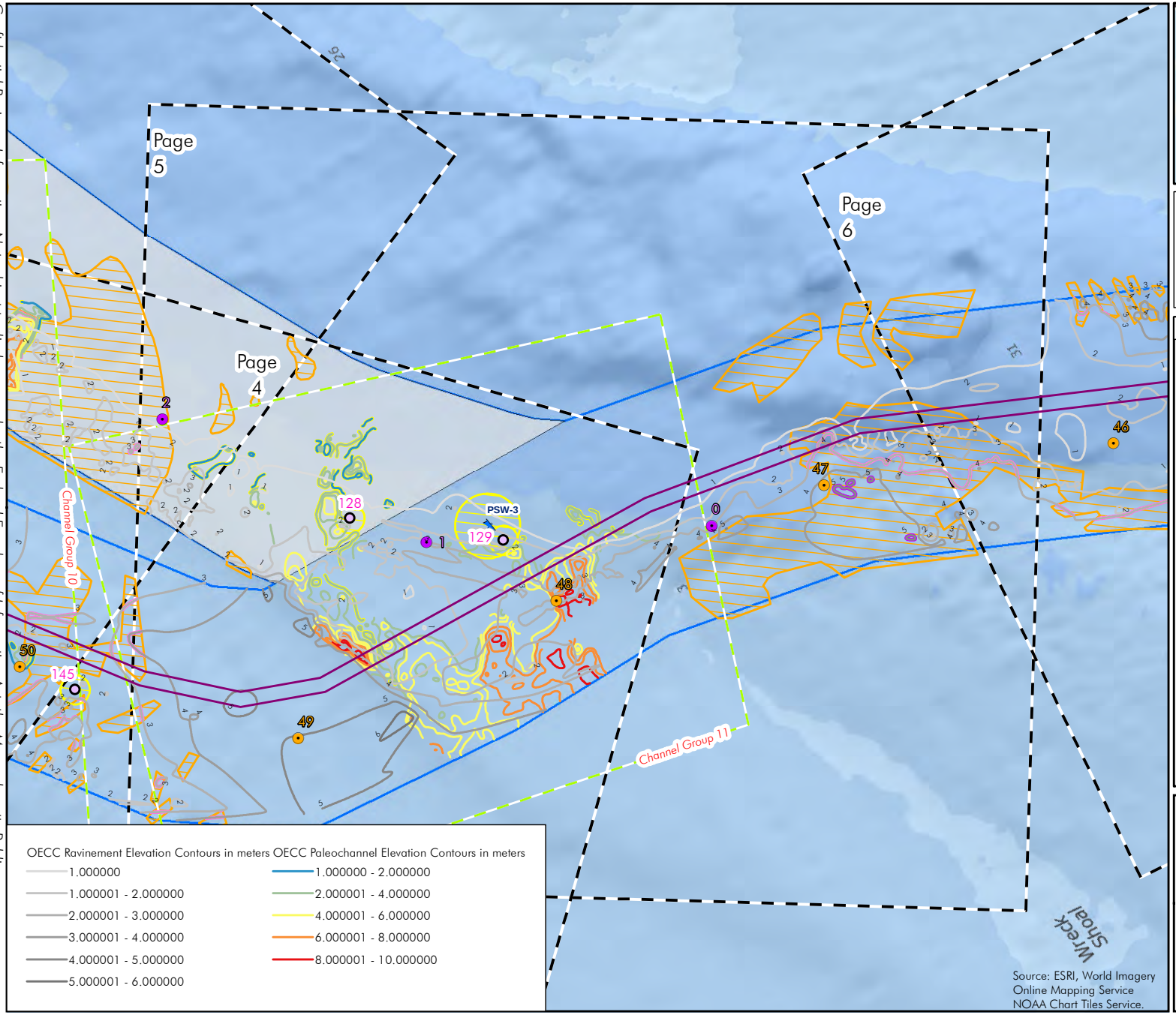
Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



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OECC Ravinement Elevation Contours in meters

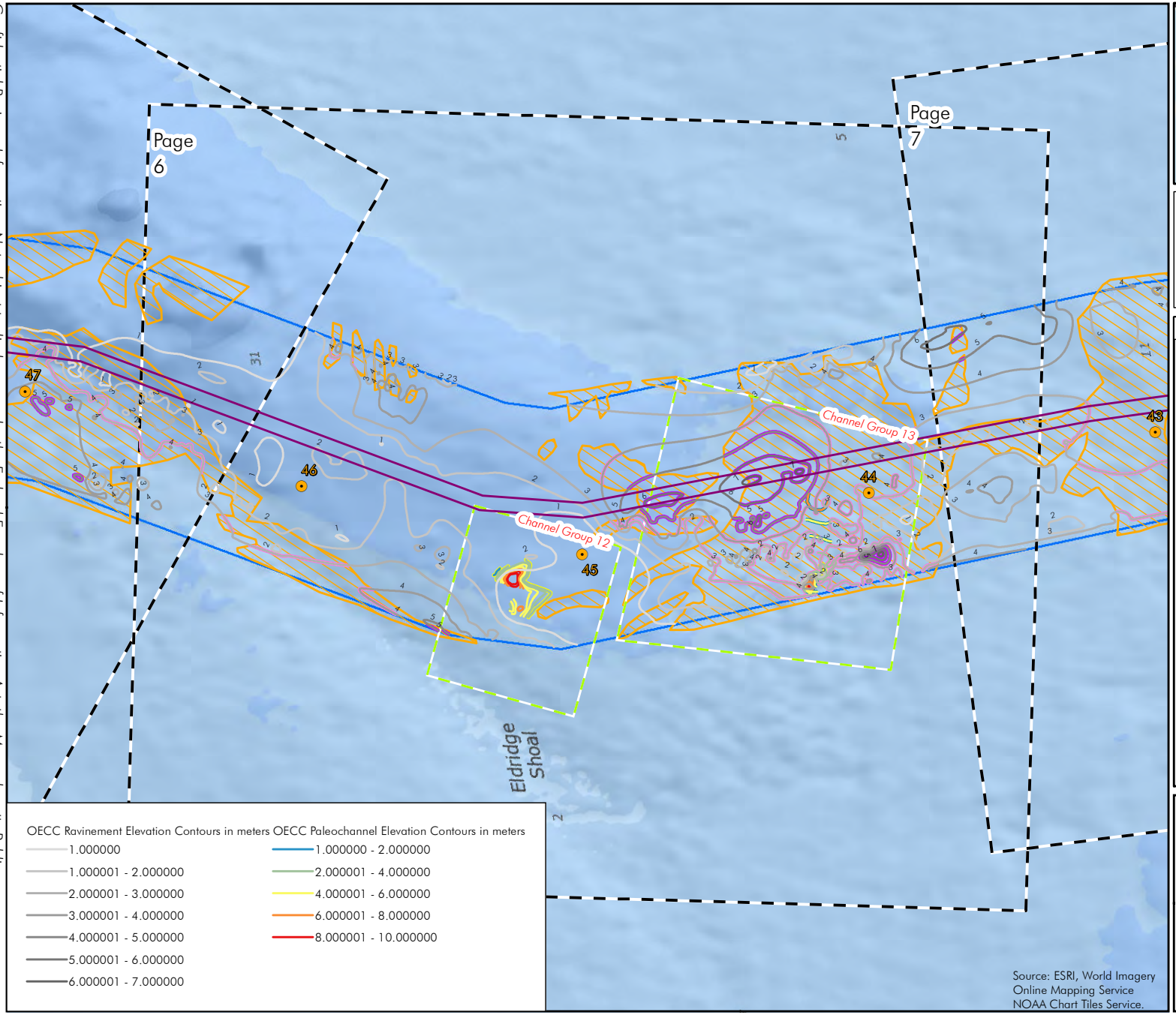
- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 4.000000
- 4.000001 - 5.000000
- 5.000001 - 6.000000

OECC Paleochannel Elevation Contours in meters

- 1.000000 - 2.000000
- 2.000001 - 4.000000
- 4.000001 - 6.000000
- 6.000001 - 8.000000
- 8.000001 - 10.000000

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



0 0.1 0.2 Miles
0 0.2 0.4 Kilometers

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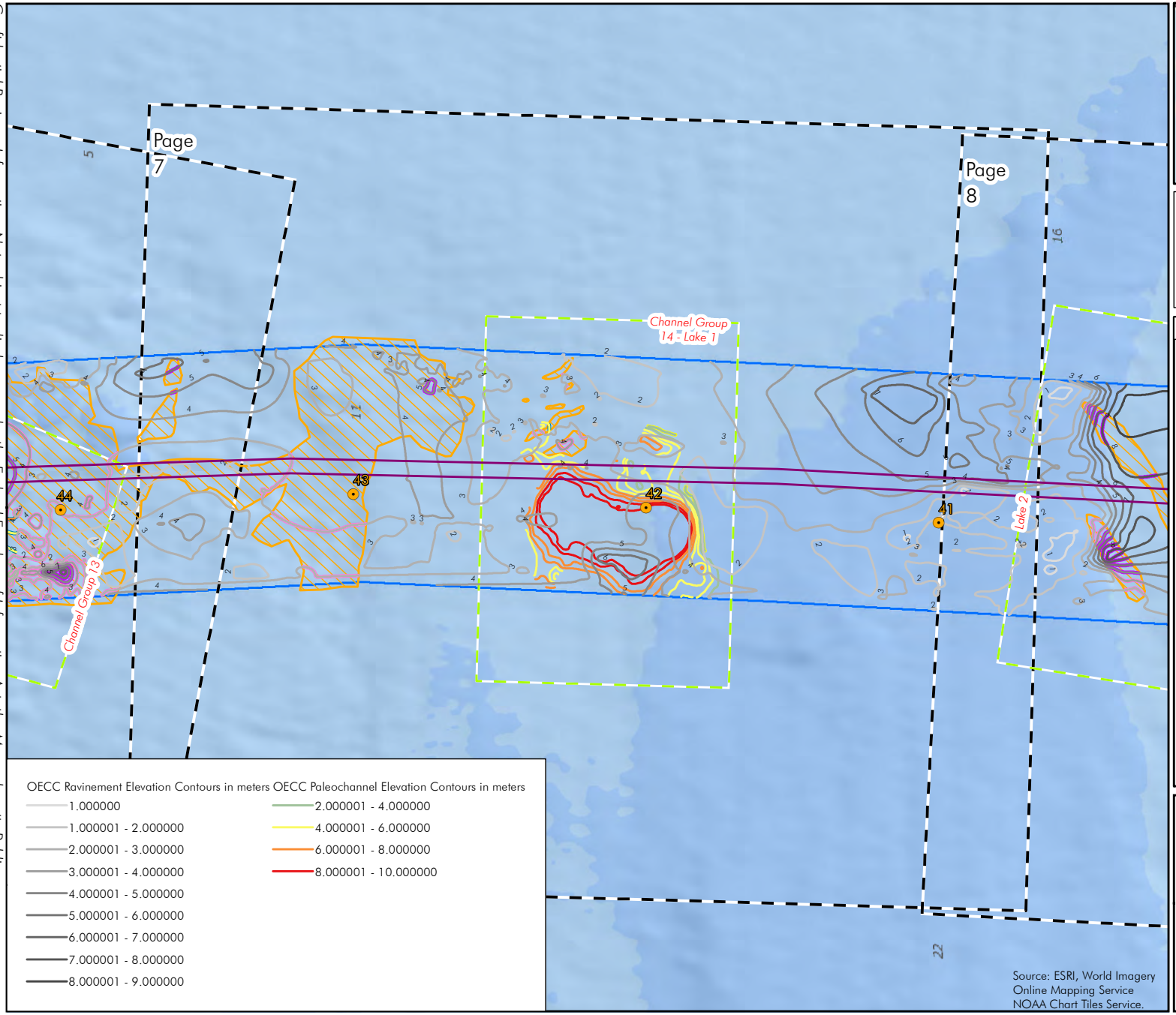
Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



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0 0.2 0.4 Kilometers

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Offshore export cable corridor archaeological avoidance areas.

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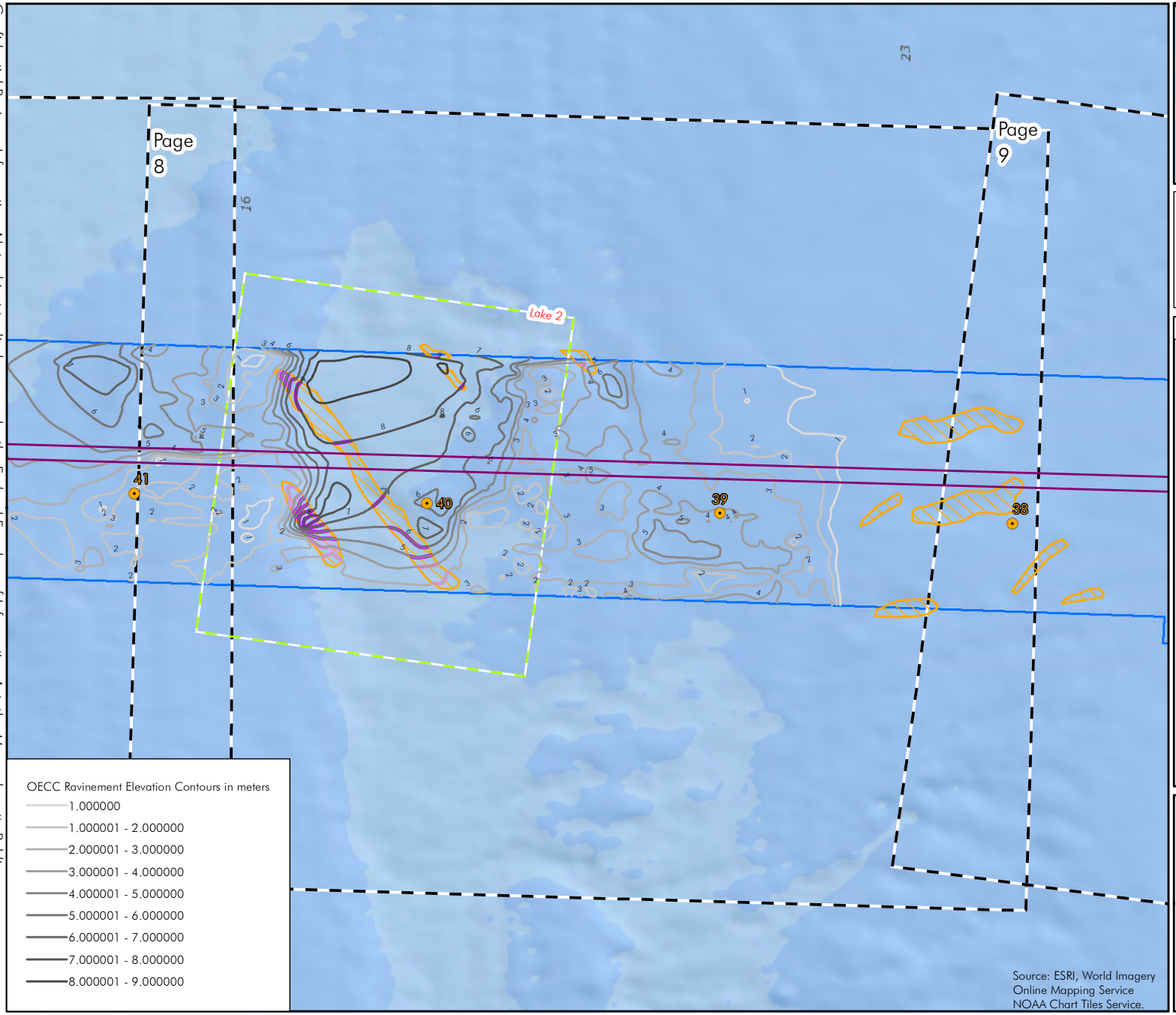

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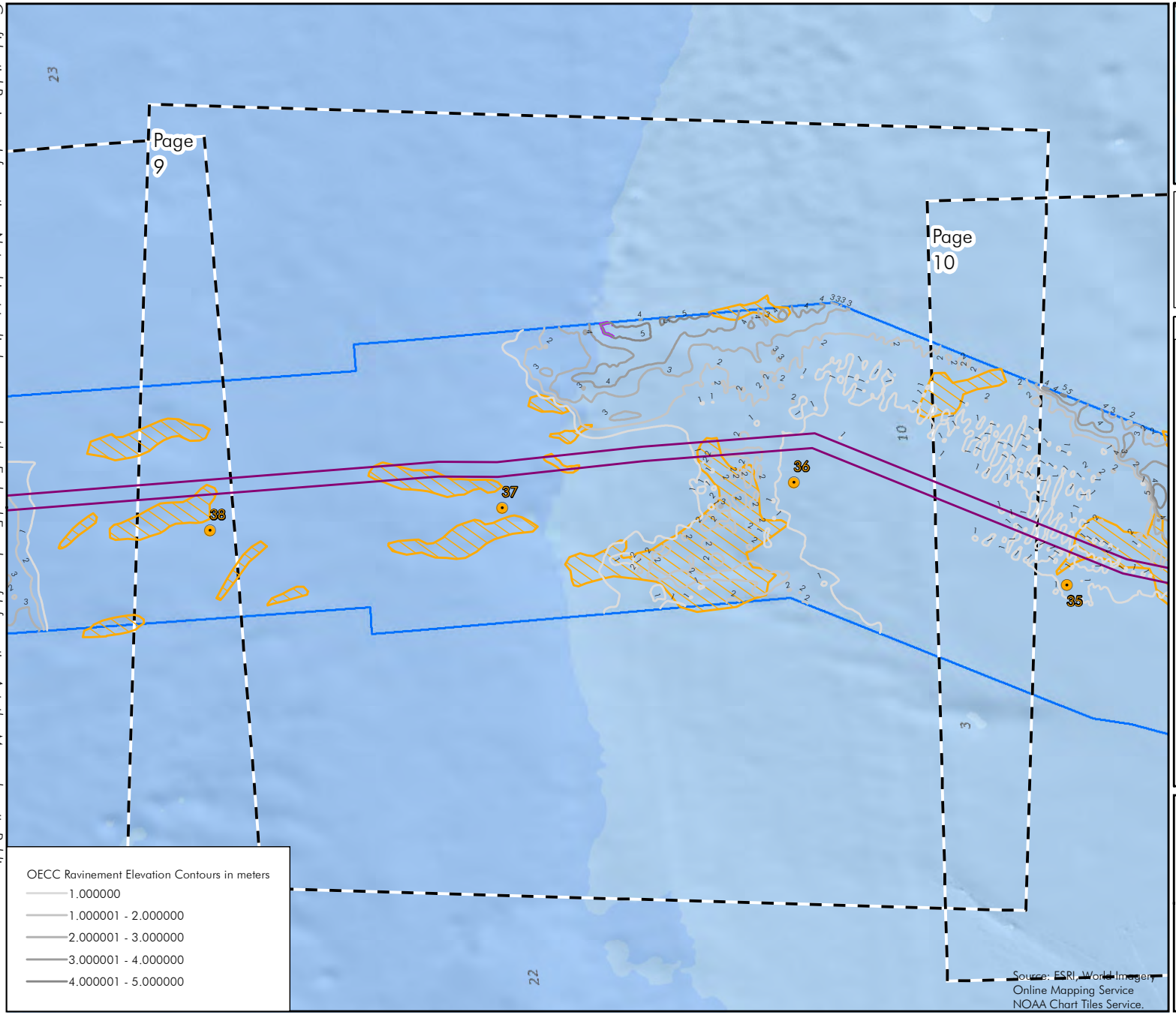
OECC Ravinement Elevation Contours in meters

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 4.000000
- 4.000001 - 5.000000
- 5.000001 - 6.000000
- 6.000001 - 7.000000
- 7.000001 - 8.000000
- 8.000001 - 9.000000

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



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Offshore export cable corridor archaeological avoidance areas.

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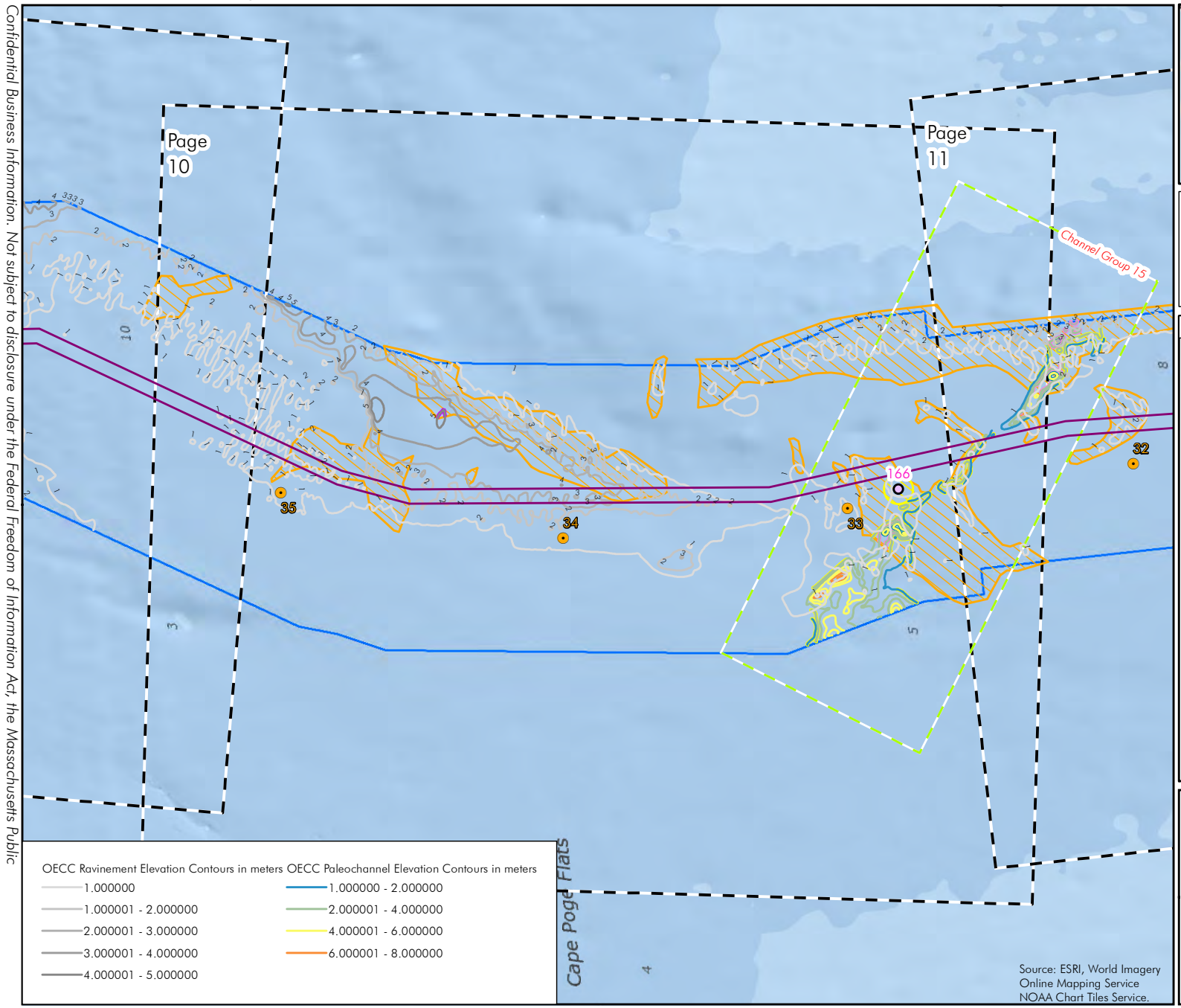

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0 0.2 0.4 Kilometers

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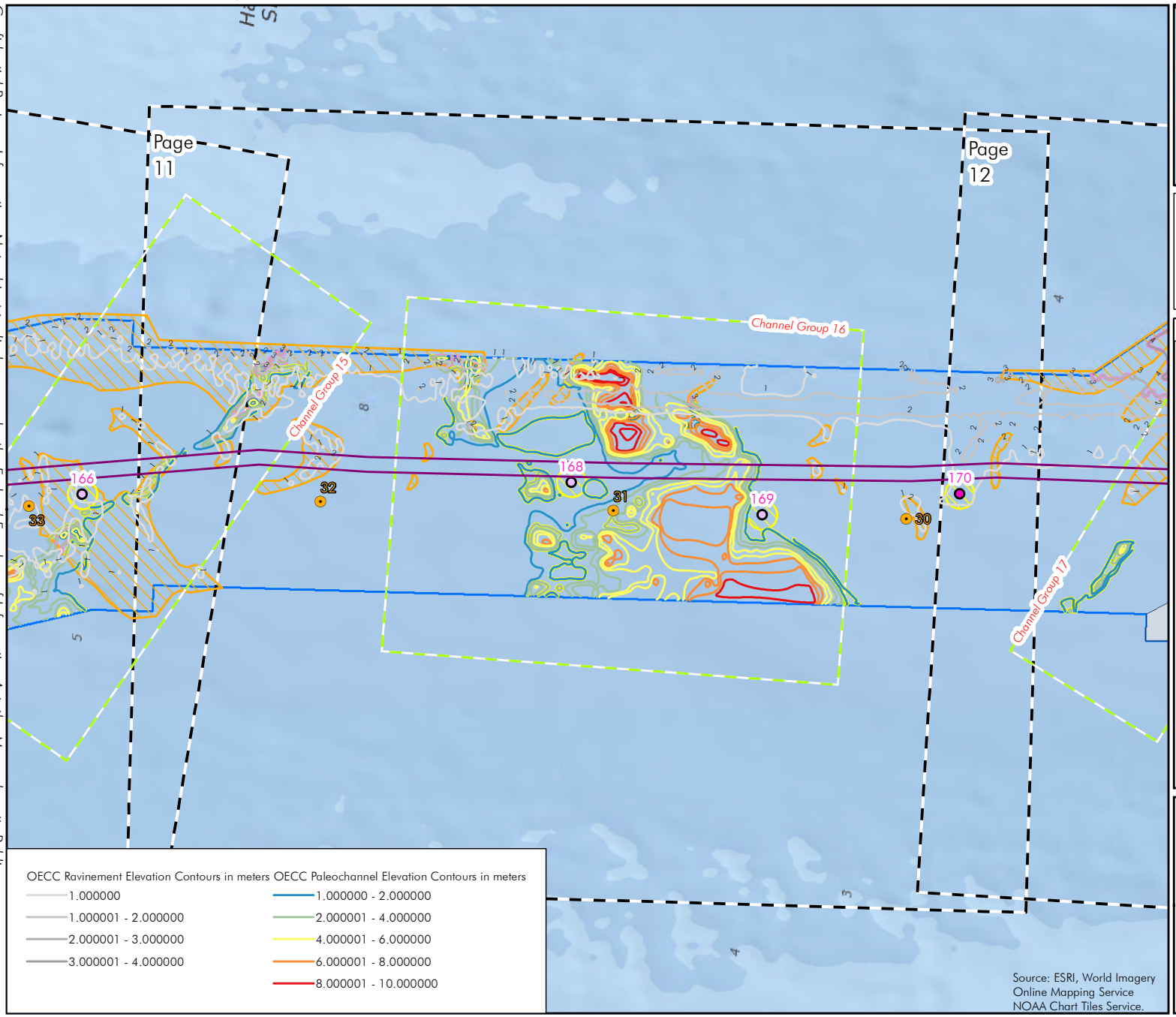
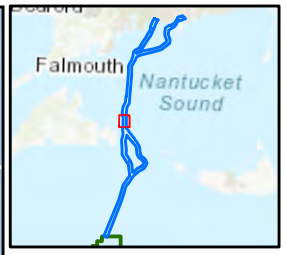
Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





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0 0.2 0.4 Kilometers

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Offshore export cable corridor archaeological avoidance areas.

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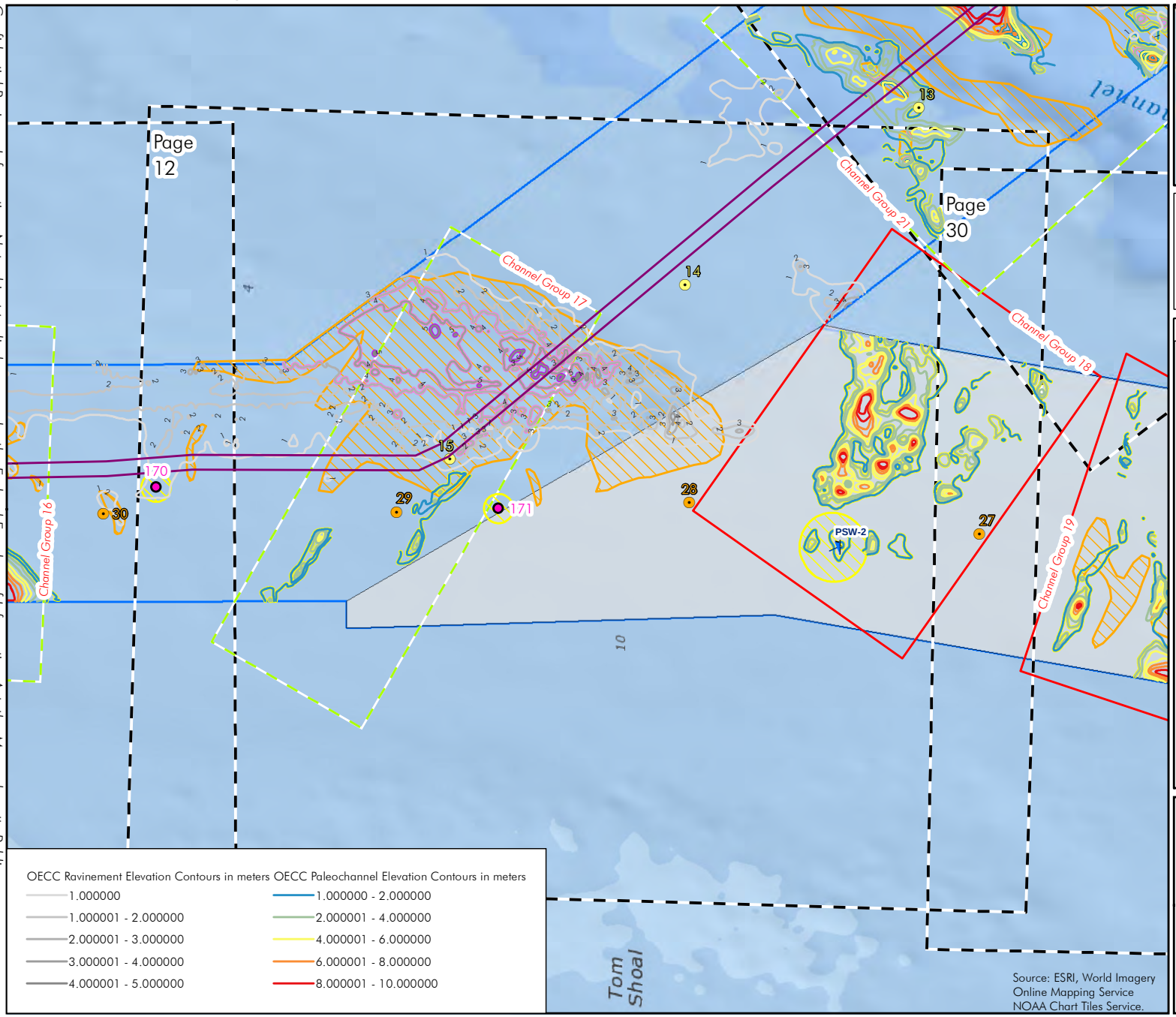

N

0 0.1 0.2 Miles

0 0.2 0.4 Kilometers

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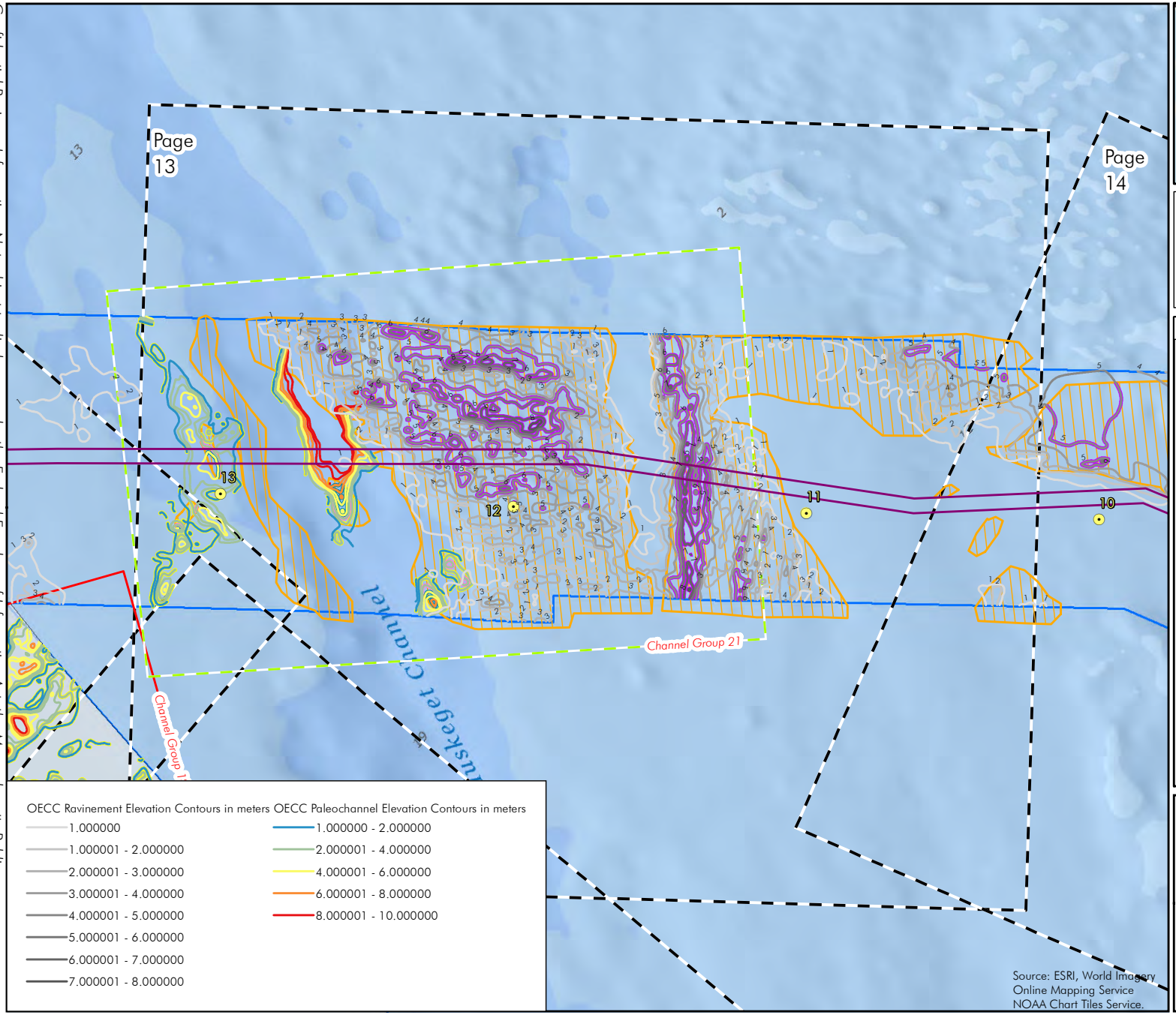
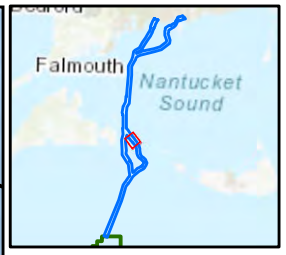
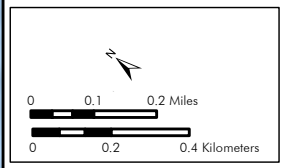
Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





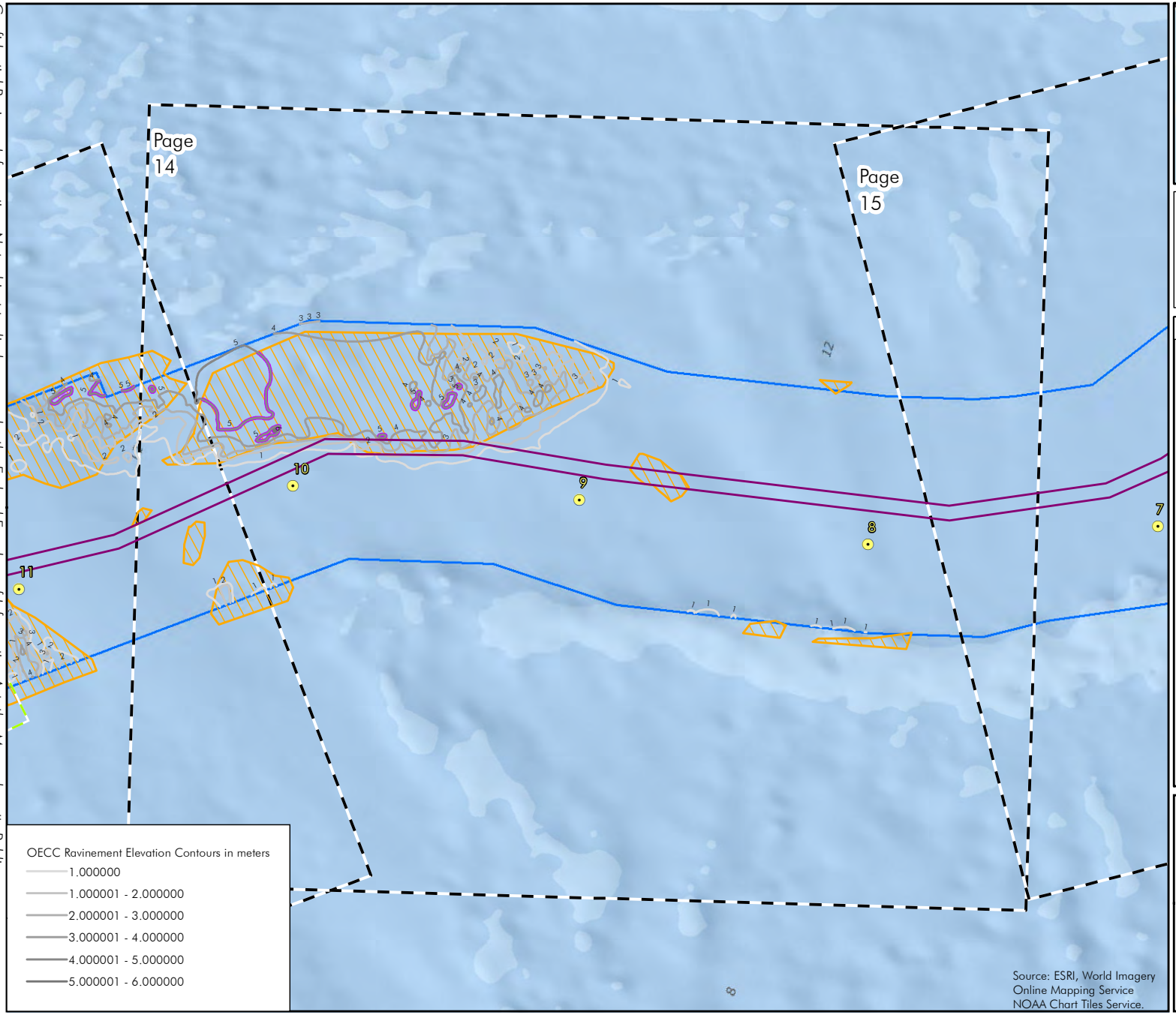


LEGEND

- Preliminary Vineyard Wind 1 Cable Alignments (to be finalized as part of the Facilities Design Report/Fabrication and Installation Report)
- KPs Eastern Muskeget Option
- KPs Covell's Beach and Western Muskeget Option
- OECC Ravinement Dredge Avoidance Areas Between 4.5-8m Below Seafloor
- OECC Paleolandscape Features Dredge Avoidance Areas Between 4.5-8m Below Seafloor
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
- Paleochannel and Paleo Features - Not Avoided
- Possible Dredge Areas
- Strip Map
- No Longer Within the Project Area of Potential Effects
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



N

0 0.1 0.2 Miles

0 0.2 0.4 Kilometers

LEGEND

Preliminary Vineyard Wind 1 Cable Alignments (to be finalized as part of the Facilities Design Report/Fabrication and Installation

OECC Ravinement Dredge Avoidance Areas Between 4.5-8m

Paleochannel and Paleo Features -

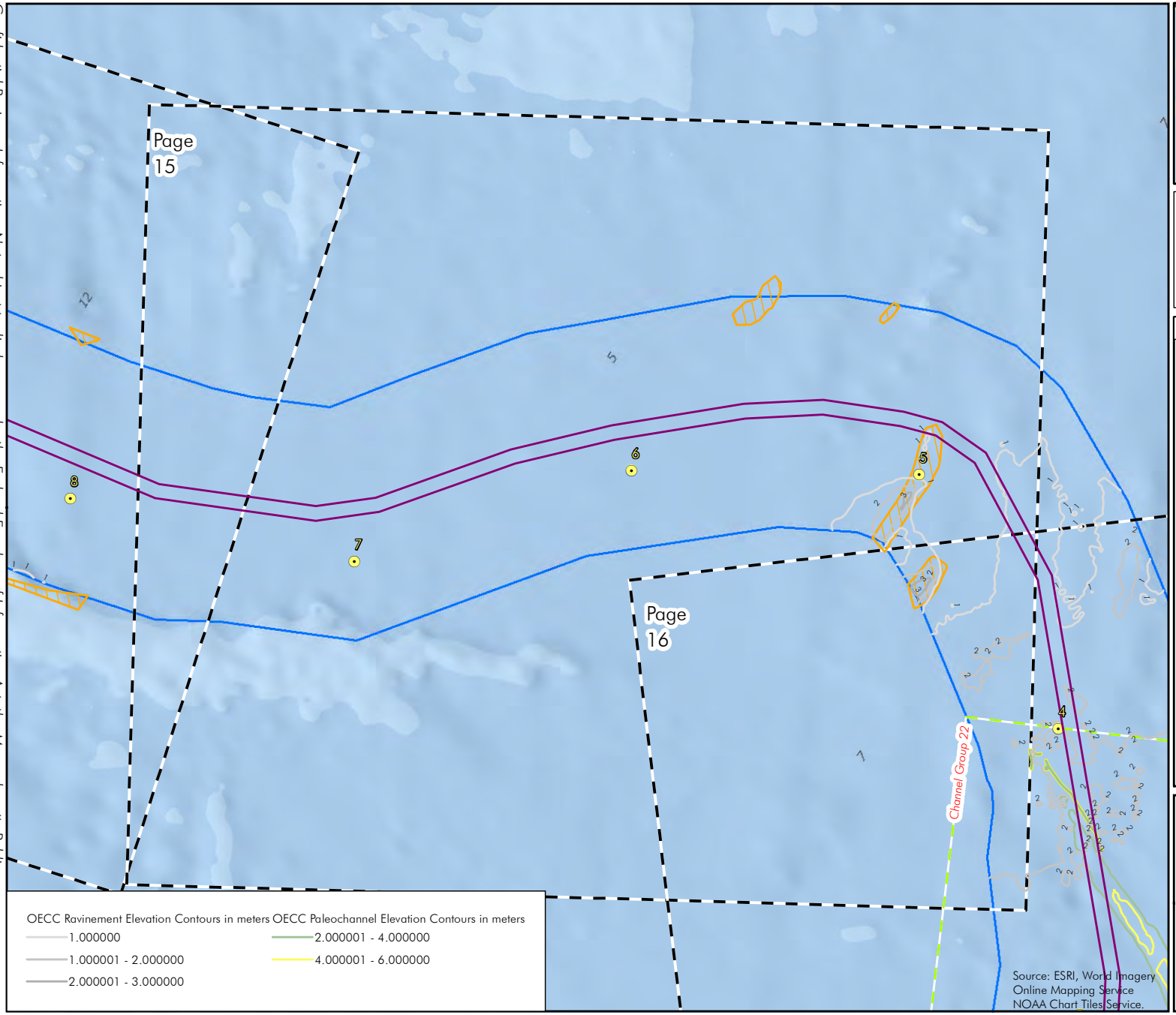
3

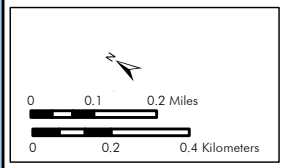
2

1

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



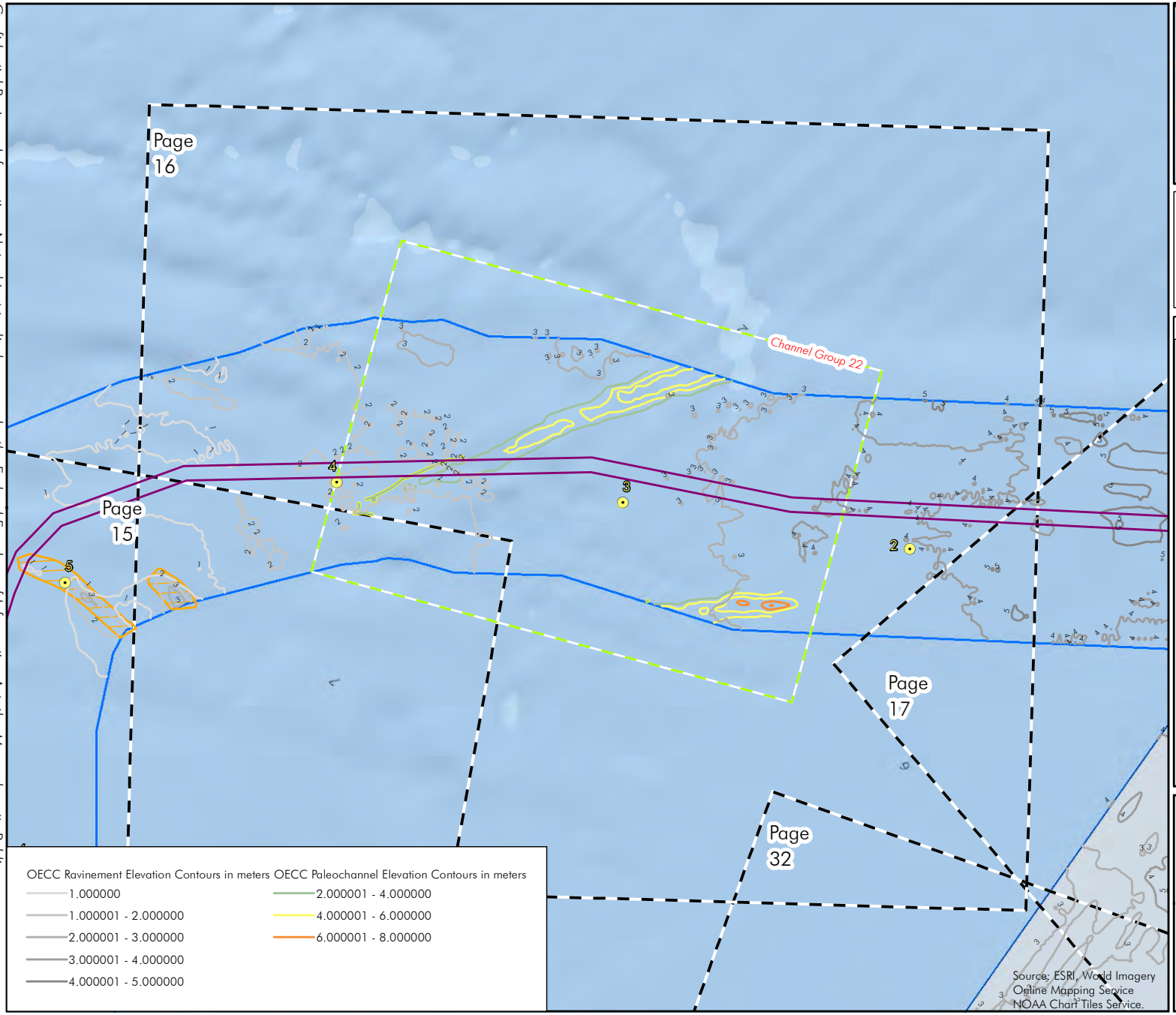


LEGEND

- Preliminary Vineyard Wind 1 Cable Alignments (to be finalized as part of the Facilities Design Report/Fabrication and Installation Report)
- KPs Eastern Muskeget Option
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Not Avoided
- Possible Dredge Areas
- Strip Map
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



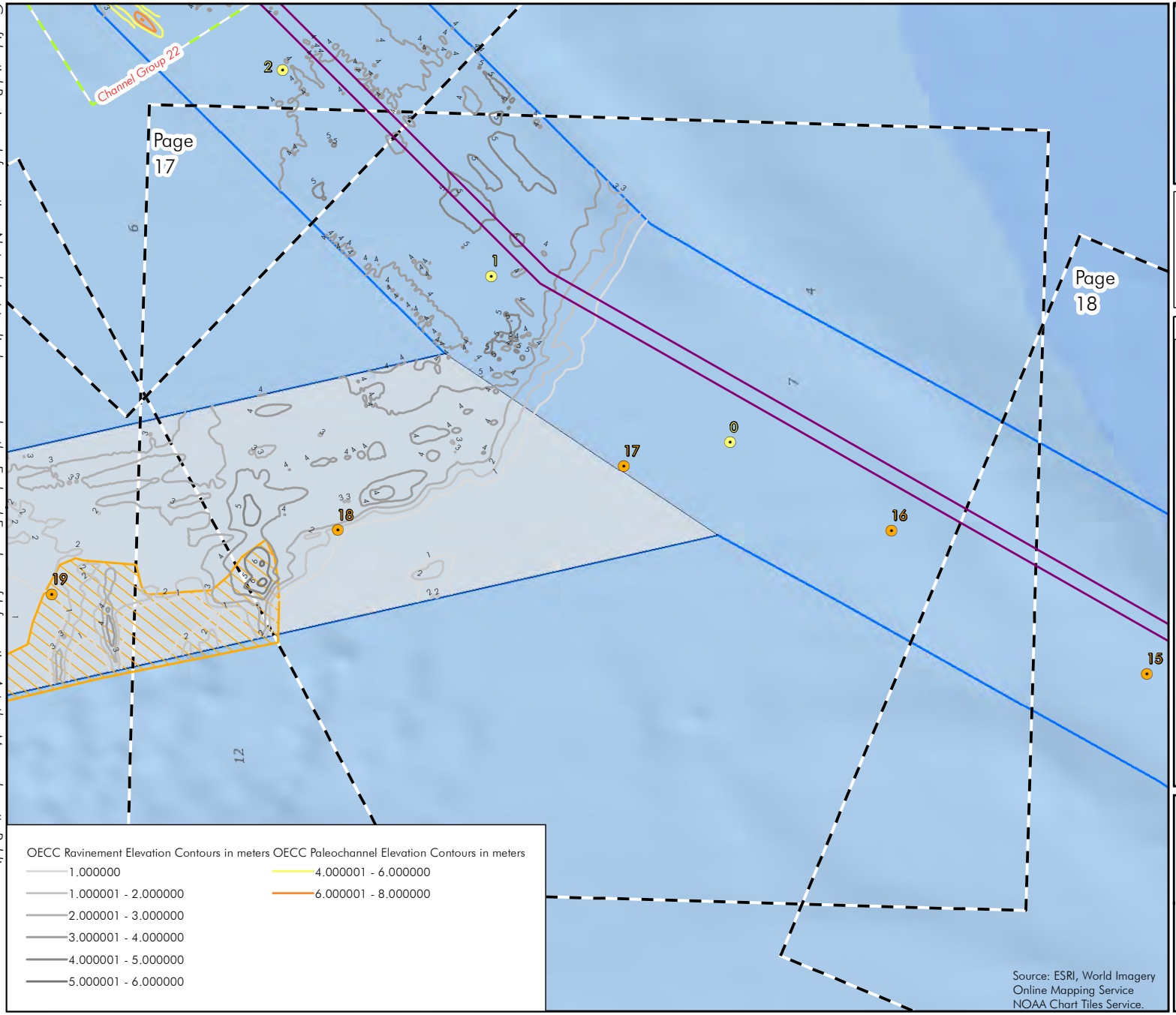
0 0.1 0.2 Miles
0 0.2 0.4 Kilometers

LEGEND

- Preliminary Vineyard Wind 1 Cable Alignments (to be finalized as part of the Facilities Design Report/Fabrication and Installation Report)
- KPs Eastern Muskeget Option
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Not Avoided
- Possible Dredge Areas
- Strip Map
- No Longer Within the Project Area of Potential Effects
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



N

0 0.1 0.2 Miles

0 0.2 0.4 Kilometers

LEGEND

- Preliminary Vineyard Wind 1 Cable Alignments (to be finalized as part of the Facilities Design Report/Fabrication and Installation Report)
- KPs Eastern Muskeget Option
- KPs Covell's Beach and Western Muskeget Option
- Paleochannel and Paleo Features - Not Avoided
- Possible Dredge Areas
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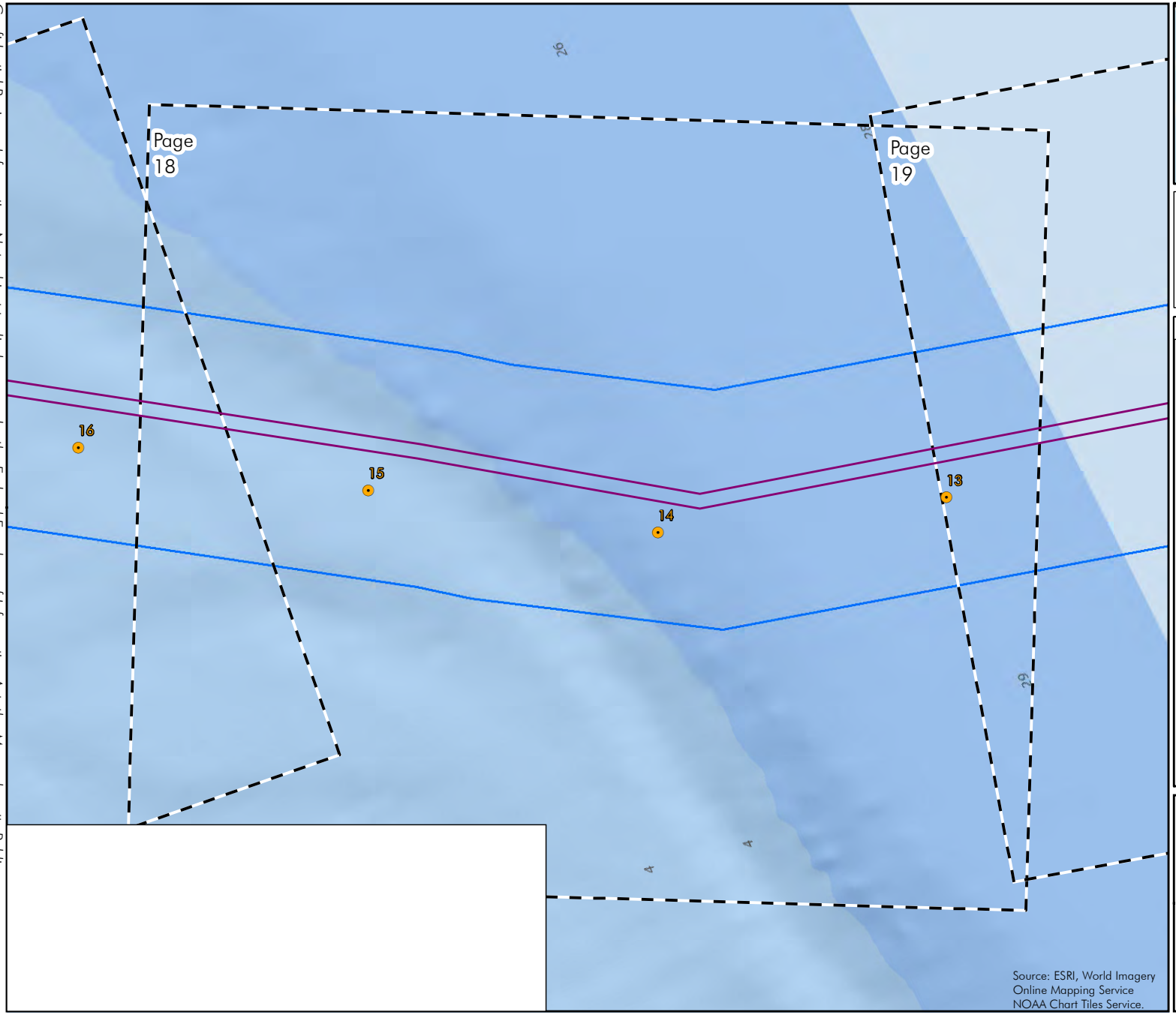
- No Longer Within the Project Area of Potential Effects
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



0 0.1 0.2 Miles

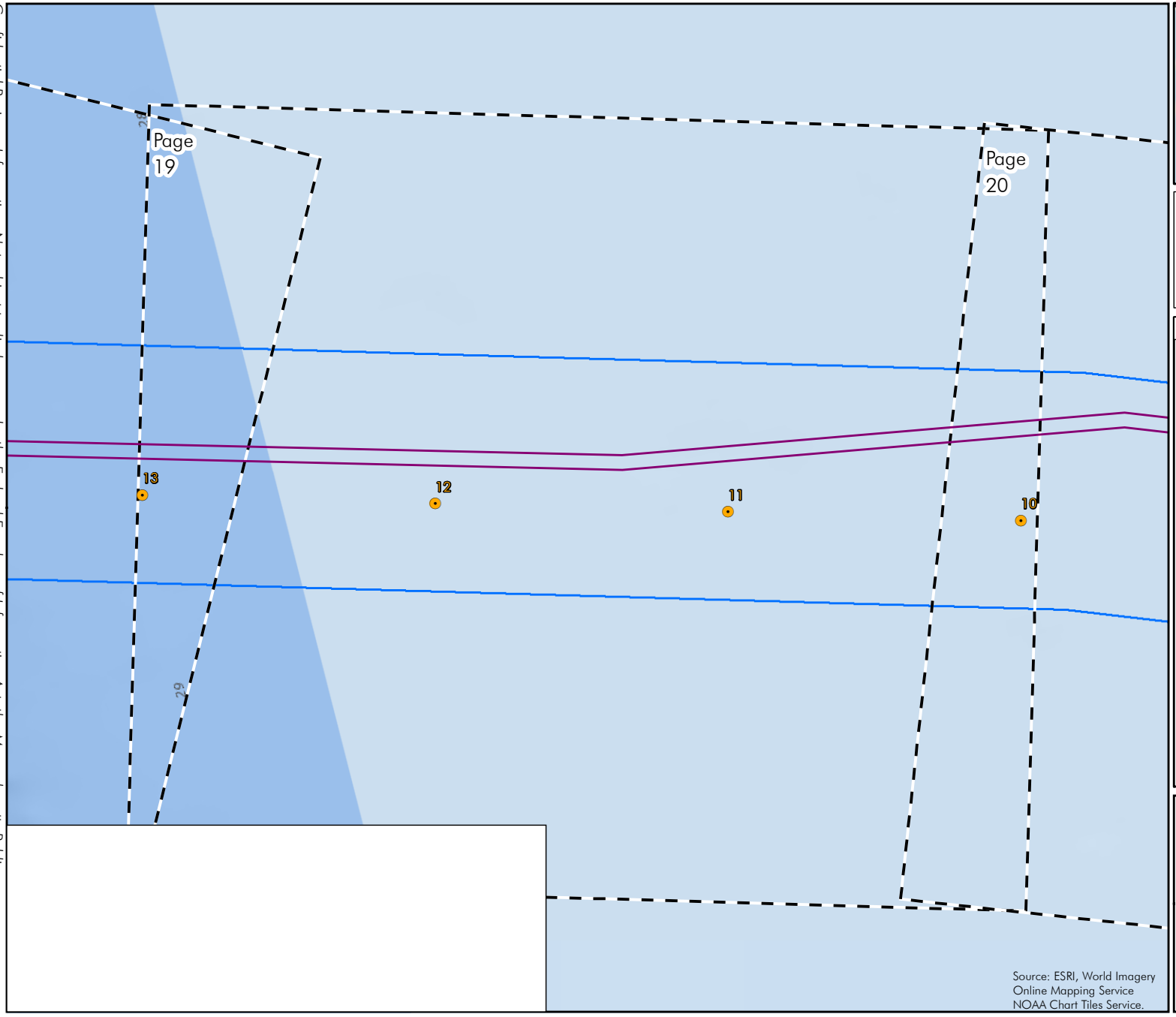
0 0.2 0.4 Kilometers

LEGEND

- Preliminary Vineyard Wind 1 Cable Alignments (to be finalized as part of the Facilities Design Report/Fabrication and Installation Report)
- KPs Covell's Beach and Western Muskeget Option
- Strip Map
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



0 0.1 0.2 Miles

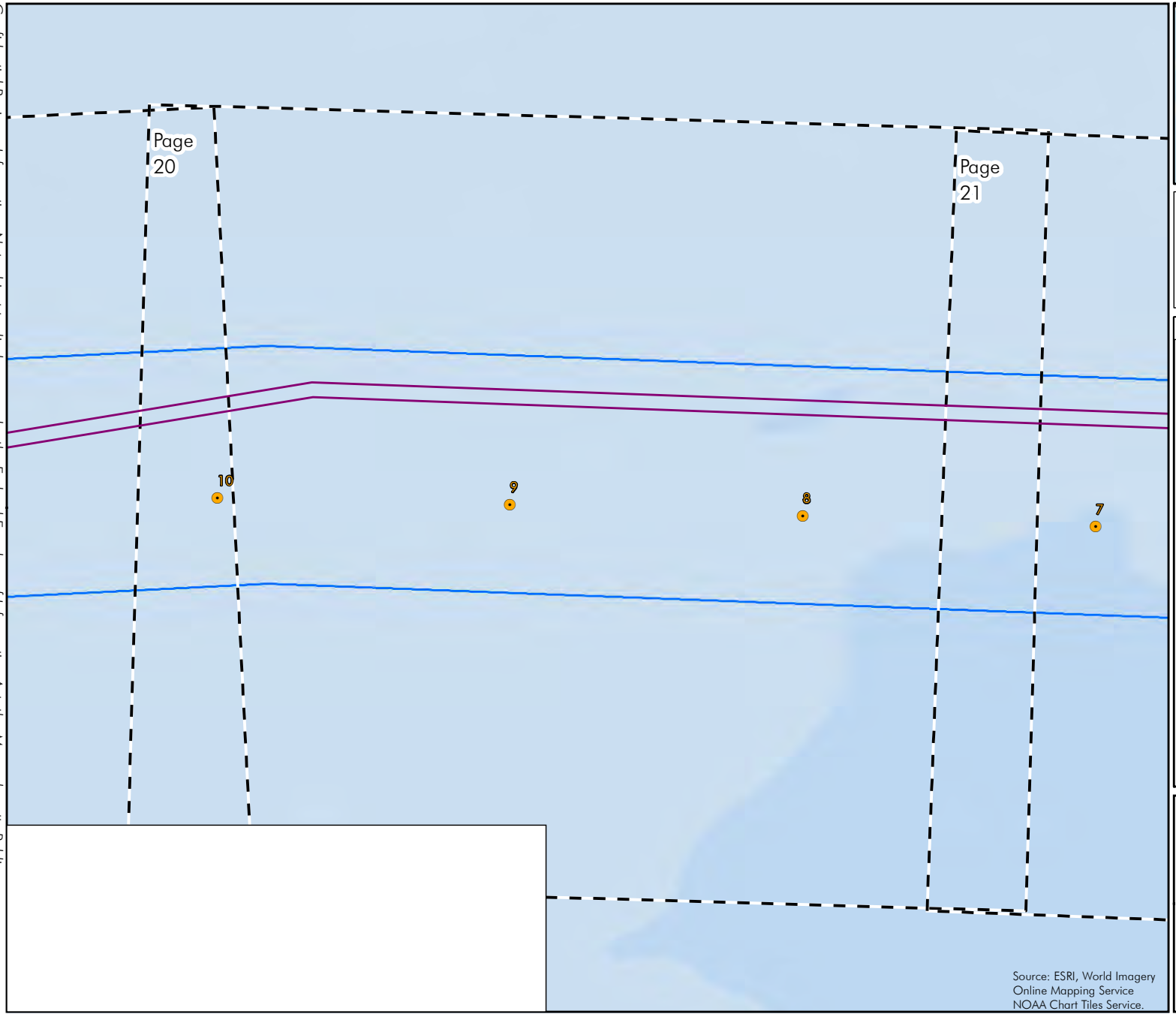
0 0.2 0.4 Kilometers

LEGEND

- Preliminary Vineyard Wind 1 Cable Alignments (to be finalized as part of the Facilities Design Report/Fabrication and Installation Report)
- KPs Covell's Beach and Western Muskeget Option
- Strip Map
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



0 0.1 0.2 Miles

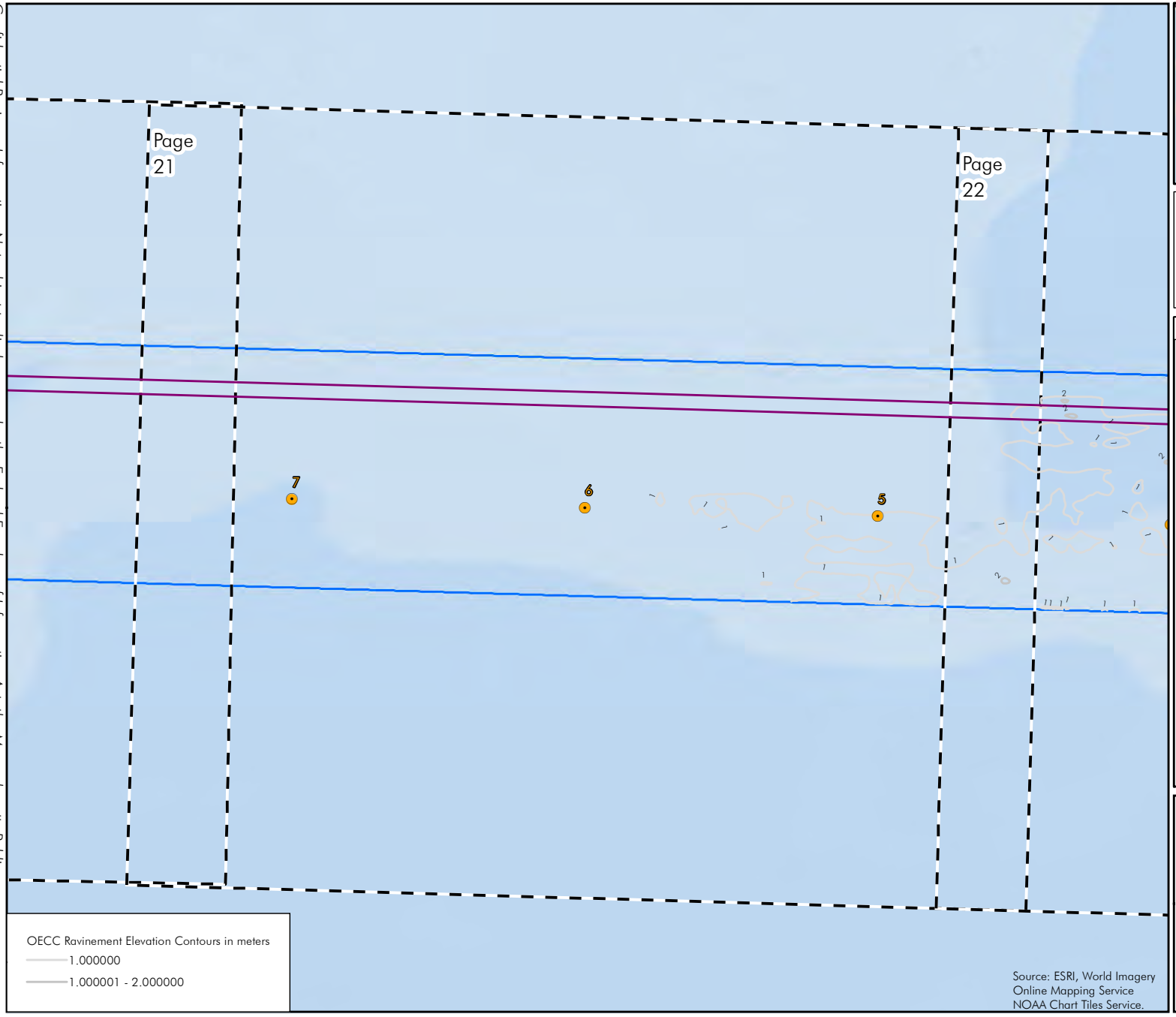
0 0.2 0.4 Kilometers

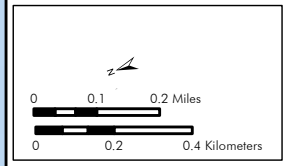
LEGEND

- Preliminary Vineyard Wind 1 Cable Alignments (to be finalized as part of the Facilities Design Report/Fabrication and Installation Report)
- KPs Covell's Beach and Western Muskeget Option
- Strip Map
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



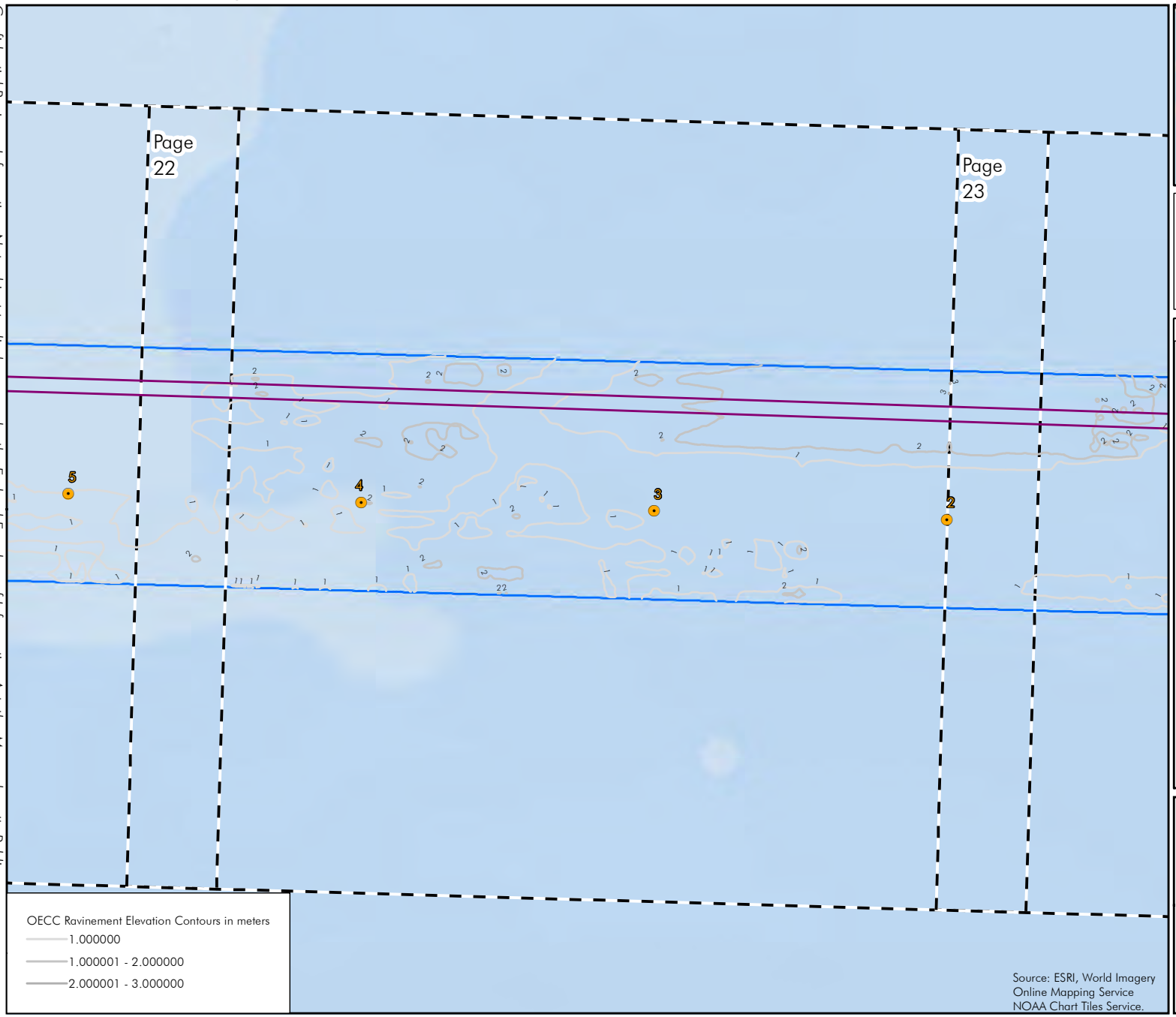


LEGEND

- Preliminary Vineyard Wind 1 Cable Alignments (to be finalized as part of the Facilities Design Report/Fabrication and Installation Report)
- KPs Covell's Beach and Western Muskeget Option
- Strip Map
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



0 0.1 0.2 Miles

0 0.2 0.4 Kilometers

LEGEND

Preliminary Vineyard Wind 1 Cable Alignments (to be finalized as part of the Facilities Design Report/Fabrication and Installation Report)

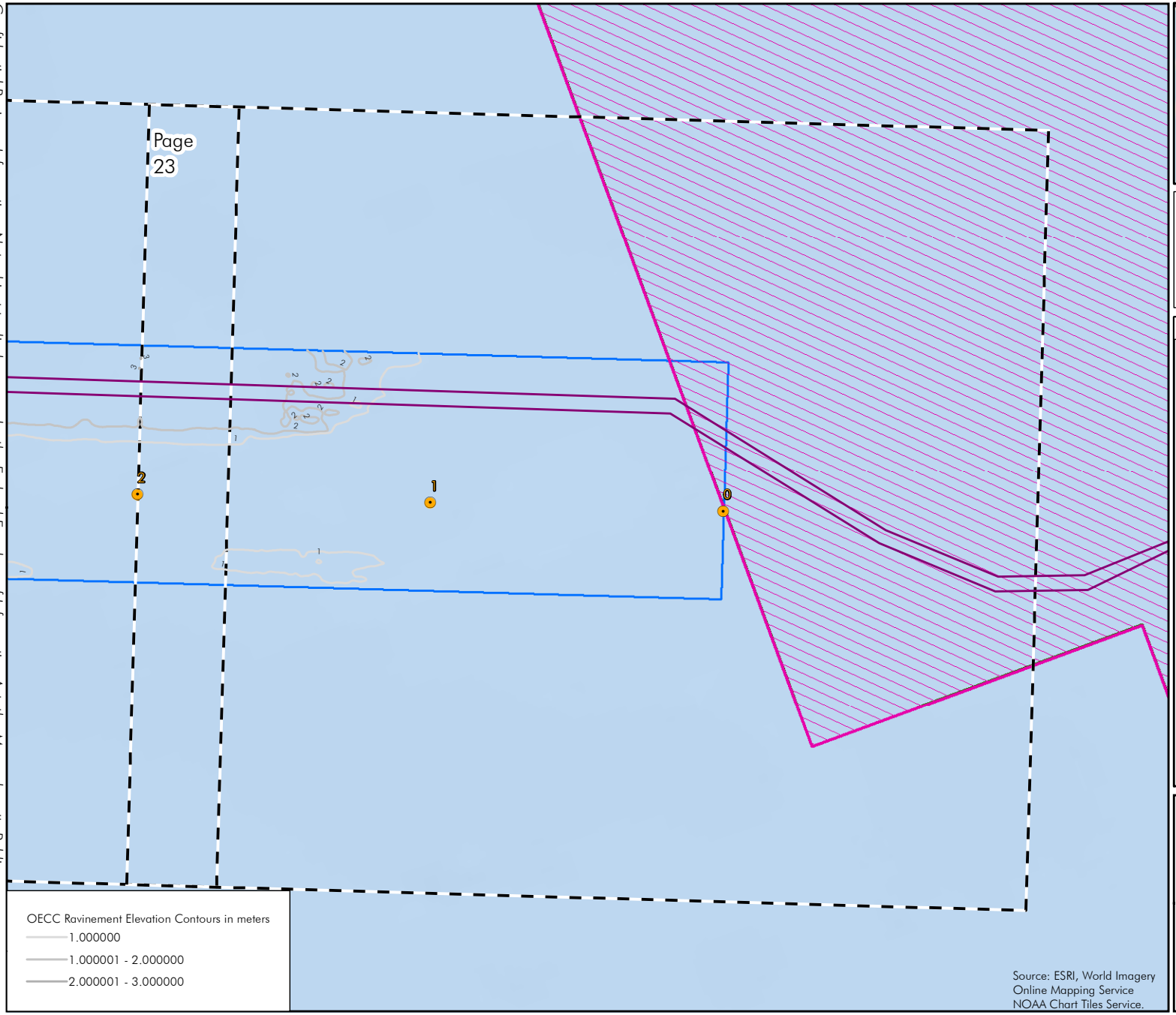
KPs Covell's Beach and Western Muskeget Option

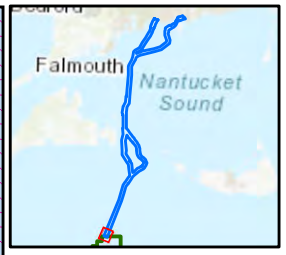
Strip Map

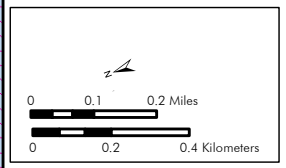
Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





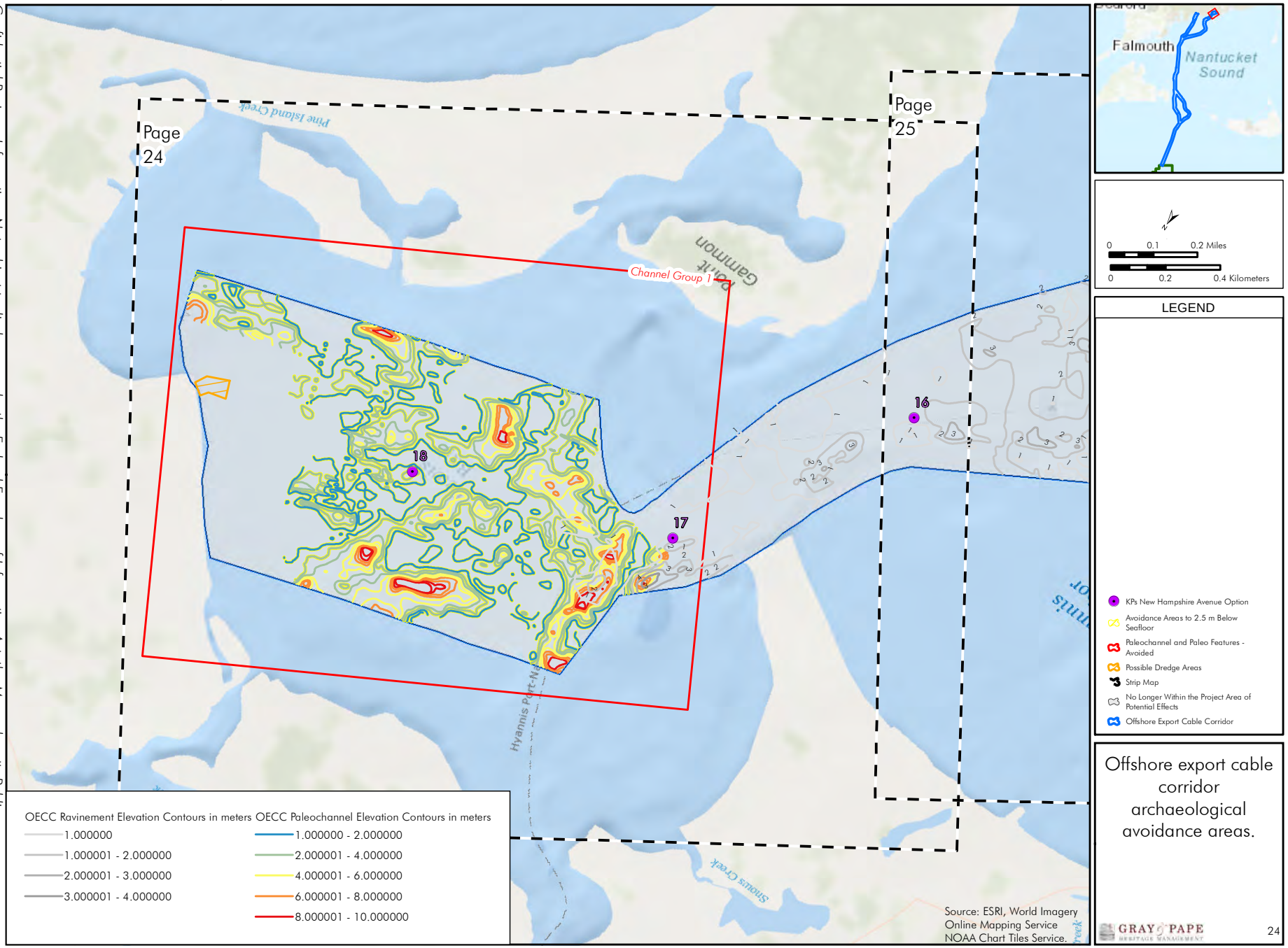


LEGEND

- Preliminary Vineyard Wind 1 Cable Alignments (to be finalized as part of the Facilities Design Report/Fabrication and Installation Report)
- KPs Covell's Beach and Western Muskeget Option
- Strip Map
- Wind Development Area
- Offshore Export Cable Corridor
- Lease Area (OCS-A 0501)

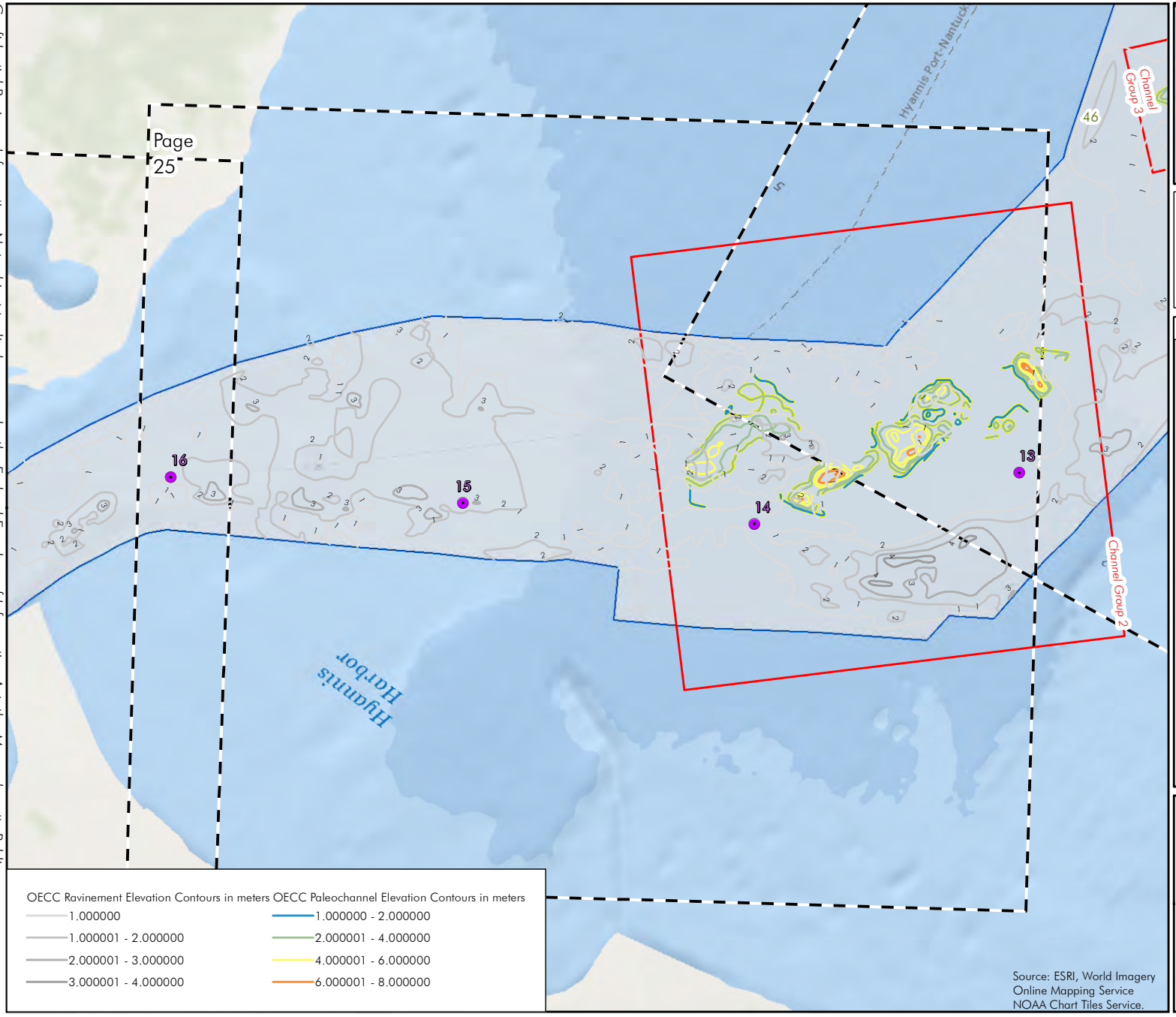
Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



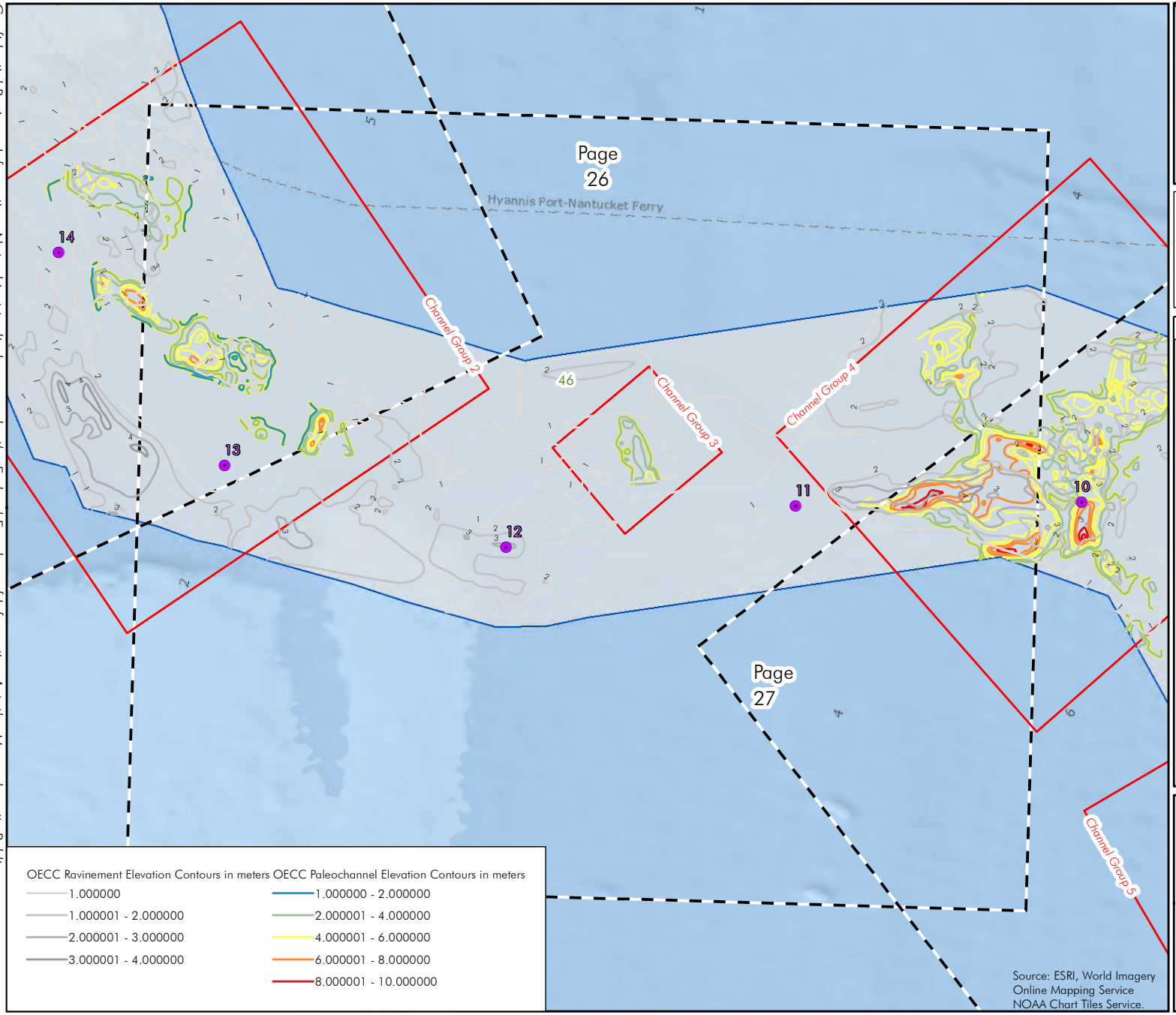
0 0.1 0.2 Miles
0 0.2 0.4 Kilometers

LEGEND

- KPs New Hampshire Avenue Option
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
- Strip Map
- No Longer Within the Project Area of Potential Effects
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



0 0.1 0.2 Miles

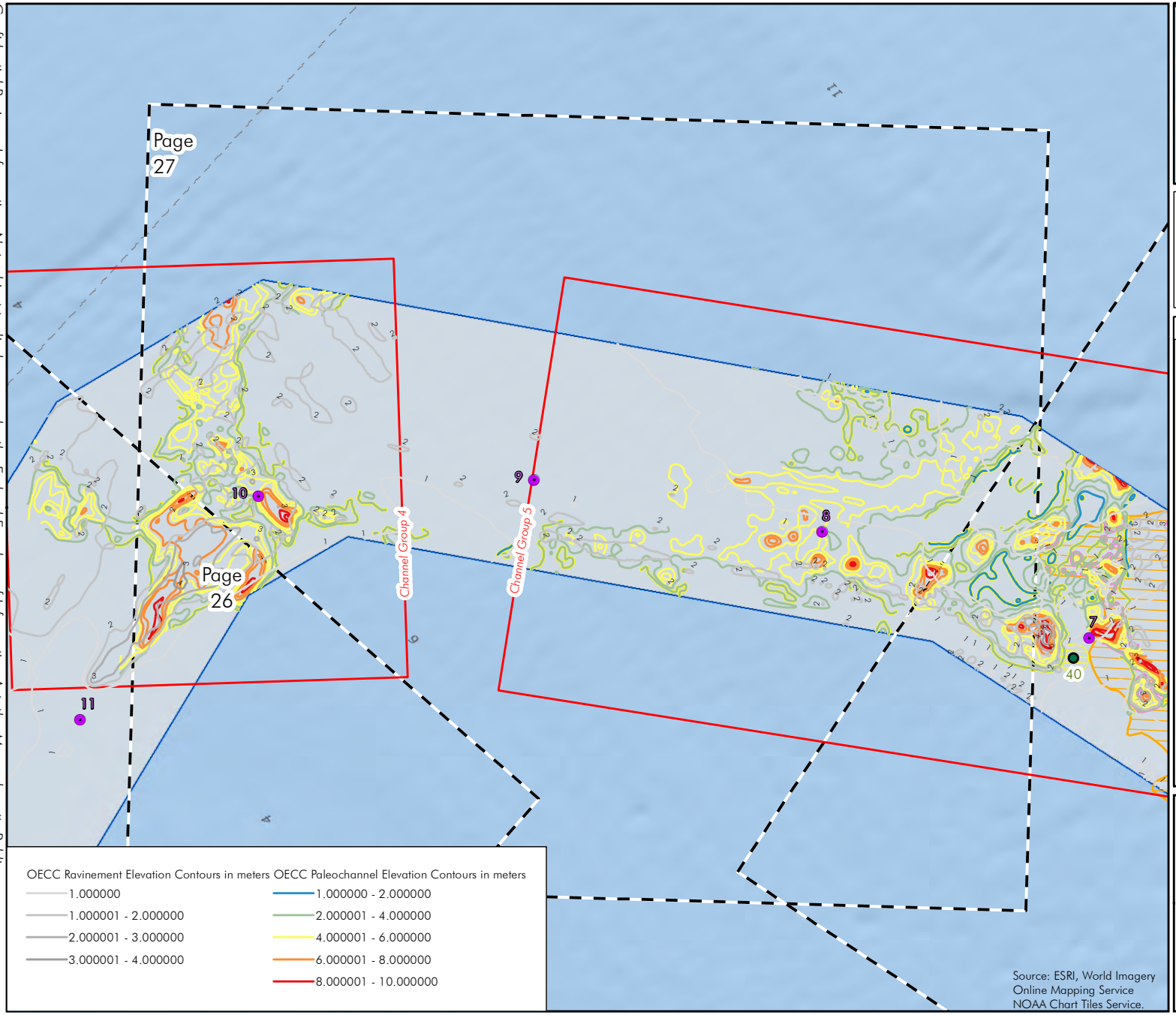
0 0.2 0.4 Kilometers

LEGEND

- KPs New Hampshire Avenue Option
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
- Strip Map
- No Longer Within the Project Area of Potential Effects
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



0 0.1 0.2 Miles

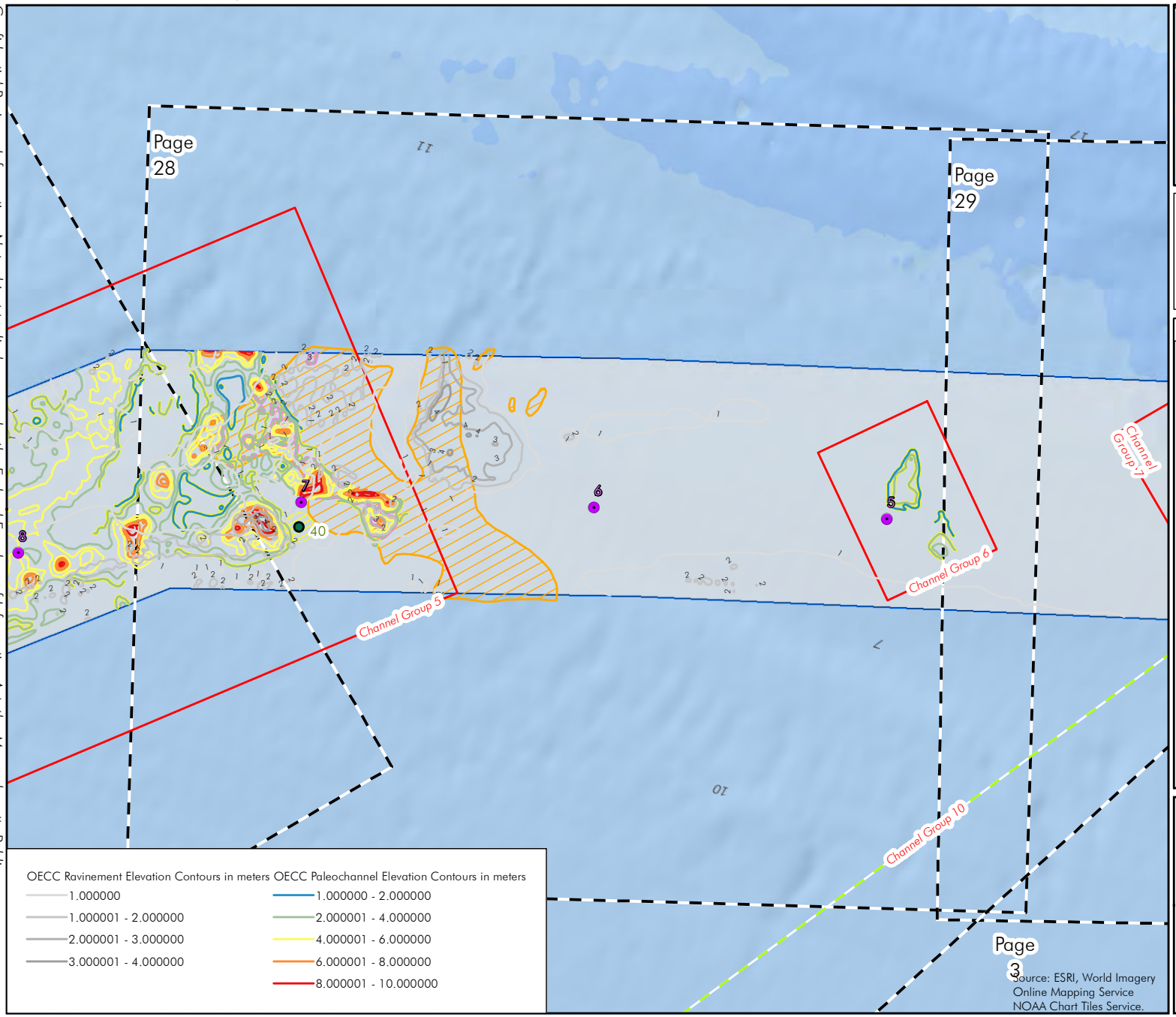
0 0.2 0.4 Kilometers

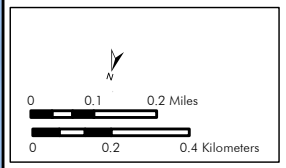
LEGEND

- 2017 Alpine Offshore Export Cable Corridor Vibracores (Cultural) - Avoided
- KPs New Hampshire Avenue Option
- Avoidance Areas to 4.5m Below Seafloor
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
- Possible Dredge Areas
- Strip Map
- No Longer Within the Project Area of Potential Effects
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





LEGEND

2017 Alpine Offshore Export Cable Corridor Vibracores (Cultural) -

Avoidance Areas to 4.5m Below

Avoidance Areas to 2.5 m Below

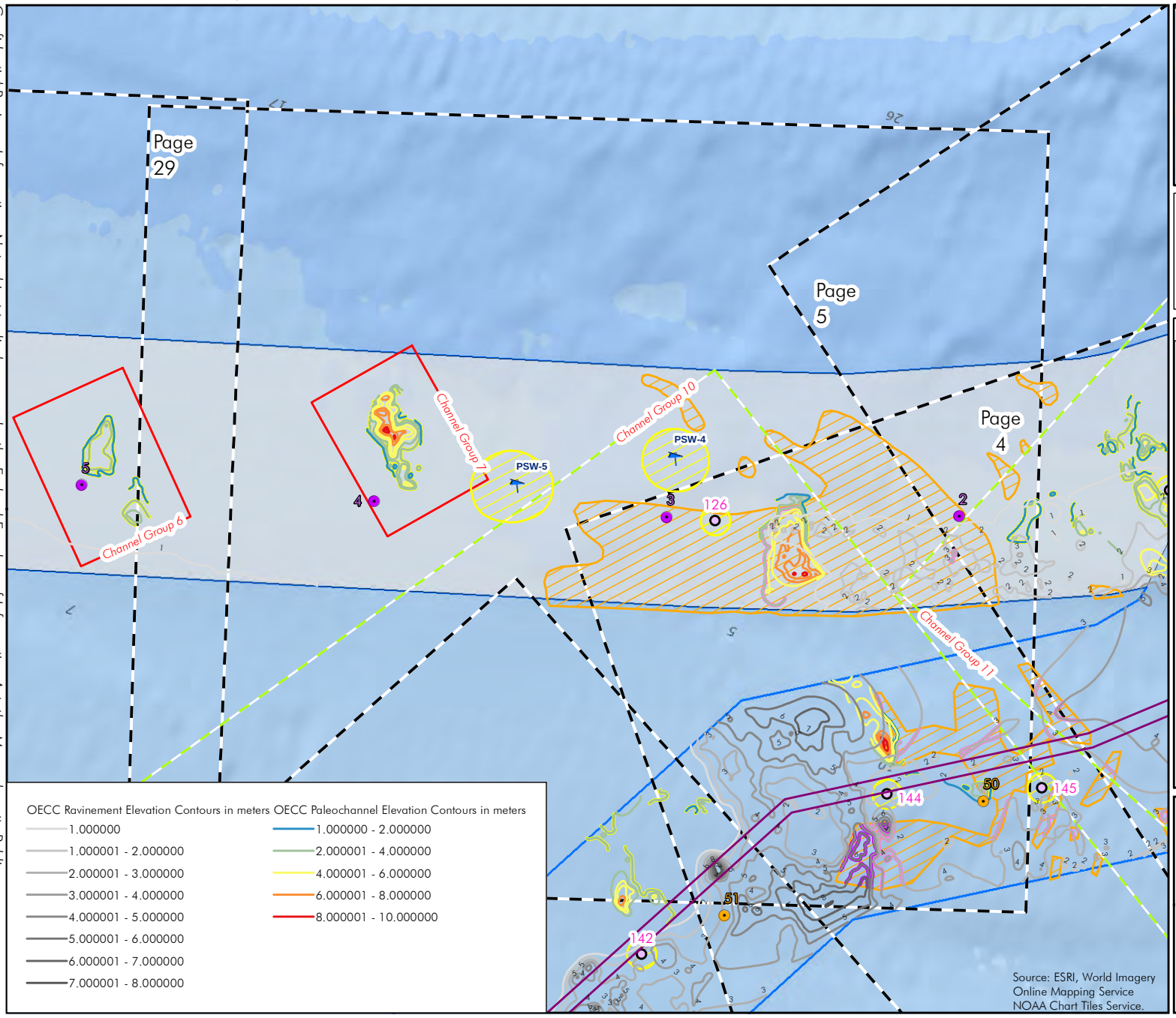
Paleochannel and Paleo Features -

Paleochannel and Paleo Features -

No Longer Within the Project Area of

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



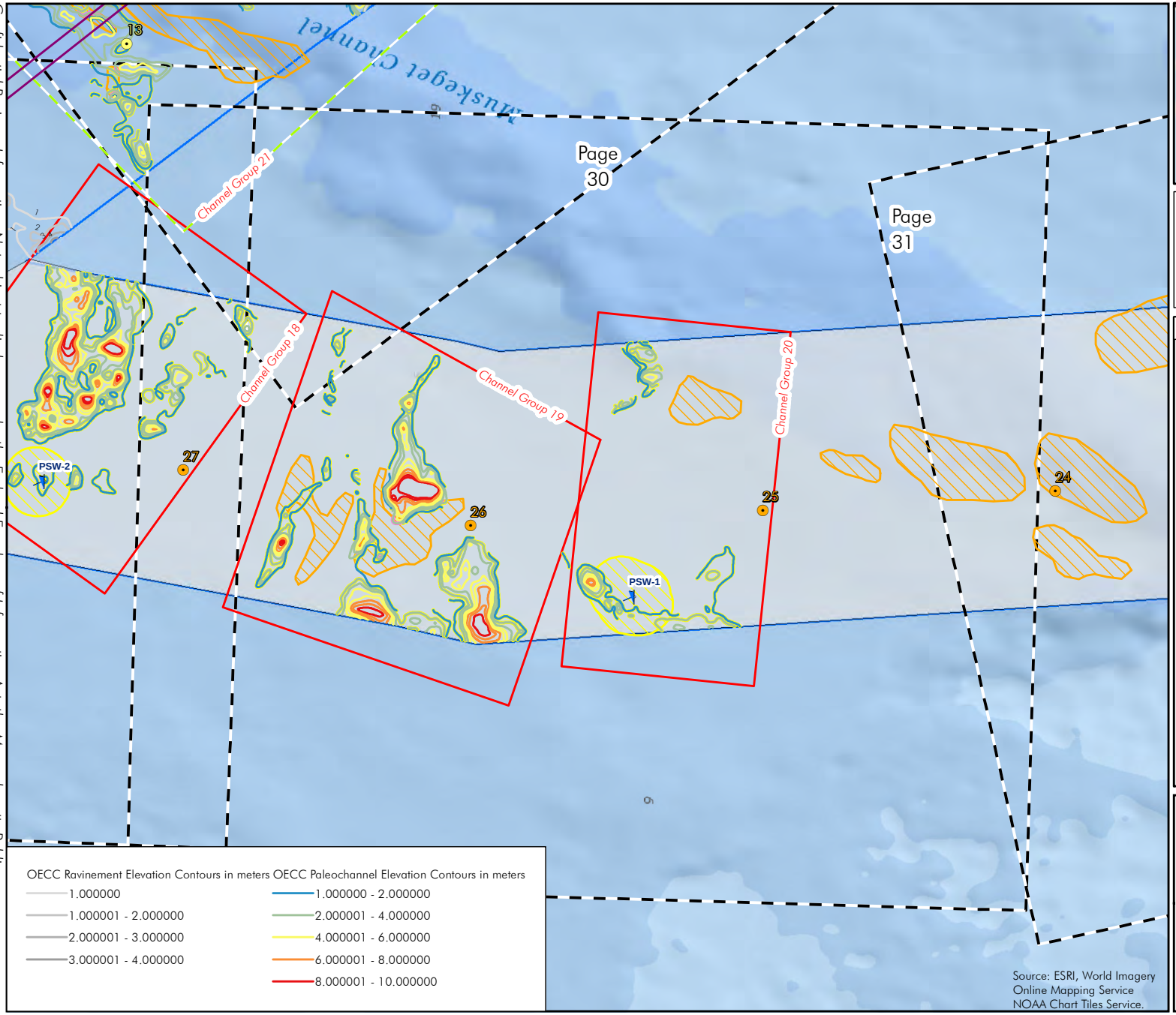
0 0.1 0.2 Miles
0 0.2 0.4 Kilometers

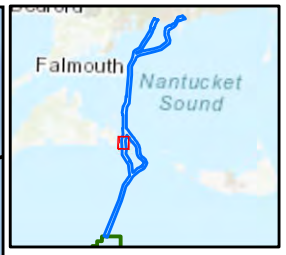
LEGEND

- Preliminary Vineyard Wind 1 Cable Alignments (to be finalized as part of the Facilities Design Report/Fabrication and Installation Report)
- Potential Shipwreck
- 2018 Alpine Offshore Export Cable Corridor Vibracores (Cultural) - Not Avoided
- KPs New Hampshire Avenue Option
- KPs Covell's Beach and Western Muskeget Option
- 2018_Alpine_OECC_CulturalCo...
- OECC Ravinement Dredge Avoidance Areas Between 4.5-8m Below Seafloor
- OECC Paleolandscape Features Dredge Avoidance Areas Between 4.5-8m Below Seafloor
- Avoidance Areas to 4.5m Below Seafloor
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
- Paleochannel and Paleo Features - Not Avoided
- Possible Dredge Areas
- Strip Map
- No Longer Within the Project Area of Potential Effects
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





0 0.1 0.2 Miles

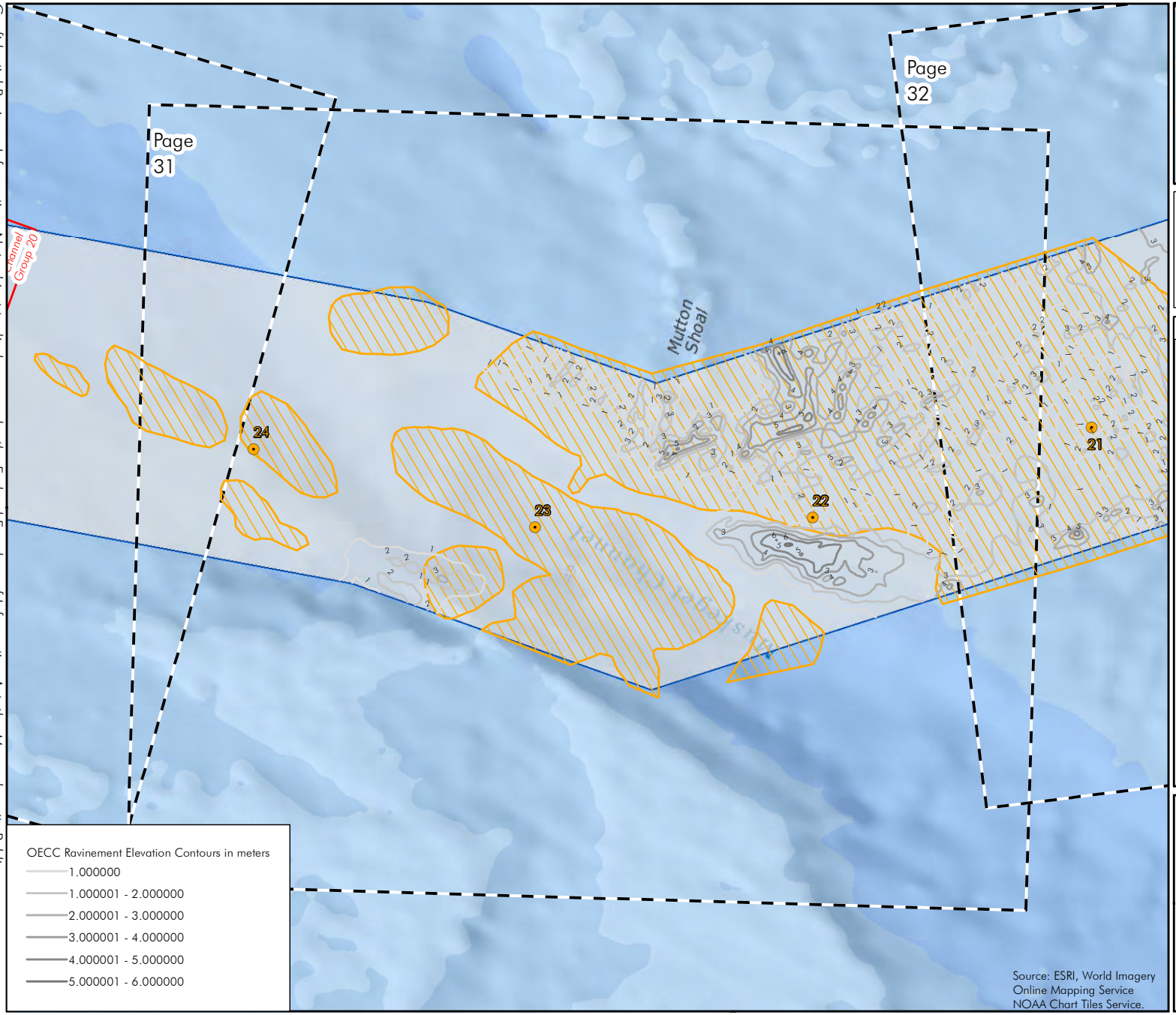
0 0.2 0.4 Kilometers

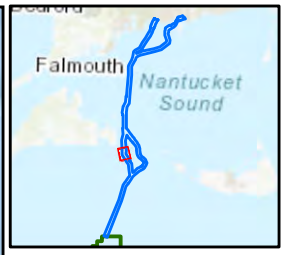
LEGEND

- Preliminary Vineyard Wind 1 Cable Alignments (to be finalized as part of the Facilities Design Report/Fabrication and Installation Report)
- Potential Shipwreck
- KPs Eastern Muskeget Option
- KPs Covell's Beach and Western Muskeget Option
- OECC Paleolandscape Features Dredge Avoidance Areas Between 4.5-8m Below Seafloor
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
- Paleochannel and Paleo Features - Not Avoided
- Possible Dredge Areas
- Strip Map
- No Longer Within the Project Area of Potential Effects
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





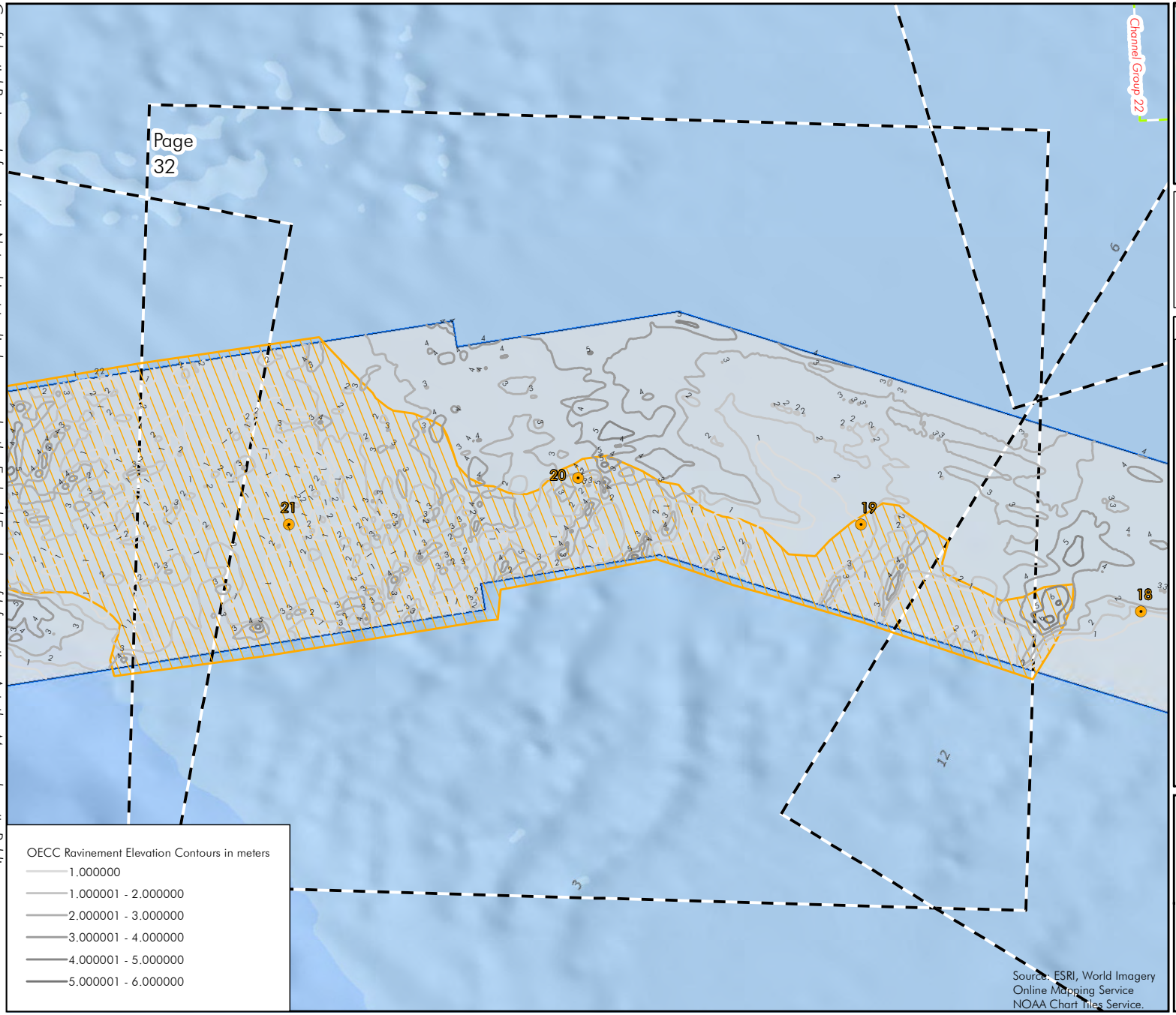
0 0.1 0.2 Miles
0 0.2 0.4 Kilometers

LEGEND

- KPs Covell's Beach and Western Muskeget Option
- Paleochannel and Paleo Features - Avoided
- Possible Dredge Areas
- Strip Map
- No Longer Within the Project Area of Potential Effects
- Offshore Export Cable Corridor

Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



0 0.1 0.2 Miles

0 0.2 0.4 Kilometers

LEGEND

KPs Covell's Beach and Western

Paleochannel and Paleo Features -

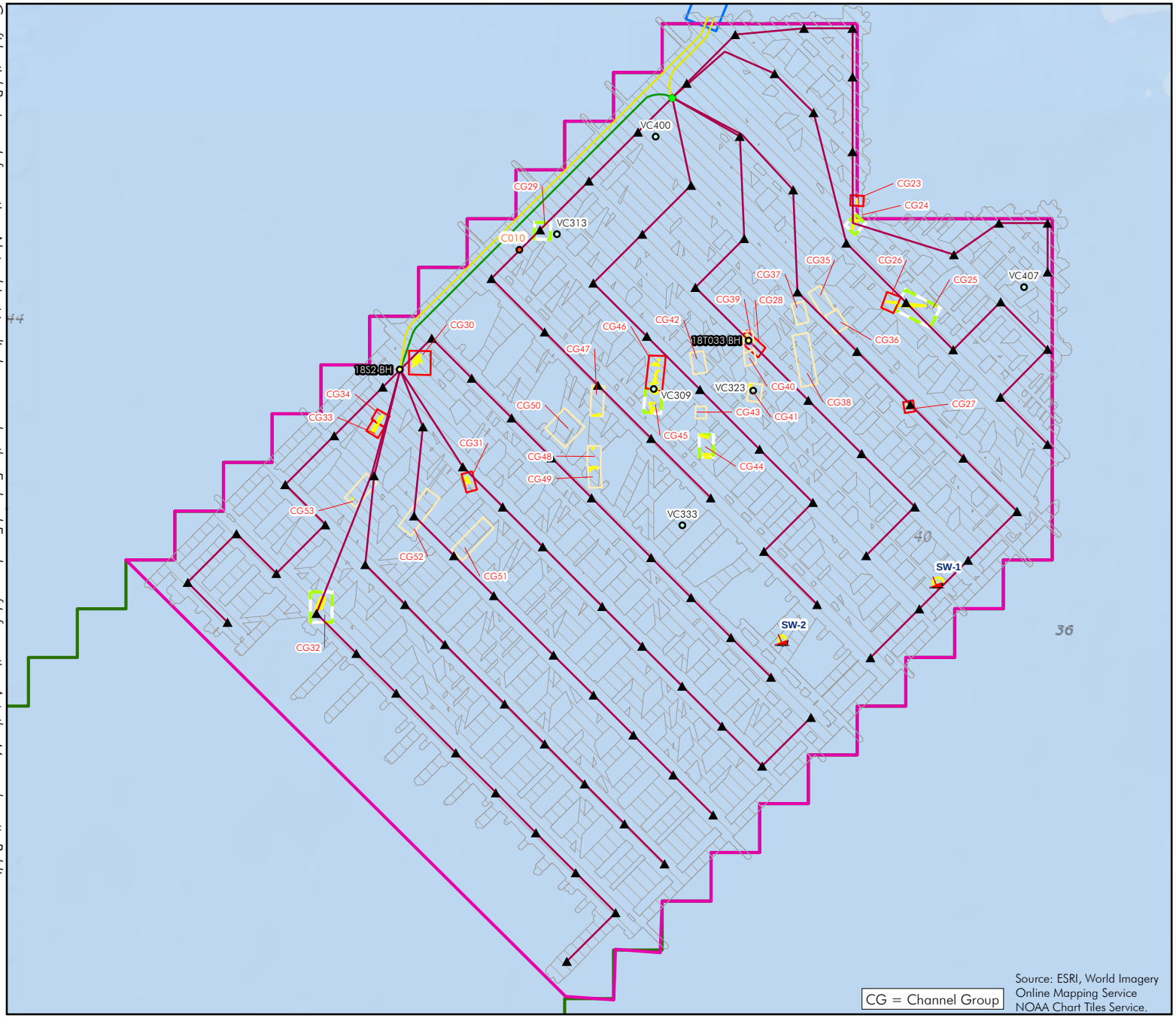
No Longer Within the Project Area of

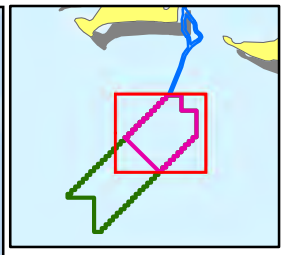
Offshore export cable corridor archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT

WDA GEOARCHAEOLOGICAL RECOMMENDATIONS MAPS

(MAPS 33-64)





N

0 1 2 Miles

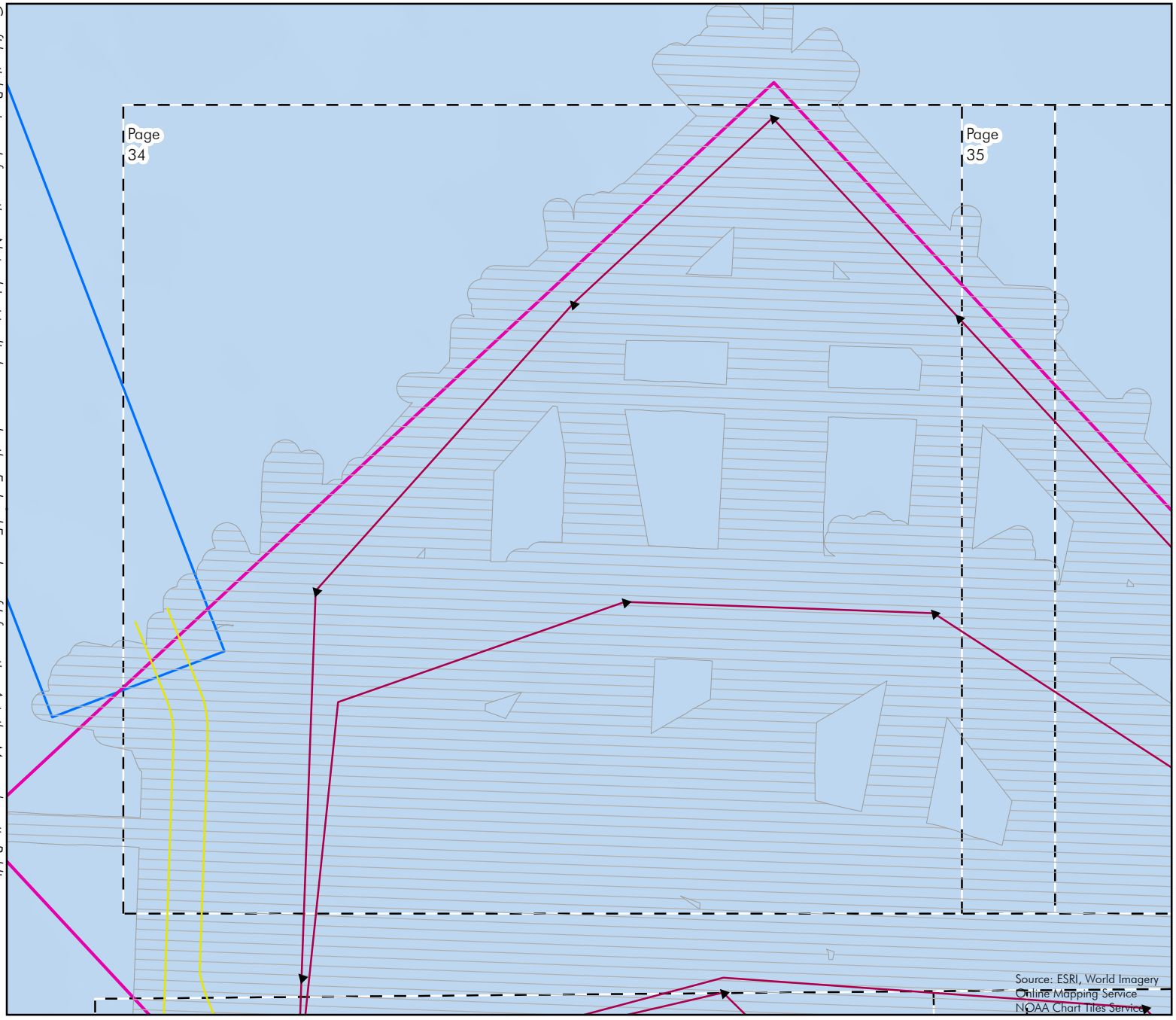
0 1.5 3 Kilometers

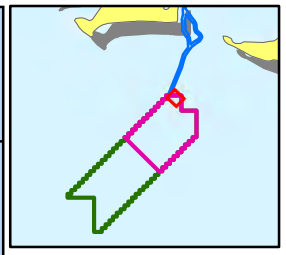
LEGEND

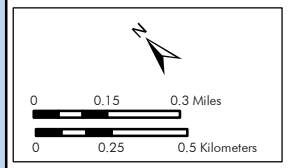
- Shipwreck
- 2018 Seaforth Bore Holes - Avoided
- 2018 Alpine Inter-Array Cable Corridor Vibracores - Avoided
- 2018 Horizon Inter-Array Cable Vibracores (Cultural) - Avoided
- Wind Turbine Generators
- Wind Turbine Generators - Removed
- Electrical Service Platform
- Electrical Service Platform - Removed
- Representative Inter-Array Cable Alignment in WDA
- Representative Export Cable Alignment in WDA
- Representative Inter-link Cable in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
- Paleochannel and Paleo Features - Not Avoided
- Paleo-landform is deeper than the APE and will not be affected
- Wind Development Area of Potential Effects
- Wind Development Area
- Offshore Export Cable Corridor
- Lease Area (OCS-A 0501)

Wind Development Area archaeological avoidance areas overview map.

GRAY & PAPE HERITAGE MANAGEMENT





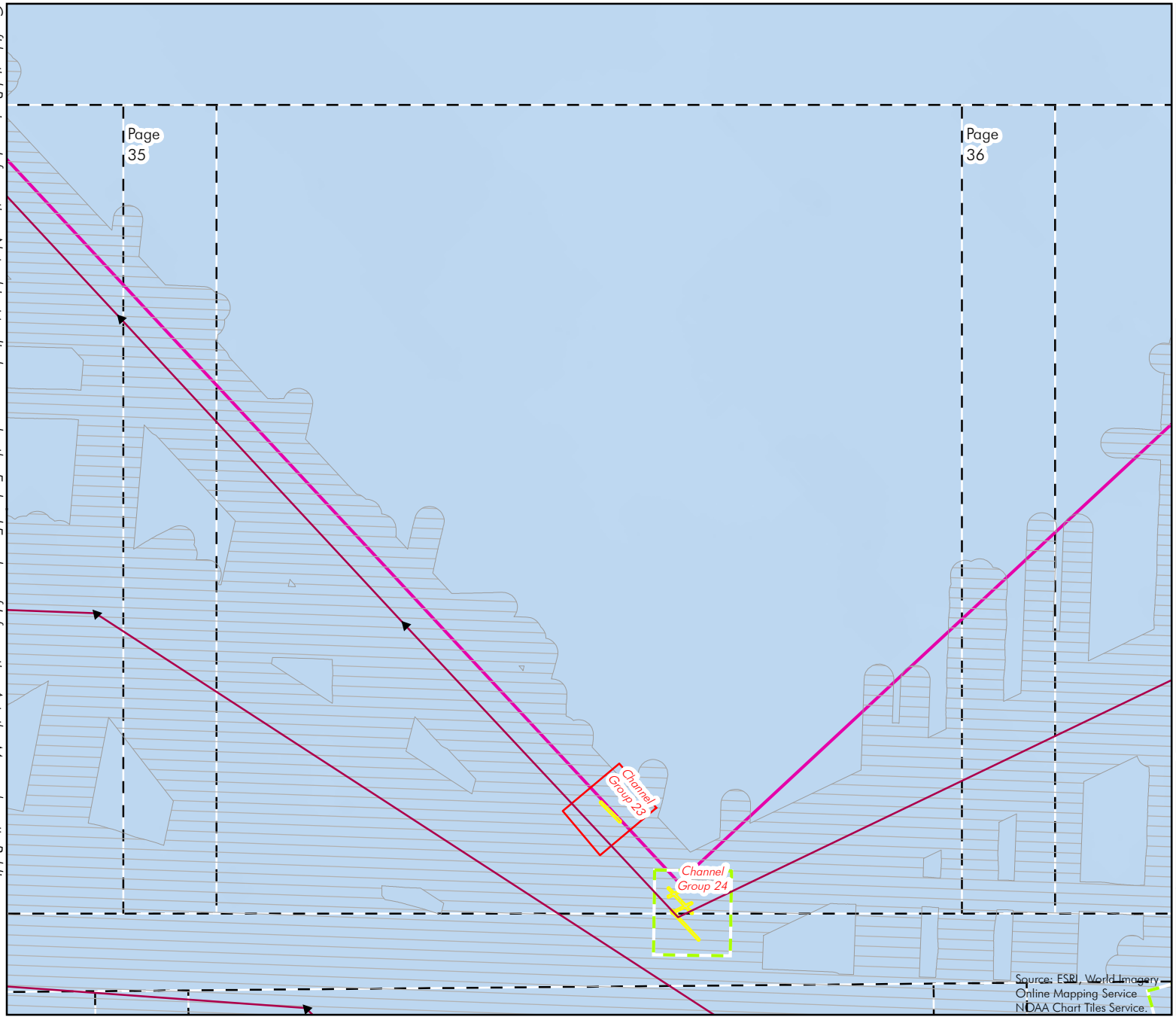


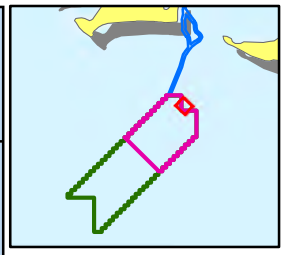
LEGEND

- Wind Turbine Generators
- Representative Inter-Array Cable Alignment in WDA
- Representative Export Cable Alignment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Wind Development Area of Potential Effects
- Wind Development Area
- Offshore Export Cable Corridor
- Strip Map

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





N

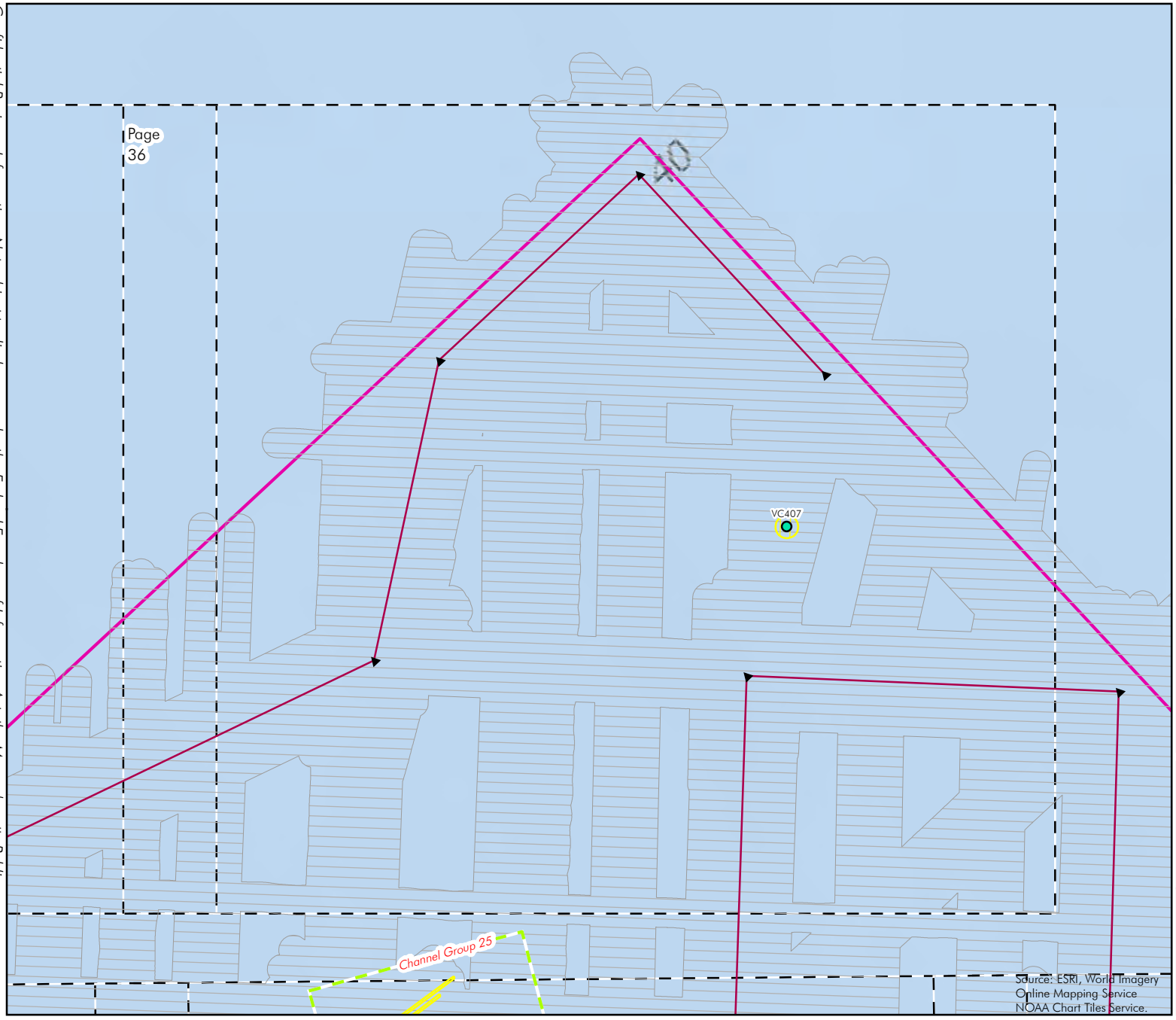
0 0.15 0.3 Miles
0 0.25 0.5 Kilometers

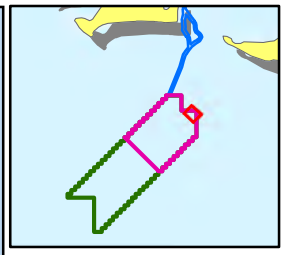
LEGEND

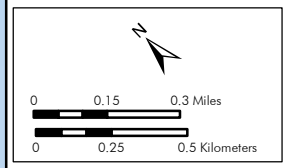
- Wind Turbine Generators
- Representative Inter-Array Cable Alignment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
- Paleochannel and Paleo Features - Not Avoided
- Wind Development Area of Potential Effects
- Wind Development Area
- Strip Map

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





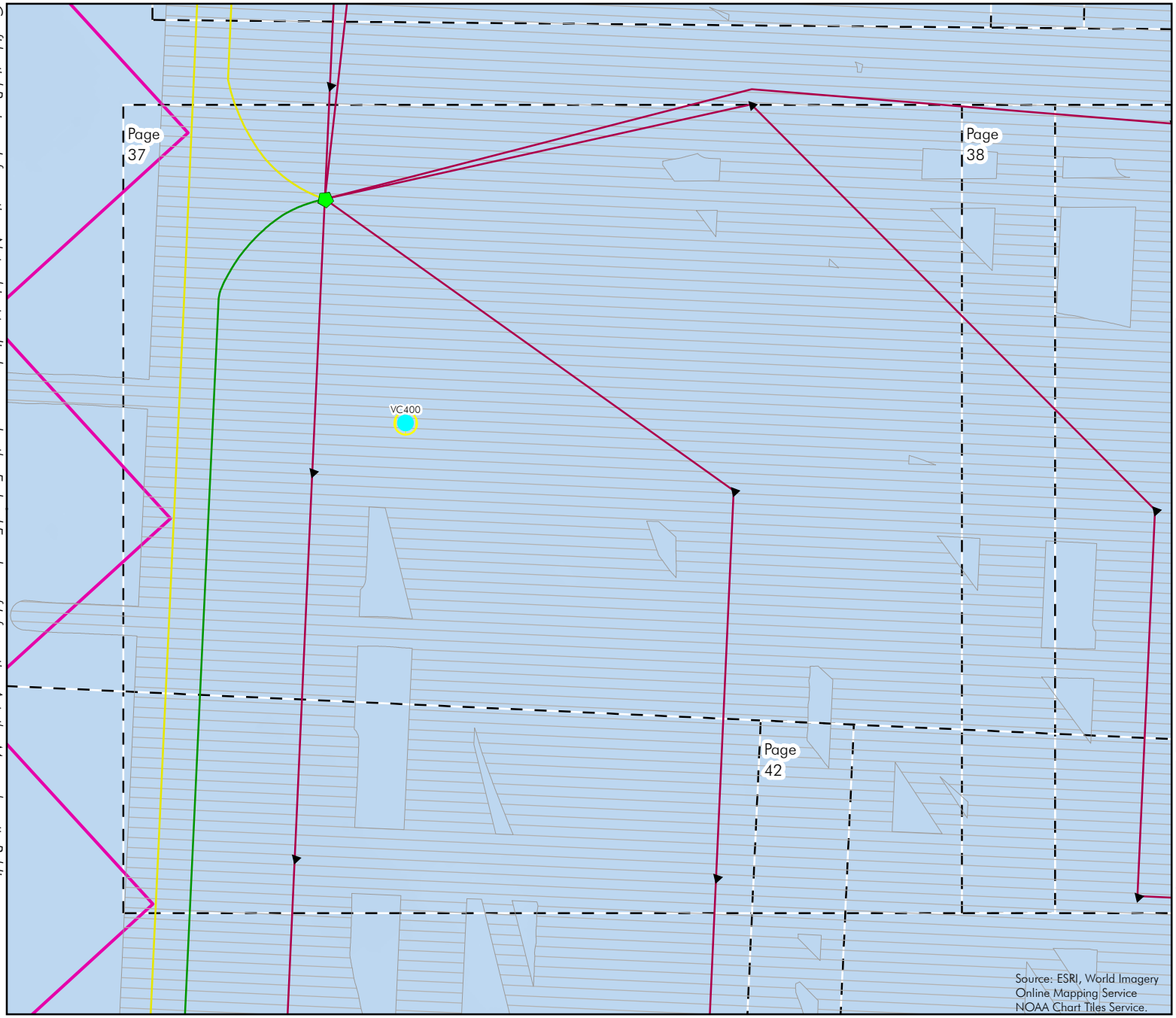


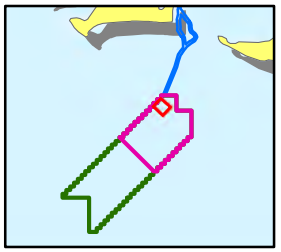
LEGEND

- 2018 Alpine Inter-Array Cable Corridor Vibracores (Cultural) - Avoided
- Wind Turbine Generators
- Representative Inter-Array Cable Alginment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Not Avoided
- Wind Development Area of Potential Effects
- Wind Development Area
- Strip Map

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





N

0 0.15 0.3 Miles

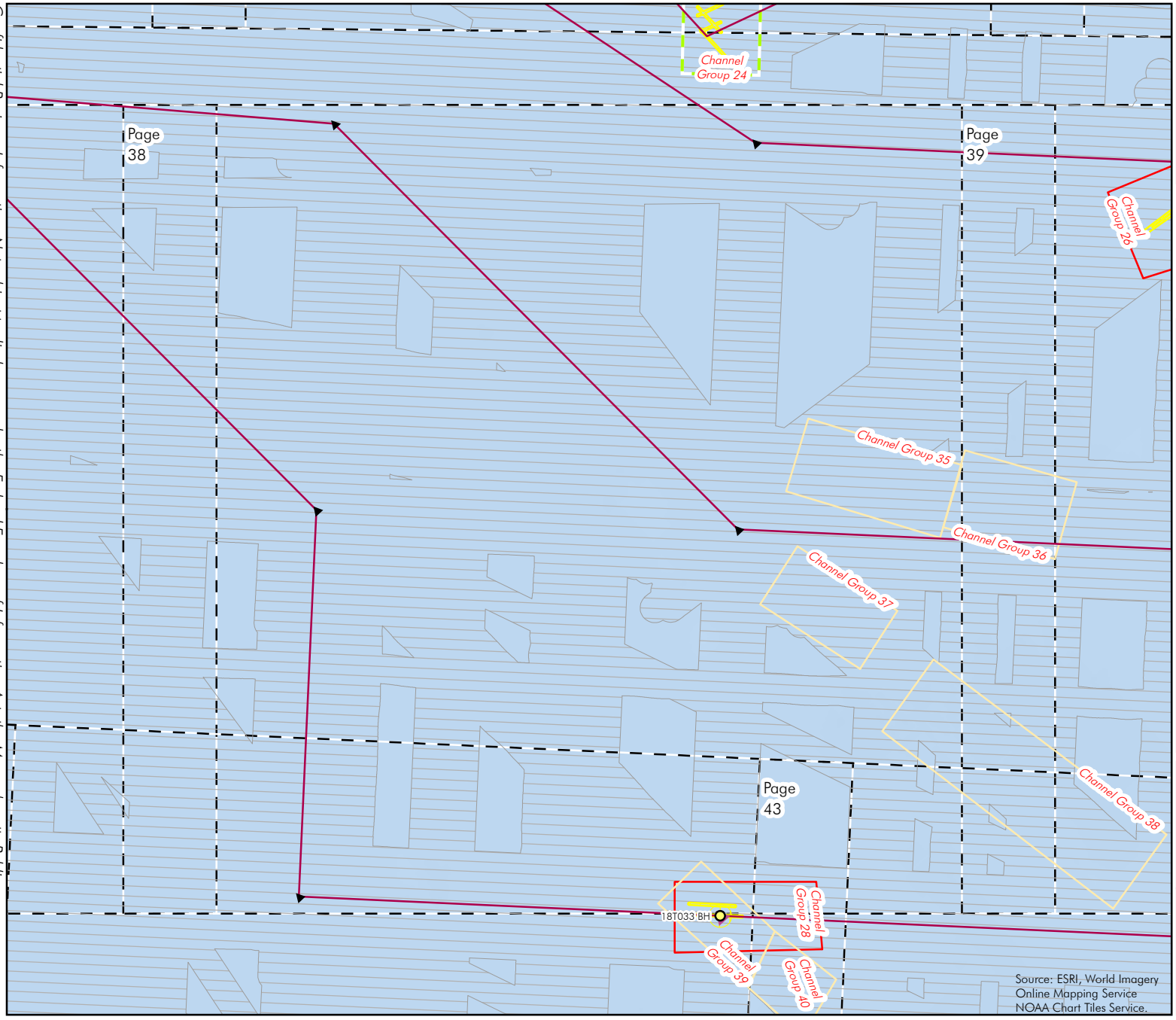
0 0.25 0.5 Kilometers

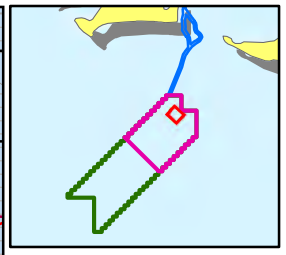
LEGEND

- 2018 Alpine Inter-Array Cable Corridor Vibracores (Cultural) - Avoided
- Wind Turbine Generators
- Electrical Service Platform
- Representative Inter-Array Cable Alignment in WDA
- Representative Export Cable Alignment in WDA
- Representative Inter-link Cable in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Wind Development Area of Potential Effects
- Wind Development Area
- Strip Map

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





N

0 0.15 0.3 Miles

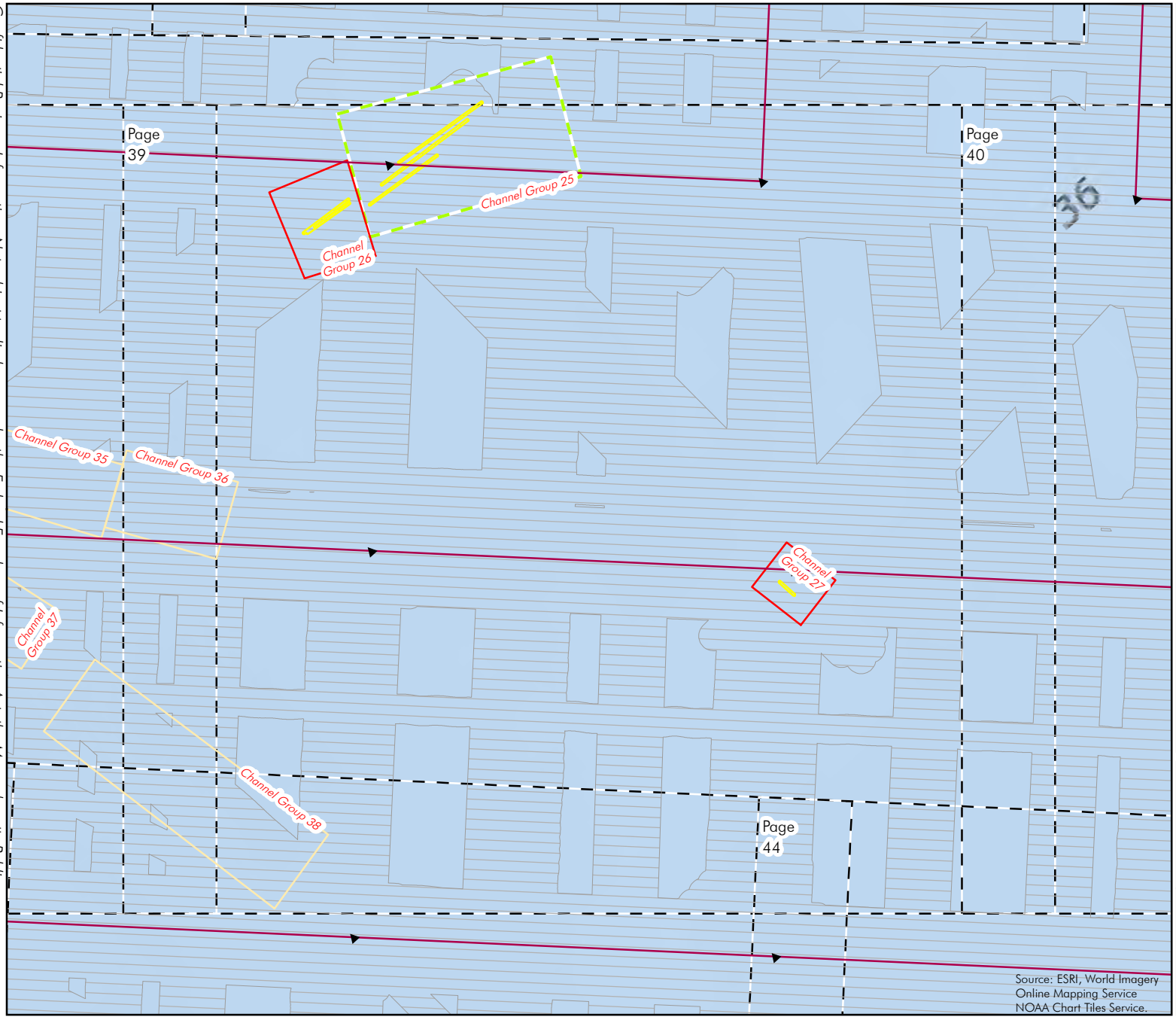
0 0.25 0.5 Kilometers

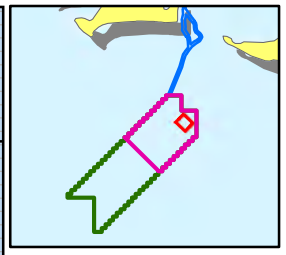
LEGEND

- 2018 Seaforth Bore Holes - Avoided
- Wind Turbine Generators
- Wind Turbine Generators - Removed
- Representative Inter-Array Cable Alginment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
- Paleochannel and Paleo Features - Not Avoided
- Paleo-landform is deeper than the APE and will not be affected
- Wind Development Area of Potential Effects
- Wind Development Area
- Strip Map

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





N

0 0.15 0.3 Miles

0 0.25 0.5 Kilometers

LEGEND

- Wind Turbine Generators
- Representative Inter-Array Cable Alginment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
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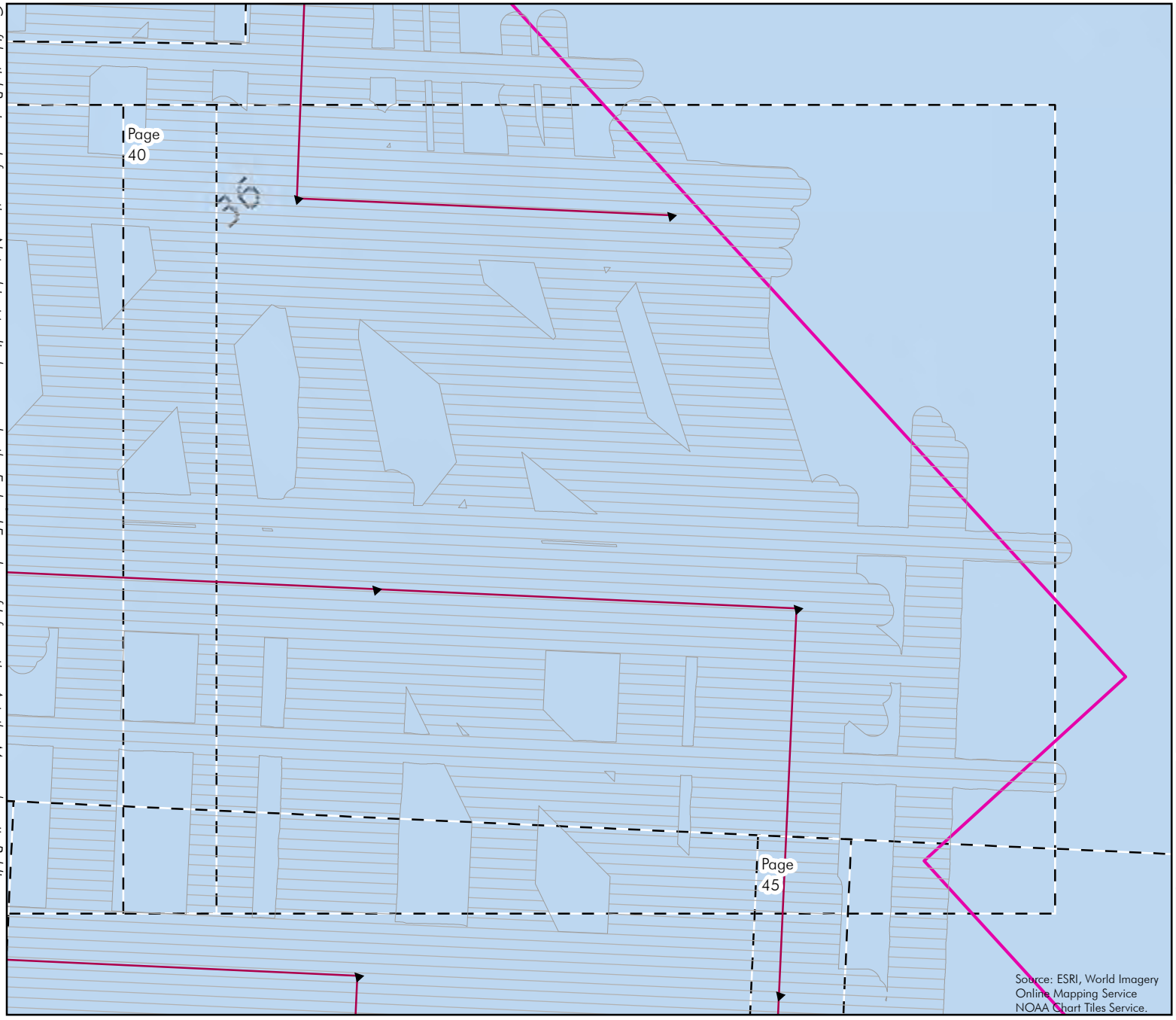
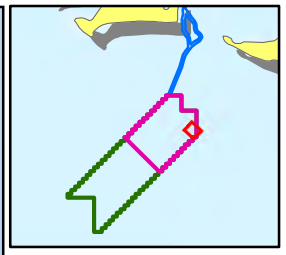
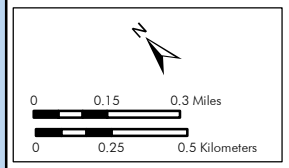
Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





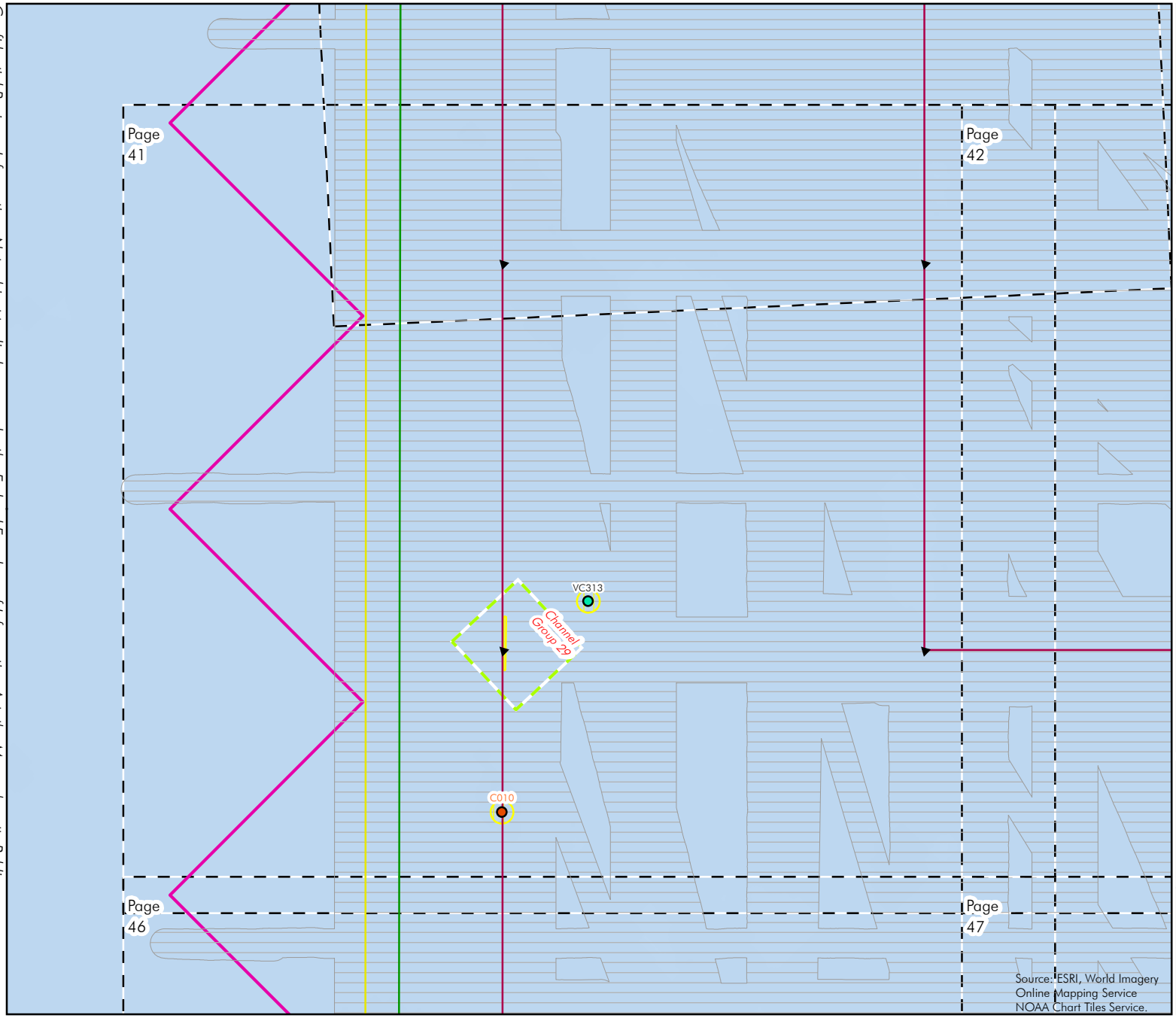


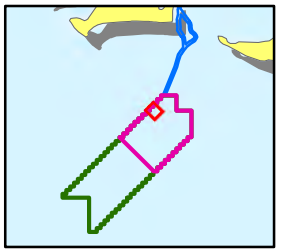
LEGEND

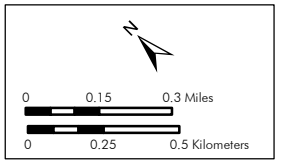
- Wind Turbine Generators
- Representative Inter-Array Cable Alignment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Wind Development Area of Potential Effects
- Wind Development Area
- Strip Map

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





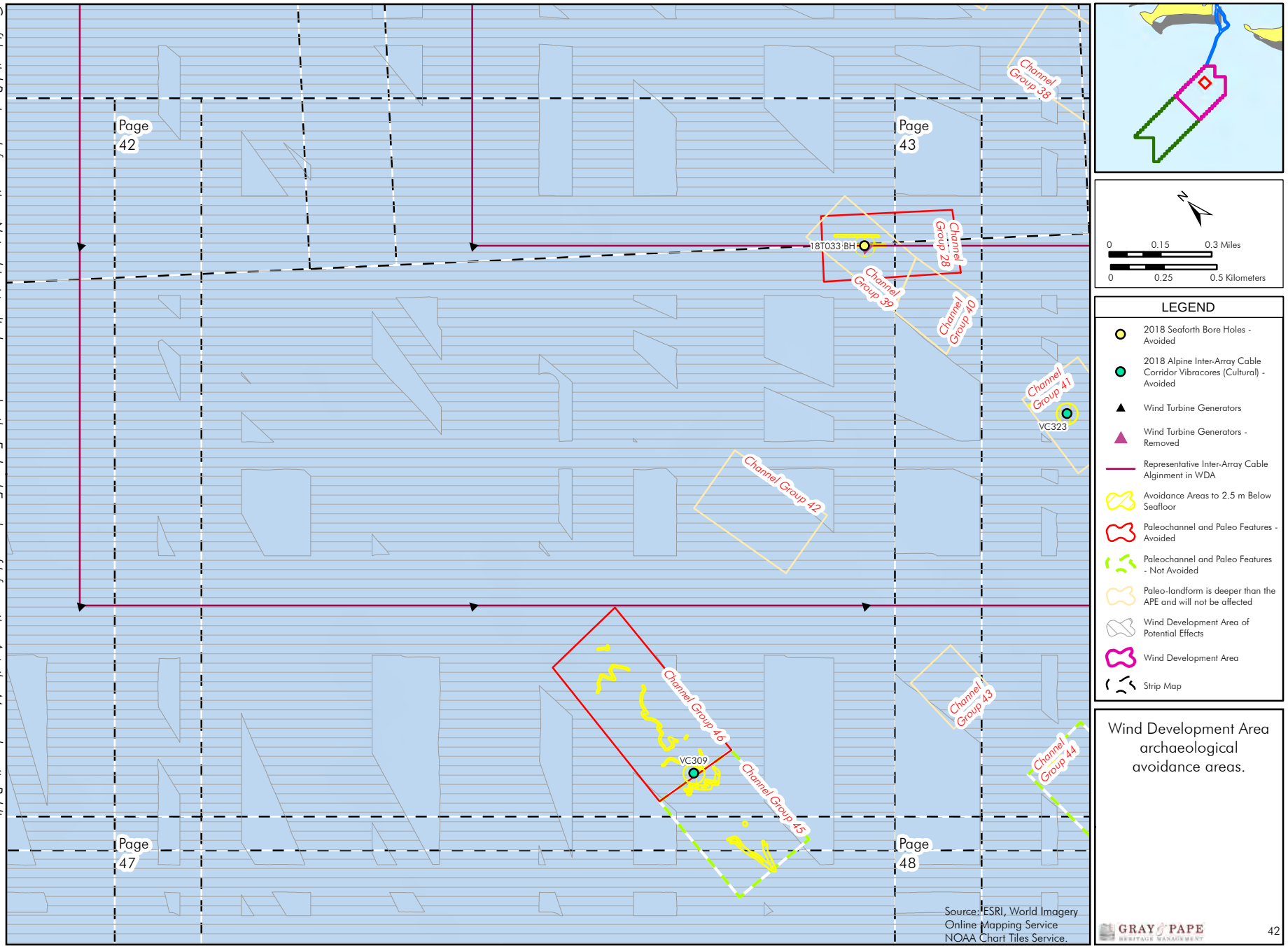


LEGEND

- 2018 Alpine Inter-Array Cable Corridor Vibracores (Cultural) - Avoided
- 2018 Horizon Inter-Array Cable Vibracores (Cultural) - Avoided
- Wind Turbine Generators
- Representative Inter-Array Cable Alignment in WDA
- Representative Export Cable Alignment in WDA
- Representative Inter-link Cable in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Not Avoided
- Wind Development Area of Potential Effects
- Wind Development Area
- Strip Map

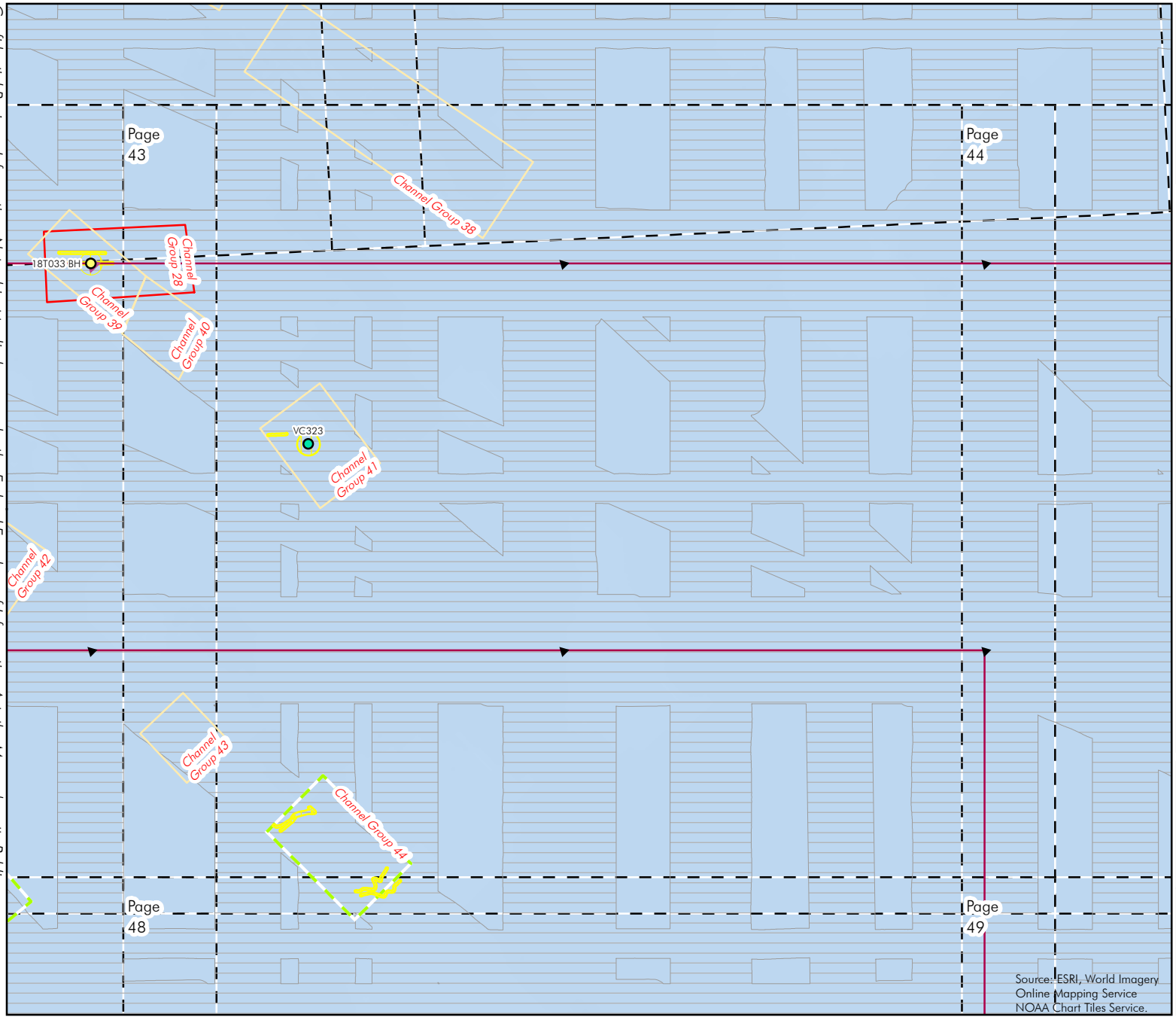
Wind Development Area archaeological avoidance areas.

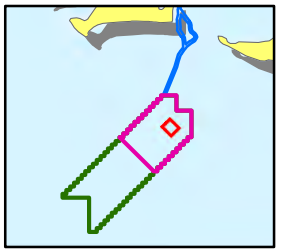
GRAY & PAPE HERITAGE MANAGEMENT



Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





N

0 0.15 0.3 Miles

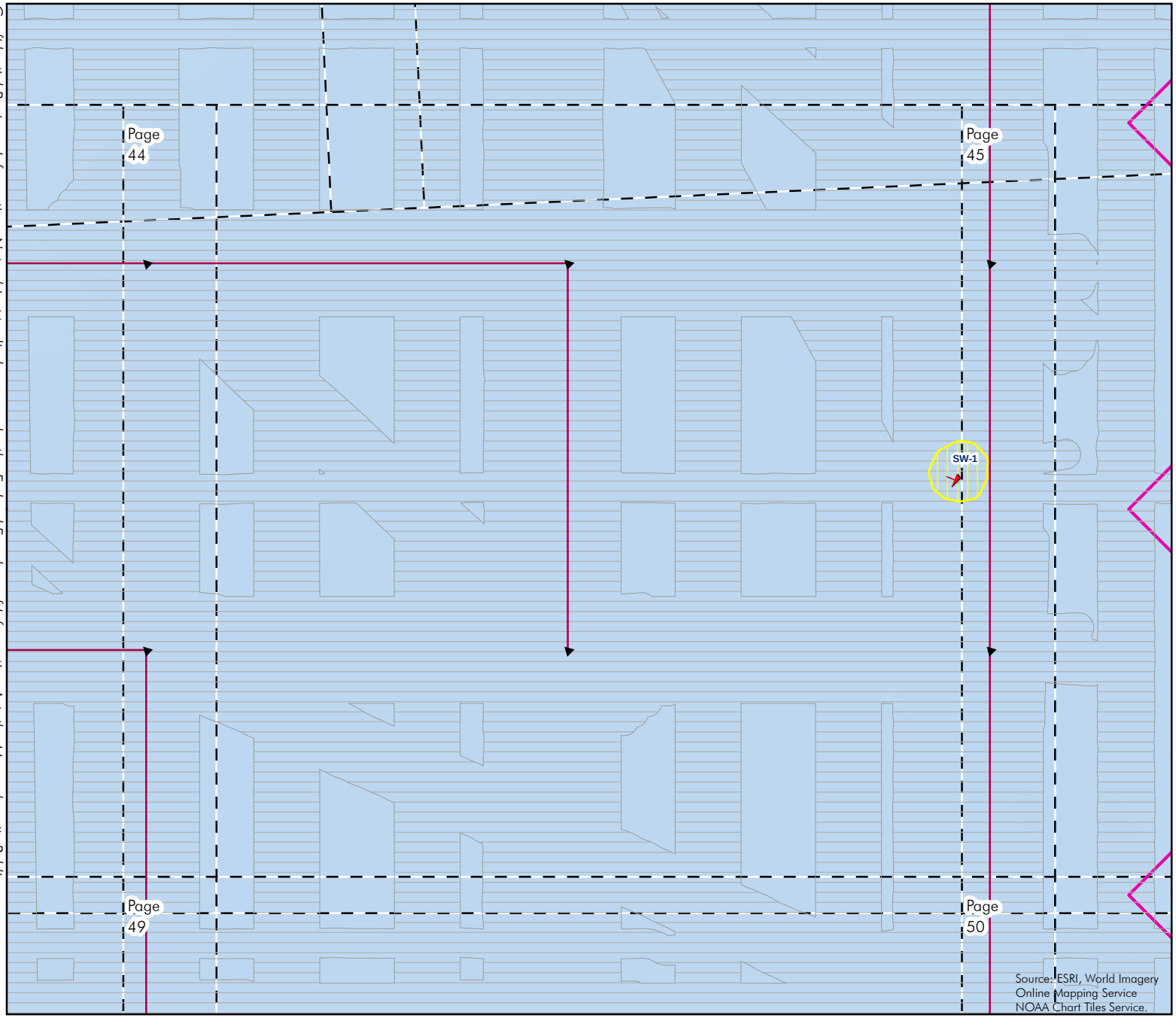
0 0.25 0.5 Kilometers

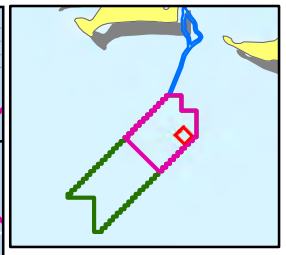
LEGEND

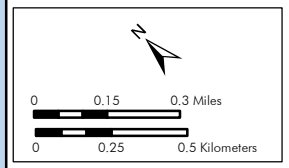
- 2018 Seaforth Bore Holes - Avoided
- 2018 Alpine Inter-Array Cable Corridor Vibracores (Cultural) - Avoided
- Wind Turbine Generators
- Wind Turbine Generators - Removed
- Representative Inter-Array Cable Alignment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
- Paleochannel and Paleo Features - Not Avoided
- Paleo-landform is deeper than the APE and will not be affected
- Wind Development Area of Potential Effects
- Wind Development Area
- Strip Map

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT







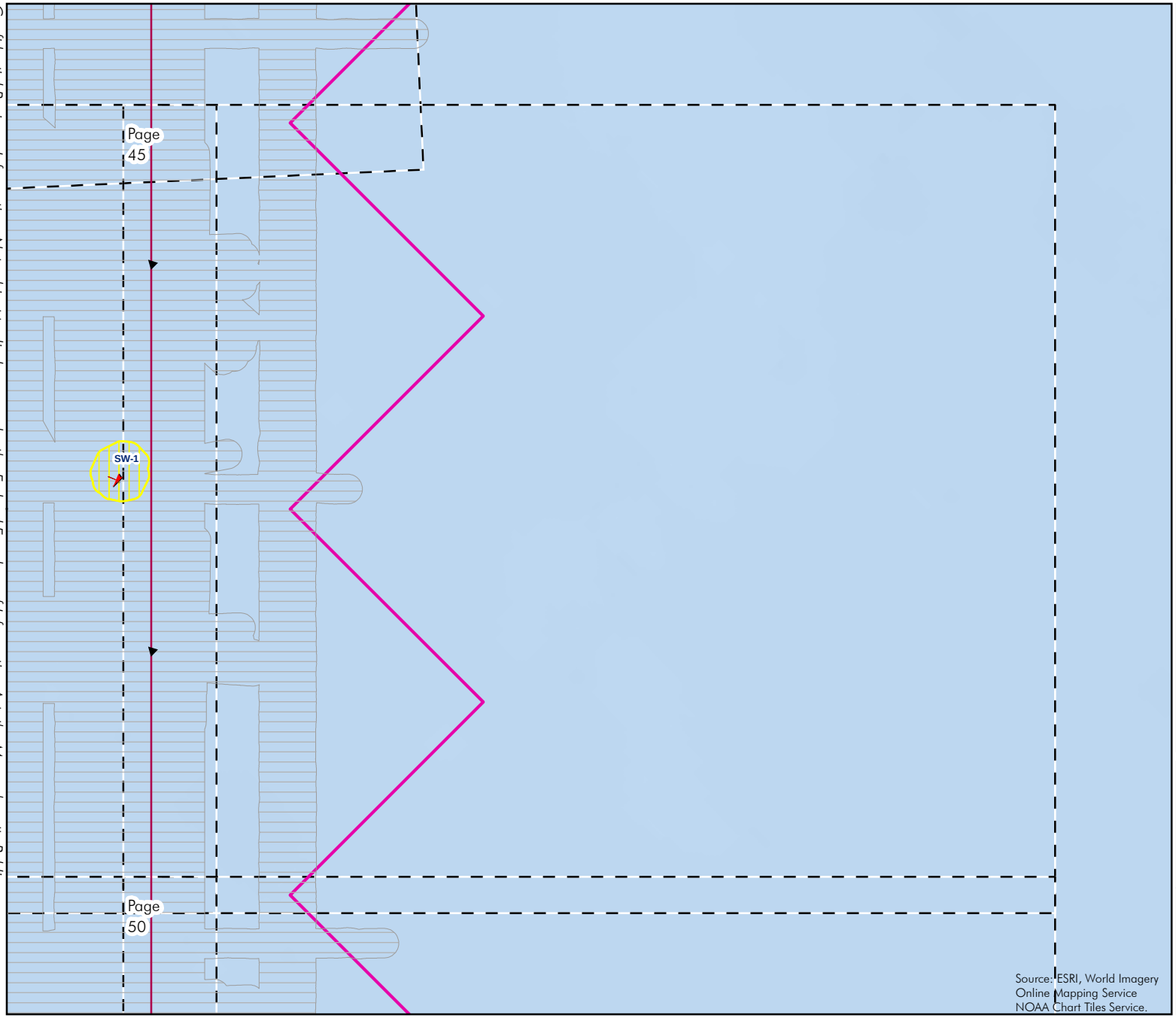
LEGEND

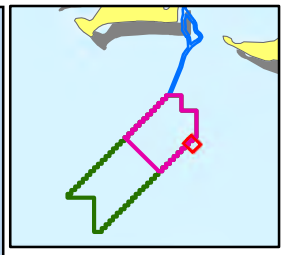
- Shipwreck
- Wind Turbine Generators
- Representative Inter-Array Cable Alignment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Wind Development Area of Potential Effects
- Wind Development Area
- Strip Map

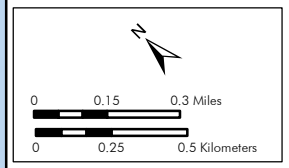
Wind Development Area archaeological avoidance areas.

Source: ESRI, World Imagery Online Mapping Service NOAA Chart Tiles Service.

GRAY & PAPE HERITAGE MANAGEMENT





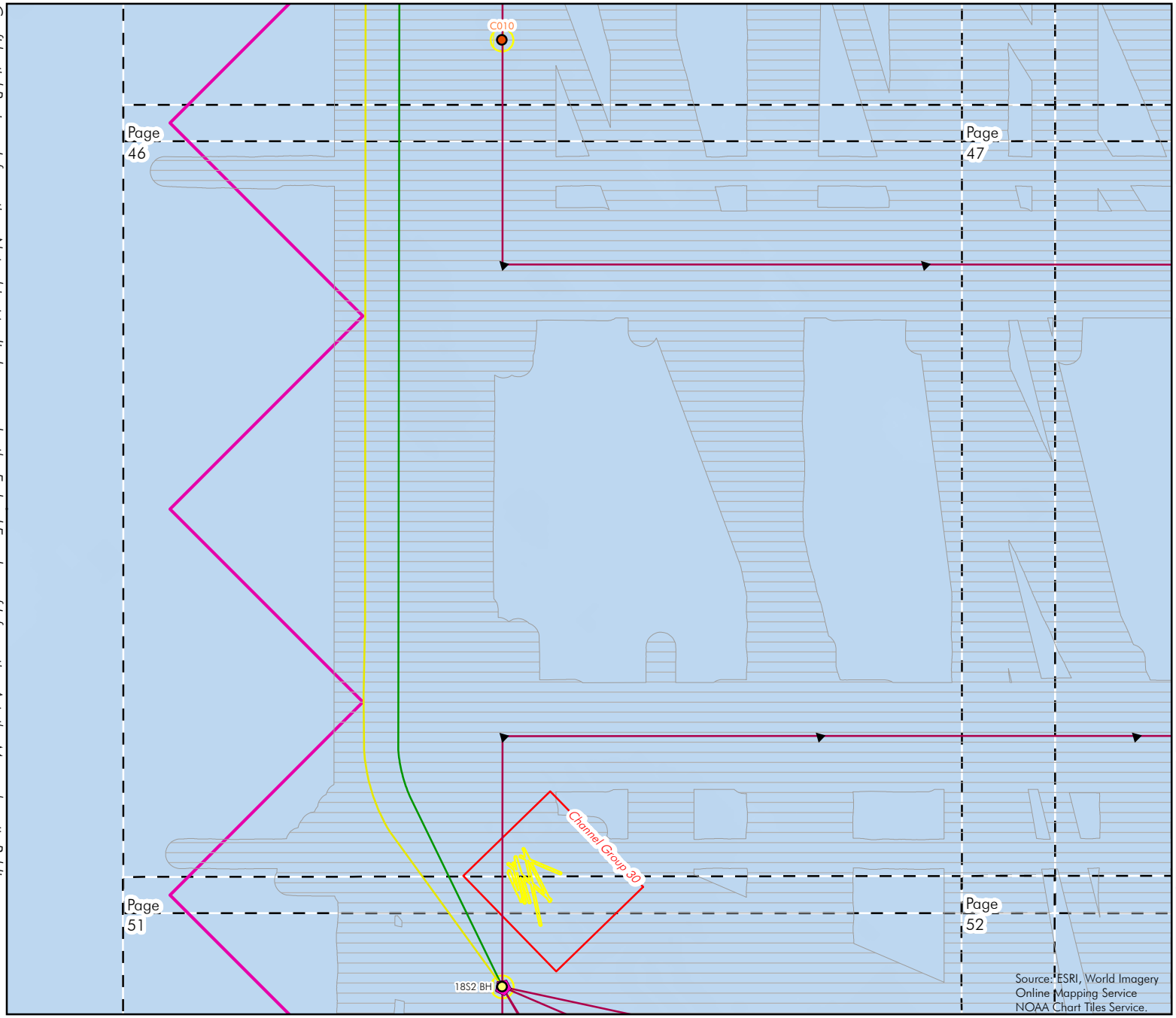


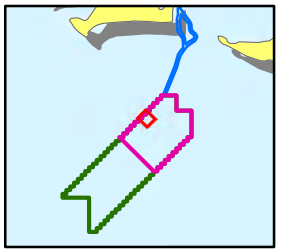
LEGEND

- Shipwreck
- Wind Turbine Generators
- Representative Inter-Array Cable Alignment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Wind Development Area of Potential Effects
- Wind Development Area
- Strip Map

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





N

0 0.15 0.3 Miles

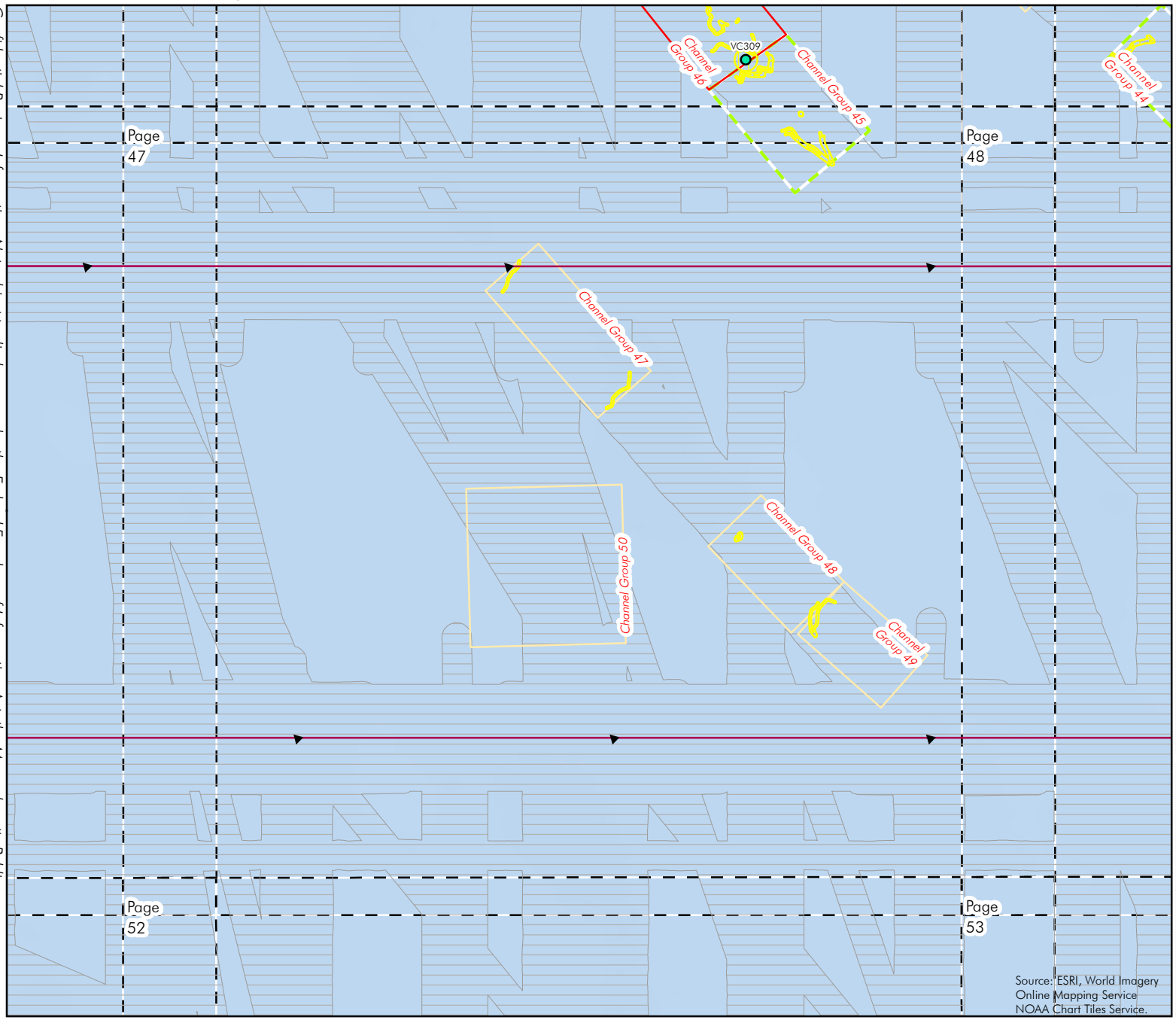
0 0.25 0.5 Kilometers

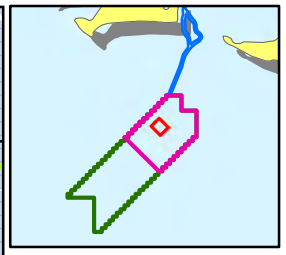
LEGEND

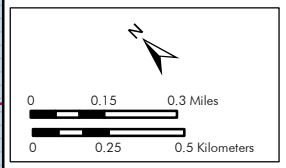
- 2018 Seaforth Bore Holes - Avoided
- 2018 Horizon Inter-Array Cable Vibracores (Cultural) - Avoided
- Wind Turbine Generators
- Electrical Service Platform - Removed
- Representative Inter-Array Cable Alignment in WDA
- Representative Export Cable Alignment in WDA
- Representative Inter-link Cable in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
- Wind Development Area of Potential Effects
- Wind Development Area
- Strip Map

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





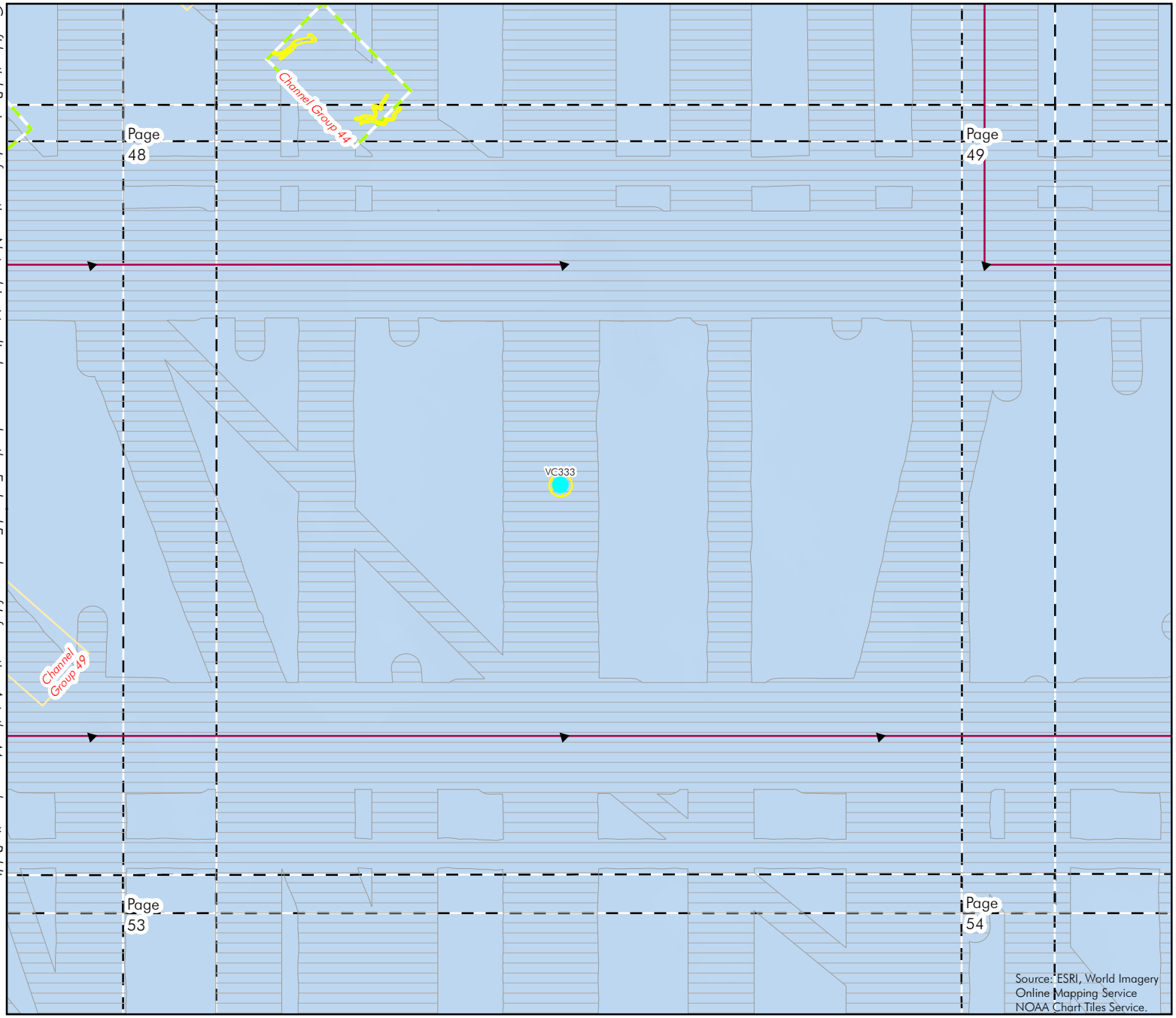


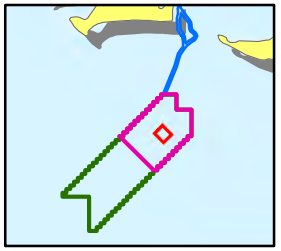
LEGEND

- 2018 Alpine Inter-Array Cable Corridor Vibracores (Cultural) - Avoided
- Wind Turbine Generators
- Representative Inter-Array Cable Alginment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
- Paleochannel and Paleo Features - Not Avoided
- Paleo-landform is deeper than the APE and will not be affected
- Wind Development Area of Potential Effects
- Wind Development Area
- Strip Map

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





N

0 0.15 0.3 Miles
0 0.25 0.5 Kilometers

LEGEND

- 2018 Alpine Inter-Array Cable Corridor Vibracores (Cultural) - Avoided
- Wind Turbine Generators
- Representative Inter-Array Cable Alginment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
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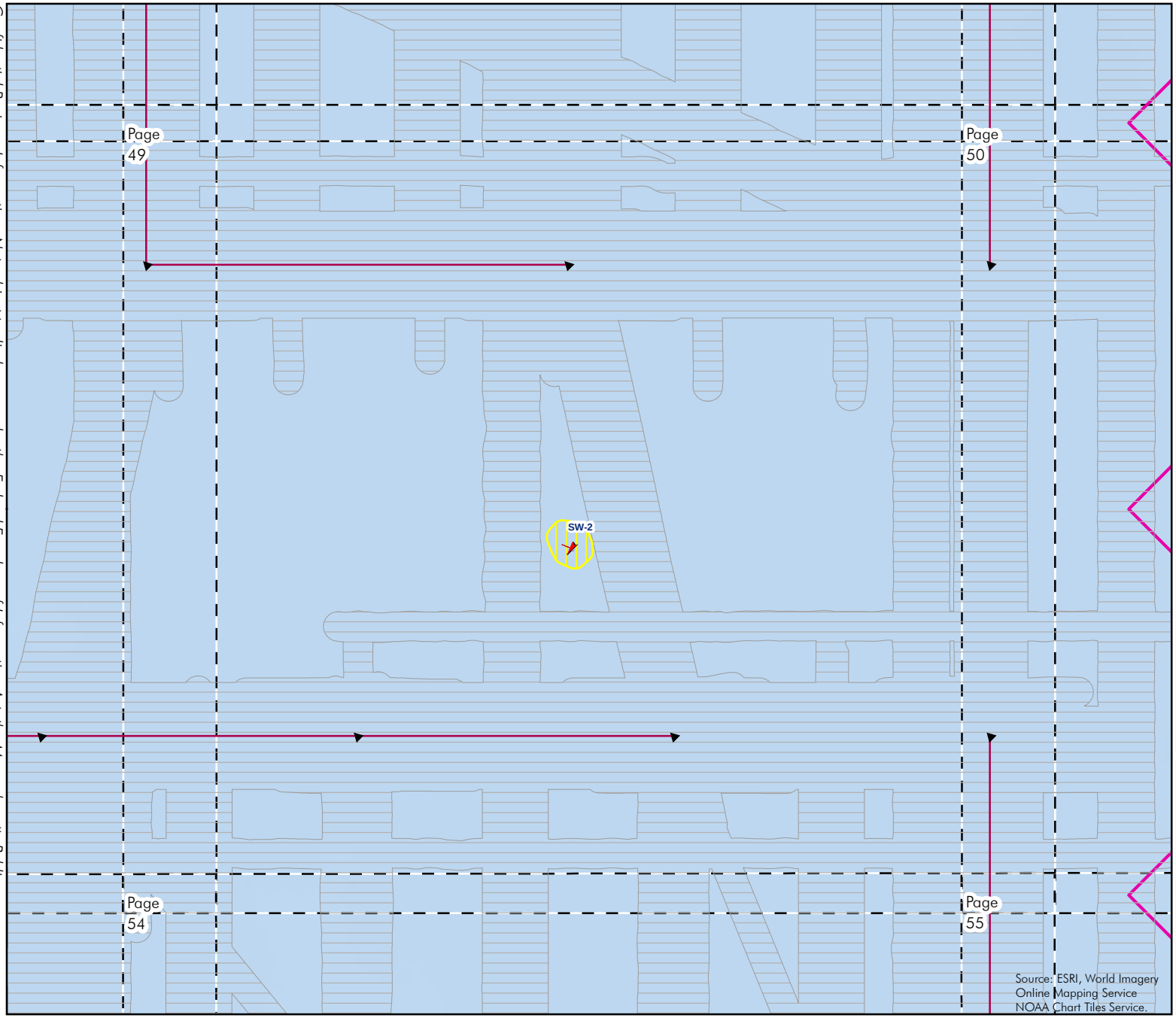
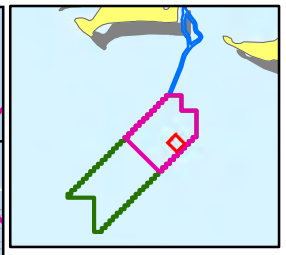
Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT





N

0 0.15 0.3 Miles
0 0.25 0.5 Kilometers

LEGEND

- Shipwreck
- Wind Turbine Generators
- Representative Inter-Array Cable Alignment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
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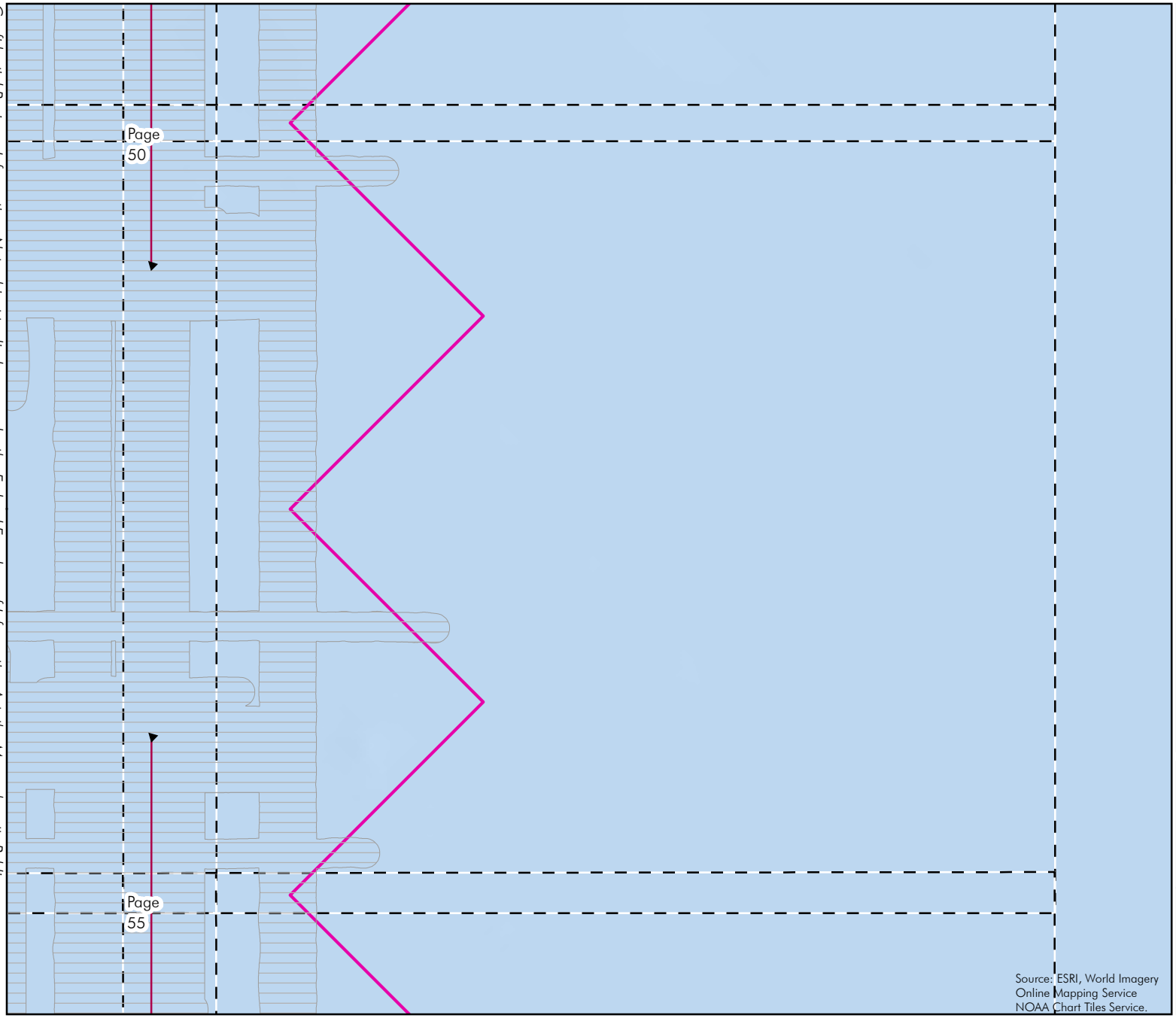
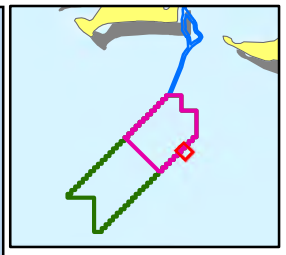
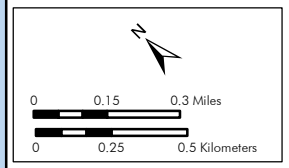
- Strip Map

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT







LEGEND

- Wind Turbine Generators
- Representative Inter-Array Cable Alignment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
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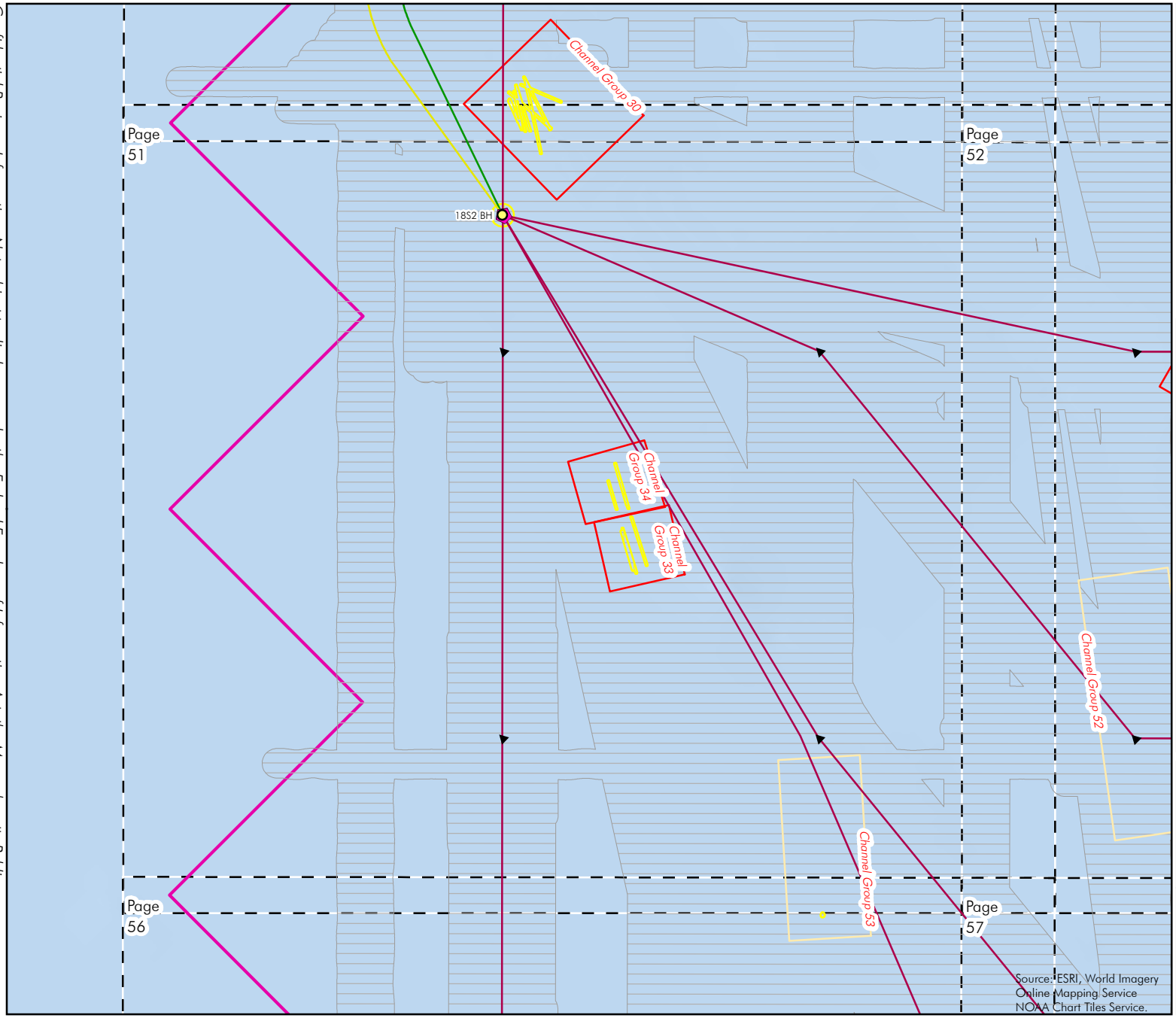
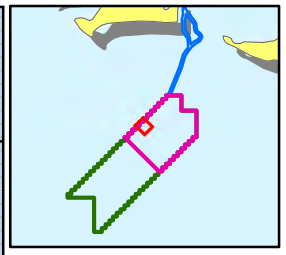
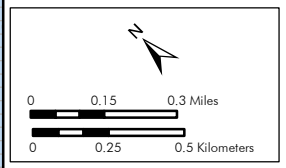
Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT



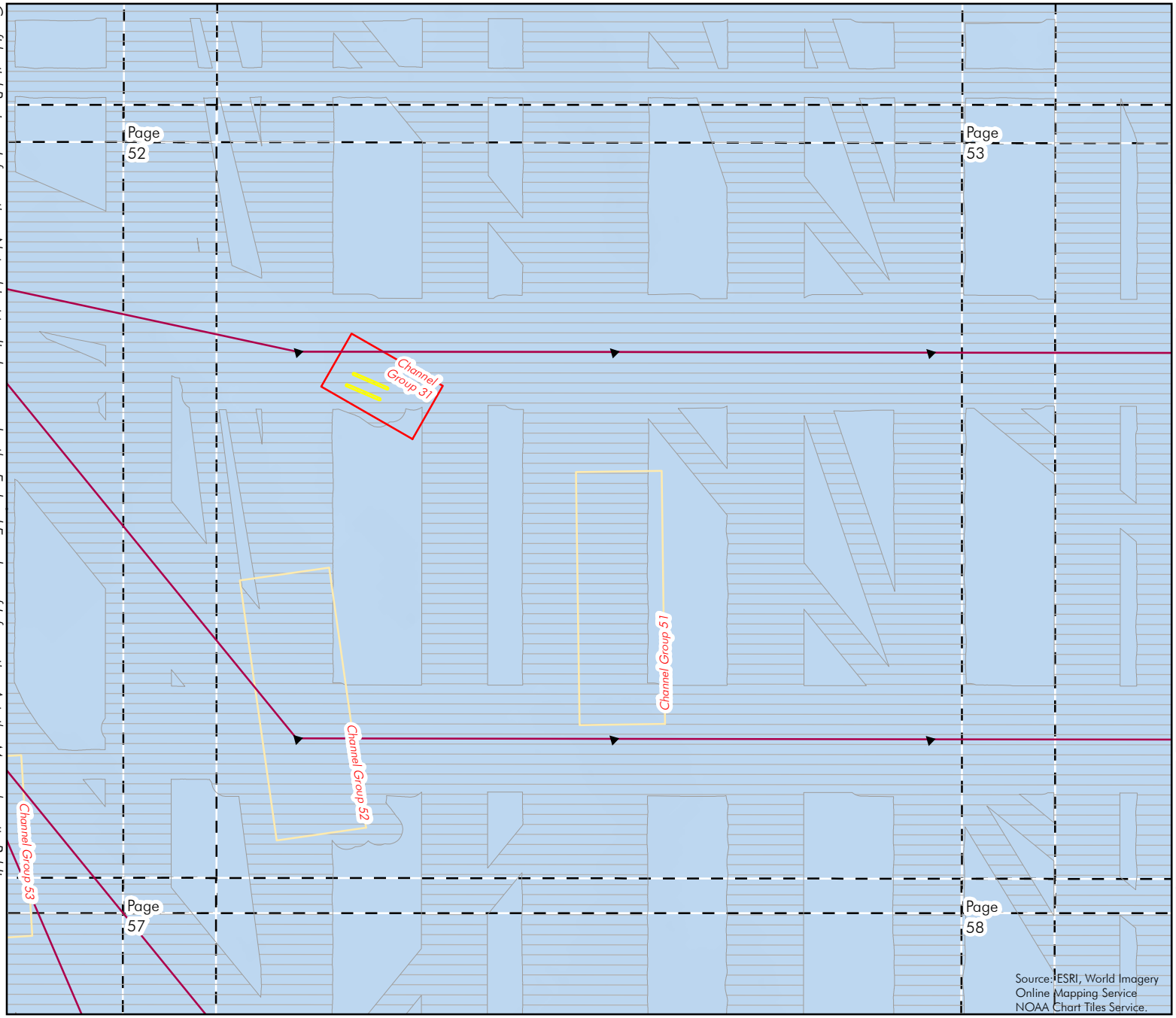


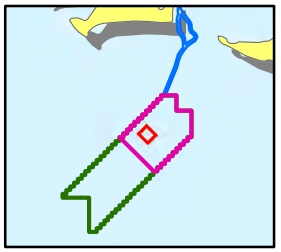


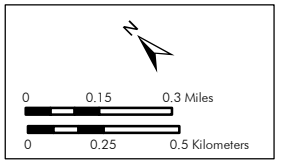
LEGEND

- 2018 Seaforth Bore Holes - Avoided
- Wind Turbine Generators
- Electrical Service Platform - Removed
- Representative Inter-Array Cable Alignment in WDA
- Representative Export Cable Alignment in WDA
- Representative Inter-link Cable in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
- Paleo-landform is deeper than the APE and will not be affected
- Wind Development Area of Potential Effects
- Wind Development Area
- Strip Map

Wind Development Area archaeological avoidance areas.







LEGEND

- Wind Turbine Generators
- Representative Inter-Array Cable Alginment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
- Paleochannel and Paleo Features - Avoided
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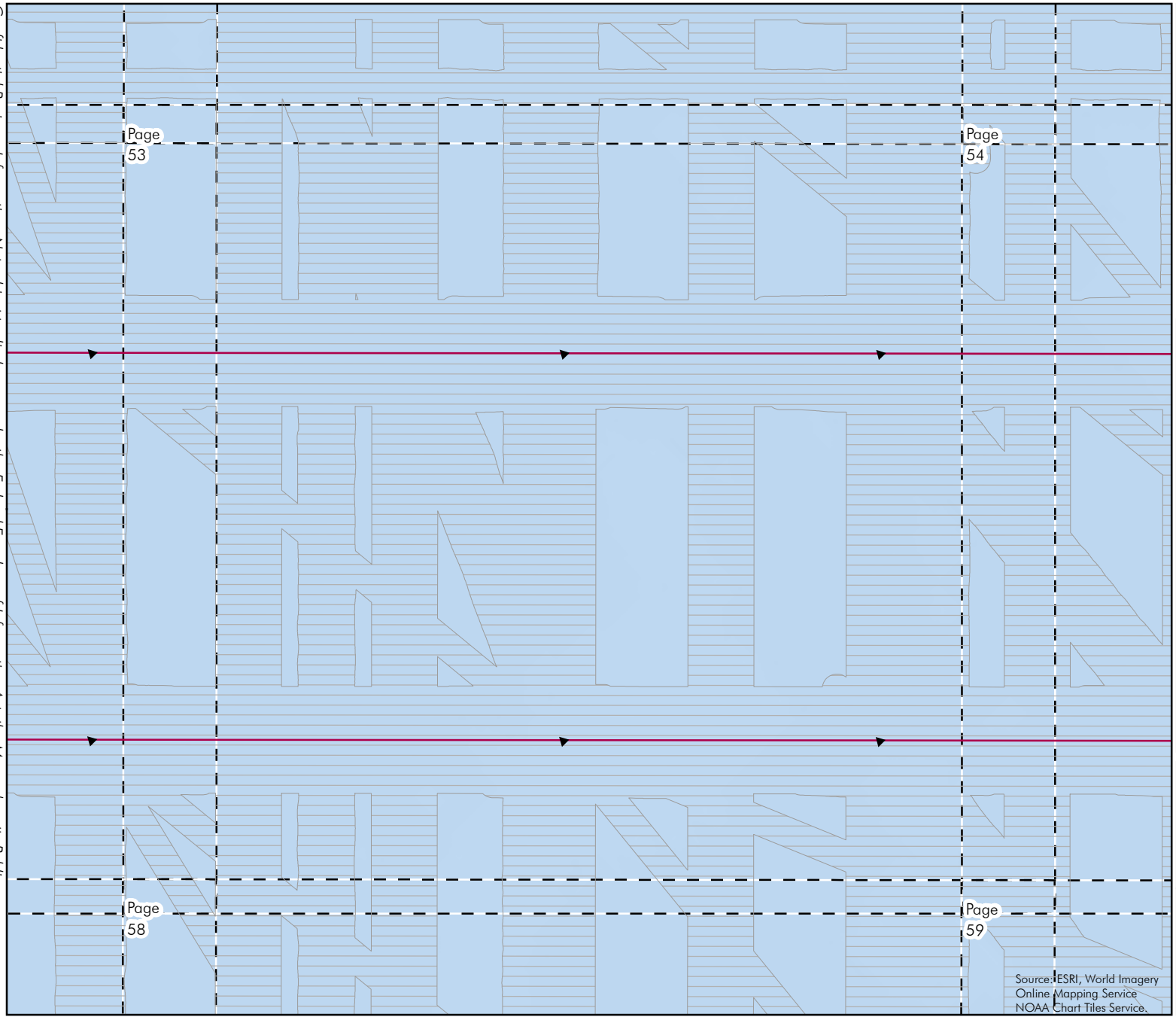
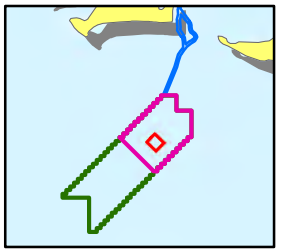
- Wind Development Area
- Strip Map

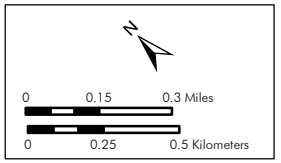
Source: ESRI, World Imagery Online Mapping Service NOAA Chart Tiles Service.

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT







LEGEND

- Wind Turbine Generators
- Representative Inter-Array Cable Alignment in WDA
- Avoidance Areas to 2.5 m Below Seafloor
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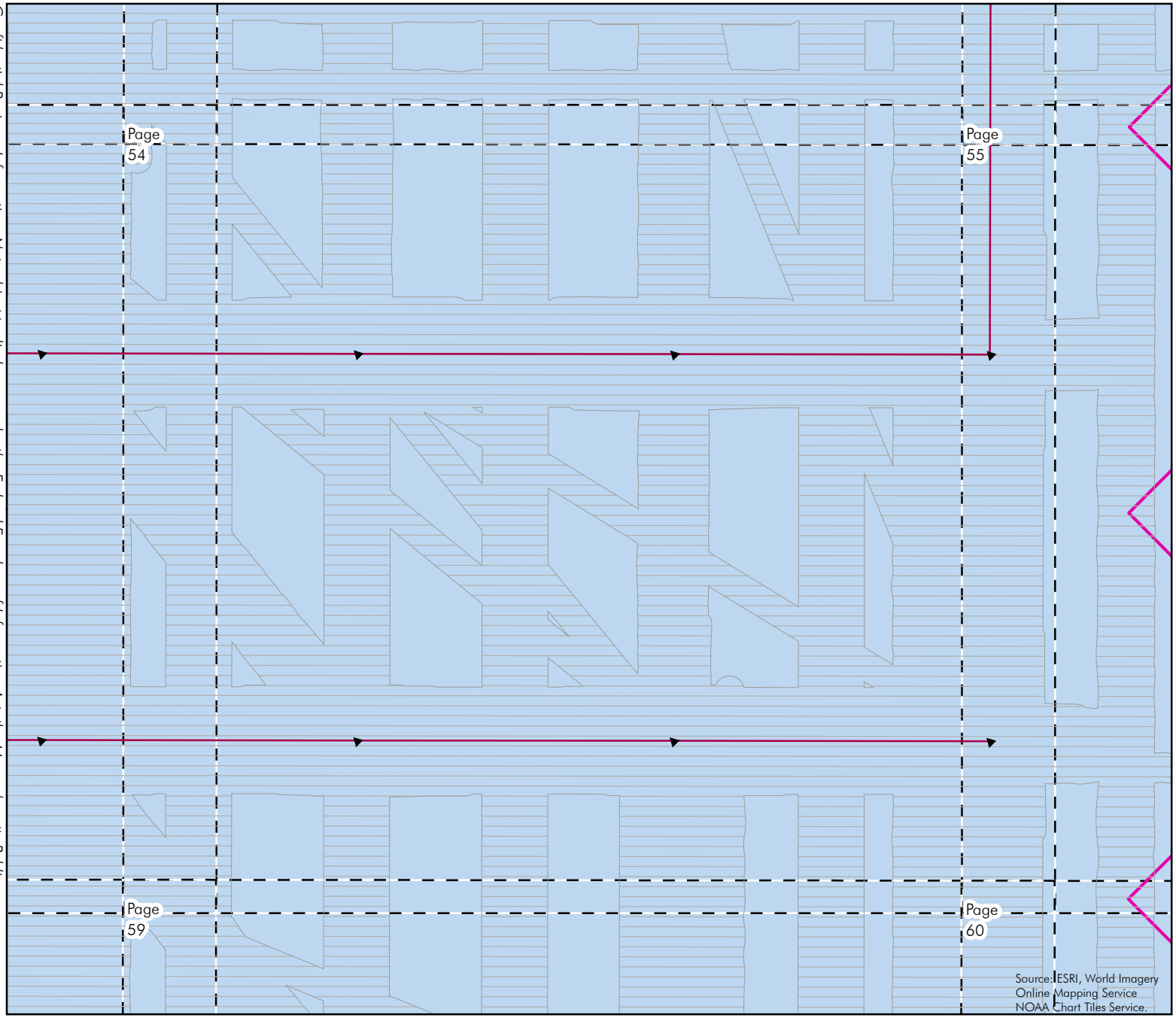
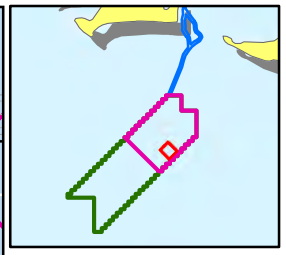
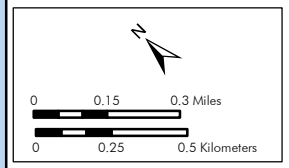
- Wind Development Area
- Strip Map

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT







LEGEND

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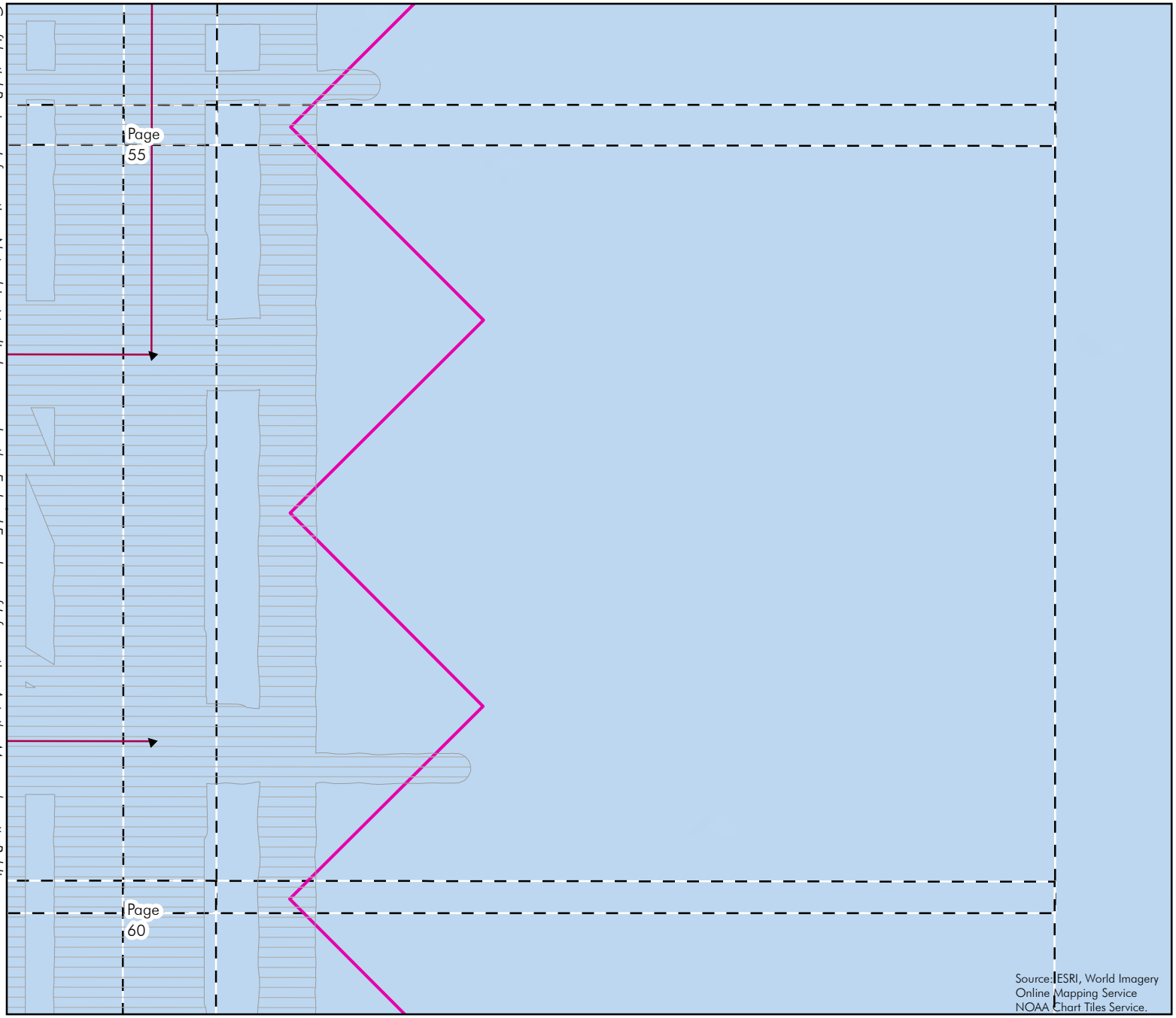
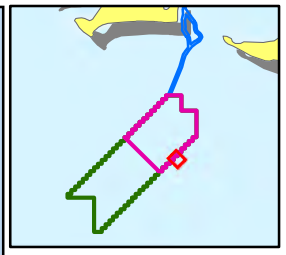
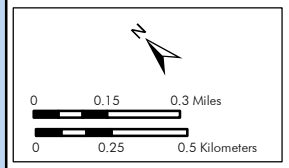
Wind Development Area archaeological avoidance areas.

Source: ESRI, World Imagery Online Mapping Service NOAA Chart Tiles Service.

GRAY & PAPE HERITAGE MANAGEMENT







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Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT

Created in ArcGIS 10.4 for G&P Project 16-73901.002

5/21/2019 M:\00_Projects_Yearly\2016\16-73901 Vineyard Wind\2019 COP Report\16-73901.002_AppendixN_WDAAvoidanceMaps.mxd

Confidential Business Information. Not subject to disclosure under the Federal Freedom of Information Act, the Massachusetts Public Records Law pursuant to M.G.L. c. 4 §7(26), subclauses (d) and (g), and the Rhode Island Access to Public Records Act, R.I.G.L. §38-2, pursuant to Section 38-2-2(4)(B),(F) and (K).

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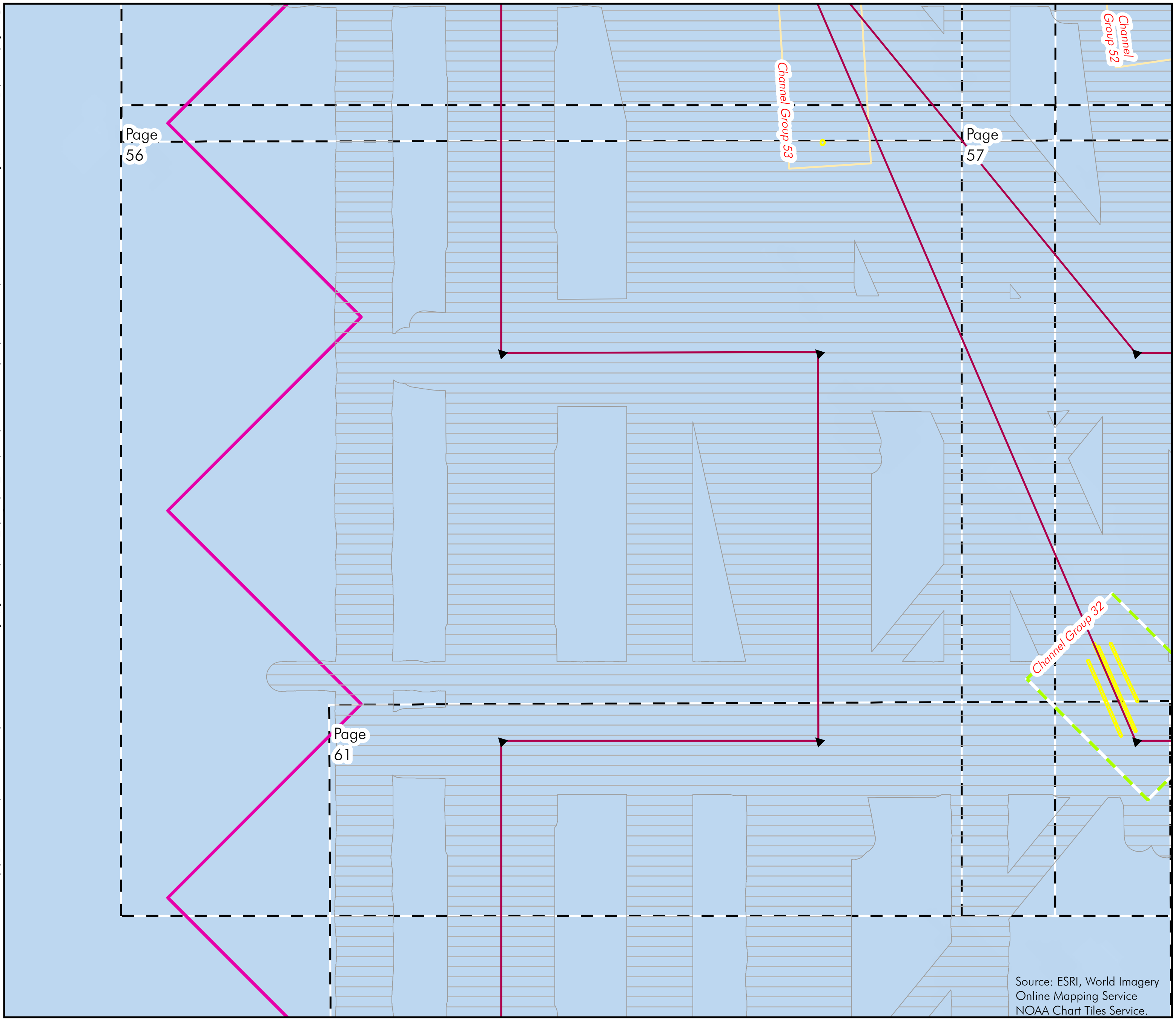

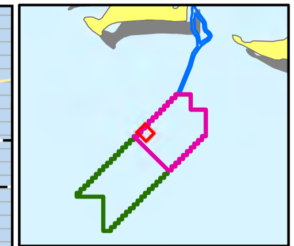

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LEGEND

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Wind Development Area archaeological avoidance areas.

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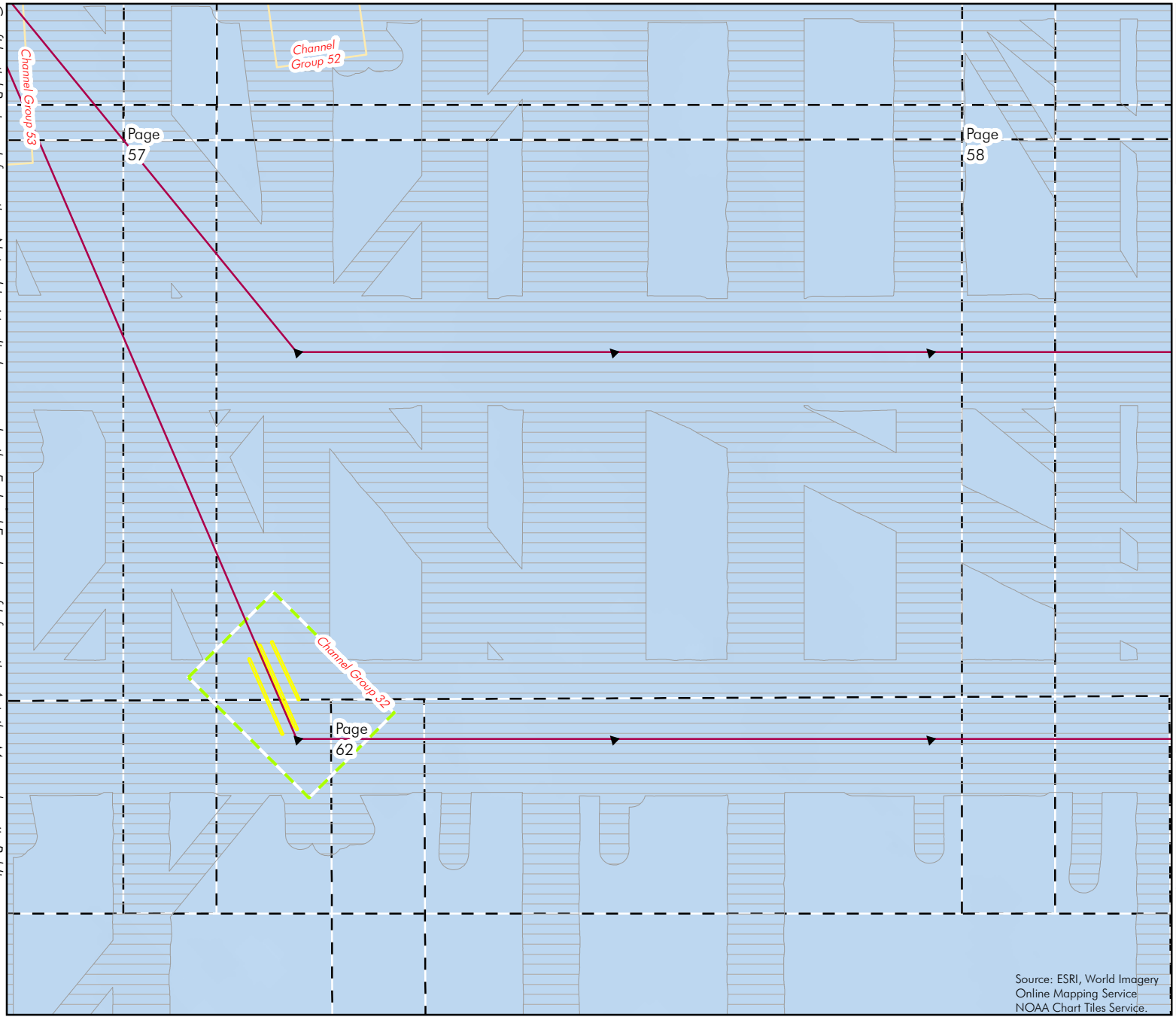

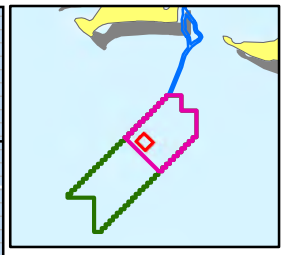

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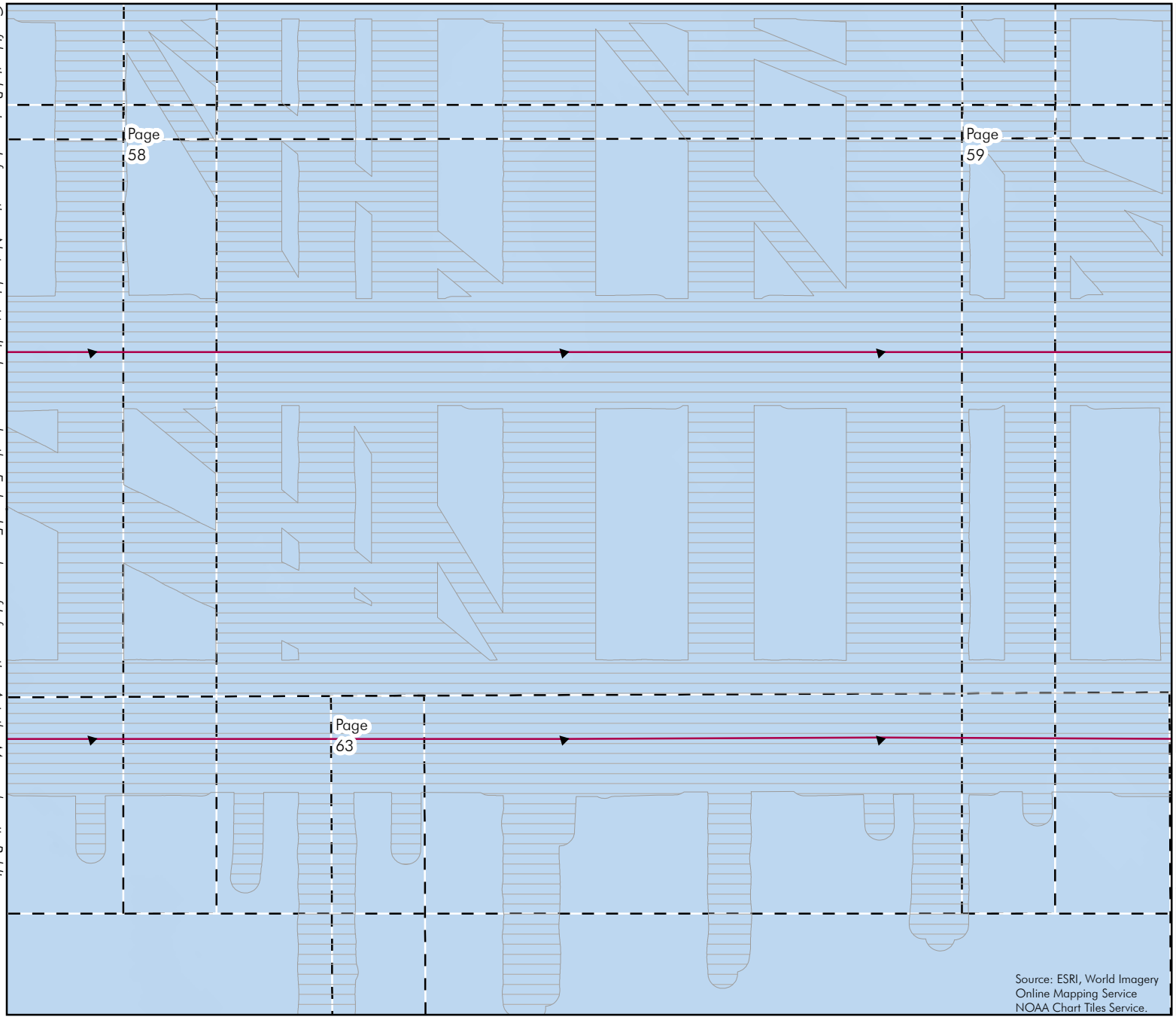

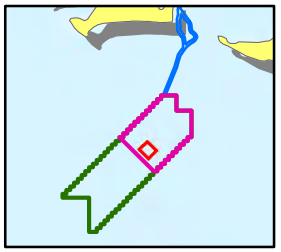

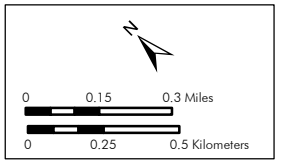

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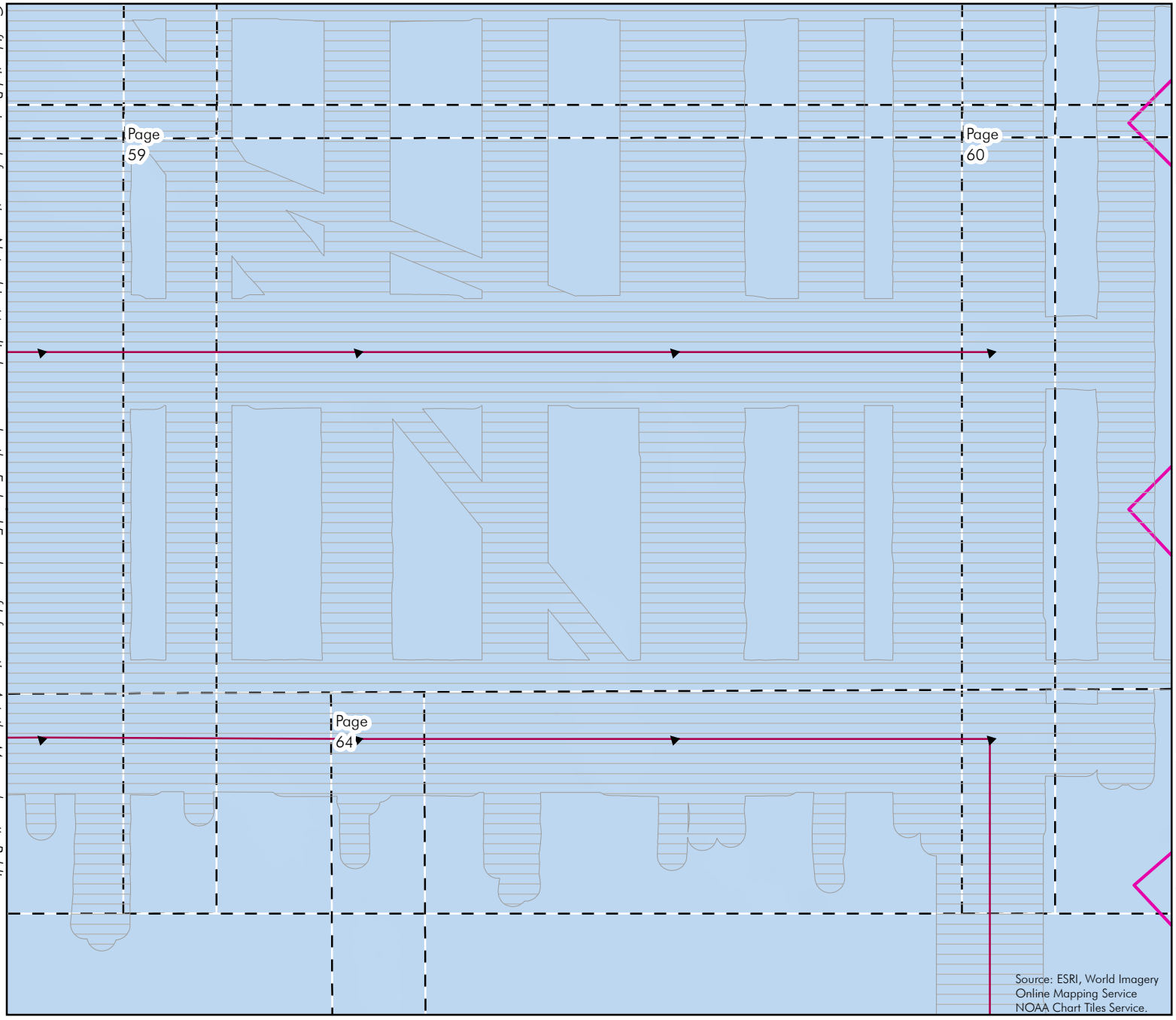

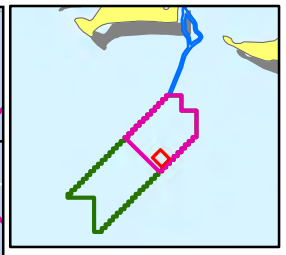

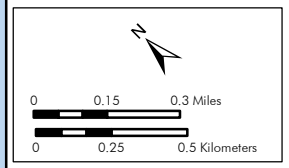

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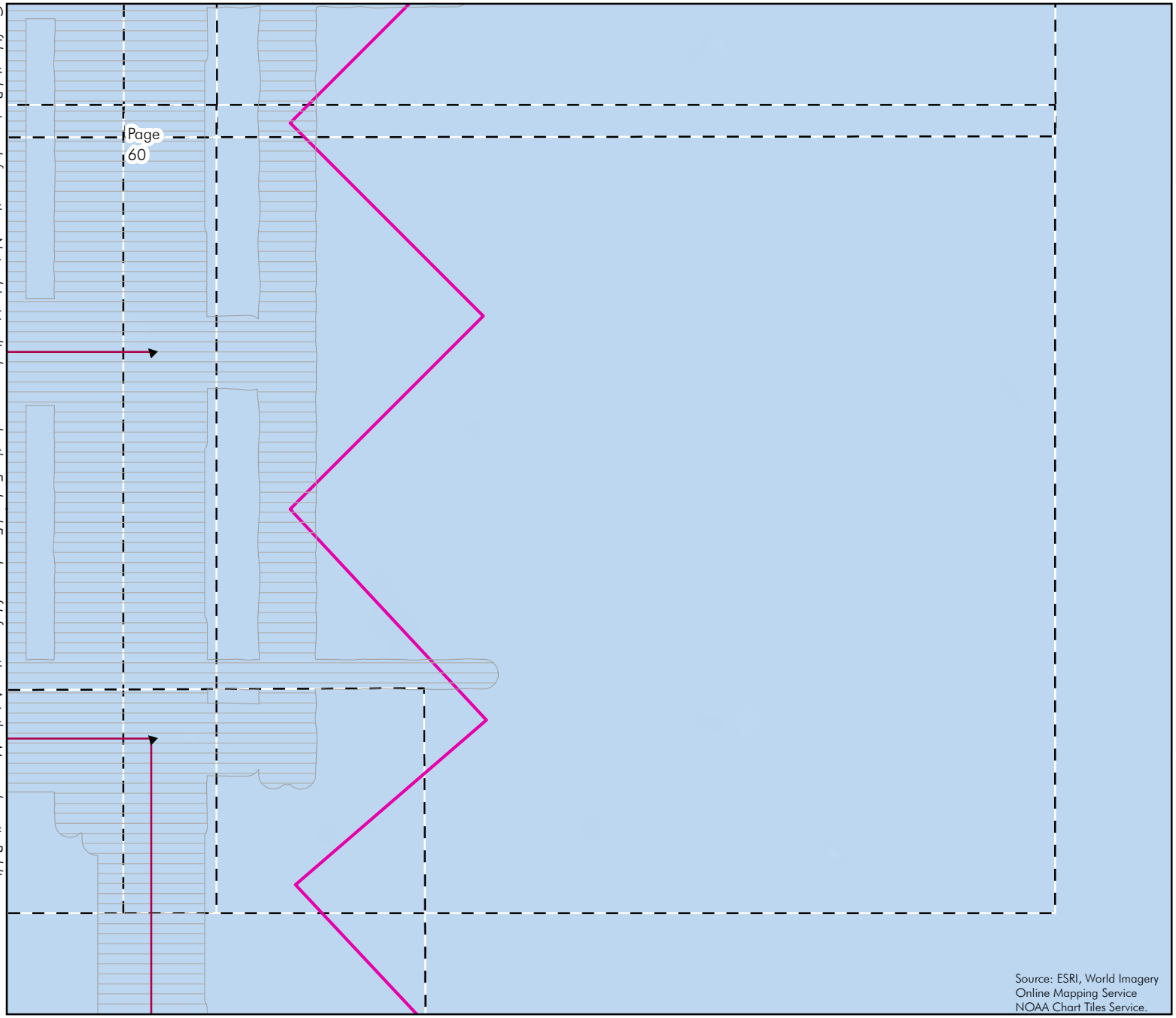

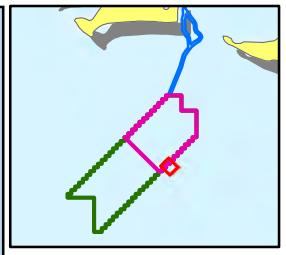

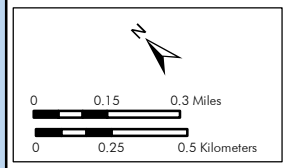

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Source: ESRI, World Imagery
Online Mapping Service
NOAA Chart Tiles Service.

Wind Development Area archaeological avoidance areas.

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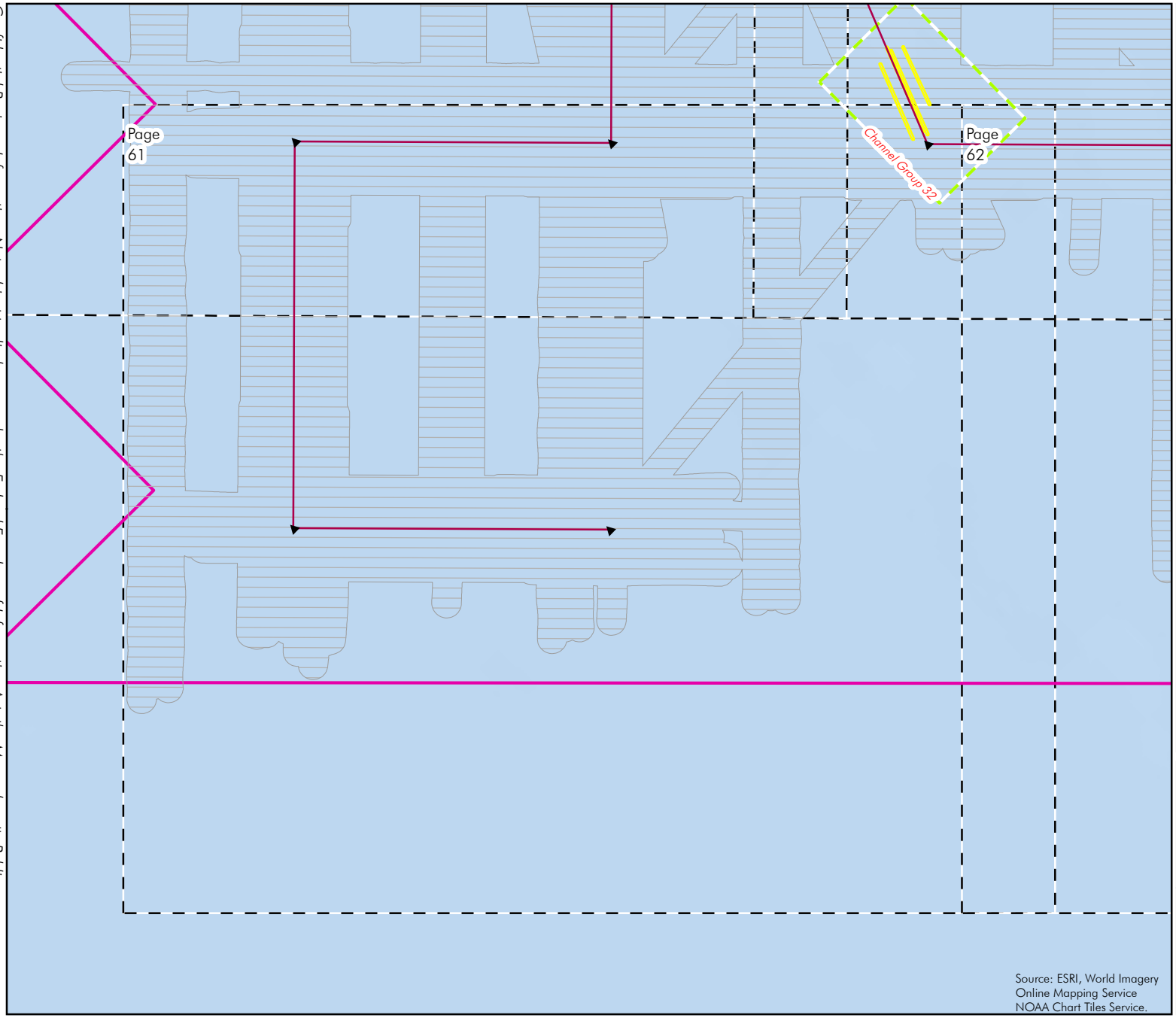

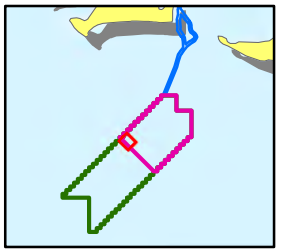

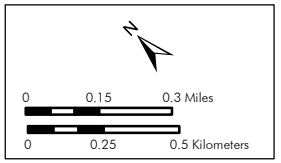

LEGEND

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Wind Development Area archaeological avoidance areas.

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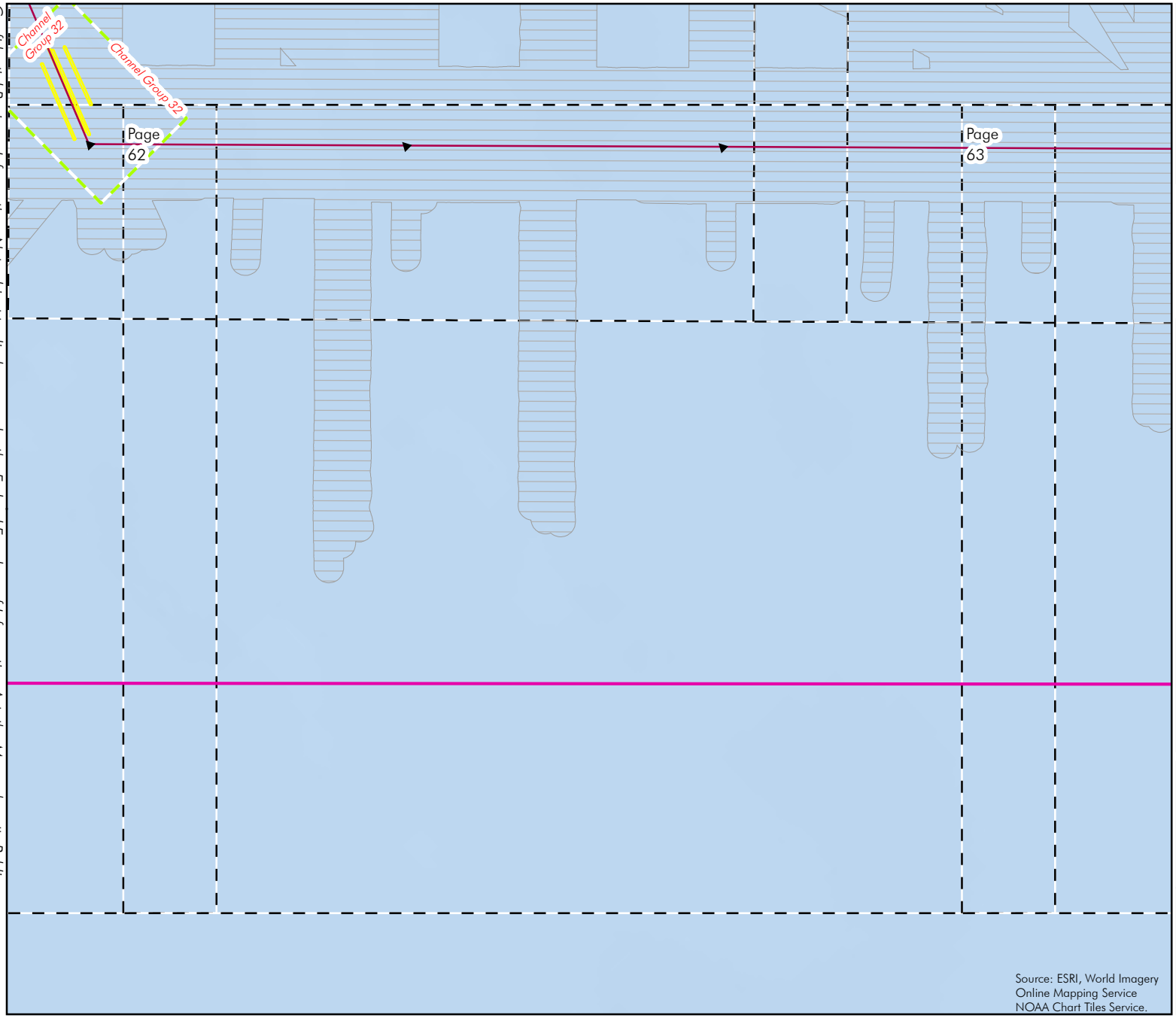

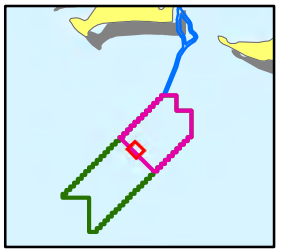

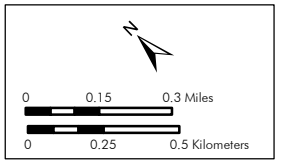

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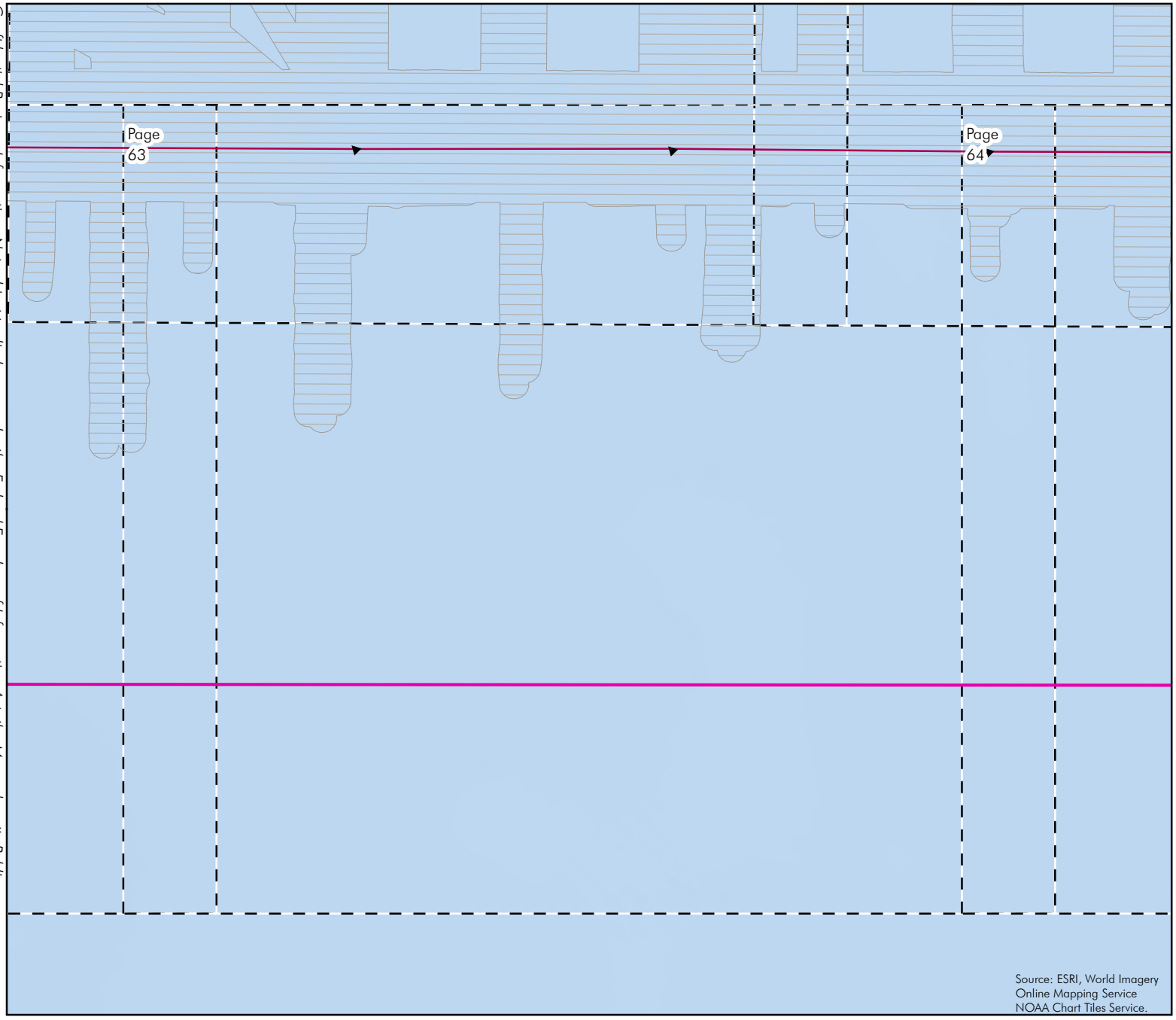

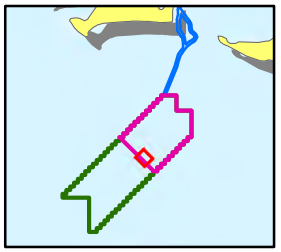

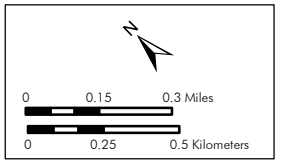

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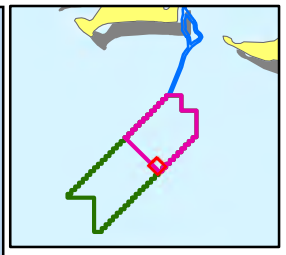
Source: ESRI, World Imagery
Online Mapping Service
NOAA Chart Tiles Service.

Wind Development Area archaeological avoidance areas.

GRAY & PAPE HERITAGE MANAGEMENT

Page 64



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0 0.15 0.3 Miles

0 0.25 0.5 Kilometers

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GRAY & PAPE HERITAGE MANAGEMENT

ATTACHMENT 9 – ONSHORE POST-REVIEW DISCOVERIES PLAN

Please refer to the attached document for the Onshore Post-Review Discoveries Plan.

Vineyard Wind 1/Connector 1 Upland Cabling Route and Substation
Vineyard Wind 1 Offshore Wind Energy Project`

Barnstable, Massachusetts

Prepared for

Vineyard Wind 1 LLC

Prepared by

The Public Archaeology Laboratory, Inc.
26 Main Street
Pawtucket, Rhode Island 02860

April 2021

Introduction

Vineyard Wind 1 LLC ("Proponent") is proposing an 800 megawatt (MW) offshore wind energy project ("Project" or "Vineyard Wind 1") within the northern portion of Lease Area OCS-A 0501, which is located in federal waters south of Martha's Vineyard and Nantucket and has been designated by the Bureau of Offshore Energy Management (BOEM) for offshore wind energy development. The Project includes offshore wind energy generation facilities that will deliver power to the ISO-New England grid via submarine cables that make landfall at Covell's Beach in Barnstable, Massachusetts. From the landfall site, underground onshore cables will deliver power to a new approximately 8-acre onshore substation site on Independence Drive within the Independence Park commercial/industrial area in Barnstable, which is adjacent to the point of interconnection at the existing Eversource 115 kilovolt (kv) Barnstable Switching Station (Plan Set, Appendix A).

Vineyard Wind 1 LLC is committed to the protection and preservation of cultural resources, in accordance with federal and state legislation, and is continuing that commitment during the construction of the upland terrestrial elements of the Vineyard Wind 1 Project including the upland cabling route and the substation (Appendix A). Vineyard Wind 1 LLC recognizes that while sections of the proposed Project's upland areas have previously been subject to archaeological investigations and other areas have been previouslydisturbed by existing utilities and buildings, it is possible that significant archaeological resources and/or human remains may be discovered during the Project's upland construction activities, particularly during excavation. The Proponent also recognizes the importance of compliance with federal, state, and municipal laws and regulations regarding the treatment of human remains, if any are discovered.

The Public Archaeology Laboratory Inc. ("PAL") is assisting the Proponent in the implementation of this Plan and the procedures guiding the unanticipated discovery of cultural resources and human remains detailed herein. The procedures will be implemented for two separate phases of work. During installation of the upland cabling under roadways and in rights-of-way, in areas designated as having moderate and high archaeological sensitivity, an archaeologist will be on-site monitoring construction. Therefore, some of the notification procedures outlined below will be streamlined. In areas where archaeological investigation has been completed, such as the substation, an archaeologist will not be present and all the notification procedures outlined below will be in effect. These procedures were developed in consultation with the Massachusetts Historical Commission ("MHC"), office of the State Historic Preservation Officer ("SHPO") and federally recognized Indian tribes. These procedures summarize the approach that the Proponent will use to address unanticipated discoveries of archaeological resources or human remains within the Project's Area of Potential Effect ("APE").

Standards/Guidelines and Laws/Regulations for Post-Review Discoveries of Archaeological Resources and Human Remains

Federal

- Section 106 of the National Historic Preservation Act of 1966, as amended (54 USC 300101) and Advisory Council on Historic Preservation implementing regulations (36 CFR 800)

- Secretary of the Interior's Standards for Archeology and Historic Preservation (48 CFR 44716-42);

- Advisory Council on Historic Preservation (ACHP): *Policy Statement Regarding Treatment of Burial Sites, Human Remains, and Funerary Objects*, Advisory Council February 23, 2007).

Massachusetts

- Massachusetts Unmarked Burial Law (M.G.L. c. 7, s. 38A, c. 38, s.6, c. 9, ss. 26A & 27C, and c.114, s.17);

- Massachusetts SHPO: *Know How #4 What to do when Human Burials are Uncovered* (no date) (Appendix B);

- Massachusetts Historical Commission *Policy and Guidelines for Non-Native Human Remains Which Are Over 100 Years Old or Older* (1990); M.G.L. Chapter 9, Section 26A (7) (Appendix C).

Consultation with Federal and State Agencies and Indian Tribes

As part of the Project, Vineyard Wind 1 LLC has been consulting with the Massachusetts SHPO, the federally recognized Indian tribes, the Mashpee Wampanoag Tribe and the Wampanoag Tribe of Gay Head/Aquinnah, and other interested stakeholders. All contact information for the SHPO, federally recognized Indian tribes, and other stakeholders is included in this document. In the event any archaeological resources and/or human remains are encountered during construction of the Project, the Proponent and their Cultural Resources Manager ("CRM") will contact the relevant parties, as set forth in these Procedures.

Identification/Training

The identification of archaeological resources requires basic training in order to recognize potential archaeological sites. Vineyard Wind 1 LLC and its employees and contractors should have a basic understanding of the nature of cultural resources. All Project inspectors, Resident Engineers, and Construction Supervisors working on the Project's upland excavation activities will be given basic training in cultural resource site recognition by qualified PAL staff.

The purpose of this training will be to review the Proponent's commitments regarding cultural resources compliance and to provide an overview of the general cultural history of the Project area, so that both the Proponent and construction personnel will be aware of the kinds of archaeological resources that may be encountered in the field. In addition, the training program will emphasize the exact protocol to be followed, as outlined in these Procedures, regarding actions to be taken and notification required in the event of a discovery, such as human remains, during construction. The MHC's fact sheet entitled "Know How #4 What to Do When Human Burials are Uncovered" will be distributed (Appendix B).

The training will be designed to ensure that Vineyard Wind personnel and construction contractors involved in the Project's upland excavation activities understand the extent of the archaeological survey program that has been performed for the upland Project and are fully aware of the distinction between sites that have been located and "cleared" under the cultural resource program and new discoveries during the construction process.

Notification Procedures

The following details the protocols that will be followed in the event that archaeological resources or human remains are discovered during the construction process.

Archaeological Discovery Protocol

The following procedures will be adhered to in the event of a potential discovery of archaeological resources during construction.

1. In the event that suspected archaeological resources are uncovered during a construction activity, that activity shall immediately be halted until it can be determined whether the archaeological resources are cultural and, if so, whether they represent a potentially significant site.

2. The Contractor will immediately notify the Resident Engineer of the potential discovery. Notification will include the specific construction area (e.g., trench wall, spoil pile, foundation excavation) in which the potential site is located.

3. The Resident Engineer will direct a Stop Work order to the Contractor's Site Foreman to flag or fence off the archaeological discovery location and direct the Contractor to take measures to ensure site security. Any discovery made on a weekend or overnight hours will be protected until all appropriate parties are notified of the discovery. The Contractor will not restart work in the area of the find until the Resident Engineer has granted clearance.

4. The Resident Engineer will indicate the location and date of the discovery on the project plans and will undertake a site visit or otherwise coordinate an on-site archaeological consultation.

5. Upon notification or discovery of a possible site, the Resident Engineer will contact its cultural resource consultants (PAL), who will in turn be responsible for determining whether a visit to the area is required. That determination may be made by viewing photographs of any object or soil discolorations sent to the archaeologist in combination with a verbal description from the Resident Engineer. If a site visit is necessary, the archaeologist will have a crew on site within 24 hours after notification.

   If on-site archaeological investigations are required, PAL will inform the Resident Engineer who then will inform the construction contractor. No construction work at the site that could affect the archaeological resources will be performed until the archaeological fieldwork is complete. The site will be flagged as being off-limits for work but will not be identified as an archaeological site *per se* in order to protect the resources.

6. If PAL determines a site visit is not required as the reported discovery of archaeological resources is determined by PAL to not be a potentially significant archaeological resource, PAL will notify the Resident Engineer who will then notify the contractor to resume work.

7. If PAL determines a site visit is required, the PAL archaeologist will conduct a review of the site in accordance with MHC standards and guidelines. Since the area will have been partially disturbed

by construction activities, the objective of cultural resource investigations will be to evaluate data quickly so that notifications and consultation can proceed.

8. The archaeologist will determine, based on the deposits found and on the cultural sensitivity of the area in general, whether the site is potentially significant and whether the SHPO requires immediate notification by telephone. If not, data regarding the site will be faxed or sent by express mail to the SHPO in order to ensure a quick site clearance. The Proponent and PAL will work with the SHPO to ensure that a treatment plan for the site is developed and implemented as quickly as possible.

9. If the resource is determined to be a significant archaeological resource and threatened by the Project's upland development, PAL, at the direction of the Proponent and in consultation with the SHPO, and, as appropriate, Indian tribes, and any other relevant consulting parties, will develop and implement under a State Archaeologist's permit (950 CMR 70) a site mitigation plan.

Duration of any work stoppages will be contingent upon the significance of the identified archaeological resource(s) and consultation with Proponent, SHPO, and other appropriate parties to determine the appropriate measures to avoid, minimize, or mitigate any adverse effects to the site.

Discovery of Human Remains Protocol

If any human remains are to be encountered, they will likely be discovered in excavations, possibly below areas where previous ground disturbance (e.g., road construction) has occurred.

At all times human remains must be treated with the utmost dignity and respect. Human remains and/or associated artifacts will be left in place and not disturbed. No skeletal remains or materials associated with the remains will be collected or removed until appropriate consultation has taken place and a plan of action has been developed.

1. If any personnel on the construction site identify human remains or possible human remains, all construction work in the immediate vicinity that could affect the integrity of the remains will cease immediately. The remains should not be touched, moved, or further disturbed. The Resident Engineer will be informed immediately and notified of the exact location of the remains, as well as of the time of discovery. The Resident Engineer will direct a Stop Work order to the Contractor's Site Foreman to take measures to ensure site security.

2. The Resident Engineer will be responsible for immediately contacting the PAL archaeologist.

3. The PAL archaeologist and Vineyard Wind 1 LLC will be responsible for notifying appropriate company personnel as well as the State Archaeologist, the Office of the Chief Medical Examiner (OCME) and the State Police. If the PAL archaeologist determines that the remains are obviously human and recent, this will be communicated to all the contacts, including the OCME. If the PAL archaeologist considers that the remains appear to be over 100 years old, this will be indicated to the OCME, and the State Archaeologist so that they can coordinate and respond. The State Archaeologist will determine if the remains are Native American and if so, will notify the Massachusetts Commission on Indian Affairs.

4. Vineyard Wind 1 LLC staff and the State Archaeologist will consult with the property owner and the Commission on Indian Affairs if the remains are Native American, to discuss whether there are

prudent and feasible alternatives to protect the remains. The results of this consultation will be made in writing. If it is not possible to protect the remains, they may be excavated only under a Special Permit (950 CMR 70.20[2]) granted by the State Archaeologist after review of an adequate data recovery plan that specifies a qualified research team and an appropriate research design (950 CMR 70.11[2]), including a proposal for disposition of the remains that is consistent with the results of consultation.

5. If the remains are non-Native, the State Archaeologist will determine whether a skeletal analysis of the remains will be conducted and whether the remains will be deposited in a curatorial facility or reinterred. These decisions will be made in consultation with interested parties as defined in the *Policy and Guidelines for Non-Native Human Remains Which Are Over 100 Years Old or Older* (MHC 1990) (Appendix C).

6. In all cases, due care will be taken in the excavation and subsequent transport and storage of the remains to ensure their security and respectful treatment.

CONTACTS

State Police
Appropriate State Police Barracks
Phone: 911
Medical Examiner

Massachusetts Office of the Chief Medical Examiner
720 Albany Street
Boston, Massachusetts 02118
Contact: Mindy Hull, MD, Chief Medical Examiner
Phone: (617) 267-6767

State Historic Preservation Office
Massachusetts Historical Commission
220 Morrissey Boulevard
Boston, Massachusetts 02125
Contact: Brona Simon, State Archaeologist and SHPOTel:
(617) 727-8470
brona.simon@state.ma.us
Jonathan Patton, Archaeologist/Preservation Planner
Phone: (617) 727-8470
Email: jonathan.patton2@state.ma.us

Massachusetts Commission on Indian Affairs
100 Cambridge Street, Suite 300
Boston, Massachusetts 02114
Contact: John A. Peters, Jr., Executive Director
Phone: (617) 573-1292
Email: john.peters@state.ma.us

Federally Recognized Tribal Contacts

Mashpee Wampanoag Indian Tribe
Tribal Historic Preservation Department
483 Great Neck Rd. South,
Mashpee, MA 02649

Contact: David Weeden, Deputy Tribal Historic Preservation Officer
Phone: (508) 447-0208, ext. 102
Email: dweeden@mwtribe.com

Wampanoag Tribe of Gay Head (Aquinnah)
20 Black Brook Road
Aquinnah, Massachusetts 02535

Contact: Bettina M. Washington, Tribal Historic Preservation Officer
Phone: (508) 560-9014
Email: thpo@wampanoagtribe-nsn.gov

Project Proponent

Vineyard Wind 1 LLC
700 Pleasant Street
New Bedford MA 02740

Contact: Elizabeth Hansel, Manager, Environmental Affairs
Phone: 508-446-7326
Email: ehansel@vineyardwind.com

Cultural Resource Consultant

The Public Archaeology Laboratory, Inc.
26 Main Street
Pawtucket, RI 02860

Contact: Deborah C. Cox. President
Phone: 401-487-4002/401-728-8780
Email: dcox@palinc.com

ATTACHMENT 10 – OFFSHORE POST REVIEW DISCOVERIES PLAN

Please refer to the attached document for the Offshore Post-Review Discoveries Plan.

PLANS AND PROCEDURES ADDRESSING UNANTICIPATED DISCOVERIES OF CULTURAL RESOURCES AND HUMAN REMAINS

In Support of the Vineyard Wind 1 Offshore Export Cable Corridor for the Construction and Operations Plan for Lease Area OCS-A 0501 Offshore Massachusetts

Prepared by:
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Kimberly M. Smith, M.A., RPA
Senior Principal Investigator

April 16, 2021

TABLE OF CONTENTS

1.0 INTRODUCTION

The Lessee (Vineyard Wind 1 LLC [Vineyard Wind 1]) will conduct activities within Massachusetts state waters and federal waters in accordance with the following Unanticipated Discoveries Plan (UDP). This UDP has been developed in conformance with the Massachusetts Bureau of Underwater Archaeological Resources' (MBUAR's) published *Policy Guidance on the Discovery of Unanticipated Underwater Archaeological Resources* (https://www.mass.gov/files/documents/2019/10/22/buar-unanticipated-new.pdf), with the MBUAR's and Massachusetts' State Archaeologist's/Massachusetts Historical Commission's (MHC) published policy guidance on the unanticipated discovery of human remains https://www.mass.gov/files/documents/2021/02/18/buar-human.pdf; https://www.sec.state.ma.us/mhc/mhcpdf/knowhow4.pdf) within state waters, and with the Bureau of Ocean Energy Management's *Guidelines for Providing Geological and Geophysical, Hazards, and Archaeological Information Pursuant to 30 CFR Part 285*, Section IV.B, "Unanticipated Discoveries (Chance Finds)" within federal waters.

This plan has been written to assist Vineyard Wind 1 in its compliance with the National Historic Preservation Act of 1966, as amended; Native American Graves Protection and Repatriation Act (NAGPRA); Lease OCS-A 0501 Lease Stipulations; and laws of the Commonwealth of Massachusetts pertinent to discoveries of unmarked burials. This provides pertinent protocols for Vineyard Wind 1 to follow in the event that an unanticipated discovery of historic properties or human remains is made during construction and operations.

Vineyard Wind 1 agrees that no authorized activities will be carried out in a manner that could adversely affect sites, structures, or objects of historical, cultural, or archaeological significance, without notice to and direction from the MBUAR on how to proceed within state waters and BOEM within federal waters.

In no case may Vineyard Wind 1 knowingly impact a potential archaeological resource without the MBUAR's and MHC's or BOEM's prior approval.

2.0 TRAINING AND ORIENTATION

Vineyard Wind 1 shall designate a person to serve as their Onboard Representative on each vessel during bottom-disturbing activities in relation to this UDP. Vineyard Wind 1 shall ensure that its Onboard Representative has sufficient training and resources (including access to the Qualified Marine Archaeologist [QMA]) to identify bone and man-made materials such as artifacts, anchors, ship timbers, potsherds, projectile points. The identification of submerged cultural resources requires basic training in order to recognize potential materials. Gray & Pape will develop a training module for the Onboard Representative(s) to complete prior to bottom-disturbing activities to review Vineyard Wind 1's commitment to cultural resources compliance and provide an overview of the relevant types of resources and unanticipated discoveries that may be encountered. This training will also review the UDP and emphasize the exact communication and notification procedures to be followed in the event of an unanticipated discovery. Personnel training will be documented.

The designated Onboard Representative will be responsible for advising all Project employees and construction contractor personnel on the procedures to follow in the event an unanticipated discovery is made, and will be responsible for contacting the QMA/Project Archaeologist as indicated in the notifications procedures. Training will occur as part of the pre-construction activities for all Project personnel aboard. The procedures and notifications described below are also summarized in the attached flow chart. The Onboard Representative will advise all operators to:

1. Stop work immediately if they observe any indications of the presence of cultural materials, animal bone, or possibly human bone.
2. Contact the Onboard Representative as soon as possible
3. Comply with unanticipated discovery procedures.
4. Treat human remains with dignity and respect.

3.0 PROCEDURES WHEN CULTURAL MATERIALS ARE OBSERVED

If Vineyard Wind 1, while conducting bottom-disturbing activities in support of the project following review and clearance of the project areas by a QMA under 4.2.4 of the Lease Terms, Conditions, and Stipulations, discovers an unanticipated potential archaeological resource, such as the presence of a shipwreck (e.g., a sonar image or visual confirmation of an iron, steel, or wooden hull, wooden timbers, anchors, concentrations of historic objects, piles of ballast rock) or evidence of a pre-contact archaeological site (e.g. stone tools, pottery or other pre-contact artifacts) within the project area, Vineyard Wind 1 must:

1. Immediately halt seafloor/bottom-disturbing activities within the area of discovery in accordance with all safety procedures and emergency shut down protocols;
2. Notify the Lessor (BOEM) within 24 hours of discovery. If the discovery is made within state waters the notification must include MBUAR and MHC;
3. Notify BOEM in writing via report to BOEM within 72 hours of its discovery. If the discovery is in state waters MBUAR and MHC will be notified in writing;
4. Keep the location of the discovery confidential and take no action that may adversely affect the archaeological resource until BOEM has made an evaluation and instructs the applicant on how to proceed; and
5. Conduct any additional investigations as directed by BOEM to determine if the resource is eligible for listing in the National Register of Historic Places (30 CFR 585.802(b)). BOEM will do this if: (1) the site has been impacted by Vineyard Wind 1's project activities; or (2) impacts to the site or to the area of potential effect cannot be avoided. If investigations indicate that the resource is potentially eligible for listing in the National Register of Historic Places, BOEM will tell Vineyard Wind 1 how to protect the resource or how to mitigate adverse effects to the site. If BOEM incurs costs in protecting the resource, under Section 110(g) of the National Historic Preservation Act, BOEM may charge Vineyard Wind 1 reasonable costs for carrying out preservation responsibilities under the OCS Lands Act (30 CFR 585.802(c-d)).

Vineyard Wind 1 will take all reasonable efforts to monitor operations and inspect equipment in compliance with this UDP. Unanticipated discoveries may be made on the seabed during survey and bottom-disturbing activities where seafloor imaging is available, or on-board the vessel when equipment is returned and inspected; all on-board personnel will be made aware of the possibility of such discoveries. In compliance with the stipulations outlined above, if bone or man-made materials (e.g., artifacts, anchors, ship timbers, potsherds, projectile points) are observed during operations, seafloor/bottom-disturbing activities shall immediately cease within the area of the discovery. Vineyard Wind 1's Onboard Representative will immediately notify Vineyard Wind 1 and the Project Archaeologist to review the information, regardless of whether in state or federal waters. This notification shall include "information on the location and any discernable characteristics of the potential cultural resource (the target), and any

survey data depicting the find" (MBUAR *Policy Guidance for the Discovery of Unanticipated Underwater Archaeological Resources*). If artifacts are inadvertently recovered onboard a construction vessel (such as caught in an anchor or trapped in a plough), the Onboard Representative will be responsible for immediately arranging for the waterlogged materials to be immersed in seawater in a suitable clean container which can be covered. The material will also be photographed in the condition in which it was recovered. No photos will be taken of any human remains found during the work. However, the vessel location recorded and marked, and the artifact(s) labeled appropriately with relevant locational information.

If, based upon the available information, the Project Archaeologist determines that the site, feature, or target is not potentially cultural, the Project Archaeologist will notify Vineyard Wind 1 that work may resume, within 24-hours, if possible. The Project Archaeologist will also notify MBUAR and MHC or BOEM of this determination. The Project Archaeologist will submit a memo with the available information describing the find and the conclusion to MBUAR, MHC, and BOEM within 72 hours of discovery.

If the Project Archaeologist determines that the site, feature, or target may be cultural, the Project Archaeologist will notify Vineyard Wind 1, who will inform their Onboard Representative that work cannot resume at the given location until written notification is provided by Vineyard Wind 1. Vineyard Wind 1 will notify the BOEM, MBUAR and MHC, and Advisory Council (if applicable) within 24 hours of discovery.

Vineyard Wind 1 will provide for a visual inspection by a QMA to allow the Project Archaeologist to determine if the site is potentially eligible for listing in the National Register. Vineyard Wind will submit the results of the survey to BOEM, MHC, MBUAR and the Advisory Council (if applicable) for final review and comment.

If, after visual inspection and analysis, it is determined that the target, feature, or site does not represent a potentially significant resource, and Vineyard Wind 1 is in receipt of written concurrence from BOEM, MHC, and MBUAR, work may resume in that area.

In the event that Project Archaeologist recommends a discovery as potentially significant and determines that the resource is threatened by continued project work, Vineyard Wind 1 will avoid and protect the resource and notify and begin consultation with BOEM, MBUAR, MHC, and the Tribal Historic Preservation Officers (THPO) (THPO for the Wampanoag Tribe of Gay Head [Aquinnah], the THPO for the Mashpee Wampanoag Tribe and the Narragansett THPO). THPOs will be contacted for all archaeological finds and all finds of human remains. MHC, MBUAR, and BOEM will provide guidance on when to contact THPOs. Vineyard Wind 1 and BOEM, in consultation with the MBUAR, MHC, and THPOs, as necessary, will discuss options and develop a plan for the treatment of unanticipated significant discoveries. A significant resource can only be removed under a Memorandum of Agreement (MOA) with all interested parties including the State Archaeologist/Deputy SHPO, MBUAR Director, MBUAR permittee and/or Lessee, and, if applicable, BOEM and the Advisory Council subject to appropriate state permits.

In the event that human remains are identified, procedures will adhere to MBUAR's *Policy Guidance on the Discovery of Unanticipated Human Remains*, the procedures outlined by which are excerpted below:

If suspected human remains are located within the waters of the Commonwealth of Massachusetts, the following procedures should be followed by MBUAR permittees and/or Lessee:

1. *In the event that suspected human remains are encountered, any activity that might affect those remains shall be immediately halted.*
2. *The Project Director and the Project Archaeologist will be informed and notified of the exact location of the remains. **
3. *The Project Archaeologist and the Project Director will be responsible for **immediately** notifying the State Police Detectives at the local District Attorney's Office, the Chief Medical Examiner, the State Archaeologist, the MBUAR, and the Environmental Police (contact information provided below).*
4. *If the Chief Medical Examiner determines that the human remains are less than 100 years old, a criminal investigation may be warranted. If the remains are determined to be older than 100 years, the Chief Medical Examiner will notify the State Archaeologist at the Massachusetts Historical Commission.*
5. *The State Archaeologist, assisted by MBUAR staff, will conduct an examination to determine the age, cultural affiliation, and identity of the remains. If it is determined that the remains are those of a Native American, the State Archaeologist will notify the Commission on Indian Affairs. The State Archaeologist and MBUAR Director will consult to determine whether any prudent and feasible alternatives exist to avoid, minimize, or mitigate impacts to the site. The results of this consultation will be made available in writing.*

*If it is not possible to protect the remains in situ, they may be excavated and/or removed only under a memorandum of agreement with all interested parties including the State Archaeologist/Deputy SHPO (State Historic Preservation Officer), MBUAR Director, MBUAR permittee and/or Lessee, and, if applicable, the Commission on Indian Affairs. This memorandum will outline an adequate data recovery plan that specifies a qualified research team and an appropriate research design (including a proposal for disposition of the remains). Any excavation of said human remains **must** be conducted under a Special Permit (950 CMR 70.20) issued by the State Archaeologist. In the event the human remains are associated with other cultural resources, such as a shipwreck, the appropriate permit must also be secured from MBUAR (if not already a permittee of MBUAR).*

*NOTE: * Under state law, the finder is responsible to ensure that the proper authority is notified when suspected human remains are encountered.*

4.0 NOTIFICATION LIST

Vineyard Wind 1
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Project Archaeologist
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Gray & Pape Heritage Management
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Dukes County District Attorney's Office
Dukes County District Attorney
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Edgartown, MA 02539
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BOEM
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703-787-1085

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and

Jonathan Patton
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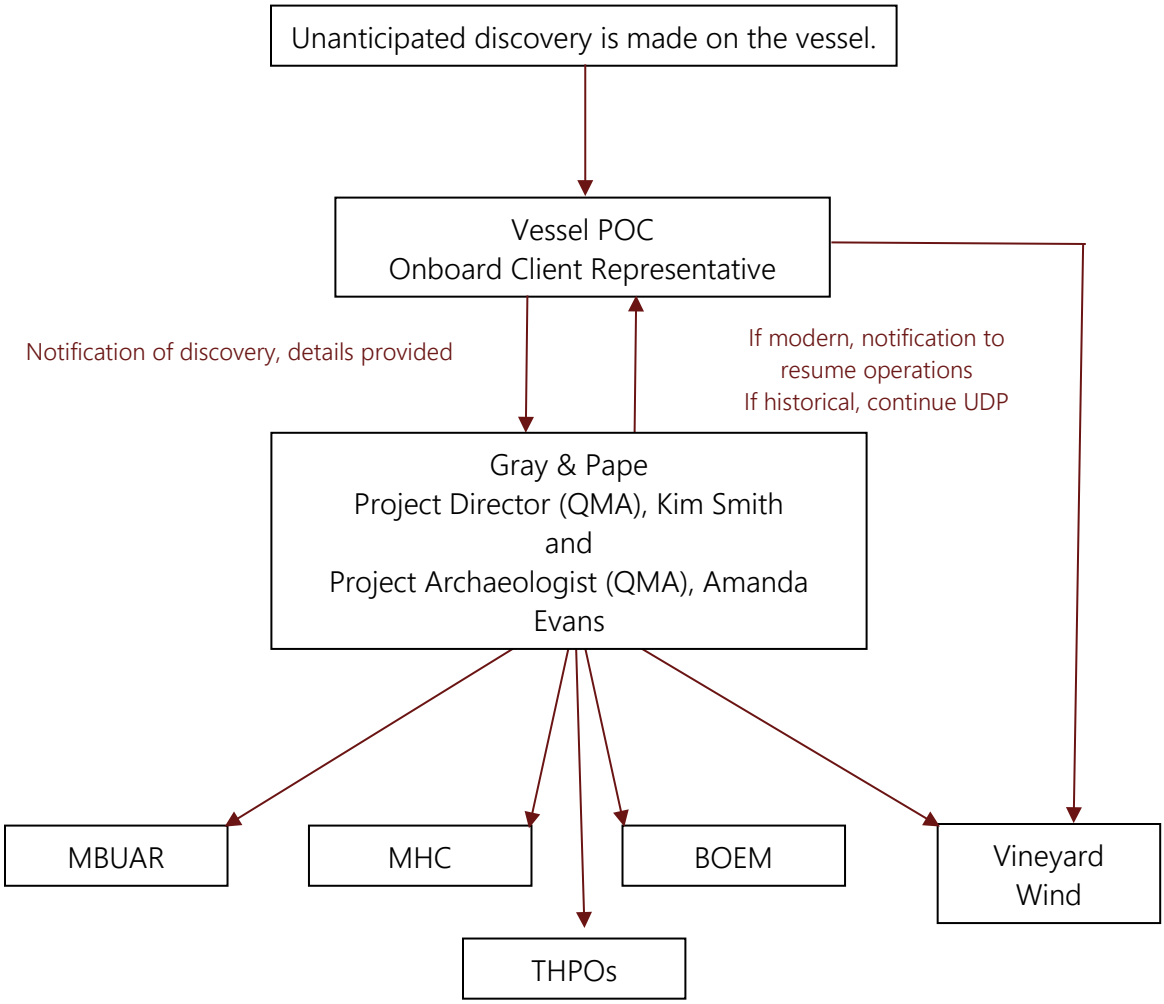
http://narragansettindiannation.org/history/historic-preservation/

5.0 COMMUNICATIONS AND NOTIFICATIONS PLAN FOR UNANTICIPATED DISCOVERIES



If the discovery is historical, the PD/PA (QMA) must notify all appropriate parties (e.g., BOEM, MBUAR, MHC) within 24 hrs as required by permit stipulations and lease terms and conditions.

The Vessel POC may notify Vineyard Wind 1 of the discovery, but the PD/PA will notify Vineyard Wind 1 as to whether the discovery is modern (and work can resume) or if further reporting and coordination of a historical resource will occur.

Additional notifications may be required (e.g., THPOs, SHPOs) but will be done by the PD/PA.

ATTACHMENT 11 – REFERENCES

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