Appendix II-N2

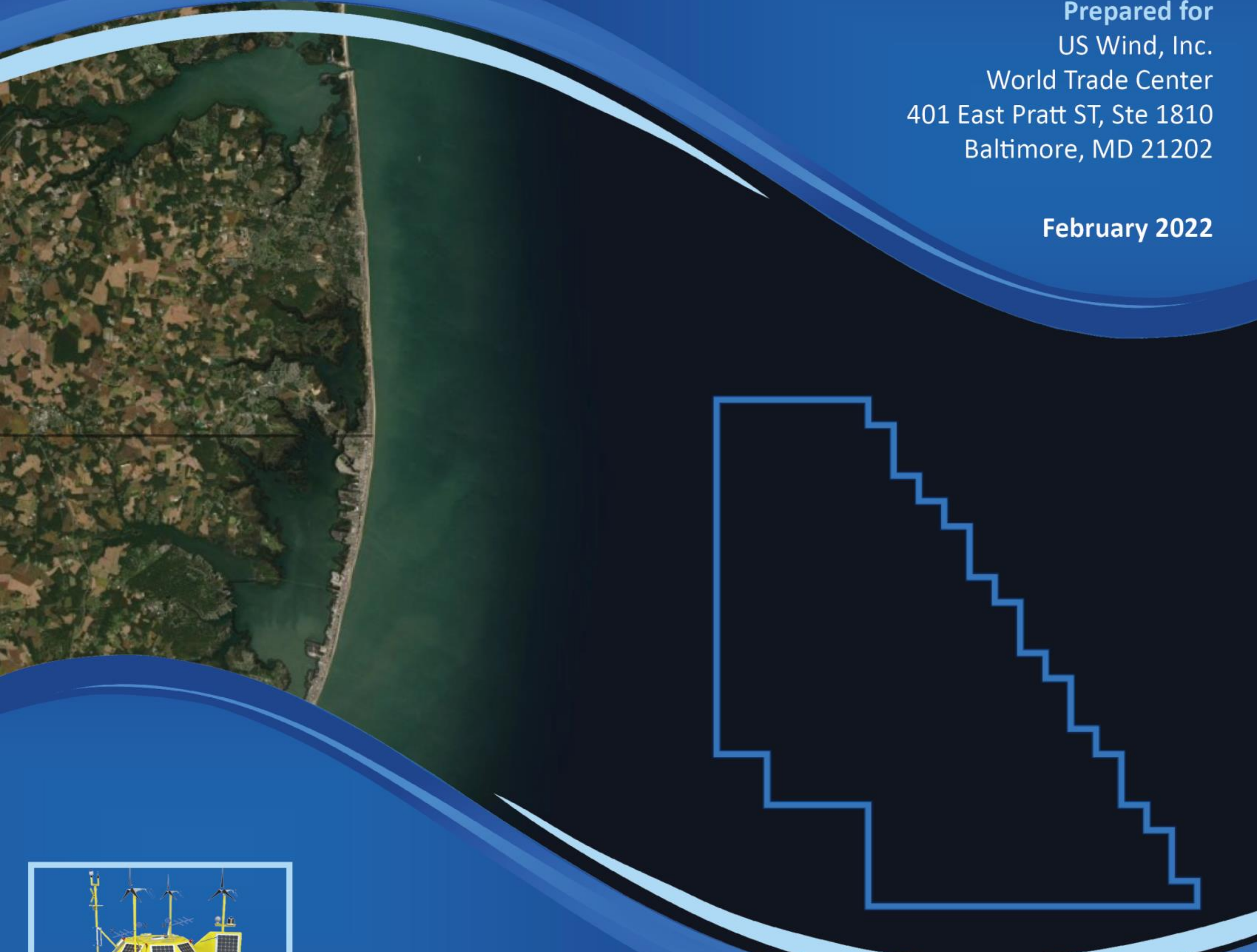
Avian Monitoring Plan

Avian Survey Plan in Support of US Wind Offshore Wind Development

Field Survey Plan

Prepared for
US Wind, Inc.
World Trade Center
401 East Pratt ST, Ste 1810
Baltimore, MD 21202

February 2022



Prepared by
Normandeau Associates, Inc.
4581 NW 6 ST, Ste H
Gainesville, FL 32609
www.Normandeau.com

Avian Survey Plan in Support of US Wind Offshore Wind Development

Field Survey Plan

Prepared for

US Wind, Inc.
World Trade Center
401 East Pratt ST, Ste 1810
Baltimore, MD 21202

Prepared by

Julia Robinson Willmott
Normandeau Associates, Inc.
4581 NW 6 ST, Ste H
Gainesville, FL 32609

February 2022

Contents

List of Figures

List of Tables

List of Abbreviations and Acronyms

APEM	APEM, Inc.
ASL	Above Sea Level
BACI	Before-After-Control-Impact designs
BOEM	Bureau of Ocean Energy Management
COP	Construction and Operations Plan
cm	Centimeter
FLiDAR	Floating Light Detection and Ranging buoy
GSD	Ground sampling distance
km	Kilometer
mph	Miles Per Hour
nmi	Nautical Mile
Normandeau	Normandeau Associates, Inc.
Project	US Wind Offshore Wind Project
QA	Quality Assurance
Site	U.S. Wind Lease Area OCS-A 0490
Survey Plan	Avian Survey Plan
Team	Normandeau Associates, Inc., and APEM, Inc.
TRBM	Trawl-Resistant Bottom Mount
TSS	Traffic Separation Scheme
USCG	US Coast Guard
USFWS	US Fish and Wildlife Service
VHF	Very High Frequency

1 Introduction

US Wind is developing an offshore wind project (Project) with up to 2 gigawatts within OCS-A 0490 (Site), an area off the coast of Maryland on the Atlantic Outer Continental Shelf. The Project would include as many as 121 wind turbine generators, up to four offshore substations, and one MET tower in the roughly 80,000-acre Lease area. OCS-A 0490 has an adjacent active Lease Area OCS-A 0519 known as Skip Jack. At its nearest point, Skip Jack is within 10.19 kilometers (km; 5.5 nautical miles [nmi]) of the Project (Figure 1-1).

OCS-A 0490 has United States Coast Guard (USCG) vessel traffic lanes running parallel with the Site's eastern boundary, finishing approximately halfway along the length of the area. USCG plans to extend the traffic separation scheme (TSS) to the full extent of the Project boundary, but the timing of this change has some uncertainty with multiple agencies involved in the plan review process. Figure 1-1 shows the current and proposed extents of the TSS.

Given the overall size of the Project, construction would likely occur in construction campaigns with a potential for the construction period to span between two and four years. The focus of the earlier campaigns would be the southern two thirds of the Site, starting in the south and developing northwards.

After completion of an avian risk assessment (Appendix II-N1 of the Construction and Operations Plan [COP]), US Wind commissioned development of an Avian Survey Plan (Survey Plan) to meet the Bureau of Ocean Energy Management (BOEM) standards under avian information requirements in 30 CFR Part 585 Subpart F.

The purpose of the Survey Plan is to:

- Provide a survey strategy that can both validate data collected in the Site between 2012 and 2014 and provide up-to-date biological information throughout the development stages of the Project
- Provide a baseline survey strategy that when implemented as part of both pre- and postconstruction monitoring has the appropriate statistical power to detect changes in distribution and densities of birds
- Collect data that would assist in reducing uncertainty surrounding the potential risks of impacts to some migrating bird species
- Inform BOEM and other regulatory agencies including the US Fish and Wildlife Service (USFWS) on bird avoidance of an offshore wind facility, providing sufficient data to quantify distance of displacement and significant changes in densities
- Provide additional information on the avoidance of vessel traffic by birds, providing sufficient data to quantify distance of displacement and significant changes in densities
- Provide additional information on the performance of bird and bat monitoring technologies, specifically detection thresholds of buoy-based detectors and receivers

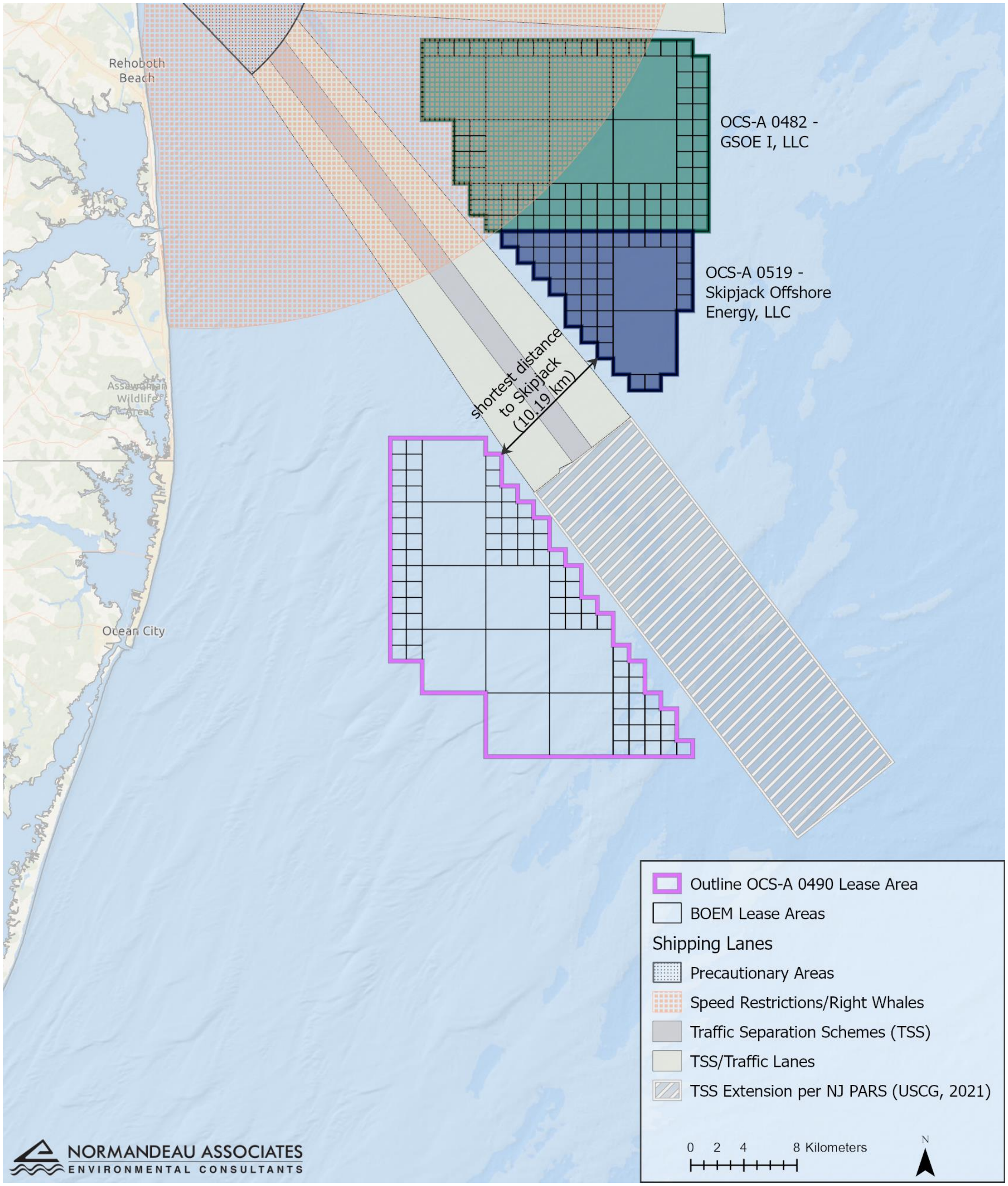


Figure 1-1. Location of OCS-A 0490, adjacent current and proposed vessel Traffic Separation Scheme, and proximity of other active lease areas

The Survey Plan addresses data gaps in the natural history of birds and bats (i.e., temporal and spatial distributions) and scientific data gaps (i.e., hypothesis-driven explanations of wind energy and wildlife interactions) in the offshore environment.

US Wind aims to assist BOEM and other regulatory agencies and stakeholders in reducing scientific uncertainty on impacts of offshore wind development by providing a hypothesis-driven Survey Plan. With this approach, hypotheses to be tested are those most relevant to the Site, derived from existing information combined with relevant unique characteristics of the Site.

1.1 Existing Data for Offshore Wind in General and the Lease Area Specifically

Between April 2012 and April 2014, the Department of Energy and Maryland state funded 16 boat-based surveys and 15 aerial digital surveys (Williams et al. 2015). The geographic scope included OCS-A 0490, and the resulting data were reviewed to ascertain baseline conditions for birds for the Site. Key findings from these studies are available in the US Wind COP and Appendix II-N1. A synthesis of bird information by survey type is shown in Table 1-1, and seasonal count data combining data from all surveys are in Table 1-2. Neither the boat-based surveys or the aerial digital surveys can collect information during the night or in poor weather conditions. For this reason, the tables do not contain information on nocturnal migrant activity.

The potential impacts to birds from offshore wind fall into two main categories: collision with the turbines and other above-water structures and displacement from the area caused by avoidance of the turbines and any associated construction and maintenance traffic.

1.1.1 Collisions

Bird collisions with offshore wind turbines appear to be rare (Pettersson 2005; Desholm 2006; Skov et al. 2018). Most European projects have used models to predict collision mortality for each offshore wind project. None of these models have been validated, so it is unclear if they accurately predict empirical collision mortality. Two built projects in the US are using technologies to monitor activity and collision rates (Block Island Wind Farm and Dominion CVOW).

1.1.2 Displacement

Published studies showing species-specific displacement from offshore wind exist, and displacement distance varies depending on the species involved (Pettersson 2005; Masden et al. 2009; Welker and Nehls 2016; Mendel et al. 2019; Peschko et al. 2020). Before-After-Control-Impact (BACI) designs are good for detecting large changes after impact, detecting permanent changes, and for monitoring changes in mean densities (Bailey et al. 2014). Some results in Europe generated using BACI study design suggest that species distributions may likely change because of either a built wind farm or vessel traffic, but that overall densities may remain the same (Vilela et al. 2021).

Some species are more sensitive to collision and/or displacement (Furness et al. 2013; Robinson Willmott et al. 2013; Dierschke et al. 2016). Dierschke et al. (2016) identified species of loons, ducks, gannets, auks, and terns as showing higher avoidance behavior, which displaces these species from the vicinity of vessel traffic and turbines. Robinson Willmott et al. (2013) also assessed the same species groups as having higher displacement risk.

Table 1-1. Densities per Season by Survey-type, Species, and Species Group
These data are based on a revision by ESS of the Williams et al. 2015 data.

Species	Counts per Square Kilometer							
	Winter (Dec-Feb)		Spring (Mar-May)		Summer (Jun-Aug)		Fall (Sep-Nov)	
	Aerial Video	Boat-based	Aerial Video	Boat-based	Aerial Video	Boat-based	Aerial Video	Boat-based
Auks (Alcidae)	**0.0199**	**0.0967**	**0.0000**	**0.0011**	**0.0000**	**0.0000**	**0.0168**	**0.0277**
Dovekie	0.0002	0.0243	0.0000	0.0000	0.0000	0.0000	0.0006	0.0093
Razorbill	0.0007	0.0627	0.0000	0.0010	0.0000	0.0000	0.0001	0.0181
Total Unidentified Alcid	0.0190	0.0097	0.0000	0.0001	0.0000	0.0000	0.0161	0.0003
Gannets (Sulidae)	**0.4324**	**0.5179**	**0.0058**	**0.1306**	**0.0002**	**0.0003**	**0.0997**	**0.4248**
Northern Gannet	0.4324	0.5179	0.0058	0.1306	0.0002	0.0003	0.0997	0.4248
Grebes (Podicipedidae)	**0.0000**	**0.0012**	**0.0000**	**0.0002**	**0.0000**	**0.0000**	**0.0001**	**0.0000**
Red-necked Grebe	0.0000	0.0012	0.0000	0.0002	0.0000	0.0000	0.0001	0.0000
Gulls and Terns (Laridae)	**0.0528**	**0.1205**	**0.0444**	**0.1528**	**0.0615**	**0.1615**	**0.1715**	**0.6714**
Bonaparte's Gull	0.0114	0.0674	0.0000	0.0211	0.0000	0.0000	0.0691	0.4747
Great Black-backed Gull	0.0020	0.0219	0.0019	0.0051	0.0016	0.0074	0.0126	0.0437
Black-legged Kittiwake	0.0000	0.0017	0.0000	0.0000	0.0000	0.0000	0.0000	0.0014
Herring Gull	0.0019	0.0245	0.0011	0.0231	0.0009	0.0008	0.0038	0.0235
Lesser Black-backed Gull	0.0002	0.0008	0.0002	0.0006	0.0002	0.0002	0.0003	0.0006
Laughing Gull	0.0001	0.0004	0.0010	0.0342	0.0055	0.0649	0.0013	0.0809
Ring-billed Gull	0.0002	0.0018	0.0000	0.0000	0.0000	0.0000	0.0001	0.0041
Black Tern	0.0000	0.0000	0.0000	0.0000	0.0025	0.0016	0.0000	0.0000
Caspian Tern	0.0000	0.0000	0.0002	0.0001	0.0005	0.0002	0.0003	0.0001
Common Tern	0.0000	0.0000	0.0000	0.0446	0.0000	0.0507	0.0000	0.0009
Royal Tern	0.0002	0.0000	0.0000	0.0109	0.0001	0.0249	0.0000	0.0012
Total Unidentified Laridae	0.0368	0.0020	0.0400	0.0131	0.0502	0.0108	0.0840	0.0403
Jaegers and Skuas (Stercorariidae)	**0.0000**	**0.0000**	**0.0006**	**0.0016**	**0.0000**	**0.0001**	**0.0001**	**0.0007**
Parasitic Jaeger	0.0000	0.0000	0.0002	0.0010	0.0000	0.0000	0.0000	0.0005
Pomarine Jaeger	0.0000	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
Unidentified Stercorariidae	0.0000	0.0000	0.0003	0.0005	0.0000	0.0001	0.0001	0.0002

Species	Counts per Square Kilometer							
	Winter (Dec-Feb)		Spring (Mar-May)		Summer (Jun-Aug)		Fall (Sep-Nov)	
	Aerial Video	Boat-based	Aerial Video	Boat-based	Aerial Video	Boat-based	Aerial Video	Boat-based
Loons (Gaviidae)	**0.2358**	**0.1043**	**0.0488**	**0.1263**	**0.0005**	**0.0007**	**0.1231**	**0.1979**
Common Loon	0.0147	0.0500	0.0196	0.0787	0.0001	0.0007	0.0120	0.1429
Red-throated Loon	0.0052	0.0501	0.0035	0.0397	0.0000	0.0000	0.0048	0.0302
Unidentified Gaviidae	0.2159	0.0042	0.0257	0.0079	0.0004	0.0000	0.1063	0.0248
Scoters, Ducks, and Geese (Anatidae)	**1.1131**	**1.0869**	**0.0111**	**0.0880**	**0.0000**	**0.0000**	**0.3900**	**0.2734**
Black Scoter	0.7066	0.1361	0.0002	0.0137	0.0000	0.0000	0.0474	0.0704
White-winged Scoter	0.0005	0.0103	0.0000	0.0011	0.0000	0.0000	0.0013	0.0078
Total Unidentified Anatidae	0.4060	0.9405	0.0109	0.0732	0.0000	0.0000	0.3413	0.1952
Shearwaters and Fulmars (Procellariidae)	**0.0006**	**0.0017**	**0.0057**	**0.0139**	**0.0004**	**0.0025**	**0.0017**	**0.0064**
Manx Shearwater	0.0000	0.0008	0.0000	0.0009	0.0000	0.0000	0.0002	0.0032
Cory's Shearwater	0.0000	0.0000	0.0006	0.0026	0.0002	0.0022	0.0004	0.0002
Greater Shearwater	0.0000	0.0000	0.0043	0.0049	0.0000	0.0000	0.0002	0.0000
Northern Fulmar	0.0005	0.0006	0.0001	0.0002	0.0000	0.0000	0.0002	0.0002
Sooty Shearwater	0.0000	0.0001	0.0002	0.0048	0.0000	0.0000	0.0000	0.0001
Unidentified Procellariidae	0.0001	0.0002	0.0005	0.0005	0.0002	0.0003	0.0007	0.0027
Storm-petrels (Hydrobatidae)	**0.0000**	**0.0000**	**0.0040**	**0.0273**	**0.0030**	**0.0335**	**0.0000**	**0.0000**
Wilson's Storm-petrel	0.0000	0.0000	0.0040	0.0273	0.0030	0.0335	0.0000	0.0000

Table 1-2. Seasonal Counts per Survey Hour by Species and Species Group
These data are based on a revision by ESS of the Williams et al. 2015 data.

Species	Seasonal Counts per Survey Hour			
	Winter	Spring	Summer	Fall
Auks (Alcidae)	**1.34**	**0.00**	**0.00**	**1.10**
Dovekie	0.20	0.00	0.00	0.22
Razorbill	0.60	0.00	0.00	0.00
Unidentified Alcid	0.54	0.00	0.00	0.88
Gannets (Sulidae)	**14.44**	**0.87**	**0.00**	**2.42**
Northern Gannet	14.44	0.87	0.00	2.42
Grebes (Podicipedidae)	**0.03**	**0.00**	**0.00**	**0.00**
Red-necked Grebe	0.03	0.00	0.00	0.00
Gulls and Terns (Laridae)	**3.52**	**5.47**	**1.47**	**4.30**
Bonaparte's Gull	0.77	0.17	0.00	1.18
Great Black-backed Gull	0.33	0.13	0.00	0.75
Black-legged Kittiwake	0.03	0.00	0.00	0.00
Herring Gull	0.49	0.59	0.00	0.30
Lesser Black-backed Gull	0.00	0.00	0.00	0.04
Laughing Gull	0.00	0.29	0.50	0.63
Ring-billed Gull	0.07	0.00	0.00	0.00
Black Tern	0.00	0.00	0.13	0.00
Caspian Tern	0.00	0.04	0.00	0.00
Common Tern	0.00	0.34	0.10	0.00
Royal Tern	0.00	0.00	0.17	0.00
Unidentified Laridae	1.83	3.91	0.57	1.40
Jaegers and Skuas (Stercorariidae)	**0.00**	**0.14**	**0.00**	**0.07**
Parasitic Jaeger	0.00	0.03	0.00	0.07
Pomarine Jaeger	0.00	0.03	0.00	0.00
Unidentified Stercorariidae	0.00	0.08	0.00	0.00
Loons (Gaviidae)	**17.02**	**4.87**	**0.04**	**3.56**
Common Loon	3.05	2.15	0.00	0.93
Red-throated Loon	1.77	0.62	0.00	0.23
Unidentified Gaviidae	12.20	2.10	0.04	2.40
Scoters, Ducks, and Geese (Anatidae)	**0.13**	**0.03**	**0.00**	**0.18**
Black Scoter	0.07	0.00	0.00	0.03
White-winged Scoter	0.03	0.00	0.00	0.00
Unidentified Anatidae	0.03	0.03	0.00	0.15

Species	Seasonal Counts per Survey Hour			
	Winter	Spring	Summer	Fall
Shearwaters and Fulmars (Procellariidae)	**0.00**	**1.59**	**0.03**	**0.11**
Manx Shearwater	0.00	0.00	0.00	0.03
Cory's Shearwater	0.00	0.22	0.03	0.00
Greater Shearwater	0.00	1.09	0.00	0.00
Northern Fulmar	0.00	0.04	0.00	0.08
Sooty Shearwater	0.00	0.04	0.00	0.00
Unidentified Procellariidae	0.00	0.20	0.00	0.00
Storm-petrels (Hydrobatidae)	**0.00**	**0.64**	**0.40**	**0.00**
Wilson's Storm-petrel	0.00	0.64	0.40	0.00

1.2 Discussion

The review of the Williams et al. (2015) data summarized in Table 1-1 and Table 1-2 shows higher densities and counts per hour in the Site for gannets, loons, and scoters than other species (

Table 1-3). These species are also identified as being sensitive to displacement.

Adjacent active Lease Area OCS-A 0519 has the potential to displace birds once constructed, and this could influence species distributions.

A USCG TSS along the eastern edge of the Project boundary probably influences some displacement-species distributions. The configuration of the TSS (Figure 1-1) is represented in historical data. However, the TSS is scheduled to be extended, which is likely to further influence distributions and densities of species (Figure 1-1). The effects of vessel lanes and TSS on species distributions and densities are unknown, but disassociate the potential impacts of offshore wind development from the impacts of vessel traffic. Understanding these interactions will also help understand future postconstruction differences when compared with historical Williams et al. (2015) baseline information on distributions and densities.

Table 1-3 Highest Density Species per Season by Survey-type

These data are based on a revision by ESS of the Williams et al. 2015 data.

Species	Counts per Square Kilometer							
	Winter (Dec-Feb)		Spring (Mar-May)		Summer (Jun-Aug)		Fall (Sep-Nov)	
	Aerial Video	Boat-based	Aerial Video	Boat-based	Aerial Video	Boat-based	Aerial Video	Boat-based
Gannets (Sulidae)	**0.4324**	**0.5179**	**0.0058**	**0.1306**	**0.0002**	**0.0003**	**0.0997**	**0.4248**
Northern Gannet	0.4324	0.5179	0.0058	0.1306	0.0002	0.0003	0.0997	0.4248
Loons (Gaviidae)	**0.2358**	**0.1043**	**0.0488**	**0.1263**	**0.0005**	**0.0007**	**0.1231**	**0.1979**
Common Loon	0.0147	0.0500	0.0196	0.0787	0.0001	0.0007	0.0120	0.1429
Red-throated Loon	0.0052	0.0501	0.0035	0.0397	0.0000	0.0000	0.0048	0.0302
Unidentified Gaviidae	0.2159	0.0042	0.0257	0.0079	0.0004	0.0000	0.1063	0.0248
Scoters, Ducks, and Geese (Anatidae)	**1.1131**	**1.0869**	**0.0111**	**0.0880**	**0.0000**	**0.0000**	**0.3900**	**0.2734**
Black Scoter	0.7066	0.1361	0.0002	0.0137	0.0000	0.0000	0.0474	0.0704
White-winged Scoter	0.0005	0.0103	0.0000	0.0011	0.0000	0.0000	0.0013	0.0078
Total Unidentified Anatidae	0.4060	0.9405	0.0109	0.0732	0.0000	0.0000	0.3413	0.1952

2 Hypotheses

Based on the information above, the following site-specific hypotheses were identified:

1. Shipping lanes near the Site will impact distributions and densities of displacement-sensitive species.
2. Siting an offshore wind facility in the Site will have displacement impacts on select species, but impacts will be a shift in distributions rather than changes in density.
3. Displacement for most species from the Site will be within 10 km of the project boundary.
4. Passage rates and densities of migrant passerines and shorebirds through the Site will be low.
5. Migrant shorebird and songbird activity at the Site will occur mostly during wind speeds less than 5 m/sec.

3 Survey Methods

Given the hypotheses proposed in Section 2, we reviewed methods for collecting the data needed. Based on this review, aerial digital surveys appear to be the best method for testing the following

1. Shipping lanes near the Site will have an impact on distributions and densities of displacement-sensitive species.

2. Siting an offshore wind facility in the Site will have displacement impacts on select species, but impacts will be a shift in distributions rather than changes in density.
3. Displacement for most species from the Site will be within 10 km of the project boundary.

Aerial digital surveys can be designed and executed to provide sufficient data with statistical power to detect change. They collect data faster than other survey methodologies, provide a snapshot in time, and minimize double counting. These surveys are conducted at an altitude high enough above sea level (ASL) to allow the same survey design to be used both pre- and postconstruction. This high altitude also minimizes observer platform attraction and repulsion effects that affect animal behavior and removes field observer biases in identification abilities, distance judgments, or swamping by large aggregations of animals. Counts are accurate, identifications can be validated, and detection of all species within the image footprint is the same. No distance sampling is required to model data, allowing more accurate densities to be estimated. The data can be revisited, and additional stored data can be analyzed should additional information be required or questions surrounding survey results arise.

Limitations with aerial digital surveys include insufficient weather variables to assess species activity under harsher weather conditions, an inability to capture species activity at night, and difficulty in finding and identifying smaller species based on camera resolution at the sea surface.

Given these limitations, sensors have been added to a floating platform described in Section 3.2 and test these hypotheses:

1. Passage rates and densities of migrant passerines and shorebirds through the Site will be low.
2. Migrant shorebird and songbird activity at the Site will occur mostly in wind speeds less than 5 m/sec.

3.1 Aerial Digital Surveys

3.1.1 Survey Design

Given the expected multi-year construction schedule and the planned USGS TSS extension predicted to occur in 2023/2024, we propose two survey designs. The first survey design (Figure 3-1) focuses on two surveys: one before TSS extension and one after TSS extension. These two surveys will also validate Williams et al. 2015 baseline for ≈66% of the Site. This survey design provides a 10-km (5.4-nmi) buffer around the first construction campaign. Figure 3-1 also shows what a 10-km buffer would look like around the entire Project (i.e., samples part of the buffer and displacement area of the neighboring active lease area OCS-A 0519 and sampling an active TSS). The figure also shows what a traditional 4-km (2.16-nmi) buffer would look like around the area of the first construction campaign, demonstrating the greater level of effort focusing survey design on understanding possible extents of displacements from the TSS extension. By using this survey design at least one year before TSS extension and focusing survey timing on species likely to be most impacted by the TSS changes (see section 3.1.6), it should be possible to tease apart impacts of vessel lanes from impacts of the Project. Conducting surveys using the same approach after TSS extension will provide insight into where these species move (up to 10 km [5.4 nmi]) and future tweaks to survey designs can be made using this *a priori* information. This survey design does not include the later construction campaign area (≈33% of the Site) but provides a buffer of over two times greater than the standard practice of 4 km (2.16 nmi). After these first two surveys, the TSS will be removed from future survey plans and the second survey design will be implemented.

The second survey design (Figure 3-2) will provide preconstruction baseline for the remaining ≈33% of the Site not captured during the first survey design and validation of the Williams et al. (2015) data for that area. The survey will also provide postconstruction monitoring for the first construction campaign and be repeated as construction campaigns are completed. The total shape of this survey design could change based on the information collected during the first two surveys if the 10-km (5.4-nmi) buffer needs to be moved to cover other buffer areas of the Project.

3.1.2 Survey Pattern

The aerial digital surveys will be collected via a grid pattern. The same proportion of area covered by a grid pattern provides greater accuracy when surveying aggregated species in comparison with the same coverage achieved by transect surveys (Elliott 1971; McGovern and Rehfisch 2015; Coppack et al. 2017). Transects will be flown collecting strips of abutting imagery and images subsampled to provide grid coverage (Figure 3-3). This survey design requires more flying time, but overall provides more evenly distributed survey effort. The survey transects will run perpendicular to the coast and be evenly spaced across the survey design (Figure 3-4). The transect lines in Figure 3-4 will be cropped depending on whether the first or the second survey design is being implemented.

3.1.3 Aerial Digital Resolution

The aerial digital surveys will be flown at 1,360 ft (415 m) ASL collecting imagery at 1.5-centimeters (cm; 0.6-inches) ground sampling distance (GSD) resolution. Although higher resolution is possible, there are no species likely to be recorded at the Site for which identification accuracy is likely to be improved and higher resolution comes with a loss of spatial coverage. Species groups containing individual species difficult to distinguish such as phalaropes, storm-petrels, and some duck species are problematic because of very similar morphological features rather than insufficient resolution in the imagery. Red knot, piping plover, and other shorebirds and songbirds will probably migrate at night and data collection on these species at any resolution is unlikely. At the recommended resolution, surveys will capture other biota visible from the sea surface such as marine mammals, turtles, sharks, large bony fishes, and fish shoals (discussed below).

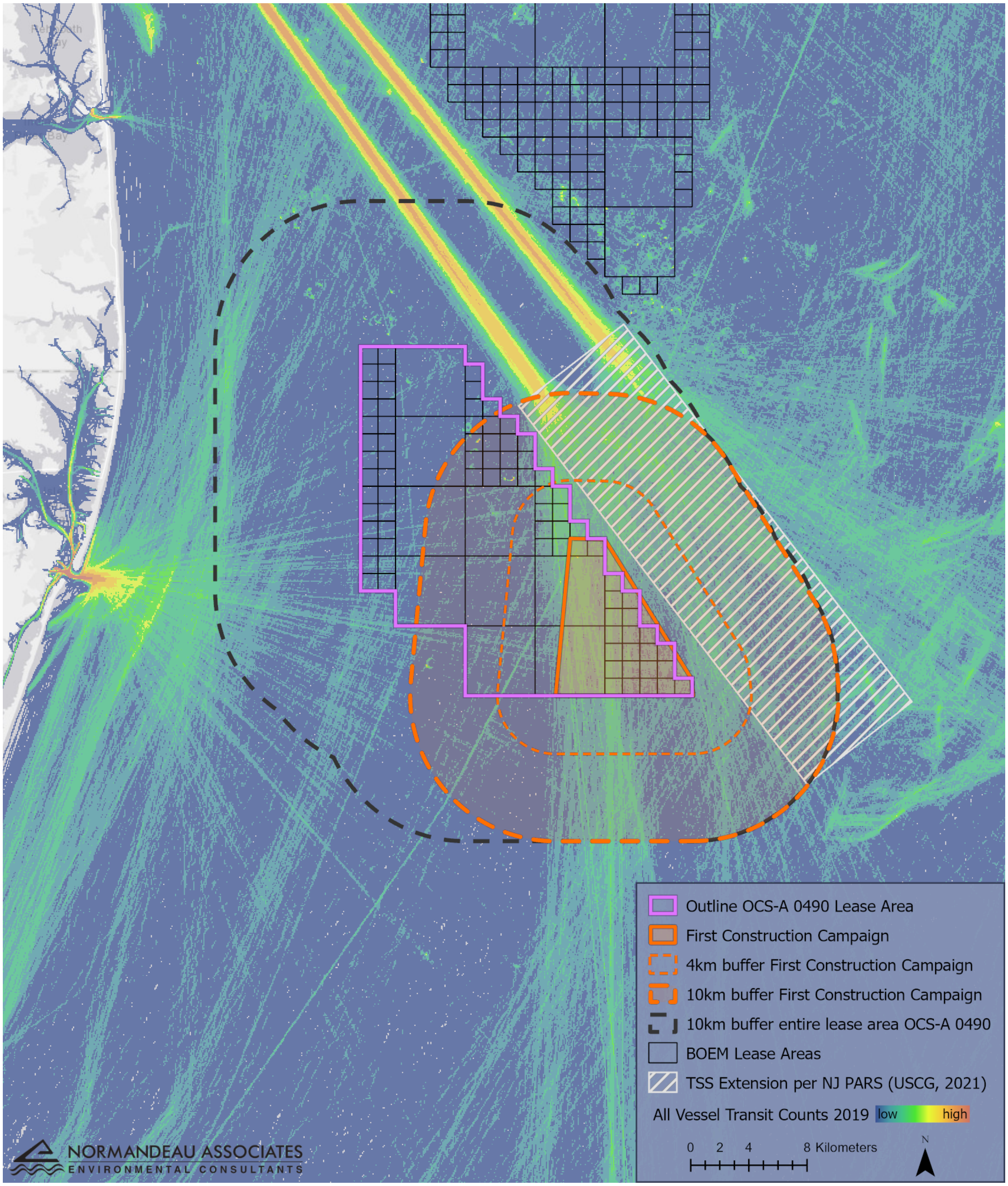


Figure 3-1. Large orange dashed outline of the spatial extent of the first survey design illustrates coverage of the TSS extension and coverage of ≈66% of the Site.

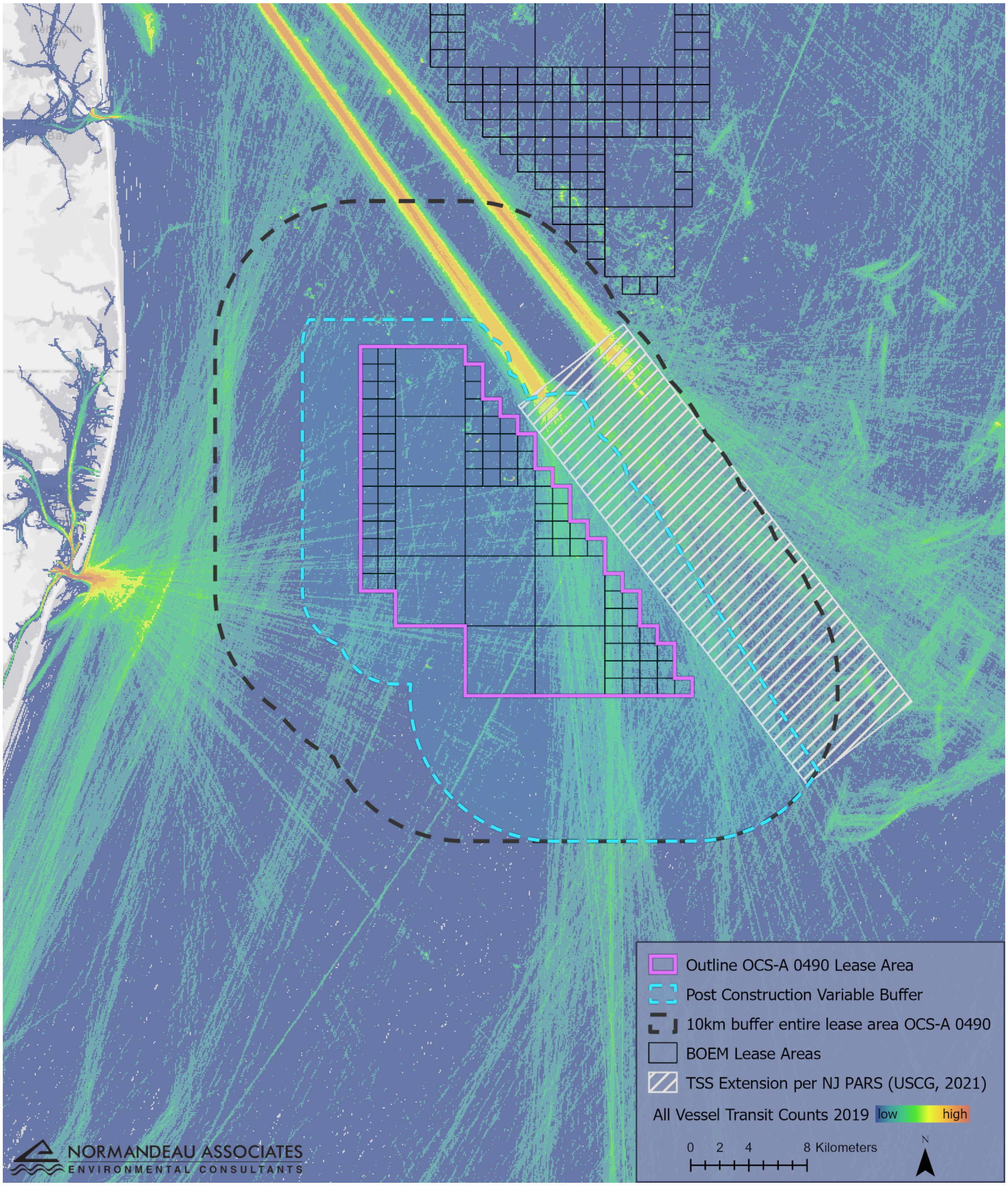


Figure 3-2. Large blue dashed outline of the spatial extent of the second survey design. Most of the TSS is removed from this and 100% of the site is covered with variable 10-km, 4-km, and 0.54-km (1-nmi) buffers.

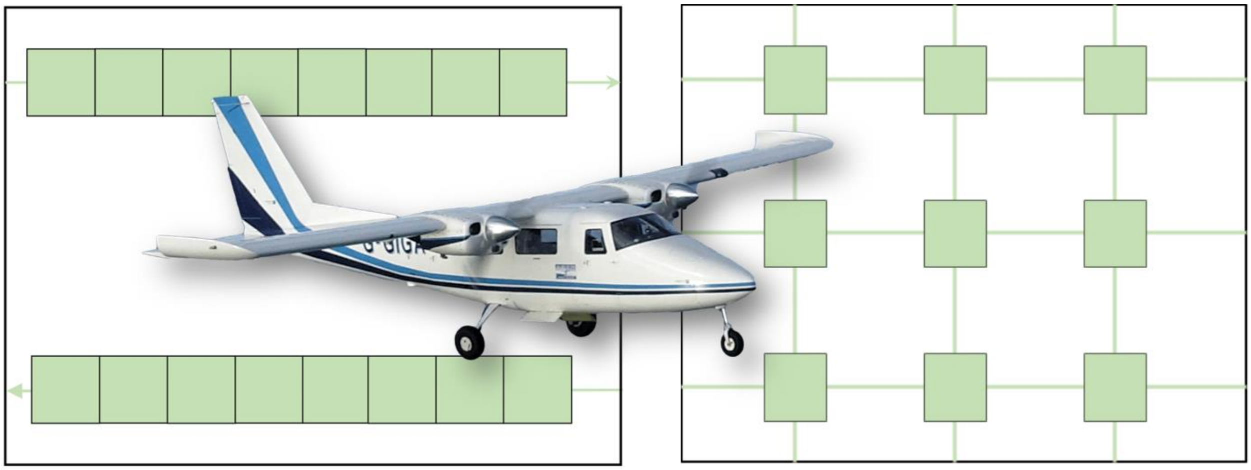


Figure 3-3. Aerial digital transect survey design on left and grid survey design on right.

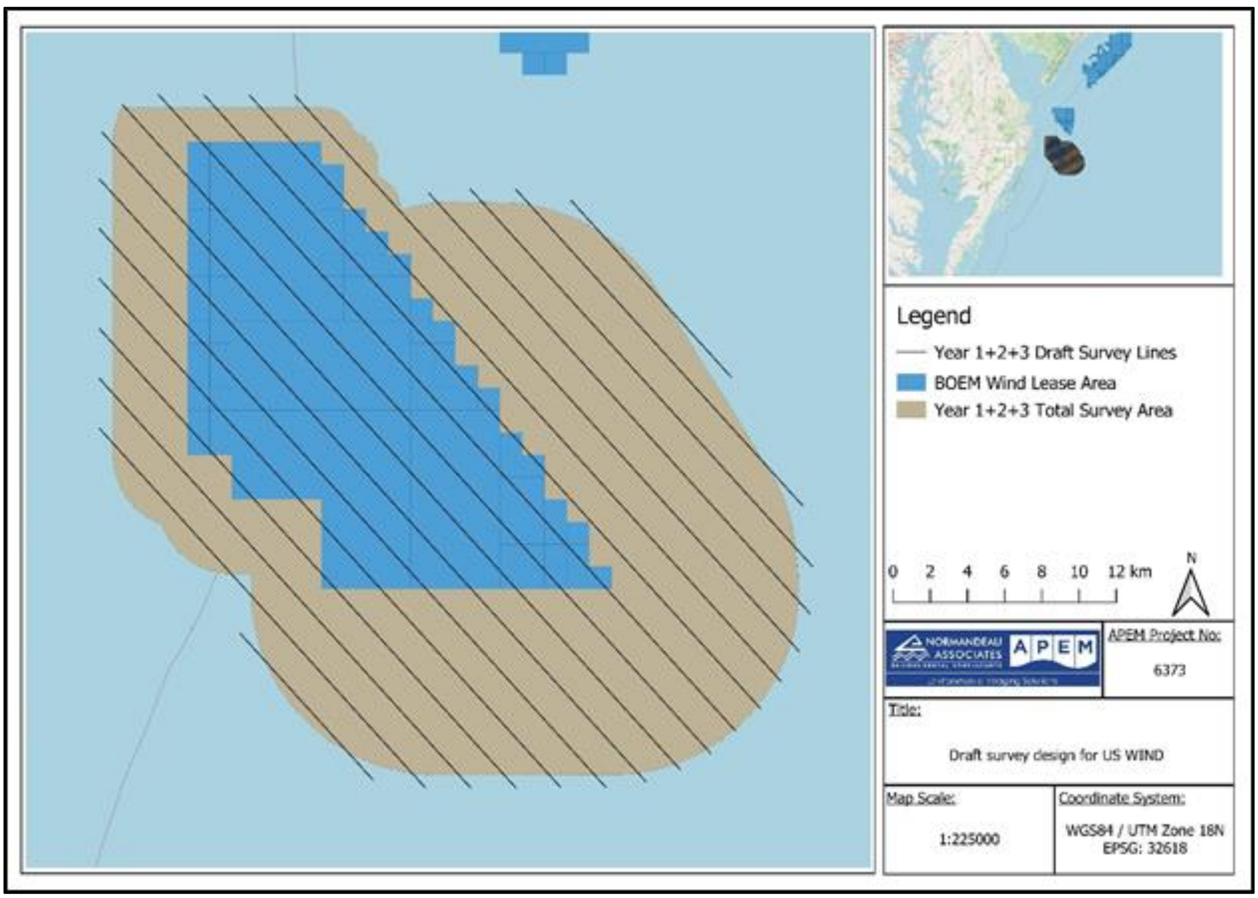


Figure 3-4. Aerial digital survey transect pattern for data collections. Survey lines will be cropped to the survey design being implemented at the time.

3.1.4 Aerial Digital Area Coverage

Using APEM, Inc.'s (APEM's) Shearwater III camera system, each image footprint will be approximately 0.043 km^2 (0.027 mi^2). At least 20% of the Lease Area including buffer will be surveyed. Images will be subsampled and analyzed to provide a grid coverage of images representing 10% of the Site. The remaining unanalyzed data (10%) will be used if questions arise or more statistical power is needed for postconstruction effects detection.

3.1.5 Aerial Digital Data Management

Each aerial survey will be managed by the camera technician. The camera technician will upload flight plans to the camera system, select which line to capture, adjust the camera exposure settings and be responsible for inflight Quality Assurance (QA) of the captured imagery.

Upon completion of each flight, all images will be securely saved and backed up on a local data processing computer. Multiple copies of the data will be created and cross-checked, providing redundancy and further QA.

3.1.6 Aerial Digital Survey Aircraft

The survey aircraft will be provided by APEM's aircraft and pilot provider. This will be a twin-engine aircraft with a floor-based survey hatch for recording imagery capable of safe, slow flight speeds of 120 knots (138 miles per hour [mph]) to provide image clarity and minimize motion blur. The aircraft will have long endurance with the payload to provide survey efficiency and will be well maintained and reliable. The aircraft and pilots will adhere to all FAA and internal guidance, and the aircraft will have all necessary safety equipment, including, but not limited to, life raft, personal location beacons, life jackets, and aviation offshore immersion suits. Aircraft will transit and be based out of local airfields near the survey area.

3.1.7 Aerial Digital Survey Conditions and Image Quality

Surveys will be conducted in weather conditions that do not limit the ability to identify marine fauna at or near the water surface following protocols identified in Camphuysen et al. (2004). These target conditions are cloud base >1,400 ft (427 m), visibility >5 km (3 mi), wind speed <30 knots (35 mph), and Douglas sea scale of >3 to maximize detectability and identifications of animals.

In addition, on days with little cloud cover, surveys will avoid the middle of the day to minimize collecting images with glint (strong reflected light off the sea) that makes finding and identifying the marine fauna recorded in the images more difficult. The onboard camera technician will continuously monitor the images collected and, if they cease to be of sufficient quality, image acquisition will cease until suitable conditions return. In addition, extra imagery will be recorded to replace potentially glint-affected images.

3.1.8 Aerial Digital Survey Schedule

The focus of the aerial digital surveys is primarily to collect sufficient data to answer questions on bird activity. Based on review of existing data, peak abundance periods were identified for bird taxa of interest (see

Table 1-3). Proposed surveys evaluate diurnally migrating, foraging, and resting birds and federally listed species for which this is an appropriate surveying technique (species active during the day).

Data collected during periods of peak abundance will enable validation of the Williams et al. (2015) baseline surveys for species within the survey area. Conversely, for rare species with low population density represented by few or no observations, neither the baseline surveys nor the surveys proposed herein are likely to adequately characterize presence, abundance, movement, or seasonality.

Aerial digital survey effort will be focused on the months when the species of interest occur. The monthly timing for these species is shown in Table 3-1 along with the number of proposed surveys in each month.

Table 3-1. Species of Interest, Timing of Peak Encounters, Months Being Surveyed, and Number of Surveys per Month

Green shading represents survey months.

Month	Frequency	Target Animals (if present)
January	1	Gannets, loons and scoters
February	1	Loons and scoters
March	1	Auks, loons, scoters
April	1	Common Tern, auks, Roseate Tern, Black Tern, Black-capped Petrel, gannets, loons, scoters
May	2	Roseate Tern, Black Tern, Common Tern, Forster's Tern, Black-capped Petrel
June	0	
July	0	
August	0	
September	1	Black Tern, Common Tern, Forster's Tern, auks, loons, scoters
October	1	Gannets, loons and scoters
November	1	Gannets, loons and scoters
December	1	Gannets, loons and scoters
TOTAL 12	**TOTAL 10**	

Aerial digital surveys also collect information on any species visible from the air including marine mammals, turtles, rays, sharks, large bony fishes, and fish shoals. Although not the primary purpose of these surveys, such information can contribute generally to the overall understanding of how such fauna use the surveyed area.

A review of Roberts et al. (2016) modeled data for the lease area and adjacent waters shows survey timings (Table 3-1) coincide with encounter months for the following marine mammal species (see Table 3-2):

1. North Atlantic right whale (*Eubalaena glacialis*)
2. Humpback whale (*Megaptera novaeangliae*)
3. Minke whale (*Balaenoptera acutorostrata*)
4. Fin whale (*Balaenoptera physalus*)
5. Bottlenose dolphin (*Tursiops truncates*)
6. Short-beaked common dolphin (*Delphinus delphis*)
7. Harbor seal (*Phoca vitulina*)
8. Harbor porpoise (*Phocoena phocoena*)

Table 3-2. Temporal Patterns of Marine Mammal Activity in the Project Area
Green shading represents survey months.

Month	Species							
	North Atlantic Right Whale	Humpback Whale	Minke Whale	Fin Whale	Bottlenose Dolphin	Short-beaked Common Dolphin	Harbor Porpoise	Harbor Seal
January	X	X	X	X		X	X	X
February	X	X	X	X		X	X	X
March	X	X	X	X	X	X	X	X
April	X	X	X	X	X			X
May (2 surveys)	X	X	X	X	X			
June		X	X	X	X			
July		X		X	X			
August		X		X	X			
September		X		X	X			
October	X	X	X	X	X			
November	X	X		X		X		
December	X	X	X	X		X	X	X

Data source: ESS and Roberts et al. (2016)

3.2 Other Data Collection Efforts Focused on Birds Using the Deployed FLiDAR Buoy

Aerial Digital Surveys do not provide information associating activity with weather variables, information or identification on smaller birds including shorebirds and songbirds, information on nocturnal activity including migratory species, or information on bats.

US Wind has equipped a Floating Light Detection and Ranging buoy (FLiDAR) and Trawl-Resistant Bottom Mount (TRBM) with additional environmental sensors. Using remote sensing will provide continuous supplemental ecological information both day and night and above and below the ocean's surface. These additional sensors are attached to the FLiDAR and the TRBM:

1. Nanotag antennas and CTT Very High Frequency (VHF) receiver
2. Bird Mic-SM4-Acoustic sensors
3. Bat Mic-SM4BAT-Acoustic sensors
4. Marine Mammal Hydrophone-Loggerhead LS1-Acoustic sensors and Chelonia F-POD
5. VEMCO fish tag receivers
6. Nortek AWAC monitoring waves and currents
7. Seabird CTD monitoring salinity, temperature, and water-level

The VHF antennas and receivers provide information from tagged birds as they fly through the region. Tagging varies by year, but for some species there are ongoing tagging efforts with which US Wind is looking into potential collaborations during the timeframe of the Project. The additional receiver and antennas on the buoy will contribute to general offshore coverage and benefit all projects undertaking tagging efforts. Detection ranges for the receiver will also be regularly tested using boat-based tests and, when possible, aircraft flyover during the aerial digital surveys. Pam Loring (USFWS) is collaborating with US Wind on this aspect of the project.

The bird acoustics provide information on any calling birds, including migratory warblers. For some songbirds, almost the entire population migrates over the Atlantic, including species such as Bicknell's thrush, Kirtland's warbler, and blackpoll warbler. Roseate terns can also be vocal and would be heard when near the FLiDAR. The bat acoustic sensors capture information on bat activity near the FLiDAR. Migrating bat species commonly occur in August and September and include eastern red bat, hoary bat, and silver-haired bat.

Marine mammal acoustics provide information on calling marine mammals. The same sensors attached to FLiDAR in a study funded by New York State Energy Research and Development Authority have identified eight species of baleen whale (see https://remote.normandeau.com/portal_buoy_data.php?pj=21).

VEMCO fish tag receivers detect tagged fishes. Tagging studies vary by year but institutional tagging studies are frequently undertaken, and the receivers deployed provide valuable data points to researchers.

Real-time wind speed and direction information, current profiles, and directional wave information plus salinity information, temperature, and water-level are all providing covariates with which to correlate activity. For birds in particular, the wind speed at which activity occurs is of major interest.

4 Data Management of Aerial Digital Survey and FLiDAR

US Wind is committed to efficient management and storage of all biological data collected during the Project and to share data easily with agencies and stakeholders. When suitable, they are also committed to making data available in public databases including OBIS-Seamap and Northwest Atlantic Seabird Catalog.

ReMOTe (https://ReMOTe.normandeau.com) acts as a data management/analysis system, providing analysis and identification tools to taxonomic experts involved in each project (aerial digital and buoy sensor analyses). ReMOTe is easy to navigate and makes sharing data and access to reports easy with collaborators and stakeholders who gain access through use of a username and password. It visualizes survey data and makes project progress easy to track.

Management of the aerial digital data will be overseen in the US with a secondary data manager in the UK. The Normandeau–APEM Team (Team) has workflows in place to ensure the rapid transportation and processing of data. Once those data have been processed and screened for potential targets, data will be accessible to the Team’s taxonomic experts for species identification and associated QA/QC of the data and processing. By the end of the project, the entire library of georectified target images and associated data and analyses (including all approved reports) will be accessible to US Wind collaborators for view and download through Normandeau’s dedicated web portal at ReMOTe.normandeau.com.

Data generated from the FLiDAR sensors are being analyzed by multiple experts, and processed data will be stored and accessible through Normandeau’s dedicated web portal at ReMOTe.normandeau.com. Reporting of the FLiDAR data will link to the environmental data also being collected from the buoy, and the system will automatically generate reports correlating all data sets. Associated reported data and reports will be available through the same web portal.

5 Summary

Surveys to validate historical baseline data, fill in data gaps surrounding some species use of the offshore environment, and detect change after the USCG TSS extension and postconstruction are summarized in Table 5-1. Table 5-1 also includes the reporting schedule and anticipated release of original data into public databases including OBIS-Seamap, Mid-Atlantic Data Portal, and Northwest Atlantic Seabird Catalog.

Table 5-1. Summary of Surveys, Timescale, Reporting and Data-sharing

Duration	Year	Reporting	Submittal to Public Databases
Aerial Digital Surveys			
Monthly over 10 months	2022–2023	Via remote.normandeau.com unanalyzed. Full detailed report with analyses within 7 months of survey completion	When fully QCd, analyzed, and publicly submitted for all stages and purposes of project
Monthly over 10 months	2023–2024 or after change to vessel traffic lane by USGC	Via remote.normandeau.com unanalyzed. Full detailed report with analyses within 7 months of survey completion	When fully QCd, analyzed, and publicly submitted for all stages and purposes of project
Design 2. Monthly over 10 months	Approximately 2–3 years post-construction campaign one and two and pre-construction subsequent construction campaigns	Via remote.normandeau.com unanalyzed. Full detailed report with analyses within 7 months of survey completion	When fully QCd, analyzed, and publicly submitted for all stages and purposes of project
Design 2. Monthly over 10 months	Approximately 2–3 years postconstruction of final campaign. Further surveys would be considered if changes were detected in previous survey	Via remote.normandeau.com unanalyzed. Full detailed report with analyses within 7 months of survey completion	When fully QCd, analyzed, and publicly submitted for all stages and purposes of project
Buoy-based (FLiDAR) Data Collection			
1. Nanotag antennas 2. Bird Mic-SM4-Acoustic 3. Bat Mic-SM4BAT-Acoustic 4. Marine Mammal Hydrophone-Loggerhead LS1-Acoustic, Chelonia F-POD 5. VEMCO fish tag receivers 6. Nortek AWAC waves, currents 7. Seabird CTD salinity, temp, water-level	May 2021-May 2023	Via remote.normandeau.com unanalyzed. Annual summary report December 2022. Full two year detailed report December 2023	When fully QCd, analyzed, and publicly submitted for all stages and purposes of project
Data Management and Storing and Data Sharing			

Duration	Year	Reporting	Submittal to Public Databases
ReMOTe.normandeau.com	Project Lifetime	Via remote.normandeau.com.	When fully QCd, analyzed, and publicly submitted for all stages and purposes of project

6 References

Bailey H, Brookes K, Thompson P. 2014. Assessing environmental impacts of offshore wind farms: lessons learned and recommendations for the future. Aquatic Biosystems 10:8.

Camphuysen KJ, Fox AD, Leopold MF, Petersen IK. 2004. Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the U.K.: a comparison of ship and aerial sampling methods for marine birds and their applicability to offshore wind farm assessments. NIOZ report to COWRIE (BAM–02-2002). Texel.

Coppack T, McGovern S, Rehfisch M, Clough S. 2017. Estimating wintering populations of waterbirds by aerial high-resolution imaging. Vogelwelt 137.

Desholm M. 2006. Wind farm related mortality among avian migrants: a remote sensing study and model analysis. University of Copenhagen.

Dierschke V, Furness RW, Garthe S. 2016. Seabirds and offshore wind farms in European waters: Avoidance and attraction. Biological Conservation Volume 202: 59-68. https://www.sciencedirect.com/science/article/abs/pii/S0006320716303196

Elliott JM. 1971. Some methods for the statistical analysis of samples of benthic invertebrates. Freshwater Biological Association Vol. 25. Cumbria (UK).

Furness RW, Wade HM, Masden E. 2013. Assessing vulnerability of marine bird populations to offshore wind farms. Journal of Environmental Management 119:56–66.

Masden EA, Haydon DT, Fox AD, Furness RW, Bullman R, Desholm M. 2009. Barriers to movement: impacts of wind farms on migrating birds. ICES Journal of Marine Science 66.

McGovern S, Rehfisch M. 2015. Comparison between transect and grid survey methods on the confidence intervals and precision of the population estimate. UK: APEM.

Mendel B, Schwemmer P, Peschko V, Muller S, Schwemmer H, Mercker M, Garthe S. 2019. Operational offshore wind farms and associated ship traffic cause profound changes in distribution patterns of loons (*Gavia* spp.). J. of Environmental Management 231:429–438.

Peschko V, Mendel B, Müller S, Markones N, Mercker M, Garthe S. 2020. Effects of offshore windfarms on seabird abundance: Strong effects in spring and in the breeding season. Marine Environmental Research Volume 162. https://www.sciencedirect.com/science/article/pii/S0141113620304402

Pettersson J. 2005. Waterfowl and offshore wind farms: a study in southern Kalmar Sound, Sweden, spring and autumn migrations 1999–2003. Lund (Sweden): Swedish Energy Agency, Lund University.

Roberts J, Best B, Mannocci L, Fujioka E, Halpin PN, Palka DL, Garrison LP, Mullin KD, Cole TVN, Khan CB, McLellan WA, Pabst DA, Lockhart G. 2016. Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico. Sci Rep 6, 22615. https://doi.org/10.1038/srep22615

Robinson Willmott J, Forcey G, Kent A. 2013. The relative vulnerability of migratory bird species to offshore wind energy projects on the Atlantic Outer Continental Shelf: An assessment method and database. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2013-207. pp. 275. Available from www.data.boem.gov/PI/PDFImages/ESPIS/5/5319.pdf

Skov H, Heinänen S, Norman T, Ward RM, Méndez-Roldán S, Ellis I. 2018. ORJIP bird collision and avoidance study: final report April 2018. London (UK): The Carbon Trust.

Vilela R, Burger C, Diedrichs A, Bachl FE, Szostek L, Freund A, Braasch A, Bellebaum J, Beckers B, Piper W, Nehls G. 2021. Use of an INLA latent Gaussian modeling approach to assess bird population changes due to the development of offshore wind farms. Frontiers in Marine Science July 2021.

Welcker J, Nehls G. 2016. Displacement of seabirds by an offshore wind farm in the North Sea. Mar. Ecol. Prog. Ser. 554:173–182. https://doi.org/10.3354/meps11812.

Williams KA, Connelly EE, Johnson SM, Stenhouse IJ, editors. 2015. Wildlife densities and habitat use across temporal and spatial scales on the mid-Atlantic outer continental shelf. Final report to the Department of Energy EERE Wind & Water Power Technologies Office. Award Number: DE-EE0005362. Report BRI 2015-11. Portland (ME): Biodiversity Research Institute. 715 pp.