Appendix L-1 – Annual Avian Survey Report

ANNUAL AVIAN SURVEY REPORT
APRIL 2013 – APRIL 2014

Virginia Offshore Wind Technology Advancement Project

(VOWTAP)

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Submitted June 2014

Revised October 2014

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ACRONYMS AND ABBREVIATIONS

Acronym	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
AIC	Akaike Information Criterion
amsl	above mean sea level
BCC	birds of conservation concern
BGEPA	Bald and Golden Eagle Protection Act
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
Dominion	Dominion Resources
EBS	Ecological Baseline Survey
ESA	Endangered Species Act
ft	feet
GAP	General Activities Plan
GPS	Global Positioning System
IDW	inverse distance-weighted average
km	kilometer
km/hr	kilometer/hour
km^2	square kilometer
kV	kilovolt
m	meter(s)
MBTA	Migratory Bird Treaty Act
mi^2	square mile(s)
MW	megawatt
NEPA	National Environmental Policy Act
NHP	Natural Heritage Program
NJDEP	New Jersey Department of Environmental Protection
NREL	National Renewable Energy Laboratory
OCS	Outer Continental Shelf
Project	Virginia Offshore Wind Technology Advancement Project
RSZ	rotor swept zone
SGCN	species of greatest conservation need
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VDGIF	Virginia Department of Game and Inland Fisheries
VOWTAP	Virginia Offshore Wind Technology Advancement Project
WEA	wind energy area
WTG	wind turbine generator

1 INTRODUCTION

Tetra Tech, Inc. (Tetra Tech) was contracted by Dominion Resources, Inc. (Dominion) to perform one year of avian surveys in support of the Virginia Offshore Wind Technology Advancement Project (VOWTAP or Project), a 12-megawatt (MW), two-turbine offshore wind demonstration project located approximately 24 nautical miles (nm) (27 statute miles [mi], 43 kilometers [km]) offshore of Virginia Beach, Virginia, adjacent to the Bureau of Ocean Energy Management (BOEM) designated commercial Wind Energy Area (WEA), referred to as the Research Lease Area. The Project will also consist of submarine cable interconnecting the wind turbine generators (WTGs) (Inter-Array Cable) and a submarine transmission cable (Export Cable) that will convey the energy produced by the WTGs to shore. The onshore components of VOWTAP are located entirely within the Camp Pendleton State Military Reserve (Camp Pendleton) in Virginia Beach, Virginia, and will comprise the following facilities:

- Switch Cabinet that will serve as the transition point where the Export Cable will be spliced with the Onshore Interconnection Cable and separate Fiber Optic Cable;
- Underground Onshore Interconnection Cable;
- Underground Fiber Optic Cable; and
- Interconnection Station.

The onshore and offshore components of VOWTAP are collectively referred to as the Project Area.

Tetra Tech has completed avian surveys in support of VOWTAP for the 12-month period extending from April 2013 to April 2014. The VOWTAP Wildlife Assessment Plan was developed to provide the VOWTAP team with the necessary data to address considerations under the Migratory Bird Treaty Act (MBTA), Endangered Species Act (ESA), Bald and Golden Eagle Protection Act (BGEPA), National Environmental Policy Act (NEPA), and state environmental regulations. The assessment approach and methods were also designed to meet BOEM's data requirements for site characterization studies to evaluate the potential impact of VOWTAP, and included surveys within the proposed Research Lease Area and a 1-nm (1.2-mi, 1.9-km) buffer around the proposed Research Lease Area (herein referred to as the Offshore Survey Area) (BOEM 2013). This report serves as a supplement to the interim VOWTAP avian report dated December 2013.

Specific objectives of the avian studies were as follows:

1) Determine the species composition of the bird community in the Offshore Survey Area
2) Gather information on the behavior of birds (e.g. foraging, sitting on the water, and following vessels).
3) Estimate the flight height of birds using the Offshore Survey Area
4) Estimate the relative abundance of the birds in the Offshore Survey Area
5) Identify the spatial and temporal distribution patterns of birds in the Offshore Survey Area
6) Assess the use of the Offshore Survey Area by rare, threatened, and endangered avian species

7) Determine if any sensitive species occur at the preferred Export Cable landfall site and along the preferred Onshore Interconnection Cable and Fiber Optic Cable corridor
8) Collect baseline information that may be useful to quantify any changes in the spatial distribution and abundance of birds following construction of the turbines

The purpose of the survey and analysis was not to estimate population size but to assess differential patterns of spatial-temporal occurrence, relative density, and flight behavior across the Offshore Survey Area. The avian survey methods were scaled to match the anticipated impacts of the proposed offshore wind project. The results of the pre-construction VOWTAP avian surveys provide adequate baseline data to characterize and assess the potential impacts of the proposed Project.

The VOWTAP avian surveys were further developed to meet the objectives identified in BOEM's avian survey guidelines (BOEM 2013). In 2013, BOEM issued guidelines for providing avian survey information (Guidelines) for renewable energy development projects on the Atlantic Outer Continental Shelf (OCS) (BOEM 2013). BOEM considers pre-construction avian surveys a component of site characterization (similar to the required geophysical surveys and others), with the purpose of evaluating the impact of the proposed development on biological resources (30 Code of Federal Regulations [CFR] Part 585 Subpart F). The Guidelines are intended to provide developers with a framework for baseline avian surveys at proposed federal offshore lease areas. The Guidelines are also intended to standardize data collection, analysis, and reporting for submittal with Research Activity Plans (RAPs) or Construction and Operations Plans.

The results of interim pre-construction surveys conducted from April to October 2013 were useful in developing a baseline of species composition, relative abundance, population density, migration phenology, and distribution patterns. Existing wildlife data from the nearby WEA was incorporated into reporting and risk analyses in this final comprehensive report.

Baseline pre-construction surveys conducted during the 2013 interim 6-month survey period included:

- Diurnal ship-based visual survey transects (once per month, seven total)
- Onshore point counts (once per month in April, August, September, and October 2013; four total). Two additional onshore point counts were conducted in March 2014 (six total).

The avian survey implemented during the baseline 2013 6-month survey period was consistent with surveys at other proposed offshore wind projects in the United States and Europe (Kahlert et al. 2000, Innogy 2003, Camphuysen et al. 2004, CEFAS 2004, BOWind 2005, Chamberlain et al. 2006, Hüppop et al. 2006, Petersen et al. 2006, Winiarski et al. 2009, NJDEP 2010, Winiarski et al. 2011, Tetra Tech 2012). Additionally, these survey techniques are complimentary to the ongoing Mid-Atlantic Baseline Study and general purpose pelagic bird sampling efforts (Boyce et al. 2010, Williams 2013).

An interim report issued in December 2013 presented the results of the first 6 months of data collection within the following discrete survey areas within the greater Project Area the Offshore Survey Area, (which included the proposed Research Lease Area, adjacent research blocks, and a 1-nm (1.2-mi, 1.9-km) buffer), the Transit Survey Area (which included the preferred Export Cable route from the Offshore Survey Area to the shore) and the Onshore Survey Area (which included areas on Camp

Pendleton in the vicinity of the Switch Cabinet, Underground Onshore Interconnection Cable, the Underground Fiber Optic Cable; and the Interconnection Station).

The first quarterly survey update was provided to BOEM, USFWS, and VDGIF on July 30, 2013. Updates were also provided separately to USFWS, BOEM, and VDGIF in late October 2013 and early December 2013. An interim report was provided in December 2013 as part of the RAP submission. The December submittal served as the second quarterly report and as an interim annual report. The third quarterly update was provided to each of the three agencies following the January 2014 ship-based survey. This comprehensive annual report will be provided to BOEM, USFWS, and VDGIF.

The following terms are used to describe discrete areas included in the VOWTAP avian surveys in 2013 and 2014:

- Offshore Survey Area – transects within 1-nm (1.2-mi, 1.9-km) buffer around proposed Research Lease Area
- Transit Survey Area – area surveyed during transit between Rudee Inlet and VOWTAP Offshore Survey Area
- Onshore Survey Area – area surveyed at the proposed location of the onshore components of the VOWTAP at Camp Pendleton

1.1 Regulatory Framework

Impacts to birds are regulated under several federal laws including the MBTA, ESA, BGEPA, and NEPA. Some species may also have additional protection under state law.

The MBTA of 1918 (16 United States Code [U.S.C.] 703−712; Ch. 128; July 13, 1918; 40 Stat. 755) was enacted as a prohibition on the killing of migratory birds. Migratory bird species listed under this act occur throughout the general Project vicinity, and indeed are ubiquitous worldwide. The MBTA does not have provisions for compliance measures to address potential incidental impacts to migratory birds. The USFWS has encouraged wind developers to evaluate existing avian resources within a proposed lease area and take reasonable measures to avoid avian mortality.

The ESA of 1973 (16 U.S.C. 1531–1544, 87 Stat. 884) prohibits the unauthorized take, possession, sale, and transport of endangered species. Section 3 of the ESA defines “take” as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to engage in any such conduct” (16 U.S.C. § 1532 [19]). Harm, in this case, means an act that actually kills or injures a federally listed wildlife species and “may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering” (50 CFR §17.3). To harass means to perform “an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include but are not limited to, breeding, feeding or sheltering” (50 CFR §17.3).

The VOWTAP avian surveys were designed to provide adequate data and analysis, and to support ESA review of the Project. The threatened and endangered avian species that are known to occur in the Mid-Atlantic Region, in the general vicinity of the Project, include the federally endangered roseate tern

(*Sterna dougallii*), federally threatened piping plover (*Charadrius melodus*), as well as red knot (*Calidris canutus*), a species proposed for federal listing as endangered (40 [176] Federal Register 53756, October 2, 2013). There is also some potential for the federally endangered Bermuda petrel (*Pterodroma cahow*) to occur in the Mid-Atlantic Region as a transient during the non-breeding season. Under the ESA, federal agencies authorizing or permitting a development project with the potential to affect listed species must coordinate with the USFWS during the permitting process. It is expected that the proposed Project will not adversely affect roseate tern, piping plover, Bermuda petrel or red knot, and therefore formal consultations with USFWS may not be required (Burger et al. 2011). If USFWS deems that the Project has the potential to adversely affect ESA-listed species, formal consultation with the USFWS may be necessary.

The BGEPA makes it unlawful to take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald or golden eagle, alive or dead, or any part, nest, or egg thereof without a permit. BGEPA defines "take" as "to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, disturb individuals, their nests and eggs" (16 U.S.C. 668c). "Disturb" is defined by regulation at 50 CFR 22.3 in 2007 as "to agitate or bother a bald or golden eagle to a degree that causes…injury to an eagle, a decrease in productivity, or nest abandonment." The Project is not expected to have any effect on bald or golden eagles because the Research Lease Area is more than 20 miles from shore and onshore Project components have been designed to avoid impacts to breeding sites.

NEPA requires that federal agencies evaluate environmental consequences of major federal actions. Major federal actions include issuance of federal permits that have the potential to affect the natural and human environments. Impacts to biological resources, including avian and bat species, must therefore be identified and evaluated as part of this environmental review process. The VOWTAP avian surveys were designed to provide adequate data and analysis to support the biological resources components of the NEPA review for BOEM and other federal and state agencies.

1.2 Agency Coordination

Prior to initiating surveys in the proposed Project Area, Dominion consulted with state and federal natural resource and wildlife agencies to determine the appropriate methods and level of effort. The avian survey methods, in the form of a Wildlife Assessment Plan, were reviewed by BOEM, USFWS, and the VDGIF in April 2013. The draft Wildlife Assessment Plan for the proposed VOWTAP was provided to BOEM, USFWS, and VDGIF for review on April 8, 2013. Comments were received from BOEM on April 11, 2013, from USFWS on April 12, 2013, and from VDGIF on April 12, 2013. A final draft of the Wildlife Assessment Plan was submitted to the agencies on April 23, 2013.

The first quarterly survey update was provided to BOEM, USFWS, and VDGIF on July 30, 2013. Updates were also provided separately to USFWS, BOEM, and VDGIF in late October and early December, prior to submitting this report. An interim report, produced in December 2013, served as the second quarterly report, and as an interim annual report. The third quarterly report was provided to each of the three agencies following the January 2014 ship-based survey. This final annual report will be provided to BOEM, USFWS, and VDGIF.

1.3 Environmental Impact of Avian Assessment Surveys

Prior to conducting the ship-based avian surveys and supplemental onshore survey, Dominion evaluated the potential environmental effects of collecting baseline avian data aboard a vessel on the OCS. It was determined that potential effects from collecting baseline survey data in the proposed Research Lease Area would be limited to impact producing factors associated with operations of the survey vessel. No wildlife were handled, captured, or restrained during wildlife assessment surveys for VOWTAP. BOEM evaluated the potential environmental effects of site assessment activities at proposed offshore wind projects on the OCS (BOEM 2012). USFWS concurred with the Environmental Assessment findings that site characterization surveys were unlikely to have a significant impact on birds or bats on the OCS.

1.4 Description of Wildlife Resources in the Proposed Research Lease Area

The proposed Research Lease Area consists of open ocean marine habitat with no islands or sand bars. The Research Lease Area has the potential to provide year-round habitat for seabirds and waterfowl, as well as for terrestrial birds during migration. Some Project components will be installed onshore and have the potential to affect migratory and non-migratory terrestrial species. However, the Onshore Interconnection Cable and Fiber Optic Cable for VOWTAP will be installed below ground from the landfall site to the proposed Interconnection Station and then to its final terminus with Dominion's existing infrastructure.

In general, avian abundance and species diversity decrease with distance from land (Petersen et al. 2006, NJDEP 2010). Offshore waters within the potential Research Lease Area likely provide habitat for sea ducks, gulls, terns, loons, grebes, storm-petrels, shearwaters, northern gannets, and alcids. The assemblage of birds in the offshore waters is dynamic, with seasonal changes in the composition of summer and winter populations. Migratory corridors may exist along the coast and over the open ocean.

The Research Lease Area is adjacent to the Atlantic coastal migratory flyway and within the Atlantic oceanic migratory flyway. The Atlantic oceanic migratory flyway is a loosely defined corridor generally encompassing most of the OCS waters of the eastern seaboard including the proposed Research Lease Area. Migrants using the Atlantic oceanic flyway may include songbirds, shorebirds, some terns, and other species moving between eastern North America (Arctic Canada, Atlantic Canada, and the northeastern U.S.) and the Caribbean, Central America, and South America. Species traveling the Atlantic oceanic flyway may occur within the proposed Research Lease Area.

The offshore waters and adjacent coastal areas of Virginia provide habitat for avian species with special state and federal conservation status. Some avian species, such as the peregrine falcon (*Falco peregrinus*), shorebirds, and passerines occur primarily in terrestrial habitat on the mainland and on barrier islands, but may also occur in the proposed Research Lease Area during migration. Federally listed and state listed avifauna may occur during migration and non-breeding periods in the proposed Research Lease Area or near proposed onshore project components (Table 1-1). The federally endangered roseate tern and federally threatened piping plover have the greatest potential to occur in the Research Lease Area and along the adjacent Virginia coastline during seasonal migration, although the frequency and distribution of their occurrence on the OCS is not well documented. A third federally listed species, Bermuda petrel, may occur in the Research Lease Area during the non-breeding period as a transient. Red knot, a species

proposed for ESA listing, may migrate through or near the proposed Research Lease Area (Harrington 2001, O'Connell et al. 2011).

Table 1-1. Federal and State Listed Avian Species That May Occur In or Near the Proposed Research Lease Area

Common Name	Scientific Name	Federal Status[1/]	State Status[1/]	Likelihood of Occurrence
Red knot	*Calidris canutus* ssp. *rufa*	PT	-	Low (May occur during the non-breeding period on the Virginia OCS, or on the Virginia coast)
Piping plover	*Charadrius melodus*	LT	LT	Moderate (May occur during the non-breeding period on the Virginia OCS, and is known to occur in Virginia beach)
Wilson's plover	*Charadrius wilsoni*	-	LE	Moderate
Bald eagle	*Haliaaetus leucocephalus*		LE	Present (Observed during May 2013 onshore point count surveys).
Peregrine falcon	*Falco peregrinus*	-	LT	Present
Caspian tern	*Sterna caspia*	-	SC	Present
Brown pelican	*Pelecanus occidentalis*	Delisted due to recovery	SC	Present
Bermuda petrel	*Pterodroma cahow*	LE	-	Low (May occur during non-breeding period on the Virginia OCS)
Roseate tern	*Sterna dougallii dougallii*	LE	LE	Low (May occur during migration on the Virginia OCS)
Least tern	*Sternula antillarum*	-	SC	Present
Gull-billed tern	*Sterna nilotica*	-	LT	Moderate
Sandwich tern	*Sterna sandvicensis*	-	SC	Present

[1/] Species Status: LE – Listed as an endangered species; LT – Listed as a threatened species; FP – Federally Protected under the Bald and Golden Eagle Protection Act, PT – Proposed for listing as threatened species; PE – Proposed for listing as endangered; SC – Species of Concern.

The potential for occurrence in the Project Area was evaluated as follows:

Unlikely – no species range overlap with Project area or unsuitable habitat in Project vicinity
Low – species range overlaps with Project area and marginally suitable habitat in Project vicinity
Moderate – species range overlaps with Project area and suitable habitat present in Project area
High – highly suitable habitat present in Project area, or known populations exist in Project vicinity
Present –- species observed during field survey

Roseate terns currently do not breed south of Long Island, New York, but they have historically nested in coastal Virginia and may occur offshore during spring and fall migration (VDGIF 2005; Burger et al. 2011; USFWS 2013). The piping plover is state and federally listed as threatened (USFWS 2012). The species is generally restricted to shorelines and is not known to make frequent flights over open water, except for possibly during migration (Burger et al 2011). Approximately 192 pairs of piping plover nested in Virginia in 2010 (Boettcher 2012; USFWS 2012).

Bald eagles (*Haliaeetus leucocephalus*), protected under the BGEPA, are known to nest in coastal Virginia. A total of 14 bald eagle nests occurred in the Virginia Beach area in 2011 (CCB 2013). However, bald eagles and other raptor species that rely on soaring flight supported by thermal updrafts are unlikely to occur in the Research Lease Area. Other species of concern may occur along coastal portions of Virginia as well as within the offshore Research Lease Area including red-throated loon (*Gavia stellata*), which may be common within the Research Lease Area, and the least tern (*Sterna*

antillarum), which also may occur in the Research Lease Area; both are birds of conservation concern (BCC) for USFWS (USFWS 2008) (Table 1-2).

There is a paucity of avian data for the Virginia OCS, though recent efforts by BOEM and the U.S. Department of Energy (DOE) have helped to increase knowledge about bird activity on the Mid-Atlantic OCS (O'Connell et al. 2009, O'Connell et al. 2011, Williams et al. 2013). Species lists for coastal Virginia and the OCS have been developed by the U.S. Navy and others; however, there is little information on the spatial-temporal distribution of birds in the proposed Research Lease Area. The Mid-Atlantic Ecological Baseline Studies and Modeling Program, funded in part by the DOE, is the first systematic effort to collect baseline information on bird occurrence and distribution on the mid-Atlantic OCS. The Program's goal is to develop baseline data on wildlife abundance, distribution, and diversity within the Mid-Atlantic WEAs. The preliminary results of this ongoing survey are particularly relevant to the evaluation of the VOWTAP because portions of the Mid-Atlantic Baseline Survey area intersect both the Virginia WEA and the proposed Research Lease Area. The DOE-funded survey area includes portions of the OCS from off the coast of Cape May, New Jersey south to the OCS east of the Virginia – North Carolina line (Williams 2013). Interim results of the 2012 Mid-Atlantic Baseline Study surveys, including ship-based and aerial surveys, have been incorporated into the avian risk analyses in the VOWTAP Research Activities Plan (RAP) document. Survey methods used for the ship-based survey component of the Mid-Atlantic Baseline Study were similar to those used in the VOWTAP site-specific surveys (Williams 2013). Conversations with the Mid-Atlantic Baseline Study's avian survey contractor (Biodiversity Research Institute) as well as with BOEM, DOE, USFWS, and VDGIF were held prior to initiating surveys for VOWTAP, to assure that data collection methods for the two avian survey efforts were generally similar and would be comparable. Final results of the ongoing Mid-Atlantic Baseline Study were not available at the time this report was prepared.

1.4.1 Other Sources of Regional Data

USGS Avian Compendium. Two reports from BOEM and the U.S. Geological Survey (USGS) are based on data from the USGS Avian Compendium. These reports evaluate bird occurrence information for shorebirds (O'Connell et al. 2011) and seabirds (O'Connell et al. 2009) in the continental shelf waters along the Atlantic Coast. Both compendium reports represent the most comprehensive modeling efforts for bird activity on the OCS. The reports are based on existing datasets, many of them historical, of the distribution and abundance of birds on the western Atlantic OCS, from Maine to Florida, as well as some data from Atlantic Canada. Each includes spatio-temporal modeling of species, as well as estimated population sizes (shorebirds only). Data from the avian compendiums will become available in GIS format in the future (O'Connell et al. 2009, 2011). The following patterns pertinent to the Virginia OCS and greater Project Area region were interpreted from a review of the BOEM and DOE sponsored research:

- Common loon (*Gavia immer*) and red-throated loon regularly occur off the coast of Virginia during the winter and early spring (O'Connell et al. 2009).
- Grebes are expected to occur off the southern coast of Virginia at relatively low densities during the winter (O'Connell et al. 2009).

- Double-crested cormorants (*Phalacrocorax auritus*) may occur in the vicinity of the Research Lease Area during winter, spring and fall, at low densities, and great cormorant (*Phalacrocorax carbo*) may occur at very low to low densities during the winter (O'Connell et al. 2009).
- Sea ducks and diving ducks (*Anatidae*) may be present off the coast of Virginia throughout the year, but are most abundant from November to April in coastal and shoal waters (O'Connell et al. 2009).
- During southward migration, sea ducks begin to arrive on the Virginia coast and OCS in November and December and depart during spring migration to more northerly breeding areas in March and April (O'Connell et al. 2009).
- In general, sea ducks are more abundant near the mouth of the Chesapeake Bay and along the Delmarva Peninsula, as opposed to the southern coast of Virginia and North Carolina (O'Connell et al. 2009).
- Shearwaters and storm-petrels are most abundant in the western Atlantic during the summer months. Some species, such as Manx's shearwater (*Puffinus puffinus*), may occur year-round (O'Connell et al. 2009). Shearwaters generally occur off the coast of Virginia during the non-breeding austral-winter period, in May through September, although as mentioned, some species may be present year round (O'Connell et al. 2009). Storm-petrels (*Hydrobatidae*) occur in the VOWTAP Wind Turbine Area region primarily during the non-breeding austral-winter period, but some species may also be present year-round (O'Connell et al. 2009).
- Two species of petrel, the black-capped petrel (*Pterodroma hasitata*) and the Bermuda petrel, may occur as vagrants on the Virginia OCS, typically within the Gulf Stream (O'Connell et al 2009). There are numerous historical records of black-capped petrel from the Virginia OCS, primarily within the Gulf Stream (O'Connell et al. 2009).
- Two species of storm-petrel, Wilson's storm-petrel (*Oceanites oceanicus*) and Leach's storm-petrel (*Oceanodroma leucorhoa*), are known to occur regularly on the Virginia OCS, primarily during the summer but also during spring and fall (O'Connell et al. 2009). A third species, the band-rumped storm-petrel (*Oceanites castro*), may occasionally occur on the Virginia OCS from spring to fall (O'Connell et al. 2009).
- Northern gannet (*Morus bassanus*) migrates from breeding areas in Atlantic Canada to lower latitudes of the Mid-Atlantic in late summer and early fall, and individuals are known to overwinter as far south as Georgia and Florida (O'Connell et al. 2009).
- During the winter, alcids (*Alcidae*) may migrate as far south as the Virginia OCS from northern breeding areas to forage on bait fish and invertebrates. Six species of alcids may occur off the coast of Virginia during winter: razorbill (*Alca torda*), common murre (*Uria aalge*), thick-billed murre (*Uria lomvia*), dovekie (*Alle alle*), black guillemot (*Cepphus grylle*), and Atlantic puffin (*Fratercula arctica*) (O'Connell et al. 2009). Alcids are not expected to be abundant in the Mid-Atlantic region (O'Connell et al. 2009).

New Jersey Department of Environmental Protection Ecological Baseline Surveys. The New Jersey Department of Environmental Protection's (NJDEP) Ecological Baseline Surveys (EBS) were performed north of the proposed Research Lease Area and Supplemental Survey Area off the coast of New Jersey. During the EBS ship-based bird surveys, a total of 153 avian species were documented. It is suspected that the offshore waters of Virginia would support a similar avian assemblage because of similarities in distance from shore, water depth, and position along the western Atlantic coast. None of the species observed during the NJDEP EBS were federally listed endangered, threatened, or candidate species (NJDEP 2010), though species of conservation concern were observed.

The NJDEP EBS ship-based surveys demonstrated that the abundance of avifauna was highest near the shoreline during all seasons and most abundant during the winter (NJDEP 2010). In offshore waters, black scoter (*Melanitta nigra*), northern gannet, and laughing gull (*Leuocophaeus atricillus*) were the most abundant species observed. These species are also likely to be abundant in the Research Lease Area. Less than five percent of birds observed during ship-based surveys were observed flying within the rotor swept zones (RSZ) of potential offshore WTGs. Most of the birds observed in the RSZ were sea ducks, specifically scaup (*Aythya* spp.). The NJDEP EBS found significant correlations between severe weather events and changes in sea duck and sea bird distributions. Cold weather and storms offshore appeared to increase the abundance of certain species in coastal waters (NJDEP 2010). Weather was found to have a significant effect on flight heights during both spring and fall migration, with decreased flight heights in inclement weather. It is probable that weather conditions will have similar effects on birds in the Research Lease Area.

Avian radar was used to characterize the spatial and temporal parameters of bird movements in the NJDEP EBS survey area. Results from the radar surveys seem to indicate that there may be less nocturnal migration activity occurring offshore than has been previously suspected (NJDEP 2010). Other similar radar studies conducted nearshore and offshore generally confirm these observations (Mizrahi et al. 2010, Mizrahi 2011, Tetra Tech 2012). Nocturnal migrant songbirds are considered to be at risk of collision with tall structures, especially during low visibility (Kerlinger et al. 2010).

Federal and State Databases. Federal and state agencies also monitor species that are at risk of becoming rare, including the species of special concern listed in Table 1-2. The USFWS monitors bird populations under a federal mandate and compiles a list of birds of conservation concern (BCC) (USFWS 2008). Species listed as BCC are not listed under the ESA but are of greater conservation concern than other avifauna; BCC listing is a precautionary measure to assure that these species receive extra attention to avoid listing under the ESA (USFWS 2008). BCC listing does not confer any additional protection to the species' status other than that already accorded under the MBTA or other relevant statutes (USFWS 2008). BCC species for the Mid-Atlantic Coast Bird Conservation Region 30 are listed in Table 1-2.

VDGIF maintains a list of species of greatest conservation need (SGCN) in the Commonwealth. These species are identified as part of the state's Wildlife Action Plan and include species with declining populations (Table 1-2).

Table 1-2. Non-Listed Species of Special Concern and Species of Greatest Conservation Need Potentially Occurring in the VOWTAP Area

Common Name	Species Name	Status
Red-throated loon	*Gavia stellata*	BCC
Pied-billed grebe	*Podilymbus podiceps*	BCC
Horned grebe	*Podiceps auritus*	BCC
Great shearwater	*Puffunus gravis*	BCC
Audubon's shearwater	*Puffinus lherminieri*	BCC
American bittern	*Botaurus stellaris*	BCC
Least bittern	*Ixobrychus exilis*	BCC
Snowy Egret	*Egretta thula*	BCC
Bald eagle	*Haliaeetus leucocephalus*	BCC / BGEPA
Peregrine falcon	*Falco peregrinus*	SGCN / SE
Wilson's plover	*Charadrius wilsonia*	BCC / SE
Lesser yellowlegs	*Tringa flavipes*	BCC
Whimbrel	*Numernius phaeopus*	BCC
Hudsonian godwit	*Limosa haemastica*	BCC
Marbled godwit	*Limosa fedoa*	BCC
Red knot	*Calidris canutus rufa*	BCC / PE / SGCN
Semipalmated sandpiper	*Calidris pusilla*	BCC
Purple sandpiper	*Calidris martima*	BCC
Buff-breasted sandpiper	*Tryngites subruficollis*	BCC
Short-billed dowitcher	*Limnodromus griseus*	BCC
Gull-billed tern	*Sterna noltica*	BCC / SGCN
Least tern	*Sterna antillarum*	BCC / SGCN
Royal tern	*Sterna maxima*	SGCN
Black skimmer	*Rynchops niger*	BCC
Tricolored heron	*Egretta tricolor*	SGCN
Glossy ibis	*Plegadis falcinellus*	SGCN
Common tern	*Sterna hirundo*	SGCN
Purple sandpiper	*Calidris maritime*	SGCN
Short-billed dowitcher	*Limnodroumus griseus*	SGCN
Marbled godwit	*Limosa fedoa*	SGCN
Forster's tern	*Sterna forsteri*	SGCN

BCC – Bird of Conservation Concern (USFWS)

BGEPA – Bald and Golden Eagle Protection Act (USFWS)

PE – Proposed as endangered for federal ESA listing (USFWS)

SOC – Species of Concern (NOAA Fisheries)

SGCN – Species of Greatest Conservation Need (VDGIF)

SE– State listed Endangered (VDGIF)

Source: VDGIF 2005, USFWS 2008, NOAA 2010, NOAA 2011

1.5 Description of Terrestrial Wildlife Habitats in the Onshore Survey Area

Terrestrial wildlife habitats on the coastal plain of Virginia are at least 24 nm (28 mi, 44 km) from the Offshore Survey Area. Virginia Beach, which encompasses the onshore portion of the Project Area, is part of a heavily developed area with population densities over 1,000 people per square kilometer (km^2) (VDGIF 2005). Habitats in the region have been altered by human development and are highly fragmented. The largest patches of natural habitat in the vicinity of the Onshore Survey Area occur on conservation lands and in protected areas, as well as on military reservations. No conservation lands occur within or immediately adjacent to the proposed alternative cable landfall sites or the alternative onshore cable routes.

The Onshore Survey Area is located in the Middle Atlantic Coastal Plain – Virginia Barrier Islands and Coastal Marshes ecoregion (EPA Level IV; Bailey et al. 1994). Beaches, dunes, and salt marshes are the dominate topography in the ecoregion (Woods et al. 1999). Farther inland the habitat transitions to the Middle Atlantic Coastal Plain – Chesapeake-Pamlico Lowlands and Tidal Marshes level IV ecoregion (Woods et al. 1999). Topography in the Chesapeake-Pamlico Lowlands consists of uniformly low, nearly flat elevation with tidal ponds, marshes and streams. Tidal marshes and some freshwater ponds occur in areas of poorly drained, silty soils. Brackish and freshwater wetlands provide habitat for marine and estuarine fishes, shellfish, and waterfowl. An Oak-Hickory-Pine forest extends from the Virginia Barrier Island and Coastal Marshes into the Chesapeake-Pamlico Lowlands ecoregion, and is the dominant community on well-drained soils. Agriculture, urban development, and industrial development are common land uses and have impacted drainage in the region. Areas of natural habitat have been isolated and fragmented by development.

Maritime Dune Grassland and Upper Beach communities occur at the Onshore Survey Area near point-count station 4 (*see* Section 2.1.2) (Fleming and Patterson 2012). Maritime Dune Grassland habitat is ranked as S2 (imperiled community type) and Upper Beach is ranked as S3 (vulnerable community type) in Virginia (Fleming and Patterson 2012). The Maritime Dune Grassland community is restricted to a small dune strip and fore-dune area above the Upper Beach and the inter-tidal zone. The Maritime Dune Grassland community is heavily influenced by wind and the maritime environment, and the dominant vegetation consists of beachgrass (*Ammophila* spp.). These habitats may be used by shorebirds and seabirds, as well as terrestrial and marine invertebrates (Fleming and Patterson 2012).

There are remnants of a Maritime Upland Forest in the Onshore Survey Area near point-count stations 2 and 3 (Section 2.1.2). Isolated hardwood stands include oak (*Quercus* spp,), maple (*Acer* spp.), and sweet gum (*Liquidambar stryaciflua*); Loblolly pine (*Pinus taeda*) also occurs and there is greenbrier (*Smilax* spp) in the understory. Other habitats in the Onshore Survey Area include early successional loblolly pine stands and mowed grass areas near point-count station 1 (*see* Section 2.1.2).

2 AVIAN ASSESSMENT METHODS

This section provides details on the methodologies employed during the April 2013 to April 2014 VOWTAP avian surveys.

2.1 Data Collection

2.1.1 Offshore Survey Area

The total area within transect boundaries during the 2013–2014 ship-based avian surveys in the Offshore Survey Area was 27.5 km^2 (10.6 square miles [mi^2]); the total size of the VOWTAP Offshore Survey Area sampled was 62.6 km^2 (24.2 mi^2).The area of the proposed research lease for the VOWTAP is six OCS lease block aliquots (an aliquot is 1/16 of a lease block) totaling 1.7 mi^2 (4.32 km^2 or 432 hectares); however, the area required for the two-WTG Project will be only a fraction of the total proposed Research Lease Area. An additional three OCS aliquots within the adjacent Virginia WEA were included during site characterization activities but are not part of the proposed Research Lease Area. A total of nine OCS lease block aliquots were evaluated.

Qualified and experienced biologists from the Center for Conservation Biology at the College of William and Mary collected the systematic ship-based visual observation survey data and provided the results to Tetra Tech's lead biologist for VOWTAP. A continuous transect traversing the Offshore Survey Area was surveyed monthly for birds from May 2013 to April 2014 (per BOEM 2013). Incidental observations of marine mammals and sea turtles were also recorded. The avian survey transect was oriented so that the majority of the Research Lease Area, including the area where WTGs will be installed, was sampled. Separation between transect segments was greater than 300 meters (m) (984 feet [ft]), to avoid double counting (Figure 2-1).

Surveys began in May 2013 and continued monthly through April 2014. Surveys were intended to start in late-April 2013 but were delayed until early May due to poor weather, which caused sea conditions to be unsafe for a productive offshore avian survey. Therefore, two avian surveys were conducted in May 2013, one early in the month and one later in the month (Table 3-1 in Section 3).

During the survey period, data were collected using standard distance sampling techniques, including distance and direction of the observed bird to the observer (Thomas et al. 2006). Data were recorded on a handheld personal digital computer, and geo-referenced with GPS locations (Trimble Yuma). All individual birds detected during the surveys were identified to species level when possible. Behavioral information was recorded for all birds, including feeding, sitting on water, direct flight, and diving. The observers estimated a perpendicular distance from the ship to observed birds using the following categories: < 50 m (164 ft), 50–100 m (164–328 ft), 101–200 m (331–656 ft), and 201–300 m (659–984 ft). For birds observed in flight, the first instance the individual or flock was sighted was used to estimate perpendicular distance from the observers. The vertical flight height above the water was estimated and recorded within the following height bins: < 10 m (33 ft), 10–25 m (33–82 ft), 26–125 m (85–410 ft), 126–200 m (413–656 ft), and > 200 m (656 ft). Instantaneous flight direction of sighted birds at the time of first sighting was also recorded as follows: north (N), northeast (NE), northwest (NW), south (S), southeast (SE), southwest (SW), east (E), west (W), and variable.

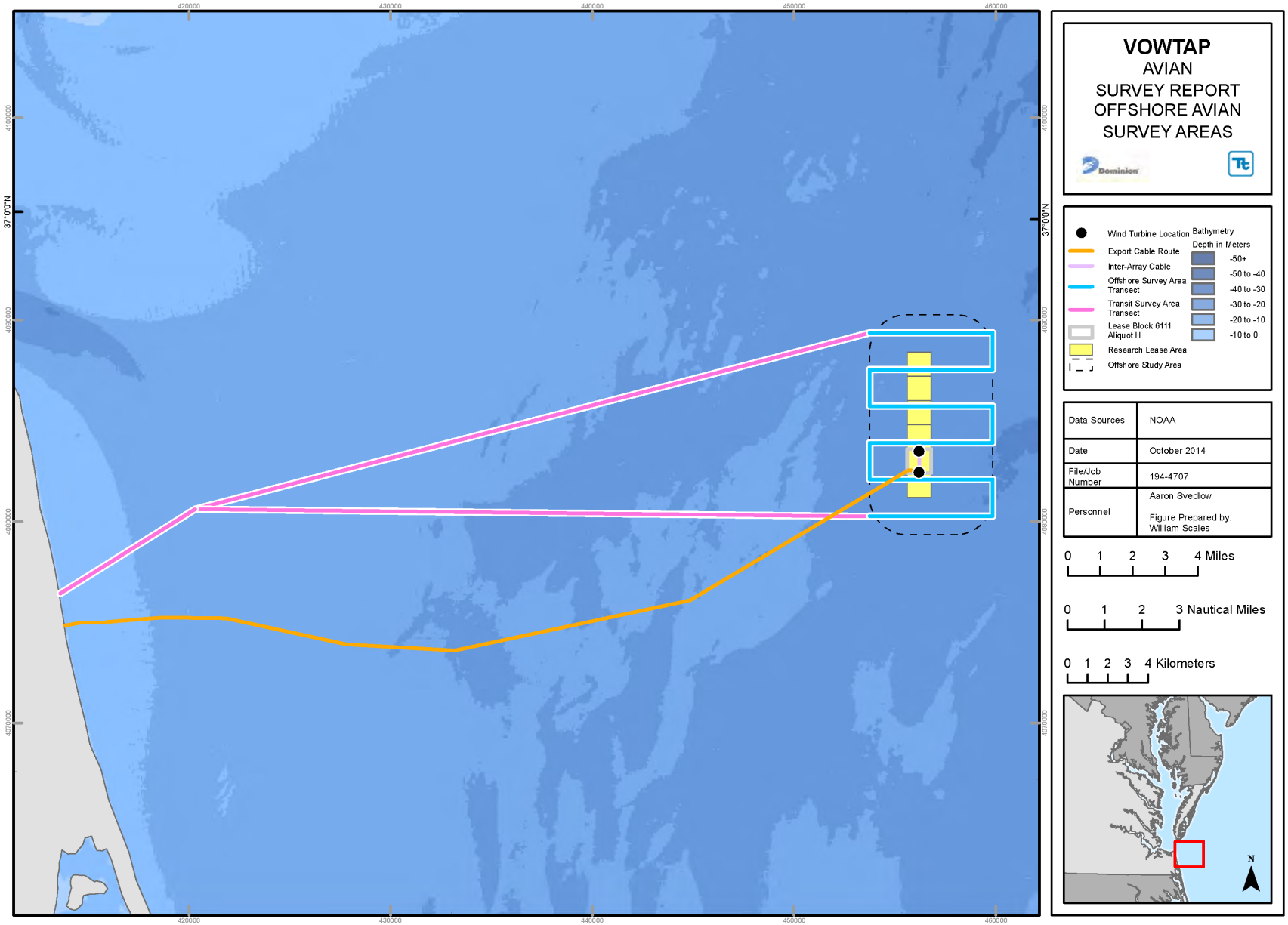

Figure 2-1. VOWTAP Ship-based Avian Survey Transects, Offshore Survey Area, Transit Survey Area, and Research Lease Area

Surveys were conducted on days when seas were appropriate for a safe and productive ship-based survey (World Meteorological Organization Sea States of 1−4). Detailed weather observations were recorded at the start and end of each survey. In addition to the bird data listed above, observers recorded absolute wind speed, wind direction, cloud cover, air temperature, relative humidity, and sea state into standardized data dictionaries stored on a handheld Trimble Global Positioning System (GPS) unit. Surveys were conducted a minimum of three days apart, and were on average at least three weeks apart. Additional incidental data were collected during transit from the Virginia mainland to the Offshore Survey Area along a pre-established survey route through the Transit Survey Area (Figure 2-1).

The survey vessel traveled at a constant speed of 10 knots (18.5 kilometers/hour [km/hr]) while in the Offshore Survey Area. One primary observer recorded all birds sighted within a moving "box" that measured 300 m (984 ft) ahead and 300 m perpendicular to the ship. The primary observer was assisted by a data recorder/secondary observer. The secondary observer sighted birds on the opposite side of the vessel to the primary observer within a 300-m (984-ft) strip transect. All observations were pooled and a 600-m transect width was used for analyses.

2.1.2 Onshore Survey Area

A series of four onshore point-count surveys were conducted in spring, summer, and fall 2013, and spring 2014 along the preferred Onshore Interconnection Cable and Fiber Optic Cable route. The surveys consisted of one survey per month in April, August, September, and October 2013, as well as in early April and late April 2014 (a survey was planned for March 2014 but was delayed until April 4 due to weather conditions and military training activity on Camp Pendleton, which delayed access to the Onshore Survey Area).

Point counts were performed using a variation of the USGS North American Breeding Bird Survey methods (USGS 2001). Four point-count stations were sampled during each survey visit (Figure 2-2). Point-count stations were labeled 1–4 starting inland at number 1 and ending at Camp Pendleton Rifle Range Road Beach at point count station 4 (Figure 2-2). Each point was surveyed for 30 minutes, and all birds were recorded on handheld tablet computers equipped with GPS. Flight heights, flight direction, behavior, and standard distance sampling metrics were recorded for each observation, as appropriate. Weather data were collected during each survey and habitat characteristics were recorded for each point-count station, with a particular focus on possible nesting or foraging areas in the vicinity of the preferred Onshore Interconnection Cable and Fiber Optic Cable route.

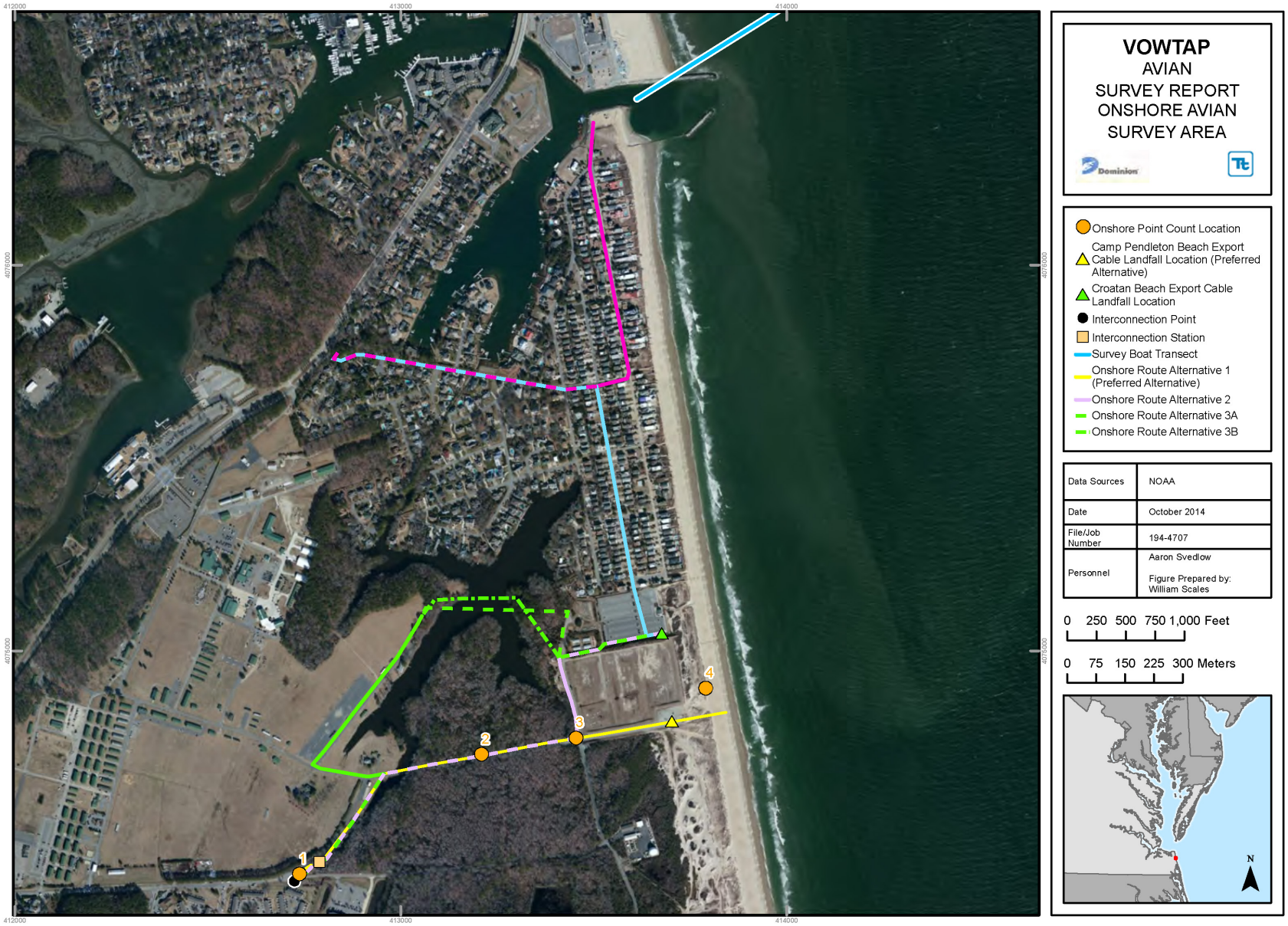

Figure 2-2. VOWTAP Onshore Survey Area (in Proximity of Preferred Cable Landfall Location and Grid Interconnection Point South of Rudee Inlet and the Offshore Ship-based Transect)

2.1.3 Transit Survey Area

Observations in the Transit Survey Area from Rudee Inlet to the Offshore Survey Area were conducted in a similar manner to the methods used during surveys in the Offshore Survey Area, with the exception that information on distance were not gathered during transit. Observations made in the Transit Survey Area were intended solely to supplement data collected in the Offshore Survey and Onshore Survey Areas. It was necessary for the survey biologists to be able to transit from shore to the primary area of interest, the Offshore Survey Area, in a timely manner, thus it was not possible to assure that the survey vessel was travelling at 10 knots, as required per standard distance sampling methods. Because the vessel speed exceeded 10 knots in the Transit Survey Area the observations made within this area could not be used for estimating density. Therefore, data from the Transit Survey Area should be treated as incidental observations made during transit.

2.2 Data Analyses

Data from the Offshore Survey Area were assessed separately from data collected in the Transit Survey Area and Onshore Survey Area. Data were archived and backed up by field biologists during transit and at Tetra Tech's Portland, Maine office. Data are available upon request to Dominion.

2.2.1 Offshore Survey Area

Observational data were evaluated by species and were organized taxonomically into species groups consisting of species with similar ancestry and or similar life history traits. Consideration of encounter rate was also important in determining the species-groups, as in the case of storm-petrels, phalaropes, and northern gannet [*Maros bassanus*], which warranted separate groups because of higher relative encounter rates. Cormorants (*Phalacrocoracidae*) were lumped with seabirds because there were few observations of cormorants in the Survey Area and they exhibit behavioral patterns similar to some seabirds.

In order to assess relative diversity, the Shannon Diversity Index was calculated for the entire Offshore Survey Area. The Shannon Diversity Index (H) is useful for comparing diversity between locations or across temporal periods. The Shannon Diversity Index considers both species richness and species abundance (Shannon and Weaver 1949, Spellerberg and Fedor 2003, Margurran 2004) and usually ranges between 1.5 and 4.5. The larger the value the more "evenly" distributed the species (i.e., similar abundances per species across all species observed), while a smaller Shannon Diversity Index value indicates a less evenly distributed abundance of the sample population across species (i.e., few species have high abundance and many have low abundance). The following formula was used to calculate the Shannon Diversity Index:

$$H = \frac{N \ln N - \sum ni * \ln(ni)}{N}$$

Where N = the total number of individuals of all species encountered

n_i = the number of individuals of species *i*

A Simpson Diversity Index was also calculated for both the Offshore and Onshore Survey Areas. The Simpson Diversity Index (D_s) is a measure of the probability that individuals selected from the sample population belong to the same species (Margurran 2004).

The following formula was used to calculate the Simpson Diversity Index:

$$Ds = \frac{\sum ni(ni-1)}{N(N-1)}$$

Where N = the total number of individuals of all species encountered

n_i = the number of individuals of species *i*

The Shannon and Simpson Diversity indices provide slightly different insights into species assemblage and abundance patterns. The Shannon Diversity Index is useful for understanding how the number of species observed (richness) and the relative abundance of those species account for the evenness of the diversity among species. The Shannon Diversity Index is a unitless statistic based on the equation's inputs. For example, if most of the observations are attributable to only a few species then the index decreases, even if overall richness is high. The Simpson Diversity Index also accounts for patterns of richness and evenness of distribution of observations among species, but is a probability value. For example, a Simpson Diversity Index value of 0.5 corresponds to a 50 percent probability that two individuals chosen at random from the sampled population will belong to the same species. A lower Simpson Diversity Index corresponds to greater diversity and evenness within the sampled population. Species richness (*S*) was also calculated for each survey area and was defined as the total number of species observed during a given survey period, or at a specific survey location.

Data collected in the Offshore Survey Area were analyzed using standard distance sampling methods to estimate density of all species pooled (Thomas et al. 2006). Differential probabilities of bird detection and adjusted density estimates derived from estimated probability of detection were calculated for all observations pooled. Data were analyzed using the program Distance (6.0), and estimator distribution was fitted using Akaike Information Criterion (AIC).

Density estimates were also calculated using interpolation analysis to account for spatial autocorrelation among observations. We employed an inverse distance-weighted average (IDW) geospatial analysis technique (ArcTool in ArcMap 9.3) to assess density estimates across the Offshore Survey Area. In IDW interpolation, data point is weighted so that the closer it is to an analysis grid cell point, the more influence it has on the calculation of the cell's mean frequency value. The IDW analysis used a default weighting coefficient of 2. The weighting coefficient determined how much influence distant points had on the abundance estimate for each grid cell (higher coefficients lead to lower influence). Spatial-temporal distributions (including distance from shore and water depth preferences) and flight heights for all observations were plotted in GIS for all species pooled.

Weather data were collected hourly during surveys in the Offshore Survey Area and were evaluated against observational data of avian activity and diversity. We used R statistical analysis package (Version 2.15.2) to assess correlations among the independent variables: average hourly temperature, average hourly cloud cover, average hourly wind speed, and average hourly sea state; and the following dependent variables: abundance, species richness, and average flight height. Simple linear and multiple linear regression were used to model the relationship between the aforementioned independent and dependent variables.

2.2.2 Onshore Survey Area

Data collected in the Onshore Survey Area were evaluated in a similar manner to data collected in the Offshore Survey Area, as described in Section 2.2.1, with the exception of density estimates and weather correlations. Both Shannon and Simpson Diversity Indices were calculated for the Onshore Survey Area as a whole, and by point count location.

2.2.3 Transit Survey Area

Basic summary statistics were calculated for observations made during transit to the Offshore Survey Area. Density estimates for these data were not calculated because the data collection methods could not adhere to the assumptions required for standard distance sampling. Additionally, no diversity indices or correlations with weather variables were calculated.

3 RESULTS

Starting in May 2013 and ending in April 2014 a total of 13 boat surveys were conducted in the Offshore and Transit Survey Areas. Surveys occurred generally once per month, with the exception of May 2013 and February 2014 when two surveys were conducted (Table 3-1). The April 2013 survey could not be conducted due to weather conditions and was delayed to early May. The survey vessel was forced to return to port during the November 2013 survey effort. Weather conditions for the remainder of the month prevented the field crew from finishing the survey; in lieu of the curtailed November survey a second survey was conducted in the Offshore Survey Area in February 2014 (total of two February surveys). The final pre-construction survey was conducted in April 2014.

Surveys consisted of the vessel leaving port, transiting to the VOWTAP Offshore Survey Area, and traveling along the pre-determined transect at a constant speed of approximately 10 knots (Figure 2-1).

3.1 Offshore Survey Area.

3.1.1 Avian Abundance and Species Richness

During the 13 surveys of the Offshore Survey Area, 1,503 individual birds were encountered representing a total of 23 species, although species richness (*S*) varied among surveys (Figure 3-1, Table 3-1). The highest species richness in the Offshore Survey Area was observed during the February and March surveys ($S = 8$ species), while the lowest species richness was during the June, July, August, and September surveys ($S = 2$ species). Average species richness (mean ± standard error) across all surveys was 4.5 ± 0.64 species per survey effort.

The number of birds encountered per survey in the Offshore Survey Area ranged from 3 birds on June 17, 2013 to 1,231 birds on February 7, 2014. The average number of birds encountered during all 13 surveys was 115.6 ± 93.1 birds per survey effort. When data from the February 7, 2014 survey are excluded from the mean encounter rate, the mean decreases to 22.7 ± 6.0 birds per survey effort. The five most frequently observed species included northern gannet (n = 1,222, 81 percent), razorbill (n = 52, 3.5 percent), common loon (n = 34, 2.3 percent), great black-backed gull (*Larus marinus*) (n = 34, 2.3 percent), and herring gull (*Larus argentatus*) (n = 31, 2.1 percent) (Table 3-1). The vast majority of northern gannets (n = 1,166, 95 percent) were observed during a single survey effort on February 7, 2014.

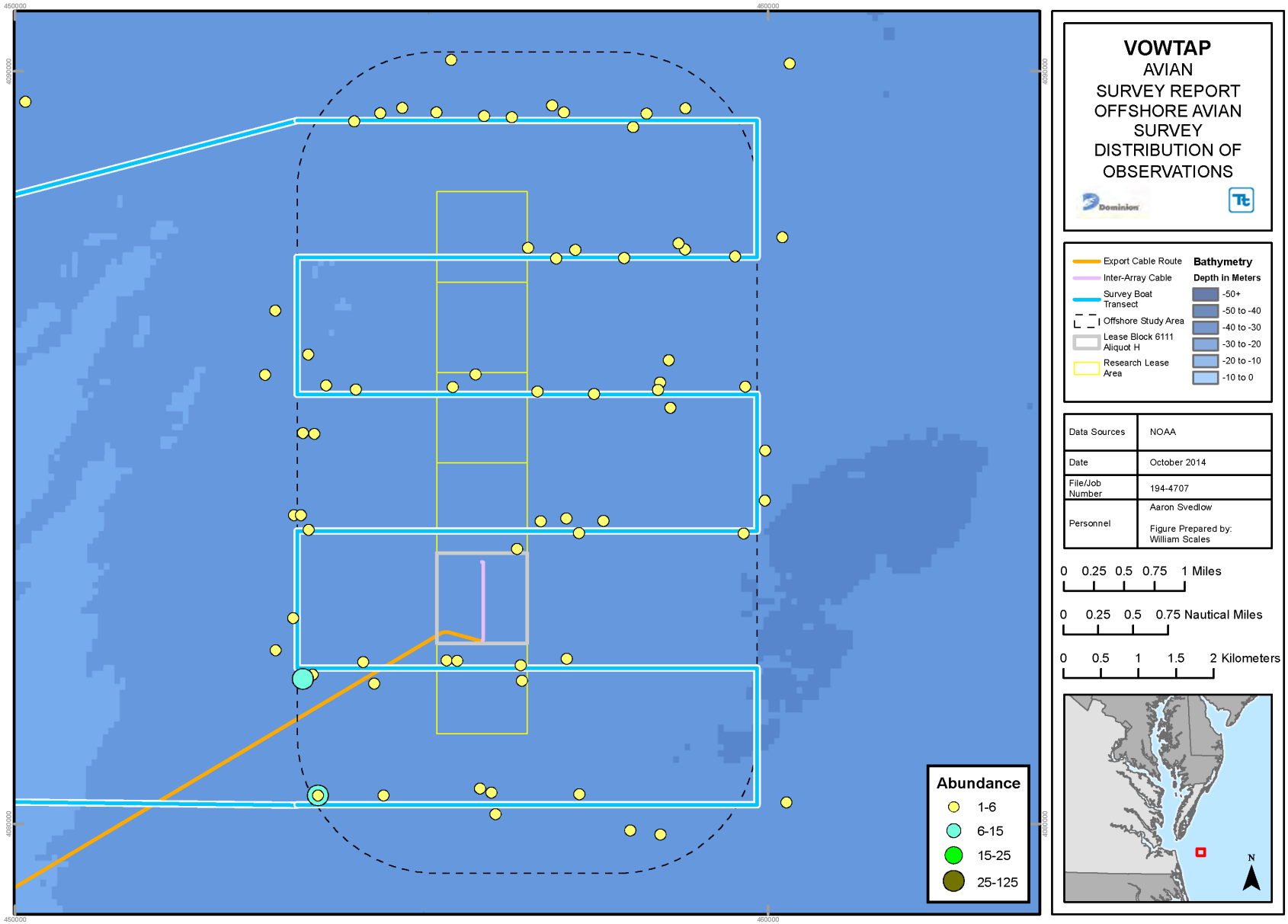

Figure 3-1. Distribution of Bird Observations during the VOWTAP Avian Surveys in the Offshore Survey Area – May 2013 to April 2014

Table 3-1. Results of the VOWTAP Offshore Avian Surveys from the Offshore Survey Area – May 2013 to April 2014

Common name	Scientific name	Number Observed by Date of Survey (2013–2014)													Total
		5/14 2013	5/22 2013	6/17 2013	7/8 2013	8/13 2013	9/10 2013	10/2 2013	12/19 2013	1/9 2014	2/7 2014	2/22 2014	3/11 2014	4/3 2014	
Northern gannet	Morus bassanus	0	0	0	0	0	0	0	2	6	1166	14	24	10	1,222
Razorbill	*Alca torda*	0	0	0	0	0	0	0	0	31	4	9	8		52
Common loon	*Gavia immers*	5	2	0	0	0	0	0	0	14	1	1	7	4	34
Great black-backed gull	*Larus marinus*	0	0	0	0	0	0	2	0	1	29	1	1		34
Herring gull	*Larus argentatus*	0	0	0	0	0	0	0	1	0	24	0	1	5	31
Black scoter	*Melanitta americana*	0	0	0	0	0	0	0	0	0	0	0	0	25	25
Bonaparte's gull	*Choroicocephalus philadelphia*	0	0	0	0	0	0	0	2	18	0	0	0	1	21
Purple martin	*Progne subis*	0	0	0	0	20	0	0	0	0	0	0	0	0	20
Laughing gull	*Leucophaeus atricilla*	0	2	1	5	4	3	2	0	0	0	0	0	0	17
Red-necked phalarope	*Phalaropus lobatus*	0	0	0	0	0	14	0	0	0	0	0	0	0	14
Red-throated loon	*Gavia stellata*	1	1	0	0	0	0	0	0	2	4	0	2	1	11
Wilson's storm-petrel	*Oceanites oceanicus*	0	3	2	0	0	0	0	0	0	0	0	0	0	5
Sanderling	*Calirdris alba*	3	0	0	0	0	0	0	0	0	0	0	0	0	3
Royal tern	*Thalasseus maximus*	0	0	0	3	0	0	0	0	0	0	0	0	0	3
Ring-billed gull	*Larus delawarensis*	0	0	0	0	0	0	1	0	1	0	0	0	0	2
Northern fulmar	*Fulmaris glacialis*	0	0	0	0	0	0	0	0	0	2	0	0	0	2
Dovekie	*Alle alle*	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Sooty shearwater	*Puffinus griseus*	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Cory's shearwater	*Calonectris diomedea*	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Lesser black-backed gull	*Larus fuscus*	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Surf scoter	*Melanitta perspicillata*	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Common grackle	*Quiscalus quiscula*	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Song sparrow	*Melospiza melodia*	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Total		**10**	**8**	**3**	**8**	**24**	**17**	**6**	**5**	**73**	**1,231**	**27**	**45**	**46**	**1,503**
Species Richness (*S*) (number of different identifiable species)		**4**	**4**	**2**	**2**	**2**	**2**	**4**	**3**	**7**	**8**	**6**	**8**	**6**	**23**

3.1.2 Species Diversity

The Shannon Diversity Index calculated for the survey period for the Offshore Survey Area was $H = 0.95$. This low value indicates relatively low diversity, and is consistent with the observational data, which indicate that a few species (northern gannet, common loon, and great black-backed gull) comprised more than 89 percent of all birds observed in the Offshore Survey Area.

The Simpson Diversity Index during the survey period for the Offshore Survey Area was $D_s = 0.66$. Diversity indices were not calculated for the Transit Survey Area. The Simpson Diversity Index for the Offshore Survey Area was relatively high, indicating that there was a small number of species with relatively high abundances.

3.1.3 Rare, Threatened, and Endangered Species

No federally threatened or endangered species were observed during the VOWTAP Offshore Avian Surveys. A single peregrine falcon (a state listed threatened species) was observed during an offshore survey in the Transit Survey Area. Peregrine falcons are uncommon residents during the summer and may occur in greater numbers during spring migration (March–April) and fall migration (September–October) in coastal Virginia (Rappole 2007). Peregrine falcons are state listed as endangered and are a species of greatest conservation need (SGCN) in Virginia (VDGIF 2005). Royal tern, also a state SGCN, was observed during the offshore surveys in the Offshore Survey Area (n = 3) and Transit Survey Area (n = 579).

3.1.4 Behavior and Flight Heights

Of the 1,503 birds encountered during the survey period in the Offshore Survey Area, 57.2 percent were in flight (n = 860) and the remainder (42.8 percent) were observed sitting on the water (n = 643). Of the 860 birds observed in flight, most (40.7 percent, n = 611) were observed flying less than 10 m (33 feet) above mean sea level (amsl). Approximately 9.6 percent (n = 145) of birds were observed flying between 10 and 25 m (33 and 82 feet) amsl. Overall, 6.9 percent (n = 104) of birds observed in flight flew 25–125 m (82–410 feet) amsl, which generally corresponds to the RSZ of the proposed Project WTGs[1]. The vast majority of birds that flew in the 25–125 m (82–410 ft) category were northern gannets (94.2 percent, n = 98). The average flight height for all birds observed during the survey period in the Offshore Survey Area was 15 m (49 feet) (SE = 1.6 m [5 ft]). Observed flight heights varied by species group, although most species flew below 25 m (82 feet) amsl (Table 3-2, Figure 3-2).

[1] In October 2014 the proposed WTG height increased 3 m (10 ft). This statement remains correct.

Table 3-2. Flight Heights Observed during the VOWTAP Offshore Avian Surveys from the Offshore Survey Area – May 2013 to April 2014

Species Group	<10m	10–25m	25–125m	Sitting on Water	Total (n)
Alcids	83.0%	3.8%	0.0%	13.2%	53
Gannets	34.2%	9.9%	8.0%	47.9%	1,222
Gulls	81.5%	9.3%	0.9%	8.3%	108
Loons	26.7%	2.2%	11.1%	60.0%	45
Purple Martins	65.0%	35.0%	0.0%	0.0%	20
Passerines	50.0%	50.0%	0.0%	0.0%	2
Phalaropes	0.0%	0.0%	0.0%	100.0%	14
Seaducks	96.2%	3.8%	0.0%	0.0%	26
Shearwaters	50.0%	0.0%	0.0%	50.0%	2
Shorebirds	100.0%	0.0%	0.0%	0.0%	3
Storm-petrels	100.0%	0.0%	0.0%	0.0%	5
Terns	33.3%	66.7%	0.0%	0.0%	3
Total	**40.7%**	**9.6%**	**6.9%**	**42.8%**	**1,503**

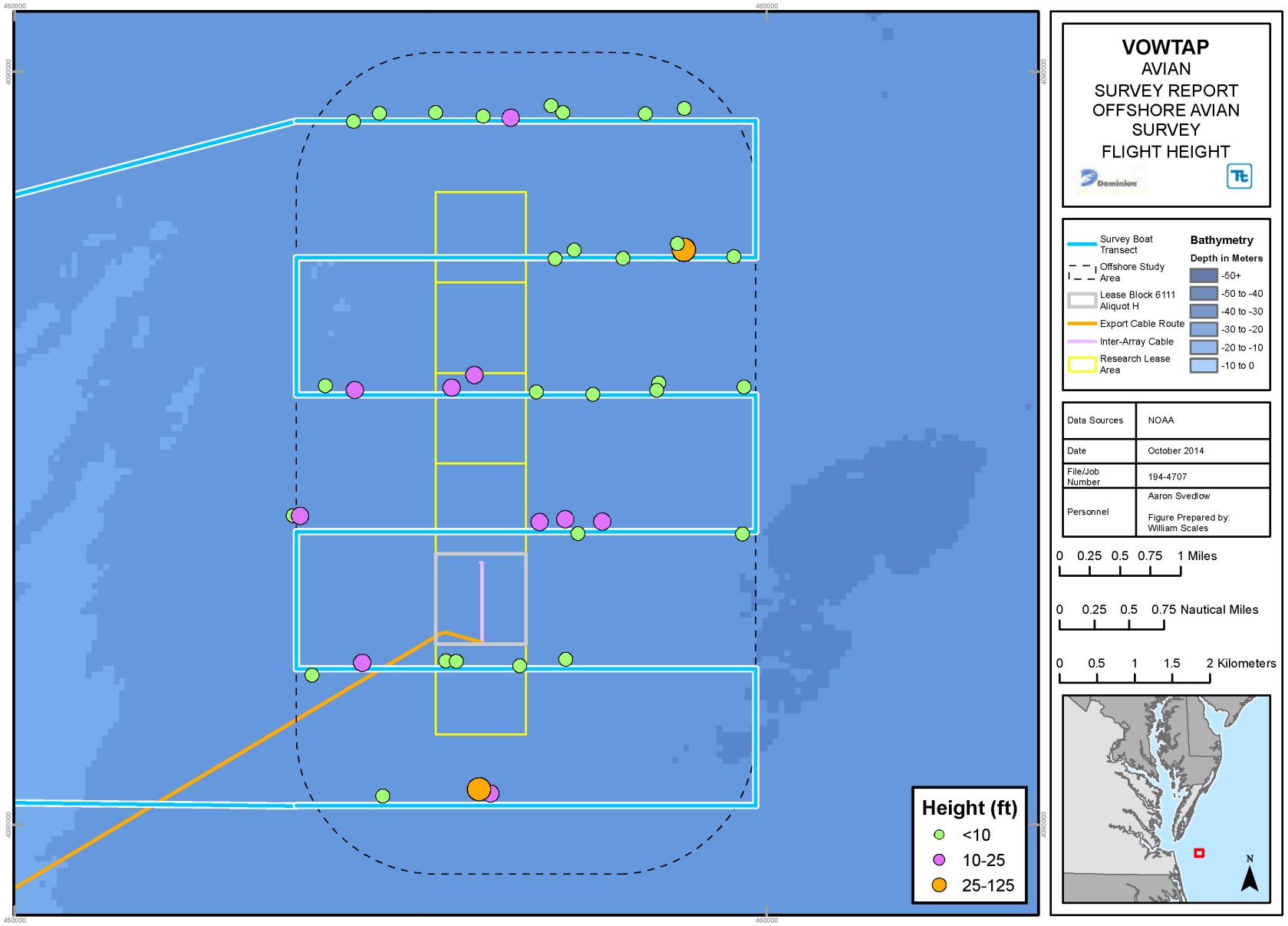

Figure 3-2. Flight Height of Bird Observations during the VOWTAP Avian Surveys in the Offshore Survey Area – May 2013 to April 2014

3.1.5 Distribution and Estimated Density

Observations of birds were generally uniform throughout the Offshore Survey Area, with the exception of observations of northern gannets and alcids. Most of the northern gannets and razorbills were observed near the southwestern corner of the Survey Area (Figure 3-1).

Density (birds per km^2) was estimated for the entire Offshore Survey Area for all species pooled. Density estimates could not be calculated for individual species because encounter rates in the Offshore Survey Area were generally low, resulting in an insufficient number of observations on which to base species specific density estimates.

Data from the VOWTAP Offshore Survey Area were fitted to a half-normal distribution with cosine adjustment and right truncation (AIC = 2,332) using program Distance 6.0. AIC values were used to assess model fit. AIC is a useful criteria on which to select the model of best fit among possible candidate models, but is not necessarily a measure of fit on an objective scale. In addition to the selected half-normal cosine model, two other models were considered: a half-normal distribution with simple polynomial adjustment and right truncation (AIC = 2,334) and a half-normal distribution with hermite polynomial adjustment and right truncations (AIC = 2334).

The corrected estimated encounter rate was 44.5 birds per survey (the observed encounter rate was 116 birds per survey) and the detection probability was estimated at 99 percent within 250 m (820 ft) (the effective transect width size). The average cluster size of the estimated population was 7.1 individuals per cluster (SE = 2.1). The estimated density was 5.1 birds per km^2 (95 percent confidence interval = 2.3– 10.9 birds per km^2; SE = 2.0). The estimated density of clusters (groups or flocks) of birds in the Offshore Survey Area was 0.7 clusters per km^2 (95 percent confidence interval = 0.4 – 1.3 birds per km^2; SE = 0.19). Density was not estimated for the Transit Survey Area because data were not collected using standardized distance sampling protocols during transit. The IDW density estimates were similar to the distance sampling estimates (6.8 ± 0.012 birds per km^2) (Figure 3-3).

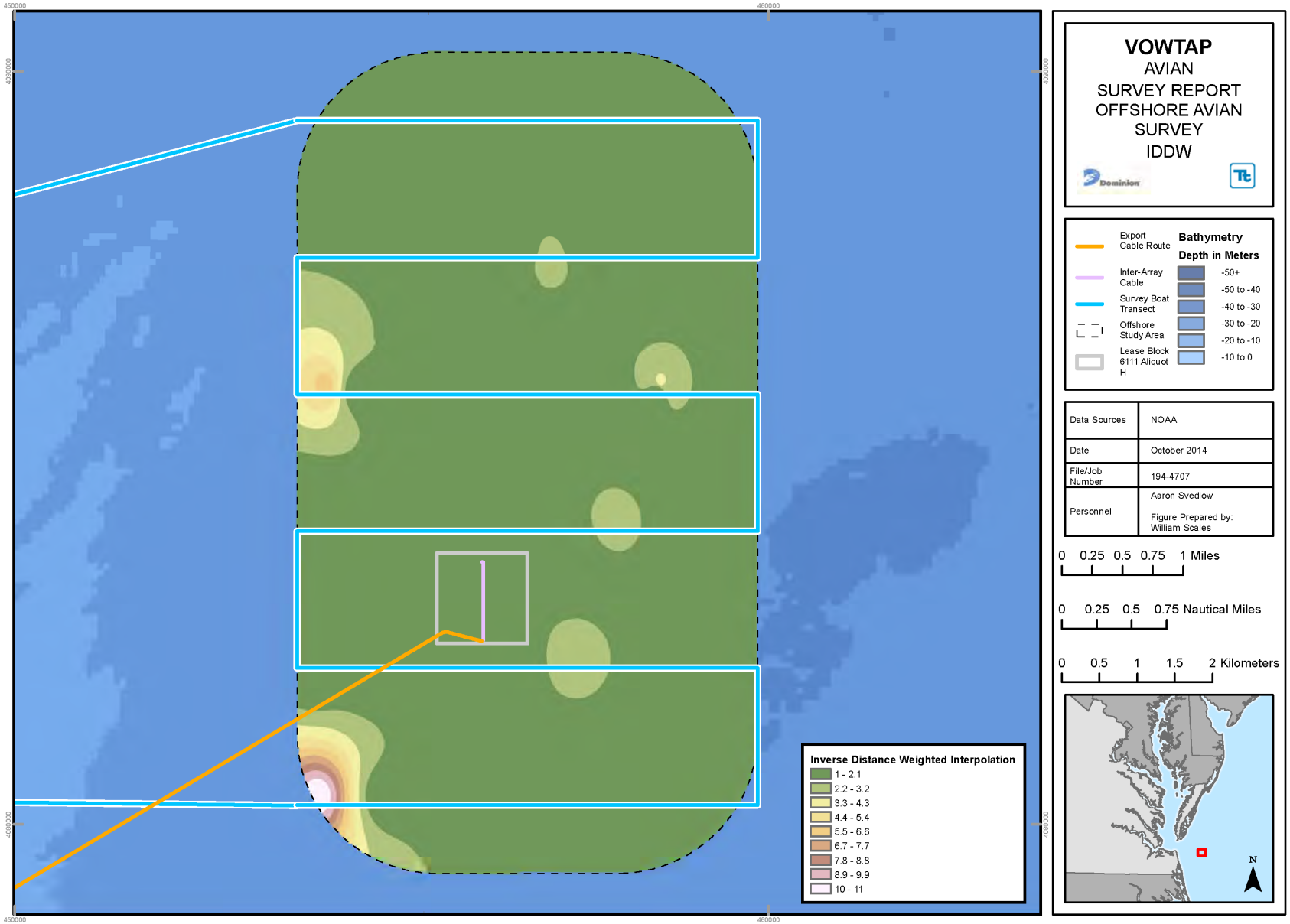

Figure 3-3. IDW Interpolation of Bird Abundance during the VOWTAP Avian Surveys in the Offshore Survey Area – May 2013 to April 2014

3.1.6 Weather

Weather data were collected during 12 of the 13 surveys (weather data were not collected during the 2013 survey effort) (Table 3-3). The average hourly temperature varied between 33 degrees Fahrenheit (°F) (0.5 degrees Celsius [°C]) (February 7, 2014) and 86 °F (30 °C) (August 13, 2013). The overall average temperature was 62.8 °F (17 °C).

There was only one significant relationship between a weather variable (mean hourly temperature) and an observed variable (species richness per survey). Species richness was negatively correlated with mean hourly temperature (Pearson's product-moment r = -0.89, adjusted R^2 = 0.78 p = <0.001). This indicates that as temperatures decreased there was a significant increase in observed species richness in the Offshore Survey Area.

Table 3-3. Mean hourly weather conditions during the VOWTAP Offshore Avian Surveys from the Offshore Survey Area – May 2013 to April 2014

Date	Average Hourly Air Temp (F)°	Average Hourly Sky Cover (Cloud Cover %)	Average Hourly Wind Speed (knots)	Average Hourly Sea State
14-May-13	54.8°	29.2	13.3	3.0
22-May-13	75.0°	20.0	20.0	4.0
17-Jun-13	75.2°	78.3	13.2	2.7
8-Jul-13	84.2°	45.0	15.2	3.3
13-Aug-13	86.2°	49.2	12.5	2.7
10-Sep-13	83.3°	22.5	5.0	2.7
2-Oct-13	76.5°	0.0	11.5	1.8
19-Dec-14	N/A	N/A	N/A	N/A
9-Jan-14	37.2°	0.0	5.0	1.0
7-Feb-14	32.8°	7.5	9.8	2.3
22-Feb-14	41.8°	88.3	9.2	2.3
11-Mar-14	53.2°	88.3	5.0	1.5
3-Apr-14	53.3°	33.3	9.5	2.0
Average	**62.8°**	**38.5**	**10.8**	**2.4**

3.1.7 Bathymetry

Bathymetry data was only collected and available within a portion of the resource lease area, greatly restricting the potential to identify relationships between avian observations and water depth. Several correlative measures were explored, but due to the small number of observations (n= 5) made within the lease area, meaningful correlations could not be made between observation locations and depth. Further, depths of the five observations varied little (24.01- 26.39 m). Provided bathymetry data for the extent of the survey transect, a more robust analysis of the relationship between depth and total avian observations (n= 136) could be conducted.

3.2 VOWTAP Onshore Survey Area

3.2.1 Avian Abundance and Species Richness

Point-count surveys were conducted in the Onshore Survey Area in April, August, September, and October 2013, and in early and late April 2014, for a total of six surveys (Figure 3-4). During the Onshore Avian Survey period, 79 species were encountered (S = 79) and 3,578 individuals were observed (Table 3-4; Figure 3-4).

Table 3-4. Species Groups Observed during the VOWTAP Onshore Avian Surveys from the Onshore Survey Area – May 2013 to April 2014

Species Group	# of birds Encountered	Percentage of Total
Landbirds/Passerine	2,667	74.5%
Gulls	383	10.7%
Seabirds	197	5.5%
Shorebirds	149	4.2%
Terns	116	3.2%
Waterfowl	29	0.8%
Raptor	25	0.7%
Wading	12	0.3%
Total	**3,578**	**--**

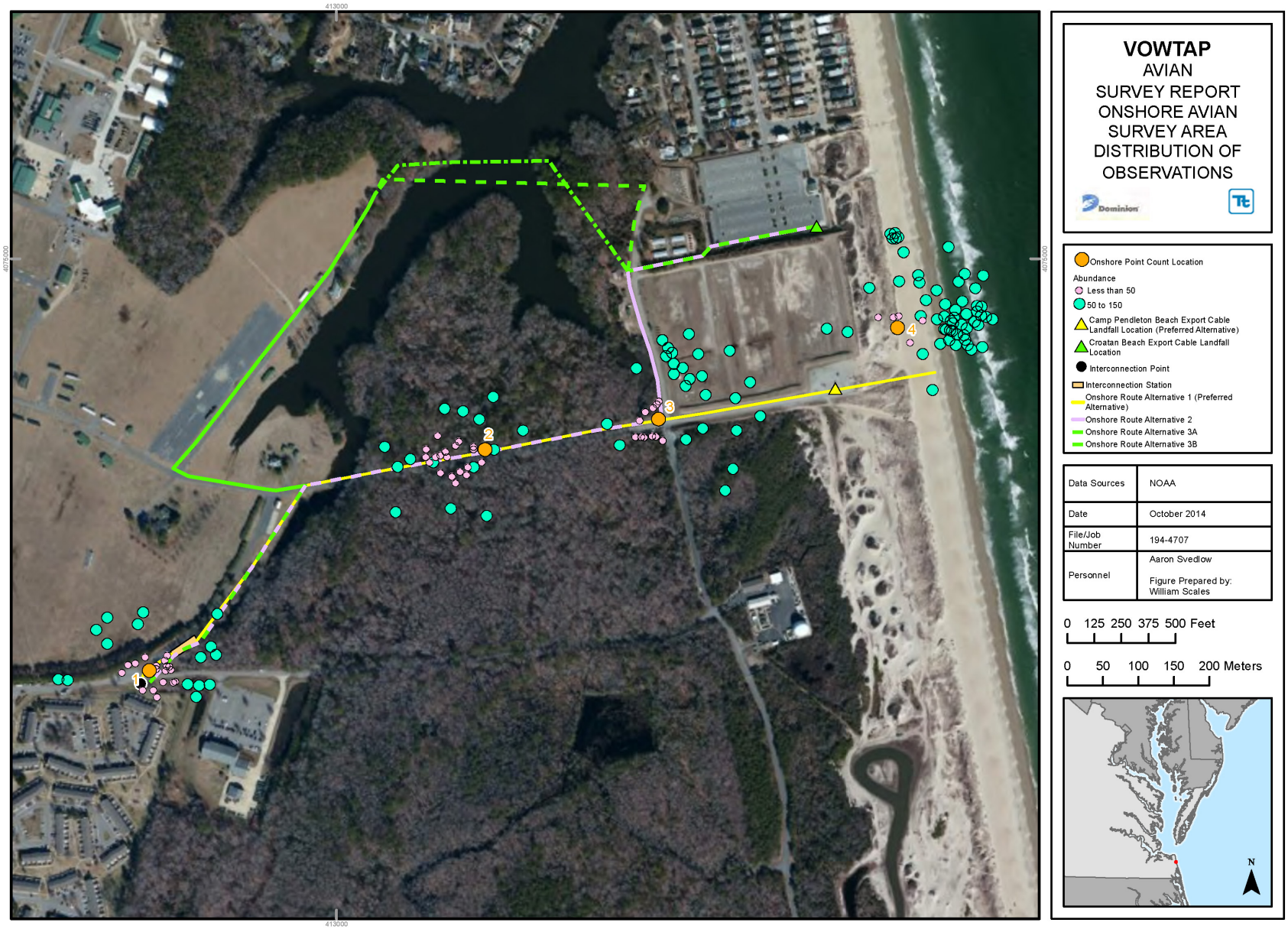

Figure 3-4. Distribution of Bird Observations during the VOWTAP Avian Surveys in the Onshore Survey Area – May 2013 to April 2014

There were 50 species of landbirds/passerines observed during the onshore avian survey period (Attachment A). In addition, we observed six gull species, six raptor species, four seabird species, seven shorebird species, three species of tern, two species of wading bird, and two species of waterfowl (Attachment A). The greatest species richness in the Onshore Survey Area was observed during the early April 2014 survey (S = 46), whereas the lowest species richness was observed during the April 2013 surveys (S = 6). Average species richness across all surveys was 29.8 ± 5.7 species per survey effort.

The number of birds encountered per 30-minute survey in the Onshore Survey Area ranged from 1 bird/30 minutes in April 2013 to 1,349 birds/30 minutes in October 2013. The average number of birds encountered was 163 birds/30 minutes ± 62.

3.2.2 Species Diversity

The Shannon Diversity Index for all data from the Onshore Survey Area pooled was H = 3.0, which is a relatively low value. The Simpson Diversity Index for the Onshore Survey Area was D_s = 0.27. Diversity among point count stations varied, with diversity highest at station 3 and lowest at station 4, as measured by the Shannon Index. The Simpson Diversity Index painted a similar picture of species evenness and diversity across point count stations. According to the Simpson Diversity Index, the highest probability of randomly selecting two individuals from the same species from the sample population would be at point count station 1, and the lowest at point count station 3, indicating that diversity and evenness are generally highest away from the coast and lowest at and near the coast (Table 3-5).

Table 3-5. Summary of Onshore Diversity Metrics during the VOWTAP Onshore Avian Surveys from the Onshore Survey Area – May 2013 to April 2014

Point-Count Station	Shannon Diversity Index (*H*)	Simpson Diversity Index (D_s)
1	0.8	0.8
2	1.2	0.6
3	2.6	0.12
4	2.0	0.19
Overall	**3.0**	**0.27**

3.2.3 Rare, Threatened, and Endangered Species

No federally listed birds were observed during the Onshore Avian Surveys. Bald eagles are no longer listed under the ESA, but are protected under the Bald and Golden Eagle Protection Act. Although two bald eagles were observed during the VOWTAP avian surveys in the Onshore Survey Area, no nests are known to occur along the proposed Onshore Interconnection Cable and Fiber Optic Cable route, or near the proposed Export Cable landfall Site. The closest known bald eagle nests are adjacent to Lake Redwing in the Dam Neck Fleet Training Center, approximately 1.2 mi (2 km) south of the Onshore Survey Area. There are two nests northwest of Lake Redwing (nests VB0601 and VB0702), both of which were occupied in 2013 (CCB 2013).

The following Virginia species of greatest conservation need were observed during the survey effort: chimney swift (*Chaetura pelagica*), whimbrel (*Numenius phaeopus*), northern parula (*Setophaga americana*), black-throated green warbler (*Setophaga virens*), black-bellied plover (*Pluvialis squatarola*), and brown thrasher (*Toxostoma rufum*) (Attachment A).

3.2.4 Distribution

The average number of birds encountered per point-count station for the survey period was 894 birds (SE = 634). Abundance and species richness varied by point-count station (Figure 3-4). The following is a summary of the results of the VOWTAP onshore avian surveys:

- At point-count station 1, the most inland point count station (located near mowed fields), a total of 1,474 birds were observed, 97 percent of which were passerines. A total of 32 species were encountered at point 1.
- At point-count station 2, in the middle of the forested buffer between the maintained fields and Camp Pendleton Rifle Range Road Beach, 590 birds were observed, 97 percent of which were passerines, representing 32 species total.
- At point-count station 3, near the edge of the forested area but west of the Camp Pendleton Rifle Range Road Beach, we observed 443 birds, 82 percent of which were passerines. A total of 42 species were observed at point count station 3.
- At point-count station 4, on the Camp Pendleton Rifle Range Road Beach, 1,071 birds were observed, 27 percent of which were passerines. A total of 24 species were observed at point count station 4. The most abundant species group at point count station 4 was gulls (35 percent) (Table 3-6) (Figure 3-4).

Table 3-6. Summary of Observations by Point-Count Station during the VOWTAP Onshore Avian Surveys from the Onshore Survey Area – May 2013 to April 2014

Species Group	Point 1	Point 2	Point 3	Point 4	Total
Landbird/Passerine	1,436	573	364	294	**2,667**
Gulls	1	1	1	380	**383**
Seabirds	0	0	7	190	**197**
Shorebirds	0	8	65	76	**149**
Terns	0	0	0	116	**116**
Waterfowl	27	0	0	2	**29**
Raptor	7	7	6	5	**25**
Wading	3	1	0	8	**12**
Total	**1,474**	**590**	**443**	**1,071**	**3,578**

Avian abundance in the Onshore Survey Area peaked in October 2013 and was lowest in August 2013. Species richness followed a similar trend (Table 3-7). The peak in landbird-passerine abundance was in October 2013, followed by April 2014. Gull abundance also peaked in October. Seabirds were most abundant in September 2013, and were not observed during surveys in August. Terns were most abundant in August and, along with waterfowl, were the only species group whose abundance peaked in August. Raptors were present during each survey month, but were most abundant in April and August.

Table 3-7. Summary of Onshore Observations by Month during the VOWTAP Onshore Avian Surveys from the Onshore Survey Area – May 2013 to April 2014

Species Group	Apr. 2013	Aug. 2013	Sept. 2013	Oct. 2013	Early Apr. 2014	Late Apr. 2014	Total
Landbirds /Passerines	0	32	92	1,889	474	178	**2,667**
Gulls	1	52	17	255	37	21	**383**
Seabirds	1	0	90	24	64	18	**197**
Shorebirds	0	14	40	7	43	48	**66**
Terns	0	39	24	3	31	19	**61**
Waterfowl	1	25	0	1	2	0	**27**
Raptors	5	5	2	4	4	5	**16**
Wading Birds	0	0	8	0	1	0	**11**
Species Richness (*S*)	**6**	**24**	**29**	**38**	**46**	**36**	**3,578**
Total	**8**	**167**	**273**	**2,188**	**656**	**286**	**79**

3.3 Transit Survey Area

In the Transit Survey Area a total of 2,616 birds were encountered, representing 32 identifiable species (n = 2,574 individuals) as well as unidentified alcids (n = 32) and unidentified shorebirds (n= 10) (Figure 3-5, Table 3-8). The five most abundant species observed included Bonaparte's gull (*Chroicocephalus philadelphia*) (n = 591, 23 percent), royal tern (*Thalasseus maximus*) (n = 579, 22 percent), red-throated loon (*Gavia stellata*) (n = 342, 13 percent), razorbill (n = 341, 13 percent), and common loon (n = 204, 8 percent).

Table 3-8. Results of the VOWTAP Offshore Avian Surveys from the Transit Survey Area – May 2013 to April 2014

Common Name	Scientific Name	Number Observed
Bonaparte's gull	*Chroicocephalus philadelphia*	591
Royal tern	*Thalasseus maximus*	579
Red-throated loon	*Gavia stellata*	342
Razorbill	*Alca torda*	341
Common loon	*Gavia immer*	204
Northern gannet	*Morus bassanus*	118
Laughing gull	*Leucophaeus atricilla*	110
Surf scoter	*Melanitta perspcillata*	63
White-winged scoter	*Melanitta deglandi*	56
Purple martin	*Progne subis*	55
Unidentified alcid	*Alcidae*	32
Scoter sp.	*Melanitta sp.*	23
Brown pelican	*Pelecanus occidentalis*	18
Herring gull	*Larus argentatus*	15
Great black-backed gull	*Larus marinus*	14
Double crested-cormorant	*Phalacrocorax auritus*	13
Common tern	*Sterna hirundo*	11
Unidentified shorebird sp.	–	10
Black scoter	*Melanitta americana*	8
Northern fulmar	*Fulmaris glacialis*	5
Sandwich tern	*Thalasseus (Sterna) sandvicensis*	5

Table 3-8. Results of the VOWTAP Offshore Avian Surveys from the Transit Survey Area – May 2013 to April 2014 (continued)

Common Name	Scientific Name	Number Observed
Dunlin	*Calidris alpina*	4
Cory's shearwater	*Calonectris diomedea*	3
Horned grebe	*Podiceps auritus*	3
Audubon's shearwater	*Puffinus lherminieri*	2
Black tern	*Childonias niger*	2
Caspian tern	*Hydroprogne caspia*	2
Osprey	*Pandion haliaetus*	2
Belted kingfisher	*Megaceryle alcyon*	1
Gull species	*Larus spp.*	1
Lesser black-backed gull	*Larus fuscus*	1
Peregrine falcon	*Falco peregrinus*	1
Red-necked grebe	*Podiceps grisegena*	1
Sanderling	*Caldris alba*	1
Short-billed dowitcher	*Limnodromus griseus*	1
Whimbrel	*Numenius phaeopus*	1
	Total	**2,616**
	Species Richness (*S*) (number of identifiable different species)	**32**

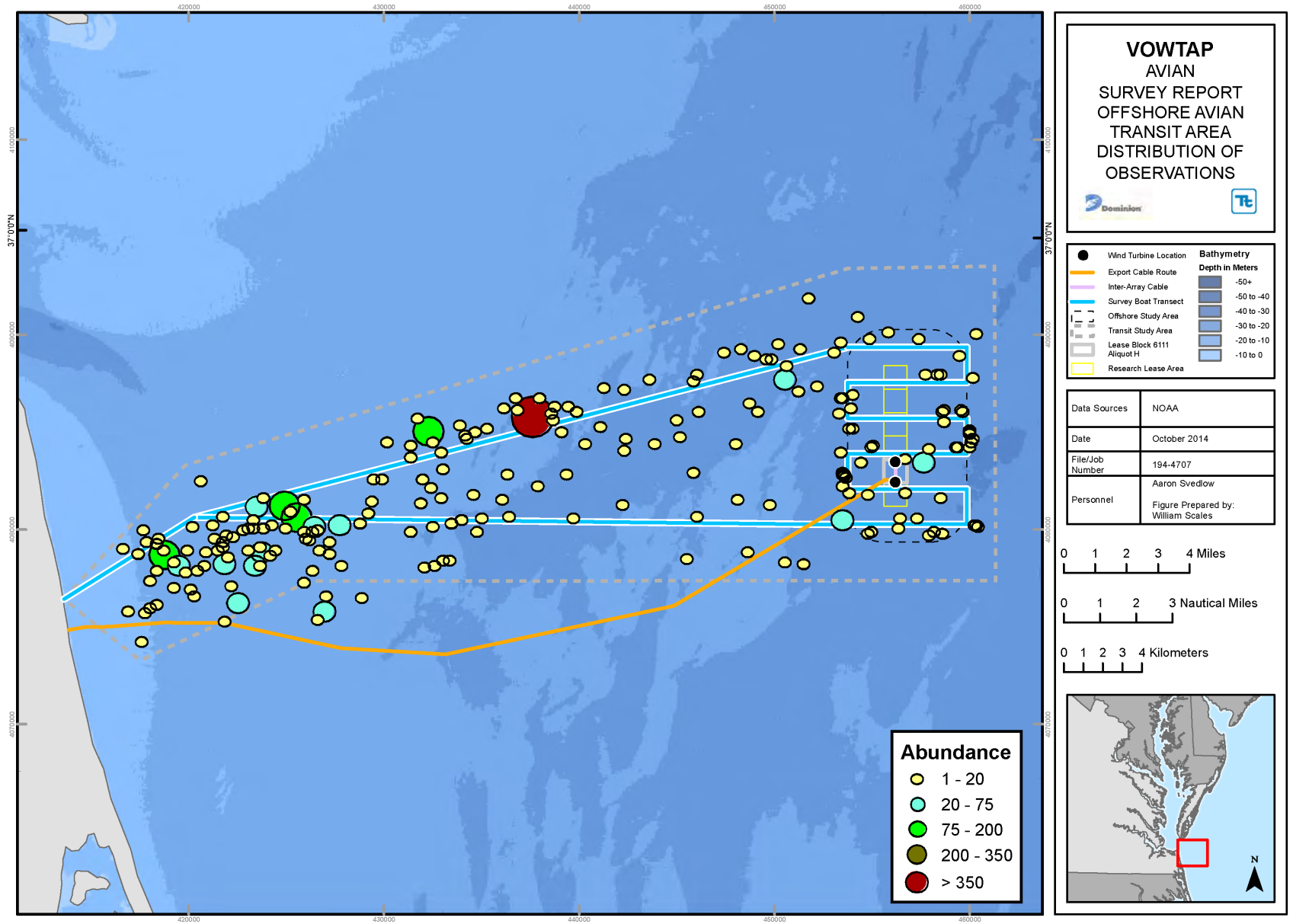

Figure 3-5. Distribution of Bird Observations during the VOWTAP Avian Surveys in the Transit Survey Area – May 2013 to April 2014

4 DISCUSSION

4.1 Offshore Survey Area

The Offshore Survey Area was located approximately 24 nm (27 mi, 43 km) from the southern Virginia coast. Waters within the Offshore Survey Area provide seasonal habitat for loons, sea ducks, gulls, terns, pelagic birds (e.g., shearwaters, storm-petrels, and allies), and alcids (e.g., dovekie [*Alle alle*], razorbill). The distance between the Offshore Survey Area and shore, as well as other factors, is likely responsible for the low abundance and diversity observed during the surveys in the Offshore Survey Area in comparison with the results of other similar studies conducted on the Mid-Atlantic OCS (Petersen et al. 2006, New Jersey Department of Environmental Protection 2010, Williams 2013). Compared to the Transit Survey Area, the Offshore Survey Area had substantially less overall abundance and fewer species. No federally listed bird species were observed during the survey period at the Offshore Survey Area.

Diversity, as well as abundance, varied seasonally in the Offshore Survey Area. The Shannon and Simpson Diversity Indices changed between the interim survey period (May–October 2013) and the comprehensive survey period (May 2013–April 2014). The Shannon Diversity Index decreased from H = 2.01 to H = 0.95, demonstrating that fewer species accounted for more of the observations during the comprehensive survey period than during the interim survey period, thereby reducing evenness and decreasing diversity. This is likely a result of the large number of northern gannet and razorbill observations during the winter months, tempered by the increase in richness observed during the interim survey period (12 species) and during the comprehensive survey period (23 species). The Simpson Diversity Index for the Offshore Survey Area increased markedly between the comprehensive survey period (D_s = 0.66) and the interim survey period (D_s = 0.16). D_s is a measure of the probability that two individuals selected at random from the sample population will belong to the same species. The increase in D_s from the interim to the comprehensive survey period is an indication that the avian population of the Offshore Survey Area became slightly more diverse between the late spring, summer, and fall survey periods (May 2013–October 2013) and the winter and late spring periods (November 2013–April 2014), but that despite an increase in diversity, the abundance of a few species was much higher than most other species observed (e.g. northern gannet and razorbill). The observed increase in both diversity indices and abundance overall was likely a result of the large number of northern gannets observed during the February 7, 2014, survey.

Flight heights in the Offshore Survey Area were generally low and below the rotor-swept zone of the proposed WTGs[2]. Slightly more than half of birds observed (57.2 percent) during the survey period were flying, and slightly less than half (42.8 percent) were sitting on the water. Flight heights in the Offshore Survey Area during the survey period averaged 15 m (49 feet) (SE = 1.6 m [5 ft]), which is well below the RSZ of the proposed WTGs (27.2–177.2 m amsl [89–581 ft amsl]). A total of 104 birds, the majority of which were northern gannets (n = 98), were observed flying in the 26–125 m (85–410 ft) flight height category (85–410 ft), which includes the majority of the RSZ of the proposed WTGs. Species observed

[2] In October 2014 the proposed WTG height increased 3 m (10 ft). Conclusions from this analysis are unchanged.

flying in the RSZ of the proposed WTG may have a greater potential for risk of collision than other species.

Collision rates have been modeled for some species, primarily sea birds, at existing European offshore wind farms (Rothery et al. 2009). This collision modeling and results of post-construction monitoring in Europe provide evidence that collision rates for WTGs offshore are likely lower than collision rates for WTGs onshore and in coastal areas (Nicholson at al. 2005, NJAS 2008, Tierney 2009). However, the complex ways in which birds interact with the marine environment and the diversity of taxa present are confounding factors for estimating collision risk.

Results from the Offshore Survey Area indicate a lower overall abundance and species richness than the Transit Survey Area or other areas on the OCS that have been surveyed with similar methods (Petersen et al. 2006, New Jersey Department of Environmental Protection 2010, Williams 2013). A species by species comparison between the interim results of the Mid-Atlantic Baseline Study (Williams 2013) and the interim results of the VOWTAP Offshore Avian Surveys was prepared as part of the VOWTAP RAP risk assessment submittal in December 2013. The results of surveys conducted at the Offshore Survey Area since submittal of the VOWTAP RAP reinforce the conclusions reached in the RAP risk assessment. The only divergence is the large number of northern gannets observed in the Offshore Survey Area since the RAP assessment. At the time of the RAP assessment, northern gannets had not been observed in the Offshore Survey Area; however, a total of 1,222 northern gannets (83 percent of total observations) were observed in the Offshore Survey Area during the winter and early spring of 2014. This increase in abundance is consistent with other datasets collected during the winter and early spring on the OCS east of Virginia. During the Mid-Atlantic Baseline Studies in 2012 a total of 408 individuals (3.2 percent of total observations) were observed during aerial surveys and 2,809 (37 percent of total observations) during ship-based surveys (Williams 2013). During the Mid-Atlantic Baseline Surveys northern gannets were only observed during March, April, May, June, and November (Williams 2013). Large concentrations of northern gannets on the OCS during the winter are not unusual, especially when ephemeral concentrations of bait fish form (Mowbray 2002). There is little evidence to indicate that the Offshore Survey Area provides a consistent concentration of bait fish that would concentrate northern gannet activity on a regular basis. The majority of the northern gannets observed in the Offshore Survey Area were observed during a single survey effort on February 7, 2014 (n = 1,166). This episodic increase in the occurrence of northern gannets was almost certainly associated with opportunistic foraging on a concentration of prey southwest of the area where WTGs are proposed. Although wind turbines may cause birds to be displaced from regularly used foraging areas, the proposed Project is not expected to cause the displacement of northern gannets or other species (Fox et al. 2006). Data collected in the Offshore Survey Area indicate that the area where the WTGs are proposed does not consistently concentrate large numbers of birds, and could not be considered an important feeding area; therefore, displacement effects are not expected to manifest as a result of the proposed WTGs (Fox et al. 2006). However, many unknowns remain about how WTGs may impact avifauna in the marine environment.

The results of the ship-based surveys from the Offshore Survey Area and Transit Survey Area provide baseline information on which to evaluate the potential effects of the proposed VOWTAP. It is evident that avian activity in the Offshore Survey Area is generally low compared with other areas of the Mid-Atlantic region (O'Connell et al. 2009, O'Connell et al. 2011, Williams 2013). The species that were the

most frequently observed in the survey area are generally common in the region. Modeling by O'Connell et al. (2009) indicates that the species most frequently observed in the Offshore Survey Area (northern gannet, razorbill, common loon, and great black-backed gull) occur seasonally in the Mid-Atlantic, but are not uniformly distributed. Concentrations of loons for example are generally higher closer to the outlets of large bay systems, whereas concentrations of great black-backed gull are generally more uniform on the OCS in the Mid-Atlantic (O'Connell et al. 2009). Our observations of the temporal distribution of northern gannets are generally consistent with the results of O'Connell et al. (2009) modeling. Northern gannets occur in the Mid-Atlantic region in the greatest abundance in winter and spring, and concentration may increase in spring on the OCS east of Chesapeake Bay north to the New York Bight. Razorbills in contrast, have a more restricted distribution near the coast and occur on the Mid-Atlantic OCS almost exclusively in the winter at a low relative abundance, which is consistent with our observed temporal and spatial distribution of the species (O'Connell et al. 2009).

One important aspect of the VOWTAP study program moving forward will be to evaluate impacts of WTGs on avifauna. As such, Dominion has agreed to implement a post-construction monitoring program during operation of the Project to evaluate actual impacts from the WTGs. Details of the post-construction monitoring plan will be developed in coordination with state and federal agencies.

4.2 Onshore Survey Area

Species diversity, richness, and abundance generally increased at point-count locations further inland in the Onshore Survey Area. No federally listed species were observed during the survey period and we did not document any osprey (*Pandion haliaetus*), bald eagle, or colonial wading bird nests along the Onshore Interconnection Cable and Fiber Optic Cable routes.

4.3 Transit Survey Area

In the Transit Survey Area species richness decreased with distance from shore, as did abundance. A single state-listed species, peregrine falcon, was observed during survey in the Transit Survey Area. Although peregrine falcons are known to migrate offshore, the species is not known to forage offshore. Peregrine falcons are unlikely to occur in high densities in the Research Lease Area because they only occur offshore during migration and do not nest or forage on the water. The species is not known to nest near any of the Project's onshore facilities. No federally listed species were observed during the survey period in the Transit Survey Area.

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Attachment A – Species Detected in the VOWTAP Onshore Survey Area – April 2013 to April 2014

Common Name	Point 1	Point 2	Point 3	Point 4	Total
Common grackle	1301	450	6		1757
Tree swallow		41	110	275	426
Laughing gull				317	317
Double-crested cormorant			7	141	148
Royal tern				82	82
European starling	36		44		80
Sanderling				72	72
Whimbrel	3		65		68
American robin		1	54		55
Brown pelican				46	46
Herring gull				44	44
House finch	11	1	26		38
American crow	8	12	7		27
Red-winged black bird			27		27
Canada goose	27				27
American goldfinch	5	5	16		26
Common tern				24	24
Eastern bluebird			20		20
Ring-billed gull		1	1	17	19
Carolina wren	8	8	2		18
Northern cardinal	5	9	3		17
Barn swallow				16	16
Cedar waxwing	14				14
Mourning dove	13	1			14
Carolina chickadee	5	5	4		14
Osprey	1	3	5	4	13
Forster's tern				10	10
Blue-grey gnatcatcher	2	5	2		9
White-throated sparrow	6	2	1		9
Great-blue heron		1		8	9
Dunlin		8			8
Unidentified Blackbird sp.			8		8
Blue jay	5		3		8
Pine warbler		6			6
Chimney swift	5		1		6
Ruby-crowned kinglet		6			6
Purple martin			2	3	5
Brown-headed cowbird		1	4		5
Red-eyed vireo		5			5
White-eyed vireo	1		3		4
Pileated woodpecker		4			4
Turkey vulture	2	2			4
Northern mockingbird	1	1	2		4
Northern flicker	1	1	2		4
Chipping sparrow	1		2		3
Eastern tufted titmouse		3			3
Cooper's hawk	2			1	3
Northern parula	1	1	1		3
Brown thrasher		2	1		3

Common Name	Point 1	Point 2	Point 3	Point 4	Total
Myrtle warbler	1		2		3
Bald eagle	2				2
Sharp-shinned hawk		1	1		2
American redstart	1		1		2
Fish crow	2				2
Surf scoter				2	2
Red-necked grebe				2	2
Black-throated blue warbler	1		1		2
Eastern towhee	1		1		2
Black-bellied plover				1	1
Red-bellied woodpecker		1			1
Bonaparte's gull				1	1
Lesser yellowlegs				1	1
Great black-backed gull				1	1
Downy woodpecker			1		1
Song sparrow			1		1
Red-tailed hawk		1			1
Stilt sandpiper				1	1
Ruby-throated hummingbird			1		1
Eastern phoebe			1		1
Rusty blackbird			1		1
Unknown larus species gull	1				1
Northern gannet				1	1
Blue grosbeak			1		1
Blackpoll warbler		1			1
Whimbrel				1	1
Great-crested flycatcher			1		1
Yellow-bellied sapsucker		1			1
Great egret			1		1
Greater yellowlegs	1				1
Total	**1,474**	**590**	**443**	**1,071**	**3,578**
Species Richness (*S*) (number of different species)	**32**	**32**	**42**	**24**	**79**