J1. Visual Impact Assessment (May 2022)

Visual Impact Assessment

Revised May 2022

Maryland Offshore Wind Project

Prepared For:

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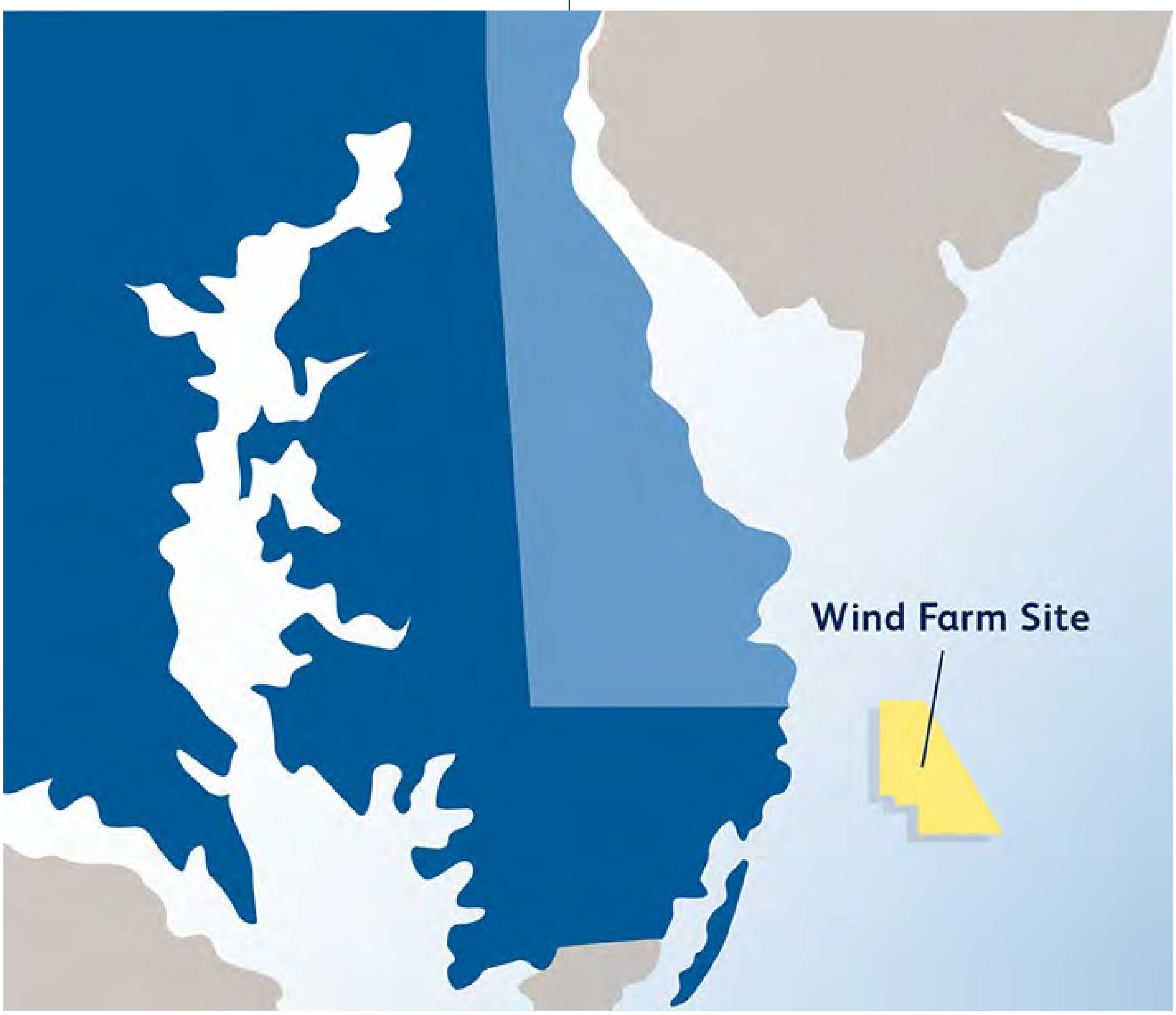

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List of Abbreviations

Notation	Definition
ADLS	Aircraft Detection Lighting System
AMSL	Above Mean Sea Level
APE	Area of Potential Effects
BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
COP	Construction and Operations Plan
FAA	Federal Aviation Administration
FOV	Field of View
FPM	Flashes per Minute
GIS	Geographic Information System
HDD	Horizontal Directional Drilling
km	Kilometer
LSZ	Landscape Similarity Zone
MHHW	Mean Higher High Water
mi	Mile
mm	Millimeter
MSL	Mean Sea Level
MW	Megawatts
NAIP	National Aerial Imagery Program
NLCD	National Land Cover Database
NM	Nautical Mile
NRHP	National Register of Historic Places
OCS	Outer Continental Shelf
OSS	Offshore Substation
PDE	Project Design Envelope
SHPO	State Historic Preservation Office
U.S.	United States of America
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard

Notation	Definition
USGS	United States Geological Survey
VIA	Visual Impact Assessment
VSA	Visual Study Area
WTG	Wind Turbine Generator
ZTV	Zone of Theoretical Visibility

1.0 Introduction

ESS Group, LLC (ESS), who merged with the TRC Companies in 2022, was retained by US Wind, Inc. (US Wind) to prepare a Visual Impact Assessment (VIA) for the proposed Maryland Offshore Wind Project (the Project) within OCS-A 0490 (the Lease), a Lease area of approximately 80,000 acres located approximately 18.5 km (11.5 miles) off the coast of Maryland on the Outer Continental Shelf.

1.1 Visual Impact Assessment Process

1. Establish an appropriate Visual Study Area (VSA) and Area of Potential Effects (APE).
2. Identify historic properties and visually sensitive resources within the APE.
3. Identify the Landscape Similarity Zones (LSZs) and User Groups within the VSA.
4. Complete a viewshed analysis of the VSA.
5. Field Photography - Visit and photograph the wind farm location from publicly accessible key observation points.
6. Prepare simulations from representative viewpoints.
7. Assess the visual impacts associated with the PDE.

2.0 Project Description

2.1 Project Design Envelope

The Project Design Envelope (PDE) considers wind turbines with nameplate capacity rating of up to 18 megawatts (MW). The offshore components in the PDE consist of up to 121 wind turbine generators (WTGs), up to 4 offshore substations (OSSs), a Meteorological (Met) Tower, inter-array cables, and up to four export cables buried beneath the seabed. The inter-array and offshore export cables would not be visible during operation of the Project and have therefore been excluded from this assessment.

2.2 Wind Turbine Generators

The nacelle and blade tip height of WTGs in the PDE will vary based on the turbine capacity rating, up to a maximum nacelle height of 161 meters (528 feet) above mean sea level (MSL) and a maximum rotor diameter of 250 meters (820 feet), for a maximum blade tip height of 286 meters (938 feet). The maximum number of WTGs in the PDE is 121. For purposes of the visual assessment, the maximum size (286 meters [938 feet]) and number of WTGs (121) in the PDE was selected for evaluation based on the assumption it would be the most visible. The WTGs were assumed to be in any of 125 potential locations within the Lease area, and therefore the OSSs were not simulated. Figure 2-1 below, shows a schematic diagram of the representative WTG used in the visual impact assessment. Figure 1[1] illustrates the proposed WTG layout. In the proposed layout, the WTGs are oriented in a grid pattern with spacing of approximately 1.02 nautical miles (NM) (1.17 miles) north to south by 0.77 NM (0.89 miles) east to west.

[1] Figures 1 through 8 are included as attachments to this Visual Impact Assessment.

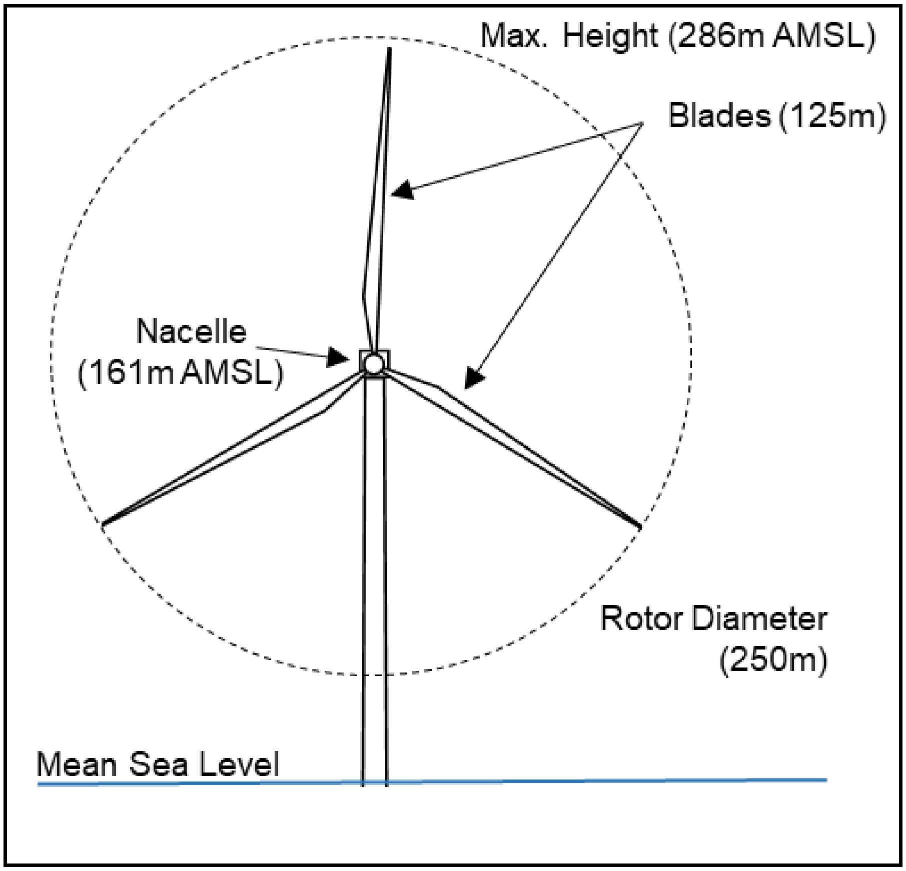

Figure 2-1. Wind Turbine Generator Schematic Diagram

2.3 Offshore Substations

The WTGs would be connected to up to four (4) OSSs where the voltage would be increased, and the power would be transmitted to the interconnection point via the offshore export cables. The OSSs would be installed on a foundation in the proposed locations shown on Figure 1. The OSS height would be significantly lower than the WTGs and would therefore not be visible above the horizon in the majority of the shoreward VSA. Under the PDE, the maximum height would be 60 meters (197 feet) (see COP Volume I, Section 2.3 for more details).

2.4 Met Tower

A Met Tower would be located along the southern edge of the Lease area. The Met Tower would also be significantly lower than the WTGs and would not be visible above the horizon in the majority of the shoreward VSA.

2.5 Lighting and Marking of Structures

US Wind's proposed lighting and marking scheme is included in Appendix II-K2 of the Construction and Operations Plan (COP). The lighting and marking described below is proposed and subject to approval by BOEM, the Federal Aviation Administration (FAA), the U.S. Coast Guard (USCG), and other relevant agencies.

Lighting and marking of structures would comply with FAA guidance regarding aviation obstruction lighting of structures and BOEM's Lighting and Marking of Structures Supporting Renewable Energy Development (BOEM 2021b). US Wind would place lighting and signage on applicable structures to aid navigation per USCG circular NVIC 01-19 Guidance on the Coast Guard's roles and responsibilities for Offshore Renewable Energy Installations (USCG 2019) and comply with any other applicable USCG requirements. An Aircraft Detection Lighting System (ADLS) is planned for the Project if technically feasible, commercially available, and approved for use by FAA, BOEM, and USCG. FAA obstruction lighting on the WTGs and OSSs would only illuminate when aircraft are approaching the Lease area.

Perimeter structures of the wind farm, located on the corners or other significant peripheral points, would be marked with quick flashing yellow marine lanterns with 360° visibility and an operational range of at least 5 NM. Intermediate perimeter structures, located along the outside boundary, would be marked with 2.5-second flashing yellow marine lanterns with 360° visibility and an operational range of at least 3 NM. Inner boundary structures would be marked with 6 or 10 second yellow flashing marine lanterns with 360° visibility and with a 2 NM operational range. Lights servicing the same structure designation would be synchronized.

2.5.1 Wind Turbine Generators

Aviation safety lighting consisting of two medium intensity flashing red obstruction aviation lights are proposed atop the nacelles, four low-intensity flashing red obstruction lights mid-tower around the tower in a ring, and a helicopter hoist status light. The aviation lights would flash simultaneously at 30 flashes per minute (FPM). The structure aviation safety lights would be visible in all directions in the horizontal plane. See Appendix II-K2 for the PDE lighting and marking scheme. When ADLS is activated upon detection of a nearby aircraft, obstruction lighting would be illuminated, but would otherwise be turned off. If ADLS is not approved for use in the Project, all FAA lights would need to be illuminated to adhere to FAA guidance noted above, which prohibits unlit gaps greater than 1 statute mile between structures.

WTGs would be marked conspicuously and distinctly for both day and night recognition. Amber flashing navigation beacons of different intensities would be installed on all WTGs. The amber flashing navigation lights would be energized from sunset to sunrise and from sunrise to sunset in restricted visibility. Navigaton lights would be visible in all directions from the horizontal.

The foundation of all WTGs would be painted yellow (RAL 1023) from the level of Mean Higher High Water (MHHW) to 15 meters (50 feet) above MHHW. Ladders at the foundation base of all turbines would be painted in a color that contrasts with the recommended yellow for ease of identification for operations and maintenance personnel. All major upper WTG components, including nacelles, blades, and towers, would be painted with color no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey. The WTG paint color will be determined in consultation with BOEM, FAA, and USCG. The simulations presented in this Visual Impact Assessment conservatively use RAL 9010 Pure White.

Each WTG would be designated, marked and charted with a unique alphanumeric designation for quick recognition and reference by mariners and agencies for search and rescue, law enforcement, and other purposes. The bottom of the alphanumeric designation would be located at least 9 meters (30 feet) and no more than 15 meters (50 feet) above MHHW. They would be approximately 3 meters (10 feet) in height, would be visible above any service platforms in a 360-degree arc from the water's surface, and would be applied with retro-reflecting paint to enhance visibility under low light conditions. Each WTG's unique alphanumeric designation would be duplicated below the service platforms.

2.5.2 Offshore Substations

Proposed lighting and marking of each OSS would include two medium intensity flashing red obstruction aviation lights, four low-intensity flashing red obstruction lights in a ring, and a helicopter hoist status light. The aviation lights would flash simultaneously at 30 flashes per minute (FPM). The structure aviation safety lights would be visible in all directions in the horizontal. Each OSS would be marked with 6 or 10 second yellow flashing marine lanterns with 360° visibility and with a 2 NM operational range.

2.5.3 Met Tower

The Met Tower is proposed to be equipped with white marine lanterns with an operational range of 10 NM.

2.6 Onshore Facilities

The proposed onshore facilities would consist of up to two new US Wind substations and interconnection to the Indian River 230 kV substation located adjacent to NRG's Indian River Power Station near Millsboro, Delaware (Figure 2), as well as an Operations and Maintenance (O&M) facility in the Ocean City, Maryland region.

The two proposed new substations would be arranged generally northwest and southwest of the Indian River substation. The onshore export cables would exit the horizontal directional drilling (HDD) duct, into underground transition vaults, and traverse underground to be terminated at the respective US Wind substation block.. A short overhead line would make the connection from each substation block to the Indian River substation. The location of the substations and interconnection are shown on Figure 2. Limited tree clearing may be required for the new Project substations and for expansion of the existing substation.

The proposed additional facilities would consist of extensions to the existing DPL Substation to accommodate the Project and two new US Wind substations. The layout of the substations would be the same at Cool Spring and Milford substations, alternate locations for the onshore facilities under consideration by US Wind. The DPL Substation would have a maximum height of approximately 18 m (60 ft). The size of the new substations will depend on the final design. A gas insulated substation would have a maximum height of approximately 18 m (60 ft) and a maximum footprint of approximately 107 m by 132 m (351 ft by 434 ft). An air insulated substation would have a maximum height of approximately 9 m (29 ft) and a maximum footprint of approximately 116 m by 205 m (380 ft by 672 ft). The proposed substation, once constructed, would be connected to the DPL Substation by an overhead line less than 152 m (500 ft) long. This is consistent with the existing substation visual character and appearance in terms of components and height (see Figure 2-2).

Figure 2-2. Indian River Substation

The onshore substations and DPL substation expansion is proposed in the immediate vicinity of the NRG Indian River Power Plant. The facility is highly industrialized and consists of multiple buildings, coal conveyors, a large coal pile, transmission lines in, around, and exiting the site, and three tall stacks (see Figure 2-3). Due to these existing conditions, the proposed additional facilities have not been evaluated further.

Figure 2-3. NRG Indian River Power Plant

The proposed O&M Facility would be located near the Ocean City Inner Harbor. The facility would likely utilize an existing structure, which would not change the existing visual character to the Ocean City Inner Harbor, an area characterized by industrial development and maritime industrial use (see Figure 2-4). Examples of development within the Ocean City Inner Harbor area include multiple marinas and boathouses, parking lots, piers and bulkheads, charter companies, and restaurants. This facility has not been evaluated further for this VIA.

Figure 2-4. Proposed Location of O&M Facility

3.0 Existing Visual Character

3.1 Visual Study Area

In order to address Project visibility from visually sensitive resources, a VSA was first established. The VSA is the approximate area in which there is a potential for visual impacts associated with the Project. The Clean Energy States Alliance Report, "A Visual Impact Assessment Process for Wind Energy Projects" suggests that a study area for offshore turbines may extend to 32 kilometers (20 miles) from the outermost turbines, as opposed to 16 kilometers (10 miles) for onshore turbines, given the varying technology and size of the WTGs

(CESA 2011). The Bureau of Land Management (BLM) uses the following range of distance zones when considering land use decisions for managing visually sensitive resources in BLM Resource Management Plans: Foreground to middle ground views extend from the viewing location out up to 8 km (5 mi), background views range from 8 to 24 km (5 to 15 mi), and views beyond 24 km (15 mi) are classified as the “Seldom Seen” zone (Sullivan et al. 2012). Observations of existing offshore facilities suggest that night visibility of aviation hazard signals are visible at distances greater than 39 km (24 mi) (Sullivan et al. 2013) and onshore wind turbines aviation lighting seen at distances greater than 58 km (36 mi) (Sullivan et al. 2012) (Note: Only the aviation lighting may be visible at these distances, not the structures.). Based on the BLM zones and the Zone of Theoretical Visibility (ZTV) of the proposed turbine models, 64 kilometers (40 miles) (applied as a radius buffer around each WTG) was determined to be an appropriate distance for the purposes of establishing a visual threshold and to represent the VSA. For daytime observations, this study area is likely overly conservative.

The resulting VSA is 13,019 km^2 (5,027 mi^2) in area and encompasses 171 km (106 mi) of oceanfront shoreline in Maryland, Delaware, Virginia, and New Jersey. Approximately 3,720 km^2 (1,436 mi^2) (21 percent) of the area is landward of the shoreline (henceforth: the shoreward study area). The balance is area within the Atlantic Ocean (Figure 3). The VSA includes portions of the counties and communities listed in Table 3-1.

Table 3-1. Cities and Towns within the Visual Study Area

Name	County
Delaware	
Bethany Beach*	Sussex
Dagsboro	Sussex
Delmar	Sussex
Dewey Beach*	Sussex
Ellendale	Sussex
Fenwick Island*	Sussex
Frankford	Sussex
Georgetown	Sussex
Henlopen Acres*	Sussex
Lewes	Sussex
Millsboro	Sussex
Millville	Sussex
Milton	Sussex
Ocean View	Sussex
Rehoboth Beach*	Sussex

Name	County
Selbyville	Sussex
South Bethany*	Sussex
Maryland	
Berlin	Worcester
Delmar	Wicomico
Ocean City*	Worcester
Pittsville	Wicomico
Pocomoke City	Worcester
Salisbury	Wicomico
Snow Hill	Worcester
Willards	Worcester
New Jersey	
Cape May City*	Cape May
Cape May Point (Borough)*	Cape May
Lower Township*	Cape May
Middle Township	Cape May
North Wildwood City*	Cape May
Stone Harbor (Borough)*	Cape May
West Cape May (Borough)	Cape May
West Wildwood (Borough)	Cape May
Wildwood City*	Cape May
Wildwood Crest (Borough)*	Cape May
Virginia	
Chincoteague*	Accomack

**Indicates coastal municipality*

Within the VSA, Project visibility in the communities listed above is most prevalent in the coastal cities and towns on the immediate Atlantic shoreline. Throughout the VSA, visibility can be restricted by intervening terrain, vegetation, man-made structures, and by atmospheric conditions. Meteorological conditions such as rain, fog, or haze have the potential to reduce the visual threshold distance dramatically, even for objects directly in the viewer's line of sight.

Appendix D includes a detailed analysis of the annual and seasonal frequency of such conditions and the impact of such meteorological conditions on visibility.

3.2 Existing Regulations

At the time of this submission, none of the states within the VSA, Delaware, Maryland, New Jersey, and Virginia, have regulations concerning the visual effects of offshore wind turbines. Zoning laws in multiple counties have regulations for small and/or large wind energy systems on land. Table 3-2 below summarizes the currently existing information.

Table 3-2. Existing Regulations Related to Visual Character

Regulation or Policy	Description	Applicability
Delaware		
Coastal Management Program *(Certification included as COP Volume II Appendix II-M2)*	Policy 5.4.22.3: The DNREC shall consider the public interest in any proposed activity which might affect the use of subaqueous lands, which includes: The potential effect on the public with respect to commerce, navigation, recreation, aesthetic enjoyment, natural resources and other uses of the subaqueous lands.	The Project is consistent with this policy. Temporary impacts will occur related to construction, installation, and maintenance of the onshore export cables. No construction will occur between Memorial Day and Labor Day.
	Policy 5.5.1: State public lands shall be protected to preserve the scenic, historic, scientific, prehistoric and wildlife values of such areas.	The Project is consistent with this Policy. Potential impacts from the Project are anticipated to be temporary and negligible, limited to the construction and installation of the onshore export cables and temporary cofferdams.
Sussex County Zoning, Article XXV Supplementary Regulations § 115-194.4A(11).	If a new wind turbine is proposed within 200 feet from a building listed on the National Register of Historic Places, then a mix of native deciduous and evergreen trees and shrubs shall be planted between the wind turbine and such building to filter views of the wind turbine from the building.	Not applicable, as this regulation relates to onshore turbines. No WTGs would be built within 200 feet of any National Register of Historic Places building.
Maryland		
Coastal Zone Management Program	Quality of Life Policy 4 – Protection of State Lands & Cultural Resources. The safety, order, and natural beauty of State parks and forests, State reserves, scenic preserves, parkways, historical monuments and recreational areas shall	The Project is consistent with this policy. It is not anticipated that the Project will significantly impact the natural beauty of such areas. No structures are planned within Maryland State waters or along the coast.

Regulation or Policy	Description	Applicability
(Certification included as COP Volume II Appendix II-M1)	be preserved. DNR (B1) Md. Code. Ann., Nat. Res. § 5-209.	
	Quality of Life Core Policy 5: The natural character and scenic value of a river or waterway must be given full consideration before the development of any water or related land resources including construction of improvements, diversions, roadways, crossings, or channelization. MDE/DNR (C7) Md. Code Ann., Nat. Res. § 8-405; COMAR 26.17.04.11.	The Project is consistent with this policy. The natural character and scenic value of a river or waterway would be given full consideration should any land development occur.
	Quality of Life Core Policy 8: Activities which will adversely affect the integrity and natural character of Assateague Island will be inconsistent with the State's Coastal Management Program and will be prohibited. MDE/DNR (B1) Md. Code. Ann., Nat. Res. §§ 5-209, 8-1102.	The Project is consistent with this policy.
	Tidal Wetlands Policy 1 – Projects that alter natural character shall avoid dredging and filling, be water-dependent and provide appropriate mitigation	The Project is consistent with this policy. The Project will not alter the natural character in, on, or over tidal wetlands; tidal marshes; and tidal waters of Chesapeake Bay and its tributaries, the coastal bays adjacent to Maryland's coastal barrier islands, and the Atlantic Ocean.
Ocean City. Code of Ordinances. Chapter 110, Article V. Division 1. Section 110-883.	Onshore small wind energy systems are subject to the use restrictions of the various zoning districts throughout the town.	Not applicable, as this regulation relates to onshore turbines. WTGs will be constructed offshore.
Worcester County. Zoning and Subdivision Control Article. § ZS 1-344(c).	Onshore wind energy conversion systems are subject to district regulations as alternative energy facilities.	Not applicable, as this regulation relates to onshore turbines. WTGs will be constructed offshore.
Wicomico County. Zoning Part 8 Special Standards for Particular Uses. § 225-115.1	Onshore small wind-energy systems shall be an accessory use in all zoning districts subject to the requirements listed in § 225-115.1.	Not applicable, as this regulation relates to onshore turbines. WTGs will be constructed offshore.
New Jersey		
Cape May County. Article VII Historic	Windmills and wind turbines that affect historic sites outside of historic districts must follow the standards adopted by the	Not applicable, as this regulation relates to onshore turbines. WTGs will be

Regulation or Policy	Description	Applicability
Preservation Districts. § 525-39F	Historic Preservation Community under Ord. No. 335-2017.	constructed offshore and will not affect any historic sites
Virginia		
Accomack County	Special use permits required for small and large wind energy systems.	Not applicable, as this regulation relates to onshore turbines. WTGs will be constructed offshore.

3.3 User Groups

Viewer sensitivity was established by identifying specific user groups within the VSA that are most likely to observe changes within the surrounding landscape and seascape. User groups were divided into five categories and are described below. Provided descriptions of sensitivity as high, medium, or low are relative to the other user groups and are based on the differences in familiarity with existing views and activities within the VSA, understanding that sensitivity can also vary due to proximity to shore and intervening terrain or objects. Viewers with higher sensitivity are more aware of existing views and more likely to perceive subtle movement or change to landscape. Viewers with lower sensitivity may be less familiar with existing views or are engaged in activities that do not involve careful observation of the horizon or seascape.

Viewer sensitivity concerning the Project is subjective and may not be easily determined. For example, a user standing on the beach on a clear day would have an unobstructed view of the Project, but three different users could respond differently. One user, with low sensitivity, may not care that the Project is present in their line of sight and ignore it. This would signify a minor change in how they view the landscape, or their landscape experience. A second user, with high sensitivity, may be concerned that there are man-made turbines visible on the open ocean. A third user, also with high sensitivity, may be in awe of the turbines and their role in renewable energy. These latter two users with high sensitivity would undergo a major change in their landscape experience, but in either a positive or negative way. To aid in assessing the visibility of the Project to various user groups, Sullivan et al.'s (2012/2013) visibility rating was used as a reference, summarized below in Table 3-3. It was divided further into categories based on the change in their landscape experience.

Table 3-3. Visibility Rating from Sullivan et al. (2012) and Sullivan et al. (2013a)

Visibility Level	Visibility Rating	Category
Level 1	Visible only after extended, close viewing; otherwise, invisible	Low
Level 2	Visible when scanning in general direction of project; likely to be missed by casual observer	
Level 3	Visible after brief glance in general direction of project and unlikely to be missed by casual observer	Medium

Visibility Level	Visibility Rating	Category
Level 4	Plainly visible and could not be missed by casual observer, but does not strongly attract visual attention, or dominate view, because of apparent size, for views in direction of project	
Level 5	Strongly attracts visual attention of views in general direction of project. Attention may be drawn by strong contrast in form, line, color, texture, luminance, or motion.	High
Level 6	Dominates view because project fills most of visual field for views in its general direction. Strong contrasts in form, line, color, texture, luminance or motion may contribute to view dominance.	

3.3.1 Commuters and Through-Travelers

Commuters and through-travelers are viewers in vehicles who are typically passing through or within an area to reach a destination with only the occasional opportunity to view the landscape. Drivers would be more focused on the roadway conditions and surroundings in the direction of travel but may occasionally glance at the rest of the surrounding landscape. Passengers are more likely to view their surroundings than drivers as they are not focused on the act of driving. The views available to drivers and passengers can be obstructed by other cars, buildings, infrastructure, vegetation, and weather. This depends on which roadway the user group is utilizing to reach their destination. If the user is passing through a state park or a similar undeveloped area (i.e. Delaware Seashore State Park), there may be an unobstructed view of the Project for a period of time. If the user is passing through an urban center (i.e. along Route 1 in Ocean City, Maryland), the view of the Project would be blocked by existing buildings.

Project visibility would vary for drivers and passengers in this user group. Drivers would likely fall under Visibility Rating Level 1 (Table 3-3), because drivers would not have extended unobstructed views of the Project. Passengers would fall under Levels 1 or 2, depending on the location of the road, either inland or coastal, respectively, and the potential obstructions along the roadway. Passengers are more likely than drivers to have the opportunity for an extended, close viewing of the landscape. However, passengers may not be able to focus in the direction of the Project long enough for it to be visible because they are in a moving vehicle. The low visibility for both drivers and passengers would result in a minor change to their landscape experience. Therefore, the overall sensitivity of commuters and through-travelers would likely be low.

3.3.2 Local Residents

Local residents are viewers who live, work, and recreate within the VSA. Residents could view the landscape from potentially anywhere within the VSA at a given time. This can include but is not limited to homes, neighborhoods, workplaces, town centers, parks, and waterways. As a result, residents could be anywhere from on the water in the immediate vicinity of the Project, to well inland with no view of the ocean, or in between, with limited or partial views of the ocean or the Project area.

Project visibility rating would range from Level 1 to Level 6, depending on the location of the viewer when looking in the direction of the Project. Local residents several miles inland from the coast would fall under Level 1 (e.g., Salisbury, Maryland), with no visibility unless they focused in the direction of the Project for an extended period of time. Local residents on the water in oceangoing vessels in the immediate vicinity of the Project or those on the waterfront (e.g., standing on the Ocean City beach or boardwalk) would fall under Level 6, as the Project would dominate their view. A viewer one block away from the ocean may be able to see the Project clearly from a certain angle but may fall under Level 3 or 4 if there are buildings, telephone poles, or other objects in the foreground with a more dominant visual presence than the distant WTGs. Variation in Project visibility would result in either a minor or major change to the user groups landscape experience. Therefore, the sensitivity of local residents would range from low to high depending on their location viewing the Project.

3.3.3 Business Employees

Business employees are viewers who work within the VSA. This user group can encompass many different types of employees, including maritime industry employees, office workers, tourism employees, agricultural workers, commercial workers, and retail workers. The maritime industry employees are discussed in more detail below as a separate user group. In traveling to their place of work, business employees would have limited but occasional chances to view the landscape during their commute. Office workers working within an office building would be focused on work activities and have limited views of adjacent buildings, parking lots, roads, cars, and the occasional landscaped shrubbery. Employees in the coastal tourism industry (e.g., restaurant staff, hotel staff, tour guides) would also be focused on work activities but would likely have more opportunities to view the landscape unobstructed since these businesses are catering to tourists who want the best views possible. Employees within this industry would only be present in significant numbers during the summer season. Agricultural workers would usually be outside in an unobstructed landscape but would be focused on work activities and not the surrounding area. Both commercial and retail workers would likely be inside buildings focused on work activities, but those working in businesses located immediately on the coast would have more opportunities to view an unobstructed landscape (e.g., Ocean City or Bethany Beach boardwalks).

Project visibility rating would range from Level 1 to Level 4, depending on the users' place of employment. Agricultural workers would fall under Level 1, since most agricultural areas within the VSA are not along the coast and therefore the Project would rarely be visible to them (see Section 3.4). Office, commercial, and retail workers would likely fall under Level 1, with no visibility of the Project unless focused in the direction or the Project Area for an extended period of time. However, depending on the buildings' proximity to the coast and building height, these workers may have an unobstructed view of the Project area, resulting in these users falling under Level 4. Employees in the coastal tourism industry would also fall under Level 4 for the same reasons as office workers in a coastally located building. This variation in Project visibility would result in either a minor or major change to the user groups landscape experience. Therefore, the sensitivity of business employees would range from low to high based on from where they are viewing the Project.

3.3.4 Recreational Users

Recreational users are viewers, both locals and tourists, who travel to an area for leisure, which could occur anywhere within the VSA. Users could be undertaking a variety of activities, including but not limited to hiking, biking, fishing, boating, swimming, taking in the scenery, looking for wildlife or enjoying a landscape (e.g., Delaware Seashore State Park, Cape Henlopen State Park, numerous private beaches). Other users may be visiting restaurants for a meal, shopping, attending concerts, or other nighttime-based activities (e.g., Ocean City boardwalk). Based on the activity, users may or may not have an unobstructed view of the Project area. For example, a user hiking in a state forest (e.g., Redden State Forest in Delaware) would be unlikely to see the Project area while a boater on the Delaware or Maryland coast would have a relatively unobstructed view.

Project visibility ratings for recreational users would range from Level 1 to Level 6, depending on the users' location. Users located at inland locations may be focused on the landscape but would be far away from the Project with a variety of obstructions between them and the Project Area, resulting in a Level 1 visibility rating. However, users located on the water in the immediate vicinity of the Project would fall under Level 6, because the Project would be the dominant feature on the landscape. It is possible that some users would seek out the Project as a tourist attraction. This variation in Project visibility would result in either a minor or major change to the user groups landscape experience. Therefore, the sensitivity of recreational users would range from low to high based on from where they are viewing the Project with the VSA.

3.3.5 Maritime Industry Users

Maritime industry users are viewers who earn a livelihood offshore on the Atlantic Ocean, including commercial fishers, vessel crews, and other offshore workers. These users would be able to view the landscape and the Project from a nearby location, likely adjacent to or in the immediate vicinity of the Project on the Outer Continental Shelf. Obstructions would result mostly from weather (e.g., fog, mist, heavy rain) or large vessels such as tankers or container ships in the direct line of sight rather than from distance from the Project. These users may also view the landscape from a coastal location, such as a local marina, dock, or pier (e.g., within Ocean City Harbor or Indian River Bay).

Project visibility rating for this user group would range from Level 1 to Level 6, based on the activity of the user at a given time. As stated above, the main obstructions for those working directly on the Atlantic Ocean would be weather related or due to other vessels. For those users transiting offshore from land, the Project would be the dominant feature on the landscape, representing a Level 6. It is likely that a user actively working (i.e., oriented towards the water's surface pulling in crab pots, loading passengers at a pier, unloading catch, work on or around the dock) would be less sensitive than a user transiting between locations, focusing on the landscape to reach their destination. A user actively engaged in working would fall under Level 1 or 2. Sensitivity for this user group would therefore range from low to high.

3.4 Landscape Character and Visual Setting

To quantify the visual impact a project may have on a VSA, it is helpful to delineate and define the various character defining zones within the VSA. Landscape Similarity Zones (LSZs) are defined as homogeneous geographic areas that exhibit similar vegetation, topography, water resources, and land use patterns. Established visual assessment methodologies (Smardon 1988), such as the use of regional and local knowledge, field observations, and Geographic Information System (GIS) analysis of the U.S. Geological Survey (USGS) National Land Cover Dataset (USGS 2019), were accessed to assist in identifying LSZs within the VSA.

The National Land Cover Database (NLCD) served as the basis for this analysis. Because land cover refers to the actual surface cover of the earth, it is typically analyzed using remote-sensing, or spatial analysis. The NLCD classification system was developed using impervious threshold values resulting from Percent Developed Imperviousness and Percent Imperviousness Change Analysis based on a series of remote-sensing data. The resulting values were hand edited using high resolution National Aerial Imagery Program (NAIP) Imagery to reduce omission and commission error. In total, there are eight (8) NLCD Classes that are further categorized into 21 unique classification descriptions, or values (MRLC 2019).

The Project VSA includes 19 unique NLCD classification descriptions or values. Because land cover, when combined with field observations and regional knowledge, can be used to infer land use, TRC was able to delineate ten (10) distinct LSZs within the VSA. The LSZs identified within the study area are illustrated in Figure 4, Overview of Landscape Similarity Zones, and in detail in Figure 5, Landscape Similarity Zones. Table 3-4, *Summary of Landscape Similarity Zones within the Visual Study Area*, provides an outline of the NLCD descriptions within each LSZ and provides an estimate of the area and percentage of each NCLD class within the VSA. Table 3-5, *Summary of Landscape Similarity Zones within the Shoreward Visual Study Area*, provides an outline of the NLCD descriptions within the shoreward portion of the visual study area. Each of these LSZs is described below.

The most prominent cover type within the VSA is open water. Open water covers approximately 81.3 percent of the 64-kilometer (40-mile) VSA and includes open ocean, bays, and ponds. Open water within the shoreward study area excludes open ocean in the Atlantic beyond the barrier islands of Maryland and Delaware and covers approximately 13.4 percent of the shoreward VSA. Users in this landscape zone include local residents, maritime industry users (e.g., commercial fishers and charter boat crews), and recreationalist boaters. Expansive views are typically available from open water locations.

Forest and forested wetlands can be found throughout the shoreward study area and accounts for approximately 37.8 percent of the shoreward VSA. Large concentrations occur within bordering emergent wetlands adjacent to open water areas. These large tracts of forest (e.g., Assawoman Wildlife Area, Redden State Forest, and Great Cypress Swamp) are typically undeveloped but are occasionally interspersed with either agricultural fields or residential developments. Users within this zone may include recreationists, agricultural workers, business employees, and local residents but the exposure to coastal views from forested areas would be minimal due to intervening vegetation.

Agricultural land accounts for approximately 28.7 percent of the shoreward VSA, are concentrated almost entirely along the western portion of the VSA and include large open field lots bordered by mature hedgerows and interspersed with rural residential lots. The user base in agricultural areas would be comprised of agricultural workers, local residents, and business employees. This zone has little exposure to coastal views and therefore low exposure to visual change.

Developed open space accounts for approximately 5.6 percent of the shoreward VSA and typically includes golf courses and recreation fields. The actual number of open recreation areas is expected to be much lower than suggested by the NLCD data due to the inclusion of expansive road shoulders, residential grass lots, and some roads due to the similar cover types. This zone may be comprised of commuters and through-travelers, recreationists, business employees, and local residents, with views often focused within the zone. In the case of golf courses, the views are generally framed with wood lots or forest to give a pastoral impression, thus expansive views beyond the zone are not typical.

Wetlands account for approximately 4.8 percent of the shoreward VSA and occur almost entirely along the perimeter of open water portions of the VSA bordering the bays, rivers and tributaries. Wetlands are typically void of any development. Low elevations and bordering vegetation typically offer little opportunity for expansive views beyond the LSZ. Users in this zone would include recreationists, local residents, and possibly maritime industry users.

Developed areas of low, medium, and high intensity are contiguous throughout the VSA. The pattern formed by these categories follows typical urban development patterns where there are multiple cores of high intensity development leading to medium and then low intensity development, similar to when an urban area becomes increasingly rural residential as one travels away from the center. In the VSA, the high intensity areas are generally clustered along the outer beaches (Ocean City and Bethany Beach) and with less development extending to the west. Along major road routes, such as Route 28 in Bethany Beach and Route 20 in Fenwick Island, some pockets of high intensity development are surrounded by medium and low intensity development. There are also areas of high intensity development in Cape May and Wildwood, New Jersey, at the outer edge of the VSA. Together these developed areas make up approximately 8.1 percent of the shoreward VSA.

Most views in the developed zone are localized and distracted by visual clutter or an abundance of visual interest within the zone itself. Exposure to expansive ocean views is limited to unobstructed shore-facing development. High intensity developed areas include urban centers, industrial areas, and mixed-use areas, typically with industrial and commercial development. Users in these areas would include residents, workers, and recreationists. Medium density developed areas include suburban commercial, village urban centers, coastal beach front residential, and some historic districts. Users here would include business employees, local residents, and occasionally recreationists. Low density developed areas include rural residential, state parks, coastal beaches, and some historic districts. Users here would include residents, business employees, agricultural workers and recreationists.

Beaches account for approximately 0.9 percent of the shoreward VSA. Beaches are located along the entire shorefront of the VSA and vary in width depending on the proximity of development. Beach areas are the recreational draw for much of the VSA and the most exposed to ocean views. Predominant users in this zone would include loca residents and recreationists. Although this LSZ is a relatively small area, it is more closely located to the Project area than the other LSZs and offers high exposure to expansive views along the coast.

Scrub/shrub and grassland areas were combined in this analysis and account for approximately 0.7 percent of the shoreward VSA. The difference between the two land cover types is based on vegetation height, but neither class is likely to obstruct visibility. Users likely found in this zone would be recreationists, local residents, and possibly agricultural workers. This landscape zone is scattered throughout the VSA and is not considered separately in this visual assessment, but rather absorbed into the analysis of the other LSZs.

Appendix C includes a photo log of representative LSZs found within the VSA.

Table 3-4. Summary of Landscape Similarity Zones within the Overall Visual Study Area

Landscape Similarity Zone	NLCD Classification	Total Sq. Mi. (%)	Sq. Mi. Visually Affected	% Visually Affected
Open Water (Includes open ocean)		**5,743 (81.3)**	**5,621**	
	Open Water	5,743	5,621	98
Forest and Forested Wetlands		**577 (8.2)**	**0.4**	
	Deciduous Forest	23	0.0011	< 1
	Evergreen Forest	102	0.015	< 1
	Mixed Forest	75	0.0059	< 1
	Woody Wetlands	377	0.33	< 1
Agriculture		**439 (6.2)**	**1.8**	
	Cultivated Crops	436	1.8	< 1
	Pasture/Hay	3.4	0.0019	< 1
		86 (1.2)	**1.2**	
	Developed, Open Space	86	1.2	1.4
Wetlands		**73 (1.0)**	**9.4**	
	Emergent Herbaceous Wetlands	73	9.4	12.9
Low Intensity Development (Residential)		**64 (0.9)**	**2.1**	
	Developed, Low Intensity	64	2.1	3.3
Medium Intensity Development (Urban Fringe)		**42 (0.5)**	**2.6**	
	Developed, Medium Intensity	42	2.6	6.3
High Intensity Development		**17 (0.2)**	**0.77**	
	Developed, High Intensity	17	0.77	4.6
Beach		**13 (0.2)**	**5.5**	
	Barren Land (Rock/Sand/Clay)	13	5.5	41.9
Shrub/Scrub and Grasslands		**11 (0.2)**	**0.87**	
	Grassland/Herbaceous	3.9	0.081	2.1
	Shrub/Scrub	7.0	0.0055	< 1
Grand Total		**7,065**	**5,646**	**-**

Table 3-5. Summary of Landscape Similarity Zones within the Shoreward Visual Study Area

Landscape Similarity Zone	NLCD Classification	Total Sq. Mi. (%)	Sq. Mi. Visually Affected	% Visually Affected
Open Water (does not include open ocean)		**205 (13.43)**	**82**	
	Open Water	205	82	40.3
Forest and Forested Wetlands		**577 (37.8)**	**0.4**	
	Deciduous Forest	23	<0.1	< 1
	Evergreen Forest	102	<0.1	< 1
	Mixed Forest	75	<0.1	< 1
	Woody Wetlands	377	0.3	< 1
Agriculture		**438 (28.7)**	**1.8**	
	Cultivated Crops	435	1.8	< 1
	Pasture/Hay	3.4	<0.1	< 1
Developed, Open Space		**86 (5.6)**	**1.2**	
	Developed, Open Space	86	1.2	1.4
Wetlands		**73 (4.8)**	**9.4**	
	Emergent Herbaceous Wetlands	73	9.4	12.9
Low Intensity Development (Residential)		**64 (4.2)**	**2.1**	
	Developed, Low Intensity	64	2.1	3.3
Medium Intensity Development (Urban Fringe)		**42 (2.8)**	**2.6**	
	Developed, Medium Intensity	42	2.6	6.3
High Intensity Development		**17 (1.1)**	**0.8**	
	Developed, High Intensity	17	0.8	4.6
Beach		**13 (0.9)**	**5.5**	
	Barren Land (Rock/Sand/Clay)	13	5.5	41.9
Shrub/Scrub and Grasslands		**11 (0.7)**	**<0.1**	
	Grassland/Herbaceous	3.9	<0.1	2.1
	Shrub/Scrub	7.0	<0.1	< 1
Grand Total		**1,526**	**106**	**-**

3.5 Visually Sensitive Historic Resources

R. Christopher Goodwin & Associates, Inc. (RCG&A) evaluated the potential for visual impacts from the Project on historic properties within the APE identified through a progressive program of consultation, archival research, outreach and engagement, windshield survey, field survey, and data analysis, including properties listed on the National Register of Historic Places (NRHP) and properties included in the respective state inventories of the Delaware, New Jersey, Virginia and Maryland State Historic Preservation Offices (SHPOs). The results of this review are detailed in the Historic Resources Visual Effects Analysis (HRVEA) included as COP Appendix II-I3. The HRVEA identified 12 historic properties that are potentially subject to visual effects from the Project. These resources can be found in Table 3-6.

3.5.1 Recreational

Recreation has been an important part of the economy of the mid-Atlantic region beginning as early as the 1830s. The region served as a seaside retreat destination for wealthy inhabitants of regional cities, like Philadelphia, New York, and Baltimore. The area also became a destination for sport hunting of waterfowl and other coastal birds between the 1890s and 1920s. Recreational resources in this area were created for visitors to enjoy the natural landscape of nearby water bodies, including the Atlantic Ocean, the Cape May, Isle of Wight, and Rehoboth bays. An example of this resource would be beachfront hotels built with beach access and unobscured views.

3.5.2 Maritime

The maritime resources category refers to the numerous facilities along the North Atlantic coastline serving as life-saving stations or lighthouses. These facilities were part of the United States Life Saving Service, which later merged with the Lighthouse Service and the U.S Revenue Service to form the United States Coast Guard (USCG). Maritime resources, like lighthouses, were built to increase the navigational and shoreline safety of those on the Atlantic Ocean and therefore required direct and unobscured views of the ocean.

3.5.3 Residential

Residential resources within the VSA have construction dates ranging from 1792 to 1928. These buildings are typically in rural, urban, or suburban areas and include outbuildings, such as tenant houses, garages, and agricultural support buildings. They typically have driveways and landscaped lawns and vegetation and do not derive their significance from views of the ocean.

3.5.4 Military

To protect shipping between Cape May, New Jersey, and Cape Henlopen, Delaware, from enemy fire, leading up to World War II, the Delaware region experienced an expansion in military coastal defense facilities. Typically, they cover hundreds of acres, and some consist of multiple buildings. These facilities required locations along the water and unobscured views of the Atlantic Ocean.

3.5.5 Bridges

One bridge is located within the VSA: the Ocean City Bridge. The bridge carries vehicular and pedestrian across the Sinepuxent Bay between West Ocean City and Ocean City. It uses modern building materials, like steel beams and jointed, concrete construction. As a bridge in a maritime setting, the Ocean City Bridge provides views to the ocean as visitors approach Ocean City.

3.5.6 Agricultural

Agriculture is a major part of the economy in Worcester County, Maryland. Produce has been shipped from the region to urban centers like Baltimore, Norfolk, Washington, D.C., and Philadelphia, via both steamboat service and railroad. This resource type typically does not have a maritime setting or a view of the ocean and often includes agricultural support buildings.

3.5.7 Commercial

Commercial buildings are generally within agricultural settings with no views to the ocean. Built during the twentieth century, they are typically modest rural buildings and built to serve local, rural communities.

3.5.8 Objects

Historic resource objects within the VSA are typically monuments constructed by government entities or cultural groups to memorize historic events or persons. They are located within maritime settings with views to the ocean and vary in height and material, typically made of stone with a placard. These monuments are also typically highly visible on the landscape.

Table 3-6. Visually Sensitive Resources

Name	SHPO ID Number	State	Eligibility Status	Maritime Setting	View of Sea	Sensitivity to Visual Effects	Potential Adverse Effect
Transpeninsular Boundary Monument	CRS: D00101	Delaware	NRHP	No	No	Low	No
Woman's Temperance Christian Union Water Fountain	CRS: 11837	Delaware	NRHP	Yes	Yes	High	Yes
Fort Miles Historic District	CRS: 06048	Delaware	NRHP	Yes	Yes	High	Yes
Fenwick Island Lighthouse Station	CRS: 00187	Delaware	NRHP	Yes	Yes	High	Yes

Name	SHPO ID Number	State	Eligibility Status	Maritime Setting	View of Sea	Sensitivity to Visual Effects	Potential Adverse Effect
Miller-Hudson House	CRS: 09777	Delaware	NRHP	No	No	Low	No
Indian River Lifesaving Station	CRS: 0453	Delaware	NRHP	Yes	No	Low	No
National Harbor of Refuge and Delaware Breakwater Historic District	CRS: 00186	Delaware	NRHP	Yes	Yes	High	Yes
White House	CRS: 00202	Delaware	Eligible	No	No	Low	No
Old Massey Road Dwelling	CRS: 01008	Delaware	Eligible	No	No	Low	No
Nogged Frame House	CRS: 00752	Delaware	Eligible	No	No	Low	No
Frank Robinson House	CRS: 02350	Delaware	Eligible	No	No	Low	No
Pokusa House	CRS: 02369	Delaware	Eligible	No	No	Low	No
Adkins House	CRS: 02099	Delaware	Eligible	No	No	Low	No
Parkwood Street Dwelling	CRS: 02134	Delaware	Eligible	Yes	Yes	High	Yes
Adkins Agricultural Complex	CRS: 02089	Delaware	Eligible	No	No	Low	No
Magee Store Building	CRS: 02076	Delaware	Eligible	No	No	Low	No
Rehoboth Beach Boardwalk	CRS: 08535	Delaware	Eligible	Yes	Yes	High	Yes
Rehoboth Beach	CRS: 08523	Delaware	Eligible	Yes	Yes	High	Yes
Henry’s Grove	MIHP No: WO-8	Maryland	NRHP	No	No	Low	No
Williams Grove	MIHP No: WO-12	Maryland	NRHP	No	No	Low	No
The Mansion House	MIHP No: WO-36	Maryland	NRHP	Yes	No	Low	No
Old Collins Farm	MIHP No: WO-236	Maryland	Eligible	No	No	Low	No
The Pier Building	MIHP No: WO-327	Maryland	Eligible	Yes	Yes	High	Yes

Name	SHPO ID Number	State	Eligibility Status	Maritime Setting	View of Sea	Sensitivity to Visual Effects	Potential Adverse Effect
Ocean City Bridge	MIHP No: WO-461	Maryland	Eligible	Yes	No	Low	No
Francis Scott Key Motel	MIHP No: WO-555	Maryland	Eligible	No	No	Low	No
Cape May Lighthouse	SHPO ID: 7752	New Jersey	NRHP	Yes	Yes	High	Yes
Cape May Historic District	SHPO ID: 3042	New Jersey	NHL	Yes	Yes	High	Yes
Wildwoods Shore Resort Historic District	SHPO ID: 4192	New Jersey	Eligible	Yes	Yes	High	Yes
Battery 223	SHPO ID: 4770	New Jersey	NRHP	Yes	Yes	High	Yes
Ocean View Motel	SHPO ID: 5778	New Jersey	Eligible	Yes	Yes	High	Yes
Wildwood Boardwalk	Interest ID: 99073653	New Jersey	Identified	Yes	Yes	High	Yes

4.0 Visual Impact Analysis

4.1 Project Visibility

A viewshed analysis, field photo documentation, and visual simulations were completed to identify potential Project visual impacts to the identified resources. The process for completing these analyses and the results of each are presented below.

4.1.1 Viewshed Analysis

The viewshed analysis was conducted over the entire VSA for both the maximum blade tip height (286 meters (938 feet) ASL) and for the center hub height (161 meters (528 feet) ASL) to refine the study area to include only those areas that would likely have visibility of the WTGs and to provide a geographic extent of visibility or APE. In performing the viewshed analysis, a conservative screening height of 12 meters (40 feet) was assumed for forested areas, which makes up the predominant land use in the mainland portion of the VSA and high-intensity developed areas. United States Army Corps of Engineers (USACE) LiDAR elevation data was used to create the Digital Surface Model and Digital Terrain Model where available (primarily in coastal areas, see Figure 6), and USGS National Elevation dataset was used in all other areas. The overall viewshed is shown in Figure 6.

According to the results of the viewshed analysis, up to 80.1 percent of the overall VSA has potential turbine blade visibility. The majority of the total visible area (over 98%) consists of the 14,143 square kilometers (5,461 square miles) of open ocean seaward of the Atlantic coast. The remainder of the visible area is the shoreward VSA. Potential turbine blade and nacelle visibility occur in approximately 7.1 percent and 4.0 percent, respectively, of the shoreward VSA. This visibility is concentrated along the entire shoreline, but in places such as Ocean City and Bethany Beach, the first row of buildings tends to block views from locations further inland (Figure 7). The locations of the historic resources listed in Table 3-6 in relation to the Landscape Similarity Zones and potential project visibility can be found in Figures 5 and 7. Being within the Project viewshed is not synonymous with Project visibility. Areas of actual visibility are anticipated to be more limited due to the narrow profile of the individual WTGs and screening from intervening vegetation and smaller structures not large enough to be accounted for in the viewshed analysis. Actual visibility also depends on weather and lighting conditions, which is especially prevalent when seaward objects are greater than 16 kilometers (10 miles) from the viewer.

Table 4-1 breaks down the viewshed areas by distance from the WTGs, which illustrates that a significant portion of the area of potential visibility occurs beyond 20 miles from the WTGs, increasing the likelihood that intervening terrain, vegetation, or structures would obstruct views of the WTGs and decreasing the visual prominence of any WTGs that are visible.

Table 4-1. Shoreward Study Area Turbine Blade Tip Land Area Viewshed Results Summary

	64-kilometer (40-mile) Radius Study Area		
Distance from Project Area	**Turbine Blade Visible**	**Turbine Nacelle Visible**	**Total Shoreward Area**
0-10 miles	N/A	N/A	N/A
10-20 miles	47.4 sq. mi (122.7 sq. km)	43.3 sq. mi (112.2 sq. km)	223.4 sq. mi (578.7 sq. km)
20-30 miles	36.3 sq. mi (93.9 sq. km)	16.3 sq. mi (42.3 sq. km)	516.5 sq. mi (1,337.6 sq. km)
30-40 miles	23.1 sq. mi (59.8 sq. km)	0.5 sq. mi (1.3 sq. km)	749.6 sq. mi (1,941.3 sq. km)
Total 40 Mile Study Area	106.7 sq. mi (276.5 sq. km)	60.2 sq. mi (155.9 sq. km)	1,489.5 sq. mi (3,857.7 sq. km)

4.1.2 Field Photo Documentation

On March 22 and 23, 2016, a visual expert visited the Project study area in order to document views in the direction of the PDE. Weather conditions were partly cloudy, and the temperature ranged from 53 to 68 degrees. According to National Weather Service Observed Weather Reports, humidity was 86 to 92 percent and visibility was ideal for maximum viewing distance. A total of 21 locations were photographed during daylight. A Nikon D810 full frame digital SLR with a 50mm lens was used to document the existing views. The camera was mounted on a tripod for stability and images were taken at 36.3 megapixels for a resulting image dimension of

7360 x 4912 pixels. GPS positions were also recorded at each photo location. Appendix B contains a Photo Log of the field photographs taken.

Table 4-2. Photo Locations Considered for Visual Simulations

ID	Location	Visual Resource	Representative Simulation
1	Ocean City, Maryland	Pier Building, Pier, Atlantic Hotel	Viewpoint 1
2	Assateague Island, Maryland	Assateague Island State Park	Viewpoint 2
3	Assateague Island, Maryland	Assateague Island National Seashore	Viewpoint 2
4	Snow Hill, Maryland	Mansion House NRHP and Public Landing	Viewpoint 2
5	Sinepuxent Neck, Maryland	Public Boat Launch	Viewpoint 2
6	Ocean City, Maryland	Isle of Wight Lifesaving Station	Viewpoint 1
7	Rehoboth Beach, Delaware	Fenwick Island State Park	Viewpoint 1
8	Ocean City, Maryland	US Coast Guard Tower, US Life Saving Station	Viewpoint 1
9	Ocean City, Maryland	Ocean City Harbor Entrance	Viewpoint 1
10	Ocean City, Maryland	Atlantic Hotel	Viewpoint 1
11	Ocean City, Maryland	Margaret Vandergrift Cottage, Lambert Ayres House	Viewpoint 1
12	Ocean City, Maryland	Mount Vernon Hotel	Viewpoint 1
13	Ocean City, Maryland	Ocean City Beach	Viewpoint 1
14	Bethany Beach, Delaware	WWII Observation Tower (Ground Level)	Viewpoint 3
15	Bethany Beach, Delaware	Bethany Beach Boardwalk and Wreck Site	Viewpoint 3
16	Bethany Beach, Delaware	Ocean View Parkway Beach Entrance	Viewpoint 3
17	Assawoman Bay, Delaware	Assawoman Bay Wildlife Area	Viewpoint 3
18	Ocean City, Maryland	Ocean City Beach, Boardwalk	Viewpoint 1
19	Rehoboth Beach, Delaware	Indian River Life Saving Station	Viewpoint 3
20	Dewey Beach, Delaware	Delaware Seashore State Park	Viewpoint 3

From the photo documentation collected during this field verification, three viewpoints were selected for the development of the Project visual simulations. The viewpoints chosen for the visual simulations were the Atlantic Hotel Pier at Ocean City Beach, Maryland; Assateague Island, Maryland; and Bethany Beach, Delaware (See Figure 8 for photo and simulation locations). These viewpoints were selected to provide representative views of the Project from directly west of the turbines (Ocean City), from the northwest (Bethany Beach), and from the southwest (Assateague Island) and were representative of the overall coastal viewing area.

4.1.3 Visual Simulations

In order to produce the visual simulations, a to-scale model of the proposed WTG was created in a 3D photorealistic modeling software, 3D Studio Max. The 125 identical WTG models were then placed in a 3D modeled environment at the proposed locations within the Lease area. The WTGs were modeled at the 121 proposed turbine locations as well as at the four proposed OSS locations. A virtual camera was also created in the virtual environment to match the exact specifications of the Nikon D810 camera, as well as the field recorded location. The camera bearing in the model was set to match the field recorded bearing line. Next, the field recorded photograph was set as the virtual camera background and the modeled horizon was matched to the actual horizon. For simulations at times of day other than the actual time of photography, representative lighting conditions were simulated using supplemental representative photographs of the sky at the simulation time taken from a nearby simulation location. The virtual camera was aligned to the baseline photograph using georeferenced flags placed in the field and recreated in the modeled environment. A virtual environment was created to match the sun and weather conditions observed in the field. Using an earth curvature model based on viewing distance, the appropriate elevation for each WTG was set so that it appeared in the correct location beyond the horizon. The WTGs were oriented toward the prevailing wind direction as well as facing the shore for maximum visibility in a separate set of simulations. Turbine blade rotational positions were randomized to replicate realistic viewing conditions. The view was then rendered, composited, and post-processed to integrate the rendered model into the photograph.

Nighttime conditions were considered to address the potential for nighttime impacts associated with the aviation safety lighting described in Section 2.2. Nighttime simulations were produced by modelling the dimensions and output for LED L-864 and L-810 FAA beacons and placing them on the appropriate positions on the WTGs. In order to verify the intensity, actual field observations of similar fixtures were included in the light model and resulting simulation. The resulting rendering of the FAA lights was then overlaid on nighttime photograph and integrated into a composite simulation.

The Visual Simulations are presented in Appendix A. Daytime simulations are provided as both panoramas and single frame details, based on the photography captured. The single frame detail was created to represent the view from the field of view of a camera. Although this may show greater detail of the surrounding landscape and Project components, it is viewing the Project in a reduced field of view as compared to a standard panorama. Panoramas are more representative of what a viewer would see standing at the selected viewpoints (discussed in Section 4.2) and is a more accurate depiction of the visual impact of the Project.

4.2 Visual Impacts at Selected Viewpoints

The Project would be comprised of up to 121 WTGs, up to 4 OSSs, and a Met Tower, of which only the WTGs would be viewed from long distances over the expanse of ocean. Although the

Project is relatively small compared to the open ocean area, the introduction of man-made moving structures can, depending on distance and meteorological conditions, create a minor visual contrast to the expanse of the ocean and sky. Difference in color and contrast between the WTGs, the sky, and the ocean is the main source of visual prominence. Motion of the WTGs is important to consider but becomes much less disruptive to the existing view with increasing distance to the viewer. The vertical scale of the turbines and horizontal extent and arrangement of the overall Project Area also differentiates impacts at different locations.

Concerns related to visual impacts of WTGs would typically be those presented by the foundation and nacelle (the widest and most substantial portions of the WTG) rather than the relatively slender tower and rotor. From coastal vantage points WTGs appear low on the distant horizon and are difficult to perceive. When detectable, the somewhat regular vertical form of the tubular towers would contrast with the horizontal form of the water/sky horizon. The neutral white color of the turbine tower, nacelle and blades would be viewed against the background sky. When the WTGs are backlit (side facing viewer is in shade) the degree of visual contrast is heightened and thus somewhat less compatible with the background sky than if viewed in a more illuminated front- or side-lit condition. Front- or side-lit conditions would cause the turbines to stand out more against a bluer sky, primarily occurring in clear conditions. The sun path for the majority of the viewpoints along the eastern shores of Delaware and Maryland is from behind the turbines in the morning (backlit condition) to behind the viewer, in front of the turbines in the evening (front-lit), with a shift to the south during the winter months that creates a side-lit condition for viewers facing east. Viewers in northern vantage points in Delaware and very small parts of New Jersey would experience more backlit condition in the winter months when the sun is in the southern sky. Color contrast decreases as distance increases and would diminish or disappear completely during periods of haze, fog or precipitation. Visibility due to meteorological conditions is addressed in COP Volume I Section 2.7 and in Appendix D. The meteorological analysis shows that these weather conditions occur for greater than 50% of daylight hours approximately 103 days per year. On an hourly basis, clear conditions occur an average of 67% of daylight hours over the course of the year.

The proposed WTGs would be the tallest visible elements on the horizon, although at a far distance. From most foreground and mid-ground vantage points (from vessels on the ocean), the WTGs would be perceived as the main visual element. When viewed from far background vantage points on land, the WTGs' perceived scale and presence would be considerably reduced. For example, the PDE maximum WTG height of 286 m (938 ft), when viewed from shore at 21 kilometers (13 miles), is equivalent in vertical scale to an object 1.4 meters (4.5 ft) tall viewed from 100 meters (328 ft) away, or a 1.4-centimeter-high (0.5-inch-high) object viewed at 1 meter (3 ft) (approximately arm's length). From an earth curvature standpoint, the turbine blades are technically visible in clear conditions from sea level at just over 69 kilometers (43 miles) but would have greatly diminished visibility beyond the point at which the nacelles and towers drop below the horizon at a viewing distance of approximately 54 kilometers (33.5 miles).

FAA aviation obstruction lights would be visible from coastal locations where daytime views of the WTG nacelles occur. Inland views are typically screened by dunes, low hills, and existing vegetation or buildings. When visible from inland locations, views would typically include existing coastal light sources that include commercial and residential building sources, streetlights, vehicle headlights, and lights from passing vessels. The FAA lights in the night sky would be noticeable from beach areas and coastal areas, where visible above the horizon. Viewer attention would be drawn by the slow flashing of the red lights and would be most noticeable from beachfront areas. Recreational beaches are primarily visited during daytime hours minimizing the number of affected viewers. The impact of FAA lighting is substantially limited by the distance of the Project from any vantage points. The WTG lights would be visible low on the horizon and would appear to vary in intensity due to the slow flash rate, intermittent shadowing as rotating blades pass in front of the light source, and atmospheric conditions. Use of ADLS as described in Section 2.5 would significantly reduce the amount of time FAA obstruction lights would be lit.

As stated in Section 2.5, the lighting and marking described in this assessment is proposed and subject to approval by BOEM, the Federal Aviation Administration (FAA), the U.S. Coast Guard (USCG), and other relevant agencies.

Review of the visual simulation images, along with photos of the existing view, allowed for comparison of the aesthetic character of each view with and without the PDE.

4.2.1 Viewpoint 1 – Ocean City Pier at Ocean City Beach, Maryland

Existing View

This view is from near the Ocean City Pier at Ocean City Beach, located approximately 21 kilometers (13 miles) west of the nearest proposed WTG location. This location provides a vantage point from which the viewer can enjoy views of the pier, dunes, beach, and commercial waterfront development to the north. This location is a popular recreation area/tourist destination that receives high visitation throughout the days and evenings during the summer and fall seasons. Recreationists and tourists can be lounging on the beach, swimming or surfing in the water, boating in the nearshore area (i.e. kayaking, jet skiing), or fishing along the shoreline. Business employees would also be present working in a variety of locations, such as shops, restaurants, hotels, or tour group meeting sites. The foreground of this view to the east (toward the PDE) is comprised predominantly of dunes, beach and the pier.

PDE

The Atlantic Ocean makes up the midground, with relatively calm, blue water drawing the viewer's eye to the background where wind turbines are visible on the horizon. With the PDE in place, the WTGs are partially visible on the horizon in the center of the view. From this location, the wind farm is between 21 and 43.5 kilometers (13 and 27 miles) from the viewer, with portions of the tower, the nacelle, and blades visible from the nearest WTG, falling off with distance to the point where only portions of the blades would be visible from the furthest visible WTGs due to the screening effects caused by the curvature of the earth. The horizontal extent of the visible WTGs is 51 degrees, which occupies approximately 41 percent of the human field of view (FOV) of 124 degrees and 28 percent of the visible seascape, which covers approximately 180 degrees from the shoreline. Existing features in this view include parking area and commercial development to the north, dunes, beach, and the pier with the expanse of ocean, and some human activity, remain secondary elements of the landscape, while the ocean and sky remain the dominant visual elements.

4.2.2 Viewpoint 2 – Assateague State Park, Maryland

Existing View

This view is from Assateague State Park and National Seashore, Maryland, approximately 25.7 kilometers (16 miles) southwest of the nearest proposed WTG location. This location provides a vantage point from which the viewer can enjoy views of the beach, ocean, recreational users and surf. It is a popular recreation area/tourist destination that receives high visitation throughout the days and evenings during the summer and fall seasons. Recreationists and tourists can be lounging on the beach, swimming or surfing in the water, boating in the nearshore area (i.e. kayaking, jet skiing), or fishing along the shoreline. The foreground of this view to the east and northeast (toward the PDE) is comprised predominantly of beach. Some beach walkers are visible to the north in the view.

PDE

The Atlantic Ocean makes up the midground, with some surf and blue water which draws the viewer's eye to the background where wind turbines are visible on the horizon. With the PDE in place, the WTGs are somewhat detectable on the horizon in the approximate center of the view. From this location, the wind farm is between 30.5 and 45.1 kilometers (19 and 28 miles) from the viewer, with portions of the tower, the nacelle and blades partially visible in the nearest WTG, falling off with distance to the point where only portions of the blades would be visible on the furthest visible WTGs due to the screening effects caused by the curvature of the earth. The horizontal extent of the visible WTGs is 42 degrees, which occupies approximately 34 percent of the human FOV of 124 degrees and 23 percent of the visible seascape, which covers approximately 180 degrees from the shoreline. Existing features in this view include beach with the expanse of ocean and human activity to the north along the beach.

4.2.3 Viewpoint 3 – Bethany Beach, Delaware

Existing View

This view is from Bethany Beach near the boardwalk approximately 30.6 kilometers (19 miles) northwest of the nearest proposed WTG location. This location provides a vantage point from which the viewer can enjoy views of the beach, ocean, recreational users, surf and sunsets. It is a popular recreation area/tourist destination that receives high visitation throughout the days and evenings during the summer and fall seasons. Recreationists and tourists can be lounging on the beach, swimming or surfing in the water, boating in the nearshore area (i.e. kayaking, jet skiing), or fishing along the shoreline. Business employees would also be present working in a variety of locations, such as shops, restaurants, hotels, or tour group meeting sites. The foreground of this view to the southwest (toward the PDE) is comprised of beach front.

PDE

The Atlantic Ocean makes up the midground, with waves and blue water drawing the viewer's eye to the background where wind turbines are visible on the horizon. With the PDE in place, the WTGs are somewhat detectable on the horizon in the right half of the view. From this location, the wind farm is between 17.7 and 49.9 kilometers (11 and 31 miles) from the viewer, with portions of the tower, the nacelle and blades visible in the nearest WTG, falling off with distance to the point where only portions of the blades would be visible on the furthest visible WTGs due to the screening effects caused by the curvature of the earth. The horizontal extent of the visible WTGs is 32 degrees, which occupies approximately 26 percent of the human FOV of 124 degrees and 18 percent of the visible seascape, which covers approximately 180 degrees from the shoreline. Existing features in this view include a section of the boardwalk, beach, and some human activity with the expanse of ocean.

4.2.4 Summary

Overall visual impact on scenic quality at selected viewpoints is likely to be variable between sites considering the broad geographic area impacted but is generally expected to be low due to the low level of visual contrast and relatively small size of the WTGs in the context of the overall oceanfront landscape. The simulations are conservative in that they present what may be visible on a clear day. Haze, rain, snow, fog, cloudy or overcast skies or sea spray that typically occurs in this location would decrease the overall visibility. The installation and decommissioning of the export cable and the WTGs would cause additional temporary impacts to visually sensitive resources in the area, but the only visible elements during operation would be the WTGs. The dominant visual element remains the sky and ocean view.

5.0 Mitigation Options

Mitigation options for reducing the visual impact of the WTGs are limited by the dimensions of the WTGs, the dimensions of the Lease area, and BOEM and FAA requirements for nighttime lighting. US Wind has incorporated many of these mitigation options into the Project design, including the location of the WTGs within the Lease area, which has been designed to maximize the distance between the shoreline and the turbine array.

The following design-level mitigation measures are recommended to reduce or mitigate visual impact of the Project.

- Locate the PDE entirely within the Lease Area identified by BOEM as suitable for wind power development. The distance of this area offshore Ocean City, a minimum of 21 km (13 mi), reduces the overall visibility of the structures from visually sensitive public resources and populated areas.
- Arrange WTG structures in a uniform grid pattern and maintain consistency in dimensions, color, design, and movement.
- Use an FAA-recommended paint color, which generally blends well with the sky at the horizon, for any WTG components visible from shore (see section 2.5). The WTG paint color will be determined in consultation with BOEM, FAA, and USCG.
- Utilize FAA warning lights with the longest off cycle permitted by the FAA, and incorporate radar activated aviation obstruction lights (such as ADLS) to minimize the amount of time the lights are on, if permitted by overseeing agencies.
- Utilize USCG warning lights with appropriate visible range for mariners (2 to 5 Nautical Miles) and locate USCG lighting on lower structures that will not likely be visible from coastal vantage points.

Based on the anticipated level of visual impact and limitations to mitigation options due to federal requirements, no further mitigation is recommended for this Project.

6.0 Conclusions

Visual impacts are dependent on the distance from shore, the earth curvature, and the atmospheric conditions that could screen some or all the foundation, and portions of the WTG tower, nacelle, and rotor. As shown in the visual simulations (Appendix A), the widest portion of the WTGs (foundation and deck) would be below the visual horizon and would not be visible for most of the WTGs from the assessed viewpoints. The narrow width of the tower and rotor combined with the distance from the viewpoints would make these elements of the WTG minimally visible by the naked eye in the best visibility conditions (a clear, low humidity day) and hard to see in haze, rain, snow, cloudy or overcast skies, sea spray or fog that typically occurs in this location.

Visibility would rarely occur beyond the eastern shore beaches and the first row of buildings or houses, except for Assateague Island and the inland shores west of Assateague Island. The viewshed analysis suggests that 7.1 percent of the shoreward VSA may have visibility of the WTGs, while 4.0 percent may have visibility of the WTG nacelles and associated FAA lights. Much of the visible area (81.4 percent) occurs over open water in the eastern portion of the VSA.

The visual simulations demonstrate that visibility of the proposed WTGs is present in most coastal areas within the VSA and the proposed WTGs would likely be distinguishable to the average viewer under clear conditions. Similarly, the FAA lights at night would most likely be visible from the shore under clear weather conditions. When the FAA obstruction lights are activated, these lights would likely be visible on clear nights from the shoreline. Therefore, the presence of a flashing light or lights on the WTGs and OSSs at night would result in minor impacts (BOEM 2007). However, the use of ADLS would greatly reduce the impacts of lighting, with lights only on and visible when aircraft are present in the area. Weather conditions such as fog, haze, clouds, or precipitation would greatly limit the visibility of the WTGs and lighting from the shore both during daytime and nighttime.

Overall, visual impacts to onshore viewers of the WTGs in clear daytime or nighttime conditions is expected to be minimal to minor in the areas from which WTGs can be seen. Based on the distance from the shoreline it is unlikely that the installation of the WTGs would diminish the enjoyment of those views or of the resources identified within the APE.

7.0 References

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Sullivan, R., L. Kirchler, J. Cothren, and S. Winters. 2013a. "Offshore Wind Turbine Visibility and Visual Impact Threshold Distances." *Environmental Practice* 15 (1):33-49. doi: 10.1017/S1466046612000464.

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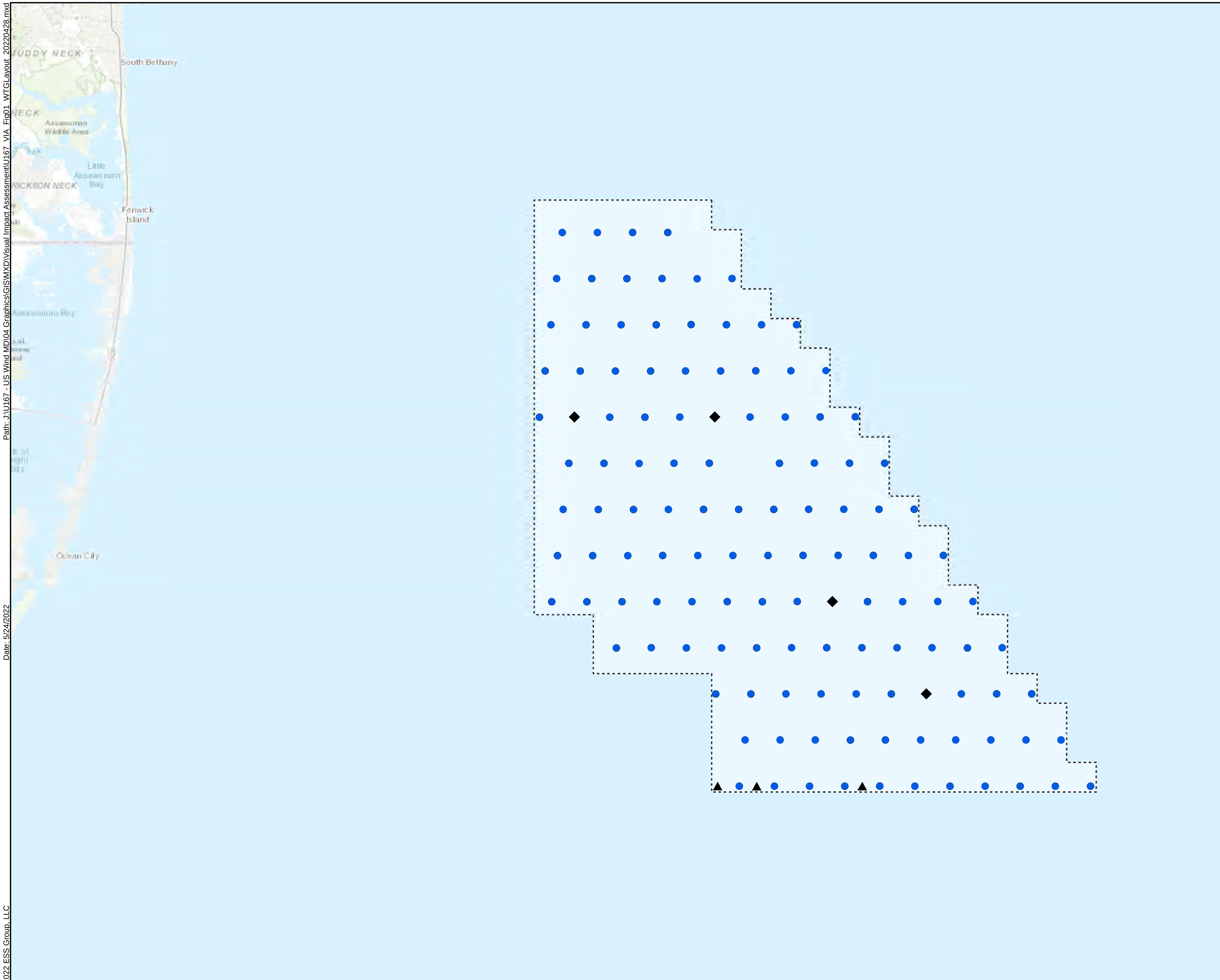
Figures



Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 1
Wind Turbine Generator Layout

Legend

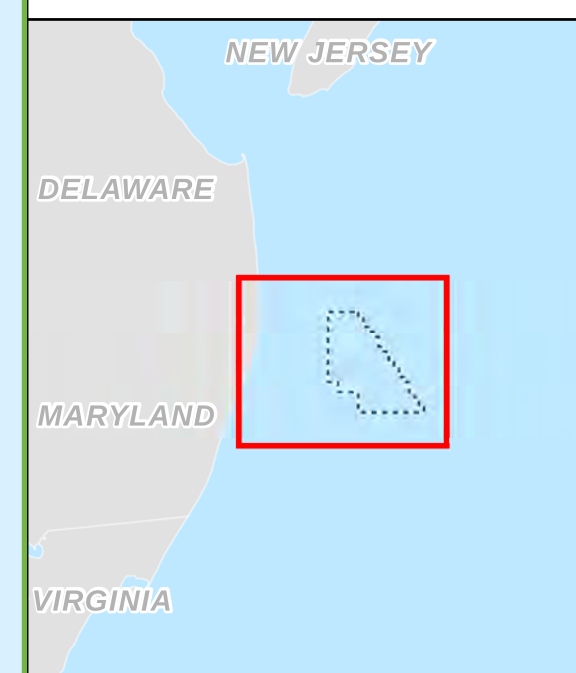
- Wind Turbine Generator (121)
- Potential Met Tower Locations (USW, 2021)
- Offshore Substation (4) (USW, 2021)
- US Wind Lease Area

0 2 4 8
Kilometers

1 inch = 12,500 feet
Inset: 1 inch = 28 miles

Source: 1) ESRI, Ocean Basemap, 2022
2) US Wind, Turbine Layout, July 2021

Datum: NAD 1983 UTM Zone 18N



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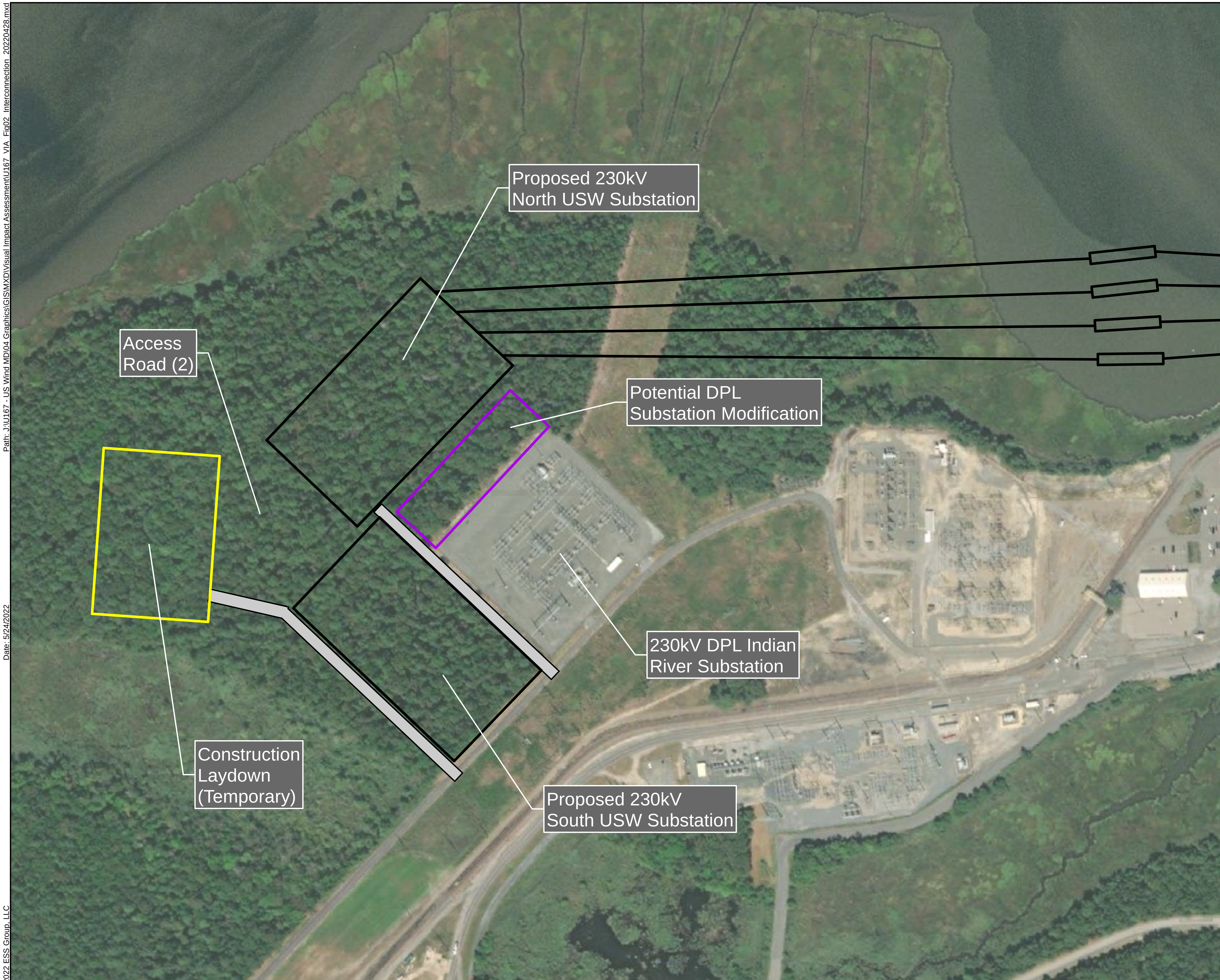
Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 2
Interconnection Location

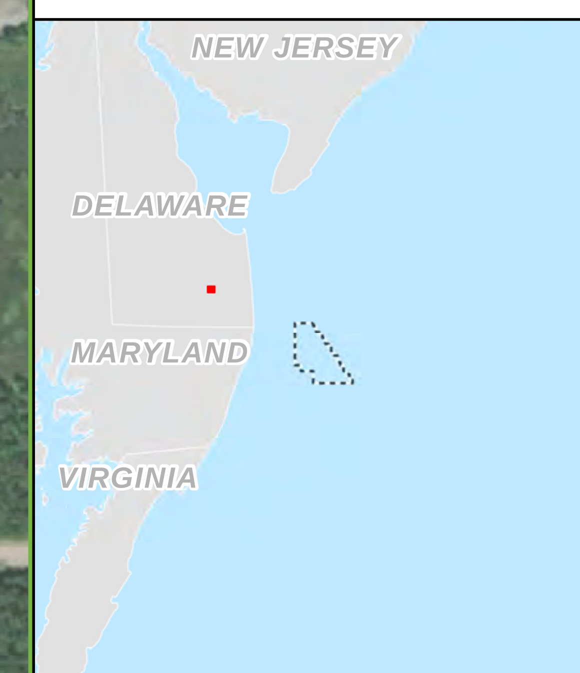


Legend
- Construction Laydown
- Proposed North Substation
- Proposed South Substation
- Proposed Substation Expansion
- Access Roads

0 0.025 0.05 0.1 Miles
0 40 80 160 Meters

Source: 1) ESRI, World Imagery, 2018
2) US Wind, Interconnection Layout, 2019

Datum: NAD 1983 UTM Zone 18N



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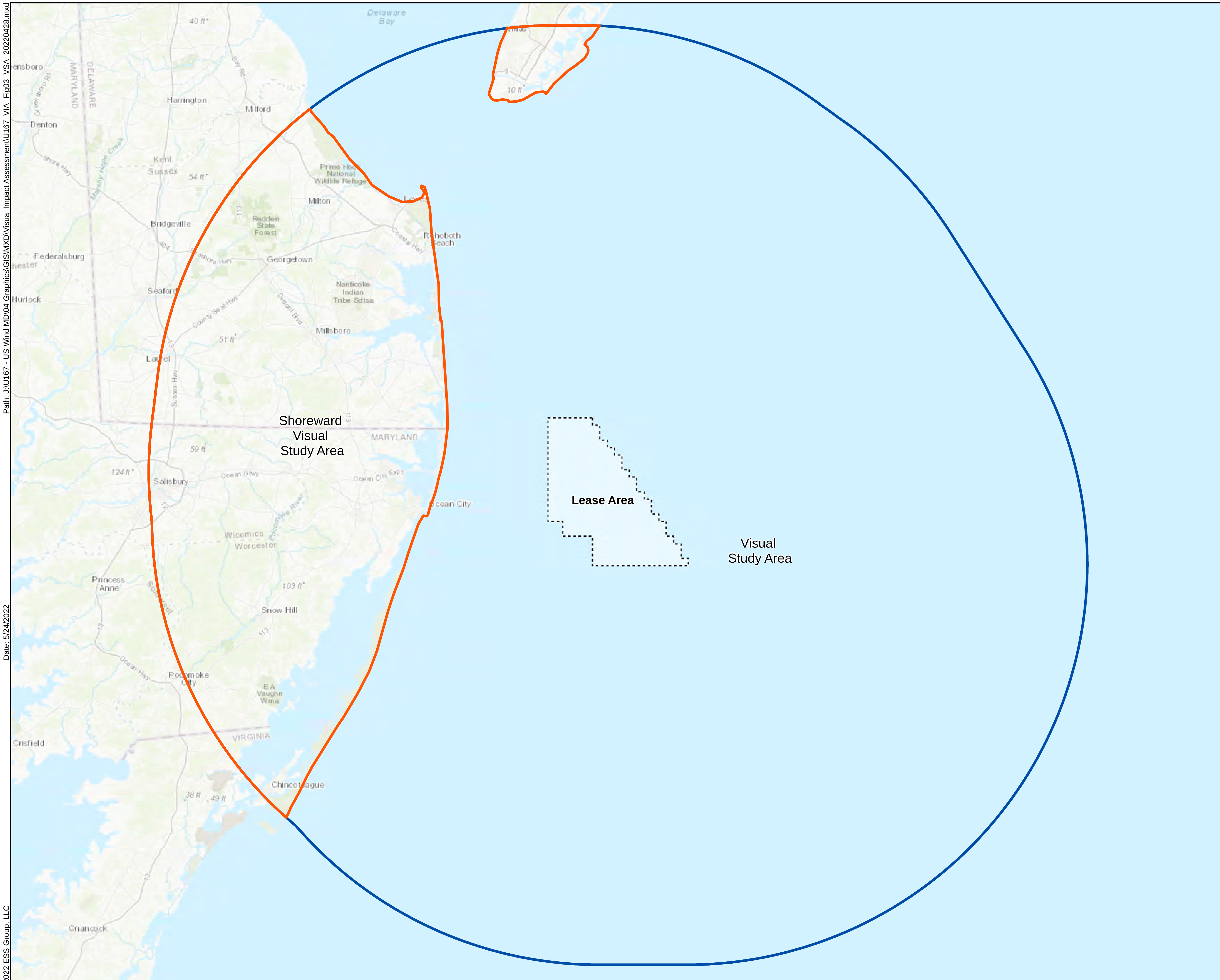


Maryland Offshore Wind Project

Offshore Maryland and Delaware

Figure 3

Visual Study Area

Legend

US Wind Lease Area

40-Mile Visual Study Area *

Visual Study Area

Shoreward Visual Study Area

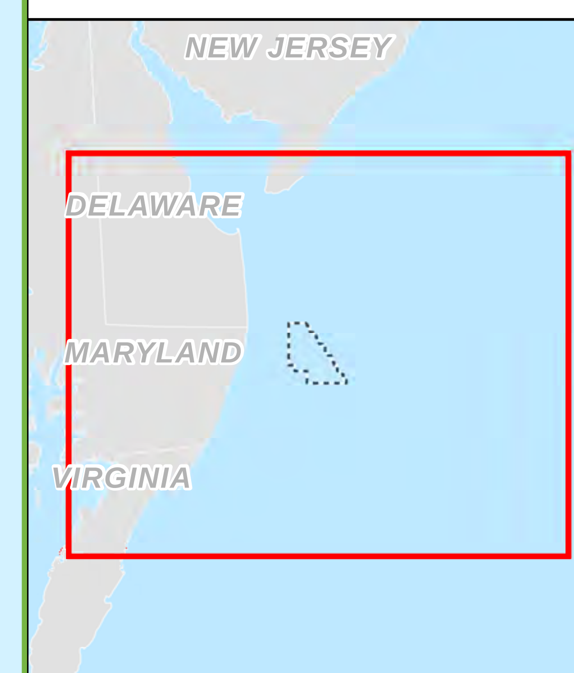
* The VSA is based on a 40-mile radius around each WTG location.

0 4.5 9 18 Miles

0 5 10 20 Kilometers

Source: 1) ESRI, World Topo Basemap, 2022
2) BOEM, Lease Area, 2018

Datum: NAD 1983 UTM Zone 18N



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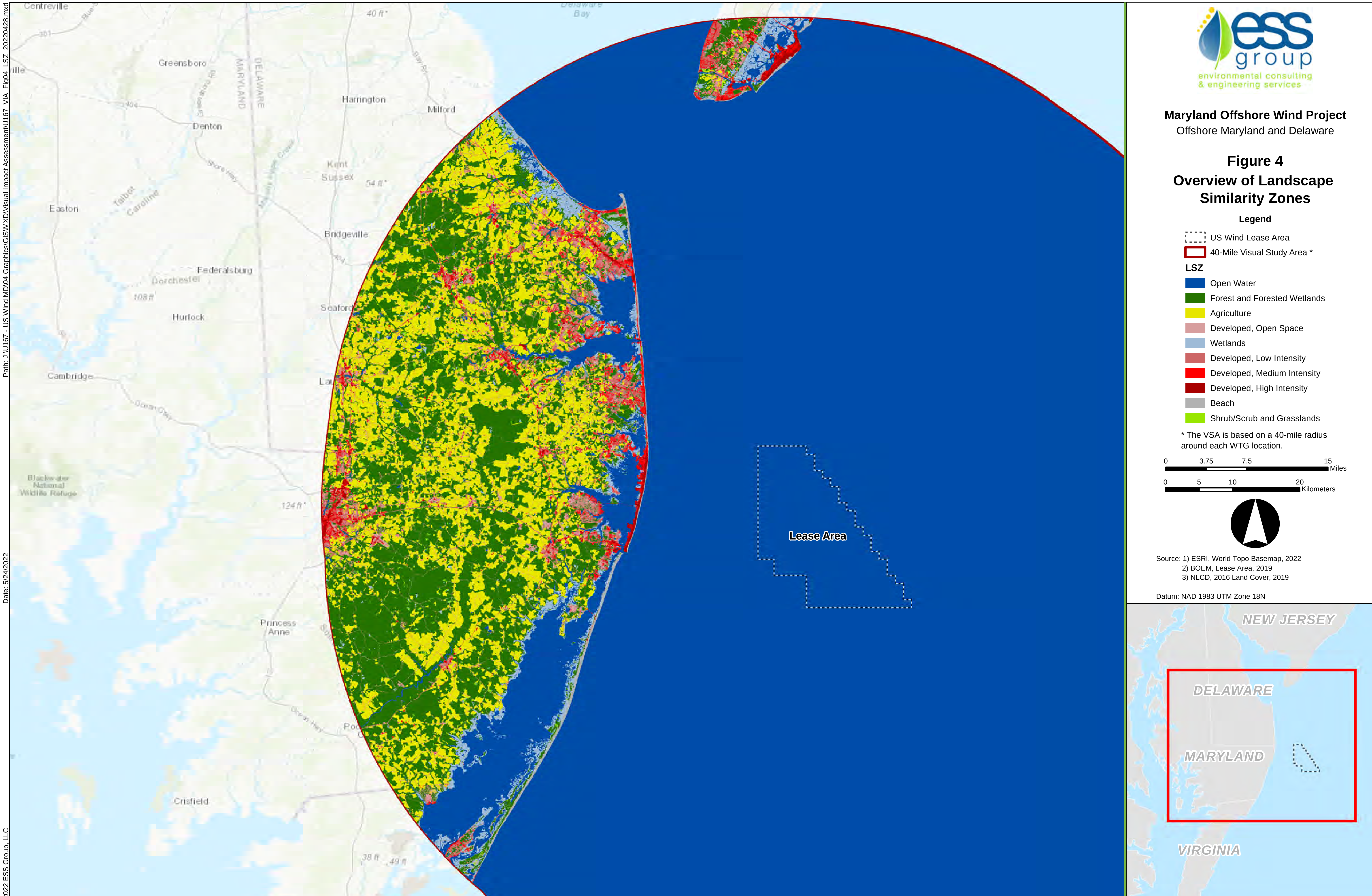

Figure 4
Overview of Landscape Similarity Zones

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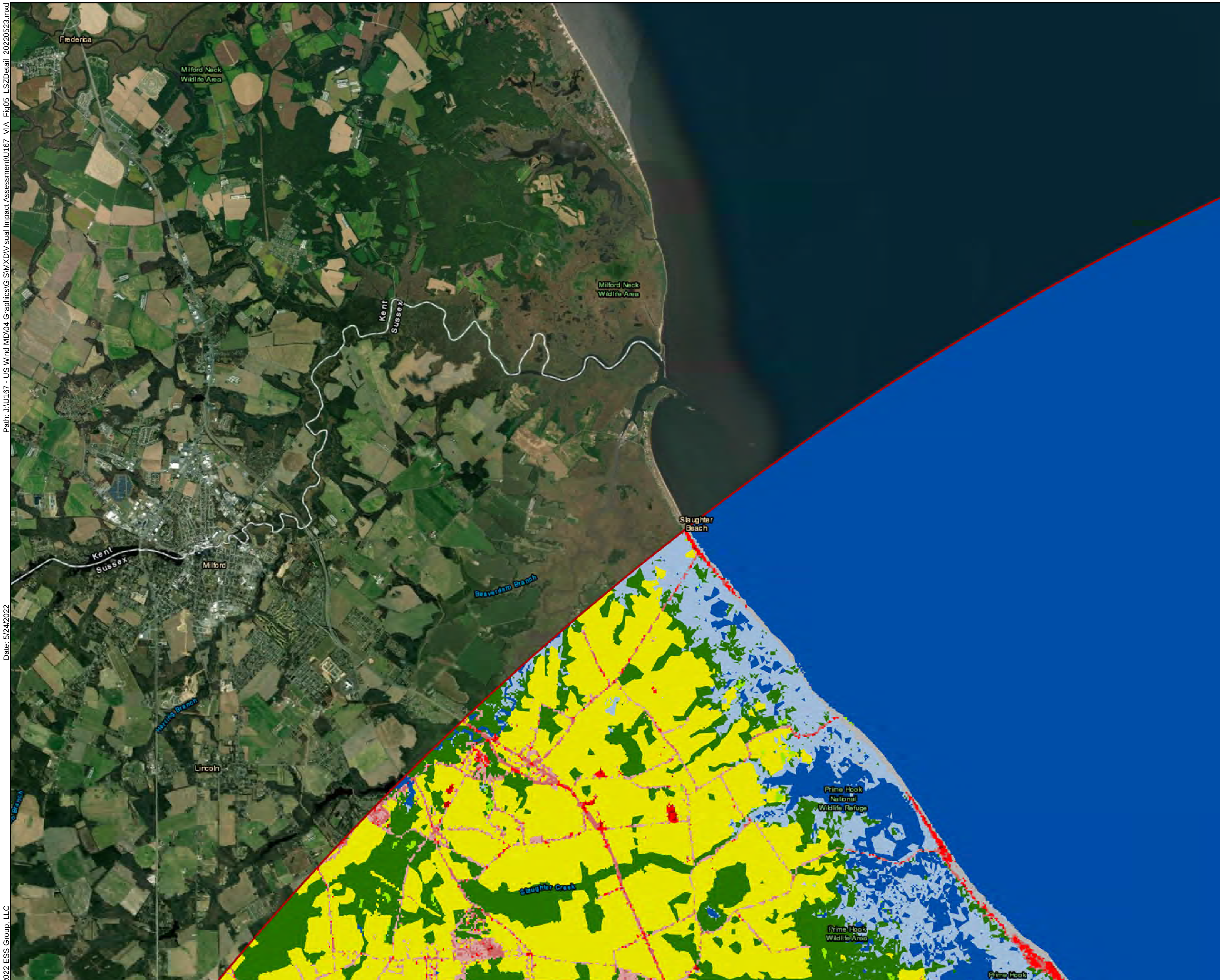

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Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 5

Sheet 1 of 12

Landscape Similarity Zones

Legend

- Historic Resources
- US Wind Lease Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- 40-Mile Visual Study Area

LSZ

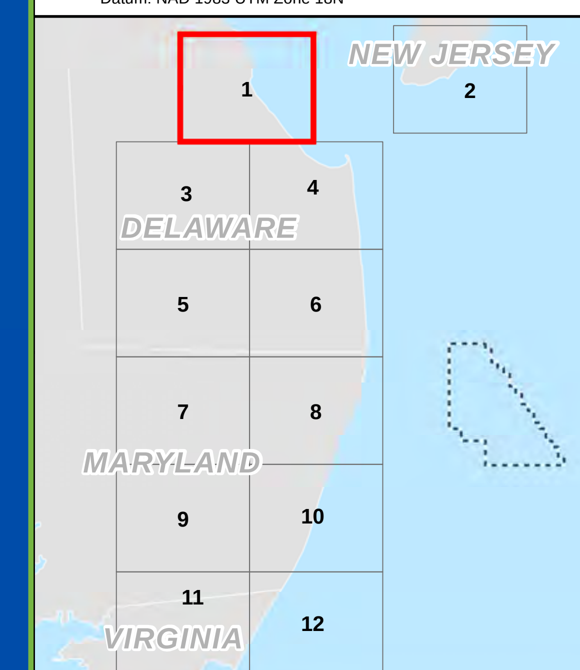
- Open Water
- Forest and Forested Wetlands
- Agriculture
- Developed, Open Space
- Wetlands
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Beach
- Shrub/Scrub and Grasslands

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

Datum: NAD 1983 UTM Zone 18N



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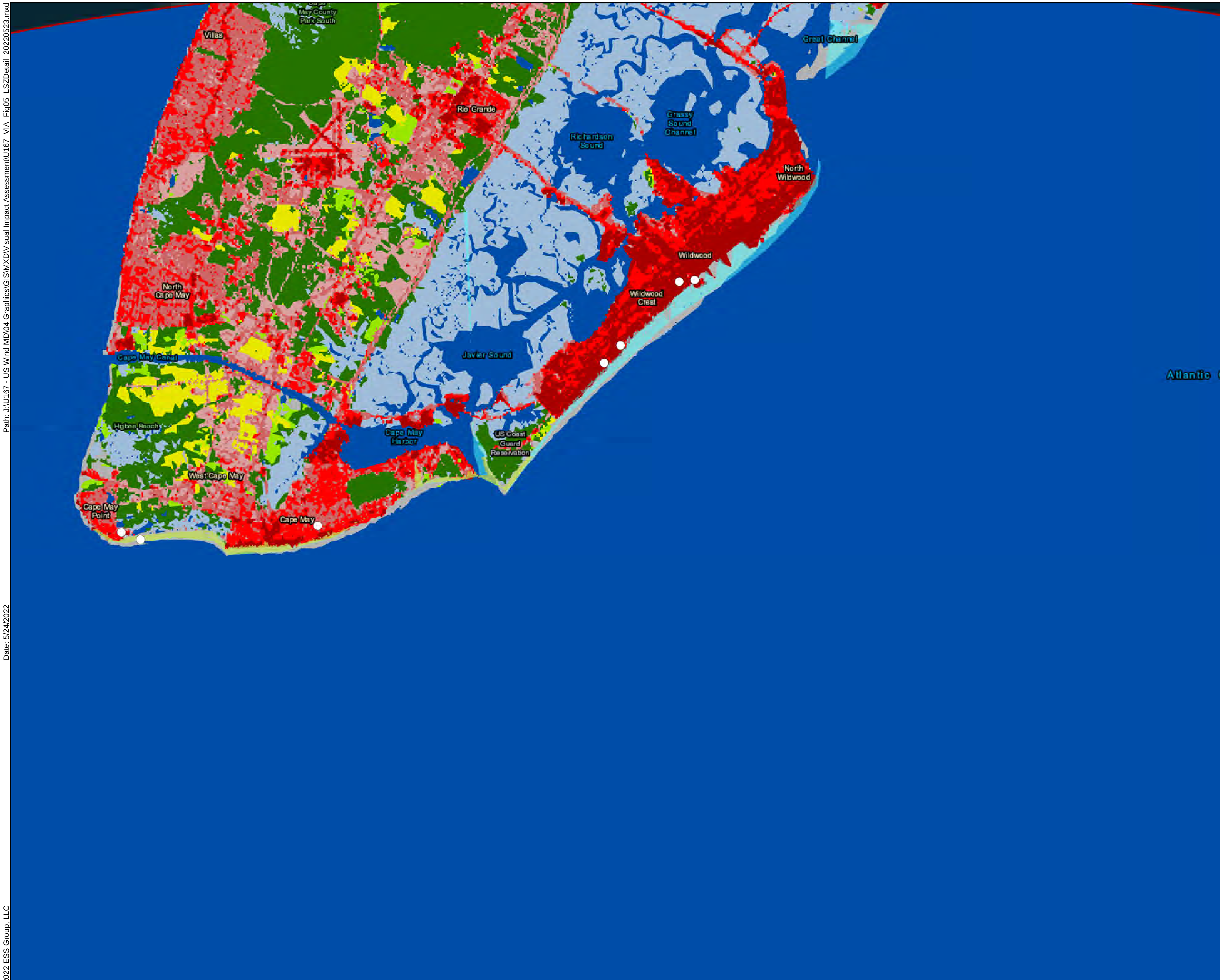

Maryland Offshore Wind Project

Offshore Maryland and Delaware

Figure 5

Sheet 2 of 12

Landscape Similarity Zones

Legend

- Historic Resources
- US Wind Lease Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- 40-Mile Visual Study Area

LSZ

- Open Water
- Forest and Forested Wetlands
- Agriculture
- Developed, Open Space
- Wetlands
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Beach
- Shrub/Scrub and Grasslands

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

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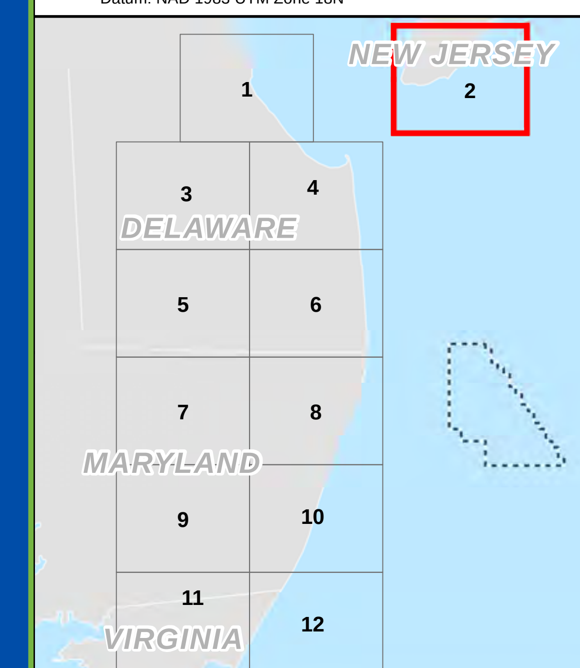

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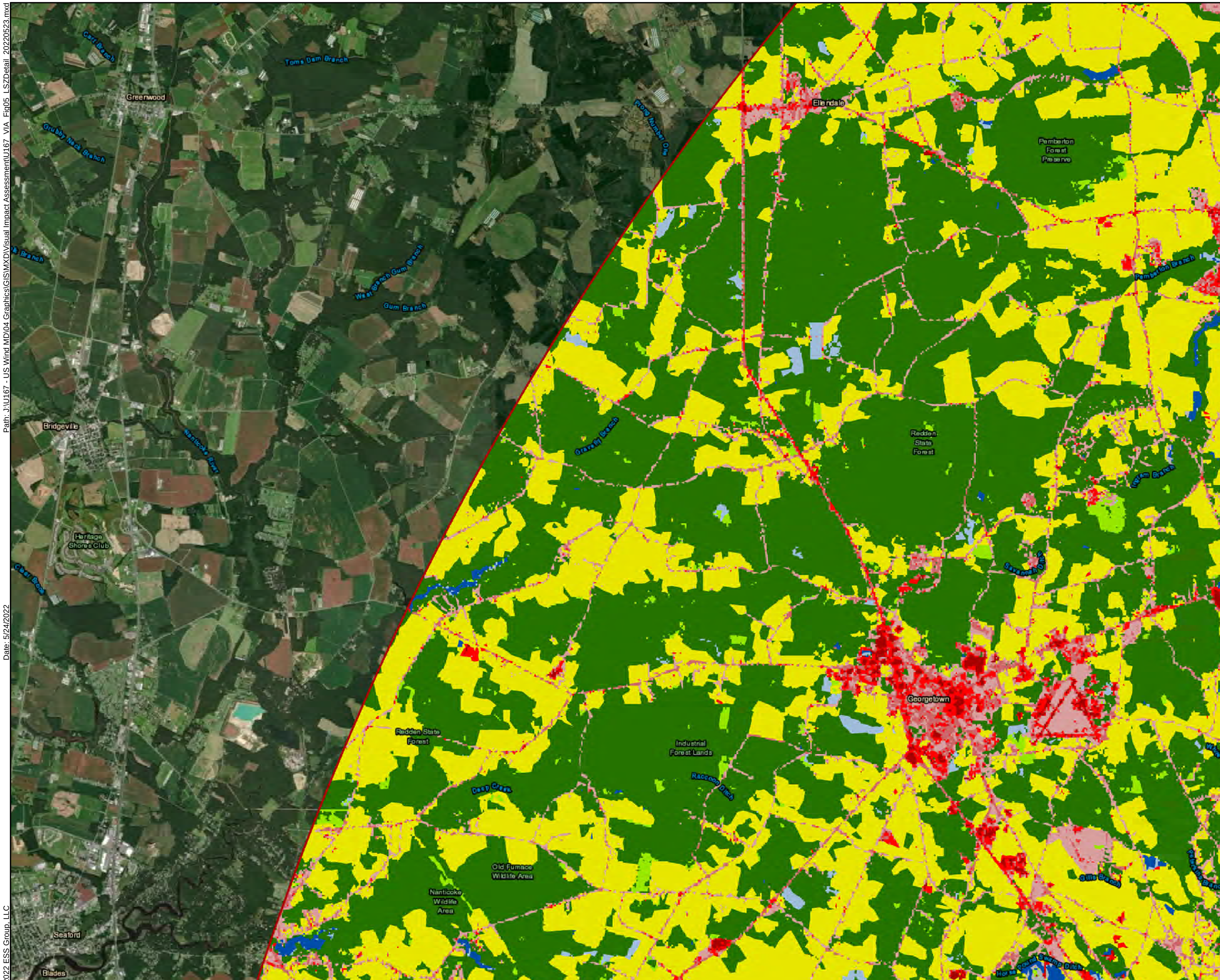

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Figure 5
Sheet 3 of 12

Landscape Similarity Zones

Legend

- Historic Resources
- US Wind Lease Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- 40-Mile Visual Study Area

LSZ

- Open Water
- Forest and Forested Wetlands
- Agriculture
- Developed, Open Space
- Wetlands
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Beach
- Shrub/Scrub and Grasslands

0 0.5 1 2 Miles
0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

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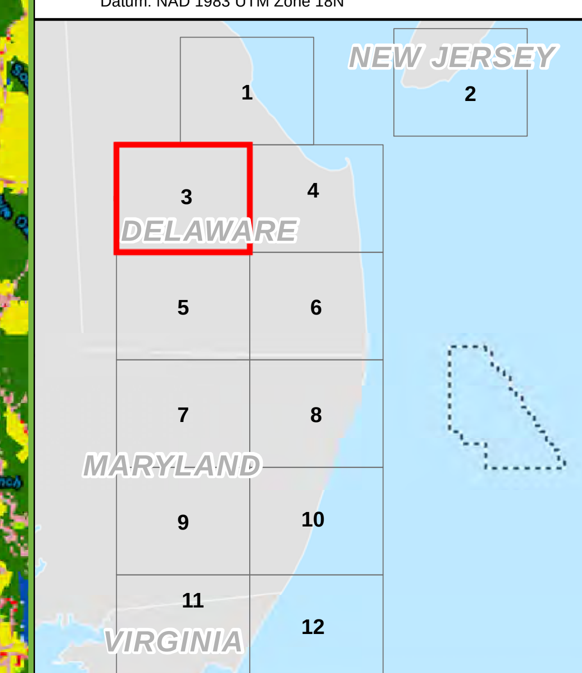

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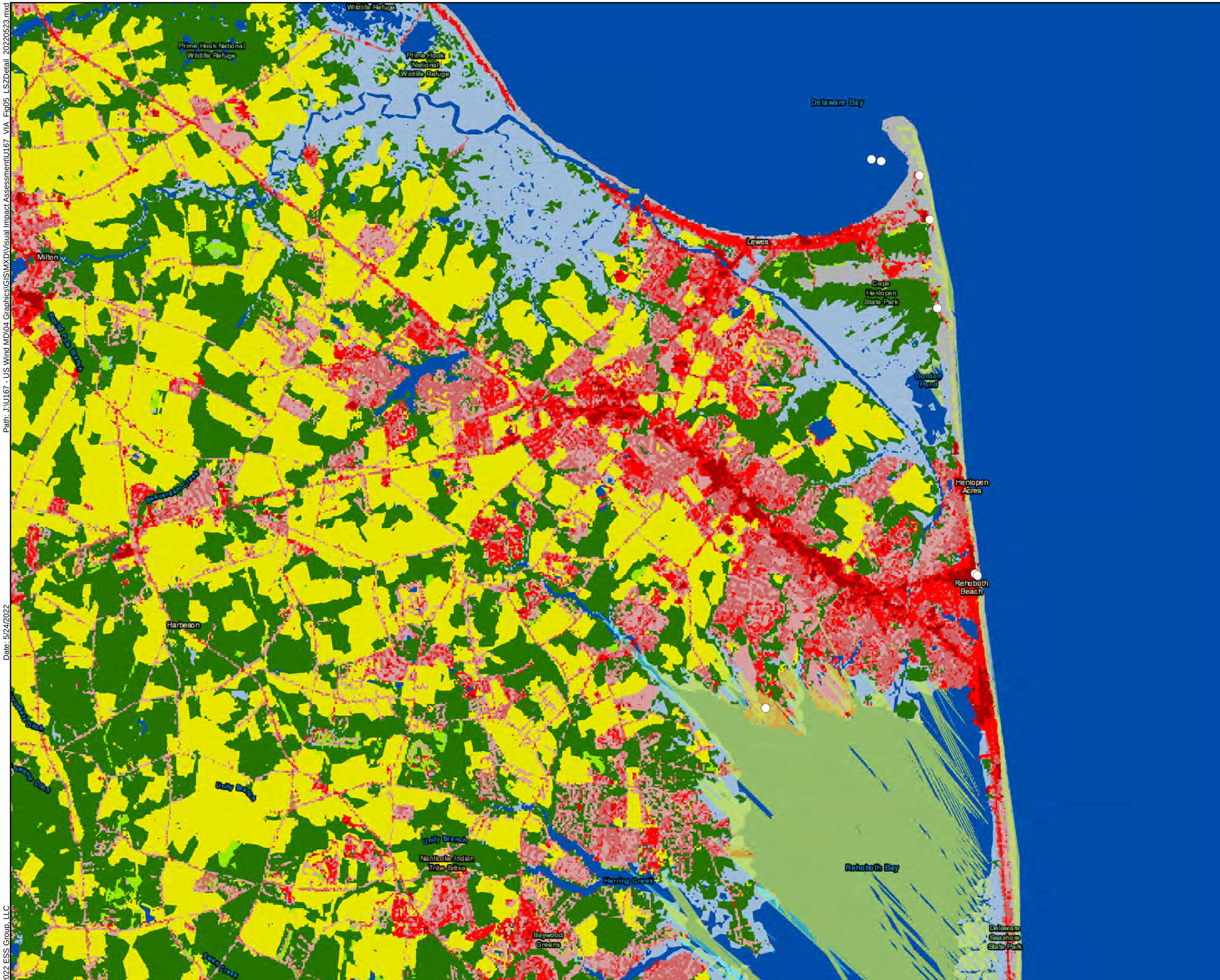

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Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 5

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Landscape Similarity Zones

Legend

- Historic Resources
- US Wind Lease Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- 40-Mile Visual Study Area

LSZ

- Open Water
- Forest and Forested Wetlands
- Agriculture
- Developed, Open Space
- Wetlands
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Beach
- Shrub/Scrub and Grasslands

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

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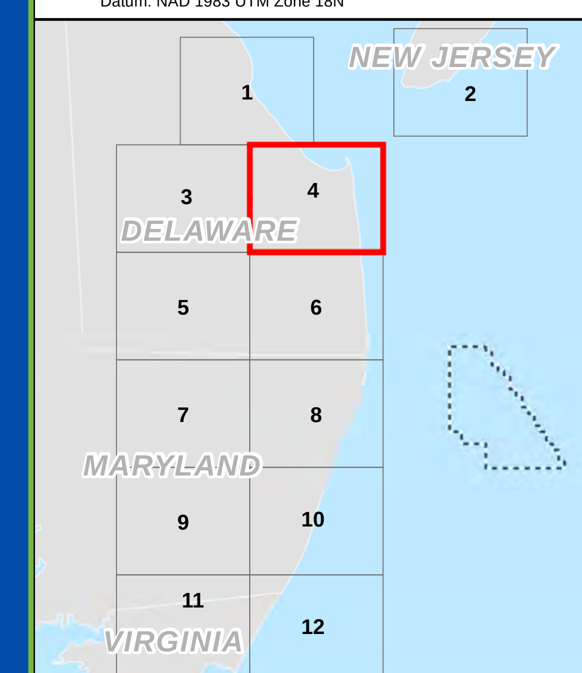

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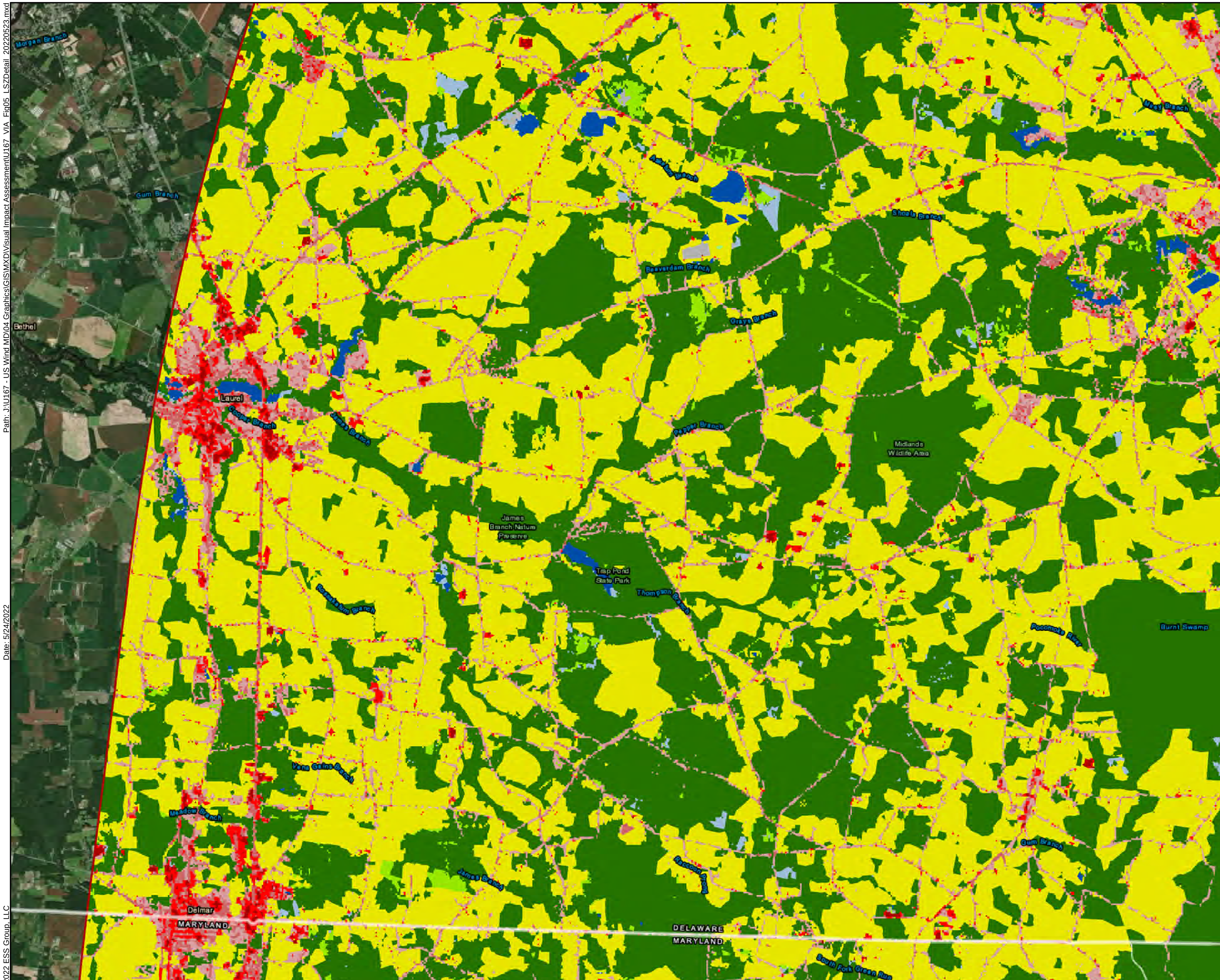

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Offshore Maryland and Delaware

Figure 5
Sheet 5 of 12

Landscape Similarity Zones

Legend

Historic Resources
US Wind Lease Area
Potential Turbine Nacelle Visibility (40 mi)
Potential Turbine Blade Visibility (40 mi)
40-Mile Visual Study Area

LSZ

Open Water
Forest and Forested Wetlands
Agriculture
Developed, Open Space
Wetlands
Developed, Low Intensity
Developed, Medium Intensity
Developed, High Intensity
Beach
Shrub/Scrub and Grasslands

0 0.5 1 2 Miles
0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
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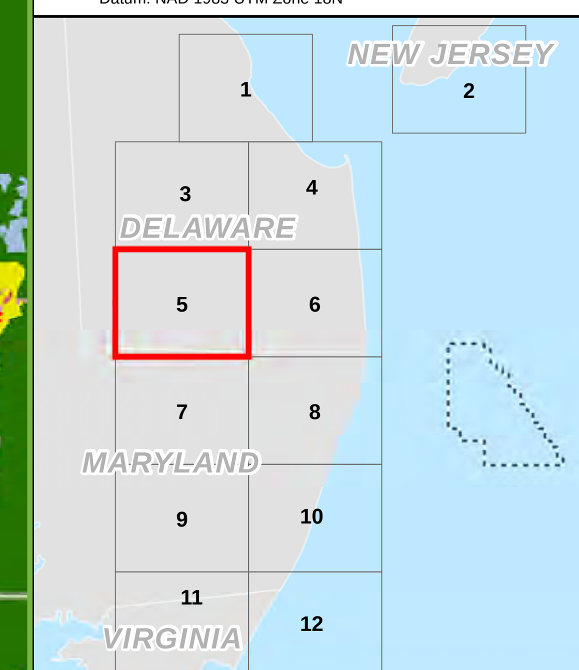

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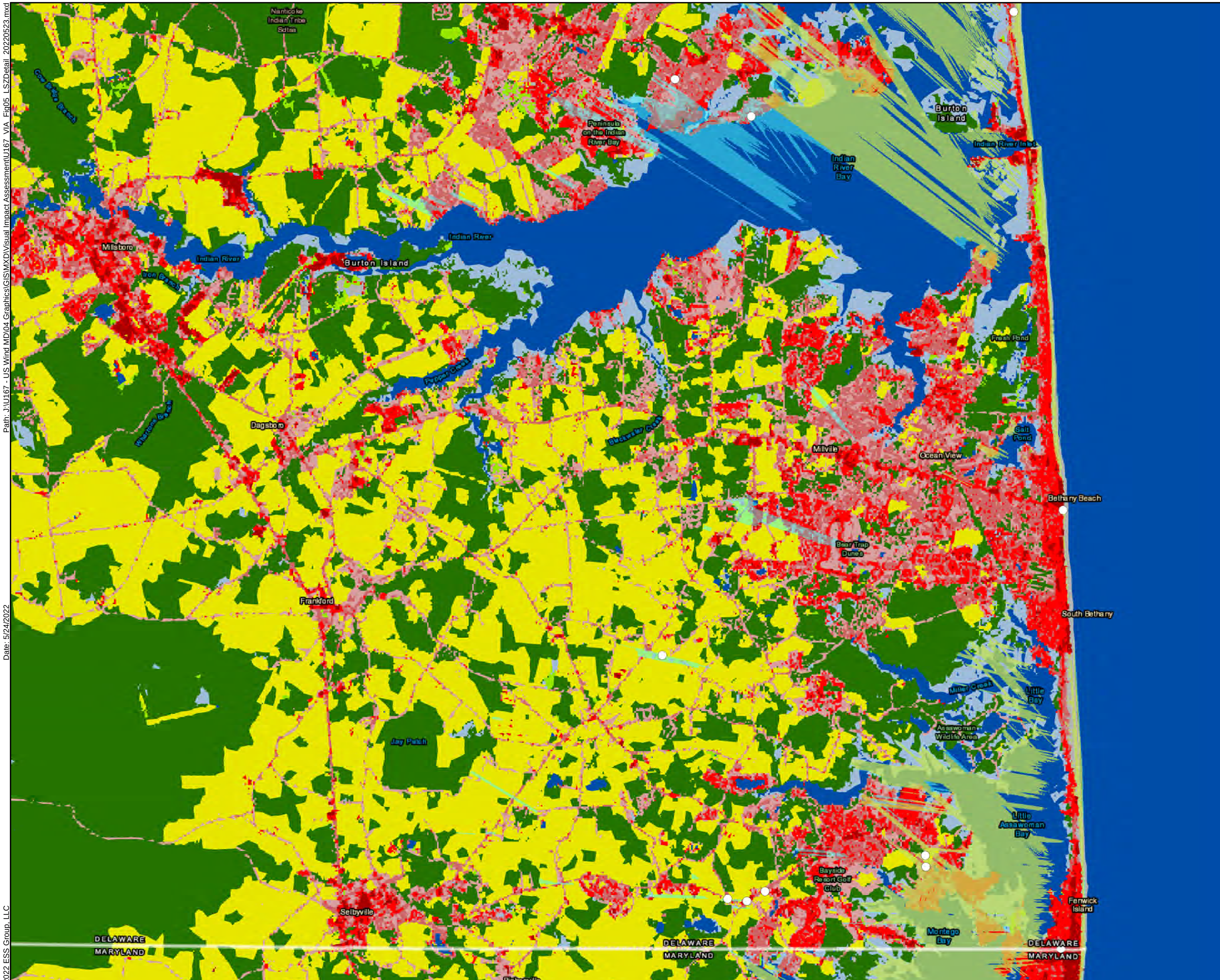

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Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 5
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Landscape Similarity Zones

Legend

- Historic Resources
- US Wind Lease Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- 40-Mile Visual Study Area

LSZ

- Open Water
- Forest and Forested Wetlands
- Agriculture
- Developed, Open Space
- Wetlands
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Beach
- Shrub/Scrub and Grasslands

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

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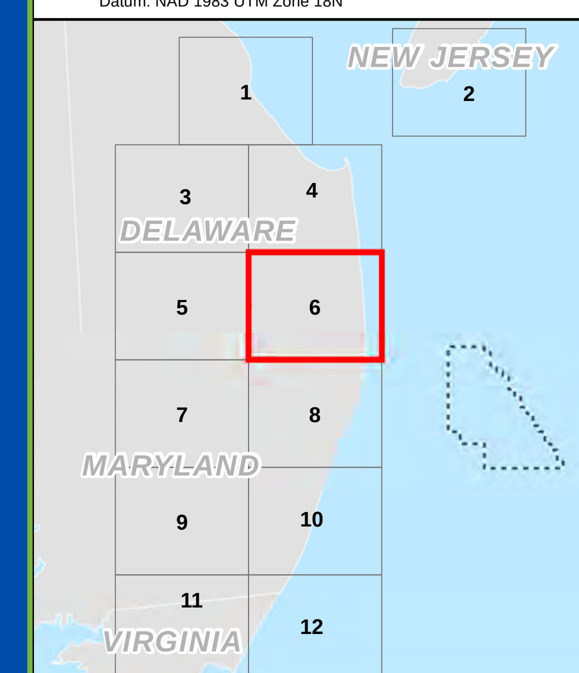

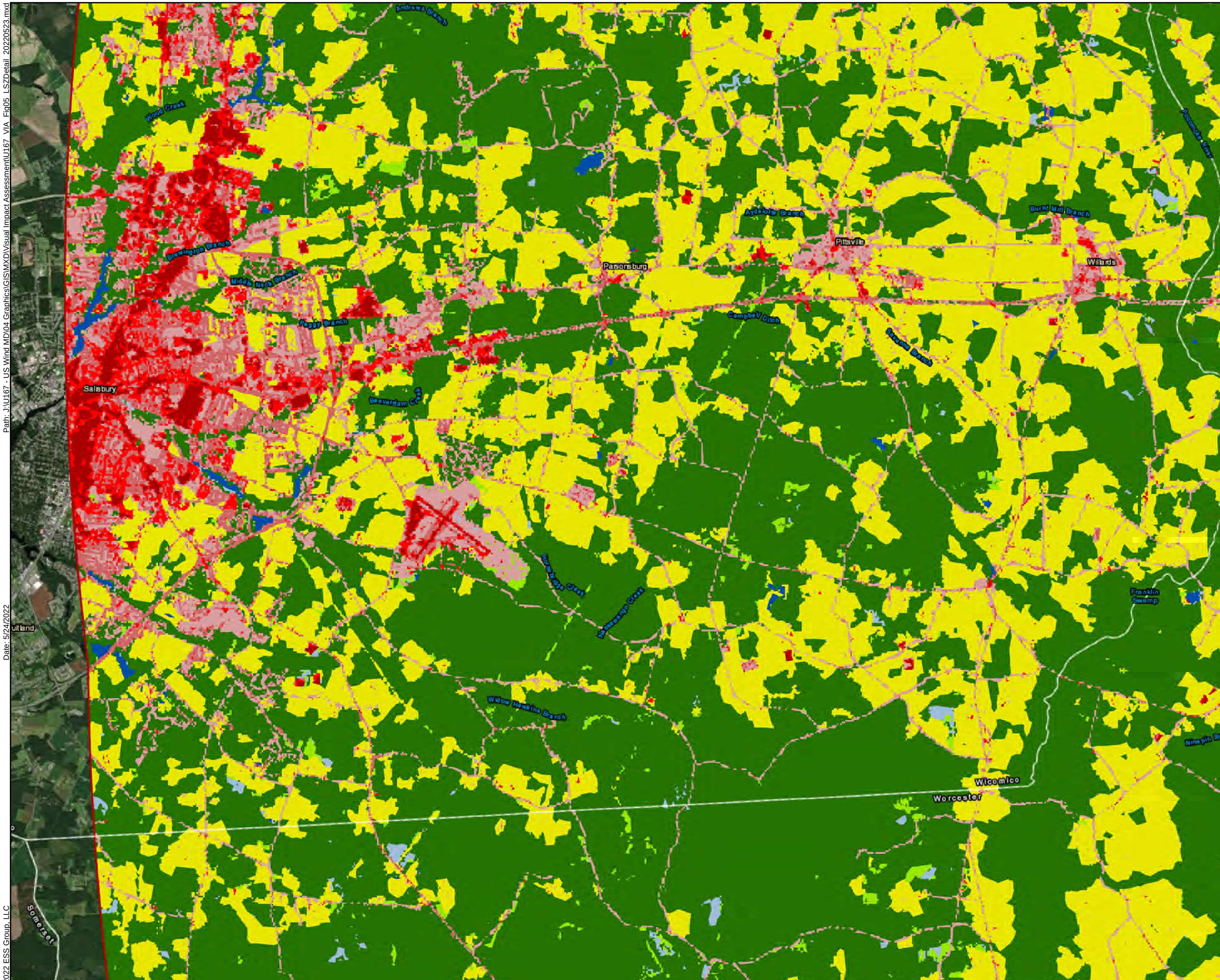

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Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 5

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Landscape Similarity Zones

Legend

- Historic Resources
- US Wind Lease Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- 40-Mile Visual Study Area

LSZ

- Open Water
- Forest and Forested Wetlands
- Agriculture
- Developed, Open Space
- Wetlands
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Beach
- Shrub/Scrub and Grasslands

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

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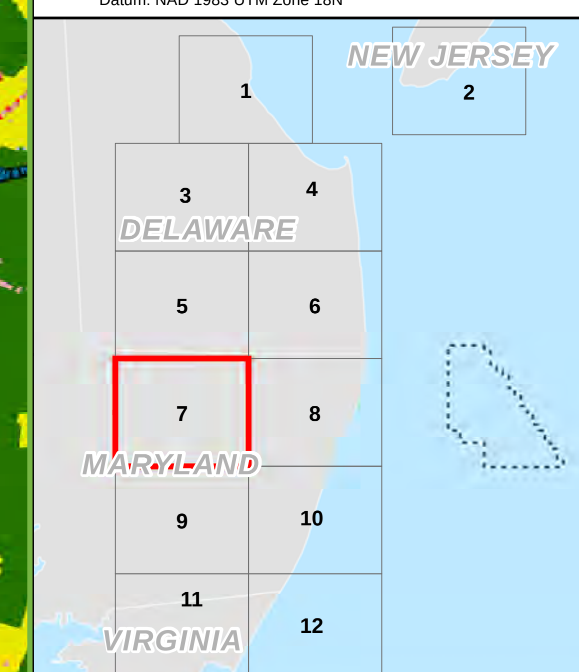

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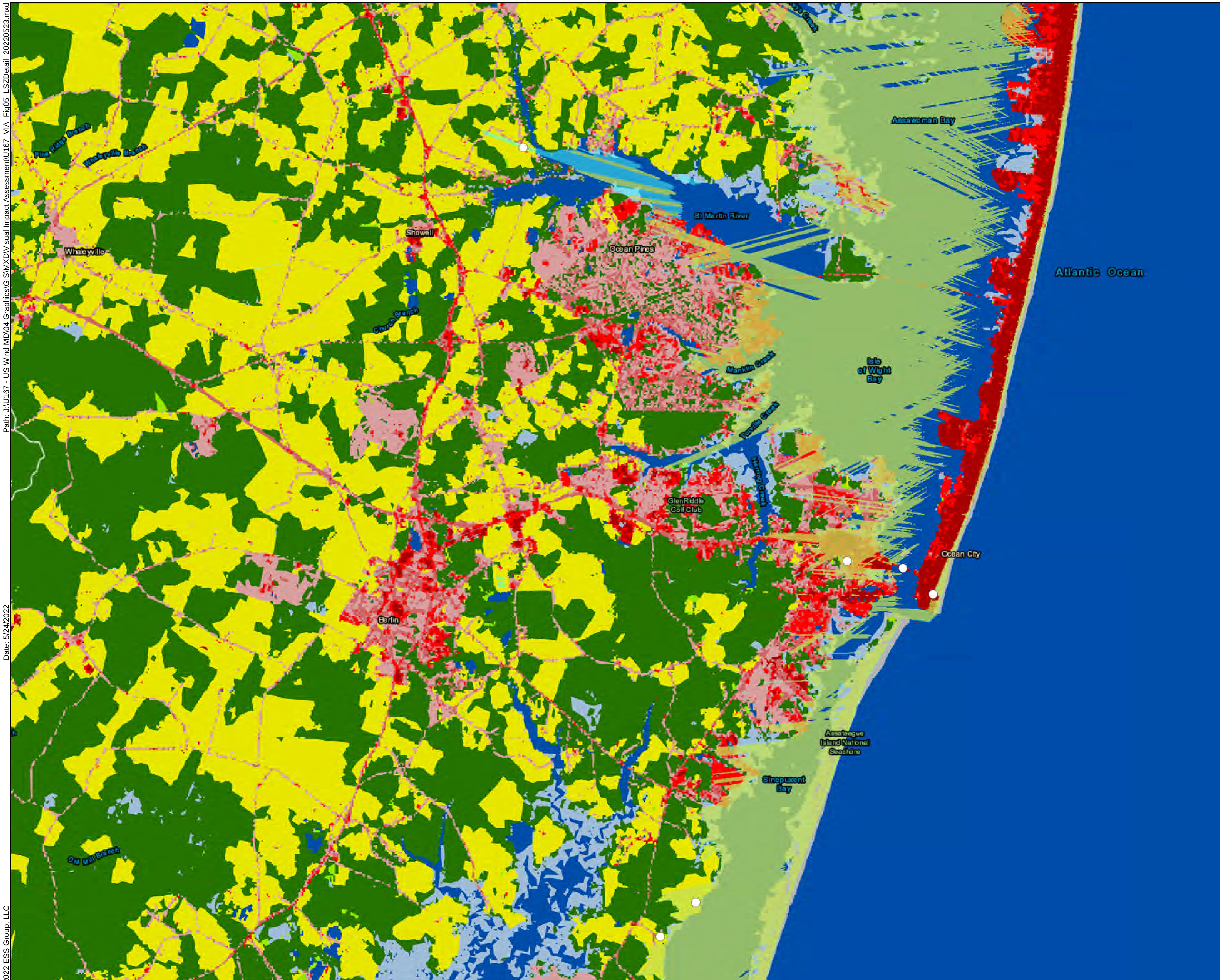

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Offshore Maryland and Delaware

Figure 5
Sheet 8 of 12

Landscape Similarity Zones

Legend

- Historic Resources
- US Wind Lease Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- 40-Mile Visual Study Area

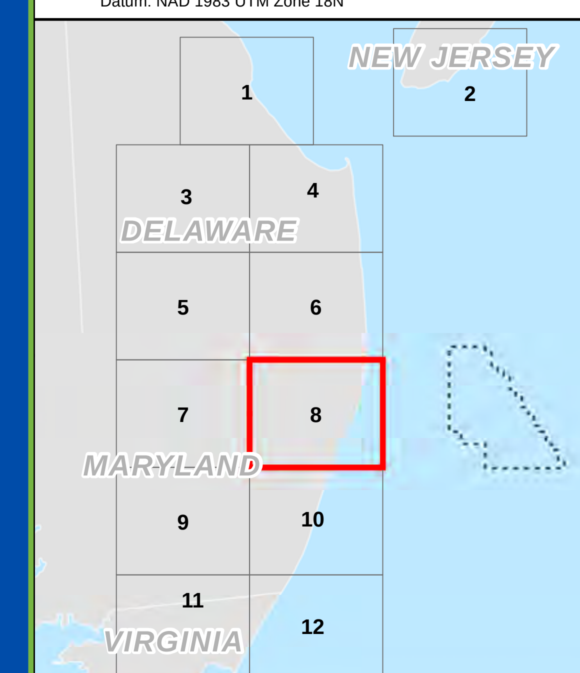
LSZ

- Open Water
- Forest and Forested Wetlands
- Agriculture
- Developed, Open Space
- Wetlands
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Beach
- Shrub/Scrub and Grasslands

0 0.5 1 2 Miles
0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

Datum: NAD 1983 UTM Zone 18N



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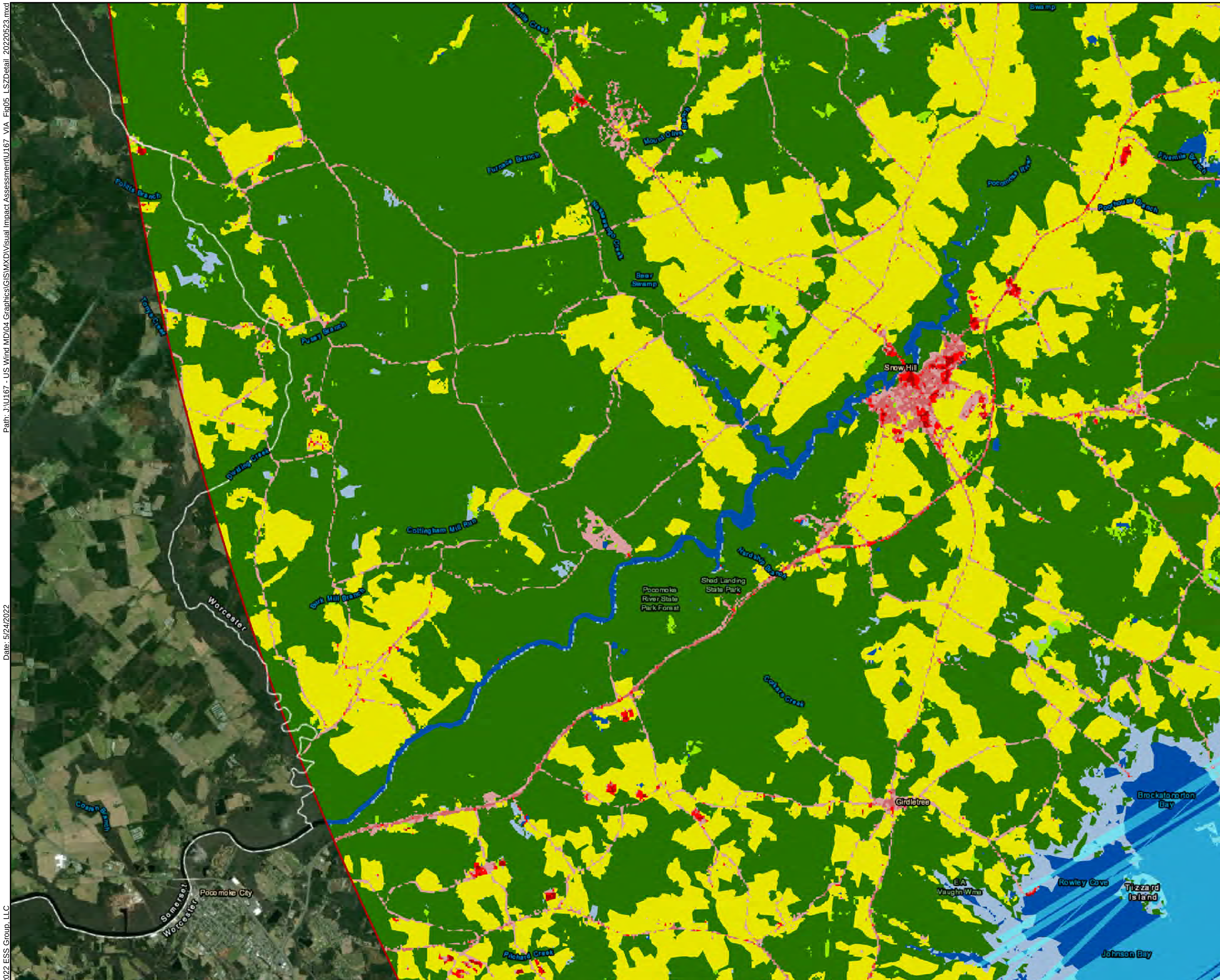


Maryland Offshore Wind Project

Offshore Maryland and Delaware

Figure 5

Sheet 9 of 12

Landscape Similarity Zones

Legend

- Historic Resources
- US Wind Lease Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- 40-Mile Visual Study Area

LSZ

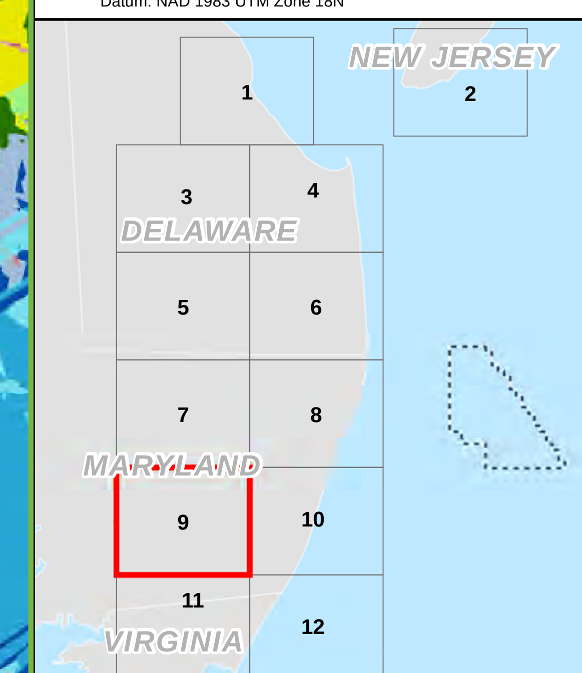
- Open Water
- Forest and Forested Wetlands
- Agriculture
- Developed, Open Space
- Wetlands
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Beach
- Shrub/Scrub and Grasslands

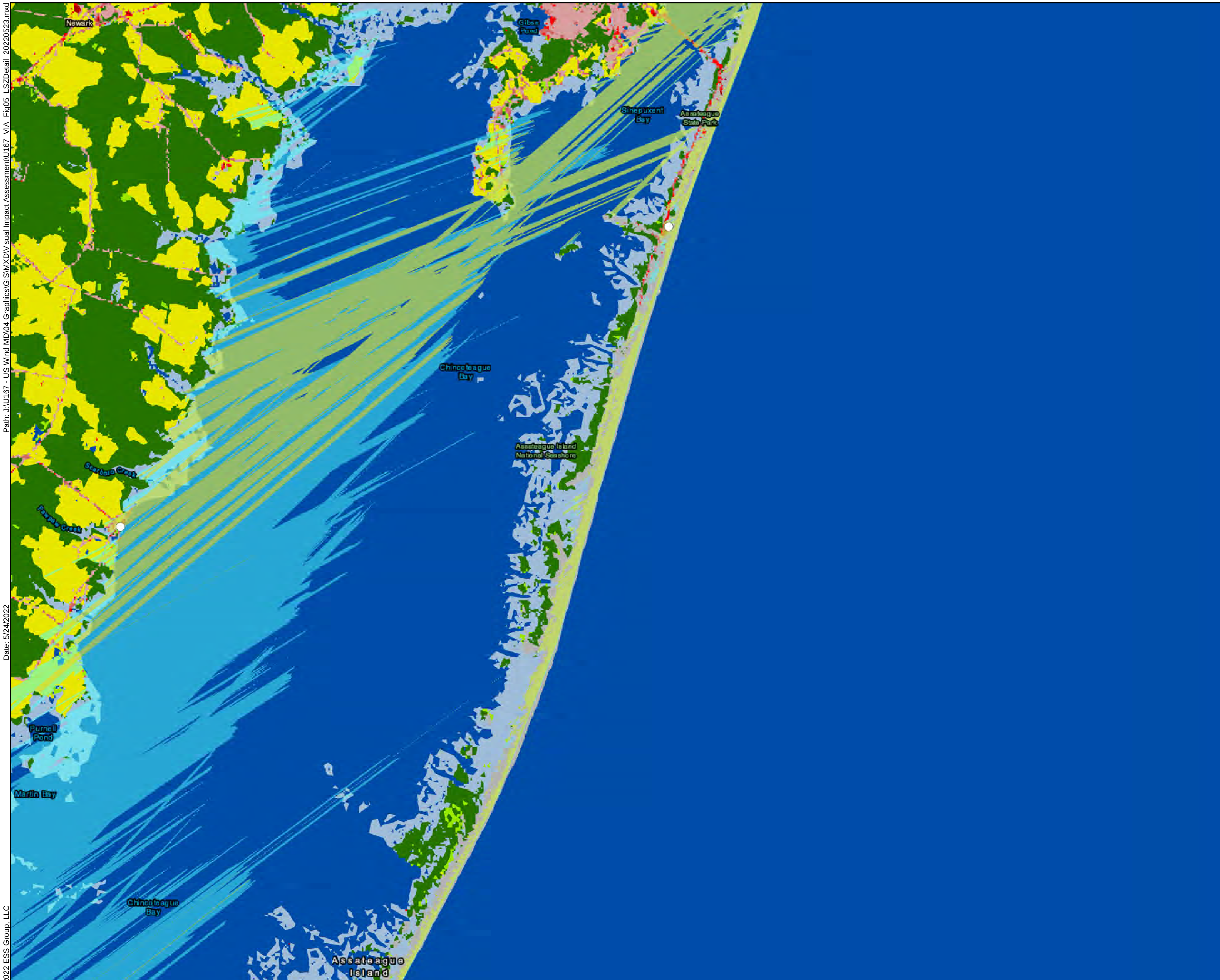
0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

Datum: NAD 1983 UTM Zone 18N





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Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 5
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Landscape Similarity Zones

Legend

- Historic Resources
- US Wind Lease Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- 40-Mile Visual Study Area

LSZ

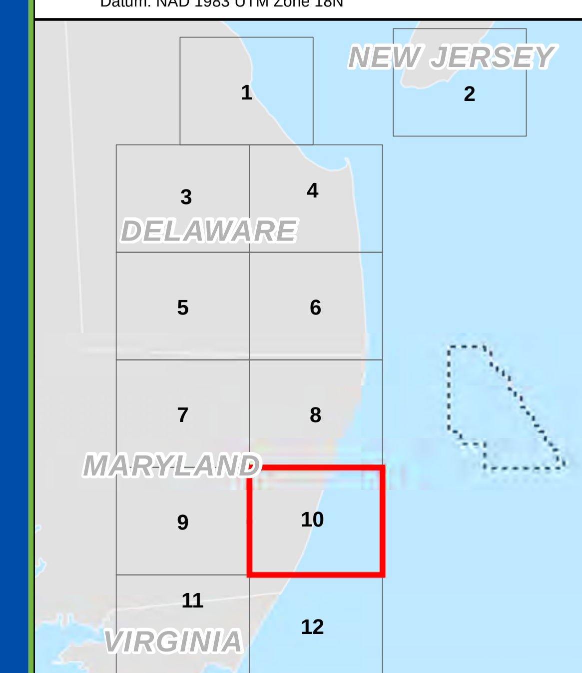
- Open Water
- Forest and Forested Wetlands
- Agriculture
- Developed, Open Space
- Wetlands
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Beach
- Shrub/Scrub and Grasslands

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

Datum: NAD 1983 UTM Zone 18N



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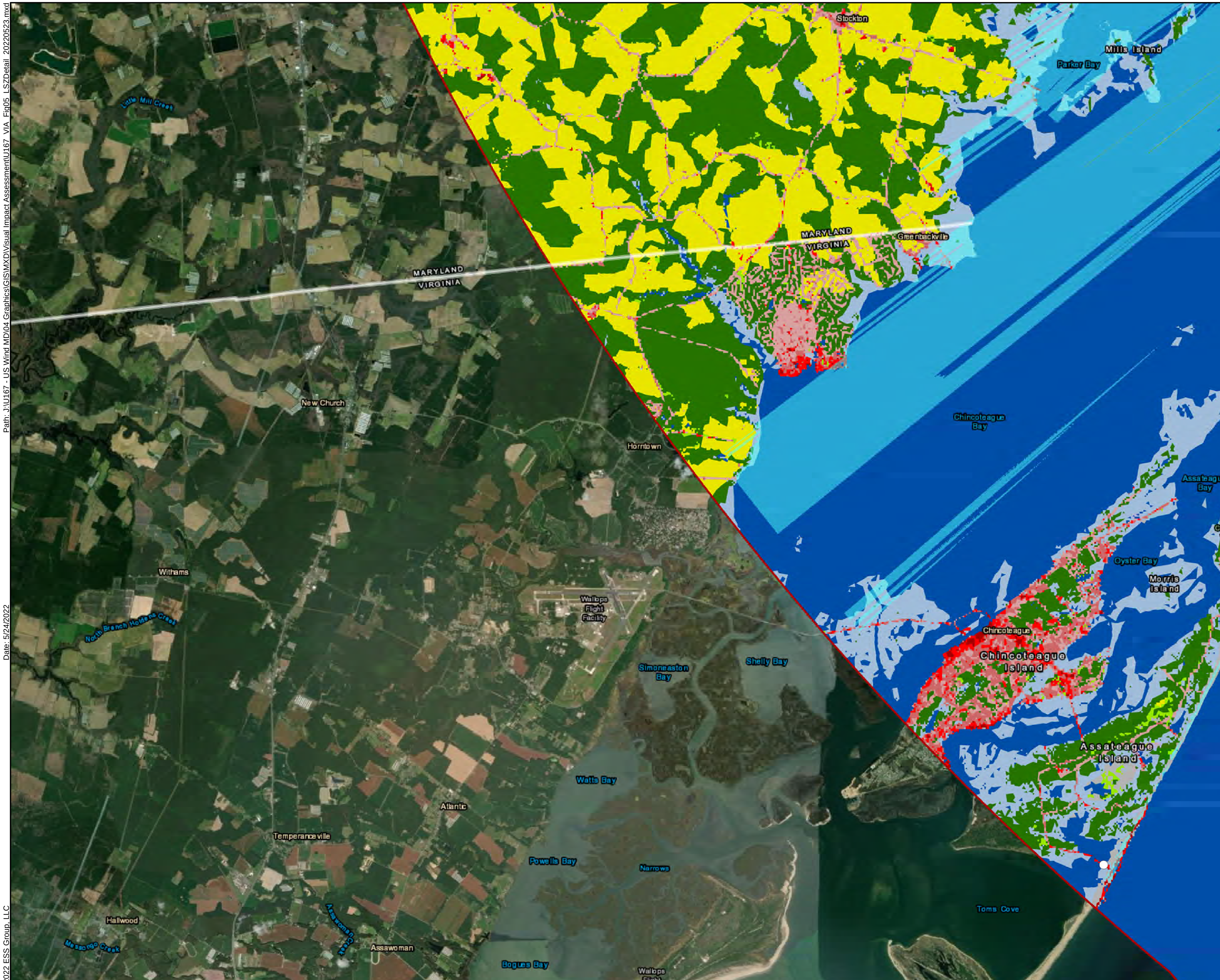

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Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 5
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Landscape Similarity Zones

Legend

- Historic Resources
- US Wind Lease Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- 40-Mile Visual Study Area

LSZ

- Open Water
- Forest and Forested Wetlands
- Agriculture
- Developed, Open Space
- Wetlands
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Beach
- Shrub/Scrub and Grasslands

0 0.5 1 2 Miles
0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

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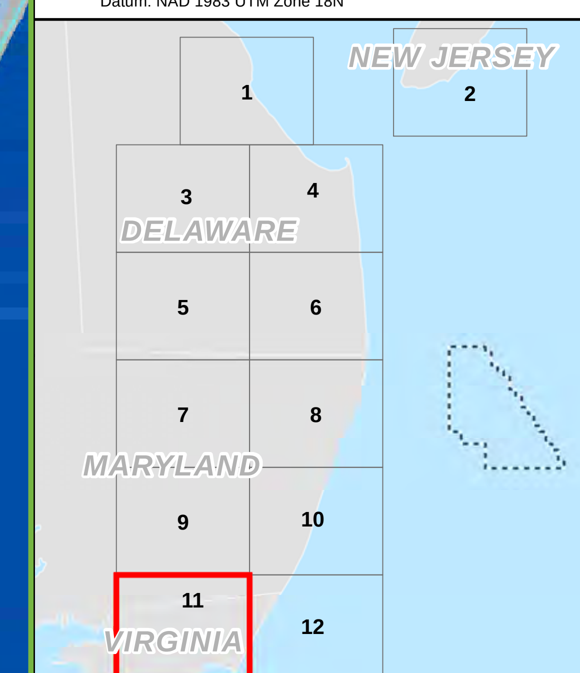

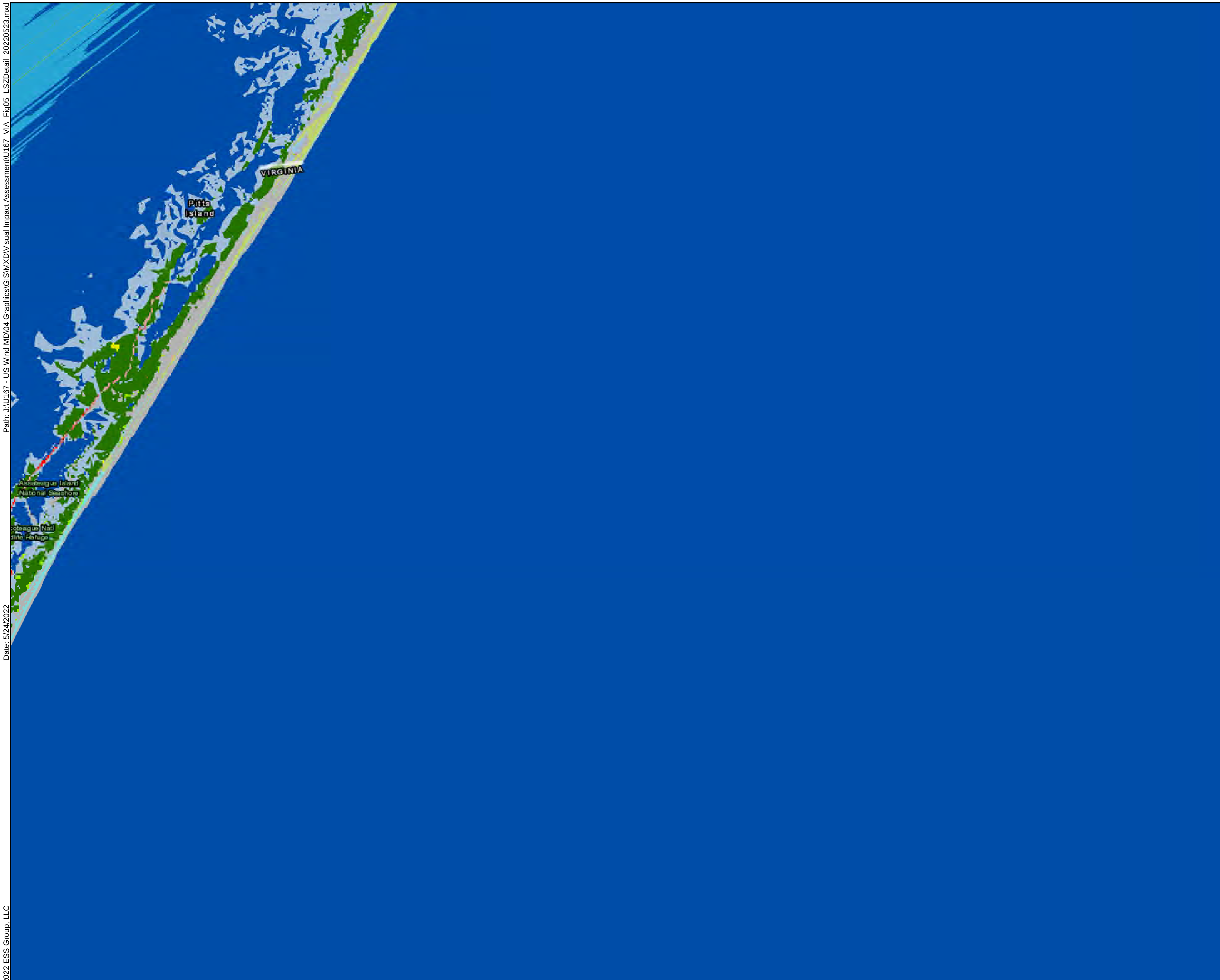

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Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 5
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Landscape Similarity Zones

Legend

- Historic Resources
- US Wind Lease Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- 40-Mile Visual Study Area

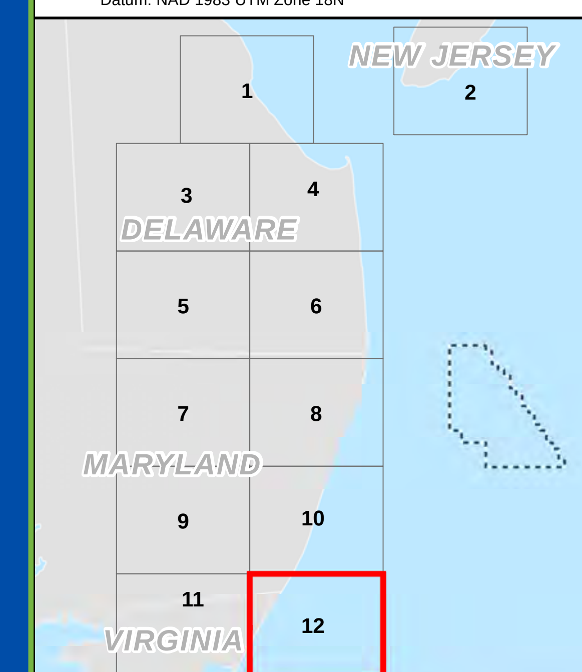
LSZ

- Open Water
- Forest and Forested Wetlands
- Agriculture
- Developed, Open Space
- Wetlands
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Beach
- Shrub/Scrub and Grasslands

0 0.5 1 2 Miles
0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

Datum: NAD 1983 UTM Zone 18N



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Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 6

Overall Project Viewshed

Legend

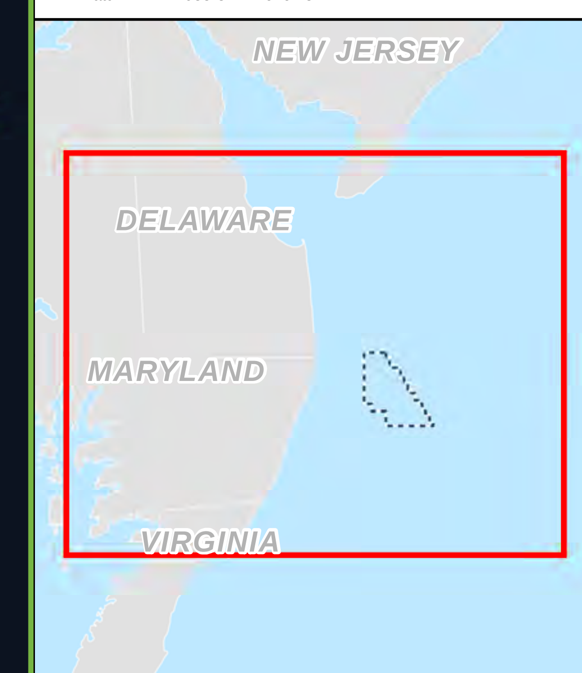
- Simulation Location
- US Wind Lease Area
- 40-Mile Visual Study Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- USACE NCMP Topobathy Lidar

0 2.5 5 10 Miles

0 3.25 6.5 13 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) USACE NCMP Topobathy Lidar- East Coast, 2017

Datum: NAD 1983 UTM Zone 18N



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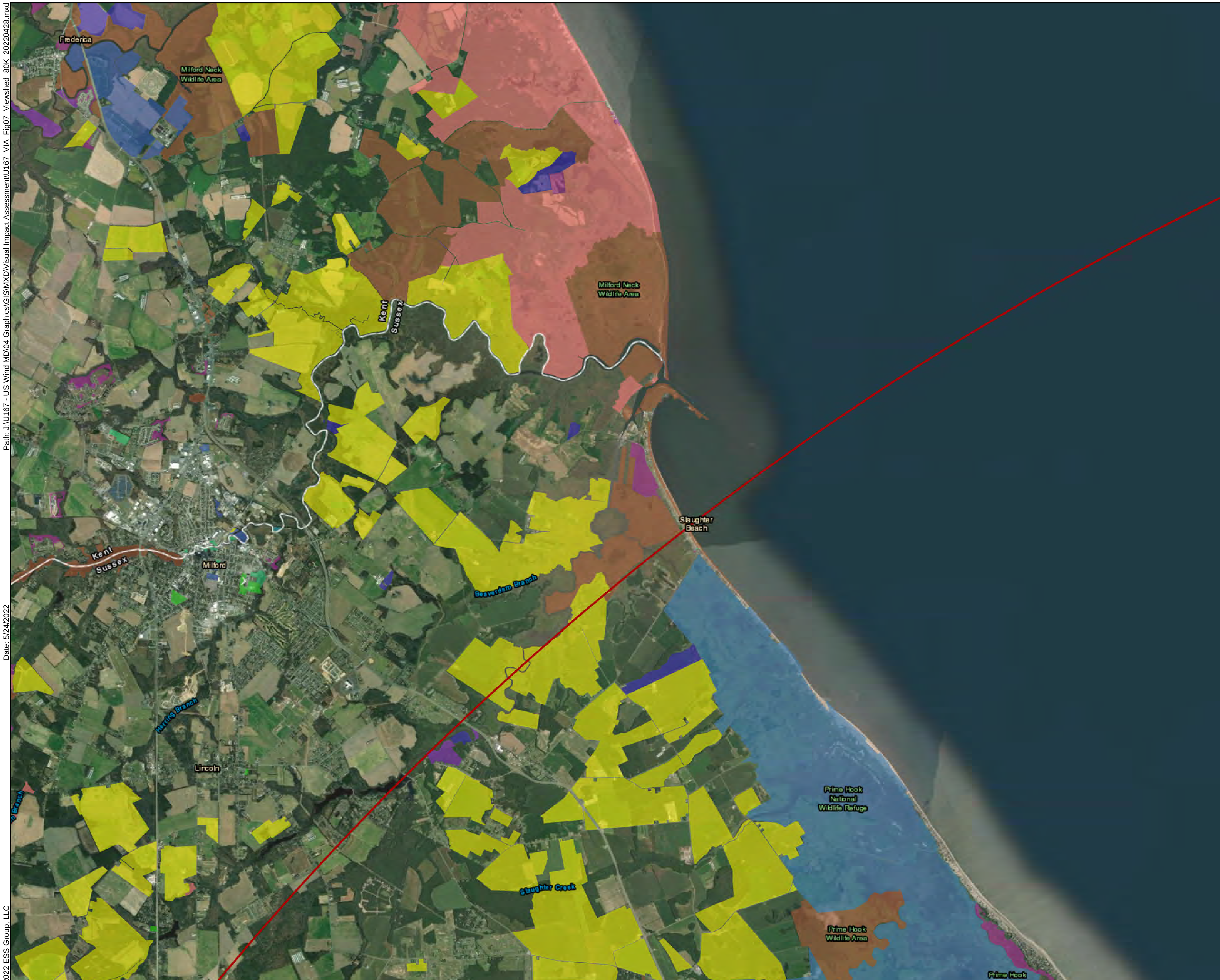

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Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 7
Sheet 1 of 12

Project Viewshed

Legend

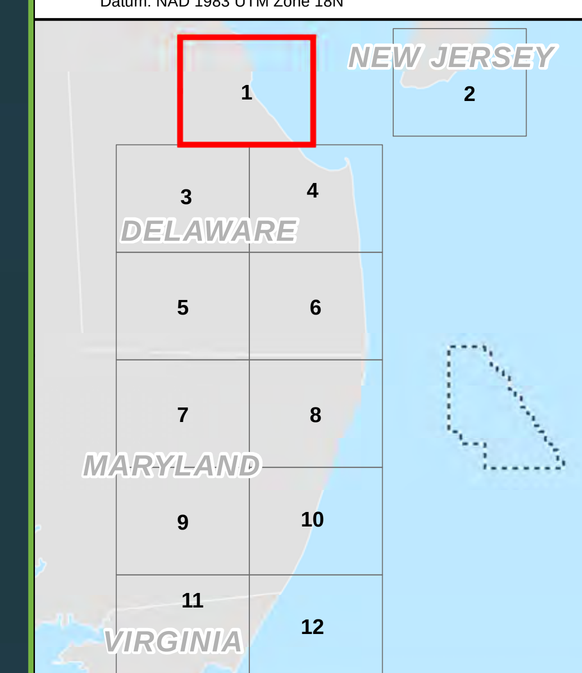
- Simulation Location
- Historic Resources
- US Wind Lease Area
- 40-Mile Visual Study Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- Agricultural Easement
- Conservation Easement
- Educational Land
- Federal Land
- Municipal Land
- Municipal Park
- National Wildlife Refuge
- Nature Reserve / Preserve / Sanctuary
- Other Land
- Private Conserved Land
- State Forest
- State Land
- State Park

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

Datum: NAD 1983 UTM Zone 18N



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Date: 5/24/2022

Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 7
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Project Viewshed

Legend

- Simulation Location
- Historic Resources
- US Wind Lease Area
- 40-Mile Visual Study Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- Conservation Easement
- Municipal Park
- National Wildlife Refuge
- Nature Reserve / Preserve / Sanctuary
- Other Land
- State Park
- Wildlife Management Area

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

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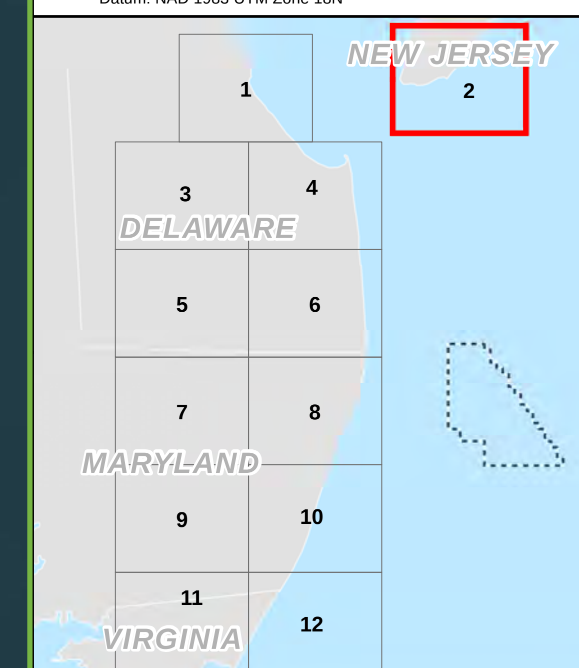

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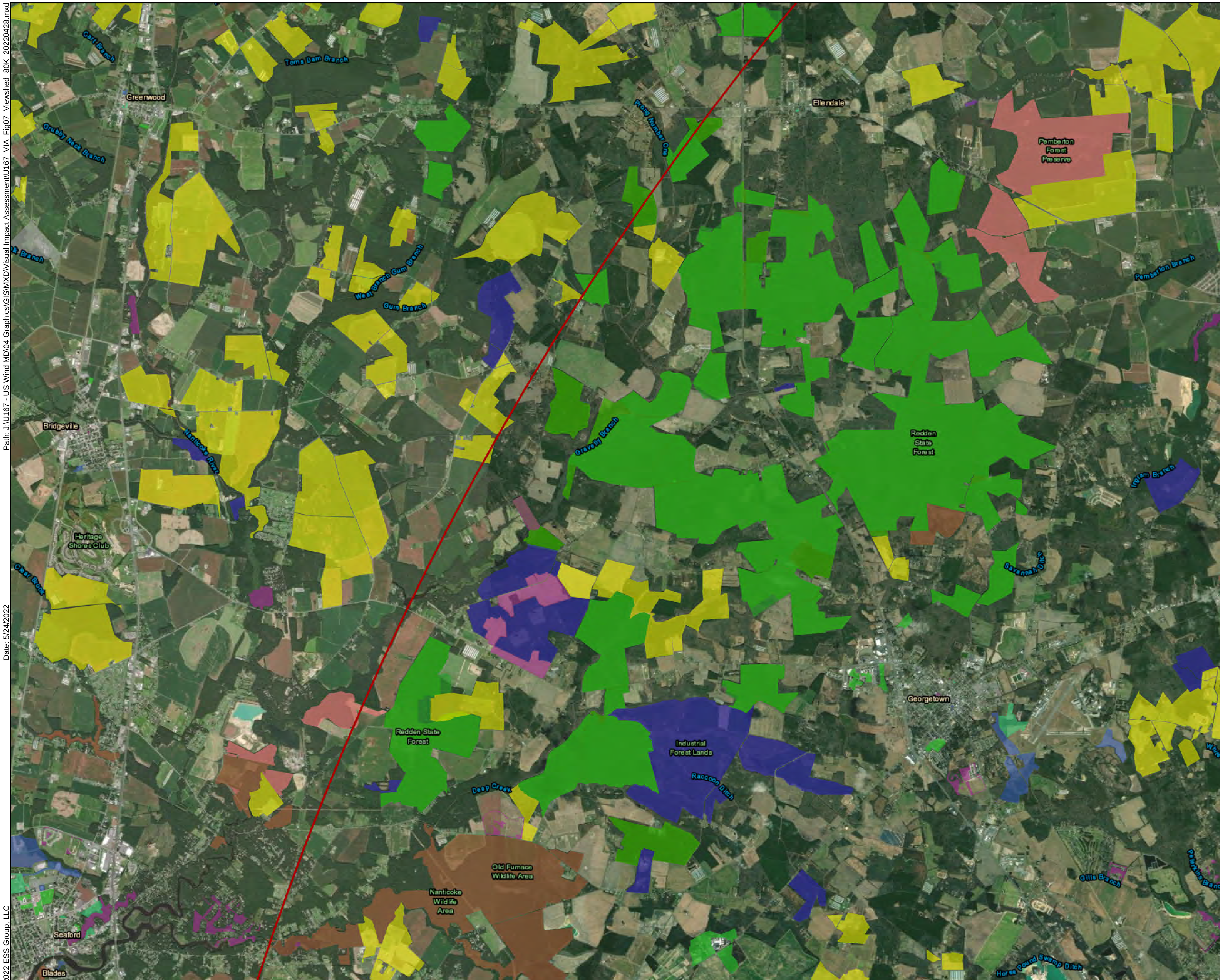

Maryland Offshore Wind Project

Offshore Maryland and Delaware

Figure 7

Sheet 3 of 12

Project Viewshed

Legend

- Simulation Location
- Historic Resources
- US Wind Lease Area
- 40-Mile Visual Study Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- Agricultural Easement
- Conservation Easement
- Educational Land
- Municipal Land
- Municipal Park
- Nature Reserve / Preserve / Sanctuary
- Other Land
- Private Conserved Land
- State Forest
- State Land
- State Park

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
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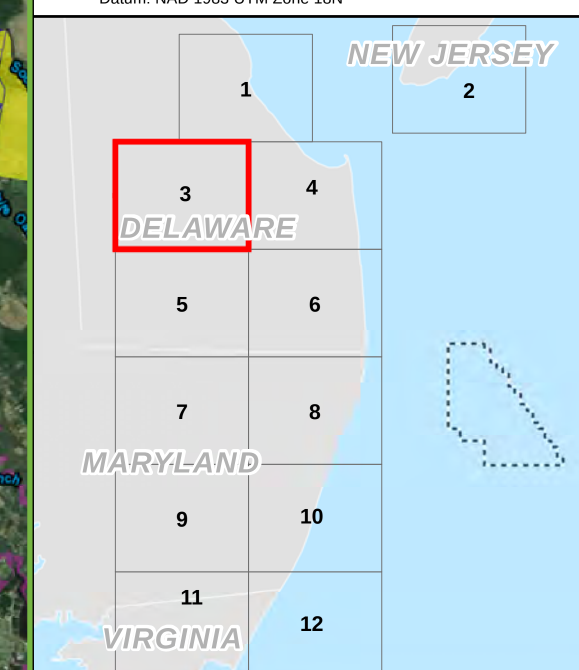

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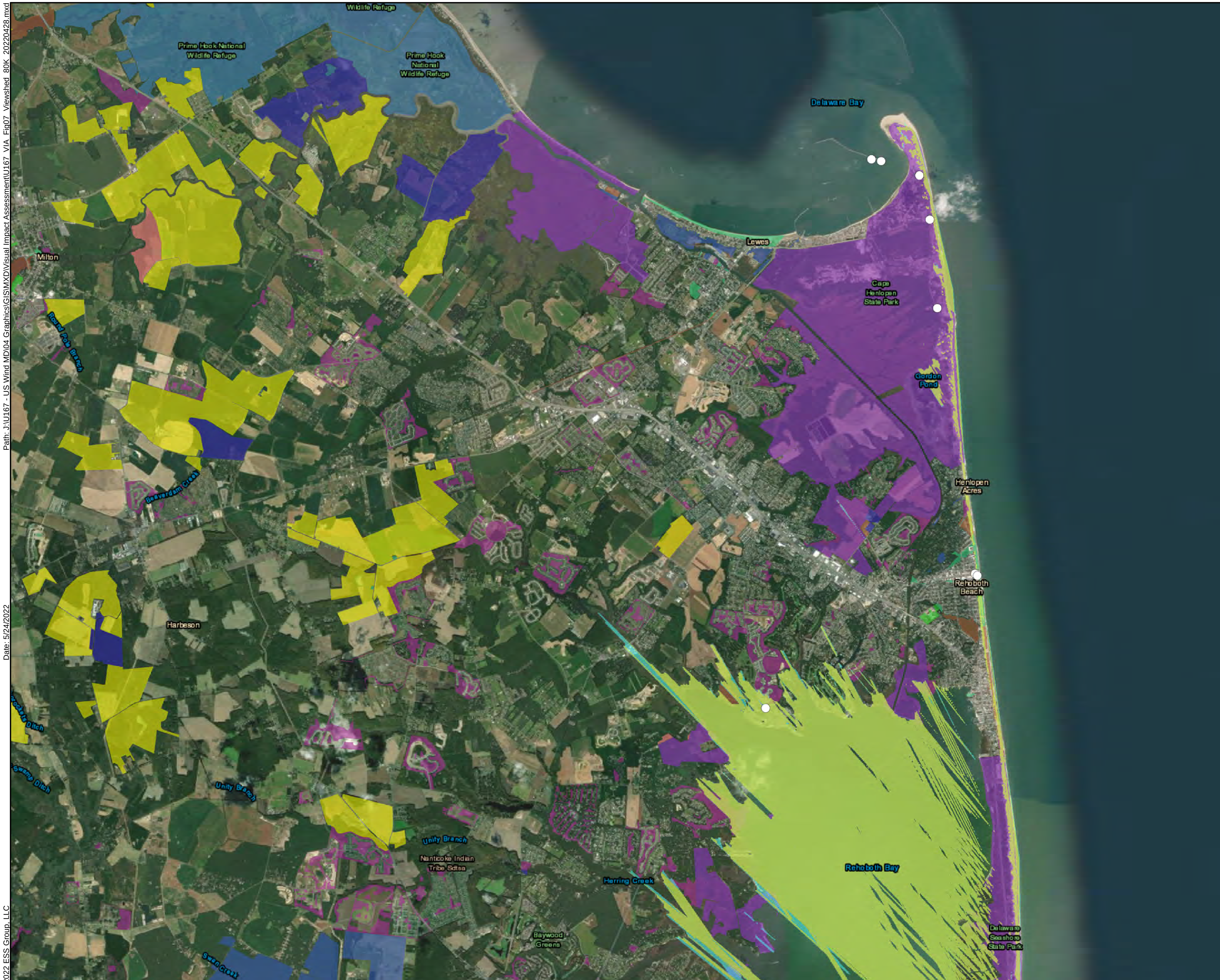

Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 7
Sheet 4 of 12

Project Viewshed

Legend

- Simulation Location
- Historic Resources
- US Wind Lease Area
- 40-Mile Visual Study Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- Agricultural Easement
- Conservation Easement
- Educational Land
- Municipal Land
- Municipal Park
- National Wildlife Refuge
- Nature Reserve / Preserve / Sanctuary
- Other Land
- Private Conserved Land
- State Forest
- State Land
- State Park

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

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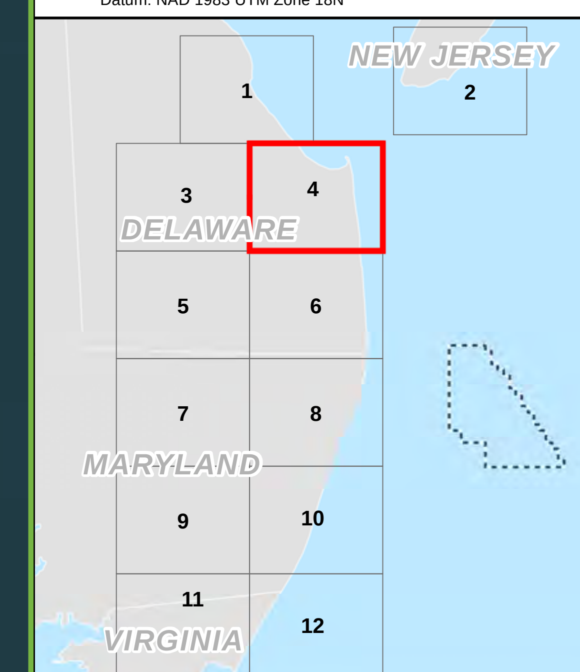

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Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 7
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Project Viewshed

Legend

- Simulation Location
- Historic Resources
- US Wind Lease Area
- 40-Mile Visual Study Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- Agricultural Easement
- Conservation Easement
- Educational Land
- Municipal Land
- Municipal Park
- Nature Reserve / Preserve / Sanctuary
- Other Land
- Private Conserved Land
- State Forest
- State Land
- State Park

0 0.5 1 2 Miles
0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

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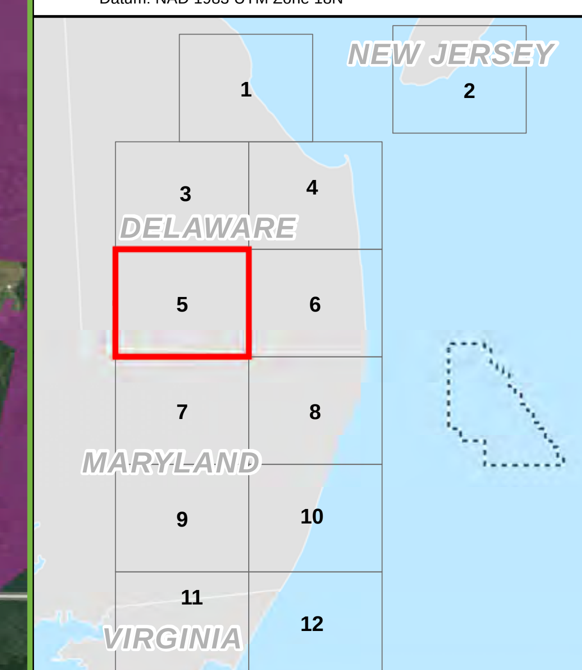

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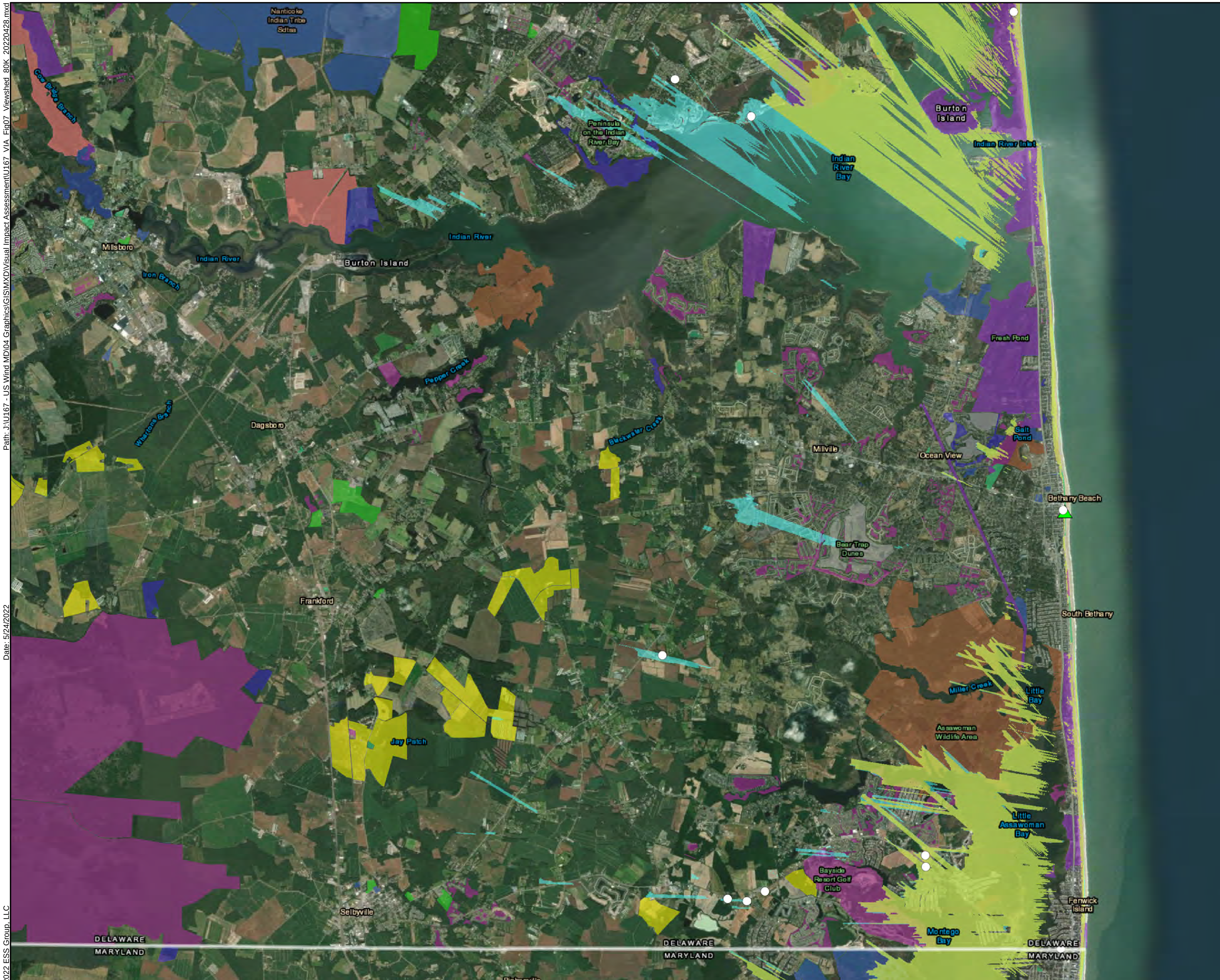

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Maryland Offshore Wind Project

Offshore Maryland and Delaware

Figure 7

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Project Viewshed

Legend

- Simulation Location
- Historic Resources
- US Wind Lease Area
- 40-Mile Visual Study Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- Agricultural Easement
- Conservation Easement
- Educational Land
- Municipal Land
- Municipal Park
- Nature Reserve / Preserve / Sanctuary
- Other Land
- Private Conserved Land
- State Forest
- State Land
- State Park

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
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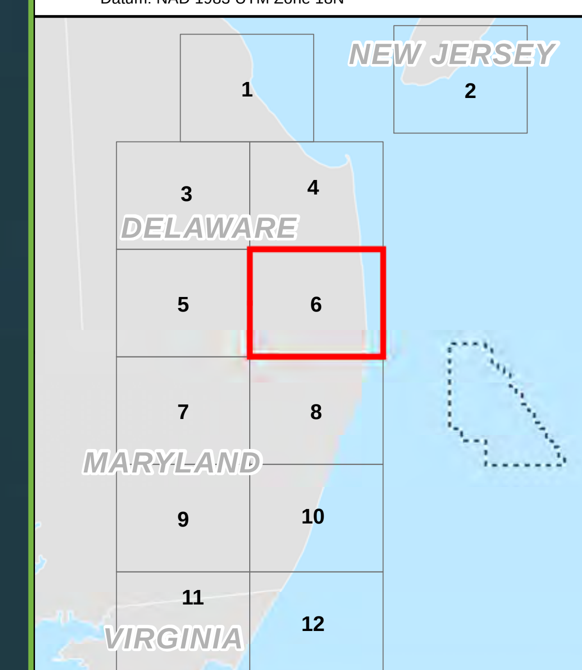

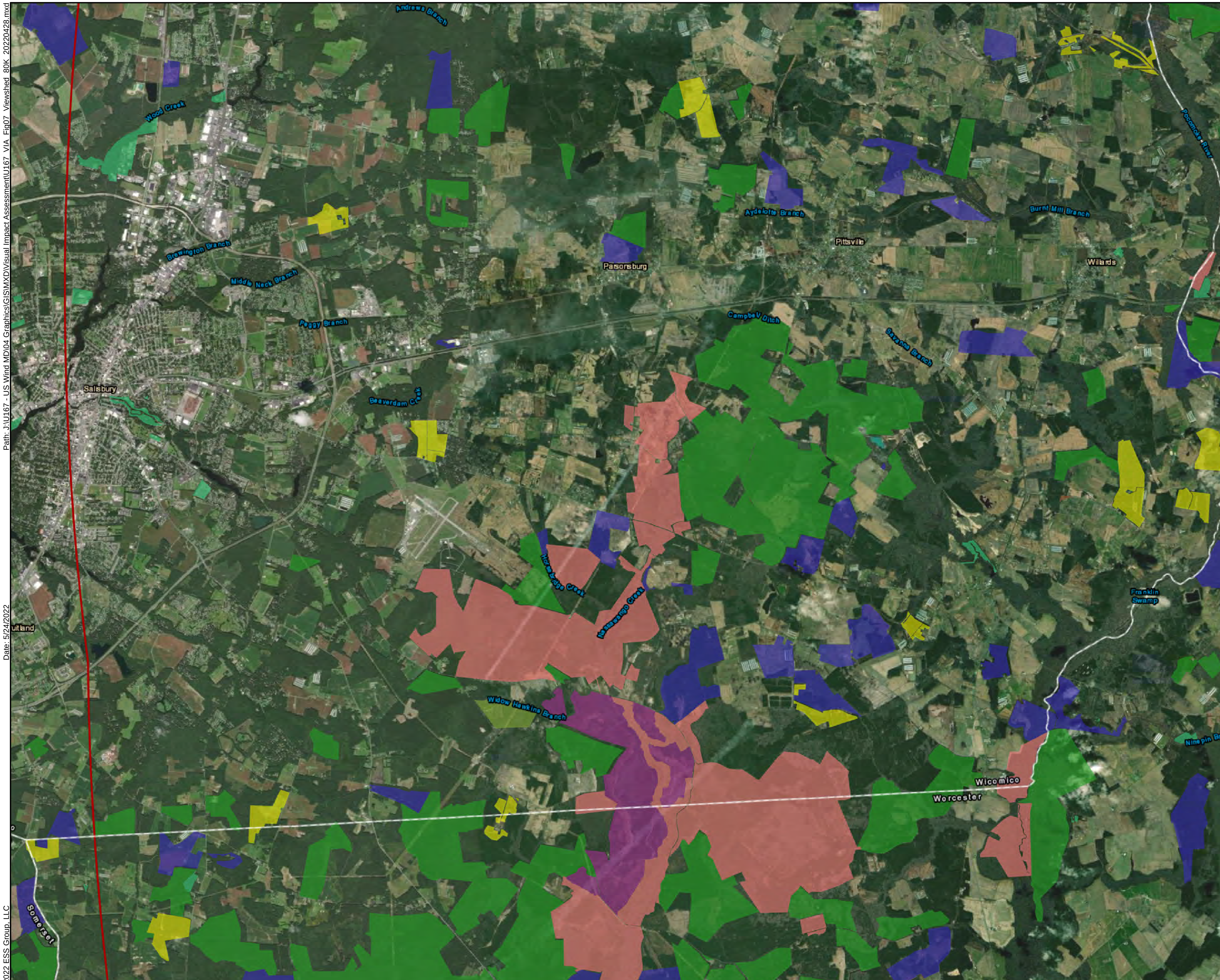

Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 7

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Project Viewshed

Legend

- Simulation Location
- Historic Resources
- US Wind Lease Area
- 40-Mile Visual Study Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- Agricultural Easement
- Conservation Easement
- Municipal Park
- Nature Reserve / Preserve / Sanctuary
- Private Conserved Land
- State Forest
- State Land
- Wildlife Management Area

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
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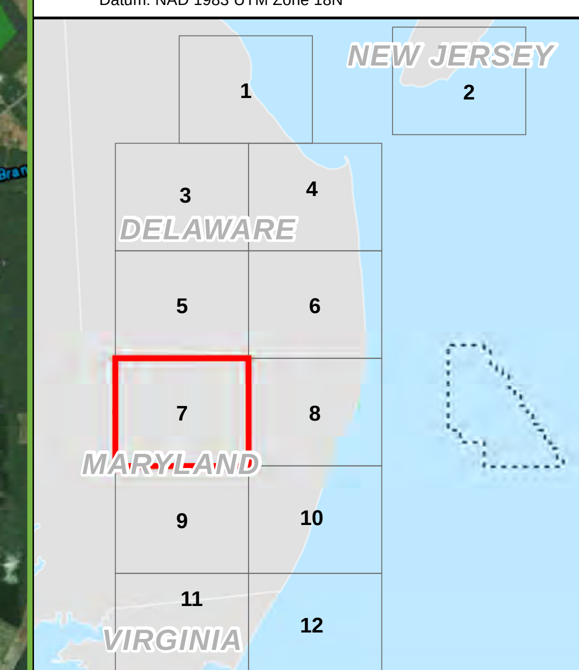

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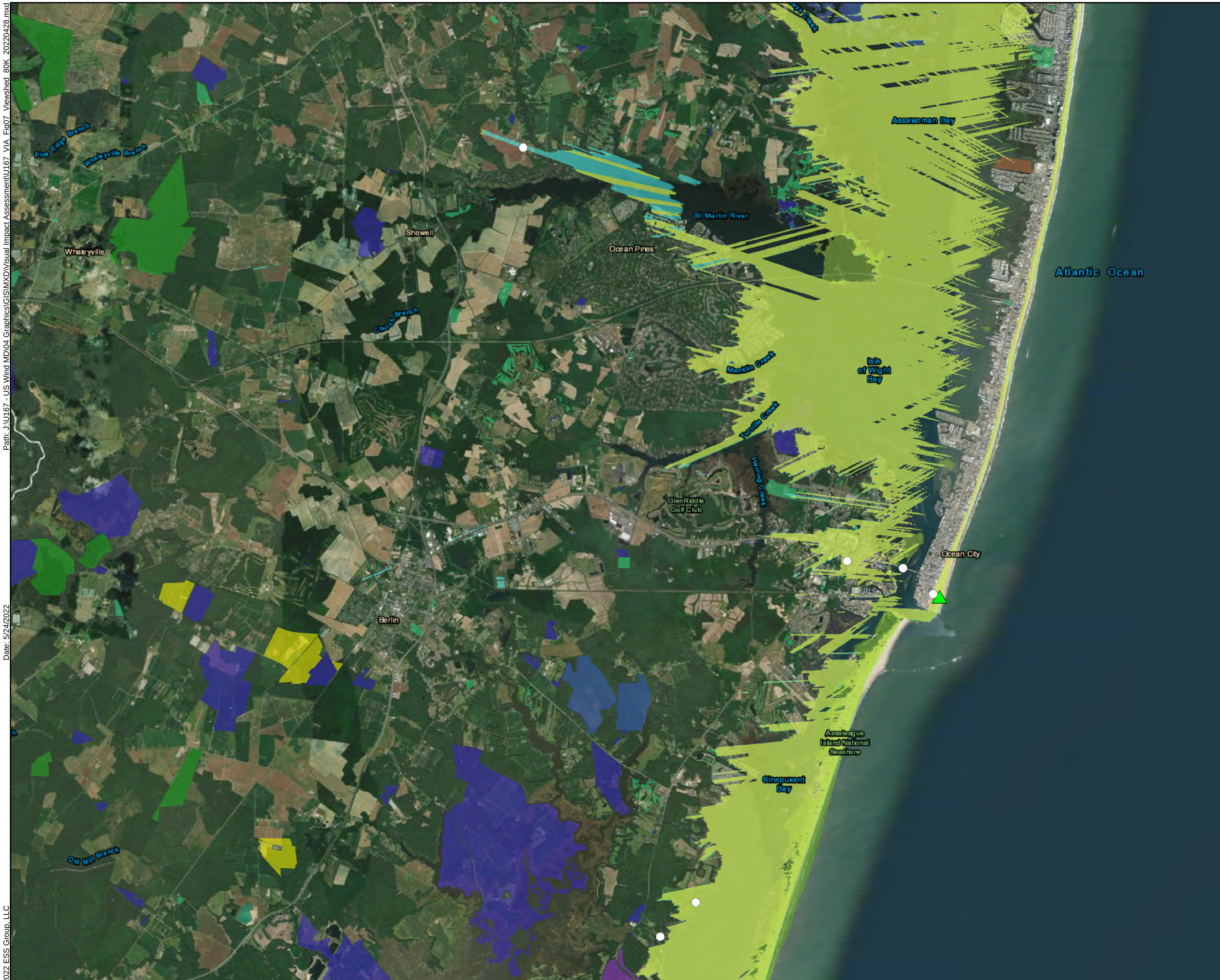

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Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 7
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Project Viewshed

Legend

- Simulation Location
- Historic Resources
- US Wind Lease Area
- 40-Mile Visual Study Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- Agricultural Easement
- Conservation Easement
- Federal Land
- Municipal Land
- Municipal Park
- National Seashore
- State Forest
- State Land
- State Park
- Wildlife Management Area

0 0.5 1 2 Miles
0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
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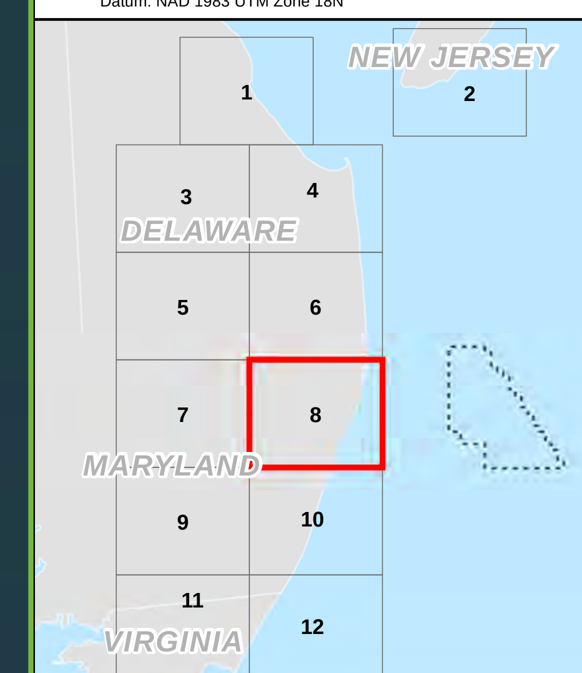

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Maryland Offshore Wind Project

Offshore Maryland and Delaware

Figure 7

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Project Viewshed

Legend

- Simulation Location
- Historic Resources
- US Wind Lease Area
- 40-Mile Visual Study Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- Agricultural Easement
- Conservation Easement
- Municipal Park
- Nature Reserve / Preserve / Sanctuary
- Private Conserved Land
- State Forest
- State Land
- State Park
- Wildlife Management Area

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
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3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
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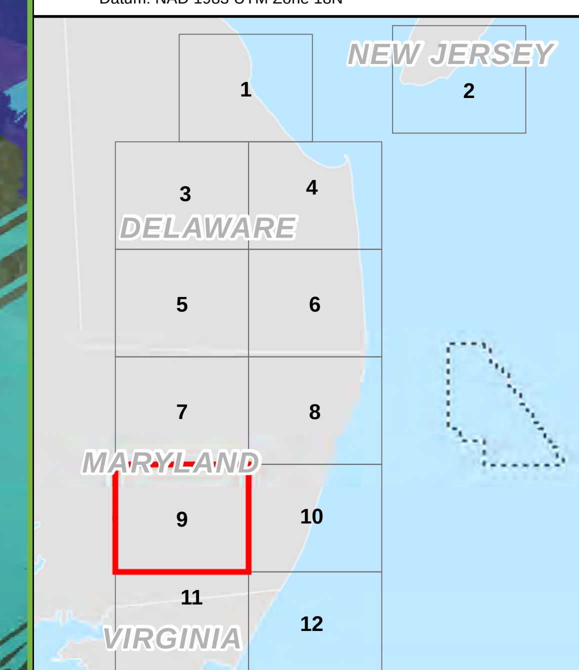

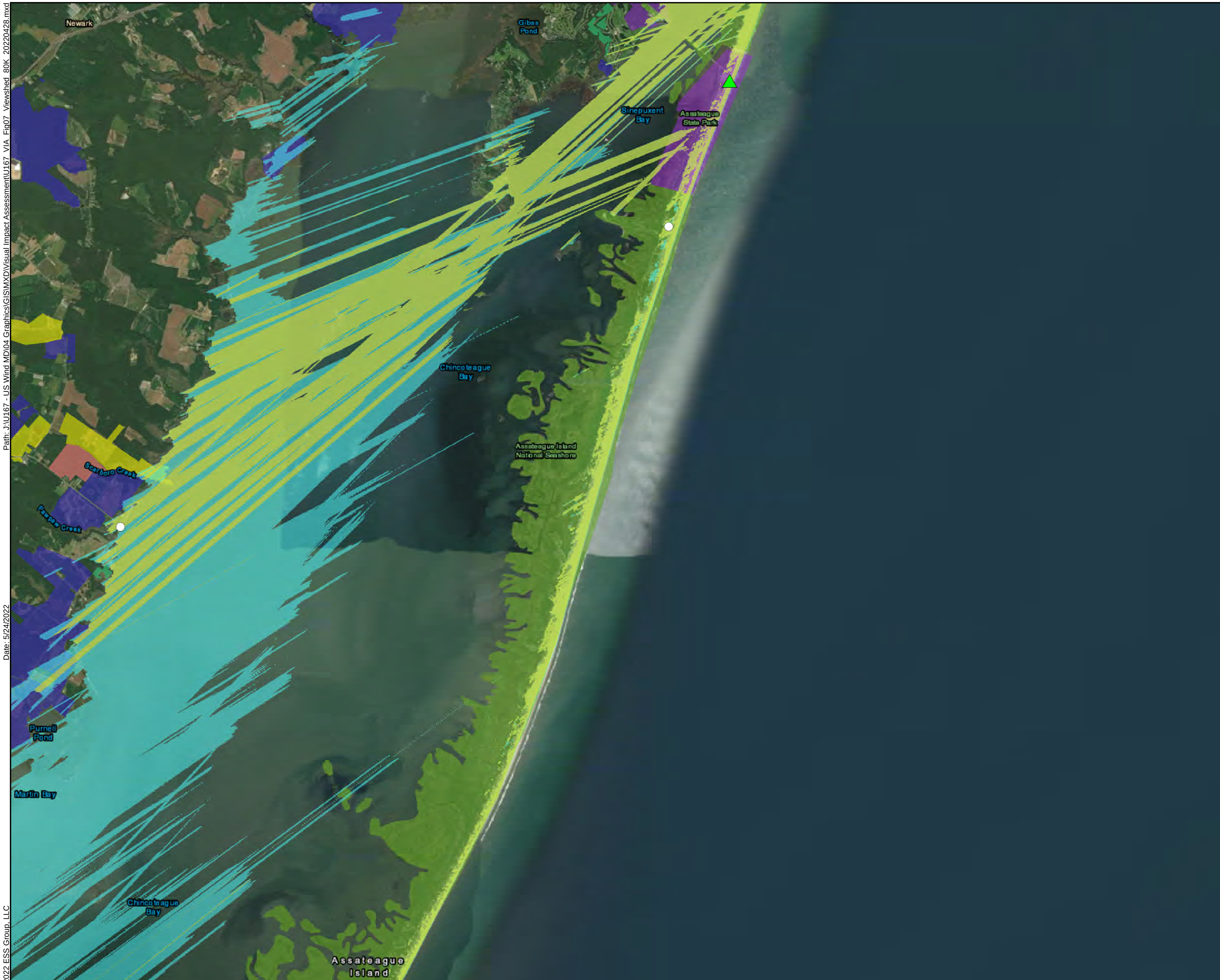

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Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 7
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Project Viewshed

Legend

- Simulation Location
- Historic Resources
- US Wind Lease Area
- 40-Mile Visual Study Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- Agricultural Easement
- Conservation Easement
- Federal Land
- Municipal Park
- National Seashore
- Nature Reserve / Preserve / Sanctuary
- State Park
- Wildlife Management Area

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
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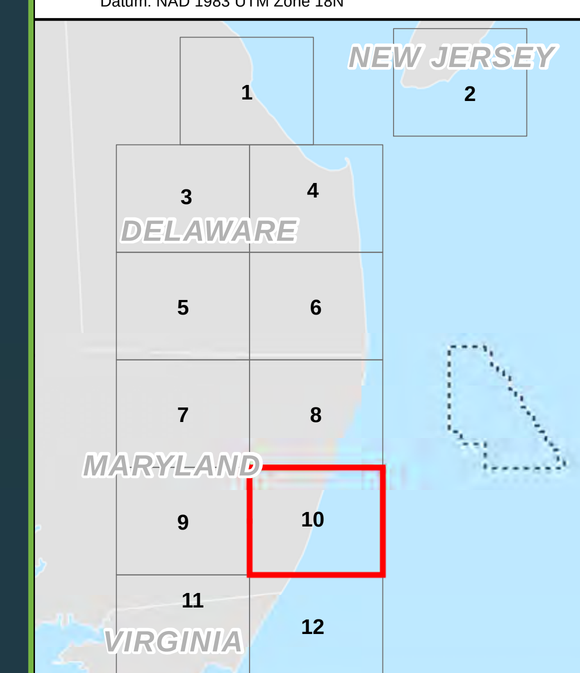

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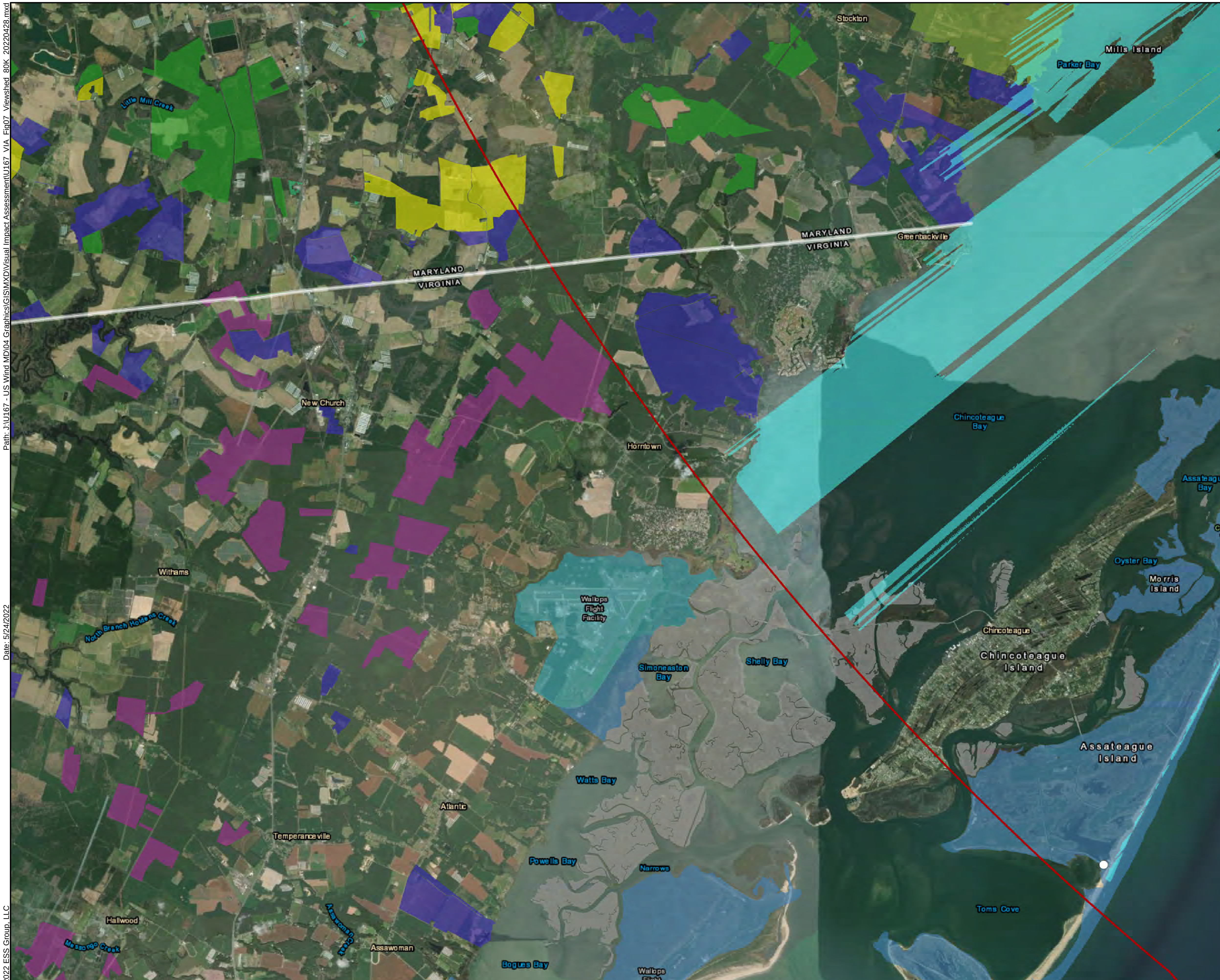

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Maryland Offshore Wind Project
Offshore Maryland and Delaware

Figure 7
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Project Viewshed

Legend

- Simulation Location
- Historic Resources
- US Wind Lease Area
- 40-Mile Visual Study Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- Agricultural Easement
- Conservation Easement
- Federal Land
- Municipal Park
- National Wildlife Refuge
- Other Land
- Private Conserved Land
- State Forest
- Wildlife Management Area

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
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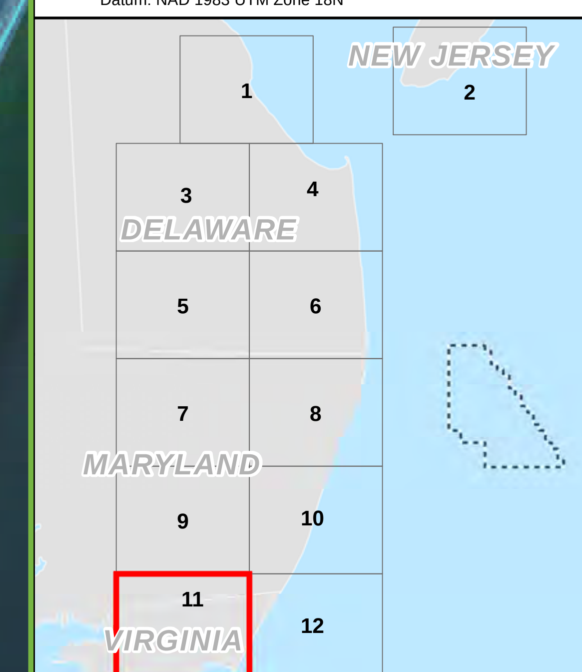


Maryland Offshore Wind Project

Offshore Maryland and Delaware

Figure 7

Sheet 12 of 12

Project Viewshed

Legend

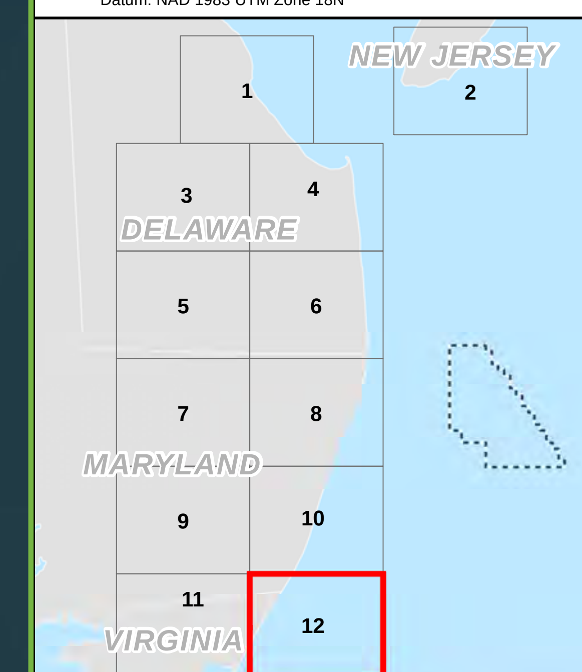
- Simulation Location
- Historic Resources
- US Wind Lease Area
- 40-Mile Visual Study Area
- Potential Turbine Nacelle Visibility (40 mi)
- Potential Turbine Blade Visibility (40 mi)
- National Seashore
- National Wildlife Refuge

0 0.5 1 2 Miles

0 0.75 1.5 3 Kilometers

Source: 1) ESRI, Imagery, Various Dates
2) BOEM, Lease Area, 2013
3) TNC, Secured Lands, 2015
4) DE Dept. of Agriculture, State Forests, 2021
5) R. Christopher Goodwin & Associates, Inc., Historic Resources, 2022

Datum: NAD 1983 UTM Zone 18N



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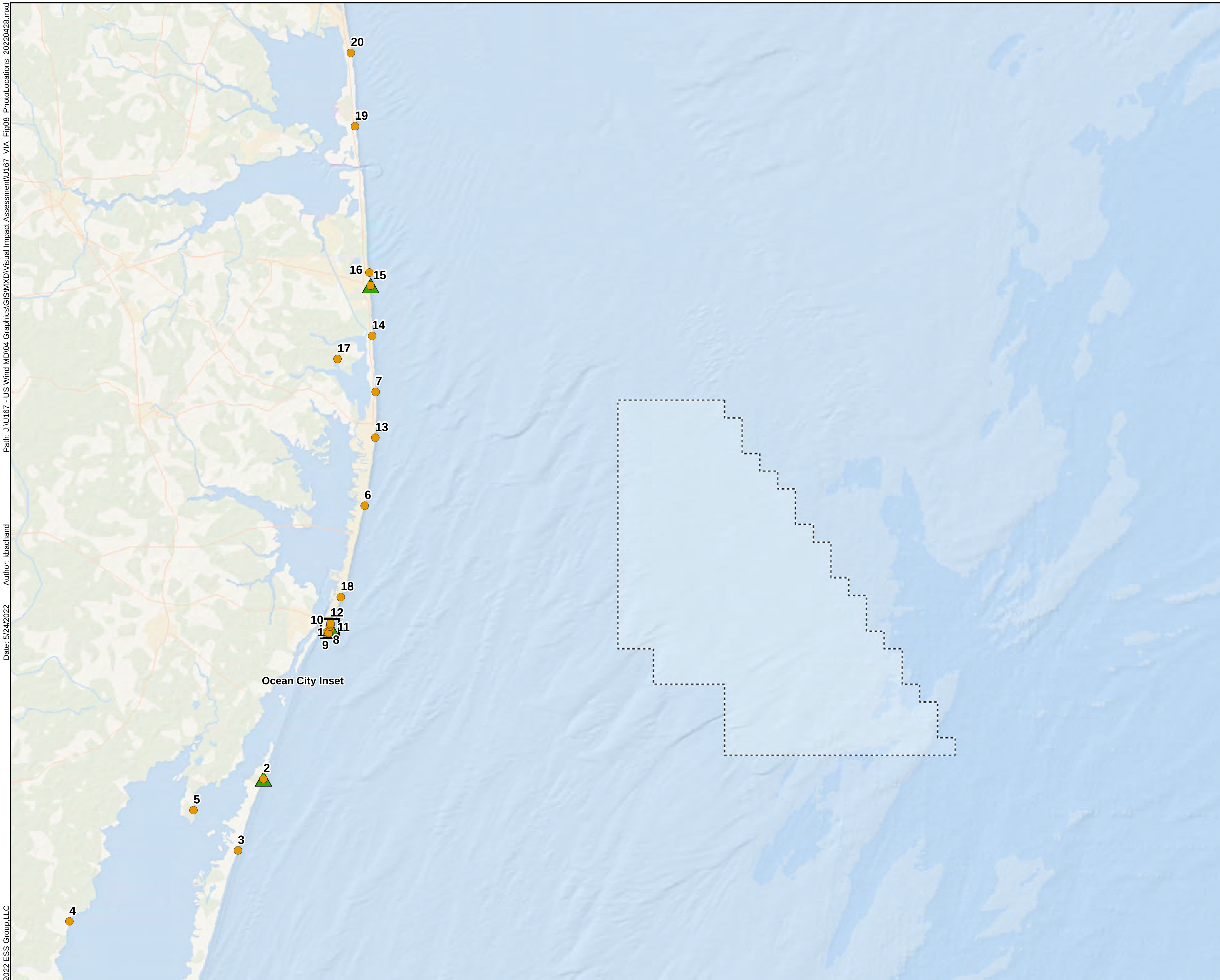
Date: 5/24/2022



environmental consulting & engineering services

Maryland Offshore Wind Project

Offshore Maryland and Delaware

Figure 8

Photo Locations for Visual Simulations (Spring 2016)

Photo Location (Spring 2016)

Selected Simulation Location (Summer 2021)

US Wind Lease Area

Map ID	Location
1	Pier Building, Pier, Atlantic Hotel
2	Assateague Island State Park
3	Assateague Island National Seashore
4	Mansion House NRHP and Public Landing
5	Public Boat Launch
6	Isle of Wight Lifesaving Station
7	Fenwick Island State Park
8	US Coast Guard Tower, US Life Saving Station
9	Ocean City Harbor Entrance
10	Atlantic Hotel
11	Margaret Vandergrift Cottage, Lambert Ayres House
12	Mount Vernon Hotel
13	Ocean City Beach
14	WWII Observation Tower (Ground Level)
15	Bethany Beach Boardwalk and Wreck Site
16	Ocean View Parkway Beach Entrance
17	Assawoman Bay Wildlife Area
18	Ocean City Beach, Boardwalk
19	Indian River Life Saving Station
20	Delaware Seashore State Park

0 1.25 2.5 5 Miles

0 2.25 4.5 9 Kilometers

Source: 1) ESRI, Ocean Basemap/Imagery, Various Dates
2) ESS, Photo Locations, 2016

Path: J:\U167 - US Wind MD\04 Graphics\GIS\MXD\Visual Impact Assessment\U167_VIA_Fig08_PhotoLocations_20220428.mxd

Author: kbachand

Date: 5/24/2022

Appendix A. Visual Simulations

Appendix B. Photo Log

Site 1 Pier Building, Pier, Atlantic Hotel - Ocean City, Maryland (Lat: 38.32766, Lon: 75.08493, Elevation FT: 14.634)

Site 2 Assateague Island State Park - Assateague Island, Maryland (Lat: 38.23586, Lon: 75.13672, Elevation FT: 13.318)

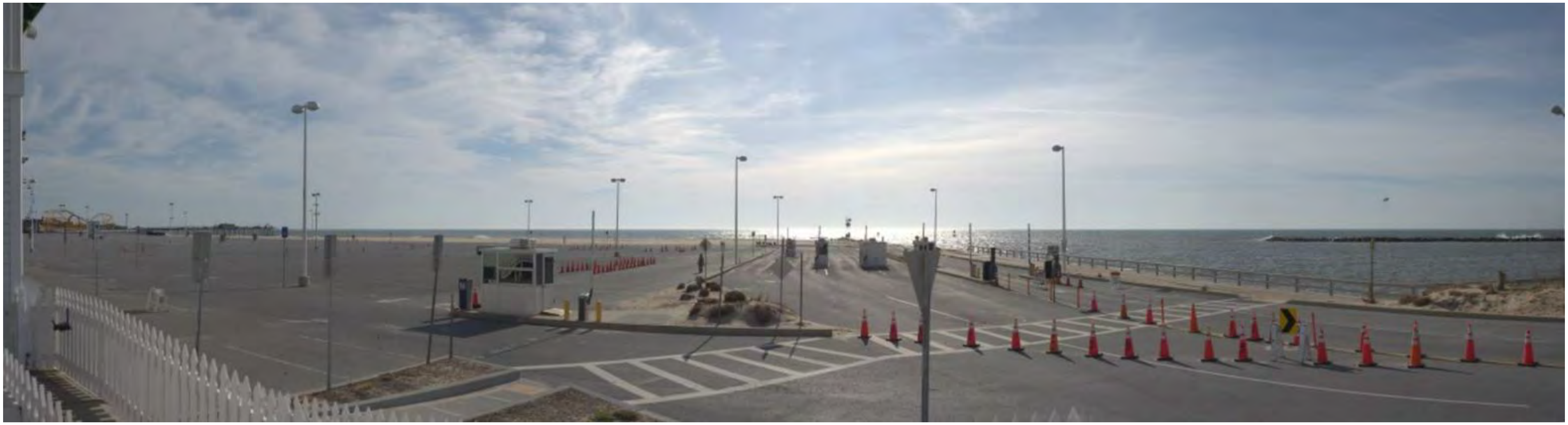
Site 3 Assateague Island National Seashore – Assateague Island, Maryland (Lat: 38.19223, Lon: 75.15631, Elevation FT: 16.321)

Site 4 Mansion House NRHP and Public Landing - Snow Hill, Maryland (Lat: 38.14877, Lon: 75.28625, Elevation FT: 0.103)

Site 5 Public Boat Launch - Sinepuxent Neck, Maryland (Lat: 38.21674, Lon: 75.19072, Elevation FT: 0.164)

Site 6 Isle of Wight Lifesaving Station - Ocean City, Maryland (Lat: 38.40237, Lon: 75.05862, Elevation FT: 14.645)

Site 7 Fenwick Island State Park - Rehoboth Beach, Delaware (Lat: 38.47174, Lon: 75.05017, Elevation FT: 12.788)



Site 8 US Coast Guard Tower, US Life Saving Station - Ocean City, Maryland (Lat: 38.32535, Lon: 75.08794, Elevation FT: 12.66)

Site 9 Ocean City Harbor Entrance - Ocean City, Maryland (Lat: 38.3247, Lon: 75.08641, Elevation FT: 6.757)

Site 10 Atlantic Hotel - Ocean City, Maryland (Lat: 38.32879, Lon: 75.08553, Elevation FT: 11.747)

Site 11 Margaret Vandergrift Cottage, Lambert Ayres House - Ocean City, Maryland (Lat: 38.32977, Lon: 75.08502, Elevation FT: 10.205)

Site 12 Mount Vernon Hotel - Ocean City, Maryland (Lat: 38.33066, Lon: 75.08499, Elevation FT: 10.158)

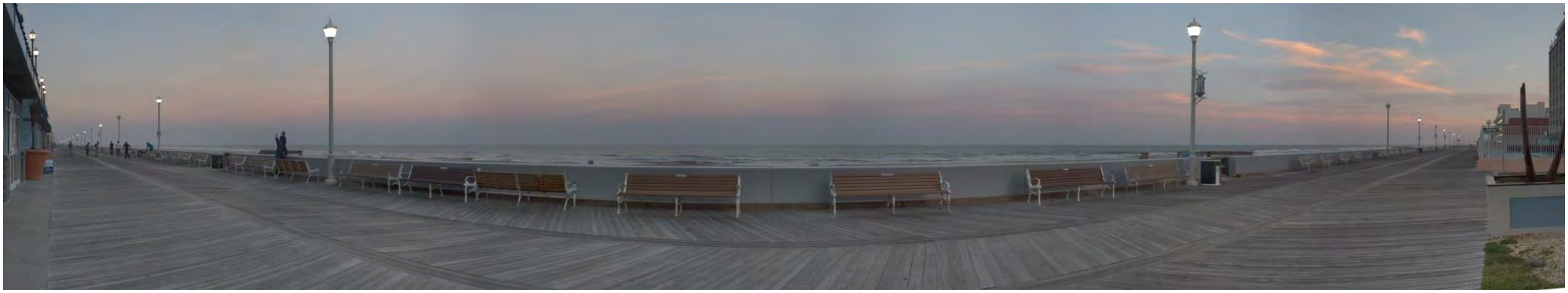
Site 13 Ocean City Beach - Ocean City, Maryland (Lat: 38.44383, Lon: 75.05038, Elevation FT: 10.623)

Site 14 WWII Observation Tow er (Ground Level) - Bethany Beach, Delaware (Lat: 38.50588, Lon: 75.05293, Elevation FT: 10.429)

Site 15 Bethany Beach Boardwalk and Wreck Site - Bethany Beach, Delaware (Lat: 38.53658, Lon: 75.0541, Elevation FT: 11.525)

Site 16 Ocean View Parkway Beach Entrance - Bethany Beach, Delaware (Lat: 38.54439, Lon: 75.05502, Elevation FT: 5.853)

Site 17 Assawoman Bay Wildlife Area - Assawoman Bay, Delaware (Lat: 38.49173, Lon: 75.07971, Elevation FT: 1.38)



Site 18 Ocean City Beach, Boardwalk - Ocean City, Maryland (Lat: 38.34664, Lon: 75.07699, Elevation FT: 10.983)

Site 19 Indian River Life Saving Station - Rehoboth Beach, Delaware (Lat: 38.63347, Lon: 75.06632, Elevation FT: 7.465)

Site 20 Delaware Seashore State Park - Dewey Beach, Delaware (Lat: 38.67826, Lon: 75.06954, Elevation FT: 12.342)

Appendix C. LSZ Photo Log


85th Street


PLIM PLAZA
A RESORT HOTEL
CARIBBEAN


Hilton
Thunderbird
BEACH
MOTEL

Appendix D. Meteorological Conditions Report

Meteorological Conditions Report for U. S. Wind Offshore Maryland Wind Energy Lease Area

PREPARED FOR:
US Wind, Inc.
1 North Charles Street, Suite 2310
Baltimore, MD 21201

PREPARED BY:
ESS Group, Inc.
10 Hemingway Drive, 2nd Floor
East Providence, Rhode Island 02915

ESS Project No. U167-061

December 8, 2016

Meteorological Conditions Report for U. S. Wind Offshore Maryland Wind Energy Lease Area

Prepared for:

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December 8, 2016

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TABLES

FIGURES

1.0 INTRODUCTION

This report provides an analysis of the meteorological conditions associated with the offshore Maryland Wind Energy Area where U. S. Wind is developing a wind energy project. Metrics associated with prevailing meteorology and will assist in understanding the meteorological conditions experienced in this area and how they may influence the visibility of a wind energy project. The analysis used existing meteorological information from a measurement site within the area where the project is located. Data for visibility at the measurement site is reported to a distance of up to 10 nautical miles (nm) and therefore, visibility beyond 10 nm was calculated beyond this distance as described further below.

2.0 DATA COLLECTION

The meteorological assessment utilized hourly meteorological surface data collected at National Weather Service (NWS) measurement site located at the Ocean City Municipal Airport in Ocean City, Maryland (Figure 1) over the 10-year period of January 1, 2006–December 31, 2015. Surface observations for the site were obtained from the National Climatic Data Center (now referred to as National Center for Environmental Information).

The hourly observations in the data sets include wind speed, wind direction, cloud cover, cloud ceiling height, visibility, weather codes denoting precipitation, ambient, dew point temperatures, and precipitation amounts.

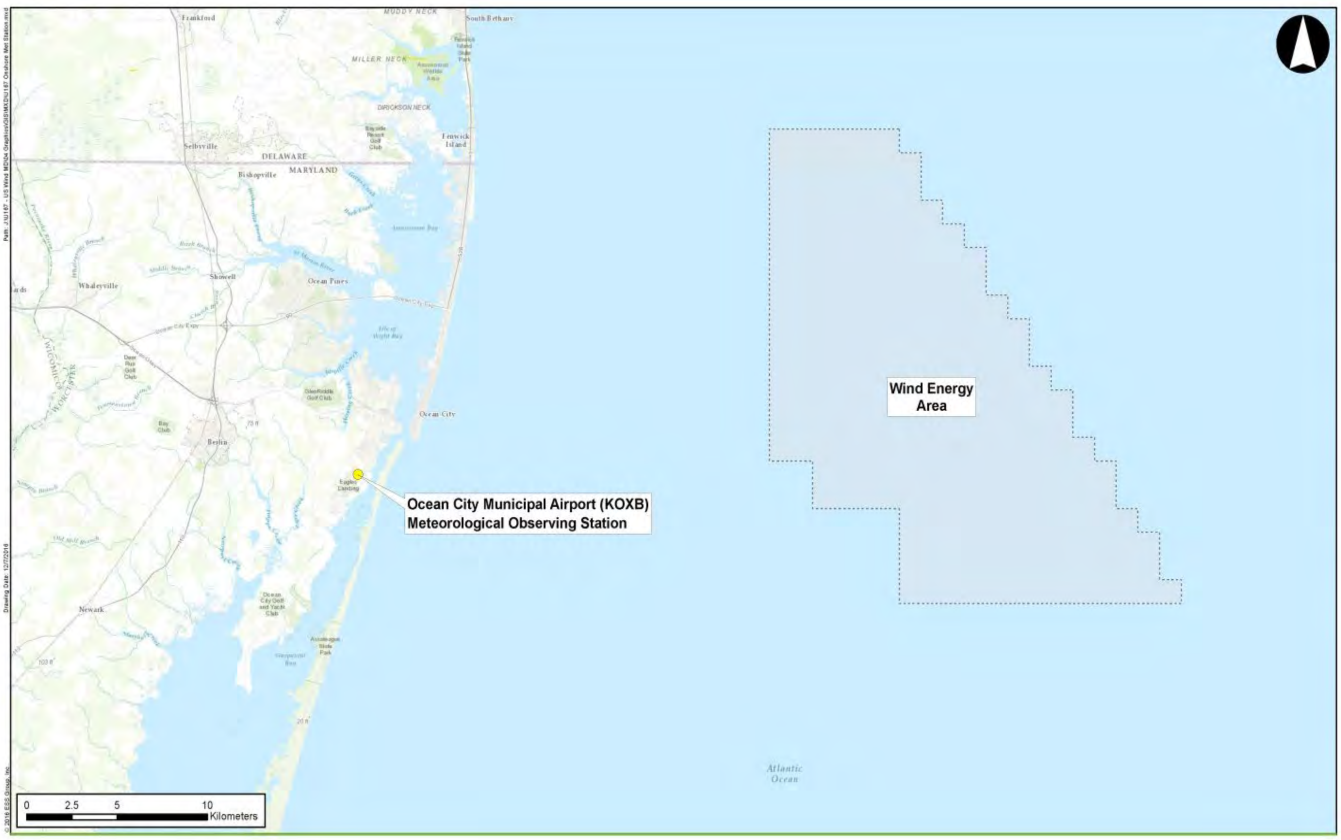

Figure 1: Location of Meteorological Measurement Site

3.0 METEOROLOGICAL CONDITIONS AND VISIBILITY ASSESSMENT

Hourly surface observations were evaluated to determine the following meteorological conditions and visibility.

Meteorological Condition

- Average number of days when it is clear, cloudy, foggy, rainy and hazy during daylight hours in each of the four seasons,
- Average number of days when it is clear, cloudy, foggy, rainy and hazy for 50% of the daylight hours in each of the four seasons,
- Average percent of daylight hours when it is clear, cloudy, foggy, rainy and hazy in each of the four seasons, and
- Average percent of nighttime hours when it is clear, cloudy, foggy, rainy and hazy in each of the four seasons (i.e. the average conditions for nighttime during each of the seasons).

Visibility

- The average number of days that there is visibility to 10 nm, 20 nm and 30 nm.
- The average number of days that have visibility to 10 nm, 20nm and 30nm for at least 50% of the day in each of the four seasons.
- The average number of days that there is visibility to 10 nm, 20nm and 30nm for at least 75% of the day in each of the four seasons.
- The average distance that visibility is reduced (from clear conditions) on each day that haze is reported in each of the 4 seasons.
- The average visibility distance in each of the four seasons.

3.1 Definition of Data Parameters

Since the analysis covers daylight and nighttime conditions, it was important to define what constitutes daylight as it changes in duration over the year. Sunrise and sunset times are recorded at the measurement site and provided in the surface observation data. Thirty minutes were added before sunrise and after sunset to account for those periods where there is sufficient light to start, or continue, outdoor activities without lighting. This corresponds to civil dusk, when the sun is 6 degrees, or less, below the horizon.

NWS stations provide excellent data capture; however, it is not 100% and missing data periods do occur. Only daylight and nighttime periods with data capture at or better than 50% for the 24-hour data period were included in the analysis, avoiding possible biases in considering periods of a few hours.

The data was evaluated for clear, cloudy, rainy, foggy and hazy conditions during daylight and nighttime hours based upon the following criteria:

- Clear conditions were defined as having an unlimited cloud ceiling height. Unlimited ceiling heights are associated with clear and scattered sky cover (up to 50% of the sky).
- Cloudy conditions were defined as broken or overcast sky cover, greater than 50% of the sky.
- Rainy conditions were defined as any “trace” or measureable precipitation (rain, snow, sleet, etc.) amount. The Local Climatological Data (LCD) data set includes weather codes that define the type and intensity of different weather conditions. Examples of the codes are RA

(rain), SN (snow), FZRA (freezing rain). A complete code list can be found in "Local Climatological Data (LCD) Dataset Documentation" (ncdc.noaa.gov).

- Foggy and hazy conditions are defined only by weather codes. Fog has a weather code of FG. Haze has a weather code of HZ.

Each individual daylight period was characterized as being clear, cloudy, rainy, foggy or hazy. When examining the five meteorological conditions, it is possible to have multiple conditions occurring concurrently. For example, haze can occur when it is sunny. Fog and rain occur when it is cloudy or there can be light rain during fog events. In order to avoid 'double counting' any of the conditions and maintaining a 100% count, conditions were assigned based on the following:

1. An hour is either clear or cloudy.
2. If clear or cloudy conditions occur for 50% or more of the daylight hours, assign the day based on visibility restriction.
3. Clear conditions are based on unlimited ceiling height and can include haze. A day was counted as hazy before being counted as sunny.
4. Cloudy conditions are based on limited ceiling height and can also include rain and fog. The day classification order was foggy, rainy and finally cloudy.
5. If clear and cloudy conditions each account for 50% of the daylight hour, the clear condition (sunny, hazy) was assigned 0.5 day as was the cloudy condition (fog, rain, cloud).

This prioritization was also used for evaluating individual hours.

Seasons were defined as follows:

- Winter = December 22–March 21
- Spring = March 22–June 21
- Summer = June 22–September 21
- Autumn = September 22–December 21

4.0 METEOROLOGICAL CONDITIONS AND VISIBILITY RESULTS

4.1 Meteorological Conditions

Table 1 presents representative seasonal and annual meteorological conditions observed at the Ocean City Municipal Airport and the frequency of occurrence and distribution of clear, foggy, rainy, hazy and cloudy conditions. The data has been rounded to a whole day value. The topmost data group presents the average number of days per season/year that each of the five conditions was observed to occur at least for one hour during the daylight period. These numbers are independent of each other and should not be summed as multiple tallies could occur in any single daylight period. For example, clouds and fog could occur in the early morning giving way to clear skies later in the morning. A thunderstorm could occur in the late afternoon. In that case, clear, cloudy, rainy and foggy conditions would all occur for at least one hour.

The second data grouping characterizes days where each day is clear, cloudy, rainy, foggy or hazy and only a single tally is made for any daylight period. This characterization is based on which of the five meteorological conditions occur for at least 50% of the hours in the daylight period. These numbers can be summed to equal to the number of valid daylight periods occurring during the year.

The third data group presents the distribution of the five meteorological conditions during daylight hours as a percentage. Each hour is characterized as clear, foggy, rainy, hazy or cloudy. The percentages of the five meteorological conditions can be summed to equal 100%.

The fourth data group presents the distribution of the five meteorological conditions during nighttime hours as a percentage. Each hour is characterized as clear, foggy, rainy, hazy or cloudy. The percentages of the five meteorological conditions can be summed to equal 100%.

Table 1 Summary of Meteorological Conditions

	Winter	Spring	Summer	Autumn	Annual
Days/Year with 1 or More Daylight Observations					
Clear	80	82	87	78	327
Foggy	5	7	2	4	19
Rainy	36	40	41	38	155
Hazy	6	15	19	6	45
Cloudy	40	52	48	51	191
Days/Year with 50% or More Daylight Observations					
Clear	62	66	74	59	260
Foggy	1	<1	0	<1	1
Rainy	13	8	4	12	37
Hazy	<1	<1	2	<1	4
Cloudy	14	16	11	21	61
Distribution of Hourly Daylight Observations (%)					
Clear	66	66	71	65	67
Foggy	2	1	<1	<1	1
Rainy	17	13	10	14	13
Hazy	1	3	6	1	3
Cloudy	15	17	13	19	16
Distribution of Hourly Nighttime Observations (%)					
Clear	63	60	62	57	60
Foggy	1	2	<1	2	2
Rainy	20	19	18	20	19
Hazy	<1	3	5	1	2
Cloudy	15	16	14	20	17

Clear conditions occur at least one hour during daylight 327 days per year with seasonal values ranging from 78 days during winter to 87 days during summer. Cloudy conditions occur 191 days per year, with seasonal values ranging from 40 days in winter to 52 days in spring. Fog occurred 19 days per year. Seasonal values range from 2 days in summer to 7 days in spring. Rain, without associated fog, occurred 155 days per year. Seasonal values range from 36 days in winter to 41 days in summer. Haze occurred about 45 days per year, ranging from 6 days in winter and autumn to 19 days in summer.

Days were characterized as clear, cloudy, foggy, rainy or hazy based on an occurrence of the meteorological condition 50% or more of daylight hours. Clear days occurred 260 days per year, with seasonal values ranging from 59 days in autumn to 74 days in summer. Cloudy days occurred 61 days per year, ranging from 11 days in summer to 21 days in autumn. Foggy days occurred one day per year, with little variation seasonally. Rainy days occurred 37 days per year, ranging from 4 days in summer to 13 days in winter. Haze occurred 4 days per year, ranging from <1 day in all seasons except summer with 2 days.

Clear conditions occurred 67% of the daylight hours over the course of the year, with seasonal values ranging from 65% in autumn to 71% in summer. Fog occurred 1% of the time, with seasonal values ranging from <1% in summer and autumn to 2% in winter. Rain, without associated fog, occurred 13% of the time, with seasonal values ranging from 10% in summer to 17% in winter. Cloudy conditions, without associated fog or rain, occurred 16% of the time, with seasonal values ranging from 13% in summer to 19% in autumn. Haze occurred 3% of the time with seasonal values ranging from 1% in autumn to 6% in summer.

Clear conditions occurred 60% of the nighttime hours over the course of the year, with seasonal values ranging from 57% in autumn to 63% in winter. Fog occurred 2% of the time, with seasonal values ranging from less than one percent in summer to 2% in spring. Rain, without associated fog, occurred 19% of the time, with seasonal values ranging from 18% in summer to 20% in autumn and winter. Cloudy conditions, without associated fog or rain, occurred 17% of the time, with seasonal values ranging from 14% in summer to 20% in autumn. Haze occurred 2% of the time with seasonal values ranging from less than one percent in winter to 5% in summer.

4.2 Visibility

Visibility observations in the NWS surface data are limited to a maximum of 10 statute miles and therefore in order to evaluate visibility at the 20 nm and 30 nm distances, a methodology was developed using the observed visibility (out to 10 statute miles) and a relational algorithm. The algorithm was developed by Egan Environmental and has been used in other analysis and calculates the visibility distance based on relative humidity.

Hourly surface observations include calculated relative humidity values. Relative humidity is calculated from ambient and dew point temperatures, which were also included in the data record. Relative humidity is calculated from the following equation:

$$RH = 100 * ((112 - 0.1 * TA + DP) / (112 + 0.9 * TA)) ^8$$

Where,
RH = relative humidity
TA = ambient temperature (ºC)
DP = dew point temperature (ºC)

As previously stated, relative humidity values are provided in the data record. These values are calculated using the temperature observations. There were some missing relative humidity values, however, in every case, this appears to be because there was insufficient temperature data to perform the relative humidity calculation.

The visible distance algorithm was developed from a regression analysis of Martha's Vineyard visibility and relative humidity observations. Visibility distance was calculated as:

$$VIS = 69.9 - 0.742 * RH$$

Where,
VIS = visibility distance (statute miles)

The calculated statue miles were then converted to nautical miles by applying a factor of 0.86839.

Visibility calculations were performed for each hour with a valid relative humidity. The calculated distance was compared to the observed distance to determine which value to carry forward in the analysis. Observations up to 10 statute miles used the observed value. Observations at 10 statute miles used the greater of the observed or calculated values.

The following table presents representative estimated visibility distances and the frequency of occurrence of visibility greater than 10, 20 and 30 nautical miles, along with the average visibility for clear, foggy, rainy, hazy and cloudy conditions. The topmost data group presents the average number of days per season/year that there was at least one hour when visibility was at least 10, 20 and 30 nautical miles during a daylight periods. The count for the 20 and 30 nm entries are also contained in the 10 nm entry. The count for the 30 nm entry is also contained in the 20 nm count.

The second and third data groups present the number of days per season/year that visibility exceeded 10, 20 and 30 nautical miles at least 50% and 75% of the daylight hours. As is the case with the topmost data group, the 20 nm and 30 nm values are subsets of the 10 nm values. The 30 nm values are subsets of the 20 nm values.

The last two data groups present the average seasonal and annual visibility distance for clear, foggy, rainy, hazy and cloudy conditions for daylight and nighttime hours. The annual and seasonal averages were determined by taking a weight average of the five meteorological conditions.

Observations up to 10 statute miles used the observed value and observations reported as 10-statute mile in the data used the greater of the observed or calculated values, resulting in a conservative estimate of visibility. Table 2 presents a summary of the visibility results.

Table 2 Summary of Visibility

	Winter	Spring	Summer	Autumn	Annual
Days/Year with 1 or More Daylight Observations					
10 nm	78	78	78	74	309
20 nm	67	57	52	58	233
30 nm	45	35	19	31	130
Days/Year with 50% or More Daylight Observations					
10 nm	68	60	55	64	246
20 nm	52	37	26	41	157
30 nm	25	14	4	14	57
Days/Year with 75% or More Daylight Observations					
10 nm	58	44	35	51	187
20 nm	39	21	10	25	95
30 nm	14	6	<1	4	24
Average Daylight Visibility (nm)					
Clear	26	21	17	21	21
Foggy	<1	<1	<1	<1	<1
Rainy	7	6	6	6	6
Hazy	5	4	4	4	4
Cloudy	18	15	14	15	15
Average	21	17	15	17	17
Average Nighttime Visibility (nm)					
Clear	18	13	10	14	14
Foggy	<1	<1	<1	<1	<1
Rainy	6	5	5	5	5
Hazy	5	4	4	4	4
Cloudy	14	11	11	12	12
Average	15	11	9	11	12

Visibility of at least 10 nm occurred for at least hour during daylight 309 days per year, with seasonal values ranging from 74 days during autumn to 78 days during the three other seasons. Visibility to 20 nm occurred 233 days per year, with seasonal values ranging from 51 days in summer to 67 days in winter. Visibility extended to 30 nm 130 days per year. Seasonal values range from 19 days in summer to 45 days in winter.

Visibility extended to 10 nm for 50% or more of the daylight hours 246 days per year, with seasonal values ranging from 55 days in summer to 68 days in winter. Visibility to 20 nm occurred 157 days per year, ranging from 26 days in summer to 52 days in winter. Visibility to 30 nm occurred 57 days per year. Seasonal values ranged from 4 days in summer to 25 days in spring.

Visibility extends to 10 nm for 75% or more of the daylight hours 187 days per year, with seasonal values ranging from 35 days in summer to 58 days in winter. Visibility to 20 nm occurred 95 days per year, ranging from 10 days in summer to 39 days in winter. Visibility to 30 nm occurred 27 days per year. Seasonal values ranged from no days in summer to14 days in winter.

The average daylight visibility for clear conditions was 21 nm, with seasonal values ranging from 17 nm in summer to 26 nm in winter. Cloudy conditions reduce the average visibility to 15 miles, ranging from 14 nm in summer to 18 nm in winter. Rainy, hazy and foggy conditions have an average visibility of 6, 4, and <1 nm, respectively. These visibilities are consistent through the year. The average daylight visibility in winter, spring, summer and fall, regardless of meteorological condition, is 21, 17, 15, and 17 nm, respectively.

The average nighttime visibility for clear conditions is 14 nm, with seasonal values ranging from 10 nm in summer to 18 nm in winter. Cloudy conditions reduce the average visibility to 12 miles, ranging from 11 nm in summer to 14 nm in winter. Rainy, hazy and foggy conditions have an average visibility of 5, 4 and <1 nm, respectively. These visibilities are consistent through the year. The average nighttime visibility in winter, spring, summer and fall, regardless of meteorological condition, is 15, 11, 9 and 11 nm, respectively.

5.0 EFFECT OF HAZE ON VISIBILITY

As shown in the table above, haze can greatly reduce visibility. Clear skies, on average, result in daytime visibilities of 17 to 26 nm, whereas hazy skies result in an average visibility of approximately 4 to 5 nm.

Based on data from the Ocean City site, daylight hazy skies result in average visibilities of 4 nm compared to 21 nm for clear conditions. In winter, clear skies have an average visibility of 26 nm, compared to 4 nm for hazy skies. This represents approximately an 83% reduction in visibility. In spring, visibility decreases from 21 nm for clear conditions to 4 nm for hazy conditions, a reduction of approximately 79%. In summer, the average visibility for clear skies is 17 nm, compared to 4 nm for hazy skies, representing a 74% reduction in visibility. In autumn, clear skies have an average visibility of 21 nm compare to 4 nm for hazy conditions, an 80% reduction in visibility.

Nighttime hazy skies result in average visibilities of 4 nm compared to 14 nm for clear conditions. In winter, clear skies have an average visibility of 18 nm compare to 5 nm for hazy skies. This represents approximately a 75% reduction in visibility. In spring, visibility decreases from 13 nm for clear conditions to 4 nm for hazy conditions, a reduction of approximately 69%. In summer, the average visibility for clear skies is 10 nm compared to 4 nm for hazy skies, representing a 58% reduction in visibility. In autumn, clear skies have an average visibility of 14 nm compare to 4 nm for hazy conditions, an approximately 70% reduction in visibility.