Ocean Wind
An Ørsted Initiative

Appendix I – Atlantic Sturgeon Supplementary Material

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Ocean Wind Offshore Wind Farm COP

1. Threatened and Endangered Fish within the Lease Area and Export Cable Routes

Two fish species are listed as federally endangered by NOAA Fisheries within the Project Area: Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and Shortnose Sturgeon (*Acipenser brevirostrum*). Additionally, two species are federally threatened within the Project Area: giant manta ray (*Manta birostris*) and oceanic whitetip shark (*Caracharinus longimanus*). However, the latter three species described above are not expected to occur within the Project Area, as discussed within Section 2.2.6.1.3 of the COP. Shortnose sturgeon rarely enter marine waters and when they do, they do not venture far from shore, and the giant manta ray and oceanic white tip generally prefer deeper, warmer waters. Therefore, this section only describes the existing populations and potential impacts to the Atlantic sturgeon, a species with a higher likelihood of existing within the Project area.

1.1 Description of the Affected Environment

Atlantic Sturgeon are distributed along the eastern coast of North America from Hamilton Inlet, Labrador, Canada to Cape Canaveral, Florida, USA (ASSRT 2007, NMFS 2012).

On April 6, 2012, NMFS divided U.S. populations of Atlantic sturgeon into five "species" or Distinct Population Segments (DPSs): the Gulf of Maine (GoM), New York Bight (NYB), Chesapeake Bay (CB), Carolina (CA), and South Atlantic (SA) DPSs (77 FR 5880 and 77 FR 5914). NMFS then listed Atlantic Sturgeon originating from the New York Bight, Chesapeake Bay, South Atlantic, and Carolina DPSs as endangered under the federal Endangered Species Act. NMFS listed Atlantic sturgeon from the Gulf of Maine DPS as threatened.

The results of genetic studies suggested that natal origin influenced the distribution of Atlantic sturgeon in the marine environment (Wirgin and King 2011 as cited in NMFS 2012, Damon-Randall *et al.* 2013). However, based on genetic data and tracking and tagging data, sturgeon from any of these DPSs and Canada can occur anywhere in the geographic range of the subspecies. Eyler *et al*. (2009) reported that Atlantic sturgeon tagged off New Jersey have been recaptured in Long Island Sound, off Maryland, Delaware, New Hampshire, and North Carolina. Consequently, the sturgeon that occur in the Project area may represent any of the five DPSs of this species.

Atlantic sturgeon have been captured in several sampling programs off the New Jersey coast (Dunton *et al*. 2010, Erickson *et al*. 2011, Eyler *et al*. 2009, Stein *et al.* 2004). Dunton *et al.* (2010) analyzed data from surveys covering the northwest Atlantic Ocean from Cape Hatteras (NC) to the Gulf of Maine conducted by five agencies. The catch per unit of effort (CPUE) for Atlantic sturgeon off New Jersey, from New York Harbor south to the entrance of Delaware Bay (DE), was second only to CPUE from the entrance of New York harbor to Montauk Point (NY).

Off New Jersey, the NJDEP finfish survey (Figure 1) indicated CPUE was highest at depths of 33 to 49 ft (10 to 15 m; 0.134 sturgeon/tow) and lowest at depths of 66 to 98 ft (20 to 30 m; 0.005 sturgeon/tow). CPUE was highest in winter months, followed by fall, with no Atlantic sturgeon captured during summer sampling. A total of about 95 percent of all Atlantic sturgeon captured in sampling off New Jersey occurred in depths less than 66 ft (20 m) and aggregations tended to occur at the mouths of large bays or estuaries during the fall and spring. In the winter, Atlantic sturgeon were found to disperse further out into marine waters throughout the Mid-Atlantic Bight (Dunton *et al.* 2010). Stein *et al*. (2004) reported that sturgeon were captured in waters up to 262 ft

(80 m) in depth, although the highest captures occurred in water depths between 66 to 98 ft (20 and 30 m). Similar temporal patterns of sturgeon abundance were observed in acoustic telemetry studies in wind energy areas located to the north and south of the Project area.

In an acoustic telemetry study conducted in the New York Wind Energy Area (NYWEA) (Lease OCS-A 0512), which is approximately 93 mi (150 km) north of the Project area, Atlantic sturgeon were found to occupy the NYWEA in distinct seasonal and spatial patterns (Frisk *et al.* 2019). The number of tagged Atlantic sturgeon detected within the NYWEA peaked during November, December, and January and were at the lowest levels in June through September with zero sturgeon detected during July and August. The number of sturgeon detected also varied along a gradient, with the greatest number of unique tags detected in the portion of the lease area closest to shore and numbers of tagged sturgeon detected declining with increasing distance from shore. However, tagged sturgeon were detected in all portions of the NYWEA, and during the months of greatest abundance appeared to be evenly spread throughout the NYWEA. The NYWEA is approximately 20 to 47 mi (32 to 76 km) from the New Jersey shoreline, while the Project area is approximately 17 to 24 mi (27 to 38 km) from the New Jersey shoreline (Frisk *et al.* 2019).

A similar temporal pattern was observed in a two-year acoustic telemetry study of the occurrence of commercially important and endangered fishes within Delaware WEAs (Haulsee *et al.* 2020). The Delaware WEA is approximately 25 to 37 mi (40 to 60 km) southwest of the Project area. The highest numbers of tagged Atlantic sturgeon were detected in November and December, and the lowest numbers of fish were detected in August. Atlantic Sturgeon were detected in all months of the year, and the number of tagged Atlantic sturgeon detected was relatively consistent at levels approximately 10 to 25 percent of the observed single month maximum (Haulsee *et al.* 2020).

Atlantic sturgeon are known to form seasonal aggregations in marine environments, generally these aggregation areas occur in the vicinity of the mouths of large coastal rivers or bay systems such as the Hudson, Delaware River, or Chesapeake Bay (Stein *et al.* 2004). The NYWEA is in line with the entrance to New York Harbor and the Hudson River, and in the vicinity of known sturgeon aggregation areas that occur of Sandy Hook and the Rockaways (Dunton *et al.* 2010). The Delaware WEA is located in line with the entrance to Delaware Bay and the Delaware River. The Project Area is not in the direct vicinity of a large coastal river or bay system, therefore the extent to which the results of these telemetry studies would be representative of the Project area is unknown. When in marine habitats Atlantic sturgeon are known to undertake seasonal migrations along the Eastern Seaboard in which they travel north in the spring and south in the fall; it is likely that this migration would pass through Project Area and vicinity (Erickson *et al.* 2011). In modeling efforts validated with telemetry data, Breece *et al.* (2018) found that the spring migration takes place in shallower nearshore waters while the fall migration takes place in deeper offshore waters. Therefore, depending the location of a Project activity (inshore vs offshore) the likelihood of sturgeon exposure will vary seasonally.

Critical habitat has been designated for the Chesapeake Bay DPS of Atlantic sturgeon (82 FR 39160, 17 August 2017). However, that critical habitat designation does not include coastal or marine waters off the Atlantic coast of New Jersey (82 FR 39160).

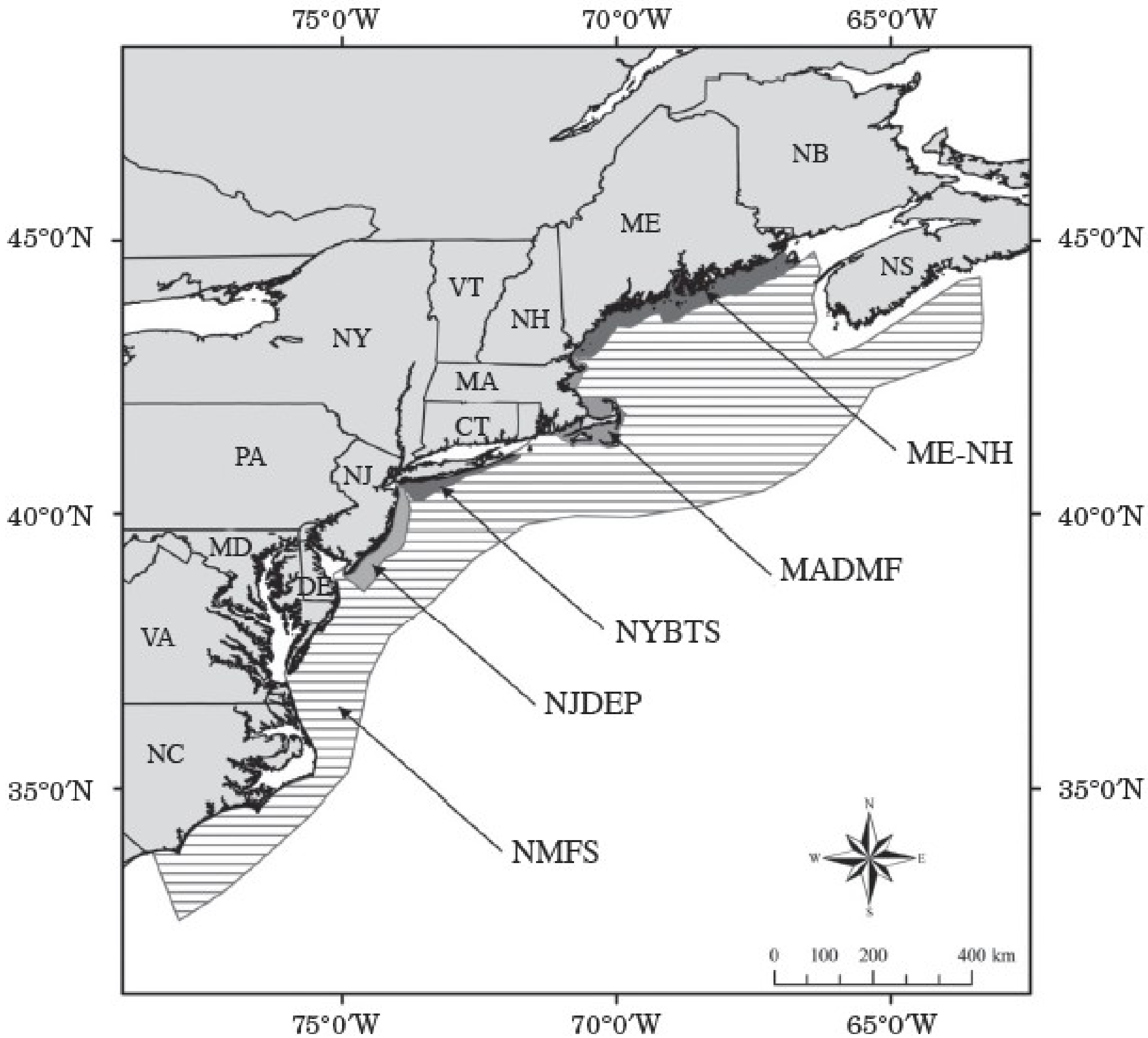

Figure 1: Coverage area of the Maine-New Hampshire inshore bottom trawl survey (ME-NH), Massachusetts Division of Marine Fisheries bottom trawl survey (MADMF), New York bottom trawl survey (NYBTS), New Jersey Department of Environmental Protection finfish survey (NJDEP), and the National Marine Fisheries Service bottom trawl surveys (NMFS). The area covered by the NMFS survey is represented by horizontal stripes. All other surveys are represented by shades of gray (Dunton *et al.* 2010).

1.2 Impacts

The Project description section of the COP describes the activities associated with the construction, operations and maintenance, and decommissioning phases of the Project (Volume I, Section 6). These analyses initially considered several impact producing factors associated with the Project that were potentially relevant to Atlantic sturgeon:

- Seafloor disturbance
- Sediment suspension

- Noise
- Electromagnetic fields (EMF)
- Vessel traffic.

Specifically, potential impacts could include the following: (1) seafloor disturbance, (2) sediment suspension, (3) underwater noise associated with the construction and operation of the Project, (4) EMF, and (5) collision risks, noise, and disturbance associated with Project-related vessel traffic. These factors were analyzed based on the information available and considering probability of exposure, detectability, duration, spatial extent, and severity.

Potential impacts due to seafloor disturbance, sediment suspension and EMF resulting from activities associated with the various Project phases are likely to have little or no measurable impact on the behavior, physiology, and ecology of Atlantic sturgeon that might be exposed to these impact producing factors.

One of these potential impact producing factors — collision risks associated with Project-related vessel traffic — was identified as a threat to Atlantic sturgeon in the final rule that listed them as endangered or threatened (77 FR 5880 and 77 FR 5914). Although all of the factors that contribute to collision risks are unknown, the most commonly discussed factors include vessel size, vessel speed, vessel draft, water depth, and the particular behavior of the sturgeon in the area (whether they are foraging, migrating, etc.). Of these factors, vessel draft, water depth, and sturgeon behavior are most likely to determine whether sturgeon might be exposed to vessel traffic. As noted above, about 95 percent of all Atlantic sturgeon captured in sampling off New Jersey occurred in depths less than 66 ft (20 m) with the highest catch-per-unit-of-effort (CPUE) at depths of 33 to 49 ft (10 to 15 m) (Dunton *et al.* 2010). At these depths in open coastal and marine environments, which would not constrain the distribution or movement of Atlantic sturgeon, they are not likely to be struck by Project-related vessels. Because Atlantic sturgeon do not occur at the lowest depths of the water column in the Project area, they are also unlikely to be affected by seafloor disturbance or suspended sediments associated with the Project or EMF associated with subsea cables. These surveys indicate that the majority of Atlantic sturgeon observed in trawl surveys occurred at depths shallower than those in the Wind Farm Area where there is the greatest concentration of activities with the potential for disturbance.

There would be temporary increases in sediment suspension and deposition during activities that entail the disturbance of the seabed. Adult and subadult sturgeon that would be expected to occur in the Project area are tolerant of elevated suspended sediment levels and as such, Johnson (2018) recommends that sturgeon should not be exposed to TSS levels of 1,000 mg/L above ambient for longer than 14 days at a time to avoid behavioral and physiological effects. The Wind Farm Area is characterized by medium to coarse grained sediments, and the resulting sediment plume that results from temporary and intermittent bottom disturbing activities is expected to settle out of the water column within a few hours. While the increase in suspended sediments has the potential to cause Atlantic sturgeon to alter their normal movements, these movements are expected to be too small to be meaningfully measured or detected. However, we expect sturgeon potentially exposed to the plume would not be adversely affected.

Similarly, Atlantic sturgeon in the Project area exist in an acoustic environment that is highly energetic under "normal" conditions. Because of the comparatively poor hearing ability of sturgeon and their tendency to be more responsive to particle motion than sound pressure (Lovell *et al*. 2005, Meyer *et al*. 2010, 2012), the sounds produced by vessels are not likely to be audible to sturgeon. As a result, the only impact producing factor associated with the Project that is considered further is underwater noise associated with the construction of Project structures and wind turbine operational noise.

1.2.1 Construction and Installation

1.2.1.1 Pile-driving noise

The data available on the potential impacts of pile-driving noise is very limited. While no studies have been conducted on Atlantic sturgeon hearing abilities, there are a few studies that document hearing abilities of other species of sturgeon (Hastings and Popper 2005, Lovell *et al*. 2005, Meyer *et al*. 2010, Meyer *et al*. 2012, Popper 2005, Popper *et al*. 2014). Data on the effect of exposure to pile-driving noise on sturgeon consists of a single study of lake sturgeon (*A. fulvescens*) conducted by Halvorsen *et al*. (2012).

Lovell *et al.* (2005) studied the hearing abilities of paddlefish (*Polyodon spathula*) and the lake sturgeon and reported that both species were responsive to sounds ranging from 100 to 500 Hertz (Hz), with lowest hearing thresholds of 119 decibels referenced to 1 microPascal (dB re 1 μPa) at 200 Hz for paddlefish and 120 dB (re 1 μPa) at 250 Hz for lake sturgeon[1]. Based on the limited data available, Atlantic sturgeon may be able to detect sounds from below 100 Hz to about 1,000 Hz and should be able to localize sound sources (Meyer and Popper (unpublished) cited in Popper (2005). These data are based on a small number of individuals and, therefore, may not be representative of all Atlantic sturgeon. Nevertheless, they suggest that sturgeon would be able to hear sounds produced by pile driving, although the consequences of pile-driving on sturgeon hearing remain unknown.

More is known about the physical effects of pile-driving on sturgeon. Because of their swim bladders, Atlantic sturgeon would be sensitive to underwater impulsive sounds with a sharp sound pressure peak occurring in short intervals of time (California Dept. of Transportation [Caltrans] 2001). As pressure waves pass through a fish, its swim bladder would be rapidly squeezed by the high pressure then would rapidly expand as the under pressure component of the wave passes through the fish. The pneumatic pounding on tissues contacting the swim bladder may rupture capillaries in internal organs as indicated by observed blood in the abdominal cavity and maceration of kidney tissues (Caltrans 2001).

Halvorsen *et al*. (2012) exposed lake sturgeon to single pile-driving strikes with single strike sound exposure levels (SEL_{ss}) ranging from 174 to 186 decibels relative to 1 micro pascal squared second (dB re 1 μPa^2. s) or cumulative sound exposure levels (SEL_{cum}) ranging from 204 to 216 (dB re 1 μPa^2. s; all treatments involved exposure to 960 strikes). No sturgeon died as a result of these exposures and no external injuries were reported. In sturgeon, injuries ranged from haematomas (which the investigators considered “moderate injuries”) and partially deflated swim bladders (which the investigators considered “mild injuries”). All of these injuries occurred during treatments with the highest single and cumulative exposures (SEL_{ss} > 183 dB re 1μPa^2. s or SEL_{cum} > 213 dB re 1 μPa^2. s). Treatments with single exposures equal to or less than SEL_{ss} = 180 dB re 1 μPa^2. s) and cumulative exposures equal to or less than SEL_{cum} = 210 (dB re 1 μPa^2. s) only resulted in mild effects (partially deflated swim bladders).

Nevertheless, Popper *et al*. (2014) recommended using acoustic exposures of 210 dB SEL_{cum} or greater than 207 dB peak as thresholds for potential sturgeon mortality and mortal injuries. They classified exposures at 203 dB SEL_{cum} or 207 dB SEL_{peak} as “recoverable injuries” and proposed 186 dB SEL_{cum} as the threshold for impairment of hearing sensitivity. They also concluded that the risks of masking and behavioral impacts would be moderate when fish such as sturgeon were near pile-driving operations and low at intermediate or greater distances. In contrast, an acoustics tool developed by NMFS’ Greater Atlantic Regional Office (2018), citing

[1] These thresholds are based on sound fields dominated by particle motion rather than sound pressure. The authors estimated both, but they concluded that both species were more responsive to particle motion than sound pressure and recommended measuring their audiogram using particle motion. This narrative follows that recommendation.

AKRF and Popper (2012), uses 150 dB re 1 μPa RMS as the threshold for behavioral impacts to sturgeon, and 206 dB_{peak} or 187 SEL_{cum} for physiological (injury) impacts.

Although no data are available on Atlantic sturgeon vocalizations, other sturgeon are known to produce a variety of sounds ranging from knocks and moans (ranging between 90 and 400 Hz) and squeaks and chirps (ranging from 1,000 to 2,000 Hz; Johnston and Phillips 2003). Lovell *et al*. (2005) concluded that these knocks and moans fall within the hearing range of the sturgeon they studied and, consequently, may serve an ecological purpose while the squeaks and chirps probably do not. Nevertheless, this assessment follows the recommendations of Popper *et al*. (2014) and assumes that sturgeon face only moderate risk of masking when they are near pile-driving operations and a low risk of masking at intermediate or greater distances.

The information available suggests that, based on its detectability, duration, spatial extent, and severity, pile driving would have little or no measurable impact on the hearing of sturgeon that might be exposed to the sound field. Pile-driving would be expected to have detectable, short-term, and potentially severe impacts on the *behavior* of sturgeon that might be exposed within 0.6 mi (1 km) of pile driving operations and it would have detectable and potentially-severe impacts on the physiology of sturgeon that might occur with 246 ft (75) m of pile driving operations.

Monitoring associated with the Pile Installation Demonstration Project associated with the Tappan Zee bridge replacement (in New York State) suggests Atlantic sturgeon may avoid the area close to an active pile-driving operation (AKRF and Popper 2012, Krebs *et al.* 2016). As part of the monitoring for this project, four acoustic monitoring devices with detection ranges of at least 1,640 ft (500 m) were deployed across the Hudson River in line with pile-driving operations. Each receiver recorded the presence, identity (tag number), and residence time of individual tagged sturgeon. When pile driving operations were distant from the detection area, there was no difference in sturgeon residence times (before pile-driving versus during pile-driving). When pile driving occurred inside the 1,640-ft (500-m) receiver detection areas, tagged Atlantic sturgeon spent significantly less time in those area during active impact pile driving compared to the period before pile-driving operations began. This effect was limited to impact pile-driving (AKRF and Popper 2012, Krebs *et al.* 2016). These data suggest that at least some Atlantic sturgeon can be expected to avoid the sound field produced by pile-driving operations.

1.2.2 Operations and Maintenance

1.2.2.1 Wind Turbine Operational Noise

Once installed, the operation of the wind turbines is not expected to generate substantial sound levels above baseline sound in the area. For the Cape Wind Project, MMS (now BOEM) reported existing underwater sound levels for the design condition were 107.2 dB, and the calculated sound level from operation of a wind turbine was 109.1 dB at 66 ft (20 m) from the monopile (i.e., about 1.9 dB above baseline sound levels), which drops to 107.5 dB at 164 ft (50 m) and to ambient levels at about 360 ft (110 m) (MMS 2008).

As discussed in Section 1.2.1.1, the lowest hearing thresholds with the sound field dominated by particle motion was 119 dB (re 1 μPa) at 200 Hz for *P. spathula* and 120 dB (re 1 μPa) at 250 Hz for *A. fulvescens* (Lovell *et al.* 2005). At 66 ft (20 m), the sounds produced by operating wind turbines are below these hearing thresholds, so Atlantic sturgeon are not likely to hear these sounds at these distances. These sound levels are well below intensities that might cause Atlantic sturgeon to experience physical injuries or physiological stress responses (Halvorsen *et al*. 2012, Popper *et al*. 2014).

1.2.3 Decommissioning

Decommissioning of the Project would include removal of all structures above the seabed in a general reversal of the installation activities. Similar equipment and number of vessels will be used to remove infrastructure. The offshore substation will be decommissioned by dismantling and removing its topside and foundation (substructure). As with the turbine components, this operation will be a reverse installation process subject to the same constraints as the original construction phase. It is anticipated that monopole foundations will be cut below the seabed level in accordance with standard practices at the time of demolition which may include mechanical cutting, water jet cutting, or other industry standing practices. Removal of structures during decommissioning as well as vessel anchoring could cause injury or mortality to Atlantic sturgeon. Removal of turbine foundations will mean loss of the unique hard substrate and vertical habitat that had established itself over the life of the Project. These impacts to Atlantic sturgeon are anticipated to be short-term and localized due to the disturbance of a relatively small area (within the Wind Farm Area) and would not cause long-term impacts once decommissioning activities are completed. Atlantic sturgeon are anticipated to avoid the area during Project decommissioning activities and are anticipated to move back into the area following disturbance activities associated with decommissioning. However, benthic habitat that serves as forage area for Atlantic sturgeon may take longer to recover to pre-impact conditions. Successional epifaunal and infaunal species are anticipated to recolonize the sediments, gradually providing the continuation of foraging habitat for Atlantic sturgeon. Overall, fish and invertebrate communities will transition back to a sandy, soft-bottom community structure recolonizing from the surrounding sandy bottom habitat.

The scour protection placed around the base of each monopile will be left *in-situ* as the default option in order to preserve the marine life that may have established itself on this substrate during the period of operation and limit the amount of material that would need to be raised through the water column for removal. If it is necessary to remove the scour protection, then its removal will proceed according to the best practices applicable at the time of decommissioning.

Offshore cables will either be left *in-situ* or removed, or a combination of both, depending on the regulatory requirements at the time of decommissioning. It is anticipated that the Array Cables will be removed using controlled flow excavation or a grapnel to lift them from the seabed. Alternatively, depending on available technology, a remote-operated vehicle may be used to cut the cable so that it can be recovered to the vessel. The Export Cables will be left *in situ* or wholly/partially removed. Any cable ends will be weighed down and buried if the cables are to be left *in-situ* to ensure that the ends are not exposed or have the potential to become exposed post- decommissioning. Cables may be left *in-situ* in certain locations, such as pipeline crossings, to avoid unnecessary risk to the integrity of the third-party cable or pipeline. The removal of cables has the potential to result in temporary localized disturbance and resuspension of benthic sediments.

There will be temporary increases in sediment suspension and deposition during structure removal activities. Johnson (2018) recommends that sturgeon should not be exposed to total suspended solids (TSS) levels of 1,000 milligrams per liter (mg/L) above ambient for longer than 14 days at a time to avoid behavioral and physiological effects. While the increase in suspended sediments may cause Atlantic sturgeon to alter their normal movements, these movements are expected to be too small to be meaningfully measured or detected. TSS is most likely to affect sturgeon if a plume causes a barrier to normal behaviors. During pile removal, sediments attached to the pile will move vertically through the water column until gravitational forces cause them to slough off under their own weight. The Wind Farm Area is characterized by coarse grained sediments, and the small resulting sediment plume is expected to settle out of the water column within a few hours. However, it is expected that sturgeon that swim through the plume would not be adversely affected.

Increased underwater noise during decommissioning would mostly be associated with structure removal activities which may include mechanical cutting, water jet cutting, or other industry standing practices. The noise produced by the pile cutting activities is not expected to be impulsive and is therefore unlikely to produce noise levels with the potential for injury. The noise levels will temporarily make the habitat less suitable and would be expected to cause Atlantic sturgeon to vacate the area of Project decommissioning activities. This impact is anticipated to be short-term and temporary and limited to the location of active pile removal which represents a small portion of the total available habitat. Further, short-term impacts to Atlantic sturgeon from sound associated with vessels or other decommissioning activity noises would occur. These adverse impacts are anticipated to be temporary and similar in nature to the current noise levels of vessels that transit the area. Atlantic sturgeon are expected to avoid the area of decommissioning activities and return to the area once activities cease. No long-term impacts to Atlantic sturgeon from decommissioning activity noise are anticipated.

2. Best Management Practices, Mitigation and Minimization Measures, and Monitoring

The proposed measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts for the Project are presented in the COP.

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