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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648-XC762

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to a Wharf Recapitalization Project

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed incidental harassment authorization; request for comments.

SUMMARY: NMFS has received a request from the U.S. Navy (Navy) for authorization to take marine mammals incidental to construction activities as part of a wharf recapitalization project. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting public comment on its proposal to issue an incidental harassment authorization (IHA) to the Navy to take, by harassment only, two species of marine mammal during the specified activity.

DATES: Comments and information must be received no later than [insert date 30 days after date of publication in the FEDERAL REGISTER].

ADDRESSES: Comments on this proposal should be addressed to Michael Payne, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service. Physical comments should be sent to 1315 East-West Highway, Silver Spring, MD 20910 and electronic comments should be sent to ITP.Laws@noaa.gov.

Instructions: Comments sent by any other method, to any other address or individual, or received after the end of the comment period, may not be considered. Comments received electronically, including all attachments, must not exceed a 25-megabyte file size. All comments received are a part of the public record. All personal identifying information (e.g., name, address) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information. Attachments to electronic comments will be accepted in Microsoft Word, Excel, or Adobe PDF file formats only.

FOR FURTHER INFORMATION CONTACT: Ben Laws, Office of Protected Resources, NMFS, (301) 427-8401.

SUPPLEMENTARY INFORMATION:

Availability

A copy of the Navy's application and any supporting documents, as well as a list of the references cited in this document, may be obtained by visiting the internet at: http://www.nmfs.noaa.gov/pr/permits/incidental.htm. In the case of problems accessing these documents, please call the contact listed above.

National Environmental Policy Act

The Navy has prepared a draft Environmental Assessment (Wharf C-2 Recapitalization at Naval Station Mayport, FL) in accordance with the National Environmental Policy Act (NEPA) and the regulations published by the Council on Environmental Quality. It is posted at the aforementioned site. NMFS will independently evaluate the EA and determine whether or not to adopt it. We may prepare a separate NEPA analysis and incorporate relevant portions of Navy's EA by reference. Information in the Navy's application, EA, and this notice collectively provide the environmental information related to proposed issuance of this IHA for public review and comment. We will review all comments submitted in response to this notice as we complete the

NEPA process, including a decision of whether to sign a Finding of No Significant Impact (FONSI), prior to a final decision on the incidental take authorization request.

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 et seq.) direct the Secretary of Commerce to allow, upon request by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified area, the incidental, but not intentional, taking of small numbers of marine mammals, providing that certain findings are made and the necessary prescriptions are established.

The incidental taking of small numbers of marine mammals may be allowed only if NMFS (through authority delegated by the Secretary) finds that the total taking by the specified activity during the specified time period will (i) have a negligible impact on the species or stock(s) and (ii) not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant). Further, the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such taking must be set forth, either in specific regulations or in an authorization.

The allowance of such incidental taking under section 101(a)(5)(A), by harassment, serious injury, death or a combination thereof, requires that regulations be established. Subsequently, a Letter of Authorization may be issued pursuant to the prescriptions established in such regulations, providing that the level of taking will be consistent with the findings made for the total taking allowable under the specific regulations. Under section 101(a)(5)(D), NMFS may authorize such incidental taking by harassment only, for periods of not more than 1 year, pursuant to requirements and conditions contained within an Incidental Harassment

Authorization. The establishment of prescriptions through either specific regulations or an authorization requires notice and opportunity for public comment.

NMFS has defined "negligible impact" in 50 CFR 216.103 as "...an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival." Except with respect to certain activities not pertinent here, section 3(18) of the MMPA defines "harassment" as: "…any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering." The former is termed Level A harassment and the latter is termed Level B harassment.

Summary of Request

On April 4, 2013, we received a request from the Navy for authorization of the taking, by Level B harassment only, of marine mammals incidental to pile driving in association with the Wharf C-2 recapitalization project at Naval Station Mayport, Florida (NSM). That request was modified on May 9 and June 5, 2013, and a final version, which we deemed adequate and complete, was submitted on August 7, 2013. In-water work associated with the project is expected to be completed within the one-year timeframe of the proposed IHA (December 1, 2013 through November 30, 2014). Two species of marine mammal are expected to be affected by the specified activities: bottlenose dolphin (Tursiops truncatus truncatus) and Atlantic spotted dolphin (Stenella frontalis). These species may occur year-round in the action area.

Wharf C-2 is a single level, general purpose berthing wharf constructed in 1960. The wharf is one of NSM's two primary deep-draft berths and is one of the primary ordnance handling wharfs. The wharf is a diaphragm steel sheet pile cell structure with a concrete apron, partial concrete encasement of the piling and an asphalt paved deck. The wharf is currently in poor condition due to advanced deterioration of the steel sheeting and lack of corrosion protection, and this structural deterioration has resulted in the institution of load restrictions within 60 ft of the wharf face. The purpose of this project is to complete necessary repairs to Wharf C-2. Please refer to Appendix A of the Navy's application for photos of existing damage and deterioration at the wharf, and to Appendix B for a contractor schematic of the project plan.

Effects to marine mammals from the specified activity are expected to result from underwater sound produced by vibratory and impact pile driving. In order to assess project impacts, the Navy used thresholds recommended by NMFS, outlined later in this document. The Navy assumed practical spreading loss and used empirically-measured source levels from representative pile driving events to estimate potential marine mammal exposures. Predicted exposures are described later in this document. The calculations predict that only Level B harassment would occur associated with pile driving activities, and required mitigation measures further ensure that no more than Level B harassment would occur.

Description of the Specified Activity

Specific Geographic Region and Duration

NSM is located in northeastern Florida, at the mouth of the St. Johns River and adjacent to the Atlantic Ocean (see Figure 2-1 of the Navy's application). The St. Johns River is the longest river in Florida, with the final 35 mi flowing through the city of Jacksonville. This portion of the river is significant for commercial shipping and military use. At the mouth of the river, near the action area, the Atlantic Ocean is the dominant influence and typical salinities are above 30 ppm. Outside the river mouth, in nearshore waters, moderate oceanic currents tend to flow southward parallel to the coast. Sea surface temperatures range from around 16°C in winter to 28°C in summer.

The specific action area consists of the NSM turning basin, an area of approximately 2,000 by 3,000 ft containing ship berthing facilities at sixteen locations along wharves around the basin perimeter. The basin was constructed during the early 1940s by dredging the eastern part of Ribault Bay (at the mouth of the St. Johns River), with dredge material from the basin used to fill parts of the bay and other low-lying areas in order to elevate the land surface. The basin is currently maintained through regular dredging at a depth of 50 ft, with depths at the berths ranging from 30-50 ft. The turning basin, connected to the St. Johns River by a 500-ft-wide entrance channel, will largely contain sound produced by project activities, with the exception of sound propagating east into nearshore Atlantic waters through the entrance channel (see Figure 2-2 of the Navy's application). Wharf C-2 is located in the northeastern corner of the Mayport turning basin.

The project is expected to require a maximum of 50 days of in-water vibratory pile driving work over a 12-month period. It is not expected that significant impact pile driving would be necessary, on the basis of expected subsurface driving conditions and past experience driving piles in the same location. However, twenty additional days of impact pile driving are included in the specified activity as a contingency, for a total of 70 days in-water pile driving considered over the 12-month timeframe of the proposed IHA.

Description of Specified Activity

In order to rehabilitate Wharf C-2, the Navy proposes to install a new steel king pile/sheet pile (SSP) bulkhead. An SSP system consists of large vertical king piles with paired steel sheet piles driven inbetween and connected to the ends of the king piles. The wall is anchored at the top with fill then placed behind the wall. Finally, a concrete cap is formed along the top and outside face of the wall to tie the entire structure together and provide a berthing surface for vessels. The new bulkhead will be designed for a 50-year service life. Please see Figures 1-1 through 1-4 and Table 1-1 in the Navy's application for project schematics, descriptive photographs, and further information about the pile types to be used. The project requires additional work (both in and out of water) that is not considered to have the potential for impacts to marine mammals; these project components are described in the Navy's EA.

The project will require installation of approximately 120 single sheet piles and 119 king piles (all steel) to support the bulkhead wall, and fifty polymeric (plastic) fender piles. Vibratory installation of the steel piles will require approximately 45 days, with approximately 5 additional days needed for vibratory installation of the plastic piles. King piles are long I-shaped guide piles that provide the structural support for the bulkhead wall. Sheet piles, which form the actual wall, will be driven in pairs between the king piles. Once piles are in position, it is expected that less than 60 seconds of vibratory driving would be required per pile to reach the required depth. Time interval between driving of each pile pair will vary, but is expected to be a minimum of several minutes due to time required for positioning, etc. One template consists of the combination of five king piles and four sheet pile pairs; it is expected that three such templates may be driven per day. Polymeric fender piles will be installed after completion of the bulkhead, at an expected rate of approximately ten piles per day.

Impact pile driving is not expected to be required for most piles, but may be used as a contingency in cases when vibratory driving is not sufficient to reach the necessary depth. A similar project completed at an adjacent wharf required impact pile driving on only seven piles (over the course of two days). Impact pile driving, if it were required, could occur on the same day as vibratory pile driving, but driving rigs would not be operated simultaneously.

Description of Sound Sources and Distances to Thresholds

Impacts from the specified activity on marine mammals are expected to result from the production of underwater sound; therefore, we provide a brief technical background on sound, the characteristics of certain sound types, and on metrics used in this proposal.

Background

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in hertz (Hz) or cycles per second. Wavelength is the distance between two peaks of a sound wave; lower frequency sounds have longer wavelengths than higher frequency sounds, and attenuate (decrease) more rapidly in shallower water. Amplitude is the height of the sound pressure wave or the "loudness" of a sound and is typically measured using the decibel (dB) scale. A dB is the ratio between a measured pressure (with sound) and a reference pressure (sound at a constant pressure, established by scientific standards), and is a logarithmic unit that accounts for large variations in amplitude; therefore, relatively small changes in dB ratings correspond to large changes in sound pressure. When referring to sound pressure levels (SPLs; the sound force per unit area), sound is referenced in the context of underwater sound pressure to 1 microPascal (μPa). One pascal is the pressure resulting from a force of one newton exerted over an area of one square meter. The source level

(SL) represents the sound level at a distance of 1 m from the source (referenced to 1 μPa). The received level is the sound level at the listener's position.

Root mean square (rms) is the quadratic mean sound pressure over the duration of an impulse. Rms is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick, 1983). Rms accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper, 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in all directions away from the source (similar to ripples on the surface of a pond), except in cases where the source is directional. The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones.

Ambient Sound

Even in the absence of sound from the specified activity, the underwater environment is typically loud due to ambient sound. Ambient sound is defined as environmental background sound levels lacking a single source or point (Richardson et al., 1995), and the sound level of a region is defined by the total acoustical energy being generated by known and unknown sources. These sources may include physical (e.g., waves, earthquakes, ice, atmospheric sound), biological (e.g., sounds produced by marine mammals, fish, and invertebrates), and anthropogenic sound (e.g., vessels, dredging, aircraft, construction). A number of sources contribute to ambient sound, including the following (Richardson et al., 1995):

- Wind and waves: The complex interactions between wind and water surface, including processes such as breaking waves and wave-induced bubble oscillations and cavitation, are a main source of naturally occurring ambient sound for frequencies between 200 Hz and 50 kHz (Mitson, 1995). In general, ambient sound levels tend to increase with increasing wind speed and wave height. Surf sound becomes important near shore, with measurements collected at a distance of 8.5 km from shore showing an increase of 10 dB in the 100 to 700 Hz band during heavy surf conditions.
- Precipitation: Sound from rain and hail impacting the water surface can become an important component of total sound at frequencies above 500 Hz, and possibly down to 100 Hz during quiet times.
- Biological: Marine mammals can contribute significantly to ambient sound levels, as can some fish and shrimp. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz.
- Anthropogenic: Sources of ambient sound related to human activity include transportation (surface vessels and aircraft), dredging and construction, oil and gas drilling and production, seismic surveys, sonar, explosions, and ocean acoustic studies. Shipping sound typically dominates the total ambient sound for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz and, if higher frequency sound levels are created, they attenuate rapidly. Sound from identifiable anthropogenic sources other than the activity of interest (e.g., a passing vessel) is sometimes termed background sound, as opposed to ambient sound.

The sum of the various natural and anthropogenic sound sources at any given location and time – which comprise "ambient" or "background" sound – depends not only on the source levels (as determined by current weather conditions and levels of biological and shipping activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor, and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10-20 dB from day to day (Richardson et al., 1995). The result is that, depending on the source type and its intensity, sound from the specified activity may be a negligible addition to the local environment or could form a distinctive signal that may affect marine mammals.

The underwater acoustic environment in the Mayport turning basin is likely to be dominated by noise from day-to-day port and vessel activities. The basin is sheltered from most wave noise, but is a high-use area for naval ships, tugboats, and security vessels. When underway, these sources can create noise between 20 Hz and 16 kHz (Lesage et al., 1999), with broadband noise levels up to 180 dB. While there are no current measurements of ambient noise levels in the turning basin, it is likely that levels within the basin periodically exceed the 120 dB threshold and, therefore, that the high levels of anthropogenic activity in the basin create an environment far different from quieter habitats where behavioral reactions to sounds around the 120 dB threshold have been observed (e.g., Malme et al., 1984, 1988).

Sound Source Characteristics

In-water construction activities associated with the project would include vibratory pile driving and possibly impact pile driving. The sounds produced by these activities fall into one of two sound types: pulsed and non-pulsed (defined in the following). The distinction between these two general sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (e.g., Ward, 1997 in Southall et al., 2007). Please see Southall et al., (2007) for an in-depth discussion of these concepts.

Pulsed sound sources (e.g., explosions, gunshots, sonic booms, impact pile driving) produce signals that are brief (typically considered to be less than 1 sec), broadband, atonal transients (ANSI, 1986; Harris, 1998; NIOSH, 1998; ISO, 2003; ANSI, 2005) and occur either as isolated events or repeated in some succession. Pulsed sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features.

Non-pulsed sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or non-continuous (ANSI, 1995; NIOSH, 1998). Some of these non-pulsed sounds can be transient signals of short duration but without the essential properties of pulses (e.g., rapid rise time). Examples of non-pulsed sounds include those produced by vessels, aircraft, machinery operations such as drilling or dredging, vibratory pile driving, and active sonar systems. The duration of such sounds, as received at a distance, can be greatly extended in a highly reverberant environment.

Impact hammers operate by repeatedly dropping a heavy piston onto a pile to drive the pile into the substrate. Sound generated by impact hammers is characterized by rapid rise times and high peak levels, a potentially injurious combination (Hastings and Popper, 2005). Vibratory hammers install piles by vibrating them and allowing the weight of the hammer to push them into the sediment. Vibratory hammers produce significantly less sound than impact hammers. Peak SPLs may be 180 dB or greater, but are generally 10 to 20 dB lower than SPLs generated during impact pile driving of the same-sized pile (Oestman et al., 2009). Rise time is slower, reducing the probability and severity of injury, and sound energy is distributed over a greater amount of time (Nedwell and Edwards, 2002; Carlson et al., 2005).

Sound Thresholds

NMFS currently uses acoustic exposure thresholds as important tools to help better characterize and quantify the effects of human-induced noise on marine mammals. These thresholds have predominantly been presented in the form of single received levels for particular source categories (e.g., impulse, continuous, or explosive) above which an exposed animal would be predicted to incur auditory injury or be behaviorally harassed. Current NMFS practice (in relation to the MMPA) regarding exposure of marine mammals to sound is that cetaceans and pinnipeds exposed to sound levels of 180 and 190 dB rms or above, respectively, are considered to have been taken by Level A (i.e., injurious) harassment, while behavioral harassment (Level B) is considered to have occurred when marine mammals are exposed to sounds at or above 120 dB rms for continuous sound (such as will be produced by vibratory pile driving) and 160 dB rms for pulsed sound (produced by impact pile driving), but below injurious thresholds. NMFS uses these levels as guidelines to estimate when harassment may occur.

NMFS is in the process of revising these acoustic thresholds, with the first step being to identify new auditory injury criteria for all source types and new behavioral criteria for seismic activities (primarily airgun-type sources). For more information on that process, please visit http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm.

Distance to Sound Thresholds

Pile driving generates underwater noise that can potentially result in disturbance to marine mammals in the project area. In order to estimate the distance at which sound produced by the specified activity would attenuate to relevant thresholds, one must, at minimum, be able to reasonably approximate source levels and transmission loss (TL), which is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source. In general, the sound pressure level (SPL) at some distance away from the source (e.g., driven pile) is governed by a measured source level, minus the TL of the energy as it dissipates with distance.

The degree to which underwater sound propagates away from a sound source is dependent on a variety of factors, including source depth and frequency, receiver depth, water depth, bottom composition and topography, presence or absence of reflective or absorptive in-water structures, and oceanographic conditions such as temperature, current, and water chemistry. The general formula for underwater TL neglects loss due to scattering and absorption, which is assumed to be zero here. Spherical spreading occurs in a perfectly unobstructed (free-field) environment not limited by depth or water surface, resulting in a 6 dB reduction in sound level for each doubling of distance from the source (20*log[range]). Cylindrical spreading occurs in an environment in which sound propagation is bounded by the water surface and sea bottom, resulting in a reduction of 3 dB in sound level for each doubling of distance from the source (10*log[range]). A practical spreading value of 15 (4.5 dB reduction in sound level for each doubling of distance) is often used under intermediate conditions, and is assumed here.

Source level, or the intensity of pile driving sound, is greatly influenced by factors such as the type of piles, hammers, and the physical environment in which the activity takes place. A number of studies, primarily on the west coast, have measured sound produced during underwater pile driving projects. However, these data are largely for impact driving of steel pipe piles and concrete piles as well as vibratory driving of steel pipe piles. We know of no existing measurements for the specific pile types planned for use at NSM (i.e., king piles, paired sheet piles, plastic pipe piles), although some data exist for single sheet piles. It was therefore necessary to extrapolate from available data to determine reasonable source levels for this project.

In order to determine reasonable SPLs and their associated effects on marine mammals that are likely to result from pile driving at NSM, the Navy first compared linear lengths (in terms of radiative surface length) of the pile types proposed for use with those for which measurements of underwater SPLs exist. For example, the total linear length of a king pile (with width of 17.87 in and height of 41.47 in) is equivalent to the circumference (i.e., linear length) of a 24-in diameter pipe pile. Please see Table 6-2 of the Navy's application for more detail on these comparisons. We recognize that these pile types may produce sound differently, given different radiative geometries, and that there may be differences in the frequency spectrum produced, but believe this to be the best available method of determining proxy source levels. We considered existing measurements from similar physical environments (sandy sediments and water depths greater than 15 ft) for impact and vibratory driving of 24-in steel pipe piles and for steel sheet piles. These studies, largely conducted by the Washington State Department of Transportation and the California Department of Transportation, show values around 160 dB for vibratory driving of 24-in pipe piles and around 162 dB for vibratory driving of sheet piles, and around 185-195 dB for impact driving of pipe piles (all measured at 10 m). Please see Laughlin (2005); Oestman et al. (2009); and Illingworth and Rodkin, Inc. (2010) for more information. For vibratory driving, 163 dB (as the highest representative value; Oestman et al., 2009) was selected as a proxy source value for both sheet piles and king piles. For impact driving of both sheet piles and king piles (should it be required), a proxy source value of 189 dB (Oestman et al., 2009) was selected for use in acoustic modeling based on similarity to the physical environment at NSM and because of the measurement location in mid-water column. No measurements are known to be available for vibratory driving of plastic polymer piles, so timber piles were considered as likely to be the most similar pile material. Although timber piles are typically installed via impact drivers, Laughlin (2011) reported a mean source measurement (at 16 m) for vibratory removal of timber piles. This value (150 dB) was selected as a proxy source value on the basis of similarity of materials between timber and polymer. No impact driving of polymer piles will occur. Please see Tables 6-3 and 6-4 in the Navy's application. All calculated distances to and the total area encompassed by the marine mammal sound thresholds are provided in Table 1.

Pile type	**Method**	**Threshold**	**Distance (m)**[1]	**Area (sq. km)**[2]
Steel (sheet and king piles)	Vibratory	Level A harassment (180 dB)	n/a	0
		Level B harassment (120 dB)	7,356	2.9
	Impact	Level A harassment (180 dB)	40	0.004
		Level B harassment (160 dB)	858	0.67
Polymeric (plastic fender piles)	Vibratory	Level A harassment (180 dB)	n/a	0
		Level B harassment (120 dB)	1,585	0.88

[1] SPLs used for calculations were: 204 dB for impact driving, 178 dB for vibratory driving steel piles, and 168 dB for vibratory driving plastic piles.

[2] Areas presented take into account attenuation and/or shadowing by land. Calculated distances to relevant thresholds cannot be reached in most directions form source piles. Please see Figures 6-1 through 6-3 in the Navy's application.

Table 1. Calculated distance(s) to and area encompassed by underwater marine mammal sound thresholds during pile installation

The Mayport turning basin does not represent open water, or free field, conditions. Therefore, sounds would attenuate as per the confines of the basin, and may only reach the full estimated distances to the harassment thresholds via the narrow, east-facing entrance channel.

Distances shown in Table 1 are estimated for free-field conditions, but areas are calculated per the actual conditions of the action area. See Figures 6-1 through 6-3 of the Navy's application for a depiction of areas in which each underwater sound threshold is predicted to occur at the project area due to pile driving.

Description of Marine Mammals in the Area of the Specified Activity

There are four marine mammal species which may inhabit or transit through the waters nearby NSM at the mouth of the St. Johns River and in nearby nearshore Atlantic waters. These include the bottlenose dolphin, Atlantic spotted dolphin, North Atlantic right whale (Eubalaena glacialis), and humpback whale (Megaptera novaeangliae). Multiple additional cetacean species occur in South Atlantic waters but would not be expected to occur in shallow nearshore waters of the action area. The right and humpback whales are both listed under the Endangered Species Act (ESA) as endangered. Table 2 lists the marine mammal species with expected potential for occurrence in the vicinity of NSM during the project timeframe. Multiple stocks of bottlenose dolphins may be present in the action area, either seasonally or year-round, and are described further below. We first address the two large whale species that may occur in the action area.

Species	Stock abundance[1] (CV, N_{min})	Relative occurrence in action area	Season of occurrence
North Atlantic right whale Western North Atlantic stock	444 (n/a, 444)	Rare inshore, regular near/offshore	November to April
Humpback whale Gulf of Maine stock	823 (n/a, 823)	Rare	Fall-Spring
Atlantic spotted dolphin Western North Atlantic stock	26,798 (0.66, 16,151)	Rare	Year-round
Bottlenose dolphin Western North Atlantic offshore stock	81,588 (0.17, 70,775)	Rare	Year-round
Bottlenose dolphin Western North Atlantic coastal, southern migratory stock	12,482 (0.32, 9,591)	Possibly common (seasonal)	January to March

Bottlenose dolphin Western North Atlantic coastal, northern Florida stock	3,064 (0.24, 2,511)	Possibly common	Year-round
Bottlenose dolphin Jacksonville Estuarine System stock	412[2] (0.06, unknown)	Possibly common	Year-round

[1] NMFS marine mammal stock assessment reports at: http://www.nmfs.noaa.gov/pr/sars/species.htm. CV is coefficient of variation; N_{min} is the minimum estimate of stock abundance.

[2] This abundance estimate is considered an overestimate because it includes non- and seasonally-resident animals.

Table 2. Marine mammals potentially present in the vicinity of NSM

Right whales occur in sub-polar to temperate waters in all major ocean basins in the world with a clear migratory pattern, occurring in high latitudes in summer (feeding) and lower latitudes in winter (breeding). North Atlantic right whales exhibit extensive migratory patterns, traveling along the eastern seaboard from calving grounds off Georgia and northern Florida to northern feeding areas off of the northeast U.S. and Canada in March/April and returning in November/December. Migrations are typically within 30 nmi of the coastline and in waters less than 160 ft deep. Although this migratory pattern is well-known, winter distribution for most of the population – the non-calving portion – is poorly known, as many whales are not observed on the calving grounds. It is unknown where these animals spend the winter, although they may occur further offshore or may remain on foraging grounds during winter (Morano et al., 2012). During the winter calving period, right whales occur regularly in offshore waters of northeastern Florida. Critical habitat for right whales in the southeast (as identified under the ESA) is designated to protect calving grounds, and encompasses waters from the coast out to 15 nmi offshore from Mayport. More rarely, right whales have been observed entering the mouth of the St. Johns River for brief periods of time (Schweitzer and Zoodsma, 2011). Right whales are not present in the region outside of the winter calving season.

Humpback whales are a cosmopolitan species that migrate seasonally between warm-water (tropical or sub-tropical) breeding and calving areas in winter months and cool-water (temperate to sub-Arctic/Antarctic) feeding areas in summer months (Gendron and Urban, 1993). They tend to occupy shallow, coastal waters, although migrations are undertaken through deep, pelagic waters. In the North Atlantic, humpback whales are known to aggregate in six summer feeding areas representing relatively discrete subpopulations (Clapham and Mayo, 1987), which share common wintering grounds in the Caribbean (and to a lesser extent off of West Africa) (Winn et al., 1975; Mattila et al., 1994; Palsbøll et al., 1997; Smith et al., 1999; Stevick et al., 2003; Cerchio et al., 2010). These populations or aggregations range from the Gulf of Maine in the west to Norway in the east, and the migratory range includes the east coast of the U.S. and Canada. The only managed stock in U.S. waters is the Gulf of Maine feeding aggregation, although other stocks occur in Canadian waters (e.g., Gulf of St. Lawrence feeding aggregation), and it is possible that whales from other stocks could occur in U.S. waters. Significant numbers of whales do remain in mid- to high-latitude waters during the winter months (Clapham et al., 1993; Swingle et al., 1993), and there have been a number of humpback sightings in coastal waters of the southeastern U.S. during the winter (Wiley et al., 1995; Laerm et al., 1997; Waring et al., 2013). According to Waring et al. (2013), it is unclear whether the increased numbers of sightings represent a distributional change, or are simply due to an increase in sighting effort and/or whale abundance. These factors aside, the humpback whale remains relatively rare in U.S. coastal waters south of the mid-Atlantic region, and is considered rare to extralimital in the action area. Any occurrences in the region would be expected in fall, winter, and spring during migration, as whales are unlikely to occur so far south during the summer feeding season.

Neither the humpback whale nor the right whale would occur within the turning basin, and only the right whale has been observed to occur as far inshore as the mouth of the St. Johns River. Therefore, the only potential for interaction with these species is likely to be within the narrow sliver of ensonified area expected to extend eastward from the entrance channel during vibratory driving of steel piles (see Figure 6-1 of the application). As described above, humpback whales are considered rare in the region, and, when considering frequency of occurrence, size of ensonified area (approximately 2 km^2), and duration (45 days), we consider the possibility for harassment of humpback whales to be discountable. For right whales, due to the greater potential for interaction during the calving season we considered available density information, including abundance data from NMFS surveys, as analyzed by the Navy to produce density estimates (NODES dataset; DoN, 2007); Duke University habitat modeling (Read et al., 2009); and global density estimates derived from relative environmental suitability modeling (Kaschner, 2004; Kaschner et al., 2006), as presented in DoN (2012). All sources show low density estimates. The Navy used the Kaschner et al. (2006) modeling, as described in the Navy Marine Species Density Database (DoN, 2012), to produce a representative estimate for the specific action area. Density values for the inshore zone were uniform across seasons; seasonal distribution changes that may be expected for right whales are reflected further offshore from the Mayport turning basin. Use of this estimate (0.00005/km^2) resulted in zero estimated exposures of right whales to sound produced by project activities. Only a small portion of the affected area (0.19 km^2; less than 5 percent of total ZOI) falls in the offshore zone for which seasonal densities are available, and including that area with the highest yearly density (0.124/km^2; Dec-Mar; NODES dataset) does not affect the zero-exposure prediction. Therefore, the humpback whale and right whale are excluded from further analysis and are not discussed further in this document.

The following summarizes the population status and abundance of the remaining species. We have reviewed the Navy's species descriptions, including life history information, for accuracy and completeness and refer the reader to Sections 3 and 4 of the Navy's application, as well as to the Navy's Marine Resource Assessment for the Charleston/Jacksonville Operating Area (DoN, 2008; available at https://portal.navfac.navy.mil/portal/page/portal/navfac/navfac_ww_pp/navfac_hq_pp/navfac_environmental/mra), instead of reprinting the information here. The following information is summarized largely from NMFS Stock Assessment Reports (http://www.nmfs.noaa.gov/pr/sars/).

Bottlenose Dolphin

Bottlenose dolphins are found worldwide in tropical to temperate waters and can be found in all depths from estuarine inshore to deep offshore waters. Temperature appears to limit the range of the species, either directly, or indirectly, for example, through distribution of prey. Off North American coasts, common bottlenose dolphins are found where surface water temperatures range from about 10º C to 32º C. In many regions, including the southeastern U.S., separate coastal and offshore populations are known. There is significant genetic, morphological, and hematological differentiation evident between the two ecotypes (e.g., Walker, 1981; Duffield et al., 1983; Duffield, 1987; Hoelzel et al., 1998), which correspond to shallow, warm water and deep, cold water. Both ecotypes have been shown to inhabit the western North Atlantic (Hersh and Duffield, 1990; Mead and Potter, 1995), where the deep-water ecotype tends to be larger and darker. In addition, several lines of evidence, including photo-identification and genetic studies, support a distinction between dolphins inhabiting coastal waters near the shore and those present in the inshore waters of bays, sounds and estuaries. This complex differentiation of bottlenose dolphin populations is observed throughout the Atlantic and Gulf of Mexico coasts where bottlenose dolphins are found, although estuarine populations have not been fully defined.

In the Mayport area, four stocks of bottlenose dolphins are currently managed, none of which are protected under the ESA. Of the four stocks – offshore, southern migratory coastal, northern Florida coastal, and Jacksonville estuarine system – only the latter three are likely to occur in the action area. Bottlenose dolphins typically occur in groups of 2-15 individuals (Shane et al., 1986; Kerr et al., 2005). Although significantly larger groups have also been reported, smaller groups are typical of shallow, confined waters. In addition, such waters typically support some degree of regional site fidelity and limited movement patterns (Shane et al., 1986; Wells et al., 1987). Observations made during recent marine mammal surveys conducted in the Mayport turning basin show bottlenose dolphins typically occurring individually or in pairs, or less frequently in larger groups. The maximum observed group size during these surveys is six, while the mode is one. Navy observations indicate that bottlenose dolphins rarely linger in a particular area in the turning basin, but rather appear to move purposefully through the basin and then leave, which likely reflects a lack of any regular foraging opportunities or habitat characteristics of any importance in the basin. Based on currently available information, it is not possible to determine which stock dolphins occurring in the action area may belong to. These stocks are described in greater detail below.

Western North Atlantic Offshore – This stock, consisting of the deep-water ecotype or offshore form of bottlenose dolphin in the western North Atlantic, is distributed primarily along the outer continental shelf and continental slope, but has been documented to occur relatively close to shore (Waring et al., 2009a). The separation between offshore and coastal morphotypes varies depending on location and season, with the ranges overlapping to some degree south of

Cape Hatteras. Based on genetic analysis, Torres et al. (2003) found a distributional break at 34 km from shore, with the offshore form found exclusively seaward of 34 km and in waters deeper than 34 m. Within 7.5 km of shore, all animals were of the coastal morphotype. More recently, coastwide, systematic biopsy collection surveys were conducted during the summer and winter to evaluate the degree of spatial overlap between the two morphotypes. South of Cape Hatteras, spatial overlap was found although the probability of a sampled group being from the offshore morphotype increased with increasing depth, and the closest distance for offshore animals was 7.3 km from shore, in water depths of 13 m just south of Cape Lookout (Garrison et al., 2003). The maximum radial distance for the largest ZOI is approximately 7.4 km (Table 1); therefore, while possible, it is unlikely that any individuals of the offshore morphotype would be affected by project activities. In terms of water depth, the affected area is generally in the range of the shallower depth reported for offshore dolphins by Garrison et al. (2003), but is far shallower than the depths reported by Torres et al. (2003). South of Cape Lookout, the zone of spatial overlap between offshore and coastal ecotypes is generally considered to occur in water depths between 20-100 m (Waring et al., 2011), which is generally deeper than waters in the action area. This stock is thus excluded from further analysis.

Western North Atlantic Coastal, Southern Migratory – The coastal morphotype of bottlenose dolphin is continuously distributed from the Gulf of Mexico to the Atlantic and north approximately to Long Island (Waring et al., 2011). On the Atlantic coast, Scott et al. (1988) hypothesized a single coastal stock, citing stranding patterns during a high mortality event in 1987-88 and observed density patterns. More recent studies demonstrate that there is instead a complex mosaic of stocks (Zolman, 2002; McLellan et al., 2003; Rosel et al., 2009). The coastal morphotype was managed by NMFS as a single stock until 2009, when it was split into five separate stocks, including northern and southern migratory stocks.

According to the Scott et al. (1988) hypothesis, a single stock was thought to migrate seasonally between New Jersey (summer) and central Florida (winter). Instead, it was determined that a mix of resident and migratory stocks exists, with the migratory movements and spatial distribution of the southern migratory stock the most poorly understood of these. Stable isotope analysis and telemetry studies provide evidence for seasonal movements of dolphins between North Carolina and northern Florida (Knoff, 2004; Waring et al., 2011), and genetic analyses and tagging studies support differentiation of northern and southern migratory stocks (Rosel et al., 2009; Waring et al., 2011). Although there is significant uncertainty regarding the southern migratory stock's spatial movements, telemetry data indicates that the stock occupies waters of southern North Carolina (south of Cape Lookout) during the fall (October-December). In winter months (January-March), the stock moves as far south as northern Florida where it overlaps spatially with the northern Florida coastal and Jacksonville estuarine system stocks. In spring (April-June), the stock returns north to waters of North Carolina, and is presumed to remain north of Cape Lookout during the summer months. Therefore, the potential exists for harassment of southern migratory dolphins, most likely during the winter only.

Bottlenose dolphins are ubiquitous in coastal waters from the mid-Atlantic through the Gulf of Mexico, and therefore interact with multiple coastal fisheries, including gillnet, trawl, and trap/pot fisheries. Stock-specific total fishery-related mortality and serious injury cannot be directly estimated because of the spatial overlap among stocks of bottlenose dolphins, as well as because of unobserved fisheries. The primary known source of fishery mortality for the southern migratory stock is the mid-Atlantic gillnet fishery, and the total estimated average annual fishery mortality (for all fisheries, based on data from 2004-08) for the stock ranges between a minimum of 24 and a maximum of 55 animals per year (Waring et al., 2011). Between 2004 and 2008, 588 bottlenose dolphins stranded along the Atlantic coast between Florida and Maryland that could potentially be assigned to the southern migratory stock, although the assignment of animals to a particular stock is impossible in some seasons and regions due to spatial overlap amongst stocks (Waring et al., 2011). Many of these animals exhibited some evidence of human interaction, such as line/net marks, gunshot wounds, or vessel strike. In addition, nearshore and estuarine habitats occupied by the coastal morphotype are adjacent to areas of high human population and some are highly industrialized. It should also be noted that stranding data underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in fishery interactions are discovered, reported or investigated, nor will all of those that are found necessarily show signs of entanglement or other fishery interaction. The level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions. Finally, multiple resident populations of bottlenose dolphins have been shown to have high concentrations of organic pollutants (e.g., Kuehl et al., 1991) and, despite little study of contaminant loads in migrating coastal dolphins, exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

The original, single stock of coastal dolphins recognized from 1995-2001 was listed as depleted under the MMPA as a result of a 1987-88 mortality event. That designation was retained when the single stock was split into multiple coastal stocks. Therefore, and as a result of the aforementioned factors, southern migratory dolphins are listed as depleted under the MMPA, and are also considered a strategic stock. The best abundance estimate for southern migratory dolphins is calculated from aerial surveys conducted in summer of 2002 (the least amount of stock overlap occurs during summer months). A more recent summer survey (2004) occurred during oceanographic conditions that resulted in significantly greater stock overlap. The resulting estimate of 12,842 (CV = 0.32) is used to calculate a minimum population estimate of 9,591 and potential biological removal (PBR) of 96 animals. Insufficient data exist to determine the population trends for this stock, and productivity rates are not known, although theoretical modeling shows that cetacean populations may not grow at rates much greater than 4 percent given the constraints of their reproductive life history (Barlow et al., 1995).

Western North Atlantic Coastal, Northern Florida – Please see above for description of the differences between coastal and offshore ecotypes and the delineation of coastal dolphins into management stocks. The northern Florida coastal stock is one of five stocks of coastal dolphins and one of three known resident stocks (other resident stocks include South Carolina/Georgia and central Florida dolphins). The spatial extent of these stocks, their potential seasonal movements, and their relationships with estuarine stocks are poorly understood. During summer months, when the migratory stocks are known to be in North Carolina waters and further north, bottlenose dolphins are still seen in coastal waters of South Carolina, Georgia and Florida, indicating the presence of additional stocks of coastal animals. Speakman et al. (2006) documented dolphins in coastal waters off Charleston, South Carolina, that are not known resident members of the estuarine stock, and genetic analyses indicate significant differences between coastal dolphins from northern Florida, Georgia and central South Carolina (NMFS, 2001; Rosel et al., 2009). The northern Florida stock is thought to be present from approximately the Georgia-Florida border south to 29.4°N.

The northern Florida coastal stock is susceptible to interactions with similar fisheries as those described above for the southern migratory stock, including gillnet, trawl, and trap/pot fisheries. No fisheries-related mortality attributable to this stock has been reported (according to 2004-08 data; Waring et al., 2011); however, many of these fisheries are not observed or have limited observer coverage and bottlenose dolphins are known to interact with these types of gear. From 2004-08, 78 stranded dolphins were recovered in northern Florida waters, although it was not possible to determine whether there was evidence of human interaction for the majority of these (Waring et al., 2011). The same concerns discussed above regarding underestimation of mortality hold for this stock and, as for southern migratory dolphins, pollutant loading is a concern.

The single stock of coastal bottlenose dolphins recognized by NMFS until 2001 was listed as depleted under the MMPA. All five stocks of coastal bottlenose dolphin that were subsequently recognized retain that designation, and are also therefore considered strategic stocks. The best abundance estimate, derived from aerial surveys conducted in summer months of 2002 and 2004, is 3,064 (CV = 0.24). The abundance estimates from these two surveys differed by nearly an order of magnitude, perhaps reflecting variability in spatial distribution for coastal dolphins. The resulting minimum population estimate is 2,511, and the PBR is 25 individuals. There are insufficient data to determine population trends or net productivity rates for this stock.

Jacksonville Estuarine System – Please see above for description of the differences between coastal and offshore ecotypes and the delineation of coastal dolphins into management stocks primarily inhabiting nearshore waters. The coastal morphotype of bottlenose dolphin is also resident to certain inshore estuarine waters (Caldwell, 2001; Gubbins, 2002; Zolman, 2002;

Gubbins et al., 2003). Multiple lines of evidence support demographic separation between coastal dolphins found in nearshore waters and those in estuarine waters, as well as between dolphins residing within estuaries along the Atlantic and Gulf coasts (e.g., Wells et al., 1987; Scott et al., 1990; Wells et al., 1996; Cortese, 2000; Zolman, 2002; Speakman, et al. 2006; Stolen et al., 2007; Balmer et al., 2008; Mazzoil et al., 2008). In particular, a study conducted near Jacksonville demonstrated significant genetic differences between coastal and estuarine dolphins (Caldwell, 2001; Rosel et al., 2009). Despite evidence for genetic differentiation between estuarine and nearshore populations, the degree of spatial overlap between these populations remains unclear. Photo-identification studies within estuaries demonstrate seasonal immigration and emigration and the presence of transient animals (e.g., Speakman et al., 2006). In addition, the degree of movement of resident estuarine animals into coastal waters on seasonal or shorter time scales is poorly understood (Waring et al., 2011).

The Jacksonville estuarine system (JES) stock has been defined as separate primarily by the results of photo-identification and genetic studies. The stock range is considered to be bounded in the north by the Georgia-Florida border at Cumberland Sound, extending south to approximately Jacksonville Beach, Florida. This encompasses an area defined during a photo-identification study of bottlenose dolphin residency patterns in the area (Caldwell, 2001), and the borders are subject to change upon further study of dolphin residency patterns in estuarine waters of southern Georgia and northern/central Florida. The habitat is comprised of several large brackish rivers, including the St. Johns River, as well as tidal marshes and shallow riverine systems. Three behaviorally different communities were identified during Caldwell's (2001) study: the estuarine waters north (Northern) and south (Southern) of the St. Johns River and the coastal area, all of which differed in density, habitat fidelity and social affiliation patterns. The coastal dolphins are believed to be members of a coastal stock, however (Waring et al., 2009b). Although Northern and Southern members of the JES stock show strong site fidelity, members of both groups have been observed outside their preferred areas. Dolphins residing within estuaries south of Jacksonville Beach down to the northern boundary of the Indian River Lagoon Estuarine System (IRLES) stock are currently not included in any stock, as there are insufficient data to determine whether animals in this area exhibit affiliation to the JES stock, the IRLES stock, or are simply transient animals associated with coastal stocks. Further research is needed to establish affinities of dolphins in the area between the ranges, as currently understood, of the JES and IRLES stocks.

The JES stock is susceptible to similar fisheries interactions as those described above for coastal stocks, although only trap/pot fisheries are likely to occur in estuarine waters frequented by the stock. Only one dolphin carcass bearing evidence of fisheries interaction was recovered during 2003-07 in the JES area (Waring et al., 2009b). An additional sixteen stranded dolphins were recovered during this time, but no determinations regarding human interactions could be made for the majority. The same concerns discussed above regarding underestimation of mortality hold for this stock and, as for stocks discussed above, pollutant loading is a concern. Although no contaminant analyses have yet been conducted in this area, the JES stock inhabits areas with significant drainage from industrial and urban sources, and as such is exposed to contaminants in runoff from these. In other estuarine areas where such analyses have been conducted, exposure to anthropogenic contaminants has been found to likely have an effect (Hansen et al. 2004; Schwacke et al., 2004; Reif et al., 2008).

The original, single stock of coastal dolphins recognized from 1995-2001 was listed as depleted under the MMPA as a result of a 1987-88 mortality event. That designation was retained when the single stock was split into multiple coastal stocks. However, Scott et al. (1988) suggested that dolphins residing in the bays, sounds and estuaries adjacent to these coastal waters were not affected by the mortality event and these animals were explicitly excluded from the depleted listing (Waring et al., 2009b). Gubbins et al. (2003), using data from Caldwell (2001), estimated the stock size to be 412 (CV = 0.06). However, NMFS considers abundance unknown because this estimate likely includes an unknown number of non-resident and seasonally-resident dolphins. It nevertheless represents the best available information regarding stock size. The minimum population estimate and PBR are considered unknown, and there are insufficient data to determine population trends. Total human-caused mortality and serious injury for this stock is also unknown, but there are known to be significant interactions between estuarine bottlenose dolphins and crab pot fisheries in other areas (Burdett and McFee, 2004). Because the stock size is likely small, and relatively few mortalities and serious injuries would exceed PBR, the stock is considered to be a strategic stock (Waring et al., 2009b).

Atlantic Spotted Dolphin

Atlantic spotted dolphins are distributed in tropical and warm temperate waters of the western North Atlantic predominantly over the continental shelf and upper slope, from southern New England through the Gulf of Mexico (Leatherwood et al., 1976). Spotted dolphins in the Atlantic Ocean and Gulf of Mexico are managed as separate stocks. The Atlantic spotted dolphin occurs in two forms which may be distinct sub-species (Perrin et al., 1987; Rice, 1998); a larger, more heavily spotted form inhabits the continental shelf inside or near the 200-m isobath and is the only form that would be expected to occur in the action area. Although typically observed in deeper waters, spotted dolphins of the western North Atlantic stock do occur regularly in nearshore waters south of the Chesapeake Bay (Mullin and Fulling, 2003). Specific data regarding seasonal occurrence in the region of activity is lacking, but higher numbers of individuals have been reported to occur in nearshore waters of the Gulf of Mexico from November to May, suggesting seasonal migration patterns (Griffin and Griffin, 2003).

Atlantic spotted dolphins are not protected under the ESA or listed as depleted under the MMPA. The best abundance estimate of the western North Atlantic stock of Atlantic spotted dolphins is 26,798 (CV = 0.66) and the minimum population size of this stock is 16,151 individuals (Waring et al., 2013). This abundance estimate was generated from shipboard and aerial surveys conducted during June-August, 2011 (Palka, 2012), and only includes data from northern U.S. waters. The aerial portion covered 5,313 km of trackline over waters shallower than the 100-m depth contour, from north of New Jersey through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of trackline in waters deeper than the 100-m depth contour out to and beyond the U.S. Exclusive Economic Zone. Additional survey effort was conducted in southern U.S. waters, from North Carolina to Florida, but data are currently being analyzed and are not included in this abundance estimate.

The resulting PBR is calculated at 162 individuals. Total annual estimated average fishery-related mortality or serious injury to this stock during 2006-10 was 0.2 animals. An additional 19 animals were stranded during this period, but only one showed evidence of human interaction (Waring et al., 2013). These data likely underestimate the full extent of human-caused mortality. However, such mortality is nevertheless likely substantially less than the PBR; therefore, Atlantic spotted dolphins are not considered a strategic stock under the MMPA. There are insufficient data to determine the population trends for this species because, prior to 1998, species of spotted dolphins were not differentiated during surveys (Waring et al., 2013).

Potential Effects of the Specified Activity on Marine Mammals

We have determined that pile driving, as outlined in the project description, has the potential to result in behavioral harassment of marine mammals that may be present in the project vicinity while construction activity is being conducted. In theory, impact pile driving could result in injury of marine mammals although, for reasons described later in this document, we do not believe such an outcome to be likely or even possible in some cases. The full range of potential effects of sound on marine mammals, and pile driving in particular, are described in this section.

Marine Mammal Hearing

Effects on marine mammals anticipated from the specified activities would be expected to result primarily from exposure of animals to underwater sound. Hearing is the most important sensory modality for marine mammals, and exposure to sound can have deleterious effects. To appropriately assess these potential effects, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (Richardson et al., 1995; Wartzok and Ketten, 1999). To reflect this, Southall et al. (2007) recommended that marine mammals be divided into functional hearing groups based on measured or estimated hearing ranges on the basis of available behavioral data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. The lower and/or upper frequencies for some of these functional hearing groups have been modified from those designated by Southall. The functional groups and the associated frequencies are indicated below (note that these frequency ranges do not necessarily correspond to the range of best hearing, which varies by species):

- Low-frequency cetaceans (mysticetes): functional hearing is estimated to occur between approximately 7 Hz and 30 kHz (extended from 22 kHz on the basis of data indicating some mysticetes can hear above 22 kHz; Au et al., 2006; Lucifredi and Stein, 2007; Ketten and Mountain, 2009; Tubelli et al., 2012);

- Mid-frequency cetaceans (larger toothed whales, beaked whales, and most delphinids): functional hearing is estimated to occur between approximately 150 Hz and 160 kHz;

- High-frequency cetaceans (porpoises, river dolphins, and members of the genera Kogia and Cephalorhynchus): functional hearing is estimated to occur between approximately 200 Hz and 180 kHz; and

- Pinnipeds in water: functional hearing is estimated to occur between approximately 75 Hz to 100 kHz for Phocidae (true seals) and between 100 Hz and 40 kHz for Otariidae (eared seals), with the greatest sensitivity between approximately 700 Hz and 20 kHz. The pinniped functional hearing group was modified from Southall et al. (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä et al., 2006; Mulsow et al., 2011).

Two cetacean species are expected to potentially be affected by the specified activity. The bottlenose and Atlantic spotted dolphins are classified as mid-frequency cetaceans (Southall et al., 2007).

Underwater Sound Effects

Potential Effects of Pile Driving Sound – The effects of sounds from pile driving might result in one or more of the following: temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, and masking (Richardson et al., 1995; Gordon et al., 2004; Nowacek et al., 2007; Southall et al., 2007). The effects of pile driving on marine mammals are dependent on several factors, including the size, type, and depth of the animal; the depth, intensity, and duration of the pile driving sound; the depth of the water column; the substrate of the habitat; the standoff distance between the pile and the animal; and the sound propagation properties of the environment. Impacts to marine mammals from pile driving activities are expected to result primarily from acoustic pathways. As such, the degree of effect is intrinsically related to the received level and duration of the sound exposure, which are in turn influenced by the distance between the animal and the source. The further away from the source, the less intense the exposure should be. The substrate and depth of the habitat affect the sound propagation properties of the environment. Shallow environments are typically more structurally complex, which leads to rapid sound attenuation. In addition, substrates that are soft (e.g., sand) would absorb or attenuate the sound more readily than hard substrates (e.g., rock) which may reflect the acoustic wave. Soft porous substrates would also likely require less time to drive the pile, and possibly less forceful equipment, which would ultimately decrease the intensity of the acoustic source.

In the absence of mitigation, impacts to marine species may result from physiological and behavioral responses to both the type and strength of the acoustic signature (Viada et al., 2008). The type and severity of behavioral impacts are more difficult to define due to limited studies addressing the behavioral effects of impulsive sounds on marine mammals. Potential effects from impulsive sound sources can range in severity, ranging from effects such as behavioral disturbance, tactile perception, physical discomfort, slight injury of the internal organs and the auditory system, to mortality (Yelverton et al., 1973).

Hearing Impairment and Other Physical Effects – Marine mammals exposed to high intensity sound repeatedly or for prolonged periods can experience hearing threshold shift (TS), which is the loss of hearing sensitivity at certain frequency ranges (Kastak et al., 1999; Schlundt et al., 2000; Finneran et al., 2002, 2005). TS can be permanent (PTS), in which case the loss of hearing sensitivity is not recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall et al., 2007). Marine mammals depend on acoustic cues for vital biological functions, (e.g., orientation, communication, finding prey, avoiding predators); thus, TTS may result in reduced fitness in survival and reproduction. However, this depends on the frequency and duration of TTS, as well as the biological context in which it occurs. TTS of limited duration, occurring in a frequency range that does not coincide with that used for recognition of important acoustic cues, would have little to no effect on an animal's fitness. Repeated sound exposure that leads to TTS could cause PTS. PTS, in the unlikely event that it occurred, would constitute injury, but TTS is not considered injury (Southall et al., 2007). It is unlikely that the project would result in any cases of temporary or especially permanent hearing impairment or any significant non-auditory physical or physiological effects for reasons discussed later in this document. Some behavioral disturbance is expected, but it is likely that this would be localized and short-term because of the short project duration.

Several aspects of the planned monitoring and mitigation measures for this project (see the "Proposed Mitigation" and "Proposed Monitoring and Reporting" sections later in this document) are designed to detect marine mammals occurring near the pile driving to avoid exposing them to sound pulses that might, in theory, cause hearing impairment. In addition, many cetaceans are likely to show some avoidance of the area where received levels of pile driving sound are high enough that hearing impairment could potentially occur. In those cases, the avoidance responses of the animals themselves would reduce or (most likely) avoid any possibility of hearing impairment. Non-auditory physical effects may also occur in marine mammals exposed to strong underwater pulsed sound. It is especially unlikely that any effects of these types would occur during the present project given the brief duration of exposure for any given individual and the planned monitoring and mitigation measures. Perhaps most importantly, impact pile driving is planned only as a contingency for this project and it is possible that little to no impact pile driving would actually occur. The following subsections discuss in somewhat more detail the possibilities of TTS, PTS, and non-auditory physical effects.

Temporary Threshold Shift – TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises, and a sound must be stronger in order to be heard. In terrestrial mammals, TTS can last from minutes or hours to days (in cases of strong TTS). For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the sound ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the published data concern TTS elicited by exposure to multiple pulses of sound. Available data on TTS in marine mammals are summarized in Southall et al. (2007).

Given the available data, the received level of a single pulse (with no frequency weighting) might need to be approximately 186 dB re 1 μPa^2-s (i.e., 186 dB sound exposure level [SEL] or approximately 221-226 dB pk-pk) in order to produce brief, mild TTS. Exposure to several strong pulses that each have received levels near 190 dB re 1 µPa rms (175-180 dB SEL) might result in cumulative exposure of approximately 186 dB SEL and thus slight TTS in a small odontocete, assuming the TTS threshold is (to a first approximation) a function of the total received pulse energy. Levels greater than or equal to 190 dB re 1 µPa rms are expected to be restricted to radii no more than 5 m (16 ft) from the pile driving. For an odontocete closer to the surface, the maximum radius with greater than or equal to 190 dB re 1 µPa rms would be smaller.

The above TTS information for odontocetes is derived from studies on the bottlenose dolphin and beluga whale (Delphinapterus leucas). There is no published TTS information for other species of cetaceans. However, preliminary evidence from a harbor porpoise exposed to pulsed sound suggests that its TTS threshold may have been lower (Lucke et al., 2009). To avoid the potential for injury, NMFS has determined that cetaceans should not be exposed to pulsed underwater sound at received levels exceeding 180 dB re 1 µPa rms. As summarized above, data that are now available imply that TTS is unlikely to occur unless odontocetes are exposed to pile driving pulses stronger than 180 dB re 1 µPa rms.

Permanent Threshold Shift – When PTS occurs, there is physical damage to the sound receptors in the ear. In severe cases, there can be total or partial deafness, while in other cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985). There is no specific evidence that exposure to pulses of sound can cause PTS in any marine mammal. However, given the possibility that mammals close to pile driving activity might incur TTS, there has been further speculation about the possibility that some individuals occurring very close to pile driving might incur PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS.

Relationships between TTS and PTS thresholds have not been studied in marine mammals but are assumed to be similar to those in humans and other terrestrial mammals. PTS might occur at a received sound level at least several decibels above that inducing mild TTS if the animal were exposed to strong sound pulses with rapid rise time. Based on data from terrestrial mammals, a precautionary assumption is that the PTS threshold for impulse sounds (such as pile driving pulses as received close to the source) is at least 6 dB higher than the TTS threshold on a peak-pressure basis and probably greater than 6 dB (Southall et al., 2007). On an SEL basis, Southall et al. (2007) estimated that received levels would need to exceed the TTS threshold by at least 15 dB for there to be risk of PTS. Thus, for cetaceans, Southall et al. (2007) estimate that the PTS threshold might be an M-weighted SEL (for the sequence of received pulses) of approximately 198 dB re 1 μPa^2-s (15 dB higher than the TTS threshold for an impulse). Given the higher level of sound necessary to cause PTS as compared with TTS, it is considerably less likely that PTS could occur.

Measured source levels from impact pile driving can be as high as 214 dB re 1 μPa at 1 m. Although no marine mammals have been shown to experience TTS or PTS as a result of being exposed to pile driving activities, captive bottlenose dolphins and beluga whales exhibited changes in behavior when exposed to strong pulsed sounds (Finneran et al., 2000, 2002, 2005). The animals tolerated high received levels of sound before exhibiting aversive behaviors. Experiments on a beluga whale showed that exposure to a single watergun impulse at a received level of 207 kPa (30 psi) p-p, which is equivalent to 228 dB p-p re 1 μPa, resulted in a 7 and 6 dB TTS in the beluga whale at 0.4 and 30 kHz, respectively. Thresholds returned to within 2 dB of the pre-exposure level within four minutes of the exposure (Finneran et al., 2002). Although the source level of pile driving from one hammer strike is expected to be much lower than the single watergun impulse cited here, animals being exposed for a prolonged period to repeated hammer strikes could receive more sound exposure in terms of SEL than from the single watergun impulse (estimated at 188 dB re 1 μPa^2-s) in the aforementioned experiment (Finneran et al., 2002). However, in order for marine mammals to experience TTS or PTS, the animals have to be close enough to be exposed to high intensity sound levels for a prolonged period of time. Based on the best scientific information available, these SPLs are far below the thresholds that could cause TTS or the onset of PTS.

Non-auditory Physiological Effects – Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox et al., 2006; Southall et al., 2007). Studies examining such effects are limited. In general, little is known about the potential for pile driving to cause auditory impairment or other physical effects in marine mammals. Available data suggest that such effects, if they occur at all, would presumably be limited to short distances from the sound source and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall et al., 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. Marine mammals that show behavioral avoidance of pile driving, including some odontocetes and some pinnipeds, are especially unlikely to incur auditory impairment or non-auditory physical effects.

Disturbance Reactions

Disturbance includes a variety of effects, including subtle changes in behavior, more conspicuous changes in activities, and displacement. Behavioral responses to sound are highly variable and context-specific and reactions, if any, depend on species, state of maturity, experience, current activity, reproductive state, auditory sensitivity, time of day, and many other factors (Richardson et al., 1995; Wartzok et al., 2003; Southall et al., 2007).

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok et al., 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. Behavioral state may affect the type of response as well. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (Richardson et al., 1995; NRC, 2003; Wartzok et al., 2003).

Controlled experiments with captive marine mammals showed pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway et al., 1997; Finneran et al., 2003). Observed responses of wild marine mammals to loud pulsed sound sources (typically seismic guns or acoustic harassment devices, but also including pile driving) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds, 2002; Thorson and Reyff, 2006; see also Gordon et al., 2004; Wartzok et al., 2003; Nowacek et al., 2007). Responses to non-pulsed sources, such as vibratory pile installation, have not been documented as well as responses to pulsed sounds.

With both types of pile driving, it is likely that the onset of pile driving could result in temporary, short term changes in an animal's typical behavior and/or avoidance of the affected area. These behavioral changes may include (Richardson et al., 1995): changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where sound sources are located; and/or flight responses (e.g., pinnipeds flushing into water from haul-outs or rookeries). Since pile driving would likely only occur for a few hours a day, over a short period of time, it is unlikely to result in permanent displacement. Any potential impacts from pile driving activities could be experienced by individual marine mammals, but would not be likely to cause population level impacts, or affect the long-term fitness of the species.

The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, the consequences of behavioral modification could be expected to be biologically significant if the change affects growth, survival, or reproduction. Significant behavioral modifications that could potentially lead to effects on growth, survival, or reproduction include:

- Drastic changes in diving/surfacing patterns (such as those thought to be causing beaked whale stranding due to exposure to military mid-frequency tactical sonar);
- Habitat abandonment due to loss of desirable acoustic environment; and
- Cessation of feeding or social interaction.

The onset of behavioral disturbance from anthropogenic sound depends on both external factors (characteristics of sound sources and their paths) and the specific characteristics of the receiving animals (hearing, motivation, experience, demography) and is difficult to predict (Southall et al., 2007).

Auditory Masking

Natural and artificial sounds can disrupt behavior by masking, or interfering with, a marine mammal's ability to hear other sounds. Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher levels. Chronic exposure to excessive, though not high-intensity, sound could cause masking at particular frequencies for marine mammals that utilize sound for vital biological functions. Masking can interfere with detection of acoustic signals such as communication calls, echolocation sounds, and environmental sounds important to marine mammals. Therefore, under certain circumstances, marine mammals whose acoustical sensors or environment are being severely masked could also be impaired from maximizing their performance fitness in survival and reproduction. If the coincident (masking) sound were man-made, it could be potentially harassing if it disrupted hearing-related behavior. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs during the sound exposure. Because masking (without resulting in TS) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

The frequency range of the potentially masking sound is important in determining any potential behavioral impacts. Because sound generated from in-water pile driving is mostly concentrated at low frequency ranges, it may have less effect on high frequency echolocation sounds made by porpoises. However, lower frequency man-made sounds are more likely to affect detection of communication calls and other potentially important natural sounds such as surf and prey sound. It may also affect communication signals when they occur near the sound band and thus reduce the communication space of animals (e.g., Clark et al., 2009) and cause increased stress levels (e.g., Foote et al., 2004; Holt et al., 2009).

Masking has the potential to impact species at population, community, or even ecosystem levels, as well as at individual levels. Masking affects both senders and receivers of the signals and can potentially have long-term chronic effects on marine mammal species and populations.

Recent research suggests that low frequency ambient sound levels have increased by as much as 20 dB (more than three times in terms of SPL) in the world's ocean from pre-industrial periods, and that most of these increases are from distant shipping (Hildebrand, 2009). All anthropogenic sound sources, such as those from vessel traffic, pile driving, and dredging activities, contribute to the elevated ambient sound levels, thus intensifying masking. However, much of the sound from the proposed activities is confined in an area of inland waters (the Mayport turning basin and mouth of the St. Johns River) that is bounded by landmass; therefore, the sound generated is not expected to contribute significantly to increased ocean ambient sound.

The most intense underwater sounds in the proposed action are those produced by impact pile driving. Given that the energy distribution of pile driving covers a broad frequency spectrum, sound from these sources would likely be within the audible range of marine mammals present in the project area. Impact pile driving activity is relatively short-term, with rapid pulses occurring for the duration of the driving event. The probability for impact pile driving resulting from this proposed action masking acoustic signals important to the behavior and survival of marine mammal species is likely to be discountable. Vibratory pile driving is also relatively short-term, with rapid oscillations occurring for the duration of the driving event, which is likely to be short for this project. It is possible that vibratory pile driving resulting from this proposed action may mask acoustic signals important to the behavior and survival of marine mammal species, but the short-term duration and limited affected area would result in insignificant impacts from masking. Any masking event that could possibly rise to Level B harassment under the MMPA would occur concurrently within the zones of behavioral harassment already estimated for vibratory and impact pile driving, and which have already been taken into account in the exposure analysis.

Anticipated Effects on Habitat

The proposed activities at NSM would not result in permanent impacts to habitats used directly by marine mammals, but may have potential short-term impacts to food sources such as forage fish and may affect acoustic habitat (see masking discussion above). There are no known foraging hotspots or other ocean bottom structure of significant biological importance to marine mammals present in the marine waters in the vicinity of the project area. Therefore, the main impact issue associated with the proposed activity would be temporarily elevated sound levels and the associated direct effects on marine mammals, as discussed previously in this document. The most likely impact to marine mammal habitat occurs from pile driving effects on likely marine mammal prey (i.e., fish) near NSM and minor impacts to the immediate substrate during installation and removal of piles during the wharf construction project.

Pile Driving Effects on Potential Prey (Fish)

Construction activities may produce both pulsed (i.e., impact pile driving) and continuous (i.e., vibratory pile driving) sounds. Fish react to sounds which are especially strong and/or intermittent low-frequency sounds. Short duration, sharp sounds can cause overt or subtle changes in fish behavior and local distribution. Hastings and Popper (2005, 2009) and Hastin identified several studies that suggest fish may relocate to avoid certain areas of sound energy. Additional studies have documented effects of pile driving (or other types of sounds) on fish, although several are based on studies in support of large, multiyear bridge construction projects (e.g., Scholik and Yan, 2001, 2002; Popper and Hastings, 2009). Sound pulses at received levels of 160 dB re 1 μPa may cause subtle changes in fish behavior. SPLs of 180 dB may cause noticeable changes in behavior (Pearson et al., 1992; Skalski et al., 1992). SPLs of sufficient strength have been known to cause injury to fish and fish mortality. The most likely impact to fish from pile driving activities at the project area would be temporary behavioral avoidance of the area. The duration of fish avoidance of this area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. In general, impacts to marine mammal prey species are expected to be minor and temporary due to the short timeframe for the project.

Pile Driving Effects on Potential Foraging Habitat

The area likely impacted by the project is relatively small compared to the available habitat in nearshore and estuarine waters in the region. Avoidance by potential prey (i.e., fish) of the immediate area due to the temporary loss of this foraging habitat is also possible. The duration of fish avoidance of this area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. Any behavioral avoidance by fish of the disturbed area would still leave significantly large areas of fish and marine mammal foraging habitat in the nearby vicinity.

Given the short daily duration of sound associated with individual pile driving events and the relatively small areas being affected, pile driving activities associated with the proposed action are not likely to have a permanent, adverse effect on any fish habitat, or populations of fish species. Therefore, pile driving is not likely to have a permanent, adverse effect on marine mammal foraging habitat at the project area. The Mayport turning basin itself is a man-made basin with significant levels of industrial activity and regular dredging, and is unlikely to harbor significant amounts of forage fish.

Proposed Mitigation

In order to issue an incidental take authorization (ITA) under section 101(a)(5)(D) of the MMPA, we must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (where relevant).

Measurements from proxy pile driving events were coupled with practical spreading loss to estimate zones of influence (ZOIs; see "Estimated Take by Incidental Harassment"); these values were used to develop mitigation measures for pile driving activities at NSM. The ZOIs effectively represent the mitigation zone that would be established around each pile to prevent Level A harassment to marine mammals, while providing estimates of the areas within which Level B harassment might occur. In addition to the specific measures described later in this section, the Navy would conduct briefings between construction supervisors and crews, marine mammal monitoring team, and Navy staff prior to the start of all pile driving activity, and when new personnel join the work, in order to explain responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures.

Monitoring and Shutdown for Pile Driving

The following measures would apply to the Navy's mitigation through shutdown and disturbance zones:

Shutdown Zone – For all pile driving and removal activities, the Navy will establish a shutdown zone intended to contain the area in which SPLs equal or exceed the 180 dB rms acoustic injury criteria. The purpose of a shutdown zone is to define an area within which shutdown of activity would occur upon sighting of a marine mammal (or in anticipation of an animal entering the defined area), thus preventing injury, serious injury, or death of marine mammals. Radial distances for shutdown zones are shown in Table 1. However, for this project, a minimum shutdown zone of 15 m will be established during all pile driving activities, regardless of the estimated zone. Vibratory pile driving activities are not predicted to produce sound exceeding the Level A standard, but these precautionary measures are intended to prevent the already unlikely possibility of physical interaction with construction equipment and to further reduce any possibility of acoustic injury. For impact driving of steel piles, the radial distance of the shutdown would be established at 40 m (Table 1).

Disturbance Zone – Disturbance zones are the areas in which SPLs equal or exceed 160 and 120 dB rms (for pulsed and non-pulsed sound, respectively). Disturbance zones provide utility for monitoring conducted for mitigation purposes (i.e., shutdown zone monitoring) by establishing monitoring protocols for areas adjacent to the shutdown zones. Monitoring of disturbance zones enables observers to be aware of and communicate the presence of marine mammals in the project area but outside the shutdown zone and thus prepare for potential shutdowns of activity. However, the primary purpose of disturbance zone monitoring is for documenting incidents of Level B harassment; disturbance zone monitoring is discussed in greater detail later (see “Proposed Monitoring and Reporting”). Nominal radial distances for disturbance zones are shown in Table 1. Given the size of the disturbance zone for vibratory pile driving, it is impossible to guarantee that all animals would be observed or to make comprehensive observations of fine-scale behavioral reactions to sound, and only a portion of the zone (e.g., what may be reasonably observed by visual observers stationed within the turning basin) would be observed.

In order to document observed incidences of harassment, monitors record all marine mammal observations, regardless of location. The observer’s location, as well as the location of the pile being driven, is known from a GPS. The location of the animal is estimated as a distance from the observer, which is then compared to the location from the pile. If acoustic monitoring is being conducted for that pile, a received SPL may be estimated, or the received level may be estimated on the basis of past or subsequent acoustic monitoring. It may then be determined whether the animal was exposed to sound levels constituting incidental harassment in post-processing of observational and acoustic data, and a precise accounting of observed incidences of harassment created. Therefore, although the predicted distances to behavioral harassment thresholds are useful for estimating incidental harassment for purposes of authorizing levels of incidental take, actual take may be determined in part through the use of empirical data. That information may then be used to extrapolate observed takes to reach an approximate understanding of actual total takes.

Monitoring Protocols – Monitoring would be conducted before, during, and after pile driving activities. In addition, observers shall record all incidences of marine mammal occurrence, regardless of distance from activity, and shall document any behavioral reactions in concert with distance from piles being driven. Observations made outside the shutdown zone will not result in shutdown; that pile segment would be completed without cessation, unless the animal approaches or enters the shutdown zone, at which point all pile driving activities would be halted. Please see the Monitoring Plan (available at http://www.nmfs.noaa.gov/pr/permits/incidental.htm), developed by the Navy in agreement with NMFS, for full details of the monitoring protocols. Monitoring will take place from 15 minutes prior to initiation through 15 minutes post-completion of pile driving activities. Pile driving activities include the time to remove a single pile or series of piles, as long as the time elapsed between uses of the pile driving equipment is no more than 30 minutes.

The following additional measures apply to visual monitoring:

(1) Monitoring will be conducted by qualified observers, who will be placed at the best vantage point(s) practicable to monitor for marine mammals and implement shutdown/delay procedures when applicable by calling for the shutdown to the hammer operator. Qualified observers are trained biologists, with the following minimum qualifications:

- Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with ability to estimate target size and distance; use of binoculars may be necessary to correctly identify the target;
- Advanced education in biological science, wildlife management, mammalogy, or related fields (bachelor's degree or higher is required);
- Experience and ability to conduct field observations and collect data according to assigned protocols (this may include academic experience);
- Experience or training in the field identification of marine mammals, including the identification of behaviors;
- Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations;
- Writing skills sufficient to prepare a report of observations including but not limited to the number and species of marine mammals observed; dates and times when in-water construction activities were conducted; dates and times when in-water construction activities were suspended to avoid potential incidental injury from construction sound of marine mammals observed within a defined shutdown zone; and marine mammal behavior; and
- Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary.

(2) Prior to the start of pile driving activity, the shutdown zone will be monitored for 15 minutes to ensure that it is clear of marine mammals. Pile driving will only commence once observers have declared the shutdown zone clear of marine mammals; animals will be allowed to remain in the shutdown zone (i.e., must leave of their own volition) and their behavior will be monitored and documented. The shutdown zone may only be declared clear, and pile driving started, when the entire shutdown zone is visible (i.e., when not obscured by dark, rain, fog, etc.). In addition, if such conditions should arise during impact pile driving that is already underway, the activity would be halted.

(3) If a marine mammal approaches or enters the shutdown zone during the course of pile driving operations, activity will be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal. Monitoring will be conducted throughout the time required to drive a pile.

Soft Start

The use of a soft-start procedure is believed to provide additional protection to marine mammals by warning or providing a chance to leave the area prior to the hammer operating at full capacity, and typically involves a requirement to initiate sound from vibratory hammers for fifteen seconds at reduced energy followed by a 30-second waiting period. This procedure is repeated two additional times. However, implementation of soft start for vibratory pile driving during previous pile driving work conducted by the Navy at another location has led to equipment failure and serious human safety concerns. Therefore, vibratory soft start is not proposed as a mitigation measure for this project, as we have determined it not to be practicable. We have further determined this measure unnecessary to providing the means of effecting the least practicable impact on marine mammals and their habitat. Prior to issuing any further IHAs to the Navy for pile driving activities in 2014 and beyond, we plan to facilitate consultation between the Navy and other practitioners (e.g., Washington State Department of Transportation and/or the California Department of Transportation) in order to determine whether the potentially significant human safety issue is inherent to implementation of the measure or is due to operator error. For impact driving, soft start will be required, and contractors will provide an initial set of three strikes from the impact hammer at 40 percent energy, followed by a 30-second waiting period, then two subsequent three-strike sets.

We have carefully evaluated the applicant's proposed mitigation measures and considered a range of other measures in the context of ensuring that we prescribe the means of effecting the least practicable impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another: (1) the manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals; (2) the proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and (3) the practicability of the measure for applicant implementation.

Based on our evaluation of the applicant's proposed measures, as well as any other potential measures that may be relevant to the specified activity, we have preliminarily determined that the proposed mitigation measures provide the means of effecting the least practicable impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to issue an ITA for an activity, section 101(a)(5)(D) of the MMPA states that we must set forth "requirements pertaining to the monitoring and reporting of such taking". The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for ITAs must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area. The Navy's proposed monitoring and reporting is also described in their Marine Mammal Monitoring Plan.

Acoustic Monitoring

The Navy has proposed a sound source level verification study during the specified activities. Data would be collected in order to estimate airborne and underwater source levels. Monitoring would include two underwater positions and one airborne monitoring position. These exact positions would be determined in the field during consultation with Navy personnel, subject to constraints related to logistics and security requirements. Underwater sound monitoring would include the measurement of peak and rms sound pressure levels during pile driving activities at Wharf C-2. Typical ambient levels would be measured during lulls in the pile installation and reported in terms of rms sound pressure levels. Frequency spectra would be provided for pile driving sounds.

Visual Marine Mammal Observations

The Navy will collect sighting data and behavioral responses to construction for marine mammal species observed in the region of activity during the period of activity. All observers will be trained in marine mammal identification and behaviors and are required to have no other construction-related tasks while conducting monitoring. The Navy will monitor the shutdown zone and disturbance zone before, during, and after pile driving, with observers located at the best practicable vantage points. Based on our requirements, the Navy would implement the following procedures for pile driving:

- MMOs would be located at the best vantage point(s) in order to properly see the entire shutdown zone and as much of the disturbance zone as possible.
- During all observation periods, observers will use binoculars and the naked eye to search continuously for marine mammals.
- If the shutdown zones are obscured by fog or poor lighting conditions, pile driving at that location will not be initiated until that zone is visible. Should such conditions arise while impact driving is underway, the activity would be halted.
- The shutdown and disturbance zones around the pile will be monitored for the presence of marine mammals before, during, and after any pile driving or removal activity.

Individuals implementing the monitoring protocol will assess its effectiveness using an adaptive approach. Monitoring biologists will use their best professional judgment throughout implementation and seek improvements to these methods when deemed appropriate. Any modifications to protocol will be coordinated between NMFS and the Navy.

Data Collection

We require that observers use approved data forms. Among other pieces of information, the Navy will record detailed information about any implementation of shutdowns, including the distance of animals to the pile and description of specific actions that ensued and resulting behavior of the animal, if any. In addition, the Navy will attempt to distinguish between the number of individual animals taken and the number of incidences of take. We require that, at a minimum, the following information be collected on the sighting forms:

- Date and time that monitored activity begins or ends;
- Construction activities occurring during each observation period;
- Weather parameters (e.g., percent cover, visibility);
- Water conditions (e.g., sea state, tide state);
- Species, numbers, and, if possible, sex and age class of marine mammals;
- Description of any observable marine mammal behavior patterns, including bearing and direction of travel, and if possible, the correlation to SPLs;
- Distance from pile driving activities to marine mammals and distance from the marine mammals to the observation point;
- Locations of all marine mammal observations; and
- Other human activity in the area.

<u>Reporting</u>

A draft report would be submitted to NMFS within 90 days of the completion of marine mammal monitoring. The report will include marine mammal observations pre-activity, during-activity, and post-activity during pile driving days, and will also provide descriptions of any adverse responses to construction activities by marine mammals and a complete description of all mitigation shutdowns and the results of those actions and a refined take estimate based on the number of marine mammals observed during the course of construction. A final report would be prepared and submitted within 30 days following resolution of comments on the draft report. A technical report summarizing the acoustic monitoring data collected would be prepared within 75 days of completion of monitoring.

Estimated Take by Incidental Harassment

With respect to the activities described here, the MMPA defines "harassment" as: “any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].” All anticipated takes would be by Level B harassment, involving temporary changes in behavior. The proposed mitigation and monitoring measures are expected to minimize the possibility of injurious or lethal takes such that take by Level A harassment, serious injury, or mortality is considered discountable. However, it is unlikely that injurious or lethal takes would occur even in the absence of the proposed mitigation and monitoring measures.

If a marine mammal responds to a stimulus by changing its behavior (e.g., through relatively minor changes in locomotion direction/speed or vocalization behavior), the response may or may not constitute taking at the individual level, and is unlikely to affect the stock or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on animals or on the stock or species could potentially be significant (Lusseau and Bejder, 2007; Weilgart, 2007). Given the many uncertainties in predicting the quantity and types of impacts of sound on marine mammals, it is common practice to estimate how many animals are likely to be present within a particular distance of a given activity, or exposed to a particular level of sound. This practice potentially overestimates the numbers of marine mammals taken. In addition, it is often difficult to distinguish between the individuals harassed and incidences of harassment. In particular, for stationary activities, it is more likely that some smaller number of individuals may accrue a number of incidences of harassment per individual than for each incidence to accrue to a new individual, especially if those individuals display some degree of residency or site fidelity and the impetus to use the site (e.g., because of foraging opportunities) is stronger than the deterrence presented by the harassing activity.

The turning basin is not important habitat for marine mammals, as it is a man-made, semi-enclosed basin with frequent industrial activity and regular maintenance dredging. The small area of ensonification extending out of the turning basin into nearshore waters is also not believed to be of any particular importance, nor is it considered an area frequented by marine mammals. Bottlenose dolphins may be observed at any time of year in estuarine and nearshore waters of the action area, but sightings of other species are rare. Therefore, behavioral disturbances that could result from anthropogenic sound associated with these activities are expected to affect only a relatively small number of individual marine mammals, although those effects could be recurring over the life of the project if the same individuals remain in the project vicinity. The Navy has requested authorization for the incidental taking of small numbers of bottlenose dolphins and Atlantic spotted dolphins in the Mayport turning basin and associated nearshore waters that may be ensonified by project activities.

Marine Mammal Densities

For all species, the best scientific information available was used to derive density estimates and the maximum appropriate density value for each species was used in the marine mammal take assessment calculation. Density values for the Atlantic spotted dolphin were derived from global density estimates produced by Sea Mammal Research Unit, Ltd. (SMRU), as presented in DoN (2012), and the highest seasonal density (spring; 0.6803/km^2) was used for take estimation. Density for bottlenose dolphin is derived from site-specific surveys conducted by the Navy. Only bottlenose dolphins have been observed in the turning basin; it is not currently possible to identify observed individuals to stock. This survey effort consists of twelve half-day observation periods covering mornings and afternoons during December 10-13, 2012, and March 4-7, 2013. During each observation period, two observers (one at ground level and one positioned at a fourth-floor observation point) monitored for the presence of marine mammals in the turning basin (0.712 km^2) and tracked their movements and behavior while inside the basin, with observations recorded for five-minute intervals every half-hour. Morning sessions typically ran from 7:00-11:30 and afternoon sessions from 1:00 to 5:30. Most observations were of individuals or pairs (mode of 1) although a maximum group size of six was observed. It was assumed that the average observed group size (1.8) could occur in the action area each day, and was thus used to calculate a density of 2.53/km^2. For comparison, the maximum density value available from the NMSDD for bottlenose dolphins in inshore areas is significantly lower (winter, 0.217/km^2, SMRU estimate) and would likely underestimate the occurrence of bottlenose dolphins in the turning basin.

Description of Take Calculation

The take calculations presented here rely on the best data currently available for marine mammal populations in the vicinity of Mayport. The following assumptions are made when estimating potential incidences of take:

- All marine mammal individuals potentially available are assumed to be present within the relevant area, and thus incidentally taken;
- An individual can only be taken once during a 24-h period; and,
- There will be 50 total days of vibratory driving (45 days for steel piles and 5 days for plastic piles) and 20 days of impact pile driving.

- Exposures to sound levels above the relevant thresholds equate to take, as defined by the MMPA.

The calculation for marine mammal takes is estimated by:

Exposure estimate = (n * ZOI) * days of total activity

where:

n = density estimate used for each species/season

ZOI = sound threshold ZOI impact area; the area encompassed by all locations where the SPLs equal or exceed the threshold being evaluated

n * ZOI produces an estimate of the abundance of animals that could be present in the area for exposure, and is rounded to the nearest whole number before multiplying by days of total activity.

The ZOI impact area is the estimated range of impact to the sound criteria. The distances specified in Table 1 were used to calculate ZOIs around each pile. The ZOI impact area calculations took into consideration the possible affected area with attenuation due to the constraints of the basin. Because the basin restricts sound from propagating outward, with the exception of the east-facing entrance channel, the radial distances to thresholds are not generally reached.

While pile driving can occur any day, and the analysis is conducted on a per day basis, only a fraction of that time (typically a matter of hours on any given day) is actually spent pile driving. The exposure assessment methodology is an estimate of the numbers of individuals exposed to the effects of pile driving activities exceeding NMFS-established thresholds. Of note in these exposure estimates, mitigation methods (i.e., visual monitoring and the use of shutdown zones; soft start for impact pile driving) were not quantified within the assessment and successful implementation of mitigation is not reflected in exposure estimates. In addition, equating exposure with response (i.e., a behavioral response meeting the definition of take under the MMPA) is simplistic and conservative assumption. For these reasons, results from this acoustic exposure assessment likely overestimate take estimates to some degree.

Species	Activity	Estimated incidences of take[1]		Total
		Level A	Level B	
Bottlenose dolphin[2]	Impact driving (steel piles)	0	40	365
	Vibratory driving (steel piles)	0	315	
	Vibratory driving (plastic piles)	0	10	
Atlantic spotted dolphin	Impact driving (steel piles)	0	0	95
	Vibratory driving (steel piles)	0	90	
	Vibratory driving (plastic piles)	0	5	

[1] Acoustic injury threshold is 180 dB for cetaceans; behavioral harassment threshold applicable to impact pile driving is 160 dB and to vibratory driving is 120 dB.

[2] It is impossible to estimate from available information which stock these takes may accrue to.

Table 3. Number of potential incidental takes of marine mammals within various acoustic threshold zones

Only bottlenose dolphins are likely to occur inside the turning basin; therefore, the estimates for spotted dolphin are likely overestimates because the ZOI areas include the turning basin. Bottlenose dolphins are likely to be exposed to sound levels that could cause behavioral harassment if they enter the turning basin while pile driving activity is occurring. Outside the turning basin, potential takes could occur if individuals of these species move through the ensonified area when pile driving is occurring. It is not possible to determine, from available information, how many of the estimated incidences of take for bottlenose dolphins may accrue to the different stocks that may occur in the action area. Similarly, animals observed in the ensonified areas will not be able to be identified to stock on the basis of visual observation.

Negligible Impact and Small Numbers Analyses and Preliminary Determinations

NMFS has defined "negligible impact" in 50 CFR 216.103 as "...an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival." In making a negligible impact determination, we considers a variety of factors, including but not limited to: (1) the number of anticipated mortalities; (2) the number and nature of anticipated injuries; (3) the number, nature, intensity, and duration of Level B harassment; and (4) the context in which the take occurs.

Small Numbers Analysis

The number of incidences of take authorized for Atlantic spotted dolphins is small relative to the relevant stock – less than one percent. As described previously, of the 365 incidences of behavioral harassment predicted to occur for bottlenose dolphin, we have no information allowing us to parse those predicted incidences amongst the three stocks of bottlenose dolphin that may occur in the ensonified area. Therefore, we assessed the total number of predicted incidences of take against the best abundance estimate for each stock, as though the total would occur for the stock in question. For two of the bottlenose dolphin stocks, the total predicted number of incidences of take authorized would be considered small – less than three percent for the southern migratory stock and less than twelve percent for the northern Florida coastal stock – even if each estimated taking occurred to a new individual. This is an extremely unlikely scenario as, for bottlenose dolphins in estuarine and nearshore waters, there is likely to be some overlap in individuals present day-to-day.

The total number of authorized takes proposed for bottlenose dolphins, if assumed to accrue solely to new individuals of the JES stock, is higher relative to the total stock abundance, which is currently considered unknown. However, these numbers represent the estimated incidences of take, not the number of individuals taken. That is, it is highly likely that a relatively small subset of JES bottlenose dolphins would be harassed by project activities. JES bottlenose dolphins range from Cumberland Sound at the Georgia-Florida border south to approximately Palm Coast, Florida, an area spanning over 120 linear km of coastline and including habitat consisting of complex inshore and estuarine waterways. JES dolphins, divided by Caldwell (2001) into Northern and Southern groups, show strong site fidelity and, although members of both groups have been observed outside their preferred areas, it is likely that the majority of JES dolphins would not occur within waters ensonified by project activities. Further, although the largest area of ensonification is predicted to extend up to 7.5 km offshore from NSM, estuarine dolphins are generally considered as restricted to inshore waters and only 1-2 km offshore. In summary, JES dolphins are (1) known to form two groups and exhibit strong site fidelity (i.e., individuals do not generally range throughout the recognized overall JES stock range); (2) would not occur at all in a significant portion of the larger ZOI extending offshore from NSM; and (3) the specified activity will be stationary within an enclosed basin not recognized as an area of any special significance that would serve to attract or aggregate dolphins. We therefore believe that the estimated numbers of takes, were they to occur, likely represent repeated exposures of a much smaller number of bottlenose dolphins and that these estimated incidences of take represent small numbers of bottlenose dolphins.

Negligible Impact Analysis

Pile driving activities associated with the Navy’s wharf project, as outlined previously, have the potential to disturb or displace marine mammals. Specifically, the specified activities may result in take, in the form of Level B harassment (behavioral disturbance) only, from underwater sounds generated from pile driving. Potential takes could occur if individuals of these species are present in the ensonified zone when pile driving is happening.

No injury, serious injury, or mortality is anticipated given the likely methods of installation and measures designed to minimize the possibility of injury to marine mammals. The potential for these outcomes is minimized through the construction method and the implementation of the planned mitigation measures. Specifically, vibratory hammers will be the primary method of installation, and this activity does not have significant potential to cause injury to marine mammals due to the relatively low source levels produced (less than 180 dB) and the lack of potentially injurious source characteristics. Impact pile driving produces short, sharp pulses with higher peak levels and much sharper rise time to reach those peaks. If impact driving is necessary, implementation of soft start and shutdown zones significantly reduces any possibility of injury. Given sufficient “notice” through use of soft start (for impact driving), marine mammals are expected to move away from a sound source that is annoying prior to its becoming potentially injurious. Environmental conditions in the confined and protected Mayport turning basin mean that marine mammal detection ability by trained observers is high, enabling a high rate of success in implementation of shutdowns to avoid injury, serious injury, or mortality.

Effects on individuals that are taken by Level B harassment, on the basis of reports in the literature as well as monitoring from other similar activities, will likely be limited to reactions such as increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring). Most likely, individuals will simply move away from the sound source and be temporarily displaced from the areas of pile driving, although even this reaction has been observed primarily only in association with impact pile driving. The pile driving activities analyzed here are similar to numerous other construction activities conducted in San Francisco

Bay and in the Puget Sound region, which have taken place with no reported injuries or mortality to marine mammals, and no known long-term adverse consequences from behavioral harassment. Repeated exposures of individuals to levels of sound that may cause Level B harassment are unlikely to result in hearing impairment or to significantly disrupt foraging behavior. Thus, even repeated Level B harassment of some small subset of the overall stock is unlikely to result in any significant realized decrease in viability for bottlenose dolphins, and thus would not result in any adverse impact to the stock as a whole. Level B harassment will be reduced to the level of least practicable impact through use of mitigation measures described herein and, if sound produced by project activities is sufficiently disturbing, animals are likely to simply avoid the turning basin while the activity is occurring.

In summary, this negligible impact analysis is founded on the following factors: (1) the possibility of injury, serious injury, or mortality may reasonably be considered discountable; (2) the anticipated incidences of Level B harassment consist of, at worst, temporary modifications in behavior; (3) the absence of any significant habitat within the project area, including known areas or features of special significance for foraging or reproduction; (4) the presumed efficacy of the proposed mitigation measures in reducing the effects of the specified activity to the level of least practicable impact. In addition, none of these stocks are listed under the ESA, although coastal bottlenose dolphins are considered depleted under the MMPA. In combination, we believe that these factors, as well as the available body of evidence from other similar activities, demonstrate that the potential effects of the specified activity will have only short-term effects on individuals. The specified activity is not expected to impact rates of recruitment or survival and will therefore not result in population-level impacts.

Preliminary Determinations

The number of marine mammals actually incidentally harassed by the project will depend on the distribution and abundance of marine mammals in the vicinity of the survey activity. However, we find that the number of potential takings authorized (by level B harassment only), which we consider to be a conservative, maximum estimate, is small relative to the relevant regional stock or population numbers, and that the effect of the activity will be mitigated to the level of least practicable impact through implementation of the mitigation and monitoring measures described previously. Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, we preliminarily find that the total taking from the activity will have a negligible impact on the affected species or stocks.

Impact on Availability of Affected Species for Taking for Subsistence Uses

There are no relevant subsistence uses of marine mammals implicated by this action. Therefore, we have determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act (ESA)

There are no ESA-listed marine mammals expected to occur in the action area. Therefore, the Navy has not requested authorization of the incidental take of ESA-listed species and no such authorization is proposed for issuance; therefore, no consultation under the ESA is required.

National Environmental Policy Act (NEPA)

The Navy has prepared a Draft Environmental Assessment (EA; Wharf C-2 Recapitalization at Naval Station Mayport, FL) in accordance with NEPA and the regulations published by the Council on Environmental Quality. We have posted it on the NMFS website (see SUPPLEMENTARY INFORMATION) concurrently with the publication of this proposed

IHA. NMFS will independently evaluate the EA and determine whether or not to adopt it. We may prepare a separate NEPA analysis and incorporate relevant portions of the Navy's EA by reference. Information in the Navy's application, EA, and this notice collectively provide the environmental information related to proposed issuance of the IHA for public review and comment. We will review all comments submitted in response to this notice as we complete the NEPA process, including a decision of whether to sign a Finding of No Significant Impact (FONSI), prior to a final decision on the IHA request.

Proposed Authorization

As a result of these preliminary determinations, we propose to authorize the take of marine mammals incidental to the Navy's wharf project, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

Dated: August 19, 2013.

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Deputy Director,

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National Marine Fisheries Service.

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