Tampa Harbor Big Bend Channel Expansion Project

Incidental Harassment Authorization (IHA) Application

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1 A DETAILED DESCRIPTION OF THE SPECIFIC ACTIVITY OR CLASS OF ACTIVITIES THAT CAN BE EXPECTED TO RESULT IN INCIDENTAL TAKING OF MARINE MAMMALS;

The proposed Tampa Harbor Big Bend Channel Expansion Project is located within Hillsborough Bay (part of Tampa Bay), Hillsborough County, Florida (Figure 1). This IHA application is for the proposed use of confined underwater blasting to deepen the project's East Channel only. The five (5) major features of the entire project include the following (refer to Figure 2):

- Feature 1 of the project will deepen the project depths of the existing Entrance Channel, Turning Basin, East Channel and Inner Channel from 10.36 meters (m) (34 feet [ft]) to 14 m (46 ft);
- Feature 2 of the project will widen the north side of the Entrance Channel by 15.2 m (50 ft), from 61 m (200 ft) to 76.2 m (250 ft) and deepen it from 10.36 m (34 feet) to 14 m (46 feet);
- Feature 3 of the project will widen the Turning Basin approximately 57.9 m (190 ft) to the southwest to provide a 365.8 m (1,200 ft) turning radius and deepen it from 10.36 m (34 ft) to 14 m (46 ft);
- Feature 4 of the project will add a widener at the southeast corner of the intersection of the Turning Basin and East Channel and deepen it from 10.36 m (34 ft) to 14 m (46 ft);
- Feature 5 of the project will deepen local service facilities (non-federal berthing areas) located north, south, and east of the East Channel and at the south end of the Inner Channel from 10.36 m (34 ft) to 14 m (46 ft).

Figure 1 – Tampa Harbor Big Bend Expansion Project Location Map

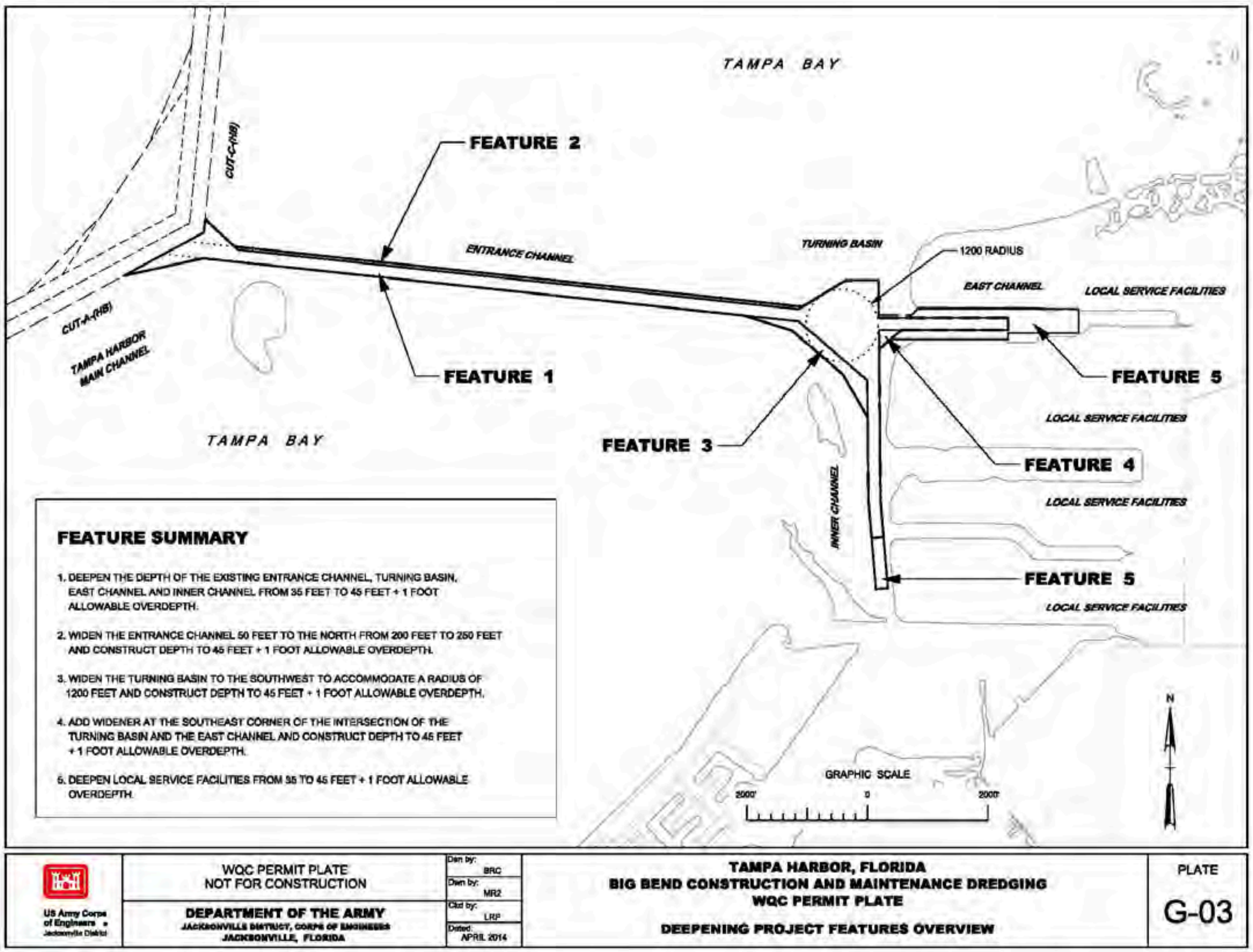


Figure 2 - Project Features

Disposal of the estimated 3,058,219 cubic meters (4,000,000 cubic yards) of dredged materials will occur at upland sites Dredged Material Management Area 3-D or 2-D. Environmental effects of the project have been evaluated and were described within a Supplemental Environmental Assessment (SEA). A Finding of No Significant Impact for the proposed work was signed on August 7, 2017. The SEA provides a detailed explanation of project location as well as all aspects of project implementation. It is available online at the following website (scroll down and click on Hillsborough County, and then scroll down to Tampa Harbor Big Bend and click on FONSI/Supplemental EA):

http://www.saj.usace.army.mil/About/Divisions-Offices/Planning/Environmental-Branch/Environmental-Documents/

To achieve the deepening of the Big Bend Channel portion of the Tampa Harbor Federal Navigation Project from the existing depth of 10.36 m (34 ft) to project depth of 14 m (46 ft), pretreatment of rock areas within the East Channel may be required using confined underwater blasting, where dredging or other rock removal methods are unsuccessful due to the hardness and massiveness of the rock. For this IHA application, blasting is defined as the use of explosive materials to breakup rock substrate along the bottom of the East Channel, Feature 5 of Figure 2. The East Channel is approximately 1,450 m (4,757 ft) long and 185 m (607 ft) wide at its widest location. Blasting is not proposed within the Entrance Channel, Turning Basin, or Inner Channel, or any other project area other than the East Channel. USACE has used core borings in conjunction with the resistivity analysis of the dredge template to determine which areas are most likely to need blasting.

Once a contractor has been selected, a more specific blasting plan will be prepared. However, as described in this document, certain restrictions shall be imposed on all blasting operations. Project specifications shall require that blasting or rock pre-treatment be restricted to April 1 through October 31, no blasting within the East Channel shall occur if common bottlenose dolphins (or any other protected species, i.e. manatee or sea turtle) are present within the channel, individual charge weights shall not exceed 18.1 kg (40 lbs)/delay, the contractor shall not exceed a total of 42 blast events, and appropriate monitoring of marine mammals shall be implemented. A blast event may include the detonation of a blast pattern with up to 40 individual charges.

Given the blasting restrictions described above, specific charge weight and size of pattern are dependent upon the size and type of dredging equipment each contractor proposes to include in their contract bid. There is an inverse relationship between dredging equipment size (cutterhead size, horsepower behind the cutterhead, backhoe size) and the frequency, size and spacing of drill holes of individual detonation events. As the size of the equipment increases, the size and number of detonations decreases and the spacing between the individual holes increases. Since the USACE does not have contract bids at this time, and is required to have all authorizations and permits completed prior to release of the request for proposal, the USACE cannot provide this information as part of the application. However, the USACE must be in possession of an incidental harassment authorization prior to receiving proposals, per the Competition in Contracting Act, and the Federal Acquisition Regulations.

The focus of the proposed blasting at Tampa Harbor Big Bend is to pre-treat the limestone formation along the bottom of the East Channel utilizing confined blasting, meaning the shots would be “confined” in the rock. Material would then be removed by a dredge. Blast holes are small in diameter, typically 5-10 cm (2-4 inches), and only 1.5-3 m (5-10 feet) deep, drilling activities take place for a short time duration, often with as few as three holes being drilled at the same time. More specific information will be made available to regulatory agencies after the contractor’s blasting plan is prepared. Typically, each blast pattern is set up in a square or rectangle area divided into rows and columns (Figures 3 & 5). Blast patterns near bulkheads can consist of a single line (Figure 4).

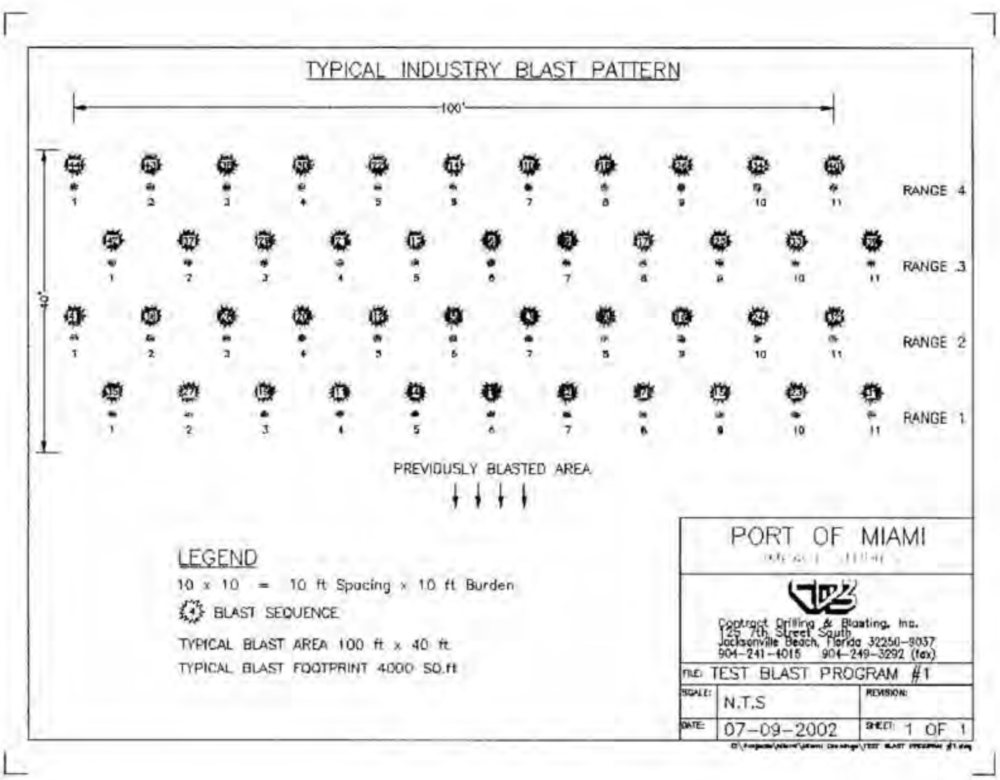


Figure 3 - Typical blast pattern – 10 holes x 10 holes; 30.5 m (100 feet) long by 12.2 m (40 feet) wide, 1,219 m^2 (4,000 ft^2) area per detonation

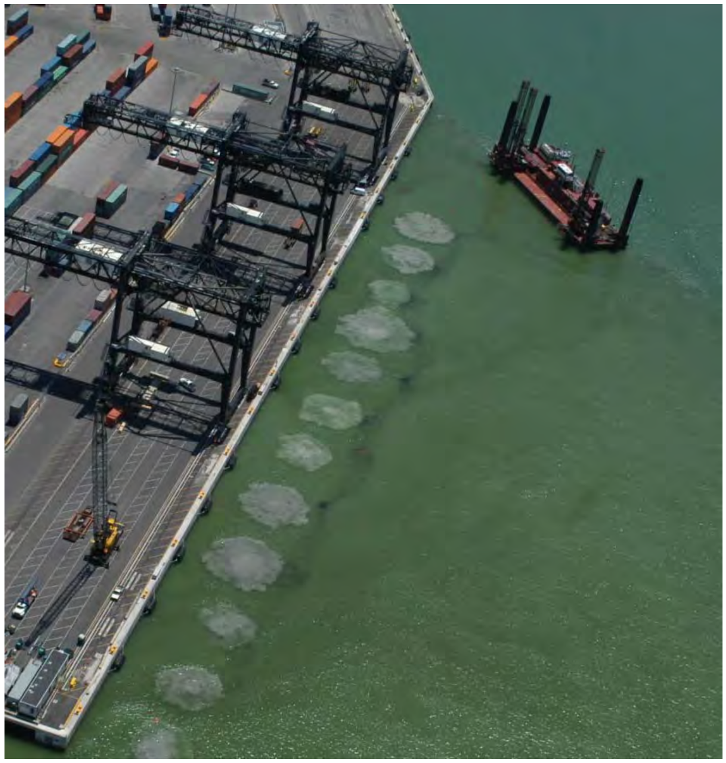


Figure 4 - Linear blast pattern along a bulkhead (Miami Harbor)

Figure 5 - Typical rectangular blast pattern (Miami Harbor)

In confined blasting, each charge is placed in a hole drilled in the rock approximately 1.5-3 m (5-10) feet deep; depending on how much rock/concrete needs to be pre-treated and the intended project depth. The hole is then capped with an inert material, such as crushed rock. This process is referred to as “stemming the hole” (see Figures 6 & 7). The Corps used this technique during the Miami Harbor Phase II project in 2005 in order to reduce pressure wave amplitude. National Marine Fisheries Service (NMFS) issued an IHA for that operation on May 29, 2003 (and renewed the IHA on April 19, 2005). For the Phase II project the stemming material was angular crushed rock. The optimum size of stemming material is material that has an average diameter of approximately 0.05 times the diameter of the blast hole. The selected material must be angular to perform properly (Konya, 2003). For the Tampa Harbor Big Bend Expansion Project, the specifications will be similar as those completed for the Miami Harbor Phase II project. Other types of stemming will be considered (either separately or combined with crushed rock) if they are documented to be as or more effective than crushed rock. However, protective zones around blast sites will be based on recent coordination with the NMFS. In addition, other means for reducing pressure wave amplitude will be investigated, such as using pneumatic barriers.

3.5.5 Stemming (SECTION 02 10 00 Page 35)
All blast holes shall be stemmed. The Blaster-in-Charge or Blasting Specialist shall determine the thickness of stemming using blasting industry conventional stemming calculation. The minimum stemming shall be 0.6 m (2 ft) thick. Stemming shall be placed in the blast hole in a zone encompassed by competent rock. Measures shall be taken to prevent bridging of explosive materials and stemming within the hole. Stemming shall be clean, angular to subangular, hard stone chips without fines having an approximate diameter of 1.3 cm (1/2-inch) to 1 cm (3/8-inch). A barrier shall be placed between the stemming and explosive product, if necessary, to prevent the stemming from settling into the explosive product. Anything contradicting the effectiveness of stemming shall not extend through the stemming.

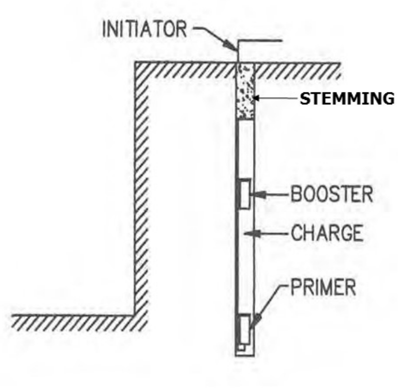


Figure 6 - Typical Drillhole configuration with stemming

Figure 7 - Stemming Material

The length of stemming material will vary based on the length of the hole drilled, however minimum lengths will be included in the project specifications. Studies have shown that stemmed blasts have up to a 60-90% decrease in the strength of the pressure wave released, compared to open water blasts of the same charge weight (Nedwell and Thandavamoorthy, 1992; Hempen *et al*., 2005; Hempen *et al*., 2007). However, unlike open water blasts (Figure 8), very little peer-reviewed research exists on the effects that confined blasting can have on marine animals near the blast (Keevin *et al*., 1999). The visual evidence from a typical confined blast is shown in Figure 9. It is possible that due to weak rock layers or incompatible stemming placement that greater pressure-wave amplitudes could be produced, due to inadvertent loss of confinement.

Figure 8- Unconfined Blast of 3.2 kg (7 lbs) of Explosives

Figure 9 - Confined Blast of 1,361 kg (3,000 lbs) Total Charge Weight of Explosives

In confined blasting, the detonation is generally conveyed from the drill barge to the primer and the charge itself by a non-electric initiation system. These are used to fire the blast from a distance which ensures human safety. These systems have a specific grain weight, and they burn like a fuse. Time from activation to detonation is less than one second.

In addition to coordination with the agencies, any new scientific studies regarding the effects of blasting on marine mammals that may be in the area will be incorporated into the design of the protection measures that will be employed in association with confined blasting activities at Big Bend. Any best new science and possible adaptive measures will be incorporated into any new IHA applications for this, and future, USACE blasting projects.

To estimate the maximum poundage of explosives that may be utilized for this project, the USACE has reviewed previous blasting projects, one at San Juan Harbor, Puerto Rico in 2000 and Miami Harbor, Florida in 2005. The San Juan Harbor project's heaviest confined blast event was 170.1 kg (375 lbs) per delay and in Miami it was 60.8 kg (134 lbs) per delay. However, based on discussions with USACE geotechnical engineers, the blasting energy required to break up rock in the East Channel of the Tampa Harbor Big Bend project will be reduced in an effort to minimize impacts to the environment and obtain some fracturing of the rock to aid removal. As stated earlier, the maximum weight of delays will not exceed 18.1 kg (40 lbs). A delay is defined as a distinct pause of predetermined time between detonation or initiation impulses, to permit the firing of explosive charges separately. Delay blasting is the practice of initiating individual explosive decks, boreholes, or rows of boreholes at predetermined time intervals using delay detonators, as compared to instantaneous blasting where all holes are fired essentially simultaneously.

Based upon industry standards and USACE Safety & Health Regulations, the blasting program may consist of the following:

- The weight of explosives to be used in each blast will be limited to the lowest kilograms (not to exceed 18.1 kg [40 lbs]/delay) of explosives that can adequately break the rock;
- Drill patterns shall be restricted to a minimum of 2.4 m (8 ft) separation from a loaded hole for this project;
- Hours of blasting are restricted from two hours after sunrise to one hour before sunset to allow for adequate observation of the project area for protected species, and will also be restricted to periods of good weather (blasting will not commence in rain, fog or otherwise poor weather conditions, and can only commence when the entire Level A Zone, Exclusion Zone, and Level B Zone are visible to observers);
- Selection of explosive products and their practical application method must address vibration and overpressure control for protection of existing structures and marine wildlife;

- Loaded blast holes will be individually delayed where larger blasts are broken into smaller blasts with a time break between them that will be determined by the contractor. Loaded blast holes will be individually delayed to reduce the maximum kilograms (pounds) per delay at point of detonation, which in turn will reduce the radius at which marine mammals may be injured or killed;
- The blast design will consider matching the energy in the "work effort" of the borehole to the rock mass or target for minimizing excess energy vented into the water column or hydraulic shock;
- Delay timing adjustments between delay detonations to stagger the blast pressures and prevent cumulative addition of pressures in the water will determined by the contractor, and will be in compliance with USACE regulations.

Test Blast Program. Prior to implementing a construction blasting program a test blast program will be completed. Since blasting is limited to April 1 through October 31, the test blast program would occur early in this period. The test blast program will have all the same protection measures in place for protected species (i.e. monitoring) as blasting for construction purposes. The purpose of the test blast program is to demonstrate and/or confirm the following:

- Drill Boat Capabilities and Production Rates
- Ideal Drill Pattern for Typical Boreholes
- Acceptable Rock Breakage for Excavation
- Tolerable Vibration Level Emitted
- Directional Vibration
- Calibration of the Environment
- Sound Parameters of the Blasting by variables of the Test Blasting and Production Blasting

The test blast program begins with a single row of individually delayed holes and progresses up to the maximum production blast intended for use. The test blast program will take place in the project area and will count toward the pre-treatment of material, since the blasts of the test blast program will be cracking rock. Test blasts will be included in the 42 total blast events limit. Each test blast is designed to establish limits of vibration and overpressure, with acceptable rock breakage for excavation. The final test event simulates the maximum explosive detonation as to size, overlying water depth, charge configuration, charge separation, initiation methods, and loading conditions anticipated for the typical production blast.

The results of the test blast program will be formatted in a regression analysis with other pertinent information and conclusions reached. This will be the basis for developing a completely engineered procedure for the construction blasting plan. Specifically, the test blast program will be used to determine the following:

- Distance between individual charges (minimum 2.4 m [8 ft] requirement)
- Kilograms/Pounds Per Delay (not to exceed 18.1 kg [40 lbs] per delay)
- Peak Particle Velocities (Threshold Limit Value TLV)
- Frequencies (TLV)
- Peak Vector Sum
- Overpressure

As part of the development of the protected species monitoring and mitigation protocols, which would be incorporated into the plans and specification for the project, USACE would continue to coordinate with the resource agencies to address concerns and potential impacts associated with the use of blasting as a construction technique. It is the intent to use the monitoring to develop Sound Parameters and report on those values from the entire blasting program.

2 THE DATE(S) AND DURATION OF SUCH ACTIVITY AND THE SPECIFIC GEOGRAPHICAL REGION WHERE IT WILL OCCUR;

In accordance with Endangered Species Act-Section 7 consultation with the U.S. Fish and Wildlife Service, confined underwater blasting operations or rock pre-treatment will only be conducted during the months of April through October (tentatively scheduled April through October 2018) in order to avoid take of the West Indian Manatee (*Trichecus manatus*). The exact duration of blasting will be dependent upon a number of factors including hardness of rock, how close the drill holes are placed, and the type of dredging equipment that will be used to remove the pretreated rock. However, certain restrictions shall be imposed on all blasting operations. In addition to the blasting window (April through October), the contractor shall not exceed a total of 42 blast events. A blast event may include the detonation of a blast pattern with up to 40 individual charges. If two blasts are performed in one day, then the blasts shall be separated by an estimated minimum 6 hours. When blasting operations are conducted, they will take place 24-hours a day, typically six days a week. The contractor may drill the blast pattern at night and then blast after at least two hours after sunrise (1-hour, plus one-hour of monitoring). After detonation of the first pattern, a second pattern may be drilled and detonated before the one-hour before sunset prohibition is triggered. Blasting activities normally will not take place on Sundays due to local ordinances.

The proposed confined underwater blasting activities would be performed only within the East Channel of the Tampa Harbor Big Bend Channel Expansion Project located within Hillsborough Bay (part of Tampa Bay), Hillsborough County, Florida (refer to Figures 1 and 2). Coordinates for the approximate center of the East Channel are 27° 48’ 25.93” N and 82° 24’ 24.21” W.

3 THE SPECIES AND NUMBERS OF MARINE MAMMALS UNDER NMFS JURISDICTION LIKELY TO BE FOUND WITHIN THE ACTIVITY AREA;

Several cetacean species and a single species of sirenian are known to or may occur in the project area and offshore of the west central Florida coastline (see Table 1 below). Species listed as endangered under the U.S. Endangered Species Act (ESA), includes the sei (*Balaenoptera borealis*), fin (*Balaenoptera physalus*), blue (*Balaenoptera musculus*), and sperm (*Physeter macrocephalus*) whales. The marine mammals that occur in the Gulf of Mexico off the west central Florida coastline belong to three taxonomic groups: mysticetes (baleen whales), odontocetes (toothed whales), and sirenians (the manatee; U.S. Fish and Wildlife Service jurisdiction). Table 1 presents information on the abundance, distribution, population status, and conservation status of species of marine mammals that may occur in the region of the proposed project area.

Table 1. The habitat, occurrence, range, abundance and conservation status of marine mammals that may occur in or near the proposed project area in the Gulf of Mexico off the Florida West central coast.

Species	Habitat	Occurrence in Proposed Project Area	Range in Atlantic Ocean	Stock Population Estimate [3]	ESA[1]	MMPA[2]
Mysticetes						
Humpback whale (*Megaptera novaeangliae*)	Pelagic, nearshore waters, and banks	Rare	Canada to Caribbean	823 – Gulf of Maine Stock	NL	NC
Minke whale (*Balaenoptera acutorostrata*)	Coastal, offshore	Rare	Arctic to Caribbean	2,591 – Canadian East Coast Stock	NL	NC
Bryde's whale (*Balaenoptera brydei*)	Pelagic and coastal	Rare	40º North to 40º South	33 – Northern Gulf of Mexico Stock	NL	S
Sei whale (*Balaenoptera borealis*)	Primarily offshore, pelagic	Rare	Canada to New Jersey	357 – Nova Scotia Stock	EN	S
Fin whale (*Balaenoptera physalus*)	Slope, mostly pelagic	Rare	Canada to North Carolina	1,618 – Western North Atlantic stock	EN	S
Blue whale (*Balaenoptera musculus*)	Pelagic and coastal	Rare	Arctic to Florida	440 – Western North Atlantic Stock	EN	S
Odontocetes						
Sperm whale (*Physeter macrocephalus*)	Pelagic, deep seas	Rare	Canada to Caribbean	763 – Northern Gulf of Mexico Stock	EN	S
Dwarf sperm whale (*Kogia sima*)	Offshore, pelagic	Rare	Massachusetts to Florida	186 – Northern Gulf of Mexico Stock	NL	NC
Gervais' beaked whale (*Mesoplodon europaeus*)	Pelagic, slope, canyons	Rare	Canada to Florida	149 – Northern Gulf of Mexico Stock	NL	NC
Sowerby's beaked whale	Pelagic, slope, canyons	Rare	Canada to Florida	7,092 – Western North Atlantic Stock	NL	NC

(*Mesoplodon bidens*)						
Blainville's beaked whale (*Mesoplodon densirostris*)	Pelagic, slope, canyons	Rare	Canada to Florida	149 – Northern Gulf of Mexico Stock	NL	NC
Cuvier's beaked whale (*Ziphius cavirostris*)	Pelagic, slope, canyons	Rare	Canada to Florida	74 – Northern Gulf of Mexico Stock	NL	NC
Killer whale (*Orcinus orca*)	Widely distributed	Rare	Arctic to Caribbean	28 – Northern Gulf of Mexico Stock	NL	NC
Short-finned pilot whale (*Globicephala macrorhynchus*)	Inshore and offshore	Rare	Massachusetts to Florida	2,415 – Northern Gulf of Mexico Stock	NL	NC
False killer whale (*Pseudorca crassidens*)	Pelagic	Rare	NA	NA – Northern Gulf of Mexico Stock	NL	NC
Melon-headed whale (*Peponocephala electra*)	Pelagic	Rare	North Carolina to Florida	2,235 – Northern Gulf of Mexico Stock	NL	NC
Pygmy killer whale (*Feresa attenuata*)	Pelagic	Rare	NA	152 – Northern Gulf of Mexico Stock	NL	NC
Risso's dolphin (*Grampus griseus*)	Pelagic, shelf	Rare	Canada to Florida	2,442 – Northern Gulf of Mexico Stock	NL	NC
Common bottlenose dolphin (*Tursiops truncatus*)	Offshore, inshore, coastal, and estuaries	Common	Canada to Florida	564/Tampa Bay Stock*	NL	S
Rough-toothed dolphins (*Steno bredanensis*)	Pelagic	Rare	New Jersey to Florida	624 – Northern Gulf of Mexico Stock	NL	NC
Fraser's dolphin (*Lagenodelphis hosei*)	Shelf and slope	Rare	North Carolina to Florida	NA – Northern Gulf of Mexico Stock	NL	NC
Striped dolphin (*Stenella coeruleoalba*)	Coastal, shelf, slope	Rare	Massachusetts to Florida	1,849 – Northern Gulf of Mexico Stock	NL	NC
Pantropical spotted dolphin (*Stenella attenuata*)	Coastal, shelf, slope	Uncommon	Massachusetts to Florida	50,880 – Northern Gulf of Mexico Stock	NL	NC
Atlantic spotted dolphin (*Stenella frontalis*)	Coastal to pelagic	Uncommon	Massachusetts to Caribbean	NA – Northern Gulf of Mexico Stock	NL	NC
Spinner dolphin (*Stenella longirostris*)	Mostly pelagic	Uncommon	Maine to Caribbean	11, 441 – Northern Gulf of Mexico Stock	NL	NC
Clymene dolphin (*Stenella clymene*)	Coastal, shelf, slope	Uncommon	North Carolina to Florida	129 – Northern Gulf of Mexico Stock	NL	NC
Sirenians						
West Indian (Florida) manatee (*Trichechus manatus latirostris*)	Coastal, rivers, and estuaries	Uncommon	Massachusetts to Florida to Texas	6,620 – Florida Stock**	T	D

[1] U.S. Endangered Species Act: EN = Endangered, T = Threatened, NL = Not listed.

[2] U.S. Marine Mammal Protection Act: D = Depleted, S = Strategic, NC = Not classified.

[3] NMFS Marine Mammal Stock Assessment Reports.

*Wells et al. 1995.

**Florida Fish and Wildlife Conservation Commission Survey Data (U.S. Fish and Wildlife jurisdiction).

Of all the species listed above that are managed under NMFS jurisdiction, the USACE believes that blasting activities for the Big Bend project will only result in take of common bottlenose dolphins living within Hillsborough Bay (Tampa Bay). Although many other marine mammals may transit through the area offshore of Tampa Harbor, the USACE does not believe the project will result in take associated with those species.

4 A DESCRIPTION OF THE STATUS, DISTRIBUTION, AND SEASONAL DISTRIBUTION (WHEN APPLICABLE) OF THE AFFECTED SPECIES OR STOCKS OF MARINE MAMMALS LIKELY TO BE AFFECTED BY SUCH ACTIVITIES;

The USACE is incorporating information from the most recent Stock Assessment Report (SAR) for Northern Gulf of Mexico, Bay, Sound, and Estuary Stocks of common bottlenose dolphins (NMFS 2017). The complete SAR is included as Attachment A; note that all citations within this section of the application with the exception of Wells *et al.* (1995) are included within the SAR.

STOCK DEFINITION AND GEOGRAPHIC RANGE

Common bottlenose dolphins are distributed throughout the bays, sound and estuaries of the Gulf of Mexico (Mullin 1988). The identification of biologically-meaningful "stocks" of common bottlenose dolphins in these waters is complicated by the high degree of behavioral variability exhibited by this species (Shane *et al.* 1986; Wells and Scott 1999; Wells 2003), and by the lack of requisite information for much of the region.

Distinct stocks are delineated in each of 31 areas of contiguous, enclosed or semi-enclosed bodies of water adjacent to the northern Gulf of Mexico. The genesis of the delineation of these stocks was work initiated in the 1970s in Sarasota Bay, Florida (Irvine *et al.* 1981), and in bays in Texas (Shane 1977; Gruber 1981). These studies documented year-round residency of individual common bottlenose dolphins in estuarine waters. As a result, the expectation of year-round resident populations was extended to bay, sound and estuary (BSE) waters across the northern Gulf of Mexico when the first stock assessment reports were established in 1995. Since these early studies, long-term (year-round, multi-year) residency has been reported from nearly every site where photographic identification (photo-ID) or tagging studies have been conducted in the Gulf of Mexico. In Texas, long-term resident dolphins have been reported in the Matagorda-Espiritu Santo Bay area (Gruber 1981; Lynn and Würsig 2002), Aransas Pass (Shane 1977; Weller 1998), San Luis Pass (Maze and Würsig 1999; Irwin and Würsig 2004), and Galveston Bay (Bräger 1993; Bräger *et al.* 1994; Fertl 1994). In Louisiana, Miller (2003) concluded the bottlenose dolphin population in the Barataria Basin was relatively closed. Hubard *et al.* (2004) reported sightings of dolphins in Mississippi Sound that were known from tagging efforts there 12–15 years prior. In Florida, long-term residency has been reported from Tampa Bay (Wells 1986; Wells *et al.* 1996b; Urian *et al.* 2009), Sarasota Bay (Irvine and Wells 1972; Irvine *et al.* 1981; Wells 1986; 1991; 2003; 2014; Wells *et al.* 1987; Scott *et al.* 1990; Wells 1991; 2003), Lemon Bay (Wells *et al.* 1996a; Bassos-Hull *et al.* 2013), Charlotte Harbor/Pine Island Sound (Shane 1990; Wells *et al.* 1996a; Wells *et al.* 1997; Shane 2004; Bassos-Hull *et* *al.* 2013) and Gasparilla Sound (Bassos-Hull *et al.* 2013). In Sarasota Bay, which has the longest research history, at least 5 concurrent generations of identifiable residents have been identified, including some of those first identified in 1970 (Wells 2014). Maximum immigration and emigration rates of about 2–3% have been estimated (Wells and Scott 1990).

Genetic data also support the concept of relatively discrete BSE stocks. Analyses of mitochondrial DNA haplotype distributions indicate the existence of clinal variations along the Gulf of Mexico coastline (Duffield and Wells 2002). Differences in reproductive seasonality from site to site also suggest genetic-based distinctions between communities (Urian *et al.* 1996). Mitochondrial DNA analyses suggest finer-scale structural levels as well. For example, dolphins in Matagorda Bay, Texas, appear to be a localized population, and differences in haplotype frequencies distinguish among adjacent communities in Tampa Bay, Sarasota Bay and Charlotte Harbor/Pine Island Sound, along the central west coast of Florida (Duffield and Wells 1991; 2002). Additionally, Sellas *et al.* (2005) examined population subdivision among dolphins sampled in Sarasota Bay, Tampa Bay, Charlotte Harbor, Matagorda Bay, and the coastal Gulf of Mexico (1–12 km offshore) from just outside Tampa Bay to the southern end of Lemon Bay, and found evidence of significant population structure among all areas on the basis of both mitochondrial DNA control region sequence data and 9 nuclear microsatellite loci. The Sellas *et al.* (2005) findings support the separate identification of BSE populations from those occurring in adjacent Gulf coastal waters.

In many cases, residents occur primarily in BSE waters, with limited movements through passes to the Gulf of Mexico (Shane 1977; 1990; Gruber 1981; Irvine *et al.* 1981; Maze and Würsig 1999; Lynn and Würsig 2002; Fazioli *et al.* 2006). These habitat use patterns are reflected in the ecology of the dolphins in some areas; for example, residents of Sarasota Bay, Florida, lacked squid in their diet, unlike non-resident dolphins stranded on nearby Gulf beaches (Barros and Wells 1998). However, in some areas year-round residents may co-occur with nonresident dolphins. For example, about 14–17% of group sightings involving resident Sarasota Bay dolphins include at least 1 non-resident as well (Wells *et al.* 1987; Fazioli *et al.* 2006). Mixing of inshore residents and non-residents has been seen at San Luis Pass, Texas (Maze and Würsig 1999), Cedar Keys, Florida (Quintana-Rizzo and Wells 2001), and Pine Island Sound, Florida (Shane 2004). Non-residents exhibit a variety of movement patterns, ranging from apparent nomadism recorded as transience to a given area, to apparent seasonal or non-seasonal migrations. Passes, especially the mouths of the larger estuaries, serve as mixing areas. For example, dolphins from several different areas were documented at the mouth of Tampa Bay, Florida (Wells 1986), and most of the dolphins identified in the mouths of Galveston Bay and Aransas Pass, Texas, were considered transients (Henningsen 1991; Bräger 1993; Weller 1998).

Seasonal movements of dolphins into and out of some of the bays, sounds and estuaries have also been documented. In Sarasota Bay, Florida, and San Luis Pass, Texas, residents have been documented moving into Gulf coastal waters in fall/winter, and returning inshore in spring/summer (Irvine *et al.* 1981; Maze and Würsig 1999). Fall/winter increases in abundance have been noted for Tampa Bay (Scott *et al.* 1989) and are thought to occur in Matagorda Bay (Gruber 1981; Lynn and Würsig 2002) and Aransas Pass (Shane 1977; Weller 1998). Spring/summer increases in abundance occur in Mississippi Sound (Hubard *et al.* 2004) and are thought to occur in Galveston Bay (Henningsen 1991; Bräger 1993; Fertl 1994).

Spring and fall increases in abundance have been reported for St. Joseph Bay, Florida. Mark-recapture abundance estimates were highest in spring and fall and lowest in summer and winter (Balmer *et al.* 2008). Individuals with low site-fidelity indices were sighted more often in spring and fall, whereas individuals sighted during summer and winter displayed higher site-fidelity indices. In conjunction with health assessments, 23 dolphins were radio tagged during April 2005 and July 2006. Dolphins tagged in spring 2005 displayed variable utilization areas and variable site fidelity patterns. In contrast, during summer 2006 the majority of radio tagged individuals displayed similar utilization areas and moderate to high site-fidelity patterns. The results of the studies suggest that during summer and winter St. Joseph Bay hosts dolphins that spend most of their time within this region, and these may represent a resident community. In spring and fall, St. Joseph Bay is visited by dolphins that range outside of this area (Balmer *et al.* 2008).

There are some estuarine areas that are not currently part of any stock's range. Many of these are areas that dolphins cannot readily access. For example, the marshlands between Galveston Bay and Sabine Lake and between Sabine Lake and Calcasieu Lake are fronted by long, sandy beaches that prohibit dolphins from entering the marshes. The region between the Calcasieu Lake and Vermilion Bay/Atchafalaya Bay stocks has some access, but these marshes are predominantly freshwater rather than saltwater marshes, making them unsuitable for long-term survival of a viable population of common bottlenose dolphins. In other regions, there is insufficient estuarine habitat to harbor a demographically independent population, for instance between the Matagorda Bay and West Bay Stocks in Texas, and/or sufficient isolation of the estuarine habitat from coastal waters. The regions between the south end of the Estero Bay Stock area to just south of Naples and between Little Sarasota Bay and Lemon Bay are highly developed and contain little appropriate habitat. South of Naples to San Marco Island and Gullivan Bay is also not currently covered in a stock boundary. This region may reasonably contain common bottlenose dolphins, but the relationship of any dolphins in this region to other BSE stocks is unknown. They may be members of the Gullivan to Chokoloskee Bay stock as there is passage behind San Marco Island that would allow dolphins to move north. The regions between Apalachee Bay and Cedar Key/Waccasassa Bay, between Crystal Bay and St. Joseph Sound and between Chokoloskee Bay and Whitewater Bay are comprised of thin strips of marshland with no barriers to adjacent coastal waters. Further work is necessary to determine whether year-round resident dolphins use these thin marshes or whether dolphins in these areas are members of the coastal stock that use the fringing marshland as well. Finally, the region between the eastern border of the Barataria Bay Stock and the Mississippi Delta Stock to the east may harbor dolphins, but the area is small and work is necessary to determine whether any dolphins utilizing this habitat come from an adjacent BSE stock.

As more information becomes available, combination or division of these stocks, or alterations to stock boundaries, may be warranted. Recent research based on photo-ID data collected by Bassos-Hull *et al.* (2013) recommended combining B21, Lemon Bay, with B22–23, Gasparilla Sound, Charlotte Harbor, and Pine Island Sound. Therefore, these stocks have been combined. However, it should be noted this change was made in the absence of genetic data and could be revised again in the future when genetic data are available. Additionally, a number of geographically and socially distinct subgroupings of dolphins in regions such as Tampa Bay, Charlotte Harbor, Pine Island Sound, Aransas Pass and Matagorda Bay have been identified, but the importance of these distinctions to stock designations remains undetermined (Shane 1977; Gruber 1981; Wells *et al.* 1996a; 1996b; 156 1997; Lynn and Würsig 2002; Urian 2002). For Tampa Bay, Urian *et al.* (2009) described 5 discrete communities (including the adjacent Sarasota Bay community) that differed in their social interactions and ranging patterns. Structure was found despite a lack of physiographic barriers to movement within this large, open embayment. Urian *et al.* (2009) further suggested that fine-scale structure may be a common element among common bottlenose dolphins in the southeastern U.S. and recommended that management should account for fine-scale structure that exists within current stock designations.

POPULATION SIZE

Population size estimates for most of the stocks are greater than 8 years old and therefore the current population size for each of these stocks is considered unknown, including Tampa Bay (Wade and Angliss 1997). Wells *et al.* (1995) performed the most recent abundance estimate of the Tampa Bay Stock of common bottlenose dolphins. Their estimation methods are summarized as follows:

Method 1 (catalog-size index) resulted in minimum population estimates of 319 to 456 dolphins over the six years of the study, with an average of 386. The Method 1 estimates are known to be underestimates because they do not take into account the unmarked dolphins. Methods 2, 3, and 4 attempted to correct for this underestimation.

Method 2 (mark-proportion method) calculated population-size estimates from proportions of marked animals relative to revised minimum, revised maximum, and final best group size estimates. The differences between minimum and maximum population-size estimates were so small that we present only the estimates based on the final best group size. The number of dolphins estimated by Method 2 ranged from 488 to 567, with an average of 524.

Method 3 (mark-resight method) obtained point estimates for each of the one to three "complete surveys" during each year. The estimates ranged from 479 to 675 across all years, with an average of 564.

Method 4 (resighting-rate method) provided annual point estimates ranging from 416 to 602 dolphins, with an average of 516.

Wells *et al.* (1995) compared Methods 2, 3, and 4. They found that estimates from Methods 2 and 4 averaged 6.0% and 8.0% lower than those of Method 3, but a Wilcoxen paired-sample test revealed no significant differences between any of these methods. The abundance estimate derived from Method 3 was used in this IHA application since it provides the most conservative, or highest, average abundance (N=564).

MINIMUM POPULATION ESTIMATE

The minimum population estimate for the Tampa Bay stock is unknown.

CURRENT POPULATION TREND

The data are insufficient to determine population trends for most of the Gulf of Mexico BSE common bottlenose dolphin stocks, including the Tampa Bay stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for these stocks. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate and a recovery factor (Wade and Angliss 1997). The recovery factor is 0.5 because these stocks are of unknown status. PBR is undetermined for all but 3 stocks because the population size estimates are more than 8 years old. The PBR for the Tampa Bay stock is unknown.

STATUS OF STOCKS

The status of these stocks relative to optimum sustainable population is unknown and this species is not listed as threatened or endangered under the Endangered Species Act. The occurrence of 13 Unusual Mortality Events (UMEs) among common bottlenose dolphins along the northern Gulf of Mexico coast since 1990 (Litz *et al.* 2014; http://www.nmfs.noaa.gov/pr/health/mmume/events.html, accessed 11 January 2016) is cause for concern. Notably, stock areas in Louisiana, Mississippi, Alabama and the western Florida panhandle have been impacted by a UME of unprecedented size and duration (began 1 February 2010, and as of December 2015, the event is under consideration for closure). However, the effects of the mortality events on stock abundance have not yet been determined, in large part because it has not been possible to assign mortalities to specific stocks due to a lack of empirical information on stock identification. Human-caused mortality and serious injury for each of these stocks is not known. Considering the evidence from stranding data and the low PBRs for stocks with recent abundance estimates, the total fishery-related mortality and serious injury likely exceeds 10% of the total known PBR or previous PBR, and therefore, it is probably not insignificant and not approaching the zero mortality and serious injury rate. NMFS considers each of these stocks to be strategic because most of the stock sizes are currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR.

5 THE TYPE OF INCIDENTAL TAKING AUTHORIZATION THAT IS BEING REQUESTED (I.E., TAKES BY HARASSMENT ONLY; TAKES BY HARASSMENT, INJURY AND/OR DEATH) AND THE METHOD OF INCIDENTAL TAKING;

The USACE is requesting authorization of incidental taking of common bottlenose dolphins (mid-frequency cetacean) by behavior harassment or Temporary Threshold Shift (TTS), Level B take, caused by the proposed confined underwater blasting operations. The USACE, Jacksonville District, has not documented any incidental take of dolphins associated with dredging activities. This was questioned in 2010 when a total of 19 common bottlenose dolphins died in the lower St. Johns River and the timing of these mortalities overlapped with a dredging project. An interagency team evaluated this unusual mortality event and identified several environmental incidents that occurred in the river which preceded or were co-associated with the deaths. An unusual bloom of *Aphanizomenon flosaquae*, a chronic multi-species fish kill and the dredging project were all ongoing during this time period. Various types of dredging equipment are anticipated to be utilized in the course of this construction dredging project and may include Mechanical (Clamshell and/or Backhoe) and Hydraulic (Hopper and/or Cutter-Suction). Dredging and direct pumping of material to the disposal site is expected, there is likely a need for pipeline to cross the channel at certain locations in order to pump material into the upland disposal area. Any such crossing would require that the top of the pipeline remain below -12.5 m (41 ft) MLLW. Placement of the pipeline below -12.5 m mllw should allow dolphins to transit through this portion of the project area. NMFS' current criteria for determination of take are included in Table 2.

Table 2. NMFS criteria for determination of take (Mid-frequency cetaceans only including common bottlenose dolphin).

Group	Species	Behavior		Slight Injury			Mortality
		Behavioral (for ≥2 pulses/24 hours)	TTS[1]	PTS[2]	Gastro-Intestinal Tract	Lung	
Mid-frequency Cetaceans	Most delphinids, medium and large toothed whales	165 dB SEL[3] (MFII)	170 dB SEL (MFII) or 224 dB peak SPL[4]	185 dB SEL (MFII) or 230 dB peak SPL	237 dB SPL or 104 psi	$I_s(M,D) = 39.1\ M^{1/3}[1+D/10.1]^{1/2}$ Where: M = animal mass D = animal depth	$I_m(M,D) = 91.4M^{1/3}[1+D/10.1]^{1/2}$ Where: M = animal mass D = animal depth

1 Temporary Threshold Shift (TTS)
2 Permanent Threshold Shift (PTS)
3 Sound Exposure Level (SEL)
4 Sound Pressure Level (SPL)

6 BY AGE, SEX, AND REPRODUCTIVE CONDITION (IF POSSIBLE), THE NUMBER OF MARINE MAMMALS (BY SPECIES) THAT MAY BE TAKEN BY EACH TYPE OF TAKING IDENTIFIED IN PARAGRAPH (A)(5) OF THIS SECTION, AND THE NUMBER OF TIMES SUCH TAKINGS BY EACH TYPE OF TAKING ARE LIKELY TO OCCUR;

As stated above, Wells *et al.* (1995) performed the most recent abundance estimate of the Tampa Bay Stock of common bottlenose dolphins. Their mark-resight method provided the most conservative, or highest average, abundance of 564 common bottlenose dolphins within the 852-km^2 study area. In order to calculate take, the USACE made an assumption that the dolphins would be evenly distributed throughout Tampa Bay. The number of dolphins per square kilometer within this area is 0.66 (564 dolphins ÷ 852 km^2 = 0.66 dolphins/km^2).

Table 3 presents estimated Level A (mortality, lung and gastro-intestinal tract injury, PTS) and Level B (TTS and behavioral) take for common bottlenose dolphins resulting from confined underwater blasting operations within the East Channel. The distances (m), or Level A and B radii around each blast, indicate how far from the blast site each level of take would occur. Radii were calculated using algorithms specifically developed for confined underwater blasting operations by the NMFS (see Attachment B; spreadsheet results also included). The algorithms compute the cumulative sound exposure impact zone due to a pattern of charges. The code calculates the total explosive energy from all charges through a summation of the individual energy emanating from each charge as a function of temporal and spatial separation of charges. Acoustical transmission loss is assumed to occur through cylindrical spreading. The SEL of the first detonation and each subsequent detonation is summed and transmission loss of acoustic energy due to cylindrical spreading is subtracted from the total SEL. Ultimately, the distance where the received level falls to the desired SEL is calculated by spherical spreading of the total SEL. However, NMFS and USACE agree that acoustic energy emanating from the East Channel and into Hillsborough Bay would rapidly decrease as the energy spreads to the north and south. Under these conditions, sound energy exceeding a 45 degree angle, or a 45 degree cone shape, would not result in Level B take (Figure 10).

Level A and B take zones (km^2) were calculated using the radii. Note that some blasting radii are contained within the water column or between the East Channel's north and south shorelines. These areas therefore are circular in shape. However, larger blasting radii, extend beyond the channel's shorelines. In these cases, the areas form an irregular polygon shape. The areas of these irregular polygon shapes were determined with computer software (Google Earth Pro). All blasting radii drawings/ electronic (kmz) files shall be provided upon request.

Blasting patterns would be comprised of maximum individual charge weights ranging between 18.1 kg (40 lbs)/delay and 4.5 kg (10 lbs)/delay and a maximum of 40 individual charges. For example, the largest blasting pattern would consist of 18.1 kg (40 lbs)/delay x 40 individual charges = 725.7 kg (1600 lbs). For Level A take zones consisting of lung injury and mortality the zones of the peak impulse are based on the maximum weight of a single charge in a blasting pattern, while for Level B take zones, the distances are based on cumulative SELs from the total weight of the charges in a blasting pattern. Level A take consisting of gastro-intestinal (GI) tract injury (threshold peak pressure at 237 dB) was determined using an equation used to calculate spreading loss.

Level A take includes mortality, as well as lung and gastrointestinal tract injuries, and PTS. It assumes no implementation of monitoring and mitigation measures. However, the USACE shall monitor blasting operations and implement protective measures. Most notably, blasting within the East Channel shall not occur if common bottlenose dolphins (or any other protected species, i.e. manatee or sea turtle) are present within the channel. Therefore, no take resulting in injury or mortality of dolphins should occur. Level B take includes TTS as well as changes in behavior.

Take Summary Request

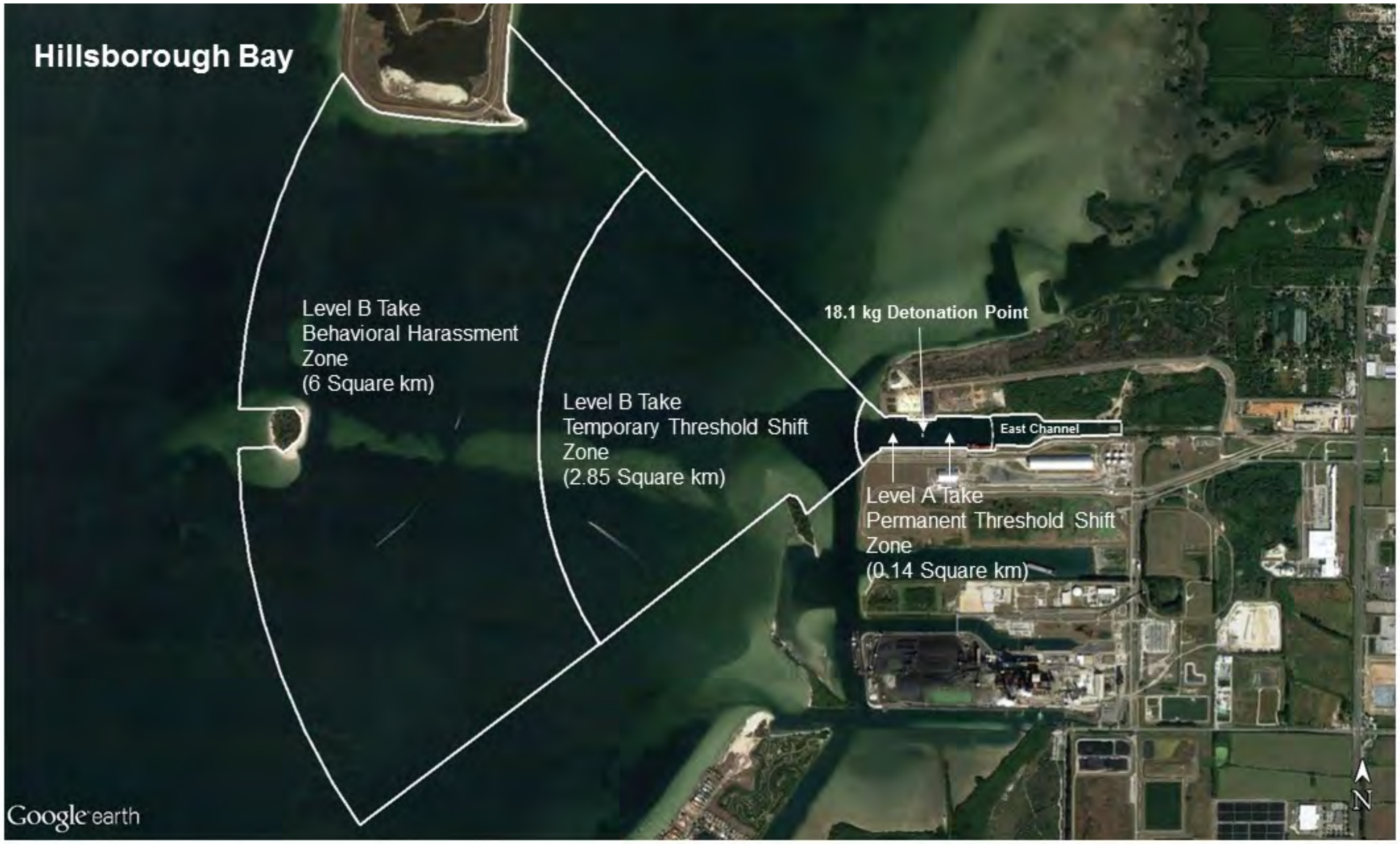
A maximum of 42 blast events would occur over the one year period of this IHA. Using the Tampa Bay Stock abundance estimate (N=564), the density of common bottlenose dolphins occurring within the footprint of the project (N=0.66 dolphins/km^2), as well as the maximum charge weight of 18.1 kg (40 lbs)/delay, the USACE is requesting Level B take for behavioral harassment and/or TTS for up to 5.84 common bottlenose dolphins per blast (refer to Table 3). An estimated 245 Level B takes would occur over the one year period of this IHA (5.84 dolphins/blast x 42 blast events = 245 Level B takes).

Table 3. Level A and Level B Take Estimates for Tampa Bay Stock Common bottlenose dolphins, Tampa Harbor Big Bend Channel Expansion Project.

TAMPA BAY STOCK TAKE ESTIMATES											
		Level B Behavior SEL	**Level B TTS SEL**	**Level A PTS SEL**	**Level A GI Tract**	**Level A Lung**	**Level A Lung**	**Level A Lung**	**Level A Mortality**	**Level A Mortality**	**Level A Mortality**
		165 dB	170 dB	185 dB	104 psi	0 m depth	12 m depth	15 m depth	0 m depth	12 m depth	15 m depth
Charge Weight (kg & lbs)/Delay*											
18.1 kg (40 lbs)	distance (m)	3779.931605	2125.611748	377.9931605	26.78981244	9.239360007	7.594743463	7.356675182	6.043063675	4.967391497	4.811681385
	area (km^2)	6	2.85	0.1377452980	0.002254702	0.000268184	0.000181207	0.000170025	0.000114727	0.000077519	0.000072735
	maximum take	3.96	1.88100	0.09091	0.00149	0.00018	0.00012	0.00011	0.00008	0.00005	0.00005
	distance (m)	3236.063417	1819.772191	323.6063417	24.34015993	8.390491712	6.896974686	6.680778982	5.48785583	4.511011278	4.369607067
13.6 kg (30 lbs)	area (km^2)	4.69	2.07	0.108138784	0.001861216	0.000221169	0.000149440	0.000140218	0.000094614	0.000063929	0.000059984
	maximum take	3.0954	1.36620	0.07137	0.00123	0.00015	0.00010	0.00009	0.00006	0.00004	0.00004
	distance (m)	2599.726996	1461.933924	259.9726996	21.26308822	7.324818046	6.020992139	5.832255383	4.790845018	3.938069179	3.814624673
9.1 kg (20 lbs)	area (km^2)	3.05	1.35	0.088579627	0.001420373	0.000168556	0.000113890	0.000106862	0.000072106	0.000048721	0.000045714
	maximum take	2.013	0.89100	0.05846	0.00094	0.00011	0.00008	0.00007	0.00005	0.00003	0.00003
	distance (m)	1788.0166	1005.475624	178.80166	16.87652430	5.806999551	4.773347055	4.623719548	3.798105931	3.122038774	3.024173928
4.5 kg (10 lbs)	area (km^2)	1.38	0.67	0.059105221	0.000894779	0.000105938	0.000071581	0.000067163	0.000045319	0.000030621	0.000028732
	maximum take	0.9108	0.4422	0.03901	0.00059	0.00007	0.00005	0.00004	0.00003	0.00002	0.00002

***** For Level A take zones consisting of lung injury and mortality the zones of the peak impulse are based on the maximum weight of a single charge in a blasting pattern, while for Level B take zones, the distances are based on cumulative SELs from the total weight of the charges in a blasting pattern. Level A take consisting of gastro-intestinal injury (threshold peak pressure at 237 dB) was determined using an equation used to calculate spreading loss.

Figure 10 – Common bottlenose dolphin example take areas for 18.1 kg (40 lbs)/delay, East Channel, Tampa Harbor Big Bend Channel Expansion Project. All other forms of Level A take (i.e. gastro-intestinal injury, lung injury, and mortality) have smaller radii than the Permanent Threshold Shift Zone.



7 THE ANTICIPATED IMPACT OF THE ACTIVITY UPON THE SPECIES OR STOCK;

In general, potential impacts to marine mammals from explosive detonations could include both lethal and non-lethal injury, as well as TTS and behavioral harassment. In the absence of monitoring and mitigation, marine mammals may be killed or injured as a result of an explosive detonation due to the response of air cavities in the body, such as the lungs and gas bubbles in the intestines. Effects are likely to be most severe in near surface waters where the reflected shock wave creates a region of negative pressure called ''cavitation.''

A second potential possible cause of mortality is the onset of extensive lung hemorrhage. Extensive lung hemorrhage is considered debilitating and potentially fatal. Suffocation caused by lung hemorrhage is likely to be the major cause of marine mammal death from underwater shock waves. The estimated range for the onset of extensive lung hemorrhage to marine mammals varies depending upon the animal's weight, with the smallest mammals having the greatest potential hazard range.

NMFS provided thresholds and criteria utilized for predicting impact analyses from the use of explosives in the notice of the proposed IHA (79 FR 6545, February 4, 2014). As part of the U.S. Navy's training and testing activities in the Atlantic Fleet Training and Testing Study Area (AFTT) final rule, NMFS updated the thresholds and criteria utilized for predicting impact analyses from the use of explosives (see Table 4). A detailed explanation of how these thresholds were derived is provided in the AFTT Environmental Impact Statement/Overseas Environmental Impact Statement (DEIS/OEIS) Criteria and Thresholds Technical Report (*http://aftteis.com/DocumentsandReferences/AFTTDocuments/SupportingTechnicalDocuments.aspx*) and summarized in Chapter 6 of the U.S. Navy's AFTT Letter of Authorization application (*http://www.nmfs.noaa.gov/pr/permits/incidental/military.htm*).

The primary potential impact to the common bottlenose dolphins occurring in the Tampa Bay-Big Bend action area from the proposed detonations is Level B harassment, in the form of behavioral harassment and TTS, incidental to noise generated by explosives. The USACE believes the proposed monitoring and mitigation measures will preclude the possibility of Level A take (permanent injury or mortality) in the case of this particular activity.

Table 4. NMFS's current thresholds and criteria utilized for predicting impact analysis from the use of explosives for mid-frequency cetaceans.

Group	Species	Behavior		Slight Injury			Mortality
		Behavioral (for ≥2 pulses/24 hours)	TTS	PTS	Gastro-Intestinal Tract	Lung	
Mid-frequency Cetaceans	Most delphinids, medium and large toothed whales	165 dB SEL (MFII)	170 dB SEL (MFII) or 224 dB peak SPL	185 dB SEL (MFII) or 230 dB peak SPL	237 dB SPL or 104 psi	$I_S(M,D) = 39.1\ M^{1/3}[1+D/10.1]^{1/2}$ Where: M = animal mass D = animal depth	$I_m(M,D) = 91.4M^{1/3}[1+D/10.1]^{1/2}$ Where: M = animal mass D = animal depth

8 THE ANTICIPATED IMPACT OF THE ACTIVITY ON THE AVAILABILITY OF THE SPECIES OR STOCKS OF MARINE MAMMALS FOR SUBSISTENCE USES;

There is no subsistence use of marine mammals in or near Tampa Bay.

9 THE ANTICIPATED IMPACT OF THE ACTIVITY UPON THE HABITAT OF THE MARINE MAMMAL POPULATIONS, AND THE LIKELIHOOD OF RESTORATION OF THE AFFECTED HABITAT;

The USACE assumes that common bottlenose dolphins utilize the East Channel as habitat for socializing, feeding, resting, etc. The bottom of the channel is previously dredged rock and unconsolidated sediment. With the exception of deepening the channel, the physical nature of the habitat is not expected to significantly change and should continue to be utilized by dolphins.

Blasting within the boundaries of the East Channel will be limited both spatially and temporally. Explosives utilized in the blasting are water soluble and non-toxic. If for some reason, a charge is unable to be fired and must be left in the drillhole, it is designed to breakdown as it is made of water soluble ammonium nitrate in a fluid gel format. Each drill hole also has a booster with detonator and detonation cord. Most of the cord is recovered onto the drill barge by pulling it back onboard the drill barge after the blast event. Small amounts of detonation cord can remain in the water after the blast has taken place, and will be recovered by small vessels with scoop nets. Any material left in the drill hole after the blast will be recovered through the dredging process, after the blasting when the dredge excavates the fractured rock material.

10 THE ANTICIPATED IMPACT OF THE LOSS OR MODIFICATION OF THE HABITAT ON THE MARINE MAMMAL POPULATIONS INVOLVED;

The anticipated modification of the habitat by channel deepening is not expected to significantly affect common bottlenose dolphins. Historically, the channel is manmade and has been deepened and maintenance dredged.

With regard to prey species (mainly fish), a very small number of fish are expected to be impacted by the project. Based on the results of the 2005 blasting project at Miami Harbor, the blasting consisted of 40 blast events over a 38-day time frame. 23 of these blasts were monitored (57.5%) by the state and had injured and dead fishes collected after the all clear was given. Noting that the "all-clear" is normally at least 2-3 minutes after the shot is fired is important, since seagulls and frigate birds quickly learned to approach the blast site and swoop in to eat some of the stunned, injured and dead fish floating on the surface. State biologists and volunteers collected the carcasses of floating fish (it should be noted that not all dead fish float after a blast, and due to safety concerns, no plans exist to put divers on the bottom of the channel in the blast zone to collect those non-floating carcasses). The fish were described to the lowest taxonomic level possible (usually species) and the injury types were categorized.

A summary of that data shows that 24 different genera were collected during the Miami Harbor blasting. The species with the highest abundance were white grunts (*Haemulon plumieri*) (N=51); scrawled cowfish (*Lactophrys quadricornis*) (N=43) and Pygmy filefish (*Monocanthus setifer*) (N=30). Total fish collected during the 23 blasts was N=288 or an average of 12.5 fish per blast (range 3 to 38). In observation of the three blasts with the greatest number of fishes killed (Table 4) and reviewing the maximum charge weight per delay for the Miami Harbor project, it appears that there is no direct correlation between charge weight and fishes killed that can be determined from such a small sample. Reviewing the 23 blasts where dead and injured fish were collected after the all clear signal was given, no discernible pattern exists. Factors that affect fish mortality include, but are not limited to: fish size, body shape (fusiform, etc) proximity of the blast to a vertical structure like a bulkhead (see the Aug 10, 2005 blast for example; a much smaller charge weight resulted in a higher fish kill due to the closeness of a bulkhead).

Table 4. Confined Blast Maximum Charge Weight and Number of Observed Fish Killed

Date	Max Charge Wt/delay (lbs)	Fish killed
7/26/2005	85	38
7/25/2005	112	35
8/10/2005	17	28

In the past, to reduce the potential for fish to be injured or killed by the blasting, the USACE has allowed, and the resource agencies have requested, that blasting contractors utilize a small, unconfined explosive charge, usually a 0.45 kg (1lb) charge weight, detonated about 30 seconds before the main blast to drive fish away from a blasting zone. It is assumed that noise or pressure generated by the small charge will drive fish from the immediate area, thereby reducing impacts from the larger and potentially more-damaging blast. Blasting companies use this method as a "good faith effort" to reduce potential impacts to aquatic resources. The explosives industry recommends firing a "warning shot" to frighten fish out of the area before seismic exploration work is begun (Anonymous 1978 in Keevin *et al*. 1997).

There is limited data available on the effectiveness of fish scare charges at actually reducing the magnitude of fish kills and the effectiveness may be based on the fish's life history. Keevin *et al* (1997) conducted a study to test if fish scare charges are effective in moving fishes away from blast zones. They used three freshwater species, largemouth bass; channel catfish and flathead catfish, equipping each fish with an internal radio tag to allow the fishes movements before and after the scare charge to be tracked. Fish movement was compared with a predicted Lethal Dose 0% mortality distance for an open water shot (no confinement) for a variety of charge weights. Largemouth bass showed little response to repelling charges and none would have moved from the kill zone calculated for any explosive size. Only one of the flathead catfish and two of the channel catfish would have moved to a safe distance for any blast. This means that only 11% of the fish used in the study would have survived the blasts. These results call into question the true effectiveness of this minimization methodology; however, some argue that based on the monetary value of fish (American Fishery Society 1992 in Keevin *et al.* 1997) including high value commercial or recreational species like snook and tarpon found in west central Florida inlets like Tampa Bay, the low cost associated with repelling charge use would be offset if only a few fish were moved from the kill zone (Keevin *et al*. 1997).

To calculate the potential loss of prey species from the project area as an impact of blasting, the Corps used a 12.5 fish/blast kill estimate based on the Miami Harbor 2005 blasting, and multiplied it by the 40 shots – reaching a total estimate of floating fish killed in the 2005 Miami project of 500 fish. As stated previously, not all carcasses float to the surface and there is no way to estimate how many carcasses did not float. However, it can be determined that at Miami Phase II, the minimum estimated fish kill for the entire project, was 500 fish.

Using the 12.5 fish killed/detonation estimate and the maximum 42 detonations for the project – the minimum number of fish expected to be killed by the Tampa Harbor Big Bend Channel Expansion Project is 525 fish.

11 THE AVAILABILITY AND FEASIBILITY (ECONOMIC AND TECHNOLOGICAL) OF EQUIPMENT, METHODS, AND MANNER OF CONDUCTING SUCH ACTIVITY OR OTHER MEANS OF EFFECTING THE LEAST PRACTICABLE ADVERSE IMPACT UPON THE AFFECTED SPECIES OR STOCKS, THEIR HABITAT, AND ON THEIR AVAILABILITY FOR SUBSISTENCE USES, PAYING PARTICULAR ATTENTION TO ROOKERIES, MATING GROUNDS, AND AREAS OF SIMILAR SIGNIFICANCE;

Over the last ten years, the Jacksonville district has been collecting data concerning the effects of confined blasting projects on marine mammals. This effort began in the early 1990s when the USACE contracted with Dr. Calvin Konya (Precision Blasting Services) to review previous USACE blasting projects, recommendations of Florida Fish and Wildlife Conservation Commission (FWC) (then known as the Florida Department of Natural Resources) and the U.S. Fish and Wildlife Service (USFWS).

As previously discussed, as part of the Miami Harbor Phase II project, the Corps monitored the blasting project and collected data on the pressures associated with confined blasts, while employing a formula to calculate zones that would be protective of protected species. Results from the pressure monitoring at Phase II demonstrate that stemming each drill hole reduces the blast pressure entering the water (Nedwell and Thandavamoorthy, 1992; Hempen *et al*., 2005; Hempen *et al*., 2007).

The following conditions shall be incorporated into the project specifications to reduce the risk to marine mammals within the project area. While this application is specific to common bottlenose dolphins, these specifications are written for all protected species that may be in the project area.

a. Confined underwater blasting shall be restricted to the East Channel only.

b. Blasting operations will only be conducted during the months of April through October (tentatively scheduled April through October 2018).

c. The contractor's approved blasting plan shall be provided to the appropriate agencies including NMFS for review at least 30 days prior to work. This blasting proposal must include information concerning a watch program and details of the blasting events and will be submitted to the following entities.

1) FWC – ISM, 620 South Meridian Street; Mail Stop 6A, Tallahassee, FL 32399-1600 or ImperiledSpecies@myfwc.com

2) NMFS-PR1, 1315 East West Highway, Silver Spring, MD 20910
3) U.S. Fish and Wildlife Service; 1339 20th Street; Vero Beach, FL 32960-3559 OR 6620 Southpoint Drive, South; Suite 310, Jacksonville, FL 32216-0912 (Project location dependent)
4) NMFS-SERO-Protected Species Management Branch, 263 13th Ave South, St. Petersburg, FL 33701

In addition to plan review, Ms. Laura Engleby, NMFS Southeast Region Marine Mammal Branch Chief (email: nmfs.ser.research.notification@noaa.gov) and Dr. Allen Foley, FWC (email: allen.foley@myfwc.com) shall be notified at the initiation and completion of all in-water blasting.

d. The plan shall include, but not be limited to, the following information:

1) A list of the observers, their qualifications, and positions for the watch, including a map depicting the proposed locations for boat or land-based observers. Qualified observers must have prior on the job experience observing for protected marine species (such as dolphins, manatees, marine turtles, etc.) during previous in-water blasting events where the blasting activities were similar in nature to this project.

2) The amount of explosive charge proposed, the explosive charge's equivalency in TNT, how it will be executed (depth of drilling, stemming, in-water, etc.), a drawing depicting the placement of the charges, size of the safety radius and how it will be marked (also depicted on a map), tide tables for the blasting event(s), and estimates of times and days for blasting events (with an understanding this is an estimate, and may change due to weather, equipment, etc.). Certain blasting restrictions will be imposed including the following: individual charge weights shall not exceed 18.1 kg (40 lbs)/delay, and the contractor shall not exceed a total of 42 blast events during the blast window.

e. For each explosive charge placed, three zones will be calculated, denoted on monitoring reports and provided to protected species observers before each blast for incorporation in the watch plan for each planned detonation. All of the zones will be noted by buoys for each of the blasts. These zones are:

1) Level A Take Zone: The Level A Take Zone is equal to the radius of the PTS Injury Zone. As shown in Table 3, as well as Figure 10, all other forms of Level A take (i.e. gastro-intestinal injury, lung injury, and mortality) have smaller radii than the PTS Injury Zone.

Detonation shall not occur if a protected species is known to be (or based on previous sightings, may be) within the Level A Take Zone.

2) Exclusion Zone: A zone which is the Level A Take Zone + 152.4 m (500 ft). Detonation will not occur if a protected species is known to be (or based on previous sightings, may be) within the Exclusion Zone;

3) Level B Take Zone: The Level B Take Zone extends from the Exclusion Zone to the Behavior Zone radius. Detonation shall occur if a protected species is within the Level B Take Zone. Any protected species within this zone shall be monitored continuously and, if they are within the Level B Take Zone during detonation, then they shall be recorded on monitoring forms. Note that the Level B Take Zone should begin immediately beyond the end of the Level A Take Zone. However, the USACE proposes to implement an Exclusion Zone. Also, the area immediately beyond the Level B Take Zone shall also be monitored for protected species.

Please refer to Figure 10 for examples of Level A and B take zones. **NOTE: Marking the Level A and Level B Takes Zones with buoys and monitoring these zones are required by NMFS. However, as an additional precaution and as stated earlier, no blasting shall occur within the East Channel if dolphins or any other protected species are present within the channel.**

f. The watch program shall begin at least one hour prior to the scheduled start of blasting to identify the possible presence of protected species. The watch program shall continue until at least one half-hour after detonations are complete.

g. The watch program shall consist of a minimum of six Protected Species Observers with a designated lead observer. Each observer shall be equipped with a two-way radio that shall be dedicated exclusively to the watch. Extra radios shall be available in case of failures. All of the observers shall be in close communication with the blasting subcontractor in order to halt the blast event if the need arises. If all observers do not have working radios and cannot contact the primary observer and the blasting subcontractor during the pre-blast watch, the blast shall be postponed until all observers are in radio contact. Observers will also be equipped with polarized sunglasses, binoculars, a red flag for backup visual communication, and a sighting log with a map to record sightings. All blasting events will be weather dependent. Climatic conditions must be suitable for adequate viewing conditions. Blasting will not commence in rain, fog or otherwise poor weather conditions, and can only commence when the entire Level A Take Zone, Exclusion Zone, and Level B Take Zone are visible to observers.

h. The watch program shall include a continuous aerial survey to be conducted by aircraft, as approved by the FAA. The blasting event shall be halted if an animal is spotted approaching or within the Exclusion Zone. An "all-clear" signal must be obtained from the aerial observer before detonation can occur. Note that all observers must give the “all-clear” signal before blasting can commence. The blasting event shall be halted immediately upon request of any of the observers. If animals are sighted, the blast event shall not take place until the animal moves out of the Exclusion Zone under its own volition. Animals shall not be herded away or harassed into leaving. Specifically, the animals must not be intentionally approached by project watercraft. Blasting may only commence when 30 minutes has passed without an animal being sighted within or approaching the Exclusion Zone or Level A Take Zone;

g. After each blast, the observers and contractors shall meet and evaluate any problems encountered during blasting events and logistical solutions shall be presented to the Contracting Officer. Corrections to the watch shall be made prior to the next blasting event. If any one of the aforementioned conditions (a through f, above) is not met prior to or during the blasting, the contractor as advised by the watch observers shall have the authority to terminate the blasting event, until resolution can be reached with the Contracting Officer. The USACE will contact FWC, USFWS and NMFS;

h. If an injured or dead protected species is sighted after the blast event, the watch observers shall contact the USACE and the USACE will contact the resource agencies at the following phone numbers:

1) FWC through the Manatee Hotline: 1-888-404-FWCC and 850-922-4300 (manatees).
(2) USFWS Jacksonville: 904-731-3336 (manatees)
(3) NMFS SERO-PRD: 772-570-5312 (sea turtles, sturgeon, and sawfish)
(4) NMFS- Emergency Stranding Hotline – 1-877-433-8299

The observers shall maintain contact with the injured or dead protected species to the greatest extent practical until authorities arrive. Blasting shall be postponed until consultations are completed and determinations can be made of the cause of injury or mortality. If blasting injuries are documented, all demolition activities shall cease. The USACE will then submit a revised plan to FWC, NMFS and USFWS for review.

i. Within 30 days after completion of all blasting events, the primary observer shall submit a report to the USACE, who will provide it to FWC, NMFS and USFWS providing a description of the event, number and location of animals seen and what actions were taken when animals were seen. Any problems associated with the event and suggestions for improvements shall also be documented in the report.

Required Monitoring Protocol During Blast Events

With some exceptions, the USACE will rely upon the same monitoring protocol developed for the Port of Miami project in 2005 (Barkaszi, 2005) and published in Jordan *et al*., 2007. A summary of that protocol is summarized here:

A watch plan will be formulated based on the required monitoring radii and optimal observation locations. The watch plan will be similar to the program that was utilized successfully at Miami Harbor in 2005 and for this project will consist of at least six observers including at least one (1) aerial observer, two (2) boat-based observers, and two (2) observers stationed on the drill barge (Figures 12, 13, 14, & 15). The 6th observer will be placed in the most optimal observation location (boat, barge or aircraft) on a day-by-day basis depending on the location of the blast and the placement of dredging equipment. There shall also be one lead observer. This process will insure complete coverage of the three zones as well as any critical areas. The watch will begin at least 1-hour prior to each blast and continue for one-half hour after each blast (Jordan *et al* 2007).

Figure 11. Typical observer helicopter

Figure 12. View of typical altitude of aerial observer operations

Figure 13. Typical vessel for boat-based observer

Figure 14. Observer on Drill Barge

The aerial observer will fly in a helicopter with doors removed at an average height of 500 ft. The helicopter will drop lower if they need to identify something in the water. This will provide maximum visibility of all zones as well as exceptional maneuverability and the needed flexibility for continual surveillance without fuel stops or down time, and the ability to deliver post-blast assistance. The area being monitored is a high traffic area, surrounded by an urban environment where animals are potentially exposed to multiple overflights daily. USACE conferred with Ms. Mary Jo Barkaszi, owner and chief observer of Continental Shelf Associates International, a protected species monitoring company with 25-years of experience, and has worked on the last five marine mammals/blasting events for the USACE throughout the country. All of these jobs had common bottlenose dolphins in the project area. Ms. Barkaszi stated that in her experience, she has not observed common bottlenose dolphins diving or fleeing the area because a helicopter is hovering nearby at 500 ft (personal communication, 2011). During monitoring events, the helicopter hovers at 500 ft above the Watch Zone and only drops below that level when helping to confirm identification of something small in the water, like a sea turtle. The USACE does not expect incidental harassment associated with helicopter-based monitoring of the blasting activities and is not requesting take associated with helicopter-based monitoring.

Boat-based observers will be placed on vessels with viewing platforms. The boat observers will cover the Level B Take Zone where waters are deep enough to safely operate the vessel.

The natural visibility of the water is expected to be poor so that animals will not be seen below the surface. As previously stated, blasting cannot commence until the entire Level A Take Zone, Exclusion Zone, and Level B Take Zone are visible to monitors, and should not commence in rain, fog, or other adverse weather conditions. However, animals surfacing in these turbid conditions are still routinely spotted from the air and from the boats, thus the overall observer program is not compromised, only the degree to which animals are tracked below the surface. Observers must confirm that all protected species are out of the Exclusion Zone and the Level A Take Zone for 30 minutes before blasting can commence, just as they are under normal visual conditions.

All observers will be equipped with marine-band VHF radios, maps of the blast zone, polarized sunglasses, and appropriate data sheets. Communications among observers and with the blaster is critical to the success of the watch plan. The aerial observer will be in contact with vessel and drill-barge based observers as well as the drill barge crew with regular 15-minute radio checks throughout the watch period. Constant tracking of animals spotted by any observer will be possible due to the amount and type of observer coverage and the communications plan. Watch hours will be restricted to between two hours after sunrise and one hour before sunset. The watch will begin at least one hour prior to the scheduled blast and is continuous throughout the blast. Watch continues for at least 30 minutes post blast at which time any animals that were seen prior to the blast are visually re-located whenever possible and all observers in boats and in the aircraft assisted in cleaning up any blast debris.

If any protected species are spotted during the watch, the observer will notify the lead observer, aerial observer, and/or the other observers via radio. The animal will be located by the aerial observer to determine its range and bearing from the blast pattern. Initial locations and all subsequent observations will be plotted on maps. Animals within or approaching the Exclusion Zone will be tracked by the aerial and boat based observers until they exit the Exclusion Zone. As stated earlier, animals that exit the Exclusion Zone and enter the Level B Take Zone will also be monitored. The animal’s heading shall be monitored continuously until it is confirmed beyond the Level B Take Zone. Anytime animals are spotted near the Exclusion Zone, the drill barge and lead observer will be alerted as to the animal’s proximity and some indication of any potential delays it might cause.

If an animal is spotted inside the Exclusion Zone and not re-observed, no blasting will be authorized until at least 30 minutes has elapsed since the last sighting of that animal. The watch will continue its countdown up until the T-minus five (5) minute point. At this time, the aerial observer will confirm that all animals are outside the Exclusion Zone and that all holds have expired prior to clearing the drill barge for the

T-minus five (5) minute notice. A fish scare charge will be fired at T-minus five (5) minutes and T-minus one (1) minute to minimize effects of the blast on fish that may be in the area of the blast pattern by scaring them from the blast area.

An actual postponement in blasting will only occur when a protected species is located within or is approaching the Exclusion Zone at the point where the blast countdown reaches the T-minus five (5) minutes. At that time, if an animal is in or near the Exclusion Zone, the countdown is put on hold until the Exclusion Zone is completely clear of protected species and all 30-minute sighting holds have expired.

12 WHERE THE PROPOSED ACTIVITY WOULD TAKE PLACE IN OR NEAR A TRADITIONAL ARCTIC SUBSISTENCE HUNTING AREA AND/OR MAY AFFECT THE AVAILABILITY OF A SPECIES OR STOCK OF MARINE MAMMAL FOR ARCTIC SUBSISTENCE USES, THE APPLICANT MUST SUBMIT EITHER A "PLAN OF COOPERATION" OR INFORMATION THAT IDENTIFIES WHAT MEASURES HAVE BEEN TAKEN AND/OR WILL BE TAKEN TO MINIMIZE ANY ADVERSE EFFECTS ON THE AVAILABILITY OF MARINE MAMMALS FOR SUBSISTENCE USES.

N/A – the project will not take place in or near a traditional Arctic subsistence hunting area, nor will it affect availability of a species or stock of marine mammal for Arctic subsistence uses.

13 THE SUGGESTED MEANS OF ACCOMPLISHING THE NECESSARY MONITORING AND REPORTING THAT WILL RESULT IN INCREASED KNOWLEDGE OF THE SPECIES, THE LEVEL OF TAKING OR IMPACTS ON POPULATIONS OF MARINE MAMMALS THAT ARE EXPECTED TO BE PRESENT WHILE CONDUCTING ACTIVITIES AND SUGGESTED MEANS OF MINIMIZING BURDENS BY COORDINATING SUCH REPORTING REQUIREMENTS WITH OTHER SCHEMES ALREADY APPLICABLE TO PERSONS CONDUCTING SUCH ACTIVITY. MONITORING PLANS SHOULD INCLUDE A DESCRIPTION OF THE SURVEY TECHNIQUES THAT WOULD BE USED TO DETERMINE THE MOVEMENT AND ACTIVITY OF MARINE MAMMALS NEAR THE ACTIVITY SITE(S) INCLUDING MIGRATION AND OTHER HABITAT USES, SUCH AS FEEDING. GUIDELINES FOR DEVELOPING A SITE-SPECIFIC MONITORING PLAN MAY BE OBTAINED BY WRITING TO THE DIRECTOR, OFFICE OF PROTECTED RESOURCES; AND

The Contractor shall use hydrophones to record the SEL and SPL associated with up to 42 blast events. The Contractor shall also record associated work as separate recordings, including borehole drilling and fish repelling charges. Files shall be provided as .wav binary files. The hydrophone shall have the ability to record the blast event, as well as providing voice recording of each hydrophone record in a standard format acceptable to the government (e.g., .cda files). The Contractor shall provide nearby hydrophone records of drilling operations of 30 minutes over three (3) early contract periods at least 18 hours apart. The Contractor shall provide hydrophone or transducer records within the contract area of three (3) 10-minute quiet periods (not necessarily 10 continuous minutes) over three (3) early contract periods at least 18 hours apart or prior to the contractor's full mobilization to the site, and 10 close-approaches of varied vessel sizes.

Information to be provided as both an EXCEL file and voice recording for each hydrophone record (.wav file) shall include:

(1) GPS Location of the hydrophone aboard the vessel. The GPS position shall use the same coordinate system as the Blasting Contractor. The vessel shall be moored approximately bow toward the blast/drilling site. The hydrophone shall be closer to the blast pattern than the vessel's bow at the waterline. The hydrophone position shall be located outside the range that would cause clipping (overloading of the hydrophone, causing the absolute peaks to be lost).

(2) Water depth to the sediment/rock bottom. The hydrophone shall be placed at the shallower of 3.0 meters (9.84 feet or 9 feet, 10 inches) depth or the mid-water column depth.

(3) Information provided by the Blasting Contractor regarding the blast pattern or drilling. The minimum data shall include, as appropriate for blast shots or drilling; the date, time, and blast number of the shot; the average water depth of the shot pattern or the average depth to sediment/rock at the nearest five (5) shot-holes closest to the hydrophone location; GPS Location of the closest shot-hole in the blast pattern to the hydrophone; minimum explosive depth below the top of rock for the closest shot-hole in the blast pattern to the hydrophone; the maximum charge weight per delay of the shot pattern in pounds of explosives; and, the largest charge weight per delay of the closest delay sequence to the hydrophone.

14 SUGGESTED MEANS OF LEARNING OF, ENCOURAGING, AND COORDINATING RESEARCH OPPORTUNITIES, PLANS, AND ACTIVITIES RELATING TO REDUCING SUCH INCIDENTAL TAKING AND EVALUATING ITS EFFECTS.

The USACE will coordinate monitoring with the appropriate federal and state resource agencies, including NMFS-OPR (HQ) and NMFS-PRD (SERO), and will provide copies of any monitoring reports prepared by the contractors.

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ATTACMENT A

STOCK ASSESSMENT REPORT

NORTHERN GULF OF MEXICO, BAY, SOUND, AND ESTUARY STOCKS OF COMMON BOTTLENOSE DOLPHINS

NMFS

FEBRUARY 2017

COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*): Northern Gulf of Mexico Bay, Sound, and Estuary Stocks

NOTE – NMFS is in the process of writing individual stock assessment reports for each of the 31 bay, sound and estuary stocks of common bottlenose dolphins that are included in this report. Until this effort is completed and this report is replaced by 31 individual reports, basic information for all individual bay, sound and estuary stocks will remain in this report: "Northern Gulf of Mexico Bay, Sound and Estuary Stocks". To date, four stocks have individual reports completed (Barataria Bay Estuarine System; Mississippi Sound, Lake Borgne, Bay Boudreau; Choctawhatchee Bay; St. Joseph Bay) and the remaining 27 stocks are assessed in this report.

STOCK DEFINITION AND GEOGRAPHIC RANGE

Common bottlenose dolphins are distributed throughout the bays, sound and estuaries of the Gulf of Mexico (Mullin 1988). The identification of biologically-meaningful "stocks" of bottlenose dolphins in these waters is complicated by the high degree of behavioral variability exhibited by this species (Shane *et al.* 1986; Wells and Scott 1999; Wells 2003), and by the lack of requisite information for much of the region.

Distinct stocks are delineated in each of 31 areas of contiguous, enclosed or semi-enclosed bodies of water adjacent to the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico; Table 1; Figure 1). The genesis of the delineation of these stocks was work initiated in the 1970s in Sarasota Bay, Florida (Irvine *et al.* 1981), and in bays in Texas (Shane 1977; Gruber 1981). These studies documented year-round residency of individual bottlenose dolphins in estuarine waters. As a result, the expectation of year-round resident populations was extended to bay, sound and estuary (BSE) waters across the northern Gulf of Mexico when the first stock assessment reports were established in 1995. Since these early studies, long-term (year-round, multi-year) residency has been reported from nearly every site where photographic identification (photo-ID) or tagging studies have been conducted in the Gulf of Mexico. In Texas, long-term resident dolphins have been reported in the Matagorda-Espiritu Santo Bay area (Gruber 1981; Lynn and Würsig 2002), Aransas Pass (Shane 1977; Weller 1998), San Luis Pass (Maze and Würsig 1999; Irwin and Würsig 2004), and Galveston Bay (Bräger 1993; Bräger *et al.* 1994; Fertl 1994). In Louisiana, Miller (2003) concluded the bottlenose dolphin population in the Barataria Basin was relatively closed. Hubard *et al.* (2004) reported sightings of dolphins in Mississippi Sound that were known from tagging efforts there 12–15 years prior. In Florida, long-term residency has been reported from Tampa Bay (Wells 1986; Wells *et al.* 1996b; Urian *et al.* 2009), Sarasota Bay (Irvine and Wells 1972; Irvine *et al.* 1981; Wells 1986; 1991; 2003; 2014; Wells *et al.* 1987; Scott *et al.* 1990; Wells 1991; 2003), Lemon Bay (Wells *et al.* 1996a; Bassos-Hull *et al.* 2013), Charlotte Harbor/Pine Island Sound (Shane 1990; Wells *et al.* 1996a; Wells *et al.* 1997; Shane 2004; Bassos-Hull *et. al.* 2013) and Gasparilla Sound (Bassos-Hull *et. al.* 2013). In Sarasota Bay, which has the longest research history, at least 5 concurrent generations of identifiable residents have been identified, including some of those first identified in 1970 (Wells 2014). Maximum immigration and emigration rates of about 2–3% have been estimated (Wells and Scott 1990).

Genetic data also support the concept of relatively discrete BSE stocks. Analyses of mitochondrial DNA haplotype distributions indicate the existence of clinal variations along the Gulf of Mexico coastline (Duffield and Wells 2002). Differences in reproductive seasonality from site to site also suggest genetic-based distinctions between communities (Urian *et al.* 1996). Mitochondrial DNA analyses suggest finer-scale structural levels as well. For example, dolphins in Matagorda Bay, Texas, appear to be a localized population, and differences in haplotype frequencies distinguish among adjacent communities in Tampa Bay, Sarasota Bay and Charlotte Harbor/Pine Island Sound, along the central west coast of Florida (Duffield and Wells 1991; 2002). Additionally, Sellas *et al.* (2005) examined population subdivision among dolphins sampled in Sarasota Bay, Tampa Bay, Charlotte Harbor, Matagorda Bay, and the coastal Gulf of Mexico (1–12 km offshore) from just outside Tampa Bay to the southern end of Lemon Bay, and found evidence of significant population structure among all areas on the basis of both mitochondrial DNA control region sequence data and 9 nuclear microsatellite loci. The Sellas *et al.* (2005) findings support the separate identification of BSE populations from those occurring in adjacent Gulf coastal waters.

In many cases, residents occur primarily in BSE waters, with limited movements through passes to the Gulf of Mexico (Shane 1977; 1990; Gruber 1981; Irvine *et al.* 1981; Maze and Würsig 1999; Lynn and Würsig 2002; Fazioli *et al.* 2006). These habitat use patterns are reflected in the ecology of the dolphins in some areas; for example, residents of Sarasota Bay, Florida, lacked squid in their diet, unlike non-resident dolphins stranded on nearby Gulf beaches (Barros and Wells 1998). However, in some areas year-round residents may co-occur with non-resident dolphins. For example, about 14–17% of group sightings involving resident Sarasota Bay dolphins include at least 1 non-resident as well (Wells *et al.* 1987; Fazioli *et al.* 2006). Mixing of inshore residents and non-residents has been seen at San Luis Pass, Texas (Maze and Würsig 1999), Cedar Keys, Florida (Quintana-Rizzo and Wells 2001), and Pine Island Sound, Florida (Shane 2004). Non-residents exhibit a variety of movement patterns, ranging from apparent nomadism recorded as transience to a given area, to apparent seasonal or non-seasonal migrations. Passes, especially the mouths of the larger estuaries, serve as mixing areas. For example, dolphins from several different areas were documented at the mouth of Tampa Bay, Florida (Wells 1986), and most of the dolphins identified in the mouths of Galveston Bay and Aransas Pass, Texas, were considered transients (Henningsen 1991; Bräger 1993; Weller 1998).

Seasonal movements of dolphins into and out of some of the bays, sounds and estuaries have also been documented. In Sarasota Bay, Florida, and San Luis Pass, Texas, residents have been documented moving into Gulf coastal waters in fall/winter, and returning inshore in spring/summer (Irvine *et al.* 1981; Maze and Würsig 1999). Fall/winter increases in abundance have been noted for Tampa Bay (Scott *et al.* 1989) and are thought to occur in Matagorda Bay (Gruber 1981; Lynn and Würsig 2002) and Aransas Pass (Shane 1977; Weller 1998). Spring/summer increases in abundance occur in Mississippi Sound (Hubard *et al.* 2004) and are thought to occur in Galveston Bay (Henningsen 1991; Bräger 1993; Fertl 1994).

Spring and fall increases in abundance have been reported for St. Joseph Bay, Florida. Mark-recapture abundance estimates were highest in spring and fall and lowest in summer and winter (Table 1; Balmer *et al.* 2008). Individuals with low site-fidelity indices were sighted more often in spring and fall, whereas individuals sighted during summer and winter displayed higher site-fidelity indices. In conjunction with health assessments, 23 dolphins were radio tagged during April 2005 and July 2006. Dolphins tagged in spring 2005 displayed variable utilization areas and variable site fidelity patterns. In contrast, during summer 2006 the majority of radio tagged individuals displayed similar utilization areas and moderate to high site-fidelity patterns. The results of the studies suggest that during summer and winter St. Joseph Bay hosts dolphins that spend most of their time within this region, and these may represent a resident community. In spring and fall, St. Joseph Bay is visited by dolphins that range outside of this area (Balmer *et al.* 2008).

The current BSE stocks are delineated as described in Table 1. There are some estuarine areas that are not currently part of any stock's range. Many of these are areas that dolphins cannot readily access. For example, the marshlands between Galveston Bay and Sabine Lake and between Sabine Lake and Calcasieu Lake are fronted by long, sandy beaches that prohibit dolphins from entering the marshes. The region between the Calcasieu Lake and Vermilion Bay/Atchafalaya Bay stocks has some access, but these marshes are predominantly freshwater rather than saltwater marshes, making them unsuitable for long-term survival of a viable population of bottlenose dolphins. In other regions, there is insufficient estuarine habitat to harbor a demographically independent population, for instance between the Matagorda Bay and West Bay Stocks in Texas, and/or sufficient isolation of the estuarine habitat from coastal waters. The regions between the south end of the Estero Bay Stock area to just south of Naples and between Little Sarasota Bay and Lemon Bay are highly developed and contain little appropriate habitat. South of Naples to San Marco Island and Gullivan Bay is also not currently covered in a stock boundary. This region may reasonably contain bottlenose dolphins, but the relationship of any dolphins in this region to other BSE stocks is unknown. They may be members of the Gullivan to Chokoloskee Bay stock as there is passage behind San Marco Island that would allow dolphins to move north. The regions between Apalachee Bay and Cedar Key/Waccasassa Bay, between Crystal Bay and St. Joseph Sound and between Chokoloskee Bay and Whitewater Bay are comprised of thin strips of marshland with no barriers to adjacent coastal waters. Further work is necessary to determine whether year-round resident dolphins use these thin marshes or whether dolphins in these areas are members of the coastal stock that use the fringing marshland as well. Finally, the region between the eastern border of the Barataria Bay Stock and the Mississippi Delta Stock to the east may harbor dolphins, but the area is small and work is necessary to determine whether any dolphins utilizing this habitat come from an adjacent BSE stock.

As more information becomes available, combination or division of these stocks, or alterations to stock boundaries, may be warranted. Recent research based on photo-ID data collected by Bassos-Hull *et al.* (2013) recommended combining B21, Lemon Bay, with B22–23, Gasparilla Sound, Charlotte Harbor, Pine Island Sound. Therefore, these stocks have been combined (see Table 1). However, it should be noted this change was made in the absence of genetic data and could be revised again in the future when genetic data are available. Additionally, a number of geographically and socially distinct subgroupings of dolphins in regions such as Tampa Bay, Charlotte Harbor, Pine Island Sound, Aransas Pass and Matagorda Bay have been identified, but the importance of these distinctions to stock designations remains undetermined (Shane 1977; Gruber 1981; Wells *et al.* 1996a; 1996b;

1997; Lynn and Würsig 2002; Urian 2002). For Tampa Bay, Urian *et al.* (2009) described 5 discrete communities (including the adjacent Sarasota Bay community) that differed in their social interactions and ranging patterns. Structure was found despite a lack of physiographic barriers to movement within this large, open embayment. Urian *et al.* (2009) further suggested that fine-scale structure may be a common element among bottlenose dolphins in the southeastern U.S. and recommended that management should account for fine-scale structure that exists within current stock designations.

Table 1. Most recent common bottlenose dolphin abundance (N_{BEST}), coefficient of variation (CV) and minimum population estimate (N_{MIN}) in northern Gulf of Mexico bays, sounds and estuaries. Because they are based on data collected more than 8 years ago, most estimates are considered unknown or undetermined for management purposes. Blocks refer to aerial survey blocks illustrated in Figure 1. PBR – Potential Biological Removal; UNK – unknown; UND – undetermined.

Blocks	Gulf of Mexico Estuary	N_{BEST}	CV	N_{MIN}	PBR	Year	Reference
B51	Laguna Madre	80	1.57	UNK	UND	1992	A
B52	Nueces Bay, Corpus Christi Bay	58	0.61	UNK	UND	1992	A
B50	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay	55	0.82	UNK	UND	1992	A
B54	Matagorda Bay, Tres Palacios Bay, Lavaca Bay	61	0.45	UNK	UND	1992	A
B55	West Bay	32	0.15	UNK	UND	2001	B
B56	Galveston Bay, East Bay, Trinity Bay	152	0.43	UNK	UND	1992	A
B57	Sabine Lake	0[a]	-		UND	1992	A
B58	Calcasieu Lake	0[a]	–		UND	1992	A
B59	Vermilion Bay, West Cote Blanche Bay, Atchafalaya Bay	0[a]	–		UND	1992	A
B60	Terrebonne Bay, Timbalier Bay	100	0.53	UNK	UND	1993	A
B61	Barataria Bay†	138	0.08	UNK	UND	2001	C
B30	Mississippi River Delta	332	0.93	170	1.7	2011–12	D
B02–05, 29, 31	Mississippi Sound, Lake Borgne, Bay Boudreau†	901	0.63	551	5.6	2012	D
B06	Mobile Bay, Bonsecour Bay	122	0.34	UNK	UND	1993	A
B07	Perdido Bay	0[a]	-		UND	1993	A
B08	Pensacola Bay, East Bay	33	0.80	UNK	UND	1993	A
B09	Choctawhatchee Bay†	179	0.04	UNK[c]	UND[c]	2007	E
B10	St. Andrew Bay	124	0.57	UNK	UND	1993	A
B11	St. Joseph Bay†	152	0.08	UNK[c]	UND[c]	2007	F
B12–13	St. Vincent Sound, Apalachicola Bay, St. George Sound	439	0.14	UNK	UND	2007	G
B14–15	Apalachee Bay	491	0.39	UNK	UND	1993	A
B16	Waccasassa Bay, Withlacoochee Bay, Crystal Bay	UNK	-	UNK	UND		
B17	St. Joseph Sound, Clearwater Harbor	UNK	-	UNK	UND		
B32–34	Tampa Bay	UNK	-	UNK	UND		
B20, 35	Sarasota Bay, Little Sarasota Bay	158	0.27	126	1.3	2015	H
B21–23	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay	826	0.09	UNK	UND	2006	I
B36	Caloosahatchee River	0[a,b]	-		UND	1985	J
B24	Estero Bay	UNK	-	UNK	UND		
B25	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay	UNK	–	UNK	UND		
B27	Whitewater Bay	UNK	–	UNK	UND		
B28	Florida Keys (Bahia Honda to Key	UNK	-	UNK	UND		

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West)
References: A – Blaylock and Hoggard 1994; B – Irwin and Würsig 2004; C – Miller 2003; D – Garrison 2017; E – Conn *et al.* 2011; F – Balmer *et al.* 2008; G – Tyson *et al.* 2011; H – Tyson and Wells 2016; I – Bassos-Hull *et al.* 2013; J –Scott *et al.* 1989 Notes: [a] During earlier surveys (Scott *et al.* 1989), the range of seasonal abundances was as follows: B57, 0–2 (CV=0.38); B58, 0–6 (0.34); B59, 0–0; B30, 0–182 (0.14); B07, 0–0; B21, 0–15 (0.43); and B36, 0–0. [b] Block not surveyed during surveys reported in Blaylock and Hoggard (1994). [c] The individual SAR for this stock has not been updated yet to reflect this change. †An individual stock assessment report is available for this stock.

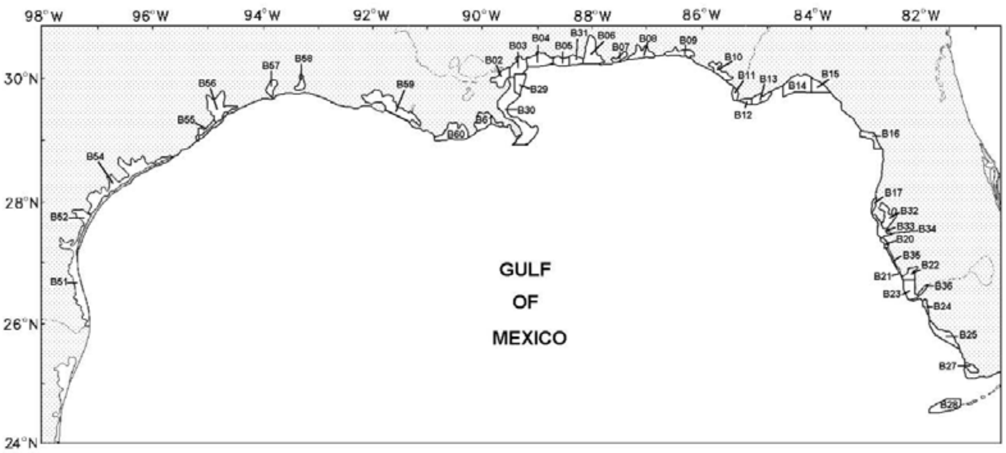

Figure 1. *Northern Gulf of Mexico bays, sounds and estuaries. Each of the alpha-numerically designated blocks corresponds to one of the NMFS Southeast Fisheries Science Center logistical aerial survey areas listed in Table 1. The common bottlenose dolphins inhabiting each bay, sound or estuary are considered to comprise a unique stock for purposes of this assessment. Four stocks have their own stock assessment report (see Table 1).*

POPULATION SIZE

Population size estimates for most of the stocks are greater than 8 years old and therefore the current population sizes for all but 3 of these stocks are considered unknown (Wade and Angliss 1997). However, a capture-mark-recapture population size estimate for 2015 is available for Sarasota Bay, Little Sarasota Bay (Tyson and Wells 2016). Recent aerial survey line-transect population size estimates are available for Mississippi River Delta and Mississippi Sound, Lake Borgne, Bay Boudreau (Garrison 2017; Table 1). Population size estimates for many stocks were generated from preliminary analyses of line-transect data collected during aerial surveys conducted in September-October 1992 in Texas and Louisiana and in September–October 1993 in Louisiana, Mississippi, Alabama and the Florida Panhandle (Blaylock and Hoggard 1994; Table 1). Standard line-transect perpendicular sighting distance analytical methods (Buckland *et al.* 1993) and the computer program DISTANCE (Laake *et al.* 1993) were used.

Minimum Population Estimate

The population sizes for all but 3 stocks are currently unknown and the minimum population estimates are given for those 3 stocks in Table 1. The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed abundance estimate. This is equivalent to the 20[th] percentile of the log-normal distribution as specified by Wade and Angliss (1997). The minimum population estimate was calculated for each block from the estimated population size and its associated coefficient of variation.

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Current Population Trend

The data are insufficient to determine population trends for most of the Gulf of Mexico BSE common bottlenose dolphin stocks.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for these stocks. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate and a recovery factor (Wade and Angliss 1997). The recovery factor is 0.5 because these stocks are of unknown status. PBR is undetermined for all but 3 stocks because the population size estimates are more than 8 years old. PBR for those stocks with population size estimates less than 8 years old is given in Table 1.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for these stocks during 2010–2014 is unknown because these stocks interact with unobserved fisheries (see below). Five-year unweighted mean mortality estimates for 2007–2011 for the commercial shrimp trawl fishery were calculated at the state level (see Shrimp Trawl section below).

Fishery Information

The commercial fisheries that interact, or that potentially could interact, with these stocks in the Gulf of Mexico are the Category II Southeastern U.S. Atlantic, Gulf of Mexico shrimp trawl; Gulf of Mexico menhaden purse seine; Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot; and Gulf of Mexico gillnet fisheries; and the Category III Gulf of Mexico blue crab trap/pot; Florida spiny lobster trap/pot; and Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line) fisheries (Appendix III).

In the following sections the number of documented interactions of common bottlenose dolphins with each of these fisheries during 2010–2014 is reported. The likely stock(s) of origin for each interaction has been inferred based on the location of the interaction and distribution of the fishery.

Shrimp Trawl

During 2010–2014, there were no documented mortalities or serious injuries of common bottlenose dolphins from Gulf of Mexico BSE stocks by commercial shrimp trawls because observer coverage of this fishery does not include BSE waters. Between 1997 and 2011, 5 common bottlenose dolphins and 7 unidentified dolphins, which could have been either common bottlenose dolphins or Atlantic spotted dolphins, became entangled in the lazy line, turtle excluder device or tickler chain gear in the commercial shrimp trawl fishery in the Gulf of Mexico. All dolphin bycatch interactions resulted in mortalities except for 1 unidentified dolphin that was released alive in 2009. Soldevilla *et al.* (2015) provided mortality estimates calculated from analysis of shrimp fishery effort data and NMFS's Observer Program bycatch data. Observer program coverage does not extend into BSE waters; time-area stratified bycatch rates were extrapolated into inshore waters to estimate bycatch mortalities from inshore fishing effort. Annual mortality estimates were calculated for the years 1997–2011 from stratified annual fishery effort and bycatch rates, and a 5-year unweighted mean mortality estimate for 2007–2011 was calculated for Gulf of Mexico dolphin stocks. The 4-area (Texas, Louisiana, Mississippi/Alabama, Florida) stratification method was chosen because it best approximates how fisheries operate (Soldevilla *et al.* 2015). The BSE stock mortality estimates were aggregated at the state level as this was the spatial resolution at which fishery effort is modeled (e.g., Nance *et al.* 2008). The mean annual mortality estimates for the BSE stocks were as follows: Texas BSE (from Galveston Bay, East Bay, Trinity Bay south to Laguna Madre): 0; Louisiana BSE (from Sabine Lake east to Barataria Bay): 88 (CV=1.01); Mississippi/Alabama BSE (from Mississippi River Delta east to Mobile Bay, Bonsecour Bay): 41 (CV=0.67); and Florida BSE (from Perdido Bay east and south to the Florida Keys): 3.4 (CV=0.99). These estimates do not include skimmer trawl effort, which may represent up to 50% of shrimp fishery effort in Louisiana, Alabama, and Mississippi inshore waters, because observer program coverage of skimmer trawls is limited. Limitations and biases of annual bycatch mortality estimates are described in detail in Soldevilla *et al.* (2015).

One mortality (2009) and 1 live release without serious injury (2012) occurred in Alabama bays during non-

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commercial shrimp trawling (see "Other Mortality" below for details).

Menhaden Purse Seine

During 2010–2014, there were 2 mortalities and 1 animal released alive without serious injury documented within BSE waters involving the menhaden purse seine fishery. All 3 interactions occurred within the waters of the Mississippi Sound, Lake Borgne, Bay Boudreau Stock (also reported in that SAR).

There is currently no observer program for the Gulf of Mexico menhaden purse seine fishery; however, recent incidental takes have been reported via two sources. First, during 2011, a pilot observer program operated from May through September, and observers documented 3 dolphins trapped within purse seine nets. All 3 were released alive without serious injury (Maze-Foley and Garrison 2016a). Two of the 3 dolphins were trapped within a single purse seine within waters of the Western Coastal Stock. The third animal was trapped in waters of the Mississippi Sound, Lake Borgne, Bay Boudreau Stock. Second, through the Marine Mammal Authorization Program (MMAP), there have been 13 self-reported incidental takes (all mortalities) of common bottlenose dolphins in northern Gulf of Mexico coastal and estuarine waters by the menhaden purse seine fishery during 2000–2014. Specific self-reported takes under the MMAP likely involving BSE stocks are as follows: 2 dolphins were reported taken in a single purse seine during 2012 in Mississippi Sound (Mississippi Sound, Lake Borgne, Bay Boudreau Stock); 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2004 that likely belonged to the Mississippi River Delta Stock; 1 take of a single unidentified dolphin reported during 2002 likely belonged to the Mississippi Sound, Lake Borgne, Bay Boudreau Stock; 1 take of a single bottlenose dolphin was reported in Louisiana waters during 2001 that likely belonged to Mississippi River Delta Stock or Northern Coastal Stock; during 2000, 1 take of a single bottlenose dolphin was reported in Louisiana waters that likely belonged to Mississippi River Delta Stock or Northern Coastal Stock; and also in 2000, 3 bottlenose dolphins were reported taken in a single purse seine in Mississippi waters that likely belonged to Mississippi Sound, Lake Borgne, Bay Boudreau Stock.

Without an ongoing observer program, it is not possible to obtain statistically reliable information for this fishery on the incidental take and mortality rates, and the stocks from which bottlenose dolphins are being taken.

Blue Crab, Stone Crab and Florida Spiny Lobster Trap/Pot

During 2010–2014 there were 4 documented interactions with trap/pot fisheries and BSE stocks. During 2013, 1 animal was disentangled and released alive from Florida spiny lobster trap/pot gear (it could not be determined if the animal was seriously injured following mitigation (disentanglement) efforts, the initial determination (pre-mitigation) was seriously injured [Maze-Foley and Garrison 2016c]). This animal likely belonged to the Florida Keys Stock. During 2011, 1 mortality occurred and 1 live animal was disentangled and released (it could not be determined if the animal was seriously injured [Maze-Foley and Garrison 2016a]). The BSE stocks involved were likely Waccasassa Bay, Withlacoochee Bay, Crystal Bay and Galveston Bay, East Bay, Trinity Bay, respectively. In 2010, a calf likely belonging to the Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay Stock was disentangled by stranding network personnel from a crab trap line wrapped around its peduncle. The animal swam away with no obvious injuries, but was considered seriously injured because it is unknown whether it was reunited with its mother (Maze-Foley and Garrison 2016a). The specific fishery could not be identified for the trap/pot gear involved in the 2011 and 2010 interactions. All mortalities and animals released alive were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015) and are included in the stranding totals in Table 1. Because there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots.

Gillnet

No marine mammal mortalities associated with gillnet fisheries have been reported or observed in recent years, but stranding data suggest that gillnet and marine mammal interactions do occur, causing mortality and serious injury. During 2010–2014, a total of 12 entanglements in research-related gillnets were reported in BSE stocks: 8 dolphins in Texas, 2 in Louisiana and 2 in Florida. Three of the 12 entanglements resulted in mortalities, and 1 in a serious injury (see "Other Mortality" below for details on recent and historical research-related entanglements).

There has been no observer coverage of this fishery in federal waters. Beginning in November 2012, NMFS began placing observers on commercial vessels in the coastal waters of Alabama, Mississippi and Louisiana (state waters only). No takes have been observed to date (Mathers *et al.* 2016). In 1995, a Florida state constitutional amendment banned gillnets and large nets from bays, sounds, estuaries and other inshore waters. Commercial and recreational gillnet fishing is also prohibited in Texas state waters.

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Hook and Line (Rod and Reel)

During 2010–2014 there were 29 documented interactions (entanglements or ingestions) with hook and line gear and BSE stocks—20 mortalities and 9 live animals for which disentanglement efforts were made. Available evidence from stranding data was examined for the 20 mortalities. For 12 of these mortalities, evidence suggested the hook and line gear interaction contributed to the cause of death. For 4 mortalities, evidence suggested the hook and line gear interaction was incidental and was not a contributing factor to cause of death. For 4 mortalities, it could not be determined if the hook and line gear interaction contributed to cause of death. Attempts were made to disentangle 9 live animals from hook and line gear, 2 of which were considered seriously injured by the gear based on observations during mitigation (disentanglement) efforts. Four live animals were considered seriously injured by the gear prior to mitigation efforts, but based on observations during mitigations, they were considered not seriously injured post-mitigation. For the remaining 3 live animals, it could not be determined if the animals were seriously injured (Maze Foley and Garrison 2016a,b,c,d). In summary, the evidence available from stranding data suggested that at least 12 mortalities and 2 serious injuries to animals from BSE stocks were a result of interactions with rod and reel hook and line gear.

Interactions by year with hook and line gear were as follows: During 2010 there were 3 mortalities, and 1 live animal was disentangled and released, considered seriously injured (Maze-Foley and Garrison 2016a). During 2011, there were 2 mortalities, and 2 live animals were disentangled from hook and line gear. One of the live animals was considered seriously injured, and 1 was not seriously injured (Maze-Foley and Garrison 2016a). During 2012 there were 8 mortalities, and 2 live animals were disentangled from hook and line gear (1 considered not seriously injured, 1 could not be determined if it was seriously injured) (Maze-Foley and Garrison 2016b). During 2013 there were 3 mortalities and 3 live animals disentangled from hook and line gear. One of the live animals was considered not seriously injured and for the other 2, it could not be determined whether they were seriously injured (Maze-Foley and Garrison 2016c). Finally, during 2014 there were 4 mortalities and 1 live animal disentangled from hook and line gear considered not seriously injured (Maze-Foley and Garrison 2016d).

The mortalities and serious injuries likely involved animals from the following BSE stocks: Pensacola Bay, East Bay; Waccasassa Bay, Withlacoochee Bay, Crystal Bay; Tampa Bay; Sarasota Bay, Little Sarasota Bay; Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay; Caloosahatchee River; Estero Bay; Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay; Galveston Bay, East Bay, Trinity Bay; West Bay; Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay; and Neuces Bay, Corpus Christi Bay.

All mortalities and live entanglements were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015) and are included in the stranding totals presented in Table 1. It should be noted that, in general, it cannot be determined if rod and reel hook and line gear originated from a commercial (i.e., charter boat and headboat) or recreational angler because the gear type used by both sources is typically the same. Also, it is not possible to estimate the total number of interactions with hook and line gear because there is no systematic observer program.

Strandings

A total of 564 common bottlenose dolphins were found stranded within bays, sounds and estuaries of the northern Gulf of Mexico from 2010 through 2014 (Table 2; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015). It could not be determined if there was evidence of human interaction for 452 of these strandings. For 27 dolphins, no evidence of human interaction was detected. Evidence of human interactions was detected for 85 of these dolphins. Human interactions were from numerous sources, including 29 entanglements with hook and line gear, 4 entanglements with trap/pot gear, 12 incidental takes in research gillnet gear, 1 stabbing with a screwdriver, 2 animals shot by arrow and 1 with gunshot, 1 entanglement in a non-commercial shrimp trawl, 1 entanglement in research longline gear, 2 strandings with visible, external oil, and 1 entrapment between oil booms (see Table 1). Strandings with evidence of fishery-related interactions are reported above in the respective gear sections. Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Gorzelany 1998; Wells *et al.* 1998, 2008), and some are struck by vessels (Wells and Scott 1997; Wells *et al.* 2008).

There are a number of difficulties associated with the interpretation of stranding data. Except in rare cases, such as Sarasota Bay, Florida, where residency can be determined, it is possible that some or all of the stranded dolphins may have been from a nearby coastal stock. However, the proportion of stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcasses originated. Stranding data probably underestimate the extent of human and fishery-related mortality and serious injury because not all of the dolphins that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier *et al.* 2012; Wells *et al.* 2015). Additionally, not all carcasses will show evidence of human interaction, entanglement or other fishery-related interaction due to decomposition, scavenger damage, etc. (Byrd *et al.* 2014). Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction.

Since 1990, there have been 13 bottlenose dolphin die-offs or Unusual Mortality Events (UMEs) in the northern Gulf of Mexico (Litz *et al.* 2014; http://www.nmfs.noaa.gov/pr/health/mmume/events.html, accessed 11 January 2016). 1) From January through May 1990, a total of 344 bottlenose dolphins stranded in the northern Gulf of Mexico. Overall this represented a two-fold increase in the prior maximum recorded number of strandings for the same period, but in some locations (i.e., Alabama) strandings were 10 times the average number. The cause of the 1990 mortality event could not be determined (Hansen 1992), however, morbillivirus may have contributed to this event (Litz *et al.* 2014). 2) A UME was declared for Sarasota Bay, Florida, in 1991 involving 31 bottlenose dolphins. The cause was not determined, but it is believed biotoxins may have contributed to this event (Litz *et al.* 2014). 3) In March and April 1992, 119 bottlenose dolphins stranded in Texas - about 9 times the average number. The cause of this event was not determined, but low salinity due to record rainfall combined with pesticide runoff and exposure to morbillivirus were suggested as potential contributing factors (Duignan *et al.* 1996; Colbert *et al.* 1999; Litz *et al.* 2014). 4) In 1993–1994 a UME of bottlenose dolphins caused by morbillivirus started in the Florida Panhandle and spread west with most of the mortalities occurring in Texas (Lipscomb 1993; Lipscomb *et al.* 1994; Litz *et al.* 2014). From February through April 1994, 236 bottlenose dolphins were found dead on Texas beaches, of which 67 occurred in a single 10-day period. 5) In 1996 a UME was declared for bottlenose dolphins in Mississippi when 31 bottlenose dolphins stranded during November and December. The cause was not determined, but a *Karenia brevis* (red tide) bloom was suspected to be responsible (Litz *et al.* 2014). 6) Between August 1999 and May 2000, 150 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle (additional strandings included 3 Atlantic spotted dolphins, *Stenella frontalis*, 1 Risso's dolphin, *Grampus griseus*, 2 Blainville's beaked whales, *Mesoplodon densirostris*, and 4 unidentified dolphins. Brevetoxin was determined to be the cause of this event (Twiner *et al.* 2012; Litz *et al.* 2014). 7) In March and April 2004, in another Florida Panhandle UME attributed to *K. brevis* blooms, 105 bottlenose dolphins and 2 unidentified dolphins stranded dead (Litz *et al.* 2014). Although there was no indication of a *K. brevis* bloom at the time, high levels of brevetoxin were found in the stomach contents of the stranded dolphins (Flewelling *et al.* 2005; Twiner *et al.* 2012). 8) In 2005, a particularly destructive red tide (*K. brevis*) bloom occurred off central west Florida. Manatee, sea turtle, bird and fish mortalities were reported in the area in early 2005 and a manatee UME had been declared. Dolphin mortalities began to rise above the historical averages by late July 2005, continued to increase through October 2005, and were then declared to be part of a multi-species UME. The multi-species UME extended into 2006, and ended in November 2006. In total, 190 dolphins were involved, primarily bottlenose dolphins (plus strandings of 1 Atlantic spotted dolphin, *S. frontalis*, and 23 unidentified dolphins). The evidence suggests a red tide bloom contributed to the cause of this event (Litz *et al.* 2014). 9) A separate UME was declared in the Florida Panhandle after elevated numbers of dolphin strandings occurred in association with a *K. brevis* bloom in September 2005. Dolphin strandings remained elevated through the spring of 2006 and brevetoxin was again detected in the tissues of most of the stranded dolphins and determined to be the cause of the event (Twiner *et al.* 2012; Litz *et al.* 2014). Between September 2005 and April 2006 when the event was officially declared over, a total of 88 bottlenose dolphin strandings occurred (plus strandings of 5 unidentified dolphins). 10) During February and March of 2007 an event was declared for northeast Texas and western Louisiana involving 64 bottlenose dolphins and 2 unidentified dolphins. Decomposition prevented conclusive analyses on most carcasses (Litz *et al.* 2014). 11) During February and March of 2008 an additional event was declared in Texas involving 111 bottlenose dolphin strandings (plus strandings of 1 unidentified dolphin and 1 melon-headed whale, *Peponocephala electra*). Most of the animals recovered were in a decomposed state. The investigation is closed and a direct cause could not be identified. However, there were numerous, co-occurring harmful algal bloom toxins detected during the time period of this UME which may have contributed to the mortalities (Fire *et al.* 2011). 12) A UME was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010 and ending 31 July 2014 (Litz *et al.* 2014; http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico.htm, accessed 1 June 2016). The UME began a few months prior to the *Deepwater Horizon* (DWH) oil spill, however most of the strandings prior to May 2010 were in Lake Pontchartrain, Louisiana, and western Mississippi and were likely a result of low salinity and cold temperatures (Venn Watson *et al.* 2015a). The largest increase in strandings (compared to historical data) occurred after May 2010 following the DWH spill, and strandings were focused in areas exposed to DWH oil. Investigations to date have determined that the DWH oil spill is the primary underlying cause of the elevated stranding numbers in the northern Gulf of Mexico after the spill (e.g., Schwacke *et al.* 2014; Venn-Watson *et al.* 2015b). 13) A UME occurred from November 2011 to March 2012 across 5 Texas counties and included 126 bottlenose dolphin strandings. The strandings were coincident with a harmful algal bloom of *K. brevis*, but researchers have not determined that was the cause of the event. During 2011, 6 animals from BSE stocks were considered to be part of the UME; during 2012, 24 animals.

Table 2. Common bottlenose dolphin strandings occurring in bays, sounds and estuaries in the northern Gulf of Mexico from 2010 to 2014, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 15 June 2015). Please note human interaction does not necessarily mean the interaction caused the animal's death. Please also note that this table does not include strandings from Barataria Bay Estuarine System; Mississippi Sound, Lake Borgne, Bay Boudreau; Choctawhatchee Bay; or St. Joseph Bay.

Stock	Category	2010	2011	2012	2013	2014	Total
Bay, Sound and Estuary	Total Stranded	96[a]	106[b]	124[c]	131[d]	107[e]	564
	Human Interaction						
	---Yes	15[f]	13[g]	23[h]	22[i]	12[j]	85
	---No	7	6	4	4	6	27
	---CBD	74	87	97	105	89	452

[a] This total includes animals that are part of the Northern Gulf of Mexico UME.

[b] This total includes animals that are part of the Northern Gulf of Mexico UME, and also includes 6 animals that were part of the 2011–2012 UME in Texas.

[c] This total includes animals that are part of the Northern Gulf of Mexico UME, and also includes 24 animals that were part of the 2011–2012 UME in Texas.

[d] This total includes animals that are part of the Northern Gulf of Mexico UME.

[e] This total includes animals that are part of the Northern Gulf of Mexico UME.

[f] Includes 4 entanglement interactions with hook and line gear (3 mortalities and 1 animal released alive seriously injured); 1 entanglement interaction with unidentified trap/pot gear (released alive seriously injured); 2 entanglement interactions with research gillnet gear (1 released alive without serious injury, 1 released alive that could not be determined if seriously injured or not); 1 live release without serious injury following entrapment between oil booms (animal was initially seriously injured, but due to mitigation efforts, was released without serious injury); 1 animal visibly oiled (mortality); and 1 entanglement interaction with unknown gear (released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury]).

[g] Includes 4 entanglement interactions with hook and line gear (2 mortalities, 1 animal released alive seriously injured, 1 released alive without serious injury [this animal was initially seriously injured, but due to mitigation efforts, was released without serious injury]); 2 entanglement interactions with research gillnet gear (1 mortality, 1 released alive without serious injury); 2 entanglement interactions with trap/pot gear (1 mortality, 1 released alive that could not be determined if seriously injured or not); and 1 animal visibly oiled (mortality).

[h] Includes 10 entanglement interactions with hook and line gear (8 mortalities, 1 released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury], 1 released alive that could not be determined if seriously injured or not); 4 entanglement interactions with research gillnet gear (1 released alive seriously injured, 3 released alive without serious injury); 1 entanglement in a non-commercial shrimp trawl net (released alive without serious injury); 1 stabbing (mortality); and 1 entanglement interaction with unknown fishing gear (released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury]).

[i] Includes 6 entanglement interactions with hook and line gear (3 mortalities, 1 animal released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury], 2 animals released alive that could not be determined if seriously injured or not); 4 entanglement interactions with research gillnet gear (2 mortalities, 1 animal released alive without serious injury, 1 animal released alive that could not be determined if seriously injured or not); 1 interaction with Florida spiny lobster trap/pot gear (released alive, could not be determined if seriously injured or not [this animal was initially seriously injured, but mitigation efforts were made]); 1 interaction with research longline gear (released alive, seriously injured); and 1 animal that was gunshot (mortality).

[j] Includes 5 entanglement interactions with hook and line gear (4 mortalities, 1 released alive without serious injury [animal was initially seriously injured, but due to mitigation efforts, was released without serious injury]) and 2 animals shot by arrow (mortalities).

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Other Mortality

There were 3 live dolphins included in the stranding database during 2010–2014 that were entangled in unidentified fishing gear or unidentified gear. One animal was seriously injured in 2013 in the Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay Stock area (Maze-Foley and Garrison 2016c). Two animals were initially considered seriously injured, but following mitigation efforts, were released alive without serious injury in 2010 (Sarasota Bay, Little Sarasota Bay Stock) and 2012 (Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay Stock) (Maze-Foley and Garrison 2016a,b). In addition, during 2012 in Alabama (Perdido Bay Stock), a dolphin was disentangled from a shrimp trawling net being used in a local ecotour. The animal was considered not seriously injured (Maze-Foley and Garrison 2016b), and was also included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015).

In addition to animals included in the stranding database, during 2010–2014, there were 20 at-sea observations in BSE stock areas of common bottlenose dolphins entangled in fishing gear or unidentified gear (hook and line, crab trap/pot and unidentified gear/line/rope). In 8 of these cases the animals were seriously injured, in 1 case the animal was not seriously injured, and for the remaining 11 cases, it could not be determined (CBD) if the animals were seriously injured (Maze-Foley and Garrison 2016a,b,c,d; see Table 3).

Table 3. At-sea observations of common bottlenose dolphins entangled in fishing gear or unidentified gear during 2010–2014, including the serious injury determination (mortality, serious injury, not a serious injury, or could not be determined (CBD) if seriously injured) and stock to which each animal likely belonged based on sighting location. Further details can be found in Maze-Foley and Garrison (2016a,b,c,d).

Year	Determination	Stock
2010	Serious injury	Mobile Bay, Bonsecour Bay
2010	CBD	Terrebonne, Timbalier Bay
2011	Serious injury	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2011	Serious injury	Pensacola Bay, East Bay
2011	CBD	Tampa Bay
2012	Serious injury	Caloosahatchee River
2012	Serious injury	Sarasota Bay, Little Sarasota Bay
2012	CBD	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay
2012	CBD	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay
2012	CBD	Tampa Bay
2013	Serious injury	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay
2013	Serious injury	Estero Bay
2013	Not serious	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay
2013	CBD	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2013	CBD	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2013	CBD	Tampa Bay
2013	CBD	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay
2014	Serious injury	St. Joseph Sound, Clearwater Harbor
2014	CBD	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay
2014	CBD	St. Andrew Bay

Common bottlenose dolphins are also known to interact with research-fishery gear. During 2010–2014, a dolphin was seriously injured during a research longline survey (Maze-Foley and Garrison 2016c; see Table 4) and 12 dolphins were entangled in research-related gillnets—in Texas (8), Louisiana (2) and Florida (2). Three of the 12 entanglements resulted in mortalities; 1 entanglement resulted in a serious injury; 6 entanglements were released alive without serious injury; and for 2 entanglements, it could not be determined if the animals were seriously injured (Maze-Foley and Garrison 2016a,b,c,d; see Table 4). All of the interactions with research gear were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished

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data, accessed 15 June 2015).

Table 4. Research-related takes of common bottlenose dolphins during 2010–2014, including the serious injury determination for each animal (mortality, serious injury, not a serious injury, or could not be determined (CBD) if seriously injured) and stock to which each animal likely belonged based on location of the interaction. All of these interactions were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015). Further details on injury determinations can be found in Maze-Foley and Garrison (2016a,b,c,d).

Year	Gear Type	Determination	Stock
2013	Longline	Serious injury	Mobile Bay, Bonsecour Bay
2010	Gillnet	Not serious	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2010	Gillnet	CBD	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2011	Gillnet	Mortality	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2011	Gillnet	Not serious	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2012	Gillnet	Serious injury	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2012	Gillnet	Not serious	Neuces Bay, Corpus Christi Bay
2012	Gillnet	Not serious	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay
2012	Gillnet	Not serious	Laguna Madre
2013	Gillnet	Not serious	Mississippi River Delta
2013	Gillnet	Mortality	Mississippi River Delta
2013	Gillnet	Mortality	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay
2013	Gillnet	CBD	Pine Island Sound, Charlotte Harbor, Gasparilla Sound, Lemon Bay

The problem of dolphin depredation of fishing gear is increasing in Gulf of Mexico coastal and estuary waters. There was a recent case within BSE waters of a shrimp fisherman illegally taking a common bottlenose dolphin in Mississippi Sound (Mississippi Sound, Lake Borgne, Bay Boudreau Stock) during summer 2012. In December 2013 the fisherman was convicted under the MMPA for knowingly shooting a dolphin with a shotgun while shrimping.

In addition to the above case where it was confirmed the fisherman retaliated against depredation by dolphins, there have been several other documented shootings of BSE common bottlenose dolphins in recent years, both by arrows and guns. During 2014 in Cow Bayou, Texas (Sabine Lake Stock), a dolphin was shot with a compound bow resulting in mortality. In 2014 near Orange Beach, Alabama (Perdido Bay Stock), a dolphin was shot with a hunting arrow. In the arrow cases, there was no evidence the acts were committed due to dolphin depredation of fishing gear. In 2014 within Choctawhatchee Bay, Florida (Choctawhatchee Bay Stock), a pregnant bottlenose dolphin was found dead with a bullet lodged in its lung. Necropsy results indicated the dolphin died of the gunshot wound. Two individual bottlenose dolphins were shot with buckshot-like ammunition in Louisiana waters: 1 in 2014 within Barataria Bay (Barataria Bay Stock), and 1 in 2013 in a canal off Terrebonne Bay (Terrebonne Bay, Timbalier Bay Stock). In 2013 in Mississippi Sound, a dolphin was found with a bullet lodged in its lung. Necropsy results indicated the bullet had been there for several months and likely was not the cause of death. In the gunshot cases, it is unknown whether the animals were shot due to depredation of fishing gear, but it is possible one or more of these acts was related to depredation. All of these shootings were included in the stranding database and in Table 2. During 2012 a dolphin was observed swimming in Perdido Bay with a screwdriver protruding from its melon and was found dead the next day. This stabbing was included in the stranding database and in Table 2.

Illegal feeding or provisioning of wild bottlenose dolphins has been documented in Florida, particularly near Panama City Beach in the Panhandle (Samuels and Bejder 2004) and in and near Sarasota Bay (Cunningham-Smith *et al.* 2006; Powell and Wells 2011), and also in Texas near Corpus Christi (Bryant 1994). Feeding wild dolphins is defined under the MMPA as a form of 'take' because it can alter their natural behavior and increase their risk of injury or death. Nevertheless, a high rate of provisioning was observed near Panama City Beach in 1998 (Samuels

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and Bejder 2004), and provisioning has been observed south of Sarasota Bay since 1990 (Cunningham-Smith *et al.* 2006; Powell and Wells 2011). There are emerging questions regarding potential linkages between provisioning and depredation of recreational fishing gear and associated entanglement and ingestion of gear, which is increasing through much of Florida. During 2006, at least 2% of the long-term resident dolphins of Sarasota Bay died from ingestion of recreational fishing gear (Powell and Wells 2011).

Swimming with wild bottlenose dolphins has also been documented in Florida in Key West (Samuels and Engleby 2007) and near Panama City Beach (Samuels and Bejder 2004). Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to illegal provisioning. Swimming with wild dolphins may cause harassment, and harassment is illegal under the MMPA.

As noted previously, bottlenose dolphins are known to be struck by vessels (Wells and Scott 1997; Wells *et al.* 2008). During 2010–2014, 19 stranded bottlenose dolphins (of 564 total strandings) showed signs of a boat collision (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015). It is possible some of the instances were post-mortem collisions. In addition to vessel collisions, the presence of vessels may also impact bottlenose dolphin behavior in bays, sounds and estuaries. Nowacek *et al.* (2001) reported that boats pass within 100 m of each bottlenose dolphin in Sarasota Bay once every 6 minutes on average, leading to changes in dive patterns and group cohesion. Buckstaff (2004) noted changes in communication patterns of Sarasota Bay dolphins when boats approached. Miller *et al.* (2008) investigated the immediate responses of bottlenose dolphins to "high-speed personal watercraft" (i.e., boats) in Mississippi Sound. They found an immediate impact on dolphin behavior demonstrated by an increase in traveling behavior and dive duration, and a decrease in feeding behavior for non-traveling groups. The findings suggested dolphins attempted to avoid high-speed personal watercraft. It is unclear whether repeated short-term effects will result in long-term consequences like reduced health and viability of dolphins. Further studies are needed to determine the impacts throughout the Gulf of Mexico.

As part of its annual coastal dredging program, the Army Corps of Engineers conducts sea turtle relocation trawling during hopper dredging as a protective measure for marine turtles. No interactions have been documented during the most recent 5 years, 2010–2014, that fall within BSE stocks in this report; however, 1 interaction occurred within the boundaries of the Mississippi Sound, Lake Borgne, Bay Boudreau Stock (please see that SAR for details). In earlier years, 5 interactions, including 4 mortalities (2003, 2005, 2006, 2007), were documented in the Gulf of Mexico involving bottlenose dolphins and relocation trawling activities. It is likely that 2 of these animals belonged to BSE stocks (2003, 2006).

There have been documented mortalities of common bottlenose dolphins during health-assessment research projects in the Gulf of Mexico, but none have occurred during the most recent 5 years, 2010–2014. Historically, 1 mortality occurred within Sarasota Bay in 2002, and 1 mortality occurred in St. Joseph Bay in 2006.

Some of the BSE communities were the focus of a live-capture fishery for bottlenose dolphins which supplied dolphins to the U.S. Navy and to oceanaria for research and public display for more than 2 decades (Reeves and Leatherwood 1984; Scott 1990). Between 1973 and 1988, 533 bottlenose dolphins were removed from Southeastern U.S. waters (Scott 1990). The impact of these removals on the stocks is unknown. In 1989, the Alliance of Marine Mammal Parks and Aquariums declared a self-imposed moratorium on the capture of bottlenose dolphins in the Gulf of Mexico (Corkeron 2009).

HABITAT ISSUES

The DWH MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500 m deep, exploded on 20 April 2010. The rig sank, and over 87 days up to ~4.9 million barrels of oil were discharged from the wellhead until it was capped on 15 July 2010 (McNutt *et al.* 2012). During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns (Buist *et al.* 1999; NOAA 2011). The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

A substantial number of beaches and wetlands along the Louisiana coast experienced heavy or moderate oiling (OSAT-2 2011; Michel *et al.* 2013). The heaviest oiling in Louisiana occurred west of the Mississippi River on the Mississippi Delta and in Barataria and Terrebonne Bays, and to the east of the river on the Chandeleur Islands. Some heavy to moderate oiling occurred on Alabama and Florida beaches, with the heaviest stretch occurring from Dauphin Island, Alabama, to Gulf Breeze, Florida. Light to trace oil was reported along the majority of Mississippi's mainland coast, from Gulf Breeze to Panama City, Florida, and outside of Atchafalaya and Vermilion Bays in western Louisiana. Heavy to light oiling occurred on Mississippi's barrier islands (Michel *et al.* 2013). Thus, it is likely that some BSE stocks were exposed to oil. Dolphins were observed with tar balls attached to them and seen swimming through oil slicks close to shore and inland bays. The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; Helm *et al.* 2015). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; Helm *et al.* 2015).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, continental shelf, coastal and estuarine marine mammals. The research is ongoing. For coastal and estuarine dolphins, the NOAA-led efforts include: active surveillance to detect stranded animals in remote locations; aerial surveys to document the distribution, abundance, species and exposure relative to oil from the DWH spill; assessment of sublethal and chronic health impacts on coastal and estuarine bottlenose dolphins in Barataria Bay, Louisiana, Mississippi Sound, and a reference site in Sarasota Bay, Florida; and assessment of injuries to dolphin stocks in Barataria Bay and Chandeleur Sound, Louisiana, Mississippi Sound, and as a reference site, St. Joseph Bay, Florida.

The nearshore habitat occupied by many of these stocks is adjacent to areas of high human population, and in some bays, such as Mobile Bay in Alabama and Galveston Bay in Texas, is highly industrialized. The area surrounding Galveston Bay, for example, has a coastal population of over 3 million people. More than 50% of all chemical products manufactured in the U.S. are produced there, and 17% of the oil produced in the Gulf of Mexico is refined there (Henningsen and Würsig 1991). Many of the enclosed bays in Texas are surrounded by agricultural lands which receive periodic pesticide applications.

Concentrations of chlorinated hydrocarbons and metals were examined in conjunction with an anomalous mortality event of bottlenose dolphins in Texas bays in 1990 and found to be relatively low in most; however, some had concentrations at levels of possible toxicological concern (Varanasi *et al.* 1992). No studies to date have determined the amount, if any, of indirect human-induced mortality resulting from pollution or habitat degradation.

Analyses of organochlorine concentrations in the tissues of bottlenose dolphins in Sarasota Bay, Florida, have found that the concentrations in male dolphins exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring, and higher contaminant concentrations in these calves and in primiparous females (Wells *et al.* 2005). While there are no direct measurements of adverse effects of pollutants on estuary dolphins, the exposure to environmental pollutants and subsequent effects on population health are areas of concern and active research.

STATUS OF STOCKS

The status of these stocks relative to OSP is unknown and this species is not listed as threatened or endangered under the Endangered Species Act. The occurrence of 13 Unusual Mortality Events (UMEs) among common bottlenose dolphins along the northern Gulf of Mexico coast since 1990 (Litz *et al.* 2014; http://www.nmfs.noaa.gov/pr/health/mmume/events.html, accessed 11 January 2016) is cause for concern. Notably, stock areas in Louisiana, Mississippi, Alabama and the western Florida panhandle have been impacted by a UME of unprecedented size and duration (began 1 February 2010, and as of December 2015, the event is under consideration for closure). However, the effects of the mortality events on stock abundance have not yet been determined, in large part because it has not been possible to assign mortalities to specific stocks due to a lack of empirical information on stock identification.

Human-caused mortality and serious injury for each of these stocks is not known. Considering the evidence from stranding data (Table 2) and the low PBRs for stocks with recent abundance estimates, the total fishery-related mortality and serious injury likely exceeds 10% of the total known PBR or previous PBR, and therefore, it is probably not insignificant and not approaching the zero mortality and serious injury rate. NMFS considers each of these stocks to be strategic because most of the stock sizes are currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR.

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ATTACHMENT B

NMFS COMPUTATIONS AND MATLAB SPREADSHEETS

COMPUTATION OF CUMULATIVE SOUND EXPOSURE IMPACT ZONE FOR ACOE MIAMI HARBOR PROJECT

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1. Determine Source Level

Peak source levels of the confined blast are calculated based on Hempen et al. (2007):

$$P = 5,640 \times \left(\frac{d}{W^{1/3}} \right)^{-1.23} \tag{1}$$

where P is peak pressure in pounds per square inch (psi), d is distance in ft, and W is weight in pounds. For source level calculation

$d = 3.281$ ft
W is chosen for: 1 through 450 lbs at increment of 1 lb,

Note: The maximum charge weight (W) of 450 lbs is based on ACOE's information for the maximum single charge in a delay. The total charge weight is conservatively defined as the product of the maximum single charge and the number of charges, since the combination of the charge weight is often unknown.

2. Explosive Energy Computation from Peak Pressure of the Single Maximum Charge

For plane wave, the energy density can be expressed as (Kinsley et al. 2000):

$$E = \frac{1}{\rho c} \int_0^\infty p^2(t) dt \tag{2}$$

where ρc is the characteristic impedance of the medium (seawater).

For underwater explosives, it is found that the shock wave, expressed as a relationship between pressure and time (t), can be approximated by (Urick 1983)[1]:

$$p(t) = P e^{-t/t_0} \tag{3}$$

[1] The decay function can be updated based on the wave form of a detonation, if provided.

where P is the initial pressure of the shock wave at $t = 0$, and t_0 is time constant when the shock pressure decays to $1/e$ of its initial value P, with unit of microsecond (Urick 1983):

$$t_0 = 58W^{1/3} \times \left(\frac{W^{1/3}}{r} \right)^{-0.22} \qquad (4)$$

and r is the range in ft.

3. Summation of Total Explosive Energy from All Charges

Due to time and spatial separation of each single charges by a distance of XX m, the accumulation of acoustic energy is added sequentially, assuming the transmission loss follows cylindrical spreading.

$$E_{total} = \sum_{i=1}^{20} E_i \qquad (5)$$

where E_{total} is the total acoustic energy from all charges, and E_i is the acoustic energy from each single detonation.

The sound exposure level can be calculated

$$SEL = 10 \log_{10} \left(\frac{E}{E_{ref}} \right) \qquad (6)$$

where $E_{ref} = 6.76 \times 10^{-19}$ W/m^2.

The subsequent sound exposure level (SEL_i) can be calculated by

$$SEL_i = SEL - TL_i \qquad (7)$$

where SEL is the sound exposure level of the first detonation, and SEL_i is the sound exposure level from each subsequent detonation, and TL_i is the transmission loss of acoustic energy due to cylindrical spreading from each subsequent detonation.

$$TL_i = 10 \log R_i \qquad (8)$$

where R_i = X, 2X, 3X, ... 39X m from the first (closest) charge.

The total sound exposure level

$$SEL_{total} = 10\log_{10}\left(10^{SEL_1/10} + 10^{SEL_2/10} + \ldots + 10^{SEL_{40}/10}\right) \quad (9)$$

4. Impact Range Calculation

The distance where the received level falls to desired SEL can be simply calculated by spherical spreading:

$$R = 10^{SPL_{total}/20} \quad (10)$$

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Level B Behavioral Harassment 165 dB

Total charge weight (lb)	cSEL @ source	Distance (m)
10-lb x 40 = 400 lbs	230.0474309	1788.0166
20-lb x 40 = 800 lbs	233.2985549	2599.726996
30-lb x 40 = 1200 lbs	235.2003405	3236.063417
40-lb x 40 = 1600 lbs	236.5496788	3779.931605

Level B TTS 170 dB

Total charge weight (lb)	cSEL @ source	Distance (m)
10-lb x 40 = 400 lbs	230.0474309	1005.475624
20-lb x 40 = 800 lbs	233.2985549	1461.933924
30-lb x 40 = 1200 lbs	235.2003405	1819.772191
40-lb x 40 = 1600 lbs	236.5496788	2125.611748

Level A PTS 185 dB

Total charge weight (lb)	cSEL @ source	Distance (m)
10-lb x 40 = 400 lbs	230.0474309	178.80166
20-lb x 40 = 800 lbs	233.2985549	259.9726996
30-lb x 40 = 1200 lbs	235.2003405	323.6063417
40-lb x 40 = 1600 lbs	236.5496788	377.9931605

Level A Take Lung Injury

Max. single charge weight (lb) in an array	Impulse (Pa-sec) @ source	Impact distance (m) @ 0 m depth	Impact distance (m) @ 12 m depth	Impact distance (m) @ 15 m depth
10	3177.7741	5.806999551	4.773347055	4.623719548
20	5056.07046	7.324818046	6.020992139	5.832255383
30	6634.2871	8.390491712	6.896974686	6.680778982
40	8044.57704	9.239360007	7.594743463	7.356675182

Level A Take Mortality

Max. single charge weight (lb) in an array	Impulse (Pa-sec) @ source	Impact distance (m) @ 0 m depth	Impact distance (m) @ 12 m depth	Impact distance (m) @ 15 m depth
10	3177.774098	3.798105931	3.122038774	3.024173928
20	5056.070464	4.790845018	3.938069179	3.814624673
30	6634.287096	5.48785583	4.511011278	4.369607067
40	8044.577038	6.043063675	4.967391497	4.811681385