



# AQUAFAC

**Marine Mammal Risk Assessment  
for the Port of Waterford's proposed  
Dredging and Disposal Programme**

**Produced by**

**AQUAFAC International Services Ltd**

**On behalf of**

**Port of Waterford**

**Issued**

**November 2017**

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# 1. Marine Mammal Risk Assessment

## 1.1. Introduction

### 1.1.1. Sound source

There will be three sound sources of relevance:

1. noise produced from the dredging activity,
2. the vessel noise and
3. noise associated with the disposal activity.

Dredging to maintain shipping lanes emits continuous broadband sound during operations, mostly in the lower frequencies (OSPAR Commission, 2009a). Dredging operations have been reported to produce low frequency omnidirectional sound of several tens of Hz to several thousand Hz (and up to approximately 20 kHz) at sound pressure levels of 135 – 186 dB re: 1  $\mu$ Pa (Richardson *et al.*, 1995; OSPAR, 2009a; 2009b cited in DAHG, 2012). In one investigation, estimated source levels ranged from 160 to 180 dB re 1  $\mu$ Pa at 1 m (maximum  $\sim$  100 Hz). Bandwidth was between 20 Hz and 1 kHz (limited by the recording equipment; most energy was below 500 Hz; Richardson *et al.* 1995). In a Defra (2003) study measured sound spectrum levels emitted by an aggregate dredger at different distances and found most energy to be below 500 Hz. Robinson *et al.*, (2011) reported on noise measurements from 5 different trailer suction hopper dredges which operate in UK waters ranging in length from 72 to 120m, in capacity from 1418 to 4832m<sup>3</sup> and in installed power from 2720 to 4920kW (2460 x 2). Operating frequencies for full dredging (draghead down, pump on) ranged from as low as 30 to 50Hz to into the high tens of kHz. Where measurements up to 100 kHz were obtained, it was clear that they correlated with sediment extraction and where measurements up to 200 kHz were observed, the evidence indicated that the levels dropped substantially above 100 kHz. The source levels ranged from c. 156 to 183 dB re 1  $\mu$ Pa at 1m.

The dredging vessel(s) are typically less than 100m in length. Typical broadband source levels for these mid-size vessels are generally in the 165 - 180 dB (re: 1 $\mu$ Pa) range (Richardson *et al.*, 1995; Kipple & Gabriel, 2003a; 2004; Heitmeyer *et al.*, 2004). There is considerable variability in the associated

frequency spectra, although medium-sized ships tend to be more similar to large vessels in that the vast majority of sound energy is in the low-frequency band (below 1 kHz) (OSPAR Commission, 2009a).

Noise from the discharge of spoil will be masked by the vessel noise. The OSPAR Commission identifies engine noise as the noise associated with the dumping of wastes at sea (OSPAR Commission, 2009b).

While the majority of the energy generated by vessel movements is below 1 kHz, full dredging can generate higher levels of broadband noise up to 200 kHz (although it is not as high for sand extraction as it is for gravel extraction) (Robinson *et al.*, 2011). The source level for both activities is predominantly between 160 and 180 dB (re: 1  $\mu$ Pa). During the disposal operation, the dredger slows to approximately 1 knot, the doors are opened at the bottom of the dredger and the contained sediments fall under gravity out of the dredger. During this process the engine noise would be at minimal levels and no dredging pumps would be in operation.

### 1.1.2. Species

The IWDG sightings database from January 2008 to December 30<sup>th</sup> 2014 (data for 2015 and beyond is not available on NBDC's web-based map viewer at time of print) reveal 411 sightings within a 25km zone around the disposal site. Figure 1 shows the data in graphical form. All records are validated by IWDG and available on [www.biodiversityireland.ie](http://www.biodiversityireland.ie). These 411 sightings comprised 2,524 individuals. Highest density of sightings and numbers of individuals were recorded from outside the harbour area (a line drawn from Hook Head to Black Knob at Dunmore East). Thirty sightings and 345 individuals were observed in the harbour area (7.3% of the total sightings and 13.7% of the total individuals). In the harbour area, no sightings were made inside of Passage East. The harbour porpoise was observed around Passage East between February and April 2013, February and September 2012, March, April and October 2011, November 2010 and April 2008 in numbers ranging from 1 to 3. The common dolphin (25 individuals) was observed in March 2013 c. 500m northwest of Duncannon quay. The harbour porpoise was also observed c. 1km northeast of Creadan Head (near the Duncannon Bay) in July 2010 (1 individual). Dolphin spp. were observed 1.5km east of Creadan Head in March 2013 (3 individuals) and the bottlenose dolphin was observed c. 500m southeast of Creadan Head in August 2008 (6 individuals). The fin whale was observed in February 2009 (3 individuals) and the minke whale in December 2008 (1 individual) c. 2.4 and 4km east of Dunmore East respectively. The common dolphin was observed

between 440m and 2km east and southeast of Dunmore East in January and February 2013 and January 2012 in numbers ranging from 7 to 150 individuals. The harbour porpoise was observed in March 2012 c. 2.5km northwest of Hook Head (2 individuals) and dolphin spp. (possibly harbour porpoise) was present in December 2011 c. 850m southeast of Dunmore East (2 individuals).

Outside of the harbour area, sightings increase significantly. Within 5km of the disposal site, 16.5% of the total number of sightings were made and 17.5% of the total number of sightings. With regards to the area outside the harbour only, the number of sightings within 5km of the disposal site represented 17.8% of the sightings made outside the harbour. This amounted to 20.2% of the individuals recorded from outside the harbour. Within 5km of the disposal site, the following 9 species were observed: harbour porpoise, Risso’s dolphin, fin whale, humpback whale, minke whale, dolphin spp. (possibly harbour porpoise, large whale spp., whale spp. and cetacean spp. throughout all months of the year except July and October.

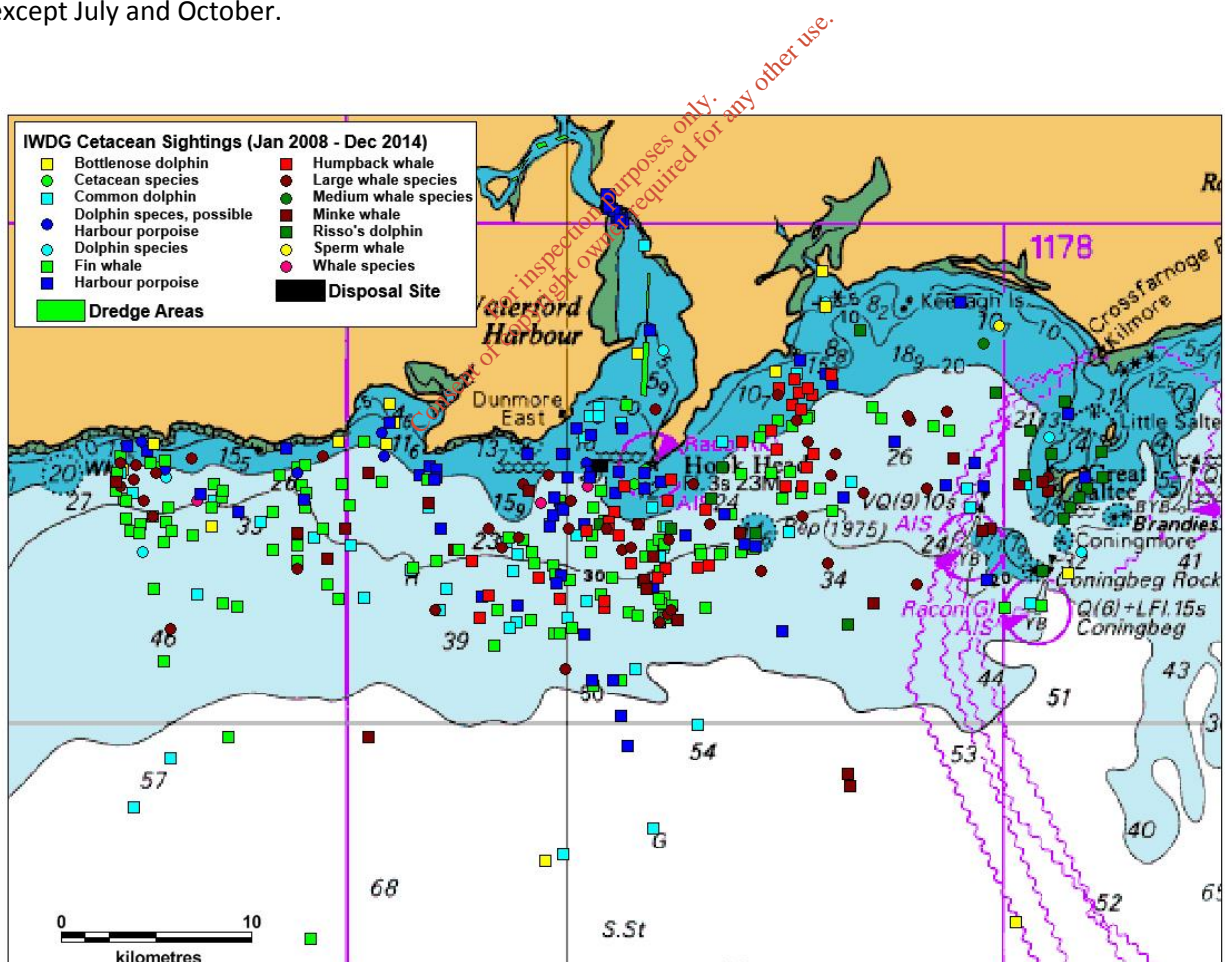


Figure 1: Cetacean sightings from January 2008 to December 2014 within 25km of the disposal site (Data from

the Marine Mammals - IWDG Casual Cetacean Sightings database held by the National Biodiversity Data Centre [www.biodiversityireland.ie](http://www.biodiversityireland.ie), [June, 2017]).

Figure 2 shows a breakdown of these sightings by species and Figure 3 shows a breakdown of these sightings by number of individuals. The fin whale was the most commonly sighted cetacean in the area (122 sightings, 29.7%), followed by the harbour porpoise (79 sightings, 19.2%), large whale spp. (46 sightings, 11.2%), the common dolphin (50 sightings, 12.2%) and humpback whale (37 sightings, 9%). In terms of numbers of individuals, the common dolphin was the most numerous with 1,421 individuals (56.3%), followed by the fin whale with 385 individuals (15.3%) and the harbour porpoise with 226 individuals (8.95%). Table 1 shows the average number of individuals per sighting per species. In total, 8 species were recorded from the area with a further 6 species not identifiable to species level were recorded. The common dolphin had the highest number (28.4) followed by the dolphin spp. (possibly harbour porpoise) with 10.4, dolphin spp. with 8.3 and bottlenose dolphin with 6.2.

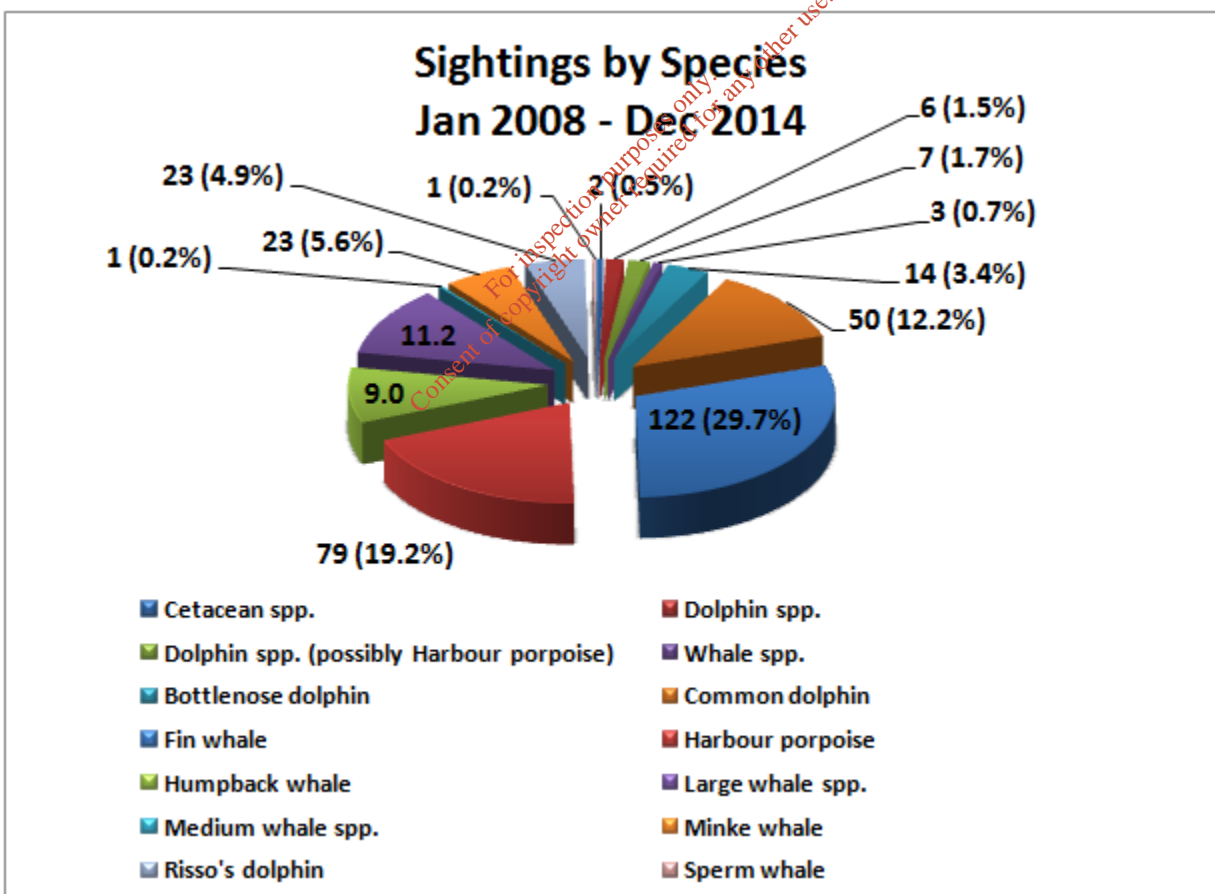


Figure 2: Number of sightings by species Jan 2008 – December 2014 (IWDG Cetacean Sightings available from [www.biodiversityireland.ie](http://www.biodiversityireland.ie))

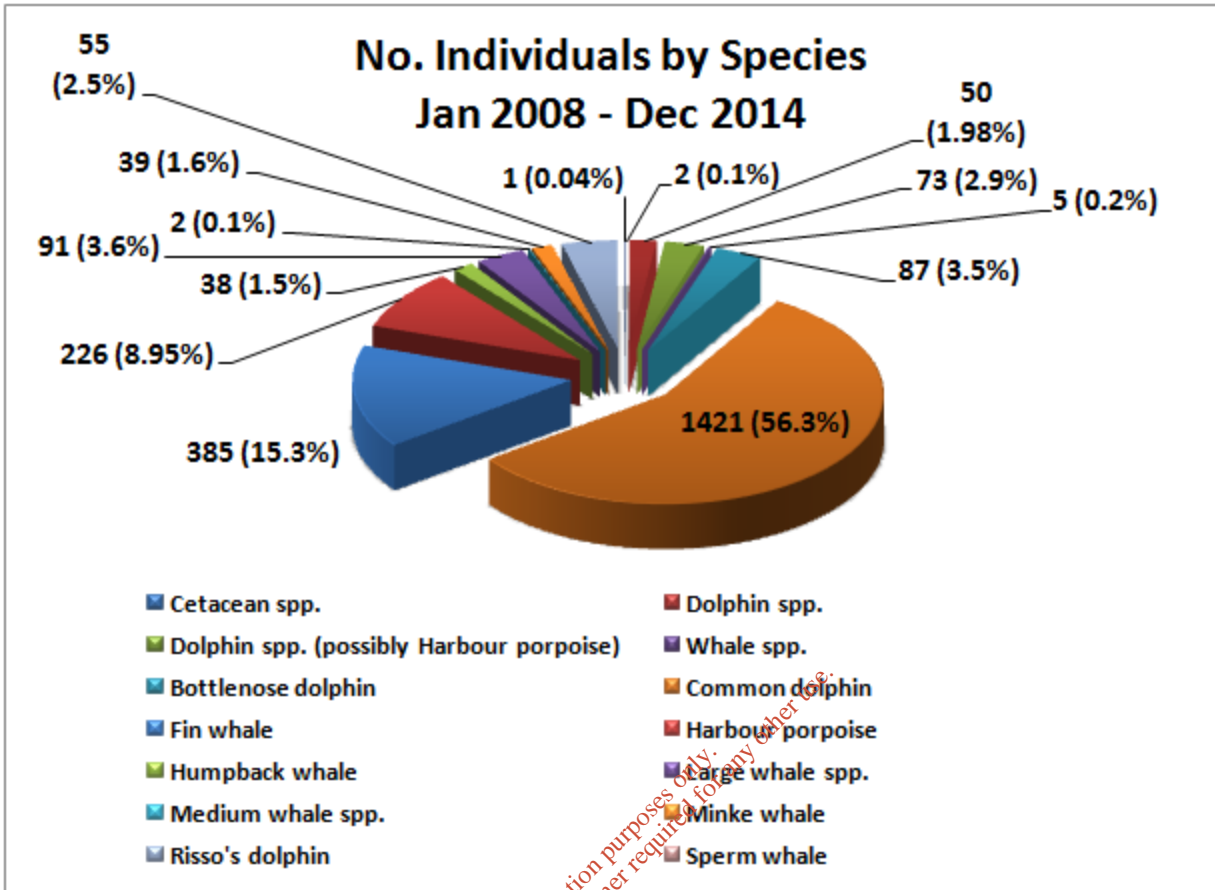


Figure 3: Number of individuals by species Jan 2008 – December 2014 (IWDG Cetacean Sightings available from www.biodiversityireland.ie).

Table 1: Average number of individuals per sighting (IWDG Cetacean Sightings available from www.biodiversityireland.ie).

Species	Average no. individuals / sighting
Common dolphin	28.4
Dolphin spp. (possibly Harbour porpoise)	10.4
Dolphin spp.	8.3
Bottlenose dolphin	6.2
Risso's dolphin	5.2
Fin whale	3.2
Harbour porpoise	2.9
Large whale spp.	2
Medium whale spp.	2

Species	Average no. individuals / sighting
Whale spp.	1.7
Minke whale	1.7
Cetacean spp.	1
Humpback whale	1
Sperm whale	1

Figures 4 and 5 shows the breakdown of sightings and number of individuals by month and Table 2 shows the average number of individuals per sighting per month. January has the highest number of sightings (122 sightings, 29.7%), followed by December (68 sightings, 15.1%), November (62 sightings, 15.1%) and February (54 sightings, 13.1%). January has the highest number of individuals (932 individuals, 36.9%), followed by November (449 individuals, 17.8%), December (447 individuals, 17.7%) and February (323 individuals, 12.8%). October and September had the lowest number of sightings (7 sightings, 1.7% and 8 individuals, 1.9% respectively) and October and April had the lowest number of individuals (10 individuals, 0.4% and 19 individuals, 0.8% respectively).

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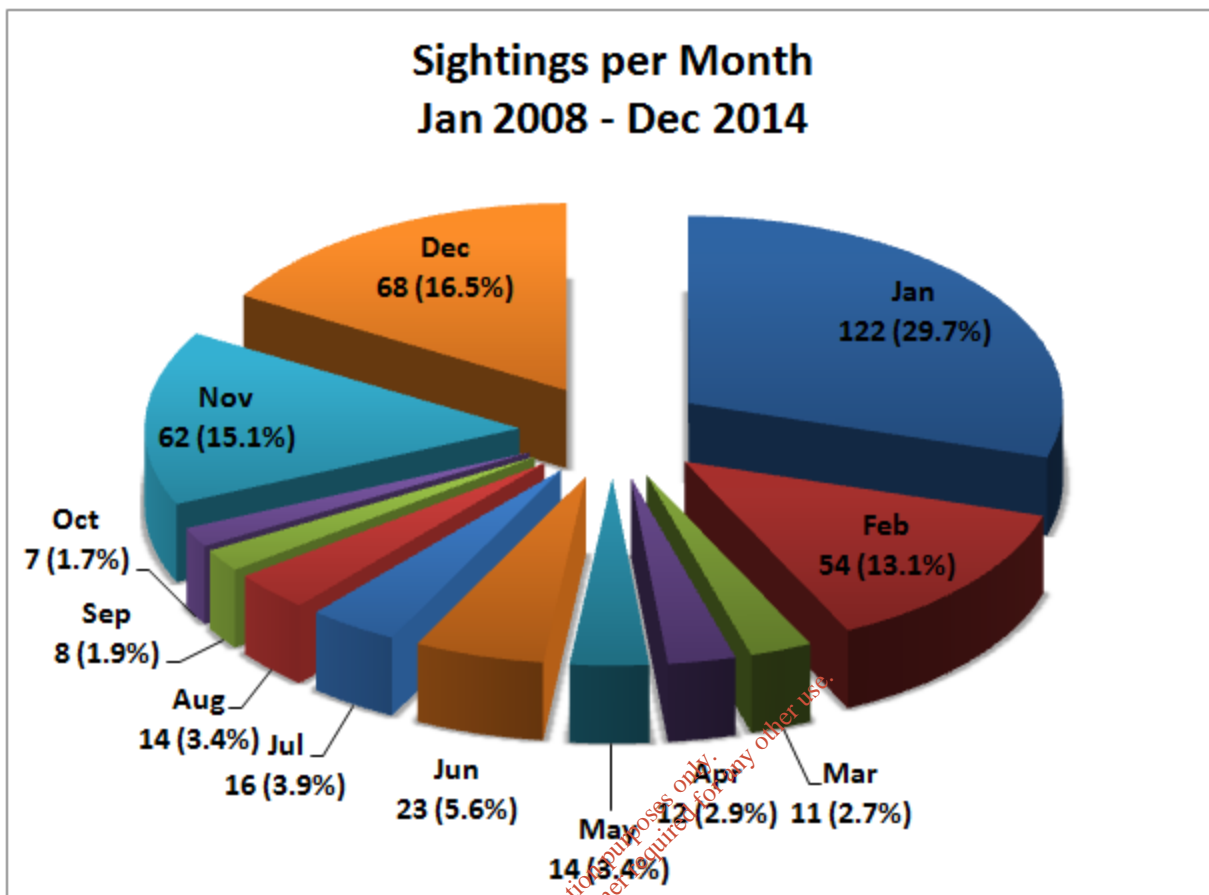


Figure 4: Number of sightings per month Jan 2008 - December 2014 (IWDG Cetacean Sightings available from [www.biodiversityireland.ie](http://www.biodiversityireland.ie)).

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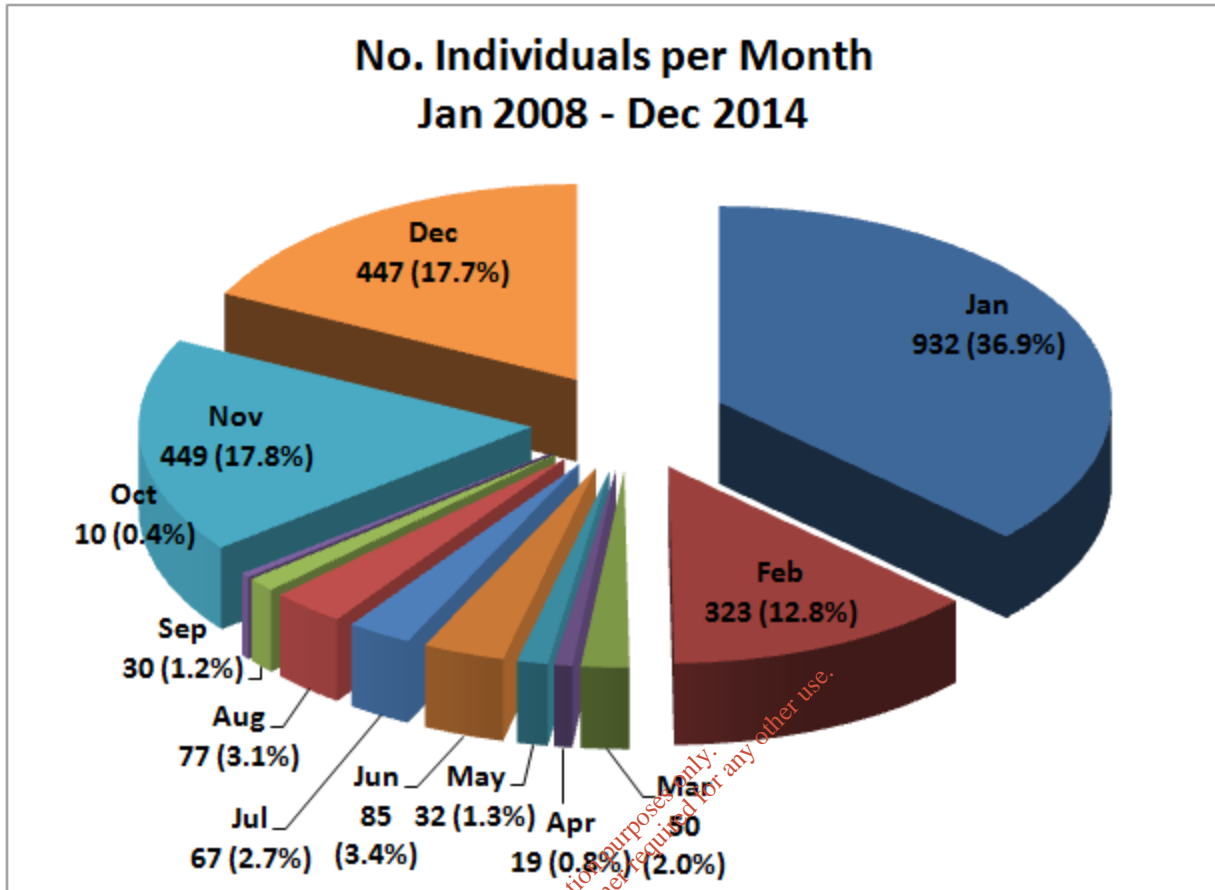


Figure 5: Number of individuals per month Jan 2008 – December 2014 (IWDG Cetacean Sightings available from www.biodiversityireland.ie).

Table 2: Average number of individuals per sighting per month (IWDG Cetacean Sightings available from www.biodiversityireland.ie).

Month	Average no. individuals / sighting
Jan	7.6
Nov	7.2
Dec	6.6
Feb	6.0
Aug	5.5
Mar	4.5
Jul	4.2
Sep	3.8
Jun	3.7

Month	Average no. individuals / sighting
May	2.3
Apr	1.6
Oct	1.4

In addition to cetaceans, two species of pinnipeds are present in the general area, the harbour or common seal and the grey seal (a qualifying interest of the Saltee Islands cSAC). The grey seal breeds on the Saltee Islands (Ó Cadhla *et al.*, 2007) and Waterford Harbour is well within its foraging range. While the harbour seal does not have key breeding or hauling sites along the south coast (Ó Cadhla *et al.*, 2007), it will still occur within the Waterford Harbour area.

### 1.1.3. Environment

A number of factors determine cetacean distribution and abundance. The availability and distribution of prey (Evans, 1990) is one. The distribution of prey is not uniform in space or time and dynamic physical and oceanographic features prevail to maintain this heterogeneous environment (Ó Cadhla *et al.*, 2004). Water temperature is another factor affecting distribution. Seasonal changes in species distribution are also evident for some species (Pollock *et al.*, 1997). These changes may be related to prey availability, migratory movements or breeding requirements.

The harbour porpoise is abundant inshore along the south and southwest coasts and they breeds in Irish waters. They occur throughout the Celtic Sea with some large aggregations noted off the south coast in the Autumn months. Some evidence for an offshore movement in spring between March and June (IWDG, 2010) which may be linked to calving.

Common dolphins are present all year round and breed in Irish waters. They are most abundant off the south and southwest coasts during late summer and autumn (Reid *et al.*, 2003). An eastward movement along the south coast occurs during autumn and winter, with sightings peaking off Kerry towards late summer, between September and January off Co. Cork and November to February off Co. Waterford (Berrow *et al.*, 2010). This is thought to be linked to prey availability.

The bottlenose dolphin have a year-round distribution with apparent peaks between May and

September and they breed in Irish waters.

Risso's dolphins recorded throughout the year in Irish waters with a wide distribution (Aecom & Metoc, 2010). They are regularly observed inshore and in bays along the southwest and southeast coasts (NPWS, 2008) and they breed in Irish waters.

A number of baleen whales have been recorded in the Waterford area. The minke whale is the most widespread and frequently recorded baleen whale in Irish waters. They are present mainly from April to November and occur along all Irish coasts, most commonly off the south and southwest of Ireland (Reid *et al.*, 2003; Berrow *et al.*, 2010).

Fin whales forage from June to February off the south coast, generally moving eastwards with the passing months. The high level of site fidelity and inter-annual occurrence of individuals along the southern Irish coast indicate that these inshore waters are an important foraging habitat for fin whales (Whooley *et al.*, 2011).

Humpback whales have been recorded in small numbers inshore off all coasts, with the majority of sightings occurring along the Cork coast (Berrow *et al.*, 2002). During 2009/2010, this species was present off the south coast from June - December (Berrow *et al.*, 2010); however, this species has been recorded in all months of the year and was sighted off the southeast coast in late 2010 and early 2011. Singing individuals have been recorded between October and March moving southwesterly, suggesting that the offshore waters off the west coast of Ireland are a migratory route (Charif *et al.*, 2001; Charif & Clark, 2009).

The grey seal and harbour seal (also known as the common seal) have established themselves in terrestrial colonies (or haul-outs) along all coastlines of Ireland, which they leave when foraging or moving between areas and to which they return to rest ashore, rear young, engage in social activity, *etc.* The haul-out groups of harbour seals have tended historically to be found among inshore bays and islands, coves and estuaries (Lockley, 1966; Summers, 1980), particularly around the hours of lowest tide. The grey seal breeds on exposed rocky shores, on sand bars or in sea caves with ready access to deep water. Other haul-out areas for the grey seal are located on exposed rocky areas or steeply

shelving sandbanks. Neither species have breeding or haul out sites in the Waterford area.

## 1.2. Risk Identification

As mentioned in Section 1, the risks associated with dredging and disposal is the noise produced from the full dredging operation, from the disposal activities and from the vessel movements between and around the dredging areas and to and from the disposal site. Vessel noise at the disposal site masks the noise generated from the disposal operations. The majority of the energy generated by vessel movements is below 1 kHz and full dredging can generate higher levels of broadband noise up to 200 kHz (although it is not as high for sand extraction as it is for gravel extraction) (Robinson *et al.*, 2011). The source level for both activities is predominantly between 160 and 180 dB (re: 1  $\mu$ Pa). Vessel noise associated with the disposal operation would be at a minimal as the vessel would slow to c. 1 knot and no dredging pumps would be in operation.

The functional frequencies of cetaceans and pinnipeds are detailed below:

- Baleen whales: low frequency - 7Hz to 22 kHz, species include humpback whale, fin whale and minke whale;
- Most toothed whales and dolphins: mid frequency – 150 Hz to 160 kHz, species include sperm whale and dolphin species;
- Certain toothed whales and porpoises: high frequency – 200 Hz to 180 kHz, species include harbour porpoise;
- Pinnipeds (in water): 75 Hz to 75 kHz, both grey and harbour seals;
- Pinnipeds (in air): 75 Hz to 30 kHz, both grey and harbour seals;

Tables 3 and 4 shows the noise exposure criteria for these cetaceans and pinnipeds (Southall *et al.*, 2007).

**Table 3: Criteria for Permanent injury – estimated values for PTS onset for non pulse sources.**

Cetaceans			Pinnipeds (in water)	Pinnipeds (in air)
Low frequency 7Hz – 22 kHz Baleen whales	Mid-frequency 150 Hz – 160 kHz Most toothed whales, dolphins	High frequency 200 Hz – 180 kHz Certain toothed whales, porpoises	75 Hz – 75 kHz	75 Hz – 30 kHz
230dB SPL 215dB SEL	230dB SPL 215dB SEL	230dB SPL 215dB SEL	218dB SPL 2203dB SEL	149dB SPL 144.5dB SEL

**Table 4: Criteria and values for disturbance/behavioural response from non pulse sources.**

Cetaceans			Pinnipeds (in water)	Pinnipeds (in air)
Low frequency 7Hz – 22 kHz Baleen whales	Mid-frequency 150 Hz – 160 kHz Most toothed whales, dolphins	High frequency 200 Hz – 180 kHz Certain toothed whales, porpoises	75 Hz – 75 kHz	75 Hz – 30 kHz
120 – 160 dB RL	90 – 200 dB RL	90 – 170 dB RL	100+ dB RL	110 – 120 dB RL

Richardson *et al.* (1995) provide an overview of investigations into behavioural responses of cetaceans to dredging. Bowhead whales (*Balaena mysticetus*) did not apparently respond to a suction dredge in one study, but individuals avoided these dredges when exposed to 122 -131 dB re 1  $\mu$ Pa (or 21-30 dB above ambient noise) in another investigation (see also Richardson *et al.* 1990). Gray whales (*Eschrichtius robustus*) ceased to use a particular breeding lagoon after an increase in industrial activities, including shipping and dredging (Bryant *et al.* 1984). However, it was not clear if this was due to sound or the increased presence of ships; no studies were made of the increase in sound or of received sound pressure levels.

### 1.3. Risk Assessment

The noise levels associated with dredging, disposal and vessel movements will not cause permanent injury to marine mammals. The noise levels are of a level that could result in a disturbance/behavioral response by marine mammals. However, given the fact that the harbour area is used very infrequently by marine mammals and in low numbers and the fact that the dredging activity is in frequent and short in duration (a 4 hour dredging cycle only comprises 1 hour of actual dredging) the risk to marine mammals during the dredging operations is considered insignificant. In addition, it is worth noting that during a recent dredging operation in Rosslare where an AQUAFACt MMO was present, observations were made of both harbour porpoises and common dolphins coming within 20m of the dredger (AQUAFACt, 2016) indicating that neither the vessel nor the dredging activity had any kind of “disturbance” effect on either of these species.

During transiting to the dumping site the dredger will have the characteristics of a small trade vessel.

Despite the fact that there are higher numbers and higher occurrences of marine mammals in the area of the disposal site, given the slow speed of the vessel during the disposal operations (c. 1 knot), the short timeframe involved (c. 10 min) and the fact that the dredging pumps will be turned off, the risks of disturbance to marine mammals during the disposal operations are considered insignificant. The presence of the vessel will be heard by any mammals in the area and if disturbed they will temporarily move away into open sea surrounding them. Also, the majority of sightings occur in December and January, a time dredging has been historically avoided, if possible, due to impact of inclement weather conditions on operations. The minimal risk is further alleviated when the frequency of dredging operations is considered (c. 12 day campaign biannually).

In addition, any cetaceans frequenting the dumping area would be used to vessel noise (there are c. 52 weekly commercial vessel movements through the harbour, not including fishing and recreational vessels) and in comparison to dumping operations these vessels pass the dumping area at speed. The mammals will hear the noises, but they will not be injured by them and depending on the species may remain in the area or temporarily vacate the immediate area during the transit operations.

With regard to increases in suspended solids due to the dredging and disposal operations, the risk of impact will be negligible as the dredging and disposal activities will be short-term and temporary and the plume of suspended sediments will be localised around the dredger and disposal site. Numerous reports have been undertaken on the effects of the dumping activities. The cetaceans will avoid the area of dredging/disposal if they are disturbed by the activity and will return to the area following the dredging/disposal operation.

As discussed in Section 8, the risk to marine mammals is insignificant given the infrequent use of the dredging areas by marine mammals. However, it may be pertinent to incorporate the use of clear 'soft-start' or 'ramp-up' procedures, whereby sound energy input to the marine environment is gradually or incrementally increased from levels unlikely to cause significant behavioural impact on marine mammals to the full output necessary for completion of the activity.

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