

Report on Marine Mammals in relation to the Dublin Array Natura Impact Statement

Report prepared for:

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1 Introduction

This report presents information on the Natura 2000 sites designated for marine mammals in the vicinity of the proposed Dublin Array wind farm and assesses the potential for significant adverse effects on any Natura 2000 site. It has been prepared with reference to the following guidelines:

- DEHLG (2009). *Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities*. Department of the Environment, Heritage and Local Government.
- NPWS (2012). *Marine Natura Impact Statements in Irish Special Areas of Conservation: A Working Document*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.
- EC (2002). *Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC*. European Commission.

2 Statement of authority

John Brophy graduated from Trinity College Dublin in 2000 with an honours degree in Natural Sciences (Zoology) and completed his masters degree in University College Cork in Fisheries Management, Development and Conservation in 2003. His M.Sc. thesis was entitled "*The diet of the common dolphin, Delphinus delphis, in Irish waters*". Following the completion of his M.Sc., John worked as a temporary research assistant in the Department of Zoology, Ecology and Plant Science in UCC on the Cetacean Strandings Project. In 2004, John began work with Ecological Consultancy Services Ltd (EcoServe) and has acquired over seven years' experience as an ecological consultant covering marine and freshwater habitats and species. John has continued his interest in marine mammals both professionally and outside of work, carrying out land-based and ship-based surveys for the Irish Whale and Dolphin Group (IWDG), attending conferences and training courses and spent two weeks on the cetacean research vessel *Song of the Whale* in 2010 assisting in a visual and hydro-acoustic survey of cetaceans off the west coast of Ireland and Scotland.

3 Background to Appropriate Assessment

Natura 2000 sites are a network of sites which are deemed to be of international importance for their habitats and/or species. This network is formed by Special Areas of Conservation (SACs) and

Special Protection Areas (SPAs), which have been designated by all member states of the European Community. Special Areas of Conservation are designated under the Habitats Directive (92/43/EEC), as transcribed into Irish law by the European Communities (Natural Habitats) Regulations, 1997 (as amended), while SPAs are designated under the Birds Directive (2009/147/EC replacing 79/409/EEC).

Article 6(3) of the Habitats Directive states that: *“Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon either individually or in combination with other plans or projects, shall be subject to **Appropriate Assessment** of its implications for the site in view of the site’s conservation objectives.”*

As such, any project likely to have a significant effect, either individually or in combination with other plans and projects, on the conservation objectives of Natura 2000 sites must undergo an assessment of the implications of this project on the relevant Natura 2000 sites.

It is detailed in the guidance documents prepared by the DEHLG (2009) and the European Commission (2002) that a staged approach to assessment is required.

A conclusion is made at the end of each stage of the assessment as to whether the project should proceed to the next stage.

- Stage 1: Screening - This stage determines whether appropriate assessment is necessary. The proposed project is defined and an assessment is made of the potential for significant effects upon the Natura 2000 network, either alone or in combination with other projects. Plans or projects directly connected with, or necessary to the nature conservation management of the site do not require an appropriate assessment.
- Stage 2: Appropriate Assessment - If there is potential for a significant effect on the Natura 2000 network an Appropriate Assessment is required. During this stage the impact of the project on the conservation objectives of the Natura 2000 sites is assessed and measures are proposed to avoid or reduce these impacts such that they do not result in a significant impact. The outcome of the assessment establishes whether the plan will have an adverse effect on the integrity of the Natura 2000 site. Factors such as the magnitude, extent, duration and reversibility of the effect are considered in this assessment.

- Stage 3 Alternative Solutions - Before a project that has adverse effects on a Natura 2000 site can proceed for imperative reasons of overriding public interest it must be objectively concluded that no less-damaging alternative solutions exist.
- Stage 4 Imperative Reasons for Overriding Public Interest (“IROPI”) - Where no alternative options exist and adverse impacts remain but imperative reasons of overriding public interest for the project exist compensatory measures must be implemented to ensure the overall coherence of the Natura 2000 site.

4 Stage 1 - Screening

4.1 Description of project

The proposed Dublin Array wind farm will be located on the Kish and Bray banks, approximately 10 km off the Dublin and Wicklow coasts (Figure 1). The proposed development will comprise 145 wind turbines with a maximum blade tip height of 160 m (maximum rotor diameter of 130 m and maximum hub height of 100 m) above mean sea level and associated infrastructure including the turbine foundations, inter-turbine cabling and offshore substation. The electricity generated by Dublin Array will be exported to the national grid via a cable that will run from an offshore substation on the banks to a proposed connection point at the existing Eirgrid Substation in Carrickmines, Co. Dublin via a cable landfall site at Shanganagh, south of Shankill, Co. Dublin and north of Bray, Co. Wicklow.

The project is not directly connected with, or necessary to the management of, any Natura 2000 site.

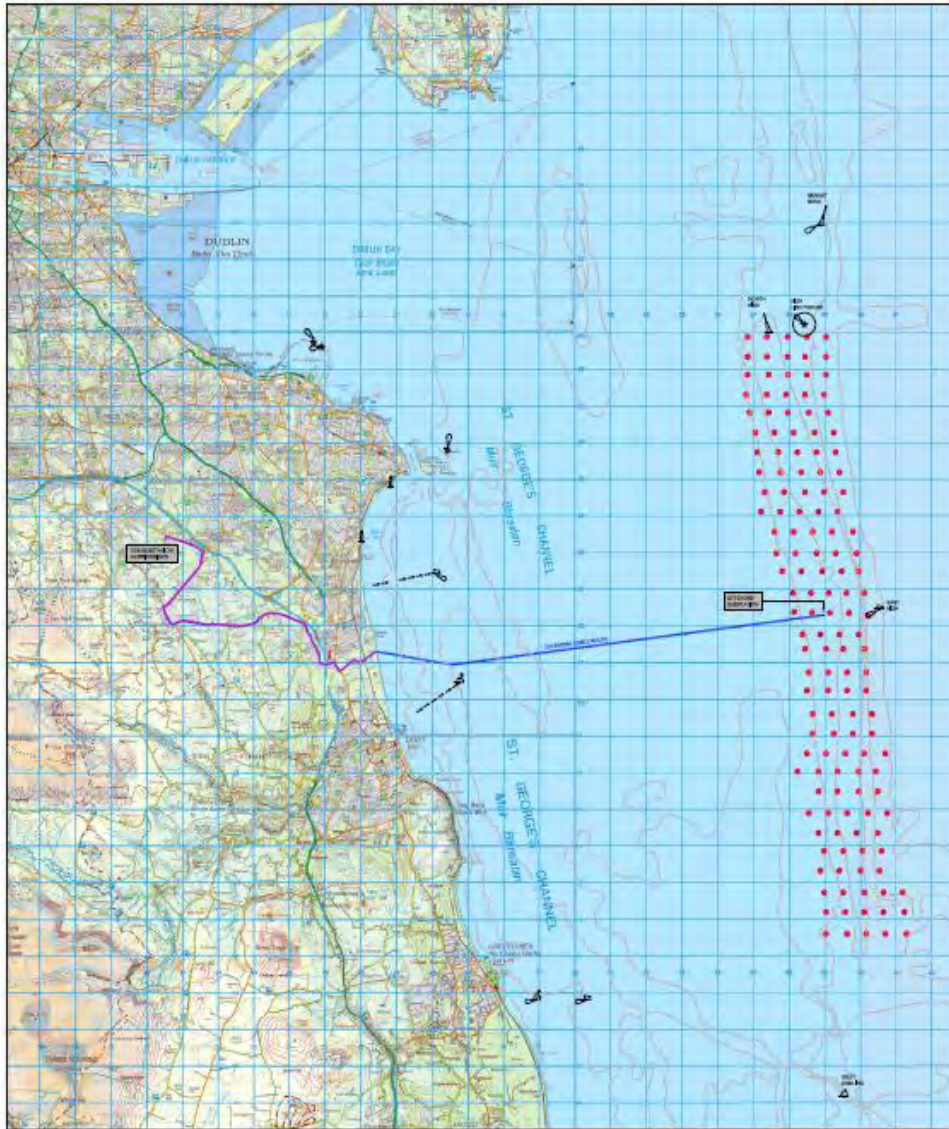


Figure 1. Location and layout of proposed Dublin Array wind farm.

The Kish and Bray banks were chosen for the location of the Dublin Array wind farm due to the relatively shallow water in this area. The completed development will cover an area of 54 km², though the footprint of the actual turbine foundations will be 0.03% of this area.

Construction will involve driving 145 monopile foundations up to 6.5 m diameter into the seabed at the Kish and Bray banks using a jack-up rig with pile-driving equipment. Wind turbines will be erected on the monopile foundations. Trenching will be required for the transmission cables between the turbines running to the offshore substation and ultimately ashore at Shanganagh. Appropriate mitigation measures will be employed during the construction activities.

A construction period of approximately 3 years is proposed for the completion of the Dublin Array. This will include monopile installation and turbine installation. This construction period is indicative only and will be subject to weather conditions and any conditions imposed in the foreshore lease.

Construction will be carried out using jack-up ships capable of carrying several complete wind turbines, with one movement into or out of Dublin Port per day estimated.

Construction activities will be carried out continuously throughout the construction period, with approximately 5% of the site under construction at any one time. Construction will either commence at the southern end of the site and progress northwards, or start in the middle of the site and progress north and south.

When construction is completed the Dublin Array wind farm will be operational over an area of 54 km². The time of operation will depend on the wind resource available at any given time. On-going maintenance of the Dublin Array is likely to consist of visits by two small boats per day.

Greater detail on all aspects of the proposed development is available in the Dublin Array Environmental Impact Statement.

4.2 Receiving environment

The Dublin Array is proposed to be constructed on the Kish and Bray banks, approximately 10 km off the Dublin and Wicklow coasts. The banks have a north-south orientation and are quasi-stable, probably maintaining their location and structure due to the interaction between waves and currents (Wheeler *et al*, 2001). The water depth at the crest of the bank can be as little as 3 m, with the surrounding area under a depth of 20-45 m, with the area west of the banks shallower than the area east of the banks.

The development site and the surrounding area support a number of Annex II marine mammal species with varying frequency, including harbour porpoise (*Phocoena phocoena*), grey seal (*Halichoerus grypus*) and bottlenose dolphin (*Tursiops truncatus*). Harbour porpoises and grey seals are resident along the east coast, while the bottlenose dolphin group that was frequenting the Killiney Bay area in Dublin since 2010, and had gained 'semi-resident' status, has not been recorded in the area since July 2012 (IWDG, 2012a). Photo-identification has confirmed that two of these individuals were recorded in Ventry Harbour, Co. Kerry in mid-July 2012 (IWDG, 2012a). Only marine mammals species are dealt with in this report, with Annex I habitats and other Annex II species dealt with in the main NIS.

The Kish and Bray banks and the surrounding area are host to numerous marine activities including commercial shipping, leisure boating, commercial and recreational fishing, etc.

4.3 Identification of Special Areas of Conservation

There is currently only one Special Area of Conservation (SAC) designated for marine mammals on the Irish east coast. Grey seal (*Halichoerus grypus*) is a Qualifying Interest for Lambay Island SAC (site code 000204), which is approximately 20 km from the proposed Dublin Array.

The Department of Arts, Heritage and the Gaeltacht is considering the possibility of designating additional sites for the protection of harbour porpoise (*Phocoena phocoena*), which is currently protected in Roaringwater Bay cSAC and Blasket Islands cSAC. The Irish Whale and Dolphin Group (IWDG) carried out surveys at five sites in 2008, the results of which were to inform any decision on further designations of SACs for harbour porpoise (Berrow *et al.*, 2008). North County Dublin and Dublin Bay were both part of this survey and the report recommended they be combined into a single site and designated as an SAC with harbour porpoise as a Qualifying Interest. The Department of Arts, Heritage and the Gaeltacht has proposed the Rockabill to Dalkey Island pcSAC (site code 003000) for designation for the protection of harbour porpoises. As this site is now proposed, it assumes the same protection that full designation affords a site; therefore, this site will be included in this NIS.

No other Natura 2000 sites designated for marine mammals will be adversely affected by the proposed development due to the distance of those sites from the development. The noise generated by piling a 6.5 m pile, without mitigation, has been estimated to return to background levels at a distance of 30 km for harbour porpoise, 40 km for bottlenose dolphin and 100 km for common seal (Subacoustech, 2006), though the exact distance depend on the local background noise conditions. The closest marine mammal SACs, outside of those being considered in this report (Lambay Island and Rockabill to Dalkey Island), are UK sites and none of these are within the relevant range for the Annex II species stated above.

4.3.1 Lambay Island SAC

Lambay Island is located off the north Dublin coast (Figure 2)

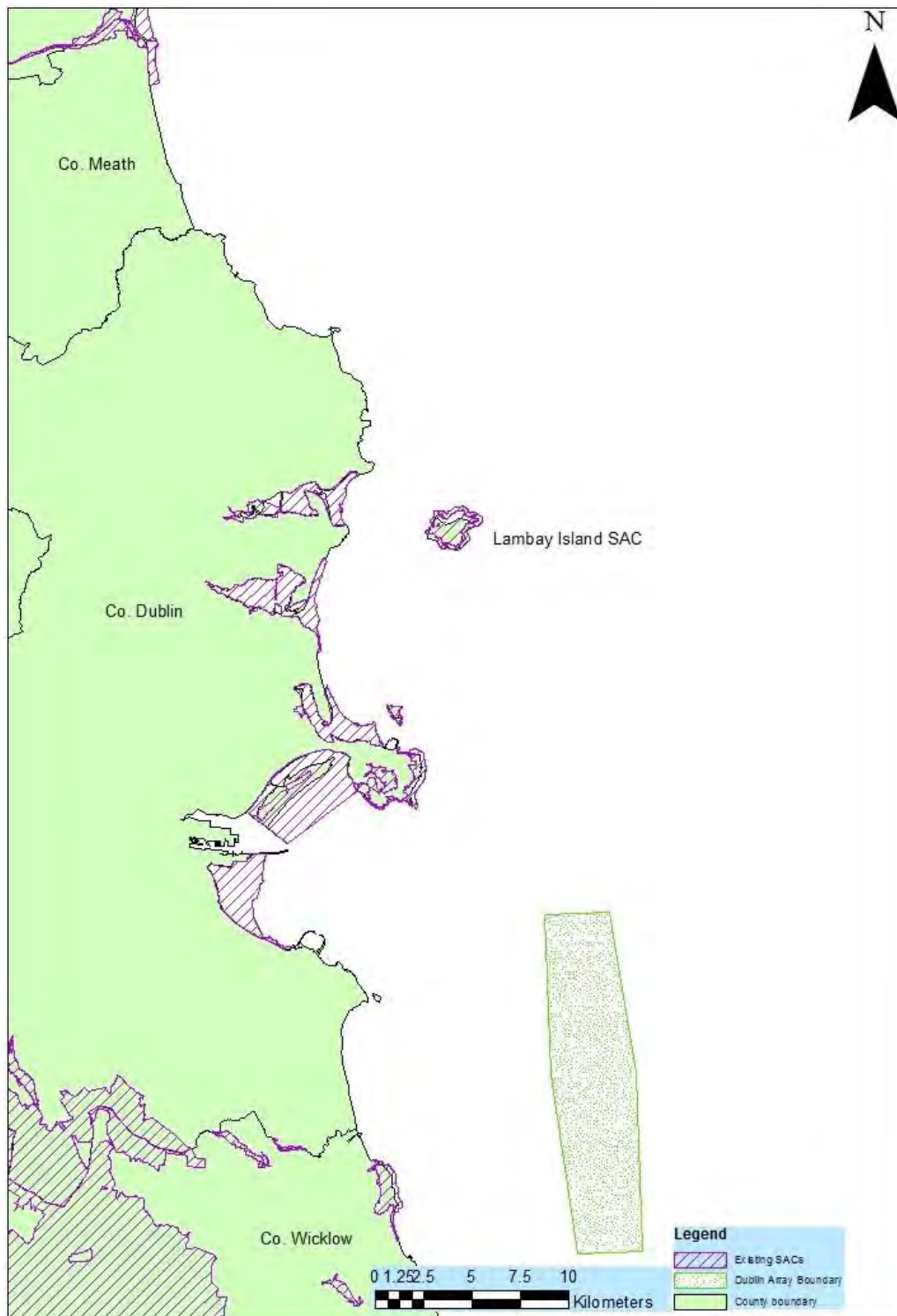


Figure 2. Location and Boundary of the Lambay Island SAC.

The Qualifying Interests of Lambay Island SAC are:

- Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]
- Grey seal (*Halichoerus grypus*) [1364]

Only grey seals will be considered further here.

The Conservation Objective for Lambay Island is as follows:

“Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected.” (NPWS, 2011)

Recent population estimates for grey seals in Ireland put the population in the range 5,509-7,083 (Ó’ Cadhla *et al.*, 2007), with a minimum population estimate (based on a moult survey) of 5,343 (Ó’ Cadhla & Strong, 2007). The main colonies are located on the Atlantic seaboard, with Inishkea North (Co. Mayo) and Great Blasket Island (Co. Kerry) supporting 45% of the population (Ó’ Cadhla & Strong, 2007). The Lambay Island population was estimated to be 45-60 in 1995 (NPWS, 1995) and 203-261 in 2005 (Ó’ Cadhla *et al.*, 2007), indicating an increasing population. The Status of EU Protected Habitats and Species in Ireland report (NPWS, 2008) assessed grey seals as being in Favourable Conservation Status. A breakdown of the assessment is presented in Table 1.

Grey seals are highly mobile predators, with studies showing movement of seals across the Irish Sea between Ireland and Wales and also between Irish sites, though female grey seals may show a degree of inter-annual site fidelity (Kiely *et al.*, 2000).

Grey seals spend more time hauled out during the breeding season (September – December) and the moulting season (November – March) (Kiely *et al.*, 2000).

Table 1. Summary of conservation status of grey seals in Ireland (NPWS, 2008)

Parameter	Status
Range	Unknown
Population	Good
Habitat	Good
Future Prospects	Good
Overall	Good

4.3.2 Rockabill to Dalkey Island pcSAC

The site planned boundary of the proposed candidate SAC Rockabill to Dalkey Island (pcSAC) is presented in Figure 3, and is approximately 1.6 km from the Dublin Array site boundary at its closest point.

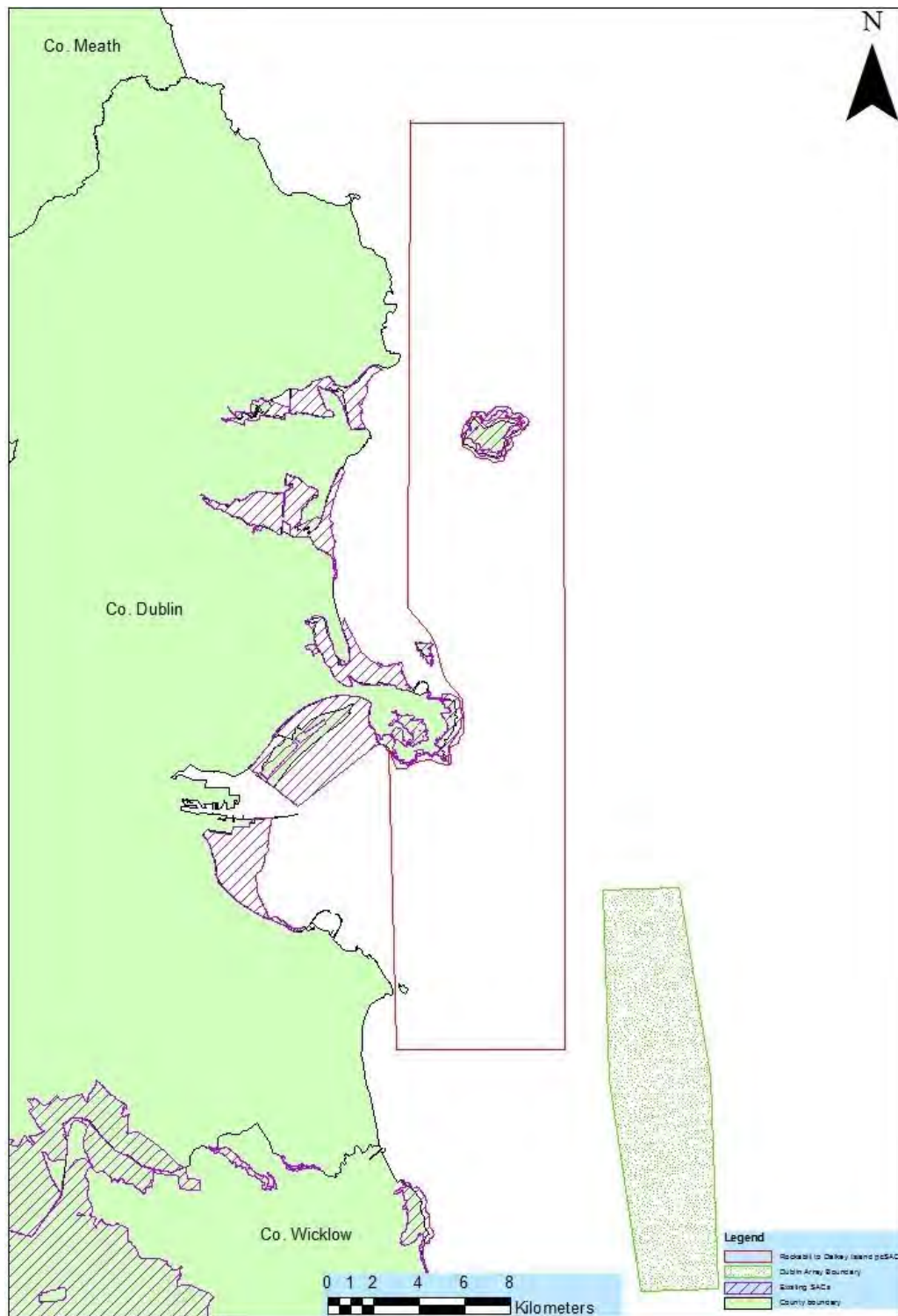


Figure 3. Boundary of the Rockabill to Dalkey Island pcSAC (from NPWS, 2012).

The potential Qualifying Interests of Rockabill to Dalkey pcSAC Island are as follows:

- Harbour porpoise (*Phocoena phocoena*) [1351]
- Reefs [1170]

Only harbour porpoises will be considered further here.

No specific Conservation Objectives are available for this site, but the following generic Conservation Objective will be considered:

“Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected.”

The harbour porpoise population in the Irish Sea in 2005 was estimated to be 15,230 (CV = 0.35) (Hammond & MacLeod, 2006), while the Celtic Sea population was calculated as 36,280 (CV=0.57) in 1994 and 80,616 (CV=0.50) in 2005 (the Celtic Sea survey area boundary varied somewhat between surveys) (Hammond *et al.*, 2002, Hammond & MacLeod, 2006). The harbour porpoise population in Irish coastal waters outside the Irish Sea was calculated to be 10,716 (CV=0.37; CI 95%=5,010 - 21,942) in 2005 (SCANS II, 2006). The surveys carried out by the IWDG in 2008 estimated an overall abundance of 211 (CV = 0.22, CI 95% = 137 – 327) in North County Dublin and 138 (CV 0.24, CI 95% = 86 – 221) in Dublin Bay (Berrow *et al.*, 2008). North County Dublin recorded the highest density of harbour porpoise of the sites surveyed and also the highest ratio of young to adults (8%), an important consideration when selecting a site for designation as an SAC (Berrow *et al.*, 2008).

The Status of EU Protected Habitats and Species in Ireland report (NPWS, 2008) assessed harbour porpoises as being in Favourable Conservation Status. A breakdown of the assessment is presented in Table 2.

No studies have been carried out to estimate the home range, or movements, of individual harbour porpoises in Irish waters, but data is available from Denmark and the Bay of Fundy on the east coast of North America (Sveegaard *et al.*, 2011, Johnston *et al.*, 2005). These studies have shown that harbour porpoises distribution is spatially and temporally variable. Harbour porpoises have been shown to range across large areas (7,738 – 11,289 km²) over the course of a month, with movements tending to be focused over a smaller area (250 – 300 km²) often around islands, headlands, or restricted channels (Johnston *et al.*, 2005). In Danish waters, harbour porpoises have also been shown to range over large areas, with seasonal shifts in their distribution (Sveegaard *et al.*, 2011).

Calving in harbour porpoise occurs between May and August, with a strong peak in June (IWDG, 2012b). It is thought that harbour porpoises move offshore in the period March – June to calving/breeding areas (IWDG, 2012b).

Table 2. Summary of conservation status of harbour porpoise in Ireland (NPWS, 2008)

Parameter	Status
Range	Good
Population	Good
Habitat	Good
Future Prospects	Good
Overall	Good

4.4 Assessment of potential impacts

The potential impacts associated with the construction and operation of the proposed Dublin Array wind farm include noise and vibration (particularly during piling operations), disturbance to and loss of habitat, increased turbidity and possible pollution.

4.4.1 Construction phase impacts

The use of heavy jack-up barges, piling equipment, cranes, trenching and cable laying vessels, and the deposition of rock armour during the construction stage of the project is likely to generate noise and vibrations and disturbance to seabed sediments in the vicinity of the site. Potential impacts on harbour porpoises and grey seals associated with these operations during the construction stage of the project include:

4.4.1.1 Noise and vibration

Noise and vibrations from shipping vessels and equipment and from operations such as pile-driving during the construction phase of the development will disturb marine mammals. Pile-driving in particular can generate very high sound levels and given the likely use of monopile foundations to support the turbines for the Dublin Array it is anticipated that the underwater noise generated by the installation of the piles during the construction stage of the project is likely to have the greatest potential effect on marine wildlife.

A detailed discussion of the impacts of noise on the marine environment can be found in the Environmental Impact Statement for the Dublin Array. A more concise assessment of the potential of noise to impact on harbour porpoises of Rockabill to Dalkey Island pcSAC and on grey seals at Lambay Island SAC is presented here.

The impact of construction noise, particularly activities with high sound levels, such as pile-driving, on marine mammals varies depending on the species, the sound level and frequency and the duration of the exposure. High noise levels can cause serious injury at close range, including physical injury to organs, and as one moves further away from the source effects diminish to permanent or temporary hearing impairment and behavioural change until the noise level is audible, but causes no measurable effect. Richardson *et al.* (1995) differentiated four zones of noise impact:

- Zone of physical impairment through hearing loss or injury
- Zone of masking
- Zone of responsiveness
- Zone of audibility

Pile-driving operations using a 6.5 m pile have been estimated to generate noise levels of 201 - 204 dB re 1 μ Pa (Peak) and 175 – 178 dB re 1 μ Pa (SEL) at 500 m in 20 m deep water (Nehls *et al.*, 2007). The following noise levels have been considered to cause Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS) in hearing of cetaceans and pinnipeds (Ketten & Finneran, 2004):

Temporary Threshold Shift:

- Cetaceans: 183 dB SEL pulses, 224 dB peak pressure
- Pinnipeds: 163 dB SEL pulses, 204 dB peak pressure

Permanent Threshold Shift:

- Cetaceans: 215 dB SEL pulses, 230 dB peak pressure
- Pinnipeds: 210 dB peak pressure

Based on these thresholds, TTS may be caused by piling operations at a range of 500 m in seals, while cetaceans would not be physically affected at this range. A marine mammal would need to be considerably closer to the source of the piling noise for PTS to occur. Lucke *et al.* (2009) established the pre-defined TTS criterion was exceeded at a sound pressure level of 199.7 dB_{pk-pk} re 1 μ Pa and an SEL of 164.3 dB re 1 μ Pa²s at 4 kHz for a captive harbour porpoise, which are lower than the levels set by Ketten & Finneran (2004). Subacoustech Ltd (2006) estimated piling to cause permanent hearing damage in harbour porpoises at a range of 150 m, while Bailey *et al.* (2010) determined that no form

of injury or hearing impairment should occur at a distance of greater than 100 m from pile-driving operations.

The zone of responsiveness in marine mammals is more difficult to define as the response of marine mammals to sound depends on so many factors, including the sound properties, physical and behavioural state of the animals and the acoustic and ecological features of the surrounding area (Hildebrand, 2005). Lucke *et al.* (2009) showed consistent aversive behavioural reactions in a captive harbour porpoise at sound levels above 174 dB_{pk-pk} re 1 µPa or an SEL of 145 dB re 1 µPa²s, which is similar to the 140 dB SEL suggested by Nehls *et al.* (2007). The distance at which harbour porpoises show behaviour effects or aversion have been suggested in the region of 13 - 15 km (Tougaard *et al.*, 2003, Subacoustech Ltd, 2006), though harbour porpoises continue to occur within this radius, with the aversion effect reducing with increasing distance from the noise source (Brandt *et al.*, 2009). No audiogram is available for grey seals, but based on best available scientific data, grey seals would show aversive reaction to pile-driving at 9 km (Subacoustech Ltd, 2006).

The grey seal population in Lambay Island SAC is approximately 20 km away from the Dublin Array at its closest point. Therefore there will be no direct effect on the grey seals within the SAC from noise generated during construction operations. Grey seals can forage at distance from their haul-outs and so could be closer to the Dublin Array during construction, and therefore there could be an impact on the seals from noise if foraging in the area. Sightings of grey seals within the Study Area during the survey area carried out by EcoServe were low and equivalent to those recorded along the control transects. This shows that the proposed wind farm area is of no greater importance to foraging grey seals than the surrounding sea area.

The Rockabill to Dalkey Island pcSAC is located closer to the proposed Dublin Array than Lambay Island SAC and the boundary is less than 1.6 km away at its closest point. Given that harbour porpoises show aversive behaviour to piling to a distance of 15 km, much of the Dublin Bay area would be affected by unmitigated piling operations (Figure 4), resulting in reduced harbour porpoise activity in the area in the short-term. The maximum area affected by unmitigated piling constitutes 52% of the Rockabill to Dalkey Island pcSAC, while works are occurring at the north-western area of the wind farm, as illustrated in Figure 4. Figures 5 and 6 illustrate the 15 km radius centred on the mid-point of the western boundary of the Dublin Array and the southwest corner respectively, indicating the reduction in area where aversive effects would be expected in harbour porpoises to 34% of the pcSAC and 7% of the pcSAC respectively. This would be a direct impact on the site. It should be noted that the 15 km radius of effect is based on studies where acoustic activity of harbour porpoises was shown to be significantly reduced up to this distance during piling operations;

however, this should not be interpreted as the creation of a 15 km exclusion zone around the piling activity, as the behavioural effects diminish as one moves away from the noise source out to the 15 km limit. Brandt *et al.* (2009) showed that harbour porpoises were observed as close as 3-4 km from the piling source, with activity generally increasing with increasing distance and it should be noted that acoustic scaring devices were used to exclude marine mammals from the area around the piling prior to the commencement of piling to prevent injury to hearing.

Porpoises from Rockabill and Dalkey Island pcSAC are also likely to forage in the vicinity of the Kish and Bray banks (though densities were not higher on the banks than the surrounding area) and therefore any serious injury, including permanent hearing damage, caused to a harbour porpoise during the piling operations would impact on the population of the pcSAC.

The impact of the noise created by the additional shipping movements to and from Dublin Port due to the construction of the Dublin Array on harbour porpoises and grey seals will not be significant when compared with the background shipping activity in the area. Dublin and Dún Laoghaire ports see a combined average of 43 ship movements per day, while the construction of the Dublin Array will see an increase in this number by one jack-up ship movement per day. The operation of smaller vessels, including recreational and fishing vessels, is highly variable throughout the year, and no significant effect will occur due to the addition of four small vessel (10 – 15 m) movements per day relating to service vessels operating to and from the Dublin Array.

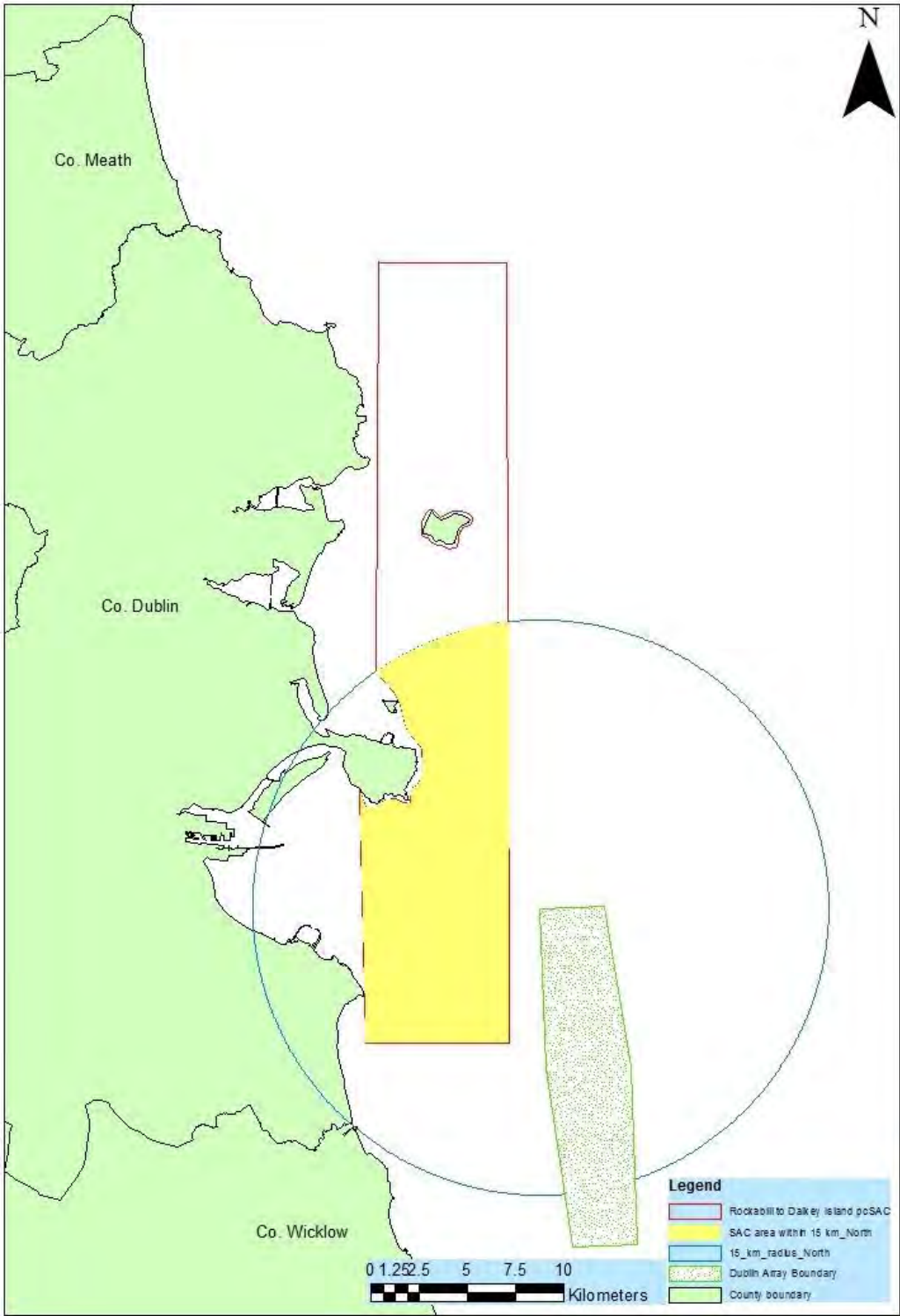


Figure 4. Area of the Rockabill to Dalkey Island pcSAC within 15 km of Dublin Array. This is the estimated unmitigated radius of expected aversive reactions for harbour porpoises, with the centre on the northwest corner of the Dublin Array, giving the worst case scenario.

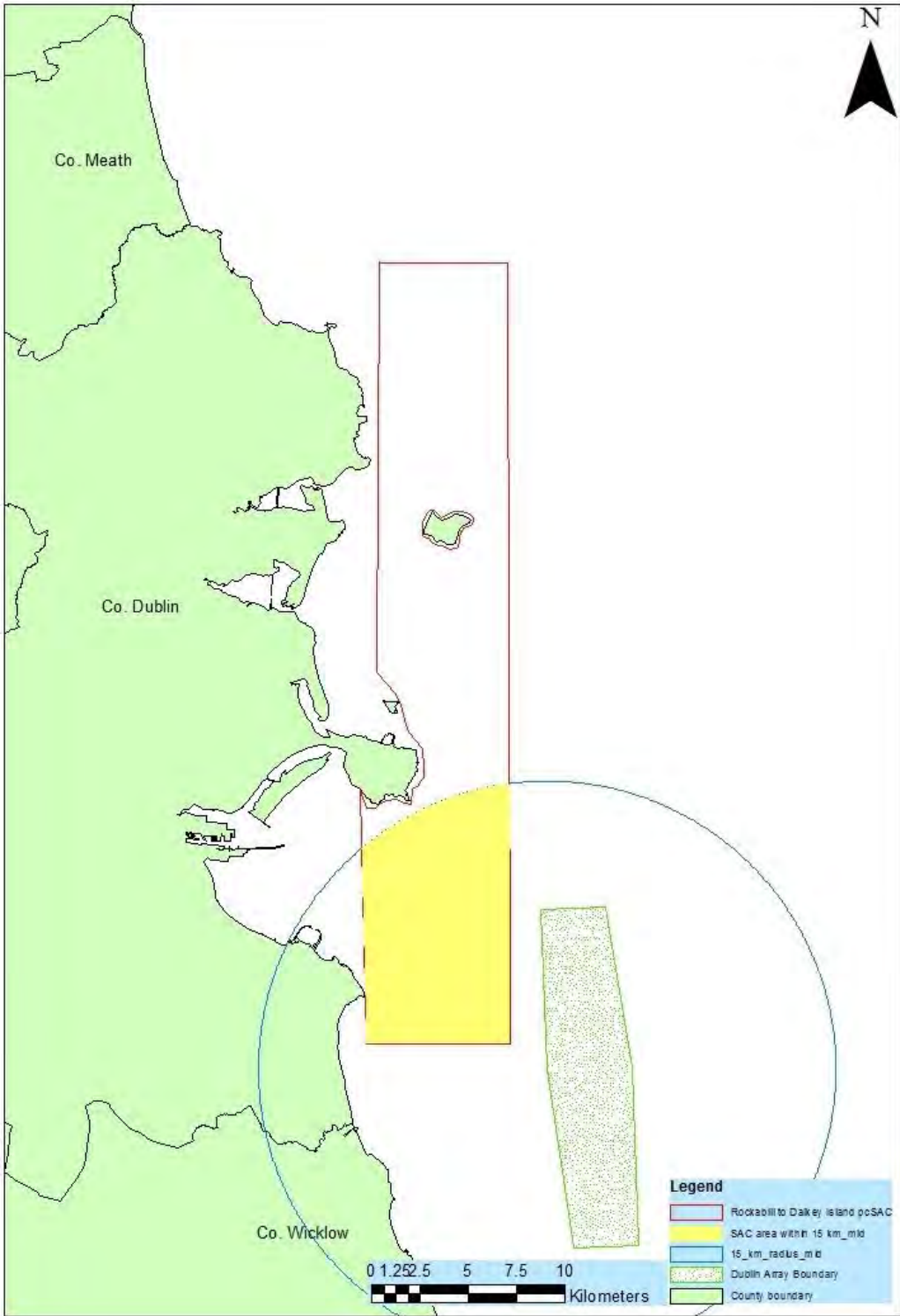


Figure 5. Area of the Rockabill to Dalkey Island pcSAC within 15 km of Dublin Array. This is the estimated unmitigated radius of expected aversive reactions for harbour porpoises, with the centre on the mid-point of the western boundary of the Dublin Array.

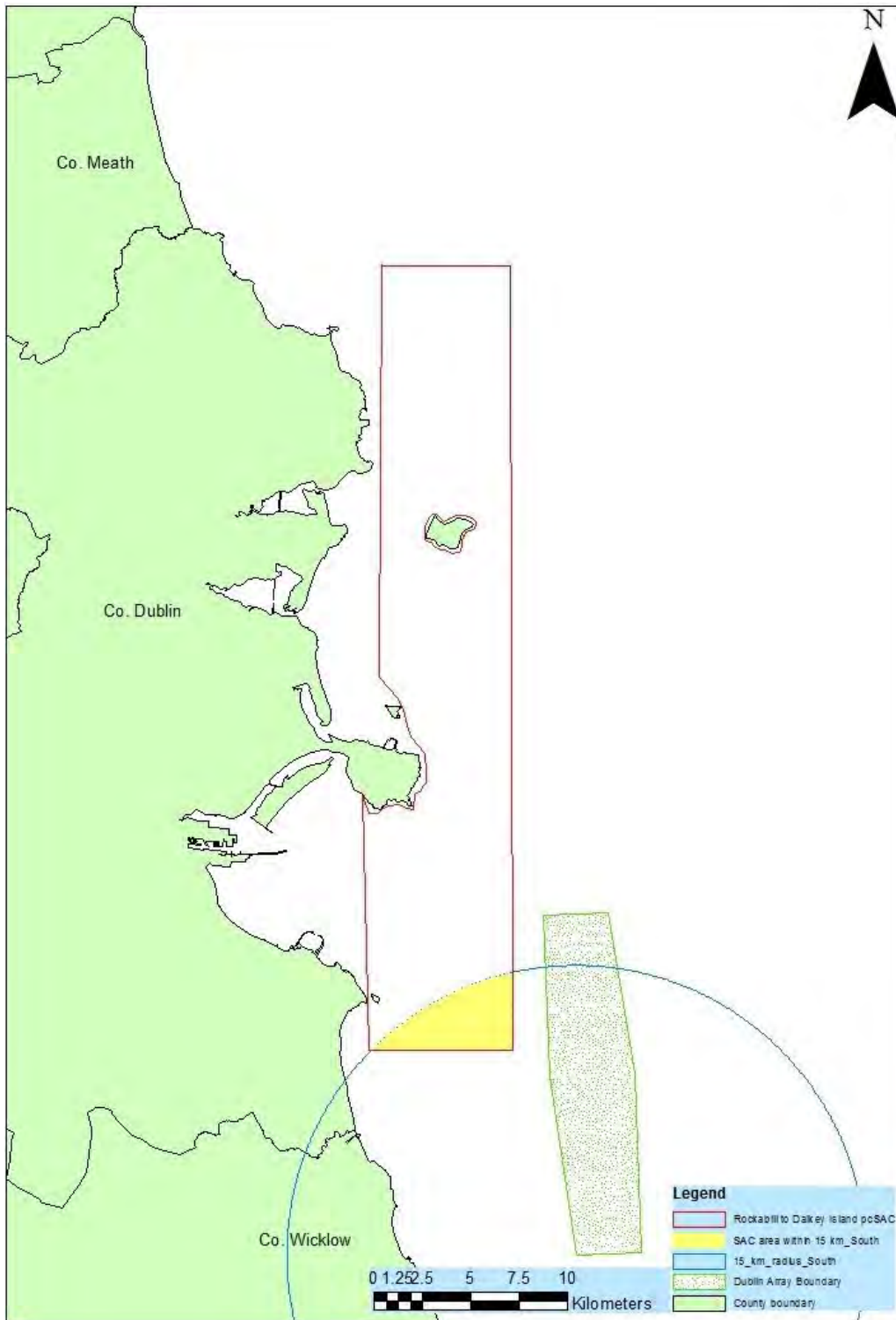


Figure 6. Area of the Rockabill to Dalkey Island pcSAC within 15 km of Dublin Array. This is the estimated unmitigated radius of expected aversive reactions for harbour porpoises, with the centre on the southwest corner of the Dublin Array.

Other cetaceans, including bottlenose dolphin, which is listed under Annex II of the Habitats Directive, occur within and around the construction area. Only bottlenose dolphins occur in the area regularly, with three dolphins (two adults and a juvenile) taking up residence on the east coast since 2010, with Killiney Bay appearing to be the core of their range. Bottlenose dolphins are estimated to show aversive reactions to piling at a range of 7 km, meaning much of their range will be unaffected by the Dublin Array construction operations. Also, the group of three bottlenose dolphins that had been frequenting the area has not been recorded since July 2012, and two of the individuals were identified in Ventry Harbour, Co. Kerry in mid-July 2012 (IWDG, 2012a).

It is concluded that the grey seals of Lambay Island SAC are outside the area of the behavioural effect that will be caused by the piling operations on the Kish and Bray banks while in and around the SAC itself. Any impact on this population would be due to the effect on individuals operating in the construction area of the Dublin Array. This is not considered significant due to the wide area available for foraging for grey seals in the Irish Sea and that seal numbers recorded in the Kish and Bray banks area were no greater than those recorded at the control sites.

A 15 km range for behavioural effect on harbour porpoise would result in almost all of Dublin Bay, and as far as just north of Ireland's Eye, being affected while unmitigated piling is underway at the northern end of the Kish Bank (Figure 4). The area of the pcSAC affected diminishes for construction activities further south (Figures 5 and 6). The area affected while unmitigated piling operations are on-going at the north end of the Kish Bank will constitute approximately 52% of the Rockabill to Dalkey Island pcSAC, though the main effect will be on the southern half of the proposed cSAC site, where lower numbers of harbour porpoises were recorded and there is a lower ratio of young to adults when compared with the North Dublin Coast area (Berrow *et al.*, 2008).

The area between the Kish and Bray banks and the coastline will all be within the 15 km range of likely behavioural effects for harbour porpoise for much of the construction period, which will result in effects on harbour porpoises in the area surrounding Rockabill to Dalkey Island pcSAC and also any porpoises from the proposed SAC area that occur outside the boundary of the site.

Bottlenose dolphins are widely ranging species and there are no SACs designated for them on the east coast of Ireland. With the range of behaviour effect for bottlenose dolphins at 7 km from the piling operations, only a relatively small area of their range is likely to be affected by piling operations, with the effect not extending to cover Killiney Bay, which was the focus of bottlenose dolphin activity when the 'semi-resident' group was present in the area.

While the effects of piling are limited to aversive behaviour effects for harbour porpoises within the Rockabill to Dalkey Island pcSAC, the closer an animal is to piling operations, the greater the risk of injury. It is this potential for injury to harbour porpoises and grey seals outside the SAC boundaries that poses the most significant risk where those animals belong to the SAC population. Given the proximity of the Rockabill to Dalkey Island pcSAC to the Dublin Array site and the wide-ranging movements of harbour porpoises (Sveegaard *et al.*, 2011, Johnston *et al.*, 2005), it is almost certain that harbour porpoises move across an area that includes the pcSAC, the Kish and Bray banks and the surrounding Irish Sea. Mitigation measures will be implemented to reduce the risk of noise effects on marine mammals, including the use of marine mammal observers (MMOs), 'soft-start' piling procedures and cofferdam systems while piling (see Section 6.1)

4.4.1.2 Habitat disturbance

As the Dublin Array is not located within any Natura 2000 site designated for marine mammals, there will be no direct effect due to habitat disturbance during construction (e.g. presence of ships, jack-up rigs, *etc.*). Harbour porpoises and grey seals occur throughout the Study Area and its surrounds and so it is certain that there will be some disturbance to the habitat utilised by these species during construction. The development site is 54 km², and less than 5% of the area will have construction activities on-going. Localised, temporary disturbance may impact the foraging activities of grey seals and harbour porpoises from Lambay Island SAC and Rockabill to Dalkey Island pcSAC, but this will not constitute a significant adverse effect due to the limited area affected as compared to the area available for foraging. While piling operations are on-going marine mammals will remain outside the area of direct habitat disturbance (as discuss in Section 4.4.1.1).

4.4.1.3 Increased suspended sediment/turbidity

As the Dublin Array is not located within any Natura 2000 site designated for marine mammals, there will be no direct effect due to increased suspended sediments during construction. The main tidal current direction along the coast off Dublin and Wicklow is along a north-south axis, flooding north and ebbing south. This current pattern means that any suspended solids generated within the wind farm area will not be carried in towards the identified SACs. Roche *et al.* (2007) showed that the sediment of the Kish Bank is dominated by medium and fine sands, with very little in the silt/clay fraction. These sand particles will settle out quickly compared to silts and clays and only 5% of the site will be under development at any one time. Therefore, the effect of increased suspended solids will be a localised, temporary effect, which may impact on foraging grey seals and harbour porpoises from Lambay Island SAC and Rockabill to Dalkey Island pcSAC, but not on the SAC waters

themselves. Only low numbers of grey seals were recorded in the course of the marine mammal survey carried out, indicating that the Kish and Bray banks do not constitute an area of high importance for grey seals. The density of harbour porpoises within the development area during the pre-construction survey was similar to that recorded outside at the control sites (0.13 porpoises km⁻¹ vs. 0.12 porpoises km⁻¹), which is considerably lower than the densities recorded in North County Dublin (0.29 porpoises per km⁻¹) and Dublin Bay (0.25 porpoises per km⁻¹). This indicates that porpoise activity is already lower in the Study Area than in the Rockabill to Dalkey Island pcSAC and, as discussed above, construction noise will be the most likely source of disturbance and will result in harbour porpoises avoiding the immediate vicinity of the construction works and therefore the area of increased suspended sediment. Based on these factors, increased suspended sediment will not constitute a significant adverse effect on the grey seal and harbour porpoise populations of Lambay Island SAC and the Rockabill to Dalkey Island pcSAC. The trenching required to connect the wind farm to land will occur approximately 2 km to the south of the Rockabill to Dalkey Island pcSAC, and similarly, there will be no significant adverse effect on the SACs from the temporary and localised increase in suspended solids.

4.4.1.4 Pollution

The operation of shipping and plant in the construction of the Dublin Array could pose a risk to marine mammals and their prey through the release of pollutants such as hydrocarbons. However, proper maintenance of machinery and ships and general construction site 'house-keeping', including an Environmental Management Plan (EMP) and a Construction Management Plan (CMP) prepared in advance will ensure that the risk of a serious pollution event occurring is minimal, and so does not constitute a significant adverse effect on marine mammals from surround SACs. Vessels involved in the installation of the wind turbines will be built and operated to Det Norske Veritas and Lloyds standards.

4.4.2 Operation phase impacts

Once the Dublin Array has become operational, the potential impacts will include noise from the operation of the turbines and maintenance, habitat loss and effect of electromagnetic fields. Potential impacts on harbour porpoises and grey seals associated with operational stage of the project include:

4.4.2.1 Noise and vibration

The noise generated by the Dublin Array, once operational, will not be sufficient to be heard by a harbour porpoise or grey seal more than a few hundred metres away (Koschinski *et al.*, 2003, Tougaard *et al.*, 2005; 2009). There will, therefore, be no direct impact on Lambay Island SAC or Rockabill to Dalkey Island pcSAC due to the noise generated by the operation of the Dublin Array. Harbour porpoises and greys seals from the nearby SACs are almost certain to move over a large area foraging, including the development site, based on studies of the range of harbour porpoises in other countries (Sveegaard *et al.*, 2011, Johnston *et al.*, 2005). The noise levels generated by the operational wind farm will not have a significant adverse effect on harbour porpoises and grey seals foraging in the immediate vicinity of the wind farm, as harbour porpoises have been shown to approach the sound of operating wind turbines, meaning there will be no exclusion of porpoises from around operating wind turbines (Kochinski *et al.*, 2003). In some instances harbour porpoise abundance has increased within a wind farm, possibly due to the 'reef effect' or reduced operation of vessels within the area (Scheidat *et al.*, 2011).

Maintenance of the wind farm will require the operation of vessels in the area, estimated to be two small boats per day. Dublin Bay and its surrounds already have high, but variable, levels of marine traffic including cargo ships, ferries, fishing vessels and leisure craft. Harbour porpoises and grey seals in the area are well-accustomed to the temporary disturbance caused by vessels and the additional boat movements related to the maintenance of the wind farm will not cause a significant adverse effect on species or the population within the SACs.

There will not be any significant adverse effect on marine mammals from Lambay Island SAC and Rockabill to Dalkey pcSAC due to the noise generated by the operation of the Dublin Array.

4.4.2.2 Loss of habitat

The footprint of the wind farm will result in the loss of habitat on the Kish and Bray banks. As the Dublin Array is to be located outside any Natura 2000 site designated for marine mammals, there will be no direct impact on a Natura 2000 site or its Qualifying Interests due to loss of habitat. Only a small percentage (0.03%) of the banks will be lost under the footprint of the development and therefore no significant adverse effect is expected on harbour porpoises or grey seals foraging in the area. In some instances harbour porpoise abundance has increased within a wind farm, possibly due to the 'reef effect' or reduced operation of vessels within the area (Scheidat *et al.*, 2011). The foundations of the wind turbines will act as Fish Aggregation Devices (FADs), attracting fish to shelter around them (Vella *et al.*, 2001). Fish have been found to aggregate around marine structure such as

oil rigs (Valdemarsen *et al.*, 1979) and despite the less complex structures involved, aggregation of fish around wind turbines does occur (Wilhelmsson *et al.*, 2006). An increase in the fish resource present within the wind farm will make the area more attractive to foraging marine mammals. No significant adverse effect on the marine mammal populations of the SACs will occur due to habitat loss from the development of the Dublin Array. The 'reef effect' caused by the construction of the wind farm is likely to constitute a positive effect for marine mammals foraging in the area by acting as a fish aggregating device. This positive effect of the 'reef effect' will extend to harbour porpoises from Rockabill to Dalkey Island pcSAC and grey seals from Lambay Island SAC if the sandbank forms part of their foraging area, which is almost certain given the proximity of the SACs to the Dublin Array site and the wide-ranging nature of both species.

4.4.2.3 Electromagnetic fields

Electromagnetic field associated with the Dublin Array wind farm will be created by the inter-turbine cables as well as the onshore transmission cable. These are all located outside any Natura 2000 site and so will have no direct effect on the SAC. Field strengths related to wind turbines that are comparable to geomagnetic fields are expected at a distance of less than 1 m (Hoffman *et al.*, 2000). Harbour porpoises and grey seals foraging in the vicinity of the Dublin Array will not be affected by the fields due to their localised effect. Alternating Current (AC) has less of an effect on marine mammals and magnetic fields are mainly used by migrating species of cetacean rather than species that use sonar and visual cues for navigation. The cables will also be shielded to reduce any potential for interference. No significant adverse effect is likely due to the presence of electromagnetic fields in the vicinity of the Dublin Array.

4.4.3 Cumulative impact

When assessing the cumulative impacts it is necessary to also consider the effect of other developments that, together with the current project, could have a cumulative impact on the marine mammal populations of Lambay Island SAC and Rockabill to Dalkey Island pcSAC.

To date two offshore wind farms have been granted a Foreshore Lease off the east coast. The Arklow Bank and the Codling Bank wind parks off the coast of County Wicklow. The Arklow Bank is located approximately 40 km south of the Kish and Bray banks, while the Codling Wind Park would be located just southeast of the Dublin Array. These developments are, therefore, outside the range at which the construction noise would impact directly on the marine mammal populations of Lambay Island SAC and Rockabill to Dalkey Island pcSAC and therefore would not have a significant adverse effect on the Natura 2000 sites. As no timeframe is set for the construction of the Dublin

Array or the Codling Bank Wind Park, no firm statements can be made with regard to the cumulative impacts outside the Rockabill to Dalkey Island pcSAC and harbour porpoises from the SAC operating in this area. Consideration should be given to this issue in the planning process and it may be appropriate to agree an appropriate construction schedule to minimise impacts on marine mammal populations in the area.

The range at which a harbour porpoise is expected to hear an operating wind turbine is in the region of 100-300 m, with the zone of responsiveness even less (Tougaard *et al.*, 2005). Therefore, there is no cumulative effect expected in terms of operational noise, should both wind farm developments proceed.

In October 2012, the Department of the Environment granted a licence to conduct exploratory drilling for oil between Dalkey Island and the Kish Bank. The Environmental Area Assessment (RPS, 2012) described the potential impact of the noise generated by the drilling operations, stating that it would fall below background levels within 1 km of the rig. The limited extent of the effect of drilling means that there will be no significant cumulative effect from the Dublin Array and the exploratory oil drilling.

In addition to operation of other wind farms in the surrounding environment, other sources of undersea noise need to be considered as cumulative with the proposed wind farm. The Irish Sea is an important shipping corridor, with regular ferries operating out of Dublin Port and Dún Laoghaire Harbour and ships generate considerable noise when in transit. Shipping noise in close proximity to a wind farm would mask the turbine noise (Madsen *et al.*, 2006). Given that ships generate transient noise, and harbour porpoises and grey seals continue to occur in areas with high levels of shipping, it is not expected that a significant adverse effect will be caused by any accumulation of these noise sources.

4.4.4 Decommissioning

Decommissioning of a wind farm is essentially the reverse of its construction, with the removal of rotors, nacelles, towers and piles using similar vessel types. The fact that piling does not occur during decommissioning means that there will be no significant adverse effect on marine mammals during the decommissioning phase.

5 Stage 1 screening conclusion

Based on the impact assessment presented in Section 4.4, most of the identified potential impacts are not likely to have a significant adverse effect on a Natura 2000 site, potential Natura 2000 site or on any Annex II marine mammal with the exception of construction noise. Therefore this impact will be considered further in Stage 2.

6 Stage 2 – Appropriate Assessment

As concluded in the screening section, noise from construction of the Dublin Array is considered to be the only potential impact likely to constitute a significant adverse effect on the marine mammals of Lambay Island SAC and the Rockabill to Dalkey Island pcSAC. As such it will be necessary to implement mitigation measures to reduce the likely impact of the construction noise on harbour porpoises and grey seals in the vicinity of the Dublin Array. Section 6.1 presents mitigation measures for construction noise and also other potential impacts considered in Section 4 in order to minimise any effects of the construction and operation of the Dublin Array on marine mammals in the area.

6.1 Mitigation measures

In order to minimise any potential impact on the marine mammal populations of Lambay Island SAC and Rockabill to Dalkey Island pcSAC, as well as any other marine mammals present in the area, the following mitigation measures are to be implemented. A detailed Construction Management Plan (CMP) and Environmental Management Plan (EMP) will be prepared prior to the commencement of any works and these plans will include detail of the mitigation measures to be implemented and will incorporate any conditions imposed by the consenting authority. The vessels involved in the installation of the wind turbines will be built and operated to Det Norske Veritas and Lloyds standards.

6.1.1 Noise and vibration

In considering the potential impact of construction noise on harbour porpoises and grey seals in Section 4.4.1.1, the impact of pile-driving with no mitigation measures was considered. Unmitigated pile-driving poses the risk of physical injury at very close ranges (<100 m), with some disturbance effects of up to 15 km. The German Federal Maritime and Hydrographic Agency (BSH) has set limits for pile-driving noise of 160 dB (SEL) and 190 dB (peak) at a distance of 750 m from the pile for the protection of harbour porpoise. In order to reduce the likely effect on marine mammals from pile-driving operations, the following mitigation measures will be implemented:

Marine Mammals Observers (MMOs) – MMOs will be employed during the construction period in order to minimise the possibility of injury to marine mammals as a result of piling operations. MMOs will ensure the area around the piling is clear of marine mammals prior to the commencement of piling. MMOs will follow the Draft Guidance to Manage the Risk to Marine Mammal from Man-made Sound Sources in Irish Waters (DAHG, 2012).

Soft-starts – In combination with the use of MMOs, and in line with the Draft Guidance to Manage the Risk to Marine Mammal from Man-made Sound Sources in Irish Waters (DAHG, 2012), ‘soft-starts’ or ‘ramp-up’ procedures will be used when commencing piling in order to reduce the risk of injury to marine mammals. By gradually increasing the power of the piling equipment, any marine mammals in the immediate vicinity of the piling operations will have sufficient warning to vacate the area prior to the piling reaching full power.

Cofferdam – a cofferdam system will be employed during piling operations in order to reduce the propagation of noise out into the water column. The cofferdam consists of a steel tube of greater diameter than the pile, which is put in place before the pile is installed. Water is pumped out from between the pile and the cofferdam before piling commences, thus reducing the ability of the sound to travel into the water column. Tests have shown that a reduction of 22 dB (SEL) and 18 dB (peak) is possible using this technology and that it is capable of meeting the 160 dB (SEL) and 190 dB (peak) limits set by the German BSH for offshore piling operations (Ramboll, 2012). These tests were carried out using a 2 m pile, but are likely to be effective for larger piles once the water is pumped out from between the pile and the cofferdam and there is no hard contact (Christopher Maxon, Ramboll, pers. comm.).

Future improvements in technology, that are proven to be effective at a commercial level, will also be considered prior to the commencement of construction.

6.1.2 Electromagnetic Fields

Subsea transmission cables will be appropriately shielded to minimise any localised effect on marine mammals.

6.1.3 Loss or alteration to habitats

The following mitigation measures will be adopted to minimise the impact the construction and operation of the wind farm on existing habitats and feeding grounds used by marine mammals:

In order to minimise the extent of potential habitat loss associated with the construction and operation of the wind farm the extent of seabed disturbed to facilitate the installation of the piles, scour protection and cable trenches will be kept to a minimum.

Cable trenches will be formed, the cable installed and the trench backfilled in a single operation using a purpose-designed plough thereby allowing immediate re-colonisation of the affected substratum from surrounding unaffected areas by the natural hydrodynamic regime over the banks.

Scour protection will be provided on the seabed around the base of each pile in order to limit the extent of seabed affected by scour associated with the alteration of hydrodynamic flows around the pile.

6.1.4 Increased suspended sediment/turbidity

The following mitigation measures will be adopted to minimise the impacts associated with increased suspended sediment and turbidity during the construction and operational stages of the wind farm on marine mammals:

In order to minimise the extent of potential sediment disturbance associated with the construction and operation of the wind farm the extent of seabed disturbed to facilitate the installation of the piles, scour protection and cable trenches will be kept to a minimum.

Scour protection will be provided on the seabed around the base of each pile in order to limit the extent of seabed affected by scour associated with the alteration of hydrodynamic flows around the pile.

6.1.5 Pollutants and Waste

The following mitigation measures will be adopted to minimise the impact of pollutants and waste generated during the construction and operation of the wind farm on marine mammals:

The Construction Management Plan will include strict controls to minimise the risk of pollution or contamination associated with the construction stage of the proposed development including the storage and use of lubricants, placement of grout, and management of waste which will be sorted and returned to shore for recycling/disposal by a Licenced contractor.

Similar controls will be adopted during the operational stage of the project to prevent pollution and contamination.

7 Residual effects

Following the implementation of the above mitigation measures, the following residual effects are expected. Only construction noise is considered here, as other potential effects were deemed unlikely to cause a significant adverse effect on Natura 2000 sites and their conservation objectives at the screening stage.

7.1 Construction noise

The implementation of MMOs and 'soft-start' procedures will ensure that there is no direct, physical impact on marine mammals in the area around construction operations. No permanent or temporary hearing loss will occur in harbour porpoises or grey seals from the nearby Lambay Island SAC or the Rockabill to Dalkey Island pcSAC that may be present in the Kish and Bray banks area. The lack of physical injury to species listed as qualifying interests of the Lambay Island SAC and Rockabill to Dalkey Island pcSAC populations prevents any direct impacts on the population dynamics through loss of individuals.

With the risk of direct injury to marine mammals greatly reduced by the implementation of MMOs and 'soft-start' procedures, potential for significant adverse effects is limited to disturbance during piling operations. The use of a cofferdam system will reduce the underwater noise levels by 22 dB (SEL) and 18 dB (peak), which equates to an approximate power reduction of a factor of 100.

While meeting the German BSH's limits with regard to noise generated during pile-driving operations does reduce the area over which disturbance may occur, it does not eliminate it. Unmitigated pile-driving may result in aversive reactions in harbour porpoises up to a distance of 15 km (Tougaard *et al.*, 2003), while Merck (2012) suggests that meeting the 160 dB (SEL) limit set by the German government reduces the range of this behavioural response to below 10 km. Based on this figure, the maximum area affected by piling, with the use of a cofferdam system as mitigation, constitutes 40% of the Rockabill to Dalkey Island pcSAC when construction is occurring in the north-western corner of the development site. This area is approximately three-quarters of the area that would be affected by unmitigated piling and only extends slightly north of Howth Head (Figure 7). As one moves south during the construction of the Dublin Array, the area of likely behavioural response decreases to 18% half way down the development site (Figure 8) and 0% at the southern end (Figure 9). When construction is on-going at the mid-point of the Dublin Array, the area of the pcSAC affected by mitigated piling is approximately half of that affected by unmitigated piling. Construction

operations at the southern end of the Dublin Array will be outside the range that may cause behavioural response in harbour porpoises in the Rockabill to Dalkey Island pcSAC.

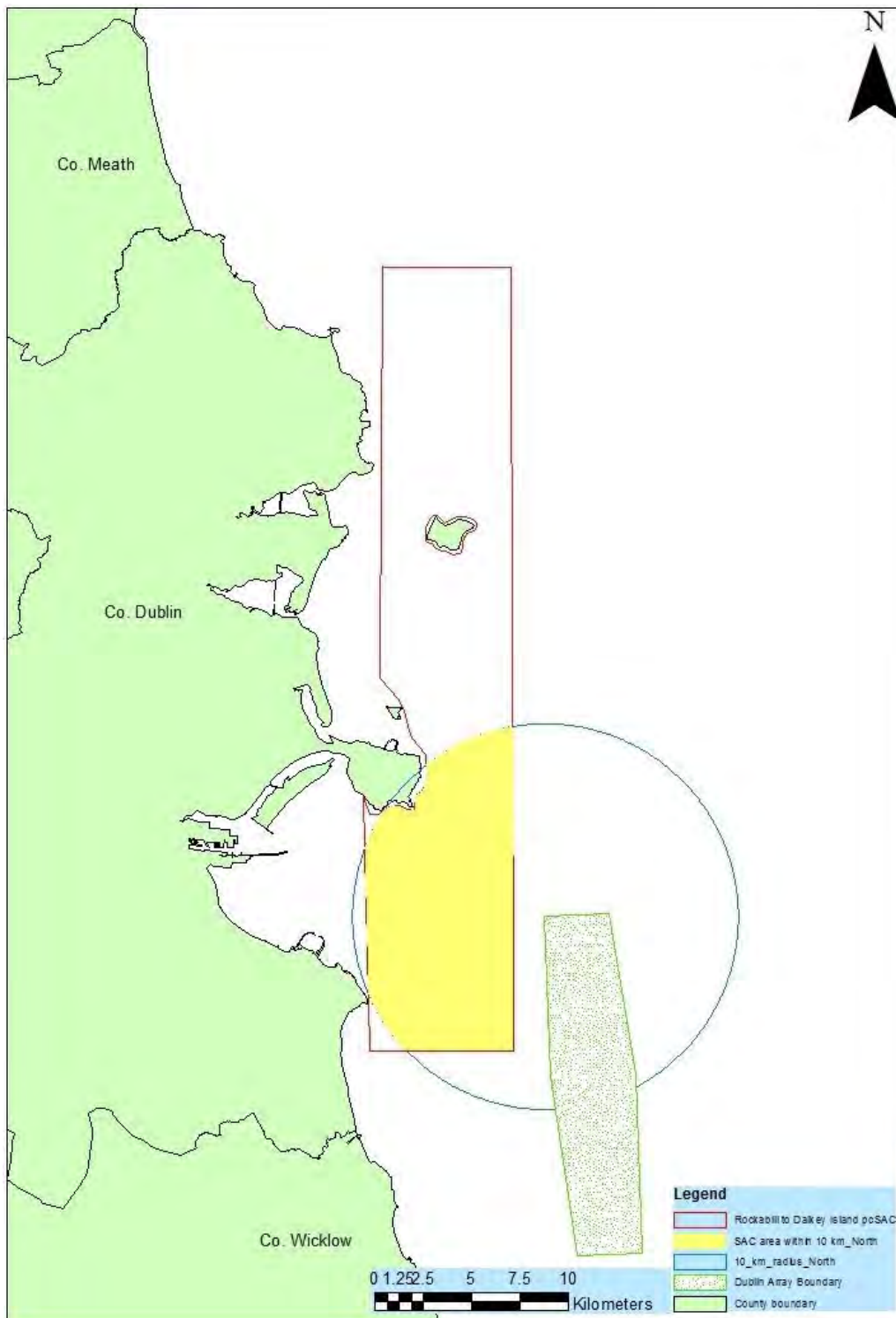


Figure 7. Area of the Rockabill to Dalkey Island pcSAC within 10 km of Dublin Array. This is the estimated radius of expected aversive reactions for harbour porpoises, with the centre on the northwest corner of the Dublin Array.

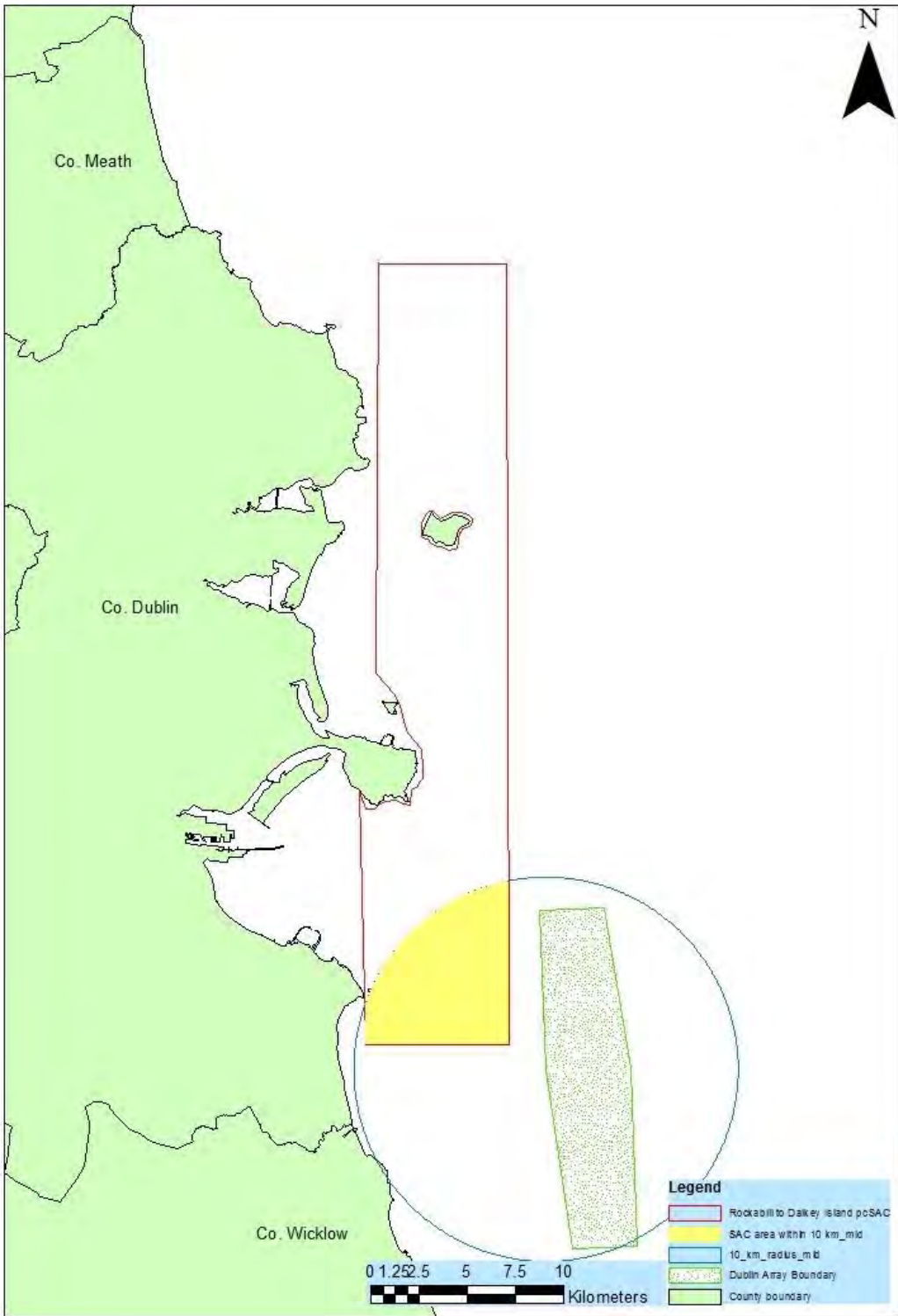


Figure 8. Area of the Rockabill to Dalkey Island pcSAC within 10 km of Dublin Array. This is the estimated radius of expected aversive reactions for harbour porpoises, with the centre on the mid-point of the western boundary of the Dublin Array.

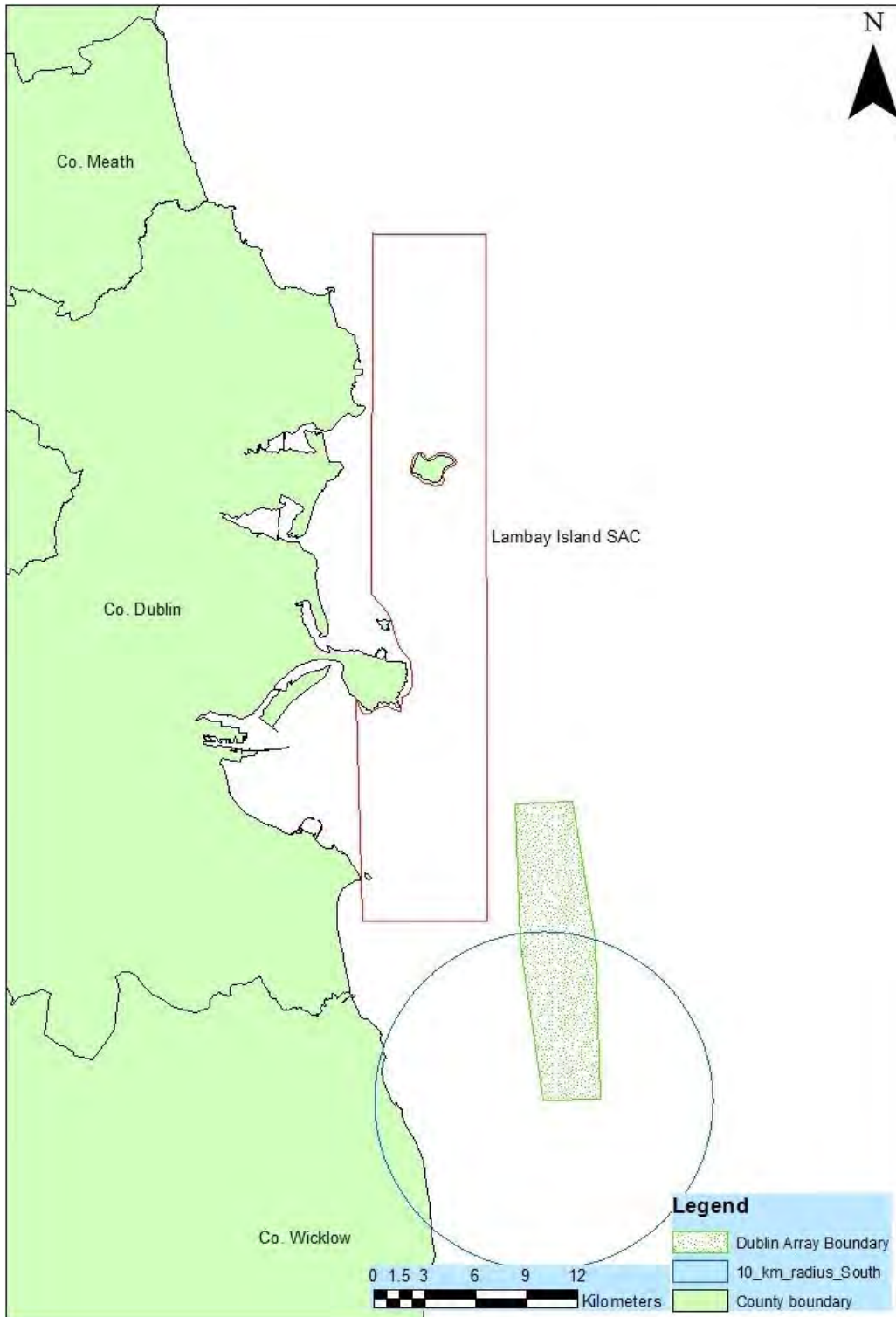


Figure 9. Area of the Rockabill to Dalkey Island pcSAC within 10 km of Dublin Array. This is the estimated radius of expected aversive reactions for harbour porpoises, with the centre on southwest corner of the Dublin Array.

North County Dublin was identified by Berrow *et al.* (2008) as being an area with the highest harbour porpoise density in Ireland, also with one of the highest proportion of young, and this area is beyond the estimated range for behavioural effects in harbour porpoises. The use of a cofferdam system and the short-term, localised nature of the piling operations (approximately 3 years, over <5% of the development site at a time), means that a maximum of 40% of the southern part of the Rockabill to Dalkey Island pcSAC will be affected to a level that may cause aversive reaction in harbour porpoise and for a limited period. This maximum effect will occur while construction is on-going at the northwest corner of the construction site and the effect will be less for construction further south and east (18% at the mid-point of the western boundary of the Dublin Array, and 0% at the southern end of the Dublin Array). Harbour porpoises are found all along the Irish coast and their distribution varies spatially and temporally (Berrow *et al.*, 2008), so any temporary displacement of harbour porpoises from the Rockabill to Dalkey Island pcSAC can be facilitated by movement of those individuals into surrounding areas. Indeed it is almost certain that the harbour porpoises that occur within the Rockabill to Dalkey Island pcSAC already exploit a much wider area as suggested by the variability of the results from the IWDG survey in 2008 (Berrow *et al.*, 2008) and other studies on the range of harbour porpoises (Sveegaard *et al.*, 2011, Johnston *et al.*, 2005). Harbour porpoises have been shown to return to areas where wind farms have been constructed following the cessation of piling works (Tougaard *et al.*, 2006, Brandt *et al.*, 2009, Scheidat *et al.*, 2011). In some cases (Egmond ann Zee) this return was rapid and a positive effect was seen once the wind farm was operational (Scheidat *et al.*, 2011), while in other cases (Nysted) the harbour porpoise numbers increased gradually over two years (Tougaard *et al.*, 2006). In the latter case, it was noted that harbour porpoise densities in the immediate area of the works were low to begin with, thus making the effect appear more dramatic (Tougaard *et al.*, 2006). Brandt *et al.* (2009) showed that harbour porpoise activity reduced in the immediate vicinity of piling operations at Horns Rev II, but it returned to pre-piling levels within days of the cessation of piling. The return to pre-piling levels occurred more quickly at greater distances, with 'normal' activity resumed within a few hours at a distance of 6-9 km.

The reduction in activity of harbour porpoises within a 10 km radius of active piling operations means that there will be a temporary reduction in harbour porpoise activity in the southern part of the Rockabill to Dalkey Island pcSAC. This reduction will be temporary and harbour porpoise distribution will begin to return to its previous pattern once piling operations have ceased within the section of the Dublin Array within 10 km of the Rockabill to Dalkey Island pcSAC. The return to pre-piling levels is expected to occur over hours or days following the cessation of piling due to the high density of harbour porpoises that occur along the Irish Coast. Low pre-construction numbers were

considered the reason that recovery to pre-construction activity levels within the Nysted wind farm took up to two years (Tougaard *et al.*, 2006), especially when compared with the results for Horns Rev II (Brandt *et al.*, 2009). The fact that the Dublin Array is not within a harbour porpoise SAC and the high porpoise densities in the Irish Sea compared to those of the Baltic Sea (North Dublin Coast – 2.03 km⁻², Dublin Bay 1.19 km⁻² and offshore North Irish Sea – 1.6 km⁻² (Berrow *et al.*, 2008; 2011) as compared to 0.1 km⁻² in the Baltic Sea (Tougaard *et al.*, 2006), means that harbour porpoise densities and activity will return to normal within the Rockabill to Dalkey Island pcSAC more rapidly. Harbour porpoises are found throughout the Irish Sea, particularly to the north, away from the construction site, and so there is ample habitat to be exploited by animals temporarily displaced by piling operations. There will be no significant adverse effect on the site causing it not to meet its Conservation Objectives from the construction of the Dublin Array.

8 Stage 2 Appropriate Assessment conclusion

Following an assessment of the potential impacts of the construction and operation of the Dublin Array Wind Farm on the Annex II marine mammals of the Lambay Island SAC (grey seals) and the Rockabill to Dalkey Island pcSAC (harbour porpoises), it is concluded that the development will not have a significant adverse effect once mitigation measures are adhered to. Direct injury to marine mammals by piling operations will be avoided through the use of MMOs and ‘soft-start’ procedures and cofferdams during piling operations. There will be no long-term impact on the integrity of the pcSAC, as the wind farm is outside the boundary of the Rockabill to Dalkey Island pcSAC and the operation of the wind turbines will not result in the exclusion of harbour porpoises from the wind farm area. While there will be a temporary reduction in harbour porpoises activity across 40% of the Rockabill to Dalkey Island pcSAC due to piling operations (though this reduces to 0% while construction is on-going at the southern end of the Array, and only 5% of the site area will be worked on at any time) the short-term and reversible nature of this effect will not prevent Natura 2000 sites from achieving their Conservation Objectives or result in significant adverse effects on the integrity of the site. The northern section of the Rockabill to Dalkey Island pcSAC has been noted as being most important for harbour porpoise calves and this area is outside the range of the effects of the piling.

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