THE PROPOSED DUBLIN ARRAY WIND FARM – ASSESSMENT OF POTENTIAL IMPACTS ON SEABIRDS

Information in support of the Appropriate Assessment of the proposed Wind Farm

Report for:

Saorgus Energy Ltd

Prepared by:

ecologyireland

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Abstract: This report assesses the potential for adverse impacts on seabirds as a result of the development of the Dublin Array wind farm. It examines the data collected during two detailed bird surveys of the study area and considers the species assemblage described and their pattern of usage of the site. The species which are listed as key conservation features of interest for Natura 2000 sites in the wider hinterland are considered in detail and the potential for significant adverse impacts on these species and the Natura 2000 sites is considered. A full literature review was carried out to best inform the assessment of the potential impacts on the seabirds that use the Kish and Bray Banks and also to assess potential cumulative impacts of the development of number of other permitted wind farms in the Irish Sea. It is concluded that there will be no significant adverse impacts on the local bird populations or SPA's in the hinterland as a result of the development of the Dublin Array wind farm.

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1. INTRODUCTION

The proposed Dublin Array offshore wind farm is to be sited on the Kish and Bray Banks, some 10 km off the Dublin and Wicklow coasts. The proposed wind farm will consist of 145 turbines, with a hub height up to 100 m and blade-tip height of up to 160 m. The entire site covers an area of 54 km^2 and the projected construction period will be approximately three years.

In line with the requirements of Article 6 of the E.U. Habitats Directive, an assessment of whether the proposed wind farm is likely to have a significant impact on any Natura 2000 site has been prepared. (A Natura 2000 site is any site designated under the E.U. Habitats or Birds Directives, i.e. as a Special Area of Conservation (SAC) or Special Protection Area (SPA)). The assessment process is known as Appropriate Assessment (AA). It is a multi-stage process, with stage 1 'Screening' determining whether there is potential for a development under consideration to cause a significant impact on a Natura 2000 site. At the end of stage 1, if it has been shown that there will not be a significant adverse impact, then a screening report is prepared and the assessment is complete. If, at the end of stage 1, it is considered that there is the potential for significant impact, then stage 2 examines the mitigation measures that can be designed in order to avoid or minimise any adverse impacts on Natura 2000 sites and their conservation objectives. This stage 2 Appropriate Assessment process evaluates the nature of the potential impacts and the likelihood that with application of appropriate mitigation that significant adverse impact can be avoided to the integrity of the conservation sites. The AA report is also known as a Natura Impact Statement. Guidance on undertaking appropriate assessment has been produced by the Department of Environment, Heritage and Local Government (DoEHLG, 2009) and was used in the preparation of this document.

This assessment of potential impacts on birds and designated SPA sites has been prepared as an addendum to the NIS for the Dublin Array wind farm. It examines the potential for impacts on birds, in particular seabirds, and any likely significant impacts of the development of the Dublin Array on any Natura 2000 site, where birds are key a conservation feature of interest. In preparing this assessment, the following issues were carefully considered:

- Usage of the Kish and Bray Banks by birds,
- The Natura 2000 sites that may be affected, and their bird interest,
- What is known of the potential impacts on birds resulting from the development of offshore wind farms and whether any of these impacts are likely to arise from the development of the Dublin Array wind farm during construction and operation phases?

In carrying out this assessment, an extensive literature review has been undertaken, focussing on the results of pre- and post-construction monitoring of existing wind farms. Wind farms with a similar range of species, habitat types and (generally) located either around the UK coastline or elsewhere in north-west Europe were used to inform our assessment. Several of the existing wind farms considered are located in the Irish Sea and are also useful in the evaluation of cumulative impacts.

Dr. Gavin Fennessy (Director & Principal Ecologist, Ecology Ireland Ltd.) prepared this report. Gavin is a professional ecologist with almost 15 years experience in consultancy. He is an expert Ornithologist who has Project Managed numerous large infrastructure and energy projects for private and public sector clients. He was awarded a PhD from UCC in 2001 for research on the Ecology of the Robin in Ireland. He carried out Post-Doctoral research on bird collision risk at civilian airports and presented papers at several international conferences. He also supervised a PhD project examining avoidance behaviour of birds to aircraft. Dr. Fennessy is a Guest Lecturer at UCC and has taught on both undergraduate and postgraduate degree programs. Gavin was formerly the lead ecologist with engineering firm Fehily Timoney & Co. (based in Cork) prior to establishing Ecology Ireland in 2011. At FTC, Dr. Fennessy project managed the offshore bird monitoring of the Arklow Bank Wind Farm on behalf of SSE Renewables. He also designed the ecological surveys and Project Managed over 30 separate wind farm impact assessments between 2006 and 2011. Dr. Fennessy is currently retained as the ornithological specialist on a number of large projects including the construction and operational phase of Booltiagh Wind Farm (Clare) and operational phase monitoring of Mt. Lucas Wind Farm (Offaly). Ecology Ireland also provides surveys and reports for the Corrib Gas Project in County Mayo. Gavin is a trained and experienced Expert Witness and has represented his clients in consultations, public presentations and Oral Hearings.

2. BIRD USAGE OF THE KISH/BRAY BANKS

Two surveys of the birds using the Kish and Bray banks have been undertaken. The first of these was by Ecology Consulting with surveys carried out between September 2001 and September 2002 (Percival *et al*., 2002). Birdwatch Ireland carried out a second survey of these areas between June 2010 and 2011 (Newton & Trewby, 2011).

The 2001 surveys used both boat based and aerial surveys to record the birds using the proposed wind farm site. The boat based surveys followed transects that covered the area for the turbines plus an additional area up to 4 km from the turbine locations. A total of 14 boat transects were undertaken, spread over the twelve month period although surveys were not carried out in October, January and February due to poor weather conditions. Additional visits were made in August and September, 2002 in a period of the year when it was considered that bird activity may be critical. Preliminary desktop studies had determined that August and September could be a key time of the year for post breeding tern populations. Seven fixed point boat surveys were also completed. Although standardised methods for undertaking bird surveys at sea have been developed since the 2001 surveys were carried out (see Camphuysen *et al*., 2004 and Camphuysen & Garthe 2004) the methods used by Percival largely follow the more recent guidelines and are considered to be robust. Percival also undertook two aerial surveys, in March and April 2002. The surveys were carried out in order to look at abundance and distribution of seabirds within a wider area and to ensure that the boat based surveys had not missed any important populations of seabirds. The aerial surveys covered an area of some 1,226 km^2. During the data analysis, statistical corrections were applied on their observations with regard to distance from the observer(s). Although the report states that flight heights were recorded, unfortunately these data are not presented in the report.

The BirdWatch Ireland (Newton & Trewby 2011) report employed similar field methods to those described by Percival *et al*. (2002). A total of 15 boat based transect surveys were undertaken on a monthly basis from June 2010 to June 2011. Again additional surveys were carried out in August and September. However, no fixed point boat surveys and no aerial surveys of the larger study area were conducted. The BirdWatch Ireland report presents the raw bird count data while the Percival *et al*. (2002) report applied a correction factor to bird observations made in the various distance bands. The BirdWatch Ireland study provides detailed information on the flight heights of various species.

Both surveys found a similar range of species to be present within the study area. Table 1 below presents the species and their peak counts recorded by the two surveys. This table shows the results from the boat based surveys only, as no aerial surveys were completed in the 2010 survey. The species recorded are generally considered to be 'seabirds' - the list does not include passerines or wading birds. Interestingly, with the exception of common scoter and red-breasted merganser, no wildfowl species were recorded on any of the surveys.

Table 1: Bird species and peak counts recorded during the 2001 (Percival *et al.*) and 2010 (Newton & Trewby) surveys.

Species	2001 (Percival *et al.*, 2002)	2010 (Newton & Trewby, 2011)
Red-throated Diver	2	22
Great Northern Diver	3	0
Great Crested Grebe	0	1
Fulmar	42	14
Manx Shearwater	3764	4513
Balearic Shearwater	2	2
Sooty Shearwater	3	0
Great Shearwater	2	0
European Storm-petrel	0	9
Gannet	107	1326
Cormorant	81	103
Shag	293	588
Red-breasted Merganser	0	1
Common Scoter	31	13
Arctic Skua	19	10
Long-tailed Skua	2	1
Great Skua	3	1
Little Gull	5	153
Black-headed Gull	8	6
Sabine's Gull	1	0
Common Gull	39	21
Lesser Black-backed Gull	5	8
Herring Gull	113	298
Great Black-backed Gull	171	58
Kittiwake	4382	1753
Roseate Tern	282	323
Common Tern	583	654
Arctic Tern	64	157
Black Tern	2	1
Common Guillemot	14218	6932
Razorbill	3110	2685
Black Guillemot	15	11
Atlantic Puffin	5	6

Guillemot was the most numerous species on both surveys although the 2001 survey recorded considerably higher peak numbers (14,218) than the 2010 survey (6,932). Gannet was a species that was recorded in much higher numbers in 2010 than in 2001 (1326 as opposed to 107), together with Arctic Tern (64 in 2001, 157 in 2010).

The 2001 survey found that the study area held, on occasion, internationally important numbers of Roseate Terns, nationally important numbers of Manx Shearwaters, Shags, Kittiwakes, Common

Terns, Guillemots and Razorbills, and regionally important numbers of Gannets, Cormorants, and Arctic Skuas. There was a marked seasonal pattern noted with more birds recorded in the spring, summer and autumn surveys. August and September were particularly important for post breeding flocks of young and adult Roseate Terns. A similar situation was found in the 2010 surveys, particularly in relation to Roseate Terns where no birds were recorded using the bank during the chick rearing stage (i.e. May to late July) but again, post breeding flocks were found on the bank in Late August and September.

The distribution of the birds throughout the study area was not found to be uniform in both surveys, with distribution varying from species to species, with some species favouring differing sections of the bank. For example, the 2001 survey found that Roseate Tern was largely restricted to the northern half of the bank. The 2010 survey also found Roseate Terns using the northern section, although by late September, the birds that remained were present in the south-eastern end of the survey area. The most numerous species, Guillemot was found along the entire bank but was more abundant in the northern two-thirds of the study area. Further discussion of the distribution of individual species (where they are features of Natura 2000 sites) is given in section 4.1 below

3. BIRD SPECIES THAT ARE FEATURES OF THE DESIGNATED SITES WITHIN 35 KM OF THE STUDY AREA

For this report, a study zone of 35 km from the proposed wind farm location was chosen as appropriate. The 35 km zone is based on the foraging ranges (see Langston 2010 for foraging ranges) of the majority of seabird species that have been recorded using the Banks and that are features of the relevant SPA's. Further details of foraging ranges are given in the individual species accounts (section 4.1). The exceptions to this are Gannet and Manx Shearwater. The mean foraging ranges for these species are 140 km and 171 km respectively. Section 4.1 gives further details for these species and the possible impacts on SPA's lying outside the 35 km study area.

Within this study area, there are 11 Special Protection Areas (SPA) that could be potentially impacted by the proposed wind farm (Figure 1). The wind farm is not located within any area that has been designated as an SPA and if there is any potential impact arising, it will be on the key bird species that are features of the individual SPAs within the study area. The 11 SPAs and the bird species that are listed as conservation features for each SPA are given in Table 2 below. Table 2 shows that a total of 38 bird species are the qualifying features for the 11 SPAs found within the study area.

Table 3 shows the full list of the species that are qualifying features and the SPAs in the 35 km hinterland in which they occur. Table 3 also indicates the species that have also been recorded during the 2001 and 2010 dedicated seabird surveys of the Dublin Array wind farm study area.

Table 3 shows that of the 38 species that are qualifying features of the relevant SPAs, 22 have been recorded during the 2001 and 2010 surveys of the Kish/Bray banks. It is quite understandable why a number of the qualifying bird species were not recorded on the Kish/Bray banks. For instance, three of the SPAs (North Bull Island, Malahide Estuary and the South Dublin Bay and River Tolka) are sites with large areas of estuarine habitats, attracting large numbers of wading birds and waterfowl: species that would not generally be expected to be recorded at off-shore areas like the Kish/Bray banks. The remaining eight SPAs are coastal sites or islands, with breeding colonies of seabirds, species that would be expected to be found on the Kish/Bray banks.

Two other species, Gannet and Manx Shearwater, are not features of the SPA's within the 35 km study area, but given their large foraging ranges, they are also given consideration in section 4.1, species accounts.

Table 2: SPAs and the qualifying bird species that lie within the study area.

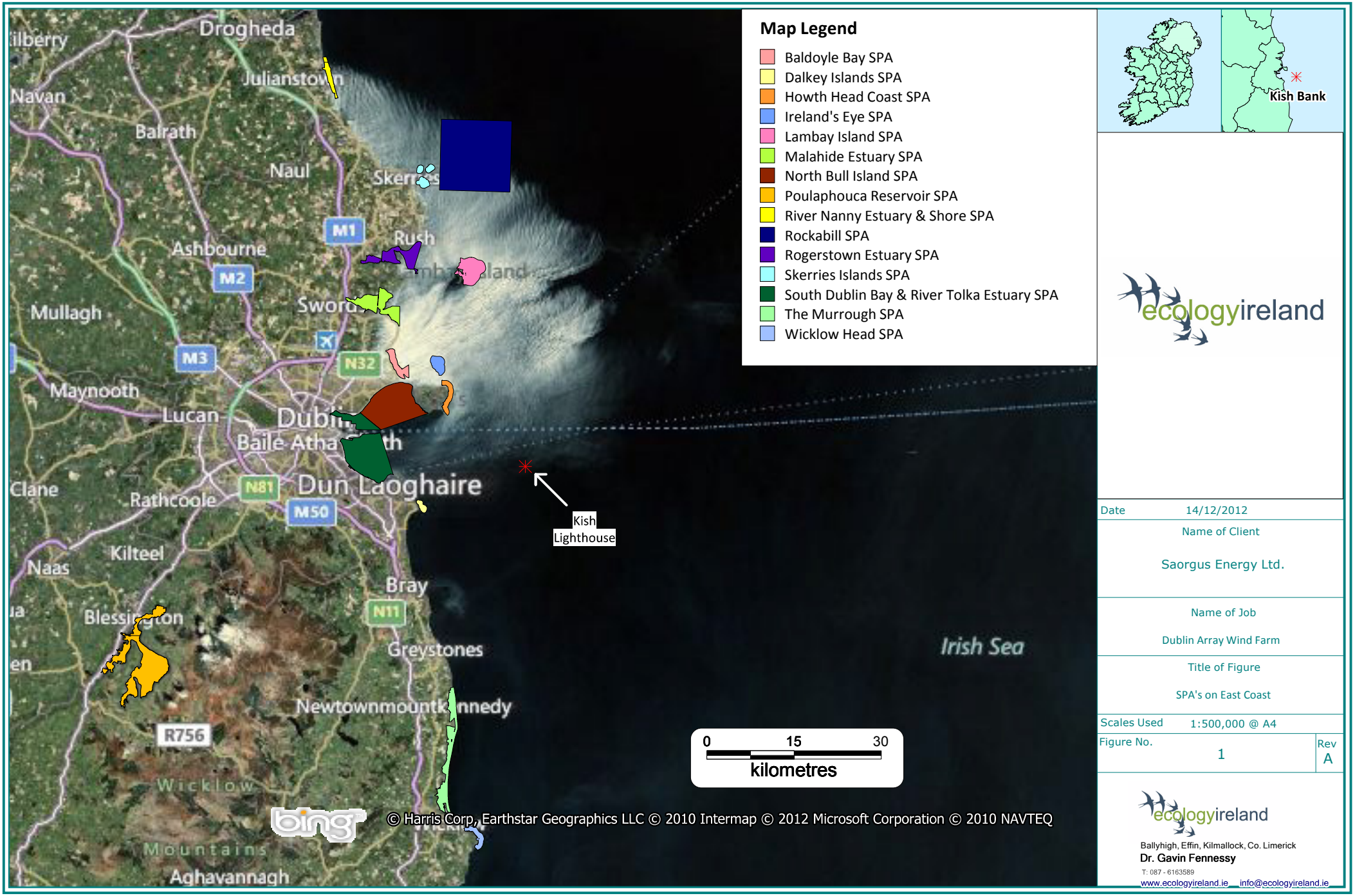
Special Protection Area (SPA)	Qualifying Features
North Bull Island SPA (004006)	Light-bellied Brent Goose (*Branta bernicla hrota*) [A046]
	Shelduck (*Tadorna tadorna*) [A048]
	Teal (*Anas crecca*) [A052]
	Pintail (*Anas acuta*) [A054]
	Shoveler (*Anas clypeata*) [A056]
	Oystercatcher (*Haematopus ostralegus*) [A130]
	Golden Plover (*Pluvialis apricaria*) [A140]
	Grey Plover (*Pluvialis squatarola*) [A141]
	Sanderling (*Calidris alba*) [A144]
	Knot (Calidris canutus) [A143]
	Dunlin (*Calidris alpina*) [A149]
	Black-tailed Godwit (*Limosa limosa*) [A156]
	Bar-tailed Godwit (*Limosa lapponica*) [A157]
	Curlew (*Numenius arquata*) [A160]
	Redshank (*Tringa totanus*) [A162]
	Turnstone (*Arenaria interpres*) [A169]
	Black-headed Gull (*Larus ridibundus*) [A179]
Rockabill SPA (004014)	Arctic Tern (*Sterna paradisaea*) [A194]
	Roseate Tern (*Sterna dougallii*) [A192]
	Common Tern (*Sterna hirundo*) [A193]
	Purple Sandpiper (*Calidris maritima*) [A148]
South Dublin Bay and River Tolka Estuary SPA (00404)	Black-headed Gull (*Larus ridibundus*) [A179]
	Roseate Tern (*Sterna dougallii*) [A192]
	Common Tern (*Sterna hirundo*) [A193]
	Arctic Tern (*Sterna paradisaea*) [A194]
	Light-bellied Brent Goose (*Branta bernicla hrota*) [A046]
	Oystercatcher (*Haematopus ostralegus*) [A130]
	Ringed Plover (*Charadrius hiaticula*) [A137]
	Grey Plover (*Pluvialis squatarola*) [A140]
	Knot (*Calidris canutus*) [A143]
	Sanderling (*Calidris alba*) [A144]
	Dunlin (*Calidris alpina*) [A149]
	Bar-tailed Godwit (*Limosa lapponica*) [A157]
	Redshank (*Tringa totanus*) [A162]
Malahide Estuary SPA (004025)	Great Crested Grebe (*Podiceps cristatus*) [A005]
	Light-bellied Brent Goose (*Branta bernicla hrota*) [A046]
	Shelduck (*Tadorna tadorna*) [A048]
	Pintail (*Anas acuta*) [A054]
	Goldeneye (*Bucephala clangula*) [A067]
	Red-breasted Merganser (*Mergus serrator*) [A069]
	Oystercatcher (*Haematopus ostralegus*) [A130]
	Golden Plover (*Pluvialis apricaria*) [A140]
	Grey Plover (*Pluvialis squatarola*) [A141]
	Knot (Calidris canutus) [A143]
	Dunlin (*Calidris alpina*) [A149]
	Black-tailed Godwit (*Limosa limosa*) [A156]
	Bar-tailed Godwit (*Limosa lapponica*) [A157]
	Redshank (*Tringa totanus*) [A162]
Lambay Island SPA (004069)	Fulmar (*Fulmarus glacialis*) [A009]

Special Protection Area (SPA)	Qualifying Features
	Cormorant (*Phalacrocorax carbo*) [A017]
	Shag (*Phalacrocorax aristotelis*) [A018]
	Lesser Black-backed Gull (*Larus fuscus*) [A183]
	Herring Gull (*Larus argentatus*) [A 184]
	Kittiwake (*Rissa tridactyla*) [A188]
	Guillemot (*Uria aalge*) [A199]
	Razorbill (*Alca torda*) [A200]
	Puffin (*Fratercula arctica*) [A204]
	Greylag Goose (*Anser anser*) [A043]
Howth Head Coast SPA (004113)	Kittiwake (*Rissa tridactyla*) [A188]
Rogerstown Estuary SPA (004015)	Greylag Goose (*Anser anser*) [A043]
	Light-bellied Brent Goose (*Branta bernicla hrota*) [A046]
	Shelduck (*Tadorna tadorna*) [A048]
	Shoveler (*Anas clypeata*) [A056]
	Oystercatcher (*Haematopus ostralegus*) [A130]
	Ringed Plover (*Charadrius hiaticula*) [A137]
	Grey Plover (*Pluvialis squatarola*) [A141]
	Knot (*Calidris canutus*) [A143]
	Dunlin (*Calidris alpina*) [A149]
	Black-tailed Godwit (*Limosa limosa*) [A156]
	Redshank (*Tringa totanus*) [A162]
Ireland's Eye SPA (004117)	Razorbill (*Alca torda*) [A200]
	Guillemot (*Uria aalge*) [A199]
	Kittiwake (*Rissa tridactyla*) [A188]
	Herring Gull (*Larus argentatus*) [A184]
	Cormorant (*Phalacrocorax carbo*) [A017]
Skerries Islands SPA (004122)	Cormorant (*Phalacrocorax carbo*) [A017]
	Shag (Phalacrocorax aristotelis) [A018]
	Herring Gull (*Larus argentatus*) [A184]
	Light-bellied Brent Goose (*Branta bernicla hrota*) [A046]
	Purple Sandpiper (*Calidris maritima*) [A148]
	Turnstone (*Arenaria interpres*) [A169]
Baldoyle Bay SPA (004016)	Light-bellied Brent Goose (*Branta bernicla hrota*) [A046]
	Shelduck (*Tadorna tadorna*) [A048]
	Ringed Plover (*Charadrius hiaticula*) [A137]
	Golden Plover (*Pluvialis apricaria*) [A140]
	Grey Plover (*Pluvialis squatarola*) [A141]
	Bar-tailed Godwit (*Limosa lapponica*) [A157]
	Arctic Tern (*Sterna paradisaea*) [A194]
Dalkey Island SPA (004172)	Arctic Tern (*Sterna paradisaea*) [A194]
	Roseate Tern (*Sterna dougallii*) [A192]
	Common Tern (*Sterna hirundo*) [A193]
The Murrough SPA (004186)	Red-throated Diver (*Gavia stellata*) [A001]
	Greylag Goose (*Anser anser*) [A043]
	Light-bellied Brent Goose (*Branta bernicla hrota*) [A046]
	Wigeon (*Anas penelope*) [A050]
	Teal (*Anas crecca*) [A052]
	Black-headed Gull (*Larus ridibundus*) [A179]
	Herring Gull (*Larus argentatus*) [A184]
	Little Tern(*Sterna albifrons*) [A195]
Wicklow Head SPA (004127)	Kittiwake (*Rissa tridactyla*) [A188]

Table 3: List of species that are qualifying features for the relevant SPAs and their occurrence within each SPA or the Dublin Array wind farm site location.

Species that are features of these SPAs	Special Protection Area or Dublin Array Wind Farm													
	N.Bull Island	Rogerstown Est.	Rockabill	S. Dublin Bay & Tolka Est.	Malahide Est.	Lambay Is.	Howth Hd. Coast	Baldoyle Bay	Ireland's Eye	Skerries Is.	Dalkey Is.	Wicklow Hd	The Murrough	DA Wind Farm
Red-throated Diver													Yes	Yes
Great Crested Grebe					Yes									Yes
Fulmar						Yes								Yes
Cormorant						Yes			Yes	Yes				Yes
Shag						Yes				Yes				Yes
Greylag Goose		Yes		Yes		Yes							Yes	
Light-bellied Brent Goose	Yes	Yes		Yes	Yes			Yes		Yes			Yes	
Shelduck	Yes	Yes		Yes	Yes			Yes						
Pintail	Yes				Yes									
Shoveler	Yes	Yes		Yes										
Wigeon													Yes	
Teal	Yes												Yes	
Goldeneye					Yes									
Red-breasted Merganser					Yes									
Oystercatcher	Yes	Yes		Yes	Yes									Yes
Ringed Plover		Yes		Yes				Yes						Yes
Grey Plover	Yes	Yes		Yes	Yes			Yes						
Golden Plover	Yes				Yes			Yes						
Knot	Yes	Yes		Yes	Yes									

Species that are features of these SPAs	Special Protection Area or Dublin Array Wind Farm													
	N.Bull Island	Rogerstown Est.	Rockabill	S. Dublin Bay & Tolka Est.	Malahide Est.	Lambay Is.	Howth Hd. Coast	Baldoyle Bay	Ireland's Eye	Skerries Is.	Dalkey Is.	Wicklow Hd	The Murrough	DA Wind Farm
Sanderling	Yes													Yes
Purple Sandpiper			Yes							Yes				
Turnstone	Yes									Yes				Yes
Dunlin	Yes	Yes		Yes	Yes									Yes
Redshank	Yes	Yes		Yes	Yes									
Black-tailed Godwit	Yes	Yes		Yes	Yes									Yes
Bar-tailed Godwit	Yes				Yes			Yes						
Curlew	Yes													Yes
Black-headed Gull	Yes													Yes
Herring Gull						Yes			Yes	Yes			Yes	Yes
Lesser Black-backed Gull						Yes							Yes	Yes
Kittiwake						Yes	Yes		Yes			Yes		Yes
Little Tern													Yes	
Common Tern			Yes								Yes			Yes
Arctic Tern			Yes								Yes			Yes
Roseate Tern			Yes								Yes			Yes
Puffin						Yes								Yes
Guillemot						Yes			Yes					Yes
Razorbill						Yes			Yes					Yes



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4. DISCUSSION

This section provides more detail on each of the 22 species that are common to the SPAs and the Kish/Bray banks and considers the potential for adverse impacts upon each of the taxa through development of the Dublin Array wind farm.

The off-shore wind energy industry is still a relatively new industry. However, a number of reviews and papers have been published on the potential impacts of off-shore wind farms on birds (e.g. Exo *et al*., 2003, Larsen & Guillemette, 2007, Budgey & Ormston, 2009, Langston 2010 and Furness & Wade, 2012). Off-shore wind farms can potentially impact on birds in the following ways:

1. Disturbance during construction and/or during operation,
2. Direct collision with the turbines,
3. Indirect habitat loss through displacement,
4. Disruption of migration routes (barrier effect).

This report provides an assessment of the likelihood of such impacts on the birds that use the Kish/Bray banks leading to a significant adverse impact on any of the SPAs lying within the 35 km hinterland. It also includes an assessment for two additional species, Gannet and Manx Shearwater. In order to produce a balanced assessment of the likely impacts an extensive review of the results of pre- and post-construction monitoring of operational off-shore wind farms has been undertaken. Budgey & Ormston (2009) have published a comprehensive review of the monitoring of ten off-shore wind farms around the UK coastline. While this review by a UK regulatory agency notes shortcomings in the assessment of offshore wind farms on seabirds around the UK, it nevertheless concludes that:

'*In virtually no case was any impact of significance found or any significant mitigation required* (arising) *from the monitoring, but this may be because all issues were dealt with during the consenting process, so that mitigation measures were built into the conditions of consent, or that insufficient sampling took place to detect change*'.

Section 3 above has shown that there are 22 bird species that were recorded during the surveys of the Kish/Bray banks that are also key species for the SPAs located in the study area. The potential impacts on each of these species are reviewed below.

4.1. SPECIES ACCOUNTS

Red-throated Diver

The 2001 survey recorded a maximum count of two birds, whilst the 2010 survey found a peak of 22 birds concentrated in foraging groups on the water at the south end of the bank in late March. The record of 22 birds is unusual as all other records for this species are of one, two or three birds on any one survey. Numbers of divers increase along the coast of Counties Wicklow and Wexford in April and May as they migrate northwards (Newton & Trewby 2011). Red-throated divers are known to be prone to disturbance and the surveys note that during the boat based surveys, divers were often flushed from the water surface some distance from the boat so that most of the records are of birds in flight. Cook *et al*. (2012) found that Red-throated Divers are a species that rarely fly at heights that would bring them within a typical rotor sweep of an offshore wind turbines (<2% of flights).

Red-throated diver is a key species for wind farms situated off the North Wales coast in Liverpool Bay. Post construction monitoring of the North Hoyle wind farm, indicates that divers may have made less use of the operational wind farm but the data is inconclusive given the small data set. Furness & Wade, 2012 note that this species is of high concern in relation to displacement and disturbance. The Murrough SPA is the only one within the 35 km hinterland that has Red-throated diver as a key species. The site synopsis presents a mean peak count over five years of 32 birds. Crowe (2005) gives an All-Ireland total for wintering Red-throated diver as 832. Crowe also notes that wintering Red-throated divers are mobile and their numbers fluctuate in response to food availability.

The pattern of usage of the Banks recorded during the dedicated seabird surveys found that numbers of divers that have been found to use the Kish/Bray is generally very low. 22 birds were recorded only on one occasion and that date was at the end of the winter period in March, when birds are on passage back to the breeding grounds. Given their response to disturbance, any Red-throated Divers using the Banks during the construction phase may be displaced from the area. However, as construction will only be ongoing in a small part of the wind farm area at any one time, any displacement of Red-throated Divers will be localised and will affect an insignificant number of birds.

During operation of the wind farm, the low numbers of Red-throated divers may be displaced from the wind farm. Recent work as reported in Furness & Wade 2012, concludes '*While it is clear that some seabirds do strongly avoid wind turbines at sea, recent work modeling the cumulative impact of disturbance by wind turbines suggests that the impact of these through increased travel distances and habitat loss is trivial, even for species that show especially strong avoidance behaviour, such as red-throated divers'*.

Given the very low numbers of birds using the Banks in the winter period it is concluded that there is no likelihood of a significant impact on the Red-throated divers using the Murrough SPA arising from the Dublin Array wind farm.

Great Crested Grebe

Great Crested Grebe is a feature for the Malahide Estuary SPA where it is noted that wintering numbers are of regional importance. Crowe (2005) gives the All-Ireland wintering population as 7,030. During the two surveys of the Kish/Bray banks, only one record of a single bird flying east in August 2010 was noted. Given the very low incidence of this species on the banks, there will be no impact on the Malahide Estuary SPA for this feature arising from the Dublin Array wind farm.

Fulmar

The only SPA in the hinterland where this species is noted as a key feature is Lambay Island. The site synopsis states that it supports a nationally important population of breeding Fulmar with a count of 635 pairs in 1999. The last major census of all seabird colonies in Ireland and Britain was the Seabird 2000 project, the results of which are given in Mitchell *et al*., 2004. They report that the All-Ireland breeding population is 38,910 Apparently Occupied Sites (AOS), with 926 AOS in counties Wicklow and Dublin.

Fulmars were recorded in both the 2001 and 2010 surveys. The peak figures in 2001 were higher than 2010, with 42 birds recorded in August 2002 and only 14 in June 2010 and again in March 2011. Birds were more numerous in spring and summer which lead Newton & Trewby (2011) to suggest that the majority were local breeding birds and the bank is not a favoured wintering area for this species. Newton & Trewby also recorded flight heights for this species, showing that mean flight heights varied from 0.5 to 3.8 m above the water level, with a maximum height of 10m recorded. This accords with Cook *et al*, 2012 who found that less than 0.2% of recorded flights were at collision heights. This is well below the proposed lowest height of the rotor blade tips for the proposed turbines of 30m. (The proposed rotor sweep will be from 30m to the maximum tip height of 160m.)

Fulmar is again a key species for the off-shore wind farms in Liverpool Bay. No issues were reported in relation to this species in the post-construction monitoring (Budgey & Ormston, 2009), although it is noted that Fulmar was recorded in such low numbers at these sites that it was not possible to determine any effect of the wind farm on their populations. Fulmar is a species that has a high tolerance of disturbance (Furness & Wade, 2012) meaning that construction activity as well as operation of the wind farm is unlikely to lead to displacement of this species.

Given the relatively low usage of the Kish/Bray banks by this species, coupled with the fact that they are generally a species that flies low to the water surface ('dynamic soaring') reducing any likelihood of collision risk, and are tolerant of disturbance, it is concluded that the proposed Dublin Array wind farm will not have a significant adverse impact on this species within the Lambay Island SPA or elsewhere in the hinterland of the development.

Cormorant

This species is a key feature for three SPAs; Lambay Island, Ireland's Eye and Skerries Islands. It is recorded as a breeding species with populations of 675, 438 and 558 pairs respectively. The breeding colony on Lambay Island is the largest in Ireland and is of international significance. Mitchell *et al*. (2004) gives the All-Ireland population as 4,736 Apparently Occupied Nests (AON). Newton & Trewby in the 2010 survey found that birds were most numerous within the Dublin Array study area during the summer months, when they were frequently seen roosting on the Kish lighthouse, in numbers which Newton & Trewby describe as 'significant'. They also found Cormorants more often in shallower water. In 2001 survey numbers of Cormorants on the bank were lower than in 2010 during the breeding season, roughly similar from late summer onwards and almost absent in winter. This is analogous to the situation found at the North Hoyle wind farm, where numbers dropped off during the summer when it was thought that birds were foraging closer to their breeding sites (nPower Renewables, 2005). Interestingly, post-construction monitoring from the North Hoyle wind farm found that birds were using the meteorological masts and marker buoys for roost sites. Cormorants will roost on handrails and other basal structures on the turbines (pers. obs.). Cormorants, at North Hoyle were also found to be associated with turbines and it was suggested they were foraging on fish which were using newly formed reefs around the turbine foundations. The data from North Hoyle indicates an increase in Cormorant numbers following construction. These data suggest that Cormorants are not displaced from foraging grounds by the presence of wind turbines. No other issues in relation to Cormorants were reported at 10 UK off-shore wind farms (Budgey & Ormston, 2009). Flight heights gathered during the 2010 survey found Cormorants flying at a maximum height of 10 m, with a mean flight height of less than 2 m, well below the proposed minimum rotor blade sweep of 30m. Based on the recorded flight heights, collision risk would not appear to be an issue for the Cormorants that use the Kish/Bray banks. Cormorant was placed low down in Furness & Wade's table for flight height/collision risk (Furness & Wade, 2012)

Cormorants are highly mobile and may forage over long distances (Langston gives the maximum foraging range as 50 km although the mean is 8.46 km). The 2001 and 2010 surveys do not provide any information on whether the birds seen on the Kish/Bray banks are drawn from local breeding colonies but as a precautionary measure, the assumption is that, at least, the majority of the birds present on the banks are from local breeding colonies, including Lambay Island and Ireland's Eye SPAs.

Cormorants do not appear to be permanently displaced from feeding habitat by the presence of wind turbines; in fact they may even show some attraction as they will use permanent structures as roosting sites (Lindeboom *et a*l, 2011). Furness & Wade (2012) give them a relatively high score for disturbance, suggesting there may be short term temporary disturbance during construction but again a phased approach to construction will limit this to local areas. During construction, there is the potential for temporary impacts on fish populations and, subsequently, potentially on Cormorant distribution. A detailed study of impacts on the commercial fisheries and marine ecology has been undertaken by Ecoserve and is presented in the Environmental Impact Statement (EIS) for the Dublin Array offshore wind farm. This study has shown that, during construction, habitat loss will be minimal and will largely be confined to the footprint of the turbines. Mitigation measures to

include back filling trenches with a similar material and to the same original bed level together with the strong tidal currents and natural sedimentation will quickly restore marine habitats. Noise and vibration impacts can also impact on fish populations but mitigation measures to include using mechanical and acoustic soft start procedures will be effective to mitigate against any significant impacts on fish during piling operations. Construction is proposed to take place over a two to three year period. A two to three year period would allow time for the benthic habitats to recover from any localised temporary disturbance associated with cable-laying. Providing the phased construction approach and the mitigation measures proposed to prevent any significant adverse impacts on local fish populations are followed, then Cormorant numbers will not be impacted during construction as their food supply will be protected and this species tolerance of disturbance. There is no likelihood of any significant adverse impacts on the Cormorant populations found within the Lambay Island, Ireland's Eye, or Skerries Islands SPAs arising from the proposed Dublin Array wind farm.

Shag

The breeding colonies of Shag on Lambay Island and Skerries Islands make them a key feature for these two SPAs. The Lambay Island colony at 1,122 pairs is the largest in Ireland and of international importance. Both surveys of the Kish/Bray banks found birds present most of the year round. The 2001 survey recorded their peak numbers (293) in September, whilst the 2010 peak (588) was in June. Again neither survey give an indication of the origin of these birds but the assumption is made that they are from local breeding colonies (including Lambay Island), although both sites are outside the quoted maximum foraging range of 20km for Shag (Birdlife International). Given the numbers of birds recorded during the surveys, it suggests that birds from Lambay are travelling to the bank to forage. Percival (2002) noted that most of the Shag records were from shallower water, particularly in the northern section, particularly around the Kish lighthouse.

Newton & Trewby (2011) recorded flight heights for this species, with a maximum recorded flight height of only 5m, with mean flight heights of less than 2 m, well below the lowest point of the turbine blades. Data from the North Hoyle wind farm suggest that there is an increase in Shag records in the wind farm since it became operational although the statistical analysis is not able to show this. As with Cormorant, the literature indicates that collision risk and displacement are not significant factors for Shag populations (Budgey & Ormston, 2009) and there is no likelihood of any significant impact on Shag populations in the SPAs that have been designated for this species.

Waders and waterbirds

This group includes all wading bird species that have been recorded on the Kish/Bray banks and are also features of the relevant SPAs, i.e. Oystercatcher, Ringed Plover, Sanderling, Turnstone, Dunlin, Black-tailed Godwit and Curlew. Typically these birds are listed conservation features for the estuarine SPAs; namely North Bull Island, South Dublin Bay,the Tolka Estuary and Malahide Estuary and also the Rogerstown Estuary and Baldoyle Bay SPA sites further north. Turnstone is also a feature for the Skerries Islands SPA. Similarly, this grouping includes the geese – Light-bellied Brent Goose and Greylag Goose- conservation features of many of the coastal SPAs.

None of these species were recorded in the 2001 survey, although it is possible that they were seen but not reported on as they are not true 'seabirds'. They were recorded in the 2010 survey but chiefly as single records of one bird (Ringed Plover, Sanderling and Turnstone), two birds (Curlew), Three birds (Oystercatcher) and five birds (Black-tailed Godwit). Dunlin was recorded on three separate occasions with a single bird in July, another single in early September and 12 birds in late September. Newton & Trewby (2011) note that all of these birds are migrants, they are not using the Kish/Bray banks for feeding or roosting as there is no suitable habitat for them. Percival (2001) notes that risk of collision with migrant waterfowl (i.e. wildfowl and wading birds) should be low/negligible if the wind farm is located several kilometres offshore. Waders tend to fly at high altitudes whilst on migration, it is when they fly between high tide roosts and feeding grounds that they fly at lower altitudes (Exo *et al*, 2003). The Banks do not lie on any direct path between roosts and feeding grounds. Whilst it is possible that waders migrating to sites further south, may overfly the area, it is also known that waders can react to the presence of turbines either by flying higher or by changing direction (Exo *et al*, 2003.). The Dublin Array wind farm does not lie on the migratory route of either Light-bellied Brent Goose or Greylag Goose. Similarly, Greenland White-fronted Geese Anser albifrons *flavirostris*, which winter in internationally important numbers in Wexford, will be at no significant risk of disturbance or collision based on what is known of their migratory routes (Stroud *et al*. 2002; Fox *et al*. 2003).

Given the low usage of the banks by these bird species added to the proposed location along the Kish/Bray banks, the likelihood of the Dublin Array wind farm impacting on the populations of these bird species within the relevant SPAs is considered negligible.

Black-headed gull

Wintering Black-headed gull numbers are a feature for three of the SPAs in the 35 km hinterland area; North Bull Island (2,996 birds), South Dublin Bay and the Tolka Estuary (3,040) and the Murrough (997). None of the relevant SPAs have been designated for breeding populations of black-headed gulls.

Both the 2001 and 2010 surveys found very low numbers of Black-headed gulls using the Kish/Bray banks, with peak counts of eight (2001) and 6 (2010). Birds were only recorded in the period August to January, with no birds recorded during the breeding season.

Newton & Trewby (2011) also recorded flight heights for this species, all flight heights were below 20m (0.8-8 m). Cook *et al* (2011) concur with finding, showing that 7.9% of all recorded flights were within rotor height. This species also seems tolerant to disturbance with Furness & Wade (2012) only giving it a score of 2 for disturbance to helicopter and boat traffic, indicating that construction activities will not lead to disturbance for this species. Given the very low numbers of this species using the banks, coupled with their low flight heights, the proposed wind farm will not have any impact on the very large numbers of wintering Black-headed Gulls using the SPAs in the wider hinterland.

Herring Gull

The breeding Herring Gull colonies found around Dublin Bay are nationally important. The colony on Lambay Island is the largest in Ireland with 1,806 pairs. The other SPAs to hold breeding colonies are Ireland's Eye (250 pairs) and the Skerries Islands (170). Additionally, wintering numbers on the Skerries Islands and the Murrough are key conservation features for these two SPAs. Table 4 below presents the peak monthly counts for Herring Gulls from the boat transect surveys from both the 2001 and 2010 surveys.

Table 4: peak monthly counts of Herring Gulls.

	2001	2010
January		26
February		
March	16	304
April	26	4
May		5
June		14
July		42
August	6	35
September	113	9
October		298
November	3	107
December	30	19

Table 4 shows that there was a marked increase in the numbers of Herring Gulls recorded in 2010 as opposed to 2001. In 2010, birds were recorded in all months except February, whilst in 2001, there were nil counts for May, June and July (no counts were undertaken in October, January and February due to unsuitable weather conditions). Newton & Trewby (2011) speculate that the increase in Herring Gull numbers is due, in part, to an increase in the breeding population at Lambay Island. Peak numbers occurred in March (2010), September (2001), October and November (both 2010), with relatively few numbers occurring during the summer months. This suggests that the birds using the banks are passage birds and not necessarily summer residents. Again, following the peak in mid-October, numbers of birds fall during the winter period, suggesting that they, at best, represent a small percentage of the wintering populations using the Skerries Islands SPA or The Murrough SPA.

Both studies found that Herring Gulls were distributed throughout the study area, although with some concentration in the northern sections. Newton & Trewby (2011) note that their wide distribution is influenced by the presence of fishing boats, with Herring Gulls being attracted to the boats.

Furness & Wade (2012) and Cook *et al*. (2012) both give Herring Gull a high score for being at risk of collision with wind turbines. This is due to their recorded flight heights, although it is acknowledged that this is a species that has a high degree of flight manoeuvrability. Recently, estimates of avoidance rates for many seabirds have been revised upwards (SNH, 2012) recognising the ability of

these species to navigate successfully through wind farms. Flight height studies by Newton & Trewby (2011) did record birds flying at up to 70 m high, within the rotor sweep of any turbines. They present their results giving mean flight heights per month. In only two months (September and October) did the mean flight height exceed 30 m i.e. within the rotor sweep of the proposed turbines. However, these two months are outside the breeding season and there is no likelihood of any significant adverse impacts on breeding Herring Gulls. Whilst birds occurring on the banks in September and October are flying at higher levels than at other stages of the year and are potentially at higher risk of collision with the turbine rotors, Scottish Natural Heritage (2012) now recognises that the basal avoidance rate should be increased from 95% to 98% for species considered to be less capable of avoiding collision. For the majority of species an avoidance rate of in excess of 99% is now considered appropriate. This reflects the growing evidence that actual collision risk is considerably lower than calculated estimates from early models. Collision risk for birds occurring on the banks in September and October will also be accordingly lower than the Furness and Wade score suggests.

Petersen *et al*., 2006 conducted a review of two wind farms constructed of the Danish coast. Their study looked at pre- and post-construction populations of birds using the wind farm areas. Herring Gulls were present at both wind farms year round, but with late autumn peaks in abundance. Their study concluded that for both wind farms considered, there was no effect on the distribution of Herring Gulls following construction. Furness & Wade (2012) have undertaken a study to assign vulnerability scores to differing seabird species in order to determine which species could be potentially impacted by offshore wind farms in Scotland. In this study they concur that Herring Gulls will not be displaced from wind farm sites through disturbance, or by the presence of wind farm structures. In fact they conclude that there may be some gain for Herring Gulls as they may use permanent structures such as the turbines (e.g. landing platforms and guard rails) or meteorological masts as perches. Newton & Trewby (2011) speculate that similar use of man-made structures is already happening on the Kish Bank, with the observation that a pair of Herring Gulls may have nested on the Kish lighthouse. Furness & Wade (2012) also score Herring Gull as being very low for disturbance, meaning that construction activities will not lead to any disturbance impacts on this species.

From our analysis of the survey data, combined with our review of the available literature we have concluded that there will be no significant adverse impact on Herring Gull populations at any of the SPAs as a result of disturbance or displacement. Given the timing of the peak numbers of Herring Gulls occurring on the banks, the main period for usage of the bank is during passage migration. It might be expected that if birds from local breeding colonies were using the banks to a large extent that high numbers would be seen in late July/September when adults and fledged birds are dispersing from the breeding colonies. However, it can be seen that peak numbers are in October and again in March, suggesting that the majority of these birds are on passage. This coincides with the time when birds seemingly are most often flying at heights that could lead to risk of collision with turbines. This leads to the conclusion that birds that are at most risk of collision are passage birds and not the breeding birds present in the relevant SPAs. SNH's recent revision of collision risks (SNH 2012) also concludes that for gull species actual collision risk is lower than predicted in models. With the application of the suggested mitigation measures there is no likelihood of any significant adverse impacts on Herring Gulls as a result of the development.

Lesser Black-backed Gull

The only SPA that lists Lesser Black-backed Gull as a key conservation feature is Lambay Island. The site synopsis notes that in 1999, 309 pairs were recorded, making this site nationally important for breeding Lesser Black-backed Gulls.

The 2001 and 2010 surveys found very low numbers of birds using the study area. The peak number of birds in the 2001 survey was five, with a peak of eight individuals in 2010. Numbers of birds using the bank during the breeding season was also very low with two birds recorded in April 2001 and none again until another two birds were noted in August. In 2010, birds were recorded in May, June and July but the highest number recorded during the breeding season was four. The 2010 study recorded two flight heights for this species; 4 m and 6 m. These flight heights are low in comparison with those predicted by Cook *et al* (2011) whose model gave 25.2% of recorded flights being at a height that brings them into risk of collision with rotor blades. It is to be noted that their study used a minimum rotor height of 20 m, not the 30 m that is proposed for the Dublin Array wind farm. Furness & Wade (2012) placed this species as third most sensitive to collision risk, due to the Cook *et al*. analysis of the percentage of flights at rotor height. Whilst there is a collision risk for this species, it is to be considered against the very low numbers of birds that use the Kish and Bray banks with peaks of five and eight birds in 2001 and 2010 respectively.

This species also seems tolerant to disturbance with Furness & Wade (2012) only giving it a score of 2 for disturbance to helicopter and boat traffic, indicating that construction activities will not lead to disturbance for this species. Given the very low numbers of this species using the bank, coupled with the low recorded flight heights, there will be no impact on the Lesser Black-backed Gulls of Lambay Island SPA.

Kittiwake

Four of the SPAs within the 35 km hinterland have breeding Kittiwakes as key features of the SPA; Lambay Island (4,091 pairs), Howth Head (2,269 pairs), Ireland's Eye (941 pairs in 1999, 1,024 in 2001) and Wicklow Head (956 pairs). All of these SPAs are considered to be nationally important for this species. Table 5 below presents the peak monthly numbers of Kittiwakes recorded during the boat transect surveys in 2001 and 2010.

Table 5: Peak monthly Kittiwake counts

	2001	2010
January		31
February		
March	266	191
April	1,052	101
May		323
June	117	419
July	479	1,577
August	530	1,753
September	4,382	1,034
October		88
November	144	111
December	149	79

Table 5 shows that Kittiwakes are recorded most of the year round but with a definite peak in July, August and September. The September count in 2001 recorded an exceptional 4,382 birds. These high counts include adults feeding fledged chicks and presumably include birds dispersing from breeding colonies. In 2001, a second peak occurred in April, probably including some birds on passage returning to the breeding colonies. Birds were recorded throughout the survey area although highest numbers were found on the bank itself and in the northern section. The 2010 survey also noted that birds were seen in the waters to the east of the bank.

Recorded flight heights in 2010 show that only in one month, November, did mean flight heights exceed 20 m (38.3 m), although the figures for August, September, October and December range from 16.9 to 19.8 m, indicating that some of these birds would have been in excess of 20 m. The highest recorded flight height was 60 m.

As with Herring Gulls, Budgey & Ormston, (2009) did not report any issues with Kittiwakes at operational wind farms in the UK. Petersen *et al*., (2006) concluded that for two wind farms off the Danish coast, there was no effect on the distribution of gulls (including Kittiwakes) following construction. Furness & Wade (2012), undertook a review of seabird sensitivities to wind farms and as with Herring Gulls, it was concluded that Kittiwakes will not be displaced from wind farm sites through disturbance or by the presence of wind farm structures, in fact there may be some positive gain as they may use permanent structures such as the turbines (e.g. landing platforms and guard rails) or meteorological masts as perches. Newton & Trewby (2011) recorded birds perched on the Kish lighthouse. Furthermore, a low score was assigned to Kittiwake for disturbance from boat and helicopter traffic, (Furness & Wade, 2012) leading to the conclusion that construction activity will not lead to any disturbance. As with Cormorants (see above), the impact assessment on fisheries undertaken for the EIS, showed that providing the mitigation measures are followed, construction activities will not significantly impact on fish populations. The presence of prey for Kittiwakes,

coupled with their tolerance of disturbance, means that construction activity will not impact Kittiwake populations.

Furness and Wade (2012) do consider Kittiwakes to be of some collision risk concern due to their range in flight height, although they do note that Kittiwakes are a highly manoeuvrable species reducing the risk of collision. Cook *et al*. (2012) assign Kittiwake to the medium collision risk group, although they note that the majority, but not all, birds tend to fly at low altitudes, below the minimum height of any turbine's rotor blades. Their model predicts that 15% of all Kittiwake flights will be at height where they are at risk of collision with the turbine rotors. For their model, they used a minimum tip height of 20 m, while the minimum proposed tip height for the Dublin Array is 30 m, suggesting that the percentage of birds flying at a height where they are at risk of collision is somewhat less than 15%. Again, due to a lack of detailed behavioural observations, the *actual* collision risk – that is taking into account the avoidance behaviour of the birds – is not available in the literature. Birds are highly capable of avoiding collision and it is worth noting that in generic Collision Risk Modelling (e.g. Band *et al*. 2007; Band 2011) that it is noted that in cases where avoidance rates have been derived from empirical data, that the avoidance rates are higher than 95%. The Band Model adopts a conservative approach to application of avoidance rates and all Gull species are assigned a 98% avoidance rate classifying them as at low risk of collision even when flying at heights within rotor sweep. Scottish Natural Heritage (2012) now recognises that the basal avoidance rate should be increased from 95% to 98% for species considered to be less capable of avoiding collision. For the majority of species an avoidance rate of in excess of 99% is now considered appropriate. This reflects the growing evidence that actual collision risk is considerably lower than calculated estimates from early models.

It is concluded that Kittiwake populations will not be impacted through displacement, however, the question of collision risk and the potential impacts on Kittiwake breeding colonies is worthy of further discussion. Large numbers of Kittiwakes were also recorded in the vicinity of the (then) proposed Arklow Bank wind farm in the Irish Sea. Potential impacts on the breeding population was a concern raised during the planning process for the Arklow Bank wind farm, and as part of the post-construction monitoring of the wind farm, the closest breeding Kittiwake colony, at Wicklow Head, was monitored on an annual basis. The most up to date, complete monitoring report available is for the period July 2007 to June 2008, year 8 of post construction monitoring. Monitoring of the Wicklow Head colony showed a slight decline in overall Kittiwake numbers between 2001 and 2008 (courtesy of *SSE Renewables*, unpublished reports). However, this has to be considered in terms of the national demographics for this species during this time-frame. Mavor *et al*. (2008) report a considerable drop in Kittiwake numbers at other Irish Kittiwake colonies and suggest that, as with similar declines observed in the UK, it may be attributed to observed declines in key prey species (Note that an impact assessment of the proposed Dublin Array offshore wind farm on fish populations has been undertaken which concludes, that with mitigation measures, there will be no significant impact on fish populations). There is no compelling evidence that Kittiwakes are in decline at Wicklow Head as a result of the Arklow Bank wind farm.

Although the shallow water around sand banks undoubtedly support high numbers of Kittiwakes, particularly during the post-breeding period, the vast majority of these birds will be flying at heights that are lower than the rotor height of the proposed turbines, greatly reducing collision risk. From

our review of available literature we have concluded that there will be no significant adverse impacts on Kittiwake breeding numbers at the SPAs as a consequence of the proposed Dublin Array wind farm.

Tern species (Common Tern, Arctic Tern and Roseate Tern)

The three Tern species are mentioned as conservation features for three SPAs; Rockabill, Dalkey Islands and South Dublin Bay and River Tolka estuary. Rockabill and Dalkey Islands are breeding colonies for all three Tern species. Rockabill is particularly noted for its Roseate Tern populations. Birdwatch Ireland figures give the population as 1,200 pairs, representing 90% of the north-western European population. Dalkey Islands have variable numbers of Terns breeding, although 11 pairs of Roseate Terns nested here in 2004. South Dublin Bay and River Tolka estuary supports a breeding colony of Common Terns (400 pairs in 2007). It is also notable for the numbers of Terns roosting there in the autumn, with up to 10,000 birds being recorded.

Table 6 below shows the peak monthly numbers of the three Tern species recorded during the boat transect surveys in 2001 and 2010.

Table 6: Peak monthly Tern counts

	Roseate Tern		Common Tern		Arctic Tern	
	2001	**2010**	**2001**	**2010**	**2001**	**2010**
January						
February						
March						
April						
May			78			62
June	4		48	35	2	2
July		2	172	146	26	157
August	282	78	583	654	120	46
September	250	323	487	391	144	2
October						
November						
December						

Terns are summer migrants to Ireland and not surprisingly do not figure in any of the counts during the winter and early spring period, i.e. October through to April. What Table 6 clearly illustrates is that Terns use the Kish and Bray banks in the late summer period with peak numbers of birds occurring in August and September. It is also clear that the banks are not important feeding areas for these birds during the breeding period. Terns are using the study area post-fledging when adults and young birds are to be found. Newton & Trewby (2011) note that Roseate Terns initially use the northern section of the banks, using the Kish lighthouse as a base to undertake foraging flights. In late September, the birds that remained were recorded in south-eastern section of the study area –

on the early stages of their migration journey. Common Terns were present throughout the study area although did tend to be associated with the Roseate Terns in the northern section.

Budgey & Ormston (2009) note that Tern species are species of interest for a number of UK off-shore wind farms but again do not report that any issues of concern have arisen following construction. The Kentish Flats wind farm reports that no changes in Common Tern numbers have been recorded but that there is some indication of a change to a flight line to a regularly used foraging area although this change is considered to be insignificant (Gill *et al*., 2008). Radar and observational studies have shown no significant barrier effect of offshore wind farms on Comic Terns (e.g. Pettersson 2005, Everaert & Stinen, 2007) and only a small percentage of flight heights are estimated at >20m over ground level (e.g. PMSS, 2007).

Everaert & Stienen (2007) report high levels of mortality in Common Tern, Sandwich Tern and Little Terns at a colony in Zeebrugge. It should be noted that the Terns were nesting on an artificial peninsula developed immediately adjacent to a wind farm. No other studies have reported issues with collision risk and it is concluded that the problems at Zeebrugge were attributable to the siting of the wind farm so close to the breeding colony. Cook *et al*. (2012) have used data from offshore wind farms in the UK to model flight heights and look at collision risk for a variety of species. They have placed all three species of Terns in the medium collision risk category. Newton & Trewby (2011) recorded flight height for all three Tern species, none of which had mean flight heights that exceeded 20 m. The highest mean flight height recorded was for Roseate Tern at 12.8 m, with the maximum recorded height for this species of 16 m. Arctic Tern had a peak mean flight height of 10.3 m (range 1 to 15 m), with Common Tern having a peak mean flight height of 11.9 m (range 1 to 20 m). These recorded flight heights are consistent with those reported in the literature (e.g. PMSS 2007, nrp *et al*. 2012) and this suggests that collision risk for all three Tern species is low for the Dublin Array wind farm.

Furness & Wade (2012) look at potential displacement risks for seabirds and assign scores of 8 (Common Tern), 9 (Roseate Tern) and 10 (Arctic Tern) for the three species. They suggest that '*species with scores over 15 (divers, scoters, Goldeneye, Scaup, Eider, Black Guillemot, Slavonian Grebe) should be considered as focal species for concern about potential displacement effects, while species with scores below 8 (Fulmar, Storm-petrels, Shearwaters, gulls, skuas, Gannet, Little Auk, and White-tailed Eagle) seem very unlikely to be affected by displacement*'. The three Tern species are therefore not considered as species of high concern with regard to displacement effects. Lindeboom *et al*. (2011) studied an offshore wind farm in the Netherlands and noted *gulls, Cormorants and Terns did not avoid the farm and used it for foraging*', although they are not specific about the Tern species they observed. Post construction monitoring of Arklow Bank wind farm found no evidence of significant displacement of Comic Terns from the wind farm area (nrp *et al*., 2012). Similarly, Wade & Furness (2012) give scores for species according to their sensitivity to disturbance (from turbines, boat and helicopter traffic) with a score of 5 being the highest sensitivity. All three tern species were given a score of 2 in terms of sensitivity to disturbance, suggesting that construction activity is likely to have little impact on tern species. Nonetheless, during construction, there will be restrictions on piling activities which would have the potential to disturb concentrations of roosting terns, particularly in the areas close to Kish Lighthouse in the north of the construction area. No piling activity will be undertaken within a buffer zone of 3km of the Kish roosting area during the

August/September period when the area is used by post fledging terns. As discussed in the Cormorant and Kittiwake sections, construction activities do have potential to impact on fish populations but mitigation measures are proposed so that these impacts are not significant and also unlikely to reduce food sources for tern species.

Our review of the bird survey data and literature on existing wind farms (relating to Terns) indicates that there is no likelihood of significant displacement and collision effects on Terns using the Kish and Bray banks during the breeding and post-fledging/staging periods. There will be no significant adverse impacts on Tern species listed as conservation features of the SPAs in the wider hinterland of the proposed Dublin Array wind farm.

Auks (Guillemot, Razorbill and Puffin)

Only two SPAs within the 35 km hinterland have auk species as key conservation features; Lambay Island (Puffin, Guillemot and Razorbill) and Ireland's Eye (Guillemot and Razorbill). Lambay Island, in particular, has large breeding populations with 59,824 Guillemots, 4,337 razorbills and 265 puffins.

Guillemots were recorded year-round in both 2001 and 2010 surveys. Peak numbers in 2001 were recorded in April with 14,218 birds whilst in 2010, peak numbers were found in July with 6,932 noted. Razorbills were also recorded throughout the survey season. Peak numbers were similar (3,110 in 2001 and 2,685 in 2011) but timing was different with the 2001 peak occurring in September and the 2010 peak in July. Puffin numbers were very low and they were not recorded at all times of the year. A peak count of five Puffins was recorded in 2001, with six being the peak noted in 2010.

Auk species are typically low flying birds and the highest recorded flight height for any of the species during the 2010 study was 8 m. Cook *et al*, 2012 showed that, in general, auks fly at low heights, considerably below collison risk height. They give less than 0.01% of Guillemot flights are at collision risk height, 0.4% of Razorbill flights and less than 0.1% of Puffin heights are at collision risk heights. Collision risks impacts for all three auk species are considered insignificant.

Puffin numbers using the study area are so low, that it is clear there will be no impact on Puffin populations within the relevant SPAs arising from the Dublin Array wind farm. Furness & Wade (2012) give Guillemot and Razorbill a medium score for disturbance from helicopter and boat traffic. There may be some localised disturbance during construction but the phased approach to construction will minimise these effects. Research conducted at Danish wind farms (Petersen *et al.*, 2006) has looked at populations of Guillemots and Razorbills pre- and post-construction of two offshore wind farms. The two species did appear to show an increased avoidance of the wind farm area. However, the authors note the distribution of these species is largely related to their prey species, pelagic fish and wide variations in their distributions from year-to-year have been recorded. Conversely, post construction monitoring of the North Hoyle wind farm (a wind farm situated in a position that is more comparable to the Dublin Array) found that Guillemots showed a statistically increased preference for the wind farm area post-construction, with an increase in numbers of 55%. There was no change in Razorbill distribution following construction (nPower renewables 2005). Fish populations and distribution are likely to be the influential factors on these two species and not

the wind farm *per se*. Providing the wind farm does not lead to a significant change in fish species, the likelihood of a significant impact on these features of the SPA arising from the wind farm is considered negligible. The impact of the wind farm on fish populations has been assessed by Ecoserve and is reported in the EIS. The potential impacts and required mitigation measures are proposed and are given in detail in the Cormorant section above. Following mitigation measures, the impacts on fish are considered to be insignificant.

Gannet

Gannets were recorded in considerably higher numbers in the 2010 survey than the 2001 survey. In 2001, the peak figure was 107 birds, with a peak of 1,326 in 2011. For all months where Gannets were recorded, the monthly peaks were higher in 2010 than 2001, except for April when figures were very similar.

Gannet is not a feature for any of the SPA's within the 35 km study area. Gannets are known to breed on Lambay Island and Ireland's Eye. Data from the JNCC online seabird register (www.jncc.defra.gov.uk), gives counts from 2010 of 138 and 360 Apparently Occupied Nests (AON) respectively. The numbers of Gannets recorded using the Banks, particularly during the 2010 survey, are considerably higher than the numbers of birds at both of these colonies and, as Newton & Trewby 2011 note, birds from the large Welsh colony at Grassholm are likely to be using the Banks. It is also possible that birds from the Saltee Islands in Co. Wexford are also foraging on the banks. The colony on Grassholm was found to be in excess of 39,000 AON's in 2009 and the Great Saltee colony was 2,446 AON's in 2004 (www.jncc.defra.gov.uk) The Grassholm colony in 1994 was considered to make up more than 12.5% of the North Atlantic breeding population. Gannets have a large foraging range, with a mean of 140 km, and a maximum recorded range of 640 km (Langston 2010). Both Grassholm and the Saltee Islands are designated as SPA's and have Gannet as a feature for the SPA designation.

Newton & Trewby (2011) recorded flight heights for Gannets. This showed considerable variation in height with the lowest recorded being 0.5 m and the highest 75 m. The monthly mean heights recorded show that the mean height did not exceed 30 m, the proposed minimum rotor height. However, in August, the mean height was 29.6 m, only just outside the minimum rotor height. During the key months of May and June, the mean recorded flight heights were 3.4 and 5.8 m respectively. No data is presented for July. Cook *et al* 2012, showed that 9.6 % of Gannet flights would be at a collision risk height, a figure they classed as very high. Cook *et al* (2012) were using 20 m as the minimum rotor tip height, not the 30 m height as proposed for the Dublin Array. They further noted:

The model for Northern Gannet shows that most, but not all birds tend to fly at low altitudes, below the minimum height of any turbines rotor blades.

Furness & Wade 2012, give Gannet a low score for displacement and comment that this species is unaffected by displacement. Construction work and operation of the wind farm will not have any impacts, therefore on Gannet populations.

Gannet is a very important breeding seabird species in the UK and Ireland (261,000 nesting pairs *per* Wanless *et al*. 2005). The risk of collision for Gannets is unclear (Langston & Boggio 2011) but as it lacks the manoeuvrability of some other seabirds it is considered to be at increased risk of collision. Several studies are underway in the UK to describe the foraging patterns of nesting Gannets (e.g. Langston & Boggio 2011, Langston & Teuten 2012; Soanes *et al*. 2012) using satellite or GPS tags to describe the foraging patterns of this large seabird. Soanes *et al*. found that gannets do not depend on specific feeding sites – varying their foraging locations opportunistically, with foraging ranges in excess of 100 km not uncommon. A thorough risk assessment for Gannets in Britain & Ireland arising from increased offshore wind development has been prepared by the Wetland & Wildfowl Trust (2012). This study includes a Population Viability Assessment (PVA) to model various scenarios and assess the impact on the population demographics. This report concludes that the Gannet population of the British Isles is robust to collision mortality because the population is large and increasing. Some 10,000 gannets per year (across all age classes in proportion to their abundance) could be taken from the population before there would be a high likelihood of a decline in overall breeding numbers, providing other aspects of gannet ecology do not change drastically. For these reasons there is no likelihood of a significant adverse impact on the Gannet population as a whole or in the protected SPA breeding colonies from which the birds observed are drawn.

Manx Shearwater

Peak numbers for Manx Shearwater were recorded in August in both survey years (2001 and 2010), with maximum counts of 3,764 and 4,513 respectively. The 2001 survey recorded higher numbers in the late spring period than in 2010 but thereafter, throughout the rest of the summer period, numbers are similar for both surveys. As Newton & Trewby 2011 note the majority of these birds are likely to originate from the Pembrokeshire Islands of Skomer and Skokholm. (Manx Shearwaters have a large foraging range, mean of 171 km, Langston, 2010).

Manx Shearwater is not a feature for any of the SPA's within the 35 km study area, although Lambay Island is known to support a small population, the site synopsis quotes 50 pairs. Skomer and Skokholm form part of a single SPA and has a breeding Manx Shearwater population in excess of 150,000 pairs forming more than 50% of the total breeding population.

Manx Shearwater is a low flying species.. Furness & Wade, 2012 give it a score of zero in terms of collision risk, with Cook *et al*. determining that only 0.04% of flights are at collision risk height. This is borne out by the recorded heights on the Banks, with a maximum height of only 5 m and the peak monthly mean height of 1.3 m (Newton & Trewby, 2011). Collision risk arising from the Dublin Array wind farm will not affect Manx Shearwater populations.

Furness & Wade 2012 also give Manx Shearwater a low score for disturbance and displacement, including disturbance form boat and helicopter traffic. In previous sections, impacts on fish

populations and recommended mitigation measures have been discussed and conclusions from a fish impact assessment have concluded that fish populations will be insignificantly impacted. Construction activity and operation of the wind farm will not have any significant adverse impacts on Manx Shearwater populations within designated SPA sites.

5. CUMULATIVE IMPACTS

Cumulative impacts for offshore wind farms are usually considered under four categories: Collision Mortality, Disturbance, Barrier Effect and Displacement (SNH, 2012). We have considered in our review the potential for collision mortality of bird species of conservation importance – in particular those listed as conservation features of interest for SPAs in the wider hinterland. We have also considered, based on the field data and the construction plan (as well as our knowledge of the ecology of the various bird species) the potential for significant disturbance or displacement of birds. We have also reviewed available information from existing offshore wind farms in the Irish Sea and considered the proposed and permitted wind farms in this area.

There are a number of sand bank sites within the Irish Sea. These banks are from north to south are Bennet, Burford, Kish, Frazer, Bray, Codling, India, Arklow, Seven Fathom Bank, Glassgorman, Rusk, Blackwater/Moneyweights, Lucifer, Long and Holdens Banks. There are two additional wind-farm projects that need to be especially considered in conjunction with the proposed Dublin Array wind farm in order to assess any cumulative impacts on the features of the relevant SPAs. These are the Arklow Bank wind farm and the Codling Bank wind farm.

The Codling Bank wind farm has permission for the construction of 220 turbines although none have been erected to date. Monitoring of the birds using the bank took place between March 2001 and April 2003 using both boat-based and aerial surveys (CWC 2009). The key species present were Manx Shearwater, Guillemot, Razorbill, Shag and Gannet. The EIS prepared for Codling Bank wind farm was reviewed; it concluded that the development area 'is *not considered to be of particular sensitivity for birds*'. The ornithological assessment found that there would be no significant impact on Irish Sea populations of any bird species from the construction or operational phases of the Codling Bank wind farm.

The impact assessment of the Dublin Array wind farm on fish populations includes a cumulative impact assessment, taking account of other offshore wind farm developments. This impact assessment states that fish populations can be impacted through loss of habitat and species, alteration in hydrology and impacts arising through vibration, noise and electromagnetic fields. The fish impact assessment concludes that the cumulative impacts on fish populations will be minimal. As there will be only minimal impacts on fish, it can be concluded that the food source for the breeding and wintering seabirds in the relevant SPAs will not be impacted through the development of the Dublin Array wind farm, in combination with the existing and consented offshore wind farms.

Arklow Bank has permission for 200 turbines, but to date only seven turbines have been erected. These turbines became operational in 2004. The EIS for the Arklow Bank project identified Red-throated Diver and Little Gull as the most sensitive species at this location. Monitoring of the seabirds using the survey area around the wind farm following construction was undertaken on an annual basis up to June 2010. The monitoring programme followed boat based transect survey methods a standard as well as monitoring numbers and productivity of the nearest seabird breeding colony of note at Wicklow Head.

The most recent full report available on the monitoring programme is for year 8, 2008. This unpublished report for Airtricity (now *SSE Renewables*) looks at the results for year 8 but also compares them with previous years' data in order to determine if there are any long term declines in any of the species using the Arklow Bank. The only statistically significant result is for Red-throated Diver, which is showing a decline in numbers using Arklow Bank. This species has only been found in extremely low numbers at the Kish and Bray banks. If Red-throated Divers are indeed being displaced from Arklow Bank, then they are not using the Kish Bray banks as an alternative feeding ground. Similarly, the EIS for Codling Bank wind farm recorded very low numbers of Red-throated Divers in the area between Arklow Bank and the Kish/Bray Banks. Therefore it can be concluded that the erection of the Dublin Array wind farm will not have any significant additive or synergistic, adverse impact on the Red-throated Diver population in the Irish Sea.

Our literature review has included Environmental Impact Statements and post construction monitoring reports for operational offshore wind farms that are located in the eastern Irish Sea, including Barrow, Burbo Bank, North Hoyle, Rhyl Flats and Gwynt y Môr. These wind farms were also included in Budgey & Ormston's review of post-construction monitoring of UK offshore windfarms (Budgey & Ormston, 2009). To date, no issues have arisen with any of these windfarms that suggest significant adverse impacts on bird populations and species of elevated conservation importance.

6. CONCLUSIONS

Offshore wind farm development is relatively new and scientific research on the impacts of offshore turbines on birds is complicated by the considerable difficulties associated with recording birds at sea. In recent years advances in survey methodology and technological advances such as bird RADAR and satellite/GPS tagging of birds have led to a proliferation of peer-reviewed literature examining the pre- and post-construction behaviour and distribution of birds at offshore wind farm sites.

The predicted impact of the erection of these structures was informed by observation at onshore wind-farms and intuitive forecasts from experienced ecologists. Thus the risk to seabirds of collision with turbines, displacement from feeding or roosting area and disturbance to migration by means of the creation of a 'barrier' to movement, were postulated as potential impacts arising from the development of offshore wind farms. The research thus far has indeed found that there are species and locations which may be vulnerable to certain adverse impacts from offshore turbines. However, the research has also shown that in the case of many of the wind-farms and species considered that there is no indication that the construction and operation of appropriately sited offshore wind farms has any significant adverse impacts on the bird species using these areas (e.g. Topping and Petersen, 2011).

For the Dublin Array wind farm, mitigation measures are proposed for the construction period. These measures are largely to prevent impacts to local fish populations which provide a food source for many of the seabird species that use the Kish and Bray banks. Mitigation measures proposed are:

- No piling activity will take place in the period August to September within a 3km buffer zone of the Kish Lighthouse roosting area for Roseate Terns. Field studies have shown that the area is used by flocks of post-fledging terns, including the internationally important Roseate Tern flocks. The buffer zone will minimise the risk of disturbance of Terns at rest during the construction phase.
- Cable trenches are to be refilled with material of a similar particle size as the original material and to the same depth in order to allow benthic habitats to recover.
- Mechanical and acoustic soft start procedures are to be used during piling operations to minimise noise and vibration impacts on fish populations.
- Construction is to take place over a two to three year period to reduce any potential disturbance impacts to birds and to allow benthic habitats to recover.

It is worth noting that development will proceed on a phased basis with approximately 5% of the area actively under construction at any one time. A full monitoring programme to determine seabird abundance and distribution is to be instigated using the same boat based survey methodology as undertaken by Percival in 2001 and Newton & Trewby in 2010. The monitoring programme is to be carried for one full 12 month period prior to construction, during all years where construction is taking place and for at least three years following construction.

Our analysis of the available literature in combination with the information collected on the birds using the proposed Dublin Array development area has concluded that the nature and extent of the predicted impacts on seabird species is not of a scale that is likely to have any significant adverse impacts on any SPA sites, or their conservation objectives.

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