River Nanny Estuary & Shore Special Protection Area

(Site Code 4158)

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Conservation Objectives Supporting Document

VERSION 1

National Parks & Wildlife Service

September 2012

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SUMMARY

This document presents conservation objectives for the Special Conservation Interests of River Nanny Estuary and Shore Special Protection Area, designated under Directive 2009/147/EC on the conservation of wild birds (Birds Directive).

Part One presents an introduction to the Special Protection Area (SPA) designation process and to the site designated as River Nanny Estuary and Shore Special Protection Area, as well as introducing the concept of conservation objectives and their formulation.

Part Two provides site designation information for River Nanny Estuary and Shore SPA and Part Three presents the conservation objectives for this site.

Part Four reviews the conservation condition of the site Special Conservation Interest (SCI) species including analysis of wintering (non-breeding) population trends, assignment of site conservation condition, and examination of site trends in light of all-Ireland and international status and trends. Importantly, this section states the current conservation condition of each of the SCI species.

Part Five provides supporting information that will assist the interpretation of the site-specific conservation objectives. This section includes a review of the ecological characteristics of the SCI species and examines waterbird distribution recorded during the 2011/12 Waterbird Survey Programme, drawing also on data from NPWS monitoring programmes (e.g. benthic surveys) and the Irish Wetland Bird Survey (I-WeBS). Part Five concludes with information on activities and events that occur in and around the site which may interact with waterbirds during the non-breeding season and includes an assessment of those activities that were recorded to cause disturbance to non-breeding waterbirds during the 2011/12 Waterbird Survey Programme.

PART ONE - INTRODUCTION

1.1 Introduction to the designation of Special Protection Areas

The over-arching framework for the conservation of wild birds within Ireland and across Europe is provided by Directive 2009/147/EC on the conservation of wild birds (the codified version of Council Directive 79/409/EEC as amended) (Birds Directive). Together with the EU Habitats Directive (Council Directive 92/43/EEC), these legislative measures provide for wild bird protection via a network of protected sites across Europe known as Natura 2000 sites, of which the overriding conservation objective is the maintenance (or restoration) of 'favourable conservation status' of habitats and species.

Under Article 4 of Directive 2009/147/EC, Ireland, along with other Member States, is required to classify the most suitable territories in number and size as Special Protection Areas (SPAs) for the conservation of certain wild bird species, which are:

- species listed in Annex I of the directive
- regularly occurring migratory species

Also under Article 4, Member States are required to pay particular attention to the protection of wetlands, especially those of international importance.

The National Parks & Wildlife Service (NPWS), part of the Department of the Arts, Heritage and the Gaeltacht, are responsible for the selection and designation of SPAs in the Republic of Ireland. NPWS have developed a set of criteria, incorporating information relating to the selection of wetland sites developed under the Ramsar Convention, which are used to identify and designate SPAs. Sites that meet any of the following criteria may be selected as SPAs:

- A site regularly supporting 20,000 waterbirds or 10,000 pairs of seabirds;
- A site regularly supporting 1% or more of the all-Ireland population of an Annex I species;
- A site regularly supporting 1% or more of the biogeographical population of a migratory species;
- A site that is one of the 'n' most suitable sites in Ireland for an Annex I species or a migratory species (where 'n' is a variable which is related to the proportion of the total biogeographic population of a species held by Ireland).

The biogeographic population estimates and the recommended 1% thresholds for wildfowl and waders are taken from Wetlands International (Wetlands International, 2002); thresholds reflecting the baseline data period used. The all-Ireland populations for the majority of wintering waterbirds are taken from Crowe et al. (2008).

Site specific information relevant to the selection and designation of a SPA is collated from a range of sources including the Irish Wetland Bird Survey (I-WeBS), The Wetland Bird Survey (WeBS) in Northern Ireland, species specific reports and a wide range of scientific publications, reports and other surveys. If, following collation of all the available scientific data, a site meets the relevant criteria for designation and is selected as an SPA, a list of species for which the site is nationally important is compiled. These species are known as **Special Conservation Interests** and can be divided into two categories:

Selection species:

The species occurring at a site which identifies the site as qualifying for SPA status i.e. a species that met at least one of the following conditions:

- An Annex I species that occurs at the site in numbers that exceed the all-Ireland 1% population threshold;

- A migratory species that occurs at the site in numbers that exceed the biogeographic 1% population threshold; and/or
- A species for which the site is considered to be one of the *'n'* most suitable sites in Ireland for the conservation of that species (where *n* is a variable that is related to the proportion of the total biogeographic population held by Ireland).

Additional Conservations Interests:

- Relevant Annex I or migratory species which exceed the all-Ireland 1% threshold during the baseline period but were not selection species for the site.

- Wetlands and waterbirds: the wetlands of northwest Europe are a vital resource for millions of northern and boreal nesting waterbird species that overwinter on these wetlands or visit them when migrating further south. To acknowledge the importance of Ireland's wetlands to wintering waterbirds the term Wetland & Waterbirds can be included as a Special Conservation Interest for a Special Protection Area that has been designated for wintering waterbirds, and is or contains a wetland site of significant importance to one or more of the species of Special Conservation Interest.

1.2 Introduction to River Nanny Estuary and Shore Special Protection Area

The River Nanny Estuary is located near the village of Laytown, Co Meath. The designated site comprises the estuary of the River Nanny and sections of the shoreline to the north and south of the estuary mouth (c. 3 km in length) (see figure in Appendix 1).

The estuarine channel within the SPA extends inland for almost 2 km as far as Julianstown south. It is a narrow and sheltered river estuary with sediments largely comprising fine particles and characterised by biotopes dominated by the Ragworm *Hediste diversicolor*. The estuary is often fringed by saltmarsh with freshwater marsh/wet grassland in places. Mixed woodland borders the site at the upper extent.

The shoreline part of the SPA is approximately 500m in width from the top of the shore to the low water mark. It comprises predominantly fine sand sediments with less c10% coarse materials (NPWS, 2011b). The shoreline is backed in places by clay cliffs.

The Site Synopsis for River Nanny Estuary and Shore SPA and a map showing the SPA boundary are given in Appendix 1.

1.3 Introduction to Conservation Objectives

The overriding objective of the Habitats Directive is to ensure that the habitats and species covered achieve '*favourable conservation status'* and that their long-term survival is secured across their entire natural range within the EU (EU Commission, 2010). In its broadest sense, favourable conservation status means that an ecological feature is being maintained in a satisfactory condition, and that this status is likely to continue into the future. Definitions as per the EU Habitats Directive are given in Box 1.

Box 1

Favourable Conservation Status as defined by Articles 1 (e) and 1(i) of the Habitats Directive

The conservation status of a natural habitat is the sum of the influences acting on it and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species. The conservation status of a natural habitat will be taken as favourable when:

- *its natural range and areas it covers within that range are stable or increasing; and*
- *the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and*
- *the conservation status of its typical species is favourable'.*

The conservation status of a species is the sum of the influences acting on the species that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as 'favourable' when:

- *the population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats; and*
- *the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and*
- *there is, and will probably continue to be, a sufficiently large habitat to maintain its populations*

Site-specific conservation objectives define the desired condition or range of conditions that a habitat or species should be in, in order for these selected features within the site to be judged as favourable. At site level, this state is termed 'favourable conservation condition.' Site conservation objectives also contribute to the achievement of the wider goal of biodiversity conservation at other geographic scales, and to the achievement of favourable conservation status at national level and across the Natura 2000 network[1].

Where relevant, conservation objectives are defined for attributes[2] relating to bird species populations, and for attributes related to the maintenance and protection of habitats that support them. These attributes are:

- Population trend;
- Population distribution;
- Habitat range and area (extent).

Further guidance is given in Section 3.1 (Conservation Objectives for the Special Conservation Interests of River Nanny Estuary and Shore Special Protection Area).

[1] Note that the terms 'conservation condition' and 'conservation status' are used to distinguish between site and the national level objectives respectively.

[2]Attribute can be defined as: 'a characteristic of a habitat, biotope, community or population of a species which most economically provides an indication of the condition of the interest feature to which it applies' (JNCC, 1998).

PART TWO – SITE DESIGNATION INFORMATION

2.1 Special Conservation Interests of River Nanny Estuary and Shore Special Protection Area

The **Selection Species** and **Additional Special Conservation Interests**[3] for River Nanny Estuary and Shore SPA are listed below and summarised in Table 2.1. This table also shows the importance of River Nanny Estuary and Shore SPA for SCI species, relative to the importance of other sites within Ireland, within the mid-east region, and within Co. Meath.

The Selection Species listed for River Nanny Estuary and Shore SPA are as follows:-

1. During winter the site regularly supports 1% or more of the all-Ireland population of Ringed Plover (*Charadrius hiaticula*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 185 individuals.

2. During winter the site regularly supports 1% or more of the all-Ireland population of Knot (*Calidris canutus*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 1,140 individuals.

3. During winter the site regularly supports 1% or more of the all-Ireland population of Sanderling (*Calidris alba*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 240 individuals.

Additional Special Conservation Interests for River Nanny Estuary and Shore SPA are as follows:

4. During winter the site regularly supports 1% or more of the all-Ireland population of Oystercatcher (*Haematopus ostralegus*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 1,014 individuals.

5. During winter the site regularly supports 1% or more of the all-Ireland population of Golden Plover (*Pluvialis apricaria*). The mean peak number of this Annex I species within the SPA during the baseline period (1995/96 – 1999/00) was 1,759 individuals.

6. During winter the site regularly supports 1% or more of the all-Ireland population of Herring Gull (*Larus argentatus*). The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 609 individuals.

7. The wetland habitats contained within River Nanny Estuary and Shore SPA are identified of conservation importance for non-breeding (wintering) migratory waterbirds. Therefore the wetland habitats are considered to be an additional Special Conservation Interest.

[3] Note that Special Conservation Interest species are listed in the order of Selection Species followed by additional Special Conservation Interest species. Within these two categories, species are listed in taxonomic order.

Table 2.1 Designation Summary: species listed for River Nanny Estuary and Shore Special Protection Area, plus site importance at national, regional and county scale

	Special Conservation Interests	Annex I species	Baseline Population[a]	Population status at baseline	National Importance Rank[1]	Regional Importance Rank[2]	County Importance Rank[3]
Selection Species	Ringed Plover (*Charadrius hiaticula*)		185	All-Ireland importance	10	1	1
	Knot (*Calidris canutus*)		1,140	All-Ireland importance	7	2	2
	Sanderling (*Calidris alba*)		240	All-Ireland importance	4	1	1
Additional Special Conservation Interests	Oystercatcher (*Haematopus ostralegus*)		1,014	All-Ireland importance	14	2	2
	Golden Plover (*Pluvialis apricaria*)	Yes	1,759	All-Ireland importance	31	2	2
	Herring Gull (*Larus argentatus*)		609	All-Ireland importance	4	1	1
Other conservation designations associated with the site[b]		**SAC**	**RAMSAR SITE**	**IMPORTANT BIRD AREA (IBA)**	**WILDFOWL SANCTUARY**	**OTHER**	**OTHER**
		No	Yes	Yes	No	pNHA	

[a] Baseline data are the 5-year mean peak counts for the period 1995/96 – 1999/00 (I-WeBS).
[b] Note that other designations associated with River Nanny Estuary may relate to different areas and/or some of these areas may extend outside the SPA boundary.
[1]National importance rank – the number given relates to the importance of the site for the non-breeding population of a SCI species during the baseline period (1995/96 – 1999/00) relative to other sites in Ireland.
[2]Regional importance rank – the number given relates to the importance of the site for the non-breeding population of a SCI species during the baseline period (1995/96 – 1999/00) relative to other sites within the Mid East region (includes the Boyne Estuary which crosses the regional border).
[3]County importance rank – the number given relates to the importance of the site for the non-breeding population of a SCI species during the baseline period (1995/96 – 1999/00) relative to other sites within Co Meath (includes the Boyne Estuary which crosses the Meath/Louth border).

PART THREE – CONSERVATION OBJECTIVES FOR RIVER NANNY ESTUARY AND SHORE SPA

3.1 Conservation Objectives for the Special Conservation Interests of River Nanny Estuary and Shore SPA

The overarching Conservation Objective for River Nanny Estuary and Shore Special Protection Area is to ensure that waterbird populations and their wetland habitats are maintained at, or restored to, favourable conservation condition. This includes, as an integral part, the need to avoid deterioration of habitats and significant disturbance; thereby ensuring the persistence of site integrity.

The site should contribute to the maintenance and improvement where necessary, of the overall favourable status of the national resource of waterbird species, and continuation of their long-term survival across their natural range.

Conservation Objectives for River Nanny Estuary and Shore Special Protection Area, based on the principles of favourable conservation status, are described below and summarised in Table 3.1. Note that these objectives should be read and interpreted in the context of information and advice provided in additional sections of this report.

Objective 1: *To maintain the favourable conservation condition of the waterbird Special Conservation Interest species listed for River Nanny Estuary and Shore SPA.*

This objective is defined by the following attributes and targets:-

- To be favourable, the long term **population trend** for each waterbird Special Conservation Interest species should be stable or increasing.[4] Waterbird populations are deemed to be unfavourable when they have declined by 25% or more, as assessed by the most recent population trend analysis.[5]

- To be favourable, there should be no significant decrease in the range, timing or intensity of use of areas by the waterbird species of Special Conservation Interest, other than that occurring from natural patterns of variation.[6]

Factors that can adversely effect the achievement of Objective 1 include:

- ❖ Habitat modification: activities that modify discreet areas or the overall habitat(s) within the SPA in terms of how one or more of the listed species use the site (e.g. as a feeding resource) could result in the displacement of these species from areas within the SPA and/or a reduction in their numbers (for further discussion on this topic please refer to Section 5.4).

- ❖ Disturbance: anthropogenic disturbance that occurs in or near the site and is either singular or cumulative in nature could result in the displacement of one or more of the listed waterbird species from areas within the SPA, and/or a reduction in their numbers (for further discussion on this topic please refer to Section 5.4).

[4] Note that 'population' refers to site population (numbers wintering at the site) rather than the species biogeographic population.

[5] Population trend analysis is presented in Section 4.

[6] Waterbird distribution from the 2011/2012 waterbird survey programme is examined in Section 5.

- ❖ Ex-situ factors: several of the listed waterbird species may at times use habitats situated within the immediate hinterland of the SPA or in areas ecologically connected to it. The reliance on these habitats will vary from species to species and from site to site. Significant habitat change or increased levels of disturbance within these areas could result in the displacement of one or more of the listed waterbird species from areas within the SPA, and/or a reduction in their numbers (for further information on this topic please refer to Section 5.2).

Objective 2: *To maintain the favourable conservation condition of the wetland habitat at River Nanny Estuary and Shore SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.*

This objective is defined by the following attributes and targets:-

- To be favourable, the permanent **area** occupied by the wetland habitat should be stable and not significantly less than the area of **230 ha**, other than that occurring from natural patterns of variation.

The boundary of River Nanny Estuary and Shore SPA was defined to include the primary wetland habitats of this site. Objective 2 seeks to maintain the permanent extent of these wetland habitats, which constitute an important resource for regularly-occurring migratory waterbirds. The wetland habitats can be categorised into three broad types: subtidal; intertidal; and supratidal. Over time and though natural variation these subcomponents of the overall wetland complex may vary due to factors such as changing rates of sedimentation, erosion etc. Waterbird species may use more than one of the habitat types for different reasons (behaviours) throughout the tidal cycle.

Subtidal areas refer to those areas contained within the SPA that lie below the mean low water mark and are predominantly covered by marine water. Tidal rivers, creeks and channels are included in this category. For River Nanny Estuary and Shore SPA this broad category is estimated to be **26 ha**. Subtidal areas are continuously available for benthic and surface feeding ducks (e.g. Wigeon) and piscivorous/other waterbirds. Various waterbirds roost in subtidal areas. The relatively low proportion of subtidal habitat is due to the fact that this SPA is designated primarily for birds using intertidal habitats.

The intertidal area is defined, in this context, as the area contained between the mean high water mark and the mean low water mark. For River Nanny Estuary and Shore SPA this is estimated to be **177 ha**. When exposed or partially exposed by the tide, intertidal habitats provide important foraging areas for many species of waterbirds, especially wading birds, as well as providing roosting/loafing[7] areas. When the intertidal area is inundated by the tide it becomes available for benthic and surface feeding ducks and piscivorous/other waterbirds. During this tidal state this area can be used by various waterbirds as a loafing/roosting resource.

The supratidal category refers to areas that are not frequently inundated by the tide (i.e. occurring above the mean high watermark) but contain shoreline and coastal habitats and can be regarded as an integral part of the shoreline. For River Nanny Estuary and Shore SPA this is estimated to be **26 ha**. Supratidal areas are used by a range of waterbird species as a roosting resource as well as providing feeding opportunities for some species.

The maintenance of the 'quality' of wetland habitat lies outside the scope of Objective 2. However, for the species of Special Conservation Interest, the scope of Objective 1 covers

[7] Loafing can be described as any behaviour not connected with breeding or feeding, and includes preening and resting.

the need to maintain, or improve where appropriate, the different properties of the wetland habitats contained within the SPA.

Table 3.1 Conservation Objectives for the waterbird Special Conservation Interests of River Nanny Estuary and Shore SPA.

Objective 1: *To maintain the favourable conservation condition of the waterbird Special Conservation Interest species listed for River Nanny Estuary and Shore SPA, which is defined by the following list of attributes and targets:*				
Parameter	**Attribute**	**Measure**	**Target**	**Notes**
Population	Population trend	Percentage change as per population trend assessment using waterbird count data collected through the Irish Wetland Bird Survey and other surveys.	The long term population trend should be stable or increasing	Waterbird population trends are presented in Part Four of this document.
Range	Distribution	Range, timing or intensity of use of areas used by waterbirds, as determined by regular low tide and other waterbird surveys.	There should be no significant decrease in the range, timing or intensity of use of areas by the waterbird species of Special Conservation Interest other than that occurring from natural patterns of variation.	Waterbird distribution from the 2011/12 waterbird survey programme is reviewed in Part Five of this document.
Objective 2: *To maintain the favourable conservation condition of the wetland habitat at River Nanny Estuary and Shore SPA as a resource for the regularly-occurring migratory waterbirds that utilise it. This is defined by the following attributes and targets:*				
Parameter	**Attribute**	**Measure**	**Target**	**Notes**
Area	Wetland habitat	Area (ha)	The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 230 ha, other than that occurring from natural patterns of variation.	The wetland habitat area was estimated as 230 ha using OSI data and relevant orthophotographs.

PART FOUR – REVIEW OF THE CONSERVATION CONDITION OF WATERBIRD SPECIAL CONSERVATION INTERESTS

4.1 Population data for waterbird SCI species of River Nanny Estuary and Shore SPA

Wintering waterbirds have been counted regularly at River Nanny Estuary as part of the Irish Wetland Bird Survey (I-WeBS) since the survey commenced in 1994 (Crowe, 2005). With the exception of two seasons, the site has been counted across a seven month period in each season, covering the months September to March inclusive. This is known as the core count period of I-WeBS and this timeframe not only covers the main winter period when many species occur in their largest concentrations, but also the autumn and spring passage periods when total waterbird numbers may be enhanced by staging/stopover birds[8].

In most seasons the site has been counted as a single count area (Laytown – Delvin River, or Laytown - Ben Head) covering approximately 370 ha (Crowe, 2005). Note that the SPA area and the I-WeBS count area are not coincident. The SPA extends further up the River Nanny estuary and extends slightly further north of Laytown than the I-WeBS count area, and while the SPA boundary ends just south of Ben Head, the I-WeBS count area extends south as far as the Delvin River.

Table 4.1(a) presents population[9] data for non-breeding waterbirds of the River Nanny Estuary. Annual maxima were identified and used to calculate the five-year mean peak for each species. The baseline period was 1995/96 – 1999/00 and the most recent five-year average is for 2005/06 – 2009/10.

When examining waterbird data, it is standard practice to use the mean of peak counts because they reflect more accurately the importance of a site for a particular species. The assessment of five-year periods helps to account for fluctuations in numbers or where there are inconsistencies in data gathering (e.g. incomplete coverage, bad weather). In general and taking into account all potential sources of error in counting wetland birds, resulting data are regarded to be underestimates of population size (Underhill & Prŷs-Jones, 1994).

Table 4.1 highlights where the numbers shown surpass thresholds of International or all-Ireland importance. These thresholds are different for the baseline and recent time periods used; international thresholds are outlined in Wetlands International (2002) and Wetlands International (2006) for the baseline and recent site data respectively, while all-Ireland thresholds are presented within Crowe et al. (2008).

The wintering distributions of gull species are widespread and not monitored routinely during I-WeBS therefore standard methods of population estimation and threshold setting are difficult. SCI selection in relation to the Herring Gull therefore relates to the known most important sites for this species and a 'threshold of significance' is applied (Crowe, 2005).[10]

[8] The terms 'stopover' and 'staging' are often used interchangeably. A stopover site can be defined as any place where a bird takes a break during migration. Staging areas are stopover sites that attract large numbers of individuals and play an important part in re-fuelling the birds before their onward migration (e.g. Warnock, 2010).

[9] Note that 'population' refers to site population (numbers wintering at the site) rather than a species' biogeographic population.

[10] Current threshold of significance is 500 for Herring Gull.

Table 4.1 Population data for waterbird Special Conservation Interest Species of River Nanny Estuary and Shore SPA

Site Special Conservation Interests (SCIs)	Baseline Period[1] (1995/96 – 1999/00)	Recent Site Data[2] (2005/06 – 2009/10)
Ringed Plover*	185 (n)	174 (n)
Knot*	1,140 (n)	2,801 (n)
Sanderling*	240 (n)	283 (n)
Oystercatcher	1,014 (n)	986 (n)
Golden Plover	1,759 (n)	440
Herring Gull	609 (n)	51

* denotes site selection species. [1]Baseline data is the 5-year mean peak count for the period 1995/96 – 1999/00;
[2]recent site data is the 5-year mean for the 5-year period 2005/06 – 2009/10 (I-WeBS).
(i) denotes numbers of international importance; (n) denotes numbers of all-Ireland importance.

4.2 Waterbird population trends for the River Nanny Estuary and Shore SPA

The calculation and assessment of waterbird population trends at Irish coastal SPA sites follows the UK Wetland Bird Survey 'Alerts System' which provides a standardised technique for monitoring changes in the numbers of non-breeding waterbirds over a range of spatial scales and time periods (Appendix 3).

Annual population indices were calculated for waterbird SCI species for the data period 1994/95 to 2008/09. Trends are given for the 'long-term' 12-year period (1995/96–2007/08) and the recent ('short-term') five-year period (2002/03 – 2007/08) (Table 4.2). The values given represent the percentage change in index (population) values across the specified time period. Positive values equate to increases in population size while negative values reflect a decrease in population size.

Waterbirds are relatively long-lived birds and changes in population size can take several years to become evident. The short-term trend can be useful to assess whether species numbers at the site are remaining stable, showing increase or signs of recovery, or are continuing to decline. For example, although a species' long-term trend may be negative, the short-term trend could be positive if numbers have increased during the recent five year period being assessed. Importantly, the short-term trend may detect more rapidly where a species population is beginning to decline.

Population indices were not calculated for Herring Gull because gulls are not counted consistently during I-WeBS. Therefore a measure of population change was calculated using the generic threshold method which compares population size at two time intervals based on five-year means (see Appendix 3 for methods), although some caution in interpretation is urged due to the noted inconsistencies in data gathering.

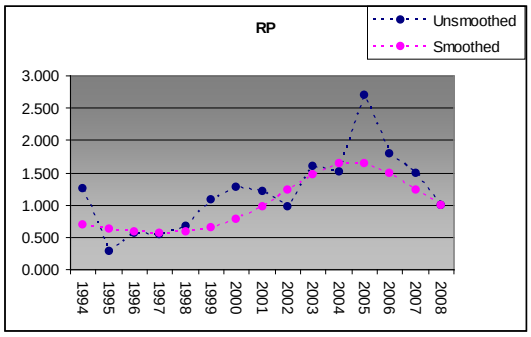
Table 4.2 Site Population Trends for waterbird Special Conservation Interest species of River Nanny Estuary and Shore SPA

Site Special Conservation Interests (SCIs)	Site Population Trend[1] 12 Yr	Site Population Trend[2] 5 Yr	Population Change[3]
Ringed Plover*	+ 97.1	+ 1.7	
Knot*	+ 878.01	+ 117.2	
Sanderling*	+ 119.6	+ 90.7	
Oystercatcher	+ 115.4	+ 34.7	
Golden Plover	- 59.8	- 36.1	
Herring Gull			-92

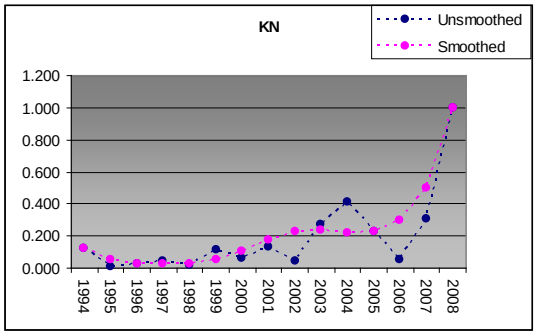
* denotes site selection species.
[1]Site population trend analysis: 12 yr = 1995/96 – 2007/08
[2]Site population trend analysis: 5 yr = 2002/03 – 2007/08.
[3]Site population change based on two five-year – means (1995/96 – 1999/00 and 2005/06 – 2009/10).

For selected species, explanatory notes are given below to aid the interpretation of trends. Smoothed and unsmoothed indices are shown graphically. Graph headings use waterbird species codes and a list of these is provided in Appendix 4.

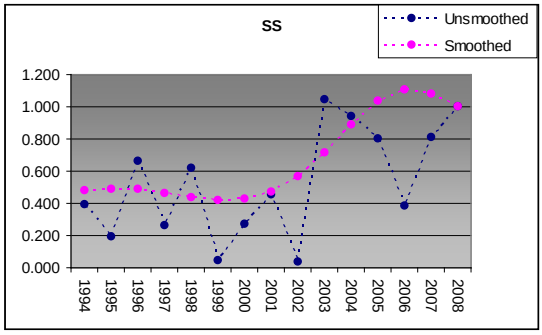
Ringed Plover – the smoothed trend highlights relatively stable numbers during the early dataset that increased up until 2005/06 then showed a declining trend up until 2008/09. The most recent index remains at a higher level than those during the mid-late 1990's. The national trend for this species is showing an increase (Boland & Crowe, 2012[11]) but this contrasts with Northern Ireland and Britain, both of which have shown a long-term decline in numbers (Calbrade et al. 2010).



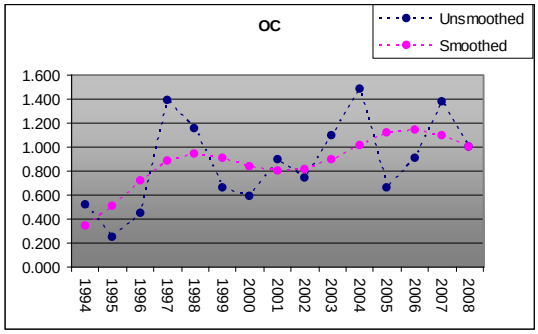
Knot – low but relatively stable numbers during the early part of I-WeBS coverage were followed by a period of gradual increase and more recently a sharp increase (peak I-WeBS count of 6,000 2008/09).
The trend for increase is consistent with the national trend which has seen substantial increases in numbers since 2005/60 (Boland & Crowe, 2012).



Sanderling – numbers fluctuated throughout and since 2003/04 have remained higher than those counted during the mid-late 1990's. This increase is consistent with the trend for the Republic of Ireland (Boland & Crowe, 2012).

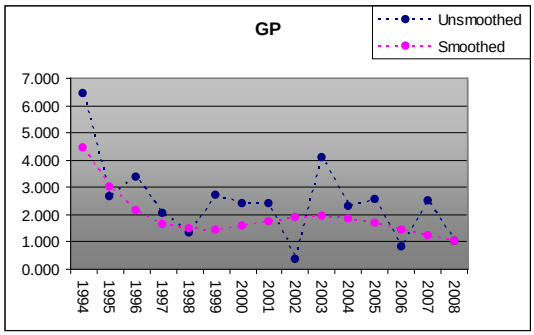


Oystercatcher – while numbers have fluctuated, the smoothed trend highlights a progressive increase in numbers since 1995/96. This is in line with the long-term trend for increase reported during I-WeBS (Boland & Crowe, 2012).



[11] National trends presented in Boland & Crowe (2012) update those previously shown in Crowe (2005).

Golden Plover – numbers have at times fluctuated widely but the smoothed trend suggests almost progressive decline across I-WeBS. Nationally, numbers have been relatively stable during this period (Boland & Crowe, 2012).



4.3 River Nanny Estuary and Shore SPA – site conservation condition of waterbird SCI species

Conservation condition of waterbird species is determined using the long-term site population trend and is assigned using the following criteria:

Favourable population = population is stable/increasing.

Intermediate (unfavourable) = Population decline in the range 1.0 – 24.9%.

Unfavourable population = populations that have declined between 25.0 – 49.9% from the baseline reference value.

Highly Unfavourable population = populations that have declined > 50.0% from the baseline reference value.

The threshold levels of >25.0% and >50.0% follows standard convention used for waterbirds (e.g. Lynas et al. 2007; Leech et al. 2002). The 'Intermediate' range (1.0% - 24.9% decline) allows for natural fluctuations and represents a range within which relatively small population declines have the potential to be reversible and less likely to influence conservation status in the long-term (Leech et al. 2002). Declines of more than 25.0% are deemed of greater ecological significance for the long-term.

With regards the six waterbird species of Special Conservation Interest listed for River Nanny Estuary and Shore SPA, and based on the long-term population trend for the site, it has been determined that (Table 4.3):-

1. 1 species is currently considered as **Highly Unfavourable** (Golden Plover);

2. 4 species are currently considered as **Favourable** (Ringed Plover, Knot, Sanderling and Oystercatcher);

3. 1 species is currently **un-assessed** (Herring Gull).

Site conservation condition and population trends were also reviewed in light of species' all-Ireland and international trends (Table 4.3). The calculation of all-Ireland trends (island of Ireland) for the long-term (12-year) data period was facilitated by the provision of indices from the I-WeBS and the WeBS database[12]; International trends follow Wetlands International (2006).

[12] kindly provided by the I-WeBS Office and the British Trust for Ornithology.

Table 4.3 SCI species of River Nanny Estuary and Shore SPA – Current Site Conservation Condition

Special Conservation Interests	BoCCI Category[a]	Site Population Trend[b]	Site Conservation Condition	Current all-Ireland Trend[c]	Current International Trend[d]
Ringed Plover*	Amber	+ 97.1	Favourable	+ 21.8	Decline
Knot*	Red	+ 878.01	Favourable	- 2.91	Decline
Sanderling*	Green	+ 119.6	Favourable	+ 109.3	Stable/Increase
Oystercatcher	Amber	+ 115.4	Favourable	+ 23.5	Decline
Golden Plover	Red	- 59.8	Highly Unfavourable	- 2.2	Decline
Herring Gull	Red	n/c	n/c	n/c	n/c

* denotes site selection species. n/c = not assessed.
[a]After Lynas *et al.* (2007); [b] Site population trend analysis; see Table 4.2; [c]all-Ireland trend calculated for period 1994/95 to 2008/09; [d]international trend after Wetland International (2006).

Table 4.3 also shows the relationship between a species' long-term site trend and the current all-Ireland trend for the same time period (1994/95 to 2008/09). The colour coding used represents the following cases:-

- Green – species whose populations are stable or increasing at both site level and all-Ireland level.
- Beige – species whose populations are declining at both site level and all-Ireland level. Therefore there is a potential for factors at a larger spatial scale to be influencing the observed trend at site level.
- Orange - species whose populations are exhibiting a 1 – 24.9% decline at site level but are stable or increasing at all-Ireland level.
- Pink - species whose populations are exhibiting a 25.0 – 49.9% decline at site level but are stable or increasing at all-Ireland level.
- Red - species whose populations are exhibiting a decline of >50.0% at site level but are stable or increasing at all-Ireland level.

The pink and red categories listed above and not found for this site, highlight where populations are stable at all-Ireland level, but where significant declines are seen at site level. In these cases it would be reasonable to suggest that site-based management issues may be responsible for the observed declining site population trends (Leech et al. 2002).

PART FIVE – SUPPORTING INFORMATION

5.1 Introduction

Part Five of this report is based around the need to review, collate and disseminate site-specific information relating to the Special Conservation Interests of River Nanny Estuary and Shore SPA.

Section 5.2 provides selected ecological summary information for the non-breeding waterbirds of the site. Section 5.3 presents results from the 2011/12 Waterbird Survey Programme. Finally, Section 5.4 provides summary information on the activities and events that occur in and around River Nanny Estuary that may either act upon the habitats within the site, or may interact with waterbirds using the site.

The information provided is intended to:-

- provide information to assist the interpretation and understanding of the site-specific conservation objectives;
- facilitate the identification of conservation priorities and direct site management measures;
- inform the scope and nature of Appropriate Assessments in applying the provisions of Article 6 of the Habitats Directive.

Note however, that the information does not aim to provide a comprehensive assessment on which to assess plans and projects as required under the Habitats Directive, but rather should inform the scope of these assessments and help direct where further detailed examinations are required. The information presented in this report was compiled in June 2012.

5.2 Waterbird species – Ecological characteristics, requirements and specialities – summary information

Waterbirds, defined as *''birds that are ecologically dependent on wetlands''* (Ramsar Convention, 1971), are a diverse group that includes divers, grebes, swans, geese and ducks, gulls, terns and wading birds. During the data period 1994/95 – 2009/10, I-WeBS recorded a total of 61 waterbird species within the River Nanny Estuary count area. These species represent eleven waterbird families: *Gaviidae* (divers), *Podicipedidae* (grebes), *Anatidae* (swans, geese and ducks), *Rallidae* (Water Rail, Moorhen & Coot), *Haematopodidae* (oystercatchers), *Charadriidae* (plovers and lapwings), *Scolopacidae* (sandpipers and allies) and *Laridae* (gulls and terns) plus *Phalacrocoracidae* (Cormorants), *Ciconiiformes* (Herons) and Alcedinidae (Kingfisher).

As described in Section 1.1, the wetland habitats contained within this SPA are considered to be a Special Conservation Interest in their own right. The wetland habitat is an important resource for listed SCI species and for other waterbird species included in the total waterbird assemblage. These species may include those that utilise the site during passage, those that are present in months of the year outside of the non-breeding season[13] or species that use the site at certain times only (e.g. as a cold weather refuge).

29 waterbird species occurred on a regular basis within the River Nanny Estuary I-WeBS count area during the period 1994/95 – 2009/10.[14] Six of these species are listed as SCIs for the SPA, and the additional 23 non-SCI species are listed in Table 5.1.

[13] Non-breeding season is defined as September – March inclusive

[14] Regular is defined as a species that has occurred in 13 out of the 16-year data period.

Table 5.1 Regularly-occurring non SCI waterbird species that occur at River Nanny Estuary & Shore during the non-breeding season

Species	Baseline Data Period[1] (1995/96 – 1999/00)	Recent Site Average[2] (2005/06 – 2009/10)
Light-bellied Brent Geese (*Branta bernicla hrota*)	145	321 (i)
Shelduck (*Tadorna tadorna*)	7	4
Wigeon (*Anas penelope*)	12	42
Teal (*Anas crecca*)	18	45
Mallard (*Anas platyrhynchos*)	76	102
Common Scoter (*Melanitta nigra*)	762	618
Great Northern Diver (*Gavia immer*)	3	2
Little Grebe (*Tachybaptus ruficollis*)	1	2
Great Crested Grebe (*Podiceps cristatus*)	9	5
Cormorant (*Phalacrocorax carbo*)	35	34
Grey Heron (*Ardea cinerea*)	2	4
Grey Plover (*Pluvialis squatarola*)	55	33
Lapwing (*Vanellus vanellus*)	1,087	423
Dunlin (*Calidris alpina*)	721	313
Snipe (*Gallinago gallinago*)	5	10
Black-tailed Godwit (*Limosa limosa*)	19	66
Bar-tailed Godwit (*Limosa lapponica*)	59	36
Curlew (*Numenius arquata*)	107	163
Greenshank (*Tringa nebularia*)	3	5
Redshank (*Tringa totanus*)	150	191
Turnstone (*Arenaria interpres*)	59	89
Black-headed Gull (*Chroicocephalus ridibundus*)	926	219
Great Black-backed Gull (*Larus marinus*)	70	10

Grey shading denotes an Annex I species; [1] Baseline data is the 5-year mean peak for the period 1995/96 – 1999/00 (I-WeBS); [2] Recent site data is the five-year mean peak for 2005/06 – 2009/10 (I-WeBS); (i) denotes numbers of international importance.

Although waterbirds may be linked by their dependence on water, different species vary considerably in aspects of their ecology due to many evolutionary adaptations and specialisations to their wetland habitats. Different species or groups of species may therefore utilise wetland habitats in very different ways which relates to how species are distributed across a site as a whole.

Table 5.2 provides selected ecological information for waterbird SCI species of River Nanny Estuary and Shore SPA. Information is provided for the following categories[15]:-

- waterbird family (group);
- winter distribution – species distribution range during winter (based on the period 2001/02 – 2008/09 (after Boland & Crowe, 2012);
- trophic (foraging) guild (after Weller, 1999; see Appendix 5);
- food/prey requirements;
- principal supporting habitat within the site;
- ability to utilise other/alternative habitat in/around the site;
- site fidelity (species 'faithfulness' to wintering sites).

It should be borne in mind that a single wetland site is unlikely to meet all of the ecological requirements of a diverse assemblage of waterbirds (Ma et al. 2010). Although some waterbird species will be faithful to specific habitats within the SPA, many will at times also use habitats situated within the immediate hinterland of the site or in areas ecologically connected to the SPA. These areas may be used as alternative high tide roosts, as a foraging resource or, be simply flown over, either on migration or on a more frequent basis throughout the non-breeding season as waterbirds move between different areas used (e.g. commuting corridors between feeding and roosting areas).

[15] Notes to aid the understanding of categories and codes used in Table 5.2 are provided in the table sub text.

Reliance on alternative habitats will vary from site to site, and between species. Use of alternative habitats is also likely to vary through time, from seasonally through to daily, and different habitats may be used by day and night (Shepherd et al. 2003). Different waterbirds may utilise wetland habitats in different ways. For example, while the majority of wading birds forage across exposed tidal flats, species such as Lapwing and Golden Plover are considered to be 'terrestrial waders' typically foraging across grassland and using tidal flats primarily for roosting. When tidal flats are covered at high water, intertidally-foraging waterbirds are excluded and many species then move to nearby fields to feed. Terrestrial foraging is also important when environmental factors (e.g. low temperature) reduce the profitability of intertidal foraging (e.g. Zwarts & Wanink, 1996b). Some waterbird species are simply generalists, and make use of a range of habitats, for example the Black-tailed Godwit that forages across intertidal mudflats and grassland habitats. Other waterbird species such as Greenland White-fronted Goose (*Anser albifrons flavirostris*) or Bewick's Swan (*Cygnus columbianus bewickii*) are herbivores and are reliant on terrestrial areas, often outside of the SPA boundary, and use the wetland site primarily for roosting. Some species switch their habitat preference as food supplies become depleted; an example being Light-bellied Brent Geese that exploit grasslands increasingly when intertidal seagrass and algae become depleted.

The topic of alternative habitat use is also applicable to benthic-foraging seaducks and divers whose foraging distribution is highly influenced by water depth and tidal conditions. Many of these species however (e.g. Great Northern Diver, Common Scoter) exhibit a widespread coastal distribution during winter utilising shallow nearshore waters to a greater degree at certain times (e.g. storms, driving onshore winds).

Thus the area designated as a SPA can represent a variable portion of the overall range of the listed waterbird species. To this end, data on waterbird use of areas adjacent to or ecologically connected to the SPA are often collected. Indeed for some species a mix of site-related and wider countryside measures are needed to ensure their effective conservation management (Kushlan, 2006). Furthermore, it is recommended that assessments that are examining factors that have the potential to affect the achievement of the site's conservation objectives should also consider the use of these '*ex-situ'* habitats, and their significance to the listed bird species.

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Table 5.2 Waterbirds – Ecological characteristics, requirements & specialities

	Family (group)	Winter distribution[A]	Trophic Guild[B]	Food/Prey Requirements[C]	Principal supporting habitat within site[D]	Ability to utilise other/alternative habitats[E]	Site Fidelity[F]
SELECTION SPECIES							
Ringed Plover *Charadrius hiaticula*	Charadriidae (wading birds)	Localised	4	Wide	Intertidal mud and sand flats	3	High
Knot *Calidris canutus*	Scolopacidae (wading birds)	Localised	4	Narrower	Intertidal mud and sand flats	3	Moderate
Sanderling *Calidris alba*	Scolopacidae (wading birds)	Localised	4, 6	Wide	Intertidal mud and sand flats	3	High
ADDITIONAL SPECIAL CONSERVATION INTERESTS							
Oystercatcher *Haematopus ostralegus*	Haematopodidae (wading birds)	Intermediate	4	Narrower	Intertidal mud and sand flats	2	High
Golden Plover *Pluvialis apricaria*	Charadriidae (wading birds)	Intermediate	4	Wide	Intertidal mud and sand flats	2	Moderate
Herring Gull *Larus argentatus*	Lariidae (gulls)	n/c	1, 2, 4, 6, 7	Wide	Intertidal mud and sand flats & sheltered & shallow subtidal	1	Unknown

[A] Winter distribution: Very widespread (>300 sites); Widespread (200 – 300 sites); Intermediate (100 – 200 sites); Localised (50-100 sites); Highly restricted (<50 sites) (based on Boland & Crowe, 2012).
[B] Waterbird foraging guilds. 1 = Surface swimmer, 2 = water column diver (shallow), 3 = water column diver (deeper), 4/5 = intertidal walker (out of water), 6 = intertidal walker (in water), 7 = terrestrial walker. Further details are given within Appendix 5.
[C] Food/prey requirements - species with a wide prey/food range; species with a narrower prey range (e.g. species that forage upon a few species/taxa only), and species with highly specialised foraging requirements (e.g. piscivores).
[D] Principal supporting habitat present within River Nanny Estuary. This is the main habitat used when foraging with the exception of Golden Plover which relates to roosting habitat.
[E] Ability to utilise alternative habitats refers to the species ability to utilise other habitats adjacent to the site. 1 = wide-ranging species with requirement to utilise the site as and when required; 2 = reliant on site but highly likely to utilise alternative habitats at certain times (e.g. high tide); 3 = considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited habitat requirements.
[F] Site fidelity on non-breeding grounds: Unknown; Weak; Moderate; or High (based on published literature).

5.3 The 2011/12 waterbird survey programme

5.3.1 Introduction

The 2011/12 waterbird survey programme was designed to investigate how waterbirds are distributed across coastal wetland sites during the low tide period. The surveys ran alongside and are complementary to the Irish Wetland Bird Survey (I-WeBS) which is a nationwide survey undertaken primarily on a rising tide or at high tide.

At River Nanny Estuary and Shore, a standard survey programme of four low tide counts (October, November & December 2011 and February 2012) and a high tide count (January 2012) were completed across the site.[16] Waterbirds were counted within a series of 13 count sections (subsites) (Appendix 6). These subsites were based on I-WeBS subsites and are not exactly coincident with the SPA boundary and several low tide subsites (0VL05, 0VL14, 0UL40 and 0VL15) plus two subtidal subsites (0V902 and 0V903) are not within the SPA. Note also that the outer seaward boundaries of offshore subsites 0V902 and 0V903 are arbitrary.

The behaviour of waterbirds during counts was attributed to one of two categories (foraging or roosting/other) while the position of birds was recorded in relation to one of four broad habitat types (intertidal, subtidal, supratidal and terrestrial). Note that these broad habitats (Table 5.3) were defined specifically for the survey programme and do not follow strict habitat-based definitions for these areas, nor follow the definitions used in relation to conservation objectives outlined in Section 3.1. For a detailed survey methodology, please refer to NPWS (2011a).

Table 5.3 Definition of broad habitat types used

Broad Habitat Type	Broad Habitat Description
Intertidal (area between mean high water and mean low water)	Refers to the area uncovered by the tide and most likely dominated by mudflats and sandflats. It may also include areas of rocky shoreline, areas of mixed sediment and grave/pebbles or shingle and gravel shores.
Subtidal (area that lies below mean low water)	Refers to areas that are covered by seawater during counts. During low-tide counts it will include offshore water, tidal channels and creeks as well as tidal rivers.
Supratidal	This category pertains to the shore area and habitats immediately marginal to and above the mean high-water mark. The supratidal section is an integral part of the shoreline. This broad habitat also includes areas of saltmarsh where the saltmarsh is contiguous with coastal habitats lying above. Note that patches of lower saltmarsh (e.g. *Spartina* sp.) surrounded by intertidal flats, were included in the intertidal category.
Terrestrial	Used where birds were recorded within habitats close to the shoreline but were above the intertidal and supratidal levels.

In addition to the main survey programme described above, two high tide roost surveys were completed on 28th November 2011 and 27th February 2012. These dates were chosen to reflect roosting distribution during a spring tide and neap tide (4.6m and 3.9m respectively). During these surveys waterbird roost sites were located, species and numbers of waterbirds counted and the position of the roosts marked onto field maps.

5.3.2 Waterbird data, analyses and presentation

The aim of data analyses was to understand how waterbirds are distributed across the site of River Nanny Estuary during the autumn and winter months. By assessing patterns of waterbird distribution at low and high tide, together with examination of data on sediment and

[16] Low tide surveys: 03/10/11, 05/11/11, 02/12/11 & 01/02/12 plus a high tide survey on 11/01/12.

invertebrate distribution and abundance, we aimed to identify areas (subsites) within the site that are the most important for foraging and roosting on a species by species basis.

Data analyses were undertaken to determine the proportional use of subsites by each Special Conservation Interest (SCI) species, relative to the whole area surveyed on each survey occasion. Analyses were undertaken on datasets as follows:

- Total numbers (low tide surveys);
- Total numbers (high tide survey);
- Total numbers of foraging birds (low tide surveys);
- Total numbers of roosting birds (low tide and high tide surveys).
- Foraging densities (low tide surveys).

For each of the analyses listed above and for each survey date completed, subsites were ranked in succession from the highest to the lowest in terms of their relative contribution to each species' distribution across all subsites surveyed. Rank positions were then converted to categories (see below) with the exception of those relating to the single high tide survey that are presented simply as rank numbers. The highest rank position/category for each subsite across any of the low tide count dates is presented in a subsite by species matrix.

Subsite Rank Position - Categories

Very High (V)	Any section ranked as 1.
High (H)	Top third of ranking placings (where n = total number of count sections species was observed in)
Moderate (M)	Mid third of ranking placings (where n = total number of count sections species was observed in)
Low (L)	Lower third of ranking placings (where n = total number of count sections species was observed in).

Intertidal foraging density was calculated for selected species and for each low tide survey, by dividing the number of the species within a subsite by the area of intertidal habitat within the same subsite. Subsites were ranked based on the peak foraging density recorded. Whole site intertidal foraging density was calculated by summing the mean subsite counts for each species and dividing by the total area of intertidal habitat.

Waterbird count data for low tide surveys are also presented as species distribution maps ('dot density maps'). Dot-density maps show waterbird species distribution within intertidal or subtidal habitat[17] divided into 'foraging' birds and 'roosting/other' birds. These maps show the number of birds represented by dots; each dot representing one, or a pre-determined number of birds. As the dots are placed in the appropriate subsites and broad habitat types for the birds counted, the resulting map is equivalent to presenting numbers and densities and provides a relatively quick way of assessing species distribution.

In contrast to dot-density maps, roost maps produced from roost survey data show the mapped locations of waterbird roosts, but note the limitations in relation to field mapping discussed below.

Notes on data interpretation and methodological limitations

Subsite rankings and dot-density maps relate to the distribution of waterbirds at subsite level as recorded within the survey area during the 2011/12 waterbird survey programme. Care

[17] Note that birds within supratidal or terrestrial habitat are not included within these maps.

must be taken in the interpretation of these data, and subsite rankings in isolation should not be used to infer a higher level of conservation importance to one area over another without a detailed examination of data and understanding of each species' ecology. For instance, while some species are known to be highly site-faithful, both at site level and within-site level (e.g. Dunlin), other species may range more widely across a site(s). While some species by their nature may aggregate in high numbers, others such as Greenshank or Grey Heron may not. It is also important to consider that distribution maps and data refer to a single season of low tide surveys. Although important patterns of distribution will emerge, these distributions should not be considered absolute; waterbirds by their nature are highly mobile and various factors including tide (e.g. spring/neap), temperature, direction of prevailing winds, changing prey densities/availabilities and degree of human activity across the site, could lead to patterns that may change in different months and years.

Dot-density maps are not intended to show the actual position of each bird; the dots are placed randomly within subsites so no conclusions can be made at a scale finer than subsite. Dots are placed in the appropriate subsites and broad habitat types for the birds counted but given that the broad habitats are based on OS mapping, there are various cases where the mapping does not accurately portray where a bird was, e.g. in the case of birds associated with freshwater flows, or small creeks that are not shown on OS maps. These associations are discussed as necessary in the individual species text tables.

The mapping of flock positions or roost locations over large distances in intertidal habitats (i.e. mapping by eye) is inherently difficult and prone to error. Flock or roost positions should therefore be viewed as indicative only.

5.3.3 Summary Results

A total of 44 waterbird species were recorded during the 2011/12 survey programme across the River Nanny Estuary and shore count area (hereafter called River Nanny Estuary and Shore) (see Appendix 6 for a map of subsites). Cummins and Crowe (2012) provide a summary of waterbird data collected.

All SCI species were recorded within all counts undertaken with the exception of Golden Plover that was absent from the first two low tide surveys. Table 5.4 shows peak numbers (whole site) for SCI species recorded during the low tide (LT) and high tide (HT) surveys.

Average percentage occupancy (Table 5.4) defined as the average proportion of subsites in which a species occurred during low tide counts was lowest for Knot (21%) and highest for Oystercatcher and Herring Gull. Golden Plover (not analysed) occurred in only two subsites (0VL05 and 0VL15) and on one occasion in each.

Average percentage area occupancy is defined as the average proportion of the total count area that a species occurred in during low tide counts. Although this is a broad calculation across all habitat zones it presents some indication of the range of a species across the site as a whole. The lowest occupancy was recorded for Knot (33%) while only two species occurred, on average, across 50% or more of the area surveyed (Oystercatcher and Herring Gull) (Table 5.4).

Table 5.4 River Nanny Estuary and Shore 2011/2012 waterbird surveys – summary data

Site Special Conservation Interests (SCIs)	Peak number - LT surveys[I]	Peak number - HT survey[II]	Average subsite % occupancy [III]	Average % area occupancy [III]
Ringed Plover*	93	294 (n)	31 (6)	43 (12)
Knot*	1,781 (n)	435 (n)	21 (13)	33 (22)
Sanderling*	595 (n)	38 (n)	29 (15)	43 (17)
Oystercatcher	1,174 (n)	1,174 (n)	56 (7)	80 (11)
Golden Plover	337	1	-	-
Herring Gull	589	86	56 (4)	85 (1)

* site selection species; (n) denotes numbers of all-Ireland importance (1% thresholds; 1999/00 – 2003/04 Crowe et al. 2008); [I] 4 low-tide counts undertaken on 03/10/11, 05/11/11, 02/12/11 & 01/02/12; [II] High-tide count undertaken on 11/01/12; [III] Mean (± s.d.) averaged across low tide surveys.

Species richness (total number of species) across the whole site varied between surveys with a total of 36, 32, 33, and 27 species recorded during the four low tide counts respectively, with 31 species recorded during the high tide survey.

During low tide surveys, subsite species richness ranged from an average two species (0V903, 0VL09 and 0VL15) to 16 species (0VL07) (Table 5.5). Most subsites supported a greater number of species during low tide as opposed to high tide surveys with the exception of 0V902, 0VL09 and 0VL15. 0UL49 (Gormanstown Bridge-Cardy Rocks) supported the highest number of species during the high tide survey (14 species).

Table 5.5 Subsite species richness

Subsite	Subsite Name	Mean (±S.D) LT Survey	HT Survey	Peak Overall
0UL49	Gormanstown Bridge-Cardy Rocks	14 (1.7)	14	16 (LT)
0V902	Laytown - Gormanstown Offshore	3 (1.7)	7	7 (HT)
0V903	Bettystown Offshore	2 (2.4)	3	5 (LT)
0VL05	Bettystown	12 (4.8)	3	19 (LT)
0VL07	Laytown Beach North	16 (2.4)	13	19 (LT)
0VL08	Delaney's Cottage	11 (2.2)	11	14 (LT)
0VL09	Ninch East	2 (1.2)	5	5 (HT)
0VL10	Ninch West	7 (1.3)	5	9 (LT)
0VL11	Corballis	12 (1.0)	10	13 (LT)
0VL12	Mosney	10 (4.2)	7	15 (LT)
0VL13	Ben Head	13 (2.7)	3	15 (LT)
0VL14	Gormanstown	15 (2.9)	0	18 (LT)
0VL15	Irishtown fields (Meath)	2 (1.3)	3	3 (LT/HT)

5.3.4 Waterbird distribution

Data analyses determined the proportional use of subsites by each Special Conservation Interest (SCI) species, relative to the site as a whole during both low tide and high tide surveys. Selected results from these 'subsite assessments' are shown in Tables 5.6 (a–f). The relative importance of each subsite is based on the final rank positions (see 5.3.2 for methodology). Where a box is left blank, means simply that a species was not recorded in that subsite.

The fact that different subsites may be ranked as 'Very High' for the same species highlights the fact that several subsites may be equally important for the species being analysed. This approach, rather than averaging across all surveys, allows for equal weightings to be given for temporal differences – e.g. concentrations of foraging birds in different subsites at different times reflecting the natural pattern of distribution across time as species move in response to changing prey densities or availabilities.

Tables 5.6 (a–f) are followed by species discussion notes which provide additional information on the distribution of each SCI species, drawing upon the full extent of the data collected and analysed for River Nanny Estuary and Shore SPA. Waterbird distribution dot-density maps are provided in Appendix 7; summary roost data are presented in Appendix 8.

Table 5.6 (a) River Nanny Estuary and Shore Subsite assessment – total numbers during LT surveys (across all behaviours and habitats) (L Low, M Moderate; H High V Very high; please see Section 5.3.2 for methods).

Species ► Subsites ▼	RP	KN	SS	OC	GP	HG
0UL49	L	M		L		H
0V902						
0V903						
0VL05	L	V	V	V	V	H
0VL07	V		H	H		H
0VL08				L		L
0VL09						
0VL10				L		
0VL11	M	H	V	M		H
0VL12		H	M	H		H
0VL13	V	H	M	V		V
0VL14	V	V	H	V		V
0VL15					V	

Table 5.6 (b) River Nanny Estuary and Shore Subsite assessment – ranked total numbers HT Survey (across all habitats)

Species ► Subsites ▼	RP	KN	SS	OC	GP	HG
0UL49		3		2		1
0V902						
0V903						
0VL05						
0VL07	1	2	2	3	1	
0VL08						
0VL09						
0VL10						
0VL11	2	1	3	4		2
0VL12			1	1		3
0VL13		4		6		
0VL14						
0VL15				5		

Table 5.6 (c) River Nanny Estuary and Shore Subsite assessment – total numbers foraging intertidally (LT surveys) Low, M Moderate; H High V Very high; please see Section 5.3.2 for methods).

Species ► Subsites ▼	RP	KN	SS	OC	GP	HG
0UL49	L	M		L		M
0V902						
0V903						
0VL05	L	V	V	V	V	V
0VL07	V		H	H		V
0VL08						
0VL09						
0VL10				L		
0VL11	M	H	V	M		V
0VL12		H	M	H		M
0VL13	V	H	M	V		V
0VL14	V	V	H	V		H
0VL15						

Table 5.6 (d) River Nanny Estuary and Shore Subsite assessment – ranked peak intertidal foraging density for selected species - LT surveys

Species ► Subsites ▼	RP	KN	SS	OC
0UL49	4	5		7
0V902				
0V903				
0VL05	6	4	4	5
0VL07	3		2	4
0VL08				
0VL09				
0VL10				8
0VL11	5	6	1	6
0VL12		2	6	3
0VL13	1	1	5	1
0VL14	2	3	3	2
0VL15				

Table 5.6 (e) River Nanny Estuary and Shore Subsite assessment – total numbers (roosting/other behaviour) intertidally during LT surveys Low, M Moderate; H High V Very high; please see Section 5.3.2 for methods).

Species ► Subsites ▼	RP	KN	SS	OC	GP	HG
0UL49				V		H
0V902						
0V903						
0VL05						V
0VL07						M
0VL08				H		
0VL09						
0VL10						
0VL11				H		H
0VL12				V		H
0VL13						M
0VL14				V		V
0VL15						

Table 5.6 (f) River Nanny Estuary and Shore Subsite assessment – ranked total numbers (roosting/other behaviour) during HT survey (Intertidal[I] & Subtidal[II]).

Species ► Subsites ▼	RP[I]	KN[I]	SS[I]	OC[I]	GP[I]	HG[I]	HG[II]
0UL49		3		2		1	
0V902							
0V903							
0VL05							
0VL07	1	1		3	1		
0VL08							
0VL09							
0VL10							
0VL11	2	2	1				1
0VL12				1			2
0VL13		4		4			
0VL14							
0VL15							

River Nanny Estuary & Shore - Waterbird Survey Programme 2011/12

Waterbird distribution - discussion notes

Where mentioned, information on benthic communities or sediment is from the intertidal and subtidal sampling programme commissioned by the National Parks & Wildlife Service (NPWS) and Marine Institute and reported in NPWS (2011b).

'I-WeBS' refers to count data recorded at River Nanny Estuary as part of the Irish Wetland Bird Survey.

Ringed Plover *Charadrius hiaticula* - Family (group): Charadriidae (wading birds)
The Ringed Plover breeds across Arctic and temperate zones from the east coast of Baffin Island, Greenland, across northern Europe and the Russian tundra to the coasts of the Bering Sea. Three subspecies are generally recognised of which the nominate subspecies, *C. h. hiaticula,* breeds in northern Europe (including Ireland) and winters in Europe and north-west Africa.
Numbers
Ringed Plovers were recorded in all five surveys of the main programme. Total site numbers of Ringed Plovers ranged from 35 (October 2011) to a peak of 294 during the high tide survey on 11th January 2012. This latter count surpassed the threshold of all-Ireland importance. Ringed Plovers were recorded in a total of six subsites throughout the survey programme although subsite use during individual low tide surveys ranged from three to five subsites, with only two subsites supporting the species during the high tide survey. The peak low tide subsite count was 46 individuals in 0VL14 (Gormanstown) on 05/11/11. 0VL07 (Laytown Beach North) held peak numbers during the high tide survey (187).
Foraging Distribution
Ringed Plovers are 'visual foragers' searching the sediment surface for the visible signs of prey such as worms, crustaceans and insects. Across the survey programme, the proportions of Ringed Plover recorded foraging ranged from 97% to 100%, predictably high for this intertidal specialist. Ringed Plovers foraged across a total of six subsites overall but only three subsites held the species during all four low tide surveys: 0VL07 (Laytown Beach North), 0VL13 (Ben Head) and 0VL14 (Gormanstown). Two subsites held peak numbers - 0VL13 (Ben Head) on 03/10/11 and 01/02/12) (22 and 34 individuals respectively), and 0VL14 (Gormanstown) on 05/11/11 and 02/12/11 (46 and 19 individuals); the latter subsite outside of the SPA boundary. The maximum number recorded foraging in 0VL07 (Laytown Beach North) during low tide surveys was 19 individuals, but this subsite was notable because 73 Ringed Plover foraged there during the high tide survey. The Ringed Plover diet is relatively broad and consists of small crustaceans, molluscs and polychaete worms, plus isopods, amphipods and insects (e.g. fly larvae). The intertidal sediments of the Nanny shore are classified as 'intertidal fine sands dominated by bivalves' (NPWS, 2011b). The fauna is dominated by the bivalves *Tellina tenuis* and *Donax vittatus* which occur in high abundances. The polychaetes *Nephtys cirrosa* and *Scolelepis squamata* and the crustacean *Crangon crangon* were recorded in moderate abundances. The peak intertidal foraging density was 2.6 Ringed Plover ha^{-1} recorded for 0VL13 (Ben Head) on 01/02/12; the only subsite to record a density of greater than one bird per hectare. The whole site average intertidal foraging density was 0.2 Ringed Plover ha^{-1}.
Roosting Distribution
During low tide surveys Ringed Plovers were almost exclusively recorded foraging. The high tide survey (11/01/12) recorded a total 221 Ringed Plovers roosting intertidally in two subsites; 114 roosted within 0VL07 (Laytown Beach North) and 107 roosted within 0VL11 (Corballis). Only 28 Ringed Plovers were recorded roosting during the November roost survey (28/11/11). These birds were located within 0VL11 (Corballis) as part of a larger mixed-species flock roosting intertidally. A further 47 foraged within this subsite and 22 foraged within 0UL49 (Gormanstown Bridge-Cardy Rocks). 51 Ringed Plovers were recorded roosting during the February roost survey (27/02/12); 40 within 0VL11 (Corballis) and a further 11 in 0UL49 (Gormanstown Bridge-Cardy Rocks), all birds positioned intertidally.

Knot *Calidris canutus* - Family (group): Scolopacidae (wading birds)
Knot are a high Arctic breeding species. Two populations are recognised in Western Eurasia and Africa - *C. c canutus* and *C. c. islandica*. The latter breeds in north and east Greenland and northern Canada and winters in north-west Europe. Knot that winter in Ireland are almost entirely from the *islandica* population. The Wadden Sea is an important staging ground for the species after a non-stop flight from the breeding grounds (van der Kam, 2004).
Numbers
Numbers of Knot peaked in December 2012 when 1,781 were recorded at the site, surpassing the threshold of all-Ireland importance. Numbers were very low in October 2011 (five birds) but relatively comparable in November 2011 and February 2012 (922 and 867 respectively). 435 Knot were counted during the high tide survey on 11/01/2012. Knot were recorded in seven subsites overall, all subsites of the Nanny shore. No subsite supported the species in all surveys. 0VL14 (Gormanstown) is the only subsite to record the species on three occasions (the first three low tide surveys), and it supported peak numbers in all of these, with 807 Knot present on 02/12/11. 0VL05 (Bettystown) held peak numbers during the final low tide survey (860 Knot). 0VL12 (Mosney) is notable for supporting 727 Knot on 02/12/11.
Foraging Distribution
Knots are specialist intertidal foragers; pecking visible items off the sediment surface or probing to the depth that their bill (3.5cm) allows. The preferred prey items are bivalve molluscs including *Scrobicularia plana, Macoma balthica* and *Mytilus edulis* of smaller size-classes (shell length in the range 6 – 16mm depending on bivalve species and shape of shell) (Dekinga & Piersma, 1993). Knot foraged intertidally across six subsites during the survey programme and all individuals recorded during low tide surveys were foraging. 0VL14 (Gormanstown) supported peak numbers in the first three low tide surveys and 0VL05 (Bettystown) held peak numbers during the final low tide survey. Both of these count subsites are outside the SPA boundary. 0VL12 (Mosney) and 0VL13 (Ben Head) are notable for supporting good numbers (727 and 366) on single occasions only. The intertidal sediments of the Nanny shore are classified as 'intertidal fine sands dominated by bivalves' (NPWS, 2011b). The fauna is dominated by the bivalves *Tellina tenuis* and *Donax vittatus* which occur in high abundances. The polychaetes *Nephtys cirrosa* and *Scolelepis squamata* and the crustacean *Crangon crangon* were recorded in moderate abundances. The peak intertidal foraging density was 28.1 Knot ha^{-1} recorded for 0VL13 (Ben Head) on 05/11/11. The second highest was 16.82 Knot ha^{-1} recorded for 0VL12 (Mosney) while 0VL14 (Gormanstown) supported 14.5 Knot ha^{-1} on 02/12/11. The whole site average intertidal foraging density was 2.3 Knot ha^{-1}.
Roosting Distribution
No roosting individuals were recorded during low tide surveys. During the January 2012 high tide survey, 335 Knot roosted intertidally across four subsites. The peak number (181) were within 0VL07 (Laytown Beach North) and a further 150 roosted within 0VL11 (Corballis). 100 individuals settled briefly within 0VL11 (Corballis) the rose and flew south. Three and one individuals respectively were recorded within 0UL49 (Gormanstown Bridge-Cardy Rocks) and 0VL13 (Ben Head). During the November roost survey (28/11/11) only one roosting Knot was recorded, a further 38 recorded foraging across the count area. Ten Knot roosted intertidally during the February roost survey (27/02/12) within 0VL11 (Corballis), part of a mixed-species roost along with Ringed Plover (40), Dunlin (120), Bar-tailed Godwit (61) and Grey Plover (11).

Sanderling *Calidris alba* - Family (group): Scolopacidae (wading birds)

Sanderlings are one of the most northerly of all Arctic-breeding waders with a circumpolar breeding range that includes Alaska, Northern Canada, Greenland and Svalbard. The species is a long-distance migrant with a wide wintering distribution that includes coastlines of much of the tropics and the Southern Hemisphere as well as northwest Europe. There is evidence of two subspecies with the nominate form *C. a. a.* breeding in East and northeast Greenland, Jan Mayen, Svalbard, Franz Joseph Land and Taymar, and thought to winter and occur on passage in northwest Europe (Delaney et al. 2009).

Numbers

Whole site numbers of Sanderlings peaked early in October 2011 (595 individuals), the numbers likely enhanced by some passage birds. Thereafter numbers ranged from 88 (02/12/11) to 325 (05/11/11). A relatively low 38 individuals were recorded during the January 2012 high tide survey.

Sanderlings were recorded in six subsites overall, all subsites of the Nanny shore. Peak numbers in October 2011 were supported by 0VL11 (Corballis) and thereafter 0VL05 (Bettystown) recorded the greatest numbers, peaking at 281 on 05/11/11 and surpassing the threshold of all-Ireland importance. 0VL07 (Laytown Beach North) and 0VL14 (Gormanstown) each supported numbers of all-Ireland importance on one occasion.

Foraging Distribution

During the non-breeding season Sanderlings can be found in a variety of coastal habitats but are characteristic of sandy shorelines (strands) where they often forage along the tide line by rushing in and out with the waves searching for small prey such as sandhoppers. Significant numbers however may also be found along non-estuarine coastlines (Crowe, 2005), outer parts of estuaries (Musgrove et al., 2003) or within sheltered bays where they may form mixed flocks with Dunlins or Ringed Plovers.

At the River Nanny estuary and shore, Sanderlings foraged intertidally across six subsites during the survey programme, and all individuals recorded during low tide surveys were foraging. Peak numbers in October 2011 were supported by 0VL11 (Corballis) (260 birds). Thereafter 0VL05 (Bettystown) recorded the greatest numbers in low tide surveys, numbers peaking at 281 on 05/11/11. With the exception of the first low tide survey when none were recorded, this subsite supported between 49% and 100% of all foraging individuals during low tide surveys. This subsite is outside the SPA boundary. 0VL07 (Laytown Beach North) and 0VL14 (Gormanstown) both supported good numbers of foraging individuals on one occasion each.

The intertidal sediments of the Nanny shore are classified as 'intertidal fine sands dominated by bivalves' (NPWS, 2011b). The fauna is dominated by the bivalves *Tellina tenuis* and *Donax vittatus* which occur in high abundances. The polychaetes *Nephtys cirrosa* and *Scolelepis squamata* and the crustacean *Crangon crangon* were recorded in moderate abundances.

The peak intertidal foraging density was 3.9 Sanderling ha^{-1} recorded for 0VL11 (Corballis). Both 0VL07 (Laytown Beach North) and 0VL14 (Gormanstown) recorded densities of 3.0 Sanderling ha^{-1}. The whole site average intertidal foraging density was 0.08 Sanderling ha^{-1}.

Roosting Distribution

No Sanderlings were recorded roosting during low tide surveys and just eight individuals roosted within 0VL11 (Corballis) during the January 2012 high tide survey.

During the November roost survey (28/11/11) just six Sanderlings were recorded roosting (0VL11) with a further 15 recorded foraging across the count area. No Sanderlings were recorded roosting during the February roost survey (27/02/12). It is highly likely that Sanderlings using the Nanny shore subsites for foraging also use areas further up and down the coast for foraging and roosting. In particular an area known as 'The Haven' at Baltray (mouth of the Boyne) just a few km north of the Nanny site is a known Sanderling roost site.

Two recent counts (early September 2012) recorded nationally-important flocks of 230 and 280 individuals comprising c.20% juveniles. These birds were observed to roost just north of the mouth of the Nanny river (0VL07) on mixed sediment substrate (N. Harmey, unpublished data). This suggests that the site could be important for passage birds, as well as for Sanderling over-wintering in Ireland.

Oystercatcher *Haematopus ostralegus* - Family (group): Haematopodidae (wading birds)

Haematopus ostralegus is polytypic; four subspecies are recognised of which only two occur within western Europe and Africa (Delaney et al. 2009). The nominate race breeds in western and northern Europe as far as Iceland, Norway and Finland and includes those birds that breed within Ireland. Irish-breeding birds are partial migrants, some moving south during winter while others remain on the Irish coast. Wintering birds are supplemented by breeding birds from Iceland and the Faeroe Islands (Wernham et al. 2002).

Numbers

Whole-site numbers rose from 681 in October 2011 to a site peak of 1,174 on 01/02/12. 1,174 were also recorded during the January 2012 high tide survey. All counts surpassed the threshold of all-Ireland importance.

Oystercatchers were relatively widespread and occurred in 10 subsites overall and within six - eight subsites during low tide surveys. 0VL14 (Gormanstown) supported peak numbers during the October and December low tide surveys (314 and 348 birds respectively). 0VL13 (Ben Head) held peak numbers on 05/11/11 (202 birds), and 0VL05 (Bettystown) held peak numbers on 01/02/12 (530), the latter also the subsite peak number.

A total 1,174 Oystercatchers were recorded during the high tide survey and 0VL12 (Mosney) and 0UL49 (Gormanstown Bridge-Cardy Rocks) together supported 77% of this number.

Foraging Distribution

Oystercatchers are large wading birds that forage primarily on tidal flats although the species can be found foraging along non-estuarine coastline or terrestrially for earthworms. On tidal flats their food consists of Cockles (*Cerastoderma edule*), Mussels (*Mytilus edulis*) and to a lesser degree other bivalve molluscs such as *Macoma balthica*, *Scrobicularia plana* and *Mya arenaria* as well as larger polychaetes such as *Arenicola marina* and *Hediste diversicolor.* Cockles and Mussels are favoured prey items and '*universally important during winter'* (Zwarts et al. 1996) because these bivalves live in the upper sediment and are nearly always accessible, although it is known that individual birds are specialised by way of their morphology with regards choosing one or the other of these prey items, and their means of handling them.

Between 97% and 100% of all Oystercatchers recorded during low tide surveys were foraging. Overall a total of eight subsites were used and between six and eight during individual low tide surveys. 0VL14 (Gormanstown) supported peak numbers during the October and December low tide surveys (outside SPA boundary). 0VL13 (Ben Head) held peak numbers on 05/11/11 (202 birds), and 0VL05 (Bettystown) held peak numbers on 01/02/12, (530 birds), the latter subsite outside the SPA boundary. 0VL07 (Laytown Beach North) held good numbers in all low tide surveys, peaking at 226 birds on 01/02/12. 0VL12 (Mosney) held fewer birds regularly, with a peak number of 246 on 02/12/11.

The intertidal sediments of the Nanny shore are classified as 'intertidal fine sands dominated by bivalves' (NPWS, 2011b). The fauna is dominated by the bivalves *Tellina tenuis* and *Donax vittatus* which occur in high abundances. The polychaetes *Nephtys cirrosa* and *Scolelepis squamata* and the crustacean *Crangon crangon* were recorded in moderate abundances.

The highest average intertidal foraging density within a single subsite was recorded for 0VL13 (Ben Head) (19.7 Oystercatcher ha^{-1}), this subsite never supporting less than 4 Oystercatchers ha^{-1} on any low tide survey occasion. 0VL14 (Gormanstown) also recorded good densities (range 1.71 – 6.2 Oystercatchers ha^{-1}). The average whole site foraging density was 2.3 individuals ha^{-1}.

Oystercatchers regularly forage terrestrially for prey such as earthworms. At River Nanny Estuary and Shore, Oystercatchers were recorded foraging within the terrestrial subsite (0VL15: Irishtown fields Meath) during the high tide survey only (24 individuals), although this behaviour is likely to occur regularly. Note that 0VL15 is outside of the SPA boundary.

Roosting Distribution

Very few Oystercatchers were recorded roosting/other during low tide surveys, records were of an irregular nature and the peak number recorded were 17 individuals within 0UL49 (Gormanstown Bridge-Cardy Rocks) on 05/11/11. 0VL12 and 0VL14 held 10 and five roosting individuals respectively.

During the January 2012 high tide survey, 1,057 Oystercatchers roosted intertidally across four subsites. 0UL49 (Gormanstown Bridge-Cardy Rocks) supported 460 birds and 0VL12 (Mosney) supported 450 birds. 90 individuals settled briefly within 0VL11 (Corballis) then rose and flew south. 0VL07 (Laytown Beach North) recorded a further 145 roosting individuals.

During the November roost survey (28/11/11) Oystercatchers were recorded roosting within four subsites (0UL49, 0VL07, 0VL08 and 0VL12). 166 roosted intertidally at two locations within 0UL49 (Gormanstown Bridge-Cardy Rocks) and 108 roosted at two locations within 0VL12 (Mosney).

255 Oystercatchers roosted across three subsites during the February roost survey (27/02/12) within a single roost of 167 birds within 0VL11 (Corballis). 64 roosted within 0UL49 (Gormanstown Bridge-Cardy Rocks).

Golden Plover *Pluvialis apricaria* - Family (group): Charadridae (wading birds)
The Eurasian Golden Plover is a Palearctic species, occurring mainly at higher latitudes of Western Europe to north-central Siberia and wintering south in Europe, north Africa and parts of Asia. Two subspecies are currently described. *P. a. altifrons* is the 'northern' form and breeds at high latitudes in Western Eurasia from Iceland and the Faeroes across northern Scandinavia to 125^{0}E in the north Siberia lowlands south of Taymyr (Delaney et al. 2009). The nominate *P. a apricaria* breeds at more southerly latitudes including Ireland and Britain and migrates south for winter. Golden Plovers that winter in Ireland are thought to be mostly Icelandic-breeding birds *P. a. altifrons* (Wernham et al. 2002).
Numbers
Golden Plover were recorded in the December 2011 and February 2012 low tide surveys with counts of 337 and 39 birds respectively. A single individual was recorded during the January 2012 high tide survey. On 02/12/11 Golden Plovers were recorded in two subsites 0VL05 (Bettystown) and 0VL15 (Irishtown fields (Meath)), the latter of which supported the majority (325 birds - 96% of total). On 01/02/12, all 39 Golden Plovers recorded were within 0VL05 (Bettystown).
Foraging Distribution
During winter, Golden Plovers feed primarily within agricultural grassland and arable land. Tidal flats are used more as a roosting/resting habitat and the birds tend to favour large, open tidal flats. As a consequence, Golden Plovers tend to be in large aggregations when observed upon tidal flats. Intertidal feeding is observed to a greater degree during cold weather periods when grassland feeding areas are frozen over. Although Golden Plovers eat a wide range of invertebrate species, relatively little is known about their intertidal feeding patterns (Gillings et al. 2006). Golden Plovers were recorded foraging intertidally within 0VL05 (Bettystown) on two occasions – 12 individuals on 02/12/11 and 39 individuals on 01/02/12 (this subsite is outside the SPA boundary). 325 Golden Plovers were foraging within 0VL15 (Irishtown fields (Meath)) on 02/12/2012. This is a terrestrial subsite, comprising largely arable land, and lies adjacent (outside) to the SPA.
Roosting Distribution
A solitary Golden Plover roosted within 0VL07 (Laytown Beach North) during the January 2012 high tide survey. No Golden Plover were recorded roosting during the November 2011 roost survey. 40 individuals roosted within 0VL08 (Delaney's Cottage) on 27/02/12. These birds were positioned intertidally, roosting along with 30 Lapwing.

Herring Gull *Larus argentatus* - Family (group): Laridae (gulls)
The Herring Gull has a Holarctic breeding distribution, nesting at boreal and middle latitudes; absent from high arctic zones apart from in Siberia (Wernham et al. 2002). The nominate *L. a. argentatus* breeds in north-west Europe of which the race *argenteus* breeds in Britain and Ireland and is largely present and seen throughout the year. Outside of the breeding season, Herring Gulls have a widespread distribution and are found along much of the coastline as well as inland.
Numbers
Numbers of Herring Gull across the whole site peaked in the low tide survey of February 2012 (589 individuals). A whole-site count of 86 was recorded during the high tide survey (11/11/12). Herring Gulls were recorded within eight subsites overall, and with the exception of one (0VL08) all were subsites of the Nanny shore. Peak numbers in the first three low tide surveys were supported by 0VL14 (Gormanstown). 0VL13 (Ben Head) held peak numbers during the final low tide survey. The subsite peak of 167 individuals was recorded for 0VL14 on 05/11/11.
Foraging Distribution
The majority of Herring Gulls foraged intertidally during low tide surveys. They foraged regularly (all four LT surveys) within four subsites: 0UL49, 0VL11, 0VL13 and 0VL14. Peak numbers were held by 0VL13 (Ben Head), 0VL07 (Laytown beach north), 0VL05 (Bettystown) & 0VL11 (Corballis), and 0VL13 (Ben Head) for the four low tide surveys respectively. The peak number foraging intertidally was 139 gulls within 0VL13 on 01/02/12. Relatively few Herring Gulls foraged subtidally with only irregular observations of one or two individuals. The exception was 01/02/12 when 68 foraged subtidally within 0VL07 (Laytown beach north) and a further 35 were recorded within 0VL12 (Mosney).
Roosting Distribution
Herring Gulls were observed in roosting/other behaviour during all low tide surveys and within eight subsites across the survey programme. 0VL14 (Gormanstown) held peak numbers roosting intertidally during the first three low tide surveys. 0VL05 (Bettystown) held peak numbers on 01/02/12. 0UL49, 0VL11 and 0VL12 held lower numbers in all four low tide surveys. During the high tide survey (11/01/12) 78 Herring Gulls roosted intertidally within 0UL49 (Gormanstown Bridge-Cardy Rocks). A further five roosted subtidally within 0VL11 (Corballis) and three within 0VL12 (Mosney). During the November roost survey (28/11/11) the majority of herring Gulls recorded roosting (76 individuals/89%), were positioned within 0UL49. Just 28 were recorded roosting during the February roost survey (27/02/12), the majority (71%) at two positions within 0UL49.

5.4 River Nanny Estuary & Shore - Activities and Events

5.4.1 Introduction

The overriding objective of the Habitats Directive is to ensure that the habitats and species covered achieve '*favourable conservation status'* and that their long-term survival is secured across their entire natural range within the EU (EU Commission, 2010). In its broadest sense, favourable conservation status means that an ecological feature is in a satisfactory condition, and that this status is likely to continue into the future.

At site level, the concept of 'favourable status' is referred to as 'conservation condition.' This can relate to not only species numbers, but importantly, to factors that influence a species abundance and distribution at a site. The identification of activities and events that occur at a designated site is therefore important, as is an assessment of how these might impact upon the waterbird species and their habitats, and thus influence the achievement of favourable condition. Site-based management and the control of factors that impact upon species or habitats of conservation importance are fundamental to the achievement of site conservation objectives.

Section 5 of the Conservation Advice Notes provides information on activities and events that occur in and around River Nanny Estuary and Shore that may either act upon the habitats within the site, or may interact with the Special Conservation Interest species and other waterbirds using the site.

5.4.2 Assessment Methods

Information on 'activities' and 'events' across the site was collected during a desk-top review which included NPWS site reporting files, Meath Draft County Development Plan (Meath County Council, 2012), County Meath Biodiversity Action Plan (Meath County Council, 2008), Water Framework Directive Eastern River Basin District documents (e.g. ERBD, 2009a,b), and other available documents relevant to the ecology of the site.

In addition, information was collected during the 2011/12 waterbird survey programme (NPWS, 2011a) as field workers recorded activities or events that occurred at the site during their survey work. This information, together with results from a 'site activity questionnaire' provides valuable information gained from 80+ hours of surveyor effort across the site. All data collected were entered into a database but as the dataset will be subject to change over time, the assessment should be viewed as a working and evolving process.

The 'activities' and 'events' information collected were categorised using the standard EU list of pressures and threats as used in Article 17 reporting under the EU Habitats Directive. Only factors likely to directly or indirectly affect waterbirds were included but the resulting list is broad and includes built elements (e.g. man-made structures such as roads and bridges that are adjacent to the site), factors associated with pollution (e.g. discharges from waste water treatment plants), various recreational and non-recreational activities as well as biological factors such as the growth of the invasive plant species *Spartina anglica*.

Data are presented in three ways:-

1. Activities and events identified to occur in and around River Nanny Estuary and Shore (through either the desk-top review or field survey programme) are listed in relation to the subsite within which they were observed or are known to occur. The activities/events are classified as follows:

   O observed or known to occur within River Nanny Estuary and Shore;
   U known to occur but unknown spatial area hence all potential subsites are included (e.g. fisheries activities);

H historic, known to have occurred in the past.
P potential to occur in the future.

2. Of the activities and events identified to occur in and around River Nanny Estuary and Shore, those that have the potential to cause disturbance to waterbird species are highlighted.

3. Data from the 2011/12 waterbird survey programme were used to inform an assessment which examined the level of disturbance caused by activities recorded during field surveys. The methodology was adapted from that used for monitoring Important Bird Areas (IBAs) (Birdlife International, 2006) and involved assigning scores which ranged between 0 and 3, to three selected attributes of each disturbance event (1) frequency/duration; (2) intensity and (3) likely response of waterbirds (after Hill et al. 1997) (Table 5.7). The rationale for scoring is provided in Appendix 10.

Table 5.7 Scoring system for disturbance assessment

Frequency/Duration	(A) Timing Score	Intensity	(B) Scope Score	Response	(C) Severity Score	TOTAL SCORE A + B + C
Continuous	3	Active, high-level	3	Most birds disturbed all of the time	3	9
Frequent	2	Medium level	2	Most birds displaced for short periods	2	6
Infrequent	1	Low-level	1	Most species tolerate disturbance	1	3
Rare	0	Very low-level	0	Most birds successfully habituate to the disturbance	0	0

The scores assigned to the three attributes were then added together to give an overall 'disturbance score' which is used to define the extent of the impact as follows:-

Scores 0 – 3 = Low
Scores 4 – 6 = Moderate
Scores 7 – 9 = High

The attributes (1) frequency/duration and (3) response were scored based on field survey observations. Attribute (2) intensity was scored based on a combination of field survey observations and best expert opinion.

5.4.3 Overview of activities at the River Nanny Estuary and Shore

Activities and events identified to occur in and around River Nanny Estuary and Shore are shown in Appendix 9, listed in terms of the subsites surveyed during the 2011/12 Waterbird Survey Programme. Activities highlighted in grey are those that have the potential to cause disturbance to waterbirds (see Section 5.4.4). For a map of count subsites, please refer to Appendix 6.

The coastline from the mouth of the Boyne (and indeed north of the Boyne estuary also) and as far south as Gormanston, is one continuous sandy beach referred to as the 'Gold Coast' (Meath County Council, 2012). Bettystown is located half way between the River Nanny Estuary and the Boyne Estuary and is the largest settlement on the coast (adjacent 0VL05). It is a centre for tourism with a concentration of large mixed use facilities, and a large hotel and apartments which are currently being built to the south of the town (Meath County

Council, 2012). Laytown is located at the mouth of the River Nanny estuary and is less developed than Bettystown. Landuse surrounding the site is predominantly low-lying agricultural with livestock grazing dominating. Meath County Council (2012b) acknowledge that development of fields that are outside of the SPA but that are used by waterbirds, could indirectly affect the conservation interests of the site.

At Laytown, the Nanny estuary is crossed by the East Coast rail line via a convention bridge. The river also flows around an abandoned landfill site located next to the old Laytown WWTP, which is now a pumping station.

The water quality of the River Nanny Estuary is classified as moderate according to the Eastern River Basin District Estuary and coastal waters Action Plan (ERBD, 2009a), although this status is extrapolated and likely related to the moderate-poor status of the lower river which is based on macroinvertebrate and chemical status (ERBD, 2010). The main pressure on the system is identified as agricultural inputs. The potential for developments in the River Nanny catchment to lead to cumulative changes in water quality has been identified (Meath County Council, 2012b).

The Nanny shore is categorised as part of the Northwestern Irish Sea (HA 08) water management unit (ERBD, 2009b) which has a current status of 'high' with an undetermined chemical status.

The River Nanny supports a small stock of wild Trout (*Salmo trutta*) and is stocked annually with Brown Trout (*Salmo trutta fario*). It also gets a small run of sea trout. River fishing is popular and there are three angling clubs on the river. A fish survey in 2009 recorded seven fish species in the Nanny (close to Julianstown): Three-spined stickleback (*Gasterosteus aculeatus*), Brown Trout, Eel (*Anguilla anguilla*), Flounder (*Plathithys flesus*), Minnow (*Phoxinus phoxinus*), Salmon (*Salmo salar*) and Stone loach (*Barbatula barbatula*) (CRFB, 2009). The shallow beaches at Bettystown and Laytown provide for sea fishing for Bass (*Dicentrarchus labrax*).

Various inshore fishing activities are likely to occur adjacent to the site (detail and spatial scale unknown). There are no known shellfish waters or aquaculture activities associated with the site. The hand-gathering of edible molluscs (e.g. Periwinkles *Littorina littorea*) was not recorded during the 2011/12 Waterbird Survey Programme. Bait-digging, although likely to occur, was also not recorded.

At noted above, Bettystown is the largest settlement within the shoreline study area (although outside the SPA site), and together with Laytown at the mouth of the Nanny Estuary, is the main source of human activity at the site, mainly in terms of coastal recreational activities. Walking, often with dogs, general beach activities and horse riding were commonly recorded activities across the Nanny shore count subsites.

A golf club is located at Bettystown (adjacent 0VL05). Sonairte, the National Ecology Centre, lies along the northern boundary of the Nanny estuary (adjacent 0VL10) and has coastal walk paths and a bird hide with views over the River Nanny.

A military base, together with associated aerodrome and firing range, is located at Irishtown, adjacent subsite 0VL13 (within subsite 0VL15).

Wildfowling was not recorded at the site during the 2011/12 Waterbird Survey Programme although pigeon/pheasant shooting was recorded within subsite 0VL15.

5.4.4 Disturbance Assessment

Five activities/events were recorded during 2011/12 survey work that had the potential to cause disturbance to waterbirds, with between one and three activities recorded within

individual subsites. The activities recorded were: walking (incl. dogs), powered watercraft, shooting, motorised vehicles and horse-riding. By far the most regular and widespread activity was people walking along the shoreline with/without dogs; recorded within nine subsites overall. Not surprisingly, this activity was almost exclusively observed along the Nanny Shore subsites and was not observed in the estuary subsites 0VL08, 0VL09 and 0VL10, with the exception of one occurrence in the latter. Just over half of all observations that included dogs (55%) were of a short or mid-length nature (short/discrete or up to 50% of count period), and just over half recorded a noticeable disturbance to waterbirds. Horse-riding displaced waterbirds within three subsites (0VL07, 0VL11 and 0VL12) and powered watercraft (a hovercraft) was recorded within 0VL05 on a single occasion.

A summary is shown in Table 5.8 and full results of the disturbance assessment are shown in Appendix 10. Individual activities/events are scored separately and there has been no attempt to produce cumulative scores for different activities occurring at the same time, although cumulative effects are likely.

As a final review, Table 5.9 shows the peak disturbance scores overlaid on the subsite assessment table (total waterbird numbers, LT surveys).

Table 5.8 Disturbance Assessment – Summary Table

Number of activities recorded during field surveys (2011/12 waterbird survey programme) observed to cause disturbance to waterbirds. The calculated peak disturbance score is shown (see text for explanation).
Scores 0 – 3 = Low Scores 4 – 6 = Moderate Scores 7 – 9 = High. Grey shading = no activity recorded.

Subsite Code	Subsite Name	Number Activities	Peak Disturbance Score	Activity Responsible
0UL49	Gormanstown Bridge-Cardy Rocks	1	6	• Walking (incl. dogs)
0V902	Laytown - Gormanstown Offshore	-		
0V903	Bettystown Offshore	-		•
0VL05	Bettystown	3	7	• Walking (incl. dogs)
0VL07	Laytown Beach North	2	7	• Walking (incl. dogs)
0VL08	Delaney's Cottage	1	6	• Walking (incl. dogs)
0VL09	Ninch East	-		
0VL10	Ninch West	-		
0VL11	Corballis	3	7	• Walking (incl. dogs)
0VL12	Mosney	3	7	• Walking (incl. dogs)
0VL13	Ben Head	2	6	• Walking (incl. dogs) • Shooting
0VL14	Gormanstown	2	6	• Walking (incl. dogs)
0VL15	Irishtown fields (Meath)	1	5	• Walking (incl. dogs)

Table 5.9 River Nanny Estuary & Shore - subsite rankings based on total numbers of waterbirds (LT surveys) by peak disturbance score

Species ► / Subsites ▼	RP	KN	SS	OC	GP	HG
0UL49	L	M		L		H
0V902						
0V903						
0VL05	L	V	V	V	V	H
0VL07	V		H	H		H
0VL08				L		L
0VL09						
0VL10				L		
0VL11	M	H	V	M		H
0VL12		H	M	H		H
0VL13	V	H	M	V		V
0VL14	V	V	H	V		V
0VL15					V	

5.4.5 Discussion

This review has highlighted that many 'activities and events' occur across the site, while the disturbance assessment represents a 'snap-shot' record of the level of disturbance-causing activities that can occur during the non-breeding season.

Many of the 'activities' identified may act so as to modify wetland habitats of the site. While physical loss might be considered more historic in nature (e.g. land claim, the construction of piers, slipways etc.), on-going modifications to intertidal habitats may occur due to changes in natural processes (e.g. sedimentation or erosion rates) as a result of former physical events. Physical damage may occur from trampling or compaction (e.g. horse-riding, humans walking).

Activities that cause disturbance can lead to the displacement of waterbirds. The significance of the impact that results from even a short-term displacement should not be underestimated. In terms of foraging habitat, displacement from feeding opportunities not only reduces a bird's energy intake but also leads to an increase in energy expenditure as a result of the energetic costs of flying to an alternative foraging area. Displacement also has knock-on ecological effects such as increased competition within and/or between different species for a common food source. In areas subject to heavy or on-going disturbance, waterbirds may be disturbed so frequently that their displacement is equivalent to habitat loss. When disturbance effects reduce species fitness[18] (reduced survival or reproductive success) consequences at population level may result.

Whilst the nature and the frequency of disturbance-causing activities are key factors when assessing likely impacts, many aspects of waterbird behaviour and ecology will influence a species response. Waterbird responses are likely to vary with each individual event and to be species-specific. The significance of a disturbance event upon waterbirds will vary according to a range of factors including:-

- Frequency/duration of disturbance event;
- Intensity of activity;

[18] defined as a measure of the relative contribution of an individual to the gene pool of the next generation.

- Response of waterbirds.

and be influenced by:-

- Temporal availability – whether waterbirds have the opportunity to exploit the food resources in a disturbed area at times when the disturbance does not occur;
- Availability of compensatory habitat - whether there is suitable alternative habitat to move to during disturbance events;
- Behavioural changes as a result of a disturbance - e.g. degree of habituation;
- Time available for acclimatisation - whether there is time available for habituation to the disturbance. (there may be a lack of time for waterbirds during the staging period);
- Age - for example when feeding, immature (1st winter birds) may be marginalised by older more dominant flocks so that their access to the optimal prey resources is limited. These individuals may already therefore be under pressure to gain their required daily energy intake before the effects of any disturbance event are taken into account;
- Timing/seasonality - birds may be more vulnerable at certain times e.g. pre- and post-migration, at the end of the winter when food resources are lower;
- Weather - birds are more vulnerable during periods of severe cold weather or strong winds;
- Site fidelity – some species are highly site faithful at site or within-site level and will therefore be affected to a greater degree than species that range more widely;
- Predation and competition – a knock-on effect of disturbance is that waterbirds may move into areas where they are subject to increased competition for prey resources, or increased predation – i.e. the disturbance results in an indirect impact which is an increased predation risk.

Knowledge of site activities and events is important when examining waterbird distribution and understanding the many factors that might influence a species' distribution across a site. The above points also highlight the complex nature of waterbird behaviour and species specificity, as well as the need for careful consideration of the impacts of disturbance upon waterbird species when undertaking Appropriate Assessments or other environmental assessments. This review could therefore form the starting point for any future study aiming to quantify the effects of activities/disturbance events across the site, as well as to help identify the extent to which existing use and management of the site are consistent with the achievement of the conservation objectives described in Part Three of this document.

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APPENDIX 1

SITE NAME: RIVER NANNY ESTUARY AND SHORE SPA

SITE CODE: 004158

The site comprises the estuary of the River Nanny and sections of the shoreline to the north and south of the estuary (c. 3 km in length), in Co. Meath. The estuarine channel, which extends inland for almost 2 km, is narrow and well sheltered. Sediments are muddy in character and edged by saltmarsh and freshwater marsh/wet grassland. The saltmarsh is best developed in the eastern portion of the estuarine channel, with species such as Sea Plantain (*Plantago maritima*), Sea Aster (*Aster tripolium*), Red Fescue (*Festuca rubra*) and Sea Purslane (*Halimione portulacoides*) occurring. Further up the estuary, the marsh habitats support species such as Bulrush (*Typha latifolia*) and Yellow Flag (*Iris pseudacorus*). The shoreline, which is approximately 500 m in width to the low tide mark, comprises beach and intertidal habitats. It is a well-exposed shore, with coarse sand sediments. The well-developed beaches, which are backed in places by clay cliffs, provide high tide roosts for the birds. The village of Laytown occurs in the northern side of the River Nanny estuary.

The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Oystercatcher, Ringed Plover, Golden Plover, Knot, Sanderling and Herring Gull. The E.U. Birds Directive pays particular attention to wetlands, and as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds.

This is an important site for wintering waders with nationally important populations of Golden Plover (1,759), Oystercatcher (1,014), Ringed Plover (185), Knot (1,140) and Sanderling (240) present (all figures are mean peaks for the 5 year period 1995/96-1999/2000). The populations of Knot and Sanderling are of particular note as they represent approximately 4% of their respective national totals. Herring Gull (609) also occurs here in nationally important numbers. A range of other waterbirds also occurs, including Cormorant (35), Light-bellied Brent Goose (145), Mallard (76), Grey Plover (55), Lapwing (1,087), Dunlin (721), Bar-tailed Godwit (59), Curlew (107), Redshank (150), Turnstone (59), Black-headed Gull (926), Common Gull (66) and Great Black-backed Gull (70). The site is of most importance as a roost area for the birds but the intertidal flats also provide feeding habitat.

The River Nanny Estuary and Shore SPA is of ornithological importance as it supports five species of wintering waterbirds and one gull species in numbers of national importance. The regular occurrence of two species listed on Annex I of the E.U. Birds Directive, i.e. Golden Plover and Bar-tailed Godwit, is of note.

25.2.2012


CO. LOUTH
Drogheda
Laytown
Navan
SPA 004158
CO. MEATH
CO. DUBLIN
Swords
Laytown
An Inse
P
PO
Br Ht
3.76m
Mound
27MP
Viaduct
Br Ht
4.29m
River Nanny
An Aini
Corballis
Ballygarth
70
Glebe
Briarleas
26MP
Mosney
Camp
Keenoge
69
Mosney
Maigh Muirí
Military
Range
Crosses
15
Burial
Ground
16
17
Irishtown
18
Bennead
68
Sarsfieldstown
Richardstown
25MP
Military
Aerodrome
Legend
SPA 004158
An Roinn
Ealaíon, Oidhreachta agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht
RIVER NANNY ESTUARY
AND SHORE SPA 004158
SPA DESIGNATION
SITE CODE:
SPA 004158 Version 2.03
0
250
500 m
N
Map Version 1
Date: Aug 2012

APPENDIX 2

Waterbird data sources

Irish Wetland Bird Survey (I-WeBS)
I-WeBS began in the Republic of Ireland in 1994/95 and aims to monitor wintering (non-breeding) waterbird populations at the wetland sites upon which they rely. Counts are carried out by volunteers and professional staff of the partner organisations across the months September to March of each year. I-WeBS counts take place on a rising tide or close to high tide. For further information please refer to Crowe (2005).

The I-WeBS Programme monitors the larger coastal wetland sites together with inland lakes, turloughs, rivers and callows. However the resulting dataset is incomplete for some waterbird species that utilise other habitats such as non-wetland habitat (e.g. grassland used by many species and particularly foraging geese, and swans), non-estuarine coastline, small and ephemeral wetlands and the open sea; the latter of which is obviously difficult to monitor from land-based surveys (Crowe, 2005).

A number of additional and special surveys are therefore conducted on an annual or regular basis and data collected are, where appropriate, integrated into the I-WeBS database. These surveys include those undertaken for swan and geese species that forage typically during daylight hours across terrestrial habitats (e.g. grassland, arable fields) using coastal wetlands sites at night when they congregate to roost. Some of the additional surveys are carried out at certain times, aimed at providing a better estimate of numbers (e.g. Greylag Geese) and for some species an assessment of breeding success during the previous summer (e.g. Light-bellied Brent Geese). These surveys are introduced briefly below and more information is provided in Crowe (2005).

- Swan Surveys

Coordinated international censuses are carried out of the wintering populations of Whooper Swan (*Cygnus cygnus*) and Bewick's Swan (*Cygnus columbianus bewickii*) at four or five-yearly intervals. The surveys are organised by I-WeBS, the Irish Whooper Swan Study group (IWSSG) and WWT.

- Greenland White-fronted Goose

Greenland White-fronted Geese are concentrated at relatively few sites during winter, many of which are non-wetland habitats. The species is therefore not covered adequately by the I-WeBS programme. The Greenland White-fronted Goose census was initiated in the late 1970's and is carried out by NPWS in Ireland and by JNCC and Scottish Natural Heritage (SNH) in Scotland.

- Greylag Geese

Data for the Icelandic breeding population of Greylag Goose that winters in Ireland are taken from special surveys organised through I-WeBS and undertaken during November each year. The surveys aim to assess the distribution and status of the migratory flocks wintering in Ireland and focus on known feeding areas (grassland & agricultural land). When calculating population estimates of the Icelandic birds, data collected are adjusted to account for feral flocks that also occur within Ireland.

- Barnacle Goose (*Branta leucopsis*)

A wintering population from the northeast Greenland breeding population winters mainly on offshore islands along the west coast of Ireland. An aerial survey is conducted of the principal wintering areas every four to five years.

- Light-bellied Brent Geese

Special autumn surveys of this species have been conducted since 1996 and organised in the Republic of Ireland by the Irish Brent Goose Research Group (IBGRG). The survey is currently conducted on a bi-annual basis during the month of October which coincides with the autumn arrival of the species. Data collected are integrated into the I-WeBS database.

APPENDIX 3

Analysing population trends: a synopsis

Monitoring of non-breeding waterbirds has been undertaken by the Irish Wetland Bird Survey (I-WeBS) and its partner, WeBS in Northern Ireland, since the mid 1990's. For such long-term count data, there is clearly a need to assess long-term trends in a consistent and objective manner (Atkinson et al. 2006).

The first stage in the analytical process involves the use of the Underhill Program (Underhill & Prŷs-Jones, 1994) which models the raw monthly counts using a Generalised Linear Model (GLM). As part of this process, it accounts for changes in numbers at the site and the timing of the count (month, year) while also taking into account completed counts and trends at other sites. When counts at a site are flagged as poor quality (e.g. due to poor visibility) or where there are missing values in a given month, then the modelled values are used. This imputation process is used widely to replace missing data points (e.g. Houlahan et al. 2000; Atkinson et al. 2006; Leech et al. 2002; Gregory et al. 2005; Crowe et al. 2008). The resulting dataset is therefore complete for all months and seasons and comprises a combination of actual count data and imputed count data.

This complete dataset is then modelled using a Generalised Additive Models (GAM) which fits a smoothed curve to the counts. GAMs are non-parametric and flexible extensions of the generalised linear model where the linear predictor of the GLM is replaced by a general additive predictor which allows mean abundance to vary as a smooth function of time. Count data are assumed to follow independent Poisson distribution with 0.3T degrees of freedom (e.g. after Atkinson et al. 2006). The application of GAMs to analyse population trends was applied to UK farmland birds by Fewster et al. (2000) and has since been adopted for modelling waterbird trends elsewhere, for example, the UK WeBS Alert system (Leech et al. 2002).

Smoothed count data for a site are then indexed to assess population trends over time. An index number can be defined as a measure of population size in one year expressed in relation to the size of the population in another selected year (Leech et al. 2002). Changes in the index numbers can therefore explain the pattern of population change over time (Underhill & Prŷs-Jones, 1994).

Annual indices are calculated separately for each species at a site. For each year included in an analysis, a total is obtained by summing the number of birds present in a predetermined number of months. The final year in the series of totals is then scaled to equal 100 (please see example in table). Index values in any given year therefore represent the number of individuals relative to those present in the final year. As this process is the same across all species and all sites analysed it allows for some useful comparisons.

Count Data	Index
264.41	128.11
262.21	127.04
234.0	113.37
126.0	61.05
197.23	95.56
206.4	100.00

Un-smoothed indices are also calculated and provide a means of examining ('eye-balling') the variation across time and can also be used to provide a measure of the mean annual change over the entire period. However, the GAM extension to the methodology and resultant smoothed indices allows for the calculation of proportional change in population size between one season and another. This latter calculation is used in Section 4.2 whereby trends are calculated for the 'long-term' 12-year period (1995–2007) and the recent five-year period (2002-2007). The values given represent the percentage change in index (population) values across the specified time period, calculated by subtracting the smoothed index value at the start of the time-frame (1995) from the smoothed index value in the reference year (2007):-

$$\text{Change} = ((I_y - I_x) / I_x) \times 100$$

where I_y is the index from the current year and I_x is the index value at the start of the selected time period (see example below)

The reference year is the penultimate year in the time series because, when smoothing, the GAM takes into account values from both the preceding and following year. The last value in the smoothed dataset (2008) is therefore likely to be the least robust because it has no following year.

The final result is therefore % change in population size across a specified time period. Larger values indicate larger proportional changes in population size; positive values indicating relative increases while negative values indicate relative decreases over the specified time period.

Worked example

Year	Unsmoothed Index	Smoothed Index
1994	0.715	0.753
1995	0.604	0.804
1996	0.739	0.835
1997	0.594	0.826
1998	0.711	0.782
1999	0.745	0.727
2000	0.618	0.691
2001	0.694	0.692
2002	0.300	0.739
2003	0.530	0.827
2004	1.348	0.936
2005	0.836	1.028
2006	0.773	1.069
2007	0.734	1.051
2008	1	1.000

Term	Change
5YR	**+ 42.80**
10YR	**+ 27.24**
ALL YR	**+ 30.72**

Further information on population indexing and trend analysis can be found in various references; for particular reference to waterbirds see Leech et al (2002) and Atkinson et al. (2006). For information on the UK WeBS Alerts system, please see Thaxter et al. (2010).

Limitations

The months chosen for the calculation of population indices aim to reflect the months when the populations at a site are the most stable, excluding months when there may be fluctuations due to passage populations. Despite this, some datasets still present a high degree of variability or fluctuation both within and between years. Because of this, we assess each species separately and take into account where a species shows a history of wide fluctuations between years (within national dataset), or where a species naturally exhibits within-season fluctuations (e.g. species considered to have weak site faithfulness). Where necessary the results of the trend analysis are assigned necessary caution.

A high proportion of imputed counts can limit the effectiveness of the analysis to aid in the interpretation of the dataset. Species for which 50% or more of the monthly count values are imputed are excluded from analysis. But sometimes the calculation of population change may involve a comparison between winters where, at least one has a value based on a high proportion of imputed data. Where data for adjacent winters are relatively complete this is not a serious concern because of the smoothing technique used. However, where data for a number of consecutive winters rely heavily on imputed data then the resulting result is considered less reliable (Thaxter et al. 2010). Where necessary the results of the trend analysis are assigned necessary caution.

Despite the smoothing effects of the GAM analysis, interpretation of population trends may sometimes still be difficult. Therefore we calculate proportional change in the population across differing time periods (e.g. 12-year, 10-year and 5-year periods) to assess more effectively how the population has fared over time.

APPENDIX 4

Waterbird species codes

AE	Arctic Tern	*Sterna paradisaea*
BY	Barnacle Goose	*Branta leucopsis*
BA	Bar-tailed Godwit	*Limosa lapponica*
BE	Bean Goose	*Anser fabalis*
BS	Bewick's Swan	*Cygnus columbianus*
AS	Black Swan	*Cygnus atratus*
BH	Black-headed Gull	*Chroicocephalus ridibundus*
BN	Black-necked Grebe	*Podiceps nigricollis*
BW	Black-tailed Godwit	*Limosa limosa*
BV	Black-throated Diver	*Gavia arctica*
BG	Brent Goose	*Branta bernicla*
CG	Canada Goose	*Branta Canadensis*
CM	Common Gull	*Larus canus*
CS	Common Sandpiper	*Actitis hypoleucos*
CX	Common Scoter	*Melanitta nigra*
CN	Common Tern	*Sterna hirundo*
CO	Coot	*Fulica atra*
CA	Cormorant	*Phalacrocorax carbo*
CU	Curlew	*Numenius arquata*
CV	Curlew Sandpiper	*Calidris ferruginea*
DN	Dunlin	*Calidris alpine*
GA	Gadwall	*Anas strepera*
GP	Golden Plover	*Pluvialis apricaria*
GN	Goldeneye	*Bucephala clangula*
GD	Goosander	*Mergus merganser*
GB	Great Black-backed Gull	*Larus marinus*
GG	Great Crested Grebe	*Podiceps cristatus*
ND	Great Northern Diver	*Gavia immer*
NW	Greenland White-fronted Goose	*Anser albifrons flavirostris*
GK	Greenshank	*Tringa nebularia*
H.	Grey Heron	*Ardea cinerea*
GV	Grey Plover	*Pluvialis squatarola*
GJ	Greylag Goose	*Anser anser*
HG	Herring Gull	*Larus argentatus*
JS	Jack Snipe	*Lymnocryptes minimus*
KF	Kingfisher	*Alcedo atthis*
KN	Knot	*Calidris canutus*
L.	Lapwing	*Vanellus vanellus*
LB	Lesser Black-backed Gull	*Larus fuscus*
PB	Light-bellied Brent Goose	*Branta bernicla hrotra*
ET	Little Egret	*Egretta garzetta*

LG	Little Grebe	*Tachybaptus ruficollis*
AF	Little Tern	*Sterna albifrons*
MA	Mallard	*Anas platyrhynchos*
MU	Mediterranean Gull	*Larus melanocephalus*
MH	Moorhen	*Gallinula chloropus*
MS	Mute Swan	*Cygnus olor*
OC	Oystercatcher	*Haematopus ostralegus*
PG	Pink-footed Goose	*Anser brachyrhynchus*
PT	Pintail	*Anas acuta*
PO	Pochard	*Aythya ferina*
PS	Purple Sandpiper	*Calidris maritime*
RM	Red-breasted Merganser	*Mergus serrator*
RH	Red-throated Diver	*Gavia stellata*
RK	Redshank	*Tringa tetanus*
RP	Ringed Plover	*Charadrius hiaticula*
RU	Ruff	*Philomachus pugnax*
SS	Sanderling	*Calidris alba*
TE	Sandwich Tern	*Sterna sandvicensis*
SP	Scaup	*Aythya marila*
SU	Shelduck	*Tadorna tadorna*
SV	Shoveler	*Anas clypeata*
SY	Smew	*Mergus albellus*
SN	Snipe	*Gallinago gallinago*
NB	Spoonbill	*Platalea leucorodia*
DR	Spotted Redshank	*Tringa erythropus*
T.	Teal	*Anas crecca*
TU	Tufted Duck	*Aythya fuligula*
TT	Turnstone	*Arenaria interpres*
WA	Water Rail	*Rallus aquaticus*
WM	Whimbrel	*Numenius phaeopus*
WG	White-fronted Goose	*Anser albifrons*
WS	Whooper Swan	*Cygnus Cygnus*
WN	Wigeon	*Anas Penelope*
WK	Woodcock	*Scolopax rusticola*

APPENDIX 5

Waterbird foraging guilds (after Weller, 1999)

Guild	Foods	Tactics	Examples…
(1) Surface swimmer	Invertebrates, vegetation & seeds	Strain/sieve/sweep/dabble/grab/up-ending	'Dabbling ducks'; e.g. Shoveler, Teal, Mallard, Pintail, Wigeon, Gadwall
(2) Water column diver – shallow[a]	Fish & Invertebrates;	Search/grab	'Diving ducks' e.g. Pochard, Tufted Duck, Scaup, Eider,
(3) Water column diver – greater depths	Fish & Invertebrates	Search/grab	Common Scoter, divers, grebes, Cormorant
(4) Intertidal walker, out of water	Invertebrates	Search (probe)/grab	Sandpipers, plovers
(5) Intertidal walker, out of water	Invertebrates, vegetation	Sieve/grab/graze	Shelduck, Avocet, Spoonbill, Wigeon, Light-Bellied Brent Goose,
(6) Intertidal walker, in water	Fish	Search/strike	Grey Heron
	Fish, Invertebrates	Probe, scythe, sweep/grab	Spoonbill, Greenshank
	Fish	Stalk	Little Egret
	Invertebrates	Probe	Several sandpiper species
(7) Terrestrial, walker (e.g. grassland/marsh)	Vegetation (inc. roots, tubers & seeds)	Graze, peck, probe	Many geese species

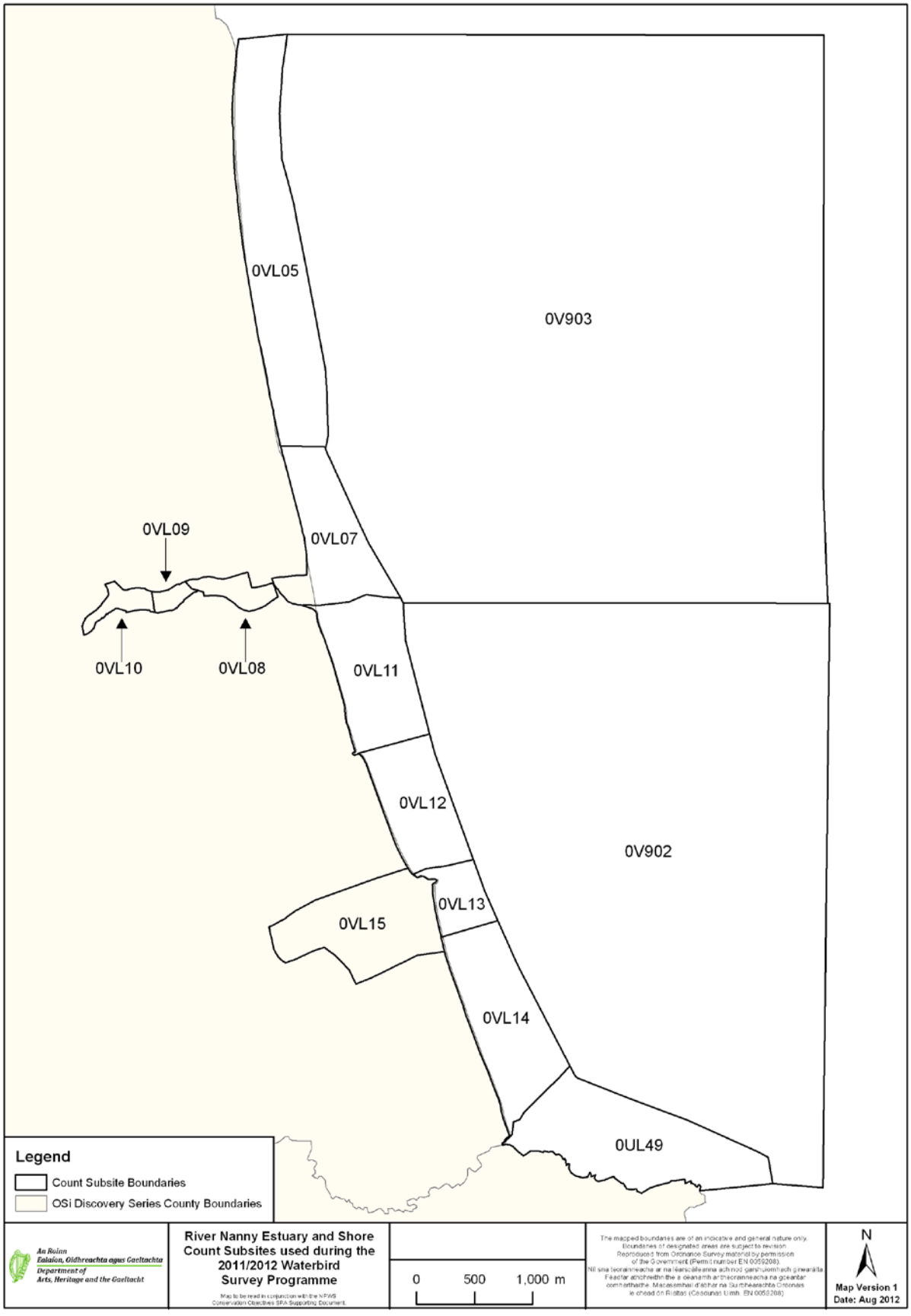
[a] dives <3m.

Please note that this table refers to generalised foraging strategies and is meant as a guide only. There is a great deal of variation between sites, seasons, tidal states and indeed, individual birds themselves. For example, some waterbird species may deploy several of the methods, e.g. Shelduck may forage by sieving intertidal mud (5) or by up-ending (1) and Pintail, although generally known as a 'dabbling' duck, does occasionally dive for food.

APPENDIX 6

River Nanny Estuary & Shore – Waterbird Survey Programme 2011/12 – Count Subsites

Subsite	Subsite Name	Subsite Area (ha)
0UL49	Gormanstown Bridge-Cardy Rocks	128.0
0V902	Laytown - Gormanstown Offshore	1339.3
0V903	Bettystown Offshore	2122.4
0VL05	Bettystown	164.5
0VL07	Laytown Beach North	77.0
0VL08	Delaney's Cottage	13.6
0VL09	Ninch East	5.7
0VL10	Ninch West	10.6
0VL11	Corballis	86.8
0VL12	Mosney	65.9
0VL13	Ben Head	26.4
0VL14	Gormanstown	95.4
0VL15	Irishtown fields (Meath)	88.0


0VL05
0V903
0VL09
0VL07
0VL10
0VL08
0VL11
0VL12
0V902
0VL13
0VL15
0VL14
0UL49
Legend
Count Subsite Boundaries
OSi Discovery Series County Boundaries
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
River Nanny Estuary and Shore Count Subsites used during the 2011/2012 Waterbird Survey Programme
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
0 500 1,000 m
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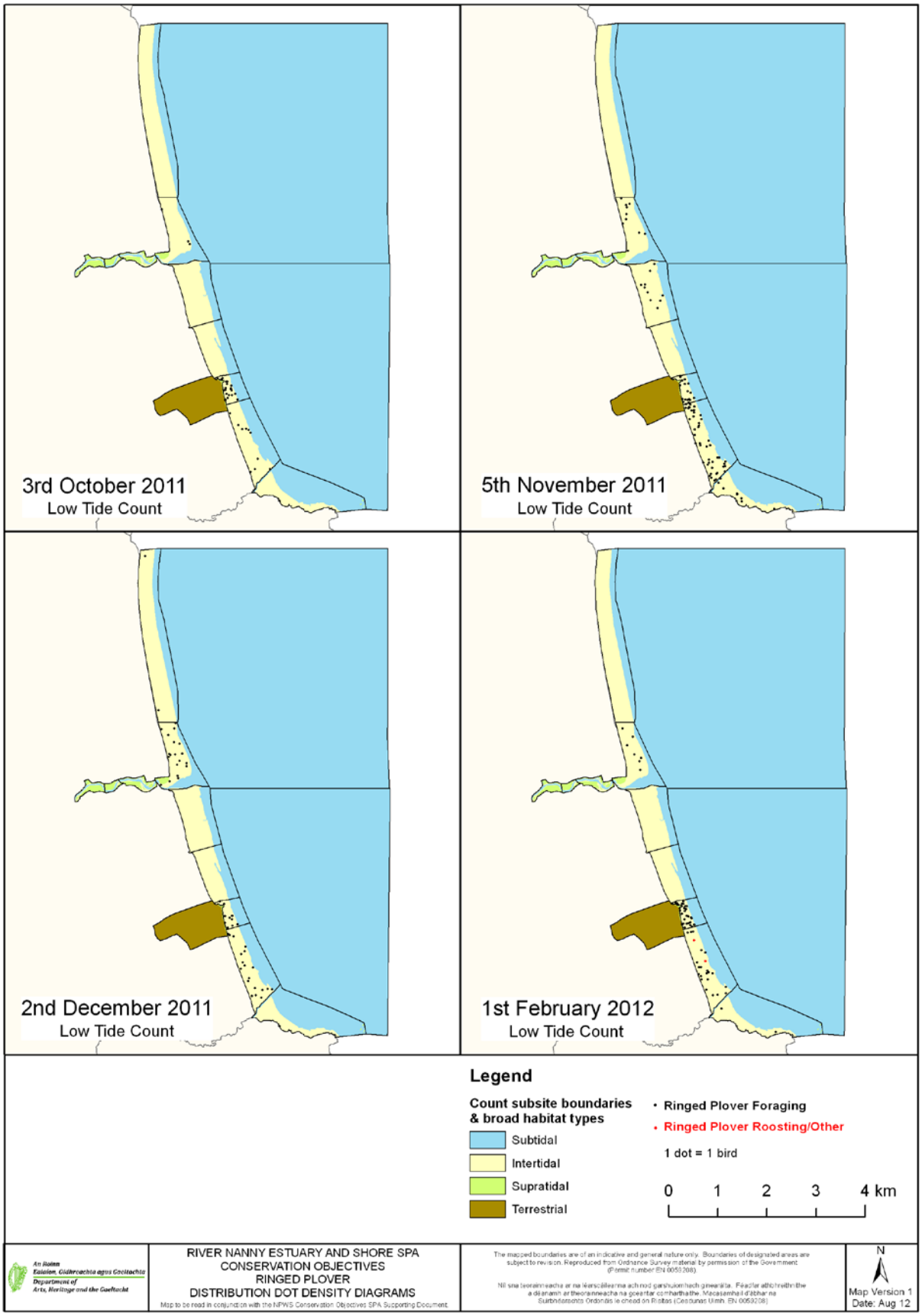
Níl sna teorainneacha ar na láithreáin ach nod ginearálta. Féadtar athchóirithe a dhéanamh ar theorainneacha na gceantar comhaltachta. Macasamhail d'aithair na Suirbhéireachta Ordanáis le cead ón Rialtas (Ceadúnas Uimh. EN 0059208)
N
Map Version 1
Date: Aug 2012

APPENDIX 7

River Nanny Estuary & Shore

Waterbird distribution (dot-density diagrams) recorded during low tide surveys (October 2011 – February 2012)

(data are presented for birds located in intertidal and subtidal habitats only)


3rd October 2011
Low Tide Count
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Ringed Plover Foraging
Ringed Plover Roosting/Other
1 dot = 1 bird
0 1 2 3 4 km
An tSeirbhís Páirceanna, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
RIVER NANNY ESTUARY AND SHORE SPA
CONSERVATION OBJECTIVES
RINGED PLOVER
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document
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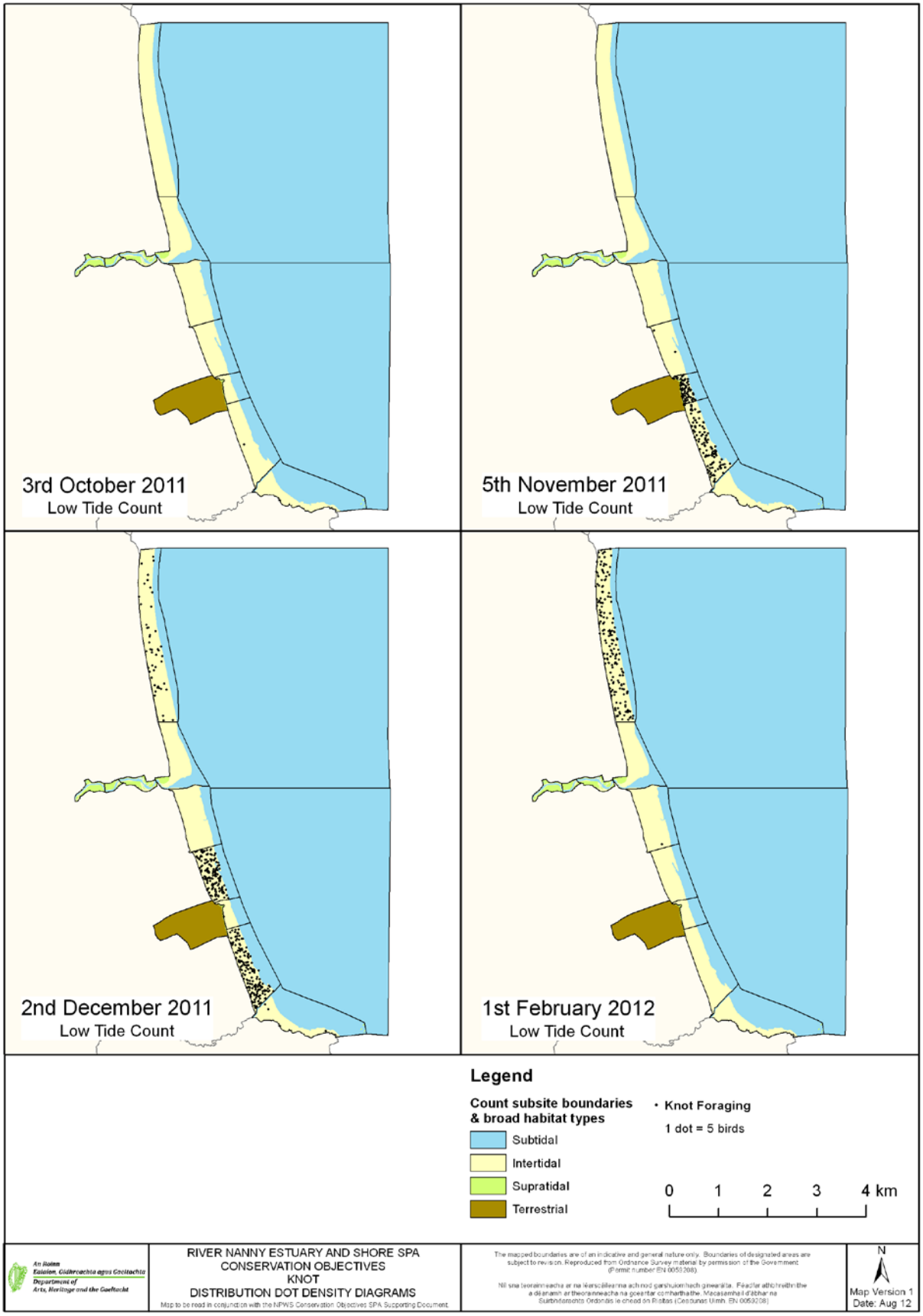
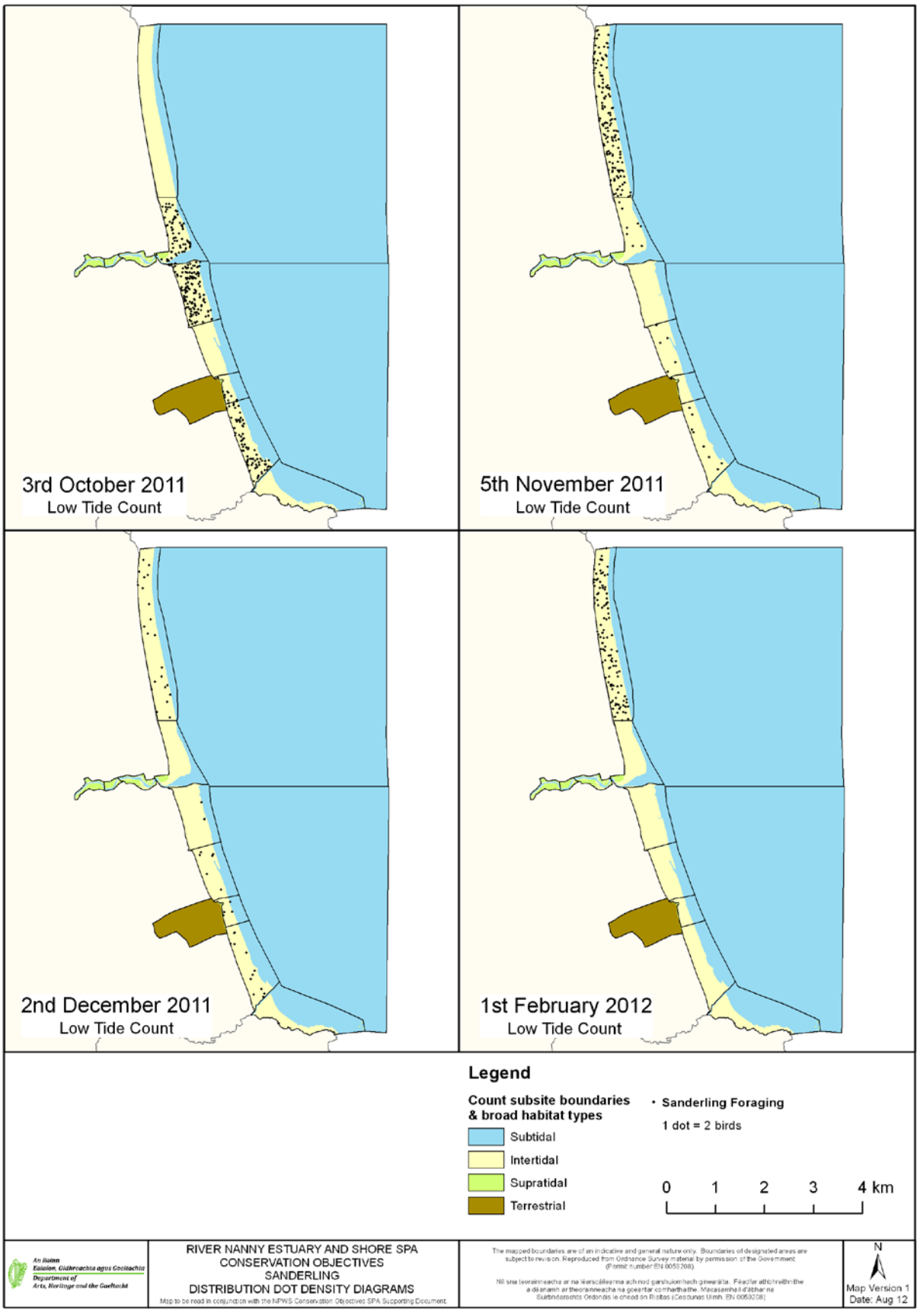
Níl sna teorainneacha ar na hÁirsiléarmna ach mar gharshuíomhach ginearálta. Féadfar athchruthú a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéireachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0053208)
N
Map Version 1
Date: Aug 12


3rd October 2011
Low Tide Count
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Knot Foraging
1 dot = 5 birds
0 1 2 3 4 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
RIVER NANNY ESTUARY AND SHORE SPA
CONSERVATION OBJECTIVES
KNOT
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0053208).
Níl sna teorainneacha ar na hIarscáileanna ach mod garshuiomhach ginearálta. Féadfar athchreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéireachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0053208).
N
Map Version 1
Date: Aug 12


3rd October 2011
Low Tide Count
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Sanderling Foraging
1 dot = 2 birds
0 1 2 3 4 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
RIVER NANNY ESTUARY AND SHORE SPA
CONSERVATION OBJECTIVES
SANDERLING
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document
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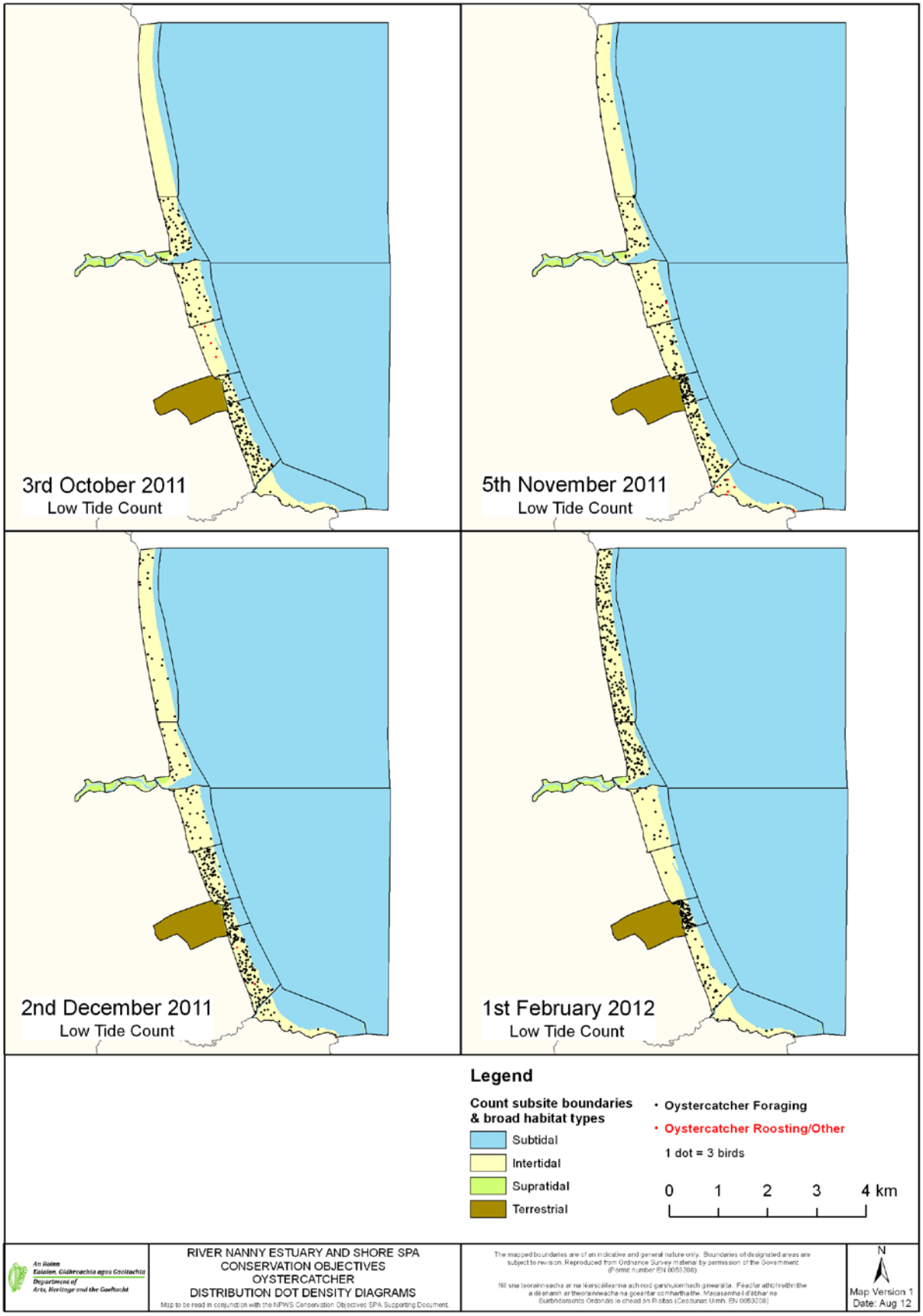
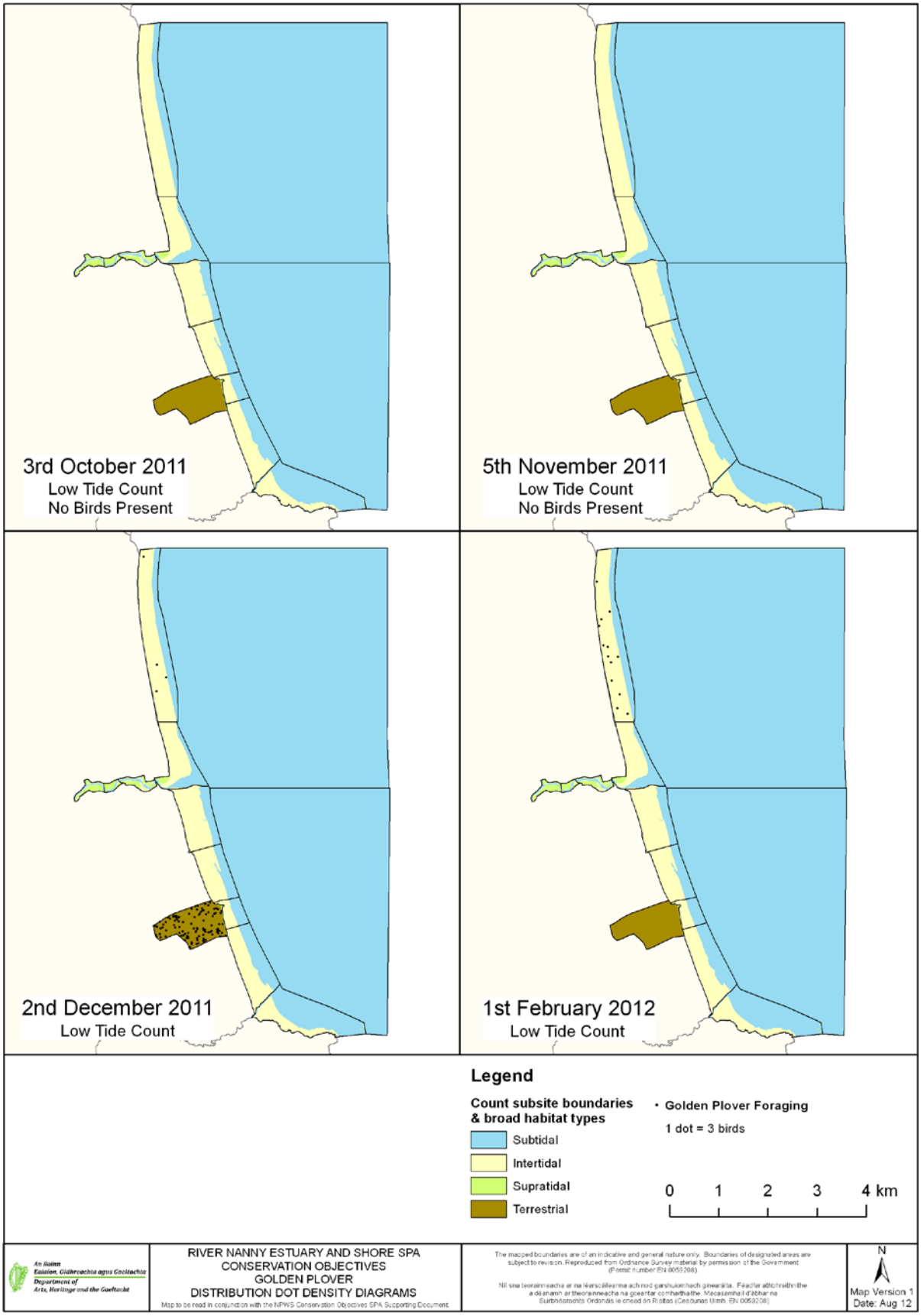
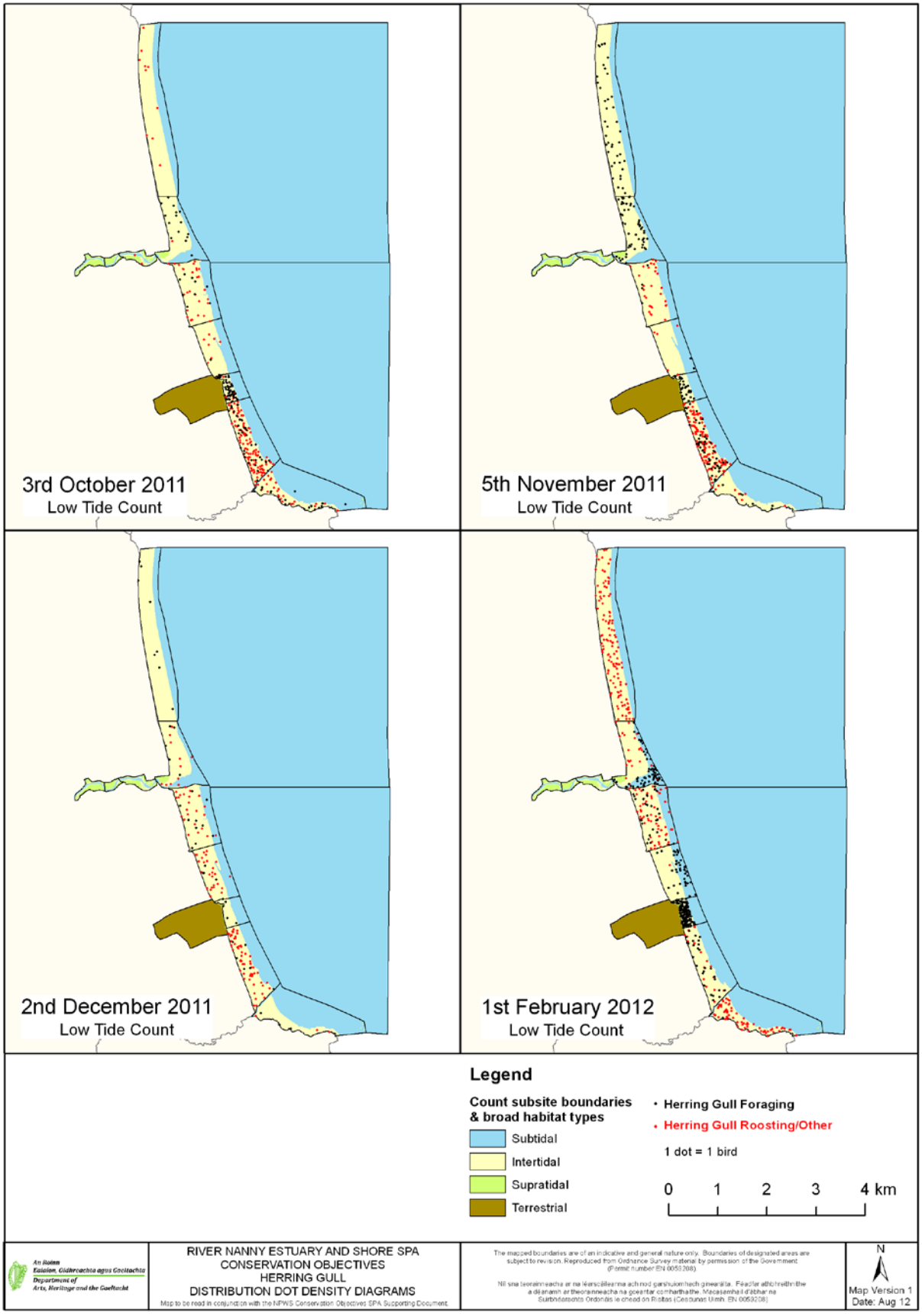
N
Map Version 1
Date: Aug 12


3rd October 2011
Low Tide Count
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Oystercatcher Foraging
Oystercatcher Roosting/Other
1 dot = 3 birds
0 1 2 3 4 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
RIVER NANNY ESTUARY AND SHORE SPA
CONSERVATION OBJECTIVES
OYSTERCATCHER
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0053208).
Nil sna teorainneacha ar na hIarscáileanna ach mód garshuiomhach ginearálta. Féadfar athchreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéireachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0053208).
N
Map Version 1
Date: Aug 12


3rd October 2011
Low Tide Count
No Birds Present
5th November 2011
Low Tide Count
No Birds Present
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Golden Plover Foraging
1 dot = 3 birds
0 1 2 3 4 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
RIVER NANNY ESTUARY AND SHORE SPA
CONSERVATION OBJECTIVES
GOLDEN PLOVER
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0053208).
Níl sna teorainneacha ar na hÁirsceálearnna ach mod garshuiomhach ginearálta. Féadfar athchreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéireachta Ordanáis le cead ón Rialtas (Ceadúnas Uimh. EN 0053208).
N
Map Version 1
Date: Aug 12


3rd October 2011
Low Tide Count
5th November 2011
Low Tide Count
2nd December 2011
Low Tide Count
1st February 2012
Low Tide Count
Legend
Count subsite boundaries & broad habitat types
Subtidal
Intertidal
Supratidal
Terrestrial
Herring Gull Foraging
Herring Gull Roosting/Other
1 dot = 1 bird
0 1 2 3 4 km
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
RIVER NANNY ESTUARY AND SHORE SPA
CONSERVATION OBJECTIVES
HERRING GULL
DISTRIBUTION DOT DENSITY DIAGRAMS
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document
The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0053208).
Nil sna teorainneacha ar na léarscáileanna ach mar ghnáthchuimhneach ginearálta. Féadfar athchreithnithe a dhéanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéireachta Ordonáis le cead ón Rialtas (Ceadúnas Uimh. EN 0053208)
N
Map Version 1
Date: Aug 12

APPENDIX 8

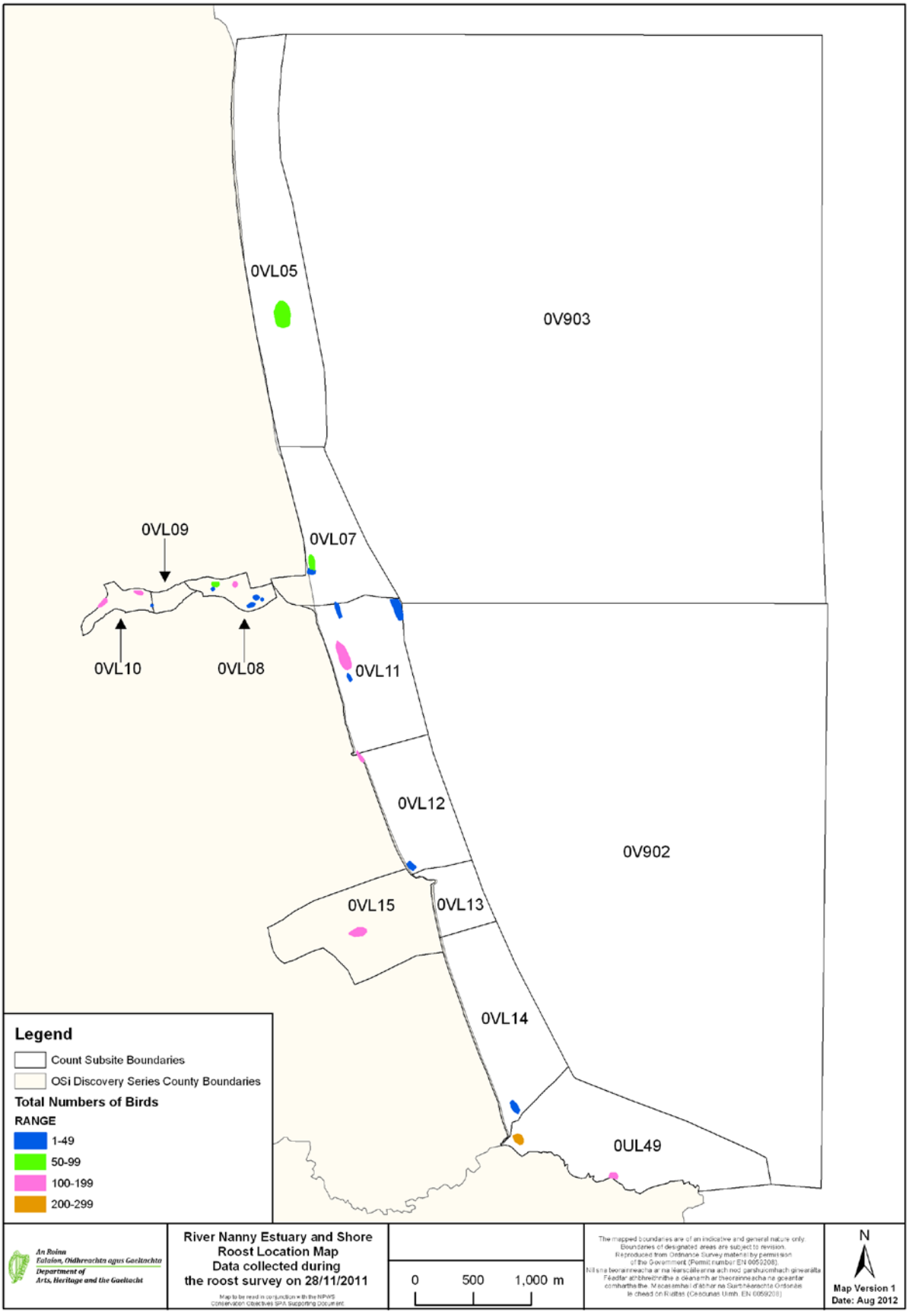
River Nanny Estuary & Shore

(1a) Summary data and roost location maps from the roost survey 28th November 2011
(Please see Sections 5.3.1 and 5.3.2 for further details on methods/limitations)

Subsite Code	Subsite Name	Number individual roost locations	No. Species	Total No. birds	Species (alphabetical order)
0UL49	Gormanstown Bridge-Cardy Rocks	2	5	375	BH, CM, GB, HG, OC
0V902	Laytown - Gormanstown Offshore	-	-	-	
0V903	Bettystown Offshore	-	-	-	
0VL05	Bettystown	1	3	70	BH, CM, HG
0VL07	Laytown Beach North	2	6	86	BH, CM, DN, KN, OC, RK
0VL08	Delaney's Cottage	6	9	258	BH, BW, CU, GK, MA, OC, RK, SU, T.
0VL09	Ninch East	-	-	-	
0VL10	Ninch West	3	8	227	BW, GK, H., MA, PT, RK, T., WN
0VL11	Corballis	4	8	244	BA, BH, CM, DN, HG, RP, SS, TT
0VL12	Mosney	2	1	108	OC
0VL13	Ben Head	-	-	-	
0VL14	Gormanstown	1	1	22	CM
0VL15	Irishtown fields (Meath)	1	1	196	L.

(1b) River Nanny Estuary and Shore SPA (4028) SCI species and recorded roosts 28/11/11 : shows number of roosting individuals and in brackets, the number of roost locations within the subsite

Subsite Code	RP	KN	SS	OC	HG
0UL49				166 (2)	76 (1)
0V902					
0V903					
0VL05					7 (1)
0VL07		1 (1)		44 (1)	
0VL08				1 (1)	
0VL09					
0VL10					
0VL11	28 (1)		6 (2)		1 (1)
0VL12				108 (2)	
0VL13					
0VL14					
0VL15					


0VL05
0V903
0VL09
0VL07
0VL10
0VL08
0VL11
0VL12
0V902
0VL15
0VL13
0VL14
0UL49
Legend
Count Subsite Boundaries
OSi Discovery Series County Boundaries
Total Numbers of Birds
RANGE
1-49
50-99
100-199
200-299
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
River Nanny Estuary and Shore
Roost Location Map
Data collected during
the roost survey on 28/11/2011
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
0
500
1,000 m
N
Map Version 1
Date: Aug 2012

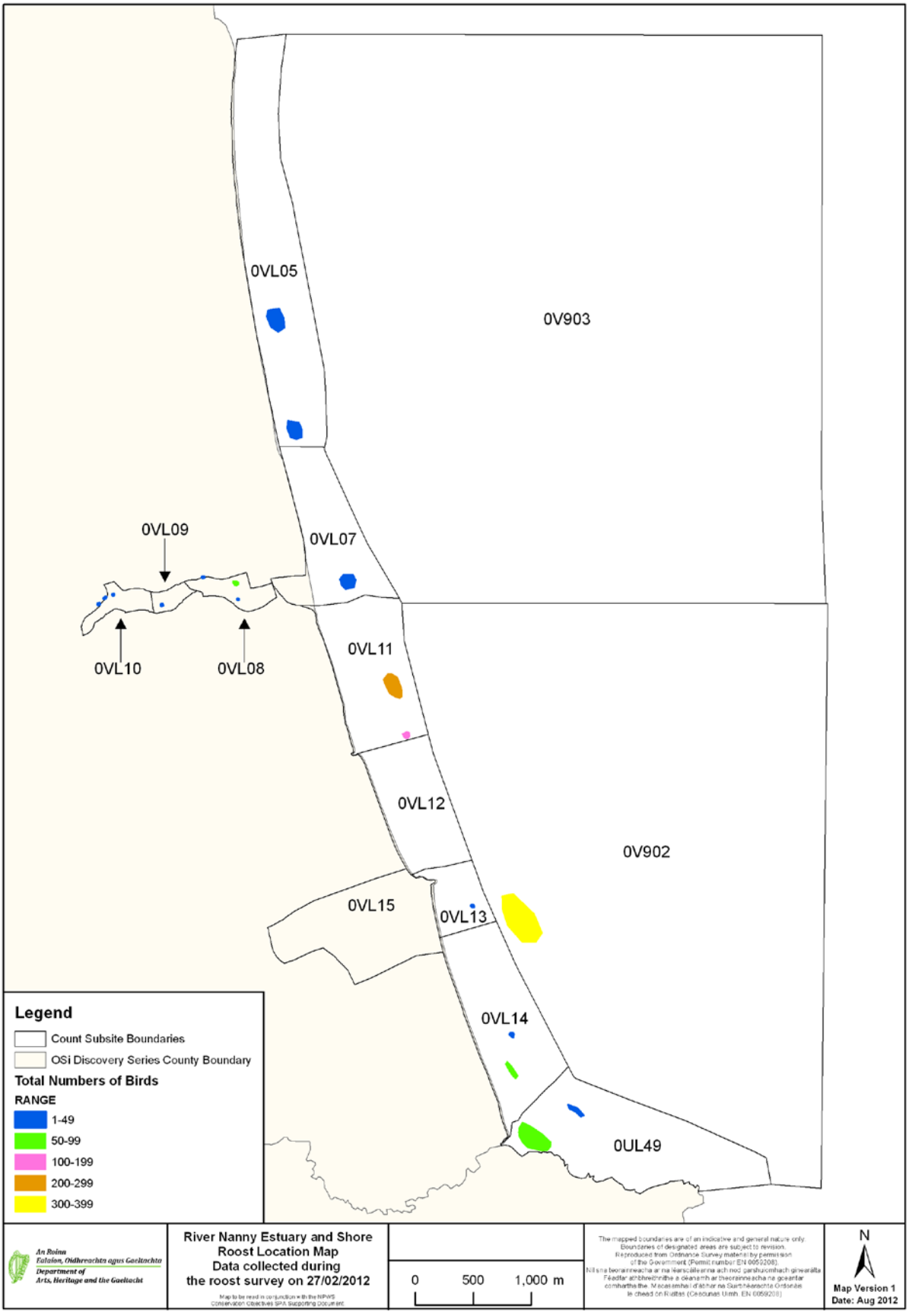
(2a) Summary data and roost location maps from the roost survey 27th February 2012

(Please see Sections 5.3.1 and 5.3.2 for further details on methods/limitations)

Subsite Code	Subsite Name	Number individual roost locations	No. Species	Total No. birds	Species (alphabetical order)
0UL49	Gormanstown Bridge-Cardy Rocks	2	6	106	BH, CM, DN, GB, HG, MU, OC, RP
0V902	Laytown - Gormanstown Offshore	1	1	345	CX
0V903	Bettystown Offshore	-	-	-	
0VL05	Bettystown	2	3	44	BH, CM, HG
0VL07	Laytown Beach North	1	2	48	BA, OC
0VL08	Delaney's Cottage	3	3	74	L., GP, CA, CU
0VL09	Ninch East	1	1	46	WN
0VL10	Ninch West	3	4	32	BW, RK, T., SU
0VL11	Corballis	2	6	409	BA, DN, GV, KN, OC, RP
0VL12	Mosney	-	-	-	
0VL13	Ben Head	1	1	1	GB
0VL14	Gormanstown	2	6	71	BH, CM, GB, HG, LB, MU
0VL15	Irishtown fields (Meath)	-	-	-	

(2b) River Nanny Estuary and Shore SPA (4028) SCI species and recorded roosts 27/02/12: shows number of roosting individuals and in brackets, the number of roost locations within the subsite

Subsite Code	RP	KN	OC	GP	HG
0UL49	11 (1)		64 (1)		20 (2)
0V902					
0V903					
0VL05					3 (1)
0VL07			24 (1)		
0VL08				40 (1)	
0VL09					
0VL10					
0VL11	40 (1)	10 (1)	167 (1)		
0VL12					
0VL13					
0VL14					5 (1)
0VL15					


0VL05
0V903
0VL09
0VL07
0VL10
0VL08
0VL11
0VL12
0V902
0VL15
0VL13
0VL14
0UL49
Legend
Count Subsite Boundaries
OSi Discovery Series County Boundary
Total Numbers of Birds
RANGE
1-49
50-99
100-199
200-299
300-399
An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht
River Nanny Estuary and Shore
Roost Location Map
Data collected during
the roost survey on 27/02/2012
Map to be read in conjunction with the NPWS Conservation Objectives SPA Supporting Document.
0 500 1,000 m
N
Map Version 1
Date: Aug 2012

APPENDIX 9

River Nanny Estuary & Shore - Activities & Events

Please note that this list is based on the current review process and is not exhaustive.

Legend:	
O	observed or known to occur in or around River Nanny Estuary.
U	known to occur but unknown area (subsites)/spatial extent; hence all potential subsites are included (e.g. fisheries activities).
H	historic, known to have occurred in the past.
P	potential to occur in the future.
	Grey highlighting refers to activities that have the potential to cause disturbance to waterbirds.

ACTIVITIES/EVENTS	0UL49	0V902	0V903	0VL05	0VL07	0VL08	0VL09	0VL10	0VL11	0VL12	0VL13	0VL14	0VL15
1. Coastal protection, sea defences & stabilisation													
1.5 Marram grass	O			O						O	O	O	
4. Industrial, port & related development													
4.3 Slipway					O								
5. Military activities													
5.2 Firing range										O	O	O	O
5.3 Military constructions													O
6. Pollution													
6.1 Domestic & urban waste water		O	O		O				O				
6.3 Landfill						O							
6.7 Solid waste incl. fly-tipping	O					O	O				O	O	
6.8 Others									O				
8. Transport & communications													
8.3 Bridges & aqueducts	O					O							
8.5 Road schemes													O
8.6 Car parks	O			O									
8.8 Rail lines	O				O	O			O	O			O
8.10 Communication masts and antennas													O
9. Urbanisation													
9.1 Urbanised areas, housing				O	O	O							O
9.2 Commercial & industrial areas					O								
9.3 Hotel & leisure complex				O									
11.2 Nature trails								O					
12. Tourism & recreation													
12.6 Power boating & water-skiing				O									

12.17 Bathing & general beach recreation	O			O	O				O	O	O	O	
12.18 Walking, incl. dog walking	O			O	O			O	O	O	O	O	O
12.19 Birdwatching	O			O	O	O	O				O	O	O
12.20 Sand-yachting				O									
12.22 Motorised vehicles				O							O	O	
12.23 Horse-riding	O			O	O				O	O	O	O	O
12.25 Golf courses				O					O				
13. Wildfowl & hunting													
13.2 Other hunting-related activities									O	O	O		O
15.1 Professional passive fishing (e.g. longlining)		U	U										
15.2 Professional active fishing		U	U										
15.3 Bottom (benthic) dredging		U	U										
15.4 Fish traps & other fixed devices & nets		U	U										
15.5 Leisure fishing		O	O										
16. Agriculture & forestry													
16.2 Grazing: intensive (terrestrial)													O
16.6 Crop production: intensive													O
16.9 Removal of hedges, scrub													O
16.10 Mowing/grassland cutting													O
16.11 Abandonment of mowing													P

APPENDIX 10

Disturbance Assessment

Scoring system - definitions & rationale

Frequency/Duration	Score	Rationale
Continuous	3	Continuous motion or noise; not necessarily 24-hours per day but zones of fairly continuous activity such as a port or marina.
Frequent	2	Frequently observed during the survey programme, can be up to several times per 6 hour tidal cycle; and/or known to occur on a frequent basis.
Infrequent	1	Observed only once or twice during the survey programme and known/considered likely to be infrequent.
Rare	0	Known to occur but not observed during the survey programme and considered likely to be rare in occurrence.
Intensity	**Score**	**Rationale**
Active, high-level	3	Would indicate an active event that is likely to displace waterbirds during its presence e.g. active shipping channel, speed boats, quad bikes, loose dogs.
Medium-level	2	Lower intensity events such as non-powered watercraft, vehicles, people walking along a shoreline (without dogs) – that are likely to result in waterbirds moving but birds will be less 'alarmed' than (1) and response will be species-specific.
Low-level	1	Although activity may be of a nature to displace waterbirds, birds move only slightly, resume normal behaviour quickly or show no determinable response at all; e.g. solitary walkers close to site but not impacting on waterbirds' immediate location; cars passing on an adjacent road…
Very low-level	0	Any activities considered to impart little effect upon waterbirds.
Response	**Score**	**Rationale**
Most birds disturbed all of the time	3	Birds do not return - therefore equivalent to habitat loss.
Most birds displaced for short periods	2	Birds return once disturbance has ceased.
Most species tolerate disturbance	1	Weak response, birds may move slightly away from disturbance source.
Most birds successfully habituate to the disturbance	0	Little determinable effects.

The scores assigned to the three attributes were then added together to give an overall 'disturbance score' which is used to define the extent of the impact as follows:-

Scores 0 – 3 = Low
Scores 4 – 6 = Moderate
Scores 7 – 9 = High

Scoring system – worked example

Disturbance event – humans walking along a beach; the beach is a popular recreational area and this activity was recorded frequently during surveys.

Attribute	Score	Rationale
Frequency/Duration	2	Recorded frequently during the survey period; known area of beach recreation.
Intensity	2	Medium level - considered likely to result in waterbirds moving away from the source of disturbance although response will be species-specific and some species may even habituate to the activity.
Response	2	Most birds are displaced for short periods and therefore will resume their previous behaviour in the area when the activity ceases.
TOTAL SCORE	**6**	**MODERATE**

Results - based on data from the 2011/12 Waterbird Survey Programme

ACTIVITIES/EVENTS	0UL49	0V902	0V903	0VL05	0VL07	0VL08	0VL09	0VL10	0VL11	0VL12	0VL13	0VL14	0VL15
12. Tourism & recreation													
12.6 Power boating & water-skiing				6									
12.18 Walking, incl. dog walking	6			7	7			6	7	7	6	6	5
12.22 Motorised vehicles				5								4	
12.23 Horse-riding					5				6	5			
13. Wildfowl & hunting													
13.2 Other hunting/shooting									6	6	6		