E.ON Climate & Renewables

Analysis of Marine Ecology Monitoring Plan Data from the Robin Rigg Offshore Wind Farm, Scotland (Operational Year 2)

Technical Report

Executive Summary and Introduction

Report: 1012206

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EXECUTIVE SUMMARY

Robin Rigg Offshore Wind Farm in the Solway Firth is operated by E.ON Climate & Renewables (E.ON) and was the first commercial offshore wind farm in Scottish waters. The site is comprised of 60 three megawatt Vestas turbines and an offshore sub-station. Construction of the offshore wind farm and its associated cabling began in December 2007 and the site became full commercial operation in April 2010.

In accordance with the consent from Scottish Ministers under Section 36 of the Electricity Act 1989, a Marine Environment Monitoring Programme (MEMP) was developed to record any changes to the local physical and ecological environment as a result of the construction of the wind farm. This included monitoring requirements for a number of ecological parameters, such as benthos, non-migratory and electrosensitive fish, birds and marine mammal.

This report represents analysis performed on ecological data collected before construction (during the baseline and pre-construction year), during construction and during the first two years of operation. The data for benthos, non-migratory and electrosensitive fish, birds and marine mammal has been examined in order to assess the impact of the offshore wind farm on the Solway ecosystem and validate the prediction made in the Environmental Statement.

This report has been structured by topic, whereby each chapter is set out as a self contained paper with introduction, methodology (for both survey and analysis), results, discussion and references for each of the four sets of survey data collected (i.e. benthic, fish, bird and mammal surveys).

Benthic Ecology

Benthic surveys, using a grab, have been undertaken within the wind farm site, along the cable route and at various references sites the during baseline, pre-construction, construction and operational phases.

The analysis undertaken on the benthic infauna data was used to identify any temporal, spatial, seasonal, and/or location trends and to determine whether any trends could be seen between the benthic infauna throughout the entire process. Benthic species compositions were analysed by Multivariate (Primer v6) and univariate [PRIMER (including the PERMANOVA+ add on)] statistics. Analysis of the results was carried out on the survey data to determine any variation in the community assemblages across all construction periods of the wind farm.

A total of 3796 individuals from 126 taxa have so far been identified from benthic grab samples during the baseline, pre-construction, construction and operational periods. The most frequently encountered species were the amphipod *Bathyporeia elegans* and the polychaete *Nephtys cirrosa*.

The results of the analysis revealed that benthic infauna community assemblages have changed over time for the whole of the Robin Rigg Wind Farm survey area (including reference areas). The greatest changes in communities occurred between the collection of baseline data and pre-construction and pre-construction and operation (i.e. in the absence of any offshore wind farm construction activity). Changes in the benthic assemblages also occurred between pre-construction and operational periods, however these were also observed at reference sites outside the offshore wind farm. No significant differences were found between the pre-construction and construction years. Differences were seen throughout the construction period and operational year one, however, biota appear to be returning to pre-wind farm, baseline, composition and variation of communities. Any significant changes in communities were due to shifts in the relative abundance of a few dominant species, which is common in naturally highly dynamic sedimentary environments. Communities inhabiting soft sediments in exposed coastal areas, such as the Solway, are prone to periodic storm-induced disturbance.

The results suggest that changes in benthic community were due to dynamic nature of the Solway Firth and cyclical patterns in benthic fauna, rather than the impact of construction and operation. The ES predicted any impacts on the benthos as a result of construction activity would not be significant and where any may occur they would be of a short duration. On this basis of this analysis the ES predictions appear to be correct.

Non-migratory and Electrosensitive Fish

The survey methodology for all non-migratory fish surveys was carried out in accordance with the MEMP requirements to follow the baseline methodology, whereby a 2 m beam trawl was towed for 15 minutes at 31 sampling stations in and around the wind farm site. These surveys were carried out during the baseline, and during construction and post construction periods. The same method was used along the cable route for the electrosensitive fish survey, during preconstruction, construction and post construction.

The species captured in the non migratory fish surveys are typical of Irish Sea estuarine environments and since thus far 39 species of fish and 64 species of invertebrates have been captured. The most commonly caught fish were juvenile plaice (*Pleuronectes platessa*), dab (*Limanda Limanda*) and whiting (*Merlangius merlangus)*. Brown shrimp (*Crangon Crangon*), brittle stars (*Ophiura ophiura*) and hermit crabs (*Pagurus bernhardus*) were the most common invertebrates captured.

The analysis considered broad-scale changes in fish and epibenthic invertebrate assemblages between construction periods and season in the inner Solway Firth area. The response of univariate and multivariate metrics exhibited significant change in response to construction periods and season. Catch abundance of fish, invertebrates, brown shrimp and whiting reduced following the commencement of construction, particularly in construction year one (February 2008 to February 2009). However, very little construction activity took place during this period; therefore it is difficult to attribute this change to construction activity. This is further supported by the results of the BEST analysis which attempted to correlate varying species assemblages with distance from the wind farm. The aim of this analysis was to determine any effects that may be attributable to construction activity/turbine presence. The low level of correlation between species assemblages and distance from site for both fish and epibenthic assemblages suggests wind farm presence is not driving change within the Solway Firth.

Mobile estuarine sand bank systems such as those present in the Solway Firth represents a highly dynamic and variable environment; continually changing environmental conditions are likely to drive natural variability in community composition at a broad scale. In the absence of highly detailed environmental parameters it is not possible to disentangle natural temporal and spatial variation from anthropogenic effects such as the presence of Robin Rigg wind farm and the export cable route; however no evidence was found to suggest that changes had occurred as a result of the wind farm.

On the electrosensitive fish survey along the cable route elasmobranch abundance was low throughout the duration of the survey with only 43 individuals recorded in 80 trawls and no significant difference detected between survey periods.

Birds

All surveys consisted of boat-based visual surveys comprising of ten transects conducted monthly or bimonthly, depending on phase. All data were collated and verified by NPC Ecology. The analytical methodology has been determined by the data available to Natural Power Consultants, collected as part of the MEMP before, during and after construction.

Preliminary analysis suggests an increase in abundance for cormorant and great black-backed gull post-construction of the wind farm. A number of species (red-throated diver, gannet, kittiwake, guillemot and razorbill) exhibit possible decline during the construction phase with signs of recovery during the first two years of operation. Only Manx shearwater and common scoter show possible evidence of a decline in numbers but further analysis is required to confirm.

Very few birds were observed flying at rotor height with only herring gull, black-backed gull and gannet demonstrating possible collision risk although the numbers of these species recorded at rotor height are still low.

Previous reports have highlighted the complexities of the bird data collected as part of the MEMP and the need for the development of more complex modelling. Preliminary data exploration demonstrates that individual models are required for each target species, a time consuming process. This work is already under way and will be fully reported upon in the next report and in the publication of peer reviewed papers.

Marine Mammals

Boat surveys were performed in conjunction with the ornithology surveys. No baseline surveys were undertaken, however monthly / bimonthly surveys (depending on MEMP requirements) have been undertaken throughout the pre-construction, construction and operational phase. The analytical methodology has been determined by the data available to Natural Power Consultants, collected as part of the MEMP before, during and after construction.

Two species of marine mammal were recorded during boat surveys conducted as part of the MEMP – harbour porpoise and grey seal. In depth analysis of the grey seal data was not possible due to the low level of sightings but the data demonstrate that seals were present in the Solway Firth throughout the year and during all three stages of the development (pre, during and after construction). The harbour porpoise data set is complex and requires the development of complex analysis protocols to understand fully, a process that is presently underway. Initial model outputs a decrease in porpoise numbers during construction and an increase during the operational phase. The complete results will be reported on in a final report and in peer reviewed papers. Underwater noise, particularly from piling, is a major concern during the construction of an offshore wind farm and measurements were collected during and post construction as part of FEPA licensing requirements. There were no requirements to record short-term behavioural responses to piling but anecdotal evidence suggests that both porpoises and grey seals are present within the survey area within 24 hours of piling events, as has been reported from other offshore wind farms.

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1. INTRODUCTION

Robin Rigg Offshore Wind Farm is E.ON Climate & Renewables' (E.ON) third offshore wind farm and the first commercial offshore wind farm in Scottish waters. The site is comprised of 60 three megawatt Vestas turbines and an offshore sub-station. Turbines began full commercial operation/generation in April 2010.

In accordance with the consent from Scottish Ministers under Section 36 of the Electricity Act 1989, a Marine Environment Monitoring Programme (MEMP) was developed to record any changes to the local physical and ecological environment as a result of the construction of the wind farm.

This report represents analysis performed on data collected before construction, during construction and during the first two years of operation. These data will form a basis from which to assess any impacts from the operational phase of Robin Rigg for E.ON, by the Robin Rigg Management Group (RRMG) and Scottish Government.

1.1. Site Description

The Robin Rigg Offshore Wind Farm is situated within the central part of the Solway Firth, immediately to the north of the English/Scottish boundary which roughly bisects the firth (see Figure 1a, b and c). The centre of the turbine layout lies some 11 km from the Dumfries and Galloway coastline within Scotland and 13.5 km from the Cumbrian coastline in England. The nearest towns are Dalbeattie in Scotland, 21 km to the north-northwest and Maryport in England, 14 km to the southeast.

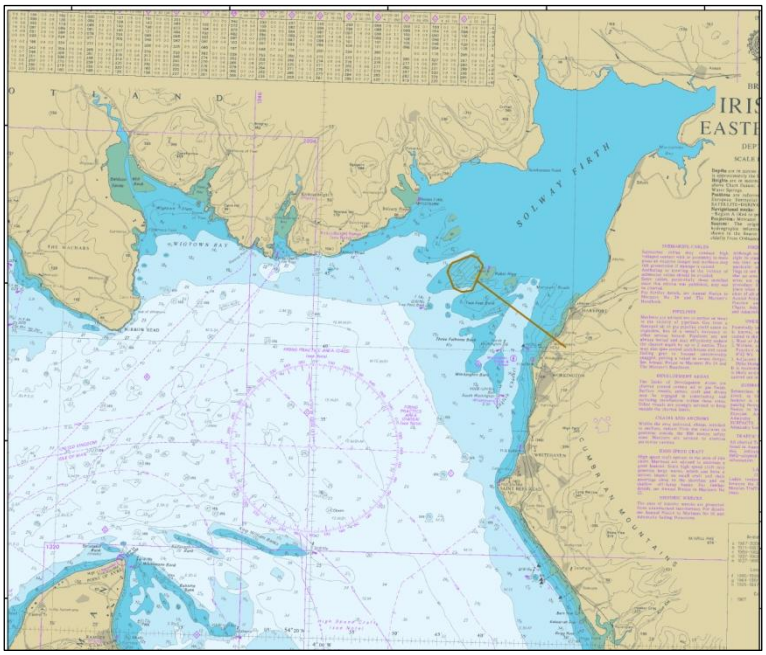

Figure 1.1 a: Map of Solway Firth showing the location of the Robin Rigg Wind Farm.

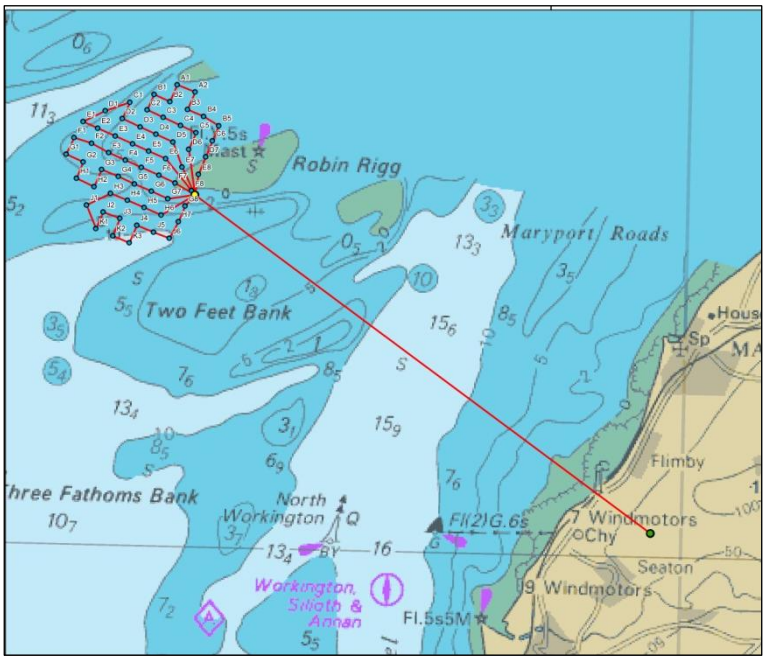

Figure 1.1b: Schematic of Robin Rigg Wind Farm showing turbine locations (blue dots), inter-array cabling and grid connection to shore (red lines).

Figure 1.1c: Photograph of Robin Rigg Offshore Wind Farm during the construction phase.

Turbine foundations are a monopole design, with a transition piece which provides boat fendering, access ladders and cable conduits. The monopole and transition piece are connected with a grouted joint.

The installation of turbine foundations occurred between December 2007 and February 2009, with a gap in construction between February and August 2008 (see Table 1.1). The number of foundations installed each month can be found in Figure 1.2.

*Table 1.1: Schematic timetable of construction activities for the Robin Rigg offshore wind farm. Pink = foundation installation; blue = turbine construction; purple = turbine commissioning; green = installation of wind farm cables; * = installation of export cable.*

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2007	Foundations												
	Installation												
	Commission												
	Cables												
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2008	Foundations												
	Installation												
	Commission												
	Cables												
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2009	Foundations												
	Installation												
	Commission												
	Cables					*				*			
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2010	Foundations												
	Installation												
	Commission												
	Cables												

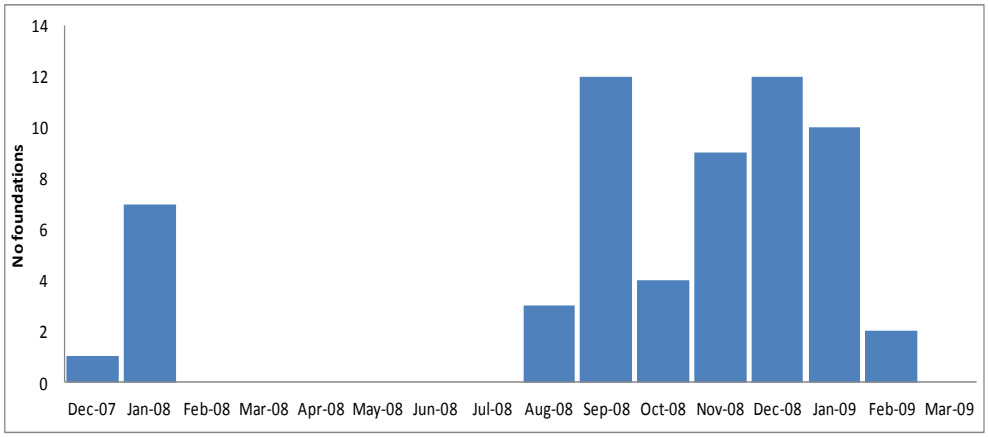

Figure 1.2: Number of foundations piled each month between December 2007 and March 2009.

Installation of the turbines commenced in November 2009 (see Table 1). These activities involved the use of large jack-up barges either towed or self propelled. The turbine towers are 80 m high and each of the three blades, 44 m long. Turbines are positioned approximately 500 m apart.

Cables were installed from July 2008 into early 2010 (see Table 1) and two different methods were used; a “lay and bury” technique and also a “surface lay and later bury” technique. The two export cables were laid in May and September 2009. The last turbine was installed during August 2009 and the first turbine operated briefly in August 2009 with main commissioning commencing in September 2009 and completed in February 2010 (see Figure 1.Figure 1.4). A variety of ports were used during construction including Belfast, Mostyn, Newcastle, Workington, Whitehaven and Barrow.

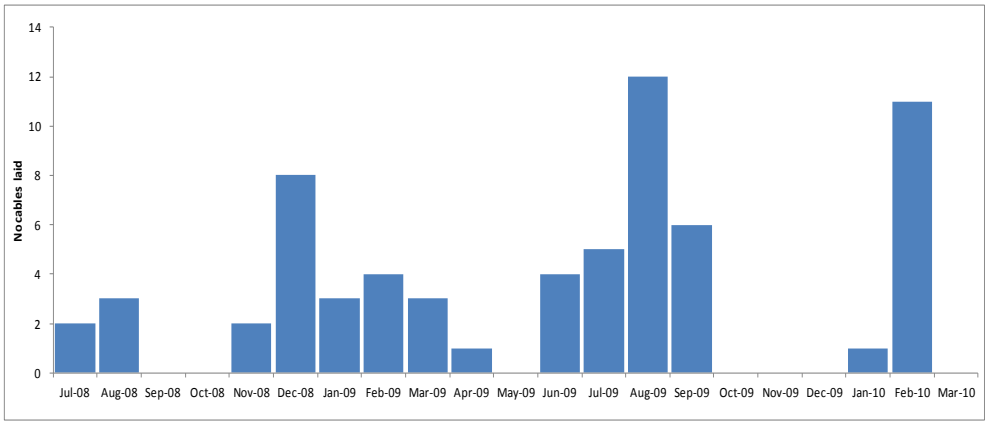

Figure 1.3: Number of cables installed each month between July 2008 and February 2010.

The turbines are connected in four loops, each containing 15 turbines, by 33 kV submarine cables with an embedded fibre optic link (see Figure 1.1b). There are 64 inter-array power cables installed between the wind turbine generators of the wind farm. The eight ends of these array cable loops are received by the two offshore substations. The array cables have two different cross-sections, varying with location; 150 mm² conductors are used close to the end points and 300 mm² conductors are used in the middle of the loop and close to the offshore sub-station.

The wind farm is connected via an offshore sub-station using two export cables which operate at 132 kV. These cables come ashore near Seaton, Cumbria and continue for approximately 2 km inland to an onshore substation. There are two submarine high voltage AC power cables connecting the offshore substation to the onshore network. These 132 kV XLPe insulated 300 mm² Cu submarine composite export cables contain three-phase power cable and one fibre optic element with double wire armour and single wire armour throughout the remainder of the route.

Turbine commissioning began in August 2009 and was completed in February 2010. The number of turbines commissioned each month is illustrated in Figure 1.4.

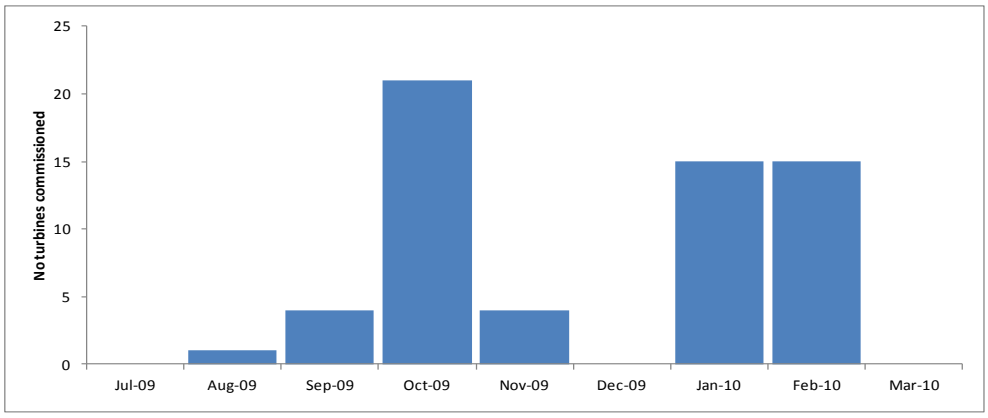

Figure 1.4: Number of turbines commissioned each month between August 2009 and February 2010.

In March 2011, the 132 kV export cables were sold by E.ON Climate & Renewables to a private transmission company "Transmission Capital" under the government's new OFTO regime. E.ON Climate & Renewables has been retained by the OFTO as their O & M contractor and this includes managing the environmental monitoring aspects of the export cable.

2. ECOLOGICAL MONITORING AT ROBIN RIGG

2.1. Ecological Monitoring Rationale and MEMP

An Environmental Statement was prepared for the Scottish Executive Energy Division under Section 36 of the Electricity Act (Scotland) 1989; a Private Bill for the Scottish Parliament; the Scottish Executive - Transport Division under Section 34 of the Coastal Protection Act 1949 and the Scottish Executive – Rural Affairs Department under the Food and Environment Protection Act 1985; and in accordance with the statutory procedures set out in The Environmental Assessment (Scotland) Regulations 1988 and the Environmental Impact Assessment (Scotland) Regulations 1999, in support of an application for an offshore wind farm at Robin Rigg in the Solway Firth.

Prior to the construction of the Robin Rigg Wind Farm, a Marine Environment Monitoring Programme (MEMP) was developed in conjunction with the Robin Rigg Management Group (RRMG), covering the pre-, during and post-construction stages of development in accordance with consent from Scottish Ministers under Section 36 of the Electricity Act 1989.

The remit of the MEMP was to record any changes to the physical and ecological environment that may be caused by the construction and operation of the wind farm, complying with condition 6.4 of Section 36 Consent conditions. The programme concentrated on areas where there was uncertainty on the effects of the wind farm and where those effects may cause potential impacts on the marine ecology. This included benthos, fish, birds and marine mammals.

This report represents analysis of data available to Natural Power. All data collected during the construction and operational phases of the Robin Rigg Wind Farm was undertaken as part of the requirements for the Marine Environment Monitoring Plan (MEMP) and agreed by the RRMG.

2.2. Survey Regime

Full details of the survey regime for all species can be found in the relevant chapters. To summarise:

Benthic surveys

Baseline data was collected as part of the ES process, via grab samples collected from over 100 stations within and adjacent to the proposed development (site and cable route). In accordance with the MEMP, bi-annual benthic surveys were conducted before and during the construction phase. Annual surveys were conducted for the first two years of operation.

Bi-annual intertidal surveys were also undertaken along the cable route land point in Cumbria, however this report relates to the offshore environment only, therefore results of the intertidal survey are not included and a separate report for these surveys has been previously issued.

Fish surveys

Non-migratory fish surveys: Baseline data was collected as part of the ES process via monthly trawls at 31 sampling stations in and around the proposed development. In accordance with the MEMP, monthly trawls were conducted for the first three months of the construction phase, after which the survey frequency was reduced to quarterly. Bi-annual surveys are required for the first three years of operation.

Electrosensitive fish surveys: In accordance with the MEMP electrosensitive fish surveys were carried out along the cable route at 8 sampling stations throughout the preconstruction, construction and operational periods. The numbers of surveys per year varied according to the MEMP and ceased in March 2011.

Bird surveys

Baseline data was collected as part of the ES process via monthly boat surveys covering the area in and around the proposed development. In accordance with the MEMP, monthly surveys were conducted prior to construction, with the frequency increasing to bi-monthly surveys for the duration of the construction phase. Monthly surveys are required for the first five years of operation, with a review of data after three years.

Marine mammal surveys

No survey data were collected for marine mammals as part of the ES process. In accordance with the MEMP, monthly surveys were conducted prior to construction, with the frequency increasing to bi-monthly surveys for the duration of the construction phase. Monthly surveys were required for the first two years of operation.

2.3. Ecological Analysis Rationale

The analytical methodology has been determined by the data available to Natural Power Consultants, collected in as part of the MEMP before, during and after construction.

The approach to the ecological analysis has been developed after reviewing the requirements of the MEMP, FEPA licensing requirements and the recent CEFAS document, "Strategic review of offshore wind farm monitoring data associated with FEPA licence conditions"[1].

As part of this process, consultation with Marine Scotland and SNH identified key questions or concerns for specific focus. Data analysis was specifically tailored to the predictions made in the EIA and addresses the licence monitoring conditions. The analysis has focused on key areas highlighted by the RRMG and where data was available and appropriate, to address uncertainties as outlined in the aims of the MEMP.

Specific key questions have been identified by E.ON Climate & Renewables (with NPC) and the RRMG for the data analysis. These relate to:

- Disturbance/displacement of specific species;
- Changes in patterns of abundance and distribution with distance from the wind farm; and
- Identifying any predicted impacts/sensitivities from the EIA process.

Analysis of the benthic, fish, bird and marine mammal data has been undertaken by the NPC Ecology & Hydrology Department. This has only been possible where these data, the survey program, the survey methods and the rigour and consistency of the data collected by 3rd party consultants allowed for the analysis to be undertaken.

Analysis of the intertidal data has not been undertaken for this report as these data were analysed as part of a separate report.

2.4. Reporting

This report represents analysis performed on ecological data collected before construction (during the baseline and pre-construction year), during construction and during the first two years of operation. The data for benthos, non-migratory and electrosensitive fish, birds and marine mammal has been examined in order to assess the impact of the offshore wind farm on the Solway ecosystem and validate the prediction made in the Environmental Statement.

This report has been structured by topic, whereby each chapter is set out as a self contained paper with introduction, methodology (for both survey and analysis), results, discussion and references for each of the four sets of survey data collected (i.e. benthic, fish, bird and mammal surveys). As such there is no overall discussion, however each chapter has where appropriate drawn on the results and conclusion of the other chapters to provide a holistic interpretation of the impact of the site on the Solway Firth ecosystem.

[1] Walker, R. & Judd, Adrian. 2010. Strategic Review of offshore wind farm monitoring data associated with FEPA licence conditions. CEFAS, SMRU Ltd, FERA on behalf of DEFRA & MMO.