East Anglia
Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

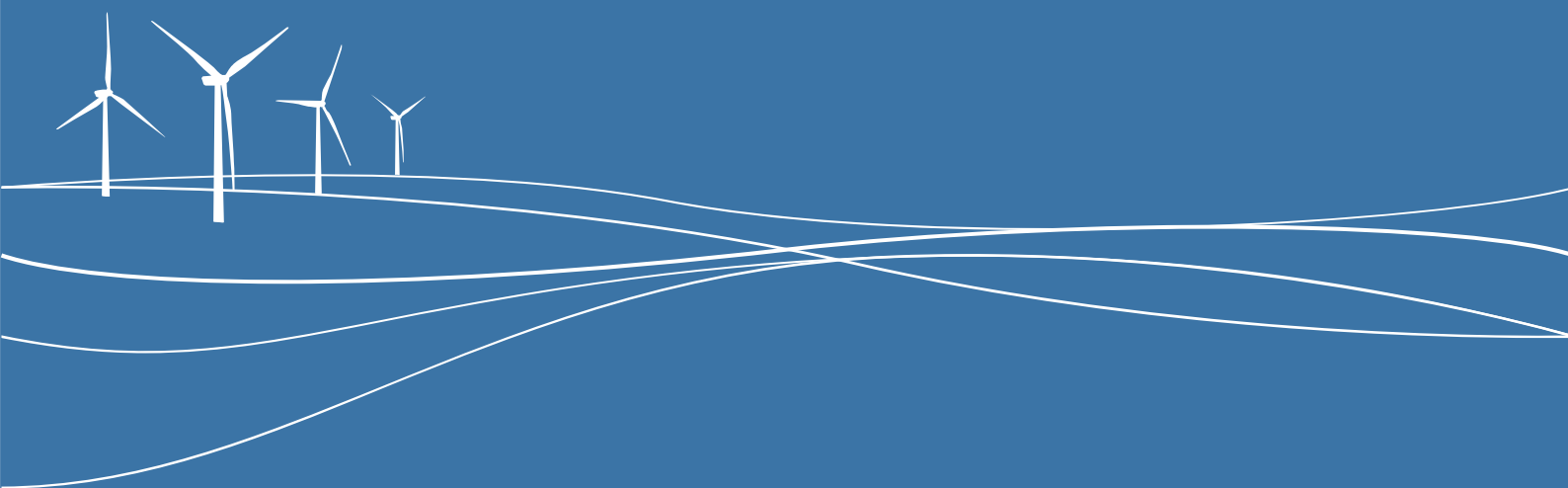
East Anglia THREE

Appendix 11.1

Fish and Shellfish Ecology Evidence Plan

Environmental Statement
Volume 3
Document Reference – 6.3.11 (1)

Author – Royal HaskoningDHV
East Anglia Three Limited
Date – November 2015
Revision History – Revision A



This Page Is Intentionally Blank

Table of Contents

11.1 FISH AND SHELLFISH ECOLOGY EVIDENCE PLAN

11.1.1 Introduction

1. This Appendix contains a number of documents which form the Evidence Plan for Fish and Shellfish Ecology, these are:

   - Evidence Plan method statement; a document which was used to inform the first fish and shellfish ecology Expert Topic Group (ETG) evidence plan meeting. This was distributed to all members of the ETG on the 3rd of September 2013 prior to the group's first meeting held on the 10th of September 2013. Section 11.1.2

   - The minutes from the first Fish and Shellfish Ecology ETG Evidence Plan meeting held on September 10th 2013. These were agreed with all members of the group. Section 11.1.3 and 11.1.5.

   - Clarification of impact assessment methodology and approach to cumulative impacts. This was requested by the group at the first meeting and was distributed to members following the meeting. Section 11.1.4

   - The minutes from the second Fish and Shellfish ecology ETG Evidence Plan meeting held on the 8th July 2014. Section 11.1.7

2. It should be noted that these documents are as close to their original form as possible and have not been updated as projects have developed. Therefore the timelines and parameters given in section 11.1.2. Furthermore, the documents within this appendix refer to the proposed East Anglia FOUR project, which at the time of writing was being progressed in parallel with the proposed East Anglia THREE project; it should be noted that this is no longer the case.

11.1.2 Fish and Shellfish Ecology Method Statement

4. Provided below is the Fish and Shellfish Ecology Method statement that was circulated members of the ETG prior to the first meeting held 10th September 2013.

East Anglia
Offshore Wind

VATTENFALL

SCOTTISHPOWER
RENEWABLES

East Anglia THREE

Evidence Plan

Fish and Shellfish Ecology Background paper

Fish and Shellfish Ecology Expert Topic Group
Preliminary meeting: September 2013

Author – Royal HaskoningDHV
East Anglia Offshore Wind Limited
Date – September 2013
Revision History – Revision B

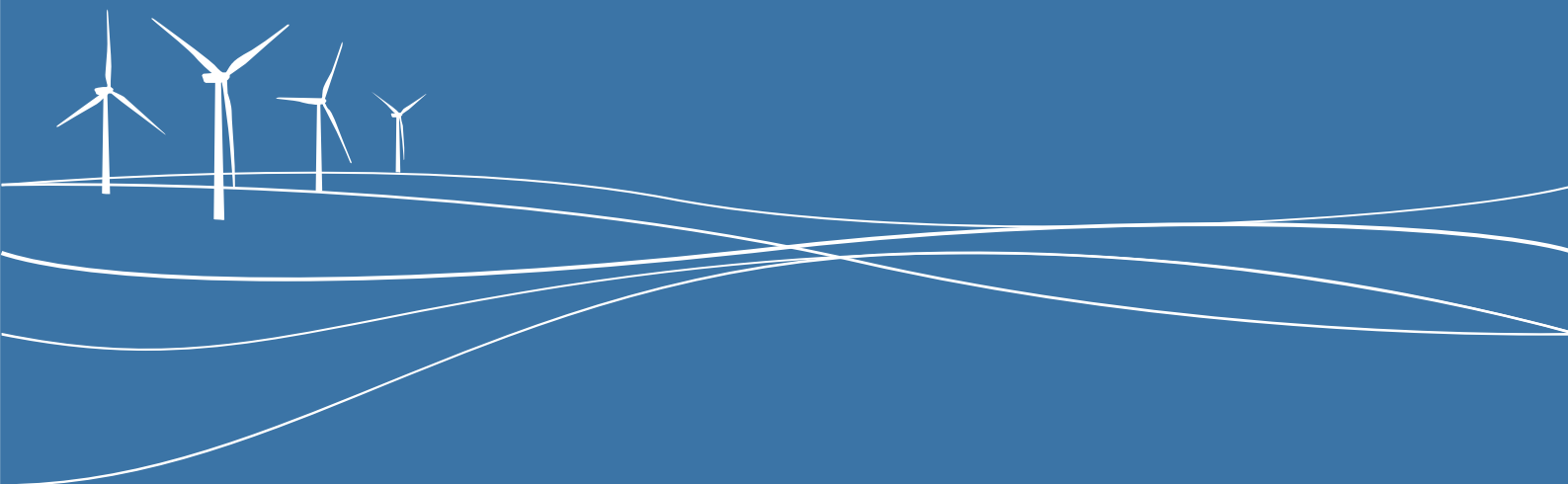


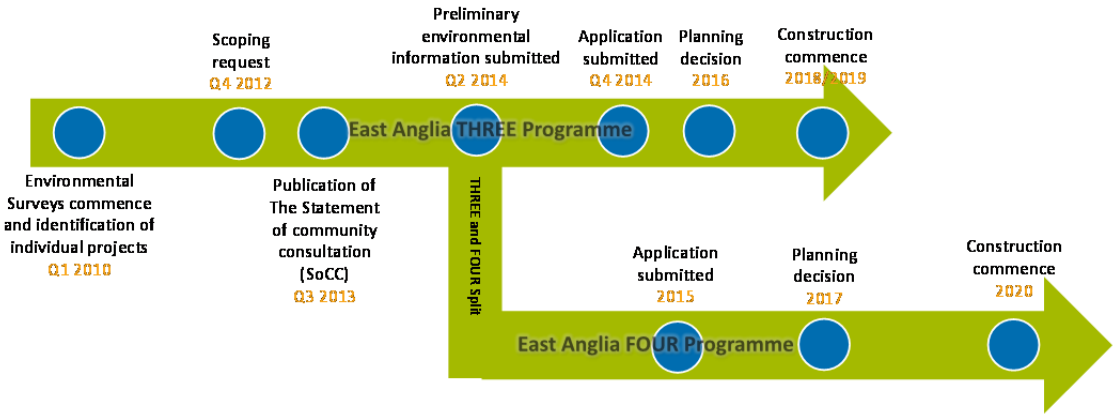
Table of Contents

1 INTRODUCTION

1. This note is designed to provide the reader with a background to the status of the Fish and Shellfish Environmental Impact Assessment (EIA) for East Anglia THREE and East Anglia FOUR offshore windfarms.

1.1 Background to East Anglia THREE and East Anglia FOUR.

2. A time line leading up to Development Consent Order submission (DCO) for both East Anglia THREE and East Anglia FOUR is displayed below. It is the intention that the PEIs (which will be draft Environmental Statements (ES)) for both projects will be submitted in May 2014 after which point effort will be focused on completing the final East Anglia THREE ES for submission in November 2014. The Final submission date for East Anglia FOUR is likely to be in Q2 of 2015.



1.2 Project Description

3. The various parameters for East Anglia THREE and East Anglia FOUR windfarms are provided in Table 1 below.

Table 1 Indicative Offshore project characteristics

Parameter	East Anglia THREE	East Anglia FOUR
Capacity	1,200MW	1,200MW
Number of wind turbines	120-240 units	120-240 units
Offshore Area	370km2	359km2
Distance from site to shore (midpoint of site to Lowestoft)	79km	91km
Maximum offshore cable corridor length	140km	160km
Maximum offshore cable corridor area	550km2	550km2
Number of export cables (HVDC)	Up to 4	Up to 4
[1]Proposed wind turbine capacity	5-10MW	5-10MW
Wind turbine rotor diameter	Up to 200m	Up to 200m
Hub height	Up to 145m (LAT)	Up to 145m (LAT)
Tip height	Up to 245m (LAT)	Up to 245m (LAT)
Minimum clearance above sea level	22m (MHWS)	22m (MHWS)
Indicative minimum separation between wind turbines	In row spacing 750m	In row spacing 750m
	Inter-row spacing 750m	Inter-row spacing 750m
Average water depth over windfarm site	Typically 35-45m	Typically 25-40m

[1] Note that it is envisaged that more than one wind turbine type and manufacturer will be employed, up to a maximum of three wind turbine models for East Anglia FOUR.

2 THE EAST ANGLIA ZONE

2.1 Finfish

4. The Zonal Environmental Appraisal (ZEA) was undertaken in 2010 with the purpose of identifying potential sites for individual windfarms within the zone. The fish and shellfish impact assessment included in the ZEA is summarised as follows:

5. The landings data show that the principal species landed by weight from the Zone are plaice *Pleuronectes platessa* and sprat *Sprattus sprattus* (both approximately 28%); cod *Gadus morhua* (approximately 13% of total landings); sole *Solea solea* (approximately 10% of total landings); with flounder *Platichthys flesus*, horse mackerel, dab, and herring each accounting for approximately 1 – 2% of the landings. Elasmobranchs (sharks and rays) make up approximately 9% of the total landings by weight with the key species caught being thornback ray *Raja clavata* and spurdog *Squalus acanthias*.

6. Of these species, plaice, sole and to a lesser extent cod are commercially important to both UK and non-UK fleets that operate within the East Anglia Zone. Other species which are of secondary importance to commercial fisheries (such as herring, sandeels and sprat) play an important role in the North Sea food web, being key prey items for marine mammals and birds.

7. Another key source of information is the International Bottom Trawl Survey (IBTS). This survey is carried out annually twice a year by eight countries and covers the entire North Sea and Skagerrak/Kattegat with the principle objectives of determining the distribution and relative abundance of pre –recruits of the main commercial fish species (e.g. herring, cod, whiting, haddock, Norway pout, mackerel, sprat and saithe), to monitoring the distribution and relative abundance of all fish species and selected invertebrates and the collection of hydrographical and environmental data (ICES, 2010). The IBTS data give an indication of the relative importance of species within the East Anglia Zone, as listed in Table 2.

Table 2 Average catch per unit effort (CPUE) for species recorded in IBTS surveys within the East Anglia Zone (2001 – 2010). Only species shown with CPUE >10

Common name	Latin Name	Average CPUE (individuals)
Sprat	*Sprattus sprattus*	761
Sandeel	*Ammodytidae*	225
Lesser weaver	*Echiichthys vipera*	154
Poor cod	*Trisopterus minutus*	118
Horse mackerel	*Trachurus trachurus*	99
Herring	*Clupea harengus*	77
Whiting	*Merlangius merlangus*	57
Sand goby	*Pomatoschistus minutus*	55
Greater sandeel	*Hyperoplus lanceolatus*	46
Smooth sandeel	*Gymnammodytes semisquamatus*	41
Mackerel	*Scomber scombrus*	39
Dab	*Limanda limanda*	34
Raitt's sandeel	*Ammodytes marinus*	26
Solenette	*Buglossidium luteum*	12

8. Elasmobranch species such as thornback ray *R. clavata*, blonde ray *Raja brachyura*, spotted ray *Raja montagui*, lesser spotted dogfish (also known as small-spotted catshark) *Scyliorhinus canicula*, smooth-hounds *Mustelus* sp., spurdog *S. acanthias*, undulate ray *Raja undulata* and tope *Galeorhinus galeus* have all been recorded in IBTS samples collected in the Zone (EAOW, 2012a).

9. Migratory species and species of conservation importance such as European eel *Anguilla anguilla*, river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus*, shad *Alosa* sp., common skate *Dipturus batis*, sea trout, salmon, shads and smelt have been occasionally recorded in landings data and/or in the IBTS data, and may transit the Zone as part of their migratory or foraging activity. In the particular case of sea trout, the East Anglian coast is thought to be an important feeding area for sea trout (post-smolts) originating from rivers of north-east England.

10. Table 3 summarises those species identified as important at the Zone level. The spawning and nursery grounds for a range of these species are shown in Figure 1 – Figure 8.

Table 3 Average catch per unit effort (CPUE) for species recorded in IBTS surveys within the East Anglia Zone (2001 – 2010). Only species shown with CPUE >10

	Zone		EA 3 and 4 overlap			
Species	*Spawning*	Nursery	Spawning	Nursery	Commercial importance	Conservation Designation
Plaice	High Intensity	None	Y	N	High	UK BAP, IUCN (least concern)
Sole	High Intensity ground in the southern half of Zone	Limited to the western edge of the Zone	Y (slight overlap THREE) N FOUR	N	High	UK BAP
Cod	Low intensity in south of Zone	Low intensity area covers much of Zone	N	Y	Medium	UK BAP, OSPAR, IUCN (vulnerable)
Sandeel	Low intensity area covers much of Zone	Low intensity area covers much of Zone	Y	Y	Low	UK BAP
Sprat	Whole Zone	South and east of Zone	Y	Y	Low	UK BAP
Herring	Low intensity in south of Zone	Low intensity area covers much of Zone	N	Y	Low	UK BAP, IUCN (least concern)
Sea trout	N	N	N	N	Medium (targeted by licensed fisheries off the coast of East Anglia)	UK BAP, IUCN (lower risk/least concern)
Spurdog	Not defined	Not defined	Not defined	Not defined	Medium	UK BAP, OSPAR, IUCN (vulnerable)
Thornback ray	Not defined	Limited to the western edge of the Zone	Not defined	N	Medium	OSPAR, IUCN (near threatened)
Tope	Not defined	Low intensity area covers whole Zone	Not defined	Y	Low	UK BAP, IUCN (vulnerable)

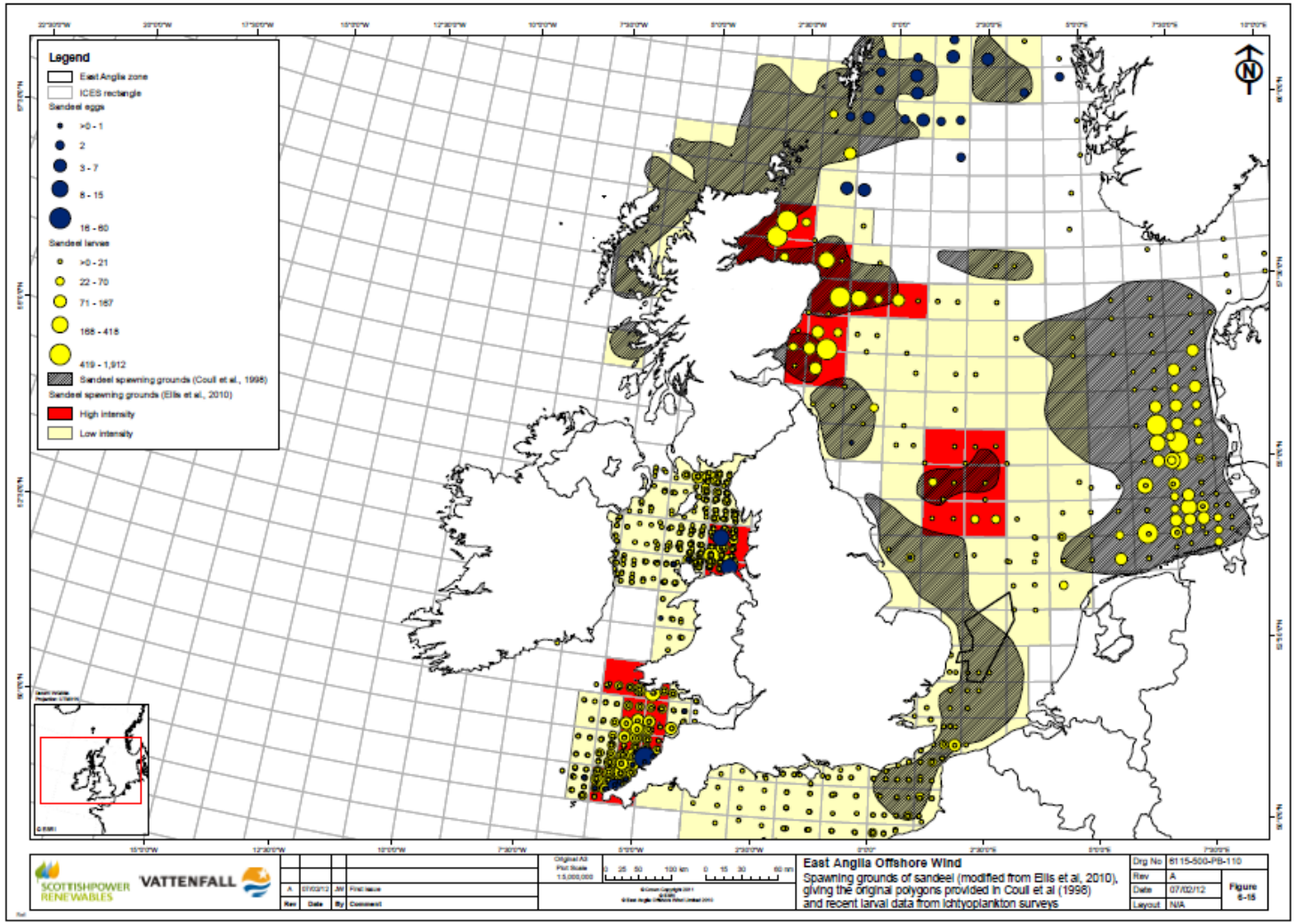


Figure 1 Spawning grounds of sandeel (modified from Ellis et al. 2010) and recent larval data from ichthyoplankton surveys

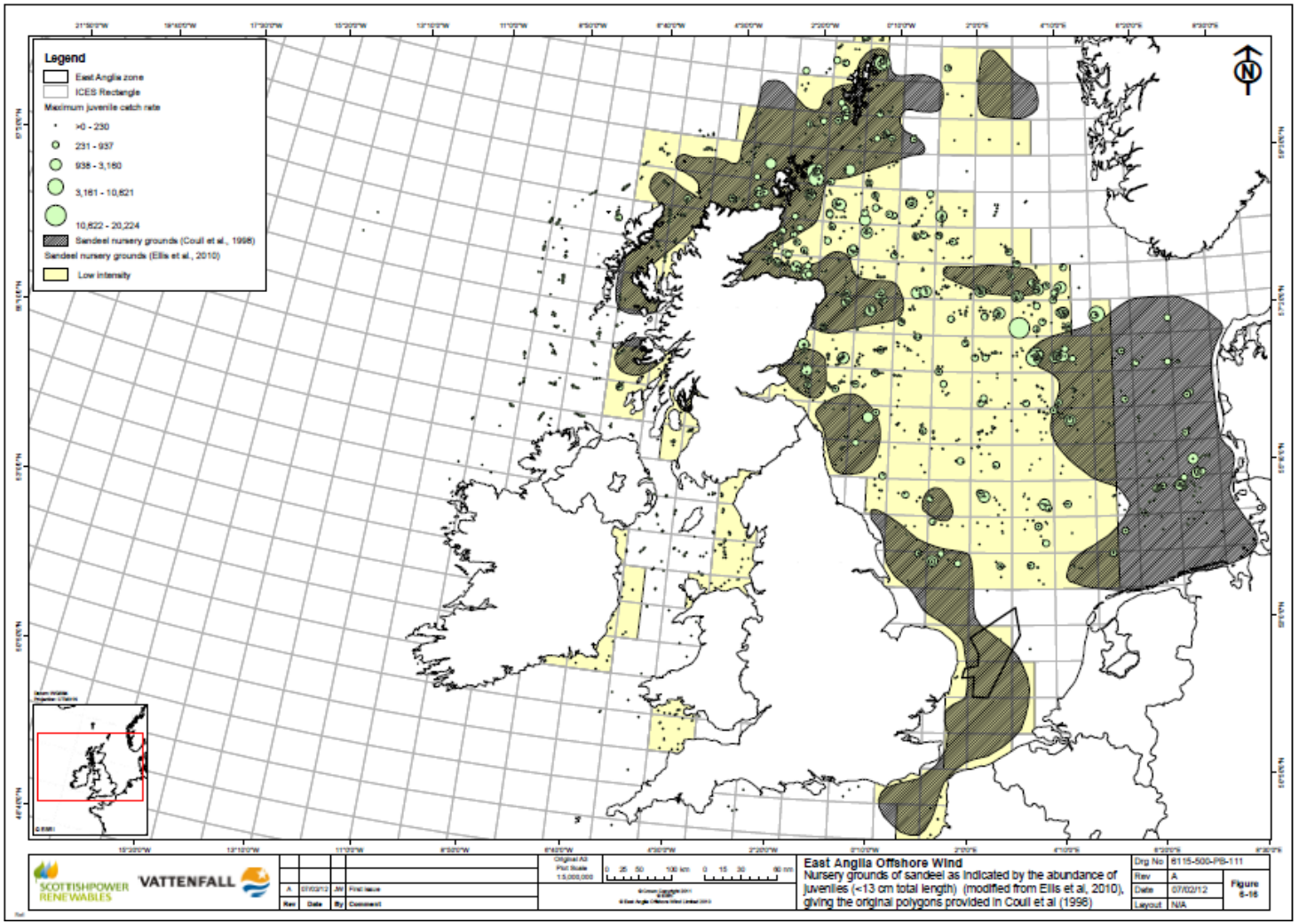


Figure 2 Nursery grounds of sandeel as indicated by the abundance of juveniles <13cm total length (modified from Ellis et al. 2010)

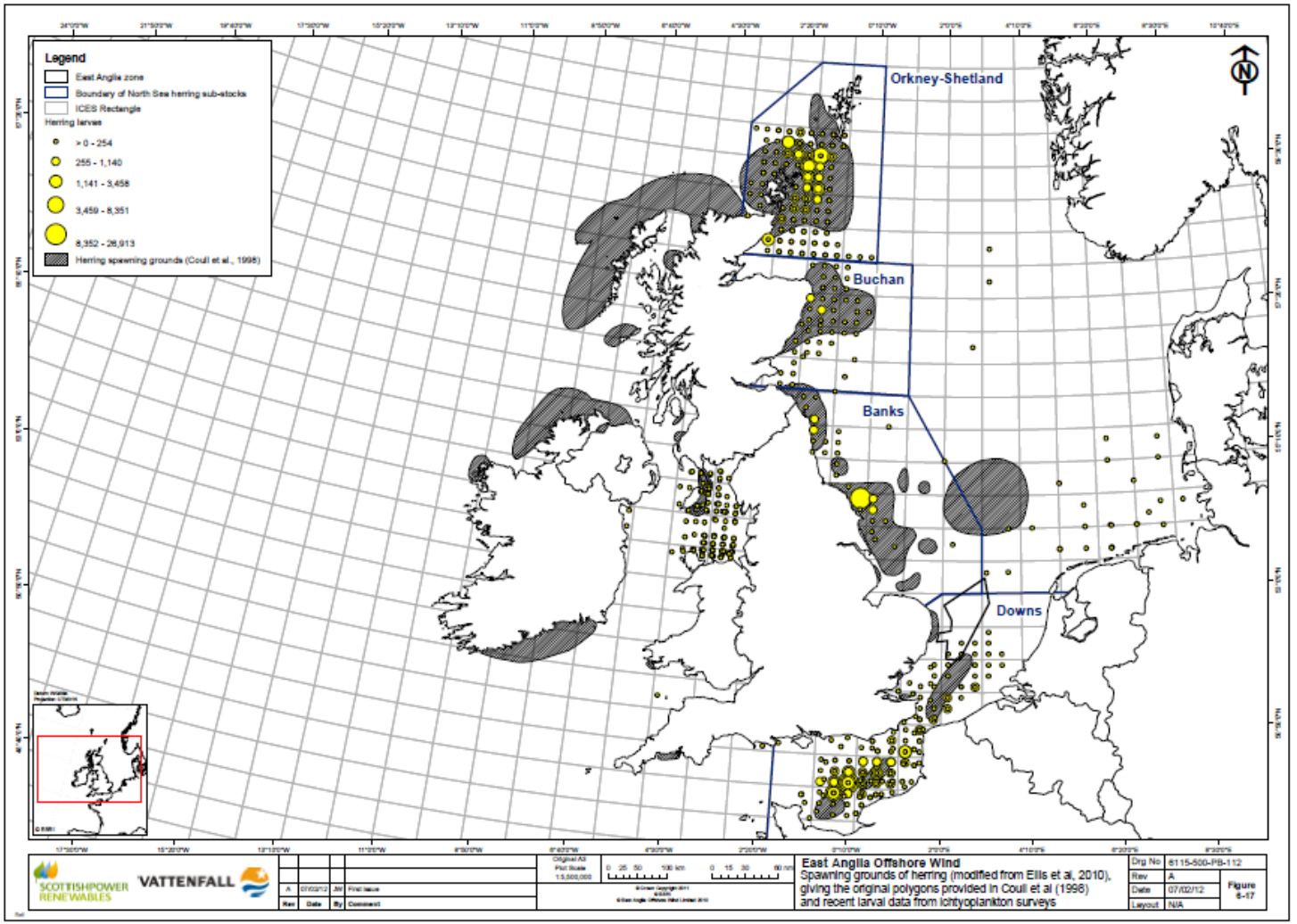


Figure 3 Spawning grounds of herring (modified from Ellis et al. 2010) and recent larval data from ichthyoplankton surveys

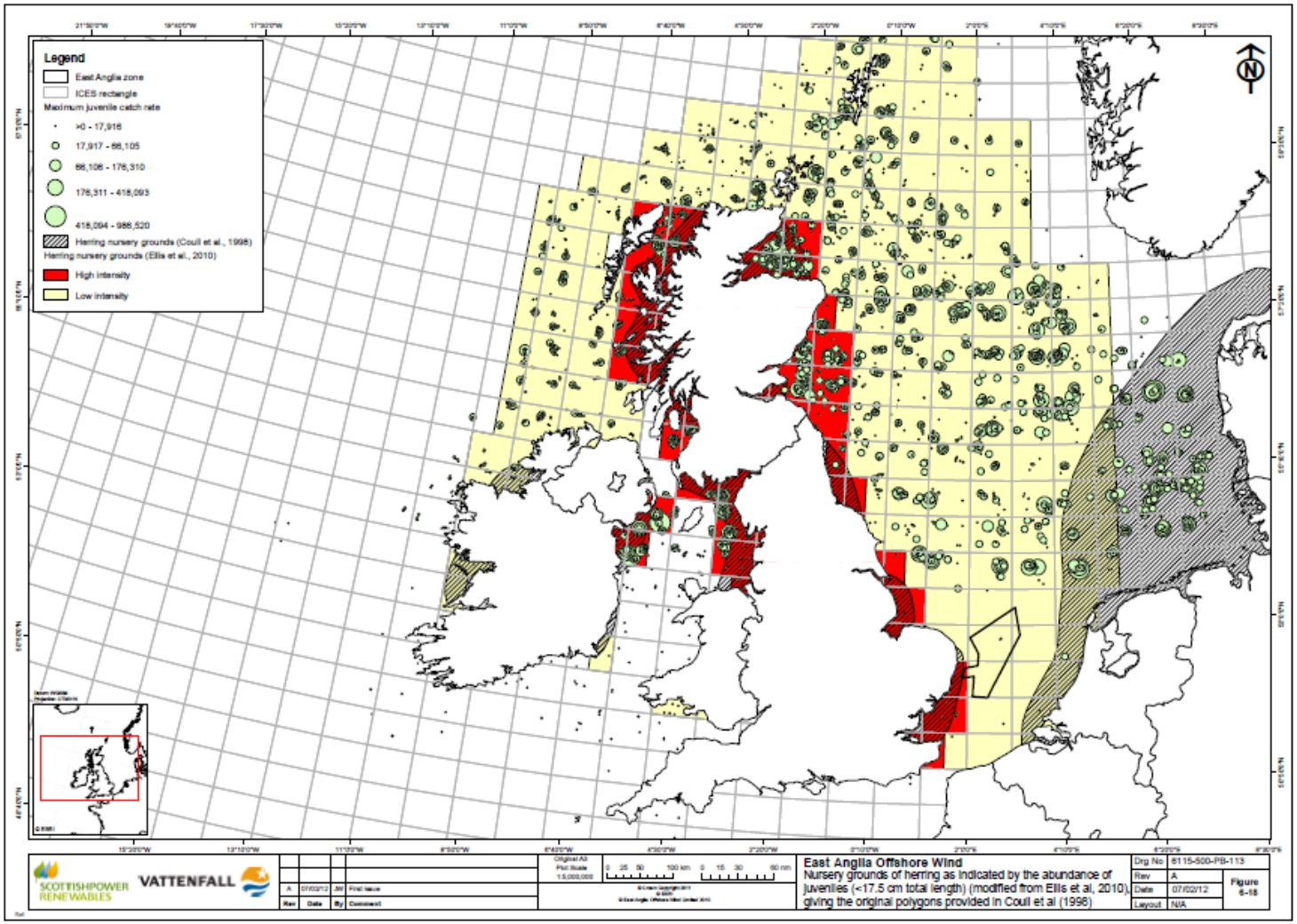


Figure 4 Nursery grounds of herring as indicated by the abundance of juveniles <17.5cm total length (modified from Ellis et al. 2010)

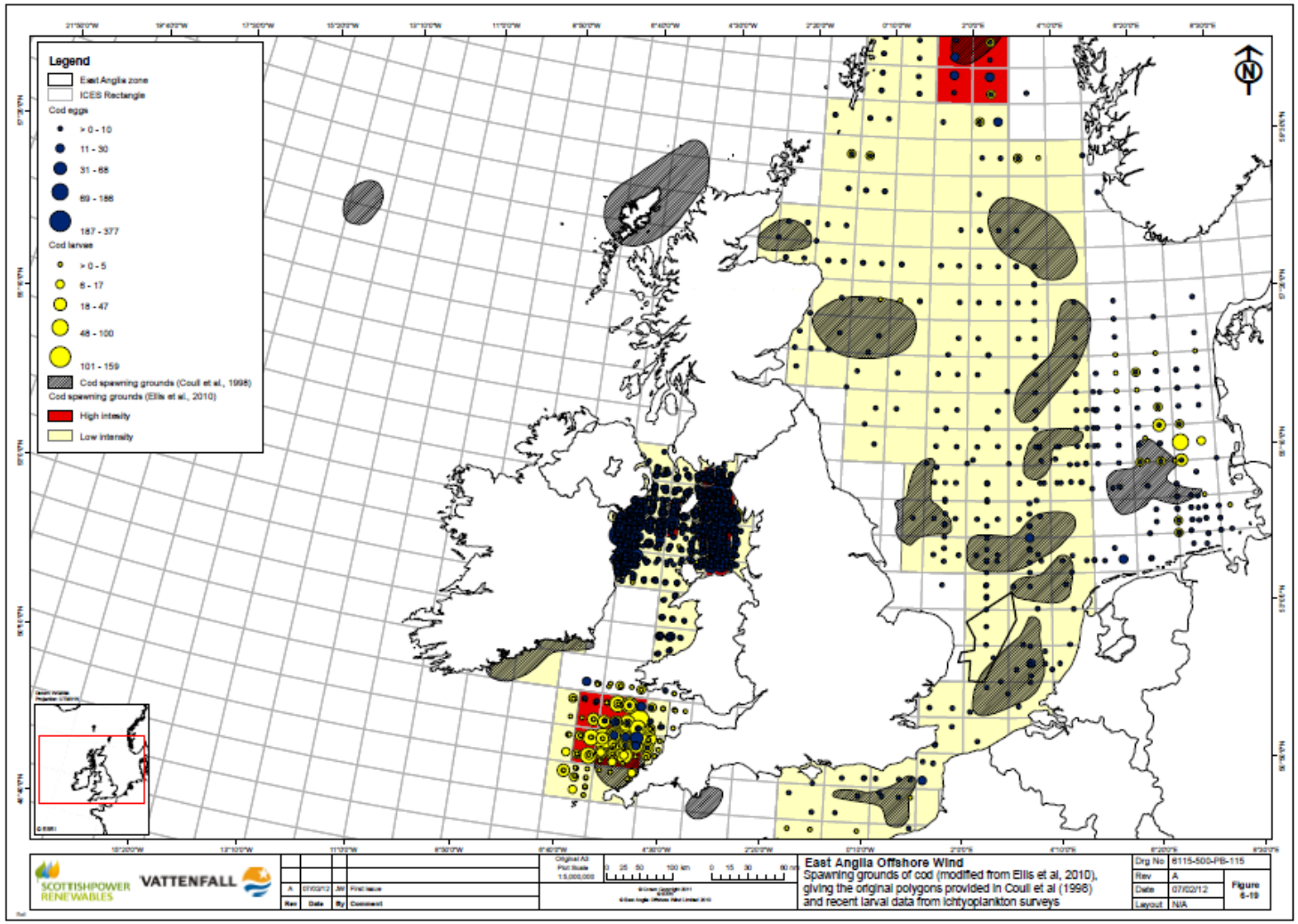


Figure 5 Spawning grounds of cod (modified from Ellis et al. 2010) and recent larval data from ichthyoplankton surveys

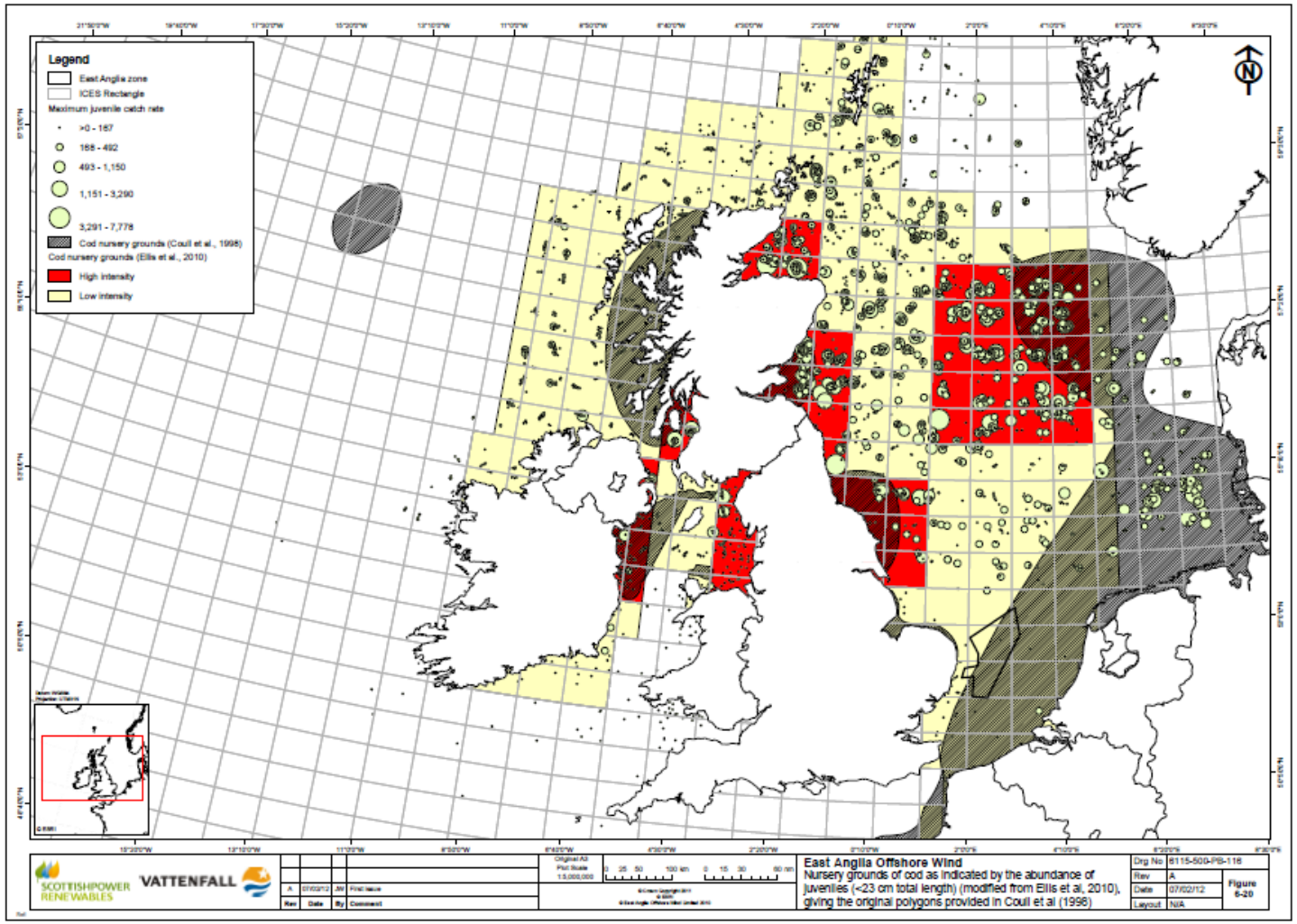


Figure 6 Nursery grounds of cod as indicated by the abundance of juveniles <23cm total length (modified from Ellis et al. 2010)

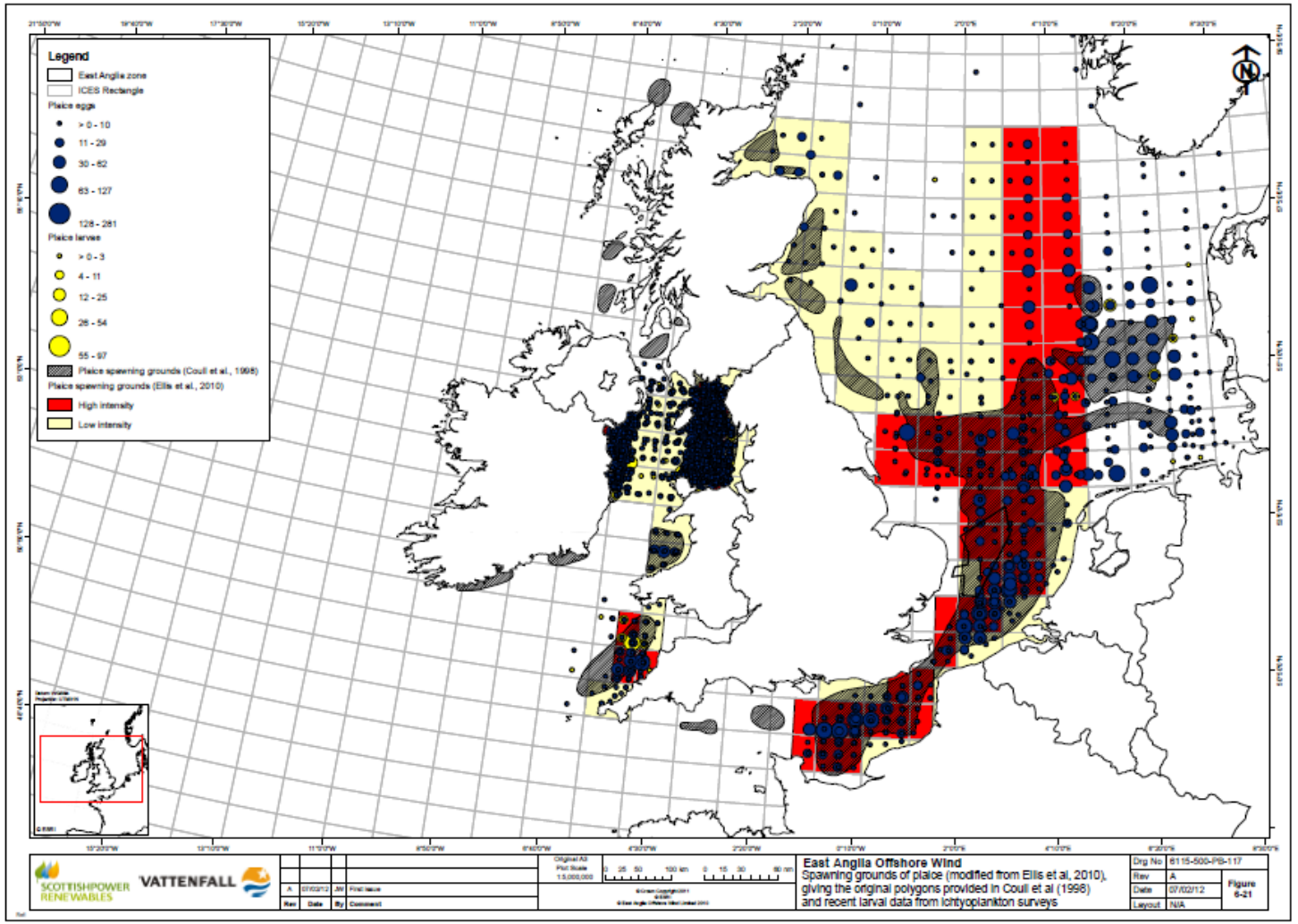


Figure 7 Spawning grounds of plaice (modified from Ellis et al. 2010) and recent larval data from ichthyoplankton surveys

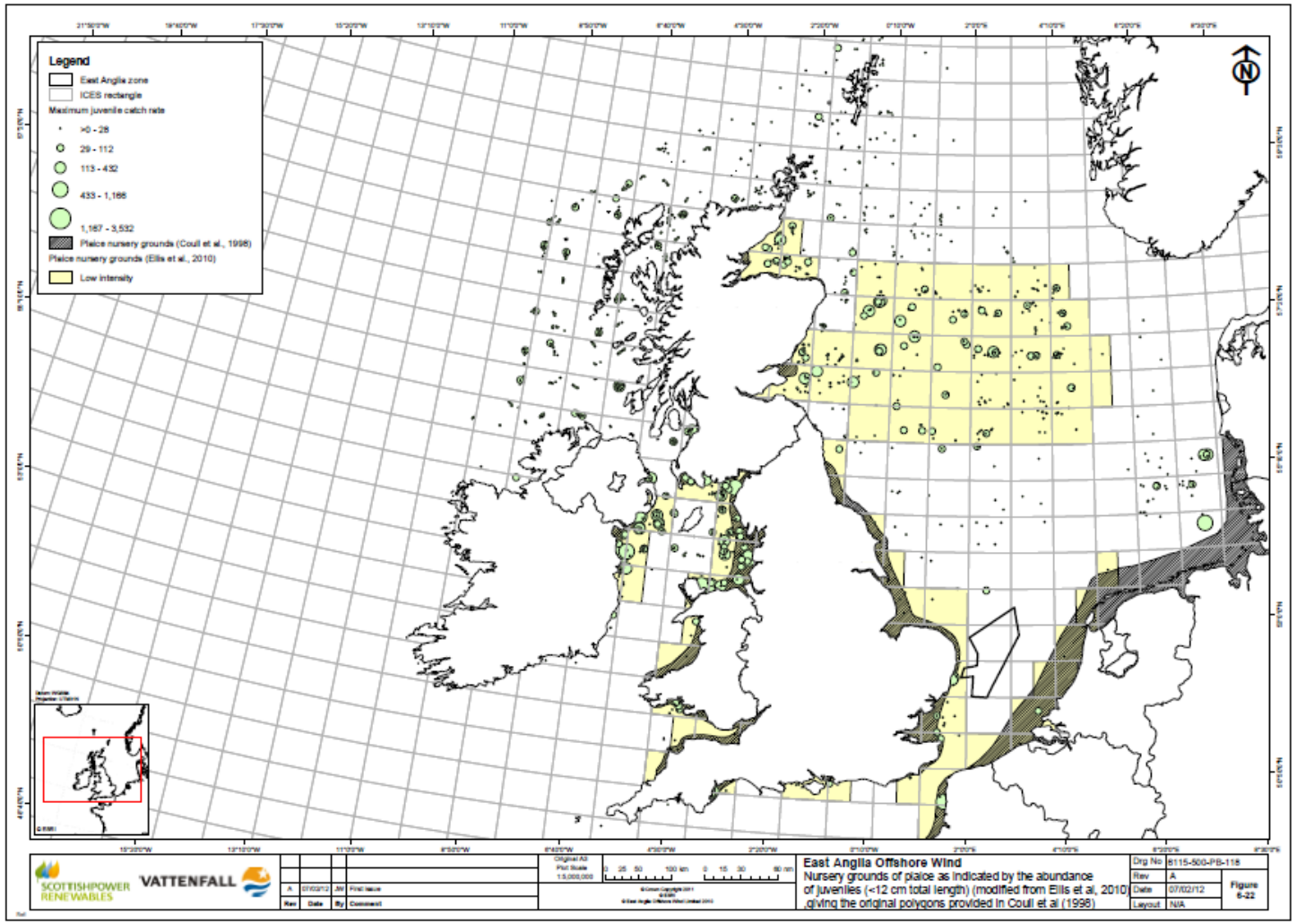


Figure 8 Nursery grounds of plaice as indicated by the abundance of juveniles <12cm total length (modified from Ellis et al. 2010)

2.2 Shellfish

11. Shellfish landings within the East Anglia Zone are comparatively low in a national context, constituting approximately 2.1% of landings by weight, with the majority consisting of edible crab *Cancer pagurus*. The shellfish reported in ICES rectangles covering the East Anglia Zone are presented in Table 4.

Table 4 Shellfish reported in ICES rectangles covering the East Anglia Zone (MMO, 2011).

List of Shellfish Species Landed from the Study Area by ICES Rectangle (MMO, 2011)							
Species		**Presence within ICES Rectangles**					
Common Name	**Scientific Name**	**33F1**	**33F2**	**34F2**	**34F3**	**35F2**	**35F3**
Crustaceans							
Brown Shrimp	*Crangon crangon*	✓	-	✓	-	-	-
Common Prawn	*Palaemon serratus*	✓	-	-	-	-	✓
Velvet Crab	*Necora puber*	✓	-	-	-	-	-
Edible Crab	*Cancer pagurus*	✓	✓	✓	✓	✓	✓
Crawfish	*Palinurus spp.*	✓	-	-	-	-	-
Green Crab	*Carcinus maenas*	✓	-	-	-	-	-
Squat Lobster	*Galatheoidea spp.*	-	✓	-	-	-	-
Lobster	*Homarus gammarus*	✓	✓	✓	✓	✓	✓
Nephrops	*Nephrops norvegicus*	✓	✓	✓	✓	✓	✓
Spider crab	*Majidae spp.*	✓	✓	-	-	✓	-
Molluscs and Bivalves							
Queen Scallop	*Aequipecten opercularis*	✓	-	✓	-	✓	-
King Scallop	*Pecten maximus*	✓	✓	✓	-	-	-
Cephalopods							
Cuttlefish	*Sepiida spp.*	✓	✓	✓	✓	✓	✓
Octopus	*Octopoda spp.*	✓	✓	✓	-	✓	-
Squid	*Teuthida spp.*	✓	✓	✓	✓	✓	✓
Gastropods							
Whelks	*Buccinum undatum*	✓	✓	✓	✓	✓	✓

3 APPROACH TO ASESSMENT

12. In accordance with the Cefas (2004) guidance the assessment phase of the EIA will consider the following aspects for fish and shellfish resources:

- Spawning grounds
- Nursery grounds
- Feeding grounds
- Shellfish production areas
- Overwintering areas for crustaceans (e.g. lobster and crab)
- Migration routes
- Conservation Interest
- Importance in the food web
- Relative commercial importance

3.1 Baseline information to inform the assessment

13. The principle sources of data and information to inform the PEI include (though not limited to):

- MMO Landings data (weight and value) by species 2002-2011 (*this data series may be updated depending on the timing of the release of data for 2012)*
- Spawning and nursery grounds of selected fish species in UK waters mapped by Coull et al 1998 and revised by Ellis et al 2012);
- North Sea International Bottom Trawl Survey Data (IBTS)
- English 3rd quarter North Sea Groundfish Survey Data
- IMARES monthly ichthyoplankton surveys in the Southern North Sea April 2010-March 2011 (van Damme et al. 2011)
- East Coast Regional Environmental Characterisation (REC) (Limpenny, 2011)
- Draft East Marine Plan documents, July 2013 (MMO, 2013)

- Reports, survey data and publications by organisations including Cefas, MMO, COWRIE, ICES, IFCA and Environment Agency
- MCZ recommendations – Net Gain and Natural England
- Other relevant peer-review publications and stock assessments

14. In addition, the fish and shellfish ecology assessment will be informed by the outcomes of the following ES Chapters -Chapter 7 Marine Geology, Oceanography and Physical Processes, Chapter 8 Marine Water and Sediment Quality, Chapter 9 Underwater Noise, Vibration and Electromagnetic fields, Chapter 10 Benthic Ecology and Chapter 14 Commercial Fisheries.

3.2 Site specific Fish Surveys (2013)

EAOW commissioned a site specific fish survey programme to characterise the fish and shellfish assemblage in the area of East Anglia THREE and East Anglia FOUR. The survey approach was agreed with the MMO and Cefas (see Appendix 1) and sampling was conducted over two periods during February and May 2013. Survey details are summarised in Table 5. The location of the otter and beam trawl fish surveys are shown in Figures 9 -12.

Table 5 Fish and shellfish surveys carried out within East Anglia THREE and East Anglia FOUR Windfarm Sites.

Sample Type	East Anglia THREE	East Anglia FOUR
Otter Trawls	9 (6 within site 3 reference locations	9 (5 within site 3 reference locations)
Beam Trawls	8 (4 within site and 4 reference locations)	8 (5 within site and 3 reference locations)

15. **It is expected that the suitability of the data collected by EAOW for characterisation of the benthos in the EIA will be agreed in Expert Topic Group (ETG) meeting 1.**

3.3 Potential Impacts

16. The fish and shellfish species present across the zone will be identified using information from site specific offshore fish surveys, IBTS, 3rd quarter surveys and IMARES ichthyoplankton surveys, commercial fisheries landings data for the ICES rectangles and peer-review publications. Key receptors will be selected in consultation with the MMO, Cefas and fisheries stakeholders

17. A range of potential impacts on fish and shellfish ecology (as described in the following sections) will be assessed separately for each of the construction, operation and decommissioning phases.

18. The sensitivity of fish and shellfish receptors to potential impacts will be informed by reference to the work of the Marine Life Information network (MarLIN), reference to monitoring results from operational offshore windfarms, peer-review publications and the findings from industry-wide studies (e.g. COWRIE funded research such as those on EMF and piling noise impacts).

19. The significance of each impact on fish and shellfish receptors, where appropriate, will be expressed in terms of the impact at a species population level. Where it is not possible to quantify impacts, and where a qualitative or semi-qualitative assessment is made, the assessment will set out the logical and robust evidence to support the assessment.

20. **It is expected that the list of potential impacts and methodologies for assessment used in the EIA will be agreed in ETG meeting 1.**

21. **It is expected that the initial impact assessment will be discussed and agreed (as far as possible) in ETG meeting 2.**

22. **It is expected that the impact assessment and any mitigation required will be discussed and agreed (as far as possible) in ETG meeting 3.**

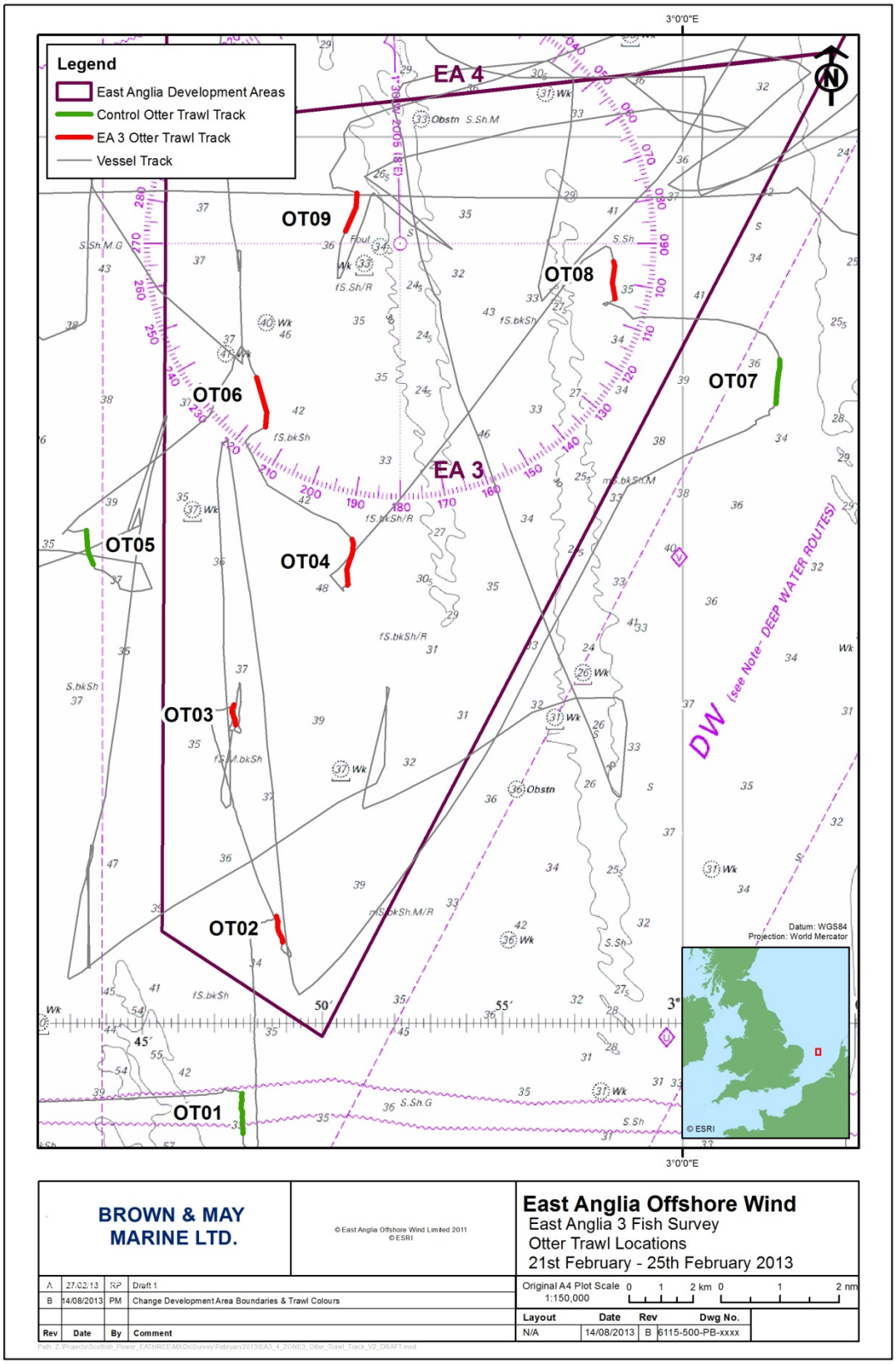


Figure 9 The location of Otter trawl sites for the fish and shellfish characterisation surveys in East Anglia THREE.

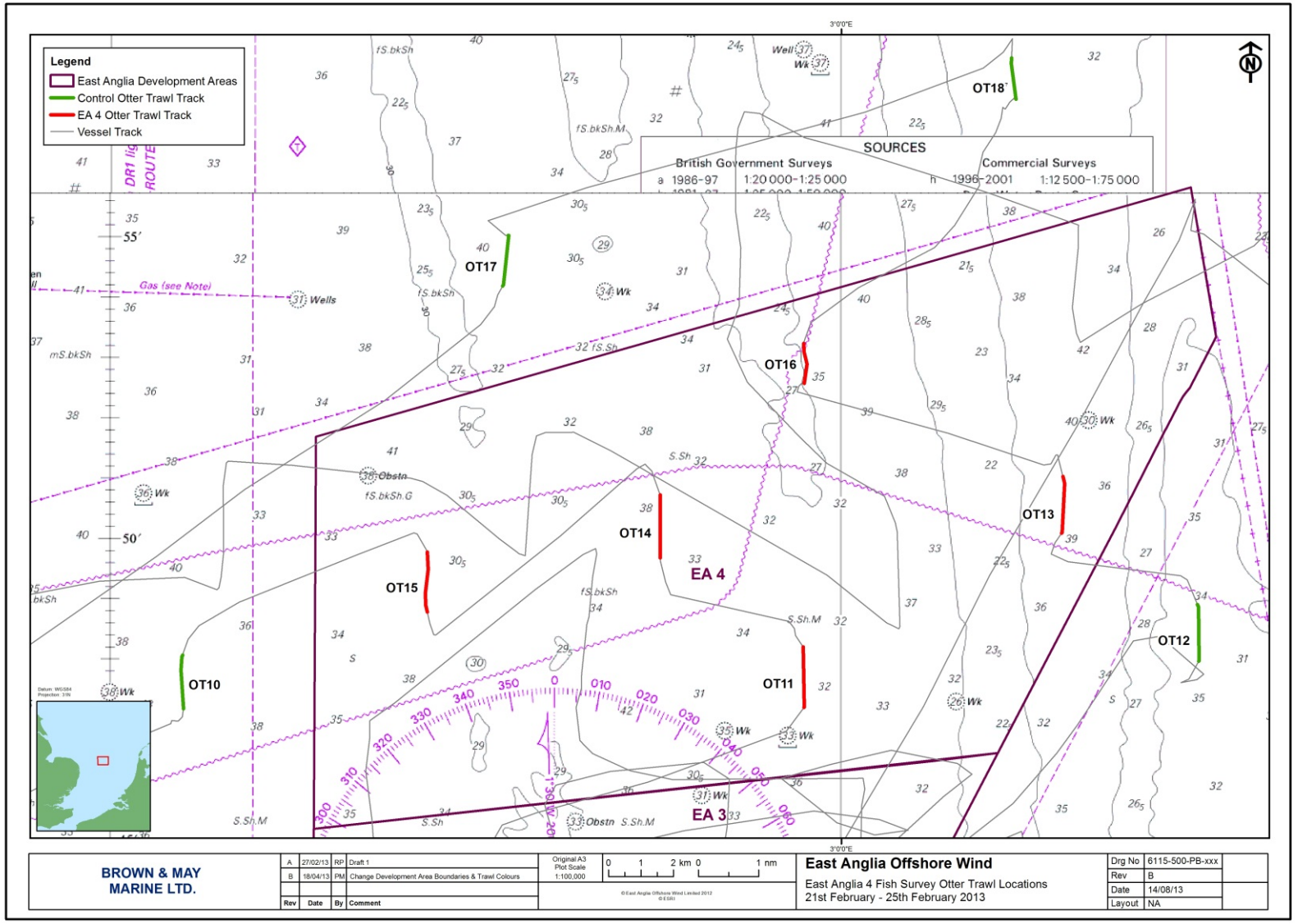


Figure 10 The location of Otter trawl sites for the fish and shellfish characterisation surveys in East Anglia FOUR.

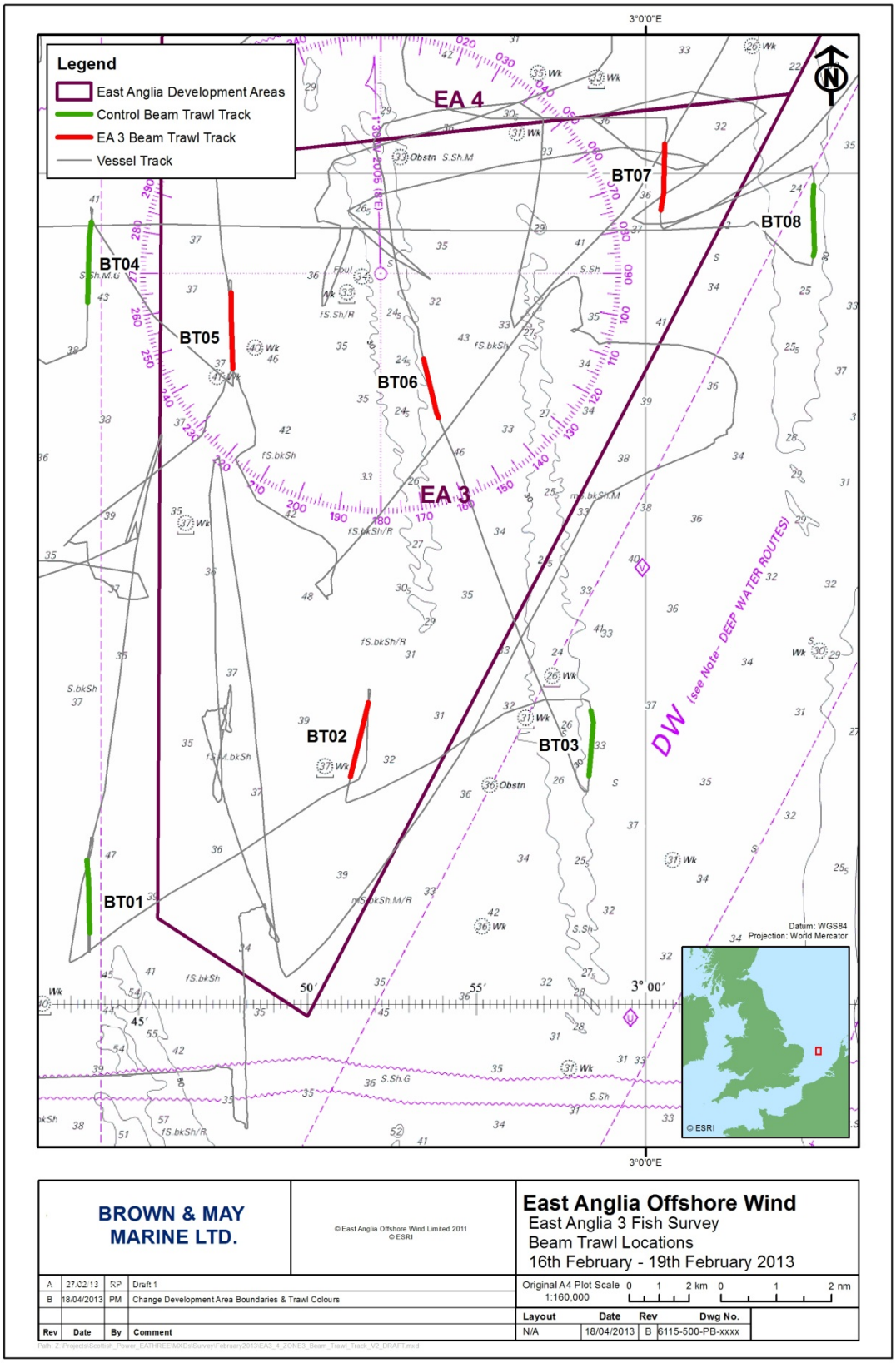


Figure 11 The location of Beam trawl sites for the fish and shellfish characterisation surveys in East Anglia THREE.

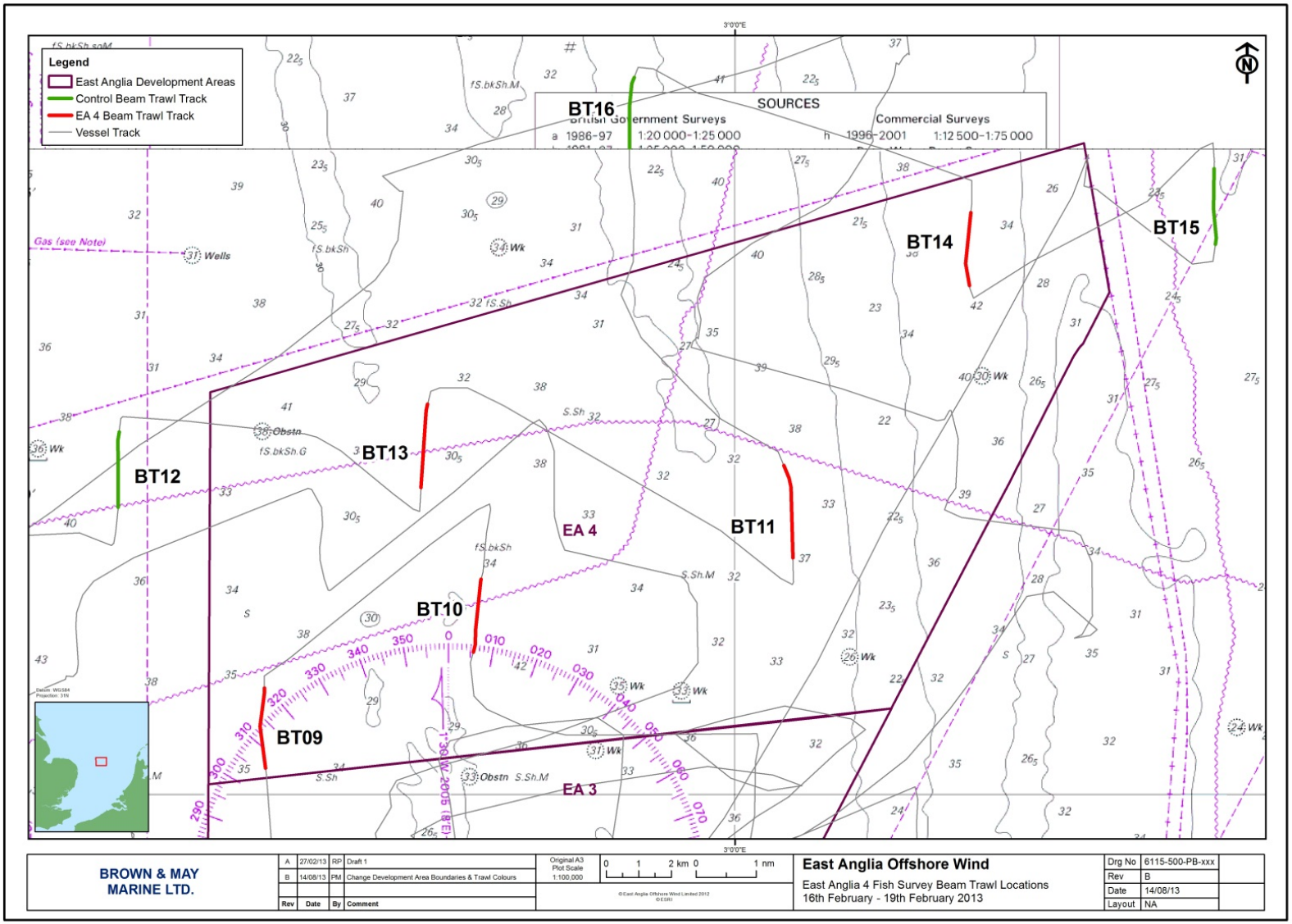


Figure 12 The location of Beam trawl sites for the fish and shellfish characterisation surveys in East Anglia FOUR

3.3.1 Potential impacts during construction

3.3.1.1 Physical disturbance

23. There is potential for direct physical disturbance of the sea bed during construction from the installation of cables foundations (through placement of jack up barge legs, spud cans and anchors/chains) and sea bed preparation (dredging). These construction phase activities have the potential to impact fish and shellfish species including species for which spawning or nursery grounds have been defined as well as those with designated conservation status. Disturbance at any particular time during the construction period will be of limited extent and duration.

3.3.1.1.1 Proposed method for assessment

- The area of impact from physical disturbance and proportion of the population affected will be assessed using a worst case scenario for the construction activities identified.
- Sensitivities will be informed by available literature including the assessments available on MarLIN. Assessments of sensitive species and species with conservation status are guided by review of available literature including Strategic Environmental Assessments (SEAs) (including Rogers and Stocks, 2001).
- Assessments to spawning and nursery grounds are guided by the known spawning and nursery habitats mapped by Coull et al, (1998) and updated by Ellis et al, (2012).
- Magnitude will be assessed based on the information presented in Chapter 7 Marine Geology, Oceanography and Physical Processes, Chapter 8 Marine Water and Sediment Quality and Chapter 10 Benthic Ecology. The level of impact will be quantified by calculating the maximum area of disturbance as a percentage of the total available habitat, spawning or nursery area within East Anglia THREE and EAST Anglia FOUR according to the worst case scenario.

3.3.1.2 Increased suspended sediments and sediment redeposition

24. Construction activities have the potential to cause mobilisation of sediments in the water column and an increase in suspended sediment concentrations (SSC). Sensitive species may react to this through physical or reproductive decline or it may impact upon migration or spawning behaviour.

3.3.1.2.1 Proposed method for assessment

- The magnitude of the potential impact will be based upon the outcomes of Chapter 7 Marine Geology, Oceanography and Physical Processes and Chapter 8 Marine Water and Sediment Quality. The magnitude of the effect of sediment smothering on fish and shellfish receptors will be considered in terms

of a worst case scenario (i.e. maximum area impacted, the maximum duration of smothering and the maximum thickness of deposited material).

- Sensitivities will be informed by available literature including the assessments available on MarLIN and peer-review publications.
- Impacts will be assessed in relation to background SSC levels and natural variations arising from storm events and seasonal changes.

3.3.1.3 Re-mobilisation of contaminated sediments

25. Sediment disturbance and subsequent deposition could lead to the mobilisation of contaminants contained in those sediments which are potentially harmful to fish and shellfish species.

3.3.1.3.1 Proposed method for assessment

- The magnitude of the potential impact will be based upon the outcomes of Chapter 8 Marine Water and Sediment Quality. The level of magnitude will be assessed based on the maximum levels of contamination within the sites and export cable routes and the maximum amount of sediment disturbance that will occur during construction.
- Assessment of sensitivities of fish and shellfish species to contaminants will be informed by review of available literature including the assessments available on MarLIN and peer-review publications.

3.3.1.4 Underwater Noise

26. Potential sources of underwater noise include piling, vessel traffic, sea bed preparation, rock dumping and cable installation. Of these, piling noise is considered have the greatest environmental impact (Nedwell et al, 2007, Lindeboom et al, 2011).

27. Noise from piling during construction (particularly for installation of monopiles) has the potential to cause significant impacts to fish and shellfish species ranging from lethal trauma to behavioural changes in susceptible fish species.

3.3.1.4.1 Proposed method for assessment

- The potential for disturbance to spawning/nursery for fish and shellfish receptors will be assessed in relation to the available data on defined spawning locations and the timing and duration of the noise generated by piling events.
- The qualification of the magnitude of this impact will be guided by both the results of noise assessments and the findings of the ES chapter that will assess the impacts of underwater noise (Chapter 9 Underwater noise, vibration and EMF).

- Assessment of sensitivities of fish and shellfish species to underwater noise will be informed by available literature including the assessments available on MarLIN and peer-review publications.

3.3.1.5 Temporary loss of sea bed habitat

28. The installation of wind turbine foundations will result in the temporary loss of some areas of natural fish and shellfish habitat during the construction phase. The temporal and spatial extent the effect will be limited and (with the possible exception of sandeels).

It is proposed that habitat loss during construction is assessed together with the physical disturbance impact.

3.3.1.5.1 Proposed method for assessment:

- Information generated as part of the coastal processes assessment and calculations based on the design parameters will be used to quantify the magnitude of the impact, these will include: The maximum sea bed area affected by sea bed preparation for foundations and export, interconnecting, and inter-array cables/platform/project cable installation.

- Levels of sensitivities of fish and shellfish receptors will be informed by available literature including the assessments available on MarLIN and peer-review publications.

- The assessment will be informed by results from monitoring at operational offshore windfarms to review recoverability e.g. Jensen et al, 2006.

3.3.1.6 Introduction of wind turbine foundations, scour protection and hard substrate.

29. The presence of windfarm infrastructure (including wind turbine towers and foundations, scour protection and cable protection) are expected to create new habitats within the windfarm colonised by a range of species with potential to increase biodiversity. The increased structural complexity from the introduced infrastructure may also provide habitat or foraging opportunities for mobile species and provide a refuge for fish and shellfish species (Hoffman et al, 2000). Results from monitoring at other sites suggest that there are no gross changes in local fish communities as a result operational windfarms (Leonhard and Pedersen 2005, Jensen et al 2006).

3.3.1.6.1 Proposed method for assessment

- The level of magnitude of the impact will be informed by the outcomes of monitoring studies at other offshore wind developments including studies of short term effects of Dutch windfarms (Lindeboom et al. 2011), the monitoring programme at Kentish flats (OES,2009) and studies at the Danish Horns Rev windfarm (Jensen, 2006).

- There is uncertainty as to whether artificial reefs facilitate recruitment in the local population, or whether the effects are simply a result of concentrating biomass from surrounding areas (Inger et al., 2009). The level of sensitivity assigned to fish and shellfish receptors will reflect the potential of the receptor to colonise or aggregate in the vicinity of introduced artificial structures.

- Assessment of sensitivities of fish and shellfish species to loss of habitat will be informed by available literature including the assessments available on MarLIN and peer-review publications.

- The impact on key receptors will be considered at the local and population level.

3.3.2 Potential impacts during operation

30. Monitoring studies conducted at operational wind farms indicate that perceived changes recorded are difficult to distinguish from expected natural variation (Judd, 2009, Vattenfall, 2009, Lindeboom et al, 2011). Whilst monitoring studies have been conducted over relatively short periods, the lack of evidence of gross changes to the fish and shellfish community at operational windfarms should be borne in mind when considering potential operational impacts.

3.3.2.1 Permanent loss of habitat:

31. The construction of the windfarm will lead to a permanent loss of habitat in the footprint of foundations and potential area of cable protection. There may also be some loss of habitat over time associated with scour around foundations or if cable protection employed during operation.

3.3.2.1.1 Proposed method for assessment

- The ZEA provides known size of area of each habitat type across the East Anglia Zone which can also be augmented by the 2013 survey data and applied to the specific sites.

- Calculations of the entire footprint of the project will be made using a worst case scenario for:

  a. Foundations (of wind turbines, collector stations, convertor stations, vessel moorings and met masts)
  b. Scour protection
  c. Cable protection (including cable crossings)

- The magnitude of the impact will be quantified by calculating the footprint as a percentage of each habitat, nursery or spawning area within East Anglia THREE

and East Anglia FOUR that would be lost if the entire windfarm were to be built within each habitat (worst case scenario).

- Assessment of sensitivities of fish and shellfish species to loss of habitat will be informed by available literature including the assessments available on MarLIN and peer-review publications.
- The impact on key receptors will be considered at the local and population level.

It is recognised that the proposed calculations will present an unrealistic worst case scenario which may lead to exaggerated percentage take figures, however this is the logical way of ensuring that the absolute worst case scenario is considered.

3.3.2.2 Increased suspended sediments and sediment redeposition:

32. Routine maintenance (discussed above) may increase SSC levels, however this will be localised and temporary and it is anticipated that overall impacts will be lower than for construction.

3.3.2.2.1 Proposed method for assessment

- The information generated by the physical processes chapters will be used to determine the magnitude of sediment redeposition both in terms of the area impacted and the thickness of deposited material.
- Assessment of sensitivities of fish and shellfish species will be informed by available literature including the assessments available on MarLIN and peer-review publications.
- The impact on key receptors will be considered at the local and population level.

3.3.2.3 Operational Noise:

33. Potential sources of operational noise include vessel movements and wind turbine operation.

34. Operational wind turbines will produce noise and vibration which will be transmitted into the sea bed and water column (Nedwell et al, 2007). Measurements made at four operational windfarms (North Hoyle, Scroby Sands, Kentish Flats and Barrow) indicate that operational noise is likely to only be a few decibels above background noise within the windfarm, significantly lower in magnitude than noise produced by other activities such as dredging (CMACS 2003, Nedwell et al, 2007). Although in these examples, wind turbines were smaller than those envisaged for East Anglia THREE and East Anglia FOUR.

3.3.2.3.1 Proposed method for assessment

- The qualification of the magnitude of this impact will be guided by both the results of noise assessments and the findings of Chapter 9 Underwater noise, vibration and EMF.
- Assessment of sensitivities of fish and shellfish species to underwater noise will be informed by available literature including the assessments available on MarLIN and peer-review publications.
- The impact on key receptors will be considered at the local and population level.

3.3.2.4 Electromagnetic fields (EMF):

35. Some species of fish, such as elasmobranchs and cod, which utilise electromagnetic fields for activities such as hunting prey and navigation are potentially vulnerable to anthropogenic sources of EMF. To date, research on the potential effects of EMF on fish and shellfish has been inconclusive (Gill et al, 2009). As part of literature review to identify potential EMF impacts for East Anglia ONE, CMACS (2012) concluded that any impacts would be limited to within a few metres of the cables and therefore would not be significant.

3.3.2.4.1 Proposed method for assessment

- The level of magnitude will be informed by the design specifications of the East Anglia THREE and East Anglia FOUR sub-sea cables.
- Assessment of sensitivities of fish and shellfish species to EMF will be informed by available literature including the assessments available on MarLIN and peer-review publications.
- The impact on key receptors will be considered at the local and population level.

3.3.2.5 Changes in Fishing Activity

36. During the operational phase of East Anglia ONE, fishing activities (including trawling and potting) may be excluded from part of or the entire offshore windfarm site. This has the potential to enhance fish and shellfish populations by providing refuge from fishing activities for certain species targeted by commercial fisheries in the southern North Sea. Alternatively, the effect may result in increased fishing pressure outside the windfarm site.

3.3.2.5.1 Proposed method for assessment

- For the purpose of this assessment it is assumed that all fishing activity will be excluded from the area of East Anglia THREE and East Anglia FOUR for the

lifetime of the project (although it should be noted that this is likely to be over-precautionary).

- The magnitude of the effect and the level of sensitivity of the receptors will be based on the outcomes of the Chapter 14 Commercial fisheries.

3.3.3 Potential impacts during decommissioning

37. During decommissioning the potential impacts are anticipated to be similar to those described above for the construction phase although on a smaller scale, for example noise impacts will be lower (as there will be no piling) and if the cables are left in situ, there will be less sea bed disturbance.

3.3.3.1.1 Proposed method for assessment

- The methods used for assessing the impacts during decommissioning will be very similar to those used during the construction phase. The operations involved will be slightly different, however it is anticipated that the magnitude of the impacts will generally be less. Each of the impacts considered for the construction phase will be assessed for the decommissioning phase.

3.3.4 Potential cumulative impacts

38. Many of the potential cumulative impacts of offshore windfarms in the Southern North Sea will be temporary, small scale and localised. Considering the recoverability of fish and shellfish receptors in the area, the cumulative impact of permanent loss of habitat during the operational phase of East Anglia windfarms and other offshore windfarms is not anticipated to be significant.

39. However, underwater noise could have cumulative impacts spatially (if two or more piling operations are undertaken simultaneously) or temporally (if piling operations are happening consecutively) with the potential for displacement impacts across the southern North Sea, noise 'barriers' blocking migration routes or consecutive piling programmes displacing sensitive fish from large areas for sustained periods. Noise modelling will be undertaken for the East Anglia THREE and East Anglia FOUR projects in isolation and cumulatively with other potential projects within the East Anglia Zone for sensitive fish species of relevance to the area. Furthermore, consideration will be given to the potential cumulative impacts from other developments in the southern North Sea.

40. The cables from East Anglia ONE, East Anglia THREE and East Anglia FOUR will cross the cables from the Greater Gabbard and Galloper offshore windfarms. Depending on the method by which these cable crossings are protected there is potential for cumulative impacts including physical disturbance and temporary habitat loss during the construction phase, in addition to permanent habitat loss and colonisation of artificial structures during the operation phase.

3.3.5 Other activities

41. There is the potential for cumulative impacts from other activities occurring in the region, these include aggregate dredging, shipping and oil and gas exploration and development. Whilst it is not considered likely that there will be significant cumulative impacts, all potential impacts (from those listed for East Anglia THREE and East Anglia FOUR projects in isolation) will be assessed as part of the EIA.

3.3.6 Transboundary impacts

42. Given the level of development in the southern North Sea in other EU Member States waters there is potential for transboundary impacts especially with regard to noise and given that populations of fish may be highly mobile.

43. The noise modelling for East Anglia ONE indicated that given the distance between site and other developments there would be no spatial overlap in terms of the likely underwater noise impact zones (EAOW, 2012b). However, as discussed above, there is still potential for cumulative displacement or migration barrier impacts from noise. Given the international nature of fisheries, there is potential for indirect transboundary impacts if commercial fish species are impacted. Potential transboundary impacts will be assessed as with the other cumulative impacts and EAOW, where possible, will liaise with developers in other Member States to get up to date project information to feed into the assessment.

4 EVIDENCE PLAN PROGRAMME AND STRATEGY

Date	Event
10th September 2013	Fish and Shellfish ETG meeting 1 Project Introduction Evidence Plan Process Baseline Methods Cumulative Assessment Statement of Common Ground (SoCG)
October/ November 2013	Project design available
November /December 2013	HRA screening
February 2014	Fish and Shellfish ETG meeting 2 Draft PEI workshop Impact assessment Thresholds, significance SoCG
April 2014	HRA draft report EA 3 & EA4
May 2014	**PEI submission (draft ES) EA 3 & EA4**
August 2014	HRA final report EA 3
Summer 2014	Fish and Shellfish ETG meeting 3 PEI feedback DCO conditions Mitigation and monitoring SoCG
November 2014	**DCO application EA 3**
Spring 2015	**DCO application EA 4**

5 REFERENCES

Centre for Marine and Coastal Studies (CMACS) (2003) A baseline assessment of electromagnetic fields generated by offshore wind farm cables.

Centre for Marine and Coastal Studies (CMACS) (2012) East Anglia One Offshore Wind Farm: electromagnetic field environmental appraisal Assessment of EMF effects on sub tidal marine ecology.

Coull, K.A., Johnstone, R. and Rogers, S.I. (1998) Fisheries Sensitivity Maps in British Waters, Published and Distributed by UKOOA Ltd, Aberdeen, pp. 63

COWRIE (2003) A baseline assessment of electromagnetic fields generated by offshore wind farm cables. CMACS/University of Liverpool & Econnect/J2733/Final_v1/07-2003.

East Anglia Offshore Wind (EAOW) (2012a) East Anglia Offshore Wind Zonal Environmental Appraisal Report March 2012

East Anglia Offshore Wind (EAOW) (2012b) East Anglia ONE Offshore Wind farm Draft Environmental Statement

Ellis, J.R., Milligan, S.P., Readdy, L., South, A., Taylor, N. and Brown, M.J. (2010) MB5301 Mapping spawning and nursery areas of species to be considered in Marine Protected Areas (Marine Conservation Zones). Report No 1: Final Report on development of derived data layers for 40 mobile species considered to be of conservation importance. Cefas Lowestoft, 89 pp.

Ellis, J.R., Milligan, S.P., Readdy, L., Taylor, N. and Brown, M.J. (2012) Spawning and nursery grounds of selected fish species in UK waters. Sci. Ser.Tech.Rep., Cefas Lowestoft, 147:56pp.

Gill, A. B., Huang, Y., Gloyne-Philips, I., Metcalfe, J., Quayle, V., Spencer, J. & Wearmouth, V. (2009). COWRIE 2.0 Electromagnetic Fields (EMF) Phase 2: EMF-sensitive fish response to EM emissions from sub-sea electricity cables of the type used by the offshore renewable energy industry. Commissioned by COWRIE Ltd (project reference COWRIE-EMF-1-06).

Hoffman, E., Astrup, J., Larsen, F. & Munch-Petersen, S. (2000) Effects of Marine Wind farms on the Distribution of Fish, Shellfish and Marine Mammals in the Horns Rev Area. Report to ELSAMPROJEKT A/S. Report No. Baggrundsrapport 24. Danish Institute for Fisheries Research, Lyngby, Denmark.

ICES (2010). Manual for the International Bottom Trawl Surveys –Revision VIII. The International Bottom Trawl Survey Working Group. ICES Copenhagen 69 pp.

IEEM (2010) Guidelines for Ecological Impact Assessment in Britain and Ireland - Marine and Coastal, Institute for Ecology and Environmental Management, Winchester, UK, 72pp.

Inger, R., Attril, M.J., Bearhop, S., Broderick, A.C., Grecian, W.J., Hodgson, D.J., Mills, C., Sheehan, E., Votier, S.C., Witt, M.J., and Godley, B.J. (2009) *Marine Renewable Energy: Potential Benefits to Biodiversity? An Urgent Call for Research*. Journal of Applied Ecology, 46, 1145-1153.

Jensen, B. A., Klaustrup, M. and Skov, H. (2006) EIA Report. Fish. Horns Rev 2 Offshore wind farm. Bioconsult.

Judd, A. (2009) Strategic Review of Offshore Wind Farm Monitoring Data Associated with FEPA Licence Conditions Fish

Leonhard, S.B., Stenberg, C. and Støttrup, J. *Eds.* (2011) Effect of the Horns Rev 1 Offshore Wind Farm on Fish Communities. Follow-up Seven Years after Construction. DTU Aqua, Orbicon, DHI, NaturFocus. Report commissioned by The Environmental Group through contract with Vattenfall Vindkraft A/S.

Limpenny, S.E., Barrio Froján, C., Cotterill, C., Foster-Smith, R.L., Pearce, B., Tizzard, L., Limpenny, D.L., Long, D., Walmsley, S., Kirby, S., Baker, K., Meadows, W.J., Rees, J., Hill, J., Wilson, C., Leivers, M., Churchley, S., Russell, J., Birchenough, A.C., Green, S.L., and Law, R.J. (2011) The East Coast Regional Environmental Characterisation. Cefas Open report 08/04. 287pp.

Lindeboom, H.J., Kouwenhoven ,H.J., Bergman M.J.N., Bouma, S., Brasseur,S., Daan, R., Fijn R.C., de Haan. D., Dirksen S., van Hal R., Hille Ris Lambers R., ter Hofstede. R, Krijgsveld K.L, Leopold M. and Scheidat (2011). Short-term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation. Environmental Research Letters 035101 (13pp)

Nedwell., J.R., Parvin, S.J., Edwards, B., Workman, R., Borkker, A.G. and Kynoch, J.E., (2007) Measurement and interpretation of underwater noise during construction and operation of offshore wind farms in UK waters. Subacoustech Report No. 544R0738 to COWRIE Ltd. ISBN: 978-0-9554279-5-4.

OES (Offshore Environmental Solutions) (2008). Kentish Flats Offshore Wind Farm. FEPA Monitoring Summary Report.

Rogers, S. and Stocks, R. 2001. North Sea Fish and Fisheries. Technical Report TR_003. Strategic Environmental Assessment-SEA2.

Vattenfall (2009). Kentish Flats Offshore Wind Farm FEPA Monitoring Summary Report. 2008 (Final).

APPENDIX 1: BENTHIC AND FISH SURVEY TERMS OF REFERENCE

EAOW THREE and FOUR Benthic And Fish Survey Terms Of Reference EAOW, CEFAS and MMO – Final			
Date of meeting:	31.07.12	Venue:	CEFAS - Lowestoft
Attendees:			

Name	Position	Organisation
Holly Drake (HD) Rebecca Walker (RW) Louise Cox (LC)	Case Officer EAOW Case Officer EAOW Fisheries Ecologist Benthic Ecologist	CEFAS CEFAS CEFAS
Paul Whomersley (PW)	Case Manager	CEFAS
Alan Gibson (AG) – by phone	Case Officer	MMO
Kathleen Mongan (KM) – by phone		MMO
Morna Cannon (MC) Martin Whyte (MW)	Assistant Project Manager Project Manager Assistant Project Manager	EAOW EAOW
Holly Wilson (HW) – by phone	Assistant Environment Manager	EAOW
Julia Bolton (JB) – by phone	Fisheries Consultant	EAOW
Stephen Appleby (SA) Victoria Allen (VA)	Senior Marine Ecologist	Brown and May APEM

Apologies: n/a

Discussion	Action
Agenda 1. **Introductions** 2. **Presentation of EAOW THREE and FOUR** 3. **Fish TOR** 4. **Benthic TOR** 5. **Next Steps**	
Introductions All persons in attendance and on the phone introduced themselves and their position in the respective organisations.	
Presentation of East Anglia Projects THREE and FOUR Morna Cannon gave a brief presentation introducing EAOW and the next two projects to be developed within the Zone East Anglia THREE and FOUR. Key things to note from the presentation were: EA THREE and FOUR are separate projects which will be subject to separate DCO applications. They will however be developed in tandem by one project development team led by Keith Morrison. The East Anglia TWO project is forthcoming and will enter the development phase shortly. This project will be subject to a further DCO and will be developed by a separate project development team. **Action 120731-1: Circulate presentation to all attendees.**	**MC/MW**

Fish TOR In general CEFAS confirmed the approach put forward for characterisation surveys was appropriate. CEFAS stressed the importance of getting good coverage and collecting information on all relevant species. Based on the sample locations put forward in the TOR it was agreed that Otter and Commercial Beam trawling would be carried out at alternating stations (i.e. one station Otter the other Beam and so on). For the Commercial Beam Trawling it was agreed that a 4m beam trawl with chain mat would be sufficient. The mesh size to be used for the beam trawl would be 80 mm. The Otter Trawl would utilise a 100 – 110mm mesh. The Commercial Beam Trawl would use a trawl with 80mm cod ends Trawl durations will be 20 minutes in the first instance. If too much is caught, then trawl durations will be reduced. If too little is caught then trawl durations will be increased. With respect to the timing of surveys it was agreed that surveys should take place in February and May in order to cover key periods. **Action 120731-2: CEFAS to confirm whether or not proposed timing is acceptable and that no autumn survey will be required. Subsequently completed.** Cefas subsequently clarified: *February and May surveys to assess and characterise fish ecology should be sufficient alongside 2m beam trawls (epibenthic trawls) in September that will sample juvenile and small bodies species. The combination of these three surveys should characterise the seasonal presence of fish assemblages and important commercial species and therefore negates the requirement for an autumnal fish ecology survey.* It was noted that the project areas are deemed to be too far out to cover herring spawning areas. It was also noted that sandeels are not likely to be an issue. It was agreed that specific fish surveys would not be carried out on the cable route. Instead any fish caught during epi-benthic trawling (see below) will be preserved, analysed and reported as part of the fisheries assessment.	**LC**
Benthic TOR CEFAS confirmed that the approach put forward in the TOR for both benthic and epi- benthic survey was acceptable for characterisation. CEFAS raised some queries regarding the statistical analysis and stated that they would like their statistician to review the report. This review would not prevent survey works commencing. EAOW offered to arrange a call with the contractor who provided the statistical analysis to answer any questions raised. **Action 120731-3: PW to send back comments on minor details of the statistical analysis via email. Subsequently completed.**	**PW**

Cefas request that a volume of grab sample rather than a depth measurement of the Hamon grab should be taken. Cefas noted that sampling outside of the planned cable route area, within the central shipping lane could be useful if H&S concerns can be overcome.	
Next Steps EAOW agreed to revise the Fish TOR based on the discussion and re-issue for approval. **Action 120731-4: EAOW to revise Fish TOR and resubmit for approval.** EAOW will proceed with the Benthic survey based on the TOR as presented. Any questions relating to the statistical analysis will be dealt with separately	**MC**

New and Outstanding Actions	
Action 120731-1: Circulate presentation to all attendees.	**MC/MW**
Action 120731-3: EAOW to revise Fish TOR and resubmit for approval.	**MC**

11.1.3 Minutes from First Fish and Shellfish Ecology Expert Topic Group Meeting

5. Provided below are the minutes from the first Fish and Shellfish Ecology ETG meeting which was held on the 10th September 2013.

EAOW Round 3 Offshore Programme East Anglia THREE & FOUR, Fish and Shellfish Ecology ETG Meeting 1			
Date of Meeting:	10.09.2013	**Venue:**	Tudor Street
Attendees			

Name	**Initials**	**Organisation**
Keith Morrison	KM	EAOW
Mandy Gloyer	MG	EAOW
Marcus Cross	MC	EOAW
Rebecca Walker	RW	Cefas
Louise Cox	LC	Cefas
Claire Ludgate	CL	Natural England
Paul Whomersley	PW	Cefas
Paolo Pizzolla	PP	Royal HaskoningDHV
David Tarrant	DT	Royal HaskoningDHV

Document Ref:		**Issue Date:**	11.09.2013

11:20-13:30

ITEM	DESCRIPTION	ACTION
1	HSE- trip hazards (bags and cables) in the room KM removed the hazards as far as possible - Safe travel	
2	KM gave an introduction, welcomed everyone to the evidence plan and thanked them for their participation.	
3	PP- Gave introduction to the evidence plan process- all agreed that we all have the same expectations for the process.	
4	CL asked what format would the SoCG. There was agreement that we will use the same format as East Anglia ONE. Aim for multi-party agreements but may need some single. MC made the point that it is equally important to find areas that we don't agree.	
5	PP – Timeline- Agreement that this seems sensible and that a workshop in the summer between PEI and submission would be useful.	Hold workshop in the summer

ITEM	DESCRIPTION	ACTION
	KM we are very driven by programme. PP we can give early sight of the chapters if it will be helpful. However RW, LC and CL are not interested unless it is complete. Next steering group meeting should be in October but will be organised by the MIEU. KM invited CL, LC and RW to feed back at the next steering group meeting.	2014 (TBC).
6	Survey data- it has been agreed that sufficient data has been collected. Inclusion of the beam trawls from benthic.	EOAW to circulate the final survey report prior to next ETG
7	Impacts- general agreement in the list of impacts proposed. The second evidence plan meeting will be the place to discuss the Worst case scenarios.	
	Agreement on approach to each impact. **Physical disturbance** and habitat loss can be assessed as one impact Ellis and Coull et al data should not be used to do calculations (e.g. of % area loss of spawning habitat) as the areas are not well defined. **Suspended sediments** Use the models from the ZEA work and East Anglia ONE for a proxy. Agreement to this in principle sand eels are used to being buried anyway. There is a paper by Last et al on the survivability of species from smothering ALSF (crab and brittle star especially good) **Noise modelling** **Habitat introduction**	EAOW to send round to the group the NPL methodology
	Cumulative – RW warning about being close to the Anglian dredging sites, they have a set methodology for assessing the impact for sandeel, which is to be agreed by Cefas and other parties. East Anglia THREE and FOUR	RW to pass on the methodology

ITEM	DESCRIPTION	ACTION
	should take this into account	when available
	HRA mention that species may transit through the site but can be screened out.	
	AOB – there is an emerging whelk fishery in 33F1 the fishermen should be consulted LC will send through some information on this. ICES have some trawl data from 2004 and Cefas have some sandeels from 2011. LC key species to consider - plaice, cod, and sandeel	EAOW Check that BMM are aware of this

ID	Issue on which EAOW THREE and FOUR seek agreement on	Agreed Position
1	Sufficient survey data has been collected	Agreed. Natural England and Cefas would like to see the 2013 site specific survey reports. To save staggered receipt of outputs, survey reports will be provided as part of package for next ETG meeting (early 2014)
2	The list of impacts proposed in the Evidence Plan method statement and the powerpoint presentation.	Agreed
3	During construction physical disturbance and habitat loss can be assessed as one impacts	Agreed
4	Agreement of the proposed methodology for each impact	
5	It is proposed not to use any site specific modelling for sediment dispersal. Use of the ZEA and the East Anglia ONE modelling as a proxy	Agreed in principle but await the results of the coastal process meeting on Friday 13th September 2013
6	It is agreed that the sensitivity and magnitude definitions are appropriate	These will be circulated along with a worked example. Once this has been reviewed it will be signed off. Cefas and Natural England will review and it was agreed will return within **two weeks**.
7	The approach to cumulative impact assessment - All impacts **apart from** underwater noise and regional impacts upon sandeel can be wrapped up in one small concise section	Agreed EAOW will circulate example text and then it can be signed off by the ETG
8	Screen out fish from the HRA (distance from designated sites and diffuse distribution of Annex 1 species)	Agreed- just need to justify why in screening document and acknowledge that Annex 1 species will be transiting the site

11.1.4 Clarification of Impact Assessment Methodology and Approach to Cumulative impacts.

Introduction

6. This note presents the Benthic Ecology and Fish and Shellfish Ecology definitions of sensitivity and magnitude which East Anglia Offshore Wind (EAOW) THREE and FOUR propose to use for their Environmental Impact Assessment (EIA). EAOW wish to agree these definitions with the Marine Management Organisation (MMO) Natural England and Cefas as part of the Evidence plan process. The sensitivity definitions for the two topics are slightly different and therefore both are presented below. A theoretical example of how these would be used within the ES is the presented.

7. Also included within the note is an example of the text we would wish to use to wrap up all the cumulative impacts to benthic ecology as part of the EIA.

Sensitivity and Magnitude

8. The sensitivity definitions for both Benthic Ecology and Fish and Shellfish are presented in Table 1 and Table 2 below

Table 1. Benthic ecology definitions of the different sensitivity levels for receptors:

Sensitivity	Definition
High	Individual receptor (species or habitat) has very limited or no capacity to accommodate, adapt or recover from the anticipated impact.
Medium	Individual receptor (species or habitat) has limited capacity to accommodate, adapt or recover from the anticipated impact.
Low	Individual receptor (species or habitat) has some tolerance to accommodate, adapt or recover from the anticipated impact.
Negligible	Individual receptor (species or habitat) is generally tolerant to and can accommodate or recover from the anticipated impact.

9. In addition, for some assessments the 'value' of a receptor may also be an element to add to the assessment where relevant – for instance if a receptor is a designated feature (i.e. ecological, geological or historic) or has an economic value.

10. It should be noted that high value and high sensitivity are not necessarily linked within a particular impact. A receptor could be of high value (e.g. a European (Annex 1) designated habitat) but have a low or negligible physical/ecological sensitivity to

an effect – it is important not to inflate impact significance simply because a feature is 'valued'. The narrative behind the assessment is important here; the value can be used where relevant as a modifier for the sensitivity (to the effect) already assigned to the receptor.

Table 3. Value definitions

Value	Definition
High	Internationally or nationally important
Medium	Regionally important / rare
Low	Locally important / rare
Negligible	Not considered to be particularly important / rare

11. The proposed definitions for levels of magnitude are displayed in Table 4.

Table 4. Definitions of the magnitude levels for a generic receptor (which could either be a benthic receptor or a Fish and Shellfish receptor):

Magnitude	Definition
High	Fundamental, permanent / irreversible changes, over the whole receptor, and / or fundamental alteration to key characteristics or features of the particular receptors character or distinctiveness.
Medium	Considerable, permanent / irreversible changes, over the majority of the receptor, and / or discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.
Low	Discernible, temporary (throughout project duration) change, over a minority of the receptor, and / or limited but discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.
Negligible	Discernible, temporary (for part of the project duration) change, or barely discernible change for any length of time, over a small area of the receptor, and/or slight alteration to key characteristics or features of the particular receptors character or distinctiveness.
No change	No loss of extent or alteration to characteristics, features or elements.

12. The matrix that corresponds to the above definitions is displayed in Table 5.

Table 5 Example impact assessment matrix

Sensitivity	Magnitude				
	High	**Medium**	**Low**	**Negligible**	**No Change**
High	Major	Major	Moderate	Minor	No change
Medium	Major	Moderate	Minor	Negligible	No change
Low	Moderate	Minor	Negligible	Negligible	No change
Negligible	Minor	Negligible	Negligible	Negligible	No change

Worked example

13. The worked example provided below is for the smothering of *Sabellaria spinulosa* during construction. The EIA will consider the impacts of smothering of all relevant species and habitats, however to keep this example short and concise only *S. spinulosa* has been considered. Please note this is a theoretical example of how the definitions and matrices will be used and in no way represents the final EIA assessment which will be further refined by amongst other things the results of the Physical Processes assessments.

14. There is potential for the following construction activities to increase suspended sediment and therefore impact upon *S. spinulosa* through smothering:

- Seabed preparation for foundations;
- Jack up barge feet placement; and
- Cable laying activities

15. Research has shown that *S. spinulosa* has limited or no sensitivity to smothering (Last et al. 2011; Jackson and Hiscock, 2008) and that the species is able to recover quickly from such events. Therefore, the sensitivity of this species to smothering is considered to be negligible.

16. Within the cable route the biotope SS.SBR.PoR.SspiMx (*S. spinulosa* on stable circalittoral mixed sediment) was identified. This biotope is of importance as it has the potential to contain Annex 1 Habitat in the form of biogenic reef. Due to its designation as an Annex 1 habitat *S. spinulosa* reef is considered to be of high value.

17. Low numbers of *S. spinulosa* were found within the East Anglia THREE site with no indication of the presence of reef forming aggregations. Slightly larger numbers of *S. spinulosa* were found within the cable route and the presence of the biotope

SS.SBR.PoR.SspiMx indicates reef forming potential. The temporary impacts associated with cable burial within the cable route and smothering within the East Anglia THREE site during construction are likely to result in a **low** magnitude of impact.

18. Considering the low sensitivity and high value of the receptor the sensitivity level has been modified from negligible to **low** and taking into account the low predicted magnitude the impact of smothering of *S.spinulosa* is likely to be of **negligible** significance.

Cumulative impacts example

19. As proposed in the Evidence plan meeting held on the 11th of September 2013 the cumulative impacts for benthic ecology (and fish and shellfish ecology with the exception of cumulative impacts upon sandeels and underwater noise impacts) will be assessed in one small concise section of the Environmental Statement (ES) chapter. The following is an example of how this may be presented. This approach may change as further information becomes available.

20. The impacts to the benthos are:

- Physical disturbance and habitat loss;
- Smothering;
- Re-mobilisation of contaminated sediments;
- Underwater noise and vibration; and
- Colonisation of foundations and cable protection.

21. These impacts will mostly be temporary, small scale and localised for the East Anglia THREE. Given the distances to other activities in the region (e.g. other offshore windfarms, aggregate extraction) and the localised nature of the impacts there is no pathway for interaction between impacts cumulatively. Whilst it is recognised that across the Zone or Regional Sea there will be additive impacts, the overall combined magnitude of these will be **negligible** relative to the scale of the habitats affected. In addition given the ubiquity and low ecological sensitivity of habitats across the Southern North Sea (and indeed across areas deemed suitable for development) sensitivity is also likely to be **low or negligible** at a cumulative scale. In the case of physical disturbance and smothering during construction there is only potential for such additive impacts if project construction schedules overlap. In cases where sensitive habitats are present, these will be avoided by micro-siting and design in

those projects (as has been committed to for East Anglia THREE), therefore there would be **negligible** or **no impacts**.

22. Therefore, given that the impacts assessed for East Anglia THREE (i.e. project level impacts) are considered **negligible** or would be avoided by design it is considered that at a cumulative (i.e. additive) level, impacts upon the benthos would be **negligible**.

References

Last KS, Hendrick VJ, Beveridge CM & Davies AJ (2011). Measuring the effects of suspended particulate matter and smothering on the behaviour, growth and survival of key species found in areas associated with aggregate dredging. Report for the Marine Aggregate Levy Sustainability Fund, Project MEPF 08/P76. 69 pp

Jackson, A. and K. Hiscock 2008. *Sabellaria spinulosa*. Ross worm. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 11/09/2013]. Available from: www.marlin.ac.uk/speciessensitivity.php?speciesID=4278

11.1.5 Emailed agreement to the outcomes of the first Fish and Shellfish Ecology ETG meeting.

23. Provided below is emailed agreement to the minutes from the first Fish and Shellfish ETG meeting and the paper clarifying the approach to the impact assessment methodology.

From: Ludgate, Claire (NE) [mailto:Claire.Ludgate@naturalengland.org.uk]
Sent: 27 September 2013 19:50
To: Tarrant, D.C. (David); Cox, Louise P.N (CEFAS); Walker, Rebecca (CEFAS); Herdson, Rebecca (NE); Whomerlsey, Paul (CEFAS); Drake, Holly (CEFAS)
Cc: Cross, M (Marcus) - Scottish Power Renewables; Mandy.gloyer@scottishpower.com; keith.morrison@ScottishPower.com; Burrows, Frances (MMO); Nicholson, Cheryl (MMO); Pearson, Fiona (Defra)
Subject: RE: Evidence Plan - Fish and Benthic Meeting Minutes [Filed 11 Oct 2013 09:06]

Hi David,

I can confirm that Natural England are content with the meeting minutes and the list of agreed points from both the fish and benthic ETG meetings and have no further comment to make on them.

With regard to the magnitude, sensitivity and cumulative impacts paper, Natural England is content with the definitions of sensitivity and magnitude to be used in the assessment.

The example cumulative impact text helpfully demonstrates the proposed approach and providing sufficient explanation is given in the text for the reasoning behind this approach, Natural England is happy for it to be used.

Kind regards,

Claire

Claire Ludgate

MSc AMIMarEST

Marine Lead Adviser

Southern North Sea Team

Natural England

Mail Hub Block B

Whittington Road

Worcester

WR5 2LQ

Tel 03000602764 Mobile:07917791632

http://www.naturalengland.org.uk

11.1.6 Emailed Agreement to Postpone ETG meeting 2

24. Provided below is an emailed agreement to postpone the second Fish and Shellfish ETG meeting.

From: Ludgate, Claire (NE) [mailto:Claire.Ludgate@naturalengland.org.uk]
Sent: 17 April 2014 18:12
To: Pizzolla, P. (Paolo); Cox, Louise P.N (CEFAS); Walker, Rebecca (CEFAS); Herdson, Rebecca (NE); Browne, S (Siobhan) - Natural England; Foden, Dean (CEFAS); Drake, Holly (CEFAS); Barrio Frojan, Christopher (CEFAS)
Cc: Covey, (Roger) - Natural England; Morrison, K (Keith) - Scottish Power Renewables; mandy.gloyer@scottishpower.com; Tarrant, D.C. (David) Subject: RE: East Anglia THREE and FOUR - Evidence Plan

Dear Paolo,
Natural England are content that there is no requirement for a further meeting to discuss benthic, fish or physical processes topics prior to the PEI in May.

We have also reviewed the HRA document and are satisfied that, as discussed in the first evidence plan meeting, all potential effects on physical processes, fish and benthic have been scoped out.

Many thanks,
Claire

Claire Ludgate
MSc AMIMarEST
Marine Lead Adviser
Lincolnshire Coast, Marshes and Marine Team
Natural England
Mail Hub Block B
Whittington Road
Worcester
WR5 2LQ
Mobile:07917 791632

www.naturalengland.org.uk

We are here to secure a healthy natural environment for people to enjoy, where wildlife is protected and England's traditional landscapes are safeguarded for future generations.

In an effort to reduce Natural England's carbon footprint, I will, wherever possible, avoid travelling to meetings and attend via audio, video or web conferencing.

Natural England is accredited to the Cabinet Office Customer Service Excellence Standard

11.1.7 Minutes from Second Fish and Shellfish Ecology Expert Topic Group Meeting

25. Provided below are the minutes from second benthic expert topic group meeting which was held on the 3rd July 2014. At this meeting other topics were discussed including Physical Processes, Fish Ecology and Marine Mammals, however for the purposes of this Appendix only the minutes relevant to Benthic Ecology have been displayed below.

Attendees		
Name	**Initials**	**Organisation**
Mandy Gloyer	MG	EATL
Kathy Wood	KW	EATL
Jesper Kyed Larsen	JKL	EATL
Lou Burton	LB	Natural England
Francesca Shapland	FS	Natural England
Kathleen Mongan	KM	MMO
Holly Drake	HD	Cefas
Dean Foden	DF	Cefas
Paul Whomersley	PW	Cefas
Louise Cox	LC	Cefas
Paolo Pizzolla	PP	Royal HaskoningDHV
Beth Mackey	BM	Royal HaskoningDHV
Nick Cooper	NC	Royal HaskoningDHV
Apologies		

AGENDA		
Item	**Description**	**Action**
1	Health and Safety Introductions - All	n/a
2	**Project update**	
5	Fish ecology	
	Approach NE/Cefas – generally content with the approach taken and the assessment. No comment on the baseline information provided	
	Conclusions *Elasmobranchs* Cefas – Spurdog will be mentioned by local	EATL to request inshore cod data from EIFCA.

AGENDA		
Item	**Description**	**Action**
	stakeholders – more needs to be made of this in the narrative although it is accepted that significant impacts are unlikely *Noise impacts* – more clarity is needed on the noise contours applied to other OWFs in the cumulative noise assessment *Cod* Cod will also be mentioned by local stakeholders. Impacts are not significant and an agreed position in the SOCG (as for EAONE) will give clarity on this. *Cable protection* As discussed for other topics greater clarity and explanation required for the level of cable protection required	

11.1.8 Follow up from ETG Meeting 2

26. Provided within chapter 11 Fish and Shellfish Ecology are comments which were submitted by Natural England following the ETG 2 meeting as part of the PEIR consultation completed under Section 42 of The Planning Act.

Appendix 11.1 Ends Here