INFRASTRUCTURE PLANNING

THE INFRASTRUCTURE PLANNING (EXAMINATIONS PROCEDURE) RULES 2010

THE THANET EXTENSION OFFSHORE WIND FARM ORDER

Response to Deadline 3 submissions submitted on behalf of the Port of London Authority and Estuary Services Limited

(Rule 8 letter 18 December 2018)

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Appendix 8 – Response to Deadline 2 submissions by Shipping Interested Parties

Page no. and Action point / ExQ1 number	Response summary/extract	PLA/ESL comments
P.5 Action Point 2A	"The Applicant notes the reference to 2nm of working sea room however does not agree that 1nm additional buffer is appropriate."	The PLA and ESL welcome the proposal from the Applicant to produce an addendum to the NRA and look forward to reviewing it when available. However, on the basis of the information currently available, the PLA and ESL maintain their position as set out in their Deadline 3 submissions that the buffer of 0.5nm is insufficient when considering an area which is used for boarding and landing in addition to through traffic. A buffer of 0.5nm is not an adequate safety buffer: the distance is neither enough to allow room for manoeuvre during pilot boarding and landing operations, nor does it give vessels enough time to execute manoeuvres safely. The PLA and ESL will give the issue of the buffer further consideration once they have had sight of the expected NRA addendum.
P.6 Action Point 9	"The Applicant strongly refutes the suggestion that data has been 'cherry picked' and emphasises that considerable additional data sets have been used to support the data requirements as prescribed in MGN543."	As described in the PLA's and ESL's Deadline 2 and 3 submissions, there are issues with the NRA's reliance on AIS data that have yet to be resolved, including that the data set is skewed towards only those vessels which carry AIS transponders. Within the AIS data itself, there is a bias towards winter data when traffic is generally lower, and some, such as recreational vessels, is much reduced in comparison to peak summer months. The PLA and ESL remain concerned that the data requirements prescribed by MGN543 are not met by the NRA as submitted with the

Page no. and Action point / ExQ1 number	Response summary/extract	PLA/ESL comments
		application for the DCO. However, the PLA and ESL will be attending a workshop with the Applicant the day following Deadline 4 (the 'NRA Hazard Workshop') which is understood will involve discussing the scoring of a new navigational risk assessment; the parties will update the ExA at Deadline 4a on any developments in respect of this Action Point.
P.10 Action Point 16	"As stated in response to action point 2A, 0.5nm has been proposed by serving master mariners as an appropriate buffer to the WTGs and is also evidenced in analysis of the existing vessel traffic data in relation to the existing wind farm. This distance is also recognised as tolerable within MGN543."	MGN543 states that a distance of 0.5nm – 3.5nm between the turbine boundary and the shipping route is tolerable provided ALARP is reached and '*additional risk assessment and proposed mitigation measures* [are] *required*'. The Applicant states that the distance is tolerable, but there is a difference between ALARP and tolerable; a risk may be reduced to a low as it is cost-effective to do so, but that does not mean it is tolerable. In the PLA and ESL's submissions it has previously been explained that the reduction to ALARP in the case of the TEOWF is based on an NRA which cannot wholly be relied on due to the weaknesses in the underlying data. Even using the applicant's NRA data – which in the PLA and ESL's view is unreliable and underestimates the risk – the risk has been shown to have increased from 1 in 6 years to 1 in 4.5. In the PLA and ESL's view this is neither acceptable nor tolerable. The PLA and ESL look forward to discussing this point with the Applicant at the NRA Hazard Workshop.

Page no. and Action point / ExQ1 number	Response summary/extract	PLA/ESL comments
P.15 Action Point 18	"whilst incidents may not always be logged as suggested by the MCA, the Applicant is not aware of any evidence by way of concerns be raised at industry forums, incident reports or issues raised to the operational wind farm (as examples). It is noted that in the case of the local fishing industry, the operational wind farm is notified of issues if they occur to seek resolution or further mitigation, however the applicant is unaware of any such concerns being highlighted by ESL during the 8 years of operation."	Given the existing state of the operational wind farm, ESL is not clear what purpose would have been served by approaching the existing operators of the wind farm to raise concerns or incident reports. There is currently just enough sea room for ESL to operate away from the boundary of the existing TOWF, albeit that the room for manoeuvre is limited. There is also no formal process to involve the existing wind farm operators in shipping and landing. If there had been a formal 'shipping plan' when the original wind farm was constructed, ESL would have followed any recognised process involved. However, this was not the case.
P.16 1.12.1 (box 2)	"The Applicant notes PLA and ESLs position however it is clear that it has not been given sea lane status and therefore cannot be considered as such."	The PLA and ESL accepts the decision of the MCA with regard to official charted sea lane status and fully supports the comment from the MCA in its Deadline 3 submissions: "Whilst the sea area concerned is not strictly a "recognised sea lane" it is argued that the sea area should be **treated as a recognised sea lane** as it is used by all vessel types every day. It is therefore considered an important route on an international scale."
P.16 1.12.1 (box 3)	"This pattern of traffic has nothing to do with the existence of the operational wind farm and relates to the shortest path through the inshore route. This is confirmed through AIS data prior to the construction of Thanet Offshore Wind Farm which shows exactly the	A report commissioned by the Department of Energy and Climate Change (DECC) in 2016 (*Influence of UK Offshore Wind Farm Installation on Commercial Vessel Navigation: A Review of Evidence* ("the DECC Report") appended to this document at Appendix 1) states at Table 9.1, page 60 that the routes surrounding the existing

Page no. and Action point / ExQ1 number	Response summary/extract	PLA/ESL comments
	same pattern of inshore traffic, Annex A to this document.”	TOWF have been directly impacted by the wind farm, particularly the increased route density and formalisation of traffic in the area.
P.17 1.12.1 (box 5)	“The Applicant agrees with this point, however the gate analysis does clearly demonstrate that vessels do pass at 0.5nm or in some cases closer. It is not suggested that all vessels would be required to pass at this distance, however it serves to illustrate that 0.5nm is a reasonable prudent mariner buffer.”	ESL and the PLA accept that vessels can and do pass a windfarm at 0.5nm. However, the evidence in the DECC Report is that such close passes are carried out by a very small minority of traffic. Within Section 8 of the DECC Report (Thames Estuary & Kent Coast Area), an analysis of CPA (closest point of approach) vessels after the completion of the existing wind farm demonstrates that approximately 1% of vessels pass within 0.5nm of the wind farm and just over 8% between 0.5nm and 1nm. Given that the gate analysis within the NRA does not give a percentage of the traffic which passes 0.5nm or less from the existing wind farm, the PLA and ESL suggests that this document provides some guidance.
P.18 1.12.1(c)	“growth in vessel numbers has been factored into the NRA. Specifically at Section 6 of the NRA an understanding of the likely increase in vessel traffic as a result of national and local statistics is provided.”	ESL and the PLA will be raising this issue with the Applicant at the NRA Hazard Workshop between the parties following Deadline 4. It is not clear to ESL and the PLA how growth in vessel numbers has been factored in to the NRA and whether the growth figures are an accurate forecast.

Page no. and Action point / ExQ1 number	Response summary/extract	PLA/ESL comments
P.19 1.12.1(d)	“The Applicant maintains that it is necessary and appropriate to benchmark areas of searoom and regional areas of vessel transit. A central tenet of the NRA was the need to search regionally and nationally for incident statistics that may be attributable to OWFs. This search was as a direct need to benchmark what is being seen in the Thanet region with the wider understanding. To not compare other regions and areas would have resulted in the risk of incident being zero.	If the Applicant considers that use of benchmarking as significant, the PLA and ESL would ask it to consider whether it would be helpful to compare the risk analysis of the extension of the wind farm to other wind farms. It would be helpful if these benchmarks could cover more areas of comparison between developments, e.g. collision baselines, and to have an understanding of how the risk for proposed TEOWF compares to other sites.
P.21 1.12.3(a) (box 2)	“The Applicant queries why ESL or PLA felt that they could not comment on the simulation report and results if, as suggested, they were not directly asked for comments. If the concerns at the time were as significant as have been subsequently raised during this examination, it would be expected that these could and would have been raised regardless.”	It is not the case that the PLA and ESL felt unable to comment on the simulation report. However, the process of dealing with feedback and consultation has not been clear. Given the feedback provided to the Applicant during the simulation study, ESL and the PLA had expected further engagement from the Applicant. The PLA and ESL note the following comment in the minutes of a meeting between the Applicant, the MCA and Trinity House on 23 August 2018 (see *Appendix 25 / Annex J – Consultation Minutes and Correspondence*, submitted at deadline 1): “*RB commented that he had received concerns from the PLA, and others, on the validity of conclusions drawn from the outcomes of simulation (that the simulation used experienced pilots who were familiar with the area) were not reflected and this was a serious concern for THLS.*” Furthermore, the minutes of the meeting between the PLA and the

Page no. and Action point / ExQ1 number	Response summary/extract	PLA/ESL comments
		Applicant on 5 December 2017 included at Annex C-3 to the NRA note: "*CS [Cathryn Spain] identified that the simulation would not be able to accurately reflect all outcomes and included experienced mariners, familiar with the Thames Estuary, and therefore did not entirely reflect the relative inexperience of masters inbound to London, in a challenging environment.*"

Appendix 3 – ISH 5 Action Points

Action point	Response summary/extract	PLA/ESL comments
2	Legal submissions concerning sea lanes.	As stated above in relation to page 16 of Appendix 8 to the Applicant's Deadline 3 submission, the PLA and ESL fully support the MCA's position on the sea lane status of the inner route.
6	"The Applicant maintains that in this instance a vessel would have the option of conducting a pilot transfer at Tongue or NE Goodwin pilot boarding station and it is counter intuitive for a vessel that chooses not to navigate the inshore route to 'dip' back into the area when alternatives are available."	The use of the Tongue or NE Goodwin pilot boarding stations in this situation would have a significant impact on the PLA and ESL's provision of pilotage. The Applicant has thus far maintained a position of there being a low impact on the inner boarding position which would suggest an expectation that ESL and the PLA should continue as with pilotage operations they do now. However, the suggestion here does not accord with that.

Action point	Response summary/extract	PLA/ESL comments
7	Refinement of RLB	The PLA and ESL welcome the movement made by the Applicant in proposing the notion of a Structure Exclusion Zone. At this stage, given the lack of information about what structures would be excluded and the duration of any exclusion, the PLA and the ESL are unable to say to what extent the proposed SEZ would alleviate its concerns. It is hoped that prior to the next Deadline the PLA and ESL will receive detail which will enable both parties to form a view on this. In any case, the PLA and ESL note that the agreed vessel lengths discussed at the workshop have not been taken forward into the SEZ document. For the purpose of the SEZ they have used 333m loa as this is the largest vessel in evidence at the inner boarding ground. It was mentioned at the workshop (we believe by Vincent Crockett – LGW consultant) that larger vessels should be considered as there is the potential for larger vessels to transit the inshore route. Given the trends towards larger vessels, a 366m loa vessel with a draft under 11.5m could be something that may occur in the future. The PLA and ESL will be participating in the NRA Hazard Workshop with the Applicant and other parties that immediately follows Deadline 4 to discuss this and other points in relation to the revised NRA. The PLA and ESL look forward to progressing these issues at that meeting and updating its submissions on these issues at Deadline 4a.

Appendix 4 – ISH 6 Action Points

Action point	Response summary/extract	PLA/ESL comments
6	"There is no evidence at all to suggest that the existence of the survey vessel would have affected other vessels behaviour such that it might affect the representativeness of survey itself"	In the PLA and ESL's experience, vessels do respond to the presence of other vessels, including survey vessels. As such, the PLA and ESL would have expected the Applicant to have considered whether the tracks of the survey vessel had an impact on the surrounding traffic, in particular in relation to the summer survey.

Appendix 40 – Outline Shipping and Navigation Liaison Plan

The PLA and ESL welcome the receipt of the draft Shipping and Navigation Liaison Plan from the Applicant. However, given the stage of the application at which this document has been submitted, the PLA and ESL recognise that the Applicant's priorities lie in resolving more central issues. There are some factual inadequacies within the Plan, in particular the role and powers of the PLA within this area. The PLA also wishes to discuss with the Applicant elements of the Plan including information sharing and is seeking to resolve these issues with the Applicant prior to the next Deadline.

APPENDIX 1

Anatec Report: Influence of UK Offshore Wind Farm Installation on Commercial Vessel Navigation: A Review of Evidence

Influence of UK Offshore Wind Farm Installation on Commercial Vessel Navigation: A Review of Evidence

Prepared by:	Anatec Limited
Presented to:	Hartley Anderson
Date:	16th February 2016
Revision No.:	01
Reference:	A3726_HA_TN_01

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Revision Number	Date	Summary of Change
00	28th January 2016	Initial Draft
01	16th February 2016	Updates Following Review

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Abbreviations

AIS	-	Automatic Identification System
COLREGs	-	International Regulations for the Preventions of Collisions at Sea
CPA	-	Closest Point of Approach
DECC	-	Department of Energy and Climate Change
DWR	-	Deep Water Route
DWT	-	Dead Weight Tonnage
GT	-	Gross Tonnage
IMO	-	International Maritime Organisation
m	-	Metre
MGN	-	Marine Guidance Note
MMO	-	Marine Management Organisation
MW	-	MegaWatt
MV	-	Merchant Vessel
nm	-	Nautical Miles
NRA	-	Navigational Risk Assessment
OESEA	-	Offshore Energy Strategic Environment Assessment
OREI	-	Offshore Renewable Energy Installation
OWF	-	Offshore Wind Farm
RoRo	-	Roll on Roll off
SOLAS	-	Safety of Life at Sea Convention
TSS	-	Traffic Separation Scheme
UK	-	United Kingdom
UKHO	-	United Kingdom Hydrographic Office
VTS	-	Vessel Traffic Services

1. Introduction

Anatec have been commissioned by Hartley Anderson to undertake a review of desktop evidence to investigate the impacts on fully commissioned offshore wind farm developments on commercial traffic movements within key areas of United Kingdom (UK) waters. This study is intended to contribute to the current Department of Energy and Climate Change (DECC) offshore energy strategic environmental assessment (OESEA), and will form a publicly available report underpinning the assessment. Automatic Identification System (AIS) data covering 4 weeks in 2007 were analysed during the first OESEA to provide accurate information on important areas for larger vessel navigation. The smallest grid cell size used within this report was 500 metres (m) and was based on interpreted AIS data. The intention of this report is to expand on the data gathered for the OESEA in 2008 by using the now extensive AIS coverage around UK waters to form a realistic picture of commercial vessel movements.

1.1 Aims of the Project

This technical report aims to fulfil the following in order to assess the impact of offshore wind farms on commercial vessel navigation:

- Undertake a review of navigation routes (using the route definition principles of Marine Guidance Note (MGN) 371) followed by commercial vessels within designated study areas (MCA, 2008);
- Identify and summarise the main changes to commercial vessel navigation following the development of each offshore wind farm (including cumulative impacts) within respective study areas;
- Provide an overview of any changes to International Maritime Organisation (IMO) routeing measures that have altered routeing in the vicinity of offshore wind farms; and
- Where possible undertake selected case histories of main commercial navigation routes and wind farm interactions in areas with multiple developments, including the conclusions of the Navigational Risk Assessments (NRA) or other AIS based studies.

1.2 Selected Areas of Assessment

From Anatec's in house knowledge, experience of commercial vessel routeing changes and known offshore wind farm locations the following areas of assessment (hereby referred as study areas) have been selected for consideration within this report:

- Northern Irish Sea;
- Southern Irish Sea;
- Humber; and
- Thames Estuary and Kent Coast.

Figure 1.1 shows these study areas relative to the UK coastline. Throughout this assessment these study areas have been used to assess AIS data and routeing; these larger areas have been used initially as a greater area is often required to fully identify traffic routeing.

However the outputs of this report (density grids and 90th percentiles) show a smaller 'results area' which are generally extended by 10 nautical miles (nm) from fully commissioned developments. It should also be noted that partially constructed wind farms have been excluded given their limited temporal effects on traffic; as have consented wind farms whose impacts could only be predicted at this stage.

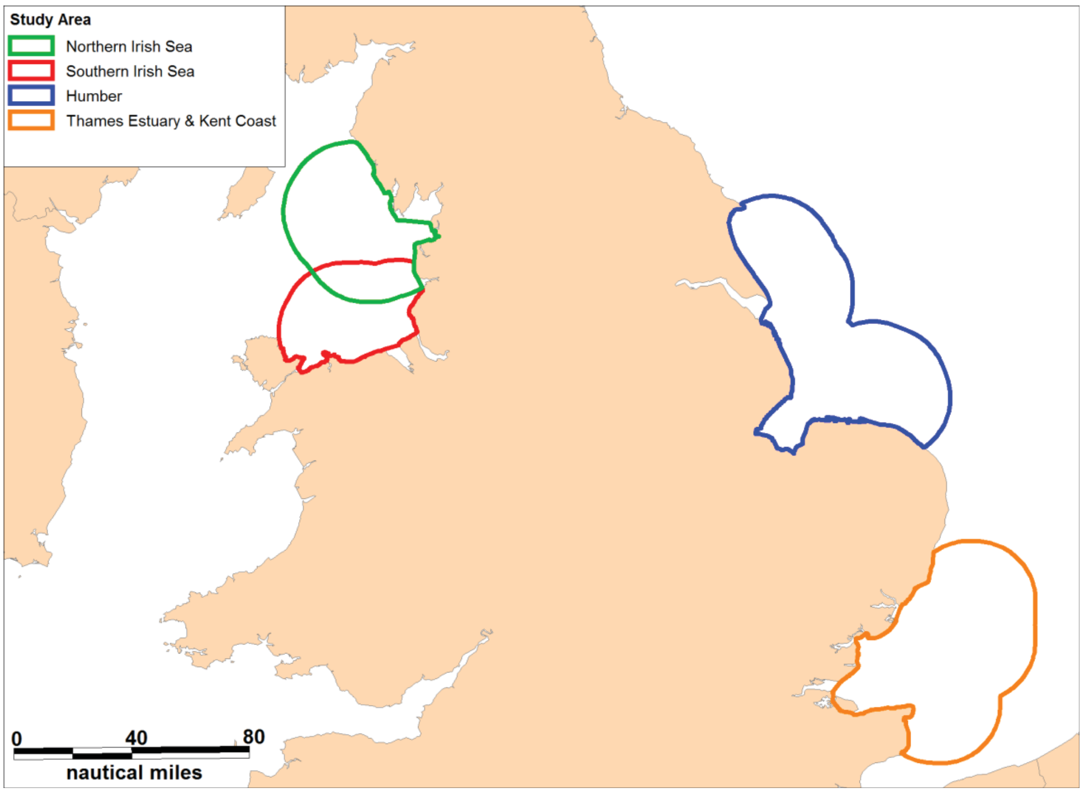


Figure 1.1 Study Area Overview ©

1.3 Data and Guidance

1.3.1 AIS Data

The data periods that have been used for each area of assessment have been summarised and illustrated at the beginning of each relevant section. These data periods have generally been selected based on the quality of the data available to ensure comprehensive data coverage for each survey period. The data has also been analysed over different periods to ensure that that the commercial routeing changes following each new wind farm development are reflected.

Regulation 19 of Safety of Life at Sea Convention (SOLAS) Chapter V - Carriage requirements for shipborne navigational systems and equipment (IMO, 2016), sets out navigational equipment to be carried on board vessels according to vessel type. In 2000, IMO adopted a new requirement (as part of a revised new chapter V) for all ships to carry AIS capable of providing information about the ship to other ships and to coastal authorities automatically. There are two classes of AIS system; A and B, each of which broadcast slightly different data.

The regulation requires AIS to be fitted aboard all ships of 300 gross tonnage (GT) and upwards engaged on international voyages, cargo ships of 500 GT and upwards not engaged on international voyages and all passenger ships irrespective of size. The requirement became effective for all vessels by 31 December 2004 (some vessel types and builds were earlier than this date); however it took several more years for the recording of the data to be most effective.

Class B AIS was specified as a less expensive alternative to Class A with the view to be used by smaller, non-SOLAS vessels such as fishing vessels below 15m and recreational vessels. The data broadcast is not as comprehensive but still contains the main information that is required for collision risk management.

The data (including seasonal variations) is used to characterise the up-to-date passing shipping traffic patterns prior to and post the different wind farm developments, see Section 1.3.5.

1.3.2 Fishing Vessels AIS Carriage Requirements

AIS is now required to be carried by fishing vessels of 15m length; however implementation of AIS was more gradual than for commercial vessels, schedule noted below.

- Fishing vessels of overall length 24m and upwards but less than 45m: not later than 31 May 2012,
- Fishing vessels of overall length 18m and upwards but less than 24m: not later than 31 May 2013,
- Fishing vessels of overall length exceeding 15m but less than 18m: not later than 31 May 2014.

New build fishing vessels of overall length exceeding 15m were subject to AIS carriage from November 2010.

1.3.3 Data Quality

AIS data beyond 20 – 25nm (depending on atmospheric conditions at the time and the size of vessels) from a receiver is not considered to be fully comprehensive and therefore could not be used in isolation for an effective navigational risk assessment. However for the purposes of this report it does provide a general overview of commercial vessels traffic routeing within the selected study areas (section 1.2) but has not been visually presented to the full extent of the study area within the report.

1.3.4 Other Data Sources and Guidance

Although AIS data provides the most useful tool for assessing the impacts on commercial vessels; the following data sources and guidance documents have also been considered.

- United Kingdom Hydrographic Office (UKHO) charted information;
- Marine Management Organisation (MMO). Mapping UK Shipping Density and Routes from AIS. June 2014.
- MGN 371 - Offshore renewable energy installations (OREIs): guidance on UK navigational practice, safety and emergency response issues. 2008.

1.3.5 Data Analysis Methodology

In order to adequately assess the impact of wind farm developments on commercial vessel routeing the following desktop analyses of the aforementioned data sources have been carried out:

- Creation of main route positions (90^{th} Percentiles);
- Vessel types;
- Vessel sizes (lengths and tonnages);
- Speeds (knots) and courses; and
- Range of passing distances to each wind farm.

In order to assess the impact of offshore wind farms on commercial vessel routeing, the data has been processed to exclude vessels engaged in fishing, vessels engaged in wind farm construction / operations & maintenance and recreational vessels. However, the AIS data for these vessel types has been illustrated for presentation purposes.

90^{th} percentiles have been identified based on the principles set out in MGN 371: the AIS data has been assessed and vessels transiting at similar headings and to similar locations have been identified as a route. Regular operator routes (e.g. a regular ferry service) have also been identified from the AIS data.

Vessel density grids (comprising of 500m x 500m cells) have been created for each study area and the density is based on the total number of vessel tracks recorded within each individual cell. The classification of density (low – high) is consistent across all survey periods within a given study area.

1.4 Interpretation of Results

Following analysis of the data the results have then been interpreted in order to allow conclusions to be drawn. This has included a review of the navigation routes against the routeing template principles contained within MGN 371, using the aforementioned process of identifying 90^{th} percentiles.

Consideration has also been given to areas where IMO routeing measures (or other changes to navigational routeing measures such as buoyage) have been implemented and routeing (in the vicinity of a developed offshore wind farm) has altered as a result of these changes. Note: IMO routes or buoyage may be out with the wind farm development area.

The impact of offshore wind farms, routeing measures and other infrastructure on commercial vessel routeing has been classified using the criteria summarised in Table 1.1.

Table 1.1 Impact Definitions

Impact	Definition
Direct	Commercial routeing change as a direct result of a single offshore wind farm.
Independent	Commercial routeing change as independent result of a vessel or external operator alteration.
In Combination	Commercial routeing change as a result of multiple offshore wind farms.
Cumulative	Commercial routeing change as a result of offshore wind farm(s) construction and changes to routeing measures and / or other infrastructure newly developed within the area.

The terms cumulative and in combination are based on classifications defined by The Crown Estate in *Strategic assessment of impacts on navigation of shipping and related effects on other marine activities arising from the development of Offshore Wind Farms in the UK REZ (*Anatec, 2012).

1.5 Case History Assessment

Based on the data analysis and interpretation of results, selected case histories of main commercial navigation routes and wind farm interactions (in areas with multiple developments) an assessment of how predictive work compares to the actual changes observed, following the construction of offshore wind farms, has been undertaken. This has included comparison with the conclusions of the navigational risk assessments (where available) and other technical AIS reports with an emphasis on in-combination risks.

2. Northern Irish Sea Area

2.1 Introduction

Table 2.1 summarises key details of the wind farm developments considered within the northern Irish Sea study area. Following this, Figure 2.1 illustrates the location of the wind farms considered in Table 2.1 and the study area. Within this study area any significant changes to infrastructure or routeing measures have been identified in order to assess the reasoning behind commercial routeing changes in that area.

Table 2.1 Wind Farm Summary – Northern Irish Sea

Wind Farm	Capacity (MW)	Turbines	Construction Start Date	Construction End Date	Commissioning Date
Barrow	90	30	May 2005	Jun 2006	22nd Sep 2006
Walney (Phase 1)	183.6	51	10th Mar 2010	Feb 2011	12th Jul 2011
Ormonde	150	30	29th Jul 2010	Aug 2011	22nd Feb 2012
Walney (Phase 2)	183.6	51	9th Apr 2011	16th Dec 2011	14th Jun 2012
West of Duddon Sands	389	108	30th Mar 2013	16th Oct 2014	30th Oct 2014

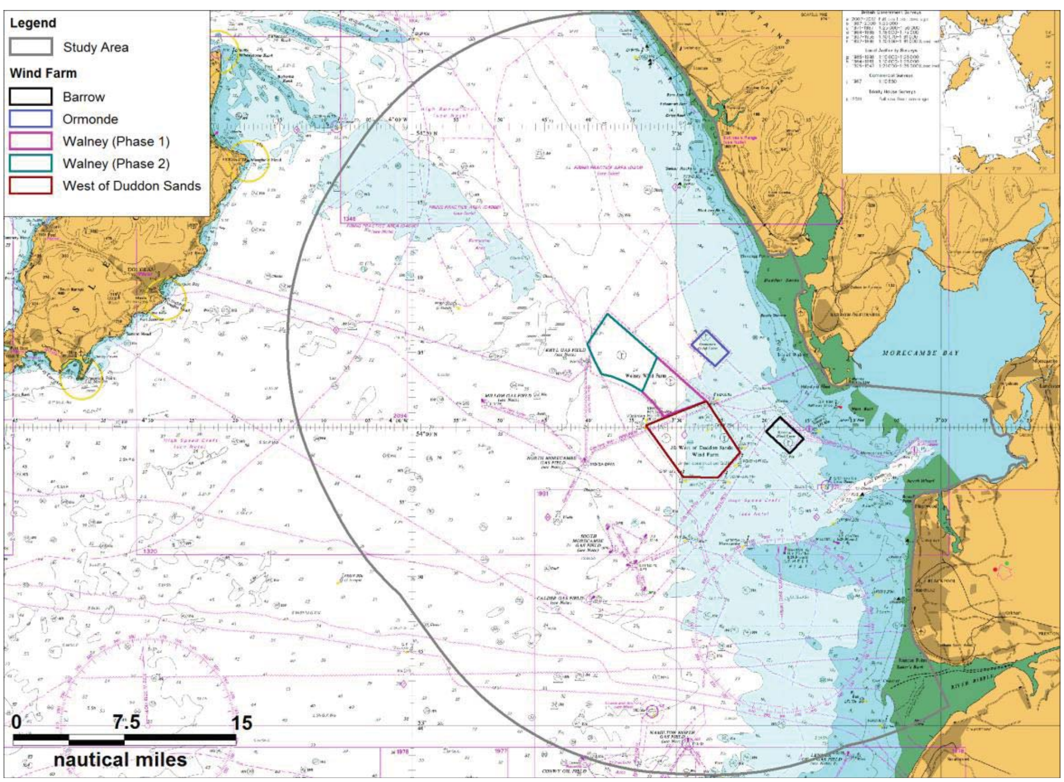


Figure 2.1 Northern Irish Sea Overview©

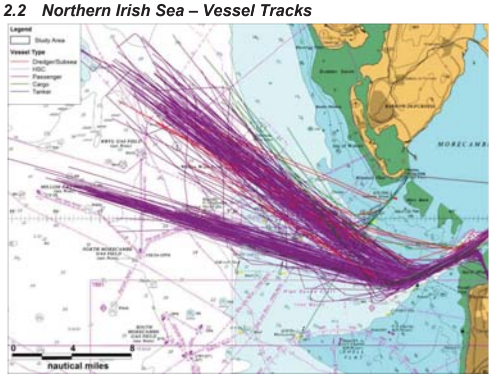
Table 2.2 summarises the data periods assessed in order to identify the impact of these wind farms on commercial vessel routeing. The status (pre or post construction) of each wind farm development considered within this study area during each respective survey period is also indicated.

Table 2.2 Summary of Data Periods – Northern Irish Sea

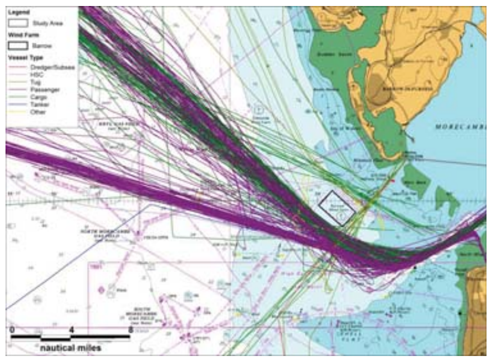
Period	Duration	Wind Farm Status
1. August / October 2004	28	Pre Barrow
December 2004 – Significant changes to AIS legislation		
2. October 2006	28	Post Barrow
3. February 2010	28	Post Barrow Pre Walney (Phases 1 and 2) Pre Ormonde
4. July 2012	28	Post Barrow Post Walney (Phases 1 and 2) Post Ormonde
5. February 2013	28	Post Barrow Post Walney (Phases 1 and 2) Post Ormonde Pre West of Duddon Sands
6. January 2015	28	Post Barrow Post Walney (Phases 1 and 2) Post Ormonde Post West of Duddon Sands

The following sections present the vessel tracks recorded during each survey period (Section 2.2), vessel density grids (Section 2.3) and the main route 90th percentiles (Section 2.4).

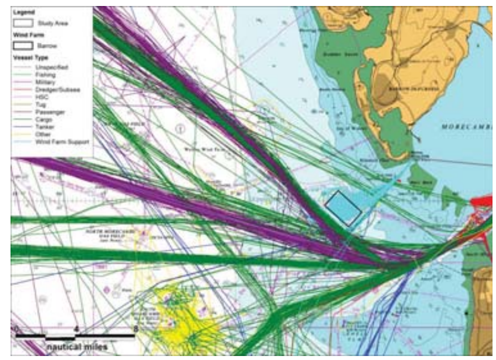
2.2 Northern Irish Sea – Vessel Tracks



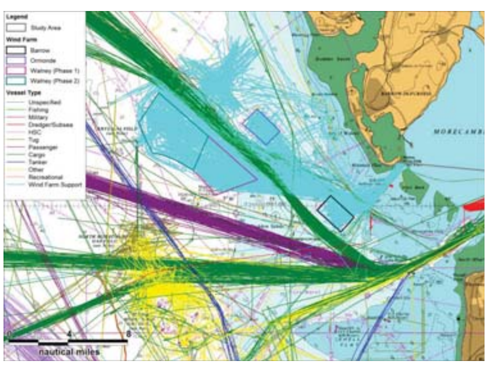
1. Aug / Oct 2004 (Pre Barrow) ***(Note: Pre Dec 2004 AIS Compliance)***



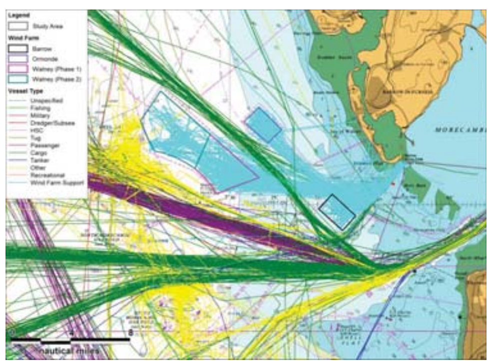
2. Oct 2006 (Post Barrow)



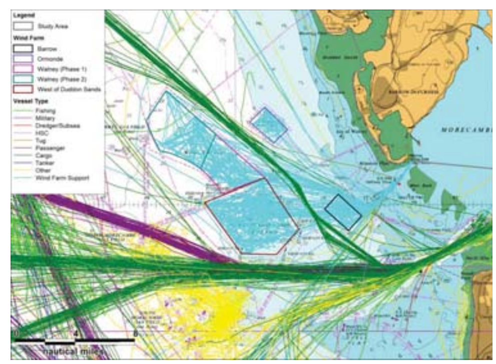
3. Feb 2010 (Post Barrow, Pre Ormonde & Pre Walney)



4. Jul 2012 (Post Barrow, Post Ormonde, Post Walney)



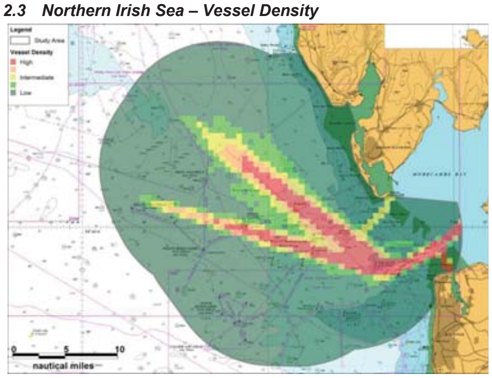
5. Feb 2013 (Post Barrow, Post Ormonde, Post Walney, Pre West of Duddon Sands)



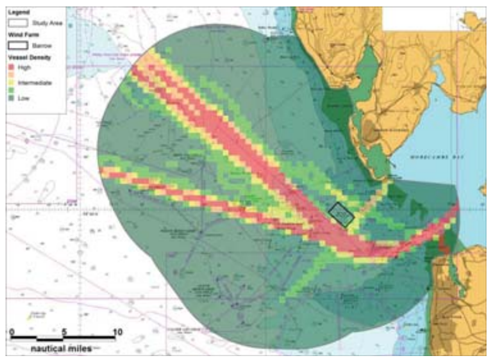
6. Jan 2015 (Post Barrow, Post Ormonde, Post Walney, Post West of Duddon Sands)

Figure 2.2 Northern Irish Sea – Vessel Type ©

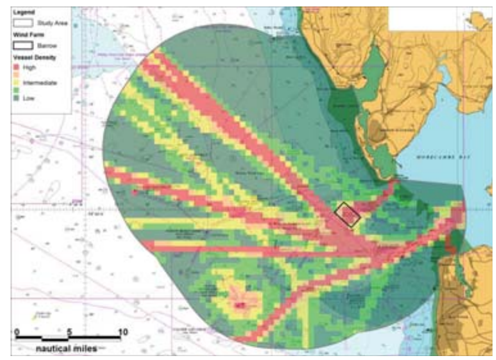
2.3 Northern Irish Sea – Vessel Density



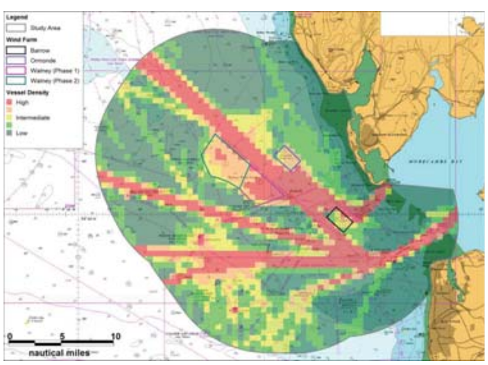
1. Aug / Oct 2004 (Pre Barrow)



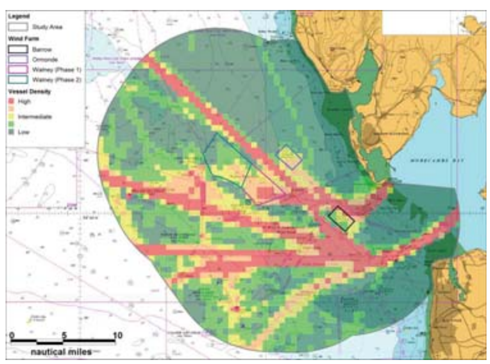
2. Oct 2006 (Post Barrow)



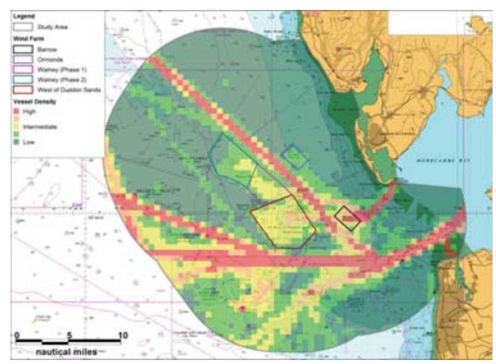
3. Feb 2010 (Post Barrow, Pre Ormonde & Pre Walney)



4. Jul 2012 (Post Barrow, Post Ormonde, Post Walney)



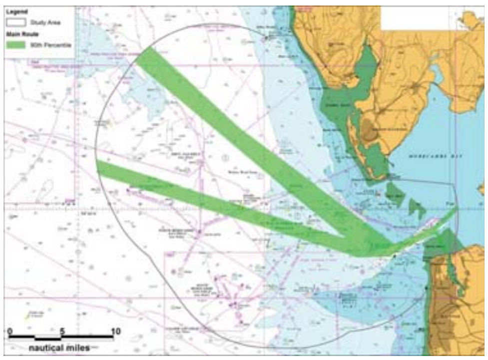
5. Feb 2013 (Post Barrow, Post Ormonde, Post Walney, Pre West of Duddon Sands)



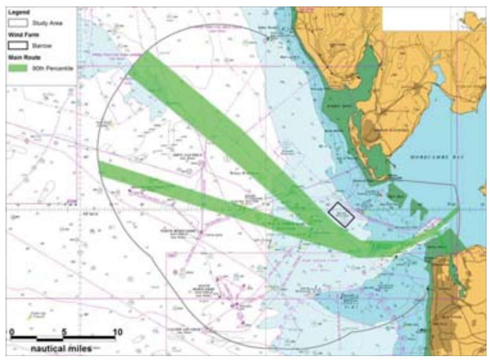
6. Jan 2015 (Post Barrow, Post Ormonde, Post Walney, Post West of Duddon Sands)

Figure 2.3 Northern Irish Sea – Vessel Density ©

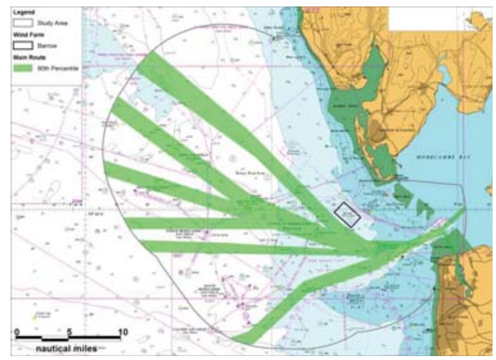
2.4 Northern Irish Sea – 90th Percentiles



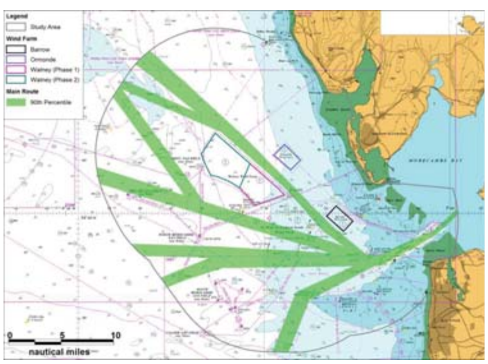
1. Aug / Oct 2004 (Pre Barrow)



2. Oct 2006 (Post Barrow)

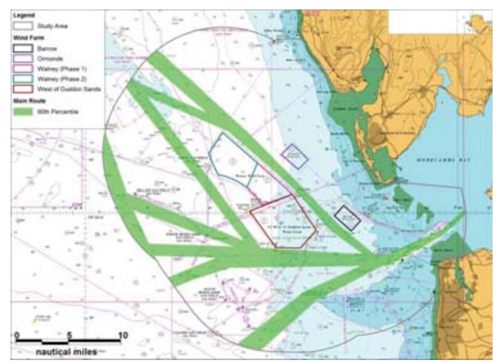


3. Feb 2010 (Post Barrow, Pre Ormonde & Pre Walney)



4. Jul 2012 (Post Barrow, Post Ormonde, Post Walney)

5. Feb 2013 (Post Barrow, Post Ormonde, Post Walney, Pre West of Duddon Sands)



6. Jan 2015 (Post Barrow, Post Ormonde, Post Walney, Post West of Duddon Sands)

Figure 2.4 Northern Irish Sea – 90th Percentiles©

2.5 Northern Irish Sea – AIS Data Analysis

The following subsection presents analysis (vessel length and average speed) of the AIS data collected throughout each survey period for the northern Irish Sea study area. The purpose of this analysis is to identify wider trends in the size and movement of vessels following the development of offshore wind farms within the northern Irish Sea.

Figure 2.5 presents the distribution of vessel lengths recorded throughout each survey period. It should be noted that throughout all survey periods, approximately 4.8% of vessels recorded within the study area did not specify a vessel length and have been excluded from the analysis.

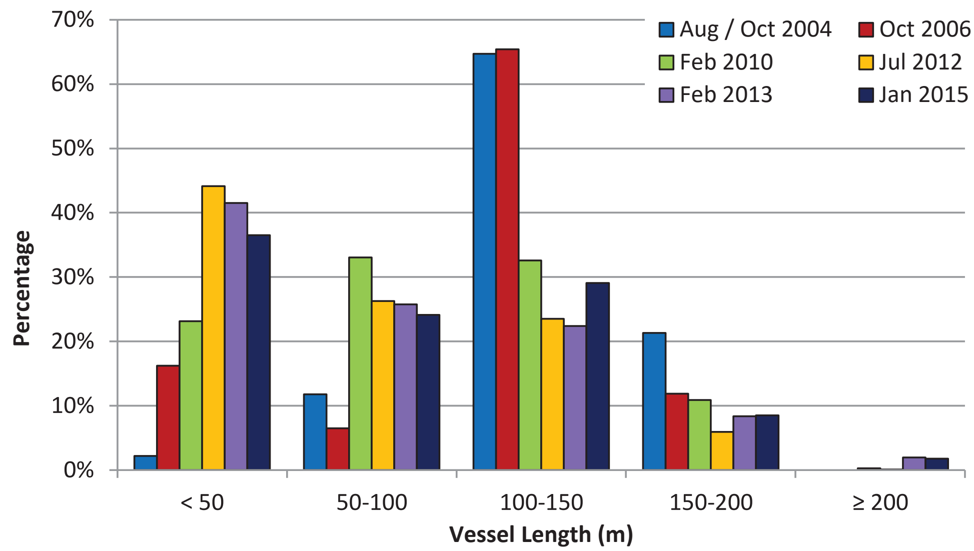


Figure 2.5 Northern Irish Sea – Vessel Length Distribution

The relative proportion of vessels measuring <50m in length has steadily increased over the survey periods, peaking in July 2012 (44.2% of marine traffic). There has also been a corresponding decrease in the proportion of larger vessels (50-200m) recorded within the study area. The reasons for these changes are two-fold:

- Firstly the uptake of AIS has become more widespread as time has passed. During the early survey periods (2004 & 2006) AIS was only carried by large commercial vessels and passenger ferries that were bound to do so by AIS carriage requirements. However, in more recent years the use of AIS has become more commonplace (notably use of AIS B) and it is now carried widely by all commercial vessels and a proportion of smaller fishing and recreational craft.
- Secondly following the increase in the cumulative total number of operational wind farms within the study area, the volume of wind farm support vessels (typically <25m in length) has also steadily increased, resulting in the relative proportion of small

vessels (<50m) steadily increasing and the relative proportion of larger vessels (50-200m) decreasing over the survey periods.

Overall it can be concluded that very large vessels (≥200m) are not recorded frequently within the study area; however their prevalence has increased in later years (2.0% of marine traffic during Feb. 2013 and 1.8% during Jan. 2015).

Figure 2.6 presents the distribution of average vessel speeds recorded throughout each survey period. It should be noted that speed information was not available for AIS data recorded throughout Oct. 2006. For all other survey periods, speed information was not available for approximately 10.3% of vessels which have been excluded from the analysis.

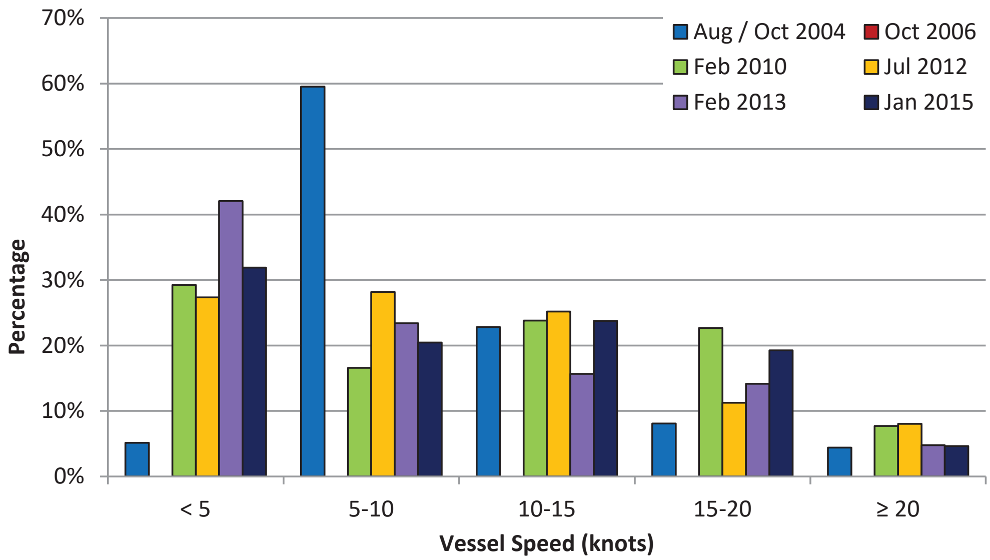


Figure 2.6 Northern Irish Sea – Average Speed Distribution

It can be concluded that the distribution of vessel average speeds has not differed significantly throughout the survey periods with variations most likely due to the prevailing season / meteorological conditions. The average speed of vessels ranged from a minimum of 7.9 knots (Feb. 2013) to a maximum of 10.3 knots (Aug. / Oct. 2004). Although the prevalence of wind farm craft would suggest a combined increase in speeds in the area this has not occurred, mostly likely to vessels transiting at higher speed to the site but operating at lower speeds within, creating a lower average speed.

Overall other than an increase in smaller vessels associated with the wind farm developments (construction as well as operations and maintenance) no significant changes are noted within the parameters of the assessments currently undertaken on the available datasets. It is acknowledged that further and more detailed assessment may highlight changes within the length of the vessels operating within the study area, given known vessel trends, however this is not considered within the scope of this report.

3. Northern Irish Sea – Summary of Changes

Table 3.1 summarises the main commercial routeing changes identified within the northern Irish Sea area from the first data collected in 2004 through to 2015. It does not specifically identify operators unless that operator is the sole or main user of an individual route; and therefore the specific details of a route prior to a change may not always be clear. Fishing activity and recreational transits that have potentially been impacted by these developments have not been considered.

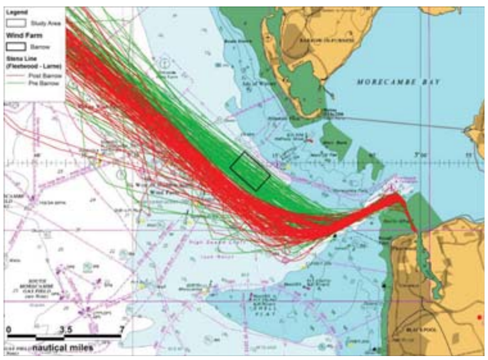
Table 3.1 Summary of Routeing Changes Identified in the Northern Irish Sea

Route Impacted	Identified Change	Main Reason For Change	Other Comments
Changes due to wind farm construction			
Fleetwood to Larne RoRo	Vessels operating on the Stena Line Fleetwood to Larne RoRo service altered route to pass to the south west of the Barrow OWF site boundary, as illustrated in Figure 3.1.1. Vessels pass post construction at an average of 0.98nm from the site boundary.	Minor route alteration following the construction of the ***Barrow OWF.***	Direct impact – Associated with the construction of the wind farm.
Glasson Dock – Ramsey (Isle of Man)	The *Silver River* altered its route to pass to the south of the Ormonde OWF and north east of Walney Phase 2 OWF, as illustrated in Figure 3.1.2.	Minor route alteration to take account of ***Barrow, Ormonde, Walney 1 and 2*** developments.	In combination impact – Associated with the construction of the wind farms.
Heysham to Belfast RoRo	Required to alter route to the north east whilst passing the Walney Phase 2 OWF.	Likely to allow increased passing distance from ***Barrow, Ormonde and Walney 1 & 2*** as illustrated in Figure 3.1.3.	In combination impact – Associated with the construction of the wind farms.
Heysham - Douglas passenger ferry	Prior to the construction of the West of Duddon Sands OWF the passenger ferry passed through the site boundary. Following construction of the West of	Minor route alteration following the construction of the ***West of Duddon Sands OWF***.	Direct impact – Associated with the construction of the wind

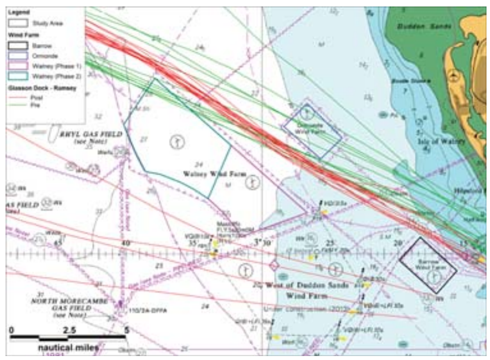
Route Impacted	Identified Change	Main Reason For Change	Other Comments
	Duddon Sands OWF the passenger ferry service altered route to pass to the south west of the site boundary, as illustrated in Figure 3.1.4. Vessels pass post construction at an average of 0.99nm from the West of Duddon Sands OWF site boundary.		farm.
Heysham – Belfast RoRo	Prior to the construction of the West of Duddon Sands OWF, the RoRo would on occasion alternate from its standard route, transiting to the west of the Walney OWF It is most likely that this alternate western route is used during periods of adverse weather site and passes through the West of Duddon Sands OWF site boundary. Following construction of the West of Duddon Sands OWF, vessels operating on the Heysham – Belfast western alternative route altered route to pass to the south west of the site boundary, as illustrated in Figure 3.1.5. Vessels pass post construction at an average of 0.88nm from the West of Duddon Sands OWF site boundary.	Minor route alteration following the construction of the ***West of Duddon Sands OWF***. It is most likely that this alternate western route is used during periods of adverse weather only.	Direct Impact – Associated with the construction of the wind farm.
Changes due to other infrastructure or routeing measure changes			
Heysham to Dublin RoRo	The Heysham – Dublin RoRo service previously passed to the south of the South Morecambe and Calder Gas Fields. However, following a change in the operator of this route (Norfolkline to Seatruck	It is likely that the change in operator triggered this routeing change.	Independent Change **although not specifically the purpose of this report*

Route Impacted	Identified Change	Main Reason For Change	Other Comments
	Ferries) the routeing altered with the newly operated Seatruck Ferries route passing to the north of the South Morecambe Gas Field, as illustrated in Figure 3.2.1.		*has been included for context of routeing changes.*
Heysham – Warrenpoint RoRo	Route previously passed both north and south of the North Morecambe Gas Field.	The only vessel recorded passing to the north of the North Morecambe Gas Field was the *Merchant Vessel (MV) Arrow*. Following the removal of the *MV Arrow* from this route, the remaining vessels were only recorded passing to the south of the North Morecambe Gas Field, as illustrated in Figure 3.2.2	Independent Change**although not specifically the purpose of this report has been included for context of routeing changes.*

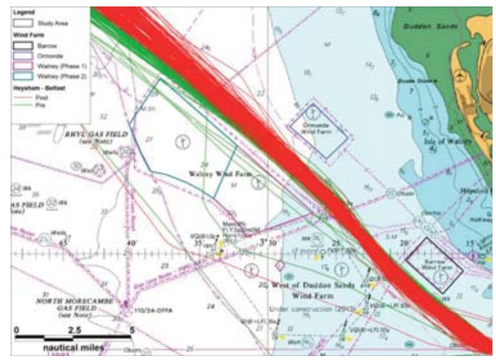
Figure 3.1 presents the commercial routeing changes that have occurred directly because of the construction of wind farms and Figure 3.2 presents changes attributed to other infrastructure and routeing measure changes as identified in Table 3.1.



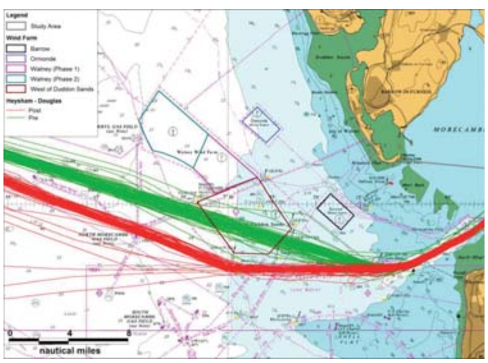
3.1.1 Fleetwood – Larne. Post Barrow (Oct. 2006)



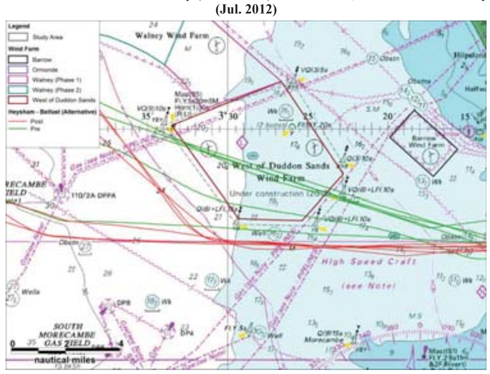
3.1.2 Glasson Dock – Ramsey (Isle of Man). Post Barrow, Ormonde and Walney (Jul. 2012)



3.1.3 Heysham – Belfast. Post Barrow, Ormonde and Walney (Jul. 2012)



3.1.4 Heysham – Douglas (Isle of Man). Post Barrow, Ormonde, Walney and West of Duddon Sands (Jan. 2015)



3.1.5 Heysham – Belfast (Alternative). Post Barrow, Ormonde, Walney and West of Duddon Sands (Jan. 2015)

Figure 3.1 Northern Irish Sea – Routeing Changes Due to Wind Farm Construction©

3.2.1 Heysham – Dublin. Post Barrow, Ormonde and Walney (Jul. 2012)

3.2.2 Heysham – Warrenpoint. Post Barrow, Ormonde and Walney (Jul. 2012)

Figure 3.2 Northern Irish Sea – Routeing Changes Due to Other Infrastructure or Routeing Measure Change©

4. Southern Irish Sea Area

4.1 Introduction

Table 4.1 summarises key details of the wind farm developments considered within the southern Irish Sea study area. Following this, Figure 4.1 illustrates the location of the wind farms considered in Table 4.1 and the study area. Within this study area any significant changes to infrastructure or routeing measures have been identified in order to assess the reasoning behind commercial routeing changes in that area.

Table 4.1 Wind Farm Summary – Southern Irish Sea

Wind Farm	Capacity (MW)	Turbines	Construction Start Date	Construction End Date	Commissioning Date
North Hoyle	60	30	3rd Apr 2003	31st Mar 2004	Jun 2004
Burbo Bank	90	25	10th Jun 2006	29th Jun 2007	18th Oct 2007
Rhyl Flats	90	25	Jun 2007	Oct 2009	2nd Dec 2009
Gwynt y Mor	576	160	27th Jan 2012	Apr 2015	18th Jun 2015

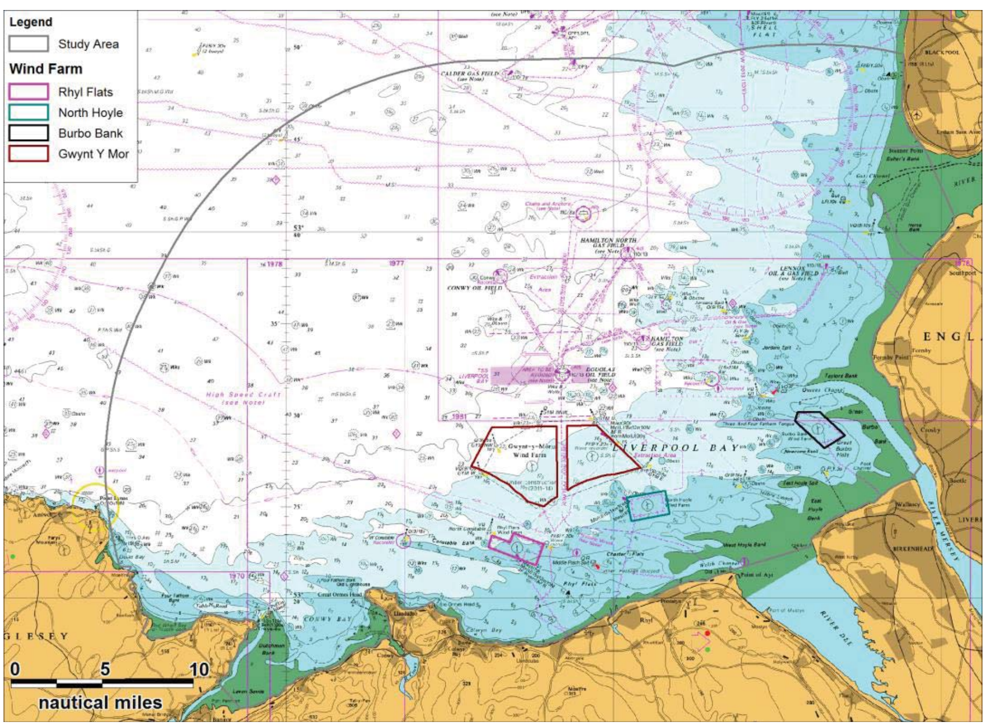


Figure 4.1 Southern Irish Sea Overview©

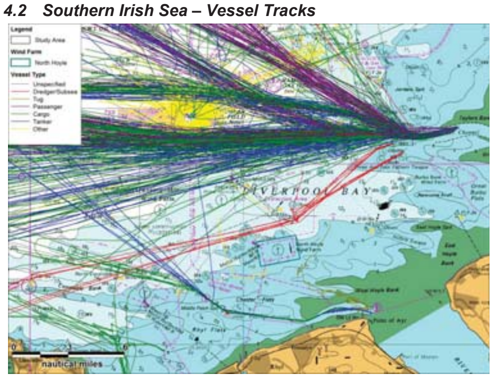
Table 4.2 summarises the data periods assessed in order to identify the impact of these wind farms on commercial vessel routeing. The status (pre or post construction) of each wind farm development considered within this study area during each respective survey period is also indicated.

Table 4.2 Summary of Data Periods – Southern Irish Sea

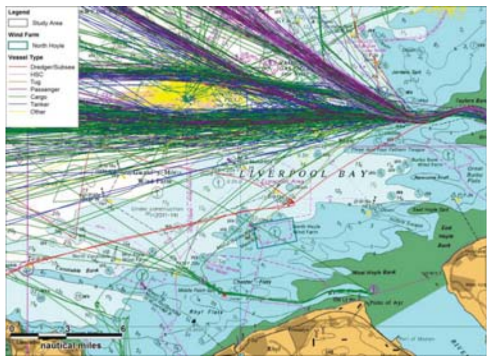
Period	Duration	Wind Farm Status
1. December 2004	14 days	Post North Hoyle
December 2004 – Significant changes to AIS legislation		
2. March 2005	14 days	Post North Hoyle Pre Burbo Bank
3. May / June 2007	28 days	Post North Hoyle Post Burbo Bank Pre Rhyl Flats
4. December 2009 / January 2010	28 days	Post North Hoyle Post Burbo Bank Post Rhyl Flats
5. December 2011	28 days	Post North Hoyle Post Burbo Bank Post Rhyl Flats Pre Gwynt y Mor
6. July 2015	28 days	Post North Hoyle Post Burbo Bank Post Rhyl Flats Post Gwynt y Mor

The following sections present the vessel tracks recorded during each survey period (Section 4.2), vessel density grids (Section 4.3) and the main route 90^{th} percentiles (Section 4.4).

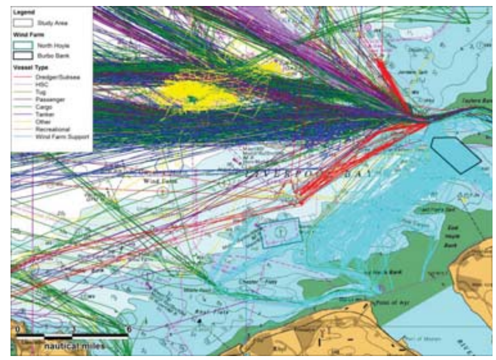
4.2 Southern Irish Sea – Vessel Tracks



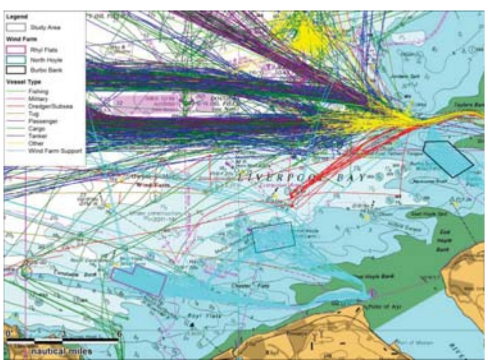
1. Dec 2004 (Post North Hoyle)



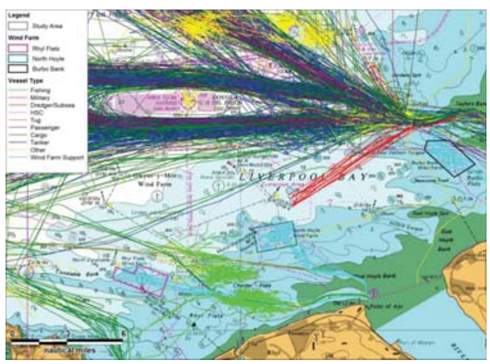
2. Mar 2005 (Post North Hoyle, Pre Burbo Bank)



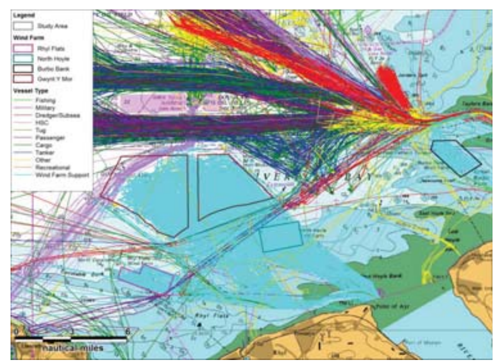
3. May / Jun 2007 (Post North Hoyle, Post Burbo Bank, Pre Rhyl Flats)



4. Dec 2009 / Jan 2010 (Post North Hoyle, Post Burbo Bank, Post Rhyl Flats)



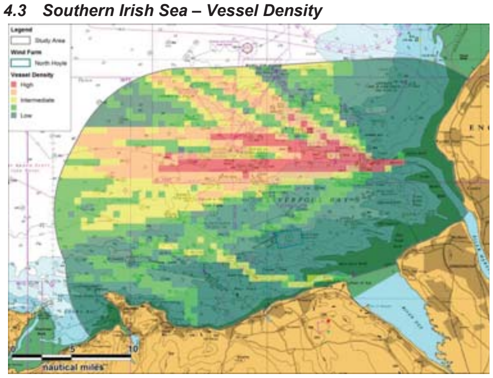
5. Dec 2011 (Post North Hoyle, Post Burbo Bank, Post Rhyl Flats, Pre Gwynt y Mor)



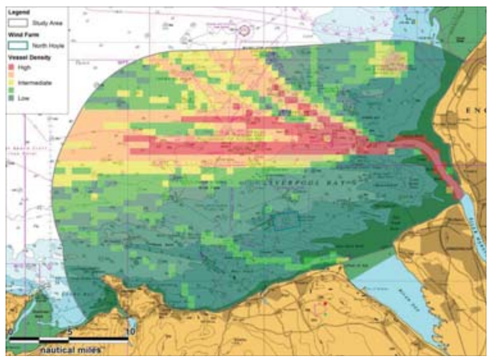
6. Jul 2015 (Post North Hoyle, Post Burbo Bank, Post Rhyl Flats, Post Gwynt y Mor)

Figure 4.2 Southern Irish Sea – Vessel Type ©

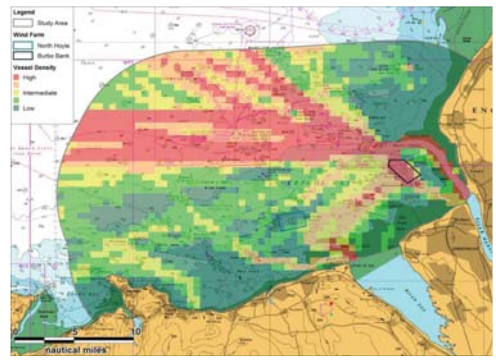
4.3 Southern Irish Sea – Vessel Density



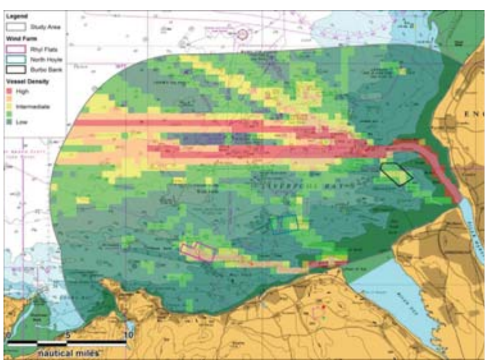
1. Dec 2004 (Post North Hoyle)



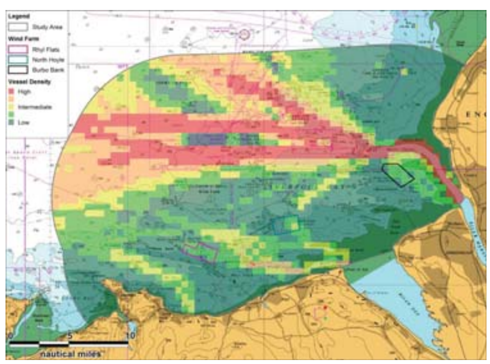
2. Mar 2005 (Post North Hoyle, Pre Burbo Bank)



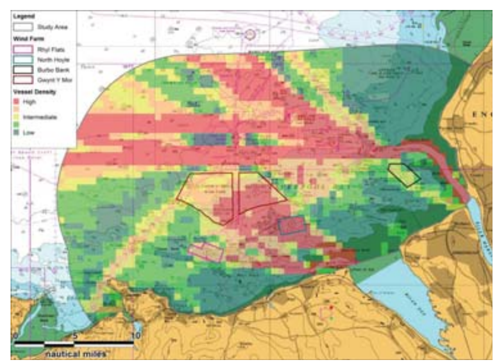
3. May / Jun 2007 (Post North Hoyle, Post Burbo Bank, Pre Rhyl Flats)



4. Dec 2009 / Jan 2010 (Post North Hoyle, Post Burbo Bank, Post Rhyl Flats)



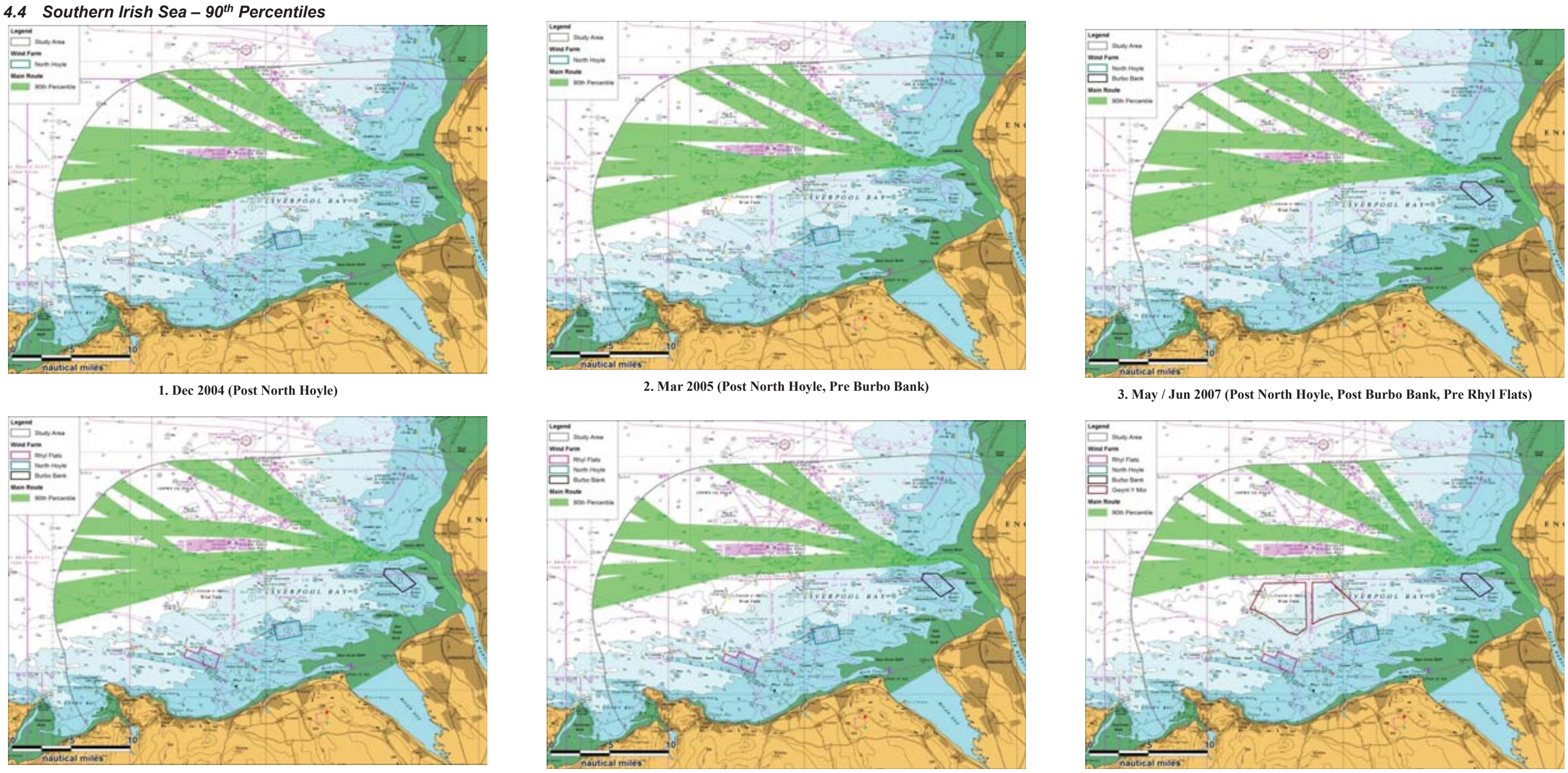
5. Dec 2011 (Post North Hoyle, Post Burbo Bank, Post Rhyl Flats, Pre Gwynt y Mor)



6. Jul 2015 (Post North Hoyle, Post Burbo Bank, Post Rhyl Flats, Post Gwynt y Mor)

Figure 4.3 Southern Irish Sea – Vessel Density ©

4.4 Southern Irish Sea – 90th Percentiles



1. Dec 2004 (Post North Hoyle)

2. Mar 2005 (Post North Hoyle, Pre Burbo Bank)

3. May / Jun 2007 (Post North Hoyle, Post Burbo Bank, Pre Rhyl Flats)

4. Dec 2009 / Jan 2010 (Post North Hoyle, Post Burbo Bank, Post Rhyl Flats)

5. Dec 2011 (Post North Hoyle, Post Burbo Bank, Post Rhyl Flats, Pre Gwynt y Mor)

6. Jul 2015 (Post North Hoyle, Post Burbo Bank, Post Rhyl Flats, Post Gwynt y Mor)

Figure 4.4 Southern Irish Sea – 90th Percentiles ©

4.5 Southern Irish Sea – AIS Analysis

The following subsection presents analysis (vessel length and average speed) of the AIS data collected throughout each survey period for the southern Irish Sea study area. The purpose of this analysis is to identify wider trends in the size and movement of vessels following the development of offshore wind farms within the southern Irish Sea.

Figure 4.5 presents the distribution of vessel lengths recorded throughout each survey period. It should be noted that throughout all survey periods, approximately 1.8% of vessels recorded within the study area did not specify a vessel length and have been excluded from the analysis.

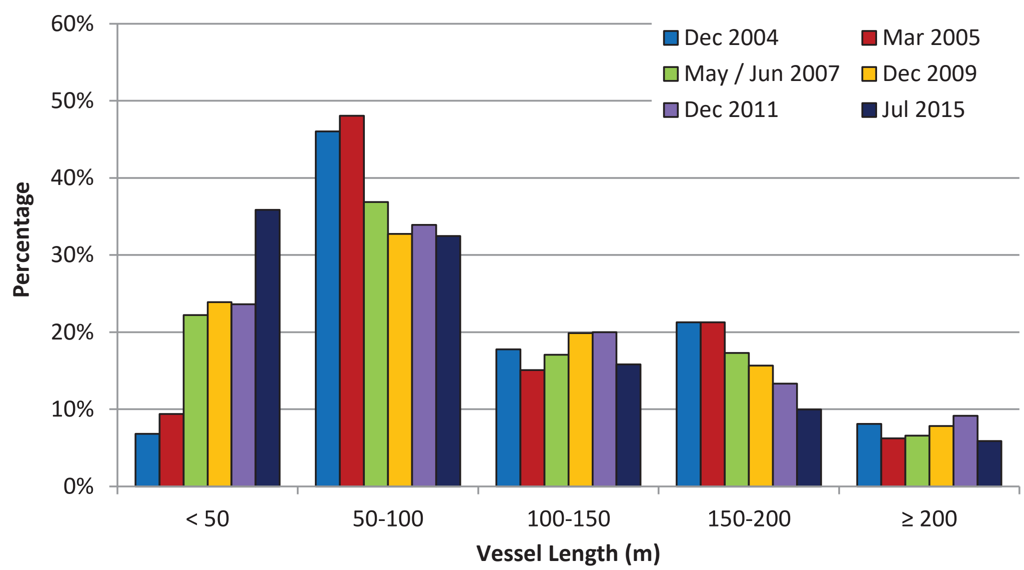


Figure 4.5 Southern Irish Sea – Vessel Length Distribution

The relative proportion of vessels measuring <50m in length has steadily increased over the survey periods, peaking in July 2015 (35.9% of marine traffic). There has also been a corresponding decrease in the proportion of larger vessels (50-100m and 150-200m) recorded within the study area. As per the northern Irish Sea study area, these changes are again due to the increased uptake of AIS in smaller vessels in later years and the increased number of operational wind farm support vessels.

The relative proportions of 100-150m and ≥200m vessels have remained stable throughout all survey periods. The prevalence of very large vessels (≥200m) within the study area is higher when compared to the northern Irish Sea study area, average of 7.3% across all surveys in southern Irish Sea study area compared to 0.7% in northern Irish Sea study area. This is due to the increased number of very large vessels on approach to / exiting Mersey ports within the southern Irish Sea study area.

Figure 4.6 presents the distribution of average vessel speeds recorded throughout each survey period. It should be noted that throughout all survey periods, speed information was not available for approximately 8.8% of vessels which have been excluded from the analysis.

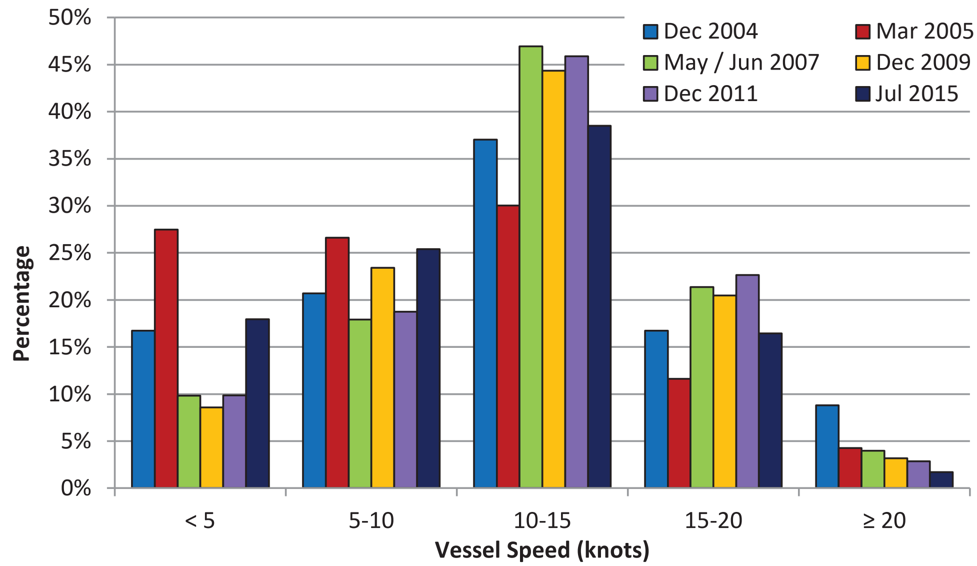


Figure 4.6 Southern Irish Sea – Average Speed Distribution

It can be concluded that the distribution of vessel average speeds has not differed significantly throughout the survey periods with variations most likely due to the prevailing season / meteorological conditions. The average speed of vessels ranged from a minimum of 9.4 knots (Mar. 2005) to a maximum of 11.8 knots (Dec. 2011).

Overall other than an increase in smaller vessels associated with the wind farm developments (construction as well as operations and maintenance) no significant changes are noted within the parameters of the assessments currently undertaken on the available datasets. It is acknowledged that further and more detailed assessment may highlight changes within the length of the vessels operating within the study area, given known vessel trends, however this is not considered within the aims of this report.

5. Southern Irish Sea – Summary of Changes

Table 5.1 summarises the main commercial routeing changes identified within the southern Irish Sea area from the first data collected in 2004 through to 2015. It does not specifically identify operators unless that operator is the sole or main user of an individual route; and therefore the specific details of a route prior to a change may not always be clear.

It is noted that some of the Round 1 wind farms within the southern Irish Sea study area are nearshore and therefore out with areas where commercial navigation will occur. As already identified within this report fishing activity and recreational transits that potentially be impacted by these near shore developments have not been considered.

Table 5.1 Summary of Routeing Changes Identified in the Southern Irish Sea Area

Route Impacted	Identified Change	Main Reason For Change	Other Comments
Changes due to wind farm construction			
Liverpool / marine aggregate extraction area to east of Gwynt y Mor / Penrhyn	Marine aggregate dredgers operating between extraction area, Liverpool and Penrhyn. Although a minor deviation this route is a good example of how a wind farm construction has created a permanent but minor deviation for vessels operating between the extraction area and Penrhyn. Routeing change illustrated in Figure 5.1.	Construction of the ***Gwynt y Mor OWF***, causing minor displacement of the route. Vessel pass (post construction) at 0.3nm on average from the ***Gwynt y Mor OWF*** boundary.	Direct impact - Associated with the construction of the wind farm.
Mersey Ports outwards / inwards (various destinations)	Traffic in bound to the rive Mersey joins the southern (inward) Traffic Separation Scheme (TSS) lane sooner than pre-construction formalising traffic into more defined 90th percentiles. See Figure 5.2.	Construction of the ***Gwynt y Mor OWF***, which borders the southern boundary of the TSS and therefore prevents access from the south east at shallow angle.	Cumulative impact - See changes due to other infrastructure or routeing measures.
Changes due to other infrastructure or routeing measure changes			
Mersey Ports outwards / inwards (various destinations)	Although post construction of the Douglas Platform in 1996, traffic to and from the Mersey has naturally been displaced. Development of the Liverpool Bay TSS has seen traffic guided by the	Implementation of the Liverpool Bay TSS in July 2009. Although it is recognised that the construction of ***Gwynt y Mor OWF*** would have been a key factor given the	Cumulative impact - See changes due to wind farm construction.

Route Impacted	Identified Change	Main Reason For Change	Other Comments
	International Regulations for the Prevention of Collisions at Sea (COLREGs) Rule 10 (IMO, 2016), and the requirement for vessel to comply with particular traffic management within that area.	increases in traffic in the area. However not the sole reason given the location of the Douglas Platform and popularity of ports within the river Mersey. The TSS is seen as overarching traffic management mitigation and an in combination effect.	

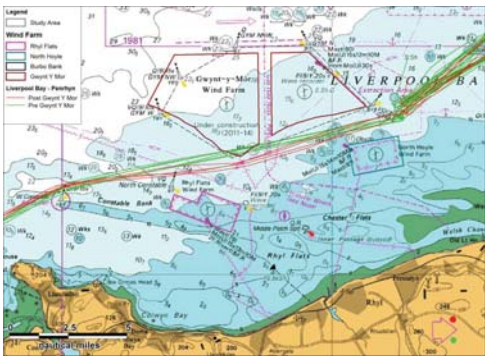


Figure 5.1 Liverpool Bay – Penrhyn (Dredging). Post Rhyl Flats, North Hoyle, Burbo Bank and Gwynt y Mor (Jul. 2015) ©

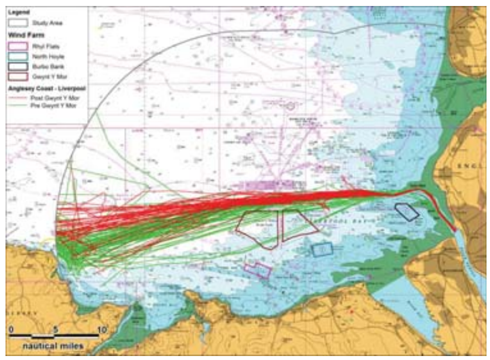


Figure 5.2 Mersey Ports Bound. Post Rhyl Flats, North Hoyle, Burbo Bank and Gwynt y Mor (Jul. 2015) ©

6. Humber Area

6.1 Introduction

Table 6.1 summarises key details of the wind farm developments considered within the Humber study area. Following this, Figure 6.1 illustrates the location of the wind farms considered in Table 6.1 and the study area. Within this study area any significant changes to infrastructure or routeing measures have been identified in order to assess the reasoning behind commercial routeing changes in that area.

Table 6.1 Wind Farm Summary – Humber

Wind Farm	Capacity (MW)	Turbines	Construction Start Date	Construction End Date	Commissioning Date
Inner Dowsing	97.2	27	Apr 2007	21st Oct 2008	Mar 2009
Lynn	97.2	27	Apr 2007	21st Oct 2008	Mar 2009
Sheringham Shoal	316.8	88	23rd Oct 2009	10th Jul 2012	30th Sep 2012
Lincs	270	75	10th Mar 2011	25th Mar 2013	23rd Sep 2013
Westermost Rough	210	35	Jul 2013	27th Mar 2015	26th May 2015
Humber Gateway	219	73	19th Jul 2013	23rd Apr 2015	5th Jun 2015

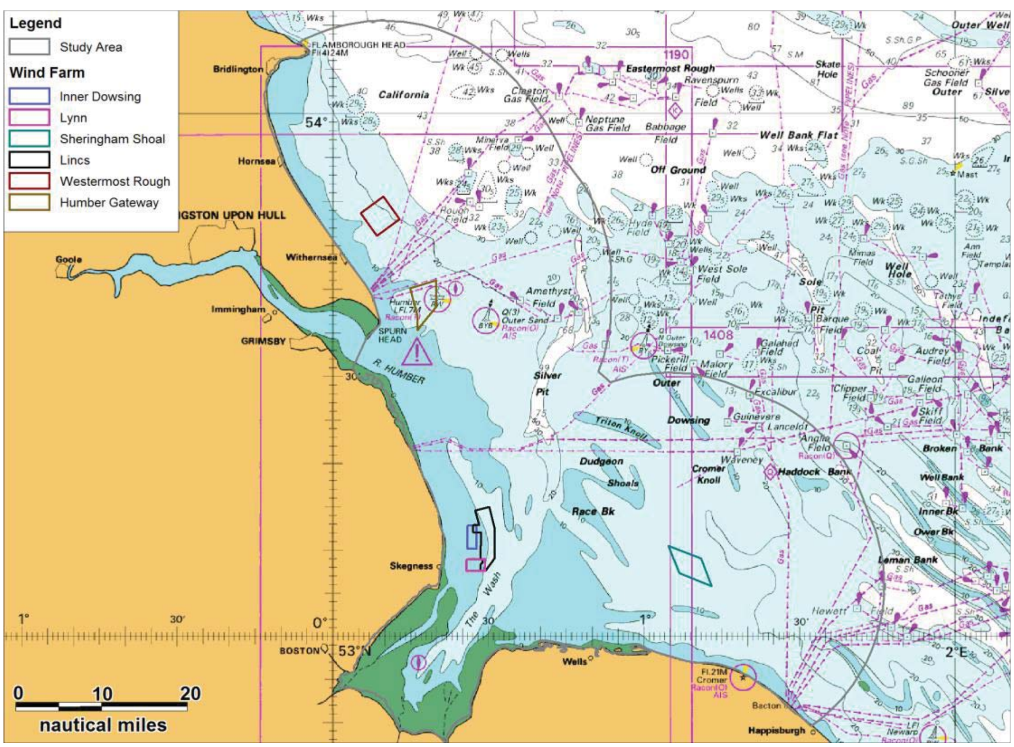


Figure 6.1 Humber Overview©

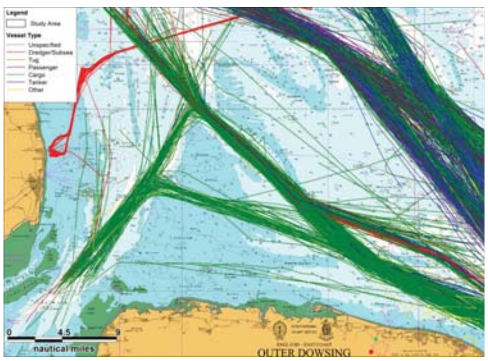
Table 6.2 summarises the data periods assessed in order to identify the impact of these wind farms on commercial vessel routeing. The status (pre-construction, constriction ongoing or post-construction) of each wind farm development considered within this study area during each respective survey period is also indicated.

Table 6.2 Summary of Data Periods – Humber

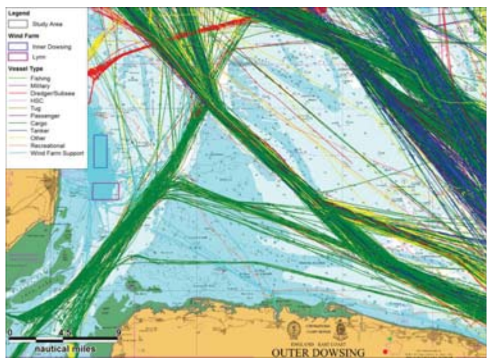
Period	Duration	Wind Farm Status
1. April 2006	28 days	Pre Inner Dowsing Pre Lynn
2. June 2009	28 days	Post Inner Dowsing Post Lynn Pre Sheringham Shoal
3. February 2011	28 days	Post Inner Dowsing Post Lynn Ongoing Construction Sheringham Shoal Pre Lincs
4. October 2012	28 days	Post Inner Dowsing Post Lynn Post Sheringham Shoal Ongoing Construction Lincs
5. June 2013	28 days	Post Inner Dowsing Post Lynn Post Sheringham Shoal Post Lincs Pre Humber Gateway Pre Westermost Rough
6. July 2015	28 days	Post Inner Dowsing Post Lynn Post Sheringham Shoal Post Lincs Post Humber Gateway Post Westermost Rough

The following sections present the vessel tracks recorded during each survey period (Section 6.2), vessel density grids (Section 6.3) and the main route 90th percentiles (Section 6.4).

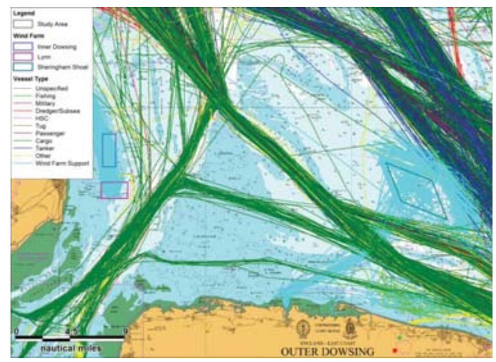
6.2 Humber – Vessel Tracks



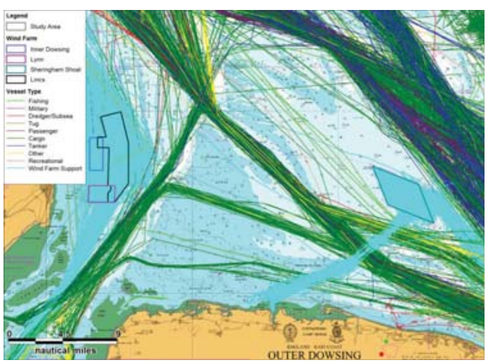
1. Apr 2006 (Pre Inner Dowsing, Pre Lynn)



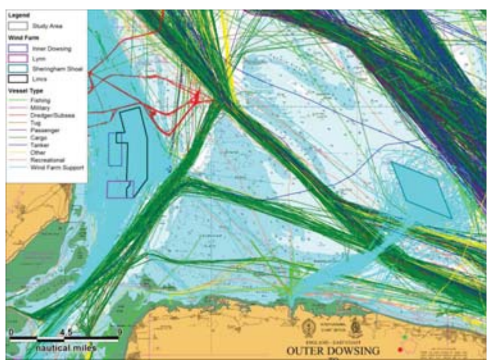
2. Jun 2009 (Post Inner Dowsing, Post Lynn, Pre Sheringham Shoal)



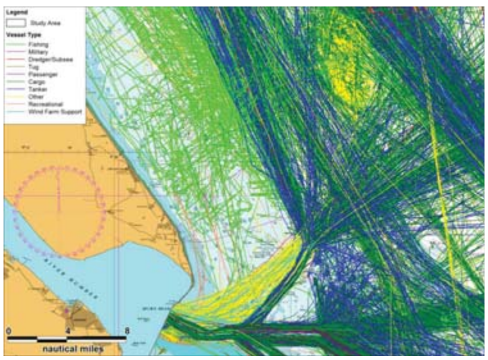
3. Feb 2011 (Post Inner Dowsing, Post Lynn, Construction ongoing Sheringham Shoal, Pre Lincs)



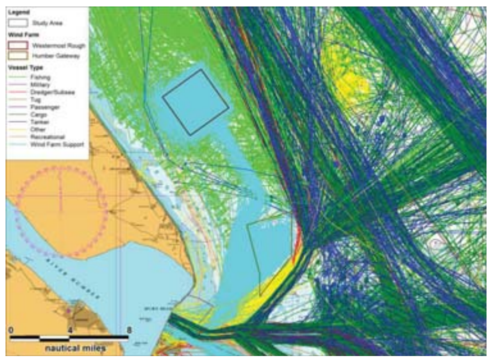
4. Oct 2012 (Post Inner Dowsing, Post Lynn, Post Sheringham Shoal, Construction ongoing Lincs)



5. Jun 2013 (Post Inner Dowsing, Post Lynn, Post Sheringham Shoal, Post Lincs)



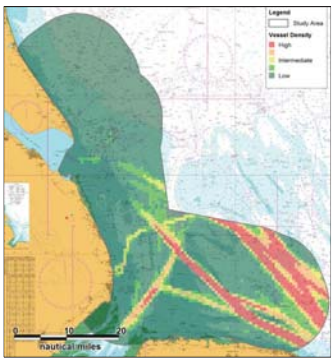
5. Jun 2013 (Pre Humber Gateway, Pre Westermost Rough)



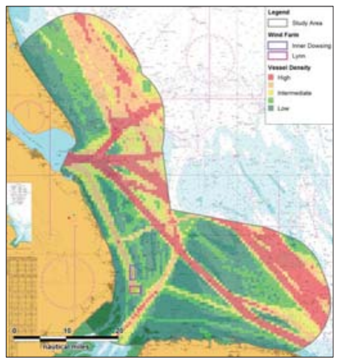
6. Jul 2015 (Post Humber Gateway, Post Westermost Rough)

Figure 6.2 Humber – Vessel Type©

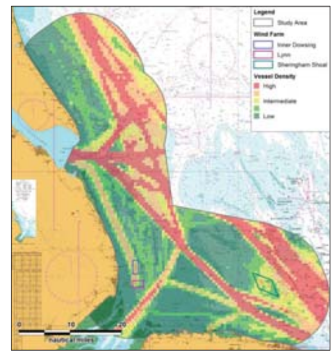
6.3 Humber – Vessel Density



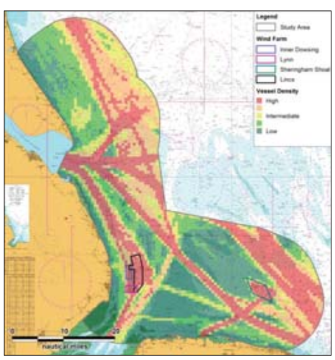
1. Apr 2006 (Pre Inner Dowsing, Pre Lynn)



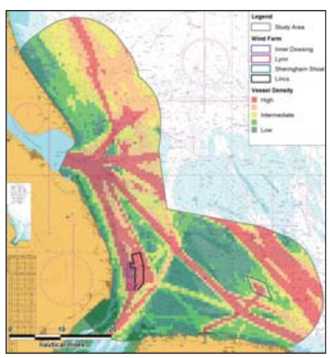
2. Jun 2009 (Post Inner Dowsing, Post Lynn, Pre Sheringham Shoal)



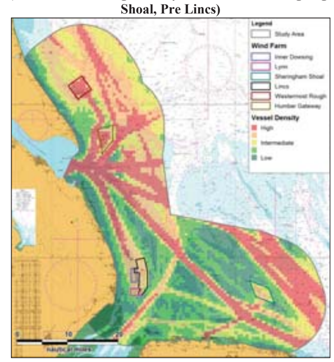
3. Feb 2011 (Post Inner Dowsing, Post Lynn, Construction ongoing Sheringham Shoal, Pre Lincs)



4. Oct 2012 (Post Inner Dowsing, Post Lynn, Post Sheringham Shoal, Construction ongoing Lincs)



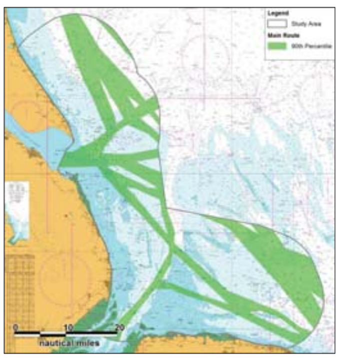
5. Jun 2013 (Post Inner Dowsing, Post Lynn, Post Sheringham Shoal, Post Lincs, Pre Humber Gateway, Pre Westermost Rough)



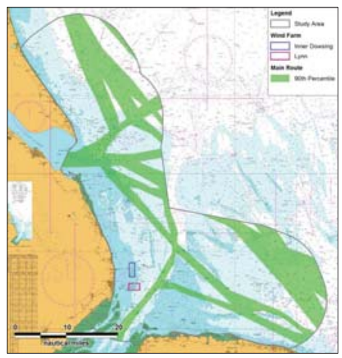
6. Jul 2015 (Post Inner Dowsing, Post Lynn, Post Sheringham Shoal, Post Lincs, Post Humber Gateway, Post Westermost Rough)

Figure 6.3 Humber – Vessel Density©

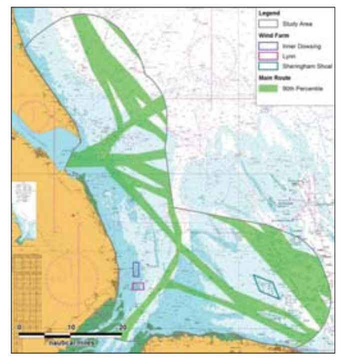
6.4 Humber – 90th Percentiles



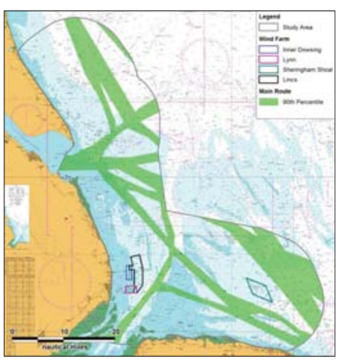
1. Apr 2006 (Pre Inner Dowsing, Pre Lynn)



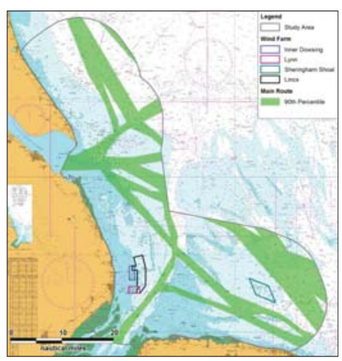
2. Jun 2009 (Post Inner Dowsing, Post Lynn, Pre Sheringham Shoal)



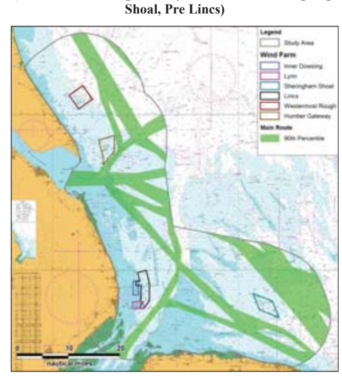
3. Feb 2011 (Post Inner Dowsing, Post Lynn, Construction ongoing Sheringham Shoal, Pre Lincs)



4. Oct 2012 (Post Inner Dowsing, Post Lynn, Post Sheringham Shoal, Construction ongoing Lincs)



5. Jun 2013 (Post Inner Dowsing, Post Lynn, Post Sheringham Shoal, Post Lincs, Pre Humber Gateway, Pre Westermost Rough)



6. Jul 2015 (Post Inner Dowsing, Post Lynn, Post Sheringham Shoal, Post Lincs, Post Humber Gateway, Post Westermost Rough)

Figure 6.4 Humber – 90th Percentiles©

6.5 Humber – AIS Analysis

The following subsection presents analysis (vessel size and average speed) of the AIS data collected throughout each survey period for the Humber study area. The purpose of this analysis is to identify wider trends in the size and movement of vessels following the development of offshore wind farms within the Humber sea area.

Figure 6.5 presents the distribution of vessel lengths recorded throughout each survey period. It should be noted that throughout all survey periods, approximately 2.0% of vessels recorded within the study area did not specify a vessel length and have been excluded from the analysis.

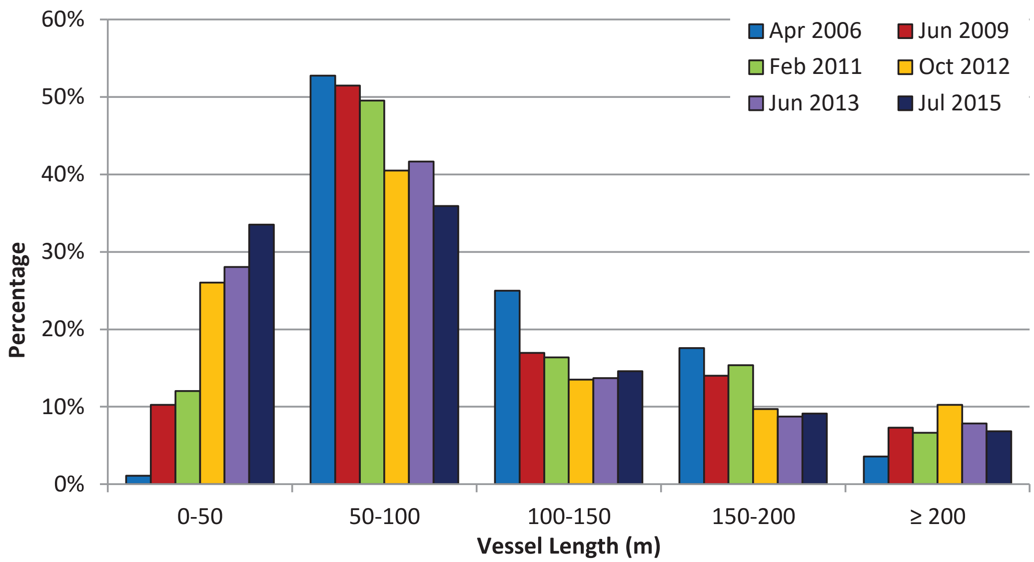


Figure 6.5 Humber – Vessel Length Distribution

The relative proportion of vessels measuring <50m in length has steadily increased over the survey periods, peaking in July 2015 (33.5% of marine traffic). There has also been a corresponding decrease in the proportion of larger vessels (50-100m, 100-150m and 150-200m) recorded within the study area. As per both the northern and southern Irish Sea study areas, these changes are again due to the increased uptake of AIS in smaller vessels in later years and the increased number of operational wind farm support vessels.

The prevalence of very large vessels (≥200m) within the study area has also steadily increased over the survey periods, peaking in Oct. 2012 (10.3% of marine traffic). This is most likely due to the wider trend within the shipping industry of increasing vessel size, in order to reduce the total number of transits to reduce costs, resulting in a corresponding increase in the proportion of these very large vessels within the Humber study area.

Figure 6.6 presents the distribution of average vessel speeds recorded throughout each survey period. It should be noted that speed information was not available for AIS data recorded throughout Jun. 2009. For all other survey periods, speed information was not available for approximately 6.6% of vessels which have been excluded from the analysis.

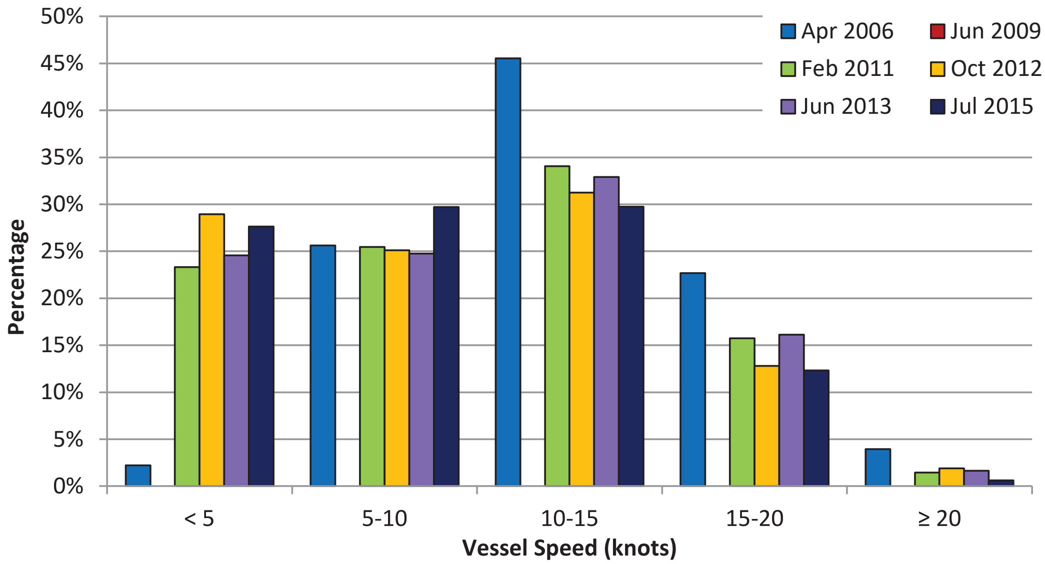


Figure 6.6 Humber – Average Speed Distribution

It can be concluded that the distribution of vessel average speeds has not differed significantly throughout the survey periods with variations most likely due to the prevailing season / meteorological conditions. The average speed of vessels ranged from a minimum of 8.5 knots (Jul. 2015) to a maximum of 12.6 knots (Apr. 2006).

Overall other than an increase in smaller vessels associated with the wind farm developments (construction as well as operations and maintenance) no significant changes are noted within the parameters of the assessments currently undertaken on the available datasets. It is acknowledged that further and more detailed assessment may highlight changes in the length of the vessels operating within the study area, given known vessel trends, however this is not considered within the scope of this report.

7. Humber – Summary of Changes

Table 7.1 summarises the main commercial routeing changes identified within the southern Humber area from the first data collected in 2006 through to 2015. It does not specifically identify operators unless that operator is the sole or main user of an individual route; and therefore the specific details of a route prior to a change may not always be clear.

It is noted that some of the round 1 wind farms within the southern Humber study area that are nearshore and therefore out with areas where commercial navigation will occur. As already identified within this report fishing activity and recreational transits could potentially have been impact by these near shore developments have not been considered.

Although some small commercials vessels were noted to have been displaced when looking at the pre and post AIS data, the actual number of vessels requiring alterations were considered to be insignificant and not a commercial vessel route amendment. Near shore wind farms which have a cumulative impact due to larger round 2 wind farms have been identified as such.

Table 7.1 Summary of Routeing Changes Identified in the Humber Area

Route Impacted	Identified Change	Main Reason For Change	Other Comments
Changes due to wind farm construction			
Humber area to Wash – inshore routeing	Increased passing distance to the east for vessels bound between the Humber and Wash estuaries on inshore routes. See Figure 7.1.	Construction of the ***Lincs OWF*** and also the construction of ***Lynn and Inner Dowsing OWFs****.	In combination impact – Associated with the construction of the wind farms.
Routes passing to the north east and south west of Sheringham Shoal.	Figure 7.2 demonstrates increased passing distances of vessels operating in proximity to the Sheringham Shoal OWF. However it is noted that routeing within the area is already constrained by the location of sand banks / shoals such as Race Bank and Dudgeon Shoal.	Construction of the ***Sheringham Shoal OWF***, however noting that the impact is on the Closest Point of Approach (CPA) of some vessels rather than the overall 90th percentile for the routes.	Direct impact – Associated with the construction of the wind farm.
North east approaches to the Humber through the	Slight route change and increased CPA following the construction of the Humber Gateway OWF, see Figure 7.3.	Amendments to the Humber TSS post 2009 have instigated the majority of changes to routeing in this area however the	Cumulative impact - See changes due to other infrastructure

Route Impacted	Identified Change	Main Reason For Change	Other Comments
New Sand Hole.		construction of the ***Humber Gateway OWF*** has also had some effects.	or routeing measures.
Vessels bound to / from NE Humber TSS.	Due to the construction of Westermost Rough OWF, traffic bound to /from the NE lane of the Humber TSS has increased its passing distance from the UK east coast and wind farm site, with some minor displacement of inshore vessels, see Figure 7.4.	Construction of the ***Westermost Rough OWF***. However the majority of vessels have not been impacted (only extremes of 90th percentile), and therefore no change to majority of vessel routeing in the area.	Direct impact associated with the construction of a wind farm.
Changes due to other infrastructure or routeing measure changes			
North east approaches to the Humber through the New Sand Hole.	Pre 2009 TSS traffic was routed into the Humber from three distinct directions: • The South East through Rosse Reach; • The East through Sea Reach; and • The North East through New Sand Hole. Post 2009 the TSS was extended to the NE.	The amendments to the Humber TSS were required for the purposes of separating opposing streams of traffic, better managing the flow of traffic in the general area and thus facilitating the preservation of navigational safety and the protection of the marine environment. This is an in combination impact due to the deep water anchorage, construction of ***Humber Gateway OWF*** (consent application submitted in 2008) and the general density of traffic entering the Humber from the north east approaches. See Figure 7.3.	Cumulative Impact - Please see changes due to wind farm construction.

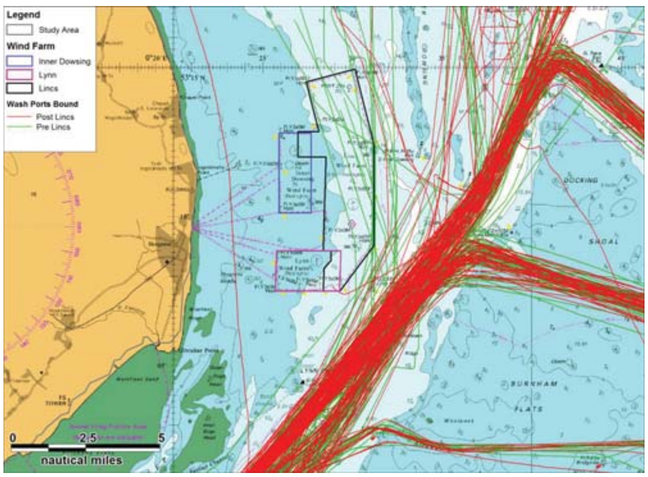
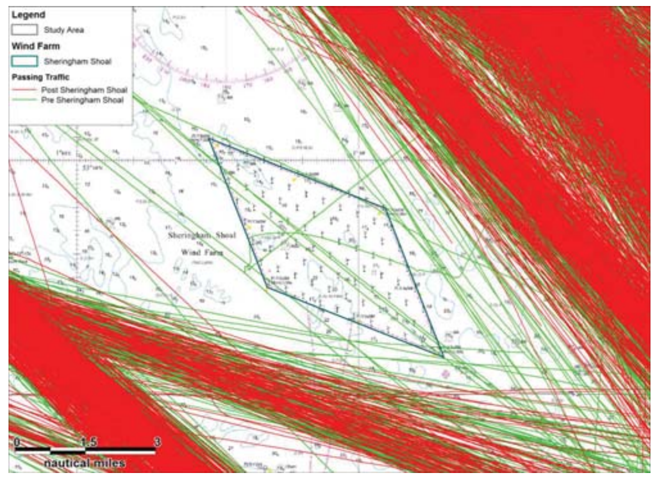


Figure 7.1 Humber – Wash (Inshore Routeing). Post Lynn, Inner Dowsing and Lincs (Jun. 2013) ©



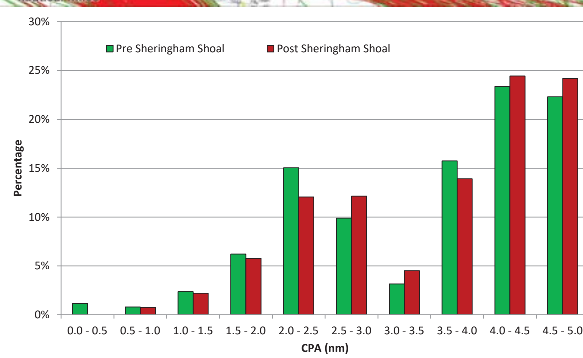


Figure 7.2 NE & SW Passing Traffic. Post Sheringham Shoal (Oct. 2012) ©

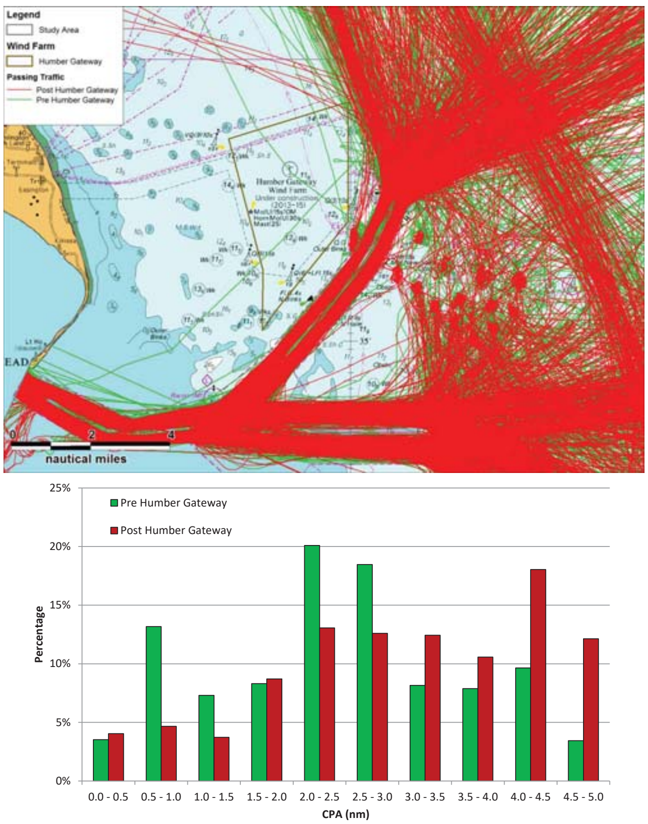


Figure 7.3 NE Approaches to Humber. Post Humber Gateway and Westermost Rough (Jul. 2015) ©

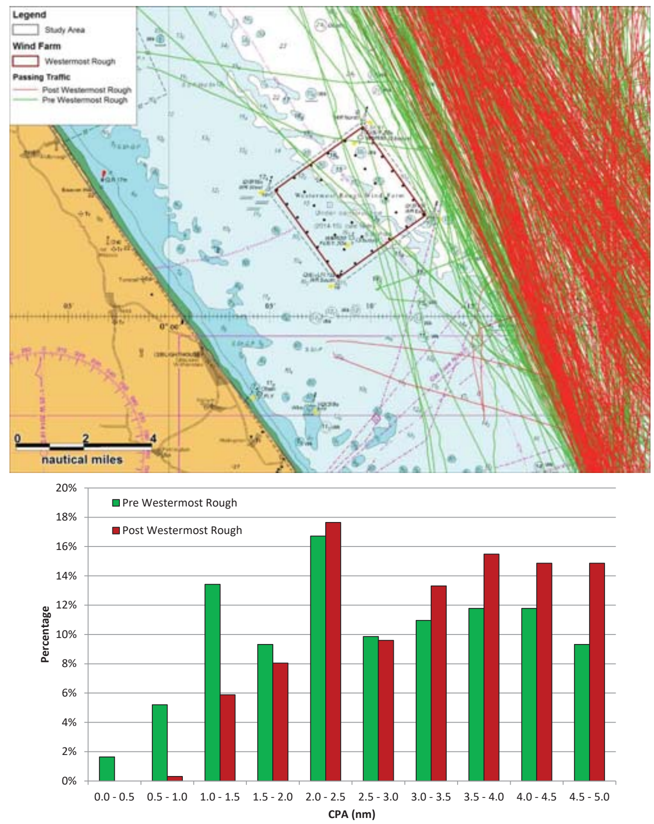


Figure 7.4 Humber NE TSS Traffic. Post Humber Gateway and Westermost Rough (Jul. 2015) ©

8. Thames Estuary & Kent Coast Area

8.1 Introduction

Table 8.1 summarises key details of the wind farm developments considered within the Thames Estuary and Kent Coast study area. Following this, Figure 8.1 illustrates the location of the wind farms considered in Table 8.1 and the study area. Within this study area any significant changes to infrastructure or routeing measures have been identified in order to assess the reasoning behind commercial routeing changes in that area.

Table 8.1 Wind Farm Summary – Thames Estuary & Kent Coast

Wind Farm	Capacity (MW)	Turbines	Construction Start Date	Construction End Date	Commissioning Date
Kentish Flats	90	30	22/08/2004	22/08/2005	Dec 2005
Gunfleet Sands	172.8	48	Apr 2008	23/01/2010	15/06/2010
Thanet	300	100	19/03/2009	28/01/2010	23/09/2010
Greater Gabbard	504	140	Jul 2009	09/03/2012	07/08/2013
London Array	630	175	02/01/2011	13/12/2012	06/04/2013
Gunfleet Sands Demonstration	12	2	07/07/2012	18/06/2013	12/09/2013
Kentish Flats Extension	49.5	15	22/10/2014	12/09/2015	02/12/2015

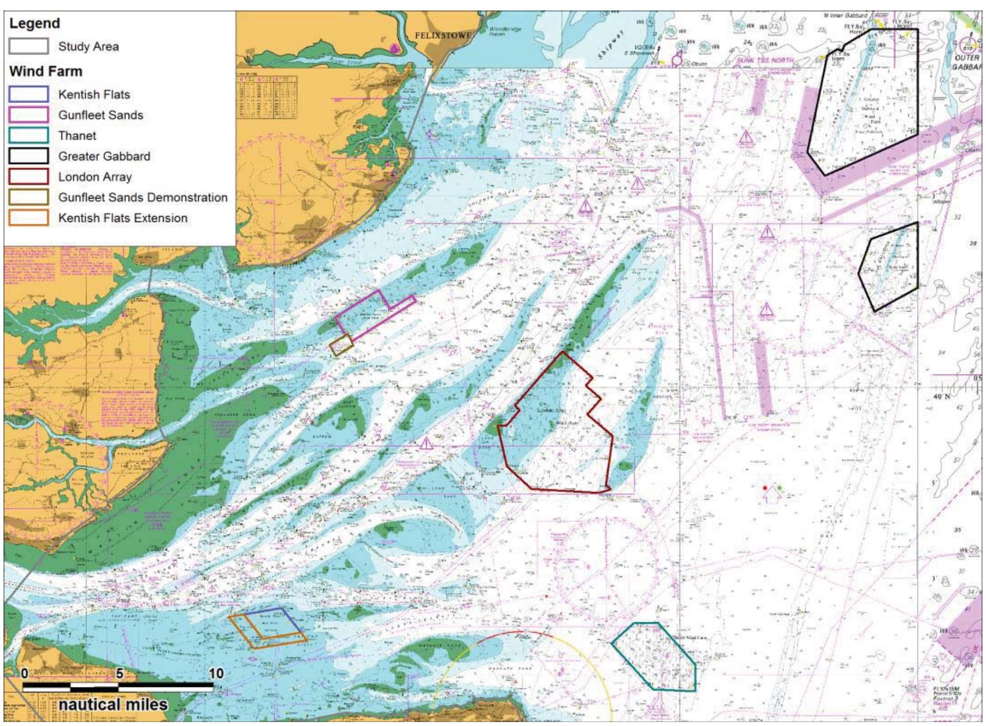


Figure 8.1 Thames Estuary & Kent Coast Overview ©

Table 8.2 summarises the data periods assessed in order to identify the impact of these wind farms on commercial vessel routeing. The status (pre-construction, construction ongoing or post-construction) of each wind farm development considered within this study area during each respective survey period is also indicated.

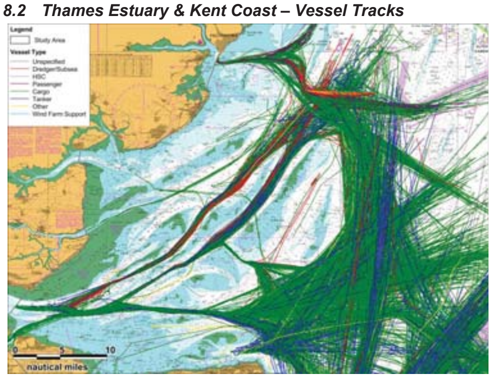
Table 8.2 Summary of Data Periods – Thames Estuary & Kent Coast

Period	Duration	Wind Farm Status
1. Sept. / Oct. 2004	28 days	Pre Kentish Flats
December 2004 – Significant changes to AIS legislation		
2. Mar. 2008	28 days	Post Kentish Flats Pre Gunfleet Sands Pre Thanet
3. May 2009	28 days	Post Kentish Flats Construction ongoing Gunfleet Sands Construction ongoing Thanet Pre Greater Gabbard
4. Feb. 2010	28 days	Post Kentish Flats Post Gunfleet Sands Post Thanet Construction ongoing Greater Gabbard Pre London Array
5. Jun. 2012	28 days	Post Kentish Flats Post Gunfleet Sands Post Thanet Construction ongoing Greater Gabbard Construction ongoing London Array Pre Gunfleet Sands Demonstration
6. Aug. 2013	28 days	Post Kentish Flats Post Gunfleet Sands Post Thanet Post Greater Gabbard Post London Array Post Gunfleet Sands Demonstration
7. Sept. 2014	28 days	Post Kentish Flats Post Gunfleet Sands Post Thanet Post Greater Gabbard Post London Array Post Gunfleet Sands Demonstration Pre Kentish Flats Extension
8. Oct. 2015	28 days	Post Kentish Flats Post Gunfleet Sands Post Thanet

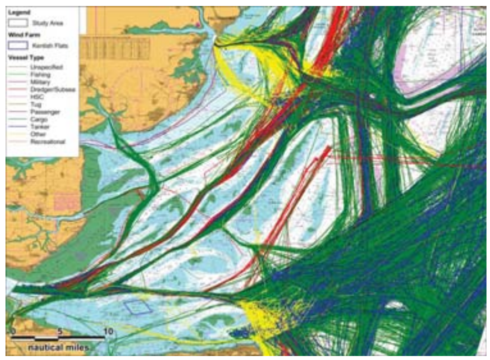
Period	Duration	Wind Farm Status
		Post Greater Gabbard Post London Array Post Gunfleet Sands Demonstration Post Kentish Flats Extension

The following sections present the vessel tracks recorded during each survey period (Section 8.2), vessel density grids (Section 8.3) and the main route 90th percentiles (Section 8.4).

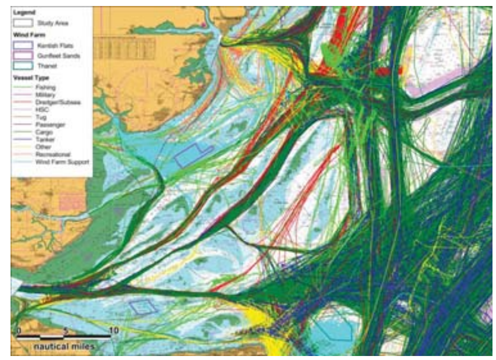
8.2 Thames Estuary & Kent Coast – Vessel Tracks



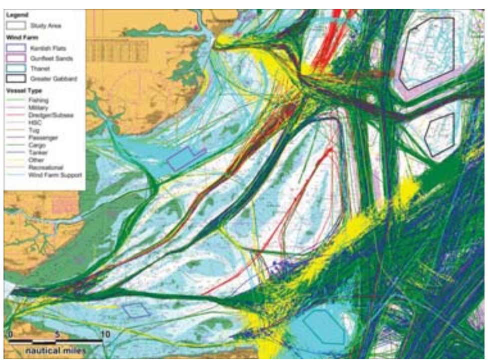
1. Sept. / Oct. 2004 (Pre Kentish Flats)



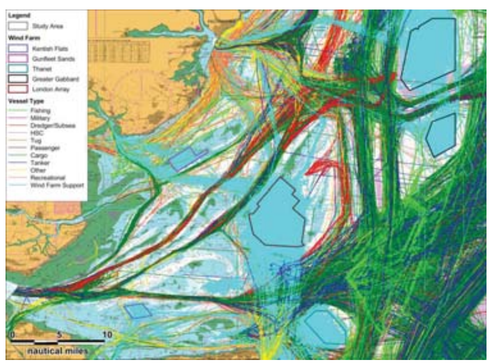
2. Mar. 2008 (Post Kentish Flats, Pre Gunfleet Sands, Pre Thanet)



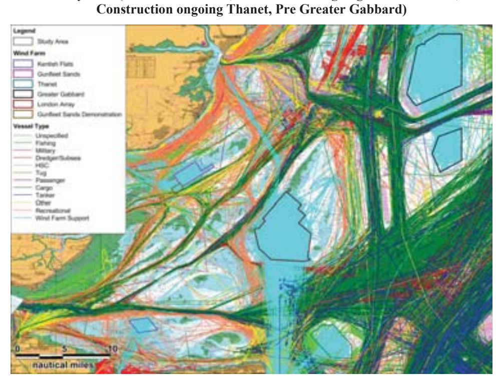
3. May 2009 (Post Kentish Flats, Construction ongoing Gunfleet Sands, Construction ongoing Thanet, Pre Greater Gabbard)



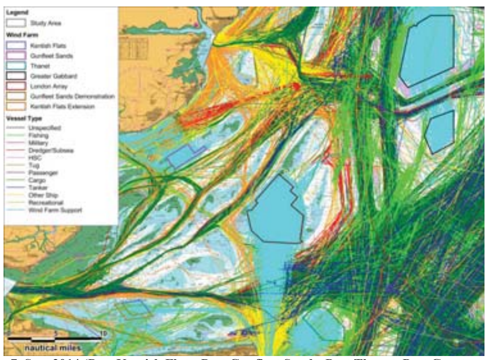
4. Feb. 2010 (Post Kentish Flats, Post Gunfleet Sands, Construction ongoing Thanet and Greater Gabbard, Pre London Array)



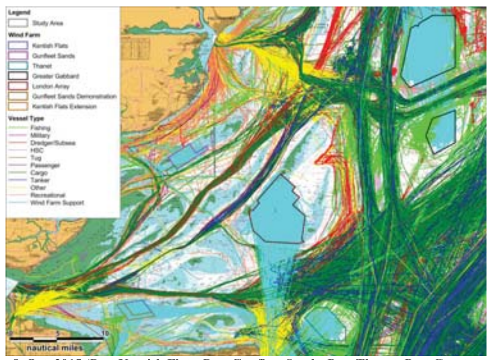
5. Jun 2012 (Post Kentish Flats, Post Gunfleet Sands, Post Thanet, Construction ongoing Greater Gabbard and London Array, Pre Gunfleet Sands Demonstration)



6. Aug. 2013 (Post Kentish Flats, Post Gunfleet Sands, Post Thanet, Post Greater Gabbard. Post London Array, Post Gunfleet Sands Demonstration)



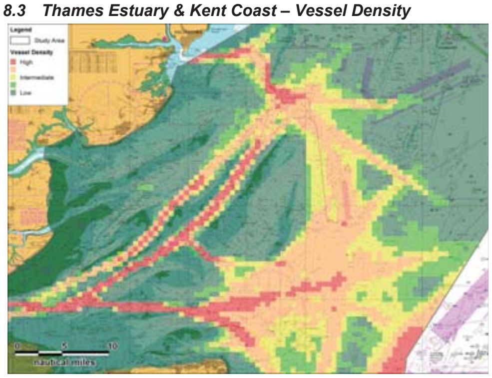
7. Sep. 2014 (Post Kentish Flats, Post Gunfleet Sands, Post Thanet, Post Greater Gabbard. Post London Array, Post Gunfleet Sands Demonstration, Pre Kentish Flats Extension)



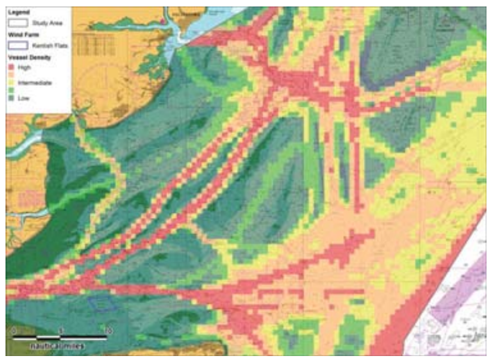
8. Oct. 2015 (Post Kentish Flats, Post Gunfleet Sands, Post Thanet, Post Greater Gabbard. Post London Array, Post Gunfleet Sands Demonstration, Post Kentish Flats Extension)

Figure 8.2 Thames Estuary & Kent Coast – Vessel Type ©

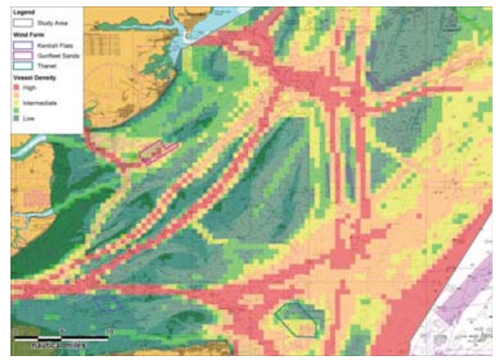
8.3 *Thames Estuary & Kent Coast – Vessel Density*



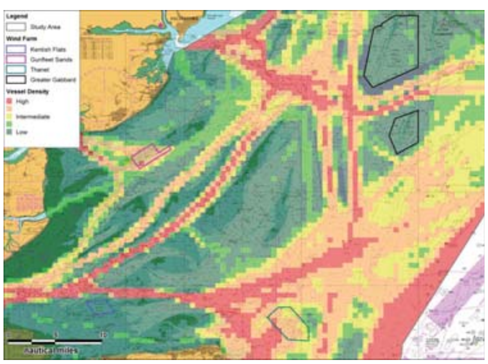
1. Sept. / Oct. 2004 (Pre Kentish Flats)



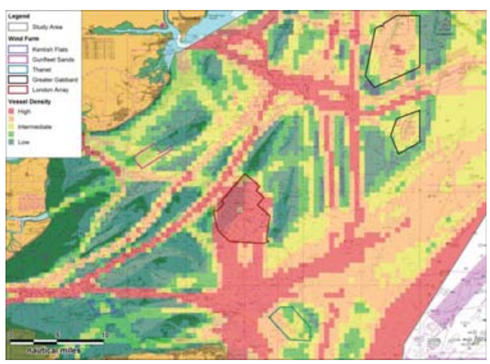
2. Mar. 2008 (Post Kentish Flats, Pre Gunfleet Sands, Pre Thanet)



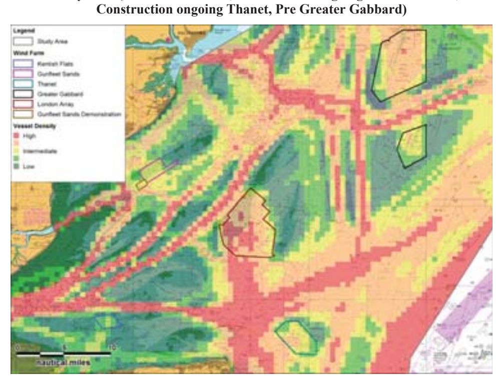
3. May 2009 (Post Kentish Flats, Construction ongoing Gunfleet Sands, Construction ongoing Thanet, Pre Greater Gabbard)



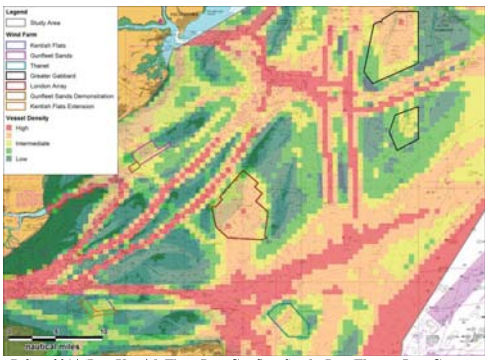
4. Feb. 2010 (Post Kentish Flats, Post Gunfleet Sands, Construction ongoing Thanet and Greater Gabbard, Pre London Array)



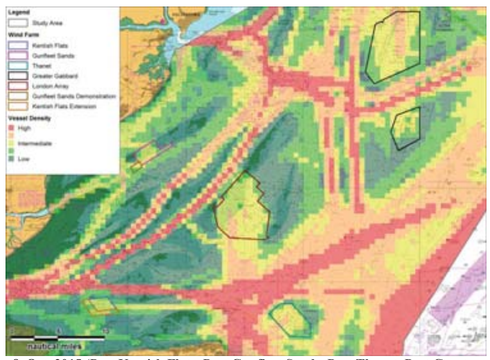
5. Jun 2012 (Post Kentish Flats, Post Gunfleet Sands, Post Thanet, Construction ongoing Greater Gabbard and London Array, Pre Gunfleet Sands Demonstration)



6. Aug. 2013 (Post Kentish Flats, Post Gunfleet Sands, Post Thanet, Post Greater Gabbard. Post London Array, Post Gunfleet Sands Demonstration)



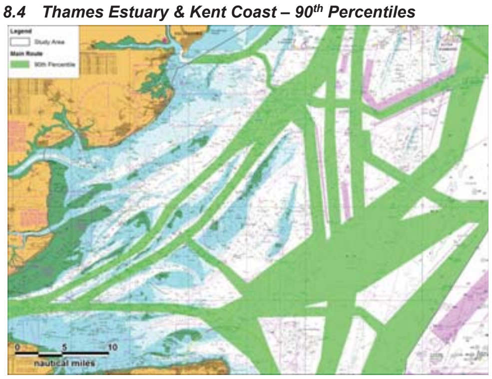
7. Sep. 2014 (Post Kentish Flats, Post Gunfleet Sands, Post Thanet, Post Greater Gabbard. Post London Array, Post Gunfleet Sands Demonstration, Pre Kentish Flats Extension)



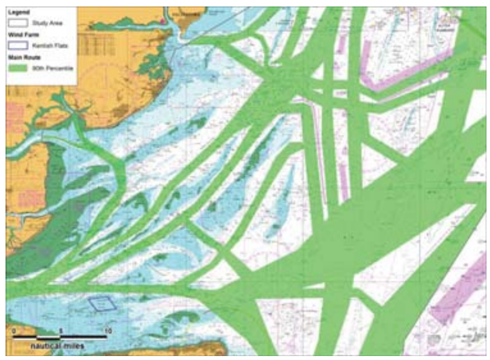
8. Oct. 2015 (Post Kentish Flats, Post Gunfleet Sands, Post Thanet, Post Greater Gabbard. Post London Array, Post Gunfleet Sands Demonstration, Post Kentish Flats Extension)

Figure 8.3 Thames Estuary & Kent Coast – Vessel Density©

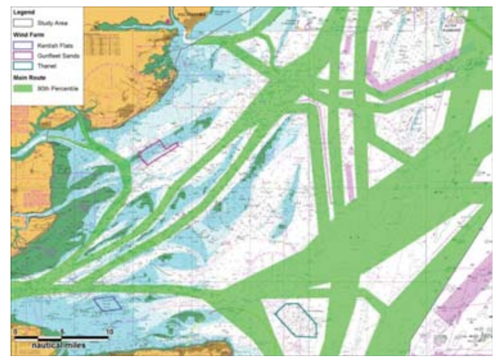
8.4 Thames Estuary & Kent Coast – 90th Percentiles



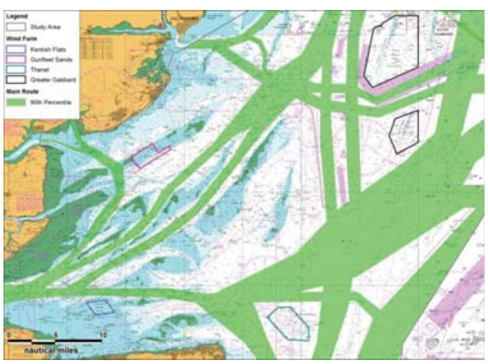
1. Sept. / Oct. 2004 (Pre Kentish Flats)



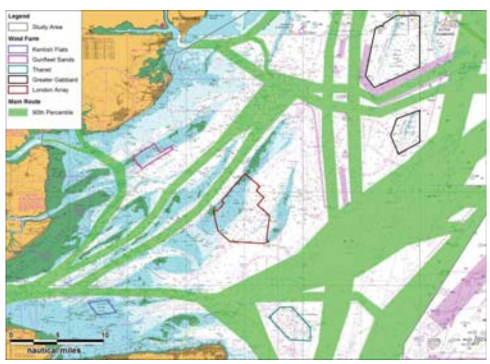
2. Mar. 2008 (Post Kentish Flats, Pre Gunfleet Sands, Pre Thanet)



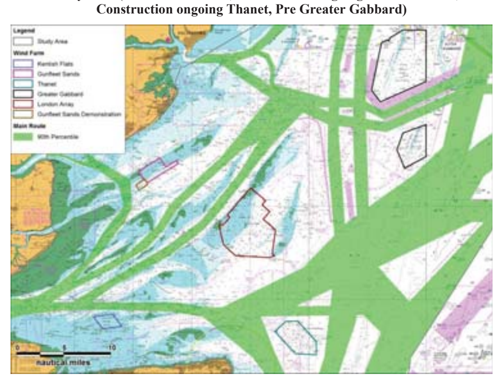
3. May 2009 (Post Kentish Flats, Construction ongoing Gunfleet Sands, Construction ongoing Thanet, Pre Greater Gabbard)



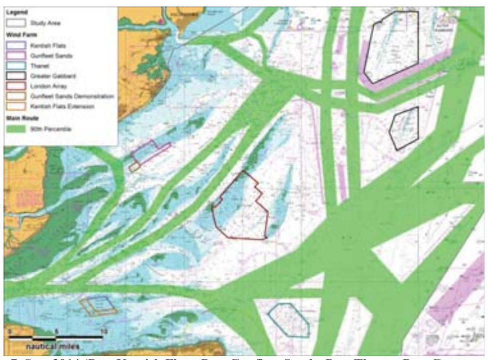
4. Feb. 2010 (Post Kentish Flats, Post Gunfleet Sands, Construction ongoing Thanet and Greater Gabbard, Pre London Array)



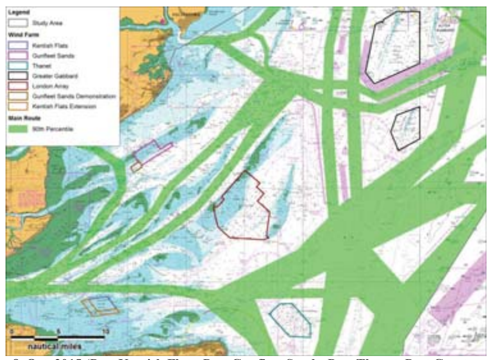
5. Jun 2012 (Post Kentish Flats, Post Gunfleet Sands, Post Thanet, Construction ongoing Greater Gabbard and London Array, Pre Gunfleet Sands Demonstration)



6. Aug. 2013 (Post Kentish Flats, Post Gunfleet Sands, Post Thanet, Post Greater Gabbard, Post London Array, Post Gunfleet Sands Demonstration)



7. Sep. 2014 (Post Kentish Flats, Post Gunfleet Sands, Post Thanet, Post Greater Gabbard. Post London Array, Post Gunfleet Sands Demonstration, Pre Kentish Flats Extension)



8. Oct. 2015 (Post Kentish Flats, Post Gunfleet Sands, Post Thanet, Post Greater Gabbard. Post London Array, Post Gunfleet Sands Demonstration, Post Kentish Flats Extension)

Figure 8.4 Thames Estuary & Kent Coast – 90th Percentiles©

8.5 Thames Estuary & Kent Coast – AIS Analysis

The following subsection presents analysis (vessel size and average speed) of the AIS data collected throughout each survey period for the Thames Estuary & Kent Coast study area. The purpose of this analysis is to identify wider trends in the size and movement of vessels following the development of offshore wind farms within the Thames Estuary & Kent coast sea area.

Figure 8.5 presents the distribution of vessel lengths recorded throughout each survey period. It should be noted that throughout all survey periods, approximately 3.4% of vessels recorded within the study area did not specify a vessel length and have been excluded from the analysis.

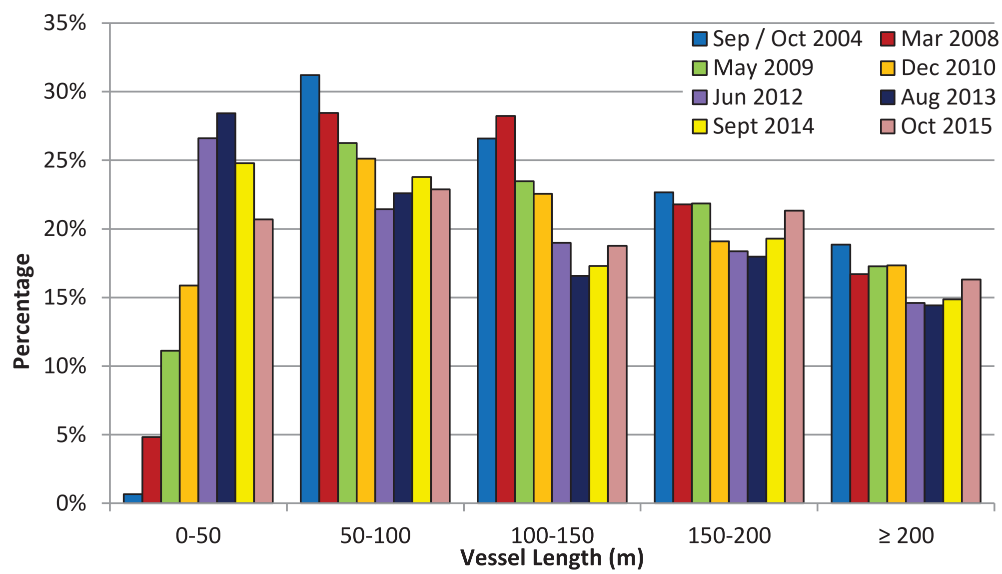


Figure 8.5 Thames Estuary & Kent Coast – Vessel Length Distribution

The relative proportion of vessels measuring <50m in length has steadily increased over the survey periods, peaking in Aug. 2013 (28.4% of marine traffic). There has also been a corresponding decrease in the proportion of larger vessels (50-100m, 100-150m and 150-200m) recorded within the study area. As per other study areas, these changes are again due to the increased uptake of AIS in smaller vessels in later years and the increased number of operational wind farm support vessels.

The prevalence of very large vessels (≥200m) within the study area has not altered significantly over the survey periods, average of 16.3% of marine traffic across all survey periods. This is most likely due to the high number of Deep Water Route (DWR) routeing measures and large commercial ports (e.g. Felixstowe, Harwich, London Gateway) within the study area that are tailored towards very large vessels.

Figure 8.6 presents the distribution of average vessel speeds recorded throughout each survey period. It should be noted that speed information was not available for AIS data recorded throughout Mar. 2008 and May. 2009. For all other survey periods, speed information was not available for approximately 9.4% of vessels which have been excluded from the analysis.

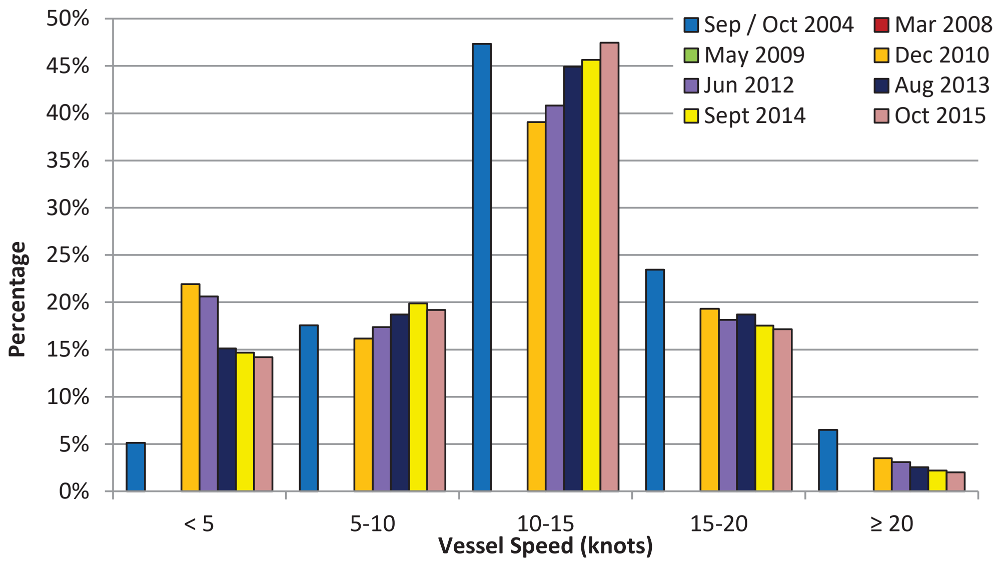


Figure 8.6 Thames Estuary & Kent Coast – Average Speed Distribution

The relative proportion of vessels transiting at speeds of 5 – 10 knots (peak of 19.9%, Sep. 2014) and 10 – 15 knots (peak of 47.4%, Oct. 2015) has increased throughout the survey periods. There has also been a corresponding decrease in the proportion of vessels recorded travelling at very slow speeds (< 5 knots) and high speeds (15 – 20 knots and ≥ 20 knots).

9. Thames Estuary & Kent Coast – Summary of Changes

Round one and Round two wind farms are generally of a smaller capacity, smaller turbine size and developed within near shore waters upon sand banks and shoals. These smaller developments are generally areas that the large majority of commercial traffic avoids. Therefore some wind farms have been developed within the Thames Estuary and Kent Coast study area that have no noticeable impact on commercial vessel routeing within the area, e.g. Kentish Flats, Gunfleet Sands, London Array, Kentish Flats Extension and Gunfleet Sands Demonstration OWFs. Figure 9.1 illustrates vessel tracks recorded prior to and post construction of each of these respective wind farms.

As already identified within this report fishing activity and recreational transits likely to be impact by these near shore developments have not been considered.

London Array, at the time of writing, is the largest fully commissioned offshore wind farm. A number of commercial vessels were noted to have been displaced when assessing the pre and post AIS data. However the actual number of vessels requiring alterations was considered to be insignificant with the majority of commercial vessels remaining within defined deeper water channels, thus avoiding the shallower water area within which London Array was constructed.

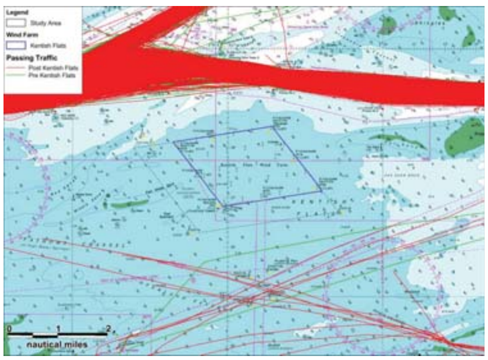


Figure 10.1.1 Princes Channel. Post Kentish Flats (Mar. 2008)

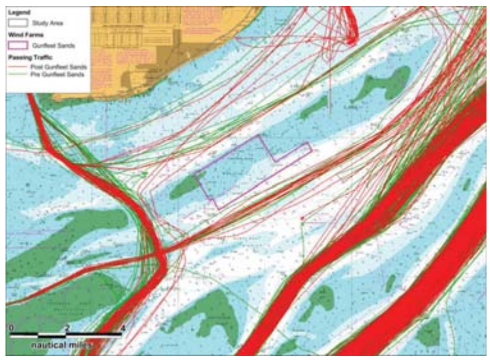


Figure 10.1.3 Passing Traffic. Post Gunfleet Sands (Dec. 2010)

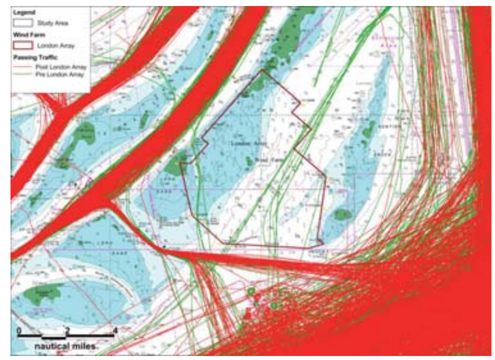


Figure 10.1.5 Passing Traffic. Post London Array (Aug. 2013)

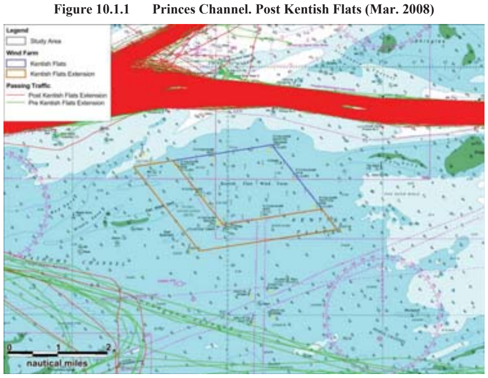


Figure 10.1.2 Princes Channel. Post Kentish Flats & Kentish Flats Extension (Oct. 2015)

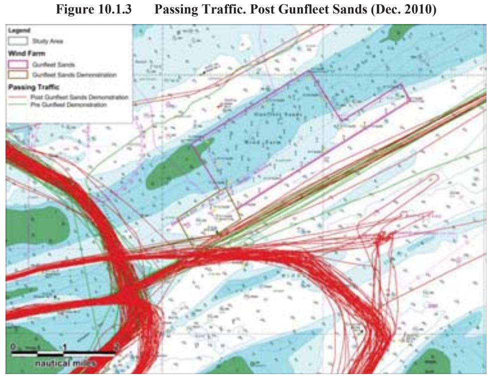


Figure 10.1.4 Passing Traffic. Post Gunfleet Sands and Gunfleet Sands Demonstration (Aug. 2013)

Figure 9.1 **Wind Farms developed within Thames Estuary with no noticeable Impact on Commercial Vessel Routeing©**

Table 9.1 summarises the main commercial routeing changes identified within the Thames Estuary and Kent Coast study area from the first data collected in 2004 through to 2015. It does not specifically identify operators unless that operator is the sole or main user of an individual route; and therefore the specific details of a route prior to a change may not always be clear.

Table 9.1 Summary of Routeing Changes Identified in the Thames Estuary & Kent Coast Area

Route Impacted	Identified Change	Main Reason For Change	Other Comments
Changes due to wind farm construction			
Route inwards and outwards from the southern Thames Estuary	Figure 9.2 shows that the routeing around the Thanet OWF has now become more pronounced and formalised into defined 90th percentiles, rather than the previous unrestricted movement of traffic across the open area of sea.	Variations in density between the 2008 data and the 2015 data (Figure 9.2) show an increase in density associated with both the route alteration and formalisation of traffic in the area (due to ***Thanet OWF)***. Also associated with general increases in traffic numbers and carriage of AIS systems within the area. Of particular note at ***Thanet OWF*** is the use of a north cardinal buoy to the north of this site resulting in the majority of traffic (90.3%) passing at least 1.0 nm from the site boundary.	Direct Impact – Associated with the construction of the wind farm.
Route to the East of Greater Gabbard OWF – Vessels transiting from the northern North Sea southwards	Route shifted further to the east due to an increased passing distance from the Outer Gabbard East Cardinal Buoy. Although the majority of north to south traffic has always passed to the east of the Outer Gabbard Buoy, including within the NRA undertaken in 2005, Figure 9.3 now shows a distinct shift in traffic increasing their CPA from the Outer Gabbard Buoy.	Construction of the ***Greater Gabbard OWF*** and implementation of the Sunk VTS and routeing measures. Likely due to the presence of the wind farm but also the traffic exiting from between the north and south portions of the wind farm, which vessels transiting in a north / south route prefer to distance themselves from any potential increased risk associated with crossing vessels.	Direct Impact – Associated with the construction of the wind farm.

Route Impacted	Identified Change	Main Reason For Change	Other Comments
Route inwards and outwards to the East from the Sunk Area.	Although already dictated by the sand banks located to the north and south of the existing route (Inner Gabbard and The Galloper), the Sunk routeing measure and construction of the wind farm have formalised the traffic into distinct routes.	Construction of the ***Greater Gabbard OWF*** and implementation of the Sunk VTS and routeing measure.	Cumulative Impact - Please see changes due to other infrastructure or routeing measures.
Changes due to other infrastructure or routeing measure changes			
Several routes on the inward and outward approaches to the Sunk area.	In July 2007 a new Sunk IMO routeing system was established which significantly altered traffic routeing within the area.	In July 2007 a new Sunk IMO routeing system including TSS's and precautionary areas were established in order to more effectively manage traffic which previously converged on the Sunk Light Buoy. This change was due, in the majority, to the increased traffic in the area bound for/from the Thames Estuary, Harwich and Felixstowe but also due to the planned construction of the ***Greater Gabbard OWF*** which was submitted for consent in 2005.	Cumulative Impact - Please see changes due to wind farm construction.

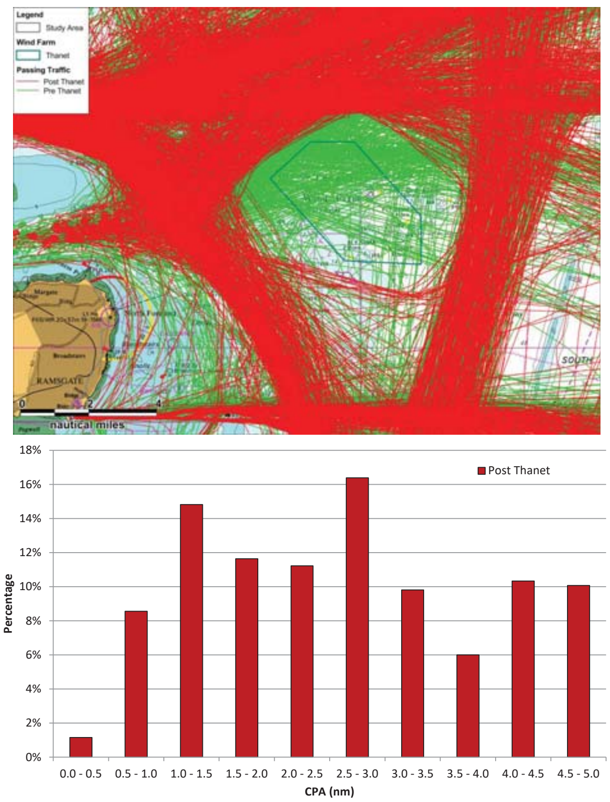


Figure 9.2 **Southern Thames Estuary. Post Thanet (Jun. 2012) ©**

Figure 9.3 **Northern North Sea – Southwards. Post Greater Gabbard (Aug. 2013) ©**

10. NRA Case History Assessment

The following section compares the accuracy of predicted commercial routeing changes (predicted as part of the NRA) with the resultant actual vessel track changes following the construction of wind farms within the northern Irish Sea.

10.1 Post Barrow

The Walney OWF NRA (Anatec, 2006) predicted that following the construction of the Barrow offshore wind farm vessels operating on the Fleetwood – Larne ferry service, "…will maintain a 500m separation from the Barrow site and keep South of the South Cardinal buoy marking the SW corner of the development site, which was indicated to be the likely outcome from the consultation with commercial users. There is some uncertainty associated with this due to the potential impact on ship radar…"

Figure 10.1 presents the predicted main route 90th percentile from the Walney OWF NRA overlaid with vessel tracks recorded (Oct. 2006) following the construction of the Barrow OWF.

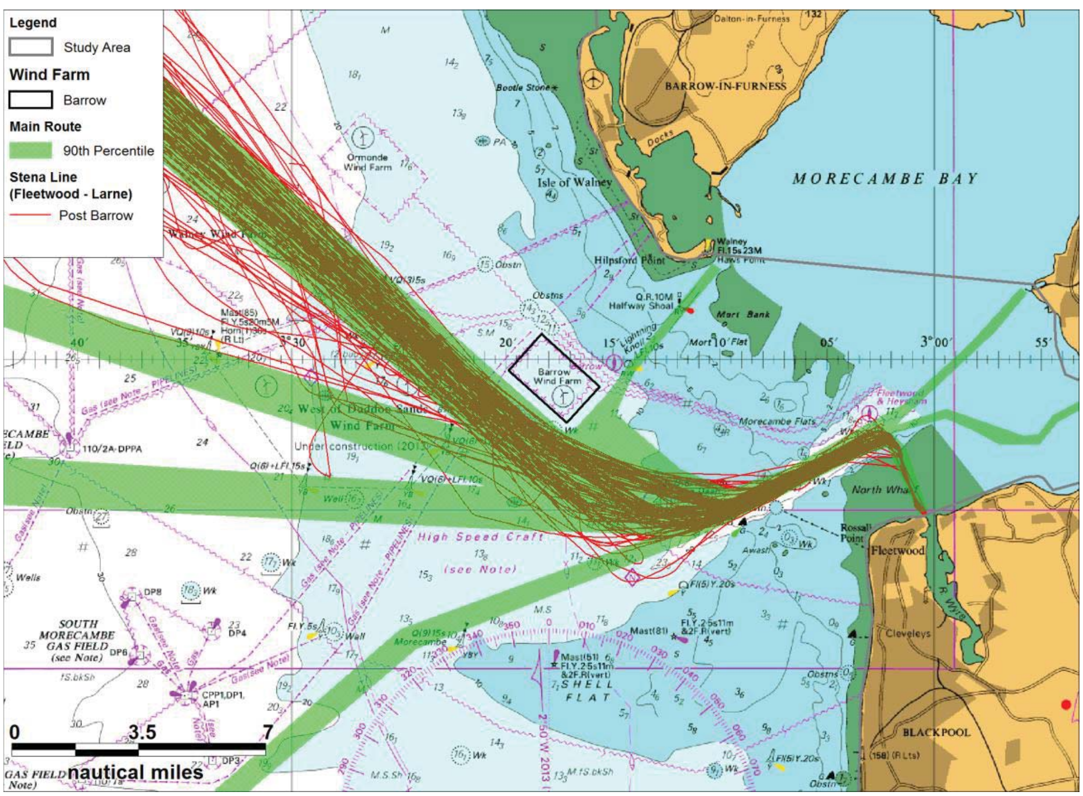


Figure 10.1 Post Barrow – NRA Comparison©

Overall it can be concluded that there is very good agreement between the predicted main route 90th percentile and the actual vessel tracks of the Fleetwood – Larne ferry service. Post-construction vessels were recorded passing at a minimum of approximately 620m (0.3nm) from the Barrow offshore wind farm site boundary thus representing an increase from the predicted 500m separation. However, overall the predicted impact of the Barrow offshore wind farm on commercial vessel routeing can be considered to be very accurate.

10.2 Post Barrow, Ormonde, Walney and West of Duddon Sands

In addition, the Walney OWF NRA (Anatec, 2006) assessed the cumulative impact of the Barrow, Ormonde, Walney and West of Duddon Sands offshore wind farms on commercial vessel routeing.

Figure 10.2 presents the predicted main route 90th percentiles from the Walney OWF NRA overlaid with vessel tracks recorded (Jan. 2015) following the construction of the West of Duddon Sands OWF, the last wind farm to be constructed within the northern Irish Sea study area.

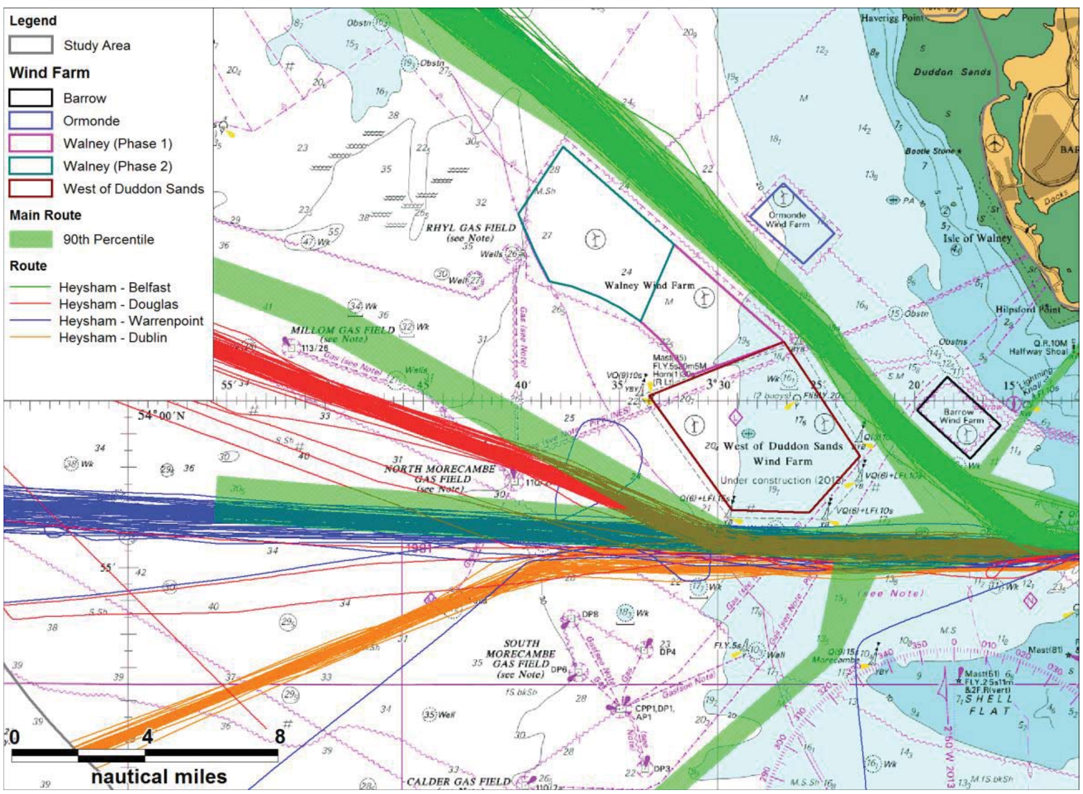


Figure 10.2 Post Barrow, Ormonde, Walney & West of Duddon Sands – NRA Comparison©

The following list summarises the overall level of agreement between the predicted main route 90th percentiles and actual vessel tracks:

- Heysham – Belfast: Overall good agreement. However there are some minor differences: predicted 90th percentile slightly wider whilst passing through Barrow and

Ormonde / Walney and West of Duddon Sands channel when compared to actual track data. Vessels recorded in actual track data also maintain steady course northeast / southwest whilst approach / passing northern extent of Walney OWF whereas 90th percentile predicted a slight course alteration at this point.

- Heysham – Douglas. Overall moderate agreement. Predicted 90th percentile and actual track data show good agreement while passing to the south of West of Duddon Sands OWF. However, 90th percentile predicted that traffic would pass north of both the North Morecambe and Millom gas platforms whereas vessels passed north of the North Morecambe platform and south of the Millom platform in reality.
- Heysham – Warrenpoint. Overall good agreement. Only difference relates to passing distance from North Morecambe gas platform: 90th percentile predicted vessels would pass in closer proximity (minimum of 1,000m) to platform compared to actual track data (minimum of 1,750m).
- Heysham – Dublin. Overall poor agreement. 90th percentiles predicted that traffic would pass to the south of platforms associated with the South Morecambe Gas Field and north of Shell Flats- vessels previously followed this route. However, actual track data indicates that vessels pass to the north of South Morecambe Gas Field and align with other commercial traffic whilst passing the West of Duddon Sands offshore wind farm. However, this is due to a change in the operator of this route (Norfolkline to Seatruck Ferries), see Figure 3.2.1.

It can therefore be concluded that for the majority of commercial routeing predictive work carried out as part of NRAs has been of a good standard showing good / moderate agreement with resultant shifts in actual vessel traffic. However, as with any predictive work there is a degree of uncertainty and commercial traffic alterations can occur for a number of reasons (e.g. change of vessel operator, master preference, changes to routeing measures, etc.) which cannot be accurately considered during predictive re-routeing, as demonstrated by the case of the Heysham – Dublin vessel routeing changes.

11. Annual and Seasonal Increases in the Traffic Densities within UK Waters.

The Marine Management Organisation (MMO) undertook a report in June 2014 titled *Mapping UK Shipping Density and Routes from AIS* (MMO, 2014). The report assessed the current level of shipping within the UK, including analysis of vessel types and size. In relation to this assessment, the report also assessed seasonal and annual data sets to demonstrate any changes in traffic densities through seasonal variations. Figure 11.1 and Figure 11.2 (taken from the report) illustrate that traffic levels around the UK coast (especially around the south coast of the UK, Dover Straits etc.) have decreased. However, in proximity to areas of offshore wind farm development, traffic movements have significantly increased, including within the summer period.

The report states "Increases in vessel transits can be seen between Ramsgate and the offshore wind farm site of London Array (the construction phase of this wind farm completed in December 2012). Further increased traffic can be seen from North Norfolk to Sheringham Shoal offshore wind farm, and to the Lincs offshore OWF." Table 6.1 and Table 8.1 summarise the construction start and end dates for each of the highlighted wind farms, which coincide as expected with the increase in traffic. These findings compare to the notable traffic increases identified within this report, when a wind farm is under construction.

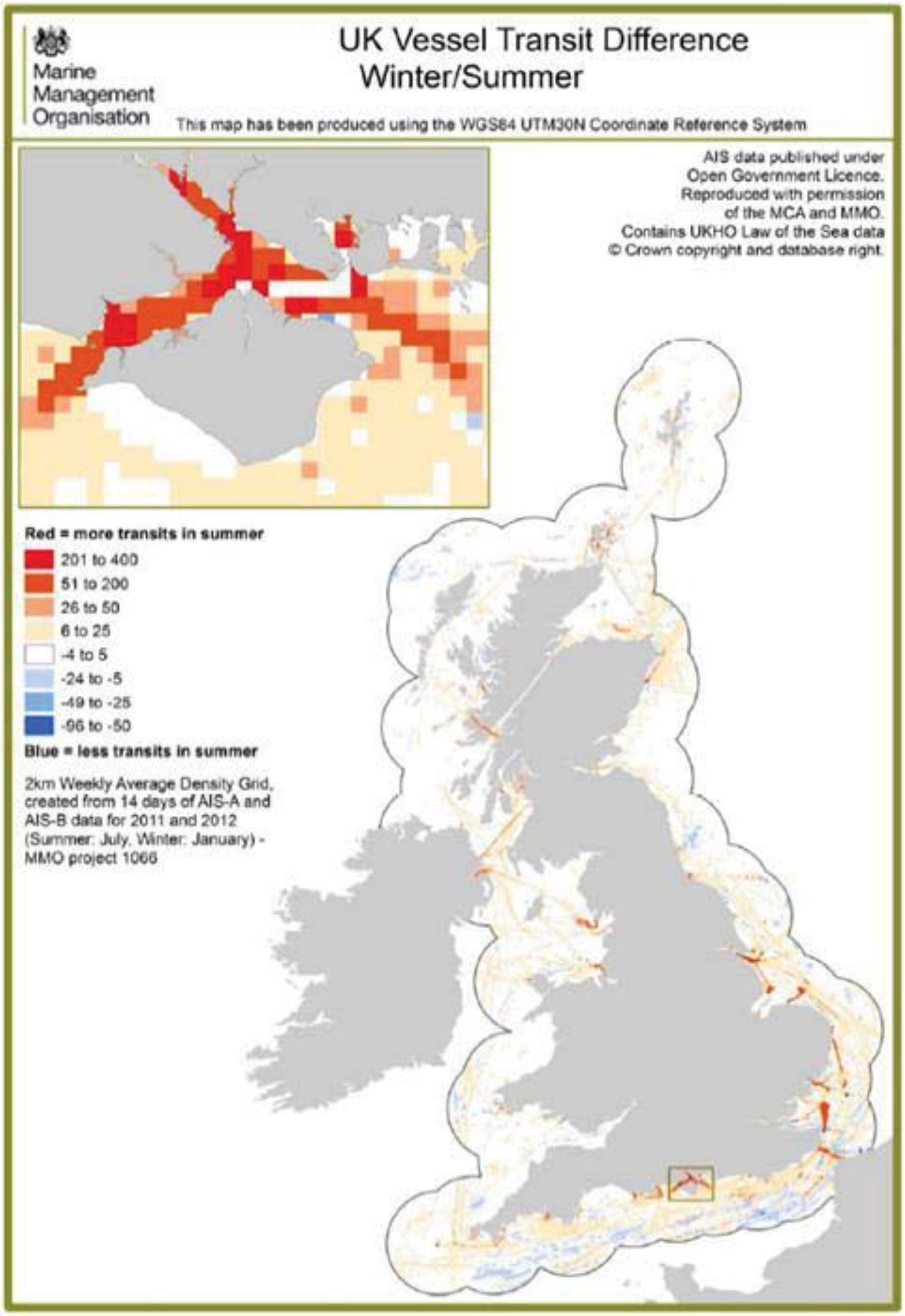


Figure 11.1 Seasonal Increases Associated with Wind Farm Source: MMO, 2014.

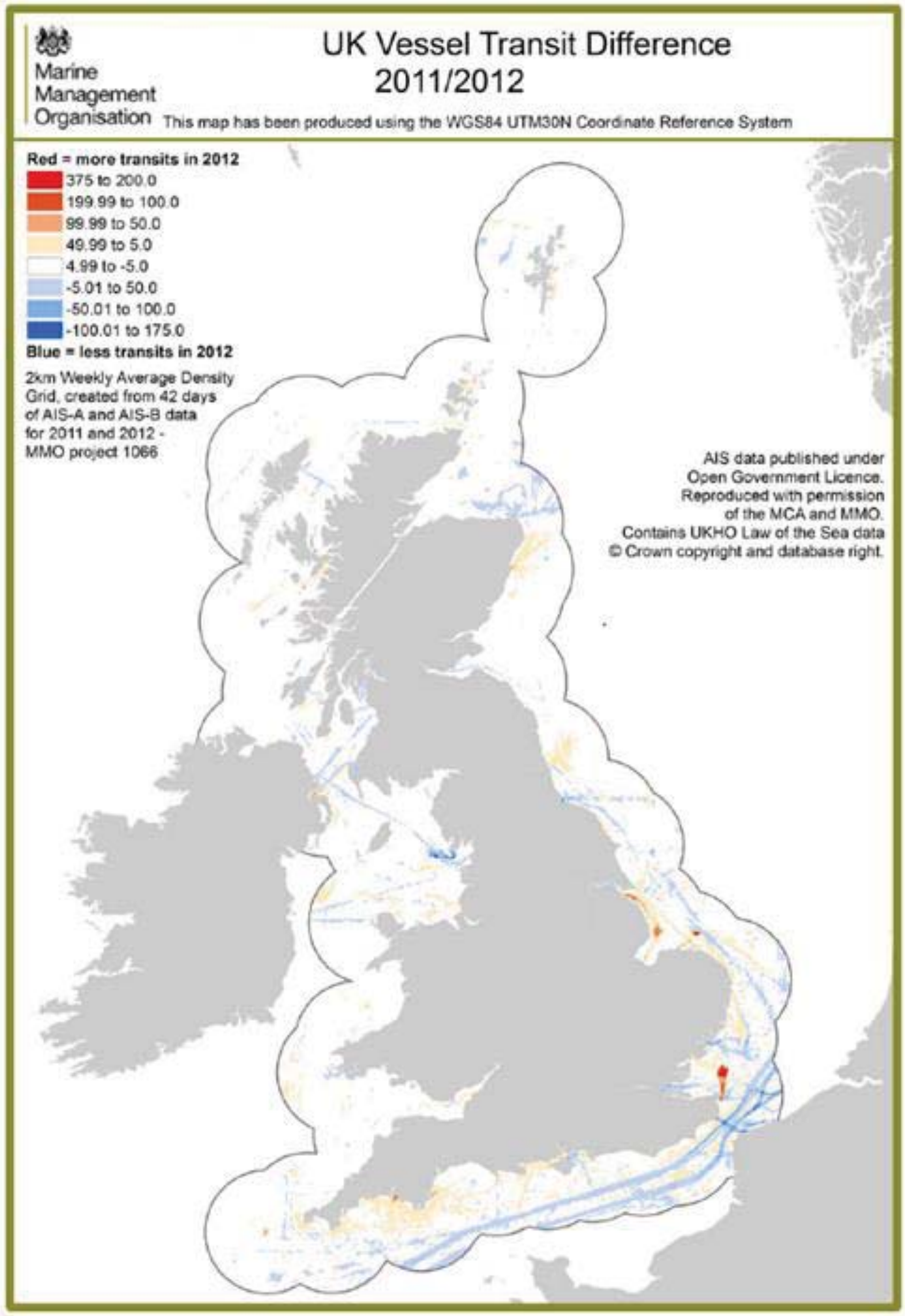


Figure 11.2 Annual Increases Associated with Wind Farm Source: MMO, 2014.

12. Summary and Key Conclusions

This section reviews the findings of this report and summarises the main route changes identified.

12.1 Summary of Route Changes

The following table (Table 12.1) reviews all findings from each study area, noting the main cause and effect of each identified route change.

Table 12.1 Summary and Key Conclusions

Impact	Causation	Route	Effect	Reference
		Northern Irish Sea		
Direct	Barrow OWF	Fleetwood – Larne	**Minor route alteration -** for single route to pass south of the constructed site.	Figure 3.1.1
In Combination	Barrow, Ormonde, Walney 1 and 2	Glasson Dock – Ramsey (Isle of Man)	**Minor route alteration -** for single operator to pass between the constructed sites.	Figure 3.1.2
In Combination	Barrow, Ormonde, Walney 1 and 2	Heysham – Belfast	**Increased passing distance** (min. of 0.6nm) – minor route alteration for single route to allow increased passing distance to north east of the constructed Walney site.	Figure 3.1.3
Direct	West of Duddon Sands OWF	Heysham – Douglas	**Minor route alteration -** for single route to pass south of the constructed site.	Figure 3.1.4
Direct	West of Duddon Sands OWF	Heysham – Belfast (Alternate)	**Minor route alteration -** for single adverse weather route to pass south of the constructed site.	Figure 3.1.5
Independent Change	Change of Vessel Operator (assumed) **although not specifically the purpose of this report has been included to provide context of routeing changes.*	Heysham – Dublin	**Significant route alteration** Change in vessel operator instigated a change in vessel routeing preference: Change in passing approach to South Morecambe and	Figure 3.2.1

Impact	Causation	Route	Effect	Reference
			Calder Gas Fields.	
Independent Change	Change of Vessel **although not specifically the purpose of this report has been included to provide context of routeing changes.*	Heysham - Warrenpoint	**Minor route alteration -** Change in vessel instigated a change in vessel routeing preference.	Figure 3.2.2
		Southern Irish Sea		
Direct	Gwynt y Mor OWF	Liverpool Bay – Penrhyn (Dredging)	**Minor route alteration** – for single operator to pass south of the site	Figure 5.1
Cumulative	Implementation of Liverpool Bay TSS, Gwynt Y Mor and general traffic increases in the area.	Mersey Ports Bound	**Multiple but minor route alterations** – vessels both using and entering TSS in compliance with COLREGs Rule 10.	Figure 5.2
		Humber		
In Combination	Lynn OWF, Inner OWF Dowsing and Lincs OWF	Humber – Wash (Inshore Routeing)	**Increased passing distance** (0.9nm) – minor route alteration (approximately 3°) for single route to allow increased passing distance from the constructed site.	Figure 7.1
Direct	Sheringham Shoal OWF	NE and SW Passing Traffic	**Increased passing distance** – minor route alteration for multiple vessels to allow increased passing distance from the constructed site – 91.3% of traffic passes in excess of 1.5nm.	Figure 7.2
Cumulative	Humber Approaches TSS, Humber Gateway OWF, deep water anchorage and general traffic increases in the area.	NE Approaches to Humber	**Multiple but minor route alterations** – vessels both using and entering TSS in compliance with COLREGs Rule 10.	Figure 7.3

Impact	Causation	Route	Effect	Reference
Direct	Westermost Rough OWF	NE - Humber	**Increased passing distance** – minor route alteration for multiple routes to allow increased passing distance from the constructed site – 99.7% of traffic passes in excess of 1.0nm.	Figure 7.4
Thames Estuary & Kent Coast				
Direct	Thanet OWF	Southern Thames Bound	**Minor route alterations –** multiple but minor route alterations and route formalisation.	Figure 9.2
Direct	Greater Gabbard OWF	Northern North Sea – South	**Increased passing distance** – minor route alteration (approximately 2°) for single route to allow increased passing distance to east of the constructed site and outward bound traffic from the Sunk Routeing Measure.	Figure 9.3
Cumulative	Sunk VTS and Routeing Measure, Greater Gabbard OWF and	Northern North Sea – South	**Multiple but minor route alterations** – vessels both using and entering TSS in compliance with COLREGs Rule 10.	Figure 9.3

12.2 Key Conclusions Northern Irish Sea

Since 2004 there has been a notable increase in both AIS carriage and coverage. Within the northern Irish Sea the majority of commercial vessels are RoRo, passenger ferry or general cargo vessels (excluding wind farm support); with a visually lower proportion of tanker tracks compared to other areas of the UK. AIS analysis also shows an increase in vessels less than 50m length overall which is associated within the use of wind farm support vessels within the area (both construction and operation phases); however this has not impacted the average speed of vessels over the study period. *(Note comments in section 2.5 with regards to AIS uptake impacting on vessel size distributions).*

The majority of routeing changes within the area are linked to RoRo or passenger vessel movements and are associated with either the development of offshore wind farms, or localised operator / vessel changes. The most frequent area where changes were noted included the approaches to the river Mersey (port of Liverpool) for vessels bound to the Isle of Man, the Republic of Ireland or Northern Ireland. Other infrastructure could also be seen to impact on vessel routeing decisions (i.e. South Morecambe and Calder Gas Fields) in that vessels were seen to be altering courses based on which side they will pass the offshore installation, but overall could not be demonstrated to significantly impact the routeing of vessels in isolation i.e. not a significant course alteration to increase journey length or time

Changes were generally noted as minor route alterations or increased passing distance as shown in Table 12.1.

12.3 Key Conclusions Southern Irish Sea

As with the northern Irish Sea study area since 2004 there has been a notable increase in both AIS carriage and coverage. AIS tracks visually show within the area a mix of vessels types including cargo, tanker as well as RoRo and passenger ferries as seen within the northern Irish Sea. Since 2004 the popularity of ports within the river Mersey has dictated traffic movements within the southern Irish Sea area. However the development of the Douglas Platform in 2006 and the Liverpool Bay TSS in 2009 have significantly formalised traffic routeing. Although the TSS was developed for a number of traffic management issues in that area, it is assumed that Gwynt y Mor OWF (which was in the early stages of planning pre 2009) did contribute to its implementation and has further dictated traffic movements (given its proximity to the southern boundary of the TSS) following its construction and commissioning. Therefore in summary routeing changes in the southern Irish Sea area are in combination impacts associated with the development of the Douglas platform, implementation of the Liverpool Bay TSS and the construction of Gwynt y Mor OWF as well as the general increases in traffic movement to the ports within the river Mersey.

It was noted that smaller, more inshore wind farms located in shallow waters have not impacted commercial vessel movements post their commissioning.

12.4 Key Conclusions Humber

AIS data generally shows a mix of traffic types within the wider Humber area: Within the Wash area there is a higher proportion of cargo vessel traffic compared to tankers. Tankers were recorded generally transiting in deeper water routes (farther offshore) than inshore coastal routes. Since 2006 there have also been some distinctive beach replenishment activities which are identified by areas of dense dredger traffic movement between dredge areas and the coastline. These dense areas of traffic have not been considered commercial routes given their limited temporal operation. As with other areas, AIS shows an overall increase in the number of vessels less than 50m length operating, which is associated with wind farm development, but no significant changes in speed.

The Humber TSS was established in 2009; this was not solely due to the development of the Humber Gateway OWF but was instead a combination of general traffic increases in the area, the deep water anchorage and the proposed wind farm. This saw the traffic, post 2009, alter into more defined routes rather than wider transits of traffic (based on measurement of percentiles). Generally route changes within this area have been noted as increasing of CPAs (directly associated with development of a wind farm) or minor route adjustments (cumulative), due to changes within the wider navigable area.

There are Round 1 wind farms within the southern Humber study area that are nearshore and therefore out with areas where commercial navigation generally occurs. However when Round 1 developments are considered in combination with Round 2 developments these have caused some isolated vessel displacement, as identified within Table 12.1, as well as increased CPAs for the main commercial vessel routes in the area.

12.5 Key Conclusions Thames Estuary & Kent Coast

The Thames Estuary and its approaches is a dense area for commercial traffic which generally includes a wide mix of vessel types. The traffic is generally dictated by water depths with a number of charted routes inward/outward between shallower sand banks. In 2007 a new routeing system at the Sunk, which included separation schemes, traffic organisation and vessel traffic services (VTS), was implemented to safely manage increased traffic volumes. The implementation of the Sunk routeing system is assumed not to be as a direct result of the development of the Greater Gabbard OWF: The implementation of the Sunk routeing system is assumed to be one of many cumulative factors within the Humber area. Therefore routeing changes around this area are of a cumulative nature.

The Thanet OWF is an example of where traffic has been significantly altered, but not significantly impacted around an offshore wind farm development. Traffic prior to the development of Thanet OWF was generally unrestricted. Post development (which includes the implementation of a north cardinal buoy to the north of the site) the traffic has become more organised into denser routes and resulted in minor rerouteing for some vessels. The north cardinal buoy has also had notable positive effects by ensuring that most traffic maintains a 1nm passing distance from the development boundary.

As detailed in Section 9, London Array is the largest fully commissioned offshore wind farm (at the time of writing). A number of commercial vessels were noted to have been displaced when assessing the pre and post AIS data. However the actual number of vessels requiring alterations was considered to be insignificant with the majority of commercial vessels remaining within defined deeper water channels, thus avoiding the shallower water area within which London Array was constructed.

As with other areas there has been a noticeable increase in the prevalence of vessels less than 50 metres in length, within no notable changes to vessel speed.

12.6 Case History Assessment Summary

A sample of project NRAs (those available) have been assessed to identify any notable patterns in their conclusions and the routeing identified as part of this report. From this assessment it can be concluded that reasonable re-routeing assumptions can be identified during the assessment stage of wind farm development given the consideration of other factors (such as other infrastructure or water depths) that dictate vessel movement. It is also noted that factors, such as change of operators / vessels, resulting in routeing changes cannot be predicted.

Based on experience of larger scale developments (Round three) the definition of post development routeing (during the assessment stage) is likely to become more difficult as wind farms are generally being constructed within deeper water and unrestricted areas where more and varied routeing options are available. However what is likely is that routeing changes, both direct and in combination will occur and that vessels size distribution with the UK waters will change to reflect the larger number of wind farm support vessels that are active. Furthermore significant increases in the density of traffic will be seen over short periods (likely over a period of seasonal construction) during the actual construction phase of future Round three developments.

13. References

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