Hornsea Project Four
Environmental Statement (ES)

PINS Document Reference: A5.11.1
APFP Regulation 5(2)(a)

Volume 5, Annex 11.1: Offshore Installation Interfaces Part 2

Deadline 2, Date: 29th March 2022
Revision: 01

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A5.11.1
Vers. B

Revision Summary

Rev	Date	Prepared by	Checked by	Approved by
01	22/03/2022	EPConsult Energies Ltd. March 2022	David King. Orsted. March 2022	Aparna Majmudar Ørsted. March 2022

Revision Change Log

Rev	Page	Section	Description
01	Annex B pg. 1		Addition of Revision Summary page
	Annex B pg. 39	6.2.1.3 - 6.2.1.5	Corrected data calculation and related conclusions: Previous version treated all platforms as manned for purpose of CPA & TCPA calculations and applied single constant speed. This was an error.
	Annex B pg. 40	6.3.1.2	As above
	Annex B pg. 48 - 51	Figures 33 - 44.	As above
	Annex B pg. 52	Table 5	As above
	Annex B pg. 54	6.7.1.4	As above
	Annex B pg. 57	7.4.1.2	As above

Appendix A Helicopter Access Report

Hornsea Project Four: Environmental Statement (ES)

Appendix A of ES Annex 11.1: Helicopter Access Report

Prepared Anatec Ltd. June 2021
Checked Nicola Allan, Orsted. August 2021
Accepted David King, Orsted. August 2021
Approved Julian Carolan, Orsted. September 2021

A5.11.1
Version B

Helicopter Access Report: Assessment of the Impact of Hornsea Project Four on Helicopter Operations to Adjacent Gas Installations

Prepared by	Anatec Limited
Presented to	Orsted Hornsea Project Four Ltd.
Date	19th August 2021
Revision Number	09
Document Reference	A4481-ORS-TN-01

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Revision Number	Date	Summary of Change
00	2nd March 2020	Initial Draft
01	3rd April 2020	Update to include Section 21
02	14th May 2020	Revised following Orsted comments
03	3rd June 2020	Revised following Orsted comments
04	16th July 2020	Revised following project design changes
05	12th August 2020	Revised following Orsted comments
06	16th September 2020	Revised following Orsted comments
07	8th June 2021	Updated with additional analysis
08	3rd August 2021	Revised following Orsted comments
09	19th August 2021	Revised following Orsted comments

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Abbreviations Table

Abbreviation	Definition
°	Degrees Magnetic
°C	Degrees Celsius
AMSL	Above Mean Sea Level
AW139	AgustaWestland 139
ARA	Airborne Radar Approach
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAT	Commercial Air Transport
EASA	European Aviation Safety Agency
ft	Foot
GPS	Global Positioning System
HMR	Helicopter Main Route
HCA	Helicopter Certification Agency
IAS	Indicated Airspeed
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
ISAR	Integrated Search and Rescue
kg	Kilogram
km	Kilometre
kt	Knot
m	Metre
MAP	Missed Approach Point
mbar	Millibar
MDH	Minimum Descent Height
mm	Millimetre
MSA	Minimum Safe Altitude
nm	Nautical Mile
NOGEPA	Nederlands Olie en Gas Exploratie en Productie Associatie
NUI	Normally Unmanned Installation

Abbreviation	Definition
OEI	One Engine Inoperative
PBN	Performance Based Navigation
PF	Pilot Flying
QNH	Ambient Air Pressure at Mean Sea Level
Radar	Radio Detection and Ranging
RFM	Rotorcraft Flight Manual
SAR	Search and Rescue
SBAS	Satellite Based Augmentation System
SOAP	SBAS Offshore Approach Procedure
SPA HOFO	Specific Approval for Helicopter Offshore Operations
TAS	True Airspeed
TDP	Take-off Decision Point
TEMPSC	Totally Enclosed Motor Propelled Survival Craft
QNH	Ambient Air Pressure at Mean Sea Level
UK	United Kingdom
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
WTG	Wind Turbine Generator

1 Executive Summary

1. This report assesses the impact that the proposed Hornsea Project Four Offshore Wind Farm (hereafter "Hornsea Four") will have on Commercial Air Transport (CAT) flights to and from gas installations in the vicinity of Hornsea Four, which occur daily for standard crew changes. Seven years of aviation meteorological data, recorded between 2013 and 2019 and sampled at a 10-minute frequency, was provided by Perenco (Perenco, 2019). The data permitted a detailed assessment of the impact which Hornsea Four is likely to have on helicopter operations to nearby helidecks. Ravenspurn North is used as a case study and discussed in Section 5. **Appendix A1: Platform Specific Data** shows platform specific data, applying the same methodology as used in this report.

1.1 Restricted Access

2. For Ravenspurn North, it was assessed that the largest impact will occur when an Airborne Radar Approach (ARA) is required due to low cloud and/or poor visibility and the wind direction is between 180° and 260°. The data indicates that for the worst-case year (2015) ARA will be impacted for up to 2.1% of the year (equivalent to 181 hours). However, for most years the impact from Hornsea Four was between 1.2% and 2.1%. The data also showed that the duration for which an ARA was obstructed was low (typically only a few hours at a time) and so there were unlikely to be any long periods of time when CAT helicopter operations were inhibited. The analysis of the other platforms indicates that the impact of Hornsea Four on their access will be even lower than the impact on Ravenspurn North.

1.2 Take-Off

3. Even though an engine failure on rotation from the platform is an unlikely event (less than 5×10^{-8} per take-off), account must be taken of the distance required to climb and turn away from the wind farm. Using the AgustaWestland 139 (AW139) as an example, calculations are shown on the minimum distance required for a one engine inoperative departure from Ravenspurn North into Instrument Meteorological Conditions (IMC).

1.3 En-Route Descent

4. Applying the European Aviation Safety Agency (EASA) Regulations for a descent made from IMC to Visual Meteorological Conditions (VMC), meteorological data indicates that on average an en-route descent could be made on 89% of occasions by day and 83% of occasions by night. Under these conditions no approach limitations whatsoever will be imposed on gas installations adjacent to Hornsea Four.

1.4 Emergency Operations

5. As Coastguard Search and Rescue (SAR) operations are not restricted by CAT Regulations, and are conducted as a State Activity under Civil Aviation Publication

(CAP) 999 (Civil Aviation Authority (CAA), 2014), the wind farm will not restrict SAR aircraft access to nearby installations.

1.5 Vantage Data

6. The Vantage data for the manned Ravenspurn North platform did not show any significant seasonal variation in flights. However, it did show a steady decline in flights since 2015, resulting in a reduced impact from Hornsea Four. If Vantage data is provided for Normally Unmanned Installations (NUI), then it is anticipated that some seasonal variation will be seen as routine work is generally planned for the summer months. It is noted that Perenco have stated that there was no specific reason for the decline in flights, and flights are just as likely to increase in the future.

1.6 Aviation and Radar Technical Report (PINS Document Reference A5.8.1)

7. **Volume A5, Annex 8.1: Aviation and Radar Technical Report** was reviewed. Previous meetings with the helicopter operators confirmed that Helicopter Main Routes (HMRs) were rarely followed in the Southern North Sea. In the unusual event of following a HMR over Hornsea Four, the Minimum Safe Altitude (MSA) would increase by circa 800 feet (ft) and so the probability of encountering icing conditions would increase slightly. The AW139 can be equipped for Limited Icing Conditions. Fitting the applicable equipment, and using a Limited Icing Approval, will minimise the impact on icing to helicopter operations in the vicinity of Hornsea Four, as well as improving safety in general.

2 Introduction

8. This report was produced as part of the Applicant's obligations under CAP 764 (CAA, 2016), where the operator of any offshore helicopter destination within nine nautical miles (nm) of a wind farm must be consulted at the planning stage of a wind farm.

9. Based on consultation and expert opinion, the location of Hornsea Four may impose operational restrictions on the nearby gas platforms. These restrictions could adversely impact on the ability to fly routine crew change flights, both to manned platforms and to support NUIs. In this report any restrictions are identified and quantified.

2.1 Background

10. During an Aviation Workshop on the 27th September 2019, conducted under the aegis of CAP 764, Perenco offered to provide meteorological data from the Ravenspurn field to assist in analysing the impact that the nearby Wind Turbine Generators (WTG) could have on helicopter operations. These data were supplied by Perenco (Perenco, 2019).

11. A second Aviation Workshop was held on the 20th January 2020 where the initial meteorological analysis was presented to show the operational impact of Hornsea Four on the Ravenspurn North platform. This initial analysis, which forms part of this report, was supplied to Perenco as a written report[1] prior to the meeting.

12. The methodology used to assess the operational impact (see Section 3) was accepted by all parties at the meeting. It was agreed that the analysis should be extended to cover all affected installations nearby Hornsea Four, as outlined in Table 3.1.

2.2 Commercial Air Transport Regulations

13. CAT flights, such as crew change flights, are regulated under the following requirements.

2.2.1 Offshore Approval

14. Offshore operations are regulated under Specific Approval for Helicopter Offshore Operations (SPA.HOFO) (CAA, 2018):

15. *"Offshore operation" means a helicopter operation that has a substantial proportion of any flight conducted over open sea areas to or from an offshore location. An offshore operation includes, but is not limited to, a helicopter flight for the purpose of:*

- *support of offshore oil, gas and mineral exploration, production, storage and transport;*

[1] Document reference A4415-ORS-SOW-02 dated 30th December 2019

- *support of offshore wind turbines and other renewable-energy sources; or*
- *support of ships including sea pilot transfer.*

2.2.2 Meteorological Limits

16. The limitations presented within this section, based on EASA CAT Regulations, have been applied to the Perenco data to identify when the Hornsea Four array may affect helicopter operations to the infrastructure presented in Table 3.1. To aid the reader, where applicable, the EASA Regulations are referenced (EASA, 2019).

2.2.3 En-Route Descent (EASA CAT.OP.MPA.247)

17. An en-route descent, where a descent is made from IMC into VMC, is permitted when:

- **Day** – cloud base ≥600 ft and visibility ≥4,000 metres (m).
- **Night** – cloud base ≥1,200 ft and visibility ≥5,000 m.

2.2.4 Shuttle Flight (EASA.SPA.HOFO.130)

18. A shuttle flight is a VMC transit between two platforms located within 10 nm of each other. A shuttle flight is permitted when:

- **Day** – cloud base ≥300 ft and visibility ≥2000 m.
- **Night** – cloud base ≥500 ft and visibility ≥ 5,000m.

2.2.5 Instrument Meteorological Conditions

19. IMC conditions are assumed to exist when the weather limits are below those for flight under VMC.

2.2.6 Airborne Radar Approach (SPA.HOFO.125)

20. An Airborne Radar Approach (ARA) is flown to a platform when the weather conditions are below the VMC limits. The minima for an ARA are:

- A descent to a Minimum Descent Height (MDH) of 200 ft by day or 300 ft by night (or deck height plus 50 ft if higher); and
- A Missed Approach Point (MAP) no closer than 0.75 nm (1,390 m) from the installation; this distance is based on the limitations of the Radio Detection and Ranging (Radar) in mapping mode and how it is displayed to the crew.

21. As the helicopter has to be below cloud and in sight of the installation before proceeding visually beyond the MAP, in practical terms this results in the following minimum weather conditions:

- **Day** – cloud base ≥300 ft and visibility ≥1390 m
- **Night** – cloud base ≥400 ft and visibility ≥1390 m

2.2.6.1 ARA Profile

22. The ARA profile is shown in Figure 2.1 and Figure 2.2. The helicopter's Radar is used as the primary means of navigation and obstacle avoidance, supported by Global Positioning System (GPS).

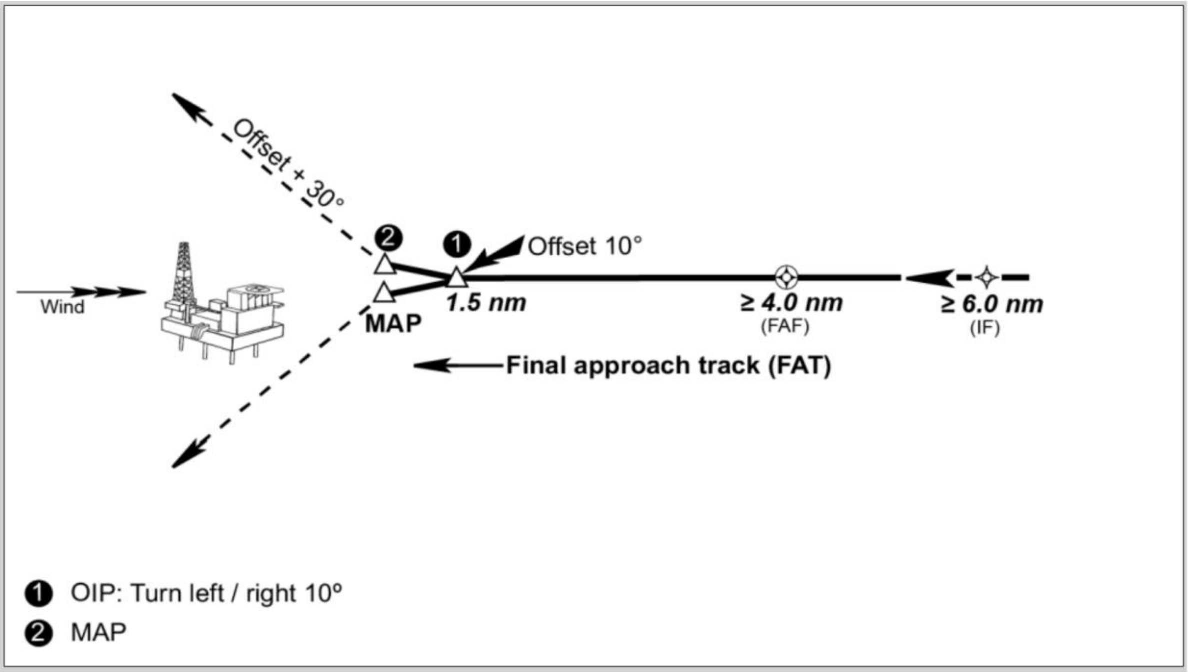


Figure 2.1 ARA Horizontal Profile

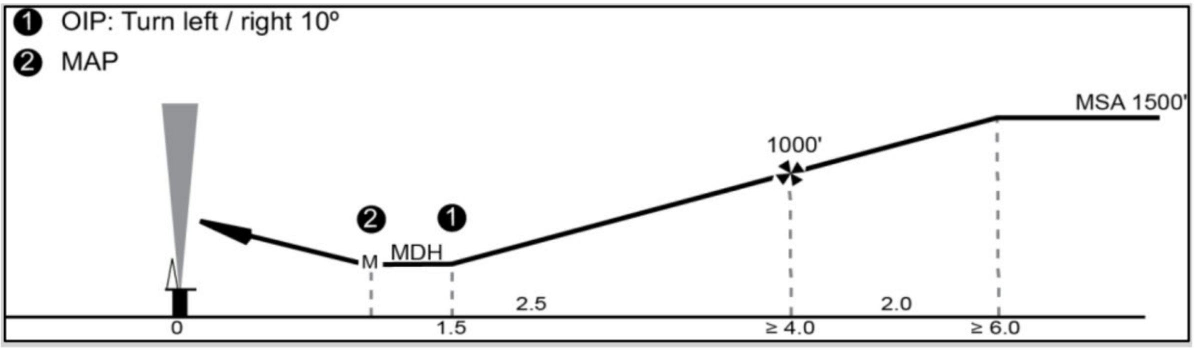


Figure 2.2 ARA Vertical Profile

2.2.7 No Fly Conditions

23. Any of the following conditions would result in flights being cancelled, or being unable to land at an offshore installation:

- Sea state (significant wave height) ≥6 m;
- Wind speed ≥60 knots (kt); this is a general limit, but it should be noted that some NUIs have values as low as 30 kt due to reduced deck friction;

- Unable to land from an ARA – cloud base <300 ft by day or <400 ft at night or visibility <1,390 m; and
- For a helicopter lacking an approval for flight in icing conditions, icing conditions occurring at 500 ft by day and 1,000 ft at night are assessed.

24. It is noted that icing conditions are defined as an air temperature below 0 degrees Celsius (°C), with an inflight visibility less than 1,000 m and visible moisture present.

3 Methodology

25. This assessment has applied the CAT weather limits, as a series of filters, to the meteorological data provided by Perenco in order to understand the potential operational impact on the Ravenspurn North installation. Ravenspurn North is used as a worked example, as it is the closest platform, located 3.0 kilometres (km) (1.6 nm) from the proposed boundary of Hornsea Four and permanently manned, therefore presenting the worst case scenario. The assessment focused on identifying any reduced access when operating under CAT Regulations, but access under SAR Regulations are also considered. Equivalent information is provided in **Appendix A1: Platform Specific Data** for each nearby installation to indicate any reduction in access which may occur when Hornsea Four is built. Unless otherwise stated, this document assumes that WTGs are installed on the Hornsea Four array area boundary, in alignment with the Principles set out in **Volume A4 Annex 4.7: Layout Principles**, and to their maximum potential design height, specified in **Volume A1 Chapter 4: Project Description**.

3.1 Infrastructure Assessed

26. The infrastructure assessed as part of this study are outlined in Table 3.1.

Table 3.1 Overview of Infrastructure Assessed

Infrastructure	Details
Ravenspurn North	This platform is the nearest (1.6 nm) to the Hornsea Four array area and is permanently manned and therefore represents the worst case.
Babbage	Cyclically manned platform. It is the only platform which may also be impacted by the cumulative effect of both Hornsea Four and Hornsea Two.
Garrow	NUI limited to daylight only operations when the wind speed is equal to or less than 30 kt.
Kilmar	NUI limited to daylight only operations when the wind speed is equal to or less than 30 kt.
Ravenspurn North ST2	NUI approved for day and night operations when the wind speed is equal to or less than 30 kt.
Ravenspurn North ST3	NUI approved for day operations only.
Ravenspurn South A	NUI limited to daylight operations only when the wind speed is equal to or less than 30 kt.
Ravenspurn South B	NUI approved for day only operations.
Ravenspurn South C	NUI approved for day only operations.

3.2 Other Infrastructure Considerations

27. The following infrastructure has not been considered in this assessment on the grounds that they are further than 10 nm from the Hornsea Four array area and

therefore not restricted by its installation. Furthermore, they are outside the 9 nm consultation zone guidance required by CAP 764 (CAA, 2016).

- Trent;
- Cleeton;
- Neptune;
- Minerva;
- Hyde; and
- Hoton.

3.3 Data Structure

28. The meteorological dataset was provided by Perenco[2] as a series of files, each holding one year of data between 2013 and 2019.

29. The data was sampled at 10-minute intervals, resulting in approximately 52,000 samples per year, except for 2019 where the data stopped on 2nd October, resulting in 39,115 samples for 2019.

30. Meteorological data sampled at a 10-minute frequency can be considered as a continuous set of data, allowing interpolation of the data where required.

31. Although the data was recorded on the Ravenspurn North platform, it is a reasonable assumption that the cloud base and visibility trends will be valid for other platforms within a 40 nm radius, as they will be located in the same air mass.

3.4 Parameters

32. The data contained the following parameters:

- Timestamp – day/month/year/hour/minute/seconds
- Visibility – m
- Precipitation – millimetres (mm)
- Cloud height – ft
- Wave height – m
- Ambient air pressure at mean sea level (QNH) – millibars (mbar)
- Mean gust speed (10 minute) – kt
- Wind speed (10 minutes) – kt
- Air temperature – °C
- Wind direction – degrees magnetic (°)

3.5 Vantage Data

33. In order to assess the impact on helicopter operations, data on the number of flights to the Ravenspurn North platform, broken down by month and year, was supplied

[2] Data source *StormGeo UK Ltd*

from the Vantage system[3]. Comparing any operational restrictions, such as reduced access, related to Hornsea Four on the Ravenspurn North platform against the historic helicopter flight schedule, permits an estimate to be made on the number of flights which could be affected.

3.6 Meteorological Filters

34. The files provided by Perenco were combined, and in order to identify conditions which may impose operational restrictions (see Sections 2.2.2 to 2.2.7), a series of filters were applied to the meteorological data. The filters were used to identify when a given operational condition prevailed. The operational conditions were then summarised in tables or graphs presented in **Appendix A1: Platform Specific Data**.

[3] Vantage POB is used by the oil and gas industry to control and monitor the movements of personnel to, from and between, offshore and onshore facilities.

4 Operational Restrictions – General for the Ravenspurn Field

35. This section will use the methodology discussed in Section 3 and apply it to Ravenspurn North, as a worked example. The same methodology has then been applied to the other relevant platforms and the results shown in **Appendix A1: Platform Specific Data**.

4.1 Take-off Limitations

36. In poor visibility, a take-off towards the wind farm must allow sufficient space to climb to a suitable height before turning away from the array. Under current EASA Regulations aircraft cannot transit within 1 nm of any obstacles in IMC unless a minimum of 1,000 ft above them, called the MSA.

37. When calculating the take-off distance required, a more limiting case is presented when account is taken of an engine failure on take-off, where the rate of climb is restricted and hence the lateral distance required to climb to a suitable height and make a turn is extended. The calculations for the AW139 helicopter, which is commonly used in the southern North Sea and therefore relevant for the Ravenspurn field, are shown in Section 5.5. The AW139 is considered as it is currently the only helicopter in its weight class which complies with all the latest safety requirements, can carry 12 passengers and is approved for flights to 15D 5.3T NUI decks.

38. During consultation for Hornsea Three with the helicopter operators, assumptions were agreed on which performance graphs to use and what ambient temperature to apply when calculating the one engine inoperative take-off distance. At the request of the helicopter operators, these assumptions were changed during consultation for Hornsea Four.

39. An engine failure on rotation is an unlikely event as helicopter manufacturers must demonstrate a probability of an engine failure during initial take-off period is no higher than 5×10^{-8} per take-off or landing[4].

4.2 Approach Limitations

40. Applying the meteorological limits described in Section 2.2.2 to the meteorological data provides the percentage of occasions when each approach type is permitted or required, as presented in Table 4.1. As these figures do not take account of any obstruction created by Hornsea Four, they can be considered valid for other nearby installations.

[4] AMC1 CAT.POL.H.305(b) Helicopter operations without an assured safe forced landing capability.

Table 4.1 Percentage Occasions When a Given Approach Type is Permitted or Required

	2019	2018	2017	2016	2015	2014	2013	Average
En-route Descent Available Day (%)	94%	88%	84%	89%	93%	88%	91%	89%
En-route Descent Available Night (%)	91%	82%	81%	81%	85%	81%	83%	83%
Shuttling Permitted Day (%)	96%	91%	88%	92%	96%	93%	94%	93%
Shuttling Permitted Night (%)	94%	89%	89%	89%	91%	89%	91%	90%
ARA Required Day (%)	4%	9%	12%	8%	4%	7%	6%	7%
ARA Required Night (%)	6%	11%	11%	11%	9%	11%	9%	10%
No Flying Due to Wind/Weather/Sea State Day (%)	3%	8%	11%	7%	3%	6%	5%	6%
No Flying Due to Wind/Weather/Sea State Night (%)	3%	7%	6%	7%	3%	5%	5%	5%

4.2.1 En-Route Descent

41. The data indicates that on average an en-route descent could be made on 89% of occasions by day and 83% of occasions by night. Under these conditions no approach limitations whatsoever will be imposed on gas installations adjacent to Hornsea Four.

4.2.2 Shuttling Permitted

42. The data indicates that on average the option of flying a shuttle flight, where the helicopter would fly an instrument approach to an initial installation (often without landing) and then transit to its destination, would be available 93% by day and 90% by night. Shuttling procedures can be used if the destination is within 10 nm of the initial installation approached. Thus, shuttling would provide an alternative approach profile within the Ravenspurn field but would not be an option for the Garrow or

Kilmar platforms since they are more than 10 nm from the Ravenspurn field. Below shuttling meteorological conditions, an ARA would be required.

4.2.3 ARA Required

43. When the weather conditions are below those permitting an en-route descent or a shuttle flight, an ARA must be flown. The data indicates that on average an ARA is required on 7% of occasions by day and 10% by night. These figures are the difference between when shuttling can be used subtracted from 100%. However, in order to assess the worst case, the evaluation below will assume that an ARA will be required whenever an en-route descent is not permitted: shuttling procedures may be used as a mitigation but will not be considered in this report - if an en-route descent cannot be made, it will be assumed that an ARA is required due to conservatism.

4.2.4 No Fly Conditions

44. No fly conditions exist for an average of 6% of occasions by day and 5% of occasions by night. No fly conditions will be higher for some NUIs where additional restrictions are in place, such as a 30 kt wind deck limit, for example the Ravenspurn North ST2 platform.

45. The gap between when a flight can be made under Visual Meteorological Conditions (VMC) and when the weather conditions preclude a flight can be quite small. For example, the gap between when an en-route descent can be made (89% by day) and when a flight is prohibited (6% by day) results in only a small reduction in capability (the remaining 5%). If an ARA has to be flown but is not obstructed by the wind farm due to the wind direction, the resulting restrictions may not be as large as initially assumed.

4.2.5 Wind Data

46. All the wind data points for 2013 to 2019 are presented in Figure 4.1, showing the wind direction by count. The most prevalent wind direction is from the south west.

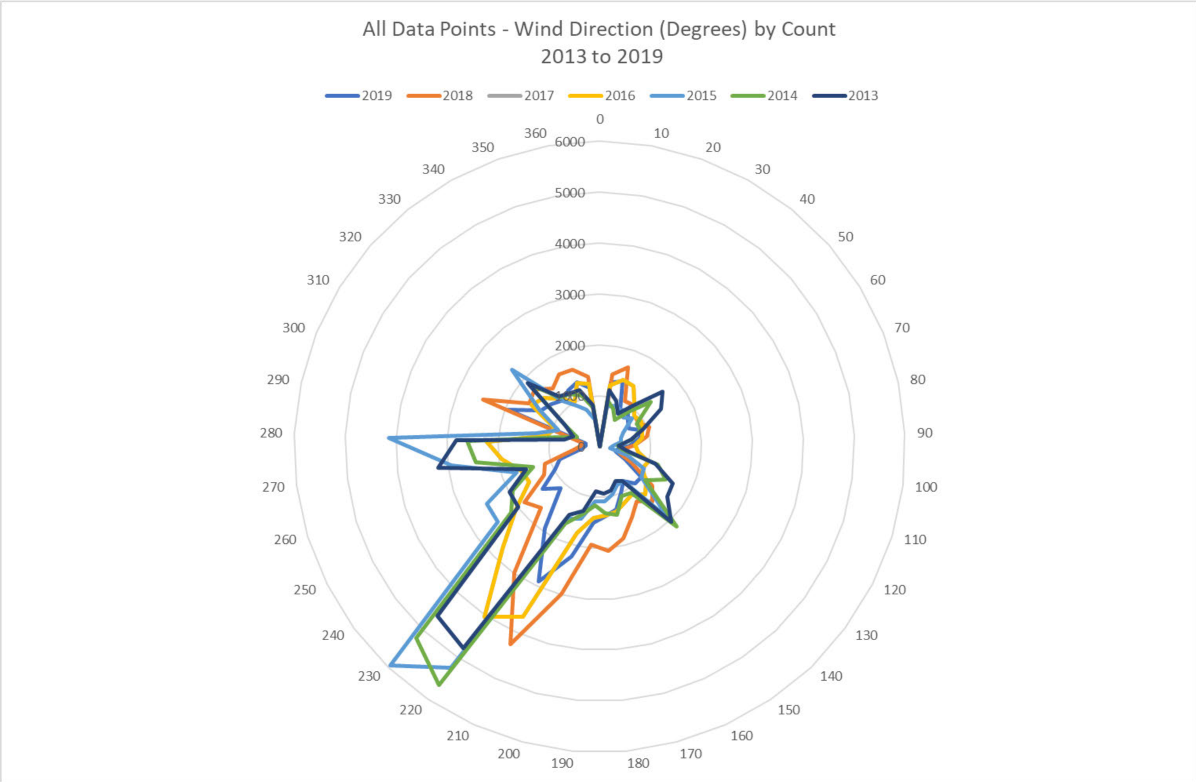


Figure 4.1 All Wind Data Points (2013 to 2019)

47. Figure 4.2 presents the wind direction by count for points where an ARA is required. In this scenario the resulting wind directions have a strong easterly component. Figure 4.2 also confirms the general tendency that fog and poor visibility is more likely on the North Sea when there is an easterly or south easterly wind. Notably, the number of data points where an ARA is required are low between 220° and 290°. This arc is where an ARA may need to be flown directly over the wind farm (see Figure 4.3), where any turbines on the approach path would have an adverse effect.

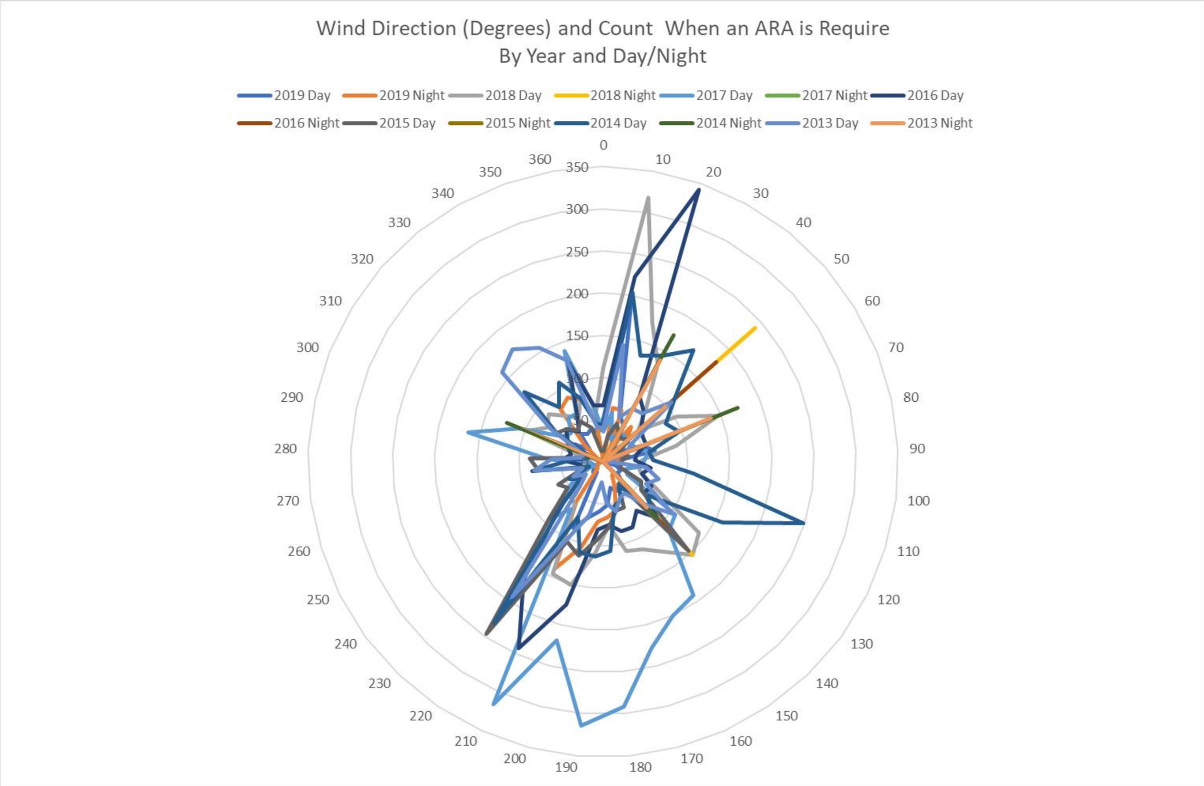


Figure 4.2 Wind Direction When an ARA is Required by Year and Day/Night

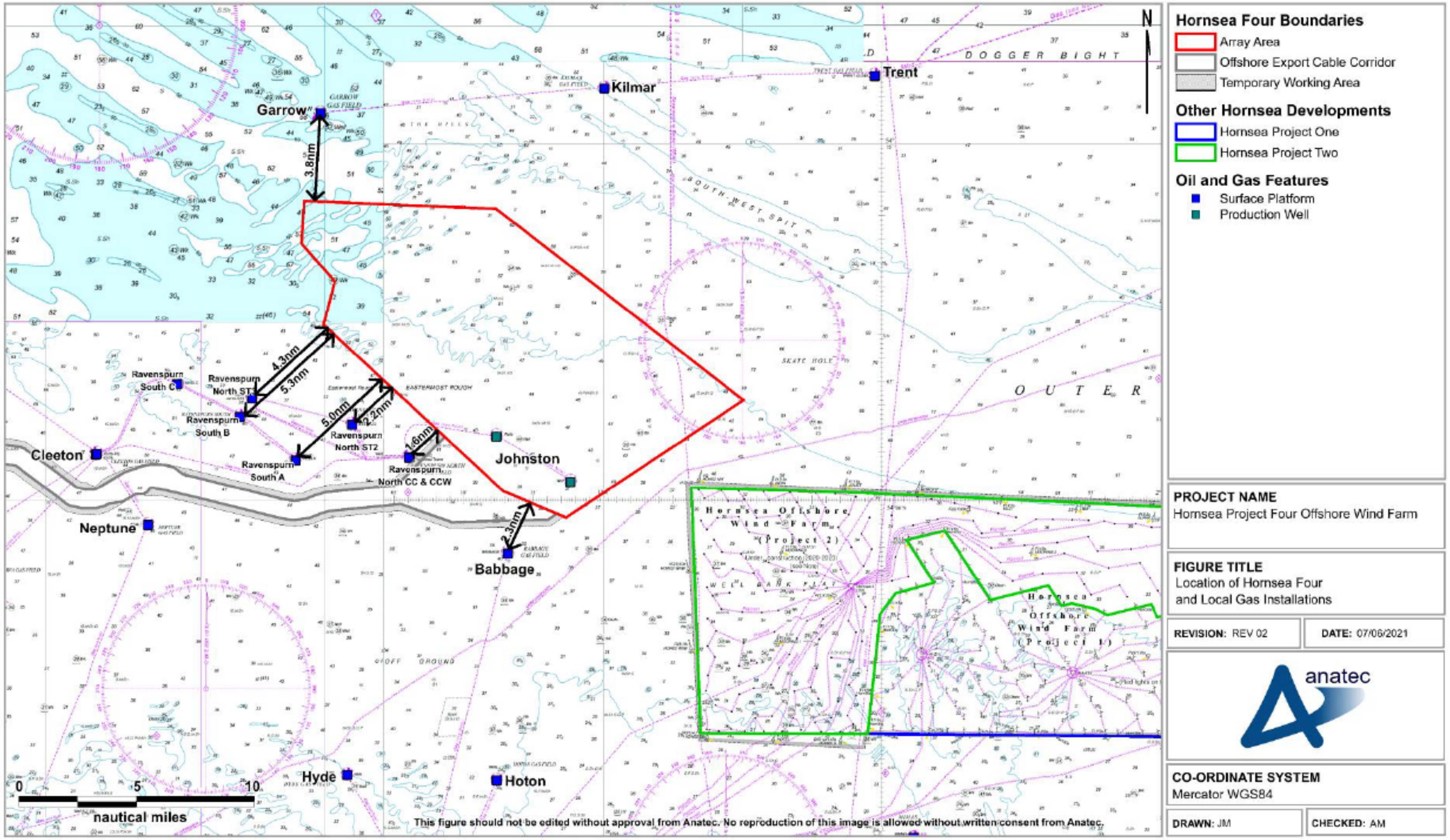


Figure 4.3 Location of Hornsea Four and Local Gas Installations

48. Based on expert judgement and as agreed by helicopter operators during the workshops held on 27th September 2019 and 9th January 2020, the majority of flights take place by day. Therefore, Figure 4.4 attempts to declutter the data in Figure 4.2 by only showing day conditions. Additionally, any day conditions when no flying conditions exist are excluded (shown in Table 4.1). Rather than showing the count of events in each wind arc, Figure 4.4 displays hours per year for each wind direction.

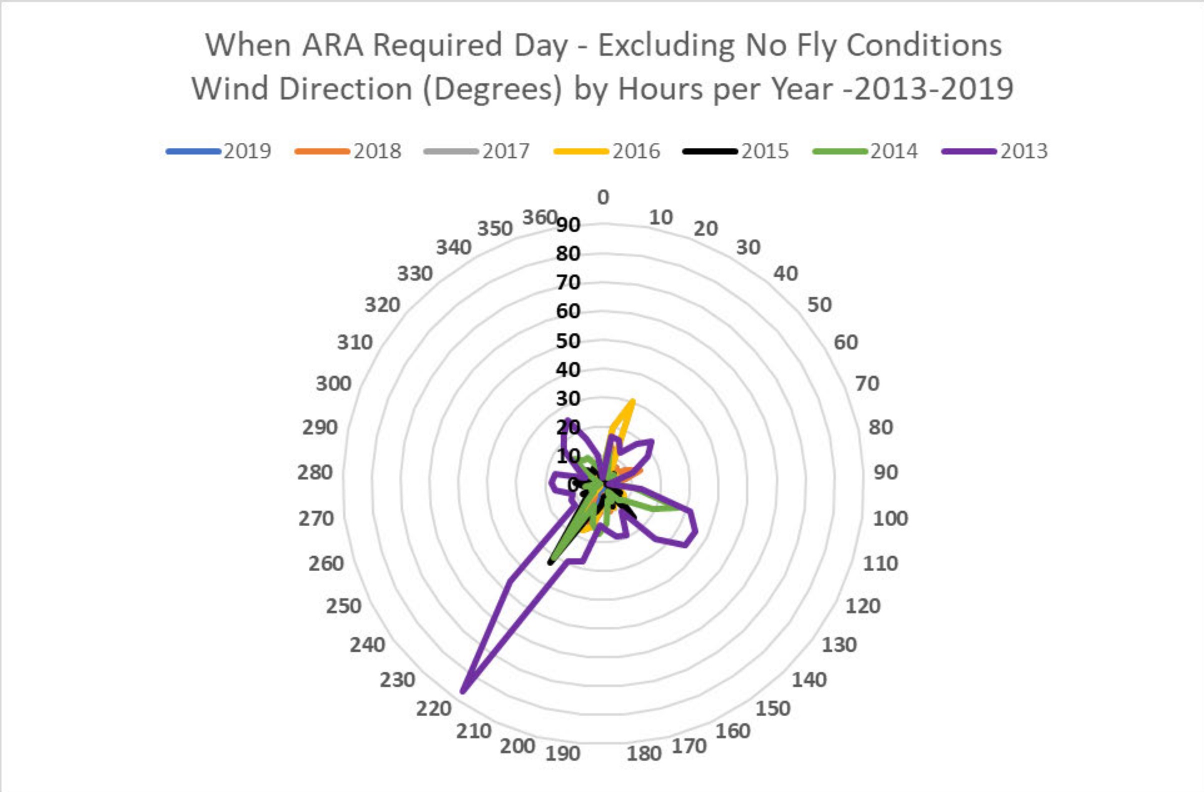


Figure 4.4 Wind Direction when an ARA is Required with No Fly Conditions Excluded

49. Although 220° is shown as a prominent spike in Figure 4.4, this only amounted to 90 hours, or 1.0% of the entirety of 2013 (the year which presented the worst case scenario).

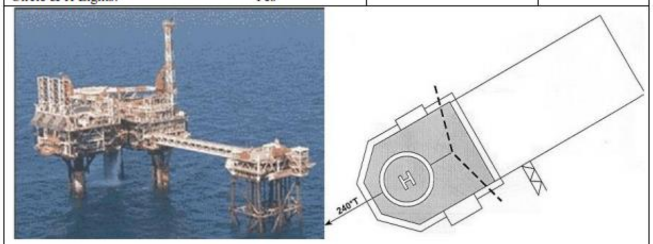
5 Operational Restrictions – Ravenspurn North Specific

5.1 Ravenspurn North Platform Characteristics

50. The Ravenspurn North installation is a manned platform which is equipped and approved for day and night operations. For that reason, 24-hour access is assessed. Figure 5.1 presents the helideck information plate for the Ravenspurn North platform.

HELIDECK INFORMATION PLATE

HELIDECK	VAR	POSITION	EGRV		
Elev 156 ft	Check	N54 01.49 E001 06.02	Ravenspurn North		
HEIGHT OF INSTALLATION: 290			VHF	NDB	Issue Date
HIGHEST OBSTACLE WITHIN 5NM: Check			129.875	N/A	13 Mar 2020
FUELLING INSTALLATION: Yes			Operating Company		Issued By
STARTING EQUIPMENT: Yes			Perenco		Helideck Certification Agency
HELIDECK D value: 22.2					
P/R/H Category: F					
Max Weight: 9.3					
Circle & H Lights: Yes					



Wind (T°)	Kts	Limitation /Comment
• 000-135	• All	Manned Platform • Daylight only operations • Possible turbulence due to turbine exhausts • Table 1(T) if overflight of 5:1 Items is unavoidable • Approved for S92 (12.0t)
		Non Compliance
5:1		North & South access platforms
Misc		Vent boom obstruction lights unserviceable Turbine exhausts to NE and SE Approved friction surface - no net

Figure 5.1 Ravenspurn North Helideck Information Plate (Source: Helideck Certification Agency (HCA))

51. For an ARA, the MDH by day is a minimum of the helideck height (156 ft) rounded up to the nearest 10 ft plus 50 ft. Therefore, the day MDH for the Ravenspurn North platform is 210 ft. The night MDH is the higher of either 300 ft or the deck height plus 100 ft, which results in a night MDH for the Ravenspurn North platform of 300 ft.

5.2 Ravenspurn North Vantage Data

52. Table 5.1 presents the breakdown of the number of flights to the Ravenspurn North platform[5]. Additional data was provided on the number of personnel carried, but at this stage the impact only on the number of flights is assessed.

Table 5.1 Vantage Data for Ravenspurn North – Flights Per Month and Year

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
2019	33	35	47	37	41	35	72	32	27	36	–	–	395
2018	34	40	35	29	38	38	54	40	29	36	32	28	433
2017	51	48	60	54	46	40	66	62	54	57	49	36	623
2016	99	105	57	51	72	52	47	55	70	69	57	48	782
2015	61	100	99	102	91	54	90	110	86	74	63	64	994
2014	74	78	99	64	98	69	78	65	69	76	73	58	901
2013	46	51	63	60	57	68	80	79	75	78	79	67	803
Total	**398**	**457**	**460**	**397**	**443**	**356**	**487**	**443**	**410**	**426**	**362**	**301**	**4,938**

53. Figure 5.2 presents the number of flights per month to the Ravenspurn North platform. Due to the level of detail in the Vantage data provided, it is not possible to discern between standard crew change flights to the platform and shuttle flights for maintenance work on NUIs. Neither is it possible to provide a breakdown between day and night flights. Based on the data supplied, there appears to be no clear monthly trend for this particular platform, even though there is a general tendency for planned drilling and offshore maintenance work, especially on NUIs, to be biased towards the summer months.

[5] Vantage data supplied by email snslogistics@uk,perenco.com Wednesday 13/11/2019 15:25

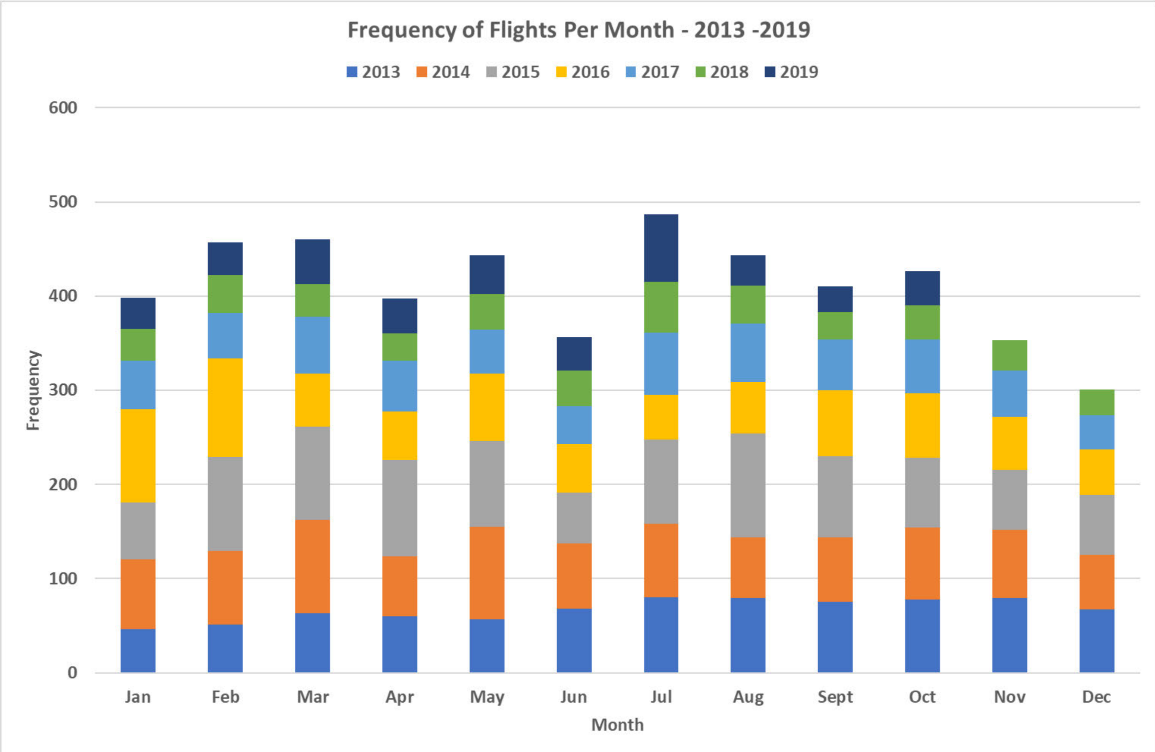


Figure 5.2 Frequency of Flights to Ravenspurn North by Month and Year

54. Figure 5.3 assesses the annual trends. The Perenco (2019) data shows a gradual decline in the number of flights since 2015. It was noted by Perenco during the workshop on 9th January 2020 that the number of flights is just as likely to increase in the future, although no evidence was provided to support this statement. This decline could be due to a combination of factors, including:

- Reduced activity due to declining exploration and production;
- A change to shift patterns to reduce costs, which accompanied the downturn in the oil price; and
- An increase in the use of walk-to-work vessels to transfer personnel from a manned platform to access NUIs.

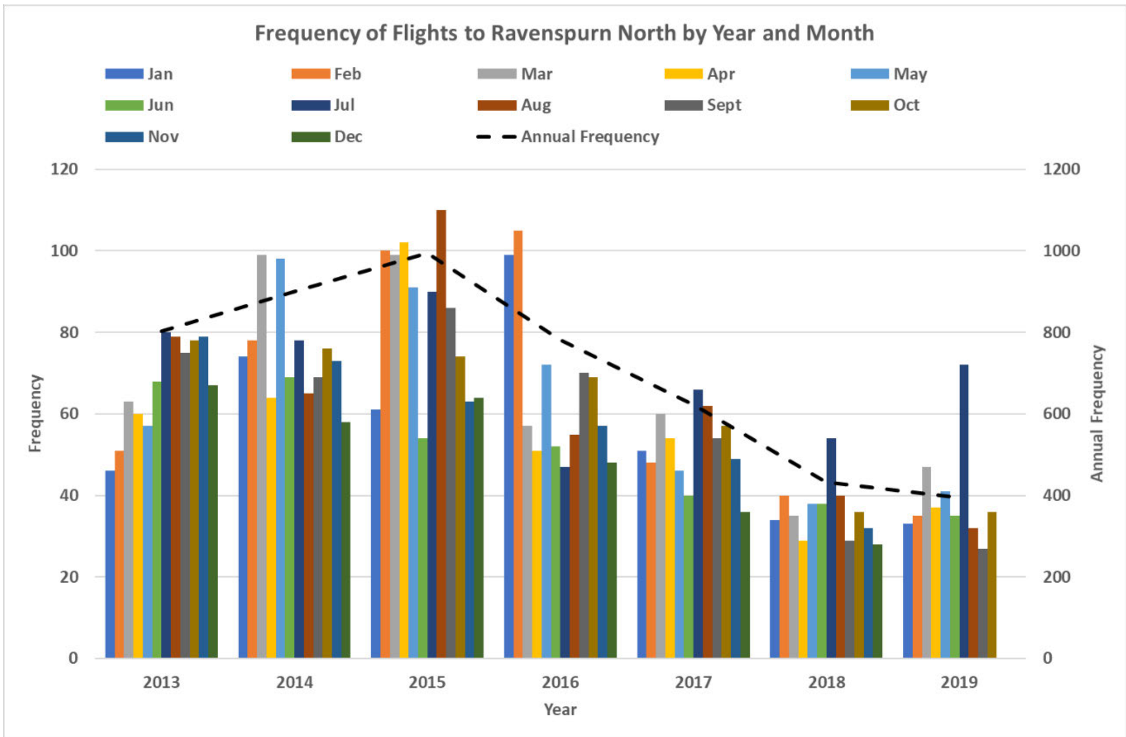


Figure 5.3 Frequency of Flights to Ravenspurn North by Year and Month

55. Based on the Vantage data provided, analysis was undertaken on both an annual and monthly basis as there were no clear seasonal trends. If other installations are assessed, especially NUIs where helicopter access is used, it is anticipated that more seasonal variation will be seen.

56. As a decline in flights has occurred, it is important to identify future trends and if this decline will continue or stabilise. If greater use is made of walk-to-work vessels and/or the number of flights remain at a low level, then the impact of Hornsea Four is likely to be reduced compared to the historic level of access required. As stated at the January 2020 workshop, it was noted by Perenco that flights may increase in future years, although no evidence was provided to support this statement. For the purposes of this analysis, it will be assumed that the number of flights will not increase above the numbers flown in 2018/19.

5.3 Location of Ravenspurn North

57. Ravenspurn North is located 1.6 nm (3.0 km) from the western and southern boundary of Hornsea Four, as shown in Figure 5.4. The western and southern boundary runs on an approximate heading of 110° to the south east and 330° to the north west. This will result in some ARA approach arcs being compromised, as illustrated in Figure 5.5, reducing access for CAT flights.

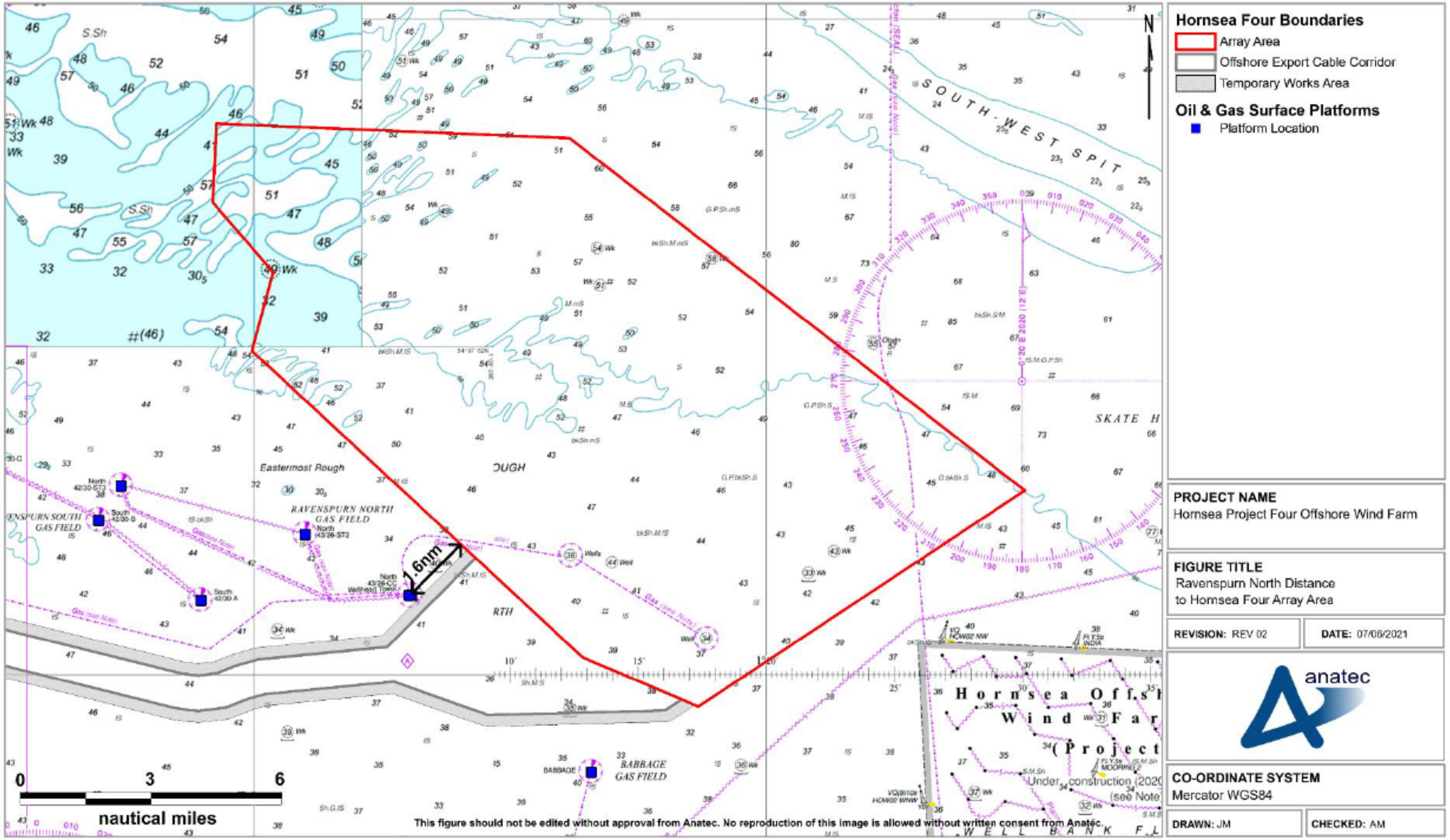


Figure 5.4 Ravenspurn North Distance to Hornsea Four Array Area

58. As discussed above, Ravenspurn North is a manned platform and approved for night operations, so 24-hour access is highly desirable for CAT Operations and essential for emergency access, including SAR, as well as emergency evacuation and Medivac flights which are also conducted under SAR Regulations. The number of hours per month, minus no-fly conditions, when an ARA was required was calculated, using the methodology set out in Section 3, and results are presented below. The sectors where the wind farm would prevent an ARA were then identified, as illustrated in Figure 5.5, and quantified in terms of hours per month. In order to show the detail required without excessive clutter, the data was plotted on an annual basis in Figure 5.5.

59. Figure 5.5 presents the data for 2018, the most recent complete year of data. Graphs and associated data in tabulated form are shown for Ravenspurn North in **Appendix A1: Platform Specific Data**, for each year from 2013 to 2019.

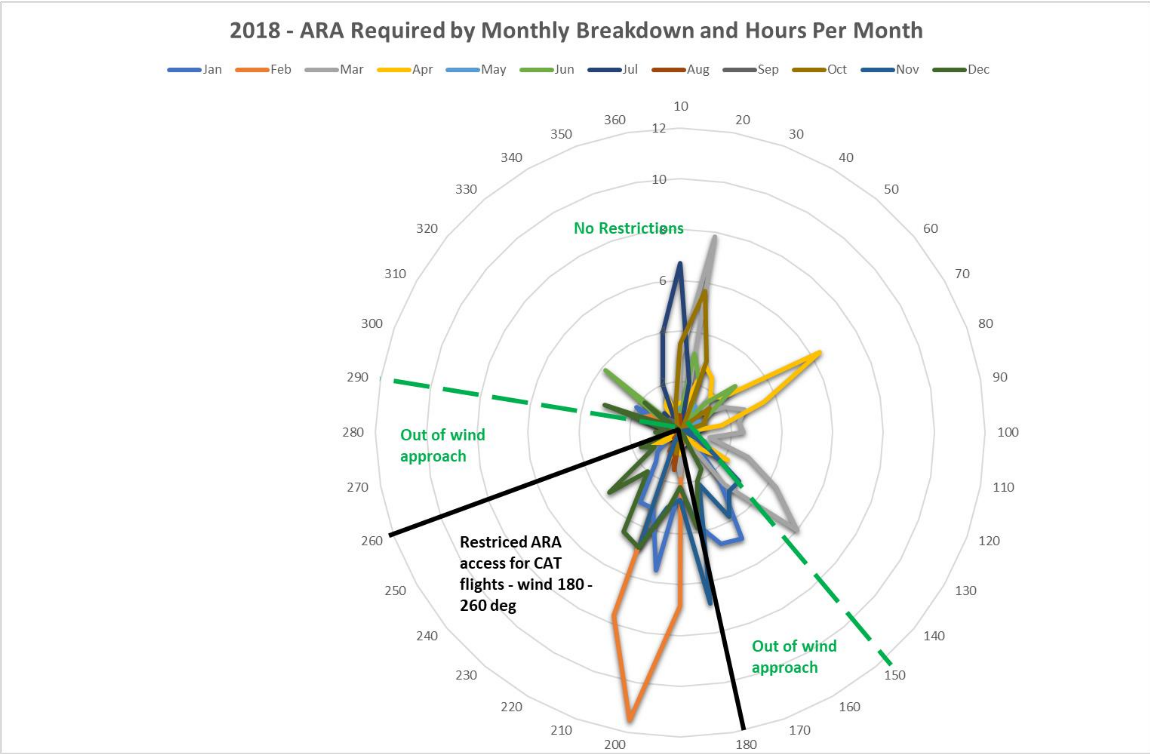


Figure 5.5 ARA Required Day or Night - 2018– Hours Per 10° Wind Segment

60. Although the boundary of the Hornsea Four array area closest to Ravenspurn North has two of the sides aligned 110° and 330°, in lighter winds this need not constrain the approach direction. If it is assumed that up to 10° of drift is allowable during an ARA, as agreed at a Hornsea Three operator workshop[6], then provided that the wind speed is at or below 20 kt, then an approach up to 30° out of wind may be flown. Allowing for an approach to be flown up to 30° out of wind would result in

[6] Helicopter Operator Workshop hosted by Ørsted Hornsea Project Three. 27th February 2019. Operators – CHC & NHV in person, Bristow and Babcock by telecon

approaches from 360° clockwise to 080° being blocked, i.e. when wind blows from 180° clockwise to 260°.

61. Table 5.2 identifies the percentage of the time each wind direction occurred in 2018, with the wind directions where an ARA would be obstructed highlighted in yellow. For 2018, the highlighted cells show that ARAs would be blocked by the wind farm for 1.2% of the year, or for approximately 108 hours in total, when no fly conditions are excluded.

Table 5.2 Percentage of Time When ARAs are Required by Wind Direction and Month (2018)

Wind Direction (°)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Sector
10	0.002	0.002	0.034	0.013	0.011	0.008	0.076	0.008	0.000	0.040	0.000	0.000	0.194
20	0.002	0.000	0.089	0.011	0.002	0.036	0.023	0.000	0.000	0.065	0.000	0.000	0.228
30	0.002	0.000	0.004	0.032	0.002	0.025	0.000	0.000	0.000	0.034	0.000	0.000	0.099
40	0.006	0.008	0.006	0.029	0.013	0.006	0.000	0.000	0.000	0.002	0.000	0.000	0.068
50	0.006	0.002	0.021	0.021	0.000	0.017	0.000	0.000	0.000	0.006	0.000	0.000	0.072
60	0.010	0.002	0.013	0.025	0.004	0.032	0.000	0.000	0.000	0.017	0.000	0.000	0.103
70	0.008	0.000	0.023	0.072	0.010	0.013	0.000	0.000	0.000	0.013	0.002	0.000	0.141
80	0.008	0.002	0.030	0.040	0.000	0.011	0.000	0.000	0.000	0.011	0.004	0.000	0.107
90	0.011	0.004	0.027	0.019	0.000	0.004	0.000	0.002	0.000	0.000	0.002	0.000	0.068
100	0.006	0.004	0.029	0.002	0.000	0.008	0.000	0.000	0.000	0.000	0.006	0.000	0.053
110	0.004	0.004	0.013	0.000	0.000	0.002	0.000	0.002	0.000	0.000	0.004	0.000	0.029
120	0.011	0.008	0.032	0.006	0.000	0.000	0.000	0.002	0.000	0.000	0.008	0.000	0.067
130	0.015	0.011	0.049	0.025	0.000	0.002	0.000	0.000	0.000	0.000	0.015	0.000	0.118
140	0.010	0.008	0.068	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.034	0.002	0.133
150	0.027	0.002	0.030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.03	0.004	0.097
160	0.055	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.002	0.044	0.019	0.122
170	0.053	0.000	0.006	0.002	0.004	0.000	0.000	0.000	0.000	0.004	0.025	0.023	0.116
180	0.042	0.002	0.006	0.004	0.004	0.000	0.000	0.000	0.000	0.006	0.078	0.044	0.185
190	0.025	0.078	0.019	0.010	0.000	0.000	0.002	0.000	0.000	0.002	0.030	0.025	0.190
200	0.063	0.131	0.010	0.002	0.000	0.000	0.000	0.017	0.000	0.010	0.034	0.036	0.303
210	0.036	0.088	0.008	0.011	0.002	0.000	0.004	0.008	0.000	0.000	0.055	0.055	0.266
220	0.036	0.002	0.008	0.000	0.000	0.000	0.002	0.010	0.000	0.000	0.006	0.051	0.114
230	0.017	0.002	0.000	0.002	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.023	0.046
240	0.013	0.002	0.000	0.002	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.042	0.063
250	0.008	0.000	0.004	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.034
260	0.008	0.000	0.000	0.013	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.019	0.042
270	0.000	0.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.015

Wind Direction (°)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Sector
280	0.004	0.000	0.002	0.002	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.011	0.021
290	0.000	0.002	0.002	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.006	0.011
300	0.013	0.019	0.004	0.000	0.000	0.002	0.000	0.023	0.000	0.000	0.000	0.036	0.097
310	0.023	0.015	0.002	0.000	0.000	0.008	0.000	0.008	0.008	0.000	0.000	0.006	0.068
320	0.002	0.008	0.004	0.010	0.002	0.044	0.000	0.013	0.002	0.000	0.000	0.021	0.105
330	0.002	0.008	0.002	0.000	0.000	0.006	0.011	0.004	0.008	0.000	0.000	0.002	0.042
340	0.000	0.010	0.002	0.013	0.002	0.004	0.004	0.004	0.006	0.000	0.000	0.000	0.044
350	0.006	0.011	0.017	0.017	0.006	0.000	0.023	0.002	0.000	0.004	0.000	0.000	0.086
360	0.000	0.008	0.004	0.006	0.006	0.000	0.046	0.008	0.000	0.011	0.000	0.000	0.088
Total Per Month	0.531	0.439	0.571	0.413	0.067	0.228	0.192	0.116	0.025	0.226	0.381	0.445	

62. A full annual breakdown of when the wind farm will restrict approaches is shown in Table 5.3. Such small numbers are unlikely to have a significant effect on routine operations. If a more detailed breakdown of the Vantage data was supplied, showing individual flights by day and time, then an exhaustive assessment could be conducted to identify which flights (historically), if any, would have been prevented by the presence of the wind farm.

Table 5.3 Hours and Percentage Per Year When Hornsea Four Would Prevent an ARA Being Flown

Year	Number of Hours When the Wind is Between 180° and 260° and an ARA Required	Percentage When the Wind is Between 180° and 260° and an ARA Required
2013	122	1.4%
2014	146	1.7%
2015	182	2.1%
2016	102	1.2%
2017	132	1.5%
2018	108	1.2%
2019*	55	0.8%

(*) The 2019 dataset is missing two winter months and so the number of hours when an ARA is required could be expected to increase over the full year.

5.4 Periods of Time When an Approach to Ravenspurn North Would be Impaired

63. As well as the total number of hours, or percentage of the time, that an ARA to the Ravenspurn North platform is impaired, it is also relevant to assess the periods of time when access to the platform is lost, as short periods of restricted access are likely to have a lesser impact on operations than large periods. Figure 5.6 to Figure 5.12 indicate the frequency and periods of time for each year, in hours, an ARA to Ravenspurn North would be prevented. It is noted that 2019 only includes 10 months of data, with November and December missing.

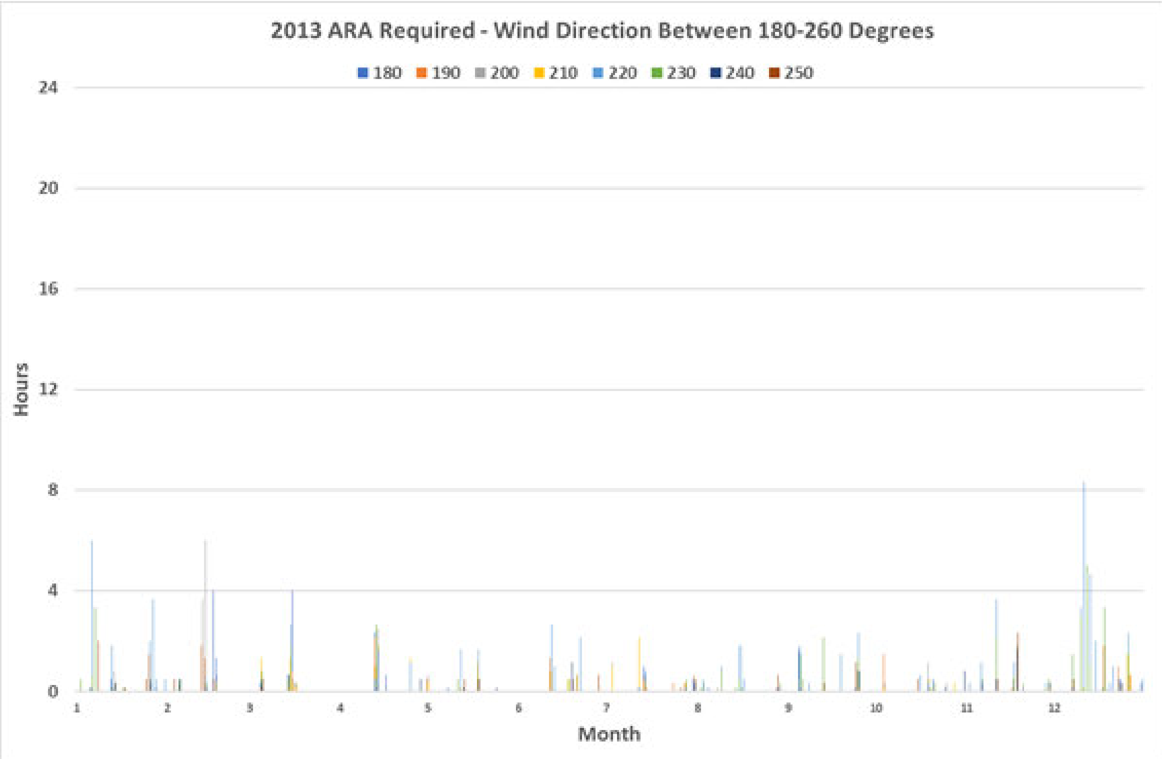


Figure 5.6 Frequency and Hours per Month an ARA to Ravenspurn North is Impaired (2013)

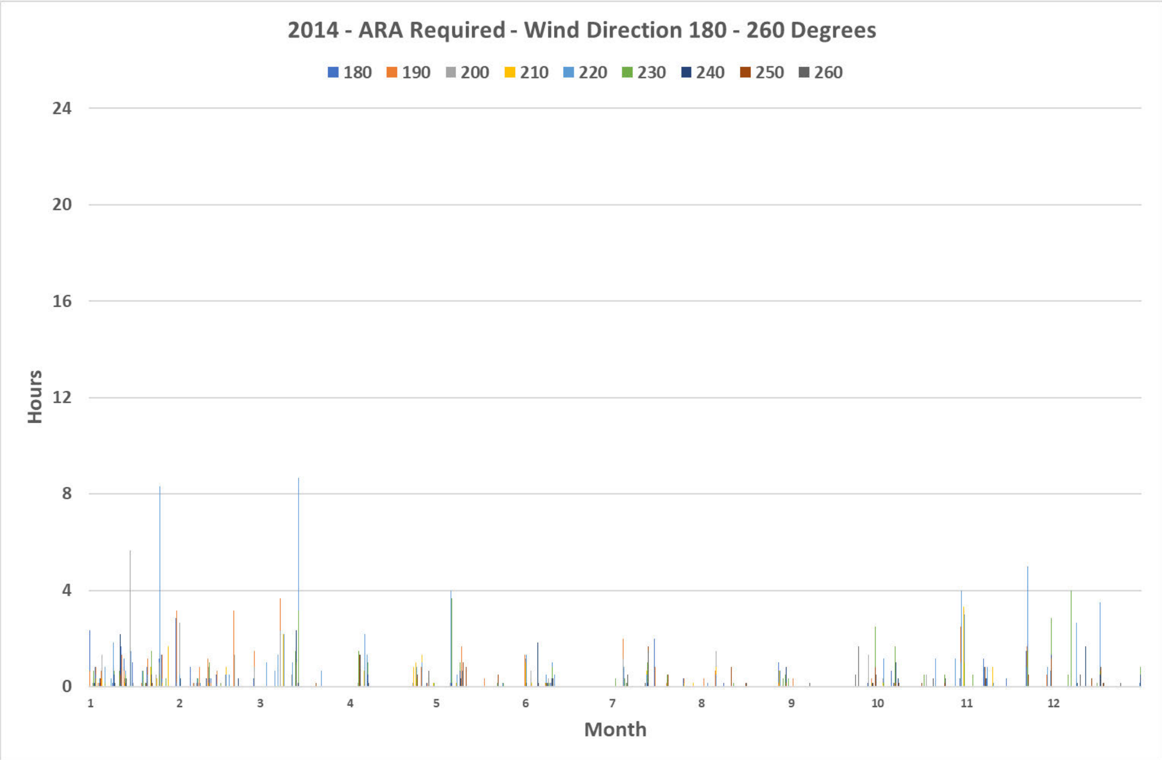


Figure 5.7 **Frequency and Hours per Month an ARA to Ravenspurn North is Impaired (2014)**

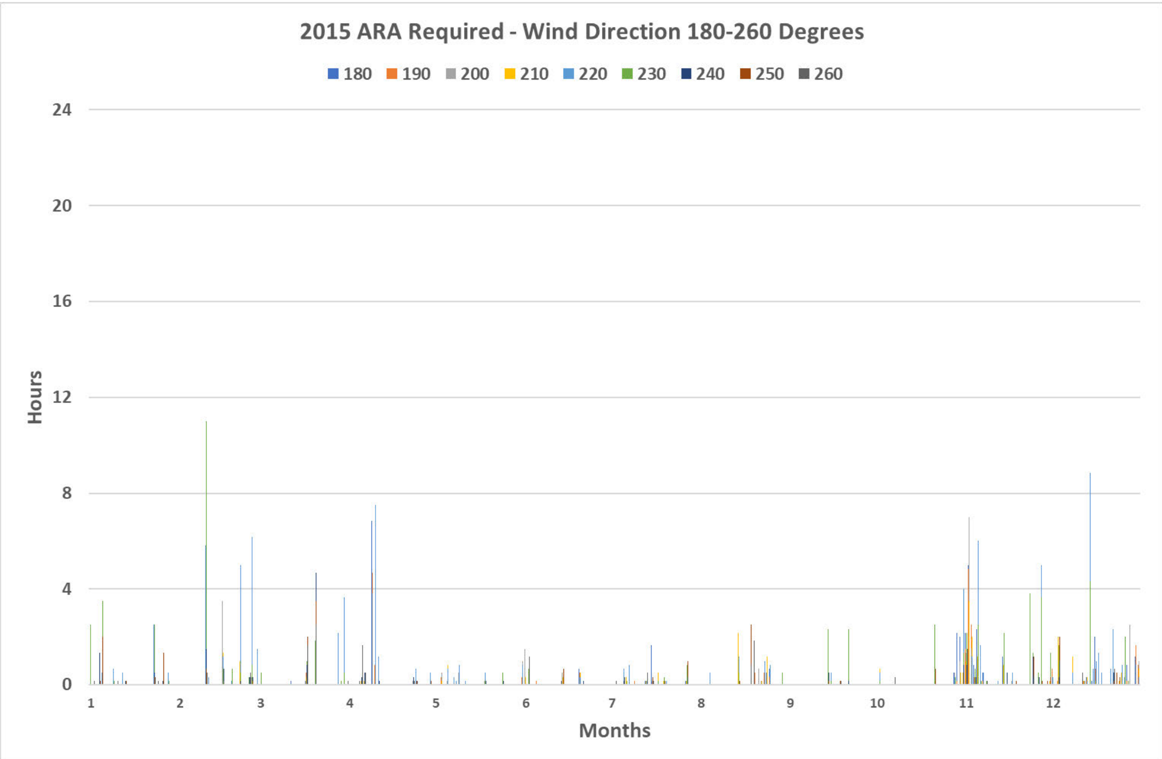


Figure 5.8 **Frequency and Hours per Month an ARA to Ravenspurn North is Impaired (2015)**

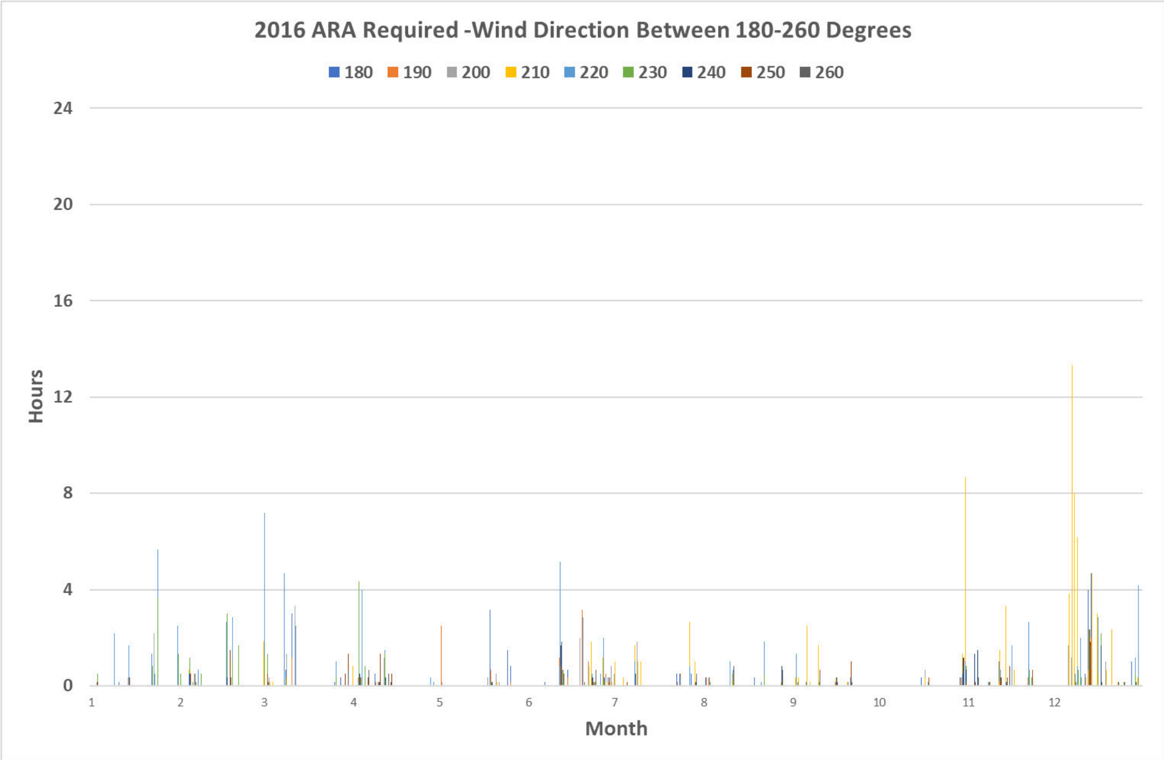


Figure 5.9 **Frequency and Hours per Month an ARA to Ravenspurn North is Impaired (2016)**

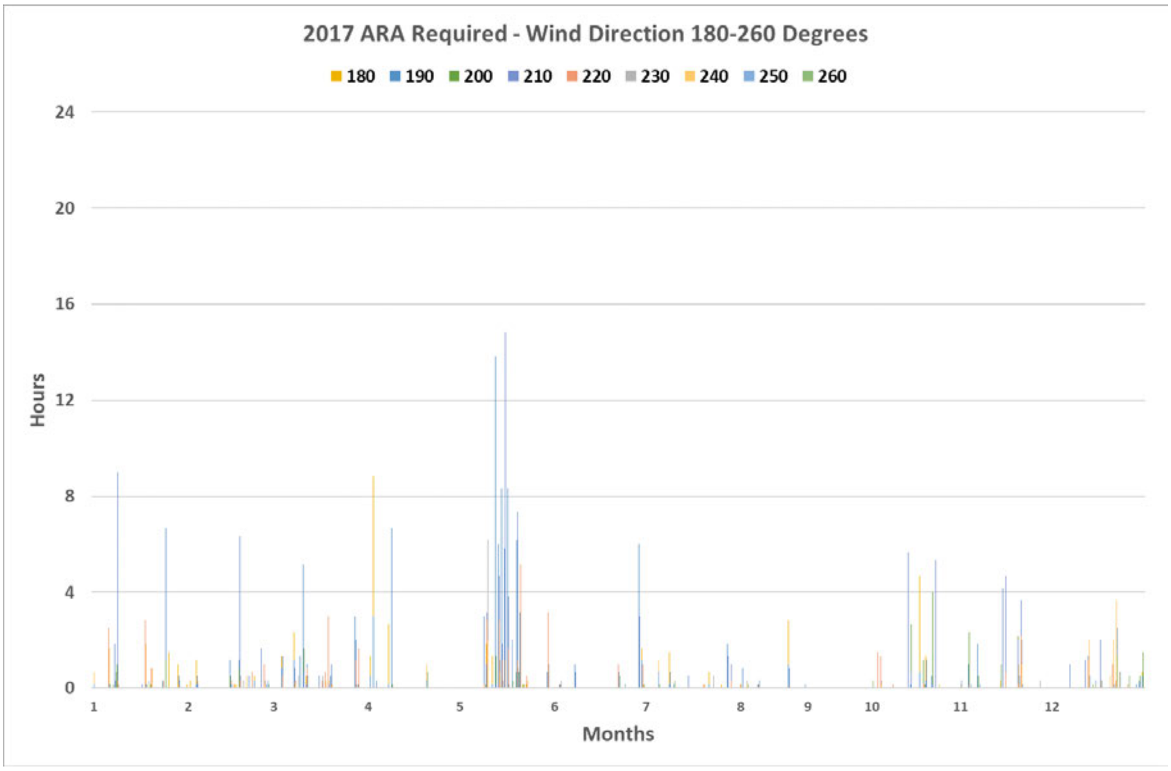


Figure 5.10 **Frequency and Hours per Month an ARA to Ravenspurn North is Impaired (2017)**

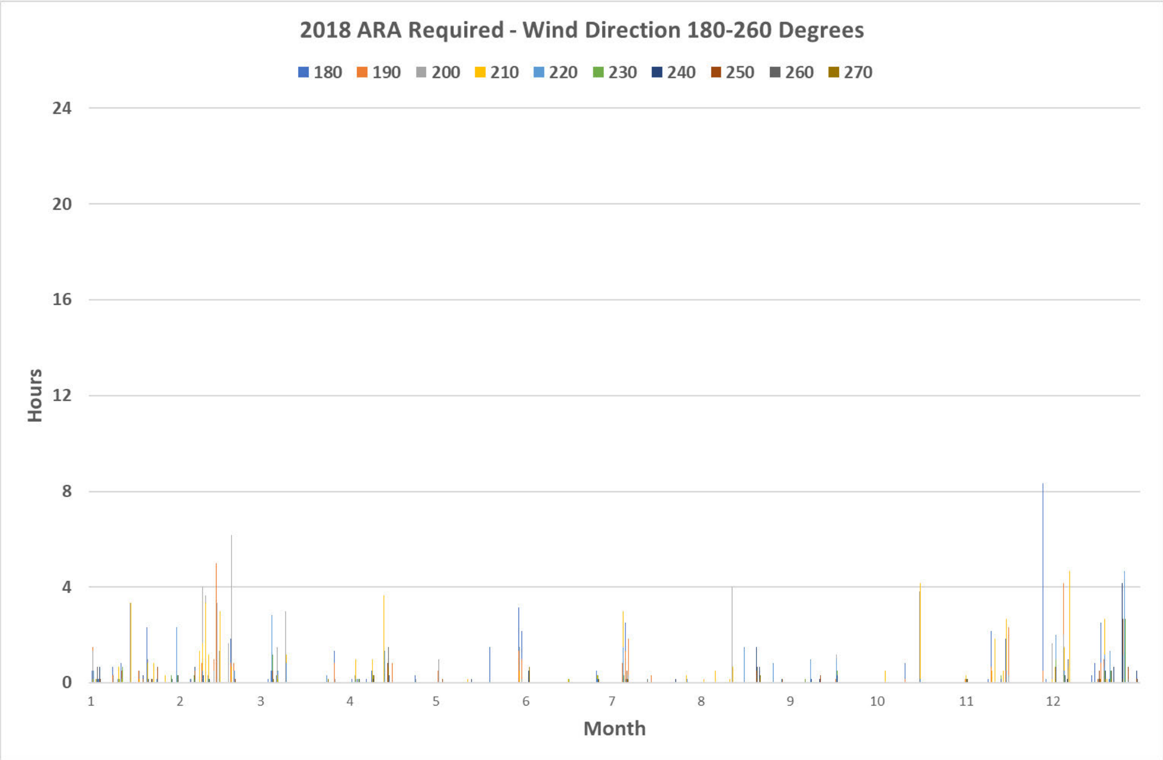


Figure 5.11 **Frequency and Hours per Month an ARA to Ravenspurn North is Impaired (2018)**

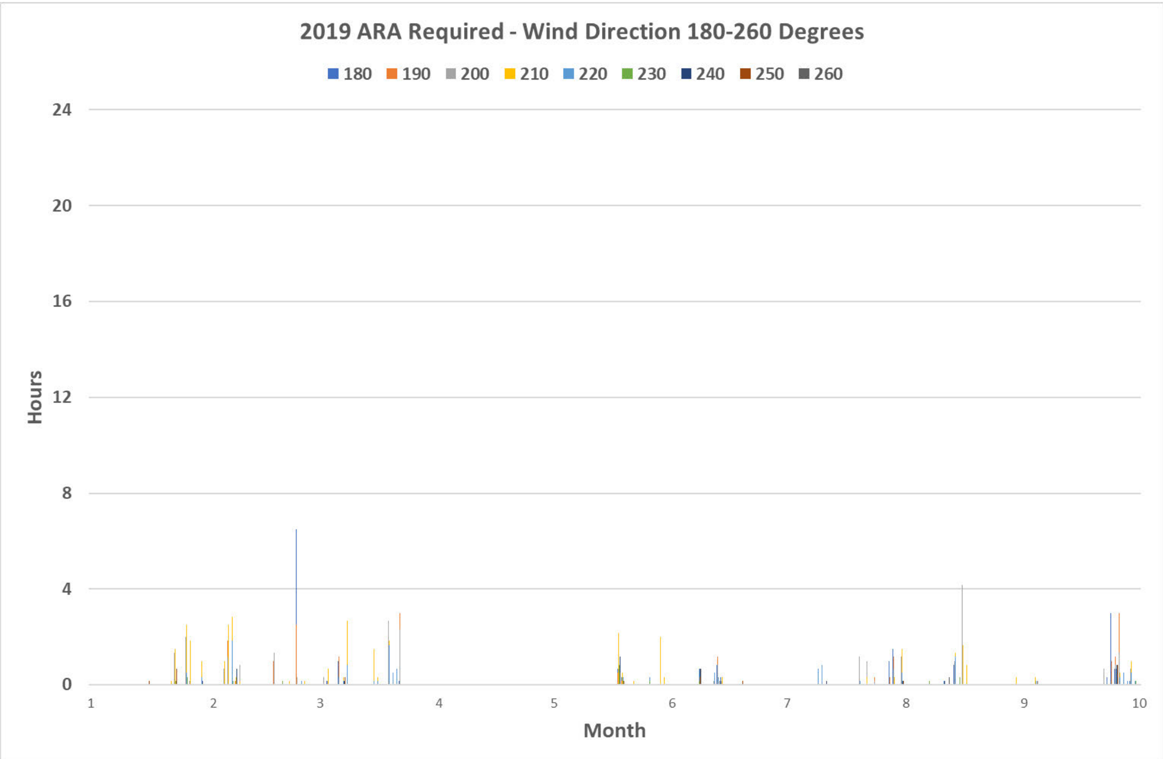


Figure 5.12 **Frequency and Hours per Month an ARA to Ravenspurn North is Impaired (2019)**

64. Similar figures showing the distribution of time when approaches are impaired, with a restricted arc from 170° to 270°, are shown in the Babbage data (see **Appendix A1: Platform Specific Data**), as the Babbage platform is a special case given that it is restricted by both Hornsea Four and Hornsea Project Two.

5.5 Calculation of Take-Off Distance Required with One Engine Inoperative

65. The AW139 is currently the only helicopter type used for gas operations in the UK southern North Sea. It is capable of transporting 12 passengers and bags as well as operations to 15D 5.3T helidecks[7], such as those on many NUIs. Over 1,000 AW139s have been built since the production line started in 2002, and the type has gone through a series of upgrades, including a recent avionic update. Previously, other medium sized helicopters were utilised on the southern North Sea, but these were retired after the Sumburgh helicopter accident in 2013. The accident resulted in the publication of CAP 1145 (CAA, 2014), CAP 1243 (CAA, 2015), and their associated Safety Directives. These resulted in legacy types, such as the S76 and EC155, being retired from the southern North Sea as they did not have crashworthy seating and fuel tanks, and could not meet all the CAA requirements whilst still carrying an economic payload.

66. In this analysis, data for the Leonardo AW139 is used, which were obtained from the AW139 Rotorcraft Flight Manual (RFM).

67. There are currently no similar sized helicopters available which are capable of operating to all the platforms in the area whilst meeting all the safety requirements identified in CAP 1145. If another helicopter type(s) is found necessary for just the crew change flights to Ravenspurn North, then this analysis should be repeated for that type.

68. A take-off from a helideck, with an engine failure on rotation, is deemed to be the most restrictive case requiring the largest distance to achieve a safe departure. This is highly unlikely, and under the EASA SPA.HOFO Guidance a probability of less than 5×10^{-8} per take-off or landing has been determined.

69. The use of the AW139 Supplement 97 and applying a temperature of 30°C at a take-off mass of 6800kg were agreed during an operator workshop on 27th February 2019, as part of the Hornsea Project Three consultation process. The relevant platforms considered were the Chiswick and Grove NUIs, which were generally supported by helicopters operating from the Dutch base at Den Helder, shuttling workers from the J6A platform. That analysis resulted in a take-off distance of 2.8nm, which was accepted by all parties.

[7] The AW139 is approved to operate to decks smaller than its longest distance of 16.63 m. Additionally, it is permitted to land at a mass above that normally permitted, due to its engine failure characteristics. This alleviation from the requirements in CAP 437 is based on a Safety Case commissioned by the helicopter manufacturer, conducted by Consultavia Ltd, and accepted by the CAA.

5.6 Further Analysis

70. As part of the Hornsea Four consultation process with the helicopter operators, as required by CAA CAP 764, two UK operators stated they routinely use the flight profiles and performance data in the AW139 Supplement 50, not Supplement 97. The reasons stated were that Supplement 50 allowed a lower thrust margin (available Power Index margin) and a simpler OEI take-off profile. Using Supplement 50 results in a slightly lower OEI rate of climb, and hence a greater distance to complete a take-off and turn away from Hornsea Four under IMC. In light of the revised performance data used by two operators, it was decided to update the analysis to determine the actual distance required under normal conditions, and to confirm if the previous temperature and take-off mass assumptions were still valid.

5.6.1 Effected Take-off Arc

71. The effected take-off arc was measured as 340° clockwise to 100°. The proximity of Ravenspurn North to the boundary of Hornsea Four is shown in Figure 5.14.

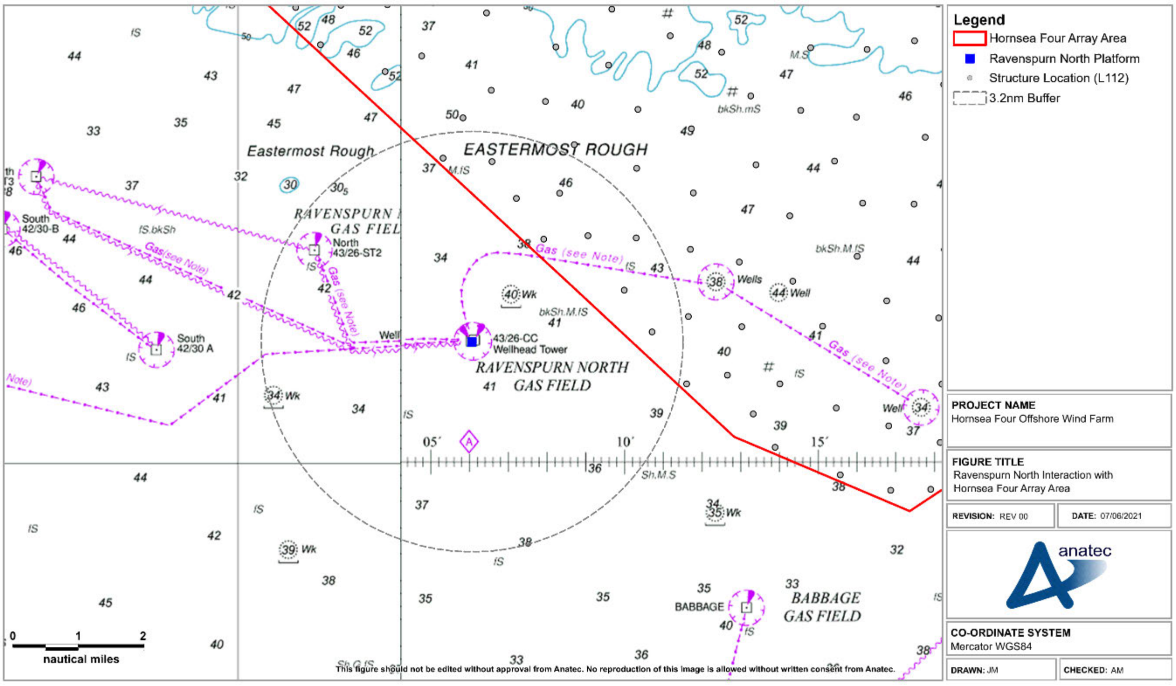


Figure 5.13 Ravenspurn North Interaction with Hornsea Four Array Area

5.6.2 Temperature

72. During the operator workshop on 27th February 2019, one assumption agreed was a temperature of 30°C should be applied to the take-off calculations as that was a worse case assumption. Higher temperatures cause a reduction in the density of the air, resulting in lower aerodynamic performance. Additionally, higher temperatures result in reduced engine performance. In reality, the offshore temperatures rarely reach 30°C, and so a more realistic temperature should be applied. The

meteorological data was analysed for the period 2013 to 2019, and the temperature noted when the wind blew from the 340° to 110° arc. The temperatures are summarised in Table 5.4.

Table 5.4 Temperature Data for the 340° to 110° Arc

Temperature Parameter	2013	2014	2015	2016	2017	2018	2019
Mean temperature (°C)	10.0	12.7	9.9	7.1	10.4	9.1	10.2
Temperature standard deviation (°C)	4.7	3.1	3.7	2.6	3.5	3.7	3.1
Temperature to two standard deviations (°C)	19.4	18.9	17.3	12.3	17.4	16.4	16.3

73. The data approximated to a normal distribution. Applying an upper temperature equating to two standard deviations will cover 97.5% of the highest temperatures. The highest value to two standard deviations was 19.4°C in 2013. However, to ease using the performance graphs, the temperature applied for all years will be rounded up to 20°C.

5.6.3 Wind from the 340° to 100° and IMC Conditions

74. The period of time the wind was in the effected arc of 340° to 110° combined with when the conditions were IMC, was assessed. The results are shown in Table 5.5, firstly as day and night combined and then day only.

Table 5.5 Percentage of the Year when Wind from 340° to 110° Arc and IMC

Scenario	2013	2014	2015	2016	2017	2018	2019
Day and night (%)	3.5	4.4	1.5	4.3	2.8	5.3	2.8
Day only (%)	1.6	2.5	0.7	2.5	1.5	2.8	1.6

N.B. This table does not take account of no-fly days due to factors such as Triggered Lightning or poor onshore weather.

75. These data show that the OEI take-off case is only applicable for a maximum of 5.3% (2018) of the year for day and night, and a maximum of 2.8% of the year if daylight operations are applied as a mitigation, when the wind direction is from the effected arc.

76. Restrictions on operations will only be necessary if an insufficient take-off distance is available. The take-off distance is now calculated using the AW139 Flight Manual Supplement 50, rather than Supplement 97, reported in Section **Error! Reference source not found.**.

77. The take-off distance calculation are shown below. In order to assist the reader, the OEI take-off profile is shown in Figure 5.15 and then explained.

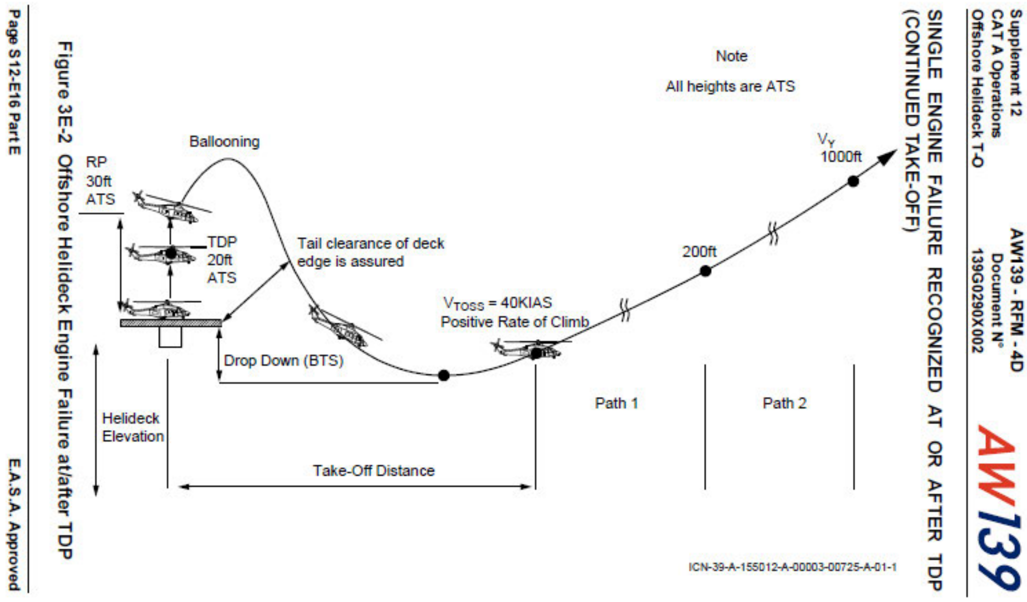


Figure 5.14 OEI Take-off Profile

78. The calculation assumes a worse case, where the engine fails at the TDP. The OEI power rating will automatically be set to the 2.5 minute power rating. The Pilot Flying (PF) is trained to rotate the pitch attitude to 10° nose down, hold for one second and then pitch up to set an attitude of 0°, i.e. a level attitude. The aircraft is accelerated to the take-off safety speed (Vtoss) at which point a 5° nose up attitude is selected to climb the aircraft. Any dropdown below the height of the helideck will increase the distance required to achieve 200 ft.

79. At 200 ft above the surface the PF continues to accelerate to the best rate of climb speed (Vy). At Vy the climb is continued to 1,000 ft reducing power to the OEI Maximum Continuous Rating, "*when convenient before expiry of the 2.5 minute rating*". The terminology used in the AW139 Flight Manual is to call the period between achieving Vtoss and reaching 200 ft, Flight Path 1 (known as 1st sector on other helicopters) and the period between 200 and 1,000 ft Flight Path 2 (known as 2nd sector on other helicopters). For the purposes of this calculation, it will be assumed that OEI Maximum Continuous Power will be selected at 200 ft, i.e. at the earliest point and therefore is a worst case assumption.

80. Two values of take-off mass were used; the maximum permitted by Supplement 50, 6,800 kg and a slightly lower value of 6,400 kg. The lower value of 6,400 kg will

usually be sufficient to carry 12 passengers if the weather at Norwich Airport is VMC[8], or in IMC conditions when the Ravenspurn North operator does not need a full load of 12 passengers and bags.

Table 5.6 Take-off and Turn Distance Required From Ravenspurn North

Parameter	For 6,400 kg	For 6,800 kg
Ravenspurn North helideck height (ft)	**156**	**156**
A – Supplement 50: Continued take-off distance OEI offshore helideck Graph 4-71		
Pressure altitude	0	0
Temperature (°C)	20	20
Aircraft mass (kg)	6,400	6,800
Distance (m)	**220**	**230**
B – Supplement 50: Drop down offshore helideck procedure Graph 4-74		
Pressure altitude	0	0
Temperature (°C)	20	20
Aircraft mass (kg)	6,400	6,800
Dropdown (ft)	**0**	**30**
C – Supplement 50: Take-off Flight Path 1 Graphs 4-81 and 4-82		
Pressure altitude	20	20
Temperature (°C)	20	20
Aircraft mass (kg)	6,400	6,800
Mean height gained in 30m horizontal distance	**23**	**18**
D – Supplement 50: Take-off Flight Path 2 Graphs 4-87 and 4-88		
Pressure altitude	600	600
Temperature (°C)	20	20
Aircraft mass (kg)	6,400	6,800
Mean height gained in 30m horizontal distance	**10.7**	**8.8**
Ravenspurn North		
A – Continued take-off distance OEI offshore helideck Graph 4-71 (m)	220	230
Helideck height (m)	156	156

[8] SPA.HOFO.120 - No alternate airfield (and fuel) required when the cloud base is either greater than 1,000 ft above the airfield, or 700 ft above the minima for the instrument approach, with the visibility equal or greater than 2,500 m.

Parameter	For 6,400 kg	For 6,800 kg
B – Drop down (m)	0	30
Initial starting height (m)	156	126
C – Flight Path 1 distance to climb to 200 ft (m)	98	126
Distance in nm	0.053	0.067
D – Flight Path 2 distance to climb from 200 to 1,000 ft (m)	2,243	2,727
Distance in nm	1.21	1.47
Total distance A+C+D (m)	2,561	3,081
Distance in nm	1.38	1.66
Distance to turn (nm)	0.34	0.34
1nm IMC buffer	1.00	1.00
Total distance required	**2.72**	**3.00**

81. In a worst case scenario when the wind is in the effected arc of 340° to 110° combined with IMC, a temperature of 20°C or less and a 6,800 kg take-off aircraft mass, a distance of 3.00 nm is required. However, if the installation operator could accept a small decrease in payloads, or the weather in Norwich is VFR, then a distance of 2.72 nm is required.

82. Another alternative would be to use the additional performance graphs in Supplement 50, which combine Flight Paths 1 and 2, using OEI 2.5 minute power until 1,000 ft is reached. Use of 2.5 minute OEI power is permitted by the Flight Manual, does not require the additional thrust margin which limits use of Supplement 97, and utilises a standard flight profile: this overcomes the two objections raised by the UK operators to using Supplement 97.

83. If approximately one minute of the 2.5 minutes of emergency power is used, then Supplement 50 Graphs 4-93 and 4-94 can be applied. These result in a higher rate of climb, which is always desirable under emergency conditions, and reduces the distances required to climb to a safe height and turn away from the wind farm. Even if an obstruction was not present, an experienced pilot would tend to use 2.5 minute power above 200 ft until established in a climb and well clear of the surface.

84. The calculations in Table 5.7 show that using the combined Flight Paths 1 and 2 graphs (Supplement 50 Graphs 4-93 and 4-94) result in a minimum distance of 2.32nm.

Table 5.7 Take-off and Turn Distance Required From Ravenspurn North – Using 2.5 Minute OEI Power

Parameter	For 6,400 kg	For 6,800 kg
Temperature (°C)	20	20
Aircraft mass (kg)	6,400	6,800
A and B unchanged		
Ravenspurn North		
A – Continued take-off distance OEI offshore helideck Graph 4-71 (m)	220	230
Helideck height (m)	156	156
B – Drop down (m)	0	30
Initial starting height (m)	156	126
E – Supplement 50: Alternative 60KIAS Path 1 and 2 Gradient 4-93 and 4-94		
Pressure altitude	600	600
Temperature (°C)	20	20
Aircraft mass (kg)	6,400	6,800
Mean height gained in 30m horizontal direction	20	16.5
E – distance to climb from drop down to 1,000 ft (m)	1,313	1,589
E – distance to climb from drop down to 1,000 ft (nm)	0.71	0.86
Time to climb to 1,000 ft – 2.5 minute OEI ROC Chart 4-40 (mins)	0.95	0.95
Total distance A+E (m)	1,481	1,819
Distance in nm	0.80	0.98
Distance to turn (nm)	0.34	0.34
1nm IMC buffer	1.00	1.00
Total distance required	**2.14**	**2.32**

5.6.4 Summary of OEI Take-Off Data

85. Table 5.8 summarises the various take-off calculations.

Table 5.8 Take-off and Distance Required from Ravenspurn North

Scenario	Take-off Mass 6400 kg	Take-off Mass 6800 kg	Comment
Flight Path 1 then Flight Path 2	2.7	3.0	OEI Max Continuous Power >200 ft
Flight Path 1 and 2 Combined	2.1	2.3	OEI 2.5 Minute power until 1,000 ft

86. Providing there are no safety implications, which have not already been identified during aircraft certification and noted in the Flight Manual, the permitted use of OEI 2.5 minute power for circa one minute will result in the aircraft climbing faster and needing a smaller distance to turn away from Hornsea Four. Use of this power rating, in the extremely unlikely event of an engine failure, will reduce the impact of Hornsea Four on helicopter operations to Ravenspurn North, and permit a full passenger load for the installation operator. Using sequential Flight Path 1 and Flight Path 2 profiles will result in a longer distance, and lower rate of climb.

6 Results

87. When the meteorological data and Hornsea Four topology is applied to all relevant installations, the number of hours of restricted CAT access were identified and are summarised in Table 6.1.

Table 6.1 Hours per Year where the Hornsea Four Array Restricts ARAs Into Given Platforms

Installation	2013	2014	2015	2016	2017	2018	2019	Worst Case
Ravenspurn North	122	145	181	102	131	109	55	181
Babbage	139	168	198	117	151	120	58	198
Garrow	41	42	38	34	28	39	45	45
Kilmar	20	8	11	25	9	28	6	25
Ravenspurn North ST2	114	125	165	93	112	92	50	165
Ravenspurn North ST3	96	87	137	72	77	49	28	137
Ravenspurn South A	89	83	127	70	74	45	28	127
Ravenspurn South B	89	83	127	70	74	45	28	127
Ravenspurn South C	43	40	61	26	26	12	2	61

88. It can be seen that the highest number of hours in any particular year where the Hornsea Four array would restrict ARAs into a given platform was 198 hours for Babbage in 2015 (equivalent to 2.3% of the year). Ravenspurn North had the second highest value of 181 hours in 2015 (equivalent to 2.1% of the year) followed by Ravenspurn North ST2 with 165 hours in 2015 (equivalent to 1.9% of the year). The number of hours was lower for the other platforms in the Ravenspurn field and much lower for the Garrow and Kilmar platforms.

89. A detailed analysis of each installation is shown in **Appendix A1: Platform Specific Data**.

7 Discussion

7.1 Emergency Conditions

90. The methodology used in Section 5 addresses access to Ravenspurn North under CAT Regulations. Emergency down manning of any installation, critical Medivacs and SAR are not constrained by CAT Regulations as these flights are generally flown by the Coastguard SAR aircraft operating under CAP 999 (CAA, 2014). The Coastguard helicopters are operated as State Aircraft under National Regulations and are not constrained by EASA Regulations. Also, commercial SAR can be flown with some alleviations from CAT Regulations. Such SAR arrangements have existed in the United Kingdom (UK), Norway and the Netherlands for decades and include SAR coverage provided by the Integrated Search and Rescue (ISAR) Consortium in Aberdeen (formerly Jigsaw Aviation), SAR helicopters based in the Ekofisk Field, and SAR helicopters under contract to Nederlands Olie en Gas Exploratie en Productie Associatie (NOGEPA), the Dutch equivalent of Oil & Gas UK.

91. CAP 999 defines the SAR operating minima as:

> *Operating minima for the dispatch and continuation of a SAR operational flight are at the discretion of the aircraft commander. However, he is to consider the urgency of the task, crew and aircraft capability and the requirement to recover the aircraft safely.*

92. Due to the SAR autopilot modes and enhanced sensors fitted to the Coastguard SAR helicopters, the CAT One Engine Inoperative (OEI) take-off distance will be sufficient to enable the SAR helicopters to enter the field and manoeuvre to land on the Ravenspurn North, even in poor weather with a westerly wind.

93. Furthermore, in the event of an emergency on the platform resulting in an explosion, fire or release of hydrocarbons, helicopters will be unable to land and so other means of escape, such as Totally Enclosed Motor Propelled Survival Craft (TEMPSC) and/or Seascape systems will be required.

8 Further Considerations

94. **Volume A5, Annex 8.1: Aviation and Radar Technical Report** characterises the aviation and radar baseline environment to analyse the impact on aviation and radar interests in proximity to the Hornsea Four array area and the surrounding area. This section supports **Volume A5, Annex 8.1: Aviation and Radar Technical Report**, providing further details on the operational impacts and additional information relevant to helicopter access.

8.1 Helicopter Main Routes

95. During meetings with the helicopter operators and a helicopter operator workshop conducted during the Hornsea Three planning phase[9], it was stated that minimal use is made of the HMR in the southern North Sea. This is partly historic, as the small and medium helicopter types operated in the area had a limited client payload and so routeing on a direct track was the preferred option to maximise client payload by minimising the time of flight and hence fuel load required. This preference for direct routing has continued even though the more capable AW139 has a larger payload and range than previous helicopter types operated in the area. HMRs are also considered in Section 3.1.4 of **Volume A5, Annex 8.1: Aviation and Radar Technical Report**.

8.2 Helicopter Icing

96. Airframe icing conditions are defined as:

- Ambient air temperature at or below 0°C;
- Visibility below 1,000 m; and
- Visible moisture present.

97. Helicopters can be certified for flight in icing conditions in accordance with Appendix C of EASA Certification Standard 29 (EASA, 2019) and a special condition for limited icing (EASA, 2007). A Limited Icing Approval permits flight in icing conditions without heavy and complex de-icing systems, such as heated rotor blades, providing a layer of positive temperature air is available close to the surface of the sea. If icing conditions outside the certified limits are encountered, then the helicopter would descend into the positive temperature air in order to shed the ice. The Limited Icing Approval has been used in the UK for several decades on many helicopter types, especially on the northern North Sea where icing is more prevalent.

98. In the uncommon event that a helicopter crew chose to follow an HMR, or transit over Hornsea Four, it is accepted that icing will be a consideration when operating in IMC. The current MSA for an IMC transit with no surface obstructions present is 1,500 ft Above Mean Sea Level (AMSL). An IMC transit over the wind farm would add

[9] Helicopter Operator Workshop hosted by Ørsted Hornsea Project Three. 27th February 2019. Operators – CHC & NHV in person, Bristow and Babcock by telecon

approximately 800 ft (2,300 ft AMSL) to the MSA and so increasing slightly the percentage of the year when icing was a factor.

99. Most of the helicopters currently operated in the area are not equipped for flight in icing conditions, even though the aircraft is certified for flight in icing and an operational approval exists. In the case of the AW139, the required modifications are shown in the AW139 RFM Supplement 76. As well as minimising the impact that icing will have on non-standard routeing via an HMR, fitting of this equipment will permit greater use of IFR operations in general, increasing overall safety during all offshore operations.

100. Fitting the applicable equipment, and using a Limited Icing Approval, will minimise the impact on icing to helicopter operations in the vicinity of Hornsea Four, as well as improving safety in general.

101. Icing conditions are also considered in Section 3.1.4.3 and Section 3.1.4.5 of **Volume A5, Annex 8.1: Aviation and Radar Technical Report**.

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Appendix A1 –
Platform Specific Data for Helicopter ARA to Gas Installations Adjacent to Hornsea Project Four

Prepared by	Anatec Limited
Presented to	Orsted Hornsea Project Four Ltd.
Date	3rd August 2021
Revision Number	02
Document Reference	A4481-ORS-TN-02

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Revision Number	Date	Summary of Change
00	14th May 2020	Initial Version
01	8th June 2021	Updated with additional analysis
02	3rd August 2021	Revised following Orsted comments

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Abbreviations Table

Abbreviation	Definition
ARA	Airborne Radar Approach
CAT	Commercial Air Transport
HCA	Helideck Certification Agency
IMC	Instrument Meteorological Conditions
km	Kilometre
nm	Nautical Mile
PF	Pilot Flying
TDP	Take-off Decision Point

1 Introduction

1. This appendix should be read in conjunction with the Assessment of the Impact of Hornsea Project Four on Helicopter Operations to Adjacent Gas Installations (**Appendix A: Helicopter Access Report** of **Volume A5 Annex 11.1**) which provides background to the data shown here. Each section of this appendix provides data indicating the hours per month when an Airborne Radar Approach (ARA) is required from each wind direction for all the platforms scoped into the aforementioned assessment; no fly conditions have been removed.

2. For each platform the helideck information plate (sourced from the Helideck Certification Agency (HCA)) is provided along with tables summarising the data for each year under consideration (2013 to 2019). It is noted that the 2019 data is incomplete (January to October only). The rows highlighted in yellow refer to the arc where ARAs will be restricted, i.e. for Ravenspurn North this is for winds from 180° clockwise to 260°.

3. Since the last complete year of data provided was 2018, a figure has been produced for each platform to represent this data and indicates the wind direction arcs and number of hours per month where an ARA is required but would be prevented; would be required but an approach with a crosswind of less than 10kt is still possible; and would be required but would not be restricted.

2 Ravenspurn North

4. As Ravenspurn North is a manned platform the data below applies to both day and night Commercial Air Transport (CAT) Regulations.

2.1 2013 Data

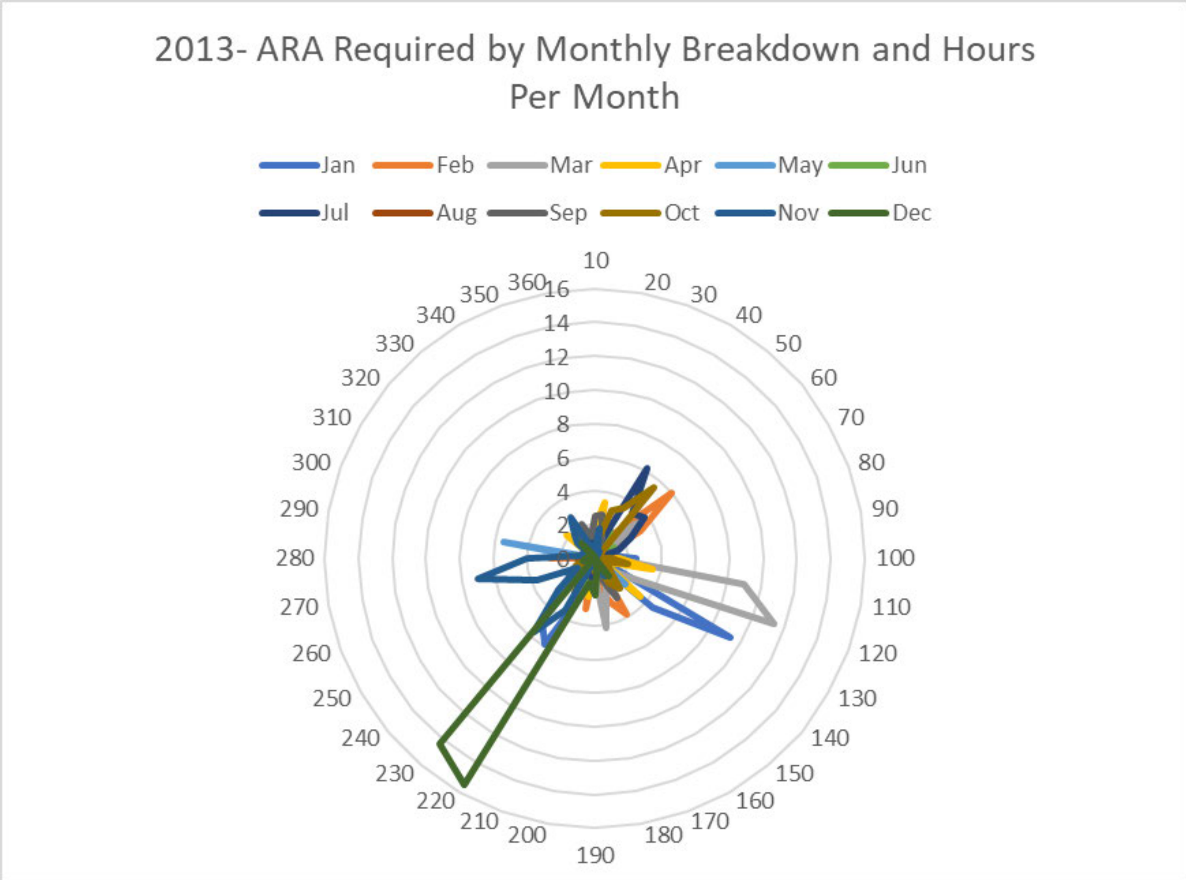


Figure 2.1 Wind Direction When an ARA is Required by Month (Ravenspurn North, 2013)

Table 2.1 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North, 2013)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Hours Per Bearing
10	0.0	0.3	0.5	1.8	1.3	0.2	0.7	0.0	2.5	0.2	0.7	0.0	8.2
20	0.0	0.2	0.5	3.3	0.0	1.2	1.0	0.3	2.7	1.2	1.8	0.0	12.2
30	0.0	0.2	0.5	0.3	0.0	0.8	1.0	0.2	1.3	3.0	0.5	0.0	7.8
40	0.2	0.2	0.0	0.3	0.0	1.8	6.2	0.0	0.2	3.5	0.5	0.0	12.8
50	0.2	2.0	1.7	0.0	0.0	0.5	3.5	0.0	0.0	5.5	0.3	0.0	13.7
60	0.7	6.0	3.3	0.0	0.0	0.8	3.8	0.0	0.0	0.5	0.2	0.0	15.3
70	0.3	3.2	0.8	0.3	0.0	1.3	2.5	0.0	0.0	0.0	0.0	0.0	8.5
80	0.3	0.0	0.0	0.7	0.0	0.0	1.5	0.5	0.0	0.3	0.0	0.0	3.3
90	1.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.3
100	2.5	0.0	1.0	1.5	0.0	0.0	0.2	0.0	0.0	1.0	0.0	0.0	6.2
110	0.3	0.2	9.0	3.5	0.5	0.0	0.0	0.0	0.0	2.0	0.0	0.0	15.5
120	0.8	1.0	11.3	0.5	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	14.7
130	9.3	0.7	2.3	1.0	0.5	0.0	0.0	0.2	0.0	1.0	0.0	0.0	15.0
140	4.5	2.2	0.8	3.5	2.3	0.0	0.0	1.0	0.0	1.3	0.0	0.0	15.7
150	0.2	0.0	1.5	0.3	1.3	0.0	0.2	0.0	0.0	2.3	0.0	1.3	7.2
160	0.8	3.8	1.5	0.0	0.0	0.0	0.2	0.0	2.7	1.7	1.2	0.7	12.5
170	0.0	2.8	2.0	0.0	0.7	0.0	0.3	0.0	1.5	0.2	0.7	0.3	8.5
180	0.0	1.8	4.2	0.2	0.2	0.0	0.0	0.0	0.0	0.5	0.2	0.8	7.8
190	0.0	0.3	1.2	1.3	0.5	0.0	0.3	0.0	0.0	0.8	0.2	2.2	6.8
200	0.2	3.0	0.7	2.3	1.0	0.7	1.2	0.0	0.0	0.3	0.5	1.5	11.3
210	2.3	0.3	2.0	1.3	0.5	1.7	0.3	0.0	0.2	0.5	0.0	2.3	11.5
220	5.8	0.0	1.8	1.5	0.5	1.7	0.0	2.3	1.2	1.0	3.5	15.5	34.8
230	4.8	0.0	1.8	1.2	0.0	1.2	0.0	0.2	0.5	0.8	5.7	14.3	30.5
240	0.7	0.0	0.5	0.2	0.2	1.2	0.0	0.0	0.0	0.8	2.8	0.2	6.5
250	1.8	0.5	0.2	0.0	0.5	0.5	0.0	0.0	0.3	0.5	1.2	0.5	6.0
260	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.3	1.2	3.7	0.3	6.7
270	0.5	0.2	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.5	7.0	0.7	9.3
280	0.3	2.7	0.0	0.0	0.3	1.0	0.0	1.0	0.0	0.3	4.0	0.5	10.2
290	0.0	0.5	0.0	0.0	5.5	1.2	0.0	0.3	0.5	0.0	0.8	0.0	8.8
300	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.3	0.2	0.2	0.8	0.2	2.7
310	0.0	0.2	0.2	0.2	0.3	0.3	0.0	0.7	0.2	0.2	0.2	0.0	2.3
320	0.0	0.0	0.0	2.2	0.0	0.3	0.5	0.0	0.7	0.8	1.3	0.2	6.0
330	0.3	0.8	0.0	1.5	0.0	0.2	1.0	0.0	0.5	0.3	1.8	1.2	7.7
340	0.0	0.7	0.0	0.5	0.7	0.3	1.8	0.0	1.8	0.7	2.8	0.2	9.5
350	0.7	0.8	0.0	1.0	1.8	0.0	1.3	0.0	2.2	0.3	0.7	0.0	8.8
360	0.0	1.0	0.2	0.7	1.0	0.3	1.5	0.0	1.3	0.3	0.5	0.0	6.8
Blocked (yellow) hrs/month	**16.6**	**5.9**	**12.4**	**8.0**	**3.6**	**7.0**	**1.8**	**2.5**	**2.5**	**6.4**	**17.8**	**37.6**	**121.9**

2.2 2014 Data

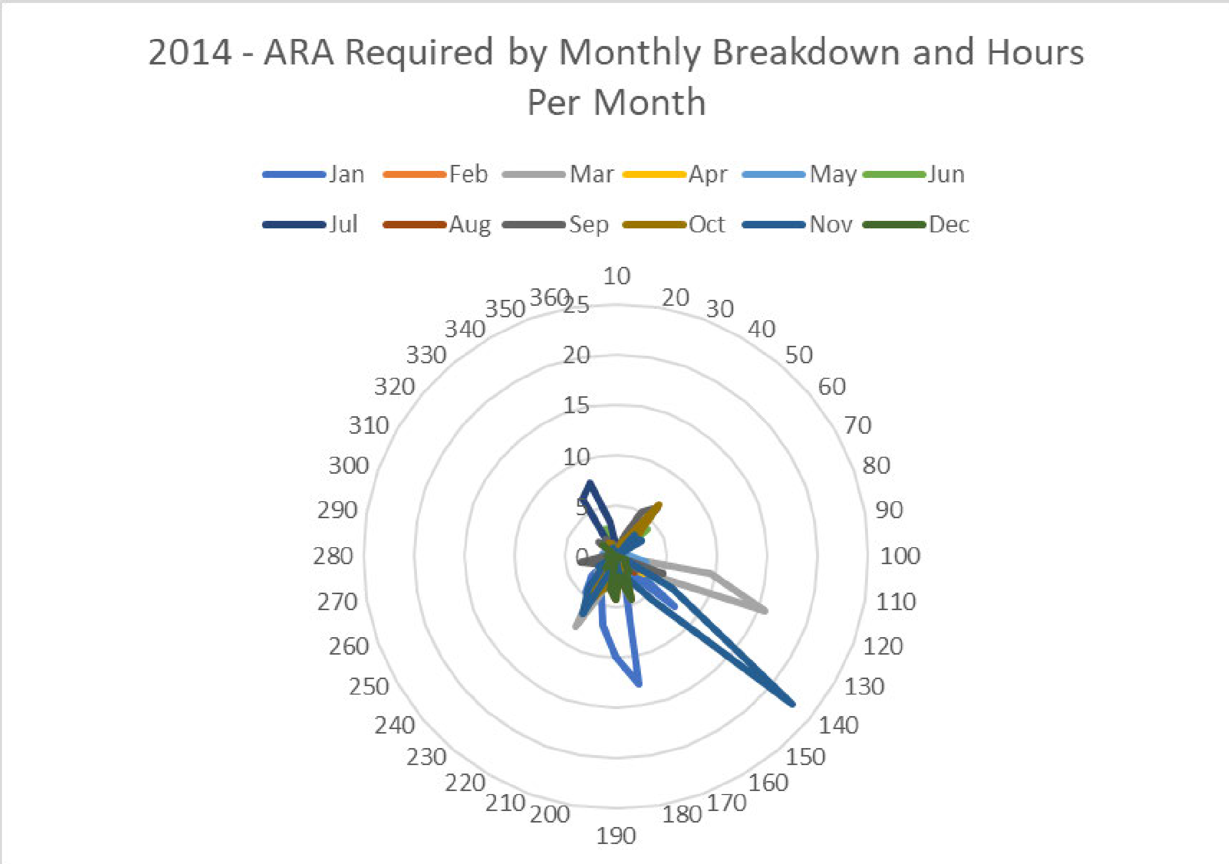


Figure 2.2 Wind Direction When an ARA is Required by Month (Ravenspurn North, 2014)

Table 2.2 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North, 2014)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Hours Per Bearing
10	0.0	0.0	0.5	0.3	0.0	0.7	1.0	0.0	0.7	0.5	0.0	0.0	3.7
20	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.3	0.2	0.0	1.2
30	0.0	0.0	0.3	0.7	1.7	0.5	0.0	0.0	2.0	1.5	0.2	0.0	6.8
40	0.0	0.0	1.0	0.0	0.7	0.3	0.2	0.0	5.0	2.0	0.2	0.0	9.3
50	0.0	0.0	2.2	0.0	0.5	0.7	0.2	0.0	6.3	6.7	2.8	0.0	19.3
60	0.0	0.0	1.2	0.0	0.7	4.2	0.0	0.0	0.5	2.2	2.7	0.0	11.3
70	0.0	0.0	0.2	0.5	0.7	0.0	0.0	0.0	0.2	0.5	3.0	0.0	5.0
80	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	1.3
90	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
100	0.0	0.0	0.3	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
110	0.2	0.2	9.5	0.7	3.0	0.0	0.0	0.0	0.2	0.2	0.0	0.2	14.0
120	0.0	1.0	15.7	2.7	0.7	0.2	0.0	0.8	5.0	0.2	0.8	1.0	28.0
130	1.7	1.2	3.2	3.3	0.8	0.3	0.0	0.5	2.5	0.0	6.3	1.2	21.0
140	7.7	1.3	1.0	1.7	0.8	0.2	0.0	2.3	1.2	0.0	22.8	1.3	40.3
150	1.8	2.0	0.2	0.2	0.0	0.5	0.2	0.0	0.7	1.0	5.5	2.0	14.0
160	1.7	2.0	0.2	0.0	0.0	0.2	0.2	0.0	0.8	1.3	2.7	2.0	11.0
170	2.5	4.5	0.7	0.7	0.0	0.2	0.0	0.0	0.3	0.7	2.8	4.5	16.8
180	12.8	2.0	0.5	0.0	0.0	0.3	0.0	0.2	0.2	0.3	1.7	2.0	20.0
190	10.0	4.3	1.8	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5	4.3	21.3
200	7.0	3.3	2.0	0.2	0.2	0.5	0.2	0.0	0.0	0.0	0.3	3.3	17.0
210	4.2	0.2	3.7	1.5	0.2	0.0	0.5	0.0	0.0	3.3	1.5	0.2	15.2
220	3.5	0.5	8.0	1.7	1.0	0.2	0.3	0.3	0.0	5.2	6.5	0.5	27.7
230	4.7	1.5	2.3	0.7	1.7	0.0	0.3	1.2	0.0	1.5	4.2	1.5	19.5
240	3.2	1.0	2.3	0.2	1.5	0.2	0.2	0.8	0.0	1.0	1.7	1.0	13.0
250	1.2	0.0	0.5	0.5	1.8	0.2	0.5	0.7	0.0	0.3	2.0	0.0	7.7
260	0.5	0.0	0.3	0.0	0.0	0.3	0.5	0.2	2.2	0.0	0.3	0.0	4.3
270	1.3	0.0	0.2	0.0	0.2	0.0	0.0	0.0	3.5	0.0	0.3	0.0	5.5
280	0.5	0.8	0.2	0.0	0.3	0.0	0.2	0.3	1.3	0.7	0.7	0.8	5.8
290	0.5	0.0	0.2	0.0	1.3	0.0	0.5	0.0	0.0	0.2	0.2	0.0	2.8
300	0.3	0.0	0.0	0.0	0.7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.3
310	0.2	0.0	0.0	0.0	0.2	0.0	0.3	0.2	0.2	0.3	0.0	0.0	1.3
320	0.8	1.7	0.2	0.2	0.5	0.5	0.8	0.8	2.2	0.7	0.2	1.7	10.2
330	0.5	0.2	0.3	0.0	0.3	0.2	0.0	0.2	1.3	0.5	0.3	0.2	4.0
340	0.5	0.0	0.2	0.0	0.2	1.0	6.5	0.0	2.0	1.5	0.5	0.0	12.3
350	0.0	0.0	0.2	0.0	0.0	2.8	7.7	0.2	1.0	1.3	0.8	0.0	14.0
360	0.2	0.0	0.0	0.0	0.2	2.0	3.5	0.2	1.3	0.2	0.5	0.0	8.0
Blocked (yellow) hrs/month	**47.1**	**12.8**	**21.4**	**4.8**	**6.4**	**1.7**	**2.5**	**3.4**	**2.7**	**11.6**	**18.7**	**12.8**	**145.7**

2.3 2015 Data

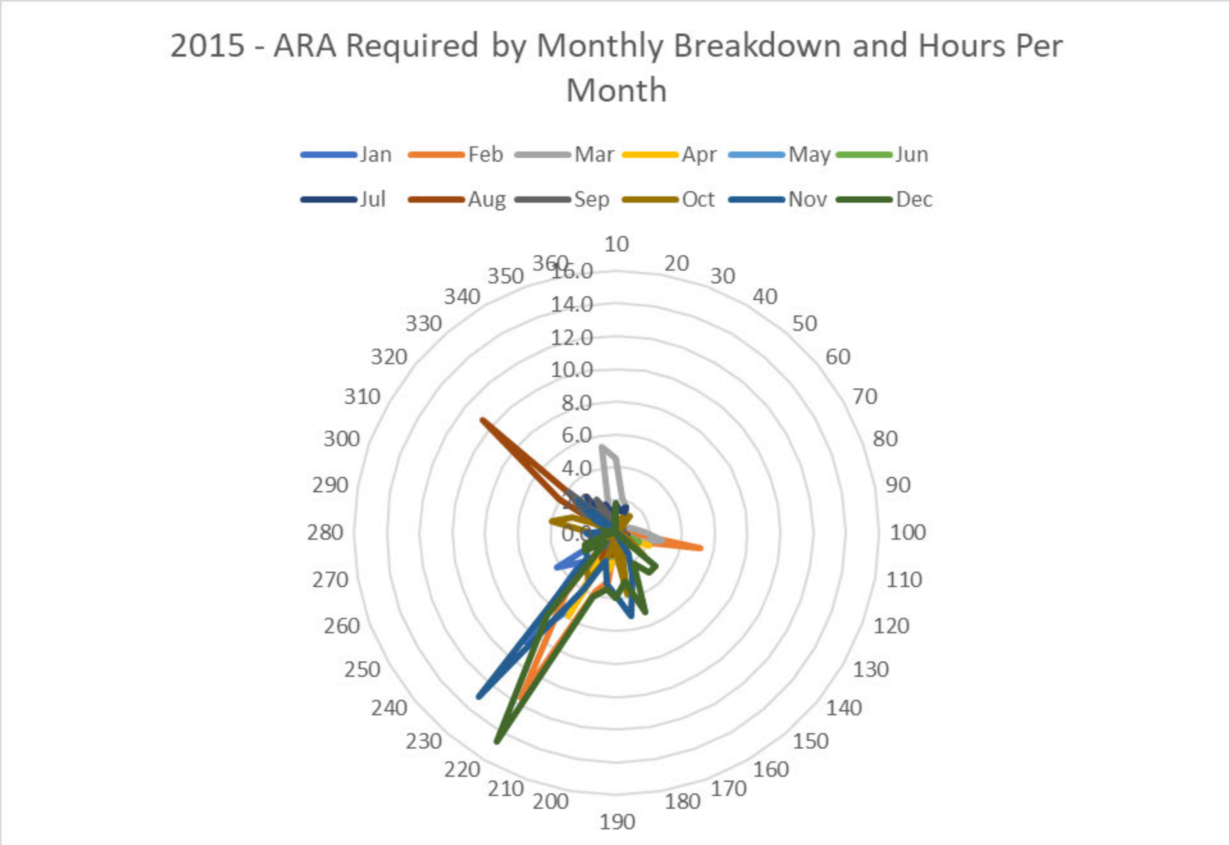


Figure 2.3 Wind Direction When an ARA is Required by Month (Ravenspurn North, 2015)

Table 2.3 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North, 2015)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Hours Per Bearing
10	0.0	0.7	4.5	1.0	0.0	0.0	1.8	0.0	0.2	0.0	0.3	1.8	10.3
20	0.0	0.5	2.2	0.5	0.0	0.2	1.3	0.0	0.0	0.0	0.0	0.0	4.7
30	0.0	1.0	1.7	0.8	0.0	0.5	1.7	0.0	0.0	1.0	0.0	0.0	6.7
40	0.0	0.5	1.2	1.0	0.0	0.2	0.3	0.0	0.2	0.5	0.0	0.0	3.8
50	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.0	0.2	1.3	0.0	0.0	2.3
60	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.0	0.0	1.3
70	0.0	0.0	0.5	0.2	0.0	0.2	0.0	0.2	0.5	0.0	0.0	0.0	1.5
80	0.0	0.5	0.8	0.0	0.0	0.3	0.0	0.0	0.2	0.2	0.0	0.0	2.0
90	0.0	1.0	1.2	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	2.7
100	0.0	0.8	1.8	0.0	0.0	0.2	0.0	0.5	0.0	0.2	0.0	0.0	3.5
110	0.0	5.2	2.8	0.0	0.5	0.3	0.7	0.2	0.2	0.0	0.0	0.0	9.8
120	0.0	1.5	1.5	2.2	1.5	1.5	0.0	0.2	0.0	0.7	0.0	0.0	9.0
130	0.0	0.0	0.8	0.7	0.3	0.0	0.0	0.5	0.0	1.2	0.2	0.0	3.7
140	0.0	1.0	0.7	1.0	0.7	0.0	0.2	0.3	0.3	2.2	1.0	3.2	10.5
150	0.0	0.5	0.7	0.8	0.5	0.0	0.7	0.0	0.3	0.0	0.0	3.2	6.7
160	0.0	1.5	0.2	0.3	0.5	0.0	0.7	0.5	0.0	1.5	1.5	2.2	8.8
170	0.0	1.7	0.0	0.0	0.5	0.0	0.0	0.8	0.2	0.8	2.8	5.2	12.0
180	0.0	0.8	0.2	0.8	0.3	0.5	0.0	1.2	0.0	3.8	5.2	3.0	15.8
190	0.0	0.5	0.3	0.8	0.2	0.3	0.0	1.3	0.0	1.2	3.8	4.0	12.5
200	0.0	3.0	0.0	2.3	0.5	1.5	0.2	1.3	0.0	0.5	3.2	3.5	16.0
210	0.0	3.8	0.2	1.0	0.2	0.7	0.3	1.2	0.0	1.7	1.8	4.2	15.0
220	5.2	11.7	4.0	5.8	0.8	0.2	0.0	1.8	0.0	3.3	4.0	14.7	51.5
230	8.7	4.8	1.5	0.5	0.0	0.0	0.3	0.0	1.2	2.8	13.0	6.7	39.5
240	2.8	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.3	0.8	10.2
250	4.2	0.0	0.2	0.2	0.0	0.8	1.0	0.2	0.2	0.7	2.2	2.2	11.7
260	0.7	0.7	1.0	0.5	0.0	0.8	0.5	1.7	0.0	0.0	1.5	2.0	9.3
270	0.2	0.0	0.8	0.3	0.0	0.8	0.2	0.5	0.0	0.0	1.5	0.7	5.0
280	0.3	0.0	0.2	0.2	0.0	0.7	0.3	0.2	0.7	1.5	1.8	0.2	6.0
290	0.2	0.0	0.0	0.2	0.0	0.3	0.2	0.0	0.5	4.0	0.5	0.8	6.7
300	0.3	0.2	0.0	0.0	0.0	0.0	0.5	0.3	1.0	2.8	0.2	0.2	5.5
310	2.0	1.2	0.7	0.5	0.0	0.2	0.0	4.0	2.2	0.8	1.5	0.3	13.3
320	1.3	0.7	2.3	0.2	0.0	0.0	0.0	10.7	3.8	0.0	3.0	0.2	22.2
330	0.2	0.2	1.3	0.3	0.0	0.0	2.8	0.0	1.2	0.0	0.7	0.0	6.7
340	0.0	0.5	2.0	0.0	0.0	0.0	0.8	0.0	2.3	0.0	0.2	0.2	6.0
350	0.0	1.3	1.2	0.5	0.0	0.0	1.8	0.0	1.2	0.0	0.5	0.2	6.7
360	0.0	0.2	5.3	0.7	0.0	0.0	1.0	0.0	0.3	0.0	0.5	0.8	8.8
Blocked (yellow) hrs/month	**21.6**	**26.5**	**7.9**	**12.2**	**2.0**	**5.3**	**2.5**	**8.7**	**1.7**	**15.2**	**37.0**	**41.1**	**181.5**

2.4 2016 Data

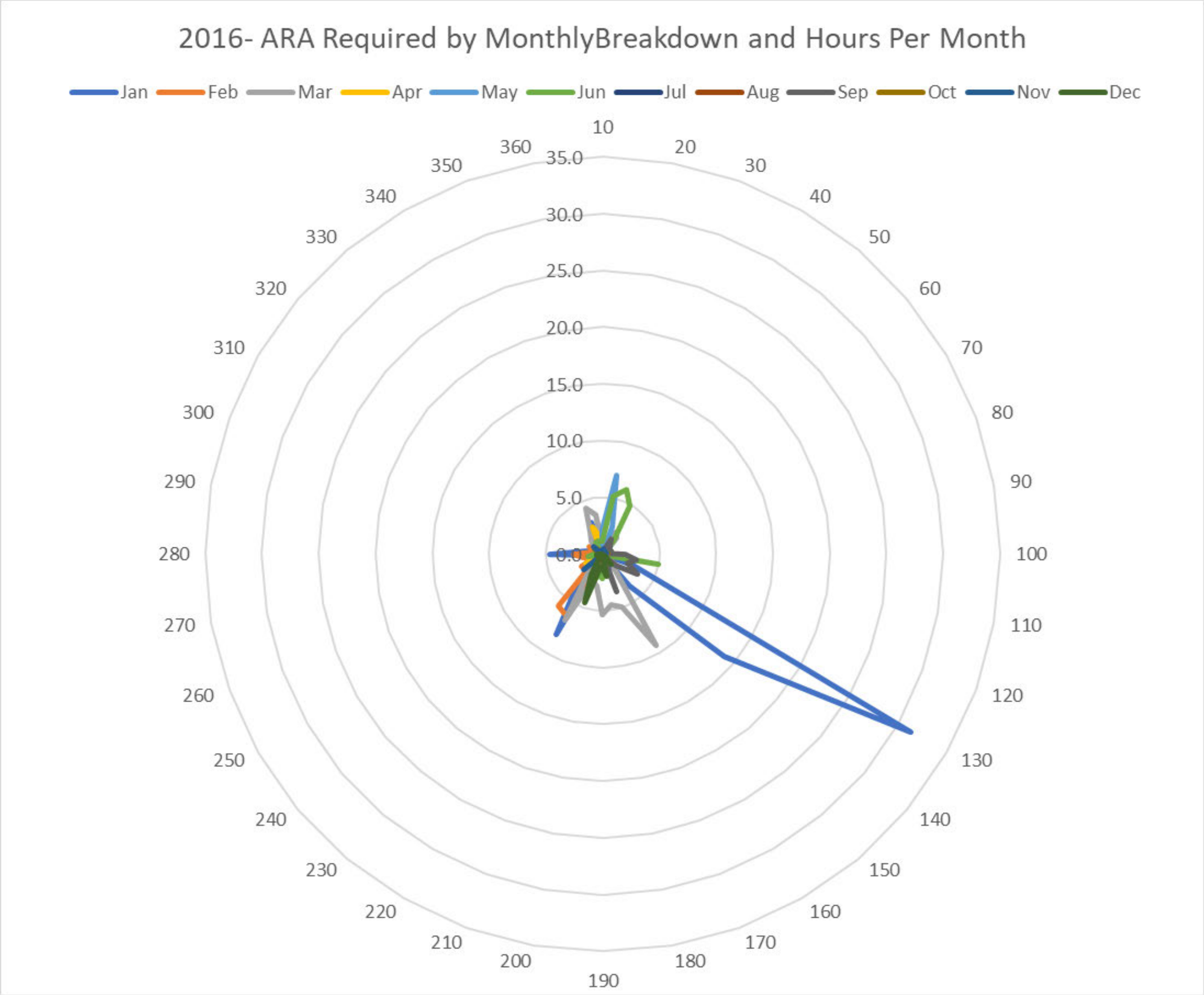


Figure 2.4 Wind Direction When an ARA is Required by Month (Ravenspurn North, 2016)

Table 2.4 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North, 2016)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.2	0.8	0.0	2.2	1.2	0.0	0.2	0.2	0.3	0.2	0.0	5.2
20	0.2	0.0	1.0	0.0	7.0	5.2	0.0	0.0	0.5	0.3	0.5	0.0	14.7
30	0.0	0.0	1.8	0.2	2.5	6.0	0.0	0.0	0.3	0.3	0.0	0.0	11.2
40	0.0	0.0	2.2	0.3	0.2	4.8	0.0	0.0	1.5	0.2	0.0	0.0	9.2
50	0.2	0.0	1.8	0.3	0.0	1.5	0.0	0.0	1.0	0.0	0.2	0.0	5.0
60	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.8	0.0	0.3	0.0	2.0
70	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.2	0.3	0.0	0.8
80	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.8	0.2	0.2	0.0	2.0
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.3	0.0	1.2
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0
110	0.0	0.0	0.0	0.7	0.0	5.0	0.0	0.0	3.0	0.0	0.0	0.0	8.7
120	2.8	0.0	0.0	0.7	0.0	0.3	0.0	0.0	2.3	0.0	0.0	0.0	6.2
130	31.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	35.0
140	14.0	1.3	1.2	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.2	18.2
150	3.7	0.3	1.7	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	1.2	7.2
160	0.5	0.0	9.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
170	1.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	3.5	0.2	0.0	0.0	9.7
180	0.0	0.0	4.5	0.3	0.8	0.3	0.0	0.0	0.2	0.3	0.0	2.0	8.5
190	0.0	0.0	5.3	0.3	0.7	2.2	0.0	0.0	0.2	0.3	0.0	1.2	10.2
200	1.8	0.0	2.8	0.7	0.7	1.8	0.8	0.0	0.3	0.3	0.0	1.2	10.5
210	0.7	0.3	2.5	0.8	0.2	2.8	2.8	0.0	2.3	0.3	0.2	4.5	17.5
220	8.2	6.3	6.7	0.8	0.0	0.8	0.0	0.3	0.3	0.8	0.5	2.0	26.8
230	3.5	6.0	1.7	0.0	0.0	0.0	0.2	0.0	0.2	0.8	0.0	0.5	12.8
240	0.2	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.2	0.2	6.7
250	0.3	2.2	1.7	1.7	0.0	0.3	0.0	0.0	0.2	0.2	0.2	0.0	6.7
260	0.0	0.7	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	2.3
270	0.8	1.7	0.7	0.3	0.0	1.3	0.0	0.0	0.2	0.2	0.0	0.5	5.7
280	4.7	2.5	0.5	0.0	0.0	0.8	0.2	0.0	0.0	0.3	0.0	0.5	9.5
290	1.5	1.0	0.0	0.7	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	3.8
300	0.5	0.7	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	2.3
310	0.8	1.3	0.0	0.0	0.0	0.8	0.0	0.0	0.3	0.8	0.5	0.0	4.7
320	0.2	0.8	0.5	0.2	0.0	0.2	0.0	0.0	0.2	0.7	1.0	0.0	3.7
330	0.2	0.8	1.5	0.2	0.0	0.3	0.0	0.0	0.2	0.3	0.0	0.0	3.5
340	1.2	1.0	2.2	0.5	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	6.2
350	3.0	0.0	4.3	2.5	0.0	1.2	0.0	0.2	0.0	0.0	0.0	0.0	11.2
360	0.7	0.5	3.5	1.7	0.0	1.2	0.0	0.0	0.2	0.0	0.3	0.0	8.0
Blocked (yellow) hrs/month	**14.7**	**16.7**	**26.4**	**5.4**	**2.4**	**8.7**	**4.0**	**0.3**	**4.0**	**4.4**	**3.1**	**11.9**	**102**

2.5 2017 Data

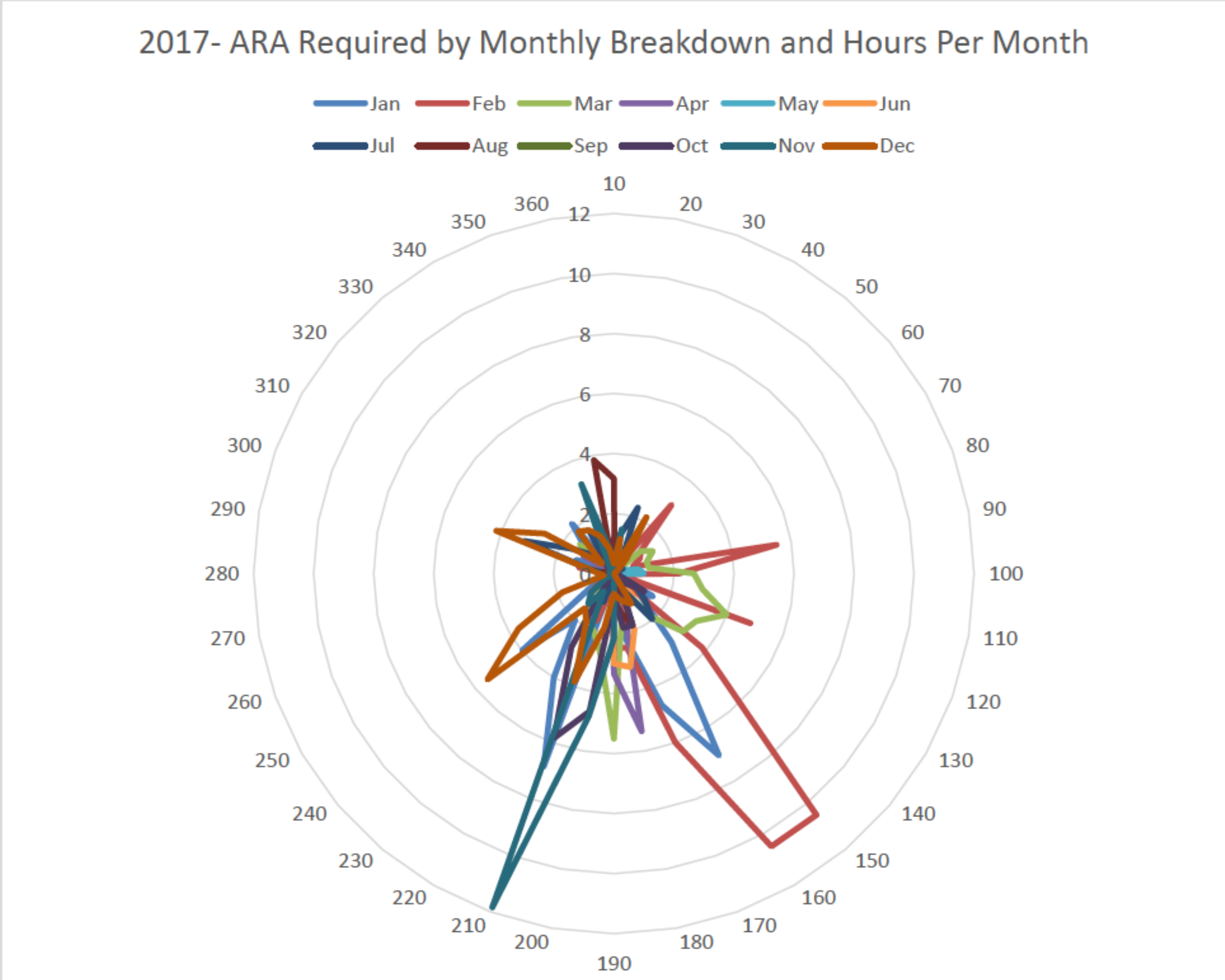


Figure 2.5 Wind Direction When an ARA is Required by Month (Ravenspurn North, 2017)

Table 2.5 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North, 2017)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Hours Per Bearing
10	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.2	0.0	0.0	0.3	0.3	5.0
20	0.7	0.0	0.0	0.0	0.0	0.0	1.3	0.2	0.0	0.0	1.5	1.2	4.8
30	0.3	0.5	0.0	0.0	0.5	0.0	2.3	0.0	0.0	0.0	0.2	0.3	4.2
40	0.0	0.3	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	2.2	3.3
50	0.2	3.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.7	4.2
60	0.0	1.2	1.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.2	2.8
70	0.0	1.0	1.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	2.8
80	0.0	0.7	1.2	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	2.3
90	0.0	5.5	1.2	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5
100	0.0	2.2	2.7	0.0	1.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	6.0
110	0.0	0.2	3.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
120	0.0	4.8	4.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.0	9.3
130	1.5	0.0	3.2	0.0	0.0	0.0	0.8	0.0	0.0	1.2	0.0	0.0	6.7
140	1.2	3.8	3.0	0.0	0.0	0.2	1.3	0.0	0.0	0.5	0.0	0.0	10.0
150	3.0	10.5	1.8	0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	18.3
160	7.0	10.5	0.5	0.0	0.0	0.0	0.7	0.2	0.0	0.5	0.0	1.2	20.5
170	4.7	6.0	0.8	0.8	0.0	2.0	0.0	1.8	0.0	1.8	0.0	1.0	19.0
180	2.2	2.5	1.5	5.3	0.0	3.2	0.5	1.3	0.0	1.8	0.0	0.8	19.2
190	0.0	2.5	5.5	3.3	0.0	3.0	1.3	0.8	0.0	0.8	2.2	0.7	20.2
200	0.3	0.5	2.7	0.2	0.0	0.2	0.2	0.0	0.0	4.7	4.8	1.8	15.3
210	6.8	1.7	2.0	0.0	0.0	0.3	1.0	0.0	0.0	5.8	11.8	3.8	33.3
220	4.0	1.8	2.3	0.0	0.0	0.3	0.2	0.0	0.0	2.8	0.7	1.8	14.0
230	2.0	1.2	0.7	0.0	0.0	0.0	0.5	0.2	0.0	0.3	1.3	1.5	7.7
240	4.0	1.0	0.5	0.0	0.0	0.2	0.2	0.3	0.0	0.2	1.0	5.5	12.8
250	0.8	0.5	0.2	0.0	0.0	0.2	0.2	0.3	0.0	0.0	0.3	3.7	6.2
260	0.5	0.2	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	1.8	3.0
270	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.8
280	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.5	1.0
290	1.2	1.2	0.0	0.0	0.0	0.2	0.8	0.3	0.0	0.0	0.0	0.8	4.5
300	1.3	0.2	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.2	4.2	9.0
310	0.5	0.2	0.5	1.2	0.0	0.2	1.7	0.0	0.0	0.0	0.2	2.7	7.0
320	1.2	0.3	1.5	0.2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	4.7
330	2.2	0.5	0.3	0.2	0.0	0.0	0.3	0.0	0.0	0.8	0.0	1.8	6.2
340	0.2	0.3	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.2	0.3	1.7	4.3
350	0.0	0.3	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.5	3.2	1.3	6.0
360	0.5	0.0	0.0	0.0	0.0	0.0	0.8	3.8	0.0	0.2	0.8	0.8	7.0
Blocked (yellow) hrs/month	**20.6**	**11.9**	**15.4**	**8.8**	**0.0**	**7.4**	**4.4**	**3.1**	**0.0**	**16.4**	**22.1**	**21.4**	**131.7**

2.6 2018 Data

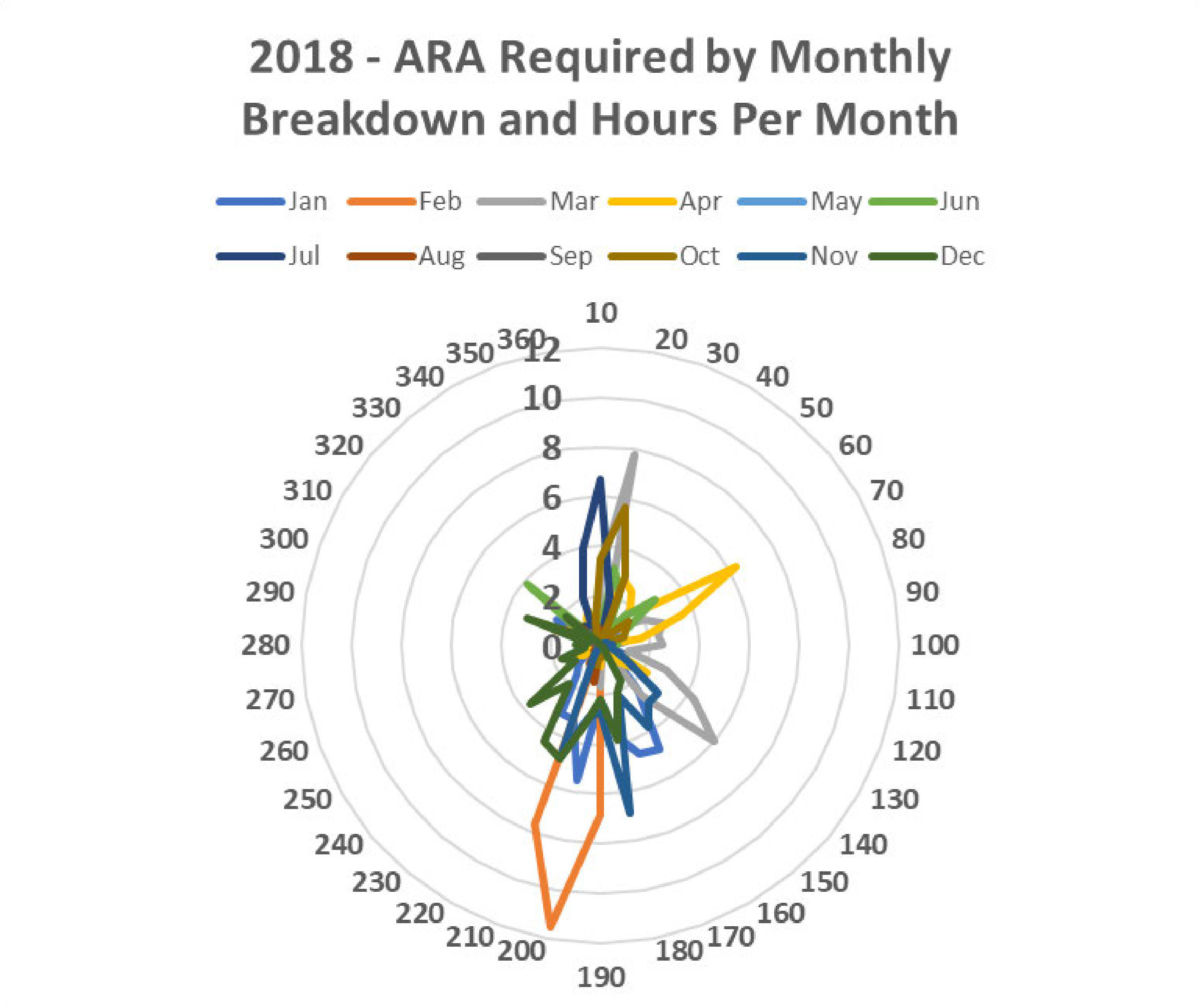


Figure 2.6 Wind Direction When an ARA is Required by Month (Ravenspurn North, 2018)

Table 2.6 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North, 2018)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.2	0.2	3.0	1.2	1.0	0.7	6.7	0.7	0.0	3.5	0.0	0.0	17.0
20	0.2	0.0	7.8	1.0	0.2	3.2	2.0	0.0	0.0	5.7	0.0	0.0	20.0
30	0.2	0.0	0.3	2.8	0.2	2.2	0.0	0.0	0.0	3.0	0.0	0.0	8.7
40	0.5	0.7	0.5	2.5	1.2	0.5	0.0	0.0	0.0	0.2	0.0	0.0	6.0
50	0.5	0.2	1.8	1.8	0.0	1.5	0.0	0.0	0.0	0.5	0.0	0.0	6.3
60	0.8	0.2	1.2	2.2	0.3	2.8	0.0	0.0	0.0	1.5	0.0	0.0	9.0
70	0.7	0.0	2.0	6.3	0.8	1.2	0.0	0.0	0.0	1.2	0.2	0.0	12.3
80	0.7	0.2	2.7	3.5	0.0	1.0	0.0	0.0	0.0	1.0	0.3	0.0	9.3
90	1.0	0.3	2.3	1.7	0.0	0.3	0.0	0.2	0.0	0.0	0.2	0.0	6.0
100	0.5	0.3	2.5	0.2	0.0	0.7	0.0	0.0	0.0	0.0	0.5	0.0	4.7
110	0.3	0.3	1.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.3	0.0	2.5
120	1.0	0.7	2.8	0.5	0.0	0.0	0.0	0.2	0.0	0.0	0.7	0.0	5.8
130	1.3	1.0	4.3	2.2	0.0	0.2	0.0	0.0	0.0	0.0	1.3	0.0	10.3
140	0.8	0.7	6.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.2	11.7
150	2.3	0.2	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.3	8.5
160	4.8	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	3.8	1.7	10.7
170	4.7	0.0	0.5	0.2	0.3	0.0	0.0	0.0	0.0	0.3	2.2	2.0	10.2
180	3.7	0.2	0.5	0.3	0.3	0.0	0.0	0.0	0.0	0.5	6.8	3.8	16.2
190	2.2	6.8	1.7	0.8	0.0	0.0	0.2	0.0	0.0	0.2	2.7	2.2	16.7
200	5.5	11.5	0.8	0.2	0.0	0.0	0.0	1.5	0.0	0.8	3.0	3.2	26.5
210	3.2	7.7	0.7	1.0	0.2	0.0	0.3	0.7	0.0	0.0	4.8	4.8	23.3
220	3.2	0.2	0.7	0.0	0.0	0.0	0.2	0.8	0.0	0.0	0.5	4.5	10.0
230	1.5	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	2.0	4.0
240	1.2	0.2	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	3.7	5.5
250	0.7	0.0	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.0
260	0.7	0.0	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.7	3.7
270	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.3
280	0.3	0.0	0.2	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.0	1.8
290	0.0	0.2	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.5	1.0
300	1.2	1.7	0.3	0.0	0.0	0.2	0.0	2.0	0.0	0.0	0.0	3.2	8.5
310	2.0	1.3	0.2	0.0	0.0	0.7	0.0	0.7	0.7	0.0	0.0	0.5	6.0
320	0.2	0.7	0.3	0.8	0.2	3.8	0.0	1.2	0.2	0.0	0.0	1.8	9.2
330	0.2	0.7	0.2	0.0	0.0	0.5	1.0	0.3	0.7	0.0	0.0	0.2	3.7
340	0.0	0.8	0.2	1.2	0.2	0.3	0.3	0.3	0.5	0.0	0.0	0.0	3.8
350	0.5	1.0	1.5	1.5	0.5	0.0	2.0	0.2	0.0	0.3	0.0	0.0	7.5
360	0.0	0.7	0.3	0.5	0.5	0.0	4.0	0.7	0.0	1.0	0.0	0.0	7.7
Blocked (yellow) hrs/month	**21.9**	**26.8**	**4.7**	**4.7**	**0.5**	**0.0**	**0.7**	**3.5**	**0.2**	**1.5**	**17.8**	**27.1**	**108.9**

2.7 2019 Data

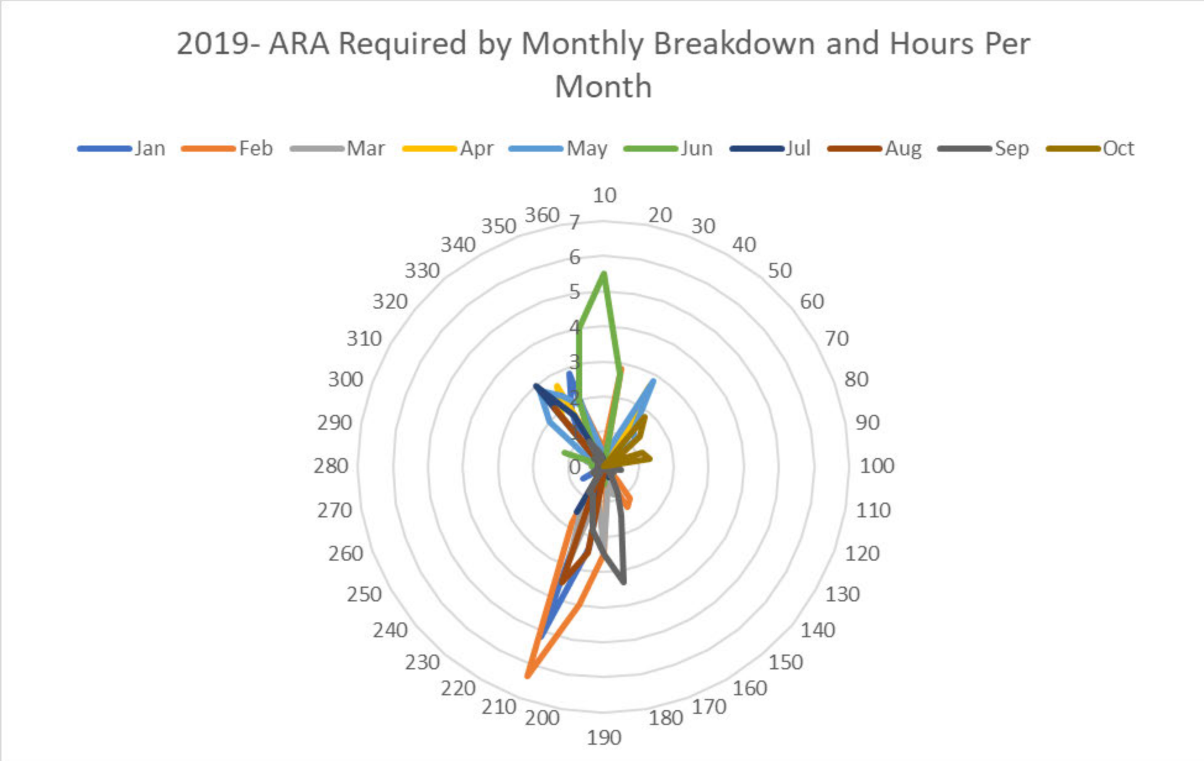


Figure 2.7 Wind Direction When an ARA is Required by Month (Ravenspurn North, 2019)

Table 2.7 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North, 2019)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Hours Per Bearing
10	0.0	0.5	0.0	0.0	0.3	5.5	0.2	0.0	0.0	0.0	6.5
20	0.0	2.8	0.0	0.0	0.3	2.7	0.0	0.0	0.0	0.0	5.8
30	0.0	0.0	0.0	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.8
40	0.0	0.7	0.0	2.7	2.8	0.0	0.0	0.0	0.0	0.0	6.2
50	0.0	0.5	0.0	0.5	1.3	0.0	0.0	0.0	0.2	1.8	4.3
60	0.0	0.3	0.0	0.3	1.2	0.0	0.0	0.0	0.0	1.3	3.2
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.5
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	1.7
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5
120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2
130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
140	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.0	1.0
150	0.0	1.2	0.0	0.2	0.0	0.3	0.0	0.2	0.3	0.0	2.2
160	0.0	1.3	0.0	0.0	0.0	0.0	0.3	0.0	0.8	0.0	2.5
170	0.0	0.3	0.8	0.3	0.0	0.0	0.2	0.0	1.5	0.0	3.2
180	0.0	0.5	0.7	0.0	0.0	0.3	0.0	0.0	3.3	0.0	4.8
190	0.0	2.5	2.3	0.0	0.0	0.5	0.0	0.2	2.5	0.0	8.0
200	2.3	4.0	0.8	0.0	0.7	0.2	1.5	2.5	1.8	0.0	13.8
210	5.2	6.3	2.8	0.0	0.7	0.2	0.0	3.5	0.8	0.0	19.5
220	0.3	1.8	1.2	0.0	0.0	0.5	1.5	0.3	0.8	0.0	6.5
230	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.7
240	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
250	0.7	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.3	0.0	1.5
260	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.3
270	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
280	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3
290	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2
300	0.5	0.0	0.5	0.0	0.0	1.2	0.0	0.0	0.2	0.0	2.3
310	0.3	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	1.0
320	0.2	0.2	0.7	0.2	2.0	0.3	0.2	0.2	0.3	0.0	4.2
330	1.0	0.2	0.5	1.8	2.8	0.0	3.0	2.2	0.2	0.0	11.7
340	1.8	0.8	0.0	2.7	2.3	0.5	1.7	0.0	0.8	0.0	10.7
350	2.8	1.8	0.0	0.3	1.8	2.0	0.2	0.0	0.5	0.0	9.5
360	0.3	0.8	0.0	0.3	0.7	4.0	0.3	0.0	0.3	0.0	6.8
Blocked (yellow) hrs/month	**8.9**	**15.3**	**8.3**	**0.0**	**1.4**	**2.1**	**3.0**	**6.8**	**9.7**	**0.0**	**55.4**

3 Babbage

5. The Babbage platform is a NUI which may be cyclically manned. Figure 3.1 presents the helideck information plate for the Ravenspurn North platform.

HCA

HELIDECK INFORMATION PLATE

HELIDECK Elev 125 ft	VAR 0	POSITION N53 57.8 E001 13.2	Babbage		
HEIGHT OF INSTALLATION: 164ft HIGHEST OBSTACLE WITHIN 5NM: Check			VHF 129.880	NDB -	Issue Date 12 Sep 2019
FUELLING INSTALLATION: No STARTING EQUIPMENT: No			Operating Company Spirit Energy		Issued By Helideck Certification Agency
HELIDECK D value: 16.66 P/R/H Category: F Max Weight: 6.8					

Wind (T°)	Kts	Limitation /Comment
		• NUI - Cyclically manned. H2 compliant • Table 1(T) if overflight of 5:1 falling infringements unavoidable
		Non Compliance
5:1		East & west access platforms extend 3.5m from SLA
Misc		No helicopter start unit on board. No automatic fire-fighting facilities No planned shutdowns

Figure 3.1 Babbage Helideck Information Plate (Source: HCA)

6. The Babbage platform is located 4.3 kilometres (km) (2.3 nautical miles (nm)) from the Hornsea Four array area. Access to the Babbage platform is further constrained by the location of Hornsea Project Two to the east, the location of which is shown on Figure 4.3 in Appendix A of Annex 11.1. When a 9 nm separation distance is applied to Hornsea Project Two, allowing for a 1 nm Instrument Meteorological Conditions (IMC) buffer, 1 nm to turn to the Initial Fix and a distance of 7 nm[1] between the Initial Fix and the platform, then the combined obstructed arc for an approach is between 140° and 300°. However, if an approach can be made up to 30° out of wind, this reduces the effected arc to 170° to 270°.

[1] EASA SPA.HOFO.125 only requires 6 nm.

3.1 2013 Data

Table 3.1 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Babbage, 2013)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.3	0.5	1.8	1.3	0.2	0.7	0.0	2.5	0.2	0.7	0.0	8.2
20	0.0	0.2	0.5	3.3	0.0	1.2	1.0	0.3	2.7	1.2	1.8	0.0	12.2
30	0.0	0.2	0.5	0.3	0.0	0.8	1.0	0.2	1.3	3.0	0.5	0.0	7.8
40	0.2	0.2	0.0	0.3	0.0	1.8	6.2	0.0	0.2	3.5	0.5	0.0	12.8
50	0.2	2.0	1.7	0.0	0.0	0.5	3.5	0.0	0.0	5.5	0.3	0.0	13.7
60	0.7	6.0	3.3	0.0	0.0	0.8	3.8	0.0	0.0	0.5	0.2	0.0	15.3
70	0.3	3.2	0.8	0.3	0.0	1.3	2.5	0.0	0.0	0.0	0.0	0.0	8.5
80	0.3	0.0	0.0	0.7	0.0	0.0	1.5	0.5	0.0	0.3	0.0	0.0	3.3
90	1.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.3
100	2.5	0.0	1.0	1.5	0.0	0.0	0.2	0.0	0.0	1.0	0.0	0.0	6.2
110	0.3	0.2	9.0	3.5	0.5	0.0	0.0	0.0	0.0	2.0	0.0	0.0	15.5
120	0.8	1.0	11.3	0.5	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	14.7
130	9.3	0.7	2.3	1.0	0.5	0.0	0.0	0.2	0.0	1.0	0.0	0.0	15.0
140	4.5	2.2	0.8	3.5	2.3	0.0	0.0	1.0	0.0	1.3	0.0	0.0	15.7
150	0.2	0.0	1.5	0.3	1.3	0.0	0.2	0.0	0.0	2.3	0.0	1.3	7.2
160	0.8	3.8	1.5	0.0	0.0	0.0	0.2	0.0	2.7	1.7	1.2	0.7	12.5
170	0.0	2.8	2.0	0.0	0.7	0.0	0.3	0.0	1.5	0.2	0.7	0.3	8.5
180	0.0	1.8	4.2	0.2	0.2	0.0	0.0	0.0	0.0	0.5	0.2	0.8	7.8
190	0.0	0.3	1.2	1.3	0.5	0.0	0.3	0.0	0.0	0.8	0.2	2.2	6.8
200	0.2	3.0	0.7	2.3	1.0	0.7	1.2	0.0	0.0	0.3	0.5	1.5	11.3
210	2.3	0.3	2.0	1.3	0.5	1.7	0.3	0.0	0.2	0.5	0.0	2.3	11.5
220	5.8	0.0	1.8	1.5	0.5	1.7	0.0	2.3	1.2	1.0	3.5	15.5	34.8
230	4.8	0.0	1.8	1.2	0.0	1.2	0.0	0.2	0.5	0.8	5.7	14.3	30.5
240	0.7	0.0	0.5	0.2	0.2	1.2	0.0	0.0	0.0	0.8	2.8	0.2	6.5
250	1.8	0.5	0.2	0.0	0.5	0.5	0.0	0.0	0.3	0.5	1.2	0.5	6.0
260	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.3	1.2	3.7	0.3	6.7
270	0.5	0.2	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.5	7.0	0.7	9.3
280	0.3	2.7	0.0	0.0	0.3	1.0	0.0	1.0	0.0	0.3	4.0	0.5	10.2
290	0.0	0.5	0.0	0.0	5.5	1.2	0.0	0.3	0.5	0.0	0.8	0.0	8.8
300	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.3	0.2	0.2	0.8	0.2	2.7
310	0.0	0.2	0.2	0.2	0.3	0.3	0.0	0.7	0.2	0.2	0.2	0.0	2.3
320	0.0	0.0	0.0	2.2	0.0	0.3	0.5	0.0	0.7	0.8	1.3	0.2	6.0
330	0.3	0.8	0.0	1.5	0.0	0.2	1.0	0.0	0.5	0.3	1.8	1.2	7.7
340	0.0	0.7	0.0	0.5	0.7	0.3	1.8	0.0	1.8	0.7	2.8	0.2	9.5
350	0.7	0.8	0.0	1.0	1.8	0.0	1.3	0.0	2.2	0.3	0.7	0.0	8.8
360	0.0	1.0	0.2	0.7	1.0	0.3	1.5	0.0	1.3	0.3	0.5	0.0	6.8

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
Blocked (yellow) hrs/month	17.2	9.0	14.3	8.0	4.3	7.2	2.2	2.5	4.0	7.2	25.3	38.7	139.8

3.2 2014 Data

Table 3.2 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Babbage, 2014)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.5	0.3	0.0	0.7	1.0	0.0	0.7	0.5	0.0	0.0	3.7
20	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.3	0.2	0.0	1.2
30	0.0	0.0	0.3	0.7	1.7	0.5	0.0	0.0	2.0	1.5	0.2	0.0	6.8
40	0.0	0.0	1.0	0.0	0.7	0.3	0.2	0.0	5.0	2.0	0.2	0.0	9.3
50	0.0	0.0	2.2	0.0	0.5	0.7	0.2	0.0	6.3	6.7	2.8	0.0	19.3
60	0.0	0.0	1.2	0.0	0.7	4.2	0.0	0.0	0.5	2.2	2.7	0.0	11.3
70	0.0	0.0	0.2	0.5	0.7	0.0	0.0	0.0	0.2	0.5	3.0	0.0	5.0
80	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	1.3
90	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
100	0.0	0.0	0.3	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
110	0.2	0.2	9.5	0.7	3.0	0.0	0.0	0.0	0.2	0.2	0.0	0.2	14.0
120	0.0	1.0	15.7	2.7	0.7	0.2	0.0	0.8	5.0	0.2	0.8	1.0	28.0
130	1.7	1.2	3.2	3.3	0.8	0.3	0.0	0.5	2.5	0.0	6.3	1.2	21.0
140	7.7	1.3	1.0	1.7	0.8	0.2	0.0	2.3	1.2	0.0	22.8	1.3	40.3
150	1.8	2.0	0.2	0.2	0.0	0.5	0.2	0.0	0.7	1.0	5.5	2.0	14.0
160	1.7	2.0	0.2	0.0	0.0	0.2	0.2	0.0	0.8	1.3	2.7	2.0	11.0
170	2.5	4.5	0.7	0.7	0.0	0.2	0.0	0.0	0.3	0.7	2.8	4.5	16.8
180	12.8	2.0	0.5	0.0	0.0	0.3	0.0	0.2	0.2	0.3	1.7	2.0	20.0
190	10.0	4.3	1.8	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5	4.3	21.3
200	7.0	3.3	2.0	0.2	0.2	0.5	0.2	0.0	0.0	0.0	0.3	3.3	17.0
210	4.2	0.2	3.7	1.5	0.2	0.0	0.5	0.0	0.0	3.3	1.5	0.2	15.2
220	3.5	0.5	8.0	1.7	1.0	0.2	0.3	0.3	0.0	5.2	6.5	0.5	27.7
230	4.7	1.5	2.3	0.7	1.7	0.0	0.3	1.2	0.0	1.5	4.2	1.5	19.5
240	3.2	1.0	2.3	0.2	1.5	0.2	0.2	0.8	0.0	1.0	1.7	1.0	13.0
250	1.2	0.0	0.5	0.5	1.8	0.2	0.5	0.7	0.0	0.3	2.0	0.0	7.7
260	0.5	0.0	0.3	0.0	0.0	0.3	0.5	0.2	2.2	0.0	0.3	0.0	4.3
270	1.3	0.0	0.2	0.0	0.2	0.0	0.0	0.0	3.5	0.0	0.3	0.0	5.5
280	0.5	0.8	0.2	0.0	0.3	0.0	0.2	0.3	1.3	0.7	0.7	0.8	5.8
290	0.5	0.0	0.2	0.0	1.3	0.0	0.5	0.0	0.0	0.2	0.2	0.0	2.8
300	0.3	0.0	0.0	0.0	0.7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.3

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
310	0.2	0.0	0.0	0.0	0.2	0.0	0.3	0.2	0.2	0.3	0.0	0.0	1.3
320	0.8	1.7	0.2	0.2	0.5	0.5	0.8	0.8	2.2	0.7	0.2	1.7	10.2
330	0.5	0.2	0.3	0.0	0.3	0.2	0.0	0.2	1.3	0.5	0.3	0.2	4.0
340	0.5	0.0	0.2	0.0	0.2	1.0	6.5	0.0	2.0	1.5	0.5	0.0	12.3
350	0.0	0.0	0.2	0.0	0.0	2.8	7.7	0.2	1.0	1.3	0.8	0.0	14.0
360	0.2	0.0	0.0	0.0	0.2	2.0	3.5	0.2	1.3	0.2	0.5	0.0	8.0
Blocked (yellow) hrs/month	**50.8**	**17.3**	**22.3**	**5.3**	**6.5**	**1.8**	**2.5**	**3.3**	**6.5**	**12.3**	**21.8**	**17.3**	**168.0**

3.3 2015 Data

Table 3.3 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Babbage, 2015)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.7	4.5	1.0	0.0	0.0	1.8	0.0	0.2	0.0	0.3	1.8	10.3
20	0.0	0.5	2.2	0.5	0.0	0.2	1.3	0.0	0.0	0.0	0.0	0.0	4.7
30	0.0	1.0	1.7	0.8	0.0	0.5	1.7	0.0	0.0	1.0	0.0	0.0	6.7
40	0.0	0.5	1.2	1.0	0.0	0.2	0.3	0.0	0.2	0.5	0.0	0.0	3.8
50	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.0	0.2	1.3	0.0	0.0	2.3
60	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.0	0.0	1.3
70	0.0	0.0	0.5	0.2	0.0	0.2	0.0	0.2	0.5	0.0	0.0	0.0	1.5
80	0.0	0.5	0.8	0.0	0.0	0.3	0.0	0.0	0.2	0.2	0.0	0.0	2.0
90	0.0	1.0	1.2	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	2.7
100	0.0	0.8	1.8	0.0	0.0	0.2	0.0	0.5	0.0	0.2	0.0	0.0	3.5
110	0.0	5.2	2.8	0.0	0.5	0.3	0.7	0.2	0.2	0.0	0.0	0.0	9.8
120	0.0	1.5	1.5	2.2	1.5	1.5	0.0	0.2	0.0	0.7	0.0	0.0	9.0
130	0.0	0.0	0.8	0.7	0.3	0.0	0.0	0.5	0.0	1.2	0.2	0.0	3.7
140	0.0	1.0	0.7	1.0	0.7	0.0	0.2	0.3	0.3	2.2	1.0	3.2	10.5
150	0.0	0.5	0.7	0.8	0.5	0.0	0.7	0.0	0.3	0.0	0.0	3.2	6.7
160	0.0	1.5	0.2	0.3	0.5	0.0	0.7	0.5	0.0	1.5	1.5	2.2	8.8
170	0.0	1.7	0.0	0.0	0.5	0.0	0.0	0.8	0.2	0.8	2.8	5.2	12.0
180	0.0	0.8	0.2	0.8	0.3	0.5	0.0	1.2	0.0	3.8	5.2	3.0	15.8
190	0.0	0.5	0.3	0.8	0.2	0.3	0.0	1.3	0.0	1.2	3.8	4.0	12.5
200	0.0	3.0	0.0	2.3	0.5	1.5	0.2	1.3	0.0	0.5	3.2	3.5	16.0
210	0.0	3.8	0.2	1.0	0.2	0.7	0.3	1.2	0.0	1.7	1.8	4.2	15.0
220	5.2	11.7	4.0	5.8	0.8	0.2	0.0	1.8	0.0	3.3	4.0	14.7	51.5
230	8.7	4.8	1.5	0.5	0.0	0.0	0.3	0.0	1.2	2.8	13.0	6.7	39.5
240	2.8	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.3	0.8	10.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
250	4.2	0.0	0.2	0.2	0.0	0.8	1.0	0.2	0.2	0.7	2.2	2.2	11.7
260	0.7	0.7	1.0	0.5	0.0	0.8	0.5	1.7	0.0	0.0	1.5	2.0	9.3
270	0.2	0.0	0.8	0.3	0.0	0.8	0.2	0.5	0.0	0.0	1.5	0.7	5.0
280	0.3	0.0	0.2	0.2	0.0	0.7	0.3	0.2	0.7	1.5	1.8	0.2	6.0
290	0.2	0.0	0.0	0.2	0.0	0.3	0.2	0.0	0.5	4.0	0.5	0.8	6.7
300	0.3	0.2	0.0	0.0	0.0	0.0	0.5	0.3	1.0	2.8	0.2	0.2	5.5
310	2.0	1.2	0.7	0.5	0.0	0.2	0.0	4.0	2.2	0.8	1.5	0.3	13.3
320	1.3	0.7	2.3	0.2	0.0	0.0	0.0	10.7	3.8	0.0	3.0	0.2	22.2
330	0.2	0.2	1.3	0.3	0.0	0.0	2.8	0.0	1.2	0.0	0.7	0.0	6.7
340	0.0	0.5	2.0	0.0	0.0	0.0	0.8	0.0	2.3	0.0	0.2	0.2	6.0
350	0.0	1.3	1.2	0.5	0.0	0.0	1.8	0.0	1.2	0.0	0.5	0.2	6.7
360	0.0	0.2	5.3	0.7	0.0	0.0	1.0	0.0	0.3	0.0	0.5	0.8	8.8
Blocked (yellow) hrs/month	**21.7**	**28.2**	**8.7**	**12.7**	**2.5**	**6.2**	**2.7**	**10.0**	**1.8**	**16.0**	**41.3**	**46.8**	**198.5**

3.4 2016 Data

Table 3.4 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Babbage, 2016)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.2	0.8	0.0	2.2	1.2	0.0	0.2	0.2	0.3	0.2	0.0	5.2
20	0.2	0.0	1.0	0.0	7.0	5.2	0.0	0.0	0.5	0.3	0.5	0.0	14.7
30	0.0	0.0	1.8	0.2	2.5	6.0	0.0	0.0	0.3	0.3	0.0	0.0	11.2
40	0.0	0.0	2.2	0.3	0.2	4.8	0.0	0.0	1.5	0.2	0.0	0.0	9.2
50	0.2	0.0	1.8	0.3	0.0	1.5	0.0	0.0	1.0	0.0	0.2	0.0	5.0
60	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.8	0.0	0.3	0.0	2.0
70	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.2	0.3	0.0	0.8
80	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.8	0.2	0.2	0.0	2.0
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.3	0.0	1.2
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0
110	0.0	0.0	0.0	0.7	0.0	5.0	0.0	0.0	3.0	0.0	0.0	0.0	8.7
120	2.8	0.0	0.0	0.7	0.0	0.3	0.0	0.0	2.3	0.0	0.0	0.0	6.2
130	31.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	35.0
140	14.0	1.3	1.2	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.2	18.2
150	3.7	0.3	1.7	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	1.2	7.2
160	0.5	0.0	9.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
170	1.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	3.5	0.2	0.0	0.0	9.7
180	0.0	0.0	4.5	0.3	0.8	0.3	0.0	0.0	0.2	0.3	0.0	2.0	8.5

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
190	0.0	0.0	5.3	0.3	0.7	2.2	0.0	0.0	0.2	0.3	0.0	1.2	10.2
200	1.8	0.0	2.8	0.7	0.7	1.8	0.8	0.0	0.3	0.3	0.0	1.2	10.5
210	0.7	0.3	2.5	0.8	0.2	2.8	2.8	0.0	2.3	0.3	0.2	4.5	17.5
220	8.2	6.3	6.7	0.8	0.0	0.8	0.0	0.3	0.3	0.8	0.5	2.0	26.8
230	3.5	6.0	1.7	0.0	0.0	0.0	0.2	0.0	0.2	0.8	0.0	0.5	12.8
240	0.2	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.2	0.2	6.7
250	0.3	2.2	1.7	1.7	0.0	0.3	0.0	0.0	0.2	0.2	0.2	0.0	6.7
260	0.0	0.7	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	2.3
270	0.8	1.7	0.7	0.3	0.0	1.3	0.0	0.0	0.2	0.2	0.0	0.5	5.7
280	4.7	2.5	0.5	0.0	0.0	0.8	0.2	0.0	0.0	0.3	0.0	0.5	9.5
290	1.5	1.0	0.0	0.7	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	3.8
300	0.5	0.7	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	2.3
310	0.8	1.3	0.0	0.0	0.0	0.8	0.0	0.0	0.3	0.8	0.5	0.0	4.7
320	0.2	0.8	0.5	0.2	0.0	0.2	0.0	0.0	0.2	0.7	1.0	0.0	3.7
330	0.2	0.8	1.5	0.2	0.0	0.3	0.0	0.0	0.2	0.3	0.0	0.0	3.5
340	1.2	1.0	2.2	0.5	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	6.2
350	3.0	0.0	4.3	2.5	0.0	1.2	0.0	0.2	0.0	0.0	0.0	0.0	11.2
360	0.7	0.5	3.5	1.7	0.0	1.2	0.0	0.0	0.2	0.0	0.3	0.0	8.0
Blocked (yellow) hrs/month	**16.5**	**18.3**	**32.0**	**5.8**	**2.3**	**10.2**	**4.0**	**0.3**	**7.7**	**4.8**	**3.0**	**12.3**	**117.3**

3.5 2017 Data

Table 3.5 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Babbage, 2017)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.2	0.0	0.0	0.3	0.3	5.0
20	0.7	0.0	0.0	0.0	0.0	0.0	1.3	0.2	0.0	0.0	1.5	1.2	4.8
30	0.3	0.5	0.0	0.0	0.5	0.0	2.3	0.0	0.0	0.0	0.2	0.3	4.2
40	0.0	0.3	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	2.2	3.3
50	0.2	3.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.7	4.2
60	0.0	1.2	1.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.2	2.8
70	0.0	1.0	1.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	2.8
80	0.0	0.7	1.2	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	2.3
90	0.0	5.5	1.2	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5
100	0.0	2.2	2.7	0.0	1.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	6.0
110	0.0	0.2	3.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
120	0.0	4.8	4.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.0	9.3

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
130	1.5	0.0	3.2	0.0	0.0	0.0	0.8	0.0	0.0	1.2	0.0	0.0	6.7
140	1.2	3.8	3.0	0.0	0.0	0.2	1.3	0.0	0.0	0.5	0.0	0.0	10.0
150	3.0	10.5	1.8	0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	18.3
160	7.0	10.5	0.5	0.0	0.0	0.0	0.7	0.2	0.0	0.5	0.0	1.2	20.5
170	4.7	6.0	0.8	0.8	0.0	2.0	0.0	1.8	0.0	1.8	0.0	1.0	19.0
180	2.2	2.5	1.5	5.3	0.0	3.2	0.5	1.3	0.0	1.8	0.0	0.8	19.2
190	0.0	2.5	5.5	3.3	0.0	3.0	1.3	0.8	0.0	0.8	2.2	0.7	20.2
200	0.3	0.5	2.7	0.2	0.0	0.2	0.2	0.0	0.0	4.7	4.8	1.8	15.3
210	6.8	1.7	2.0	0.0	0.0	0.3	1.0	0.0	0.0	5.8	11.8	3.8	33.3
220	4.0	1.8	2.3	0.0	0.0	0.3	0.2	0.0	0.0	2.8	0.7	1.8	14.0
230	2.0	1.2	0.7	0.0	0.0	0.0	0.5	0.2	0.0	0.3	1.3	1.5	7.7
240	4.0	1.0	0.5	0.0	0.0	0.2	0.2	0.3	0.0	0.2	1.0	5.5	12.8
250	0.8	0.5	0.2	0.0	0.0	0.2	0.2	0.3	0.0	0.0	0.3	3.7	6.2
260	0.5	0.2	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	1.8	3.0
270	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.8
280	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.5	1.0
290	1.2	1.2	0.0	0.0	0.0	0.2	0.8	0.3	0.0	0.0	0.0	0.8	4.5
300	1.3	0.2	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.2	4.2	9.0
310	0.5	0.2	0.5	1.2	0.0	0.2	1.7	0.0	0.0	0.0	0.2	2.7	7.0
320	1.2	0.3	1.5	0.2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	4.7
330	2.2	0.5	0.3	0.2	0.0	0.0	0.3	0.0	0.0	0.8	0.0	1.8	6.2
340	0.2	0.3	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.2	0.3	1.7	4.3
350	0.0	0.3	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.5	3.2	1.3	6.0
360	0.5	0.0	0.0	0.0	0.0	0.0	0.8	3.8	0.0	0.2	0.8	0.8	7.0
Blocked (yellow) hrs/month	**25.5**	**18.0**	**16.2**	**9.7**	**0.0**	**9.3**	**4.5**	**5.0**	**0.0**	**18.3**	**22.2**	**22.8**	**151.5**

3.6 2018 Data

Table 3.6 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Babbage, 2018)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	**0.2**	**0.2**	**3.0**	**1.2**	**1.0**	**0.7**	**6.7**	**0.7**	**0.0**	**3.5**	**0.0**	**0.0**	**17.0**
20	**0.2**	**0.0**	**7.8**	**1.0**	**0.2**	**3.2**	**2.0**	**0.0**	**0.0**	**5.7**	**0.0**	**0.0**	**20.0**
30	**0.2**	**0.0**	**0.3**	**2.8**	**0.2**	**2.2**	**0.0**	**0.0**	**0.0**	**3.0**	**0.0**	**0.0**	**8.7**
40	0.5	0.7	0.5	2.5	1.2	0.5	0.0	0.0	0.0	0.2	0.0	0.0	6.0
50	0.5	0.2	1.8	1.8	0.0	1.5	0.0	0.0	0.0	0.5	0.0	0.0	6.3
60	0.8	0.2	1.2	2.2	0.3	2.8	0.0	0.0	0.0	1.5	0.0	0.0	9.0

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
70	0.7	0.0	2.0	6.3	0.8	1.2	0.0	0.0	0.0	1.2	0.2	0.0	12.3
80	0.7	0.2	2.7	3.5	0.0	1.0	0.0	0.0	0.0	1.0	0.3	0.0	9.3
90	1.0	0.3	2.3	1.7	0.0	0.3	0.0	0.2	0.0	0.0	0.2	0.0	6.0
100	0.5	0.3	2.5	0.2	0.0	0.7	0.0	0.0	0.0	0.0	0.5	0.0	4.7
110	0.3	0.3	1.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.3	0.0	2.5
120	1.0	0.7	2.8	0.5	0.0	0.0	0.0	0.2	0.0	0.0	0.7	0.0	5.8
130	1.3	1.0	4.3	2.2	0.0	0.2	0.0	0.0	0.0	0.0	1.3	0.0	10.3
140	0.8	0.7	6.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.2	11.7
150	2.3	0.2	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.3	8.5
160	4.8	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	3.8	1.7	10.7
170	4.7	0.0	0.5	0.2	0.3	0.0	0.0	0.0	0.0	0.3	2.2	2.0	10.2
180	3.7	0.2	0.5	0.3	0.3	0.0	0.0	0.0	0.0	0.5	6.8	3.8	16.2
190	2.2	6.8	1.7	0.8	0.0	0.0	0.2	0.0	0.0	0.2	2.7	2.2	16.7
200	5.5	11.5	0.8	0.2	0.0	0.0	0.0	1.5	0.0	0.8	3.0	3.2	26.5
210	3.2	7.7	0.7	1.0	0.2	0.0	0.3	0.7	0.0	0.0	4.8	4.8	23.3
220	3.2	0.2	0.7	0.0	0.0	0.0	0.2	0.8	0.0	0.0	0.5	4.5	10.0
230	1.5	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	2.0	4.0
240	1.2	0.2	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	3.7	5.5
250	0.7	0.0	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.0
260	0.7	0.0	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.7	3.7
270	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.3
280	0.3	0.0	0.2	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.0	1.8
290	0.0	0.2	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.5	1.0
300	1.2	1.7	0.3	0.0	0.0	0.2	0.0	2.0	0.0	0.0	0.0	3.2	8.5
310	2.0	1.3	0.2	0.0	0.0	0.7	0.0	0.7	0.7	0.0	0.0	0.5	6.0
320	0.2	0.7	0.3	0.8	0.2	3.8	0.0	1.2	0.2	0.0	0.0	1.8	9.2
330	0.2	0.7	0.2	0.0	0.0	0.5	1.0	0.3	0.7	0.0	0.0	0.2	3.7
340	0.0	0.8	0.2	1.2	0.2	0.3	0.3	0.3	0.5	0.0	0.0	0.0	3.8
350	0.5	1.0	1.5	1.5	0.5	0.0	2.0	0.2	0.0	0.3	0.0	0.0	7.5
360	0.0	0.7	0.3	0.5	0.5	0.0	4.0	0.7	0.0	1.0	0.0	0.0	7.7
Blocked (yellow) hrs/month	26.3	26.7	5.5	5.2	0.8	0.0	0.7	3.5	0.2	1.8	20.0	29.7	120.3

3.7 2019 Data

Table 3.7 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Babbage, 2019)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
10	0.0	0.5	0.0	0.0	0.3	5.5	0.2	0.0	0.0	0.0	6.5
20	0.0	2.8	0.0	0.0	0.3	2.7	0.0	0.0	0.0	0.0	5.8
30	0.0	0.0	0.0	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.8
40	0.0	0.7	0.0	2.7	2.8	0.0	0.0	0.0	0.0	0.0	6.2
50	0.0	0.5	0.0	0.5	1.3	0.0	0.0	0.0	0.2	1.8	4.3
60	0.0	0.3	0.0	0.3	1.2	0.0	0.0	0.0	0.0	1.3	3.2
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.5
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	1.7
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5
120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2
130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
140	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.0	1.0
150	0.0	1.2	0.0	0.2	0.0	0.3	0.0	0.2	0.3	0.0	2.2
160	0.0	1.3	0.0	0.0	0.0	0.0	0.3	0.0	0.8	0.0	2.5
170	0.0	0.3	0.8	0.3	0.0	0.0	0.2	0.0	1.5	0.0	3.2
180	0.0	0.5	0.7	0.0	0.0	0.3	0.0	0.0	3.3	0.0	4.8
190	0.0	2.5	2.3	0.0	0.0	0.5	0.0	0.2	2.5	0.0	8.0
200	2.3	4.0	0.8	0.0	0.7	0.2	1.5	2.5	1.8	0.0	13.8
210	5.2	6.3	2.8	0.0	0.7	0.2	0.0	3.5	0.8	0.0	19.5
220	0.3	1.8	1.2	0.0	0.0	0.5	1.5	0.3	0.8	0.0	6.5
230	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.7
240	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
250	0.7	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.3	0.0	1.5
260	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.3
270	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
280	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3
290	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2
300	0.5	0.0	0.5	0.0	0.0	1.2	0.0	0.0	0.2	0.0	2.3
310	0.3	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	1.0
320	0.2	0.2	0.7	0.2	2.0	0.3	0.2	0.2	0.3	0.0	4.2
330	1.0	0.2	0.5	1.8	2.8	0.0	3.0	2.2	0.2	0.0	11.7
340	1.8	0.8	0.0	2.7	2.3	0.5	1.7	0.0	0.8	0.0	10.7
350	2.8	1.8	0.0	0.3	1.8	2.0	0.2	0.0	0.5	0.0	9.5
360	0.3	0.8	0.0	0.3	0.7	4.0	0.3	0.0	0.3	0.0	6.8

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
Blocked (yellow) hrs/month	9.0	15.7	9.2	0.3	1.3	2.0	3.2	6.8	11.3	0.0	58.8

7. As well as the total number of hours, or percentage of the time, that an ARA to the Babbage platform is impaired, it is also relevant to assess the periods of time when access to the platform is lost, as short periods of restricted access are likely to have a lesser impact on operations than large periods. Figures 3.3 onwards indicate the frequency and periods of time for each year, in hours, an ARA to Babbage would be prevented.

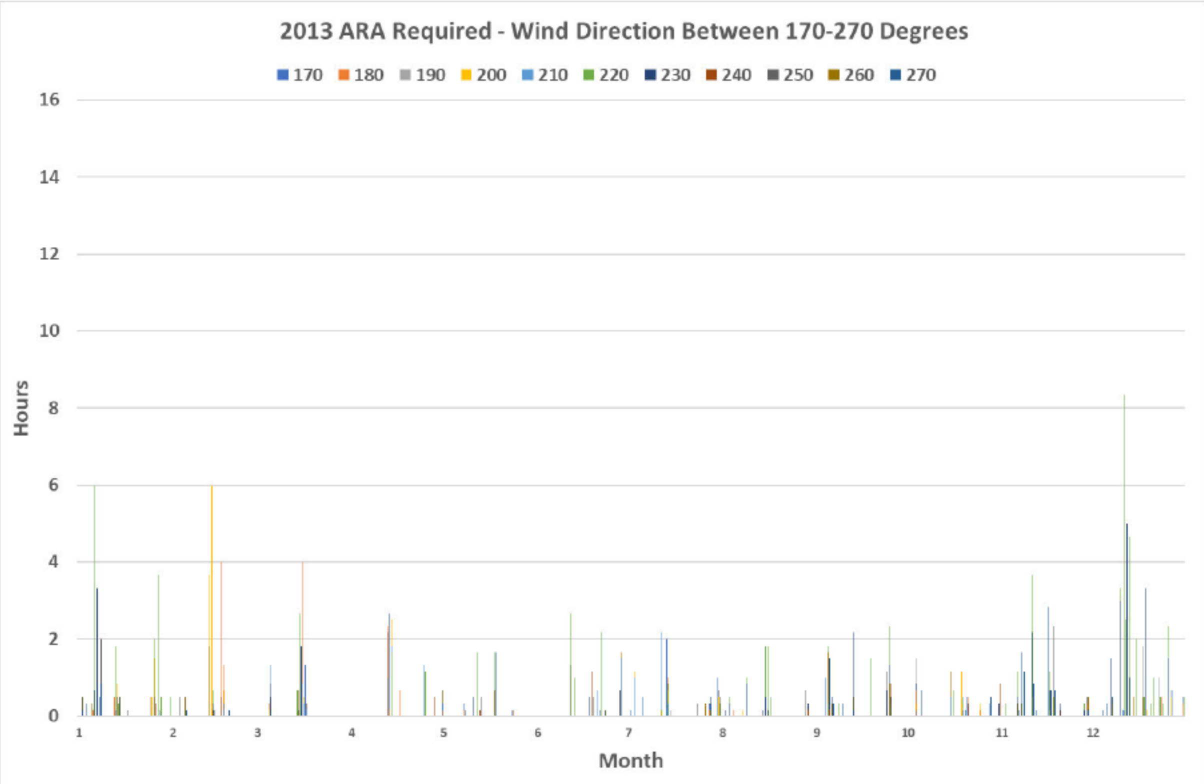


Figure 3.2 Frequency and Hours per Month an ARA to Babbage is Impaired (2013)

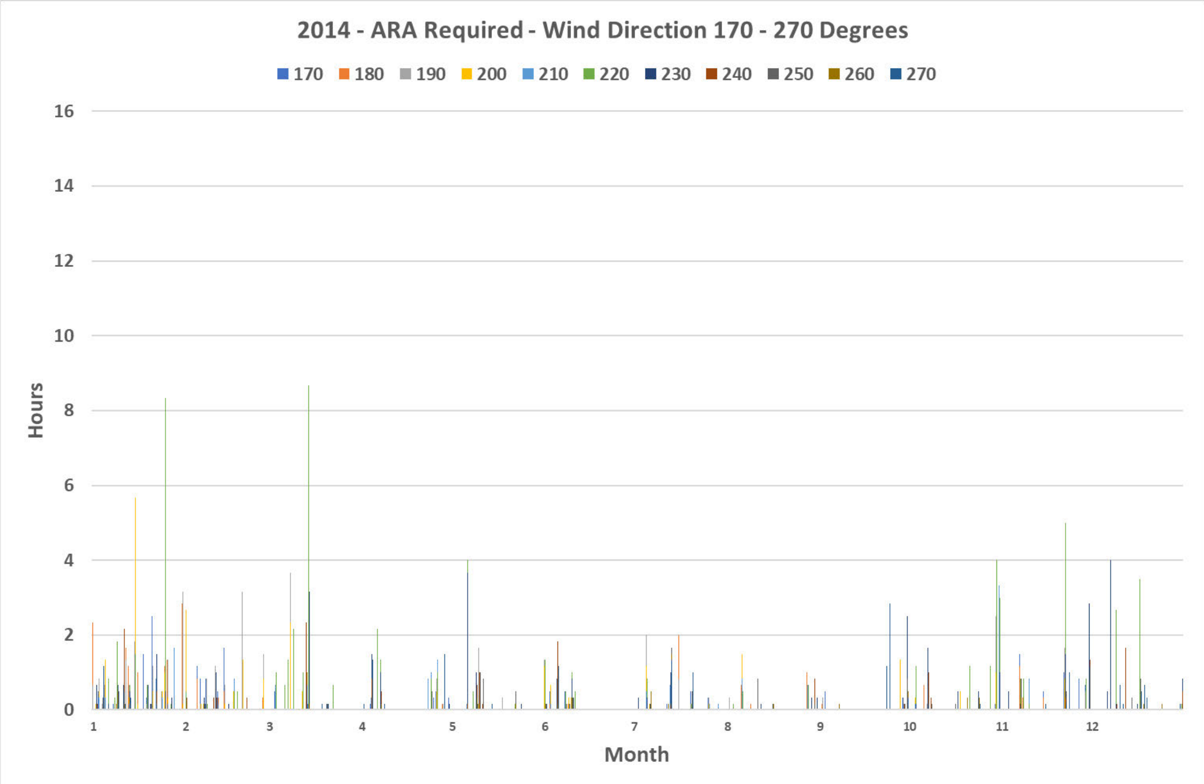


Figure 3.3 Frequency and Hours per Month an ARA to Babbage is Impaired (2014)

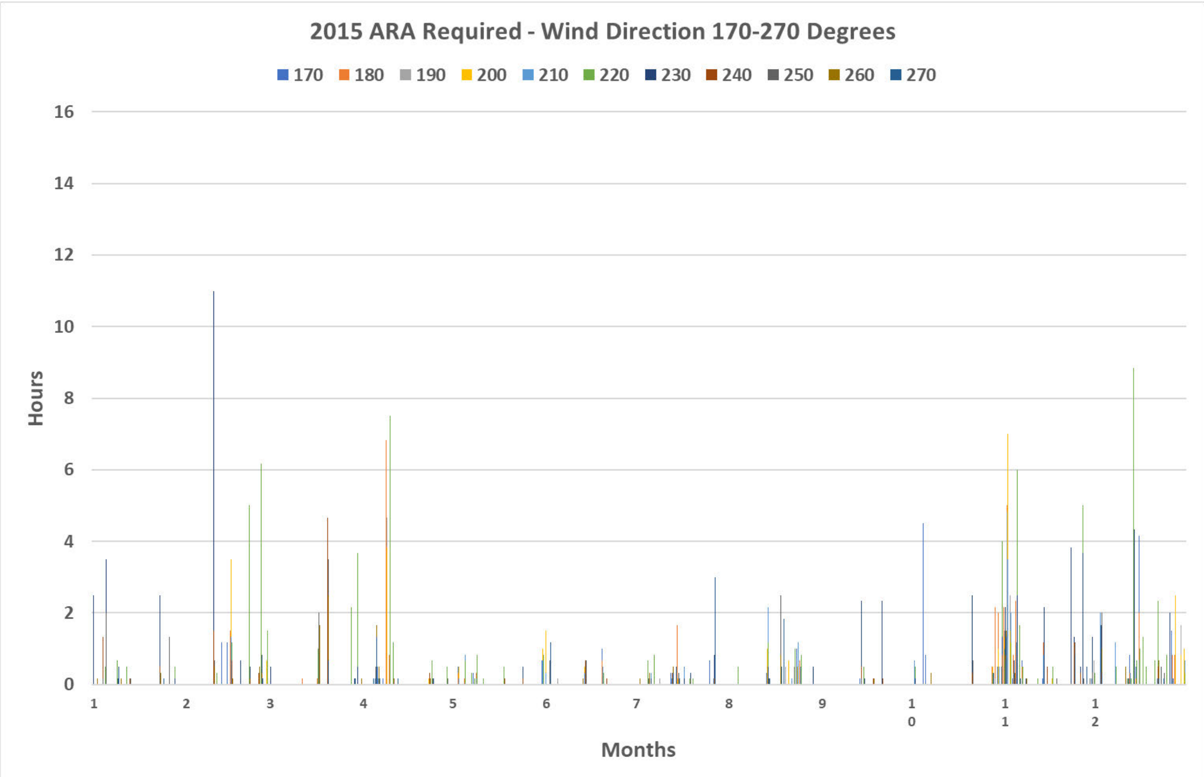


Figure 3.4 Frequency and Hours per Month an ARA to Babbage is Impaired (2015)

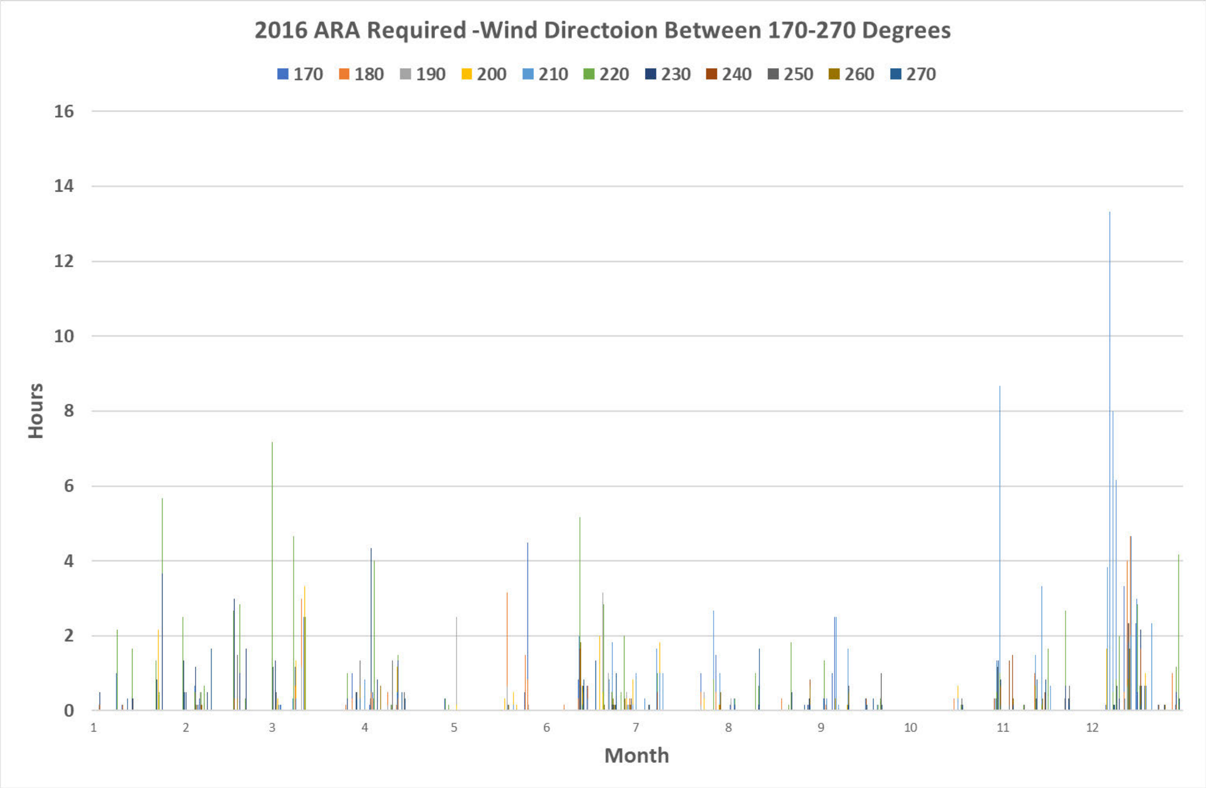


Figure 3.5 Frequency and Hours per Month an ARA to Babbage is Impaired (2016)

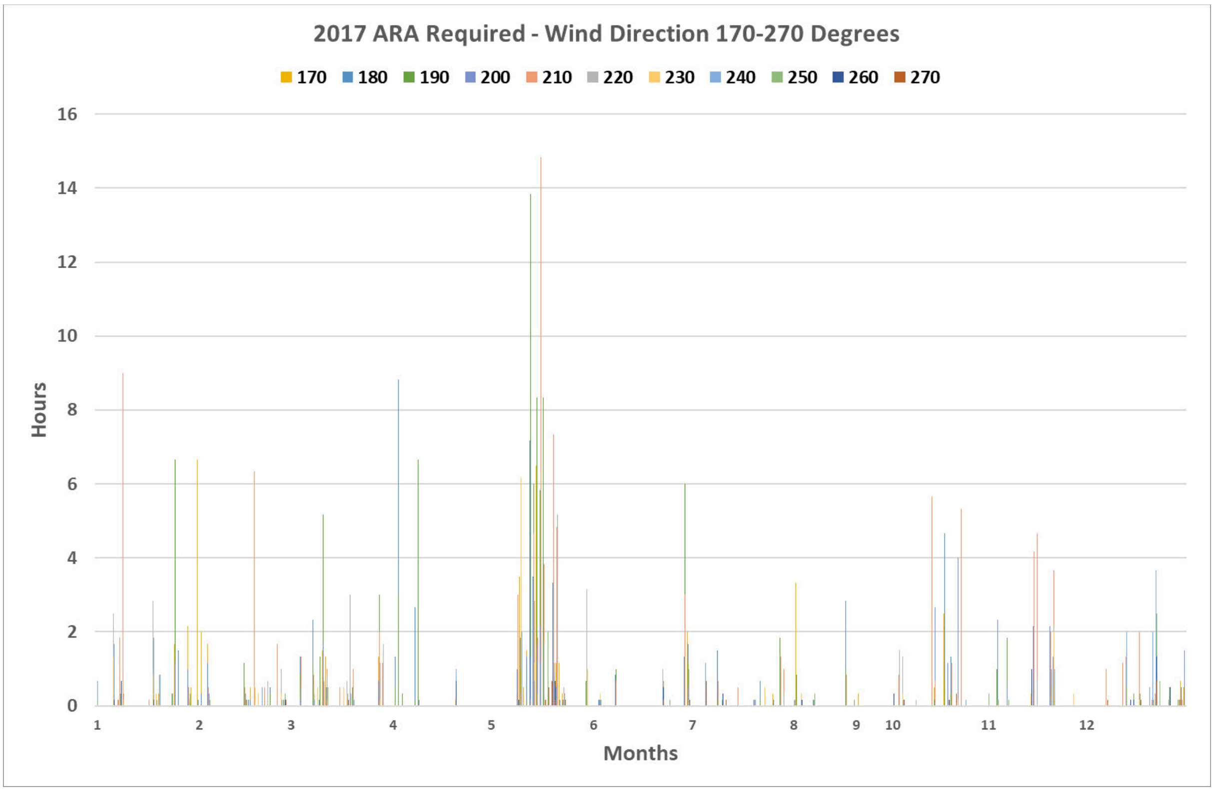


Figure 3.6 Frequency and Hours per Month an ARA to Babbage is Impaired (2017)

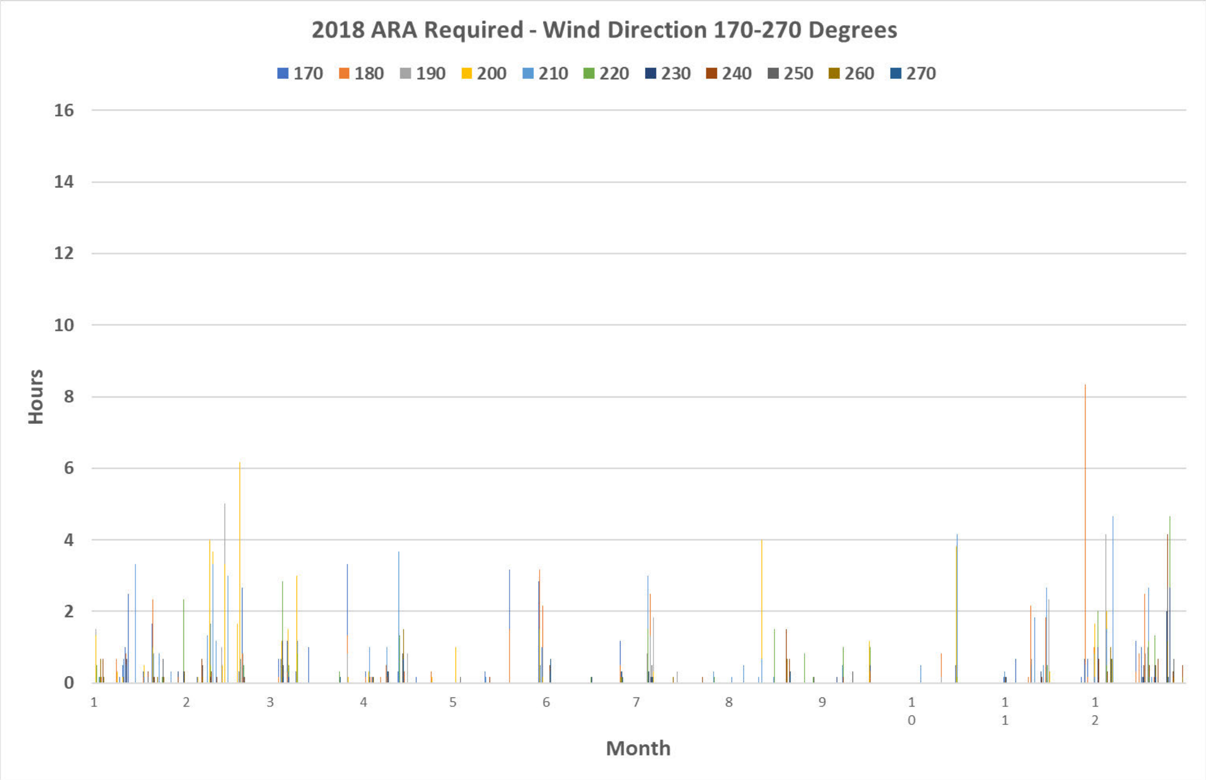


Figure 3.7 Frequency and Hours per Month an ARA to Babbage is Impaired (2018)

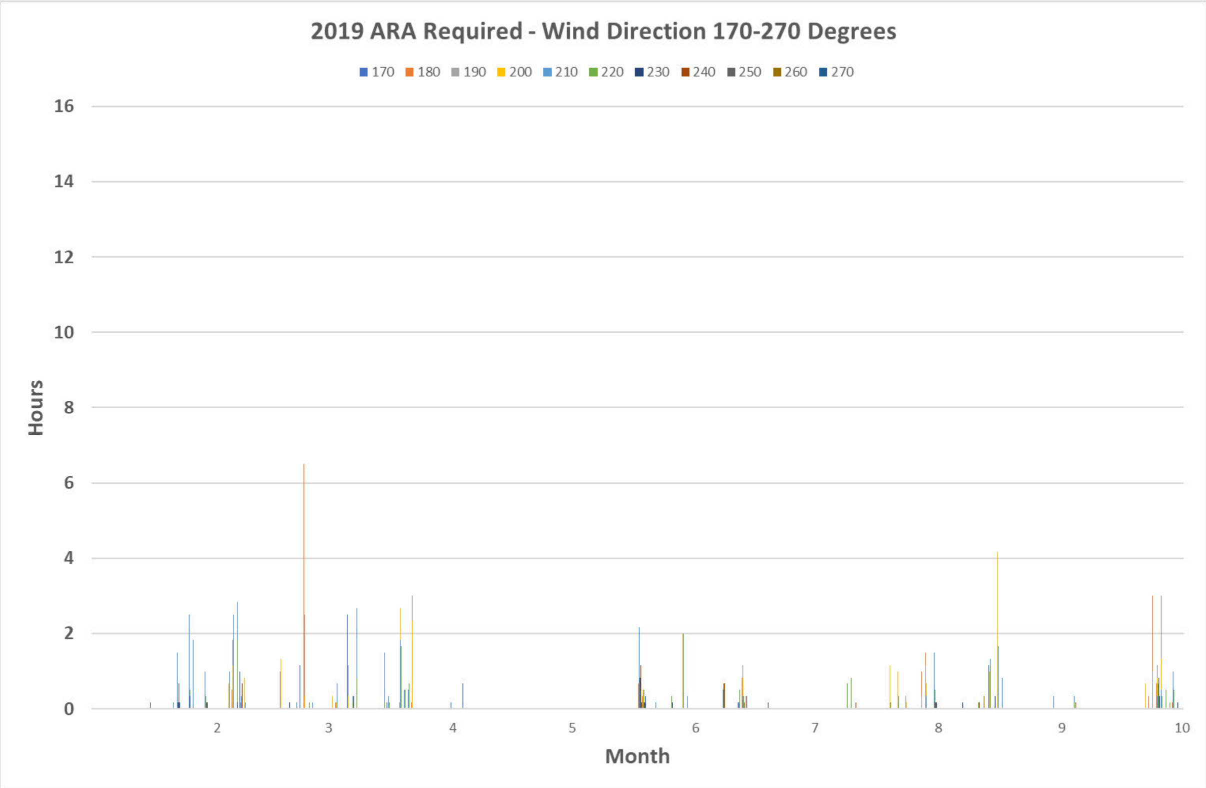


Figure 3.8 Frequency and Hours per Month an ARA to Babbage is Impaired (2019)

3.8 Calculation of Take-Off Distance Required with One Engine Inoperative

8. The Babbage platform is situated approximately 2.3 nm from the Hornsea Four array area. Due to this distance, the take-off case must also be considered, as under extremely remote circumstances it could impact on Commercial Air Transport flights.

9. The AW139 is currently the only helicopter type used for gas operations in the UK southern North Sea. It is capable of transporting 12 passengers and bags as well as operations to 15D 5.3T helidecks , such as those on many NUIs. Over 1,000 AW139s have been built since the production line started in 2002, and the type has gone through a series of upgrades, including a recent avionic update. Previously, other medium sized helicopters were utilised on the southern North Sea, but these were retired after the Sumburgh helicopter accident in 2013. The accident resulted in the publication of CAP 1145 (CAA, 2014), CAP 1243 (CAA, 2015), and their associated Safety Directives. These resulted in legacy types, such as the S76 and EC155, being retired from the southern North Sea as they did not have crashworthy seating and fuel tanks, and could not meet all the CAA requirements whilst still carrying an economic payload.

10. In this analysis, data for the Leonardo AW139 is used, which were obtained from the AW139 Rotorcraft Flight Manual (RFM).

11. There are currently no similar sized helicopters available which are capable of operating to all the platforms in the area whilst meeting all the safety requirements identified in CAP 1145. If another helicopter type(s) is found necessary for just the crew change flights to Babbage, then this analysis should be repeated for that type.

12. A take-off from a helideck, with an engine failure on rotation, is deemed to be the most restrictive case requiring the largest distance to achieve a safe departure. This is highly unlikely, and under the EASA SPA.HOFO Guidance a probability of less than 5×10^{-8} per take-off or landing has been determined.

13. The use of the AW139 Supplement 97 and applying a temperature of 30°C at a take-off mass of 6800kg were agreed during an operator workshop on 27th February 2019, as part of the Hornsea Project Three consultation process. The relevant platforms considered were the Chiswick and Grove NUIs, which were generally supported by helicopters operating from the Dutch base at Den Helder, shuttling workers from the J6A platform. That analysis resulted in a take-off distance of 2.8nm, which was accepted by all parties.

14. As part of the Hornsea Four consultation process with the helicopter operators, as required by CAA CAP 764, two UK operators stated they routinely use the flight profiles and performance data in the AW139 Supplement 50, not Supplement 97. The reasons stated were that Supplement 50 allowed a lower thrust margin (available Power Index margin) and a simpler OEI take-off profile. Using Supplement 50 results in a slightly lower OEI rate of climb, and hence a greater distance to

complete a take-off and turn away from Hornsea Four under IMC. In light of the revised performance data used by two operators, it was decided to update the analysis to determine the actual distance required under normal conditions, and to confirm if the previous temperature and take-off mass assumptions were still valid.

3.8.1 Effected Take-off Arc

15. The Hornsea Four array could potentially impact take-off from the Babbage platform when the wind is blowing from 350° clockwise to 060°.The period of time the wind was in the effected arc of 350° to 060° combined with when the conditions were IMC, was assessed. The results are shown in Table 3.8, firstly as day and night combined and then day only.

Table 3.8 Percentage of the Year when Wind from 350° to 060° Arc and IMC

	2013	2014	2015	2016	2017	2018	2019
Day and night (%)	2.5	3.1	0.9	3.3	1.5	3.7	2.0
Day only (%)	1.2	1.8	0.5	2.0	0.9	2.0	1.2

N.B. This table does not take account of no-fly days due to factors such as Triggered Lightning or poor onshore weather.

16. These data show that the OEI take-off case is only applicable for a maximum of 3.7% (2018) for day and night, and a maximum of 2.0% (2016 & 2018) of the year if daylight operations are applied as a mitigation, when the wind direction is from the effected arc.

3.8.2 Temperature

17. During the Operator Workshop on 27th February 2019, one assumption agreed was a temperature of 30°C should be applied to the take-off calculations as that was a worse case assumption. Higher temperatures cause a reduction in the density of the air, resulting in lower aerodynamic performance. Additionally, higher temperatures result in reduced engine performance. In reality, the offshore temperatures rarely reach 30°C, and so a more realistic temperature should be applied. The meteorological data was analysed for the period 2013 to 2019, and the temperature noted when the wind blew from the 350° to 060° arc. The temperatures are summarised in Table 3.9.

Table 3.9 Temperature Data for the 350° to 060° Arc

	2013	2014	2015	2016	2017	2018	2019
Mean temperature (°C)	10.4	13.5	9.5	7.3	10.9	9.9	10.3

	2013	2014	2015	2016	2017	2018	2019
Temperature standard deviation (°C)	4.8	3.0	3.7	2.2	3.6	3.0	2.7
Temperature to two standard deviations (°C)	20.0	19.5	16.9	11.7	18.1	15.9	15.7

18. The data approximated to a normal distribution. Applying an upper temperature equating to two standard deviations will cover 97.5% of the highest temperatures. The highest value to two standard deviations was 20.0°C in 2013. However, to ease using the performance graphs, the temperature applied for all years will be rounded up to 20°C.

19. The take-off distance calculation are shown below. In order to assist the reader, the OEI take-off profile is shown in Figure 3.10 and then explained.

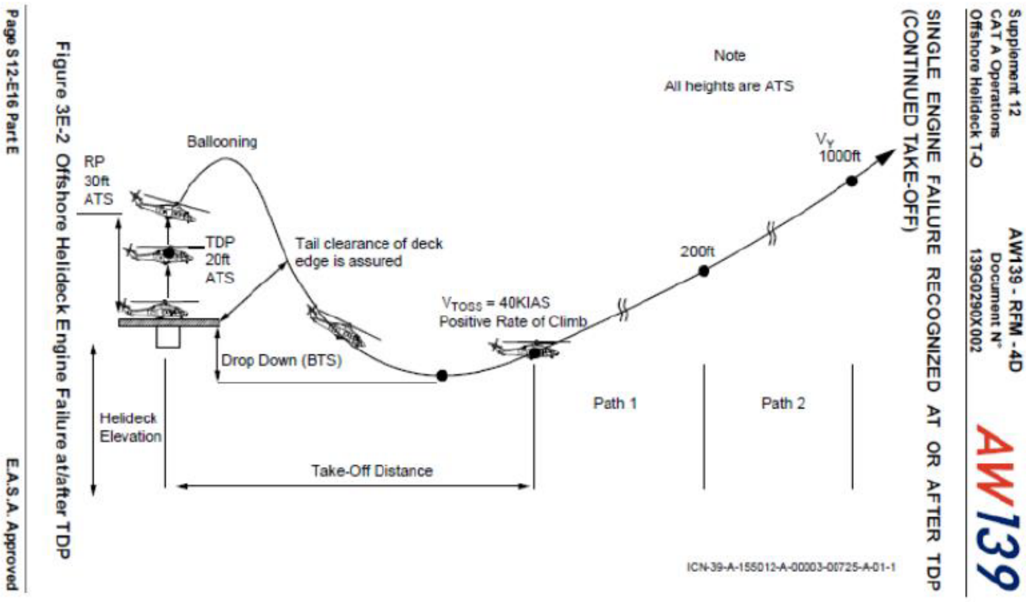


Figure 3.10 OEI Take-off Profile

20. The calculation assumes a worse case, where the engine fails at the Take-off Decision Point (TDP). The OEI power rating will automatically be set to the 2.5 minute power rating. The Pilot Flying (PF) is trained to rotate the pitch attitude to 10° nose down, hold for one second and then pitch up to set an attitude of 0°, i.e. a level attitude. The aircraft is accelerated to the take-off safety speed (Vtoss) at which point a 5°

nose up attitude is selected to climb the aircraft. Any dropdown below the height of the helideck will increase the distance required to achieve 200 ft.

21. At 200 ft above the surface the PF continues to accelerate to the best rate of climb speed (Vy). At Vy the climb is continued to 1,000 ft reducing power to the OEI Maximum Continuous Rating, "*when convenient before expiry of the 2.5 minute rating*". The terminology used in the AW139 Flight Manual is to call the period between achieving Vtoss and reaching 200 ft, Flight Path 1 (known as 1st sector on other helicopters) and the period between 200 and 1,000 ft Flight Path 2 (known as 2nd sector on other helicopters). For the purposes of this calculation, it will be assumed that OEI Maximum Continuous Power will be selected at 200 ft, i.e. at the earliest point and therefore constitutes a worst case assumption.

22. Two values of take-off mass were used, the maximum permitted by Supplement 50, of 6,800kg and a slightly lower value of 6,400 kg. The lower value of 6,400 kg will usually be sufficient to carry 12 passengers if the weather at Norwich Airport is VMC[2], or in IMC conditions when the Babbage operator does not need a full load of 12 passengers and bags.

Table 3.10 Take-off and Turn Distance Required From Babbage

Parameter	For 6,400 kg	For 6,800 kg
Babbage helideck height (ft)	**125**	**125**
A – Supplement 50: Continued take-off distance OEI offshore helideck Graph 4-71		
Pressure altitude	0	0
Temperature (°C)	20	20
Aircraft mass (kg)	6,400	6,800
Distance (m)	**220**	**230**
B – Supplement 50: Drop down offshore helideck procedure Graph 4-74		
Pressure altitude	0	0
Temperature (°C)	20	20
Aircraft mass (kg)	6,400	6,800
Dropdown (ft)	**0**	**30**
C – Supplement 50: Take-off Flight Path 1 Graphs 4-81 and 4-82		
Pressure altitude	200	200

[2] SPA.HOFO.120 - No alternate airfield (and fuel) required when the cloud base is either greater than 1,000 ft above the airfield, or 700 ft above the minima for the instrument approach, with the visibility equal or greater than 2,500 m.

Parameter	For 6,400 kg	For 6,800 kg
Temperature (°C)	20	20
Aircraft mass (kg)	6,400	6,800
Mean height gained in 30m horizontal distance	**23**	**18**
D – Supplement 50: Take-off Flight Path 2 Graphs 4-87 and 4-88		
Pressure altitude	600	600
Temperature (°C)	20	20
Aircraft mass (kg)	6,400	6,800
Mean height gained in 30m horizontal distance	**10.7**	**8.8**
Babbage		
A – Continued take-off distance OEI offshore helideck Graph 4-71 (m)	220	230
Helideck height (m)	125	2125
B – Drop down (m)	0	30
Initial starting height (m)	125	95
C – Flight Path 1 distance to climb to 200 ft (m)	98	175
Distance in nm	0.053	0.094
D – Flight Path 2 distance to climb from 200 to 1,000 ft (m)	2,243	2,727
Distance in nm	1.21	1.47
Total distance A+C+D (m)	2,561	3,132
Distance in nm	1.38	1.69
Distance to turn (nm)	0.34	0.34
1nm IMC buffer	1.00	1.00
Total distance required	**2.72**	**3.03**

23. In a worst case scenario when the wind is in the effected arc of 350° to 060° combined with IMC, a temperature of 20°C or less, and full 6,800kg take-off aircraft mass, a distance of 3.03 nm is required. However, if the installation operator could accept a small decrease in payloads, or the weather in Norwich is VFR, then a distance of 2.72 nm is required.

24. Another alternative would be to use the additional performance graphs in Supplement 50, which combine Flightpaths 1 and 2, using OEI 2.5 minute power until 1,000 ft is reached. Use of 2.5 minute OEI power is permitted by the Flight Manual,

does not require the additional thrust margin which limits use of Supplement 97, and utilises a standard flight profile: this overcomes the two objections raised by the UK operators to using Supplement 97.

25. If approximately one minute of the 2.5 minutes of emergency power is used, then Supplement 50 Graphs 4-93 and 4-94 can be applied. These result in a higher rate of climb, which is always desirable under emergency conditions, and reduces the distances required to climb to a safe height and turn away from the wind farm. Even if an obstruction was not present, an experienced pilot would tend to use 2.5 minute power above 200 ft until established in a climb and well clear of the surface.

26. The calculations in Table 3.11 show that using the combined Flight Paths 1 and 2 graphs (Supplement 50 Graphs 4-93 and 4-94) result in a minimum distance of 2.35nm.

Table 3.11 Take-off and Turn Distance Required from Babbage – Using 2.5 Minute OEI Power

Parameter	For 6,400 kg	For 6,800 kg
Temperature (°C)	20	20
Aircraft mass (kg)	6,400	6,800
A and B unchanged		
Babbage		
A – Continued take-off distance OEI offshore helideck Graph 4-71 (m)	220	230
Helideck height (m)	125	125
B – Drop down (m)	0	30
Initial starting height (m)	125	95
E – Supplement 50: Alternative 60KIAS Path 1 and 2 Gradient 4-93 and 4-94		
Pressure altitude	600	600
Temperature (°C)	20	20
Aircraft mass (kg)	6,400	6,800
Mean height gained in 30m horizontal direction	20	16.5
E – distance to climb from drop down to 1,000 ft (m)	1,313	1,645
E – distance to climb from drop down to 1,000 ft (nm)	0.71	0.89
Time to climb to 1,000 ft – 2.5 minute OEI ROC Chart 4-40 (mins)	0.95	0.95
Total distance A+E (m)	1,533	1,875
Distance in nm	0.83	1.01

Parameter	For 6,400 kg	For 6,800 kg
Distance to turn (nm)	0.34	0.34
1nm IMC buffer	1.00	1.00
Total distance required	**2.17**	**2.35**

3.8.1 Summary of OEI Take-Off Data

27. Table 3.12 summarises the various take-off calculations.

Table 3.12 Take-off and Turn Distance Required from Babbage

Scenario	Take-off Mass 6400 kg	Take-off Mass 6800 kg	Comment
Flight Path 1 then Flight Path 2	2.72	3.03	OEI Max Continuous Power >200 ft
Flight Path 1 and 2 Combined	2.17	2.35	OEI 2.5 Minute power until 1,000 ft

28. Providing there are no safety implications, which have not already been identified during aircraft certification and noted in the Flight Manual, the permitted use of OEI 2.5 minute power for circa one minute will result in the aircraft climbing faster and needing a smaller distance to turn away from Hornsea Four. Use of this power rating, in the extremely unlikely event of an engine failure, will reduce the impact of Hornsea Four on helicopter operations to the Babbage platform, and permit a full passenger load for the installation operator. Using sequential Flight Path 1 and Flight Path 2 profiles will result in a longer distance, and lower rate of climb.

4 Garrow

29. The Garrow platform is a NUI approved for daylight operations only with a wind speed of 30 kt or less. Figure 4.1 presents the helideck information plate for the Garrow platform.

HELIDECK INFORMATION PLATE

HELIDECK Elev 103 ft	VAR Check	POSITION N54 16.3 E000 59.7	EGGK **Garrow**		
HEIGHT OF INSTALLATION: 127 HIGHEST OBSTACLE WITHIN 5NM: **Check**			VHF **120.075**	NDB	Issue Date **28 Jan 2020**
FUELLING INSTALLATION: **No** STARTING EQUIPMENT: **No** Norway 1.25D - 'D' = **16.02m** HELIDECK D value: **16.02** P/R/H Category: **F** Max Weight: **5.3**			Operating Company **Perenco UK Ltd**		Issued By **Helideck Certification Agency**

Wind (T°)	Kts	Limitation /Comment
	30>	NUI • Daylight operations only - Circle and "H" lights not fitted • No helicopter operations • Table 1(T) if overflight of 5:1 items unavoidable
		Non Compliance
	5:1	East and west access platforms
	Misc	Friction test not completed No automatic fire-fighting facilities for AW 139 (6.8t) — Cleared

Figure 4.1 Garrow Helideck Information Plate (Source: HCA)

30. The Garrow platform is located 7.0 km (3.8 nm) from the Hornsea Four array area. The Hornsea Four array obstructs an approach arc from 300° to 040°. However, if an approach can be made up to 30° out of wind, then this arc reduces to 330° to 010°. The following tables highlight in yellow the percentage of the time when an ARA is required but would be obstructed by the array.

4.1 2013 Data

Table 4.1 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Garrow, 2013)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.3	0.5	1.8	1.3	0.2	0.7	0.0	2.5	0.2	0.7	0.0	8.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
20	0.0	0.2	0.5	3.3	0.0	1.2	1.0	0.3	2.7	1.2	1.8	0.0	12.2
30	0.0	0.2	0.5	0.3	0.0	0.8	1.0	0.2	1.3	3.0	0.5	0.0	7.8
40	0.2	0.2	0.0	0.3	0.0	1.8	6.2	0.0	0.2	3.5	0.5	0.0	12.8
50	0.2	2.0	1.7	0.0	0.0	0.5	3.5	0.0	0.0	5.5	0.3	0.0	13.7
60	0.7	6.0	3.3	0.0	0.0	0.8	3.8	0.0	0.0	0.5	0.2	0.0	15.3
70	0.3	3.2	0.8	0.3	0.0	1.3	2.5	0.0	0.0	0.0	0.0	0.0	8.5
80	0.3	0.0	0.0	0.7	0.0	0.0	1.5	0.5	0.0	0.3	0.0	0.0	3.3
90	1.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.3
100	2.5	0.0	1.0	1.5	0.0	0.0	0.2	0.0	0.0	1.0	0.0	0.0	6.2
110	0.3	0.2	9.0	3.5	0.5	0.0	0.0	0.0	0.0	2.0	0.0	0.0	15.5
120	0.8	1.0	11.3	0.5	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	14.7
130	9.3	0.7	2.3	1.0	0.5	0.0	0.0	0.2	0.0	1.0	0.0	0.0	15.0
140	4.5	2.2	0.8	3.5	2.3	0.0	0.0	1.0	0.0	1.3	0.0	0.0	15.7
150	0.2	0.0	1.5	0.3	1.3	0.0	0.2	0.0	0.0	2.3	0.0	1.3	7.2
160	0.8	3.8	1.5	0.0	0.0	0.0	0.2	0.0	2.7	1.7	1.2	0.7	12.5
170	0.0	2.8	2.0	0.0	0.7	0.0	0.3	0.0	1.5	0.2	0.7	0.3	8.5
180	0.0	1.8	4.2	0.2	0.2	0.0	0.0	0.0	0.0	0.5	0.2	0.8	7.8
190	0.0	0.3	1.2	1.3	0.5	0.0	0.3	0.0	0.0	0.8	0.2	2.2	6.8
200	0.2	3.0	0.7	2.3	1.0	0.7	1.2	0.0	0.0	0.3	0.5	1.5	11.3
210	2.3	0.3	2.0	1.3	0.5	1.7	0.3	0.0	0.2	0.5	0.0	2.3	11.5
220	5.8	0.0	1.8	1.5	0.5	1.7	0.0	2.3	1.2	1.0	3.5	15.5	34.8
230	4.8	0.0	1.8	1.2	0.0	1.2	0.0	0.2	0.5	0.8	5.7	14.3	30.5
240	0.7	0.0	0.5	0.2	0.2	1.2	0.0	0.0	0.0	0.8	2.8	0.2	6.5
250	1.8	0.5	0.2	0.0	0.5	0.5	0.0	0.0	0.3	0.5	1.2	0.5	6.0
260	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.3	1.2	3.7	0.3	6.7
270	0.5	0.2	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.5	7.0	0.7	9.3
280	0.3	2.7	0.0	0.0	0.3	1.0	0.0	1.0	0.0	0.3	4.0	0.5	10.2
290	0.0	0.5	0.0	0.0	5.5	1.2	0.0	0.3	0.5	0.0	0.8	0.0	8.8
300	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.3	0.2	0.2	0.8	0.2	2.7
310	0.0	0.2	0.2	0.2	0.3	0.3	0.0	0.7	0.2	0.2	0.2	0.0	2.3
320	0.0	0.0	0.0	2.2	0.0	0.3	0.5	0.0	0.7	0.8	1.3	0.2	6.0
330	0.3	0.8	0.0	1.5	0.0	0.2	1.0	0.0	0.5	0.3	1.8	1.2	7.7
340	0.0	0.7	0.0	0.5	0.7	0.3	1.8	0.0	1.8	0.7	2.8	0.2	9.5
350	0.7	0.8	0.0	1.0	1.8	0.0	1.3	0.0	2.2	0.3	0.7	0.0	8.8
360	0.0	1.0	0.2	0.7	1.0	0.3	1.5	0.0	1.3	0.3	0.5	0.0	6.8
Blocked (yellow) hrs/month	**1.0**	**3.7**	**0.7**	**5.5**	**4.8**	**1.0**	**6.3**	**0.0**	**8.3**	**1.8**	**6.5**	**1.3**	**41.0**

4.2 2014 Data

Table 4.2 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Garrow, 2014)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.5	0.3	0.0	0.7	1.0	0.0	0.7	0.5	0.0	0.0	3.7
20	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.3	0.2	0.0	1.2
30	0.0	0.0	0.3	0.7	1.7	0.5	0.0	0.0	2.0	1.5	0.2	0.0	6.8
40	0.0	0.0	1.0	0.0	0.7	0.3	0.2	0.0	5.0	2.0	0.2	0.0	9.3
50	0.0	0.0	2.2	0.0	0.5	0.7	0.2	0.0	6.3	6.7	2.8	0.0	19.3
60	0.0	0.0	1.2	0.0	0.7	4.2	0.0	0.0	0.5	2.2	2.7	0.0	11.3
70	0.0	0.0	0.2	0.5	0.7	0.0	0.0	0.0	0.2	0.5	3.0	0.0	5.0
80	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	1.3
90	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
100	0.0	0.0	0.3	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
110	0.2	0.2	9.5	0.7	3.0	0.0	0.0	0.0	0.2	0.2	0.0	0.2	14.0
120	0.0	1.0	15.7	2.7	0.7	0.2	0.0	0.8	5.0	0.2	0.8	1.0	28.0
130	1.7	1.2	3.2	3.3	0.8	0.3	0.0	0.5	2.5	0.0	6.3	1.2	21.0
140	7.7	1.3	1.0	1.7	0.8	0.2	0.0	2.3	1.2	0.0	22.8	1.3	40.3
150	1.8	2.0	0.2	0.2	0.0	0.5	0.2	0.0	0.7	1.0	5.5	2.0	14.0
160	1.7	2.0	0.2	0.0	0.0	0.2	0.2	0.0	0.8	1.3	2.7	2.0	11.0
170	2.5	4.5	0.7	0.7	0.0	0.2	0.0	0.0	0.3	0.7	2.8	4.5	16.8
180	12.8	2.0	0.5	0.0	0.0	0.3	0.0	0.2	0.2	0.3	1.7	2.0	20.0
190	10.0	4.3	1.8	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5	4.3	21.3
200	7.0	3.3	2.0	0.2	0.2	0.5	0.2	0.0	0.0	0.0	0.3	3.3	17.0
210	4.2	0.2	3.7	1.5	0.2	0.0	0.5	0.0	0.0	3.3	1.5	0.2	15.2
220	3.5	0.5	8.0	1.7	1.0	0.2	0.3	0.3	0.0	5.2	6.5	0.5	27.7
230	4.7	1.5	2.3	0.7	1.7	0.0	0.3	1.2	0.0	1.5	4.2	1.5	19.5
240	3.2	1.0	2.3	0.2	1.5	0.2	0.2	0.8	0.0	1.0	1.7	1.0	13.0
250	1.2	0.0	0.5	0.5	1.8	0.2	0.5	0.7	0.0	0.3	2.0	0.0	7.7
260	0.5	0.0	0.3	0.0	0.0	0.3	0.5	0.2	2.2	0.0	0.3	0.0	4.3
270	1.3	0.0	0.2	0.0	0.2	0.0	0.0	0.0	3.5	0.0	0.3	0.0	5.5
280	0.5	0.8	0.2	0.0	0.3	0.0	0.2	0.3	1.3	0.7	0.7	0.8	5.8
290	0.5	0.0	0.2	0.0	1.3	0.0	0.5	0.0	0.0	0.2	0.2	0.0	2.8
300	0.3	0.0	0.0	0.0	0.7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.3
310	0.2	0.0	0.0	0.0	0.2	0.0	0.3	0.2	0.2	0.3	0.0	0.0	1.3
320	0.8	1.7	0.2	0.2	0.5	0.5	0.8	0.8	2.2	0.7	0.2	1.7	10.2
330	0.5	0.2	0.3	0.0	0.3	0.2	0.0	0.2	1.3	0.5	0.3	0.2	4.0
340	0.5	0.0	0.2	0.0	0.2	1.0	6.5	0.0	2.0	1.5	0.5	0.0	12.3
350	0.0	0.0	0.2	0.0	0.0	2.8	7.7	0.2	1.0	1.3	0.8	0.0	14.0
360	0.2	0.0	0.0	0.0	0.2	2.0	3.5	0.2	1.3	0.2	0.5	0.0	8.0

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
Blocked (yellow) hrs/month	1.2	0.2	1.2	0.3	0.7	6.7	18.7	0.5	6.3	4.0	2.2	0.2	42.0

4.3 2015 Data

Table 4.3 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Garrow, 2015)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.7	4.5	1.0	0.0	0.0	1.8	0.0	0.2	0.0	0.3	1.8	10.3
20	0.0	0.5	2.2	0.5	0.0	0.2	1.3	0.0	0.0	0.0	0.0	0.0	4.7
30	0.0	1.0	1.7	0.8	0.0	0.5	1.7	0.0	0.0	1.0	0.0	0.0	6.7
40	0.0	0.5	1.2	1.0	0.0	0.2	0.3	0.0	0.2	0.5	0.0	0.0	3.8
50	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.0	0.2	1.3	0.0	0.0	2.3
60	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.0	0.0	1.3
70	0.0	0.0	0.5	0.2	0.0	0.2	0.0	0.2	0.5	0.0	0.0	0.0	1.5
80	0.0	0.5	0.8	0.0	0.0	0.3	0.0	0.0	0.2	0.2	0.0	0.0	2.0
90	0.0	1.0	1.2	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	2.7
100	0.0	0.8	1.8	0.0	0.0	0.2	0.0	0.5	0.0	0.2	0.0	0.0	3.5
110	0.0	5.2	2.8	0.0	0.5	0.3	0.7	0.2	0.2	0.0	0.0	0.0	9.8
120	0.0	1.5	1.5	2.2	1.5	1.5	0.0	0.2	0.0	0.7	0.0	0.0	9.0
130	0.0	0.0	0.8	0.7	0.3	0.0	0.0	0.5	0.0	1.2	0.2	0.0	3.7
140	0.0	1.0	0.7	1.0	0.7	0.0	0.2	0.3	0.3	2.2	1.0	3.2	10.5
150	0.0	0.5	0.7	0.8	0.5	0.0	0.7	0.0	0.3	0.0	0.0	3.2	6.7
160	0.0	1.5	0.2	0.3	0.5	0.0	0.7	0.5	0.0	1.5	1.5	2.2	8.8
170	0.0	1.7	0.0	0.0	0.5	0.0	0.0	0.8	0.2	0.8	2.8	5.2	12.0
180	0.0	0.8	0.2	0.8	0.3	0.5	0.0	1.2	0.0	3.8	5.2	3.0	15.8
190	0.0	0.5	0.3	0.8	0.2	0.3	0.0	1.3	0.0	1.2	3.8	4.0	12.5
200	0.0	3.0	0.0	2.3	0.5	1.5	0.2	1.3	0.0	0.5	3.2	3.5	16.0
210	0.0	3.8	0.2	1.0	0.2	0.7	0.3	1.2	0.0	1.7	1.8	4.2	15.0
220	5.2	11.7	4.0	5.8	0.8	0.2	0.0	1.8	0.0	3.3	4.0	14.7	51.5
230	8.7	4.8	1.5	0.5	0.0	0.0	0.3	0.0	1.2	2.8	13.0	6.7	39.5
240	2.8	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.3	0.8	10.2
250	4.2	0.0	0.2	0.2	0.0	0.8	1.0	0.2	0.2	0.7	2.2	2.2	11.7
260	0.7	0.7	1.0	0.5	0.0	0.8	0.5	1.7	0.0	0.0	1.5	2.0	9.3
270	0.2	0.0	0.8	0.3	0.0	0.8	0.2	0.5	0.0	0.0	1.5	0.7	5.0
280	0.3	0.0	0.2	0.2	0.0	0.7	0.3	0.2	0.7	1.5	1.8	0.2	6.0
290	0.2	0.0	0.0	0.2	0.0	0.3	0.2	0.0	0.5	4.0	0.5	0.8	6.7
300	0.3	0.2	0.0	0.0	0.0	0.0	0.5	0.3	1.0	2.8	0.2	0.2	5.5

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
310	2.0	1.2	0.7	0.5	0.0	0.2	0.0	4.0	2.2	0.8	1.5	0.3	13.3
320	1.3	0.7	2.3	0.2	0.0	0.0	0.0	10.7	3.8	0.0	3.0	0.2	22.2
330	0.2	0.2	1.3	0.3	0.0	0.0	2.8	0.0	1.2	0.0	0.7	0.0	6.7
340	0.0	0.5	2.0	0.0	0.0	0.0	0.8	0.0	2.3	0.0	0.2	0.2	6.0
350	0.0	1.3	1.2	0.5	0.0	0.0	1.8	0.0	1.2	0.0	0.5	0.2	6.7
360	0.0	0.2	5.3	0.7	0.0	0.0	1.0	0.0	0.3	0.0	0.5	0.8	8.8
Blocked (yellow) hrs/month	**0.2**	**2.8**	**14.3**	**2.5**	**0.0**	**0.0**	**8.3**	**0.0**	**5.2**	**0.0**	**2.2**	**3.0**	**38.5**

4.4 2016 Data

Table 4.4 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Garrow, 2016)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.2	0.8	0.0	2.2	1.2	0.0	0.2	0.2	0.3	0.2	0.0	5.2
20	0.2	0.0	1.0	0.0	7.0	5.2	0.0	0.0	0.5	0.3	0.5	0.0	14.7
30	0.0	0.0	1.8	0.2	2.5	6.0	0.0	0.0	0.3	0.3	0.0	0.0	11.2
40	0.0	0.0	2.2	0.3	0.2	4.8	0.0	0.0	1.5	0.2	0.0	0.0	9.2
50	0.2	0.0	1.8	0.3	0.0	1.5	0.0	0.0	1.0	0.0	0.2	0.0	5.0
60	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.8	0.0	0.3	0.0	2.0
70	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.2	0.3	0.0	0.8
80	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.8	0.2	0.2	0.0	2.0
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.3	0.0	1.2
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0
110	0.0	0.0	0.0	0.7	0.0	5.0	0.0	0.0	3.0	0.0	0.0	0.0	8.7
120	2.8	0.0	0.0	0.7	0.0	0.3	0.0	0.0	2.3	0.0	0.0	0.0	6.2
130	31.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	35.0
140	14.0	1.3	1.2	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.2	18.2
150	3.7	0.3	1.7	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	1.2	7.2
160	0.5	0.0	9.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
170	1.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	3.5	0.2	0.0	0.0	9.7
180	0.0	0.0	4.5	0.3	0.8	0.3	0.0	0.0	0.2	0.3	0.0	2.0	8.5
190	0.0	0.0	5.3	0.3	0.7	2.2	0.0	0.0	0.2	0.3	0.0	1.2	10.2
200	1.8	0.0	2.8	0.7	0.7	1.8	0.8	0.0	0.3	0.3	0.0	1.2	10.5
210	0.7	0.3	2.5	0.8	0.2	2.8	2.8	0.0	2.3	0.3	0.2	4.5	17.5
220	8.2	6.3	6.7	0.8	0.0	0.8	0.0	0.3	0.3	0.8	0.5	2.0	26.8
230	3.5	6.0	1.7	0.0	0.0	0.0	0.2	0.0	0.2	0.8	0.0	0.5	12.8
240	0.2	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.2	0.2	6.7

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
250	0.3	2.2	1.7	1.7	0.0	0.3	0.0	0.0	0.2	0.2	0.2	0.0	6.7
260	0.0	0.7	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	2.3
270	0.8	1.7	0.7	0.3	0.0	1.3	0.0	0.0	0.2	0.2	0.0	0.5	5.7
280	4.7	2.5	0.5	0.0	0.0	0.8	0.2	0.0	0.0	0.3	0.0	0.5	9.5
290	1.5	1.0	0.0	0.7	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	3.8
300	0.5	0.7	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	2.3
310	0.8	1.3	0.0	0.0	0.0	0.8	0.0	0.0	0.3	0.8	0.5	0.0	4.7
320	0.2	0.8	0.5	0.2	0.0	0.2	0.0	0.0	0.2	0.7	1.0	0.0	3.7
330	0.2	0.8	1.5	0.2	0.0	0.3	0.0	0.0	0.2	0.3	0.0	0.0	3.5
340	1.2	1.0	2.2	0.5	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	6.2
350	3.0	0.0	4.3	2.5	0.0	1.2	0.0	0.2	0.0	0.0	0.0	0.0	11.2
360	0.7	0.5	3.5	1.7	0.0	1.2	0.0	0.0	0.2	0.0	0.3	0.0	8.0
Blocked (yellow) hrs/month	**5.0**	**2.5**	**12.3**	**4.8**	**2.2**	**5.0**	**0.0**	**0.3**	**0.5**	**0.8**	**0.5**	**0.0**	**34.0**

4.5 2017 Data

Table 4.5 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Garrow, 2017)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.2	0.0	0.0	0.3	0.3	5.0
20	0.7	0.0	0.0	0.0	0.0	0.0	1.3	0.2	0.0	0.0	1.5	1.2	4.8
30	0.3	0.5	0.0	0.0	0.5	0.0	2.3	0.0	0.0	0.0	0.2	0.3	4.2
40	0.0	0.3	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	2.2	3.3
50	0.2	3.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.7	4.2
60	0.0	1.2	1.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.2	2.8
70	0.0	1.0	1.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	2.8
80	0.0	0.7	1.2	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	2.3
90	0.0	5.5	1.2	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5
100	0.0	2.2	2.7	0.0	1.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	6.0
110	0.0	0.2	3.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
120	0.0	4.8	4.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.0	9.3
130	1.5	0.0	3.2	0.0	0.0	0.0	0.8	0.0	0.0	1.2	0.0	0.0	6.7
140	1.2	3.8	3.0	0.0	0.0	0.2	1.3	0.0	0.0	0.5	0.0	0.0	10.0
150	3.0	10.5	1.8	0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	18.3
160	7.0	10.5	0.5	0.0	0.0	0.0	0.7	0.2	0.0	0.5	0.0	1.2	20.5
170	4.7	6.0	0.8	0.8	0.0	2.0	0.0	1.8	0.0	1.8	0.0	1.0	19.0
180	2.2	2.5	1.5	5.3	0.0	3.2	0.5	1.3	0.0	1.8	0.0	0.8	19.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
190	0.0	2.5	5.5	3.3	0.0	3.0	1.3	0.8	0.0	0.8	2.2	0.7	20.2
200	0.3	0.5	2.7	0.2	0.0	0.2	0.2	0.0	0.0	4.7	4.8	1.8	15.3
210	6.8	1.7	2.0	0.0	0.0	0.3	1.0	0.0	0.0	5.8	11.8	3.8	33.3
220	4.0	1.8	2.3	0.0	0.0	0.3	0.2	0.0	0.0	2.8	0.7	1.8	14.0
230	2.0	1.2	0.7	0.0	0.0	0.0	0.5	0.2	0.0	0.3	1.3	1.5	7.7
240	4.0	1.0	0.5	0.0	0.0	0.2	0.2	0.3	0.0	0.2	1.0	5.5	12.8
250	0.8	0.5	0.2	0.0	0.0	0.2	0.2	0.3	0.0	0.0	0.3	3.7	6.2
260	0.5	0.2	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	1.8	3.0
270	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.8
280	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.5	1.0
290	1.2	1.2	0.0	0.0	0.0	0.2	0.8	0.3	0.0	0.0	0.0	0.8	4.5
300	1.3	0.2	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.2	4.2	9.0
310	0.5	0.2	0.5	1.2	0.0	0.2	1.7	0.0	0.0	0.0	0.2	2.7	7.0
320	1.2	0.3	1.5	0.2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	4.7
330	2.2	0.5	0.3	0.2	0.0	0.0	0.3	0.0	0.0	0.8	0.0	1.8	6.2
340	0.2	0.3	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.2	0.3	1.7	4.3
350	0.0	0.3	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.5	3.2	1.3	6.0
360	0.5	0.0	0.0	0.0	0.0	0.0	0.8	3.8	0.0	0.2	0.8	0.8	7.0
Blocked (yellow) hrs/month	2.8	1.2	0.3	0.2	0.0	0.0	4.7	7.0	0.0	1.7	4.7	6.0	28.5

4.6 2018 Data

Table 4.6 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Garrow, 2018)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.2	0.2	3.0	1.2	1.0	0.7	6.7	0.7	0.0	3.5	0.0	0.0	17.0
20	0.2	0.0	7.8	1.0	0.2	3.2	2.0	0.0	0.0	5.7	0.0	0.0	20.0
30	0.2	0.0	0.3	2.8	0.2	2.2	0.0	0.0	0.0	3.0	0.0	0.0	8.7
40	0.5	0.7	0.5	2.5	1.2	0.5	0.0	0.0	0.0	0.2	0.0	0.0	6.0
50	0.5	0.2	1.8	1.8	0.0	1.5	0.0	0.0	0.0	0.5	0.0	0.0	6.3
60	0.8	0.2	1.2	2.2	0.3	2.8	0.0	0.0	0.0	1.5	0.0	0.0	9.0
70	0.7	0.0	2.0	6.3	0.8	1.2	0.0	0.0	0.0	1.2	0.2	0.0	12.3
80	0.7	0.2	2.7	3.5	0.0	1.0	0.0	0.0	0.0	1.0	0.3	0.0	9.3
90	1.0	0.3	2.3	1.7	0.0	0.3	0.0	0.2	0.0	0.0	0.2	0.0	6.0
100	0.5	0.3	2.5	0.2	0.0	0.7	0.0	0.0	0.0	0.0	0.5	0.0	4.7
110	0.3	0.3	1.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.3	0.0	2.5
120	1.0	0.7	2.8	0.5	0.0	0.0	0.0	0.2	0.0	0.0	0.7	0.0	5.8

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
130	1.3	1.0	4.3	2.2	0.0	0.2	0.0	0.0	0.0	0.0	1.3	0.0	10.3
140	0.8	0.7	6.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.2	11.7
150	2.3	0.2	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.3	8.5
160	4.8	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	3.8	1.7	10.7
170	4.7	0.0	0.5	0.2	0.3	0.0	0.0	0.0	0.0	0.3	2.2	2.0	10.2
180	3.7	0.2	0.5	0.3	0.3	0.0	0.0	0.0	0.0	0.5	6.8	3.8	16.2
190	2.2	6.8	1.7	0.8	0.0	0.0	0.2	0.0	0.0	0.2	2.7	2.2	16.7
200	5.5	11.5	0.8	0.2	0.0	0.0	0.0	1.5	0.0	0.8	3.0	3.2	26.5
210	3.2	7.7	0.7	1.0	0.2	0.0	0.3	0.7	0.0	0.0	4.8	4.8	23.3
220	3.2	0.2	0.7	0.0	0.0	0.0	0.2	0.8	0.0	0.0	0.5	4.5	10.0
230	1.5	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	2.0	4.0
240	1.2	0.2	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	3.7	5.5
250	0.7	0.0	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.0
260	0.7	0.0	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.7	3.7
270	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.3
280	0.3	0.0	0.2	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.0	1.8
290	0.0	0.2	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.5	1.0
300	1.2	1.7	0.3	0.0	0.0	0.2	0.0	2.0	0.0	0.0	0.0	3.2	8.5
310	2.0	1.3	0.2	0.0	0.0	0.7	0.0	0.7	0.7	0.0	0.0	0.5	6.0
320	0.2	0.7	0.3	0.8	0.2	3.8	0.0	1.2	0.2	0.0	0.0	1.8	9.2
330	0.2	0.7	0.2	0.0	0.0	0.5	1.0	0.3	0.7	0.0	0.0	0.2	3.7
340	0.0	0.8	0.2	1.2	0.2	0.3	0.3	0.3	0.5	0.0	0.0	0.0	3.8
350	0.5	1.0	1.5	1.5	0.5	0.0	2.0	0.2	0.0	0.3	0.0	0.0	7.5
360	0.0	0.7	0.3	0.5	0.5	0.0	4.0	0.7	0.0	1.0	0.0	0.0	7.7
Blocked (yellow) hrs/month	**0.8**	**3.3**	**5.2**	**4.3**	**2.2**	**1.5**	**14.0**	**2.2**	**1.2**	**4.8**	**0.0**	**0.2**	**39.7**

4.7 2019 Data

Table 4.7 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Garrow, 2019)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
10	0.0	0.5	0.0	0.0	0.3	5.5	0.2	0.0	0.0	0.0	6.5
20	0.0	2.8	0.0	0.0	0.3	2.7	0.0	0.0	0.0	0.0	5.8
30	0.0	0.0	0.0	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.8
40	0.0	0.7	0.0	2.7	2.8	0.0	0.0	0.0	0.0	0.0	6.2

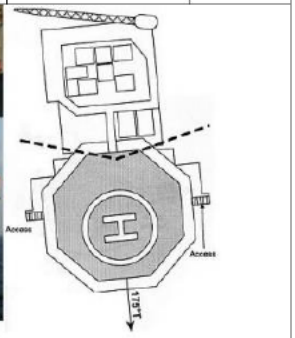
Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
50	0.0	0.5	0.0	0.5	1.3	0.0	0.0	0.0	0.2	1.8	4.3
60	0.0	0.3	0.0	0.3	1.2	0.0	0.0	0.0	0.0	1.3	3.2
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.5
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	1.7
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5
120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2
130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
140	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.0	1.0
150	0.0	1.2	0.0	0.2	0.0	0.3	0.0	0.2	0.3	0.0	2.2
160	0.0	1.3	0.0	0.0	0.0	0.0	0.3	0.0	0.8	0.0	2.5
170	0.0	0.3	0.8	0.3	0.0	0.0	0.2	0.0	1.5	0.0	3.2
180	0.0	0.5	0.7	0.0	0.0	0.3	0.0	0.0	3.3	0.0	4.8
190	0.0	2.5	2.3	0.0	0.0	0.5	0.0	0.2	2.5	0.0	8.0
200	2.3	4.0	0.8	0.0	0.7	0.2	1.5	2.5	1.8	0.0	13.8
210	5.2	6.3	2.8	0.0	0.7	0.2	0.0	3.5	0.8	0.0	19.5
220	0.3	1.8	1.2	0.0	0.0	0.5	1.5	0.3	0.8	0.0	6.5
230	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.7
240	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
250	0.7	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.3	0.0	1.5
260	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.3
270	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
280	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3
290	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2
300	0.5	0.0	0.5	0.0	0.0	1.2	0.0	0.0	0.2	0.0	2.3
310	0.3	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	1.0
320	0.2	0.2	0.7	0.2	2.0	0.3	0.2	0.2	0.3	0.0	4.2
330	1.0	0.2	0.5	1.8	2.8	0.0	3.0	2.2	0.2	0.0	11.7
340	1.8	0.8	0.0	2.7	2.3	0.5	1.7	0.0	0.8	0.0	10.7
350	2.8	1.8	0.0	0.3	1.8	2.0	0.2	0.0	0.5	0.0	9.5
360	0.3	0.8	0.0	0.3	0.7	4.0	0.3	0.0	0.3	0.0	6.8
Blocked (yellow) hrs/month	**6.0**	**4.2**	**0.5**	**5.2**	**8.0**	**12.0**	**5.3**	**2.2**	**1.8**	**0.0**	**45.2**

5 Kilmar

31. The Kilmar platform is a NUI approved for daylight operations only with a wind speed of 30 kt or less. Figure 3.1 presents the helideck information plate for the Kilmar platform.

HCA — HELIDECK INFORMATION PLATE

HELIDECK Elev 102 ft	VAR 0	POSITION N54 17.4 E001 20.1	EGKI **Kilmar**	
HEIGHT OF INSTALLATION: 121 HIGHEST OBSTACLE WITHIN 5NM: Check		VHF 120.075	NDB -	Issue Date 30 Jan 2020
FUELLING INSTALLATION: No STARTING EQUIPMENT: No		Operating Company Pereneo		Issued By Helideck Certification Agency
Norway 1.25D - 'D' = 16.02 HELIDECK D value: 16.02 P/R/H Category: F Max Weight: 5.3				



Wind (T°)	Kts	Limitation /Comment
	30>	NUI • No helicopter operations • Table 1(T) if overflight of 5:1 items unavoidable • Daylight operations only - Aiming circle & "H" lights not fitted
		Non Compliance
	5:1	East and west access and platform structure inboard from access points infringe sector
	Misc	No automatic fire-fighting facilities Friction test not completed Cleared for AW 139 (6.8t)

Figure 5.1 Kilmar Helideck Information Plate (Source: HCA)

32. The Kilmar platform is located 12.9 km (7.0 nm) from the Hornsea Four array area. The Hornsea Four array obstructs an approach arc from 350° to 060°. However, if an approach can be made up to 30° out of wind, then this arc reduces to 020° to 030°.

5.1 2013 Data

Table 5.1 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Kilmar, 2013)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.3	0.5	1.8	1.3	0.2	0.7	0.0	2.5	0.2	0.7	0.0	8.2
20	0.0	0.2	0.5	3.3	0.0	1.2	1.0	0.3	2.7	1.2	1.8	0.0	12.2
30	0.0	0.2	0.5	0.3	0.0	0.8	1.0	0.2	1.3	3.0	0.5	0.0	7.8

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
40	0.2	0.2	0.0	0.3	0.0	1.8	6.2	0.0	0.2	3.5	0.5	0.0	12.8
50	0.2	2.0	1.7	0.0	0.0	0.5	3.5	0.0	0.0	5.5	0.3	0.0	13.7
60	0.7	6.0	3.3	0.0	0.0	0.8	3.8	0.0	0.0	0.5	0.2	0.0	15.3
70	0.3	3.2	0.8	0.3	0.0	1.3	2.5	0.0	0.0	0.0	0.0	0.0	8.5
80	0.3	0.0	0.0	0.7	0.0	0.0	1.5	0.5	0.0	0.3	0.0	0.0	3.3
90	1.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.3
100	2.5	0.0	1.0	1.5	0.0	0.0	0.2	0.0	0.0	1.0	0.0	0.0	6.2
110	0.3	0.2	9.0	3.5	0.5	0.0	0.0	0.0	0.0	2.0	0.0	0.0	15.5
120	0.8	1.0	11.3	0.5	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	14.7
130	9.3	0.7	2.3	1.0	0.5	0.0	0.0	0.2	0.0	1.0	0.0	0.0	15.0
140	4.5	2.2	0.8	3.5	2.3	0.0	0.0	1.0	0.0	1.3	0.0	0.0	15.7
150	0.2	0.0	1.5	0.3	1.3	0.0	0.2	0.0	0.0	2.3	0.0	1.3	7.2
160	0.8	3.8	1.5	0.0	0.0	0.0	0.2	0.0	2.7	1.7	1.2	0.7	12.5
170	0.0	2.8	2.0	0.0	0.7	0.0	0.3	0.0	1.5	0.2	0.7	0.3	8.5
180	0.0	1.8	4.2	0.2	0.2	0.0	0.0	0.0	0.0	0.5	0.2	0.8	7.8
190	0.0	0.3	1.2	1.3	0.5	0.0	0.3	0.0	0.0	0.8	0.2	2.2	6.8
200	0.2	3.0	0.7	2.3	1.0	0.7	1.2	0.0	0.0	0.3	0.5	1.5	11.3
210	2.3	0.3	2.0	1.3	0.5	1.7	0.3	0.0	0.2	0.5	0.0	2.3	11.5
220	5.8	0.0	1.8	1.5	0.5	1.7	0.0	2.3	1.2	1.0	3.5	15.5	34.8
230	4.8	0.0	1.8	1.2	0.0	1.2	0.0	0.2	0.5	0.8	5.7	14.3	30.5
240	0.7	0.0	0.5	0.2	0.2	1.2	0.0	0.0	0.0	0.8	2.8	0.2	6.5
250	1.8	0.5	0.2	0.0	0.5	0.5	0.0	0.0	0.3	0.5	1.2	0.5	6.0
260	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.3	1.2	3.7	0.3	6.7
270	0.5	0.2	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.5	7.0	0.7	9.3
280	0.3	2.7	0.0	0.0	0.3	1.0	0.0	1.0	0.0	0.3	4.0	0.5	10.2
290	0.0	0.5	0.0	0.0	5.5	1.2	0.0	0.3	0.5	0.0	0.8	0.0	8.8
300	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.3	0.2	0.2	0.8	0.2	2.7
310	0.0	0.2	0.2	0.2	0.3	0.3	0.0	0.7	0.2	0.2	0.2	0.0	2.3
320	0.0	0.0	0.0	2.2	0.0	0.3	0.5	0.0	0.7	0.8	1.3	0.2	6.0
330	0.3	0.8	0.0	1.5	0.0	0.2	1.0	0.0	0.5	0.3	1.8	1.2	7.7
340	0.0	0.7	0.0	0.5	0.7	0.3	1.8	0.0	1.8	0.7	2.8	0.2	9.5
350	0.7	0.8	0.0	1.0	1.8	0.0	1.3	0.0	2.2	0.3	0.7	0.0	8.8
360	0.0	1.0	0.2	0.7	1.0	0.3	1.5	0.0	1.3	0.3	0.5	0.0	6.8
Blocked (yellow) hrs/month	**0.0**	**0.3**	**1.0**	**3.7**	**0.0**	**2.0**	**2.0**	**0.5**	**4.0**	**4.2**	**2.3**	**0.0**	**20.0**

5.2 2014 Data

Table 5.2 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Kilmar, 2014)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.5	0.3	0.0	0.7	1.0	0.0	0.7	0.5	0.0	0.0	3.7
20	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.3	0.2	0.0	1.2
30	0.0	0.0	0.3	0.7	1.7	0.5	0.0	0.0	2.0	1.5	0.2	0.0	6.8
40	0.0	0.0	1.0	0.0	0.7	0.3	0.2	0.0	5.0	2.0	0.2	0.0	9.3
50	0.0	0.0	2.2	0.0	0.5	0.7	0.2	0.0	6.3	6.7	2.8	0.0	19.3
60	0.0	0.0	1.2	0.0	0.7	4.2	0.0	0.0	0.5	2.2	2.7	0.0	11.3
70	0.0	0.0	0.2	0.5	0.7	0.0	0.0	0.0	0.2	0.5	3.0	0.0	5.0
80	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	1.3
90	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
100	0.0	0.0	0.3	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
110	0.2	0.2	9.5	0.7	3.0	0.0	0.0	0.0	0.2	0.2	0.0	0.2	14.0
120	0.0	1.0	15.7	2.7	0.7	0.2	0.0	0.8	5.0	0.2	0.8	1.0	28.0
130	1.7	1.2	3.2	3.3	0.8	0.3	0.0	0.5	2.5	0.0	6.3	1.2	21.0
140	7.7	1.3	1.0	1.7	0.8	0.2	0.0	2.3	1.2	0.0	22.8	1.3	40.3
150	1.8	2.0	0.2	0.2	0.0	0.5	0.2	0.0	0.7	1.0	5.5	2.0	14.0
160	1.7	2.0	0.2	0.0	0.0	0.2	0.2	0.0	0.8	1.3	2.7	2.0	11.0
170	2.5	4.5	0.7	0.7	0.0	0.2	0.0	0.0	0.3	0.7	2.8	4.5	16.8
180	12.8	2.0	0.5	0.0	0.0	0.3	0.0	0.2	0.2	0.3	1.7	2.0	20.0
190	10.0	4.3	1.8	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5	4.3	21.3
200	7.0	3.3	2.0	0.2	0.2	0.5	0.2	0.0	0.0	0.0	0.3	3.3	17.0
210	4.2	0.2	3.7	1.5	0.2	0.0	0.5	0.0	0.0	3.3	1.5	0.2	15.2
220	3.5	0.5	8.0	1.7	1.0	0.2	0.3	0.3	0.0	5.2	6.5	0.5	27.7
230	4.7	1.5	2.3	0.7	1.7	0.0	0.3	1.2	0.0	1.5	4.2	1.5	19.5
240	3.2	1.0	2.3	0.2	1.5	0.2	0.2	0.8	0.0	1.0	1.7	1.0	13.0
250	1.2	0.0	0.5	0.5	1.8	0.2	0.5	0.7	0.0	0.3	2.0	0.0	7.7
260	0.5	0.0	0.3	0.0	0.0	0.3	0.5	0.2	2.2	0.0	0.3	0.0	4.3
270	1.3	0.0	0.2	0.0	0.2	0.0	0.0	0.0	3.5	0.0	0.3	0.0	5.5
280	0.5	0.8	0.2	0.0	0.3	0.0	0.2	0.3	1.3	0.7	0.7	0.8	5.8
290	0.5	0.0	0.2	0.0	1.3	0.0	0.5	0.0	0.0	0.2	0.2	0.0	2.8
300	0.3	0.0	0.0	0.0	0.7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.3
310	0.2	0.0	0.0	0.0	0.2	0.0	0.3	0.2	0.2	0.3	0.0	0.0	1.3
320	0.8	1.7	0.2	0.2	0.5	0.5	0.8	0.8	2.2	0.7	0.2	1.7	10.2
330	0.5	0.2	0.3	0.0	0.3	0.2	0.0	0.2	1.3	0.5	0.3	0.2	4.0
340	0.5	0.0	0.2	0.0	0.2	1.0	6.5	0.0	2.0	1.5	0.5	0.0	12.3
350	0.0	0.0	0.2	0.0	0.0	2.8	7.7	0.2	1.0	1.3	0.8	0.0	14.0
360	0.2	0.0	0.0	0.0	0.2	2.0	3.5	0.2	1.3	0.2	0.5	0.0	8.0

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
Blocked (yellow) hrs/month	0.0	0.0	0.3	1.0	1.7	0.5	0.0	0.0	2.3	1.8	0.3	0.0	8.0

5.3 2015 Data

Table 5.3 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Kilmar, 2015)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.7	4.5	1.0	0.0	0.0	1.8	0.0	0.2	0.0	0.3	1.8	10.3
20	0.0	0.5	2.2	0.5	0.0	0.2	1.3	0.0	0.0	0.0	0.0	0.0	4.7
30	0.0	1.0	1.7	0.8	0.0	0.5	1.7	0.0	0.0	1.0	0.0	0.0	6.7
40	0.0	0.5	1.2	1.0	0.0	0.2	0.3	0.0	0.2	0.5	0.0	0.0	3.8
50	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.0	0.2	1.3	0.0	0.0	2.3
60	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.0	0.0	1.3
70	0.0	0.0	0.5	0.2	0.0	0.2	0.0	0.2	0.5	0.0	0.0	0.0	1.5
80	0.0	0.5	0.8	0.0	0.0	0.3	0.0	0.0	0.2	0.2	0.0	0.0	2.0
90	0.0	1.0	1.2	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	2.7
100	0.0	0.8	1.8	0.0	0.0	0.2	0.0	0.5	0.0	0.2	0.0	0.0	3.5
110	0.0	5.2	2.8	0.0	0.5	0.3	0.7	0.2	0.2	0.0	0.0	0.0	9.8
120	0.0	1.5	1.5	2.2	1.5	1.5	0.0	0.2	0.0	0.7	0.0	0.0	9.0
130	0.0	0.0	0.8	0.7	0.3	0.0	0.0	0.5	0.0	1.2	0.2	0.0	3.7
140	0.0	1.0	0.7	1.0	0.7	0.0	0.2	0.3	0.3	2.2	1.0	3.2	10.5
150	0.0	0.5	0.7	0.8	0.5	0.0	0.7	0.0	0.3	0.0	0.0	3.2	6.7
160	0.0	1.5	0.2	0.3	0.5	0.0	0.7	0.5	0.0	1.5	1.5	2.2	8.8
170	0.0	1.7	0.0	0.0	0.5	0.0	0.0	0.8	0.2	0.8	2.8	5.2	12.0
180	0.0	0.8	0.2	0.8	0.3	0.5	0.0	1.2	0.0	3.8	5.2	3.0	15.8
190	0.0	0.5	0.3	0.8	0.2	0.3	0.0	1.3	0.0	1.2	3.8	4.0	12.5
200	0.0	3.0	0.0	2.3	0.5	1.5	0.2	1.3	0.0	0.5	3.2	3.5	16.0
210	0.0	3.8	0.2	1.0	0.2	0.7	0.3	1.2	0.0	1.7	1.8	4.2	15.0
220	5.2	11.7	4.0	5.8	0.8	0.2	0.0	1.8	0.0	3.3	4.0	14.7	51.5
230	8.7	4.8	1.5	0.5	0.0	0.0	0.3	0.0	1.2	2.8	13.0	6.7	39.5
240	2.8	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.3	0.8	10.2
250	4.2	0.0	0.2	0.2	0.0	0.8	1.0	0.2	0.2	0.7	2.2	2.2	11.7
260	0.7	0.7	1.0	0.5	0.0	0.8	0.5	1.7	0.0	0.0	1.5	2.0	9.3
270	0.2	0.0	0.8	0.3	0.0	0.8	0.2	0.5	0.0	0.0	1.5	0.7	5.0
280	0.3	0.0	0.2	0.2	0.0	0.7	0.3	0.2	0.7	1.5	1.8	0.2	6.0
290	0.2	0.0	0.0	0.2	0.0	0.3	0.2	0.0	0.5	4.0	0.5	0.8	6.7
300	0.3	0.2	0.0	0.0	0.0	0.0	0.5	0.3	1.0	2.8	0.2	0.2	5.5

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
310	2.0	1.2	0.7	0.5	0.0	0.2	0.0	4.0	2.2	0.8	1.5	0.3	13.3
320	1.3	0.7	2.3	0.2	0.0	0.0	0.0	10.7	3.8	0.0	3.0	0.2	22.2
330	0.2	0.2	1.3	0.3	0.0	0.0	2.8	0.0	1.2	0.0	0.7	0.0	6.7
340	0.0	0.5	2.0	0.0	0.0	0.0	0.8	0.0	2.3	0.0	0.2	0.2	6.0
350	0.0	1.3	1.2	0.5	0.0	0.0	1.8	0.0	1.2	0.0	0.5	0.2	6.7
360	0.0	0.2	5.3	0.7	0.0	0.0	1.0	0.0	0.3	0.0	0.5	0.8	8.8
Blocked (yellow) hrs/month	**0.0**	**1.5**	**3.8**	**1.3**	**0.0**	**0.7**	**3.0**	**0.0**	**0.0**	**1.0**	**0.0**	**0.0**	**11.3**

5.4 2016 Data

Table 5.4 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Kilmar, 2016)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.2	0.8	0.0	2.2	1.2	0.0	0.2	0.2	0.3	0.2	0.0	5.2
20	0.2	0.0	1.0	0.0	7.0	5.2	0.0	0.0	0.5	0.3	0.5	0.0	14.7
30	0.0	0.0	1.8	0.2	2.5	6.0	0.0	0.0	0.3	0.3	0.0	0.0	11.2
40	0.0	0.0	2.2	0.3	0.2	4.8	0.0	0.0	1.5	0.2	0.0	0.0	9.2
50	0.2	0.0	1.8	0.3	0.0	1.5	0.0	0.0	1.0	0.0	0.2	0.0	5.0
60	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.8	0.0	0.3	0.0	2.0
70	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.2	0.3	0.0	0.8
80	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.8	0.2	0.2	0.0	2.0
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.3	0.0	1.2
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0
110	0.0	0.0	0.0	0.7	0.0	5.0	0.0	0.0	3.0	0.0	0.0	0.0	8.7
120	2.8	0.0	0.0	0.7	0.0	0.3	0.0	0.0	2.3	0.0	0.0	0.0	6.2
130	31.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	35.0
140	14.0	1.3	1.2	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.2	18.2
150	3.7	0.3	1.7	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	1.2	7.2
160	0.5	0.0	9.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
170	1.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	3.5	0.2	0.0	0.0	9.7
180	0.0	0.0	4.5	0.3	0.8	0.3	0.0	0.0	0.2	0.3	0.0	2.0	8.5
190	0.0	0.0	5.3	0.3	0.7	2.2	0.0	0.0	0.2	0.3	0.0	1.2	10.2
200	1.8	0.0	2.8	0.7	0.7	1.8	0.8	0.0	0.3	0.3	0.0	1.2	10.5
210	0.7	0.3	2.5	0.8	0.2	2.8	2.8	0.0	2.3	0.3	0.2	4.5	17.5
220	8.2	6.3	6.7	0.8	0.0	0.8	0.0	0.3	0.3	0.8	0.5	2.0	26.8
230	3.5	6.0	1.7	0.0	0.0	0.0	0.2	0.0	0.2	0.8	0.0	0.5	12.8
240	0.2	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.2	0.2	6.7

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
250	0.3	2.2	1.7	1.7	0.0	0.3	0.0	0.0	0.2	0.2	0.2	0.0	6.7
260	0.0	0.7	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	2.3
270	0.8	1.7	0.7	0.3	0.0	1.3	0.0	0.0	0.2	0.2	0.0	0.5	5.7
280	4.7	2.5	0.5	0.0	0.0	0.8	0.2	0.0	0.0	0.3	0.0	0.5	9.5
290	1.5	1.0	0.0	0.7	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	3.8
300	0.5	0.7	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	2.3
310	0.8	1.3	0.0	0.0	0.0	0.8	0.0	0.0	0.3	0.8	0.5	0.0	4.7
320	0.2	0.8	0.5	0.2	0.0	0.2	0.0	0.0	0.2	0.7	1.0	0.0	3.7
330	0.2	0.8	1.5	0.2	0.0	0.3	0.0	0.0	0.2	0.3	0.0	0.0	3.5
340	1.2	1.0	2.2	0.5	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	6.2
350	3.0	0.0	4.3	2.5	0.0	1.2	0.0	0.2	0.0	0.0	0.0	0.0	11.2
360	0.7	0.5	3.5	1.7	0.0	1.2	0.0	0.0	0.2	0.0	0.3	0.0	8.0
Blocked (yellow) hrs/month	**0.2**	**0.0**	**2.8**	**0.2**	**9.5**	**11.2**	**0.0**	**0.0**	**0.8**	**0.7**	**0.5**	**0.0**	**25.8**

5.5 2017 Data

Table 5.5 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Kilmar, 2017)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.2	0.0	0.0	0.3	0.3	5.0
20	0.7	0.0	0.0	0.0	0.0	0.0	1.3	0.2	0.0	0.0	1.5	1.2	4.8
30	0.3	0.5	0.0	0.0	0.5	0.0	2.3	0.0	0.0	0.0	0.2	0.3	4.2
40	0.0	0.3	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	2.2	3.3
50	0.2	3.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.7	4.2
60	0.0	1.2	1.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.2	2.8
70	0.0	1.0	1.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	2.8
80	0.0	0.7	1.2	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	2.3
90	0.0	5.5	1.2	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5
100	0.0	2.2	2.7	0.0	1.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	6.0
110	0.0	0.2	3.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
120	0.0	4.8	4.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.0	9.3
130	1.5	0.0	3.2	0.0	0.0	0.0	0.8	0.0	0.0	1.2	0.0	0.0	6.7
140	1.2	3.8	3.0	0.0	0.0	0.2	1.3	0.0	0.0	0.5	0.0	0.0	10.0
150	3.0	10.5	1.8	0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	18.3
160	7.0	10.5	0.5	0.0	0.0	0.0	0.7	0.2	0.0	0.5	0.0	1.2	20.5
170	4.7	6.0	0.8	0.8	0.0	2.0	0.0	1.8	0.0	1.8	0.0	1.0	19.0
180	2.2	2.5	1.5	5.3	0.0	3.2	0.5	1.3	0.0	1.8	0.0	0.8	19.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
190	0.0	2.5	5.5	3.3	0.0	3.0	1.3	0.8	0.0	0.8	2.2	0.7	20.2
200	0.3	0.5	2.7	0.2	0.0	0.2	0.2	0.0	0.0	4.7	4.8	1.8	15.3
210	6.8	1.7	2.0	0.0	0.0	0.3	1.0	0.0	0.0	5.8	11.8	3.8	33.3
220	4.0	1.8	2.3	0.0	0.0	0.3	0.2	0.0	0.0	2.8	0.7	1.8	14.0
230	2.0	1.2	0.7	0.0	0.0	0.0	0.5	0.2	0.0	0.3	1.3	1.5	7.7
240	4.0	1.0	0.5	0.0	0.0	0.2	0.2	0.3	0.0	0.2	1.0	5.5	12.8
250	0.8	0.5	0.2	0.0	0.0	0.2	0.2	0.3	0.0	0.0	0.3	3.7	6.2
260	0.5	0.2	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	1.8	3.0
270	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.8
280	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.5	1.0
290	1.2	1.2	0.0	0.0	0.0	0.2	0.8	0.3	0.0	0.0	0.0	0.8	4.5
300	1.3	0.2	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.2	4.2	9.0
310	0.5	0.2	0.5	1.2	0.0	0.2	1.7	0.0	0.0	0.0	0.2	2.7	7.0
320	1.2	0.3	1.5	0.2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	4.7
330	2.2	0.5	0.3	0.2	0.0	0.0	0.3	0.0	0.0	0.8	0.0	1.8	6.2
340	0.2	0.3	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.2	0.3	1.7	4.3
350	0.0	0.3	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.5	3.2	1.3	6.0
360	0.5	0.0	0.0	0.0	0.0	0.0	0.8	3.8	0.0	0.2	0.8	0.8	7.0
Blocked (yellow) hrs/month	**1.0**	**0.5**	**0.0**	**0.0**	**0.5**	**0.0**	**3.7**	**0.2**	**0.0**	**0.0**	**1.7**	**1.5**	**9.0**

5.6 2018 Data

Table 5.6 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Kilmar, 2018)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.2	0.2	3.0	1.2	1.0	0.7	6.7	0.7	0.0	3.5	0.0	0.0	17.0
20	0.2	0.0	7.8	1.0	0.2	3.2	2.0	0.0	0.0	5.7	0.0	0.0	20.0
30	0.2	0.0	0.3	2.8	0.2	2.2	0.0	0.0	0.0	3.0	0.0	0.0	8.7
40	0.5	0.7	0.5	2.5	1.2	0.5	0.0	0.0	0.0	0.2	0.0	0.0	6.0
50	0.5	0.2	1.8	1.8	0.0	1.5	0.0	0.0	0.0	0.5	0.0	0.0	6.3
60	0.8	0.2	1.2	2.2	0.3	2.8	0.0	0.0	0.0	1.5	0.0	0.0	9.0
70	0.7	0.0	2.0	6.3	0.8	1.2	0.0	0.0	0.0	1.2	0.2	0.0	12.3
80	0.7	0.2	2.7	3.5	0.0	1.0	0.0	0.0	0.0	1.0	0.3	0.0	9.3
90	1.0	0.3	2.3	1.7	0.0	0.3	0.0	0.2	0.0	0.0	0.2	0.0	6.0
100	0.5	0.3	2.5	0.2	0.0	0.7	0.0	0.0	0.0	0.0	0.5	0.0	4.7
110	0.3	0.3	1.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.3	0.0	2.5
120	1.0	0.7	2.8	0.5	0.0	0.0	0.0	0.2	0.0	0.0	0.7	0.0	5.8

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
130	1.3	1.0	4.3	2.2	0.0	0.2	0.0	0.0	0.0	0.0	1.3	0.0	10.3
140	0.8	0.7	6.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.2	11.7
150	2.3	0.2	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.3	8.5
160	4.8	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	3.8	1.7	10.7
170	4.7	0.0	0.5	0.2	0.3	0.0	0.0	0.0	0.0	0.3	2.2	2.0	10.2
180	3.7	0.2	0.5	0.3	0.3	0.0	0.0	0.0	0.0	0.5	6.8	3.8	16.2
190	2.2	6.8	1.7	0.8	0.0	0.0	0.2	0.0	0.0	0.2	2.7	2.2	16.7
200	5.5	11.5	0.8	0.2	0.0	0.0	0.0	1.5	0.0	0.8	3.0	3.2	26.5
210	3.2	7.7	0.7	1.0	0.2	0.0	0.3	0.7	0.0	0.0	4.8	4.8	23.3
220	3.2	0.2	0.7	0.0	0.0	0.0	0.2	0.8	0.0	0.0	0.5	4.5	10.0
230	1.5	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	2.0	4.0
240	1.2	0.2	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	3.7	5.5
250	0.7	0.0	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.0
260	0.7	0.0	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.7	3.7
270	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.3
280	0.3	0.0	0.2	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.0	1.8
290	0.0	0.2	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.5	1.0
300	1.2	1.7	0.3	0.0	0.0	0.2	0.0	2.0	0.0	0.0	0.0	3.2	8.5
310	2.0	1.3	0.2	0.0	0.0	0.7	0.0	0.7	0.7	0.0	0.0	0.5	6.0
320	0.2	0.7	0.3	0.8	0.2	3.8	0.0	1.2	0.2	0.0	0.0	1.8	9.2
330	0.2	0.7	0.2	0.0	0.0	0.5	1.0	0.3	0.7	0.0	0.0	0.2	3.7
340	0.0	0.8	0.2	1.2	0.2	0.3	0.3	0.3	0.5	0.0	0.0	0.0	3.8
350	0.5	1.0	1.5	1.5	0.5	0.0	2.0	0.2	0.0	0.3	0.0	0.0	7.5
360	0.0	0.7	0.3	0.5	0.5	0.0	4.0	0.7	0.0	1.0	0.0	0.0	7.7
Blocked (yellow) hrs/month	**0.3**	**0.0**	**8.2**	**3.8**	**0.3**	**5.3**	**2.0**	**0.0**	**0.0**	**8.7**	**0.0**	**0.0**	**28.7**

5.7 2019 Data

Table 5.7 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Kilmar, 2013)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
10	0.0	0.5	0.0	0.0	0.3	5.5	0.2	0.0	0.0	0.0	6.5
20	0.0	2.8	0.0	0.0	0.3	2.7	0.0	0.0	0.0	0.0	5.8
30	0.0	0.0	0.0	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.8

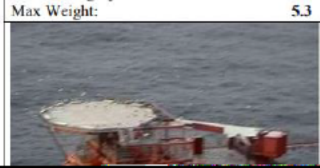
Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.5
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	1.7
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5
120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2
130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
140	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.0	1.0
150	0.0	1.2	0.0	0.2	0.0	0.3	0.0	0.2	0.3	0.0	2.2
160	0.0	1.3	0.0	0.0	0.0	0.0	0.3	0.0	0.8	0.0	2.5
170	0.0	0.3	0.8	0.3	0.0	0.0	0.2	0.0	1.5	0.0	3.2
180	0.0	0.5	0.7	0.0	0.0	0.3	0.0	0.0	3.3	0.0	4.8
190	0.0	2.5	2.3	0.0	0.0	0.5	0.0	0.2	2.5	0.0	8.0
200	2.3	4.0	0.8	0.0	0.7	0.2	1.5	2.5	1.8	0.0	13.8
210	5.2	6.3	2.8	0.0	0.7	0.2	0.0	3.5	0.8	0.0	19.5
220	0.3	1.8	1.2	0.0	0.0	0.5	1.5	0.3	0.8	0.0	6.5
230	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.7
240	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
250	0.7	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.3	0.0	1.5
260	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.3
270	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
280	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3
290	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2
300	0.5	0.0	0.5	0.0	0.0	1.2	0.0	0.0	0.2	0.0	2.3
310	0.3	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	1.0
320	0.2	0.2	0.7	0.2	2.0	0.3	0.2	0.2	0.3	0.0	4.2
330	1.0	0.2	0.5	1.8	2.8	0.0	3.0	2.2	0.2	0.0	11.7
340	1.8	0.8	0.0	2.7	2.3	0.5	1.7	0.0	0.8	0.0	10.7
350	2.8	1.8	0.0	0.3	1.8	2.0	0.2	0.0	0.5	0.0	9.5
360	0.3	0.8	0.0	0.3	0.7	4.0	0.3	0.0	0.3	0.0	6.8
Blocked (yellow) hrs/month	**0.0**	**2.8**	**0.0**	**0.2**	**1.0**	**2.7**	**0.0**	**0.0**	**0.0**	**0.0**	**6.7**

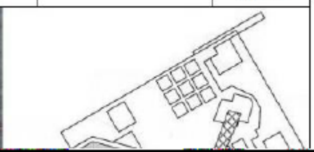
6 Ravenspurn North ST2

33. The Ravenspurn North ST2 platform is a NUI approved for daylight operations only, with a wind speed below 30 kt. Figure 6.1 presents the helideck information plate for the Ravenspurn North ST2 platform.

HELIDECK INFORMATION PLATE

HELIDECK Elev 123 ft	VAR Check	POSITION N54 03.2 E001 02.0	Ravenspurn North ST2		
HEIGHT OF INSTALLATION: 123 HIGHEST OBSTACLE WITHIN 5NM: Check			VHF 129.875	NDB Nil	Issue Date 07 Feb 2020
FUELLING INSTALLATION: No STARTING EQUIPMENT: No			Operating Company Perenco		Issued By Helideck Certification Agency
HELIDECK D value: 15 P/R/H Category: F Max Weight: 5.3					





Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
30	0.0	0.2	0.5	0.3	0.0	0.8	1.0	0.2	1.3	3.0	0.5	0.0	7.8
40	0.2	0.2	0.0	0.3	0.0	1.8	6.2	0.0	0.2	3.5	0.5	0.0	12.8
50	0.2	2.0	1.7	0.0	0.0	0.5	3.5	0.0	0.0	5.5	0.3	0.0	13.7
60	0.7	6.0	3.3	0.0	0.0	0.8	3.8	0.0	0.0	0.5	0.2	0.0	15.3
70	0.3	3.2	0.8	0.3	0.0	1.3	2.5	0.0	0.0	0.0	0.0	0.0	8.5
80	0.3	0.0	0.0	0.7	0.0	0.0	1.5	0.5	0.0	0.3	0.0	0.0	3.3
90	1.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.3
100	2.5	0.0	1.0	1.5	0.0	0.0	0.2	0.0	0.0	1.0	0.0	0.0	6.2
110	0.3	0.2	9.0	3.5	0.5	0.0	0.0	0.0	0.0	2.0	0.0	0.0	15.5
120	0.8	1.0	11.3	0.5	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	14.7
130	9.3	0.7	2.3	1.0	0.5	0.0	0.0	0.2	0.0	1.0	0.0	0.0	15.0
140	4.5	2.2	0.8	3.5	2.3	0.0	0.0	1.0	0.0	1.3	0.0	0.0	15.7
150	0.2	0.0	1.5	0.3	1.3	0.0	0.2	0.0	0.0	2.3	0.0	1.3	7.2
160	0.8	3.8	1.5	0.0	0.0	0.0	0.2	0.0	2.7	1.7	1.2	0.7	12.5
170	0.0	2.8	2.0	0.0	0.7	0.0	0.3	0.0	1.5	0.2	0.7	0.3	8.5
180	0.0	1.8	4.2	0.2	0.2	0.0	0.0	0.0	0.0	0.5	0.2	0.8	7.8
190	0.0	0.3	1.2	1.3	0.5	0.0	0.3	0.0	0.0	0.8	0.2	2.2	6.8
200	0.2	3.0	0.7	2.3	1.0	0.7	1.2	0.0	0.0	0.3	0.5	1.5	11.3
210	2.3	0.3	2.0	1.3	0.5	1.7	0.3	0.0	0.2	0.5	0.0	2.3	11.5
220	5.8	0.0	1.8	1.5	0.5	1.7	0.0	2.3	1.2	1.0	3.5	15.5	34.8
230	4.8	0.0	1.8	1.2	0.0	1.2	0.0	0.2	0.5	0.8	5.7	14.3	30.5
240	0.7	0.0	0.5	0.2	0.2	1.2	0.0	0.0	0.0	0.8	2.8	0.2	6.5
250	1.8	0.5	0.2	0.0	0.5	0.5	0.0	0.0	0.3	0.5	1.2	0.5	6.0
260	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.3	1.2	3.7	0.3	6.7
270	0.5	0.2	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.5	7.0	0.7	9.3
280	0.3	2.7	0.0	0.0	0.3	1.0	0.0	1.0	0.0	0.3	4.0	0.5	10.2
290	0.0	0.5	0.0	0.0	5.5	1.2	0.0	0.3	0.5	0.0	0.8	0.0	8.8
300	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.3	0.2	0.2	0.8	0.2	2.7
310	0.0	0.2	0.2	0.2	0.3	0.3	0.0	0.7	0.2	0.2	0.2	0.0	2.3
320	0.0	0.0	0.0	2.2	0.0	0.3	0.5	0.0	0.7	0.8	1.3	0.2	6.0
330	0.3	0.8	0.0	1.5	0.0	0.2	1.0	0.0	0.5	0.3	1.8	1.2	7.7
340	0.0	0.7	0.0	0.5	0.7	0.3	1.8	0.0	1.8	0.7	2.8	0.2	9.5
350	0.7	0.8	0.0	1.0	1.8	0.0	1.3	0.0	2.2	0.3	0.7	0.0	8.8
360	0.0	1.0	0.2	0.7	1.0	0.3	1.5	0.0	1.3	0.3	0.5	0.0	6.8
Blocked (yellow) hrs/month	**16.7**	**4.2**	**8.2**	**7.8**	**3.3**	**6.8**	**1.8**	**2.5**	**2.5**	**6.0**	**17.5**	**36.8**	**114.2**

6.2 2014 Data

Table 6.2 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North ST2, 2014)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.5	0.3	0.0	0.7	1.0	0.0	0.7	0.5	0.0	0.0	3.7
20	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.3	0.2	0.0	1.2
30	0.0	0.0	0.3	0.7	1.7	0.5	0.0	0.0	2.0	1.5	0.2	0.0	6.8
40	0.0	0.0	1.0	0.0	0.7	0.3	0.2	0.0	5.0	2.0	0.2	0.0	9.3
50	0.0	0.0	2.2	0.0	0.5	0.7	0.2	0.0	6.3	6.7	2.8	0.0	19.3
60	0.0	0.0	1.2	0.0	0.7	4.2	0.0	0.0	0.5	2.2	2.7	0.0	11.3
70	0.0	0.0	0.2	0.5	0.7	0.0	0.0	0.0	0.2	0.5	3.0	0.0	5.0
80	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	1.3
90	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
100	0.0	0.0	0.3	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
110	0.2	0.2	9.5	0.7	3.0	0.0	0.0	0.0	0.2	0.2	0.0	0.2	14.0
120	0.0	1.0	15.7	2.7	0.7	0.2	0.0	0.8	5.0	0.2	0.8	1.0	28.0
130	1.7	1.2	3.2	3.3	0.8	0.3	0.0	0.5	2.5	0.0	6.3	1.2	21.0
140	7.7	1.3	1.0	1.7	0.8	0.2	0.0	2.3	1.2	0.0	22.8	1.3	40.3
150	1.8	2.0	0.2	0.2	0.0	0.5	0.2	0.0	0.7	1.0	5.5	2.0	14.0
160	1.7	2.0	0.2	0.0	0.0	0.2	0.2	0.0	0.8	1.3	2.7	2.0	11.0
170	2.5	4.5	0.7	0.7	0.0	0.2	0.0	0.0	0.3	0.7	2.8	4.5	16.8
180	12.8	2.0	0.5	0.0	0.0	0.3	0.0	0.2	0.2	0.3	1.7	2.0	20.0
190	10.0	4.3	1.8	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5	4.3	21.3
200	7.0	3.3	2.0	0.2	0.2	0.5	0.2	0.0	0.0	0.0	0.3	3.3	17.0
210	4.2	0.2	3.7	1.5	0.2	0.0	0.5	0.0	0.0	3.3	1.5	0.2	15.2
220	3.5	0.5	8.0	1.7	1.0	0.2	0.3	0.3	0.0	5.2	6.5	0.5	27.7
230	4.7	1.5	2.3	0.7	1.7	0.0	0.3	1.2	0.0	1.5	4.2	1.5	19.5
240	3.2	1.0	2.3	0.2	1.5	0.2	0.2	0.8	0.0	1.0	1.7	1.0	13.0
250	1.2	0.0	0.5	0.5	1.8	0.2	0.5	0.7	0.0	0.3	2.0	0.0	7.7
260	0.5	0.0	0.3	0.0	0.0	0.3	0.5	0.2	2.2	0.0	0.3	0.0	4.3
270	1.3	0.0	0.2	0.0	0.2	0.0	0.0	0.0	3.5	0.0	0.3	0.0	5.5
280	0.5	0.8	0.2	0.0	0.3	0.0	0.2	0.3	1.3	0.7	0.7	0.8	5.8
290	0.5	0.0	0.2	0.0	1.3	0.0	0.5	0.0	0.0	0.2	0.2	0.0	2.8
300	0.3	0.0	0.0	0.0	0.7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.3
310	0.2	0.0	0.0	0.0	0.2	0.0	0.3	0.2	0.2	0.3	0.0	0.0	1.3
320	0.8	1.7	0.2	0.2	0.5	0.5	0.8	0.8	2.2	0.7	0.2	1.7	10.2
330	0.5	0.2	0.3	0.0	0.3	0.2	0.0	0.2	1.3	0.5	0.3	0.2	4.0
340	0.5	0.0	0.2	0.0	0.2	1.0	6.5	0.0	2.0	1.5	0.5	0.0	12.3
350	0.0	0.0	0.2	0.0	0.0	2.8	7.7	0.2	1.0	1.3	0.8	0.0	14.0
360	0.2	0.0	0.0	0.0	0.2	2.0	3.5	0.2	1.3	0.2	0.5	0.0	8.0

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
Blocked (yellow) hrs/month	34.2	10.8	21.0	4.7	6.3	1.3	2.5	3.2	2.5	11.3	17.0	10.8	125.7

6.3 2015 Data

Table 6.3 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North ST2, 2015)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.7	4.5	1.0	0.0	0.0	1.8	0.0	0.2	0.0	0.3	1.8	10.3
20	0.0	0.5	2.2	0.5	0.0	0.2	1.3	0.0	0.0	0.0	0.0	0.0	4.7
30	0.0	1.0	1.7	0.8	0.0	0.5	1.7	0.0	0.0	1.0	0.0	0.0	6.7
40	0.0	0.5	1.2	1.0	0.0	0.2	0.3	0.0	0.2	0.5	0.0	0.0	3.8
50	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.0	0.2	1.3	0.0	0.0	2.3
60	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.0	0.0	1.3
70	0.0	0.0	0.5	0.2	0.0	0.2	0.0	0.2	0.5	0.0	0.0	0.0	1.5
80	0.0	0.5	0.8	0.0	0.0	0.3	0.0	0.0	0.2	0.2	0.0	0.0	2.0
90	0.0	1.0	1.2	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	2.7
100	0.0	0.8	1.8	0.0	0.0	0.2	0.0	0.5	0.0	0.2	0.0	0.0	3.5
110	0.0	5.2	2.8	0.0	0.5	0.3	0.7	0.2	0.2	0.0	0.0	0.0	9.8
120	0.0	1.5	1.5	2.2	1.5	1.5	0.0	0.2	0.0	0.7	0.0	0.0	9.0
130	0.0	0.0	0.8	0.7	0.3	0.0	0.0	0.5	0.0	1.2	0.2	0.0	3.7
140	0.0	1.0	0.7	1.0	0.7	0.0	0.2	0.3	0.3	2.2	1.0	3.2	10.5
150	0.0	0.5	0.7	0.8	0.5	0.0	0.7	0.0	0.3	0.0	0.0	3.2	6.7
160	0.0	1.5	0.2	0.3	0.5	0.0	0.7	0.5	0.0	1.5	1.5	2.2	8.8
170	0.0	1.7	0.0	0.0	0.5	0.0	0.0	0.8	0.2	0.8	2.8	5.2	12.0
180	0.0	0.8	0.2	0.8	0.3	0.5	0.0	1.2	0.0	3.8	5.2	3.0	15.8
190	0.0	0.5	0.3	0.8	0.2	0.3	0.0	1.3	0.0	1.2	3.8	4.0	12.5
200	0.0	3.0	0.0	2.3	0.5	1.5	0.2	1.3	0.0	0.5	3.2	3.5	16.0
210	0.0	3.8	0.2	1.0	0.2	0.7	0.3	1.2	0.0	1.7	1.8	4.2	15.0
220	5.2	11.7	4.0	5.8	0.8	0.2	0.0	1.8	0.0	3.3	4.0	14.7	51.5
230	8.7	4.8	1.5	0.5	0.0	0.0	0.3	0.0	1.2	2.8	13.0	6.7	39.5
240	2.8	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.3	0.8	10.2
250	4.2	0.0	0.2	0.2	0.0	0.8	1.0	0.2	0.2	0.7	2.2	2.2	11.7
260	0.7	0.7	1.0	0.5	0.0	0.8	0.5	1.7	0.0	0.0	1.5	2.0	9.3
270	0.2	0.0	0.8	0.3	0.0	0.8	0.2	0.5	0.0	0.0	1.5	0.7	5.0
280	0.3	0.0	0.2	0.2	0.0	0.7	0.3	0.2	0.7	1.5	1.8	0.2	6.0
290	0.2	0.0	0.0	0.2	0.0	0.3	0.2	0.0	0.5	4.0	0.5	0.8	6.7
300	0.3	0.2	0.0	0.0	0.0	0.0	0.5	0.3	1.0	2.8	0.2	0.2	5.5

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
310	2.0	1.2	0.7	0.5	0.0	0.2	0.0	4.0	2.2	0.8	1.5	0.3	13.3
320	1.3	0.7	2.3	0.2	0.0	0.0	0.0	10.7	3.8	0.0	3.0	0.2	22.2
330	0.2	0.2	1.3	0.3	0.0	0.0	2.8	0.0	1.2	0.0	0.7	0.0	6.7
340	0.0	0.5	2.0	0.0	0.0	0.0	0.8	0.0	2.3	0.0	0.2	0.2	6.0
350	0.0	1.3	1.2	0.5	0.0	0.0	1.8	0.0	1.2	0.0	0.5	0.2	6.7
360	0.0	0.2	5.3	0.7	0.0	0.0	1.0	0.0	0.3	0.0	0.5	0.8	8.8
Blocked (yellow) hrs/month	**21.5**	**25.7**	**7.7**	**11.5**	**1.7**	**4.8**	**2.5**	**7.5**	**1.7**	**11.3**	**31.8**	**38.0**	**165.7**

6.4 2016 Data

Table 6.4 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North ST2, 2016)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.2	0.8	0.0	2.2	1.2	0.0	0.2	0.2	0.3	0.2	0.0	5.2
20	0.2	0.0	1.0	0.0	7.0	5.2	0.0	0.0	0.5	0.3	0.5	0.0	14.7
30	0.0	0.0	1.8	0.2	2.5	6.0	0.0	0.0	0.3	0.3	0.0	0.0	11.2
40	0.0	0.0	2.2	0.3	0.2	4.8	0.0	0.0	1.5	0.2	0.0	0.0	9.2
50	0.2	0.0	1.8	0.3	0.0	1.5	0.0	0.0	1.0	0.0	0.2	0.0	5.0
60	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.8	0.0	0.3	0.0	2.0
70	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.2	0.3	0.0	0.8
80	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.8	0.2	0.2	0.0	2.0
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.3	0.0	1.2
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0
110	0.0	0.0	0.0	0.7	0.0	5.0	0.0	0.0	3.0	0.0	0.0	0.0	8.7
120	2.8	0.0	0.0	0.7	0.0	0.3	0.0	0.0	2.3	0.0	0.0	0.0	6.2
130	31.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	35.0
140	14.0	1.3	1.2	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.2	18.2
150	3.7	0.3	1.7	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	1.2	7.2
160	0.5	0.0	9.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
170	1.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	3.5	0.2	0.0	0.0	9.7
180	0.0	0.0	4.5	0.3	0.8	0.3	0.0	0.0	0.2	0.3	0.0	2.0	8.5
190	0.0	0.0	5.3	0.3	0.7	2.2	0.0	0.0	0.2	0.3	0.0	1.2	10.2
200	1.8	0.0	2.8	0.7	0.7	1.8	0.8	0.0	0.3	0.3	0.0	1.2	10.5
210	0.7	0.3	2.5	0.8	0.2	2.8	2.8	0.0	2.3	0.3	0.2	4.5	17.5
220	8.2	6.3	6.7	0.8	0.0	0.8	0.0	0.3	0.3	0.8	0.5	2.0	26.8
230	3.5	6.0	1.7	0.0	0.0	0.0	0.2	0.0	0.2	0.8	0.0	0.5	12.8
240	0.2	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.2	0.2	6.7

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
250	0.3	2.2	1.7	1.7	0.0	0.3	0.0	0.0	0.2	0.2	0.2	0.0	6.7
260	0.0	0.7	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	2.3
270	0.8	1.7	0.7	0.3	0.0	1.3	0.0	0.0	0.2	0.2	0.0	0.5	5.7
280	4.7	2.5	0.5	0.0	0.0	0.8	0.2	0.0	0.0	0.3	0.0	0.5	9.5
290	1.5	1.0	0.0	0.7	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	3.8
300	0.5	0.7	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	2.3
310	0.8	1.3	0.0	0.0	0.0	0.8	0.0	0.0	0.3	0.8	0.5	0.0	4.7
320	0.2	0.8	0.5	0.2	0.0	0.2	0.0	0.0	0.2	0.7	1.0	0.0	3.7
330	0.2	0.8	1.5	0.2	0.0	0.3	0.0	0.0	0.2	0.3	0.0	0.0	3.5
340	1.2	1.0	2.2	0.5	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	6.2
350	3.0	0.0	4.3	2.5	0.0	1.2	0.0	0.2	0.0	0.0	0.0	0.0	11.2
360	0.7	0.5	3.5	1.7	0.0	1.2	0.0	0.0	0.2	0.0	0.3	0.0	8.0
Blocked (yellow) hrs/month	**14.7**	**16.7**	**21.8**	**5.2**	**1.5**	**8.5**	**4.0**	**0.3**	**3.8**	**4.2**	**3.0**	**9.8**	**93.5**

6.5 2017 Data

Table 6.5 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North ST2, 2017)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.2	0.0	0.0	0.3	0.3	5.0
20	0.7	0.0	0.0	0.0	0.0	0.0	1.3	0.2	0.0	0.0	1.5	1.2	4.8
30	0.3	0.5	0.0	0.0	0.5	0.0	2.3	0.0	0.0	0.0	0.2	0.3	4.2
40	0.0	0.3	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	2.2	3.3
50	0.2	3.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.7	4.2
60	0.0	1.2	1.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.2	2.8
70	0.0	1.0	1.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	2.8
80	0.0	0.7	1.2	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	2.3
90	0.0	5.5	1.2	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5
100	0.0	2.2	2.7	0.0	1.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	6.0
110	0.0	0.2	3.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
120	0.0	4.8	4.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.0	9.3
130	1.5	0.0	3.2	0.0	0.0	0.0	0.8	0.0	0.0	1.2	0.0	0.0	6.7
140	1.2	3.8	3.0	0.0	0.0	0.2	1.3	0.0	0.0	0.5	0.0	0.0	10.0
150	3.0	10.5	1.8	0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	18.3
160	7.0	10.5	0.5	0.0	0.0	0.0	0.7	0.2	0.0	0.5	0.0	1.2	20.5
170	4.7	6.0	0.8	0.8	0.0	2.0	0.0	1.8	0.0	1.8	0.0	1.0	19.0
180	2.2	2.5	1.5	5.3	0.0	3.2	0.5	1.3	0.0	1.8	0.0	0.8	19.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
190	0.0	2.5	5.5	3.3	0.0	3.0	1.3	0.8	0.0	0.8	2.2	0.7	20.2
200	0.3	0.5	2.7	0.2	0.0	0.2	0.2	0.0	0.0	4.7	4.8	1.8	15.3
210	6.8	1.7	2.0	0.0	0.0	0.3	1.0	0.0	0.0	5.8	11.8	3.8	33.3
220	4.0	1.8	2.3	0.0	0.0	0.3	0.2	0.0	0.0	2.8	0.7	1.8	14.0
230	2.0	1.2	0.7	0.0	0.0	0.0	0.5	0.2	0.0	0.3	1.3	1.5	7.7
240	4.0	1.0	0.5	0.0	0.0	0.2	0.2	0.3	0.0	0.2	1.0	5.5	12.8
250	0.8	0.5	0.2	0.0	0.0	0.2	0.2	0.3	0.0	0.0	0.3	3.7	6.2
260	0.5	0.2	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	1.8	3.0
270	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.8
280	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.5	1.0
290	1.2	1.2	0.0	0.0	0.0	0.2	0.8	0.3	0.0	0.0	0.0	0.8	4.5
300	1.3	0.2	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.2	4.2	9.0
310	0.5	0.2	0.5	1.2	0.0	0.2	1.7	0.0	0.0	0.0	0.2	2.7	7.0
320	1.2	0.3	1.5	0.2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	4.7
330	2.2	0.5	0.3	0.2	0.0	0.0	0.3	0.0	0.0	0.8	0.0	1.8	6.2
340	0.2	0.3	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.2	0.3	1.7	4.3
350	0.0	0.3	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.5	3.2	1.3	6.0
360	0.5	0.0	0.0	0.0	0.0	0.0	0.8	3.8	0.0	0.2	0.8	0.8	7.0
Blocked (yellow) hrs/month	18.5	9.3	13.8	3.5	0.0	4.2	3.8	1.8	0.0	14.7	22.2	20.7	112.5

6.6 2018 Data

Table 6.6 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North ST2, 2018)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.2	0.2	3.0	1.2	1.0	0.7	6.7	0.7	0.0	3.5	0.0	0.0	17.0
20	0.2	0.0	7.8	1.0	0.2	3.2	2.0	0.0	0.0	5.7	0.0	0.0	20.0
30	0.2	0.0	0.3	2.8	0.2	2.2	0.0	0.0	0.0	3.0	0.0	0.0	8.7
40	0.5	0.7	0.5	2.5	1.2	0.5	0.0	0.0	0.0	0.2	0.0	0.0	6.0
50	0.5	0.2	1.8	1.8	0.0	1.5	0.0	0.0	0.0	0.5	0.0	0.0	6.3
60	0.8	0.2	1.2	2.2	0.3	2.8	0.0	0.0	0.0	1.5	0.0	0.0	9.0
70	0.7	0.0	2.0	6.3	0.8	1.2	0.0	0.0	0.0	1.2	0.2	0.0	12.3
80	0.7	0.2	2.7	3.5	0.0	1.0	0.0	0.0	0.0	1.0	0.3	0.0	9.3
90	1.0	0.3	2.3	1.7	0.0	0.3	0.0	0.2	0.0	0.0	0.2	0.0	6.0
100	0.5	0.3	2.5	0.2	0.0	0.7	0.0	0.0	0.0	0.0	0.5	0.0	4.7
110	0.3	0.3	1.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.3	0.0	2.5
120	1.0	0.7	2.8	0.5	0.0	0.0	0.0	0.2	0.0	0.0	0.7	0.0	5.8

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
130	1.3	1.0	4.3	2.2	0.0	0.2	0.0	0.0	0.0	0.0	1.3	0.0	10.3
140	0.8	0.7	6.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.2	11.7
150	2.3	0.2	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.3	8.5
160	4.8	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	3.8	1.7	10.7
170	4.7	0.0	0.5	0.2	0.3	0.0	0.0	0.0	0.0	0.3	2.2	2.0	10.2
180	3.7	0.2	0.5	0.3	0.3	0.0	0.0	0.0	0.0	0.5	6.8	3.8	16.2
190	2.2	6.8	1.7	0.8	0.0	0.0	0.2	0.0	0.0	0.2	2.7	2.2	16.7
200	5.5	11.5	0.8	0.2	0.0	0.0	0.0	1.5	0.0	0.8	3.0	3.2	26.5
210	3.2	7.7	0.7	1.0	0.2	0.0	0.3	0.7	0.0	0.0	4.8	4.8	23.3
220	3.2	0.2	0.7	0.0	0.0	0.0	0.2	0.8	0.0	0.0	0.5	4.5	10.0
230	1.5	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	2.0	4.0
240	1.2	0.2	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	3.7	5.5
250	0.7	0.0	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.0
260	0.7	0.0	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.7	3.7
270	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.3
280	0.3	0.0	0.2	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.0	1.8
290	0.0	0.2	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.5	1.0
300	1.2	1.7	0.3	0.0	0.0	0.2	0.0	2.0	0.0	0.0	0.0	3.2	8.5
310	2.0	1.3	0.2	0.0	0.0	0.7	0.0	0.7	0.7	0.0	0.0	0.5	6.0
320	0.2	0.7	0.3	0.8	0.2	3.8	0.0	1.2	0.2	0.0	0.0	1.8	9.2
330	0.2	0.7	0.2	0.0	0.0	0.5	1.0	0.3	0.7	0.0	0.0	0.2	3.7
340	0.0	0.8	0.2	1.2	0.2	0.3	0.3	0.3	0.5	0.0	0.0	0.0	3.8
350	0.5	1.0	1.5	1.5	0.5	0.0	2.0	0.2	0.0	0.3	0.0	0.0	7.5
360	0.0	0.7	0.3	0.5	0.5	0.0	4.0	0.7	0.0	1.0	0.0	0.0	7.7
Blocked (yellow) hrs/month	**18.0**	**26.4**	**4.2**	**4.3**	**0.2**	**0.0**	**0.7**	**3.5**	**0.2**	**1.0**	**11.0**	**23.2**	**92.7**

6.7 2019 Data

Table 6.7 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North ST2, 2019)

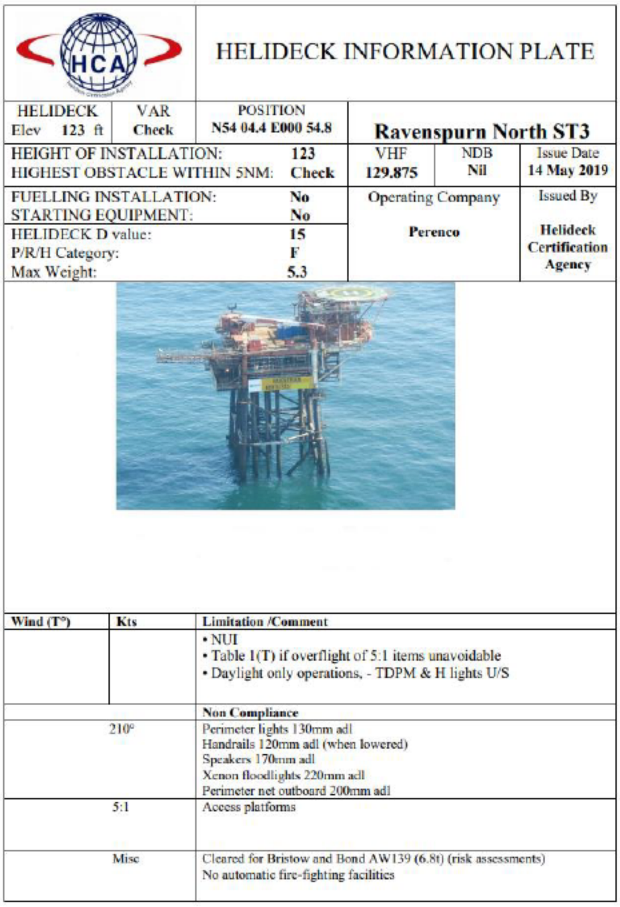
Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
10	0.0	0.5	0.0	0.0	0.3	5.5	0.2	0.0	0.0	0.0	6.5
20	0.0	2.8	0.0	0.0	0.3	2.7	0.0	0.0	0.0	0.0	5.8
30	0.0	0.0	0.0	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.8
40	0.0	0.7	0.0	2.7	2.8	0.0	0.0	0.0	0.0	0.0	6.2
50	0.0	0.5	0.0	0.5	1.3	0.0	0.0	0.0	0.2	1.8	4.3
60	0.0	0.3	0.0	0.3	1.2	0.0	0.0	0.0	0.0	1.3	3.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.5
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	1.7
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5
120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2
130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
140	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.0	1.0
150	0.0	1.2	0.0	0.2	0.0	0.3	0.0	0.2	0.3	0.0	2.2
160	0.0	1.3	0.0	0.0	0.0	0.0	0.3	0.0	0.8	0.0	2.5
170	0.0	0.3	0.8	0.3	0.0	0.0	0.2	0.0	1.5	0.0	3.2
180	0.0	0.5	0.7	0.0	0.0	0.3	0.0	0.0	3.3	0.0	4.8
190	0.0	2.5	2.3	0.0	0.0	0.5	0.0	0.2	2.5	0.0	8.0
200	2.3	4.0	0.8	0.0	0.7	0.2	1.5	2.5	1.8	0.0	13.8
210	5.2	6.3	2.8	0.0	0.7	0.2	0.0	3.5	0.8	0.0	19.5
220	0.3	1.8	1.2	0.0	0.0	0.5	1.5	0.3	0.8	0.0	6.5
230	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.7
240	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
250	0.7	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.3	0.0	1.5
260	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.3
270	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
280	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3
290	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2
300	0.5	0.0	0.5	0.0	0.0	1.2	0.0	0.0	0.2	0.0	2.3
310	0.3	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	1.0
320	0.2	0.2	0.7	0.2	2.0	0.3	0.2	0.2	0.3	0.0	4.2
330	1.0	0.2	0.5	1.8	2.8	0.0	3.0	2.2	0.2	0.0	11.7
340	1.8	0.8	0.0	2.7	2.3	0.5	1.7	0.0	0.8	0.0	10.7
350	2.8	1.8	0.0	0.3	1.8	2.0	0.2	0.0	0.5	0.0	9.5
360	0.3	0.8	0.0	0.3	0.7	4.0	0.3	0.0	0.3	0.0	6.8
Blocked (yellow) hrs/month	8.8	14.8	7.7	0.0	1.3	1.7	3.0	6.8	6.5	0.0	50.7

6.8 Take-Off Distance

35. Due to Ravenspurn North ST2 being located 2.3nm from the boundary of Hornsea Four, the take-off distance available needs to be considered. The distances are identified in Appendix A: Helicopter Access Report of Volume A5 Annex 11.1).Ravenspurn North ST3

36. The Ravenspurn North ST3 platform is a NUI approved for daylight operations only. Figure 6.2 presents the helideck information plate for the Ravenspurn North ST3 platform.


HCA — HELIDECK INFORMATION PLATE

HELIDECK Elev 123 ft	VAR Check	POSITION N54 04.4 E000 54.8	Ravenspurn North ST3	
HEIGHT OF INSTALLATION: 123		VHF 129.875	NDB Nil	Issue Date 14 May 2019
HIGHEST OBSTACLE WITHIN 5NM: Check				
FUELLING INSTALLATION: No		Operating Company: Perenco		Issued By: Helideck Certification Agency
STARTING EQUIPMENT: No				
HELIDECK D value: 15				
P/R/H Category: F				
Max Weight: 5.3				

Wind (T°)	Kts	Limitation /Comment
		• NUI • Table 1(T) if overflight of 5:1 items unavoidable • Daylight only operations, - TDPM & H lights U/S
		Non Compliance
210°		Perimeter lights 130mm adl Handrails 120mm adl (when lowered) Speakers 170mm adl Xenon floodlights 220mm adl Perimeter net outboard 200mm adl
5:1		Access platforms
Misc		Cleared for Bristow and Bond AW139 (6.8t) (risk assessments) No automatic fire-fighting facilities

Figure 6.2 Ravenspurn North ST3 Helideck Information Plate (Source: HCA)

37. The Ravenspurn North ST3 platform is located 7.8 km (4.3 nm) from the Hornsea Four array area. The Hornsea Four array obstructs an approach arc from 180° to 285°. However, if an approach can be made up to 30° out of wind, then these arcs reduce to 210° to 255°.

6.9 2013 Data

Table 6.8 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North ST3, 2013)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.3	0.5	1.8	1.3	0.2	0.7	0.0	2.5	0.2	0.7	0.0	8.2
20	0.0	0.2	0.5	3.3	0.0	1.2	1.0	0.3	2.7	1.2	1.8	0.0	12.2
30	0.0	0.2	0.5	0.3	0.0	0.8	1.0	0.2	1.3	3.0	0.5	0.0	7.8
40	0.2	0.2	0.0	0.3	0.0	1.8	6.2	0.0	0.2	3.5	0.5	0.0	12.8

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
50	0.2	2.0	1.7	0.0	0.0	0.5	3.5	0.0	0.0	5.5	0.3	0.0	13.7
60	0.7	6.0	3.3	0.0	0.0	0.8	3.8	0.0	0.0	0.5	0.2	0.0	15.3
70	0.3	3.2	0.8	0.3	0.0	1.3	2.5	0.0	0.0	0.0	0.0	0.0	8.5
80	0.3	0.0	0.0	0.7	0.0	0.0	1.5	0.5	0.0	0.3	0.0	0.0	3.3
90	1.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.3
100	2.5	0.0	1.0	1.5	0.0	0.0	0.2	0.0	0.0	1.0	0.0	0.0	6.2
110	0.3	0.2	9.0	3.5	0.5	0.0	0.0	0.0	0.0	2.0	0.0	0.0	15.5
120	0.8	1.0	11.3	0.5	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	14.7
130	9.3	0.7	2.3	1.0	0.5	0.0	0.0	0.2	0.0	1.0	0.0	0.0	15.0
140	4.5	2.2	0.8	3.5	2.3	0.0	0.0	1.0	0.0	1.3	0.0	0.0	15.7
150	0.2	0.0	1.5	0.3	1.3	0.0	0.2	0.0	0.0	2.3	0.0	1.3	7.2
160	0.8	3.8	1.5	0.0	0.0	0.0	0.2	0.0	2.7	1.7	1.2	0.7	12.5
170	0.0	2.8	2.0	0.0	0.7	0.0	0.3	0.0	1.5	0.2	0.7	0.3	8.5
180	0.0	1.8	4.2	0.2	0.2	0.0	0.0	0.0	0.0	0.5	0.2	0.8	7.8
190	0.0	0.3	1.2	1.3	0.5	0.0	0.3	0.0	0.0	0.8	0.2	2.2	6.8
200	0.2	3.0	0.7	2.3	1.0	0.7	1.2	0.0	0.0	0.3	0.5	1.5	11.3
210	2.3	0.3	2.0	1.3	0.5	1.7	0.3	0.0	0.2	0.5	0.0	2.3	11.5
220	5.8	0.0	1.8	1.5	0.5	1.7	0.0	2.3	1.2	1.0	3.5	15.5	34.8
230	4.8	0.0	1.8	1.2	0.0	1.2	0.0	0.2	0.5	0.8	5.7	14.3	30.5
240	0.7	0.0	0.5	0.2	0.2	1.2	0.0	0.0	0.0	0.8	2.8	0.2	6.5
250	1.8	0.5	0.2	0.0	0.5	0.5	0.0	0.0	0.3	0.5	1.2	0.5	6.0
260	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.3	1.2	3.7	0.3	6.7
270	0.5	0.2	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.5	7.0	0.7	9.3
280	0.3	2.7	0.0	0.0	0.3	1.0	0.0	1.0	0.0	0.3	4.0	0.5	10.2
290	0.0	0.5	0.0	0.0	5.5	1.2	0.0	0.3	0.5	0.0	0.8	0.0	8.8
300	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.3	0.2	0.2	0.8	0.2	2.7
310	0.0	0.2	0.2	0.2	0.3	0.3	0.0	0.7	0.2	0.2	0.2	0.0	2.3
320	0.0	0.0	0.0	2.2	0.0	0.3	0.5	0.0	0.7	0.8	1.3	0.2	6.0
330	0.3	0.8	0.0	1.5	0.0	0.2	1.0	0.0	0.5	0.3	1.8	1.2	7.7
340	0.0	0.7	0.0	0.5	0.7	0.3	1.8	0.0	1.8	0.7	2.8	0.2	9.5
350	0.7	0.8	0.0	1.0	1.8	0.0	1.3	0.0	2.2	0.3	0.7	0.0	8.8
360	0.0	1.0	0.2	0.7	1.0	0.3	1.5	0.0	1.3	0.3	0.5	0.0	6.8
Blocked (yellow) hrs/month	**16.5**	**0.8**	**6.3**	**4.2**	**1.8**	**6.2**	**0.3**	**2.5**	**2.5**	**4.8**	**16.8**	**33.2**	**96.0**

6.10 2014 Data

Table 6.9 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North ST3, 2014)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.5	0.3	0.0	0.7	1.0	0.0	0.7	0.5	0.0	0.0	3.7
20	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.3	0.2	0.0	1.2
30	0.0	0.0	0.3	0.7	1.7	0.5	0.0	0.0	2.0	1.5	0.2	0.0	6.8
40	0.0	0.0	1.0	0.0	0.7	0.3	0.2	0.0	5.0	2.0	0.2	0.0	9.3
50	0.0	0.0	2.2	0.0	0.5	0.7	0.2	0.0	6.3	6.7	2.8	0.0	19.3
60	0.0	0.0	1.2	0.0	0.7	4.2	0.0	0.0	0.5	2.2	2.7	0.0	11.3
70	0.0	0.0	0.2	0.5	0.7	0.0	0.0	0.0	0.2	0.5	3.0	0.0	5.0
80	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	1.3
90	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
100	0.0	0.0	0.3	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
110	0.2	0.2	9.5	0.7	3.0	0.0	0.0	0.0	0.2	0.2	0.0	0.2	14.0
120	0.0	1.0	15.7	2.7	0.7	0.2	0.0	0.8	5.0	0.2	0.8	1.0	28.0
130	1.7	1.2	3.2	3.3	0.8	0.3	0.0	0.5	2.5	0.0	6.3	1.2	21.0
140	7.7	1.3	1.0	1.7	0.8	0.2	0.0	2.3	1.2	0.0	22.8	1.3	40.3
150	1.8	2.0	0.2	0.2	0.0	0.5	0.2	0.0	0.7	1.0	5.5	2.0	14.0
160	1.7	2.0	0.2	0.0	0.0	0.2	0.2	0.0	0.8	1.3	2.7	2.0	11.0
170	2.5	4.5	0.7	0.7	0.0	0.2	0.0	0.0	0.3	0.7	2.8	4.5	16.8
180	12.8	2.0	0.5	0.0	0.0	0.3	0.0	0.2	0.2	0.3	1.7	2.0	20.0
190	10.0	4.3	1.8	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5	4.3	21.3
200	7.0	3.3	2.0	0.2	0.2	0.5	0.2	0.0	0.0	0.0	0.3	3.3	17.0
210	4.2	0.2	3.7	1.5	0.2	0.0	0.5	0.0	0.0	3.3	1.5	0.2	15.2
220	3.5	0.5	8.0	1.7	1.0	0.2	0.3	0.3	0.0	5.2	6.5	0.5	27.7
230	4.7	1.5	2.3	0.7	1.7	0.0	0.3	1.2	0.0	1.5	4.2	1.5	19.5
240	3.2	1.0	2.3	0.2	1.5	0.2	0.2	0.8	0.0	1.0	1.7	1.0	13.0
250	1.2	0.0	0.5	0.5	1.8	0.2	0.5	0.7	0.0	0.3	2.0	0.0	7.7
260	0.5	0.0	0.3	0.0	0.0	0.3	0.5	0.2	2.2	0.0	0.3	0.0	4.3
270	1.3	0.0	0.2	0.0	0.2	0.0	0.0	0.0	3.5	0.0	0.3	0.0	5.5
280	0.5	0.8	0.2	0.0	0.3	0.0	0.2	0.3	1.3	0.7	0.7	0.8	5.8
290	0.5	0.0	0.2	0.0	1.3	0.0	0.5	0.0	0.0	0.2	0.2	0.0	2.8
300	0.3	0.0	0.0	0.0	0.7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.3
310	0.2	0.0	0.0	0.0	0.2	0.0	0.3	0.2	0.2	0.3	0.0	0.0	1.3
320	0.8	1.7	0.2	0.2	0.5	0.5	0.8	0.8	2.2	0.7	0.2	1.7	10.2
330	0.5	0.2	0.3	0.0	0.3	0.2	0.0	0.2	1.3	0.5	0.3	0.2	4.0
340	0.5	0.0	0.2	0.0	0.2	1.0	6.5	0.0	2.0	1.5	0.5	0.0	12.3
350	0.0	0.0	0.2	0.0	0.0	2.8	7.7	0.2	1.0	1.3	0.8	0.0	14.0
360	0.2	0.0	0.0	0.0	0.2	2.0	3.5	0.2	1.3	0.2	0.5	0.0	8.0

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
Blocked (yellow) hrs/month	17.2	3.2	17.2	4.5	6.2	0.8	2.3	3.2	2.2	11.3	16.2	3.2	87.3

6.11 2015 Data

Table 6.10 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North ST3, 2015)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.7	4.5	1.0	0.0	0.0	1.8	0.0	0.2	0.0	0.3	1.8	10.3
20	0.0	0.5	2.2	0.5	0.0	0.2	1.3	0.0	0.0	0.0	0.0	0.0	4.7
30	0.0	1.0	1.7	0.8	0.0	0.5	1.7	0.0	0.0	1.0	0.0	0.0	6.7
40	0.0	0.5	1.2	1.0	0.0	0.2	0.3	0.0	0.2	0.5	0.0	0.0	3.8
50	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.0	0.2	1.3	0.0	0.0	2.3
60	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.0	0.0	1.3
70	0.0	0.0	0.5	0.2	0.0	0.2	0.0	0.2	0.5	0.0	0.0	0.0	1.5
80	0.0	0.5	0.8	0.0	0.0	0.3	0.0	0.0	0.2	0.2	0.0	0.0	2.0
90	0.0	1.0	1.2	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	2.7
100	0.0	0.8	1.8	0.0	0.0	0.2	0.0	0.5	0.0	0.2	0.0	0.0	3.5
110	0.0	5.2	2.8	0.0	0.5	0.3	0.7	0.2	0.2	0.0	0.0	0.0	9.8
120	0.0	1.5	1.5	2.2	1.5	1.5	0.0	0.2	0.0	0.7	0.0	0.0	9.0
130	0.0	0.0	0.8	0.7	0.3	0.0	0.0	0.5	0.0	1.2	0.2	0.0	3.7
140	0.0	1.0	0.7	1.0	0.7	0.0	0.2	0.3	0.3	2.2	1.0	3.2	10.5
150	0.0	0.5	0.7	0.8	0.5	0.0	0.7	0.0	0.3	0.0	0.0	3.2	6.7
160	0.0	1.5	0.2	0.3	0.5	0.0	0.7	0.5	0.0	1.5	1.5	2.2	8.8
170	0.0	1.7	0.0	0.0	0.5	0.0	0.0	0.8	0.2	0.8	2.8	5.2	12.0
180	0.0	0.8	0.2	0.8	0.3	0.5	0.0	1.2	0.0	3.8	5.2	3.0	15.8
190	0.0	0.5	0.3	0.8	0.2	0.3	0.0	1.3	0.0	1.2	3.8	4.0	12.5
200	0.0	3.0	0.0	2.3	0.5	1.5	0.2	1.3	0.0	0.5	3.2	3.5	16.0
210	0.0	3.8	0.2	1.0	0.2	0.7	0.3	1.2	0.0	1.7	1.8	4.2	15.0
220	5.2	11.7	4.0	5.8	0.8	0.2	0.0	1.8	0.0	3.3	4.0	14.7	51.5
230	8.7	4.8	1.5	0.5	0.0	0.0	0.3	0.0	1.2	2.8	13.0	6.7	39.5
240	2.8	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.3	0.8	10.2
250	4.2	0.0	0.2	0.2	0.0	0.8	1.0	0.2	0.2	0.7	2.2	2.2	11.7
260	0.7	0.7	1.0	0.5	0.0	0.8	0.5	1.7	0.0	0.0	1.5	2.0	9.3
270	0.2	0.0	0.8	0.3	0.0	0.8	0.2	0.5	0.0	0.0	1.5	0.7	5.0
280	0.3	0.0	0.2	0.2	0.0	0.7	0.3	0.2	0.7	1.5	1.8	0.2	6.0
290	0.2	0.0	0.0	0.2	0.0	0.3	0.2	0.0	0.5	4.0	0.5	0.8	6.7
300	0.3	0.2	0.0	0.0	0.0	0.0	0.5	0.3	1.0	2.8	0.2	0.2	5.5

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
310	2.0	1.2	0.7	0.5	0.0	0.2	0.0	4.0	2.2	0.8	1.5	0.3	13.3
320	1.3	0.7	2.3	0.2	0.0	0.0	0.0	10.7	3.8	0.0	3.0	0.2	22.2
330	0.2	0.2	1.3	0.3	0.0	0.0	2.8	0.0	1.2	0.0	0.7	0.0	6.7
340	0.0	0.5	2.0	0.0	0.0	0.0	0.8	0.0	2.3	0.0	0.2	0.2	6.0
350	0.0	1.3	1.2	0.5	0.0	0.0	1.8	0.0	1.2	0.0	0.5	0.2	6.7
360	0.0	0.2	5.3	0.7	0.0	0.0	1.0	0.0	0.3	0.0	0.5	0.8	8.8
Blocked (yellow) hrs/month	21.5	22.2	7.3	8.3	1.0	3.0	2.3	4.8	1.7	9.7	24.8	30.5	137.2

6.12 2016 Data

Table 6.11 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North ST3, 2016)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.2	0.8	0.0	2.2	1.2	0.0	0.2	0.2	0.3	0.2	0.0	5.2
20	0.2	0.0	1.0	0.0	7.0	5.2	0.0	0.0	0.5	0.3	0.5	0.0	14.7
30	0.0	0.0	1.8	0.2	2.5	6.0	0.0	0.0	0.3	0.3	0.0	0.0	11.2
40	0.0	0.0	2.2	0.3	0.2	4.8	0.0	0.0	1.5	0.2	0.0	0.0	9.2
50	0.2	0.0	1.8	0.3	0.0	1.5	0.0	0.0	1.0	0.0	0.2	0.0	5.0
60	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.8	0.0	0.3	0.0	2.0
70	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.2	0.3	0.0	0.8
80	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.8	0.2	0.2	0.0	2.0
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.3	0.0	1.2
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0
110	0.0	0.0	0.0	0.7	0.0	5.0	0.0	0.0	3.0	0.0	0.0	0.0	8.7
120	2.8	0.0	0.0	0.7	0.0	0.3	0.0	0.0	2.3	0.0	0.0	0.0	6.2
130	31.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	35.0
140	14.0	1.3	1.2	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.2	18.2
150	3.7	0.3	1.7	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	1.2	7.2
160	0.5	0.0	9.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
170	1.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	3.5	0.2	0.0	0.0	9.7
180	0.0	0.0	4.5	0.3	0.8	0.3	0.0	0.0	0.2	0.3	0.0	2.0	8.5
190	0.0	0.0	5.3	0.3	0.7	2.2	0.0	0.0	0.2	0.3	0.0	1.2	10.2
200	1.8	0.0	2.8	0.7	0.7	1.8	0.8	0.0	0.3	0.3	0.0	1.2	10.5
210	0.7	0.3	2.5	0.8	0.2	2.8	2.8	0.0	2.3	0.3	0.2	4.5	17.5
220	8.2	6.3	6.7	0.8	0.0	0.8	0.0	0.3	0.3	0.8	0.5	2.0	26.8
230	3.5	6.0	1.7	0.0	0.0	0.0	0.2	0.0	0.2	0.8	0.0	0.5	12.8
240	0.2	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.2	0.2	6.7

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
250	0.3	2.2	1.7	1.7	0.0	0.3	0.0	0.0	0.2	0.2	0.2	0.0	6.7
260	0.0	0.7	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	2.3
270	0.8	1.7	0.7	0.3	0.0	1.3	0.0	0.0	0.2	0.2	0.0	0.5	5.7
280	4.7	2.5	0.5	0.0	0.0	0.8	0.2	0.0	0.0	0.3	0.0	0.5	9.5
290	1.5	1.0	0.0	0.7	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	3.8
300	0.5	0.7	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	2.3
310	0.8	1.3	0.0	0.0	0.0	0.8	0.0	0.0	0.3	0.8	0.5	0.0	4.7
320	0.2	0.8	0.5	0.2	0.0	0.2	0.0	0.0	0.2	0.7	1.0	0.0	3.7
330	0.2	0.8	1.5	0.2	0.0	0.3	0.0	0.0	0.2	0.3	0.0	0.0	3.5
340	1.2	1.0	2.2	0.5	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	6.2
350	3.0	0.0	4.3	2.5	0.0	1.2	0.0	0.2	0.0	0.0	0.0	0.0	11.2
360	0.7	0.5	3.5	1.7	0.0	1.2	0.0	0.0	0.2	0.0	0.3	0.0	8.0
Blocked (yellow) hrs/month	**12.8**	**16.7**	**13.7**	**4.2**	**0.2**	**4.5**	**3.2**	**0.3**	**3.3**	**3.5**	**3.0**	**7.5**	**72.8**

6.13 2017 Data

Table 6.12 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North ST3, 2017)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.2	0.0	0.0	0.3	0.3	5.0
20	0.7	0.0	0.0	0.0	0.0	0.0	1.3	0.2	0.0	0.0	1.5	1.2	4.8
30	0.3	0.5	0.0	0.0	0.5	0.0	2.3	0.0	0.0	0.0	0.2	0.3	4.2
40	0.0	0.3	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	2.2	3.3
50	0.2	3.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.7	4.2
60	0.0	1.2	1.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.2	2.8
70	0.0	1.0	1.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	2.8
80	0.0	0.7	1.2	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	2.3
90	0.0	5.5	1.2	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5
100	0.0	2.2	2.7	0.0	1.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	6.0
110	0.0	0.2	3.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
120	0.0	4.8	4.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.0	9.3
130	1.5	0.0	3.2	0.0	0.0	0.0	0.8	0.0	0.0	1.2	0.0	0.0	6.7
140	1.2	3.8	3.0	0.0	0.0	0.2	1.3	0.0	0.0	0.5	0.0	0.0	10.0
150	3.0	10.5	1.8	0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	18.3
160	7.0	10.5	0.5	0.0	0.0	0.0	0.7	0.2	0.0	0.5	0.0	1.2	20.5
170	4.7	6.0	0.8	0.8	0.0	2.0	0.0	1.8	0.0	1.8	0.0	1.0	19.0
180	2.2	2.5	1.5	5.3	0.0	3.2	0.5	1.3	0.0	1.8	0.0	0.8	19.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
190	0.0	2.5	5.5	3.3	0.0	3.0	1.3	0.8	0.0	0.8	2.2	0.7	20.2
200	0.3	0.5	2.7	0.2	0.0	0.2	0.2	0.0	0.0	4.7	4.8	1.8	15.3
210	6.8	1.7	2.0	0.0	0.0	0.3	1.0	0.0	0.0	5.8	11.8	3.8	33.3
220	4.0	1.8	2.3	0.0	0.0	0.3	0.2	0.0	0.0	2.8	0.7	1.8	14.0
230	2.0	1.2	0.7	0.0	0.0	0.0	0.5	0.2	0.0	0.3	1.3	1.5	7.7
240	4.0	1.0	0.5	0.0	0.0	0.2	0.2	0.3	0.0	0.2	1.0	5.5	12.8
250	0.8	0.5	0.2	0.0	0.0	0.2	0.2	0.3	0.0	0.0	0.3	3.7	6.2
260	0.5	0.2	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	1.8	3.0
270	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.8
280	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.5	1.0
290	1.2	1.2	0.0	0.0	0.0	0.2	0.8	0.3	0.0	0.0	0.0	0.8	4.5
300	1.3	0.2	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.2	4.2	9.0
310	0.5	0.2	0.5	1.2	0.0	0.2	1.7	0.0	0.0	0.0	0.2	2.7	7.0
320	1.2	0.3	1.5	0.2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	4.7
330	2.2	0.5	0.3	0.2	0.0	0.0	0.3	0.0	0.0	0.8	0.0	1.8	6.2
340	0.2	0.3	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.2	0.3	1.7	4.3
350	0.0	0.3	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.5	3.2	1.3	6.0
360	0.5	0.0	0.0	0.0	0.0	0.0	0.8	3.8	0.0	0.2	0.8	0.8	7.0
Blocked (yellow) hrs/month	18.2	6.3	5.7	0.0	0.0	1.0	2.3	1.0	0.0	9.2	15.2	18.2	77.0

6.14 2018 Data

Table 6.13 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North ST3, 2018)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.2	0.2	3.0	1.2	1.0	0.7	6.7	0.7	0.0	3.5	0.0	0.0	17.0
20	0.2	0.0	7.8	1.0	0.2	3.2	2.0	0.0	0.0	5.7	0.0	0.0	20.0
30	0.2	0.0	0.3	2.8	0.2	2.2	0.0	0.0	0.0	3.0	0.0	0.0	8.7
40	0.5	0.7	0.5	2.5	1.2	0.5	0.0	0.0	0.0	0.2	0.0	0.0	6.0
50	0.5	0.2	1.8	1.8	0.0	1.5	0.0	0.0	0.0	0.5	0.0	0.0	6.3
60	0.8	0.2	1.2	2.2	0.3	2.8	0.0	0.0	0.0	1.5	0.0	0.0	9.0
70	0.7	0.0	2.0	6.3	0.8	1.2	0.0	0.0	0.0	1.2	0.2	0.0	12.3
80	0.7	0.2	2.7	3.5	0.0	1.0	0.0	0.0	0.0	1.0	0.3	0.0	9.3
90	1.0	0.3	2.3	1.7	0.0	0.3	0.0	0.2	0.0	0.0	0.2	0.0	6.0
100	0.5	0.3	2.5	0.2	0.0	0.7	0.0	0.0	0.0	0.0	0.5	0.0	4.7
110	0.3	0.3	1.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.3	0.0	2.5
120	1.0	0.7	2.8	0.5	0.0	0.0	0.0	0.2	0.0	0.0	0.7	0.0	5.8

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
130	1.3	1.0	4.3	2.2	0.0	0.2	0.0	0.0	0.0	0.0	1.3	0.0	10.3
140	0.8	0.7	6.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.2	11.7
150	2.3	0.2	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.3	8.5
160	4.8	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	3.8	1.7	10.7
170	4.7	0.0	0.5	0.2	0.3	0.0	0.0	0.0	0.0	0.3	2.2	2.0	10.2
180	3.7	0.2	0.5	0.3	0.3	0.0	0.0	0.0	0.0	0.5	6.8	3.8	16.2
190	2.2	6.8	1.7	0.8	0.0	0.0	0.2	0.0	0.0	0.2	2.7	2.2	16.7
200	5.5	11.5	0.8	0.2	0.0	0.0	0.0	1.5	0.0	0.8	3.0	3.2	26.5
210	3.2	7.7	0.7	1.0	0.2	0.0	0.3	0.7	0.0	0.0	4.8	4.8	23.3
220	3.2	0.2	0.7	0.0	0.0	0.0	0.2	0.8	0.0	0.0	0.5	4.5	10.0
230	1.5	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	2.0	4.0
240	1.2	0.2	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	3.7	5.5
250	0.7	0.0	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.0
260	0.7	0.0	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.7	3.7
270	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.3
280	0.3	0.0	0.2	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.0	1.8
290	0.0	0.2	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.5	1.0
300	1.2	1.7	0.3	0.0	0.0	0.2	0.0	2.0	0.0	0.0	0.0	3.2	8.5
310	2.0	1.3	0.2	0.0	0.0	0.7	0.0	0.7	0.7	0.0	0.0	0.5	6.0
320	0.2	0.7	0.3	0.8	0.2	3.8	0.0	1.2	0.2	0.0	0.0	1.8	9.2
330	0.2	0.7	0.2	0.0	0.0	0.5	1.0	0.3	0.7	0.0	0.0	0.2	3.7
340	0.0	0.8	0.2	1.2	0.2	0.3	0.3	0.3	0.5	0.0	0.0	0.0	3.8
350	0.5	1.0	1.5	1.5	0.5	0.0	2.0	0.2	0.0	0.3	0.0	0.0	7.5
360	0.0	0.7	0.3	0.5	0.5	0.0	4.0	0.7	0.0	1.0	0.0	0.0	7.7
Blocked (yellow) hrs/month	**10.3**	**8.2**	**1.7**	**3.3**	**0.2**	**0.0**	**0.5**	**2.0**	**0.2**	**0.0**	**5.3**	**17.8**	**49.5**

6.15 2019 Data

Table 6.14 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn North ST3, 2019)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
10	0.0	0.5	0.0	0.0	0.3	5.5	0.2	0.0	0.0	0.0	6.5
20	0.0	2.8	0.0	0.0	0.3	2.7	0.0	0.0	0.0	0.0	5.8
30	0.0	0.0	0.0	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.8
40	0.0	0.7	0.0	2.7	2.8	0.0	0.0	0.0	0.0	0.0	6.2
50	0.0	0.5	0.0	0.5	1.3	0.0	0.0	0.0	0.2	1.8	4.3
60	0.0	0.3	0.0	0.3	1.2	0.0	0.0	0.0	0.0	1.3	3.2

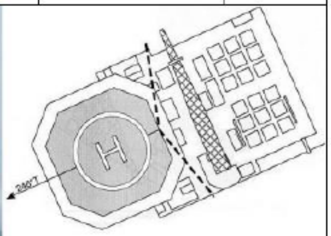
Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.5
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	1.7
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5
120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2
130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
140	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.0	1.0
150	0.0	1.2	0.0	0.2	0.0	0.3	0.0	0.2	0.3	0.0	2.2
160	0.0	1.3	0.0	0.0	0.0	0.0	0.3	0.0	0.8	0.0	2.5
170	0.0	0.3	0.8	0.3	0.0	0.0	0.2	0.0	1.5	0.0	3.2
180	0.0	0.5	0.7	0.0	0.0	0.3	0.0	0.0	3.3	0.0	4.8
190	0.0	2.5	2.3	0.0	0.0	0.5	0.0	0.2	2.5	0.0	8.0
200	2.3	4.0	0.8	0.0	0.7	0.2	1.5	2.5	1.8	0.0	13.8
210	5.2	6.3	2.8	0.0	0.7	0.2	0.0	3.5	0.8	0.0	19.5
220	0.3	1.8	1.2	0.0	0.0	0.5	1.5	0.3	0.8	0.0	6.5
230	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.7
240	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
250	0.7	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.3	0.0	1.5
260	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.3
270	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
280	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3
290	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2
300	0.5	0.0	0.5	0.0	0.0	1.2	0.0	0.0	0.2	0.0	2.3
310	0.3	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	1.0
320	0.2	0.2	0.7	0.2	2.0	0.3	0.2	0.2	0.3	0.0	4.2
330	1.0	0.2	0.5	1.8	2.8	0.0	3.0	2.2	0.2	0.0	11.7
340	1.8	0.8	0.0	2.7	2.3	0.5	1.7	0.0	0.8	0.0	10.7
350	2.8	1.8	0.0	0.3	1.8	2.0	0.2	0.0	0.5	0.0	9.5
360	0.3	0.8	0.0	0.3	0.7	4.0	0.3	0.0	0.3	0.0	6.8
Blocked (yellow) hrs/month	**6.5**	**8.3**	**4.5**	**0.0**	**0.7**	**1.0**	**1.5**	**4.2**	**2.2**	**0.0**	**28.8**

7 Ravenspurn South A

38. The Ravenspurn South A platform is a NUI approved for daylight operations only with a wind speed of 30 kt or less. Figure 7.1 presents the helideck information plate for the Ravenspurn North ST2 platform.

HELIDECK INFORMATION PLATE

HELIDECK Elev 111 ft	VAR Check	POSITION N54 01.45 E000 57.55	Ravenspurn A		
HEIGHT OF INSTALLATION: 111 HIGHEST OBSTACLE WITHIN 5NM: Rav North 290			VHF 129.875	NDB Nil	Issue Date 07 Feb 2020
FUELLING INSTALLATION: No STARTING EQUIPMENT: No HELIDECK D value: 16.01 P/R/H Category: F Max Weight: 5.3			Operating Company Perenco		Issued By Helideck Certification Agency



Wind (T°)	Kts	Limitation /Comment
		• NUI • Table 1(T) if overflight of 5:1 items are unavoidable • Daylight only operations (TDPM & H lights U/S)
		Non Compliance
	5:1	SE & NW access platforms
	Misc	No automatic fire-fighting facilities • Cleared for AW139 (6.8t)

Figure 7.1 Ravenspurn South A Helideck Information Plate (Source: HCA)

39. The Ravenspurn South A platform is located 9.3 km (5.1 nm) from the Hornsea Four array area. The Hornsea Four array obstructs an approach arc from 180° to 280°. However, if an approach can be made up to 30° out of wind, then these arcs reduce to 210° to 250°.

7.1 2013 Data

Table 7.1 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South A, 2013)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.3	0.5	1.8	1.3	0.2	0.7	0.0	2.5	0.2	0.7	0.0	8.2
20	0.0	0.2	0.5	3.3	0.0	1.2	1.0	0.3	2.7	1.2	1.8	0.0	12.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
30	0.0	0.2	0.5	0.3	0.0	0.8	1.0	0.2	1.3	3.0	0.5	0.0	7.8
40	0.2	0.2	0.0	0.3	0.0	1.8	6.2	0.0	0.2	3.5	0.5	0.0	12.8
50	0.2	2.0	1.7	0.0	0.0	0.5	3.5	0.0	0.0	5.5	0.3	0.0	13.7
60	0.7	6.0	3.3	0.0	0.0	0.8	3.8	0.0	0.0	0.5	0.2	0.0	15.3
70	0.3	3.2	0.8	0.3	0.0	1.3	2.5	0.0	0.0	0.0	0.0	0.0	8.5
80	0.3	0.0	0.0	0.7	0.0	0.0	1.5	0.5	0.0	0.3	0.0	0.0	3.3
90	1.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.3
100	2.5	0.0	1.0	1.5	0.0	0.0	0.2	0.0	0.0	1.0	0.0	0.0	6.2
110	0.3	0.2	9.0	3.5	0.5	0.0	0.0	0.0	0.0	2.0	0.0	0.0	15.5
120	0.8	1.0	11.3	0.5	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	14.7
130	9.3	0.7	2.3	1.0	0.5	0.0	0.0	0.2	0.0	1.0	0.0	0.0	15.0
140	4.5	2.2	0.8	3.5	2.3	0.0	0.0	1.0	0.0	1.3	0.0	0.0	15.7
150	0.2	0.0	1.5	0.3	1.3	0.0	0.2	0.0	0.0	2.3	0.0	1.3	7.2
160	0.8	3.8	1.5	0.0	0.0	0.0	0.2	0.0	2.7	1.7	1.2	0.7	12.5
170	0.0	2.8	2.0	0.0	0.7	0.0	0.3	0.0	1.5	0.2	0.7	0.3	8.5
180	0.0	1.8	4.2	0.2	0.2	0.0	0.0	0.0	0.0	0.5	0.2	0.8	7.8
190	0.0	0.3	1.2	1.3	0.5	0.0	0.3	0.0	0.0	0.8	0.2	2.2	6.8
200	0.2	3.0	0.7	2.3	1.0	0.7	1.2	0.0	0.0	0.3	0.5	1.5	11.3
210	2.3	0.3	2.0	1.3	0.5	1.7	0.3	0.0	0.2	0.5	0.0	2.3	11.5
220	5.8	0.0	1.8	1.5	0.5	1.7	0.0	2.3	1.2	1.0	3.5	15.5	34.8
230	4.8	0.0	1.8	1.2	0.0	1.2	0.0	0.2	0.5	0.8	5.7	14.3	30.5
240	0.7	0.0	0.5	0.2	0.2	1.2	0.0	0.0	0.0	0.8	2.8	0.2	6.5
250	1.8	0.5	0.2	0.0	0.5	0.5	0.0	0.0	0.3	0.5	1.2	0.5	6.0
260	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.3	1.2	3.7	0.3	6.7
270	0.5	0.2	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.5	7.0	0.7	9.3
280	0.3	2.7	0.0	0.0	0.3	1.0	0.0	1.0	0.0	0.3	4.0	0.5	10.2
290	0.0	0.5	0.0	0.0	5.5	1.2	0.0	0.3	0.5	0.0	0.8	0.0	8.8
300	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.3	0.2	0.2	0.8	0.2	2.7
310	0.0	0.2	0.2	0.2	0.3	0.3	0.0	0.7	0.2	0.2	0.2	0.0	2.3
320	0.0	0.0	0.0	2.2	0.0	0.3	0.5	0.0	0.7	0.8	1.3	0.2	6.0
330	0.3	0.8	0.0	1.5	0.0	0.2	1.0	0.0	0.5	0.3	1.8	1.2	7.7
340	0.0	0.7	0.0	0.5	0.7	0.3	1.8	0.0	1.8	0.7	2.8	0.2	9.5
350	0.7	0.8	0.0	1.0	1.8	0.0	1.3	0.0	2.2	0.3	0.7	0.0	8.8
360	0.0	1.0	0.2	0.7	1.0	0.3	1.5	0.0	1.3	0.3	0.5	0.0	6.8
Blocked (yellow) hrs/month	**15.5**	**0.8**	**6.3**	**4.2**	**1.7**	**6.2**	**0.3**	**2.5**	**2.2**	**3.7**	**13.2**	**32.8**	**89.3**

7.2 2014 Data

Table 7.2 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South A, 2014)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.5	0.3	0.0	0.7	1.0	0.0	0.7	0.5	0.0	0.0	3.7
20	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.3	0.2	0.0	1.2
30	0.0	0.0	0.3	0.7	1.7	0.5	0.0	0.0	2.0	1.5	0.2	0.0	6.8
40	0.0	0.0	1.0	0.0	0.7	0.3	0.2	0.0	5.0	2.0	0.2	0.0	9.3
50	0.0	0.0	2.2	0.0	0.5	0.7	0.2	0.0	6.3	6.7	2.8	0.0	19.3
60	0.0	0.0	1.2	0.0	0.7	4.2	0.0	0.0	0.5	2.2	2.7	0.0	11.3
70	0.0	0.0	0.2	0.5	0.7	0.0	0.0	0.0	0.2	0.5	3.0	0.0	5.0
80	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	1.3
90	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
100	0.0	0.0	0.3	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
110	0.2	0.2	9.5	0.7	3.0	0.0	0.0	0.0	0.2	0.2	0.0	0.2	14.0
120	0.0	1.0	15.7	2.7	0.7	0.2	0.0	0.8	5.0	0.2	0.8	1.0	28.0
130	1.7	1.2	3.2	3.3	0.8	0.3	0.0	0.5	2.5	0.0	6.3	1.2	21.0
140	7.7	1.3	1.0	1.7	0.8	0.2	0.0	2.3	1.2	0.0	22.8	1.3	40.3
150	1.8	2.0	0.2	0.2	0.0	0.5	0.2	0.0	0.7	1.0	5.5	2.0	14.0
160	1.7	2.0	0.2	0.0	0.0	0.2	0.2	0.0	0.8	1.3	2.7	2.0	11.0
170	2.5	4.5	0.7	0.7	0.0	0.2	0.0	0.0	0.3	0.7	2.8	4.5	16.8
180	12.8	2.0	0.5	0.0	0.0	0.3	0.0	0.2	0.2	0.3	1.7	2.0	20.0
190	10.0	4.3	1.8	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5	4.3	21.3
200	7.0	3.3	2.0	0.2	0.2	0.5	0.2	0.0	0.0	0.0	0.3	3.3	17.0
210	4.2	0.2	3.7	1.5	0.2	0.0	0.5	0.0	0.0	3.3	1.5	0.2	15.2
220	3.5	0.5	8.0	1.7	1.0	0.2	0.3	0.3	0.0	5.2	6.5	0.5	27.7
230	4.7	1.5	2.3	0.7	1.7	0.0	0.3	1.2	0.0	1.5	4.2	1.5	19.5
240	3.2	1.0	2.3	0.2	1.5	0.2	0.2	0.8	0.0	1.0	1.7	1.0	13.0
250	1.2	0.0	0.5	0.5	1.8	0.2	0.5	0.7	0.0	0.3	2.0	0.0	7.7
260	0.5	0.0	0.3	0.0	0.0	0.3	0.5	0.2	2.2	0.0	0.3	0.0	4.3
270	1.3	0.0	0.2	0.0	0.2	0.0	0.0	0.0	3.5	0.0	0.3	0.0	5.5
280	0.5	0.8	0.2	0.0	0.3	0.0	0.2	0.3	1.3	0.7	0.7	0.8	5.8
290	0.5	0.0	0.2	0.0	1.3	0.0	0.5	0.0	0.0	0.2	0.2	0.0	2.8
300	0.3	0.0	0.0	0.0	0.7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.3
310	0.2	0.0	0.0	0.0	0.2	0.0	0.3	0.2	0.2	0.3	0.0	0.0	1.3
320	0.8	1.7	0.2	0.2	0.5	0.5	0.8	0.8	2.2	0.7	0.2	1.7	10.2
330	0.5	0.2	0.3	0.0	0.3	0.2	0.0	0.2	1.3	0.5	0.3	0.2	4.0
340	0.5	0.0	0.2	0.0	0.2	1.0	6.5	0.0	2.0	1.5	0.5	0.0	12.3
350	0.0	0.0	0.2	0.0	0.0	2.8	7.7	0.2	1.0	1.3	0.8	0.0	14.0
360	0.2	0.0	0.0	0.0	0.2	2.0	3.5	0.2	1.3	0.2	0.5	0.0	8.0

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
Blocked (yellow) hrs/month	**16.7**	**3.2**	**16.8**	**4.5**	**6.2**	**0.5**	**1.8**	**3.0**	**0.0**	**11.3**	**15.8**	**3.2**	**83.0**

7.3 2015 Data

Table 7.3 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South A, 2015)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.7	4.5	1.0	0.0	0.0	1.8	0.0	0.2	0.0	0.3	1.8	10.3
20	0.0	0.5	2.2	0.5	0.0	0.2	1.3	0.0	0.0	0.0	0.0	0.0	4.7
30	0.0	1.0	1.7	0.8	0.0	0.5	1.7	0.0	0.0	1.0	0.0	0.0	6.7
40	0.0	0.5	1.2	1.0	0.0	0.2	0.3	0.0	0.2	0.5	0.0	0.0	3.8
50	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.0	0.2	1.3	0.0	0.0	2.3
60	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.0	0.0	1.3
70	0.0	0.0	0.5	0.2	0.0	0.2	0.0	0.2	0.5	0.0	0.0	0.0	1.5
80	0.0	0.5	0.8	0.0	0.0	0.3	0.0	0.0	0.2	0.2	0.0	0.0	2.0
90	0.0	1.0	1.2	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	2.7
100	0.0	0.8	1.8	0.0	0.0	0.2	0.0	0.5	0.0	0.2	0.0	0.0	3.5
110	0.0	5.2	2.8	0.0	0.5	0.3	0.7	0.2	0.2	0.0	0.0	0.0	9.8
120	0.0	1.5	1.5	2.2	1.5	1.5	0.0	0.2	0.0	0.7	0.0	0.0	9.0
130	0.0	0.0	0.8	0.7	0.3	0.0	0.0	0.5	0.0	1.2	0.2	0.0	3.7
140	0.0	1.0	0.7	1.0	0.7	0.0	0.2	0.3	0.3	2.2	1.0	3.2	10.5
150	0.0	0.5	0.7	0.8	0.5	0.0	0.7	0.0	0.3	0.0	0.0	3.2	6.7
160	0.0	1.5	0.2	0.3	0.5	0.0	0.7	0.5	0.0	1.5	1.5	2.2	8.8
170	0.0	1.7	0.0	0.0	0.5	0.0	0.0	0.8	0.2	0.8	2.8	5.2	12.0
180	0.0	0.8	0.2	0.8	0.3	0.5	0.0	1.2	0.0	3.8	5.2	3.0	15.8
190	0.0	0.5	0.3	0.8	0.2	0.3	0.0	1.3	0.0	1.2	3.8	4.0	12.5
200	0.0	3.0	0.0	2.3	0.5	1.5	0.2	1.3	0.0	0.5	3.2	3.5	16.0
210	0.0	3.8	0.2	1.0	0.2	0.7	0.3	1.2	0.0	1.7	1.8	4.2	15.0
220	5.2	11.7	4.0	5.8	0.8	0.2	0.0	1.8	0.0	3.3	4.0	14.7	51.5
230	8.7	4.8	1.5	0.5	0.0	0.0	0.3	0.0	1.2	2.8	13.0	6.7	39.5
240	2.8	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.3	0.8	10.2
250	4.2	0.0	0.2	0.2	0.0	0.8	1.0	0.2	0.2	0.7	2.2	2.2	11.7
260	0.7	0.7	1.0	0.5	0.0	0.8	0.5	1.7	0.0	0.0	1.5	2.0	9.3
270	0.2	0.0	0.8	0.3	0.0	0.8	0.2	0.5	0.0	0.0	1.5	0.7	5.0
280	0.3	0.0	0.2	0.2	0.0	0.7	0.3	0.2	0.7	1.5	1.8	0.2	6.0
290	0.2	0.0	0.0	0.2	0.0	0.3	0.2	0.0	0.5	4.0	0.5	0.8	6.7
300	0.3	0.2	0.0	0.0	0.0	0.0	0.5	0.3	1.0	2.8	0.2	0.2	5.5

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
310	2.0	1.2	0.7	0.5	0.0	0.2	0.0	4.0	2.2	0.8	1.5	0.3	13.3
320	1.3	0.7	2.3	0.2	0.0	0.0	0.0	10.7	3.8	0.0	3.0	0.2	22.2
330	0.2	0.2	1.3	0.3	0.0	0.0	2.8	0.0	1.2	0.0	0.7	0.0	6.7
340	0.0	0.5	2.0	0.0	0.0	0.0	0.8	0.0	2.3	0.0	0.2	0.2	6.0
350	0.0	1.3	1.2	0.5	0.0	0.0	1.8	0.0	1.2	0.0	0.5	0.2	6.7
360	0.0	0.2	5.3	0.7	0.0	0.0	1.0	0.0	0.3	0.0	0.5	0.8	8.8
Blocked (yellow) hrs/month	**20.8**	**21.5**	**6.3**	**7.8**	**1.0**	**2.2**	**1.8**	**3.2**	**1.7**	**9.7**	**23.3**	**28.5**	**127.8**

7.4 2016 Data

Table 7.4 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South A, 2016)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.2	0.8	0.0	2.2	1.2	0.0	0.2	0.2	0.3	0.2	0.0	5.2
20	0.2	0.0	1.0	0.0	7.0	5.2	0.0	0.0	0.5	0.3	0.5	0.0	14.7
30	0.0	0.0	1.8	0.2	2.5	6.0	0.0	0.0	0.3	0.3	0.0	0.0	11.2
40	0.0	0.0	2.2	0.3	0.2	4.8	0.0	0.0	1.5	0.2	0.0	0.0	9.2
50	0.2	0.0	1.8	0.3	0.0	1.5	0.0	0.0	1.0	0.0	0.2	0.0	5.0
60	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.8	0.0	0.3	0.0	2.0
70	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.2	0.3	0.0	0.8
80	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.8	0.2	0.2	0.0	2.0
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.3	0.0	1.2
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0
110	0.0	0.0	0.0	0.7	0.0	5.0	0.0	0.0	3.0	0.0	0.0	0.0	8.7
120	2.8	0.0	0.0	0.7	0.0	0.3	0.0	0.0	2.3	0.0	0.0	0.0	6.2
130	31.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	35.0
140	14.0	1.3	1.2	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.2	18.2
150	3.7	0.3	1.7	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	1.2	7.2
160	0.5	0.0	9.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
170	1.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	3.5	0.2	0.0	0.0	9.7
180	0.0	0.0	4.5	0.3	0.8	0.3	0.0	0.0	0.2	0.3	0.0	2.0	8.5
190	0.0	0.0	5.3	0.3	0.7	2.2	0.0	0.0	0.2	0.3	0.0	1.2	10.2
200	1.8	0.0	2.8	0.7	0.7	1.8	0.8	0.0	0.3	0.3	0.0	1.2	10.5
210	0.7	0.3	2.5	0.8	0.2	2.8	2.8	0.0	2.3	0.3	0.2	4.5	17.5
220	8.2	6.3	6.7	0.8	0.0	0.8	0.0	0.3	0.3	0.8	0.5	2.0	26.8
230	3.5	6.0	1.7	0.0	0.0	0.0	0.2	0.0	0.2	0.8	0.0	0.5	12.8
240	0.2	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.2	0.2	6.7

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
250	0.3	2.2	1.7	1.7	0.0	0.3	0.0	0.0	0.2	0.2	0.2	0.0	6.7
260	0.0	0.7	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	2.3
270	0.8	1.7	0.7	0.3	0.0	1.3	0.0	0.0	0.2	0.2	0.0	0.5	5.7
280	4.7	2.5	0.5	0.0	0.0	0.8	0.2	0.0	0.0	0.3	0.0	0.5	9.5
290	1.5	1.0	0.0	0.7	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	3.8
300	0.5	0.7	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	2.3
310	0.8	1.3	0.0	0.0	0.0	0.8	0.0	0.0	0.3	0.8	0.5	0.0	4.7
320	0.2	0.8	0.5	0.2	0.0	0.2	0.0	0.0	0.2	0.7	1.0	0.0	3.7
330	0.2	0.8	1.5	0.2	0.0	0.3	0.0	0.0	0.2	0.3	0.0	0.0	3.5
340	1.2	1.0	2.2	0.5	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	6.2
350	3.0	0.0	4.3	2.5	0.0	1.2	0.0	0.2	0.0	0.0	0.0	0.0	11.2
360	0.7	0.5	3.5	1.7	0.0	1.2	0.0	0.0	0.2	0.0	0.3	0.0	8.0
Blocked (yellow) hrs/month	**12.8**	**16.0**	**13.0**	**3.7**	**0.2**	**4.5**	**3.2**	**0.3**	**3.3**	**3.3**	**3.0**	**7.2**	**70.5**

7.5 2017 Data

Table 7.5 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South A, 2017)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.2	0.0	0.0	0.3	0.3	5.0
20	0.7	0.0	0.0	0.0	0.0	0.0	1.3	0.2	0.0	0.0	1.5	1.2	4.8
30	0.3	0.5	0.0	0.0	0.5	0.0	2.3	0.0	0.0	0.0	0.2	0.3	4.2
40	0.0	0.3	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	2.2	3.3
50	0.2	3.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.7	4.2
60	0.0	1.2	1.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.2	2.8
70	0.0	1.0	1.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	2.8
80	0.0	0.7	1.2	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	2.3
90	0.0	5.5	1.2	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5
100	0.0	2.2	2.7	0.0	1.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	6.0
110	0.0	0.2	3.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
120	0.0	4.8	4.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.0	9.3
130	1.5	0.0	3.2	0.0	0.0	0.0	0.8	0.0	0.0	1.2	0.0	0.0	6.7
140	1.2	3.8	3.0	0.0	0.0	0.2	1.3	0.0	0.0	0.5	0.0	0.0	10.0
150	3.0	10.5	1.8	0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	18.3
160	7.0	10.5	0.5	0.0	0.0	0.0	0.7	0.2	0.0	0.5	0.0	1.2	20.5
170	4.7	6.0	0.8	0.8	0.0	2.0	0.0	1.8	0.0	1.8	0.0	1.0	19.0
180	2.2	2.5	1.5	5.3	0.0	3.2	0.5	1.3	0.0	1.8	0.0	0.8	19.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
190	0.0	2.5	5.5	3.3	0.0	3.0	1.3	0.8	0.0	0.8	2.2	0.7	20.2
200	0.3	0.5	2.7	0.2	0.0	0.2	0.2	0.0	0.0	4.7	4.8	1.8	15.3
210	6.8	1.7	2.0	0.0	0.0	0.3	1.0	0.0	0.0	5.8	11.8	3.8	33.3
220	4.0	1.8	2.3	0.0	0.0	0.3	0.2	0.0	0.0	2.8	0.7	1.8	14.0
230	2.0	1.2	0.7	0.0	0.0	0.0	0.5	0.2	0.0	0.3	1.3	1.5	7.7
240	4.0	1.0	0.5	0.0	0.0	0.2	0.2	0.3	0.0	0.2	1.0	5.5	12.8
250	0.8	0.5	0.2	0.0	0.0	0.2	0.2	0.3	0.0	0.0	0.3	3.7	6.2
260	0.5	0.2	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	1.8	3.0
270	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.8
280	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.5	1.0
290	1.2	1.2	0.0	0.0	0.0	0.2	0.8	0.3	0.0	0.0	0.0	0.8	4.5
300	1.3	0.2	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.2	4.2	9.0
310	0.5	0.2	0.5	1.2	0.0	0.2	1.7	0.0	0.0	0.0	0.2	2.7	7.0
320	1.2	0.3	1.5	0.2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	4.7
330	2.2	0.5	0.3	0.2	0.0	0.0	0.3	0.0	0.0	0.8	0.0	1.8	6.2
340	0.2	0.3	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.2	0.3	1.7	4.3
350	0.0	0.3	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.5	3.2	1.3	6.0
360	0.5	0.0	0.0	0.0	0.0	0.0	0.8	3.8	0.0	0.2	0.8	0.8	7.0
Blocked (yellow) hrs/month	17.7	6.2	5.7	0.0	0.0	1.0	2.0	0.8	0.0	9.2	15.2	16.3	74.0

7.6 2018 Data

Table 7.6 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South A, 2018)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.2	0.2	3.0	1.2	1.0	0.7	6.7	0.7	0.0	3.5	0.0	0.0	17.0
20	0.2	0.0	7.8	1.0	0.2	3.2	2.0	0.0	0.0	5.7	0.0	0.0	20.0
30	0.2	0.0	0.3	2.8	0.2	2.2	0.0	0.0	0.0	3.0	0.0	0.0	8.7
40	0.5	0.7	0.5	2.5	1.2	0.5	0.0	0.0	0.0	0.2	0.0	0.0	6.0
50	0.5	0.2	1.8	1.8	0.0	1.5	0.0	0.0	0.0	0.5	0.0	0.0	6.3
60	0.8	0.2	1.2	2.2	0.3	2.8	0.0	0.0	0.0	1.5	0.0	0.0	9.0
70	0.7	0.0	2.0	6.3	0.8	1.2	0.0	0.0	0.0	1.2	0.2	0.0	12.3
80	0.7	0.2	2.7	3.5	0.0	1.0	0.0	0.0	0.0	1.0	0.3	0.0	9.3
90	1.0	0.3	2.3	1.7	0.0	0.3	0.0	0.2	0.0	0.0	0.2	0.0	6.0
100	0.5	0.3	2.5	0.2	0.0	0.7	0.0	0.0	0.0	0.0	0.5	0.0	4.7
110	0.3	0.3	1.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.3	0.0	2.5
120	1.0	0.7	2.8	0.5	0.0	0.0	0.0	0.2	0.0	0.0	0.7	0.0	5.8

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
130	1.3	1.0	4.3	2.2	0.0	0.2	0.0	0.0	0.0	0.0	1.3	0.0	10.3
140	0.8	0.7	6.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.2	11.7
150	2.3	0.2	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.3	8.5
160	4.8	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	3.8	1.7	10.7
170	4.7	0.0	0.5	0.2	0.3	0.0	0.0	0.0	0.0	0.3	2.2	2.0	10.2
180	3.7	0.2	0.5	0.3	0.3	0.0	0.0	0.0	0.0	0.5	6.8	3.8	16.2
190	2.2	6.8	1.7	0.8	0.0	0.0	0.2	0.0	0.0	0.2	2.7	2.2	16.7
200	5.5	11.5	0.8	0.2	0.0	0.0	0.0	1.5	0.0	0.8	3.0	3.2	26.5
210	3.2	7.7	0.7	1.0	0.2	0.0	0.3	0.7	0.0	0.0	4.8	4.8	23.3
220	3.2	0.2	0.7	0.0	0.0	0.0	0.2	0.8	0.0	0.0	0.5	4.5	10.0
230	1.5	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	2.0	4.0
240	1.2	0.2	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	3.7	5.5
250	0.7	0.0	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.0
260	0.7	0.0	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.7	3.7
270	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.3
280	0.3	0.0	0.2	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.0	1.8
290	0.0	0.2	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.5	1.0
300	1.2	1.7	0.3	0.0	0.0	0.2	0.0	2.0	0.0	0.0	0.0	3.2	8.5
310	2.0	1.3	0.2	0.0	0.0	0.7	0.0	0.7	0.7	0.0	0.0	0.5	6.0
320	0.2	0.7	0.3	0.8	0.2	3.8	0.0	1.2	0.2	0.0	0.0	1.8	9.2
330	0.2	0.7	0.2	0.0	0.0	0.5	1.0	0.3	0.7	0.0	0.0	0.2	3.7
340	0.0	0.8	0.2	1.2	0.2	0.3	0.3	0.3	0.5	0.0	0.0	0.0	3.8
350	0.5	1.0	1.5	1.5	0.5	0.0	2.0	0.2	0.0	0.3	0.0	0.0	7.5
360	0.0	0.7	0.3	0.5	0.5	0.0	4.0	0.7	0.0	1.0	0.0	0.0	7.7
Blocked (yellow) hrs/month	**9.7**	**8.2**	**1.7**	**2.2**	**0.2**	**0.0**	**0.5**	**1.8**	**0.2**	**0.0**	**5.3**	**16.2**	**45.8**

2019 Data

Table 7.7 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South A, 2019)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
10	0.0	0.5	0.0	0.0	0.3	5.5	0.2	0.0	0.0	0.0	6.5
20	0.0	2.8	0.0	0.0	0.3	2.7	0.0	0.0	0.0	0.0	5.8
30	0.0	0.0	0.0	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.8
40	0.0	0.7	0.0	2.7	2.8	0.0	0.0	0.0	0.0	0.0	6.2
50	0.0	0.5	0.0	0.5	1.3	0.0	0.0	0.0	0.2	1.8	4.3
60	0.0	0.3	0.0	0.3	1.2	0.0	0.0	0.0	0.0	1.3	3.2

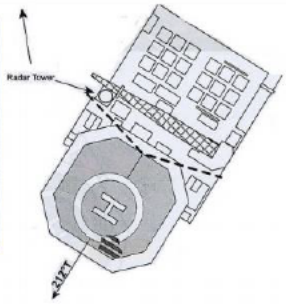
Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.5
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	1.7
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5
120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2
130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
140	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.0	1.0
150	0.0	1.2	0.0	0.2	0.0	0.3	0.0	0.2	0.3	0.0	2.2
160	0.0	1.3	0.0	0.0	0.0	0.0	0.3	0.0	0.8	0.0	2.5
170	0.0	0.3	0.8	0.3	0.0	0.0	0.2	0.0	1.5	0.0	3.2
180	0.0	0.5	0.7	0.0	0.0	0.3	0.0	0.0	3.3	0.0	4.8
190	0.0	2.5	2.3	0.0	0.0	0.5	0.0	0.2	2.5	0.0	8.0
200	2.3	4.0	0.8	0.0	0.7	0.2	1.5	2.5	1.8	0.0	13.8
210	5.2	6.3	2.8	0.0	0.7	0.2	0.0	3.5	0.8	0.0	19.5
220	0.3	1.8	1.2	0.0	0.0	0.5	1.5	0.3	0.8	0.0	6.5
230	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.7
240	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
250	0.7	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.3	0.0	1.5
260	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.3
270	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
280	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3
290	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2
300	0.5	0.0	0.5	0.0	0.0	1.2	0.0	0.0	0.2	0.0	2.3
310	0.3	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	1.0
320	0.2	0.2	0.7	0.2	2.0	0.3	0.2	0.2	0.3	0.0	4.2
330	1.0	0.2	0.5	1.8	2.8	0.0	3.0	2.2	0.2	0.0	11.7
340	1.8	0.8	0.0	2.7	2.3	0.5	1.7	0.0	0.8	0.0	10.7
350	2.8	1.8	0.0	0.3	1.8	2.0	0.2	0.0	0.5	0.0	9.5
360	0.3	0.8	0.0	0.3	0.7	4.0	0.3	0.0	0.3	0.0	6.8
Blocked (yellow) hrs/month	**6.5**	**8.3**	**4.5**	**0.0**	**0.7**	**0.8**	**1.5**	**4.2**	**2.0**	**0.0**	**28.5**

8 Ravenspurn South B

40. The Ravenspurn South B platform is a NUI approved for daylight operations only. Figure 8.1 presents the helideck information plate for the Ravenspurn South B platform.

HCA HELIDECK INFORMATION PLATE

HELIDECK Elev 111 ft	VAR 0	POSITION N54 03.37 E000 53.55	EGRY **Ravenspurn B**		
HEIGHT OF INSTALLATION: 127 HIGHEST OBSTACLE WITHIN 5NM:			VHF 129.875	NDB Nil	Issue Date 05 Feb 2020
FUELLING INSTALLATION: No STARTING EQUIPMENT: No			Operating Company		Issued By
Norway 1.25D - 'D' = 16.01m HELIDECK D value: 16.01 P/R/H Category: F Max Weight: 5.3			Perenco UK Ltd		Helideck Certification Agency



Wind (T°)	Kts	Limitation /Comment
		• NUI • Daylight operations only • Prohibited landing sector 155 degree - 185 degree • Table 1(T) if overflight of either access unavoidable
		Non Compliance
150°		Radar tower in second sector
5:1		SE / NW access platforms and platform structure north
Misc		Circle and H lights fitted but switched off and isolated Aiming circle offset No automatic fire-fighting facilities Gull Scat fitted (Bird scaring system - irregular loud noises) Cleared for AW139 (6.8t)

Figure 8.1 Ravenspurn South B Helideck Information Plate (Source: HCA)

41. The Ravenspurn South B platform is located 9.8 km (5.3 nm) from the Hornsea Four array area. The Hornsea Four array obstructs an approach arc from 180° to 280°. However, if an approach can be made up to 30° out of wind, then these arcs reduce to 210° to 250°.

8.1 2013 Data

Table 8.1 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South B, 2013)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.3	0.5	1.8	1.3	0.2	0.7	0.0	2.5	0.2	0.7	0.0	8.2
20	0.0	0.2	0.5	3.3	0.0	1.2	1.0	0.3	2.7	1.2	1.8	0.0	12.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
30	0.0	0.2	0.5	0.3	0.0	0.8	1.0	0.2	1.3	3.0	0.5	0.0	7.8
40	0.2	0.2	0.0	0.3	0.0	1.8	6.2	0.0	0.2	3.5	0.5	0.0	12.8
50	0.2	2.0	1.7	0.0	0.0	0.5	3.5	0.0	0.0	5.5	0.3	0.0	13.7
60	0.7	6.0	3.3	0.0	0.0	0.8	3.8	0.0	0.0	0.5	0.2	0.0	15.3
70	0.3	3.2	0.8	0.3	0.0	1.3	2.5	0.0	0.0	0.0	0.0	0.0	8.5
80	0.3	0.0	0.0	0.7	0.0	0.0	1.5	0.5	0.0	0.3	0.0	0.0	3.3
90	1.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.3
100	2.5	0.0	1.0	1.5	0.0	0.0	0.2	0.0	0.0	1.0	0.0	0.0	6.2
110	0.3	0.2	9.0	3.5	0.5	0.0	0.0	0.0	0.0	2.0	0.0	0.0	15.5
120	0.8	1.0	11.3	0.5	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	14.7
130	9.3	0.7	2.3	1.0	0.5	0.0	0.0	0.2	0.0	1.0	0.0	0.0	15.0
140	4.5	2.2	0.8	3.5	2.3	0.0	0.0	1.0	0.0	1.3	0.0	0.0	15.7
150	0.2	0.0	1.5	0.3	1.3	0.0	0.2	0.0	0.0	2.3	0.0	1.3	7.2
160	0.8	3.8	1.5	0.0	0.0	0.0	0.2	0.0	2.7	1.7	1.2	0.7	12.5
170	0.0	2.8	2.0	0.0	0.7	0.0	0.3	0.0	1.5	0.2	0.7	0.3	8.5
180	0.0	1.8	4.2	0.2	0.2	0.0	0.0	0.0	0.0	0.5	0.2	0.8	7.8
190	0.0	0.3	1.2	1.3	0.5	0.0	0.3	0.0	0.0	0.8	0.2	2.2	6.8
200	0.2	3.0	0.7	2.3	1.0	0.7	1.2	0.0	0.0	0.3	0.5	1.5	11.3
210	2.3	0.3	2.0	1.3	0.5	1.7	0.3	0.0	0.2	0.5	0.0	2.3	11.5
220	5.8	0.0	1.8	1.5	0.5	1.7	0.0	2.3	1.2	1.0	3.5	15.5	34.8
230	4.8	0.0	1.8	1.2	0.0	1.2	0.0	0.2	0.5	0.8	5.7	14.3	30.5
240	0.7	0.0	0.5	0.2	0.2	1.2	0.0	0.0	0.0	0.8	2.8	0.2	6.5
250	1.8	0.5	0.2	0.0	0.5	0.5	0.0	0.0	0.3	0.5	1.2	0.5	6.0
260	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.3	1.2	3.7	0.3	6.7
270	0.5	0.2	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.5	7.0	0.7	9.3
280	0.3	2.7	0.0	0.0	0.3	1.0	0.0	1.0	0.0	0.3	4.0	0.5	10.2
290	0.0	0.5	0.0	0.0	5.5	1.2	0.0	0.3	0.5	0.0	0.8	0.0	8.8
300	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.3	0.2	0.2	0.8	0.2	2.7
310	0.0	0.2	0.2	0.2	0.3	0.3	0.0	0.7	0.2	0.2	0.2	0.0	2.3
320	0.0	0.0	0.0	2.2	0.0	0.3	0.5	0.0	0.7	0.8	1.3	0.2	6.0
330	0.3	0.8	0.0	1.5	0.0	0.2	1.0	0.0	0.5	0.3	1.8	1.2	7.7
340	0.0	0.7	0.0	0.5	0.7	0.3	1.8	0.0	1.8	0.7	2.8	0.2	9.5
350	0.7	0.8	0.0	1.0	1.8	0.0	1.3	0.0	2.2	0.3	0.7	0.0	8.8
360	0.0	1.0	0.2	0.7	1.0	0.3	1.5	0.0	1.3	0.3	0.5	0.0	6.8
Blocked (yellow) hrs/month	**15.5**	**0.8**	**6.3**	**4.2**	**1.7**	**6.2**	**0.3**	**2.5**	**2.2**	**3.7**	**13.2**	**32.8**	**89.3**

8.2 2014 Data

Table 8.2 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South B, 2014)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.5	0.3	0.0	0.7	1.0	0.0	0.7	0.5	0.0	0.0	3.7
20	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.3	0.2	0.0	1.2
30	0.0	0.0	0.3	0.7	1.7	0.5	0.0	0.0	2.0	1.5	0.2	0.0	6.8
40	0.0	0.0	1.0	0.0	0.7	0.3	0.2	0.0	5.0	2.0	0.2	0.0	9.3
50	0.0	0.0	2.2	0.0	0.5	0.7	0.2	0.0	6.3	6.7	2.8	0.0	19.3
60	0.0	0.0	1.2	0.0	0.7	4.2	0.0	0.0	0.5	2.2	2.7	0.0	11.3
70	0.0	0.0	0.2	0.5	0.7	0.0	0.0	0.0	0.2	0.5	3.0	0.0	5.0
80	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	1.3
90	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
100	0.0	0.0	0.3	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
110	0.2	0.2	9.5	0.7	3.0	0.0	0.0	0.0	0.2	0.2	0.0	0.2	14.0
120	0.0	1.0	15.7	2.7	0.7	0.2	0.0	0.8	5.0	0.2	0.8	1.0	28.0
130	1.7	1.2	3.2	3.3	0.8	0.3	0.0	0.5	2.5	0.0	6.3	1.2	21.0
140	7.7	1.3	1.0	1.7	0.8	0.2	0.0	2.3	1.2	0.0	22.8	1.3	40.3
150	1.8	2.0	0.2	0.2	0.0	0.5	0.2	0.0	0.7	1.0	5.5	2.0	14.0
160	1.7	2.0	0.2	0.0	0.0	0.2	0.2	0.0	0.8	1.3	2.7	2.0	11.0
170	2.5	4.5	0.7	0.7	0.0	0.2	0.0	0.0	0.3	0.7	2.8	4.5	16.8
180	12.8	2.0	0.5	0.0	0.0	0.3	0.0	0.2	0.2	0.3	1.7	2.0	20.0
190	10.0	4.3	1.8	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5	4.3	21.3
200	7.0	3.3	2.0	0.2	0.2	0.5	0.2	0.0	0.0	0.0	0.3	3.3	17.0
210	4.2	0.2	3.7	1.5	0.2	0.0	0.5	0.0	0.0	3.3	1.5	0.2	15.2
220	3.5	0.5	8.0	1.7	1.0	0.2	0.3	0.3	0.0	5.2	6.5	0.5	27.7
230	4.7	1.5	2.3	0.7	1.7	0.0	0.3	1.2	0.0	1.5	4.2	1.5	19.5
240	3.2	1.0	2.3	0.2	1.5	0.2	0.2	0.8	0.0	1.0	1.7	1.0	13.0
250	1.2	0.0	0.5	0.5	1.8	0.2	0.5	0.7	0.0	0.3	2.0	0.0	7.7
260	0.5	0.0	0.3	0.0	0.0	0.3	0.5	0.2	2.2	0.0	0.3	0.0	4.3
270	1.3	0.0	0.2	0.0	0.2	0.0	0.0	0.0	3.5	0.0	0.3	0.0	5.5
280	0.5	0.8	0.2	0.0	0.3	0.0	0.2	0.3	1.3	0.7	0.7	0.8	5.8
290	0.5	0.0	0.2	0.0	1.3	0.0	0.5	0.0	0.0	0.2	0.2	0.0	2.8
300	0.3	0.0	0.0	0.0	0.7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.3
310	0.2	0.0	0.0	0.0	0.2	0.0	0.3	0.2	0.2	0.3	0.0	0.0	1.3
320	0.8	1.7	0.2	0.2	0.5	0.5	0.8	0.8	2.2	0.7	0.2	1.7	10.2
330	0.5	0.2	0.3	0.0	0.3	0.2	0.0	0.2	1.3	0.5	0.3	0.2	4.0
340	0.5	0.0	0.2	0.0	0.2	1.0	6.5	0.0	2.0	1.5	0.5	0.0	12.3
350	0.0	0.0	0.2	0.0	0.0	2.8	7.7	0.2	1.0	1.3	0.8	0.0	14.0
360	0.2	0.0	0.0	0.0	0.2	2.0	3.5	0.2	1.3	0.2	0.5	0.0	8.0

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
Blocked (yellow) hrs/month	16.7	3.2	16.8	4.5	6.2	0.5	1.8	3.0	0.0	11.3	15.8	3.2	83.0

8.3 2015 Data

Table 8.3 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South B, 2015)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.7	4.5	1.0	0.0	0.0	1.8	0.0	0.2	0.0	0.3	1.8	10.3
20	0.0	0.5	2.2	0.5	0.0	0.2	1.3	0.0	0.0	0.0	0.0	0.0	4.7
30	0.0	1.0	1.7	0.8	0.0	0.5	1.7	0.0	0.0	1.0	0.0	0.0	6.7
40	0.0	0.5	1.2	1.0	0.0	0.2	0.3	0.0	0.2	0.5	0.0	0.0	3.8
50	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.0	0.2	1.3	0.0	0.0	2.3
60	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.0	0.0	1.3
70	0.0	0.0	0.5	0.2	0.0	0.2	0.0	0.2	0.5	0.0	0.0	0.0	1.5
80	0.0	0.5	0.8	0.0	0.0	0.3	0.0	0.0	0.2	0.2	0.0	0.0	2.0
90	0.0	1.0	1.2	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	2.7
100	0.0	0.8	1.8	0.0	0.0	0.2	0.0	0.5	0.0	0.2	0.0	0.0	3.5
110	0.0	5.2	2.8	0.0	0.5	0.3	0.7	0.2	0.2	0.0	0.0	0.0	9.8
120	0.0	1.5	1.5	2.2	1.5	1.5	0.0	0.2	0.0	0.7	0.0	0.0	9.0
130	0.0	0.0	0.8	0.7	0.3	0.0	0.0	0.5	0.0	1.2	0.2	0.0	3.7
140	0.0	1.0	0.7	1.0	0.7	0.0	0.2	0.3	0.3	2.2	1.0	3.2	10.5
150	0.0	0.5	0.7	0.8	0.5	0.0	0.7	0.0	0.3	0.0	0.0	3.2	6.7
160	0.0	1.5	0.2	0.3	0.5	0.0	0.7	0.5	0.0	1.5	1.5	2.2	8.8
170	0.0	1.7	0.0	0.0	0.5	0.0	0.0	0.8	0.2	0.8	2.8	5.2	12.0
180	0.0	0.8	0.2	0.8	0.3	0.5	0.0	1.2	0.0	3.8	5.2	3.0	15.8
190	0.0	0.5	0.3	0.8	0.2	0.3	0.0	1.3	0.0	1.2	3.8	4.0	12.5
200	0.0	3.0	0.0	2.3	0.5	1.5	0.2	1.3	0.0	0.5	3.2	3.5	16.0
210	0.0	3.8	0.2	1.0	0.2	0.7	0.3	1.2	0.0	1.7	1.8	4.2	15.0
220	5.2	11.7	4.0	5.8	0.8	0.2	0.0	1.8	0.0	3.3	4.0	14.7	51.5
230	8.7	4.8	1.5	0.5	0.0	0.0	0.3	0.0	1.2	2.8	13.0	6.7	39.5
240	2.8	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.3	0.8	10.2
250	4.2	0.0	0.2	0.2	0.0	0.8	1.0	0.2	0.2	0.7	2.2	2.2	11.7
260	0.7	0.7	1.0	0.5	0.0	0.8	0.5	1.7	0.0	0.0	1.5	2.0	9.3
270	0.2	0.0	0.8	0.3	0.0	0.8	0.2	0.5	0.0	0.0	1.5	0.7	5.0
280	0.3	0.0	0.2	0.2	0.0	0.7	0.3	0.2	0.7	1.5	1.8	0.2	6.0
290	0.2	0.0	0.0	0.2	0.0	0.3	0.2	0.0	0.5	4.0	0.5	0.8	6.7
300	0.3	0.2	0.0	0.0	0.0	0.0	0.5	0.3	1.0	2.8	0.2	0.2	5.5

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
310	2.0	1.2	0.7	0.5	0.0	0.2	0.0	4.0	2.2	0.8	1.5	0.3	13.3
320	1.3	0.7	2.3	0.2	0.0	0.0	0.0	10.7	3.8	0.0	3.0	0.2	22.2
330	0.2	0.2	1.3	0.3	0.0	0.0	2.8	0.0	1.2	0.0	0.7	0.0	6.7
340	0.0	0.5	2.0	0.0	0.0	0.0	0.8	0.0	2.3	0.0	0.2	0.2	6.0
350	0.0	1.3	1.2	0.5	0.0	0.0	1.8	0.0	1.2	0.0	0.5	0.2	6.7
360	0.0	0.2	5.3	0.7	0.0	0.0	1.0	0.0	0.3	0.0	0.5	0.8	8.8
Blocked (yellow) hrs/month	**20.8**	**21.5**	**6.3**	**7.8**	**1.0**	**2.2**	**1.8**	**3.2**	**1.7**	**9.7**	**23.3**	**28.5**	**127.8**

8.4 2016 Data

Table 8.4 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South B, 2016)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.2	0.8	0.0	2.2	1.2	0.0	0.2	0.2	0.3	0.2	0.0	5.2
20	0.2	0.0	1.0	0.0	7.0	5.2	0.0	0.0	0.5	0.3	0.5	0.0	14.7
30	0.0	0.0	1.8	0.2	2.5	6.0	0.0	0.0	0.3	0.3	0.0	0.0	11.2
40	0.0	0.0	2.2	0.3	0.2	4.8	0.0	0.0	1.5	0.2	0.0	0.0	9.2
50	0.2	0.0	1.8	0.3	0.0	1.5	0.0	0.0	1.0	0.0	0.2	0.0	5.0
60	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.8	0.0	0.3	0.0	2.0
70	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.2	0.3	0.0	0.8
80	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.8	0.2	0.2	0.0	2.0
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.3	0.0	1.2
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0
110	0.0	0.0	0.0	0.7	0.0	5.0	0.0	0.0	3.0	0.0	0.0	0.0	8.7
120	2.8	0.0	0.0	0.7	0.0	0.3	0.0	0.0	2.3	0.0	0.0	0.0	6.2
130	31.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	35.0
140	14.0	1.3	1.2	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.2	18.2
150	3.7	0.3	1.7	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	1.2	7.2
160	0.5	0.0	9.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
170	1.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	3.5	0.2	0.0	0.0	9.7
180	0.0	0.0	4.5	0.3	0.8	0.3	0.0	0.0	0.2	0.3	0.0	2.0	8.5
190	0.0	0.0	5.3	0.3	0.7	2.2	0.0	0.0	0.2	0.3	0.0	1.2	10.2
200	1.8	0.0	2.8	0.7	0.7	1.8	0.8	0.0	0.3	0.3	0.0	1.2	10.5
210	0.7	0.3	2.5	0.8	0.2	2.8	2.8	0.0	2.3	0.3	0.2	4.5	17.5
220	8.2	6.3	6.7	0.8	0.0	0.8	0.0	0.3	0.3	0.8	0.5	2.0	26.8
230	3.5	6.0	1.7	0.0	0.0	0.0	0.2	0.0	0.2	0.8	0.0	0.5	12.8
240	0.2	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.2	0.2	6.7

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
250	0.3	2.2	1.7	1.7	0.0	0.3	0.0	0.0	0.2	0.2	0.2	0.0	6.7
260	0.0	0.7	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	2.3
270	0.8	1.7	0.7	0.3	0.0	1.3	0.0	0.0	0.2	0.2	0.0	0.5	5.7
280	4.7	2.5	0.5	0.0	0.0	0.8	0.2	0.0	0.0	0.3	0.0	0.5	9.5
290	1.5	1.0	0.0	0.7	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	3.8
300	0.5	0.7	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	2.3
310	0.8	1.3	0.0	0.0	0.0	0.8	0.0	0.0	0.3	0.8	0.5	0.0	4.7
320	0.2	0.8	0.5	0.2	0.0	0.2	0.0	0.0	0.2	0.7	1.0	0.0	3.7
330	0.2	0.8	1.5	0.2	0.0	0.3	0.0	0.0	0.2	0.3	0.0	0.0	3.5
340	1.2	1.0	2.2	0.5	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	6.2
350	3.0	0.0	4.3	2.5	0.0	1.2	0.0	0.2	0.0	0.0	0.0	0.0	11.2
360	0.7	0.5	3.5	1.7	0.0	1.2	0.0	0.0	0.2	0.0	0.3	0.0	8.0
Blocked (yellow) hrs/month	**12.8**	**16.0**	**13.0**	**3.7**	**0.2**	**4.5**	**3.2**	**0.3**	**3.3**	**3.3**	**3.0**	**7.2**	**70.5**

8.5 2017 Data

Table 8.5 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South B, 2017)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.2	0.0	0.0	0.3	0.3	5.0
20	0.7	0.0	0.0	0.0	0.0	0.0	1.3	0.2	0.0	0.0	1.5	1.2	4.8
30	0.3	0.5	0.0	0.0	0.5	0.0	2.3	0.0	0.0	0.0	0.2	0.3	4.2
40	0.0	0.3	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	2.2	3.3
50	0.2	3.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.7	4.2
60	0.0	1.2	1.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.2	2.8
70	0.0	1.0	1.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	2.8
80	0.0	0.7	1.2	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	2.3
90	0.0	5.5	1.2	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5
100	0.0	2.2	2.7	0.0	1.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	6.0
110	0.0	0.2	3.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
120	0.0	4.8	4.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.0	9.3
130	1.5	0.0	3.2	0.0	0.0	0.0	0.8	0.0	0.0	1.2	0.0	0.0	6.7
140	1.2	3.8	3.0	0.0	0.0	0.2	1.3	0.0	0.0	0.5	0.0	0.0	10.0
150	3.0	10.5	1.8	0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	18.3
160	7.0	10.5	0.5	0.0	0.0	0.0	0.7	0.2	0.0	0.5	0.0	1.2	20.5
170	4.7	6.0	0.8	0.8	0.0	2.0	0.0	1.8	0.0	1.8	0.0	1.0	19.0
180	2.2	2.5	1.5	5.3	0.0	3.2	0.5	1.3	0.0	1.8	0.0	0.8	19.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
190	0.0	2.5	5.5	3.3	0.0	3.0	1.3	0.8	0.0	0.8	2.2	0.7	20.2
200	0.3	0.5	2.7	0.2	0.0	0.2	0.2	0.0	0.0	4.7	4.8	1.8	15.3
210	6.8	1.7	2.0	0.0	0.0	0.3	1.0	0.0	0.0	5.8	11.8	3.8	33.3
220	4.0	1.8	2.3	0.0	0.0	0.3	0.2	0.0	0.0	2.8	0.7	1.8	14.0
230	2.0	1.2	0.7	0.0	0.0	0.0	0.5	0.2	0.0	0.3	1.3	1.5	7.7
240	4.0	1.0	0.5	0.0	0.0	0.2	0.2	0.3	0.0	0.2	1.0	5.5	12.8
250	0.8	0.5	0.2	0.0	0.0	0.2	0.2	0.3	0.0	0.0	0.3	3.7	6.2
260	0.5	0.2	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	1.8	3.0
270	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.8
280	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.5	1.0
290	1.2	1.2	0.0	0.0	0.0	0.2	0.8	0.3	0.0	0.0	0.0	0.8	4.5
300	1.3	0.2	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.2	4.2	9.0
310	0.5	0.2	0.5	1.2	0.0	0.2	1.7	0.0	0.0	0.0	0.2	2.7	7.0
320	1.2	0.3	1.5	0.2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	4.7
330	2.2	0.5	0.3	0.2	0.0	0.0	0.3	0.0	0.0	0.8	0.0	1.8	6.2
340	0.2	0.3	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.2	0.3	1.7	4.3
350	0.0	0.3	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.5	3.2	1.3	6.0
360	0.5	0.0	0.0	0.0	0.0	0.0	0.8	3.8	0.0	0.2	0.8	0.8	7.0
Blocked (yellow) hrs/month	**17.7**	**6.2**	**5.7**	**0.0**	**0.0**	**1.0**	**2.0**	**0.8**	**0.0**	**9.2**	**15.2**	**16.3**	**74.0**

8.6 2018 Data

Table 8.6 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South B, 2018)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.2	0.2	3.0	1.2	1.0	0.7	6.7	0.7	0.0	3.5	0.0	0.0	17.0
20	0.2	0.0	7.8	1.0	0.2	3.2	2.0	0.0	0.0	5.7	0.0	0.0	20.0
30	0.2	0.0	0.3	2.8	0.2	2.2	0.0	0.0	0.0	3.0	0.0	0.0	8.7
40	0.5	0.7	0.5	2.5	1.2	0.5	0.0	0.0	0.0	0.2	0.0	0.0	6.0
50	0.5	0.2	1.8	1.8	0.0	1.5	0.0	0.0	0.0	0.5	0.0	0.0	6.3
60	0.8	0.2	1.2	2.2	0.3	2.8	0.0	0.0	0.0	1.5	0.0	0.0	9.0
70	0.7	0.0	2.0	6.3	0.8	1.2	0.0	0.0	0.0	1.2	0.2	0.0	12.3
80	0.7	0.2	2.7	3.5	0.0	1.0	0.0	0.0	0.0	1.0	0.3	0.0	9.3
90	1.0	0.3	2.3	1.7	0.0	0.3	0.0	0.2	0.0	0.0	0.2	0.0	6.0
100	0.5	0.3	2.5	0.2	0.0	0.7	0.0	0.0	0.0	0.0	0.5	0.0	4.7
110	0.3	0.3	1.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.3	0.0	2.5
120	1.0	0.7	2.8	0.5	0.0	0.0	0.0	0.2	0.0	0.0	0.7	0.0	5.8

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
130	1.3	1.0	4.3	2.2	0.0	0.2	0.0	0.0	0.0	0.0	1.3	0.0	10.3
140	0.8	0.7	6.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.2	11.7
150	2.3	0.2	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.3	8.5
160	4.8	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	3.8	1.7	10.7
170	4.7	0.0	0.5	0.2	0.3	0.0	0.0	0.0	0.0	0.3	2.2	2.0	10.2
180	3.7	0.2	0.5	0.3	0.3	0.0	0.0	0.0	0.0	0.5	6.8	3.8	16.2
190	2.2	6.8	1.7	0.8	0.0	0.0	0.2	0.0	0.0	0.2	2.7	2.2	16.7
200	5.5	11.5	0.8	0.2	0.0	0.0	0.0	1.5	0.0	0.8	3.0	3.2	26.5
210	3.2	7.7	0.7	1.0	0.2	0.0	0.3	0.7	0.0	0.0	4.8	4.8	23.3
220	3.2	0.2	0.7	0.0	0.0	0.0	0.2	0.8	0.0	0.0	0.5	4.5	10.0
230	1.5	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	2.0	4.0
240	1.2	0.2	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	3.7	5.5
250	0.7	0.0	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.0
260	0.7	0.0	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.7	3.7
270	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.3
280	0.3	0.0	0.2	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.0	1.8
290	0.0	0.2	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.5	1.0
300	1.2	1.7	0.3	0.0	0.0	0.2	0.0	2.0	0.0	0.0	0.0	3.2	8.5
310	2.0	1.3	0.2	0.0	0.0	0.7	0.0	0.7	0.7	0.0	0.0	0.5	6.0
320	0.2	0.7	0.3	0.8	0.2	3.8	0.0	1.2	0.2	0.0	0.0	1.8	9.2
330	0.2	0.7	0.2	0.0	0.0	0.5	1.0	0.3	0.7	0.0	0.0	0.2	3.7
340	0.0	0.8	0.2	1.2	0.2	0.3	0.3	0.3	0.5	0.0	0.0	0.0	3.8
350	0.5	1.0	1.5	1.5	0.5	0.0	2.0	0.2	0.0	0.3	0.0	0.0	7.5
360	0.0	0.7	0.3	0.5	0.5	0.0	4.0	0.7	0.0	1.0	0.0	0.0	7.7
Blocked (yellow) hrs/month	**9.7**	**8.2**	**1.7**	**2.2**	**0.2**	**0.0**	**0.5**	**1.8**	**0.2**	**0.0**	**5.3**	**16.2**	**45.8**

8.7 2019 Data

Table 8.7 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South B, 2019)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
10	0.0	0.5	0.0	0.0	0.3	5.5	0.2	0.0	0.0	0.0	6.5
20	0.0	2.8	0.0	0.0	0.3	2.7	0.0	0.0	0.0	0.0	5.8
30	0.0	0.0	0.0	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.8
40	0.0	0.7	0.0	2.7	2.8	0.0	0.0	0.0	0.0	0.0	6.2
50	0.0	0.5	0.0	0.5	1.3	0.0	0.0	0.0	0.2	1.8	4.3
60	0.0	0.3	0.0	0.3	1.2	0.0	0.0	0.0	0.0	1.3	3.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.5
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	1.7
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5
120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2
130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
140	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.0	1.0
150	0.0	1.2	0.0	0.2	0.0	0.3	0.0	0.2	0.3	0.0	2.2
160	0.0	1.3	0.0	0.0	0.0	0.0	0.3	0.0	0.8	0.0	2.5
170	0.0	0.3	0.8	0.3	0.0	0.0	0.2	0.0	1.5	0.0	3.2
180	0.0	0.5	0.7	0.0	0.0	0.3	0.0	0.0	3.3	0.0	4.8
190	0.0	2.5	2.3	0.0	0.0	0.5	0.0	0.2	2.5	0.0	8.0
200	2.3	4.0	0.8	0.0	0.7	0.2	1.5	2.5	1.8	0.0	13.8
210	5.2	6.3	2.8	0.0	0.7	0.2	0.0	3.5	0.8	0.0	19.5
220	0.3	1.8	1.2	0.0	0.0	0.5	1.5	0.3	0.8	0.0	6.5
230	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.7
240	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
250	0.7	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.3	0.0	1.5
260	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.3
270	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
280	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3
290	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2
300	0.5	0.0	0.5	0.0	0.0	1.2	0.0	0.0	0.2	0.0	2.3
310	0.3	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	1.0
320	0.2	0.2	0.7	0.2	2.0	0.3	0.2	0.2	0.3	0.0	4.2
330	1.0	0.2	0.5	1.8	2.8	0.0	3.0	2.2	0.2	0.0	11.7
340	1.8	0.8	0.0	2.7	2.3	0.5	1.7	0.0	0.8	0.0	10.7
350	2.8	1.8	0.0	0.3	1.8	2.0	0.2	0.0	0.5	0.0	9.5
360	0.3	0.8	0.0	0.3	0.7	4.0	0.3	0.0	0.3	0.0	6.8
Blocked (yellow) hrs/month	**6.5**	**8.3**	**4.5**	**0.0**	**0.7**	**0.8**	**1.5**	**4.2**	**2.0**	**0.0**	**28.5**

9 Ravenspurn South C

42. The Ravenspurn South C platform is a NUI approved for daylight operations only. Figure 9.1 presents the helideck information plate for the Ravenspurn South C platform.

HCA | HELIDECK INFORMATION PLATE

HELIDECK Elev 111 ft	VAR 0	POSITION N54 05.0 E000 49.28	Ravenspurn C		
HEIGHT OF INSTALLATION: 111ft HIGHEST OBSTACLE WITHIN 5NM: Check			VHF 129.875	NDB Nil	Issue Date Jan 2019
FUELLING INSTALLATION: No STARTING EQUIPMENT: No HELIDECK D value: 16.01 P/R/H Category: F Max Weight: 5.3			Operating Company Perenco		Issued By Helideck Certification Agency

Wind (T°)	Kts	Limitation /Comment
		NUI • Table 1(T) if overflight of 5:1 items is unavoidable • Cleared for AW139 (6.8t) • Daylight only operations TDPM & H lights U/S
		Non Compliance
	5:1	SE access 3.4m from SLA, NW access and microwave dish 5m from SLA
	Misc	Gull Scat fitted -(Bird scaring system - irregular loud noises) No automatic fire-fighting facilities

Figure 9.1 Ravenspurn South C Helideck Information Plate (Source: HCA)

43. The Ravenspurn South C is located 12.9 km (7.0 nm) from the Hornsea Four array area. The Hornsea Four array obstructs an approach arc from 200° to 280°. However, if an approach can be made up to 30° out of wind, then these arcs reduce to 230° to 250°.

9.1 2013 Data

Table 9.1 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South C, 2013)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.3	0.5	1.8	1.3	0.2	0.7	0.0	2.5	0.2	0.7	0.0	8.2
20	0.0	0.2	0.5	3.3	0.0	1.2	1.0	0.3	2.7	1.2	1.8	0.0	12.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
30	0.0	0.2	0.5	0.3	0.0	0.8	1.0	0.2	1.3	3.0	0.5	0.0	7.8
40	0.2	0.2	0.0	0.3	0.0	1.8	6.2	0.0	0.2	3.5	0.5	0.0	12.8
50	0.2	2.0	1.7	0.0	0.0	0.5	3.5	0.0	0.0	5.5	0.3	0.0	13.7
60	0.7	6.0	3.3	0.0	0.0	0.8	3.8	0.0	0.0	0.5	0.2	0.0	15.3
70	0.3	3.2	0.8	0.3	0.0	1.3	2.5	0.0	0.0	0.0	0.0	0.0	8.5
80	0.3	0.0	0.0	0.7	0.0	0.0	1.5	0.5	0.0	0.3	0.0	0.0	3.3
90	1.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.3
100	2.5	0.0	1.0	1.5	0.0	0.0	0.2	0.0	0.0	1.0	0.0	0.0	6.2
110	0.3	0.2	9.0	3.5	0.5	0.0	0.0	0.0	0.0	2.0	0.0	0.0	15.5
120	0.8	1.0	11.3	0.5	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.0	14.7
130	9.3	0.7	2.3	1.0	0.5	0.0	0.0	0.2	0.0	1.0	0.0	0.0	15.0
140	4.5	2.2	0.8	3.5	2.3	0.0	0.0	1.0	0.0	1.3	0.0	0.0	15.7
150	0.2	0.0	1.5	0.3	1.3	0.0	0.2	0.0	0.0	2.3	0.0	1.3	7.2
160	0.8	3.8	1.5	0.0	0.0	0.0	0.2	0.0	2.7	1.7	1.2	0.7	12.5
170	0.0	2.8	2.0	0.0	0.7	0.0	0.3	0.0	1.5	0.2	0.7	0.3	8.5
180	0.0	1.8	4.2	0.2	0.2	0.0	0.0	0.0	0.0	0.5	0.2	0.8	7.8
190	0.0	0.3	1.2	1.3	0.5	0.0	0.3	0.0	0.0	0.8	0.2	2.2	6.8
200	0.2	3.0	0.7	2.3	1.0	0.7	1.2	0.0	0.0	0.3	0.5	1.5	11.3
210	2.3	0.3	2.0	1.3	0.5	1.7	0.3	0.0	0.2	0.5	0.0	2.3	11.5
220	5.8	0.0	1.8	1.5	0.5	1.7	0.0	2.3	1.2	1.0	3.5	15.5	34.8
230	4.8	0.0	1.8	1.2	0.0	1.2	0.0	0.2	0.5	0.8	5.7	14.3	30.5
240	0.7	0.0	0.5	0.2	0.2	1.2	0.0	0.0	0.0	0.8	2.8	0.2	6.5
250	1.8	0.5	0.2	0.0	0.5	0.5	0.0	0.0	0.3	0.5	1.2	0.5	6.0
260	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.3	1.2	3.7	0.3	6.7
270	0.5	0.2	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.5	7.0	0.7	9.3
280	0.3	2.7	0.0	0.0	0.3	1.0	0.0	1.0	0.0	0.3	4.0	0.5	10.2
290	0.0	0.5	0.0	0.0	5.5	1.2	0.0	0.3	0.5	0.0	0.8	0.0	8.8
300	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.3	0.2	0.2	0.8	0.2	2.7
310	0.0	0.2	0.2	0.2	0.3	0.3	0.0	0.7	0.2	0.2	0.2	0.0	2.3
320	0.0	0.0	0.0	2.2	0.0	0.3	0.5	0.0	0.7	0.8	1.3	0.2	6.0
330	0.3	0.8	0.0	1.5	0.0	0.2	1.0	0.0	0.5	0.3	1.8	1.2	7.7
340	0.0	0.7	0.0	0.5	0.7	0.3	1.8	0.0	1.8	0.7	2.8	0.2	9.5
350	0.7	0.8	0.0	1.0	1.8	0.0	1.3	0.0	2.2	0.3	0.7	0.0	8.8
360	0.0	1.0	0.2	0.7	1.0	0.3	1.5	0.0	1.3	0.3	0.5	0.0	6.8
Blocked (yellow) hrs/month	**7.3**	**0.5**	**2.5**	**1.3**	**0.7**	**2.8**	**0.0**	**0.2**	**0.8**	**2.2**	**9.7**	**15.0**	**43.0**

9.2 2014 Data

Table 9.2 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South C, 2014)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.5	0.3	0.0	0.7	1.0	0.0	0.7	0.5	0.0	0.0	3.7
20	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.3	0.2	0.0	1.2
30	0.0	0.0	0.3	0.7	1.7	0.5	0.0	0.0	2.0	1.5	0.2	0.0	6.8
40	0.0	0.0	1.0	0.0	0.7	0.3	0.2	0.0	5.0	2.0	0.2	0.0	9.3
50	0.0	0.0	2.2	0.0	0.5	0.7	0.2	0.0	6.3	6.7	2.8	0.0	19.3
60	0.0	0.0	1.2	0.0	0.7	4.2	0.0	0.0	0.5	2.2	2.7	0.0	11.3
70	0.0	0.0	0.2	0.5	0.7	0.0	0.0	0.0	0.2	0.5	3.0	0.0	5.0
80	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	1.3
90	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
100	0.0	0.0	0.3	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
110	0.2	0.2	9.5	0.7	3.0	0.0	0.0	0.0	0.2	0.2	0.0	0.2	14.0
120	0.0	1.0	15.7	2.7	0.7	0.2	0.0	0.8	5.0	0.2	0.8	1.0	28.0
130	1.7	1.2	3.2	3.3	0.8	0.3	0.0	0.5	2.5	0.0	6.3	1.2	21.0
140	7.7	1.3	1.0	1.7	0.8	0.2	0.0	2.3	1.2	0.0	22.8	1.3	40.3
150	1.8	2.0	0.2	0.2	0.0	0.5	0.2	0.0	0.7	1.0	5.5	2.0	14.0
160	1.7	2.0	0.2	0.0	0.0	0.2	0.2	0.0	0.8	1.3	2.7	2.0	11.0
170	2.5	4.5	0.7	0.7	0.0	0.2	0.0	0.0	0.3	0.7	2.8	4.5	16.8
180	12.8	2.0	0.5	0.0	0.0	0.3	0.0	0.2	0.2	0.3	1.7	2.0	20.0
190	10.0	4.3	1.8	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5	4.3	21.3
200	7.0	3.3	2.0	0.2	0.2	0.5	0.2	0.0	0.0	0.0	0.3	3.3	17.0
210	4.2	0.2	3.7	1.5	0.2	0.0	0.5	0.0	0.0	3.3	1.5	0.2	15.2
220	3.5	0.5	8.0	1.7	1.0	0.2	0.3	0.3	0.0	5.2	6.5	0.5	27.7
230	4.7	1.5	2.3	0.7	1.7	0.0	0.3	1.2	0.0	1.5	4.2	1.5	19.5
240	3.2	1.0	2.3	0.2	1.5	0.2	0.2	0.8	0.0	1.0	1.7	1.0	13.0
250	1.2	0.0	0.5	0.5	1.8	0.2	0.5	0.7	0.0	0.3	2.0	0.0	7.7
260	0.5	0.0	0.3	0.0	0.0	0.3	0.5	0.2	2.2	0.0	0.3	0.0	4.3
270	1.3	0.0	0.2	0.0	0.2	0.0	0.0	0.0	3.5	0.0	0.3	0.0	5.5
280	0.5	0.8	0.2	0.0	0.3	0.0	0.2	0.3	1.3	0.7	0.7	0.8	5.8
290	0.5	0.0	0.2	0.0	1.3	0.0	0.5	0.0	0.0	0.2	0.2	0.0	2.8
300	0.3	0.0	0.0	0.0	0.7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.3
310	0.2	0.0	0.0	0.0	0.2	0.0	0.3	0.2	0.2	0.3	0.0	0.0	1.3
320	0.8	1.7	0.2	0.2	0.5	0.5	0.8	0.8	2.2	0.7	0.2	1.7	10.2
330	0.5	0.2	0.3	0.0	0.3	0.2	0.0	0.2	1.3	0.5	0.3	0.2	4.0
340	0.5	0.0	0.2	0.0	0.2	1.0	6.5	0.0	2.0	1.5	0.5	0.0	12.3
350	0.0	0.0	0.2	0.0	0.0	2.8	7.7	0.2	1.0	1.3	0.8	0.0	14.0
360	0.2	0.0	0.0	0.0	0.2	2.0	3.5	0.2	1.3	0.2	0.5	0.0	8.0

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
Blocked (yellow) hrs/month	**9.0**	**2.5**	**5.2**	**1.3**	**5.0**	**0.3**	**1.0**	**2.7**	**0.0**	**2.8**	**7.8**	**2.5**	**40.2**

9.3 2015 Data

Table 9.3 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South C, 2015)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.7	4.5	1.0	0.0	0.0	1.8	0.0	0.2	0.0	0.3	1.8	10.3
20	0.0	0.5	2.2	0.5	0.0	0.2	1.3	0.0	0.0	0.0	0.0	0.0	4.7
30	0.0	1.0	1.7	0.8	0.0	0.5	1.7	0.0	0.0	1.0	0.0	0.0	6.7
40	0.0	0.5	1.2	1.0	0.0	0.2	0.3	0.0	0.2	0.5	0.0	0.0	3.8
50	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.0	0.2	1.3	0.0	0.0	2.3
60	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.3	0.2	0.2	0.0	0.0	1.3
70	0.0	0.0	0.5	0.2	0.0	0.2	0.0	0.2	0.5	0.0	0.0	0.0	1.5
80	0.0	0.5	0.8	0.0	0.0	0.3	0.0	0.0	0.2	0.2	0.0	0.0	2.0
90	0.0	1.0	1.2	0.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	2.7
100	0.0	0.8	1.8	0.0	0.0	0.2	0.0	0.5	0.0	0.2	0.0	0.0	3.5
110	0.0	5.2	2.8	0.0	0.5	0.3	0.7	0.2	0.2	0.0	0.0	0.0	9.8
120	0.0	1.5	1.5	2.2	1.5	1.5	0.0	0.2	0.0	0.7	0.0	0.0	9.0
130	0.0	0.0	0.8	0.7	0.3	0.0	0.0	0.5	0.0	1.2	0.2	0.0	3.7
140	0.0	1.0	0.7	1.0	0.7	0.0	0.2	0.3	0.3	2.2	1.0	3.2	10.5
150	0.0	0.5	0.7	0.8	0.5	0.0	0.7	0.0	0.3	0.0	0.0	3.2	6.7
160	0.0	1.5	0.2	0.3	0.5	0.0	0.7	0.5	0.0	1.5	1.5	2.2	8.8
170	0.0	1.7	0.0	0.0	0.5	0.0	0.0	0.8	0.2	0.8	2.8	5.2	12.0
180	0.0	0.8	0.2	0.8	0.3	0.5	0.0	1.2	0.0	3.8	5.2	3.0	15.8
190	0.0	0.5	0.3	0.8	0.2	0.3	0.0	1.3	0.0	1.2	3.8	4.0	12.5
200	0.0	3.0	0.0	2.3	0.5	1.5	0.2	1.3	0.0	0.5	3.2	3.5	16.0
210	0.0	3.8	0.2	1.0	0.2	0.7	0.3	1.2	0.0	1.7	1.8	4.2	15.0
220	5.2	11.7	4.0	5.8	0.8	0.2	0.0	1.8	0.0	3.3	4.0	14.7	51.5
230	8.7	4.8	1.5	0.5	0.0	0.0	0.3	0.0	1.2	2.8	13.0	6.7	39.5
240	2.8	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.3	0.8	10.2
250	4.2	0.0	0.2	0.2	0.0	0.8	1.0	0.2	0.2	0.7	2.2	2.2	11.7
260	0.7	0.7	1.0	0.5	0.0	0.8	0.5	1.7	0.0	0.0	1.5	2.0	9.3
270	0.2	0.0	0.8	0.3	0.0	0.8	0.2	0.5	0.0	0.0	1.5	0.7	5.0
280	0.3	0.0	0.2	0.2	0.0	0.7	0.3	0.2	0.7	1.5	1.8	0.2	6.0
290	0.2	0.0	0.0	0.2	0.0	0.3	0.2	0.0	0.5	4.0	0.5	0.8	6.7
300	0.3	0.2	0.0	0.0	0.0	0.0	0.5	0.3	1.0	2.8	0.2	0.2	5.5

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
310	2.0	1.2	0.7	0.5	0.0	0.2	0.0	4.0	2.2	0.8	1.5	0.3	13.3
320	1.3	0.7	2.3	0.2	0.0	0.0	0.0	10.7	3.8	0.0	3.0	0.2	22.2
330	0.2	0.2	1.3	0.3	0.0	0.0	2.8	0.0	1.2	0.0	0.7	0.0	6.7
340	0.0	0.5	2.0	0.0	0.0	0.0	0.8	0.0	2.3	0.0	0.2	0.2	6.0
350	0.0	1.3	1.2	0.5	0.0	0.0	1.8	0.0	1.2	0.0	0.5	0.2	6.7
360	0.0	0.2	5.3	0.7	0.0	0.0	1.0	0.0	0.3	0.0	0.5	0.8	8.8
Blocked (yellow) hrs/month	**15.7**	**6.0**	**2.2**	**1.0**	**0.0**	**1.3**	**1.5**	**0.2**	**1.7**	**4.7**	**17.5**	**9.7**	**61.3**

9.4 2016 Data

Table 9.4 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South C, 2016)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.2	0.8	0.0	2.2	1.2	0.0	0.2	0.2	0.3	0.2	0.0	5.2
20	0.2	0.0	1.0	0.0	7.0	5.2	0.0	0.0	0.5	0.3	0.5	0.0	14.7
30	0.0	0.0	1.8	0.2	2.5	6.0	0.0	0.0	0.3	0.3	0.0	0.0	11.2
40	0.0	0.0	2.2	0.3	0.2	4.8	0.0	0.0	1.5	0.2	0.0	0.0	9.2
50	0.2	0.0	1.8	0.3	0.0	1.5	0.0	0.0	1.0	0.0	0.2	0.0	5.0
60	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.0	0.8	0.0	0.3	0.0	2.0
70	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.2	0.3	0.0	0.8
80	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.8	0.2	0.2	0.0	2.0
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.3	0.0	1.2
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0
110	0.0	0.0	0.0	0.7	0.0	5.0	0.0	0.0	3.0	0.0	0.0	0.0	8.7
120	2.8	0.0	0.0	0.7	0.0	0.3	0.0	0.0	2.3	0.0	0.0	0.0	6.2
130	31.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	35.0
140	14.0	1.3	1.2	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.2	18.2
150	3.7	0.3	1.7	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	1.2	7.2
160	0.5	0.0	9.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
170	1.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	3.5	0.2	0.0	0.0	9.7
180	0.0	0.0	4.5	0.3	0.8	0.3	0.0	0.0	0.2	0.3	0.0	2.0	8.5
190	0.0	0.0	5.3	0.3	0.7	2.2	0.0	0.0	0.2	0.3	0.0	1.2	10.2
200	1.8	0.0	2.8	0.7	0.7	1.8	0.8	0.0	0.3	0.3	0.0	1.2	10.5
210	0.7	0.3	2.5	0.8	0.2	2.8	2.8	0.0	2.3	0.3	0.2	4.5	17.5
220	8.2	6.3	6.7	0.8	0.0	0.8	0.0	0.3	0.3	0.8	0.5	2.0	26.8
230	3.5	6.0	1.7	0.0	0.0	0.0	0.2	0.0	0.2	0.8	0.0	0.5	12.8
240	0.2	1.2	0.5	0.3	0.0	0.5	0.2	0.0	0.3	1.2	2.2	0.2	6.7

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
250	0.3	2.2	1.7	1.7	0.0	0.3	0.0	0.0	0.2	0.2	0.2	0.0	6.7
260	0.0	0.7	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	2.3
270	0.8	1.7	0.7	0.3	0.0	1.3	0.0	0.0	0.2	0.2	0.0	0.5	5.7
280	4.7	2.5	0.5	0.0	0.0	0.8	0.2	0.0	0.0	0.3	0.0	0.5	9.5
290	1.5	1.0	0.0	0.7	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	3.8
300	0.5	0.7	0.0	0.3	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	2.3
310	0.8	1.3	0.0	0.0	0.0	0.8	0.0	0.0	0.3	0.8	0.5	0.0	4.7
320	0.2	0.8	0.5	0.2	0.0	0.2	0.0	0.0	0.2	0.7	1.0	0.0	3.7
330	0.2	0.8	1.5	0.2	0.0	0.3	0.0	0.0	0.2	0.3	0.0	0.0	3.5
340	1.2	1.0	2.2	0.5	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	6.2
350	3.0	0.0	4.3	2.5	0.0	1.2	0.0	0.2	0.0	0.0	0.0	0.0	11.2
360	0.7	0.5	3.5	1.7	0.0	1.2	0.0	0.0	0.2	0.0	0.3	0.0	8.0
Blocked (yellow) hrs/month	**4.0**	**9.3**	**3.8**	**2.0**	**0.0**	**0.8**	**0.3**	**0.0**	**0.7**	**2.2**	**2.3**	**0.7**	**26.2**

9.5 2017 Data

Table 9.5 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South C, 2017)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.2	0.0	0.0	0.3	0.3	5.0
20	0.7	0.0	0.0	0.0	0.0	0.0	1.3	0.2	0.0	0.0	1.5	1.2	4.8
30	0.3	0.5	0.0	0.0	0.5	0.0	2.3	0.0	0.0	0.0	0.2	0.3	4.2
40	0.0	0.3	0.0	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	2.2	3.3
50	0.2	3.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.7	4.2
60	0.0	1.2	1.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.2	2.8
70	0.0	1.0	1.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	2.8
80	0.0	0.7	1.2	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	2.3
90	0.0	5.5	1.2	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5
100	0.0	2.2	2.7	0.0	1.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	6.0
110	0.0	0.2	3.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
120	0.0	4.8	4.0	0.0	0.2	0.0	0.2	0.0	0.0	0.2	0.0	0.0	9.3
130	1.5	0.0	3.2	0.0	0.0	0.0	0.8	0.0	0.0	1.2	0.0	0.0	6.7
140	1.2	3.8	3.0	0.0	0.0	0.2	1.3	0.0	0.0	0.5	0.0	0.0	10.0
150	3.0	10.5	1.8	0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	18.3
160	7.0	10.5	0.5	0.0	0.0	0.0	0.7	0.2	0.0	0.5	0.0	1.2	20.5
170	4.7	6.0	0.8	0.8	0.0	2.0	0.0	1.8	0.0	1.8	0.0	1.0	19.0
180	2.2	2.5	1.5	5.3	0.0	3.2	0.5	1.3	0.0	1.8	0.0	0.8	19.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
190	0.0	2.5	5.5	3.3	0.0	3.0	1.3	0.8	0.0	0.8	2.2	0.7	20.2
200	0.3	0.5	2.7	0.2	0.0	0.2	0.2	0.0	0.0	4.7	4.8	1.8	15.3
210	6.8	1.7	2.0	0.0	0.0	0.3	1.0	0.0	0.0	5.8	11.8	3.8	33.3
220	4.0	1.8	2.3	0.0	0.0	0.3	0.2	0.0	0.0	2.8	0.7	1.8	14.0
230	2.0	1.2	0.7	0.0	0.0	0.0	0.5	0.2	0.0	0.3	1.3	1.5	7.7
240	4.0	1.0	0.5	0.0	0.0	0.2	0.2	0.3	0.0	0.2	1.0	5.5	12.8
250	0.8	0.5	0.2	0.0	0.0	0.2	0.2	0.3	0.0	0.0	0.3	3.7	6.2
260	0.5	0.2	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	1.8	3.0
270	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.8
280	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.5	1.0
290	1.2	1.2	0.0	0.0	0.0	0.2	0.8	0.3	0.0	0.0	0.0	0.8	4.5
300	1.3	0.2	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.2	4.2	9.0
310	0.5	0.2	0.5	1.2	0.0	0.2	1.7	0.0	0.0	0.0	0.2	2.7	7.0
320	1.2	0.3	1.5	0.2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.5	4.7
330	2.2	0.5	0.3	0.2	0.0	0.0	0.3	0.0	0.0	0.8	0.0	1.8	6.2
340	0.2	0.3	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.2	0.3	1.7	4.3
350	0.0	0.3	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.5	3.2	1.3	6.0
360	0.5	0.0	0.0	0.0	0.0	0.0	0.8	3.8	0.0	0.2	0.8	0.8	7.0
Blocked (yellow) hrs/month	**6.8**	**2.7**	**1.3**	**0.0**	**0.0**	**0.3**	**0.8**	**0.8**	**0.0**	**0.5**	**2.7**	**10.7**	**26.7**

9.6 2018 Data

Table 9.6 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South C, 2018)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
10	0.2	0.2	3.0	1.2	1.0	0.7	6.7	0.7	0.0	3.5	0.0	0.0	17.0
20	0.2	0.0	7.8	1.0	0.2	3.2	2.0	0.0	0.0	5.7	0.0	0.0	20.0
30	0.2	0.0	0.3	2.8	0.2	2.2	0.0	0.0	0.0	3.0	0.0	0.0	8.7
40	0.5	0.7	0.5	2.5	1.2	0.5	0.0	0.0	0.0	0.2	0.0	0.0	6.0
50	0.5	0.2	1.8	1.8	0.0	1.5	0.0	0.0	0.0	0.5	0.0	0.0	6.3
60	0.8	0.2	1.2	2.2	0.3	2.8	0.0	0.0	0.0	1.5	0.0	0.0	9.0
70	0.7	0.0	2.0	6.3	0.8	1.2	0.0	0.0	0.0	1.2	0.2	0.0	12.3
80	0.7	0.2	2.7	3.5	0.0	1.0	0.0	0.0	0.0	1.0	0.3	0.0	9.3
90	1.0	0.3	2.3	1.7	0.0	0.3	0.0	0.2	0.0	0.0	0.2	0.0	6.0
100	0.5	0.3	2.5	0.2	0.0	0.7	0.0	0.0	0.0	0.0	0.5	0.0	4.7
110	0.3	0.3	1.2	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.3	0.0	2.5
120	1.0	0.7	2.8	0.5	0.0	0.0	0.0	0.2	0.0	0.0	0.7	0.0	5.8

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Per Bearing
130	1.3	1.0	4.3	2.2	0.0	0.2	0.0	0.0	0.0	0.0	1.3	0.0	10.3
140	0.8	0.7	6.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.2	11.7
150	2.3	0.2	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.3	8.5
160	4.8	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	3.8	1.7	10.7
170	4.7	0.0	0.5	0.2	0.3	0.0	0.0	0.0	0.0	0.3	2.2	2.0	10.2
180	3.7	0.2	0.5	0.3	0.3	0.0	0.0	0.0	0.0	0.5	6.8	3.8	16.2
190	2.2	6.8	1.7	0.8	0.0	0.0	0.2	0.0	0.0	0.2	2.7	2.2	16.7
200	5.5	11.5	0.8	0.2	0.0	0.0	0.0	1.5	0.0	0.8	3.0	3.2	26.5
210	3.2	7.7	0.7	1.0	0.2	0.0	0.3	0.7	0.0	0.0	4.8	4.8	23.3
220	3.2	0.2	0.7	0.0	0.0	0.0	0.2	0.8	0.0	0.0	0.5	4.5	10.0
230	1.5	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	2.0	4.0
240	1.2	0.2	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	3.7	5.5
250	0.7	0.0	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	3.0
260	0.7	0.0	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.7	3.7
270	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.3
280	0.3	0.0	0.2	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.0	1.8
290	0.0	0.2	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.5	1.0
300	1.2	1.7	0.3	0.0	0.0	0.2	0.0	2.0	0.0	0.0	0.0	3.2	8.5
310	2.0	1.3	0.2	0.0	0.0	0.7	0.0	0.7	0.7	0.0	0.0	0.5	6.0
320	0.2	0.7	0.3	0.8	0.2	3.8	0.0	1.2	0.2	0.0	0.0	1.8	9.2
330	0.2	0.7	0.2	0.0	0.0	0.5	1.0	0.3	0.7	0.0	0.0	0.2	3.7
340	0.0	0.8	0.2	1.2	0.2	0.3	0.3	0.3	0.5	0.0	0.0	0.0	3.8
350	0.5	1.0	1.5	1.5	0.5	0.0	2.0	0.2	0.0	0.3	0.0	0.0	7.5
360	0.0	0.7	0.3	0.5	0.5	0.0	4.0	0.7	0.0	1.0	0.0	0.0	7.7
Blocked (yellow) hrs/month	**3.3**	**0.3**	**0.3**	**1.2**	**0.0**	**0.0**	**0.0**	**0.3**	**0.2**	**0.0**	**0.0**	**6.8**	**12.5**

9.7 2019 Data

Table 9.7 Breakdown of Hours When an ARA is Required by Wind Direction and Month (Ravenspurn South C, 2019)

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
10	0.0	0.5	0.0	0.0	0.3	5.5	0.2	0.0	0.0	0.0	6.5
20	0.0	2.8	0.0	0.0	0.3	2.7	0.0	0.0	0.0	0.0	5.8
30	0.0	0.0	0.0	0.2	0.7	0.0	0.0	0.0	0.0	0.0	0.8
40	0.0	0.7	0.0	2.7	2.8	0.0	0.0	0.0	0.0	0.0	6.2
50	0.0	0.5	0.0	0.5	1.3	0.0	0.0	0.0	0.2	1.8	4.3
60	0.0	0.3	0.0	0.3	1.2	0.0	0.0	0.0	0.0	1.3	3.2

Wind Direction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total Per Bearing
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.5
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	1.7
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5
120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2
130	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
140	0.0	0.5	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.0	1.0
150	0.0	1.2	0.0	0.2	0.0	0.3	0.0	0.2	0.3	0.0	2.2
160	0.0	1.3	0.0	0.0	0.0	0.0	0.3	0.0	0.8	0.0	2.5
170	0.0	0.3	0.8	0.3	0.0	0.0	0.2	0.0	1.5	0.0	3.2
180	0.0	0.5	0.7	0.0	0.0	0.3	0.0	0.0	3.3	0.0	4.8
190	0.0	2.5	2.3	0.0	0.0	0.5	0.0	0.2	2.5	0.0	8.0
200	2.3	4.0	0.8	0.0	0.7	0.2	1.5	2.5	1.8	0.0	13.8
210	5.2	6.3	2.8	0.0	0.7	0.2	0.0	3.5	0.8	0.0	19.5
220	0.3	1.8	1.2	0.0	0.0	0.5	1.5	0.3	0.8	0.0	6.5
230	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.7
240	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
250	0.7	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.3	0.0	1.5
260	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.3
270	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
280	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3
290	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2
300	0.5	0.0	0.5	0.0	0.0	1.2	0.0	0.0	0.2	0.0	2.3
310	0.3	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	1.0
320	0.2	0.2	0.7	0.2	2.0	0.3	0.2	0.2	0.3	0.0	4.2
330	1.0	0.2	0.5	1.8	2.8	0.0	3.0	2.2	0.2	0.0	11.7
340	1.8	0.8	0.0	2.7	2.3	0.5	1.7	0.0	0.8	0.0	10.7
350	2.8	1.8	0.0	0.3	1.8	2.0	0.2	0.0	0.5	0.0	9.5
360	0.3	0.8	0.0	0.3	0.7	4.0	0.3	0.0	0.3	0.0	6.8
Blocked (yellow) hrs/month	**1.0**	**0.2**	**0.5**	**0.0**	**0.0**	**0.2**	**0.0**	**0.3**	**0.3**	**0.0**	**2.5**

Appendix B Radar Early Warning Technical Report

Hornsea Project Four Environmental Statement (ES)

Appendix B of ES Annex 11.1: Radar Early Warning Technical Report

Deadline 2, Date: 29th March 2022
Revision: 01

Prepared Manchester Advanced Radar Services. January 2022
Checked GoBe Consultants Ltd. January 2022
Accepted Nicola Allan, Orsted. March 2022
Approved Aparna Majmudar, Orsted. March 2022

Appendix B of A5.11.1
Vers B

Revision Summary				
Rev	*Date*	*Prepared by*	*Checked by*	*Approved by*
01	22/03/2022	Manchester Advanced Radar Services. January 2022	GoBe Consultants Ltd. January 2022	Nicola Allan, Ørsted. March 2022

Revision Change Log			
Rev	*Page*	*Section*	*Description*
01	1		Addition of Revision Summary page
	39	6.2.1.3 - 6.2.1.5	Corrected data calculation and related conclusions: Previous version treated all platforms as manned for purpose of CPA & TCPA calculations and applied single constant speed. This was an error.
	40	6.3.1.2	As above
	48 - 51	Figures 33 - 44.	As above
	52	Table 5	As above
	54	6.7.1.4	As above
	57	7.4.1.2	As above

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Glossary

Term	Definition
Allision	The act of striking or collision of a moving vessel against a stationary object.
Clutter	Clutter is the term used for unwanted echoes in electronic systems, particularly in reference to radars. Such echoes are typically returned from ground, sea, rain, animals/insects, chaff and atmospheric turbulences, and can cause serious performance issues with radar systems.
Doppler signature	Doppler signature is the parameter used by Doppler enabled radars to produce velocity data about objects at a distance. It does this by bouncing a microwave signal off a desired target and analysing how the object's motion has altered the frequency of the returned signal. This variation gives direct and highly accurate measurements of the radial component of a target's velocity relative to the radar.
Former Hornsea Zone	The former Hornsea Zone was one of nine offshore wind generation zones around the UK coast identified by The Crown Estate (TCE) during its third round of offshore wind licensing. In March 2016, the Hornsea Zone Development Agreement was terminated and project specific agreements, Agreement for Leases, were agreed with The Crown Estate for Hornsea Project One Offshore Wind Farm, Hornsea Project Two Offshore Wind Farm, Hornsea Project Three Offshore Wind Farm and Hornsea Four. The Hornsea Zone has therefore been dissolved and is referred to throughout as the former Hornsea Zone.
Hornsea Project Four Offshore Wind Farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
Orsted Hornsea Project Four Ltd.	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).
Radar Cross-Section (RCS)	RCS is the measure of a target's ability to reflect radar signals in the direction of the radar receiver. An object reflects a limited amount of radar energy back to the source. A larger RCS indicates that an object is more easily detected.
Radar returns	The electromagnetic signal that has been reflected back to the radar antenna. Such reflections contain information about the location and distance of the reflecting object.
Radar Shadow	Radar shadow is the region whereby the radar beam is unable to fully illuminate a region due to blockage from terrain or structures within the area of coverage. Radar shadowing causes objects within the shadow region to produce reduced radar returns which can affect the radar's ability to detect such objects.
Target detection	A radar's ability to distinguish between radar returns from wanted targets and returns from clutter and/or the system's noise level.
Target tracking	This refers to the radar's ability to continually detect the target. Target tracking is a component of a radar system, or an associated command and control system, that associates consecutive radar observations of the same target into tracks. Radar tracking uses software algorithms to track objects and compensate for momentary loss of detection without losing the track.

Acronyms

Acronym	Definition
AD	Air Defence
AIS	Automatic Identification System
AMSL	Above Mean Sea Level
ATC	Air Traffic Control
CA	Constant Averaging
CAD	Computer Aided Design
CFAR	Constant False-Alarm Rate
CPA	Closest Point of Approach
ERRV	Emergency Response and Rescue Vessels
ES	Environmental Statement
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
LAT	Lowest Astronomical Tide
LoS	Line of Sight
MDS	Maximum Design Scenario
MTI	Moving Target Indicator
NUI	Normally Unmanned Installation
RCS	Radar Cross Section
REWS	Radar Early Warning System
TCPA	Time to the Closest Point of Approach
UHF	Ultra-High Frequency
VTS	Vessel Traffic Services

Units

Term	Definition
°	Degrees
dB	Decibel
dBsm	Decibel Square Metres
ft	Feet
GHz	Gigahertz
GT	Gross tons
hr	Hours
kHz	Kilohertz
km	Kilometre
kt	knot
kW	Kilowatt
mm	Millimetres
ms-1	Metres per second
MW	Megawatt
nm	Nautical miles
ns	Nanoseconds
RPM	Rotations per minute

1 Introduction

1.1 Overview

1.1.1.1 This document is an appendix to **Volume A5, Annex 11.1: Offshore Installation Interfaces** and considers the potential effect of the Hornsea Project Four Offshore Wind Farm (hereafter 'Hornsea Four') during the operation and maintenance phase on Radar Early Warning Systems (REWS) located on offshore oil and gas platforms. Specifically, this appendix considers the effects of Hornsea Four on the ability of REWS to detect vessels within the vicinity of the wind farm and the effect of rerouted traffic on the REWS alarm rates. There may be effects associated with the construction and decommissioning phase of Hornsea Four in regard to increased movement within the Hornsea Four array. This is not within the scope of this study as it needs detailed data regarding vessel movements during the construction and decommissioning procedures, which might be governed by separate agreements between the REWS operators and Orsted Hornsea Project Four Limited (hereafter 'the Applicant'). As such, this has not been included in the assessment, which considers the maximum design scenario (MDS) for the operation and maintenance phase of Hornsea Four.

1.1.1.2 REWS uses the radar returns to monitor and track vessels within the detection region and alert the operator when a proximity violation or an allision threat is detected. The modelling work presented within this report considers a REWS configuration, which was based on technical information provided by the REWS operators (see **Section 3.1.3.6**). It addresses the effects of Hornsea Four on vessel detection due to raised thresholds, clutter returns and radar shadowing effects generated from the turbines. The REWS also uses a defined set of rules to identify a breach of the Closest Point of Approach (CPA) and Time to Closest Point of Approach (TCPA) alarms. This report will present modelling work and analysis results that aims to predict the effect of traffic rerouted as a result of the presence of the operational Hornsea Four on the CPA/TCPA alarm rates.

1.1.1.3 The report considers two platforms where REWS are installed that are in close proximity to the Hornsea Four array area. The two identified platforms are both operated by Perenco and they are Ravenspurn North CC and Ravenspurn South Bravo. These two REWS installations, along with the REWS site on the Cleeton CC platform, provide radar coverage and protection for a number of other nearby Perenco offshore platforms (i.e. Ravenspurn North S2, Ravenspurn North ST3, Ravenspurn South A, Ravenspurn South C, Cleeton CC, Neptune, Hoton, Hyde, Trent, A1D). Other oil and gas platforms in the region were also identified to be within close proximity of Hornsea Four array area, namely; the NEO operated Babbage platform and the Alpha Petroleum operated Kilmar and Garrow Normally Unmanned Installations (NUIs). These platforms are not assessed within this report because consultations with their respective operators indicated that REWS is not used to monitor these platforms.

1.1.1.4 This report also provides the technical information and modelling results considering the cumulative impact of Hornsea Four and other projects and plans, specifically other projects within the former Hornsea Zone, namely Hornsea Project One Offshore Wind Farm (hereafter 'Hornsea Project One'), Hornsea Project Two Offshore Wind Farm (hereafter 'Hornsea Project Two') and Hornsea Project Three Offshore Wind Farm (hereafter 'Hornsea Three'). No other developments have been identified as being in close enough proximity to Hornsea Four to result in a cumulative impact on REWS and the CPA/TCPA alarms assessments.

1.2 Background

1.2.1.1 Wind farm turbines and associated offshore structures (such as accommodation platforms and offshore substations) located within the line-of-sight (LoS) of radars, may interfere with the radar performance and degrade its ability to distinguish between turbines and associated offshore structures, and returns from targets of interest.

1.2.1.2 REWS are primarily used to detect and track vessels navigating in the vicinity of offshore oil and gas assets and provide allision warning when vessels are in breach of defined CPA and TCPA parameters. The impact of offshore wind farms on REWS may arise from a number of factors such as; high radar returns from the turbines and associated offshore structures, increased number of detections and false alarm/track generation.

1.2.1.3 Offshore wind turbines are large structures with geometries and materials that may cause them to have a high radar cross-section (RCS). Furthermore, the rotation of the turbine blades produces a time-variable RCS fluctuation and a Doppler frequency shift that can confuse radars that rely on moving target indicator (MTI) filters to distinguish between static objects and moving targets of interest. The interference to Doppler based Air Traffic Control (ATC) and Air Defence (AD) radars due to the rotating blades and the large reflection of the radar signal has been well reported and explained (Jago and Taylor 2002; Poupart 2003; Wind Energy, Defence & Civil Aviation Interests Working Group 2002). However, this technical report discusses and models the potential impact of Hornsea Four on the REWS used on oil and gas platforms which have been identified as potentially being affected by Hornsea Four due to their location. Typically, REWS does not employ Doppler processing and MTI filters as it operates in naval environments whereby the returns from the sea surface (and the movement of the waves) may generate radar returns with Doppler signatures similar to that of surface vessels. REWS can be integrated with newer radar transceivers that are capable of Doppler processing if deemed necessary.

1.2.1.4 For non-Doppler based radars such as the REWS, the potential impact from offshore wind farms may arise due to the large radar returns. The large RCS of turbines may cause target spreading at extended ranges and potential detections through the sidelobes at close ranges. This will cause smearing and cluttering of the radar screen and potentially mask other targets in the area. In addition, depending on the thresholding techniques used within a radar system, the presence of turbines and associated offshore structures may increase the threshold over parts of the array area, which potentially may cause smaller targets to be lost.

1.2.1.5 Degradation of the radar performance may also be caused by the radar shadow due to the presence of wind turbines within the LoS of the radar, as shown in **Figure 1**. Shadowing may cause smaller targets to temporarily disappear from the radar display as it moves in and out of the shadow regions. The extent of the impact caused by shadowing depends on the size and height of the turbine and the target of interest (i.e. different effects may be observed if looking at surface targets or air targets). However, previous studies and trials showed that the effect of shadowing can be considered to be an effect of secondary importance that may have little impact on the REWS performance due to the size of vessels that the REWS is typically interested in detecting (Butler and Johnson 2003; Greenwell 2016).

1.2.1.6 This report uses a number of modelling techniques developed at the University of Manchester to model and predict the impact of turbines and associated offshore structures on radar systems. These models have been verified and were compared against real-life radar and RCS measurements and it is noted that the modelling results showed very good correlation with measurements. The models used within this report allow the radar returns coming both from the wanted target and Hornsea Four to be simulated so that the effects on radar detection can be evaluated. The results from the models can then be used to indicate the regions within which vessels can be detected and tracked. **Section 2** below describes the different modelling techniques utilised in the Hornsea Four assessment.

2 Scope of Assessment

2.1 Target Masking

2.1.1.1 The size, geometry and construction materials of turbines cause them to have a very large radar return. This may cause target spreading (smearing) at extended ranges and potential detections through the sidelobes at close ranges. Such effects will add clutter to the radar screen and potentially mask other targets in the area. This may also affect the tracking software performance when vessels are travelling within the Hornsea Four array area causing the radar tracks of vessels to be seduced and merged into the larger returns generated from the turbines. This report addresses the impact of target masking and compares the levels of the turbine radar returns against that of a typical vessel within the radar detection range. This report does not consider the effects of varying turbine returns on the tracker as this requires a detailed knowledge of the employed tracking software which is proprietary information, discussed further in **paragraph 2.5.1.1**. Despite this, it remains possible to draw robust conclusions.

2.2 Shadowing Effects

2.2.1.1 The extent and length of the shadow region cast by a turbine depends on the size of the turbine, the distance to the radar antenna, the height of the radar and the height of the target of interest. The severity of the shadow will also depend on the distance of the target from the turbine. This is illustrated in **Figure 1**.

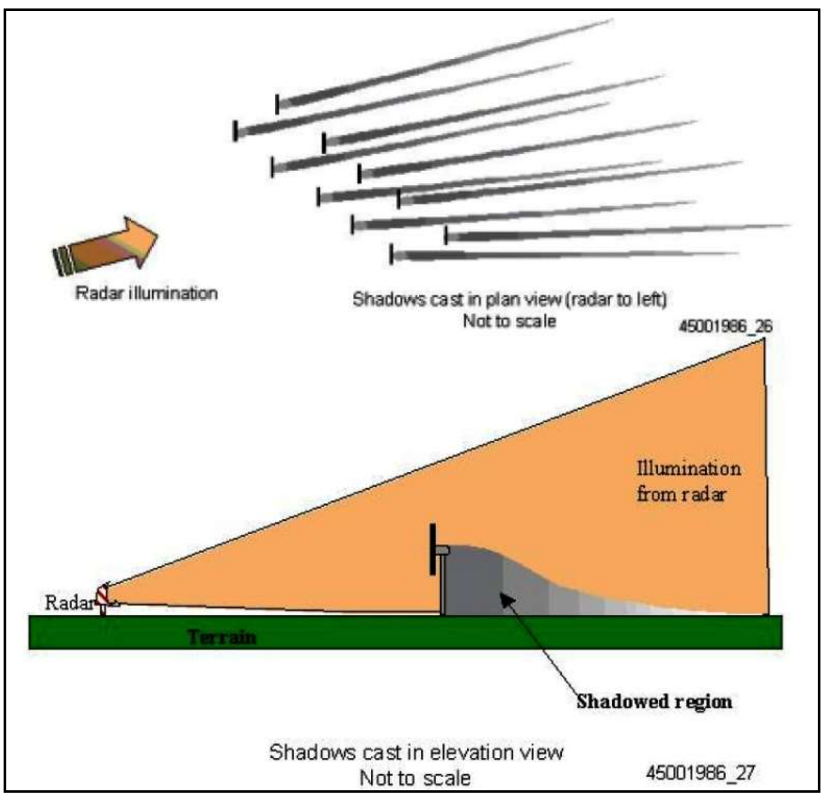

Figure 1: Illustration of radar shadowing with diffraction effects (Butler and Johnson 2003).

2.2.1.2 Due to the diffraction of the radar waves around the turbine, increasing the range between the target and the turbine will reduce the severity of the attenuation to the target's returns. It has been reported that a target 1 km behind the turbine will experience 6 dB reduction in the returned power while targets that are significantly further suffer only 2 dB reduction in the received radar echo (Butler and Johnson 2003). This is an important characteristic of the radar shadow and is illustrated in **Figure 1**. This is in good agreement with the recent measurement campaign carried out by Ultra Electronics to assess the effects of wind farms on the REWS performance located in the east Irish Sea (Greenwell 2016). The measurement campaign and the work presented in Danoon and Brown (2014) indicate that shadowing may not have a significant effect on the performance of the REWS due to the diffraction effects and the size of the vessel, which might be larger than the shadow region generated from individual turbines.

2.2.1.3 For completeness, a shadowing assessment has been undertaken within this assessment and is used in conjunction with the study of the rerouting of traffic around Hornsea Four (see **Section 2.3**). Within this assessment the radar shadows were modelled based on optical shadowing. Optical shadows conservatively assume no diffraction effects and therefore ignore the improvement in the shadow region at extended ranges. Depending on the turbine size and radar height, the optical shadows may extend all the way to the radar horizon. The use of optical shadows is used to assess scenarios which might have an impact on the radar's performance.

2.3 Rerouted Traffic

2.3.1.1 Some of the existing shipping routes will be altered by the physical presence of Hornsea Four and vessels may be rerouted nearer to existing platforms covered by the REWS as they deviate around the wind farm (as shown in **Figure 29** and described in detail within **Annex 7.1: Navigation Risk Assessment**). This may cause an increase in the CPA/TCPA alarm rates. The effects of the rerouting of traffic on the alarm rates are discussed in **Section 6**.

2.4 Adaptive Detection Threshold Modelling

2.4.1.1 A REWS deploys a number of techniques for clutter thresholding, target extraction and tracking. The use of adaptive thresholding algorithms such as Constant False Alarm Rate (CFAR) is very common within offshore REWS installations. A variety of CFAR algorithms can be used to adjust the threshold around noisy/cluttered areas to avoid unwanted and false detections depending on the clutter within the local environment. REWS uses CFAR techniques to dynamically adjust the detection threshold over sea and rain clutter. Digital signal processing is applied to calculate a constant false alarm rate for plot-extraction by generating a radar threshold below which all radar samples are ignored as they are considered to be noise or clutter. The threshold is calculated individually for each radar cell using a two-dimensional sliding window area technique whereby surrounding cells in both range and azimuth are considered. Typically, the mean and standard deviation of samples is calculated, and the threshold is set to the mean value plus a factor derived from the standard deviation of the sample.

2.4.1.2 Finally, it is worth noting that as CFAR uses multiple adjacent range and azimuth cells (see **Figure 2**) to derive the detection threshold, the presence of a single turbine will affect the threshold of multiple cells around it as shown in **Figure 2**.

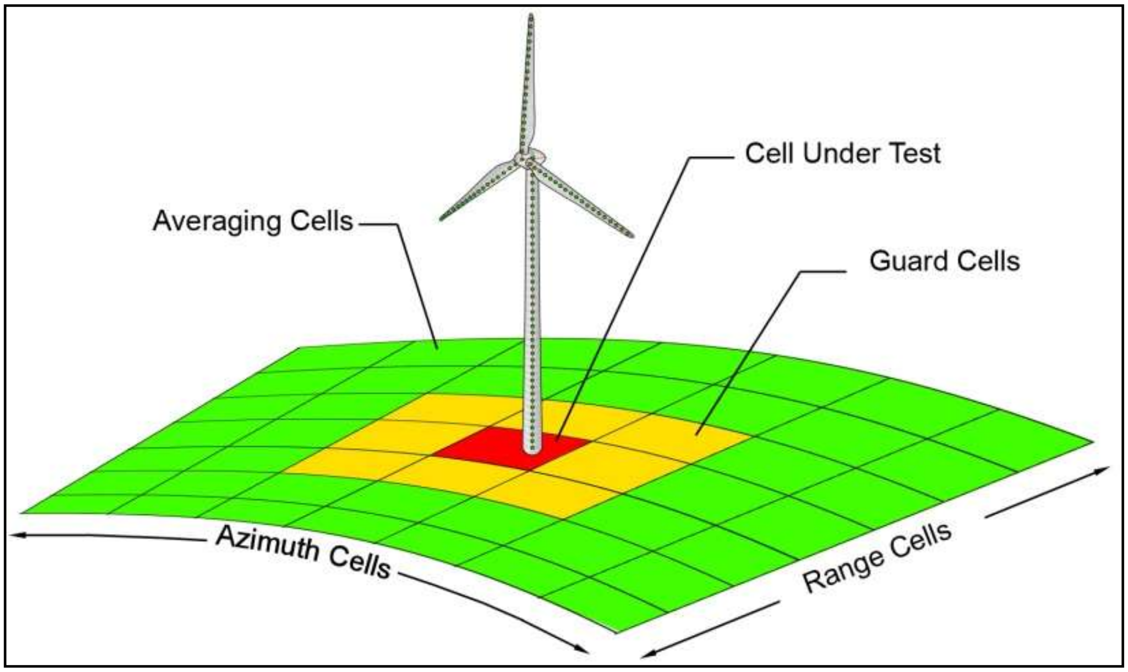

Figure 2: 2D CFAR cells around a given cell with wind turbine present.

2.5 Tracker Modelling

2.5.1.1 Radar trackers provide the radar operator with a processed and clear image of the location and bearing of moving targets in the area of interest. It is also very common for currently used radar trackers to compensate for momentary loss of detection of a target over multiple radar rotations and maintain an active track. The presence of advanced tracking within REWS can greatly benefit and enhance the operator's ability to maintain radar visibility of moving targets near or within a wind farm. REWS deploy proprietary tracker algorithms, which may vary depending on the system supplier. The impact of the wind farm on the tracker performance cannot be accurately modelled without detailed knowledge of the tracker and the proprietary tracking algorithms - which are not available to Hornsea Four and so were not included in this assessment. However, it is expected that the tracker software along with integration of Automatic Identification System (AIS) within the REWS data will enhance the detection and tracking of vessels within Hornsea Four.

2.6 Ultra-High Frequency (UHF) Communication Links

2.6.1.1 Depending on the REWS system and the tracker software, it is possible that returns from the turbines will add new target detections to the track-table. The track-tables are shared with Emergency Response and Rescue Vessels (ERRVs) via ultra-high frequency (UHF) radio links. UHF links use a low-bandwidth telemetry system and have a limit on the total number of tracks that can be transmitted. The maximum size of the track-table is a system limitation that depends largely on the hardware used and hence cannot be modelled. A typical number for the maximum track-table size is assumed to be between 400 and 600 tracked targets. Depending on the tracking software, the number of tracks within the track-table can be reduced by applying non-acquire zones over the wind farm area or by applying filters to track moving targets only. UHF communications are different and separate systems than the radar. They operate at different frequencies than the radar frequency and use different modulation techniques to transmit and receive data. Therefore, the potential impact of wind farms on the performance of UHF communication systems cannot be modelled and assessed using the radar models used within this assessment. As such, the effects of Hornsea Four on UHF communication links are considered outside the scope of this work.

2.7 Other Effects

2.7.1.1 False tracks may be initiated due to the variation of the turbines radar returns over multiple range-cells. However, the radar tracker requires consecutive detections over a number of radar rotations, which will reduce the likelihood of false track initiation. Furthermore, to raise a TCPA alarm, the track vector must continue to breach the TCPA condition for multiple radar rotations. Thus, raising false alarms due to range-cell spreading is considered very unlikely and was not included in this assessment.

2.7.1.2 It is also possible to model the effects of multiple reflections of the radar signal within the Hornsea Four array area, and between the turbines and nearby large targets, using the radar and WinR (Wind Turbine RCS) models developed at the University of Manchester. However, as the closest modelled turbine in the Hornsea Four array area is approximately 3 km away from any REWS, the effects of the multiple reflections were considered to be of second order (not a primary cause or concern) and were not included in the models (QinetiQ 2005; Baker 2007).

2.7.1.3 Depending on the detailed structure of the REWS host platform, the presence of external fittings near the radar antenna such as masts, wires and other structural elements may cause distortion of the antenna pattern and possibly the appearance of false reflection if a flat surface is near the antenna. The inclusion of such structures will greatly increase the modelling complexity and is not expected to affect the overall findings of the assessment. Therefore, these effects were not modelled.

3 Modelling Parameters

3.1 Hornsea Four

3.1.1 Summary of REWS Modelling Parameters

3.1.1.1 A summary of the MDS parameters for the REWS modelling is presented in **Table 1**.

Table 1: MDS parameters for the REWS modelling.

Hornsea Four parameter	Value
Maximum number of turbines	180
Rotor diameter	305 m
Hub height (centre point)	217.5 m above mean sea level (AMSL)
Hub height (lowest point)	212.5 m AMSL
Maximum blade tip height	370 m
Blade length	147.5 m
Turbine tower upper diameter	8 m
Turbine tower lower diameter	10 m
Transition piece diameter	12 m
Maximum number of small offshore substations within the array area	6
Maximum dimensions of small offshore substations	90 m (length) x 90 m (width) x 100 m (height)
Maximum number of large offshore substations within the array area	3
Maximum dimensions of small offshore substations	180 m (length) x 90 m (width) x 100 m (height)
Maximum number of accommodation platforms within the array area	1
Maximum dimensions of small offshore substations	60 m (length) x 60 m (width) x 64 m (height)
Total RCS of offshore substations and platforms	4,000 m^2

3.1.2 Wind Turbine Parameters

3.1.2.1 The maximum dimensions of the turbines proposed for Hornsea Four have been defined in the MDS in **Volume A1, Chapter 4: Project Description**, and are shown in **Table 1**.

3.1.2.2 In order to accurately predict the RCS of turbines at different orientations and ranges, the wind turbines need to be modelled as continuous curved surfaces that represent the geometry of the turbine. This includes the shape of the tower, the nacelle and the airfoil profile of the blades. However, the MDS only provides the main features and dimensions of the turbines and it does not provide details of the tower, blades, nacelle and hub geometries. Therefore, to undertake this study and to better model the RCS of the turbines, a realistic model of pre-existing turbine surfaces was used. This was achieved by using a realistic blade shape and airfoil profile of a 5 Megawatt (MW) turbine that was scaled up to match the MDS parameters. The shape of the nacelle, hub and tower were also scaled to match the MDS turbines. The resultant scaled turbine matches the MDS parameters and has a realistic geometry that can then be used to model the RCS and radar returns.

3.1.2.3 The scaled Computer Aided Design (CAD) geometries for the modelled turbines (i.e. 180 turbines with a rotor diameter of 305 m and a hub height of 217.5 m) used to compute the RCS of the turbines are shown in **Figure 3** below. Details such as ladders, warning lights, wind measurement/lightning protection equipment etc., were removed from the turbine CAD for RCS modelling as these will not have a significant effect on the scattering profile which is dominated by the larger components (i.e. tower, blades and nacelle), and will greatly increase the computational complexity.

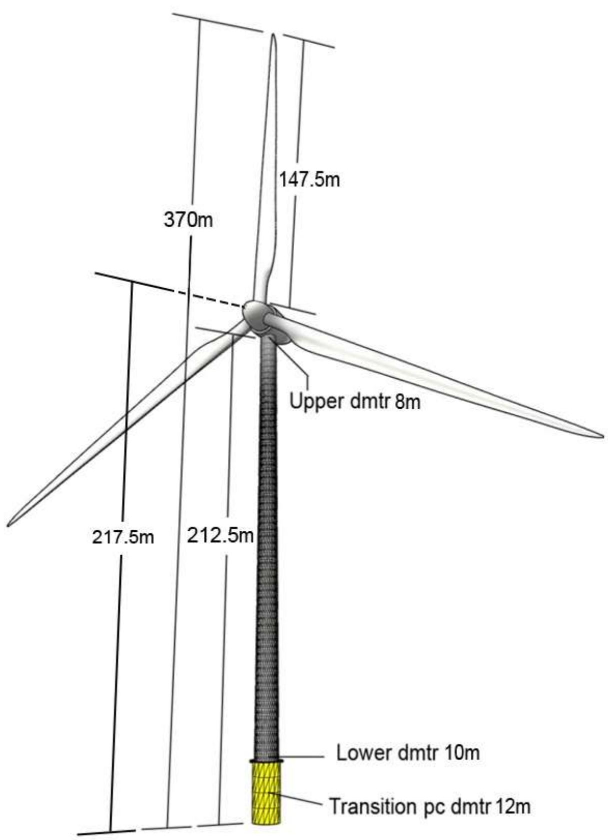

Figure 3: Modelled turbine geometry.

3.1.2.4 Within this assessment, the MDS has assumed the turbines are mounted on a monopile foundation with a transition piece leading to the tower. Traditionally, the monopile with the transition piece design gives a very large radar return, which in some cases might dominate the turbine RCS. This is due to the shape and construction materials of the transition piece which makes it highly reflective to the radar. The upright cylindrical and parallel, metallic sides of the transition piece will reflect the radar energy directly to the radar which may make up to 80% of the total radar signature generated from the turbine. Other supporting structures, such as jacket foundations are expected to have tapered sides and smaller reflective areas which will not be as prominent as the monopile foundation. Monopile foundations therefore represent the MDS for RCS. The indicative MDS layout of the turbines is presented in **Figure 4**.

3.1.2.5 When assessing the potential impact of Hornsea Four (alone) and Hornsea Project One, Hornsea Project Two, Hornsea Three and Hornsea Four (cumulatively) on a given REWS, the wind is conservatively assumed to be coming from the radar site in the direction of the centre of the wind farms. This results in the majority of the turbines facing the radar, which will then give the maximum RCS value. As the RCS of each turbine is individually computed, the blades rotation angle on each turbine is generated randomly as a value between 0° and 119°. This results in a different RCS for each turbine rather than an unrealistic unified rotation angle across all turbines.

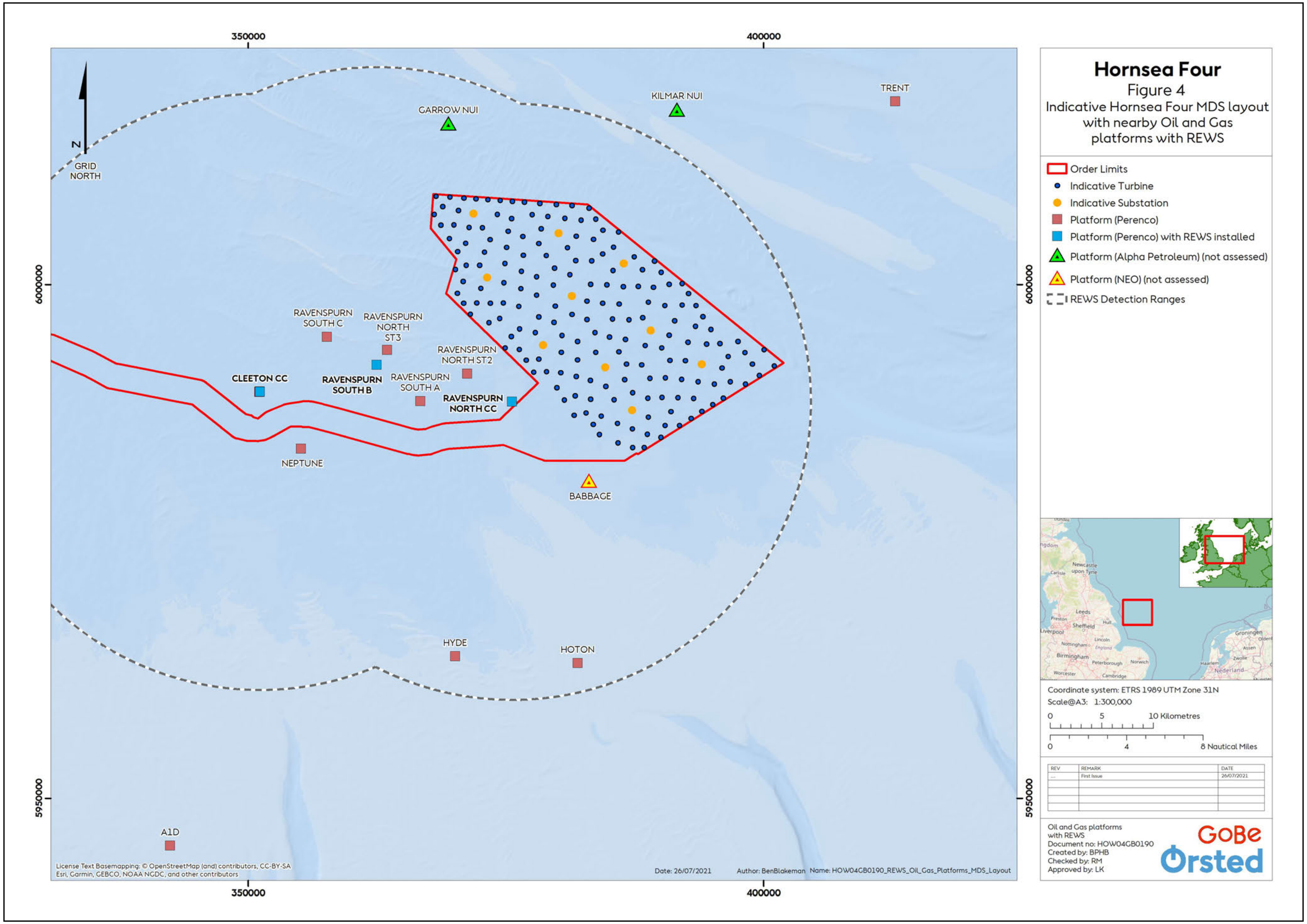

Figure 4: Indicative Hornsea Four MDS layout (180 turbines and 10 offshore substations/platforms) with nearby oil and gas platforms with REWS.

3.1.3 Hornsea Four Indicative Turbine and Offshore Substations/Platform Layout

3.1.3.1 The indicative Hornsea Four layout was imported into the models using proposed coordinates for each turbine and offshore substation/platform. The locations of the offshore substations/platforms and the imported turbine locations are shown in **Figure 5**.

3.1.3.2 Ten offshore substations/platforms are allocated within the envelope of Hornsea Four. The exact geometry and scattering profile of the substations is not defined at this stage and is not considered to be of significant importance to the radar modelling results. However, when considering offshore substations, it is important to include an approximated source of radar echoes and a structure that will cast a radar shadow. Therefore, the modelling results that are shown within this report assume that the offshore substations/platforms are large offshore structures. The radar scattering from the substations was estimated by modelling a number of scattering points distributed within a rectangular box. The dimensions of the offshore substations/platforms are presented in **Table 1**. The total RCS of each substation was set to be 4,000 m^2. This is an approximate value used to assess the impact of the substation on the shadowing and the radar detection threshold. The exact scattering characteristic will depend on the substation's geometry and construction material as well as its range from the radar antenna.

3.1.3.3 Once the locations of the turbines and the offshore substations/platforms were defined, a desk-based review of charts was undertaken alongside consultation with oil and gas operators (as set out in Table 11.4 of **Volume A2, Chapter 11: Infrastructure and Other Users**) in order to identify the location of nearby offshore oil and gas platforms and any REWS installations that might be affected by the presence of Hornsea Four. The location of offshore oil and gas platforms and the identified REWS host platforms are also shown in **Figure 4**.

3.1.3.4 Typically, a 30 km (16 nm) detection range is assumed to be the minimum requirement for REWS to detect and track smaller vessels (100 m^2 RCS). This indicates that three of Perenco's REWS installations will have a direct LoS with the Hornsea Four array area. The three REWS installations are located on Ravenspurn North CC, Ravenspurn South B, and Cleeton CC. These REWS installations provide a good overlapping radar coverage in the area to protect other Perenco assets in the region (see **Figure 10**).

3.1.3.5 Due to the close proximity of Ravenspurn North CC and Ravenspurn South B to the Hornsea Four boundaries, this report will address the potential impact of the wind farm on the radar coverage and the detection performance of these two REWS installations. The Cleeton CC REWS is not considered within this assessment due to its location, which is approximately 20 km away from the Hornsea Four array area and due to the fact that any loss of detection experienced by the Cleeton CC REWS will be compensated by the coverage provided by the REWS installations on Ravenspurn North CC and Ravenspurn South B due to the overlapping coverage of the REWS installations.

3.1.3.6 The other oil and gas platforms in the region, i.e., the Babbage platform operated by NEO Energy and the Kilmar and Garrow NUIs operated by Alpha Petroleum were also identified to be close to the Hornsea Four array area and are shown in **Figure 4**. However, at the time of writing of this Technical Report, consultations with the operators of these platforms indicated that REWS is not currently used to monitor these platforms. Therefore, no REWS detection and alarm assessments for these assets are considered within this report.

3.2 REWS Modelling

3.2.1.1 REWS provides coverage over offshore oil and gas installations and provides early warning to the operators' when vessels breach the alarm settings. REWS use pre-set allision alarm rules. Typically, for both manned and NUI an Amber alarm is raised if a vessel is within CPA of 1 nm and a Red alarm is raised if the CPA is 0.27 nm. For manned installations an Amber TCPA alarm is raised if a vessel is 40 minutes away and a Red alarm is raised if the vessel is 30 minutes away. For NUI an Amber TCPA alarm is raised if a vessel is 25 minutes away and a Red alarm is raised if the vessel is 15 minutes away. Should a vessel breach these rules an automatic alarm is raised to alert the operator. It is worth noting that TCPA alarms are only triggered if the vessel's vector remains in breach of the TCPA condition for a set number of radar rotations. For Perenco's REWS, there is a delay of 90 seconds (or 36 radar rotations) before an alarm is triggered. This setting is included to avoid alarms due to temporary vector breach of the TCPA while vessels are turning.

3.2.1.2 In addition to radar data, REWS are often integrated with AIS fitted onboard ships. If a vessel is fitted with an AIS transponder and is detected by the radar, the REWS will include the AIS data into the track data. AIS is a very useful source of vessel information and location data that can complement the radar data when temporary losses are experienced.

3.2.1.3 Within this document, the performance of the REWS is based on the specification of Raytheon's Pathfinder/ST MK2 X-band transceiver with Mariners Pathfinder X-band 12 ft antenna system. The details of the modelling parameters used are shown in **Table 2** and the antenna pattern used in the modelling is shown in **Figure 5**.

Table 2: Radar modelling parameters.

Modelling parameter	Value
Gain	30 dB
Transmitter Power	25 kW
Frequency	9.411 GHz
Pulse Width	250 ns
Rotation Rate	25 rotations per minute (RPM)
Pulse Repletion Frequency	2.0 kHz
Noise Figure	5.5 dB
Dissipative Losses	1.0 dB
Beam-shape Losses	0.6 dB
Azimuth beam width	0.7°
Elevation beam width	23.0°
Antenna Height	55 m AMSL

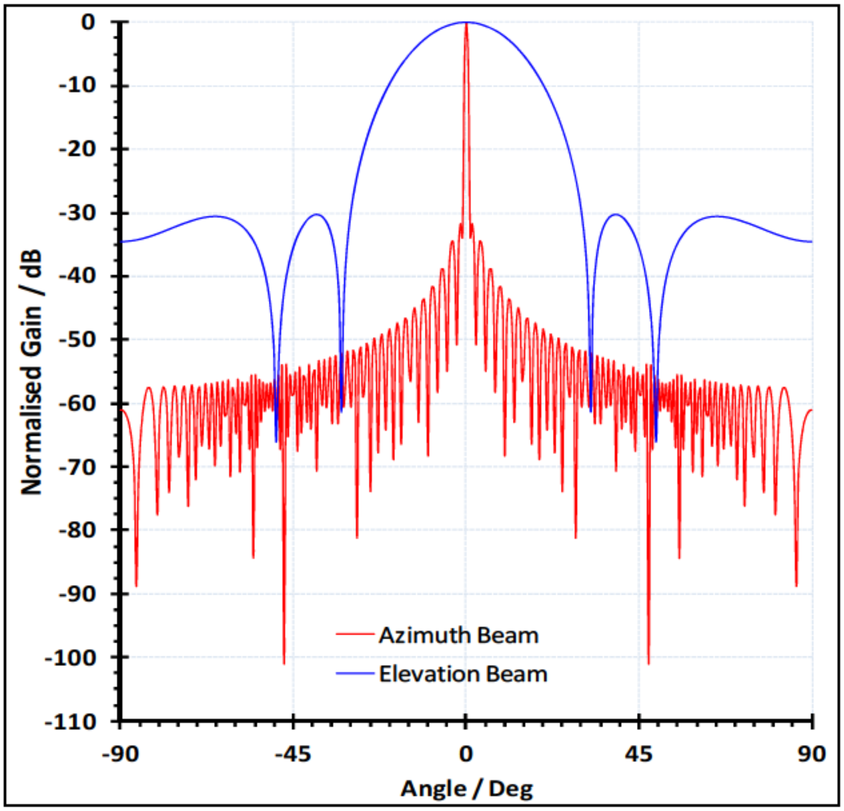

Figure 5: The radar antenna elevation and azimuth patterns.

3.2.1.1 The modelling is conducted at a rainfall rate of 0 mm/hr and sea-state 3 (wind speeds 9.6 ms-1 and average wave height of 1.3 m). When computing returns from the sea surface and the rain clutter the models provide the mean levels of returns.

3.2.1.2 REWS processing deploys scan-to-scan correlation, which improves the noise and clutter suppression. However, this is not considered in depth as part of this study as it requires detailed knowledge of the proprietary software used within the system's signal processing.

3.2.1.3 It is worth noting that only the medium pulse width of 250 ns was used throughout the Hornsea Four assessment. This gives an approximated range resolution of 37.5 m which is then equated to the range-cell length. As the turbine rotor diameter is much larger than the range cell length (depending on the yaw angle with respect to the radar), parts of the blades will fall into adjacent range-cells as the turbine blades rotate. This phenomenon will be referred to as "range-cell spreading" within this document.

3.3 Detection Threshold (CFAR)

3.3.1.1 There are multiple variations of CFAR that can be used where different weights can be applied to each cell prior to the final averaging. However, within this document and to examine the effect of Hornsea Four on the threshold levels, a Constant Averaging (CA) CFAR is applied over the clutter map. The CA-CFAR modelled within this assessment uses two range cells on both sides of the cell under test as the guard region while the averaging considers six range cells on both sides of the guard region. In Azimuth the modelled CA-CFAR uses one guard cell and two averaging cells on both sides in azimuth. The overall resultant threshold was set to provide a constant 10^{-5} probability of false alarm.

3.4 Target Modelling

3.4.1.1 REWS are mainly interested in detecting and tracking surface targets such as large fishing boats, maintenance vessels and larger ships and tankers. The role of the REWS is to alert the operator when a vessel is on a allision course with the platform. Although air targets may also appear on the radar display, the management and trafficking of air targets is controlled by other radar systems such as ATC primary and secondary radars or AD radar systems. Thus, the analysis of the potential impact of Hornsea Four on REWS is limited to surface targets only.

3.4.1.2 Large vessels in excess of 1,000 gross tons (GT) are the primary concern when it comes to managing the safety of offshore platforms (Love, 2014). However, within this report, the test target was set to represent a medium sized maintenance vessel with a steel/metallic hull. The test vessel is assumed to have an RCS of 100 m^2 and a height of 6 m. These parameters are typically used for REWS performance analysis and system acceptance testing and they comply with the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Vessel Traffic Services (VTS) guidelines for radar modelling of different vessel types. The test vessel was set to have an average speed of 12 knots (22.2 km/hr).

3.5 Turbine Shadow Modelling

3.5.1.1 As discussed in **Section 2.2**, when turbines are placed within the LoS of radar systems, radar shadowing will occur behind the structure. The extent and length of the shadow region depends on the size of the turbine, the distance to the radar antenna, the height of the radar and the height of the target of interest. Shadowing produced by turbines may cause targets to be lost as they move in and out of the shadow region. Depending on the size of the shadow region, this may cause existing tracks to be lost or discontinued.

3.5.1.2 As REWS are mainly used to detect and track surface moving targets (ships, boats etc.), only surface or near-surface shadowing is considered. This can be approximated by using the optical shadowing/blockage cast by the turbine over the sea surface. The use of optical blockage to estimate the radar shadowing will give pessimistic results but is deemed acceptable for objects that are much larger than the radar wavelength at relatively short ranges (such as offshore wind turbines). Optical blockage does not account for diffraction effects around the structure which would normally reduce the shadow length. Diffraction and partial shadowing of an object has been shown to significantly improve the radar detection. Practical measurements and other studies show that the shadowing effects from the turbines may reduce the overall detection range of the radar but may not severely affect the detection of objects within the shadow regions.

3.5.1.3 One thousand GT plus vessels (which are the main safety concern to offshore platforms) vary in size and typical vessel lengths are between 15 m and 60 m. However, the shadows from the turbines are relatively narrow and are typically between 4 m and 20 m in width. This indicates that a large 1,000 GT vessel will be partially shadowed by the turbine as it moves through the shadow regions (as shown in **Figure 6**). Partial shadowing will allow some of the radar energy to be reflected back to the radar and it might be possible for this energy to be detected by the REWS. Hence, smaller vessels can be assumed as point scatterers while larger vessels can be assessed for partial shadowing.

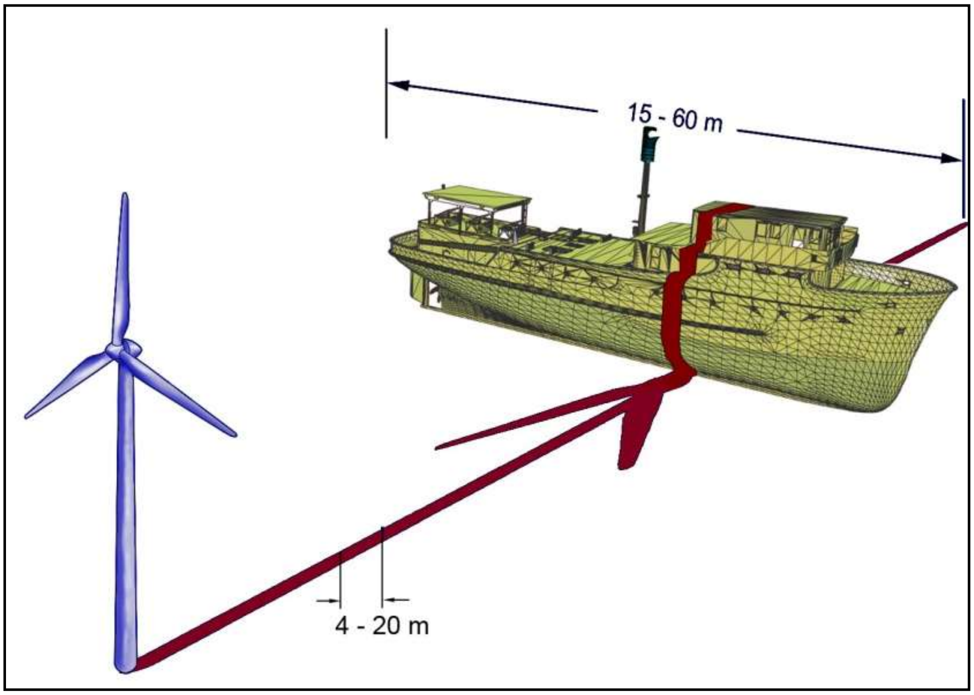

Figure 6: Optical blockage and partial shadowing.

3.6 Measurements and Modelling of RCS of WTGs

3.6.1.1 A number of studies have attempted to determine the RCS of turbines through measurements of the power received by a radar in the region. A study undertaken by Terma within Hornsea Project One (Terma 2021) highlights the difference between measured and theoretical RCS values of turbines obtained from computational modelling. The turbines deployed at Hornsea Project One have a rotor diameter of 154 m and a hub height of 117.9 m AMSL. Although these turbines are smaller than the MDS turbines considered for Hornsea Four, they are still considered to be very large structures for radars. The results of the field study show that the power received from turbines within Hornsea Project One are within reasonable levels and the radar is able to detect a vessel travelling within the array area. The layout showing the location of the radar within the wind farm is shown in **Figure 7**. The power received by the radar is shown in **Figure 8**. **Figure 8** shows that the radar, which is using pulse compression to improve resolution and power levels, can detect a service vessel travelling within the array area.

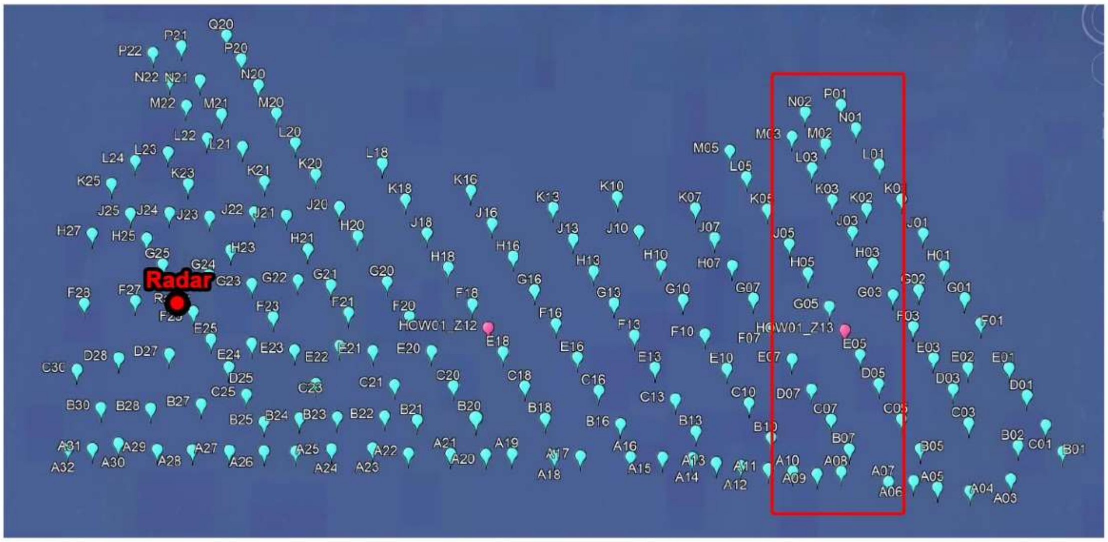

Figure 7: Turbine layout at Hornsea Project One array area and the location of the radar system used in the study. The red area denotes the region shown in Figure 8 (Terma 2021).

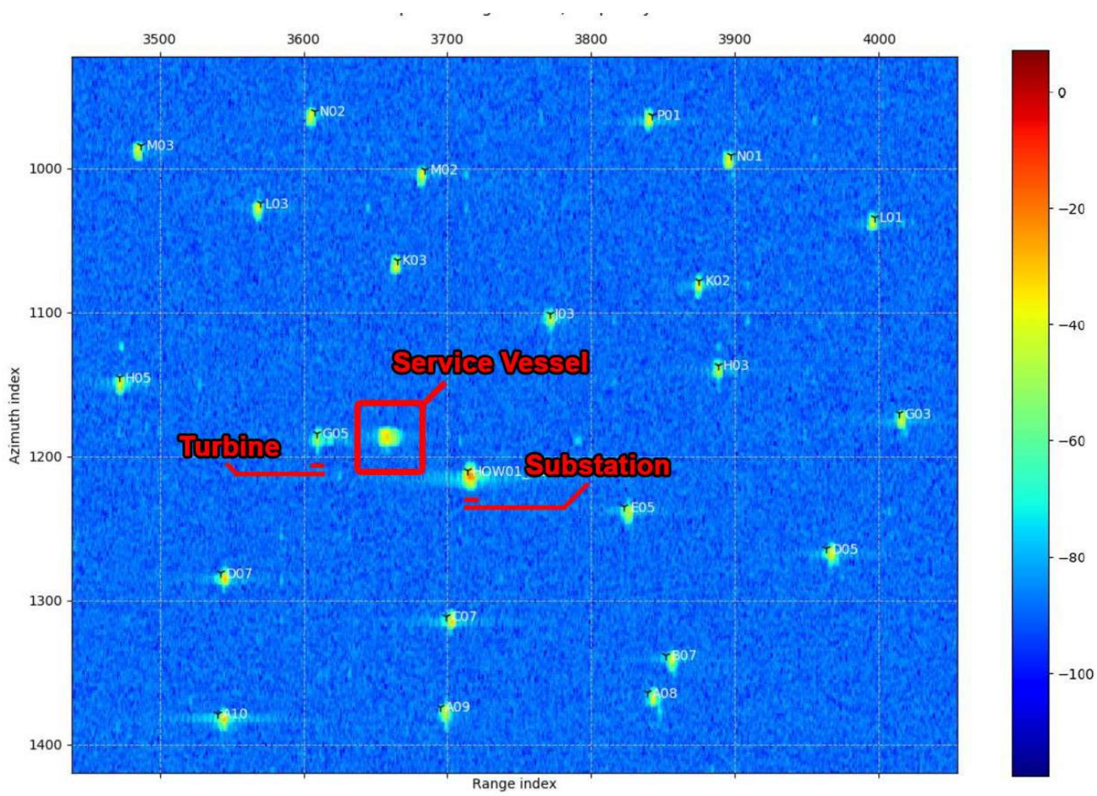

Figure 8: Compressed radar image in range-azimuth coordinates showing a zoomed area of the Hornsea Project One array area around a substation platform (Z13). A vessel is visible between Z13 and WTG G05. The signal level (in dB) is colour coded.

3.6.1.2 A key finding of the Terma study was that turbines located within 10 km of the radar had a lower RCS than traditional RCS models would suggest. Traditional RCS modelling methods would often need to utilise a number of assumptions in order to reduce the complexity of the RCS modelling and computational efforts needed. Many of these assumptions are related to the effect of the range (distance from the radar) on the radar signature from these large objects. Objects within close range to the radar (within the near-field) often have a lower RCS value.

3.6.1.3 Although the models used within this technical annex address many of these assumptions and account for the effect of range on the scattering profile and signal levels from the turbines, the utilised models still need to make certain assumptions regarding the exact geometry of the turbine, the materials used, and the exact blade profile under wind loading (as blades bend due to wind loading). Some of these assumptions would result in higher than expected RCS values but are still considered within acceptable limits and produce similar results to the measurements shown in the Terma study as illustrated in **Figure 8**.

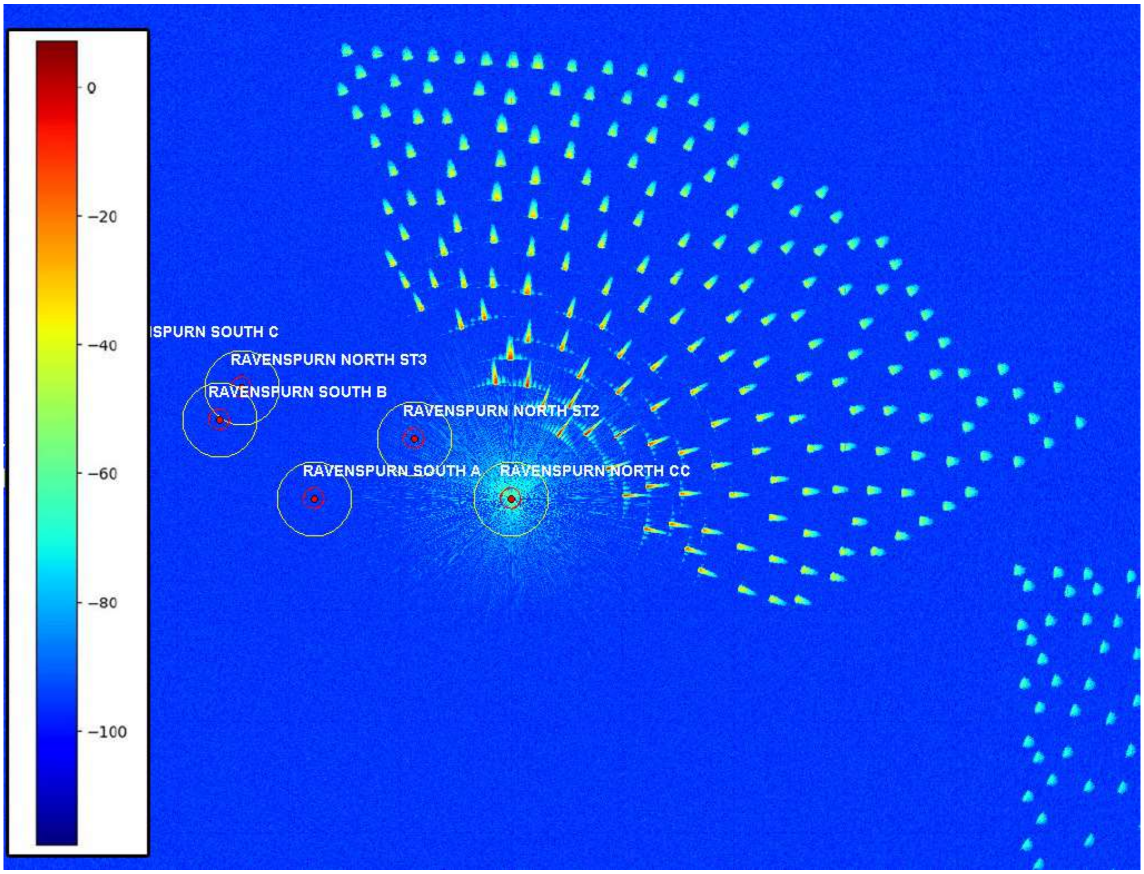

Figure 9: Power received by the REWS on Perenco's Raven Spurn North CC platform.

4 Perenco Ravenspurn North CC Platform REWS Assessment

4.1 Overview

4.1.1.1 Perenco operates several offshore platforms near the proposed Hornsea Four array area. Currently this region has a number of regular vessels travelling along routes passing through the area. Therefore, Perenco has multiple REWS installations in the region to monitor and protect their assets from potential allision (**Figure 4**).

4.1.1.2 The REWS on the Perenco operated Ravenspurn North CC platform provides coverage and protection to the Ravenspurn North CC platform and other Perenco platforms in the area.

4.1.1.3 This section presents the Ravenspurn North CC REWS returns and detection modelling associated with the modelled indicative. As stated in Sections 3.1.2 and 3.1.3, the current indicative MDS layout of turbines (180) and offshore substations and platforms (10) within the Hornsea Four array area and the nearby platforms are shown in Figure 10. The small red circle around each platform denotes the 0.27 nm Red CPA alarm while the larger yellow circle denotes the 1 nm Amber CPA alarm.

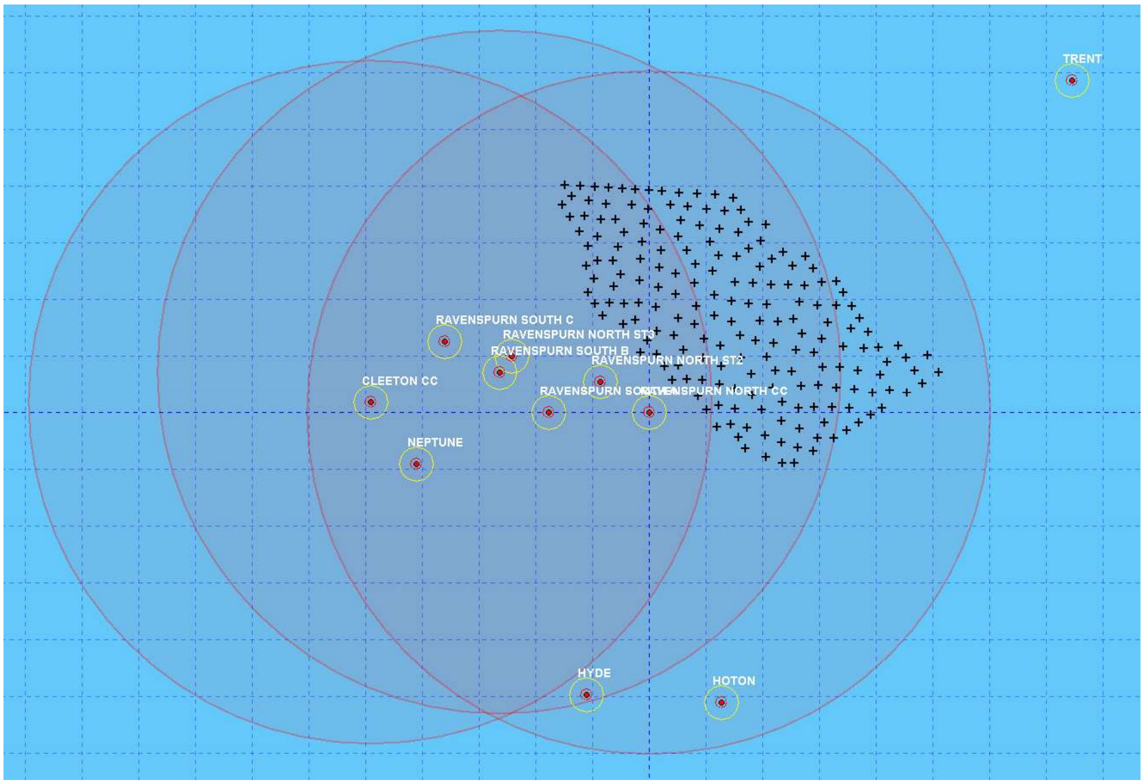

Figure 10: Modelled layout for Hornsea Four and the Perenco operated platforms.

4.2 REWS Assessment for Hornsea Four In Isolation

4.2.1.1 As shown in Figure 10, Hornsea Four falls within close proximity of Ravenspurn North CC, Ravenspurn South Bravo, Cleeton CC, Ravenspurn North S2, Ravenspurn North ST3, Ravenspurn South A, Ravenspurn South C, Hoton and Hyde.

4.2.1.2 For platforms with REWS installations such as Ravenspurn North CC, this close proximity is likely to have potential effects on the REWS' ability to detect and track vessels travelling through the Hornsea Four array area. If the REWS is unable to detect and track the vessel within the Hornsea Four array area, it may cause the REWS to issue delayed TCPA alarms, resulting in insufficient response times to deal with potential allision threats. Figure 11 shows the power received (radar returns) from the turbines along with the assumed clutter generated from the sea surface. The green regions represent areas where radar returns are being detected. Brighter shades of green indicate higher returns while darker green regions indicate low returns.

4.2.1.3 To further assess the REWS' ability to detect vessels within the Hornsea Four array area, a CFAR threshold over the detection region was modelled using a 2D CA CFAR (as highlighted in **Section 3.3**). The modelling results are shown in **Figure 12**. The figure shows the regions with higher detection threshold as brighter shades of green. The strong returns from the turbines will significantly alter the threshold levels. It can be noted that the threshold is raised over multiple cells around each turbine since the CFAR threshold averages the returns over a 2D sliding window of multiple cells in azimuth and range.

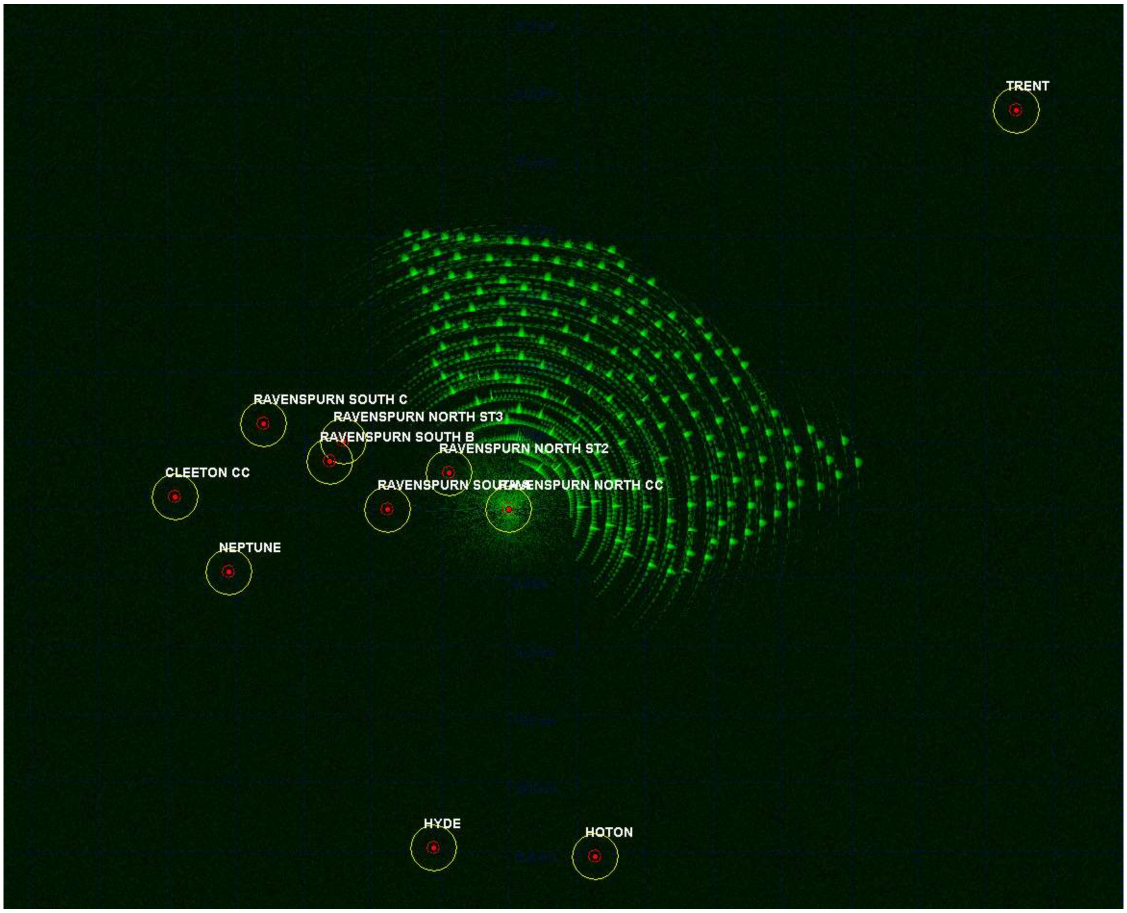

Figure 11: Ravenspurn North CC platform REWS clutter map showing returns from the turbines and sea clutter.

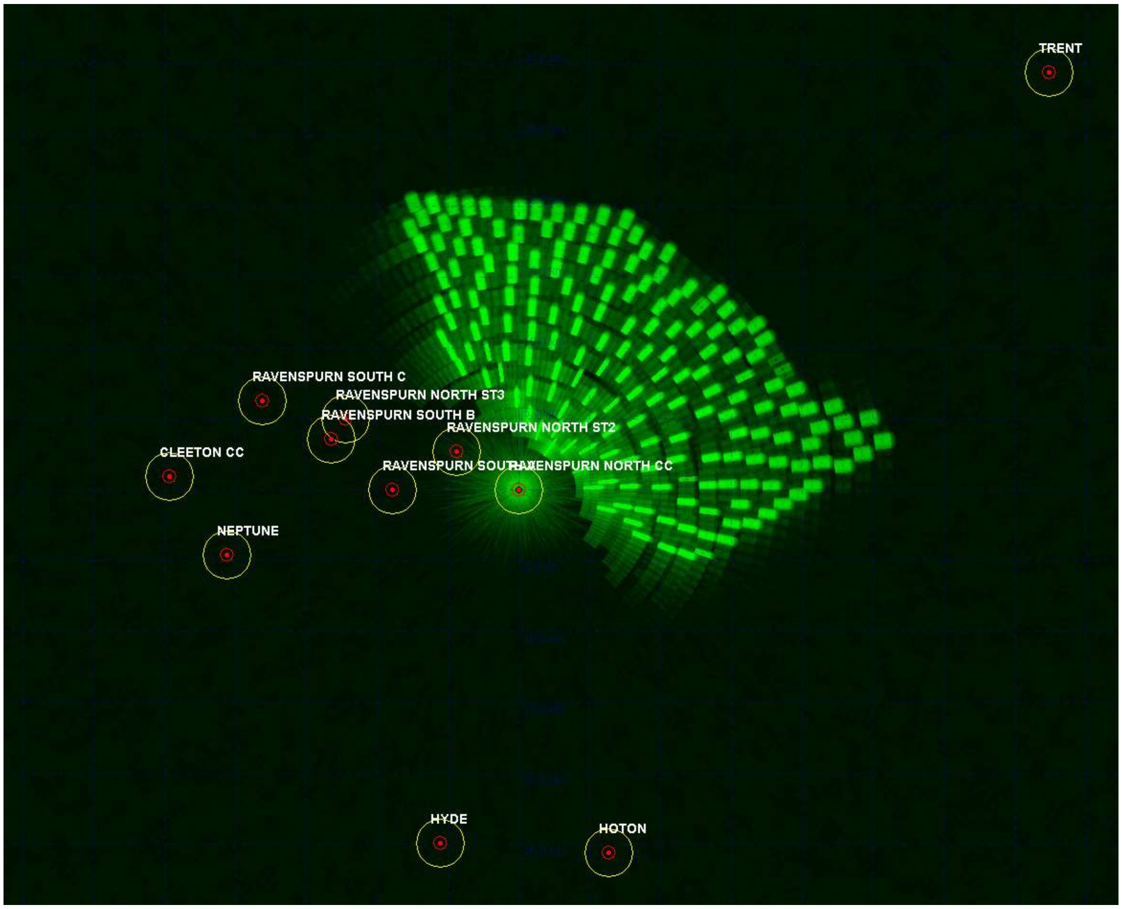

Figure 12: Ravenspurn North CC platform REWS detection threshold over the Hornsea Four array area.

4.2.1.4 In order to establish the detection regions for a given vessel, the returns from the 100 m^2 RCS test vessel are modelled with respect to range and plotted around the REWS as shown in **Figure 13**. **Figure 13** shows that the vessel has high returns at close ranges which then reduces as range increases up to approximately 16 nm (30 km). The blue region in the figure represents the region beyond the radar detection range (16 nm) that has not been modelled. Higher returns are illustrated by brighter shades of green. **Figure 14** shows the effect of shadowing on the returns from the vessel. The narrow lines illustrate the shadow generated from each turbine.

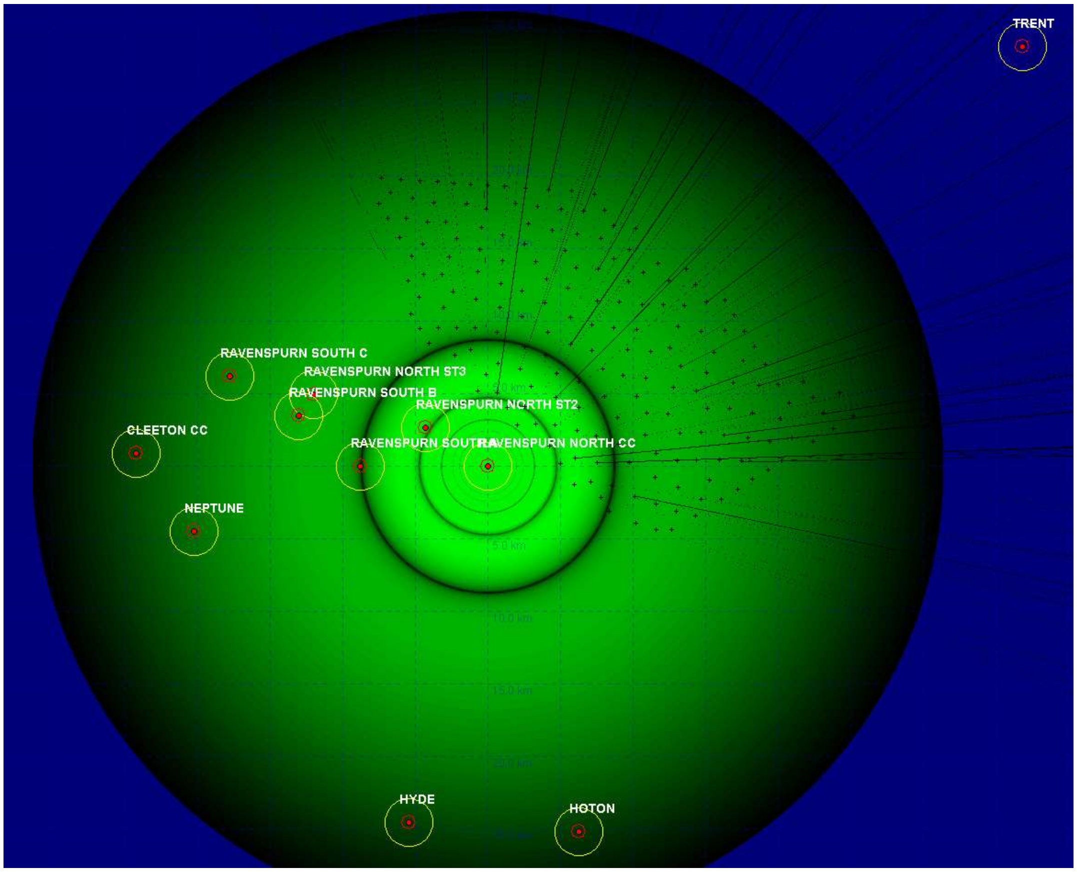

Figure 13: Modelled power received from 100 m^2 target (coverage).

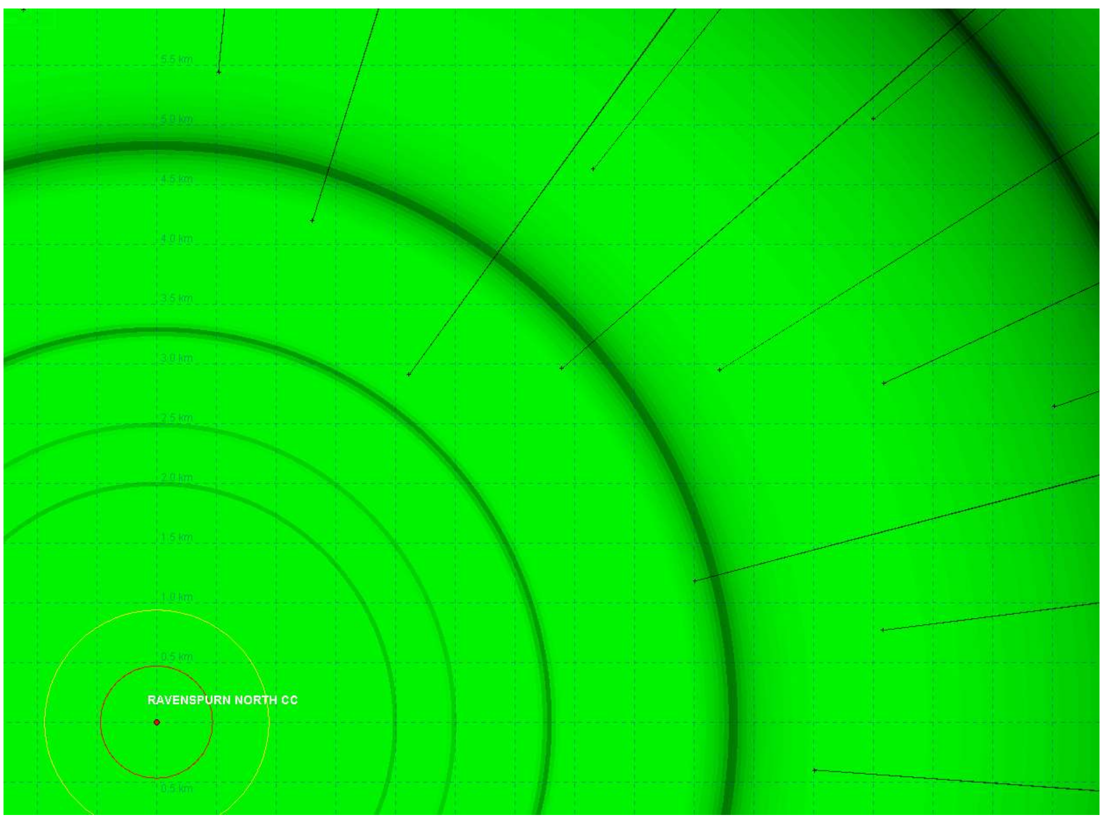

Figure 14: Modelled shadow regions within the detection range of the 100 m^2 target.

4.2.1.5 The returns from the vessel are then compared against the CFAR detection threshold shown in **Figure 12** to establish the detection regions. If the vessel returns are above the CFAR threshold, then the vessel is detected, however, if the returns are below the threshold, the target is assumed to be undetected within that region. **Figure 15** shows the detection plot for the 100 m² test vessel over the Hornsea Four array area. Dark areas within the plot denote regions where the vessels will not be detected. The shadow regions are very narrow and are not visible within the figures due to the scale.

4.2.1.6 The results show that at close ranges, the REWS easily detects the test vessel as the returns are above the detection threshold. Once the vessel is travelling within the Hornsea Four array area, the raised threshold over the cells around each turbine can cause loss of detection. This effect, in combination with the shadowing effects, may cause the REWS to lose tracks of the vessels and fail in raising TCPA alarms in a timely manner as stated for the CPA/TCPA alarm requirements.

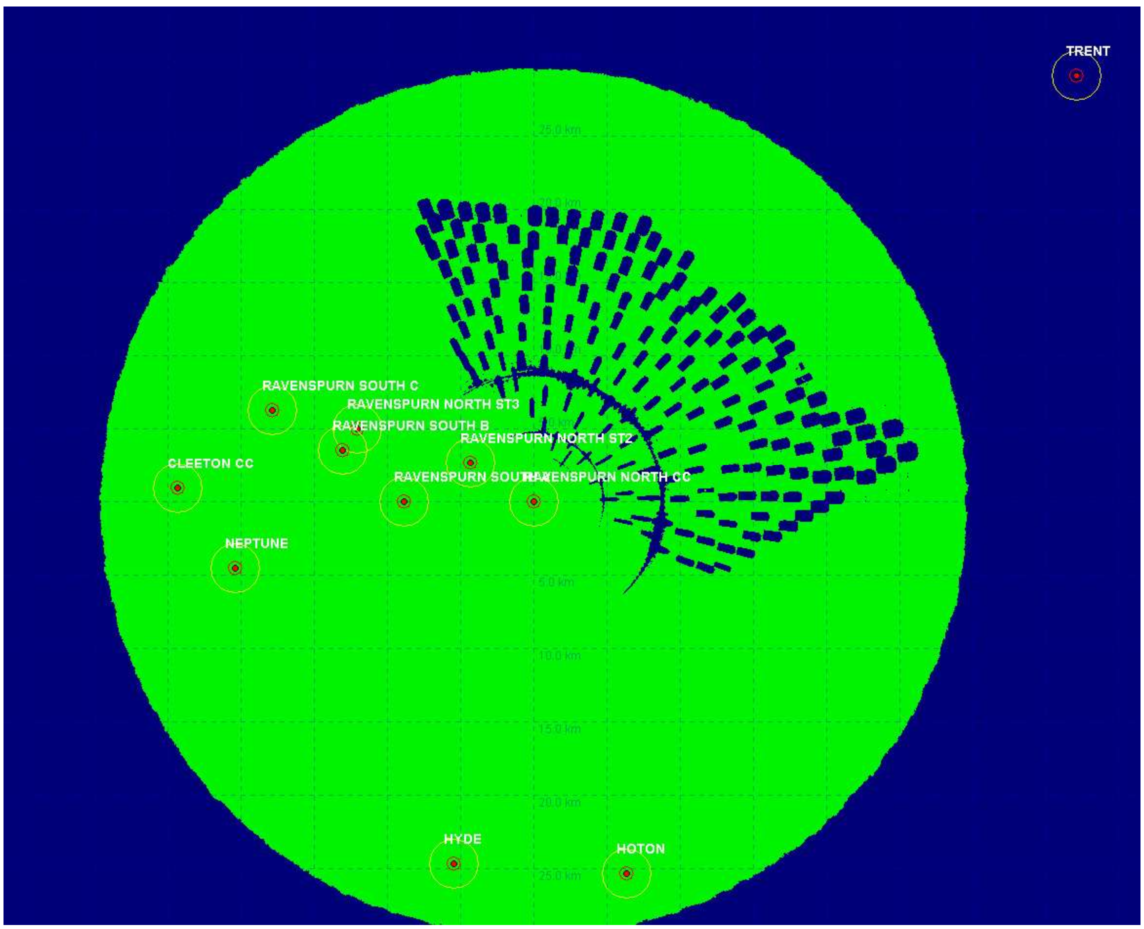

Figure 15: Ravenspurn North CC platform REWS detection plot showing loss regions for a 100 m² target.

4.3 Cumulative REWS Returns and Detection Assessment of Hornsea Project One, Hornsea Project Two, Hornsea Three and Hornsea Four

4.3.1.1 When considering **Figure 13**, it can be noted that the 100 m² target the detection range of the REWS extends slightly beyond the array area of Hornsea Four. Additionally, the test target used within the modelling is considered a small vessel in terms of risk to the offshore oil and gas platforms. REWS operators are often more concerned with detecting larger vessels that are 1,000 GT or more as they pose a more significant threat to the platforms in case of an allision. Larger vessels will have a greater RCS - an 1,000 GT vessel can be assumed to have a 1,000+ m^2 RCS. Therefore, the detection range will extend further when considering larger targets, which can be well within the boundaries of Hornsea Project One and Hornsea Project Two. Furthermore, due to the height of the turbines and their large radar signature, turbines will be detected even at long ranges, extending to the radar horizon. This will add to the clutter map and may affect the detection of larger vessels.

4.3.1.2 In addition to the possible loss of detection within the wind farm, a more important aspect of modelling the cumulative case is the impact of the combined projects on the rerouting of traffic around the developments in the former Hornsea Zone. Therefore, an assessment of the cumulative impact of Hornsea Project One, Hornsea Project Two, Hornsea Three and Hornsea Four was undertaken. This section will examine the cumulative effects of these projects on the REWS detection, with the rerouting of traffic detailed in **Section 6**.

4.3.1.3 This study has been based on final design information for Hornsea Project One and Hornsea Project Two and information available in the Hornsea Three Environmental Statement (ES). It is noted however, that the project parameters quoted in Environmental StatementsES are often refined during the determination period of the application or post-consent and are therefore considered conservative. The combined impact modelling of Hornsea Four along with the above named projects on the Perenco REWS installations was conducted in the same manner as that shown previously for Hornsea Four alone. Turbine numbers and specifications used within the cumulative impact modelling are presented in **Table 3** below.

Table 3: Turbine numbers and specifications used within the cumulative impact modelling.

Project	Number of turbines	Turbine rotor diameter (m)	Hub height relative to Lowest Astronomical Tide (LAT) (m)
Hornsea Project One	174	180	107
Hornsea Project Two	165	135	90
Hornsea Three*	300	185	127

* Note the turbine numbers and specifications for Hornsea Three have been assumed based on the Hornsea Three ES.

4.3.1.4 The results presented in **Figure 16** show the cumulative returns from the turbines and the sea surface. It can be noted that the turbines from Hornsea Project One and Hornsea Project Two are still generating significant returns and are being detected by the REWS. The effective threshold map is shown in **Figure 17** and the detection regions for the 100 m^2 target are shown in **Figure 18**.

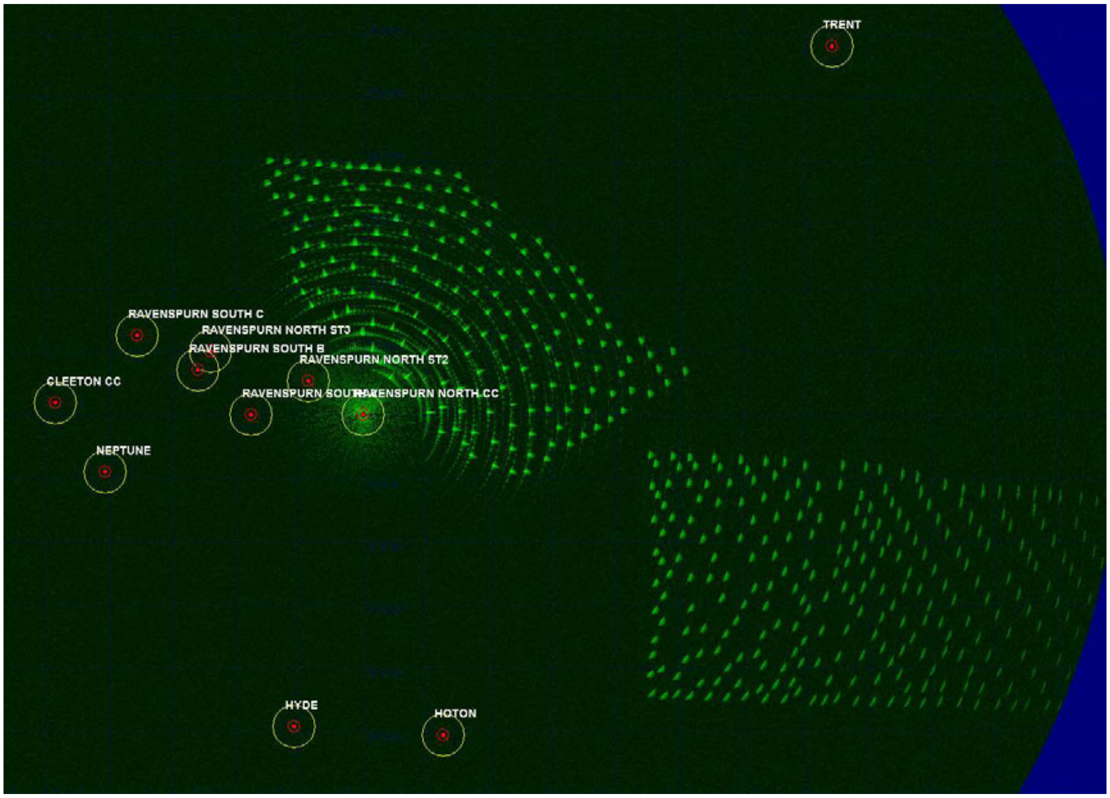

Figure 16: Ravenspurn North CC platform REWS clutter map showing returns from the turbines and sea clutter from the cumulative Hornsea projects.

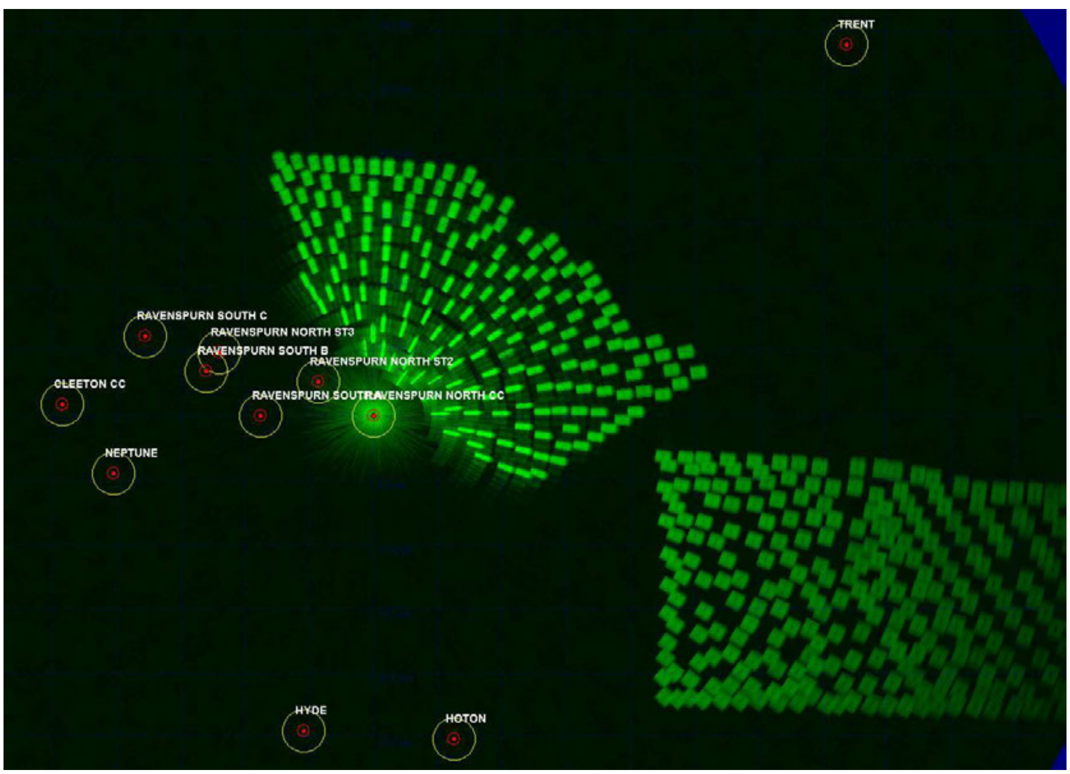

Figure 17: Ravenspurn North CC platform REWS detection threshold over the cumulative Hornsea projects.

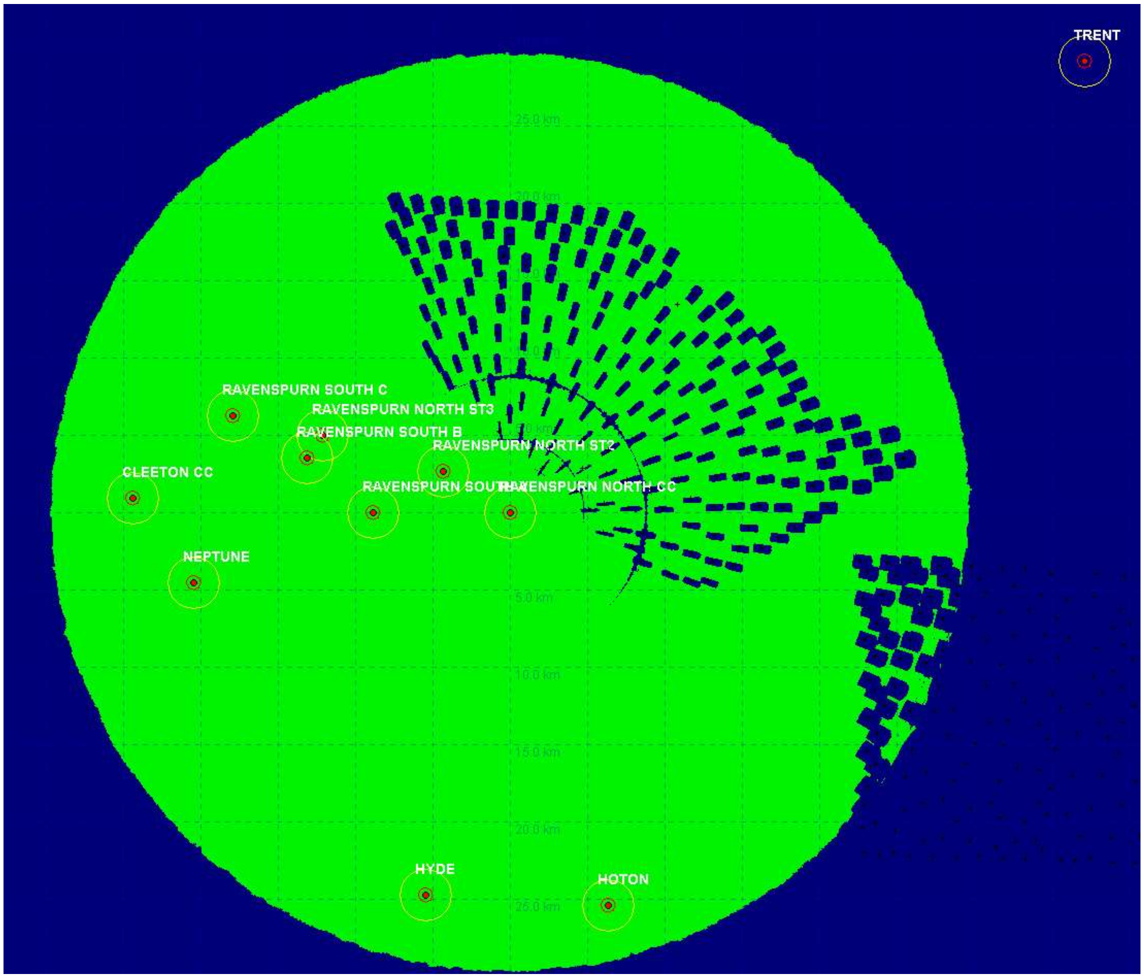

Figure 18: Ravenspurn North CC platform REWS detection plot showing loss regions for a 100 m^2 target.

4.3.1.5 The results indicate that the raw, single scan detection performance of the REWS due to the presence of Hornsea Four in isolation and cumulatively with Hornsea Project One and Hornsea Project Two is affected adversely within the wind farm regions. Radar detection of vessels travelling within the modelled Hornsea Projects may be lost temporarily as they move close to the modelled turbines located within the radar range. The loss of detection is mainly caused by the elevated threshold levels due to the presence of the turbines while a small amount of losses are expected to occur due to shadowing.

4.3.1.6 Typically, in terms of tracking vessels within the wind farm, the tracker software is expected to compensate for most of the detection losses of the vessels. Additionally, the integration of AIS data with the REWS will provide an alternative source of vessel information and location which can complement the data when temporary radar losses are experienced.

5 Perenco Ravenspurn South B Platform REWS Assessment

5.1 Overview

5.1.1.1 Perenco's Ravenspurn South B platform is equipped with REWS and is approximately 8.6 km away from the Hornsea Four array area. At this range, the REWS will have direct line of sight of the turbines and will experience some degradation to the detection performance within the Hornsea Four array area. This section will present radar detection modelling results for the Ravenspurn South B REWS in a similar manner as shown in **Section 4**.

5.2 REWS Assessment for Hornsea Four In Isolation

5.2.1.1 To model the detection regions of the REWS on board the Ravenspurn South B platform, the returns of a 100 m^2 target was compared against the expected threshold with the presence of the turbines. To achieve this, the returns from the turbines were modelled and then the detection threshold was computed using the adaptive CFAR method. The results of the Hornsea Four returns are shown in **Figure 19** and the resultant detection threshold is illustrated in **Figure 20**.

5.2.1.2 **Figure 21** shows the modelled radar returns from the 100m^2 target. The inner rings within the coverage are due to a radar phenomenon known as detection nulls, which is caused by multi-path propagation and reflections from the sea surface. This phenomenon is not related to presence of the turbines.

5.2.1.3 The radar detection map is obtained by comparing the levels of the target returns (shown in **Figure 21**) with the threshold levels (shown in **Figure 20**). The resultant coverage map is shown in **Figure 22**. The results show that due to the presence of Hornsea Four, the radar's ability to detect vessels within the Hornsea Four array area will be affected due to the elevated threshold levels. The effects of shadowing are considered to be small and transient in nature. The overall effect and the level of impact of the turbines on the detection and tracking of vessels is discussed in more detail in **Section 5.3**.

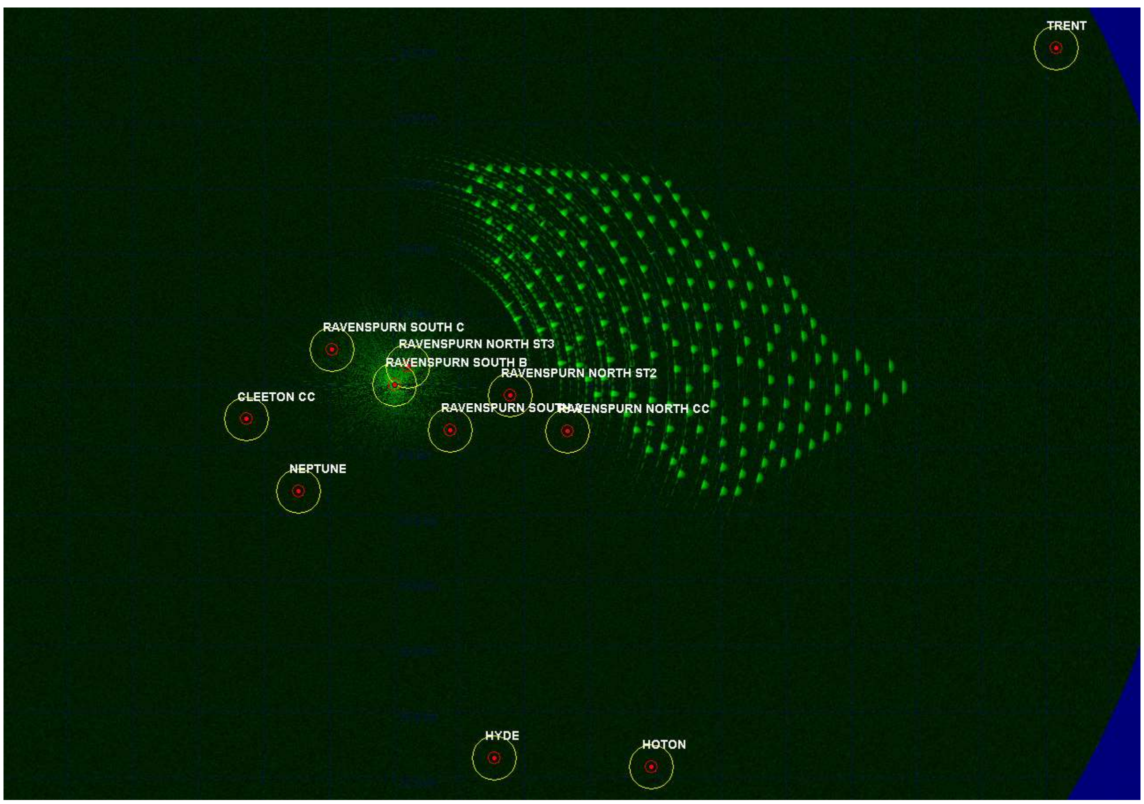

Figure 19: Ravenspurn South B platform REWS clutter map showing returns from the turbines and sea clutter.

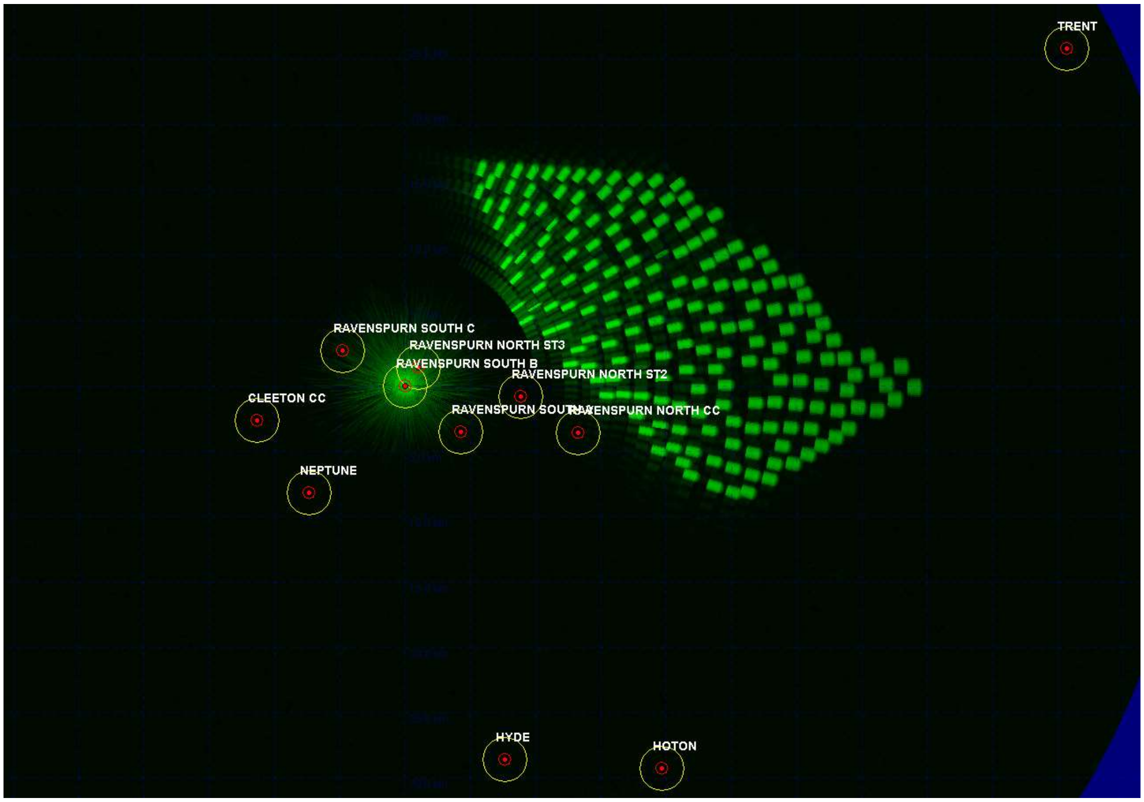

Figure 20: Ravenspurn South B platform REWS detection threshold over the Hornsea Four array area.

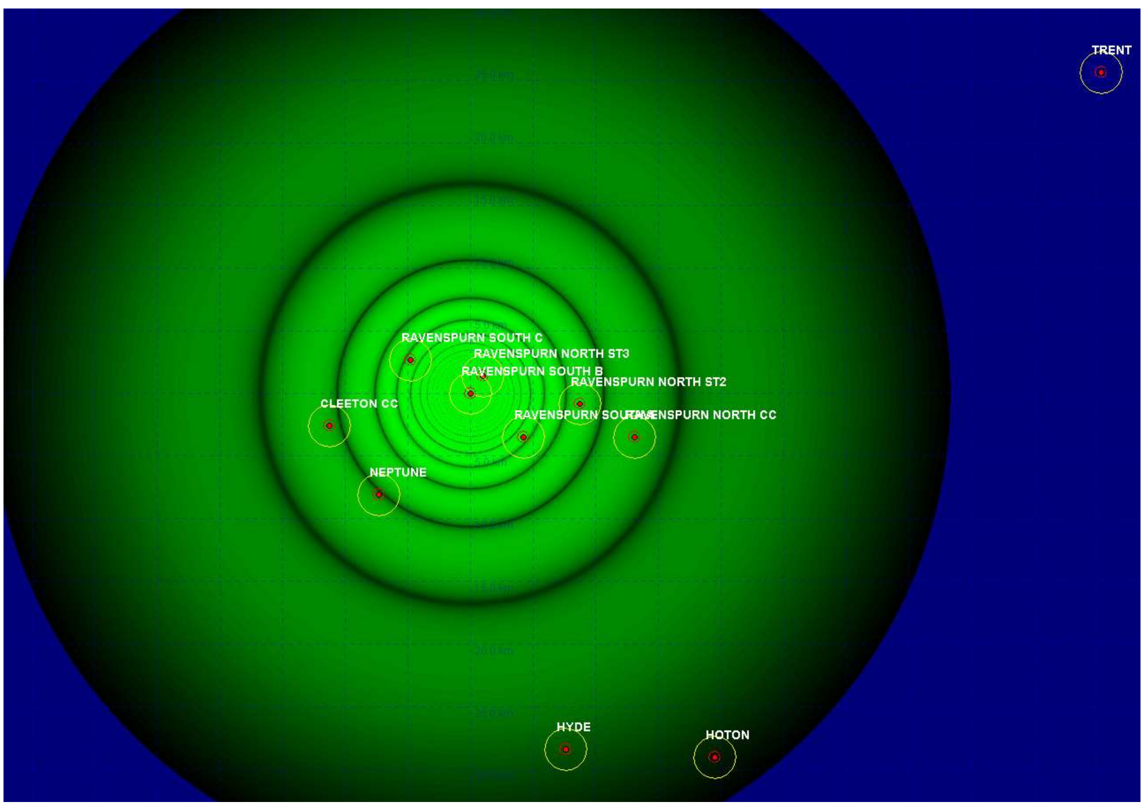

Figure 21: Modelled power received from 100 m^2 target (coverage).

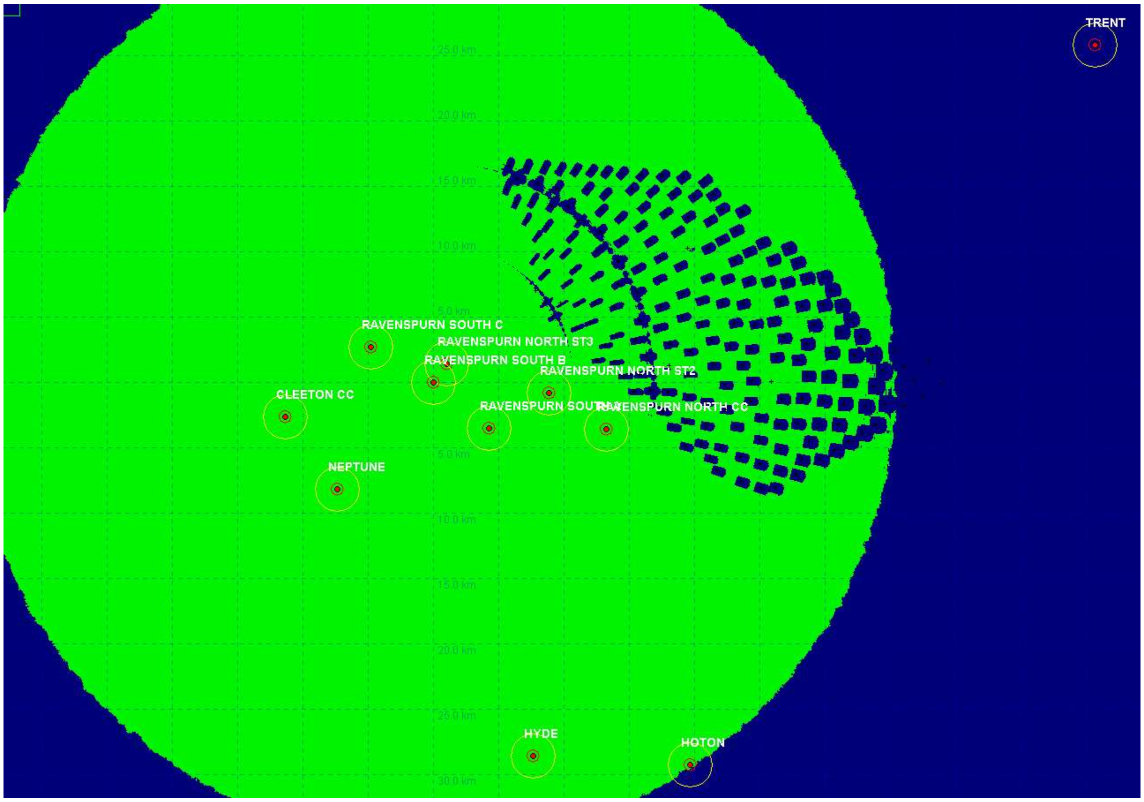

Figure 22: Ravenspurn South B platform REWS detection plot showing loss regions for a 100 m^2 target.

5.3 Cumulative REWS Returns and Detection Assessment of Hornsea Project One, Hornsea Project Two, Hornsea Three and Hornsea Four

5.3.1.1 Perenco's REWS on the Ravenspurn South B platform will illuminate Hornsea Four turbines and will also receive radar returns from the turbines in Hornsea Project One and Hornsea Project Two. The radar clutter map generated due to the presence of the cumulative case is shown in **Figure 23** and the resultant threshold is shown in **Figure 24**.

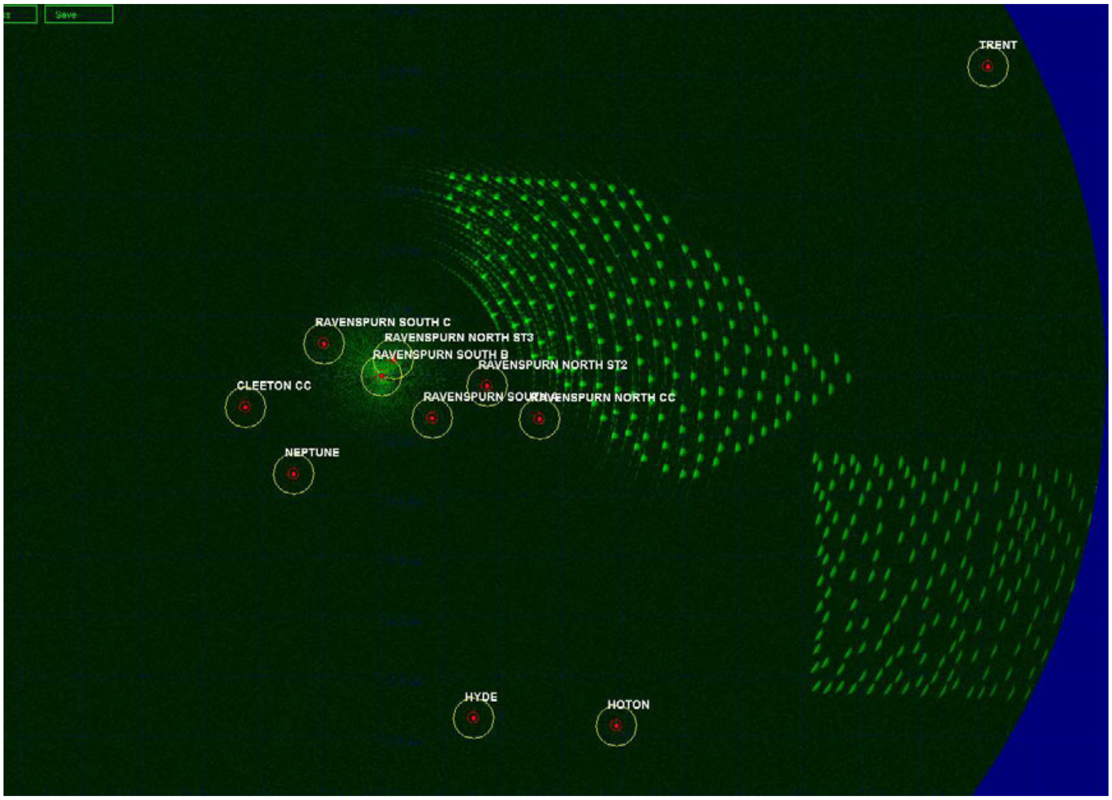

Figure 23: Ravenspurn South B platform REWS clutter map showing returns from the turbines and sea clutter from the cumulative Hornsea projects.

Figure 24: Ravenspurn South B platform REWS detection threshold over the cumulative Hornsea Projects array area.

5.3.1.1 The detection map of the small 100 m^2 target is shown in **Figure 25**. The detection map shows that the REWS detection performance will only experience a small number of additional detection gaps caused by turbines at the edge of Hornsea Project Two.

5.3.1.2 As discussed previously in **paragraph 4.3.1.1**, the radar coverage of a 100 m^2 target is expected to be approximately 30 km around the REWS while the detection of turbines is expected to extend up to the radar horizon. Assessing the impact of the cumulative case on the detection of a small 100 m^2 target may not show a significant difference when compared to the Hornsea Four in isolation; however, it is important to consider when looking at larger vessels (1,000 GT or more) and when assessing the effects of rerouted traffic around the projects.

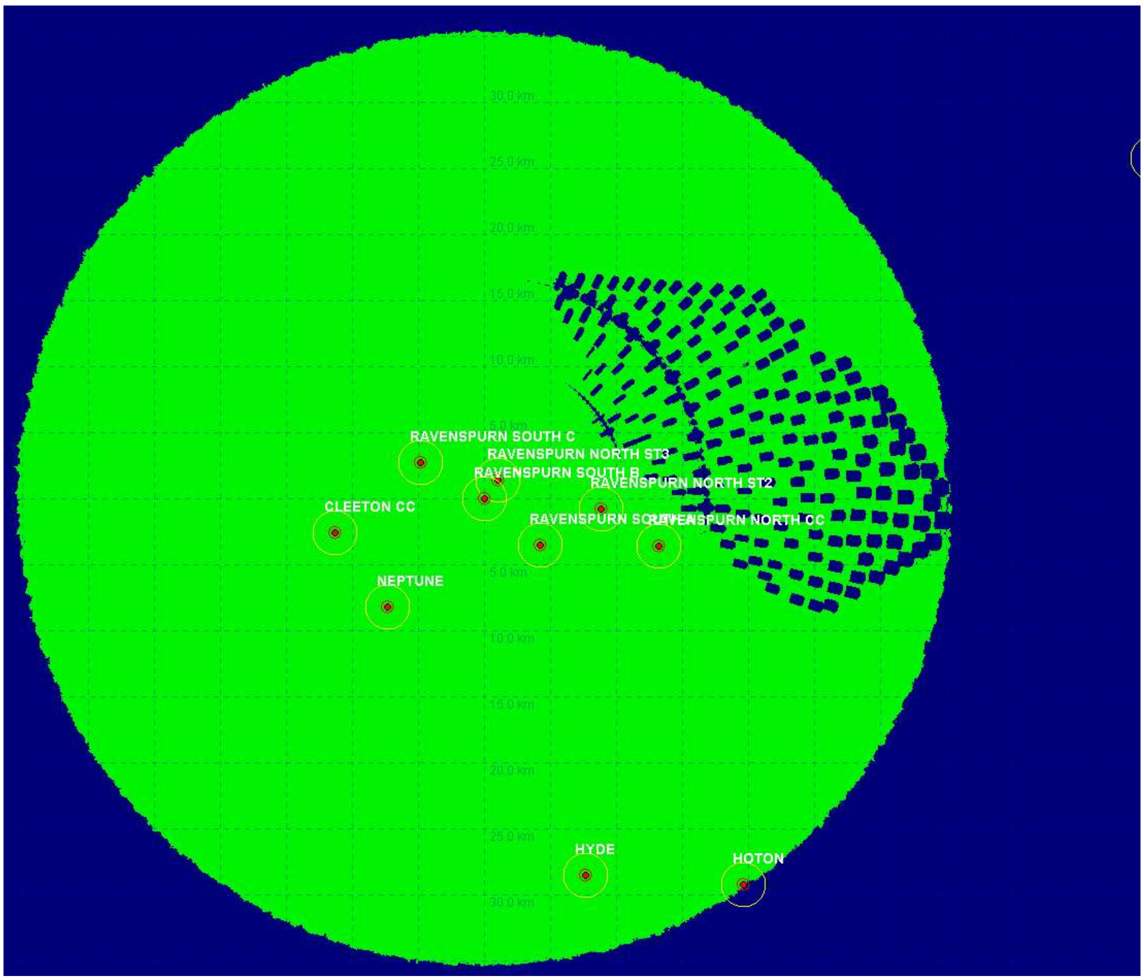

Figure 25: Ravenspurn South B REWS detection plot showing loss regions for a 100 m^2 target.

5.4 Tracker Considerations and the Effects of Overlapping Radar Coverage from Multiple REWS Installations

5.4.1.1 REWS are complex systems that rely on receiving data from the radar scanner and a host of other sources such as radio communications and AIS data. The REWS is equipped with advanced and robust tracking and filtering algorithms that enables the operator to see a refined and simplified view of the region. These tracking algorithms are equipped with a number of tools that are specifically tailored for detecting and tracking moving vessels in a cluttered environment.

5.4.1.2 The tracking algorithms typically use the detection history of a target, movement speed, direction as well as the latest detection to predict the location of the target for subsequent radar rotations. If available, the tracker will also integrate and use data from AIS to complement the coverage and tracking capability. Hence, the system can compensate for momentary loss of radar over a number of radar rotations even with the absence of AIS data.

5.4.1.3 Therefore, in the case of temporary detection loss, as in the case of passing through a shadow region of a detection gap, the tracking software will maintain the existing track of the vessel using either AIS data or the tracker's ability to predict the location of the vessel using the track history.

5.4.1.4 Perenco operates a number of REWS installations close to the proposed Hornsea Four array area. These REWS installations have an overlapping radar cover as shown in **Figure 10**. Modern REWS software has the ability to use radar data from multiple installations to produce a compound radar detection and tracking area. This will allow the system to compensate any areas that are not covered by a given radar with coverage from another nearby radar. This is often referred to as data fusion from multiple radars. Overlapping coverage and data fusion are incredibly powerful tools to mitigate the effects of turbine shadowing and reduce the effects of detection gaps within the wind farm.

5.4.1.5 The coverage from Ravenspurn North CC REWS and Ravenspurn South B REWS have a good overlap over the Hornsea Four array area as shown in **Figure 10**. When integrating the data from both REWS installations, the coverage and detection performance within the wind farm is enhanced and the effects of shadowing are greatly reduced. **Figure 26** shows a visual representation of the combined coverage from Ravenspurn North CC REWS and Ravenspurn South B REWS. As Cleeton CC also has a REWS installation, that provides an overlapping coverage, the data fusion from the three systems is expected to further improve the detection and tracking within the wind farm.

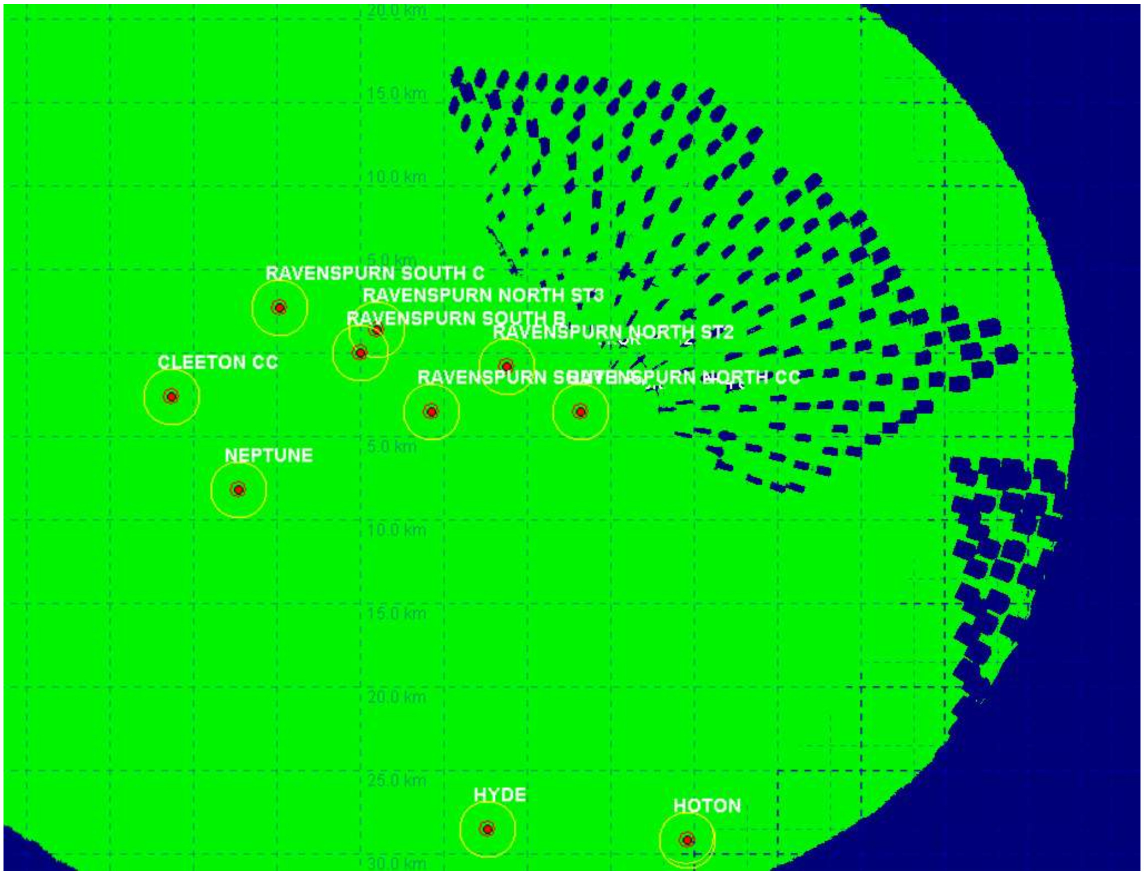

Figure 26: Compound North CC and South B REWS detection plot for a 100 m^2 target.

6 Assessment of Rerouted Traffic on the REWS Alarms

6.1 Overview

6.1.1.1 The REWS uses the radar returns to monitor and track vessels within the detection region and alert the operator when a proximity violation or an allision threat is detected. The REWS uses a defined set of rules to identify a breach of the CPA and TCPA parameters. For the assessed platforms, the alarm parameters and conditions are as outlined in **paragraph 3.2.1.1**.

6.1.1.2 Within this technical report, the effect of the rerouting of traffic on the REWS alarm rates have been modelled based on the existing traffic in the region and the predicted alterations to the traffic around Hornsea Four and cumulatively with Hornsea Project One, Hornsea Project Two and Hornsea Three.

6.1.1.3 Due to the location of Hornsea Four and the predicted changes to the existing shipping traffic routes, this assessment considers the effect of rerouted shipping routes on the Perenco assets in the vicinity, namely Ravenspurn North CC, Ravenspurn South Bravo, Ravenspurn North ST2, Ravenspurn North ST3, Ravenspurn South A, Ravenspurn South C, Cleeton CC, Neptune, Hoton, Hyde, Trent and A1D platforms (all of which are protected by the REWS installations located on the Ravenspurn North CC, Ravenspurn South Bravo and Cleeton CC Platforms).

6.2 Routes and Alarms Modelling

6.2.1.1 A review of vessel movements in the region, and predicted shipping reroutes to account for

Hornsea Four in isolation, and cumulatively with Hornsea Project One, Hornsea Project Two and Hornsea Three is provided in **Annex 7.1: Navigation Risk Assessment**. **Annex 7.1** includes measured radar and AIS data for the base case and predicted data for future reroutes around Hornsea Four in isolation and cumulatively with Hornsea Project One, Hornsea Project Two and Hornsea Three. The routes and their statistical data (including each routes' mean and standard deviation) were imported into the REWS models. The statistical data enables the REWS models to estimate the width of the shipping route and the likelihood of vessels to deviate from the central (mean) route. Accounting for possible deviations from the central line of the route in a manner which is representative to the real movements of traffic in the region provides a good indication of the overall existing and future alarm rates.

6.2.1.2 The route statistical data is given as a set of discrete points along key locations on the route containing the mean and the 90th percentile width of the route. Once the discrete route data were imported, the models then used linear interpolation between data points to extract the standard deviation at intermediate points. The mean and standard deviation is then used to generate 1000 paths along each route in both the forward and reverse directions (a total of 2,000 runs per route). This was done in order to generate a large set of data that can then be used for statistical analysis. This large number of runs was then used to estimate the probability of raising TCPA or CPA alarms for each route. The probability of raising an alarm was then multiplied by the number of vessels travelling on each route per year to establish the number of alarms expected per year for each platform.

6.2.1.3 For each of the platforms considered in the assessment (i.e. Ravenspurn North ST2, Ravenspurn North ST3, Ravenspurn South A, Ravenspurn South C, Cleeton CC, Neptune, Hoton, Hyde, Trent, A1D), the assessment utilised the CPA/TCPA parameters described in **paragraph 6.1.1.1** above whereby all the modelled platforms (except Cleeton CC and Ravenspurn CC) were assumed to be NUIs. In order to better model the impact of moving vessels on TCPA alarms, marine traffic data collected as part of the overarching Navigation Risk Assessment process was used to estimate a speed distribution representative of routed vessels in the area of most relevance to the REWS report. This provides a good approximation of the speeds of different sizes of vessels in the region. A TCPA/CPA alarm was assumed to be raised whenever a vessel breached the alarm rules.

6.2.1.4 Typically, an amber TCPA alarm is triggered when a vessel is heading along a vector that would bring it within 1 nm from a protected platform within a specified time range (40 minutes for manned installations and 25 minutes for NUIs). If the vessel continues along its path and is 30 minutes away from a manned installations or 15 minutes from an NUI, the alarm status would escalate to a red alarm. In scenarios whereby multiple platforms are present in the region (such as with Perenco's Ravenspurn complex) a vessel may trigger multiple TCPA alarms for different platforms along the route of the vessel. If a vessel raises a TCPA alarm, the REWS operator or the ERRV crew would attempt to establish radio contact with the vessel to make them aware of the presence of platforms along the routes. If no radio contact is established the ERRV would be deployed to intercept the vessel and issue audio and/or visual warnings to get the attention of the crew on the offending vessel. Hence, it is assumed within this study that once an alarm triggered and addressed by the REWS operator or ERRV crew, no alarm escalation would occur and no further alarms are registered for other platforms along the route, as it is assumed that the vessel has already been communicated with and is known to be under command and aware of the platforms.

6.2.1.5 Finally, to avoid false alarms due to temporary vector breach of the TCPA while vessels are turning, the models were set to only issue a TCPA alarm if the vessel continues to breach the TCPA rules for more than 36 radar rotations (as noted in **Section 6.1** above).

6.3 Modelling the Existing Traffic (Pre-Development of Hornsea Four)

6.3.1.1 In order to be able to estimate a change in alarm rates due to the rerouting of traffic around the Hornsea Four array area, a base case scenario was considered. The base case scenario utilises the existing traffic data within the region, as provided by radar and AIS data, along with extrapolated data in the regions where no data was available.

6.3.1.2 This study assessed a region of 10 nm around the Hornsea Four array area in order to provide a sufficient range to assess the TCPA alarms. The complete list of routes is shown in **Table 4** and is illustrated in **Figure 27**. It was noted that some of the routes will remain unchanged post construction of Hornsea Four and indeed in the cumulative case as well. Therefore, a subset of the complete list of routes was modelled (i.e. only route numbers 1, 3 , 4, 6, 8,10 , 11 ,12,). **Figure 28** illustrates the modelled routes output for 1,000 runs, showing the variation of route traffic around the mean line. Individual red lines/strands represent the modelled possibilities of vessels travelling along the modelled routes.

Table 4: Shipping routes in the region and the number of vessels travelling on each route per day.

Route number	Average transits per day	Description (main ports, also may include alternative ports)
1	2	Immingham–Gothenburg. Route 1 is generally transited by cargo vessels (81%) and tankers (11%) and is a DFDS Seaways cargo ferry route between Immingham and Gothenburg. The main vessels operating on this route are the Begonia Seaways, Ficaria Seaways and Freesia Seaways.
2	2	Newcastle–Amsterdam (Netherlands). Route 2 is transited by passenger vessels (100%) and is a DFDS Seaways passenger ferry route between North Shields (UK) and Ijmuiden (Netherlands). The main vessels operating on this route are the King Seaways and Princess Seaways.
3	1 to 2	Immingham–Esbjerg. Route 3 is generally transited by cargo vessels (83%) and tankers (12%) and is a DFDS Seaways cargo ferry route between Immingham and Esbjerg. The main vessels currently operating on this route are the Magnolia Seaways and Petunia Seaways.
4	1 to 2	Immingham–Hamburg (Germany). Route 4 is generally transited by cargo vessels (50%) and tankers (35%).
5	1	Immingham–north Norway ports. Route 5 is transited by cargo vessels (83%) and tankers (17%) and is a Sea-Cargo cargo ferry route between Immingham and Tananger (Norway).
6	1	Grangemouth (UK)–Rotterdam. Route 6 is generally transited by cargo vessels (84%).
7	1	Tees–Rotterdam. Route 7 is generally transited by tankers (46%), cargo vessels (29%) and oil and gas vessels (11%).
8	1	Tees–Rotterdam. Route 8 is generally transited by cargo vessels (62%) and tankers (38%).
9	0 to 1	Immingham–Antwerp. Route 9 is generally transited by cargo vessels (53%) and tankers (40%).
10	0 to 1	Immingham–Baltic ports. Route 10 is generally transited by cargo vessels (85%) and tankers (12%).
11	0 to 1	Great Yarmouth (UK)–Trent gas field. Route 11 is transited by oil and gas vessels (100%).
12	0 to 1	Immingham–Baltic ports. Route 12 is transited by cargo vessels (100%).
13	0 to 1	Immingham–northern Norway ports. Route 13 is transited by cargo vessels (100%) and is a Finnlines cargo ferry route between Hull (UK) and Helsinki (Finland).
14	0 to 1	Tees–Amsterdam. Route 14 is generally transited by tankers (80%).

(*) From the vessel traffic survey data, the average transits per day on this route was lower; however DFDS Seaways confirmed during consultation that the King Seaways was in dry dock during the majority of the winter survey period. Therefore, the number given above is reflective of the typical transit activity on this route.

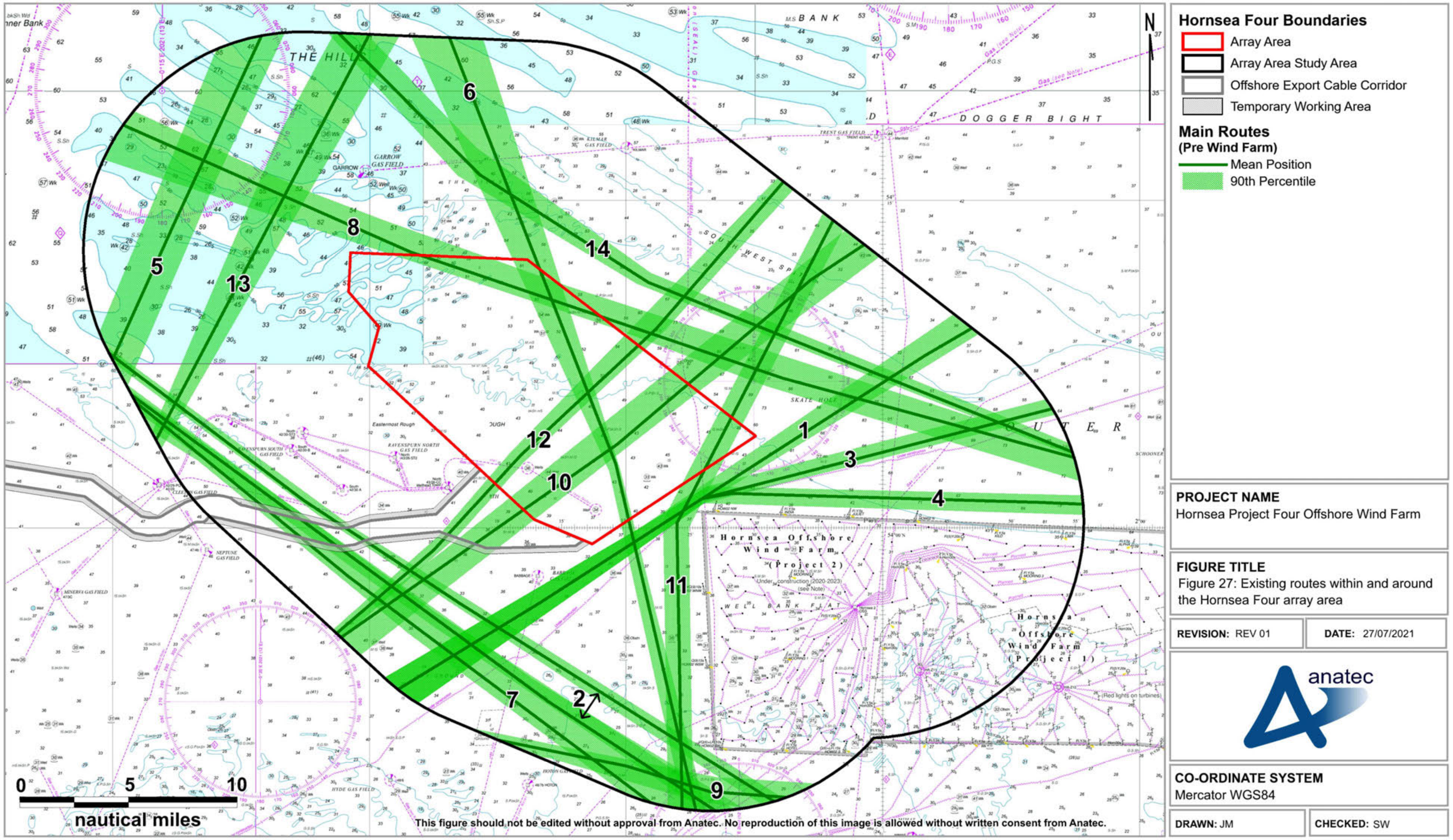

Figure 27: Existing routes within and around the Hornsea Four array area.

Figure 28: Modelled existing shipping routes (1000 variations each route).

6.3.1.3 The models were used to simulate each route in both directions and identify each type of alarm on every platform. Using the statistical nature of the data, a probability of alarm is calculated for each platform by taking the number of alarms triggered over the 1000 runs and presenting this as a platform percentage. This probability is then used in conjunction with the data in **Table 4** to estimate the number of alarms per day and then ultimately the number of alarms per year for each platform.

6.3.1.4 It is noted that in some cases within the base scenario, some routes raised no alarms while other routes show some probability of alarms in the existing (base) case. This is due to the proximity and direction of the route as well as the statistical nature/width of the route. Although the results presented are an estimate of the existing effect of traffic on the REWS alarms, it provides a good basis from which to compare predicted future cases.

6.4 Modelling the Predicted Shipping Reroutes Around Hornsea Four Alone (and cumulatively with Hornsea Project One, Hornsea Project Two and Hornsea Three)

6.4.1.1 In a similar manner to the base-case scenario, the vessel traffic around Hornsea Four (in isolation) was modelled based on the reroutes predicted and described in **Annex 7.1: Navigation Risk Assessment**. Both the mean line for each route, along with its standard deviation, were considered in the model. The predicted rerouted traffic is shown in **Figure 29**. This data was then used to create 1,000 runs for each route in either direction (total of 2,000 runs) to provide sufficiently large set of results to undergo statistical analysis of the data. and the modelled routes are shown in **Figure 30**.

6.4.1.2 Once each route was modelled and the yearly alarm rates were obtained, the modelling results for the predicted traffic were compared against the base-case.

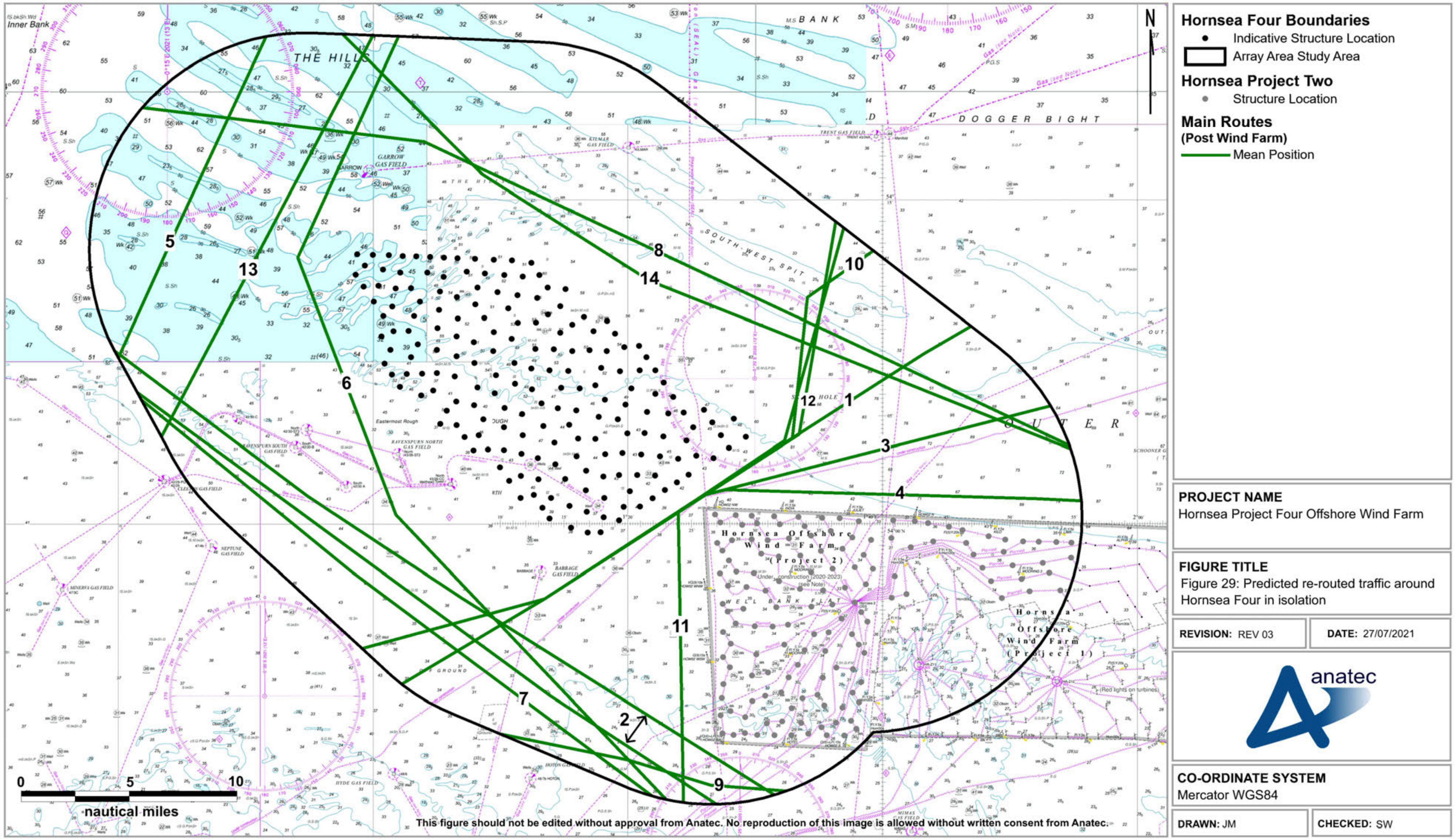

Figure 29: Predicted rerouted traffic around Hornsea Four in isolation.

Figure 30: Modelled shipping routes post-construction of Hornsea Four in isolation.

6.5 Modelling the Predicted Shipping Reroutes around Hornsea Four alongside Hornsea Project One, Hornsea Project Two and Hornsea Three.

6.5.1.1 When assessing the cumulative case, the vessel traffic around Hornsea Four considered cumulatively with Hornsea Project One, Hornsea Project Two and Hornsea Three was modelled based on the predicted reroutes. The predicted rerouted traffic is shown in Figure 31. This data was then used to create 1,000 runs for each route for each direction (2,000 runs in total). Figure 32 shows the modelled routes for the alarm assessment.

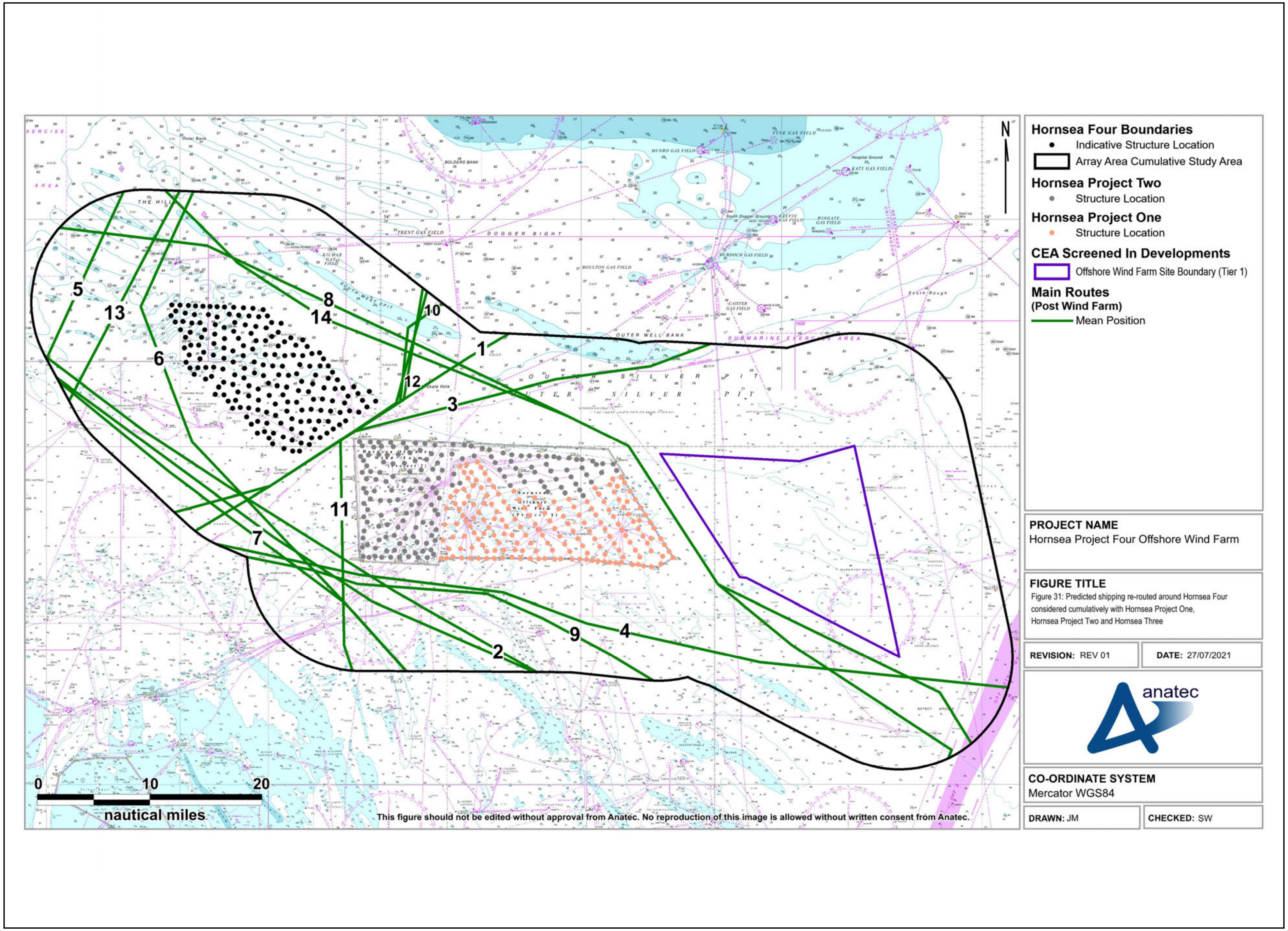

Figure 31: Predicted shipping reroutes around Hornsea Four considered cumulatively with Hornsea Project One, Hornsea Project Two and Hornsea Three.

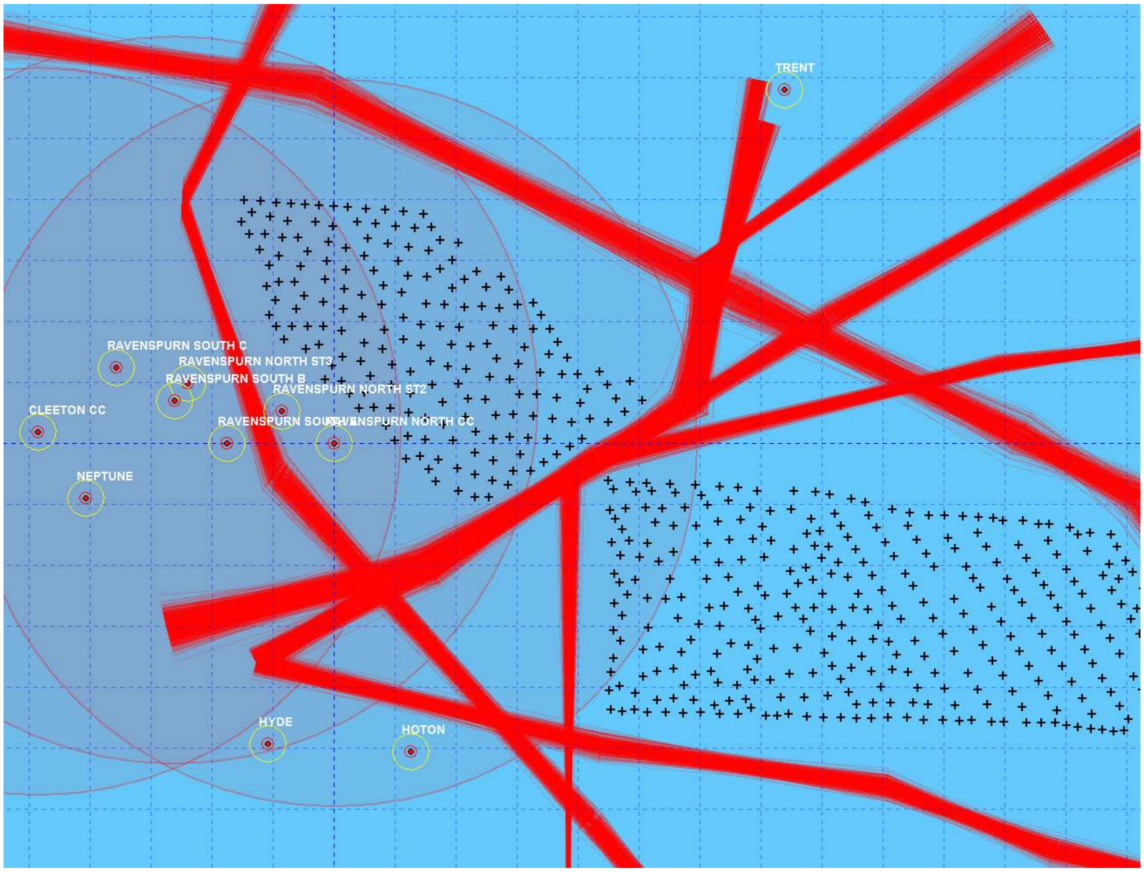

Figure 32: Modelled shipping routes around Hornsea Four considered cumulatively with Hornsea Project One, Hornsea Project Two and Hornsea Three.

6.6 Modelling results and comparison of the base case and the predicted shipping reroutes around Hornsea Four in isolation and cumulatively with Hornsea Project One, Hornsea Project Two and Hornsea Three.

6.6.1.1 To understand the potential impact of Hornsea Four on the alarm rates, the modelled data from the existing base case was compared against the post construction modelling results. The comparison looks at the number of alarms each platform is expected to have in a one-year period. The data compares both Amber and Red TCPA alarms for the base case, Hornsea Four in isolation and Hornsea Four alongside Hornsea Project One, Hornsea Project Two and Hornsea Three. The results for each platform are shown in Figure 30 – Figure 41.

6.6.1.2

6.6.1.3 Table 5 shows the estimated difference in alarm rates between the base case and both Hornsea Four scenarios (i.e. in isolation and in combination with Hornsea Project One, Hornsea Project Two and Hornsea Three).

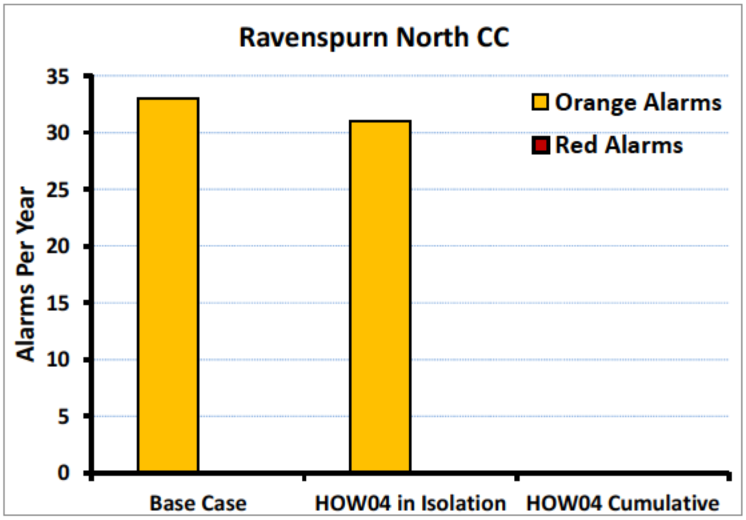

Figure 33: Modelled yearly alarm rates for the Ravenspurn North CC platform.

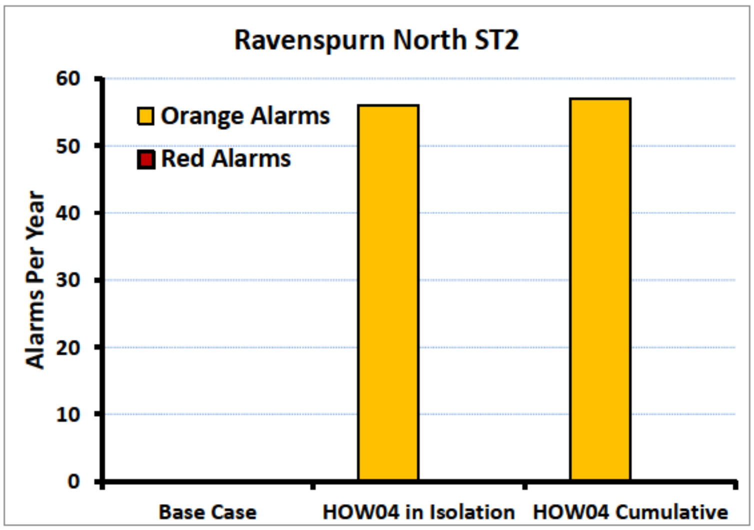

Figure 34: Modelled yearly alarm rates for the Ravenspurn North ST2 platform.

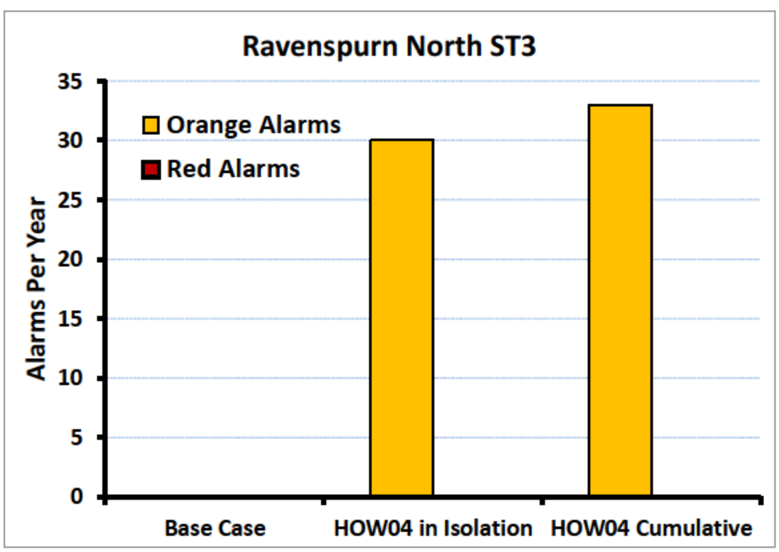

Figure 35: Modelled yearly alarm rates for the Ravenspurn North ST3 platform.

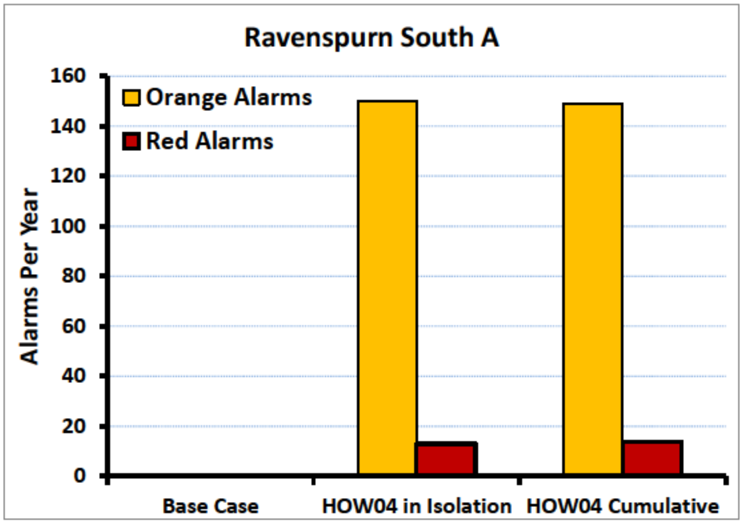

Figure 36: Modelled yearly alarm rates for the Ravenspurn South A platform.

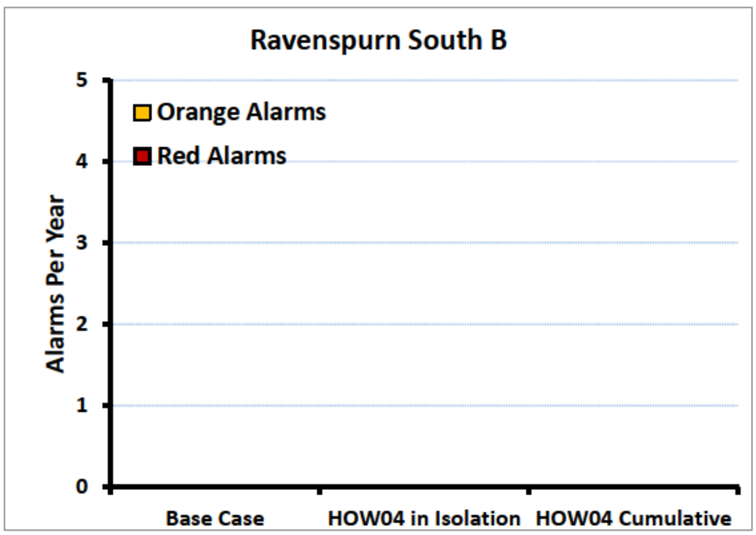

Figure 37: Modelled yearly alarm rates for the Ravenspurn South B platform

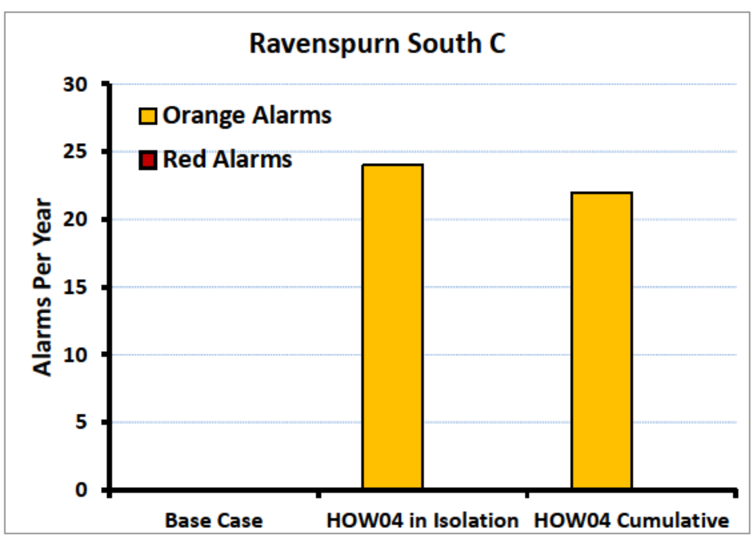

Figure 38: Modelled yearly alarm rates for the Ravenspurn South C platform.

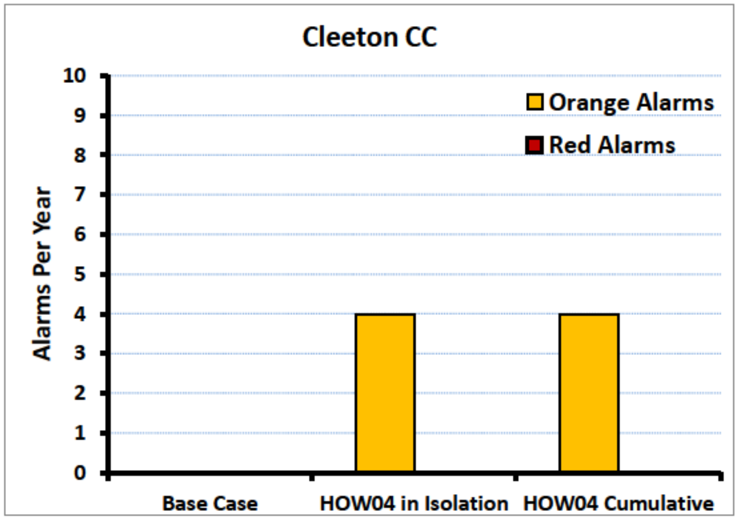

Figure 39: Modelled yearly alarm rates for the Cleeton CC platform.

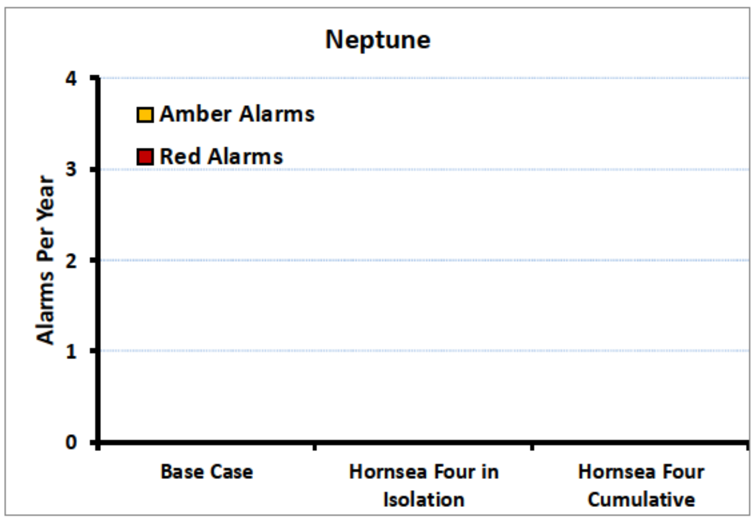

Figure 40: Modelled yearly alarm rates for the Neptune platform.

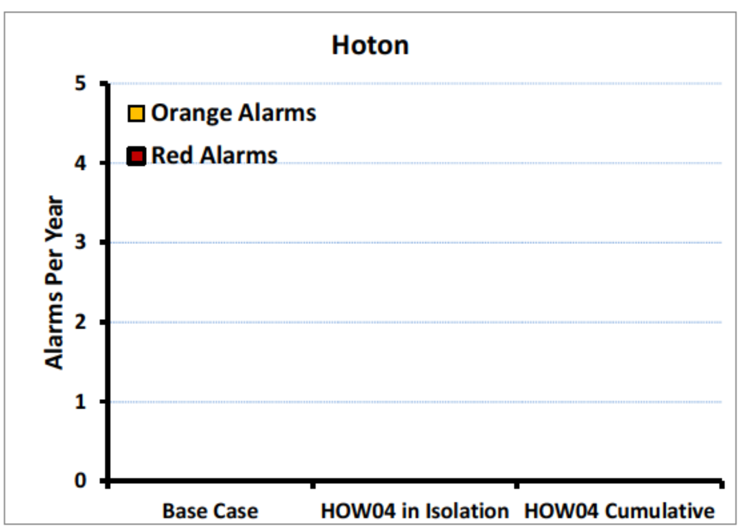

Figure 41: Modelled yearly alarm rates for the Hoton platform.

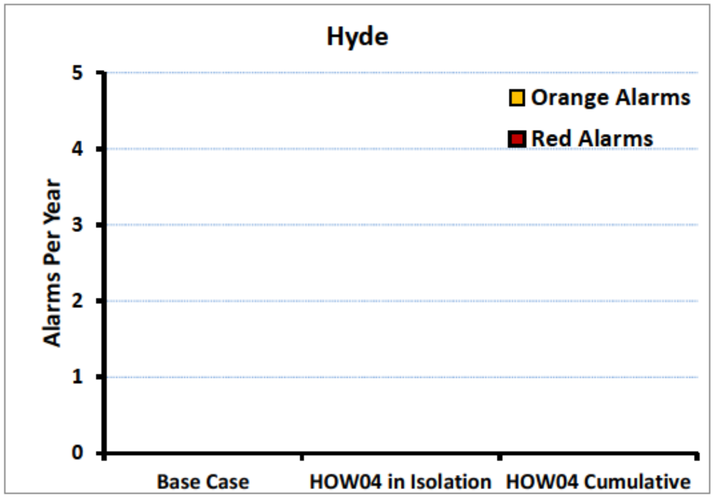

Figure 42: Modelled yearly alarm rates for the Hyde platform.

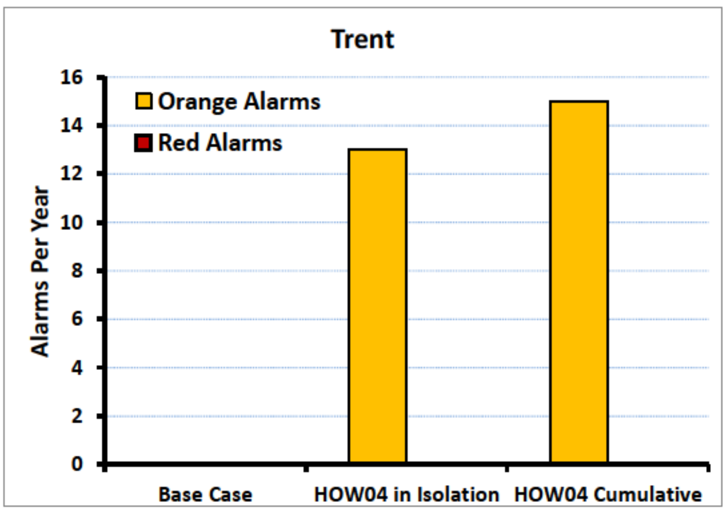

Figure 43: Modelled yearly alarm rates for the Trent platform.

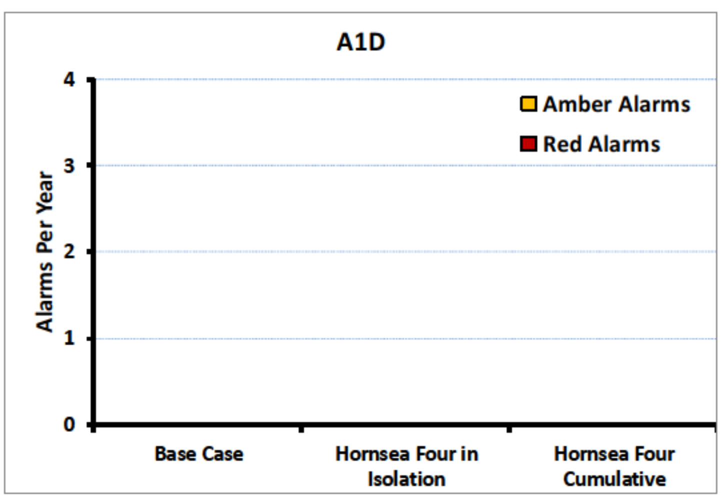

Figure 44: Modelled yearly alarm rates for the A1D platform.

Table 5: The estimated change in yearly alarm rates against the base case.

Platform	Change* in Yearly Alarm Rates Considering Hornsea Four in Isolation		Change* in Yearly Alarm Rates Considering Hornsea Four Cumulatively	
	Amber TCPA	Red TCPA	Amber TCPA	Red TCPA
Ravenspurn North CC	-2	0	-33	0
Ravenspurn North ST2	56	0	57	0
Ravenspurn North ST3	30	0	33	0
Ravenspurn South A	150	13	149	14
Ravenspurn South B	4	0	4	0
Ravenspurn South C	24	0	22	0
Cleeton CC	4	0	4	0
Neptune	0	0	0	0
Hoton	0	0	0	0
Hyde	0	0	0	0
Trent	13	0	15	0
A1D	0	0	0	0

(*) The models use statistical data to generate a large number of paths along a given route (adhering to a Normal Distribution specified by the provided route data). The results are expected to vary slightly (by approximately ±3%) between each run due to the nature of the Normal Distribution of the generated paths.

6.6.1.4 The modelling results indicate that while some platforms will not experience a change in yearly alarm rates, other platforms will see an increase of alarm rates due to the displacement of traffic around the Hornsea Four array area. The re-routed lanes alter the direction and heading of the routes making them more likely to trigger TCPA alarms. Also, as some routes are pushed closer to some platforms, the increased density of traffic along with the closer proximity will result in an increase in both CPA and TCPA alarms. Further analysis and discussion of the results are given in Section 6.7.

6.6.1.5 It can be noted that modelling results for the yearly alarm rates for Hornsea Four only and Hornsea Four in combination with Hornsea One, Hornsea Two and Hornsea Three are similar in numbers, and in some cases reduce the number of alarms. This is the case as most routes will follow the same path in both scenarios (Hornsea Four in isolation and Hornsea Four in combination with Hornsea Project One, Hornsea Project Two and Hornsea Three). It is also worth noting that the models generate a large number of vessel paths within each route by generating the way points in a random manner (based on the mean and standard deviation of each route). Therefore, the results of the statistical analysis may vary slightly depending on the normal distribution around the mean line of each route. Therefore, some of the small changes in the alarm rates observed in between the project alone and cumulative assessment (less than 1%) can be assumed to fall within the error margins of the predicted data and the statistical approach used within the models.

6.7 Remarks on the TCPA/CPA Modelling Results

6.7.1.1 The existing case sees regular traffic in the proposed Hornsea Four array area and surrounding region (Figure 27). For this reason, Perenco has deployed three REWS installations in the region to protect and manage their offshore platforms. However, upon construction of Hornsea Four, the traffic is expected to be rerouted around the Hornsea Four array area bringing some of the existing routes closer to some of the Perenco platforms and hence increasing the density of traffic in the area and increasing the proximity to some of the platforms. The examination of the re-routed traffic and the modelling results indicate that both the change in the routes headings and the rerouting of some routes closer to the platforms will result in an increase in both CPA and TCPA alarms.

6.7.1.2 Closer examination of the rerouted traffic and the alarms triggered showed that the majority of the alarms are generated along one of the rerouted lanes -Route 6: Grangemouth (UK) to Rotterdam (Netherlands). **Figure 45** shows the rerouted traffic along this route and a sample of the location where the TCPA alarms are triggered. In **Figure 45** the dark circle denotes the location of the vessel while the blue lines denote the direction of travel. It can be seen in the samples presented that the vessels have a projected path that would cross the CPA alarm zones, which will cause the amber alarm or a red alarm to be triggered.

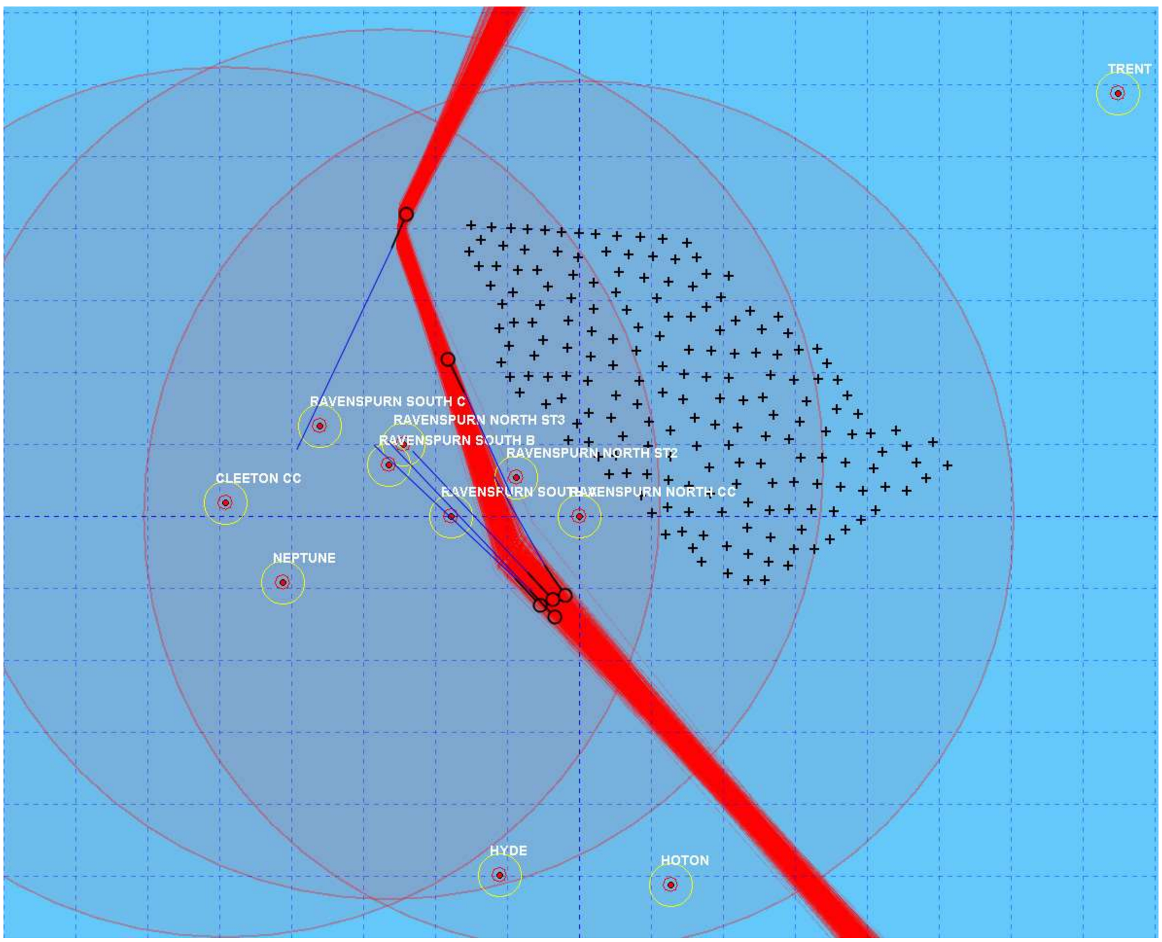

Figure 45: Location of alarms triggered along Route 6: Grangemouth (UK) to Rotterdam (Netherlands).

6.7.1.3 Route 6 is predicted to be rerouted between some of the Ravenspurn platforms in the future (Ravenspurn North CC, North ST2, South A and South B). Although it maintains a good distance from the platforms along most of the route, it comes close to the Ravenspurn North ST2 platform in some cases (minimum modelled case 0.30 nm). However, as shown in **Figure 45,** the main reason of alarms being generated is not due to the proximity of the traffic to the platforms but due to the heading/direction of the route along some segments. These segments are shown in **Figure 45** where the travel vector of the vessels appears to be heading towards Ravenspurn North ST2, North ST3, South A, South B and South C. Vessels travelling along these vectors will trigger TCPA alarms on these platform as illustrated in the results shown in the previous section.

6.7.1.4 Additionally, Perenco's Trent platform has limited radar coverage from the REWS installations in the Ravenspurn complex region. However, due to the existing routes and distribution of traffic, these platforms currently experience a small number of alarms that are within the safety case and operation standards by Perenco. The rerouted traffic due to Hornsea Four may push vessels to pass closer to the Trent platform and potentially increase alarm rates and the risk to these platforms if no adequate radar coverage is present.

6.7.1.5 Finally, this assessment was conducted for the Perenco operated platforms where a number of REWS installations are present. However, the Babbage Platform, which is operated by NEO Energy and the Kilmar NUI and Garrow NUI, which are operated by Alpha Petroleum have no REWS coverage. After the construction of the Hornsea Four, these platforms may have more vessels passing by at closer proximity and at a higher frequency. Upon undertaking this study, little was known about the means used to protect these platforms. Therefore, no assessment of the risk to the Babbage, Kilmar NUI and Garrow NUI platforms was undertaken.

7 Summary and Final Remarks

7.1 General REWS Modelling Summary

7.1.1.1 This assessment was undertaken for the MDS based on the available project parameters in **Volume A1, Chapter 4: Project Description**. The presence of turbines is expected to affect the REWS by introducing shadow regions and increasing the detection threshold around the turbines which may reduce the REWS' ability to detect and track targets within the affected area.

7.1.1.2 The RCS profile will depend on the size and the geometry of the turbines ultimately built within the Hornsea Four array area, along with other external factors such as blade bending and tower vibration.

7.1.1.3 An existing, generic 5 MW wind turbine geometry was used and scaled up to provide a 3-dimensional representation of the MDS turbine geometry. Towers with monopile transition pieces were modelled as the MDS, which give high RCS.

7.1.1.4 Optical shadowing was used to approximate the shadowing effects produced by the turbine towers. This assumes no diffraction around the tower and hence extended shadow lengths.

7.1.1.5 The shadows from the towers are assumed to generate detection nulls for point targets. The modelling results show that the width of the nulls varies between 4 and 15 m. For larger vessels over 1,000 GT, the dimensions of the vessel may exceed the width of the shadowing null. This can cause a portion of the radar signal to be reflected back to the radar. Depending on the levels of the reflected energy, it may be possible to detect the vessel while moving behind the turbines.

7.1.1.6 Some of the assumptions considered within the turbine RCS and shadow modelling are expected to overestimate the effects of turbines on REWS. Measurements show that the radar shadows from turbines diminish gradually with range due to the diffraction effects. Additionally, turbine materials, exact geometry, manufacturing tolerances, and external effects such as blade and tower bending due to wind loading are expected to effect and reduce the RCS of the turbines. This report considers the worst-case scenario using the MDS parameters for the Hornsea Four array area and turbines described in **Volume A1, Chapter 4: Project Description**.

7.1.1.7 REWS often use proprietary thresholding algorithms which are dependent on the system configuration and the operating environment. CA-CFAR is applied over the clutter map to provide a constant 10^{-5} probability of false alarm. The CA-CFAR within this study uses two range cells on both sides of the cell under test as the guard region while the averaging considers six range cells on both sides of the guard region. In Azimuth the modelled CA-CFAR uses one guard cell and two averaging cells on both sides in azimuth.

7.1.1.8 The test vessel parameters were chosen based on the information provided by the REWS operators and comply with the IALA VTS modelling standards.

7.1.1.9 No assessment was made for the NEO operated Babbage platform and the Alpha Petroleum operated Kilmar and Garrow platform as no REWS coverage is present for these platforms.

7.2 Perenco's REWS Returns and Target Detection Assessment

7.2.1.1 Target spreading due to large turbine RCS occurs and may cause occasional masking of targets depending on the vessel size and path. The modelling indicates that sidelobe detection may not impact the overall performance of the REWS.

7.2.1.2 The radar is considered to be sufficiently far from Hornsea Four that the possibility of significant multiple reflections between turbines (only) is very small, and therefore have not been modelled.

7.2.1.3 When a target is very close to the turbines (less than 1.5 km) it is possible that multiple reflections between the target and the turbine can occur which could generate false detections. However as this is normally considered a second order effect it has not at this stage been computed as it is not expected to add to the findings of this assessment. Such effects can be included in the simulations as a standard feature but add significantly to the modelling run time.

7.2.1.4 Hornsea Four will introduce up to 190 new target detections (180 turbines and 10 offshore substations/platforms) on the REWS which might be added to the track table.

7.2.1.5 The high returns from the turbines and the offshore substations will raise the detection threshold over multiple cells around each turbine/substation. This will cause returns from smaller targets to fall under the detection threshold and therefore lose detection while travelling within some parts of the Hornsea Four array area. However, these losses are expected to be transient and will be compensated in most cases by the tracker software.

7.2.1.6 Given the close proximity of the Hornsea Four array area to Perenco's platforms, the modelling suggests that the performance of the REWS on the Ravenspurn North CC and South B platforms is likely to experience some negative impact due to the presence of the Hornsea Four turbines. The raised detection threshold and the shadowing from the turbines will impact the REWS's ability to detect and track targets within the Hornsea Four wind farm. This may reduce the individual REWS's efficiency in issuing TCPA alarms in a timely manner as vessels exit the Hornsea Four array area from the western edge towards Perenco's platforms. However, field measurements of radar performance within Hornsea One have shown that radars are able to detect moving vessels within a wind farm in most cases. In the small number of occurrences where the vessels were within the shadow or masked by the returns from the turbine, the radar signal processing and tracking software were able to compensate for these losses and maintain a track in most cases.

7.2.1.7 Given thatthere are three REWS installations in the region, the possible use of data fusion of radars output feeds could reduce the effect of shadowing and can further reduce the detection gaps due to the elevated thresholds. The use of data fusion is dependent on system readiness and availability of communication links between radar stations.

7.2.1.8 It is expected that there will be no further adverse effects on target detection when considering the effects from Hornsea Project One, Hornsea Project Two and Hornsea Three in combination with Hornsea Four.

7.3 General TCPA/CPA Modelling Summary

7.3.1.1 The shipping routes and reroutes were modelled based on the available data provided by Anatec (see **Annex 7.1: Navigation Risk Assessment** and **Appendix C** of **Annex 11.1: Offshore Installation Interfaces**), which included measured radar and AIS data for the base case and predicted data for future reroutes around Hornsea Four in isolation and around Hornsea Four considered cumulatively with Hornsea Project One, Hornsea Project Two and Hornsea Three. The data included route widths based on their 90th percentiles. This was then used to derive the mean central line and the standard deviation values along each assessed route and reroute.

7.3.1.2 The modelled routes and reroutes were chosen based on their general direction and close proximity to Perenco's operated Ravenspurn North CC, Ravenspurn South Bravo, Ravenspurn North ST2, Ravenspurn North ST3, Ravenspurn South A, Ravenspurn South C, Cleeton CC, Neptune, Hoton, Hyde, Trent and A1D platforms. The routes were chosen for their proximity for CPA alarms assessment and for their general heading vectors for TCPA alarms assessment.

7.3.1.3 Once Hornsea Four is constructed, some routes may remain unchanged relative to the assessed platforms while others might result in closer proximity to the platforms. Therefore, when assessing Hornsea Four in isolation and cumulatively with Hornsea Project One, Hornsea Project Two and Hornsea Three, only selected routes were modelled (Routes: 1, 4, 5, 7, 9, 11, 12, 13).

7.3.1.4 One thousand vessel paths were generated along each route in both the forward and reverse directions (a total of 2,000 runs per route). This was used to estimate the probability of raising a TCPA and/or CPA alarm for each route on each of the assessed platforms. The number of expected alarms per year was derived from the frequency of vessels travelling along each route.

7.3.1.5 The models were set to only issue a TCPA alarm if the vessel continues to breach the TCPA rules for more than 36 radar rotations. This was implemented to avoid false alarms due to temporary vector breach of the TCPA while vessels are turning. This is a particular setting included based on consultation with Perenco.

7.3.1.6 NEO's Babbage platform is located approximately 4.7 km away from the Hornsea Four array area and approximately 2.4 km away from the centre-line of some of the rerouted traffic. However, due to the lack of REWS coverage and information regarding the protection method utilised by NEO to manage their platform, no alarm assessment was undertaken within this study.

7.4 Perenco's TCPA/CPA Alarm Modelling

7.4.1.1 The modelling results indicate that Hornsea Four will, in certain cases, have an impact on the alarm rates at certain Perenco platforms, which could potentially increase the alarm rates. The effect of this on the safety case is considered in more detail in **Volume A5, Annex 11.1: Offshore Installation Interfaces**.

7.4.1.2 While some platforms will not experience any change in the probability of alarms, other platforms are expected to see an increase of alarm rates due to the displacement of traffic around the Hornsea Four array area. Upon construction of Hornsea Four, the traffic is expected to be rerouted around the Hornsea Four array area bringing some the existing routes closer to some of the Perenco platforms and changing their general heading in some sections. However, it should also be considered that certain routes are anticipated to be displaced away from the Perenco platforms. These changes have increased the alarm rates for certain platforms as shown in **Table 5** (North ST2, North ST3, South A, South B, South C,Cleeton CC and Trent). The cause of this increase in alarm rates comes as a result of rerouting Route 6: Grangemouth (UK) to Rotterdam (Netherlands). Vessels on this reroute may trigger TCPA alarms as they travel along certain segments that will have a travel vector heading towards the aforementioned platforms. In theory, the triggering of alarms along those routes can be avoided if the ship's captain could ensure that the heading of the ship along the affected segments is not along a vector heading towards the platform. However, the precise passage taken will depend on a number of factors that are considered outside the scope of this work (e.g., weather and sea conditions, locations of other installations) and is subject to discussion with the operators of the REWS and the vessels. In effect, the potential impact to the risk of allision might be affected, but is considered outside the scope of this document and is discussed in more detail in the Allision Technical Report (**Appendix C** of **Volume A5, Annex 11.1: Offshore Installation Interfaces**).

7.4.1.3 The modelling results also indicated that Perenco's Trent platform will see an increase in annual alarm rates by approximately 15 alarms per year. However, Perenco's Trent platform has limited radar coverage from the REWS installations in the region. The rerouted traffic due to the presence of Hornsea Four may result in vessels passing closer to the platform and hence increase the alarm rates. Using AIS coverage in the region or more comprehensive radar coverage in the area may help in resolving these concerns.

7.5 Further Considerations

7.5.1.1 The variation of returns in range cells due to rotation of the blades may cause the tracker to initiate false tracks. In order for the false track to raise a TCPA alarm the generated track needs to maintain its vector for a set number of radar rotations (typically 5 to 10). This is deemed to be very unlikely and has not been previously reported; however, the effect of this cannot be quantified due to not having access to the supplier's proprietary algorithms used within the system.

7.5.1.2 The study of the shadowing and masking depends on the indicative layout of the Hornsea Four array area and was based on the indicative layout within the design envelope. Should the final turbine positions change significantly, the details of the shadowing and masking analysis may be affected and may need checking. Slight changes within tens of metres due to seabed conditions are not expected to change the shadowing effects significantly. It is also worth noting that if, in the final design for Hornsea Three and Hornsea Four, a reduction in the number of turbines is expected; this will reduce the effects on the REWS.

7.5.1.3 The introduction of turbines to the radar coverage area will increase the number of target detections. Depending on the tracker configuration, turbine detections may be included in the track-table. The track-table is transmitted to ERRV's via a low bandwidth UHF telemetry link. Using non-acquire zones and configuring the tracker to include only moving targets in the track-table may reduce the load on the UHF links. However, the effect of the track-table size and the UHF links are not considered within the scope of this study as it falls within the effects on wireless communications rather than radar.

7.5.1.4 The REWS uses a tracking algorithm to predict the vessels movement and compensate for momentary loss of detection. Such tracking algorithms are proprietary to the manufacturer. In general, such tracking may allow improved performance in the Hornsea Four array area vicinity to compensate for temporary losses due to raised threshold levels or shadowing effects. However, typically a track will be established within 5 to 10 rotations of the radar antenna (for antenna with 24 RPM, this is equivalent to 12.5 seconds).

7.5.1.5 Large (time varying) returns from turbines might cause the processed tracks from vessels to be seduced into the large turbine returns causing errors in tracking. This will be corrected after a number of radar rotations and the correct track will be resolved eventually. However, this is dependent on the tracking algorithm and post signal processing, which may be mitigated through the use of narrow non-acquire zones around each turbine.

7.5.1.6 Improvements to the CFAR performance might be achieved by using more sophisticated CFAR algorithms with different weighting on the averaging cells in order to improve the radar performance within the wind farm. Also, modification to the way that the CFAR calculations compute the threshold average over the wind farm might be modified to minimise the blind regions.

7.5.1.7 In the event mitigation is required for the REWS installations operated by Perenco, there are various options available. The implementation of any mitigation measures through software modifications is highly dependent on the REWS supplier's/operator's setup and a separate study might be needed to establish if such mitigation measures are possible and meet the platform operator's safety and operational requirements.

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Appendix C Allision Technical Report

Hornsea Project Four: Environmental Statement (ES)

Appendix C of ES Annex 11.1: Allision Technical Report

Prepared Anatec Ltd. June 2021
Checked Nicola Allan, Orsted. August 2021
Accepted David King, Orsted. September 2021
Approved Julian Carolan, Orsted. September 2021

A5.11.1
Version B

Assessment of the Impact of Hornsea Four on Offshore Oil and Gas Installations (Allision & Vessel/Rig Access)

Prepared by	Anatec Limited
Presented to	Orsted Hornsea Project Four Limited
Date	19/08/2021
Revision Number	003b
Document Reference	A4481-ORS-OGA-3

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Revision Number	Date	Summary of Change
003	09/06/2021	First issue of V3.
003a	03/08/2021	Updated following client comments.
003b	19/08/2021	Finalised Version.

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Glossary of Terms

Term	Definition
Access	Means by which vessels can transit to and operate at terminus installation.
Allision	Allision has been used in this report to describe contact between a ship and an offshore installation
Automatic Identification System (AIS)	A system by which vessels automatically broadcast their identity, key statistics including location, destination, length, speed, and current status, e.g., under power. Most commercial vessels and European Union (EU) fishing vessels over 15 meters (m) length are required to carry AIS.
Design Envelope	A description of the range of possible elements that make up the Hornsea Four design options under consideration, as set out in detail in **Volume A1, Chapter 4: Project Description**. This envelope is used to define Hornsea Four for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the “Rochdale Envelope” approach.
Deviation	Change in established vessel routeing arising as a result of an offshore development.
Environmental Statement (ES)	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into United Kingdom (UK) law by the EIA Regulations.
Formal Safety Assessment (FSA)	A structured and systematic process for assessing the risks and costs (if applicable) associated with shipping activity.
Former Hornsea Zone	The former Hornsea Zone was one of nine offshore wind generation zones around the UK coast identified by The Crown Estate (TCE) during its third round of offshore wind licensing. In March 2016, the Hornsea Zone Development Agreement was terminated and project specific agreements, Agreement for Leases (AfLs), were agreed with The Crown Estate for Hornsea Project One Offshore Wind Farm, Hornsea Project Two Offshore Wind Farm, Hornsea Project Three Offshore Wind Farm and Hornsea Four. The Hornsea Zone has therefore been dissolved and is referred to throughout as the former Hornsea Zone.
Hornsea Project Four Offshore Wind Farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
Main Route	Defined transit route (mean position) of commercial vessels identified within the specified shipping and navigation study area.
Marine Guidance Note (MGN)	A system of guidance notes issued by the Maritime and Coastguard Agency (MCA) which provide significant advice relating to the improvement of the safety of shipping at sea, and to prevent or minimise pollution from shipping.
Mitigation	A term used interchangeably with Commitment(s). Mitigation measures (Commitments) are embedded within the assessment at the relevant point in the EIA process (e.g. at Scoping, Preliminary Environmental Information Report (PEIR) or the Environmental Statement (ES)).
Maximum Design Scenario (MDS)	The maximum design parameters of each Hornsea Four asset (both on and offshore) considered to be a worst case for any given assessment.

Term	Definition
Navigational Risk Assessment (NRA)	A document which assesses the overall impact to shipping and navigation of a proposed Offshore Renewable Energy Installation (OREI) based upon Formal Safety Assessment (FSA).
Orsted Hornsea Project Four Ltd.	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).
Subsea	Situated or occurring beneath the surface of the sea.
Unique Vessel	An individual vessel identified on any particular calendar day, irrespective of how many tracks were recorded for that vessel on that day. This prevents vessels being over counted. Individual vessels are identified using their Maritime Mobile Service Identity (MMSI).

Abbreviations Table

Abbreviation	Definition
AfL	Agreement for Lease
AIS	Automatic Identification System
CEA	Cumulative Effect Assessment
DCO	Development Consent Order
ECC	Export Cable Corridor
ERRV	Emergency Response and Rescue Vessel (traditionally known as standby vessel)
EIA	Environmental Impact Assessment
ES	Environmental Statement
EU	European Union
FSA	Formal Safety Assessment
GOMO	Guidelines for Offshore Marine Operations
HLV	Heavy Lift Vessel
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IMO	International Maritime Organization
km	Kilometres
km^2	Square Kilometre
m	Metre
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
MGN	Marine Guidance Note
MMO	Marine Management Organisation

Abbreviation	Definition
MMSI	Maritime Mobile Service Identity
MRP	Mean Route Position
nm	Nautical miles
nm^2	Square Nautical Mile
NRA	Navigational Risk Assessment
NtM	Notice to Mariners
NUI	Normally Unmanned Installation
O&G	Oil and Gas
OREI	Offshore Renewable Energy Installation
PEIR	Preliminary Environmental Information Report
REWS	Radar Early Warning System
SEAL	Shearwater to Bacton
TCE	The Crown Estate
UK	United Kingdom
WTG	Wind Turbine Generator

1 Introduction

1. Orsted Hornsea Project Four Limited (the Applicant) is intending to construct and operate the proposed Hornsea Project Four Offshore Wind Farm (hereafter Hornsea Four) located within the former Hornsea Zone. The construction and operation of Hornsea Four may impact on Oil and Gas (O&G) assets in the vicinity of Hornsea Four. These impacts will be assessed in full as part of the Environmental Statement (ES) which will be submitted to the Planning Inspectorate as part of the Hornsea Four Development Consent Order (DCO) application. The main assessments will take place in **Volume A5, Annex 11.1: Offshore Installation Interfaces,** which feeds into the relevant ES Chapter (**Volume A2, Chapter 11: Infrastructure and Other Users**).

2. Anatec Ltd have been commissioned to undertake a dedicated vessel/rig access and allision assessment as an appendix to **Volume A5, Annex 11.1: Offshore Installation Interfaces**, focussing on the impact of allision risk and access as a result of Hornsea Four.

3. On this basis, the output of this assessment is a significance ranking for each O&G asset assessed in terms of allision risk, routine access deviations, and spacing / proximity concerns. Significance has been determined via the International Maritime Organization (IMO) Formal Safety Assessment (FSA) approach (IMO, 2018), in line with the approach undertaken within the Navigation Risk Assessment (NRA) (**Volume A5, Annex 7.1**). Full details of the methodology utilised to ascertain significance and the associated definitions are provided within Section 3 of this report.

4. Reference within this assessment is made to the NRA (**Volume A5, Annex 7.1**), which provides full assessment of impacts to shipping and navigation users that may be affected by the presence of Hornsea Four and the associated works. In particular, marine traffic data collected as required under the Maritime and Coastguard Agency's (MCA's) Marine Guidance Note (MGN) 654 (MCA, 2021) as part of the NRA process is utilised as a primary input into this assessment. Full assessment and background of the marine traffic data utilised can be found within the NRA.

2 Consultation

5. Consultation undertaken to date in relation to this assessment is summarised within this section. Only points deemed relevant to either allision or access have been included.

Table 2.1 Consultation Summary

Consultation Aspect	Relevant Points Raised	Where Addressed
Hazard Workshop 27th June 2019 Perenco, Alpha Petroleum, and Premier Oil (now Harbour Energy[1]) represented	Johnston subsea well, which ties into Ravenspurn, was visited by a dive support vessel the month previous to the workshop, and access to this well should therefore be considered.	Johnston screened into access assessment as per Section 3.
	Kilmar and Garrow are unmanned platforms, but are still visited (albeit not regularly) from Great Yarmouth and Lowestoft.	Kilmar and Garrow screened into access assessment as per Section 3. Origin ports considered in routeing assessment in Section 6.4.
	Jack-ups for the Kilmar and Garrow platforms approach from "Platform North" north (Kilmar's Platform North is 7.35 degrees West of Grid North and Garrow's Platform North is 25 degrees West of Grid North). Anchor placement could be up to 800m around the platform dependent on the catenary angles and the avoidance of pipelines and structure. Note this point was clarified via additional email correspondence on 01/07/20 from Alpha Petroleum after the workshop.	Noted, and considered in impact assessment (Section 8.3.2). Given distances of Kilmar and Garrow to the Hornsea Four array area (6.8nm and 3.8nm respectively), no access or proximity impacts are likely.
	The cumulative impact of the Hornsea developments collectively was the key concern for O&G vessel transits.	This assessment has considered the other Hornsea projects throughout.
	The compression of vessel traffic may create a greater risk of allision with a platform, with the DFDS ferry route to Ijmuiden of particular concern.	Allision has been assessed in Section 7.
Hazard Workshop 28th May 2020 Perenco, NEO Energy, and Premier Oil (now Harbour Energy) represented	Queries raised over whether changes to the array area would be assessed in terms of allision risk to the Babbage platform.	Allision has been assessed in Section 7.
Aviation Workshop 27th September 2019 (Perenco, Alpha Petroleum represented)	Criteria for attending Normally Unmanned Installation (NUI) are based on weather, and it was noted that overnight stays have occurred.	Weather restrictions considered in impact assessment (see Section 8).
	It was suggested that joint emergency response procedures between the Applicant and nearby operators were agreed in advance of construction of Hornsea Four	Considered as additional mitigation (see Section 7.7).

[1] Chrysaor merged with Premier Oil to create Harbour Energy in 2021. Therefore, Harbour Energy are referred to in this report, noting the original consultations preceded the merger and hence were with Premier Oil.

Consultation Aspect	Relevant Points Raised	Where Addressed
Aviation Workshop 9th January 2020 (Perenco, Alpha Petroleum represented)	Concerns were raised over the potential rise in allision rates to O&G assets as a result of third-party traffic deviating to avoid the Hornsea Four array area.	Allision has been assessed in Section 7.
	It was suggested that other assets out with the 10 nautical mile (nm) threshold considered within the NRA may also be affected in terms of allision risk. Assets mentioned specifically were Cleeton, Hyde, Hoton, West Sole, Minerva, and Neptune.	Assets outside of the 10nm threshold have been screened in based on criteria given in Section 3 (including those raised specifically).
	Concern was raised over risks to Walk to Work operations from potential increases in passing third party traffic levels.	Allision has been assessed in Section 7.
Premier Oil (now Harbour Energy) Meeting – 30th October 2019	Discussion of Tolmount assets relative to booster station search area.	The Tolmount Main platform has been screened into the assessment as per Section 3.2.
	Concerns were raised over interaction between Hornsea Four vessels / structures and the activities associated with the decommissioning of the Johnston infrastructure (with rig access being the primary concern).	Access issues associated with the Johnston assets are assessed in Section 8.3.1.2.
Premier Oil (now Harbour Energy) Simultaneous Operations Workshop 9th December 2019	Discussions of simultaneous operations between the Applicant and Premier Oil (now Harbour Energy). Included discussions of spacing required for safe operations.	Workshop output considered within access impact assessment (see Section 8.3).
Perenco and Alpha Petroleum Meeting – 19th May 2020	Discussions around changes in routeing post wind farm and effects on operator risk assessments.	Changes in allision risk to relevant assets is assessed in Section 7.
NEO Energy Meeting – 29th July 2020	Queries raised over changes in density within the vicinity of Babbage, and over potential increases in wind farm vessel activity.	Traffic patterns and changes post wind farm relative to Babbage are assessed in Section 7. Wind farm activity (and how this will be managed) is discussed in Section 8.
NEO Energy Meeting – 15th January 2021	Discussion /overview of latest results was provided.	Relevant results presented in Sections 7 and 8.
Premier Oil (now Harbour Energy) Meeting – 30th November 2020	Premier Oil (now Harbour Energy) confirmed content with marine access requirements in relation to Johnstone Field on the basis that a 1,000m wide corridor around the relevant pipelines and to the south of the J4/J5 wells would be maintained within the Hornsea Four array area.	Factored into access impact assessment (see Section 8.3).
Perenco Meeting – 25th May 2021	Queries raised around mitigations and procedures that will be in place during the construction phase of Hornsea Four noting proximity of Ravenspurn North complex.	Impacts associated with access to the Ravenspurn North Complex (including during construction) are assessed in Section 8.3.2.
Section 42 Consultation in response to Chapter 12: Infrastructure and Other	Premier Oil (now Harbour Energy) raised concerns over access to Johnston Field infrastructure for dive operations, inspections, maintenance / repairs, and decommissioning, with space to operate for such operations when within the Hornsea Four array area also of concern.	Access issues associated with the Johnston assets are assessed in Section 8.3.1.2.

Consultation Aspect	Relevant Points Raised	Where Addressed
Users of the Preliminary Environmental Information Report (PEIR) (Orsted, 2019)	Speedwell Energy[2] raised that planned development of a pipeline and umbilical from wellhead locations in block 43/21b to the Ravenspurn North platform would require access into the Hornsea Four array area.	As per Section 3.1, assets that are planned (as opposed to consented, constructing, or operational) are not included within this assessment.
	Alpha Petroleum raised concern over the impact of the structures within the Hornsea Four array area on attending vessel operations at the Garrow and Kilmar offshore gas platforms	Access issues to Kilmar and Garrow assets are assessed in Section 8.3.2.
	Spirit Energy[3] noted that due to the close proximity of the Babbage platform to the Hornsea Four array area, associated vessel operations may be affected. Concerns were also raised over displacement of third party traffic closer to the Babbage platform.	Considered in Section 8.3.2.

[2] Note: RockRose acquired Speedwell Energy in 2020 and have since formally relinquished the relevant acreage.
[3] Note: operation of Babbage has since been transferred to NEO Energy.

3 Asset Screening

3.1 CEA Screening Overview

6. For the purposes of this assessment, each O&G asset included in the Cumulative Effect Assessment (CEA) (see **Volume A4, Annex 5.3: Offshore Cumulative Effects**) has been assigned an assessment tier based on the criteria provided in Table 3.1.

7. The asset screening process is then summarised in Table 3.2. The full list of O&G assets considered is provided in the CEA, noting that any asset within the CEA but not listed in Table 3.2 has not been assessed within this assessment based on the screening criteria as detailed in Table 3.1. Sections 3.2.1 to 3.2.3 provide further details of each Tier assessed.

8. Subsea pipelines have been considered when within the Hornsea Four array area (i.e., Tier 1 as per Table 3.1), however it is noted that these are not included in the CEA and hence are not shown in Table 3.2.

9. It should be considered that certain assets screened in may be decommissioned prior to construction of Hornsea Four. However, given uncertainty around decommissioning dates, the prospect of assets being removed prior to construction has not been accounted for. Impacts associated with required access and spacing during decommissioning have still been assessed.

10. Assets that are planned (as opposed to consented, constructing, or operational) are not included within this assessment, however discussions will be ongoing with the relevant operators.

Table 3.1 Asset Screening Methodology

Tier	Criteria	Assessment Approach
1	▪ Pre-existing asset within Hornsea Four array area.	Impacts associated with allision and access assessed, including access impacts to associated subsea infrastructure (e.g., pipelines).
2	▪ Surface asset outside of Hornsea Four array area but within 10nm; **or** ▪ Surface asset within 10nm of the High Voltage Alternating Current (HVAC) booster station search area.	Impacts associated with allision and access assessed.

Tier	Criteria	Assessment Approach
3	▪ Asset not within 10nm but raised during consultation by a relevant stakeholder; **or** ▪ Asset not within 10nm but route to asset will require deviation as a result of Hornsea Four array area.	Impacts associated with allision and access assessed[4]

Table 3.2 Asset Screening Process

Project	Operator	Status	Distance (nm)		Tier
			Array	HVAC	
Johnston Subsea Wellhead Protection Structure	Harbour Energy[5]	Operational	Inside	> 10	1
Johnston Template/Manifold	Harbour Energy[5]	Operational	Inside	> 10	1
Ravenspurn North Complex (CC / CCW)	Perenco	Active	1.6	> 10	2
Ravenspurn North ST2	Perenco	Active	2.2	> 10	2
Babbage	NEO Energy[6]	Active	2.3	> 10	2
Garrow NUI	Alpha Petroleum	Active	3.8	> 10	2
Ravenspurn North ST3	Perenco	Active	4.3	> 10	2
Ravenspurn South A	Perenco	Active	5.0	> 10	2
Ravenspurn South B	Perenco	Active	5.2	> 10	2
Ravenspurn South C	Perenco	Active	6.6	> 10	2
Kilmar NUI	Alpha Petroleum	Active	6.8	> 10	2
Cleeton CC	Perenco	Active	11.0	> 10	3
Cleeton WLTR	Perenco	Active	11.0	> 10	3
Cleeton PQ	Perenco	Active	11.0	> 10	3
Neptune	Perenco	Active	11.2	> 10	3
Hoton	Perenco	Active	11.5	> 10	3
Hyde	Perenco	Active	13.7	> 10	3
Trent	Perenco	Active	14.2	> 10	3

[4] Assessment approach differs from Tier 2 in that marine traffic data utilised within NRA does not extend beyond 10nm from Hornsea Four array area.
[5] Chrysaor merged with Premier Oil to create Harbour Energy in 2021, and therefore initial consultations were with Premier Oil.
[6] Note Spirit Energy were operating Babbage during initial consultation, but have since transferred operation to NEO Energy.

Project	Operator	Status	Distance (nm)		Tier
			Array	HVAC	
West Sole C	Perenco	Active	15.9	> 10	3
West Sole B	Perenco	Active	17.3	> 10	3
Minerva	Perenco	Active	17.6	9.0	2
West Sole A (PP/SP/8 leg/ 6 leg)	Perenco	Active	17.8	> 10	3
Tolmount Main Platform	Harbour Energy[7]	Consented	19.8	1.3	2

3.2 Tier Summary

3.2.1 Tier 1

11. Based on the asset screening process, Tier 1 assets are shown relative to the Hornsea Four array area in Figure 3.1. In summary, Tier 1 assets are comprised of the subsea infrastructure associated with the Johnston Field (all of which are operated by Harbour Energy) and the Shell operated Shearwater to Bacton (SEAL) pipeline.

12. The Johnston Field assets include:

- Six wells divided between two locations (J1, J2, J3 & J6 at the Johnston manifold template, and J4 & J5 at a separate step out location);
- One exploration and appraisal well east of the template;
- Rigid pipeline between Johnston template and Ravenspurn North (only includes section within the Hornsea Four array area); and
- Flexible pipeline and umbilical between the J4 & J5 step out and the Template.

[7] Chrysaor merged with Premier Oil to create Harbour Energy in 2021, and therefore initial consultations were with Premier Oil.

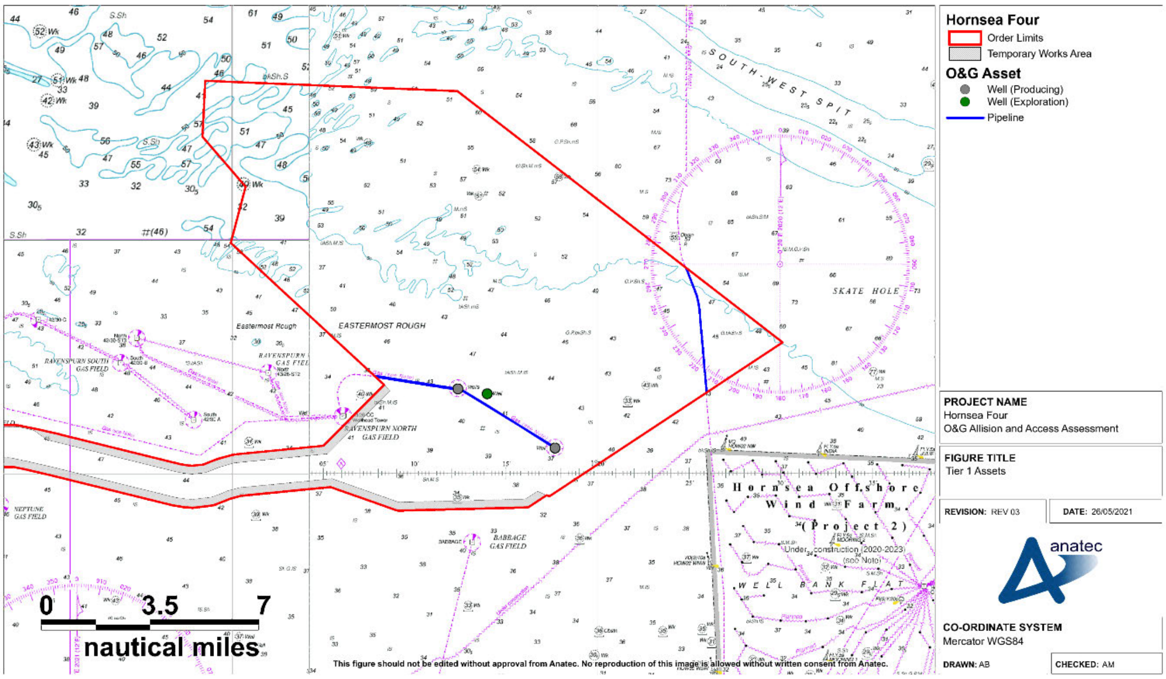

Figure 3.1 Tier 1 Assets

3.2.2 Tier 2

13. As per Section 3.1, Tier 2 assets are those that are either within 10nm of the Hornsea Four array area or within 10nm of the HVAC booster station search area.

3.2.2.1 Hornsea Four Array Area

14. The platforms within 10nm of Hornsea Four array area are shown in Figure 3.2. These are:

- Babbage;
- Garrow;
- Kilmar;
- Ravenspurn North (CC complex, ST2, and ST3); and
- Ravenspurn South (A, B, and C).

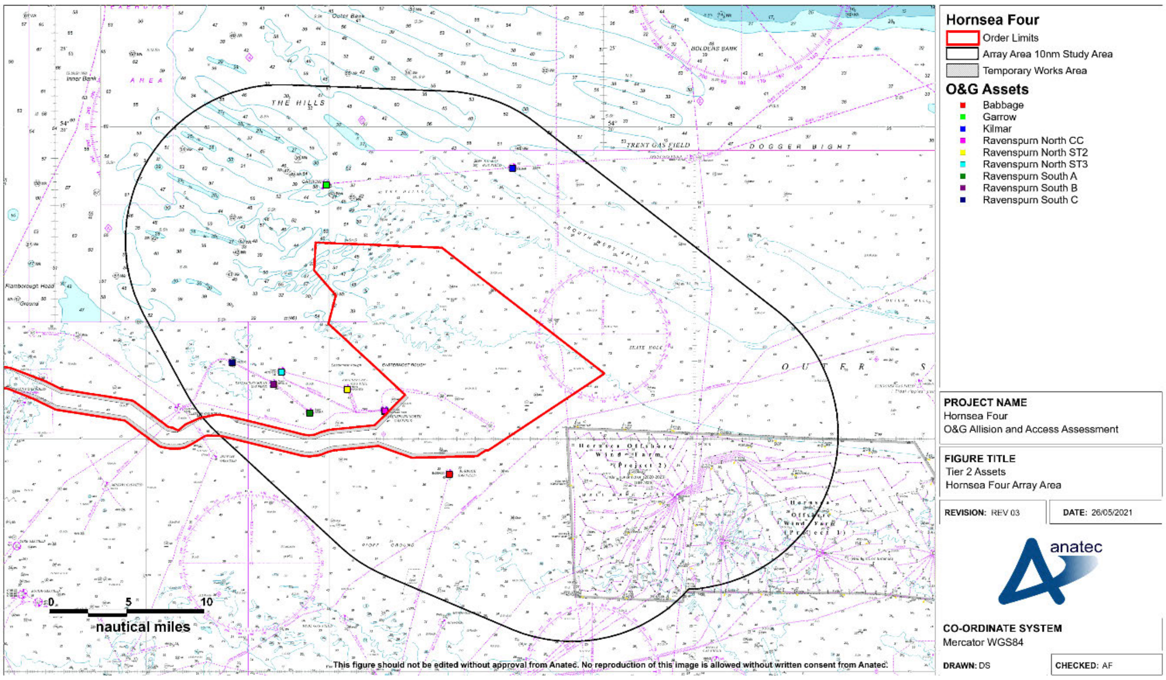

Figure 3.2 Tier 2 Assets

3.2.2.2 HVAC Booster Station Search Area

15. Other Tier 2 assets comprise the locations within 10nm of the HVAC booster station search area. These are the Tolmount Main Platform (which was installed in 2020), and the existing Minerva platform. These locations are shown relative to the HVAC booster station search area in Figure 3.3.

16. It is noted that additional assets associated with the Tolmount field are being considered, dependent on the outcomes of future drilling operations. Discussions will be ongoing with the relevant operator as to the status of these assets.

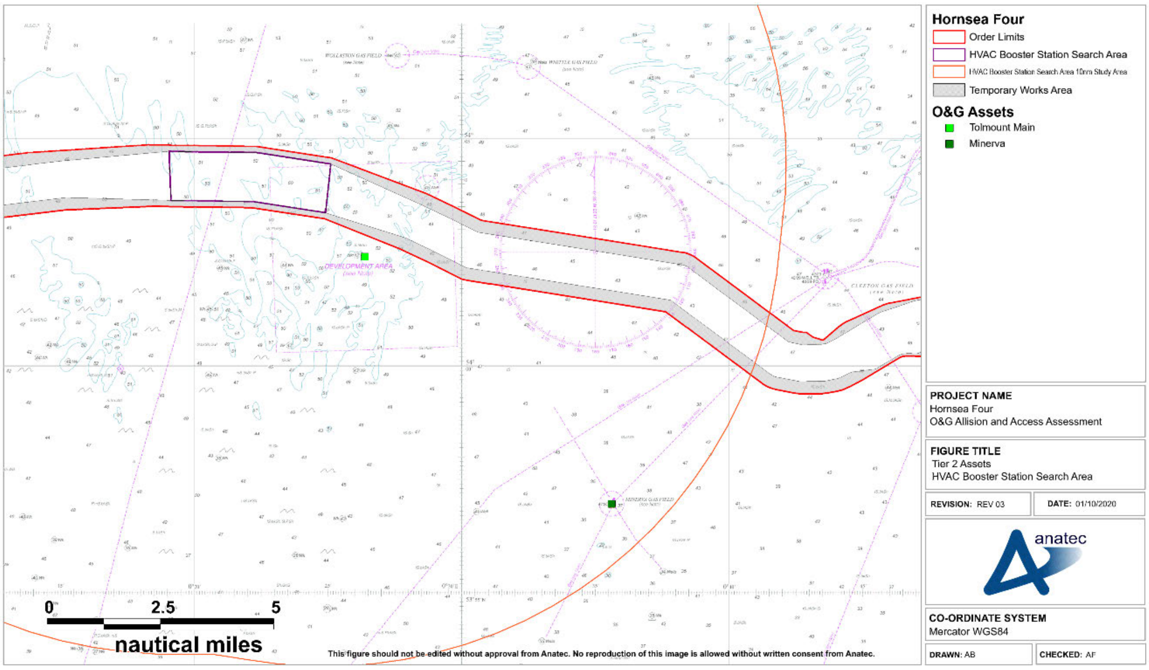

Figure 3.3 Tier 2 Assets (within 10nm of HVAC Booster Station Search Area)

3.2.3 Tier 3

17. Based on the asset screening process, Tier 3 assets are shown relative to the Hornsea Four array area in Figure 3.4. These are primarily comprised of any platform raised during consultation by a relevant operator in relation to the Hornsea Four array area, but located in excess of 10nm from the Hornsea Four array area:

- Cleeton;
- Hoton;
- Hyde;
- Neptune; and
- West Sole (A complex, B, and C).

18. Tier 3 also comprises any platform in excess of 10nm from the Hornsea Four array area that will require routine support vessels to deviate as a result of the Hornsea Four structures, based on the post wind farm routeing as identified within the NRA and presented in Figure 6.4 of **Volume A5, Annex 7.1**. The only surface asset fitting these criteria was the Trent platform.

19. It is noted that the Minerva platform was also raised during consultation (see Table 2.1) and is further than 10nm from the Hornsea Four array area, however this is covered under Tier 2 given it is within 10nm of the HVAC booster station search area.

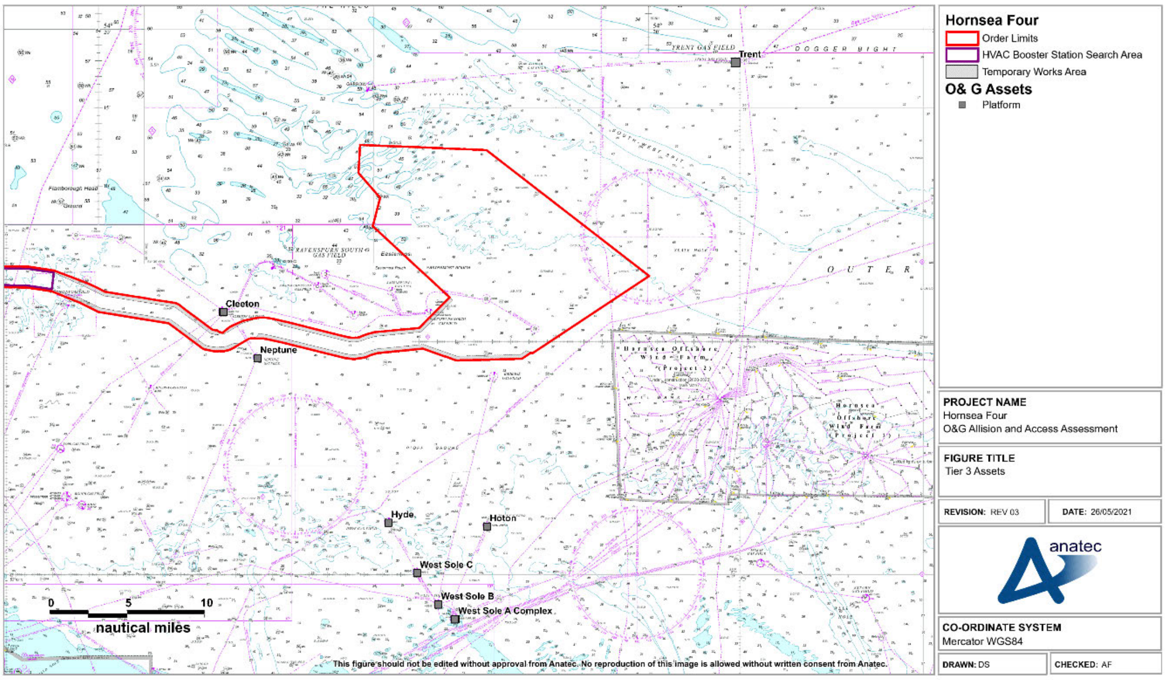

Figure 3.4 Tier 3 Assets

4 Methodology

4.1 Impacts Assessed

20. This assessment has focussed on impacts associated with allision and vessel access to O&G assets, identified during consultation and as part of the Infrastructure and Other Users chapter of the PEIR (Ørsted, 2019). Separate studies are being carried out with respect to the impact on Radar Early Warning Systems (REWS) (**Appendix B of Volume A5, Annex 11.1**) and helicopter operations (**Appendix A of Volume A5, Annex 11.1**).

21. On this basis, impacts assessed within this assessment are as follows:

- Wind turbines and associated works may result in deviations to routine support vessel routeing to O&G platforms;
- Proximity of wind turbines and associated works may restrict / hamper vessel access to O&G platforms and subsurface infrastructure during certain periods (e.g., allowable weather); and
- Potential allision risk to O&G platforms due to vessels being deviated from existing routes due to the presence of the Hornsea Four infrastructure.

4.2 Assessment Methodology

22. This assessment is intended to inform **Volume A5, Annex 11.1: Offshore Installation Interfaces** which has been prepared in support of the Infrastructure and Other Users Chapter (**Volume A2, Chapter 11: Infrastructure and Other Users**) of the Hornsea Four ES. On this basis, it does not seek to replace the subsequent impact assessment of the ES. Instead, it serves as an initial screening and assessment to inform **Volume A5, Annex 11.1: Offshore Installation Interfaces**.

23. Within **Volume A5, Annex 11.1: Offshore Installation Interfaces**, impacts to each asset considered will be assigned a “consequence” and “probability” ranking, which will then be used to assess significance.

24. This aligns with the FSA (IMO, 2018) approach undertaken within the NRA, and as such this assessment has utilised the FSA approach, meaning the outputs can be adapted to feed into in **Volume A5, Annex 11.1: Offshore Installation Interfaces**.

25. The FSA approach within the NRA uses probability (frequency) and consequence to determine the significance of each impact as being either broadly acceptable, tolerable, or unacceptable for each asset screened in. Impacts that are determined to be unacceptable must be reduced to within broadly acceptable or tolerable parameters via additional mitigation over that considered embedded at present.

26. It should be considered that the output of this assessment considers impacts associated with allision and access only, and as such will not supersede the asset rankings that will be determined in **Volume A5, Annex 11.1: Offshore Installation Interfaces**, which will consider all impacts, and forms the primary input to **ES Volume A2, Chapter 11: Infrastructure and Other Users**.

27. On this basis, methodologies for assessing the significance of allision and access impacts are provided in Sections 4.2.1 and 4.2.2. It is noted that a tiered approach to assessment has been undertaken, with each asset assessed assigned into one of three assessment tiers, as defined in Table 3.1, depending on location and status. Further details are provided in Section 3.

4.2.1 Allision

28. It should be considered that proximity between offshore installations and passing traffic is a primary factor affecting allision risk. On this basis, the assessment of allision risk undertaken within this assessment has focused on changes to traffic patterns passing within two nm of the relevant assets as a result of Hornsea Four. This has been based on the pre- and post-wind farm routes as identified within the NRA (**Volume A5, Annex 7.1**). Consideration has also been given to any routeing restrictions which may increase allision risk (e.g., searoom between assets).

29. The significance of allision risk has then been assessed on a qualitative basis as per the criteria given in Table 4.1. It is noted that the definitions of these rankings must be considered in conjunction with the assumptions detailed in Section 4.4.

Table 4.1 Allision Assessment Significance Criteria

Significance	Description	Criteria
Broadly Acceptable	Beneficial (potential decrease in allision risk)	Decrease in vessel numbers in proximity to asset
	No impact	No or negligible change in vessel numbers in proximity to asset
	Adverse – low (potential for low or possible increase in allision frequency)	Low change in vessel numbers in proximity to asset
Tolerable with Mitigation	Adverse – moderate (potential for possible or high increase in allision frequency)	Moderate to high change in vessel numbers in proximity to asset but available searoom for transit
Unacceptable	Adverse – High (potential for high or very high increase in allision frequency)	High change in vessel numbers with limited searoom for transit

4.2.2 Vessel/Rig Access

30. Impacts associated with access have been separated into two categories as follows:

- Deviations required for routine offshore support vessel visits (e.g., supply and standby) to assets as a result of Hornsea Four, i.e., impact on surface navigation only; and
- Hornsea Four structures or works restricting or hampering the ability to carry out O&G operations at assets within the Hornsea Four array area, or nearby, e.g., rig work.

31. Deviations have been assessed by identifying baseline vessel routeing to screened in assets via the use of marine traffic data (see Section 6) and Anatec's internal routeing database (Anatec, 2021). This has then been compared against likely post wind farm deviations (Section 7.3), which have been primarily based on the findings of the NRA. In any cases where routes to relevant assets were not defined within the NRA (i.e., such routes were not reflected within the marine traffic data), these have been defined via Anatec's internal routeing database (Anatec, 2021).

32. Impacts associated with the potential for operations at O&G assets to be restricted or hampered have been assessed based on the proximity of the assets to the Hornsea Four structures, which is illustrated in Table 3.2. The available space (i.e., distance between the asset and Hornsea Four array area and/or HVAC Booster Station Search Area) has been assessed against existing cases of relevant operations occurring in the vicinity of or within constructing or operational wind farms, with consultation undertaken for Hornsea Four with the relevant operators in regards to spacing needs (see Section 2) taken into consideration.

33. Significance is then assessed on a qualitative basis according to the criteria detailed in Table 4.2. It is noted that the definitions of these rankings must be considered in conjunction with the assumptions detailed in Section 4.4.

Table 4.2 Access Assessment Significance Criteria

Significance	Description	Assessment Criteria	
		Deviations	Restriction / Hampering of O&G Operations
Broadly Acceptable	No impact	Route to asset unaffected by Hornsea Four structure	No impact on operations
	Adverse – low	Minimal deviation required with limited impact on transit distance / time	Limited impact on O&G operations
Tolerable with Mitigation	Adverse – moderate	Moderate deviation required with potential for notable impact on transit distance / time	Potential for moderate restriction / hampering of O&G operations
Unacceptable	Adverse - High	Deviation not possible without unacceptable impacts on vessel safety	Wind farm structures prevent practicable access to asset by a rig / vessel required to undertake an operation at that asset

4.3 Maximum Design Scenario

34. The Maximum Design Scenario (MDS) within which impacts have been assessed is summarised as follows, noting that further details are provided within the NRA (**Volume A5, Annex 7.1**) which holds the same MDS:

- Maximum extent of buoyed construction / decommissioning area during the construction and decommissioning phases, and maximum extent of the Hornsea Four array area within the operational phase (maximum deviations, and lowest proximity to O&G assets outside of the array); and
- Maximum number of surface structures - 190 locations (maximum site build out and minimum spacing within the array).

4.4 Assumptions

4.4.1 Assessment Approach

35. Given that Anatec is not privy to individual O&G operator's Safety Cases, it is not possible to determine whether impacts to the relevant assets are "tolerable" within the context of those Safety Cases. It should therefore be considered that the assessment output is based on whether the direct hazards / impacts assessed as part of the scope of this particular assessment (i.e., allision and access) are considered to be tolerable considering the known mitigations assumed to be in place (see Section 4.4.2). On this basis, cumulative tolerability of all potential hazards that personnel on the installations are exposed to has not been considered.

4.4.2 Mitigation

36. Impacts have been assessed on the assumption that known embedded mitigations will be in place, both on the part of the Applicant and the relevant O&G operators. On this basis, where an impact has been assessed as being within tolerable parameters, key measures assumed to be in place include the following:

- The Applicant will consider local O&G assets and associated operational requirements, where appropriate (i.e., assets which may be affected in terms of access), within their site design, and continue to consult and liaise with relevant operators in this regard;
- O&G operators will continue to provide suitable Collision Risk Management measures for their assets (e.g., Emergency Response and Rescue Vessel (ERRV), REWS, etc.) taking into account fluctuations in local passing traffic levels over time;
- Promulgation of information including to regular commercial vessel operators in the area to ensure they are aware of Hornsea Four, ensuring they can passage plan taking into account both the Hornsea Four array area and the existing O&G assets;

- The Applicant will promulgate information regarding Hornsea Four as required to relevant O&G vessel operators, who will utilise this information to passage plan to minimise deviations to routes to local assets; and
- Consultation with Trinity House to determine appropriate lighting and marking taking into consideration the existing O&G assets.

5 Project Description

5.1 Overview

37. The Hornsea Project Four Agreement for Lease (AfL) is located approximately 37 nm (69 kilometres (km)) east of the United Kingdom (UK) coast, at Flamborough Head, East Riding of Yorkshire. The total area of the Array considered at the point of DCO application is approximately 136 Square Nautical Miles (nm^2) (467 Square Kilometres (km^2)).

38. There are three other Hornsea developments in proximity to Hornsea Four, specifically Hornsea One (Operational), Hornsea Two (Construction) and Hornsea Three (Consented).

39. Figure 5.1 presents the location of Hornsea Four relative to the other Hornsea projects.

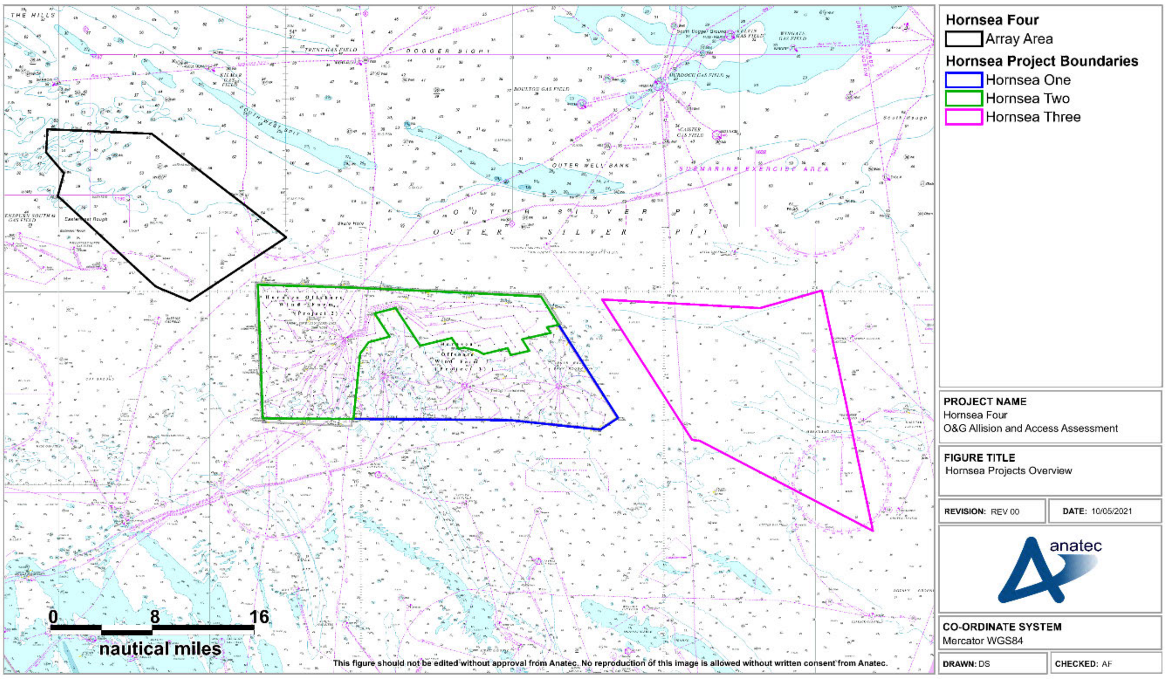

Figure 5.1 Hornsea Projects Overview

40. The project design envelope includes up to three HVAC booster stations, which will be located within the HVAC booster station search area within the offshore Export Cable Corridor (ECC) as shown in Figure 5.2. It is noted that should a High Voltage Direct Current (HVDC) transmission option be selected, then no HVAC booster stations will be required.

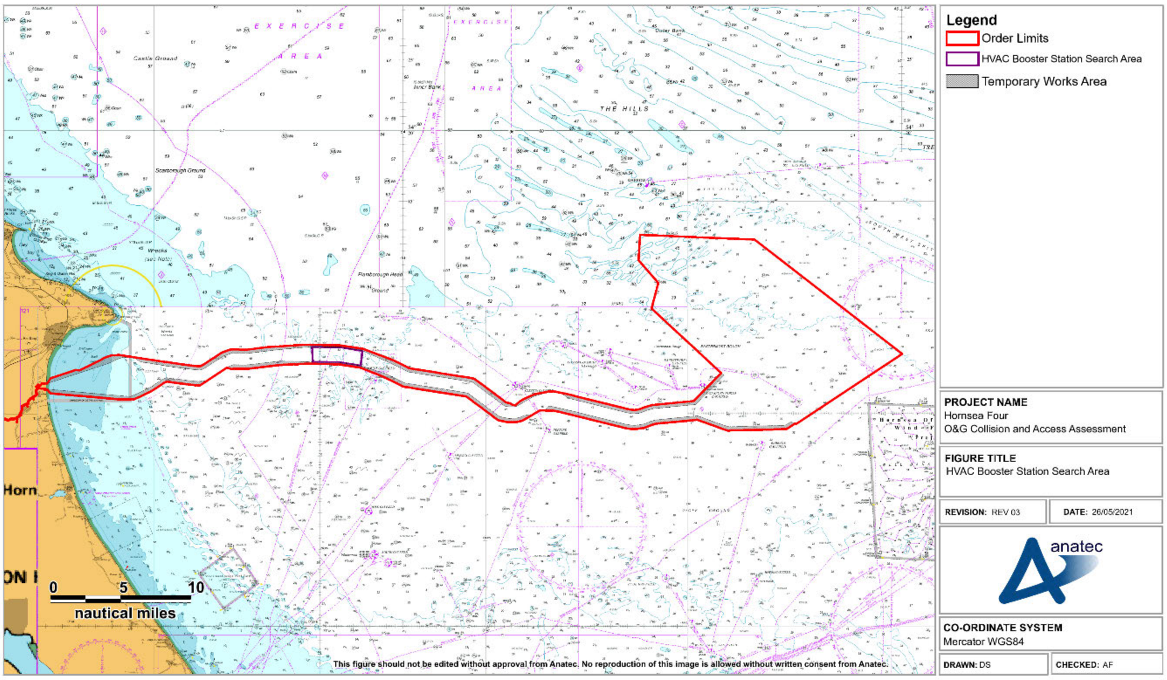

Figure 5.2 HVAC Booster Station Search Area

5.2 Layout

41. An indicative layout has been utilised for the purposes of this assessment, as shown in Figure 5.3, noting that this is also the layout assessed within the NRA. It is noted that locations for substations and the accommodation platform have not yet been defined so these structures have been placed according to a MDS for shipping and navigation. Further details are provided within the NRA (**Volume A5, Annex 7.1).**

42. It should be considered when viewing this layout that it is not necessarily reflective of the final layout(s) that will be agreed with the Marine Management Organisation (MMO) post-consent in consultation with the MCA and Trinity House and is presented purely for the purposes of illustration within this assessment. The Applicant will agree a set of Layout Principles (**Volume A4, Annex 4.7: Layout Principles**) with MCA and Trinity House, and the final layout will comply with the agreed principles.

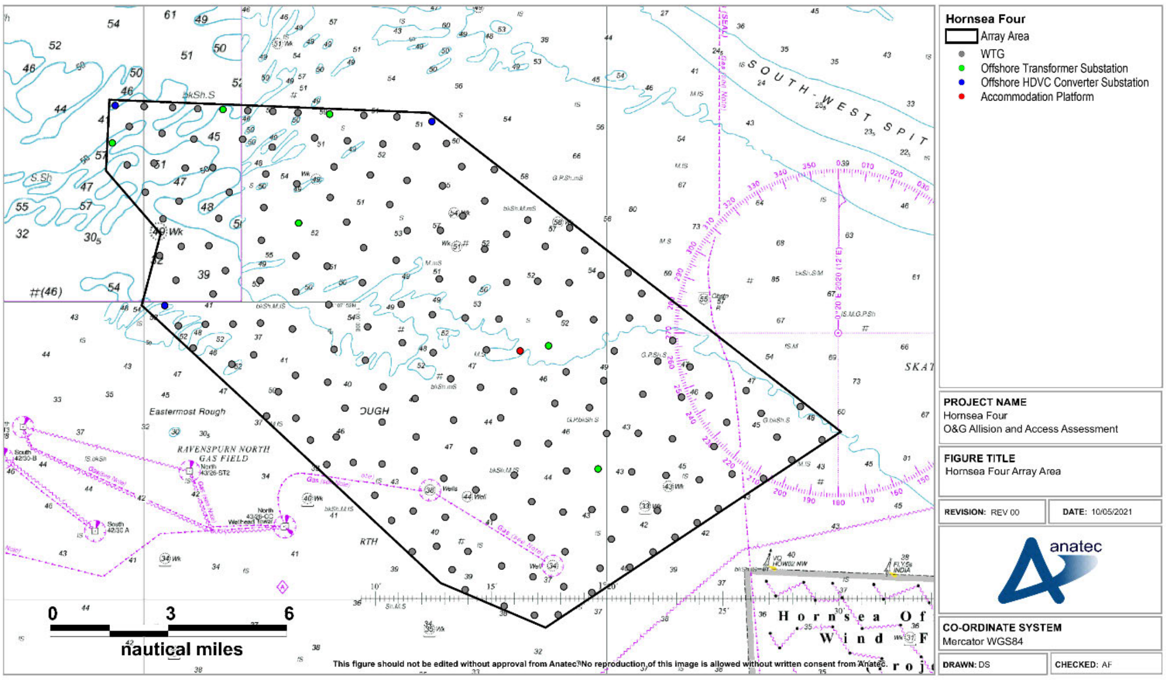

Figure 5.3 Hornsea Four Array Area Illustrative Layout

6 Marine Traffic Assessment

6.1 Survey Methodology

43. As part of the NRA process, Hornsea Four have collected various periods of marine traffic survey data, including via dedicated vessel based on-site surveys and additional periods of terrestrial on-shore AIS data. Full details are contained within the NRA (**Volume A5, Annex 7.1**).

44. For the purposes of this assessment, the following periods have been presented (noting potential effects of the COVID pandemic on the data are considered within the NRA):

- Array Area:
  - 25th July to 7th August 2020 (AIS).
  - 24th February to 10th March 2021 (AIS, Radar, visual observations).
- HVAC
  - 17th to 30th June 2020 (AIS).
  - 10th to 24th March 2021 (AIS, Radar, visual observations).

45. In line with standard shipping and navigation assessments, the data collected was considered within a study area defined via a minimum 10nm buffer around the Hornsea Four array area (see NRA, **Volume A5, Annex 7.1** for full details), which ensured good data quality within the area studied. It also ensured relevant passing traffic was captured while still remaining site specific to Hornsea Four. It should be considered that any vessels deemed as representing non-routine traffic (e.g., surveys) have been excluded from the assessment.

46. It is noted that the marine traffic study area as defined within the NRA omits the Tier 3 assets (see Section 3.2.3), given that these are in excess of 10nm from the Hornsea Four array area. The furthest of the Tier 3 assets from the Hornsea Four array area is the West Sole A complex located 17.7nm to the south. Data quality at that proximity would not necessarily be reliable (due to the distance from the survey vessel), particularly during winter periods, and therefore it was not considered appropriate to extend the marine traffic study area over that assessed within the NRA to cover the Tier 3 assets. Instead, the main routes identified within the study area, and the subsequent deviations assessed as part of the NRA have been considered within an extended threshold that encompasses the Tier 3 assets.

47. This approach ensured the impacts of Hornsea Four can still be assessed for the Tier 3 assets effectively, given that the routes identified were validated against Anatec's internal routeing database (Anatec, 2021).

48. Further details of the main routes are given in Section 6.3.

49. Detailed marine traffic assessment in the vicinity of the HVAC booster station search area has also been undertaken, and full details are included within the NRA (**Volume A5, Annex 7.1**). An overview of the data and associated main routes identified as part of the NRA process are shown in Sections 6.2.2 and 6.3.2, given that these are of relevance to the assessment of certain Tier 2 assets (see Section 3.2.2).

6.2 Data Overview

6.2.1 Hornsea Four Array Area

50. The 28 days of data collected is shown relative to the Hornsea Four array area and the O&G assets screened into Tiers 1 and 2 in Figure 6.1.

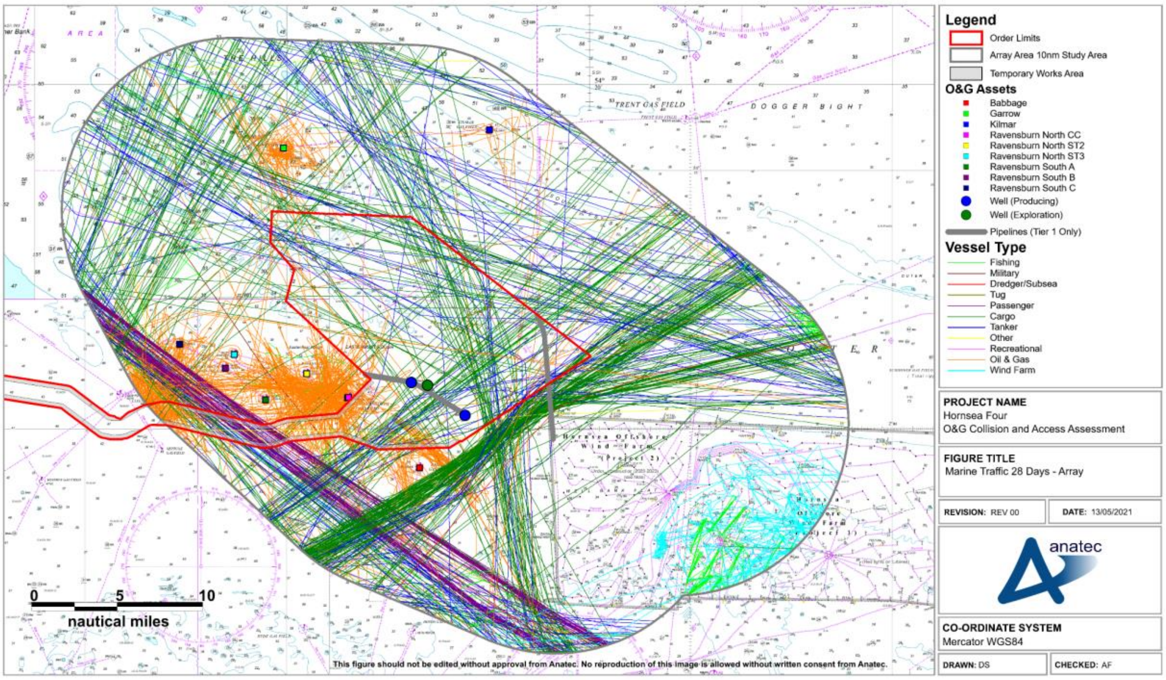

Figure 6.1 Marine Traffic Survey Data 28 Days – Array

51. An average of 25 unique vessels per day were recorded within the study area over the 28 days of marine traffic data studied, with the most commonly recorded vessels being commercial vessels (cargo and tankers) which accounted for approximately 62% of

traffic. O&G support traffic levels were also notable, accounting for approximately 18% of all vessels recorded.

6.2.2 HVAC Booster Station Search Area

52. The 28 days of data collected is shown relative to the Hornsea Four HVAC booster station search area and the O&G assets within 10nm, this is presented in Figure 6.2.

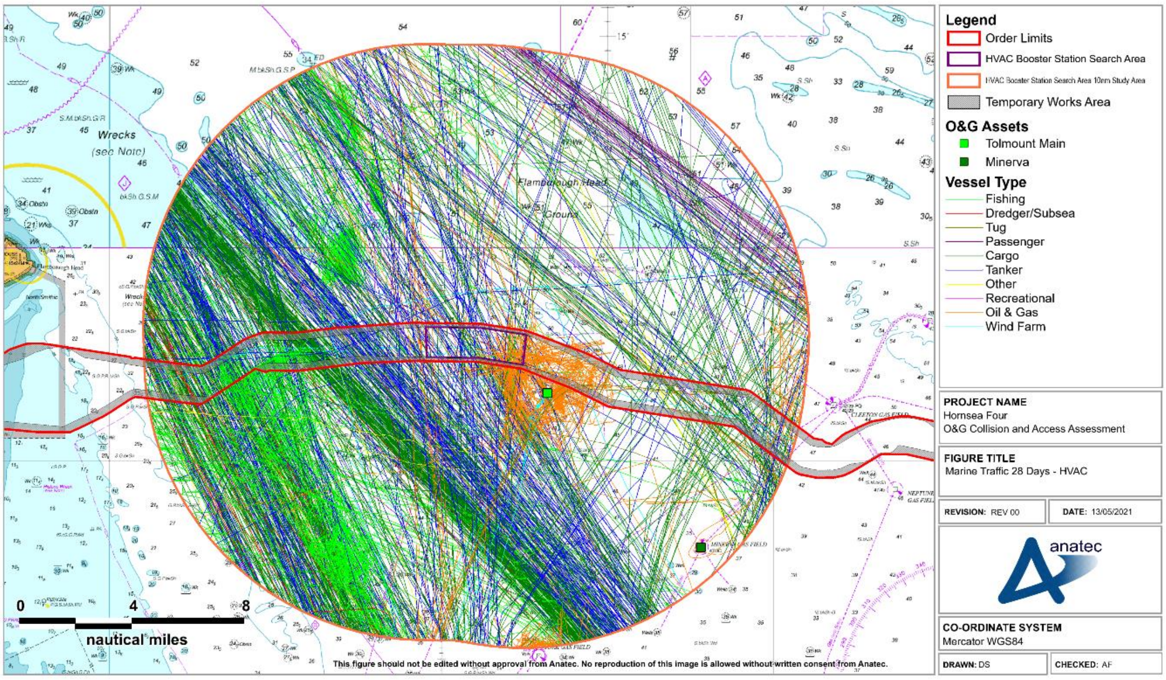

Figure 6.2 Marine Traffic Survey Data 28 Days – HVAC Booster Station Search Area

53. An average of 41 unique vessels per day were recorded within the study area over the 28 days of marine traffic data studied, with the most commonly recorded vessels being commercial vessels (cargo and tankers) which accounted for approximately 67% of traffic. O&G support traffic levels within the area accounted for approximately 14% of vessels recorded.

6.3 Commercial Vessels

6.3.1 Hornsea Four Array Area

54. An average of approximately six commercial vessels were recorded per day transiting through the Hornsea Four array area. The busiest days were the 30th July 2020 and 8th February 2021, where ten unique commercial vessels were recorded transiting through the array area. The quietest full days were the 3rd August 2020 and 3rd March 2021, with two unique vessels transiting through the array area.

55. The marine traffic data (see Section 6.2) was used to identify the main routes within the study area using the principles set out in MGN 654 (MCA, 2021). A total of 14 main routes were identified on this basis. The identified routes are shown relative to the Hornsea Four array area and the screened in assets (as per Section 3) in Figure 6.3. In line with MGN 654, 90th percentiles for the sections of routes within the study area were produced as part of the NRA process. These are included in Figure 6.3.

56. Further details of the routes in terms of vessel numbers and origin / terminus ports are provided in Table 6.1. It should be considered that the origin / terminus ports have been identified via common destinations transmitted by vessels recorded on any given route. As such, vessels on a route within the study area will not necessarily be associated with the ports listed.

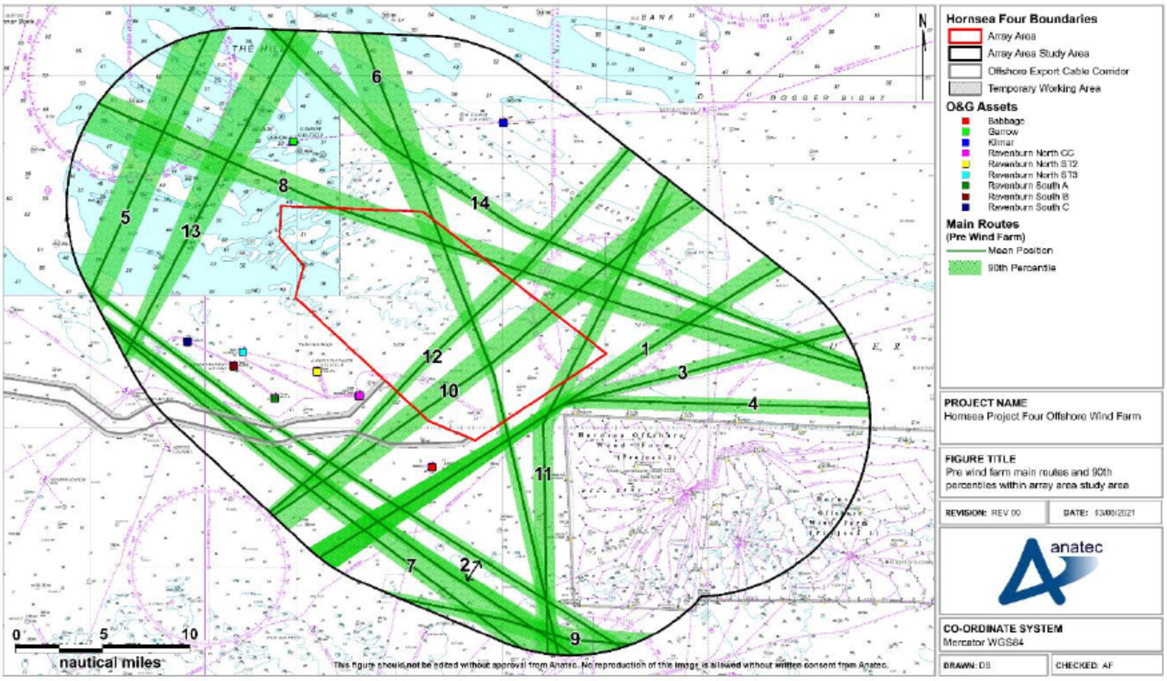

Figure 6.3 Main Routes

Table 6.1 Summary of Main Route Details

Route Number	Average Transits per Day	Description (main ports, also may include alternative ports)
1	2	**Immingham–Gothenburg**. Route 1 is generally transited by cargo vessels (81%) and tankers (11%) and is a DFDS Seaways cargo ferry route between Immingham and Gothenburg. The main vessels operating on this route are the *Begonia Seaways*, *Ficaria Seaways* and *Freesia Seaways*.
2	2	**Newcastle–Amsterdam**. Route 2 is transited by passenger vessels (100%) and is a DFDS Seaways passenger ferry route between North

Route Number	Average Transits per Day	Description (main ports, also may include alternative ports)
		Shields (UK) and Ijmuiden (Netherlands). The main vessels operating on this route are the *King Seaways* and *Princess Seaways*.
3	1 to 2	**Immingham–Esbjerg**. Route 3 is generally transited by cargo vessels (83%) and tankers (12%) and is DFDS Seaways cargo ferry route between Immingham and Esbjerg. The main vessels currently operating on this route are the *Magnolia Seaways* and *Petunia Seaways*.
4	1 to 2	**Immingham–Hamburg**. Route 4 is generally transited cargo vessels (50%) and tankers (35%).
5	1	**Immingham–north Norway ports**. Route 5 is transited by cargo vessels (83%) and tankers (17%) and is a Sea-Cargo cargo ferry route between Immingham and Tananger.
6	1	**Grangemouth–Rotterdam**. Route 6 is generally transited by cargo vessels (84%).
7	1	**Tees–Rotterdam**. Route 7 is generally transited by tankers (46%), cargo vessels (29%) and oil and gas vessels (11%).
8	1	**Tees–Rotterdam**. Route 8 is generally transited by cargo vessels (62%) and tankers (38%).
9	0 to 1	**Immingham–Antwerp.** Route 9 is generally transited by cargo vessels (53%) and tankers (40%).
10	0 to 1	**Immingham–Baltic ports**. Route 10 is generally transited by cargo vessels (85%) and tankers (12%).
11	0 to 1	**Great Yarmouth–Trent gas field**. Route 11 is transited by oil and gas vessels (100%).
12	0 to 1	**Immingham–Baltic ports**. Route 12 is transited by cargo vessels (100%).
13	0 to 1	**Immingham–northern Norway ports**. Route 13 is transited by cargo vessels (100%) and is a Finnlines cargo ferry route between Hull and Helsinki.
14	0 to 1	**Tees–Amsterdam**. Route 14 is generally transited by tankers (80%).

57. As noted in Section 6.1, the main routes have also been considered within an extended threshold to ensure traffic passing Tier 3 assets is accounted for, noting that the routes within the extended threshold have been extrapolated based on Anatec's in house routeing database (Anatec, 2021), rather than being explicitly defined by the marine traffic data collected during the Hornsea Four surveys. The extended routes are shown in Figure 6.4.

58. It is important to consider that only the routes identified from the marine traffic data within 10nm of the Hornsea Four array area are shown in Figure 6.4 (i.e., any route not passing within 10nm of the Hornsea Four array area is not included).

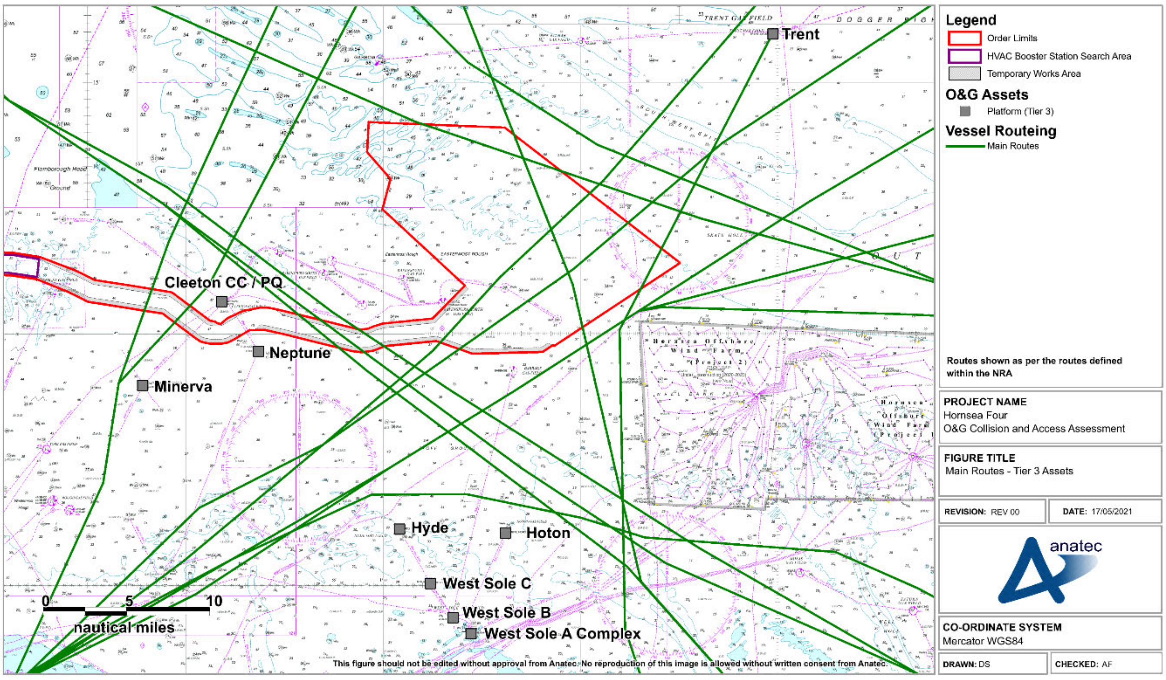

Figure 6.4 Main Routes relative to Tier 3 Assets

6.3.2 HVAC Booster Station Search Area

59. The main routes identified within 10nm of the HVAC booster station search area as part of the NRA process are shown in Figure 6.5. Following this, relevant route details are provided in Table 6.2. These routes were identified based on assessment of the marine traffic data shown in Section 6.2.2, with full details provided in the NRA.

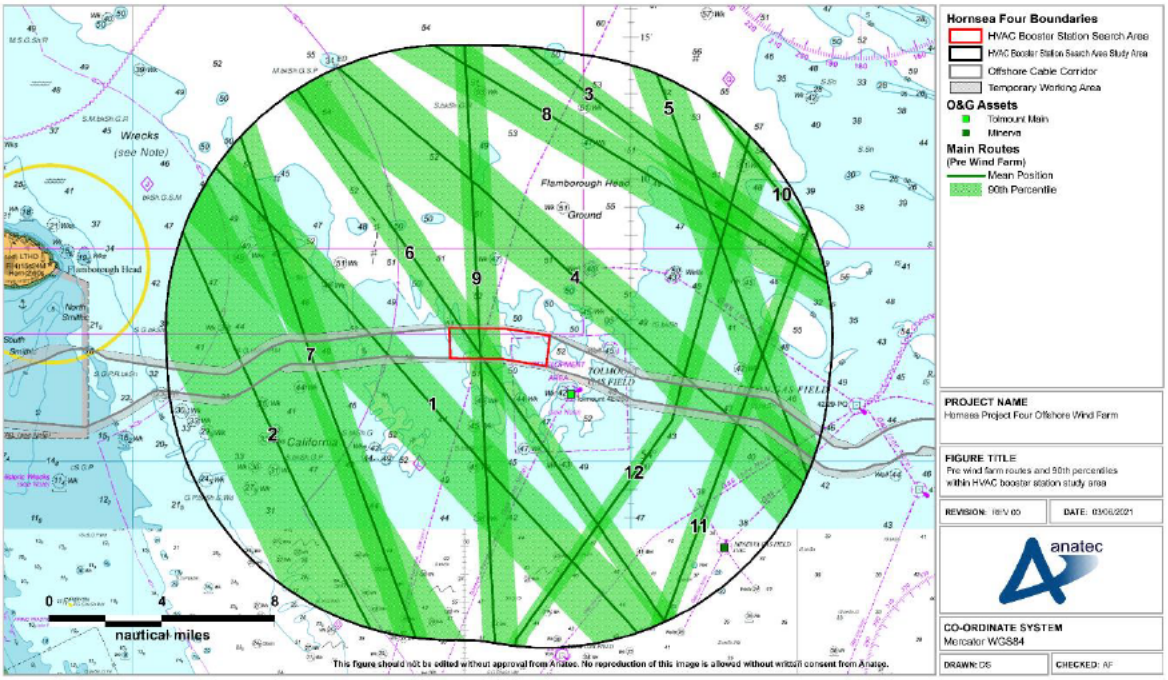

Figure 6.5 Main Routes (HVAC Booster Station Search Area)

Table 6.2 Summary of Main Route Details (HVAC)

Route Number	Average Transits per Day	Description (main ports, also may include alternative ports)
1	9	**Tees–Rotterdam/Zeebrugge**. Route 1 is generally transited by cargo vessels (64%) and tankers (32%) and is a P&O Ferries cargo ferry route between the Tees and Rotterdam and Zeebrugge. The main vessels operating on this route are the *Bore Song* and *Estraden*.
2	8 to 9	**Tees–Rotterdam**. Route 2 is generally transited by cargo vessels (59%) and tankers (30%).
3	2[8]	**Newcastle–Amsterdam**. Route 3 is transited by passenger vessels (100%) and is a DFDS Seaways passenger ferry route between North Shields (UK) and Ijmuiden (Netherlands).
4	1 to 2	**Tees–Amsterdam**. Route 4 is generally transited by cargo vessels (66%) and tankers (20%).
5	1	**Grangemouth–Rotterdam**. Route 5 is transited by cargo vessels (77%) and tankers (23%).
6	1	**Grangemouth–Rotterdam**. Route 6 is generally transited by tankers (55%) and cargo vessels (38%).

[8] From the vessel traffic survey data, the average transits per day on this route was lower, owing to the lack of transits in the summer period. This was a result of the summer data predating Hornsea Project Two construction which has subsequently resulted in the route shifting to a position within the Hornsea Four HVAC booster station search area shipping and navigation study area. The shift in this route is illustrated in Figure 16.4 and is anticipated to be a permanent change.

Route Number	Average Transits per Day	Description (main ports, also may include alternative ports)
7	1	**Immingham–Moray Firth ports**. Route 7 is generally transited by cargo vessels (70%) and tankers (26%).
8	1	**Tees–Rotterdam**. Route 8 is transited by cargo vessels (75%) and tankers (25%).
9	1	**Immingham–north Norway ports**. Route 9 is transited by cargo vessels (43%), tankers (43%) and oil and gas vessels (14%).
10	0 to 1	**Grangemouth–Ghent**. Route 10 is generally transited by tankers (80%).
11	0 to 1	**Immingham–north Norway ports**. Route 11 is generally transited by cargo vessels (87%) and is a Sea-Cargo cargo ferry route between Immingham and Tananger.
12	0 to 1	**Immingham–north Norway ports**. Route 12 is used by cargo vessels (73%) and tankers (27%).

6.4 Oil and Gas Support Vessels

60. The O&G support vessels recorded during the study period are presented in Figure 6.6. The associated O&G assets are also shown for context.

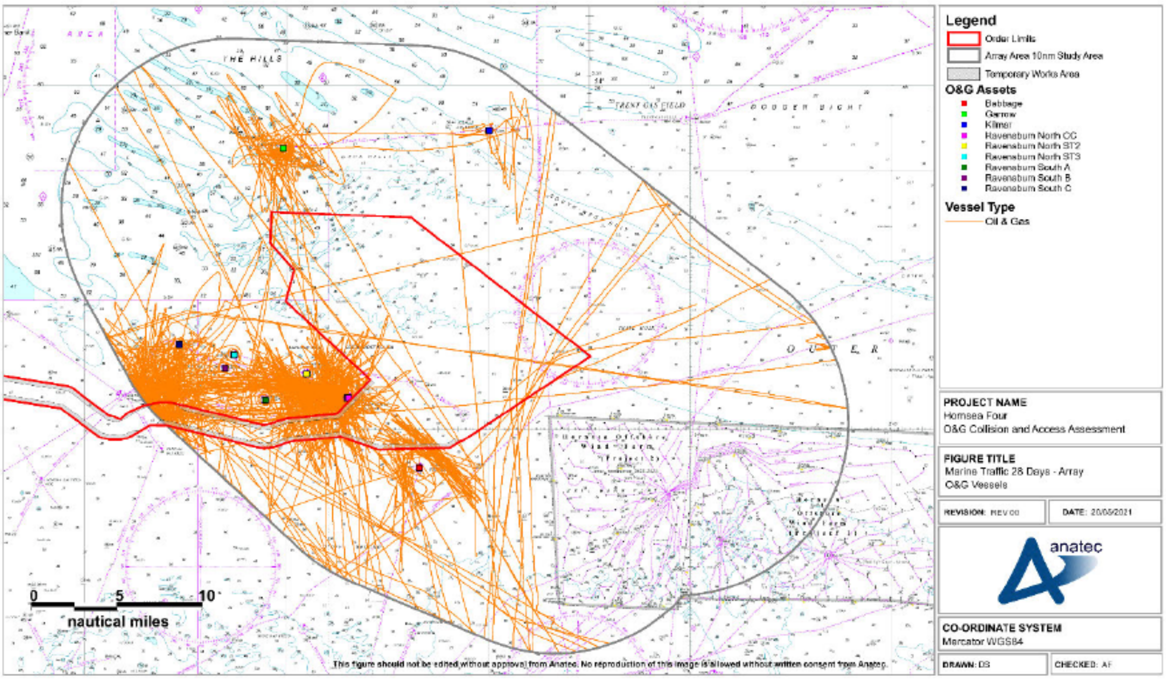

Figure 6.6 O&G Support Vessels within the Array Area Study Area

61. There was an average of five O&G support vessels per day recorded during the study period within 10nm of the Hornsea Four array area. The busiest day was 28th July 2020 with eight O&G support vessels detected. Six separate days during the study period

were considered the "quietest" days, with three O&G support vessels recorded on each.

62. The majority of O&G support vessels were observed to be associated with the Ravenspurn assets, noting that vessels were also recorded at the Babbage, Garrow and Kilmar platforms.

63. It is observed that the significant majority of baseline activity associated with the surface platforms in the area remained outside of the Hornsea Four array area.

64. Routes to the Tier 2 assets were not defined within the NRA given the period studied did not provide sufficient vessel numbers to do so. Therefore, for the purposes of this assessment, routes have been created based on Anatec's in-house routeing database (Anatec, 2021). These routes are shown in Figure 6.7.

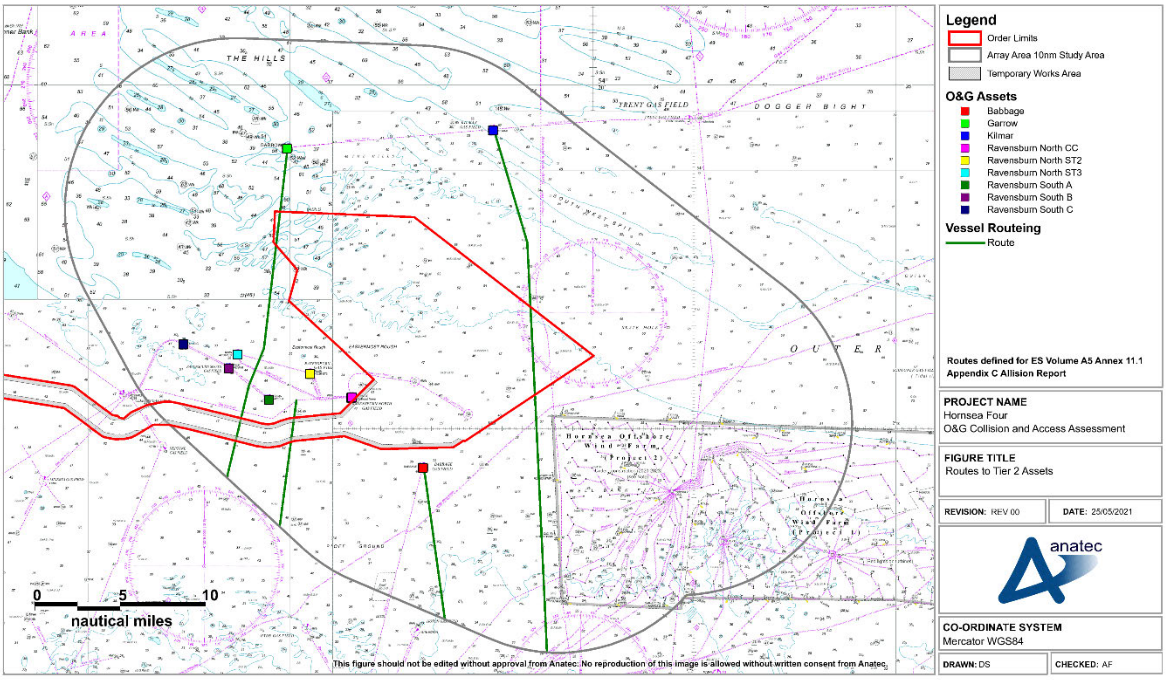

Figure 6.7 Routes to Tier 2 Assets

6.5 Fishing Vessels

65. The fishing vessels recorded during the study period are presented in Figure 6.8. It should be considered that the summer survey period is AIS only, and as such fishing vessel activity may be underrepresented (however it is considered unlikely that smaller non AIS fishing vessels would transit this far offshore on a regular basis).

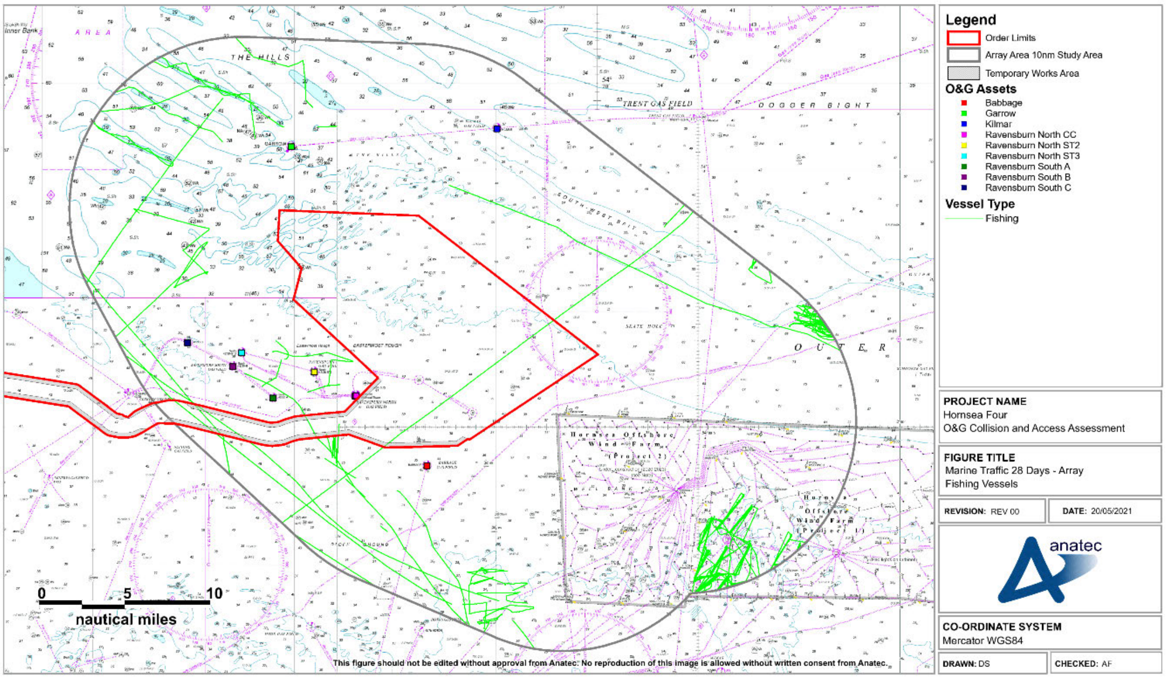

Figure 6.8 Fishing Vessels within the Array Area Study Area

66. There was an average of between one and two unique fishing vessels per day recorded within the study area. Five separate days during the study period were considered the "busiest" days, with four fishing vessels recorded on each. It should be considered that 78% of the fishing vessels were recorded during the summer study period (noting the offshore location of the Hornsea Four array area meaning that fishing vessel levels would be expected to reduce during periods of less favourable weather conditions).

67. No clear active fishing (i.e., vessels considered likely as having gear deployed) was observed within the Hornsea Four array area.

68. In terms of gear type, the majority of activity recorded was observed to be associated with beam / demersal trawling.

6.6 Recreational Vessels

69. The recreational vessels recorded during the study period are presented in Figure 6.9. Recreational transits were observed to be limited, which is to be expected given the distance offshore of the Hornsea Four array area. It should be considered that the summer survey period considered is AIS only, and as such recreational activity may be underrepresented (however it is considered unlikely that smaller non AIS recreational vessels would transit this far offshore on a regular basis).

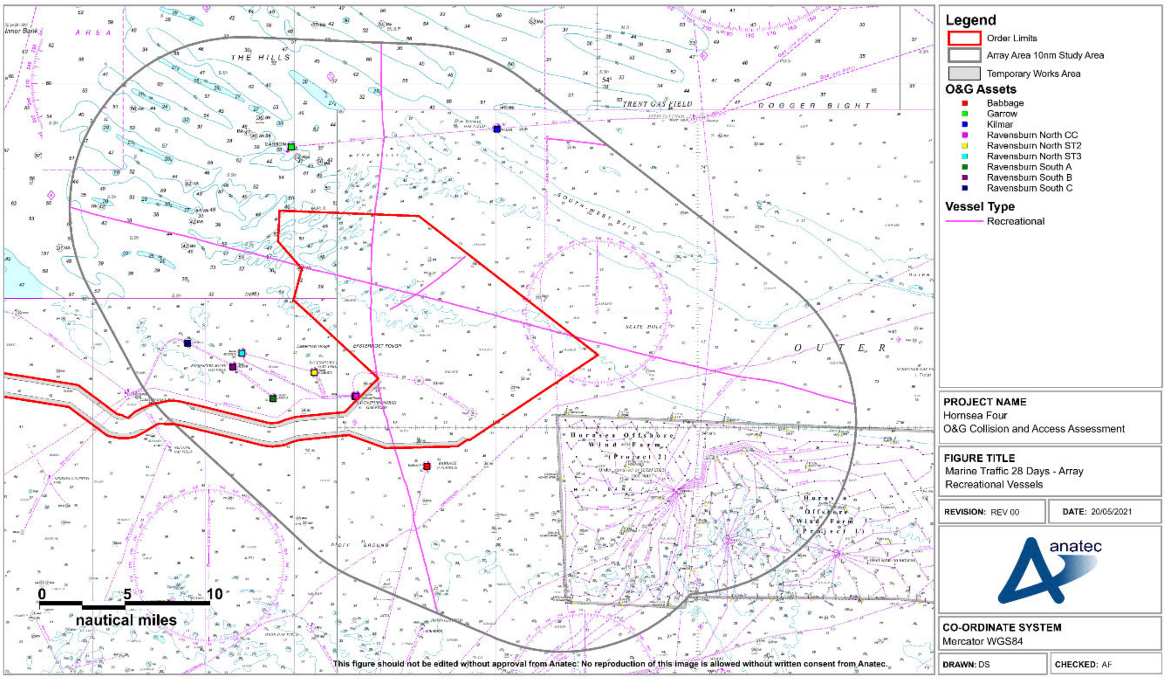

Figure 6.9 Recreational Vessels within the Array Area Study Area

7 Impact on Oil and Gas Platform Allision Risk

7.1 Introduction

70. This section assesses potential impacts in relation to allision risk to O&G assets, that may arise as a result of the construction and operation of Hornsea Four. Assets in proximity have been screened in where appropriate as per Section 3, and changes between baseline vessel activity (see Section 6) and the predicted future case have then been used to assess the significance of the potential impacts.

7.2 Identification of Oil and Gas Facilities Potentially Impacted

71. Details of asset screening are provided in Section 3. In summary, the assets shown in Table 7.1 have been assessed in terms of allision on the basis that the construction or presence of the structures within the Hornsea Four array area may have an impact on allision risk levels.

72. The subsea Tier 1 assets are included on the basis that any associated surface activity is at risk of allision in the case of stationed rigs, or collision with the supporting vessels or other vessels associated with the subsea infrastructure (as opposed to the assets themselves).

Table 7.1 Assets assessed in terms of Allision

Tier 1	Tier 2	Tier 3
▪ Johnston Manifold Template ▪ Step Out Location (J4/J5) ▪ Exploration Well ▪ Template to Ravenspurn Pipeline ▪ Step Out to Template Pipeline ▪ SEAL Pipeline	▪ Babbage ▪ Garrow ▪ Kilmar ▪ Ravenspurn North Complex ▪ Ravenspurn North ST2 ▪ Ravenspurn North ST3 ▪ Ravenspurn South A ▪ Ravenspurn South B ▪ Ravenspurn South C ▪ Tolmount Main ▪ Minerva	▪ Cleeton ▪ Hoton ▪ Hyde ▪ Neptune ▪ West Sole A ▪ West Sole B ▪ West Sole C ▪ Trent

7.3 Future Case Shipping

73. Changes in allision (collision risk also for Tier 1 assets) risk will primarily be based on changes in routeing that arise as a result of the construction and operation of Hornsea Four. Full details as to how post wind farm routeing has been defined are provided in the NRA (**Volume A5, Annex 7.1**). In summary, given that it is not possible to consider all potential alternative routeing options for commercial traffic, worst case alternatives have been considered where possible in consultation with operators.

74. Therefore, key assumptions for re-routeing include:

- All alternative Mean Route Position (MRP) maintain a minimum distance of 1nm from offshore installations and existing Wind Turbine Generators (WTGs) boundaries in line with the MGN 654 Shipping Route Template (MCA, 2021) – note that this approach assumes vessel transits are distributed around the MRP, and as such certain vessels will still pass closer than 1nm to assets; and
- All routes take into account sandbanks and known routeing preferences.

7.3.1 Tier 1

75. Post wind farm routeing as identified within the NRA is shown relative to the Tier 1 assets in Figure 7.1. As shown, all main routes in the area are expected to deviate to avoid the Hornsea Four array area altogether (and by extension the subsea Tier 1 assets).

76. It should be considered that while larger commercial vessels are likely to avoid the Hornsea Four infrastructure, smaller vessels (e.g., fishing and recreation) may still choose to transit through. However, as per Sections 6.5 and 6.6, baseline transits of such vessels within the study area were low.

77. Based on the post wind farm routeing, all routes are in excess of 2nm from the surface Tier 1 assets.

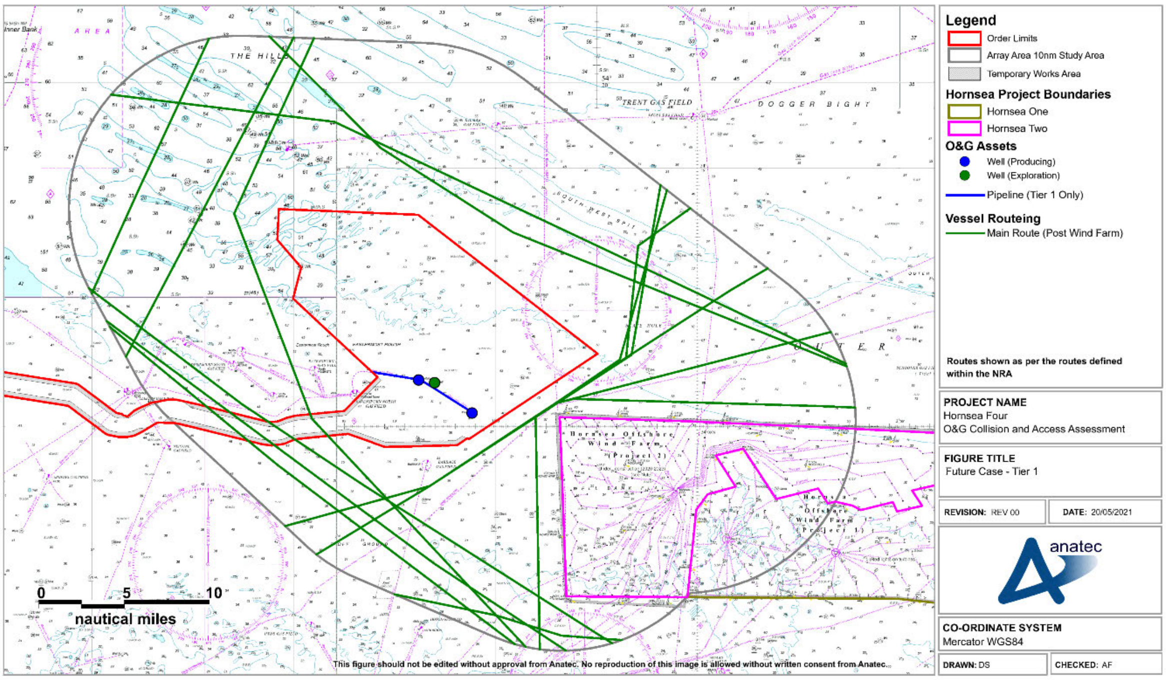

Figure 7.1 Future Case – Tier 1 Assets

7.3.2 Tier 2

7.3.2.1 Hornsea Four Array Area

78. Post wind farm routeing as identified within the NRA is shown relative to the Tier 2 assets within 10nm of the Hornsea Four array area in Figure 7.2. Noting the presence of Hornsea One and Two (see Figure 5.1), it is considered likely that the majority of commercial vessels on affected routes will pass between Hornsea Four and Hornsea Two.

79. Further details as to changes in vessel levels within close proximity to each asset are provided in Section 7.4.

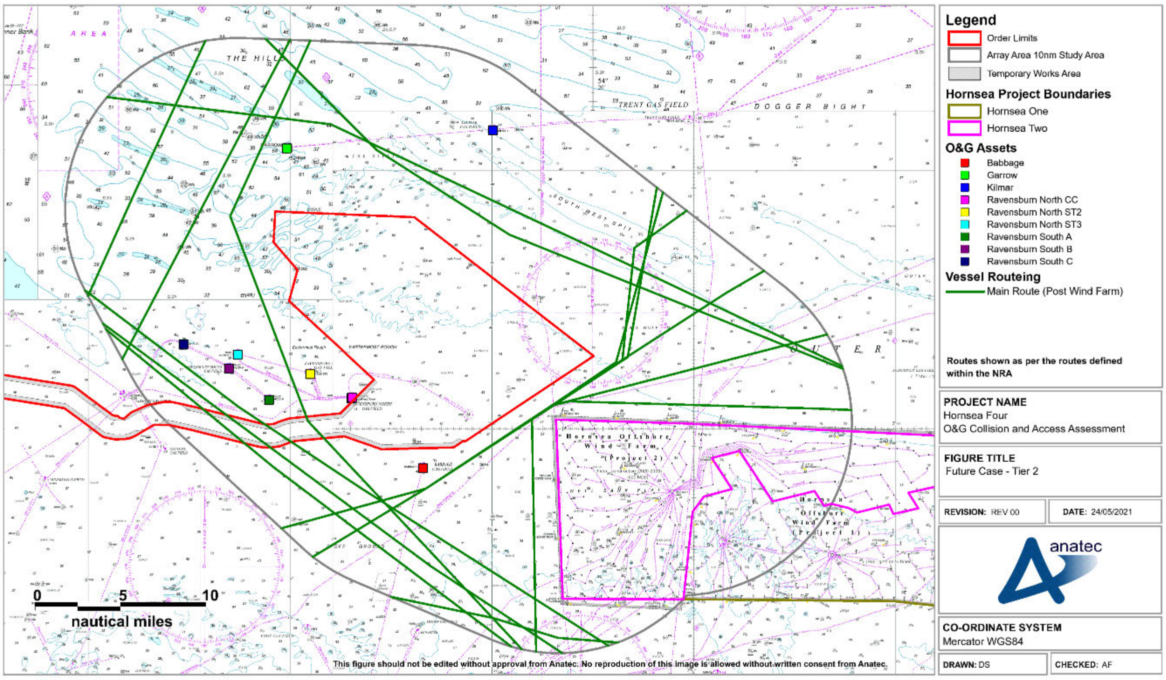

Figure 7.2 Future Case – Tier 2 Assets

7.3.2.2 HVAC Booster Station Search Area

80. The post wind farm routeing within 10nm of the HVAC booster station search area as assessed within the NRA is shown relative to the relevant Tier 2 assets in Figure 7.3.

81. Only routes 6 and 9 require deviation, they are predicted to shift to the west to avoid the likely HVAC booster station locations, which results in traffic moving away from the Tolmount Main platform.

82. It should be considered that the routeing shown is base case pre-wind farm, and as such does not account for future development of the Tolmount Field, which will be discussed with the relevant operator when appropriate.

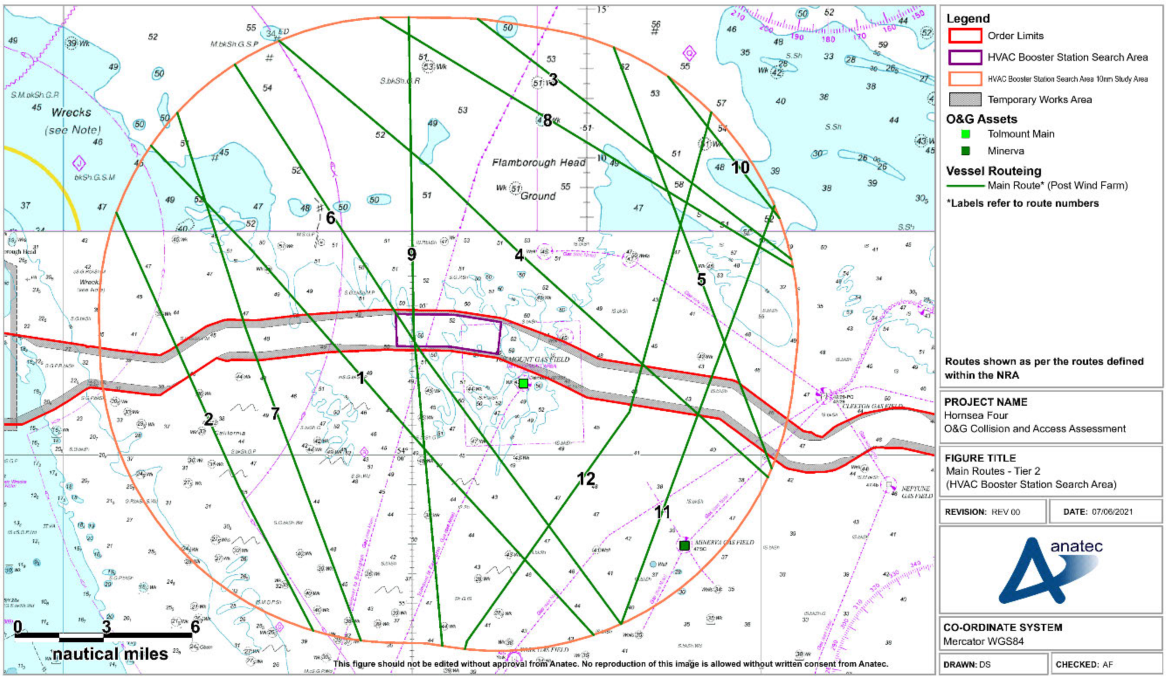

Figure 7.3 Future Case – Tier 2 (within 10nm of HVAC Booster Station Search Area)

7.3.3 Tier 3

83. Post wind farm routeing as identified within the NRA is shown relative to the Tier 3 assets in Figure 7.4. It must be considered that only routes that pass within 10nm of the Hornsea Four array area are shown.

84. The key change relevant to Tier 3 assets is an increase in vessels passing south east of the Hornsea Four array area, between the Hornsea Four array area and Hornsea Two. Further details as to changes in vessel levels within close proximity to each asset are provided in Section 6.3.2.

85. It is also noted that, based on the NRA deviations, vessels utilising the route to the Trent platform (Route 12, see Section 6.3.1) will deviate between Hornsea Four and Hornsea Two, before accessing the platform (see Figure 7.4).

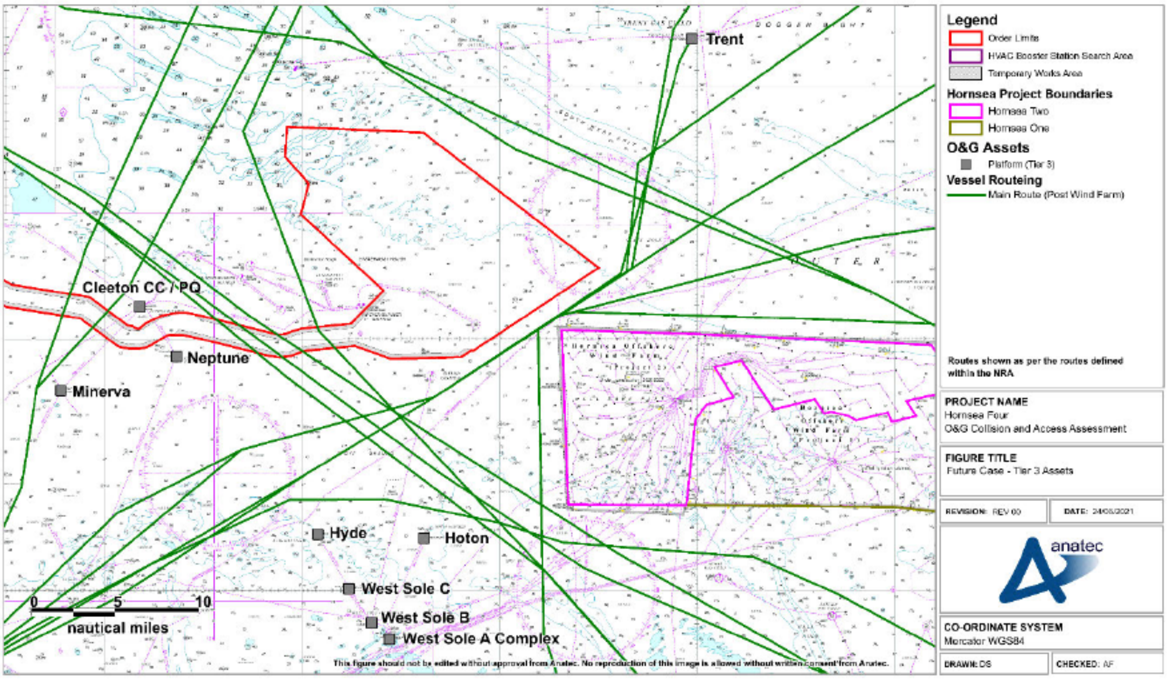

Figure 7.4 Future Case – Tier 3 Assets

7.4 Proximity Assessment

86. As per Section 4.2.1, assessment of the potential change in traffic levels within 2nm of each asset in Tiers 1 to 3 has been undertaken. The results of this assessment are provided in Table 7.2.

Table 7.2 Change in Vessel Numbers within 2nm of Assets

Asset	Change in Vessel Numbers per Day within 2nm
Tier 1	
Johnston Manifold Template	-1
Step Out Location (J4/J5)	-2
Exploration Well	-1
Template to Ravenspurn Pipeline	-1
Step Out to Template Pipeline	-2
SEAL Pipeline	0
Tier 2	
Babbage	1
Garrow	2
Kilmar	0
Ravenspurn North Complex	0

Asset	Change in Vessel Numbers per Day within 2nm
Ravenspurn North ST2	1
Ravenspurn North ST3	0
Ravenspurn South A	1
Ravenspurn South B	0
Ravenspurn South C	0
Tolmount Main	-1
Minerva	0
Tier 3	
Cleeton	0
Hoton	0
Hyde	0
Neptune	0
West Sole A Complex	0
West Sole B	0
West Sole C	0
Trent	0

7.5 Impact Assessment

7.5.1 Tier 1

87. Tier 1 assets are at no risk of allision as they are subsea, however it should be considered that rigs used for any associated operations are at risk of allision when stationed on site over the assets (and supporting vessels at risk of collision). It is noted that impacts associated with spacing / proximity relative to the Hornsea Four structures and works are assessed separately in Section 8.3.

88. As per the assessment undertaken in Section 7.4, vessel numbers passing within 2nm of the Johnston assets are expected to decrease (see Table 7.2), given that the commercial vessel routes that currently intersect the Hornsea Four array area are expected to deviate to avoid the structures. It is noted in this regard that as per Section 7.3.1, all post wind farm mean route positions are anticipated to pass in excess of 2nm from the Johnston assets. Experience of other projects (including Hornsea Project One) shows that the majority of commercial vessels will begin to deviate once the construction buoyage is in place, and as such allision / collision risk to vessels associated with the Tier 1 assets from routed third party traffic will also decrease.

89. It should be considered that while there is no increase in traffic within 2nm of the section of SEAL pipeline within the Hornsea Four array area, traffic will be concentrated over the section of SEAL pipeline in between Hornsea Two and Hornsea Four, and as such any associated pipeline maintenance operations in this area would need to account for the passing traffic. However, the likelihood of a need for such an operation is considered low, noting that as per the NRA consultation (**Volume A5, Annex 7.1**), vessel operators have indicated that any anchoring between Hornsea Two and Hornsea Four (and by extension any potential for pipeline interaction / damage) would be an extremely unlikely occurrence.

90. The focus of this assessment is commercial vessels, however it should be considered that smaller vessels (e.g., fishing, recreation) may still choose to transit through the Hornsea Four array area, and as such may still pose allision / collision risk to vessels / operations associated with the Tier 1 assets. The associated risk will depend on how fishing vessels choose to behave post wind farm construction. However, it is unlikely that levels will increase over the pre-wind farm case. As per Sections 6.5 and 6.6, baseline levels are low (albeit only based on the period studied) and as such any associated risk is likely to be low.

91. It should be noted that the wind farm support vessels within the Hornsea Four array area during the construction and operational phases are also an allision / collision risk to the operations associated with the Tier 1 assets. However, such vessels will likely be more aware of associated Tier 1 works than passing third party traffic, and it should be considered that they also provide additional response resources in the event of an emergency within or near the wind farm. Details of the construction and maintenance of Hornsea Four will be promulgated to the relevant operators (including Harbour Energy as the operators of the majority of the Tier 1 assets) to ensure they are aware of the ongoing works and any periods / locations where project vessel activity may be increased, and there is potential for cooperation and liaison agreements between the Applicant and the operators to ensure risks associated with simultaneous operations are limited.

92. Given a reduction in traffic in proximity to the Johnston assets, and no anticipated change for the SEAL pipeline within the array area, and noting that Hornsea Four will have appropriate vessel management procedures in place to ensure risk from project vessels is minimised, it is considered that the allision / collision risk to operations associated with Tier 1 assets is **broadly acceptable**.

7.5.2 Tier 2

7.5.2.1 Hornsea Four Array Area

93. As can be seen from the proximity assessment in Section 7.4, it is predicted that vessel numbers within 2nm of Babbage, Garrow, Ravenspurn North ST2 and Ravenspurn South A will increase by up to (approximately) two vessels per day. There are no changes predicted for the other Tier 2 assets.

94. It is important to note that these are based on the worst-case deviations assessed within the NRA, and as such in reality vessels may choose alternate routes, including passing further from the assets given there is sea room available to do so.

95. It is noted that during consultation with the operator of the Babbage platform (see Table 2.1), queries were raised over a potential rise in allision risk associated with deviated vessels passing in proximity to the asset. As per the proximity assessment (see Section 7.4), there will be an increase of one vessel per day. However, it is noted that based upon the worst-case NRA deviations, no deviated routes are expected to make passage between Babbage and the Hornsea Four array area (see Section 7.3.2). It should be considered that there would be no restrictions on vessels taking such passage. However, such transits are considered to be an extremely unlikely occurrence, noting the presence of the Hornsea One and Two sites to the east (see Figure 5.1) making it more likely that any vessels not passing between Hornsea Four and Hornsea Two will pass south of the Hornsea projects altogether. This is discussed further in Section 7.3, and is considered to be beneficial in terms of allision risk to the Babbage platform.

96. Given at most low increases in vessel numbers predicted within 2nm, significance in terms of allision for all Tier 2 platforms within 10nm of the Hornsea Four array area is considered to be **broadly acceptable**.

7.5.2.2 HVAC Booster Station Search Area

97. As per the proximity assessment in Section 7.4, vessel numbers within 2nm of the Tolmount Main platform are anticipated to decrease following the installation of the HVAC booster stations. This is due to vessels currently intersecting the HVAC booster station search area generally anticipated to pass further to the west as a result of the booster stations, if a HVAC transmission option is selected (see Section 7.3.2.2). This would represent a reduction in allision risk overall, given vessels will be passing further from the assets. There is no change to vessel levels within 2nm of the Minerva platform.

98. The significance of allision risk is therefore assessed as **broadly acceptable**.

7.5.3 Tier 3

99. Based on the proximity assessment undertaken in Section 7.4, vessel numbers are unlikely to change notably for the Tier 3 assets as a result of the construction and operation of Hornsea Four. It is important to note that these are based on the worst-case deviations assessed within the NRA, and as such in reality vessels may choose alternate routes, including considerations to pass further from O&G assets than has been assessed.

100. Given no notable effect on vessel numbers predicted within 2nm, significance in terms of allision for all Tier 3 platforms is considered to be **broadly acceptable**.

7.6 Risk Ranking

101. Based on the assessment within this allision section, the significance of allision risk (including collision for Tier 1) to each of the assets assessed is summarised in Table 7.3.

Table 7.3 Allision Impact Assessment Summary

Asset	Significance
Tier 1	
Johnston Manifold Template	Broadly Acceptable
Step Out Location (J4/J5)	Broadly Acceptable
Exploration Well	Broadly Acceptable
Template to Ravenspurn Pipeline	Broadly Acceptable
Step Out to Template Pipeline	Broadly Acceptable
SEAL Pipeline	Broadly Acceptable
Tier 2	
Babbage	Broadly Acceptable
Garrow	Broadly Acceptable
Kilmar	Broadly Acceptable
Ravenspurn North Complex	Broadly Acceptable
Ravenspurn North ST2	Broadly Acceptable
Ravenspurn North ST3	Broadly Acceptable
Ravenspurn South A	Broadly Acceptable
Ravenspurn South B	Broadly Acceptable
Ravenspurn South C	Broadly Acceptable
Tolmount Main	Broadly Acceptable
Minerva	Broadly Acceptable
Tier 3	
Cleeton	Broadly Acceptable
Hoton	Broadly Acceptable
Hyde	Broadly Acceptable
Neptune	Broadly Acceptable
West Sole A	Broadly Acceptable

Asset	Significance
West Sole B	Broadly Acceptable
West Sole C	Broadly Acceptable
Trent	Broadly Acceptable

7.7 Risk Mitigation

102. Allision impacts to all assets are considered **broadly acceptable** and as such no additional mitigation measures are necessary above those considered embedded (see Section 4.4.2).

8 Impact on Oil and Gas Access (Rigs & Vessels)

8.1 Introduction

103. This section assesses potential impacts in relation to access to O&G assets that may arise as a result of the construction and operation of Hornsea Four. The assets within 10nm (see Section 2) have been screened to identify which may be affected in terms of access by the structures within the Hornsea Four array area. As described in Section 4.2.2, both deviations to routine support vessel routeing and spacing / proximity issues relative to the Hornsea Four structures have been considered.

8.2 Identification of Oil and Gas Facilities Potentially Impacted

104. Assets assessed in terms of potential access issues are summarised in Table 8.1. This includes the manning status of the platforms (i.e., manned or NUI) as well as the distance from the Hornsea Four array area. Subsea infrastructure has been highlighted as such, noting that associated operations will still require surface access.

105. Based on consultation and a review of the destination information transmitted within the marine traffic data studied (see Section 6), the majority of support vessels making routine visits to the surface assets assessed will originate from either Great Yarmouth or Lowestoft. Routeing to the surface platforms has been defined on this basis as per Section 6.4.

106. Minimum potential proximity to the nearest Hornsea Four structure (i.e., either Hornsea Four array area or HVAC booster station search area) has been included as this will inform the proximity / spacing assessment.

Table 8.1 Assets assessed in terms of Access Impacts

Asset Name	Status	Minimum Potential Distance from nearest Hornsea Four structure (nm)	Deviation Required for Routine Visits	Estimated Additional Transit Distance
Tier 1				
Johnston Manifold Template	n/a (subsea)	Inside	n/a	n/a
Step Out Location (J4/J5)	n/a (subsea)	Inside	n/a	n/a
Exploration Well	n/a (subsea)	Inside	n/a	n/a
Template to Ravenspurn Pipeline	n/a (subsea)	Inside	n/a	n/a
Step Out to Template Pipeline	n/a (subsea)	Inside	n/a	n/a
SEAL Pipeline	n/a (subsea)	Inside	n/a	n/a

Asset Name	Status	Minimum Potential Distance from nearest Hornsea Four structure (nm)	Deviation Required for Routine Visits	Estimated Additional Transit Distance
Tier 2				
Ravenspurn North Complex	Manned	1.6	No	n/a
Ravenspurn North ST2	NUI	2.2	No	n/a
Ravenspurn North ST3	NUI	4.3	No	n/a
Ravenspurn South Alpha	NUI	5.0	No	n/a
Ravenspurn South Bravo	NUI	5.2	No	n/a
Ravenspurn South Charlie	NUI	6.6	No	n/a
Babbage	Not Permanently Attended Installation	2.3	No	n/a
Garrow	NUI	3.8	Yes	0.3nm (< 1% increase)
Kilmar	NUI	6.8	Yes	4nm (4% increase)
Tolmount Main	NUI	1.3[9]	No	n/a
Minerva	NUI	9.0[3]	No	n/a
Tier 3				
Cleeton	Manned	11.0	No	n/a
Hoton	NUI	11.5	No	n/a
Hyde	NUI	13.7	No	n/a
Neptune	NUI	11.2	No	n/a
West Sole A Complex	Manned	17.8	No	n/a
West Sole B	NUI	17.3	No	n/a
West Sole C	NUI	15.9	No	n/a
Trent	NUI	14.2	Yes	1.0nm (1% increase)

8.3 Impact Assessment

8.3.1 Tier 1

8.3.1.1 Deviations

107. It should be considered that given the Tier 1 assets are subsea, "routine" visits are unlikely to be as frequent as for the surface assets within the other tiers. Further, the primary concern for Tier 1 assets is available spacing for rig access, and (where required) anchor spreads (which is assessed separately within Section 8.3.1.2).

[9] Distance shown from HVAC booster station search area

However, it was raised during consultation that dive support vessel access will still be required to the Johnston assets, and it should be considered that access to SEAL pipeline may also be necessary. Therefore, surface routeing has still been considered.

108. Given that all Tier 1 assets are within the Hornsea Four array area, it will be necessary for vessels associated with the assets to enter into the array, and on this basis, there will be no route deviation as such. However, the presence of the structures and Hornsea Four vessels may impact upon O&G support vessels ability to access the areas needed to undertake any operations associated with the Tier 1 assets.

109. O&G vessels accessing the Tier 1 assets from the south would experience minimum access issues given the location of the assets near the southern periphery, and it is noted that no Hornsea Four works would enter into the 500m safety zones (except in an emergency situation). However, vessels approaching from the north or west would either need to navigate within the array, or deviate to access via the south (it is considered unlikely that vessels would seek access from the east).

110. Minimum spacing under consideration between the centre points of WTGs is 810m, however actual spacing may be higher, noting that minimum spacing of the layout used within this assessment is 1,111m. It is likely that the minimum spacing and final structure layout will dictate how O&G vessels choose to access the Tier 1 assets, with the worst case (in terms of deviation) likely being vessels being required to deviate around the site to access from the south. However, it is important to consider that this is not likely to be a frequent occurrence.

111. While re-routeing may be necessary, details of Hornsea Four would be promulgated in advance via the usual means (e.g., Notice to Mariners (NtM)), including directly to the relevant operators as identified within this assessment and consulted with to date. This will facilitate advanced passage planning, ensuring any deviations are minimal, and will allow the locations of completed or partially completed structures to be accounted for.

112. On this basis, the impact of deviation is assessed as being **tolerable with mitigation** for Tier 1 assets.

8.3.1.2 Proximity (Vessels / Rigs)

113. The Tier 1 assets will be required to accommodate various O&G operations requiring vessel access, including inspections, maintenance interventions, and emergency repairs. Access will also be required to decommission the infrastructure and/or if further production or exploration is undertaken. The vessels associated with these operations (including supporting vessels) will require room to operate, and anchor

spreads (where required) would also need to be accommodated, both in terms of access and room to set the anchors. The spatial extent of these operations will depend on the vessels used, and whether anchor spreads are required.

114. This section assesses the potential impact of the Hornsea Four structures and works on such operations. Of primary concern is that limited searoom caused by the wind farm may result in the periods during which the O&G assets can be practicably accessed being restricted (e.g., more onerous restrictions due to weather), and/or require vessels of a higher specification to be utilised over those that would be required in open water.

115. This could have operational implications, noting that certain operations will require additional searoom beyond the 500m threshold of the safety zones (e.g., where support tugs are required, anchor spreads etc), and these will need to be considered by the Applicant during the layout approval process. Similarly, routeing to the assets for operations involving larger vessels (such as a jack up rig) and any supporting tugs will need to be planned with respect to the available searoom, noting that limits on spacing in this regard may restrict the periods in which the assets can be practicably accessed for such operations (e.g., allowable weather), and/or restrict the types of vessels that can be used. This will also need to be considered as part of the layout design, and as such consultation and liaison between the Applicant and the relevant operators should be ongoing. It should be noted that current indications are that Johnston will cease production early in the 2020s decade, with decommissioning at some point in the future, not necessarily immediately after cessation of production.

116. It is noted that transit access to any wells within the Hornsea Four array area by larger vessels (e.g., jack ups) and supporting tugs will need to be accommodated by the layout, and sufficient room to move such units to / from these assets must therefore be inbuilt into the layout. Requirements will therefore be discussed on an ongoing basis with the relevant operators, noting that as above, current indications are that Johnston will cease production early in the 2020s decade, with decommissioning at some point in the future, not necessarily immediately after cessation of production.

117. Experience at other wind farms that have been constructed within close proximity to O&G assets shows that large rig operations can still occur within limited searoom. A relevant example is the Walney Extension Offshore Wind Farm located within the Irish Sea, where three wells (an exploration, appraisal, and development well) are present inside the array area. Despite intervention and subsequent decommissioning activities being required, to date there have been no reported issues.

118. Similarly, Heavy Lift Vessel (HLV) activities associated with wind farm construction has occurred within arrays. An example would be the Stanislav Yudin HLV (with anchor spread) which has carried out operations in the Dudgeon and Beatrice Wind Farms, as well as O&G decommissioning operations where there are other platforms in proximity.

119. These operations are able to be undertaken noting the available industry experience and guidance, such as the Guidelines for Offshore Marine Operations (GOMO) (2020). This guidance facilitates effective planning of these types of operations, taking into account restrictions, to help ensure safe and efficient operations even when searoom is limited.

120. Given a final layout is not yet available and will be dependent on MMO sign off, following MCA and Trinity House consultation as the regulatory bodies associated with layout approval, the spacing available for any vessels / rigs cannot be defined at this stage. However, regardless of the final layout, any infrastructure locations would be avoided for installation positions. In particular, the 500m safety zones would be avoided at all times by vessels associated with Hornsea Four (with the exception of an emergency situation), and as agreed with Premier Oil (now Harbour Energy) a 1,000m corridor will be maintained around the Johnston pipeline within the Hornsea Four array area, and to the south of the J4/J5 wells. As per Section 2, Harbour Energy are content with marine access to their assets on this basis.

121. Accounting for the above, proximity impacts to the Tier 1 assets are considered to be **tolerable with mitigation** on the basis that layout design must facilitate access to all Tier 1 assets**.**

8.3.2 Tier 2

8.3.2.1 Deviations

122. As per Section 8.2, review of the available data and consultation indicates that the majority of vessels visiting the Tier 2 assets within 10nm of the Hornsea Four array area do so from Lowestoft or Great Yarmouth, and as such will approach from the south. On this basis, only vessels associated with Kilmar or Garrow will be affected by the construction of Hornsea Four in terms of access, given that these assets are located north of the array area. Based on Anatec's internal routeing database (Anatec, 2021), and applying the approach detailed in Section 7.3 in terms of rerouting, it is considered likely that vessels accessing Kilmar will choose to transit between Hornsea Two and Hornsea Four, whereas vessels accessing Garrow may pass west of the site. This routeing is shown in Figure 8.1, and equates to an estimated increase in journey

distance of 0.3nm for routine visits to Garrow, and an additional 4nm for visits to Kilmar.

123. As discussed in Section 6.4, and noted above, the routes upon which these deviations are based were not assessed within the NRA, however they have been defined for the purposes of this assessment based on Anatec's internal routeing database (Anatec, 2021). Regardless, these deviations have been based on the same methodology as assumed within the NRA (i.e., worst case, see Section 7.3).

124. It should be considered that both Kilmar and Garrow are NUI, and as such will be less frequently visited than manned assets.

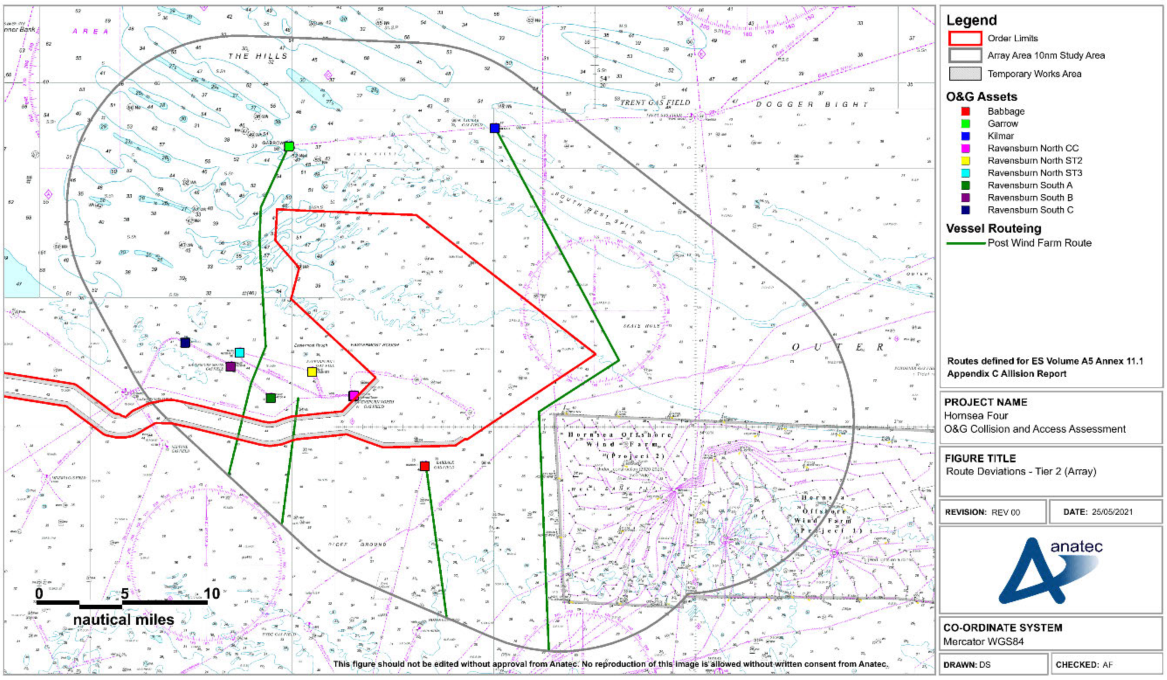

Figure 8.1 Route Deviations Tier 2 - Array

125. No notable deviations are likely for routine routeing to the Tier 2 assets within 10nm of the HVAC booster station search area (Tolmount and Minerva).

126. Details of Hornsea Four would be promulgated in advance via the usual means (e.g., NtM), including directly to the relevant operators as identified within this assessment and consulted with to date. This will facilitate advanced passage planning, ensuring any deviations are minimal, and will allow the locations of completed or partially completed structures to be accounted for.

127. Deviation impacts to all Tier 2 surface platforms are considered to be **broadly acceptable**, given only minor deviations will be required for the Garrow and Kilmar

platforms, and noting the potential for a limited impact to any vessels visiting other assets from ports other than Lowestoft or Great Yarmouth.

8.3.2.2 Proximity (Vessels / Rigs)

128. As per Table 8.1, the closest Tier 2 platform is the Ravenspurn North complex, located approximately 1.6nm to the south of the Hornsea Four array area. All other Tier 2 platforms are in excess of 2nm in proximity. As discussed in the corresponding assessment of Tier 1 assets, large scale operations associated with O&G assets are able to be undertaken in proximity to wind farm structures, including with lower space than is available in this instance (see Section 8.3.1.2 for further details). Further, as noted in Section 6.4, based on the marine traffic data studied, the majority of O&G vessel activity associated with the Ravenspurn assets remain outside of the Hornsea Four array area. Regardless, noting that Perenco queried how simultaneous operations would be managed (see Table 2.1), ongoing liaison would be necessary to ensure cooperation particularly during the construction phase. This includes consideration of works associated with export cable installation noting that the export cable corridor is in close proximity to the Ravenspurn North platform (within 0.5nm). Appropriate protocols should therefore be agreed.

129. It is noted that access to the Babbage platform has been discussed with NEO Energy as part of consultation (see Table 2.1), with the platform being located approximately 2.3nm from the Hornsea Four array area. Discussions around marine access are ongoing with NEO Energy, and it is noted that based on marine traffic analysis (see Section 6.4), activity associated with the Babbage platform remained outside of the Hornsea Four array area. Regardless, as is the case for the Ravenspurn North complex discussed above, ongoing liaison would be necessary to ensure cooperation in terms of simultaneous operations particularly in relation to works associated with export cable installation, noting that the export cable corridor is in proximity to the Babbage platform (approximately 1.35nm). Appropriate protocols should therefore be agreed.

130. In terms of the Tolmount Main platform, following responses to the Section 42 consultation, the Applicant refined both the offshore ECC and the HVAC booster station search area between the PEIR and ES stages, as captured in **Volume A4, Annex 3.2: Selection and Refinement of the Offshore Infrastructure**, to increase spacing available. This represents a material change resultant of consultation, and further discussions with Premier Oil (now Harbour Energy) indicated that the refined areas are considered suitable in terms of proximity, assuming ongoing discussions to ensure effective coexistence. The Tolmount Main platform is to be positioned 1.3nm from the HVAC booster station search area, however it should be considered that this is a

worst-case distance, as if HVAC booster stations are utilised then they could be positioned anywhere within the search area.

131. It is noted that during the construction phase, details of the ongoing works of Hornsea Four would be promulgated in advance including to the relevant operators of O&G assets in the area. This would include details of specific operations being undertaken, and the vessel types involved.

132. Given proximity of the Ravenspurn North complex, and concerns raised over Babbage, these assets are considered to be **tolerable with mitigation**. Similarly, the Tolmount Main platform is considered to be **tolerable with mitigation** given its proximity to the HVAC booster station search area. All other Tier 2 assets are considered to be of **broadly acceptable** significance in terms of proximity / spacing.

8.3.3 Tier 3

8.3.3.1 Deviations

133. The only Tier 3 asset which will require a deviation in terms of routine supply visits is the Trent platform, given it is located north of the Hornsea Four array area. Based on the NRA deviations (see Figure 7.4), it is likely that vessels visiting the Trent platform will pass between Hornsea Four and Hornsea Two. This is estimated to result in a journey increase of 1.0nm, which represents a 1% increase over the pre-wind farm route.

134. It should be considered that the Trent platform is a NUI, and as such will be less frequently visited than manned assets.

135. As discussed in the corresponding Tier 1 and 2 assessments, details of Hornsea Four would be promulgated in advance via the usual means (including directly with Perenco as the Trent operator). This will facilitate advanced passage planning, ensuring any deviations are minimal, and will allow the locations of completed or partially completed structures to be accounted for.

136. All Tier 3 assets are considered to be of **broadly acceptable** significance in terms of deviations, given only minor deviations required in the case of Trent, and noting the potential for a limited impact to any vessels visiting other Tier 3 assets from ports other than Lowestoft or Great Yarmouth.

8.3.3.2 Proximity (Vessels / Rigs)

137. Given all Tier 3 assets are in excess of 10nm from the Hornsea Four array area and HVAC booster station search area, there is considered to be **no impact** in terms of proximity.

8.4 Risk Ranking

138. Based on the assessment within this access section, the significance of deviation and proximity impacts to each of the assets assessed is summarised in Table 8.2.

Table 8.2 Access Impact Assessment Summary

Asset	Significance - Deviations	Significance - Proximity
Tier 1		
Johnston Manifold Template	Tolerable with Mitigation	Tolerable with Mitigation
Step Out Location (J4/J5)	Tolerable with Mitigation	Tolerable with Mitigation
Exploration Well	Tolerable with Mitigation	Tolerable with Mitigation
Template to Ravenspurn Pipeline	Tolerable with Mitigation	Tolerable with Mitigation
Step Out to Template Pipeline	Tolerable with Mitigation	Tolerable with Mitigation
SEAL Pipeline	Tolerable with Mitigation	Tolerable with Mitigation
Tier 2		
Babbage	Broadly Acceptable	Tolerable with Mitigation
Garrow	Broadly Acceptable	Broadly Acceptable
Kilmar	Broadly Acceptable	Broadly Acceptable
Ravenspurn North Complex	Broadly Acceptable	Tolerable with Mitigation
Ravenspurn North ST2	Broadly Acceptable	Broadly Acceptable
Ravenspurn North ST3	Broadly Acceptable	Broadly Acceptable
Ravenspurn South A	Broadly Acceptable	Broadly Acceptable
Ravenspurn South B	Broadly Acceptable	Broadly Acceptable
Ravenspurn South C	Broadly Acceptable	Broadly Acceptable
Tolmount Main	Broadly Acceptable	Tolerable with Mitigation
Minerva	Broadly Acceptable	Broadly Acceptable
Tier 3		
Cleeton	Broadly Acceptable	No Impact
Hoton	Broadly Acceptable	No Impact
Hyde	Broadly Acceptable	No Impact
Neptune	Broadly Acceptable	No Impact
West Sole A Complex	Broadly Acceptable	No Impact
West Sole B	Broadly Acceptable	No Impact
West Sole C	Broadly Acceptable	No Impact
Trent	Broadly Acceptable	No Impact

8.5 Risk Mitigation

139. Noting that impacts associated with access are **tolerable with mitigation** for certain assets, the following additional mitigation measures should be considered for implementation in terms of reducing effects to within As Low As Reasonably Practicable parameters:

- Focused / targeted promulgation of information to relevant O&G operators; and
- Cooperation and liaison agreements between Hornsea Four and relevant O&G operators in terms of simultaneous operations to ensure any access issues are minimised (noting this should include in relation to works associated with the export cable corridor).

9 Summary

140. This assessment has assessed potential allision (allision & collision risk for Tier 1 assets) risk and access issues that may arise to O&G assets as a result of the construction and operation of Hornsea Four. The assessment has primarily been informed via marine traffic data collected within the vicinity of the HVAC booster station search area and the Hornsea Four array area as part of the NRA process, which has been used to identify the baseline (including in terms of O&G activity) and to assess routeing changes that may arise following construction of Hornsea Four.

141. A summary of the findings of the assessment are provided in Table 9.1. These rankings are designed to feed into **Volume A5, Annex 11.1: Offshore Installation Interfaces,** which forms the technical assessment to the relevant ES Chapter (**Volume A2, Chapter 11: Infrastructure and Other Users**).

Table 9.1 Impact Assessment Summary

Asset	Allision	Deviations	Proximity
Tier 1			
Johnston Manifold Template	Broadly Acceptable	Tolerable with Mitigation	Tolerable with Mitigation
Step Out Location (J4/J5)	Broadly Acceptable	Tolerable with Mitigation	Tolerable with Mitigation
Exploration Well	Broadly Acceptable	Tolerable with Mitigation	Tolerable with Mitigation
Template to Ravenspurn Pipeline	Broadly Acceptable	Tolerable with Mitigation	Tolerable with Mitigation
Step Out to Template Pipeline	Broadly Acceptable	Tolerable with Mitigation	Tolerable with Mitigation
SEAL Pipeline	Broadly Acceptable	Tolerable with Mitigation	Tolerable with Mitigation
Tier 2			
Babbage	Broadly Acceptable	Broadly Acceptable	Tolerable with Mitigation
Garrow	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable
Kilmar	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable
Ravenspurn North Complex	Broadly Acceptable	Broadly Acceptable	Tolerable with Mitigation
Ravenspurn North ST2	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable
Ravenspurn North ST3	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable
Ravenspurn South A	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable
Ravenspurn South B	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable
Ravenspurn South C	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable
Tolmount Main	Broadly Acceptable	Broadly Acceptable	Tolerable with Mitigation
Minerva	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable
Tier 3			
Cleeton	Broadly Acceptable	Broadly Acceptable	No Impact
Hoton	Broadly Acceptable	Broadly Acceptable	No Impact
Hyde	Broadly Acceptable	Broadly Acceptable	No Impact
Neptune	Broadly Acceptable	Broadly Acceptable	No Impact
West Sole A Complex	Broadly Acceptable	Broadly Acceptable	No Impact
West Sole B	Broadly Acceptable	Broadly Acceptable	No Impact
West Sole C	Broadly Acceptable	Broadly Acceptable	No Impact
Trent	Broadly Acceptable	Broadly Acceptable	No Impact

10 References

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Appendix D Premier Oil - Hornsea Four SIMOPS Workshop (non-confidential version)

[Redacted due to the potential for the content (in part) to be commercially sensitive]

Appendix E Hornsea Four Oil & Gas Consultations Standalone Report

[Redacted due to the potential for the content (in part) to be commercially sensitive]