Appendix 16.1 Marine Radar Report

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Quanterness Onshore Windfarm Development
Marine Radar Interference Review Technical Note

Prepared by	Anatec Limited
Presented to	ITPEnergised
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Table of Contents

Abbreviations Table

Abbreviation	Definition
AIS	Automatic Identification System
COLREGS	International Regulations for the Prevention of Collisions at Sea
EMEC	European Marine Energy Centre
GT	Gross Tonnage
m	Metre
LOA	Length Overall
MCA	Maritime and Coastguard Agency
MGN	Marine Guidance Note
nm	Nautical mile
NW	North West
RIB	Rigid-hulled Inflatable Boat
VTS	Vessel Traffic Service
WTG	Wind Turbine Generator

1 Development Overview

ITPEnergised have requested that Anatec investigate the potential for any impact associated with the Quanterness Onshore Wind Farm Development on the Orkney Harbour Authority Vessel Traffic Services (VTS) and on vessel based marine Radars operating in the area. This technical note identifies the marine traffic in the area using Automatic Identification System (AIS) data, as well as Orkney Harbours AIS and Radar stations (Orkney Harbour Hand Book, 2015) in relation to the proposed wind turbine generator (WTG) locations.

The distance between the proposed onshore WTGs varies between 540 metres (m) and 640m – tower to tower. An overview of the Quanterness WTG locations is presented in Figure 1.1, overlaid onto an Admiralty chart. It is noted that water depths within a quarter nautical mile (nm) of the WTG locations is very shallow at 0 to 5m below chart datum; outward from that to Quanterness Skerry the depth does not exceed 10m chart datum.

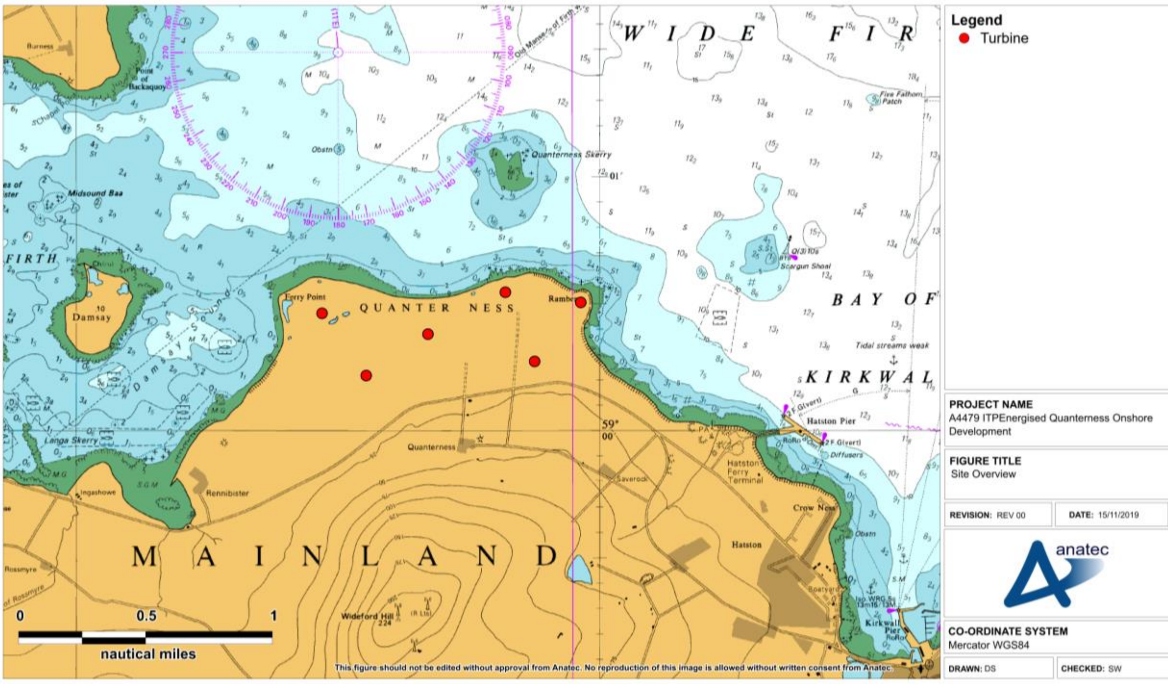

Figure 1.1 Proposed WTG Locations Overlaid on Admiralty Chart

2 AIS Data

2.1 Marine Traffic Vessel Survey Periods

For marine traffic vessel survey, 28 days of AIS data has been processed and analysed within three nm of the Quanterness site (study area). This data covers two periods:

- 1st to 14th January 2019 (14 days, winter); and
- 7th to 20th July 2019 (14 days, summer).

The use of a summer and winter dataset assists in identifying seasonal variations. It has been ensured that this survey period provides optimal available coverage relative to the site.

2.2 AIS Limitations

The review undertaken should be considered a high level assessment with further investigation required to validate the findings. In particular, not all vessels are required to carry an AIS transceiver; AIS carriage is mandatory for all vessels of 300 Gross Tonnes (GT) and upwards on international voyages, cargo vessels of 500GT and upwards not engaged on international voyages and all passenger vessels irrespective of size. In addition, fishing vessels with length overall (LOA) 15 m and greater must carry AIS. Smaller fishing vessels, recreational vessels and military vessels are not required to broadcast on AIS but may do so voluntarily. Therefore there is likely to be a proportion of the vessel traffic which is not covered by the AIS data.

Within the dataset any vessels classified as temporary have been removed. These are vessels undertaking or associated with non-routine operations such as surveys and decommissioning tidal operations at the European Marine Energy Centre (EMEC) site.

3 Shore Based AIS and Radar Stations

The Quanterness site is situated to the northwest of Kirkwall (Orkney Islands) (closest WTG approximately 1.9nm).

AIS and Radar stations for Orkney Harbour Authority VTS operations are noted at Kirkwall, Scapa, Hill of Midland, Sandy Hill, Black Craig and Ness. The locations of these stations are presented in Figure 3.1.

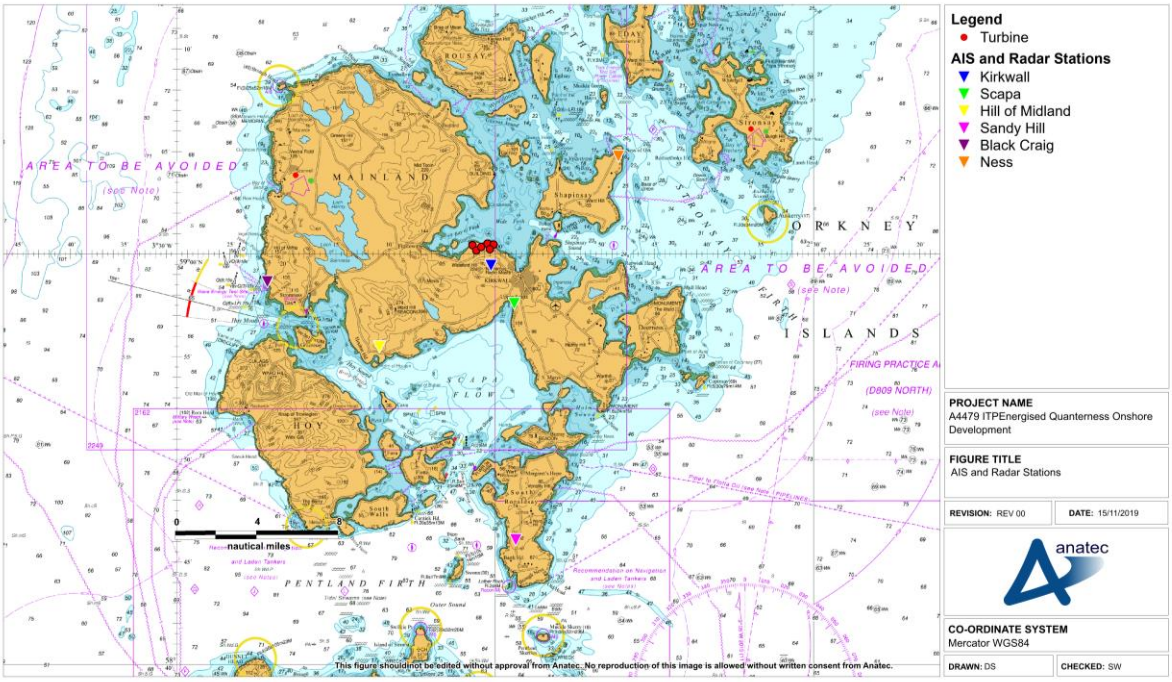

Figure 3.1 AIS and Radar Stations of Orkney VTS

The closest of these stations to the WTGs is located to the south east on Wideford Hill, west of Kirkwall. It is assumed this provides the VTS with unrestricted coverage of the sea area north of Quanterness.

4 Vessel Activity

Figure 4.1 presents a plot of the AIS tracks colour-coded by vessel type recorded within 3nm of the Quanterness site over the 28-day survey period.

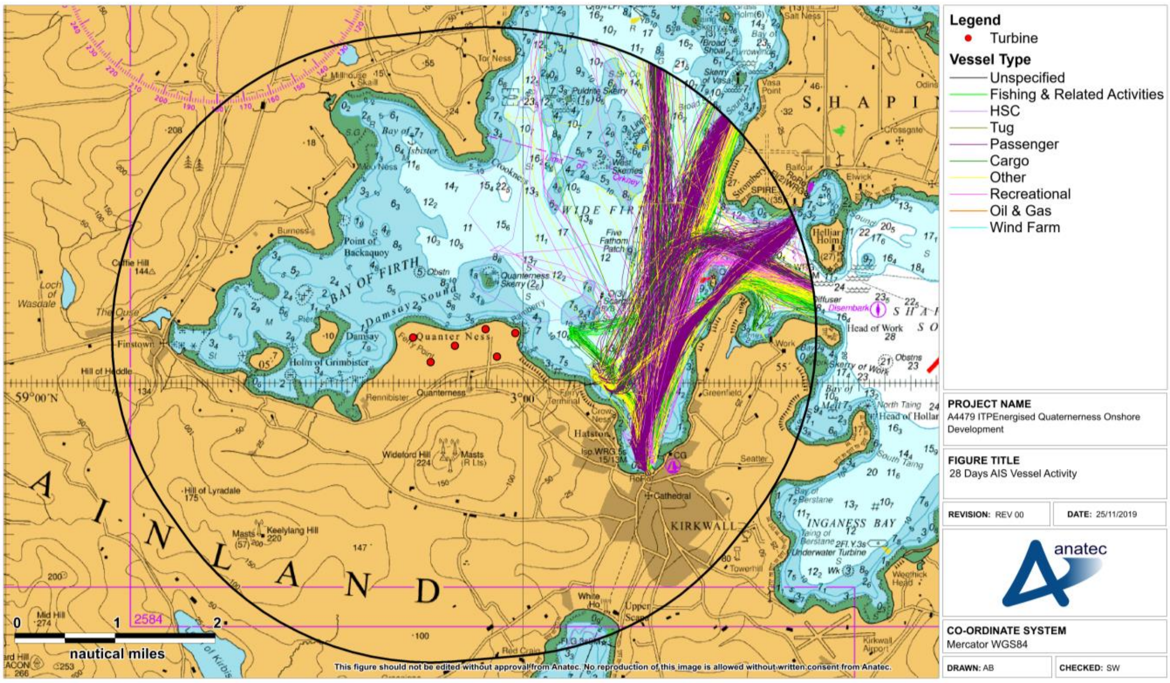

Figure 4.1 28 Days AIS Vessel Activity

On average, 25 unique vessels[1] were recorded per day within the study area, with the majority to the east heading to/from Kirkwall. The most common vessel types recorded during the survey period were passenger and recreational vessels.

Passenger vessels routeing in the area are mainly operated by Orkney Ferries and NorthLink Ferries. The Orkney Ferries routeing includes transits between Kirkwall and nearby Shapinsay, to the northeast of the study area, and the Outer Northern Isles services between Kirkwall and various northern islands of Orkney. There are two distinct routes heading north with a split noted where the traffic navigates around the shallow water depths. The Orkney Ferries are relatively small in size (below 100m in length), when compared to the larger NorthLink ferries, and dock at Kirkwall Harbour situated approximately 1.9nm from the nearest WTG.

The NorthLink Ferries transit between Kirkwall and Aberdeen / Lerwick using Shapinsay Sound (The String) between Helliar Holm and the Head of Work when approaching Kirkwall Bay. These larger passenger vessels are typically above 100m in length and dock at the Hatston Ferry Terminal, situated approximately 1.0nm from the nearest WTG. A small charter vessel was also recorded transiting daily between Kirkwall and Shapinsay.

[1] It is noted that vessels making multiple transits per day, such as ferries, are counted once per day.

Significant fishing vessel activity was noted during the survey period. A fish farm was regularly visited by support vessels, 0.3nm to the North West (NW) of the Hatston Ferry Terminal. The closest WTG is situated 0.5nm from the fish farm boundary.

Recreational vessel activity predominantly consisted of yachts associated with Kirkwall Marina, with vessels heading north and east while generally staying close to shore. During the 28 day survey period, no recreational vessels broadcasting on AIS passed within 0.5nm of the Quanterness site.

One vessel was noted passing within 0.5nm during the 28 day survey period, a Rigid-hulled Inflatable Boat (RIB) *Sula,* recorded passing between Quanterness Skerry and the Quanterness site.

It is again noted that AIS carriage is not mandatory for all vessels, with small craft such as fishing and recreational vessels likely to be under-represented (Section 2.2).

5 Potential Impacts Associated with the Quanterness WTGs

5.1 Impacts on Orkney Harbour VTS

WTGs located within the line of sight of shore based Radar stations may interfere with Radar performance and degrade its ability to distinguish between the WTGs and returns from the targets of interest. The Orkney Harbour uses the AIS and Radar stations located around the islands to support its VTS service.

5.1.1 Radar Shadow

Radar shadow is the region whereby the Radar beam is unable to fully illuminate a region due to blockage from structures within the Radars 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 (mask) and track such objects.

The extent and length of the shadow region cast by a WTG depends on the spacing between WTGs, the size of each individual WTG (blades are not considered a factor due to their limited cross section and motion), the distance to the Radar scanner from the target and the height of the target of interest.

This also includes the height of the WTG unless a Radar station is located significantly higher allowing oversight of the Radar Beam. However at the Quarterness development the height of the WTG hub[2] is greater than the height of the Kirkwall Radar station location (Wideford Hill) and therefore the WTGs would present Radar shadow (longitudinally and horizontally) potentially impacting the tracking of vessels on the water side of the individual WTG locations from the Kirkwall Radar station.

Figure 5.1 shows a potential area of effect for Radar shadow noting that the shadow would only occur directly behind the WTG.

[2] [2] Based upon assumed heights: Kirkwall VTS Radar scanner hill height above sea level – 100m, Kirkwall VTS Radar scanner height above ground– 4m, WTG hub height – 81.9m, WTG height above sea level – 25m.

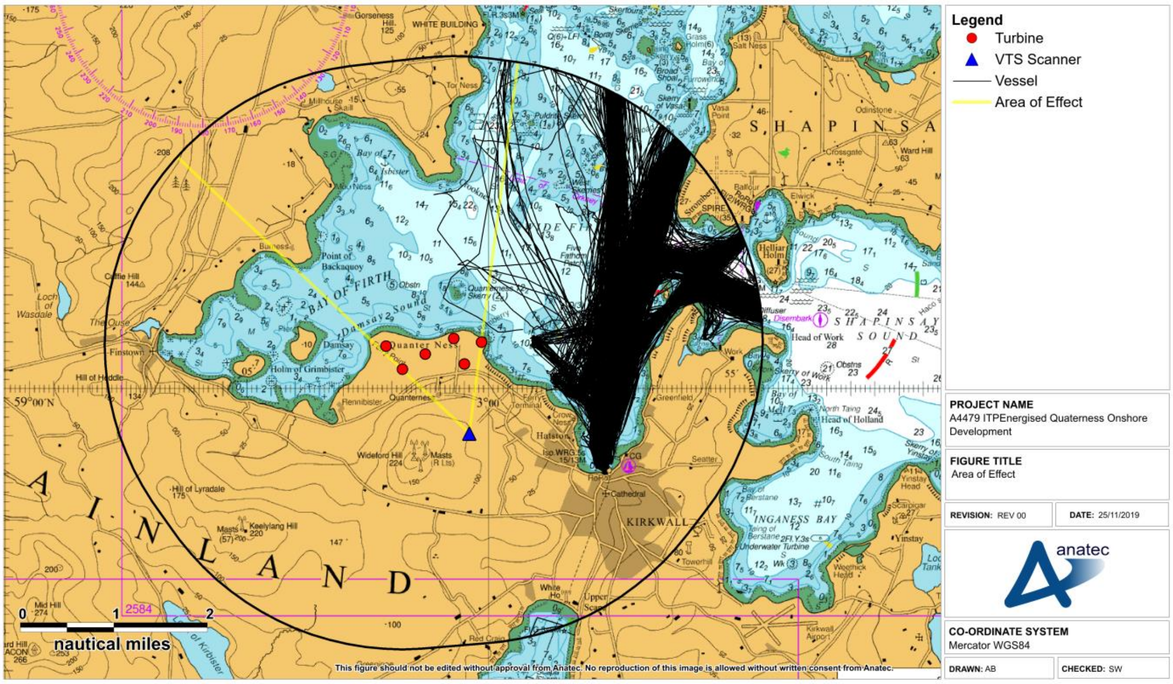

Figure 5.1 Potential for Radar Effects

5.1.1.1 Likelihood of Effects on Radar Tracking

Due to the technology built into modern Radars (which assumed the case at Orkney Habour VTS) it is estimated that a vessel being tracked by the Kirkwall Radar station would continue to be tracked when passing north of the Quanterness WTGs. It would only be if a small vessel was stationary immediately behind a WTG (and in the area of effect shown in Figure 5.1) that it could theoretically be dropped, which is not considered likely given vessels will generally be transiting and will therefore only spend a very brief time in any shadow. It is also noted the very limited number of vessels will be moving within the area of effect and any vessel noted should be identifiable (above the typical level of clutter found on a coastline).

It is also noted that the WTGs will not affect the Radar picture to the east of the Quanterness site (once clear of the WTGs and out with the area of effect) and given the sea room available before a vessel exiting the Quanterness area enters the main shipping channel to/from Kirkwall any target will be identifiable, including in adverse weather conditions when vessels and VTS are more reliant on Radar (noting the provisions of COLREGs). It is not anticipated that the vessels within the area of effect are being regularly tracked by Orkney Harbour VTS until they approach the main shipping channel to/from Kirkwall.

It is also noted that in adverse weather when tracking of targets is more critical to a VTS, the smaller vessels typically seen within the area of effect are unlikely to be at sea, again reducing the number of targets likely to be impacted.

5.1.2 Multiple Echoes

Radar studies undertaken at existing United Kingdom (UK) offshore wind farms by the Maritime and Coastguard Agency (MCA, 2004) have shown that vessels may generate multiple echoes on shore based radar scanners where vessels are within 0.5nm of a WTG.

5.1.2.1 Likelihood of Effect on Radar Tracking

It was noted that there was a significant amount of clear space amongst the returns to ensure the recognition of vessels moving amongst and behind structures. Noting the shallow waters, there are not anticipated to be a large number of vessels within 0.5nm of the WTGs as per the vessel activity noted in section 4.

5.2 Impacts on Vessel Based Radar Scanners

Figure 5.2 shows a 0.5nm buffer applied to the WTG locations. This is the distance at which impacts on marine based Radar scanners can become intolerable, as per Table 5.1.

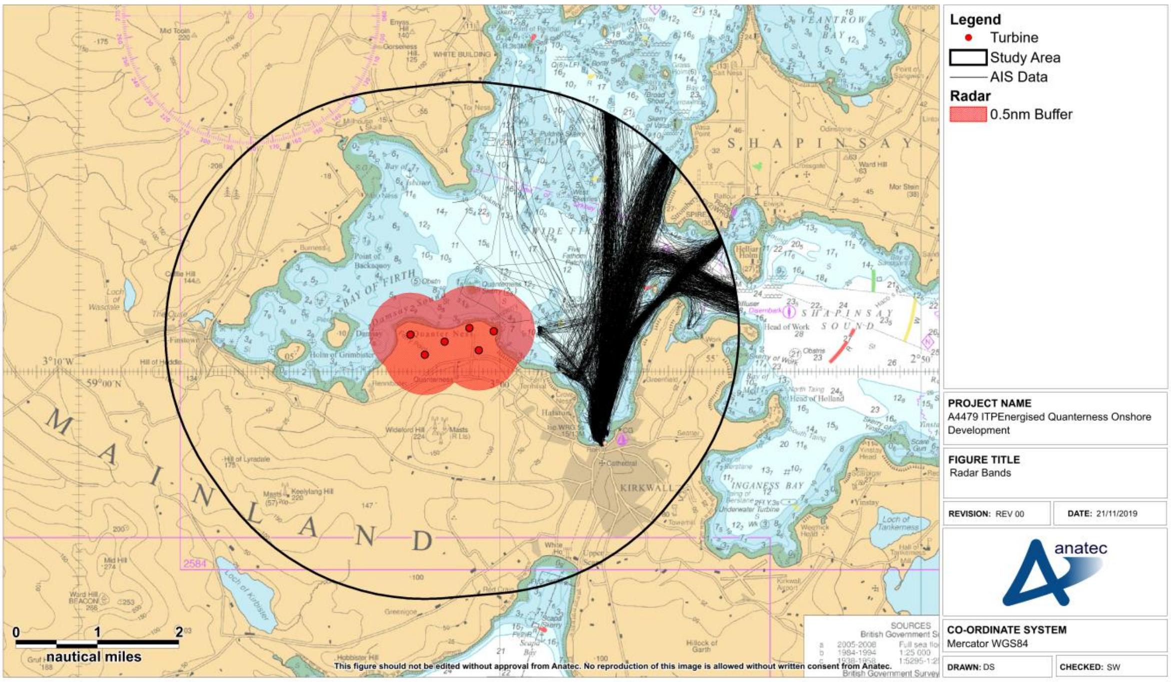

Figure 5.2 Radar Interference Buffer

The onset range from the WTGs of false returns or echoes is approximately 1.5nm, with progressive deterioration in the Radar display as the range closes as noted in Table 5.1 Studies undertaken by the MCA (2004) note that impacts on marine Radar are manageable with mitigation including minor adjustment of Radar settings, increasing passing distances where possible and application of COLREGs.

Table 5.1 Distances at which impacts on marine radar occur

Distance at which effect occurs	Identified Effect
0.5nm	▪ Intolerable impacts can be experienced. ▪ X Band radar interference is intolerable under 0.25nm
1.5nm	▪ Under Marine Guidance Note (MGN) 543 impacts on Radar are considered to be tolerable (with mitigation) between 0.5nm and 3.5nm. ▪ Echoes develop at about 1.5 nm, with progressive deterioration in the radar display as the range closes. Where a main vessel routes passes within this range considerable interference may be expected along a line of WTGs. ▪ Target size of the WTG echo increases close to the structure with a consequent degradation of target definition and bearing discrimination. ▪ Effects were encountered on both X and S band radars.

The majority of marine traffic was situated over 1.0nm from the WTG locations, noting this is AIS data only. However when considering the water depths between the WTG locations and the Quanterness Skerry it is unlikely that all of the vessels operating in the area would be using Radar scanners for navigation and instead operating using visual navigation. As noted in section 5.1.1.1 these smaller craft are also unlikely to be out at sea in adverse weather.

If interfering echoes develop, the requirements of the COLREGs Rule 6 Safe speed are particularly applicable and must be observed with due regard to the prevailing circumstances. In restricted visibility, Rule 19 Conduct of vessels in restricted visibility applies and compliance with Rule 6 becomes especially relevant. In such conditions, mariners are required, under Rule 5 Lookout to take into account information from other sources which may include sound signals and VHF information.

5.3 Impacts AIS and Very High Frequency (VHF) Radio

Trials undertaken by the Maritime and Coastguard have not identified any impacts on the use of AIS or VHF radios and therefore any vessels broadcasting on AIS will continue to be clearly identifiable in all areas of existing coverage. This is not considered further within this report.

6 Mitigation

It is noted that there are expected to be some radar effects from the locating of WTGs at Quanterness, although the impacts are expected to be low based on existing traffic volumes and the location of the Kirkwall Radar scanner (used by Orkney Harbour VTS). The following points are noted and additional work recommended.

- It is recommended consultation takes place with Orkney Harbour Authority (operators of the VTS), who operate Radar and AIS stations in the area, to confirm the extent and nature of non-AIS traffic in the area off Quanterness as well as the frequency of tracking vessels in this area.
- The Orkney Harbour VTS monitor the area, and although it is noted that the WTGs can influence the Radar picture (infrequently) the presence of a manned VTS will minimise any expected impacts. It is noted that Radar scanners for onshore VTS and offshore installation traffic monitoring are located in the vicinity of large offshore wind farms in the Southern North Sea and East Irish Sea.
- There is very limited vessel activity within 0.5nm of the WTG locations given the shallow waters so any impacts on vessel tracking directly behind the WTG locations is expected to be minimal. Any vessels in the 'area of effect' are likely to be small craft or RIBs and therefore more likely to rely on visual navigation than Radar systems.
- It is recommended that the impact on Orkney Harbour VTS is modelled (using Radar modelling systems) to confirm desktop conclusions. It is noted that shore based or fixed Radar systems can be configured to take into account permanent fixed obstructions further minimising the impact.

Although the AIS data assessed within this report give a high level overview of the vessel activity in proximity to the Quanterness site, it does not necessarily provide insight into all vessel movements. As noted in Section 2.2, AIS carriage is not mandatory for all vessels, with small craft such as fishing vessels and recreational vessels under-represented. It may be that the volume of such activity is significantly higher however it is not considered to be likely (given water depths) that any increase in volume would be significant enough to change the outputs of this assessment.

7 References

Orkney Harbours (2015). Port Handbook for Orkney, 6th Edition.

MCA and QinetiQ (2004). *Results of the Electromagnetic Investigations 2nd Edition*. Southampton, UK: MCA and QinetiQ.

MCA (2016). Marine Guidance Note 543 Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response. Southampton: MCA.

UKHO Chart Number 2584