Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Environmental Statement

Volume 3

Appendix 15.1 - Technical Report including Radar Line of Sight Images

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Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Aviation Impact Assessment

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Acronyms

Acronym	Definition
2D	2-Dimensional
3D	3-Dimensional
ACC	Area Control Centre
ACP	Airspace Change Proposal
ADR	Air Defence Radar
A/G	Air to Ground
agl	above ground level
AIA	Aviation Impact Assessment
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
amsl	above mean sea level
ANO	Air Navigation Order
ANSP	Air Navigation Service Provider
ASACS	Air Surveillance and Control Systems
ATA	Aerial Tactics Area
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATCSMAC	Air Traffic Control Surveillance Minimum Altitude Chart
ATM	Air Traffic Management
ATDI	Advanced Topographic Development and Images
ATS	Air Traffic Service
BEIS	Department for Business, Energy and Industrial Strategy
CAA	Civil Aviation Authority

Acronym	Definition
CAP	Civil Aviation Publication
CAS	Controlled Air Space
cd	Candela
CIA	Cumulative Impact Assessment
DCO	Development Consent Order
DEP	Dudgeon Offshore Wind Farm Extension Project
DGC	Defence Geographic Centre
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
ES	Environmental Statement
FIR	Flight Information Region
FL	Flight Level
ft	feet
HAT	Highest Astronomical Tide
HMR	Helicopter Main Route
HTZ	Helicopter Traffic Zone
IAIP	Integrated Aeronautical Information Package
ICAO	International Civil Aviation Organisation
IFP	Instrument Flight Procedure
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
km	kilometre
LARS	Lower Airspace Radar Service
LOS	Line of Sight
m	metre

Acronym	Definition
MGN	Marine Guidance Note
MCA	Maritime and Coastguard Agency
Met	Meteorological Office
Mil AIP	Military Aeronautical Information Package
MOD	Ministry Of Defence
MSA	Minimum safe Altitude
MW	MegaWatt
NAIZ	Non-Automatic Initiation Zone
NATS	National Air Traffic Services
NERL	NATS En Route Ltd
NM	nautical mile
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
OREI	Offshore Renewable Energy Infrastructure
OWF	Offshore Wind Farm
PAR	Precision Approach Radar
PEIR	Preliminary Environmental Information Report
PEXA	Practice and Exercise Area
PSR	Primary Surveillance Radar
RAF	Royal Air Force
RAP	Recognised Air Picture
RCS	Radar Cross Section
RDP	Radar Data Processor
RDDS	Radar data Display screen
RMS	Radar Mitigation Scheme

Acronym	Definition
rpm	revolutions per minute
RRH	Remote Radar Head
SAR	Search and Rescue
SEP	Sheringham Shoal Offshore Wind Farm Extension Project
SNS	Southern North Sea
SSR	Secondary Surveillance Radar
TMZ	Transponder Mandatory Zone
UHF	Ultra-High Frequency
UKLFS	United Kingdom Low Flying System
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
WAM	Wide Area Multilateration

Executive Summary

The Sheringham Shoal Offshore Wind Farm Extension Project (SEP) and the Dudgeon Offshore Wind Farm Extension Project (DEP) (the Project) are being developed by Equinor New Energy Ltd (Equinor) and will be extensions to the existing Dudgeon Offshore Wind Farm (OWF) and the existing Sheringham Shoal OWF which are located off the North Norfolk Coast.

SEP and DEP were assessed against their potential interactions with the following aviation stakeholders/receptors:

- National Air Traffic Services (NATS) En-route Primary Surveillance Radar (PSR);
- The Ministry of Defence (MOD); and
- Norwich Airport.

NATS Impact Assessment Conclusions

The SEP and DEP Projects will theoretically be detectable by the NATS Cromer and Claxby PSR which will produce unacceptable clutter on radar displays. Consultation with NATS is progressing, NATS have identified a preferred Radar Mitigation Scheme (RMS) which has been endorsed by NATS Air Traffic Control (ATC) who are the end users of the radar data. Contractual discussions are continuing in order to establish the agreed RMS which will remove the radar interference created by the operational wind turbines detectability by NATS PSR systems.

NATS preferred RMS to address the impact SEP and DEP will create on NATS radar systems will comprise of radar blanking of the affected radar systems above the array areas which will remove radar 'clutter', together with an application to change airspace (through an Airspace Change Proposal (ACP) to the Civil Aviation Authority (CAA) following the guidance provided in Civil Aviation Publication (CAP) 1616[1]). The acceptance of the application to the CAA, together with radar blanking of the effected PSR systems, will allow 'uncluttered' radar surveillance by effected NATS PSR to continue with the operation of SEP and DEP.

Ministry of Defence Impact Assessment Conclusions

Unacceptable impact is predicted to the Trimingham Air Defence Radar (ADR) created by both project Extensions.

The Royal Air Force (RAF) Coningsby PSR will theoretically detect all of the SEP wind turbines at a worst-case blade tip height of 330 metres (m) above mean sea level (amsl); with a lesser effect created by Dudgeon North and South array areas where intermittent and occasional detection cannot be ruled out. The MOD has completed an operational assessment of the potential effects to the RAF Coningsby PSR and has confirmed in their response to the Preliminary Environmental Information Report (PEIR) that effects can be managed operationally and therefore the MOD has no concerns regarding this PSR.

Construction of the onshore Export Cable Corridor (ECC) may create an effect to the Weybourne Transmitter site. The MOD has responded to the potential effect created during ECC construction and has provided a maximum height above the ground, to prevent interference to the transmitters, which should not be breached by construction infrastructure – this will be adhered to.

Creation of an obstruction is likely to effect low flying operations, however, low flying operations continue safely in the presence of the existing operational SEP and DEP OWFs through the use of notification through promulgation of the developments in the UK Integrated Aeronautical Information Package (UKIAIP) and the Military Aeronautical Information Publication (Mil AIP), inclusion on aviation charts and electronic cockpit information systems and the fitment of aviation lighting (also notified) of these developments which will be applied to SEP and DEP.

Norwich Airport Impact Assessment Conclusions

SEP and DEP South are theoretically highly likely to be detectable by the Norwich Airport PSR and intermittent detection of the western area of DEP North cannot be ruled out. Radar detection of the operational wind turbines by the Norwich PSR will create radar clutter on Norwich Airport radar displays. Norwich Airport confirmed the potential effect to the PSR within a response to consultation which also included a potential solution which is in place to mitigate the existing SEP and DEP developments. Consultation is progressing to reach agreement on an RMS which will remove the effect created by the developments.

Norwich also raised concerns with regard to the height of the wind turbines and the possibility of a requirement to raise the Norwich Airport ATC Surveillance Minimum Altitude Chart (ATCSMAC). An Osprey CAA approved Instrument Flight Procedure (IFP) designer has completed an analysis of the ATCSMAC and has confirmed with the maximum blade tip height (330m amsl), the ATCSMAC would be breached resulting in a requirement for the ATCSMAC minimum to be raised in the sectors affected. Norwich Airport consultation is progressing to reach a mutually applicable solution.

Offshore Helicopter Operations

Offshore helicopter operations can be completed in Visual Flight Rules (VFR) (weather conditions where pilots can see and avoid obstructions) or Instrument Meteorological Conditions (IMC) (where the icing level permits it). When operating above the project array areas, should weather conditions exist whereby either VFR or Instrument Flight Rules (IFR) transits cannot be continued, helicopters

[1] Available at [redacted]

may choose to reroute or climb to avoid the array areas. An obstacle free route is available as a deviation around the array areas if required and, therefore, the ability of the helicopter operator to safely undertake the intended journey is not affected, however, issues of increased workload, fuel burn and flight times will require consideration. Consultation with potentially affected helicopter operators is being progressed to fully understand any potential effect created by SEP and DEP.

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1 Introduction

Equinor is seeking consent to construct extensions to the existing Sheringham Shoal and Dudgeon Offshore Wind Farms in which Equinor are partners. Equinor has appointed Osprey to carry out this Aviation Impact Assessment (AIA) as part of the Environmental Impact Assessment (EIA) that is being submitted as part of the Development Consent Order (DCO) for the Sheringham Shoal Offshore Wind Farm Extension Project (SEP) and the Dudgeon Offshore Wind Farm Extension Project (DEP). This document presents the background, scope and results of the AIA.

1.1 Background

The effects of wind turbines on aviation interests have been widely publicised but the primary concern is one of safety. There are innumerable subtleties in the actual effects but there are two dominant scenarios that lead to objection from aviation stakeholders:

- Physical: wind turbines can present a physical obstruction to aircraft in transit at low altitudes; and
- Radar/Air Traffic Services (ATS): Wind turbine derived clutter appearing on radar displays can affect the safe provision of ATS as it can mask unidentified aircraft from the air traffic controller and/or prevent the controller from accurately identifying aircraft under control. In some cases, radar reflections from the wind turbines can affect the performance of the radar system itself.

Radar operates by alternately transmitting a stream of high-power radio frequency pulses and 'listening' to echoes received back from reflective objects within its coverage. The amount of energy that an object reflects back is related to the object's Radar Cross Section (RCS) which is proportionate to the physical size of the object. Generally, radars employ a rotating antenna which provides 360° coverage subject to terrain and other blocking infringements. The target range is measured based on the overall time taken for the transmitted pulse to arrive back at the receiver. The azimuth of the target is derived from the position of the antenna against a north reference point and where the pulse under consideration is the strongest in signal amplitude. Typically, ATS systems employ a cosec^2 antenna which produces two beams (low and high). The two beams give a capability to reduce fixed ground clutter in the immediate area of the radar. These systems provide target detection in range and azimuth only and are generally known as 2-Dimensional (2D) radars.

ADR systems typically employ complex rotating phased array antennas. The antennas produce many smaller 'pencil' beams which are stacked in elevation, this allows the system to process the received targets signal strength in each of the pencil beams, which in turn gives the radar the ability to provide an indication of the coarse height of a target as well as its range and azimuth. These types of radar are generally referred to as 3-Dimensional (3D) systems.

The rotation rate of a radars antenna directly impacts upon the range achievable, the target update rate and the ability to resolve targets that are close together:

- ATS systems generally rotate between 10 and 15 rotations per minute (rpm) thus giving a target update every four to six seconds; and
- ADR systems generally rotate between 5 and 12 rpm, dependent on the role, configuration and range required.

All radars employ processing techniques to reduce or remove targets that are unwanted, for example echoes from birds or fixed structures. These echoes are more commonly known as 'clutter'. One key technique is to identify whether a target is moving or not, this is done through doppler processing where the phase of the pulse is assessed against the transmitted pulse. If the phases are different, then the target is moving.

A Primary Surveillance Radar (PSR) such as the type in use at aerodromes across the UK has no height finding capability and as such the Air Traffic Control Officer (ATCO) relies on Secondary Surveillance Radar (SSR) for this purpose. SSR is a collaborative radar system which means that the radar will 'interrogate' a transponder on the aircraft for useful information such as altitude and heading, which is then passed to the ATC display console. All military aircraft (and most civilian aircraft) carry transponders which respond to secondary radar interrogation.

1.2 Wind Turbine Effects on Radar

Radar detectable wind turbines are a significant cause of radar false plots, or clutter, as the rotating blades can trigger the Doppler threshold (e.g., minimum shift in signal frequency) of the Radar Data Processor (RDP) and, as such, may be interpreted as aircraft targets. Significant effects have been observed on radar sensitivity caused by the substantial RCS of the wind turbines structural components (blades, tower and nacelle) which can exceed that of a large aircraft; the effect 'blinds' the radar (or the operator) to required targets in the immediate vicinity of the wind turbine. False plots and reduced radar sensitivity may reduce the effectiveness of radar to an unacceptable level and compromise the provision of a safe radar service to participating aircraft and detection of aircraft targets.

Stationary objects do not cause an effect to radar systems as radar processing techniques remove stationary objects from the radar display; therefore, radar detectable wind turbines only affect radars once they are in operation.

Generally, the larger a wind turbine is, the larger its RCS will be to a radar. This results in more energy being reflected and an increased chance of it creating unwanted returns (clutter). This clutter will be processed by the radar and presented to the ATCO on their Radar Data Display Screens (RDDS). The rotations of turbine blades give an indication that the target is moving with respect to the radar and thus defeating doppler processing techniques. This issue can be further compounded by a large number of wind turbines located together which cause a cumulative effect over a greater volume with higher densities of clutter produced.

The generalised effects wind turbines have on radar systems are as follows:

- Twinkling appearance/blade flash effect which can distract a controller;
- Masking of true aircraft targets by increased clutter on an RDDS;
- Increase in unwanted targets or false aircraft tracks;
- Receiver saturation;
- Target desensitisation causing loss of valid targets that are of a small RCS;
- Shadowing behind the wind turbines caused by physical obstruction (blocking of radar transmitted signal);
- Degradation of tracking capabilities including track seduction; and

- Degradation of target processing capability and processing overload.

Without specific wind turbine mitigation processing capabilities, radars cannot distinguish between returns from wind turbines (false returns, or 'clutter') and those from aircraft. ATCO's and Air Defence controllers are required to assume that actual aircraft targets could be lost over the location of a wind farm; furthermore, identification of aircraft under control could be lost or interrupted. It is mainly for the above reasons that aviation radar system operators object to wind farm developments that are within Line of Sight (LOS) of their radar systems.

1.3 Creation of an Obstruction

Wind turbines dependent on location and maximum height may create a physical obstruction to flight to both en-route aircraft and aircraft operating to and from a landing area. Pilots are obliged to plan their flying activities in advance and to be familiar with any en-route obstacles they may encounter; however, during flight, weather conditions or operational requirements may necessitate route adjustments. In Visual Meteorological Conditions (VMC), pilots are ultimately responsible for seeing and avoiding obstructions such as wind turbines and will be aware through notifications of all phases of the development (construction, operation and decommissioning) activities. Furthermore, when flying in Instrument Meteorological Conditions (IMC) and operating above the construction area, pilots will utilise on board radar which detects obstructions and are likely to be under the control of ATC with an appropriate level of radar service. Furthermore, aircraft will be operating above the Minimum Safe Altitude (MSA). A range of mitigation measures, in the form of appropriate notifications to aviation stakeholders, lighting and marking to minimise effects to aviation flight operations and the inclusion of the extent of the development array areas on aviation charts and documentation would apply to the development of the projects. These measures would comply with current aviation guidelines and be agreed with the appropriate stakeholders.

1.4 Document Structure

The AIA utilises the following structure:

- Section 1 provides the introduction to the report;
- Section 2 lists the guidance and legislation available for the assessment of wind turbine effects to aviation activities;
- Section 3 describes the projects;
- Section 4 provides the baseline environment;
- Section 5 delivers the impact assessment methodology;
- Section 6 lists the data sources;
- Section 7 provides a table of consultation;
- Section 8 provides the impact assessment;
- Section 9 assesses cumulative effect;
- Section 10 provides the transboundary assessment; and
- Section 11 provides the conclusions of the assessment.

13 provides the graphics from the radar LOS analysis.

2 Guidance and Legislation

This section lists the appropriate guidance and legislation which has assisted the assessment.

2.1 Legislation

The primary source of relevant legislation are the National Policy Statements (NPS). These are the principal decision-making documents for Nationally Significant Infrastructure Projects (NSIPs). Those relevant to SEP and DEP are:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (Reference 1);
- NPS for Renewable Energy Infrastructure (EN-3) (Reference 2); and
- NPS for Electricity Networks Infrastructure (EN-5) (Reference 3).

It is noted that the NPS for Energy (EN-1) and the NPS for Renewable Energy Infrastructure (EN-3) are in the process of being revised. Draft versions were published for consultation in September 2021 (Department for Business Energy and Industrial Strategy (Reference 4). A review of the draft versions has been undertaken in the context of the assessment in Environmental Statement (ES) Chapter 15 Aviation and Radar.

2.2 Policy and Guidance

In addition to the NPS, there are a number of pieces of legislation, policy and guidance applicable to the assessment of Aviation and Radar. These include:

- Civil Aviation Authority (CAA) Civil Aviation Publication (CAP) 168: Licensing of Aerodromes (Reference 5): Sets out the standards required at UK licensed aerodromes relating to its management systems, operational procedures, physical characteristics, assessment and treatment of obstacles, and visual aids;
- CAA CAP 393: The Air Navigation Order (ANO) (Reference 6): It is prepared for those concerned with day-to-day matters relating to air navigation that require an up-to-date version of the air navigation regulations and is edited by the Legal Advisers Department of the CAA. CAP 393 also includes application of aviation obstruction lighting to wind turbines in UK territorial waters;
- CAA CAP 764 Policy and Guidelines on Wind Turbines (Reference 7): Provides assistance to aviation stakeholders to help understand and address wind energy related issues thereby ensuring greater consistency in the consideration of the potential impact of proposed wind farm developments;
- CAA CAP 437: Standards for Offshore Helicopter Landing Areas (Reference 8): Provides the criteria applied by the CAA in assessing helicopter landing areas for worldwide use by helicopters registered in the UK. It includes design of winching area arrangements located on wind turbine platforms to represent current best practice;
- CAA CAP 670: Air Traffic Services Safety Requirements (Reference 9): Sets out the safety regulatory framework and requirements associated with the provision of an ATS; and
- CAP 1616: Airspace Design: Guidance on the regulatory process for changing airspace design including community engagement requirements (Reference 10):

Sets out the regulatory framework for the conduct of an Airspace Change Proposal (ACP).

- International Civil Aviation Organisation (ICAO), Document 8168 Ops/611 Procedures for Air Navigation Services Aircraft Operations (Reference 16): Describes operational procedures recommended for the guidance of flight operations personnel. It illustrates the need for operational personnel including flight crew to adhere strictly to published procedures to achieve and maintain an acceptable level of safety in operations.

3 Project Description

SEP and DEP are located off the North Norfolk Coast and represent extensions to the existing Sheringham Shoal and Dudgeon Offshore Wind Farms (OWFs) respectively.

3.1 Overview

The existing Sheringham Shoal and the Dudgeon wind farms are located off the Norfolk coast and have been in operation since 2011 and 2017 respectively. The Crown Estate has accepted applications for extensions to offshore wind assets in England and Wales, and Equinor (the Applicant) being successful in application is seeking to double the capacity of these two wind farms.

Sheringham Shoal comprises 88 wind turbines with a generating capacity of 317 MW. The proposed area of development for SEP is located immediately to the north and east of the existing Sheringham Shoal Wind Farm.

The existing Dudgeon wind farm comprises 67 wind turbines, and a generating capacity of 402 MW. DEP is proposed to consist of the development of two separate areas adjoining the north and the southeast of the existing asset boundary.

SEP will occupy 97.0 km^2 and will comprise up to 23 wind turbines (between 13 and 23). DEP covers 114.75 km^2 and would comprise up to 30 wind turbines (between 17 and 30). Each wind turbine would have a maximum blade tip height of 330 m (between 265 m and 330 m) above Highest Astronomical Tide (HAT).

3.2 Parameters and Location

The offshore array areas are located in the Southern North Sea (SNS), approximately 17 kilometre (km) off the North Norfolk Coast near Sheringham. SEP and DEP adjoin the existing Sheringham Shoal and Dudgeon wind farms. There are three potential development areas; SEP, Dep North and DEP South

SEP is single array adjoining the north-eastern edge of the Sheringham Shoal OWF. DEP is split into two arrays: DEP North and DEP South. Figure 1 shows SEP as a red line boundary and the two DEP arrays in blue.

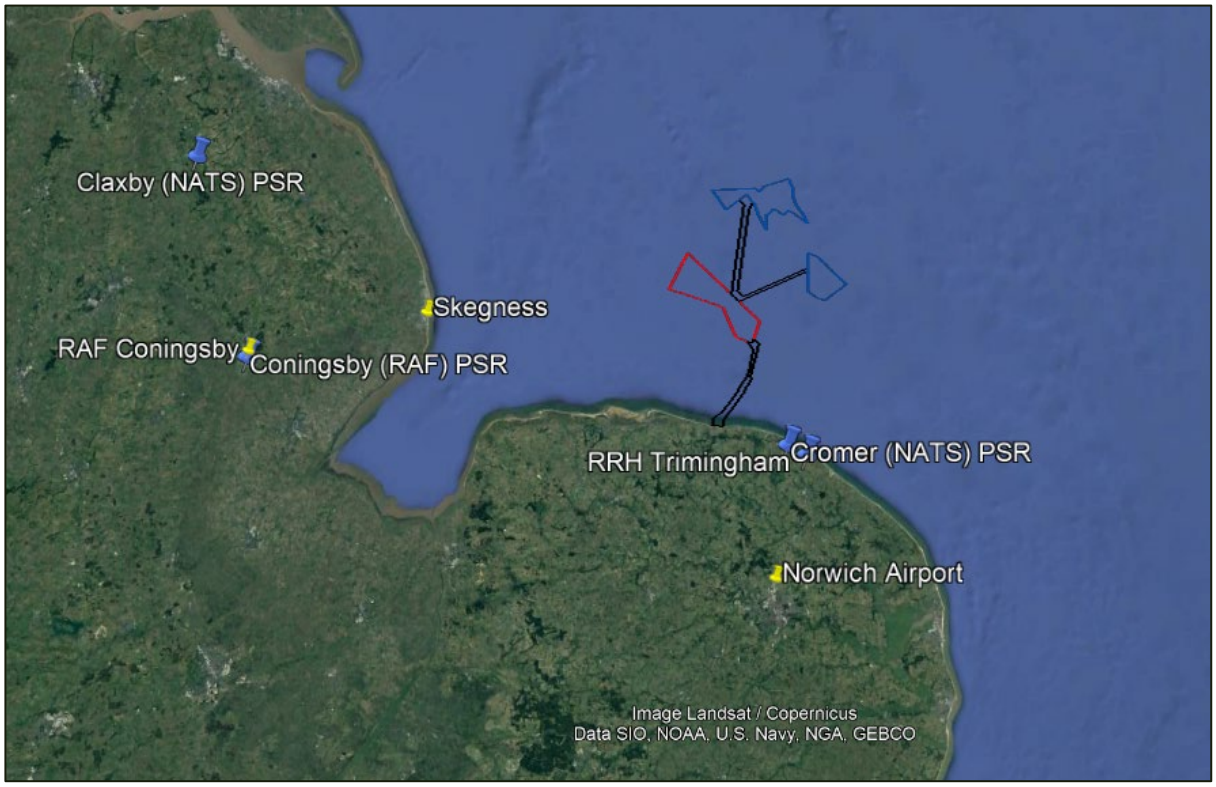

Figure 1 Location of SEP and DEP Offshore Array Areas, Export and Interlink Cable Corridors.

3.3 Offshore Substation

A maximum of two substations are being considered for the development: with the base case being a single 784 Megawatt (MW) substation or two substations of maximum 338 MW (SEP) and 448 MW (DEP). No helideck is envisaged; however, a deck may be included for heli-hoist operations.

3.4 Embedded Mitigation

A proportion of the onshore cable corridor near landfall, falls within the statutory technical safeguarding area of the MOD Weybourne Transmitter site. Construction and any permanent above ground level (agl) infrastructure will remain below the MOD safeguarded area of the Weybourne Transmitter site which has been confirmed to the MOD.

A range of specific mitigation measures (notification, lighting and marking) to minimise environmental effects would apply to the development of the proposed Project. These 'embedded' mitigation measures will comply with current guidelines and will be agreed with the appropriate stakeholders. Embedded mitigations are as follows:

- CAP 393 Article 223 (Reference 6) sets out the mandatory requirements for the lighting of offshore wind turbines:
    - Legislation requires the fitting of obstacle lighting on offshore wind turbines with a height of 60 m or more above the level of the sea at HAT.
    - Where four or more wind turbines are located together in the same group, with the permission of the CAA, only those on the periphery of the group need to be fitted with at least one medium intensity steady red light positioned as close as reasonably practicable to the top of the fixed structure.

    - The obstruction light or lights must be fitted to show when displayed in all directions without interruption. The requirements of the angle of the plane of the beam and peak intensity levels are defined within CAP 393.
- CAP 437 *Standards for Offshore Helicopter Landing Areas* [Reference 8] sets out a procedure to indicate to a helicopter operator that the wind turbine blades and nacelle are safely secured in position prior to helicopter hoist operations commencing:
    - CAP 437 states that this is best achieved through the provision of a Heli hoist status light located on the nacelle of the wind turbine within the pilot's field of view, which is capable of being operated remotely and from the platform itself or from within the nacelle.
    - A steady green light is displayed to indicate to the pilot that the wind turbine blades, and nacelle are secure, and it is safe to operate. A flashing green light is displayed to indicate that the wind turbine is in a state of preparation to accept hoist operations or, when displayed during hoist operations, that parameters are moving out of limits. When the light is extinguished, this indicates to the operator that it is not safe to conduct helicopter hoist operations.
    - Obstruction lighting in the vicinity of the winching area that has a potential to cause glare or dazzle to the pilot or to a helicopter hoist operations crew member should be switched off prior to, and during, helicopter hoist operations.
- *Royal Air Force Obstruction Lighting Guidance* [Reference 11] provides the following information regarding MOD requirements for the lighting of offshore developments:
    - The MOD minimum standard for offshore developments is a 200 candela (cd) flashing red light on wind turbines and, because MOD aircraft operate to lower altitudes over-sea (using altimeters) without night vision devices/systems, offshore developments therefore require both visible and IR lighting. In the majority of cases though, this MOD requirement is exceeded by the CAA, Maritime and Coastguard Agency MCA) and Trinity House statutory requirements.

4 Baseline Environment

SEP and DEP are within operating range of several PSR related to the provision of Air Traffic Services as well as within range of Military ADR which is used for the provision of radar data for air combat training and real intercepts.. The projects are situated within a complex offshore airspace environment that includes military exercise areas, civil airways, helicopter platforms and transit routes.

4.1 Airspace

The offshore arrays lie beneath complex airspace characterised by military exercise areas, restrictive airspace, airways, and offshore helicopter platforms and transit routes. Figure 2 shows a transparent overlay[2] of the proposed extensions on a Visual Flight Rules (VFR)[3] aviation chart to illustrate this complexity.

[2] [redacted] C) OpenStreetMap and CC-BY-SA and Equinor

[3] Visual Flight Rules - A set of regulations under which a pilot operates an aircraft in weather conditions clear enough to allow the pilot to see where the aircraft is going; the pilot must be able to operate the aircraft with visual reference to the ground, and by visually avoiding obstructions and other flying machines.

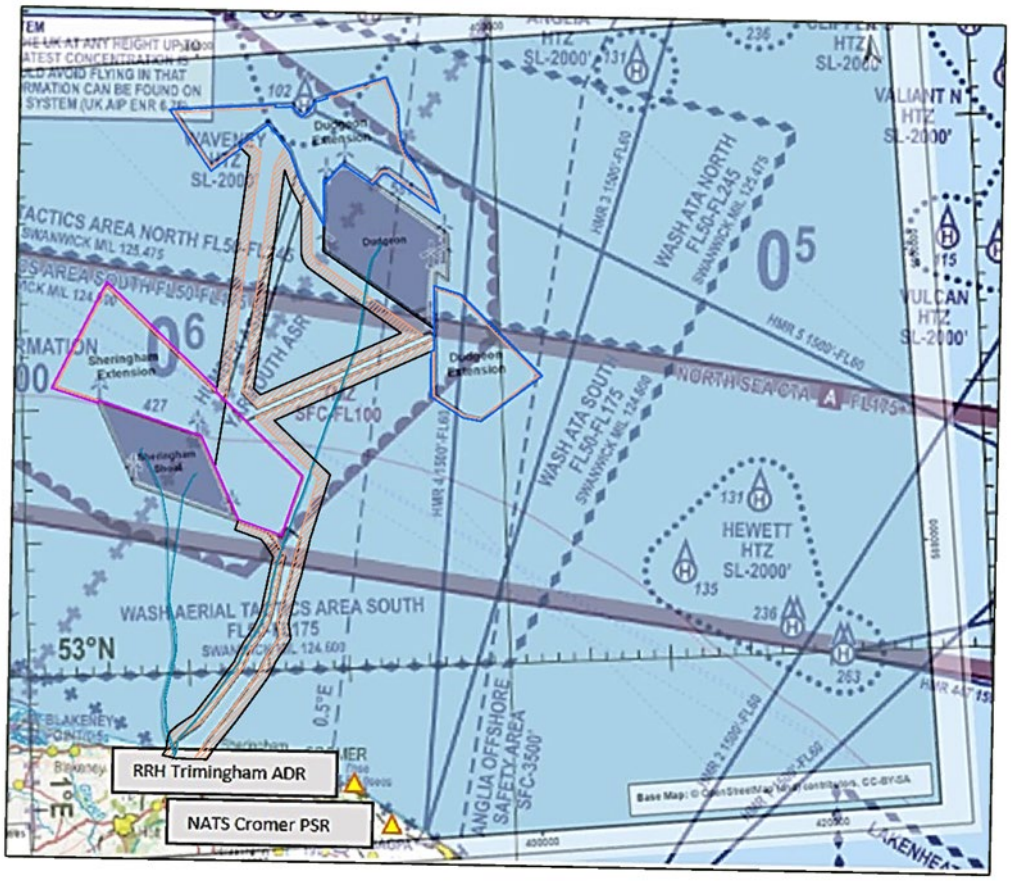

Figure 2 Airspace and Offshore Platforms

The airspace within, above and surrounding the array areas is used by both military and civil registered aircraft which observe the airspace rules dependent on the classification of airspace they are operating in as follows:

- Glass G uncontrolled airspace: any aircraft can operate in an area of uncontrolled airspace without any mandatory requirement to be in communication with ATC. Pilots of aircraft operating under VFR in Class G airspace are ultimately responsible for seeing and avoiding other aircraft, terrain and obstructions; and
- Class A and C Controlled Airspace (CAS): all aircraft operating in this airspace must be in receipt of an ATS.

The airspace immediately surrounding SEP is classified as a Transponder Mandatory Zone (TMZ) established to mitigate the impact of the existing Sheringham Shoal and Dudgeon OWFs on aviation radar systems. The TMZ extends from the surface up to Flight Level (FL) 100 (or 10,000 feet (ft)) amsl and adopts the classification of airspace in which it is located (Class G in this case) however, no aircraft may fly within the TMZ without operating a serviceable transponder unless specific authority is granted.

The MOD stated within their Scoping Response that impact to military Practice and Exercise Area (PEXA - Wash ATA) is not expected from the proposed Developments. The Planning Inspectorate agreed that effects on PEXA are only likely to be significant during the operational phase and limited to effects on radar (and the creation of radar clutter) as the

training area flight level is between 5,000 ft and 17,500 ft amsl. i.e. well above the wind turbine blade tip height.

PSR and ADR systems utilised in the provision of a radar based ATS and for surveillance of UK airspace utilising ADR to identify a potential threat are likely to be impacted by both SEP and DEP.

A number of ADR systems are located throughout the UK and are utilised to maintain a constant watch of UK airspace in order to respond to any potential airborne threat. Trimingham ADR, on the North Norfolk coast, is the core system utilised for surveillance of the airspace above the Sheringham and Dudgeon OWFs and their Extensions.

NATS utilise a number of PSR systems which are located across the UK for the provision of radar data which supplements their provision of an ATS. The Cromer PSR, on the North Norfolk coast, and Claxby PSR, in Lincolnshire, are utilised by NATS controllers at Swanwick Area Control Centre (ACC) and Aberdeen Airport (*Anglia Radar*) for the provision of ATS in the airspace above the Sheringham and Dudgeon OWFs and their Extensions. Both the Claxby and Cromer PSR systems are located within the study area and close enough for turbines to be detectable on these PSR systems.

4.2 Sheringham Extension Project

Above the TMZ is airspace associated with military exercises; the Wash Aerial Tactics Area (ATA) South is Class G airspace which extends above SEP between FL 50 (5,000 ft) and FL 175 (17,500 ft) amsl. Crossing SEP above FL 175 (17,500 ft) is an airway designated North Sea Control Area, Class A CAS. Air Navigation Services in the area are provided by NATS and military controllers based at the Swanwick ACC.

The southern edge of the array is within approximately 6.5 Nautical Mile (NM)of Helicopter Main Route (HMR) 4 and hence will not be impacted by the development of SEP. There are no offshore platforms with helidecks located within the 9 NM consultation zone.

4.3 Dudgeon Extension Project

The airspace immediately surrounding DEP is also the TMZ established to mitigate the impact of the existing Sheringham Shoal and Dudgeon OWFs on NATS PSR; however, not all of DEP North and DEP South lie within the TMZ boundary. The Class G airspace TMZ extends from the surface up to FL100 (or 10,000 ft). No aircraft may fly within this area without operating a serviceable transponder unless specific authority is granted.

Above the TMZ is airspace associated with military exercises:

- The DEP North array area is located beneath the Wash ATA North which extends between FL 50 (5,000 ft) and FL 245 (24,500 ft). The DEP South array area straddles the Wash ATA North and South segments; and
- The DEP South array is partially beneath the airway designated North Sea Control Area Class A airspace above FL 175. Air Navigation Services in the area are provided by NATS and military controllers based at the Swanwick ACC utilising primarily the Claxby and Cromer PSRs.

The DEP North array area sits within the Helicopter Traffic Zone (HTZ) for the Waveney Field and the northern boundary of DEP lies 500 m from the Perenco operated Waveney platform, HTZs are established as notifications of helicopters engaged in platform approaches, departures and extensive uncoordinated inter-platform transit flying. The HTZ is formed of lines of 5 NM joining circles of radius 1.5 NM around each platform.

HMR 5 crosses the DEP North array between the southernmost platform in the Waveney field (532109N 0011811E) to the Leman field (530313N 0021358E).

HMR 4 which is operated between 1,500 ft to FL 60 (6,000 ft) crosses DEP South. This route is between waypoint BAGPA (525338N 012421E) on the North Norfolk coast and platforms in the Trent Field (541755N 0013930E). The maximum cruise level for helicopters on this route is FL 40 (4,000 ft) unless cleared by Anglia Radar (NATS).

HMR 3 passes within 1.5 NM of DEP South. This route is between waypoint BAGPA (525338N 012421E) on the North Norfolk coast to platforms in the Munro field (542602N 0024617E).

HMRs are routes typically and routinely flown by helicopters operating to and from offshore destinations and are promulgated for the purpose of signposting concentrations of helicopter traffic to other airspace users. HMR promulgation does not predicate the flow of helicopter traffic. Whilst HMRs have no airspace status and assume the background airspace classification within which they lie (in the case of the SNS, Class G), they are used by the Air Navigation Service Providers (ANSPs) and helicopter operators for flight planning and management purposes. Previously, consultation with helicopter operators has advised that the HMR network is not widely used in the SNS with helicopter operators choosing instead to route directly to their destination. CAP 764 states the following:

'*There should be no obstacles within 2 NM either side of HMRs but where planned should be consulted upon with the helicopter operators and Air Navigation Service Provider (ANSP). The 2 NM distance is based upon: operational experience; the accuracy of navigation systems; and, importantly, practicality. Such a distance (2 NM) would provide time and space for helicopter pilots to descend safely to an operating height below the icing level*'.

4.4 Military Operations

The Wash ATA North and South is used intensively by military aircraft for tactical training above the SNS. Aircraft whilst in receipt of an ATS will be under the control of air defence controllers utilising ADR (Trimingham ADR observes the airspace above the Sheringham and Dudgeon OWFs and their Extensions), air traffic controllers utilising NATS radar systems at Swanwick or airborne assets. When the exercise areas are not required for specific military training or exercise use, the airspace is then available for use for civil and military en-route operations.

4.5 Norwich Airport

Norwich Airport operates a PSR that will detect operational wind turbines of SEP and DEP. In the context of the two projects, Norwich Airport provides Air Navigation Services to helicopters transiting to the SNS mineral exploration fields. Further away from the airport this responsibility is transferred to Anglia Radar who are based at Aberdeen Airport and who utilise NATS radar systems. Norwich Airport also receives radar data from the NATS Cromer PSR system and also provides a Lower Airspace Radar Service (LARS) to those aircraft requesting it.

4.6 Meteorological Office Radar

The Meteorological (Met) Office radar infrastructure is safeguarded by the Met Office. Its weather radar network currently consists of 16 sites. The Met Office employs wind turbine safeguarding guidelines that may result in an objection for any development within 20 km of any affected weather radar.

Analysis of the site boundaries concludes that there are no weather radar stations within 20 km of the array areas.

Figure 3 shows the baseline environment including littoral areas for SEP and DEP.

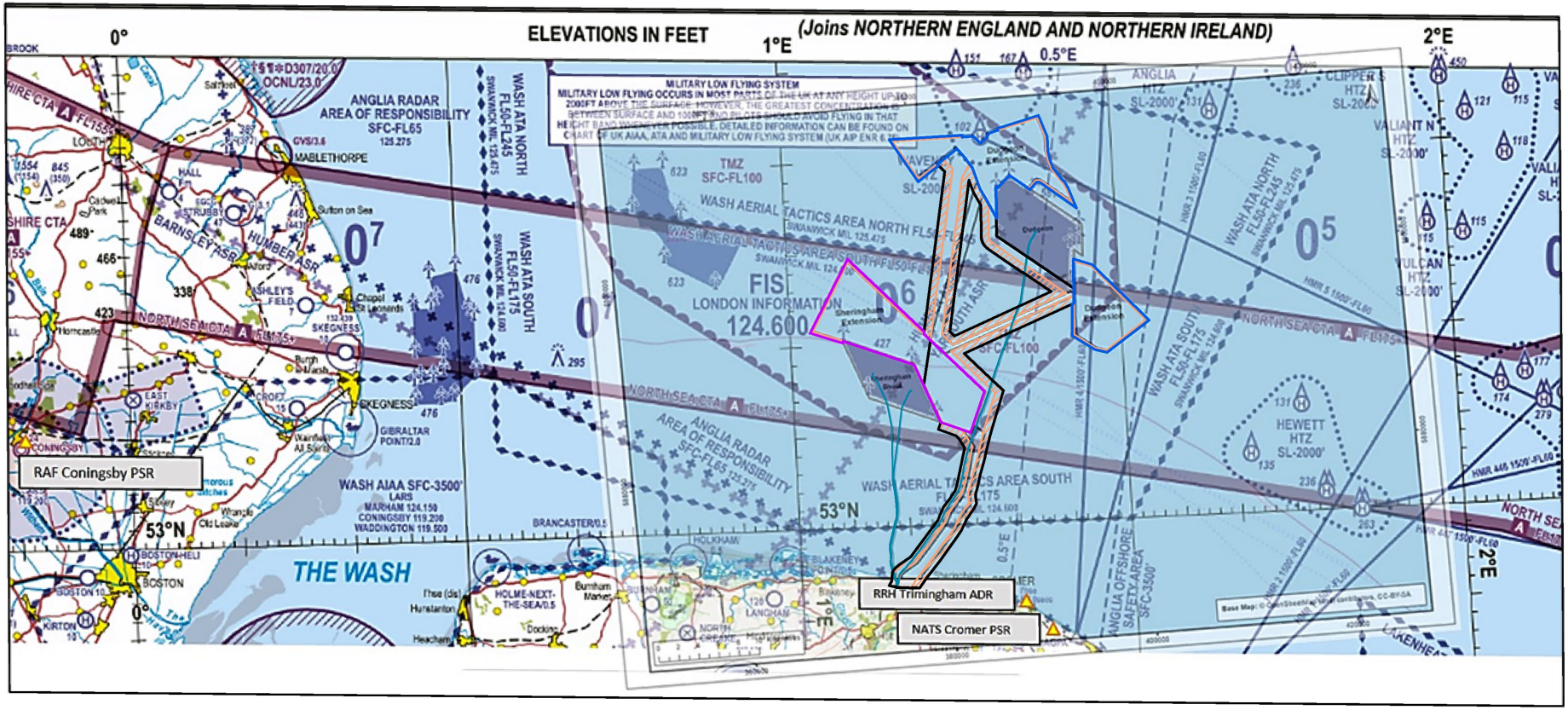

Figure 3 Baseline Environment for SEP and DEP

5 Impact Assessment Methodology

5.1 Study Area and Scope

The study area encapsulates SEP and DEP in addition to other offshore wind farms in the SNS that potentially impact the identified aviation receptors for the purposes of assessing the cumulative effects.

The study area includes:

- Military ADR and aerodrome PSR systems on the eastern coast of England within operating range of SEP and DEP array areas;
- Civil Airports operating PSR within operating range of the offshore arrays.
- NATS En-route PSR systems;
- Offshore helicopter operations to the Oil and Gas platforms fitted with a helideck that have a 9 NM CAA recommended 'consultation buffer' that overlap with the offshore array areas (see ES Chapter 16 Petroleum Industry and Other Marine Users); and
- Littoral MOD assets within Statutory Technical Safeguarding range of any landfall elements of the onshore cable corridor.

Transboundary effects are scoped out in the EIA due to the location of the projects lying within UK waters/airspace.

As all of the offshore cable corridors will be below sea-level, there is no potential source/receptor pathway for an impact to arise on aviation interests and, therefore, offshore cable corridors are not considered further.

The following are scoped into the assessment:

- Effects on the Remote Radar Head (RRH) Trimingham ADR;
- A proportion of the landfall site at Weybourne falls into the statutory technical safeguarding area of RAF Weybourne transmitter site in particular the MOD quoted *'any development height zone'*;
- Effects on Norwich Airport PSR and the Norwich Airport ATCSMAC; and
- Effects on the en-route PSR operated by NATS at Cromer (Norfolk Coast) and Claxby (Lincolnshire).

5.2 Methodology

Osprey recommends that the developer considers the information in this report when assessing the safety of any installation, construction or maintenance phases with respect to aviation interests.

The phases of the AIA carried out by Osprey are outlined below:

- Stakeholder Identification: Osprey identifies a list of potential aviation stakeholders in accordance with CAA, CAP 764 *Policy and Guidelines on Wind Turbines* [Reference 7] and considers the en-route and other radar systems within operational range of the proposed wind development. The operational range of a radar system is dependent on the type of radar used and its operational requirement. CAP 764 provides a guide of 30 km for assessment of radar impact; however, any impact is

dependent on radar detectability of operational wind turbines, the radars operational range and the use of airspace in which the development sits;

- The identification stage also considers military areas of operation, tactical training, ADR, PEXA and military low flying operations.;
- Stakeholder Impact: for each identified stakeholder Osprey considers radar impact and subsequently the operational impact of the wind turbines being detectable by that radar; and
- The operational impact pays heed to, but is not limited to, consideration of: the orientation of approach and departure flight paths, physical safeguarding of flight, types of aircraft flying near to the development, airspace characteristics and flight procedures as published in the *UKIAIP Integrated Aeronautical Information Package* (IAIP) (for civilian aviation activities) [Reference 12] and the *Military Aeronautical Information Publication* (Mil AIP) [Reference 13].

5.3 Definitions

For each effect, the assessment identifies receptors sensitive to that effect and implements a systematic approach to understanding the impact pathways and the level of impacts on given receptors. The definitions of sensitivity and magnitude for the purpose of the Aviation and Radar assessment are provided in Table 1 and Table 7 below.

Sensitivity	Definition
High	Receptor provides a service which is of high value to the local, regional or national economy, and/or the receptor is generally vulnerable to impacts that may arise from the projects, and/or recoverability is slow and/or costly.
Medium	Receptor provides a service which is of moderate value to the local, regional or national economy, and/or the receptor is somewhat vulnerable to impacts that may arise from the projects, and/or has moderate to high levels of recoverability.
Low	Receptor provides a service which is of low value to the local, regional or national economy, and/or the receptor is not generally vulnerable to impacts that may arise from the projects, and/or has high recoverability.
Negligible	Receptor provides a service which is of negligible value to the local, regional or national economy, and/or the receptor is not vulnerable to impacts that may arise from the projects, and/or has high recoverability.

Table 1 Definition of Sensitivity for an Aviation and Radar Receptor

Magnitude	Definition
High	Total loss of ability to carry on activities and/or impact is of extended physical extent and/or long-term duration (i.e., total life of project and/or frequency of repetition is continuous and/or effect is not reversible for the projects).
Medium	Loss or alteration to significant portions of key components of current activity and/or physical extent of impact is moderate and/or medium-term duration (i.e., operational period) and/or frequency of repetition

Magnitude	Definition
	is medium to continuous and/or effect is not reversible for the project phase.
Low	Minor shift away from baseline, leading to a reduction in level of activity that may be undertaken and/or physical extent of impact is low and/or short to medium term duration (i.e., construction period) and/or frequency of repetition is low to continuous and/or effect is not reversible for the projects phase.
Negligible	Very slight change from baseline condition and/or physical extent of impact is negligible and/or short- term duration (i.e., less than two years) and/or frequency of repetition is negligible to continuous and/or effect is reversible.

Table 2 Definition of Magnitude

5.4 Impact Significance

In basic terms, the potential significance of an impact is a function of the sensitivity of the receptor and the magnitude of the effect. The determination of significance is guided by the use of an impact significance matrix, as shown in Table 8. Definitions of each level of significance as they apply to aviation and radar receptors are provided in Table 9.

Potential impacts identified within the assessment as Major or Moderate are regarded as significant in terms of the EIA regulations. Where appropriate, the acceptability in regard to the provision of an ATS safety is also highlighted. Appropriate mitigation has been identified, where possible, in consultation with the regulatory authorities and relevant stakeholders. The aim of mitigation measures is to avoid or reduce the overall residual impact to an acceptable level.

		Adverse Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	*Major*	*Major*	*Moderate*	*Minor*	*Minor*	*Moderate*	*Major*	*Major*
	Medium	*Major*	*Moderate*	*Minor*	*Minor*	*Minor*	*Minor*	*Moderate*	*Major*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*	*Negligible*	*Minor*	*Minor*	*Moderate*
	Negligible	*Minor*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Minor*

Table 3 Impact Significance Matrix

Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or could result in exceedance of statutory objectives and / or breaches of legislation.

Significance	Definition
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision-making process.
Negligible	No discernible change in receptor condition.
No change	No impact, therefore, no change in receptor condition.

Table 4 Definition of Impact Significance

5.5 Radar Line of Sight Methodology

Osprey used the Advanced Topographic Development and Images (ATDI) ICS LT (Version 22.4.7 x64) tool to model the terrain elevation profile between the identified radar systems and the array areas. This is otherwise known as a point-to-point LOS analysis. Wind turbine analysis points of reference in the form of a grid pattern at a blade tip height of 330 m amsl across the offshore array areas were utilised to complete the analysis. The result is a graphical representation of the intervening terrain and the direct signal LOS (considering earth curvature and radar signal properties).

The analysis undertaken gives an indication of the likelihood of wind turbines being theoretically detected such that the operational significance of the wind turbine relative to nearby aviation radar assets can be assessed. It is important to note that the analysis of radar detectability of wind turbines is a limited and theoretical desk-based study; in reality there are unpredictable levels of signal diffraction and attenuation within a given radar environment (ambient air pressure, density and humidity) that can each influence the probability of a wind turbine being detected. However, radar LOS analysis provides an indication of the potential of radar detectability to assess potential impacts on aviation surveillance equipment.

The radar LOS analysis is completed at a wind turbine height measured above mean sea level. The project wind turbines are referred to in Applicant documents as measured above HAT. The difference between the measurements is 2.7 m which will not impact on the results of the radar LOS analysis.

5.6 Radar Line of Sight Qualitative Definitions

The qualitative definitions used in the LOS assessment are defined in Table 5.

Result	Definition
Highly Likely	The wind turbine is highly likely to be detected by the radar: Direct LOS exists between the radar and the turbine.
Likely	The wind turbine is likely to be detected by the radar at least intermittently.
Unlikely	The wind turbine is unlikely to be detected by the radar but cannot rule out occasional detection.

Result	Definition
Not Detectable	The wind turbine is unlikely to be detected by the radar as significant intervening terrain exists.

Table 5 Qualitative Definitions of Radar LOS Results

6 Data Sources

6.1 Notification and Lighting Requirements

Tall slender constructions such as wind turbines or anemometer masts, despite their size, can be difficult to see from the air in certain weather conditions. Guidance has been issued by RenewableUK[4], which recommends that to facilitate safe visual flight, day or night, in the vicinity of anemometer masts and/or wind turbines:

- Information regarding construction should be passed to the Defence Geographic Centre (DGC) (at dvof@mod.gov.uk) at least 10 weeks in advance of the obstacle type(s)erection, position, height (tip of arc) and type of aviation lighting. Once reported, all will be included in the DGC Obstruction database and all that meet chart inclusion criteria will be published for broader awareness.
- Guidance regarding the lighting of wind turbines in UK territorial waters is contained in CAA CAP 393 Air Navigation: The Air Navigation Order – Article 223 (Reference 6).

Appropriate information about the site construction and any associated lighting (where applicable), for example the height and temporary location of construction cranes, should be provided to the UK Aeronautical Information Service (NATS Aeronautical Information Service (AIS)) for promulgation in applicable aviation publications including the UK IAIP.

The data used in this AIA are the most up to date publicly available information which can be obtained. Information sources have included the following:

- CAA CAP 032 UK IAIP (Reference 12): The main resource for information and flight procedures at all licensed UK airports as well as airspace, en-route procedures, charts and other air navigation information;
- MOD Aeronautical Information Publication (AIP), (Reference 13): The main resource for information and flight procedures at all military aerodromes as well as airspace, en-route procedures, charts and other air navigation information;
- MCA Marine Guidance Note (MGN) 654 Safety of Navigation: Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response (Reference 14): Contains information for operators and developers in formulating their emergency response plans and site safety management;
- CAA Visual Flight Rules Chart (Reference 15): Provides topographical air chart information on aerodrome, airspace and areas of Air Traffic Control (ATC) responsibilities; and

[4] [redacted]

7 Consultation

This section provides the results of consultation with relevant aviation stakeholders..

The key elements of the consultation process to date have included scoping, the Preliminary Environmental Information Report (PEIR) and focused consultation with aviation and radar stakeholders undertaken by Osprey on behalf of the Applicant. A summary of consultation held to date is shown in Table 6.

Consultee	Date/ Document	Comment	Project Response
Scoping Responses			
The Planning Inspectorate	19/11/19 Scoping Opinion	"The Scoping Report explains that Royal HaskoningDHV (2013) assessed that the distance to the nearest airfield to the Dudgeon Offshore Wind Farm was too great for an unacceptable hazard to flight to occur. It concluded that although the extension projects weren't assessed and are located closer to the airfield, it is reasonable to conclude that the same applies to the SEP and DEP sites. It explains that aircraft taking-off and landing will be at an altitude significantly greater than the tallest infrastructure related to any phase of the Proposed Development. The Inspectorate agrees that significant effects to flight safety are unlikely and that this matter can be scoped out of the ES.	Impacts to aviation and radar, in addition to impacts on flight safety, where necessary, have been assessed within Section 8. Impacts associated with surveillance minimum altitude are assessed in Appendix 15.2 and in Chapter 15 Aviation and Radar.
The Planning Inspectorate	19/11/19 Scoping Opinion	The Inspectorate agrees that effects on military training areas in the region are only likely to be significant during the operational phase since	The Planning Inspectorate agreed that impacts on military training

Consultee	Date/ Document	Comment	Project Response
		they occur as a result of impacts to radar and therefore can be scoped out of the assessment for construction and decommissioning. With regards to the operational phase, paragraph 509 of the Scoping Report explains that potential effects are related to radar rather than physical obstruction as the training area flight level is between 5,000 feet (ft) and 24,500ft which is well above the proposed turbine height. The Inspectorate is content with this approach.	areas can be scoped out of the assessment for the construction and decommissioning phase and are therefore not considered further. The assessment of impacts on military training areas during operation has focused on the impact to radar in line with the Scoping Report and the Inspectorate's comments.
The Planning Inspectorate	19/11/19 Scoping Opinion	The Inspectorate agrees that given the distance of the Proposed Development from international boundaries, transboundary effects are unlikely to be significant and this matter can be scoped out of the ES.	Transboundary impacts have been scoped out of the assessment in line with the Scoping Report and the Inspectorate's comments.
The Planning Inspectorate	19/11/19 Scoping Opinion	"The Applicant is reminded of the need within the EIA Regulations 2017 to consider the significance of effects. The ES should therefore clearly identify whether or not an effect is considered to be significant."	Chapter 15 Aviation and Radar identifies the impact significance of each potential impact in line with the EIA Regulations.
The Planning Inspectorate	19/11/19 Scoping Opinion	"The ES should assess any significant effects associated with impacts to known Ministry of Defence (MOD)	Chapter 15 Aviation and Radar identifies the significance

Consultee	Date/ Document	Comment	Project Response
		receptor locations. The MOD consultation response highlights that the turbines on the western edge of the SEP would be detectable to the Primary Surveillance Radar (PSR) at Royal Air Force (RAF) Coningsby. It also notes that part of the cable corridor at the Weybourne landfall site occupies the eastern extent of the statutory safeguarding zone surrounding the RAF Weybourne transmitter site; and that the Bacton landfall site occupies the statutory safeguarding zone encompassing the Air Defence Radar (ADR) at Remote Radar Head (RRH) Trimingham."	of each potential impact in line with the EIA Regulations including effects on the RAF Weybourne transmitter. Following subsequent analysis, the MOD determined that there would be no impact to RAF Coningsby which has subsequently been scoped out of the assessment. Following site selection work carried out since scoping, the Bacton landfall is no longer in the project design envelope. Therefore, impacts relating to a Bacton landfall are not considered further.
Marine and Coastguard Agency (MCA)	01/11/19 Scoping Response	"The turbine layout design will require MCA approval prior to construction to minimise the risks to surface vessels, including rescue boats, and Search and Rescue (SAR) aircraft operating within the site."	Noted that layout approval will be undertaken following consent.

Consultee	Date/ Document	Comment	Project Response
MCA	18/11/20 Consultation Response	The MCA stated that they "will engage with the Applicant from a SAR and navigation safety point of view. "	See Section 42 response below. An assessment of low flying aircraft and the potential creation of an obstruction is presented in Section 8.3.3. The turbine layout will be agreed post consent in consultation with MCA.
MOD	01/11/19 Scoping Response	"The applicant has recognised the potential need for mitigation to address the impacts on air defence systems and states they will engage with the MOD on this. The ADR at RRH Trimingham has been identified as a relevant receptor. Both extension areas will be detectable to RRH Trimingham and will impact upon the operation of the air defence system. The impact on the ADR will need to be mitigated and it will be for the application to provide appropriate technical mitigation(s)."	Impacts to RRH Trimingham are assessed in Section 8.2.
MOD	01/11/19 Scoping Response	"Another consideration not covered in the Scoping Report is the impact of the turbines on the radar at RAF Coningsby PSR. Turbines on the western edge of the Sheringham Shoal extension area will be detectable to the PSR at RAF Coningsby. This will need to be addressed and an appropriate technical	Impacts to RAF Coningsby are scoped out following subsequent assessment by MOD.

Consultee	Date/ Document	Comment	Project Response
		mitigation will need to be provided by the applicant."	
MOD	01/11/19 Scoping Response	"The Scoping Report makes reference to the lighting of the Dudgeon Offshore Wind Farm and the MOD's Lighting Guidance is listed as a data source. In the interest of air safety, the Sheringham Shoal and Dudgeon extension areas should be fitted with MOD accredited aviation safety lighting in accordance with the Air Navigation Order (ANO) 2016. The MOD would need to confirm the specification of the lighting to be used."	Lighting will be in accordance with the ANO and MOD requirements. The requirement for consideration of the fitment of aviation lighting is embedded in the project design Section 3.4.
MOD	01/11/19 Scoping Response	"Part of the cable corridor at the Weybourne landfall site occupies the eastern extent of the statutory technical safeguarding zone surrounding the RAF Weybourne transmitter site, in particular the any development height zone. Any development within these zones will need to be compatible with technical safeguarding requirements."	An assessment of the Weybourne transmitter site is provided in Section 8.3.4.
NATS	01/11/19 Scoping Response	NATS state that their operations in the Southern North Sea (SNS) should be considered. NATS noted that both the existing Sheringham Shoal and Dudgeon wind farms lie within the Greater Wash Transponder Mandatory Zone (TMZ), and the entirety of the proposed extensions do not.	An assessment of theoretical radar detectability of wind turbines and how detectability will impact NATS radar systems is provided in Section 8.1.
Perenco	01/02/21 Meeting minutes	Perenco confirmed DEP may interact with the Waveney gas platform and its	Consultation with Perenco is ongoing. An

Consultee	Date/ Document	Comment	Project Response
		associated activities are of potential concern. A helicopter visits Waveney approximately once per month and Perenco requested information about turbine dimensions and locations in order to understand possible implications for helicopter approach to the platform.	independent assessment of potential helicopter and marine vessel access impacts has been commissioned and included in Chapter 16 Petroleum Industry and Other Marine Users.
Other Consultation			
Noordzee Helikopters Vlaanderen (NHV) Group	13/10/20 Consultation Response	The wind farm sites and the obstruction that they may present are located to the south and west of normal NHV operations. Overflight of the wind farm sites may be required during poor weather conditions where the wind turbines cannot be visually acquired by the pilot. Overflight will be at a height which may on occasion force the aircraft into icing conditions therefore to permit flight at a lower altitude where icing conditions are not a factor, obstacle free transit corridors may be required through the array areas.	Impacts to ATCSMAC are assessed within Appendix 15.2 of the EIA and in Section 8.4.3.
Anglia Radar	13/10/20 Consultation Response	Impact to NATS radar systems is predicted. The use of Helicopter Main Routes [5](HMR) and Minimum Safe Altitudes (MSA) in the vicinity of the wind farm sites will require an assessment of the potential obstruction	An assessment of theoretical radar detectability of wind turbines and how detectability will impact NATS radar systems is

[5] HMR will shortly be renamed Helicopter Main Route Indicators (HMRI).

Consultee	Date/ Document	Comment	Project Response
		created by the wind turbines. Consultation with helicopter operators operating in the area of the wind farms is recommended.	provided in Section 8.1. Impacts to MSA is provided in Section 8.4.3 and Appendix 15.2 of the EIA. Consultation with offshore helicopter operators is ongoing.
Norwich Airport	21/10/20 Consultation Response	"Impact to the Norwich Airport Surveillance Minimum Altitude Chart (SMAC) due to the height above mean sea level (amsl) may be apparent and will require assessment. Furthermore, the Norwich Airport and Cromer PSR may be impacted by the radar detection of the Project wind turbines".	An assessment of the Norwich Airport ATCSMAC is contained within Section 8.4.3 and Appendix 15.2 of the EIA. The conclusions of theoretical radar detectability of wind turbines and how detectability will impact NATS and the Norwich Airport radar systems is provided in Section 8.4.
NATS	26/10/20 Consultation Response	The results of the radar Line of Sight (LOS) analysis were provided to NATS; analysis predicted an impact to the NATS operated Claxby and Cromer PSRs. NATS stated that they would investigate the level of impact to the two PSR and discuss the potential for a mitigation solution internally.	An assessment of theoretical radar detectability of wind turbines and how detectability will impact NATS radar systems is provided in Section 8.1.
UniFly Helicopters	18/11/20 Consultation Response	UniFly Helicopters have no comment to make on the Projects.	N/A

Consultee	Date/ Document	Comment	Project Response
MCA	18/11/20 Consultation Response	The MCA sated that they "will engage with the Applicant from a SAR and navigation safety point of view."	An assessment of low flying aircraft and the potential creation of an obstruction is presented in Chapter 15 Aviation and Radar.
Perenco	01/02/21 Meeting minutes	Perenco confirmed that DEP interactions with the Waveney gas platform and its associated activities are of potential concern. A helicopter visits Waveney approximately once per month and Perenco requested information about turbine dimensions and locations in order to understand possible implications for helicopter approach to the platform.	An assessment of helicopter access impacts has been undertaken in Chapter 16 Petroleum Industry and Other Marine Users and Appendix 16.2.
MOD	02/07/21 Meeting	The MOD will object to the Projects on application based on affect to the Trimingham ADR.	The effect to the Trimingham ADR is assessed in Section 8.2.
NATS	19/10/21 Consultation Response	NATS confirmed that on conclusion of internal discussions, blanking of the affected PSR together with an extension of the Greater Wash TMZ would mitigate the predicted affect to the Claxby and Cromer PSRs.	Consideration of the Claxby and Cromer PSRs is provided in Chapter 15 Aviation and Radar. Additional mitigations are detailed in Chapter 15 Aviation and Radar.
NATS	16/12/21	NATS is presently objecting based on the impacts to Cromer and Claxby. A two-	Impacts to the Claxby and Cromer PSRs are

Consultee	Date/ Document	Comment	Project Response
		step approach of radar blanking followed by extension to the TMZ, via the CAP 1616 process, was identified by NATS as the preferred mitigation solution. This approach to mitigation was agreed and it was expressed by NATS that the blanking of Claxby and Cromer would be relatively simple from NATS' side.	assessed in Chapter 15 Aviation and Radar.
Norwich Airport	04/02/22 Meeting	Norwich Airport stated that by raising the ATCSMAC, a risk to helicopter icing in certain conditions may arise however raising the ATCSMAC to accommodate the projects may be a possibility. With regard to impact of the Norwich Airport PSR, the airport stated that the current mitigation in place which mitigates the Scroby sands and Sheringham Shoal Wind farms could be utilised to mitigate the projects.	Consideration of the Norwich Airport impacts are discussed within Chapter 15 Aviation and Radar, Section 15.6.2.4.
Norwich Airport	04/02/22	It was noted that stakeholder comments must be taken into account throughout the CAP 1616 engagement and consultation process. The Norwich Airport PSR filters out known wind farm areas at Scroby Sands and Sheringham Shoal and subject to assessment, radar modelling and any reconfiguration of the PSR may provide a mitigation solution to the Norwich Airport PSR system this may take the form of radar	Noted. Stakeholders will continue to be consulted throughout the CAP 1616 process in line with requirements.

Consultee	Date/ Document	Comment	Project Response
		manipulation or the use of technical radar mitigation techniques such as the use of holographic radar. Norwich Airport, however, would be happy to support an extension to the TMZ.	
Norwich Airport	04/02/22	HMR's to the north do cross the proposed extension projects, however, they are not regulated airspace and many operators take a direct route rather than following the HMR.	Noted.
MOD	08/02/22 Meeting	The MOD confirmed the process to be followed for mitigation of the Trimingham ADR which initially will consist of the developer providing a principle for mitigation which will be assessed for suitability by the MOD. Within 750m [of the Weybourne transmitter] any large buildings, shrubs, trees, or soil engineering/soil piling should be avoided. There is a Wide Area Multilateration (WAM) surveillance network employing multiple remote sensors in vicinity of the onshore cable corridor.	Mitigation of the Trimingham ADR is discussed in the Chapter 15 Aviation and Radar. No permanent above ground structures would be placed within this zone, A temporary rig for horizontal drilling will be located outside of the zone and vehicles will use the existing transport route Noted. Information has been supplied to the MOD for evaluation. Discussions are

Consultee	Date/ Document	Comment	Project Response
		Impacts are unlikely if no surface structures are to be installed.	ongoing with the MOD to establish implications to the WAM.
Norwich Helicopter Operators	28/04/22	As far as helicopter pilots are concerned the stated worst-case scenario of the tallest wind turbines is their 'best-case' scenario in terms of access/ avoidance [due to spacing].	Impacts associated with helicopter access to nearby infrastructure are assessed within Chapter 16 Petroleum Industry and Other Marine Users.
Norwich Helicopter Operators	28/04/22	Aircrews would effectively avoid the block of obstruction (the wind farm arrays) by climbing above the tallest height of the obstruction(s) and hence reducing the navigable airspace available.	Impacts on ACTSMAC are assessed within Chapter 15 Aviation and Radar.
Norwich Helicopter Operators	28/04/22	A climb in altitude would be required in order to meet the required obstruction avoidance with the extensions in place and at a blade tip height of 330m, outbound transit flights across the arrays would be at an altitude of 2,100 and 3,100 ft inbound, which may, in certain weather conditions, require flight in IMC and subject the aircraft to icing conditions, which would be unacceptable.	Impacts on ATCSMAC are assessed within Chapter 15 Aviation and Radar.
Norwich Helicopter Operators	28/04/22	A number of routes from Norwich Airport take the aircraft towards and to the north of the extension arrays in support of Oil and Gas/ operational wind farms.	Noted.

Consultee	Date/ Document	Comment	Project Response
Norwich Helicopter Operators	28/04/22	DEP South array has a disproportionately large impact for the given small overlap with NE quadrant. Committing to not putting 330m turbines here would free up access to that whole quadrant and so many of the North Sea routes.	Impacts on ATCSMAC are assessed within Chapter 15 Aviation and Radar.
Norwich Helicopter Operators	28/04/22	A re-route of aircraft would increase the km flown per trip, leading to a reduced aircraft payload, increased fuel costs and would produce a 'bottleneck' for normal routings.	Noted. Impacts on ATCSMAC are assessed within Chapter 15 Aviation and Radar.
Norwich Airport	12/07/22	A change to the Norwich Airport ATCSMAC will require an amendment to the extant Letter of Agreement between Norwich Airport, NATS (Anglia Radar) and Norwich based offshore helicopter operators (CHC, Bristow and NHV), specifically regarding Operational aspects and standard routing altitudes.	Noted.
Norwich Airport	12/07/22	Raising the ATCSMAC as discussed [within the segmented area] will not impact Norwich Airport ATC; the Airport would not object to the suggested amendment however, Norwich Airport could not speak for NATS (Anglia Radar) and the Norwich based helicopter operators.	Noted.
MOD	10/08/22	Reassessment of the new location of the Trimingham ADR has been completed and the majority of both of the proposed Sheringham Shoal and Dudgeon wind	Noted. Impacts to the Trimingham ADR are assessed in Chapter 15

Consultee	Date/ Document	Comment	Project Response
		farms will be line of sight to the ADR when located at Neatishead.	Aviation and Radar.
Section 42 Responses			
NATS	10/05/21 PEIR Response	NATS stated that the operational Sheringham Shoal and Dudgeon Wind Farm array areas are located within the Greater Wash TMZ which was established to mitigate effect to aviation PSR.	An assessment of theoretical radar detectability of wind turbines and how detectability will impact NATS radar systems is provided in Chapter 15 Aviation and Radar
MOD	09/06/21 PEIR Response	Both Projects will be detectable by the Trimingham ADR and will impact the operation of the air defence system. Mitigation will be required.	Impact to the Trimingham ADR is considered in Chapter 15 Aviation and Radar of the EIA.
MOD	09/06/21 PEIR Response	The RAF Coningsby ATC PSR is also predicted to detect the operational wind turbines in both arrays; however, the MOD assessment concludes that there will be no operational impact and therefore, the MOD have no concerns for this radar and mitigation is not required. Additionally, no impact will be created to military danger area or PEXA.	Noted.
MOD	09/06/21 PEIR Response	The MOD will require that the array areas should be fitted with MOD accredited aviation safety lighting in accordance with the ANO. The MOD would need to confirm the	Lighting of the Projects will be in accordance with the ANO and MOD requirements.

Consultee	Date/ Document	Comment	Project Response
		specification of the lighting to be used.	Consideration of the fitment of aviation lighting is provided in Chapter 15 Aviation and Radar of the EIA.
MOD	09/06/21 PEIR Response	Construction activity in the location of the Weybourne transmitter site will need to be compatible with technical safeguarding requirements.	Consideration of the Weybourne Transmitter site is provided Chapter 15 Aviation and Radar of the EIA.
MCA	10/06/21 PEIR Response	The MCA response focused on shipping and navigation elements of the PEIR; however, the MCA will continue to engage with the Applicant from an airborne SAR and navigation safety point of view.	An assessment of low flying aircraft and the creation of an obstruction is presented in Chapter 15 Aviation and Radar of the EIA.
IOG	10/06/21 PEIR Response	IOG as operator of the Blyth offshore platform highlighted that helicopter approaches to the Blyth platform helideck continue in varying weather conditions.	A Helicopter Access Study with a focus on access to nearby oil and gas assets has been undertaken. The results are detailed within Chapter 16 Petroleum Industry and Other Marine Users, and its Appendix, of the EIA.
North Norfolk District Council (NNDC)	10/06/21 PEIR Response	NNDC would defer to the advice of the MCA, MOD, NATS and other experts in respect of matters within this Chapter of the PEIR.	Noted.

Table 6 Consultation Responses

8 Impact Assessment

The following sections provide the assessment of SEP and DEP arrays on radar and aviation activities and infrastructure.

8.1 NATS

8.1.1 About this Receptor

NATS provide an ATS at some airports in the UK and to traffic en-route (overflying or flying between airports) in UK airspace. NATS operates a number of long-range PSRs and SSR positioned to provide maximum coverage of UK airspace. Additionally, NATS has a licence obligation to provide radar data to other aviation stakeholders, to a high quality and performance standard for the benefit of UK aviation as a whole. Any impact that SEP and DEP might have on NATS radars must be considered both in terms of effect on the civilian en-route services and in the context of its remote users.

In addition, Military ATC Units are based within the Swanwick NATS ACC alongside their civilian colleagues, to facilitate the control of aircraft that require ATS outside and crossing CAS. Norwich Airport also receive SSR and PSR data from the Cromer radar facility, NATS has a contracted responsibility to provide appropriate PSR and SSR coverage to support this task.

The CAA, through CAP 764, advises that 10 km radius of an SSR facility should be used as the trigger point for further discussions with the appropriate service provider who can make a more detailed, accurate assessment of the likely effect on their SSR. SEP and DEP are in excess of 10 km from any SSR facility and, therefore, no impact is assessed on SSR.

8.1.2 En-route Operations

NATS En Route Ltd (NERL) uses PSRs based in North Lincolnshire (Claxby) and Norfolk (Cromer) to support its provision of ATS to aircraft operating between the UK and mainland Europe, and to those overflying the UK FIR in the vicinity of SEP and DEP.

NATS Anglia Radar uses the Claxby and Cromer PSRs to support its provision of an Offshore ATS to helicopters supporting the offshore Oil and Gas industry platforms and installations in the vicinity of the SEP and DEP. Mitigation of the NATS PSR assets impacted by SEP and DEP will also mitigate the radar impact to its end users of the data including Anglia Radar.

8.1.3 Sheringham Extension Project Impact on NATS

Wind turbines at a blade tip height of 330 m amsl placed within SEP will be theoretically detectable by the NATS Claxby and NATS Cromer PSRs. The development site is within an area of significance for the provision of en-route ATS by NATS and their end users including services to offshore helicopter operations and military aircraft on exercise in the North Sea. The LOS images for the arrays can be found in Annex A1.

This impact will require mitigation.

Radar	Summary of results
NATS Claxby	Highly Likely, whole array visible
NATS Cromer	Highly Likely, whole array visible

Table 7 NATS Radar LOS Results for SEP

8.1.4 DEP North Impact on NATS

Wind turbines at a blade tip height of 330 m amsl placed within the DEP North array will be theoretically detected by the NATS Claxby and NATS Cromer PSRs. The development site is within an area of significance for the provision of an en-route ATS by NATS and their end users including services to offshore helicopter operations and military aircraft on exercise in the North Sea.

This impact will require mitigation.

DEP North	
NATS Claxby	Highly Likely, whole array visible
NATS Cromer	Highley Likely, whole array visible

Table 8 NATS Radar LOS Results for Dudgeon North

8.1.5 DEP South Impact on NATS

Wind turbines at a blade tip height of 330 m amsl placed within the DEP South array will be theoretically detected by the NATS Claxby and NATS Cromer PSRs. The development site is within an area of significance for the provision of an en-route ATS by NATS and their end users including services to offshore helicopter operations and military aircraft on exercise in the North Sea.

This impact is likely to require mitigation.

DEP South	
NATS Claxby	Highly Likely, whole array visible
NATS Cromer	Highly Likely, whole array visible

Table 9 NATS Radar LOS Results for DEP South

8.1.6 Consultation Response

NATS highlighted that SEP and DEP array areas traverse the area of airspace contained in the extant Greater Wash TMZ which mitigates offshore wind farms including the existing operational Sheringham Shoal and Dudgeon wind farms. The SEP array area is contained in the present TMZ, however, not all of DEP is similarly contained. NATS confirmed a conclusion to internal discussions and that blanking of the affected PSRs together with an extension of the Greater Wash TMZ through a successful application to the CAA through the airspace change process will mitigate the predicted affect to the Claxby and Cromer PSRs.

8.1.7 Assessment of Effect

Theoretically the projects operational wind turbines would all be highly likely to be detectable by the NATS Claxby and Cromer PSRs, and the MOD ADR located at Trimingham. The operation of the projects in isolation or together will have a detrimental effect to these radar systems. Wind turbines detectable by the NATS Cromer and Claxby PSRs will degrade the system by creating false targets, reducing system sensitivity, creating radar shadowing behind the wind turbines and saturating the radar receiver. This 'clutter' would have potential to conceal real aircraft targets leading to a loss of situational awareness by ATC.

Without mitigation the impacts created by the detection of operational wind turbines is predicted to be repetitious, long-term and continuous. It is predicted that the impact will affect the receptor directly and the magnitude of effect is considered to be **medium**.

The ability of NATS to accurately use their PSR systems for the provision of an ATS is likely to be impacted in the presence of wind turbine clutter. All radar receptors aim to ensure 'clutter free' radar to continue to deliver a safe and effective ATS. NATS are considered to be of high vulnerability, low recoverability and high value. The sensitivity of these receptors is therefore considered to be **high**.

The magnitude of effect is deemed to be medium; the sensitivity of the receptors is considered to be high. Without further mitigation, the impact will therefore be of major adverse significance for both SEP and DEP, which is significant in EIA terms.

8.1.8 Mitigation

NATS has previously suggested a preferred mitigation solution for other offshore developments in the SNS which will be applicable for SEP and DEP. If applied this mitigation will remove impacts from both developments on the Claxby and Cromer PSRs. The mitigation will require two stages – blanking of the affected radar systems by NATS; and an application to the UK regulator (the CAA) under an ACP detailed in CAP 1616 to extend the current area of the extant Greater Wash TMZ to envelope the project array areas.

8.1.9 Residual Impacts

Should both projects be constructed the residual impact to all civil and military radar systems is considered to be **minor adverse** which is not significant in EIA terms.

8.2 MOD

8.2.1 Overview

Military air traffic controllers sitting alongside their civilian counterparts at the NATS Swanwick ACC utilise NATS radar for the provision of ATS to en-route aircraft flying outside of CAS above FL 100. Additionally, most military UK aerodromes are equipped with an ATC PSR staffed by military ATCO's; for those that do not and to which the operational task requires it, adjacent military aerodromes may provide radar-based ATC services to aircraft within radar and radio coverage.

The MOD through the Air Surveillance and Control Systems (ASACS) Force is responsible for compiling a Recognised Air Picture (RAP) to monitor the airspace in and around the UK to launch a response to any potential airborne threat. This is achieved through the utilisation of a network of long-range ADR, some of which are located along the east coast of the UK. Any identified effect of wind turbines on the ASACS radars that serve the airspace above SEP and DEP would potentially reduce the capability of the ASACS Force. Additionally, ASACS radar resources are also used in support of MOD training and exercises on an almost daily basis. A network of PEXA are established over the North Sea; within the lateral and vertical confines of the PEXA, air combat training, high energy manoeuvres and supersonic flight can be expected. Due to the vertical limits of these PEXA in the region of

the offshore arrays no physical obstruction effect is predicted. Impact to PEXA is limited to detection of the development wind turbines by those radar systems that provide radar information to the ATCO who is controlling the PEXA activity by radar.

The MOD utilises a single ADR system in the region of SEP and DEP array areas to provide the required low level radar coverage; the Trimingham ADR, situated in North Norfolk has an operational range of approximately 450 km[6].

8.2.2 Sheringham Extension Project Impact on MOD Radars

The array is predicted to be detectable by the RRH Trimingham ADR. The whole array will also be detected by the ATC PSR at RAF Coningsby however the MOD have confirmed in their response to PEIR that the predicted effect to the RAF Coningsby PSR will be operationally managed.

The LoS images for the arrays can be found in Annex A1.

Radar	Summary of results
RAF Marham PSR	No LOS
RRH Trimingham ADR*	Highly Likely, whole array visible

*because of the coastal location and lack of blocking terrain impacts are not expected to change once relocated to Neatishead.

Table 10 MOD Radar LOS Results for SEP

8.2.3 DEP North Impact on MOD Radars

The array is predicted to be detectable by the RRH Trimingham ADR. Intermittent detection of the western edge of the array by the RAF Coningsby PSR cannot be ruled out; however, the MOD have confirmed in their response to PEIR that the predicted effect to the RAF Coningsby PSR will be operationally managed.

The LOS images for the arrays can be found in Annex A1.

DEP North	
RAF Marham PSR	No LOS
RRH Trimingham ADR	Highly Likely, whole array visible

*because of the coastal location and lack of blocking terrain impacts are not expected to change once relocated to Neatishead.

Table 11 MOD Radar LOS Results for DEP North

8.2.4 DEP South Impact on MOD Radars

The array is predicted to be detectable by the RRH Trimingham ADR and occasional detection by RRH Staxton Wold cannot be ruled out. Occasional detection by the PSR at RAF

[6] Radar LOS analysis was also completed between the array areas and the Brizlee Wood ADR results of which indicate that theoretically the Brizlee Wood ADR will not detect wind turbines placed in the array areas at a maximum blade tip height of 330 m amsl.

Coningsby cannot be ruled out however, the MOD have confirmed in their response to PEIR that the predicted effect to the RAF Coningsby PSR will be operationally managed.

The LOS images for the arrays can be found in Annex A1.

DEP South	
RAF Marham	No LOS
RRH Trimingham	Highly Likely, whole array visible

*because of the coastal location and lack of blocking terrain impacts are not expected to change once relocated to Neatishead.

Table 12 MOD Radar LOS Results for DEP South

8.3 Military Air Traffic Management

8.3.1 Radar Systems

Military Air Traffic Management (ATM) is supported by Military radars. These are typically standard airfield ATC radars with an instrumented range of 60 NM. Military ATM is also supported by Military landing aids, Precision Approach Radar (PAR) at certain airfields which aid final approach guidance to the runway; these have a much shorter instrumented range and are safeguarded out to 20 NM in certain directions.

Analysis of the site boundary and preliminary parameters (assuming 330 m wind turbine blade tip height) predicts that wind turbines in the SEP and DEP array areas would not be detectable by any aerodrome based Military landing aids.

The radar LOS to RAF Coningsby PSR is assessed as theoretically highly likely for SEP with occasional detection of the western area of DEP North array however, the MOD has stated that the effect to the RAF Coningsby can be managed without mitigation and therefore RAF Coningsby is not considered further.

The RRH Trimingham ADR will theoretically detect wind turbines at a maximum height of 330 m amsl throughout the SEP and DEP.

8.3.2 Obstruction Lighting

The MOD have requested that the offshore arrays are fitted with MOD accredited aviation safety lighting in accordance with the ANO; the MOD will need to confirm the specification of the lighting however the MOD have published to be used through consultation.

8.3.3 Low Flying

The UK Low Flying System (UKLFS) used for Military Low Flying activity covers the open airspace over the entire UK land mass (excluding specific areas) and surrounding sea areas generally out to 2 NM from the coastline (however, military low flying does take place further offshore), from the surface to 2,000 ft. agl where applicable, or amsl. Wind turbine infrastructure above HAT could pose a physical obstruction to flight operations in the vicinity and specifically to low flying aircraft. Construction and decommissioning infrastructure, substations and erected wind turbines can be difficult to see from the air, particularly in poor meteorological conditions leading to potential increased obstacle collision risk. Furthermore, during the construction and decommissioning phases, the presence and movement of construction/decommissioning infrastructure may present a potential obstacle collision risk to aircraft flight operations

8.3.4 Weybourne Transmitter

The consultation response provided by the MOD stated that the Weybourne landfall site would occupy the eastern extent of the statutory technical safeguarding zone surrounding the RAF Weybourne transmitter site, *'in particular the any development height zone*'. Air-Ground (A/G) communications equipment enables ATC to communicate with aircraft operating in the surrounding area. Communications are critical to flight safety due to ATC reliance upon voice communication for giving instructions and verifying the flight crew confirmation responses. Therefore, technical safeguarding requirements exist to protect communications equipment such as Very High Frequency (VHF) / Ultra High Frequency (UHF) Transmitters. The Weybourne Transmitter site location is approximately 346 m from the onshore cable corridor at its closest point (within safeguarded area).

8.3.5 Mitigation Strategy

ADR

The TPS77 ADR has an inherent resilience, utilising hardware and software, to wind turbine induced clutter through the use of pulse Doppler processing; however, where the inherent radar performance is not considered to be satisfactory for ADR purposes, the TPS77 has an enhanced signal processing capability which enables the implementation of a Non-Automatic Initiation Zone (NAIZ).

A NAIZ prevents the radar from automatically creating tracks from any returns that originate within the NAIZ. In creating an NAIZ around a wind farm, none of the wind turbine returns will be processed, thereby significantly reducing the possibility of unwanted tracks. Tracks which have been formed from returns originating outside the NAIZ (an aircraft transiting through the NAIZ) will still be tracked.

On the 24 August 2018, the MOD released information by email regarding ADR mitigation in which it stated that the receipt and assessment of any technical mitigation reports/submissions reports, relating to the TPS 77 ADRs (as operated at RRH Trimingham) and multi-turbine wind farms will be paused with immediate effect[7]. An update to this statement was provided on the 12 June 2019 in which the MOD stated that it continues to work collaboratively with Government and wind farm developers to "*fully understand and mitigate all risks to our current and future military air surveillance capabilities*". The MOD confirmed that they will *"...continue to work with industry to resolve*

[7] Air Defence Radar (ADR) Mitigation

The MOD has recently conducted a trial looking at the real-life impact of 2 offshore wind farms in the vicinity of the Humber Estuary on the TPS 77 radar that was situated at Remote Radar Head Staxton Wold. The trial determined that the wind farms had a detrimental effect on radar operations, specifically probability of detection and the aviation specification performance. The detrimental effect was not expected and the MOD needs to consider the findings of the trial further. As a result, the MOD must pause the receipt and assessment of any technical mitigation reports/submissions e.g. SERCO reports, relating to the TPS 77 radars and multi-turbine wind farms with immediate effect. Technical mitigation reports relating to single turbine developments will still be received and assessed by MOD.

The MOD is aware of the impact that the pause may have on wind farm projects seeking to provide mitigation for the TPS 77 radars and is working to minimise the duration of the pause. Further upgrades to the radar software are being scoped and it is hoped that this will improve the situation. An informed position to review this situation will likely be established within a 6-month time frame.

With radar performance essential to the Air Defence of the UK and Flight Safety, it is paramount that the MOD takes this pause to ensure safe operations and the continued security to the UK. The MOD will provide an update when further information is known.

the current issues and will, on a case-by-case basis, consider certain developments where impacts on operational capability is deemed to be acceptable". The applicant is in discussion with the MOD in order to reach agreement that any suggested mitigation solution provides a volume of airspace above the proposed development which achieves agreed performance metric when the mitigation is in place; a technical mitigation solution will be agreed with the MOD prior to operation of the proposed development.

Obstruction Lighting

Pilots will be notified of infrastructure and any maintenance activities, and lighting and marking of the wind turbines and offshore substation platforms which will be in accordance with the latest relevant available standard industry guidance and as advised by Trinity House, MCA, CAA and the MOD as appropriate. The magnitude of effect is deemed to be **low**; the sensitivity of the receptors is considered to be **medium**. Therefore, the impact will be of **minor adverse** significance, which is not significant in EIA terms.

Low Flying

In VMC, in which low flying operations are conducted, pilots are ultimately responsible for seeing and avoiding obstructions such as wind turbines and will be aware through notification procedures of the proposed projects and the magnitude of effect is thus deemed to be **low**.

A range of embedded mitigation measures, in the form of appropriate notification to aviation stakeholders of the extent of the array areas, the maximum height of obstructions, the operational period and timings of any maintenance activity, together with the lighting and marking of infrastructure (in accordance with regulations) will minimise effects to aviation flight operations. Receptors will be notified of all phases of the projects. which together with the embedded mitigation measures will enable aviation receptors to continue to operate safely in the airspace surrounding the project array, the sensitivity of the receptors is therefore considered to be **medium**.

The magnitude of effect is deemed to be **low**; the sensitivity of the receptors is considered to be **medium**. Therefore, the impact on fixed wing and rotary aircraft during all phases is considered to be of **minor adverse** significance for both projects, which is not significant in EIA terms.

Weybourne Transmitter

The onshore cable corridor will route via Weybourne to the substation located as close as practicable to the National Grid substation at Norwich Main. The Weybourne landfall site will occupy the eastern extent of the RAF Weybourne Transmitter site which consists of two transmitter aerials (TX 1 and TX 2) located at E609900, N343769. Safeguarding of such sites falls into two processes: Physical Protection and Radio Spectrum Protection. Radio Spectrum Protection may occur when radio signals (from the Transmitter) are degraded by interference from other radio stations whose harmonics conflict with the Transmitter frequency.

Physical Protection safeguarding protects against the possibility that buildings or other structures erected within a defined safeguarded area surrounding the site do not cause interference to the signal radiated by the safeguarded station. CAP 670 Air Traffic Services Safety Requirements [Reference 9] provides the following frame sizes of a VHF/UHF Transmitter sites:

'Ground level safeguarding of circle radius 91 m centred on the base of the main aerial tower (or equivalent structure). Additionally, from an elevation of 9 m on this circle a 2% (1:50) slope out to a radius of 610 m'.

Detailed analysis of the landfall cable corridor has been completed and included within the EIA in order to establish if an impact to the Weybourne Transmitter is predicted. This analysis concluded that only a small portion of the onshore cable search area lies within the confines of the outer safeguarded area of the transmitters.

The safeguarding slope for TX 1 is the most onerous in terms of development restrictions. Satisfying the TX 1 safeguarding requirements would also satisfy the requirements for TX 2. Assessment conclusions indicate that the maximum height of any development within the specified area for TX 1 is 14.1m above the transmitter base datum height, rising in line with the 1:50 safeguarding slope moving eastwards until the slope ends 610m from the TX 1 transmitter base. The magnitude of effect is considered to be **negligible** so long as construction and any permanent above-ground infrastructure remain below the safeguarding requirements.

The sensitivity of ATC and aviation receptors is considered to be **medium** and has moderate to high levels of recoverability. Receptors will be notified of construction activity and the maximum height of construction equipment. The magnitude of effect is deemed to be **negligible**; the sensitivity of the receptors is considered to be **medium**. The impact will therefore be of **minor adverse** significance which is not significant in EIA terms.

8.3.6 Residual Impacts

With all effects predicted to MOD operations, the residual impact to military radar systems, low flying operations and to the Weybourne Transmitter is considered to be minor adverse with embedded or a technical Radar Mitigation Scheme (RMS) in place which is not significant in EIA terms.

8.4 Norwich Airport

8.4.1 Operations at Norwich Airport

Norwich Airport is a regional international airport located 4 km north of the City of Norwich, Norfolk. It operates a number of flights per day to Amsterdam and Aberdeen together with Inclusive Tour flights to holiday destinations. It is also a base for support to the offshore industry with numerous helicopter companies based at the Airport and hosts numerous General Aviation aircraft and flight training establishments.

As well as providing a radar based ATS to aircraft inbound and outbound to the Airport, Norwich also provides radar services to pilots on request of a LARS. The service is available to all aircraft flying outside CAS up to FL 100, within the limits of radar and radio cover. LARS is provided by Norwich Airport to a service radius of 30 NM from the airport within the times of operation.

The closest edge of the combined Extension projects (southern part of SEP is located 45.8 km (24.7 NM) from the Norwich Airport Airfield Reference Point.

8.4.2 Radar Line of Sight Results

Wind turbines at a blade tip height of 330 m amsl inside both SEP and DEP arrays will be theoretically detected by the Norwich Airport PSR[8], analysis cannot rule out occasional detection of operational wind turbines at DEP North.

The LOS images for the arrays can be found in Annex A1.

[8] Norwich Airport is also provided radar data from the NATS operated Cromer PSR, any mitigation solution agreed for the Cromer PSR with NATS will also remove clutter from the radar data provided to Norwich Airport.

Norwich Airport PSR LOS	
SEP	Highly Likely, whole array detectable
DEP North	The western edge of the array is Likely to be detectable
DEP South	Highly Likely, whole array detectable

Table 13 Summary of Norwich Radar LOS Results for all Three Array Areas

8.4.3 Air Traffic Control Surveillance Minimum Altitude Chart

Norwich also raised concerns with regard to the height of the wind turbines and the possibility of a requirement to raise the Norwich Airport ATCSMAC. An Osprey CAA approved Instrument Flight Procedure (IFP) designer has completed an analysis of the ATCSMAC and has confirmed with the maximum blade tip height in place the ATCSMAC minima would be breached resulting in a requirement for the ATCSMAC minima to be raised in the sectors affected. Norwich Airport consultation is progressing to reach a mutually applicable solution.

8.4.4 Mitigation Strategy

Radar

Consultation with the Norwich ATC Safeguarding Team has commenced and will continue to establish an agreed radar mitigation strategy to remove the predicted effect created by the detection of the operational wind turbines by the Norwich Airport PSR. The Norwich PSR and to a certain extent the Indra RDP which is in use at the airport, filter out known wind farms at Scroby Sands & Sheringham Shoal. Further wind farm development will require modelling and if necessary, re-configuration of the Norwich Airport PSR by the radar manufacturer. Consultation with the airport safeguarding team has commenced and will continue to reach agreement on the best mitigation solution to remove the impact created by the projects. The magnitude of effect is deemed to be **medium**; the sensitivity of the receptors is considered to be **high**. Without mitigation, the impact will therefore be of **major adverse** significance, which is significant in EIA terms.

ATCSMAC

The analysis conclusions of the Norwich Airport ATCSMAC Report, which is contained as an Appendix to Chapter 15 Aviation and Radar, provides a mitigation solution of the lowering of the wind turbines to remain below the level of the ATCSMAC however this would not be commercially viable. Alternatively an increase in height of the ATCSMAC minima in the sectors effected by the projects would mitigate effect. Sectorisation of the existing northern ATCSMAC quadrants to minimise impacts to helicopter operations is supported by Norwich Airport. Where significant diversions are required which markedly increase flight times and fuel burn, commercial agreements will be sought where necessary. Assessment is ongoing to quantify the level of impact of diversions in IMC. Consultation with the airport has commenced for an agreement by the airport to increase the level of the ATCSMAC minima and further related work is required by the airport; however, it is expected that agreement will be made with the airport to mitigate the effect to the ATCSMAC. The magnitude of effect is deemed to be **medium;** the sensitivity of the receptors is considered to be **high**. Without mitigation, the impact will therefore be of **major adverse** significance, which is significant in EIA terms

8.4.5 Residual Impacts

The residual impact to the Norwich Airport PSR and ATCSMAC is considered to be **minor adverse** with a technical mitigation scheme, as described above, in place, which is not significant in EIA terms.

8.5 Offshore Helicopter Operations

8.5.1 Overview

The DEP arrays reside in a complex helicopter operations environment. SEP resides in a more benign helicopter environment as it is further away from the platforms associated with the oil and gas fields and outside the CAA recommended 9 NM consultation zones. Figure 4 provides an illustration of the airspace construction, hydrocarbon platforms and the location of the projects.

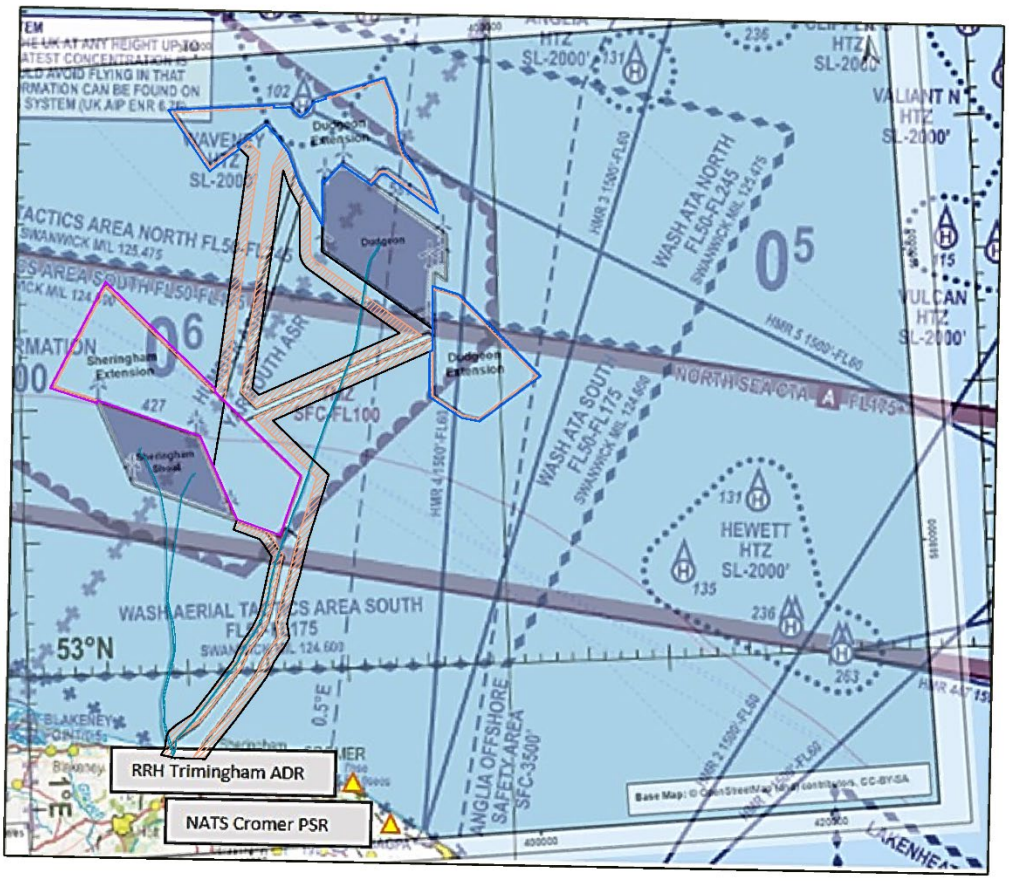

Figure 4 Airspace and Offshore Platforms (Temporary Works Area shown in Orange).

8.5.2 Disruption to aircraft using Helicopter Main Routes

HMR are not religiously flown by crews in the SNS however, the presence of the wind turbines below HMR 4 and 5 is likely to limit the use of these routes when the prevailing weather conditions in which visual avoidance of turbines is not possible requires a higher transit flight altitude to avoid the wind turbines. This higher altitude may place the aircraft into icing conditions which would be unacceptable for those aircraft not equipped with an

anti-icing capability. In inclement cold weather conditions, helicopters without anti-icing may also require to fly at a lower altitude to remain below the icing level (the level at which the air temperature reaches freezing). Due to the infrequent use of HMR, the effect is predicted to be at low frequency when low flying is necessary over SEP and DEP however non anti-icing equipped helicopters would be restricted in overflight of SEP and DEP in conditions which preclude higher altitude of flight above the wind farms therefore the magnitude is considered to be **medium**.

The sensitivity of the receptors relates to its value and its vulnerability to the effect. Helicopters provide an important service to a high value industry (oil and gas) and are also an important component of offshore SAR capability. Offshore helicopter flights would only be vulnerable in low visibility conditions (IMC) when the icing level is <2,000ft. UK SAR helicopters have a full icing clearance (icing protection capability) at an icing level <2,000ft. Helicopters servicing the oil and gas industry may also have a certain level of icing protection. There are alternative routes that can be flown to avoid DEP North array area and DEP South array area, although with the consequence of increased journey times and fuel burn. Although helicopter operations are of high value, due to their ability to avoid the altitude restrictions in the vicinity of DEP North array area and DEP South array area, their vulnerability is considered low and therefore the sensitivity of the receptor is considered to be **low.**

Overall, the sensitivity of the receptor is considered to be **low**, and the magnitude of effect is assessed as **medium**. The impact will therefore be of **minor adverse** significance for DEP in isolation (i.e. not significant in EIA terms) and **no impact** associated with the operation of SEP in isolation.

There are no HMRs that have the potential to be impacted by SEP. Potential impact to HMR operations is restricted to DEP. The impact from the operation of both SEP and DEP will therefore be the same as for DEP in isolation, of **minor adverse** significance, which is not significant in EIA terms.

8.5.3 Mitigation

No additional mitigation above that embedded is proposed.

An assessment of interaction between the projects and the offshore helicopter operations has been completed, conclusions are included within **Chapter 16 Petroleum Industry and Other Marine Users** contained in the EIA.

9 Cumulative Impact Assessment

9.1 Cumulative Impacts

9.1.1 Identification

The first step in the cumulative assessment is the identification of which residual impacts assessed for the projects on their own have the potential for a cumulative impact with other plans, projects and activities. This information is set out in Table 14, together with a consideration of the confidence in the data that is available to inform a detailed assessment and the associated rationale. The impact categories established for assessment within Chapter 15 Aviation and Radar have been used for the purposes of cumulative assessment. Only potential impacts assessed as negligible or above are included in the Cumulative Impact Assessment (CIA) (i.e. those assessed as 'no impact' are not taken forward as there is no potential for them to contribute to a cumulative impact).

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Construction			
Impact 1: Creation of an obstacle to fixed wing and rotary aircraft operating offshore	Yes	High	Multiple wind turbines located closely together will restrict the area for aircraft operation.
Impact 2: Interference to the RAF Weybourne Transmitter	No	High	Any impact from export cable activities would be highly localised.
Operation			
Impact 1: Creation of an obstacle to fixed wing and rotary aircraft operating offshore	Yes	High	Multiple wind turbines located closely together will restrict the area for aircraft operation.
Impact 2: Wind turbines causing interference on civil and military radar systems	Yes	High	Unmitigated multiple radar detectable wind turbines may adversely impact a radar system.
Impact 3: Disruption to aircraft using HMRs	No	High	Any impacts would be highly localised. Potential impacts from DEP only.
Impact 4: Impact to the Norwich Airport ATCSMAC	No	High	The maximum blade tip height of the SEP and DEP wind turbines would breach the Norwich Airport ATCSMAC leading to an impact to aircraft operations.
Decommissioning			

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Impact 1: Creation of an obstacle to fixed wing and rotary aircraft operating offshore	Yes	High	Multiple wind turbines located closely together will restrict the area for aircraft operation.

Table 14 Potential Cumulative Impacts (during screening)

9.1.2 Other Plans, Projects and Activities

The second step in the cumulative assessment is the identification of the other plans, projects and activities that may result in cumulative impacts for inclusion in the CIA (described as 'project screening'). This information is set out in Table 15 together with a consideration of the relevant details of each, including current status (e.g. under construction), planned construction period, closest distance to the projects, status of available data and rationale for including or excluding from the assessment.

The project screening has been informed by the development of a CIA Project List which forms an exhaustive list of plans, projects and activities in a very large study area relevant to the projects. The list has been appraised, based on the confidence in being able to undertake an assessment from the information and data available, enabling individual plans, projects and activities to be screened in or out.

Other projects within 100 km (based on professional opinion on the maximum range where radar cumulative effect may occur) of the projects are considered for the effect of wind turbines causing interference on radar systems; in regard to the creation of an obstacle to fixed wing and rotary aircraft operating offshore. Other projects within 40 km of the projects (based on professional opinion) are considered for the effect of creating an obstacle to fixed and rotary wing aircraft operating offshore.

Project	Status	Construction Period	Closest Distance from the Project (km)*	Confidence in data	Included in the CIA (Y/N)	Rationale
Hornsea Project Three Offshore Wind Farm	Consented	2023 to 2031 (offshore export cable construction. 2026-2027 possible also 2030-2031.	83 (array area)	High	Y	There is potential for overlap in the construction and operational phases of the OWF and SEP and DEP.
Outer Dowsing	Pre-Scoping	Unknown	13 (array area)	High	Y	There is the potential for overlap in the operational phases of the OWF and SEP and DEP.
Hornsea Project Four Offshore Wind Farm	Application submitted	2024 to 2029	52 (array area)	Medium	Y	There is potential for overlap in the construction and operational phases of the OWF and SEP and DEP.
Hornsea Project Two Offshore Wind Farm	In Construction	2020 to 2022 (offshore construction)	52 (array area)	High	Y	There is potential for overlap in the construction and operational phases of the OWF and SEP and DEP.
Norfolk Vanguard Offshore Wind Farm	Consented	2025 – 2027 (offshore construction)	58 (array area)	High	Y	There is potential for overlap in the construction and

Project	Status	Construction Period	Closest Distance from the Project (km)*	Confidence in data	Included in the CIA (Y/N)	Rationale
						operational phases of the OWF and SEP and DEP.
Five Estuaries Offshore Wind Farm	Pre-PEIR	Late 2020s	135 (array area)	Low	Y	There is potential for overlap in the construction and operational phases of the OWF and SEP and DEP.
North Falls Offshore Wind Farm	Pre- PEIR	Late 2020s	128 (array area)	Low	Y	There is potential for overlap in the construction and operational phases of the OWF and SEP and DEP.
East Anglia Three Offshore Wind Farm	Consented	2023-2026	95 (array area)	High	N	There is potential for overlap in the construction and operational phases of the OWF and SEP and DEP.
East Anglia ONE North Offshore Wind Farm	Under determination	2023-2026	98 (array area)	High	Y	There is potential for overlap in the construction and operational phases of the OWF and SEP and DEP.
Norfolk Boreas Offshore Wind Farm	Consented	2025-2029	82 (array area)	High	Y	There is potential for overlap in the construction and operational phases of the OWF and SEP and DEP.

Table 15 Summary of Projects Considered for the CIA

9.1.3 Assessment of Cumulative Effects

Having established the residual impacts from the projects with the potential for a cumulative impact, along with the other relevant plans, projects and activities, the following sections provide an assessment of the level of impact that may arise.

Impact 1. Creation of an obstacle to low flying fixed wing and rotary aircraft operating offshore

There is potential for cumulative effects on fixed wing and rotary aircraft as a result of obstacles created by construction, operation and decommissioning activities associated with the projects and other wind farms. For the purposes of this assessment, this possible cumulative effect has been assessed for projects within 40 km, which is considered to be the maximum range where the creation of a cumulative aviation obstacle to fixed wing and rotary aircraft operating offshore may occur.

As for obstacles associated with the projects, at times of sufficient visibility (VMC) pilots are ultimately responsible for seeing and avoiding obstructions such as wind turbines and other infrastructure and will be aware through notification procedures of the projects. When flying in low visibility (IMC) pilots will be operating above the MSA and utilising on board radar which detects obstructions and may be under the control of ATC with an appropriate level of radar service.

Aviation operations in the UK are highly regulated. The study area is located in airspace where the provision of an ATS is routine. The same rules of the air which maintain a safe operating environment in the current baseline will apply in the other projects in the southern North Sea. Pilots of military low flying aircraft and other low flying operations such as in the support of the oil and gas industry are obliged to plan their flying activities in advance and to be familiar with any en-route obstacles they may encounter and will be notified of all project phases through notification procedures.

The impact is predicted to be of long-term duration, not reversable and continuous for the operational lifetime of the projects. It is predicted that the impact will affect the aviation receptors operating in the airspace directly. Receptors will be notified of all phases of the projects. The ability of aviation receptors to continue to operate safely in the vicinity of the wind farm sites remains as the obstacles are marked, lit and notified; however, in poor weather conditions and at night, some aircraft, dependent upon onboard systems and operator role, will alter tracks and operation to avoid the area. The sensitivity of the receptors is considered to be **medium** and the magnitude **low**, as while a larger area will be affected, in the context of the airspace available there is not a substantial increase of effects from the projects in isolation.

Overall, the sensitivity of the receptors is considered to be **medium** and the magnitude of cumulative effects is deemed to be **low**. The effect will, therefore, be of **minor adverse** significance for all scenarios, which is not significant in EIA terms.

Impact 2. Wind turbines causing interference on civil and military radar systems

The potential for cumulative impact created by the radar detection of the projects exists to those radar systems that will also detect the wind farm developments. Cumulative radar effect is only possible in the operational phase of the projects. For the purposes of this assessment, this additive impact has been assessed within 100 km from the projects, which is considered to be the maximum range where radar cumulative effect may occur.

Theoretical radar LOS analysis indicates that wind turbines with a tip height of 330 m HAT within the wind farm array areas would be theoretically detectable (by varying degrees) by the Claxby, Cromer, Norwich Airport and the Trimingham ADR radar systems. The potential cumulative impact of unmitigated radar systems will be increased radar clutter and

possibly an increase in the individual signal processing demands affected radar systems. The worst-case magnitude of potential cumulative effects is deemed to be medium. However, on the basis that no wind farm will be permitted to operate without the necessary radar mitigation in place in agreement with key aviation stakeholders, it is considered that with radar mitigation in place the projects will not contribute to adverse cumulative impacts on aviation radar. With mitigation in place the magnitude is considered to be **low**.

All radar stakeholders will ensure 'clutter free' radar to continue to deliver a safe and effective ATS to their customers and to monitor UK airspace in a safety critical environment. As described previously, the sensitivity of radar stakeholders is considered to be **high**.

The sensitivity of the receptors considered is **high** and the worst-case magnitude of potential cumulative effects is deemed to be **medium** without mitigation in place. The impact for all of the receptors considered would therefore, in the absence of mitigation, have the potential for major adverse cumulative impacts on radar receptors. However, as mitigation will be required for those radar systems which are affected by other projects, no radar cumulative effect will be apparent and therefore with mitigation in place the effect will be **minor adverse** for all scenarios due to the requirement for a technical solution to mitigate radar effect.

10 Transboundary Impact Assessment

This section considers transboundary effects created by the developments.

10.1 Transboundary Considerations

SEP and DEP are contained wholly in the UK Flight Information Region[9] (FIR) and therefore there are no transboundary considerations.

[9] A specified region of airspace in which a flight information service and an alerting service are provided. All airspace around the world is divided into Flight Information Regions (FIRs). Each FIR is managed by a controlling authority that has responsibility for ensuring that air traffic services are provided to the aircraft flying within it.

11 Conclusions

11.1 Summary of Assessment

SEP and DEP were assessed against their potential interactions with the following aviation stakeholders/receptors:

- NATS En-route PSR's;
- The MOD;
- Norwich Airport; and
- Offshore helicopter operations in the vicinity of SEP and DEP (an assessment of oil and gas access is provided in EIA Chapter 16 Petroleum Industry and Other Marine Users).

11.2 NATS Impact Assessment Conclusions

1.1 NATS Conclusions

The NATS Claxby PSR, which is located in North Lincolnshire and the Cromer PSR located on the north Norfolk coast provide radar coverage in the airspace above and surrounding SEP and DEP array areas which enables the provision of radar based ATS to those aircraft operating within and overflying the London FIR. Radar detectability of operational wind turbines will create a detrimental effect to operations utilising the subject radar systems. For previous developments in the North Sea (including Sheringham and Dudgeon Wind Farms), NATS preferred mitigation solution to address the impact offshore wind farms would create on NATS radar systems has previously comprised of blanking of the affected radar systems, together with a proposal to change airspace (through an ACP) above the array area.

If this is the agreed solution, it would be implemented in two stages. The first stage will require an application to the UK regulator (the CAA) under an ACP detailed in CAP 1616 Airspace Design: Guidance on the regulatory process for changing airspace design including community engagement requirements [Reference 10]. Secondly on approval of the ACP, radar blanking of the NATS Claxby and Cromer PSRs will remove all wind turbine induced radar returns. The Applicant will continue to consult with NATS and the CAA to reach a suitable mitigation solution.

11.3 MOD Impact Assessment

Unacceptable impact is predicted to the Trimingham ADR created by both project Extensions. Impact is also expected, based on current parameters, to the Export Cable Corridor (ECC) landfall site at Weybourne to MOD supporting infrastructure. Creation of an obstruction is likely to effect military low flying; however, military low flying operations continue safely in the presence of the operational Sheringham Shoal and Dudgeon OWFs through the use of notification and lighting of these developments which will be applied to the Extension projects.

The applicant is in discussion with the MOD in order to reach agreement that any suggested mitigation solution for the Trimingham ADR provides a volume of airspace above the proposed development which achieves agreed performance metric when the mitigation is in place; a technical mitigation solution will be agreed with the MOD prior to operation of the proposed development.

The MOD have responded to the potential effect created during ECC construction and have provided a maximum height above the ground, which to prevent interference to the transmitters, should not be breached by construction infrastructure – this will be adhered to by the Applicant.

11.4 Norwich Airport Impact Assessment

SEP and the DEP South array are theoretically highly likely to be detectable by the Norwich Airport PSR; intermittent detection of the western area of the DEP North array cannot be ruled out. The location of the wind turbines would result in clutter close to the routes used by aircraft en-route to support offshore operations and is likely to lead to a reduction in radar sensitivity. The Norwich PSR and to a certain extent the Indra RDP, which is in use at the airport, filter out known wind farms at Scroby Sands & Sheringham Shoal. Further wind farm development will require modelling and if necessary, re-configuration of the Norwich Airport PSR by the radar manufacturer. Engagement with the airport safeguarding team has commenced and will continue to reach agreement on the best mitigation solution to remove the impact created by the projects.

An increase in height of the ATCSMAC minima in the sectors effected by the projects would mitigate effect. Sectorisation of the existing northern ATCSMAC quadrants to minimise impacts to helicopter operations is supported by Norwich Airport. Where significant diversions are required which markedly increase flight times and fuel burn, commercial agreements will be sought where necessary. Assessment is ongoing to quantify the level of impact of diversions in IMC.

11.5 Offshore Helicopter Operations

Offshore helicopter operations can be completed in VMC (weather conditions where pilots can see and avoid obstructions) or IMC conditions (where the icing level permits it) within the Class G airspace surrounding the extended arrays. Consultation with the helicopter operators will continue in order to reach a mutually acceptable mitigation solution.

12 References

Reference	Name	Origin
1	EN-1 Overarching NPS for Energy July 2011	DECC
2	EN-3 National Policy Statement for Renewable Energy Infrastructure July 2011	DECC
3	EN-5 National Policy Statement for Electricity Networks July 2011	DECC
4	Draft referenced NPS Available online https://www.gov.uk/government/consultations/planning-for-new-energy-infrastructure-review-of-energy-national-policy-statements Accessed 14 February 2022	BEIS
5	CAP 168 Licensing of Aerodromes March 2019	CAA
6	CAP 393 – The Air Navigation Order January 2021	CAA
7	CAP 764 - CAA Policy and Guidance on Wind Turbines February 2016	CAA
8	CAP 437 – Standards for Offshore Helicopter Operations July 2021	CAA
9	CAP 670 Air Traffic Services Safety Requirements June 2019	CAA
10	fr - Airspace change: Guidance on the regulatory process for changing the notified airspace design and planned and permanent redistribution of air traffic, and on providing airspace information March 2021	CAA
11	MOD Obstruction Lighting Guidance January 2020	MOD

Reference	Name	Origin
12	CAP 032 - UK Integrated Aeronautical Information Package AIRAC 01/2022	NATS
13	Military Aeronautical Information Publication AIRAC 01/2022	MOD
14	MCA Marine Guidance Note (MGN) 654 Safety of Navigation Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response April 2021	MCA
15	1:500k VFR Chart March 2021	NATS
16	Procedures for Air Navigation Services Aircraft Operations Volume 1 Flight Procedures November 2006	ICAO

Table 16 Table of References

13 LOS Results Images

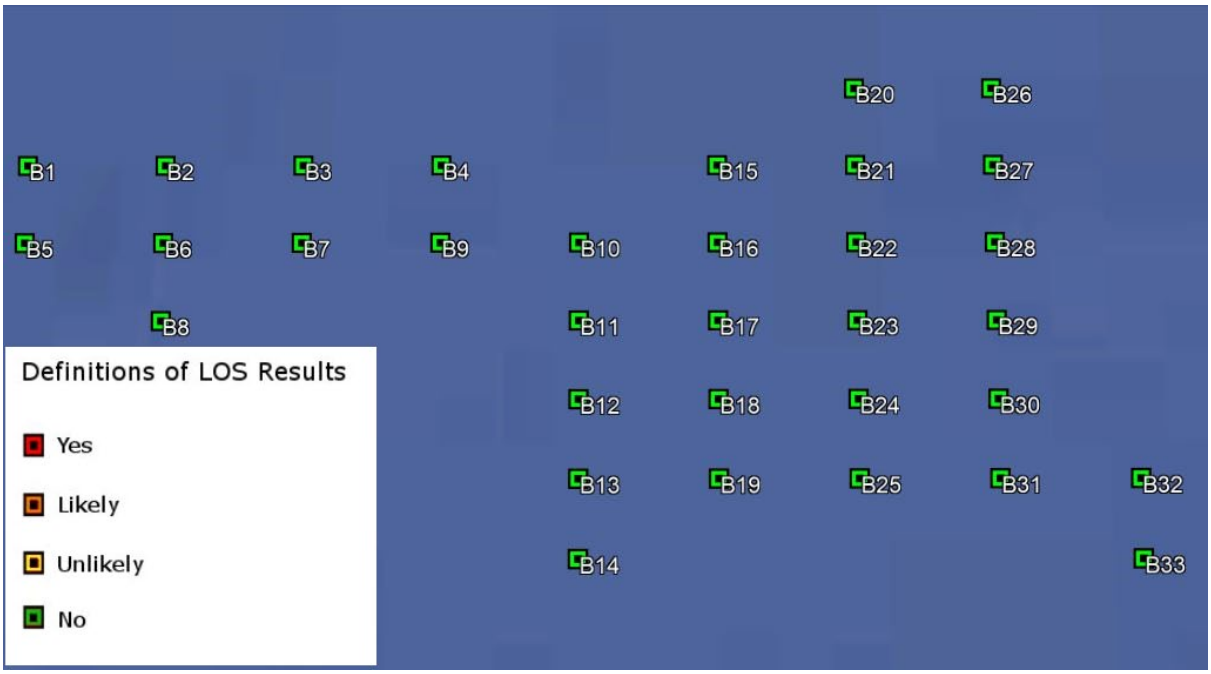

Figure 5 ADR RRH Brizlee Wood to DEP North

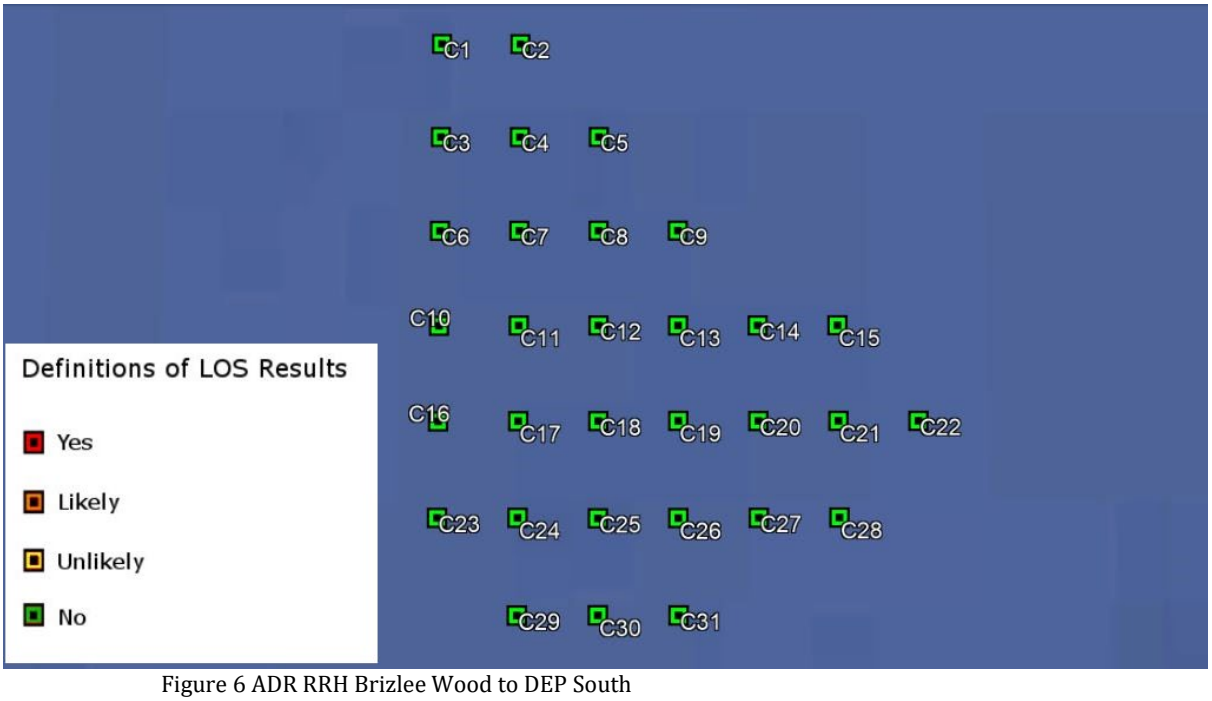

Figure 6 ADR RRH Brizlee Wood to DEP South

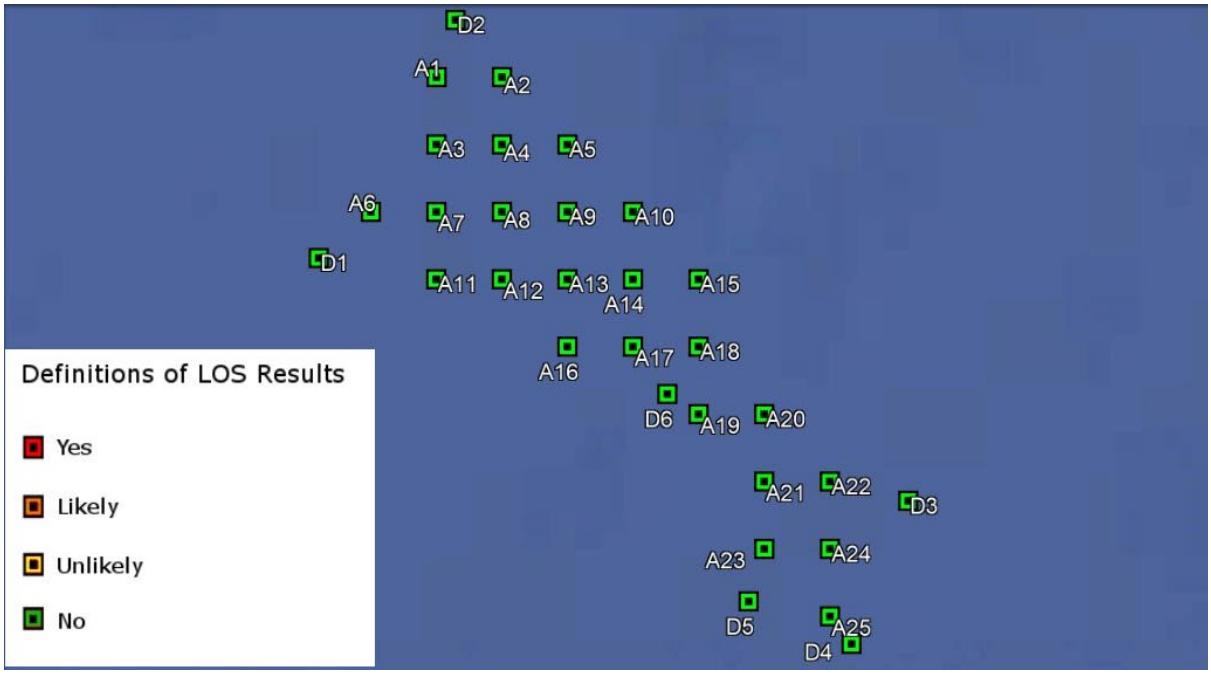

Figure 7 ADR RRH Brizlee Wood to SEP

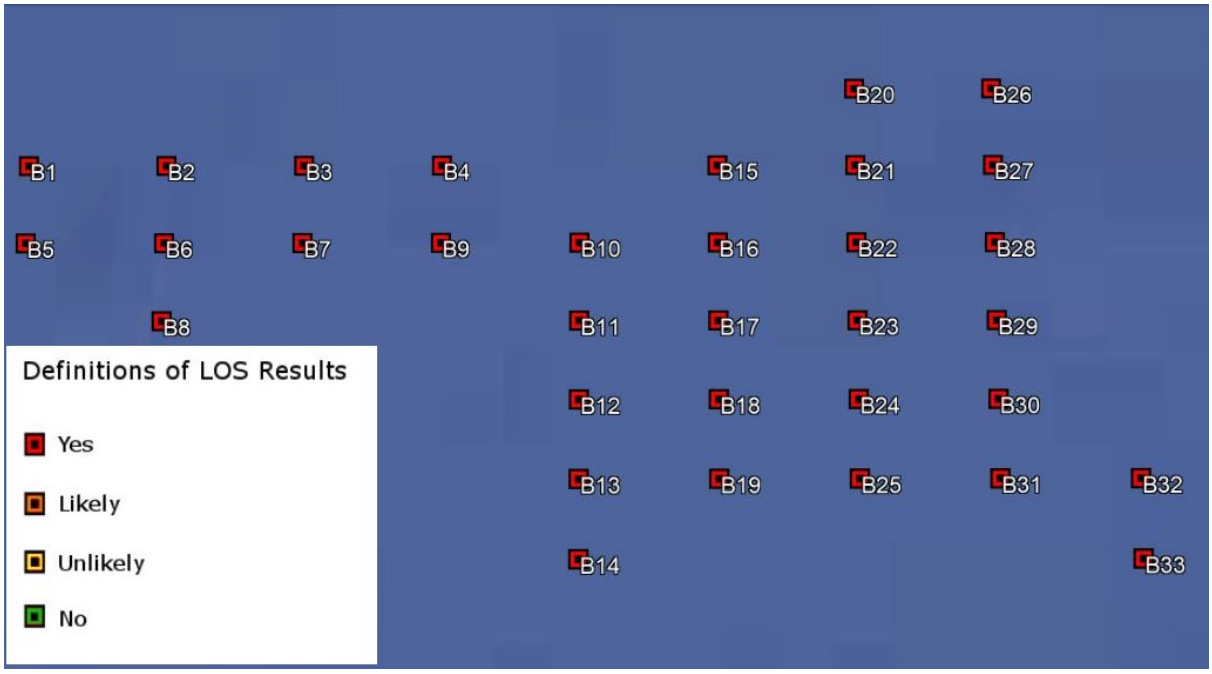

Figure 8 NATS Claxby to DEP North

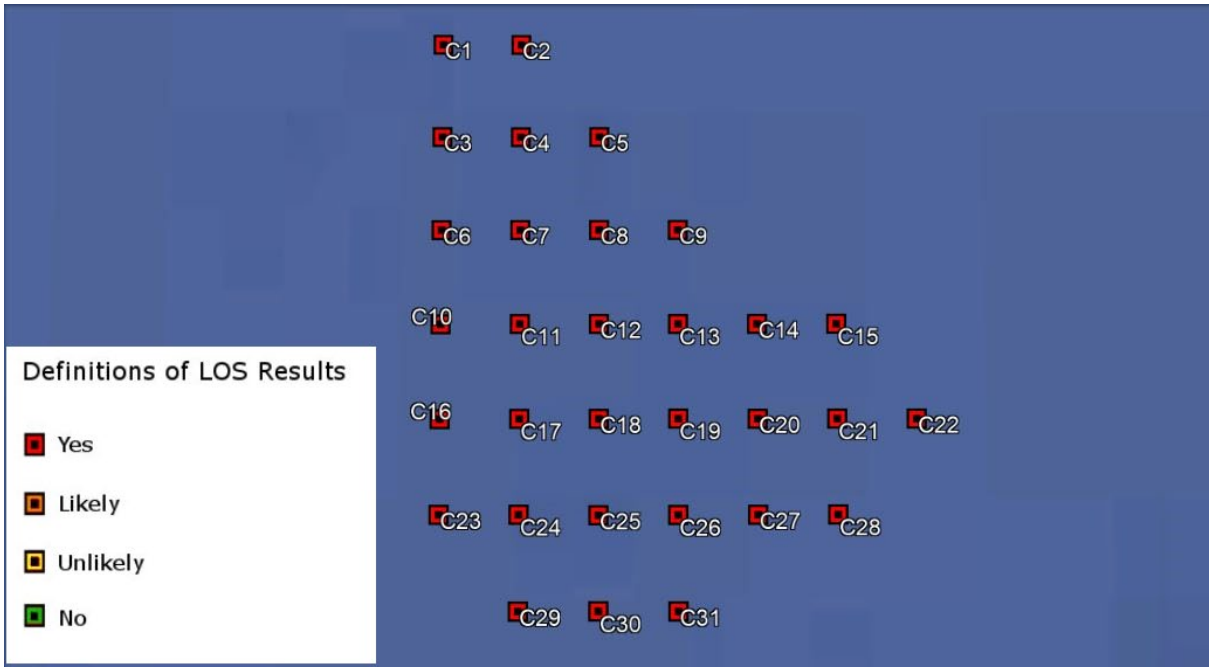

Figure 9 NATS Claxby to DEP South

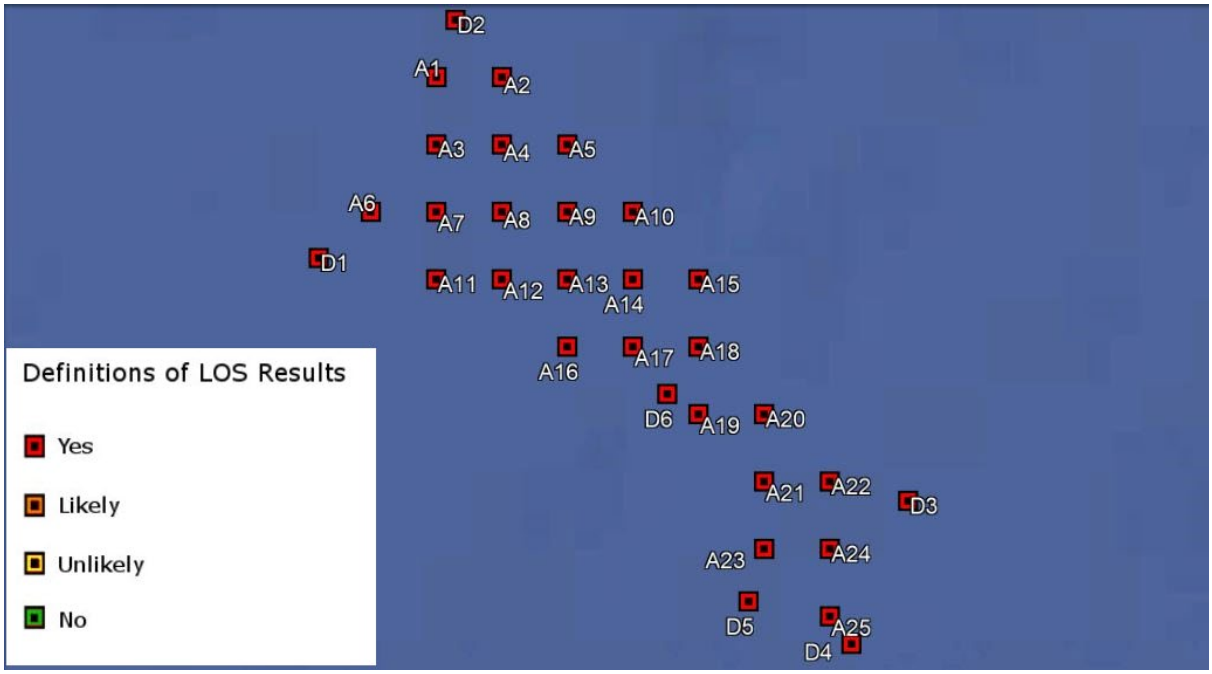

Figure 10 NATS Claxby to SEP

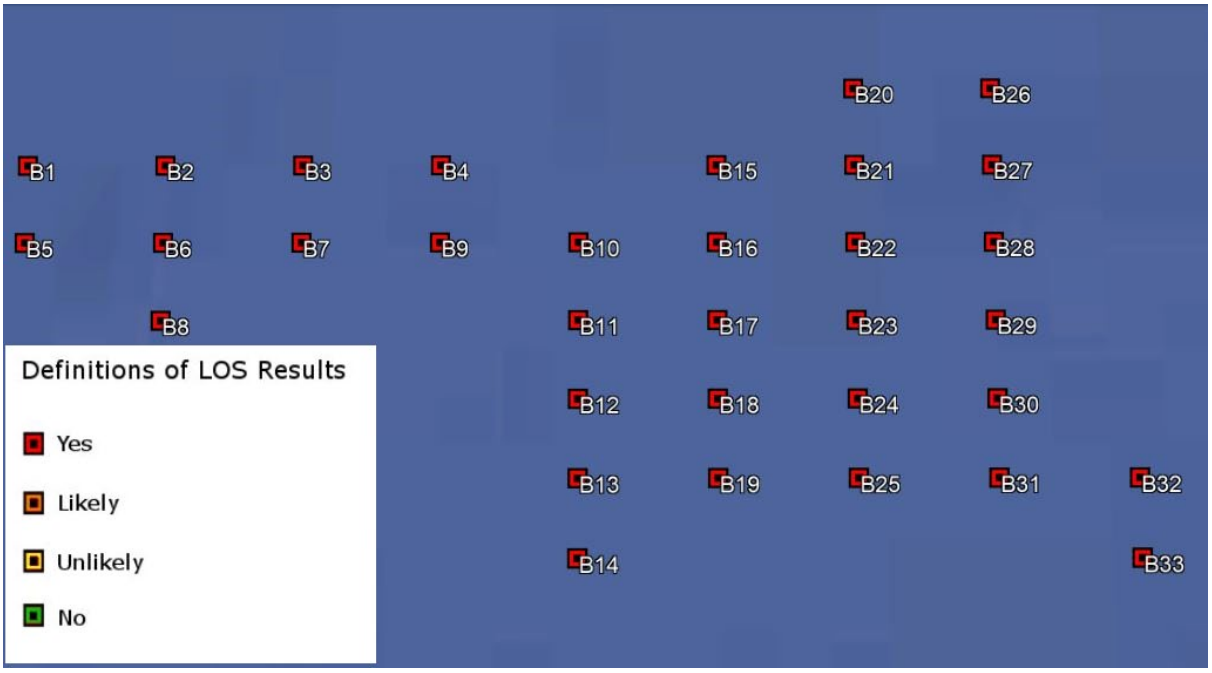

Figure 11 NATS Cromer to DEP North

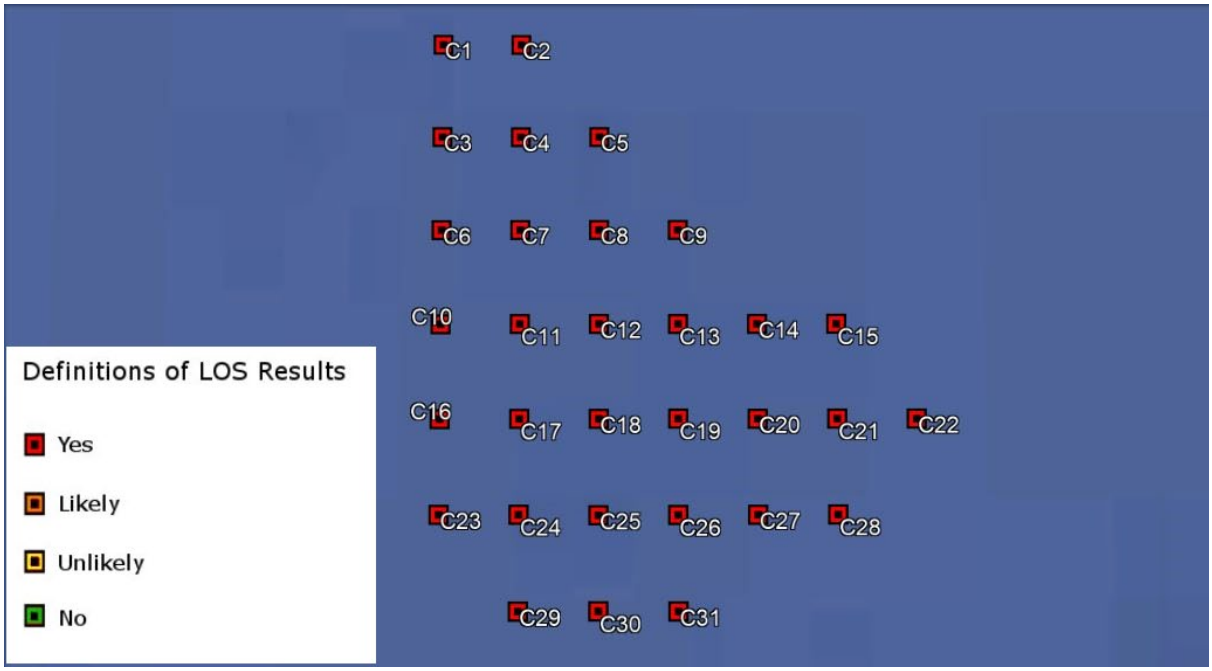

Figure 12 NATS Cromer to DEP South

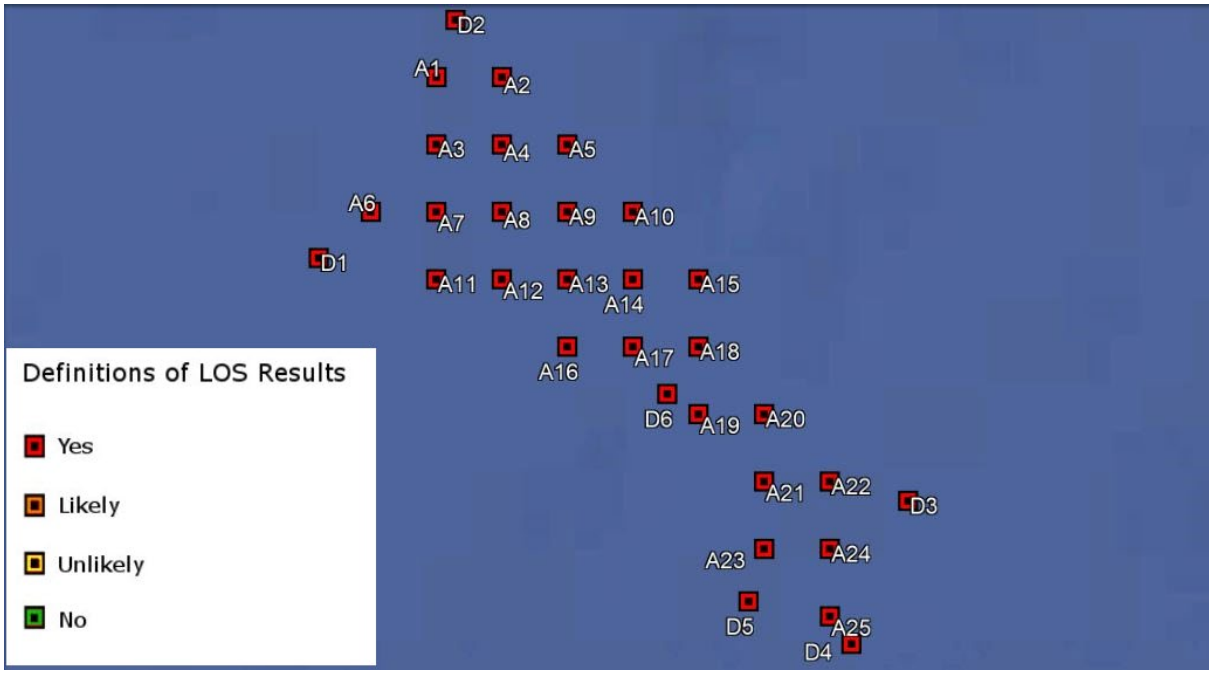

Figure 13 NATS Cromer to SEP

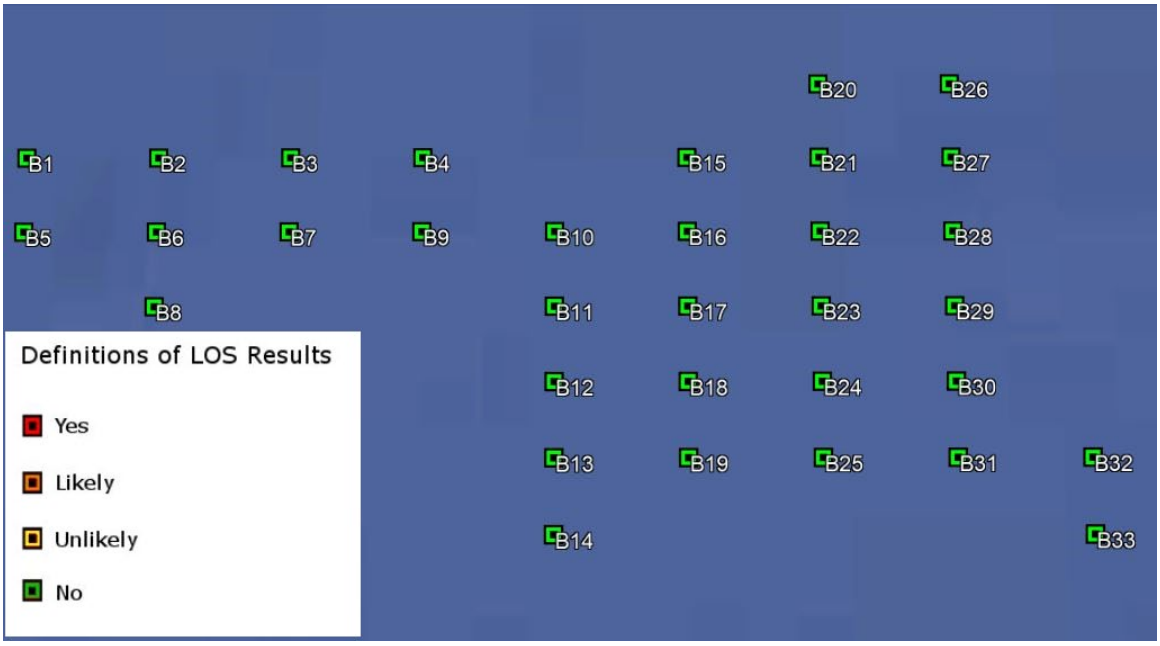

Figure 14 RAF Marham to DEP North

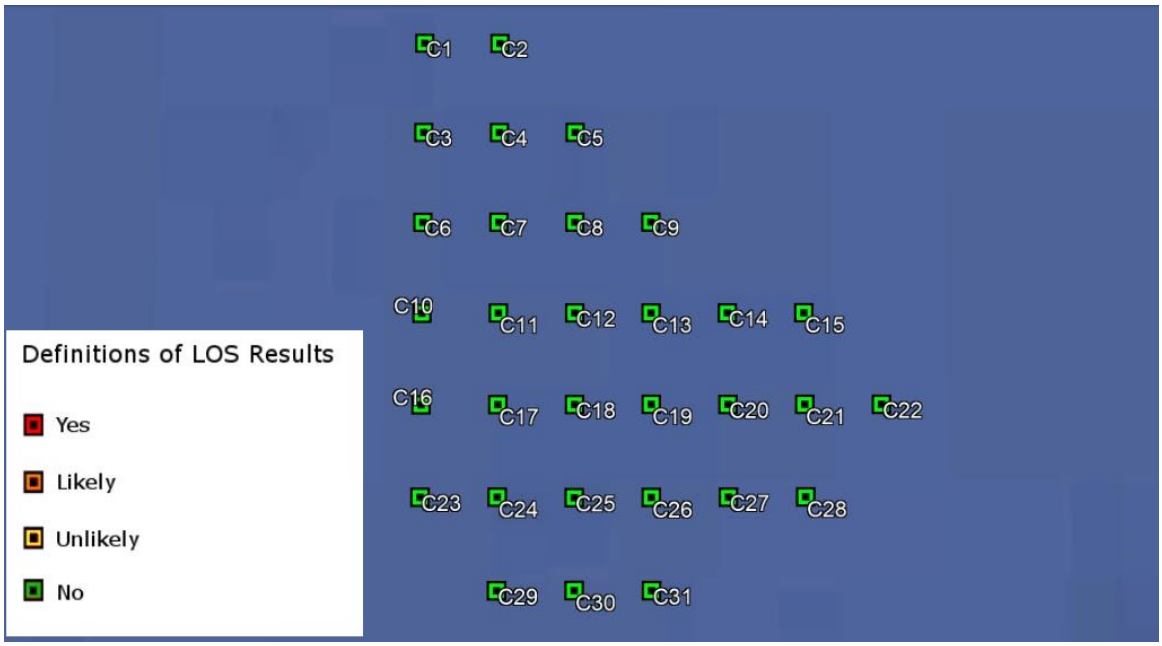

Figure 15 RAF Marham to DEP South

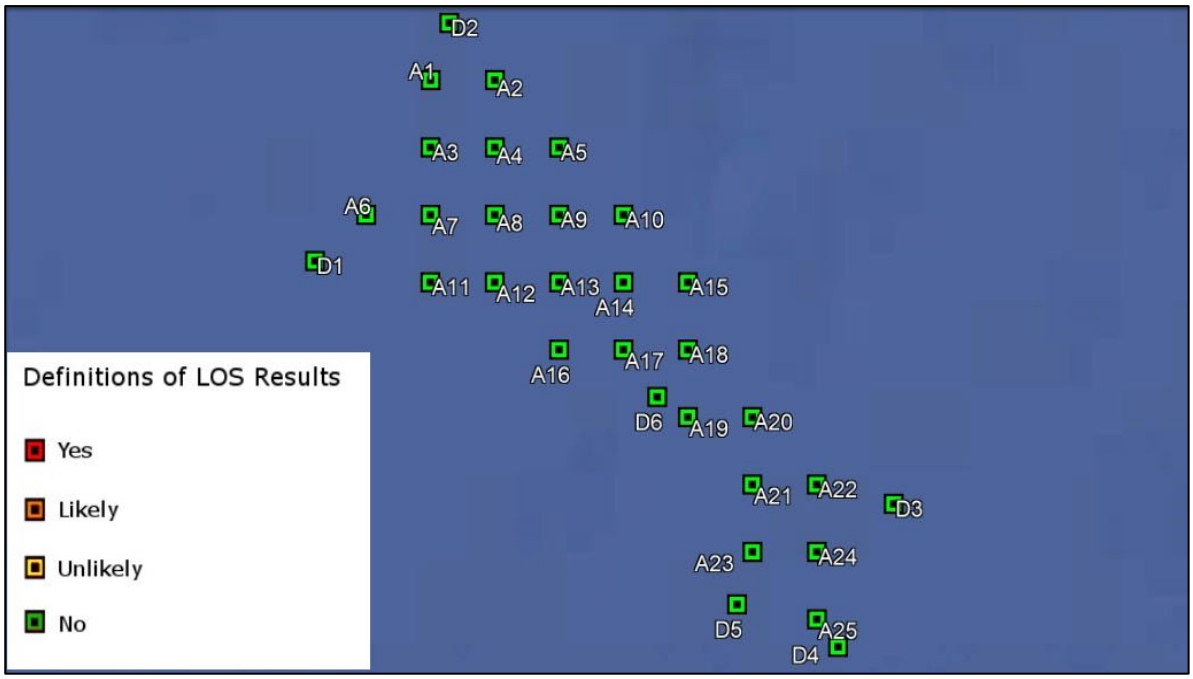

Figure 16 RAF Marham to SEP

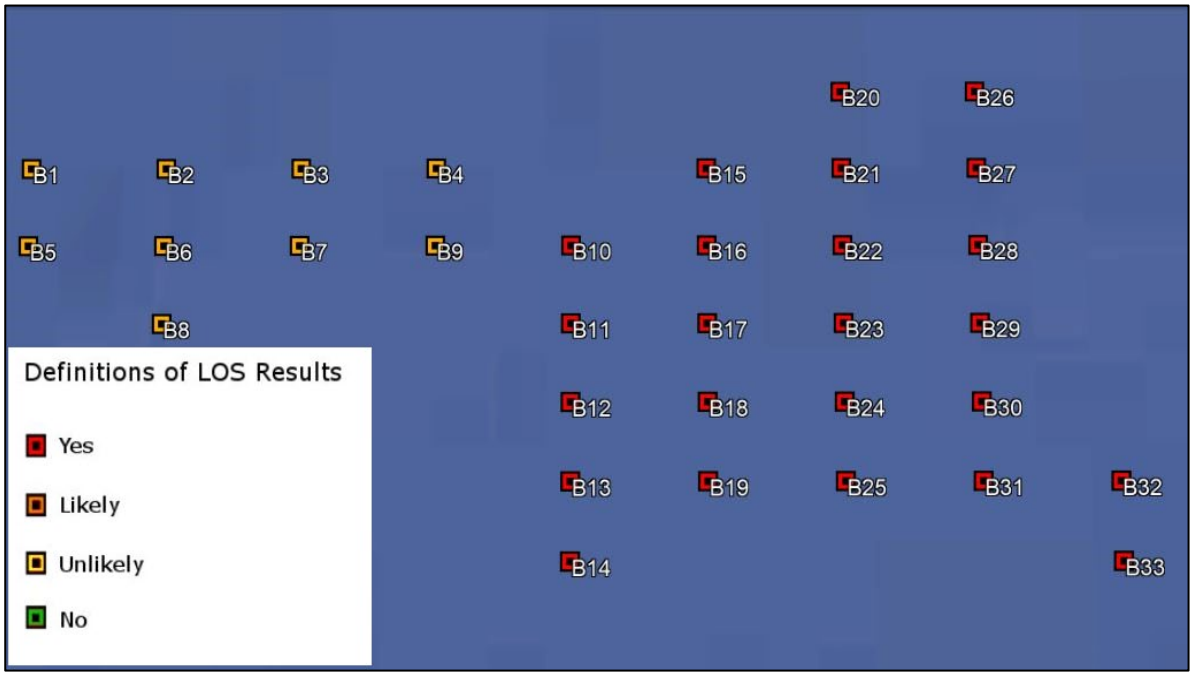

Figure 17 Norwich Airport to DEP North

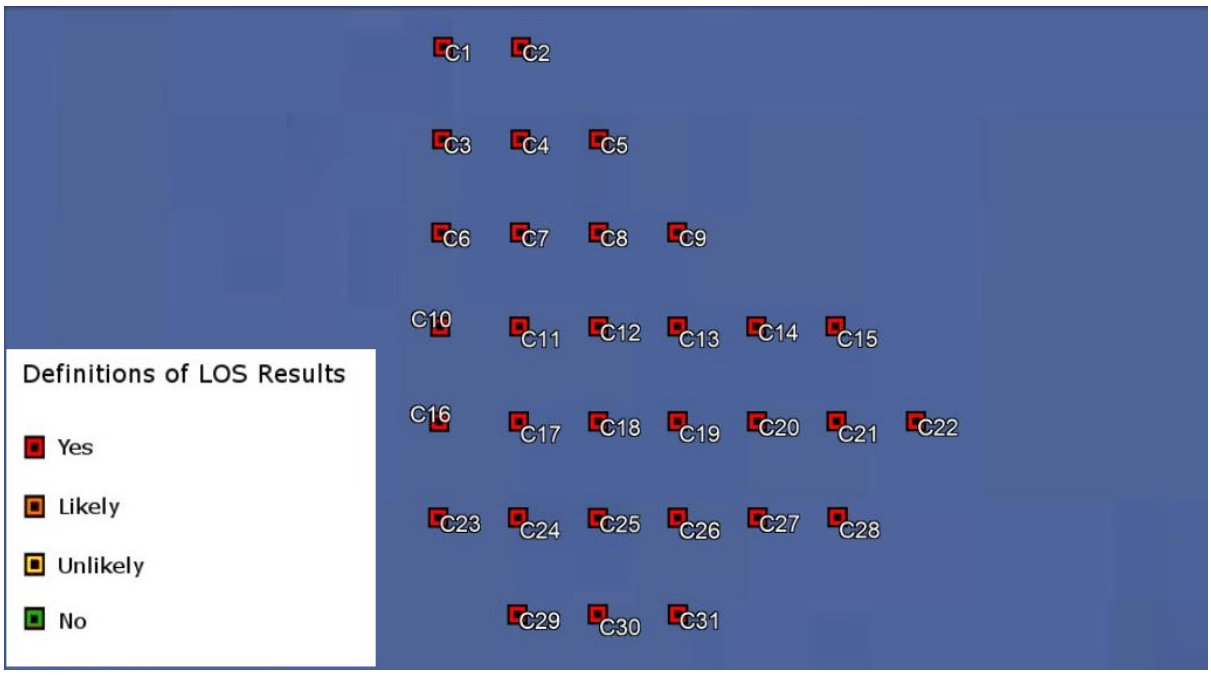

Figure 18 Norwich Airport to DEP South

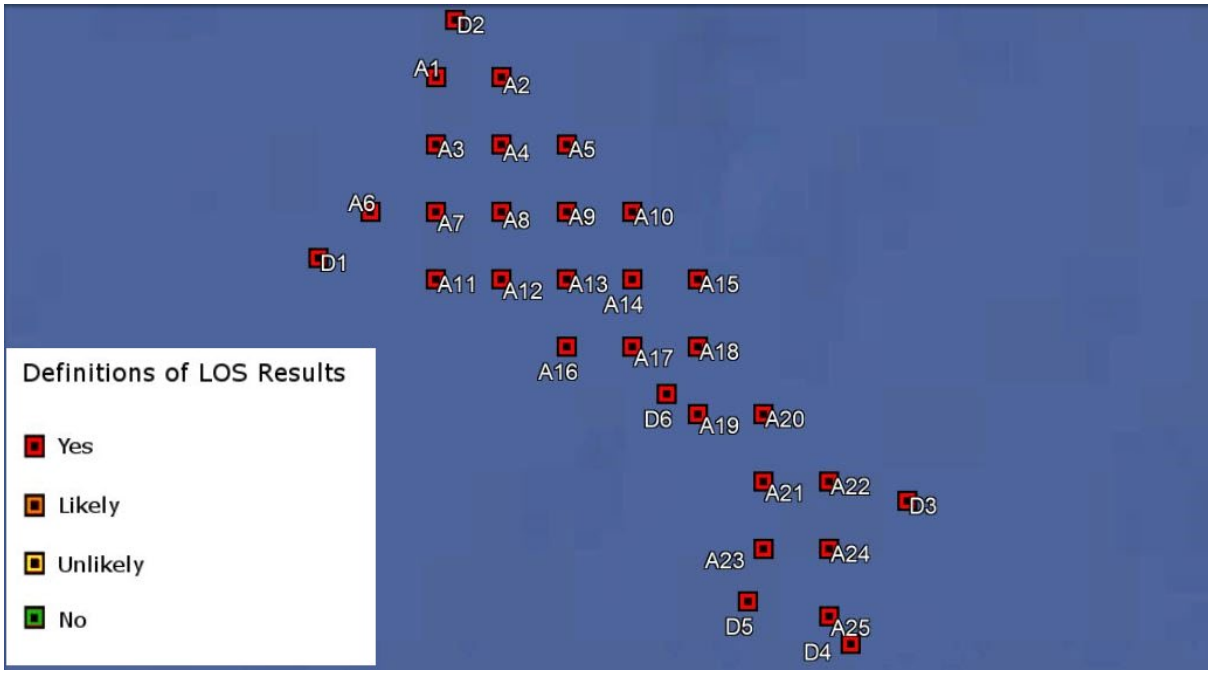

Figure 19 Norwich Airport to SEP

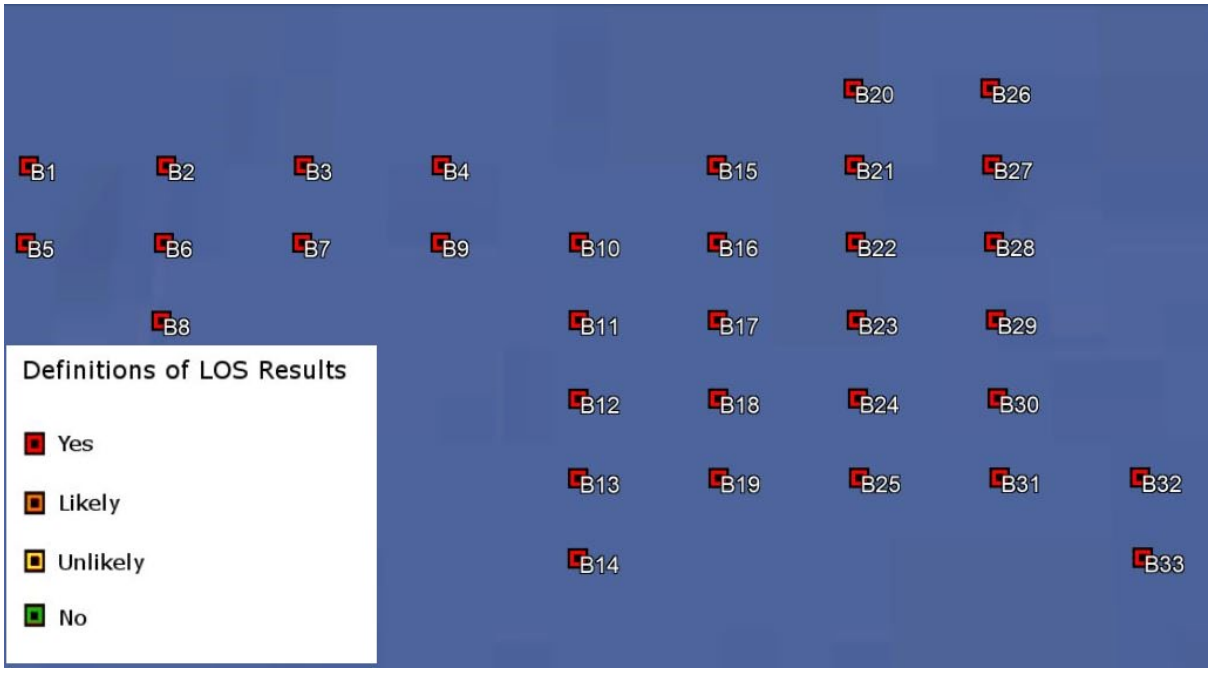

Figure 20 RAF Trimingham to DEP North

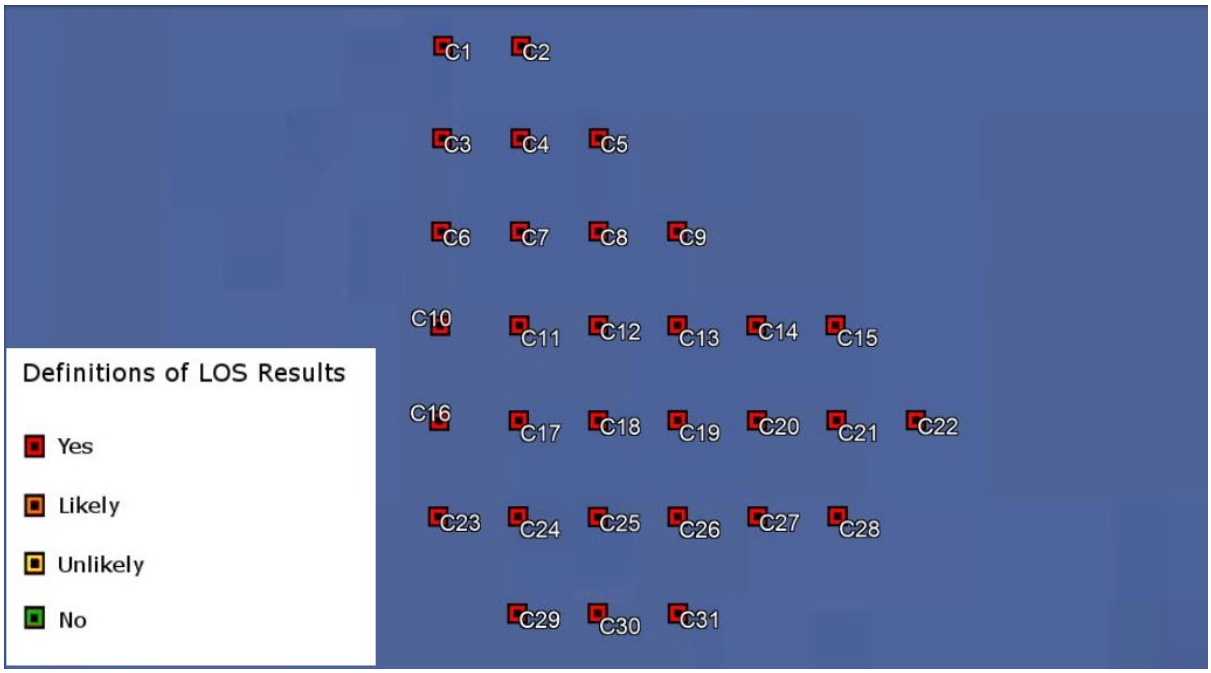

Figure 21 RAF Trimingham to DEP South

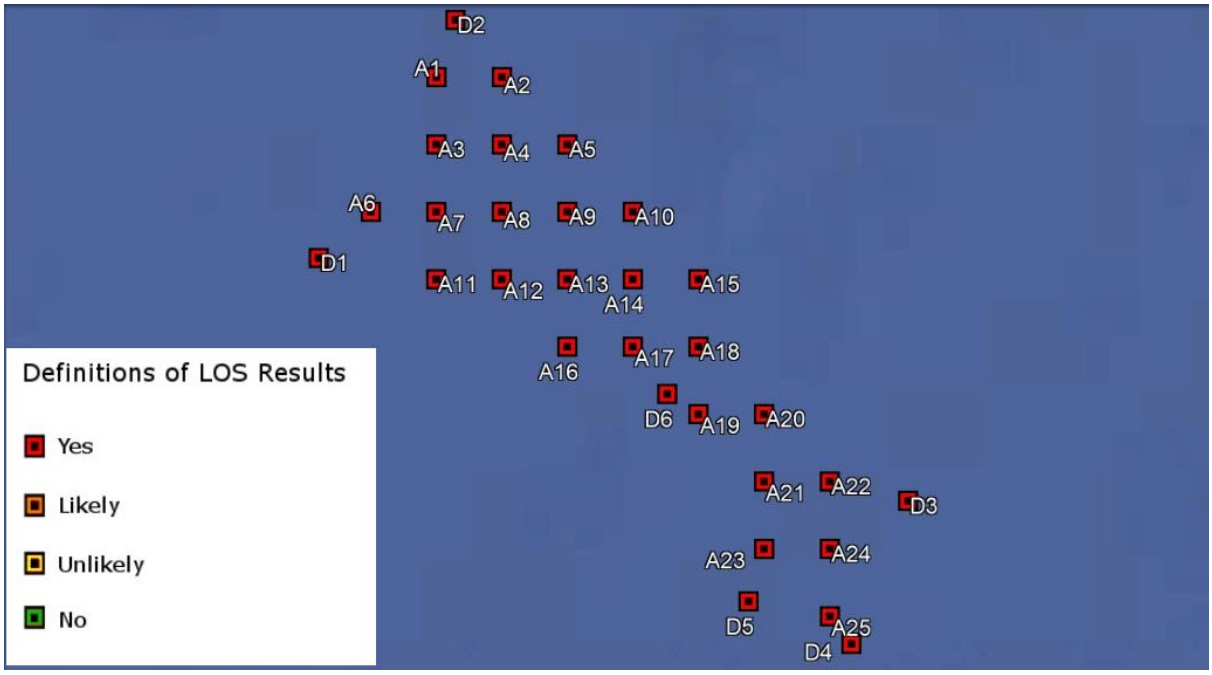

Figure 22 RAF Trimingham to SEP