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Glossary

Air Defence Radar (ADR)	A series of fixed air defence radars feed data into a central Control and Reporting Centre (CRC) providing surveillance information for air defence controllers.
Civil Aviation Authority (CAA)	The statutory regulatory body which oversees and regulates all aspects of civil aviation in the United Kingdom (UK).
Civil Aviation Publication (CAP)	A series of documents published by the CAA containing aviation policy and guidance.
Defence Infrastructure Organisation (DIO)	Responsible for MOD Safeguarding (see below)
Control and Reporting Centre (CRC)	A location where ADR is used to police airspace, scrambling fighter jets where necessary to intercept and identify any aircraft that are deemed to be suspicious.
Helicopter Main Route (HMR)	A route where civilian helicopters operate on a regular and frequent basis.
Military Aeronautical Information Publication	A document which provides comprehensive information on general and en-route procedures together with information on UK military aerodromes.
Primary Surveillance Radar (PSR)	A radar system used in Air Traffic Control (ATC) that detects objects by means of reflected radio signals.
Safeguarding	Safeguarding ensures operational facilities such as aerodromes, explosive stores, radar facilities and range areas are not compromised by either onshore or offshore development.
Safeguarding (MOD)	Wind turbines can adversely affect a number of MOD operations including radars, seismological recording equipment, communications facilities, naval operations and low flying. These effects are not limited to specific geographical areas. MOD Safeguarding is undertaken by the DIO and is the formal consultation process through which MOD is engaged on development proposals, including those for wind energy developments. https://www.gov.uk/government/publications/wind-farms-ministry-of-defence-safeguarding/wind-farms-mod-safeguarding
Secondary Surveillance Radar (SSR)	A radar system used in ATC that detects aircraft position through communication with an on-board radar transponder. It also requests additional information from the aircraft such as identity and altitude
Temporary Reserved Area (TRA)	Airspace of defined dimensions allocated for a specific user during a determined period of time.

UK Integrated
Aeronautical
Information Package
(UK IAIP)

A publication, updated every 28 days, which contains information of lasting (permanent) character essential to air navigation.

Abbreviations and Acronyms

ACC	Area Control Centre
AOC	Aircraft Operator Certificate
ADR	Air Defence Radar
agl	above ground level
AIP	Aeronautical Information Publication
AIRAC	Aeronautical Information Regulation and Control
AIS	Aeronautical Information Service
ALARP	As low as reasonably practicable
amsl	Above Mean Sea Level
ANSP	Air Navigation Service Provider
ASACS	Air Surveillance and Control Systems
ATC	Air Traffic Control
ATS	Air Traffic Service
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAS	Controlled Airspace
CIA	Cumulative Impact Assessment
CRC	Control and Reporting Centre
DGC	Defence Geographic Centre
DIO	Defence Infrastructure Organisation
DOC	Declared Operational Coverage
DS	Deconfliction Service
DSLPL	Development and Specification Layout Plan

EIA	Environmental Impact Assessment
ERCoP	Emergency Response Co-operation Plan
ES	Environmental Statement
FIR	Flight Information Region
FL	Flight Level
ft	Feet
GAAC	General Aviation Awareness Council
GPS	Global Positioning System
HAT	Highest Astronomical Tide
HMR	Helicopter Main Route
IAIP	Integrated Aeronautical Information Package
ICAO	International Civil Aviation Organisation
ICOL	Inch Cape Offshore Limited
IFP	Instrument Flight Procedure
km	Kilometre
LARS	Lower Airspace Radar Service
LAT	Lowest Astronomical Tide
LOS	Line of Sight
m	Metre
MAA	Military Aviation Authority
MADS	Manual of Aerodrome Design and Safeguarding
MCA	Maritime and Coastguard Agency
MGN	Maritime Guidance Note
Mil AIP	Military Aeronautical Information Publication

MOD	Ministry of Defence
MORL	Moray Offshore Renewables Limited
MRCC	Maritime Rescue Co-ordination Centre
MS-LOT	Marine Scotland Licensing Operations Team
NAIZ	Non-Automatic Initiation Zone
NATS	National Air Traffic Control Services
NM	Nautical Mile
NnG	Neart na Gaoithe
NOTAM	Notice to Airmen
O&M	Operation and Maintenance
OfTW	Offshore Transmission Works
OREI	Offshore Renewable Energy Installation
OSP	Offshore Substation Platform
PAR	Precision Approach Radar
PSR	Primary Surveillance Radar
RAF	Royal Air Force
RAG	Range Azimuth Gating
RAP	Recognised Air Picture
RCS	Radar Cross Section
RDDS	Radar Data Display System
RDP	Radar Data Processor
RRH	Remote Radar Head
SAR	Search and Rescue
SSR	Secondary Surveillance Radar

SLVIA	Seascape, Landscape and Visual Impact Assessment
TMZ	Transponder Mandatory Zone
TRA	Temporary Reserved Area
U	Upper
UIR	Upper Information Region
UK	United Kingdom
UK IAIP	UK Integrated Aeronautical Information Package
UKHO	United Kingdom Hydrographic Office
UKLFS	United Kingdom Low Flying System
VFR	Visual Flight Rules
WTG	Wind Turbine Generator

17 Aviation

17.1 Introduction

- 1 This chapter presents the assessment of potential impacts on aviation interests predicted to arise from the Inch Cape Wind Farm and associated Offshore Transmission Works (OfTW).
- 2 It describes the existing environment and presents the results of desk top studies and consultations with key stakeholders, followed by an assessment on the impacts resulting from the operation phase (for the purposes of this assessment please see the definition below) of the Development regarding aviation infrastructure and operations within and around the Wind Farm. Details of any required mitigation are also presented.
- 3 The following appendices and chapters, as well as the *introductory chapters (1-8)* should be read in conjunction with this chapter:
 - *Appendix 17A: Aviation and Lighting Requirements*; and
 - *Chapter 12: Seascape, Landscape and Visual Impact Assessment (SLVIA)*

17.2 Potential Impacts

- 4 The potential impacts of wind farms on aviation fall into two scenarios:
 - Physical obstruction: infrastructure can present a physical obstruction at, or close to, an aerodrome, flight path or other landing/take off point; and
 - Radar/air traffic services: clutter resulting from infrastructure, appearing on a radar display, can affect the safe provision of air traffic services as it can mask unidentified aircraft from air traffic controllers and/or prevent accurate identification of aircraft under their control. In some cases, radar reflections from Wind Turbine Generators (WTG) can affect the detection performance of the radar system itself.
- 5 The worst-case design scenario used for the impacts assessment on aviation radar services assumes that the entirety of the Development Area will be populated with WTG at the maximum blade tip height being considered (291 metres (m)) (955 feet (ft)) above Lowest Astronomical Tide (LAT).
- 6 As elements of the OfTW are below sea level and Offshore Substation Platforms (OSPs) are below the height of the WTGs, the OfTW will not have an impact on aviation interests and therefore has been scoped out of this chapter. However, the Ministry of Defence (MOD) Defence Infrastructure Organisation (DIO) may request aviation lighting to be fitted to structures featured in the Development (such as OSPs) where there is no mandatory requirement for installation. For impacts of lighting resulting from the installation of the aviation lighting requirements please refer to *Chapter 12*.
- 7 During the construction phase, stationary elements, such as the tower of the WTG will not be processed and presented onto a Radar Data Display System (RDDS) by the associated

aviation radar. Likewise, during the gradual decommissioning of above sea level infrastructure at the Development Area, the impact on radar would be incrementally reduced until the final WTG is incapable of rotation. Any agreed mitigation, where required, will be maintained until the last WTG is decommissioned. Therefore, for the purpose of this aviation assessment, the operational phase is taken to be from the point at which WTG blades are capable of rotating to the point at which the last WTG ceases to have the capability to rotate.

- 8 In aviation terms, the standard measurement of altitude or vertical distance is in feet, and nautical miles (NM) are used for navigational distances: one foot equates to 0.305 m; and one nautical mile equates to 1.852 kilometres (km).

17.3 Consultation and Scoping

- 9 Inch Cape Offshore Limited (ICOL) has consulted a number of aviation stakeholders throughout the scoping of the Development, and these consultations are summarised in Table 17.1 below. It is acknowledged as consultation progresses, that a number of impacts will be resolved post consent through applicable consent conditions.

Table 17.1: Consultation and Scoping responses and actions

Consultees	Scoping Response	ICOL Response
MODDIO	<p>DIO, whom safeguard MOD infrastructure, indicated by email to ICOL on the 7 June 2017 that an assessment is being conducted on the Inch Cape Wind Farm consisting of WTGs of the worst-case scenario of 301 m blade tip height above LAT.</p> <p>The Scoping response from DIO stated that DIO will continue to work with ICOL to ensure that the MOD (DIO) concerns are addressed. The MOD (DIO) has not conducted a new technical and operational assessment of the updated parameters of the proposed development, and as such is unable to comment on whether conditions 20 and 21¹ of the original 2014 consent would be applicable.</p> <p>MOD (DIO) provided the results of their assessment by email on the 13 December 2017. The assessment was completed on the basis that there would be up to 72 WTGs at a</p>	<p>ICOL is keen to know the potential impacts of the Inch Cape Wind Farm on MOD infrastructure in order to understand what operational effects would be presented and what mitigation may be required. To that end, the MOD (DIO) were contacted by email on 6 June 2017 with details of the updated Development design envelope for assessment of a maximum WTG tip height of 301 m above LAT.</p> <p>On receipt of the MOD (DIO) Scoping response ICOL contacted DIO by email on the 12 July 2017, in which, an enquiry was made on the intention of the MOD (DIO) to complete the aforementioned assessment was made.</p> <p>ICOL are further engaging with the MOD (DIO) to understand the extent of the potential impacts and understand the detail of appropriate mitigation that would meet MOD (DIO) requirements. The MOD (DIO)</p>

¹ Consent conditions relate to the submission of an ATC Radar Mitigation Scheme and technical mitigation scheme for RAF Leuchars and RRH Buchan respectively

Consultees	Scoping Response	ICOL Response
	<p>maximum of 301 m from ground level² to blade tip and located in the boundary indicated by grid reference provided to them. Results of the assessment stated that the Development would cause unacceptable interference to the Leuchars Station Air Traffic Control (ATC) Primary Surveillance Radar (PSR) and the Remote Radar Head (RRH) Air Defence Radar (ADR) at Buchan and Brizlee Wood.</p>	<p>were contacted again on 29 August 2017 and the 14 September 2017 requesting an update on when ICOL might be presented with the results of the MOD (DIO) assessment for the application.</p> <p>In order for the MOD (DIO) to complete its assessment (as indicated in the scoping response), details of WTG coordinates and WTG blade tip height of 291 m above LAT were provided to the MOD (DIO) by email on the 6 October 2017. However, the assessment was completed on the basis that there would be up to 72 WTGs at a maximum of 301 m from ground level³ to blade tip and located in the boundary indicated by grid reference provided to them.</p> <p>ICOL have completed within this Chapter an assessment on the potential of the Leuchars PSR and RRH Buchan and Brizlee Wood ADRs to be impacted by the Development Area.</p>
<p>National Air Traffic Control Services (NATS)</p>	<p>The results of a NATS technical safeguarding assessment have concluded that NATS has no safeguarding objection to the Inch Cape Wind Farm.</p>	<p>Impact to NATS infrastructure has been scoped out of this assessment.</p>
<p>Aberdeen International Airport</p>	<p>The Aberdeen International Airport Safeguarding Team were contacted by email on 4 September 2017 and provided details of the Inch Cape Wind Farm with a request for the Safeguarding Team to provide comment on any safeguarding concerns that they may have.</p>	<p>Aberdeen International Airport responded by email on the 29 September 2017 informing that the Development is located out-with their consultation zone and is not visible to radars utilised by the airport and therefore had no comment to make and need not be consulted further.</p> <p>Impacts on the Aberdeen International Airport have therefore been scoped out of this assessment.</p>

² MOD (DIO) stated in their response that the content of their letter is applicable to WTGs of heights 291 m or 301 m (blade tip).

³ MOD (DIO) stated in their response that the content of their letter is applicable to WTGs of heights 291 m or 301 m (blade tip).

17.4 Scope of Assessment

- 10 As part of this application, ICOL have drawn on the detail presented in the Scoping Report and Scoping Opinion from Marine Scotland Licensing Operations Team (MS-LOT) and subsequent consultee responses to agree on those impacts that may lead to a significant effect on identified Aviation Stakeholder infrastructure or operations. Therefore, this chapter focusses on those impacts on aviation that have been agreed throughout this process as being necessary to be assessed.
- 11 For further information reference should be made to the Scoping Report and the Scoping Opinion which can be found on Marine Scotland's website⁴.
- 12 Whilst not definitive, Civil Aviation Authority (CAA), Civil Aviation Publication (CAP) 764 *Policy and Guidelines on Wind Turbines* (CAA, 2016) provides criteria for assessing whether a WTG development might have an impact on civil aerodrome related operations. Consideration of the applications potential to impact on aviation stakeholders and receptors has been undertaken in accordance with the standard consultation distances stated in CAP 764. A number of potential consultees and receptors were scoped out from the consultation process as they were out-with the CAP 764 consultation zones or criteria which include:
- Within 30 km of an aerodrome with surveillance radar – although it is acknowledged that the distance quoted in CAP 764 can be greater than 30 km dependent on a number of factors at individual aerodromes, including type and coverage of radar utilised. For example, Aberdeen International Airport and Edinburgh Airports⁵ are located outside of 30 km; however, dependent on radar operating range, flight procedures and detectability of WTGs consideration of impact through consultation has been completed;
 - Airspace coincident with published Instrument Flight Procedures (IFPs) to take into account the requirement for an aerodrome's requirement to protect its IFP's; there is no such airspace within the Development Area; and
 - Within 17 km of a non-radar equipped licensed aerodrome with a runway of 1,100 m or more; there are no such aerodromes within 17 km of the proposed Development Area.
- 13 The offshore location of the Inch Cape Wind Farm excludes consideration of other minor aerodrome related distances included within CAP 764.
- 14 Radar detectable WTGs 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 therefore may be interpreted as aircraft movements/returns. While the reflected radar signal from stationary elements of the WTG can be removed using stationary clutter filters, significant effects have been observed on radar sensitivity caused by the substantial Radar Cross Section (RCS) of the WTG structural

⁴ Available at: <http://www.gov.scot/Topics/marine/Licensing/marine/scoping/ICOLRevised-2017> [Accessed 25/04/2018]

⁵ In response to Scoping Edinburgh Airport sent a nil return; therefore, had no comment to make.

components (blades, tower and nacelle) which can exceed that of a large aircraft; the effect 'blinds' the radar (or the operator) to wanted targets in the immediate vicinity of the WTG.

- 15 False plots and reduced radar sensitivity may reduce the effectiveness of radar to an unacceptable level and compromise the provision of a safe and expeditious radar service to participating aircraft.
- 16 It is mainly for these reasons that Air Navigation Service Providers (ANSPs) utilising radar, object to wind farm developments that are within radar Line of Sight (LOS) to their radar. However, it is worth noting that detectability of WTGs does not automatically constitute a valid reason for objection as dependent on the class and operational use of airspace, the extent of WTG induced clutter and impact to operations; in a small amount of instances aviation stakeholders may operationally mitigate impacts dependent on cumulative effects.
- 17 The Development study area depends on the maximum operating range of each of the radar systems scoped in to the assessment and the potential of the radar system to detect the WTGs. The operational range of the radar system is dependent on the type of radar used, its function and its operational requirement.
- 18 Where relevant, the maximum operating range of the radar system identified is used within the baseline study and is as follows:
 - The Leuchars Station Primary Surveillance Radar (PSR) is located on the Leuchars Station airfield and has a standard operating range of 40 NM (74.1 km) radius; and
 - The RRH Brizlee Wood and RRH Buchan Air Defence Radar (ADR) systems are long range radar systems, which have an estimated operational range of 200 NM (370 km); however, due to their strategic value to national security their specific operating parameters are not known to Osprey. The Development is located inside the expected operational range of both the Brizlee Wood and Buchan ADRs and therefore there is no limitation of the assessment of impact on these two ADR systems.
- 19 Table 17.2 below provides the scope of the assessment and Table 17.3 those impacts that have been scoped out.

Table 17.2: Scope of assessment covered in this chapter

Potential Impact	Scope of Assessment	Reason
Operation & Maintenance (O&M) Phase⁶		
Detectability of the WTGs by the Leuchars Station PSR during the operational phase may create clutter to be produced on a Radar Data Display Screen (RDDS) and impact the provision of radar services to aircraft.	The MOD (DIO) have objected to the Development based on radar detectability of the WTGs by the Leuchars Station PSR. Therefore, an assessment on the likely impacts and mitigation requirements are presented.	WTGs detectable by radar might degrade the system by creating false targets, reduce system sensitivity, create radar shadowing behind the WTGs and saturate the radar receiver leading to clutter potentially concealing real aircraft targets.
Detectability of the WTGs by the RRH Brizlee Wood ADR system during the operational phase may create clutter to be produced on an RDDS and impact the provision of radar services to aircraft.	The MOD (DIO) have objected to the Development based on radar detectability of the WTGs by RRH Brizlee Wood ADR. Therefore, an assessment on the likely impacts and mitigation requirements are presented.	WTGs detectable by radar might degrade the system by creating false targets, reduce system sensitivity, create radar shadowing behind the WTGs and saturate the radar receiver leading to clutter potentially concealing real aircraft targets.
Detectability of the WTGs by the RRH Buchan ADR system during the operational phase may create clutter to be produced on an RDDS and impact the provision of radar services to aircraft.	The MOD (DIO) have objected to the Development based on radar detectability of the WTGs by RRH Buchan ADR. Therefore, an assessment on the likely impacts and mitigation requirements are presented.	WTGs detectable by radar might degrade the system by creating false targets, reduce system sensitivity, create radar shadowing behind the WTGs and saturate the radar receiver leading to clutter potentially concealing real aircraft targets.

⁶ NB. During the gradual construction of above LAT infrastructure in the Development Area, the effect on radar would be incrementally increased as the WTGs are commissioned and the blades are capable of turning. However, since it is not known at this stage in what WTG order this will occur, for the purposes of this aviation assessment, the operational phase is taken to be from the point when the first WTGs are capable of turning, until the last WTG ceases to turn, during that time any agreed mitigation will need to be in place and maintained.

Table 17.3: Impacts scoped out of this chapter

Potential Impact	Justification for Scoping Out of the Environmental Impact Assessment (EIA)
Construction (& Decommissioning) Phase	
Radar detectability of the WTGs by NATS Perwinnes and Allanshill PSRs causing unacceptable interference to the radar.	NATS have no safeguarding objection to the Development.
Radar detectability of the WTGs by Edinburgh Airport PSR causing unacceptable interference to the radar.	Edinburgh Airport have no safeguarding objection to the Development.
Radar detectability of the WTGs by Aberdeen International Airport PSR causing unacceptable interference to the radar.	The Aberdeen International Airport safeguarding team have stated that the Development is outside of their safeguarded area and that they have no concerns.
Radar detectability of the WTGs by the Leuchars Station Precision Approach Radar (PAR) causing unacceptable interference to the radar.	The Developable Area of the Inch Cape Wind Farm is outside of the safeguarded area of the Leuchars Station PAR system which extends 20 NM from the touchdown point on the runway and 20° either side of the centreline of the runway in use. In response to scoping the MOD(DIO) have not objected to the Development based on effect to the Leuchars Station PAR system.
Helicopters Operating in Support of Offshore Oil and Gas Operations.	ATC services are available to helicopters operating offshore in support of the oil and gas industries and to other aircraft operating to and from their operating base or transiting the area. There are no offshore oil and gas installations in the vicinity of the Development. In the northern North Sea helicopters operating in support of offshore oil and gas platforms are likely to operate on Helicopter Main Routes (HMRs) between Aberdeen Airport and the offshore installations. All of the HMRs are located approximately 40 NM north of the Development Area and outside of any CAA recommended consultation range.
Physical obstruction to Search and Rescue (SAR) Flight Operations.	When on an operational mission, SAR aircraft are not constrained by the normal rules of the air, and operate in accordance with their Aircraft Operator Certificate (AOC). This allows SAR pilots total flexibility to manoeuvre using best judgement thus making them highly adaptable to the environment and conditions in which they are operating. 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. Pilots are ultimately responsible for seeing and avoiding obstructions such as WTGs and will be aware through notification procedures of the proposed project. Embedded mitigation and notification of construction, operation and decommissioning of the wind farm and the lighting and promulgation on aviation charts will reduce

Potential Impact	Justification for Scoping Out of the Environmental Impact Assessment (EIA)
	any physical obstruction effect on SAR flight operations.
Physical obstruction to military low flying activities.	<p>The presence and movement of certain vessels (e.g. tall cranes) may present a potential collision risk to military low flying aircraft.</p> <p>A range of embedded mitigation measures relating to lighting, notification, promulgation and the inclusion of the Development on relevant aviation material and charts will reduce impact to low flying aircraft.</p>
O&M Phase	
Radar detectability of the WTGs by NATS Perwinnes and Allanshill PSRs causing unacceptable interference to the radar.	NATS have stated within their Scoping response that there will be no safeguarding impact to their systems.
Radar detectability of the WTGs by Edinburgh Airport PSR causing unacceptable interference to the radar.	Edinburgh Airport have no safeguarding objection to the Development.
Radar detectability of the WTGs by Aberdeen Airport PSR causing unacceptable interference to the radar.	Aberdeen International Airport have no safeguarding objection to the Development.
Radar detectability of the WTGs by the Leuchars Station PAR causing unacceptable interference to the radar.	As per the construction and decommissioning phases.
Helicopters Operating in Support of Offshore Oil and Gas Operations.	As per the construction and decommissioning phases.
Physical obstruction to SAR Flight Operations.	As per the construction and decommissioning phases.
Physical obstruction to military low flying activities.	As per the construction and decommissioning phases.

17.5 Regulation and Guidance

- 20 Policy of specific relevance to this chapter includes *The Scottish Government Planning Policy (2014)*, paragraph 169 notes that considerations in the determination of applications for energy infrastructure developments are likely to include impacts on aviation and defence interests.
- 21 A variety of aviation publications contain information and guidance relating to the potential effects of wind energy development on aviation stakeholders. Baseline characterisation data has been collated combining a thorough desk-based study of extant data supplemented with a detailed literature review. The following documents informed the assessment of the potential impacts of the Development on aviation interests.
- CAA CAP 764 (CAA, 2016) 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 on aviation systems and flight operations;
 - CAA CAP 168 *Licensing of Aerodromes* (CAA, 2014) sets out the standards required at United Kingdom (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 2016 and Regulations (Fifth Edition Amendment 3)* (CAA, 2018) sets out the provisions of the Air Navigation Order as amended together with regulations made under the Order. 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;
 - CAA CAP 670 *Air Traffic Services Safety Requirements* (CAA, 2014a) sets out the safety regulatory framework and requirements associated with the provision of an Air Traffic Service (ATS); and
 - CAA CAP 437 *Standards for Offshore Helicopter Landing Areas* (CAA, 2016a) provides guidance on standards and 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 WTG platforms to represent current best practice.
- 22 Other guidance considered under the review of the baseline environment definition included the following:
- *Military Aeronautical Information Publication (Mil AIP)* (MOD, 2018) provides details of military aerodromes in the UK and abroad together with military Air Traffic Control (ATC) procedures and facilities;
 - The Military Aviation Authority (MAA) *Manual of Aerodrome Design and Safeguarding (MADS)* (MAA, 2014) provides details of safeguarding of military aerodromes and the management of obstacles on or around a military aerodrome;

- CAA CAP 032 *The UK Integrated Aeronautical Information Package* (UK IAIP) (National Air Traffic Control Services (NATS), 2018) is 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; and
- Maritime and Coastguard Agency (MCA) *Maritime Guidance Note (MGN) 543: Safety of Navigation Offshore Renewable Energy Installations (OREIs)* (MCA, 2016) provides guidance on UK navigational practice, safety and emergency response for operators and developers in formulating their emergency response plans and site safety management.

17.6 Design Envelope and Embedded Mitigation

17.6.1 Design Envelope

- 23 The project parameters and scenarios are defined as a design envelope and presented in *Chapter 7: Description of Development*. The assessment of potential impacts on aviation is based upon the worst-case scenario as identified from this design envelope, and is specific to the potential impacts assessed in this chapter.
- 24 As discussed in the footnote to Table 17.2, during the gradual construction of above LAT infrastructure in the Development Area, the effect on radar due to unmitigated radar clutter and on the full provision of an unlimited ATS would be incrementally increased as WTGs are commissioned and the blades are capable of turning. However, since it is not known at this stage in what WTG order this will occur, for the purposes of this aviation assessment, the operational phase is taken to be from the point when the first WTGs are capable of turning, until the last WTG ceases to turn, during that time any agreed mitigation, if required, will need to be in place and maintained. On this basis, construction and decommissioning effects are scoped out of this assessment and therefore no worst-case design scenario is identified for these phases. Notification procedures for cranes and lifting equipment are likely to be required as they are likely to cause an obstruction to radar.
- 25 For this aviation assessment, the worst-case scenario for all impacts being assessed is the maximum number of WTGs in the Development Area (72 WTGS) at the largest height to blade tip (291 m). The worst-case scenario also assumes that the entirety of the Development Area will be populated by WTGs. This is because the largest area of WTGs will create the largest impact from a radar detectability perspective, leading to a greater effect on radar and aviation services. Any aspects of the infrastructure that are lower in height than the WTGs and within the Development Area (e.g. OSPs) will not create an incremental effect on aviation interests.

17.6.2 Embedded Mitigation

- 26 A range of embedded mitigation measures to minimise effects were identified during the development of the Inch Cape Wind Farm. These will comply with current guidelines as follows:

- *CAP 393 Article 223* (CAA, 2018) sets out the mandatory requirements for lighting of offshore WTGs.
 - Legislation requires the fitting of obstacle lighting on offshore WTGs with a height of 60 m or more above the level of the sea at the Highest Astronomical Tide (HAT);
 - When four or more WTGs 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; and
 - 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* (CAA, 2018).
 - *CAP 437* (CAA, 2016a) sets out a procedure to indicate to a helicopter operator that the WTG 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 helihoist status light located on the nacelle of the WTG 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 WTG blades and nacelle are secure and it is safe to operate. A flashing green light is displayed to indicate that the WTG 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; and
 - 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.
- 27 A Lighting and Marking Plan will be submitted for approval to MS-LOT outlining the Development's lighting and marking strategy to mitigate the risk to aviation safety during all phases of the Development and will be in line with *CAP 393* (CAA, 2018) and *CAP 437* (CAA, 2016a).
- 28 Appropriate information about the site construction and any associated lighting (where applicable), for example the height and temporary location of construction cranes, will be provided to the UK Aeronautical Information Service (NATS AIS) for promulgation within the UK IAIP (NATS, 2018).
- 29 Prior to commencement of the Development, information will be circulated to relevant aviation stakeholders, including the UK Hydrographic Office (UKHO), which will include the positions and maximum heights of the WTGs and construction equipment above 150 ft above LAT for inclusion on aviation charts. The UK IAIP is updated on a monthly basis under the Aeronautical Information Regulation and Control (AIRAC) system. Information provided

under the AIRAC system shall be distributed by AIS at least 42 days in advance of the effective date with the objective of reaching recipients at least 28 days in advance of the effective date.

- 30 Further to the embedded mitigation it is also recognised practice to notify aviation stakeholders of the location and dimension of any wind energy development and the associated construction activities. Information regarding construction should be passed to the Defence Geographic Centre (DGC) and the General Aviation Awareness Council (GAAC) at least 10 weeks in advance of the erection of the first WTG and to follow up on the day with a confirmation that the activity has taken place. The data should include:
- Location, height (of all structures over 150 ft (45.7 m), date of erection, date of removal and lighting type (none, infra-red or lighting brightness); and
 - Local aerodromes identified during consultation should be notified, particularly any police helicopter or air ambulance unit.
- 31 Appropriate liaison with NATS AIS will be completed to ensure information on the construction of the wind farm is circulated in a Notice to Airmen (NOTAM) and other appropriate media.
- 32 The Wind Farm will be designed, operated and decommissioned as per MGN 543, including Annex 5 which details '*Standards and procedures for generator shutdown and other operational requirements in the event of a SAR, counter pollution or salvage incident in or around an Offshore Renewable Energy Installation (OREI)*'. An Emergency Response Co-operation Plan (ERCoP) based on the MCA template and site Safety Management Systems, in consultation with the MCA will be created. Procedures will be followed in the event of an emergency during all phases of the Development.

17.6.3 Consent Conditions

- 33 As well as the embedded mitigation measures, ICOL proposes to commit to the purpose of the relevant consent conditions granted for the Inch Cape 2014 Consent, as they are still relevant to this application. This will provide reassurance to stakeholders that the relevant issues will be addressed and secured by way of appropriate conditions.
- 34 ICOL recognises that the wording and detail of the consent conditions will be at the discretion of the Scottish Ministers. For Aviation interests, ICOL propose that the consent conditions address matters surrounding, but not limited to, the following;
- Submit an ATC Radar Mitigation Scheme in order to mitigate adverse impacts on the ATC radar at Leuchars Station and the operations of the MOD;
 - Submit a technical proposal to mitigate the MODs concern on RRH Buchan; and
 - Provide an approved Development and Specification Layout Plan (DSLPL) noting the positions and maximum heights of the WTGs, construction equipment over 150 ft in height (measured above LAT).

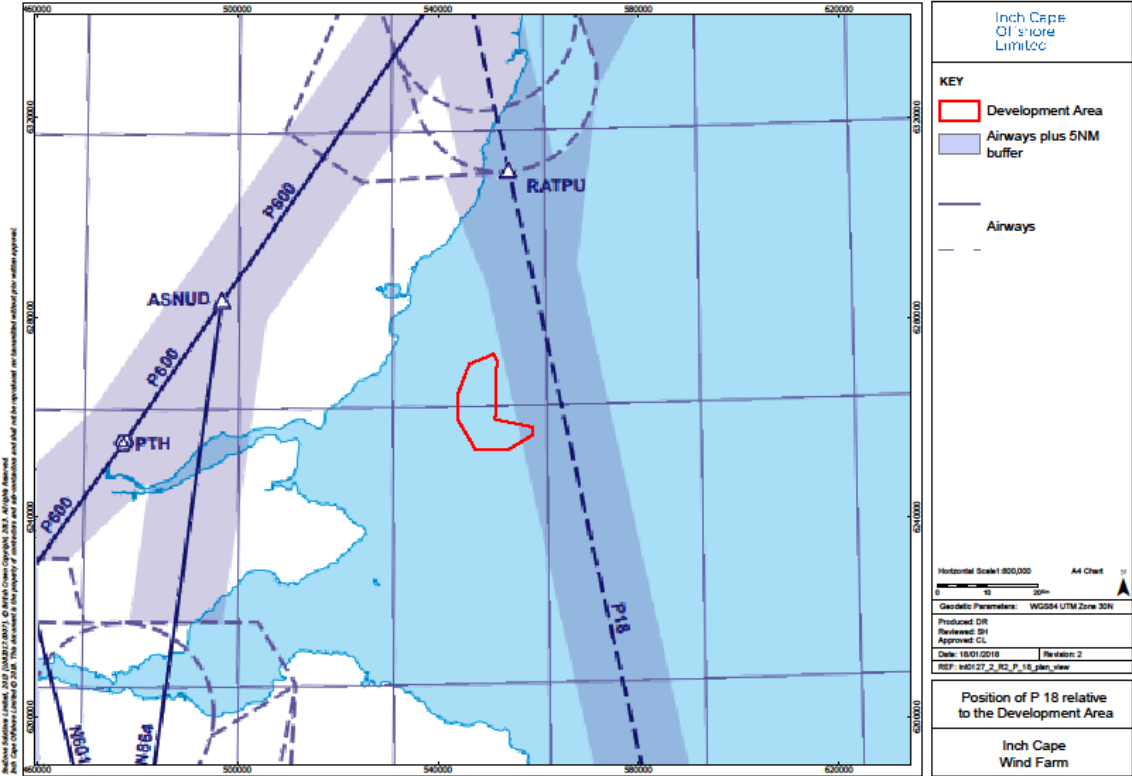
17.7 Baseline Environment

17.7.1 Aviation Study Area – Existing Airspace Environment

- 35 In the UK Flight Information Region (FIR) and Upper Information Region (UIR), airspace is classified as A to G in accordance with International Civil Aviation Organisation (ICAO) standards (note: there is no airspace designated as Class B or Class F in UK airspace). Airspace Classes A to E are variants of Controlled Airspace (CAS) in which aircraft require an ATC clearance. Class G airspace is airspace in which aircraft can operate autonomously without any clearance required. The Development Area will be situated in an area of predominately class G uncontrolled airspace, which is established from sea level up to Flight Level (FL) 195 (approximately 19,500 ft), there are also discrete areas of Class C CAS above FL 195.
- 36 The classification and the controlling authority of the various airspace sectors above the Development Area are described and categorised as follows:
- Class G uncontrolled airspace: any aircraft can operate in this area of uncontrolled airspace without any mandatory requirement to be in communication with, or receive an ATS from any ATC establishment. Pilots of aircraft operating under Visual Flight Rules⁷ (VFR) in Class G airspace are ultimately responsible for seeing and avoiding other aircraft and obstructions; and
 - Class C CAS: only aircraft that have filed a flight plan can operate within CAS. ATC applies the required levels of separation to aircraft operating in CAS and generally instructions issued to the pilot flying in CAS are mandatory. Aircraft operating in CAS must be in receipt of an ATS from NATS or an authorised military service provider.
- 37 The Class C CAS above FL 195 contains a number of airways which are designated by a letter and number sequence. Airways P18, Upper (U) P18 and UP59 are located above the Development Area. Airway P18 is classified as a lower airway located below FL 245 and is only activated during discrete operating hours; UP18 and UP59 are located above FL 245 and are designated as upper airways. Airways are predominantly used by en-route civil aircraft, an ATS to pilots operating on the airways above the Development Area is provided by NATS controllers operating from the Prestwick Area Control Centre (ACC) utilising remote long-range radar systems (NATS responded within their Scoping Response that they have no safeguarding concerns to the Inch Cape Wind Farm). The width of a lower airway is generally 5 NM either side of the airway centreline, upper air routes (above FL 245) have no declared width but for the purpose of ATS provision are deemed to be 5 NM either side of a straight line joining each two consecutive points.
- 38 Figure 17.1 and Figure 17.2 below provide a graphical representation of the Development Area and the location of the adjacent airways.

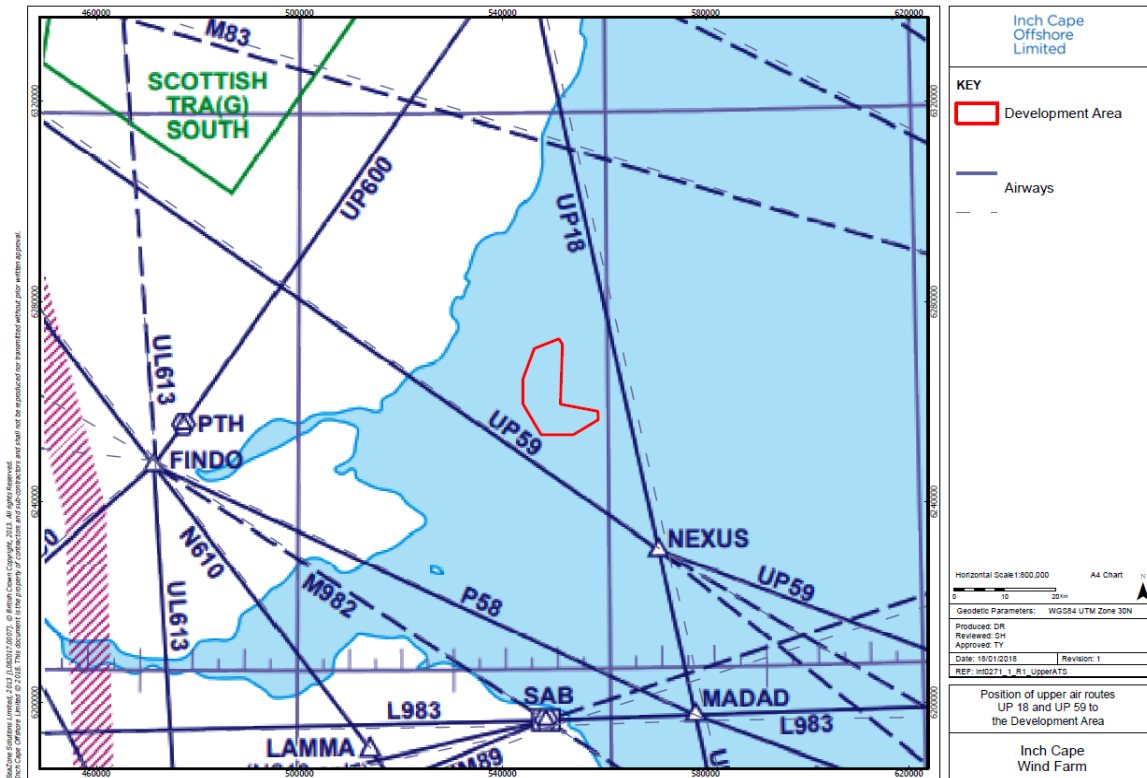
⁷ A set of regulations under which a pilot operates an aircraft in weather conditions clear enough to allow the pilot to see where the aircraft is going; the pilot must be able to operate the aircraft with visual reference to the ground, and by visually avoiding obstructions and other flying machines.

Figure 17.1: Position of Airway P18 relative to Development Area



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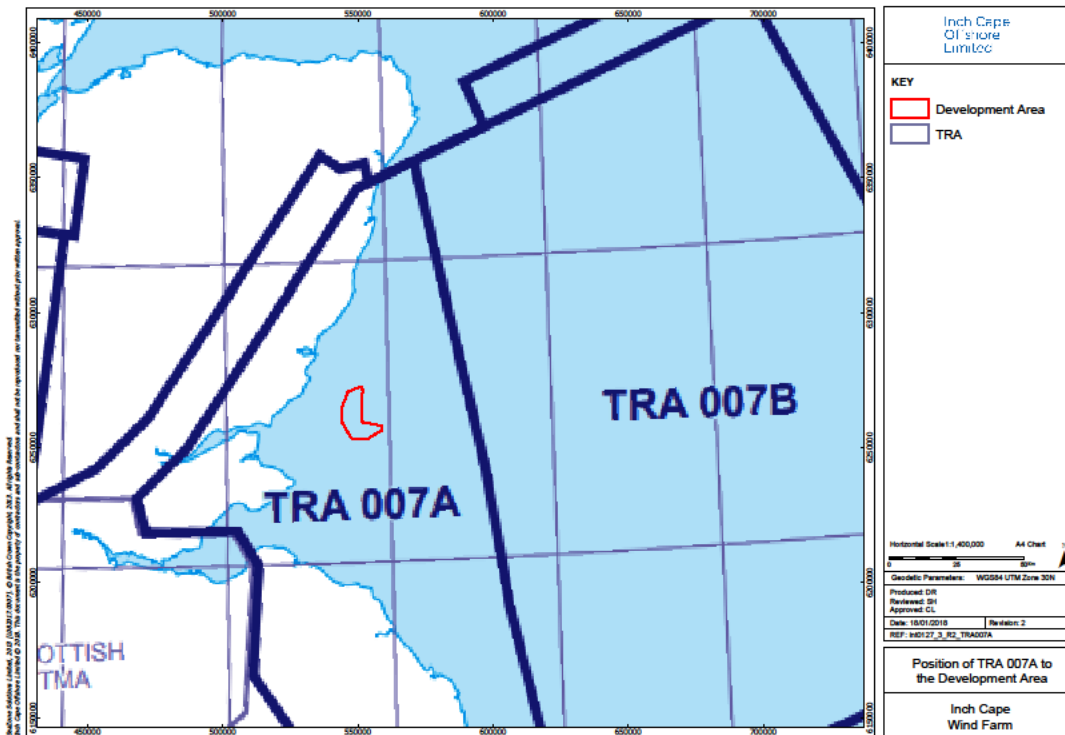
Figure 17.2: Position of UP18 and UP59 relative to the Development Area



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- 39 Military air defence controllers utilising radar data from ADRs are able to provide an airways crossing service to aircraft under air defence control, utilising ADR systems, and are likely to operate in the airspace above the Development. Figure 17.2 also shows the location of a portion of the Scottish Temporary Reserved Area (TRA) (G) South, which is a temporary allocated piece of airspace used for Gliding (G). The Pink hatching on the left side of the figure, illustrates an eastern boundary of the Hebrides Upper Control Area (UTA) where specific rules apply, an explanation although not relevant to the Development, is provided for completeness.
- 40 TRA 007A is used by military aircraft for activities including air combat training, training exercises and supersonic flight. A portion of TRA 007A is established above the Development Area from FL 195 (19,500 ft) to FL 245 (24,500 ft) and is activated Monday to Friday 0830 to 1700 (0730 to 1700 during the months of summer). TRA 007A does not include CAS within airway P18 during the published hours of the airway. TRAs allow military aircraft to work autonomously or to be in receipt of an ATS from approved military ATS units, to avoid operational restrictions to the pilot. Air defence controllers using radar data from ADR systems and airborne radar assets may be responsible for navigation services and support to aircraft activity within TRA 007A during its opening hours. Figure 17.3 below shows the position of TRA 007A.

Figure 17.3: Position of TRA 007A relative to the Development Area



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- 41 There would be no direct impact to the TRA airspace created by the Development Area; the impact on the TRA would be as a consequence of the radar detectability of the Development Area by radar utilised for the identification and control of aircraft operating in the TRA.

17.7.2 Identified Radar Receptors

Leuchars Station ATC PSR

- 42 Leuchars Station operates a Watchman PSR system, which is located on the airfield at the Station; the radar has an operating range of 40 NM (74.1 km) radius of the radar location. The PSR is located approximately 20.1 NM (37.3 km) from the western edge of the Development Area and is utilised by Leuchars Station ATC in the provision of air traffic services to aircraft operating in and out of the airfield and in addition the provision of a Lower Airspace Radar Service (LARS) below FL 100 to transitory civil and military aircraft within a radius of 40 NM (74.1 km) of the airfield every day of the year, 24 hours per day.
- 43 In 2014 the MOD appointed a service provider to identify and evaluate options for the future delivery of their military terminal Air Traffic Management (ATM) capability, which ensures that all flights are safely and efficiently managed and sequenced for take-off and landing; this is known as Project Marshall. The current military ATM infrastructure is approaching obsolescence and to be compliant with mandatory international regulations, Project Marshall will deliver enhanced capability and significant cost savings to military ATM provision.

- 44 A request for information under the Freedom of Information (FOI) Act led to a response from the MOD (MOD, 2015) ⁸ which listed those MOD radar systems included within the primary radar replacement programme of Project Marshall and whether the radar system was to be replaced or upgraded. At the time of publication of the response to FOI (which remains currently available online), no time period was set for the replacement or upgrade of the Leuchars PSR; however, it was stated that Leuchars is undergoing an assessment to determine its inclusion within the Marshall Contract and until this assessment concludes, the site will continue to be safeguarded.
- 45 The Leuchars Safety Assessment (SA) which was completed by the MOD for the Neart na Gaoithe (NnG) and Inch Cape Transponder Mandatory Zone (TMZ) makes several references to the Watchman PSR being replaced within Project Marshall. The Defence Equipment and Support (DE&S) which is a trading entity and joint-defence organisation within the UK MOD, stated that the *“DE&S Windfarm Delivery Team will commence activities to implement the Range Azimuth Gating (RAG) blanking at Royal Air Force (RAF) Leuchars and subsequent equivalent RAG blanking capability that will be required to be installed if the Watchman PSR is replaced”* (MOD, 2017). There are currently no known plans for the Leuchars Station PSR to be upgraded or replaced as part of the Project Marshall programme. In addition, it is understood that the Watchmen PSR replacement programme has been extended until 2021.
- 46 Leuchars Station used to be known as RAF Leuchars however, on the 31 March 2015 the Station was handed over to the British Army. Based Typhoon aircraft were relocated to RAF Lossiemouth, Morayshire and continued their Quick Reaction Alert in defence of the UK from their new base. The airfield at Leuchars Station remains open with a number of based aircraft and is administered by RAF personnel who also provide ATC with a number of skilled personnel in specific roles. The proximity of the airfield to the military practice Danger Areas to the east and southeast makes Leuchars Station airfield an attractive, and possibly the only military aerodrome option, for aircraft diverting in following an inflight emergency or due to inclement weather conditions at their home base.
- 47 In its response to Scoping the MOD (DIO) objected⁹ to the Development as the Development Area WTGs will be detectable and cause unacceptable interference to the Leuchars Station ATC PSR.

RRH Brizlee Wood and RRH Buchan ADRs

- 48 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 in order 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

⁸ Available at:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/453017/20150807-FOI2015_06386_radar_replacement_publish-O.pdf [Accessed on 25/4/2018]

⁹ Please note that the applicant is aware that the MOD (DIO) technically cannot object to the project until the formal application has being submitted.

the UK and include RRH Brizlee Wood and RRH Buchan ADRs. Any identified effect of WTGs on the ASACS radars that serve the airspace above the Development Area would reduce the capability of aircraft detection by the ASACS Force. ASACS radar resources are also used in support of military training and exercises on an almost daily basis. Within the lateral and vertical confines of TRAs, aircraft completing air combat training, high energy manoeuvres and supersonic flight can be provided a radar service utilising data from ADR systems.

- 49 ADR are considered to have an operational range in excess of 200 NM, although due to the sensitivity of this information to national security, actual operational capabilities of the radar systems are not known. RRH Brizlee Wood is located on Alnwick Moor, Northumberland approximately 63.3 NM (117.3 km) from the southern edge of the Development Area. RRH Buchan ADR is located near Peterhead, Scotland approximately 53.2 NM (98.5 km) from the northern edge of the Development Area.

17.7.3 Other Receptors

- 50 ICOL has considered the potential for impacts on a number of other receptors upon which it has been concluded the potential for impacts are unlikely. As such, they are scoped out of the impact assessment and only detailed in the baseline for completeness.

Helicopters Operating in Support of Offshore Oil and Gas Operations

- 51 Offshore oil and gas platforms in the Northern North Sea are supported by a number of helicopter operators who ferry crews and supplies to and from the mainland. The routes taken by helicopters on such flights may follow HMRs which form a network of corridors between offshore platforms and their operating base. HMRs, which are concentrated in the northern North Sea, east and northeast of Aberdeen Airport (in excess of 40 NM from the Development Area), are all situated outside of CAA recommended consultation distances which states that there should be no obstacles within 2 NM either side of a HMR.

Physical Obstruction to Search and Rescue (SAR) Flight Operations

- 52 The physical presence of the WTGs within the Development Area has the potential to represent a collision risk to airborne SAR operations, operating in the vicinity of the Development Area. The SAR force provides 24-hour aeronautical SAR cover in the UK. The SAR role is operated from ten strategically located bases across the UK. The bases are positioned close to SAR hotspots so that aircraft can provide support as quickly and efficiently as possible. Bristow helicopters were awarded the contract to provide SAR helicopter services for the UK in 2013.
- 53 The development of the Inch Cape Wind Farm will lead to a change of the operating environment should an airborne SAR operation be required within or close to the proposed development. When on an operational mission, SAR aircraft are not constrained by the normal rules of the air, and operate in accordance with their (Bristow) AOC. This allows SAR pilots total flexibility to manoeuvre using best judgement thus making them highly adaptable to the environment and conditions in which they are operating.

- 54 An ERCoP will be in place for the construction, operation and decommissioning phases of the proposed development. The ERCoP is completed initially in discussion between the developer and the MCA, SAR and Navigation Safety Branches. Detailed completion of the plan will then be in cooperation with the Maritime Rescue Co-ordination Centre (MRCC), responsible for maritime emergency response. The ERCoP must then be submitted to and approved by the MCA. The ERCoP will detail specific marking and lighting of the WTGs. The SAR helicopter bases will be supplied with an accurate chart of the Development Area WTG Global Positioning System (GPS) positions. The requirements for the lighting of WTGs are contained in Article 223 of CAP 393 (CAA, 2018).

Physical Obstruction to Military Low Flying Activities

- 55 Military low flying takes place within the United Kingdom Low Flying System (UKLFS) which utilises all Class G airspace below 2,000 ft above ground level (agl) or above mean sea level (amsl), with the exception of certain specified designated areas. A range of embedded mitigation measures detailed in *Section 17.5.2*, relating to lighting, notification, promulgation and the inclusion of the Development on relevant aviation material will reduce impact to low flying aircraft operating in the vicinity of the Development Area. When operating in the Class G airspace above the Development Area pilots are ultimately responsible for seeing and avoiding other aircraft and obstructions. Operations will be conducted in VFR conditions which dictate a minimum in-flight visibility of 5 km (approximately 3 NM). In the response to scoping, the MOD (DIO) have not raised concerns with regard to low flying other than to request aviation lighting of WTGs in accordance with the *Air Navigation Order* (CAA, 2018). The MOD (DIO) may request aviation lighting to be fitted to structures featured in the Development (such as OSPs) where there is no mandatory requirement for installation, to mitigate any effect to military low flying aircraft operating over the sea.

17.7.4 Summary of the Baseline

56 This section has identified the aviation and radar receptors which had the potential to interact with the Development and associated works within the Development Area. Those with no identifiable interaction are not considered further in the assessment. The following Table 17.4 summarises the receptors which are taken forward to the impact assessment.

Table 17.4: Summary of the receptors taken forward to the assessment

Receptor Group	Receptors	Impact Assessment
ATC Radar	Aberdeen Airport PSR	No
	Edinburgh Airport PSR	No
	Leuchars Station PSR	Yes
	NATS Perwinnes and Allanshill PSR	No
PAR	Leuchars Station PAR	No
ADR	RRH Brizlee Wood ADR	Yes
	RRH Buchan ADR	Yes
Physical Obstruction to Aviation	Helicopters Supporting Offshore Oil and Gas Operations	No
	SAR Flight Operations	No
	Military Low Flying	No

17.7.5 Baseline without the Development

57 In the future, it is anticipated that the airspace above the Development Area would continue to be utilised by those aviation stakeholders described earlier and the baseline would remain as detailed.

17.8 Assessment Methodology

17.8.1 Sensitivity of Receptor

58 The sensitivity of a receptor is subjective in aviation terms and therefore difficult to quantify. Whereas an ADR system would be an obvious high value and high sensitivity receptor (due to its role in UK national security), the sensitivity of a local aerodrome can also often be rated high if the body making the determination considers the receptor to be a significant asset to the local area. The identified aviation receptors in this assessment are considered to have a high sensitivity to effects, given their safety critical function. Table 17.5 below provides the criteria for classifying the sensitivity of the receptor.

Table 17.5: Criteria for classifying sensitivity of receptor

Sensitivity	Definition
High	Receptor provides a service, which is of major importance to the local, regional or national economy, and/or the receptor is generally vulnerable to impacts that may arise from the Development, 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 Development, and/or has moderate to high levels of recoverability.
Low	Receptor provides a service, which is of minor value to the local, regional or national economy, and/or the receptor is not generally vulnerable to impacts that may arise from the Development, 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 Development, and/or has high recoverability.

17.8.2 Magnitude of Impact

59 The magnitude criterion of the potential impacts on aviation and radar receptors is assessed using the method and terminology given in Table 17.6 below.

Table 17.6: Classification of magnitude of impact

Magnitude	Definition
High	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements.
Medium	Loss of resource, but not adversely affecting integrity of resource; partial loss of damage to key characteristics, features or elements.

Magnitude	Definition
Low	Some measurable change in attributes, quality or vulnerability, minor loss of, or alteration to, one (maybe more) key characteristics, features or elements.
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements.
No Change	No loss or alteration or characteristics, features or elements; no observable impact in either direction.

17.8.3 Method for Assigning Significance of Effect

60 In assessing the significance of the effects from the Development, it was necessary to identify whether or not there would be an impact on aviation operations. The aviation industry is highly regulated and subject to numerous mandatory standards, checks and safety requirements, many international in nature and requiring the issue of operating licences.

61 For the purpose of the aviation assessment any effect that is considered major or moderate is considered significant, which represents a slight deviation from the standard methodology presented in *Chapter 4: Process and Methodology*, whereby moderate is classed as non-significant. Any effect that is minor or below is not considered significant. Table 17.7 below provides the significance of potential effects. With the definitions of what this significance means in terms of aviation presented in Table 17.8 below.

Table 17.7: Significance of potential effects

		Magnitude of Impact			
		High	Medium	Low	Negligible
Sensitivity	High	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Minor	Negligible
	Low	Moderate	Minor	Negligible	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible

Table 17.8: Definitions applied to the Significance

Significance	Definition
Major	Receptor unable to continue safe operations or safe provision of air navigation services (radar) or effective air defence surveillance in the presence of wind turbines. Technical or operational mitigation of the impact is required.
Moderate	Receptor able to continue safe operations but with some restrictions or non-standard mitigation measures in place.
Minor	The proposed project would have little impact on the aviation stakeholder or the level of impact would be acceptable to the aviation stakeholder.
Negligible/ No Change	The proposed project would have no impact on the aviation stakeholder and would be acceptable to the aviation stakeholder.

62 In the instance where impacts are significant then ICOL will work with the relevant stakeholders to find appropriate mitigation solutions. These solutions should be agreed between ICOL and the Scottish Ministers in consultation with the infrastructure owner/operator.

17.9 Impact Assessment - Development Area

17.9.1 Introduction

63 The impacts resulting from the operation of the Inch Cape Wind Farm have been assessed on aviation receptors identified within the maximum operating range of the radar system identified and as defined under *Section 17.2* and described under *Section 17.6*. A discussion of the likely significance of each effect resulting from each impact is presented below.

17.9.2 Effects of the Operational Phase

Leuchars Station PSR

64 Radar propagation modelling, also known as radar LOS, between the Development Area and the Leuchars Station PSR was completed for the Inch Cape 2013 Environmental Statement (ES) at a blade tip height of 215 m above LAT the results of which indicated that the Leuchars Station PSR would theoretically detect the WTGs within the Development Area. As WTGs in the Development design envelope are taller than those in the Inch Cape 2013 ES there was no requirement to repeat the radar propagation modelling. The MOD (DIO) has confirmed that WTGs within the Development Area will be detectable by, and will cause unacceptable interference to the ATC PSR at Leuchars Station. This direct, permanent effect of clutter as generated by WTGs within the Development Area may hamper the radar operator's ability to distinguish actual aircraft returns from those created by the WTGs, and therefore degrade the safety and efficiency of the ATS being provided.

- 65 In the vicinity of the Development Area, aircraft under the control of Leuchars Station ATC will be operating in Class G airspace and may request a Deconfliction Service (DS). DS is the highest level of radar service provided to pilots in Class G uncontrolled airspace: essentially the controller must provide instructions to the pilot to ensure the aircraft remains adequately separated from 'unknown traffic' or clutter. For a pilot requesting a DS, on a flight path within five NM of the unmitigated WTGs, the air traffic controller will likely be unable to provide the five NM separation (between clutter created by the WTGs and an aircraft) required for the safe provision of an ATS without turning the aircraft away from the clutter.
- 66 The sensitivity of the receptor is high. The magnitude of impacts is also assessed as high. Consequently, the significance of effect has been assessed to be **major** which therefore is significant for the purposes of this assessment.

Remote Radar Head (RRH) Brizlee Wood and RRH Buchan Air Defence Radar (ADR)

- 67 The original EIA radar LOS assessment at a WTG blade tip height of 215 m above LAT provided mixed results, whilst the RRH Buchan ADR would theoretically detect WTGs placed in the Development Area; the RRH Brizlee Wood ADR would theoretically detect WTGs in the south eastern part of the Development Area. Due to the increase in blade tip height to 291 m above LAT increased detectability of WTGs to the ADR systems was possible however, due to the fact that the exact operating parameters of the RRH Buchan and RRH Brizlee Wood ADRs are not known the radar LOS was not rerun. However, the results of assessment by the MOD (DIO) provided confirmation that both the ADR systems would detect the WTGs at the increased blade tip height creating unacceptable interference to both the ADR systems.
- 68 The MOD (DIO) have objected to the Development as the Development Area WTGs will be detectable to both the RRH Buchan and RRH Brizlee Wood ADR systems and are predicted to cause unacceptable interference to the radar systems exceeding their "cumulative effect" thresholds. Radar detectable WTGs in radar coverage areas of ASACS ADRs could potentially shield the radar from genuine aircraft targets and/or hide genuine aircraft targets, in displayed clutter, from the air defence controller. Furthermore, a degree of 'shadowing' could be created behind detectable WTGs. These direct and permanent effects would affect the air defence controller's ability to detect an airborne threat and to provide a safe service to aircraft in support of air defence activities. Consequently, any identified effect of WTGs on the ASACS ADRs that serve the airspace above the Development Area would potentially reduce the capability of the ASACS Force.
- 69 The sensitivity of the receptor is high. The magnitude of impacts is assessed as high. Consequently, the significance of effect has been assessed to be **major** which therefore is significant for the purposes of this assessment.

17.10 Cumulative Impact Assessment (CIA)

17.10.1 Introduction

- 70 In assessing the potential cumulative impact(s) for the Development Area, it is important to bear in mind that for some projects, predominantly those 'proposed' or identified in development plans etc. may or may not actually be taken forward. There is thus a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which might arise from such proposals. For example, relevant projects/plans that are already under construction are likely to contribute to cumulative impact with the Wind Farm (providing effects or spatial pathways exist), whereas projects/plans not yet approved or not yet submitted are less certain to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors. In this context, the term 'projects' is considered to refer to any project with comparable effects and is not limited to offshore wind projects.
- 71 The full list of projects considered within the CIA are listed below:
- Worst-case scenario of the NnG Wind Farm (consented 2014) or as per the 2017 Scoping Report;
 - Worst-case scenario for the Seagreen Alpha and Bravo Wind Farm (consented 2014) or Seagreen 2017 Scoping Report (see paragraph below);
 - Hywind Scotland Park;
 - Blyth Offshore Demonstrator Wind Farm (Phase 1 to 3);
 - Beatrice Offshore Wind Farm;
 - Moray Offshore Renewables Ltd (MORL) Eastern Development Area or MORL Eastern Development Area (Alternative Design) Scoping Report;
 - Moray West Offshore Wind Farm;
 - European Offshore Wind Deployment Centre;
 - Kincardine Floating Offshore Wind Farm;
 - Forthwind Offshore Wind Farm Phase 1 and 2; and
 - Offshore Renewable Energy Catapult Levenmouth.
- 72 As the baseline and status for cumulative projects are ever evolving a cut-off date of November 2017 was used to allow the EIA and CIA to progress. ICOL appreciates and acknowledges that the status of some of these projects may have changed since this date and note however that the individual status of projects has not been updated in the EIA Report due to the time restrictions associated with the assessment.
- 73 It is assumed that those offshore wind farms, that have been consented, or are operational, have (or will have) technical mitigation in place (if required), which will mitigate effects to any relevant radar systems.

- 74 In assessing the cumulative impacts for the Inch Cape Wind Farm, the worst-case scenario with respect to the consented design envelopes for the NnG and Seagreen offshore wind farm projects has been considered. A second scenario which incorporates the design envelopes for the proposed NnG and Seagreen projects as detailed in the Scoping Reports submitted to MS-LOT in 2017 is considered to be the likely worst-case scenario as any increase in WTG blade tip height above LAT, is likely to increase detectability to regional radar systems.

17.10.2 Operational Phase Impacts

Leuchars Station PSR

- 75 The Leuchars Station PSR has a Declared Operational Coverage (DOC) of 40 NM. Therefore, the potential for cumulative effect is limited to those developments, within 40 NM of the PSR, which unmitigated could create a cumulative impact. The parameters which make up the worst-case scenario are those which would cause the greatest cumulative impact on the Leuchars PSR i.e. largest number of tallest WTGs within radar LOS.
- 76 Radar LOS indicates that the Development Area will be theoretically detectable by the Leuchars Station PSR. It is expected that due to lack of intervening terrain that the NnG and Seagreen Phase 2 wind farms will also be detectable by the radar. As per the Development alone, increased radar clutter may hamper the controllers' ability to distinguish actual aircraft returns from those created by the wind farms. Radar detectability of the wind farms would create, in effect, a larger area within which significant clutter can be expected from detectable WTGs. It is evident that, as larger areas are covered and the extent of the clutter increases, the availability of uncluttered airspace reduces.
- 77 The sensitivity of the receptor is high. The magnitude of impacts is assessed as high. Consequently, the cumulative impact has been assessed to be **major** which therefore is a significant effect for the purposes of this assessment.

RRH Brizlee Wood and RRH Buchan ADRs

- 78 The RRH Brizlee Wood and Buchan ADRs are thought to have an operational range of 200 NM although due to the sensitivity of the role completed by the radar systems, exact operating parameters are not known. Other unmitigated developments which are within radar LOS to the radar systems within operational range could create a cumulative impact. The MOD (DIO) response to scoping indicates that the quantity of the WTGs detectable to the ADRs of the proposed project alone will exceed the MOD's cumulative effect threshold. It is implicit that the more sites that are proposed or built, the greater the impact on the provision of radar services. In effect, a larger area within which significant clutter can be expected will be created from unmitigated developments.
- 79 The sensitivity of the receptor is high. The magnitude of impacts is assessed as high. Consequently, the cumulative impact has been assessed to be **major** which therefore is a significant effect for the purposes of this assessment.

17.11 Impact Interactions

- 80 The potential for individual impacts from the Development alone and from other projects to interact and create new, or more significant or greater long-term effect has been reviewed. No such interactions have been identified.

17.12 Additional Mitigation

Leuchars Station PSR

- 81 The Leuchars Station PSR will theoretically detect the Development Area WTGs; this detection will result in an unacceptable impact to the radar system and the provision of an ATS and will require the application of an agreed mitigation strategy.
- 82 The airspace regulator, the CAA, has approved an Airspace Change Proposal for the introduction of a TMZ over the Development Area in relation to the Inch Cape 2014 consented parameters. The Airspace Change would occur in two stages; stage one includes radar blanking of the Leuchars Station PSR; stage two is the introduction of the TMZ covering the Development Area.
- 83 The carriage and operation of transponder equipment in the aircraft is mandatory whilst flying within a TMZ, this enables a controller to track the aircraft using the data from its Secondary Surveillance Radar (SSR) transponder and provide a SSR Alone radar service. As identified in the Leuchars SA NnG and Inch Cape Offshore Wind Farm TMZ (MOD, 2017), the TMZ airspace will allow Leuchars ATC to continue to provide safe and expeditious air traffic services within its area of responsibility when the offshore wind turbines are operational, using SSR only.
- 84 The Hazard/Risk Owner (Station Commander RAF Lossiemouth) has noted contentment with the proposals for the Leuchars TMZ and that the risk is Tolerable and 'As Low As Reasonably Practicable' (ALARP). Furthermore, the Hazard/Risk Owner notes that *"...aircraft would have to enter the zones unseen and that they are over the sea making undetected entry less likely. This is to be reviewed on usual timescales or with the introduction of any Project Marshall changes"*. Therefore, ICOL consider the TMZ as an enduring solution, removing any impact created by the Wind Farm; however, the MOD considers that this option as an interim solution. Therefore, if an improved, enduring PSR technical solution is identified, tested and implemented, ICOL consider that this solution must be cost effective, time bound and subject to the usual MOD approach to mitigation (ALARP principle).
- 85 With the agreed two stage TMZ mitigation in place, the sensitivity of the receptor is high, and the magnitude of impact is negligible; therefore, the residual impact would be of minor significance, which is not significant effect for the purposes of this assessment.
- 86 With regard to cumulative effects, it is understood that a TMZ has also been approved for the NnG Wind Farm. It is assumed that such an arrangement will also be agreed for Seagreen Phase 1 Offshore Wind Farm if required.

Enduring Technical Solution

- 87 Previous technical mitigation solutions accepted by the MOD for radar impacts have included 'in-fill' solutions. An in-fill solution involves the removal of PSR data where radar clutter is anticipated in the vicinity of the WTGs, and replacing it with data from an alternate radar source which is not affected by radar clutter. The MOD has previously stated a requirement for 'seamless integration' to be an integral factor in the acceptability of any technical in-fill mitigation solution for ATC radar. A number of emerging technologies may potentially offer acceptable technical mitigation for ATC radar impacts and have been considered by some airports across the UK in wind farm mitigation procurement activities. As noted above, should an improved technical solution be identified, tested and implemented by the MOD, ICOL consider that this solution must follow the ALARP principle.

RRH Brizlee Wood and Buchan ADRs

- 88 The RRH Brizlee Wood and RRH Buchan ADR systems will theoretically detect WTGs of 291 m above LAT blade tips within the Development Area. The MOD (DIO) have stated in their response to scoping that several of the WTGs within the Development Area are within radar LOS to both RRH Brizlee Wood and RRH Buchan ADR systems.
- 89 RRH Brizlee Wood and RRH Buchan (which have been upgraded to TPS-77 radar standard) have an inherent resilience, utilising hardware and software, to WTG induced clutter through the use of pulse Doppler processing. However, where the inherent radar performance is not considered satisfactory for ADR purposes, the TPS-77 has an enhanced signal processing capability, which enables the implementation of a Non-Automatic Initiation Zone (NAIZ).
- 90 A NAIZ prevents the radar from automatically creating tracks from any returns that originate within the lateral confines of the NAIZ. In creating a NAIZ around a wind farm, none of the WTG radar returns will be processed, thereby significantly reducing the possibility of unwanted tracks. Mature tracks, which have been formed from returns originating outside the NAIZ (an aircraft transiting through the NAIZ) will still be tracked and updated. If it is concluded that the addition of NAIZ to the TPS-77 at RRH Brizlee Wood and RRH Buchan is not suitable, a technical solution/mitigation will be agreed with the MOD prior to construction.
- 91 It is likely that the MOD (DIO) would need to consider the cumulative effects of multiple wind farms in the region as there might be limitations on the signal processing capability of the ADR TPS-77 radar system to implement a technical solution for other offshore wind farms within the area (consented and in development) which are also detectable by the RRH Brizlee Wood and RRH Buchan ADRs. If this mitigation solution is not acceptable an alternative technical mitigation solution will be agreed with the MOD before construction.
- 92 It is the desire of ICOL that a collaborative approach to mitigating the effects of the Development with adjacent developments is undertaken to ensure an acceptable effect on the Leuchars ATC PSR and Brizlee Wood and Buchan ADRs. ICOL will continue to work with

other developers and the MOD to ensure that opportunities are identified, and where possible, mitigation proposals are aligned.

- 93 With mitigation in place, the sensitivity of the receptor is high and the magnitude of impact is negligible; therefore, the impact would be of minor significance, which is not significant effect for the purposes of this assessment.

17.13 Conclusion and Residual Effects

17.13.1 Development Area

- 94 In the absence of mitigation, significant effects on the following identified receptors will occur:

- Leuchars Station PSR;
- RRH Brizlee Wood ADR; and
- RRH Buchan ADR.

- 95 When suitable technological mitigation is procured and in operation, there will be a minor residual effect on the Leuchars Station PSR and the RRH Brizlee Wood and RRH Buchan ADR systems.

Table 17.9: Summary of effects and mitigation

Impact	Receptor	Pre-mitigation Effect	Mitigation	Post-Mitigation Effect
O&M				
ATC Radar	Leuchars Station PSR	Significant	Mitigation in the form of the regulator approved TMZ and associated radar blanking will remove the WTG radar returns from the Leuchars Station PSR, or if an enduring technical solution is identified (which has to be cost effective, time bound and subject to the usual MOD approach to mitigation (ALARP principle)) or should the ATC PSR no longer be operational, no mitigation will be required.	Not Significant
ADR	RRH Brizlee Wood and RRH Buchan ADRs	Significant	Subject to stakeholder approval technical mitigation will most likely be in the form of modifications to the Brizlee Wood and Buchan ADRs in the form of a NAIZ which will	Not Significant

Impact	Receptor	Pre-mitigation Effect	Mitigation	Post-Mitigation Effect
			remove impact to the Brizlee Wood and Buchan ADRs. If this mitigation solution is not acceptable a technical mitigation solution will be agreed with the MOD before construction.	

17.13.2 Cumulative Impacts

- 96 The conclusions for the Development with other projects are the same as the Development Area in isolation.

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