

Technical Aerodrome Safeguarding Assessment

Mayfield Medlock Limited

Mayfield Plot 1b

November 2024

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ADMINISTRATION PAGE

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been commissioned to investigate the potential impact of a proposed building development upon aviation activity and infrastructure associated with Manchester Airport. The proposed development is located off Hoyle Street, Manchester, approximately 12.5km north-east of Manchester Airport.

The proposed development will consist of four towers, with a maximum altitude of 129.44m above ordnance datum (AOD) and a maximum height of 90.64m above ground level (agl).

Overall Conclusions

Line of sight analysis has been undertaken for the proposed development with respect to the Secondary Surveillance Radar (SSR) at Manchester Airport. When considering additional screening the analysis shows that three buildings within the proposed development would be significantly screened from the SSR. The J01 building is however predicted to be visible to the SSR and therefore a technical impact upon the radar is considered possible. Due to the location of the proposed development within Manchester Airport's operational airspace, an operational impact is predicted and mitigation may be required.

If mitigation is required, the most likely solution would be a technical fix to the radar implemented by NATS, whereby the building development is defined as a known reflector. The feasibility of the solution would need to be discussed with NATS, but this solution is routinely implemented for developments of this type in the vicinity of SSR. The fee for implementation would be payable to NATS.

The proposed development is vertically clear of the Obstacle Limitation Surfaces (OLS) for Manchester Airport by a minimum margin of 77m, and therefore will not present a collision risk with respect to the OLS. As long as any cranes used during construction do not exceed 77m above the maximum building height, they will also remain clear of the OLS.

The proposed development is not predicted to impact the Instrument Flight Procedures (IFPs). It is possible however that a detailed IFP assessment may be requested by Manchester Airport Group (MAG), who safeguard Manchester Airport. If a detailed IFP assessment is required, details of any proposed crane locations, heights, and jib radius will need to be provided.

Considerations of aviation lighting indicate that aviation lighting is unlikely to be required for the proposed development, based on the proposed height of the development.

An aviation lighting scheme for cranes is likely to be required for any cranes measuring 150m or more agl or above. A lighting scheme will need to be agreed with the CAA and MAG.

It is recommended that this report is provided to Manchester Airport and NATS for their comment and position on the proposed development.

Technical Summary

Manchester Airport SSR

The proposed development is located approximately 15.3km from the SSR at Manchester Airport. One of four proposed towers is predicted to be visible, with the remaining three predicted to be significantly screened by existing obstructions along the line-of-sight profile.

The proposed development will be of similar scale to those surrounding it. No significant shadowing effects are anticipated.

The radar has specific features that reduce the radar's susceptibility to interference from buildings. Whilst the impact is predicted to be relatively small, due to the advanced built-in capabilities for increasing its reliability and performance, the potential for some adverse effects on the radar cannot be conclusively ruled out. Therefore, mitigation may be required.

If mitigation is required, the most likely solution would be a technical fix to the radar and implemented by NATS. The solution would define the building as a known reflector and has been implemented for many developments of this type in the vicinity of SSR.

Consultation with NATS, who safeguards the Manchester Airport radar, is recommended.

Manchester Airport's Obstacle Limitation Surfaces

- The proposed development is vertically clear of the Obstacle Limitation Surface (OLS) and beneath the Outer Horizontal Surface (OHS) for Manchester Airport;
- The analysis has shown that the proposed development, with a maximum altitude of 129.44m AOD, is vertically clear of the OHS. The minimum margin of clearance is 77m;
- Any cranes less than 77.00m above the maximum height of the development will also be clear of the OHS.

Instrument Flight Procedures at Manchester Airport – High-Level

A high-level review of the IFPs relative to the proposed development indicates sufficient clearances between the proposed development and aircraft flying procedures. There are also taller existing buildings in the surrounding area that already co-exist with the current IFPs. Therefore, no impact upon the IFP is predicted. It is possible however that a detailed IFP assessment may be requested by MAG. If a detailed IFP assessment is required, details of any proposed crane locations, heights, and jib radius will need to be provided.

Aviation Lighting and Crane Usage – High-Level

The following is true regarding the proposed development:

- The structure itself does not extend above to 150m agl or more (the building has a maximum height of 129.44m agl);
- The building does not infringe the OLS;
- Cranes are not expected to breach the OHS or extend to 150m agl or more. Crane that do breach or exceed to 150m agl or more, will require aviation lighting.

On this basis, aviation lighting is not mandatory for the building structure as per the associated Air Navigation Order guidance.

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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 60 countries within Europe, Africa, America, Asia and Oceania.

The company comprises a team of experts to provide technical expertise and guidance on a range of planning issues for large and small developments.

Pager Power was established in 1997. Initially the company focus was on modelling the impact of wind turbines on radar systems. Over the years, the company has expanded into numerous fields including:

- Renewable energy projects;
- Building developments;
- Aviation and telecommunication systems.

Pager Power prides itself on providing comprehensive, understandable and accurate assessments of complex issues in line with national and international standards. This is underpinned by its custom software, longstanding relationships with stakeholders and active role in conferences and research efforts around the world.

Pager Power's assessments withstand legal scrutiny and the company can provide support for a project at any stage.

1 BACKGROUND

1.1 Introduction

Pager Power has been commissioned to investigate the potential impact of a proposed building development upon aviation activity and infrastructure associated with Manchester Airport. The proposed development is located off Hoyle Street, Manchester, approximately 12.5km north-east of Manchester Airport.

The proposed development will consist of four towers, with a maximum altitude of 129.44m above ordnance datum (AOD) and a maximum height of 90.64m above ground level (agl).

Building developments have the potential to affect aviation operations in numerous ways. The most common impacts relate to building developments as physical obstructions both to aircraft and wireless signals used for radar and radio systems. This assessment has identified and assessed all the aviation constraints for the proposed development.

In detail the report includes:

- Proposed development details;
- Radar impact assessment for the Manchester Airport Secondary Surveillance Radar (SSR);
- Obstacle limitation surfaces (OLS) assessment for Manchester Airport;
- High-level assessment of Instrument Flight Procedures (IFPs);
- Commentary on crane usage and lighting requirements;
- Overall conclusions and recommendations.

Following the results of the analysis, conclusions and recommendations are made.

1.2 Proposed Development Site Layout

The proposed development consists of four tower blocks, referenced “J01”, “J02”, “K1”, and “K2”. The site layout plan¹ for blocks J01 and J02 are shown in Figure 1 below.

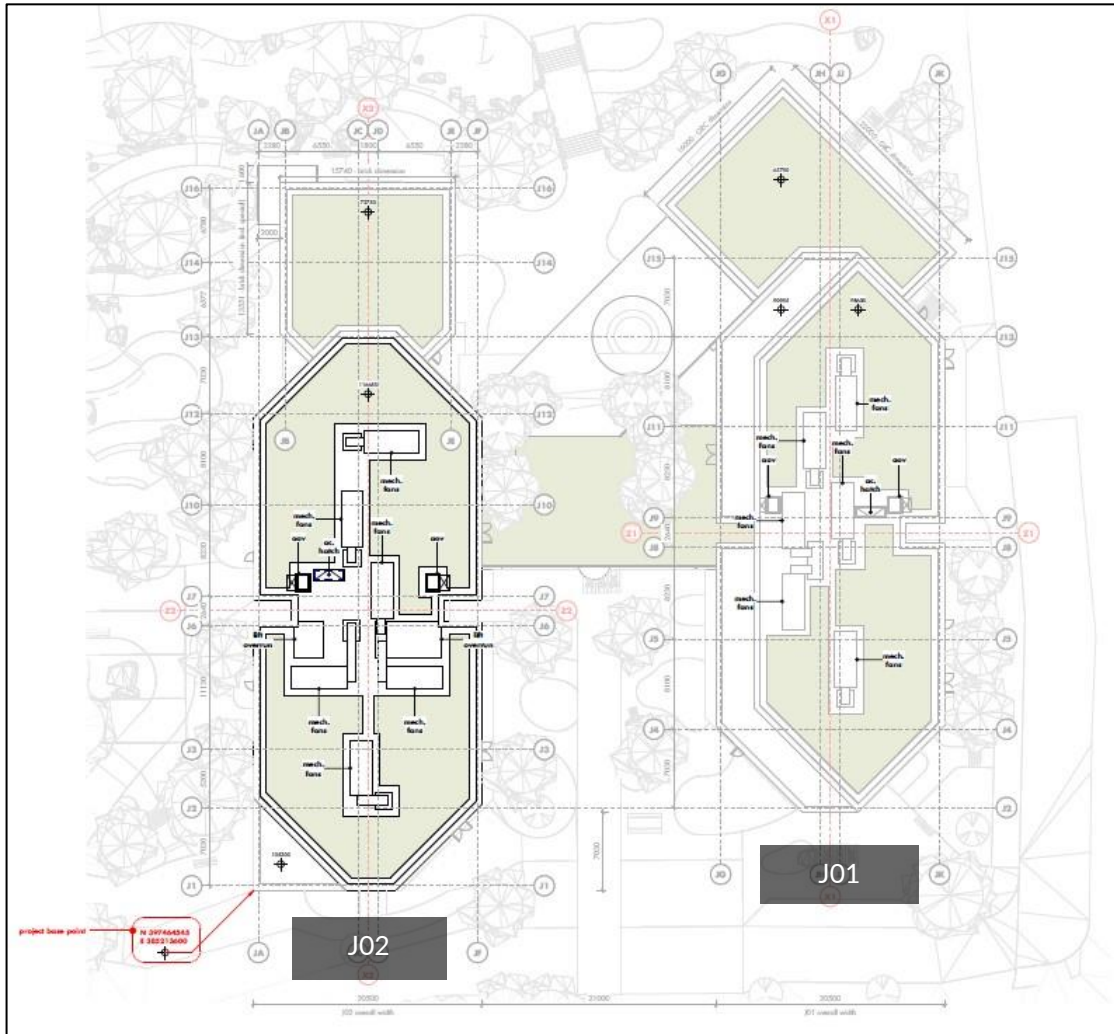


Figure 1 Proposed development site layout plan – Buildings J01 and J02

The site layout plan² for blocks K1 and K2 are shown in Figure 2 on the following page.

¹ Source: 0200_MAY-SKM-J0X-123R-DR-A-039123_P01.01.pdf

² Source: 0199-MAY-SEW-K01-128L-DR-A-001128.pdf

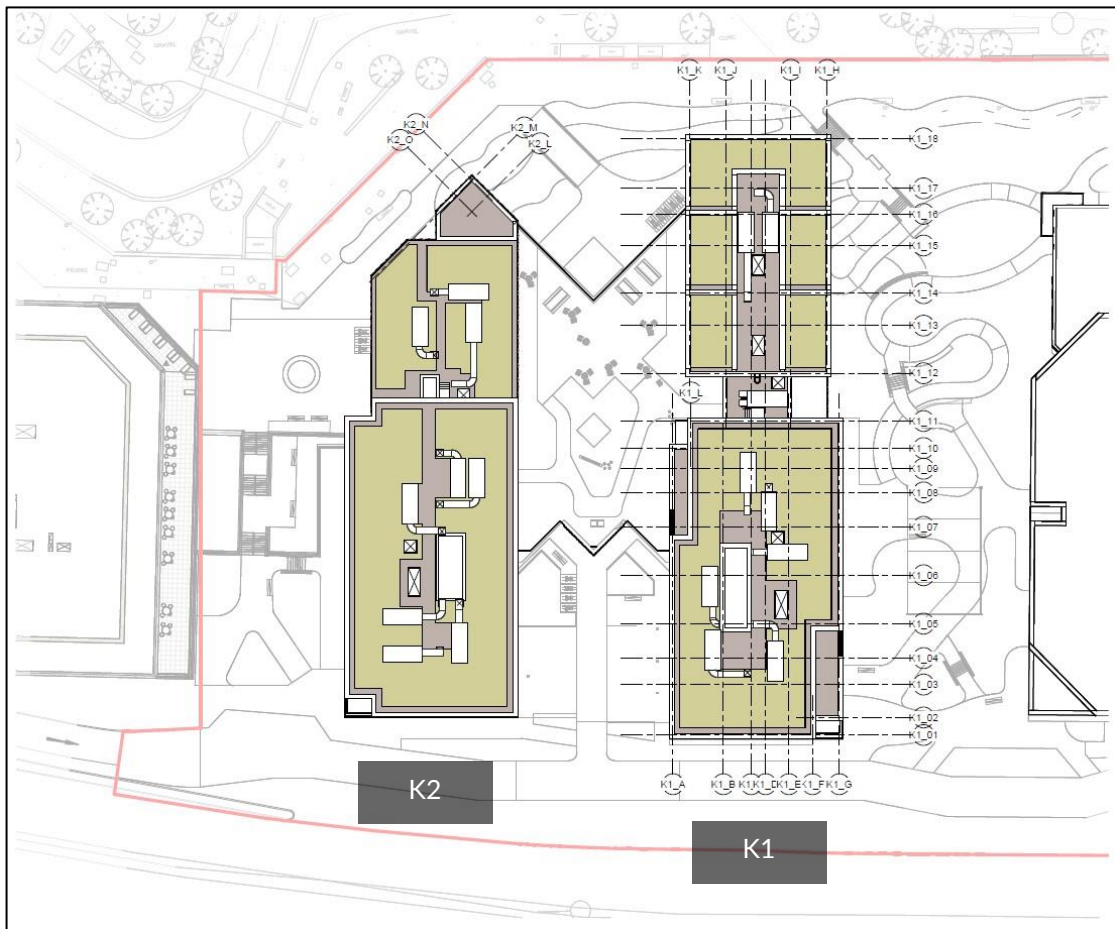


Figure 2 Proposed development general arrangement plan - Buildings K1 and K2

1.3 Maximum Elevations

The towers' heights and altitudes information³ are presented in Table 1 below.

Plot	Height (agl)	Altitude (AOD)
J01	77.7m	117.7m
J02	59.7m	99.7m
K1	89.44m	129.44m
K2	66.14m	105.14m

Table 1 Tower block heights and altitudes

³ AOD values confirmed by email dated 25/10/2024. AGL values are calculated from AOD values and OSGB terrain data.

1.4 3D Building Representation

The corner coordinates for the tower blocks have been extrapolated from the site drawing and are presented in Appendix A.

A representative 3D aerial image of the proposed development is shown in Figure 3 below.

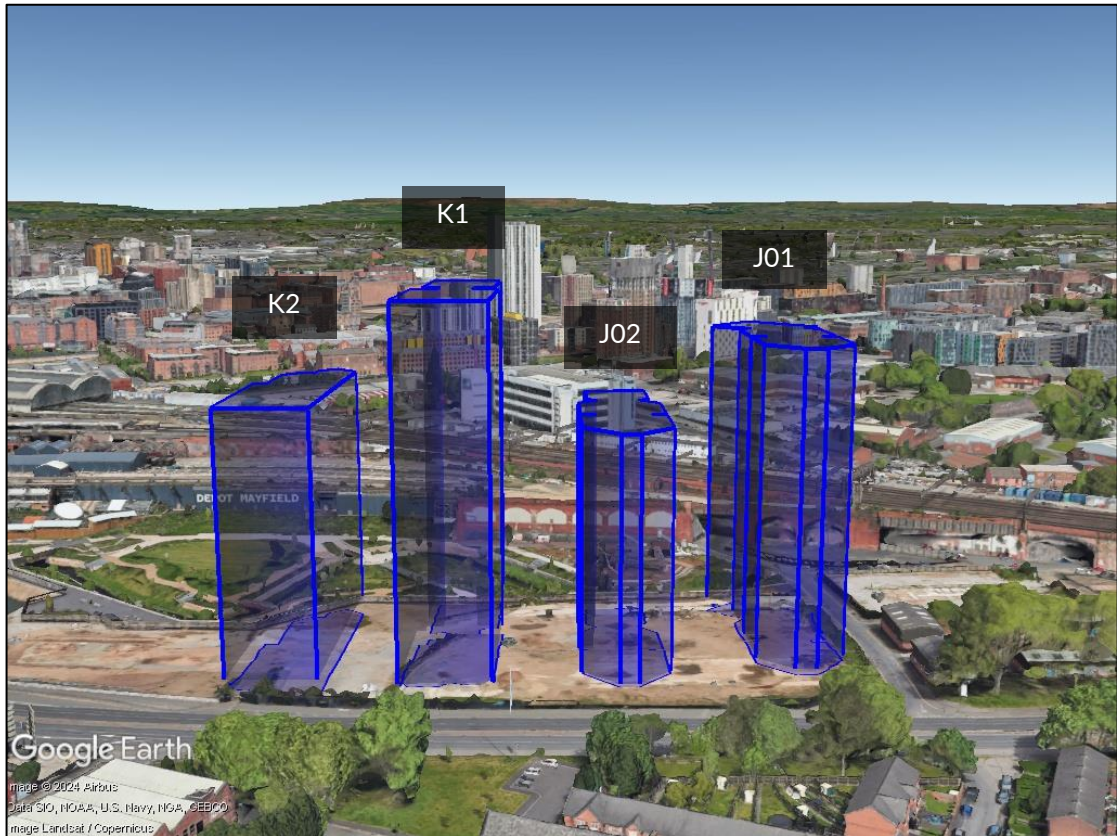


Figure 3 3D building representation

2 MANCHESTER AIRPORT DETAILS

2.1 Aerodrome Details

Manchester Airport is approximately 12.5km south south-west of the proposed development. The location relative to the proposed development is shown in Figure 4 below.

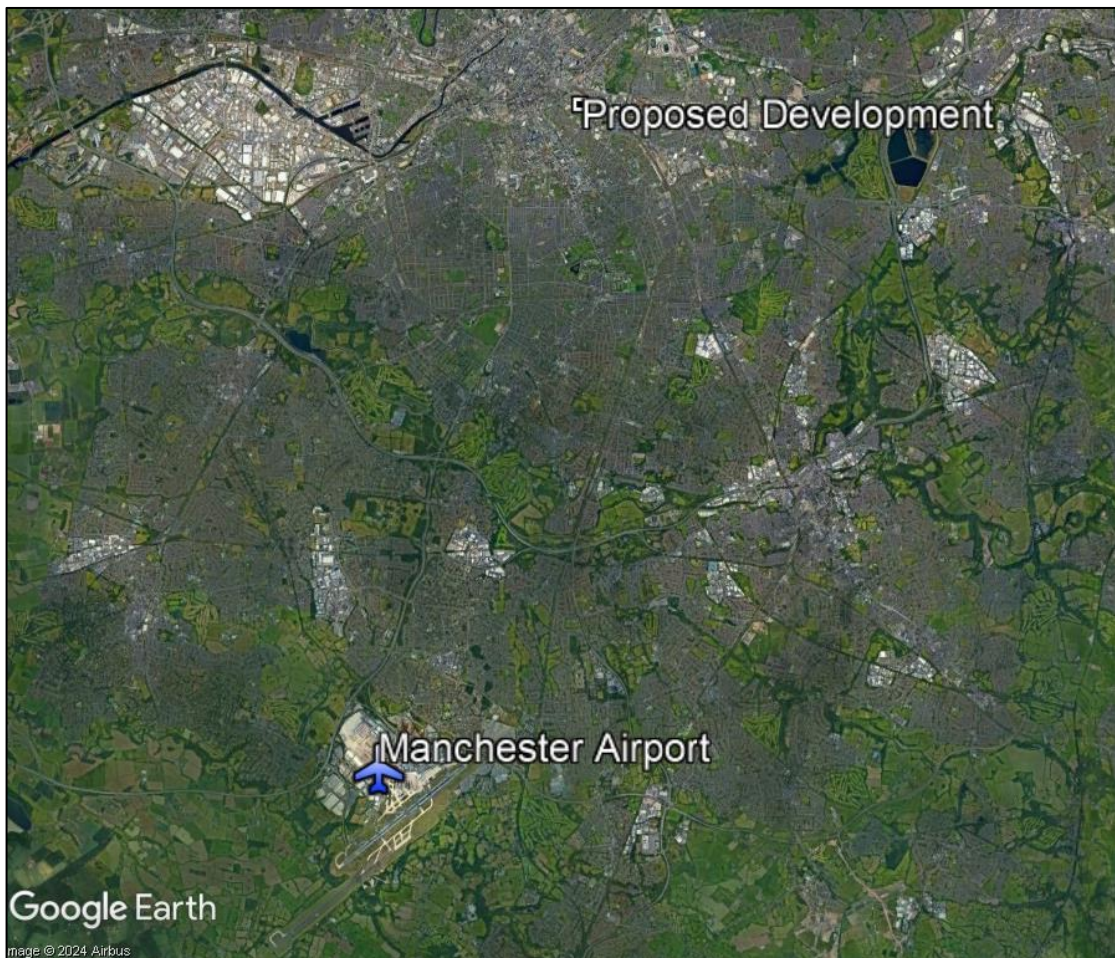


Figure 4 Location of Manchester Airport relative to the proposed development

Manchester Airport is a CAA licenced airport with an ATC Tower and two runways. The runway details⁴ are presented below:

- 05L/23R measuring 3,048m by 45m (concrete and asphalt);
- 05R/23L measuring 3,050m by 45m (concrete and asphalt).

The aerodrome chart for Manchester Airport is shown in Figure 5 on the following page.

⁴ NATS AIP

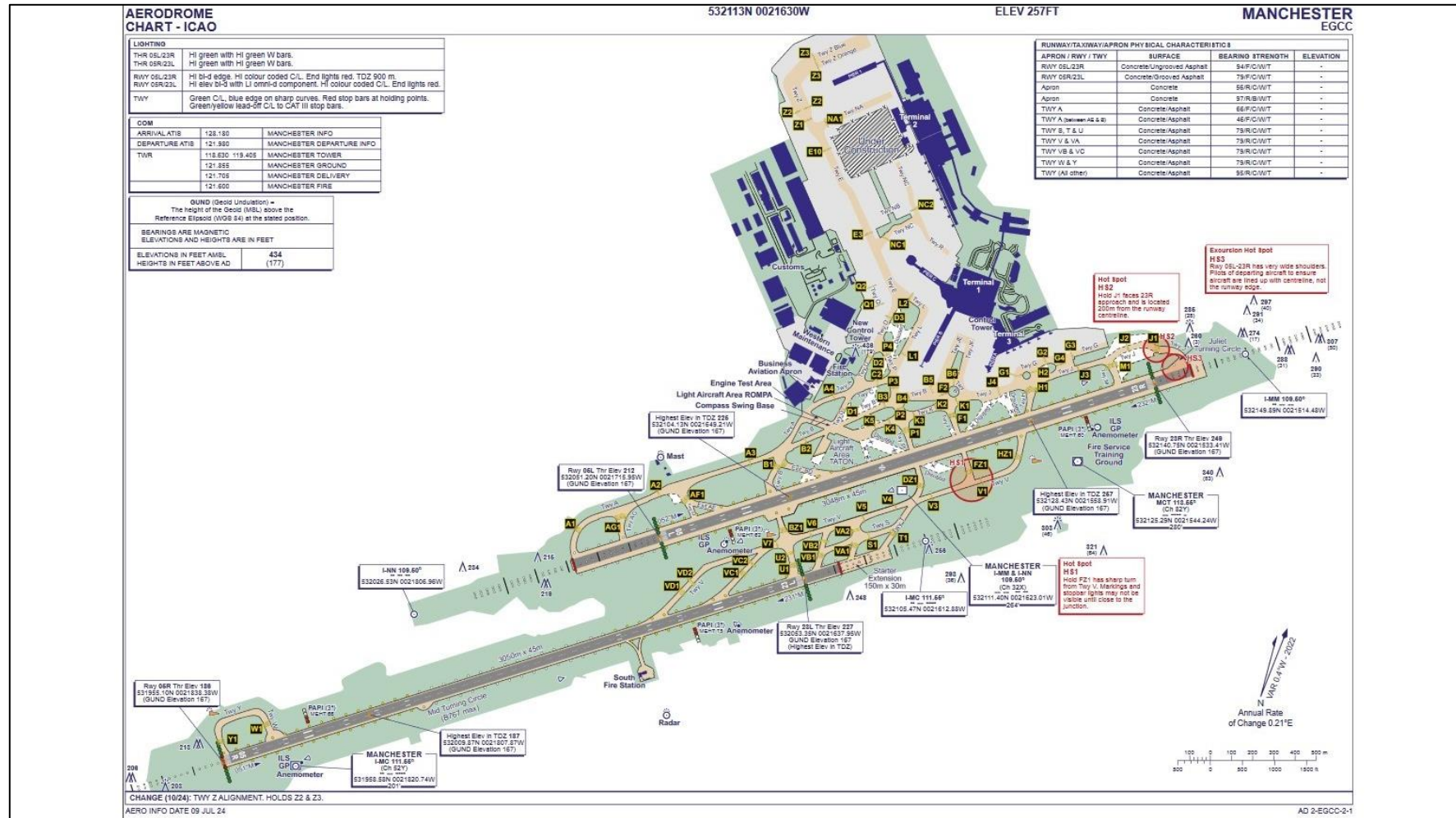


Figure 5 Aerodrome Chart for Manchester Airport

3 RADAR INFORMATION

3.1 Radar Data

Table 2 below provides the details for the assessed Manchester Airport SSR radar. Radar data has been provided by NATS.

Radar	Secondary Surveillance Radar (SSR)
Overall radar altitude above mean sea level	97m
Distance between the proposed development and radar	15.3km
Average grid bearing from radar to proposed development	14.6°

Table 2 Manchester Airport SSR radar location details

3.2 Radar Types and Usage

There are two radar situated upon the metal lattice tower. The lower radar is a non-cooperative PSR, the taller is the co-operative SSR which has been assessed within this report.

SSR broadcast interrogating radio signals that are detected by aircraft with on-board transponders. The transponder responds by broadcasting a radio reply which normally contains identification and altitude information. The SSR determines the aircraft's horizontal position from the direction the antenna is orientated and the time taken to receive a response from the interrogation.

Both radar will be used by air traffic controllers to provide approach services to aircraft landing at and departing Manchester Airport. Both radar will also be used by air traffic controllers at national air traffic control centres to provide services to en-route aircraft.

The radar of significance with respect to the predicted impact is the SSR. The PSR is not expected to be significantly affected.

3.3 SSR Location

The location of the SSR for Manchester Airport is shown in Figure 6 on the following page.



Figure 6 Location of the SSR within Manchester Airport

4 RADAR INTERFERENCE

4.1 Overview

An overview of the various possible interference mechanisms is presented in the following subsections.

4.2 Interference

Buildings, structures and terrain can interfere with SSR. The level of interference normally depends on the size of the interfering structure and its distance from the radar. A larger structure closer to the radar is more likely to interfere than a smaller structure which is further away. The two predominant forms of interference are considered. These are listed in the following subsections.

4.2.1 Reflections

Reflections from a structure can potentially result in genuine aircraft returns being plotted in the wrong place as a result of the structure reflecting signals in a specular (mirror-like) way. This means that an air traffic controller could mis-manage aircraft, leading to safety implications.

Both in-bound and out-bound signals are weakened due to reflections because they are reflected by a structure in both directions.

4.2.2 Shadowing

Radar signals are weakened by physical obstacles. The most significant signal blocking is often caused by terrain. Large obstructions within a radar's area of coverage can have a 'shadowing' effect, reducing the signal strength immediately behind them.

This effect is most pronounced immediately behind the structure and becomes less pronounced with distance. This is important because it means a structure's 'shadow' does not block radar coverage indefinitely, and the areas with the highest losses should be considered in an operational context.

Both in-bound and out-bound signals are weakened by shadowing because signals are attenuated by a structure in both directions.

4.3 SSR Capabilities

The radar is a Secondary Surveillance Radar (SSR) fitted with a Large Vertical Aperture (LVA) antenna. The radar is located to the south of Manchester Airport. It is a Mode S monopulse SSR supplied by Raytheon Systems Limited as part of a nationwide contract to upgrade NATS' national network of twenty sites.

The radar is understood to be a Condor 300 dual channel system with Mode S capabilities. This radar has a range of advanced built-in capabilities for increasing its reliability and performance. Specific features that reduce the radar's susceptibility to interference from buildings are listed in Table 3 on the following pages.

Feature	Form of interference	How feature reduces interference	Additional Information
Integral Tracking Function	Reflections	More likely to determine return is genuine if it moves as an aircraft return is expected to.	Ensures good false target suppression.
Refined Algorithms	Reflections and Shadowing	Experience on many sites used to enhance performance.	Ensures good performance in complex environments.
Identification and rejection of false replies	Reflections	False returns are rejected	If two or more replies are identified from the same source all but the first is rejected.
Side Lobe Suppression	Reflections	False returns arising from antenna sidelobes are rejected	P1 and P2 pulses are used. This is an encoding system which enables sidelobe signals to be detected by comparing pulse sizes.
Sensitivity Time Control (STC)	Reflections	Removes reflections	Removes relatively low amplitude replies
Minimum Detection Signal Level (MDS)	Shadowing	Maximises radar coverage whilst minimising noise detections	-
Dynamic Threshold	Shadowing	Weak signals stronger than any interference signals are detected.	-
Reply to Reply Correlation	Reflections	Multiple replies required for target processing	Single reply reports are rejected.
FRUIT ⁵ Rejection	Reflections	Track initiation only allowed if report contains two or more correlating replies in the same SSR mode	e.g. two or more Mode A replies

⁵ FRUIT – False Replies Unsynchronized in Time
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Feature	Form of interference	How feature reduces interference	Additional Information
Track Processing	Reflections and Shadowing	Improvements are made in target location using history of target position.	Improvements made when confidence in location information is low
False Target Processing	Reflections	Advanced processing that applies a series of tests to identify and reject false returns	Techniques include: 1: Check whether Mode A code is unique 2: Check "known" reflection zones 3: Use geometric analysis for checking reflection zones 4: Self adaptive processing

Table 3 Radar features for reducing interference

5 RADAR LINE OF SIGHT ANALYSIS

5.1 Methodology

The approach taken within this report is presented in the following section.

5.1.1 Technical Assessment

- Radar line of sight assessment based on the tower coordinates assessed at their relative height above ground level;
- Screening assessment to determine whether existing buildings and/or landscape features would hide/shield the proposed development from the SSR;
- Consideration of the distance from the SSR.

5.1.2 Cumulative Assessment

- Assessment of the predicted impact in the context of the existing environment has been undertaken.

5.2 Radar Line of Sight Analysis

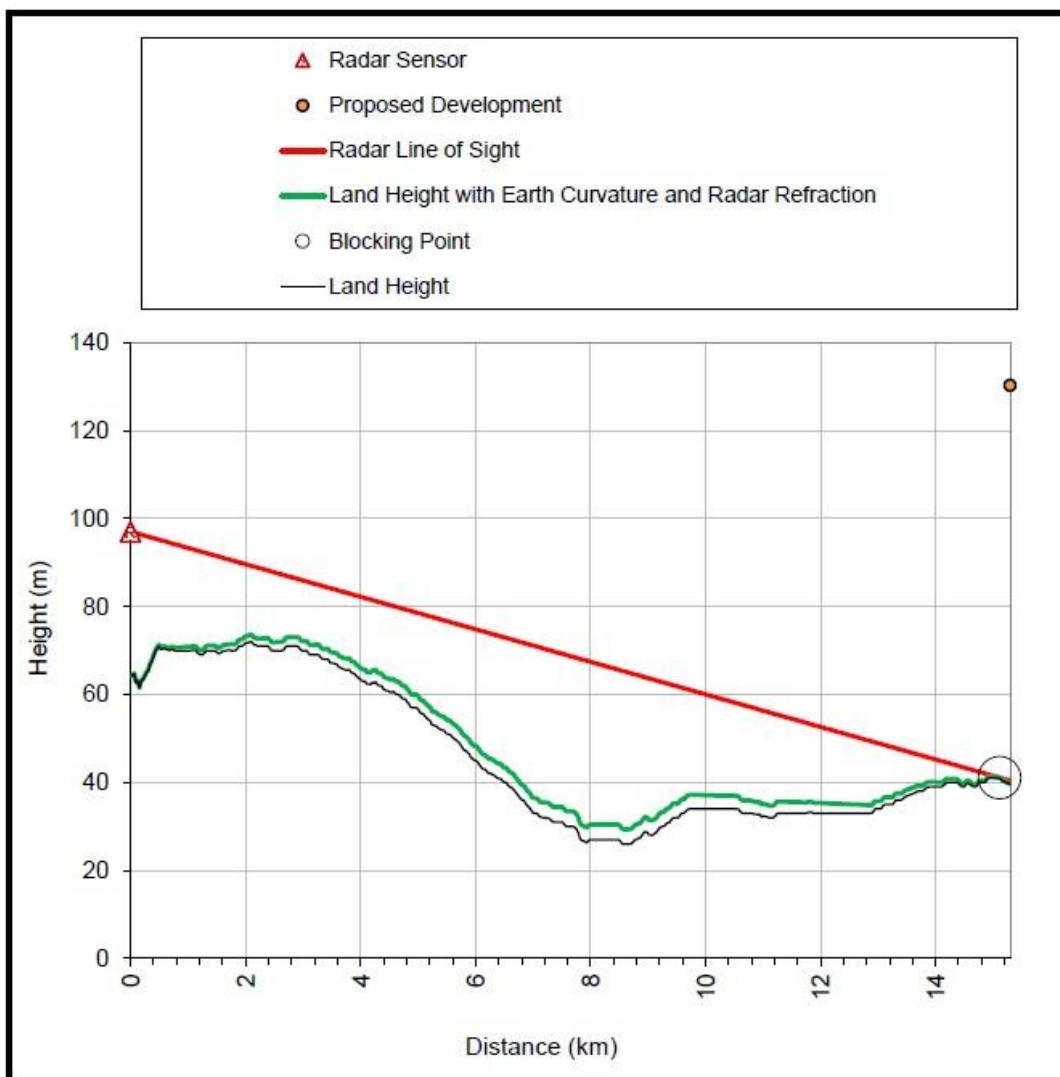
Figure 7 on the following page shows the line-of-sight chart for building K2 (the building with the greatest visibility to the SSR). Information regarding the methodology or the additional line of sight charts can be provided upon request. The tower height above ground level has been adjusted to account for the terrain height based on OSGB36 terrain data at that particular location.

Radar Line of Sight Calculation

Manchester Airport SSR

13229 Mayfield Plot 1b

Building	K2
Result	VISIBLE
Certainty	89.8 metres



Building Height (m)	90.64
Base Elevation (m)	39.6
Building Location	E385151 N397470
Distance to radar (km)	15.3
Blocking Point Location	E385105 N397292
Distance to BP (km)	0.2

Additional Analysis	
Angle (Radar to Tip)	0.073 degrees up
Maximum Tip Height	0.80 metres

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Figure 7 Radar line of sight chart

The box labelled 'certainty' in Figure 7 provides the distance (in metres) by which the proposed development is or is not within line of sight to the assessed radar.

In this case the proposed development would be fully visible considering bare earth terrain.

5.3 Line of Sight Results – Bare Earth Terrain

A summary of the line-of-sight assessments for each building is presented in Table 4 below. The results are shown for the most visible building vertex.

Building	Result (Bare earth terrain)
J01	The building is visible by a margin of 59.1m
J02	The building is visible by a margin of 77.0m
K1	The building is visible by a margin of 64.7m
K2	The building is visible by a margin of 89.8m

Table 4 Line of sight results for each assessed building point – bare earth terrain

5.4 Additional Screening Analysis

The modelling described in the sections above accounts for the intervening terrain. It does not account for additional obstructions within the radar line of sight e.g. buildings or vegetation. A review of additional screening has therefore been undertaken. Figure 8 on the following page shows the line-of-sight towards the proposed development from the SSR. Figure 9 on page 25 shows a closer view of the existing building (4M Office Building) near the airport, which has the potential to obscure visibility from the SSR to buildings J02, K1, and K2 within the proposed development (line of sight to building J01 is not obstructed by the building).

Line-of-sight calculations considering the additional screening identified have been undertaken which conclude that the radar will not have line-of-sight to buildings J02, K1, and K2. Line-of-sight to building J01 is not significantly obstructed.

As such, buildings J02, K1, and K2 are not predicted to be visible to the radar and no technical impact is predicted from these buildings. Building J01 is predicted to be visible and a technical impact upon the radar is considered possible.



Figure 8 Point-of-view from the SSR at Manchester Airport

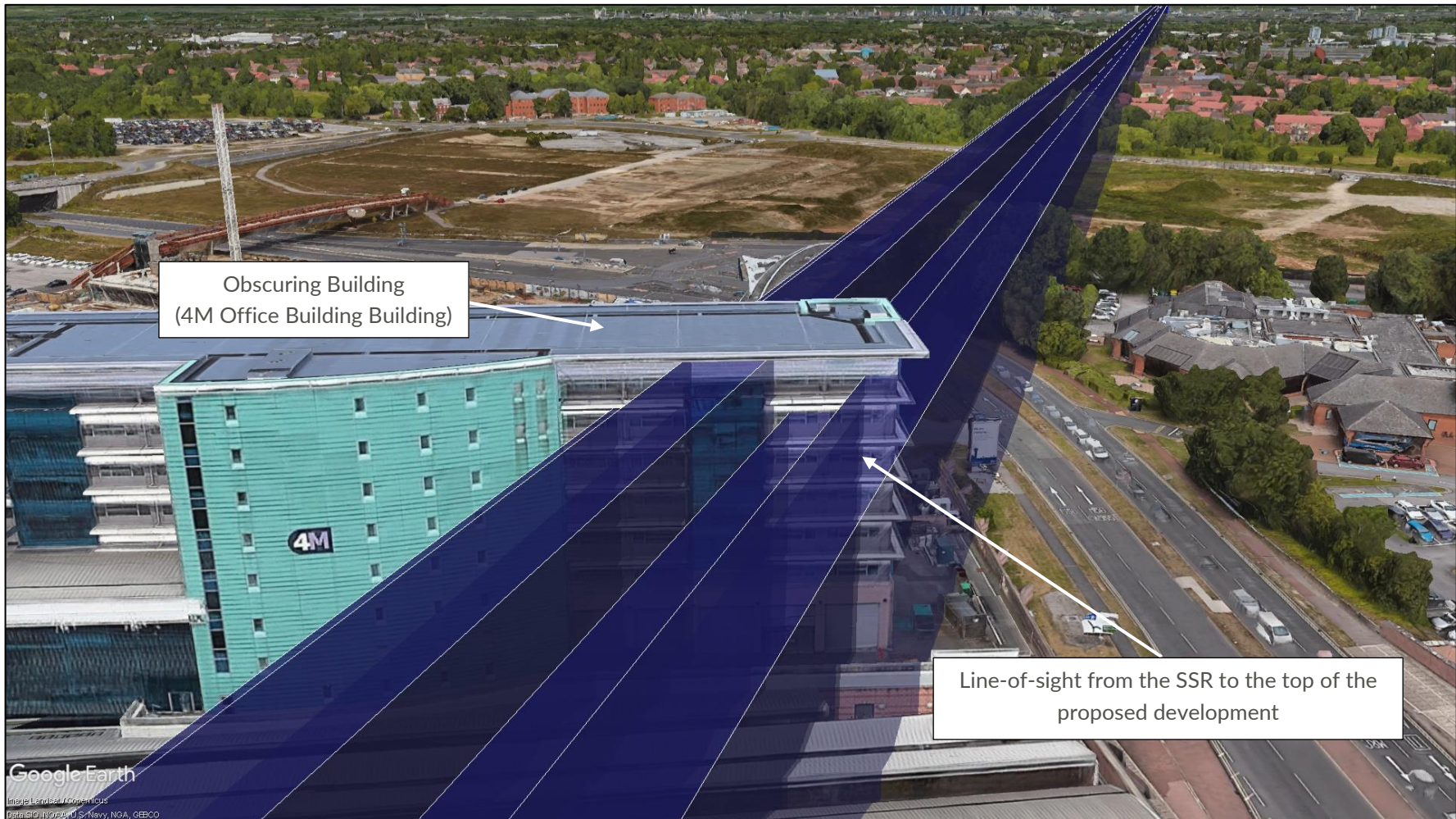


Figure 9 Close view of the existing building development partially obscuring line-of-sight from the SSR – 3D view

5.5 Radar Line of Sight Conclusions

The results show that three buildings within the proposed development would be significantly screened from the SSR at Manchester Airport. The J01 building is predicted to be visible to the SSR and therefore a technical impact upon the radar is considered possible. These are discussed further in the following subsection. Due to the location of the proposed development within Manchester Airport's operational airspace (see Figure 12 on page 33), an operational impact is predicted.

A technical and operational impact is predicted, and mitigation may be required.

5.6 Interference Assessment

SSR radar broadcast interrogating radio signals that are detected by aircraft with on-board transponders. The transponder responds by broadcasting a radio reply which normally contains identification and altitude information. The SSR determines the aircraft's horizontal position from the orientation of the antenna and the time taken to receive a response from the interrogation.

Buildings, structures and terrain can interfere with SSR. The level of interference normally depends on the size of the interfering structure and its distance from the radar. A larger structure closer to the radar is more likely to interfere than a smaller structure which is further away. Two forms of interference have been considered. These are:

1. Reflections – Either in-bound or out-bound signals are reflected off a structure;
2. Shadowing – Either in-bound or out-bound signals are weakened because they are attenuated by a structure.

The proposed development's location, height, and orientation have been reviewed and the reflection and shadow zones considered at a high level.

5.6.1 Reflection Effects

The proposed development can be considered a flat façade acting as a uniform reflector. Reflection effects caused by static structures have the potential to create false targets, azimuth errors and target fading issues. These could occur when an obstruction reflects the outgoing and/or incoming radar signals between the SSR and an aircraft. To be received by the radar the signals also have to be strong enough to be detected. A radar return that is reflected via a building will be significantly weaker than a return received directly from an aircraft. Furthermore, a radar antenna is also designed to have reduced gain at very low angles to reduce ground clutter returns. Overall, radar returns that are reflected via buildings are significantly weaker than those that are received directly from aircraft.

A 59.1m tall section of the façades of the J01 building will be exposed to the radar, where reflections would be geometrically possible, and therefore concerns due to reflections are possible.

In practice, the effects from the proposed development are likely to be small. The radar is understood to be a Condor 300 dual channel system with Mode S capabilities. This radar has a

range of specific features that reduce the radar's susceptibility to interference from buildings as shown in Section 4.3.

Whilst the impact is predicted to be small, the potential for some adverse effects on the radar cannot be conclusively ruled out. It is therefore possible that NATS would object to the development in the absence of mitigation.

The most common mitigation solution for building developments at this range from modern SSR is a software-based solution whereby the building information, specifically coordinates and altitudes of each building corner, are programmed into the radar system such that reflection effects can be ameliorated.

This agreement would be funded by the developer and commercially agreed with NATS via a contract ahead of starting development. Deployment of the solution is typically within six months of the final agreement between the developer and NATS, therefore it is recommended that engagement regarding the mitigation process is progressed with this timescale in mind.

It is possible that NATS would seek to limit any construction at the site to five metres above ground prior to installation of the mitigation solution (i.e. within six months of signing the mitigation agreement).

5.6.2 Shadowing Effects

Shadowing effects will be extremely limited. This is because the development is already within a built-up area of Manchester city centre, including the Deansgate Square Development that consists of four towers. These towers have a similar bearing as the proposed development relative to the SSR.

5.7 Assessment Conclusions

The modelling has concluded that buildings J02, K1, and K2 within the proposed development are not predicted to be visible to the radar and no technical impact is predicted from these buildings. Building J01 is predicted to be visible to the SSR at Manchester Airport.

Whilst the impact is predicted to be small, due to the advanced built-in capabilities for increasing its reliability and performance (see Section 4.3), the potential for some adverse effects on the radar cannot be conclusively ruled out.

Consultation with NATS, who safeguards the radar, is recommended to confirm their position on the proposed development. Mitigation is expected to be required at the cost of the developer.

6 OBSTACLE LIMITATION SURFACES ASSESSMENT

6.1 Overview

The Obstacle Limitation Surfaces (OLS) for Manchester Airport have been modelled with respect to the building plot coordinates. The aim is to identify whether the proposed development would infringe the OLS at Manchester Airport.

6.2 Manchester Airport Obstacle Limitation Surfaces

Obstacle Limitation Surfaces are imaginary planes defined in three dimensions for physical safeguarding purposes (i.e. ensuring that physical structures do not present a safety hazard at an airfield) and are defined around licensed airfields. The dimensions and geometry of the surfaces are constructed based on detailed rules defined in the UK Civil Aviation Authority's Civil Aviation Publication 168. The size of the surfaces is dependent on the number of runways, their dimensions and the procedures carried out at the airfield.

The OLS for Manchester Airport are presented in Figure 10 on the following page. The proposed development building plot coordinates are shown as red crosses. Due to the scale these icons overlap and appear as a single cross.

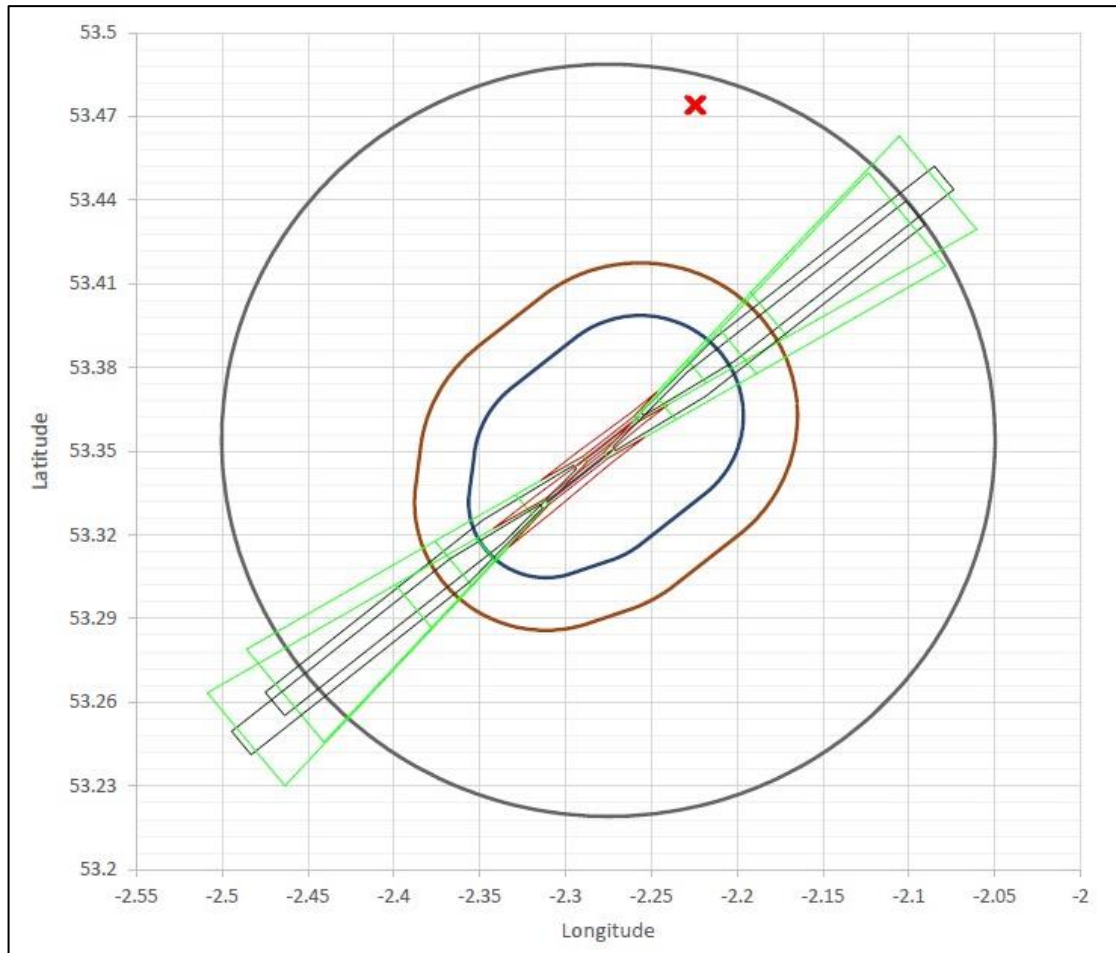


Figure 10 Manchester Airport Obstacle Limitation Surfaces chart

Table 5 below presents a summary of the OLS assessment results.

Building	Distance	Surface
J01	<u>Clear</u> by 107 metres	Outer Horizontal Surface
J02	<u>Clear</u> by 89 metres	Outer Horizontal Surface
K1	<u>Clear</u> by 77 metres	Outer Horizontal Surface
K2	<u>Clear</u> by 101 metres	Outer Horizontal Surface

Table 5 OLS assessment results

6.3 Obstacle Limitation Surfaces Conclusions

The analysis has shown that the proposed development does not infringe the OLS at Manchester Airport. The building is clear of the most restrictive surface (OHS) by a minimum of 77 metres⁶. No physical safeguarding concerns with respect to the OLS and the building structure itself are predicted. Despite the proposed development's clearance of the OHS, cranes could breach the OLS during construction if they are not planned appropriately. It is possible that a crane operation scheme will need to be agreed with Manchester Airport and aviation lighting for cranes and the proposed development (discussed further in Section 8)

⁶ Rounded down to remain conservative

7 HIGH-LEVEL INSTRUMENT FLIGHT ANALYSIS

7.1 Overview

Instrument Flight Procedures (IFPs) are published documents that consist of defined three dimensional routes for aircraft arriving and departing airports.

In practice, aircraft do not necessarily fly these routes exactly due to limitations on the performance of aeronautical instruments, pilots and variations in wind and pressure conditions. This means that an area around and beneath these three-dimensional routes must be kept clear of obstacles to ensure that there is no significant collision risk to aircraft flying these procedures, as shown in Figure 11 below.

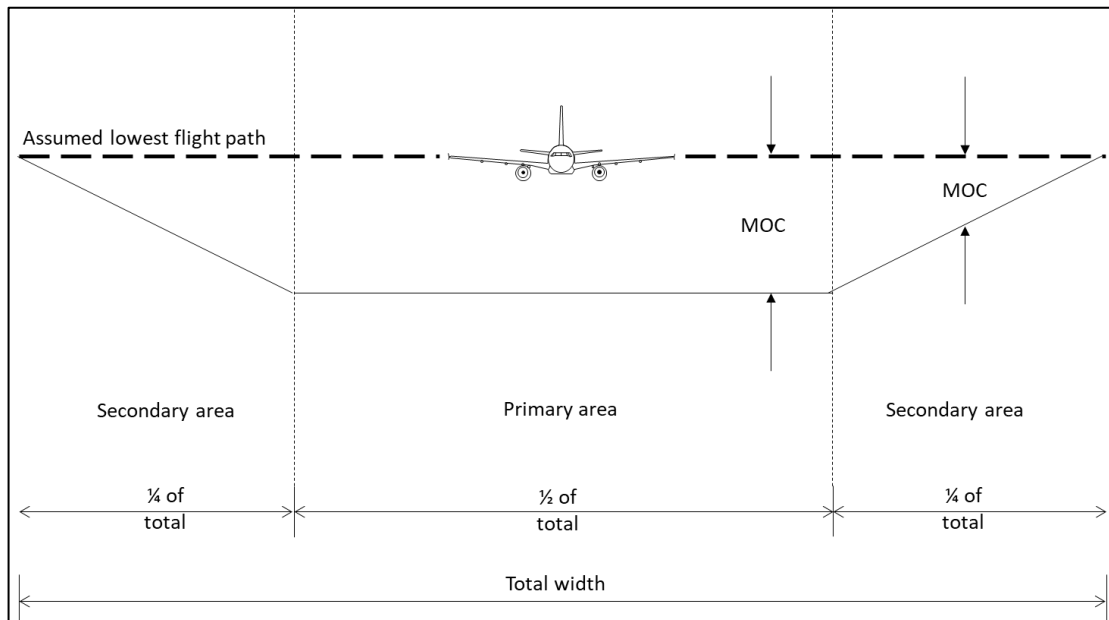


Figure 11 *Instrument Flight Procedure Minimum Obstacle Clearances*

As a general rule, IFPs are designed so that there are vertical and horizontal safety margins between the specified trajectory and surrounding terrain and obstacles. These margins vary depending on the phase of flight and whether UK, European or International rules are being considered. Nevertheless, the vertical margins are typically 300m (984 feet)⁷ except in particularly mountainous regions, which Manchester is not. This means that if the vertical

⁷ 300m (984ft). Procedures for Air Navigation Services, Aircraft Operations (PANS OPS) guidance states 1,000ft. It is open to interpretation whether to apply 984ft or 1000ft. In this report the former has been applied. Procedures for Air Navigation Services, Aircraft Operations, Volume II Construction of Visual and Instrument Flight Procedures. Fifth edition (2006). International Civil Aviation Organization (ICAO). Section 1-1-1-5. Part I – Section I, Chapter I. 'Minimum sector altitude (MSA). The lowest altitude which may be used which will provide a minimum clearance of 300 m (1 000 ft) above all objects located in an area contained within a sector of a circle of 46 km (25 NM) radius centred on a radio aid to navigation.'

clearance between an IFP route and the top of the proposed development exceeds 300m (984 feet) then it will not have a significant safety impact on aircraft flying the route.

The maximum altitude of the proposed development is 424.7 feet. This means that aircraft subject to any IFP route or limit of more than 1,408 feet will not be affected. Key IFPs are discussed in the following subsection.

Aircraft flying IFR have been assessed at a high-level by considering:

- Impact on Manchester Airport Surveillance Minimum Altitude Chart (SMAC);
- Impact on current Manchester Airport Standard Instrument Departures;
- Impact on current Manchester Airport Standard Arrival Charts;
- Impact on current Manchester Airport Instrument Approach Charts.

This has been undertaken to determine whether an impact upon IFPs is likely or whether further, more detailed, analysis is required.

7.2 Minimum Obstacle Clearance

The Minimum Obstacle Clearance provides the minimum obstacle clearance above all obstacles (terrain and structures) in a particular quadrangle of an aeronautical chart. The Area Minimum Altitude shown for the quadrangle in which the development is located is 3,400 feet AMSL. The proposed development has a maximum altitude of 429.1 feet AMSL which is 2,975.3 feet below the Area Minimum Altitude. The proposed development will therefore not affect the current Area Minimum Altitude.

7.3 Surveillance Minimum Altitude Chart (SMAC)

Surveillance Minimum Altitude Charts (SMAC)⁸ are published to show the lowest altitude a pilot will be instructed to fly whilst receiving an air traffic control service. The Manchester Airport SMAC shows that the minimum altitude for the Surveillance Minimum Altitude Area (SMAA) is 2,400 feet AMSL and within a buffer of 5NM of the proposed development. The proposed development has a maximum altitude of 424.7 feet. The vertical clearance between aircraft subject to a radar control service and the top of both buildings will be at least 1,975.3 feet. This is greater than the specified clearance of 984 feet stated in the CAA publication (CAP 777) for designing SMACs. This means that aircraft flying IFR and receiving a radar control service will have an acceptably low collision risk.

Figure 12 on the following page shows the ATC Surveillance Minimum Altitude Chart for Manchester Airport. It presents the approximate location of the proposed development (yellow dot) as well as the area of tall buildings present in the surrounding city centre.

⁸ NATS AIP, AD 2.EGCC-5-1 (cropped)

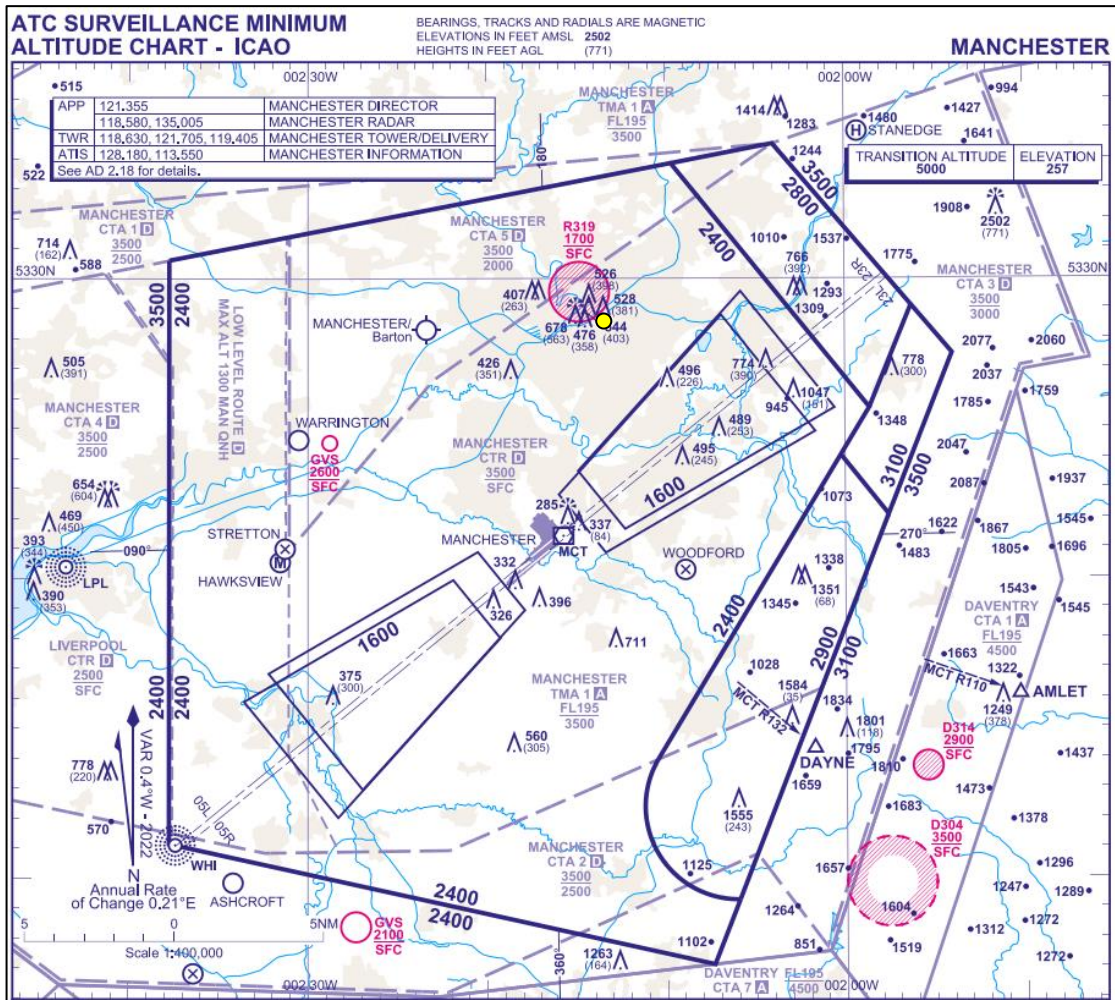


Figure 12 Manchester Airport ATC Surveillance Minimum Altitude Chart

7.4 Minimum Sector Altitudes (MSAs)

The procedures also show MSAs for aircraft flying within 25 nautical miles of an airport.

The MSA⁹ for the sector in which the proposed development is located is 3,500ft, therefore the proposed development is over 3,075 feet vertically clear and therefore will not impact the MSA.

⁹ MSA 25NM NDB(L) BHX and MSA 25NM ARP.

7.5 Omni-Directional Departure Procedures

Omni-directional departures are not used in practice at Manchester Airport but have been assessed as part of a conservative and thorough analysis of instrument flight procedures. If a proposed building is not predicted to infringe omni-directional departures, it can be predicted that the proposed building will not impact other departure procedures. If an infringement is predicted, more detailed analysis of specific departure procedures is undertaken.

Departure charts have been examined to identify the appropriate climb profile. The climb profile varies along and between departure procedures, the lowest profile used is 3.43%, which has been assumed throughout for simplicity. If the proposed development does not infringe under a climb profile of 3.43% it will not infringe when a steeper profile is used.

A maximum allowed height of 1449.73ft (441.88m) AMSL at the location of the proposed development. The maximum elevation of the proposed development is 424.7ft (129.44m). Thus the proposed development is clear of the omni-directional departures by 1025ft (312.4m) and is not predicted to infringe this procedure. Cranes with a maximum altitude lower than 1449.73ft (312.4m) are also not expected to impact this procedure.

7.6 Standard Instrument Departures (SIDs)

As the proposed development is not predicted to infringe the omni-directional departures, the proposed development is also not predicted to infringe specific instrument departures. However, as part of a conservative analysis, each SID is considered in more detail in this section.

Manchester Airport has seven published Standard Instrument Departure procedures (SIDs). Each of these has been assessed with respect to the proposed development. Results of the assessment are shown in Table 6 below and on the following page.

SID Name	Observations	Assessed Impact	Recommendation
MONTY 1R 1S 1Y 1Z	SID is laterally 3.2NM south-west of the proposed development At this point of the procedure, aircraft will be at a minimum altitude of 1,500ft	Aircraft will be 1,075 ft vertically clear of the proposed development, therefore no further impact	No further action
ASMIM 1S 1Z/KUXEM 1R 1Y/EKLAD 1R 1Y	SID is laterally 3.2NM south-west of the proposed development At this point of the procedure, aircraft will be at a minimum altitude of 1,500ft	Aircraft will be 1,075 ft vertically clear of the proposed development therefore no further impact	No further action

SID Name	Observations	Assessed Impact	Recommendation
LISTO 2S 2Z	SID is laterally 5.9NM south of the proposed development	No impact. The development is significantly horizontally clear of this SID	No further action
LISTO 2R 2Y	Runway threshold is 7.9NM to the south-west. SID tracks south-west	No impact. The development is significantly horizontally clear of this SID	No further action
POL 5R 4S 1Y 1Z	SID is laterally 4.4NM south-east of the proposed development At this point of the procedure, aircraft will be at a minimum altitude of 2,500ft	Aircraft will be 2,075 ft vertically clear of the proposed development therefore no further impact	No further action
SONEX 1R 1Y/DESIG 1S 1Z	SID is laterally 1.1NM north of the proposed development At this point of the procedure, aircraft will be at a minimum altitude of 5,000ft	Aircraft will be 4,575 ft vertically clear of the proposed development therefore no further impact	No further action
SANBA 1R 1Y	Runway threshold is 8NM to the south-west. SID tracks south-west	No impact. The development is significantly horizontally clear of this SID	No further action

Table 6 Standard Instrument Departure (SID) assessment results

The building is likely to present an acceptably low collision risk to aircraft flying all Standard Instrument Departure routes.

7.7 Standard Arrival Charts (STARs)

Manchester Airport has four published Standard Arrival (STARs) Charts. Each of these has been assessed with respect to the proposed development. Results of the assessment are shown in Table 7 below.

STAR Name	Observations	Assessed Impact	Recommendation
via ROSUN (north)	Minimum Altitude FL70	Aircraft will be 6,575 ft vertically clear of the proposed development	No further action
via ROSUN (east)	Minimum Altitude FL70	Aircraft will be 6,575 ft vertically clear of the proposed development	No further action
via MIRSI	Minimum Altitude FL70	Aircraft will be 6,575 ft vertically clear of the proposed development	No further action
via DAYNE	Minimum Altitude FL80	Aircraft will be 7,575 ft vertically clear of the proposed development	No further action

Table 7 Standard Arrival Chart (STARs) Assessment Results

Aircraft flying Manchester Airport's Standard Arrival Routes will be at least 6,575 feet vertically clear of the building. This means that such aircraft will have an acceptably low collision risk.

7.8 Instrument Approach Charts

Manchester Airport has 15 published Instrument Approach Charts. Each of these has been assessed with respect to the proposed development. For each, the following have been considered:

- The final approach phase;
- Earlier approach phases shown on the chart;
- Missed approach procedure;
- Decision heights and circling minima;
- Minimum Sector Altitude (MSA) within 25 nautical miles.

Results of the assessment are shown in Table 8 on the following pages.

V = vertically and H = horizontally.

The proposed development is not predicted to impact the Instrument Approach Charts. No further action is recommended.

Name	Final Approach	Earlier Approach	Missed Approach	Decision and Circling	MSA	Assessed Impact	Recommended Action
ILS/DME (I-MC) RWY 05R	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None
ILS/DME (MCT) RWY 05R	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None
LOC/DME (I-MC) RWY 05R	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None
VOR/DME RWY 05R	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None
ILS/DME (I-MM) RWY 05L	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None
ILS/DME (MCT) RWY 05L	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None
LOC/DME RWY 05L	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None
VOR/DME RWY 05L	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None
ILS/DME (I-NN) RWY 23R	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None

Name	Final Approach	Earlier Approach	Missed Approach	Decision and Circling	MSA	Assessed Impact	Recommended Action
ILS/DME (MCT) RWY 23R	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None
LOC/DME RWY 23R	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None
VOR/DME RWY 23R	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None
VOR/DME RWY 23L	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None
RNP RWY 23L	Clear V,H	Clear V,H	Clear V,H	Clear V,H	Clear V	None	None

Table 8 Instrument Approach Charts assessment results

7.9 High-level IFP Assessment – Obstacle Clearance Margins Conclusions

It is likely that if an obstacle does not infringe the OLS it will not adversely affect the IFP. The OLS will not be affected by the proposed development. A high-level review of the IFPs relative to the proposed development indicates sufficient clearances. There are also taller existing buildings in the surrounding area that already co-exist with the current IFPs. Therefore, no impact upon the IFPs is predicted and a detailed IFP assessment is not recommended. It is possible however that this could still be requested by Manchester Airport.

8 HIGH-LEVEL AVIATION LIGHTING AND CRANE USAGE CONSIDERATIONS

8.1 Overview

Aviation lighting is required where an object becomes a collision risk. This is most likely where there is an infringement of the OLS. It also becomes mandatory to have lighting where an object extends to 150m above ground level or more¹⁰. The following section explores the requirement for aviation lighting at a high-level.

8.2 Lighting Requirements

The following is true regarding the proposed development:

- The structure itself does not extend above to 150m agl or more (the building has a maximum height of 129.44m agl);
- The building does not infringe the OLS;
- Cranes are not expected to breach the OLS or extend to 150m agl or more. Crane that do breach or exceed to 150m agl or more, will require aviation lighting.

On this basis, aviation lighting is not mandatory for the building structure as per the associated Air Navigation Order guidance.

8.3 Crane Operations Scheme

It is possible that Manchester Airport Group (MAG) may request a crane operations scheme despite cranes being unlikely to breach the OLS.

The Civil Aviation Authority (CAA) should also be notified of the proposed development and any proposed cranes. All cranes and obstacle notifications to the CAA should be made to the Airspace Coordination and Obstacle Management Service (ACOMS). The registration process is via the CAA customer portal to access the ACOMS service to submit notification.

It is recommended that the developer applies for a crane permit from the CAA 8 weeks in advance. It is likely that MAG may request a crane operations scheme.

¹⁰ Air Navigation Order, 2016. There is a requirement unless the CAA allow otherwise. Last accessed 26.10.22.

9 CONCLUSIONS

9.1 Manchester Airport SSR

The proposed development is located approximately 15.3km from the SSR at Manchester Airport. One of four proposed towers is predicted to be visible, with the remaining three predicted to be significantly screened by existing obstructions along the line-of-sight profile.

The proposed development will be of similar scale to those surrounding it. No significant shadowing effects are anticipated.

The radar has specific features that reduce the radar's susceptibility to interference from buildings. Whilst the impact is predicted to be relatively small, due to the advanced built-in capabilities for increasing its reliability and performance, the potential for some adverse effects on the radar cannot be conclusively ruled out. Therefore, mitigation may be required.

If mitigation is required, the most likely solution would be a technical fix to the radar and implemented by NATS. The solution would define the building as a known reflector and has been implemented for many developments of this type in the vicinity of SSR.

Consultation with NATS, who safeguards the Manchester Airport radar, is recommended.

9.2 Manchester Airport's Obstacle Limitation Surfaces

- The proposed development is vertically clear of the Obstacle Limitation Surface (OLS) and beneath the Outer Horizontal Surface (OHS) for Manchester Airport;
- The analysis has shown that the proposed development, with a maximum altitude of 129.44m AOD, is vertically clear of the OHS. The minimum margin of clearance is 77m;
- Any cranes less than 77.00m above the maximum height of the development will also be clear of the OHS.

9.3 Instrument Flight Procedures at Manchester Airport – High-Level

A high-level review of the IFPs relative to the proposed development indicates sufficient clearances between the proposed development and aircraft flying procedures. There are also taller existing buildings in the surrounding area that already co-exist with the current IFPs. Therefore, no impact upon the IFP is predicted. It is possible however that a detailed IFP assessment may be requested by MAG. If a detailed IFP assessment is required, details of any proposed crane locations, heights, and jib radius will need to be provided.

9.4 Aviation Lighting and Crane Usage – High-Level

The following is true regarding the proposed development:

- The structure itself does not extend above to 150m agl or more (the building has a maximum height of 129.44m agl);
- The building does not infringe the OLS;
- Cranes are not expected to breach the OHS or extend to 150m agl or more. Crane that do breach or exceed to 150m agl or more, will require aviation lighting.

On this basis, aviation lighting is not mandatory for the building structure as per the associated Air Navigation Order guidance.

9.5 Overall Conclusions

Line of sight analysis has been undertaken for the proposed development with respect to the Secondary Surveillance Radar (SSR) at Manchester Airport. When considering additional screening the analysis shows that three buildings within the proposed development would be significantly screened from the SSR. The J01 building is however predicted to be visible to the SSR and therefore a technical impact upon the radar is considered possible. Due to the location of the proposed development within Manchester Airport's operational airspace, an operational impact is predicted and mitigation may be required.

If mitigation is required, the most likely solution would be a technical fix to the radar implemented by NATS, whereby the building development is defined as a known reflector. The feasibility of the solution would need to be discussed with NATS, but this solution is routinely implemented for developments of this type in the vicinity of SSR. The fee for implementation would be payable to NATS.

The proposed development is vertically clear of the Obstacle Limitation Surfaces (OLS) for Manchester Airport by a minimum margin of 77m, and therefore will not present a collision risk with respect to the OLS. As long as any cranes used during construction do not exceed 77m above the maximum building height, they will also remain clear of the OLS.

The proposed development is not predicted to impact the Instrument Flight Procedures (IFPs). It is possible however that a detailed IFP assessment may be requested by Manchester Airport Group (MAG), who safeguard Manchester Airport. If a detailed IFP assessment is required, details of any proposed crane locations, heights, and jib radius will need to be provided.

Considerations of aviation lighting indicate that aviation lighting is unlikely to be required for the proposed development, based on the proposed height of the development.

An aviation lighting scheme for cranes is likely to be required for any cranes measuring 150m or more agl or above. A lighting scheme will need to be agreed with the CAA and MAG.

It is recommended that this report is provided to Manchester Airport and NATS for their comment and position on the proposed development.

APPENDIX A – COORDINATE DATA

Assessed Building Points

The coordinates outlining the building are given below. Maximum building elevations are presented in Section 1.3.

Point	Longitude (°)	Latitude (°)	Point	Longitude (°)	Latitude (°)
1	-2.22330	53.47383	11	-2.22356	53.47418
2	-2.22330	53.47398	12	-2.22361	53.47415
3	-2.22335	53.47398	13	-2.22361	53.47400
4	-2.22335	53.47400	14	-2.22356	53.47400
5	-2.22330	53.47400	15	-2.22356	53.47398
6	-2.22330	53.47415	16	-2.22361	53.47398
7	-2.22335	53.47418	17	-2.22361	53.47383
8	-2.22329	53.47422	18	-2.22350	53.47376
9	-2.22352	53.47436	19	-2.22342	53.47376
10	-2.22370	53.47425			

Building coordinates – J01

Point	Longitude (°)	Latitude (°)	Point	Longitude (°)	Latitude (°)
1	-2.22405	53.47370	11	-2.22421	53.47428
2	-2.22393	53.47377	12	-2.22421	53.47415
3	-2.22393	53.47392	13	-2.22417	53.47413
4	-2.22399	53.47392	14	-2.22425	53.47408
5	-2.22399	53.47393	15	-2.22425	53.47393
6	-2.22393	53.47393	16	-2.22420	53.47393
7	-2.22393	53.47408	17	-2.22420	53.47392
8	-2.22401	53.47413	18	-2.22425	53.47392

Point	Longitude (°)	Latitude (°)	Point	Longitude (°)	Latitude (°)
9	-2.22397	53.47415	19	-2.22425	53.47377
10	-2.22397	53.47428	20	-2.22412	53.47370

Building coordinates – J02

Point	Longitude (°)	Latitude (°)	Point	Longitude (°)	Latitude (°)
1	-2.22456	53.47372	8	-2.22485	53.47413
2	-2.22455	53.47408	9	-2.22478	53.47413
3	-2.22465	53.47408	10	-2.22478	53.47408
4	-2.22464	53.47413	11	-2.22484	53.47408
5	-2.22457	53.47413	12	-2.22484	53.47405
6	-2.22456	53.47440	13	-2.22488	53.47405
7	-2.22484	53.47440	14	-2.22489	53.47373

Building coordinates – K1

Point	Longitude (°)	Latitude (°)	Point	Longitude (°)	Latitude (°)
1	-2.22517	53.47375	6	-2.22537	53.47429
2	-2.22516	53.47431	7	-2.22544	53.47425
3	-2.22524	53.47436	8	-2.22544	53.47409
4	-2.22531	53.47432	9	-2.22549	53.47409
5	-2.22531	53.47429	10	-2.22550	53.47376

Building coordinates – K2



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