



Norwich Western Link

Airport Safeguarding Assessment

Appendix 1: Instruments Flight Procedures

Author: Norfolk County Council

Document Reference: 4.05.02

Version Number: 00

Date: March 2024



Contents

1	Introduction	3
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1. Introduction

Cyrus Limited was commissioned by NCC to complete an Instruments Flight Procedures Analysis. This appendix contains text, figures and drawings showing the analysis done.

We have included a summary of key information shown in this document in an accessible format in section 1.1. However, some users may not be able to access all technical details that are included in the rest of this document. If you require this document in a more accessible format, please contact norwichwesternlink@norfolk.gov.uk.

IFP Safeguarding
Proposed Scheme Western Link
Norwich Airport

15 May 2023

CL-5890-RPT-002 V1.4

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Version	V1.4
Document reference	CL-5890-RPT-002 V1.4
Date of release	15 May 2023

Issue	Change History Reference	Date	Details
1.0	Initial Issue	06 February 2023	Initial Issue
1.1	Conclusion amended – the construction of the bridges won't be done at the same time and thus restriction across the site not required.	08 February 2023	Second Issue
1.2	Textual. Pg.15 & 16 OCA amended to 560 ft. OCA value in meters added as per clients' request.	11 April 2023	Third Issue
1.3	Mitigations, Max operational heights added point 3. Pg.18 amended	17 April 2023	Fourth Issue
1.4	Green Bridges (4 x positions) added.	15 May 2023	Fifth Issue

Executive Summary

The Applicant have requested an Instrument Flight Procedure (IFP) Safeguarding Assessment on proposed crane activity during construction, green bridges, and proposed lamp posts for a new road near Norwich Airport.

The assessment has been carried out in relation to seven cranes at seven specified positions for the construction of multiple bridges, four green bridge positions as well as the addition of fifteen lamp posts approximately 3.44 Nautical Miles (NM) West from the threshold (THR) of Runway (RWY) 09 at Norwich Airport.

The purpose of this assessment is to assess if the proposed cranes, green bridges, and lamp posts penetrate the protection areas/surfaces of the IFPs serving the Airport. These protection areas and surfaces (sloping or level) are established based upon the runway and thresholds, Aerodrome Reference Point (ARP), clearways, ground navigation equipment, and established waypoints.

The assessment has determined the following:

The proposed green bridge locations and lamp posts do not impact the currently published IFPs for Norwich Airport. However, two of the proposed cranes located at the **Broadway Green Bridge** and **Foxburrow Plantation Green Bridge** impact the NDB (L) DME RWY 09 Final Approach, increasing the published Obstacle Clearance Altitude / Height (OCA/H) as indicated in Table 1.

Category	Currently Published OCA/H (ft)	Resultant OCA/H (ft)	Increase
CAT A – D (WITH DME)	560 (443) ft	610 (493)	50 ft

Table 1: NDB(L)/DME RWY 09 Minima

The mitigation options are presented in the conclusion.

Abbreviations

AD	Aerodrome
AGL	Above Ground Level
AOD	Above Ordnance Datum
AIP	Aeronautical Information Publication
AIRAC	Aeronautical Information Regulation and Control
AMSL	Above Mean Sea Level
APD	Approved Procedure Designer
ARP	Aerodrome Reference Point
ATCSMAC	Air Traffic Control Surveillance Minimum Altitude Chart
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAT	Category
DTM	Digital Terrain Model
DME	Distance Measuring Equipment
DVOF	Digital Vertical Obstacle File
FAF	Final Approach Fix
GB	Green Bridge
m	Meters
IFPs	Instrument Flight Procedure(s)
IAPs	Instrument Approach Procedure(s)
ICAO	International Civil Aviation Organisation
ILS	Instrument Landing System
LOC	Localiser
MAPt	Missed Approach Point
MOC	Minimum Obstacle Clearance
MOCA	Minimum Obstacle Clearance Altitude
MSA	Minimum Sector Altitudes
NDB	Non-Directional Beacon
NM	Nautical Mile
OCA/H	Obstacle Clearance Altitude / Height
OSGB	Ordnance Survey British National Grid
RWY	Runway

THR	Threshold
UTM	Universal Transverse Mercator
VM(C)	Visual Manoeuvring (Circling)

References

- [1] ICAO DOC 8168 - Procedures for Air Navigation Services, Aircraft Operations, Vol II, 7th Ed, Amendment 9, Corrigendum 2, dated 21 March 2022.
- [2] CAP785B Implementation and Safeguarding of Instrument Flight Procedures (IFPs) in the UK dated September 2022

Contents

EXECUTIVE SUMMARY	4
ABBREVIATIONS.....	5
REFERENCES.....	7
CONTENTS	8
INTRODUCTION.....	10
Overview	10
ASSESSMENT.....	11
IFP’s Assessed.....	11
Data	11
Discrepancies and Assumptions	12
IFP Safeguarding Assessment.....	16
IMPACTED INSTRUMENT APPROACH PROCEDURE.....	17
NDB(L)/DME RWY 09 – Final Approach (WITH DME)	17
Basic Description	17
Obstacle Assessment.....	18
CONCLUSION	21

List of figures

Figure 1: Site Location Relative to THR 09	10
Figure 2: Crane and Lamp post position(s)	13
Figure 3: Green Bridge position(s)	14
Figure 4: Worst-Case Boundary (Assessment Area).....	14
Figure 5: Crane Data.....	15
Figure 6: NDB (L) RWY 09 - Protection Areas	17
Figure 7: Final Approach – Controlling Obstacles	19
Figure 8: Final Approach - Checked Obstacles (Site Boundary)	20

List of tables

Table 1: NDB(L)/DME RWY 09 Minima.....	4
Table 2: Positional Data	13

Table 3: IFP Assessment Impact Summary	16
Table 4: Obstacle Assessment CAT A-D (WITH DME) – General	18
Table 5: Final Approach - Checked Obstacles (Cranes ONLY)	18
Table 6: Obstacle Assessment CAT A-D (WITH DME) – General	19
Table 7: Final Approach - Checked Obstacles (Green Bridges ONLY)	19
Table 8: Obstacle Assessment CAT A-D (WITH DME) – General	20
Table 9: Final Approach - Checked Obstacles (Site Boundary)	20

Introduction

Overview

The Link is a proposed new section of dual carriageway to connect the Broadland Northway (formerly known as the Northern Distributor Road) between the A1067 and the A47 in the west of Norwich. It will be 3.8 miles long.

The assessment has been carried out in relation to seven cranes at seven specified positions for the construction of multiple bridges, as well as four green bridge positions and the addition of fifteen lamp posts approximately 3.44 NM West from the threshold of RWY 09 at Norwich Airport.

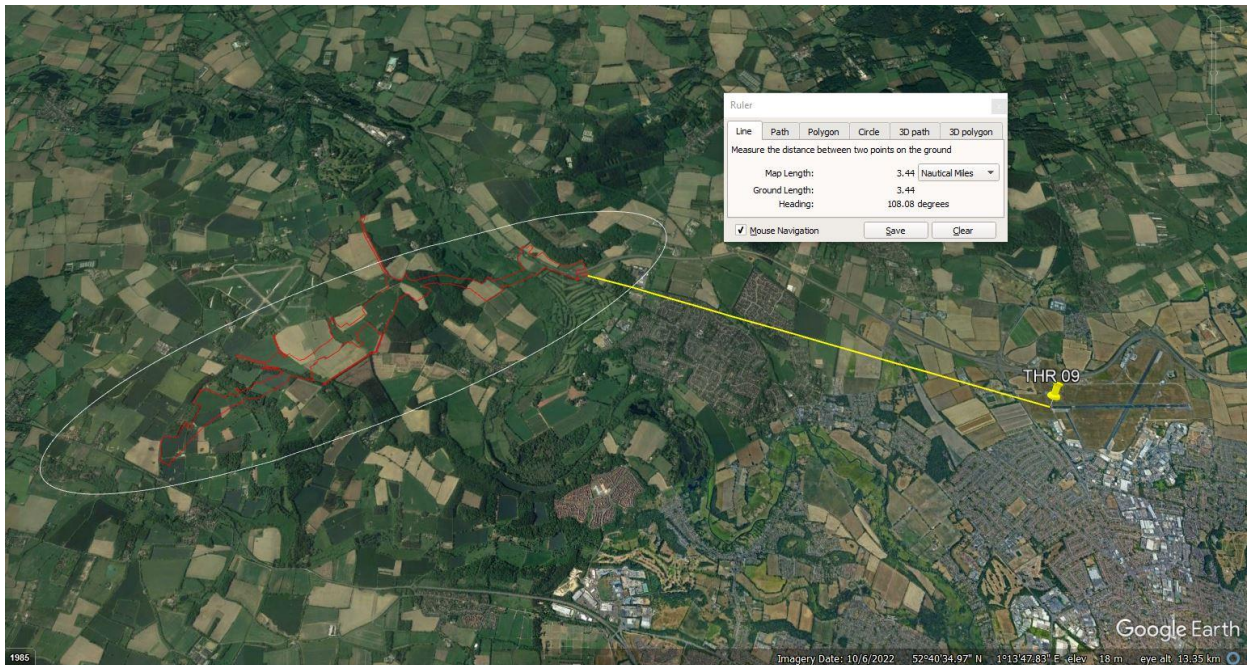


Figure 1: Site Location Relative to THR 09

Assessment

IFP's Assessed

The following IFPs, as published in the UK Aeronautical Information Publication (AIP) were assessed.

- ATC SURVEILLANCE MINIMUM ALTITUDE CHART
- INSTRUMENT APPROACH NDB(L)/DME RWY 09
- INSTRUMENT APPROACH ILS/DME/NDB(L) RWY 27
- INSTRUMENT APPROACH LOC/DME/NDB(L) RWY 27
- INSTRUMENT APPROACH NDB(L)/DME RWY 27

Data

The following data received from the Applicant was used for the purpose of this assessment:

- Site boundary CAD – NCCT41793-RAM-GEN-FSC-DR-CH-0002 Standard.zip;
- 7000262350-L01-00 – Mammoet precast slabs.pdf;
- PK1002-RAM-HLG-MLE-DR-CH-1310.zip;
- Green Bridge positions – Email: 'RE:NWL – Airport Meeting for IFP assessment' dated 10 May 2023.

In addition to the proposed cranes, green bridge positions and lamp post data, the current obstacle environment data for Norwich Airport was used for the design of the currently published IFPs, including the Air Traffic Surveillance Minimum Altitude Chart (ATCSMAC) for the purpose of this assessment:

- All CAP 1732 data imported into AutoCAD has a 20 m horizontal buffer applied. The March 2022 data was used.
- The United Kingdom Aeronautical Information Publication (UK AIP) – Aeronautical Information Regulation and Control (AIRAC) effective date 29 December 2022 data was referenced.
- The December 2023 Digital Vertical Obstacle File (DVOF) was imported into the model with a 50 m horizontal buffer.
- Digital Terrain Model (DTM) terrain data (25 m post spacing) was obtained from NEXTMap Britain.

Discrepancies and Assumptions

The Applicant provided the site boundary in NH/NE Local Grid. To transform the CAD drawing into Ordnance Survey National Grid reference system (OSGB), 'Coordinate Conversion Instructions' received from the Applicant was used. Global Mapper was used to transform the OSGB drawing file into World Geodetic System 1984 (WGS-84), Universal Transverse Mercator (UTM31N).

Coordinates for the location of the proposed cranes and lamp posts were not provided. Following a TEAMS meeting held on 17 January 2023, the Applicant confirmed the proposed locations referencing 'Site boundary CAD – NCCT41793-RAM-GEN-FSC-DR-CH-0002.dwg'. The details are provided in Table 2 and depicted in Figure 2. The maximum height and radius used for the proposed cranes were extracted from '7000262350-L01-00 – Mammoet precast slabs.pdf' as indicated in Figure 5 and detailed in Table 2.

Lamp post heights were indicated as 10 m Above Ground Level (AGL) in PK1002-RAM-HLG-MLE-DR-CH-1310.dwg.

The Applicant also indicated that the crane operations will be conducted across the development site. To cater for such occurrences an additional boundary was created around the site, at a radius (offset) of 40 m and maximum elevation of 108.09 m (AMSL) as depicted in Figure 4 (Yellow boundary).

Following correspondence after issuing IFP Safeguarding report 'CL-5890-RPT-003 V1.3' the Applicant requested that the four green bridge locations be added to the assessment. Location and elevation of the proposed green bridges were confirmed via email by the Applicant – see 'RE:NWL – Airport Meeting for IFP assessment' dated 10 May 2023. The data is captured in Table 2 and depicted in Figure 3.

Obstacle (No./Name)	Latitude (WGS84)	Longitude (WGS84)	Height (m AGL)	Radius (m)	Ground Level (m AMSL)	Elevation (m AMSL)
Crane Position 1 Viaduct Crossing (River Wensum)	52°41'35.2520"N	001°09'56.1794"E	53.093	40	10	63.093
Crane Position 2	52°41'30.8560"N	001°09'17.9290"E	53.093	40	31	84.093
Crane Position 3 Ringland Lane Underbridge	52°41'28.7361"N	001°08'34.6595"E	53.093	40	33	86.093
Crane Position 4 Morton Green Bridge	52°41'13.7634"N	001°08'08.5191"E	53.093	40	40	93.093
Crane Position 5 The Broadway Green Bridge	52°40'48.4742"N	001°07'18.7291"E	53.093	40	55	108.093

Obstacle (No./Name)	Latitude (WGS84)	Longitude (WGS84)	Height (m AGL)	Radius (m)	Ground Level (m AMSL)	Elevation (m AMSL)
Crane Position 6 Foxburrow Plantation Green Bridge	52°40'37.9984"N	001°06'48.2329"E	53.093	40	46	99.093
Crane Position 7 Bat Underpass	52°40'36.0250"N	001°06'43.6887"E	53.093	40	41	94.093
Lamp Position Boundary	52°40'16.1348"N 52°40'18.5522"N 52°40'13.3987"N 52°40'10.9814"N	001°06'11.9654"E 001°06'08.2120"E 001°05'59.2305"E 001°06'02.9840"E	10	Area	52	62.00
Green Bridge 1: Broadway	52°40'48.4742"N	001°07'18.7291"E	11.00	40	55	66.0
Green Bridge 2: Foxburrow Plantation	52°40'37.9984"N	001°06'48.2329"E	11.00	40	46	57.0
Green Bridge 4: Morton	52°41'13.7634"N	001°08'08.5191"E	10.70	40	40	50.7
Green Bridge 5: Nursery Woodland	52°41'30.8560"N	001°09'17.9290"E	10.50	40	31	41.5

Table 2: Positional Data

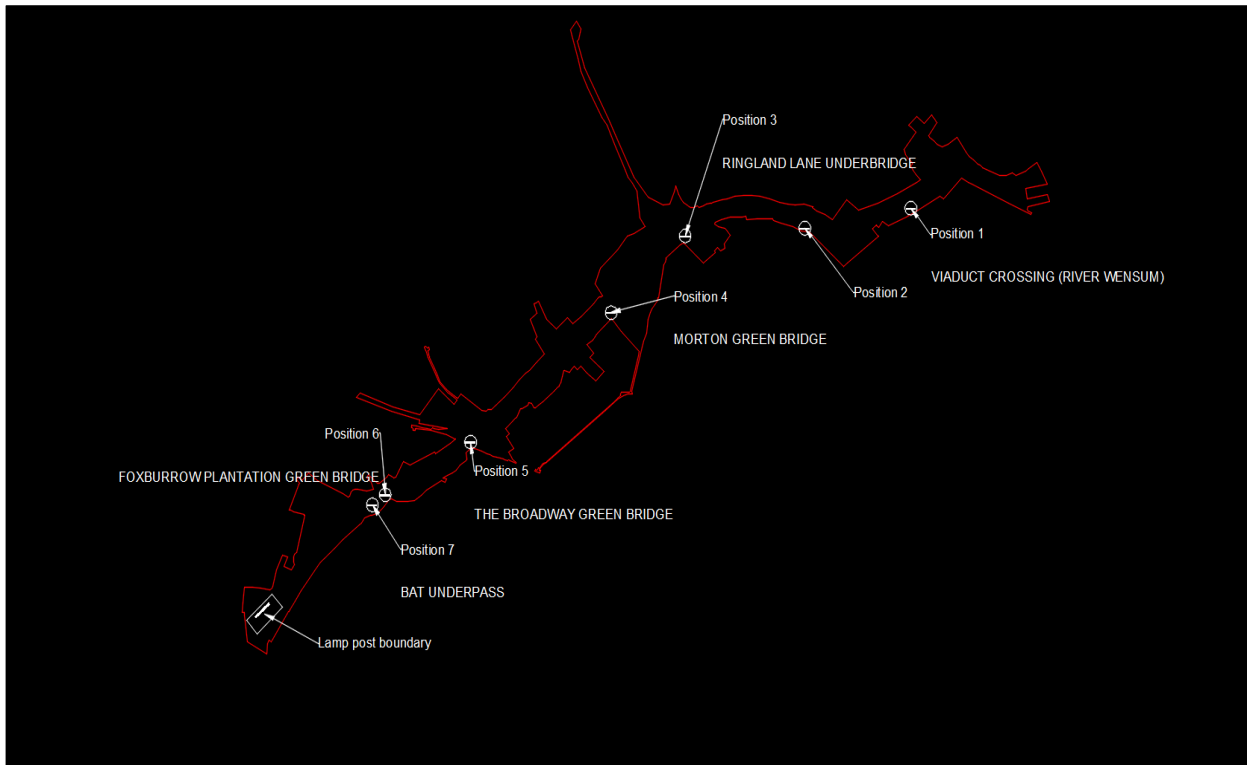


Figure 2: Crane and Lamp post position(s)



Figure 3: Green Bridge position(s)

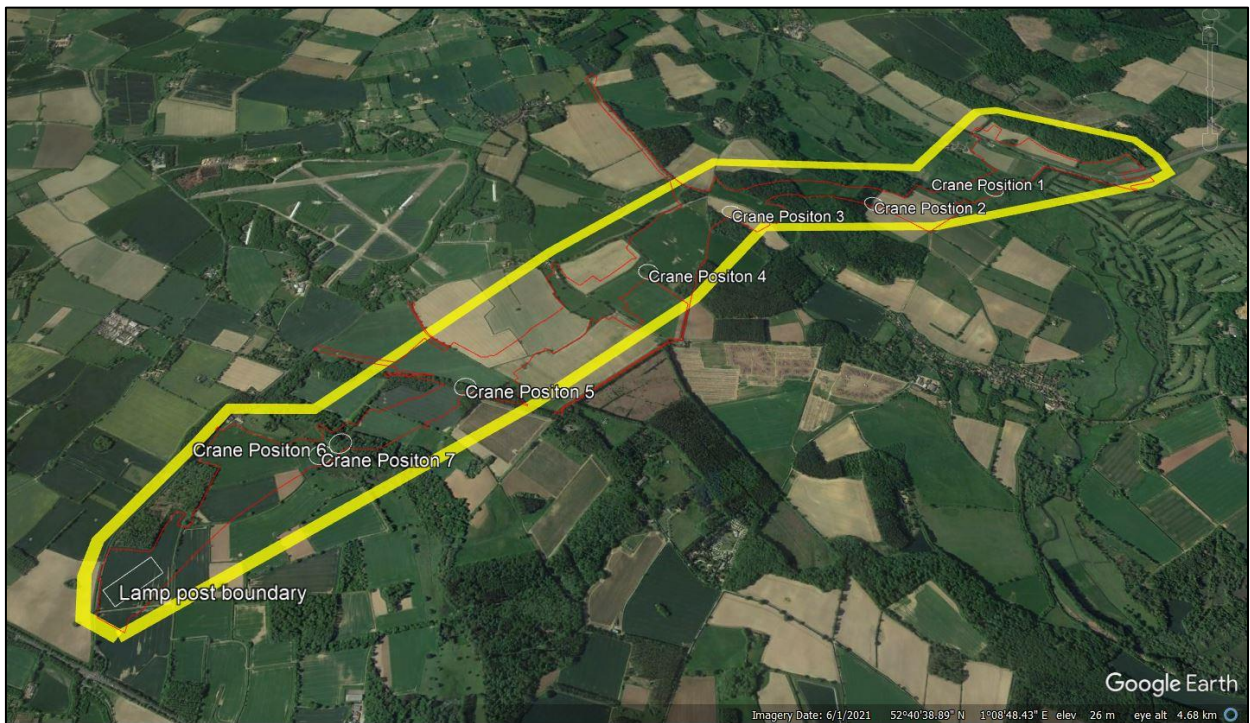


Figure 4: Worst-Case Boundary (Assessment Area)

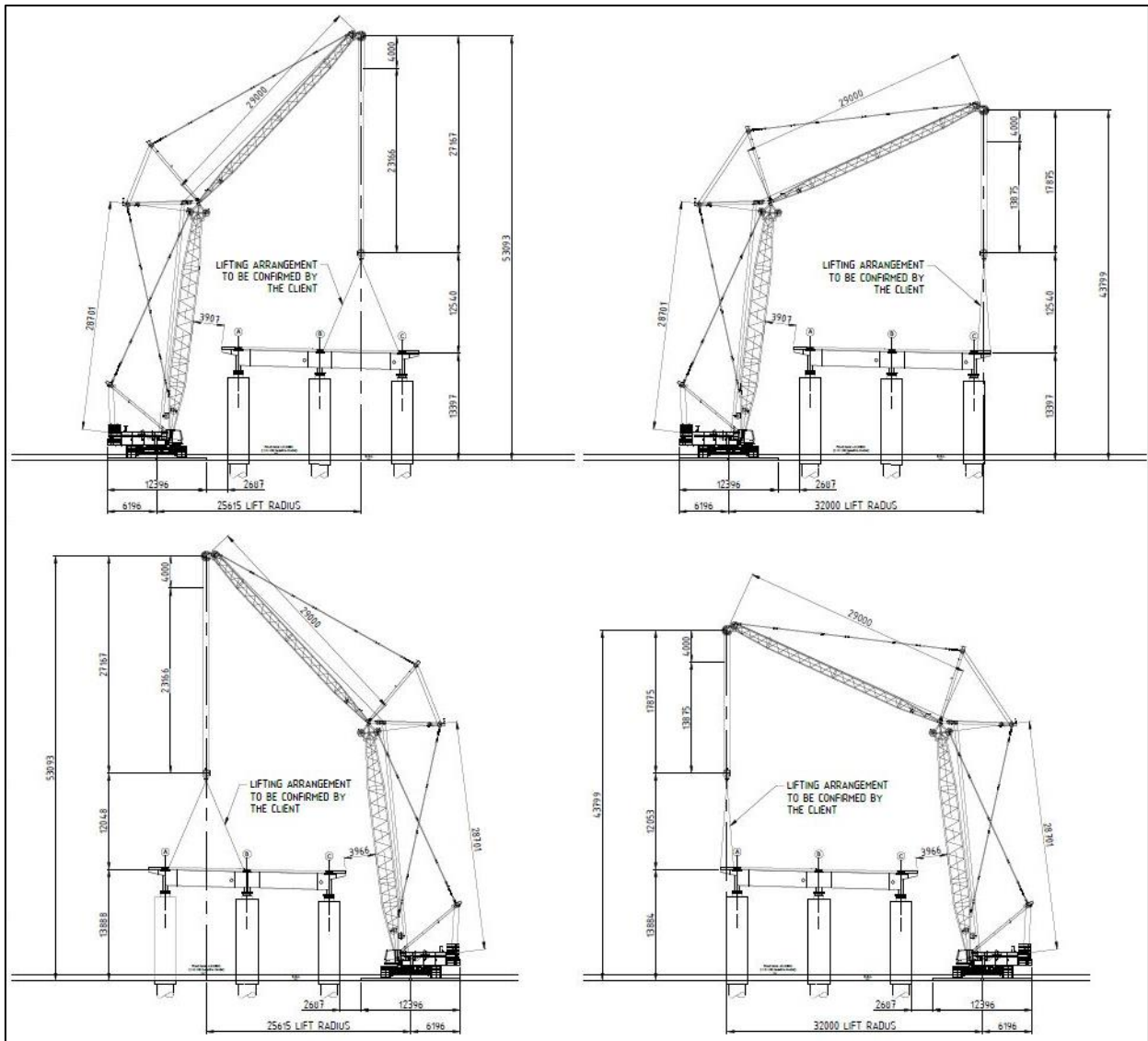


Figure 5: Crane Data

IFP Safeguarding Assessment

An IFP Safeguarding assessment was completed against the applicable procedures for Runway 09 / 27 at Norwich Airport.

Due to the technical nature of the information, this report is a distillation of the IFP modelling and subsequent assessment of the obstacles, the full data set is available if required¹. The purpose of this report is to identify what procedures were assessed and whether there is an impact, in the event of an impact, potential mitigation is provided². Where an impact was identified, only the assessment of the respective segment for said procedure, is provided.

The IFPs were assessed using PHX V21.0.3.12510.

Table 3 provides an impact summary of all the IFPs that were assessed.

Assessed Procedure	Runway	Impact	Comments
ATCSMAC	Both	No	Nil
Visual Manoeuvring Circling (VM(C))		No	Nil
Minimum Sector Altitudes (MSA)		No	Nil
NDB(L)/DME	09	Yes	Published (OCA/H) impacted. See conclusion.
ILS/DME/NDB(L)	27	No	Nil
LOC/DME/NDB(L)		No	Nil
NDB(L)/DME		No	Nil

Table 3: IFP Assessment Impact Summary

¹ Please note that the full data set can run into an excess of 20 pages per procedure and can only be decoded by those familiar with the output generation from the IFP Software and trained IFP Designers.

² Mitigation for the IFPs is for the Airport (Sponsor) to decide upon as these may have a direct impact on their operations. It is recommended that further discussion and guidance is obtained from the CAA.

Impacted Instrument Approach Procedure

NDB(L)/DME RWY 09 – Final Approach (WITH DME)

Basic Description

This segment begins at the earliest Final Approach Fix (FAF) tolerance, which is established at 5.7 DME I-NH (zero ranged to THR 09) and ends at the nominal Missed Approach Point (MAPt).

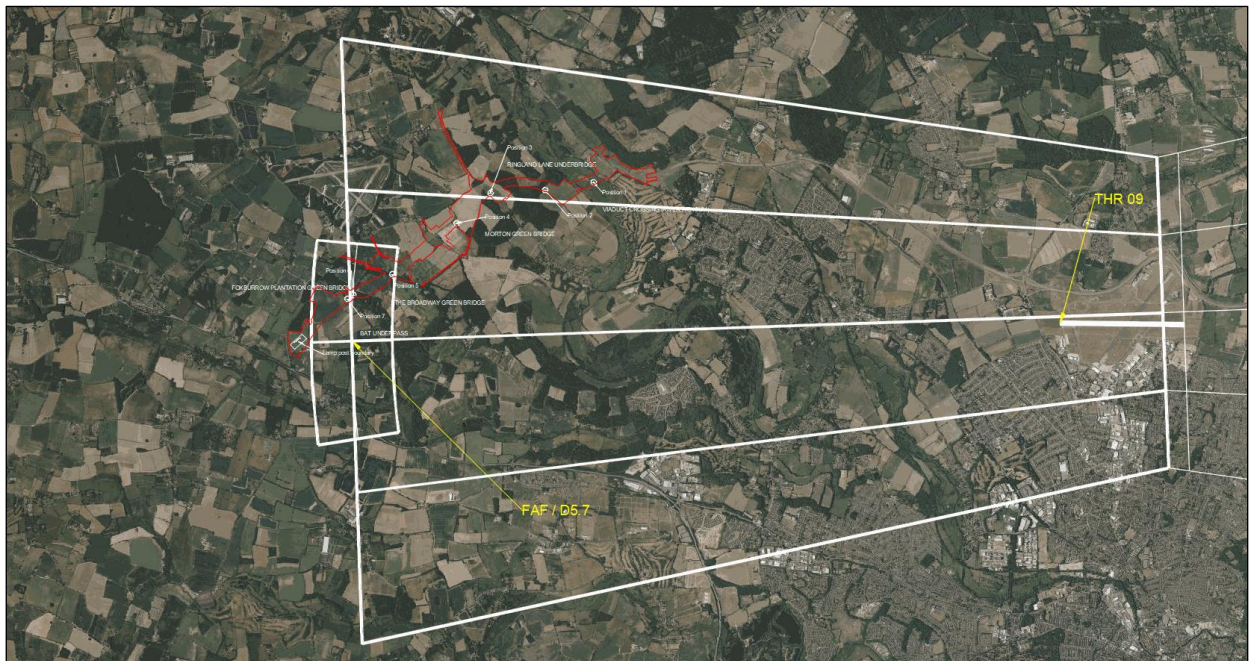


Figure 6: NDB (L) RWY 09 - Protection Areas

As indicated in Figure 6, the site boundary and cranes fall inside the primary and secondary protection areas of the Final Approach.

Obstacle Assessment

General	
Primary MOC	75 m
Obstacles	
Number of Checked Obstacles	7

Table 4: Obstacle Assessment CAT A-D (WITH DME) – General

Name	Latitude	Longitude	Alt. (m)	Area	Dist. in (m)	MOC applied (m)	OCA (ft)
Crane Position 5	52°40'49.77"N	001°07'18.67"E	108.1	Primary	N/A	75.0	600.7
Crane Position 6	52°40'39.29"N	001°06'48.18"E	99.1	Primary	N/A	75.0	571.2
Crane Position 7	52°40'37.32"N	001°06'43.63"E	94.1	Primary	N/A	75.0	554.8
Crane Position 4	52°41'15.06"N	001°08'08.46"E	93.1	Primary	N/A	75.0	551.5
Crane Position 3	52°41'30.03"N	001°08'34.60"E	86.1	Secondary	58.3	72.9	521.6
Crane Position 2	52°41'32.15"N	001°09'17.87"E	84.1	Secondary	148.6	69.4	503.6
Crane Position 1	52°41'36.55"N	001°09'56.13"E	63.1	Secondary	306.7	63.0	413.8

Table 5: Final Approach - Checked Obstacles (Cranes ONLY)

As can be seen from Table 5, the OCA is 600.7 ft rounded to 610 ft which is higher than the currently published OCA of 560 ft (171 m).

The controlling obstacles are Crane Position 5 (The Broadway Green Bridge) and Crane Position 6 (Foxburrow Plantation Green Bridge) as depicted in Figure 7.

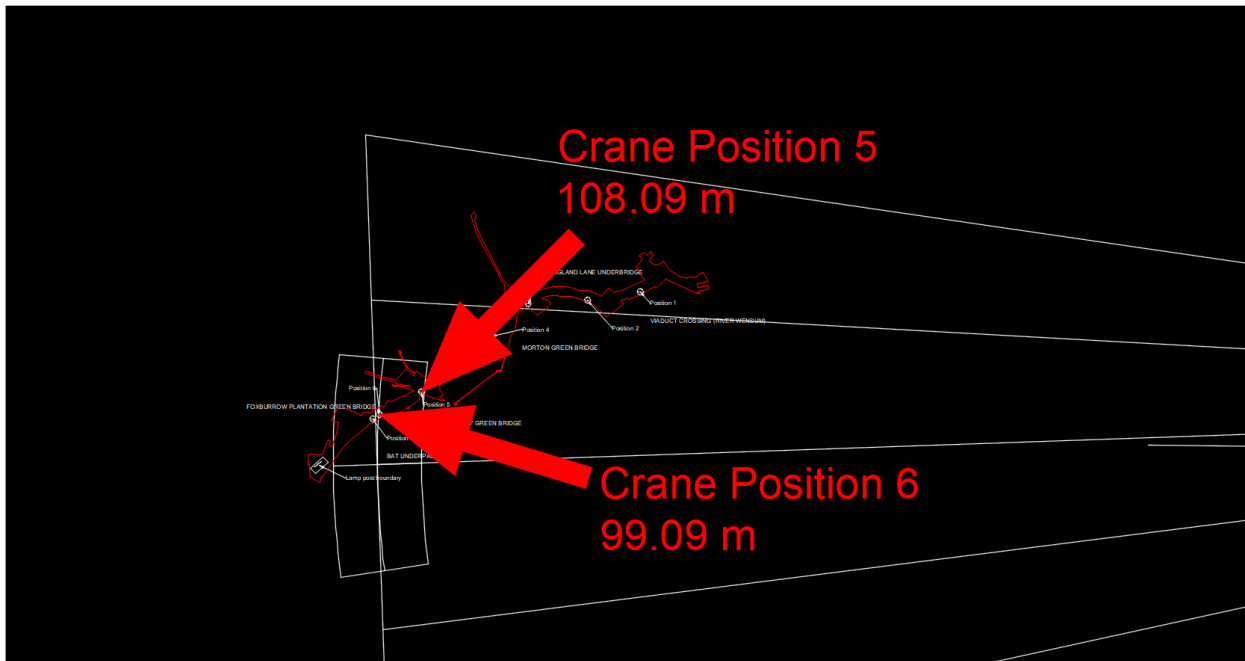


Figure 7: Final Approach – Controlling Obstacles

General	
Primary MOC	75 m
Obstacles	
Number of Checked Obstacles	4

Table 6: Obstacle Assessment CAT A-D (WITH DME) – General

Name	Latitude	Longitude	Alt. (m)	Area	Dist. in (m)	MOC applied (m)	MOCA (ft)
Green Bridge 1: Broadway	52°40'48.47"N	001°07'18.73"E	66.0	Primary	N/A	75.0	462.6
Green Bridge 2: Foxburrow Plantation	52°40'38.00"N	001°06'48.23"E	57.0	Primary	N/A	75.0	433.1
Green Bridge 4: Morton	52°41'13.76"N	001°08'08.52"E	50.7	Primary	N/A	75.0	412.5
Green Bridge 5: Nursery Woodland	52°41'30.86"N	001°09'17.93"E	41.5	Secondary	118.5	70.5	367.6

Table 7: Final Approach - Checked Obstacles (Green Bridges ONLY)

As indicated in Table 7 the green bridges have no impact to the currently published OCA/H minima of 560 ft.

A further assessment was conducted at the worst case as the Applicant had indicated that the crane operations will be conducted across the development site. To cater for such occurrences an additional boundary was created around the site, at a radius (offset) of 40 m and maximum elevation of 108.09 m (AMSL).

General	
Primary MOC	75 m
Obstacles	
Number of Checked Obstacles	1

Table 8: Obstacle Assessment CAT A-D (WITH DME) – General

Name	Latitude	Longitude	Alt. (m)	Area	Dist. in (m)	MOC applied (m)	OCA (ft)
Contour	52°40'43.71"N	001°07'36.50"E	108.1	Primary	N/A	75.0	600.7
Contour	52°41'33.50"N	001°10'40.57"E	108.1	Secondary	237.6	65.3	569.1
Contour	52°41'39.41"N	001°08'30.25"E	108.1	Secondary	346.7	62.4	559.5
Contour	52°41'37.83"N	001°09'31.89"E	108.1	Secondary	332.8	62.3	559.0
Contour	52°41'36.60"N	001°10'48.66"E	108.1	Secondary	338.3	61.1	555.3
Contour	52°41'41.08"N	001°10'47.38"E	108.1	Secondary	476.7	55.5	536.7
Contour	52°41'45.66"N	001°10'42.85"E	108.1	Secondary	616.1	49.9	518.3

Table 9: Final Approach - Checked Obstacles (Site Boundary)

As can be seen from Table 9, the OCA is 600.7 ft rounded to 610 ft which is higher than the currently published OCA of 560 ft (171 m).

The boundary impacts the primary and secondary area of the protection areas as in depicted in Figure 8.

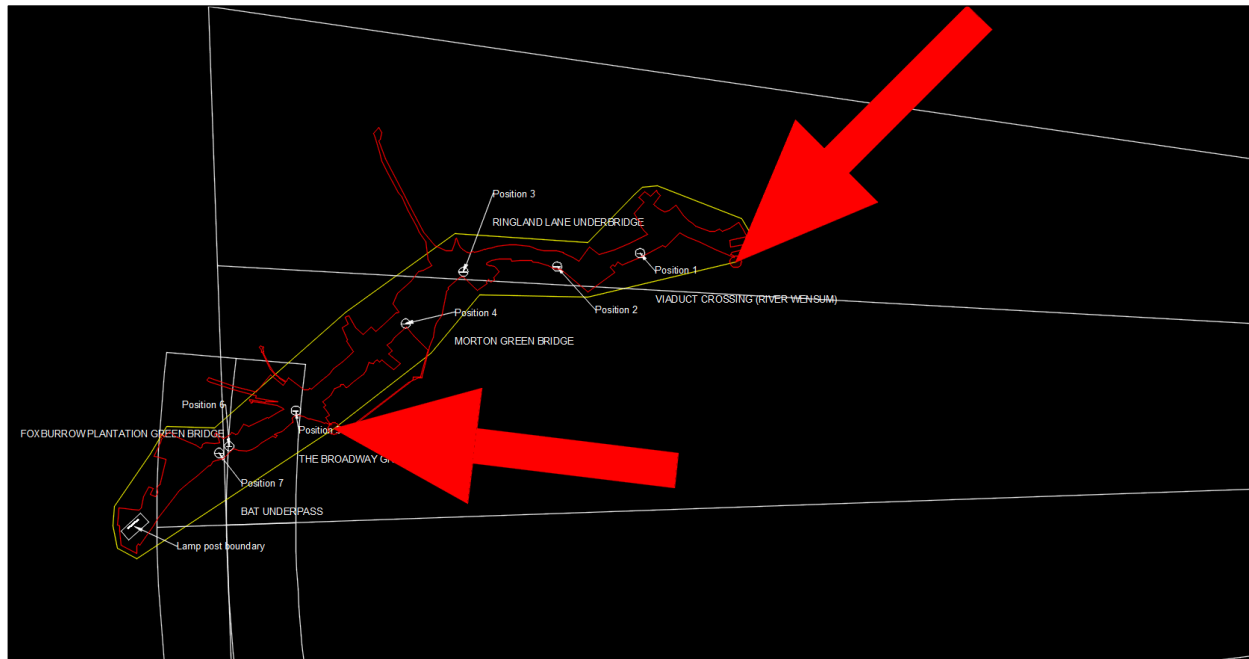


Figure 8: Final Approach - Checked Obstacles (Site Boundary)

Conclusion

The proposed green bridge positions and lamp posts do not impact the currently published IFPs for Norwich Airport. However, two of the proposed cranes located at the **Broadway Green Bridge** and **Foxburrow Plantation Green Bridge** impact the NDB (L) DME RWY 09 Final Approach, increasing the OCA/H.

This report considers two types of mitigation, the first is for the Developer to consider and the second for the Airport. Where mitigation is for the Airport's consideration, this will be subject to their Safety Management System (SMS) requirements and the commercial benefit/impacts of accepting the mitigation.

Mitigation Options

1. Reduce the Obstacle Dimensions.

The maximum elevation required to eliminate penetration to the NDB (L) DME RWY 09 Final Approach would be:

Crane Position 5 (The Broadway Green Bridge) – 40 m AGL / 95 m AMSL

Crane Position 6 (Foxburrow Plantation Green Bridge) – 49 m AGL / 95 m AMSL.

2. Raise the OCA (temporary nature) to 610 ft (186 m).

For obstacles or structures of a temporary nature, the information must be published via NOTAM for up to 90 days.

For time scales longer than 90 days the Sponsor (Airport) should contact the Civil Aviation Authority (CAA) as the impacted IFP charts will need to be amended via 'PERM NOTAM' and require approval from the CAA.

3. Maximum Operational height for cranes Above Ordnance Datum (AOD);
For the currently published OCA **560 ft** the maximum operational height is **95 m** (AOD).
For the raised OCA (temporary nature) **610 ft** the maximum operational height is **110 m** (AOD).

Note:

The Civil Aviation Authority have published information on their website concerning "Event and obstacle notification"³ for notification of obstacles including cranes and buildings, to the CAA.

³ <https://www.caa.co.uk/commercial-industry/airspace/event-and-obstacle-notification/event-and-obstacle-notification/>

The CAA have also published information on their website concerning requirements for “Lighting and marking of obstacles⁴.”

⁴ <https://www.caa.co.uk/commercial-industry/airspace/event-and-obstacle-notification/lighting-and-marking-of-obstacles/>



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