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1.0 Introduction

1.1 Motion has been instructed by Gleeson Strategic Land (the Applicant) to develop a site access strategy in respect of a proposed development of 133 dwellings at land to the west of the A281 at Broadbridge Heath, West Sussex.

1.2 This Design Audit details the factors taken into consideration during the design process for the proposed highway alterations, which consist of upgrading an existing 3-arm roundabout to a 4-arm roundabout and provision of a new shared footway / cycleway.

2.0 Existing Highway Arrangements

2.1 The development site consists of land located on the southern part of Lower Broadbridge Farm, at Broadbridge Heath, West Sussex.

2.2 Lower Broadbridge Farm is located to the west of the built-up area boundary of Broadbridge Health within the administrative boundaries of Horsham District Council (HDC) and West Sussex County Council (WSCC). The site is adjoined by the A281 to the east and the A264 Five Oaks Road to the south; it is located approximately 3.3 kilometres to the west of Horsham town centre.

2.3 In the vicinity of the site, the A281 is a single carriageway 'A' class distributor road which provides a link between Guildford (approximately 14 miles to the northwest) and the Farthings Hill interchange on the A24, located on the southern edge of Broadbridge Heath.

2.4 The 0.6 kilometre long section of road between the Lawson Hunt roundabout (to the northeast of the site) and the Newbridge roundabout (to the east of the site), is unlit and is subject to the national speed limit, which drops to a 40mph speed limit on the approach to the Newbridge roundabout (to the east of the site). It has no footways along the majority of its length; however, a short length of pedestrian footway is provided on the eastern side between the existing vehicular access to Lower Broadbridge Farm and the Newbridge roundabout. There are no other accesses on this section of the A281.

2.5 The 0.2 kilometre long section of road between the Newbridge roundabout and the Five Oaks roundabout (to the south of the site) has streetlighting, a pedestrian footway on the northern side and a pedestrian footway on the southern side between the Newbridge roundabout and Edwards Close. There is a priority junction with a ghost island right lane, serving Edwards Close to the south. This section of the A281 is subject to a 40mph speed limit.

2.6 The A281 does not form part of the national trunk road network and therefore falls under the responsibility of the Local Highway Authority, West Sussex County Council.

3.0 Design Considerations

Design Guidance and Standards

3.1 The design standards and guidance referred to as part of the design process include local guidance (where applicable) and national guidance. In particular, reference has been made to the relevant sections of Manual for Streets 1 and 2 (MfS), the Design Manual for Roads and Bridges (DMRB).

3.2 With respect to the application of MfS and DMRB at this location, it is noted that the DMRB sets out the mandatory standards for trunk road design and is therefore not mandatory on a non-trunk road such as the A281. Furthermore, MfS2 states that *"Most MfS advice can be applied to a highway regardless of speed limit. It is therefore recommended that as a starting point for any scheme affecting non-trunk roads, designers should start with MfS."*

3.3 Based on the above, it is considered that MfS guidance is applicable to the highway design at this location. However, the Designer considers that it is beneficial to refer to the standards in Sections CD 109, CD 143, and CD 116 of the DMRB, to serve as a useful reference for guidance on the appropriate highway geometries and stopping sight distances on the A281.

4.0 Proposed Highway Arrangements

4.1 The proposed highway arrangements are shown on drawing 1902029-10, and consist of a new site access in the form of a 7.3 metre wide road which forms an additional fourth arm on the existing three-arm Five Oaks roundabout. The new arm will serve as the vehicular access to the proposed residential development and will include a 2 metre wide pedestrian footway on its western side, tying into the existing footway on the northern side of the A281. On the eastern side of the site access, a new 3 metre wide shared footway / cycleway will be provided which will extend around to the existing Lower Broadbridge Farm site access.

4.2 The existing Lower Broadbridge Farm site access is designated as a Public Right of Way; therefore, it is considered that this will serve as a route for pedestrians and cyclists travelling between the proposed development and Broadbridge Heath.

Junction Geometry

4.3 In order to provide the additional arm on the Five Oaks roundabout, it will be necessary to increase the current inscribed circle diameter (ICD) from 50 metres up to a proposed ICD of 60 metres, with a circulatory carriageway width of 10 metres. In addition, dropped kerb crossing points will be provided on the northern and western arms, to facilitate pedestrians crossing at these locations.

4.4 The proposed roundabout layout is shown on drawing 1902029-11 and its key geometry dimensions are indicated on drawing 1902029-12. Drawing 1902029-13 shows the entry angle for each arm and drawing 1902029-14 shows the entry path geometry for the straight-ahead movement on each arm.

4.5 The key geometrical elements of the proposed roundabout are summarised in table 1 below. The table includes references to the most appropriate design standards / recommendations, in order to highlight any departures from those standards.

Design Element	Western Arm Five Oaks Rd	Northern Arm Site Access	Eastern Arm A281	Southern Arm A281/A264	Relevant Design Standards	Departure from Standards?
Entry width	7m (2 lanes)	7m (2 lanes)	9m (2 lanes)	7.0m (2 lanes)	Requirements: CD116 paras 3.13, 3.14 Recommendations: CD116 Paras 3.14.1, 3.14.2 3.13 On a dual carriageway approach to a normal roundabout, the entry width shall not exceed 15m. 3.14 Lane widths at the give way line for normal and compact roundabouts shall be no less than 3m and no greater than 4.5m. 3.14.1 At the give way line, a lane width value of 4.5m should be used at single lane entries. 3.14.2 At the give way line, lane width values of between 3m and 3.5m should be used at multi-lane entries.	None (Eastern arm is not in accordance with recommendation at 3.14.2, but not mandatory so not a dfs).
Entry angle	32°	24°	49°	27°	Recommendations: CD116 paragraph 3.18.1 3.18.1 The entry angle should be no less than 20° and no greater than 60° for normal and compact roundabouts.	None.
Entry radius	21m	20m	21m	20m	Recommendations: CD116 paragraphs 3.19.1, 3.19.2 3.19.1 The entry kerb radius should not be less than 10 metres. 3.19.2 The entry kerb radius should not be greater than 100 metres.	None.
Entry path radii	50m to 70m	43m to 52m	92m to 41m	45m to 50m	Requirements: CD116 paras 3.26 3.26 At normal roundabouts, the entry path radius shall not exceed 100 metres.	None
Exit width	7.1m / 6.1m	7m / 6.4m	8.6m / 7.7m	7.4m	Recommendations: CD116 paragraphs 3.28.1, 3.28.2, 3.28.3 and 3.28.4 3.28.1 The exit width for normal roundabouts should accommodate one more traffic lane than is present on the link downstream. 3.28.2 At a normal roundabout, if the downstream link is a single carriageway road, the exit width should be between 7m and 7.5m and the exit should taper down to a minimum of 6m. 3.28.3 Where the downstream link is a single carriageway road, the exit width should reduce at a taper of 1:15 to 1:20, starting at the end of the exit from the roundabout, ensuring 6 metres at end of traffic island, to avoid exiting vehicles encroaching onto the opposing lane at the end of the traffic island. 3.28.4 At a normal roundabout, if the downstream link is an all-purpose two-lane dual carriageway, the exit width should be between 10 metres and 11 metres, with the exit tapering down to two lanes wide.	None. (Eastern and southern arms not in accordance with recommendation at 3.28.1 and 3.28.4; but not mandatory so not a dfs).

Exit radius	80m	80m	100m	96m	Recommendations: CD116 paragraphs 3.29.1, 3.29.2 and 3.29.3 3.29.1 At normal roundabouts the exit kerb radius should exceed the largest entry radius. 3.29.2 At normal roundabouts, the exit kerb radius should be 40 metres. 3.29.3 Where an exit kerb radius of 40 metres cannot be achieved, the exit kerb radius should be no less than 20 metres and no greater than 100 metres.	None (No arms are in accordance with recommendation at 3.29.2; but not mandatory so not a dfs).
Forward visibility to give way line	120m (40mph DMRB)	43m (30mph MfS2)	120m (40mph DMRB)	120m (40mph DMRB)	Requirements: CD116 para 3.40 3.40 Visibility on the approach, 'a', to the roundabout shall conform to CD 109. (the desirable minimum SSD for the design speed of the road). SSD requirements for 60mph approach roads on northern and southern arms: CD109 table 2.10 Table 2.10 – SSD for 70kph design speed = 120 metres. SSD recommendation for 30mph approach roads on eastern and western arms: Manual for Streets 2 para 10.1.13 10.1.13 – SSD for 30mph design speed = 43 metres.	None.

Table 1 – Key geometrical features of proposed roundabout

4.6 The proposed roundabout arrangement does not contain any departures from standards; however, there are elements of the existing arrangement that are not in accordance with design recommendations.

4.7 In particular, the existing entry width on the eastern arm is 9 metres (consisting of two lanes 4.5 metres wide). Paragraph 3.14.2 of CD116 recommends that at the give way line, lane width values of between 3 metres and 3.5 metres should be used at multi-lane entries. Paragraph 3.14 requires that lane widths at the give way line for normal and compact roundabouts shall be no less than 3 metres and no greater than 4.5 metres. Given that this is an existing arrangement on the three-arm roundabout, which has been operating without issue; it is considered appropriate for this entry width to be carried over into the design of the 4-arm roundabout.

4.8 Paragraph of CD116 3.28.1 recommends that the exit width for normal roundabouts should accommodate one more traffic lane than is present on the link downstream; and paragraph 3.28.4 of CD116 recommends and that if the downstream link is an all-purpose two-lane dual carriageway, the exit width should be between 10 metres and 11 metres, with the exit tapering down to two lanes wide. The exits on the existing eastern and southern arms consist of two lanes, each leading into a section of two-lane dual carriageway and are therefore not consistent with the advice in paragraphs 3.28.1 and 3.28.4. However, given that this is an existing arrangement on the three-arm roundabout, which has been operating without issue; it is considered appropriate for this exit arrangement to be carried over into the design of the 4-arm roundabout.

4.9 Paragraph 3.29.2 of CD116 recommends that at normal roundabouts, the exit kerb radius should be 40 metres. The exit kerb radii are larger than 40 metres but are all within the range of 20 to 100 metres, as recommended at paragraph 3.29.3. Therefore, this arrangement is considered to be appropriate.

4.10 The forward visibility on approach has been checked for each arm, in accordance with CD 116. The western, southern and eastern arms can all accommodate a forward visibility splay of 120 metres as required for 40mph roads (derived from CD 109). The proposed site access road leading into the development will be designed to a 30mph design speed and will accommodate the corresponding forward visibility splay of 43 metres (derived from MfS).

4.11 The proposed highway arrangements have been subject to a stage 1 road safety audit. The audit and designer's response report are appended to this document.

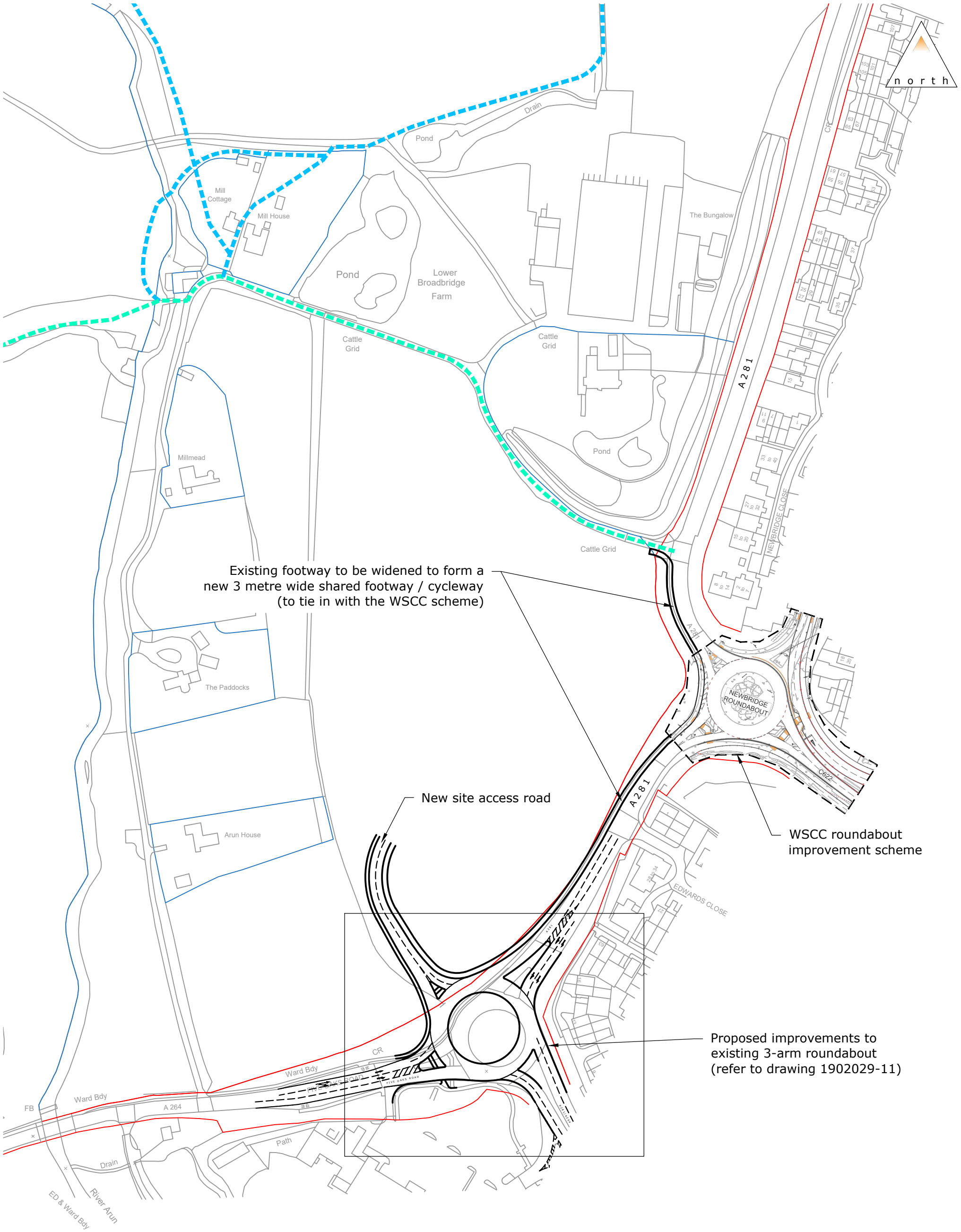
5.0 Summary

5.1 The proposed highway arrangement consists of:

- A new site access in the form of a 7.3 metre wide road which forms an additional fourth arm on the existing three-arm Five Oaks roundabout.
- The new arm will include a 2 metre wide pedestrian footway on its western side, tying into the existing footway on the northern side of the A281.
- On the eastern side of the site access, a new 3 metre wide shared footway / cycleway will be provided which will extend around to the existing Lower Broadbridge Farm site access.

5.2 As part of the above highway proposals, the existing Five Oaks roundabout will be increased from a 50 metre ICD three-arm roundabout to a 60 metre ICD four-arm roundabout. The roundabout geometry has been designed in accordance with the DMRB with no departures from standard.

5.3 On the basis of the above considerations, the proposed highway arrangements are considered to be appropriate at this location.



Legend

- Highway Boundary
- Land Boundary
- Public Footpath 1453
- Public Footpath 1454

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Project:
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Title:
Overview of Highway Improvement Works

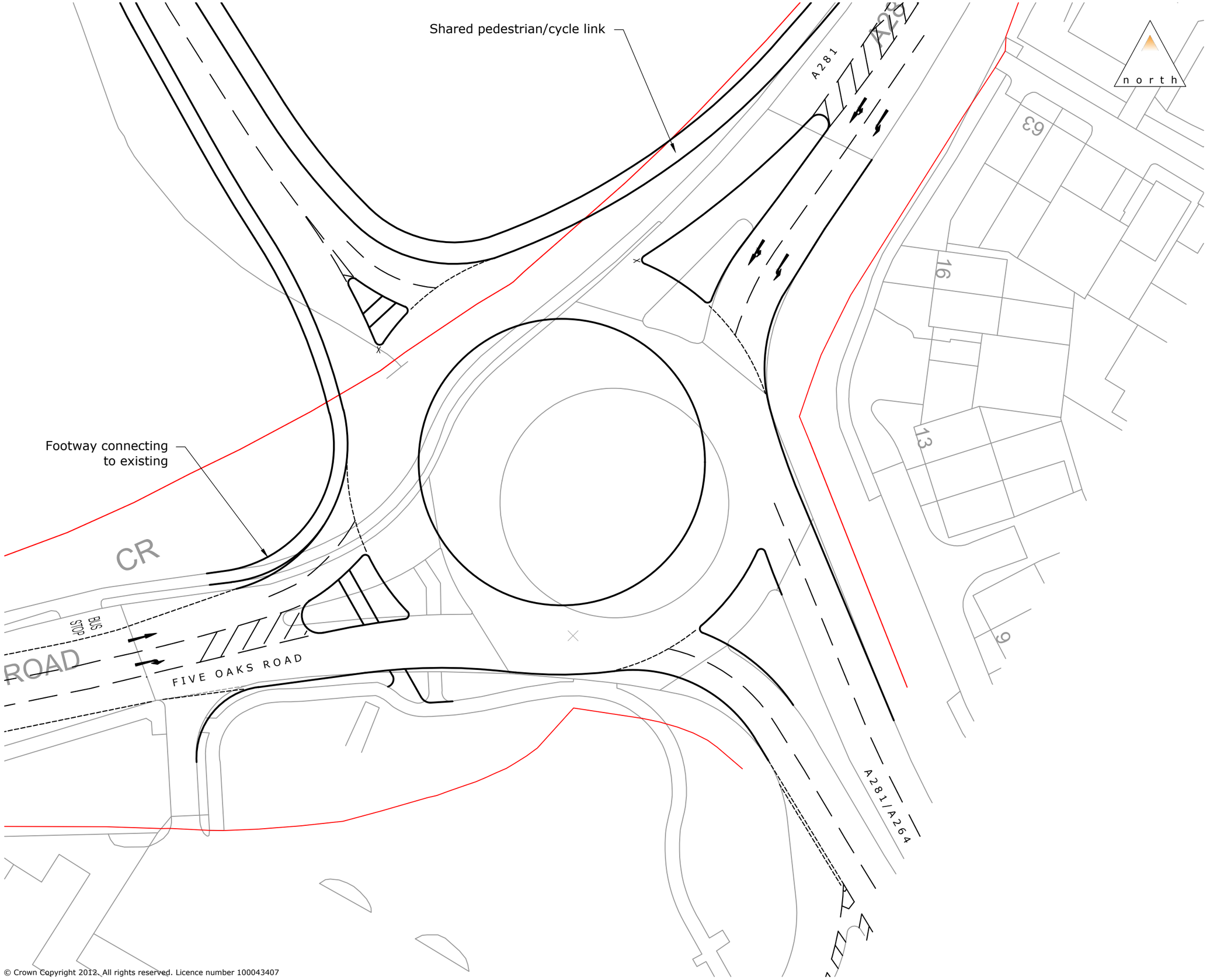
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Notes:

Drawing: 1902029-10

Revision: A

C:\Users\JulianSmith\Motion\StaffSite - Glbroa 1902029\Drawings\1902029-10a.dwg



Key:

Highway Boundary

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Project:
Land at Lower Broadbridge Farm

Title:
Indicative Access / Roundabout Arrangement

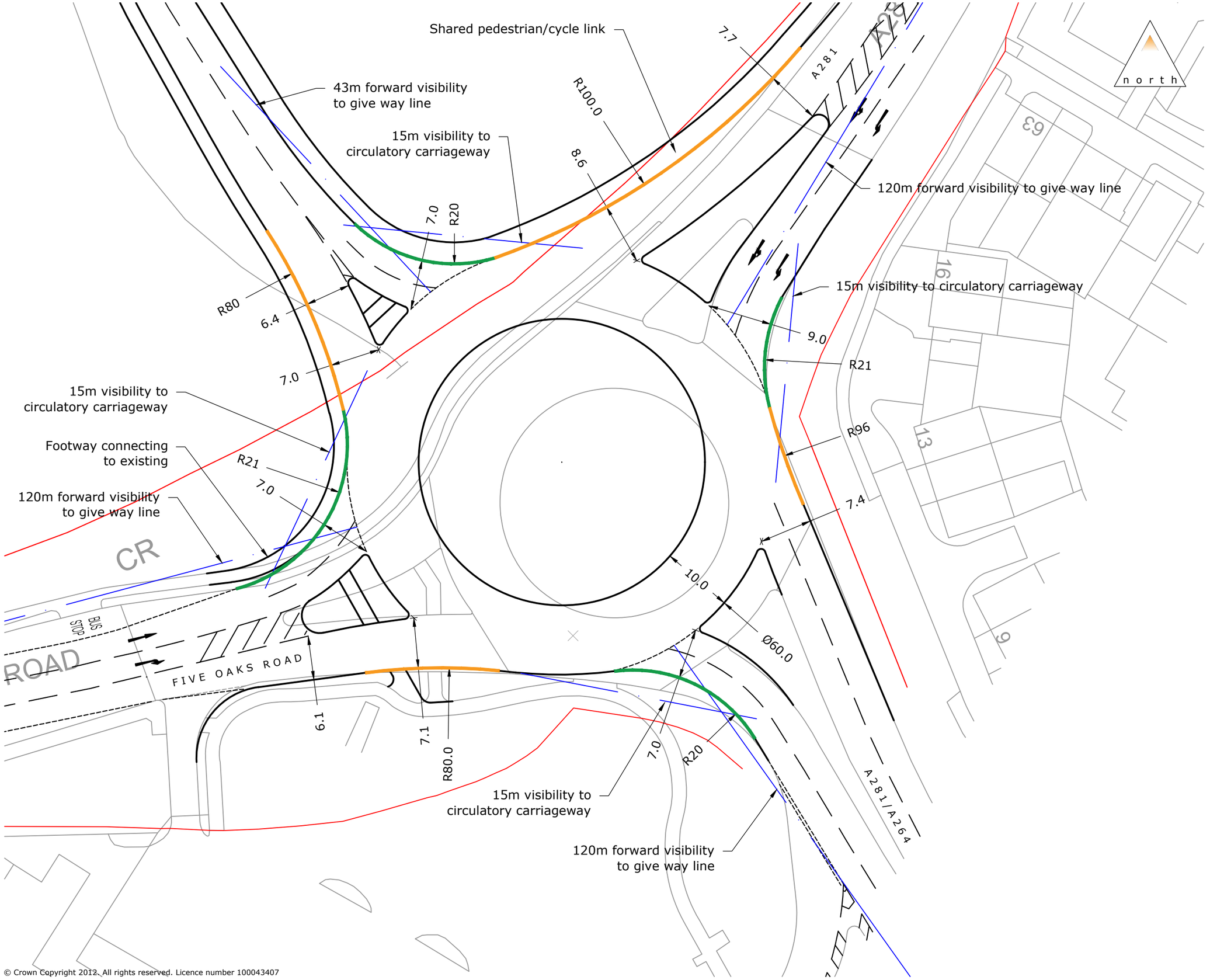
Scale: 1:500 (@ A3)

Drawing: 1902029-11

Revision: B

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Key:
- Highway Boundary
- Entry kerb radius
- Exit kerb radius

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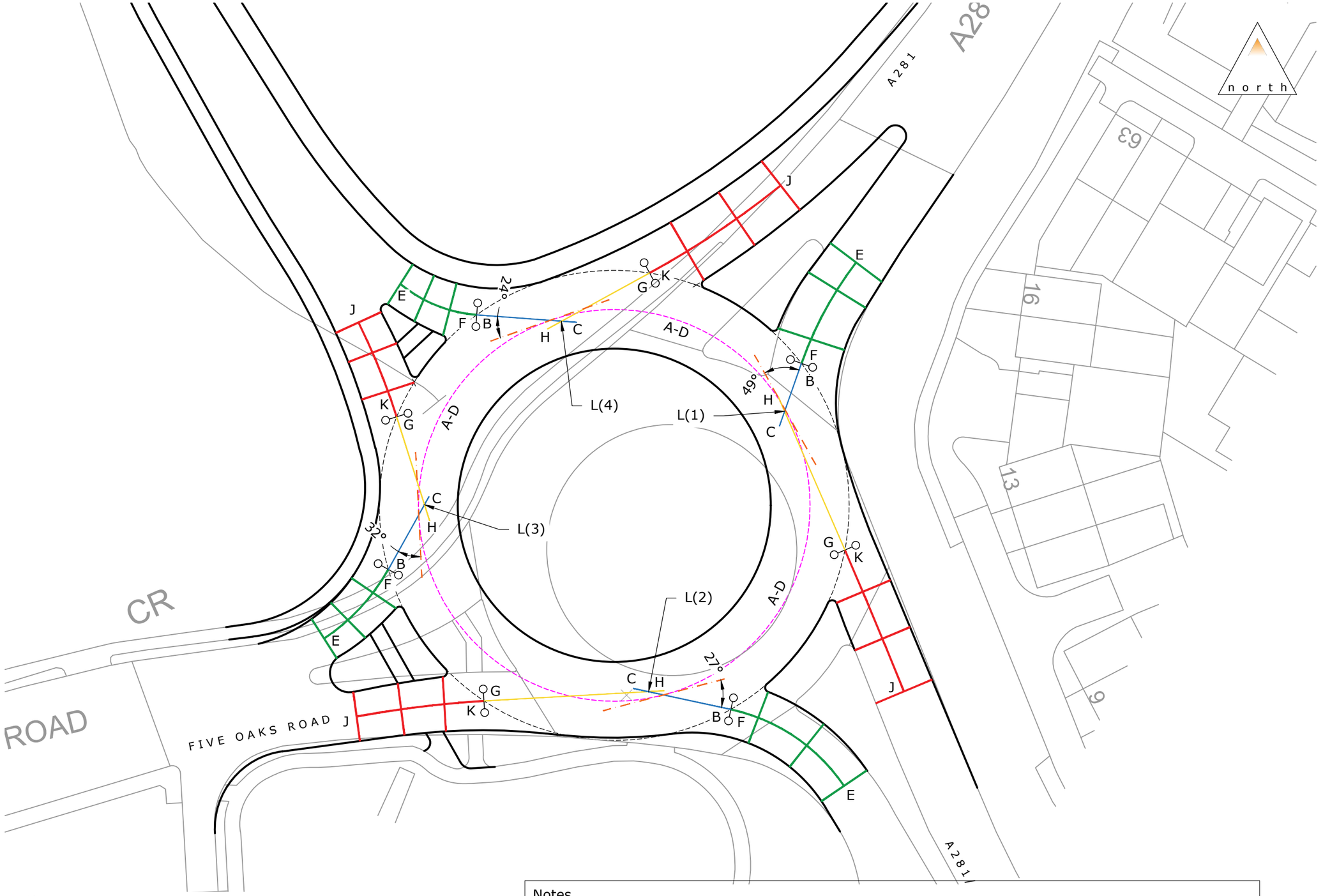
Project:
Land at Lower Broadbridge Farm

Title:
Indicative Access / Roundabout Arrangement
(with Dimensions)

Scale: 1:500 (@ A3)

Drawing: 1902029-12

Revision: B



Key:

- Line E-F (locus of entry lane midpoint)
- Line B-C (line tangential to E-F at ICD)
- Line J-K (locus of exit lane midpoint)
- Line G-H (line tangential to J-K at ICD)
- Line A-D (locus of circulatory carriageway midpoint)
- Line tangential to Line A-D

Notes

1. Geometry labelling is in accordance with paragraph 3.18 of section CD116 of the DMRB.
2. All points labelled 'L1' to 'L4' (which is the intersection of lines B-C and G-H), are located inside of line AD (locus of midpoint of circulatory carriageway). Therefore, the entry angle Φ has been determined using the method illustrated by figure 3.18N2 in section CD116 of the DMRB (in accordance with CD116 appendix A1.1).

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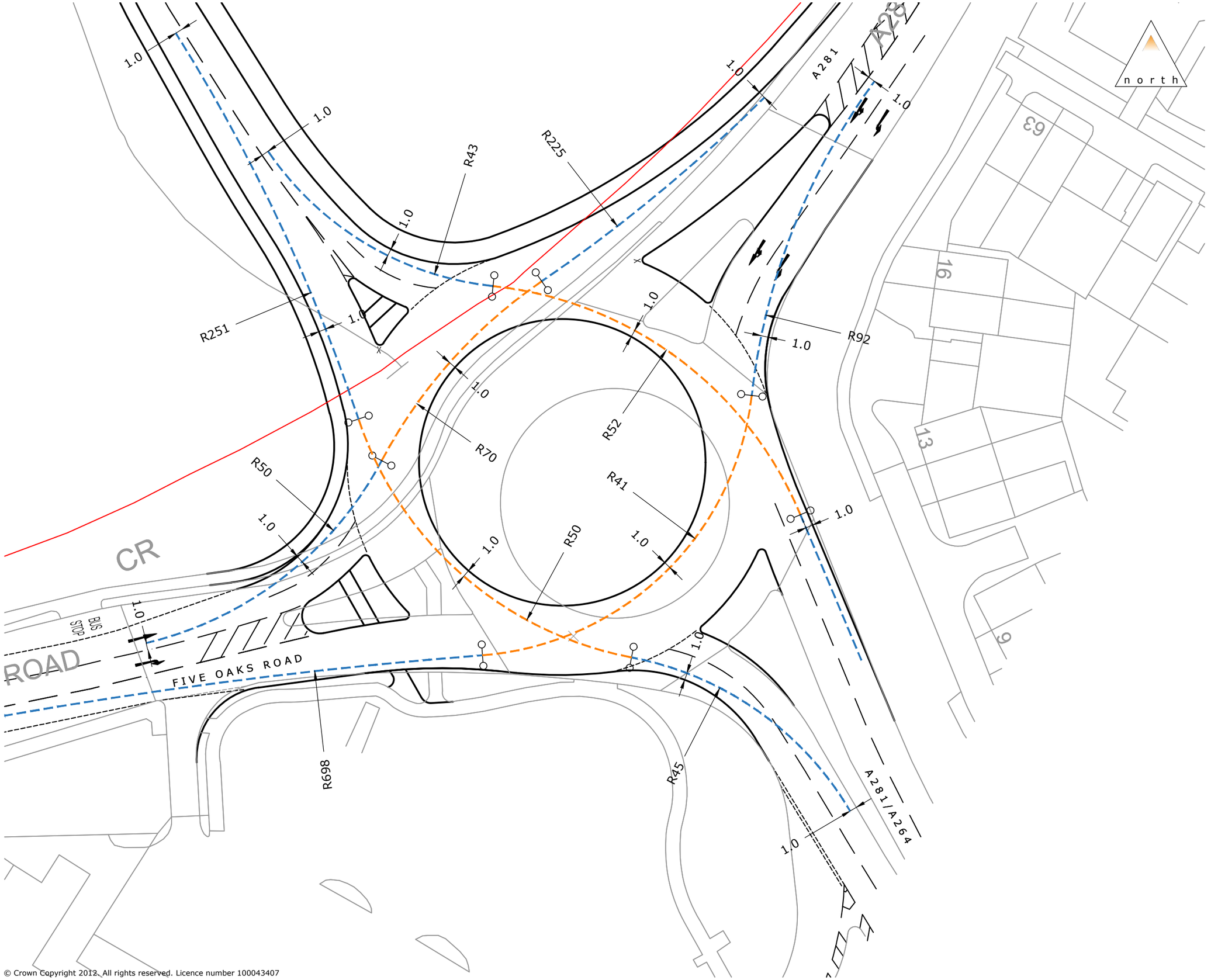
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Indicative Access / Roundabout Arrangement
(with Entry Angle Geometry)

Scale: 1:500 (@ A3)

Drawing: 1902029-13

Revision:

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Project:
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Title:
Indicative Access / Roundabout Arrangement
(with Entry Path Geometry)

Scale: 1:500 (@ A3)

Drawing: 1902029-14

Revision:

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LAND AT LOWER BROADBRIDGE FARM, BROADBRIDGE HEATH

Proposed Highway Access and Improvement Works

Stage 1 Road Safety Audit
Requested by Motion

February 2022

Gateway TSP

Road Safety Engineering

Project:	Land at Lower Broadbridge Farm, Broadbridge Heath Proposed Highway Access and Improvement Works
Client:	Motion
Document:	Stage 1 Road Safety Audit
Gateway TSP ref:	SG/WP/1902029 RSA1(B) v2.0
Issue date:	03/03/2022
Status:	Issued as v2.0
Authorised by:	WP

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Road Safety Engineering

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CONTENTS

1 Introduction 1
2 Items Considered by this Road Safety Audit 3
3 Previous Road Safety Audit 4
4 Collision Data 5
5 Problems Identified by this Road Safety Audit 6
6 Audit Team Statement 7

Appendices

Appendix A: Location Plan(s)

1 INTRODUCTION

1.1 This report describes a Stage 1 Road Safety Audit (RSA) of highway works associated with a residential development on the west side of Broadbridge Heath, in West Sussex. The proposed development is to provide approximately 133 dwellings and this audit considers the highway works associated with development of land on the southern part of Lower Broadbridge Farm, which comprise:

- Enlargement of the A281/Five Oaks Road/A264 roundabout and addition of a fourth arm to the serve the development
- Widening of the footway running along the west side of the A281, to provide a 3m shared foot/cycleway tying in with the WSCC Newbridge Roundabout improvement scheme (which is not part of this audit)

1.2 Guildford Road is of single carriageway configuration and subject to the 60mph national speed limit ('derestricted'), changing to 40mph north of the Newbridge Roundabout (Guildford Road/Broadbridge Way). There is street lighting within the 40mph speed limit zone, but not the derestricted section. Similarly, no footways are provided within the derestricted section of Guildford Road. Public footpath 1453 meets Guildford Road at the proposed pedestrian crossing facility, where presently there are steps on both sides, but no ramps or refuge island.

1.3 This Road Safety Audit was carried out by Steve Giles and Wendy Palmer and consisted of a desktop study and a site visit which was carried out on Tuesday 18th January 2022, between the hours of 1.00 and 2.00pm, when the weather was fine and the road surface dry. Traffic flows on the existing roads were steady and no congestion was observed. Traffic speeds appeared to be generally within the signposted speed limits.

1.4 The terms of reference for this RSA are as described in the Design Manual for Roads and Bridges (DMRB) document GG119. The Audit Team is independent of the project design team and has not been involved in the design process in any other capacity. The audit considers only the potential road safety implications of the scheme and has not verified compliance of the design with any other criteria.

1.5 The Audit Team has not been made aware of any Departures from Standard. Whilst reference may be made to design standards, this report is not intended to provide a design check.

1.6 Recommendations are aimed at addressing the identified potential road safety problems. However, there may be other acceptable ways to overcome a problem, considering wider constraints and opportunities; the Auditors would be pleased to discuss such alternative solutions as appropriate. The recommendations contained herein do not absolve the Designer of his/her responsibilities.

2 ITEMS CONSIDERED BY THIS ROAD SAFETY AUDIT

Document ref.	Rev.	Originator	Title
1902029-10	-	Motion	Overview of Highway Improvement Works
1902029-11	A	Motion	Indicative Access/Roundabout Arrangement
1909029-12	-	Motion	Indicative Access/Roundabout Arrangement (with Dimensions)

Additional/background information provided to the Audit Team

- Sussex Safer Roads Partnership Collision Report, 01/10/2016 – 30/09/2021

3 PREVIOUS ROAD SAFETY AUDIT

3.1 The Audit Team is not aware of any previous road safety audits having been carried out on these proposals.

4 COLLISION DATA

4.1 The Sussex Safer Roads Partnership Collision Report indicates that three personal injury collisions (PICs) occurred at or close to the Newbridge Roundabout in the last five years. However, the junction improvements implemented by West Sussex County Council are beyond the scope of this audit.

4.2 Two collisions occurred at the A281/A264 Five Oaks Road roundabout. The first was in May 2020 and involved a westbound car overtaking and striking a cyclist with its trailer. It was daylight/fine/dry and the cyclist sustained slight injuries. The second collision was in March 2021, in daylight/wet/damp conditions, and occurred when two cars attempted to turn left into Five Oaks Road simultaneously. Both drivers sustained slight injuries.

5 PROBLEMS IDENTIFIED BY THIS ROAD SAFETY AUDIT

General Matters

5.1 The Audit Team raises no concerns at this Stage 1 RSA in respect of general matters.

Local Alignment

5.2 The Audit Team raises no concerns at this Stage 1 RSA in respect of local alignment.

Junctions

5.3 Problem

Vehicle side-impact collisions due to parallel circulating

Location: Circulatory carriageway of proposed roundabout

The proposed roundabout design incorporates two entry lanes on each arm. Vehicle swept path analysis has not been provided and it is therefore not clear whether two large vehicles will be able to circulate simultaneously. Insufficient circulating carriageway width could lead to side impact collisions.

Recommendation

Carry out vehicle swept path analysis for side-by-side turning movements at the proposed roundabout and, if appropriate, provide arrow markings within each lane on the approaches.

Walking, Cycling and Horse Riding

5.4 The Audit Team raises no concerns at this Stage 1 RSA in respect of walking, cycling and horse riding.

Road Signs, Carriageway Markings and Lighting

5.5 The Audit Team raises no concerns at this Stage 1 RSA in respect of road signs, carriageway markings and lighting.

6 AUDIT TEAM STATEMENT

6.1 We certify that this Road Safety Audit has been carried out in accordance with DMRB document GG119.

Audit Team Leader

Steve Giles
BEng (Hons), IEng, FIHE, MCIHT, MICE, CMILT, MSoRSA, HE Cert Comp
Director & Senior Road Safety Consultant

Signed: 

Date: 28/02/2022

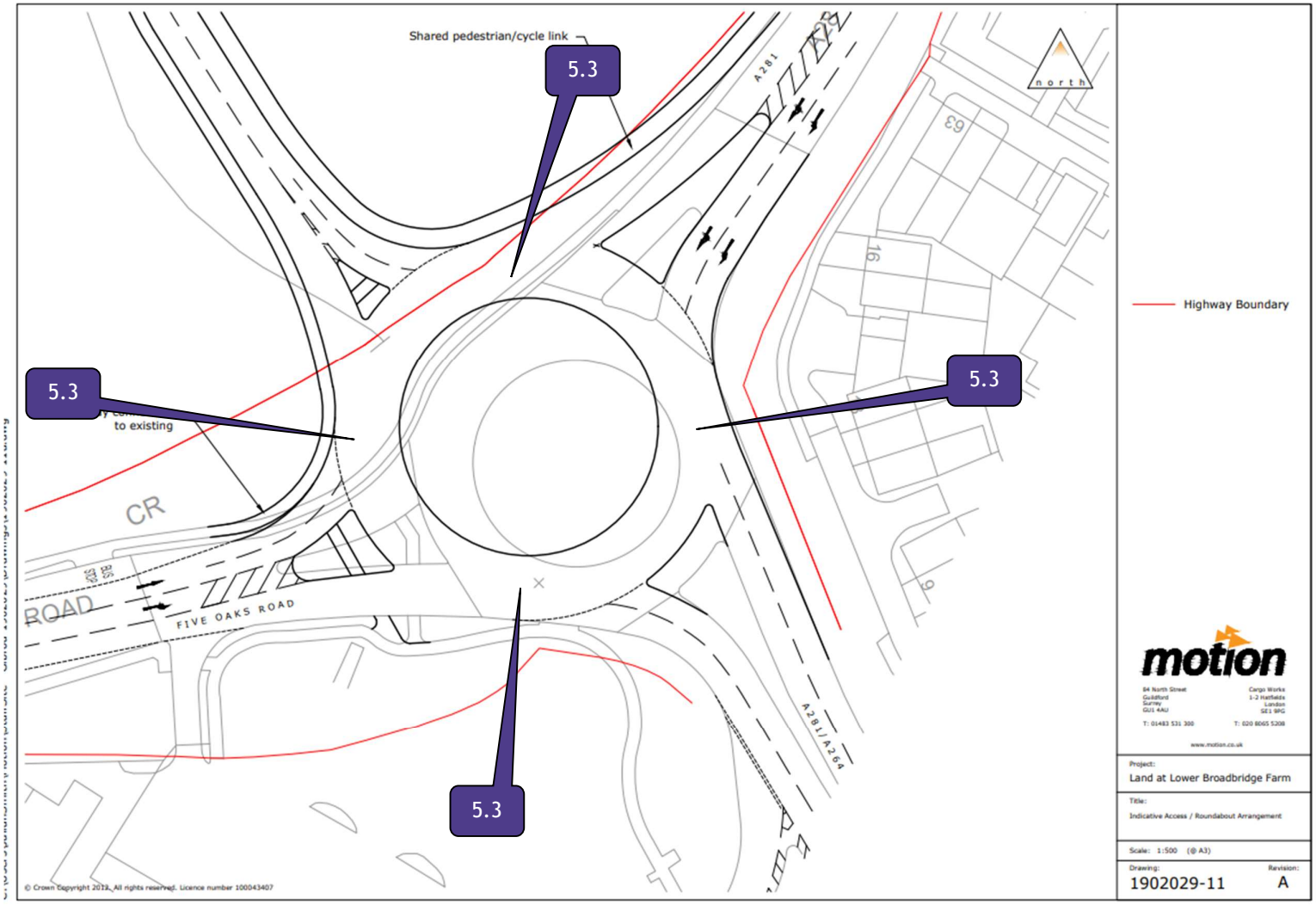
Audit Team Member(s)

Wendy Palmer
MCIHT, MSoRSA, FIHE, HE Cert Comp
Road Safety Engineer

Signed: 

Date: 28/02/2021

APPENDIX A
Location Plan(s)


Shared pedestrian/cycle link
5.3
5.3
5.3
5.3
to existing
A281
north
63
16
9
CR
ROAD
FIVE OAKS ROAD
A281/A264
Highway Boundary
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Project:
Land at Lower Broadbridge Farm
Title:
Indicative Access / Roundabout Arrangement
Scale: 1:500 (@ A3)
Drawing:
1902029-11
Revision:
A

DMRB GG119 - ROAD SAFETY AUDIT RESPONSE REPORT

PROJECT DETAILS

Report Title RSA1 - Lower Broadbridge Farm (South), Broadbridge Heath
Date 25th August 2022
Document ref and rev 1902029-RSA1-DR-SOUTH
Prepared by Motion
On behalf of West Sussex County Council (overseeing organisation)

AUTHORISATION SHEET
Project
Report Title
Prepared by;
Name:
Position:
Signed:

Organisation:
Date:

Approved by;
Name:
Position:
Signed:

Organisation:
Date:

INTRODUCTION

The highway works comprise (i) Enlargement of the A281/Five Oaks Road/A264 roundabout and addition of a fourth arm to the serve the development site (ii) Widening of the footway running along the west side of the A281, to provide a 3m shared foot/cycleway tying in with the WSCC Newbridge Roundabout improvement scheme (which is not part of this audit).

KEY PERSONNEL

Overseeing Organisation	Ian Gledhill (West Sussex County Council)
RSA Team	Wendy Palmer and Steve Giles (Gateway TSP)
Design Organisation	Julian Smith (Motion)

ROAD SAFETY AUDIT DECISION LOG

Item No.	RSA Recommendation	Design Organisation Response	Overseeing Organisation Response	Agreed RSA Action (design organisation and overseeing organisations agreed action to the problem)
5.1	N/a			
5.2	N/a			
5.3	Carry out vehicle swept path analysis for side-by-side turning movements at the proposed roundabout and, if appropriate, provide arrow markings within each lane on the approaches.	Vehicle tracking has been carried out and is shown on drawings 1902029-TK101a, 1902029-TK102a, and 1902029-TK103a, which demonstrate that vehicles can pass one another and drive around the circulatory carriageway simultaneously.		
5.4	N/a			
5.5	N/a			

DESIGN ORGANISATION AND OVERSEEING ORGANISATION STATEMENTS

Design Organisation Statement

On behalf of the design organisation I certify that:

1. **The RSA actions identified in response to the road safety audit problems in this road safety audit have been discussed and agreed with the Overseeing Organisation.**

Name:
Position:
Signed:



Organisation:
Date:

Overseeing Organisation Statement

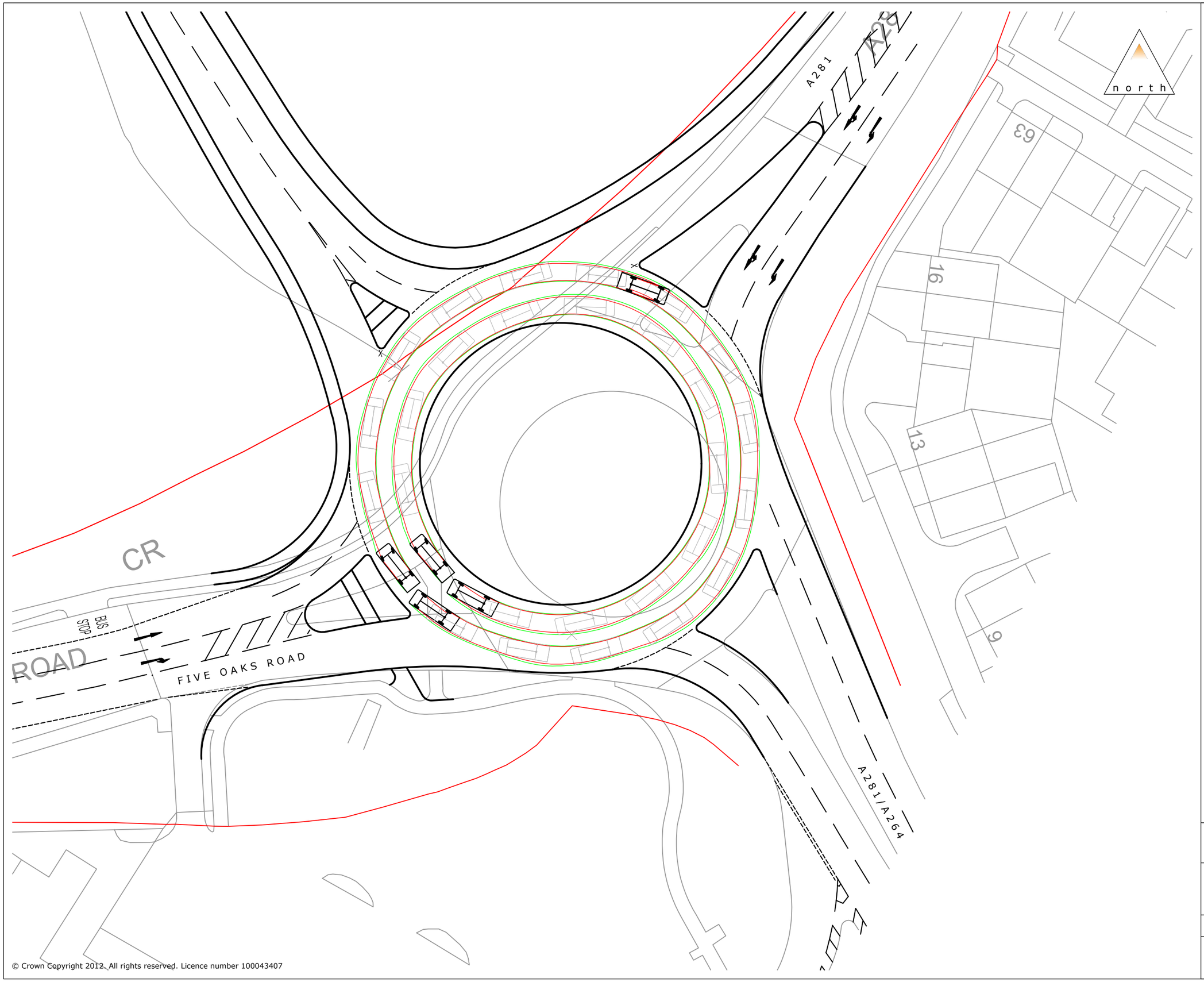
On behalf of the overseeing organisation I certify that:

1. **The RSA actions identified in response to the road safety audit problems in this road safety audit have been discussed and agreed with the design organisation.**
2. **The agreed RSA actions will be progressed.**

Name:
Position:
Signed:



Organisation:
Date:



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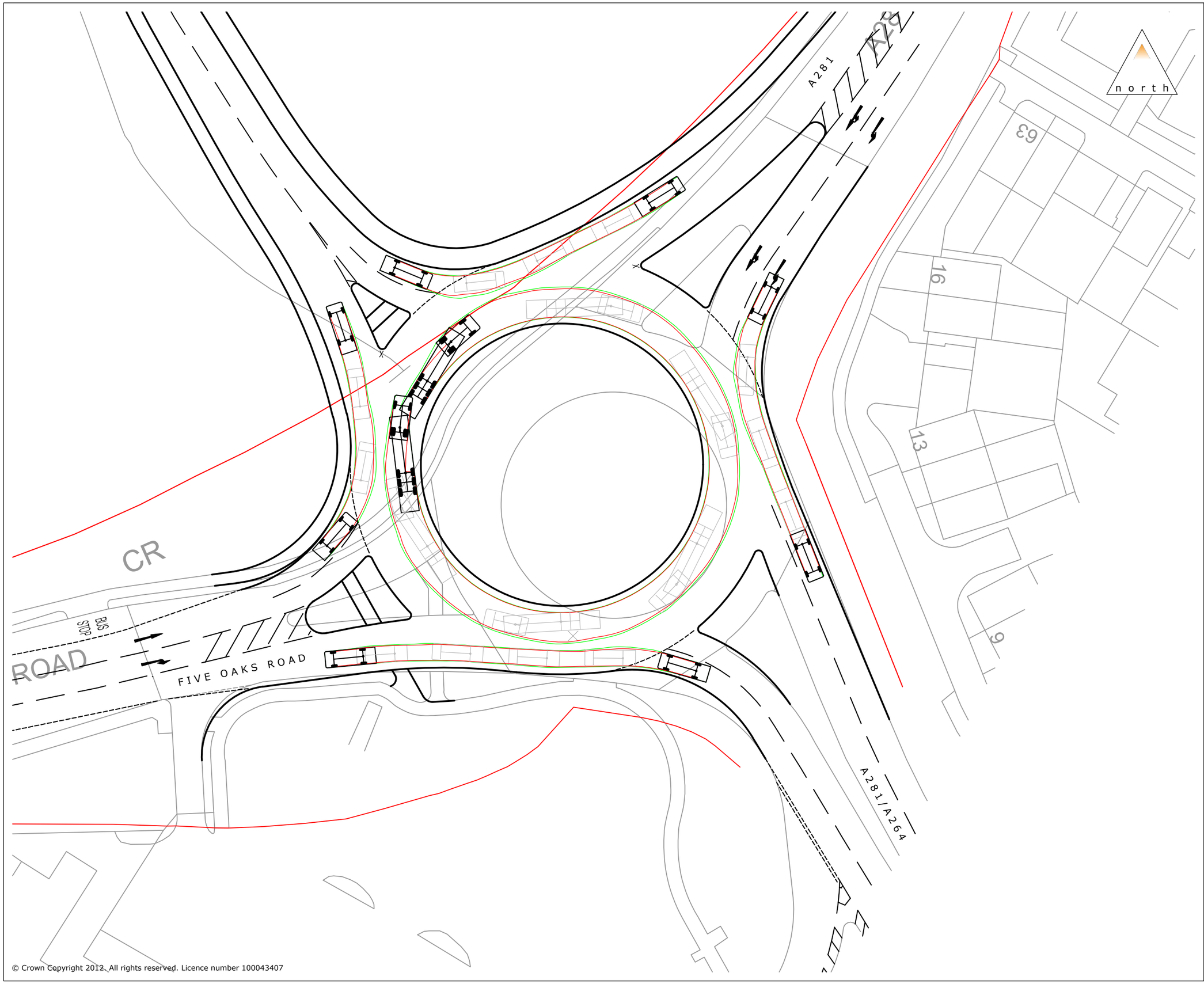
Project:
Land at Lower Broadbridge Farm

Title:
Swept Path of 7.2m Light Goods Vehicles on Circulatory Carriageway

Scale: 1:500 (@ A3)

Drawing: 1902029-TK101 Revision: A

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Highway Boundary

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Project:
Land at Lower Broadbridge Farm

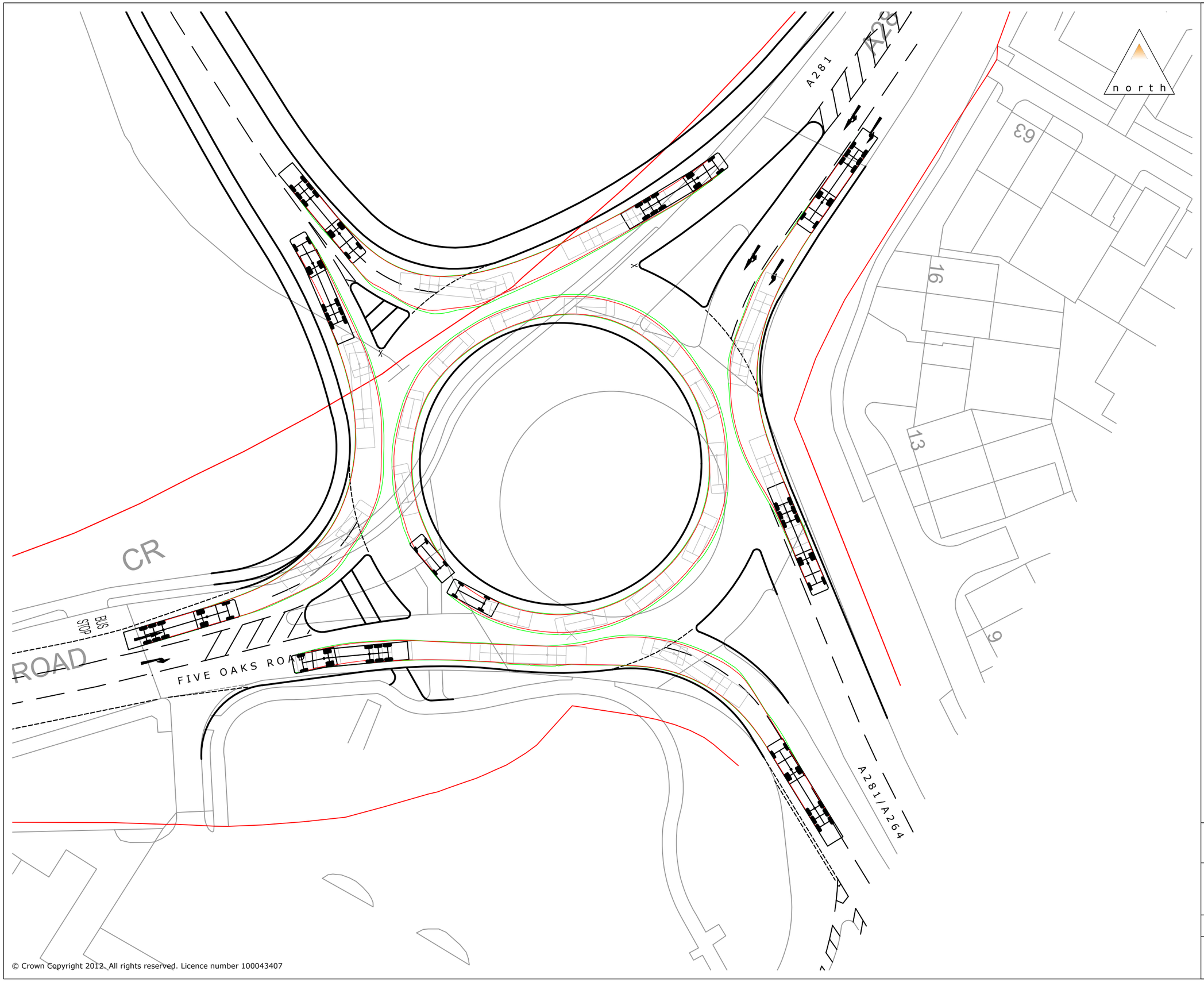
Title:
Swept Path of 16.5m Articulated Vehicle and 7.2m Light Goods Vehicles

Scale: 1:500 (@ A3)

Drawing: 1902029-TK102

Revision: A

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Project:
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Title:
Swept Path of 7.2m Light Goods Vehicle and 16.5m Articulated Vehicles

Scale: 1:500 (@ A3)

Drawing: 1902029-TK103

Revision: A