Stage 4 Safety Audit



NORWICH: A1270 BROADLAND NORTHWAY

STAGE 4 SAFETY AUDIT

REPORT REF: GEN/188 September 2019

Report Prepared for: Infrastructure and Major Highways Projects

Highways and Waste Norfolk County Council

Stage 4 Safety Audit



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Holder of Certificate of Competency (SoRSA Cert no 23)

Report Status:

Issue	Status	Purpose	Name/Signature	Date
1	Stage 4 Safety Audit	Client Issue	Nevil Calder	03/10/19
	Report		Myloalder	



1 INTRODUCTION

- 1.1 This report contains the results of a Road Safety Audit Stage 4 (12 month post-opening monitoring). The report has been produced as part of routine accident monitoring/Road Safety Audit process.
- 1.2 The Audit Team membership was as follows:-

Nevil Calder Bsc(Hons) CEng MICE MCIHT MSoRSA Principal Engineer
Holder of Certificate of Competency (SoRSA cert no. 23) Highway Safety

(Audit Team Leader) WSP

Kevin Allen BEng(Hons) IEng MCIHT MSoRSA Project Engineer
Network Safety

Norfolk County Council

- 1.3 The terms of reference are as described in Community and Environmental Services Highways Service Manual Procedure SP03-07-P01. The Auditors have examined and reported only on the road safety implications of the scheme and have not verified the compliance of the design to any other criteria.
- 1.4 A site visit was undertaken on 26 July 2019, during which the weather was bright/cloudy and the road surface was slightly damp; traffic conditions were moderate and free flowing. A further night-time visit was undertaken on 03 September 2019 at 20:00hrs. During the night-time site visit the weather was overcast and the road surface dry.

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2 SCHEME DETAILS

- 2.1 The audited scheme is a new 70mph speed limit dual carriageway distributor road approximately 19km long around the north of Norwich, with frequent at-grade roundabout junctions (unlit); a grade-separated interchange is provided at A140. The scheme also includes single carriageway links, Non-motorised user (NMU) routes and overbridges.
- 2.2 The road was opened in phases with the whole route becoming trafficked in April 2018.

 After initial accident concerns at some roundabouts, further countdown signing and road marking works were undertaken in late September & November 2018.

3 ANALYSIS OF ACCIDENTS

3.1 Whole Route Overview (See Appendix A for stick diagrams)

Note: a multiple vehicle pia (stick diag 6) was found to have occurred on A140 due to a large fuel spillage on the carriageway. It is unrelated to the scheme and has therefore been excluded from the following analysis.

3.1.1 During the 12 month period (17/04/18 - 16/04/19) since full route opening a total of 28 personal injury accidents (pias) (2 serious, 26 slight) were recorded throughout the scheme.

Accident Trend: downward - marked drop in last quarter (9 in Q1, 9 in Q2, 8 in Q3, 2 in Q4)

Accident Rate: high* - 244 pias/Bvkm (cf 72 on modern D2 roads with hard strips – source WebTAG COBALT 3)

Severity Index: low - 7% (cf 15% on modern D2 roads with hard strips – source WebTAG COBALT 3)

Key factors:

4 (14%) wet road low (cf 31% on non built-up roads – source RRCGB 2017).

10 (36%) darkness elevated** (cf 28% on non built-up roads – source RRCGB 2017)

10 (36%) very high*** (8% on non built-up A-roads – source RRCGB 2017)

motorcyclists

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Ksi casualties (Safe System considerations):

2 ksi casualties (serious) occurred in 2 accidents:-

both resulting from riding motorcycles (vehicle not Safe System compliant).

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Accident distribution:

25 pias (89%) occurred at roundabout junctions; 3 (11%) non-junction mainline.

- 3.1.2 *The accident rate is high for a modern D2 road but this is considered misleading as 89% of the accidents are at junctions (more normally around 25% on a modern D2 road) due in part no doubt to the high frequency of junctions. Since those junctions are all roundabouts this also helps explain the low severity index (a much smaller proportion of the accidents are at high-speed on the mainline carriageway). However, not all of the roundabouts have a significant accident record 75% of total accidents occurred at only 4 roundabouts.
- 3.1.3 **The elevated proportion of dark accidents (at those frequent roundabouts) results from approximately 2 more dark accidents than might be expected (value of prevention £290,128 source WebTAG).
- 3.1.4 ***The proportion of accidents involving motorcycles is very high and mostly (90%) at roundabouts. However, the causation is mixed:-
 - 4 motorcyclist blameworthy (2 overshoot, I loss of control, 1 tail-end)
 - 2 cars blameworthy (fail to give way on entering) and
 - 3 unclear blame (2 lane change on exit, 1 circulatory sideswipe).

No specific problem is suggested other than inappropriate speed and a possible lack of conspicuity in this environment.

3.1.4 Due to the phased opening, earlier sections have had longer to 'bed in' and more accident data is available. Each phase is therefore considered separately in more detail below:-



3.2 Western Section (A1067 to A140)

Opened 11 Nov 2017; Length: 6.7km (4 mainline roundabouts; 2 grade-separated roundabouts).

3.2.1 During the initial 12 month monitoring period (11/11/17 - 10/11/18) a total of 7 personal injury accidents (1 serious, 6 slight) were recorded; in the following 7 months a further 1 pia (slight) was recorded - total 8 pias:-

Accident Trend: declining – only 1 pia in last 9 months

Severity Index: in line - 13% (cf 15% on modern D2 roads – source WebTAG)

Key factors:

3 (38%) wet road In line (cf 31% on non built-up roads – source RRCGB 2017).

4 (50%) darkness High (cf 28% on non built-up roads – source RRCGB 2017)

3 (38%) pedal High (cf 11% on roundabouts - source RRCGB 2017)

cyclists

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3 (38%) High (cf 9% on non-built-up roundabouts - source RRCGB 2017)

motorcyclists

Ksi casualties (Safe System considerations):

1 ksi casualty (serious) occurred in 1 accident:-

• NMU (pedal cyclist) struck by car/trailer on roundabout.

Accident distribution:

6 pias occurred at four roundabouts, 2 non-junction

- 3.2.2 Low severity, declining trend, no clusters; however -
 - 6pias (75%) involve 2-wheelers, of which 5 on roundabouts (3 pedal cyclist, 2 motorcyclist) including 3 failure to give way to 2-wheelers in darkness suggests low conspicuity of 2-wheelers on unlit roundabouts.



3.3 Central Section (A140 to A1151)

Opened 21 Dec 2017; Length: 7.4km (3 mainline roundabouts).

3.3.1 During the initial 12 month monitoring period (21/11/17 - 20/12/18) a total of 14 personal injury accidents (all slight) were recorded; in the following 5 months a further 5 pias (all slight) were recorded – total 19 pias:-

Accident Trend: gentle rise overall – but some reduction in last 6 months

Severity Index: very low - 0% (cf 15% on modern D2 roads – source WebTAG)

Key factors:

4 (21%) wet road Low (cf 31% on non built-up roads – source RRCGB 2017).

9 (47%) darkness High (cf 28% on non built-up roads – source RRCGB 2017)

5 (26%) High (cf 9% on non-built-up roundabouts – source RRCGB 2017)

motorcyclists

Ksi casualties (Safe System considerations):

None.

Accident distribution:

17 pias (89%) occurred at three roundabouts; 2 non-junction (1 drunk driver).

3.3.2 Trend unclear, very low severity, but high number of dark accidents, and high proportion involve motorcyclists. Almost 90% of pias occurred at 3 roundabout clusters which needs further consideration:-

5 at Airport roundabout

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- 3 NEbound overshoot in dark (only 1 since countdown signs/ enhanced markings in Sep 2018);
- 2 loss of control (1 motorcyclist on wet circulatory and 1 involving police pursuit);
- suggests excessive speed of approach, perhaps due to low likelihood of needing to give way on entry.

5 at North Walsham Rd roundabout

- only 1 since countdown signs/ enhanced markings installed in November 2018;
- all daylight; 4 on mainline (2 on entry, 2 on exit); 2 motorcyclist;
- mixed causation (2 fail to give way, 1 tail-end, 2 lane change on exit);



7 at Wroxham Rd roundabout

- 5 since countdown signs/ enhanced markings in September 2018;
- 4 dark; 6 on mainline (4 on entry, 2 on exit); 2 motorcyclist;
- mixed causation (1 overshoot, 1 fail to give way, 3 tail-end, 2 lane change on exit);
- dark & speed/close following implicated; 1 involved peak-hour mainline queuing.

3.4 Eastern Section (A1151 to Postwick Business Park)

Opened 17 April 2018; Length: 5.2km (2 mainline roundabouts).

3.3.1 During the initial 12 month monitoring period (17/04/18 - 16/04/19) a total of 8 personal injury accidents (all slight) were recorded; in the following 2 months no further pias were recorded – total 8 pias:-

Accident Trend: steep decline overall - only 1 pia in last 6 months

Severity Index: elevated - 25% (cf 15% on modern D2 roads – source WebTAG)

Key factors:

1 (13%) wet road Low (cf 31% on non built-up roads – source RRCGB 2017).

1 (13%) darkness Low (cf 28% on non built-up roads – source RRCGB 2017)

3 (38%) motorcyclist High (cf 8% on roundabouts – source RRCGB 2017)

Ksi casualties (Safe System considerations):

2 ksi casualties (serious) occurred in 2 accidents:-

both resulting from riding motorcycles (non safe system compliant vehicle)

Accident distribution:

8 pias occurred at two roundabouts.

3.3.2 Clear downward trend, elevated severity, but 1 roundabout cluster:-

6 at Salhouse Rd roundabout

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 3 SEbound overshoot in dark (none since countdown signs/ enhanced markings installed November 2018);

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 3 other mixed causation (1 very elderly driver tail end, 1 sideswipe on circulatory, 1 merging on exit).

Also 2 at Norwich Rd roundabout - both motorcyclists (1 sideswipe on roundabout, 1 loss of control on entry).

3.5 Summary

- High accident rate, very high junction involvement and low severity all appear to reflect the character of the road with frequent roundabout junctions;
- Accident trend appears to be downwards in western and eastern sections, less clear in central section;
- Elevated dark proportion;
- High motorcyclist involvement but no common type;
- 75% of all accidents in the first year occurred at 4 specific roundabouts (consecutive in the NE quadrant):-
 - Airport roundabout
 - North Walsham Road
 - Wroxham Road
 - Salhouse Road.

4 TRAFFIC CONDITIONS

- 4.1 Post-opening traffic monitoring was undertaken in 2018 (within the first year of opening) which showed flows along the route ranging from 7,000 to 22,000 vehicles per day (average 16,500 vehicles per day). On the western and eastern sections these were around 60% of the predicted opening year flow, and on the central section around 85% of predicted.
- 4.2 The road generally operates under free-flow conditions, however peak-hour queuing is reported on mainline approaches to A1151 Wroxham Road roundabout.



5 SAFETY ISSUES AND PROBLEMS

5.1 Review of Issues from Previous Stage 3 Road Safety Audit

Western Section (A1067 to A140)

5.1.1 All issues raised at the stage 3 RSA were resolved and closed-out at 27/07/18. At that time some of the agreed works were yet to be implemented, however there have been no recorded pias since the close-out date.

Central Section (A140 to A1151)

5.1.2 All issues raised at the stage 3 RSA were resolved and closed out at 09/02/18. At that time some of the agreed works were yet to be implemented; however, they do not appear to be implicated in the subsequent accident record, with the possible exception of Problem 3.1 where overshoot concerns were raised at the Airport Roundabout and it was agreed to add a further chevron sign on the roundabout. Due to subsequent accidents at the Airport and A1151 roundabouts further enhanced signing was added in late September 2018.

Eastern Section (A1151 to Postwick Business Park)

5.1.3 All issues raised at the stage 3 RSA were resolved and closed out at 24/07/18. At that time some of the agreed works were yet to be implemented, however they do not appear to be implicated in the subsequent accident record.

5.2 Concerns Raised by Public post-opening

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5.2.1 Since opening, numerous damage-only accidents at the roundabouts have been reported in the local press, with comments regarding roundabout conspicuity and layout. These have been supplemented by public reports expressing concern over position of chevron signs being out of drivers' direct field of view, reducing roundabout conspicuity and also about the lack of lighting (or road studs) on the roundabouts. The police have also commented on the low conspicuity of the roundabouts in darkness/bad weather.

Comment - 39% of roundabout accidents involve overshoot/losing control/tail-end collision suggesting inappropriate speed of approach. This could be due to lack of





awareness of a roundabout, or simply poor driver judgement (considered further at specific cluster site roundabouts in 5.3.5 below). The specific issue of lighting is considered further in 5.3.3 below.

- 5.2.2 The police have raised the issue of lane designation on roundabouts with 3-lane entries. They have suggested designating the nearside lane for left-turns-only in order to avoid drivers in the outside lane of the roundabout crossing an exit ahead of them. The potential for this kind of exit conflict has also been raised by others.
 - Comment the rationale for this suggestion appears attractive, however it is not possible to tell if this scenario is implicated in the accident record, although there have been 4 pias involving lane changes at exit on roundabouts with 3-lane entries. This type of conflict typically involves sideswipe collision which is more likely to have a non-injury outcome. Further consideration of this issue would entail the need for a conflict study (video surveillance) and a check on any capacity implications.
- 5.2.3 Concern has been raised about the safety of the uncontrolled pedestrian/cyclist crossing point of the dual carriageway at the Salhouse Road roundabout. This concern was subsequently extended to include all mainline NMU crossing points at roundabouts. A request has been made for signs warning of pedestrians crossing.
 Comment this is not implicated in the current accident record; however, TA91/05 notes that informal at-grade NMU crossings are normally not appropriate on dual carriageways with flows above 25,000 AADT. Current crossing demand appears to be very low, suggesting that controlled facilities are unlikely to be viable. It is suggested that this issue be kept under review as traffic and NMU flows increase.

5.3 Problems Identified at this Stage 4A audit

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5.3.1 A high accident rate, with predominant junction involvement and low severity have been identified, which all appear to reflect the character of the road and its frequent roundabout junctions. Together they may illustrate an inherent tension between a non-built-up 70mph dual carriageway road and yet a frequent need to give way and potentially stop (note: average roundabout spacing on Broadland Northway is very similar to A11 Thetford bypass, however there are more than twice as many





roundabouts on Broadland Northway than A11). There may also perhaps be mismatched driver expectations for the route - it mirrors the A47 southern bypass and has a similar appearance between junctions. However, it should be noted that 75% of all accidents in the first year occurred at only 4 roundabouts (see 5.3.5 below).

- 5.3.2 The accident trend appears to be downwards in the western and eastern sections, less clear in the central section. This may be due to a degree of 'bedding in' and some improvement due to the subsequent roundabout signing/ marking enhancements; however, the current period is too short to be confident about this.
- 5.3.3 The somewhat elevated proportion of dark accidents is likely to be due to above average night-time activity in an urban fringe location, coupled with the lack of roundabout lighting on a high-speed road. However, provision of lighting at the roundabouts would entail significant cost and would not conform to the planning consent granted for construction of Broadland Northway on environmental grounds. It is therefore recommended that this issue should be subject to monitoring/evaluation over a longer period, of at least 3 years.
- 5.3.4 High motorcyclist involvement but with no common accident type does not highlight a specific problem other than this type of vehicle's safety shortcomings and rider vulnerability in a high-speed environment.
- 5.3.5 Although the large majority of accidents occurred at roundabouts, only four of the nine at-grade roundabouts account for 75% of all accidents in the first year. This suggests focussing on those problem locations:-

Airport roundabout

- Accidents may be diminishing.
- Record suggests excessive speed of approach, perhaps due to low likelihood of needing to give way on entry.
- Site inspection identified:
 - eastbound mainline approach median visibility screening not fully effective due to spacing of 'baffles' and screen ends too far from roundabout (due to VRS terminating at that point);
 - westbound mainline approach suffers from excessive approach visibility of circulatory traffic across flat central island; planting does not currently obstruct



this and will take several years to mature; the area of planting does not appear to be maximised.

B1150 North Walsham Rd roundabout

- Only 1 accident since countdown signs/ enhanced markings introduced.
- Mixed causation; all daylight.
- Site inspection identified:
 - westbound mainline approach chevrons too far to the left for optimum conspicuity at the stopping sight distance.

A1151 Wroxham Rd roundabout

- 5 pias since countdown signs/enhanced markings September 2018, of which 4 dark.
- 86% on mainline (4 on entry, 2 on exit).
- Mixed causation; dark & speed/close following implicated; 1 involved peak-hr mainline queuing.
- Site inspection identified:
 - westbound mainline approach chevrons too far to the left for optimum conspicuity at the stopping sight distance;
 - both mainline approaches suffer from excessive approach visibility and seethrough across flat central island, planting does not currently obstruct this and will take several years to mature, the area of planting does not appear to be maximised;
 - coupled with the straight approach alignment, the above may result in headlight dazzle/ driver confusion at night-time.

C283 Salhouse Rd roundabout

- No accidents since countdown signs/ enhanced markings installed.
- Site inspection identified no issues which relate to the accident record.

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5.3.6 General Comments:

- The auditors noted that a considerable number of roundabout chevron signs are showing deterioration in the form of widespread mottling of the surface, which may affect their reflectivity/conspicuity. The suggests a defective batch of signs.
- Considerable loose red gravel was noted on circulatory carriageway at the Airport roundabout and originates from a surface treatment to the farm access road.

6 OPTIONS FOR TREATMENT

6.1 Measures at Roundabouts

6.1.1 Airport roundabout

Measures to reduce excessive approach/entry visibility:-

- improved spacing of 'baffles' on the median visibility screens is recommended (closer spacing is needed nearer the roundabout).
- due to the difficulty in extending the length of screening nearer to the roundabout (VRS terminates too soon for this purpose), reducing excessive visibility across the central island is also recommended. Doming the central island would be expensive and may not conform with the project Development Consent Order due to a change in approved ground levels. Instead, alternative methods of screening should be explored on a short to medium term basis until the existing planting matures. The area within should be maximised commensurate with maintaining 50m entry/circulatory visibility (TD16 table 8/1). This would enable additional planting, particularly some evergreen species (more driving in darkness occurs during winter).

6.1.2 B1150 North Walsham Rd roundabout

Measures to improve roundabout conspicuity:-

• the westbound mainline approach would benefit from an additional chevron sited to the right of existing to improve roundabout conspicuity at the stopping site distance.

6.1.3 A1151 Wroxham Rd roundabout

Measures to improve roundabout conspicuity:-

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• the westbound mainline approach would benefit from an additional chevron sited to the right of existing to improve roundabout conspicuity at the stopping site distance.

Measures to reduce excessive approach/entry visibility and potential headlight dazzle/confusion across the flat central island:-

- Doming the central island would be expensive and may not conform with the project Development Consent Order due to a change in approved ground levels.. Therefore, alternative semi-permanent screening methods are recommended to obstruct visibility until planting matures sufficiently. The area within should be maximised commensurate with maintaining 50m entry/circulatory visibility (TD16 table 8/1). This would enable additional planting, particularly some evergreen species (more driving in darkness occurs during winter).
- Also hedge planting on NE and SW quadrants is recommended to screen minor road approaches from mainline traffic.

6.1.4 Salhouse Rd roundabout

Further measures are not considered justified at this stage, and monitoring should continue.

6.2 Economic Assessment

- 6.2.1 Ten of the recorded accidents at the three roundabouts are considered treatable by the recommended measures. A collision saving of 30% is deemed appropriate, suggesting an annual saving of 3 accidents per year, which is equivalent to £435,192 based on the national average value of prevention of £145,064 (source: *TAG Data Book May 2019, Table A4.1.4*).
- 6.2.2 The First Year Rate of Return (FYRR) for an investment of say £50,000 is therefore estimated to be 870%

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7 CONCLUSIONS/RECOMMENDATIONS

7.1 The first year's data indicate a high accident rate, high junction involvement and low accident severity which all appear to reflect the character of the road with frequent roundabout junctions and perhaps some mismatched driver expectations of the road.

- 7.2 The accident trend appears to be downwards, perhaps due to a degree of 'bedding in' and subsequent enhancements to roundabout signing/marking implemented in late 2018; however, the current period is too short to be confident about this. In view of the very low severity of accidents, a wait-and-see approach can be taken. Further monitoring is therefore recommended to provide a better indication of safety performance of the scheme when a full 3 years' 'after' data is available.
- 7.3 In the meantime, some targeted measures are recommended at three roundabouts with a significant accident record, potentially offering a good First Year Rate of Return.

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AUDIT TEAM STATEMENT

We certify that this audit has been carried out in accordance with Norfolk County Council Community and Environmental Procedure SP03-07-P01

Signed (ATL) Nevil Calder

Dated 03 October 2019

Signed KJ J Kevin Allen

Dated 3 October 2019





APPENDIX A: Stick Diagrams

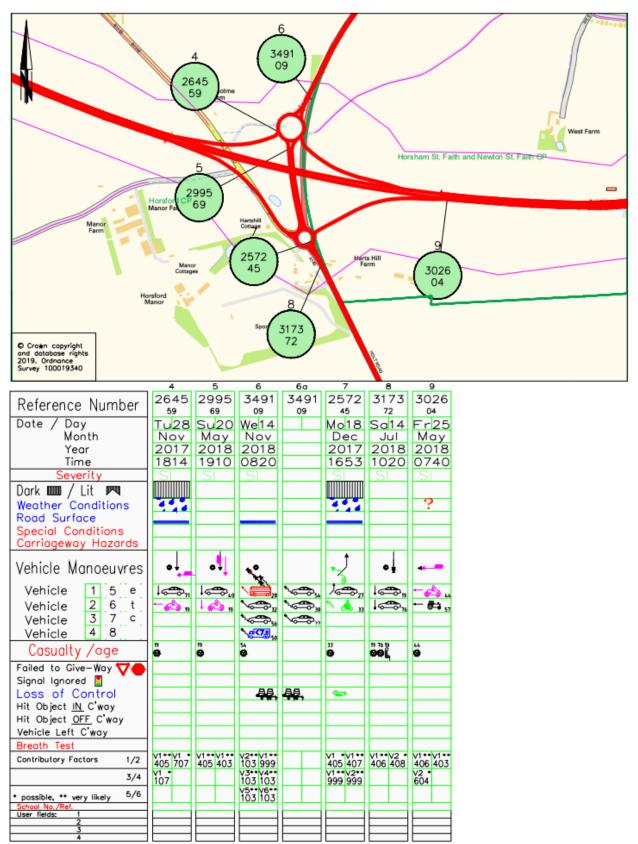
A1067 to B1149



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Reference Number	51	89	90
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Month	Mar	Jan	Jan
Year	2018	2018	2019
Time	1540	2015	2210
Severity	Se	SL	SL
Dark / Lit Weather Conditions Road Surface			
Special Conditions Carriageway Hazards			-
Vehicle Manoeuvres	•./	↑• ↓	:
Vehicle 1 5 e	1600 n	ارچې	•
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Contributory Factors 1/2	407 602	406 409	507 50
3/4		607 707	V1 *V1 405 40
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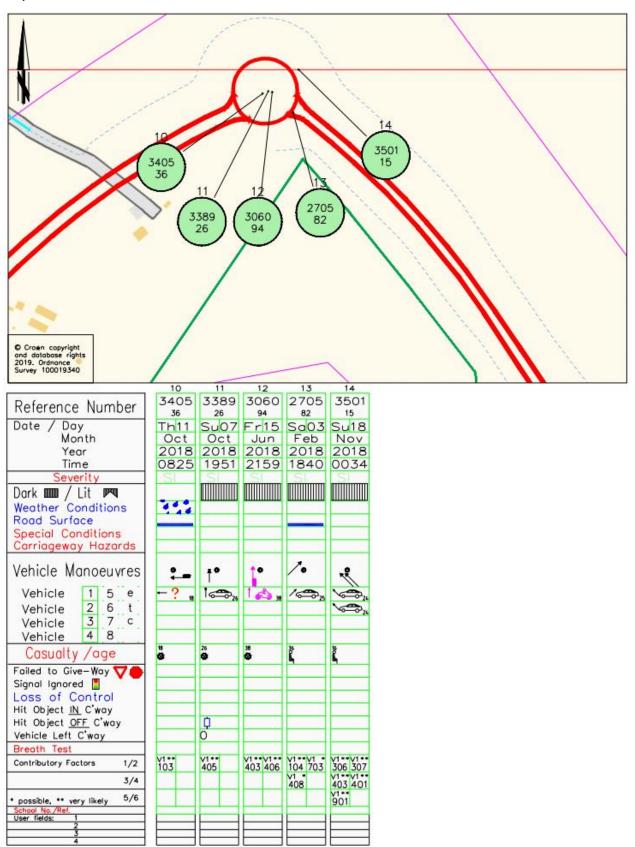


A140 Interchange



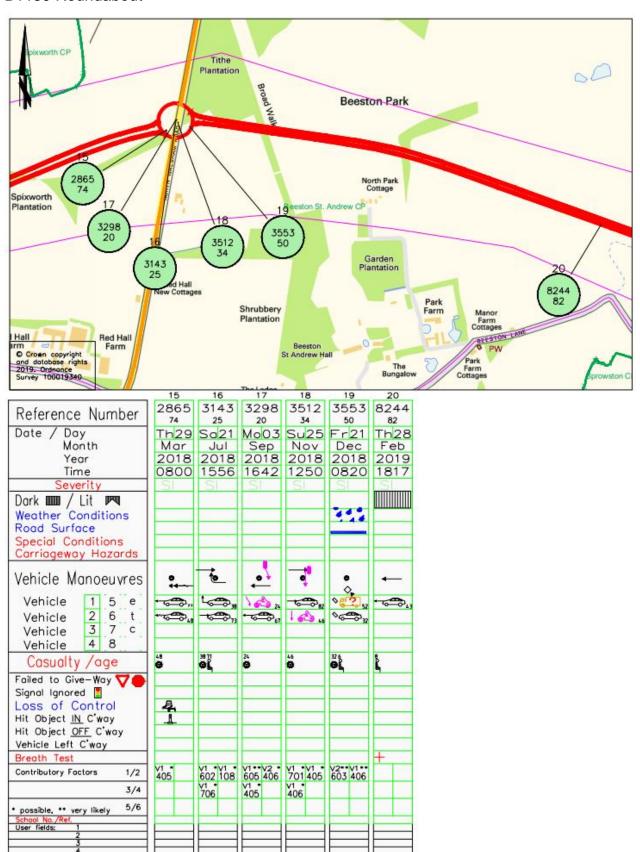


Airport Roundabout



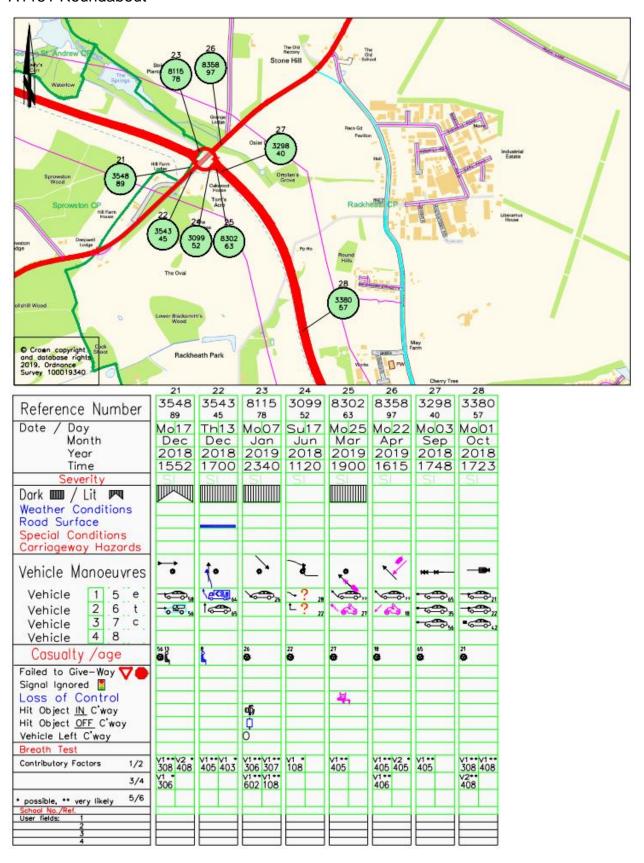


B1150 Roundabout





A1151 Roundabout





Salhouse Road/Plumstead Road

