

Lincoln Eastern Bypass

Model Sensitivity Test Note

June 2015

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Contents

Document Control Sheet	i
Contents	ii
Table of Figures	iii
Tables	iv
1 Introduction	5
1.1 Purpose of the Report.....	5
1.2 Structure of this Report.....	5
2 Count Data Review	6
2.1 Introduction.....	6
2.2 2006 Model.....	6
2.3 2012 Model Overview.....	6
2.4 Compiled Count Data.....	7
3 Model Recalibration Sensitivity	9
3.1 Introduction.....	9
3.2 Validation Commentary.....	9
3.3 Validation Conclusion.....	9
4 Future Year Forecasting	10
4.1 Introduction.....	10
4.2 Overview of Matrix Building Process.....	10
4.3 Summary of Model Outputs.....	11
4.4 Traffic Flow Patterns.....	12
5 Economic Evaluation	15
5.1 Introduction.....	15
5.2 Scheme Economic Performance.....	15
5.3 Summary.....	15
6 Overall Conclusions	16
6.1 Summary.....	16
6.2 Conclusions.....	16
APPENDIX A Original 2006 Model	17
APPENDIX B Sensitivity Validation	18
APPENDIX C Forecast Sensitivity Model Output	27
APPENDIX D Core Model Turn Flows	31
APPENDIX E Sensitivity Model Turn Flows	77

Table of Figures

Figure 4-1 – Summary of Matrix Building Process	10
Figure 4-2 – Model Turn Flow Locations.....	13

Tables

Table 2-1 - Hawthorn Road Counts	7
Table 4-1 – Forecast Matrix Totals	11
Table 4-2 – Description of LEB Sections.....	12
Table 4-3 – Forecast AADT Flows on each Section of the LEB	12
Table 5-1 – TUBA Results Summary Table	15

1 Introduction

1.1 Purpose of the Report

The LEB model has been re-calibrated and validated in advance of the 2015 public inquiry. Much of this work has involved the refinement of traffic flows through the disaggregation of original traffic data to be more representative of actual choices facing specific travellers.

To assist in the exercise some additional survey data has been collected in early March 2015. This has been reviewed and specific traffic patterns have been identified as worthy of investigation. This note investigates traffic patterns and implements the conclusions of this within a sensitivity exercise.

1.2 Structure of this Report

Following this introduction the note is structured as follows:

- Chapter 2. Reviews Count Data in locality
- Chapter 3. Considers the implications of count data if used in calibration and validation
- Chapter 4. Considers the forecast implications
- Chapter 5. Considers the economic evaluation implications
- Chapter 6. Concludes on the exercise.

2 Count Data Review

2.1 Introduction

At an earlier meeting held between LCC, Mouchel and the Hawthorn Road Closure objectors the issue of detailed traffic counts in the vicinity of Hawthorn Road arose.

The objectors' concerns were several.

- The 2015 count evidence appeared to differ from the higher flows referenced in the 2006 model
- There appeared to be some difference between the count patterns derived from the ANPR exercise compared with the isolated junction counts.

In view of the critical nature of this information to the current exercise it was decided to conduct further investigation.

2.2 2006 Model

The 2006 model was developed for LCC by Jacobs Consultancy and was originally produced as a regional model suitable for the generic analysis of a range of traffic infrastructure interventions across the City of Lincoln and its wider area of interest.

The model was developed using travel patterns from a set of postcard interview surveys. Further review indicates that Hawthorn Road was not included in this exercise

With respect to Hawthorn Road it was stated that

"it was found that a number of ATCs were damaged or incorrectly placed during the data collection period and.... it was not possible to utilise this data for modelling purposes"

Whilst a Hawthorn Road count was not used within the model validation a locally adjacent screenline (3 – traffic volumes to east of Lincoln) demonstrated an appropriate flow volume in respect of GEH proximity. This is indicated in Appendix A.

No specific reference is provided to Hawthorn Road. From this it can be ascertained that this detail was excluded from the model development, which fulfilled its requirements as a strategic tool.

2.3 2012 Model Overview

Following further investigation of Lincoln traffic problems and development of the LEB business case the 2012 model was presented to DfT and approved for the evaluation and appraisal of the business case.

This process involved the recombination of existing 2006 data with further data collected between 2008 and 2011, with a more refined method of infilling unobserved movements. Traffic information derived from this model was presented in the 2014 Public Inquiry.

In this work Appendix B of the earlier LMVR refers to ATC89 flow volume on Hawthorn Road of 259 vehicles EB and 509 vehicles WB for the AM peak. Based on the statements in the original 2006 model this data is considered to be under question as to accuracy and appropriateness.

These values were used in the AM peak model with values in the IP and PM peak model set to the values obtained from 2011 counts. As the model had undertaken an infill process to fill in several minor gaps in the cordon, including Hawthorn Road, as follows:

“For each non-interview site with count data available, trips were in-filled by creating all-vehicle select link analysis (SLA) matrices at each link and in both directions using the previous incarnation of the base model. These have then been cleaned in a similar fashion to the postcard interview data to discard any illogical movements. The matrices were then segmented by purpose by applying the observed cordonwide purpose splits from the observed records. Segmented matrices were then controlled to the normalised count data and person trips were calculated by applying the average vehicle occupancy for each purpose.

2.4 Compiled Count Data

In light of the above discussion, and given objectors’ concerns over counts, it is appropriate to review the count evidence available, which is shown in table 2-1 below.

Table 2-1 - Hawthorn Road Counts

Time Period & Direction	2006 ATC	2012 Model Update	2014 Link Counts	2015 Turn Counts	2015 Implied from ANPR ¹
AM Wb	506	-	236	256	126
AM Eb	259	-	228	202	223
IP Wb	-	122	140	155	-
IP Eb	-	143	163	186	-
PM Wb	-	108	154	172	142
PM Eb	-	229	307	321	279

In this sequence the AM westbound and PM eastbound (single day MCC collected in 2011) look anomalous to the pattern of data otherwise collected in a comprehensive and controlled manner in 2015. The 2006 AM looks unreasonably high and the PM eastbound looks slightly low.

¹ Includes only matched records – total flow is likely to exceed these values

Development in the area (Bunkers Hill) has increased from 2006 to 2015 by approximately 400 dwellings and the Villages of Reepham and Cherry Willingham have gained over 200 homes, whereas the AM flow in particular has apparently declined if the 2006 flow is accepted as correct. This does not appear intuitive.

The ANPR data collected on a different day, but similar time to the turn counts has also been included. The reporting includes only those matched data items. Unmatched data is excluded and can refer to flow through the area that has been missed or vehicles terminating within the area. This is quantified as 14% of observations in the AM peak, 28% in the PM peak.

In the AM peak eastbound the ANPR data is in excess of the junction turn counts, which would not ordinarily be expected given the exclusion of unmatched data. Nevertheless flow variation would be expected from day to day. The AM peak eastbound figure in particular demonstrates a heavy volume by ANPR. This reflects the school movement and there could be specific reasons for AM peak variability on two days, such as weather, school parental involvement / trips or unrepresentative traffic/delay on parallel routes.

In any event the variability is not excessive and the general conclusion that can be drawn from the exercise is that the 2006 model observed AM westbound data appears to be high whereas the 2006 PM eastbound data looks low.

A sensitivity test was thereby conducted with the model controlled to different parameters in the area.

3 Model Recalibration Sensitivity

3.1 Introduction

In view of the count conclusions a sensitivity test was developed, to control base year 2006 traffic data to local values collected in 2015.

For this data translation a general assumption of a flat traffic profile was used. The general evidence behind this is presented in the Survey and LMVR note, stemming primarily from the recession of 2008-2013. The modest growth of 200 houses in the eastern Villages was ignored in this test (it would only serve to reduce flows further). Also the Bunkers Hill development was ignored as it is felt that the interaction between the eastern Villages and Lincoln would be unaffected by this development. The school would still have received pupils from its catchment area including the villages and eastern Lincoln.

As the flat growth profile was accepted 2015 control traffic counts on Wragby Road, St Augustines Road and Hawthorn Road west of Cherry Willingham were input to a round of matrix estimation to adjust demand to seek the required flow targets. The resultant flow patterns are indicated in Appendix B.

3.2 Validation Commentary

In general the performance of the model in the local area looks much improved. In general all link flows are within a close level of tolerance of the observed data, indicating that the model performs well in replicating traffic patterns. The worst performing link is PM Croft Lane southbound with a GEH of 11 whereas most other links indicate a GEH of 5 or under.

Regionally the validation is also improved. Appendix B contains the detail. In short the model exceeds the recommended DMRB / WebTAG criteria, with consistently over 85% of screenlines meeting the criteria.

The journey time routes presented show that the revised flow validation does not adversely impact upon travel times and that the performance of the model is maintained.

3.3 Validation Conclusion

The overall conclusion of the sensitivity test calibration and validation is that the changes made to the Hawthorn Road flows do not adversely impact the performance of the model. Indeed the performance is enhanced.

4 Future Year Forecasting

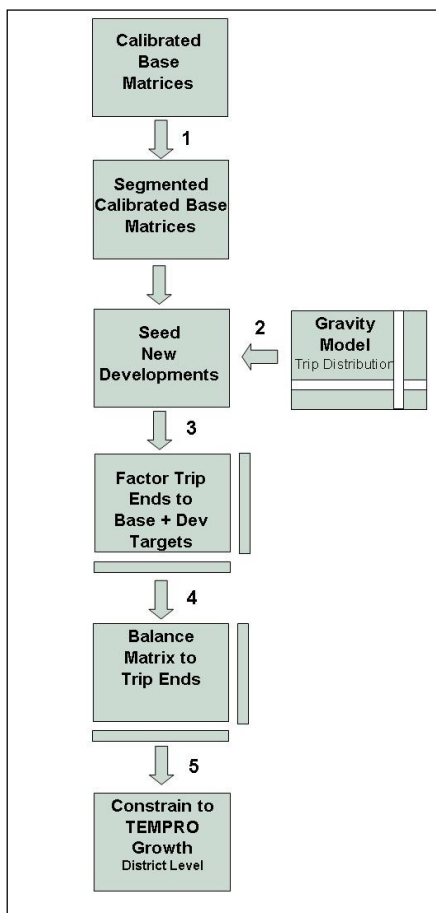
4.1 Introduction

A revised base model sensitivity test is available and has been demonstrated to perform well with unobserved data points from 2006 replaced with revised 2015 values.

The subsequent step has been to develop a forecast matrix for the process.

The exact same process has been used as documented in the June 2015 Forecast and Economic Note. As a reminder the process is detailed in Figure 4.1 below

Figure 4-1 – Summary of Matrix Building Process



4.2 Overview of Matrix Building Process

The matrix was developed using the same process and same development assumptions as the main forecast model. The detail is reported in the Forecast and Economics Note (June 2015). Resultant from the modified base year model the outturn forecast matrix totals are revised. The data is quantified in Table 4.1 below

Table 4-1 – Forecast Matrix Totals

Period	Year	Core		Sensitivity	
		DM	DS	DM	DS
AM Peak	2006	59,126		59,465	
	2018	61,669	61,669	62,025	62,025
	2033	69,294	71,143	69,695	71,547
Inter Peak	2006	55,197		55,197	
	2018	58,022	58,022	58,022	58,022
	2033	67,467	68,546	67,467	68,546
PM Peak	2006	59,627		59,817	
	2018	62,288	62,288	62,488	62,488
	2033	70,385	72,103	70,606	72,325

The above table indicates that the Base matrices used in the sensitivity test are higher by 339 trips in the AM peak and 190 trips in the PM peak. These increases are equivalent to approximately 0.6% and 0.3% in the AM and PM peak hours respectively. The matrices for the Inter Peak hour remains the same.

As per the core model the differences between 2033 DM and DS models reflects the difference in dependent development, with dependency upon LEB for the NEQ development site.

4.3 Summary of Model Outputs

The forecast flows in the vicinity of Hawthorn Road are indicated in Figures within Appendix C.

The traffic flows figures indicate the flows on Hawthorn Road to the west of the proposed bypass are forecast to decrease considerably with the scheme in place. These can be attributed to the removal of the east-west movement associated with the stopping of Hawthorn Road.

There are relatively small forecast changes in traffic flow on Hawthorn Road to the east of the proposed bypass, with trips still assigned to this section in order to access the left-in left-out junction with the LEB.

The performance of the LEB by section (defined in Table 4.2) are indicated in Table 4.3.

The sensitivity test forecasts generally show a slight decrease in 2-way AADT demand on the LEB of between 100 to 300 vehicles dependent on location. These differences are small relative to the total LEB flow and cannot be considered significant.

Table 4-2 – Description of LEB Sections

LEB Section	Start Point	End Point	Speed Limit	Length (km)
Section 1a	Wragby Rd East	Hawthorn Rd	96kph	0.45
Section 1b	Hawthorn Rd	Greetwell Rd	96kph	1.30
Section 2	Greetwell Rd	B1190 Washingb' Rd	96kph	1.35
Section 3	B1190 Washingb' Rd	B1188 Lincoln Rd	96kph	2.05
Section 4	B1188 Lincoln Rd	A15 Sleaford Rd	96kph	2.35
Total (km)				7.50

Table 4-3 – Forecast AADT Flows on each Section of the LEB

Section	2018 Forecast Two Way AADT Flows		2033 Forecast Two Way AADT Flows	
	Core Model	Sensitivity Model	Core Model	Sensitivity Model
Section 1a	17,700	17,800	21,300	21,200
Section 1b	17,400	17,200	20,600	20,300
Section 2	20,500	20,300	27,500	27,200
Section 3	14,500	14,300	21,800	21,500
Section 4	15,800	15,700	21,000	20,800

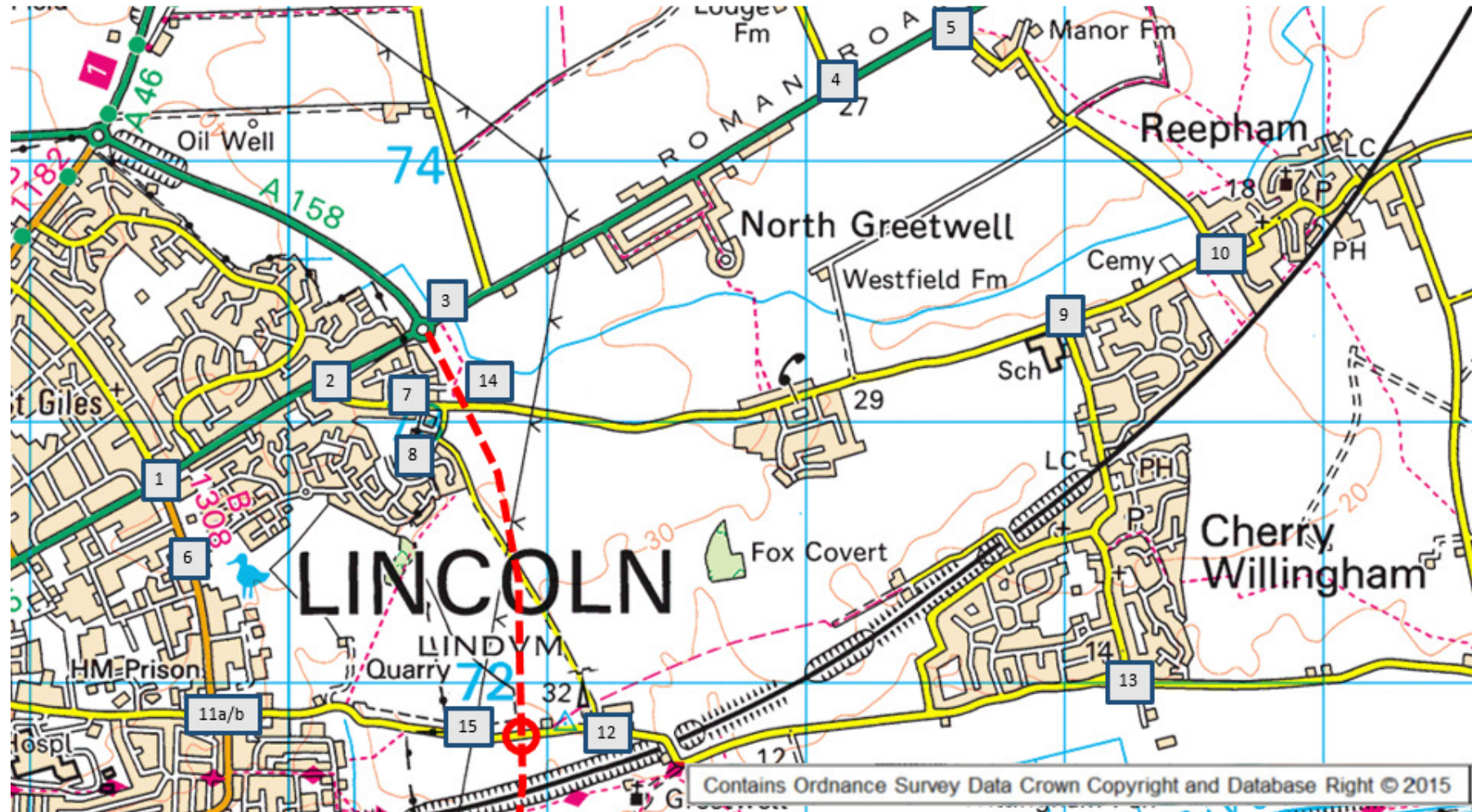
4.4 Traffic Flow Patterns

The traffic model flow patterns are recorded in Appendix D for the Core Model and Appendix E for the Sensitivity Model. In each case Junctions 1 through 13 are presented for the 2006 base and 2018 DM/DS opening year in the following order

- 2006 AM
- 2006 PM
- 2018 AM DM
- 2018 PM DM
- 2018 AM DS
- 2018 PM DS

Junctions 14 and 15 representing LEB junctions are only available in DS options.

Figure 4-2 – Model Turn Flow Locations



5 Economic Evaluation

5.1 Introduction

A revised sensitivity test base year with new data applied for Hawthorn Road has resulted in updated DM and DS traffic flows. This analysis has been input into the transport user benefit analysis (TUBA). The resultant output is detailed in this section

5.2 Scheme Economic Performance

A summary of the revised TUBA outputs are detailed in Table 5.1 below. All Values are in £'000 at 2010 prices and values. A comparative assessment of the changes for the Core and Sensitivity model is incorporated.

Table 5-1 – TUBA Results Summary Table

Cost and Benefits	Core Model	Sensitivity Model
Economic Efficiency		
Consumer User (Commute)	76,330	78,869
Consumer User (Other)	299,974	302,686
Business User and Provider	534,833	525,975
Indirect Tax Revenue	-11,018	-11,622
Carbon Benefits	3,821	4,068
Present Value of Benefits (PVB)	893,940	899,976
Broad Transport Budget		
Investment Costs	96,304	96,304
Present Value of Costs (PVC)	96,304	96,304
Overall Impacts		
Net Present Value (NPV)	797,636	803,672

5.3 Summary

The Sensitivity model results indicate similar economic benefit compared to the Core model. It is therefore expected that, if conducted, a similar pattern of accident benefits would also be replicated in the sensitivity test.

6 Overall Conclusions

6.1 Summary

Count data for 2015 suggests that there is a case for revision to the 2006 Hawthorn Road Counts based on lack of original ATC data coupled with the employment of subsequent synthetic and infill techniques.

The resultant model calibration represents an improvement to the Core model.

The forecast process results in similar traffic flows in both the DM and DS models for both Core and Sensitivity tests.

The sensitivity test forecast flows are attuned to the reduced Hawthorn Road flows in the base year.

The transport economic benefits of the LEB are maintained under both model variants.

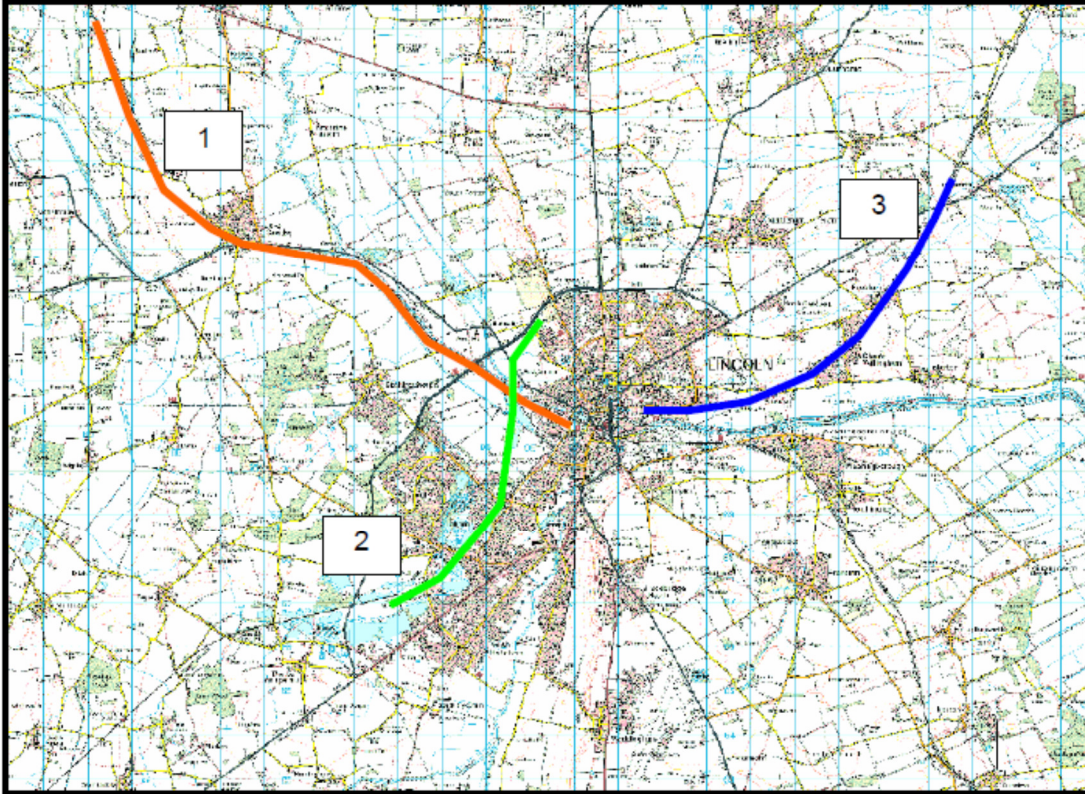
6.2 Conclusions

The presence or absence of specific traffic counts for Hawthorn Road is immaterial to the output LEB flows and economic assessments.

With the sensitivity test, as with the Core model, the forecast flows on Hawthorn Road are forecast to decrease considerably to the west of the proposed bypass whilst no material differences are forecast to the east.

APPENDIX A Original 2006 Model

Original 2006 Model Screenlines

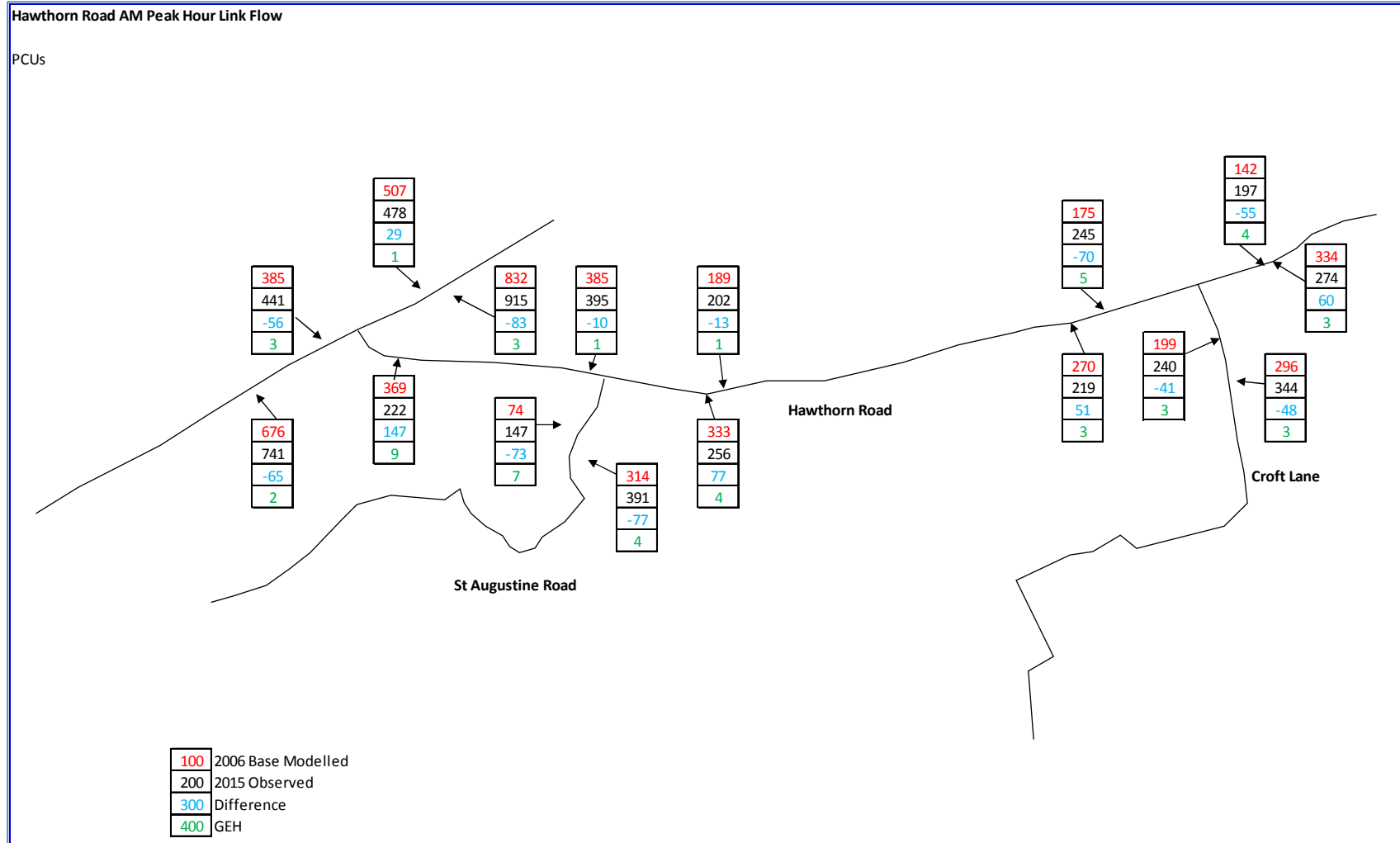


Original 2006 Model Screenline Comparison

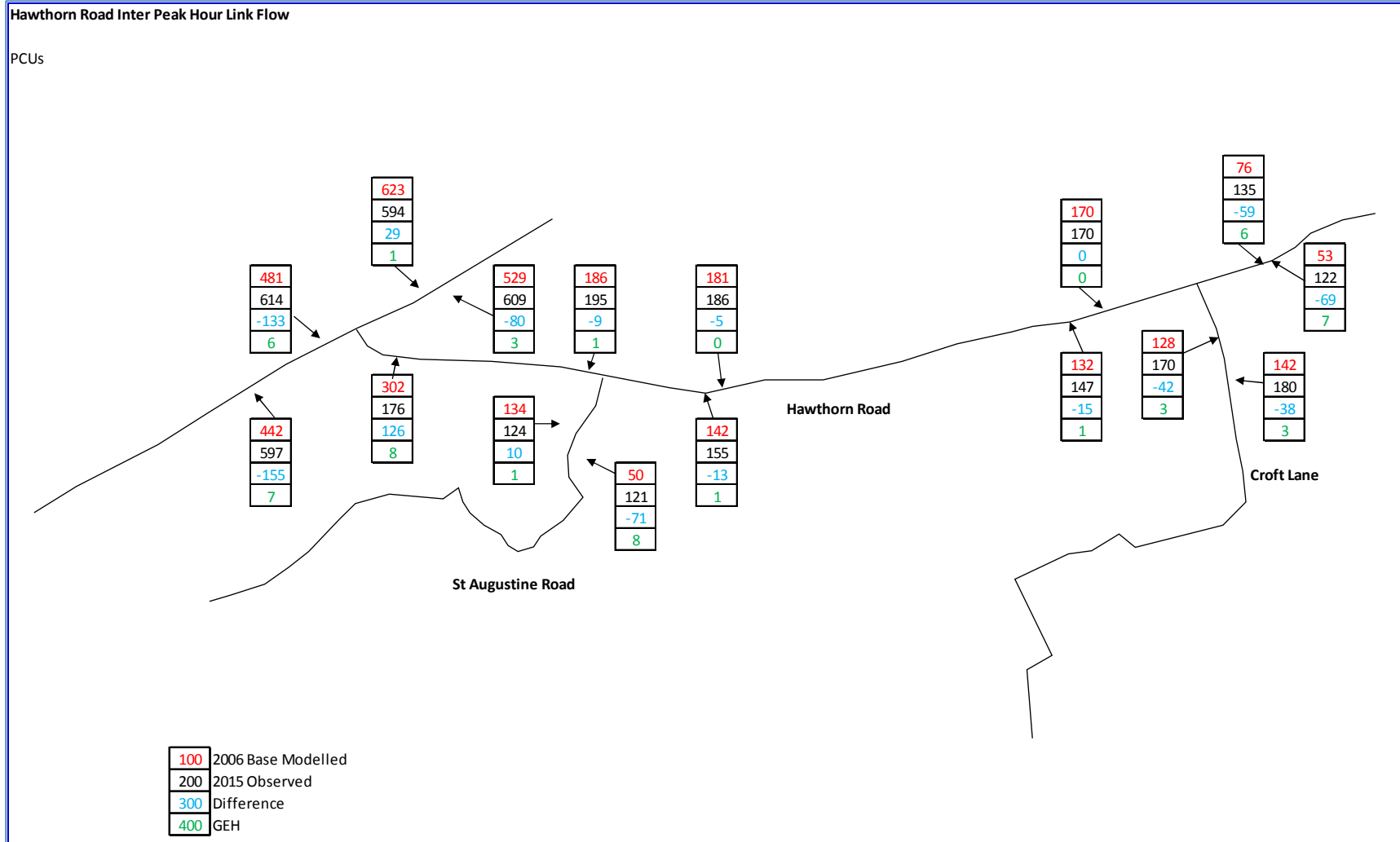
Screenlines	1		2		3	
	In	Out	In	Out	In	Out
AM	1.22	3.37	1.43	0.42	3.44	3.92
PM	0.29	1.77	2.61	3.30	1.15	3.49
IP	1.03	1.61	2.03	2.75	2.11	2.85

APPENDIX B Sensitivity Validation

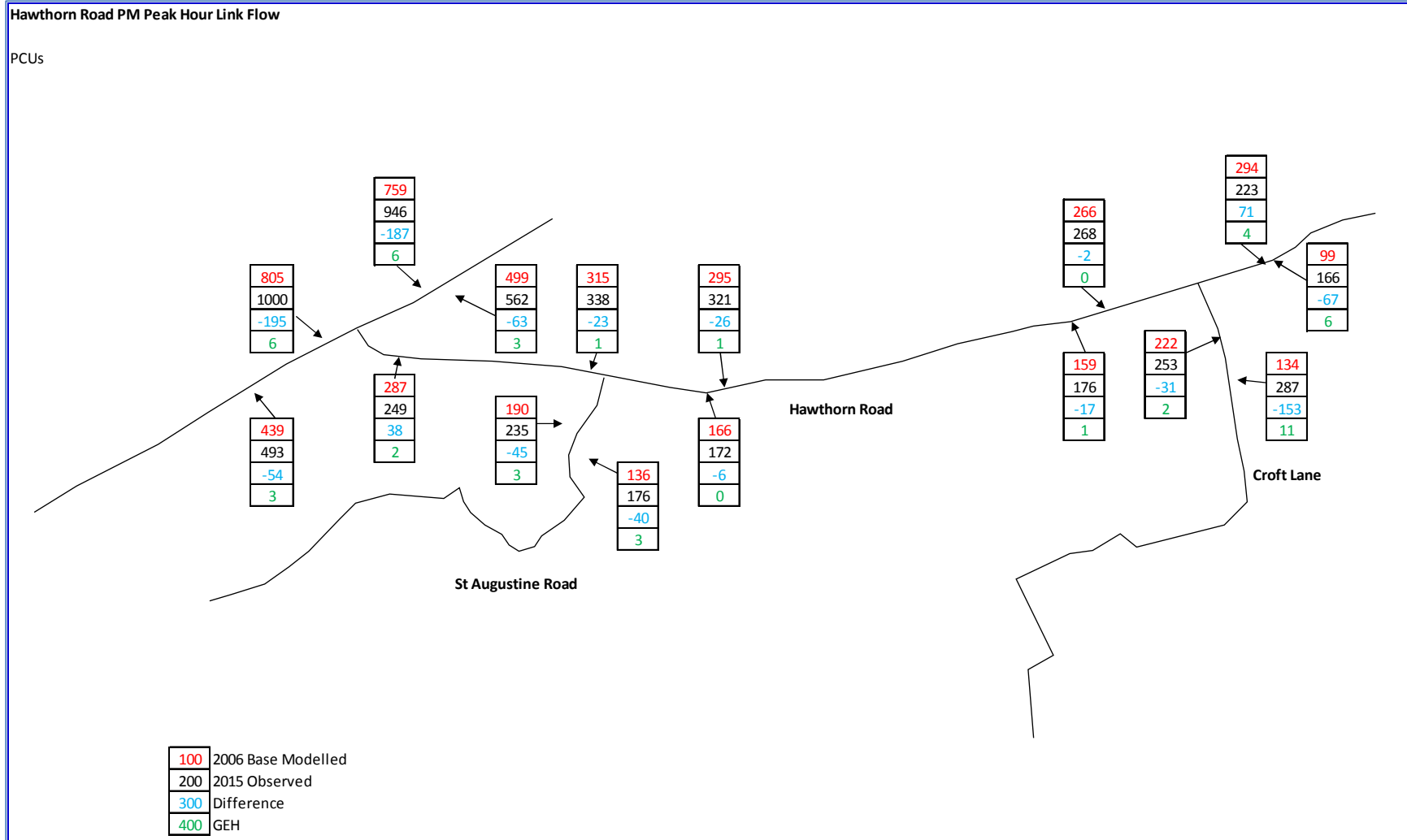
2006 AM Peak Traffic Flow Validation



2006 Inter Peak Traffic Flow Validation



2006 PM Peak Traffic Flow Validation



Lincoln Eastern Bypass

Model Sensitivity Note

AM Peak Screenline Flow Validation Summary

Sc.	Obs (pcu)	Mod (pcu)	Diff	% Diff	GEH	Flows	GEH
Sc. 1 (NB)	1,767	1,698	-69	-4%	1.7	✓	✓
Sc. 1 (SB)	3,356	3,241	-115	-3%	2.0	✓	✓
Sc. 2 (EB)	1,838	1,910	73	4%	1.7	✓	✓
Sc. 2 (WB)	3,473	3,441	-32	-1%	0.5	✓	✓
Sc. 3 (NB)	1,371	1,318	-53	-4%	1.5	✓	✓
Sc. 3 (SB)	1,538	1,397	-141	-9%	3.7	✓	✓
Sc. 4 (EB)	5,344	5,193	-150	-3%	2.1	✓	✓
Sc. 4 (WB)	3,965	3,933	-32	-1%	0.5	✓	✓
Sc. 5 (NB)	5,272	5,545	273	5%	3.7	✓	✓
Sc. 5 (SB)	4,212	4,251	39	1%	0.6	✓	✓
Sc. 6 (EB)	7,206	7,378	172	2%	2.0	✓	✓
Sc. 6 (WB)	6,051	5,827	-224	-4%	2.9	✓	✓
Sc. 7 (EB)	5,555	5,656	101	2%	1.4	✓	✓
Sc. 7 (WB)	6,128	6,019	-110	-2%	1.4	✓	✓
						100%	100%

Inter Peak Screenline Flow Validation Summary

Sc.	Obs (pcu)	Mod (pcu)	Diff	% Diff	GEH	Flows	GEH
Sc. 1 (NB)	1,814	1,868	54	3%	1.2	✓	✓
Sc. 1 (SB)	1,840	1,735	-105	-6%	2.5	✓	✓
Sc. 2 (EB)	1,971	2,042	71	4%	1.6	✓	✓
Sc. 2 (WB)	1,876	1,866	-10	-1%	0.2	✓	✓
Sc. 3 (NB)	855	866	10	1%	0.4	✓	✓
Sc. 3 (SB)	1,021	1,081	60	6%	1.8	✓	✓
Sc. 4 (EB)	3,512	3,737	226	6%	3.8	✓	✓
Sc. 4 (WB)	3,617	3,758	141	4%	2.3	✓	✓
Sc. 5 (NB)	3,510	3,700	190	5%	3.2	✓	✓
Sc. 5 (SB)	3,904	4,164	260	7%	4.1	✓	*
Sc. 6 (EB)	5,593	5,364	-229	-4%	3.1	✓	✓
Sc. 6 (WB)	5,471	5,315	-156	-3%	2.1	✓	✓
Sc. 7 (EB)	4,804	4,700	-104	-2%	1.5	✓	✓
Sc. 7 (WB)	5,318	5,079	-240	-5%	3.3	✓	✓
						100%	93%

Lincoln Eastern Bypass

Model Sensitivity Note

PM Peak Screenline Flow Validation Summary

Sc.	Obs (pcu)	Mod (pcu)	Diff	% Diff	GEH	Flows	GEH
Sc. 1 (NB)	3,264	3,428	163	5%	2.8	✓	✓
Sc. 1 (SB)	2,302	2,491	190	8%	3.9	✓	✓
Sc. 2 (EB)	3,477	3,422	-55	-2%	0.9	✓	✓
Sc. 2 (WB)	1,939	2,080	141	7%	3.2	✓	✓
Sc. 3 (NB)	1,396	1,467	71	5%	1.9	✓	✓
Sc. 3 (SB)	1,492	1,381	-110	-7%	2.9	✓	✓
Sc. 4 (EB)	4,687	4,619	-68	-1%	1.0	✓	✓
Sc. 4 (WB)	4,963	4,867	-96	-2%	1.4	✓	✓
Sc. 5 (NB)	4,358	4,377	19	0%	0.3	✓	✓
Sc. 5 (SB)	5,269	5,470	202	4%	2.8	✓	✓
Sc. 6 (EB)	6,843	6,466	-377	-6%	4.6	✓	✗
Sc. 6 (WB)	6,474	6,685	212	3%	2.6	✓	✓
Sc. 7 (EB)	6,276	6,053	-223	-4%	2.8	✓	✓
Sc. 7 (WB)	6,299	5,951	-348	-6%	4.4	✓	✗
						100%	86%

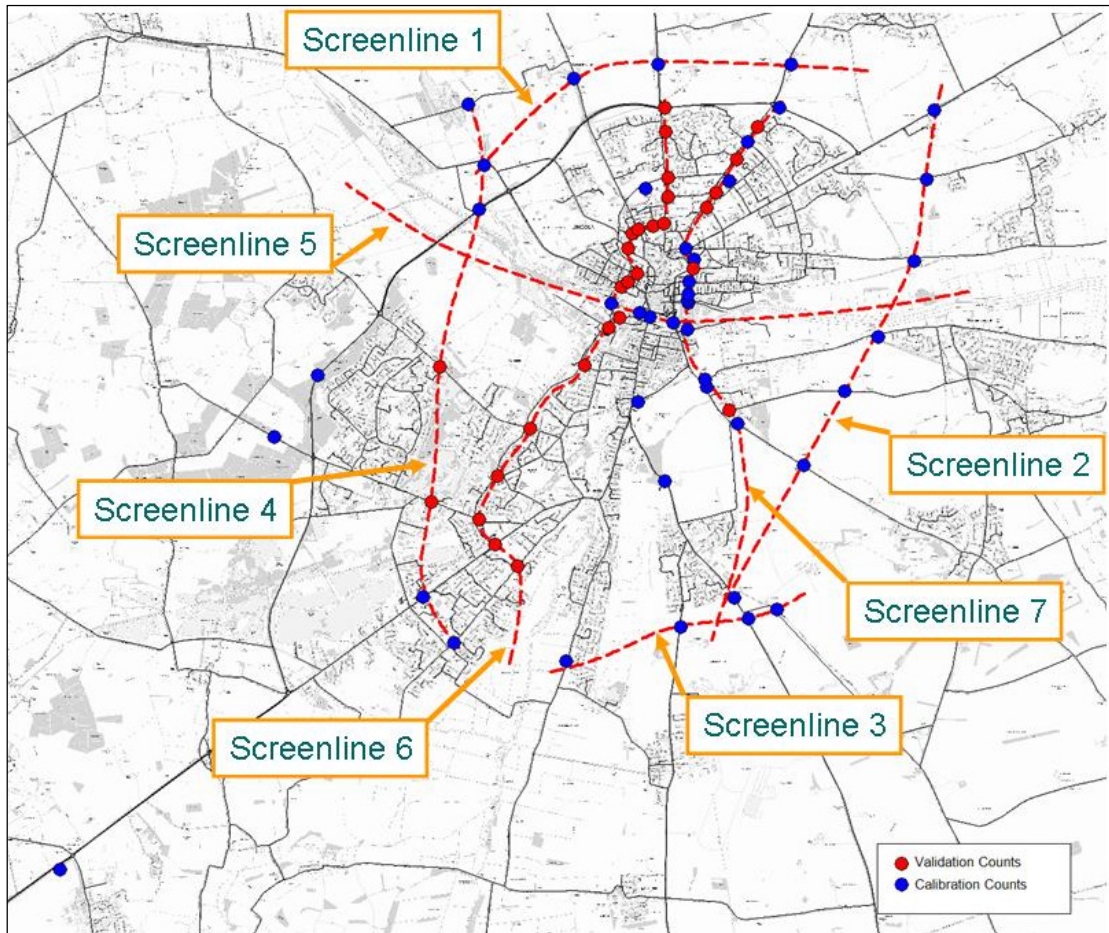
Journey Time Route Validation

AM Route	Ass Dist	Obs Time	Ass Time	Diff	% Diff	Pass / Fail
1	8.48	1,231	1,174	-57	-5%	✓
2	8.43	1,115	1,200	85	8%	✓
3	46.77	3,052	3,141	89	3%	✓
4	46.85	3,381	3,369	-12	0%	✓
5	36.38	2,727	3,064	337	12%	✓
6	36.42	2,947	2,959	12	0%	✓
7	34.32	2,511	2,527	16	1%	✓
8	34.42	2,978	2,539	-439	-15%	✓
9	25.88	2,044	2,138	94	5%	✓
10	26.14	1,957	2,174	217	11%	✓
11	28.74	1,678	1,958	280	17%	×
12	28.74	1,724	1,661	-63	-4%	✓
13	19.52	1,263	1,374	111	9%	✓
14	19.50	1,369	1,183	-186	-14%	✓
15	36.52	2,688	2,798	110	4%	✓
16	36.66	2,824	2,946	122	4%	✓
17	21.34	1,793	1,791	-2	0%	✓
18	21.48	2,049	1,796	-253	-12%	✓
19	23.72	2,218	2,237	19	1%	✓
20	23.70	2,181	2,037	-144	-7%	✓
						95%

IP Route	Ass Dist.	Obs Time	Ass Time	Diff	% Diff	Pass / Fail
1	8.48	1,151	1,051	-100	-9%	✓
2	8.43	1,073	938	-135	-13%	✓
3	46.92	3,030	3,249	219	7%	✓
4	46.86	3,002	2,844	-158	-5%	✓
5	36.38	2,514	2,475	-39	-2%	✓
6	36.42	2,736	2,531	-205	-8%	✓
7	34.32	2,444	2,494	50	2%	✓
8	34.42	2,654	2,421	-233	-9%	✓
9	25.88	1,866	1,873	7	0%	✓
10	26.14	1,825	1,876	51	3%	✓
11	28.74	1,640	1,491	-149	-9%	✓
12	28.74	1,664	1,480	-184	-11%	✓
13	19.52	1,118	935	-183	-16%	×
14	19.50	1,169	960	-209	-18%	×
15	36.52	2,488	2,484	-4	0%	✓
16	36.66	2,608	2,585	-23	-1%	✓
17	21.34	1,777	1,758	-19	-1%	✓
18	21.48	1,872	1,655	-217	-12%	✓
19	23.72	2,221	1,903	-318	-14%	✓
20	23.70	2,036	1,881	-155	-8%	✓
						90%

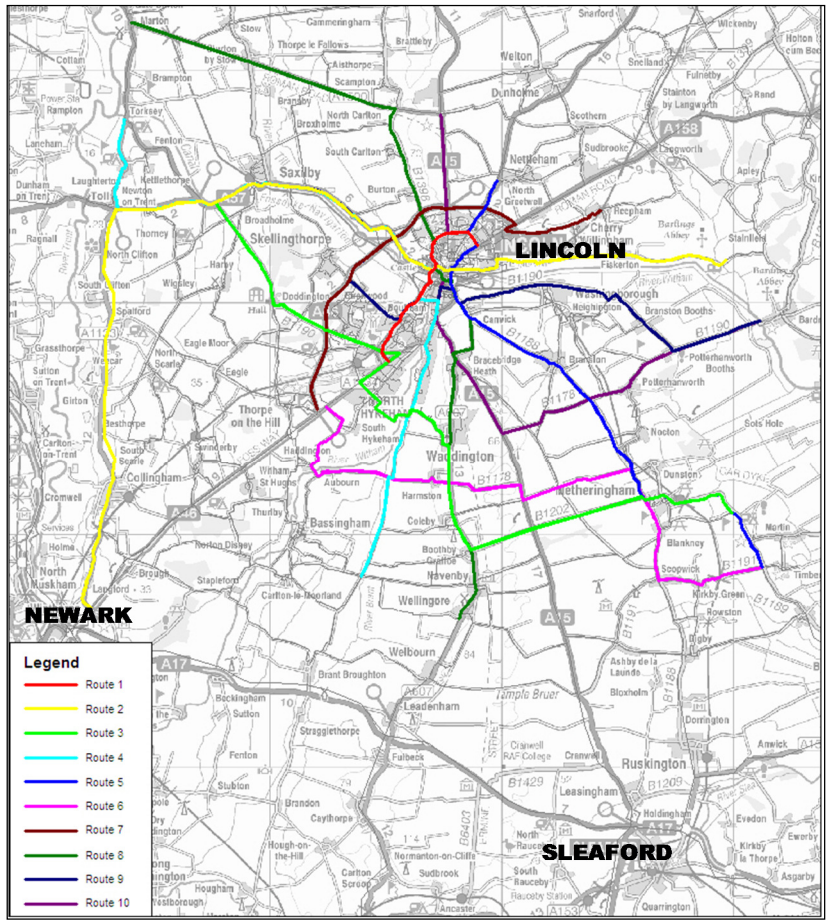
PM Route	Ass Dist.	Obs Time	Ass Time	Diff	% Diff	Pass / Fail
1	8.478	1,320	1,543	223	17%	×
2	8.434	1,174	1,255	81	7%	✓
3	46.96	3,315	3,612	297	9%	✓
4	46.9	2,904	3,263	359	12%	✓
5	36.38	2,863	3,277	414	14%	✓
6	36.42	2,912	3,258	346	12%	✓
7	34.32	2,651	3,287	636	24%	×
8	34.42	2,746	3,230	484	18%	×
9	25.88	2,064	2,356	292	14%	✓
10	26.14	2,025	2,244	219	11%	✓
11	28.74	1,656	1,858	202	12%	✓
12	28.74	1,668	1,785	117	7%	✓
13	19.52	1,274	1,378	104	8%	✓
14	19.5	1,338	1,031	-307	-23%	×
15	36.52	2,782	3,034	252	9%	✓
16	36.66	2,836	2,985	149	5%	✓
17	21.34	2,158	2,268	110	5%	✓
18	21.53	1,968	1,805	-163	-8%	✓
19	23.72	2,374	2,561	187	8%	✓
20	23.7	2,247	2,370	123	5%	✓
						80%

Screenline Plan



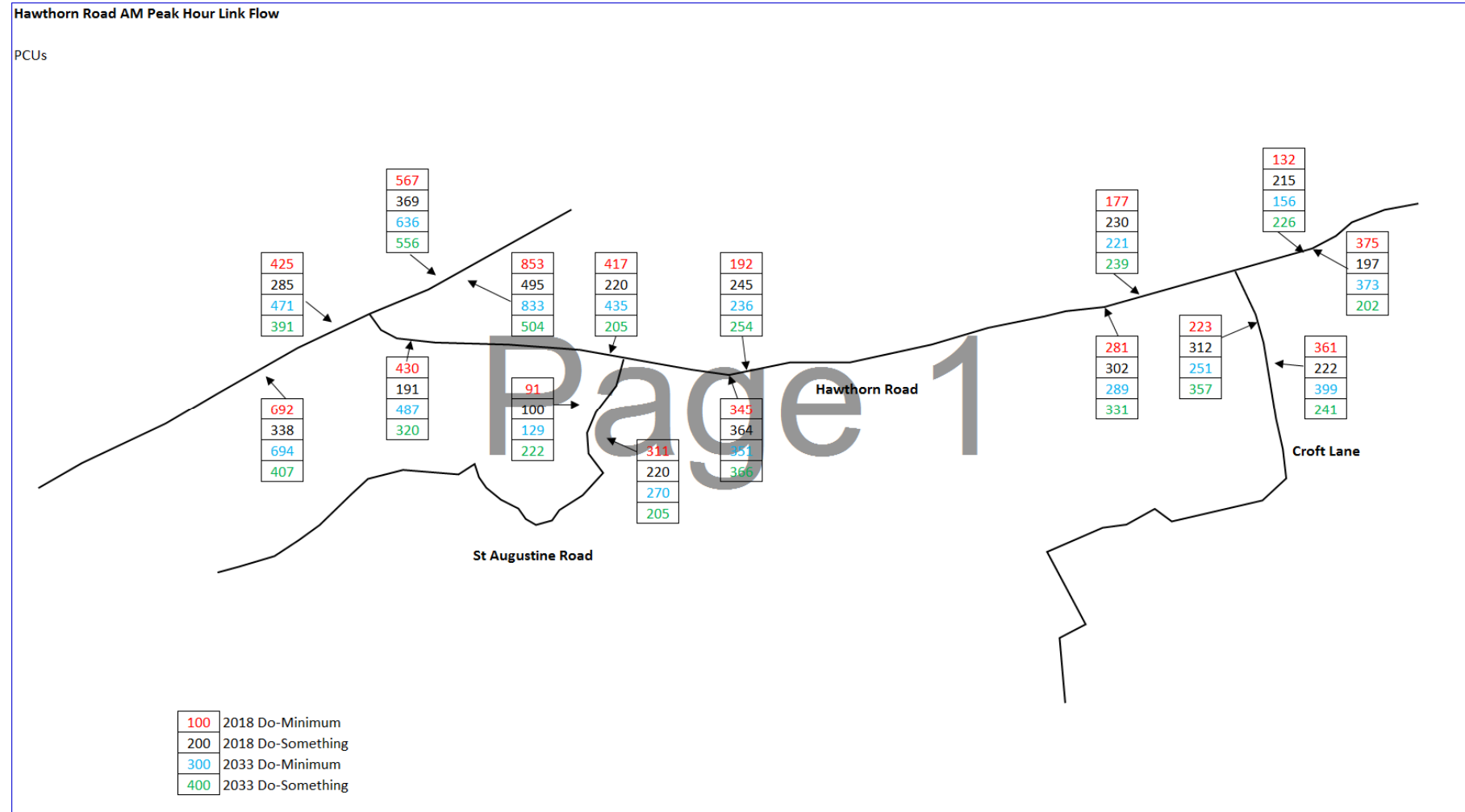
Lincoln Eastern Bypass
Model Sensitivity Note

Journey Time Routes

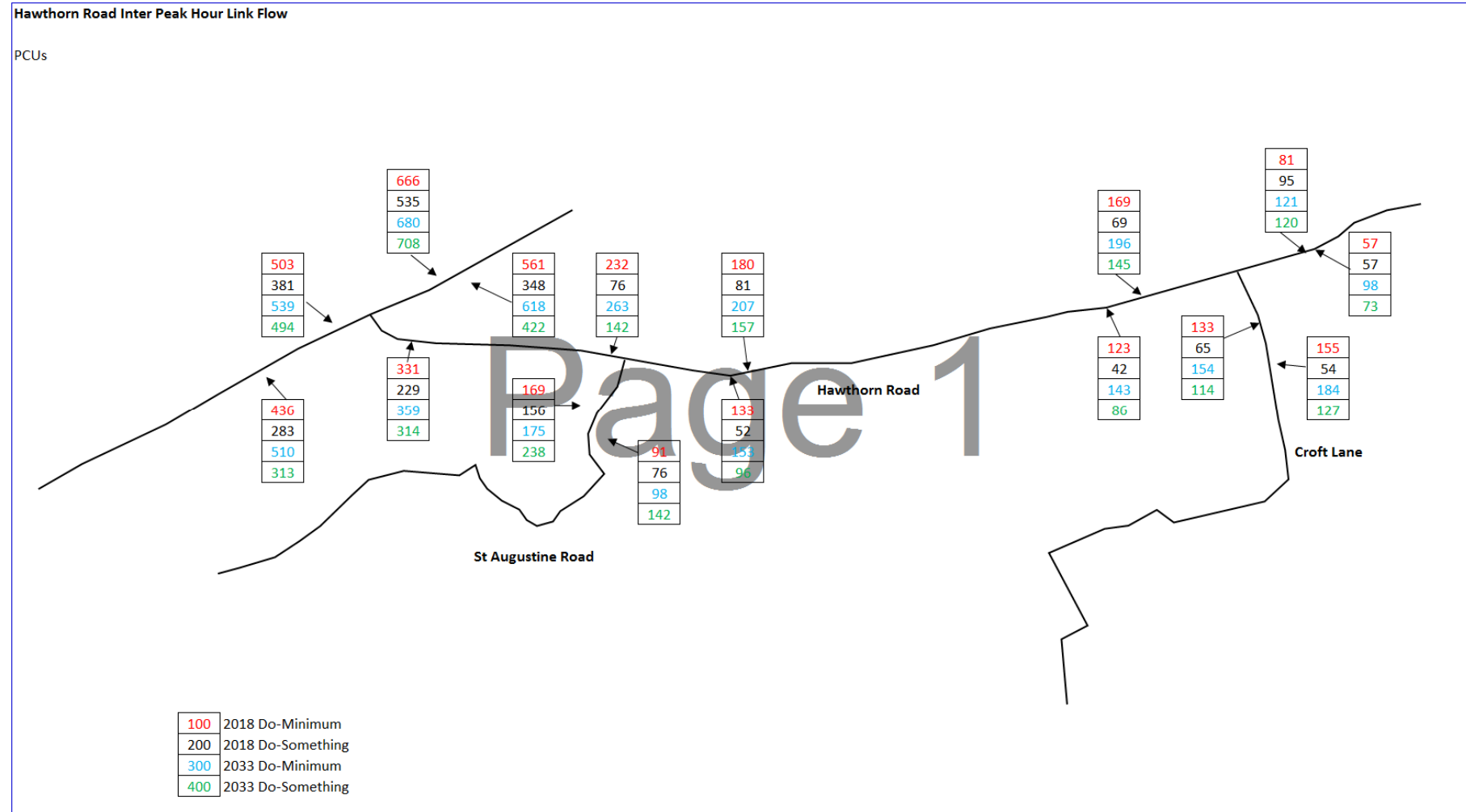


APPENDIX C Forecast Sensitivity Model Output

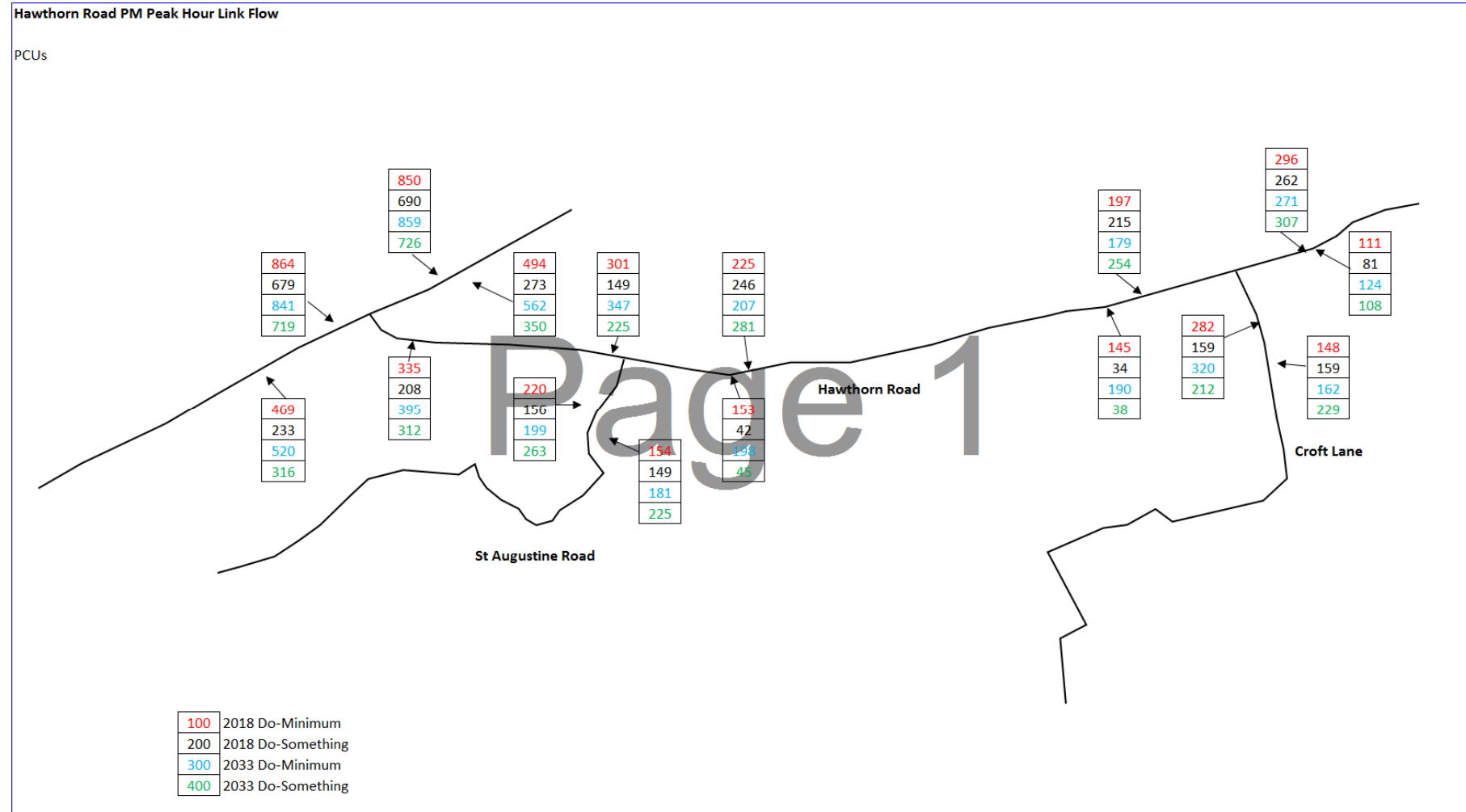
AM Peak Forecast Model Traffic Flows



Inter Peak Forecast Model Traffic Flows



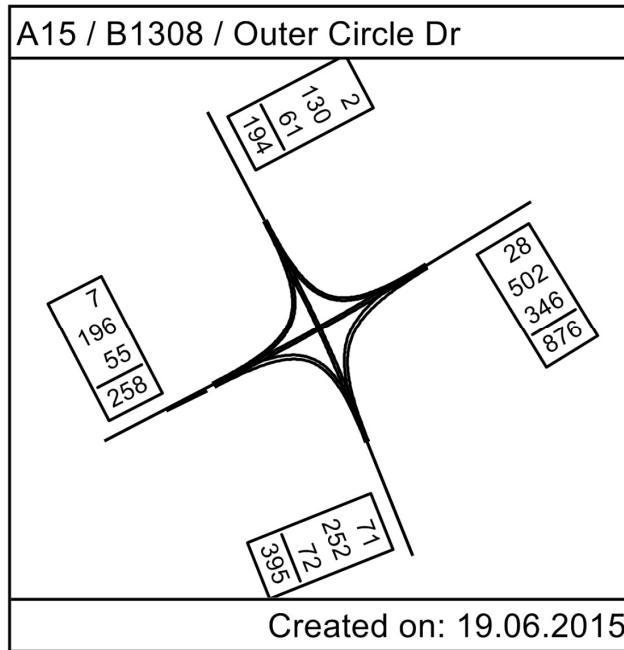
PM Peak Forecast Model Traffic Flows



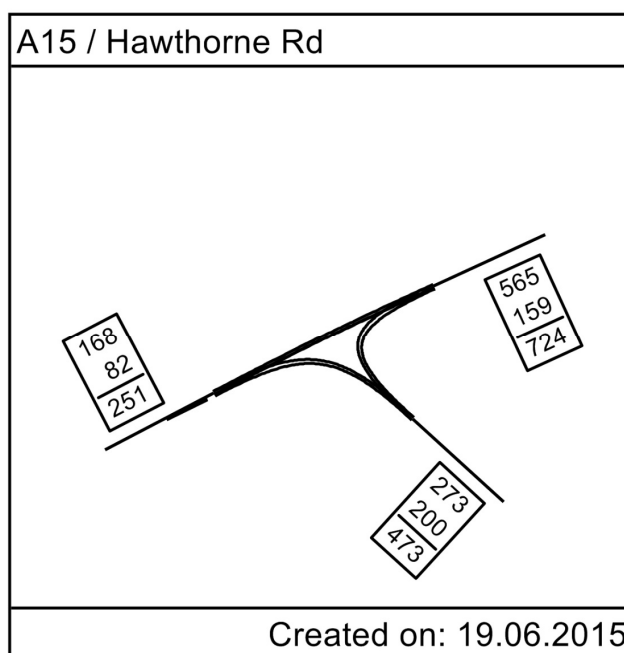
APPENDIX D Core Model Turn Flows

2006 AM Peak

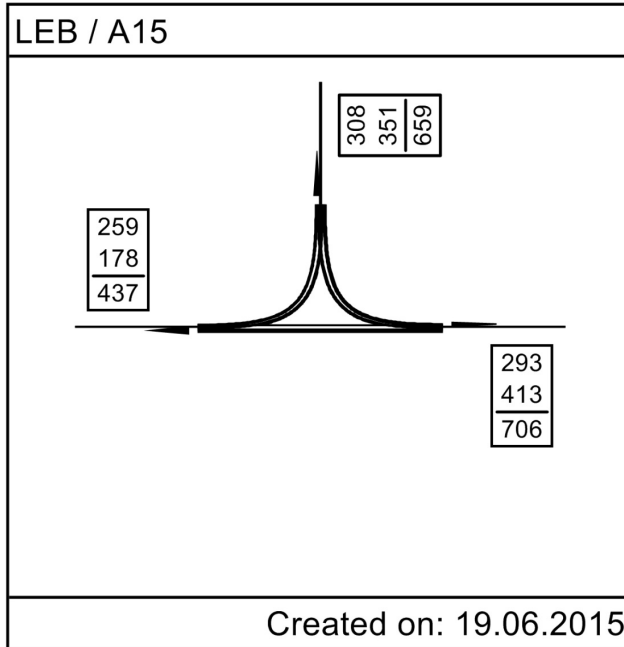
1. A15 Wragby Road / Outer Cir Road



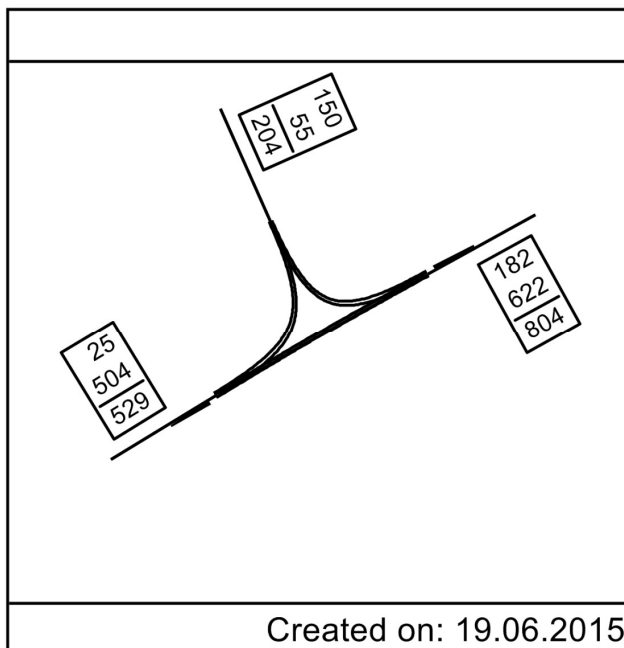
2. A15 Bunkers Hill / Hawthorn Road



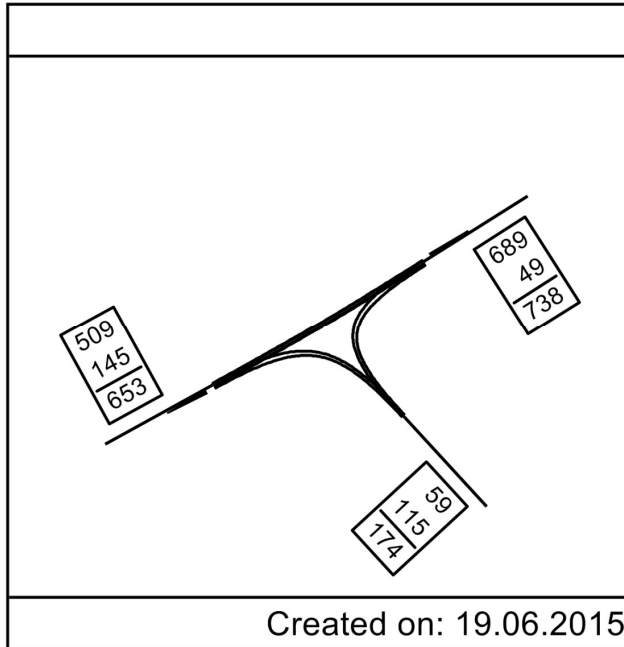
3. A158 / A15 Bunkers Hill / A158 Wragby Road



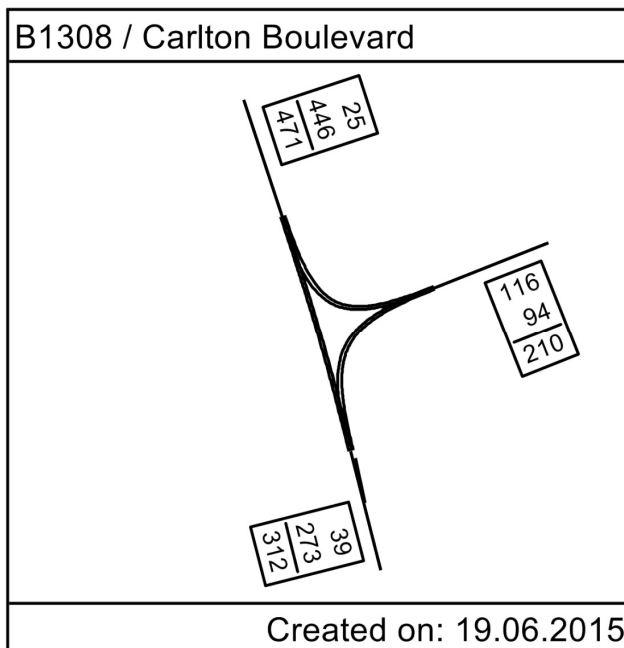
4. A158 Wragby Road / Lodge Lane



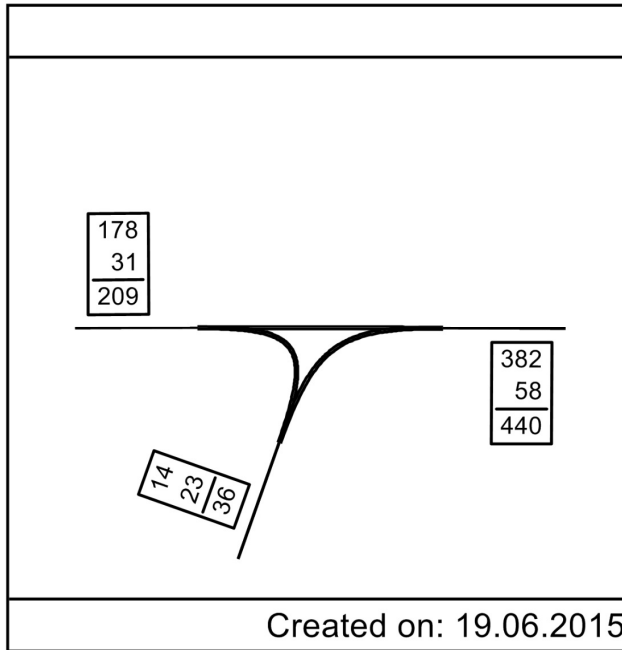
5. A158 Wragby Road / Kennel Lane



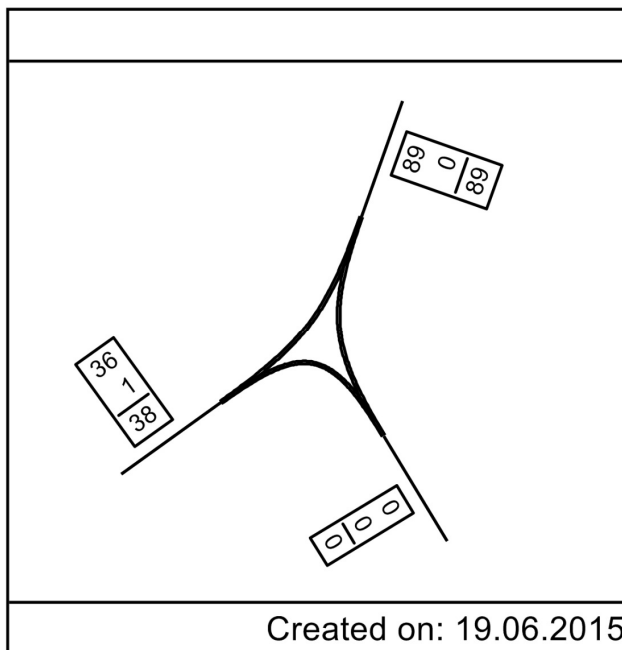
6. Outer Cir Road / Carlton Boulevard



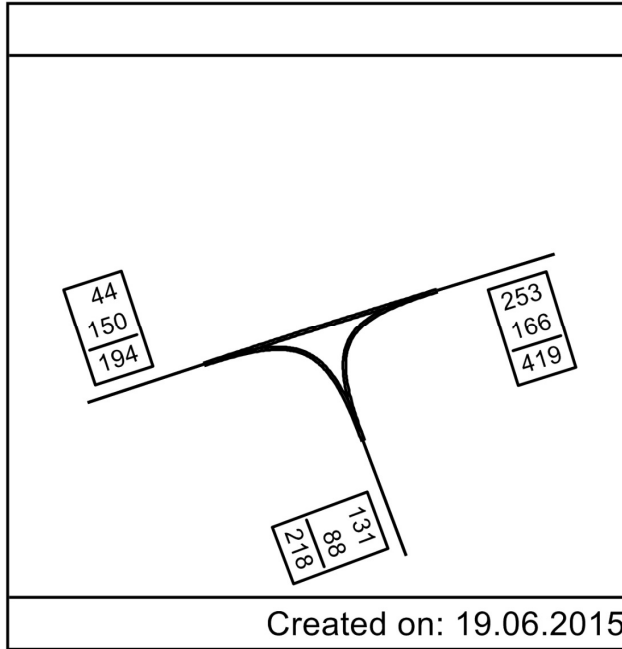
7. Hawthorn Road / St Augustine Road



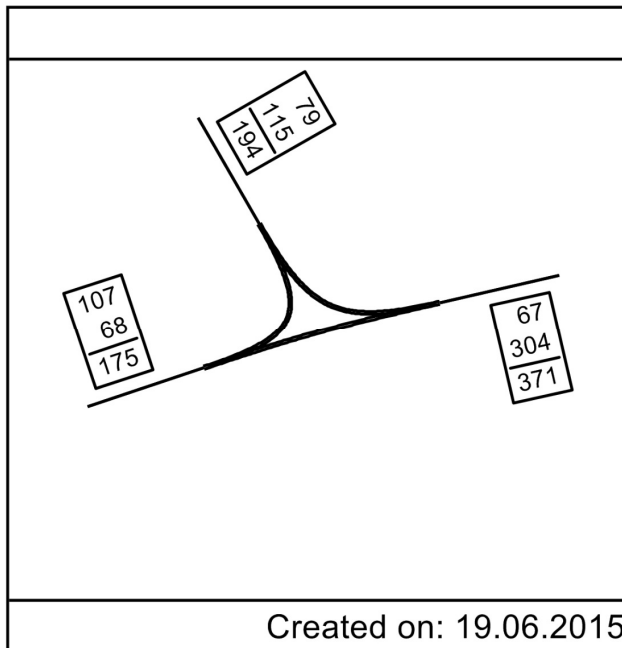
8. St Augustine Road / Dirt Track



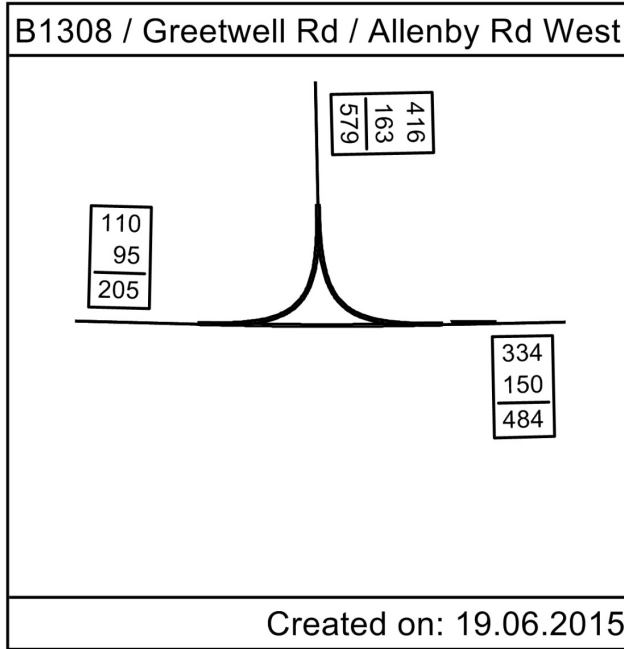
9. Hawthorn Road / Croft Lane



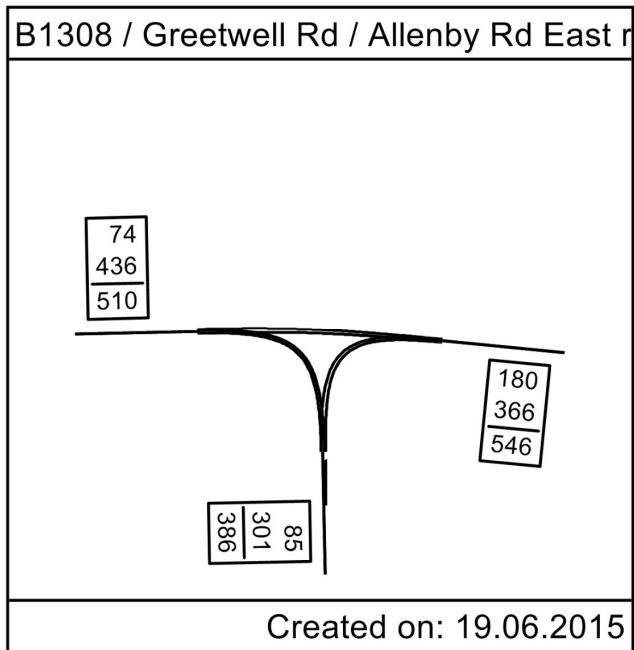
10. Hawthorn Road / Kennel Lane



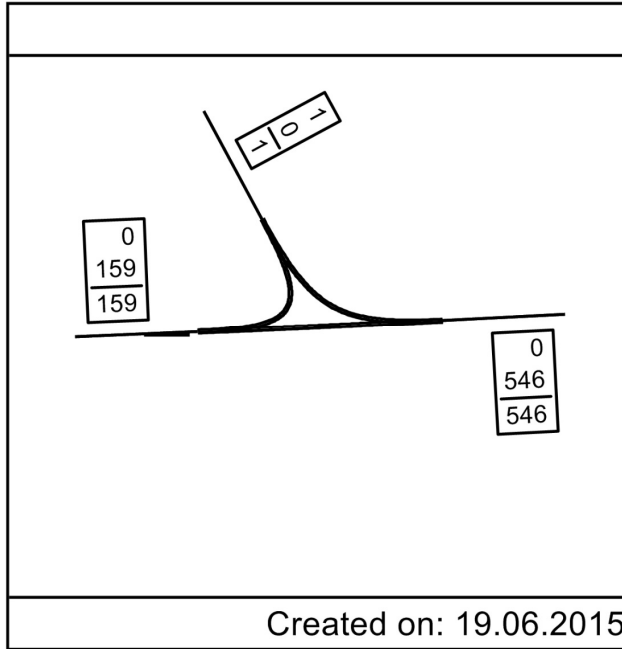
11a. Greetwell Road / Outer Cir Road



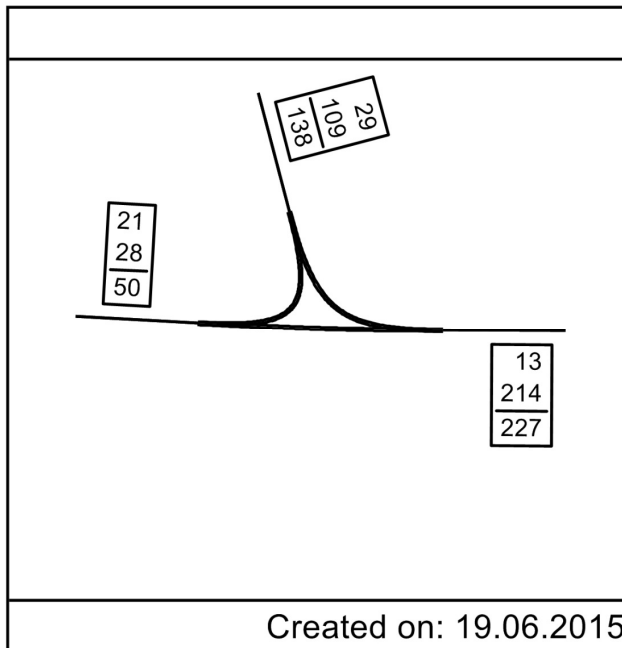
11b. Greetwell Road / Allenby Road



12. Greetwell Road / Dirt Track

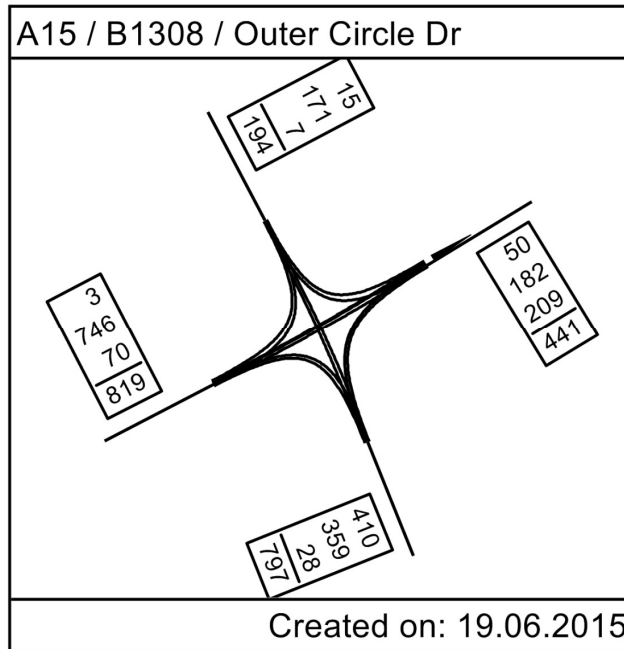


13. Fiskerton Road / Church Lane

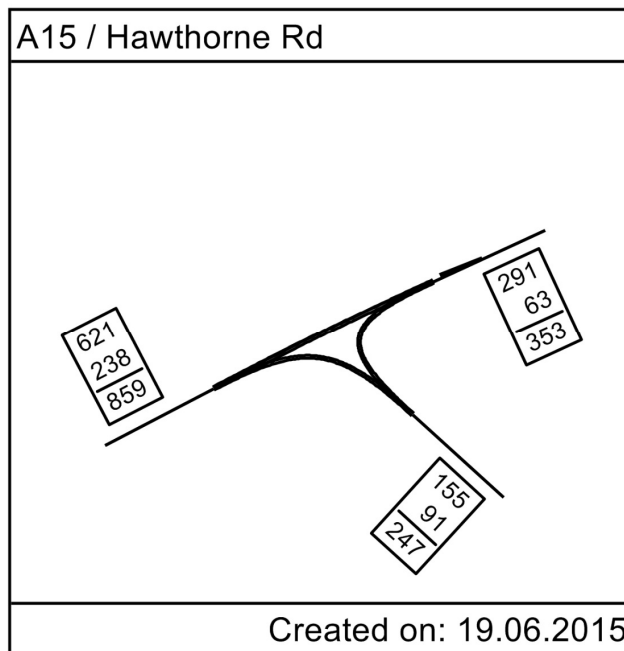


2006 PM Peak

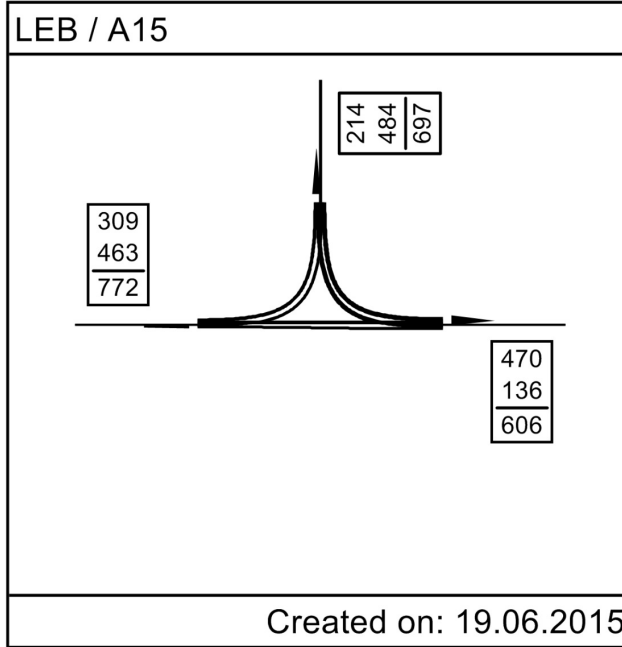
1. A15WragbyRoad/OuterCirRoad



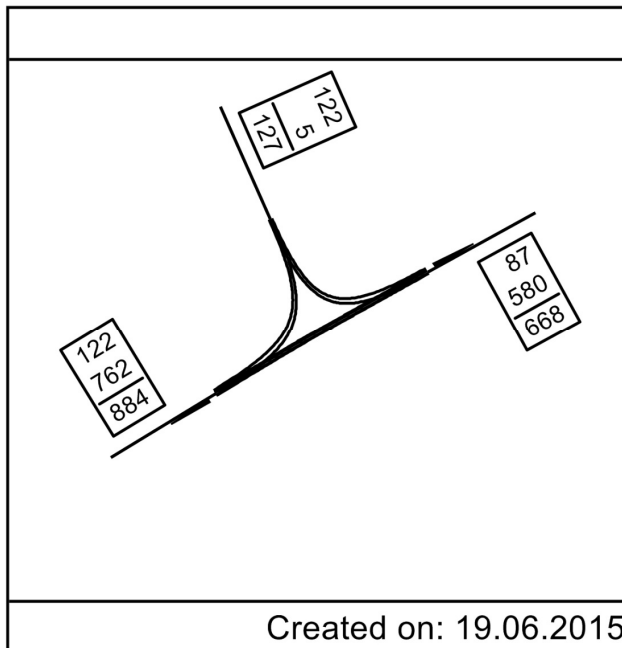
2. A15BunkersHill/HawthornRoad



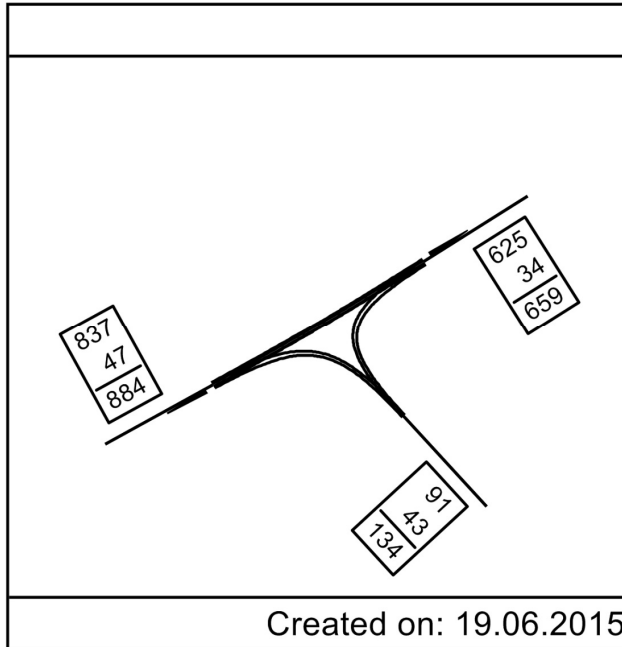
3. A158/A15BunkersHill/A158WragbyRoad



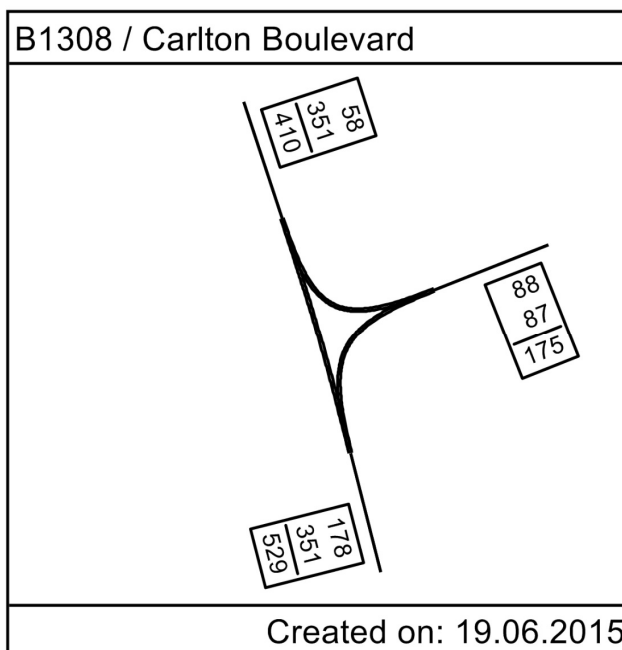
4. A158WragbyRoad/LodgeLane



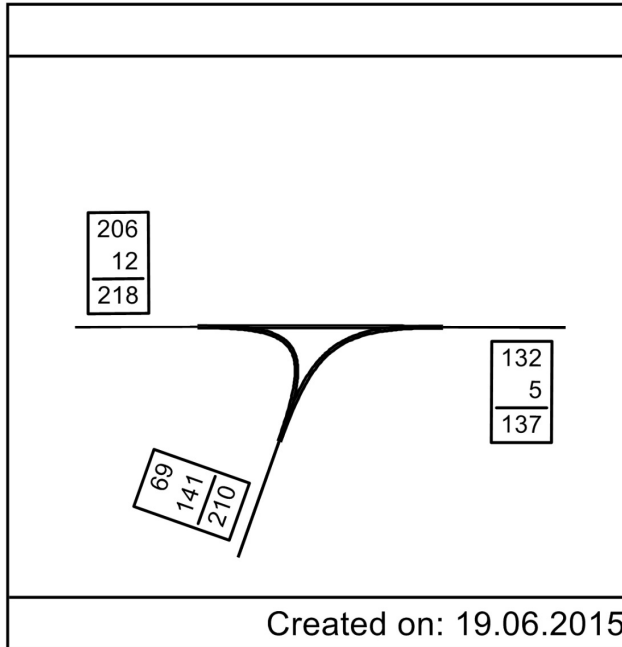
5. A158WragbyRoad/KennelLane



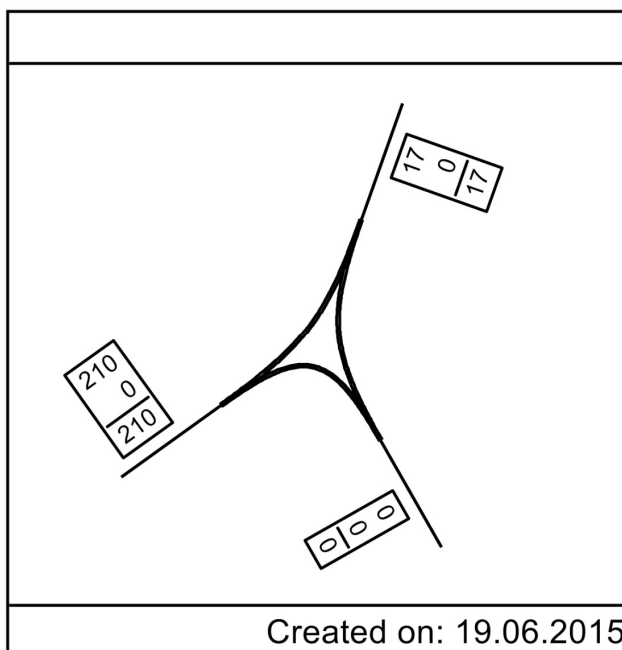
6. OuterCirRoad/CarltonBoulevard



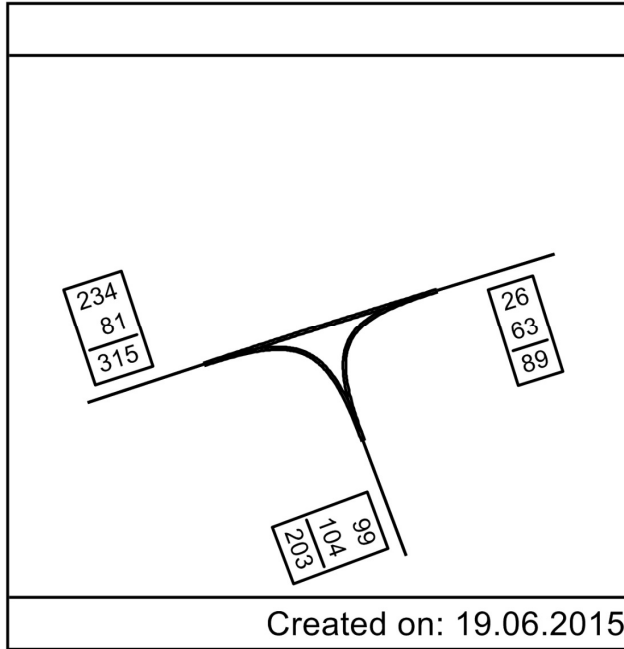
7. HawthornRoad/StAugustineRoad



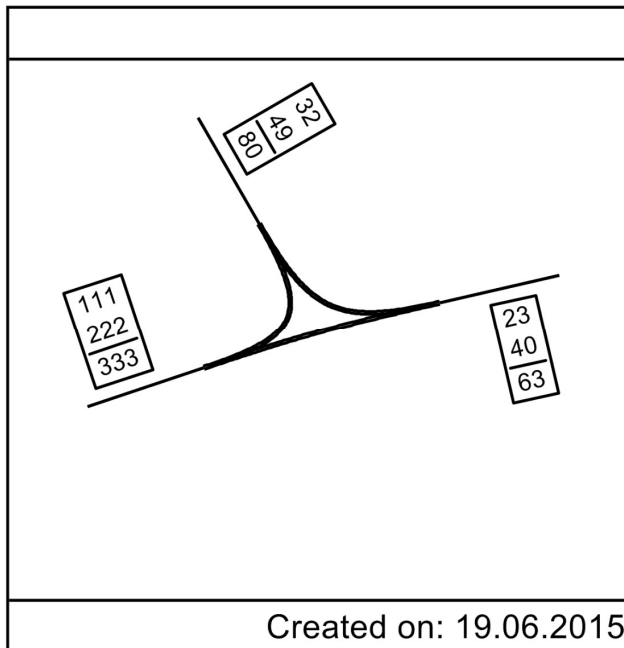
8. StAugustineRoad/DirtTrack



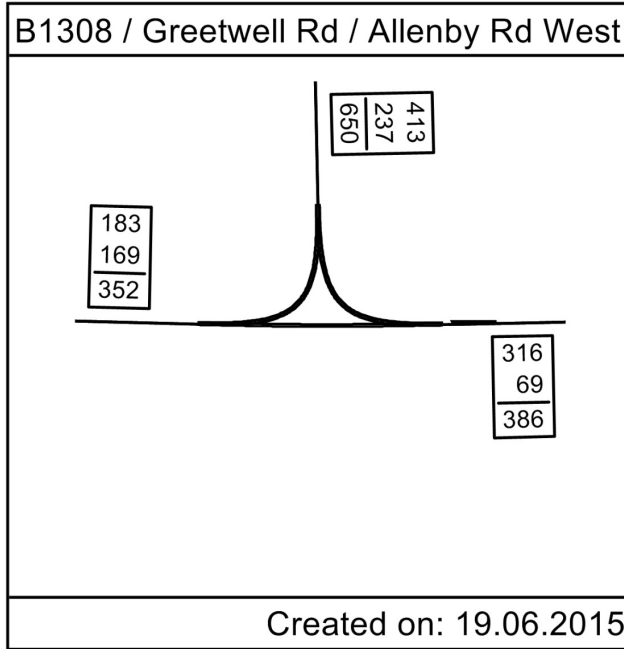
9.HawthornRoad/CroftLane



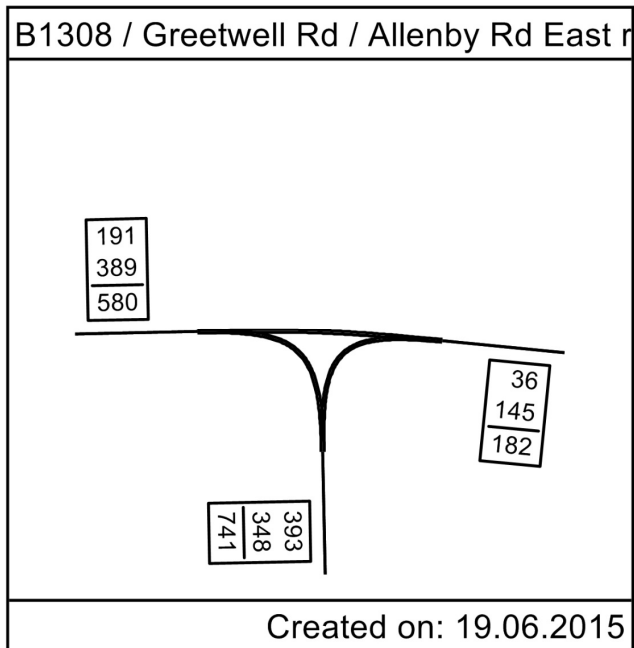
10.HawthornRoad/KennelLane



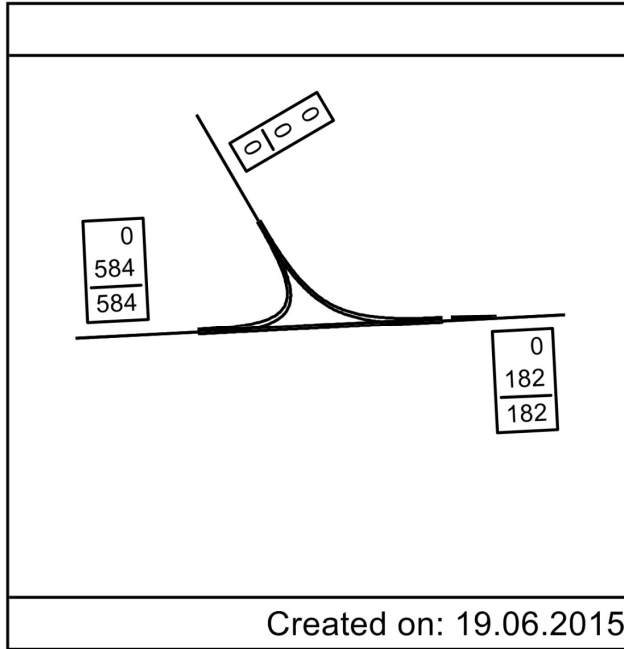
11a.GreetwellRoad/OuterCirRoad



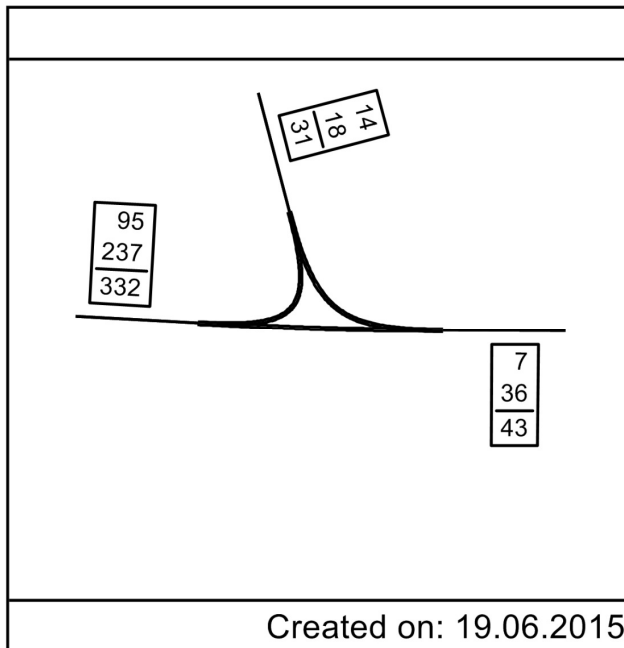
11b.GreetwellRoad/AllenbyRoad



12. Greetwell Road/Dirt Track

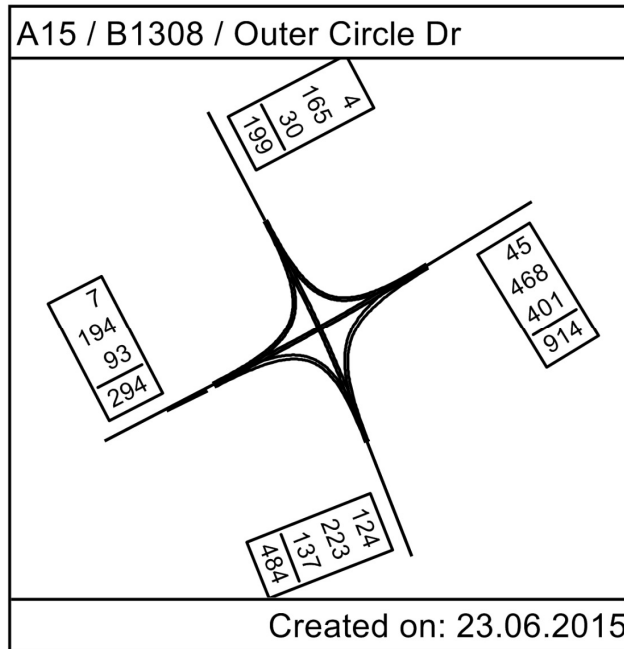


13. Fiskerton Road/Church Lane

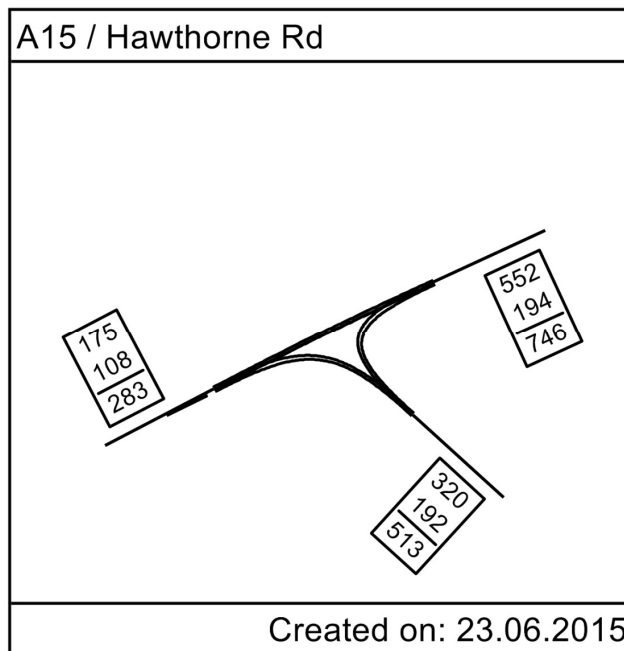


2018 DM AM

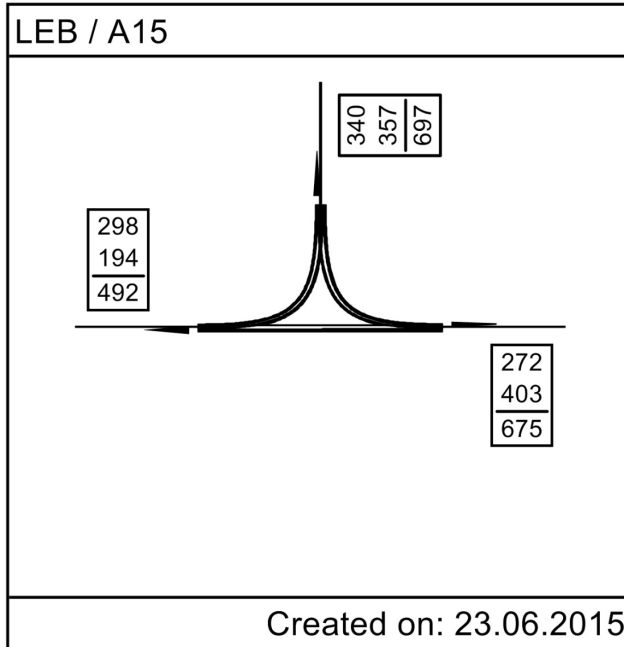
1. A15 Wragby Road / Outer Cir Road



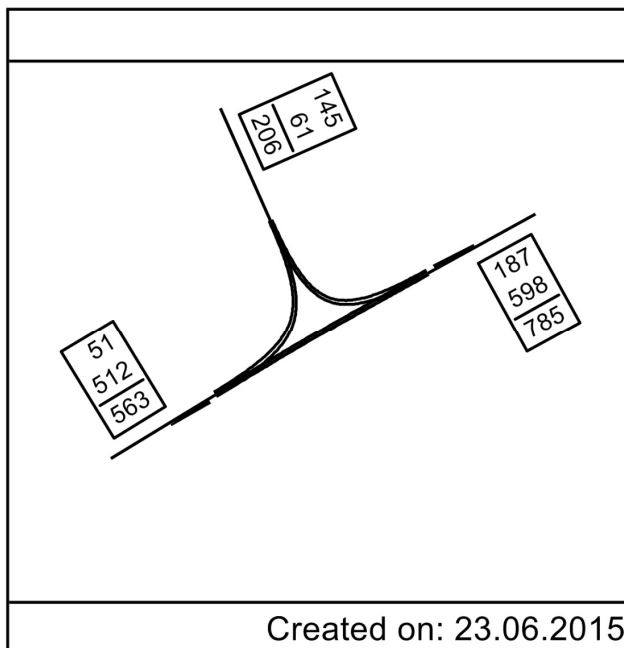
2. A15 Bunkers Hill / Hawthorn Road



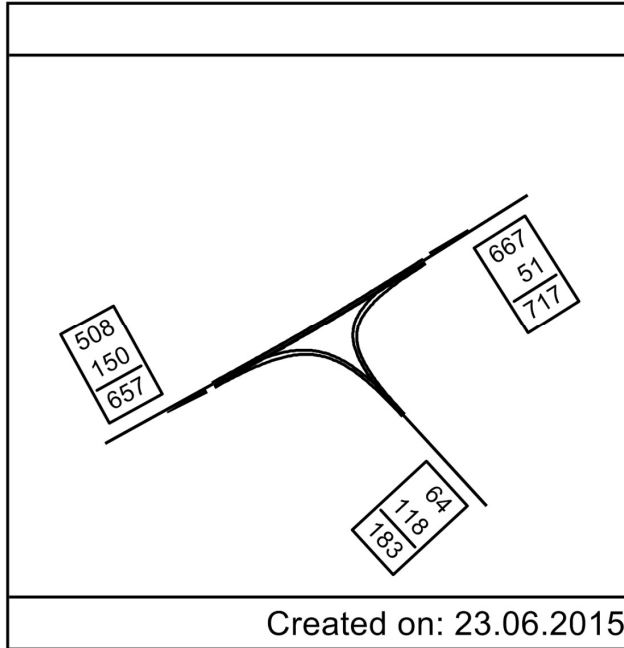
3. A158 / A15 Bunkers Hill / A15 Wragby Road



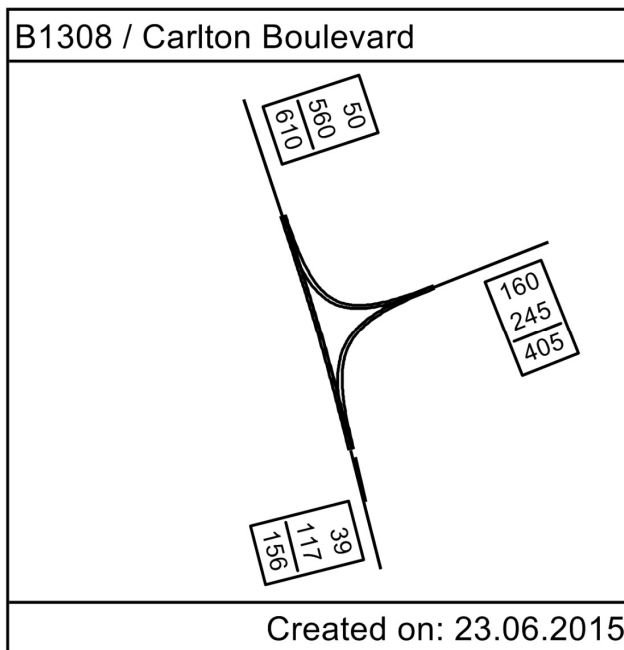
4. A158 Wragby Road / Lodge Lane



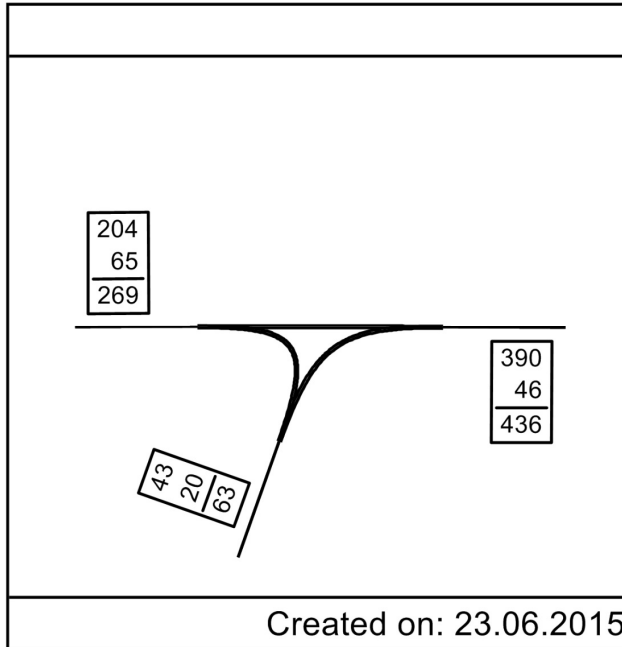
5. A158 Wragby Road / Kennel Lane



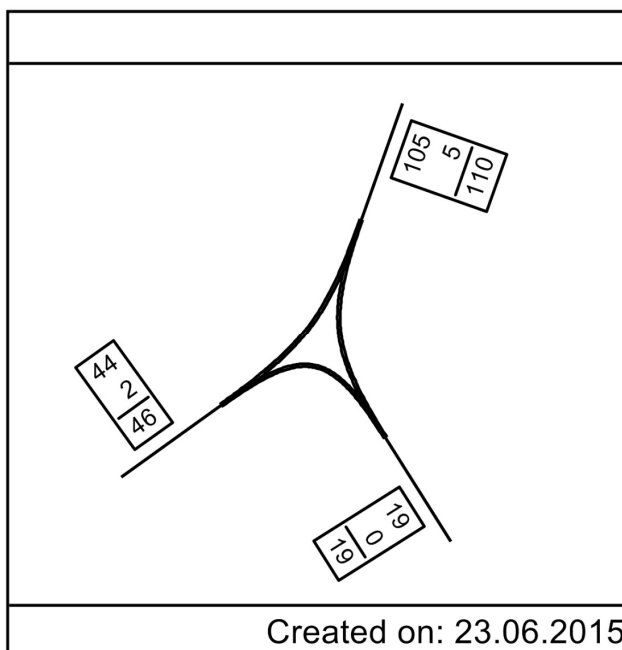
6. Outer Cir Road / Carlton Boulevard



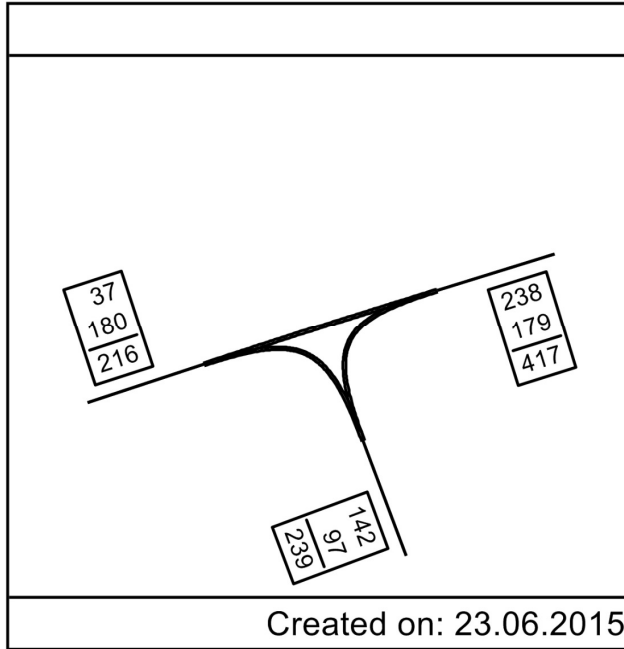
7. Hawthorn Road / St Augustine Road



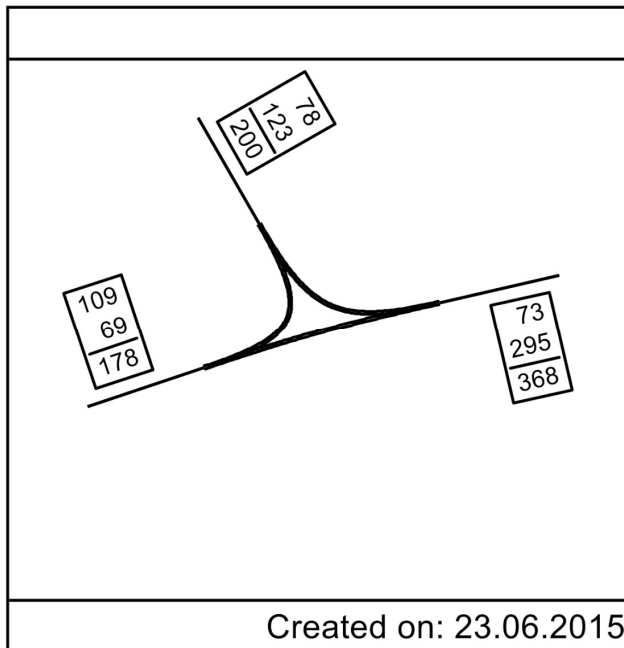
8. St Augustine Road / Dirt Track



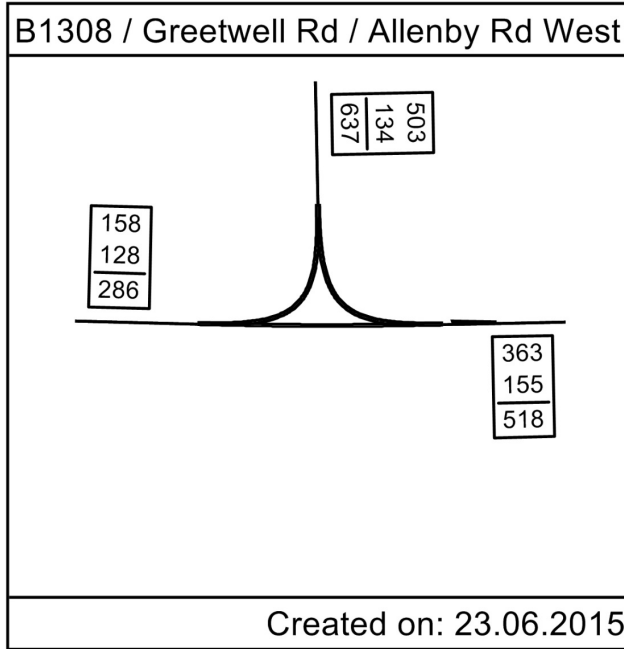
9. Hawthorn Road / Croft Lane



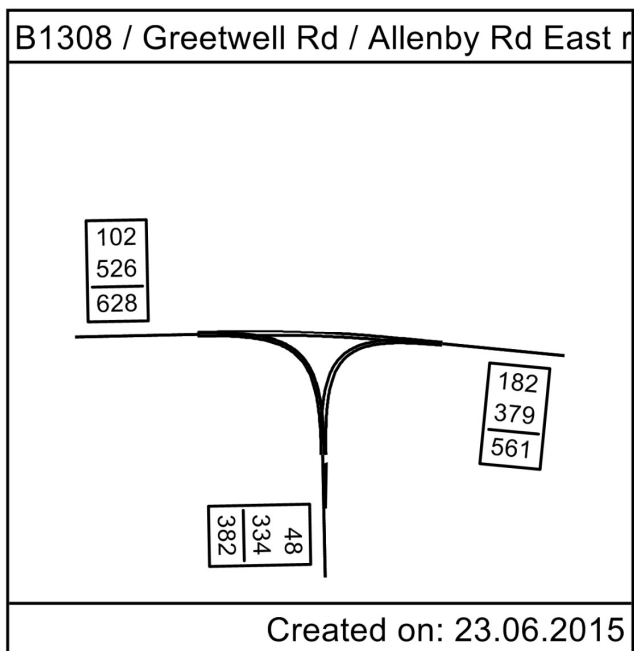
10. Hawthorn Road / Kennel Lane



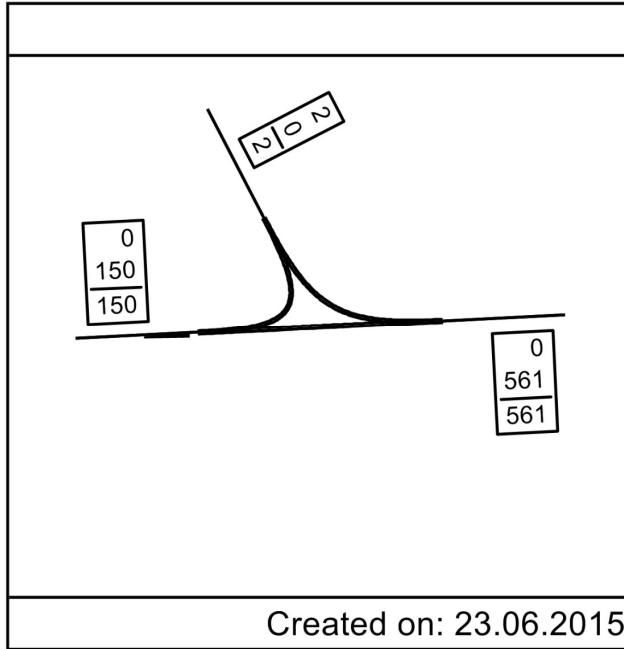
11a. Greetwell Road / Outer Cir Road



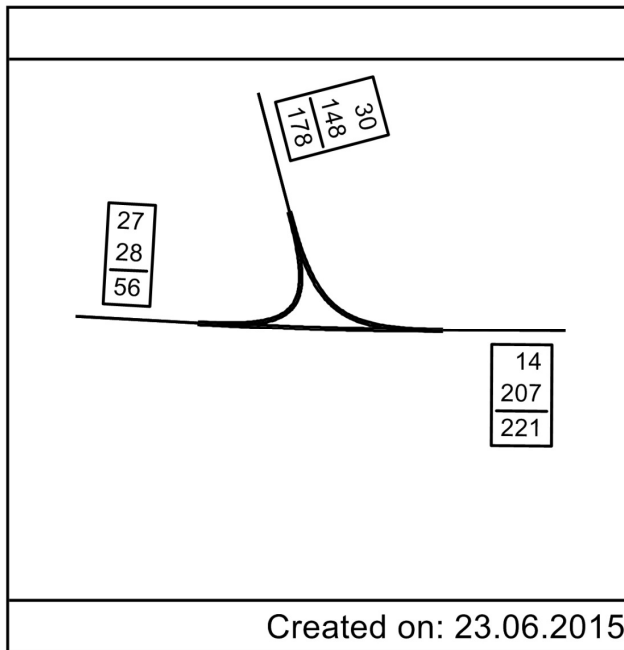
11b. Greetwell Road / Allenby Road



12. Greetwell Road / Dirt Track

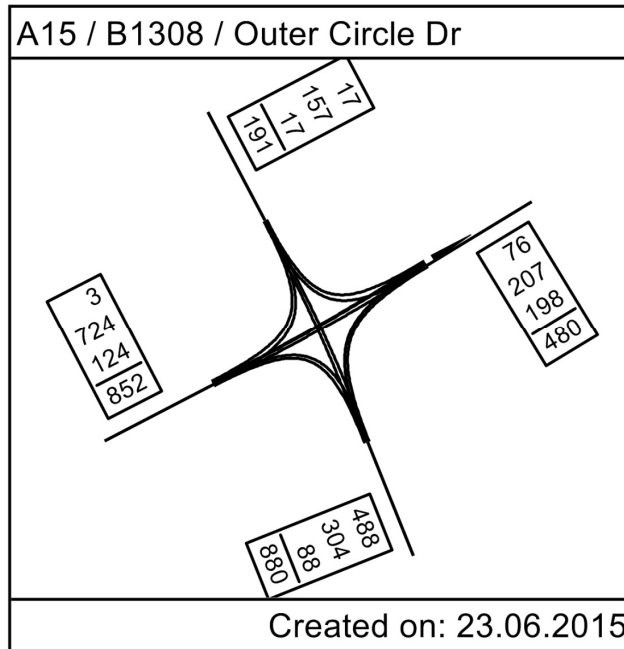


13. Fiskerton Road / Church Lane

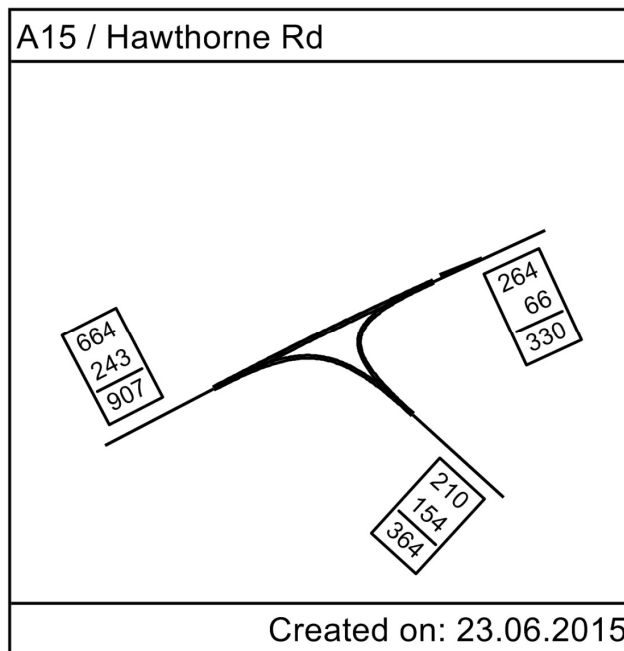


2018 DM PM

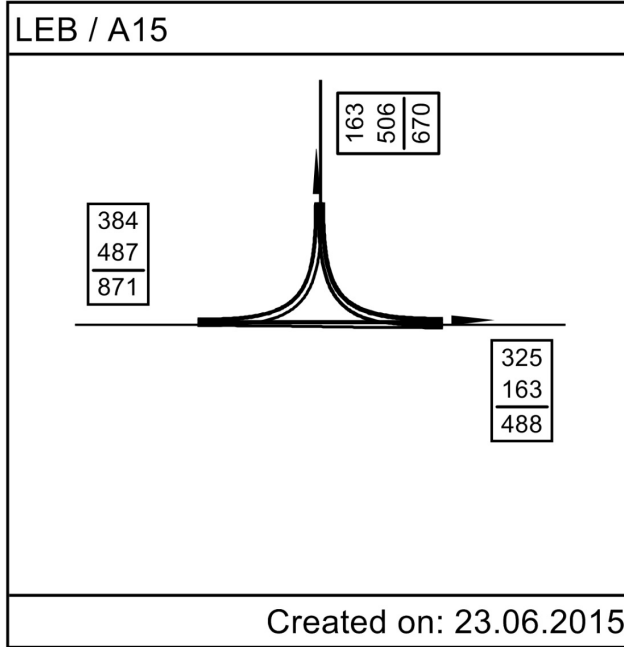
1. A15 Wragby Road / Outer Cir Road



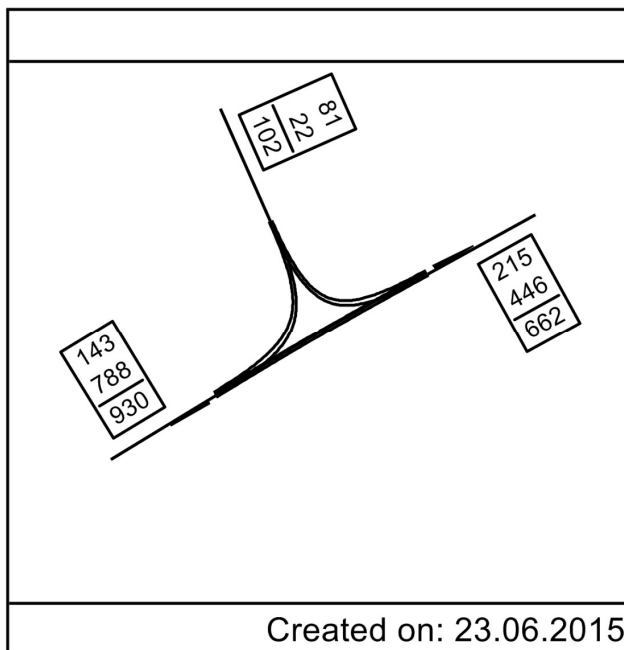
2. A15 Bunkers Hill / Hawthorn Road



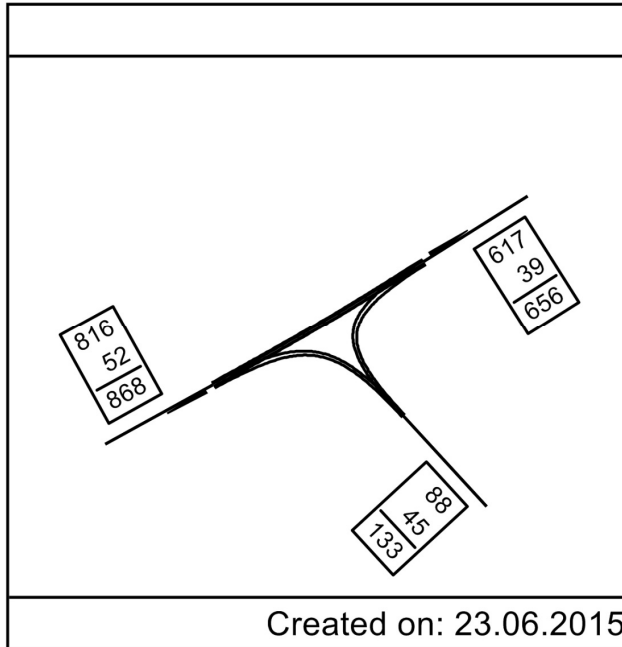
3. A158 / A15 Bunkers Hill / A158 Wragby Road



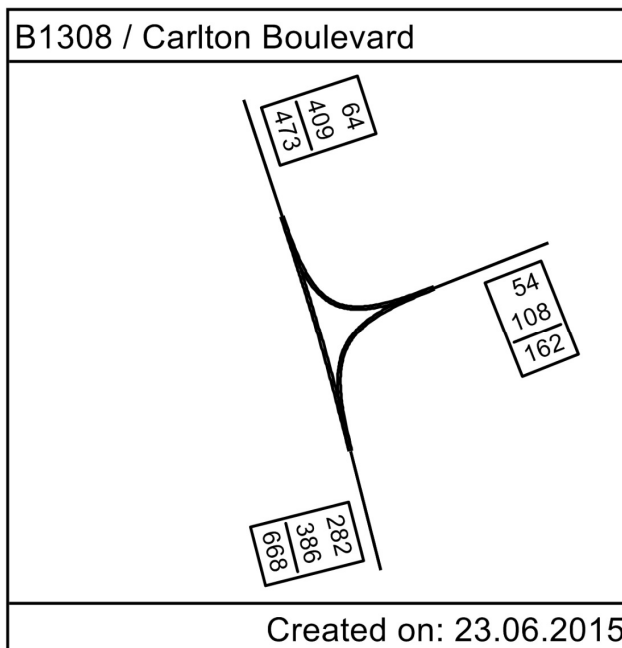
4. A158 Wragby Road / Lodge Lane



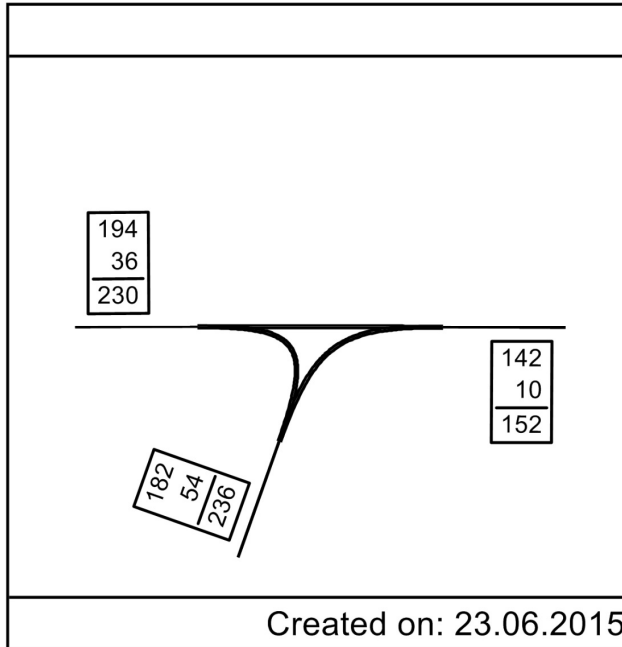
5. A158 Wragby Road / Kennel Lane



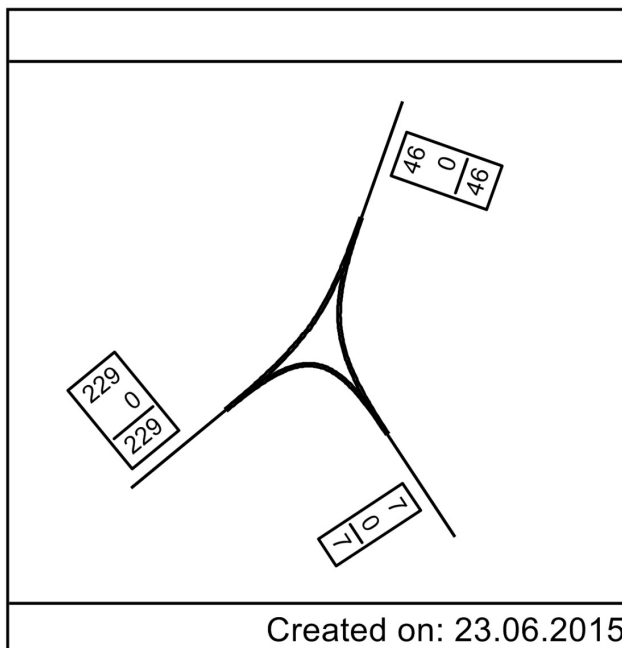
6. Outer Cir Road / Carlton Boulevard



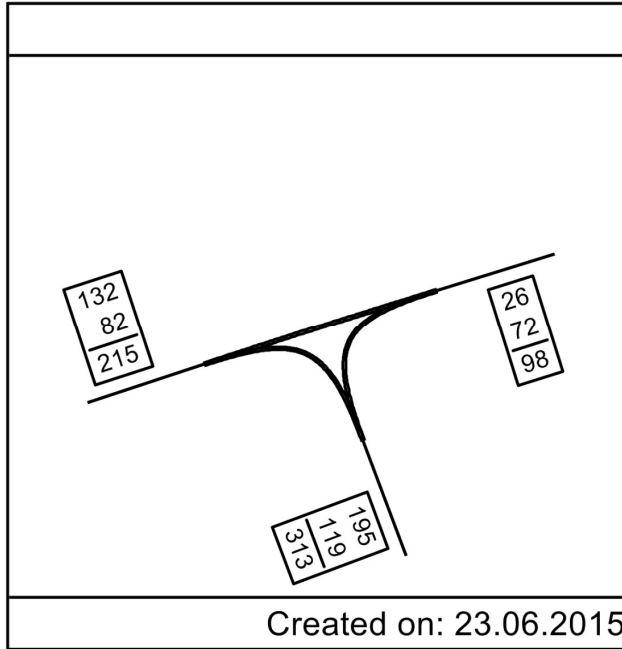
7. Hawthorn Road / St Augustine Road



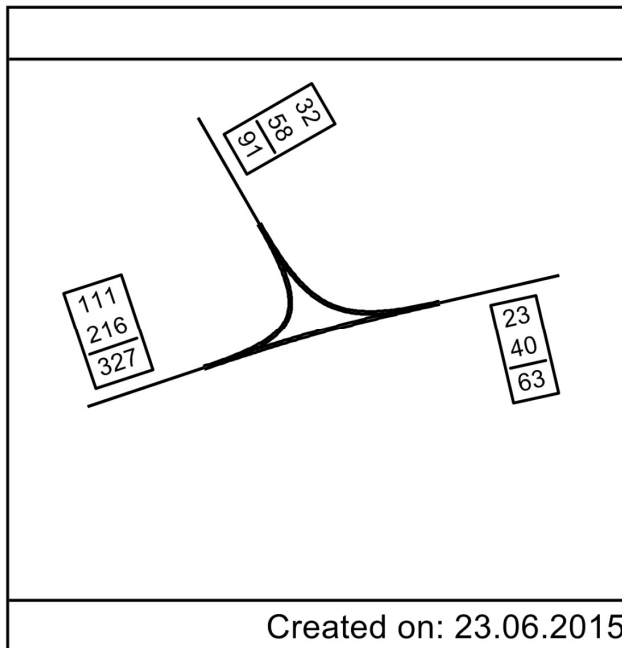
8. St Augustine Road / Dirt Track



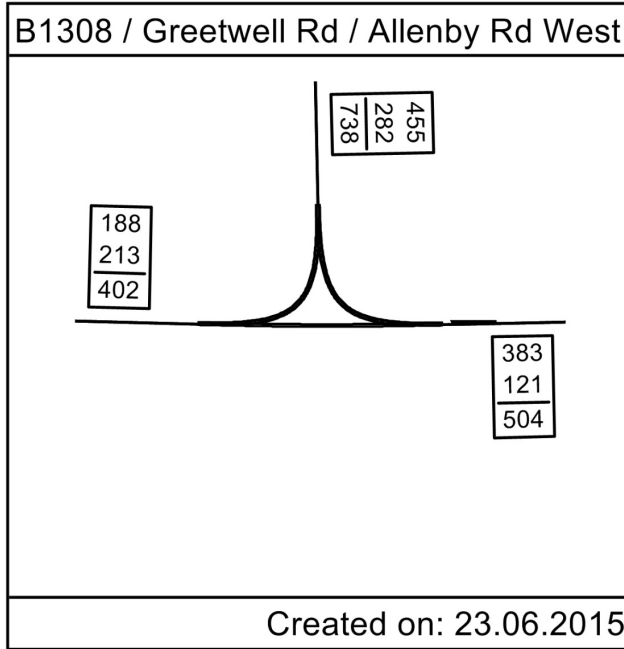
9. Hawthorn Road / Croft Lane



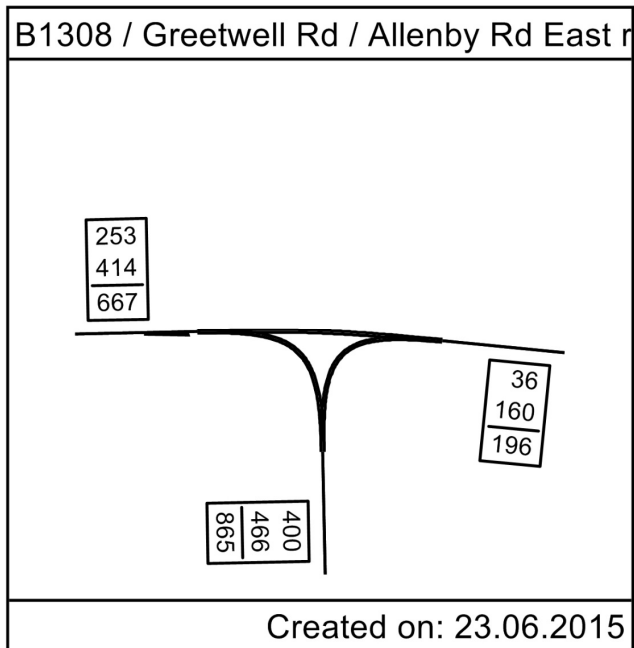
10. Hawthorn Road / Kennel Lane



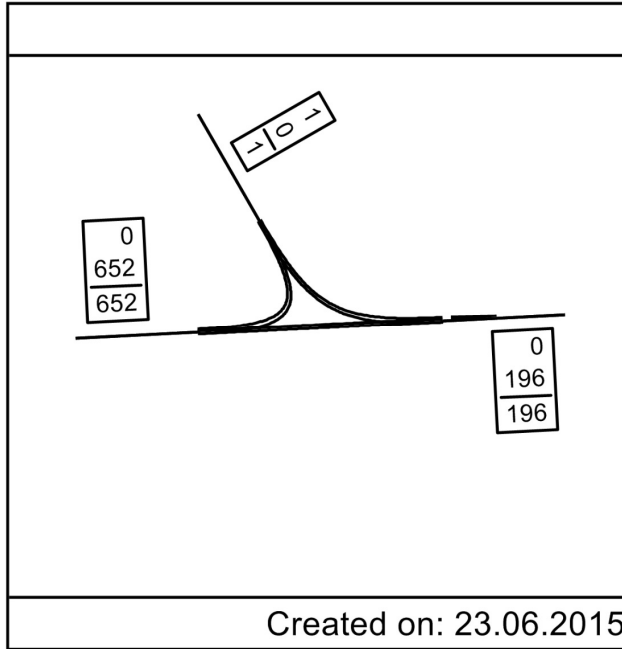
11a. Greetwell Road / Outer Cir Road



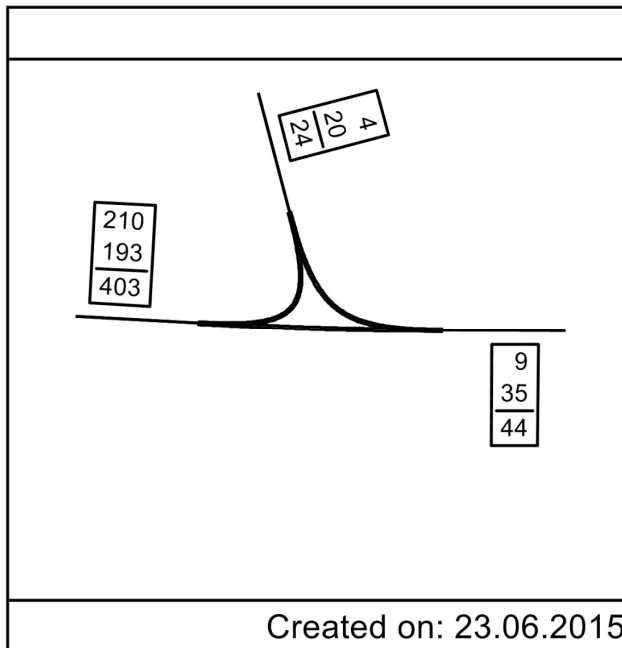
11b. Greetwell Road / Allenby Road



12. Greetwell Road / Dirt Track

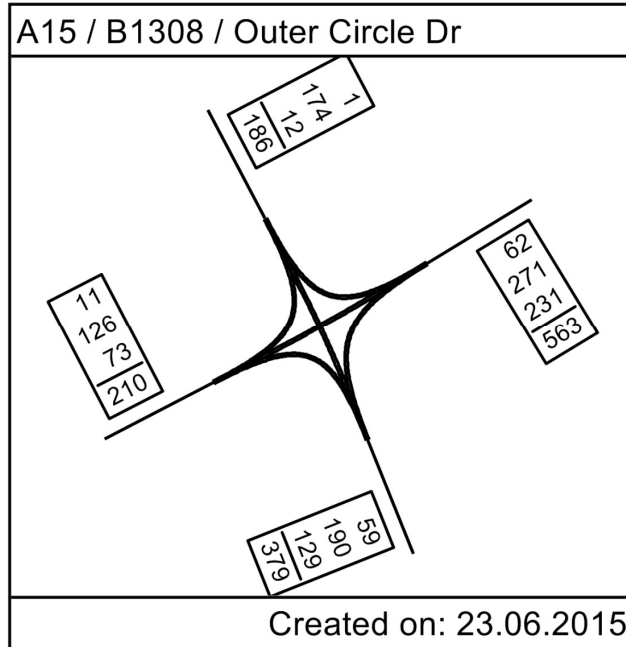


13. Fiskerton Road / Church Lane

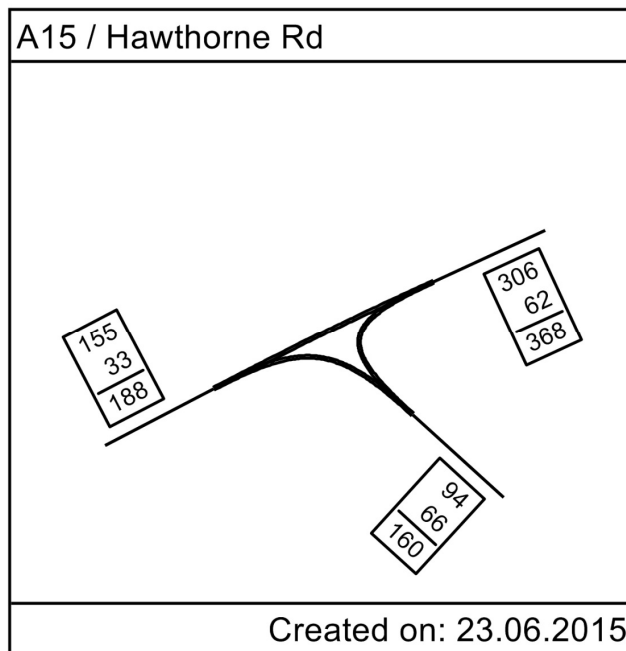


2018 AM DS

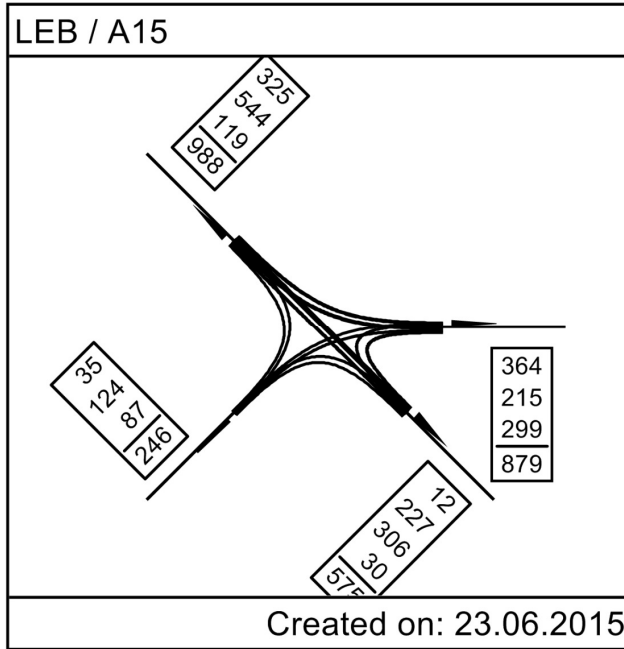
1. A15 Wragby Road / Outer Cir Road



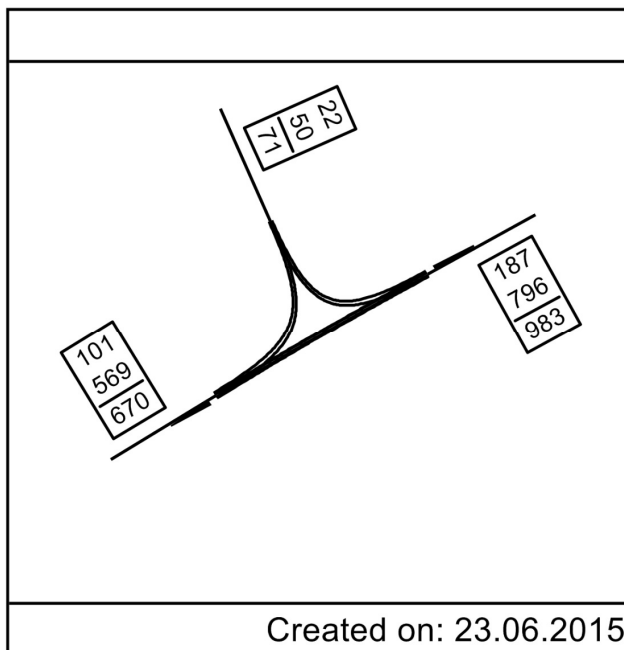
2. A15 Bunkers Hill / Hawthorn Road



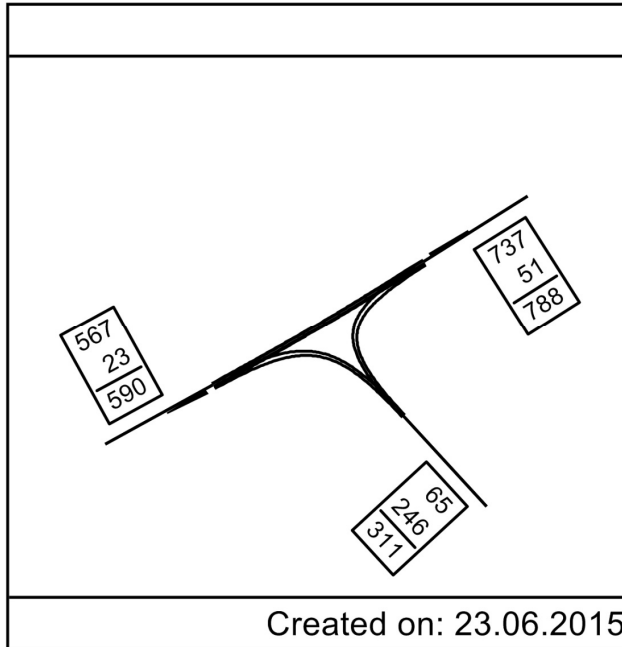
3. A158 / A15 Bunkers Hill / A158 Wragby Road



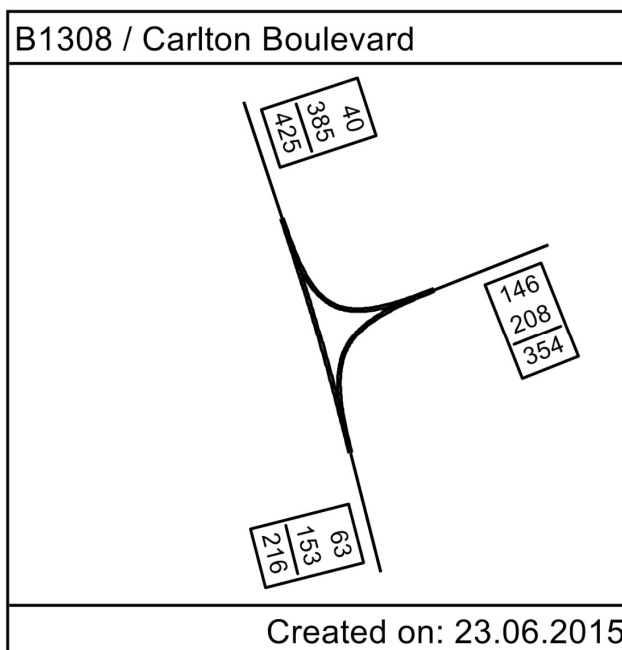
4. A158 Wragby Road / Lodge Lane



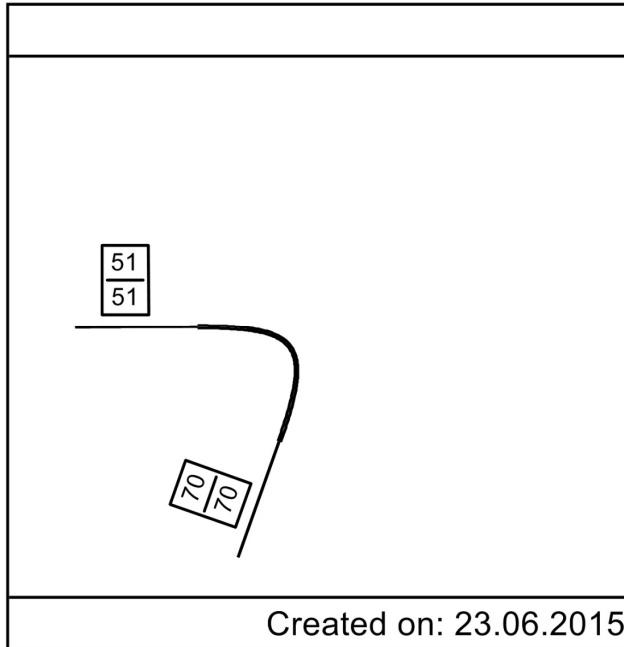
5. A158 Wragby Road / Kennel Lane



6. Outer Cir Road / Carlton Boulevard

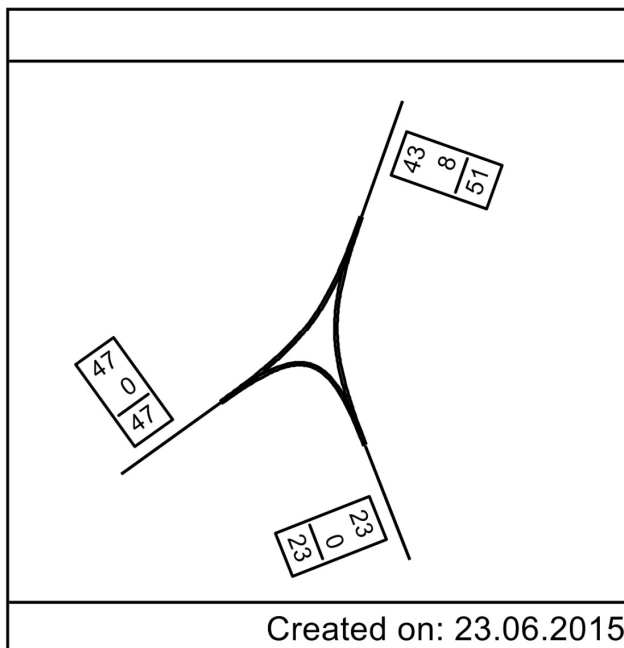


7. Hawthorn Road / St Augustine Road

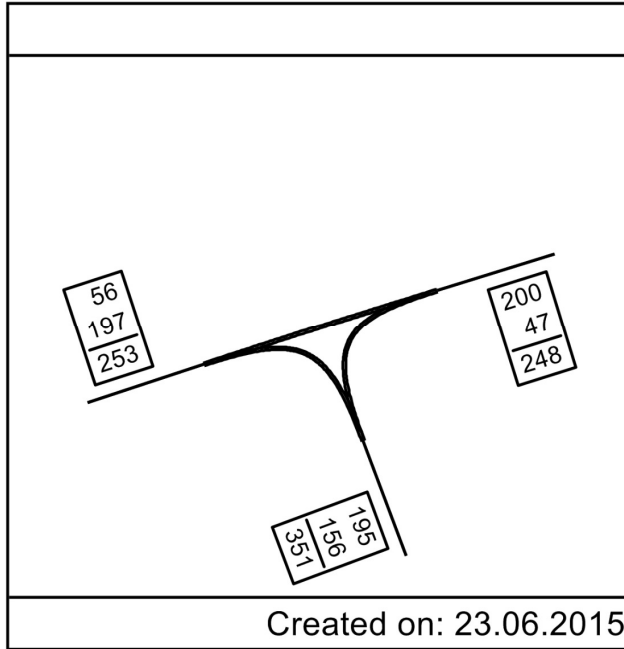


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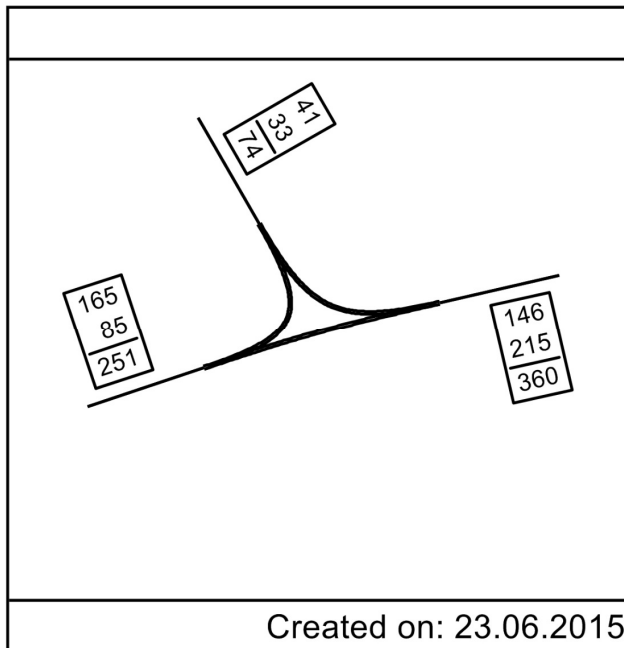
8. St Augustine Road / Dirt Track



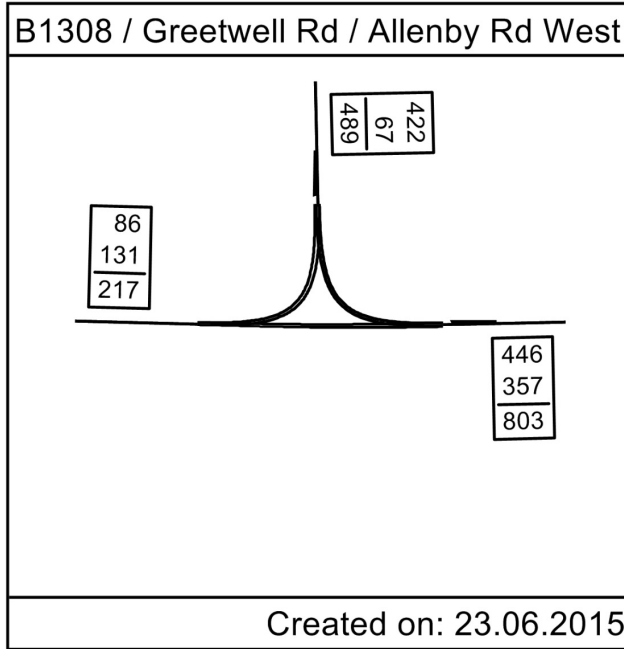
9. Hawthorn Road / Croft Lane



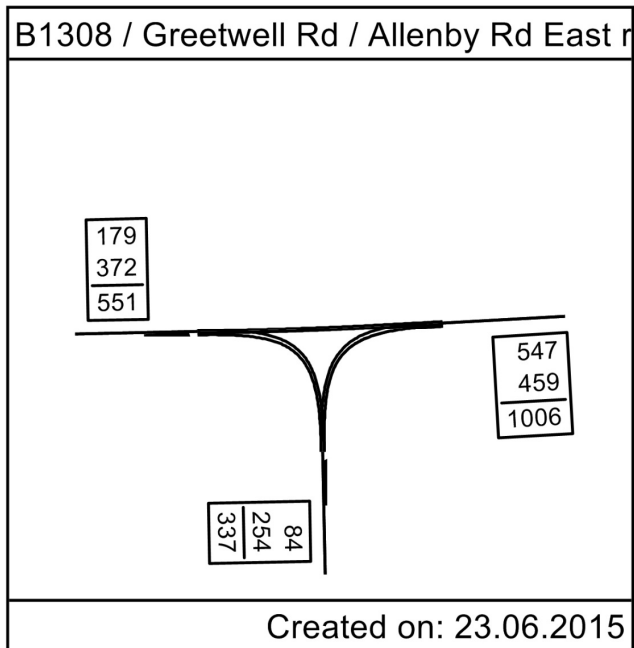
10. Hawthorn Road / Kennel Lane



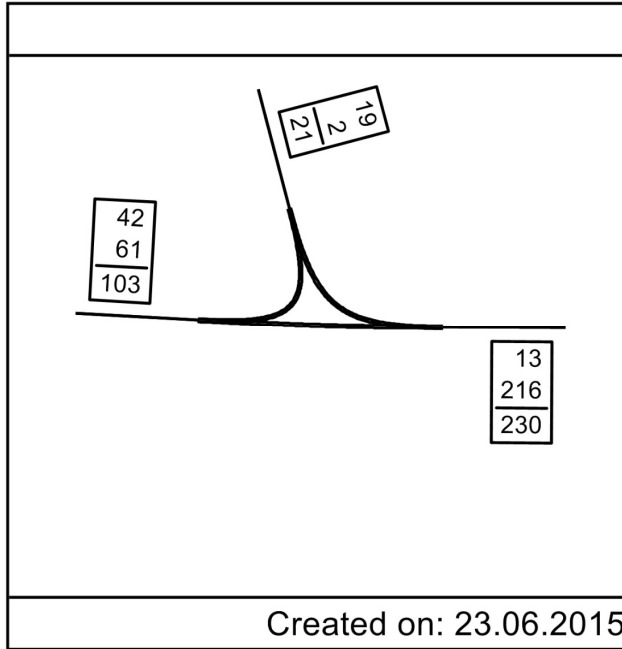
11a. Greetwell Road / Outer Cir Road



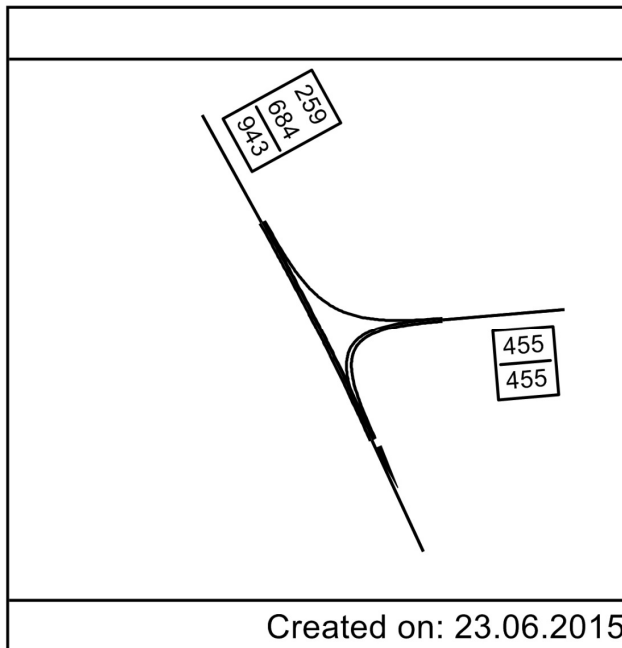
11b. Greetwell Road / Allenby Road



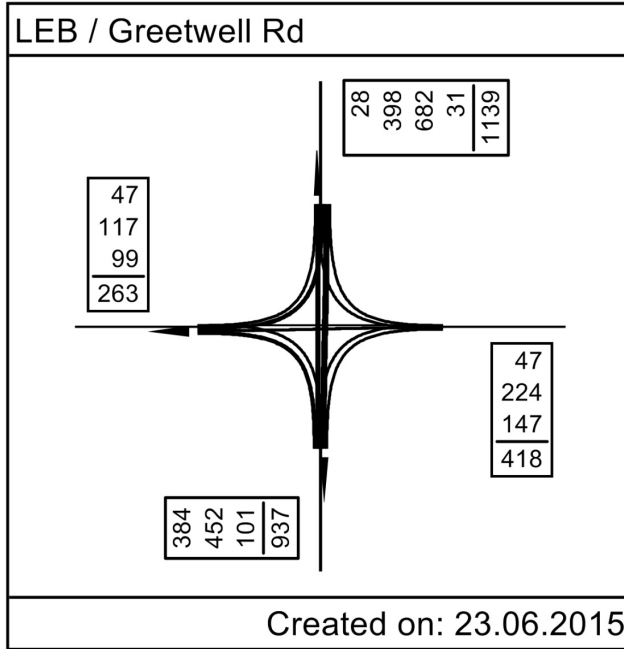
13. Fiskerton Road / Church Lane



14. LEB Southbound / Hawthorn Road

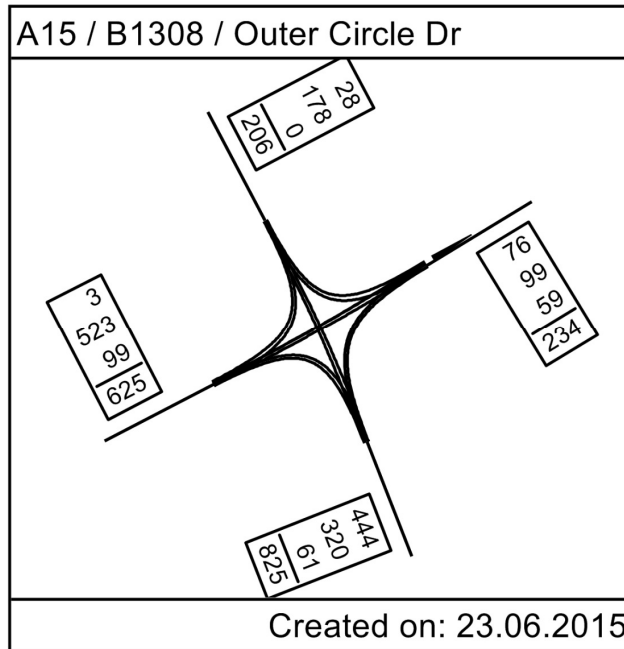


15. LEB / Greetwell Road

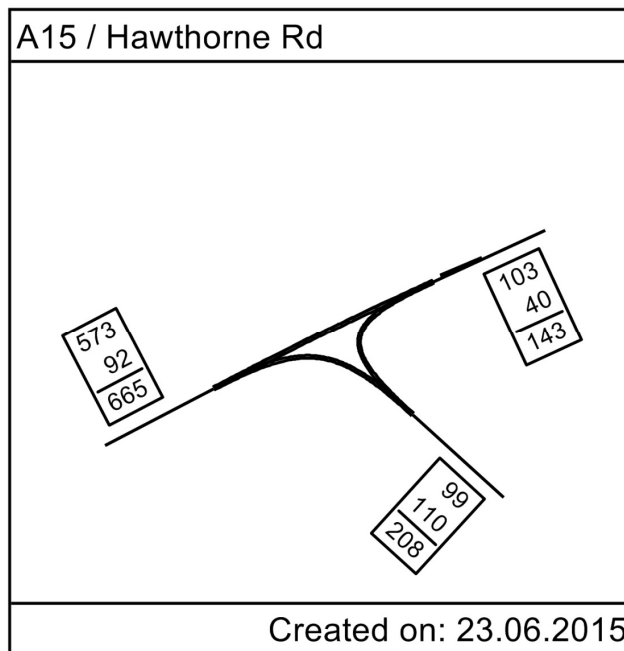


2018 PM DS

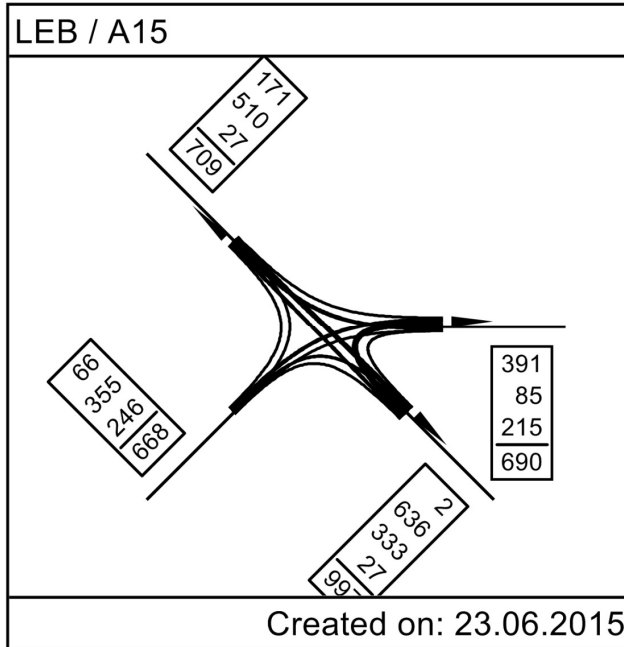
1. A15 Wragby Road / Outer Cir Road



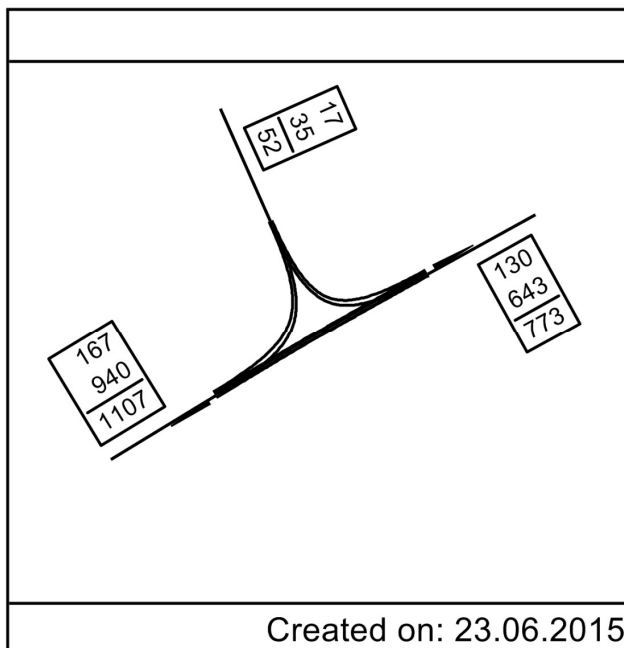
2. A15 Bunkers Hill / Hawthorn Road



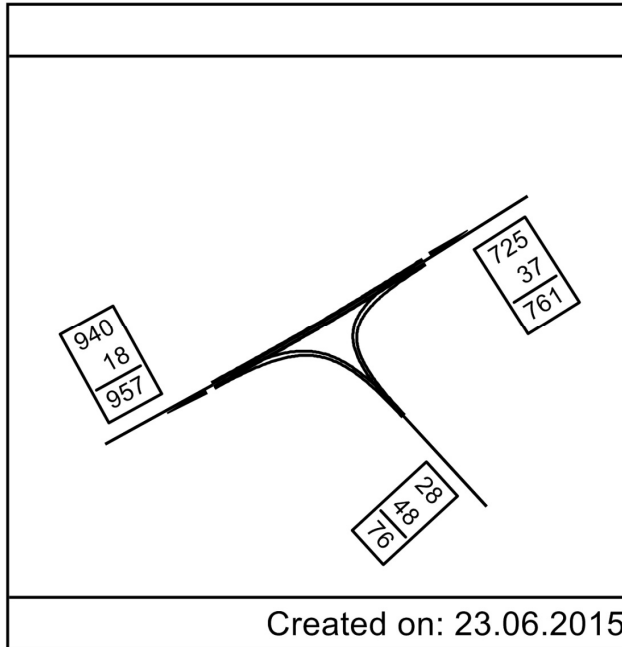
3. A158 / A15 Bunkers Hill / A158 Wragby Road



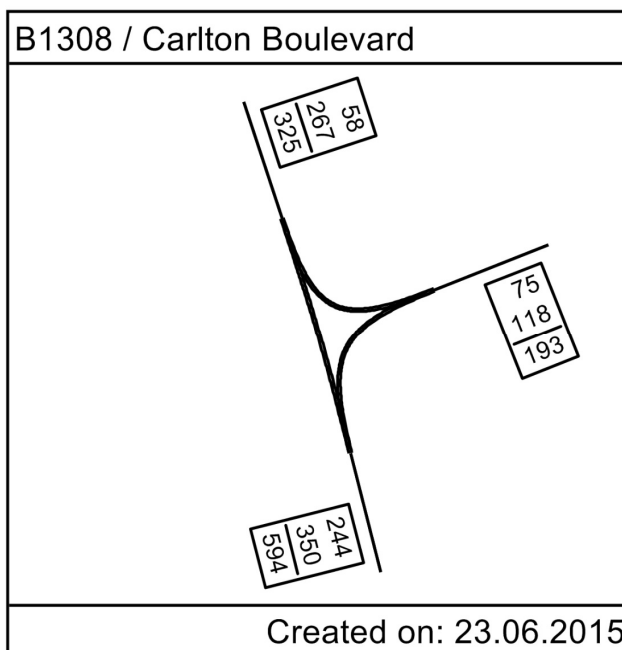
4. A158 Wragby Road / Lodge Lane



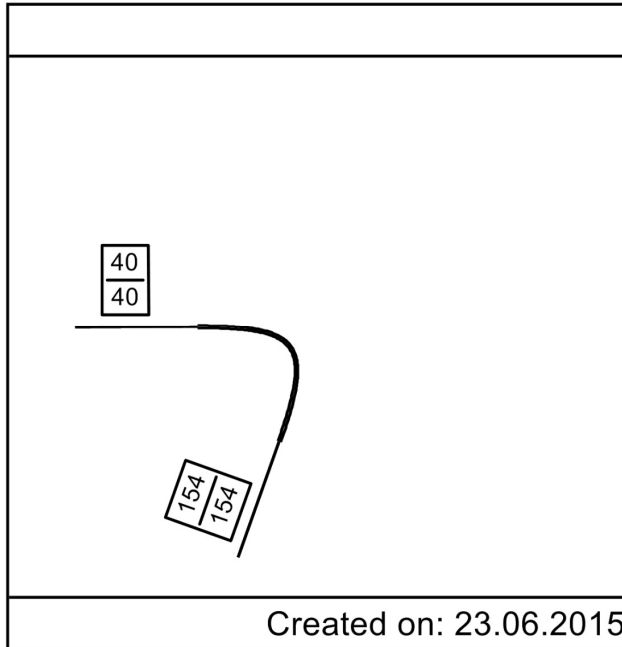
5. A158 Wragby Road / Kennel Lane



6. Outer Cir Road / Carlton Boulevard

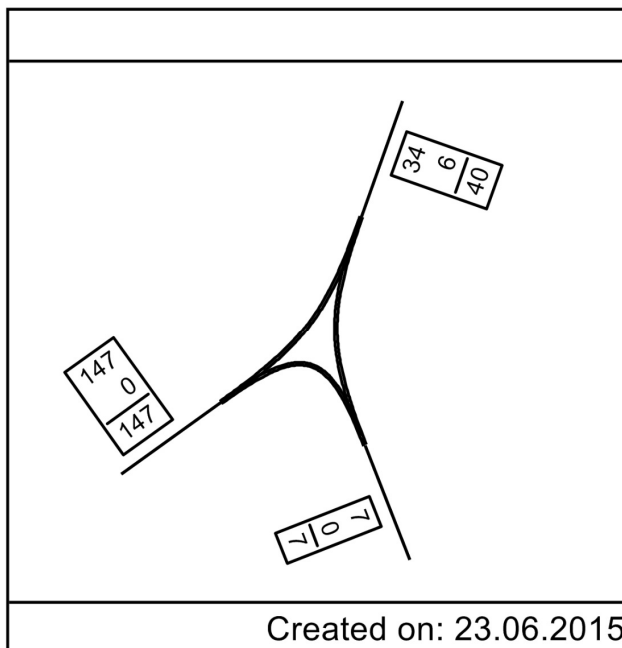


7. Hawthorn Road / St Augustine Road

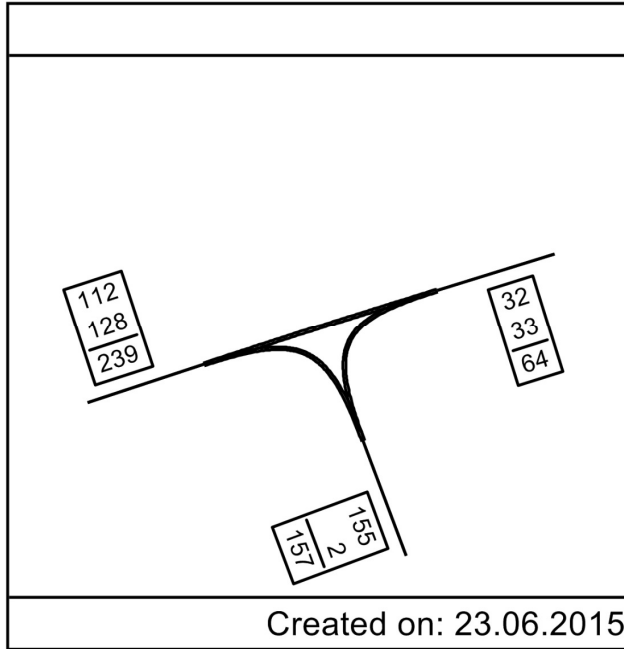


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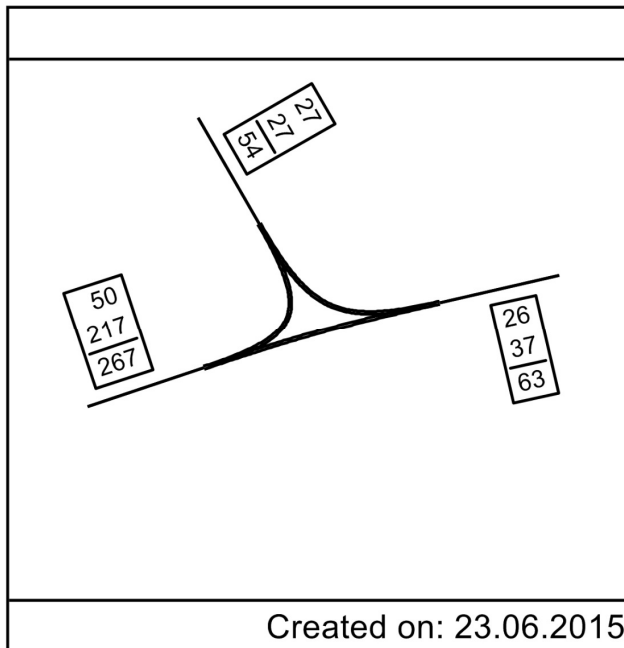
8. St Augustine Road / Dirt Track



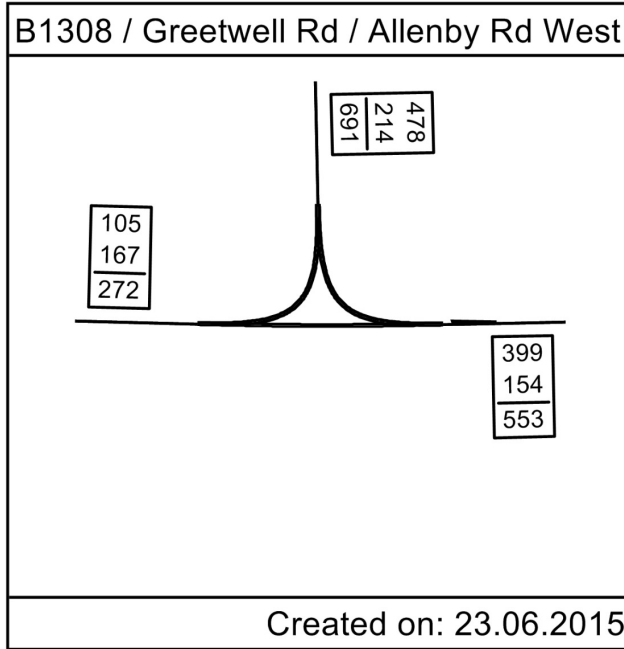
9. Hawthorn Road / Croft Lane



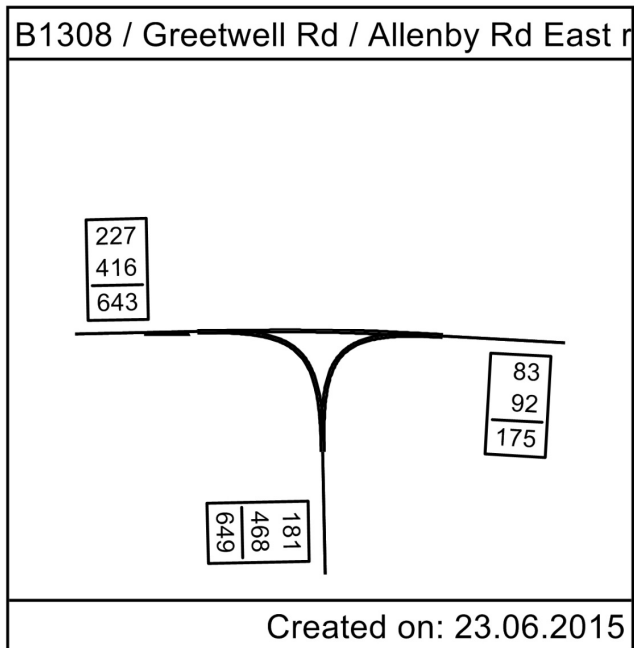
10. Hawthorn Road / Kennel Lane



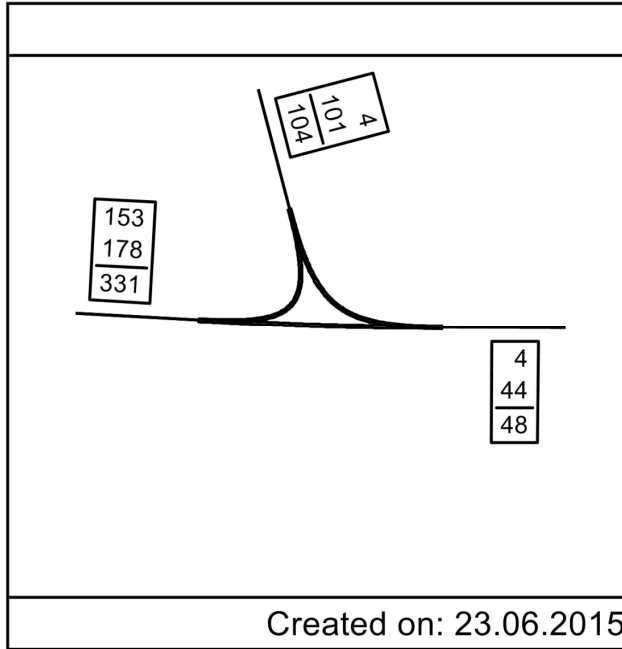
11a. Greetwell Road / Outer Cir Road



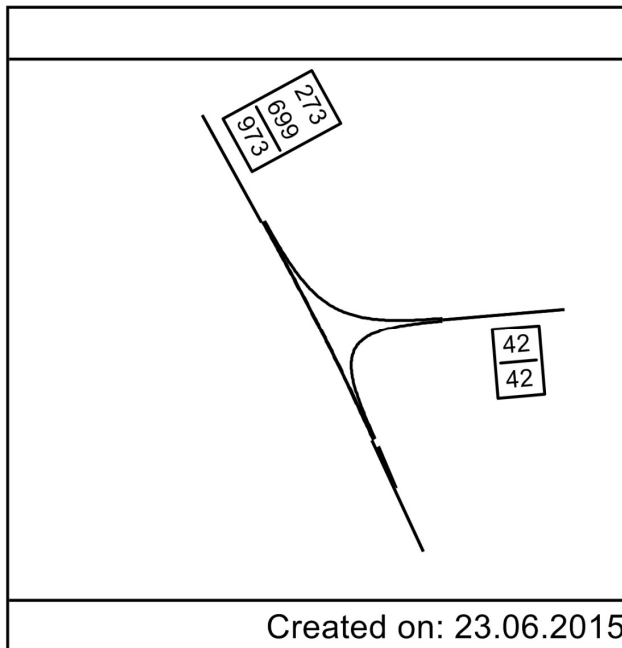
11b. Greetwell Road / Allenby Road



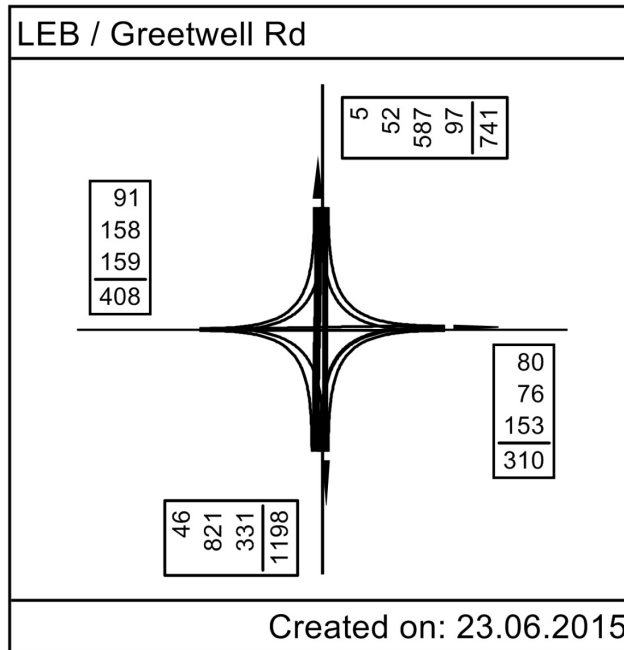
13. Fiskerton Road / Church Lane



14. LEB Southbound / Hawthorn Road



15. LEB / Greetwell Road

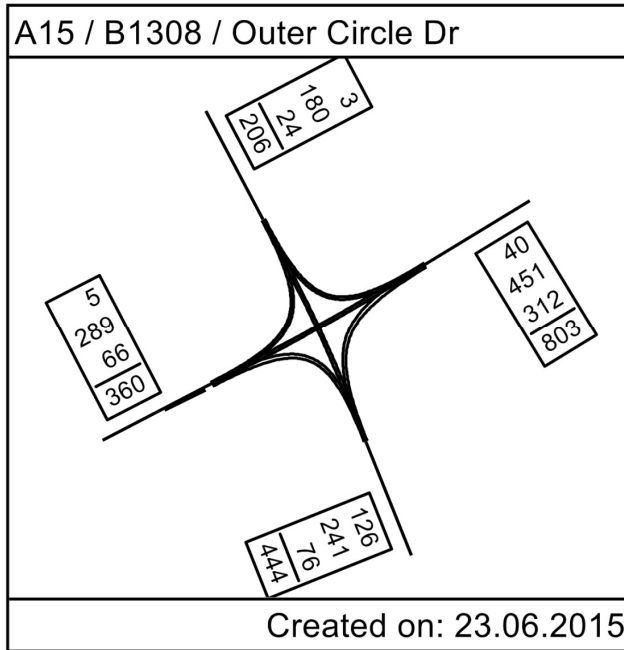


Lincoln Eastern Bypass
Model Sensitivity Note

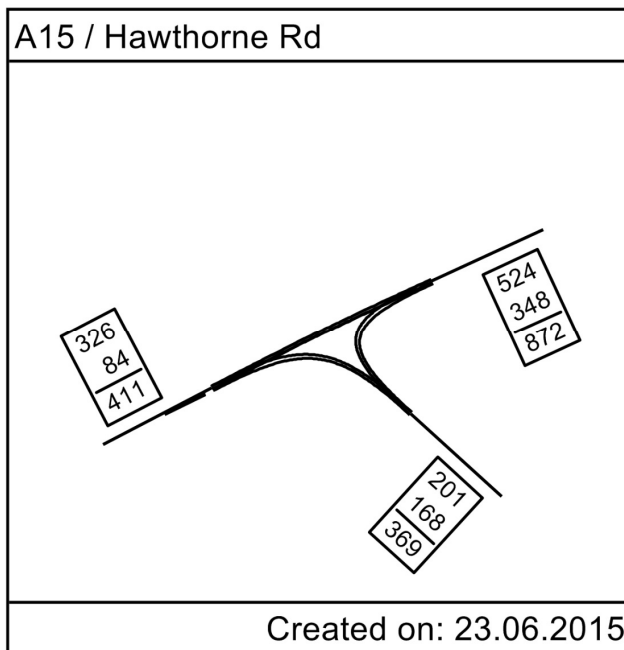
APPENDIX E Sensitivity Model Turn Flows

2006 AM Peak

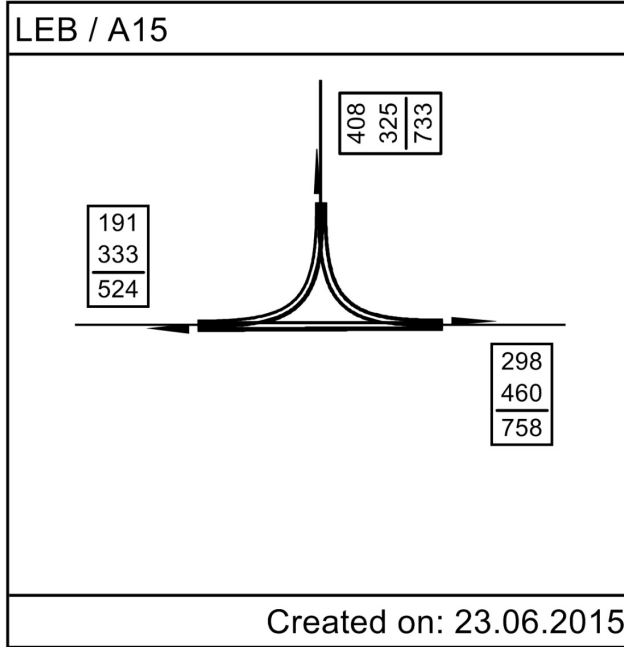
1. A15 Wragby Road / Outer Cir Road



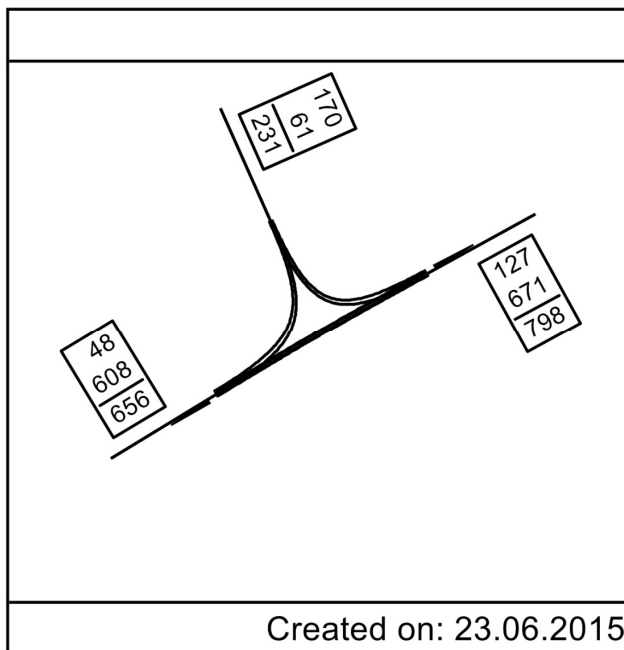
2. A15 Bunkers Hill / Hawthorn Road



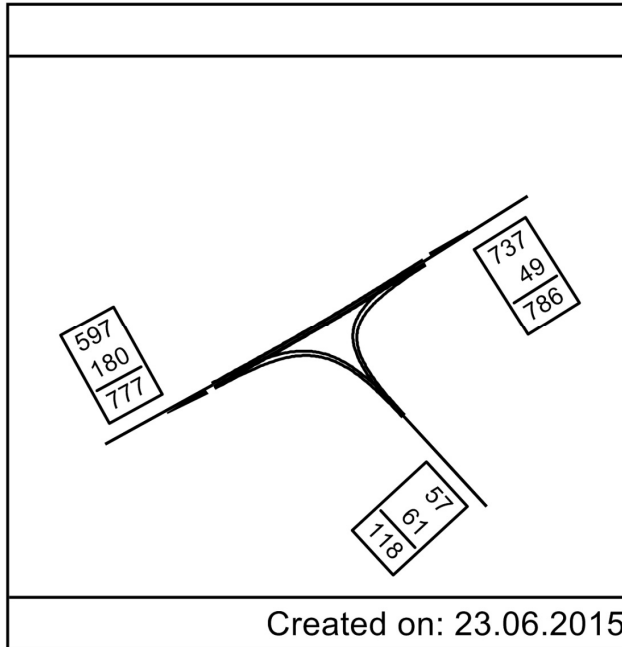
3. A158 / A15 Bunkers Hill / A158 Wragby Road



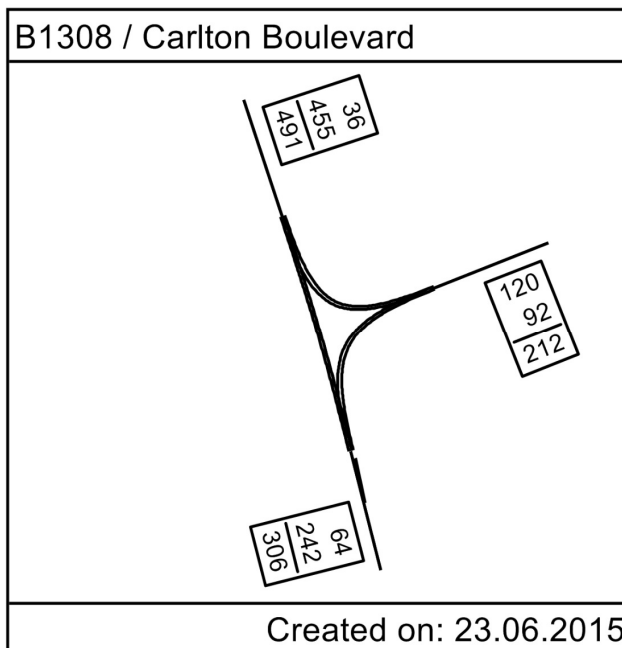
4. A158 Wragby Road / Lodge Lane



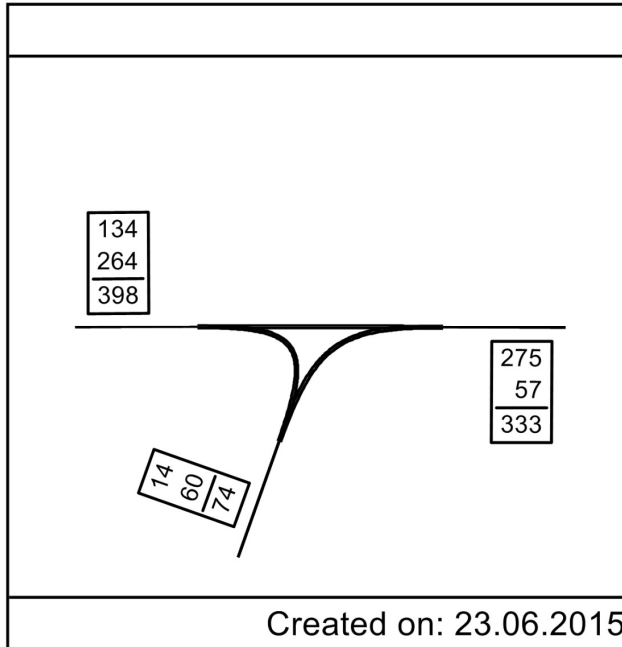
5. A158 Wragby Road / Kennel Lane



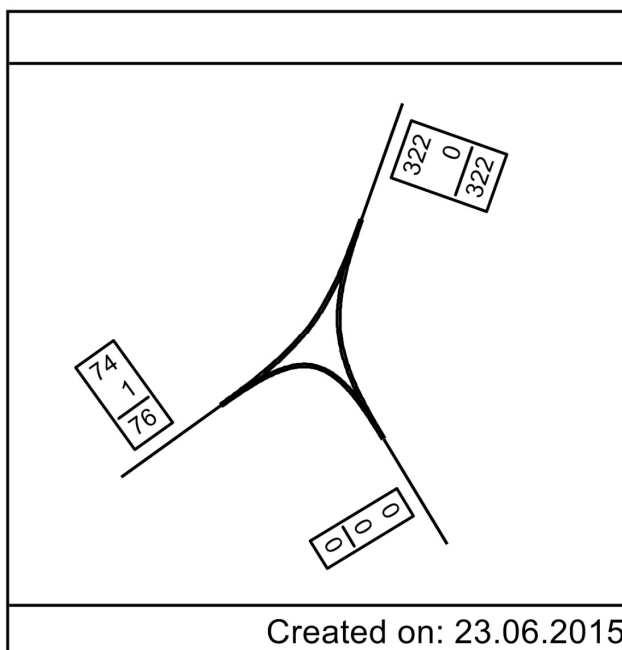
6. Outer Cir Road / Carlton Boulevard



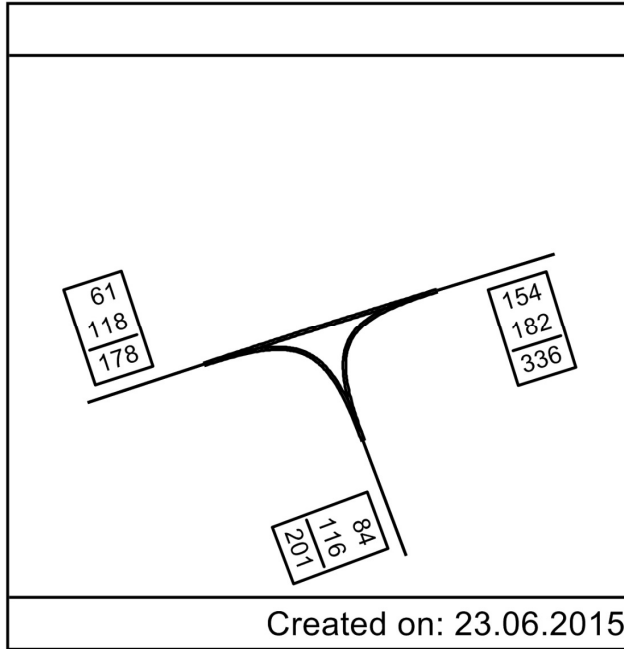
7. Hawthorn Road / St Augustine Road



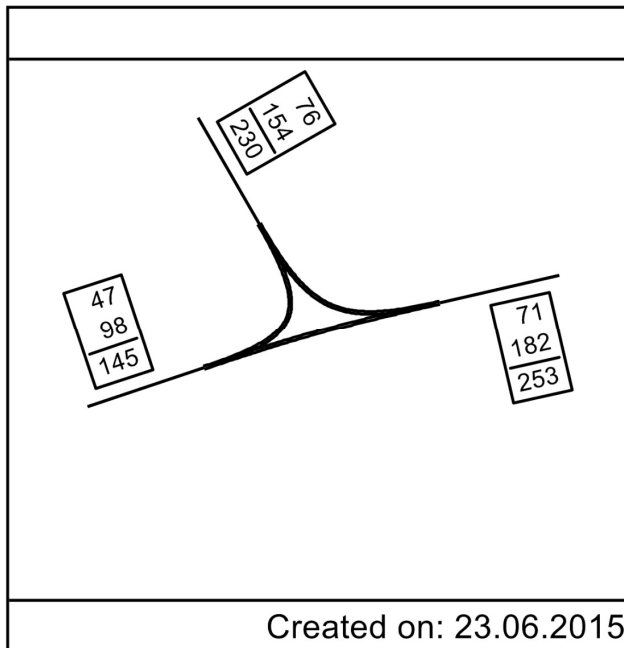
8. St Augustine Road / Dirt Track



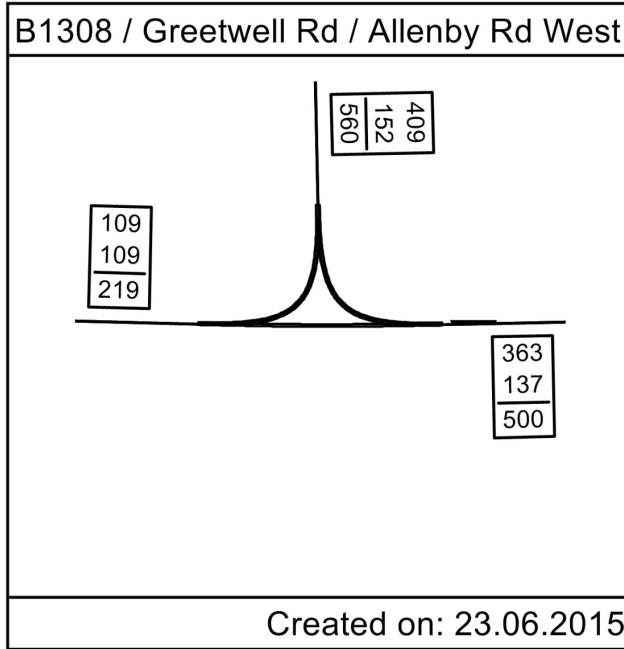
9. Hawthorn Road / Croft Lane



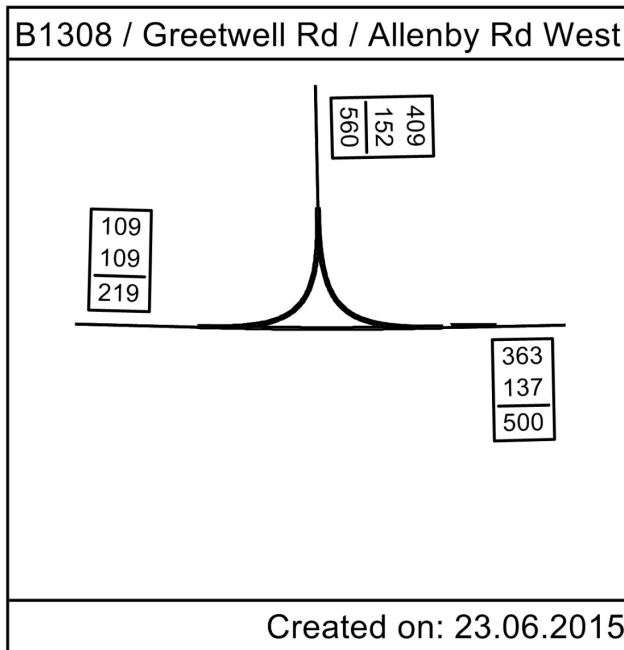
10. Hawthorn Road / Kennel Lane



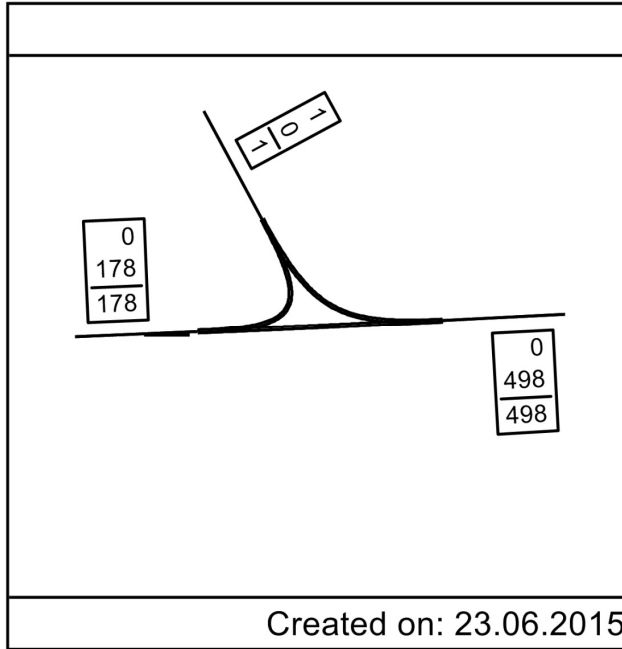
11a. Greetwell Road / Outer Cir Road



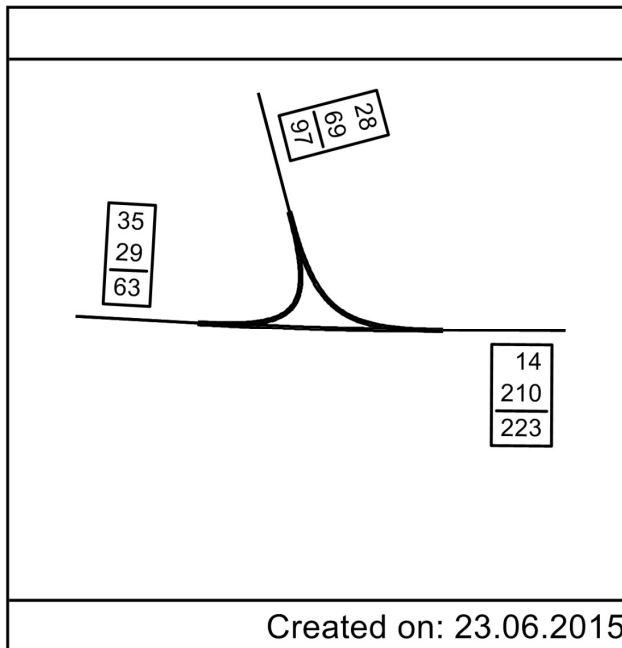
11b. Greetwell Road / Allenby Road



12. Greetwell Road / Dirt Track

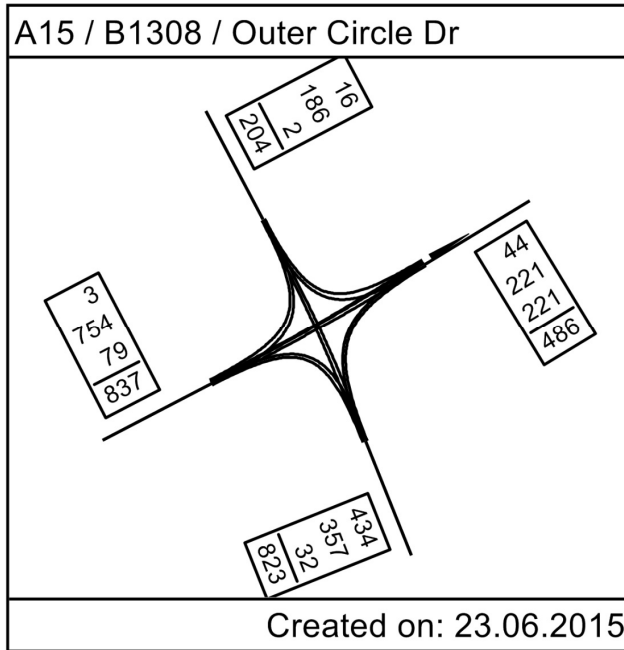


13. Fiskerton Road / Church Lane

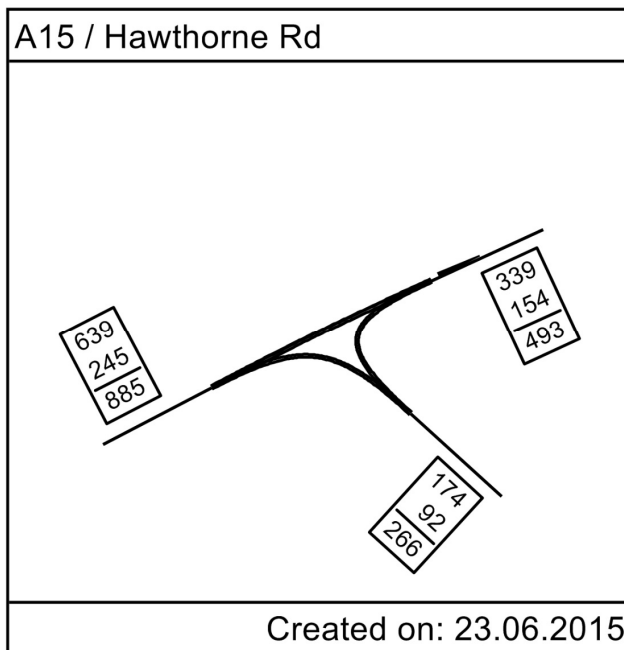


2006 PM Peak

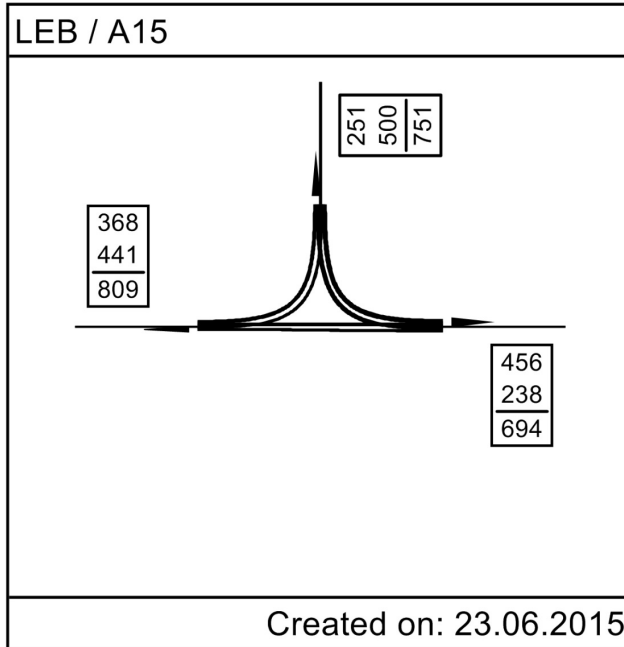
1. A15 Wragby Road / Outer Cir Road



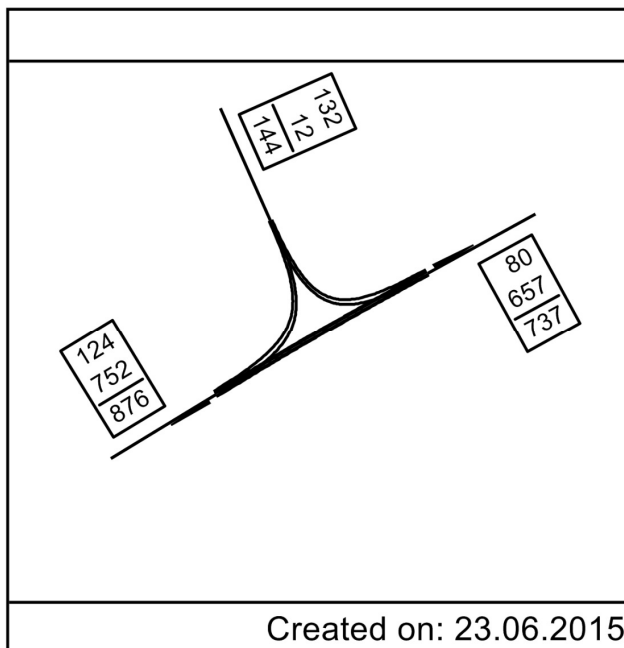
2. A15 Bunkers Hill / Hawthorn Road



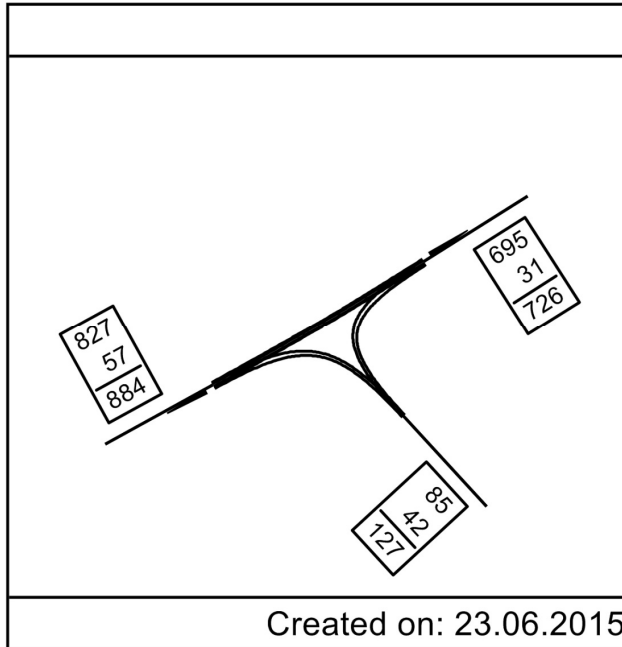
3. A158 / A15 Bunkers Hill / A158 Wragby Road



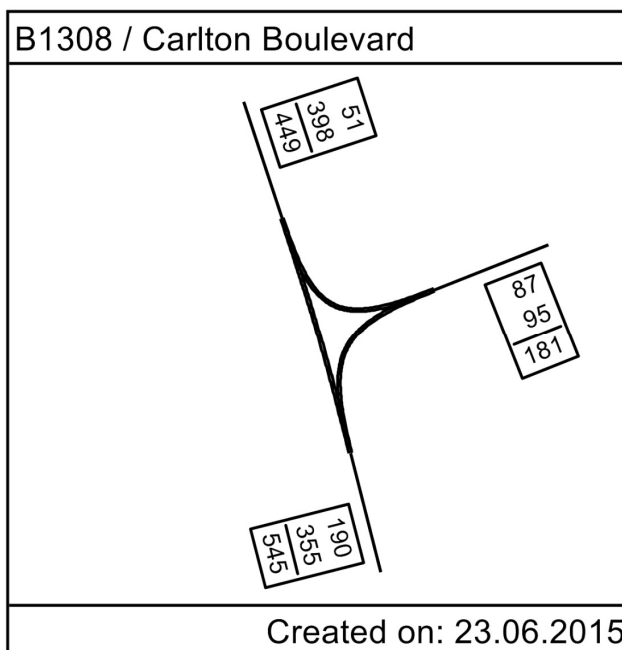
4. A158 Wragby Road / Lodge Lane



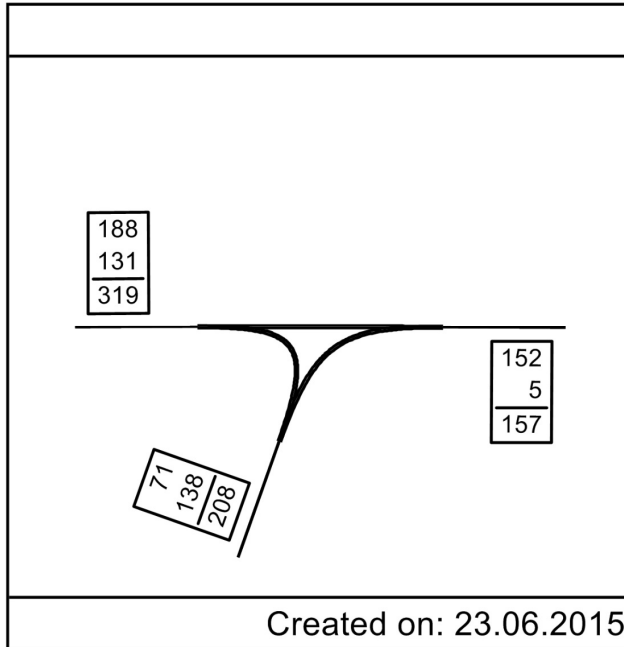
5. A158 Wragby Road / Kennel Lane



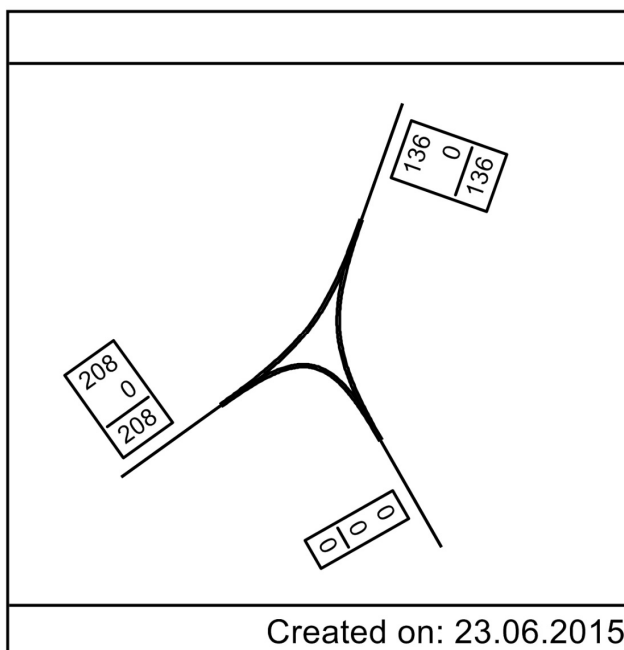
6. Outer Cir Road / Carlton Boulevard



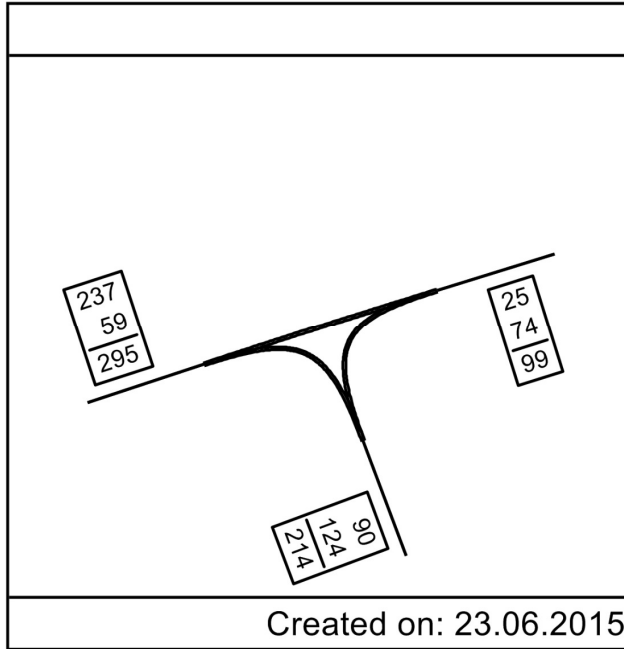
7. Hawthorn Road / St Augustine Road



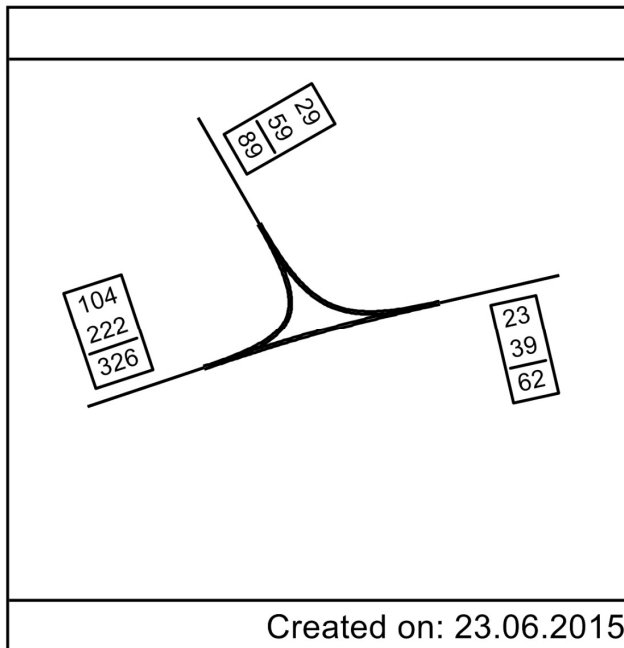
8. St Augustine Road / Dirt Track



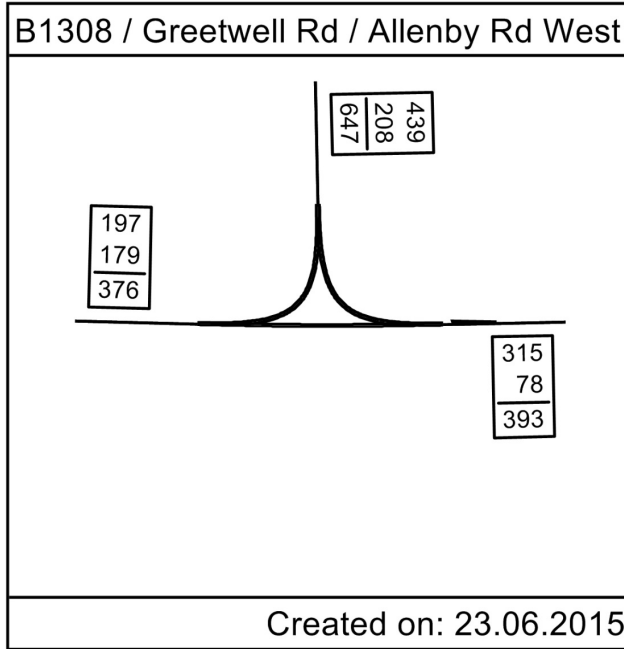
9. Hawthorn Road / Croft Lane



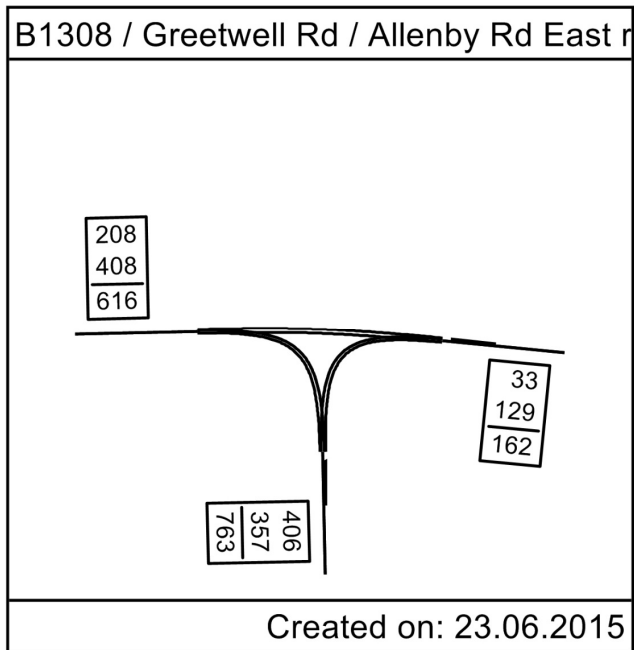
10. Hawthorn Road / Kennel Lane



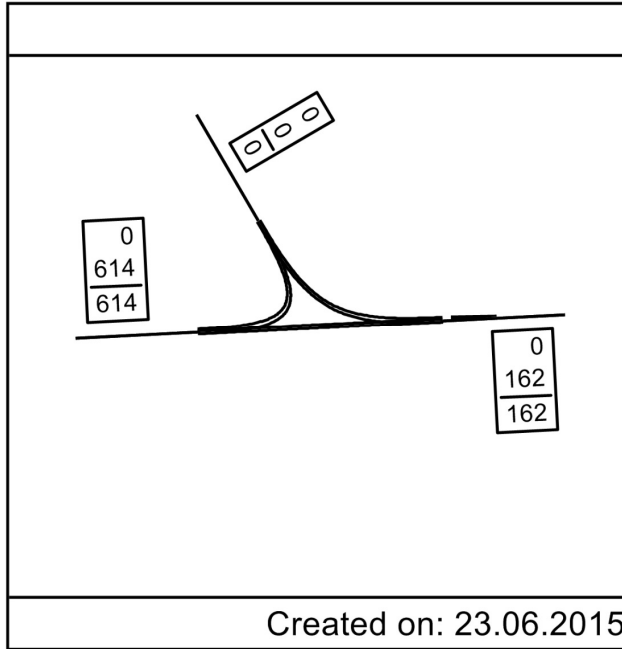
11a. Greetwell Road / Outer Cir Road



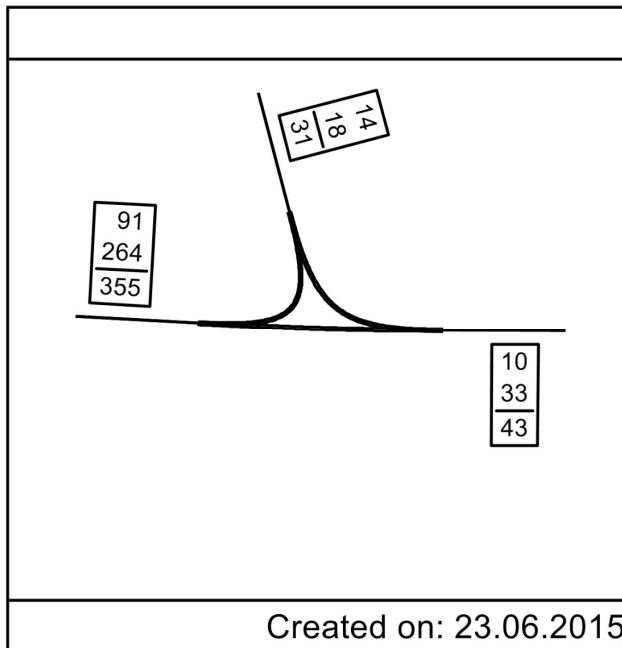
11b. Greetwell Road / Allenby Road



12. Greetwell Road / Dirt Track

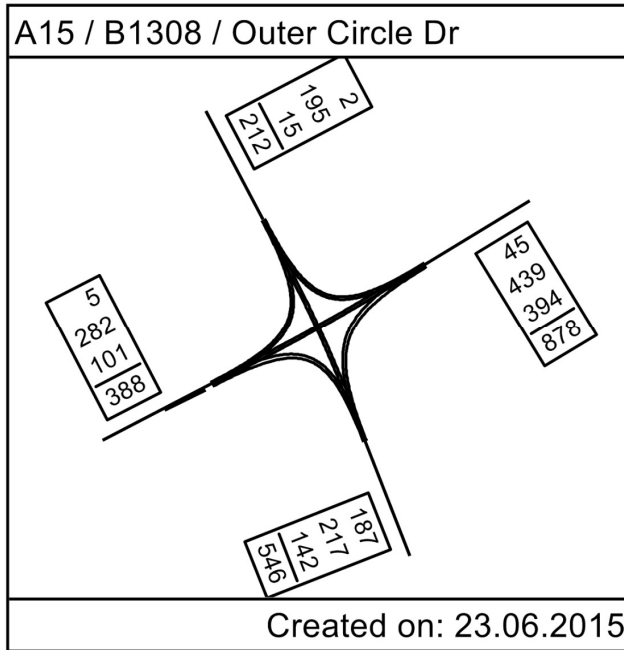


13. Fiskerton Road / Church Lane

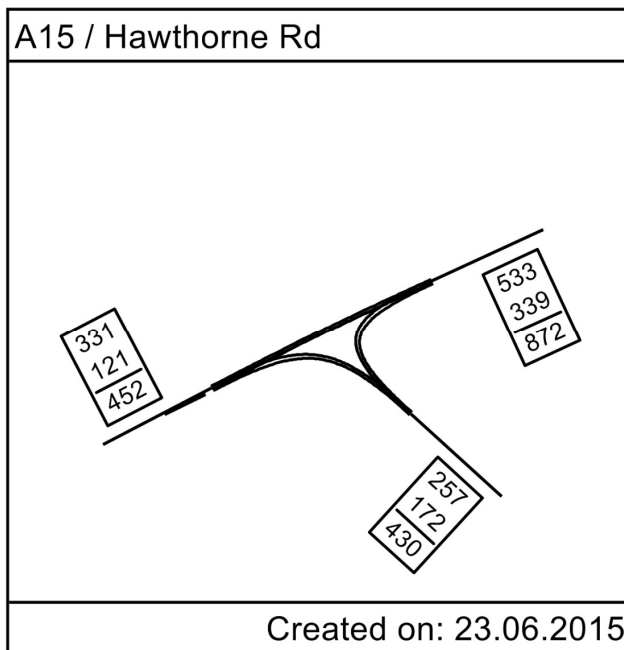


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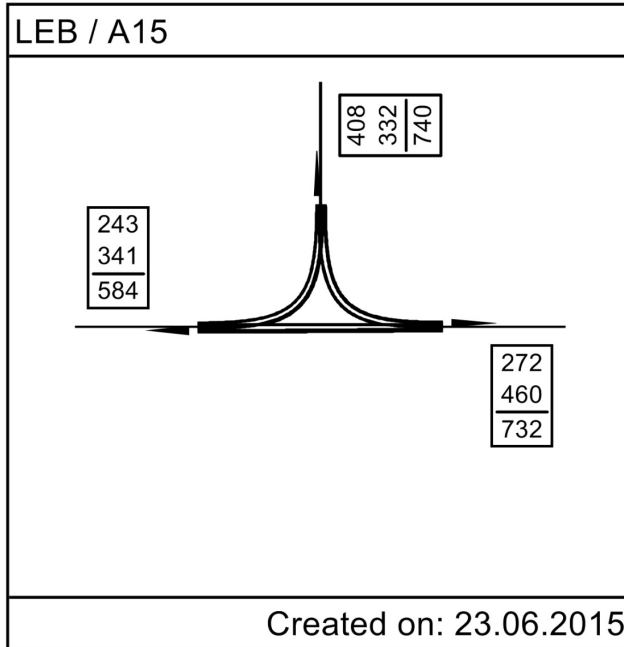
1. A15 Wragby Road / Outer Cir Road



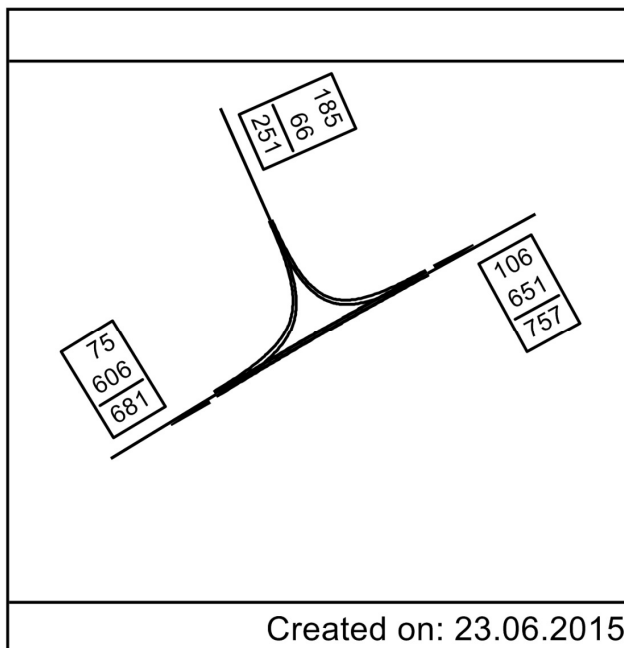
2. A15 Bunkers Hill / Hawthorn Road



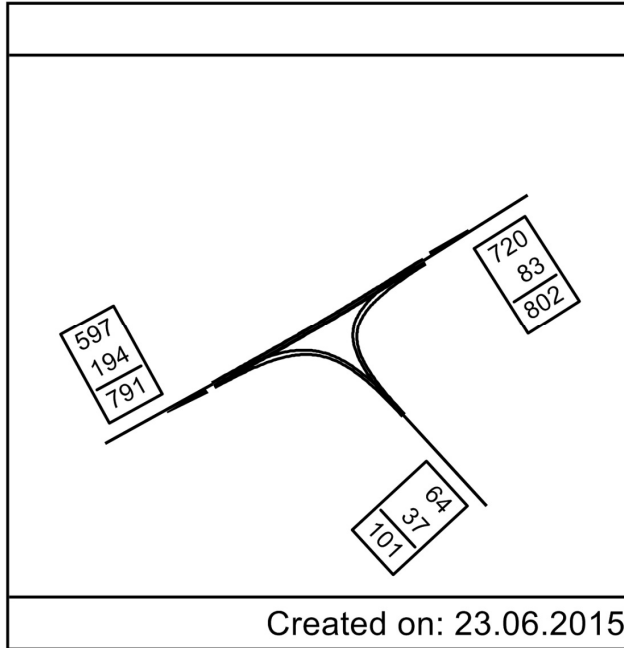
3. A158 / A15 Bunkers Hill / A158 Wragby Road



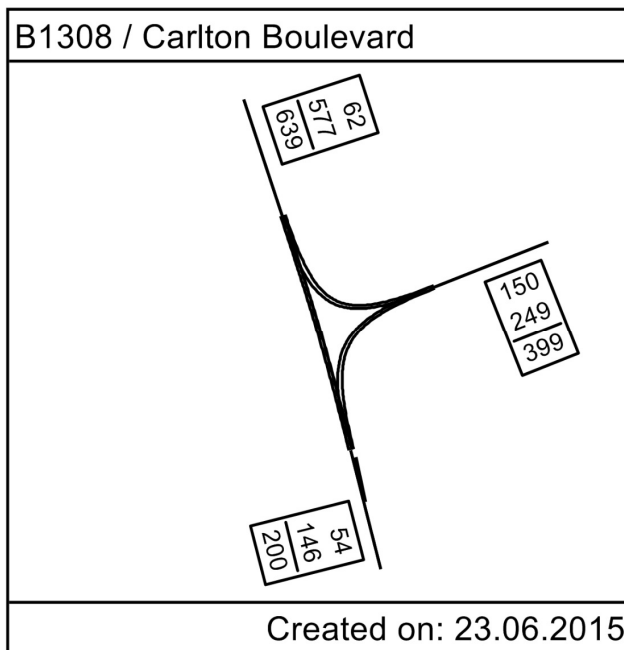
4. A158 Wragby Road / Lodge Lane



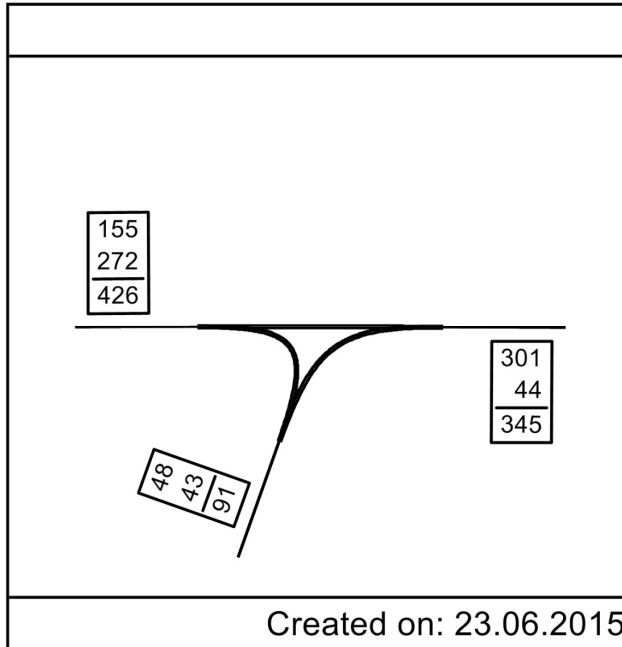
5. A158 Wragby Road / Kennel Lane



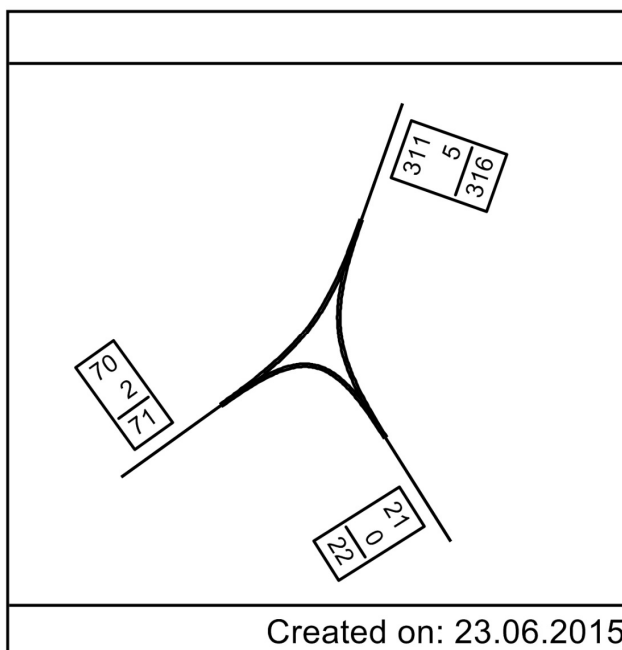
6. Outer Cir Road / Carlton Boulevard



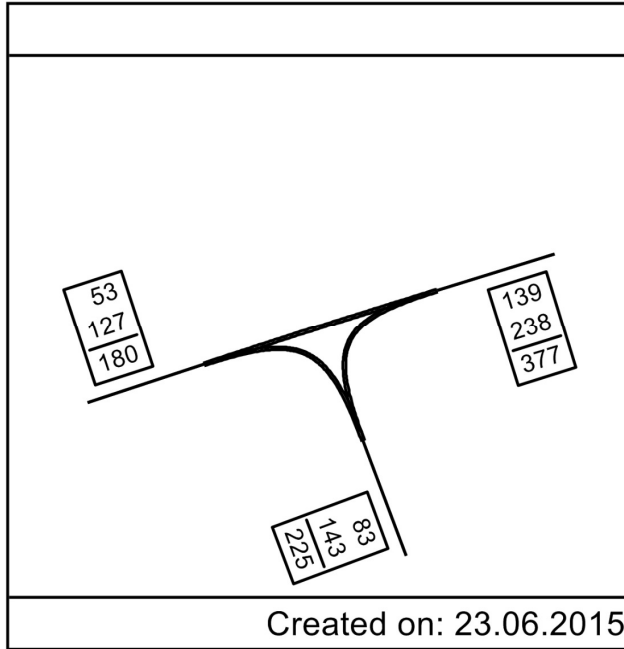
7. Hawthorn Road / St Augustine Road



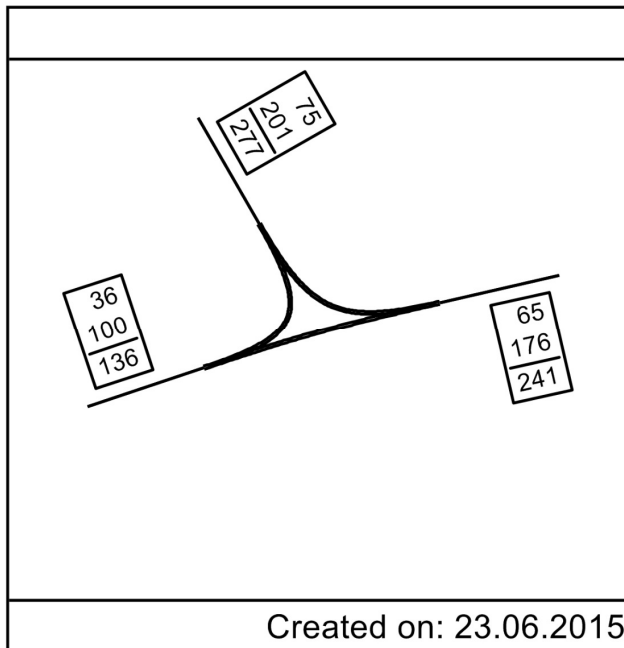
8. St Augustine Road / Dirt Track



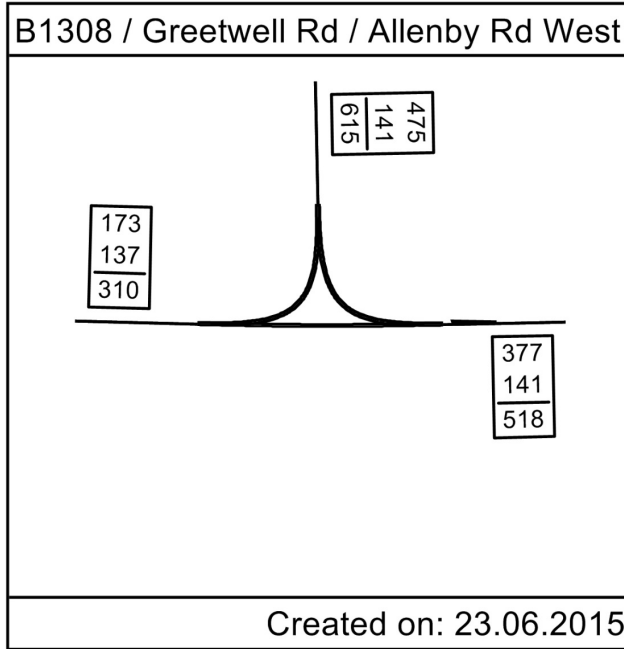
9. Hawthorn Road / Croft Lane



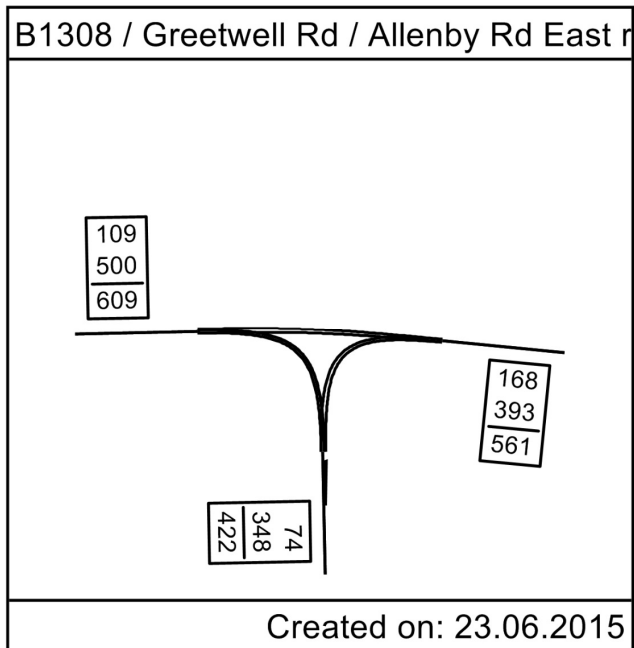
10. Hawthorn Road / Kennel Lane



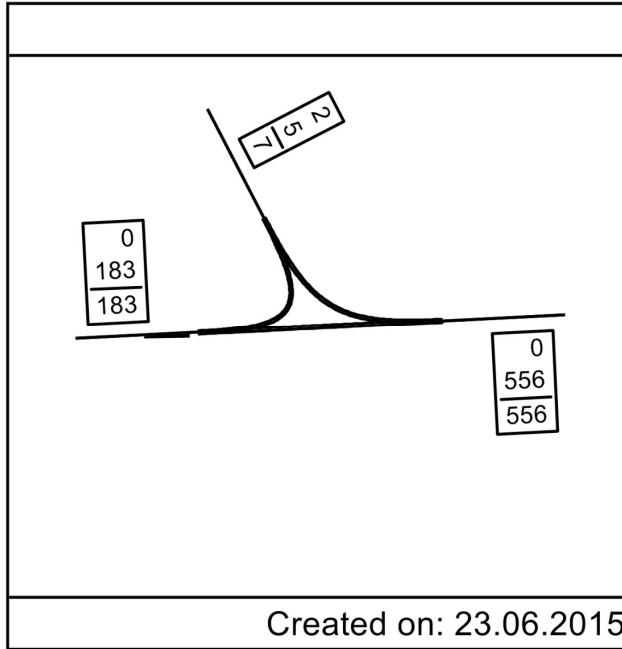
11a. Greetwell Road / Outer Cir Road



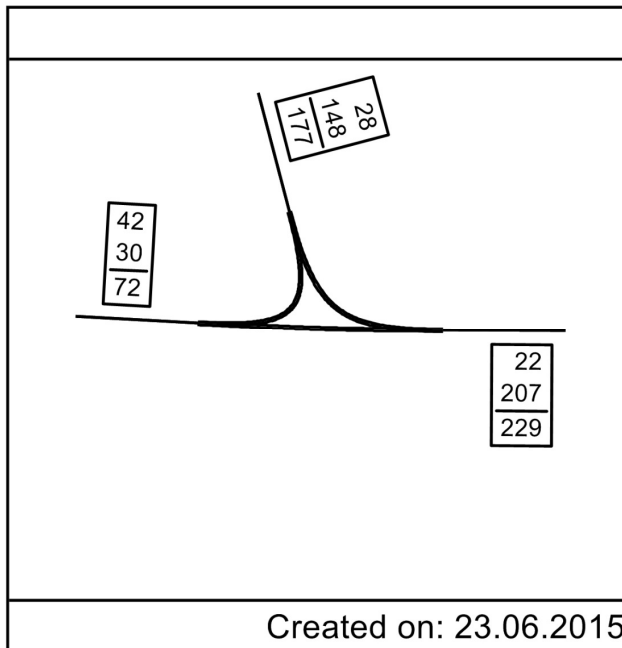
11b. Greetwell Road / Allenby Road



12. Greetwell Road / Dirt Track

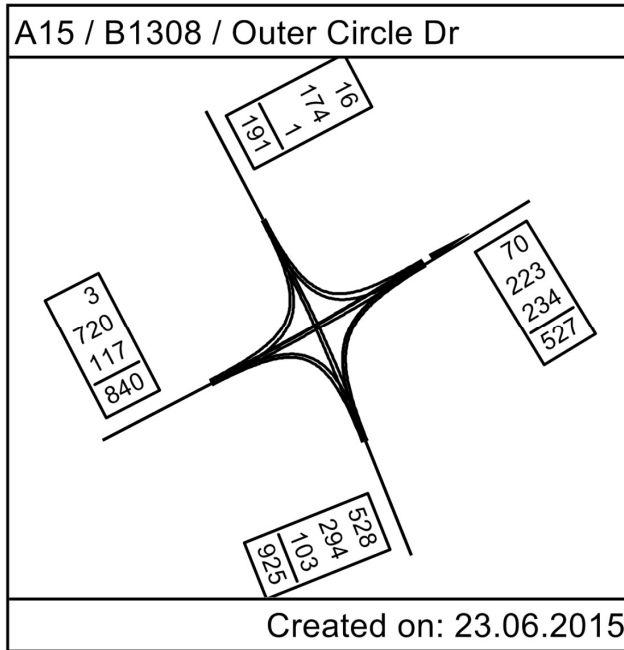


13. Fiskerton Road / Church Lane

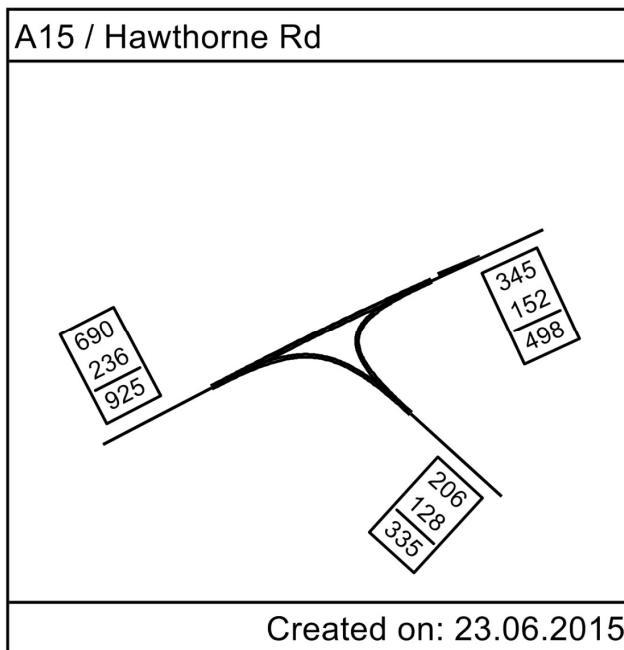


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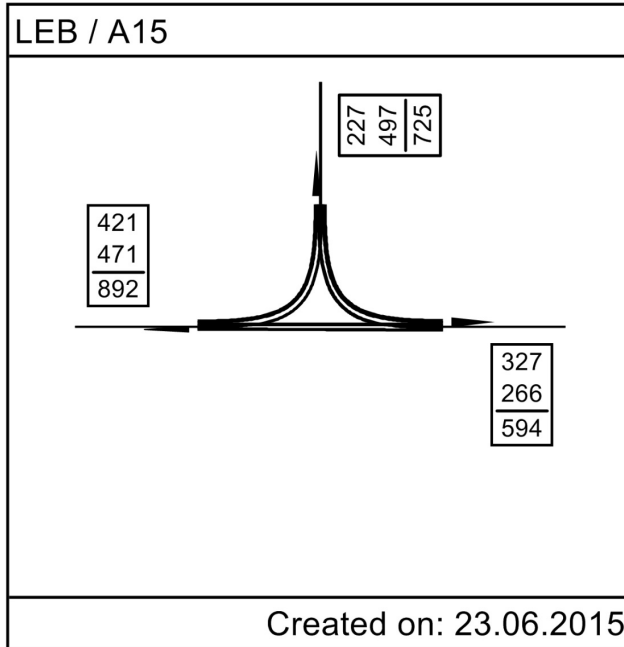
1. A15 Wragby Road / Outer Cir Road



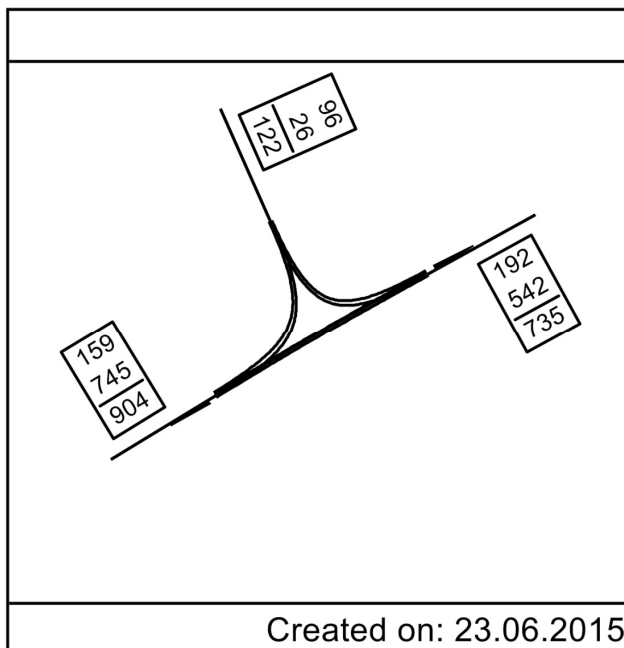
2. A15 Bunkers Hill / Hawthorn Road



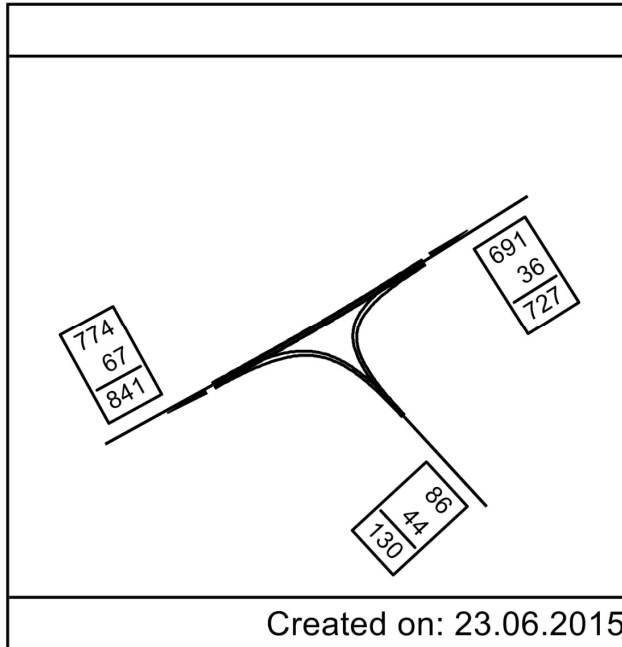
3. A158 / A15 Bunkers Hill / A158 Wragby Road



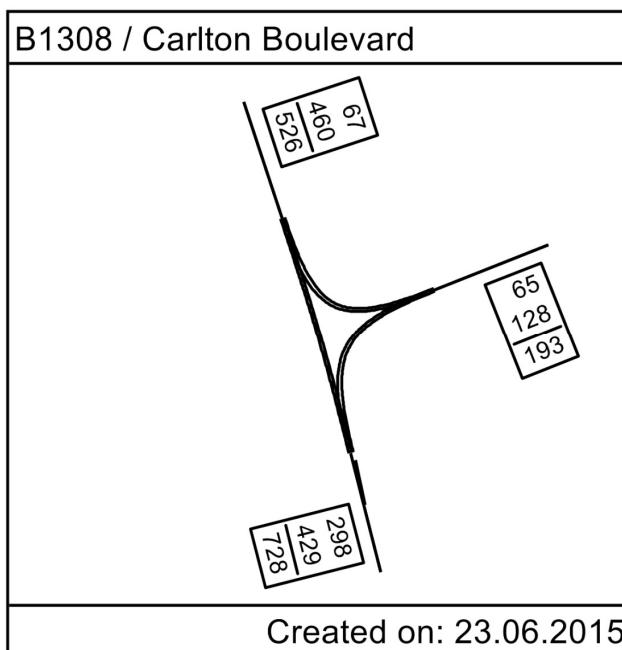
4. A158 Wragby Road / Lodge Lane



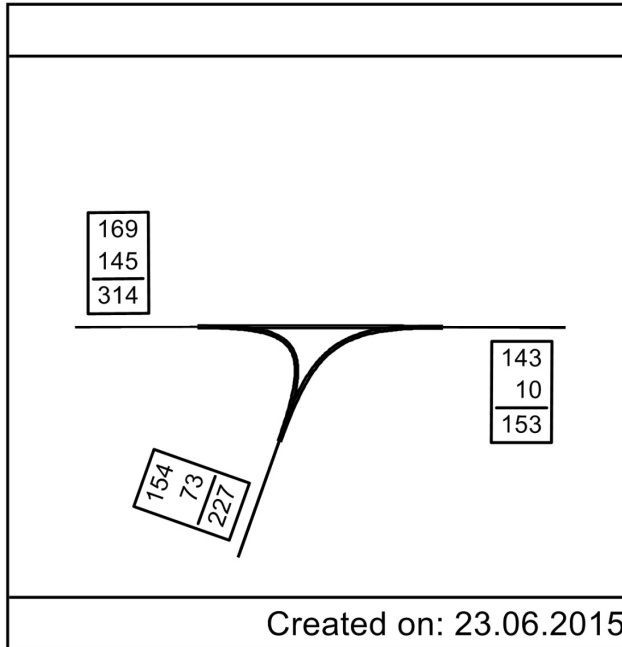
5. A158 Wragby Road / Kennel Lane



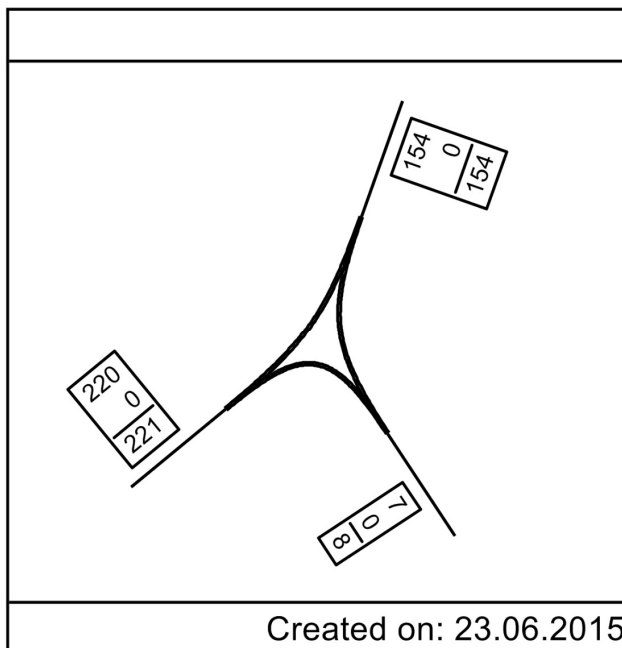
6. Outer Cir Road / Carlton Boulevard



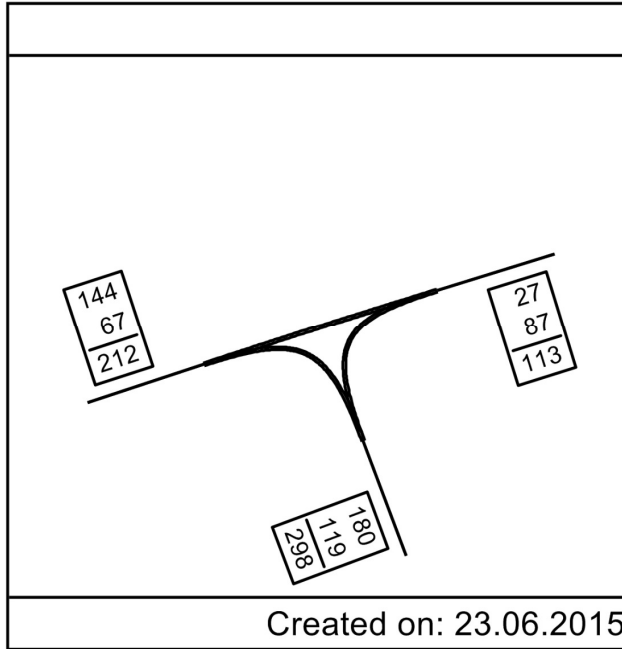
7. Hawthorn Road / St Augustine Road



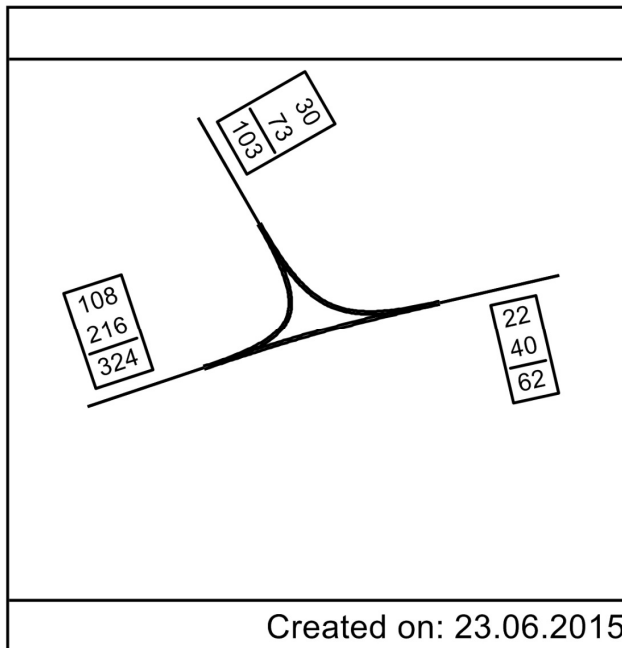
8. St Augustine Road / Dirt Track



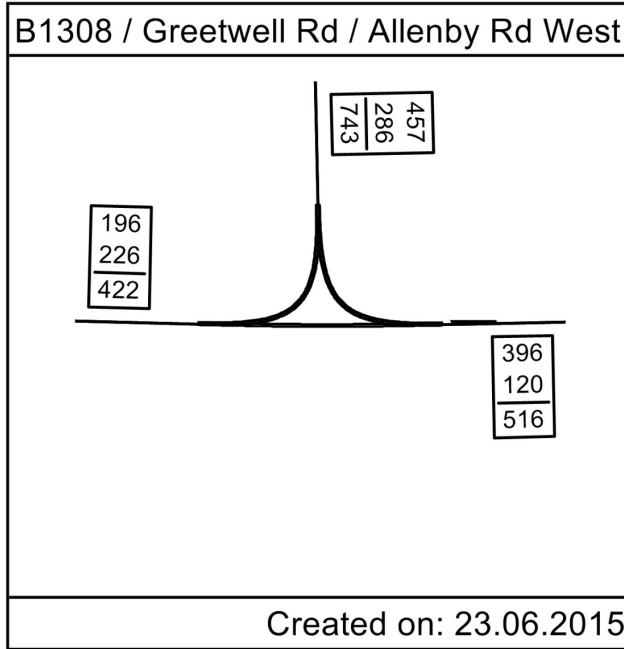
9. Hawthorn Road / Croft Lane



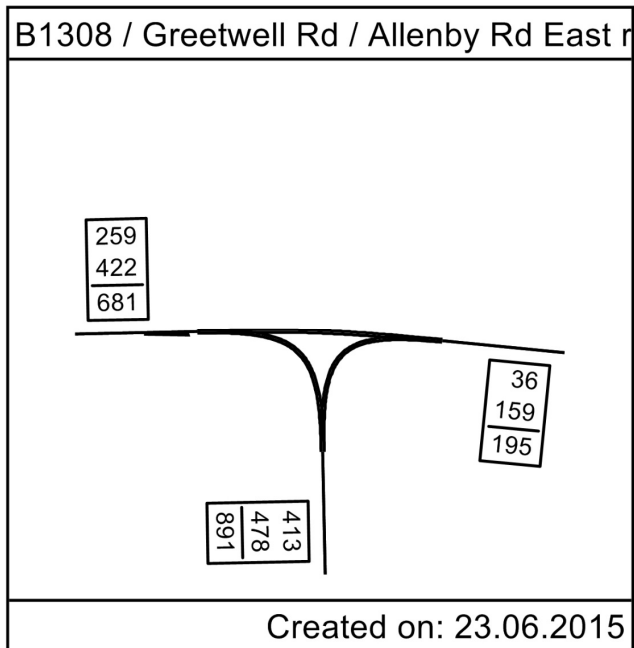
10. Hawthorn Road / Kennel Lane



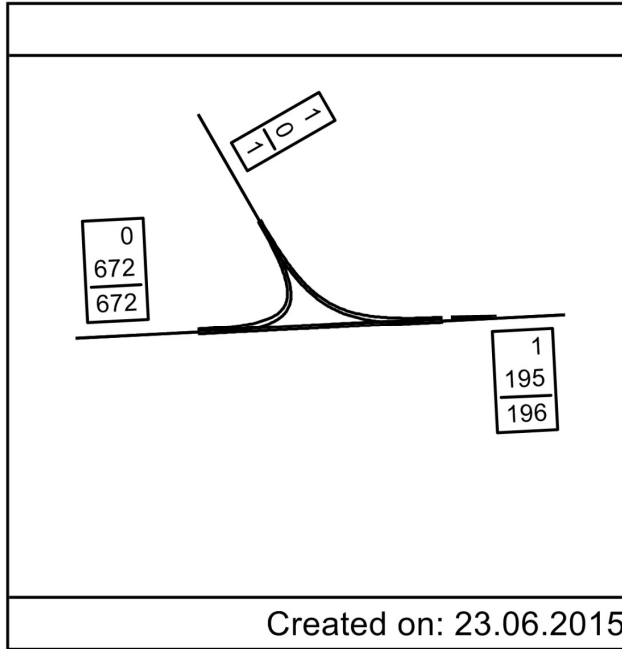
11a. Greetwell Road / Outer Cir Road



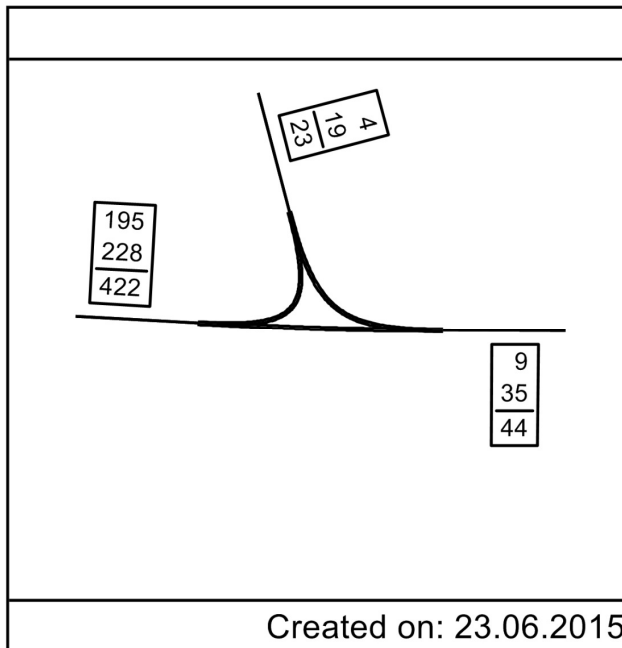
11b. Greetwell Road / Allenby Road



12. Greetwell Road / Dirt Track

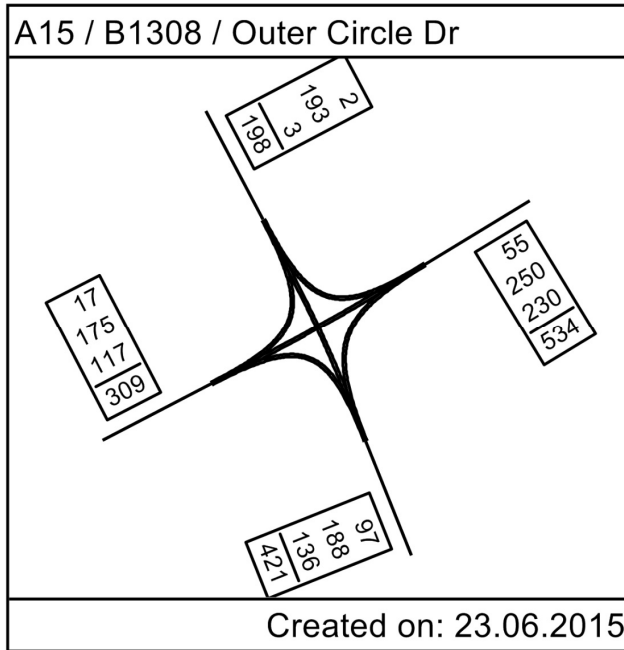


13. Fiskerton Road / Church Lane

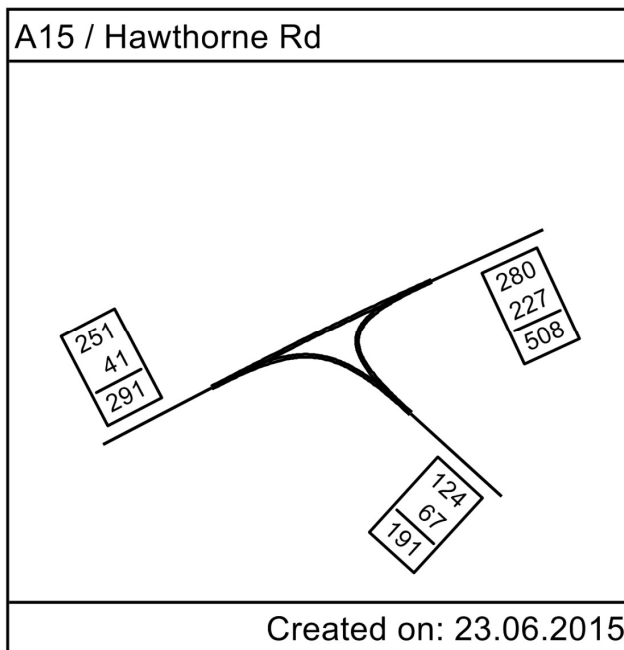


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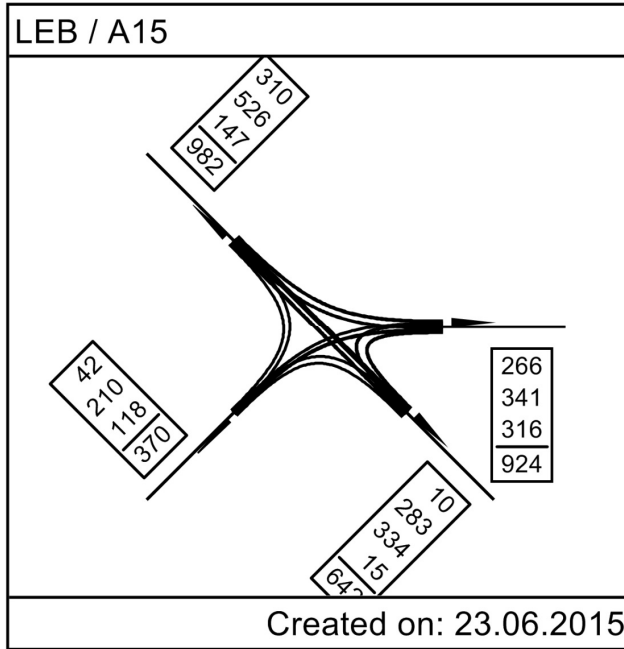
1. A15 Wragby Road / Outer Cir Road



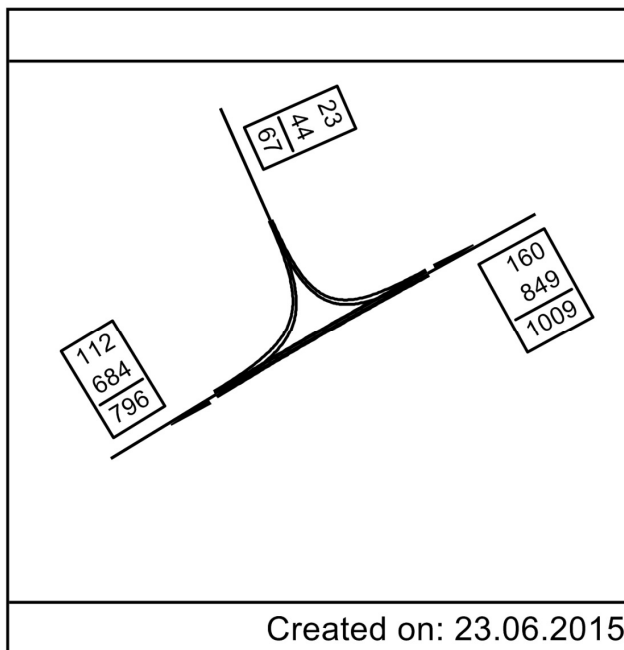
2. A15 Bunkers Hill / Hawthorn Road



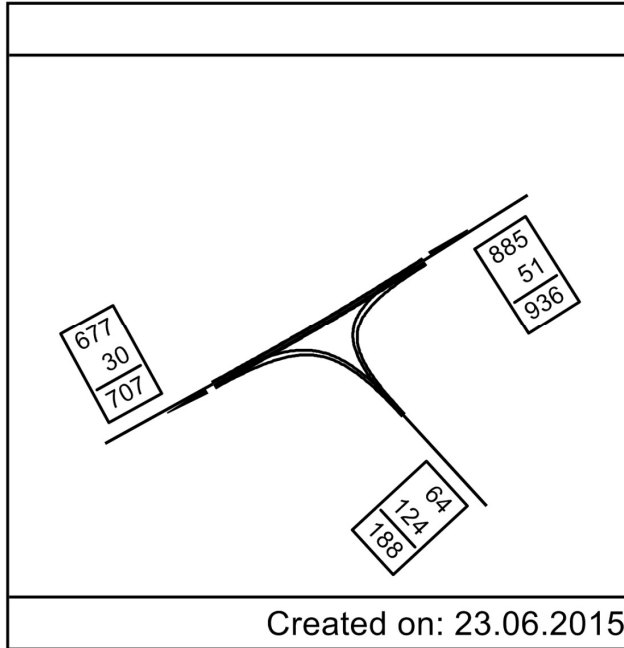
3. A158 / A15 Bunkers Hill / A158 Wragby Road



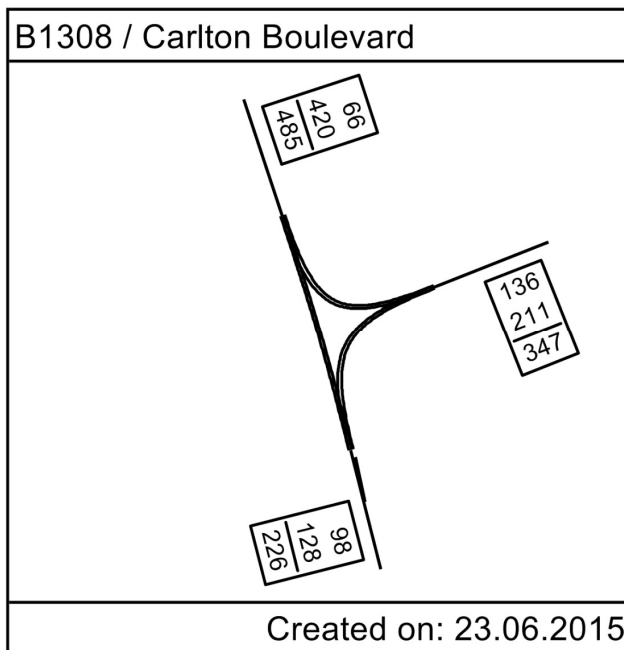
4. A158 Wragby Road / Lodge Lane



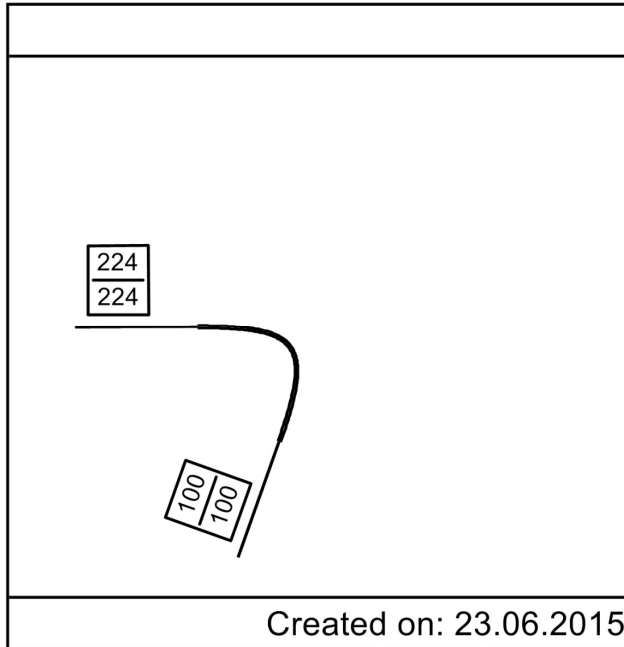
5. A158 Wragby Road / Kennel Lane



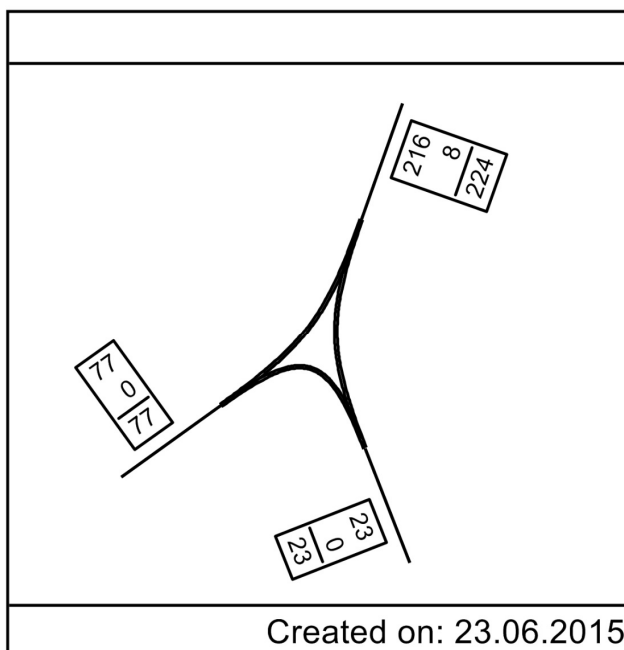
6. Outer Cir Road / Carlton Boulevard



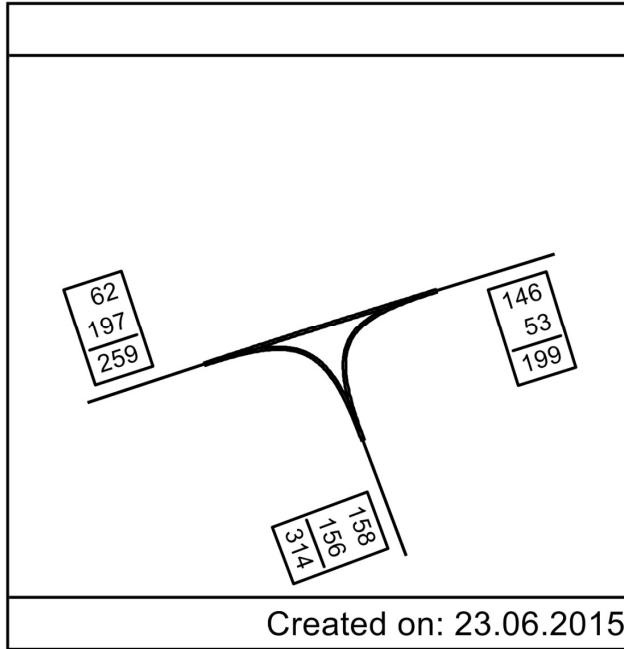
7. Hawthorn Road / St Augustine Road



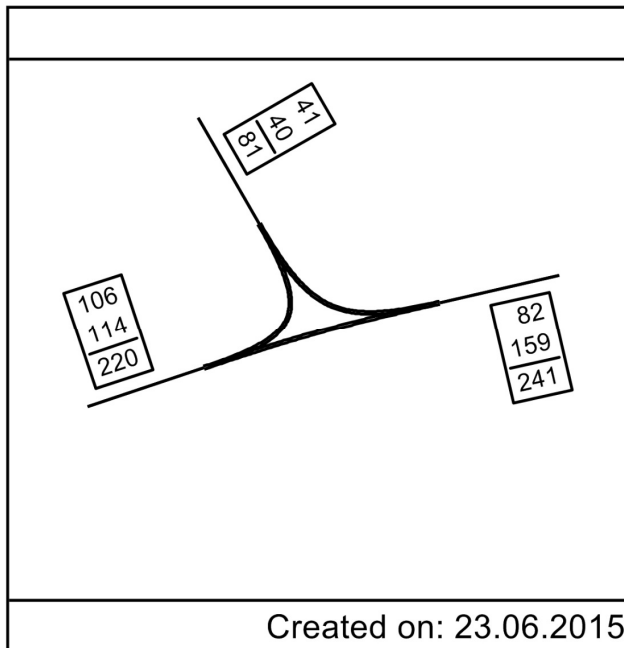
8. St Augustine Road / Dirt Track



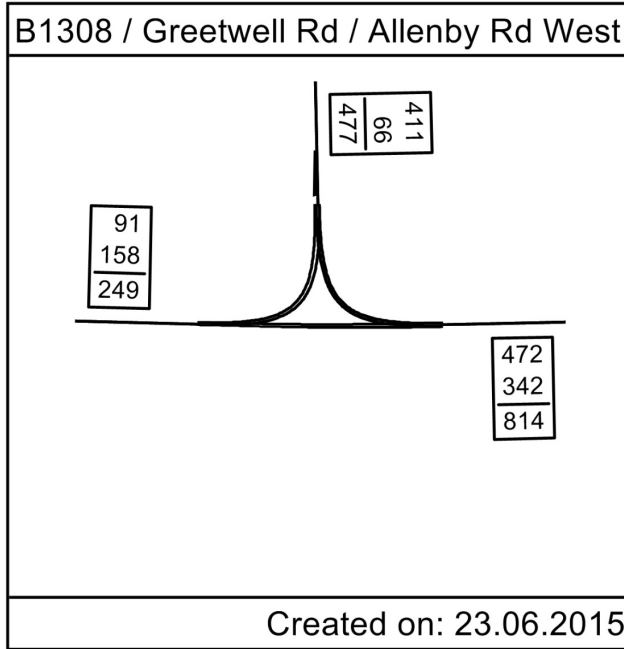
9. Hawthorn Road / Croft Lane



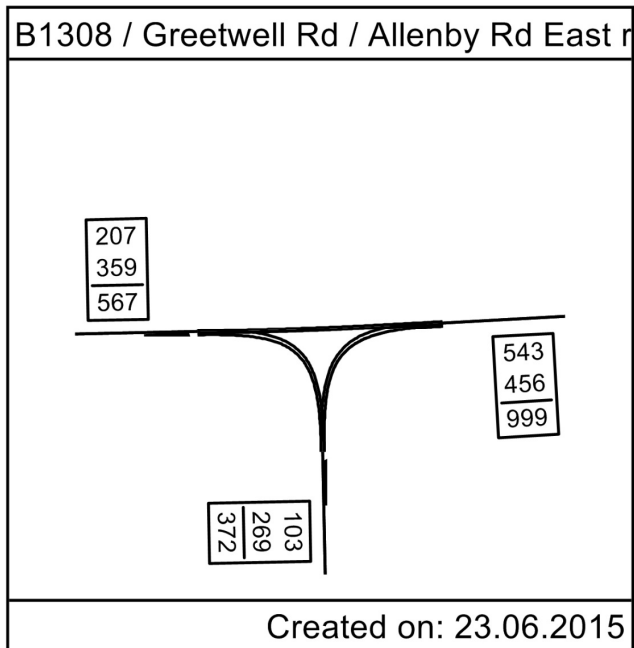
10. Hawthorn Road / Kennel Lane



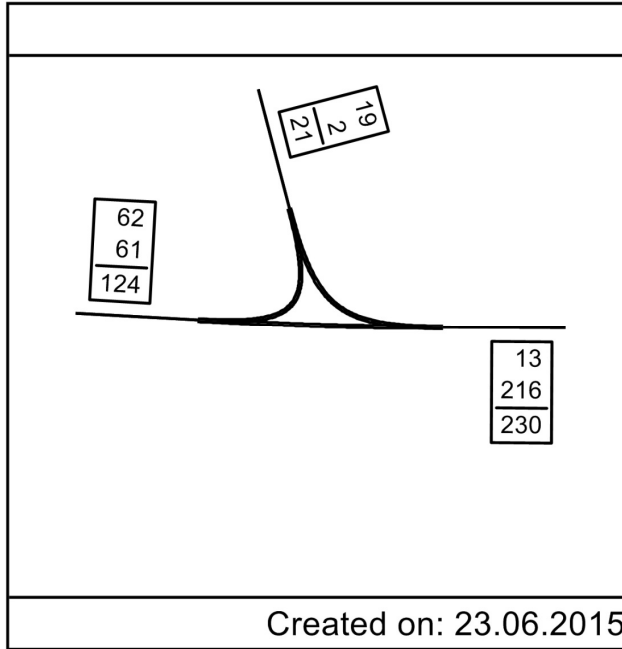
11a. Greetwell Road / Outer Cir Road



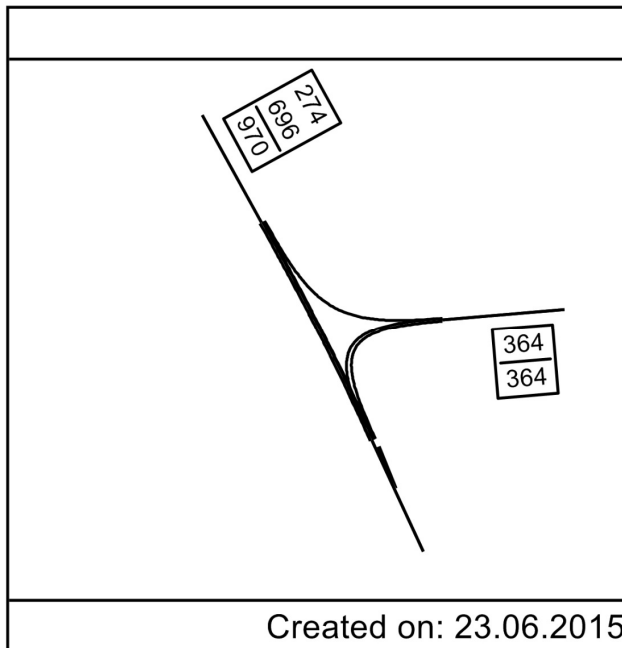
11b. Greetwell Road / Allenby Road



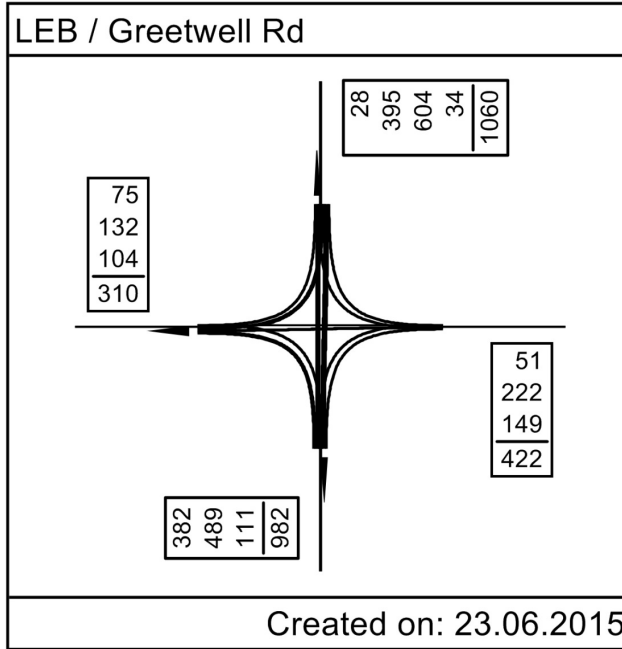
13. Fiskerton Road / Church Lane



14. LEB Southbound / Hawthorn Road

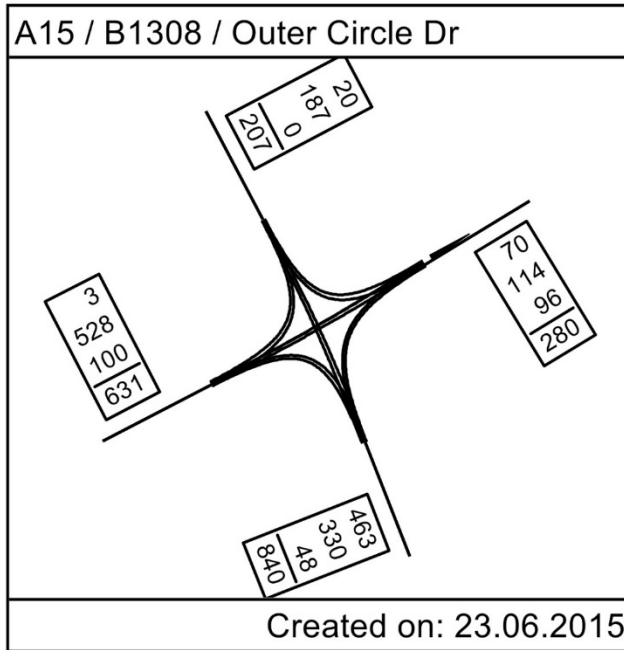


15. LEB / Greetwell Road

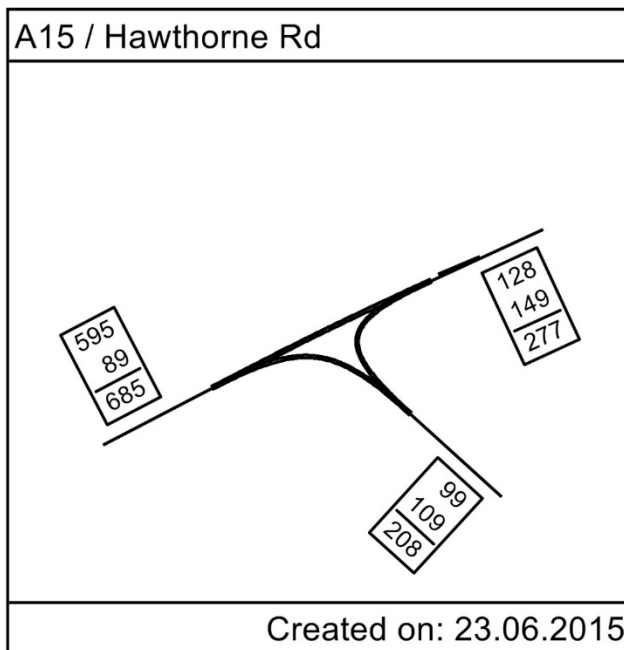


2018 DS PM

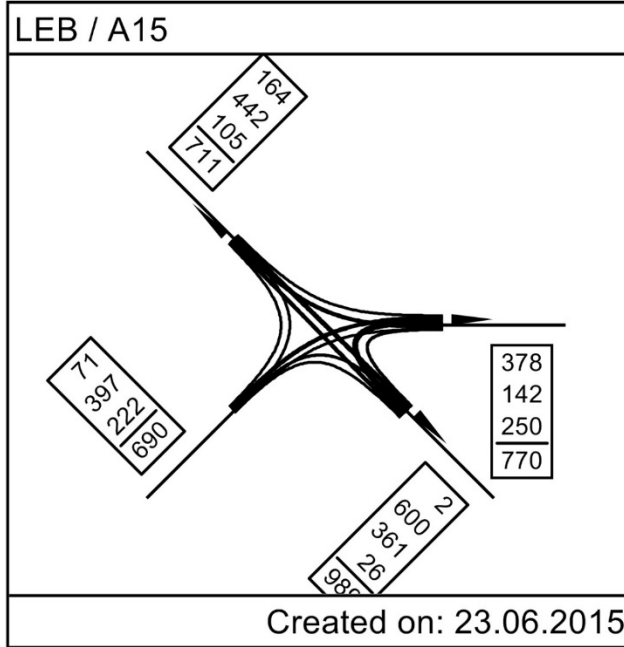
1. A15 Wragby Road / Outer Cir Road



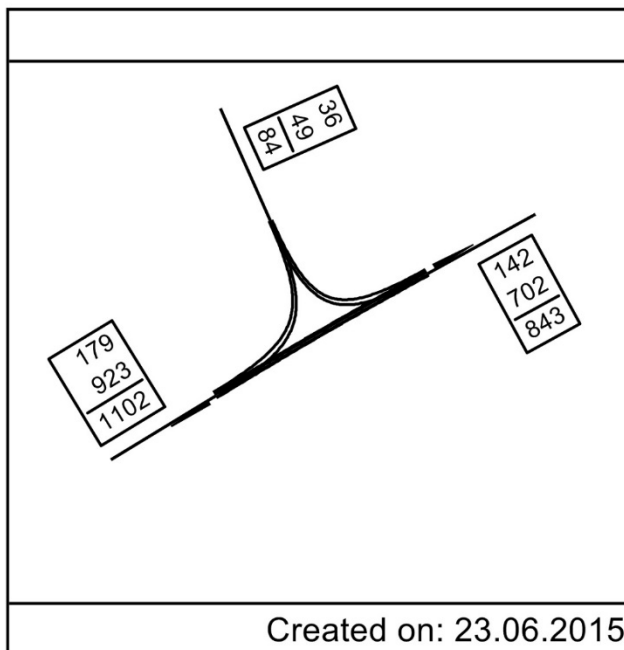
2. A15 Bunkers Hill / Hawthorn Road



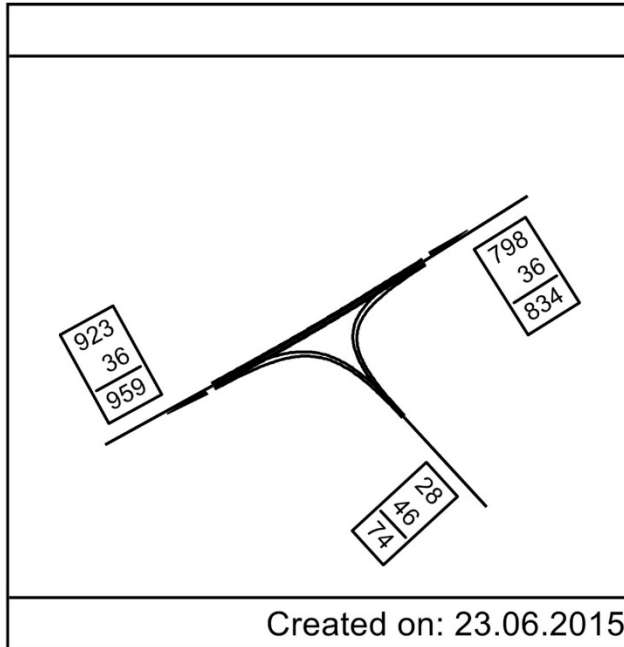
3. A158 / A15 Bunkers Hill / A158 Wragby Road



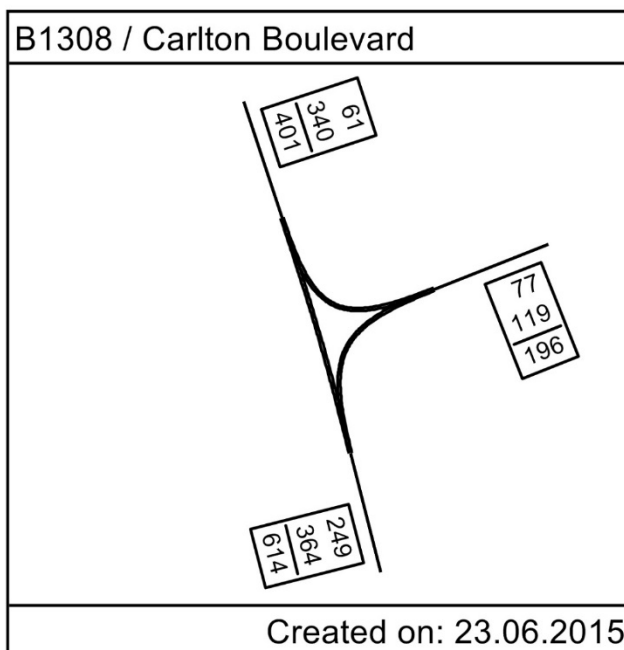
4. A158 Wragby Road / Lodge Lane



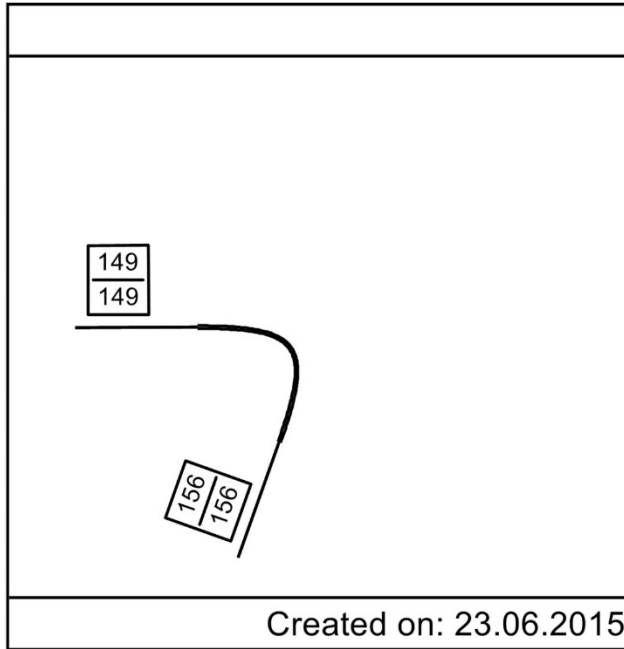
5. A158 Wragby Road / Kennel Lane



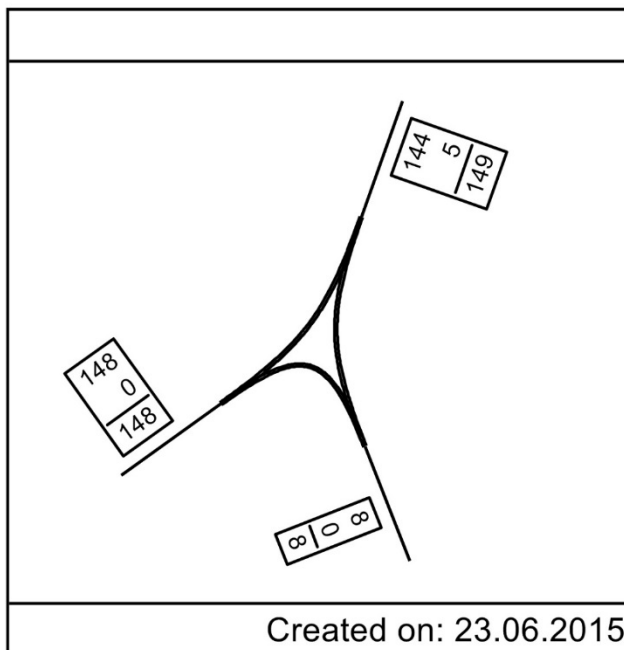
6. Outer Cir Road / Carlton Boulevard



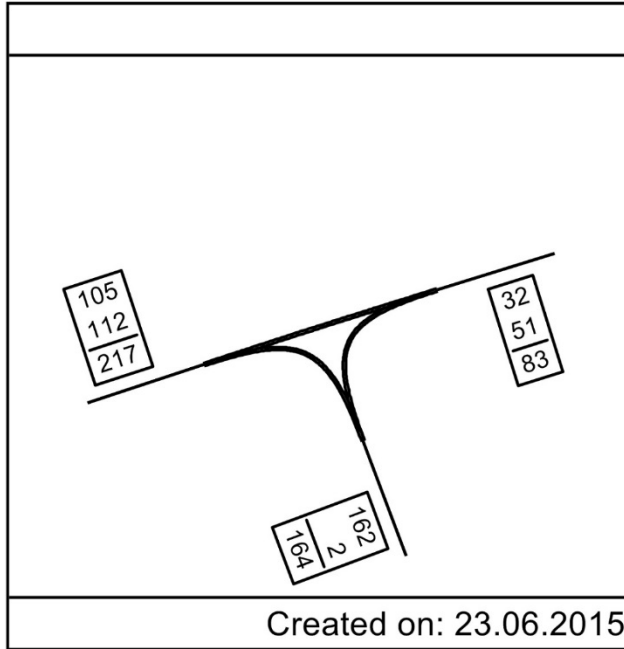
7. Hawthorn Road / St Augustine Road



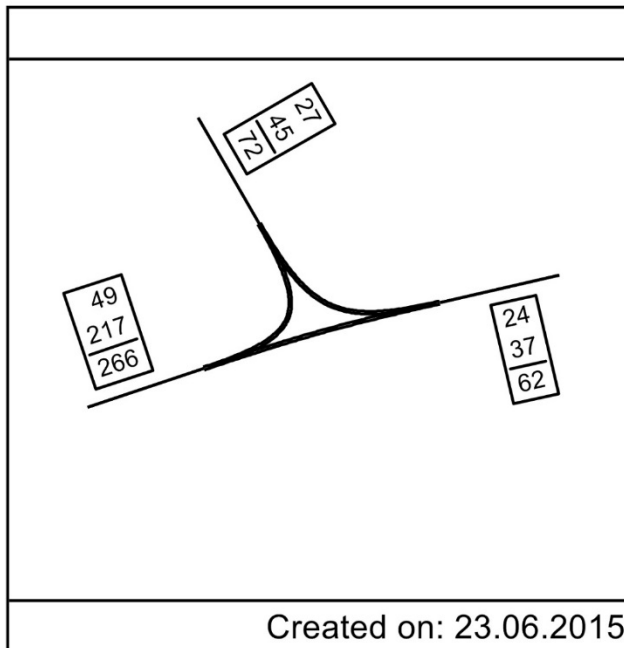
8. St Augustine Road / Dirt Track



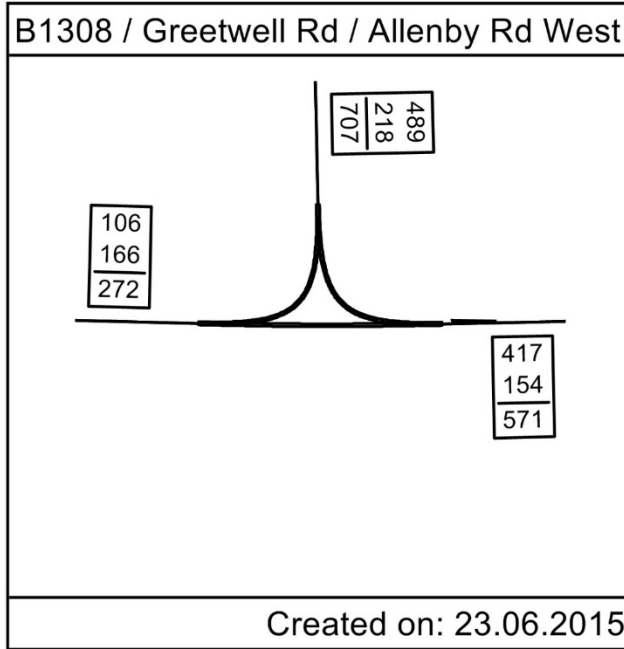
9. Hawthorn Road / Croft Lane



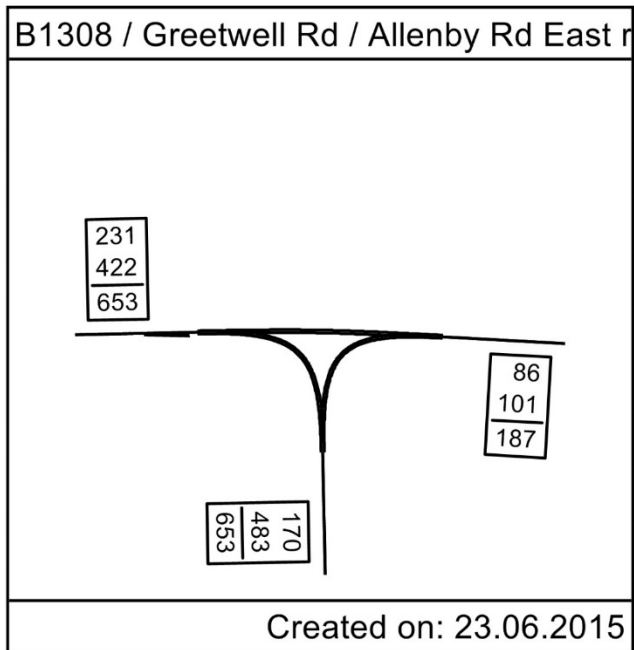
10. Hawthorn Road / Kennel Lane



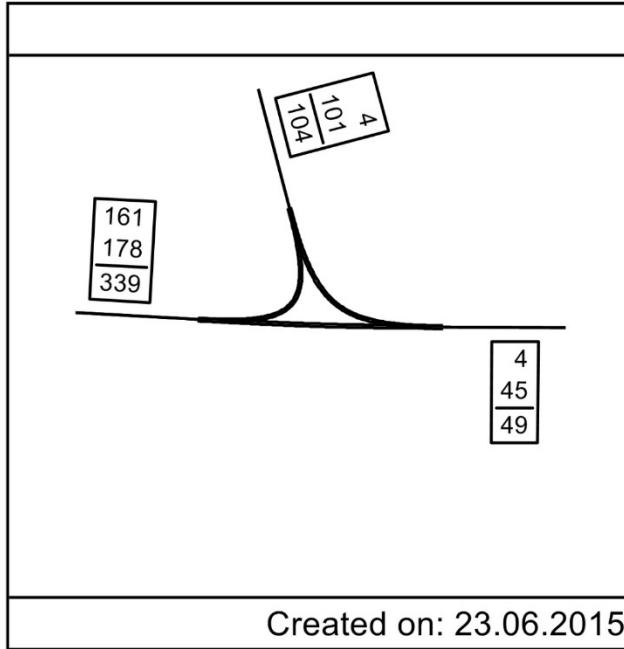
11a. Greetwell Road / Outer Cir Road



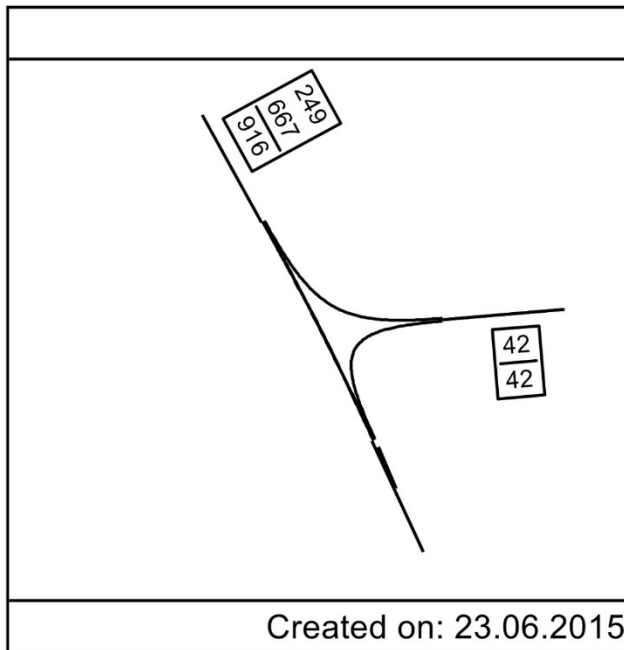
11b. Greetwell Road / Allenby Road



13. Fiskerton Road / Church Lane



14. LEB Southbound / Hawthorn Road



15. LEB / Greetwell Road

