Department for Regional Development - TransportNI

A24 BALLYNAHINCH BYPASS

Public Inquiry

January 2016

Proof of Evidence:

Traffic and Economic Assessment

by

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1. INTRODUCTION

1.1 Qualifications, Role and Experience

1.1.1 My name is Russell Bissland. I am a Chartered Civil Engineer with a Bachelor of Science degree in Civil Engineering. I have been a member of the Institution of Civil Engineers since 1988 and a member of the Chartered Institution of Highways and Transportation since 1991.

1.1.2 I have more than 38 years experience in civil engineering projects through my employment with various organisations including British Rail, Local Roads Authorities and Consulting Engineers.

1.1.3 I am presently employed by AECOM (formerly URS) as a Technical Director with responsibility for the traffic and economic assessment of major transport improvement schemes. For the purpose of this Proof of Evidence, any reference to URS may include reference to its former legacy companies, including Scott Wilson.

1.1.4 I am responsible for the traffic and economic assessment of major road improvement schemes throughout Scotland, Northern Ireland and the north of England. In Northern Ireland specifically, I have been responsible for undertaking the appraisal of road schemes in Armagh, Enniskillen, Omagh and for the traffic and economic assessment of numerous major road improvement schemes including the A8 Belfast to Larne Improvement, the M2 Motorway Widening, the A1 Beech Hill to Cloghogue Dualling, the A6 Randalstown to Castledawson Dualling, the A6 Londonderry to Claudy Dualling and the York Street Interchange.

1.2 Scope of Evidence

1.2.1 The scope of my evidence concerns the Stage 3 Traffic and Economic Assessment Report, dated 7 April 2015, for the Proposed Scheme.

1.2.2 The method adopted for the traffic and economic assessment of the Proposed Scheme is in line with the requirements of the Design Manual for Roads and Bridges (DMRB).

1.2.3 The purpose of the Stage 3 Traffic and Economic Assessment Report is to describe existing traffic conditions in the Ballynahinch study area, to outline the indicative costs, risks and optimism bias associated with the Proposed Scheme and to describe the work undertaken to develop the various computer models. The report also considers future traffic conditions over the economic life of the scheme and presents the results of an operational and economic assessment of the Proposed Scheme. Given the uncertainty in predicting future traffic conditions over the economic life of the scheme, the results from a series of sensitivity tests of future traffic growth have also been presented in this report.

2. ASSESSMENT OF NEED AND KEY OBJECTIVES

2.1 Strategic Transport Needs and Objectives

2.1.1 The Regional Transportation Strategy (RTS) 2002-2012 identified strategic transportation investment priorities and considered potential funding sources and affordability of planned initiatives over a 10 year period. The RTS identified a significant uplift in major highway improvements, aimed mainly at removing bottlenecks from the existing strategic network and provided details of the Strategic Road Improvements (SRIs).

2.1.2 The Regional Strategic Transport Network Transport Plan (RSTN TP) 2015 highlights that SRIs have a key role to play in delivering a modern, safe and sustainable transport system for Northern Ireland. It envisaged significantly increased investment in SRIs to remove bottlenecks on the key network where lack of capacity is causing serious congestion, and to improve the environment by providing bypasses to towns situated on the RSTN, relieving the effects of heavy through traffic.

2.1.3 The A24 Ballynahinch Bypass is identified in the RSTN TP as a proposed SRI scheme on the Trunk Road Network.

2.1.4 The Investment Delivery Plan (IDP) for Roads notes that the strategic road network is the main transport network of the region and connects all the main centres of economic and social activity. It notes that the SRI Programme aims to develop the strategic road network, targeting bottlenecks, in order to make all areas of the Province readily accessible to the Regional Gateways and the Belfast Metropolitan Area.

2.1.5 The IDP (Roads) defines a 10-Year Forward Planning Schedule that contains a number of schemes, including the A24 Ballynahinch Bypass as a 4.1km single carriageway bypassing Ballynahinch and incorporating climbing lanes which, together with those schemes in the Preparation Pool, could be started within the next 10 years, subject to satisfactory economic and other appraisals, availability of funding, and satisfactory progression through the statutory processes.

2.2 Specific Transport Needs and Objectives

2.2.1 The A24 is on the T2 Trunk Road linking the Belfast Metropolitan Area to Newcastle and is of strategic importance. The route currently passes through the centre of Ballynahinch and the local urban road network and junctions.

2.2.2 Operating conditions in Ballynahinch are such that road users experience significant delays and congestion especially during periods of peak traffic demand due to the combined effects

of strategic through-traffic travelling north/south through Ballynahinch and local traffic movements within the town centre.

2.2.3 This conflict between strategic and local traffic movements impacts on both journey times and journey time reliability.

2.2.4 The specific transport objectives developed for the A24 Ballynahinch Bypass are:

- To reduce journey times for strategic A24 traffic in the opening year;
- To improve journey time reliability for strategic A24 traffic in the opening year;
- To contribute positively to transport economic efficiency;
- To contribute positively to road safety;
- To minimise the impact of the scheme on the environment; and
- To achieve value for money.

2.3 Scheme Development and Reporting

2.3.1 The Stage 1 Scheme Assessment completed in May 2007 considered three bypass corridors, one to the west and two to the east, around Ballynahinch for strategic traffic on the mainly north/south A24 route.

2.3.2 The Stage 1 Preliminary Options Report recommended that TransportNI proceed with a Stage 2 Assessment in accordance with DMRB TD37/93 within the eastern corridor route Option A.

2.3.3 The Stage 2 Assessment completed in January 2012 considered three route alignments, referred to as the Red, Blue and Yellow Route options, within the eastern corridor.

2.3.4 The Stage 2 Preferred Options Report recommended that TransportNI proceed to develop a specimen design and complete a Stage 3 Scheme Assessment Report, progress the scheme through the Statutory Procedures and complete an Economic Appraisal Report in accordance with RSPPG_E030 based on the Red Route option. It was also recommended that TransportNI should consider the provision of a junction with the B7 Crossgar Road.

2.3.5 The Stage 3 Scheme Assessment Report completed in March 2015 indicated that the Proposed Scheme would provide a good economic return and concluded that implementation of the Proposed Scheme will greatly improve conditions for both strategic and local road users by enhancing the transport network.

3. EXISTING CONDITIONS

3.1 Existing Conditions

3.1.1 The existing A24 is on the T2 Trunk Road linking Belfast and Newcastle and passes through the centre of Ballynahinch in an approximate north/south direction as shown in Figure 3.1.

3.1.2 Operating conditions in Ballynahinch are such that road users experience significant delays and congestion especially during periods of peak traffic demand due to the combined effects of strategic through-traffic and local traffic movements within the town centre.

3.1.3 The study area for the traffic and economic assessment, which extends from Belfast Road to the north of Ballynahinch to Drumaness Road to the south of Ballynahinch, was defined to encompass the Proposed Scheme being considered.

3.1.4 General location plans of the main roads and streets within the Ballynahinch area are shown in Figures 3.2 and 3.3 respectively.

4. TRAFFIC SURVEYS AND DATA COLLECTION

4.1 Data Collection Surveys

4.1.1 A detailed programme of data collection surveys was undertaken within the study area in 2013 to assist in establishing current traffic volumes and vehicle proportions at key locations, to quantify variations in hourly and daily traffic demand, to establish queues and delays experienced by road users, and to estimate current vehicle speeds and journey times in the study area. Through the collection and analysis of this information, the prevailing traffic demand, trip patterns and operating conditions in the study area have been established.

4.1.2 In summary, the surveys included the following:

- Manual Classified Counts;
- Queue Surveys;
- Automatic Traffic Counts;
- Journey Time Surveys; and
- Vehicle Registration Number Surveys.

4.2 Manual Classified Counts

4.2.1 Manual Classified Counts (MCCs) were undertaken at fourteen locations within the study area on Tuesday 24 September 2013 to define current traffic volumes and turning movements.

4.2.2 The locations of the MCCs are shown in Figure 4.1.

4.2.3 The MCC data for each site were collected in 15-minute intervals between 07:00 hours and 19:00 hours over the survey period to provide a 12-hour record of turning movements.

4.2.4 The results from the MCC Surveys are summarised in Table 4.1.

Table 4.1: Summary of 12-hour Traffic Volumes – Town Centre MCC Sites

Site	Description	Total Flow
J1	High Street/Church Street/Dromore Street	18,676
J2	High Street/Windmill Street	20,976
J3	Main Street/High Street/Lisburn Street	17,542
J4	Main Street/Harmony Way	18,493
J5	Harmony Way/Windmill Street	13,680

4.3 Queue Surveys

4.3.1 Queue length surveys were undertaken at three locations within the study area on Tuesday 24 September 2013 to assist in establishing operating conditions on the approach roads to Ballynahinch and within Ballynahinch town centre. The queue length surveys were undertaken at the following locations:

- Q1 – High Street/Church Street/Dromore Street;
- Q2 – High Street/Windmill Street; and
- Q3 – Main Street/High Street/Lisburn Street.

4.3.2 The locations of the Queue Surveys are shown in Figure 4.2.

4.4 Temporary Automatic Traffic Counts

4.4.1 Six temporary Automatic Traffic Counters (ATCs) were installed during the survey period at key locations in the study area to define directional, hourly and daily variations in traffic flows.

4.4.2 The locations of the temporary ATC Sites are shown in Figure 4.3.

4.4.3 The temporary ATCs provide a record of traffic flows over a two week period between Saturday 14 September and Friday 27 September 2013.

4.4.4 The results from the temporary ATC Sites during the week of the MCC survey are summarised in Table 4.2.

Table 4.2: Temporary Automatic Traffic Count Results

ATC Site	5-Day Average 12-Hour Traffic Flow	5-Day Average 24-Hour Traffic Flow	7-Day Average 24-Hour Traffic Flow
ATC 1 - Belfast Road	9,897	12,170	11,672
ATC 2 – Crossgar Road	3,374	4,021	3,694
ATC 3 – Church Road	13,666	16,819	16,167
ATC 4 – Dromore Road	2,712	3,252	2,995
ATC 5 – Ballynahinch Road	3,011	3,505	3,284
ATC 6 – Magheraknock Road	4,451	5,468	5,185

4.4.5 Comparison of the temporary ATC 12-hour 2-way flows recorded on the same day of the MCC survey on Tuesday 24 September 2013 indicates that the ATC flows recorded at ATC Sites 1 to Site 4 are within 4% of the MCC flows recorded at the neighbouring junctions. This demonstrates a high degree of correlation between the survey data.

4.5 Permanent Automatic Traffic Counts

4.5.1 In addition to the temporary ATCs, TransportNI maintains a system of permanent ATCs across the trunk road network, one of which is located on the A24 Belfast Road to the north of Ballynahinch and is a suitable source of long-term traffic flow data.

4.5.2 The location of the permanent ATC is shown in Figure 4.4.

4.5.3 A summary of the two-way average daily traffic flows in August and September in 2010 is shown in Table 4.3**.**

Table 4.3: Summary of 2010 Two-Way Monthly Average Daily Traffic Flows

Month	Flow	Factor Relative to AADT
August	9,624	1.08
September	8,996	1.01
AADT	**8,890**	**-**

4.5.4 Examination of the average monthly traffic flows recorded in 2010 on the A24 Belfast Road to the north of Ballynahinch indicates the peak traffic volumes occur in August when the traffic flow is 8% higher than the annual average daily traffic flow.

4.5.5 The data shown in the above table also demonstrates that the data collected during the surveys in late September are likely to be representative of annual average traffic conditions in Ballynahinch.

4.6 Journey Time Surveys

4.6.1 A survey of current journey times was undertaken along two main routes through Ballynahinch town centre. The first route travelled north/south through the town and the second route, which was sub-divided into four sections, travelled east/west through the town.

4.6.2 The limits of the journey time survey and the locations of the measurement points of the routes are shown in Figures 4.5 and 4.6.

4.6.3 The surveys were carried out on Tuesday 24 and Wednesday 25 September 2013 using one survey vehicle. Various runs were carried out for the two journey time survey routes between 07:00 hours and 19:00 hours to record variations in journey times throughout the day.

4.6.4 The three survey periods were as follows:

- AM Peak Period: 07:00 hours - 10:00 hours;
- Interpeak Period: 11:00 hours – 15:00 hours; and
- PM Peak Period 16:00 hours – 19:00 hours.

4.6.5 The results of the Journey Time Surveys for Route 1 are summarised in Table 4.4.

Table 4.4: Summary of Journey Time Survey Results

Time Period	Length (km)	Route 1 (Southbound) Average Speed (mph / kph)	Route 1 (Northbound) Average Speed (mph / kph)
Full Day	8.8	36 mph / 58 kph	33 mph / 52 kph

4.6.6 The results from the Journey Time Surveys for the main A24 route are shown in Figures 4.7 and 4.8 for the southbound and northbound directions of travel respectively.

4.6.7 These Figures illustrate the contrast in operating conditions along the A24 where average speeds on the rural sections are approximately 53mph but reduce significantly in the town centre to approximately 15mph.

4.6.8 During periods of high traffic demand which coincide with special events held in the vicinity of the Ballynahinch study area, road users can experience significant additional delays and congestion relative to typical operating conditions within Ballynahinch town centre and on the approach roads to Ballynahinch. During the Festival of Flight event, held in Newcastle in August 2013, a significant southbound queue length was observed extending from Ballynahinch town centre to the A24/Saintfield Road junction with an associated reduction in journey times.

4.7 Vehicle Registration Number Surveys

4.7.1 A vehicle registration number survey was undertaken to define travel patterns through the town and to assist in estimating the volume of traffic that could potentially transfer to the proposed A24 Ballynahinch Bypass.

4.7.2 The survey was undertaken on Tuesday 24 September 2013 at the following locations:

- R1/2 – A24 Belfast Road;
- R3/4 – Crossgar Road;
- R5/6 – A24 Church Road;
- R7/8 – Dromore Road;
- R9/10 – Ballynahinch Road; and
- R11/12 – Magheraknock Road.

4.7.3 Vehicle registration numbers were recorded in both directions at the above sites for a period of 12 hours from 07:00 hours to 19:00 hours to provide a record of traffic patterns along the key routes likely to be affected by the Proposed Scheme.

4.7.4 Examination of the results from the survey indicates that the registration numbers of 98% of all vehicles that passed the survey points on the key routes into Ballynahinch were recorded. Due to the high sample rate achieved, the results can be considered with a high degree of confidence.

4.7.5 The results of the Vehicle Registration Number Surveys for Site R2 (Belfast Road) and Site R5 (Church Road) on the A24 to the north and south of Ballynahinch respectively are summarised in Table 4.5.

Table 4.5: Summary of Vehicle Registration Number Survey Results

Site	Traffic Flow	Recorded Reg. No	Achieved Sample (%)	Unmatched Reg. No.	Matched Reg. No.	Matched Trips (%)
R2 – S/b	4,261	4,240	99.5%	1,725	2,515	59.3%
R5 – N/b	6,528	6,165	94.4%	2,305	3,860	62.6%

4.7.6 The locations of the vehicle registration survey points and the overall trip patterns derived for vehicle registration number sites R2 and R5 are shown diagrammatically in Figures 4.9 and 4.10 respectively.

4.7.7 This information is summarised in Table 4.6 for Sites R2 (Belfast Road) and R5 (Church Road), and highlights the number of trips which were matched passing through Ballynahinch in less than 30 minutes.

Table 4.6: Summary of Vehicle Registration Number Survey Results

Site	Total Matched Reg. No.	Matched Trips <30 mins	Matched Trips <30 mins (%)
R2 – S/b	2,515	2,174	86.4%
R5 – N/b	3,860	3,427	88.8%

4.7.8 The distribution of trip destinations derived from the analysis of all vehicles over the full 12-hour survey period are shown in Table 4.7 for Sites R2 and R5 for matched trips less than 30 minutes.

Table 4.7: Summary of Vehicle Registration Number Survey Results < 30 minutes

	Destination						
Origin	**1**	**4**	**6**	**7**	**9**	**11**	**Total**
R2 – S/b	279 (13%)	79 (4%)	1,546 (71%)	158 (7%)	77 (4%)	35 (2%)	**2,174 (100%)**
R5 – N/b	1,598 (47%)	90 (3%)	352 (10%)	147 (4%)	233 (7%)	1,007 (29%)	**3,427 (100%)**

4.7.9 Examination of the results from the registration number survey at R2 (Belfast Road) indicates that of the 2,174 southbound matched vehicle registration numbers that passed through the site within 30 minutes of travel time during the 12-hour survey period, some 1,546 (71%) trips were matched at R6 (Church Road).

4.7.10 The 1,546 matched trips equates to 36% of the total 4,240 vehicles observed at Site R2.

4.7.11 Examination of the results from the registration number survey at R5 (Church Road) indicates that of the 3,427 northbound matched vehicle registration numbers that passed through the site within 30 minutes of travel time during the 12-hour survey period, some 1,598 (47%) were matched at R1 (Belfast Road).

4.7.12 The 1,598 matched trips equates to 26% of the total 6,165 vehicles observed at Site R5.

4.7.13 The locations of the vehicle registration survey points and the overall trip patterns derived for the six vehicle registration number sites are shown diagrammatically in Figure 4.11. This Figure highlights the volume of strategic trips passing through Ballynahinch.

5. THE PROPOSED SCHEME

5.1 Description of the Proposed Scheme

5.1.1 The Proposed Scheme involves the provision of a new 3.1km bypass to the east of Ballynahinch which will allow strategic through-traffic using the A24 to bypass the town. The scheme includes a new 66m diameter Saintfield Road Roundabout at the northern end of the scheme with a 660m (approx.) southbound differential acceleration lane to allow overtaking of slow moving vehicles, a grade-separated junction at Crossgar Road to allow access to the local road network and a new 62m diameter Downpatrick Road Roundabout at the southern end of the scheme with an 880m (approx.) northbound wide single 2+1 carriageway.

5.1.2 The general layout of the Proposed Scheme is shown in Figure 5.1.

5.2 Costs, Risks and Optimism Bias

5.2.1 Detailed cost estimates were prepared for the Proposed Scheme. These costs, which are based on current rates, were used to define both the total construction cost and total land cost of the Proposed Scheme.

5.2.2 A summary of the estimated costs of the Proposed Scheme in Q4 2014 prices is shown in Table 5.1.

Table 5.1: Estimated Proposed Scheme Cost Summary

Item	Scheme Cost (£m's)
Total Construction Cost	£30.787
Total Land Cost	£6.587
Preparation (6% of Total Construction and Land Cost)	£2.242
Supervision (5% of Total Construction and Land Cost)	£1.869
Total Scheme Cost	£41.484

Note: All costs are in Q4, 2014 prices and exclude VAT.

5.3 Assessment of Risk

5.3.1 An investigation of prevailing rates was undertaken to establish reasonable costs for the Proposed Scheme including an assessment of risk. The work undertaken to date is therefore considered to be sufficient to establish reasonable rates for cost estimating purposes.

5.3.2 A risk workshop was undertaken in September 2013 to focus on project risk and value engineering for the Proposed Scheme.

5.3.3 A risk review workshop was undertaken in December 2014 involving key representatives from all disciplines. Based on the results and conclusions of the workshop, an appropriate allowance for risk was determined for the Proposed Scheme.

5.4 Optimism Bias

5.4.1 As there is a tendency for project appraisers to be overly optimistic when assessing total scheme costs, optimism bias has been included in the appraisal to increase the capital expenditure estimate of the Proposed Scheme in accordance with the operational advice concerning H.M. Treasury's New Green Book on Appraisal and Evaluation in Central Government and the relevant Transport NI Policy and Procedures Guides.

5.4.2 As schemes progress through the various stages from the identification of a general corridor to the development of various route options and finally the selection of the Proposed Scheme, the level of optimism bias is likely to reduce accordingly.

5.4.3 Current Transport NI guidance recommends that the costs used in the economic assessment of schemes include an upper bound allowance. At this stage of the project, an allowance of 18% for optimism bias has been used in the economic assessment of the Proposed Scheme.

5.4.4 A summary of the estimated costs in Q4 2014 Prices, excluding VAT but including 18% optimism bias is shown in Table 5.2.

Table 5.2: Estimated Proposed Scheme Cost Summary, Including 18% Optimism Bias

Item	Scheme Cost (£m's)
Total Construction Cost	£36.328
Total Land Cost	£7.772
Preparation (6% of Total Construction and Land Cost)	£2.646
Supervision (5% of Total Construction and Land Cost)	£2.205
Total Scheme Cost	£48.951

Note: All costs are in Q4, 2014 prices and exclude VAT.

5.5 Cost Profile

5.5.1 For the purpose of the economic assessment, the cost profile shown in Table 5.3 has been adopted.

5.5.2 The Proposed Scheme is based on a one and a half year construction period commencing in 2017 with a 2019 Opening Year.

Table 5.3: Proposed Scheme Cost Profile

Year	Cost Profile	
	Construction	Land
2017	29%	100%
2018	68%	0%
2019	3%	0%

Note: The construction cost profile is based on a typical profile with a 1.5 year construction period.

6. DEVELOPMENT OF COMPUTER MODELS

6.1 Overview

6.1.1 The quantitative assessment of the transport economic efficiency and road safety aspects of a proposed road improvement scheme requires the development and application of various computer models. In the case of the A24 Ballynahinch Bypass, this has involved the development of a COBA (Cost Benefit Analysis) model.

6.2 The COBA Model

6.2.1 COBA is the standard computer model introduced in the 1970s to examine proposed investments in the trunk road network by comparing the costs of the road scheme with the associated road user benefits. The procedures for developing and applying the COBA model are set out in the Design Manual for Roads and Bridges (DMRB) Volume 13.

6.2.2 The geographical area of the model, which extends from Belfast Road to the north of Ballynahinch to Drumaness Road to the south of Ballynahinch, was defined to encompass the Proposed Scheme.

6.2.3 The A24 Ballynahinch models are based on the 12-hour traffic flows and turning movements observed in September 2013.

6.2.4 The assessment is based on standard COBA default values where these are considered appropriate. For example, the default proportion of in-work trips has been adopted and default accident rates have been applied to both the Do-Minimum and Do-Something networks.

6.3 The Do-Minimum Network

6.3.1 The Do-Minimum network is the base road network against which the Do-Something network is assessed. In the case of the A24 Ballynahinch Bypass, no specific changes to the base road network have been identified and consequently the Do-Minimum network is consistent with the existing Do-Nothing network.

6.3.2 The limits of the highway network defined for the Do-Minimum model were defined to encompass the area surrounding Ballynahinch that is likely to be significantly affected by the potential reassignment of traffic on to the proposed bypass.

6.3.3 The location and identification of the various links and nodes which define the Do-Minimum network are shown in Figure 6.1.

6.4 Model Calibration and Validation

6.4.1 The Do-Minimum COBA model was calibrated by varying the characteristics of the links and junctions to obtain a reasonable representation of observed conditions.

6.4.2 In the case of the Proposed Scheme, changes in travel times between the Do-Minimum and the Do-Something networks are likely to represent the most significant change in road user economic benefits. It is therefore important to demonstrate that the Do-Minimum model provides a reasonable basis to assess transport conditions within the study area.

6.4.3 To demonstrate that the model provides a reasonable representation of existing transport conditions in the area, the observed journey times and modelled times over the proposed improvement section derived from the COBA model were compared. The results of this comparison are shown in Table 6.1.

Table 6.1: Comparison of Observed and Modelled Link Time

Improvement Section	Length (km)	Average Total Time (secs)	Average Speed (kph)	Average Speed (mph)
Observed	3.55	345	37.0 kph	23.2 mph
Modelled	3.55	357	35.8 kph	22.4 mph
Difference	-	12	1.2 kph	0.8 mph
% Difference	-	3.5%	3.5%	3.5%

6.4.4 The 3.5% correlation between the observed times and the times derived from the calibrated model, which are well within the 15% target defined in the DMRB, demonstrates that the model provides a reasonable representation of actual operating conditions on the network.

6.5 COBA Do-Something Model

6.5.1 The location and identification of the various links and nodes which define the Do-Something network are shown in Figure 6.2.

6.5.2 The volume of trips likely to transfer on to the Proposed Scheme was based on a detailed analysis of observed traffic conditions within and around Ballynahinch including an assessment of matched trips passing through Ballynahinch from the vehicle registration number survey and the observed traffic flows throughout the day of survey.

7. FUTURE CONDITIONS

7.1.1 For the purpose of the economic assessment, it has been assumed that construction of the scheme would be undertaken in 2017 and 2018, with the scheme opening in 2019. This timeframe has been adopted to provide a reasonable basis for the economic assessment of the Proposed Scheme.

7.1.2 Given the strategic nature of the A24 route, the most likely forecast of long term traffic growth within the study area for the assessment of the Proposed Scheme can be defined by the application of national forecasts of traffic growth. The National Road Traffic Forecasts (1997) have therefore been adopted to provide a reasonable estimate of long-term future traffic flows within the area over the 60 year economic assessment period.

7.1.3 Examination of the traffic flow data recorded by the permanent traffic counter located on the A24 north of Ballynahinch since 2002 provides an indication of local trends in traffic growth.

7.1.4 For the purpose of the economic appraisal of the proposed A24 Ballynahinch Bypass, it has therefore been assumed that traffic growth will generally follow National Road Traffic Forecast (NRTF) low growth projections, which equates to approximately 0.9% growth per annum over the 5-year period between 2013 and 2018. This rate of growth is generally consistent with the trends observed between 2002 and 2007 prior to the economic recession and takes into account the potential changes resulting from new developments in the Ballynahinch study area. The effects of the Proposed Scheme have also been considered under NRTF central growth projections as part of a sensitivity test.

7.1.5 The growth factors for low and central traffic growth from the 2013 Base Year to the 2019 Opening Year and the 2033 Design Year are shown in Table 7.1.

Table 7.1: NRTF Growth Factors

Period (Years)	NRTF Low Growth (Main Assessment)	NRTF Central Growth (Sensitivity Test)
2013 Base Year to 2019 Opening Year	1.06	1.08
2019 Opening Year to 2033 Design Year	1.06	1.11

8. OPERATIONAL ASSESSMENT

8.1 Traffic Flows

8.1.1 The Proposed Scheme has been developed to improve the movement of strategic traffic along the A24 transport corridor at Ballynahinch. Through the development of the COBA computer models and an estimate of the likely changes in travel patterns resulting from the provision of the Proposed Scheme, the changes in traffic flows across the network can be estimated.

8.1.2 A detailed comparison between the 2013 Base Year and 2019 Opening Year two-way 24-hour AADT traffic flows for the existing road links in both the Do-Minimum and the Do-Something networks under the NRTF low traffic growth forecast is shown in Table 8.1.

Table 8.1: Key Approach Road Traffic Flows

Approach Road	2013 Do-Min (vpd)	2019 Do-Min (vpd)	2019 Do-Som (vpd)	2019 Change (%)
Belfast Road (Link 30)	8,230	8,690	8,690	0.0%
Belfast Road (Link 40)	10,850	11,460	7,220	-37.0%
Belfast Road (Link 60)	14,050	14,840	10,600	-28.6%
Harmony Road (Link 70)	16,240	17,160	12,880	-24.9%
Windmill Street (Link 90)	14,730	15,560	13,370	-14.1%
High Street (Link 100)	19,870	21,000	16,720	-20.4%
Church Road (Link 110)	14,120	14,910	10,640	-28.6%
Drumaness Road (Link 140)	10,730	11,340	11,340	0.0%

8.1.3 Comparison of the 2019 Opening Year traffic flows for the Do-Minimum and Do-Something networks under the NRTF low traffic growth forecast indicates that traffic flows would decrease significantly along Belfast Road by approximately 37% and reduce by approximately 29% on Church Road. This level of reduction in traffic flows would result in significant improvements in traffic conditions in the area in terms of both delays and congestion.

8.1.4 The two-way 24-hour AADT traffic flows for the Do-Minimum network in the 2013 Base Year, the 2019 Opening Year and the 2033 Design Year under the NRTF low and central traffic growth forecast are shown in Figures 8.1 and 8.2 respectively.

8.1.5 The corresponding two-way 24-hour AADT traffic flows for the Do-Something network in the 2019 Opening Year and 2033 Design Year under the NRTF low and central traffic growth forecast are shown in Figures 8.3 and 8.4 respectively.

8.1.6 The differences between the two-way 24-hour AADT traffic flows for the Do-Minimum and Do-Something networks in the 2019 Opening Year under the NRTF low and central traffic growth forecast are shown in Figures 8.5 and 8.6 respectively.

8.2 Journey Times

8.2.1 Savings in journey times are generally one of the most significant benefits resulting from the provision of a new transport improvement scheme.

8.2.2 COBA considers changes in traffic conditions during the day by modelling the 8,760 hours in a year in different portions called Flow Groups (FGs). Flow Groups 1-5 represent Weekday Hours, with FG4/5 representing the busiest 2 weekday hours per day, FG3 representing the next busiest 2 weekday hours, FG2 representing the next busiest 8 weekday hours, and FG1 representing the remaining 12 weekday hours.

8.2.3 Flow Groups 6-10 represent Weekend Hours, with FG9/10 representing the busiest 2 weekend hours per day, FG8 representing the next busiest 2 weekend hours, FG7 representing the next busiest 8 weekend hours, and FG6 representing the remaining 12 weekend hours.

8.2.4 To provide a direct comparison between journey times in the Do-Minimum and the Do-Something networks in the proposed 2019 Opening Year, the average vehicle speeds for each link in the network and the corresponding junction delays along the route were extracted from the COBA models for light vehicles based on FG2 and FG4 traffic flow conditions to provide a reasonable representation of operating conditions during the inter-peak and peak period respectively.

8.2.5 The journey time routes for the Do-Minimum and Do-Something networks are shown in Figure 8.7.

8.2.6 The results of the journey time analysis are summarised in Table 8.2.

Table 8.2: Reductions in Journey Times: Flow Groups 2 and 4

Network	Dir	Flow Group 2 (Inter-Peak)		Flow Group 4 (Peak)	
		2019	2033	2019	2033
Do-Minimum (mins)	S/b	9.99	10.17	11.70	12.02
Do-Something (mins)	S/b	6.87	6.89	7.04	7.08
Time Savings (mins)	S/b	3.12	3.28	4.66	4.94
Time Savings (%)	**S/b**	**31%**	**32%**	**40%**	**41%**
Do-Minimum (mins)	N/b	9.77	9.93	11.49	11.70
Do-Something (mins)	N/b	6.74	6.77	6.93	6.96
Time Savings (mins)	N/b	3.03	3.17	4.56	4.73
Time Savings (%)	**N/b**	**31%**	**32%**	**40%**	**40%**

8.2.7 Examination of the above information indicates that the Proposed Scheme would result in significant savings in journey times for strategic A24 traffic of approximately 31% during the inter-peak period to approximately 40% during the peak period.

8.3 Do-Minimum Network Capacity

8.3.1 Based on the information obtained from the COBA models, the links and junctions that are reported as being over-capacity have been identified to provide an indication of the traffic conditions on the various networks. The assessment considers the effects of normal variations in traffic demand that occur during the day, as defined by the various Flow Groups, and the effects of growth in traffic from the 2013 Base Year to the 2019 Opening Year and the 2033 Design Year.

8.3.2 The number of over-capacity links and junctions in the Do-Minimum network under the NRTF low traffic growth forecast is summarised in Table 8.3.

Table 8.3: Number of Over-Capacity Links and Junctions: Do-Minimum Network

Year	Flow Group	Do-Minimum Network	
		Link	Junction
2013	Flow Groups 3 & 4/5	8	0
2019	Flow Groups 3 & 4/5	9	1
2033	Flow Groups 3 & 4/5	12	2

8.3.3 Examination of the above results indicates that traffic demand in 2013 under peak traffic conditions would exceed capacity on 8 links. By the 2019 Opening Year, this would increase to 9 links and 1 junction, and to 12 links and 2 junctions in 2033.

8.3.4 The locations of the links and junctions that are over-capacity under the NRTF low traffic growth forecast for the Do-Minimum Network are shown in Figure 8.8.

8.4 Do-Something Network Capacity

8.4.1 The number of over-capacity links and junctions in the Do-Something network under the NRTF low traffic growth forecast is summarised in Table 8.4.

Table 8.4: Number of Over-Capacity Links and Junctions: Do-Something Network

Year	Flow Group	Do-Something Network	
		Link	Junction
2013	Flow Groups 3 & 4/5	n/a	n/a
2019	Flow Groups 3 & 4/5	5	0
2033	Flow Groups 3 & 4/5	5	1

8.4.2 Examination of the above results indicates that traffic demand in the 2019 Opening Year under peak traffic conditions would exceed capacity on 5 links. By the 2033 Design Year, 5 links and 1 junction would exceed capacity.

8.4.3 The provision of the Proposed Scheme would therefore significantly reduce the number of over-capacity links around the centre of Ballynahinch.

8.4.4 The locations of the links and junctions that are over-capacity under the NRTF low traffic growth forecast for the Do-Something network are shown in Figure 8.9.

8.5 Road Safety

8.5.1 Given the inherent uncertainties in predicting future accident rates and casualty severities over the 60-year economic assessment period from the proposed year of opening, the COBA assessment has been based on the application of default accident rates and costs. These have been applied to both the Do-Minimum and Do-Something networks to provide a reasonable measure of the relative change in road traffic accident characteristics associated with the two networks.

8.5.2 The changes in the number of personal injury accidents and the corresponding casualty severities over the 60-year assessment period under NRTF low traffic growth forecast due to the provision of the Proposed Scheme are shown in Tables 8.5 and 8.6. The associated Present Value of Benefits is also shown in these Tables.

Table 8.5: Accident Numbers and Costs

Network	Number of Accidents			Accidents Total Cost (£m's)
	2019 Opening Year	2033 Design Year	60-Year Total	
Do-Minimum	27.5	27.6	1,654.7	108.697
Do-Something	25.1	25.1	1,503.1	100.973
Benefits	2.5	2.5	151.6	7.724

Table 8.6: Casualties by Severity

Network	Accident severity			Total Accidents
	Fatal	Serious	Slight	
Do-Minimum	24.8	217.8	2,149.0	1,654.7
Do-Something	24.4	205.1	1,956.4	1,503.1
Benefits	0.4	12.7	192.6	151.6

8.5.3 From the above information, the Proposed Scheme would save approximately 152 personal injury accidents over the 60-year period, which equates to an economic benefit of £7.7m under the NRTF low growth traffic forecast.

9. ECONOMIC APPRAISAL

9.1 COBA Appraisal

9.1.1 The economic results from the COBA model for the Proposed Scheme, based on the scheme costs defined previously including optimism bias and the application of the NRTF low traffic growth projection, are summarised in Table 9.1.

Table 9.1: COBA Proposed Scheme Appraisal Summary

Item	Do-Something Network Proposed Scheme NRTF Low Growth
Present Value of Benefits (PVB) (£m's)	£68.025
Present Value of Costs (PVC) (£m's)	£31.702
Net Present Value (NPV) (£m's)	£36.323
Benefit to Cost Ratio (BCR)	2.146

Note: results expressed in 2010 prices.

9.1.2 Based on the above assessment and the application of NRTF low traffic growth, the Proposed Scheme would provide a good economic return with a Net Present Value of £36.323m and a Benefit to Cost Ratio of 2.146.

10. SENSITIVITY TESTS

10.1 Traffic Forecast Sensitivity Tests

10.1.1 As there is an inherent degree of uncertainty in predicting long-term future traffic flows over the 60-year period of the economic assessment, a series of sensitivity tests has been undertaken to examine the extent to which the results from the COBA economic appraisals vary under various scenarios.

10.1.2 The Proposed Scheme has therefore been tested considering the effects of NRTF central growth projections from the year 2013 onwards. In addition, the Proposed Scheme has also been tested considering the effects of zero growth from the year 2013 onwards.

10.1.3 The results of the COBA sensitivity tests based on zero and central growth projections are shown in Table 10.1. The results of the main COBA run, which is based on the NRTF low growth traffic forecast, are also included for comparison.

Table 10.1: COBA Proposed Scheme Appraisal Summary – Traffic Forecast Sensitivity Tests

Item	Do-Something Network Proposed Scheme		
	NRTF Growth Projection		
	Zero Growth	Low Growth	Central Growth
Present Value of Benefits (PVB) (£m's)	£53.199	**£68.025**	£77.599
Present Value of Costs (PVC) (£m's)	£31.702	**£31.702**	£31.702
Net Present Value (NPV) (£m's)	£21.497	**£36.323**	£45.897
Benefit to Cost Ratio (BCR)	1.678	**2.146**	2.448

Note: results expressed in 2010 prices.

10.1.4 The results of the COBA traffic forecast sensitivity tests indicate that the Net Present Value of the Proposed Scheme improves as the level of future traffic growth increases and that the Proposed Scheme provides a good economic return under a range of future traffic growth forecasts.

11. CONCLUSIONS

11.1.1 My evidence has described the extensive data collection surveys undertaken over a period of many years throughout the progressive DMRB Stage 1, Stage 2 and Stage 3 assessments to define baseline conditions and the level of congestion within the Ballynahinch study area. In addition to describing the development, validation and application of the various industry standard computer models, my evidence has presented the results of the operational and economic assessments of the Proposed Scheme and the results of the various sensitivity tests.

11.1.2 The results of the operational assessments indicate that the Proposed Scheme would significantly reduce journey times and improve journey time reliability for strategic A24 traffic and reduce congestion in the Ballynahinch area.

11.1.3 The results of the economic assessments indicate that the Proposed Scheme would contribute positively to transport economic efficiency and road safety with an overall Net Present Value of £36.323m and a Benefit to Cost Ratio of 2.146 under the NRTF low traffic growth forecast scenario.

11.1.4 The results of the various sensitivity tests indicate that the Proposed Scheme would generate a positive Net Present Value over a range of test scenarios where the overall benefits exceed the cost of the scheme.

11.1.5 Based on the above results, it is concluded that the Proposed Scheme would improve operating conditions in the Ballynahinch area and represents good value for money.

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APPENDIX A FIGURES

List of Figures

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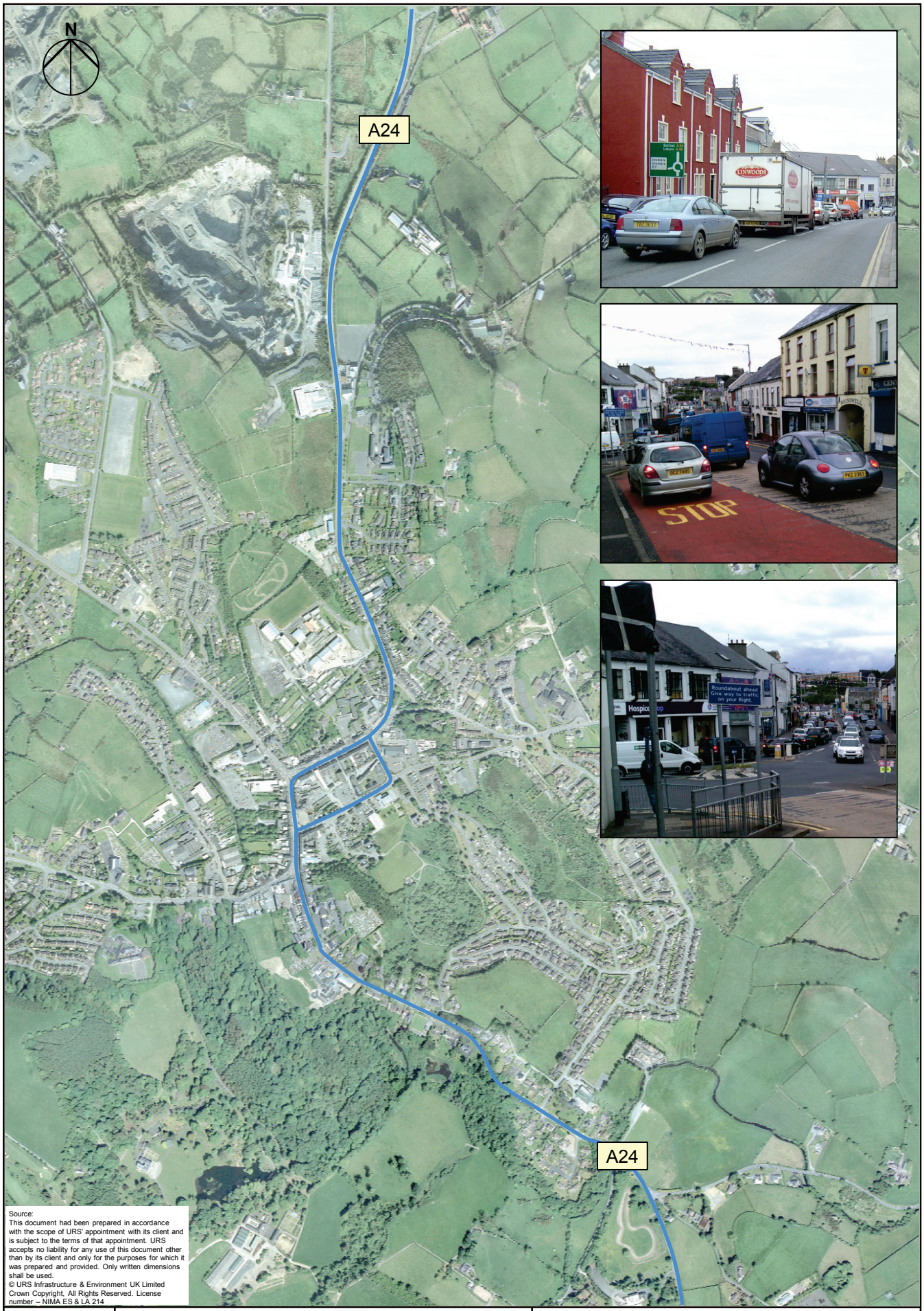

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Figure 3.1
Existing A24 Route

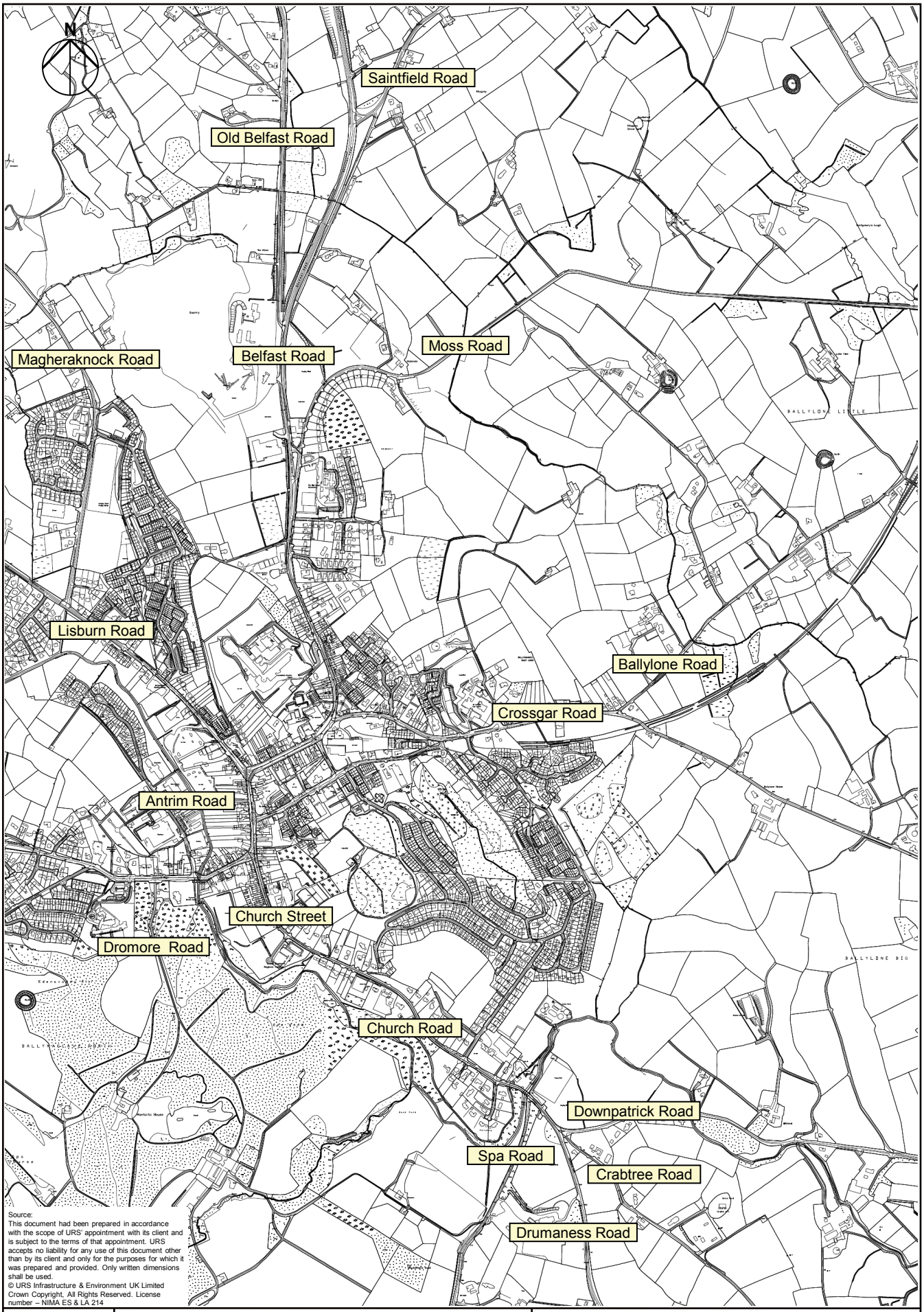

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Figure 3.2
General Location Plan

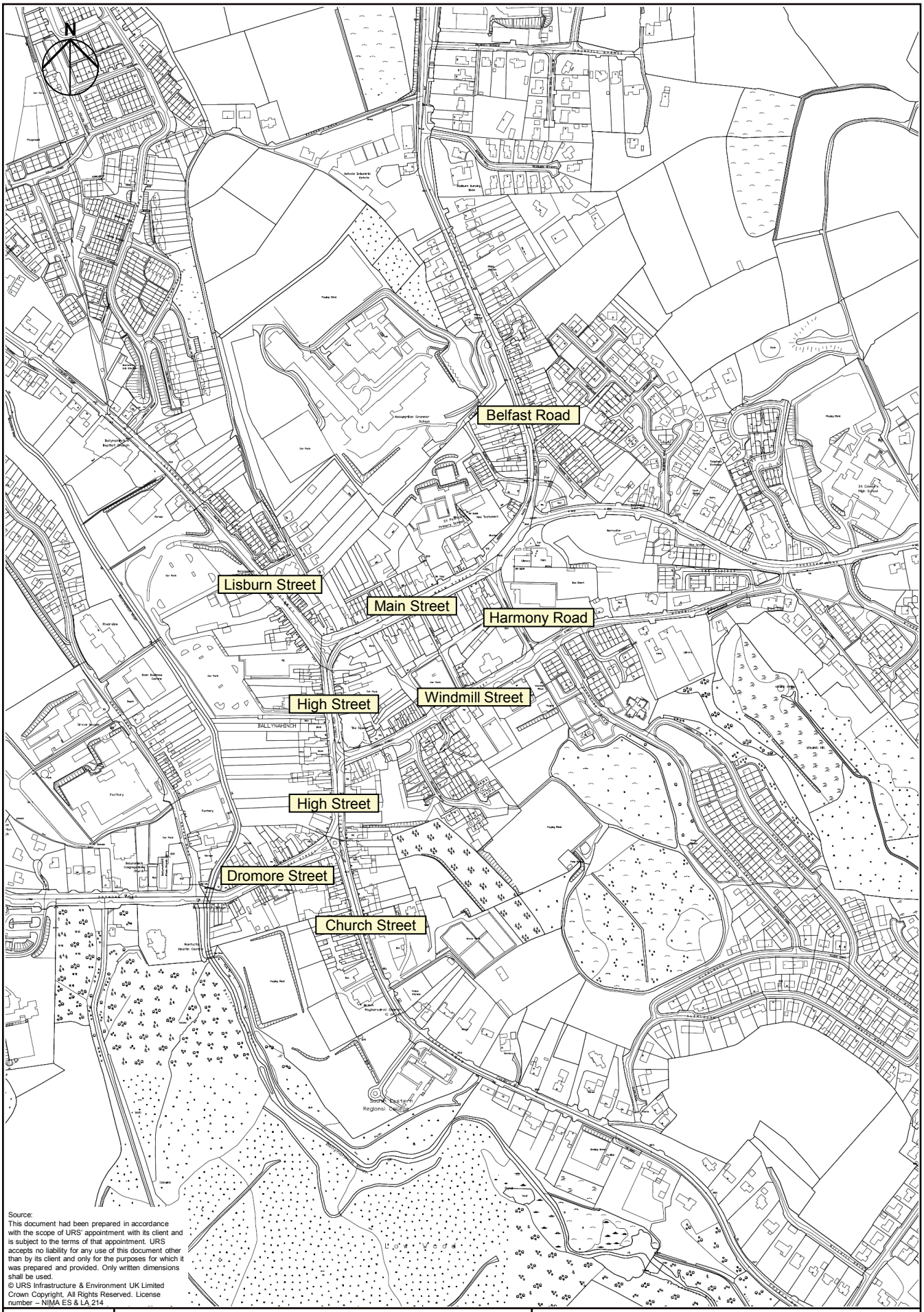

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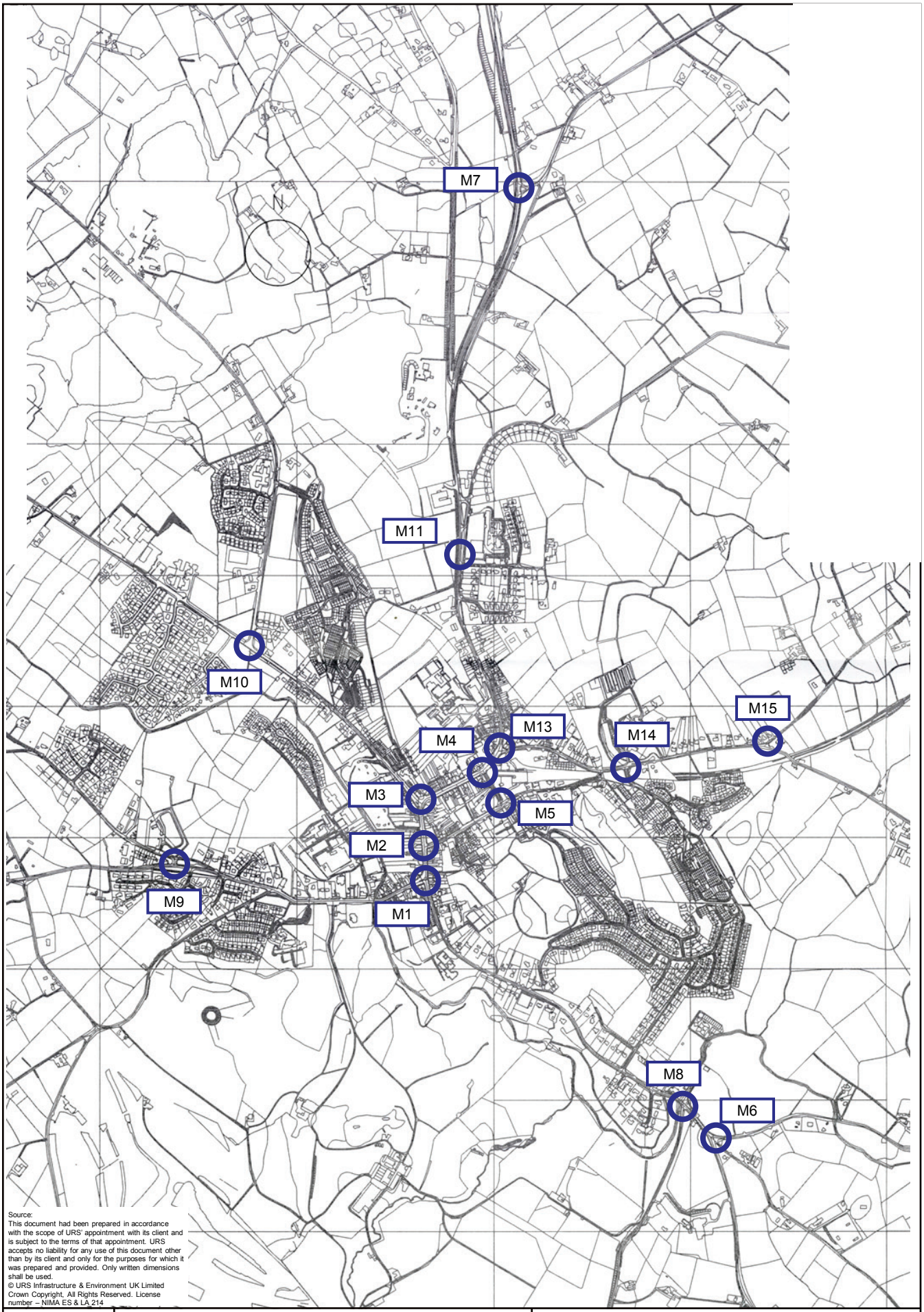
Figure 3.3
Ballynahinch Town Centre



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MCC Survey Location (Full Junction)

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Figure 4.1
MCC Survey Locations

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Queue Survey Location

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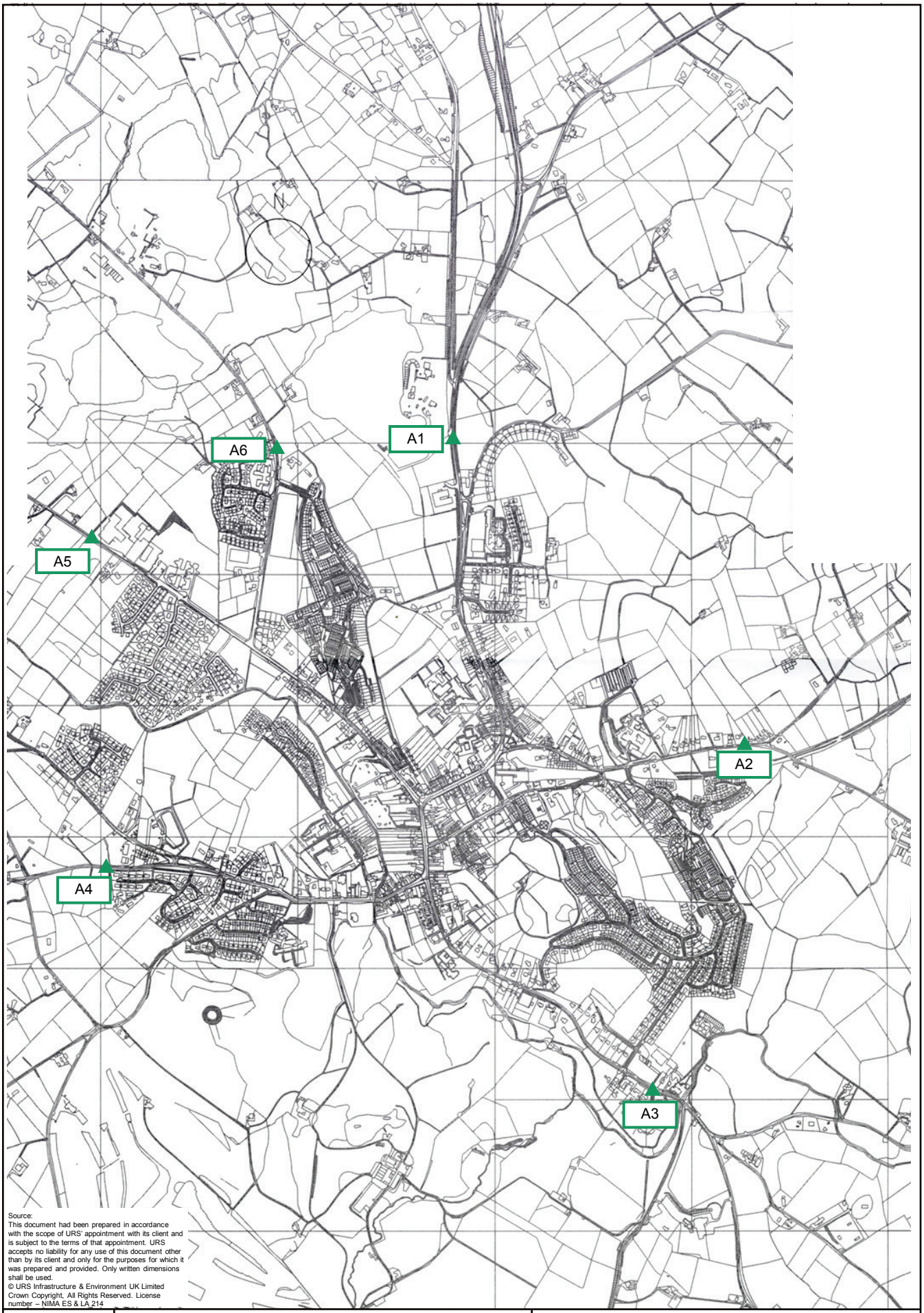
Figure 4.2
Queue Survey Locations – Approach Arms



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Notes

▲ ATC Survey Location

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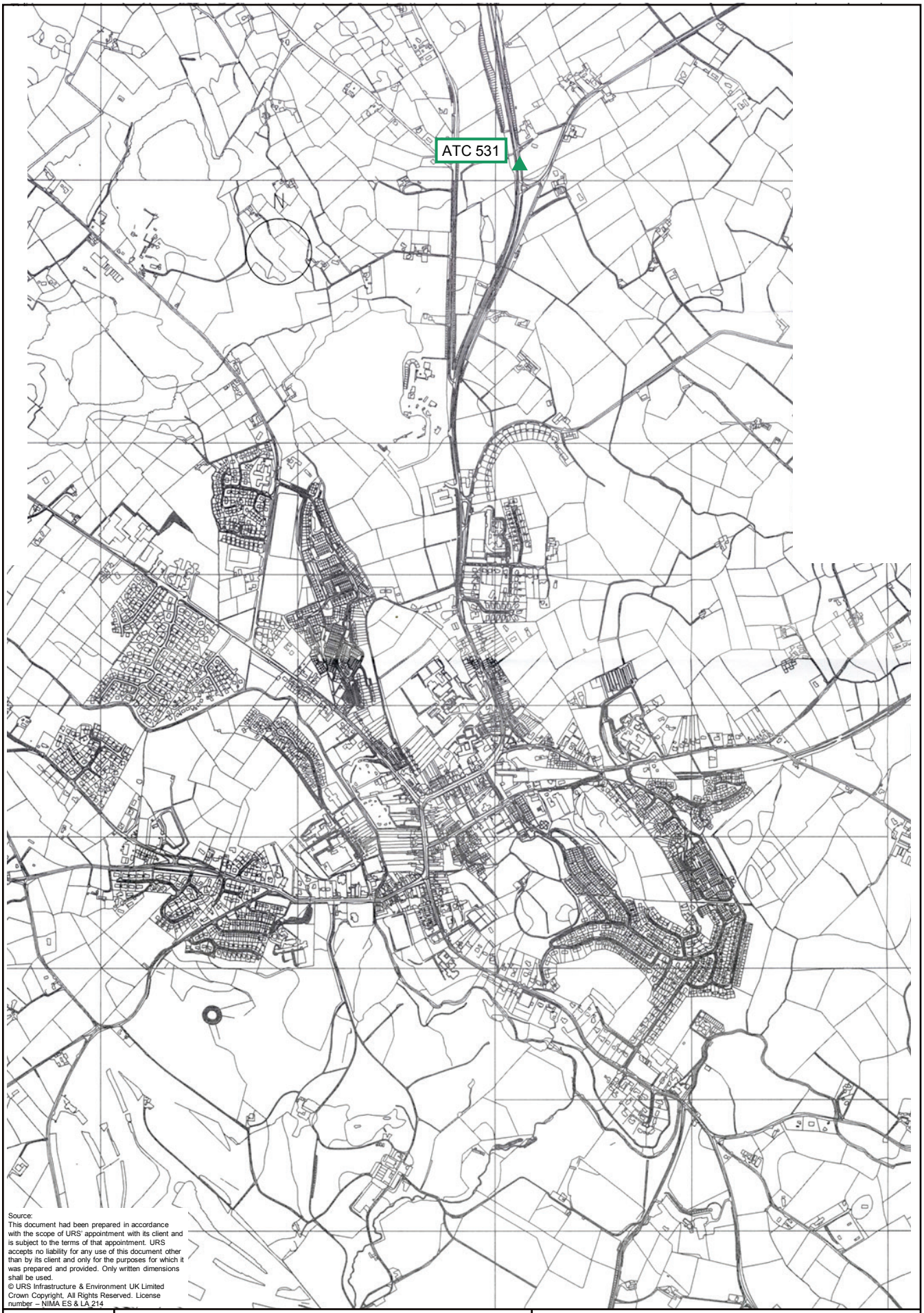
Figure 4.3
ATC Survey Locations



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▲ Permanent ATC Location

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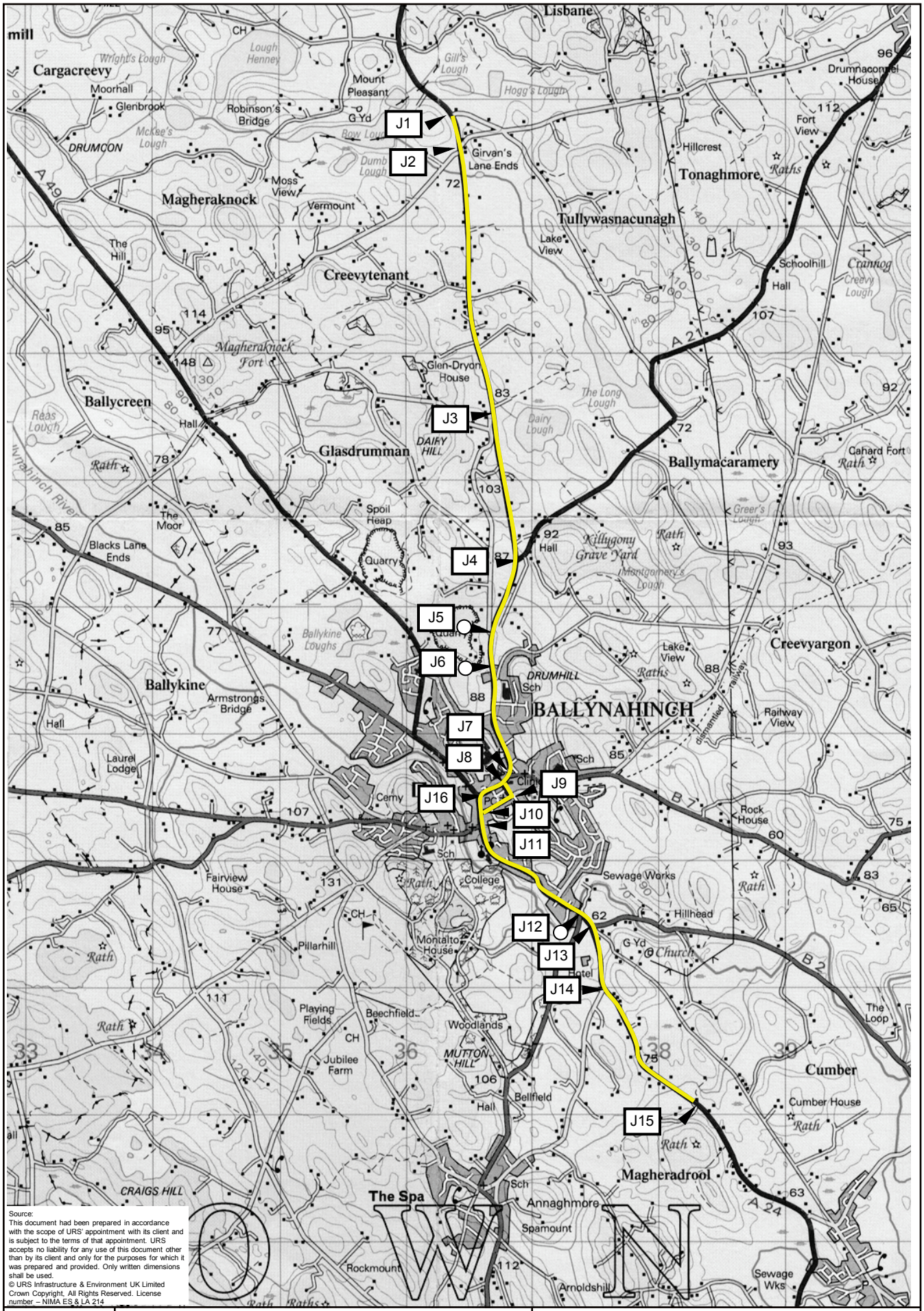
Figure 4.4
Permanent ATC Location



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Notes
- Journey Time Survey Route
- Journey Time Survey Measurement Point
- Journey Time Survey Speed Limit Measurement Point

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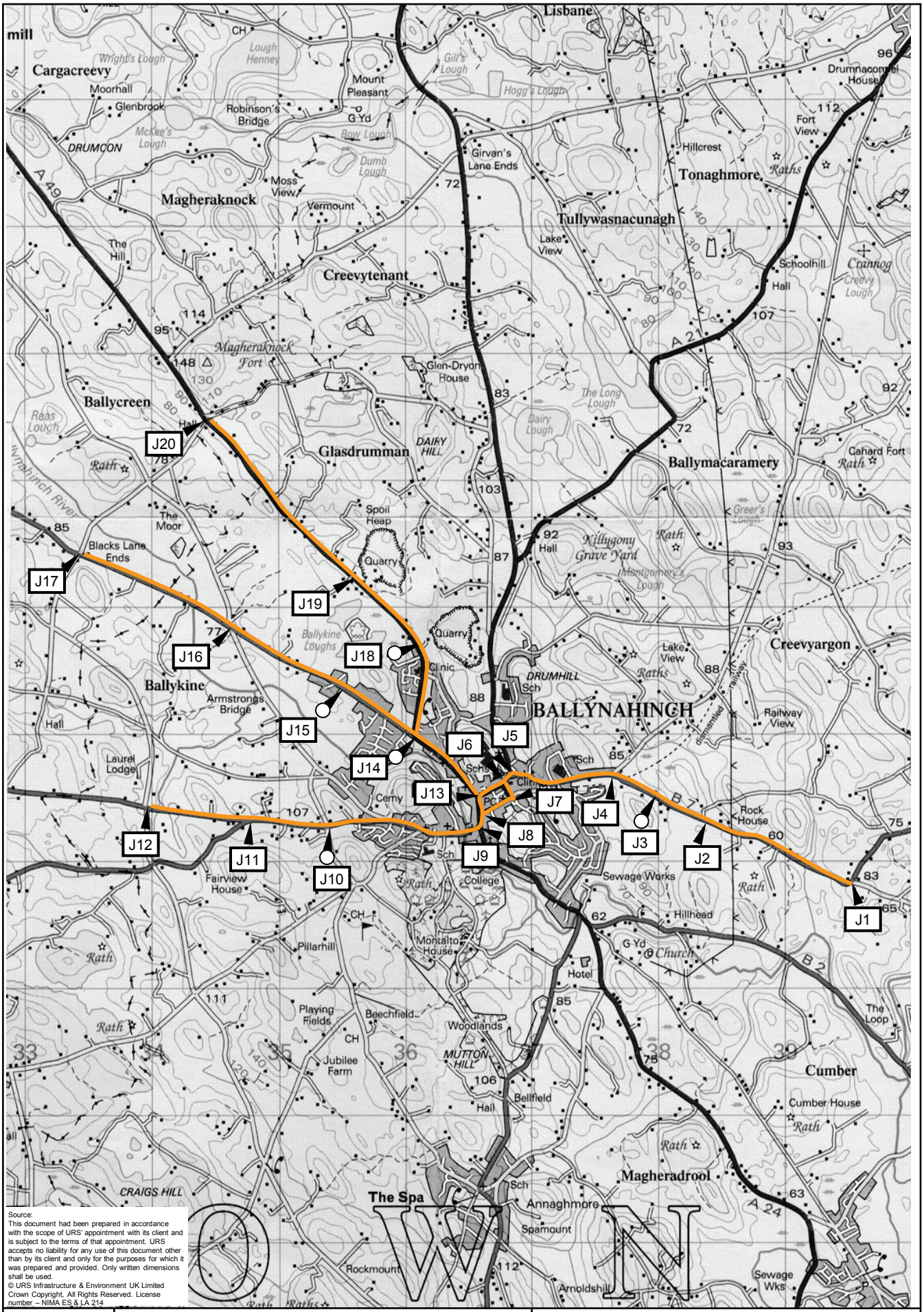
Figure 4.5
Journey Time Survey Locations – Route 1



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Notes
- Journey Time Survey Route
- Journey Time Survey Measurement Point
- Journey Time Survey Speed Limit Measurement Point

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Figure 4.6
Journey Time Survey Locations – Route 2

A24 Southbound Speeds

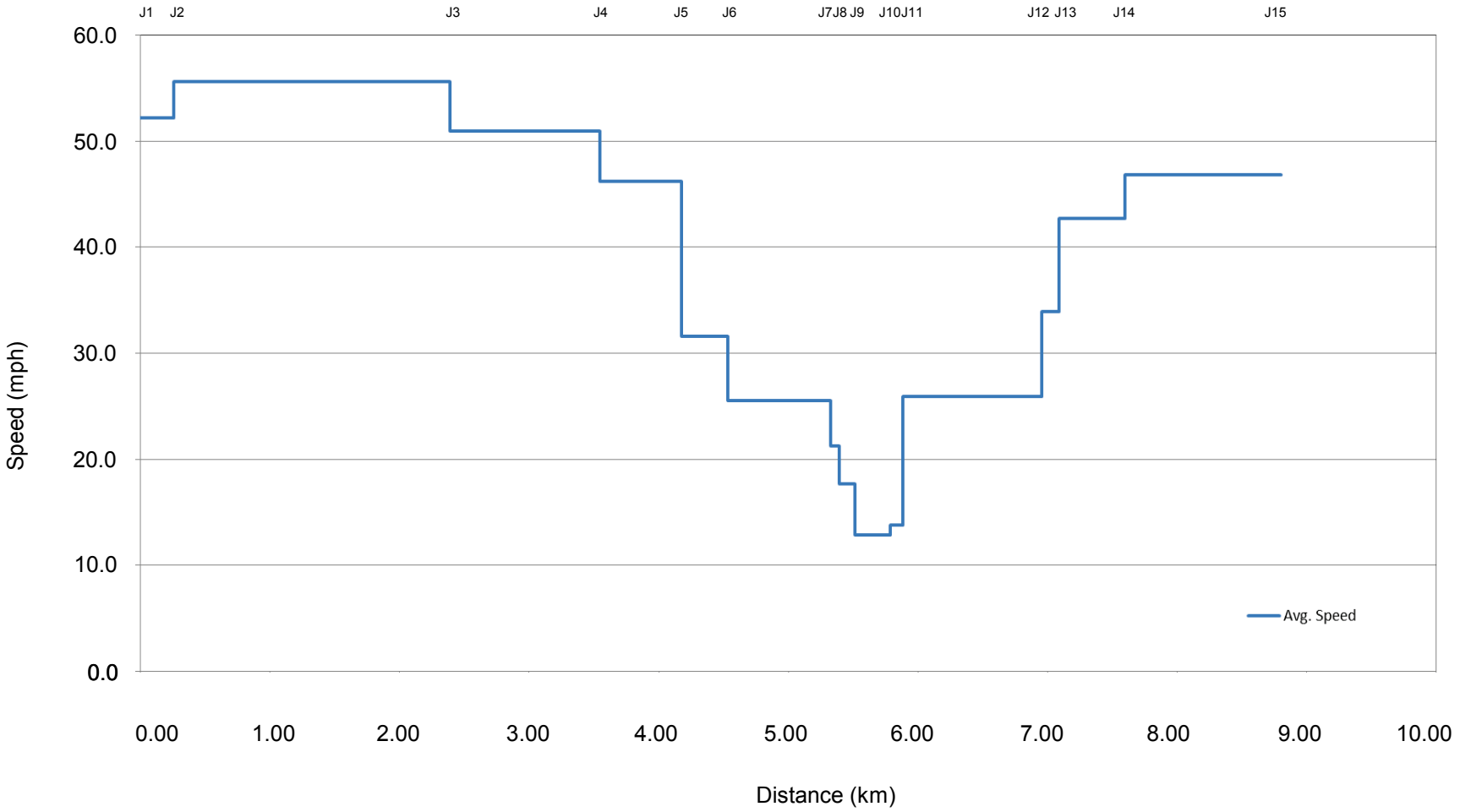

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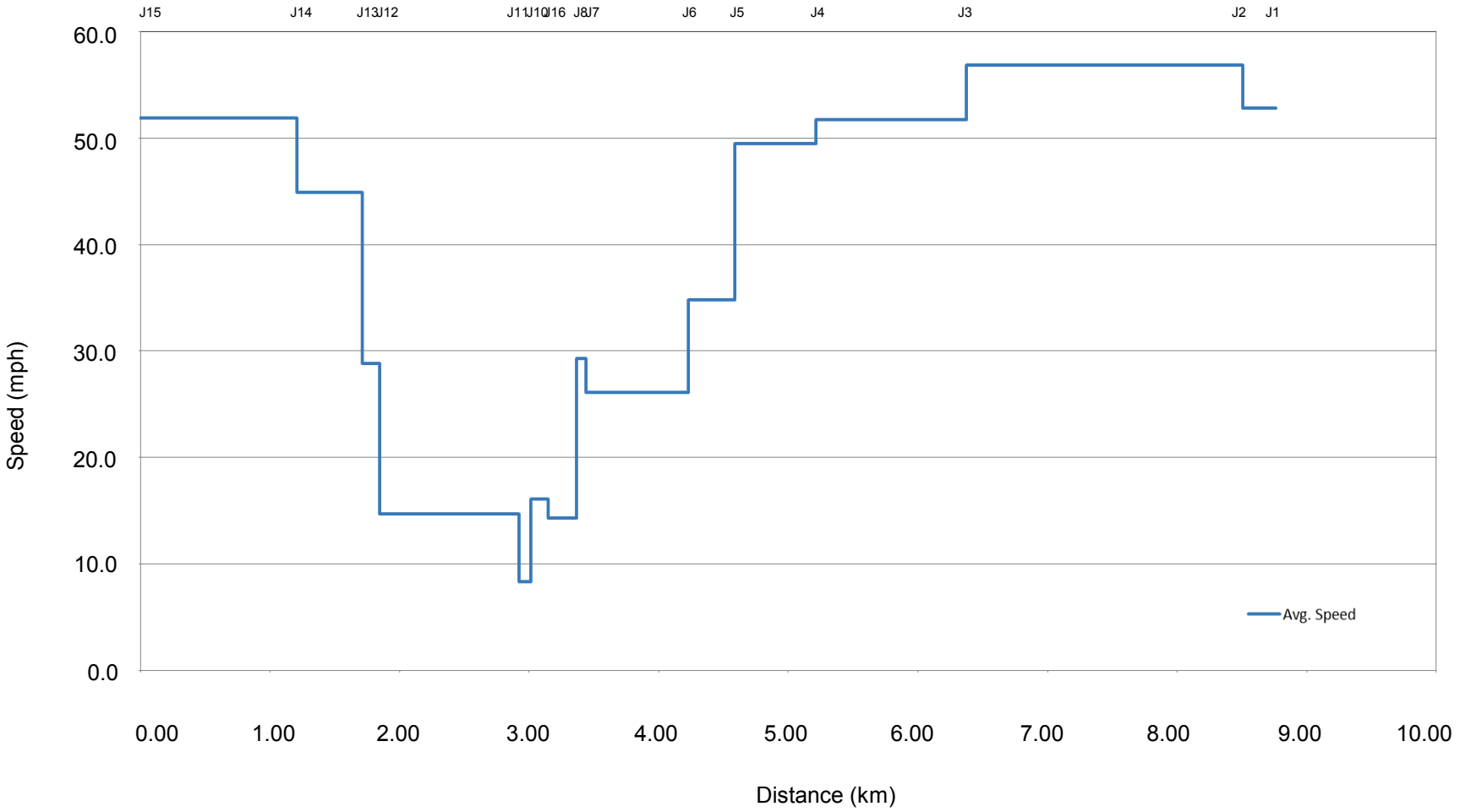
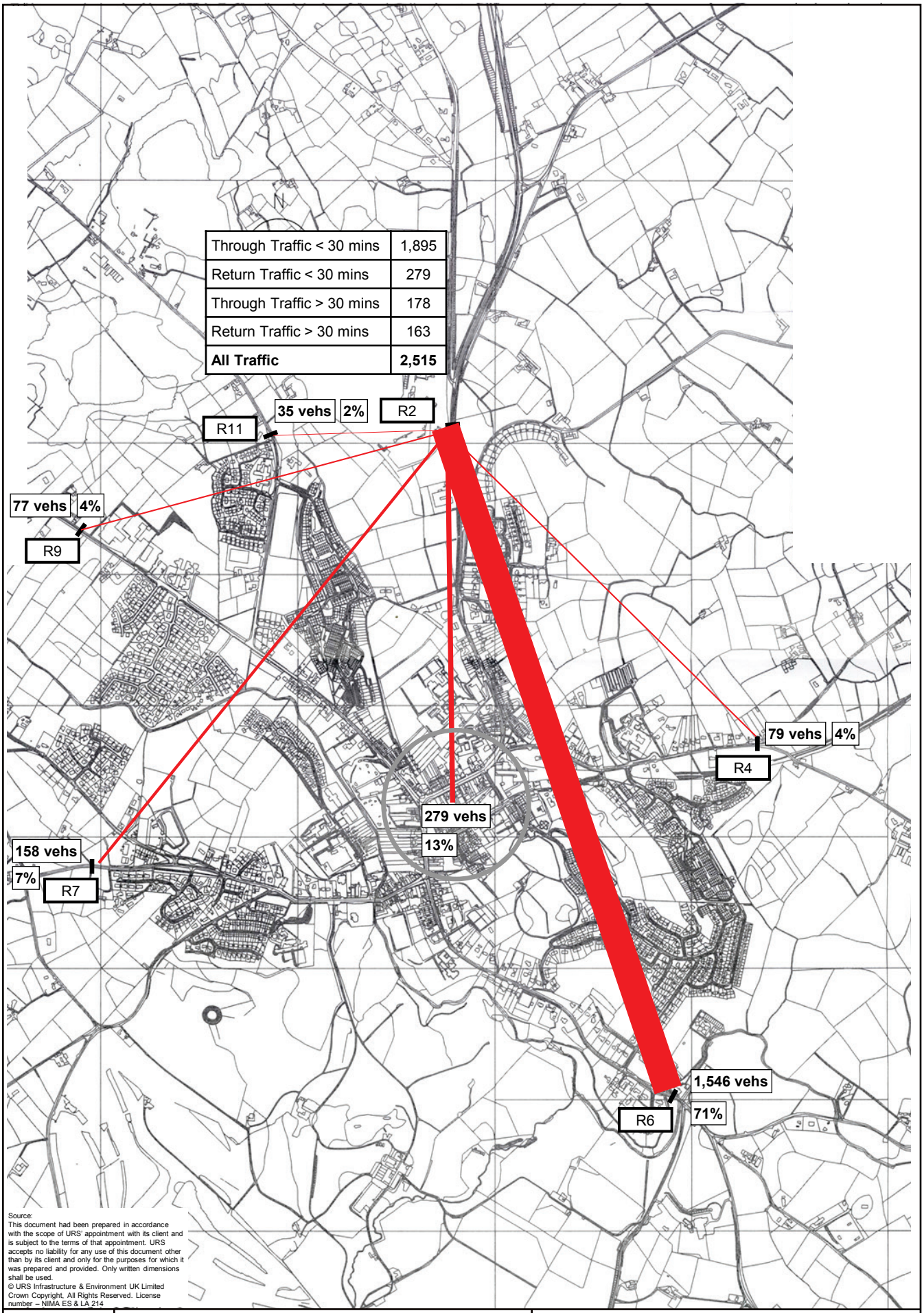
Figure 4.7
A24 Southbound Chainage Speeds (mph)
Route 1 Average Speeds

A24 Northbound Speeds



URS www.ursglobal.com		Notes	**A24 Ballynahinch Bypass – Stage 3 Proposed Scheme** **Public Inquiry – January 2016** Figure 4.8 A24 Northbound Chainage Speeds (mph) Route 1 Average Speeds



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Notes
R2 Veh Reg Survey

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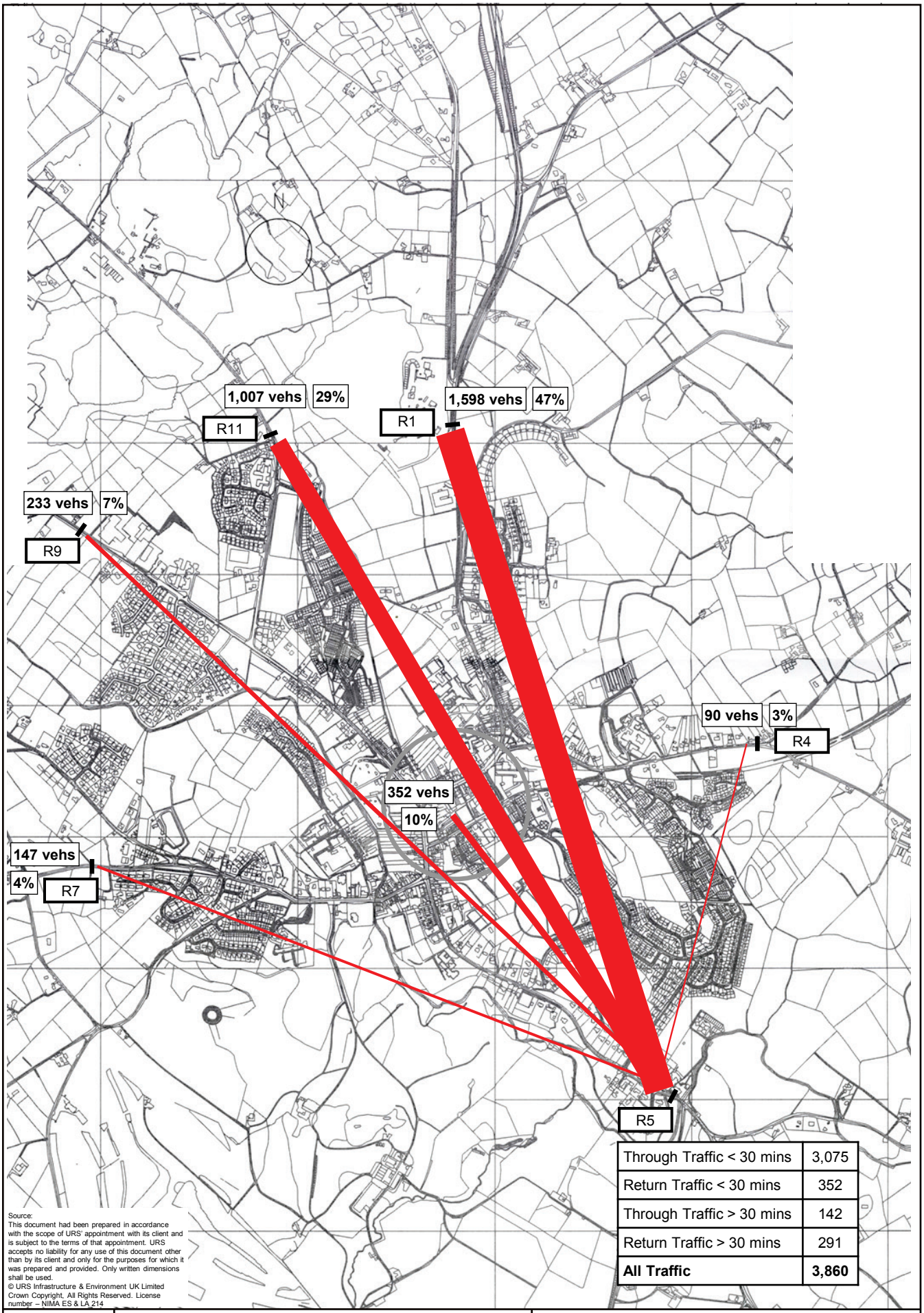
Figure 4.9
Site 2 Trip Destinations within 30 minutes



Through Traffic < 30 mins	3,075
Return Traffic < 30 mins	352
Through Traffic > 30 mins	142
Return Traffic > 30 mins	291
All Traffic	**3,860**

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Notes
R5 Veh Reg Survey

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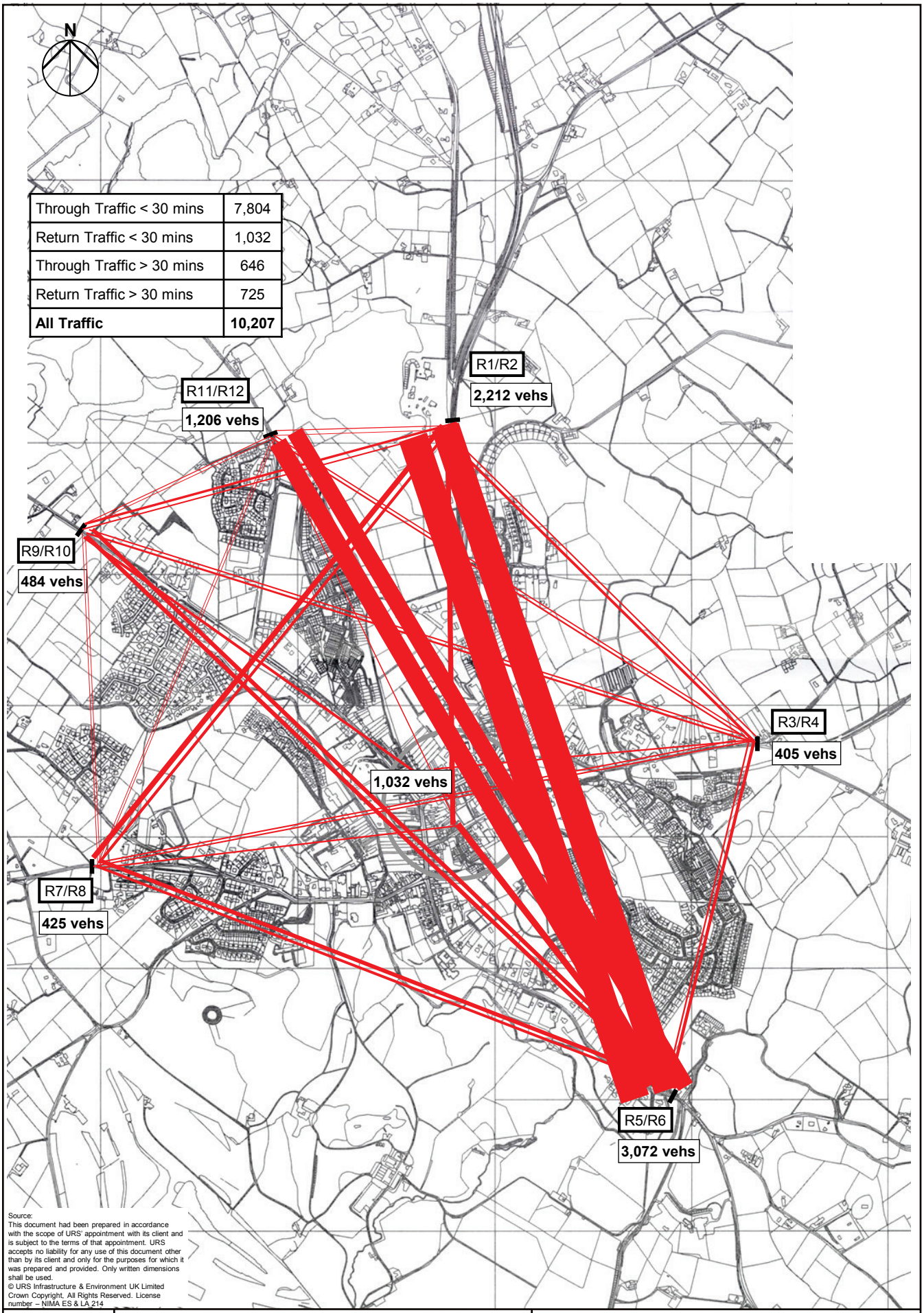
Figure 4.10
Site 5 Trip Destinations within 30 minutes



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R1 Veh Reg Survey Location

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Figure 4.11
Overall Trip Destinations within 30 minutes
Tuesday 24 September 2013

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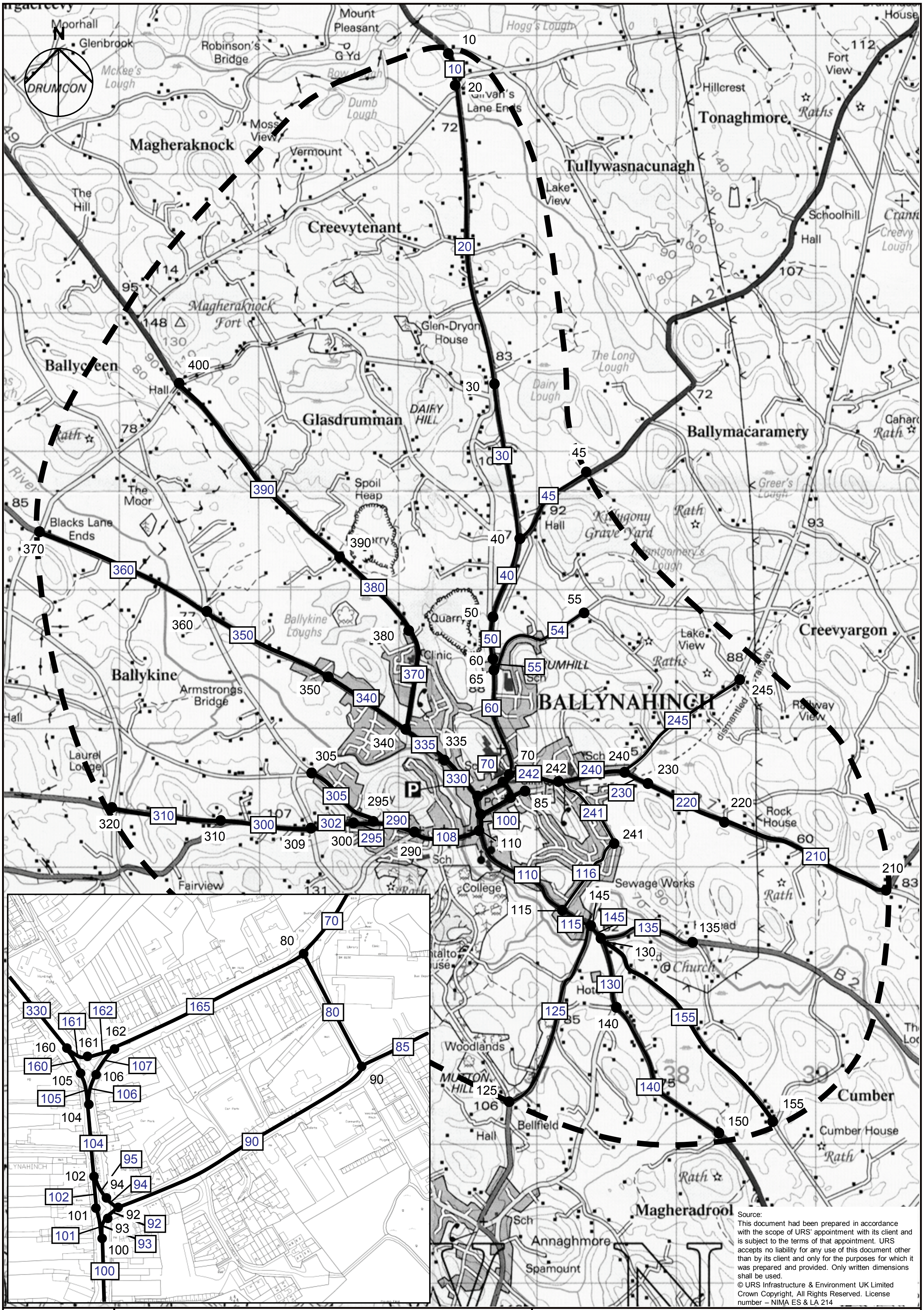
Figure 5.1
Proposed Scheme



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- — Do-Minimum Link
- ● Node Point
- **100** Node Number
- – – Study Area
- [100] Link Number

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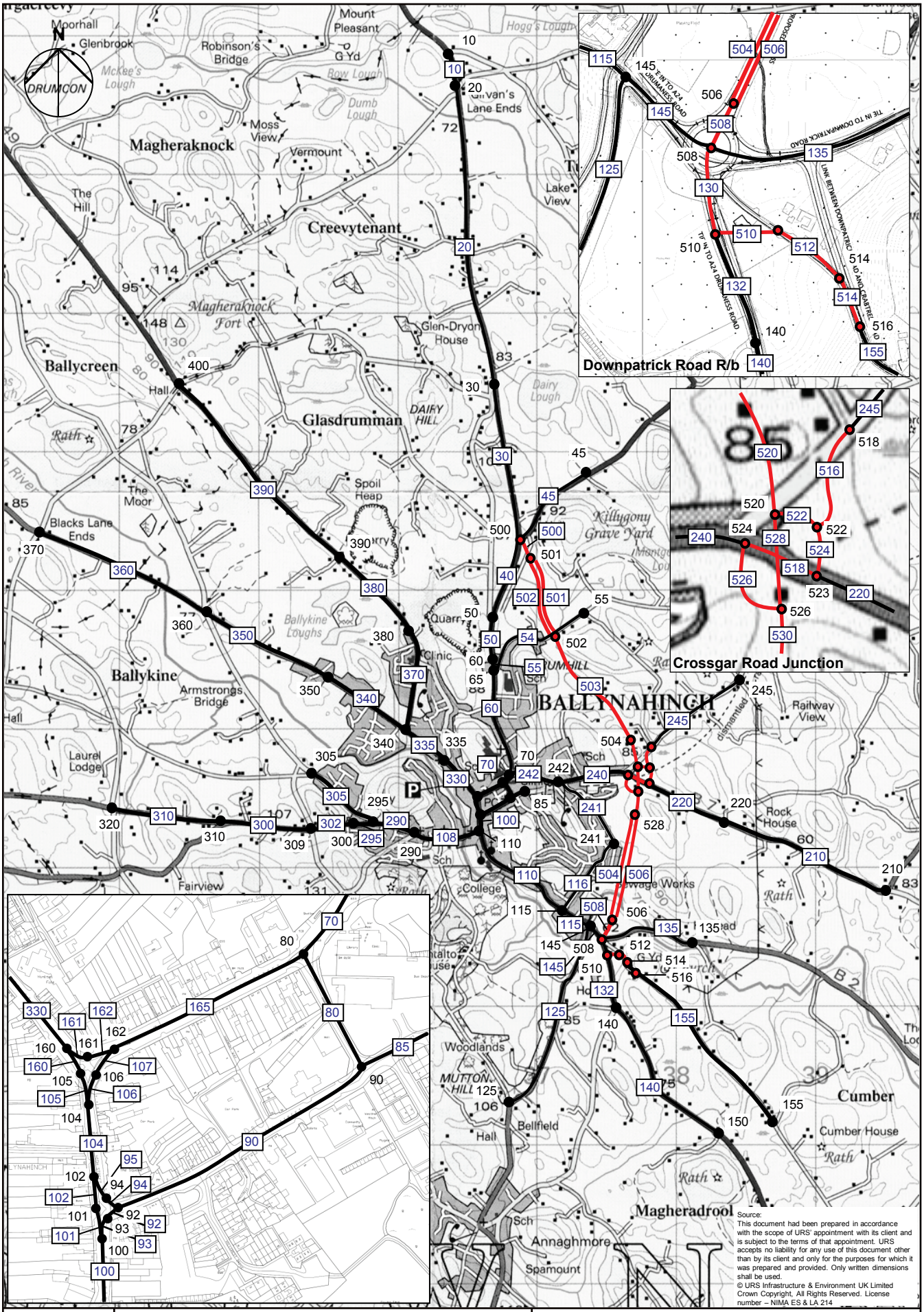
Figure 6.1
Do-Minimum Network
COBA Link and Node Diagram



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- Do-Minimum Link
- Do-Something Link
- 100 Node Number
- 100 Link Number
- Node Point

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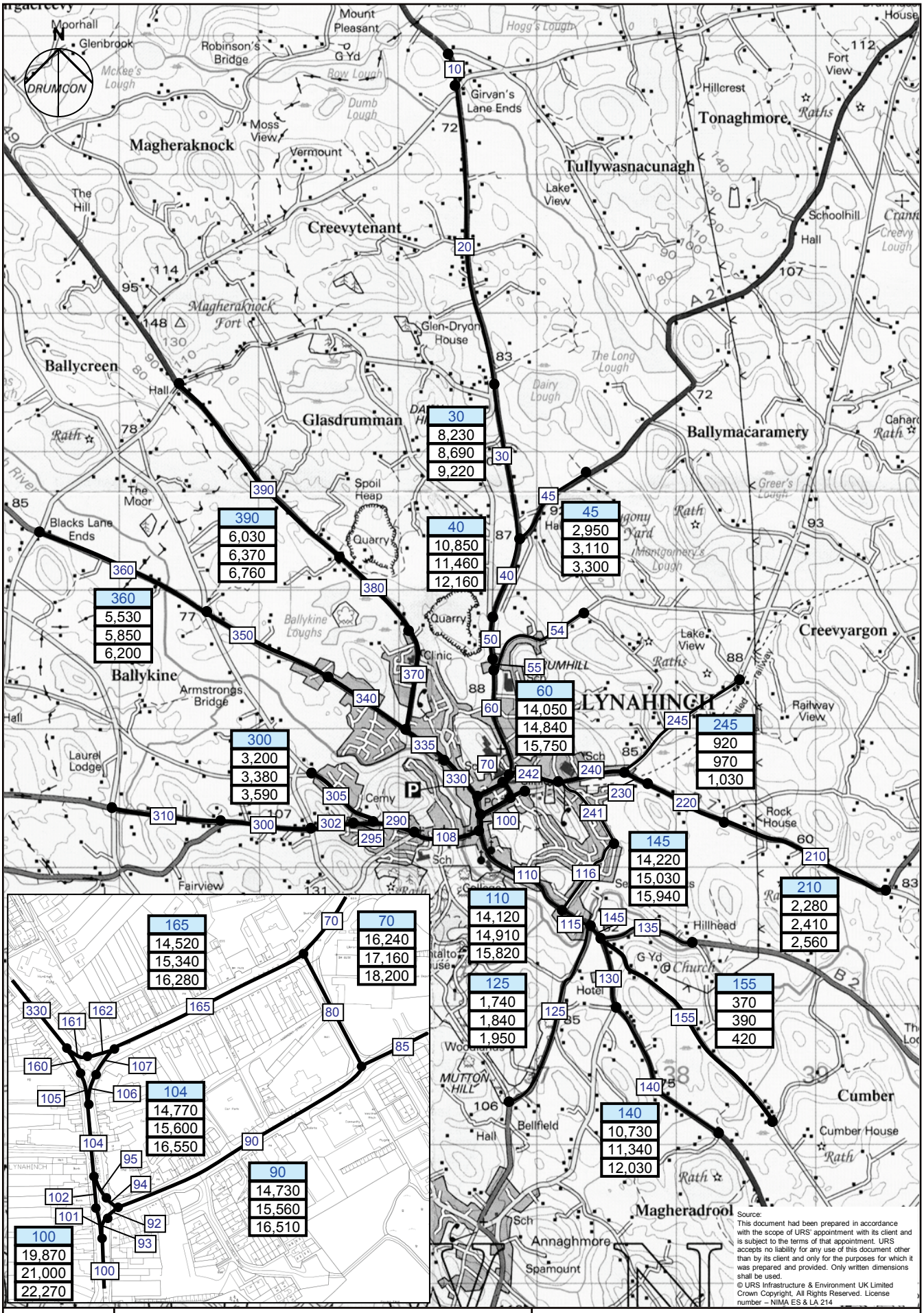
Figure 6.2
Do-Something Network
COBA Link and Node Diagram



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Link Number
2013 24hr Do-Min Flow
2019 24hr Do-Min Flow
2033 24hr Do-Min Flow

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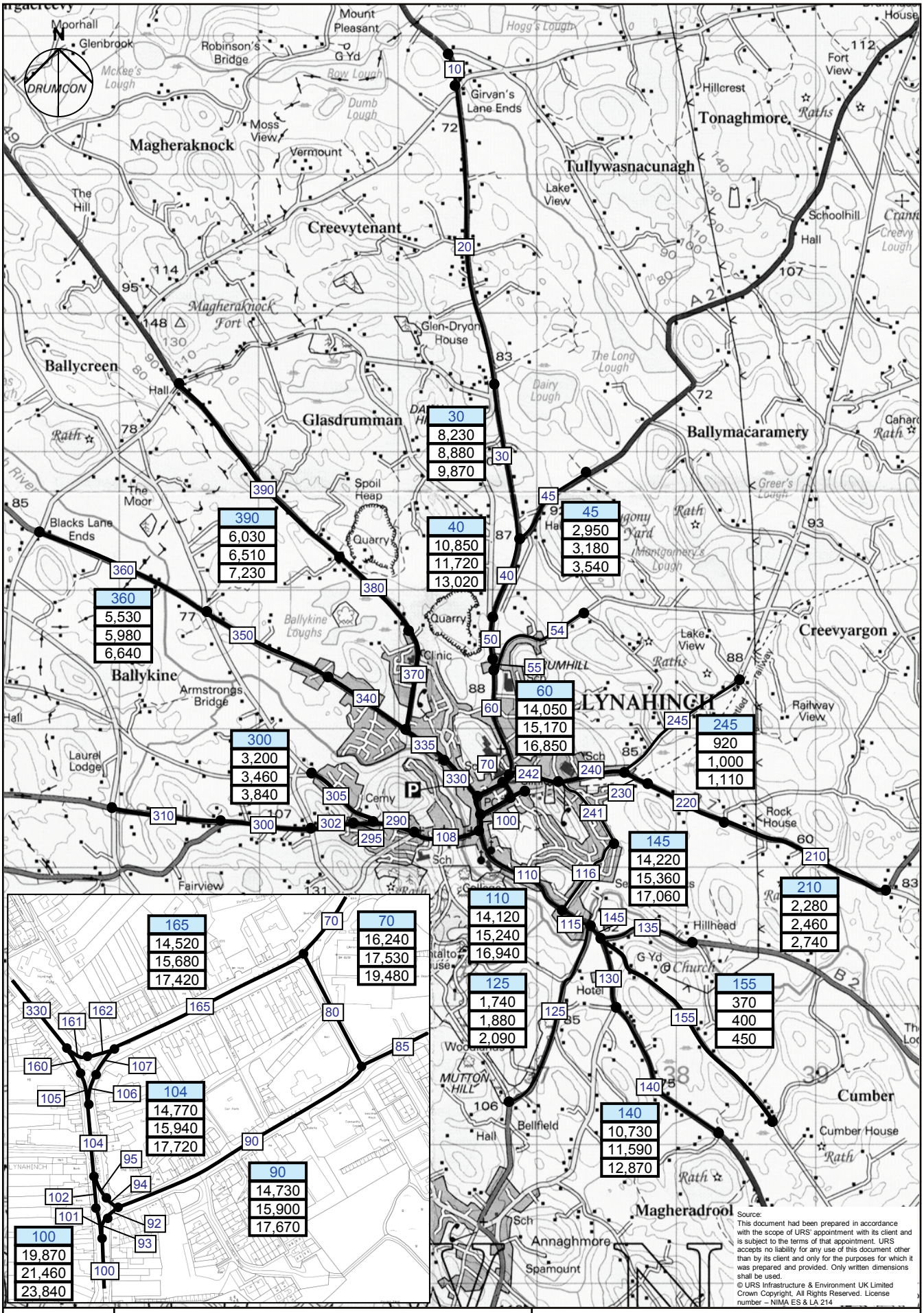
Figure 8.1
Do-Minimum 24-hour Link Flows
NRTF Low Growth



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Link Number
2013 24hr Do-Min Flow
2019 24hr Do-Min Flow
2033 24hr Do-Min Flow

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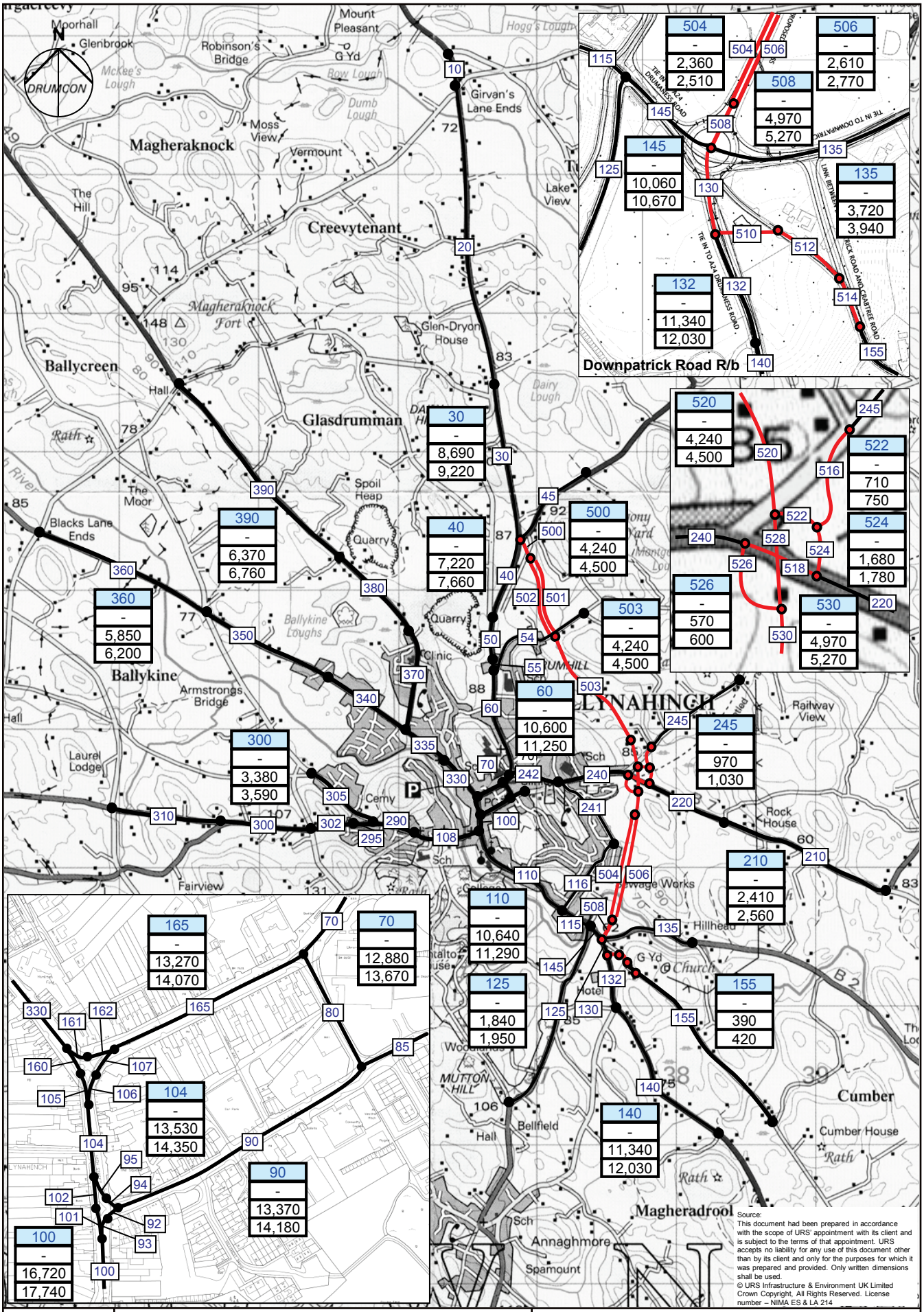
Figure 8.2
Do-Minimum 24-hour Link Flows
NRTF Central Growth



Link Number	2019 24hr Do-Some Flow	2033 24hr Do-Some Flow
10	12,880	13,670
20	10,640	11,290
30	8,690	9,220
40	7,220	7,660
45	10,600	11,250
50	3,380	3,590
54	4,240	4,500
55	4,240	4,500
60	10,600	11,250
70	12,880	13,670
80	13,530	14,350
85	13,530	14,350
90	13,370	14,180
92	13,370	14,180
93	13,370	14,180
94	13,370	14,180
95	13,370	14,180
100	16,720	17,740
101	16,720	17,740
102	16,720	17,740
104	13,530	14,350
105	13,530	14,350
106	13,530	14,350
107	13,530	14,350
108	13,530	14,350
110	10,640	11,290
115	2,360	2,510
116	2,360	2,510
125	1,840	1,950
130	1,840	1,950
132	11,340	12,030
135	3,720	3,940
140	11,340	12,030
145	10,060	10,670
155	390	420
160	13,270	14,070
161	13,270	14,070
162	13,270	14,070
165	13,270	14,070
210	2,410	2,560
220	970	1,030
240	4,240	4,500
241	4,240	4,500
242	4,240	4,500
245	970	1,030
290	3,380	3,590
295	3,380	3,590
300	3,380	3,590
302	3,380	3,590
305	3,380	3,590
310	3,380	3,590
330	13,270	14,070
335	10,600	11,250
340	10,600	11,250
350	6,370	6,760
360	5,850	6,200
370	10,600	11,250
380	7,220	7,660
390	6,370	6,760
500	4,240	4,500
501	4,240	4,500
502	4,240	4,500
503	4,240	4,500
504	2,360	2,510
506	2,610	2,770
508	4,970	5,270
510	3,720	3,940
512	3,720	3,940
514	3,720	3,940
155	3,720	3,940
520	4,240	4,500
522	710	750
524	1,680	1,780
526	570	600
528	1,680	1,780
530	4,970	5,270
140	11,340	12,030

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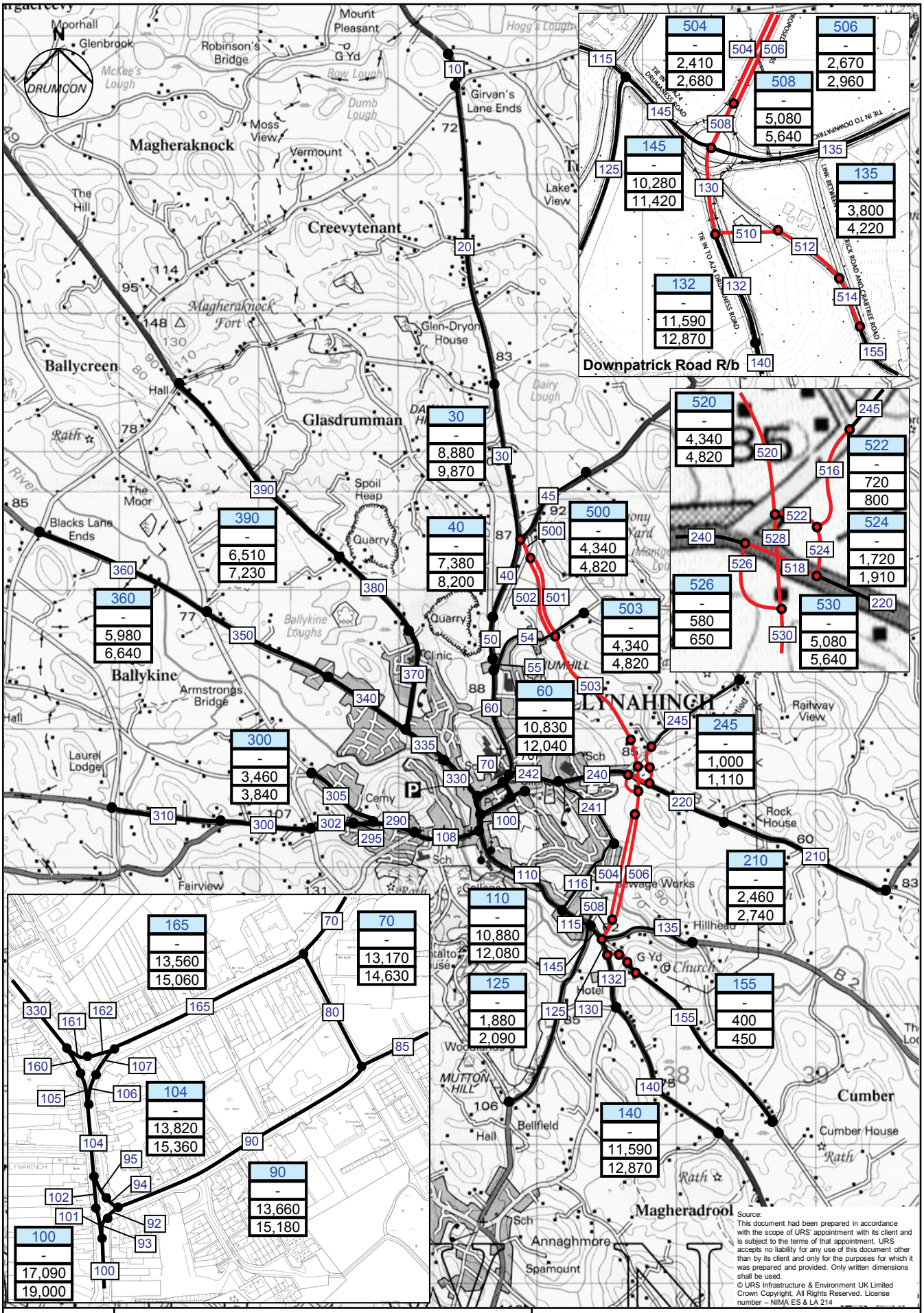
Figure 8.3
Do-Something 24-hour Link Flows
NRTF Low Growth



Link Number	2019 24hr Do-Some Flow	2033 24hr Do-Some Flow
10	2,410	2,680
20	10,280	11,420
30	8,880	9,870
40	7,380	8,200
45	4,340	4,820
50	10,830	12,040
54	4,340	4,820
55	1,000	1,110
60	10,880	12,080
70	13,170	14,630
80	13,660	15,180
85	13,560	15,060
90	13,820	15,360
100	17,090	19,000
104	1,880	2,090
108	3,460	3,840
110	2,460	2,740
115	400	450
125	11,590	12,870
130	5,080	5,640
132	2,670	2,960
135	3,800	4,220
140	580	650
145	1,720	1,910
155	5,080	5,640
165	6,510	7,230
210	5,980	6,640
220	4,340	4,820
240	1,720	1,910
245	5,080	5,640
290	3,460	3,840
300	4,340	4,820
302	4,340	4,820
305	10,830	12,040
330	1,000	1,110
335	2,460	2,740
340	400	450
350	11,590	12,870
360	5,080	5,640
370	4,340	4,820
380	7,380	8,200
390	6,510	7,230
500	4,340	4,820
501	4,340	4,820
502	4,340	4,820
503	4,340	4,820
504	2,410	2,680
506	2,670	2,960
508	5,080	5,640
510	3,800	4,220
512	11,590	12,870
514	11,590	12,870
516	720	800
518	1,720	1,910
520	4,340	4,820
522	720	800
524	1,720	1,910
526	580	650
528	1,720	1,910
530	5,080	5,640

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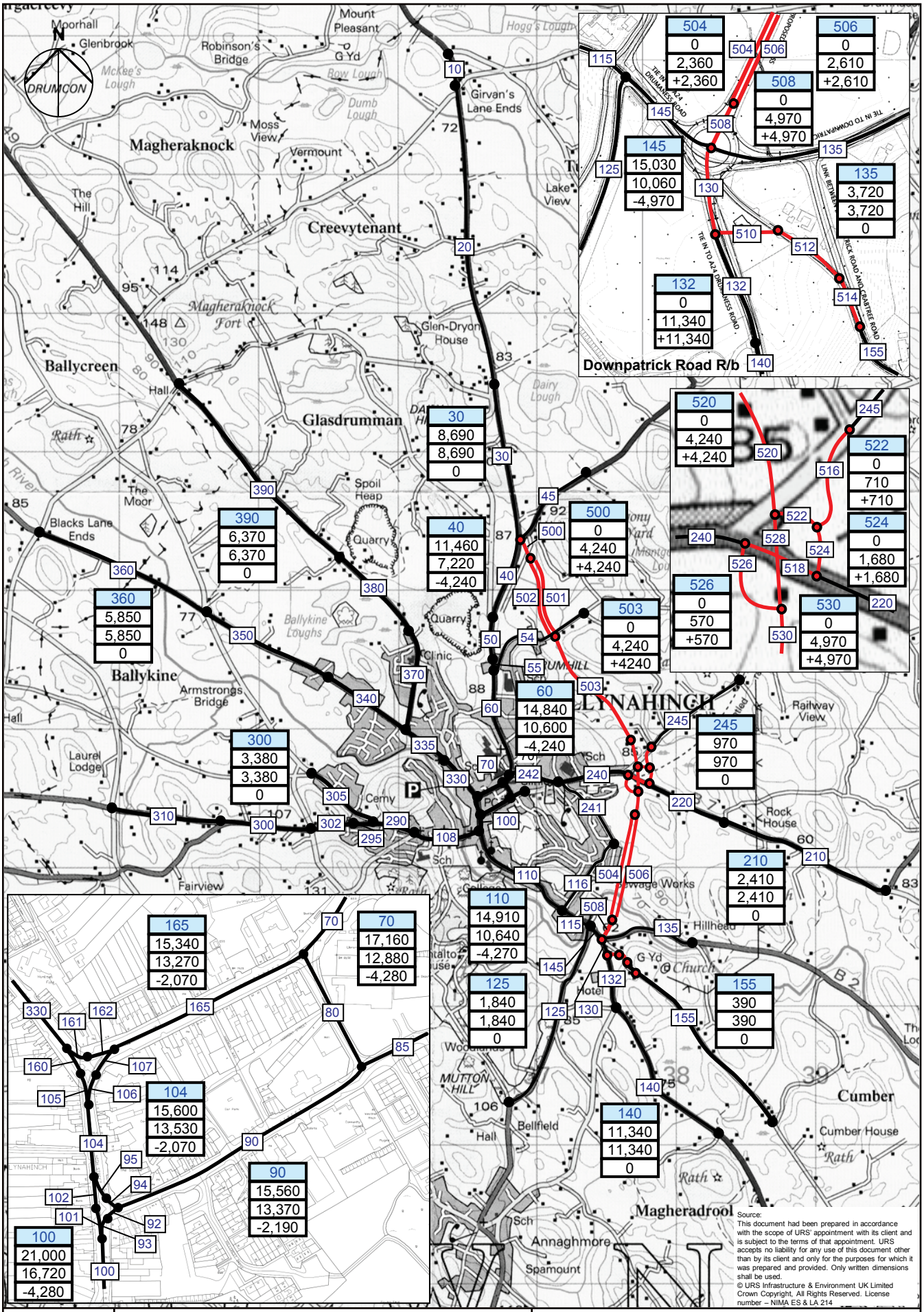
Figure 8.4
Do-Something 24-hour Link Flows
NRTF Central Growth



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Notes

Link Number
2019 24hr Do-Min Flow
2019 24hr Do-Some Flow
2019 24hr Flow Difference

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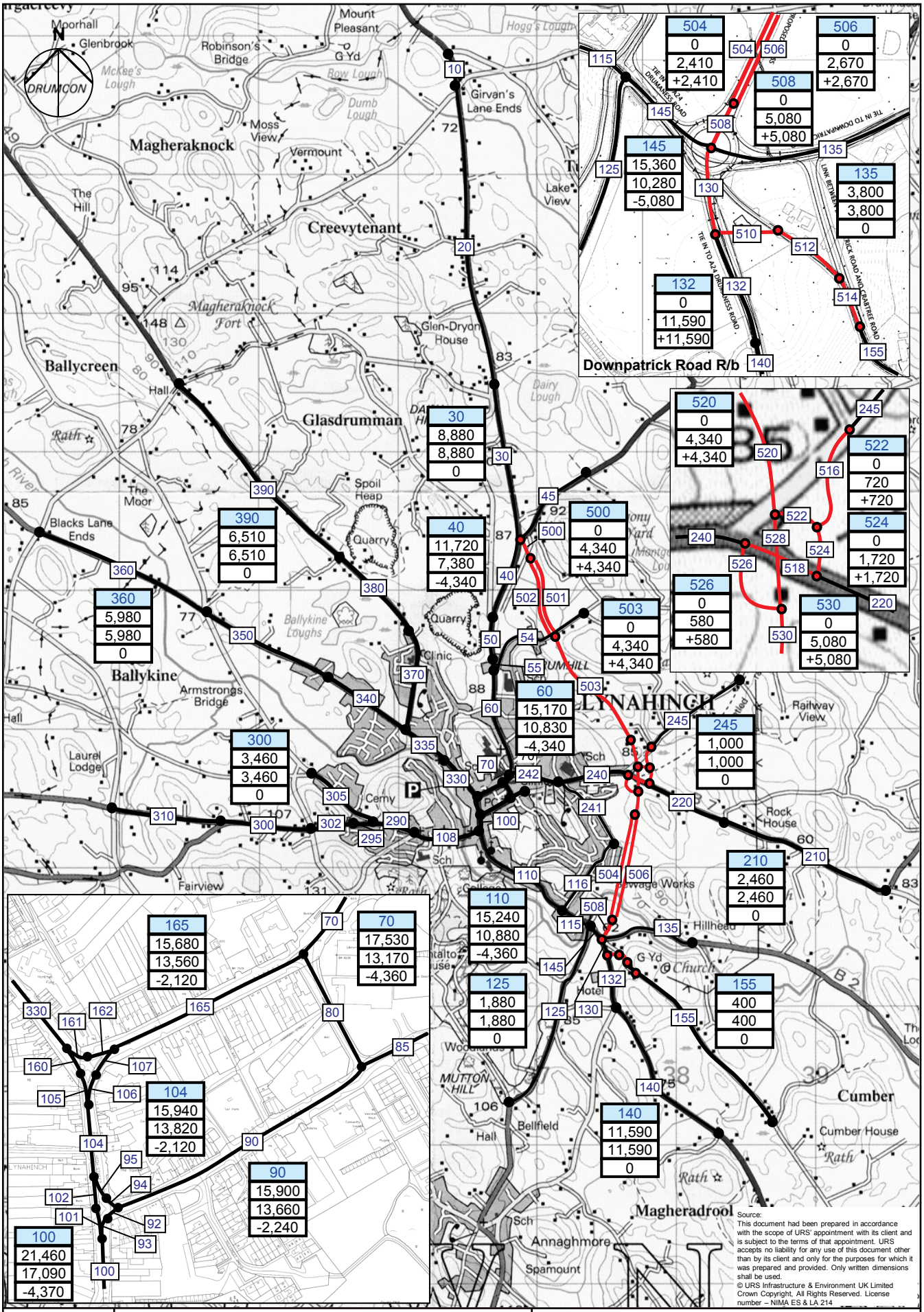
Figure 8.5
Difference between Do-Min and Do-Some 24hr Link Flows 2019 NRTF Low Growth



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Notes

Link Number
2019 24hr Do-Min Flow
2019 24hr Do-Some Flow
2019 24hr Flow Difference

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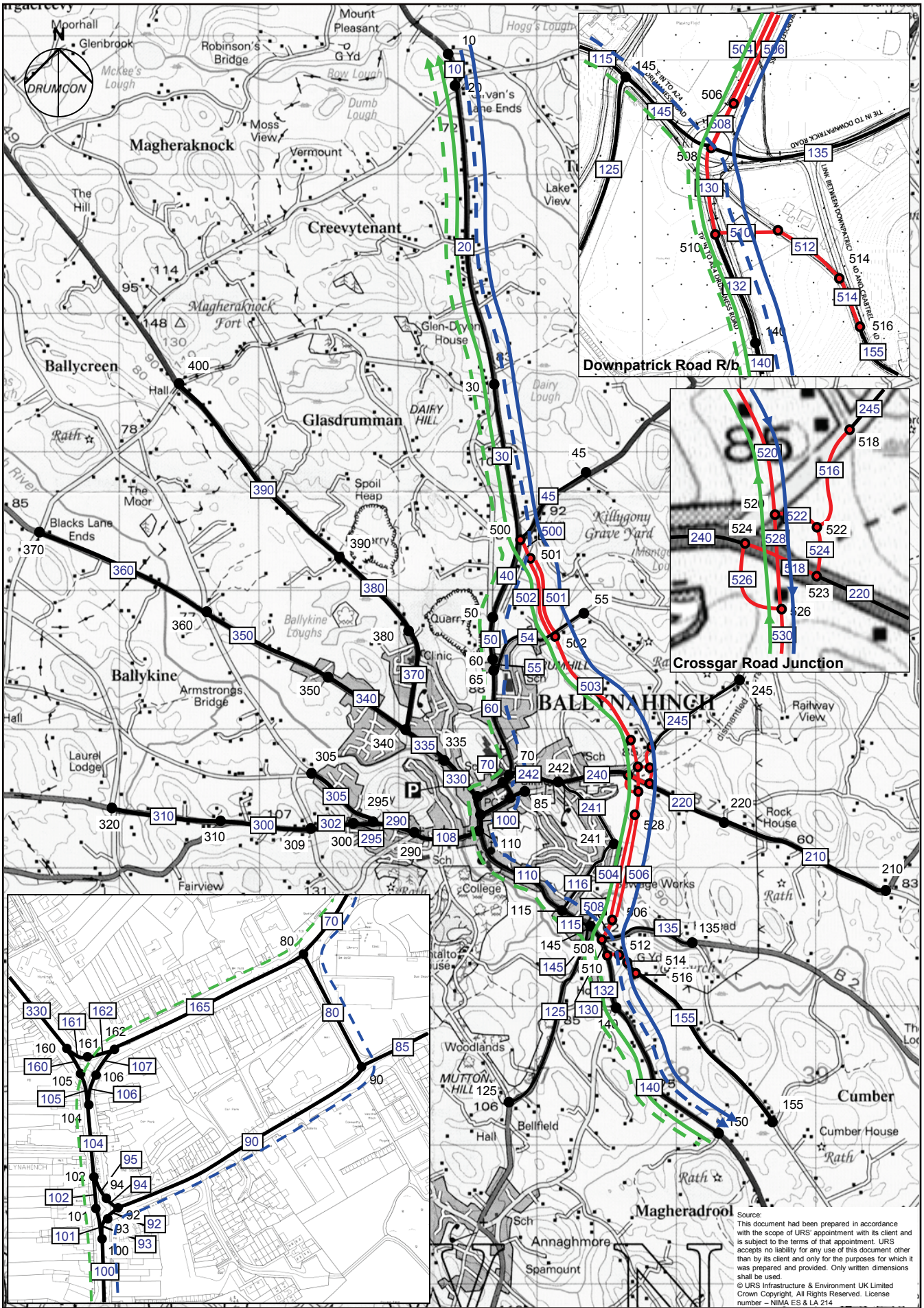
Figure 8.6
Difference between Do-Min and Do-Some 24hr Link Flows 2019 NRTF Central Growth



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Notes

- Node Point
- Do-Minimum Link
- Do-Something Link
- 100 Node Number
- 100 Link Number
- Do-Min Southbound Journey Time Route
- Do-Min Northbound Journey Time Route
- Do-Som Southbound Journey Time Route
- Do-Som Northbound Journey Time Route

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Figure 8.7
Do-Minimum & Do-Something Networks
Modelled Journey Time Routes

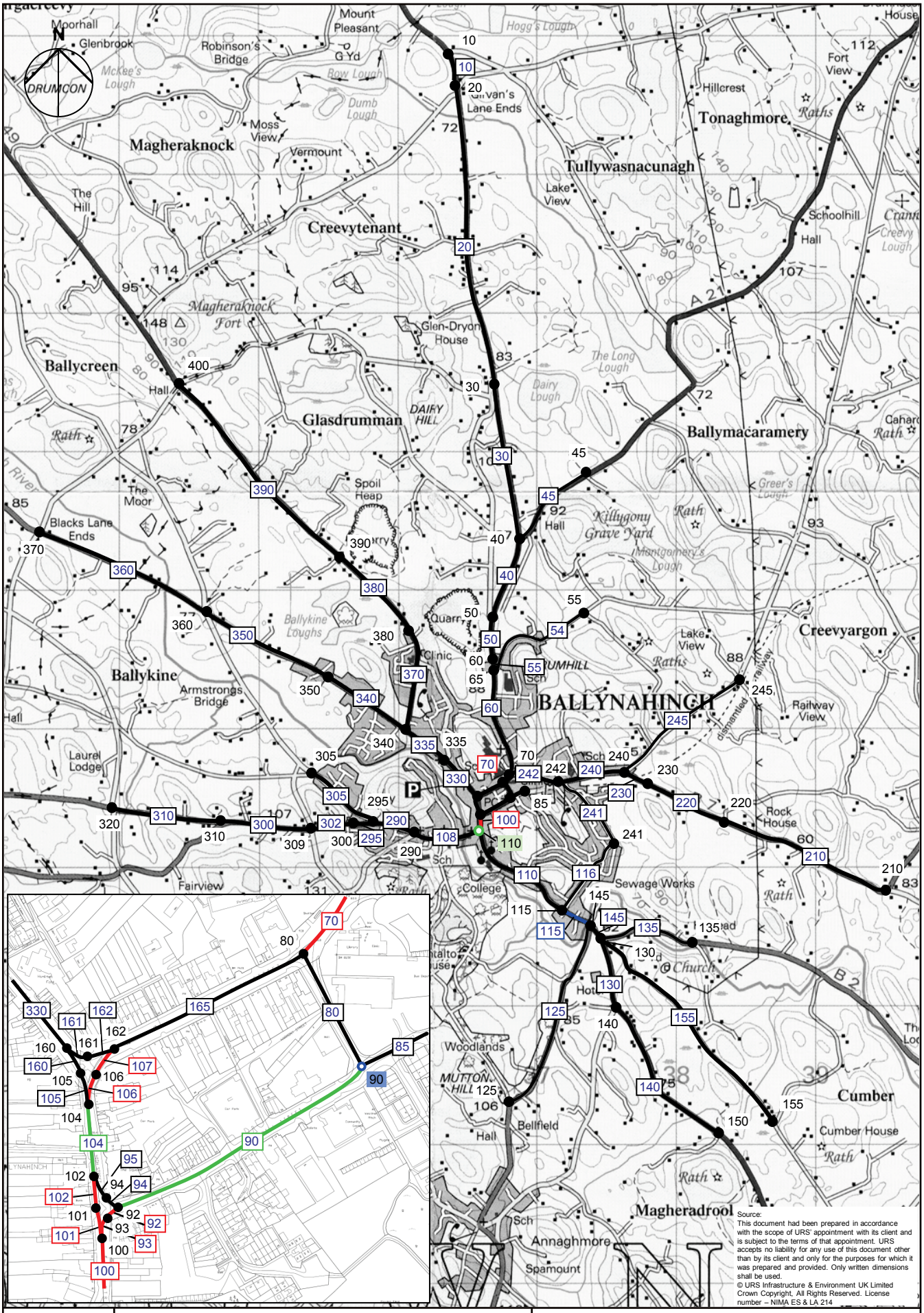
Notes
Over-Capacity Link – 2013 Base Year
Over-Capacity Link – 2019 Year of Opening
Over-Capacity Link – 2033 Design Year
Over-Capacity Junction – 2019 Year of Opening
Over-Capacity Junction – 2033 Design Year
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Figure 8.8
Do-Minimum Network
COBA Overcapacity Links and Junctions
Source:
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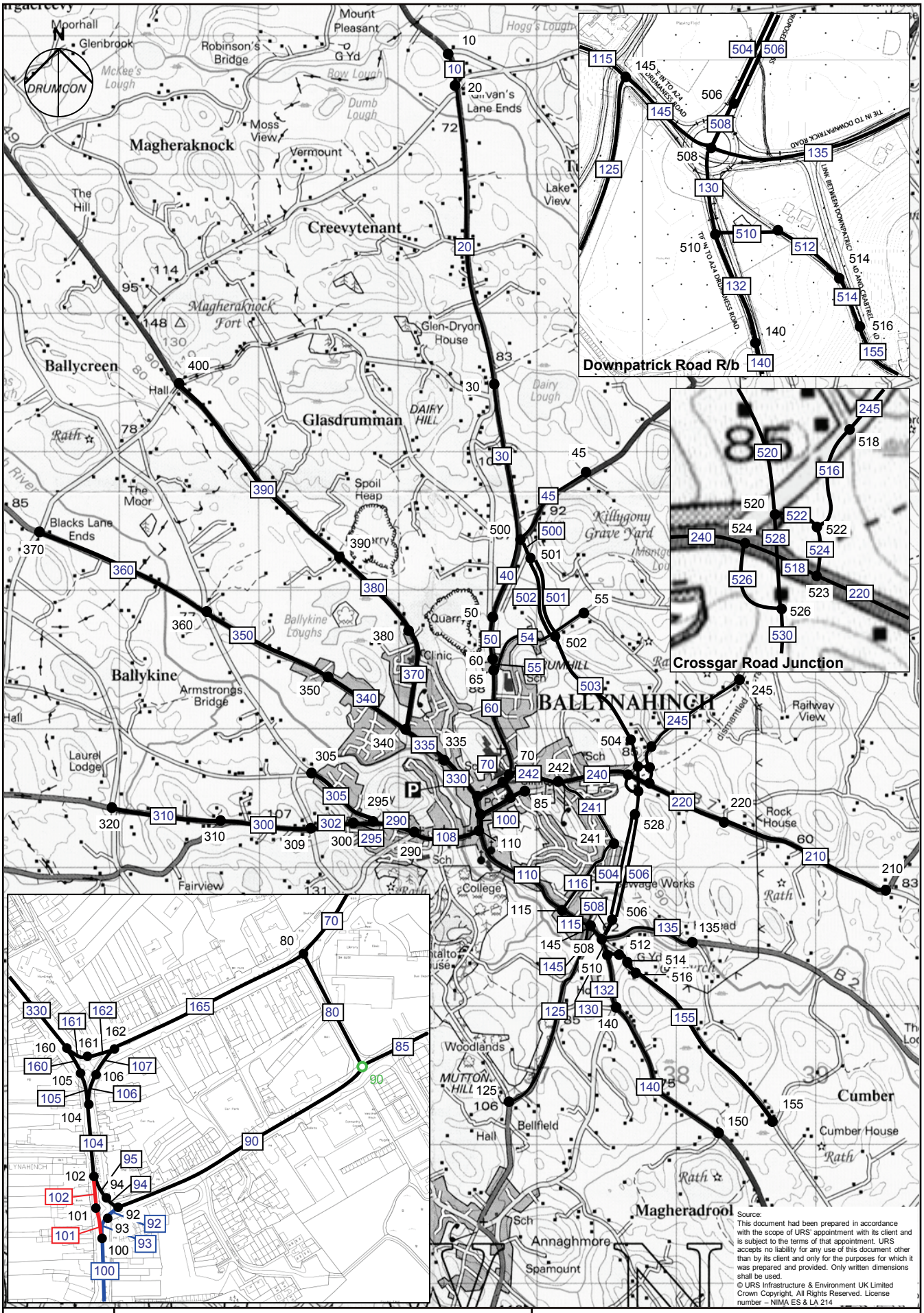

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Notes

- Over-Capacity Link – 2013
- Over-Capacity Link – 2019
- Over-Capacity Link – 2033
- Over-Capacity Junction – 2013
- Over-Capacity Junction – 2019
- Over-Capacity Junction – 2033

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Figure 8.9
Do-Something Network
COBA Overcapacity Links and Junctions