Department for Infrastructure

The Roads (Northern Ireland) Order 1993
The Local Government Act (Northern Ireland) 1972

A1 JUNCTIONS PHASE 2 ROAD IMPROVEMENT SCHEME
PUBLIC INQUIRY
March 2020

Proof of Evidence
(Traffic and Economic Assessment)

By

Ross Coulthart

RPS-Sweco Consortium
Elmwood House
74 Boucher Road
Belfast
BT12 6RZ

Table of Contents

Contents

1 QUALIFICATIONS AND EXPERTISE

1.1.1 My name is Ross Coulthart and I am a Principal Consultant in the Sweco Glasgow Transportation team. I have an MA degree in Geography (2003) and I am a Member of the Chartered Institute of Highways and Transportation (MCIHT).

1.1.2 I have more than 15 years' experience in civil engineering projects through my employment with various consulting engineering companies and secondment at Transport Scotland. At Sweco I sit within the transport planning team in Glasgow and currently have a technical authority role responsible for traffic modelling and appraisal of highways projects in Scotland and Northern Ireland.

1.1.3 I am responsible for traffic and economic analysis for the Stage 3 Scheme Assessment of the A1 Junctions Phase 2 Project.

2 SCOPE OF EVIDENCE

2.1.1 The scope of my evidence concerns Traffic and Economic Assessment Sections of the A1 Junctions Phase 2 - Road Improvement Scheme: Stage 3 Scheme Assessment Report.

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

2.1.3 The purpose of Stage 3 Traffic and Economic Assessment reporting is to describe the traffic and economic modelling work undertaken to appraise the scheme. The assessment considers future traffic conditions over the economic life of the scheme and presents the results of an operational and economic assessment. Given the uncertainty in predicting future traffic conditions over the economic life of the scheme, the results from sensitivity tests of future traffic growth are also presented in the report.

3 ASSESSMENT OF NEED AND KEY OBJECTIVES

3.1.1 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).

3.1.2 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.

3.1.3 The A1 Junctions is identified in the RSTN TP as a proposed SRI scheme on the Trunk Road Network.

3.1.4 The Investment Delivery Plan (IDP) for Roads 2015 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 Northern Ireland readily accessible to the Regional Gateways and the Belfast Metropolitan Area.

3.1.5 The IDP (Roads) defines a 10-Year Forward Planning Schedule that contains a number of schemes, including the A1 Junctions, together with those schemes in the Preparation Pool, that 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.

3.2 Regional Objectives

3.2.1 The appraisal of proposals for improvement works are assessed against the Government's five criteria of Environment, Safety, Economy, Accessibility and Integration and also against the regional objectives:

- To improve health, safety and security;
- To support the spatial development strategy in the Regional Development Strategy (RDS);
- To develop and maintain the RSTN for all users;

- To protect the natural and built environment;
- To support sustainable economic growth; and
- To improve access to regional gateways.

3.3 Scheme Specific Objectives

3.3.1 The specific transport objectives developed for A1 Junctions Phase 2 are:

- To improve safety for all road users;
- To provide a standard of route appropriate to its strategic function;
- To be affordable and provide value for money; and
- To improve journey times and journey time reliability for strategic A1 traffic.

4 EXISTING CONDITIONS

4.1 Traffic Flow

4.1.1 The Department for Infrastructure (DfI) maintains a number of permanent Automatic Traffic Counters (ATC) sites throughout Northern Ireland and publish the data annually via their website. Within the study area there are several ATC sites from which data is available, illustrated in Figure 4.1. These sites are:

- 522 Lisburn
- 530 Hillsborough
- 410 Dromore
- 411 Banbridge
- 419 Loughbrickland

4.1.2 AADT flows are higher at the northern end of the study area compared to the southern end. Flows recorded in 2016 were approximately 37,000 AADT in the northern end of the study area and approximately 26,000 AADT in the southern end of the study area.

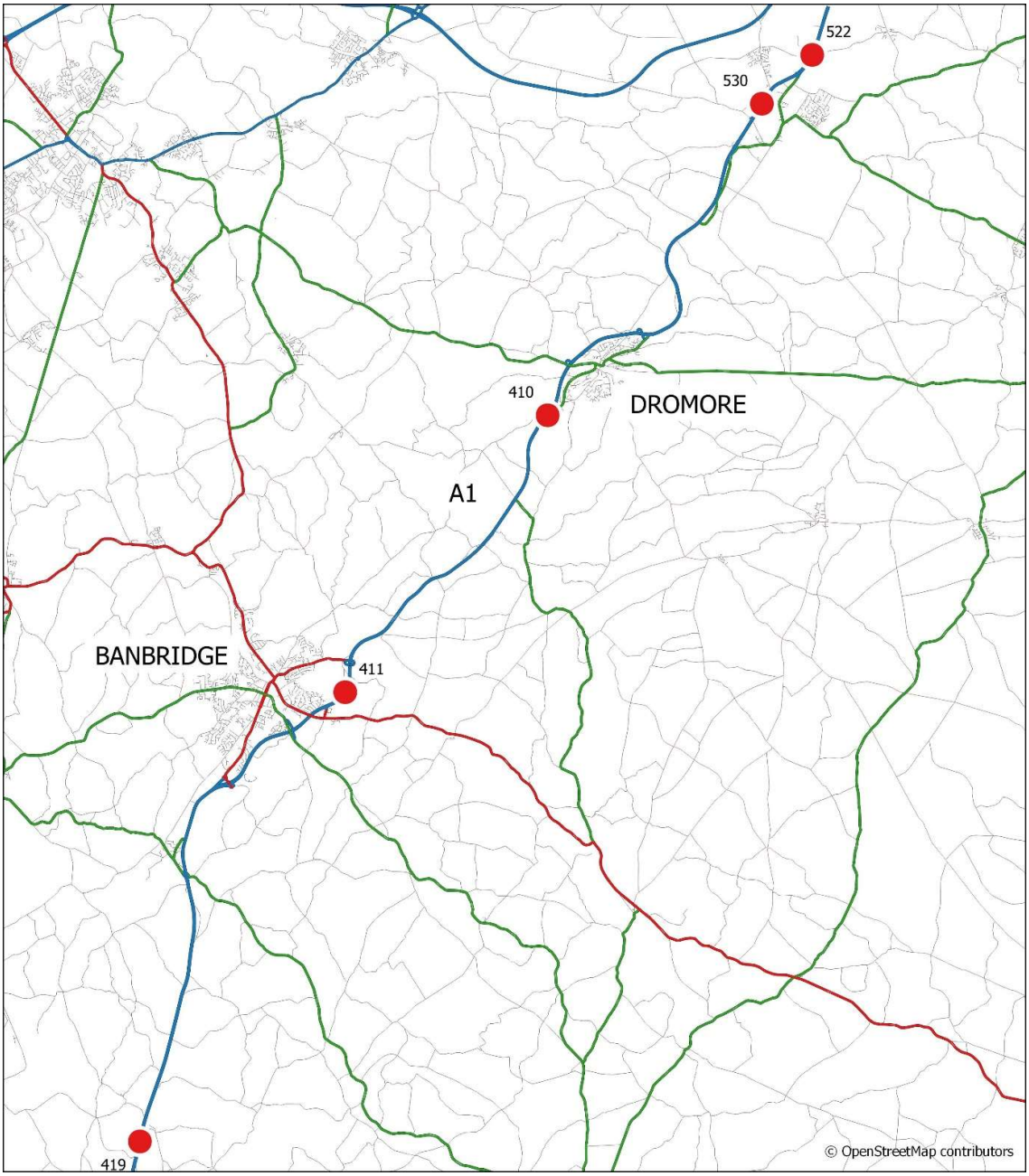


Figure 4.1 – Automatic Traffic Count Sites

4.2 Journey Times

4.2.1 Table 4.2 presents surveyed journey times between November 22nd and 24th 2016 between the grade-separated junction at Loughbrickland to the Hillsborough Roundabout, a distance of approximately 25km. With the exception of northbound journeys in the AM peak, journey times are broadly consistent for both directions in all peaks with all average journey times between 15 and 16 minutes. Northbound journey times in the AM peak exceed 17 minutes. This is due to congestion at the Hillsborough Roundabout in the morning peak.

Table 4.2 – Average Journey Times: A1 Hillsborough Roundabout to Loughbrickland Grade-separated Junction

Average Journey Times (mins)		
	Northbound	**Southbound**
07:00 – 10:00	0:17:06	0:15:15
11:00 – 14:00	0:15:03	0:15:08
15:00 – 19:00	0:15:26	0:15:42

4.2.2 The A1 can be subject to partial or full closures to allow the emergency services to deal with traffic collisions and other incidents. The resultant detours can significantly impact on journey times.

5 TRAFFIC SURVEYS AND DATA COLLECTION

5.1 Data Collection

5.1.1 UK Department for Transport (DfT) Transport Analysis Guidance (TAG) Unit M1.2 Data Sources and Surveys recommends that data collection is undertaken within a neutral month including:

- late March and April – excluding the weeks before and after Easter;
- May - excluding the Thursday before and all of the week of each Bank Holiday;
- June;
- September – excluding school holidays or return to school weeks;
- all of October; and
- all of November – provided adequate lighting is available.

5.1.2 These neutral months avoid main and local holiday periods, school holidays and other non-standard traffic periods.

5.2 Junction Turning Counts

5.2.1 To supplement previous data collected during Stage 2, junction turning counts on A1 junctions were undertaken between 0700 and 1900 on Wednesday 23rd November 2016.

5.2.2 Before the surveys took place, the survey company confirmed and cleared dates and times of the surveys with Armagh City, Banbridge and Craigavon Borough Council, Lisburn and Castlereagh City Council, DfI Roads (previously Transport Northern Ireland at the time of the surveys taking place) and the Police Service of Northern Ireland to ensure that the routes were clear of road works and that no planned events resulted in atypical data.

5.2.3 Table 5.1 provides site references and junction names of the 2016 survey sites.

Site	Name	Site	Name
1	Hillsborough Roundabout	15	Drumneath Road
2	Ballygowan Road/ Dromore Road, Hillsborough	16	Skelton Road
3	Dromara Road	17	Graceystown Road
4	Taughblane Road	18	Waringsford Road
5	Backnamullagh Road	19	A26 Dromore Road
6	Listullycurran Road	20	Lisnaree Road
7	B2 Hillsborough Road	21	Old Manse Road
8	Maypole Hill	22	Old Manse Road/ Castlewellan Road
9	B2 Lurgan Road	23	Castlewellan Road/ Chinauley Park
10	Lower Quilly Road	24	Rathfriland Road
11	Rowantree Road/ B2 Banbridge Road, Dromore	25	Cascum Road/ Newry Road Junction
12	Gowdystown Road	26	Banbridge Road
13	Mount Ida Road	27	B3 Dublin Road & B3 Grovehill Road
14	Edenordinary Road		

Table 5.1 – JTC Site Locations

5.2.4 Figure 5.1 illustrates the location of the survey sites graphically and also provides existing data sites surveyed in 2013.

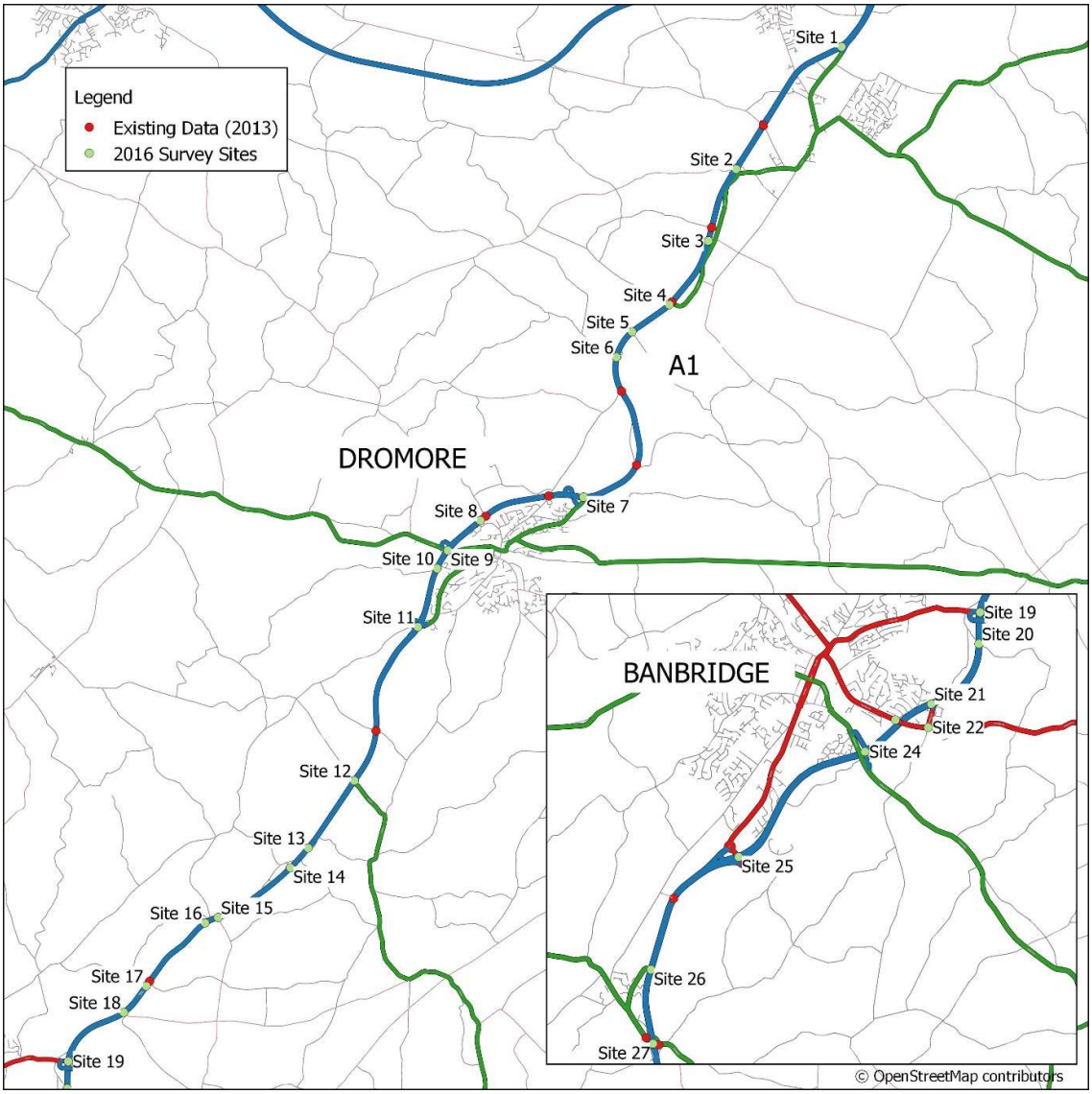


Figure 5.1 – 2016 Junction Turning Count Survey Locations

5.2.5 Following public consultation, some additional sites were identified for survey. Supplementary junction turning counts were undertaken between 0700 and 1900 at the following locations on the following dates:

- Site 28 & 29 - November 23rd, 2017
- Sites 30 & 31 - April 10th, 2018

Site	Name
28	A1 & Kilmacrew Rd
29	Castlewellan Road & Chinauley Park
30	A1 & Milebush Rd (South)
31	Milebush Rd & Maypole Rd

5.3 Journey Time Surveys

5.3.1 Journey time survey data was also collected between 22-24 November, 2016. Surveys were undertaken to cover both peak and interpeak periods in line with guidance within the DfT's COst Benefit Analysis (COBA) manual. Journey times have been collected using the moving observer technique through a Global Positioning System (GPS) device for a minimum of 5 runs in each direction. Timing points are illustrated in Figure 5.2.

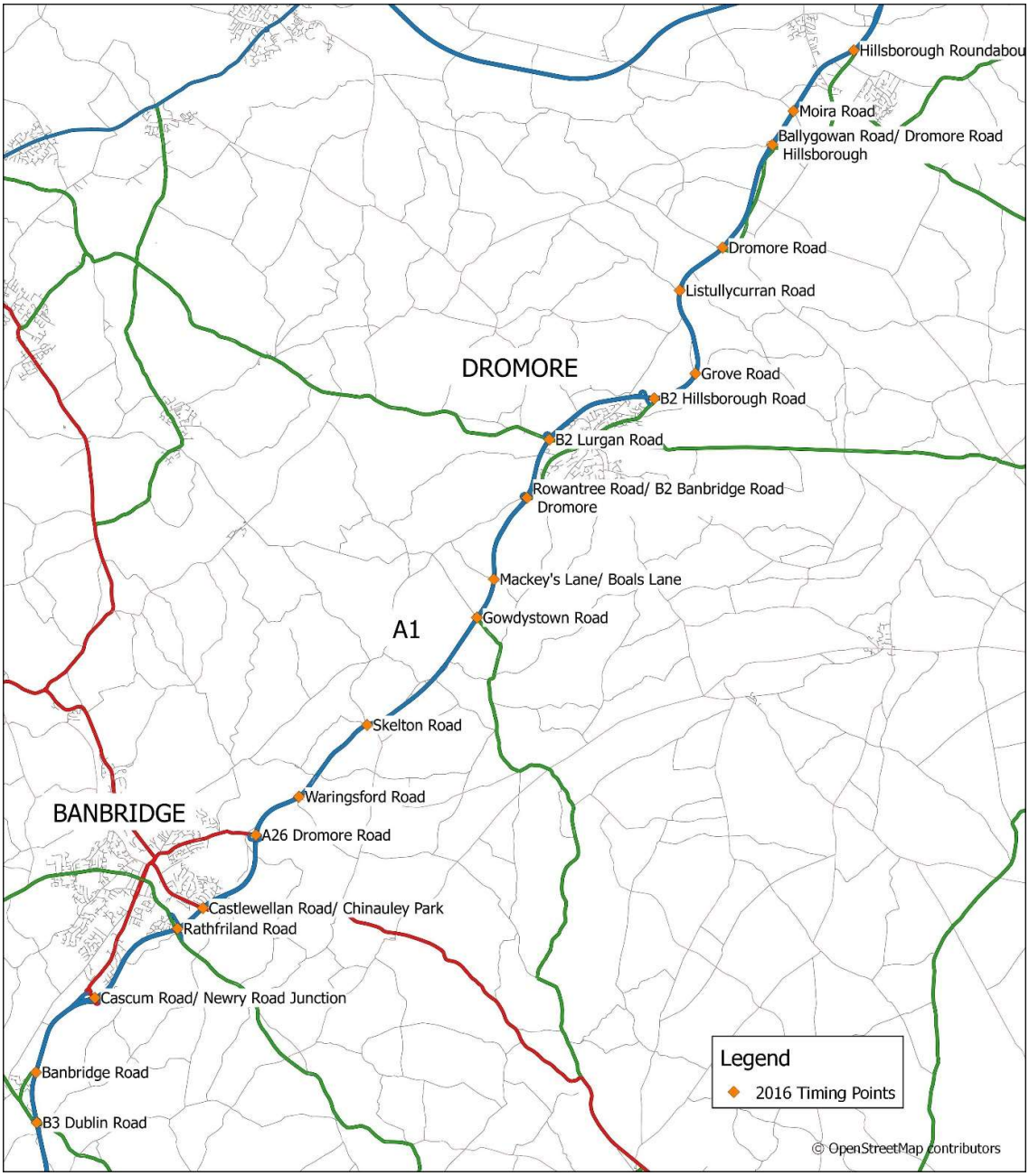


Figure 5.1 – Journey Time Timing Points

6 MODELLING

6.1 Overview

6.1.1 The traffic and economic assessment of the proposed scheme was undertaken using a spreadsheet model developed during the Stage 2 assessment. This spreadsheet model was refined following a data collection exercise which updated the model to a base year of 2016.

6.1.2 The model was used to assign forecasts of travel demand to determine the effects of the proposed scheme compared to the Do-Minimum scenario, with an assumed 2021 year of opening for the scheme, and a 2036 design year (15 years post-opening). The model has been used to inform the design of the proposed scheme, and undertake operational, environmental and economic assessments.

6.2 Methodology

6.2.1 The traffic model has been developed based on the existing road network and scheme proposals. The implications for traffic movements arising from the scheme primarily affect those that must use alternative routes due to closures and those who currently turn right onto or off the dual carriageway. The traffic assessment has considered how these movements reassign when the scheme is in place at each respective public road junction. Given the scale of likely overall impacts to traffic of the scheme, a spreadsheet model approach is considered proportionate. A fixed demand approach is also considered appropriate as it is not anticipated that introduction of the scheme would result in induced demand or changes to mode choice.

6.3 Model Validation

6.3.1 Journey time measurements are required to validate the COst Benefit Analysis (COBA) model. Journey time surveys were undertaken along the A1 between Hillsborough Roundabout and Loughbrickland grade separated junction on Tuesday 22nd November 2016 between 11:00-14:00. The journey time data collected was compared to the journey time outputs from the COBA model on the same sections of the road.

6.3.2 To demonstrate that the model was fit for purpose, the 2016 observed and modelled journey times were compared in accordance with the TAG criterion, which states that 85% of journey times routes are to be within 15% of observed times or one minute (if greater than 15%). It should be noted that the modelled journey time produced by COBA is aggregated to give an average for all vehicle types whereas a car was used for the journey time surveys therefore surveyed speeds are likely to be higher.

Table 6.1 – COBA Journey Time Model Validation (2016)

NODE - LINKS	NORTHBOUND				SOUTHBOUND			
	COBA (SEC)	SURVEY (SEC)	DIFFERENCE (SEC)	% DIFFERENCE	COBA (SEC)	SURVEY (SEC)	DIFFERENCE (SEC)	% DIFFERENCE
Hillsborough Rbt - Moira Road	59	56	3		59	57	2	
Moira Road - Dromore GSJ	27	23	4		27	24	3	
Dromore GSJ - Dromore Road	81	66	15		80	68	12	
Dromore Road - Listullycurran Road	43	36	7		43	37	6	
Listullycurran Road - Grove Road	60	51	9		61	53	8	
Grove Road - Hillsborough GSJ	34	30	4		34	33	1	
Hillsborough GSJ - Church Street	80	78	2		79	75	4	
Church Street - Banbridge Road	43	40	3		44	40	4	
Banbridge Road - Boals Lane	63	57	6		61	55	6	
Boals Lane - Gowdystown Road	28	25	3		29	25	4	
Gowdystown Road - Skeltons Road	109	92	17		109	92	17	
Skeltons Road - Waringsford Road	69	59	10		68	59	9	
Waringsford Road - Dromore Street	41	37	4		41	39	2	
Dromore Street - Castlewellan Road	69	64	5		69	65	4	
Castlewellan Road - Rathfriland Road	22	21	1		21	21	0	
Rathfriland Road - Newry Road GSJ	75	72	3		74	74	0	
Newry Road GSJ - Old Newry Road	70	66	4		69	60	9	
Old Newry Road - Loughbrickland GSJ	37	30	7		36	31	5	
Total	**1009**	**903**	**106**	**10%**	**1004**	**908**	**96**	**10%**

6.3.3 As shown in Table 6.1 the overall journey time difference along the scheme length is within 15% for both directions, in accordance with TAG guidance.

6.4 Do-Minimum Scenario

6.4.1 The 'Do-Minimum' provides a description of the scenario that would exist if the scheme proposals were not implemented but all other committed land use and transport schemes were completed. TAG guidance recommends inclusion of only those schemes or developments in the core scenario that are either 'near certain' or 'more than likely'.

6.4.2 The Do-Minimum network is the road network against which the Do-Something network is assessed. No specific changes to the base road network have been identified and consequently the Do-Minimum network is consistent with the existing Base network.

6.5 Do-Something Scenario

6.5.1 The 'Do-Something' describes the scenario with scheme proposals in place, incorporating new grade-separated junctions, new links, road closures, and conversion to left-in left-out function arrangements.

6.5.2 For the purposes of the assessment, assumptions have been made about how vehicles will reassign in the Do-Something scenario. Trips that must reroute due to closures will use available junctions based on proximity to roads used previously.

6.5.3 Right turns onto the A1 that would be prevented as a result of the scheme have been reassigned to either turn left onto the A1 and then u-turn at a suitable junction or use the minor road network to access the A1 at a grade-separated junction, depending on which route is deemed most attractive in terms of time, distance or road suitability.

6.5.4 Right turns off the A1 that would also be prevented as a result of the scheme have been reassigned to either travel further down the A1 to u-turn at a suitable junction or leave the A1 earlier and access via the minor road network, again depending on which route is deemed most attractive.

6.5.5 Each junction location has been considered individually. The resulting flows at each of the existing and proposed grade separated junctions along the A1 have been calculated.

6.5.6 It is assumed that demand is fixed between the Do-Minimum (without scheme) and Do-Something (with scheme) scenarios. All changes to flows between the two scenarios are due to local reassignment for right-turning vehicles that must divert with the scheme in place or due to proposed closures. A full diagram of traffic flows and turning movements for the study area for all modelled scenarios has been presented in Appendix A.

7 FUTURE CONDITIONS

7.1.1 Forecast traffic flows are required for various assessments in the Stage 3 process at both the scheme opening year (2021) and the design year which is fifteen years after opening (2036).

7.1.2 In the UK, traffic forecasts are produced using Trip End Model Presentation Program (TEMPRO) software which has been developed by the DfT. A bespoke version of TEMPRO for Northern Ireland, known as TEMPRO-NI, was developed in 2011.

7.1.3 During the Stage 3 Assessment, the DfI advised that TEMPRO-NI was undergoing an update and was not available for use on this project. Traffic growth assumptions have therefore been based on growth trends from local Automatic Traffic Count (ATC) data.

7.1.4 An average annual growth factor for 2005 to 2016 has been determined from the local ATC sites. This has been calculated as 3.02% growth per annum. This period includes a recession and period of recovery. The observed local growth rate has been used to produce the core forecast scenarios for opening and design years.

7.1.5 To account for the uncertainty inherent in forecasting and in line with TAG guidance, the Do-Something Scenario comprises Core, Low Growth, and High Growth Scenarios. All Do-Something scenarios incorporate the proposed changes to the network, which include junction closures, the banning of right turn movements, and junction improvements.

7.1.6 High and low growth scenarios allow testing of whether a scheme is still effective under high demand assumptions or if it is still economically viable under low demand assumptions.

7.2 The three growth scenarios for a 2021 opening year are as follows:

- 'Core' local growth of 3.02% per annum (i.e. 16.04% growth from 2016 to 2021);
- 'Low Growth' i.e. 10.45% growth from 2016 to 2021; and
- 'High Growth' i.e. 21.63% growth from 2016 to 2021.

7.3 The three growth scenarios for a 2036 design year are as follows:

- 'Core' local growth of 3.02% per annum (i.e. 81.31% growth from 2016 to 2036);
- 'Low Growth' i.e. 70.13% growth from 2016 to 2036; and
- 'High Growth' i.e. 92.49% growth from 2016 to 2036.

8 OPERATIONAL ASSESSMENT

8.1 Traffic Flows

8.1.1 The improvements to the A1 and its junctions will improve junction capacity and the reliability and safety of the strategic transport network in the area. The scheme will provide a more consistent route and improved safety by closing gaps in the central reserve to ban right turn and u-turn manoeuvres. Provision of a central reserve barrier along the length of the corridor will improve safety as errant vehicles will no longer be able to drift across the central reserve towards oncoming traffic. Other benefits include a more consistent route design and more reliable journey times.

8.1.2 The proposals prohibit all right turn, u-turn and crossover movements through the installation of a continuous central reserve barrier, upgrading at grade junctions to Left-In Left-Out (LILO) and the provision of new compact grade separated junctions (CGSJ). The proposals remove central reserve and cross over manoeuvres at 21 at grade junctions, with a further 9 junctions fully closed and 6 junctions incorporated into 4 new CGSJ's, a new slip road and a new link road to an existing CGSJ, adding to the existing 8 grade-separated junctions within the study area.

8.1.3 A degree of re-routing will occur as a result of the improvements leading to increases in flows in some sections and longer journey times and distances travelled for some trips. However, it is assumed that the operational effect of this will be minimal with affected traffic exiting at the closest available junction and performing a u-turn, and traffic from side roads re-routing to the nearest available junction. Any increase in traffic due to this re-routing is anticipated to be well within the operating capacity of the local road network. The model shows that re-routing traffic will form less than 10% of the overall flow on the mainline at any point on the scheme and is considered to have a negligible effect. The junctions with the largest change in flow are the existing and proposed grade-separated junctions, due to U-turns for trips to partially-closed and fully-closed junctions.

8.2 Journey Times

8.2.1 Vehicles that currently slow down to turn right off the A1 will be re-routed, thereby removing delays for vehicles travelling in the offside lane. This is expected to marginally improve overall journey times for strategic traffic, thereby improving reliability as a minor beneficial effect. Network reliability will also be enhanced by a reduction in the number of collisions, which will in turn reduce the number of major incidents requiring partial or full closures of the A1.

8.3 Road Safety

8.3.1 The impact of the scheme on the number of accidents within the study area was estimated using COBA. The numbers and costs of accidents at junctions and on links have been estimated separately. The estimated value of impacts for the forecast years was converted to an estimated Net Present Value (NPV) of accident savings in 2010 prices and valued over a 60-year appraisal period (2021-2080). The results of this calculation are shown in Table 8.1 – Accident Benefits.

8.3.2 Accident benefits were calculated for the study area using default national accident rates. A breakdown is detailed in Table 8.1.

Table 8.1 – Accident Benefits

Element	Do Minimum	Do Something	Scheme Benefit
Accident Numbers – Links	1054	1071	-17
Accident Numbers – Junctions	2889	1175	1713
Accident Numbers – Total	3943	2246	1697
Accident Costs – Links	£59,187k	£60,146k	£-959k
Accidents costs – Junctions	£159,888k	£61,070k	£98,818k
Casualties – Slight	5682	3113	2569
Casualties – Serious	644	335	309
Casualties – Fatal	82	47	35
Casualties – Total	6408	3495	2913
Accident Total Costs	£219,075k	£121,216k	£97,859k

All costs are in £k 2010 Prices, discounted to 2010, 3.5% discount rate for 30 years, thereafter 3.0%.

8.3.3 There is an increase in the number of predicted accidents on links. This results in an increase of seventeen accidents (a disbenefit of -£959k) over the 60-year appraisal

period. This is due to an increase in vehicle kilometres travelled with the scheme in place.

8.3.4 The number and cost of accidents at junctions reduces by nearly 60% as a result of junction improvements, closures of the median crossovers and conversion of existing junctions to left-in, left-out arrangements. This generates a £98,818k benefit arising from the junction accidents savings. Overall, the number of accidents on links and at junctions decreases by 43% (1,697) over the 60-year appraisal period.

8.3.5 The number of casualties reduces by 45% (2,913), with 2,569 fewer slight casualties, 309 fewer serious casualties and 35 fewer fatalities. Accordingly, the costs associated with these accidents reduce from £219,075k in the Do Minimum to £121,216k in the Do Something. This produces an overall accident benefit for the scheme of £97,859k over the 60-year appraisal period.

8.4 Chinauley Park Microsimulation

8.4.1 During the public consultation process, local residents of the Chinauley Park Estate raised concerns that the proposed Castlewellan Road northbound merge slip would adversely affect the operation of the adjacent junction with Chinauley Park, restricting access to the Chinauley Estate during peak times. A microsimulation model was developed using Paramics Discovery software to assess the operation of the proposals at this location for the opening year to review the concerns raised.

8.4.2 An Automatic Number Plate Recognition survey was undertaken in April 2018 to provide existing traffic movements in the area. This provided origin-destination data at the existing priority junction of Castlewellan Road and Chinauley Park. The ANPR survey also provided journey times between survey points for use in validation of the model. Queue length data was also recorded to understand capacity at this location and for use in calibration of the model.

8.4.3 Full calibration and validation data is presented in Appendix B. The base model representing traffic flows during the peak hours of 0800-0900 and 1700-1800.is deemed to be a good representation of existing conditions and fit for the purpose of assessing changes proposed at this location.

8.4.4 Forecast traffic flows from the spreadsheet model have been applied to the Paramics model to create 2021 Do Minimum and Do Something scenarios. The Do Minimum model represents a scenario with 2021 traffic flows and no proposed scheme is in place i.e. vehicles continue to access the A1 northbound via the existing junction with Old Manse Road. The Do Something represents a scenario with 2021 traffic flows and the proposed scheme in place. Northbound vehicles access the A1 via the proposed northbound merge slip and the right-turn from Old Manse Road to A1 northbound is closed. The northbound slip is assumed to operate as a priority junction with

Castlewellan Road. A comparison of the Do Minimum and Do Something Paramics model scenarios allows an operational assessment of impacts of the scheme at this location.

8.4.5 Journey time data output from the models indicate that journey times for vehicles travelling through the Castlewellan Road/Chinauley Park junction have either decreased or remained similar after the introduction of the scheme. The modelling predicts either an improvement or very similar operation of the existing junction with the scheme in place for different journey time routes.

8.4.6 Queue data output from the models indicate that maximum queue lengths at this location have either decreased or remained similar after the introduction of the scheme. The modelling predicts either an improvement or very similar operation of the existing junction with the scheme in place.

9 ECONOMIC APPRAISAL

9.1 COBA Appraisal

9.1.1 The COBA (COst Benefit Analysis) program is an economic assessment tool which can be used to assess the Transport Economic Efficiency, Accident and Greenhouse Gases impacts of proposed projects. In particular, COBA compares the costs of a proposed highway scheme with the benefits derived by road users (in terms of time, vehicle operating costs and accidents), and expresses the results in terms of a monetary valuation. The output contributes to the appraisal process in the following ways:

- 'Transport Economic Efficiency': Time and Vehicle Operating Cost (VOC) changes:
- 'Accidents': Changes in Accident Costs and Casualties;
- 'Greenhouse Gases': Changes in the amount of fuel used to assist in determining changes in carbon dioxide emissions.

9.1.2 The total costs of the scheme are considered in terms of capital costs and changes in the capital cost of maintenance of the network.

9.1.3 The spreadsheet model has been used to determine changes to traffic flows. These outputs were then input to the DfT COBA software version 11.19.0.1 to identify the economic benefits of the proposed scheme (Do-Something) compared to the Do-Minimum scenario.

9.2 Costs

9.2.1 The estimated construction costs for the proposed interventions have been calculated based on current market rates for projects of a similar nature and value. It is believed that these rates reflect construction costs within the current economic climate. Land, property and compensation costs are based on rates provided by Land and Property Services (LPS) in July 2018.

9.2.2 Construction Price Inflation has been determined at 14.1% and when applied to the construction elements (£43,316k), amounts to £6,108k. Therefore, for the purposes of the economic assessments, the Cost Estimate of the Preferred Scheme, including Construction Price Inflation, is £72,782k (Q1 2018 prices).

9.2.3 The Stage 3 appraisal is based on the scheme cost estimates presented in Table 9.1.

Table 9.1 – Stage 3 scheme costs estimate (Q1 2018 prices - £k)

Q1 2018 prices	Cost (£k)
Construction Cost	£43,316
Preparation and Supervision	£4,813
Risk Allowance	£3,643
Optimism Bias	£3,883
Lands & Compensation	£6,988
Costs Incurred to Date	£4,031
Construction Stage Inflation (14.1%)	£6,108
TOTAL COSTS	£72,782

9.3 Assessment of Risk

9.3.1 Construction schemes contain a number of uncertainties that have the potential to impact upon the scheme costs. Risk Analysis and Management is a structured approach to identifying, assessing and controlling risk that emerges during the course of a project lifecycle. Its task is to ensure a cost-effective use of a risk process that has a series of well-defined steps to support better decision-making through good understanding of the risks inherent in a proposal and their likely impact.

9.3.2 Risk Management Workshops, attended by the scheme stakeholders, identified and assessed the key risks likely to emerge during the design and construction lifecycle of the scheme. Based on these reviews, Monte Carlo simulation software (@RISK) was utilised to calculate an appropriate risk premium for inclusion in the Cost Estimate to account for those uncertainties.

9.4 Optimism Bias

Optimism bias is defined as the systematic tendency for project appraisers to underestimate their scheme's cost (and therefore overestimate the strength of its economic case). In line with guidance, the cost estimates have been uplifted by 7.5% to allow for optimism bias. No optimism bias has been applied to lands and compensation costs.

9.5 Transport Economic Efficiency Results

9.5.1 The COBA results for the scheme are shown in Table 9.2.

9.5.2 Diagrams of the COBA network for both the Do Minimum and Do Something schemes are presented in Appendix C.

Table 9.2 – TEE COBA Results for Scheme Proposals (£k)

Stage 3 Economic Assessment	£(k)
Expenditure	
(A) Operating Costs*	£0
(B) Investment Costs	£53,955
Present Value of Costs A+B = PVC	£53,955
Benefits	
(C) Consumer User Benefits	£11,152
(D) Business Benefits	£11,807
(E) Private Sector Provider Impacts	£61
(F) Accident Benefits	£97,859
(G) Indirect Tax Revenues	£-2,299
(H) Emissions Benefits	£397
Present Value of Benefits C+D+E+F+G+H = PVB	£118,976
Overall Impacts	
Net Present Value (PVB – PVC = NPV)	£65,021
Benefit/Cost Ratio (PVB / PVC = BCR)	2.21

All costs are 2010 values and 2010 prices. A discount rate of 3.5% per annum has been applied to the first 30 years after scheme opening, followed by 3.0% per annum thereafter.

*Operating costs are included in Table 10.2 in Section 10

10 SENSITIVITY TESTS

10.1 Traffic Forecast Sensitivity Tests

10.1.1 TAG Unit M4 "Forecasting and Uncertainty" states that the 'core' forecasting scenario should form the basis for the analysis. The core traffic forecasting scenario for the A1 Junctions Phase 2 scheme utilises the observed 3.02% per annum traffic growth rate, equating to 16.04% between the 2016 base year and 2021 scheme opening year. The core scenario also includes the development traffic associated with the Bridgewater Park proposals.

10.1.2 The core scenario is therefore considered to be the most realistic and plausible reflection of future year conditions. In terms of the Economic Assessment, the COBA analysis utilises the 2021 opening year Do Minimum and Do Something flows and reverts to default national central growth rates after this date. This results in a NPV of £65,021k and BCR of 2.21 for the core scenario.

10.1.3 However, TAG Unit M4 notes that there is no guarantee that the outturn will match the assumptions made for the core scenario. Where traffic demand is higher than anticipated then a particular scheme may not be as effective in reducing congestion and adverse safety or environmental effects may be experienced. Conversely, in a low demand scenario, a particular scheme may not be economically viable.

10.1.4 TAG Unit M4 therefore recommends that alternative scenarios consider both high and low growth situations. The alternative scenarios are discussed in further detail in the previous chapter. The Low growth scenario utilises a 10.45% growth rate between 2016 and 2021 and the High growth scenario utilises a 21.63% growth rate for the same period. In both scenarios, the development traffic associated with the Bridgewater Park proposals is also included. The growth rate again reverts to default national central growth rates in COBA after this date. Default national accident rates have also been assumed in these scenarios.

10.1.5 Table 10.1 presents the results of the COBA assessments for the Low, Core and High growth scenarios. For the Low growth scenario, the assessments show that a positive NPV of £58,366k and BCR of 2.08 is generated. The lower number of users on the network results in lower benefits overall.

Table 10.1 – TEE COBA Results for Scheme Proposals – Low and High Growth Scenarios (£k)

STAGE 3 ECONOMIC ASSESSMENT	LOW	CORE	HIGH
Expenditure			
(A) Operating Costs*	£0	£0	£0
(B) Investment Costs	£53,955	£53,955	£53,955
Present Value of Costs A+B = PVC	£53,955	£53,955	£53,955
Benefits			
(C) Consumer Benefits	£8,929	£11,152	£9,623
(D) Business Benefits	£9,746	£11,807	£10,601
(E) Private Sector Provider Impacts	£41	£61	£45
(F) Accident Benefits	£95,042	£97,859	£99,902
(G) Indirect Tax Revenues	£-1,737	£-2,299	£-1,915
(H) Emissions Benefits	£299	£397	£330
Present Value of Benefits C+D+E+F+G+H = PVB	£112,321	£118,976	£118,587
Overall Impacts			
Net Present Value (PVB – PVC = NPV)	£58,366	£65,021	£64,632
Benefit/Cost Ratio (PVB / PVC = BCR)	2.08	2.21	2.20

All costs are 2010 values and 2010 prices. A discount rate of 3.5% per annum has been applied to the first 30 years after scheme opening, followed by 3.0% per annum thereafter.

*Operating costs are included in Table 10.2

10.1.6 The assessments for the High growth scenario also show a positive NPV of £64,632k and BCR of 2.20. The NPV and BCR is similar to that of the Core growth scenario but marginally lower; the increase in traffic results in an increase in accident benefits however this is offset by reduced consumer and business benefits resulting in the marginally lower NPV and BCR figures when compared to the Core growth scenario.

10.1.7 The alternative scenarios produce BCRs ranging from 2.08 to 2.21 based on the COBA assessment. This shows that the scheme would generate benefits in alternative traffic growth scenarios.

10.2 QUADRO Appraisal

10.2.1 As part of the Stage 3 economic assessment a Queues And Delays at Roadworks (QUADRO) model was constructed to assess the delay costs to road users of regular maintenance and construction works e.g. delays due to reduced speed limit/diversionary works.

10.2.2 Table 10.2 below, presents a revised BCR accounting for impacts of construction and maintenance.

Table 10.2 – Combined COBA and QUADRO Results

Costs in 2010 Values and Prices (£)	Do Minimum Maintenance	Do Something Maintenance	Do Something Construction
Net Consumer Impact	10,645,116	10,683,214	684,729
Net Business Impact	5,481,993	5,505,604	377,959
Fuel Carbon Emission Costs	- 5,119	- 5120	46
Indirect Tax Revenues	843,322	843,689	- 34,329
PVB (Consumer + Business Impact + Carbon Emission + Indirect Tax Revenues)	-16,965,312	-17,027,387	-1,028,405
PVC (Maintenance Costs)	16,087,000	18,017,000	-
QUADRO PVB (Do Som PVB + Construction PVB – DoMin PVB)	-1,090,480		
QUADRO PVC (Do Som PVC – DoMin PVC)	1,930,000		
QUADRO NPV (PVB - PVC)	-3,020,480		
Combined COBA and QUADRO Results	Costs in 2010 Values and Prices (£)		
COMBINED PVB	117,886,000		
COMBINED PVC	55,885,000		
COMBINED NPV	62,001,000		
COMBINED BCR	2.11		

10.2.3 Considering the additional costs for users during construction and maintenance in QUADRO, analysis reduces the NPV to £62,001k based on a core growth scenario. This generates a BCR of 2.11, which is considered value for money.

11 CONCLUSION

11.1 My evidence has described the data collection surveys undertaken to define baseline conditions, the development, validation and application of the traffic model, the results of the operational and economic assessments of the Proposed Scheme and the results of sensitivity tests.

11.1.1 The improvements to the A1 and its junctions will improve junction capacity and the reliability and safety of the strategic transport network in the area. The scheme will provide a more consistent route and improved safety by closing gaps in the central reserve to ban right turn and u-turn manoeuvres. Provision of a central reserve barrier along the length of the corridor will improve safety as errant vehicles will no longer be able to drift across the central reserve towards oncoming traffic. Other benefits include a more consistent route design and more reliable journey times.

11.2 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 £62,001k and a Benefit to Cost Ratio of 2.11 under the core traffic growth forecast scenario. This includes £97,859k in accident benefits.

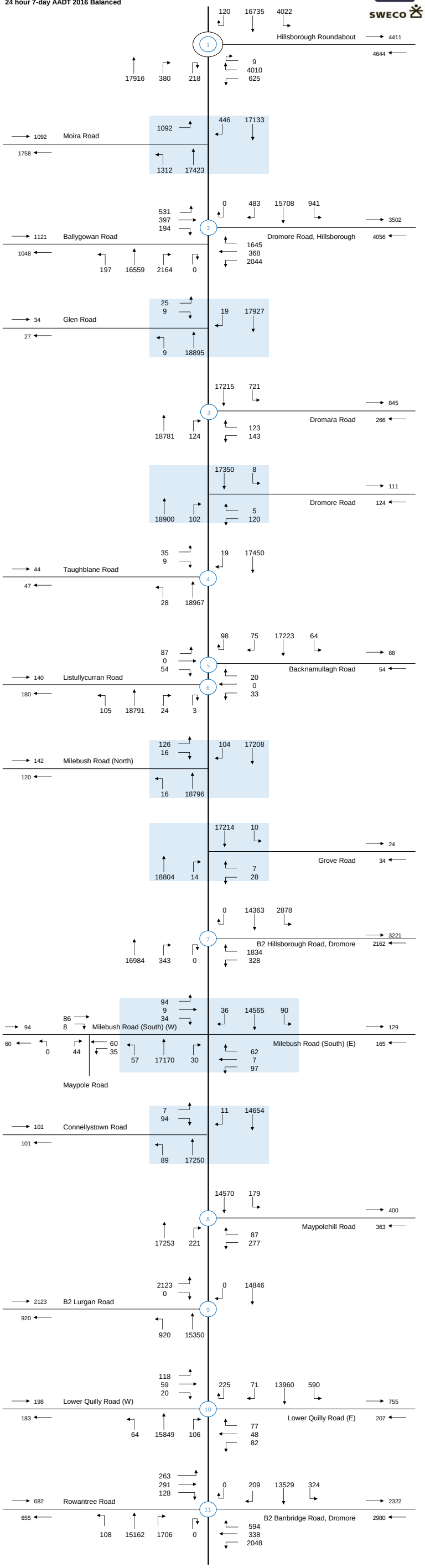
11.3 The results of sensitivity tests indicate that the Proposed Scheme would generate a positive Net Present Value over a range of traffic growth scenarios where the overall benefits exceed the cost of the scheme.

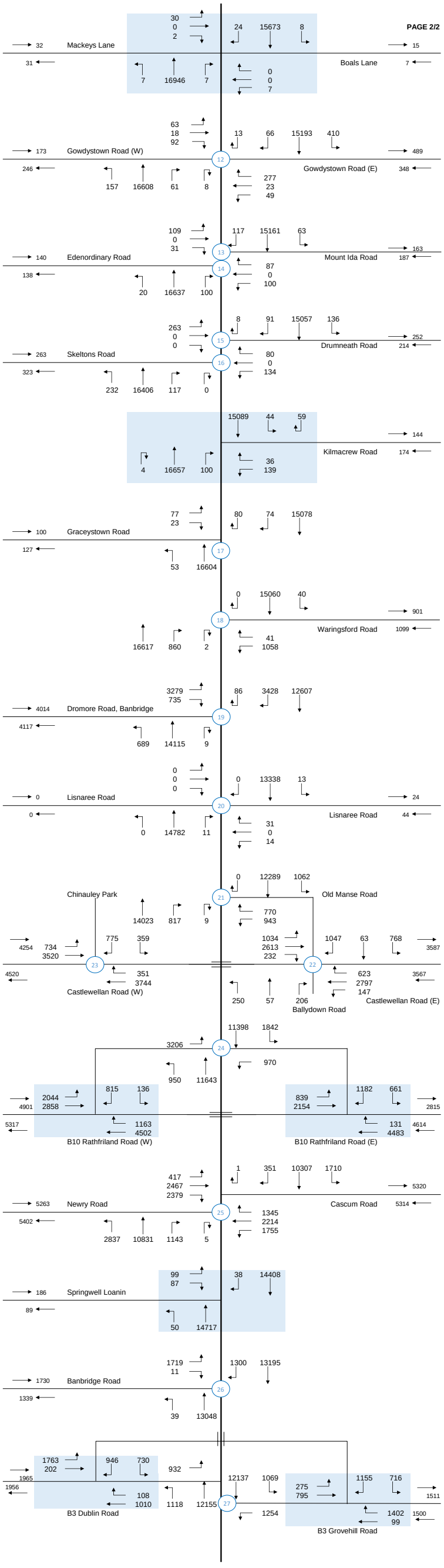
11.4 It is concluded that the Proposed Scheme would improve safety and operating conditions and represents value for money.

APPENDIX A - NETWORK FLOW DIAGRAMS

A1 Junctions Phase 2 - Network Flow Diagrams

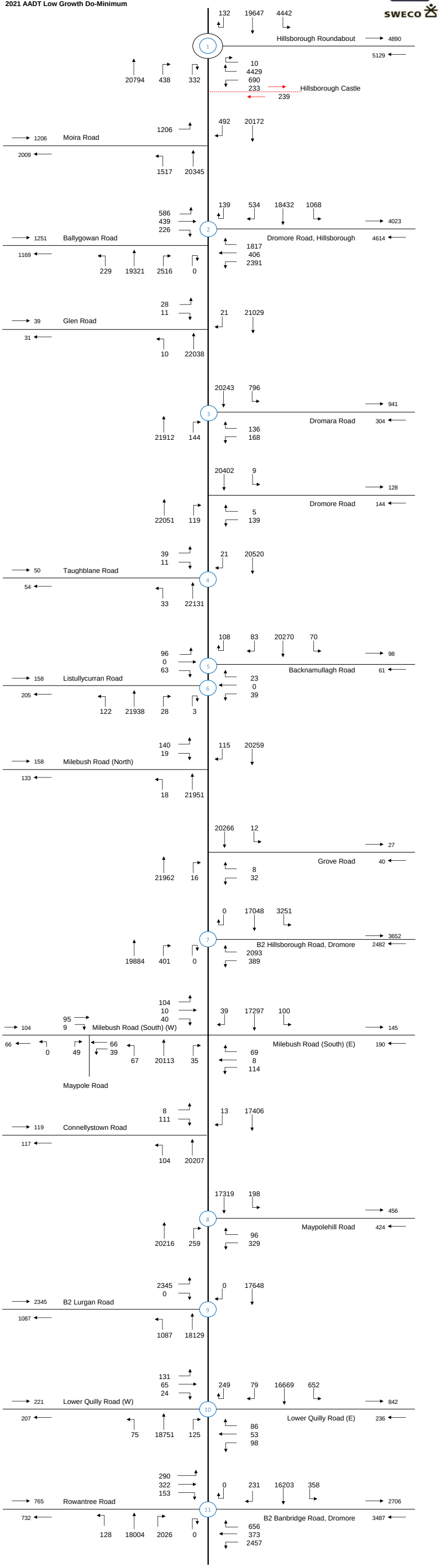
24 hour 7-day AADT 2016 Balanced

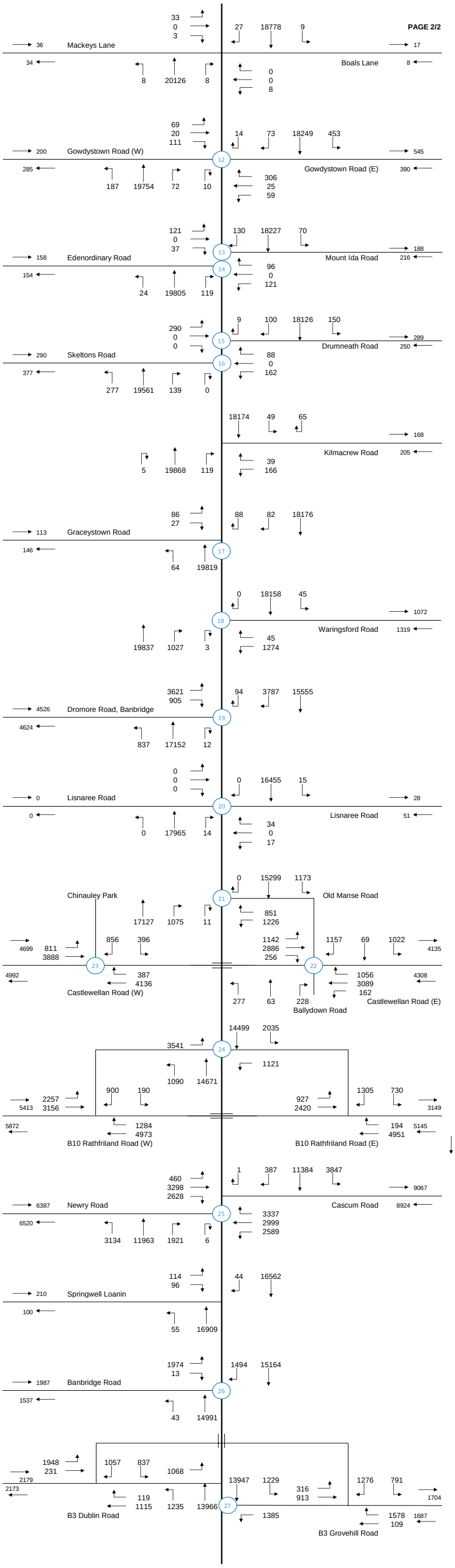



Mackeys Lane
Boals Lane
Gowdystown Road (W)
Gowdystown Road (E)
Edenordinary Road
Mount Ida Road
Skeltons Road
Drumneath Road
Kilmacrew Road
Graceystown Road
Waringsford Road
Dromore Road, Banbridge
Lisnaree Road
Lisnaree Road
Chinauley Park
Old Manse Road
Castlewellan Road (W)
Ballydown Road
Castlewellan Road (E)
B10 Rathfriland Road (W)
B10 Rathfriland Road (E)
Newry Road
Cascum Road
Springwell Loanin
Banbridge Road
B3 Dublin Road
B3 Grovehill Road

A1 Junctions Phase 2 - Network Flow Diagrams

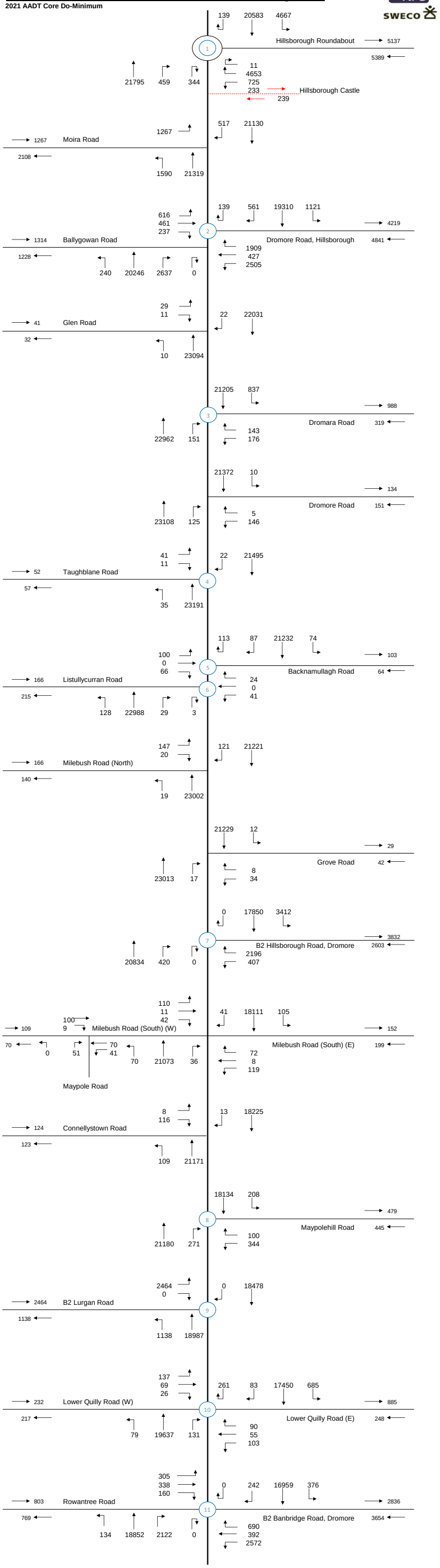
2021 AADT Low Growth Do-Minimum

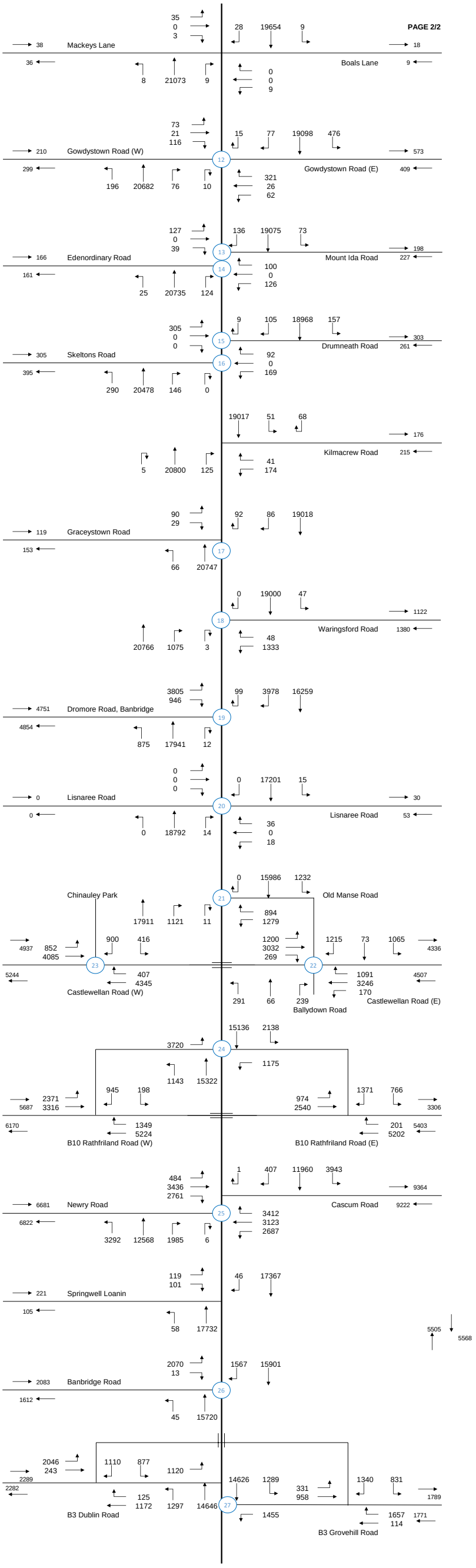



Mackeys Lane
Boals Lane
Gowdystown Road (W)
Gowdystown Road (E)
Edenordinary Road
Mount Ida Road
Skeltons Road
Drumneath Road
Kilmacrew Road
Graceystown Road
Waringsford Road
Dromore Road, Banbridge
Lisnaree Road
Lisnaree Road
Chinauley Park
Old Manse Road
Castlewellan Road (W)
Ballydown Road
Castlewellan Road (E)
B10 Rathfriland Road (W)
B10 Rathfriland Road (E)
Newry Road
Cascum Road
Springwell Loanin
Banbridge Road
B3 Dublin Road
B3 Grovehill Road

A1 Junctions Phase 2 - Network Flow Diagrams

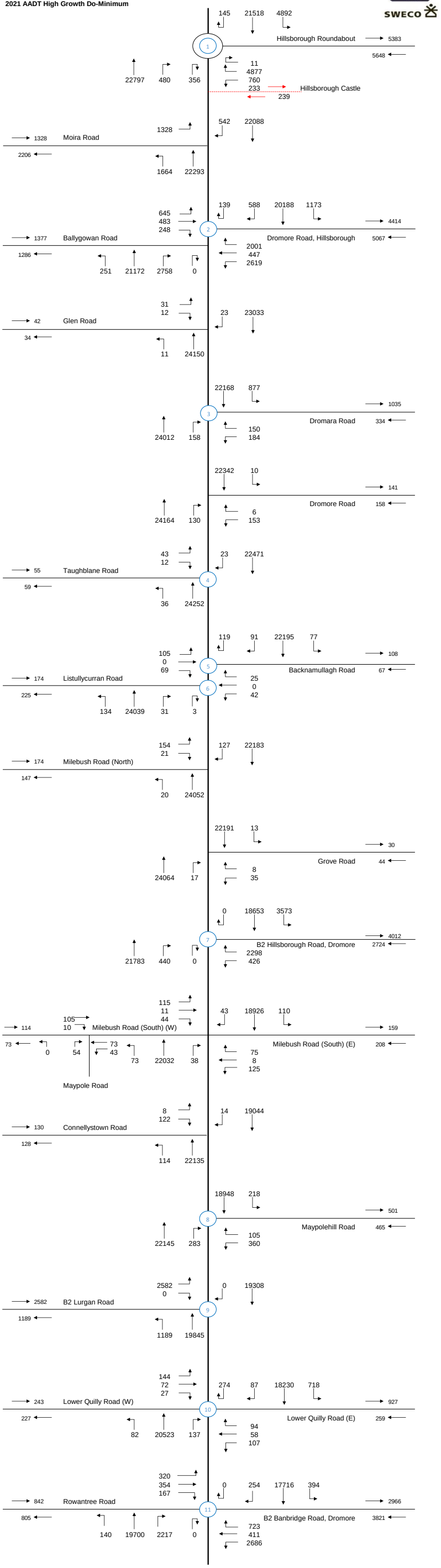
2021 AADT Core Do-Minimum

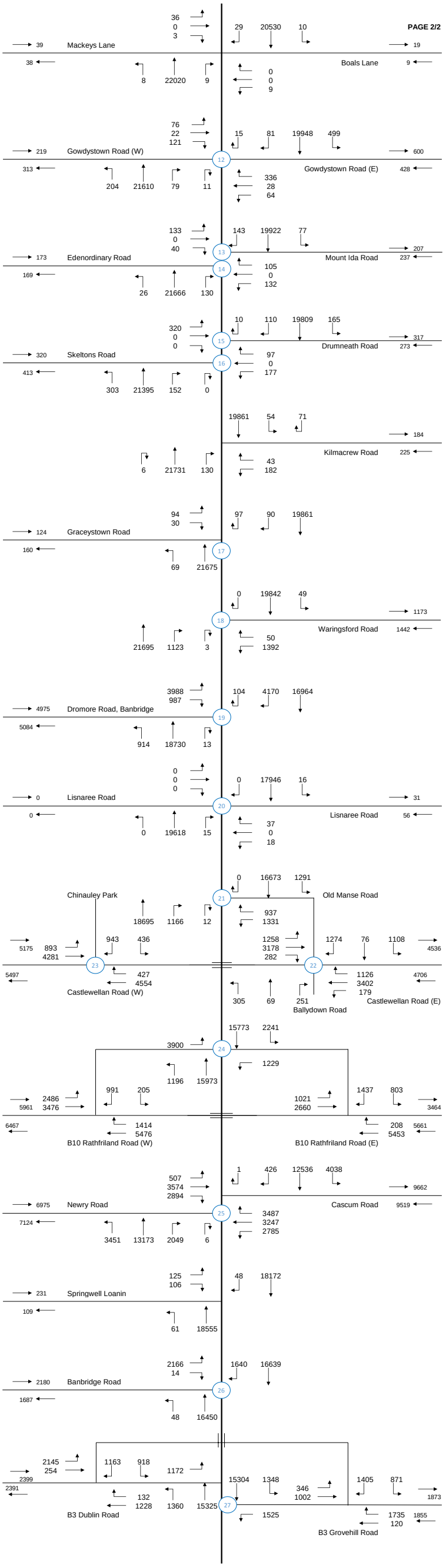



Mackeys Lane
Boals Lane
Gowdystown Road (W)
Gowdystown Road (E)
Edenordinary Road
Mount Ida Road
Skeltons Road
Drumneath Road
Kilmacrew Road
Graceystown Road
Waringsford Road
Dromore Road, Banbridge
Lisnaree Road
Lisnaree Road
Chinauley Park
Old Manse Road
Castlewellan Road (W)
Ballydown Road
Castlewellan Road (E)
B10 Rathfriland Road (W)
B10 Rathfriland Road (E)
Newry Road
Cascum Road
Springwell Loanin
Banbridge Road
B3 Dublin Road
B3 Grovehill Road

A1 Junctions Phase 2 - Network Flow Diagrams

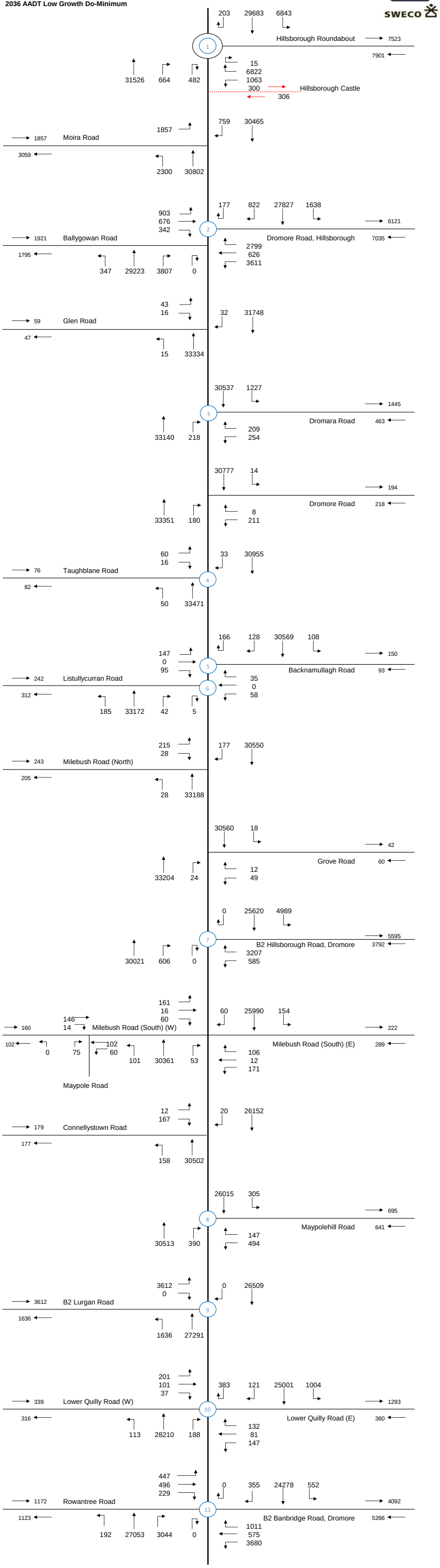
2021 AADT High Growth Do-Minimum

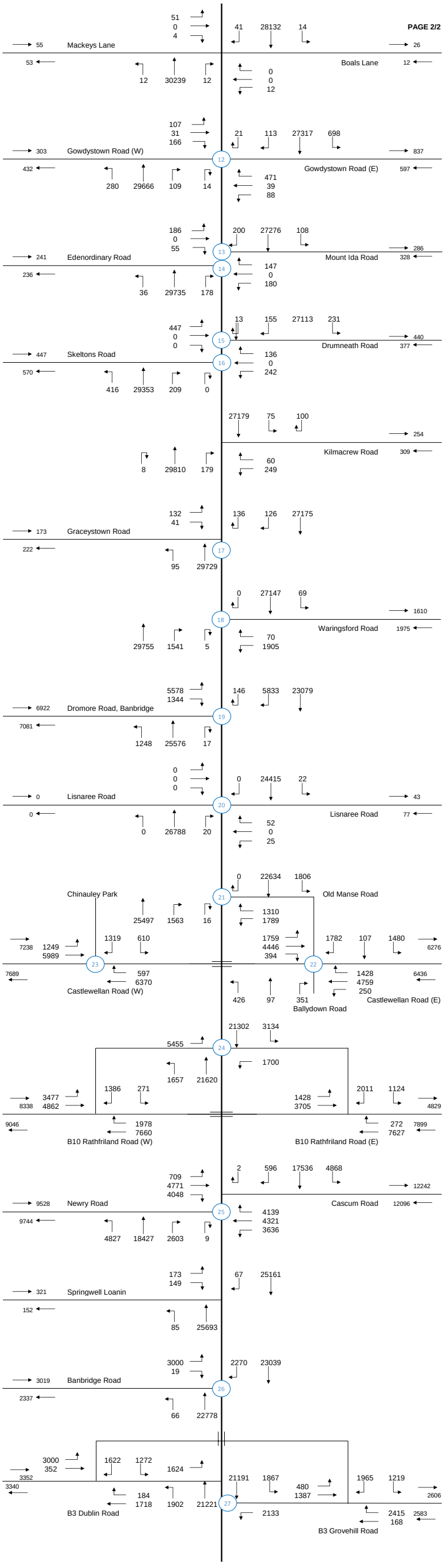



Mackeys Lane
Boals Lane
Gowdystown Road (W)
Gowdystown Road (E)
Edenordinary Road
Mount Ida Road
Skeltons Road
Drumneath Road
Kilmacrew Road
Graceystown Road
Waringsford Road
Dromore Road, Banbridge
Lisnaree Road
Lisnaree Road
Chinauley Park
Old Manse Road
Castlewellan Road (W)
Castlewellan Road (E)
Ballydown Road
B10 Rathfriland Road (W)
B10 Rathfriland Road (E)
Newry Road
Cascum Road
Springwell Loanin
Banbridge Road
B3 Dublin Road
B3 Grovehill Road

A1 Junctions Phase 2 - Network Flow Diagrams

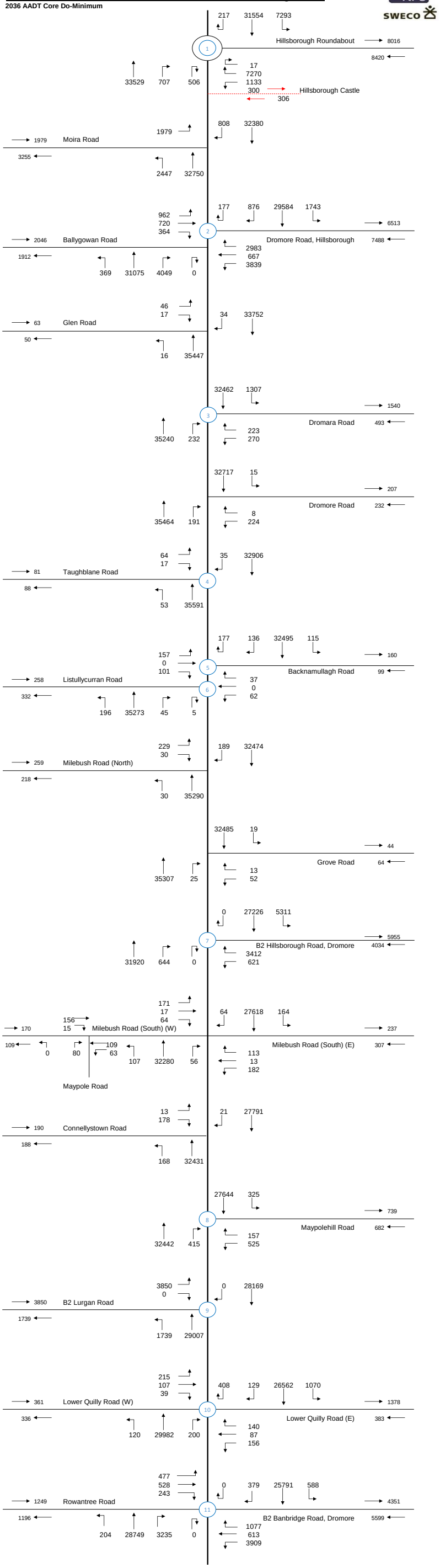
2036 AADT Low Growth Do-Minimum

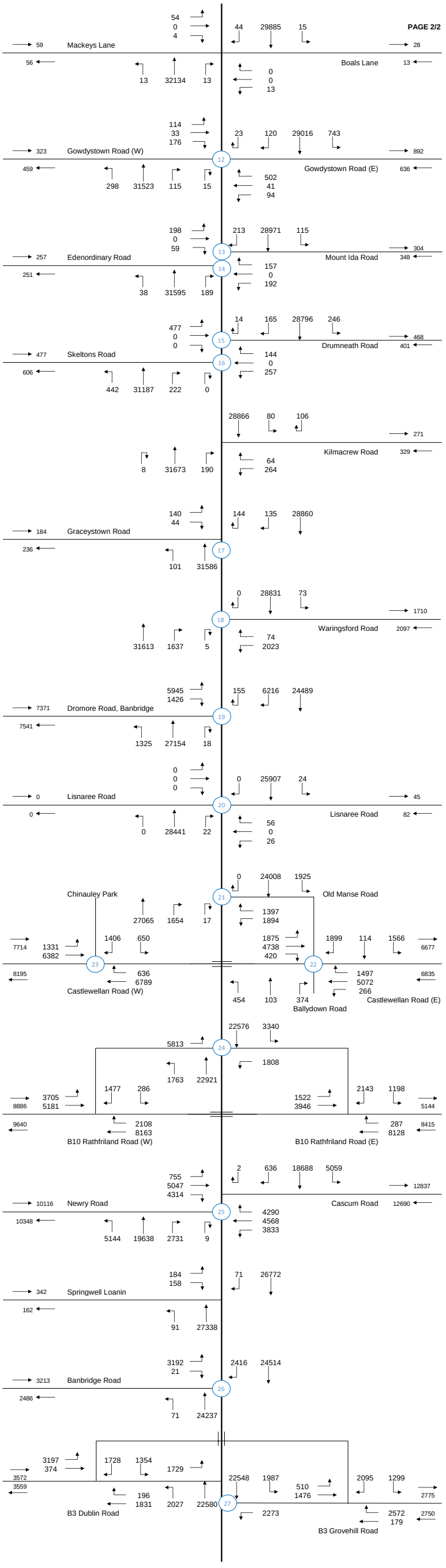



Mackeys Lane
Boals Lane
Gowdystown Road (W)
Gowdystown Road (E)
Edenordinary Road
Mount Ida Road
Skeltons Road
Drumneath Road
Kilmacrew Road
Graceystown Road
Waringsford Road
Dromore Road, Banbridge
Lisnaree Road
Lisnaree Road
Chinauley Park
Old Manse Road
Castlewellan Road (W)
Castlewellan Road (E)
Ballydown Road
B10 Rathfriland Road (W)
B10 Rathfriland Road (E)
Newry Road
Cascum Road
Springwell Loanin
Banbridge Road
B3 Dublin Road
B3 Grovehill Road

A1 Junctions Phase 2 - Network Flow Diagrams

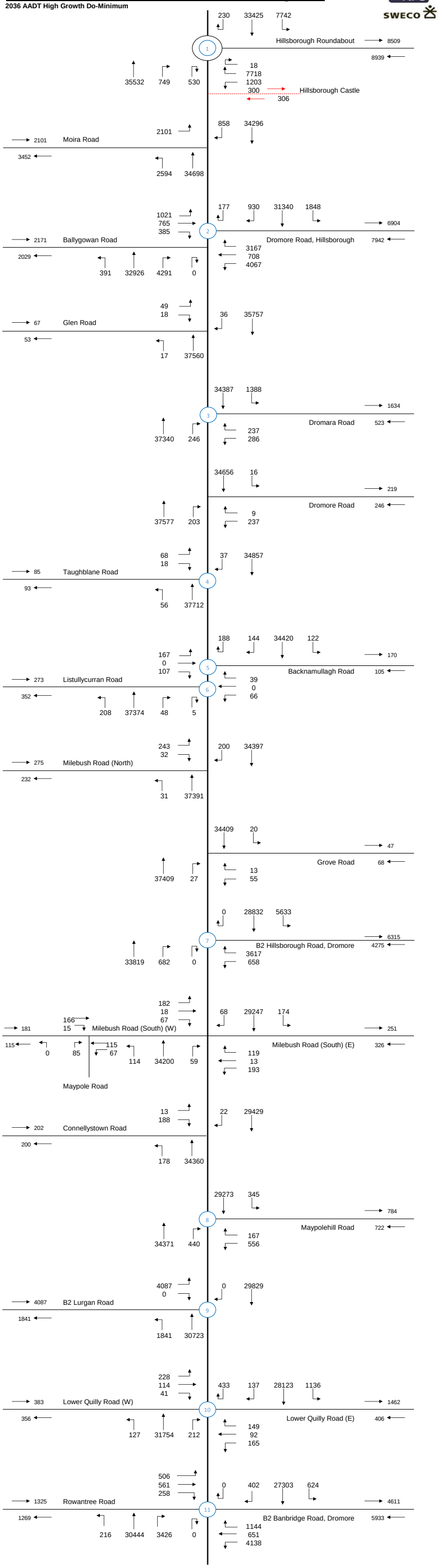
2036 AADT Core Do-Minimum

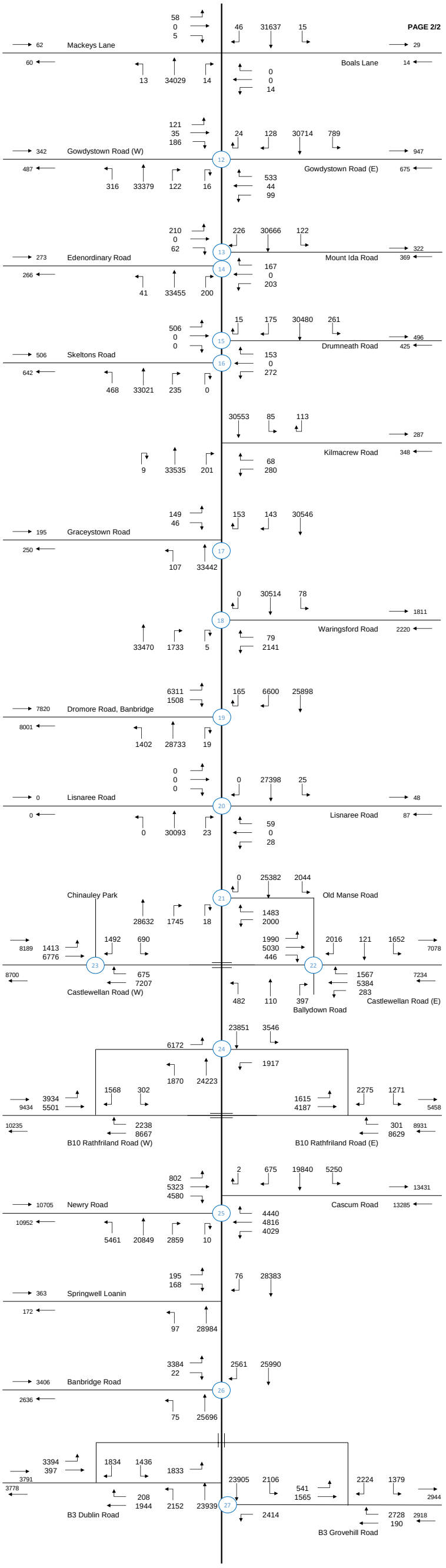



Mackeys Lane
59
54
0
4
44
29885
15
28
56
13
32134
13
Boals Lane
13
0
0
13
Gowdystown Road (W)
323
114
33
176
23
120
29016
743
892
12
459
298
31523
115
15
Gowdystown Road (E)
636
502
41
94
Edenordinary Road
257
198
0
59
213
28971
115
304
13
Mount Ida Road
348
14
251
38
31595
189
157
0
192
Skeltons Road
477
477
0
0
14
165
28796
246
468
15
Drumneath Road
401
16
606
442
31187
222
0
144
0
257
28866
80
106
271
Kilmacrew Road
329
8
31673
190
64
264
Graceystown Road
184
140
44
144
135
28860
236
17
101
31586
0
28831
73
1710
18
Waringsford Road
2097
31613
1637
5
74
2023
Dromore Road, Banbridge
7371
5945
1426
155
6216
24489
7541
19
1325
27154
18
Lisnaree Road
0
0
0
0
25907
24
45
0
20
Lisnaree Road
82
0
28441
22
56
0
26
Chinauley Park
Old Manse Road
0
24008
1925
21
27065
1654
17
1397
1894
7714
1331
6382
1406
650
1875
4738
420
1899
114
1566
6677
23
22
8195
636
6789
1497
5072
266
6835
Castlewellan Road (W)
454
103
374
Ballydown Road
Castlewellan Road (E)
22576
3340
5813
24
1808
1763
22921
3705
5181
1477
286
1522
3946
2143
1198
8886
5144
9640
2108
8163
287
8128
8415
B10 Rathfriland Road (W)
B10 Rathfriland Road (E)
755
5047
4314
2
636
18688
5059
12837
10116
Newry Road
Cascum Road
12690
25
10348
5144
19638
2731
9
4290
4568
3833
184
158
71
26772
342
Springwell Loanin
162
91
27338
3192
21
2416
24514
3213
Banbridge Road
26
2486
71
24237
3197
374
1728
1354
1729
3572
3559
22548
1987
510
1476
2095
1299
2775
196
1831
2027
22580
27
2273
2572
179
2750
B3 Dublin Road
B3 Grovehill Road

A1 Junctions Phase 2 - Network Flow Diagrams

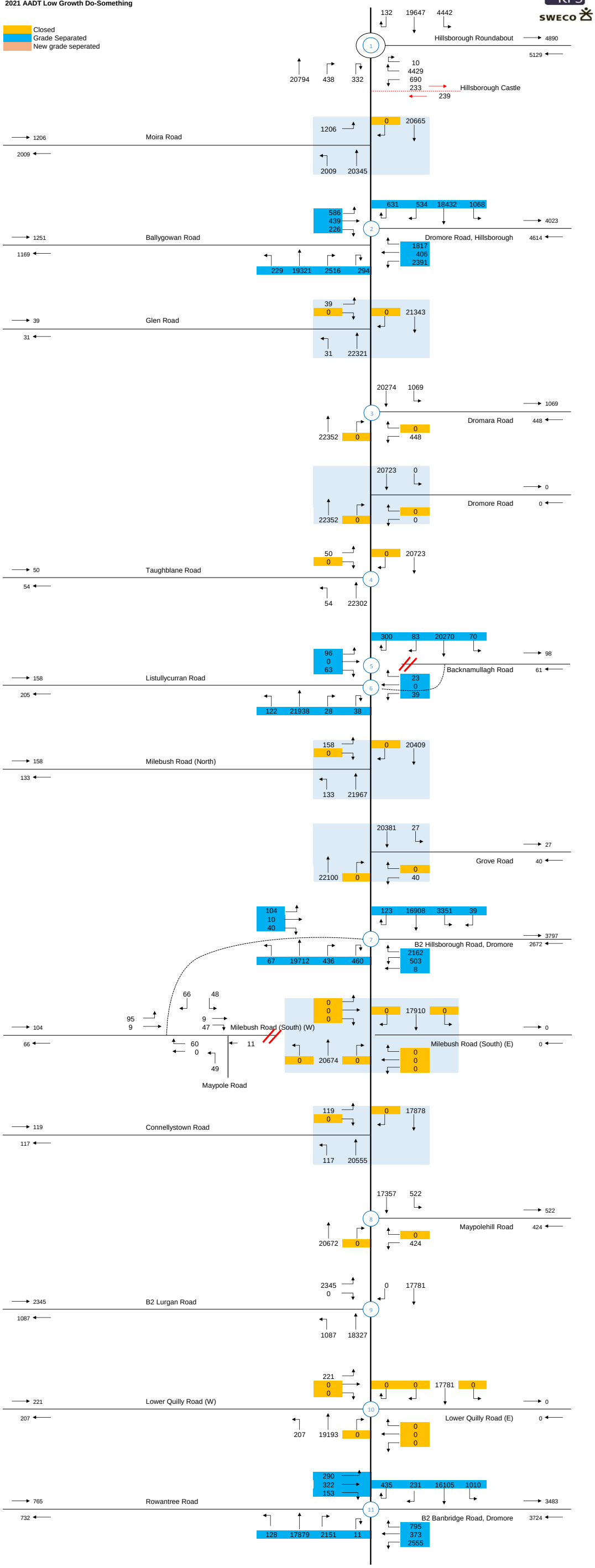
2036 AADT High Growth Do-Minimum

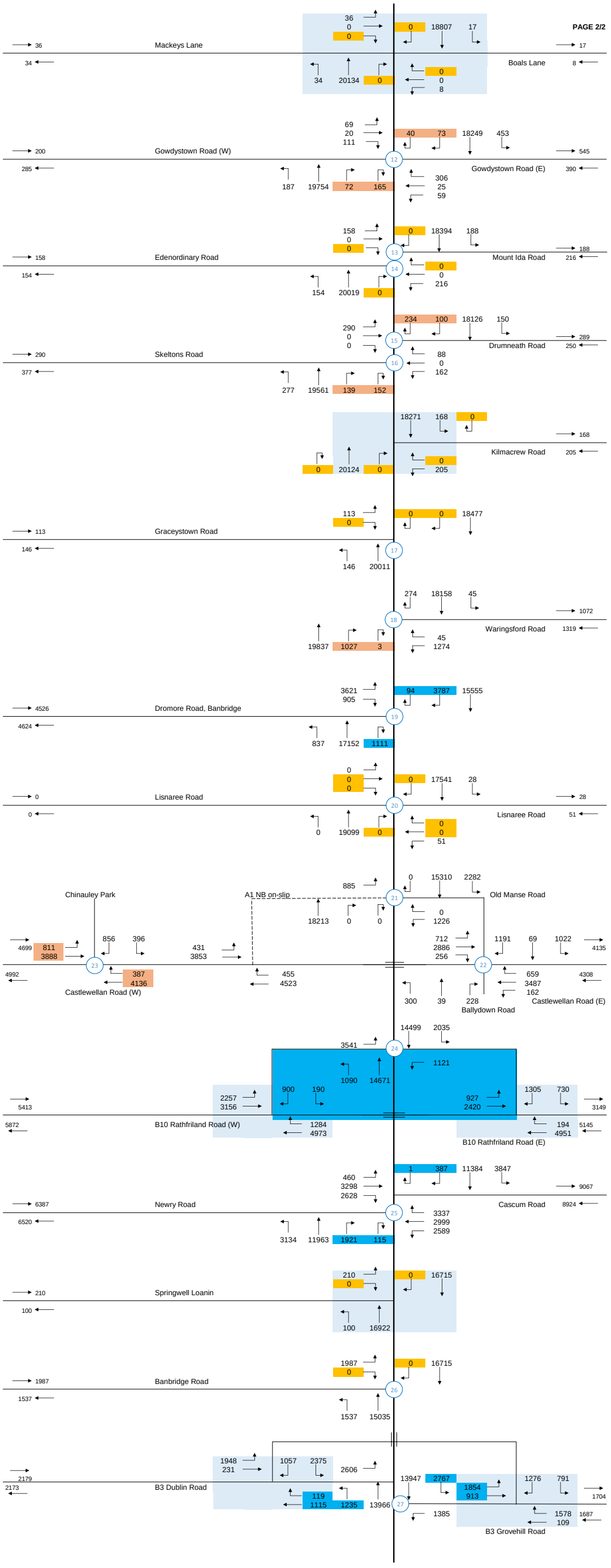



Mackeys Lane
Boals Lane
Gowdystown Road (W)
Gowdystown Road (E)
Edenordinary Road
Mount Ida Road
Skeltons Road
Drumneath Road
Kilmacrew Road
Graceystown Road
Waringsford Road
Dromore Road, Banbridge
Lisnaree Road
Lisnaree Road
Chinauley Park
Old Manse Road
Castlewellan Road (W)
Castlewellan Road (E)
Ballydown Road
B10 Rathfriland Road (W)
B10 Rathfriland Road (E)
Newry Road
Cascum Road
Springwell Loanin
Banbridge Road
B3 Dublin Road
B3 Grovehill Road

A1 Junctions Phase 2 - Network Flow Diagrams

2021 AADT Low Growth Do-Something

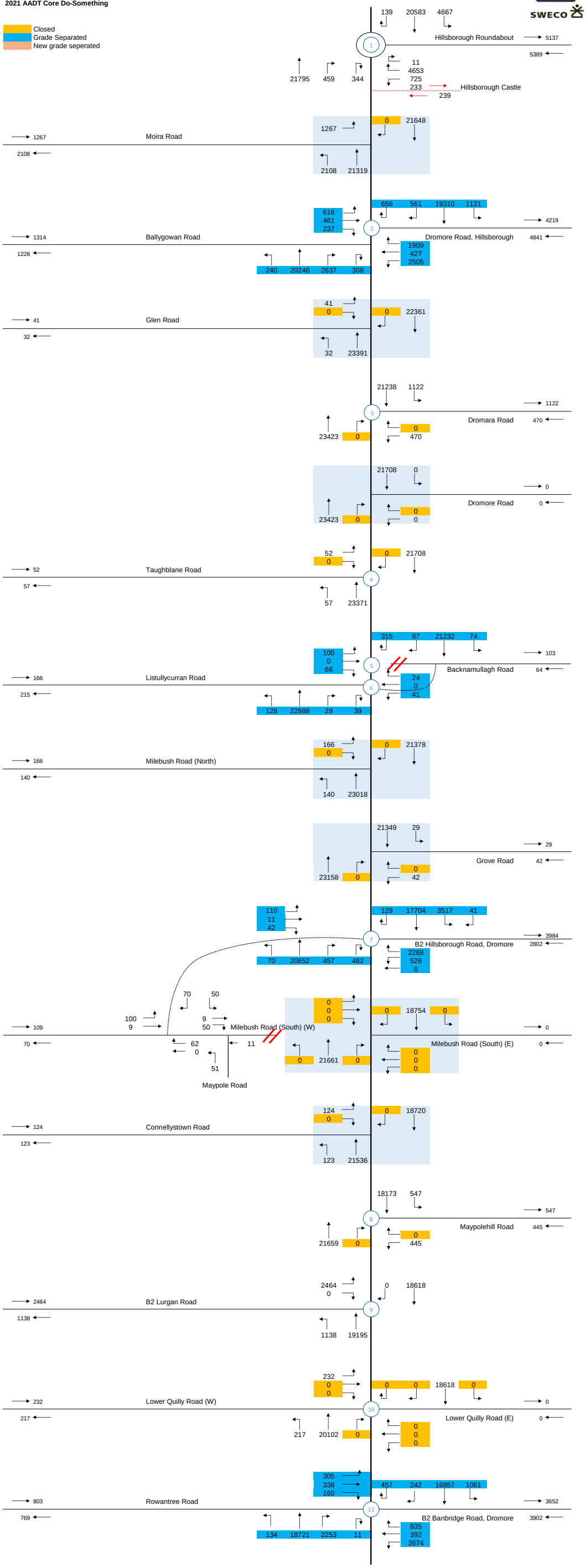


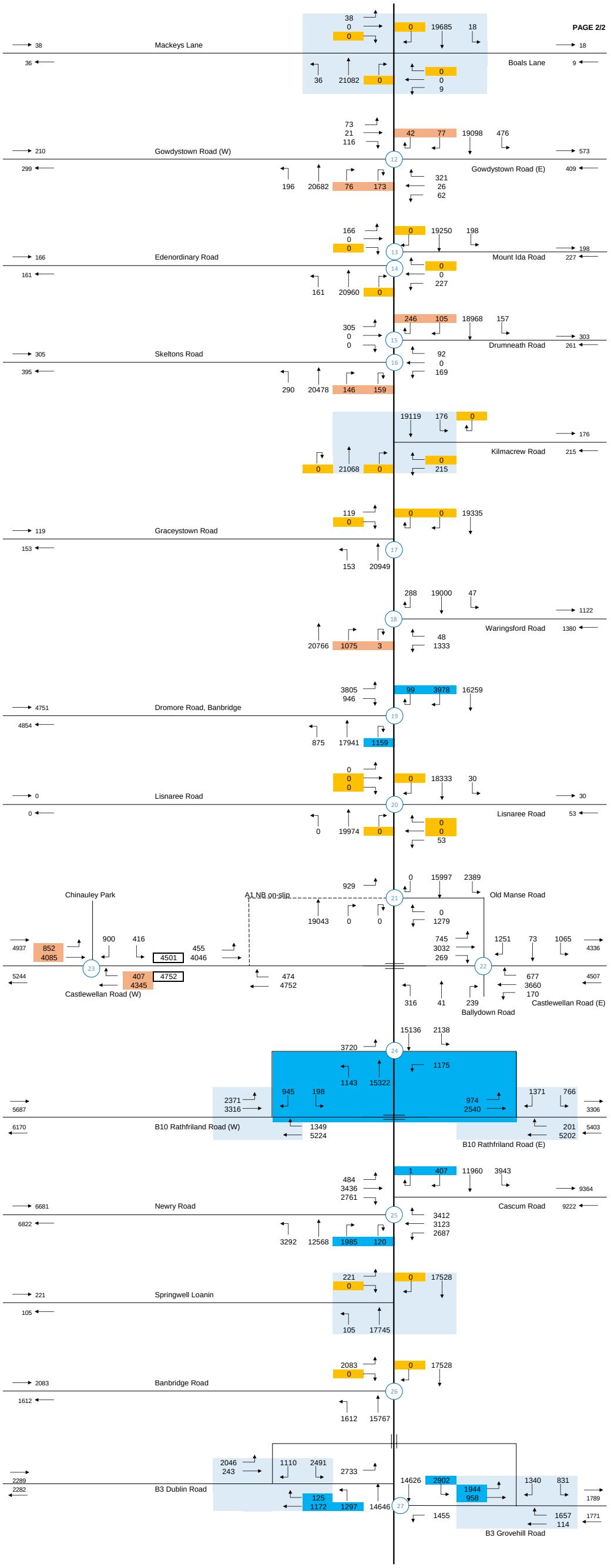

Mackeys Lane
Boals Lane
Gowdystown Road (W)
Gowdystown Road (E)
Edenordinary Road
Mount Ida Road
Skeltons Road
Drumneath Road
Kilmacrew Road
Graceystown Road
Waringsford Road
Dromore Road, Banbridge
Lisnaree Road
Lisnaree Road
Chinauley Park
A1 NB on-slip
Old Manse Road
Castlewellan Road (W)
Ballydown Road
Castlewellan Road (E)
B10 Rathfriland Road (W)
B10 Rathfriland Road (E)
Newry Road
Cascum Road
Springwell Loanin
Banbridge Road
B3 Dublin Road
B3 Grovehill Road

A1 Junctions Phase 2 - Network Flow Diagrams

2021 AADT Core Do-Something

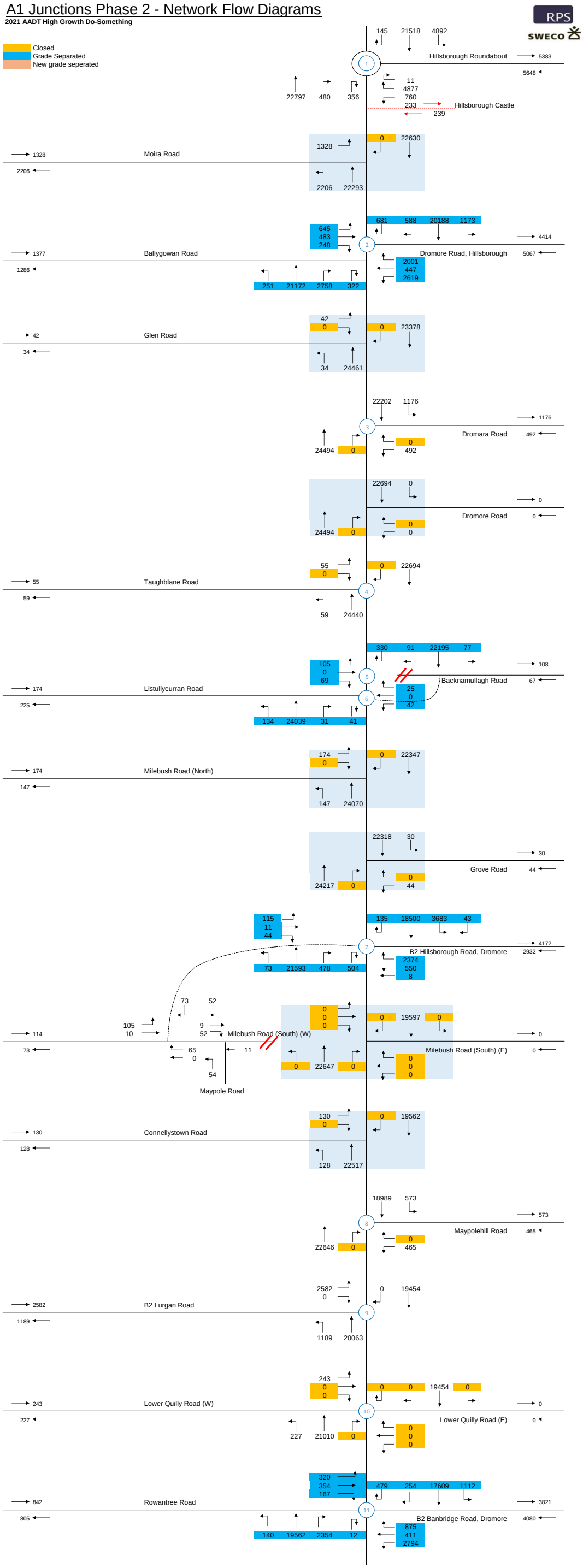
RPS SWECO

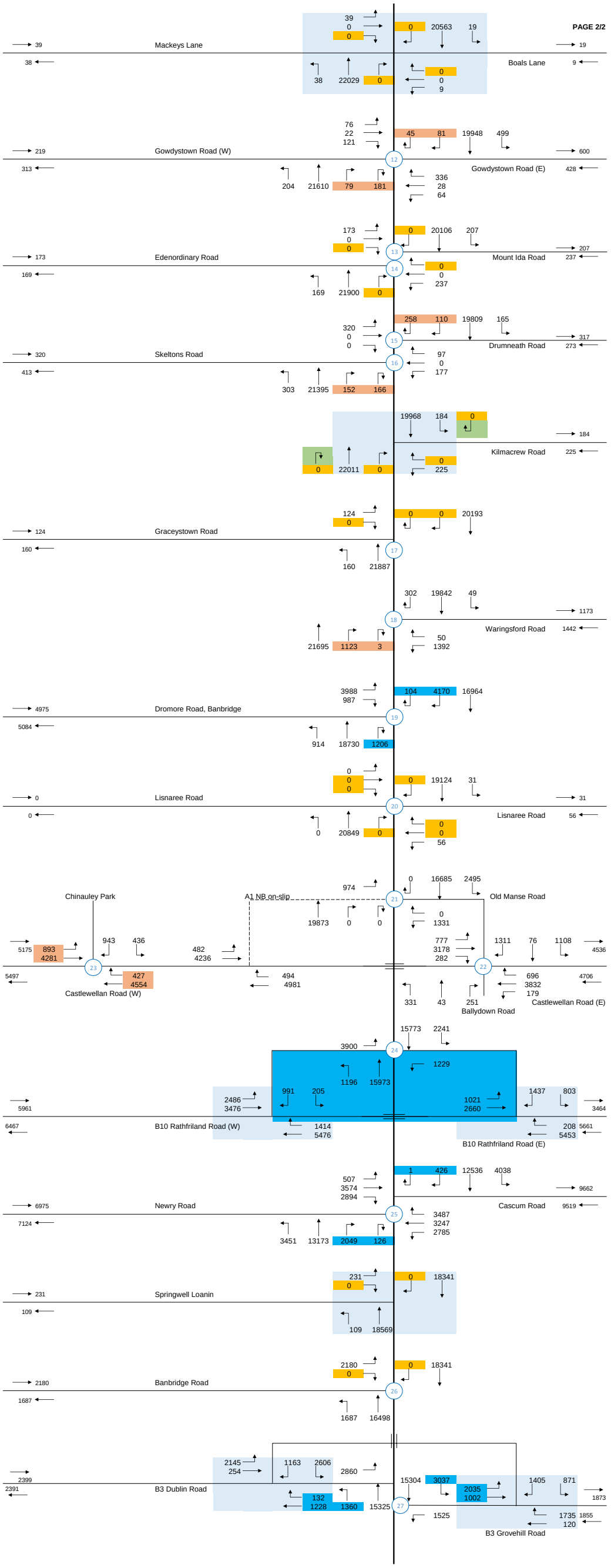



Mackeys Lane
Boals Lane
Gowdystown Road (W)
Gowdystown Road (E)
Edenordinary Road
Mount Ida Road
Skeltons Road
Drumneath Road
Kilmacrew Road
Graceystown Road
Waringsford Road
Dromore Road, Banbridge
Lisnaree Road
Lisnaree Road
Chinauley Park
A1 NB on-slip
Old Manse Road
Castlewellan Road (W)
Ballydown Road
Castlewellan Road (E)
B10 Rathfriland Road (W)
B10 Rathfriland Road (E)
Newry Road
Cascum Road
Springwell Loanin
Banbridge Road
B3 Dublin Road
B3 Grovehill Road

A1 Junctions Phase 2 - Network Flow Diagrams

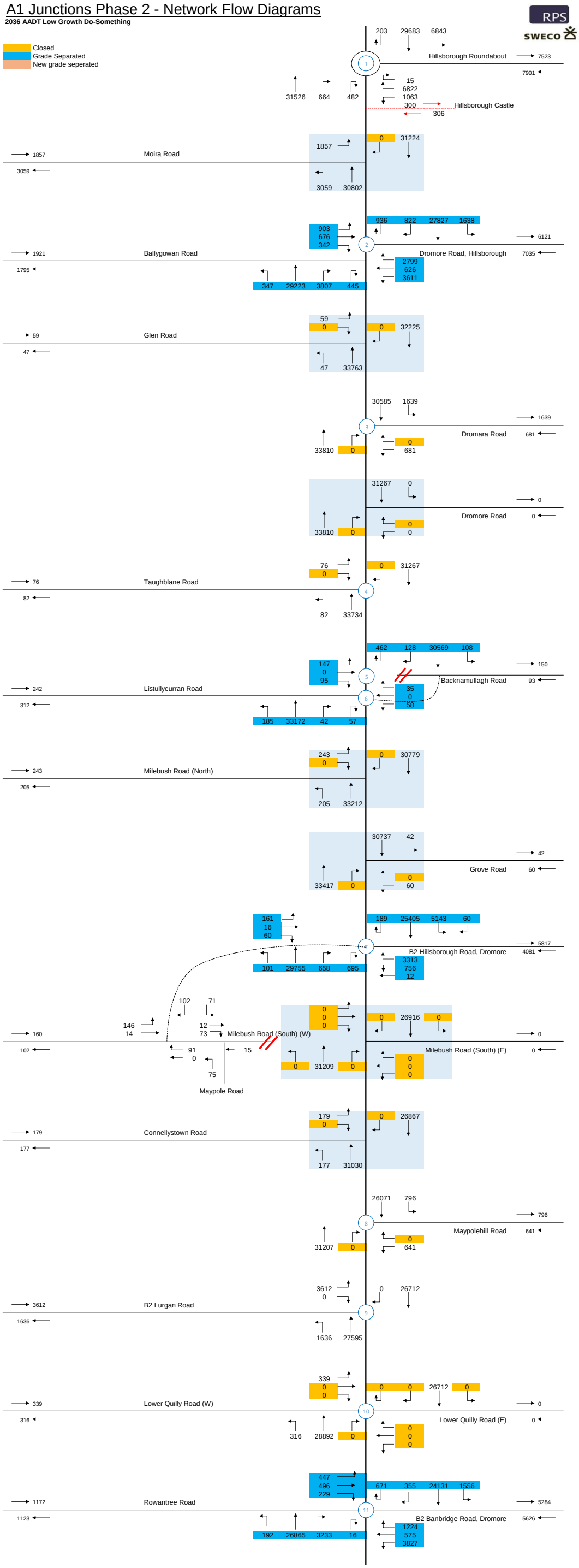
2021 AADT High Growth Do-Something

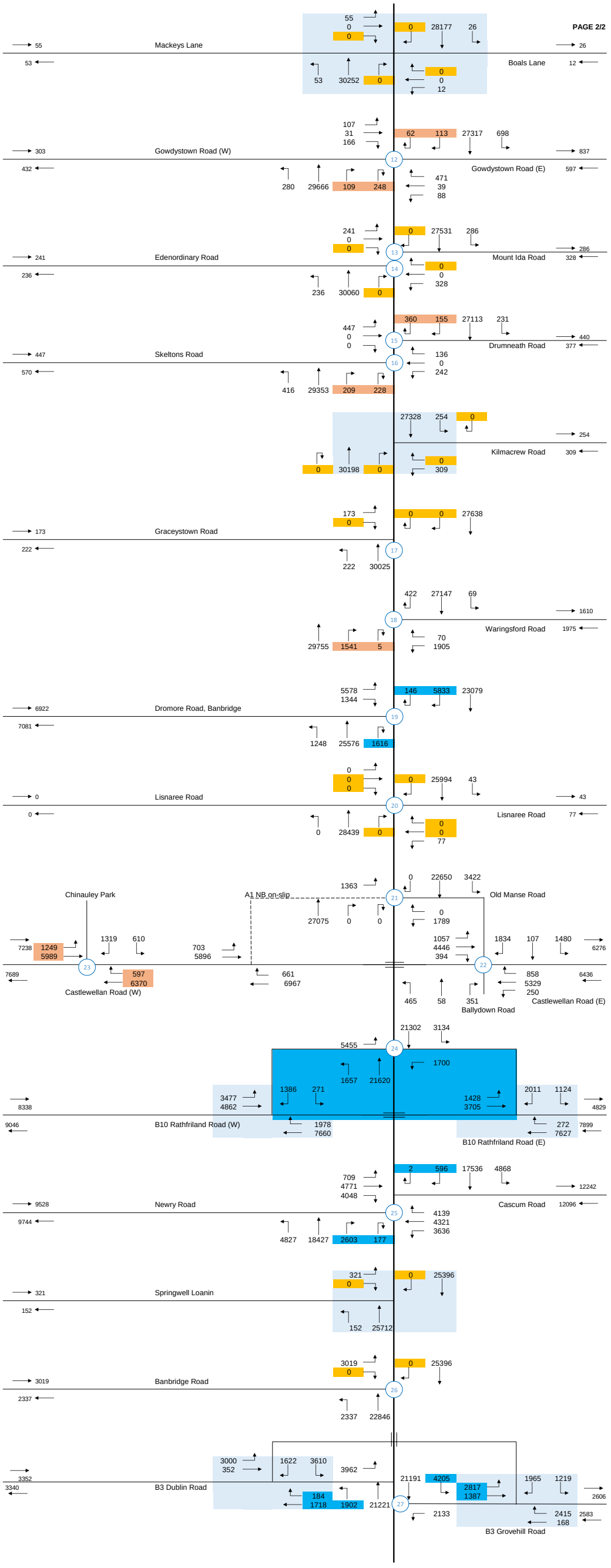



Mackeys Lane
Boals Lane
Gowdystown Road (W)
Gowdystown Road (E)
Edenordinary Road
Mount Ida Road
Skeltons Road
Drumneath Road
Kilmacrew Road
Graceystown Road
Waringsford Road
Dromore Road, Banbridge
Lisnaree Road
Lisnaree Road
Chinauley Park
A1 NB on-slip
Old Manse Road
Castlewellan Road (W)
Ballydown Road
Castlewellan Road (E)
B10 Rathfriland Road (W)
B10 Rathfriland Road (E)
Newry Road
Cascum Road
Springwell Loanin
Banbridge Road
B3 Dublin Road
B3 Grovehill Road

A1 Junctions Phase 2 - Network Flow Diagrams

2036 AADT Low Growth Do-Something

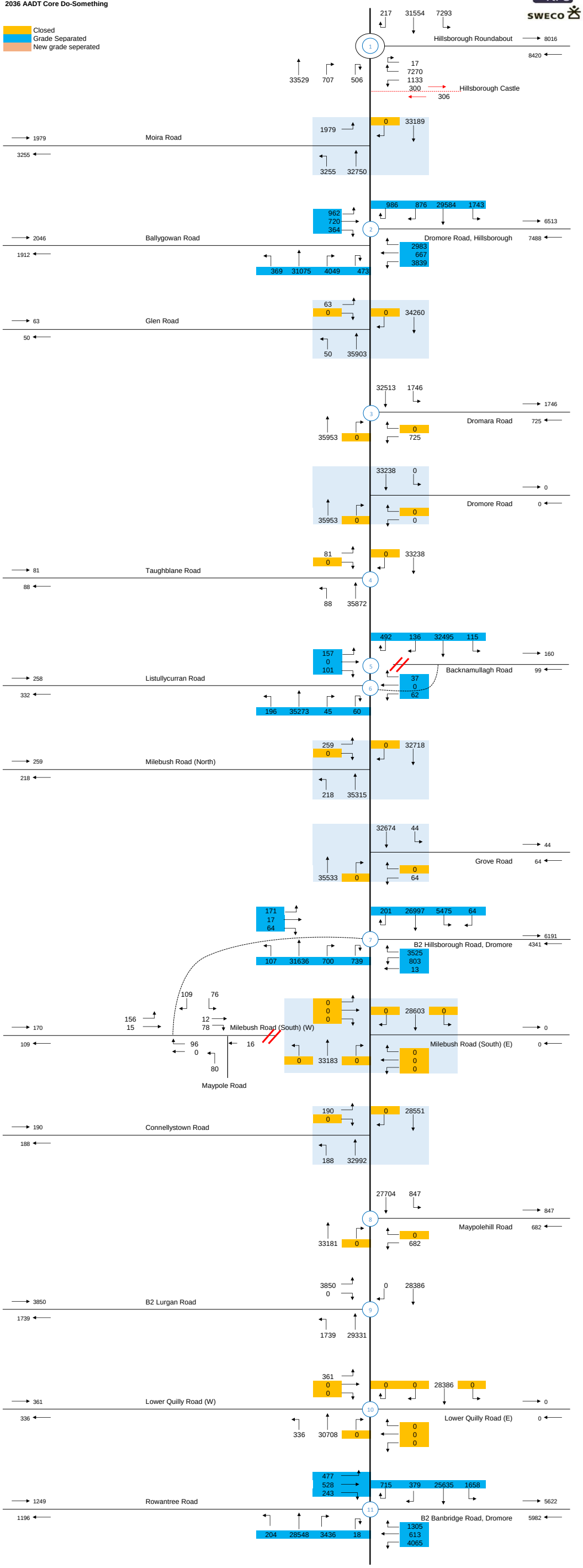


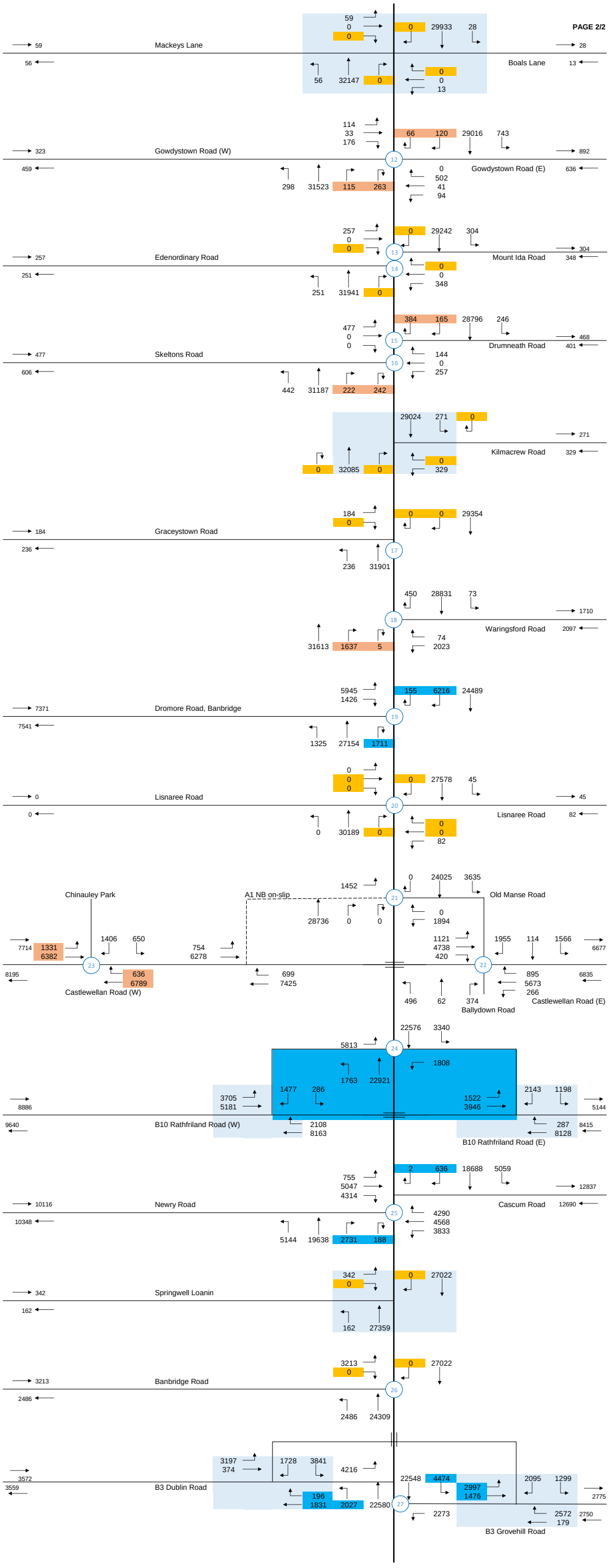

Mackeys Lane
Boals Lane
Gowdystown Road (W)
Gowdystown Road (E)
Edenordinary Road
Mount Ida Road
Skeltons Road
Drumneath Road
Kilmacrew Road
Graceystown Road
Waringsford Road
Dromore Road, Banbridge
Lisnaree Road
Lisnaree Road
Chinauley Park
A1 NB on-slip
Old Manse Road
Castlewellan Road (W)
Ballydown Road
Castlewellan Road (E)
B10 Rathfriland Road (W)
B10 Rathfriland Road (E)
Newry Road
Cascum Road
Springwell Loanin
Banbridge Road
B3 Dublin Road
B3 Grovehill Road

A1 Junctions Phase 2 - Network Flow Diagrams

2036 AADT Core Do-Something

RPS SWECO

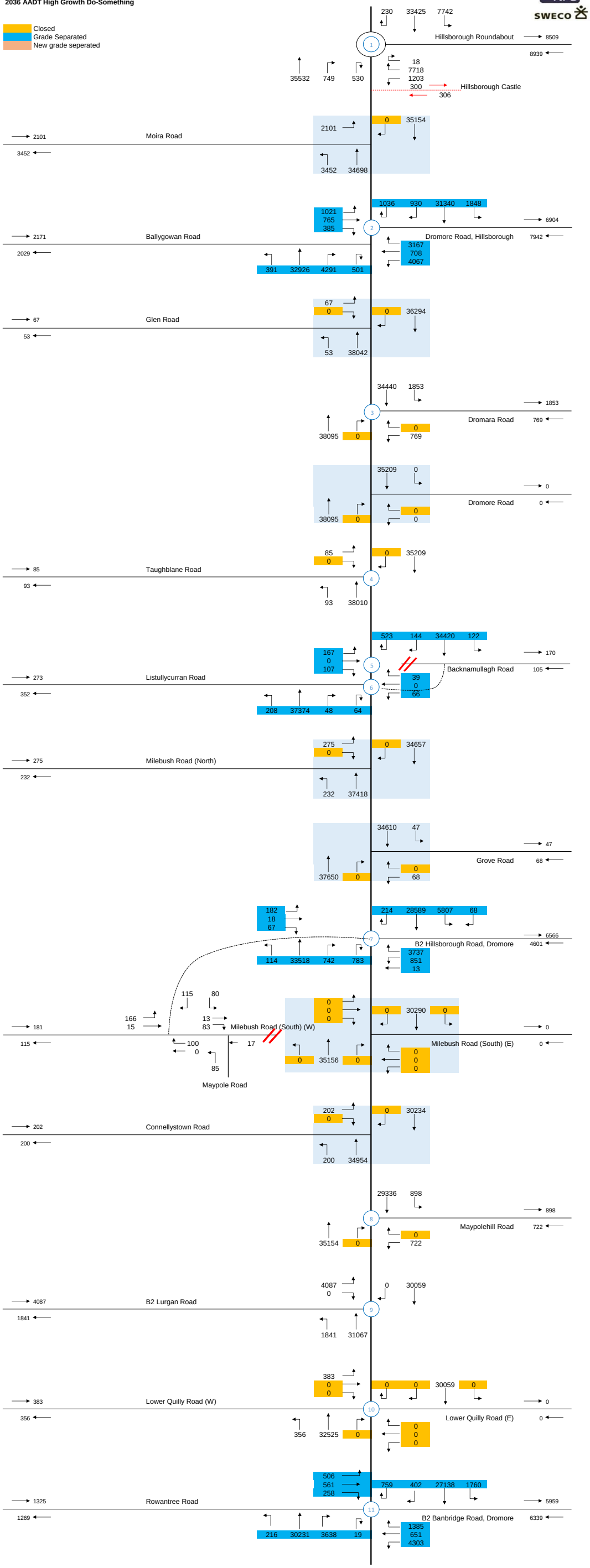


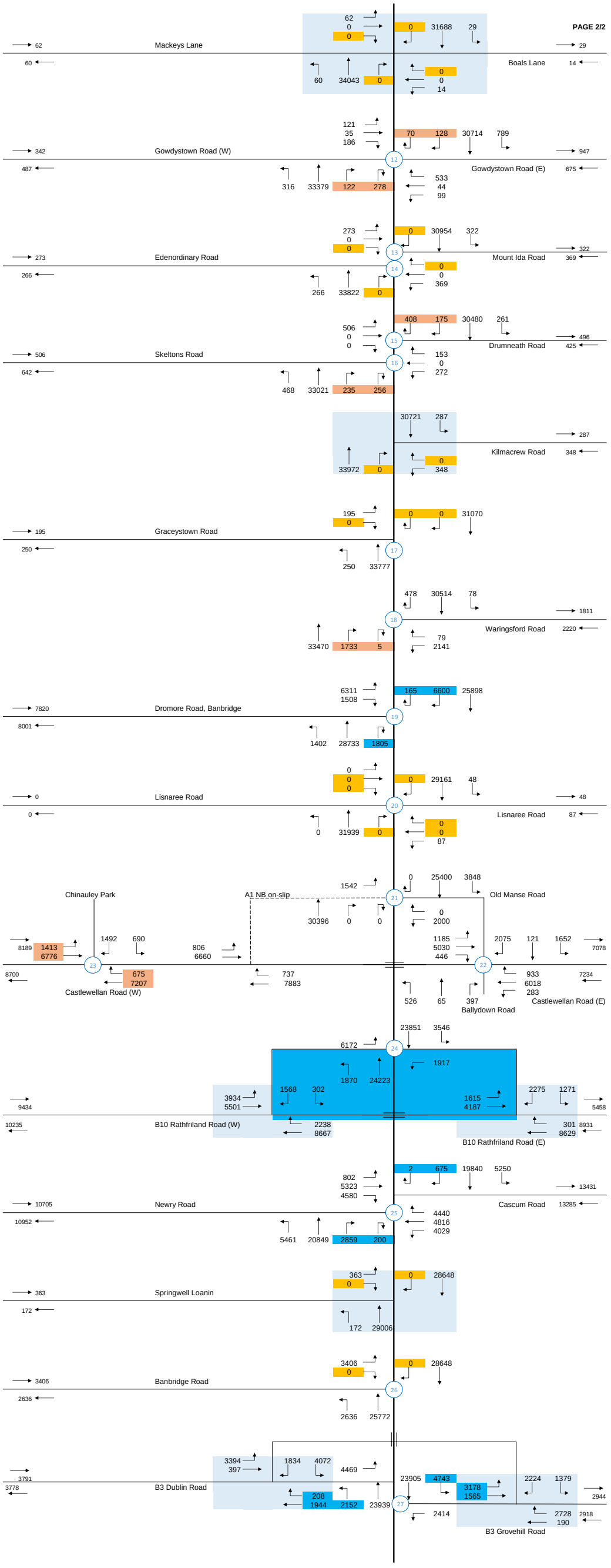

Mackeys Lane
Boals Lane
Gowdystown Road (W)
Gowdystown Road (E)
Edenordinary Road
Mount Ida Road
Skeltons Road
Drumneath Road
Kilmacrew Road
Graceystown Road
Waringsford Road
Dromore Road, Banbridge
Lisnaree Road
Lisnaree Road
Chinauley Park
A1 NB on-slip
Old Manse Road
Castlewellan Road (W)
Ballydown Road
Castlewellan Road (E)
B10 Rathfriland Road (W)
B10 Rathfriland Road (E)
Newry Road
Cascum Road
Springwell Loanin
Banbridge Road
B3 Dublin Road
B3 Grovehill Road

A1 Junctions Phase 2 - Network Flow Diagrams

2036 AADT High Growth Do-Something

RPS SWECO




Mackeys Lane
Boals Lane
Gowdystown Road (W)
Gowdystown Road (E)
Edenordinary Road
Mount Ida Road
Skeltons Road
Drumneath Road
Kilmacrew Road
Graceystown Road
Waringsford Road
Dromore Road, Banbridge
Lisnaree Road
Lisnaree Road
Chinauley Park
A1 NB on-slip
Old Manse Road
Castlewellan Road (W)
Ballydown Road
Castlewellan Road (E)
B10 Rathfriland Road (W)
B10 Rathfriland Road (E)
Newry Road
Cascum Road
Springwell Loanin
Banbridge Road
B3 Dublin Road
B3 Grovehill Road

APPENDIX B – CHINAULEY PARK MICROSIMULATION

A1 Junctions Phase 2 - Chinauley Park Microsimulation

Turning Count Calibration 0800-0900

	Description	Direction	Link	Traffic Flow (Vehicles)				GEH	WebTAG Criteria Met	< 700 vph	700 - 2700 vph	> 2700 vph	WebTAG Criteria Met
				Observed	Modelled	Difference				< 100 vph Diff	< 15% Diff	< 400 vph Diff	
0800-0900	Castlewellan Rd (A50) - East	EB	12:14	264	262	-2	-0.8%	0.1	YES	YES			YES
	Castlewellan Rd (A50) - East	WB	14:12	412	410	-2	-0.5%	0.1	YES	YES			YES
	Kids Academy access road	SB	10:19	17	17	0	0.0%	0.0	YES	YES			YES
	Kids Academy access road	NB	19:10	29	29	0	0.0%	0.0	YES	YES			YES
	Castlewellan Rd (A50) - West	WB	11:18	506	505	-1	-0.2%	0.0	YES	YES			YES
	Castlewellan Rd (A50) - West	EB	18:11	260	259	-1	-0.4%	0.1	YES	YES			YES
	Chinauley Park - West	WB	15:08	5	5	0	0.0%	0.0	YES	YES			YES
	Chinauley Park - West	EB	08:15	4	4	0	0.0%	0.0	YES	YES			YES
	Chinauley Park - North	NB	02:20	34	34	0	0.0%	0.0	YES	YES			YES
	Chinauley Park - North	SB	20:02	121	121	0	0.0%	0.0	YES	YES			YES
								MAX GEH					
								0.1	100.0%				100.0%

A1 Junctions Phase 2 - Chinauley Park Microsimulation

Turning Count Calibration 1700-1800

	Description	Direction	Link	Traffic Flow (Vehicles)				GEH	WebTAG Criteria Met	< 700 vph	700 - 2700 vph	> 2700 vph	WebTAG Criteria Met
				Observed	Modelled	Difference				< 100 vph Diff	< 15% Diff	< 400 vph Diff	
1700-1800	Castlewellan Rd (A50) - East	EB	12:14	407	406	-1	-0.2%	0.0	YES	YES			YES
	Castlewellan Rd (A50) - East	WB	14:12	434	433	-1	-0.2%	0.0	YES	YES			YES
	Kids Academy access road	SB	10:19	34	34	0	0.0%	0.0	YES	YES			YES
	Kids Academy access road	NB	19:10	47	47	0	0.0%	0.0	YES	YES			YES
	Castlewellan Rd (A50) - West	WB	11:18	429	427	-2	-0.5%	0.1	YES	YES			YES
	Castlewellan Rd (A50) - West	EB	18:11	483	481	-2	-0.4%	0.1	YES	YES			YES
	Chinauley Park - West	WB	15:08	6	6	0	0.0%	0.0	YES	YES			YES
	Chinauley Park - West	EB	08:15	5	5	0	0.0%	0.0	YES	YES			YES
	Chinauley Park - North	NB	02:20	153	153	0	0.0%	0.0	YES	YES			YES
	Chinauley Park - North	SB	20:02	60	60	0	0.0%	0.0	YES	YES			YES
								MAX GEH	WebTAG Critera Met				
								0.1	100.0%				100.0%

A1 Junctions Phase 2 - Chinauley Park Microsimulation

Journey Time Validation 0800-0900

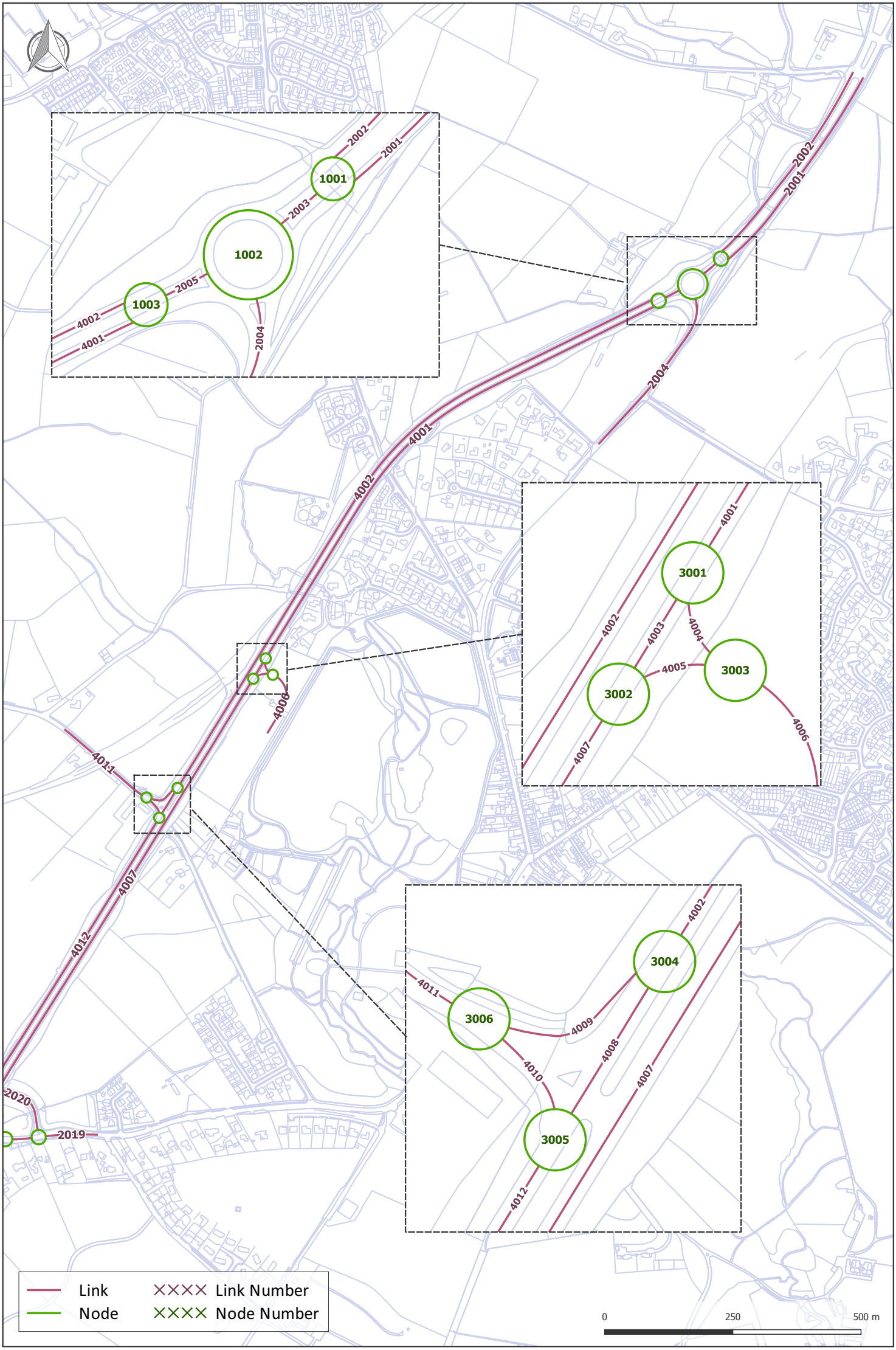
	Movement	Modelled (s)	Observed (s)	Difference	% Difference	Within 15%	Within 1 Minute	WebTAG Criteria
0800-0900	2-3	18	19	1	8%	YES	YES	YES
	2-5	20	20	0	0%	YES	YES	YES
	2-7	20	28	8	41%	NO	YES	YES
	2-9	22	22	0	-1%	YES	YES	YES
	4-1	24	29	5	23%	NO	YES	YES
	4-5	14	14	0	0%	YES	YES	YES
	4-7	-	-	-	-	-	-	-
	4-9	-	-	-	-	-	-	-
	6-1	20	17	-3	-17%	NO	YES	YES
	6-3	16	12	-4	-23%	NO	YES	YES
	6-7	13	23	10	80%	NO	YES	YES
	6-9	16	16	0	3%	YES	YES	YES
	8-1	22	36	14	64%	NO	YES	YES
	8-3	-	-	-	-	-	-	-
	8-5	25	42	17	68%	NO	YES	YES
	8-9	-	-	-	-	-	-	-
	10-1	24	26	2	10%	YES	YES	YES
	10-3	-	-	-	-	-	-	-
	10-5	11	31	20	191%	NO	YES	YES
	10-7	-	-	-	-	-	-	-

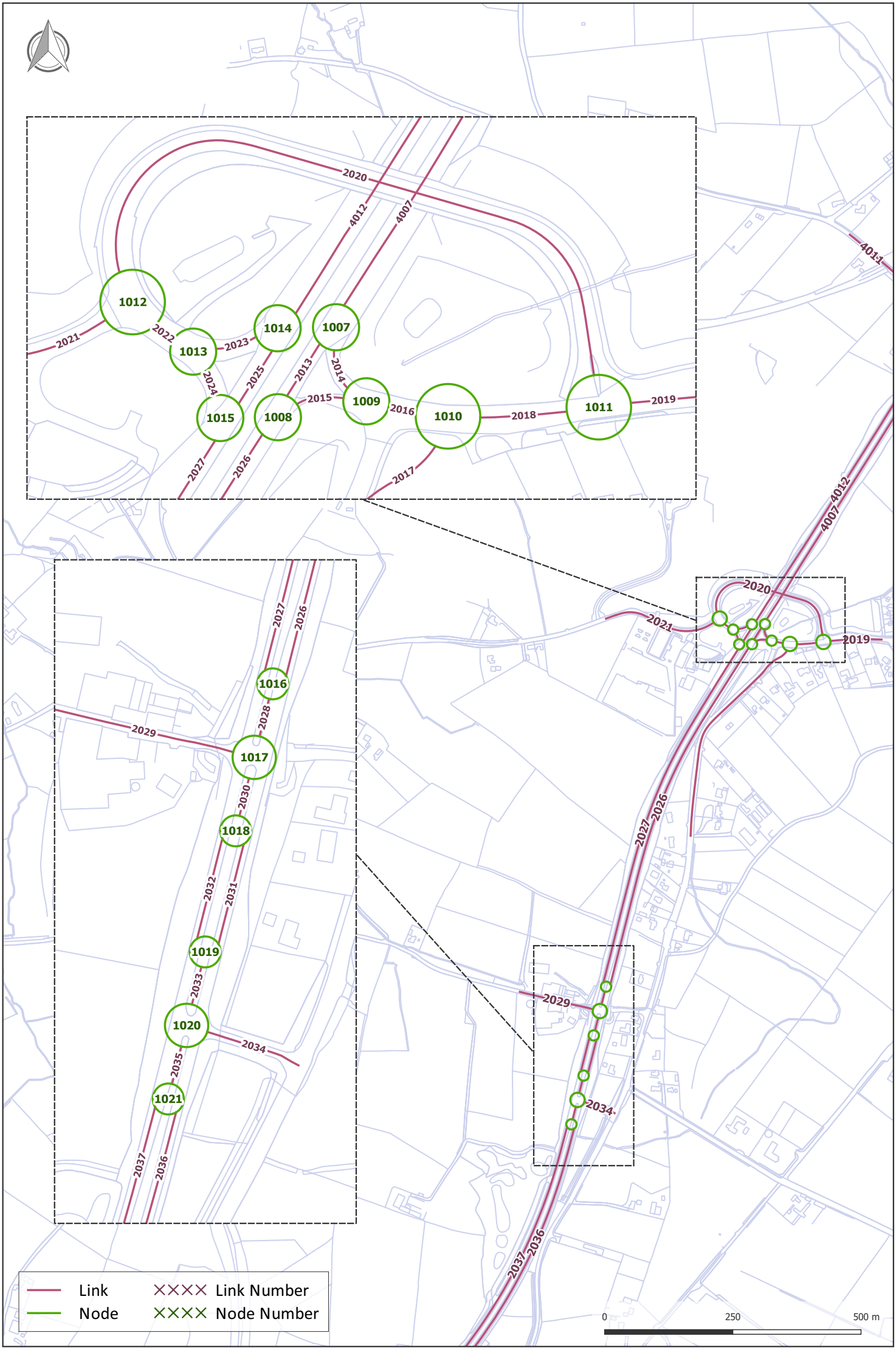
A1 Junctions Phase 2 - Chinauley Park Microsimulation

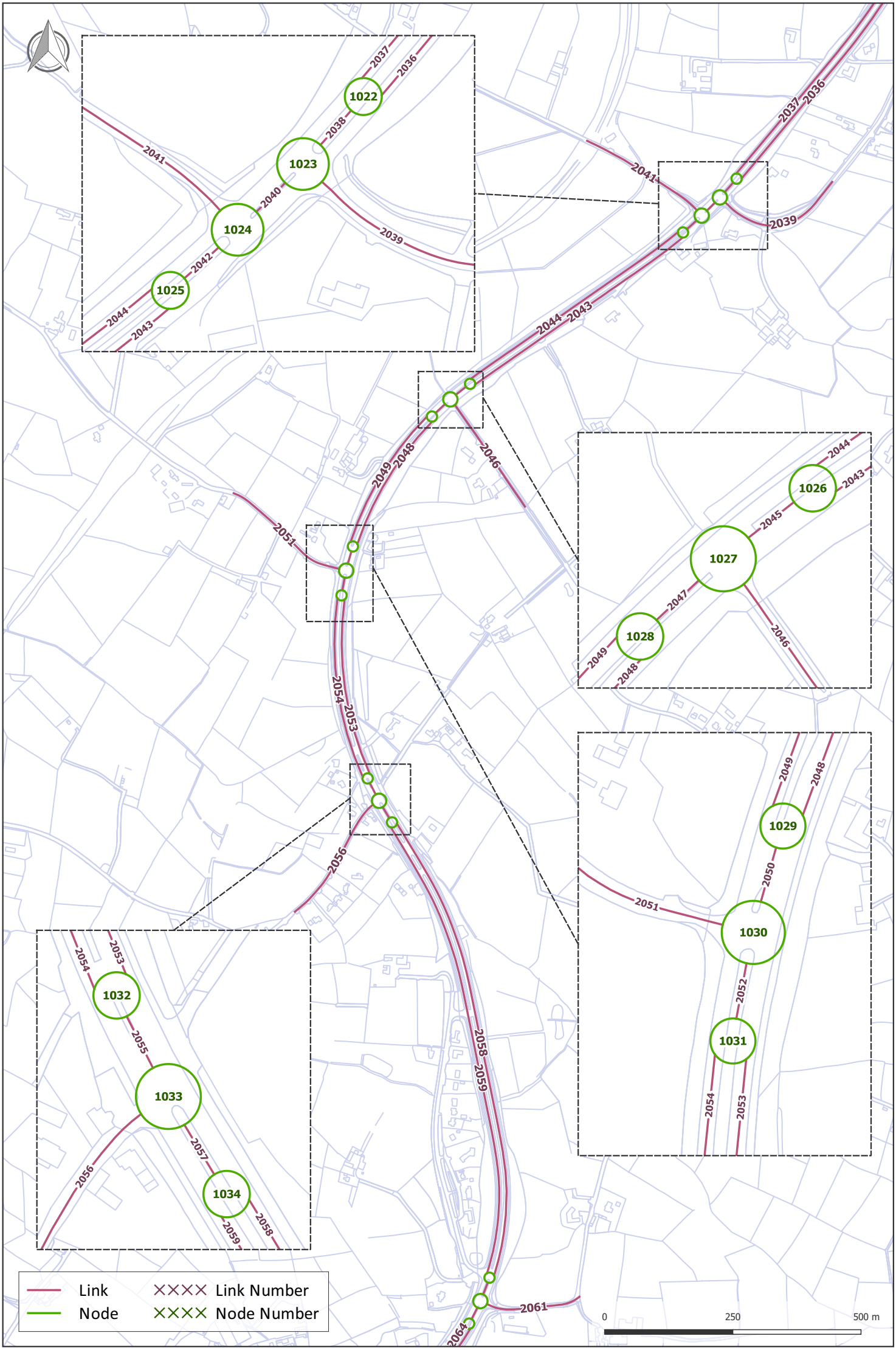
Journey Time Validation 1700-1800

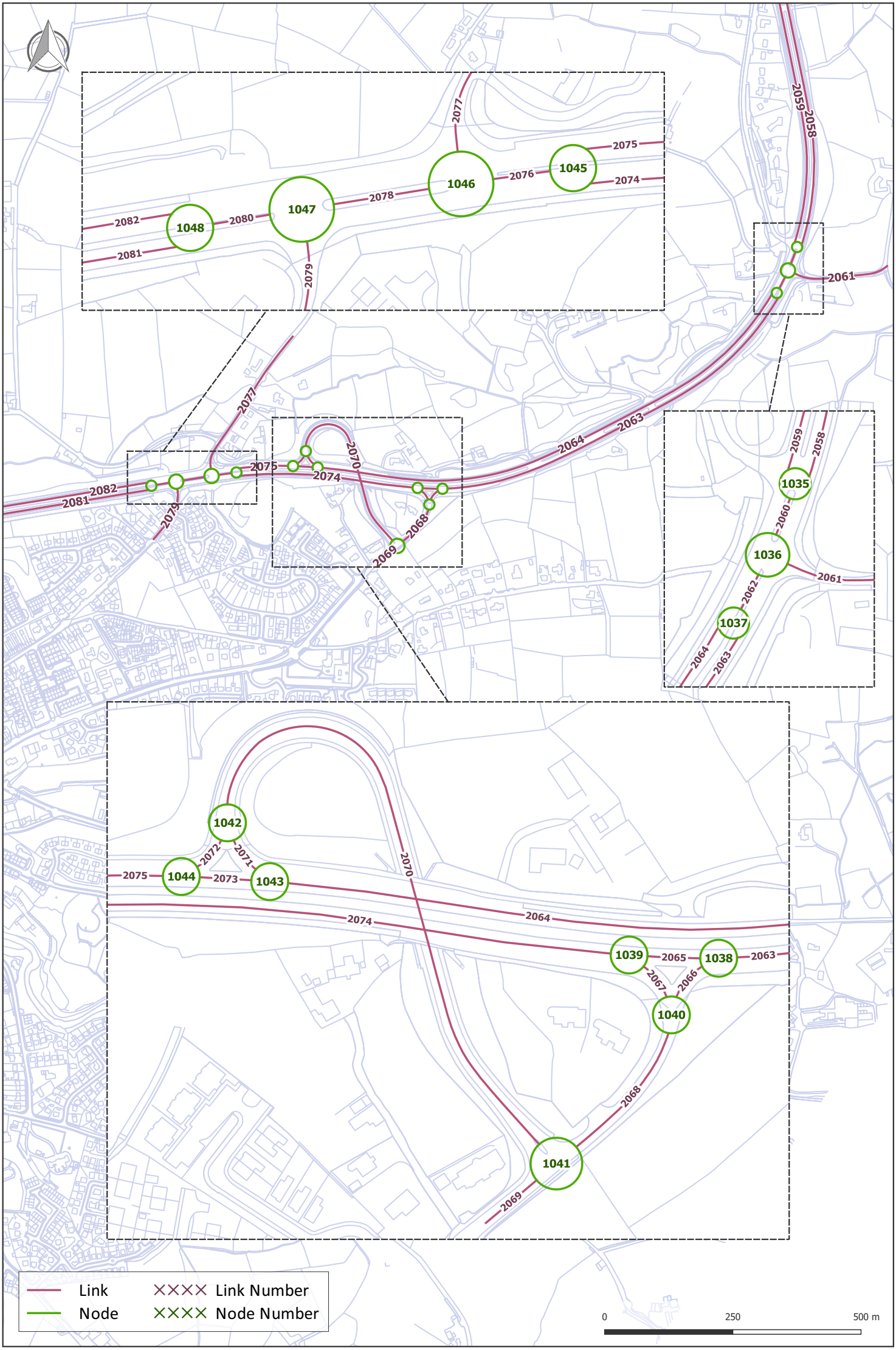
	Movement	Modelled (s)	Observed (s)	Difference	% Difference	Within 15%	Within 1 Minute	WebTAG Criteria
1700-1800	2-3	18	17	-1	-4%	YES	YES	YES
	2-5	20	20	0	0%	YES	YES	YES
	2-7	21	30	9	43%	NO		
	2-9	24	25	1	4%	YES		
	4-1	24	26	2	7%	YES		
	4-5	14	12	-2	-15%	YES	YES	YES
	4-7	-	-	-	-	-	-	-
	4-9	28	20	-8	-28%	NO	YES	YES
	6-1	20	16	-4	-21%	NO	YES	YES
	6-3	14	9	-5	-35%	NO	YES	YES
	6-7	13	21	8	62%	NO	YES	YES
	6-9	16	16	0	2%	YES	YES	YES
	8-1	18	28	10	57%	NO	YES	YES
	8-3	-	-	-	-	-	-	-
	8-5	12	38	26	217%	NO	YES	YES
	8-9	-	-	-	-	-	-	-
	10-1	11	28	17	150%	NO	YES	YES
	10-3	15	24	9	60%	NO	YES	YES
	10-5	11	36	25	219%	NO	YES	YES
	10-7	-	-	-	-	-	-	-

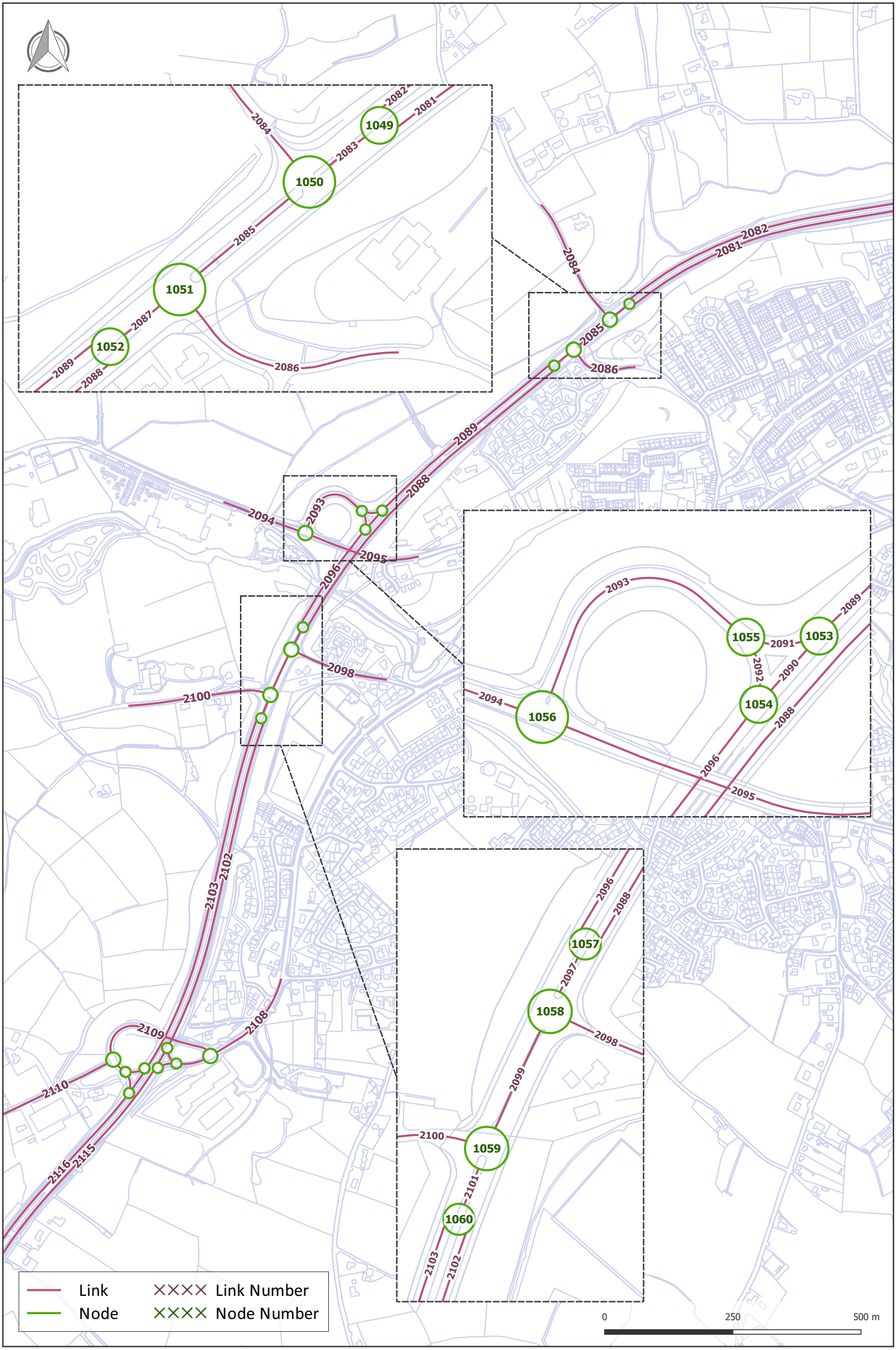
APPENDIX C – COBA NETWORK FOR DO-MINIMUM AND DO-SOMETHING SCENARIOS

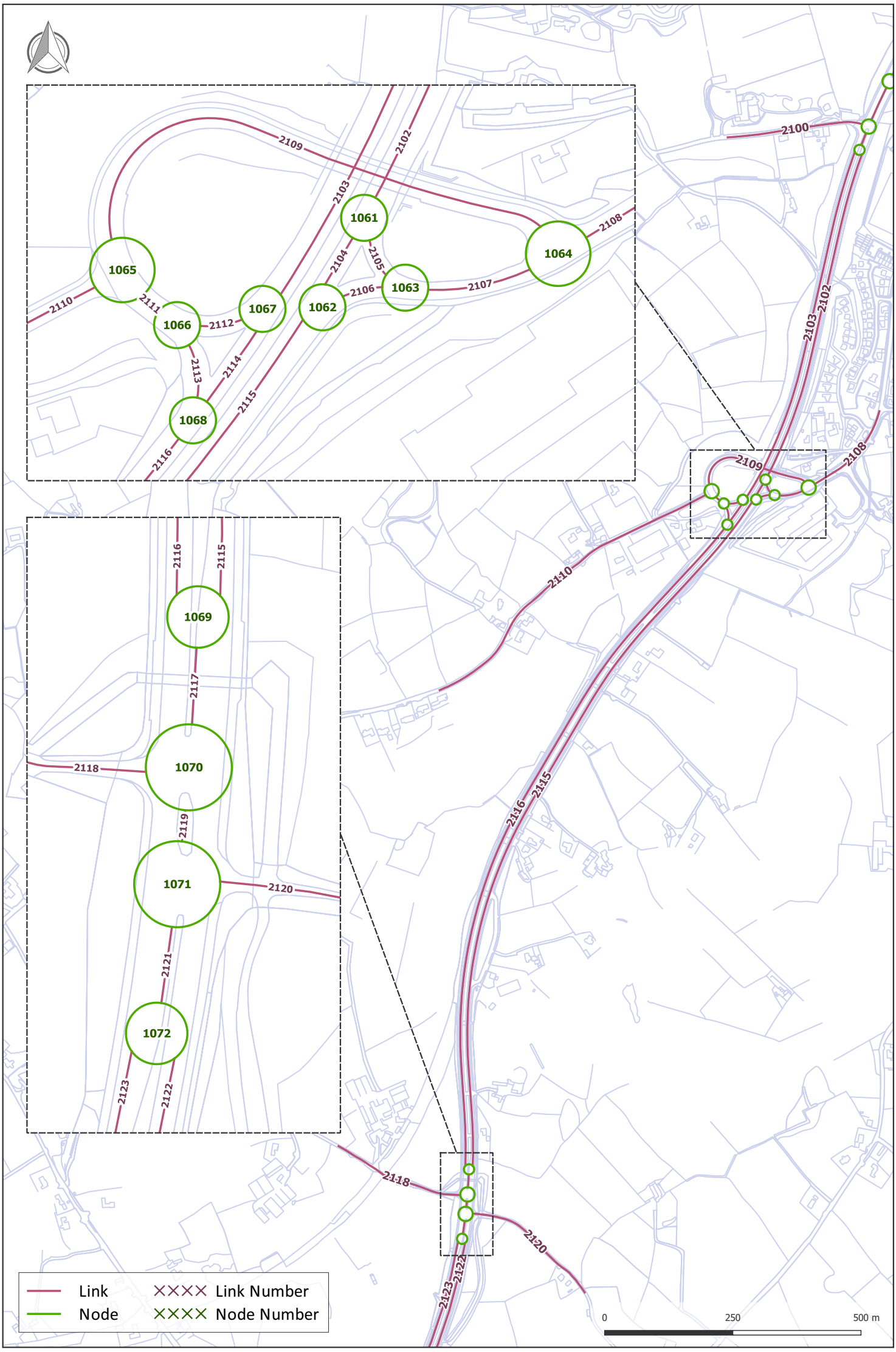

1001
1002
1003
2001
2002
2003
2004
2005
4001
4002
3001
3002
3003
4003
4004
4005
4006
4007
4008
3004
3005
3006
4009
4010
4011
4012
2019
2020
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

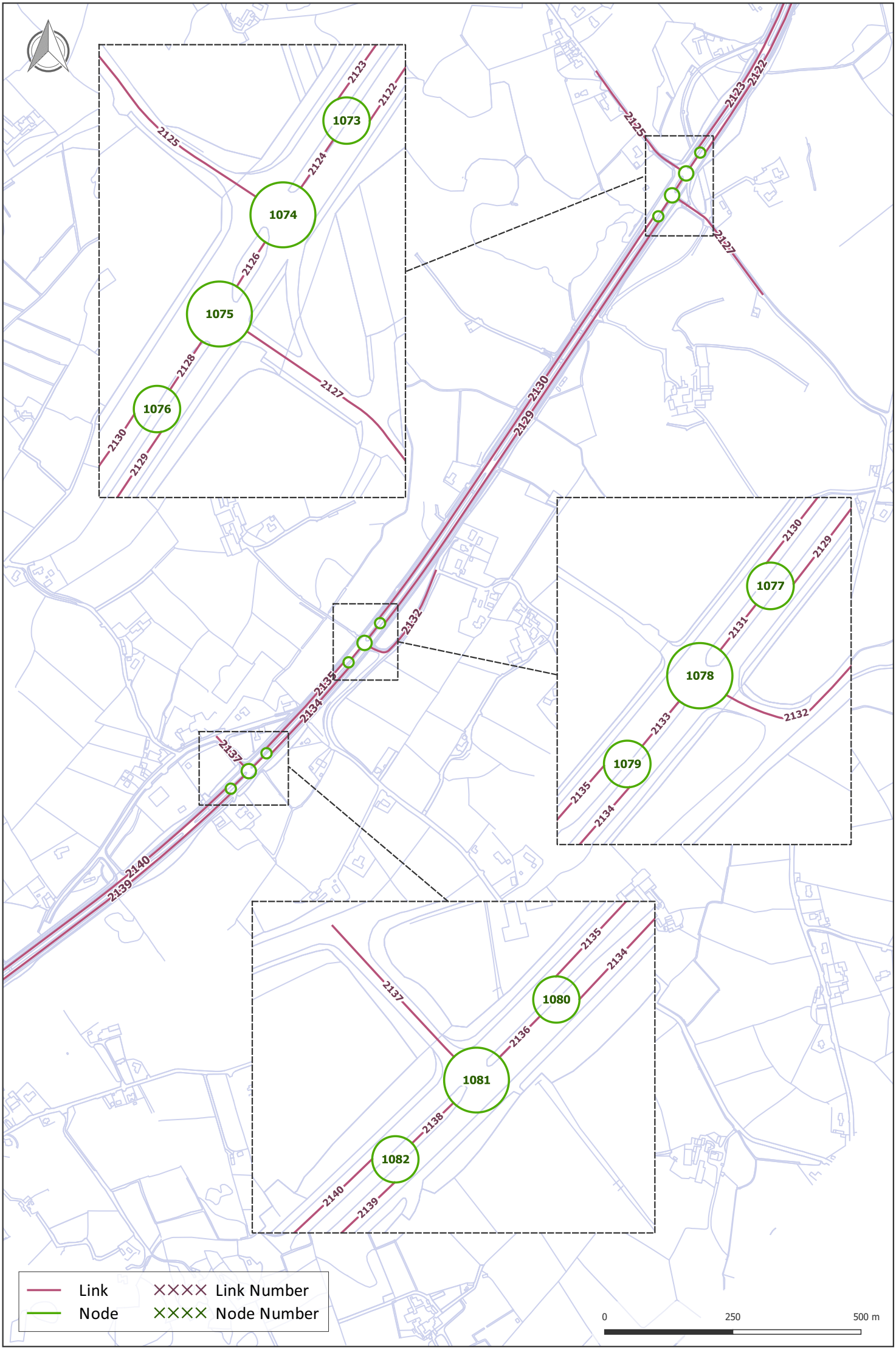

1012
1013
1014
1007
1015
1008
1009
1010
1011
1016
1017
1018
1019
1020
1021
2020
2021
2022
2023
2024
2025
2013
2014
2015
2016
2018
2019
2017
2026
2027
4012
4007
4011
2029
2028
2030
2031
2032
2033
2034
2035
2036
2037
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

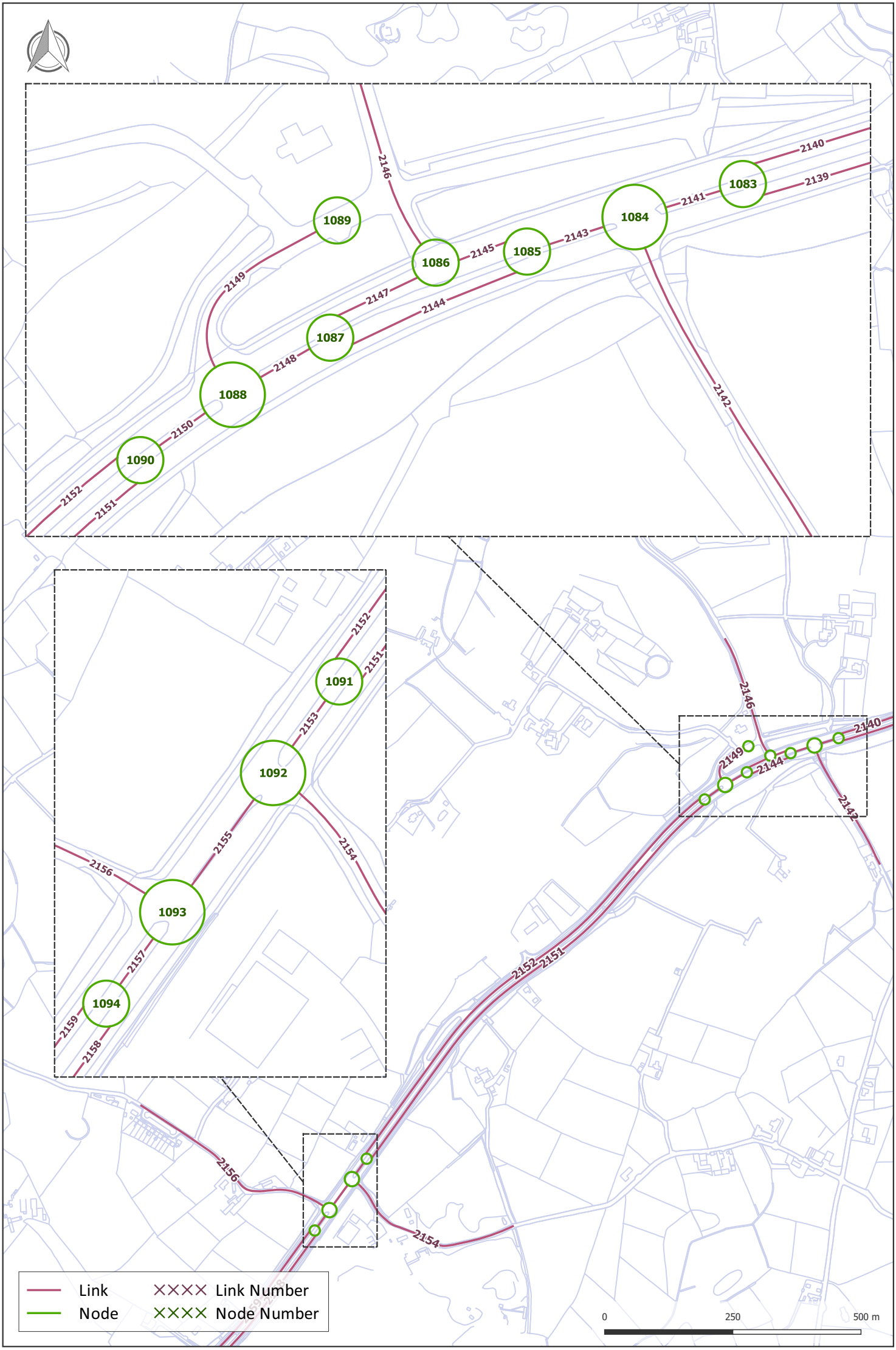

1022
1023
1024
1025
2041
2037
2036
2038
2040
2039
2042
2044
2043
2041
2037
2036
2039
2044
2043
2049
2048
2046
2051
2054
2053
2056
1026
1027
1028
2044
2043
2045
2047
2046
2049
2048
1029
1030
1031
2049
2048
2050
2051
2052
2054
2053
1032
1033
1034
2054
2053
2055
2056
2057
2058
2059
2058
2059
2061
2064
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

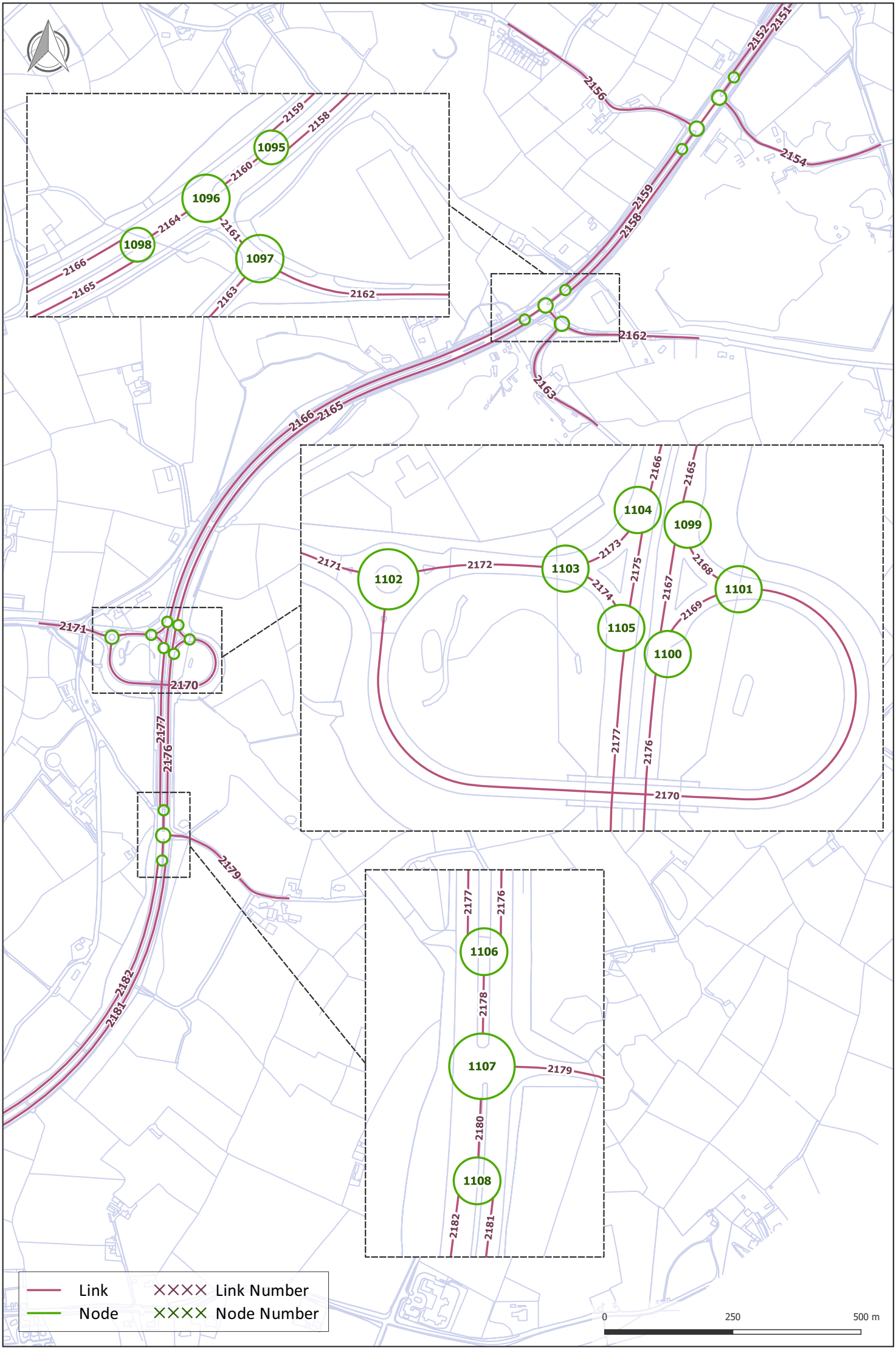

1048
1047
1046
1045
1035
1036
1037
1042
1044
1043
1039
1038
1040
1041
2082
2081
2080
2079
2078
2077
2076
2075
2074
2073
2072
2071
2070
2069
2068
2067
2066
2065
2064
2063
2062
2061
2060
2059
2058
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

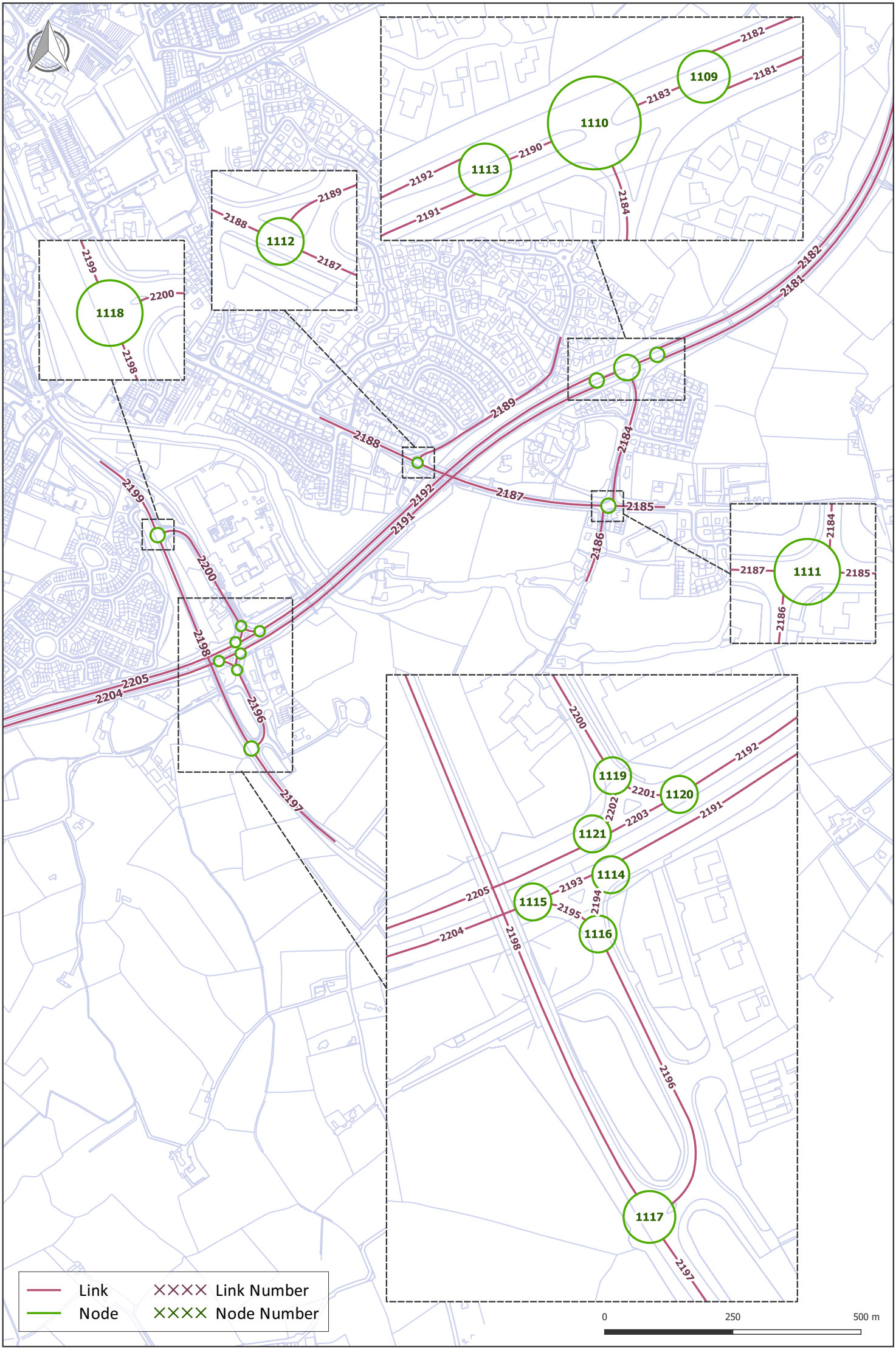

1049
1050
1051
1052
1053
1054
1055
1056
1057
1058
1059
1060
2081
2082
2083
2084
2085
2086
2087
2088
2089
2090
2091
2092
2093
2094
2095
2096
2097
2098
2099
2100
2101
2102
2103
2108
2109
2110
2115
2116
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m


1061
1062
1063
1064
1065
1066
1067
1068
1069
1070
1071
1072
2100
2102
2103
2104
2105
2106
2107
2108
2109
2110
2111
2112
2113
2114
2115
2116
2117
2118
2119
2120
2121
2122
2123
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

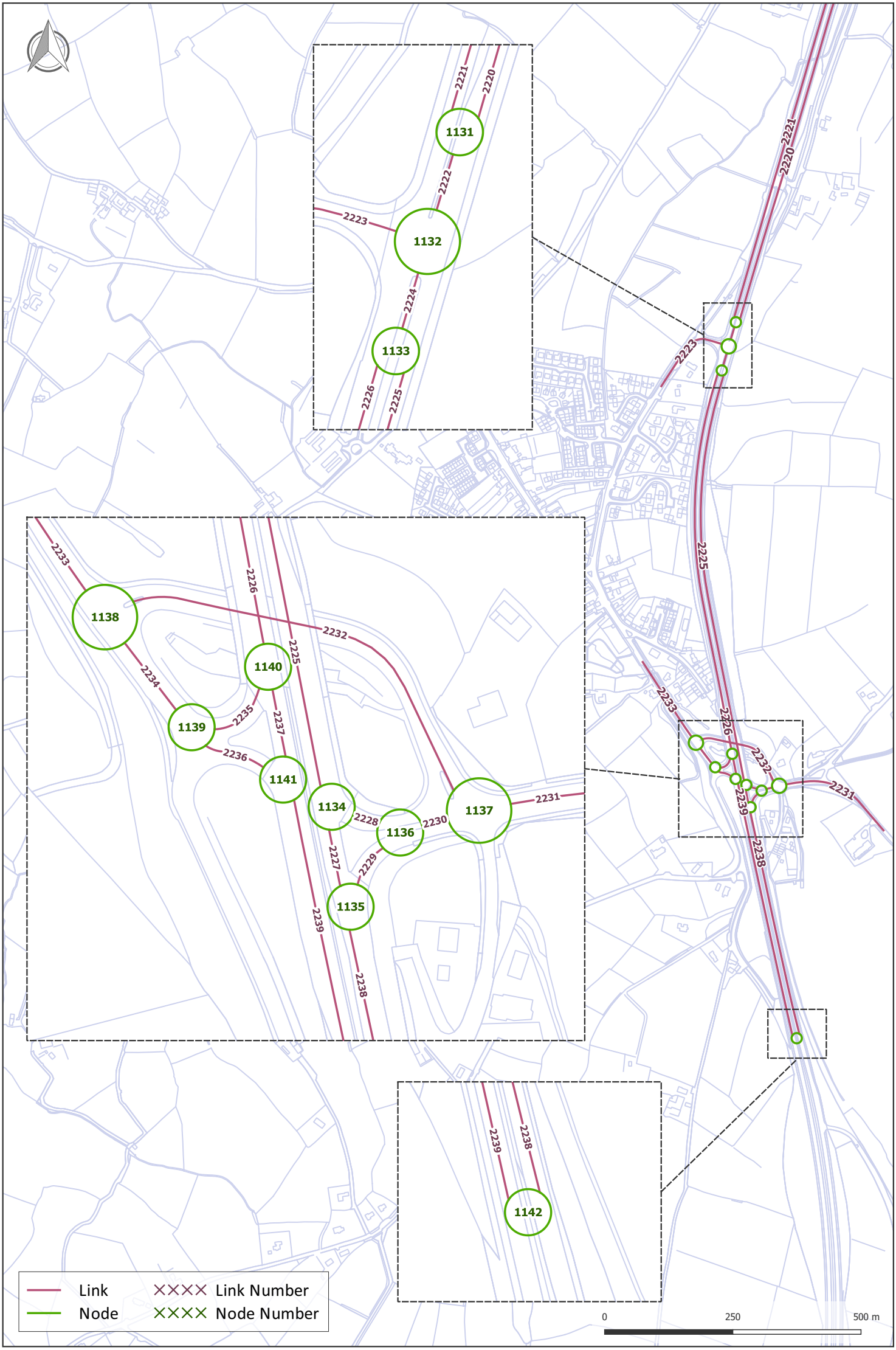

1073
1074
1075
1076
1077
1078
1079
1080
1081
1082
2121
2122
2123
2124
2125
2126
2127
2128
2129
2130
2131
2132
2133
2134
2135
2136
2137
2138
2139
2140
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

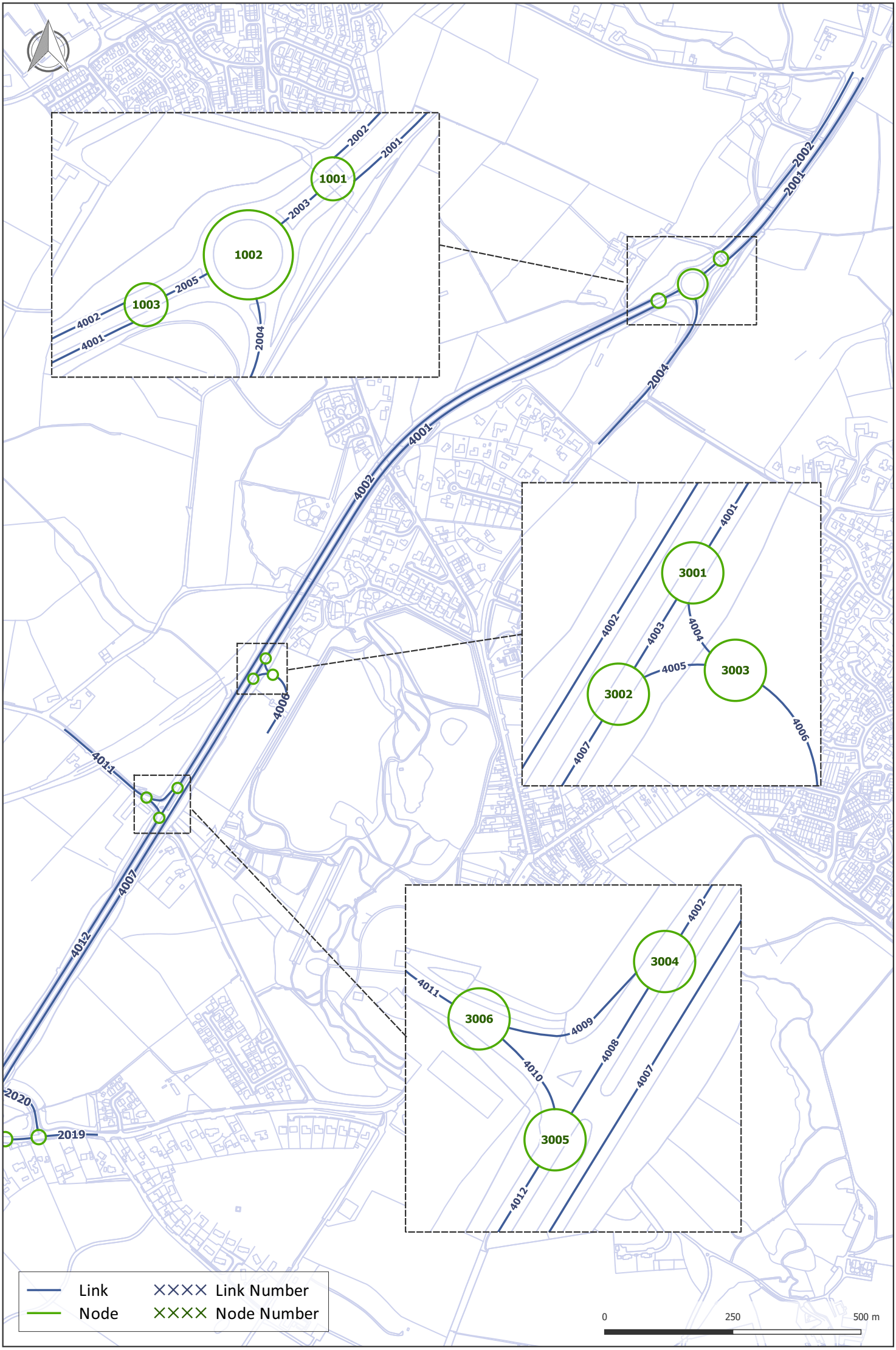

1089
1086
1085
1084
1083
1087
1088
1090
1091
1092
1093
1094
2139
2140
2141
2142
2143
2144
2145
2146
2147
2148
2149
2150
2151
2152
2153
2154
2155
2156
2157
2158
2159
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

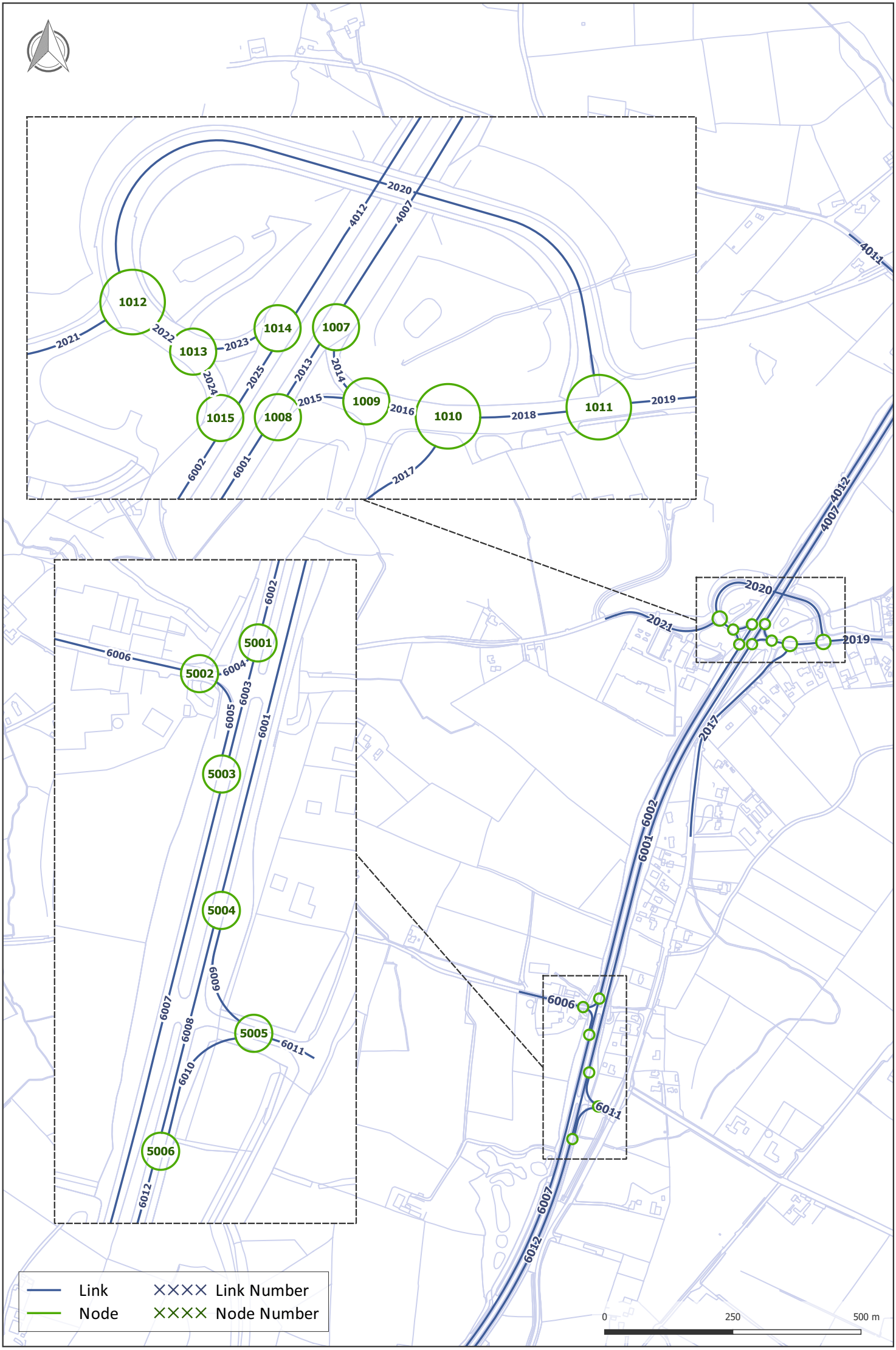

1095
1096
1097
1098
2159
2158
2160
2161
2164
2166
2165
2163
2162
2156
2152
2151
2154
1104
1099
1103
1102
1101
1105
1100
2171
2172
2173
2174
2175
2167
2168
2169
2170
2177
2176
2179
1106
1107
1108
2178
2180
2182
2181
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

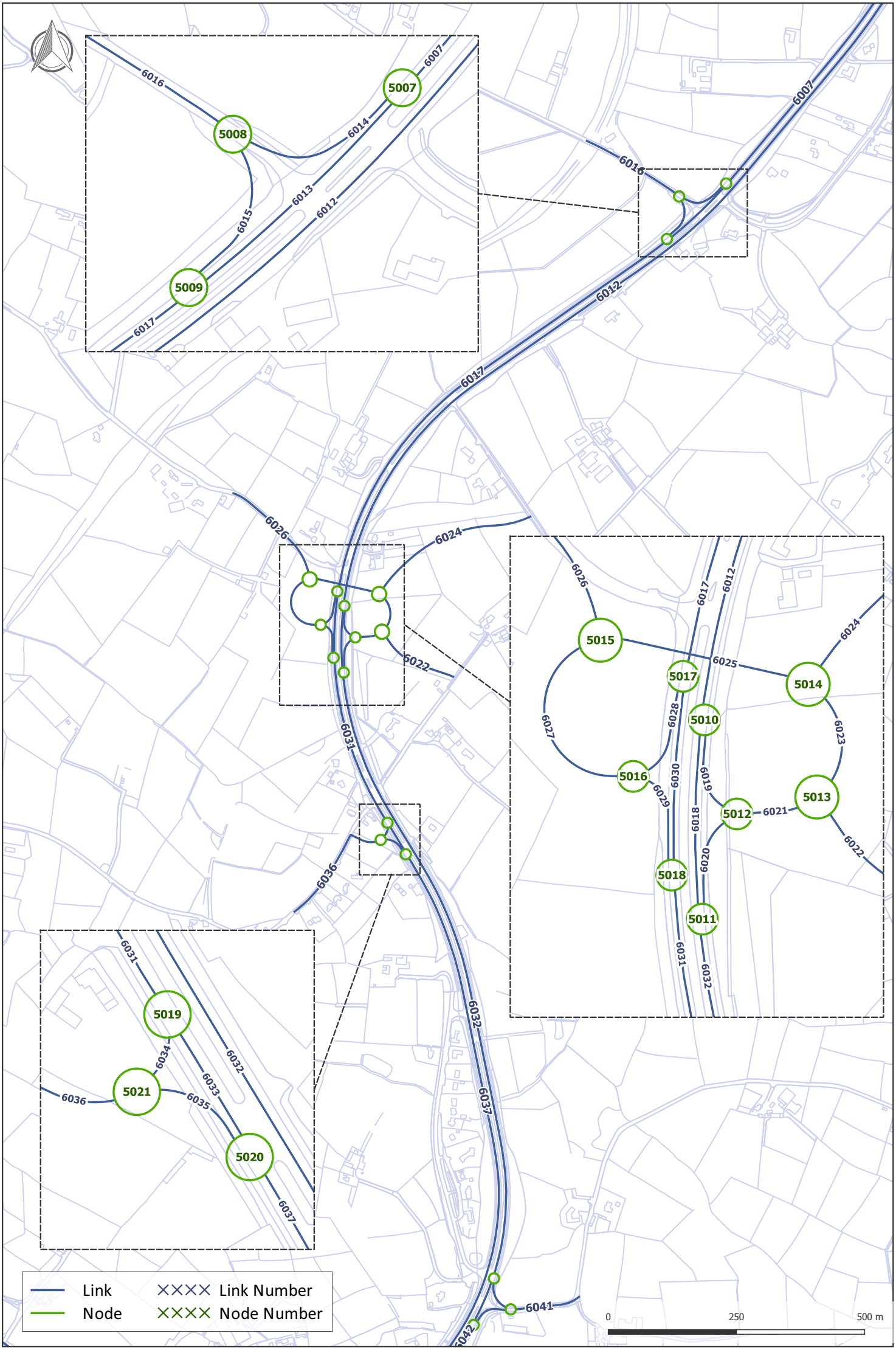

1109
1110
1111
1112
1113
1114
1115
1116
1117
1118
1119
1120
1121
2181
2182
2183
2184
2185
2186
2187
2188
2189
2190
2191
2192
2193
2194
2195
2196
2197
2198
2199
2200
2201
2202
2203
2204
2205
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

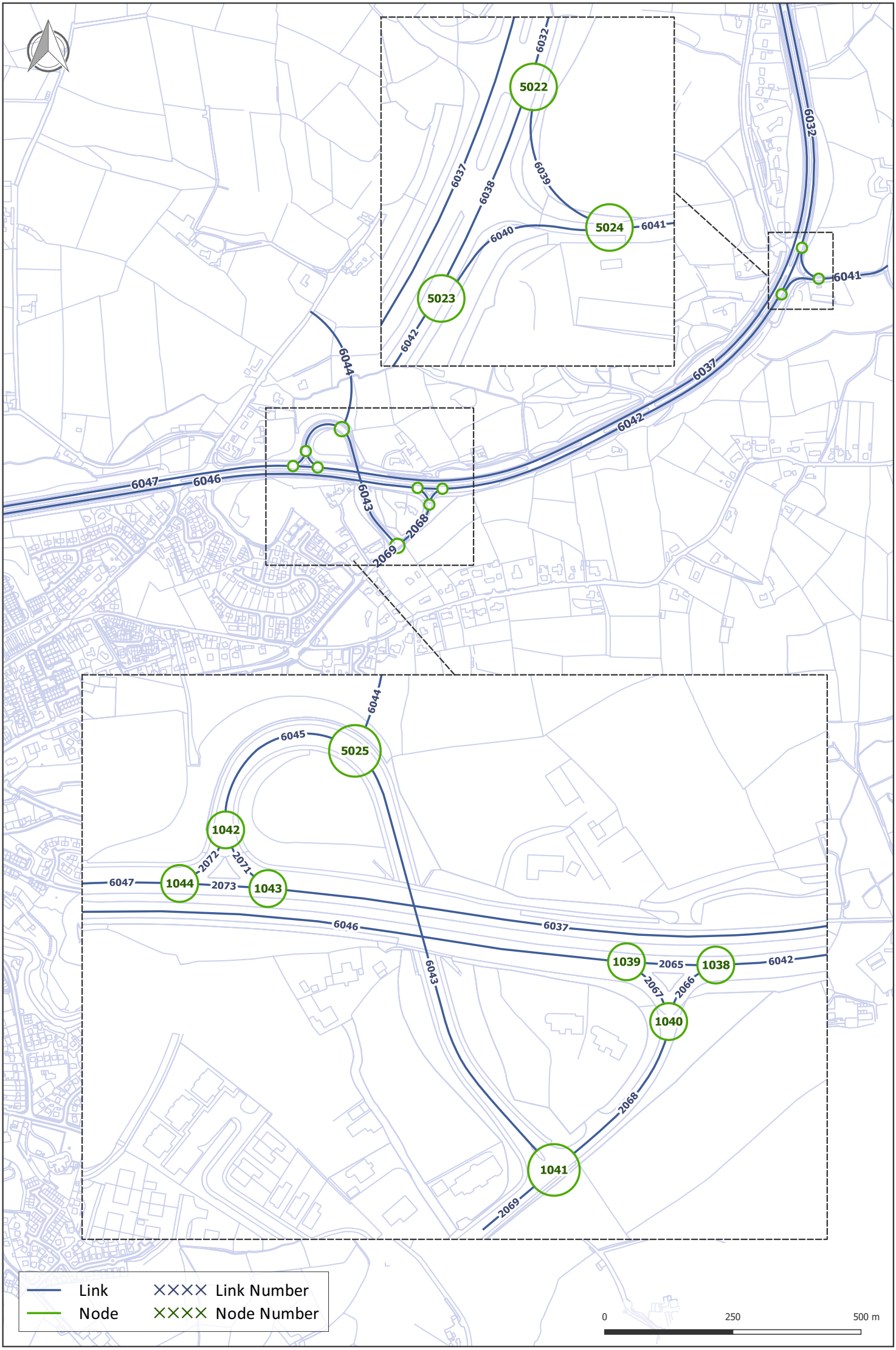

1122
1125
1126
1124
1127
1123
1128
1129
1130
2204
2205
2206
2207
2208
2209
2210
2211
2212
2213
2214
2215
2216
2217
2218
2219
2220
2221
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

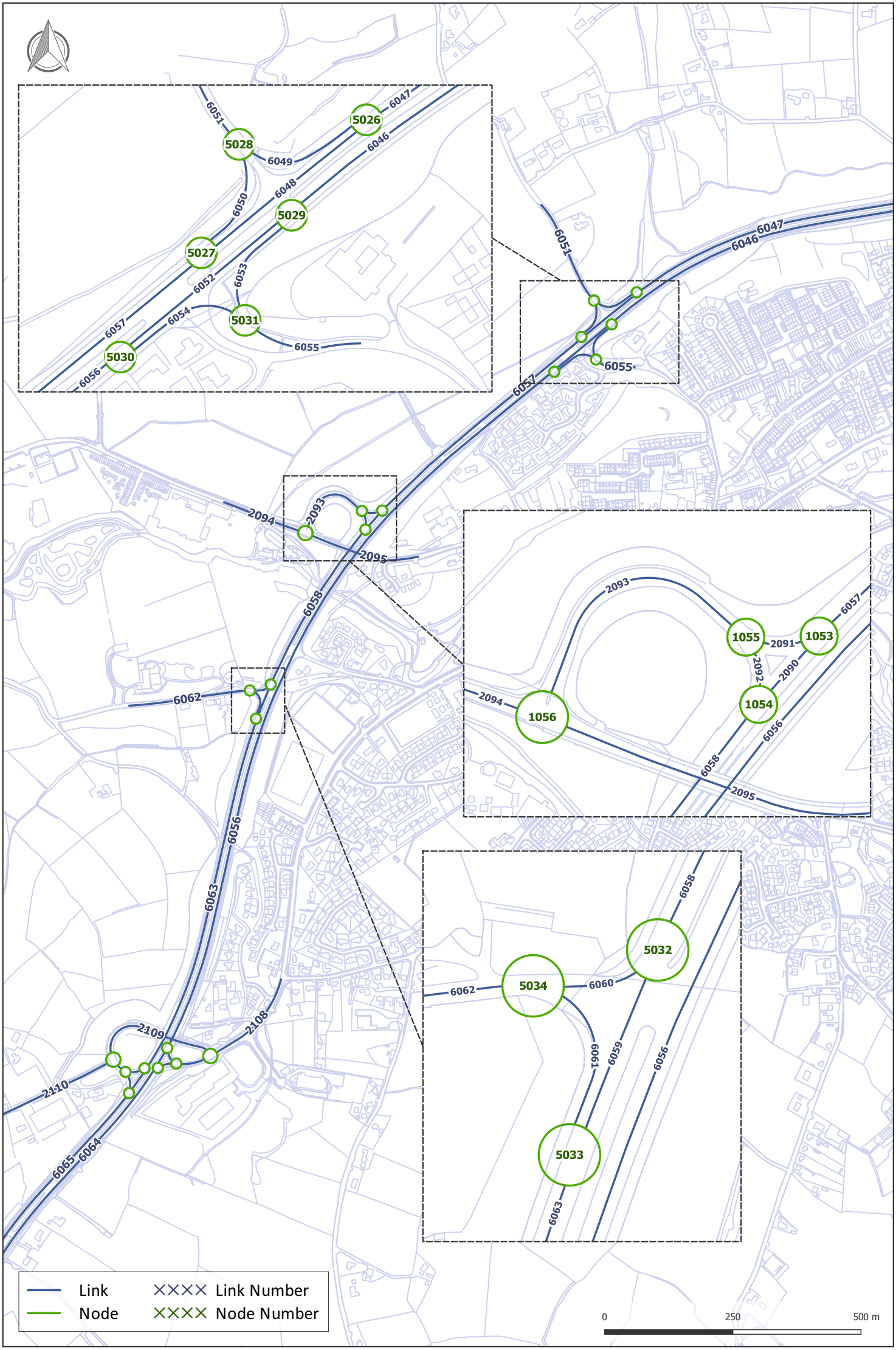

1131
1132
1133
1134
1135
1136
1137
1138
1139
1140
1141
1142
2220
2221
2222
2223
2224
2225
2226
2227
2228
2229
2230
2231
2232
2233
2234
2235
2236
2237
2238
2239
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

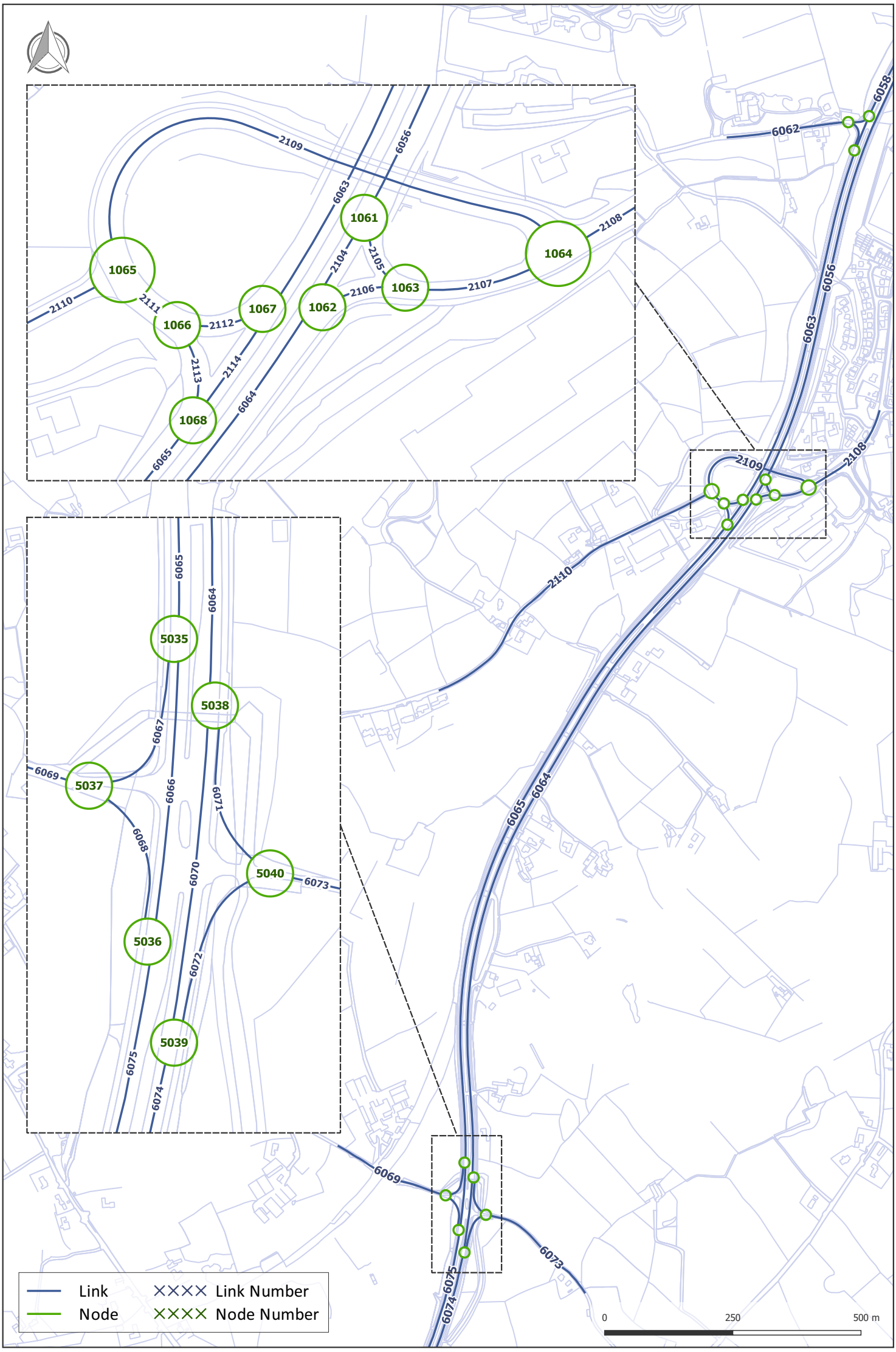

1001
1002
1003
2001
2002
2003
2004
2005
4001
4002
3001
3002
3003
4003
4004
4005
4006
4007
4008
3004
3005
3006
4009
4010
4011
4012
2019
2020
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

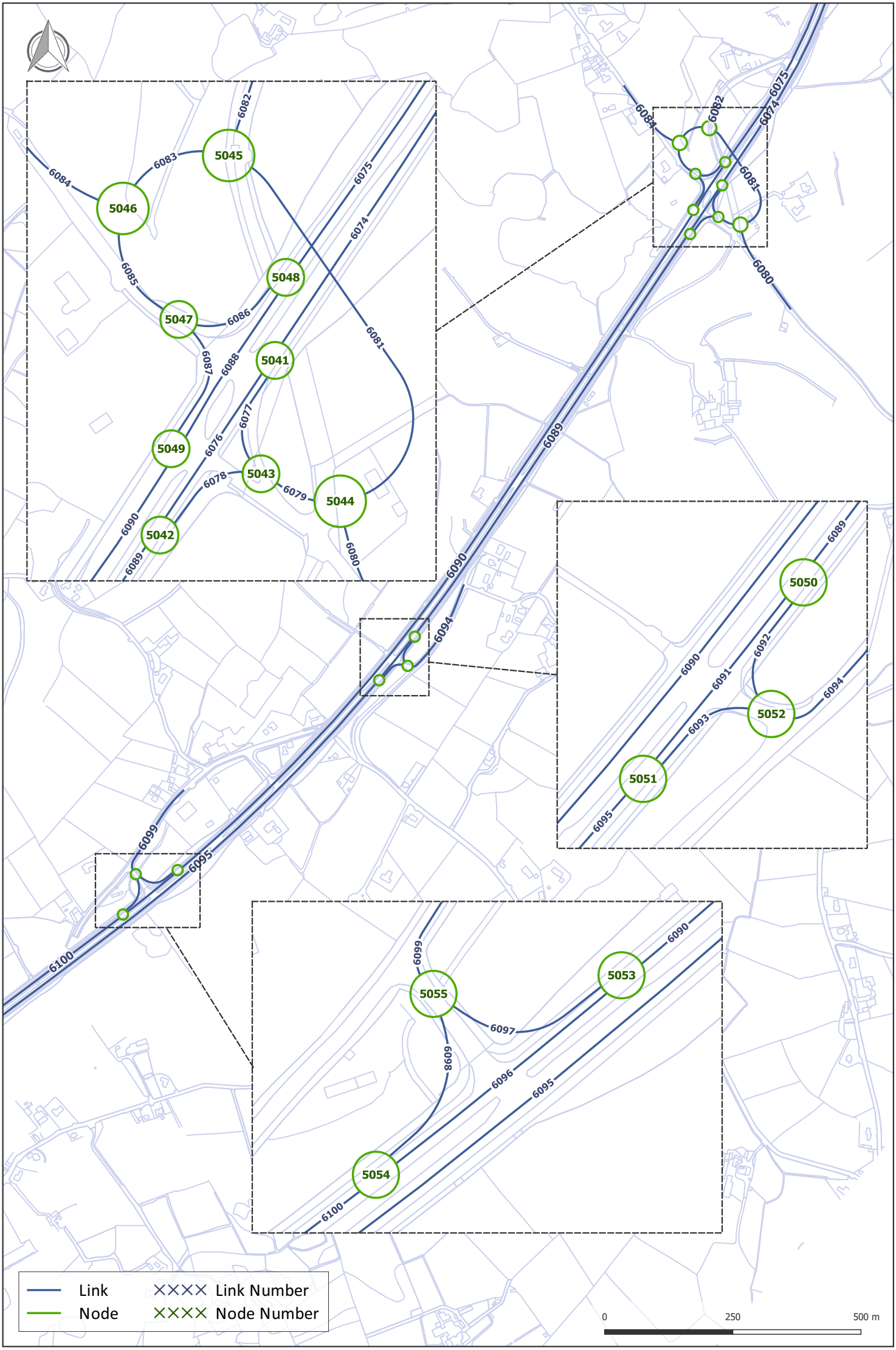

1012
1013
1014
1007
1015
1008
1009
1010
1011
2020
4012
4007
4011
2021
2022
2023
2024
2025
2013
2014
2015
2016
2018
2019
2017
6002
6001
5001
5002
5003
5004
5005
5006
6006
6004
6003
6005
6009
6007
6008
6010
6011
6012
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m


5007
5008
5009
6016
6007
6014
6013
6012
6015
6017
6026
6024
6022
6031
6036
5015
5017
5014
5010
5016
5013
5012
5018
5011
6025
6028
6027
6030
6029
6019
6021
6018
6020
6023
6032
6037
5019
5021
5020
6034
6033
6035
6041
6042
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m


5022
5023
5024
5025
1039
1040
1041
1042
1043
1044
1038
6032
6037
6038
6039
6040
6041
6042
6043
6044
6045
6046
6047
2065
2066
2067
2068
2069
2071
2072
2073
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

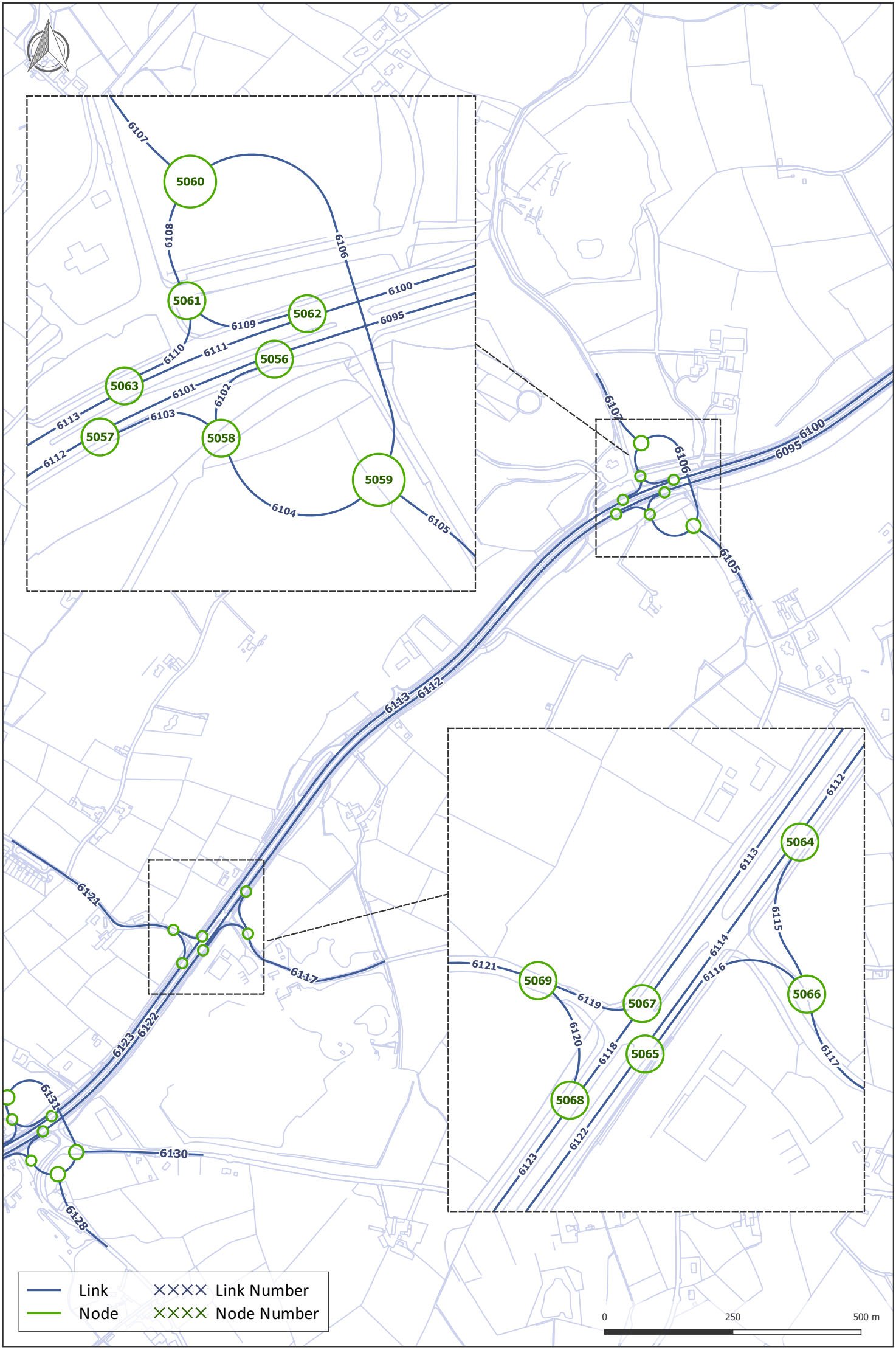

5026
5028
5029
5027
5031
5030
6051
6047
6049
6046
6048
6050
6053
6052
6054
6057
6056
6055
2094
2093
2095
6058
6062
6056
6063
2109
2108
2110
6065
6064
1055
1053
1054
1056
2091
2092
2090
2093
2094
2095
6057
6056
6058
5032
5034
5033
6062
6060
6058
6059
6061
6056
6063
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

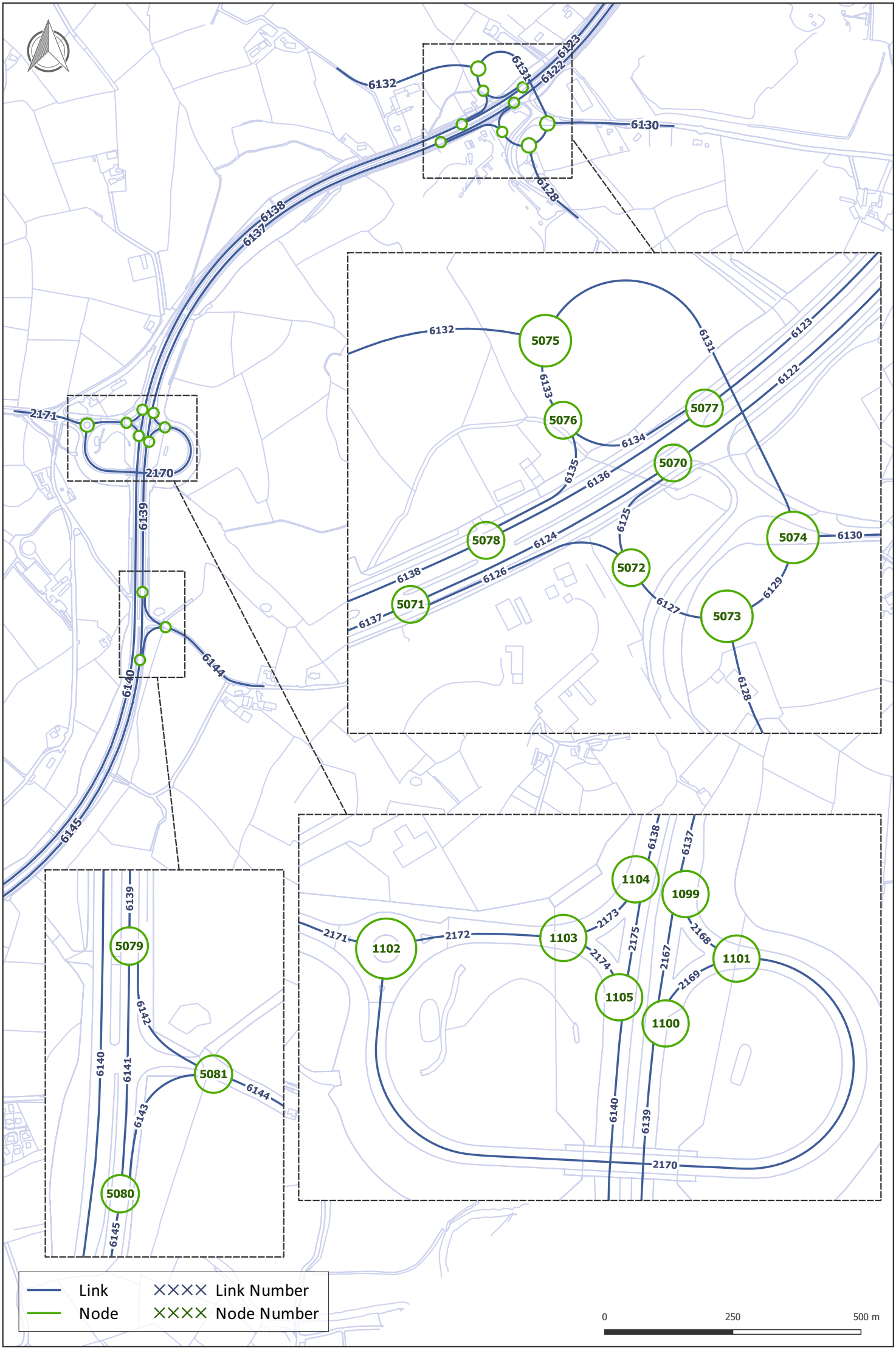

1061
1062
1063
1064
1065
1066
1067
1068
2109
2110
2111
2112
2113
2114
2104
2105
2106
2107
2108
6056
6062
6063
6064
6065
6058
5035
5036
5037
5038
5039
5040
6066
6067
6068
6069
6070
6071
6072
6073
6074
6075
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m

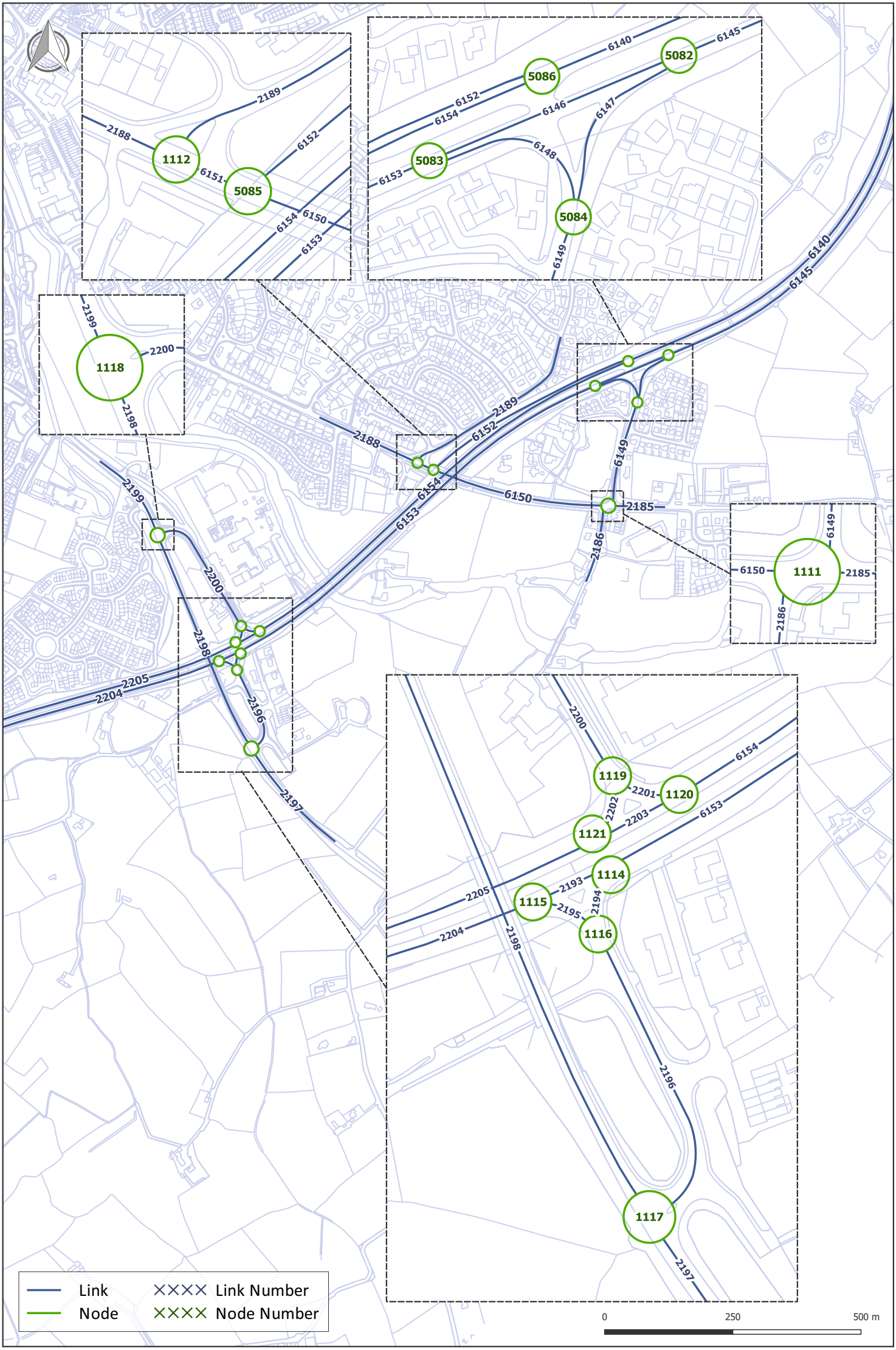


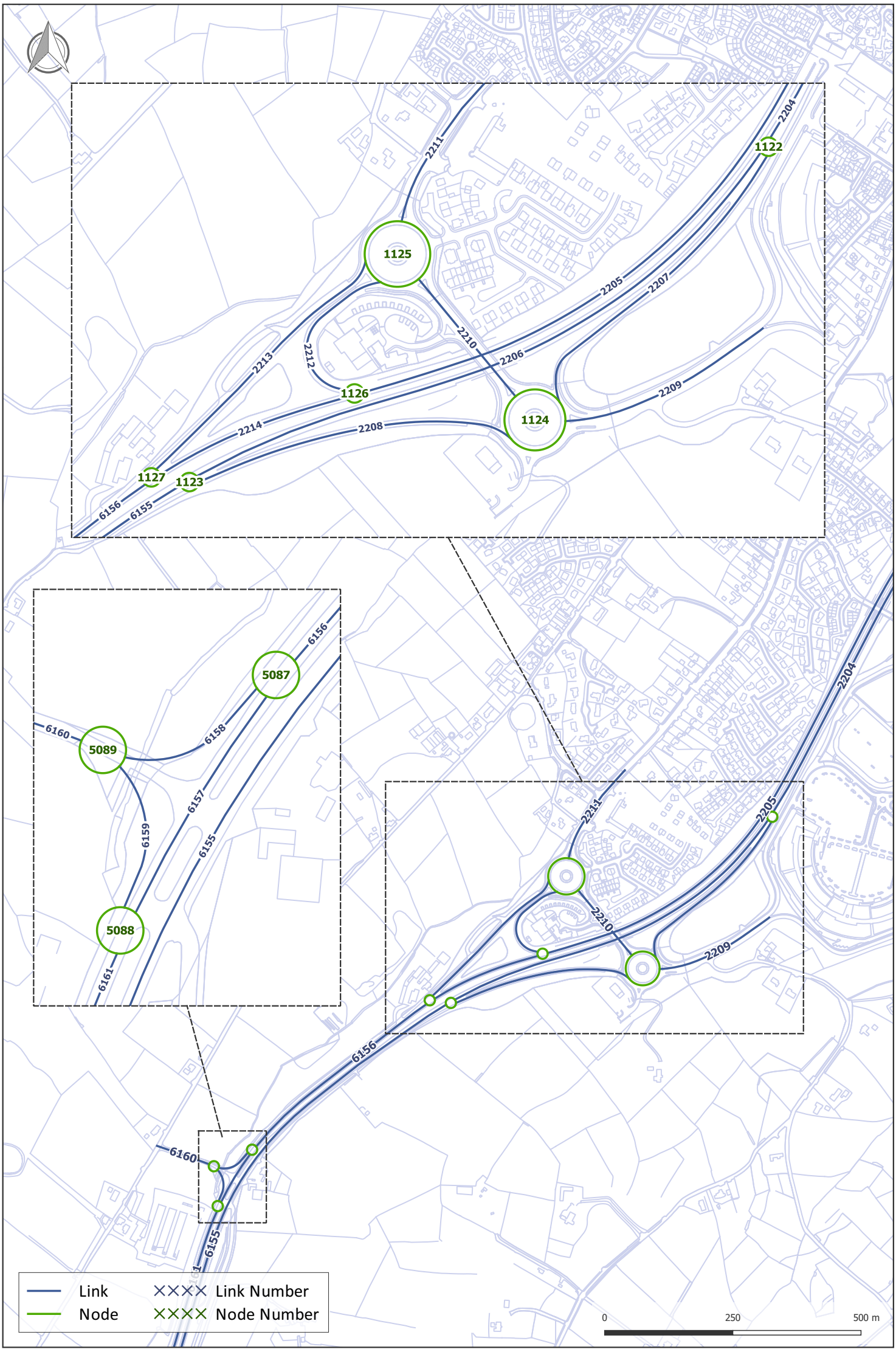
Link
Node
XXXX Link Number
XXXX Node Number

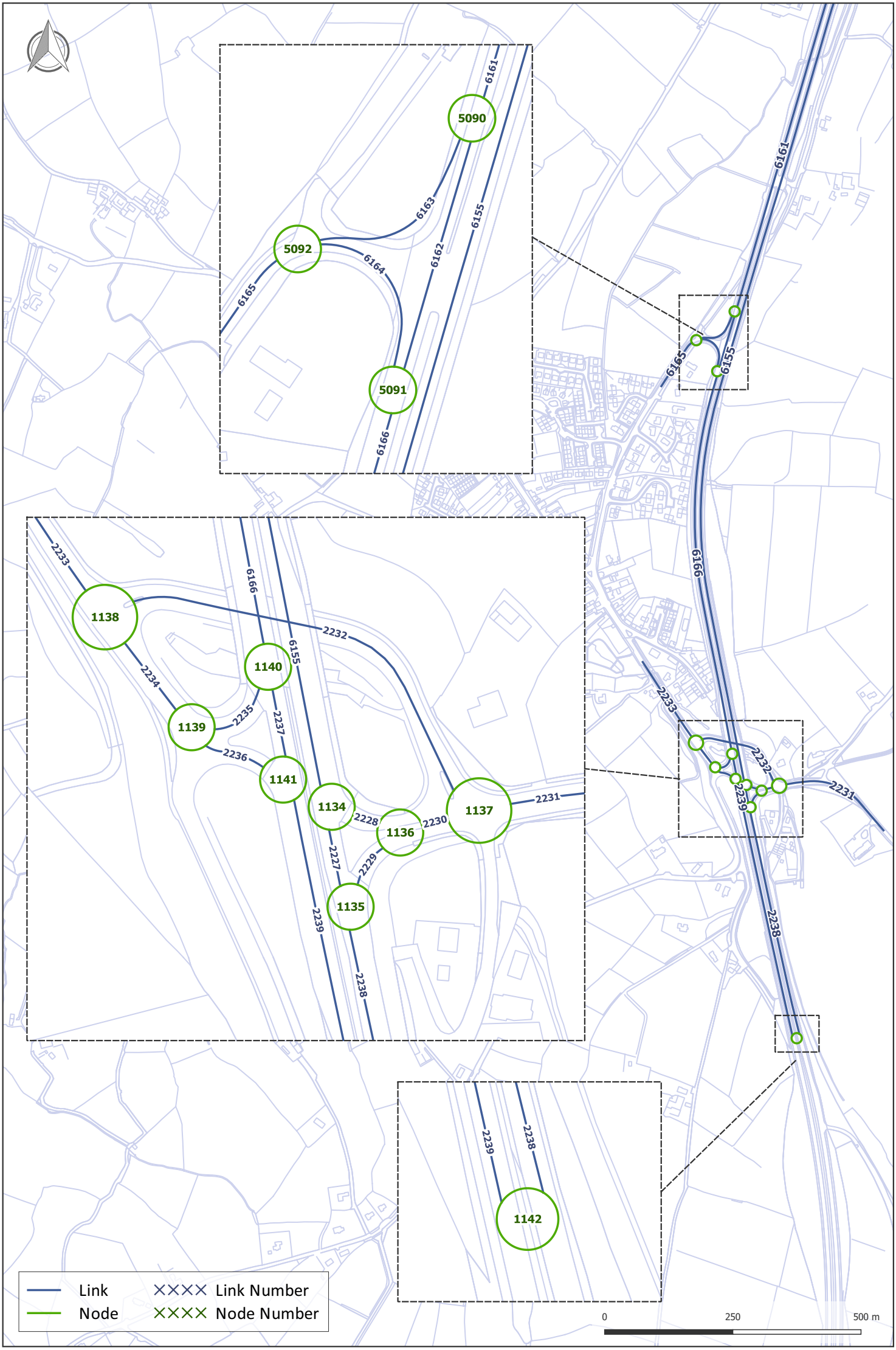
0 250 500 m


5060
5061
5062
5063
5056
5057
5058
5059
6107
6108
6106
6100
6109
6095
6110
6111
6101
6102
6113
6103
6112
6104
6105
6107
6106
6100
6095
6105
6113
6112
6121
6117
6122
6123
6131
6130
6128
5064
6112
6113
6115
6114
6116
5066
6121
5069
6119
5067
6120
6118
5065
6117
5068
6123
6122
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m


6132
6131
6122
6123
6130
6128
6138
6137
2171
2170
6139
6144
6140
6145
6132
5075
6131
6123
6122
6133
5076
5077
6134
5070
6135
6136
6125
5078
6124
5074
6130
6138
6126
5072
6129
6137
5071
6127
5073
6128
6139
5079
6142
6140
6141
5081
6144
6143
5080
6145
2171
1102
2172
1103
2173
1104
6138
6137
1099
2168
2175
2167
1101
2174
2169
1105
1100
6140
6139
2170
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m


1112
5085
5086
5082
5083
5084
1118
1111
1119
1120
1121
1114
1115
1116
1117
2189
2188
6152
6151
6154
6150
6153
6140
6145
6146
6147
6148
6149
2199
2200
2198
2185
2186
2205
2204
2196
2197
2201
2202
2203
2193
2194
2195
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m


1125
1122
1126
1124
1127
1123
5087
5089
5088
2211
2204
2205
2207
2210
2206
2212
2213
2214
2208
2209
6156
6155
6158
6157
6159
6160
6161
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m


5090
5092
5091
6161
6163
6164
6165
6162
6155
6166
1138
1140
1139
1141
1134
1136
1135
1137
2233
2232
2234
2235
2237
2236
2228
2230
2227
2229
2231
2239
2238
1142
Link
Node
XXXX Link Number
XXXX Node Number
0
250
500 m